THE SOCIALIST REPUBLIC OF VIETNAM
ELECTRICITY OF VIETNAM

PREPARATORY SURVEY ON O MON III COMBINED CYCLE POWER PLANT CONSTRUCTION PROJECT

DRAFT FINAL REPORT


Phu My I Combined Cycle Power Plant (1,090 MW) in Vietnam
Design, Construction by NEWJEC Inc.

April 2012

NEWJEC

Location of O Mon Power Complex

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Abbreviations

ADB	Asian Development Bank
BCC	Business Co-operation Contract
BOT	Build-Operate -Transfer
CCGT	Combined Cycle Gas Turbine
CDM	Clean Development Mechanism
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CPI	Consumer Price Index
CPP	Central Processing Platform
CTTP	Cantho Thermal Power Company Limited
CW	Cooling Water
DO	Distillate Fuel Oil
DP	Delivery Point
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EOH	Equivalent Operation Hours
EPC	Engineering, Procurement and Construction
ERAV	Electricity Regulatory Authority of Vietnam
EVN	Vietnam Electricity
FDP	Field Development Plan
FEED	Front End Engineering Design
FID	Final Investment Decision
F/S	Feasibility Study
FSO	Floating Storage Offloading
GDP	Gross Domestic Product
GSPA	Gas Sales and Purchase Agreement
GSA	Gas Sales Agreement
GTA	Gas Transportation Agreement
HHV	Higher Heating Value
HOA	Heads of Agreement
HRSG	Heat Recovery Steam Generator
HSFO	High Sulfur Fuel Oil
HWL	High Water Level
ICB	International Competitive Bidding
IFC	International Finance Corporation
IE	Institute of Energy
IP	Industrial Park
IPP	Independent Power Producer
ISO	International Organization for Standardization
JICA	Japan International Cooperation Agency
JSC	Joint Stock Company

KfW	Kreditanstalt für Wiederaufbau
LHV	Lower Heating Value
LNG	Liquid Natural Gas
LQ	Living Quarters
MOECO	Mitsui Oil Exploration Co. Limited
MOF	Ministry of Finance
MOIT	Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
NH_3	Ammonia
NO_2	Nitrogen Oxide
ODA	Official Development Assistance
PDP6	Sixth Power Development Master Plan
PDP7	Seventh Power Development Master Plan
PECC2	Power Engineering Consulting Company No.2
PECC3	Power Engineering Consulting Company No.3
PL	Gas Pipeline
PSC	Product Sharing Contract
PTSC	PetroVietnam Technical Service Company
PVC	PetroVietnam Construction
PVN	Petrovietnam (Vietnam Oil and Gas Group)
SCADA	Supervisory Control and Data Acquisition
SO_2	Sulfur Dioxide
SPC	Southern Power Corporation
VCGM	Vietnam Competitive Generation Market
WB	World Bank
WHP	Well Head Platform
WL	Water Level

Units

bbl	Barrel (1 bbl = 159 liter)
BTU	British Thermal Unit
kW	kilowatt
MW	Megawatt (= 1,000 kW)
GW	Gigawatt (=1,000 MW = 1,000,000 kW)
kWh	Kilowatt - hour
MWh	Megawatt – hour (= 1,000 kWh)
GWh	Gigawatt – hour (=1,000 MWh = 1,000,000 kWh)
kV	Kilo Volt
kVA	Kilo Volt Ampere
VND	Viet Nam Dong
Hz	Hertz
km	Kilometer
km^2	square kilometer
V	Volt
m	meter
mm	millimeter
MMBTU	= 1,000,000 BTU
NCM	Normal Cubic Meter
SCM	Standard Cubic Meter
m^3	cubic meter
s	second
hPa	Hectopascal (1 hPa = 1 milibar)
MPa	Mega Pascal (= 10.197 kgf/cm^2)
USD	United States Dollar(1 USD = 21,000 VND as Dec. 2011)

CHAPTER 1 BACKGROUND OF THE STUDY

1.1 BACKGROUND OF THE STUDY

In recent years, Vietnam recorded high Gross Domestic Product (GDP) growth rate of approximately 8%. Accordingly, the power demand is increasing at the annual average rate of 13.5% for the last 5 years from 2005 to 2009, and the peak demand is also increased from 10,500 MW in 2005 to 13,800 MW in 2009, i.e., 1.3 times increase in 5 years. Although this growth trend was affected by the recent worldwide financial and economic crisis, it is forecasted to soar again toward high economic growth as the mid and long term trend. In the 7th National Power Development Plan (PDP7) approved in 2011, it is planned to develop the total of nearly 50,000 MW of power source in a decade from 2011 to 2020. However, many of the power development and investment projects planned in the 6th National Power Development Plan are delayed in its implementation at present. Accordingly, the power supply balance in Vietnam is affected, and the rotational power interruption is forced to be implemented at the peak time of power demand. Such being the situation, to meet the power demand in Vietnam, in the PDP7, the power import from the neighbouring countries and/or the development of renewable energy are studied and considered. For the stable supply of power, Unit No.1 of the first Nuclear Power Station in Vietnam is expected to be commissioned in the year 2020.

The energy resources are unevenly distributed in Vietnam. The main energy sources for power generation in the northern part are hydro and coal, while in the southern part it is the natural gas. The total installed capacity of the whole country in 2010 is 21,297 MW, and hydroelectric power plants occupy 34.8%. Toward the year 2030, the government commits to increase the proportion of the thermal power plants.

Under these circumstances, the government of Vietnam has requested the Yen Credit to the Japanese Government for the construction of 750 MW combined cycle power plant and related facility at O Mon Site in Can Tho Province of the southern part of Vietnam to improve the power supply capacity in the region and to contribute to the acceleration of economic growth and strengthen the international competitiveness. In response to this request, Japan International Cooperation Agency (JICA) on behalf of the Japanese Government decided to conduct the study on the necessity and validity of the Project, and the Consultant, namely, NEWJEC Inc. was appointed to carry out the study on its behalf.

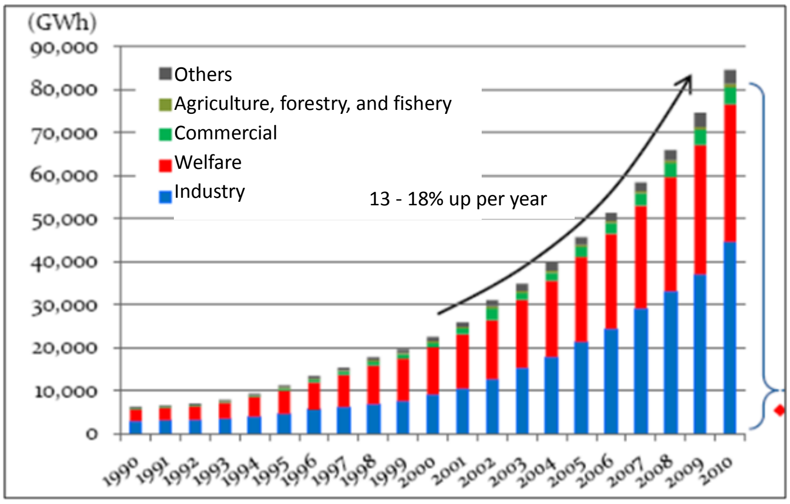
1.2 OBJECTIVE OF THE STUDY

The objective of the Study is to review the Feasibility Study (F/S) of the Project carried out by the fund of the implementing agency, i.e., Electricity of Vietnam (EVN) and to verify the feasibility of the Project to be implemented by the Yen credit by collecting and analyzing the detailed information, etc.

CHAPTER 2 ISSUES AND CURRENT STATUS OF POWER SECTOR IN VIETNAM

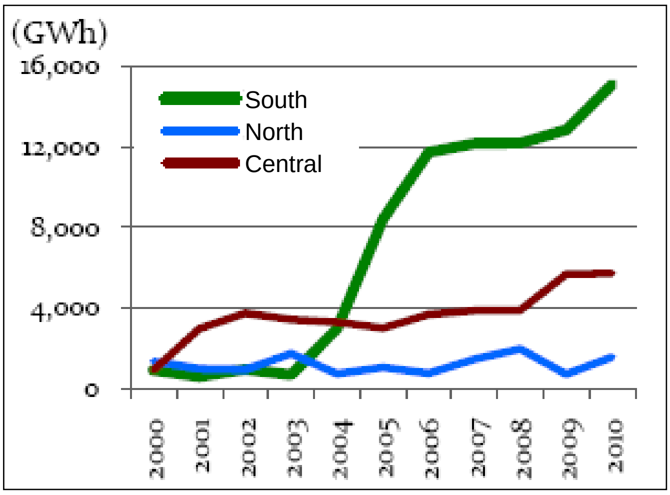
2.1 IMPLEMENTATION PROGRESS OF 6TH POWER DEVELOPMENT MASTER PLAN (PDP6)

GDP growth rate in Vietnam from the year 2006 onwards has increased by 6 ~ 7 %[1] per annum compared to the previous year and Vietnam has achieved remarkable economic growth recently. In parallel with the economic growth, power consumption has also been stably increased by 6 ~ 8 % per annum as shown in Fig. 2.1-1. Especially power consumptions for household and industry have increased remarkably. Focusing on the regional base, power delivery to the Southern region is distinguished compared to Northern and Central regions as shown in Fig. 2.1-2 and the Southern region is supposed to be the largest power demand area in Vietnam.



Source: "Power Sector Survey 2011", June 2011, by JETRO Hanoi Center

Fig. 2.1-1 Growth Rate of Power Consumption in Vietnam



Source: "Power Sector Survey 2011", June 2011, by JETRO Hanoi Center

Fig. 2.1-2 Power Delivery from 500kV Substaions

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[1] Source: "Statistical Yearbook of Vietnam 2010", Statistical Publishing House

In order to meet the increase of power demand as mentioned above, the government of Vietnam developed the 6th National Power Development Plan (PDP6) from 2006 toward 2015 and has reinforced and extended the power facilities. However, as shown in Table 2.1-1, the implementation of the plan has achieved about 70% as of December 2010. If the plan had been implemented 100 %, the installed capacity in Vietnam 2010 would be 25,797 MW instead of 21,297 MW as indicated in Table 2.1-2. In respect to the power source composition, hydropower plants account for one third or 34.8%, coal-fired thermal power plants account for 18.5%, oil and gas-fired thermal power plants account for 38.8%, small hydropower plants and renewable energy account for 3.2%, and power import accounts for 4.7% as shown in Table 2.1-3. In respect to the regional base, the installed capacity in the Northern region occupies 38.9% of the total installed capacity in Vietnam, 16.4% for the Central region and 44.7% for Southern region, and the installed capacity in the Southern region is the largest one compared to other regions.

Concerning the implementation ratio of the power system in PDP6, the implementation ratio achieved only 46% in quantity base and 50% in capacity base as shown in Table 2.1-4.

Table 2.1-1 Actual Progress of Power Source Development in PDP6

	2006	2007	2008	2009	2010	2006-2010
By Prime Minister's Decision on PDP6 (MW)	861	2,096	3,271	3,393	4,960	14,581
Actual Installed (MW)	756	1,297	2,251	2,136	3,641	10,081
Percentage of Implementation	87.8%	61.9%	68.8%	63.0%	73.4%	69.1%

Source: Information by IE dated on December 8, 2011

Table 2.1-2 Power Source Composition as of 2010 end

Year 2010	Unit	Hydropower and PSPP	Coal Thermal	Oil/Gas Thermal & CCGT	Small HPPs + Renewable	Nuclear PPs	Import	Total
Installed Capacity	MW	7,411	3,940	8,264	682	0	1,000	21,297
Power Composition	%	34.8%	18.5%	38.8%	3.2%	0.0%	4.7%	100.0%

Source : The Study Team prepared based on "Vietnam Power Development Plan Period (2011-2020)" provided by IE.

Table 2.1-3 Installed Capacity by Regional Base

Region	North	Central	South	Total
Installed Capacity (MW)	8,278	3,496	9,523	21,297
%	38.9%	16.4%	44.7%	100.0%

Source : "Vietnam Power Development Plan Period (2011-2020)", IE

Table 2.1-4 Actual Progress of Power System Reinforcement and Extension in PDP6

2006 ~ 2010	Plan		Actual		%	
	Quantity	MVA-km	Quantity	MVA-km	Quantity	Capacity
500 kV Sub-stations						
New add. & expansion	16	8,400	9	4,950	56%	59%
500 kV Lines						
New add. & expansion	12	1,339	6	549	50%	41%
220 kV Sub-stations						
New add. & expansion	87	19,326	40	8,938	46%	46%
220 kV Lines						
New add. & expansion	117	4,666	52	2,323	44%	50%
Total	232	33,731	107	16,760	46%	50%

Source : Information by IE dated on December 8, 2011

Institute of Energy (IE) belonging to MOIT, which prepares PDP6, analyzed the why the implementation ratio of PDP6 was low. IE's analysis[2] is as follows;

- Long time to negotiate loans
- Lack of capital
- Lack of experience and ability on bidding, Consultant, EPC Contractors and Project Management Units
- In case of Chinese EPC contractor, the project is always delayed
- Long time of PPA negotiation due to the low power tariff (the average power tariff as of March 2011 was 1,242 VND/kWh or about 6.2 US cent/kWh)
- Coordination between investor and local offices was not well done

Addition to the low implementation ratio of power source with about 70% in PDP6, unusual draught occurred in 2010. Actual generation energy was reduced by 3.2% or to 93,946 GWh in comparison with the planned generation energy of 97,010 GWh in 2010. Especially, generation energy by hydropower plants is reduced by 18.2%. Generation energy of 93,946 GWh in 2010 has increased by about 13%[3] only compared to 82,807 GWh produced in 2009, and caused frequent planned blackouts in Northern and Southern regions.

JETRO Ho Chi Minh Office held the seminar titled "Current Power Situation and Projection in Vietnam" on December 15, 2012 and a lot of Japanese firms (about one hundred firms) operating in the Industry Parks in the Southern region participated in the seminar because they have much interested in the current power situation and projection due to suffering from power supply shortage.

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[2] Besides the IE's analysis, World Bank listed the three reasons such as "lack of Contractor's capability", "Delayed payment to the Contractor", and "lack of management capability of EVN".

[3] If generation energy had been produced as planned, generation energy in 2010 would be increased by 17% compared to the generation energy in 2009.

Table 2.1-5 Comparison of Generation Energy between 2010 and 2009

Type of Power Plants		Installed Capacity (MW)	Generation in 2010 (GWh)		Generation in 2009	2010	Capacity Factor		
			Plan (a)	Actual (b)		(b) / (a)	2010 (a)	2009 (b)	(a) - (b)
A.	Hydropower	7,530	**29,131**	**23,837**	**27,007**	**81.8%**	**36.1%**	**40.9%**	**-4.8%**
B.	Coal-fired thermal plants	2,745	**12,820**	**12,638**	**9,823**	**98.6%**	**52.6%**	**40.9%**	**11.7%**
C.	Oil & gas-fired thermal plants	3,636	**20,060**	**22,622**	**20,117**	**112.8%**	**71.0%**	**63.2%**	**7.8%**
D.	Diesel plants	285	**68**	**58**	**54**	**85.9%**	2.3%	2.2%	0.1%
F.	IPP and BOT	6,131	**34,931**	**34,791**	**25,805**	**99.6%**	**64.8%**	**48.0%**	**16.8%**
Total		20,327	97,010	93,946	82,807	96.8%			

Note : Installed capacity and its total area a little different from IE data and EVN data. This table is focusing on just generation energy.
Source : EVN's data provided by December 9, 2011

2.2 DEVELOPMENT OF POWER UTILITIES IN THE 7TH NATIONAL POWER DEVELOPMENT PLAN (PDP7)

2.2.1 Development Plan of Power Utilities

(1) Development of Power Sources

The government of Vietnam prepared the PDP7 after PDP6 and proceed to develop the power sources from 2011 to 2020. According to PDP7, power supply and demand balance for the regional base is shown in Table 2.2-1. Northern region and central region are expected to have rather high reserve margin[4], say 19.9 % to 47.9% for the northern region and 124.5% to 71.8% for the central region, for the period from 2011 to 2015. On the other hand, the reserve margin at the southern region is estimated to become minus (-7.0% in 2013 and -7.6% in 2014), which w ill cause the severe power supply shortage.

As shown in Table 2.2-2, hydropower plants will decrease from 34.8% in 2010 to 25.5% in 2020. On the other hand, coal-fired thermal plants will increase from 18.5% in 2010 to 43.9% in 2020 and coal-fired thermal plants are planned to occupy the lager part in the power source composition in PDP7. And power supply will more depend on thermal plants except nuclear plants from 57.3% in 2010 to 61.5% in 2020 in future.

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[4] Reserve margin(%) is defined as {Installed Capacity (MW) / Power Demand (MW) -1}

Table 2.2-1 Power Supply-Demand Balance in PDP7

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
North												
Demand	MW		7,902	8,948	10,132	11,474	12,965	14,343	15,869	17,557	19,425	21,528
Installed Capacity	MW	8,278										
New Capacity	MW		1,195	2,077	2,047	2,272	3,306	2,604	3,233	2,600	2,635	884
Available Capacity	MW		9,473	11,550	13,597	15,869	19,175	21,779	25,012	27,612	30,247	31,131
Balance	MW		1,571	2,602	3,465	4,395	6,210	7,436	9,143	10,055	10,822	9,603
Reserve Margin			19.9%	29.1%	34.2%	38.3%	47.9%	51.8%	57.6%	57.3%	55.7%	44.6%
Central												
Demand	MW		1,912	2,185	2,498	2,855	3,269	3,626	4,021	4,459	4,945	5,486
Installed Capacity	MW	3,496										
New Capacity	MW		797	292	275	393	364	592	639	500	480	1,160
Available Capacity	MW		4,293	4,585	4,860	5,253	5,617	6,209	6,848	7,348	7,828	8,988
Balance	MW		2,381	2,400	2,362	2,398	2,348	2,583	2,827	2,889	2,883	3,502
Reserve Margin			124.5%	109.8%	94.6%	84.0%	71.8%	71.2%	70.3%	64.8%	58.3%	63.8%
South												
Demand	MW		9,359	10,675	12,177	13,891	15,831	17,556	19,496	21,650	24,042	26,686
Installed Capacity	MW	9,523										
New Capacity	MW		1,381	270	150	1,510	3,825	4,856	2,770	2,510	2,705	3,758
Available Capacity	MW		10,904	11,174	11,324	12,834	16,659	21,515	24,285	26,795	29,500	33,258
Balance	MW		1,545	499	-853	-1,057	828	3,959	4,789	5,145	5,458	6,572
Reserve Margin			16.5%	4.7%	-7.0%	-7.6%	5.2%	22.6%	24.6%	23.8%	22.7%	24.6%
Whole Country												
Demand	MW		19,173	21,808	24,807	28,220	32,065	35,525	39,386	43,666	48,412	53,700
Installed Capacity	MW	21,297										
New Capacity	MW		3,373	2,639	2,472	4,175	7,495	8,052	6,642	5,610	5,820	5,802
Available Capacity	MW		24,670	27,309	29,781	33,956	41,451	49,503	56,145	61,755	67,575	73,377
Balance	MW		5,497	5,501	4,974	5,736	9,386	13,978	16,759	18,089	19,163	19,677
Reserve Margin			28.7%	25.2%	20.1%	20.3%	29.3%	39.3%	42.6%	41.4%	39.6%	36.6%
Breakdown of Available Capacity												
Hydropower & PSPP	MW	7,411	10,674	12,875	13,477	14,032	15,142	16,430	17,502	17,502	17,987	18,699
Coal Thermal	MW	3,940	4,185	4,635	6,105	8,805	13,655	18,555	23,175	26,595	29,695	32,205
Oil/Gas Thermal & CCGT	MW	8,264	8,362	8,362	8,362	9,082	9,832	11,332	11,332	11,722	12,127	12,935
Small HPPs + Renewable	MW	682	511	749	1,149	1,349	1,749	1,849	2,499	2,849	3,249	3,699
Nuclear PPs	MW	0	0	0	0	0	0	0	0	0	0	2,000
Import	MW	1,000	938	688	688	688	1,073	1,337	1,337	2,487	3,617	3,839
Total	MW	21,297	24,670	27,309	29,781	33,956	41,451	49,503	55,845	61,155	66,675	73,377
			ok	ok	ok	ok	ok	ok	300	600	900	ok

New Additional Capacity												
Hydropower & PSPP	MW	0	3,263	2,201	602	555	1,110	1,288	1,072	0	485	712
Coal Thermal	MW	0	245	450	1,470	2,700	4,850	4,900	4,620	3,420	3,100	2,510
Oil/Gas Thermal & CCGT	MW	0	98	0	0	720	750	1,500	0	390	405	808
Small HPPs + Renewable	MW	0	-171	238	400	200	400	100	650	350	400	450
Nuclear PPs	MW	0	0	0	0	0	0	0	0	0	0	2,000
Import	MW	0	-62	-250	0	0	385	264	0	1,150	1,130	222
Total	MW	0	3,373	2,639	2,472	4,175	7,495	8,052	6,342	5,310	5,520	6,702

Source: The JICA Study Team develops based on the IE's information on December 8, 2011.

Table 2.2-2 Future Power Source Composition in PDP7

Year 2010	Unit	Hydropower and PSPP	Coal Thermal	Oil/Gas Thermal & CCGT	Small HPPs + Renewable	Nuclear PPs	Import	Total
Installed Capacity	MW	7,411	3,940	8,264	682	0	1,000	21,297
Power Composition	%	34.8%	18.5%	38.8%	3.2%	0.0%	4.7%	100.0%

Year 2015	Unit	Hydropower and PSPP	Coal Thermal	Oil/Gas Thermal & CCGT	Small HPPs + Renewable	Nuclear PPs	Import	Total
Installed Capacity	MW	15,142	13,655	9,832	1,749	0	1,073	41,451
Power Composition	%	36.5%	32.9%	23.7%	4.2%	0.0%	2.6%	100.0%

Year 2020	Unit	Hydropower and PSPP	Coal Thermal	Oil/Gas Thermal & CCGT	Small HPPs + Renewable	Nuclear PPs	Import	Total
Installed Capacity	MW	18,699	32,205	12,935	3,699	2,000	3,839	73,377
Power Composition	%	25.5%	43.9%	17.6%	5.0%	2.7%	5.2%	100.0%

Source : The JICA Study Team develops based on IE's information

Table 2.2-3 shows the power source development plan from 2011 to 2020 and the following findings are observed by Table 2.2-3.

- Hydropower plants and power import will increase from 2,496 MW in 2011 to 5,737 MW in 2020 and 3,241 MW will be newly developed. 3,241 MW consists of small hydropower plants and renewable energy of 1,150 MW (35.5%), power import of 640 MW (19.7%), and hydropower plants and pumped storage power plants of 1,451 MW (44.85). Operation of pumped storage power plants is planned to commence in 2019 and the installed capacity will be 900 MW (27.8%) in 2020.

- Thermal plants will increase from 8,408 MW in 2011 to 27,521 MW in 2020 and 19,113 MW will be newly developed. 19,113 MW consists of O Mon 2, 3 and 4 thermal plants of 2,250 MW (11.8%), new coal-fired thermal plants of 12,840 MW (67.2%), and nuclear plants of 2,000 MW (10.5%). New coal-fired thermal plants are to be developed from the year 2014 and 600 MW and more are to be developed annually. Especially, 3,000 MW of coal-fired thermal plants are to be developed in 2016.

- Table 2.2-4 shows the expected power source composition in 2020 provided that the all power sources will be developed as planned based on PDP7. The power source in 2020 will consists of hydropower and power import of 17.2%, thermal plants including gas-fired, coal-fired and nuclear plants of 82.7%. And power supply will more depend on thermal plants from 77.1% in 2010 to 82.7% in 2020 in future.

Table 2.2-3 Power Source Development Plan in PDP7for Southern Region (2011-2020)(1/2)

TT	Target / Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	Demand in the South	**9359**	**10675**	**12177**	**13891**	**15831**	**17556**	**19496**	**21650**	**24042**	**26686**
	Total available Cap. in peak month	**10904**	**11174**	**11324**	**12834**	**16659**	**21515**	**24285**	**26795**	**29500**	**33258**
	Balance	**1545**	**499**	**-853**	**-1057**	**828**	**3959**	**4789**	**5145**	**5458**	**6572**
	Reserved South	***16.5%***	***4.7%***	***-7.0%***	***-7.6%***	***5.2%***	***22.6%***	***24.6%***	***23.8%***	***22.7%***	***24.6%***
I.	**Hydropowers+Import**	**2496**	**2616**	**2766**	**2956**	**3631**	**3987**	**4237**	**4437**	**4937**	**5737**
1	Đa Nhim	160	160	160	160	160	160	160	160	160	160
2	Trị An	400	400	400	400	400	400	400	400	400	400
3	Thác Mơ	150	150	150	150	150	150	150	150	150	150
4	Hàm Thuận	300	300	300	300	300	300	300	300	300	300
5	Đa Mi	177	177	177	177	177	177	177	177	177	177
6	Cần Đơn	72	72	72	72	72	72	72	72	72	72
7	Srok Phu Miêng	51	51	51	51	51	51	51	51	51	51
8	Bắc Bình	35	35	35	35	35	35	35	35	35	35
9	Đại Ninh	300	300	300	300	300	300	300	300	300	300
10	Đak Rtih	72	72	72	72	72	72	72	72	72	72
11	Đồng Nai 3+4	520	520	520	520	520	520	520	520	520	520
	Đồng Nai 3	180	180	180	180	180	180	180	180	180	180
	Đồng Nai 4	340	340	340	340	340	340	340	340	340	340
12	Đa Dâng 2	0	70	70	70	70	70	70	70	70	70
13	Đam Bri	0	0	0	140	140	140	140	140	140	140
14	Đồng Nai 6	0	0	0	0	135	135	135	135	135	135
	Đồng Nai 6A	0	0	0	0	0	106	106	106	106	106
	Phú Tân 2	0	0	0	0	60	60	60	60	60	60
	Thanh Sơn	0	0	0	0	40	40	40	40	40	40
15	Đa Dâng 2 (34MW)	34	34	34	34	34	34	34	34	34	34
16	Đam Bri	72	72	72	72	72	72	72	72	72	72
17	Hydropower PSPP	0	0	0	0	0	0	0		300	900
1.a	**Small Hydropower+Renewable**	**153**	**203**	**353**	**403**	**553**	**603**	**853**	**903**	**1103**	**1303**
1	Da Dâng Da Chomo	16	16	16	16	16	16	16	16	16	16
2	Bảo Lộc-Dasiat	37	37	37	37	37	37	37	37	37	37
3	TĐN New South	100	100	200	200	300	300	500	500	600	700
4	Wind powers+Renewables	0	50	100	150	200	250	300	350	450	550
1.b	**Import**	**0**	**0**	**0**	**0**	**290**	**490**	**490**	**640**	**640**	**640**
1	Sê Ka man 1 (Lào)	0	0	0	0	290	290	290	290	290	290
2	Hạ Sê San 2 (Campuchia) 50%	0	0	0	0	0	200	200	200	200	200
3	Sê Kông (Campuchia)	0	0	0	0	0	0	0	150	150	150
II.	**Thermals**	**8408**	**8558**	**8558**	**9878**	**13028**	**17528**	**20048**	**22358**	**24563**	**27521**
1	**Phú Mỹ CCGT**	**3890**	**3890**	**3890**	**3890**	**3890**	**3890**	**3890**	**3890**	**3890**	**3890**
	Phú Mỹ 2-1	450	450	450	450	450	450	450	450	450	450
	Phú Mỹ 2-1 MR	440	440	440	440	440	440	440	440	440	440
	Phú Mỹ 4	450	450	450	450	450	450	450	450	450	450
	Phú Mỹ 1	1090	1090	1090	1090	1090	1090	1090	1090	1090	1090
	Phú Mỹ 2-2	720	720	720	720	720	720	720	720	720	720
	Phú Mỹ 3	720	720	720	720	720	720	720	720	720	720
	Phu My fertilizer	20	20	20	20	20	20	20	20	20	20
2	**Nhơn Trạch**	**1200**	**1200**	**1200**	**1200**	**1200**	**1200**	**1200**	**1200**	**1200**	**1200**
	Nhon Trach I CCGT	450	450	450	450	450	450	450	450	450	450
	Nhon Trach II CCGT	750	750	750	750	750	750	750	750	750	750
3	**Thermal Thủ Đức**	**153**	**153**	**153**	**153**	**153**	**153**	**153**	**153**	**153**	**0**
4	**Gas turbine Thủ Đức**	**119**	**119**	**119**	**119**	**119**	**119**	**119**	**119**	**119**	**0**
	Thu Duc #4 GT	23	23	23	23	23	23	23	23	23	0
	Thu Duc #5 GT	15	15	15	15	15	15	15	15	15	0
	Thu Duc #6 GT	15	15	15	15	15	15	15	15	15	0
	Thu Duc #7 GT	33	33	33	33	33	33	33	33	33	0
	Thu Duc #8 GT	33	33	33	33	33	33	33	33	33	0
5	**Bà Rịa**	**370**	**370**	**370**	**370**	**370**	**370**	**370**	**370**	**370**	**370**
	Ba Ria GT #1	20	20	20	20	20	20	20	20	20	20
	Ba Ria GT #2	20	20	20	20	20	20	20	20	20	20
	BaRiaC/C#1GT3x37.5ST56	160	160	160	160	160	160	160	160	160	160
	Ba Ria C/C#2 GT3x37.5MW, ST1x62M	170	170	170	170	170	170	170	170	170	170
6	**Thermal Cần Thơ**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**0**

Table 2.2-3 Power Source Development Plan in PDP7for Southern Region (2011-2020)(2/2)

TT	Target / Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	Demand in the South	**9359**	**10675**	**12177**	**13891**	**15831**	**17556**	**19496**	**21650**	**24042**	**26686**
	Total available Cap. in peak month	**10904**	**11174**	**11324**	**12834**	**16659**	**21515**	**24285**	**26795**	**29500**	**33258**
	Balance	**1545**	**499**	**-853**	**-1057**	**828**	**3959**	**4789**	**5145**	**5458**	**6572**
	Reserved South	***16.5%***	***4.7%***	***-7.0%***	***-7.6%***	***5.2%***	***22.6%***	***24.6%***	***23.8%***	***22.7%***	***24.6%***
7	**Gas turbine Cần Thơ**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**0**
8	**Formosa**	**150**	**300**	**300**	**300**	**300**	**300**	**300**	**300**	**300**	**300**
9	**Ô Môn**	**330**	**330**	**330**	**660**	**1410**	**2910**	**2910**	**2910**	**2910**	**2910**
	Ô Môn I #1-FO	330	330	330	330	0	0	0	0	0	
	Ô Môn I #2-FO	0	0	0	330		0	0	0	0	
	Ô Môn I #1-Gas	0	0	0		330	330	330	330	330	330
	Ô Môn I #2-Gas	0	0	0		330	330	330	330	330	330
	Ô Môn II (BOT)	0	0	0	0	0	750	750	750	750	750
	Ô Môn III	0	0	0	0	750	750	750	750	750	750
	Ô Môn IV	0	0	0	0	0	750	750	750	750	750
10	**Cà Mau**	**1500**	**1500**	**1500**	**1500**	**1500**	**1500**	**1500**	**1500**	**1500**	**1500**
	Ca Mau I CCGT	750	750	750	750	750	750	750	750	750	750
	Ca Mau II CCGT	750	750	750	750	750	750	750	750	750	750
11	**Hiệp Phước**	**375**	**375**	**375**	**765**	**765**	**765**	**765**	**765**	**780**	**780**
12	**Amata+Vedan+Bourbon**	**109**	**109**	**109**	**109**	**109**	**109**	**109**	**109**	**109**	**109**
13	**Diesel**	**62**	**62**	**62**	**62**	**62**	**62**	**62**	**62**	**62**	**62**
14	**New CCGT**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**390**	**780**	**1560**
	CCGT Sơn Mỹ I #1	0	0	0	0	0	0	0	390	390	390
	CCGT Sơn Mỹ I #2	0	0	0	0	0	0	0	0	0	390
	CCGT Sơn Mỹ I #3	0	0	0	0	0	0	0	0	390	390
	CCGT Sơn Mỹ I #4	0	0	0	0	0	0	0	0	0	390
15	**Nuclear PPs**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2000**
	Nuclear #1-Phuoc Dinh 1	0	0	0	0	0	0	0	0	0	1000
	Nuclear #3-Vinh Hai 1	0	0	0	0	0	0	0	0	0	1000
16	**South Coal**	**0**	**0**	**0**	**600**	**3000**	**6000**	**8520**	**10440**	**12240**	**12840**
	South Coal 2 (Vinh Tan II #1)	0	0	0	600	600	600	600	600	600	600
	South Coal 5 (Vinh Tan II #2)	0	0	0	0	600	600	600	600	600	600
	South Coal 2 (Vinh Tan I #1)	0	0	0	0	0	600	600	600	600	600
	South Coal 5 (Vinh Tan I #2)	0	0	0	0	0	600	600	600	600	600
	South Coal 660 #1 (Vinh Tan III	0	0	0	0	0	0	660	660	660	660
	South Coal 660 #2 (Vinh Tan III	0	0	0	0	0	0	0	660	660	660
	South Coal 3 (Duyen Hai I #1)	0	0	0	0	600	600	600	600	600	600
	South Coal 4 (Duyen Hai I #2)	0	0	0	0	600	600	600	600	600	600
	South Coal 11 (Duyen Hai II #1)	0	0	0	0	0	0	0	0	600	600
	South Coal 12 (Duyen Hai II #2)	0	0	0	0	0	0	0	0	600	600
	South Coal 13 (D.Hai III,1)	0	0	0	0	0	600	600	600	600	600
	South Coal 14 (D.Hai III,2)	0	0	0	0	0	600	600	600	600	600
	South Coal 15 (D.Hai III,3)	0	0	0	0	0	0	600	600	600	600
	Coal Van Phong #1-660MW	0	0	0	0	0	0	660	660	660	660
	Coal Van Phong #2-660MW	0	0	0	0	0	0	0	660	660	660
	South Coal 7 (Long Phu I #1)	0	0	0	0	600	600	600	600	600	600
	South Coal 8 (Long Phu I #2)	0	0	0	0	0	600	600	600	600	600
	South Coal 18 (Song Hau I #1)	0	0	0	0	0	0	600	600	600	600
	South Coal 19 (Song Hau I #2)	0	0	0	0	0	0	0	600	600	600
	South Coal 9 (Kien Giang I #1)	0	0	0	0	0	0	0	0	600	600
	South Coal 10 (Kien Giang I #2)	0	0	0	0	0	0	0	0	0	600

Source: Information by IE on December 8, 2011.

Table 2.2-4 Power Source Composition (2011 & 2020)

Year 2011	Unit	Hydropower and PSPP	Coal Thermal	Oil/Gas Thermal & CCGT	Small HPPs + Renewable	Nuclear PPs	Import	Total
Installed Capacity	MW	(9,463)	-	3,300	8,408	-	1090	3,335
Power Composition	%	-283.7%	0.0%	99.0%	252.1%	0.0%	32.7%	100.0%

Year 2020	Unit	Hydropower and PSPP	Coal Thermal	Oil/Gas Thermal & CCGT	Small HPPs + Renewable	Nuclear PPs	Import	Total
Installed Capacity	MW	(28,576)	600	3,152	27,521	12,840	1090	16,627
Power Composition	%	-171.9%	3.6%	19.0%	165.5%	77.2%	6.6%	100.0%

Source : The JICA Study Team developed based on PDP7

(2) Power System Extension and Reinforcement

Fig. 2.2-1 shows the power system for whole Vietnam, and Table 2.2-5 and Table 2.2-6 shows the power system extension and reinforcement plan relating to 500 kV transmission line and 500 kV substations.

Fig. 2.2-2 and Fig.2.2-3 shows the power system at the periphery of O Mon Power Complex and Ho Chi Minh City. After the implementation of O Mon 3 power plant, power generated by O Mon 3 power plant will be delivered to Mekong Delta and South-east area, which centers on Ho Chi Minh City, via Thot Not substation.

Fig. 2.2-1 Power System for Whole Vietnam

Source : EVN Corporate Profile 2009-2010

Table 2.2-5 500 kV Transmission Line Extension Plan (2012 - 2015)

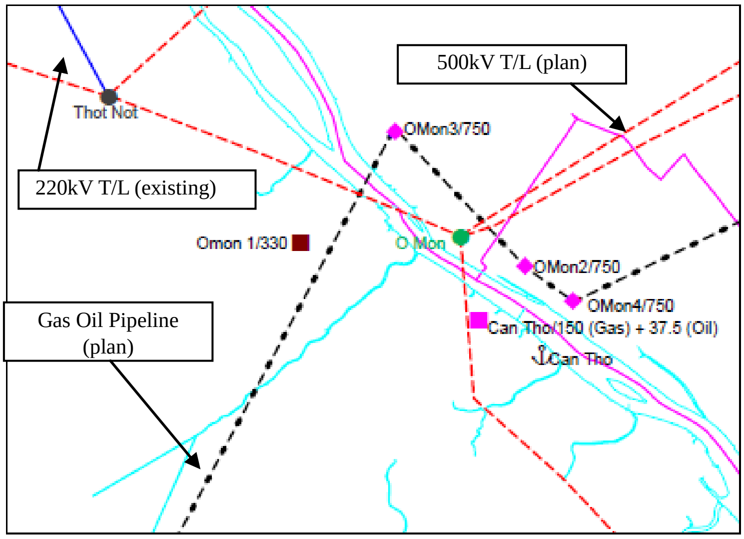
No.	Project Name	Curcuit x Length(km)	Expected Operation Year
1	Son La - Hiep Hoa line	2 x 286	2012 - 2015
2	Quang Ninh - Hiep Hoa line	2 x 140	2012 - 2015
3	Quang Ninh - Mong Duong line	2 x 25	2012 - 2015
4	Pho Noi - Quang Ninh & Thuong Tin line	4 x 10	2012 - 2015
5	Vung Ang - Ha Tinh & Da Nang line	4 x 18	2012 - 2015
6	Son La - Lai Chau line	2 x 180	2012 - 2015
7	Nho Quang - Ha Tinh line : Upgrading capacitor	2000 A	2012 - 2015
8	Pleiku - My Phuoc - Cau Bong line	2 x 437	2012 - 2015
9	HatXan - Pleiku line	2 x 92	2012 - 2015
10	Ta Tinh - Da Nang line : Upgrading capacitor	2000 A	2012 - 2015
11	Song May - Tan Dinh line	2 x 41	2012 - 2015
12	Phu My - Song May line	2 x 66	2012 - 2015
13	Vinh Tan - Song may line	2 x 235	2012 - 2015
14	Cau Bong connection branches	4 x 1	2012 - 2015
15	Duc Hoa connection branches	4 x 8	2012 - 2015
16	Son May - Tan Uyen line	2 x 22	2012 - 2015
17	My Tho - Duc Hoa line	2 x 60	2012 - 2015
18	Duyen Hai - My Tho line	2 x 113	2012 - 2015
19	Long Phu - O Mon line	2 x 84	2012 - 2015
20	O Mon - Thot Not line	2 x 16	2012 - 2015
21	My Tho connection branches	4 x 1	2012 - 2015
22	Pleiku - Dak Nong - Phu Lam & Pleiku - Di Linh - Tan Dinh line : Upgrading capacitor	2000 A	2012 - 2015
20	Phu My 4 - Phu My line : Upgrading conductor	-	2012 - 2015

Source: Data provided by EVN on December 8, 2011

Table 2.2-6 500 kV Substation Extension and Reinforcement Plan (2012 - 2015)

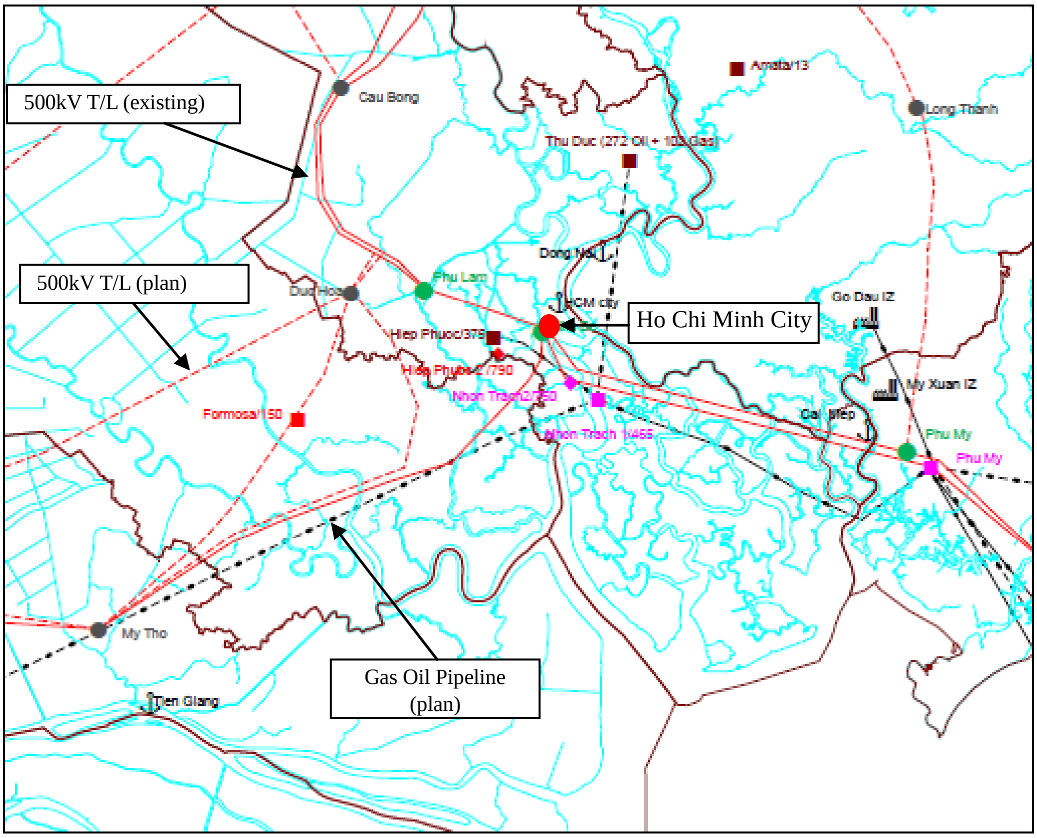
No.	Project Name	Capacity (MVA)	Expected Operation Year
1	Pho Noi Substation	2 x 600	2012 - 2015
2	Viet Tri Substation	1 x 450	2012 - 2015
3	Vung Ang Substation	2 x 450	2012 - 2015
4	Quang Ninh Substation (unit 2)	1 x 450	2012 - 2015
5	Lai Chau Substation	1 x 450	2012 - 2015
6	Thanh My Substation	2 x 450	2012 - 2015
7	Phu Lam Substation (replacing transformer)	2 x 900	2012 - 2015
8	Song May Substation	1 x 600	2012 - 2015
9	Cau Bong Substation	2 x 900	2012 - 2015
10	Duc Hoa Substation	1 x 900	2012 - 2015
11	Tan Uyen Substation	1 x 900	2012 - 2015
12	O Mon Substation (unit 2)	1 x 450	2012 - 2015
13	Tan Dinh Substation (replacing transformer)	1 x 900	2012 - 2015
14	Thot Not Substation	1 x 600	2012 - 2015
15	My Tho Substation	1 x 900	2012 - 2015
16	Long Phu Substation	1 x 450	2012 - 2015
17	Duyen hai Substation	1 x 450	2012 - 2015
18	Vinh Tan Substation	2 x 450	2012 - 2015

Source: Data provided by EVN on December 8, 2011



Source: JETRO Vietnam Energy Map 2010

Fig. 2.2-2 Power System at Periphery of O Mon Power Complex



Source: JETRO Vietnam Energy Map 2010

Fig. 2.2-3 Power System at Periphery of Ho Chi Minh City

2.2.2 Actual Achievement and Future Development Plan of IPPs Power Stations in PDP7

(1) Actual Achievement of IPPs Power Stations

As shown in Table 2.2-7, IPPs and BOTs power stations account for 32.3% out of total installed capacity in whole Vietnam and play important role on the power supply. Table 2.2-8 shows the breakdown of IPPs and BOTs power station by regional base. Installed capacity of each power plant type is hydropower plants with 1,216 MW, coal-fired thermal plants with 1,196 MW, gas-fired thermal plants with 4,288 MW, diesel plants with 14 MW and other oil-fired thermal plants with 399 MW. Petro Vietnam (PVN) and VINACOMIN play an important role on development of gas-fired thermal plants and coal-fired thermal plants respectively. Hydropower plants are widely distributed to the northern, central and southern regions. On the other hand, coal-fired thermal plants are mainly distributed to the northern region and gas-fired thermal plants are mainly distributed to the southern region.

Table 2.2-7 Owner of Power Plants (as of December 2011)

Owner	Installed Capacity (MW)	%
Vietnam Electricity (EVN)	11,168	50.7%
EVN JSC.	3,748	17.0%
Local & Foreign Developers	7,113	32.3%
Total	22,029	100.0%

Source : Data provided by EVN on December 8, 2011

Table 2.2-8 List of IPPs and BOTs Power Plants (as of December 2011)

Existing IPP Project List as of Dec.31, 2011

I. Hydripower Plant

No.	Power Plant	Region	Installed Capacity (MW)	Owner
1	Cửa Đạt	N	97	Local IPP
2	Nậm Chiến 2	N	32	Local IPP
3	Bản Cốc	N	18	Local IPP
4	Hương Sơn	N	34	Local IPP
5	Mường Hum	N	30	Local IPP
6	Bình Điền	C	44	Local IPP
7	Hương Điền	C	54	Local IPP
8	Sông Côn	C	63	Local IPP
9	EaKrông Hnang	C	64	Local IPP
10	Sêrêpok 4	C	80	Local IPP
11	Sê San 4A	C	63	Local IPP
12	Đa Dâng 2	S	34	Local IPP
13	Cần Đơn	S	78	Local IPP
14	Srok Phu Miêng	S	51	Local IPP
15	Đak Rtih	S	144	Local IPP
16	Za Hung	N/A	30	Local IPP
17	Others total	-	300	Local IPP

V. Diesel

No.	Power Plant	Region	Installed Capacity (MW)	Owner
1	Amata	S	14	Foreign IPP

Source: Data provided by EVN on December 8, 2011.

IPP Project List as of Dec.31, 2011

II. Coal-fired Themal Plant

No.	Power Plant	Region	Installed Capacity (MW)	Owner
1	Na Duong	N	111	Vinacomin
2	Cao Ngạn	N	115	Vinacomin
3	Cẩm phả	N	600	Vinacomin
4	Sơn Động	N	220	Vinacomin
5	Formosa	S	150	Local IPP

Note: N; North, C;Central, S;South, N/A; Not Available

III. Oil-fired Themal Plant

No.	Power Plant	Region	Installed Capacity (MW)	Owner
1	Hiệp Phước	S	375	Foreign IPP
2	Bourbon	S	24	Foreign IPP

IV. Combined/ Open cycle gas turbine

No.	Power Plant	Region	Installed Capacity (MW)	Owner
1	Nhon Trach I	S	465	Petro Vietnam
2	Nhon Trach II	S	750	Petro Vietnam
3	Cà Mau I	S	750	Petro Vietnam
4	Cà Mau II	S	750	Petro Vietnam
5	Phú Mỹ 2-2	S	740	Foreign IPP
6	Phú Mỹ 3	S	740	Foreign IPP
7	Ve Dan	S	72	Foreign IPP
8	Đạm Phú Mỹ	S	21	Foreign IPP

(2) Future Development Plan in PDP7

Table 2.2-9 shows the future development plan by IPPs, BOTs and JSC. IPPs , BOTs and JSC are expected to develop power plants amounted to 11,795 MW in northern region, 715 MW in central region and 14,190 MW in southern region up to the year 2020. Table 2.2-10 is developed by the Study Team based on the Table 2.2-1 and Table 2.2-9, and shows percentages of power source development by IPPs, BOTs and JSC out of the total power source development by regional base. In 2020, the percentages of development by IPPs , BOTs and JSC will occupy about 51% of whole Vietnam development, consisting of 50% in northern region, 13% in central region and 60% in southern region approximately. However, as shown in Table 2.2-9, since some projects are not defined concrete developers and described as just BOT, it still remains a concern whether power source development by IPPs, BOTs and JSC will be implemented as planned in PDP7. If the development by IPPs, BOTs and JSC cannot achieve the percentages listed in Table 2.2-10, Power supply-demand balance, especially for the southern region with low reserve margin, will become worse.

Table 2.2-9 Power Source Development Plan[5] by IPPs, BOTs and JSTs (2011~2020)

No.	Power Plant	Installed Capacity (MW)	Plant Type	Region	Operation Year	Project Owner
1	Nậm Chiến #1	100	HP	N	2011	Song Da Group
2	Na Le (Bac Ha) #1,2	90	HP	N	2011	LICOGI
3	Nậm Chiến #2	100	HP	N	2011	Song Da Group
4	Nho Quế III #1,2	110	HP	N	2011	BITEXCO
5	Cẩm phả II	300	TH	N	2011	VINACOMIN
6	Hủa Na #1,2	180	HP	N	2012	Hua Na Hydropower Plant Stock Company
7	Khe Bố #1,2	100	HP	N	2012	Electricity Stock Company
8	An Khánh I #1	50	TH	N	2012	An Khan Thermal Power Plant Stock Company
9	Mao Khe #1, 2	440	TH	N	2012	VINACOMIN (2012, 2013)
10	Bá Thước 2 #1,2	80	HP	N	2013	IPP
11	Nậm Na 2	66	HP	N	2013	IPP
12	Vung Ang I #1	600	TH	N	2013	PVN
13	An Khánh I #2	50	TH	N	2013	An Khan Thermal Power Plant Stock Company
14	Nậm Na 3	84	HP	N	2014	IPP
15	Vung Ang I #2	600	TH	N	2014	PVN
16	Thai Binh II #1	600	TH	N	2014	PVN
17	Yên Sơn	58	HP	N	2015	Binh Minh Construction & Tourism Stock Company (70 MW)
18	Nậm Mô (Laos)	95	HP	N	2015	IPP
19	Thai Binh II #2	600	TH	N	2015	PVN
20	Mong Duong II #1,2	1200	TH	N	2015	AES/BOT
21	Lục Nam 1	50	TH	N	2015	IPP
22	Hai Duong #1	600	TH	N	2016	Jack Resource - Malaysia /BOT
23	Thăng Long #1	300	TH	N	2017	Thang Long Thermal Power Plant Stock Company
24	Hai Duong #2	600	TH	N	2017	Jack Resource - Malaysia /BOT
25	Nghi Son II #1,2	1200	TH	N	2017	BOT
26	Quang Trach I #1	600	TH	N	2018	PVN
27	Nam Dinh I#1	600	TH	N	2018	Tai Kwang - Korea/BOT
28	Thăng Long #2	300	TH	N	2018	Thang Long Thermal Power Plant Stock Company
29	Nam Xam #1,2 (Laos)	130	HP	N	2019	Sai Gon Invest
30	Na Duong II #1,2	100	TH	N	2019	VINACOMIN
31	Quang Trach I #2	600	TH	N	2019	PVN
32	Nam Dinh I#2	600	TH	N	2019	Tai Kwang - Korea/BOT
33	Bảo Lâm	112	HP	N	2020	Song Da Group (120 MW)
34	Nam Xam 3 (Laos)	150	HP	N	2020	Sai Gon Invest
35	An Khánh II #1	150	TH	N	2020	An Khan Thermal Power Plant Stock Company
36	An Khánh II #2	150	TH	N	2020	An Khan Thermal Power Plant Stock Company
37	Lục Nam 2	50	TH	N	2020	IPP
40	Sê San 4A	63	HP	C	2011	Se San 4A Hydropower Plant Stock Company
41	Đak Mi 4	190	HP	C	2011	IDICO
42	Thượng Kon Tum	220	HP	C	2014	Vinh Son - Song Hinh Electricity Construction Company
43	Sêrêpok 4A	64	HP	C	2015	Buon Don hydropower Plant Stock Company
44	Đak Mi 2	98	HP	C	2016	IPP
45	Vinh Son II	80	HP	C	2019	IPP
46	Đam Bri	72	HP	S	2011	IPP (75 MW)
47	Đak Rtih	72	HP	S	2011	Construction Company No.1 (144 MW)
48	Nhon Trach II	750	TH	S	2011	PVN
49	Đồng Nai 2	70	HP	S	2012	IPP
50	Formosa 2	150	TH	S	2012	Formosa Hung Nghiep Ltd Company
51	Đồng Nai 5	140	HP	S	2014	VINACOMIN (145 MW)
52	Đồng Nai 6	135	HP	S	2015	Duc Long Gia Lai Company
53	Sê Ka man 1 (Lào)	290	HP	S	2015	Viet Lao Stock Company
54	Long Phu I #1	600	TH	S	2015	PVN
55	Đồng Nai 6A	106	HP	S	2016	Duc Long Gia Lai Company
56	Hạ Sê San 2 (Campuchia) 50%	200	HP	S	2016	EVN - BOT
57	Long Phu I #2	600	TH	S	2016	PVN
58	Vinh Tan I #1,2	1200	TH	S	2016	CSG/BOT
59	Ô Môn II	750	TH	S	2016	BOT
60	Van Phong I #1	660	TH	S	2017	Sumitomo - Hanoinco/ BOT
61	Vinh Tan III #1	660	TH	S	2017	Vinh Tan 3 Energy Stock Company/ BOT
62	Song Hau I #1	600	TH	S	2017	PVN
63	Sê Kông (Campuchia)	150	HP	S	2018	Song Da Group (205 MW)
64	Van Phong I #2	660	TH	S	2018	Sumitomo - Hanoinco/ BOT
65	Song Hau I #2	600	TH	S	2018	PVN
66	Sơn Mỹ I #1, 2, 3	1170	TH	S	2018	(IP-Sojitsu - Pacific)/BOT (2018, 2020, 2019)
67	Vinh Tan III #2	660	TH	S	2018	Vinh Tan 3 Energy Stock Company/ BOT
68	Duyen Hai II #1	600	TH	S	2019	Janakusa/ BOT
69	Duyen Hai II #2	600	TH	S	2019	Janakusa/ BOT
70	Kien Giang I #1	600	TH	S	2019	Tan Tao
71	Sơn Mỹ I #4,5	780	TH	S	2020	(IP-Sojitsu - Pacific)/BOT (2020, 2022)
72	Kien Giang I #2	600	TH	S	2020	Tan Tao

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[5] The Table is prepared by the Study Team based on "Annex i, issued with decision 1208/QD-TTg dated July 21st 2011by the Prime Minister" and "Power Balance in PDP7, IE". Installed capacity described in Project Owner is quoted from "Annex i". "HP" means hydropower plants and "TH" means thermal power plants.

Table 2.2-10 Percentage of IPPs, BOTs and JSTc in PDP7

	Region / Year	2015	2020
(1)	North Region		
	Planned new installed capacity in PDP7 (MW)	10,897	22,853
	New installed capacity by IPP, BOT, JSC (MW)	5,553	11,795
	Development ratio by IPP, BOT and JSC scheme	51.0%	51.6%
(2)	Central Region		
	Planned new installed capacity in PDP7 (MW)	2,121	5,492
	New installed capacity by IPP, BOT, JSC (MW)	537	715
	Development ratio by IPP, BOT and JSC scheme	25.3%	13.0%
(3)	South Region		
	Planned new installed capacity in PDP7 (MW)	7,136	23,735
	New installed capacity by IPP, BOT, JSC (MW)	2,279	14,190
	Development ratio by IPP, BOT and JSC scheme	31.9%	59.8%
(4)	Whole Vietnam		
	Planned new installed capacity in PDP7 (MW)	20,154	52,080
	New installed capacity by IPP, BOT, JSC (MW)	8,369	26,700
	Development ratio by IPP, BOT and JSC scheme	41.5%	51.3%

2.2.3 Issues on Power Sector based on the PDP7

Issues on Power Sector in Vietnam based on the PDP7 are deemed to be as follows.

(1) Issues analyzed in PDP6

Issues analyzed by IE in respect to the implementation of PDP6 as described in Section 2.1still remains in PDP7, because those issues have not been yet solved basically. Especially procurement of fund to develop power facilities seems to be the serious issue. In PDP6, the total developing capacity for the five (5) yeas from 2006 to 2010 was 14,581 MW. On the other hand, the total developing capacity for the five (5) years from 2011 to 2015 is expected to be 20,154 MW as shown in Table 2.2-10 and becomes 38 % more in comparison with PDP6. EVN has to arrange and procure the developing fund accounting for 60 % of the total fund by their own and/or by utilizing the international finance institutions, provided that the remaining 40 % of the total fund will be procured by IPPs, BOTs and JSTs.

Table 2.2-11 shows the planned power plants already committed by international finance institutions and by lateral cooperation. The number of committed power plants seem to be still less in terms of necessary developing capacity. “Negotiation and conclusion with the international finance institutions had been delayed due to the huge investment cost for the development” pointed out by IE in the evaluation of PDP6 is also observed in PDP7.

Table 2.2-11 List of Power Plants committed by International Finance Institutions and Bilateral Cooperation

Name of Power Plant	Region	Finance Source	Operation Year in PDP7
Mong Duong Thermal 1 Power Plant 1)	North	ADB	2016
Huoi Quang Hydropower Power Plant 1)	North	AFD	2015
Nghi Son 1 Thermal Power Plant 1)	North	JICA	2013
Vinh Tan 2 Thermal Power Plant 1)	South	China	2014
Trung Son Hydropower Plant 2)	North	WB	2016
O Mon IV Thermal Power Plant 3)	South	ADB	2016
O Mon III Thermal Power Plant	South	JICA (plan)	2015
Duyen Hai III 1 Thermal Power Plant 4)	South	China	2016
Duyen Hai III 3 Thermal Power Plant 4)	South	China	2017

Source: 1) EVN Corporate Profile 2009-2010, 2) ADB Website, 3) WB Website, 4)EVN

2.3 IMPLEMENTATION PLAN OF O MON 4 AND O MON 5 POWER PLANTS

2.3.1 Implementation Plan of O Mon 4 Power Plant

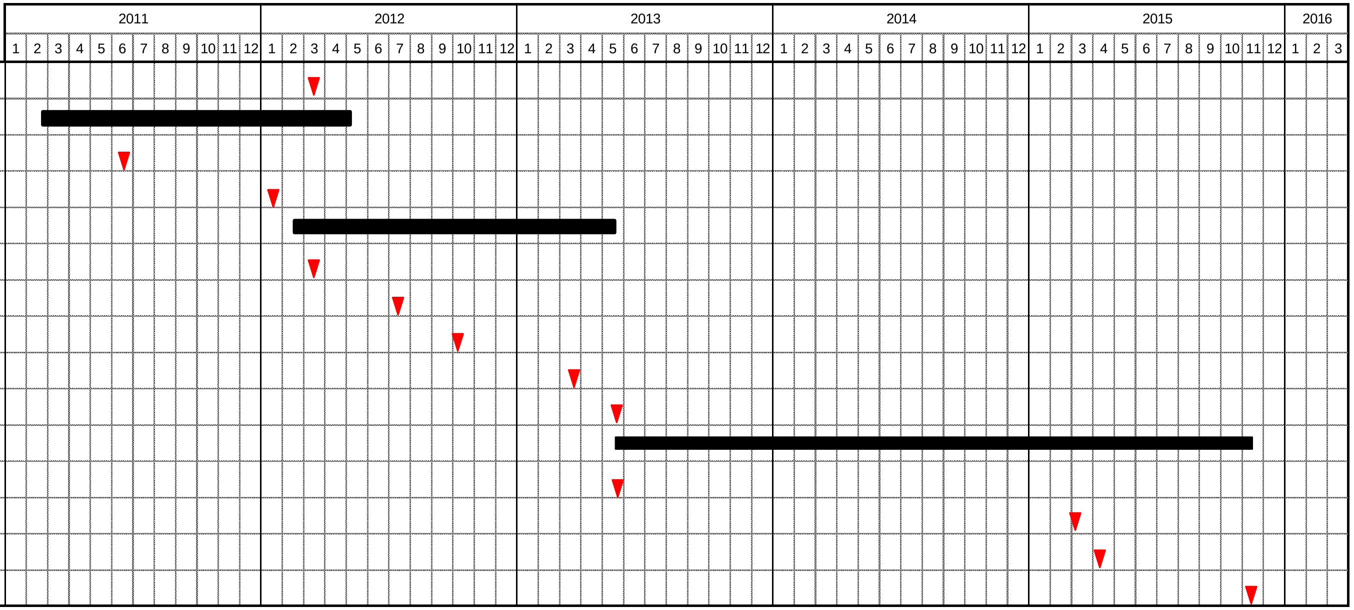
O Mon 4 power plant was approved by the board of ADB on November 25, 2011 and under the internal procedure for the approval by the Government of Vietnam. Table 2.3-1 shows the implementation schedule for O Mon 4 power plant informed by CTTP in December 2011, which was already approved by the EVN. According to the implementation schedule, the construction work begins in May 2013 and completes in November 2015. The construction period is estimated thirty (30) months.

2.3.2 Implementation Plan of O Mon 5 Power Plant

O Mon 5 power plant is not included in the list of power plants in PDP7, although F/S Report describes the development of O Mon 5 power plant. EVN informed in the meeting on February 2, 2012 that the development of O Mon 5 power plant had never been discussed in the government level and just proposed idea by PECC2, who prepared F/S Report. Therefore, there is no development plan for O Mon 5 power plant.

Table 2.3-1 Implementation Plan of O Mon 4 Power Plant

1	**Effectiveness of Loan Agreement**	Mar-12
3	**International Consultant Service**	
3.1	Issuance of RFP for international consultant	Jun.17, 2011
3.2	Contract signing of inernational consultant	Jan.20, 2012
4	**EPC Package / Bidding Process inc. PQ**	**14.9 months**
4.1	Notice of invitation for EPC Contractor for PQ	Mar.16, 2012
4.2	Issuance of Bidding Document	Jul.14, 2012
4.3	Bid opening	Oct.12, 2012
4.4	Contract signing of EPC Contrator	Mar.27, 2013
4.5	L/C opening and contract effectiveness	May.26, 2013
5	**EPC Package / Implementaion Process**	**29.7 months**
5.1	Ground breaking	May.27, 2013
5.2	Gas turbine #1 commissioning	Mar.09, 2015
5.3	Gas turbine #2 commissioning	Apr.09, 2015
5.4	Operation of whle combined cycle power plant	Nov.16, 2015



Source: TPC CAN THO dated on December 12,2011

2.4 CURRENT STATUS AND FUTURE PLAN OF EVN REORGANIZATION

EVN’s reorganization is under process in parallel with the reform of Power Sector in Vietnam, such as establishment of power market. Fig. 2.4-1 shows the EVN organization chart as of the end of 2011.

(1) Generation

At present, EVN is managing and operating 24 power generation companies under the forms of dependent accounting generation companies; Independent accounting generation companies with 100% charter capital held by EVN(Independent accounting member company and One Member Limited Liability Company); Generation Joint Stock Companies having EVN’s major shares. With total installed capacity of approximately 13,934 MW, these power plants contribute up to 63.3 % of the whole system’s installed capacity.

In preparation for the start up of a competitive power generation market and under the Government’s instruction, a restructuring project is being carried out to transform generation units into independent generation corporations (Gencos). Thereby, all Gencos under the approved roadmap are tasked with investment for promoting electricity generation and sales. EVN will directly be in charge of managing strategic and multi-purpose hydropower plants and investing in nuclear power projects.

(2) Transmission

Established upon the incorporation of units in charge of power transmission investment and management, National Power Transmission Corporation (NT) established in July 2008 with 100% charter capital held by EVN is responsible for centralizing resources and consistently monitoring transmission networks as well as developing national power transmission system.

(3) Distribution

With a view to enhancing capacity of distribution units and promoting customer services, 5 distribution corporations with 100% charter capital held by EV were founded in the form of mother-daughter companies during 2010 upon the restructuring of 11 distribution companies under EVN. Member units under 5 distribution corporations are scheduled to transform into one member-limited liability companies aiming at a higher level of decentralization, enhanced operational efficiency and better services in power distribution and commercial business.

(4) Roadmap of EVN Reorganization

EVN submitted the EVN’s restructuring plan to MOIT in December 2011 and the plan has not been approved by the MOIT as of February 2012. Due to the above reason, the roadmap for EVN’s restructuring was not provided to the Study Team. EVN informed the Study Team that EVN’s restructuring would never affect the implementation of O Mon 3 power plant because three (3) Gencos to be established would be still under control of EVN.

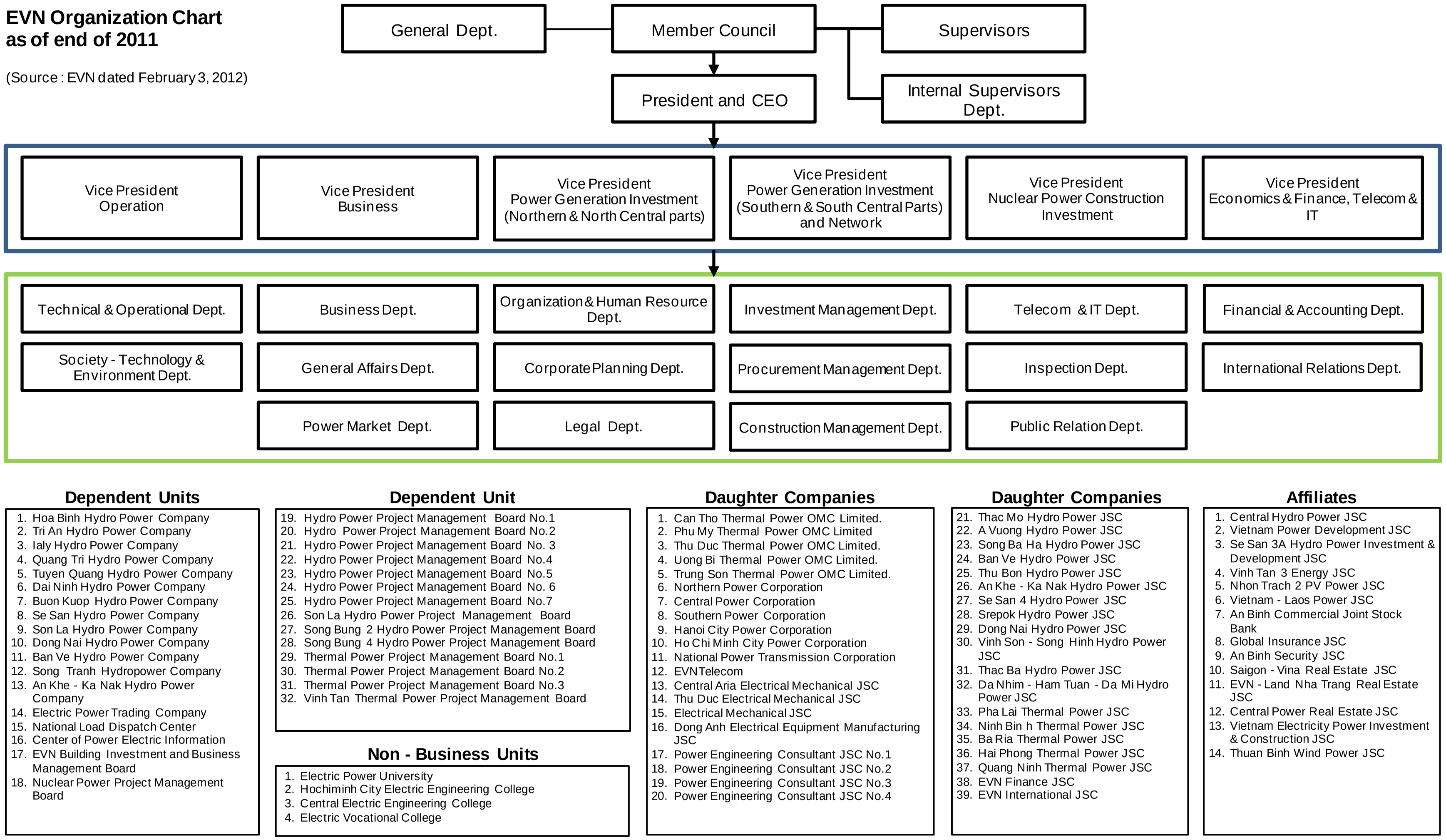


Fig. 2.4-1 Organization of EVN (end of 2011)

2.5 POWER SECTOR REFORM ROADMAP

(1) Electricity Regulatory Authority of Vietnam (ERAV)

Electricity Regulatory Authority of Vietnam established[6] in 2005 under MOIT is responsible for the reform of Power Sector in Vietnam.

Based on the "Development Strategy for the period of 2004-2010 with vision to 2020" [7] and "Electricity Law" imposed in 2004, the reform of power sector is under process to overcome the lack of investment capital and inefficient performance of power sector by introducing power market. ERAV's main tasks are (a) power market development and regulation, (b) electricity price management and regulation, (c) electricity activities licensing and (d) inspection and dispute resolution in electricity activities.

(2) Establishment of Power Market

As the roadmap for the establishment of power market is shown in Fig. 2.5-1, the power market will consist of three (3) stages, such as (a) competitive generation market (CGM), (b) electricity wholesale market and (c) electricity retail market. And each stage has a pilot operation and a full operation. The CGM started in July 1, 2011 and completes in 2014.

Power plants, of which installed capacity is 30 MW and more except BOTs power plants, are required to participate in the Vietnam Competitive Generation Market (VCGM). Overall structure of CGM is shown in Fig. 2.5-2. System and Market Operator (SMO) [8] $^{\text{announces}}$ the required amount of generation energy for the next day by one hour basis, and generation corporations (Gencos) make a bid[9] for SMO. SMO issues an dispatch order to generation corporations in lower tender price order until the required power and energy are satisfied (spot market). Generated power and energy are transferred to the regional power corporations via National Transmission Power Corporation and supplied to consumers by the regional power corporations. The regional power corporations pay electricity charge to the Single Buyer[10] in exchange of power receipt and the Single Buyer also pays electricity charge to Genco based on spot price in CGM and capacity payment stipulated in Power Purchase Agreement (PPA) concluded between Genco and EVN. The capacity payment accounts for 90 ~ 95% of total payment to Genco currently, but weight of the capacity payment is planned to be reducing gradually and the weight of spot price in CGM is planned to be increasing in future.

Metering Data Management Service Provider (MDMSP) , of which services are recording power volume of transaction and providing such information to the Single Buyer and Genco, is also planned to be established in CGM. Since VCGM has just started and is now under pilot operation, the evaluation of VCGM has not been done yet. And a blueprint of an overall structure for future electricity market and electricity retail market has not been prepared yet

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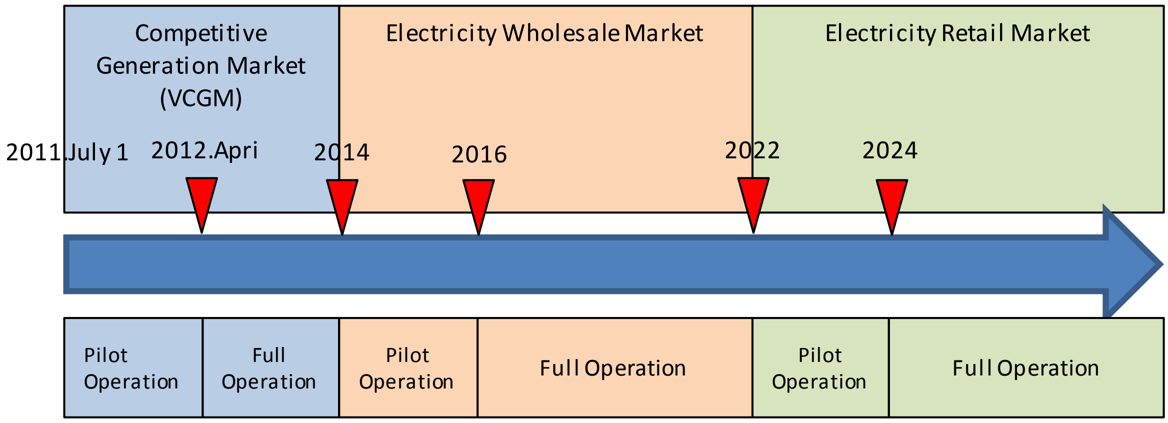
[6] The Prime Minister's Decision (No.258/2005/QD-TTg), approved on October 19, 2005

[7] Approved by the Prime Minister on October 5, 2004

[8] National Load Dispatching Center (NLDC) under EVN plays the role of SMO at present and will be an independent organization in future.

[9] The capped tender price for thermal power plants is the total amount of variable cost at 100% load and average start-up cost, and the minimum tender price is 1 VND/kWh. In case of hydropower plants, the capped tender price is 110% of the water value and the minimum tender price is 0 VND/kWh.

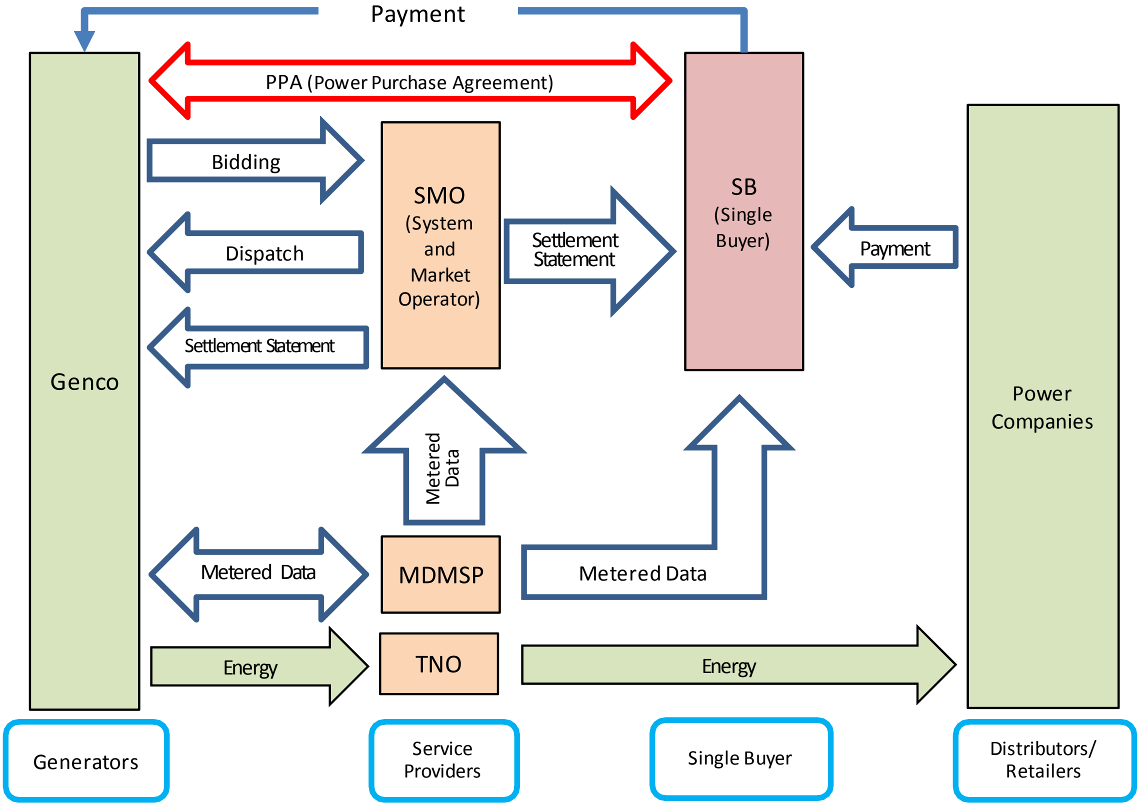
[10] EVN is nominated as a single buyer for a time.



VCGM: Vietnam Competitive Generation Market

Source: Information by ERAV dated December 8, 2011

Fig. 2.5-1 Roadmap for Establishment of Power Market



Note: MDMSP; Metering Data Management Service Provider, TNO; National Power Transmission Corporation

Source: "Vietnam Competitive Generation Market, VCGM Overview", ERAV

Fig. 2.5-2 Overall Structure for Competitive Generation Market (CGM)

2.6 CURRENT SITUATION ON REVISION OF POWER TARIFF

(1) Revision of Power Tariff

Retail price of power tariff for consumers was amended by MOIT Degree (No.05/2011/TT-BCT) on March 1, 2011and the average retail power tariff is resulted in 1,242 VND/kWh[11]. Table 2.6-1 shows the new retail power tariff structure. The retail power tariff in Table 2.6-1 is applicable to the consumers connected to the national grid. For the consumers not connected to the national grid, the retail price is set by the above degree as 1,863 VND/kWh for the minimum and 3,105 VND/kWh for 3,105 VND/kWh for the maximum.

Table 2.6-1 New Retail Power Tariff Structure

I	Retail Prices of Electricity for the Manufacturing Sector			
	STT	Subject to the Application Price		VND/kWh
	1	Electricity tariffs at voltage levels of 110 kV and above		
		a)	Normal hours	1,043
		b)	Off-peak hours	646
		c)	Peak hours	1,862
	2	Electricity tariffs at voltage levels from 22 kV to below 110 kV		
		a)	Normal hours	1,068
		b)	Off-peak hours	670
		c)	Peak hours	1,937
	3	Electricity tariffs at voltage levels from 6 kV to below 22 kV		
		a)	Normal hours	1,093
		b)	Off-peak hours	683
		c)	Peak hours	1,999
	4	Electricity tariffs at voltage levels lower than 6 kV		
		a)	Normal hours	1,139
		b)	Off-peak hours	708
		c)	Peak hours	2,061
II	Retail Prices of Electricity for Irrigation			
	STT	Subject to the Application Price		VND/kWh
	1	Electricity tariffs at voltage level from 6 kV and above		
		a)	Normal hours	956
		b)	Off-peak hours	497
		c)	Peak hours	1,415
	2	Electricity tariffs at voltage levels lower than 6 kV		
		a)	Normal hours	1,023
		b)	Off-peak hours	521
		c)	Peak hours	1,465
III	Retail Prices of Electricity for Administration Career			
	STT	Subject to the Application Price		VND/kWh
	1	Hospitals, Child Care, Preschool, School		
		a)	Electricity tariffs at voltage levels of 6 kV and above	1,117
		b)	Electricity tariffs at voltage levels lower than 6 kV	1,192
	2	Public Lighting		
		a)	Electricity tariffs at voltage levels of 6 kV and above	1,217
		b)	Electricity tariffs at voltage levels lower than 6 kV	1,291
	3	Administrative Units and Business		
		a)	Electricity tariffs at voltage levels of 6 kV and above	1,242
		b)	Electricity tariffs at voltage levels lower than 6 kV	1,291

IV	Retail Prices of Electricity for Business			
	STT	Subject to the Application Price		VND/kWh
	1	Electricity tariffs at voltage levels of 22 kV and above		
		a)	Normal hours	1,713
		b)	Off-peak hours	968
		c)	Peak hours	2,955
	2	Electricity tariffs at voltage levels from 6 kV to below 22 kV		
		a)	Normal hours	1,838
		b)	Off-peak hours	1,093
		c)	Peak hours	3,067
	3	Electricity tariffs at voltage levels lower than 6 kV		
		a)	Normal hours	1,862
		b)	Off-peak hours	1,142
		c)	Peak hours	3,193
V	Retail Prices of Electricity for Household			
	STT	Subject to the Application Price		VND/kWh
	1	For 50 kWh (for poor and low income)		993
	2	For 000 ~ 100 kWh (for regular household income)		1,242
	3	For 101 ~ 150 kWh		1,304
	4	For 151 ~ 200 kWh		1,651
	5	For 201 ~ 300 kWh		1,788
	6	For 301 ~ 400 kWh		1,912
	7	For 400 kWh and above		1,962

Definition of Normal, Peak and Off-peak hours

1	Monday ~ Saturday	
	1) Normal hours	
		04:00 ~ 09:30 (5.5 hours)
		11:30 ~ 17:00 (5.5 hours)
		20:00 ~ 22:00 (2.0 hours)
	2) Peak hours	
		09:30 ~ 11:30 (2.0 hours)
		17:00 ~ 20:00 (3.0 hours)
	3) Off-peak hours	
		22:00 ~ 04:00 (6.0 hours)
2	Sunday	
	1) Normal hours	
		04:00 ~ 22:00 (18.0 hours)
	2) Off-peak hours	
		22:00 ~ 04:00 (6.0 hours)

Source: MOIT Decree No.05/2011/TT-BCT effected on March 1, 2011

(2) Market-based Electricity Sales Price Adjustment

Prior to the competitive generation market starting from July1, 2011, the market-based electricity sales adjustment by the Prime Minister's Decision (No.24/2011/QD-TTg) [12] was put into force on June 1, 2011. According to the new decision, EVN was newly empowered in respect to setting power tariff structure to a certain extent, although the setting of power tariff structure had been a fully approved matter by the Prime Minister before the issuance of the new decision. And the establishment of price stabilization fund was also stipulated in the new decision. The relevant articles in the new decision are as follows;

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[11] Source:"MOIT Degree No.05/2011/TT-BCT", increase rate of 15.28 %

[12] Approved by the Prime Minister on April 15, 2011

1) Principles of market-based electricity sale price adjustment (Article 4)

- In a fiscal year, electricity sale price can be only adjusted when there are changes to the basic input parameters (fuel cost, exchange rate and generation mix, which are out of control of generation companies) which are different from the ones used for calculating the current electricity sale price.

- The interval between two (02) consecutive adjustments shall be three (03) months as a minimum.

2) Mechanism and jurisdiction for adjusting electricity sale price (Article 5)

- In case the fuel price, foreign exchange rate at the point of calculation change compared to the parameters which were used to calculate the current electricity price and the generation mix changes compared to the generating plan approved by MOIT which cause sale price at the point of calculation increase compared to the current electricity price with the follow levels:
  a. 5% then EVN is allowed to increase the electricity sale price at the corresponding level after having registered with and being approved by MOIT. Within 5 working days, MOIT is responsible to reply so that EVN can apply implementation. In case after 5 working days, MOIT does not reply, EVN is allowed to increase the sale price 5% and report to MOIT and MOF for monitoring.
  b. Over 5%, EVN shall report to the MOIT and send the proposal to MOF for appraisal. Within 5 working days after receiving the proposal from EVN, MOF is responsible for appraising and send its opinion to MOIT. MOIT is responsible for consolidating opinions and report to PM for review and approval after 5 working days after receiving the appraisal opinion from MOF.
  After 15 working days since the day MOIT submitted PM its recommendation, in case that the Prime Minister has not yet issued a response, EVN is allowed to increase the current sale price of 5%.

- At a point of calculation, in case fuel price, foreign exchange changes compared to the parameters used to determine the current electricity sales price and the generation mix changes to the generating plan approved by MOIT, which cause the current sale price at the point of calculation decreases from 5% and up in comparison with the current sale price, EVN decides to adjust the electricity sale price by the corresponding level and concurrently reports to MOIT for monitoring.

3) Price stabilization fund (Article 6)

- Price stabilization fund is formed for the purpose of electricity price stabilization.

- Sources for the Price stabilization fund are taken from electricity sale price and are included into electricity production and business costs.

4) Inspection, supervision of the electricity sale price adjustment (Article 7)

- MOIT inspects, supervises the implementation of electricity sale price adjustment. If necessary, MOIT sends EVN a formal instruction in writing to request EVN temporarily to halt the increase of electricity sales price or the adjustment for the subsequent adjustment. MOIT is allowed to invite independent Consultants to inspect the dossier of electricity sales price adjustment.

- MOF monitors the implementation of electricity price adjustment; co-ordinates with MOIT to check the reasonability, eligibility of the differences of costs in comparison with the calculated figures in the electricity sale price proposal after having obtained data from consolidated financial reports and audited financial reports.

5) Implementation effect (Article 9)

- This Decision takes effect from 1/6/2011.

2.7 CURRENT SITUATION ON OTHER INTERNATIONAL DONORS' SUPPORT FOR POWER SECTOR IN VIETNAM (WORLD BANK AND ASIAN DEVELOPMENT BANK)

Table 2.7-1 and Table 2.7-2 show the projects in power sector in Vietnam supported by ADB and WB as of February 2012.

ADB supports five(5) projects at present, such as (a) Mong Duong 1 Thermal Power Project - Project 1, (b) Power Transmission Investment Program, (c) Northern Power Transmission (Sector) Project, (d) Renewable Energy Development and Network Expansion and Rehabilitation for Remote Communes and (e) O Mon 4 Combined Cycle Power Plant Project. Five (5) projects consist of two (2) power source development projects and three (3) transmission line related projects including others. Out of five (5) projects, four (4) projects are on schedule and one (1) project (Renewable Energy Development and Network Expansion and Rehabilitation for Remote Communes) is behind the schedule for 3 months due to the environmental related issue.

WB supports seven (7) projects at present and all projects are on schedule. The breakout of seven (7) projects is (a) one power source development project such as VN-Trung Son Hydropower Project, and the remains are transmission line related projects such as Second Transmission and Distribution Project and rural electrification projects and so on. According to WB's information on February 3, WB has an intention to support the transmission line related projects and rural electrification projects within the limited financial source and has no plan to support the power source development in future.

And WB informed the Study Team that projects requesting for assistance by international financial institutes submitted by the Government of Vietnam were not discussed among the international financial institutions on which institute would support the projects, and EVN prepared projects list for each international financial institution in advance.

Table 2.7-1 (1/2) Current Situation for Power Sector in Vietnam (ADB)

Project No.	Project Name	Amount [Proposed]	Description	Outputs	Board Approval	Executing Agency	Current Situation as of Feb.2012
39595- 02	Mong Duong 1 Thermal Power Project - Project 1	US¤ 27.86 million	The main objective of the proposed project is to expand the generating capacity of Electricity of Viet Nam (EVN) in order to help mitigate shortage of power in Northern Viet Nam and to support industrial and economic growth. The Project provides for the construction of four units of 250 MW circulatory fluidized bed (CFB) generating units and the common facilities for another 1,000 MW to 1,200 MW installed generating capacity utilizing domestic coal as fuel. This constitutes as Phase 1 of the first stage development program envisaged to establish in two phases and increase the generating capacity of this new power station to 2,200 MW. The 2,000 MW Mong Duong Thermal Power Project will a mine mouth based power plant.	Recruitment of Implementation consultants Design Bidding Evaluation of EPC Packages Construction, installation testing and commissioning of Unit 1 by October 2013 and Unit 2 by May 2014 Implementation of environmental and social plans for: Implement EMP from Dec 2007 (ongoing) Implement resettlement plan Tranche 2 from Dec 2009	2-Oct-07	Viet Nam Electricity	On Shedule (ended by 2014)
42039- 04	Power Transmission Investment Program (MFF)	US¤ 730.00 million	The investment program will enhance the capacity of the transmission network to balance power loads in northern, central, and southern Viet Nam. It will (i) expand the electricity transmission infrastructure by constructing and upgrading 500 kilovolt (kV) and 220 kV transmission lines and associated substations, (ii) improve the operational effectiveness and efficiency of the National Power Transmission Corporation, and (iii) support the implementation of the investment program.	Component 1: Expanded Transmission Network Component 2: Improved Operational Effectiveness and Efficiency of NPT Component 3: Project Implementation Support	16-Dec-11	National Power Transmission Corporation	On schedule. Tranche 1: 2011-2015 Tranche 2: 2012-2013 Tranche 3: 2013/2014-2017 Tranche 4: 2016-2019
32273- 01	Northern Power Transmission (Sector) Project	US¤ 120.00 million	The objectives of the Project are to (i) expand and strengthen EVN's transmission system in the north to improve system reliability and quality; and (ii) improve the efficiency of the power sector by supporting restructuring and commercialization of EVN. The Project will support the power sector reform efforts by ensuring that EVN's generation units are corporatized and its four transmission units are merged into one prior to the establishment of a 'single-buyer' model of operation for EVN in 2007.	Expanded and upgraded 500 kV and 220 kV transmission systems Expanded and upgraded supervisory control and data acquisition (SCADA) and telecommunications system	13-Dec-04	Viet Nam Electricity	In three-month grace period (ended by March 31 2012)

Source : ADB Webiste and EVN

Table 2.7-1 (2/2) Current Situation for Power Sector in Vietnam (ADB)

Project No.	Project Name	Amount [Proposed]	Description	Outputs	Board Approval	Executing Agency	Current Situation as of Feb.2012
42182- 01	Renewable Energy Development and Network Expansion and Rehabilitation for Remote Communes Sector Project (Formerly Renewable Energy for Remote Communes Sector Project)	US¤ 151.00 million	The primary objective of the sector Project is to develop rural electrification and renewable energy in Viet Nam to benefit ethnic minority communities inhabiting remote and poorer parts of the country. The Renewable Energy Development and Network Expansion and Rehabilitation for Remote Communes Sector Project consists of two investment components: (i) mini-hydropower plants in mountain provinces, and (ii) network expansion and rehabilitation of distribution networks serving poor provinces.	1. Installation of 5 to 10 mini-hydropower plants to electrify mountainous communes. 2. Electrification of 1,000 villages through grid expansion.	30-Mar-09	Northern Power Corporation Southern Power Corporation Central Power Corporation	In progress with delay due to difficulties in safeguard policy expediment (environment, resettlement, compensation and ethnic minority people) Expected completion year 2015
43400- 01	O Mon 4 Combined Cycle Power Plant Project	US¤ 309.89 million	The project will construct a 750-megawatt (MW) combined cycle gas turbine (CCGT) power plant at the O Mon thermal power complex. The project is in O Mon district in the city of Can Tho, about 250 kilometers south of Ho Chi Minh City. The project will help Viet Nam meet the fast-growing demand for electricity to foster socioeconomic development and industrialization in the south, particularly in the Mekong Delta. The project is part of the least-cost Seventh Master Power Development Plan approved by the Government of Viet Nam in 2011.	CCGT O Mon IV power plant operational Common facilities for O Mon IV and O Mon III operational Capacity of the Implementing Agency strengthened	25-Nov-11	Viet Nam Electricity	On schedule Expected completion year: 2016

Source : ADB Website and EVN

Source : ADB Webiste and EVN

Table 2.7-2 (1/2) Current Situation for Power Sector in Vietnam (World Bank)

Project ID	Project Name	Total Project Cos	Description	Approval Date (Closing Date)	Implementing Agency	Current Situation as of Feb. 2012
P084773	VN-Trung Son Hydropower Project	411.72 Millin US$	The objective of the Trung Son Hydropower Project for Vietnam is to improve, or at least restore, livelihoods and living standards of affected households and villages while allowing them to maintain their cultural identity. There are four components to the project. The first component of the project is dam and ancillary construction. Construction of main dam and appurtenant structures, supply and installation of hydraulic mechanical and electro-mechanical equipment, access roads, bridges, borrow pits and quarries, power supply lines for construction and provision of supporting consultant services. The second component of the project is transmission line. Construction of the transmission line to evacuate power from the plant during the operation phase. The third component of the project is social and environment impact management. Implementation of the resettlement, livelihoods and ethnic minorities' development program, the public health action plan and the environment management plan. The fourth component of the project is capacity development and scale-up. Building of Vietnam Electricity (EVN) capacity to prepare hydropower projects to international standards.	2011/4/26 (2017/12/31)	ELECTRICITY OF VIETNAM	On shchedule
P114875	Second Transmission and Distribution Project Additional Financing	180 Million US$	The objective of the Additional Financing for the Second Transmission and Distribution Project is to assist the borrower in developing efficient electricity transmission and distribution system, thus enabling the timely evacuation of power from new electricity generation plants to growing load centers and the maintenance of system security and reliability and power quality; and contribute to the restructuring of the borrower's power sector. The additional financing will scale up the transmission system expansion and reinforcement subcomponent of the project so as to support efficient development of Vietnam's power transmission system. This subcomponent comprises 500 kilovolt (kV) and 220kV transmission lines and substations. A small amount of additional financing (US$0.50 million) will be added to component 3 - transition to market - to upgrade the capacity of the newly established National Power Transmission Company (NPT) to efficiently plan and finance its investment program and operations in a financially sustainable manner. The project development objective is to support the efficient development of Vietnam's transmission and distribution system.	2011/3/29 (2014/06/30)	VIETNAM ELECTRICITY	On shchedule
P103238	Vietnam Renewable Energy Development Project	318.05 Million US$	The objective of the Renewable Energy Development Project for Vietnam is to increase the supply of electricity to the national grid from renewable energy sources on a commercially, environmentally, and socially sustainable basis. There are three components to the project. The first component of the project is renewable energy investments. The second component of the project is regulatory development. This component will provide technical assistance for developing the regulatory infrastructure and building the requisite capacities of MOIT, the electricity regulatory authority of Vietnam, and other relevant government agencies for renewable energy development particularly for grid-connected electricity generation projects not exceeding 30 MW. The third component of the project is pipeline development. This component will support activities to facilitate the development of further renewable energy projects contributing directly to building a pipeline of renewable energy projects.	2009/5/5 (2014/06/30)	MINISTRY OF INDUSTRY AND TRADE	On shchedule

Source : ADB Webiste and EVN

Table 2.7-3 (2/2) Current Situation for Power Sector in Vietnam (World Bank)

Project ID	Project Name	Total Project Cos	Description	Approval Date (Closing Date)	Implementing Agency	Current Situation as of Feb. 2012
P099211	Rural Distribution Project	206.28 Million US$	The objective of the Rural Distribution Project is to improve the reliability and quality of medium voltage service to targeted retail electricity distribution systems. There are seven components to the project.	2008/5/22 (2013/06/30)	ELECTRICITY OF VIETNAM	On shchedule
P084871	Second Transmission and Distribution Project	212.27 Million US$	The objective of the Second Transmission and Distribution Project for Vietnam is the efficient development of Vietnam's transmission distribution system. The project consists of the following components: Component 1) will build new, or reinforce existing, 500, 220 and 1 l0kV transmission and distribution lines and substations. Component 2) consists of (i) the supply and installation of a supervisory control and data acquisition and energy management system (SCADA/EMS) for the national load dispatch center (NLDC) with integral market and meter management systems; (ii) replacement of the existing VietPool Interim Market System with a full-function market management system; and (iii) improving the telecommunications backbone to support the new systems. Component 3) will provide support to Electricity of Vietnam (EVN) to develop its transmission business as a separate entity and establishment of an internal power market, with particular focus on: (i) enabling it to manage power market operations; (ii) reviewing future investments in transmission and regional interconnections; (iii) developing a generation expansion investment plan; (iv) preparing a business plan; and (v) providing training and support in development of a power market.	2005/7/28 (2014/06/30)	MINISTRY OF INDUSTRY/ELECT RICITY CORPORATION OF VIETNAM	On shchedule
P074688	Second Rural Energy Project	324.25 Million US$	The objective of the Additional financing for Second Rural Energy Project is to improve access to good quality, affordable electricity services to rural communities in an efficient and sustainable manner, to support Vietnam's efforts towards socioeconomic development. The global environment objective is to reduce greenhouse gas emissions by improving and sustaining the energy efficiency of local distribution utilities. The additional credit will help finance the costs associated with: (a) completion of the original project activities as a result of an unanticipated financing gap. It will enable completion o f the original target of about 1,200 communes, compared with the current expectation of about 968; and (b) implementation of expanded activities that will scale up the project's impact and development effectiveness by increasing the number of communes from 1,200 to 1,500. As a result of the two uses of the additional financing, an estimated 532 communes or about 5 50,000 households will receive access to good quality, affordable electricity.	2004/11/18 (2014/06/30)	MINISTRY OF INDUSTRY, ELECTRICITY OF VIETNAM	On shchedule
P066396	System Efficiency Improvement, Equitization & Renewables Project	347.9 Million US$	The objective of the Project is to improve the overall efficiency of power system services, particularly to the poor in rural areas, by optimizing the transmission systems, and upgrading sub-transmissions, and medium voltage distribution lines for rural electrification.	2002/6/25 (2012/12/31)	ELECTRICITY OF VIETNAM (EVN)/MINISTRY OF INDUSTRY (MOI)	On shchedule

Source : ADB Webiste and EVN

CHAPTER 3 NECESSITY OF THE PROJECT

3.1 POSITION OF O MON 3 POWER PLANT IN PDP7

According to PDP7, O Mon 3 power plant is planned to be put into operation in 2015 and the reserve margin in the southern region will be recovered to 5.2% in combination with implementation of other power plants. However the reserve margin of 5.2% seems still low in comparison with the average reserve margin of 8% in Japan. Therefore, once the similar drought as well as 2010 occurs in 2015, the southern region will be suffered from power supply shortage due to the less generation energy by hydropower plants, even though O Mon 3 power plant starts the operation.

On the other hand, EVN expected as of December 2011 that O Mon 3 power plant could be put into operation in 2016. The Contribution of O Mon 3 power plant to the reserve margin of 22.6 % in 2016 is demonstrated in Table 3.1-1. If O Mon 3 cannot be put into operation in 2016, power supply will be decreased by 3.5 % and the reserve margin will be decreased to 18.3 %.

And as mentioned in Section 2.2, the concrete developer for O Mon 2 has not been fixed yet at present. Therefore, commencement of commercial operation of O Mon 2 power plant in 2016 as scheduled in PDP7 seems to be impossible. According to CTTP's information, O Mon 2 power plant is expected to be put into operation in 2017. If O Mon 3 power plant cannot be put into operation in 2016 and operation of O Mon 2 power plant is delayed in 2017, the reserve margin in the southern region in 2016 will reduced to 14.0%. The reserve margin of 14.0 % seems absolutely insufficient for Vietnam which largely depends on power generation produced by hydropower plants because severe planned blackout occurred in the northern and southern regions in 2010 in spite of the average reserve margin of 38.1 % [1]for whole country in 2010.

Based on the above discussion, if the operation of O Mon 3 power plant is delayed in 2017, the southern region will be suffered from power supply shortage in 2016 and power supply shortage in the southern region will continue from the year 2012 to 2016.
For the above reason, O Mon 3 power plant will play the important role in PDP7.

Table 3.1-1 Contribution of O Mon 3 Power Plant (750 MW） in 2016

Operation of O Mon 2	O Mon 3 power plant	Power Demand	Power Supply	Reserve Margin
Year 2016	With operation	17,556 MW	21,515 MW (100 %)	22.6 %
	Without operation	17,556 MW	20,765 MW (96.5 %)	18.3 %
Year 2017	With operation	17,556 MW	20,765MW (100 %)	18.3 %
	Without operation	17,556 MW	20,015 MW (96.4 %)	14.0 %

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[1] According to IE's information, the peak demand in 2010 was 15,416 MW and installed capacity was 21,297 MW. Therefore, the reserve margin in 2010 was 38.1 %.

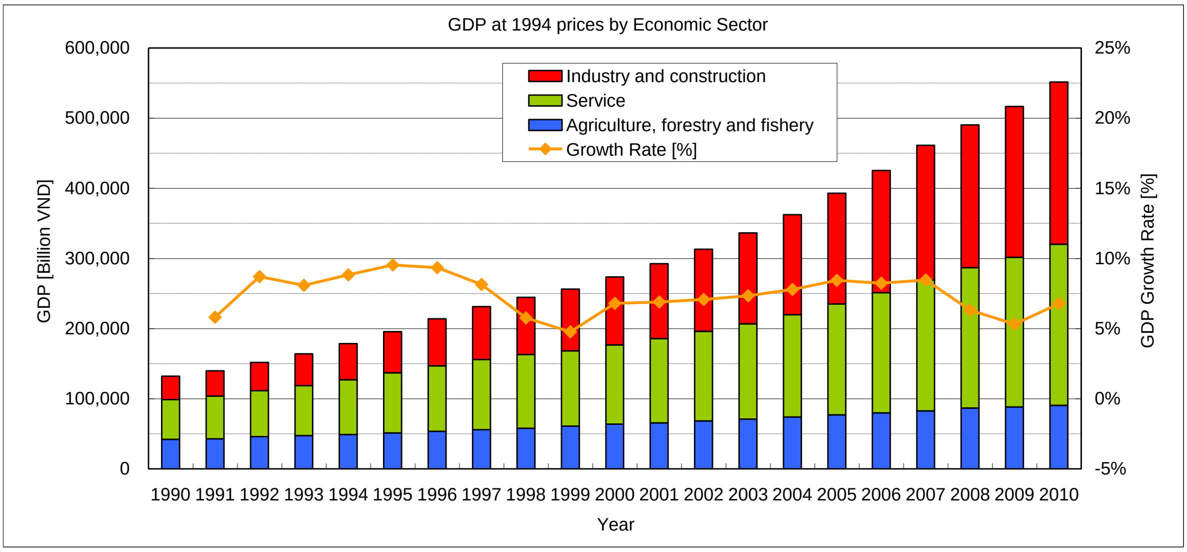
3.2 ECONOMIC CONDITION OF THE SOUTHERN AND MEKONG DELTA REGIONS

3.2.1 Economic Condition of Vietnam

(1) Economic Trend of Vietnam

Vietnam has experienced rapid economic growth of 7 to 9 % after 1990's under "Doi Moi" policy (Renovation) focusing on market oriented economic management. Furthermore, Vietnam attracts worldwide attention after joining to WTO (World Trade Organization) as the 150th member in 2007. As for the economical relation between Japan and Vietnam, economic relation will be expected to expand more than ever after the conclusion and validation of EPA (Economic Partnership Agreement) in 2008.[2]

As shown in Fig. 3.2-1, the high economic growth rate (GDP: Gross Domestic Product) has been maintained except 1999 of which growth rate was less than 5 % in. GDP and its growth by economic sector indicate that the growth of the Industry & Construction Sector is remarkable to be the leader of the economy.



Unit: Billion VND

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Industry and construction	58,550 30%	67,016 31%	75,474 33%	81,764 33%	88,047 34%	96,913 35%	106,986 37%	117,125 37%	129,399 38%	142,621 39%	157,867 40%	174,259 41%	192,065 42%	203,554 42%	214,799 42%	231,336 42%
Service	85,698 44%	93,240 44%	99,895 43%	104,966 43%	107,330 42%	113,036 41%	119,931 41%	127,770 41%	136,016 40%	145,897 40%	158,276 40%	171,391 40%	186,562 40%	200,317 41%	213,601 41%	229,660 42%
Agriculture, forestry and fishery	51,319 26%	53,577 25%	55,895 24%	57,866 24%	60,895 24%	63,717 23%	65,618 22%	68,352 22%	70,827 21%	73,917 20%	76,888 20%	79,723 19%	82,717 18%	86,587 18%	88,166 17%	90,613 16%
Total	195,568	213,834	231,265	244,597	256,273	273,667	292,536	313,248	336,243	362,436	393,032	425,374	461,345	490,459	516,567	551,610
Growth Rate [%]	9.5%	9.3%	8.2%	5.8%	4.8%	6.8%	6.9%	7.1%	7.3%	7.8%	8.4%	8.2%	8.5%	6.3%	5.3%	6.8%

Fig. 3.2-1 Economic Growth of Vietnam

Source: GSO (General Statistics Office of Vietnam)

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[2] JETRO Ho Chi Minh Office "Industry Analysis of Vietnam", 2010

(2) Foreign Direct Investment (FDI)

Foreign direct investment (FDI) to Vietnam increased rapidly to reach 10,000 million USD (registered capital) in 1996 in the context of legislation of Foreign Investment Law in 1988 and removing the economic sanctions by USA. After 1997, with the exception of some periods due to Asian currency crisis, FDI has been increasing rapidly. This is because that receiving FDI was ready for the Vietnam side by reviewing and improving of the legal system, development of Industrial Parks, and preparation of receiving foreign companies. Furthermore, foreign investors paid considerable attention to offset the risk and to avoid excessive concentration of China.

Accession to WTO in 2007 accelerated FDI to reach 71.7 billion US dollars of registered capital and 11.5 billion US dollars of implementation capital in 2008 as shown in Fig.3.2-2. Though FDI decreased rapidly in 2009 due to Lehman's fall to 21.5 billion US dollars of registered capital in 2009, it seems to be recovered after 2010.[3]

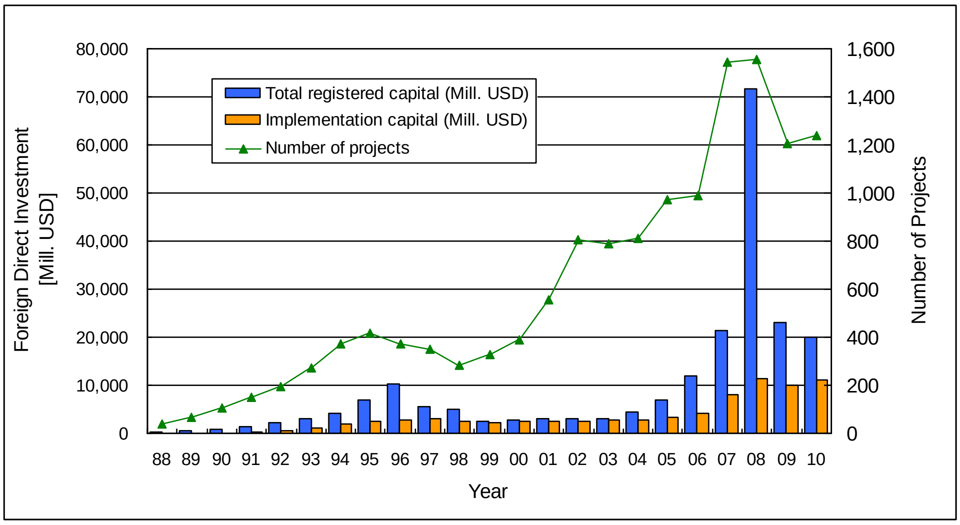

Fig. 3.2-2 Foreign Direct Investment to Vietnam

Source: GSO

(3) Foreign Direct Investment from each country

Among the total of Foreign Direct Investment (FDI) to Vietnam on the base of registered capital of 19.8 billion US dollar in 2010, the largest amount of FDI comes from Singapore followed by Korea, Netherland, and Japan as the larger investment countries (Fig.3.2-3(1)). Fig. 3.2-3(2) shows the FDI accumulated until December 2010 and indicates that the largest amount of Taiwan is followed by Korea, Singapore, and Japan.

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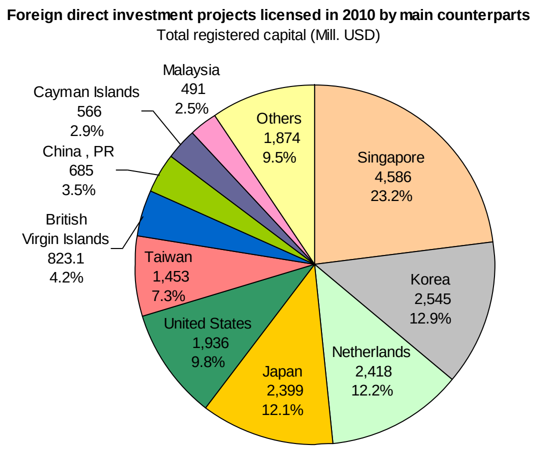
[3] JBIC: Investment Environment in Vietnam, 2011



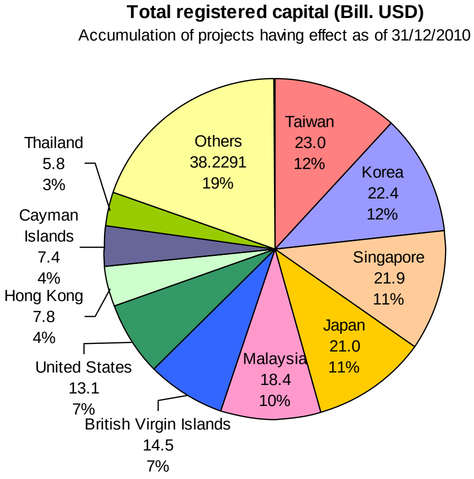


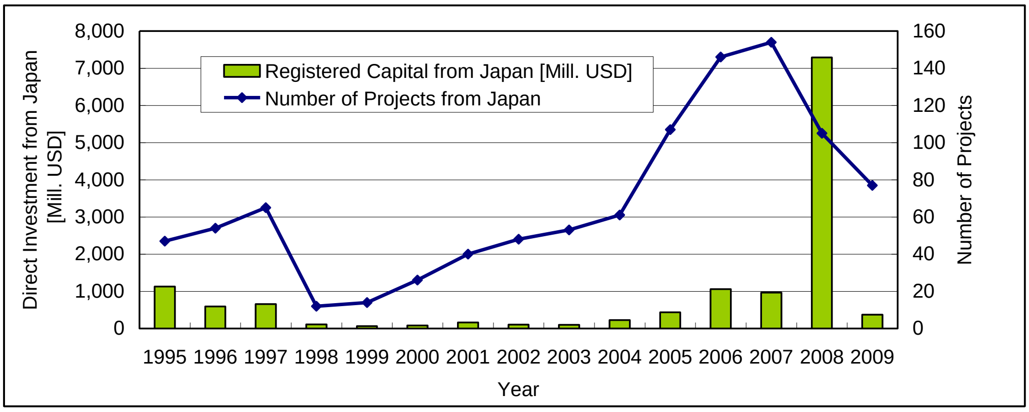
Fig. 3.2-3 (1) FDI in 2010 by Main Countries

Fig. 3.2-3(2) Accumulated FDI by Main Countries as of December 2010

Source: GSO

(4) Direct Investment from Japan

Direct investment from Japan to Vietnam has increased after legislation of Vietnam Investment Law and recommencement of ODA's assistance in 1990's. Though investment stayed stagnant for a while in the effect of Asian Currency Crisis, investment from Japan increased rapidly after around 2004 on the background of establishment of Industrial Parks and preparation of receiving Japanese companies (Fig.3.2-4).



Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total Registered Capital [Mill.USD]	6,524	8,497	4,737	3,658	1,567	1,989	2,192	1,558	1,914	2,222	4,002	7,570	17,885	71,726	21,482
Registered Capital from Japan [Mill. USD]	1,130	591	657	108	62	81	164	102	100	224	437	1,056	965	7,288	373
Number of Projects from Japan	47	54	65	12	14	26	40	48	53	61	107	146	154	105	77
Proportion of Japan to Total Investment [%]	17.3%	7.0%	13.9%	3.0%	4.0%	4.1%	7.5%	6.5%	5.2%	10.1%	10.9%	13.9%	5.4%	10.2%	1.7%

Fig. 3.2-4 Trend of Direct Investment from Japan

Source: JETRO, MPI, GSO

3.2.2 Economic Condition of the Southern and Mekong Delta Regions

Most of the FDI to Vietnam has been coming to the Southern Region from the period of investment boom started after 1990's to 2000. One of the reasons is that infrastructures such as roads and electricity were developed earlier than other regions from the period of the Vietnam War by the United States of America. Furthermore, the most important reason is that preparation for receiving FDI was made from the earlier period by improving industrial infrastructures and developing Industrial Parks and Export Promoting Zones so that investors can start new business easily. As shown in below, the Southern Region plays the most important role in the economy and industry, while shortage of electricity is one of the most important issues.

(1) Population, Income and Consumption per capita

As shown in Table 3.2-1, the population in whole Vietnam is approximately 87 million, including 30 million each in the Northern and the Southern Regions and 24 million in the Central Region. The Population density of the Southern Region is the highest as 497 persons/km^2 while those of the Northern and Central Regions are 266 persons/km^2 and 160 persons/km^2, respectively. As shown in the Fig. 3.2-5, the income and consumption of the Southern Region is the highest, and it can be said that the Southern Region is attractive also for the market.

Table 3.2-1 Trend of Population for Each Region

Average population by province (Thousand persons)

	Population Density (2010)	Area (km^2) (*)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total	263	331,051	78,621	79,538	80,467	81,436	82,392	83,311	84,219	85,119	86,025	86,928
	(person/km^2)	*(100%)*	*(100%)*	*(100%)*	*(100%)*	*(100%)*	*(100%)*	*(100%)*	*(100%)*	*(100%)*	*(100%)*	*(100%)*
North	266	116,402	28,572	28,873	29,177	29,489	29,775	30,013	30,233	30,471	30,692	30,939
	(person/km^2)	*(35%)*	*(36%)*	*(36%)*	*(36%)*	*(36%)*	*(36%)*	*(36%)*	*(36%)*	*(36%)*	*(36%)*	*(36%)*
Central	160	150,526	22,673	22,850	23,021	23,203	23,377	23,528	23,677	23,835	23,985	24,150
	(person/km^2)	*(45%)*	*(29%)*	*(29%)*	*(29%)*	*(28%)*	*(28%)*	*(28%)*	*(28%)*	*(28%)*	*(28%)*	*(28%)*
South	497	64,124	27,376	27,815	28,270	28,745	29,240	29,770	30,308	30,813	31,349	31,839
	(person/km^2)	*(19%)*	*(35%)*	*(35%)*	*(35%)*	*(35%)*	*(35%)*	*(36%)*	*(36%)*	*(36%)*	*(36%)*	*(37%)*

(*) Area data as of 01 January 2009 according to Decision No. 2097b/QD-BTNMT dated 29 October 2009 of Minister of the Ministry of Natural Resources and Environment.

Source: GSO

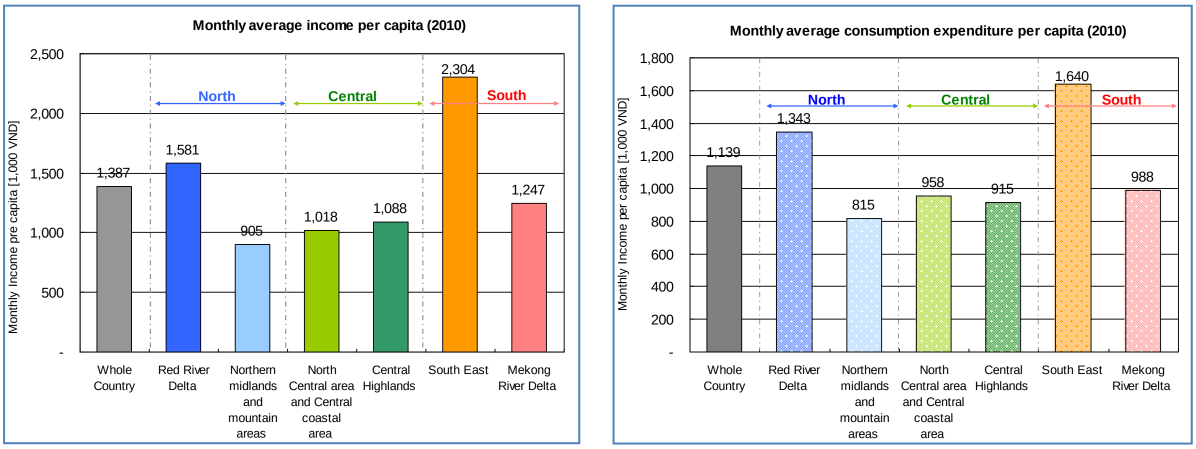


Fig. 3.2-5 Monthly Average Income per Capita for Each Region and Monthly Average Consumption per Capita for Each Region

Source: GSO

(2) Gross Output of Industry

Gross output of industry has been increasing every year as shown in Fig.3.2-6. Among that the output of industry in the Southern Region is more than 50 % (53 % in 2010) of the total output. This indicates that the Southern Region plays the most important roles for industries which lead the Vitamin economy.

	Gross output of Industry 2009 at Constant 1994 Prices (Bill.VND)						
		2005	2006	2007	2008	2009	2010
	Total	415,895.8 *(100%)*	485,896.0 *(100%)*	567,448.3 *(100%)*	646,353.0 *(100%)*	701,183.8 *(100%)*	808,745.4 *(100%)*
	North (A ~ B)	116,798.1 *(28%)*	141,346.0 *(29%)*	172,132.9 *(30%)*	199,089.3 *(31%)*	217,006.5 *(31%)*	251,079.0 *(31%)*
A	Red River Delta	102,314.4	124,573.0	152,283.6	176,474.9	192,753.7	223,179.1
B	Northern midlands and mountain areas	14,483.5	16,772.8	19,849.0	22,614.1	24,252.5	27,899.6
	Central (C ~ D)	42,881.5 *(10%)*	48,577.9 *(10%)*	56,117.1 *(10%)*	64,553.6 *(10%)*	73,126.4 *(10%)*	93,885.7 *(12%)*
C	Northern central and central coast areas	39,374.5	44,503.0	51,223.3	58,605.5	66,734.4	86,484.1
D	Central Highlands	3,506.9	4,074.8	4,893.7	5,948.0	6,391.9	7,401.5
	South (E ~ F)	236,297.2 *(57%)*	273,651.5 *(56%)*	314,600.9 *(55%)*	356,098.7 *(55%)*	380,942.3 *(54%)*	429,577.2 *(53%)*
E	South East	198,896.8	229,296.0	259,909.2	291,716.4	311,715.6	349,591.7
F	Mekong River Delta	37,399.9	44,355.0	54,691.2	64,381.8	69,226.3	79,985.1
G	No Place and Port	19,919.8 *(5%)*	22,321.5 *(5%)*	24,598.3 *(4%)*	26,612.3 *(4%)*	30,109.4 *(4%)*	34,204.3 *(4%)*

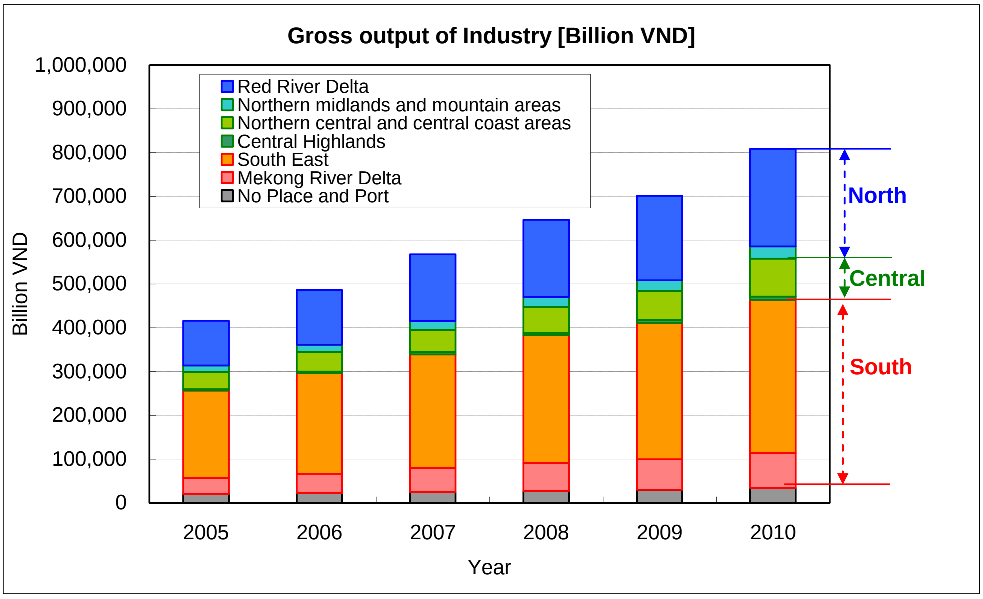


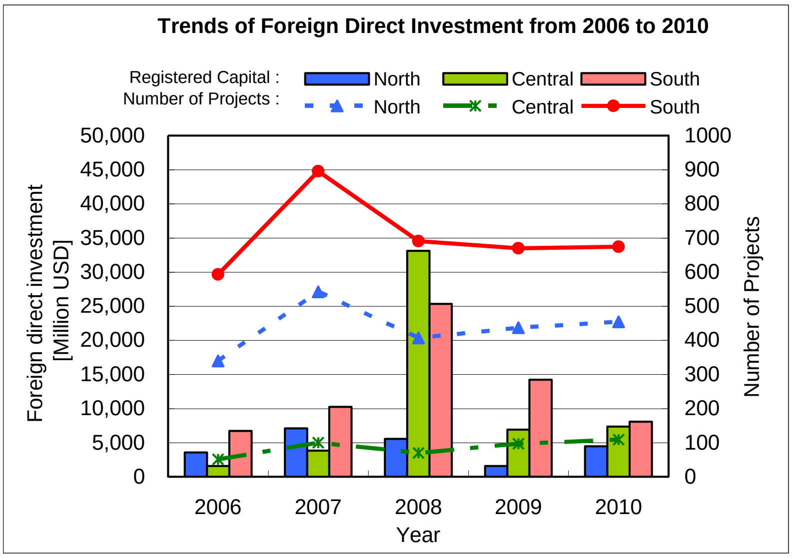
Fig. 3.2-6 Gross Output of Industry for Each Region

Source: GSO

(3) Foreign Direct Investment for each Region

Recent trend of FDI for each region is shown in Fig.3.2-7. FDI for the Southern Region is the highest 54 % of the total 1,200 projects and 41 % of the total 2 billion US dollar in 2010. FDI for the Southern Region is the highest not only the project number but also the registered capitals.

The Southern Region has been the most important region for FDI because of improved infrastructures and development of numbers of Industrial Parks available for foreign enterprises. The accumulated number of project and total capital until 2010 shown in Fig. 3.2-8 indicates that the Southern Region is overwhelming to other regions in both number of projects and investment amount.



Number of projects

	North	Central	South
2006	339 (34%)	51 (5%)	593 (60%)
2007	542 (35%)	100 (7%)	896 (58%)
2008	407 (35%)	70 (6%)	691 (59%)
2009	437 (36%)	97 (8%)	670 (56%)
2010	454 (37%)	109 (9%)	674 (54%)

Total registered capital (Mill. USD)

	North	Central	South
2006	3,578 (30%)	1,575 (13%)	6,734 (57%)
2007	7,094 (34%)	3,829 (18%)	10,244 (48%)
2008	5,553 (9%)	33,108 (52%)	25,334 (40%)
2009	1,580 (7%)	6,912 (30%)	14,220 (63%)
2010	4,475 (23%)	7,341 (37%)	8,070 (41%)

Fig. 3.2-7 FDI for Each Region (2006 - 2010)

Source: GSO

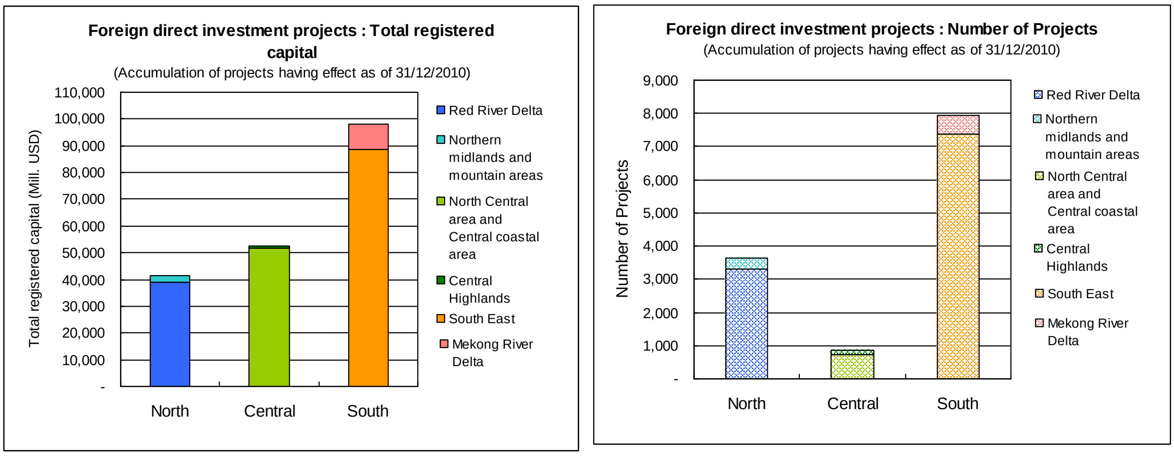


Fig. 3.2-8 FDI accumulated until 2010 for Each Region
(Left:Registered Capital, Right: Number of Projects)

Source: GSO

3.3 OVERVIEW OF INDUSTRIAL PARKS AND JAPANESE COMPANIES IN THE SOUTHERN REGIONS

3.3.1 Overview of Industrial Parks in Vietnam

Vietnam government established the system of Industrial Parks (IPs), Export Processing Zones (EPZs), and High-Tech Parks - collectively means Industrial Parks -, to promote investment for industrial products, exports, and high-tech products. Companies in these Industrial Zones for manufacturing and related service business of industrial products, exports and high-tech products are given preferential treatment for corporate income taxes, export taxes and import taxes.

The number and size of Industrial Parks have been increasing as shown in Fig.3-1. As for electricity supply, Industrial Parks were suffered from power shortage and planned blackout in 2010 due to drought from the previous year though electricity are to be distributed to Industrial Parks preferentially.

Fig.3.3-1 shows distribution map of Industrial Parks.

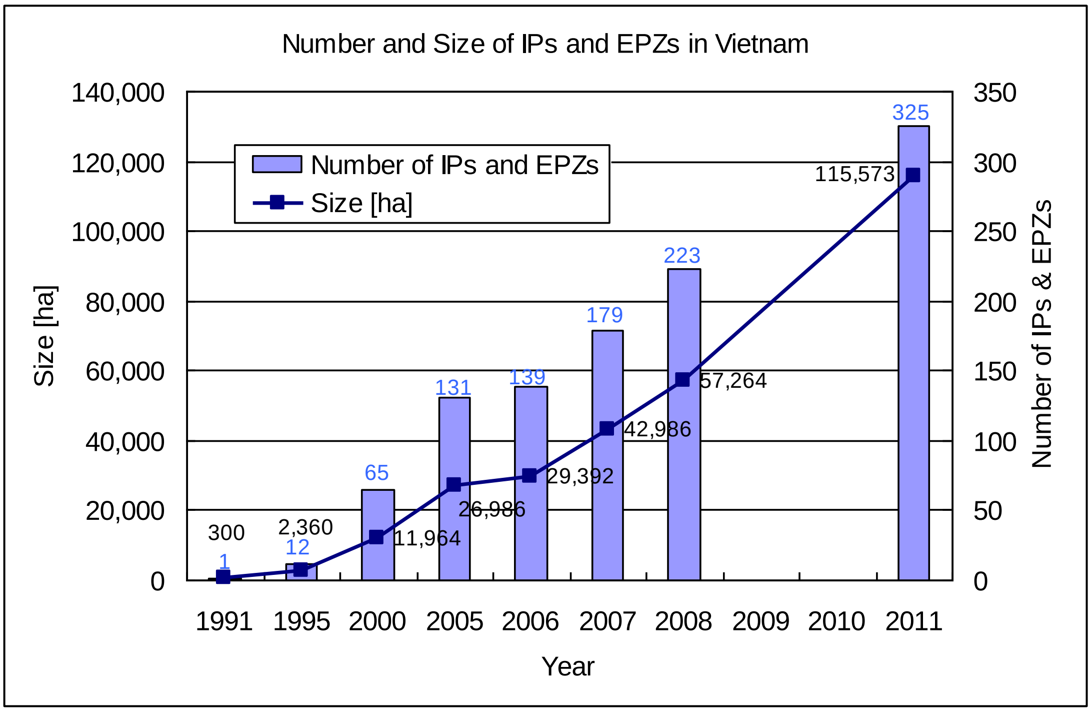


Fig. 3.3-1 Number and Size of Industrial Parks in Vietnam

Source: The Study Team prepared based on MPI "Vietnam's IPs, EPZs and EZs" (2009)

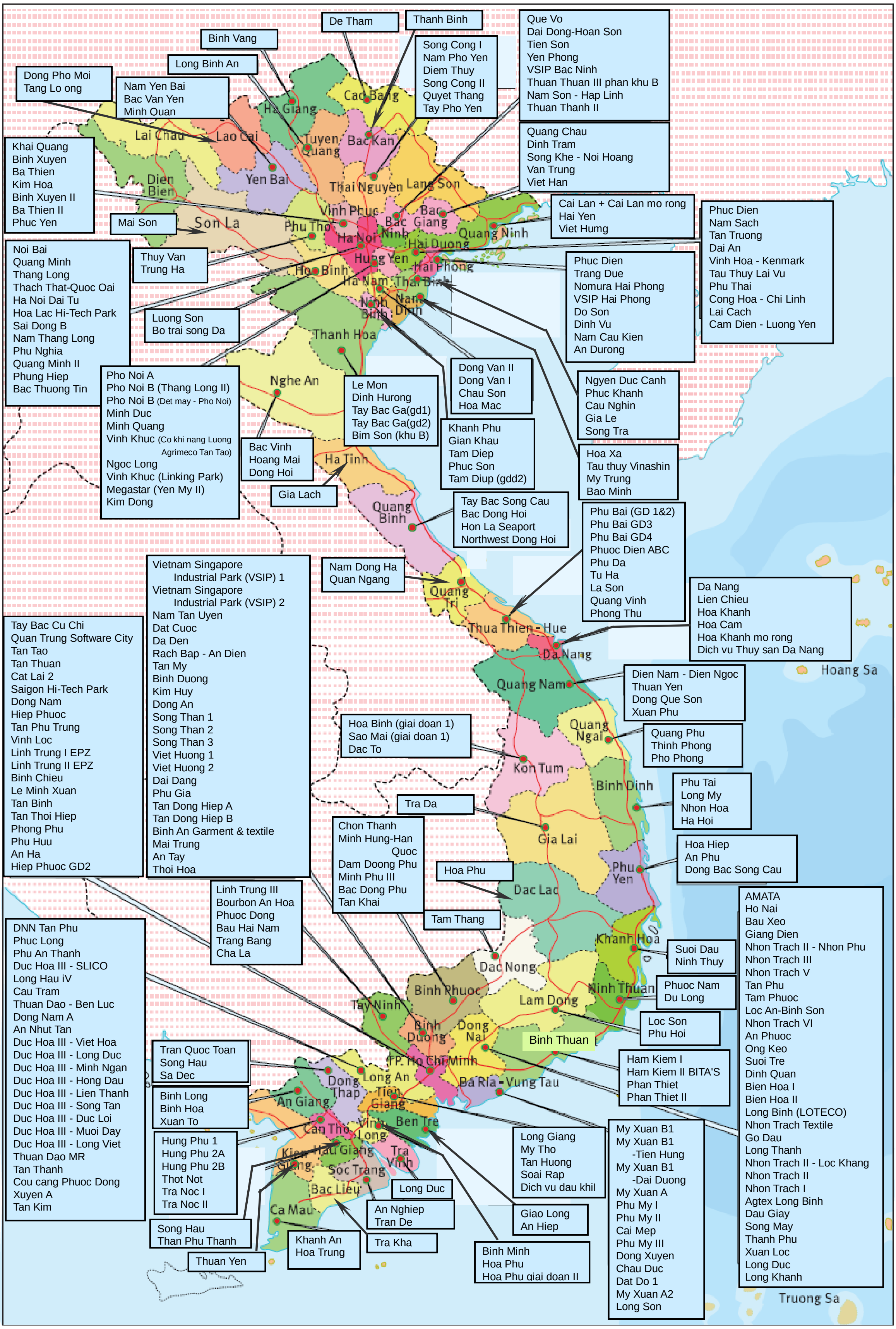


Fig. 3.3-2 Distributions of Industrial Parks

Source: The Study Team prepared based on MPI "Vietnam's IPs, EPZs and EZs"(2009)

3.3.2 Industrial Parks in the Southern Region

(1) Interregional Comparison of Industrial Parks

Numbers and sizes of Industrial Parks for each region are shown in Fig.3.3-3. The number and size of the Southern Region is the largest of all the region while 50.8 % in the number (Northern 30.8 %, Central 18.5 %) of the total, and 48.8 % in the size (Northern 41.5 %, Central 9.7 %). Of the Southern Region, Southern eastern region covers 31.7 % in the number and 40.0 % in the size, the Mekong region covers 19.1 % and 8.8 % respectively.

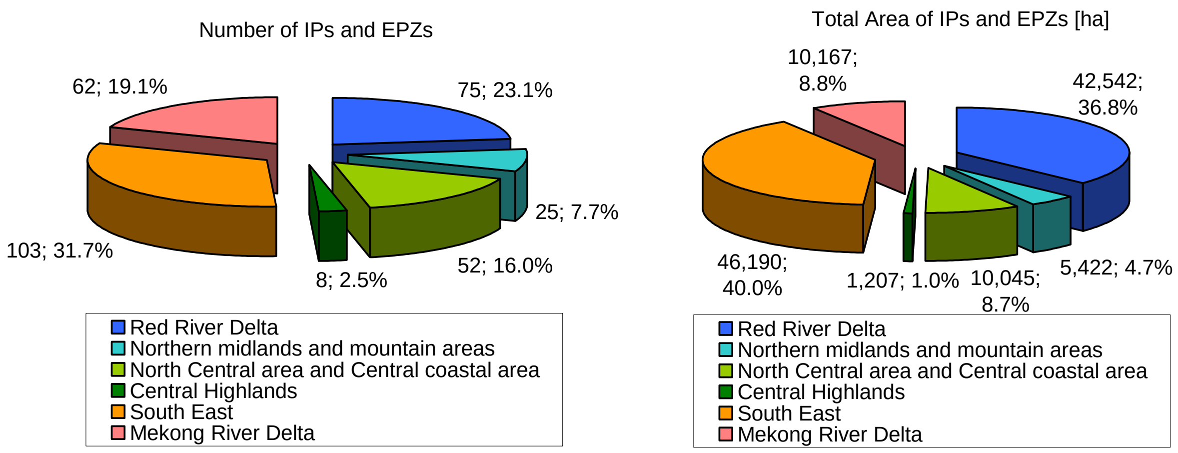


Fig. 3.3-3 Number and Size of IPs and EPZs of Each Region

Source: MPI, JETRO

(2) Overview of Industrial Parks in the Southern Region

There are Industrial Parks (IPs), Export Processing Zones (EPZs) and High-tech Parks in the Southern Region, 60 % of them are concentrated in Ho Chi Minh City, Dong Nai Province and Binh Duong Province. Though electricity for these Industrial Parks is supplied by EVN, planned blackout was executed in some areas due to power shortage in 2010.

(3) Current Situation of Japanese Companies in the Southern Region

Fig.3.3-4 indicates that number of companies of Industrial Parks locate in the Southern Region is the largest. The number of Japanese companies is the largest in the Southern Region. These facts indicate that the Southern Region plays quite important role for industrial production in Vietnam.

The list of Industrial Parks in the Southeastern and Mekong Delta Region is shown in Table 3.3-1. This list was updated in this JICA Study Team based on the list provided by MPI and information from JETRO. According to this list as of February 2012, the number of Industrial Parks is 103 in the Southeast, 62 in the Mekong Delta, and 165 in total of the Southern Region. The number of the company in the Industrial Parks in the Southern Region is the largest, 4,701 companies, including 411 Japanese companies.

As for the electricity demand and supply, blackout took place so often especially in the Industrial Zones in the Southern Region in the period of power shortage in 2010 due to water shortage. Same information was also obtained in the interviews not only at MPI but also

JETRO Ho Chi Minh Office. One of the most important and basic issue for the Industrial Parks in the Southern Region is the problem of electricity supply. Developing new power source in the Southern Region is important and prioritized issues for developing Industrial Parks and developing economy in Vietnam. JETRO Ho Chi Minh Office held the seminar on December 15, 2011 relating to "Current Status of the Power Supply and its Vision in Vietnam", and about 100 Japanese firms participated in the seminar. This fact indicates that how Japanese firms take much interest in the current shortage of power supply in the Southern Region.

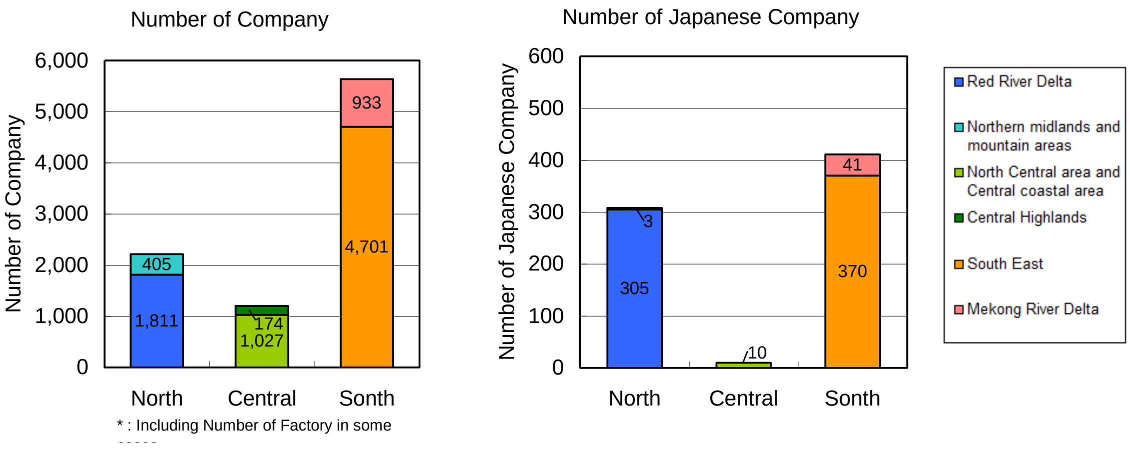


Fig. 3.3-4 Numbers of Companies in Industrial Parks of Each Region (Left: Total, Right: Japanese)

Source: MPI, JETRO

Table 3.3-1 List of Industrial Parks in the Southern Region (1/3)

		Industrial Zone	Year of Establishment	Total Area [ha]	Industrial Area [ha]	Leased Area [ha]	Number of Company*	Japanese Company	Sourece
		South					**5,634**	**411**	
		South East		46,190 ha			**4701**	**370**	
1		**Binh Phuoc**					**82**	**0**	
	1	Chon Thanh	2003	120	73	41	21		2,3
	2	Minh Hung-Han Quoc	2007	194	132	122	52		3
	3	Dam Doong Phu	2008	72	44				3
	4	Minh Phu III	2008	292	178	49	2		3
	5	Bac Dong Phu	2010	184	126	26	5		3
	6	Tan Khai	2010	46	34	4	2		3
2		**Tay Ninh**					**234**	**13**	
	1	Linh Trung III	2002	203	132	101	139	13	1,3
	2	Bourbon An Hoa	2010	1,020	760	15	12		1,3
	3	Phuoc Dong	2010	3,276	2,190	1,418	6	0	1,3
	4	Bau Hai Nam		191	114	0			1
	5	Trang Bang	1999	191	133	131	75		2,3
	6	Cha La	2009	43	32	20	2		3
3		**Binh Duong**					**1697**	**150**	
	1	Bau Bang	2007	2,000	100	300	40	6	1,3
	2	My Phuoc I ~ IV	2002	4,200	1,700	1,300	340	37	1,2,3
	3	Ascendas-Protrade Singapore Tech Park		500	500				1
	4	Dong An II	2007	158	101	60	22	2	1,3
	5	Vietnam Singapore Industrial Park (VSIP) 1	1996	500	483	483	241	59	1,2,3
	6	Vietnam Singapore Industrial Park (VSIP) 2	2004	6,345	1,345	445	170	38	1,3
	7	Nam Tan Uyen	2005	331	204	185	86	2	1,3
	8	Dat Cuoc	2007	212	131	67	30	1	1,3
	9	Da Den		274	166	75	34	1	1
	10	Rach Bap - An Dien	2005	279	188	10	6	1	1,2,3
	11	Tan My		117	100	10	5		1
	12	Binh Duong	1997	17	14	14	12		2,3
	13	Kim Huy	2006	214	145	76	11		2,3
	14	Dong An	1996	139	93	93	147		2,3
	15	Song Than 1	1995	178	140	140	211		2,3
	16	Song Than 2	1996	279	217	214	128	3	2,3,4
	17	Song Than 3	2007	534	327	141	23		2,3
	18	Viet Huong 1	1996	36	25	25	69		2,3
	19	Viet Huong 2	2004, 2007	250	169	123	29		2,3
	20	Dai Dang	2005	274	166	74	33		2,3
	21	Phu Gia	2007	133	86	17	2		2,3
	22	Tan Dong Hiep A	2001	53	37	37	18		2,3
	23	Tan Dong Hiep B	2002	163	103	86	32		2,3
	24	Binh An Garment & textile	2004	26	19	19	5		2,3
	25	Mai Trung	2005	51	35	22	3		2,3
	26	An Tay	2007	500	335				3
	27	Thoi Hoa	2004	202	135				3
4		**Dong Nai**					**1049**	**94**	
	1	AMATA	1994, 2002	494	314	298	124	55	1,2,3
	2	Ho Nai	1998, 2007	497	301	139	90		1,2,3
	3	Bau Xeo	2006	500	328	307	25		1,2,3
	4	Giang Dien	2008	529	325		2		1,2,3
	5	Nhon Trach II - Nhon Phu	2006	183	126	65	19		1,2,3
	6	Nhon Trach III	1997	688	461	323	57	7	1,2,3
	7	Nhon Trach V	2003	302	205	184	18		1,2,3
	8	Tan Phu	2007	54	35		1		1,2,3
	9	Tam Phuoc	2003	323	215	215	54		1,2,3
	10	Loc An-Binh Son	2010	498	336		1		1,3
	11	Nhon Trach VI	2005	315	220		1		1,2,3
	12	An Phuoc	2003	130	91		4		1,2,3
	13	Ong Keo	2008	823	503	425	14		1,2,3
	14	Suoi Tre		50	29	13	5		1
	15	Dinh Quan	2004	54	38	45	14		1,3
	16	Bien Hoa I	2000	335	248	248	80	3	1,2,3
	17	Bien Hoa II	1995	365	261	261	120	12	1,2,3
	18	Long Binh (LOTECO)	1996	100	72	72	48	13	1,3

（Source） *: Including Numbers of Factories in some cases

1：JETRO (Japan External Trade Organization)
2：MPI "Vietnam's Ips, EPZs and Ezs, Ideal Places for Manufacturing Base, A guide for Investing in Vietnam's Ips, EPZs and Ezs"
3："Tinh Ninh Hoat Dong Cua Cac Khu Cong Nghiep Viet Nam Den Nam 2011" (Operating Industrial Zones by 2011 in Viet Nam), provided by MPI in Feb. 3, 2012
4：ASEAN-Japan Center WEB page (http://www.asean.or.jp/ja/asean/know/country/vietnam/invest/industrialestate)

Table 3.3-1 List of Industrial Parks in the Southern Region (2/3)

		Industrial Zone	Year of Establishment	Total Area [ha]	Industrial Area [ha]	Leased Area [ha]	Number of Company*	Japanese Company	Sourece
	19	Nhon Trach Textile	2003	184	121	96	35		2,3
	20	Go Dau	1955	184	137	137	28	2	2,3,4
	21	Long Thanh	2003	488	283	224	79	1	2,3,4
	22	Nhon Trach II - Loc Khang	2006	70	43	27	3		2,3
	23	Nhon Trach II	1997, 2005	347	257	257	61		2,3
	24	Nhon Trach I	1995	430	311	279	85		2,3
	25	Agtex Long Binh	2007	43	28	26	10		2,3
	26	Dau Giay	2008	331	206	1	2		2,3
	27	Song May	1988, 2007	474	334	135	57		2,3
	28	Thanh Phu	2006	177	124	58	8		2,3
	29	Xuan Loc	2006	109	64	40	2	1	2,3,4
	30	Long Duc	2007	283	183		1		2,3
	31	Long Khanh	2008	264	169		1		3
5		**Ba Ria - Vung Tau**					**264**	**9**	
	1	My Xuan B1	1998	226	158	55	5		1,2,3
	2	My Xuan B1-Tien Hung	2007	200	140	30	4		1,3
	3	My Xuan B1-Dai Duong	2006	139	138	94	13		1,3
	4	My Xuan A	1996, 2002	304	228	198	34	3	1,2,3
	5	Phu My I	1998	945	651	586	60	1	1,2,3
	6	Phu My II	2001	620	373	198	34	3	1,2,3
	7	Cai Mep	2002	670	414	80	11		1,2,3
	8	Phu My III	2007	942	803				1,2,3
	9	Dong Xuyen	1996	161	128	126	68	1	1,2,3
	10	Chau Duc	2008	1,556	1,066	13	3		1,2,3
	11	Dat Do 1	2009	496	496	301	0		1,3
	12	My Xuan A2	2001, 2007	422	292	277	30	1	2,3,4
	13	Long Son	2008	1,250	890	440	2		2,3
6		**TP. Ho Chi Minh**					**1375**	**104**	
	1	Tay Bac Cu Chi	1997	220	141	141	44		1,2,3
	2	Quan Trung Software City		43		28	32	28	1
	3	Tan Tao	1996, 2000	392	220	181	268		1,2,3
	4	Tan Thuan	1991	300	195	165	171	66	1,2,3
	5	Cat Lai 2	2003	117	82	82	60		1,2,3
	6	Saigon Hi-Tech Park		913	458	111	53	5	1
	7	Dong Nam	2010	343	287	180	6	0	1,3
	8	Hiep Phuoc	1996, 2008	311	222	222	95	1	1,2,3
	9	Tan Phu Trung	2004	590	359	91	60	1	1,2,3
	10	Vinh Loc	1997	203	115	115	121		2,3
	11	Linh Trung I EPZ	1992	62	42	42	30	3	2,3,4
	12	Linh Trung II EPZ	1997	62	44	44	41		2,3
	13	Binh Chieu	1998	27	21	21	20		2,3
	14	Le Minh Xuan	1997	100	66	66	181		2,3
	15	Tan Binh	1997, 2009	130	90	87	164		2,3
	16	Tan Thoi Hiep	1997	28	20	20	29		2,3
	17	Phong Phu	2002	163	88				2,3
	18	Phu Huu	2006	114	74				2,3
	19	An Ha		124					3
	20	Hiep Phuoc GD2	2008	597	285				
		Mekong River Delta		10,167 ha			**933**	**41**	
1		**Long An**					**474**	**30**	
	1	Duc Hoa III - Resco	2008	296	206	60	5		1,3
	2	Duc Hoa III - Anh Houng	2008	55	41	14	5		1,3
	3	Duc Hoa III - Thai Hoa	2008	100	70	30	26		1,3
	4	Tan Duc	2005	275	194	168	110	5	1,3
	5	Nhut Chanh	2007	106	74	59	17		1,2,3
	6	Long Hau	2006	249	152	100	84	22	1,3
	7	Vinh Loc-Ben Luc	2008	226	148	70	20		1,3
	8	Duc Hoa I	1999	70	47	47	74		1,3
	9	DNN Tan Phu	2011	105	74	10	3	0	1,3
	10	Phuc Long	2010	80	51	12	2		1,3
	11	Phu An Thanh	2008	392	392	50	7	1	1,3

（Source） *: Including Numbers of Factories in some cases

1：JETRO (Japan External Trade Organization)
2：MPI "Vietnam's Ips, EPZs and Ezs, Ideal Places for Manufacturing Base, A guide for Investing in Vietnam's Ips, EPZs and Ezs"
3："Tinh Ninh Hoat Dong Cua Cac Khu Cong Nghiep Viet Nam Den Nam 2011" (Operating Industrial Zones by 2011 in Viet Nam), provided by MPI in Feb. 3, 2012
4：ASEAN-Japan Center WEB page (http://www.asean.or.jp/ja/asean/know/country/vietnam/invest/industrialestate)

Table 3.3-2 The List of Industrial Parks in the Southern Region (3/3)

		Industrial Zone	Year of Establishment	Total Area [ha]	Industrial Area [ha]	Leased Area [ha]	Number of Company*	Japanese Company	Soure ce
	12	Duc Hoa III - SLICO	2008	196	138	0			1,3
	13	Long Hau iV		117	82	3			1
	14	Cau Tram	2007	78	54	6	5		2,3
	15	Thuan Dao - Ben Luc	2003	114	74	74	10		2,3
	16	Dong Nam A	2009	396	296	179	1		2,3
	17	An Nhut Tan	2008	120	81	2	1		2,3
	18	Duc Hoa III - Viet Hoa	2008	83	52	26	7	2	3
	19	Duc Hoa III - Long Duc	2010	175	114				3
	20	Duc Hoa III - Minh Ngan	2010	147	114	0			3
	21	Duc Hoa III - Hong Dau	2008	100	66	7	2		3
	22	Duc Hoa III - Lien Thanh	2008	92	64				3
	23	Duc Hoa III - Song Tan	2008	307	235				3
	24	Duc Hoa III - Duc Loi	2009	110	64				3
	25	Duc Hoa III - Muoi Day	2010	114	89				3
	26	Duc Hoa III - Long Viet	2011	87	50				3
	27	Thuan Dao MR	2011	190	134				3
	28	Tan Thanh	2010	296	204				3
	29	Cou cang Phuoc Dong	2011	129	83				3
	30	Xuyen A	1997	306	199	94	82		3
	31	Tan Kim	2004	104	67	36	13		3
2		**Tien Giang**					**61**	**1**	
	1	Long Giang	2007	540	378	92	11	1	1,3
	2	My Tho	1997	79	58	58	28		2,3
	3	Tan Huong	2004	197	138	81	22		2,3
	4	Soai Rap	2006	285					3
	5	Dich vu dau khi	2008						3
3		**Ben Tre**					**12**	**10**	
	1	Giao Long	2005	102	66	53	9	5	2,3
	2	An Hiep	2008	72	48	38	3	5	2,3
4		**Tra Vinh**					**26**	**0**	
	1	Long Duc	2005	100	62	62	26		2,3
5		**Vinh Long**					**24**	**0**	
	1	Binh Minh	2007	162	132	54	7		1,2,3
	2	Hoa Phu	2007	122	92	92	17		2,3
	3	Hoa Phu giai doan II	2010	130	91				3
6		**Dong Thap**					**57**	**0**	
	1	Tran Quoc Toan	2002	56	39	9	5		1,2,3
	2	Song Hau	2006	66	45	31	5		1,2,3
	3	Sa Dec	1997	134	100	40	47		2,3
7		**An Giang**					**15**	**0**	
	1	Binh Long	2007	29	19	14	6		2,3
	2	Binh Hoa	2009	132	100	40	9		2,3
	3	Xuan To	2005	57	32	11	4		2,3
8		**Kien Giang**					**0**	**0**	
	1	Thuan Yen	2009	141	91	17			3
9		**Can Tho**					**201**	**0**	
	1	Hung Phu 1	2004	270	262	26	5		1,2
	2	Hung Phu 2A	2009	134	114	21	4		3
	3	Hung Phu 2B	2009	63	44	15			3
	4	Thot Not	2008	150	102	49	10		3
	5	Tra Noc I	1995	135	112	112	122		2,3
	6	Tra Noc II	1998	155	121	115	60		2,3
10		**Hau Giang**					**18**	**0**	
	1	Song Hau	2007	291	282	175	6		2,3
	2	Than Phu Thanh	2009	201	149	74	18		3
11		**Soc Trang**					**31**	**0**	
	1	An Nghiep	2005	251	163	140	31		1,2,3
	2	Tran De		120	95				1
12		**Bac Lieu**					**4**	**0**	
	1	Tra Kha	2007	65	45	31	4		3
13		**Ca Mau**					**10**	**0**	
	1	Khanh An	2007	360	290	25	2		1,2,3
	2	Hoa Trung	2009	352	229	15	10		3

（Source）

*: Including Numbers of Factories in some cases

1：JETRO (Japan External Trade Organization)
2：MPI "Vietnam's Ips, EPZs and Ezs, Ideal Places for Manufacturing Base, A guide for Investing in Vietnam's Ips, EPZs and Ezs"
3："Tinh Ninh Hoat Dong Cua Cac Khu Cong Nghiep Viet Nam Den Nam 2011" (Operating Industrial Zones by 2011 in Viet Nam), provided by MPI in Feb. 3, 2012
4：ASEAN-Japan Center WEB page (http://www.asean.or.jp/ja/asean/know/country/vietnam/invest/industrialestate)

(4) Planning Projects of Industrial Parks

Following to the current active development, Industrial Parks will be developed also in the future. 10 expansion projects (increasing 2,000 ha) and 42 newly development projects (increasing 13,600 ha) are planned up to 2015 (Table 3.3-2 and Table 3.3-3) according to the Prime Minister Decision No. 1107/ 2006/QD-TTg. Therefore, demand of electricity will also increase more and more in the future.

Table 3.3-2 List of Industrial Parks in the Southern Region to be expanded up to 2015

No.	Names of industrial parks	Localities	To be-expanded area (ha)
1	Dinh Quan Industrial Park	Dong Nai	150
2	Viet Huong II Industrial Park	Binh Duong	140
3	Chon Thanh Industrial Park	Binh Phuoc	255
4	My Xuan A2 Industrial Park	Ba Ria-Vung Tau	90
5	My Xuan B1 (Dai Duong) Industrial Park	Ba Ria-Vung Tau	146
6	Hiep Phuoc Industrial Park	Ho Chi Minh City	630
7	Northwestern Cu Chi Industrial Park	Ho Chi Minh City	170
8	Trang Bang Industrial Park	Tay Ninh	163
9	Thuan Dao Industrial Park	Long An	200
10	Tan Kim Industrial Park	Long An	56

Source: Prime Ministers Decision No. 1107/ 2006/QD-TTg

Table 3.3-3 (1) List of Industrial Parks to be Formed up to 2015 (Southeast)

No.	Names of industrial parks	Localities	Projected area up to 2015 (ha)
1	Tan Phu Industrial Park	Dong Nai	60
2	Ong Keo Industrial Park	Dong Nai	300
3	Bau Xeo Industrial Park	Dong Nai	500
4	Loc An-Binh Son Industrial Park	Dong Nai	500
5	Long Duc Industrial Park	Dong Nai	450
6	Long Khanh Industrial Park	Dong Nai	300
7	Giang Dien Industrial Park	Dong Nai	500
8	Dau Giay Industrial Park	Dong Nai	300
9	My Phuoc 3 Industrial Park	Binh Duong	1,000
10	Xanh Binh Duong Industrial Park	Binh Duong	200
11	An Tay Industrial Park	Binh Duong	500
12	Southern Dong Phu Industrial Park	Binh Phuoc	150
13	Tan Khai Industrial Park	Binh Phuoc	700
14	Minh Hung Industrial Park	Binh Phuoc	700
15	Dong Xoai Industrial Park	Binh Phuoc	650
16	Northern Dong Phu Industrial Park	Binh Phuoc	250
17	Long Huong Industrial Park	Ba Ria-Vung Tau	400
18	Phu Huu Industrial Park	Ho Chi Minh City	162
19	Tram Vang Industrial Park	Tay Ninh	375

Source: Prime Ministers Decision No. 1107/ 2006/QD-TTg

Table 3.3-3(2) List of Industrial Parks to be Formed up to 2015 (Mekong Delta)

No.	Names of industrial parks	Localities	Projected area up to 2015 (ha)
1	Cau Tram (Cau Duoc) Industrial Park	Long An	80
2	My Yen-Tan Buu-Long Hiep (Ben Luc) Industrial Park	Long An	340
3	Nhat Chanh Industrial Park	Long An	122
4	Duc Hoa III Industrial Park	Long An	2,300
5	Thanh Duc Industrial Park	Long An	256
6	An Nhat Tan Industrial Park	Long An	120
7	Long Hau Industrial Park	Long An	142
8	Tan Thanh Industrial Park	Long An	300
9	Southern Tan Lap Industrial Park	Long An	200
10	Northern Tan Lap Industrial Park	Long An	100
11	Soai Rap Ship Industrial Park	Tien Giang	290
12	An Hiep Industrial Park	Ben Tre	72
13	Hau River Industrial Park	Dong Thap	60
14	Binh Minh Industrial Park	Vinh Long	162
15	Hung Phu 2 Industrial Park	Can Tho	226
16	Binh Long Industrial Park	An Giang	67
17	Binh Hoa Industrial Park	An Giang	150
18	Thanh Loc Industrial Park	Kien Giang	100
19	Vuot Canal Industrial Park	Kien Giang	100
20	Hau River Industrial Park	Hau Giang	150
21	Tran De Industrial Park	Soc Trang	140
22	Dai Ngai Industrial Park	Soc Trang	120
23	Tra Kha Industrial Park	Bac Lieu	66

Source: Prime Ministers Decision No. 1107/ 2006/QD-TTg

3.4 CURRENT SITUATION ON POWER FACILITIES AND POWER BALANCE IN MEKONG DELTA

3.4.1 Power Supply to the Southern Region in Vietnam

Generated power is transferred to five (5) regional power corporations under EVN via 500 kV and 220 kV transmission lines. There are two power corporations in the southern region. One is Southern Power Corporation (SPC) and the other is Ho Chi Minh Power Corporation. The former supplies power to the whole southern region (18 provinces) except Ho Chi Minh City and parts of central region (3 provinces[4]) and the latter supplies power to Ho Chi Minh City. SPC provides power to consumers via twenty (20) power companies distributed to the provincial level and one power company[5] with independent accounting.

Fig. 3.4-1 shows the organization chart of SPC and Fig. 3.4-2 shows the power grid of SPC.

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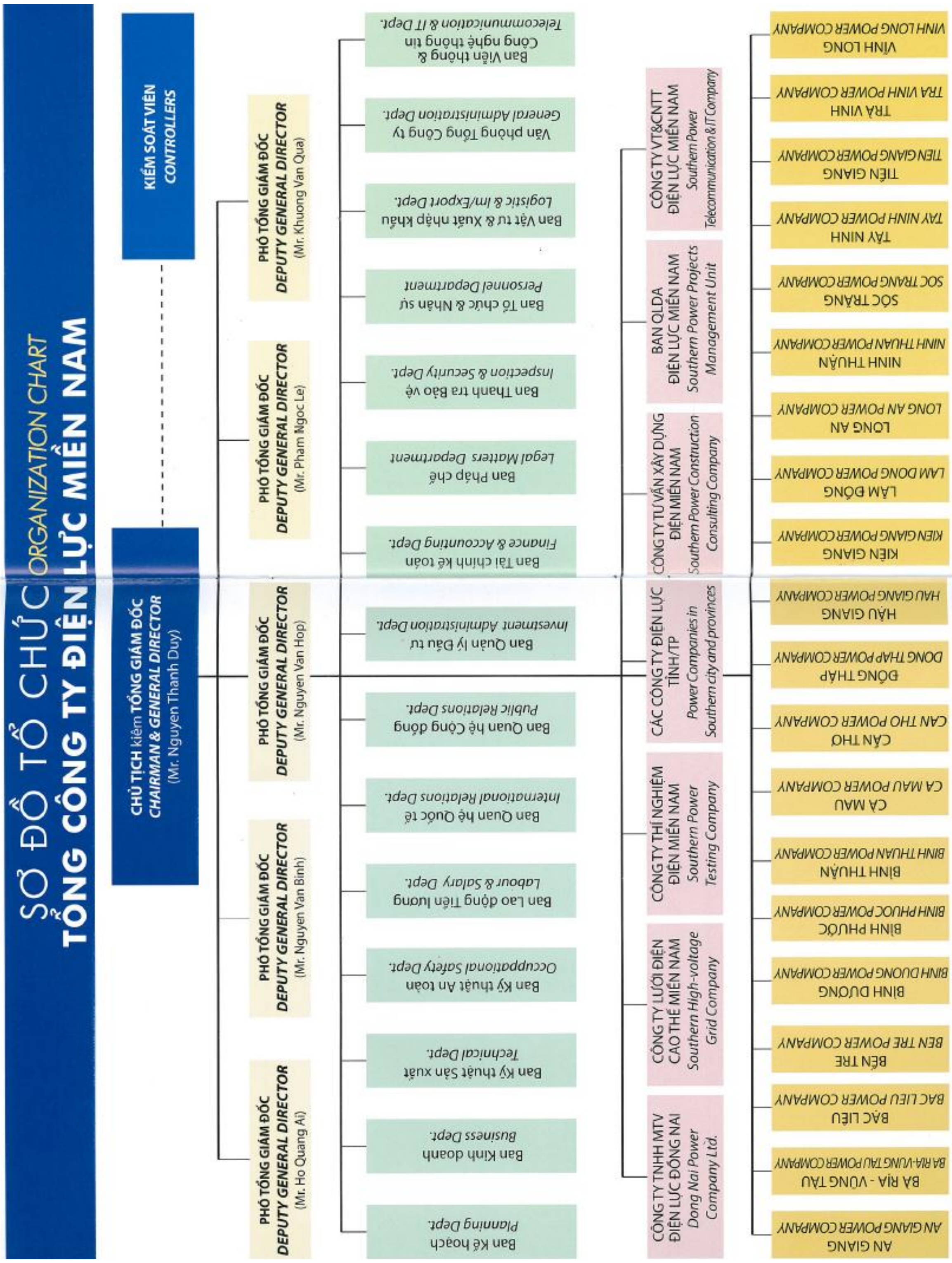
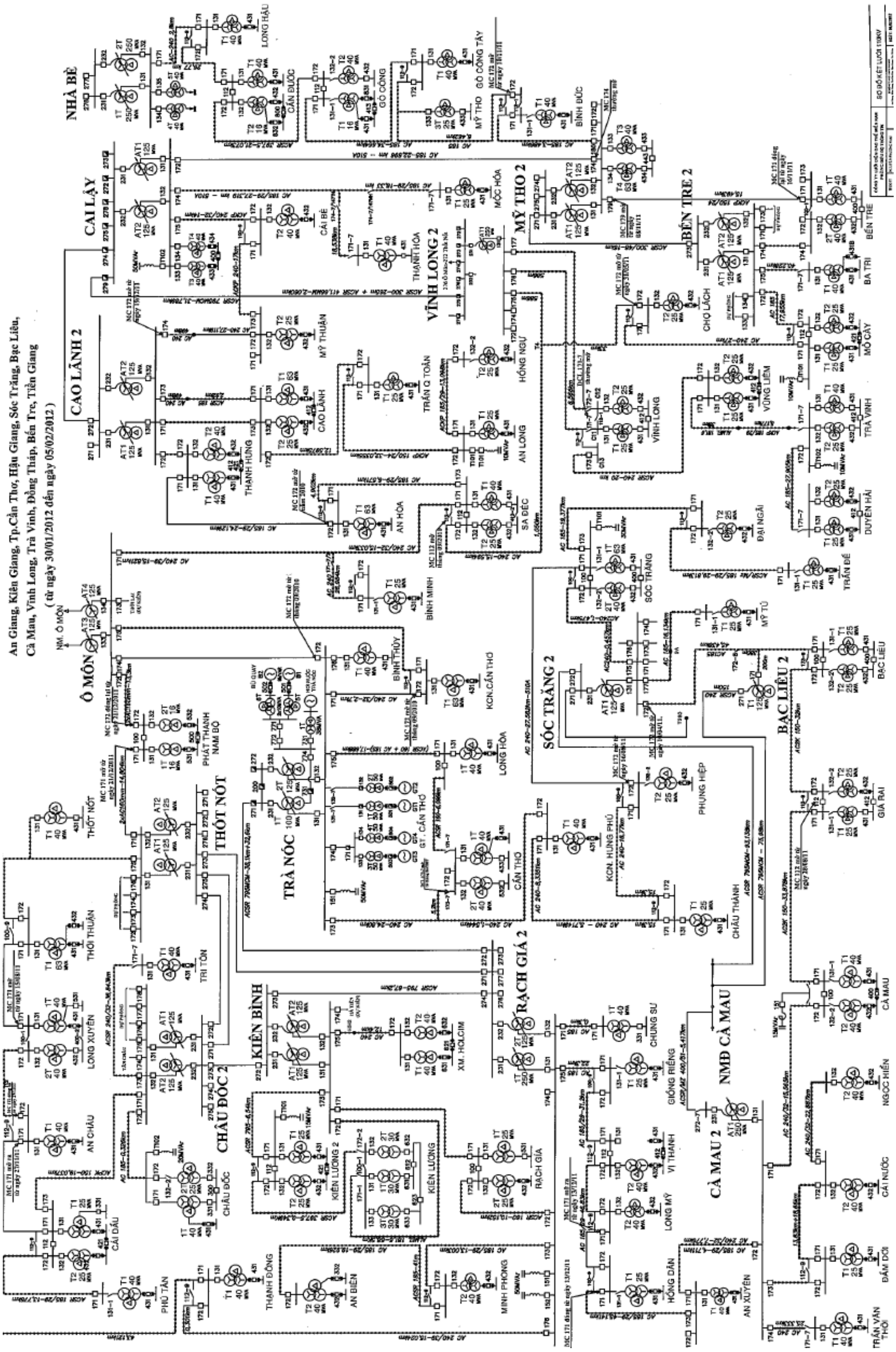
[4] Lam Dong Province, Ninh Thuan Province and Binh Thauan Province

[5] Dong Nai Power Company Ltd.



Source: "Southern Power Corporation 2005-2010"

Fig. 3.4-1 Organization Chart of SPC



Source: SPC

Fig. 3.4-2 Power Grid of SPC

3.4.2 Power Balance of SPC's Supply Area

Table 3.4-1 shows the list of 220/110 kV substations and their transformer capacity (kVA) owned by SPC. For example, the total capacity of transformers of 10615.2 MVA in 2011 means the maximum power supply capacity from the upper power grid (500/220 kV) basically. On the other hand, the peak demand in 2011 was 5,087 MW or 5,191 MVA. Therefore, the peak demand accounts for 49% of the maximum power supply capacity of 10615.2 MVA and the power balance is kept well, if sufficient power had been supplied from the upper grid. However, the sufficient power is not supplied from the upper grid in actual fact due to the absolute shortage of power resources under present and a lot of blackouts as to be described in Section 3.4.4 occur in the area of SPC.

Table 3.4-1 Power Balance of SPC Area for Last 5 Years

No	Province	Name of Substation	Transformer	Capacity [MVA]				
				2007	2008	2009	2010	2011
1	An Giang	Châu Đốc 2	1			125	125	125
			2					125
2	Cần Thơ	Thốt Nốt 2	1				125	125
			2				125	125
		Trà Nóc	1	100	100	100	100	100
			2	125	125	125	125	125
		Ô Môn	3		125	125	125	125
			4		125	125	125	125
3	Kiên Giang	Kiên Bình	1				125	125
			2				125	125
		Rạch Giá 2	1	250	250	250	250	250
			2	125	125	125	125	125
4	Cà Mau	Cà Mau 2	1	250	250	250	250	250
5	Bạc Liêu	Bạc Liêu 2	1	125	125	125	125	125
6	Sóc Trăng	Sóc Trăng 2	1			125	125	125
7	Đồng Tháp	Cao Lãnh 2	1			125	125	125
			2					125
8	Vĩnh Long	Vĩnh Long 2	1	125	125	125	125	250
			2	125	125	125	125	125
9	Bến Tre	Bến Tre 2				125	125	125
						125	125	125
10	Tiền Giang	Cai Lậy	1	125	125	125	125	125
			2	125	125	125	125	125
		Mỹ Tho 2	1	125	125	125	125	125
			2	0			125	125
11	Long An	Long An 2	1				125	125
			2				125	250
		Nhà Bè		30	35	40	45	50
		Phú Lâm		40	45	60	70	80
12	Tây Ninh	Trảng Bàng 2	1	250	250	250	250	250
			2	250	250	250	250	250
13	Bình Dương	Mỹ Phước	1	250	250	250	250	250
		Tân Định	3	0	0	0	0	250
			4	250	250	250	250	250
		Bình Hòa	1	250	250	250	250	250
			2	250	250	250	250	250
			5	0	0	0	0	250
			110kV	103	103	126	126	126

Table 3.4-2 Power Balance for Last 5 Years of SPC Area

No	Province	Name of Substation	Transformer	Capacity [MVA]				
				2007	2008	2009	2010	2011
14	Bình Phước	Bình Long 2	1					125
			2					125
		TĐ S.P.Miêng	1	30	30	30	30	30
			2	30	30	30	30	30
		TĐ Cần Đơn	1	48.5	48.5	48.5	48.5	48.5
			2	48.5	48.5	48.5	48.5	48.5
		TĐ Thác Mơ	1	88	88	88	88	88
			2	88	88	88	88	88
		TĐ Đắk Glun	1					10.6
			2					10.6
15	Đồng Nai	NM Trị An	1	63	63	63	63	125
			2	63	63	63	63	125
		Long Bình	1	250	250	250	250	250
			2	250	250	250	250	250
			3	0	0	0	0	250
		Long Thành	1	250	250	250	250	250
			2				250	250
			110kV	300	300	300	300	300
		Xuân Lộc	1					250
16	Lâm Đồng	Bảo Lộc	1	63	63	63	63	63
			2	125	125	125	125	125
			110kV	40	40	40	40	40
		NM Đa Nhim	9	63	63	63	63	63
			10	63	63	63	63	63
		NM BauXit Lâm Đồng	1					40
			2					40
		TĐ Bảo Lộc	1			16	16	16
			2			16	16	16
		TĐ Đa Dâng 2	1				23	23
			2				23	23
17	Ninh Thuận	TĐ Sông Pha	1	10	10	10	10	10
		TĐ Sông Ông	1	4	4	4	4	4
18	Bình Thuận	TĐ Bắc Bình	1			20	20	20
			2			20	20	20
		TĐ Đại Ninh	3	63	63	63	63	63
		Phan Thiết 2	1				125	250
		TĐ Hàm Thuận	3	63	63	63	63	63
19	BRVT	Gas Bà Rịa (220kV)	1	125	125	125	125	125
		Gas Bà Rịa (110kV)	1	25	25	25	25	25
			2	25	25	25	25	25
			3	50	50	50	50	50
			4	50	50	50	50	50
			8	50	50	50	50	50
			10	88	88	88	88	88
		NM Phú Mỹ	5	250	250	250	250	250
			6	250	250	250	250	250
	EVN SPC	Sum of Capacity [MVA] (a)		6189	6449	7189	8500	10615.2
		Demand of EVN SPC [MW] (b)		3544	3852	4197	4558	5087.26
		Ratio [%] ((b)/0.98/(a))		58%	61%	60%	55%	49%

Source :SPC

3.4.3 Power Energy Sales in SPC Supply Area

Table 3.4-3 shows sold energy (MWh) in 2011 for twenty-one (21) provinces including direct sales by SPC. The total sold energy in 2011 was 32,307 GWh. The sold energy to industry and construction was 20,451 GWh and accounts for 63.3% of the total sold energy. For the provincial basis, the sold energy to Binh Duong Province and Dong Nai Province, of which provinces have a lot of industry parks, is remarkable in comparison with other provinces and the both provinces occupy 37.9 % of the total sold energy.

Table 3.4-4 shows the growth rate of sold energy for twenty-one (21) provinces. The average growth rate for the period from 2006 to 2010 was 16.04 % and three provinces such as Binh Phuoc Province of 23.16 %, Ba Ria-Vung Tau Province of 21.12 % and Binh Thuan Province of 20.53 % in the Central region exceed 20% of grow rate.

Table 3.4-3 Sold Energy in SPC Area (2011)

No	Province/ Daughter's Company	Total Sales in 2011 (MWh)	Consumers				
			Agriculture	Industry and Construction	Restaurant and Hotel	Household	Others
1	Binh Phuoc	577,092	368	224,972	10,601	321,003	20,148
2	Binh Thuan (Central)	1,146,199	11,050	579,243	74,683	459,685	21,538
3	Lam Dong (Central)	659,521	60,251	170,629	31,318	361,087	36,236
4	Binh Duong	5,102,239	870	4,082,492	108,711	836,256	73,910
5	Tay Ninh	1,111,159	10,788	626,379	16,985	418,146	38,861
6	Hau Giang	326,543	1,010	112,873	4,935	193,632	14,093
7	Long An	1,857,227	6,928	1,252,574	40,616	515,377	41,732
8	Dong Thap	1,240,906	72,682	666,397	16,162	451,183	34,482
9	Tien Giang	1,308,036	23,039	677,031	26,845	542,483	38,638
10	Ben Tre	604,521	10,417	186,685	15,760	365,935	25,724
11	Vinh Long	525,882	468	186,800	16,326	299,568	22,720
12	Can Tho	1,401,890	2,378	796,885	65,833	461,985	74,809
13	An Giang	1,316,509	64,755	525,192	34,849	658,234	33,479
14	Kien Giang	975,492	18,040	406,244	38,839	475,977	36,392
15	Ca Mau	709,299	9,148	296,006	24,314	360,030	19,801
16	Vung Tau	1,867,206	32,853	1,080,147	108,467	573,860	71,879
17	Tra Vinh	411,394	549	140,897	11,028	247,158	11,762
18	Soc Trang	629,878	51,246	223,380	14,685	305,519	35,048
19	Ninh Thuan (Central)	355,725	70,093	89,763	12,078	167,512	16,279
20	Bac Lieu	445,876	8,739	157,358	8,930	249,115	21,734
21	Dong Nai	7,133,198	122,566	5,615,771	82,839	1,171,396	140,626
22	VP-EVNSPC	2,601,060	-	2,353,511	-	-	247,549
Toal		32,306,852	578,238	20,451,229	764,804	9,435,141	1,077,440

Source : SPC

Table 3.4-4 Growth Rate of Sold Energy in SPC Area (2006 – 2010)

No.	Province/ Daughter's Company	Growth Rate of kWh Sales (%)					Average 2006-2010
		2006	2007	2008	2009	2010	
1	Binh Phuoc	18.57	16.92	15.08	20.93	41.40	23.16
2	Binh Thuan (Central)	16.98	17.48	17.87	21.04	21.81	21.46
3	Lam Dong (Central)	13.73	8.60	9.05	10.06	9.55	9.31
4	Binh Duong	23.71	28.54	15.04	11.27	14.45	17.14
5	Tay Ninh	24.49	12.16	11.64	30.14	18.66	17.92
6	Hau Giang	14.63	10.05	9.80	14.16	10.19	11.04
7	Long An	20.75	23.72	14.27	19.94	19.12	19.21
8	Dong Thap	13.16	15.96	22.07	22.56	17.70	19.54
9	Tien Giang	14.68	12.37	14.66	13.25	14.13	13.60
10	Ben Tre	15.02	6.61	9.40	12.44	22.49	10.73
11	Vinh Long	9.70	14.63	13.24	18.64	8.69	13.75
12	TP Can Tho	16.60	18.65	18.88	13.45	11.96	15.69
13	An Giang	13.78	11.94	14.82	15.85	11.15	13.42
14	Kien Giang	10.66	33.19	10.61	8.69	6.68	14.32
15	Ca Mau	12.39	5.64	12.03	13.89	12.15	10.88
16	Ba Ria -Vung Tau	29.70	25.39	24.26	15.55	19.54	21.12
17	Tra Vinh	11.67	9.44	14.19	19.16	13.83	14.10
18	Soc Trang	14.01	14.37	8.74	8.85	8.29	10.04
19	Ninh Thuan (Central)	8.53	7.39	11.43	25.78	18.33	15.52
20	Bac Lieu	12.56	7.31	11.03	17.36	13.11	12.14
21	Dong Nai	18.90	16.82	14.70	9.54	18.56	14.85
Total		18.24	18.89	15.24	14.20	15.89	16.04

Source: SPC

3.4.4 Blackout in SPC Area

Table 3.4-5 shows number of times of blackouts, and hours of blackouts in SPC area for the past three (3) years. The forced blackouts (forced outage) of 206 times occurs in 2010 and far exceed 63 times in 2009 and 13 times in 2011 because 206 times in 2010 include the blackouts caused by the actuation of voltage protection relay (110 kV± 5%) detecting the rapid drop of the voltage due to the instant stop of the operation of the hydropower plants. And some blackouts occurred due to the troubles at power plants and failures of transferring power to lower grid (110 kV) because of overload of upper grid and substations.

Planned blackouts continuously occurred in the last three years, such as 345 times in 2009, 341times in 2010 and 340 times in 2011 due to the absolute lack of power sources. The hours per one time blackout are seven (7) hours (or 420 minutes) for all planned blackouts. The number of blackouts, such as 340 ~ 345 times means that the blackout occurs almost every in a place within the jurisdiction area of SPC. The planned blackout of seven (7) hours starts from 8:00 AM to 16:00 PM except 12:00~13:00 and the operation hour of manufactures is subject to the above blackout time. And about 150 MW is saved per one blackout.

Table 3.4-5 Number of Times and Hours of Blackout in SCP Area (Last 3 years)

Year	Forced Blackout			Planned Blackout		
	Times	Hours (minutes)	Hours per one time (minutes)	Times	Hours per one time (minutes)	Hours per one time (minutes)
2009	63	20,910	332	345	144,900	420
2010	206	87,626	425	341	143,220	420
2011	13	1,842	142	340	142,800	420

Source: SPC

CHAPTER 4 CONFIRMATION ON PROJECT SCOPE AND VALIDITY

4.1 FUEL SUPPLY PLAN

4.1.1 Development Scheme of Block B&52 Gas Project

The project is planned to supply gas exploited from Block B&52 to O Mon Power Complex via Ca Mau Power station through undersea and aboveground gas pipeline.

As shown in Fig. 4.1-1, the length of undersea gas pipeline is ca. 250 km, that of aboveground gas pipeline is ca. 150 km respectively, and total gas pipeline length is ca. 400 km.

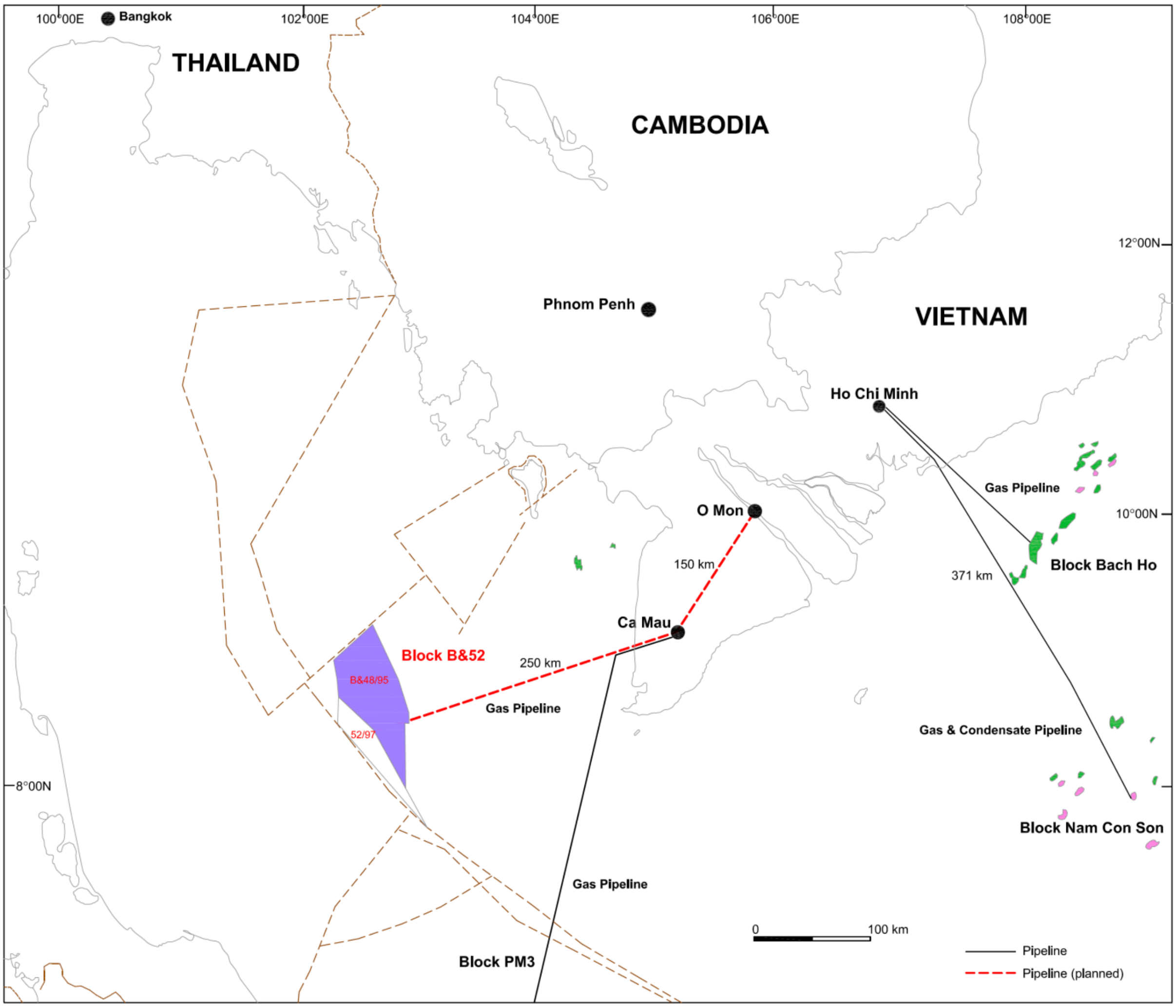


Fig. 4.1-1 Location Map of Block B&52

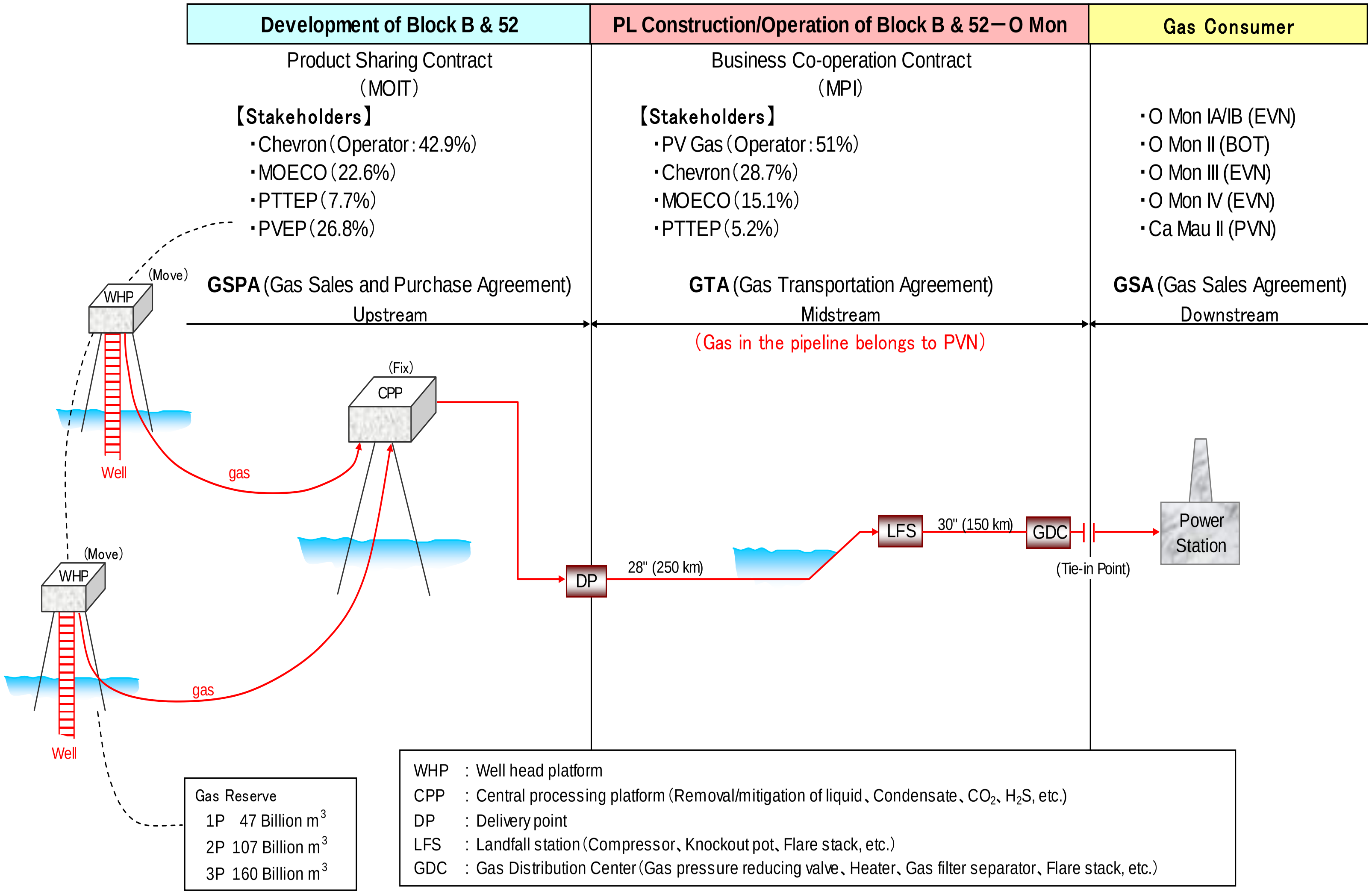


Fig. 4.1-2 Development Scheme of Block B&52

Chevron Vietnam is the operator of the upstream Block B&52 Gas Project, offshore southwest Vietnam. The company's co-ventures include MOECO of Japan, PTTEP of Thailand and PVEP Corporation (one of subsidiaries of PVN). Shares of the Block B&52 Gas Project are 42.9%, 22.6%, 7.7%, 26.8% respectively.

According to F/S report by PECC2, gas reserve is 47 billion m^3 as 1P, 113 billion m^3 as 2P and 160 billion m^3 as 3P respectively. However, 2P is revised slightly downward to 107 billion m^3 (3.78 Trillion cubic feet) by the investigation of JICA Project. Furthermore, 107 billion m^3 is upstream production and 100 billion m^3 (3.5 Trillion cubic feet) will be delivered to midstream gas pipeline.

Exploitation of Block B&52 is carried out based on PSC (Project Sharing Contract) under control of MOIT. Exploited gas will be supplied to PVN after the conclusion of GSPA (Gas Sales Purchase Agreement) between PVN and Chevron.

PV Gas (one of subsidiaries of PVN) is the operator of the midstream gas pipeline construction & operation Project. The company's co-ventures include Chevron, MOECO of Japan, PTTEP of Thailand. Shares of the gas pipeline Project are 51%, 28.7%, 15.1%, 5.2% respectively.

Construction and operation of the gas pipeline is implemented based on BCC (Business Co-operation Contract) under control of MPI, and will be commenced after the conclusion of GTA (Gas Transfer Agreement) between PVN and PVN Gas.

Gas in the gas pipeline belongs to PVN.

Downstream gas consumers of Block B&52 are O Mon 1A (330 MW), O Mon 1B (330 MW) O Mon 3 (> 750 MW), Mon 4 (> 750 MW), those are operated by EVN, O Mon 2 operated By BOT and Ca Mau II (750 MW) operated by the subsidiary company of PVN.

O Mon 1A is now running by heavy fuel oil and Ca Mau II is running by gas from PM3, therefore, after gas from Block B &52 is available, the heavy fuel oil and gas from PM3 will be converted to gas from Block B &52.

Gas supply to aforementioned power plant is conducted based on GSA (Gas Sales Agreement) between EVN and PVN.

Gas for Ca Mau I and Ca Mau Fertilize Plant is supplied from PM3, and even if gas is shortfall in the future, PVN will try to supply gas from other gas sources than Block B&52.

Gas supply for Tra Noc Power Station is canceled due to small gas consumption that cannot compensate the construction cost of gas pipeline to the Power Station. Gas supply for O Mon 5 is also canceled because there is no concrete construction plan in the national power development plan for the time being.

The most important thing in Fig. 4.1-2 is that exploitation of gas from Block B&52, construction of the gas pipeline and construction of the power plants should be completed simultaneously.

4.1.2 Milestones on Development of Gas from Block B& 52

PSC for B&48/95 and PSC for 52/97 were effectuated in May 1996 and October 1999, respectively.

Through the declaration of gas discovery and the setting of joint development area, HOA (Head of Agreement) for GSPA and GTA was concluded among PVN, Block B&52 development consortium member (Chevron, MOECO, PTTEP and PVEP) and gas pipeline construction & operation consortium member (PV Gas, Chevron, MOECO and PTTEP) in July 2009.

The content of HOA is as follows;

1) FEED (Front End Engineering Design) for upstream exploitation and PL (Gas Pipeline) to be commenced
2) Negotiation on terms and conditions of GSPA and GTA to be started
3) Explicit statement on FID (Final Investment Decision) conditions
4) Negotiation on PL BCC (Gas Pipeline Business Co-operation Contract) to be started

PL BCC was agreed in February 2010 that stipulates the right and obligation in terms of ownership, design, construction and operation of PL.

FEED was completed in March 2011, and gas price formula, DCQ (Daily Contract Quantity) and Standard gas calorific values, etc. were agreed.

During JICA 1st mission on December 2011, there was information of “gas price is recently submitted to Vietnamese Government. The approval from the Government is expected within this year and GSA will hopefully be concluded 1st Quarter of next year”.

However, During JICA 2nd mission on February 2012, the JICA Study Team is informed that Vietnamese Government has not yet approved the gas price due to higher its price compared with precedent gas prices.

Gas price is explained in Section 4.1.5.

The steps from now on to conclusion of FID are anticipated as follows;

1) Board Agreement of each developer (consortium member) of Block B&52
2) Agreement on GSPA, GTA and GSA
3) Approval of FDP (Field Development Plan) by Vietnamese Government
   (Approval by MOIT → Approval by the Prime Minister)
4) Endorsement by Vietnamese Government (concurrence with the Prime Minister)
   Payment bond, Conversion guarantee (VND → USD), Performance Guarantee, etc.
5) Duty exemption treatment for the gas Pipeline
6) Extension of PSCs
7) Conclusion of FID

Consortium member will independently select the bank for loan. After the loan agreements, Block B&52 exploitation work and the gas pipeline construction work will be put into practice.

Installation work period of the gas pipeline is estimated at ca. 42 months. Construction work period for upstream facilities such as CPP (Central Processing Platform), WHP (Well Head

Platform) is within 42 months.

Installation works of the gas pipeline will be conducted by Vietsovpetro, PVC and PTSC. Construction works of upstream facilities are divided into two portions

1) CPP, LQ (Living Quarter) and FSO (Floating Storage Offloading) are implemented by ICB (International Competitive Bidding)
2) WHP and Infield Pipeline are implemented by the direct negotiation with PTSC (EPC Contract)

Table 4.1-1 shows the milestones on development of Block B&52.

Table 4.1-1 Milestones on Development of Block B&52

Year/Month	Milestone	Remarks
1996/05	Issuance of PSC for Block B&48/95	PSC: Product Sharing Contract
1999/10	Issuance of PSC for Block 52/97	
2002/05	Declaration of gas discovery	
2003/02	Setting of Joint Development Area	
2007/09	Joint Development Agreement/ Utilization Agreement	
2009/07	FEED HOA/PL HOA	Agreement on main commercial and technical terms to start the basic design. FEED: Front End Engineering & Design PL: Gas Pipeline HOA: Head of Agreement
2010/02	Pipeline BCC	Agreement of right/obligation on design, construction and operation of gas pipeline. BCC: Business Cooperation Contract
2011/03	Completion of FEED	Agreement of gas price formula, gas supply quantity, standard gas calorific value, etc. in GSPA. GSPA: Gas Sales and Purchase Agreement
After 2012/02	Final Investment Decision (FID)	Steps to conclusion of FID and loan agreements with banks; 1) Board Agreement of each consortium member 2) Conclusions of GSPA, GTA and GSA 3) Approval of Field Development plan (FDP) from Vietnamese Government Approval by MOIT → Approval by the Prime Minister 4) Endorsement from Vietnamese Government (Concurrence with the Prime Minister) Payment bond, Conversion guarantee (VND → USD), Performance guarantee, etc. 5) Duty exemption treatment for the gas Pipeline 6) Extension of PSCs 7) Conclusion of FID
	Loan agreements with Banks	Consortium member will independently select the bank for loan.
	Implementation of Works	Construction period of gas pipeline is ca. 42 months. Contractors are Vietsovpetro, PVC and PTSC. Construction period of off-shore platforms is within 42 months. Construction works are divided by two. - CPP, LQ and FSO are determined by ICB - WHP and Infield pipeline is determined by direct negotiation (EPC) with PTSC

4.1.3 Gas Supply and Demand Balance

(1) Gas User of Block B&52

Gas from Block B&52 is exclusive to be used for O Mon 1A/1B, 2, 3, 4 and Ca Mau II. Gas is planned to be supplied by the following conditions.

1) O Mon 4 is commissioned on November 2015
2) O Mon 3 is commissioned on October 2016
3) O Mon 2 is commissioned on October 2017
4) Ca Mau II consumes gas from Block B&52 from October 2015
5) Gas is not supplied to Tra Noc and O Mon 5
6) O Mon 1A/1B are heavy fuel oil/gas dual firing units, therefore, if gas is short, these units will use heavy fuel oil.

Loan Agreement of O Mon 4 financed by the loan from ADB and KfW is almost concluded among the relevant governments, and the selection of Consultant is ongoing by EVN. On the other hand, Investors of O Mon 2 developed by BOT haven't yet appeared so far.

(2) Expected Output of O Mon 2, 3 and 4 Power Stations

While the output of O Mon 2, 3 and 4 power stations is planned to be 750 MW (at site conditions) by F/S of PECC2 in 2009, the latest power output of F type GT combined cycle (2-2-1) exceeds 850 MW (at ISO rating) because the gas turbine technology has been rapidly progressing these days.

During JICA 2nd mission on February 2012, the JICA Study Team explained expected output of O Mon 2,3 and 4 based on responses from major gas turbine manufacturers.

However, as the JICA Study Team could get Gas Turbine World 2012 GTW Handbook this March 7 that describes officially recognized GT and its combined cycle specifications as 2011 version, the JICA Study Team revised Table 4.1-2 based on the handbook.

Major revisions from the previous our explanation are as follows;

1) KA26-2 (2011) is added in Alstom
2) 209FB (2011) is added in GE
3) M701 F5 is added in MHI

Expected COD of these models are as follows;

1) KA26-2 (2011)[1]: Late 2014 in Thailand
2) 209FB (2011): 2015 in France
3) M701F5[2]: 2016 in Japan

As there seems to be no operating hours as complete set of the model during the forthcoming bidding period for O Mon 3, although key components such as Compressor, Combustor and Turbine of some models have already operational experiences as component wise, JICA Study Team excludes these three (3) models from this F/S.

---

[1] Two (2) years operational experience for Combustor and Turbine in the Spanish project

[2] Operational experiences for Compressor & Combustor as G type and Turbine as J type

Reflecting the slight up-rating of other models, the latest output of F type GT combined cycle, candidate for O Mon 2, 3 and 4 power stations is divided into 850 MW class and 950 MW class (ISO rating).

Table 4.1-2 Specifications of Latest F Type GT Combined Cycle (ISO Rating)

Manufacturer	ALSTOM (2011)		GE (2011)		MHI (2011)		SIEMENS (2011)
Model	KA26-2 (2006)	KA26-2 (2011)	209FB (2003)	209FB (2011)	M701F4	M701F5	SCC5-4000F
Year First Machine	1996	1996	2003	2011	1992	1992	1995
Plant Output (MW)	870.0	935.0	913.6	1,025.6	958.8	1,053.3	853.0
Plant Efficiency (%)	59.0	59.5	59.7	61.1	60.2	61.2	58.5
Heat Rate (kJ/kWh)	6102	6050	6027	5892	5981	5883	6158
Gas Turbine Output (MW)	-	-	592.5	678.3	639.8	708.0	576.0
Steam Turbine Output (MW)	-	-	337.3	360	319.0	345.3	272.0
GT Type/Number.	GT26 (2006)/2	GT26 (2011)/2	9FB (2003)/2	9FB (2011)/2	M701F4/ 2	M701F5/ 2	SGT5-4000F 2
HRSG Type	Triple Pressure Reheat		Reheat*		Triple Pressure Reheat		Triple Pressure Reheat

* may be triple pressure

Source: Gas Turbine World 2012 GTW Handbook

(3) Estimated Gas Consumption of F Type GT Combined Cycle

Table 4.1-2 is based on ISO rating (15°C). The output and efficiency of GT combined cycle is varied by ambient conditions (temperature, pressure and humidity). Among these ambient conditions, temperature is the key affecter. The output and efficiency are declined in accordance with temperature rise. Table 4.1-3 shows our preliminary estimated specifications of F type GT combined cycle at the site conditions (30°C), and expected annual gas consumptions (6000 operational hours) based on the site conditions.

Table 4.1-3 Expected Specifications of Latest F Type GT Combined Cycle (Site Conditions)

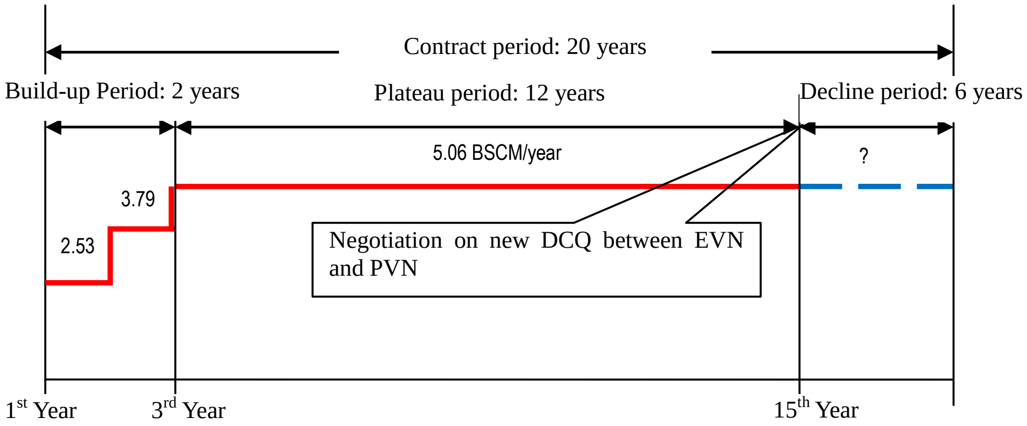
Gas Turbine Model		Alstom GT26 (2006)	GE 9FB	Mitsubishi M701F4	Siemens SGT5-4000F
Plant Formation		2-2-1	2-2-1	2-2-1	2-2-1
Output of GT (2 units)	MW	528.5	536.7	577.3	521.1
Output of ST (1unit)	MW	290.6	318.1	300.3	268.6
Auxiliary Power & TR Loss	MW	16.4	17.1	17.6	15.8
Net Output		802.7	837.7	860.0	773.9
Heat Rate (LHV)	kJ/kWh	6,249	6,278	6,242	6,435
Efficiency (LHV)	%	57.6	57.3	57.7	55.9
Estimated Gas Consumption (6000 hours) BNCM	Billion Nm^3	0.97	1.02	1.04	0.97
Estimated Gas Consumption (6000 hours) BSCM	Billion Sm^3	1.02	1.08	1.10	1.02

Two following cases are considered as annual gas consumption (6000 Hours);

1) 1.02 Billion Sm^3 as 850 MW class (ISO rating)
2) 1.10 Billion Sm^3 as 950 MW class (ISO rating)

(4) Gas supply from Block B&52

Gas supply from Block B&52 is envisaged below;



Annual gas supply of 5.06 BSCM/year during the plateau period is derived from DCQ (Daily Contract Quantity: 490 MMSCF) specified in GSPA and GSA.

$$13.88\ MSCM\ (490\ MSCFD) \times 365 = 5.06\ BSCM/year$$

MDCQ (Maximum Daily Contract Quantity) is also stipulated in GSPA and GSA with 117.35% swing.

$$MDCQ = 13.88\ MSCM\ (490\ MSCF) \times\ 1.1735 = 16.29\ MSCM$$
$$Annual\ MDCQ = 16.29\ MSCM \times 365 = 5.94\ BSCM/year$$

DCQ is subject to “Take or Pay” contract, but MDCQ is not.

After commencement of gas consuming from Block B&52, EVN has right to purchase gas between DCQ and MDCQ. As long as gas consuming is above DCQ, EVN can keep away from “Take or Pay” contract. On the other hand, PVN has obligation to supply gas to EVN up to MDCQ.

As DCQ and MDCQ are specified by calorie supply based on higher calorific value of 870 Btu/scf, if gas calorific value is higher than 870 Btu/scf, supply gas quantity is lower than DCQ, and vice versa.

The plateau period is defined by another method in which it becomes shorter. The details are specified in Chapter 4.1.4 “Study on Plateau Period”.

(5) Gas Supply and Demand Balance

As the outputs of O Mon 2, 3 and 4 power stations will be determined from now on through ICB, etc., the following four (4) cases are studied to analyze gas supply and demand balance.

1) 850 MW class (ISO rating) F type GT combined cycle is applied to all three (3) power stations

2) 850 MW class F type GT combined cycle is applied to two (2) power stations and 950

MW class (ISO rating) F type GT combined cycle is applied to one (1) power station

3) 850 MW class F type GT combined cycle is applied to one (1) power station and 950 MW class F type GT combined cycle is applied to two (2) power stations
4) 950 MW class F type GT combined cycle is applied to all three (3) power stations

(a) Table 4.1-4 and Table 4.1-5 shows the results of case 1)

During the plateau period, while gas supply to O Mon 1A is ca. 82% of required gas quantity, gas supply to O Mon 1B, 2, 3, 4 and Ca Mau II is satisfied.
If EVN chose MDCQ, gas supply exceeds the demand except 1st year.

(b) Table 4.1-6 and Table 4.1-7 shows the results of case 2)

During the plateau period, while gas supply to O Mon 1A is ca. 68% of required gas quantity, gas supply to O Mon 1B, 2, 3, 4 and Ca Mau II is satisfied.
If EVN chose MDCQ, gas supply exceeds the demand except 1st year.

(c) Table 4.1-8 and Table 4.1-9 shows the results of case 3)

During the plateau period, while gas supply to O Mon 1A is ca. 55% of required gas quantity, gas supply to O Mon 1B, 2, 3, 4 and Ca Mau II is satisfied.
If EVN chose MDCQ, gas supply exceeds the demand except 1st year.

(d) Table 4.1-10 and Table 4.1-11 shows the results of case 4)

During the plateau period, while gas supply to O Mon 1A is ca. 42% of required gas quantity, gas supply to O Mon 1B, 2, 3, 4 and Ca Mau II is satisfied.
If EVN chose MDCQ, gas supply exceeds the demand except 1st year.

Based on the aforementioned analysis, either of following countermeasures to be taken to meet the gas demand;

1) Gas deficiency is made up by heavy fuel oil that can be used in O Mon 1A/1B
2) Adoption of MDCQ

Countermeasure of 1) seems to be realistic solution because the plateau period is shortened by one (1) year in case of 2).

With regard to utilization of LNG (Liquefied Natural Gas) in case of gas deficiency, the study is out of consideration in this F/S because it's realization is unknown for the time being due to tremendous investment cost of the LNG terminal and high LNG price.

Table 4.1-4 Gas Supply- Demand Balance Sheet in 2015 - 2027

(850 MW x 3/DCQ Basis)

Ô Môn IV starts commissioning from 04/2015 and commercial operation from 11/2015
Cà Mau 2 starts operating by Lot.B&52 Gas from 10/2015

(standard billion m3)

	1 st year	2nd year	3rd year	4	5	6	7	8	9	10	11	12
NĂM (year)	**10/2015-10/2016**	**10/2016-10/2017**	**10/2017-10/2018**	**10/2019**	**10/2020**	**10/2021**	**10/2022**	**10/2023**	**10/2024**	**10/2025**	**10/2026**	**10/2027**
CUNG (supply)	**2.53**	**3.79**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**
CẦU (demand)	**2.53**	**3.79**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**
Cà Mau 2 (750 MW)	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Ô Môn IA (330 MW)	0.00	0.24	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Ô Môn IB (330 MW)	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Ô Môn II (850 MW)			1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ô Môn III (850 MW)		1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ô Môn IV (850 MW)	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ô Môn V	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
CUNG - CẦU (balance)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

O Mon I-A,B will be flexible operated (gas and/or heavy fuel oil) to ensure the maximum reliability and availability of O Mon Complex.
Gas quantity marked in red shows the case that gas is not enough for 0.60 Billion m3 in O Mon I-A,B

Table 4.1-5 Gas Supply- Demand Balance Sheet in 2015 - 2027

(850 MW x 3/MDCQ Basis)

Ô Môn IV starts commissioning from 04/2015 and commercial operation from 11/2015
Cà Mau 2 starts operating by Lot.B&52 Gas from 10/2015

(standard billion m3)

	1 st year	2nd year	3rd year	4	5	6	7	8	9	10	11	12
NĂM (year)	10/2015-10/2016	10/2016-10/2017	10/2017-10/2018	10/2019	10/2020	10/2021	10/2022	10/2023	10/2024	10/2025	10/2026	10/2027
CUNG (supply)	**2.97**	**4.45**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**
CẦU (demand)	**2.97**	**4.15**	**5.17**	**5.17**	**5.17**	**5.17**	**5.17**	**5.17**	**5.17**	**5.17**	**5.17**	**5.17**
Cà Mau 2 (750 MW)	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Ô Môn IA (330 MW)	0.44	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Ô Môn IB (330 MW)	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Ô Môn II (850 MW)			1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ô Môn III (850 MW)		1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ô Môn IV (850 MW)	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ô Môn V	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
CUNG - CẦU (balance)	**0.00**	**0.30**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**

O Mon I-A,B will be flexible operated (gas and/or heavy fuel oil) to ensure the maximum reliability and availability of O Mon Complex.
Gas quantity marked in red shows the case that gas is not enough for 0.60 Billion m3 in O Mon I-A,B

Table 4.1-6 Gas Supply- Demand Balance Sheet in 2015 - 2027

(850 MW x 2 + 950 Mw x 1/DCQ Basis)

Ô Môn IV starts commissioning from 04/2015 and commercial operation from 11/2015
Cà Mau 2 starts operating by Lot.B&52 Gas from 10/2015

(standard billion m3)

	1 st year	2nd year	3rd year	4	5	6	7	8	9	10	11	12
NĂM (year)	**10/2015-10/2016**	**10/2016-10/2017**	**10/2017-10/2018**	**10/2019**	**10/2020**	**10/2021**	**10/2022**	**10/2023**	**10/2024**	**10/2025**	**10/2026**	**10/2027**
CUNG (supply)	**2.53**	**3.79**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**
CẦU (demand)	**2.53**	**3.79**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**
Cà Mau 2 (750 MW)	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Ô Môn IA (330 MW)	0.00	0.16	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Ô Môn IB (330 MW)	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Ô Môn II (850 MW)			1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ô Môn III (950 MW)		1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Ô Môn IV (850 MW)	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ô Môn V	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
CUNG - CẦU (balance)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

O Mon I-A,B will be flexible operated (gas and/or heavy fuel oil) to ensure the maximum reliability and availability of O Mon Complex.
Gas quantity marked in red shows the case that gas is not enough for 0.60 Billion m3 in O Mon I-A,B

Table 4.1-7 Gas Supply- Demand Balance Sheet in 2015 - 2027

(850 MW x 2 + 950 MW x 1)/MDCQ Basis)

Ô Môn IV starts commissioning from 04/2015 and commercial operation from 11/2015
Cà Mau 2 starts operating by Lot.B&52 Gas from 10/2015

(standard billion m3)

	1 st year	2nd year	3rd year	4	5	6	7	8	9	10	11	12
NĂM (year)	**10/2015-10/2016**	**10/2016-10/2017**	**10/2017-10/2018**	**10/2019**	**10/2020**	**10/2021**	**10/2022**	**10/2023**	**10/2024**	**10/2025**	**10/2026**	**10/2027**
CUNG (supply)	**2.97**	**4.45**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**
CẦU (demand)	**2.97**	**4.23**	**5.25**	**5.25**	**5.25**	**5.25**	**5.25**	**5.25**	**5.25**	**5.25**	**5.25**	**5.25**
Cà Mau 2 (750 MW)	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Ô Môn IA (330 MW)	0.44	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Ô Môn IB (330 MW)	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Ô Môn II (850 MW)			1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ô Môn III (950 MW)		1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Ô Môn IV (850 MW)	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ô Môn V	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
CUNG - CẦU (balance)	**0.00**	**0.22**	**0.69**	**0.69**	**0.69**	**0.69**	**0.69**	**0.69**	**0.69**	**0.69**	**0.69**	**0.69**

O Mon I-A,B will be flexible operated (gas and/or heavy fuel oil) to ensure the maximum reliability and availability of O Mon Complex.
Gas quantity marked in red shows the case that gas is not enough for 0.60 Billion m3 in O Mon I-A,B

Table 4.1-8]   Gas Supply- Demand Balance Sheet in 2015 - 2027

(850 MW x 1 + 950 Mw x 2/DCQ Basis)

Ô Môn IV starts commissioning from 04/2015 and commercial operation from 11/2015
Cà Mau 2 starts operating by Lot.B&52 Gas from 10/2015

(standard billion m3)

	1 st year	2nd year	3rd year	4	5	6	7	8	9	10	11	12
NĂM (year)	**10/2015-10/2016**	**10/2016-10/2017**	**10/2017-10/2018**	**10/2019**	**10/2020**	**10/2021**	**10/2022**	**10/2023**	**10/2024**	**10/2025**	**10/2026**	**10/2027**
CUNG (supply)	**2.53**	**3.79**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**
CẦU (demand)	**2.53**	**3.79**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**
Cà Mau 2 (750 MW)	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Ô Môn IA (330 MW)	0.00	0.16	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Ô Môn IB (330 MW)	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Ô Môn II (950 MW)			1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Ô Môn III (950 MW)		1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Ô Môn IV (850 MW)	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ô Môn V	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
CUNG - CẦU (balance)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

O Mon I-A,B will be flexible operated (gas and/or heavy fuel oil) to ensure the maximum reliability and availability of O Mon Complex.
Gas quantity marked in red shows the case that gas is not enough for 0.60 Billion m3 in O Mon I-A,B

Table 4.1-9 Gas Supply - Demand Balance Sheet in 2015 - 2027

(850 MW x 1 + 950 MW x 2)/MDCQ Basis)

Ô Môn IV starts commissioning from 04/2015 and commercial operation from 11/2015
Cà Mau 2 starts operating by Lot.B&52 Gas from 10/2015

(standard billion m3)

	1 st year	2nd year	3rd year	4	5	6	7	8	9	10	11	12
NĂM (year)	**10/2015-10/2016**	**10/2016-10/2017**	**10/2017-10/2018**	**10/2019**	**10/2020**	**10/2021**	**10/2022**	**10/2023**	**10/2024**	**10/2025**	**10/2026**	**10/2027**
CUNG (supply)	**2.97**	**4.45**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**
CẦU (demand)	**2.97**	**4.23**	**5.33**	**5.33**	**5.33**	**5.33**	**5.33**	**5.33**	**5.33**	**5.33**	**5.33**	**5.33**
Cà Mau 2 (750 MW)	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Ô Môn IA (330 MW)	0.44	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Ô Môn IB (330 MW)	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Ô Môn II (950 MW)			1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Ô Môn III (950 MW)		1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Ô Môn IV (850 MW)	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ô Môn V	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
CUNG - CẦU (balance)	**0.00**	**0.22**	**0.61**	**0.61**	**0.61**	**0.61**	**0.61**	**0.61**	**0.61**	**0.61**	**0.61**	**0.61**

O Mon I-A,B will be flexible operated (gas and/or heavy fuel oil) to ensure the maximum reliability and availability of O Mon Complex.
Gas quantity marked in red shows the case that gas is not enough for 0.60 Billion m3 in O Mon I-A,B

Table 4.1-10 Gas Supply - Demand Balance Sheet in 2015 - 2027

(950 Mw x 3/DCQ Basis)

Ô Môn IV starts commissioning from 04/2015 and commercial operation from 11/2015
Cà Mau 2 starts operating by Lot.B&52 Gas from 10/2015

(standard billion m3)

	1 st year	2nd year	3rd year	4	5	6	7	8	9	10	11	12
NĂM (year)	**10/2015-10/2016**	**10/2016-10/2017**	**10/2017-10/2018**	**10/2019**	**10/2020**	**10/2021**	**10/2022**	**10/2023**	**10/2024**	**10/2025**	**10/2026**	**10/2027**
CUNG (supply)	**2.53**	**3.79**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**
CẦU (demand)	**2.53**	**3.79**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**	**5.06**
Cà Mau 2 (750 MW)	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Ô Môn IA (330 MW)	0.00	0.08	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Ô Môn IB (330 MW)	0.52	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Ô Môn II (950 MW)			1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Ô Môn III (950 MW)		1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Ô Môn IV (950 MW)	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Ô Môn V	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
CUNG - CẦU (balance)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

O Mon I-A,B will be flexible operated (gas and/or heavy fuel oil) to ensure the maximum reliability and availability of O Mon Complex.
Gas quantity marked in red shows the case that gas is not enough for 0.60 Billion m3 in O Mon I-A,B

Table 4.1-11 Gas Supply - Demand Balance Sheet in 2015 - 2027

(950 MW x 3)/MDCQ Basis)

Ô Môn IV starts commissioning from 04/2015 and commercial operation from 11/2015
Cà Mau 2 starts operating by Lot.B&52 Gas from 10/2015

(standard billion m3)

	1 st year	2nd year	3rd year	4	5	6	7	8	9	10	11	12
NĂM (year)	**10/2015-10/2016**	**10/2016-10/2017**	**10/2017-10/2018**	**10/2019**	**10/2020**	**10/2021**	**10/2022**	**10/2023**	**10/2024**	**10/2025**	**10/2026**	**10/2027**
CUNG (supply)	**2.97**	**4.45**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**	**5.94**
CẦU (demand)	**2.97**	**4.31**	**5.41**	**5.41**	**5.41**	**5.41**	**5.41**	**5.41**	**5.41**	**5.41**	**5.41**	**5.41**
Cà Mau 2 (750 MW)	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Ô Môn IA (330 MW)	0.36	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Ô Môn IB (330 MW)	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Ô Môn II (950 MW)			1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Ô Môn III (950 MW)		1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Ô Môn IV (950 MW)	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Ô Môn V	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
CUNG - CẦU (balance)	**0.00**	**0.14**	**0.53**	**0.53**	**0.53**	**0.53**	**0.53**	**0.53**	**0.53**	**0.53**	**0.53**	**0.53**

O Mon I-A,B will be flexible operated (gas and/or heavy fuel oil) to ensure the maximum reliability and availability of O Mon Complex.
Gas quantity marked in red shows the case that gas is not enough for 0.60 Billion m3 in O Mon I-A,B

4.1.4 Study on Plateau Period

(1) Definition of the Plateau Period of Block B&52

The plateau period shall end on the earlier of the following two (2) cases;

(a) December 31st of the contract year during which the twelfth (12th) anniversary of the end of the build-up period occurs

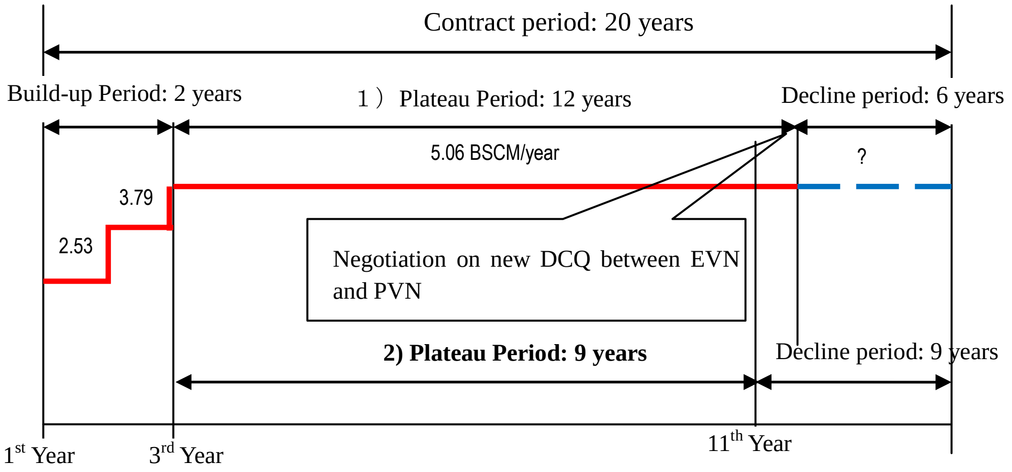
(b) December 31st of the contract year in which the sellers have sold to the buyer the accumulative quantity of sales gas equal to at least fifty percent (50%) of the current field reserve.

Based on the 2P of 100 BSCM (available reserve to midstream), the plateau period defied by (b) is calculated as follows;

$$(50 - 2.53 - 3.79)/5.06 = 8.6 \rightarrow 9 \text{ years}$$

Therefore, the end of the plateau period is 2 + 9 = 11th year from the start of gas supply.

In case of O Mon 3, as gas supply will start from 2nd year, the end of the plateau period is 10th year from the start of gas supply.



In case that EVN consume full gas of MDCQ, the plateau period defied by (b) is calculated as follows;

$$(50 - 2.53 - 3.79)/5.94 = 7.4 \rightarrow 8 \text{ years}$$

Therefore, the end of the plateau period is 2 + 8 = 10th year from the start of gas supply.

In case of O Mon 3, as gas supply will start from 2nd year, the end of the plateau period is 9th year from the start of gas supply.

(2) Plateau Period of the Past Project

Attachment 4.1-1 shows the pertinent clause in GSPA of Block Nam Con Son developed by British Petroleum. The gas is supplied to PM-1 F type combined cycle plant (1,090 MW).

Definition of the end of the plateau period is same as that in GSPA of Block B&52, i.e. consisting of two (2) cases.

Although the end of the plateau period derived from gas 50 % consumption cannot be calculated because DCQ is unknown for us, another condition stipulates that the plateau period is 11th anniversary of the commissioning date.
Therefore, definition of the end of the plateau period is similar for both GSPA.

(3) Information about Gas Stable Supply to O Mon Power Complex

1) PVN's obligation in GSA

There is a sentence in GSA that if gas from Block B&52 to O Mon Power Complex is short, PVN obliges to supply gas from other gas sources.

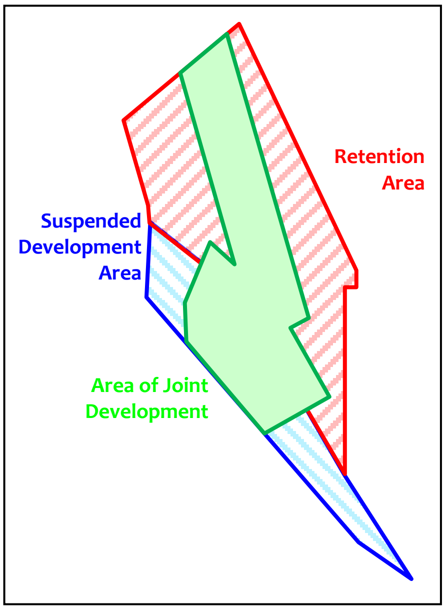
2) Unexploited area of Block B&52

As shown in the right side drawing, the portion of Joint Development Area is ca. 1/3 of Block B&52.

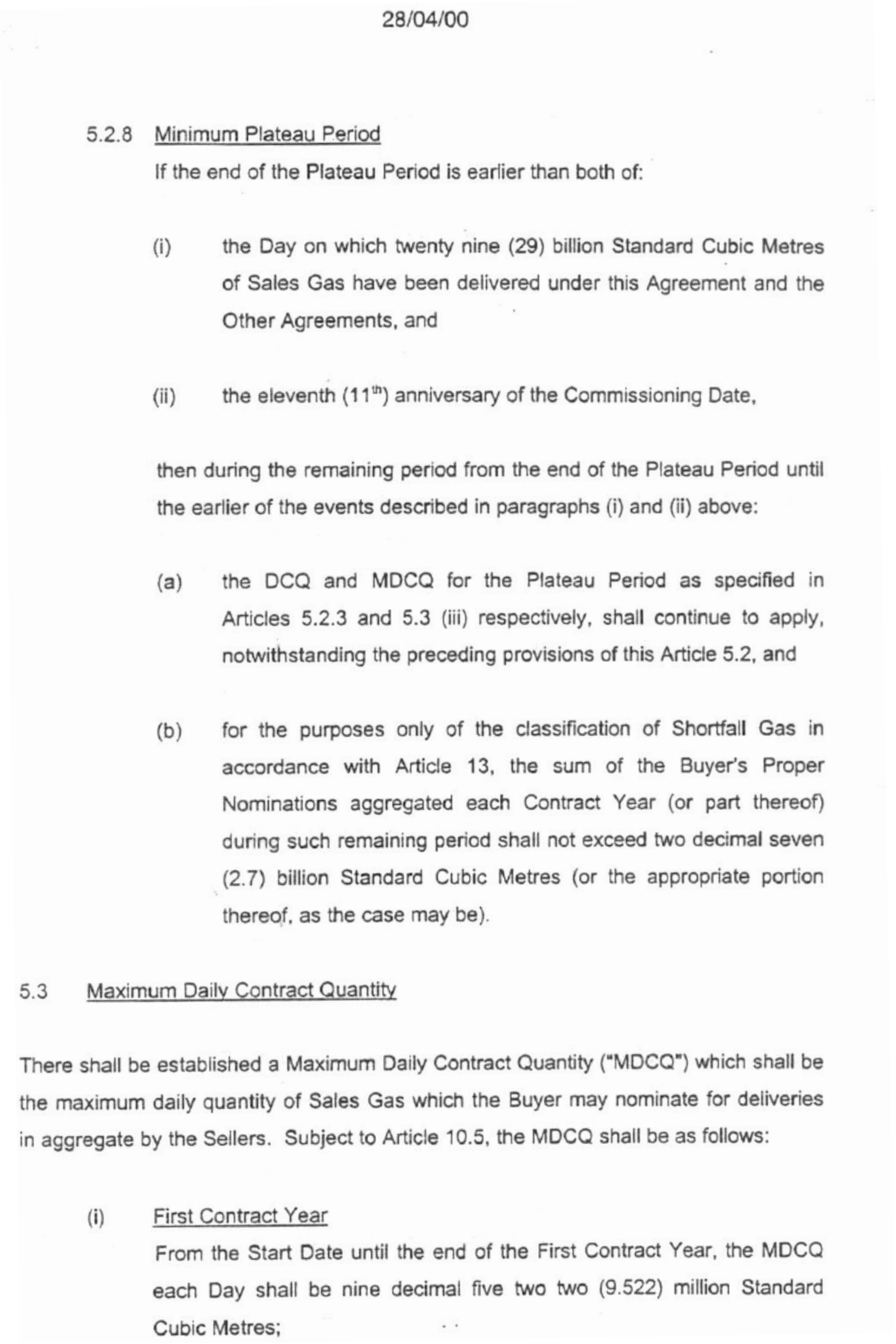
Two (2) wells will be tested in suspended Development Area in 2012.

On the other hand, wells in Retention Area will be tested after the Conclusion of FID.

There is a possibility that the plateau period is improved by the results of these test wells.



Attachment 4.1-1



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5.2.8 Minimum Plateau Period

If the end of the Plateau Period is earlier than both of:

(i) the Day on which twenty nine (29) billion Standard Cubic Metres of Sales Gas have been delivered under this Agreement and the Other Agreements, and

(ii) the eleventh (11th) anniversary of the Commissioning Date,

then during the remaining period from the end of the Plateau Period until the earlier of the events described in paragraphs (i) and (ii) above:

(a) the DCQ and MDCQ for the Plateau Period as specified in Articles 5.2.3 and 5.3 (iii) respectively, shall continue to apply, notwithstanding the preceding provisions of this Article 5.2, and

(b) for the purposes only of the classification of Shortfall Gas in accordance with Article 13, the sum of the Buyer's Proper Nominations aggregated each Contract Year (or part thereof) during such remaining period shall not exceed two decimal seven (2.7) billion Standard Cubic Metres (or the appropriate portion thereof, as the case may be).

5.3 Maximum Daily Contract Quantity

There shall be established a Maximum Daily Contract Quantity ("MDCQ") which shall be the maximum daily quantity of Sales Gas which the Buyer may nominate for deliveries in aggregate by the Sellers. Subject to Article 10.5, the MDCQ shall be as follows:

(i) First Contract Year

From the Start Date until the end of the First Contract Year, the MDCQ each Day shall be nine decimal five two two (9.522) million Standard Cubic Metres;

4.1.5 Gas Price

(1) Information about the Gas Price

Gas price submitted to Vietnamese Government for their approval at the end of last year is 9 ~ 10 USD/MMBtu. The Government has not yet approved due to higher its price compared with precedent gas prices.

On the other hand, IE prepared F/S on “Economic analysis between the gas fired combined cycle plant and the coal fired conventional power plant” financed by Chevron.

Conclusions of F/S are as follows;

1) The gas fired combined cycle plant is superior to the coal fired conventional power plant based on the gas price submitted to the Government
2) Little impact to the whole power tariff is anticipated even if the gas price submitted to the Government is adopted

The F/S report has submitted to MOIT, EVN and PVN.

(2) Formula for the Gas Price

1) GSPA

Initial gas price is escalated with 1) two previous quarter of CPI[3] and 2) previous quarter of HSFO (high sulfur fuel oil)[4].

2) GTA

Initial transportation price is escalated with two previous quarter of CPI.

3) GSA

GSA = GSPA + GTA + PVN administration cost.

4.1.6 Gas Specifications

Table 4.12 shows seven (7) sorts of gas from Block B&52. Some of gas contain inert gas (N_2 + CO_2) more than 20 % that GT manufactures can barely use as fuel gas.

PVN recommended adopting 893 in the table as design purpose whose detail specifications are described in Table 4.1-13.

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[3] Arithmetic average of American consumer price index

[4] Arithmetic average of all Singapore HSFO 180 cst 3.5 % S

Table 4.1-12 Gas Specifications of Block B&52

Anticipated Sales Gas Compositions
HCDP 7.2C (45F), Water 7 Ib/MMscfd

		Within LOI Specifications						
HCDP		**45.07F**	**44.97F**	**44.66F**	**45.06F**	**44.59F**	**44.61F**	**44.98F**
Cal's HHV		**856**	**866**	**879**	**893**	**949**	**1,014**	**1,050**
Component		Mol %	Mol %	Mol %	Mol %	Mol %	Mol %	Mol %
C1	Methane	71.5500	77.1600	73.1400	80.4884	84.9397	66.4000	74.2251
C2	Ethane	2.8100	2.9400	2.9100	2.7368	3.0212	6.2100	5.0397
C3	Propane	1.4700	0.3200	1.5200	0.2997	0.4152	5.4200	4.5097
iC4	Isobutane	0.4200	0.1100	0.4400	0.0964	0.1318	1.1300	1.3076
nC4	n-Butane	0.3300	0.0800	0.3500	0.0698	0.1066	1.0300	0.8459
iC5	Isopentane	0.1600	0.0800	0.2100	0.0631	0.0742	0.2700	0.2834
nC5	n-Pentane	0.0900	0.0400	0.1400	0.0265	0.0366	0.1500	0.1552
C6	Hexane	0.0900	0.1400	0.0900	0.1232	0.1452	0.0600	0.0580
C7	Heptane	0.0600	0.1235	0.0450	0.1269	0.0794	0.0150	0.0130
C8+	Octane+	0.0190	0.0025	0.0200	0.0045	0.0160	0.0000	0.0100
N2	Nitrogen	2.9900	1.8700	2.7100	2.0158	2.1286	2.5600	5.3679
CO_2	Carbon dioxide	20.0000	17.1200	18.4100	13.9367	8.8900	16.7400	8.1680
H_2O	Water vapour	0.0147	0.0147	0.0147	0.0147	0.0147	0.0147	0.0147
Total		**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Inert		23.0	19.0	21.1	16.0	11.0	19.3	13.5
MW		23.4	21.9	23.0	21.0	19.7	24.6	22.2
SG (60F, 14.696 psia)		0.81	0.76	0.79	0.72	0.68	0.85	0.76
LHV (Btu/scf)		773	781	794	806	856	920	951
HHV (Btu/scf)		856	866	879	893	949	1,014	1,050
Wobbe Index at 60F		953	997	988	1050	1,152	1,101	1,202
Modified Wobbe Index at 60F		37.7	39.4	39.1	41.5	45.6	43.8	47.7
Sample Point No.		1	2	3	4	5	6	7

Table 4.1-13 Detailed Gas Specifications of 893

			HCDP cal's GHV	45.06F 893	Recommended Range for Bid	Recommended Range for Bid	
No.	Property		Unit	Typical Value	Min. Value	Max. Value	Contractually Committed
I	**Composition**						
1.a	Methane	CH4	% mol	80.4884%	66.4%	95%	
1.b	Methane	CH4	& of total reactance		82.3%	100%	**Yes** (> 82% of total reactants)
2	Ethane	C2H6	% mol	2.7368%	1%	8%	
3	Propane	C3H8	% mol	0.2997%	0%	6%	
4	i-Butane	C4H10	% mol	0.0964%	0%	3%	
5	n-Butane	C4H10	% mol	0.0698%	0%	3%	
6	i-Pentane	C5H12	% mol	0.0631%	0%	0.4%	
7	n-Pentane	C5H12	% mol	0.0265%	0%	0.3%	
8	Hexane	C6H14	% mol	0.1232%	0%	0.2%	
9	Heptane	C7H16	% mol	0.1269%	0%	0.2%	
10	Octane plus	(C8+)	% mol	0.0045%	0%	0.1%	
11	Nitrogen	N2	% mol	2.0158%	0%	8%	**Yes**
12	Carbon dioxide	CO2	% mol	13.9367%	0%	20%	20% CO_2 in the first 5 contract years, after that consider to increase up to 21%
13	Water vapor	H20	% mol	0.0147%	0%	0.0147%	**Yes**
14	Helium	He	% mol	0.00%	0%	0%	
15	Oxygen	O2	% mol	0.00%	0%	0.1%	**Yes**
16	Hydrogen	H2	% mol	0.00%	0%	0%	
17	Carbon monoxide	CO	% mol	0.00%	0%	0%	
18	Other components		% mol	0.00%	0%	0%	
19	**Total**		**% mol**	**100.00%**	**N/A**	**N/A**	
20	Sum of higher hydrocarbons	C2+	% mol	3.5468%			
21	Total inert		% mol	15.9526%	0%	23.0%	**Yes**
22	Variation of C2+		% mol		0%	17.0%	
II	**Gas Conditions (at power plant - Provided by PV Gas)**						
1	Pressure at TP		Barg		40	60	**Yes**
2	Pressure variation		%				
3	Temperature at TP		°C		+10°C above HCDP and 10°C above Water dew point	60	**Yes**
III	**Physical Properties**						
1.b	Hydrocarbon Dew Point at 60 bar (870 psig)		°C	1.7		7.2	**Yes**
2	Hydrocarbon Dew Point at Cricondentherm		°C	7.3			
3	Water dew point at 60 bar (870 psig) based on water content 7 Ib/MMscf		°C	-2.6			
4	Hydrocarbon Dew Point at 60 bar (870 psig)		F	35			
5	Hydrocarbon Dew Point at Cricondentherm		F	45.06			
6	Water dew point at 60 bar (870 psig) based on water content 7 Ib/MMscf		F	27.2			
7	MW			20.97			
8	SG			0.72			
9	Density at 60F		Ib/ft3	0.055			
10	Density at 15°C		kg/m^3	0.89			
11	Higher Heating Value (HHV)		BTU/scf	893	850	1,050	**Yes**
12	Lower Heating Value (LHV)		BTU/scf	806	773	951	
13	Absolute Limit of Wobbe Index at 60F (LHV/SG^0.5)		BTU/scf	947	858	1,140	**Yes**
14	Operating Gas Wobbe Index Range for Period From First Gas to the End of 5th Contract Year		BTU/scf		858 (953 - 10%)	1,048 (953 + 10%)	**Yes**
15	Operating Gas Wobbe Index Variation Range Relative to Midpoint		%		-10%	+10%	**Yes**
16	Option to Change Wobbe Index Range with Respect to Midpoint, Subject to Proper Notification				No change permitted in first five (5) years of operation, commencing from the Start Date	Seller has the option to request a change in Wobbe Index range three (3) times in the first 20 years of the project and a total of four (4) times over the life of the project. The fourth (4th) change, if required, will be subject to mutual agreement by the Parties, based on Block B field conditions at that time.	**Yes**

4.1.7 Location of Gas Distribution Center and Tie-in Point of the Gas Pipeline

(1) Location of the Gas Distribution Center

Gas distribution center that planned to be constructed by PV Gas is located at ca. 300 m south as the crow flies from the main gate of O Mon Power Complex.
The area is ca. 7.5 ha, and resettlement of the inhabitants within the area has been completed.

Photo 4.1-1 shows the area for the gas distribution center and Photo 4.1-2 shows the view from the area for the gas distribution center to O Mon Power Complex.

(2) Tie-in Point of the Gas Pipeline

Tie-in point of the gas pipeline at the premises of O Mon Power Complex is located adjacent the oil jetty as shown in Fig. 4.1-3.

Photo 4.1-1 Area for Gas Distribution Center

Photo 4.1-2 View from the Area to O Mon Power Complex

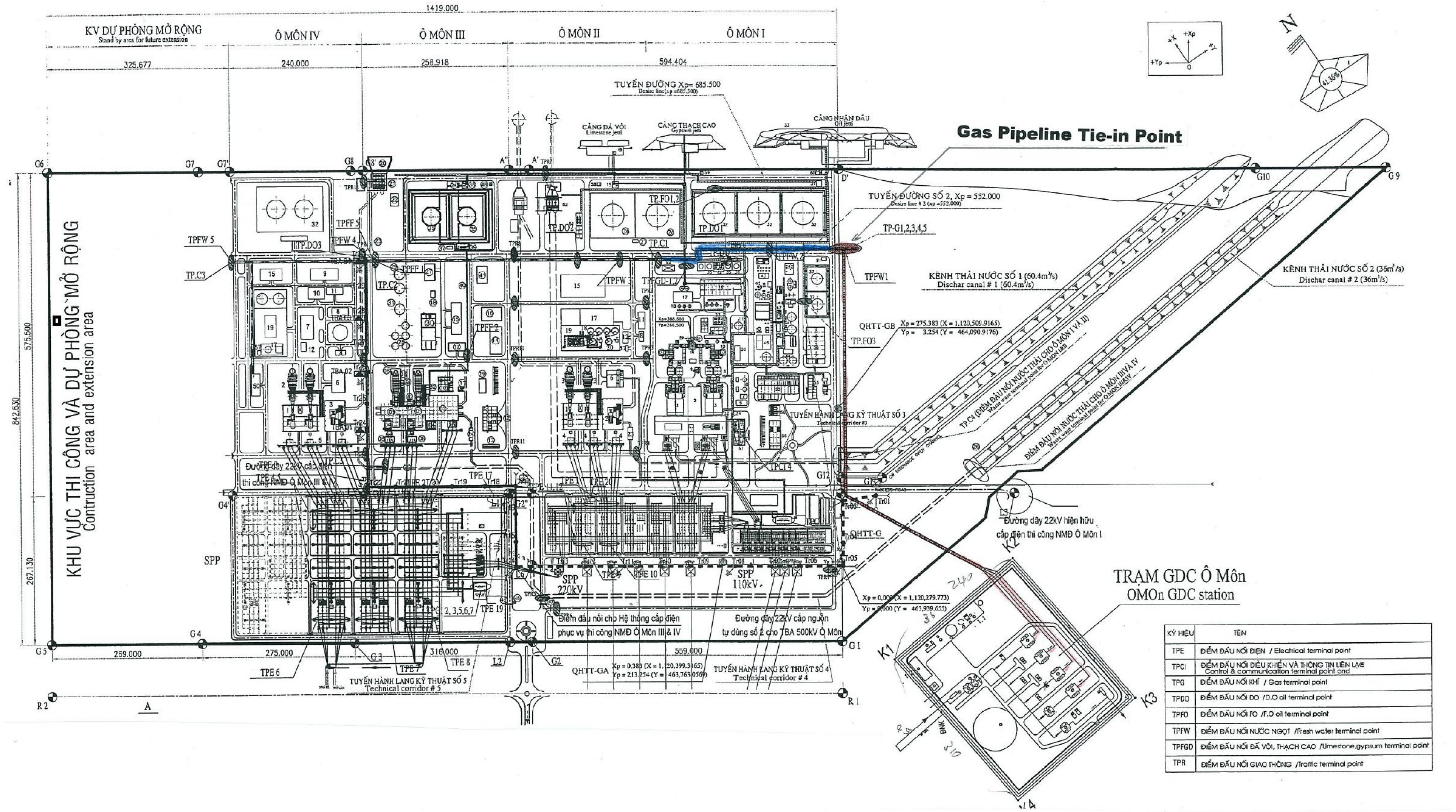


Fig. 4.1-3 Tie-in Point of the Gas Pipeline

4.1.8 Emergency Fuel (Diesel Oil)

(1) Specifications of Diesel Oil

Diesel oil is used as the start-up fuel in O Mon 1A. The amount of diesel oil per one start-up is ca. 43 ton.
Specifications of diesel oil are specified in Table 4.1-14.

(2) Price of Diesel Oil

Present price is 20,350 ~ 24,619 VND/litter (0.97 ~ 1.18 USD/litter) at 15°C.

(3) Sellers of Diesel Oil and Delivery Methods to O Mon Power Complex

Domestic distributors such as Petrolimex supply diesel oil imported from Singapore to O Mon Complex. Diesel oil storage facilities are located at Can Tho city and Ho Chi Min city, and diesel oil is delivered to the site through ca. 500 DWT barges in one (1) day from Can Tho city and in three (3) days from Ho Chi Min city.

Although Dung Quat oil refinery plant is put into operation, there is no plan to use it at O Mon Power Complex for now.

(4) Unloading of Diesel Oil at O Mon Power Complex

Diesel oil is unloaded by one (1) oil unloading arm (400 m^3/h capacity) at the jetty and delivered to the diesel oil tanks at the premises of O Mon Power Complex.

Table 4.1-14 Diesel Oil Specification

Characteristic	Unit	Specific Value	Range
Compositions (% weight)			
Carbon	%	86.19	85.3 - 86.5
Hydrogen	%	13.11	12.6 - 13.8
Nitrogen	%	0.1	
Oxygen	%	0.1	
Sulfur	%	0.5	1.0 Max
Moisture	%	0	
Ash content	%	0	0.01 Max
Total	%	100	
High heating value (HHV)	kJ/kg	45,225	44,800 - 46,050
Low heating value (LHV)	kJ/kg	42,600	
Kinematic viscosity at 40°C	cSt		1.3 - 5.5
Flash point	°C		50 Min
Pour point	°C		-6 Max
Water and Sediment	% Vol		0.05 Max
Conradson Carbon Residue (10% day)	% Wt		0.35
Distillation - 90% vol. recovered	°C		282 - 338
Metal corrosion (V + Pb + Zn + Ni)	ppm		1 Max

4.2 OVERALL PLAN

4.2.1 Construction Plan of the Project

(1) Current Status of Power Plants Construction in O Mon Power Complex

Construction plan of power plants in O Mon power complex is planned as shown in Table 4.2-1. The commercial operation of O Mon 4 power plant is planned to be one year earlier than that of O Mon 3 power plant and the total installed capacity in O Mon Power Complex becomes 2,160 MW in 2016.

Table 4.2-1 Construction Plan of Power Plants in O Mon Power Complex

Power Plant	Generation Type	Capacity	Operation Year	Remarks
O Mon 1	Conventional	660 MW	1-A Unit in 2009 1-B Unit in 2014	I-B :JICA Finance
O Mon 2	Combined Cycle	750 MW	2016	BOT Project Operation year is based on PDP7
O Mon 3	Combined Cycle	750 MW	2016.11	The latest plan approved by EVN JICA Finance (plan)
O Mon 4	Combined Cycle	750 MW	2015.11	The latest plan approved by EVN ADB Finance
O Mon 5	-	-	-	Construction plan was cancelled.

(2) Breakdown of Land Area and Main Facilities for Power Plants in O Mon Power Complex

The total land area of O Mon Power Complex is 191 ha (including open space, road out side of the fence and housing for staff, etc.).

JICA Study Team obtained the data and CAD drawings as shown in Fig. 4.2-1 and Fig. 4.2-2 from CTTP and all facilities and land area relating to the O Mon power complex are confirmed as shown in Table 4.2-2.

Table 4.2-2 Breakdown of Land Area by Facilities Base of Power Plants

(unit：ha)

	Total Land Area	Main Equipment and Facilities									
		Generation Facilities		Fuel Facilities		Switchyard		Other Facilities		Green Space	
O Mon 1	32.4535	3.0863	9.5%	3.1201	9.6%	4.6275	14.3%	18.0749	55.7%	3.5447	10.9%
O Mon 2	14.2632	3.7235	26.1%	2.1676	15.2%	—	—	7.3925	51.8%	0.9796	6.9%
O Mon 3	52.0171	2.6665	5.1%	1.9212	1.3%	9.5710	18.4%	32.1113	61.7%	5.7471	11.1%
O Mon 4	13.812	2.3248	16.8%	2.0465	14.8%	—	—	6.7208	48.7%	2.7199	19.7%

(Source：CTTP)

Contents of Confirmation

<Land Area of O Mon 3 Power Plant>

(1) The land area of O Mon 3 is the most specious among O Mon 1 to O Mon 4 in the O Mon Power Complex .The land area of O Mon 3is 3.8times of that of O Mon 4.

(2) The land area of O Mon 3 is divided into the following 3 blocks excluding the 220/500kV switchyards area (9,571ha).(See Fig. 4.2-1)

1) O Mon3KV1 (14.905ha) - Power generation equipment & facilities compartment.

2) O Mon3KV2 (12.8905ha) - Open space on the south side of 220kV Switchyard.

3) O Mon3KV3 (14,6502ha) - Open space on the ground of the planned CW Discharge Culvert.

(3) The administration building/guard house/gates (main & sub) are installed in O Mon 3 and are used as the common facilities of O Mon 3and O Mon 4.

(4) The 220kV Control Room has already been installed in the 220kV/110kV switchyard on the south of O Mon 1& O Mon2.

(5) The ratio of the current greening plan of O Mon 3 is 11%.But there is sufficient open space for the green tract of land area to be expanded in O Mon Power Complex.

(6) Materials and Equipment Yard during the construction of O Mon2/O Mon 3/O Mon 4 are planned as follows.(See Fig. 4.2-2)

1) O Mon2: O Mon KV2

2) O Mon3: 1/2Area of the open space on the west side of O Mon4.(Front Side of Hau River)

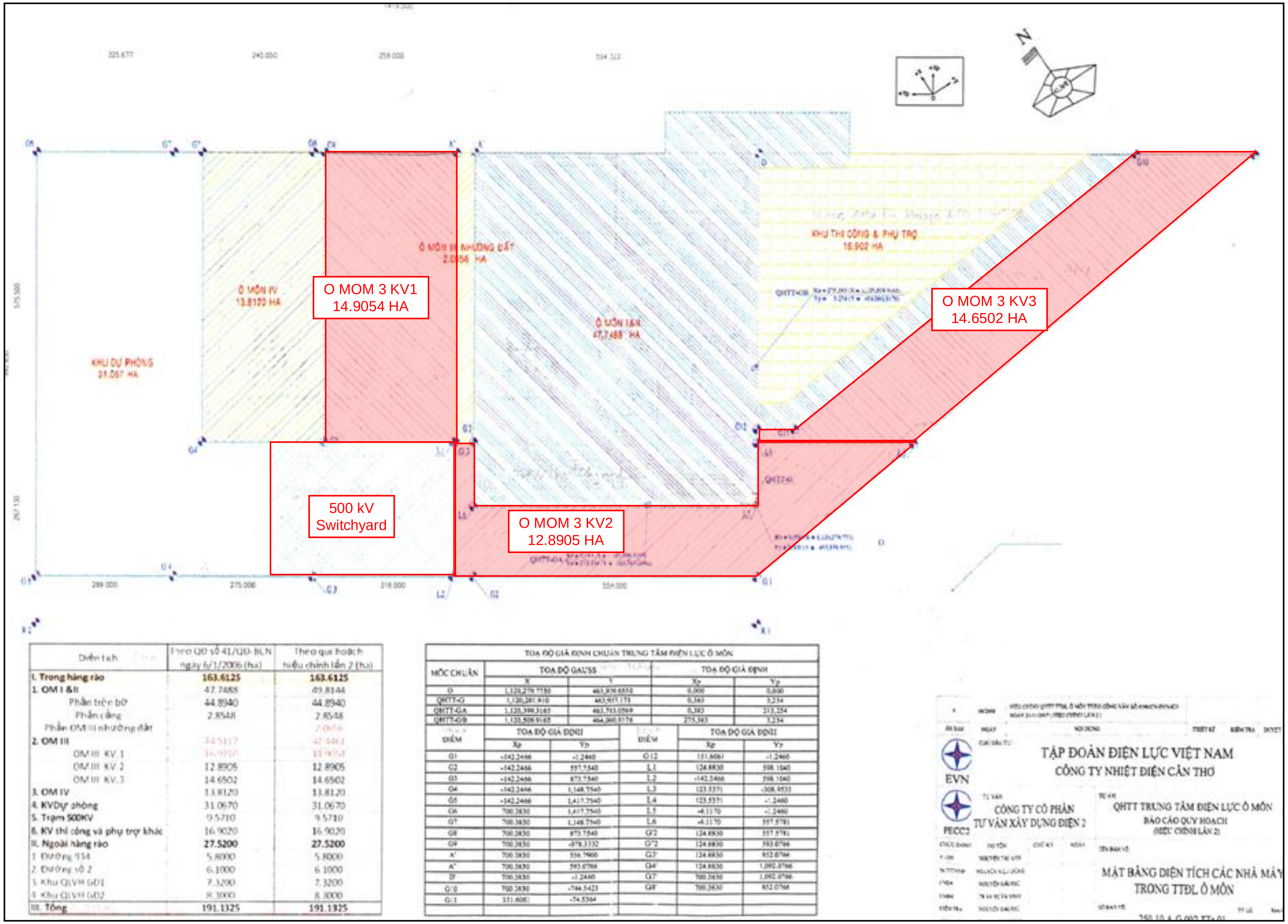
3) O Mon4:1/2Area of the open space on the west side of O Mon4 (West Side of 500kV Switchyard)

<Others>

(1) The Area No.1& No.2 of Staff Apartment are planned outside of the fence.

(2) The open space for Storage& Construction are planned in the east side of O Mon1.

(Note) Switchyards:
- O Mon1and O Mon2are connected to 220kV/110kV switchyard.
- O Mon3and O Mon4are connected to 500kV switchyard.



Diện tích	Theo QĐ số 41/QĐ-BCN ngày 6/1/2006 (ha)	Theo quy hoạch hiệu chỉnh lần 2 (ha)
I. Trong hàng rào	**163.6125**	**163.6125**
1. OM I &II	47.7488	49.8144
Phần trên bờ	44.8940	44.8940
Phần cảng	2.8548	2.8548
Phần OM III nhường đất		2.0656
2. OM III	[illegible]	42.4461
OM III KV.1	[illegible]	[illegible]
OM III KV.2	12.8905	12.8905
OM III KV.3	14.6502	14.6502
3. OM IV	13.8120	13.8120
4. KVDự phòng	31.0670	31.0670
5. Trạm 500KV	9.5710	9.5710
6. KV thi công và phụ trợ khác	16.9020	16.9020
II. Ngoài hàng rào	**27.5200**	**27.5200**
1. Đường 934	5.8000	5.8000
2. Đường số 2	6.1000	6.1000
3. Khu QLVH GĐ1	7.3200	7.3200
4. Khu QLVH GĐ2	8.3000	8.3000
III. Tổng	191.1325	191.1325

Fig. 4.2-1 Land Area for O Mon 3 Power Plant

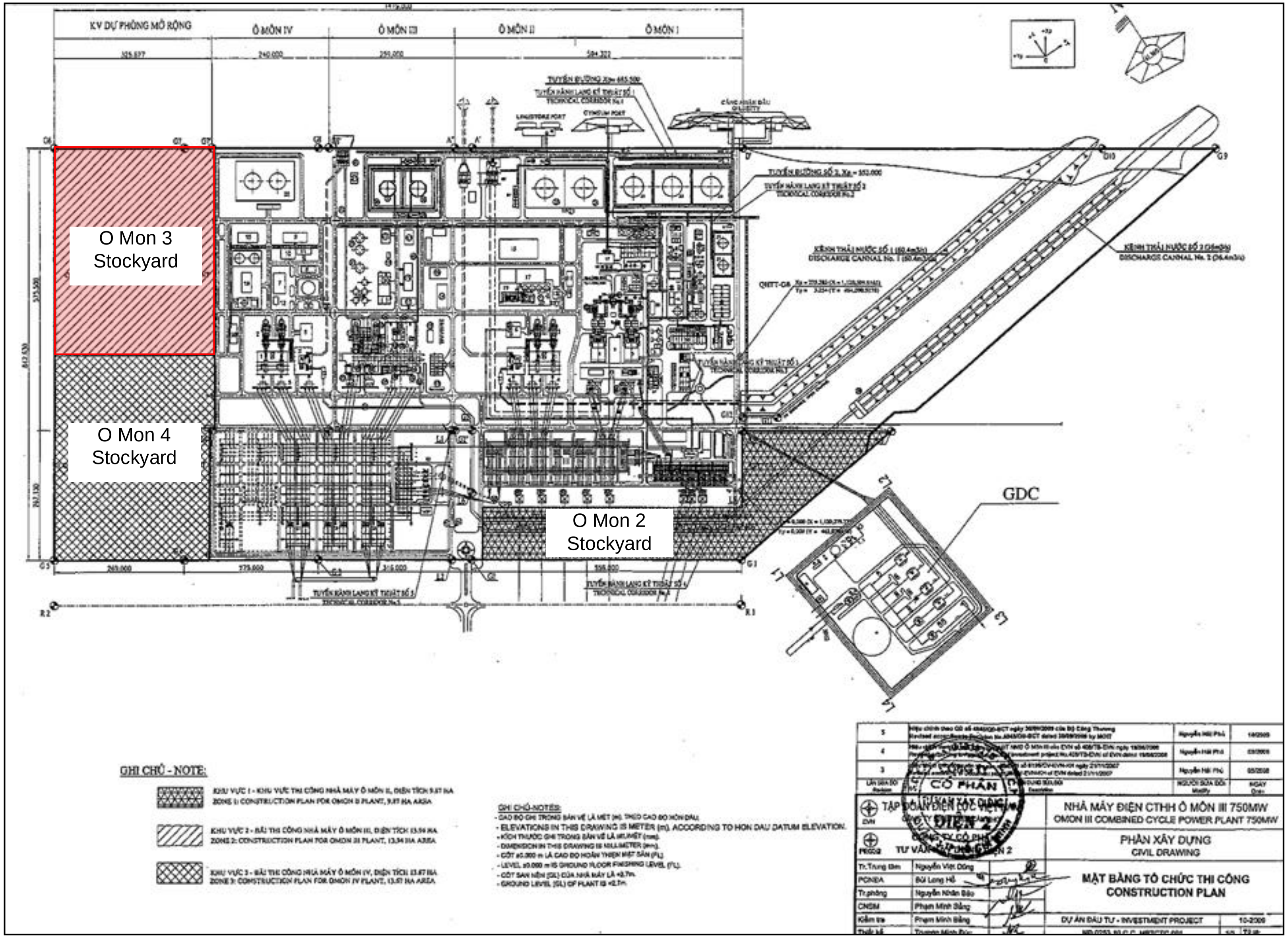


Fig. 4.2-2 Layout of Temporary Stockyard in O Mon Power Complex

(3) Confirmation on Layout of O Mon 3 Power Plant

Layout of O Mon 3 power plant is confirmed by the drawing provided by CTTP as shown in Fig. 4.2-3. According to Fig. 4.2-3, O Mon power plant is to be constructed in O Mon 3 KV1 and consists of the following four (4) areas.

Area 1: located between Area 2 and Area 4 and the following facilities are arranged.

- main plant housing of the two gas turbine generators and one steam turbine generator;
- HRSGs and the two main stacks, and the two by pass stacks;
- three main transformers and the two Aux. transformers;
- pipe rack;
- control building of STG, GTG;
- sampling house;
- center control building;
- feed water pump station and the sampling house;
- siphon pit and the CW discharge culvert;
- diesel generator station.
- administration building;
- motorbike shed;
- canteen;

Area 2: located between Area 1 and Area 3 and the following facilities are arranged.

- water demineralizing area;
- waste treatment;
- filtered water tanks;
- demineralizing water tank;
- water treatment control building house;
- fire pump station;
- garage;
- warehouse;
- workshop;
- fire truck station;
- pipe sleeper.

Area 3: located Hau River on the front of O Mon 3 and the following facilities are arranged.

- CW inlet canal
- CW pump station and CW supplying pipe
- Oil measurement station
- DO storage tanks
- Oil protection embankment
- Oil separator tank
- Oil recovery tank
- DO pump station
- fuel gas treatment and supply plant.
- Pipe sleeper
- watch tower

Area 4: located between Area 1 and Access Road No.2 and the following facilities are arranged.

- CW discharge culvert
- CW discharge canal

- guard house
- main gate
- aux. gate
- 220kV/500kV switchyards:

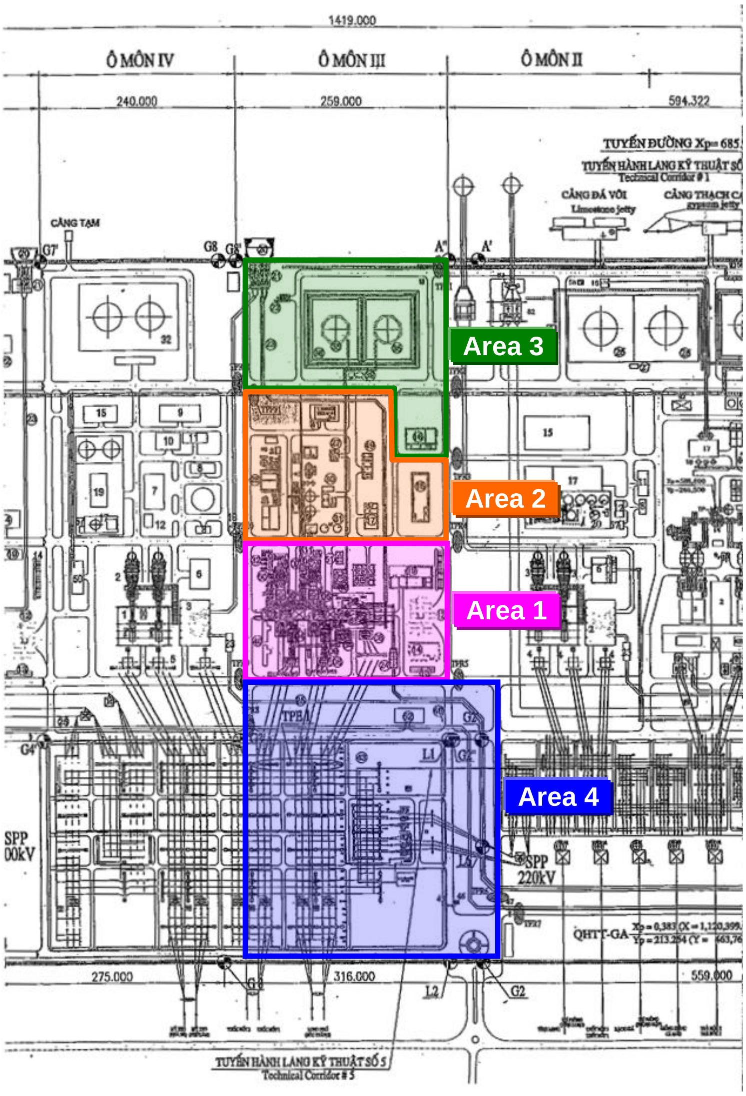


Fig. 4.2-3 Arrangement of Area 1 ~ Area 4 for O Mon 3 Power Plant

4.2.2 Specifications for Facilities Planning

Based on the specification of facilities planning in Table 4.2-3, Construction plan for O Mon 3 power plant was reviewed.

Table 4.2-3 Specification and Confirmation of Facilities Planning for O Mon 3

No.	Specifications of Facilities Planning	Contents of Confirmation
1	Main Characteristics	Design overview of the main facilities
2	Construction details	Outline of specifications of main equipment &facilities
3	Efficient layout of power plant equipment & facilities	(1) Layout of the main power generation equipment &facilities (2) Layout of the ancillary facilities
4	Consideration for the surrounding residential (Environmental Measures)	(1) Air pollution measures equipment, (2) Thermal effluent measures equipment (3) Drainage measures equipment (4) Noise preventive measures equipment (5) Greening measures
5	Safety equipment and disaster prevention	(1)Security Facilities (2)Fire Fighting equipment and facilities
6	Consideration for the conditions of topography and geology of the site;	Risk of topography, geology, earthquakes and others
7	Environmental evaluation to the natural , consideration for the landscape	(1) Intake and discharge method of condenser cooling water (2) Presence or absence of scenic spots
8	- Possibility of the common equipment facilities - construction status of the common equipment & facilities	(1) Possibility of the common equipment & facilities (2) Progress of the construction of the common equipment & facilities
9	Connection to the transmission grid	Status of the 500kV switchyards
10	Appropriate leveling , Foundation plan	Current status of the embankment and foundation plan
11	Access road to O Mon III	Progress of the construction of access road No.2
12	Layout plan of temporary facility for construction work	Unloading Jetty/Construction power/TTPC &Consultant site office/Contractor site office

The result of review is shown in Table 4.2-4.

Table 4.2-4 Result of Review based on Specifications of Facilities Planning

No.	Items	Contents of Confirmation

1 Main characteristics of O Mon 3 power plant ;

(Source：O Mon Combined Cycle Power Project Feasibility Study Report,Sep,2010,PECC2)

Name of Power Plant	O Mon 3 Combined Cycle Power Plant.
Location	Thoi Loi Hamlet, Phuoc Thoi Commune, O Mon District, Can Tho City, Vietnam.
Scale of Capacity	Min.750MW
Configuration	Configuration of 2-2-1, Gas Turbine Unit is F Type Technology: Gas turbine for Combine Cycle Power Plant.
Fuel	Gas from B&52, through the B&52-O MON Gas pipe line. D.O.-Back up fuel, DO storage tanks (10,600 m^3×2tanks).
Cooling Water	Cooling water take from Hau river and drainage far away to Hau river with discharge volume of 18 m^3/s.
Fresh water	The fresh water for construction and operation are planned to supply and treat from Hau River.
Transmission voltage level	500kV
Annual average operation hours	6,000 hours/year
Design operation hour	6,500 hours/year
Economic life of plant	25 years

2 Specifications of Main Equipment &Facilities;

Outline of specifications of main equipment and facilities

(Source: O Mon Combined Cycle Power Project Feasibility Study Report,Sep.2010,PECC2)

(1) Main buildings

No.	Facilities Name	Quant.	length (m)	Width (m)	Height (m)
1	Gas Turbines Building	1	86	19	25.2
2	Steam Turbine Building	1	49.5	42	25.2
3	Electrical Control Building	1	24	24	10.28
4	Diesel Generation Station	1			
5	Administration Building	1	42	25.2	14.8
6	Bypass Stack, HRSG and Main Stack	2 2	Dia.6.8 Dia.6.8		30 40
7	Canteen	1	25	12	4

(2) Auxiliary Buildings

No.	Facilities Name	Quant.	length (m)	Width (m	Height (m)
1	Warehouse	1	36	24	12.6
2	Workshop	1	56	18	13.8
3	Vehicle maintenance and garage building	1	34	12	5.7
4	Motorbike shed	1	30	6	2.2

(3) Fuel Oil/Gas Supply System

No.	Facilities Name	Quant.	length (m)	Width (m)	Height (m)
1	Fuel Oil Pipeline	1system			
2	Fuel Gas Pipeline	1system			
3	DO Tank &Bound Foundation	2	130	105	2.0
4	Fuel Oil Counter Station	1	52	17	6.7

No.	Items	Contents of Confirmation

No.	Facilities Name	Quant.	length (m)	Width (m)	Height (m)
5	Fuel Oil Pump House	1	18	7.2	4,2
6	Fuel Oil Recovery Sump	1	9	4	4.5
7	Fuel Gas Treatment & Distribution Station	1	30	14.4	4.2

(4) Water Treatment and Drainage Systems

No.	Facilities Name	Quant.	length (m)	Width (m)	Height (m)
1	Pre-treatment Water Treatment Plant	1system	85	37	
2	Demineralized Water Treatment Plant	1system			
3	Portable Water Tank Foundation	2	16	16	1.4
4	Demineralized Water Tank Foundation	2	11.6	11.6	1.0
5	Storm Water Drainage System	1system			
6	Water Treatment Building	1system	60	30	
7	Oily, Chemical Water	1system			
8	Drainage System	1system			

(5) Electrical System

No.	Facilities Name	Quant.	length (m)	Width (m)	Height (m)
1	500kV Switchyard	1	263	234	
2	220kV Switchyard	1	118	40	
3	House to put the Control Panel for 500kV Switchyards	1	10	8	3.0
4	Main Transformer System	3	17	14	10
5	Auxiliary Transformer	4	18	5	4.5
6	Cable Trench and Duct Bank System	1system			

(6) Fire-Fighting System

No.	Facilities Name	Quant.	length ( )	Width (m)	Height (m)
1	Fire Fighting Pump Station	1	12	7.2	5.5
2	Fire Fighting Water Pipeline	1system			

(7) Road System

No.	Facilities Name	Quant.	length (m)	Width (m)	Height (m)
1	Plant Internal Road	1system			
2	Plant External Road	1system			

(8) Security System

No.	Facilities Name	Quant.	length (m)	Width (m)	Height (m)
1	Perimeter Fence	1system			3.0
2	Main Gate	1			
3	Security tower	1	4.8	4.8	9
4	Guard House	1	6	4	4

<table>
<tr><th>No.</th><th>Items</th><th>Contents of Confirmation</th></tr>
<tr><td></td><td colspan="2">(9) Cooling Water System
<table>
<tr><th>No.</th><th>Facilities Name</th><th>Quant.</th><th>length (m)</th><th>Width (m)</th><th>Height (m)</th></tr>
<tr><td>1</td><td>CW Intake Head</td><td>1</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>Pipeline to CW Pump Station</td><td>1</td><td>Dia.3.0m</td><td></td><td></td></tr>
<tr><td>3</td><td>CW Pump House</td><td>1</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>Pipeline from CW Pump to Condenser</td><td>1</td><td>Dia.3.0m</td><td></td><td></td></tr>
<tr><td>5</td><td>CW Discharge Culvert</td><td>1line</td><td></td><td>4.5</td><td>4.5</td></tr>
<tr><td>6</td><td>CW Open Discharge Canal</td><td>1</td><td></td><td></td><td></td></tr>
<tr><td>7</td><td>Chlorination Plant Building</td><td>1</td><td>1</td><td>8</td><td>66</td></tr>
</table></td></tr>
<tr><td>3</td><td>Efficient layout of power plant equipment & facilities</td><td>O Mon 3 will be arranged in one package related to the equipment& facilities in the following Area 1 from Area. It has become effective arrangement considering operation & monitoring of the equipment、root of patrol inspection and maintenance space, etc.</td></tr>
<tr><td>3.1</td><td>Layout of the main power generation equipment & facilities</td><td>Area1: Open Cycle Gas Turbine Generator (2 sets) Combined Cycle Steam Turbine Generator (1set) are arranged indoor to account for operation& monitoring of the equipment and maintenance.
In addition, Those equipment are arranged close to Center control building, a diesel generator building
- HRSGs and main stacks/by- pass stacks are arranged on the north side of GTG building. As for those facilities、the installation and the space maintaining are considered.
Area2: Arrange in one package BOP facility of water facilities，drainage facilities and fire fighting water facilities .Those arrangements are made considering the operation& monitoring of equipment and the root of patrol inspection.
Area3: Arrange in one package CW intake facilities & DFO storage facilities .Those arrangements are considering the operation& monitoring of equipment and the root of patrol inspection.
Area4: - The control room of 220kV/500kV switchyards has already been installed.
- The root of the installation of CW discharge culvert/CW discharge canal will be arranged considering the working space.</td></tr>
<tr><td>3.2</td><td>Layout of the ancillary facilities</td><td>The ancillary facilities will be arranged considering day shift members engaged in Area 4 from Area1 maintenance place and safety& security.
Area1: - Administration building，Motorbike shed and Canteen are efficiently arranged close to the Main power building.
Area2: - Warehouse/Workshop of maintenance facility and garage are efficiently arranged in one package.
Area3: - Watch tower will be arranged as the safety &security facility on the front of Hau River as the safety & security facility.
Area4: - Guard House and Gate (Main & Sub) will be arranged at the entrance of O Mon 3 as the safety & security facility.</td></tr>
<tr><td>4</td><td>Consideration for the surrounding residential (Environmental measures)</td><td>(1) The site of O Mon 3 was procured without problems in accordance with the law.
(2) As for air pollution/thermal effluent/waste water/noise etc. it was</td></tr>
</table>

No.	Items	Contents of Confirmation
		confirmed that the following measures were taken for the facilities to comply with the value of environmental standards.

Air pollution measures equipment	(1) Main Strack:40m high×2sets. (2) By pass Stack:30m high×2sets.
Thermal effluent measures equipment	(1) Deep water intake: Condenser cooling water ($18m^3$/h) to take in water from the front of Hau River of O MON 3. Condenser Cooling water intake will be shared with O Mon 4. (2) Cooling water discharge: Cooling water discharge culvert and cooling water discharge canal No.2 in the south side of O Mon 3 using the common facilities of O Mon 3 &O Mon 4.(Total Volume Capacity:$36m^3$/h)h)
Drainage measures equipment	(1) Wastewater treatment facility (Design capacity: Max$50m^3$) will be arranged in the south of Demineralizing Area. (2) Regular volume of wastewater per day from O Mon III is about $999m^3$/day ($41m^3$/h). In addition, the position of wastewater outlet of O Mon 3 is undetermined. (After determining the Contractor, the position of drain outlet will)
Noise preventive measures equipment	(1) Gus-turbine, generator/Steam-turbine, generator will be installed in the turbine buildings. (2) The following equipment to install the silencer. - Exhaust Pipes of Gas Turbines - Exhaust Pipes of Ancillary System - Air Intake of Air Compressor (3) Limit noise levels - Substation :105dB(A) - Air filter of compressor :105dB(A) - Noise level at100m far from noise source :60 dB(A) (Note) Allowable noise level in resident area is 75dB(A)from6h~18h, 75dB(A)and18h~22h, and50dB(A)from22h~6h.
Greening measures	(1) Greening of the current planning area is 5.747 ha. Greening rate is 11%. *Expansion of green area space is sufficient.

No.	Items	Contents of Confirmation
5	**Safety equipment and disaster prevention**	Confirmation of the following equipment & facilities. (1) Security Facilities; 1) The perimeter fence work around the O Mon Power Complex is currently conducted by CTTP. 2) Guard house x1Gate(main & sub)and security tower ,etc. are arranged as common facilities with O Mon4 (2) Fire fighting system ; 1) Fire truck station & fire pump station 2) Water loop pipeline for fire fighting, in addition ,Fire fighting water piping is connected to O Mon 3 and O Mon 4 (Tie-Point is undecided) 3) Fire-fighting engines: - Water fire-engine - Chemical-water fire engine 4)Sprinkler System - Oil tank cooling system - CO_2 system

<table>
<tr><th>No.</th><th>Items</th><th>Contents of Confirmation</th></tr>
<tr><td></td><td></td><td>5) Other equipment
- Fire alarm system
- Portable CO_2 bottles and Dry chemical bottles etc.</td></tr>
<tr><td>6</td><td>Consideration for the conditions of topography and geology</td><td>(1) O Mon Power Complex is geologically stable. There is no particular problem because of lower risk of earthquake.
(2) O Mon 3 is located at an appropriate altitude, and the cost can be compressed. In addition, the overall cost of foundation work is appropriate.</td></tr>
<tr><td>7</td><td>Evaluation to the natural environment and consideration for the landscape</td><td>(1) As a result of the comparison of One-through Cooling System and Cooling Tower System, JICA Study Team adopts One-through Cooling System because it has little impact on the river from practical aspect.
(2) Because there are no scenic spots around the O Mon Power Complex, there is no particular need of consideration for landscape.</td></tr>
<tr><td>8</td><td colspan="2">Construction status and possibility of the common equipment & facilities are as follows. In addition, the common equipment & facilities of O Mon 3 are involved in the following 15.

Common equipment & facilities related to O Mon 3
<table>
<tr><th>No.</th><th>Common Equipment & Facilities</th><th>To be used for</th><th>New</th><th>Existing</th></tr>
<tr><td>1</td><td>Administration Building</td><td>O Mon 3 & O Mon 4</td><td>○</td><td></td></tr>
<tr><td>2</td><td>500KV Switchyards(Common Civil work)</td><td>O Mon 3 & O Mon 4</td><td>○</td><td></td></tr>
<tr><td>3</td><td>500KV Stations (including Switchyard Control House)</td><td>O Mon 3 & O Mon 4</td><td></td><td>○</td></tr>
<tr><td>4</td><td>CW Intake and CW Pump Station</td><td>O Mon 3 & O Mon 4</td><td>○</td><td></td></tr>
<tr><td>5</td><td>CW Discharge Culvert</td><td>O Mon 3 & O Mon 4</td><td>○</td><td></td></tr>
<tr><td>6</td><td>CW Discharge Canal No.2</td><td>O Mon 3 & O Mon 4</td><td>○</td><td></td></tr>
<tr><td>7</td><td>Construction Power</td><td>O Mon 3 & O Mon 4</td><td>○</td><td></td></tr>
<tr><td>8</td><td>DO Unloading Jetty</td><td>O Mon 1 ~ O Mon 4</td><td></td><td>○</td></tr>
<tr><td>9</td><td>Piping Rack & Sleeper for DO/Gas</td><td>O Mon 1 ~ O Mon 4</td><td>○</td><td></td></tr>
<tr><td>10</td><td>220kV Switchyard & 220kV Control Room</td><td>O Mon 1 ~ O Mon 4</td><td></td><td>○</td></tr>
<tr><td>11</td><td>Pire fighting Trucks</td><td>O Mon 3 & O Mon 4</td><td>○</td><td></td></tr>
<tr><td>12</td><td>200kV Relay Control Room</td><td>O Mon 1 ~ O Mon 4</td><td>○</td><td></td></tr>
<tr><td>13</td><td>Guard House & Gate(main & sub)</td><td>O Mon 3 & O Mon 4</td><td>○</td><td></td></tr>
<tr><td>14</td><td>Circle Fire Fighting Piping System</td><td>O Mon 3 & O Mon 4</td><td>○</td><td></td></tr>
<tr><td>15</td><td>Watch Tower</td><td>O Mon 1 ~ O Mon 4</td><td>○</td><td></td></tr>
</table></td></tr>
<tr><td>9</td><td>Connection to the transmission grid</td><td>(1) 500kV Switchyards (3lines of GTG-1/GTG-2/STG-1) is the common facilities of O Mon 3 & O Mon 4.
(2) It was confirmed that the preceding works of the civil work& control house, etc. had already been carried out in 500kV Switchyards.</td></tr>
<tr><td>10</td><td>Appropriate leveling, Foundation plan</td><td>(1) The leveling plan is also in EL.2.70m as with O Mon 1and Embankment will be completed in 2012 up to the height plan.
(2) The foundation plan has been established based on the geological survey & the results of O Mon 1.</td></tr>
<tr><td>11</td><td>Access road to O Mon III</td><td>(1) The access road up to the entrance of O Mon 3 in the south side of 500kV switchyard from National Road No.91 through access road No.2 has been planned.
In addition、Access Road No.2 land acquisition is completed by EVN, It is currently under construction. (Scheduled for completion in Aprl,2012).</td></tr>
</table>

No.	Items	Contents of Confirmation
12	Layout plan of temporary facility construction work pertaining to power plant	(1) Unloading berth: The temporary unloading berth is available that is installed near the existing Jetty No.1. There is a space of the temporary unloading berth along Hau River on the front of O Mon 3& O Mon 4. (2) Temporary construction power: New transmission line has been planned for O Mon 3 & O Mon 4、has been installed on the south side of O Mon 1 & O Mon 2. (3) Site office of CTTP & Consultant: The construction personnel plan of O Mon 3 will be fixed and the site office will be planned on Hau River side of the northwest side of O Mon 4. (4) Site office of Contractor: The Contractor is undetermined. In principle, the selection of the Contractor's site office is done by Contractor.

4.2.3 Required Water Amount for O Mon Power Plant

(1) Confirmation on Water Sources for O Mon 3 Power Plant

It is confirmed that well water and underground water is used for only construction stage, and cooling water for condenser and fresh water for the power plant for operation stage are provided by Hau River in front of O Mon 3 power plant.

< Note >

Fresh water is used to Make-up Water (Make-up water for plant)/Demineralizing Water (Pure water) / Filtered Water below (General service water)

- Make-up Water : Make-up water used for the purpose of power generation. (The flow volume during power generation and unrecovered auxiliary steam volume)
- Demineralizing : Demineralizing water used for cooling and maintenance of water auxiliary equipment, water pressure tests, cleaning of deionizer and other works.
- Filtered Water : Filtered water used for cooling and maintenance of auxiliary equipment, water pressure tests, cleaning of deionizer, living water, fire-fighting water, site spring water and other works.

(2) Required Cooling Water Volume for Condenser and Fresh Water for Power Plants

Required cooling water for condenser provided by the Hau River is shown in Table 4.2-5 and required fresh water for power plants is shown in Table 4.2-6.

Table 4.2-5 Required Cooling Water and its Specification

Item P/S	Water Source : Hau River (m^3/h)	Specification				
		Capacity (MW)	Technology	Temperature Increase (°C)	Water heat Capacity (k/kg°C)	Total demand Cooling Water (m^3/s)
O Mon 1	52,000	660	Conventional Steam PP	7	4.19	**30.2**
O Mon 2	64,800	750	CCPP	7	4.19	**18**
O Mon 3	**64,800**	**750**	**CCPP**	7	**4.19**	**18**
O Mon 4	64,800	750	CCPP	7	4.19	**18**
Total	246,400	2,910	—	—	—	**84.2**

(Source: CTTP)

Table 4.2-6 Required Fresh Water for Power Plants

No.	Specification		O Mon 1	O Mon 2	O Mon 3	O Mon 4	Total
1	Capacity	MW	660	750	750	750	2,910
2	Water demand for Construction Phase	m^3/day	2,640	3,000	3,000	3,000	11,640
3	Water demand for Operation Phase	m^3/day	4,000	1,449	1,449	1,449	8,489
4	Total demand	m^3/day	6,640	4,449	4,449	4,449	20,129
5	Operation scheduled for		(Unit 1) 2/2009 (Unit 2) 3/2012	—	12/2015	4/2015	—

(Source : CTTP)

(3) Amount of Daily Fresh Water Intake for Each Power Plant and Storage Facilities

Daily intake amount of fresh water from the Hau River and storage facilities are shown in Table 4.2-7.

Table 4.2-7 Daily Intake Amount from Hau River and Outline of Storage Facilities

Item P/S	Water Source: Hau River (m^3/day)	Storage Facilities		
		Make-up Water Storage Tank	Demineralizing Storage Tank	Filtered Water Storage Tank
O Mon 1 660MW Conventional	1,254,640	1,200 m^3 × 1 tank 300 m^3 × 1 tank	2,000 m^3 × 2 tanks	3,000 m^3 × 2 tanks 150 m^3 × 1 tank
O Mon 2 750MW CCPP	1,559,649	—	—	—
O Mon 3 750MW CCPP	**1,559,649**	*** m^3 × 1 tank**	**1,600 m^3 × 2 tanks**	**1,200 m^3 × 2 tanks**
O Mon 4 750MW CCPP	1,559,649	—	2,000 m^3 × 2 tanks	2,000 m^3 × 2 tanks

* Storage capacity shall be decided by O Mon 3 contractor

(Source：CTTP)

Preprocession of fresh water from the Hau River is done by Pre-Treatment System.

< Note >

In accordance with Article 13 of Decree No.149/2004/ND-CP dated July 27,2004 relating to the Regulation on issuing permits of survey, exploitation and usage of water source and water discharge, it is stipulated that:

1) The Ministry of Natural Resource and environment will issue, extend the permit validity, modify or annul validity of the permit or forfeit the permit in the following case:
    (a) The important projects of exploitation and usage of water as approved by Prime Minister;
    (b) Project of survey and exploit the underground water with 3,000 m^3/day flow rate;
    (c) Survey and exploit the surface water for cultivation with 2 m^2/second or higher flow rate;
    (d) Survey and exploit the surface water for power generation with 2,000kW or above;
    (e) Survey and exploit the surface water for other purposes with 50,000 m^3/day flow rate or higher;
    (f) Discharge to the water source with the flow rate of 5,000 m^3/day or much more.

2) Province People’s committee will issue, extend the permit validity, modify or annual validity of the permit or forfeit the permit in other cases not mentioned above.

4.3 MECHANICAL EQUIPMENT

4.3.1 Selection of Type of Power Plant

Feasibility Study Report made by PECC2 (hereinafter called as the F/S report) studied the optimum type of power plant for O MON 3. The following three types of power plant were compared.

- Open cycle gas turbine power plant
- Gas turbine combined power plant
- Conventional boiler – steam turbine power plant

The comparison was done in many aspects such as initial investment costs, installation areas, operation and maintenance costs, availability of fuels, and environmental impacts.

In the conclusion, the gas turbine combined cycle power plant using natural gas as main fuel was selected as the most preferable power plant for O MON 3 from the reasons of most economical, minimum environmental impact, etc.

Furthermore, its shorter installation period than the conventional power plant was evaluated for resolving critical circumstances of shortage of electricity supply in Vietnam.

For selecting the gas turbine power plant, the availability and low price of natural gas for a long time is the most important point. If this requirement is secured, the selection of gas turbine combined plant is the most reasonable conclusion without any discussion.

4.3.2 Plant Configuration and Generation Capacity

(1) Plant Configuration

In gas turbine combined plants, there are two type configurations; i.e.

- Single shaft arrangement, in which the gas turbine, steam turbine and associated generator are connected in line through one shaft
- Multi-shaft arrangement, in which the gas turbine and the steam turbine are arranged separately, i.e. each turbine has each own generator.

The F/S report compared these two type arrangements in the aspects of investment cost, power generation efficiency, flexibilities of operation, etc.

Generally, these both types are popular and have a lot of experiences, and no significant difference in the cost, efficiency and technical point of view. If point out the difference between two types, that is a difference of commencement time of commercial operation of gas turbine.

The completion times of gas turbine pant and gas turbine combined plant are usually 18 months and 32 months respectively, because the bottoming plant (HRSG and steam turbine) require a longer completion time than gas turbine. In case of multi-shaft gas turbine plant, the gas turbine and bottoming plant can be constructed separately, and then the gas turbine can be commenced in to commercial operation in simple cycle operation prior to the completion of bottoming plant. That means that the owner can get electricity supply earlier by 2-stage construction of gas turbine and bottoming plant.

However, for enabling the simple cycle operation of gas turbine, a bypass stack is required to be installed between gas turbine and HRSG; that result in some additional cost.

The F/S report says;

"Should it is built up in one phase, single-shaft configuration will be selected to improve the economy of the project, Should it is the case of two phases, multi-shaft configuration will be proposed for selection, single-shaft configuration or multi-shaft configuration to be consider in Bidding evaluation stage."

And no apparent conclusion is not provided. However, the layout and other technical and financial studies were carried out on the basis of multi-shaft configuration.

In case that a multi-shaft configuration is applied, as explained the next section, the plant will consist of two gas turbines, two HRSG and one steam turbine; i.e. 2-2-1 configuration.

(2) Plant Generation Capacity

According to the Master Plan VII, the capacity of O MON 3 power plant was planned to be 750 MW.

The F/S report selected F type gas turbines as the most preferable gas turbine for O MON 3 power plant. The capacity range of F type gas turbines are around 250 – 300 MW. Then, the required generation capacity will be attained by installing two gas turbines in 2-2-1 configuration.

In the world gas turbine market, there are four gas turbine manufacturers can supply F type gas turbines; i.e. Alstom, GE Energy, Mitsubishi Heavy Industries (MHI) and Siemens. Although some manufacturers among these above have developed new gas turbine models called as "G" or "H" type gas turbines, of which capacities and efficiencies are much higher than those of F type gas turbines, the F/S report selected F type gas turbines because of its longer term experiences in commercial operation (higher reliability) and engineer's and operator's technical levels in Vietnam. At present this selection would be really reasonable.

The generation capacity of the gas turbine combined cycle plant is solely determined by the selected gas turbine model. In the F/S report, the net generation capacity of the combined cycle plant using F type gas turbines manufactured by the above four manufacturers are assumed to be ranged from 740 to 770 MW.

While the gas turbine technologies have been progressed continuously, therefore, even if the model is the same, its capacity and also its efficiency has been already up rated from the time the F/S report was issued.

Then, the JICA Study Team confirmed EVN the criteria of selection of gas turbines and the required power generation range. Their intension was confirmed as follows;

- F type gas turbine
- EOH (Equivalent Operation Hours) more than 8,000 hrs
- Power generation is larger than 750 MW, and no upper limitation

Then, JICA Study Team assumes the range of power generation on the basis of the latest information of gas turbine performance as follows.

Table 4.3-1 shows the latest ISO base performance of F type gas turbine derived from 2011 edition of GTW Handbook. And Table 4.3-2 shows the expected power generation, efficiency and natural gas demand of combined cycle plant designed at site conditions of O MON power complex.

(The performance shown in Table 4.3-2 are not presented by the manufacturers but expected one only)

Table 4.3-1 Performance of Gas Turbines (Natural Gas Fired, ISO Condition)

Candidate Gas Turbine Model		Alstom GT26	GE 9FB	Mitsubishi M701F4	Siemens SGT5-4000F
Year admitted	Year	1994	2003	1992	1995
Power Generation	kW	296,400	298,174	324,300	289,000
Heat Rate (LHV)	kJ/kWh	9,091	9,342	9,027	9,128
Efficiency (LHV)	%	39.6	38.5	39.9	39.4

Table 4.3-2 Expected Performance of Combined Cycle Plant (Natural gas fired, Site Conditions $^{(*)}$)

Candidate Gas Turbine Model		Alstom GT26	GE 9FB	Mitsubishi M701F4	Siemens SGT5-4000F
Plant Configuration		2-2-1	2-2-1	2-2-1	2-2-1
Gas Turbine (2 units)	MW	528.5	536.7	577.3	521.1
Steam Turbine (1 unit)	MW	290.6	318.1	300.3	268.6
Auxiliary Power	MW	16.4	17.1	17.6	15.8
Net Power Output	MW	802.7	837.7	860.0	773.9
Net Heat Rate (LHV)	kJ/kWh	6,249	6,278	6,242	6,435
Net Efficiency (LHV)	%	57.6	57.3	57.7	55.9

$^{(*)}$ Site Conditions:	Ambient temperature	30 °C
	Relative humidity	80 %
	Atmospheric pressure	1,013 mbar
	Cooling water temperature	30 °C

From the above, the expected net power output of O MON 3 power plant will be ranged from 770 to 860 MW. And yearly natural gas demand based on plant capacity factor of 68.5 % (100 % load x 6,000 hrs) will be around 0.97 ~ 1.04 Billion Nm^3/year as standard fuel of 870 BTU/SCF.

The study about the relation between the above assumed gas demand and supply quantity by GSA (Gas Sales Agreement) is referred in Section 4.1.

4.3.3 Specification of Main Equipment

(1) Gas Turbine

The required specifications described in the F/S report are as follows:

- F type gas turbines made by four major suppliers (Alstom, GE Energy, MHI and Siemens) with over 8,000 EOH in commercial operation
- Dual fuel type; natural gas as main fuel and diesel oil as back-up fuel
- Indoor installation
- Equipped with DLN (Dry Low NOx) combustor
- Bypass damper and stack is provided for enabling simple cycle operation of gas turbine

The above requirements are ordinary and not special ones.

In addition an applicability of inlet air cooling system was studied for an augmentation measure for power output at high temperature atmospheres. However, this technology is rather new and requires a big amount of demineralized water. In addition its operation experience in F type gas turbine is not so many. Then the F/S report advised that the application of this cooling system should be investigated more and be reconsidered in bidding stage.
This air cooling system have been usually installed in the existing plant and supplied by a company specializing in manufacturing this kind cooling system other than gas turbine suppliers. Therefore, when this cooling system is inquired in Bidding, it is doubtful whether the EPC contractor can guarantee the performance of the whole plant including such inlet air cooling system. Therefore, to inquire to install such system including in the plant proposed, existing of the precedent of performance guarantee involving the air cooling system should be reviewed again.

The bypass stack to be capable of simple cycle operation of gas turbine will be installed at the outlet of gas turbine. The F/S report decided that the height of the bypass stack is 30 m and this height is enough for keeping flue gas dispersion under the atmospheric pollutant limitations. However, as seen the layout drawing, this height is almost the same or little bit higher than the neighboring gas turbine building and HRSG. That arrangement may have a possibility to occur a down- wash-effect of flue gas at relatively low exhaust velocity in lower load operation. To avoid this problem, it is recommended that the height of bypass stack will be at least 40 m as the same as the main stack.

(2) Steam Cycle and Heat Recovery Steam Generator (HRSG)

1) Steam Cycle

For steam cycle of the combined cycle plant the F/S report selected 3-pressure/reheat cycle because of its high efficiency.

Generally, when a fuel price is high, a steam cycle with higher efficiency, such as 3-pressure reheat, has a benefit in economical evaluation, on the contrary, when a fuel price is relatively low, a simple steam cycle, such as dual-pressure or non-reheat cycle is superior for the sake of its lower investment cost. However, the price of natural gas has been continuing to go up and furthermore escalation in future is presumed. Considering such economical circumstances in the world, the selection of the steam cycle with higher efficiency like a 3-steam pressure/reheat can be considered reasonable and preferable in spite of its complexity in system and higher initial investment cost.

The F/S report requires installing 100 % capacity turbine bypass system for each pressure level of steam. These systems are effective for start and stop operation and as pressure relieving device.

2) HRSG

In the F/S report, the following several types of HRSG were studied and evaluated:

- With or without supplementary firing system
- Horizontal or vertical flue gas flow
- Natural circulation or forced circulation of boiler water

[Supplementary firing]

Supplementary firing can compensate a reduction of steam flow during low load operation of gas turbine in hot season. However, the F/S report concluded that the supplementary firing system is not necessary from the reasons that the efficiency of the whole plant is reduced by supplemental firing and this power plant is not required a function of covering peak-load.

The supplementary firing is very effective for the following plants:

- Cogeneration plant, in which a constant flow of process/heating steam is required to supply regardless of gas turbine load
- The plant with large difference of power output between hot and cold seasons

However, both of the above situations are not applied to O MON power plant. Thus the supplementary firing system is considered unnecessary.

[Horizontal or vertical flue gas flow]

Each type HRSG has a strong point and a weak point respectively, but there is no critical deficiency on both types. And many horizontal gas flow and vertical gas flow type HRSGs have been installed and successfully operated. So, the F/S report accepts both types of HRSG. This conclusion is fair and reasonable on condition that the bidder has a lot of experiences of the proposed type of HRSG.

[Natural circulation or forced circulation of boiler water]

In the F/S report, “horizontal gas flow HRSG with natural circulation” and “vertical gas flow HRSG with forced circulation” were compared. However, many “vertical gas flow HRSG with natural circulation” have been used worldwide. Therefore, “vertical gas flow HRSG with natural circulation” should also be accepted on condition that the supplier has a plenty and long period experience of the same type HRSG in the past.

(3) Steam Turbine

Regarding the turbine proper only “three-pressure/reheat type and double casing” are specified and any other special requirement and comparison was described.

As for the condensate system, feedwater system, vacuum system, etc. no special requirements other than standard constructions was provided. The condensate pumps and boiler feedwater pumps are specified as 3 × 50% capacity. However, 2 × 100% capacity design is also acceptable.

4.3.4 Plant Auxiliary Equipment

(1) Fuel Gas Supply System

Fuel gas will be supplied from Gas Distribution Center of PVN, which is located near O MON power complex, through an individual pipeline to each power plant of O MON 1 to 4.

From the gas flow meter for trading, which is provided by PVN, fuel gas is transferred to the gas turbines through an emergency stop valve, gas cleaning equipment and pressure regulator. This system is usual and has no special requirement.

(2) Fuel Oil Supply System

Fuel oil (diesel oil) is a back-up fuel when fuel gas supply is interrupted.

The fuel oil will be unloaded from a ship by the existing oil unloading system and transferred to each power plant with branching from the common oil pipeline.

Each power plant has an individual oil storage system. O MON 3 power plant has two (2) of 10,600 m^3 capacity storage tank, of which capacity corresponds to a demand of oil for 7 days at full load operation of the plant.

The fuel oil is supplied to the gas turbines passing through oil filters, transfer pumps and pressure accumulator. This system is usual and has no special requirement.

(3) Feed Water Supply System

Regarding with fresh water supply source for construction stage, the F/S report suggested Hau River, but for normal operation after construction, suggested a possibility of Tra Noc Water Plant in addition to Hau River.

Then the JICA Study Team asked CTTP a possibility of water supply from Tra Noc Water Plant. CTTP confirmed “The water supply from Tra Noc Water Plant may be one option for construction stage, but for normal operation, Hau River is a possible single supply source”.

Considering a big amount of water flow of Hau River, there would be no limitation in quantity of water usage. Therefore, the opinion of CTTP is considered reasonable.

Specified pre-treatment plant (coagulation, sedimentation equipment and filter) is acceptable. However, the demineralized water plant is planned to be a combination of RO (Reverse Osmosis) filter and mixed bed polisher. For water treatment to treat fresh water in power plant a water treatment system in combination of 2-bed/3-tower ion exchanger and mixed bed polisher is much regular. And the existing O MON 1 also applies this type system. Therefore, it is required to explain clearly the reason why RO filter is selected.

(4) Circulating Cooling Water System

Fresh water pumped from Hau River is used for circulating cooling water.

Water intake and discharge culvert are common for O MON 3 and 4 power plant. This equipment will be constructed in construction of preceding project among O MON 3 and 4. (at the present schedule it would be constructed by O MON 4)
Two (2) 50 % capacity circulating water pumps are planned to be installed, and no stand-by

pump is provided. Since this pump is of very large capacity and expensive, and even when one pump is stopped accidentally the power plant can continue to operate by the remaining pump at lower load. Therefore, this selection seems to be reasonable from economical consideration.

There is no description about a tube cleaning device of the turbine steam condenser in the F/S report. It is recommended that a ball type tube cleaning device will be installed.

(5) Closed Cooling Water System

The F/S report describes that the required cooling water for gas turbine system, steam turbine system and other ancillary equipment (except for steam turbine condenser) is supplied from this closed cooling water system. However, in case that the plant is constructed in two-stage, i.e. gas turbine simple cycle system and bottoming system, the cooling water for the gas turbines is necessary to be supplied other independent cooling water system.

This system is already included in Equipment Cost Estimation, however, the location of this equipment should be considered in the plant layout.

(6) West Water Treatment System

Pre-treatment of waste water (water/oil separation, primary neutralization, sewage treatment, etc.) will be done by each power plant (O MON 1 to 4), however, it is not clear whether the final treatment (aeration, final neutralization, sedimentation, etc) is done by individual treatment system or by the common system, because the F/S report describes "<u>the collected waste water is pumped to the waste water treatment area and treated on the common waste water treatment system</u>".

It is usual that the final treatment is carried out by a system common for several power plants, however, for this case, reviewing the capacity of the existing final water treatment plant is necessary. On the other hand, there is some information that according to the regulation of Vietnam it is not permitted to discharge own waste water to the other areas or plants; information from CTTP. So the detail coverage of this regulation should also be reviewed.

(7) Compressed Air Supply System

According to the plan described in the F/S report, 2 units of 100 % capacity compressors will supply total required air for both of instrumentation air and plant service air. However, this arrangement is not preferable for supplying the air to instruments at steady pressure condition. Because a demand of the service air is intermittent and large amount use, that may cause a pressure fluctuation of the air supply system. Therefore the compressed air supply system should be divided into the instrument air and plant service air supply systems. And both systems should have 2 units of 100 % capacity compressors. In addition, for making a reliability of instrumentation air system higher, provision of interconnecting line from service air to instrumentation air system is recommended; passing through this line back-up air will be supplied from the service air to instrumentation air in emergency.

(8) Fire Prevention and Protection System

In the F/S report, the fire water supply system and fire-truck will be common for O MON 3 and 4. However, the engineer of CTTP has an intension that each plant of O MON 3 and 4 has an individual water supply system and fire-truck for higher reliability.
This issue should be discussed and confirmed again before Bidding.

(9) Ventilation and Air Conditioning System

There is no comment.

(10) H_2 Gas Generation System

There is no comment.

(11) Auxiliary Steam System

There is no description about auxiliary steam system, however, it is recommended that the auxiliary boiler, which supplies the steam necessary for start-up operation of the plant, is provided as common equipment for O MON 3 and 4.

(12) Cranes and Hoists

Although the F/S report does not provide any detail description about cranes and hoists, one unit of overhead crane for turbine hall is included in Equipment Cost Estimation.

In case of multi-shaft configuration, gas turbine building and steam turbine building are built separately and each building requires one unit of overhead crane. Therefore, one unit of overhead crane for the steam turbine should be added.

4.4 ELECTRICAL EQUIPMENT

4.4.1 Specification of Electrical Equipment

(1) Generator

F/S report specifies the generator as follow;

- Type of the generator : Synchronous generator
- Capacity : 300~320MVA
- Power factor : 0.85(Lag) ~0.9(lead)
- Insulation level : F class (allows B class temperature rise)
- Cooling : Air cooled or Hydrogen cooled
- Type of exciter : Static exciter

1) Generator capacity

As discussed in mechanical section of this report, the generator capacity tends to be larger than the above, due to the latest progress of gas turbine technology.

The generator has no technical restriction to cover the latest gas turbine capacities, even if, the lager capacity than 300~320 MVA is applied.

2) Cooling of the generator

F/S report accepts to apply the manufacturer's standard design cooling system whether air cooling or hydrogen cooling.

However, in general, generators of 200~250 MVA class or over is believed that it is economical to apply hydrogen cooling system, even if it has to be provided with hydrogen generator, hydrogen gas storage system, CO_2 gas equipment to replace hydrogen gas when maintenance, etc. because of its high cooling efficiency.

3) Type of exciter

F/S report studies only static exciter, however, brushless exciter is applied in many projects, because of its price, easy maintenance due to no brush is required.
Static exciter has advantage in quick response to sudden load change and in smaller installation space due to shorter rotor size of generator.
Static exciter has no brush, so that easiness of maintenance is the same as brushless exciter.
EVN report considers quick response is advantageous.
Many other projects generally apply synchronous generator, same range of power factor, F class insulation level.
EVN's selection of generator specification is reasonable.

(2) Transformers

F/S report considers that three (3) transformers, two main transformers for gas turbine generators and one (1) main transformer for steam turbine generator, are considered. This means that there is no start-up transformer.

Main transformer is to step-up generator output voltage up to 500kV to export generated power output to the national power grid.

During the start-up of the unit, the main transformers introduce power from the national grid to feed 6.6kV switchgears via auxiliary transformer for the house loads.

When the gas turbine is ready to start, the generator circuit breaker is closed to feed the generator to start-up as a motor to drive the compressor of the gas turbine and purge the combustor and ignition follow.

Three generator transformers of two(2) gas turbine generators and one(1) steam turbine generator export the generated power to the national grid after stepped-up the generated voltage up to 500kV.

This is commonly applied system in latest combined cycle power plant.

F/S report specifies the specifications of transformers as follow;

- Type ; Three phases, two windings, oil immersed, outdoor
- Vector group ; YNd11
- Rated voltage ; generator output voltage(manufacturer’s standard)/500kV
- Lightning impulse withstand voltage ; 1,800kV
- Switching impulse withstand voltage ; 1,175kV
- With on-load tap changer
- Cooling ; ONAN/ONAF or ONAN/ONAF/DAF
- Noise level ; Less than 70 dB

The above mentioned type, vector group and rated voltage are normally used in power plants. On-load tap changer is also normally applied in generator transformers.

Lightning impulse withstand voltage, switching impulse withstand voltage and power frequency withstand voltage are in accordance with IEC 76.

F/S report says that the manufacturer can offer his standard system, but ONAF/ONAF (70%/100%) or ONAN/ONAF/ODAF (40%/70%/100).

It is understandable that EVN will accept the manufacturer’s standard design of cooling system. However, in case of failure of cooling fans or cooling pumps, the generator output would be restricted to 70% or 40%.

It is recommendable to apply ONAN/ONAF than ONAN/ONAF/ODAF, because, in the worst case, the generator output will be limited to 40% in case of ONAN/ONAF/ODAF versus 70% in case of ONAN/ONAF.

Regarding the noise level of 70dB, discussion with the manufacturer during the contract negotiation shall be considered.

(3) Emergency power supply system

The emergency power supply system is composed of emergency diesel generator, battery chargers, batteries, inverters, emergency AC distribution board and Dc distribution board.
O Mon 3 combined cycle power plant is supposed to operate only when the national power grid is active, so that the black start is not required.

That means the capacity of the emergency diesel generator is not required of the capacity to start any one (1) gas turbine when all AC power failed, but to have enough capacity to shut down the unit safely.

F/S report specifies the emergency diesel generator as;

- Diesel engine
  - Fuel ; Distillate oil
  - Cooling system ; Radiator

- Generator
  - Type ; Synchronous, rotating magnetic field, cylinder rotor, solidly coupled with engine shaft
  - Rated voltage ; 0.4kV
  - Capacity ; 1,000kVA
  - Power factor ; 0.85
  - Insulation level ; class F (Class B insulation design temperature rise)
  - Cooling system ; Air
  - Excitation system ; Static excitation

The rated current of the generator with the capacity of 1,000kVA and voltage of 0.4kV is approximately 1,500A.

The rated current of 1,500A may be irrational for the emergency diesel generator of this size from the view point of design.

Only one (1) set of emergency generator for O Mon 3 (GTx2+STx1) may need 1,000kVA capacity of emergency loads. Each of the emergency loads has not so large capacities that can be fed from 0.4kV power supply system.

To cope with this technical problem, there will be two options;

1) Three(3) diesel generator for each GT & ST generator shall be planned instead of one(1) in order to reduce the rated current of individual generator

2) The generator output voltage shall be 6.6kV. In this case, additional 6.6kV switchgear and auxiliary transformer shall be designed.

JICA Study Team would recommend three diesel generators with 0.4kV output, each one (1) for each generator.
Cost impact owing to above modification is trivial.

As for the excitation system, brushless excitation system is recommendable, instead of static excitation. Because the emergency generator will be operated when all power are failed. During these time, there is no stable power supply to support the static exciter.

DC power supply system

DC power supply system is composed of two (2) systems, one is AC power is converted to DC power by battery chargers, the other is directly supplied from batteries.

Normally, battery charger output is fed to DC loads and battery output back-up the battery charger when it failed.

DC power is used for DC motors, control systems, emergency lightings, protection relays, instrumentations, alarms, communication systems, fire alarm system, uninterruptible power supply system (UPS), etc.

DC power supply systems are individually designed for gas turbine system, steam turbine system and power plant complex.

DC power supply system are divided into DC220v for DC power drive and DC24V(or 48V) for electronics use such as control system, computer system and communication systems.

F/S report plans that 24V (or 48V) shall be divided from DC220 busbar by DC/DC converters.

JICA Study Team would recommend to install independent DC24V (or 48V) battery system and DC220V battery system from the view point of noise and voltage fluctuations.

1) The auxiliary power system

The auxiliary power supply systems are devices to provide electric power to equipment/plants.
F/S report divides the system into 6.6kV switchgears, 0.4kV switchgears and 220V switchgears.

6.6kV switchgears are to provide electric power to other plants, lower voltage switchgears and motors larger or equal to 200kW.

0.4kV switchgears are to provide electric power to motors smaller than 200kW or other auxiliary equipment or plants.

220V switchgears are to provide electric power to small motors, lighting system, instruments/control systems and small auxiliaries or devices.

(4) Switchgear Equipment

F/S report plans to install 6.6kV, 0.4kV and 220V systems for all gas turbine systems and steam turbine system.

However, there is no large auxiliary equipment in gas turbine plant which needs to be fed from 6.6kV power supply. Therefore, 6.6kV switchgears for gas turbine plants can be deleted.

6.6kV switchgear is required only for steam turbine plant.

Cost impact due to deletion of 6.6kV switchgears from gas turbine plant is small.

(5) Power Supply System during Start-up

Unit start-up is processed with generator circuit breaker open.

500kV power will be introduced from switchyard to generator transformer to auxiliary transformer. 0.4kV power for house load is prepared.

Preparation of start-up of gas turbine are processed by this 0.4kV power source.

After all the preparation of all start-up processes are ready, generator circuit breaker for gas turbine generator is closed to drive the generator as a motor.

Directly connected compressor to generator shaft start sending combustion air to the combustor of the gas turbine.

If the field circuit of the generator is excited through static exciter, the generator will generate electric power to export energy through 500kV switchyard to national grid.

F/S report specifies that the type of generator circuit breaker is of SF_6 circuit breaker. Although SF_6 gas has strong green house effect, this type of circuit breaker has the most reliable and high performance in present technology.

(6) Protection system (relay, interlock)

Normally, combined cycle power plant is so interlocked that something abnormal happened in steam turbine plant, high temperature exhaust gas of gas turbine is relieved to atmosphere through the bypass stack and gas turbine keeps its simple cycle operation.

If the exhaust gas cannot be relieved, the unit has to be tripped.

The former part of F/S report shows negative stand on the necessity of this interlock, however, the latter part describes that it is indispensable.

Without the interlock, even sound gas turbine cannot be operated if steam turbine failed. With the interlock, gas turbine can be kept operation as simple cycle even though the output and efficiency will a little bit be lowered.
For O Mon 3 project, the bypass stack must be installed.

The interlock system described in the F/S report will generally be reasonable.
EVN should discuss the detail interlocks with the manufacturer during the contract negotiation

(7) Lighting and small power system

Lighting and small power system are composed of normal and emergency lighting systems and small power supply system.
Normal lighting system includes indoor and outdoor lighting system for security, internal fences, perimeter fences, internal roads, corridors, stairs, etc.

Emergency lighting system which illuminates essential equipment and area are used when AC lighting power failed, by switching the power to the battery supply system.

Small power supply system include normal socket and industry socket which is provided for maintenance such as drills, welders, etc.

F/S report requests that the following lighting fittings shall be provided;

- Fluorescent lamps for indoor lighting
- Mercury high pressure luminaries
- Mercury high pressure luminaries
- 250W high pressure sodium floodlight for switchyard and heat recovery steam generator(HRSG)

From the point of energy saving point of view, fluorescent lamp, mercury high pressure luminaries and 250W high pressure sodium floodlight shall be substituted for LED lamps and halogen gas lamps.

LED lamp need a little bit longer time for start-up, but has no problem for use.

Halogen gas lamps has more natural and softer color tone than mercury high pressure lamps and high pressure sodium lamps.

They have higher illumination and smaller energy consumption.

(8) Cables and cabling works (Power, control and instrumentation

Cables are material to connect between equipment to supply electric energy to equipment. They are;

From main transformer to 500kV switchyard
From generator terminals to main transformer or auxiliary transformer
From auxiliary transformer to 6.6kV switchgears
From 6.6kV switchgear to HV motors or 0.4kV switchgears
From 0.4kV switchgear to each loads
Control and Instrumentation
Communication
Special cables

F/S report does not mention about cables and/or cabling works except isolated phase bus duct (IPB) which connect between generator terminals and transformers.

The main transformer will be connected to 500kV switchyard with overhead Aluminum Conductor Steel Reinforced (ACSR).

The generator terminals will be connected to the main and auxiliary transformers with isolated phase bus duct (IPB).

IPB are composed of aluminum bus, joints, insulators, aluminum duct, etc.

They are insulated safe for human beings.

Cross linked polyethylene (XLPE) insulated cables shall be laid on trays in a concrete trench from auxiliary transformer to 6.6kV switchgears.

XLPE insulated cables shall be flame retardant, rodent proof in accordance with IEC 332 and IEC 502.

Cable sizes shall be determined in such a manner that the normal conductor temperature shall not exceed 90°C, short time short circuit conductor temperature shall not exceed 230°C and voltage drop shall be within 5% of the nominal voltage.

The conductor temperature is designed not to deteriorate insulation performance of the material.

From 6.6kV switchgears to large motors and 0.4kV switchgears and from 0.4kV switchgears to each load, cables shall also be laid on cable tray in concrete trench underground or on cable tray above ground.

Control and instrumentation cables shall be laid apart from power cables in order to avert electric noise.

Cables shall be of flame retardant and rodent proof in accordance with IEC 332 and IEC 502.

Instrumentation cables shall be of pair twisted, copper or steel tape shielded.

4.4.2 Control System

F/S report proposes that DCS (Distributed Control System) shall be applied for the control system of O Mon 3 power plant which is widely used as modern control system in power plant. This proposal is reasonable.
EVN's design philosophy as mentioned below is proper.

In the combined cycle power plant, the energy is mainly generated by the gas turbine sets combined with heat recovery steam generator (HRSG) and a condensing turbine plant.
The electrical grid demand shall be controlled by the gas turbines which play the leading roles.
O Mon 3 combined cycle power plant is designed to combine two (2) gas turbines and one (1) steam turbine. In this case, if one (1) gas turbine is failed, the steam turbine output will be decreased to meet the heat of the other gas turbine's exhaust gas.
If the steam turbine is failed, the exhaust gas of the gas turbines will be interlocked to be switched off to the bypass stack and transferred to simple cycle operation.

The gas turbine/HRSG sets of O Mon 3 shall be designed for electrical dispatch load operation as normal operation regimes. O Mon 3 will participate in the frequency support of the grid and therefore both gas turbines shall be equipped with selectable frequency support and shall operate with a Block Dispatch Load Controller.

HRSG is the connecting link between gas turbine and steam turbine and the steam turbine always follows the load of the connected gas turbine sets.
Auxiliaries like the HP, IP and LP bypass station of HRSG shall control the HP, IP and LP outlet steam pressure during start up, shut down and steam turbine disturbances or stand still.
During normal operation, the HP, IP and LP bypass stations are closed and their function shall be to insure that the low steam pressure is not rising over the sliding maximum value. The LP bypass station will automatically start to control the LP steam pressure after the limit value is reached.
Plant Master Control functions shall be implemented to reduce the operator workload. This function shall be connected to Plant Master Coordinator.
The Plant Master Coordinator shall coordinate and interlock the operation modes of all block of main units. The Plant Master Coordinator shall also coordinate and sequences the unit control levels during start up and shut down of block main units and associated process areas.

(1) Control mode of the gas turbine sets

1) Speed control mode

Speed control mode is automatically selected during start up, shut down, generator synchronization and island operation.

2) Block dispatch load control mode

The electrical load delivery shall be determined by the operating gas turbine sets in accordance with a target given to the operators by the dispatching center.

This control mode shall include grid frequency support, which starts acting immediately upon frequency deviations after selection.

Each gas turbine control shall be designed so that load rejections from full load to house load are possible.

3) Unit load control mode

For special cases, the unit load control mode of gas turbine can be selectable by the operator. In this mode, the gas turbine governor shall use its internal load set point, which is normally tracked upon the external set point from the dispatch load control. The electrical load output of the gas turbine is then determined upon the internal load target set by the operator. Bumpless switching between the load modes shall be ensured by tracking the load ratio setting at dispatch load controls. This control mode shall also include grid frequency support.

4) Island load control mode

The island load control mode shall be automatically selected for the gas turbines in case both respective 500kV circuit breakers are tripped and the respective generator circuit breaker remains closed.

(2) Control Mode of the Steam Turbine Set

1) Admission pressure control mode

In the admission pressure control mode, the steam turbine follows the gas turbine/HRSG sets by controlling the steam pressure at the common HP steam bus bar. The steam flow and the generator load dependent of the firing rates of the gas turbine units in accordance with the plant load target set by the operator. The turbine control system shall be capable of sliding pressure operation, where the steam pressure upstream of the turbine is not kept constant but varies proportionally with loads. The sliding pressure reduces the throttling losses in the turbine. On the other hand, steam pressure changes shall be done slowly in a way that does not disturb the HP drum level control of the HRSG.

2) Unit load control mode

The unit load control mode will mainly be used in the start and shut down procedures. During these procedures the steam turbine cannot follow the gas turbine/HRSG sets and therefore this mode will be used after synchronization until HP bypass system are closed or it is used to reduce the turbine load before shut down. While the load control mode is selected admission pressure controller functions as limit controller for HP minimum pressure.

3) Speed control mode

The speed control mode is used during start and warm up until synchronization.

EVN’s design concept of control is that all modulating and sequence control shall be capable of manual operation. The manual control mode shall inhibit automatic action, but protection shall always be active and override both manual and automatic controls.

Switching to manual or automatic control modes must be bumpless for the control process.

EVN’s design concept is proper and many power plants apply the same concept, however, it must be prudentially considered how far the protection override the manual operation. During the contract negotiation, this must be discussed with the manufacturer.

For example, in the case that one (1) of two (2) auxiliaries would be failed, the load must immediately be reduced to some level to which the remaining auxiliaries can support. In this process, which has the priority, operator or the protection system.

Once in the past, a civil aviation pilot maneuvered to avoid accident, but some protection signal contradicted against his maneuvering ending up with disastrous result.

Concept of control in the central control room
It is proper, as 7.25.8 Control rooms and equipment of F/S report mentions, that the power block of O Mon 3 shall be controlled from the central control room. As for the control of 500kV switchyard, it should be managed from the existing control board installed in the control room of 500kV switchyard after the software of control system is modified to meet addition of O Mon 3 equipment.

7.25.10 Central electrical control room (CECR) of F/S report proposes that CECR will be expanded from the 500kV switchyard control room or new construction next to this control building or next to the central control room in the control building of the power plant.

This concept of control of 500kV switchyard seems to contradict the existing control system of 500kV switchyard.

This idea seems that the control of 110/220/500kV switchyard and the communication between O Mon power complex and A0/A2 shall be done in the Central electrical control room (CECR).

This description contradicts the following concept;

7.21.2 500kV switchyard control system of F/S report says that the switchyard control system will be extended from the existing switchyard control system. All new provision shall be designed in accordance with the existing control system.

Chapter 5 of 7.25.12 Configuration of the plant control system of F/S report mentions that the switchyard will be controlled at the central control room.

This concept also contradicts the above description of 7.21.2.

Existing control configuration is that 110/220kV switchyard are controlled in the control room separately located near the switchyard.

500kV switchyard is controlled in the independent control room located in the 500 kV switchyard area. (Refer to attached Photo 4.4-1 Control board of 500kV switchyard)

The 500kV switchyard control system must be extended from the existing switchyard control system as mentioned in 7.21.2 500kV switchyard control system of F/S report.

The switchyard must be controlled from one (1) control room monitoring one (1) display by one (1) operator.

It is very dangerous to operate one (1) switchyard from two separate control rooms such as central control room (CCR) and central electrical control room (CECR).

Control of 500kV switchyard from central control room (CCR) of O Mon 3 is not recommendable.

Photo 4.4-1 Overview of control board of 500kV switchyard shows general view of existing control board of 500kV switchyard.

Photo 4.4-2 Display of 500kV switchyard control board shows diagram of present 500kV switchyard.

The left hand of the display is for the space for O Mon 3 extension.

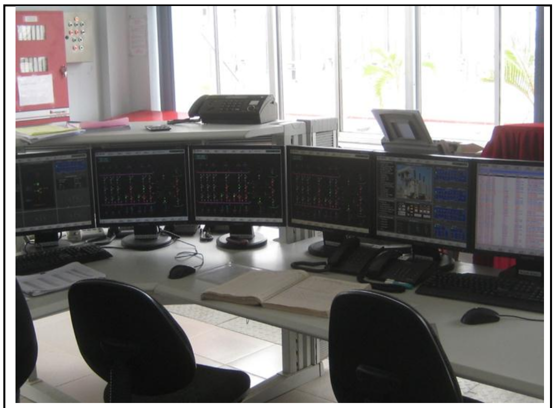


Photo 4.4-1 Control Board in 500 kV Switchyard

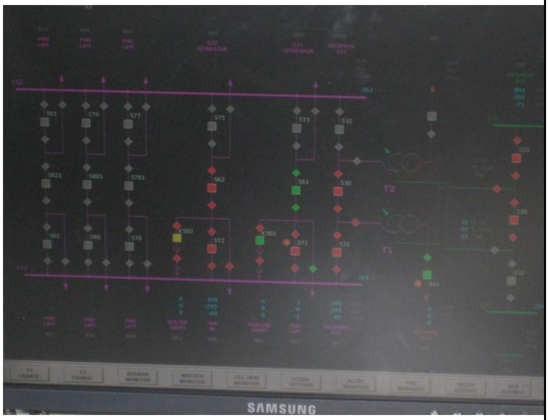


Photo 4.4-2 Display of Control Board

4.4.3 Switchyard

O Mon power complex is planned with four power plants, O Mon 1, O Mon 2, O Mon 3 and O Mon 4, and there are 500kV switchyard, 220kV switchyard and 110kV switchyard as their common equipment. The generated power of the power plants is transferred to the power transmission system via the switch yards. The position of switchyards in O Mon power complex is shown in Fig. 4.4-1.

Currently, O Mon 1 power plant is connected to 220kV switchyard and it is connected to 500kV switchyard and 110kV switchyard through 500/220kV transformer and 220/110kV transformer and the generated power of the O Mon 1 power plant is transferred to the power transmission system via each switchyard. The single line diagrams showing the present connection state of each switchyard is shown in Fig. 4.4-2 and Fig.4.4-3. In addition, connection to 220kV switchyard for O Mon 1B power plant and O Mon 2 power plant and connection to 500kV switchyard for O Mon 3 power plant and O Mon 4 power plant is planned respectively. The planned single line diagrams are shown in Fig. 4.4-4 and Fig.4.4.5.

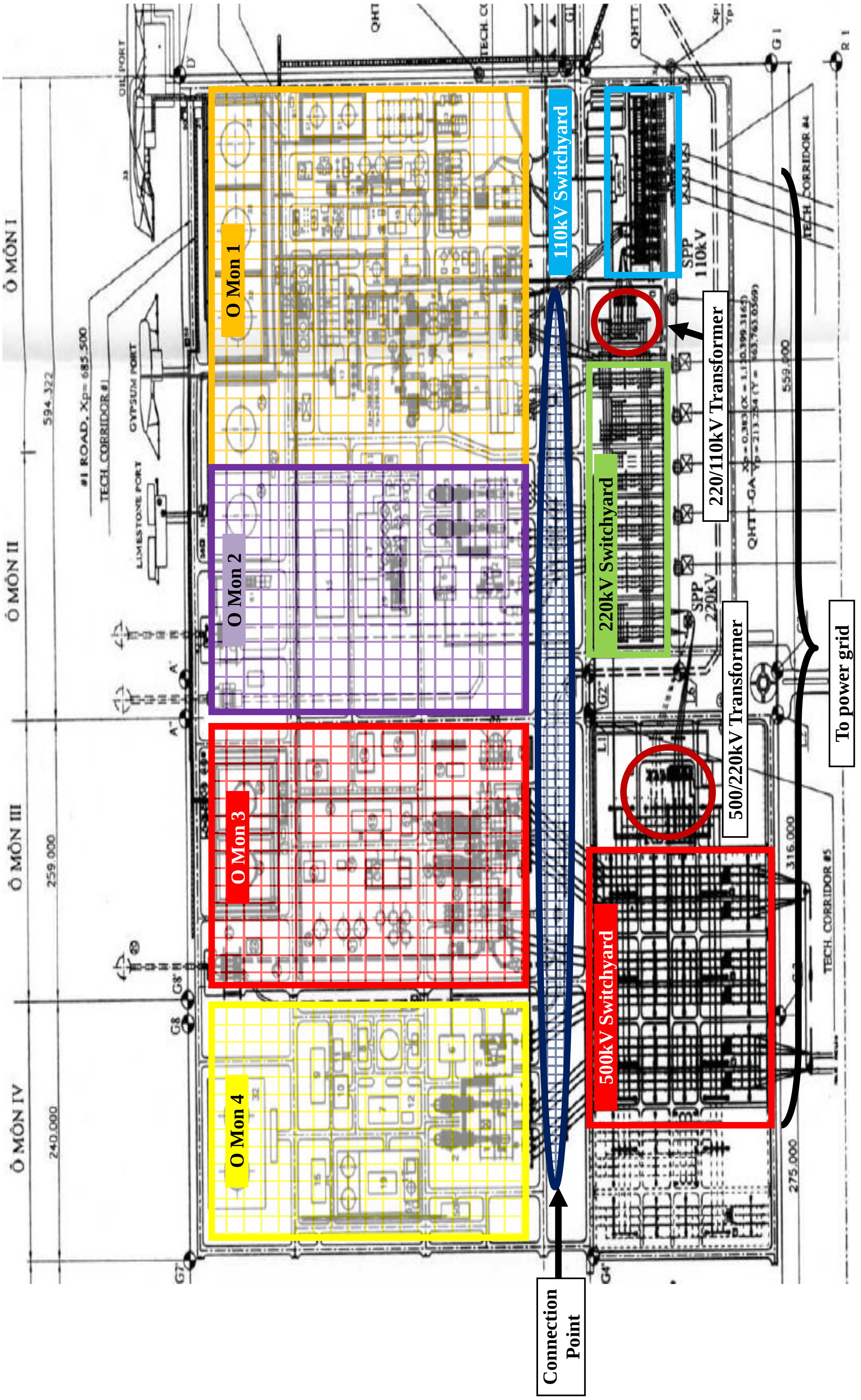


Fig. 4.4-1 Switchyards in O Mon Power Complex

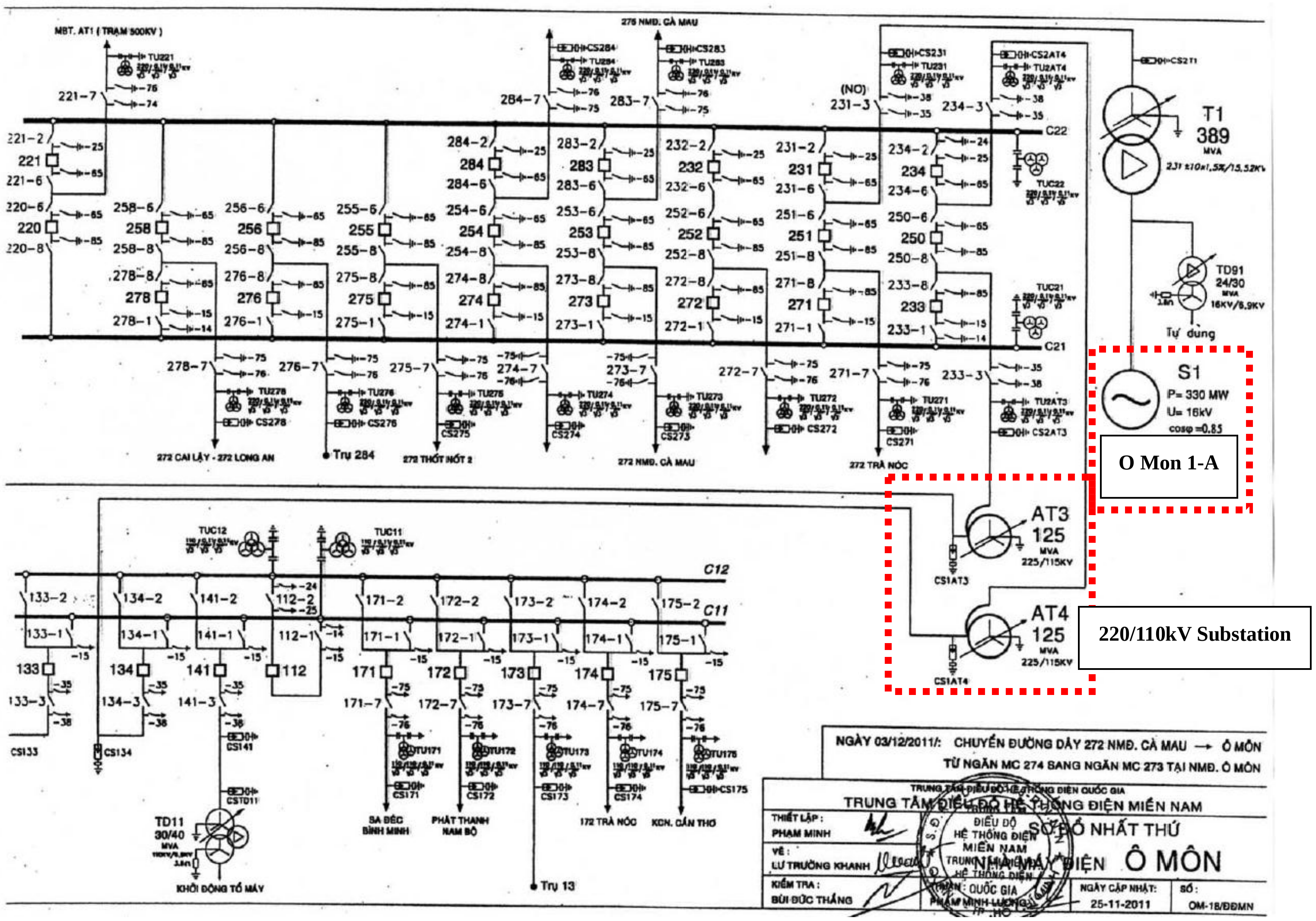


Fig. 4.4-2 Single Line Diagram for 220kVSwitchyard and110kV Switchyard

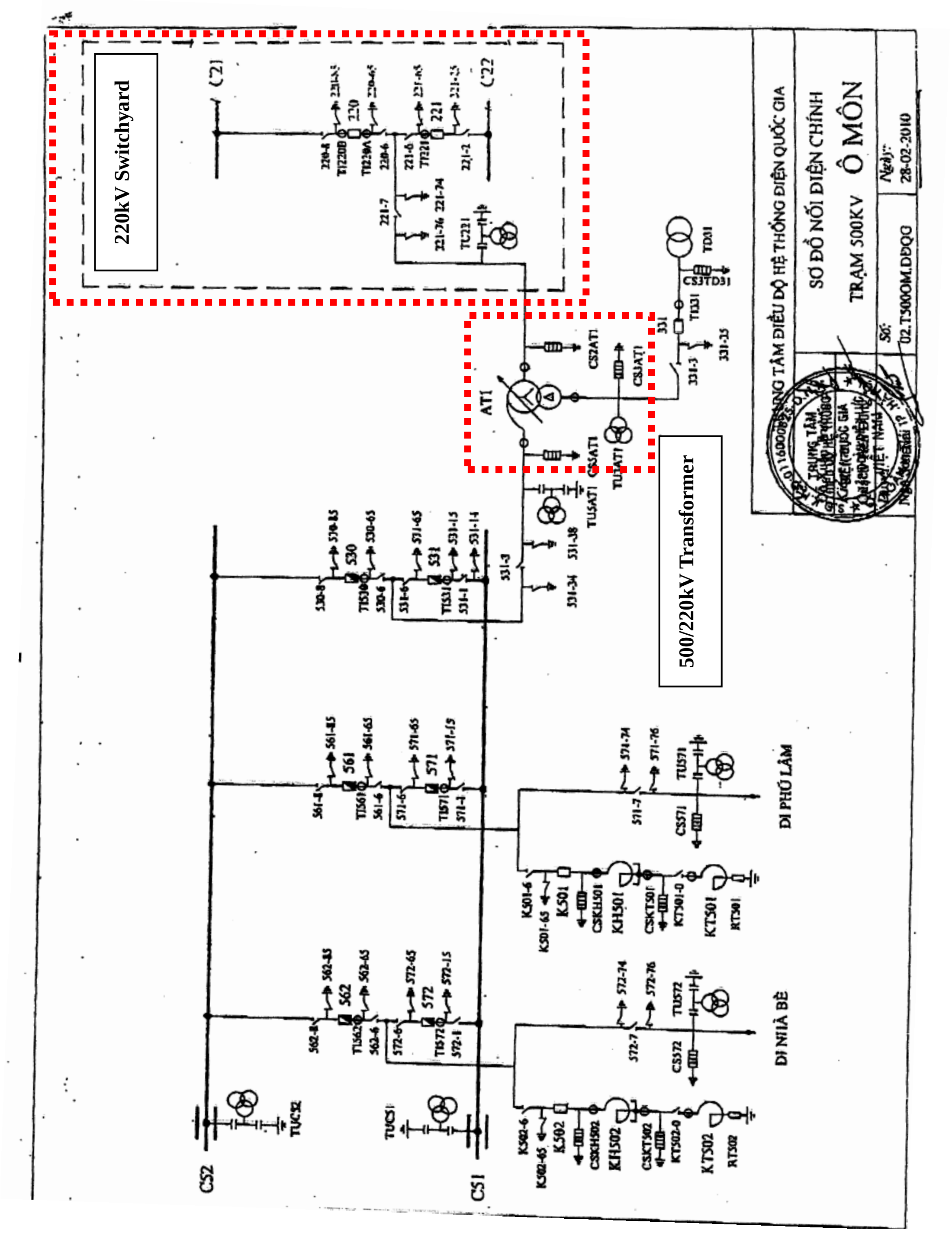


Fig. 4.4-3 Single Line Diagram for 220kV Switchyard and 500kV Switchyard

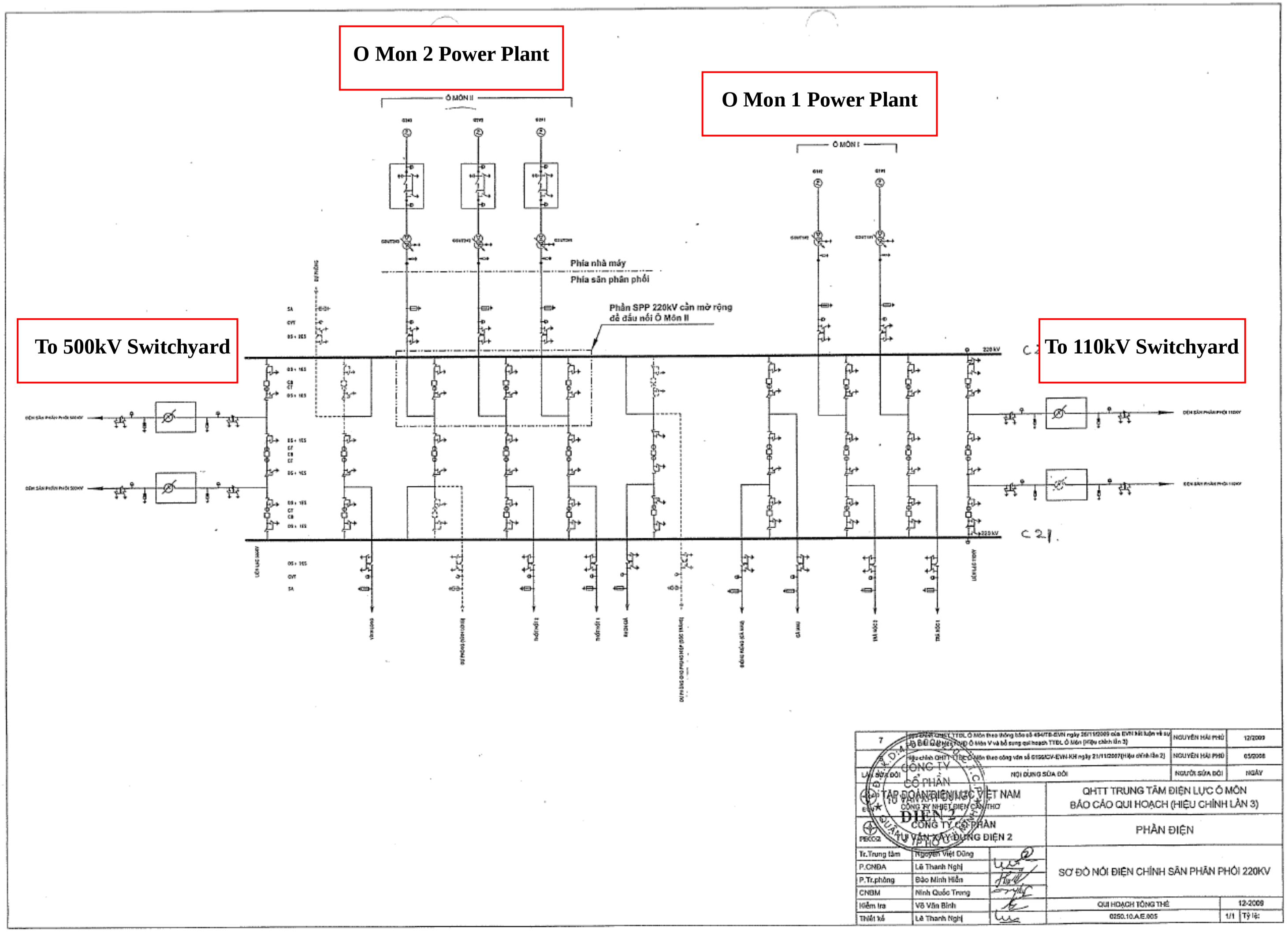


Fig. 4.4-4 Single Line Diagram for 220kV Switchyard (Future Plan)

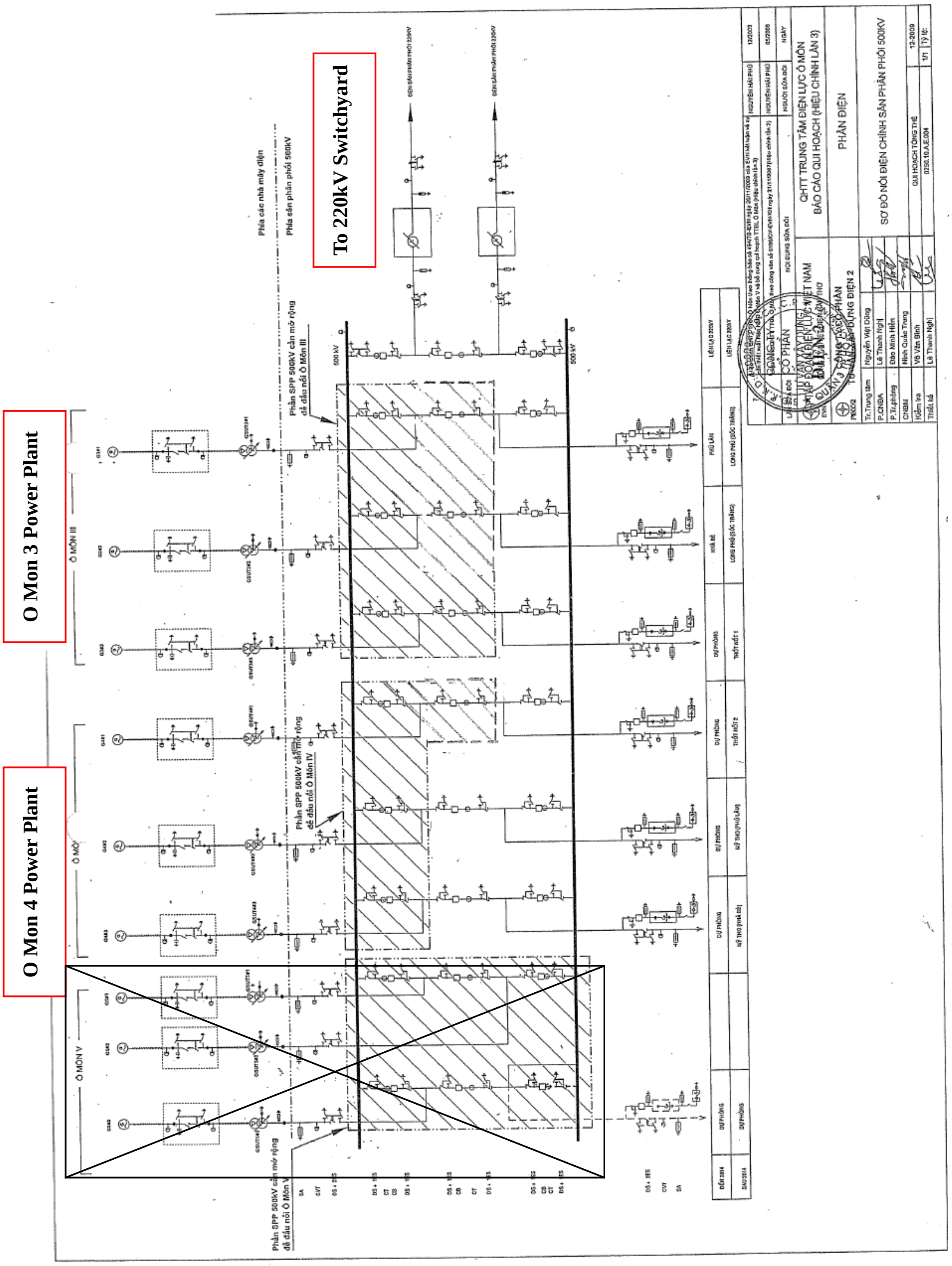


Fig. 4.4-5 Single Line Diagram for 500kV Switchyard (Future Plan)

4.4.4 Communication System

To operate and exchange data between power plant and outside system, parts of power plant each other and between power plant and National load dispatch center (A0) and Southern Regional load dispatch center (A2), it is necessary to have a communication and data transmission system which is effective and suitable with the latest technology servicing for information technology at present as well as oriented technology in the future. For this purpose, SCADA system is widely used.

Operation data by using gateways to connect to computerized control systems (DCS) of power plant and switchyard shall be transmitted to load dispatch centers (A0 & A2) through optical fiber stranded grounding wire (OPGW) of transmission lines. This transmission process is dealt with SCADA system installed in the Electrical control room in 500kV switchyard

F/S report suggests the following options for the transmission media;

- Copper wire: Twin cable, coaxial cable, etc.
- PLC (Power Line Carrier)
- Optical fiber stranded grounding wire of transmission line (OPGW)
- VHF/UHF/Viba

At present, OPGW is in operation, so that there is no other option available.

F/S report suggests that VHF/UHF has many disadvantage of capacity, distance and influence of the environment, weather, etc. so that this solution shall not be applied to data transferring.

F/S report also suggests that PLC solution shall be applied to some special power transmission line for telecommunication and other important power transmission line for teleprotection because of reliability and transfer time of the protection signal.

It is EVN’s correct evaluation that the solution of optical fiber associates with power transmission line (OPGW) shall be applied firstly because of its advantage in the ring system and development of technology and the reduction of cost. The best solution for transferring data is OPGW.

The scope of O Mon 3 project is just to connect the operation data by non-metallic cable to the existing junction box of OPGW and ODF (IDF) in the equipment room. There will be no need to install new additional communication line.

Photo 4.4-3 SCADA system installed in the Electrical Control Room in 500kV switchyard shows SCADA system in operation at present.

Photo 4.4-3
SCADA System installed in the Electrical Control Room in 500kV Switchyard

4.5 ASSOCIATED TRANSMISSION LINE AND SUBSTATIONS

4.5.1 Existing Transmission Line and Substations in Southern Region

In Vietnam, national power transmission lines have three voltage level: 500kV, 220kV and 110kV. The schematic view of the existing 500kV transmission system in 2011 is shown in Fig. 4.5-1. In the figure, the position of each substation is ballpark position and the geographical construction situation of transmission lines is disregarded. And the existing transmission system around O Mon power complex in 2010 is shown in Fig. 4.5-2.

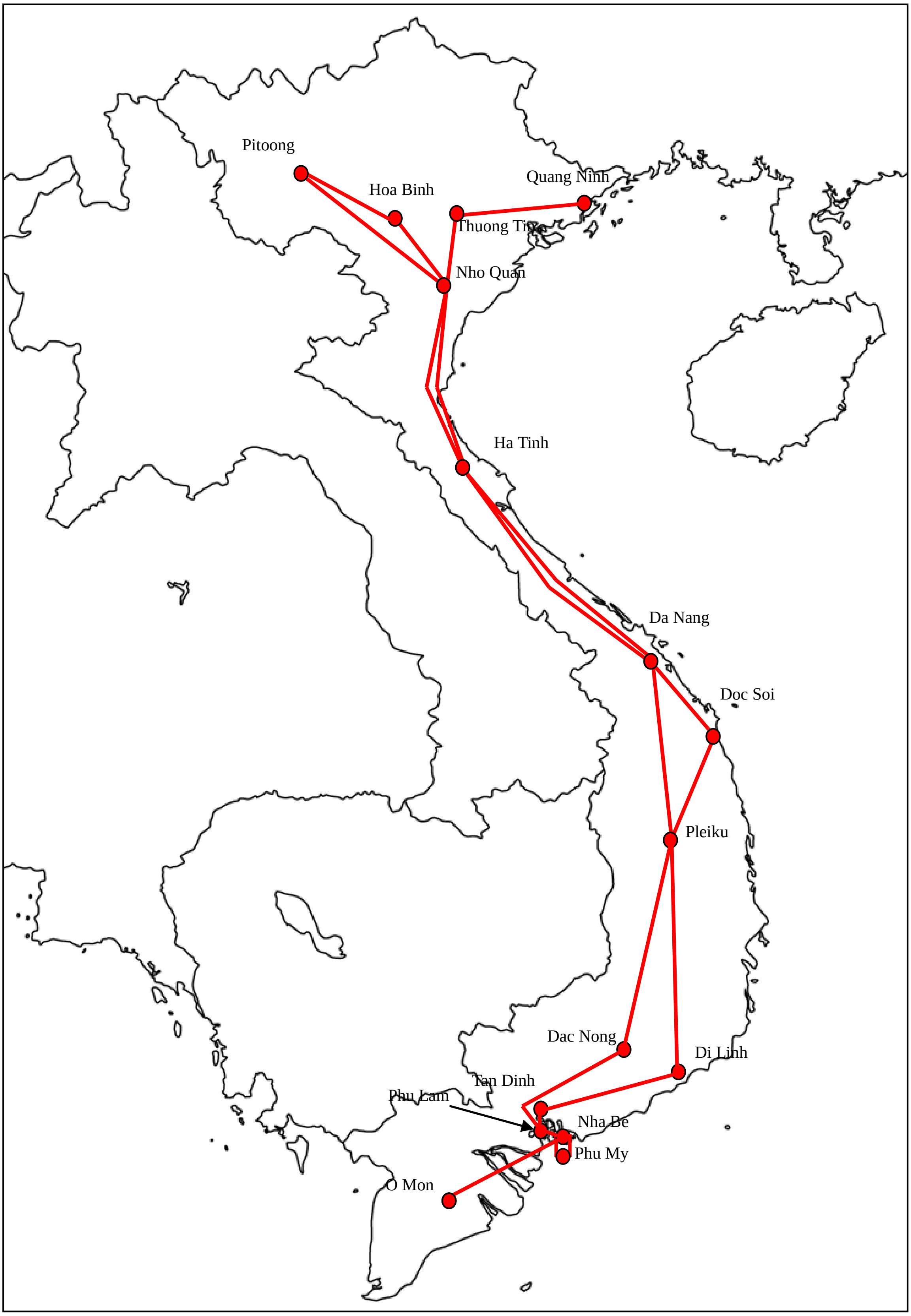


Fig. 4.5-1 Schematic View of the Existing 500kV Transmission System in 2011

Source : The Study team created from various data

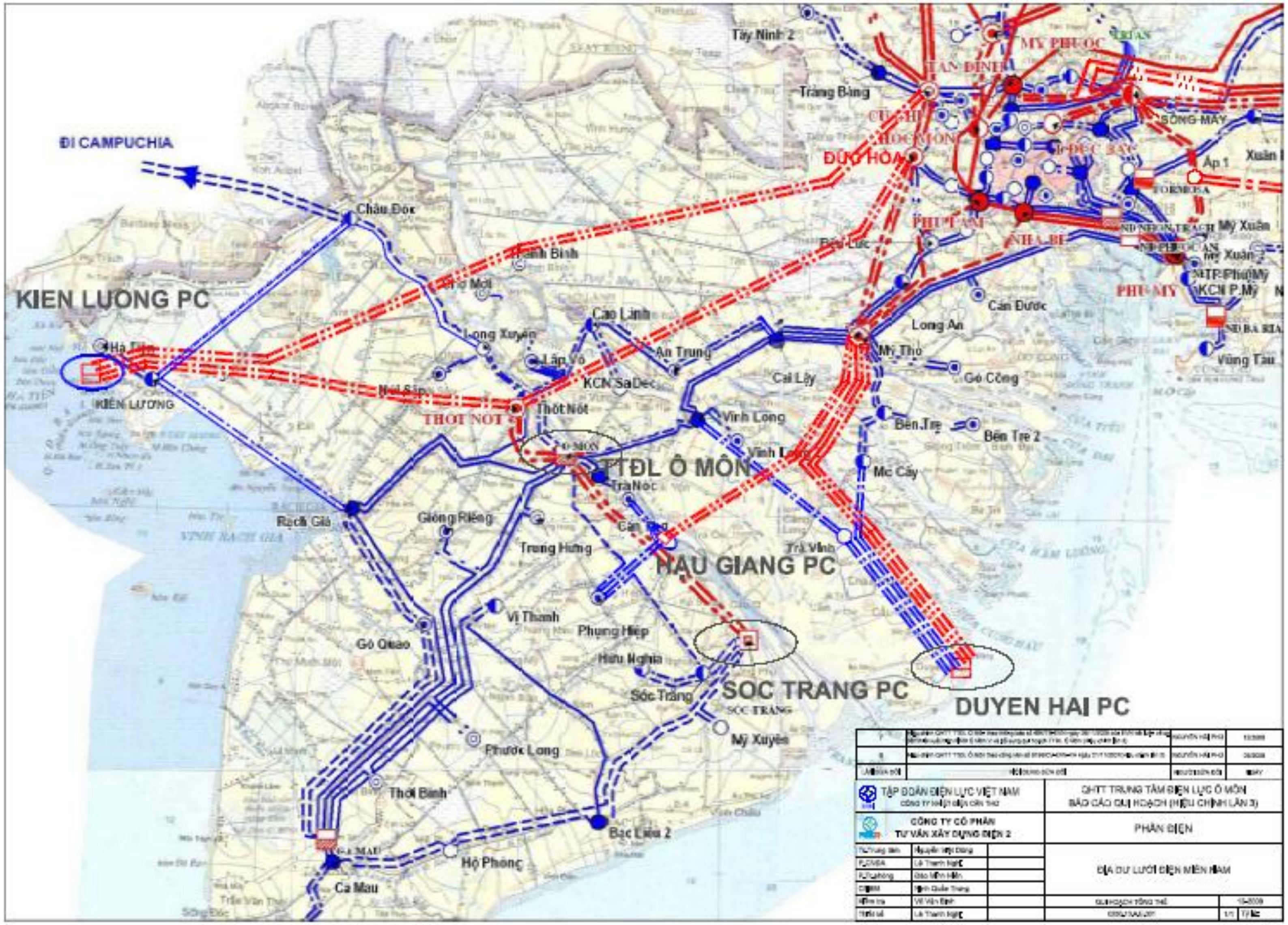


Fig. 4.5-2 Existing Transmission System around O Mon power complex in 2010

Source: CTTP

4.5.2 Associated Transmission Line and Substations to be connected to O Mon 3

As described in 4.4.3, O Mon power complex is planned with four power plants, O Mon 1, O Mon 2, O Mon 3 and O Mon4, and there are 500kV switchyard, 220kV switchyard and 110kV switchyard as their common equipments. The generated power of the power plants is transferred to the power transmission system via the switch yards. Each switchyard is interconnected by 500/220kV transformer and 220/110kV transformer. Therefore, for O Mon 3 power plant, an original plan of interconnection to the national transmission system does not exit but the plan turns into one as the whole O Mon power complex.

In addition, for O Mon power complex, even switchyards are its management boundaries. Then the transmission lines and substations which is to be connected to and the routing of transmission lines, construction schedule of transmission lines and substations will be determined on the plan(national electric power master plan) of EVN. The substations which O MON power complex is and will be connected to in this time as a result of the interview fro CTTP and PECC2 are shown in Table 4.5-1 (The scheduled completion year in the table is based on the PDP7).

Table 4.5-1 Connected Substation of O Mon Power Complex (at Present and the Plan)

Voltage	cct	Connected Substation	
		present	plan
500	2	NHA BE S/S (2 × 600MVA)	MY THO S/S (1 × 900MVA) [2015]
		CAI LAY S/S (2 × 125MVA) This connection is operating as 220kV.	
	2	-	THOT NOT S/S (1 × 600MVA) [2015]
	2	-	LONG PHU S/S (1 × 450MVA) [2015]
220	2	TOT NOT S/S (2 × 125MVA)	Same as on the present
	1	CAI LAY S/S (2 × 125MVA)	Same as on the present
	2	TRA NOC S/S (125 + 100MVA) Only 1 cct is operating.	Same as on the present
	2	CA MAU 1 P/S (3 × 250MW)	Same as on the present
	2	-	SOC TRANG S/S (1 × 125MVA) [2015]
	1	-	RACH GIA S/S (250 + 125MVA)
110	2	BINH MINH S/S (25WVA) KCN SONG HAU S/S (40MVA)	BINH MINH S/S (25WVA) KCN SONG HAU S/S (40MVA) SA DEC S/S (2 × 25MVA)
		KCN CAN THO S/S (25MVA + 63MVA)	Same as on the present
	2	TRA NOC S/S (125 + 100MVA)	Same as on the present
		PT NAM BO S/S (2 × 16MVA)	Same as on the present
	1	LONG XUYEN (2 × 40MVA)	Same as on the present

*The figure in [ ] is the scheduled completion year described in the PDP7.

4.5.3 Power Flow Analysis and Power System Stability Analysis (to be replaced)

(1) The year and System for Analysis

In the F/S report, power flow analyses and N-1 analyses were carried out in the peak demand of the dry season in 2015 base on PDP6 and the output of O Mon complex was 2,910MW. On the other hand, according to each plant construction schedule of O Mon power complex shown in Table 4.5-2, O Mon 3 power plant will be operated in 2016, and the installed capacity of the whole O Mon power complex will become 2,910 MW at he time. Therefore, in this Study, power flow analysis and system stability analysis are carried out in the state in 2016 where all the power plant of O Mon power complex operates.

500kV and 220kV system south of Pleiku, which is the 500kV substation in the central area, will be the area for the analysis in this Study.

Table 4.5-2 Power Plant Construction Schedule of O Mon Power Complex

Plant No.	Type	Installed Capacity	Operation Year
1	Conventional	660MW	2009(1A), 2014(1B)
2	Combined Cycle	750MW	2017
3	Combined Cycle	750MW	2016
4	Combined Cycle	750MW	2015

(2) The acquisition Data

For power flow analysis and system stability analysis, the data which came to hand is shown in from Table 4.5-3 to Table 4.5-9.

Table 4.5-3 Acquisition Data for Power Flow Analysis and System Stability Analysis

No.	Obtained data	Place to obtain	Remark
1	The existing 500kV power transmission grid (the end of 2007)	JICA (Feasibility Report)	See Table 4.5-4 and Table 4.5-5
2	The construction plan of 500kV power transmission grid in the South in the stage 2007 -2010 based on the Master Plan VI	JICA (Feasibility Report)	See Table 4.5-6 and Table 4.5-7
3	The construction or rehabilitation plan of 220kV power transmission grid in the South in the stage 2007 -2010 based on the Master Plan VI	JICA (Feasibility Report)	See Table 4.5-8 and Table 4.5-9
4	One line diagram of the entire power system of Vietnam (2011)	CTTP and PECC2	See Fig. 4.5-3
5	Power flow diagram of the Southern system (2015)	PECC2 (a part of Vietnamese Feasibility Report, PL-TLSC-DN-2015-01)	See Fig. 4.5-4
6	The Construction plan of Power Sources in the stage 2011 -2016	PECC2 (Vietnamese Master Plan VII)	See Appendix 4.5-1
7	The construction plan of 500kV power transmission grid in the Central and Southern Vietnam in the stage 2011 -2015	PECC2 (Vietnamese Master Plan VII)	See Appendix 4.5-2 and Appendix 4.5-3
8	The construction plan of 220kV power transmission grid in the Central and Southern Vietnam in the stage 2011 -2015	PECC2 (Vietnamese Master Plan VII)	See Appendix 4.5-4 and Appendix 4.5-5
9	Power system operation standard (criteria)	PECC2 (Vietnamese Transmission System Regulation : MOIT Circular No.12-2010)	See Table 4.5-9

Table 4.5-4 List of 500kV Transmission Lines in the end of 2007

No.	Name of transmission line	No. of circuits × km
Northern Part		
1	Hoa Binh - Ha Tinh	1 × 341
2	Nho Quan - Ha Tinh	1 × 297
3	Nho Quan - Thuong Tin	1 × 76
4	Transitory connection to 500kV Nho Quen substation	2 × 32
Central Part		
1	Ha Tinh - Da Nang (line 1)	1 × 390
2	Ha Tinh - Da Nang (line 2)	1 × 392
3	Da Nang - Pleiku	1 × 259
4	Da Nang – Doc Soi – Pleiku	1 × 297
5	Yaly - Pleiku	2 × 23
Southern Part		
1	Pleiku - Phu Lam (line 1)	1 × 496
2	Pleiku - Phu Lam (line 2)	1 × 542
3	Phu My - Nha Be	2 × 43
4	Nha Be - Phu Lam	1 × 16
5	Nha Be - O Mon	1 × 77.4

Table 4.5-5 List of Substations in the end of 2007

No.	Name of substation	Number of transformer × MVA	Rating-MVA
Northern Part			**2,250**
1	Hoa Binh	2 × 450	900
2	Nho Quan	1 × 450	450
3	Thuong Tin	1 × 450	450
4	Ha Tinh	1 × 450	450
Central Part			**1,800**
1	Pleiku	1 × 450	900
2	Di Linh	1 × 450	450
3	Da Nang	2 × 450	900
Southern Part			**3,000**
1	Phu Lam	2 × 450	900
2	Phu My	1 × 450	450
3	Tan Dinh	1 × 450	450
4	Nha Be	2 × 600	1,200

Table 4.5-6 500kV Transmission Lines Constructed from 2007 to 2010

No.	Name of transmission line	No. of circuits × km
1	Nha Be - O Mon	1 × 152
2	Ohu Lam - O Mon	1 × 148.7
3	Branch to Dong Nai 3&4	2 × 2
4	Phu My - Song May	2 × 63
5	Song May - Tan Dinh	2 × 40
6	Than Vinh Tan - Song May	2 × 260
7	Branch to Cau Bong	2 × 0.5

Table 4.5-7 500kV Substations Constructed from 2007 to 2010

No.	Name of substation	Number of transformer x MVA	Rating-MVA
1	Phu My	1 × 450	450
2	Tan Dinh	1 × 450	450
3	Di Linh	1 × 450	450
4	Nhon Trach	1 × 450	450
5	Song May	1 × 600	600
6	Cau Bong	1 × 600	600
7	O Mon	2 × 450	900
8	Dak Nong	2 × 450	900

Table 4.5-8 Construction or Rehabilitation Plan of 220kV Substation in the South (2007-2010)

No.	Name of transmission line	No. of circuits × km
1	Ba Ria - Vung Tau	2 × 14
2	Da Lat - Da Nhim	1 × 28
3	Dai Ninh - Di Linh	2 × 39
4	TD Dong Nai 3 - Dak Nong	2 × 25
5	TD Dong Nai 4 - Dak Nong	2 × 15
6	TD Dak Tih - Dak Nong	1 × 10
7	Di Linh - Tan Rai	2 × 10
8	Tan Dinh - My Phuoc	2 × 50
9	My Phuoc - Binh Long	2 × 38
10	Branch Xuan Loc	4 × 5
11	Branch Hiep Binh - Phuoc	4 × 2
12	Branch Nam SG	2 × 1
13	Branch Binh Tan	2 × 1
14	Branch Thaun An	2 × 1
15	Branch Long An	2 × 1
16	Branch Song May – Tri An – Long Binh	4 × 5
17	Branch Song May – Bao Loc – Long Binh	4 × 10
18	Branch Song May - Long Binh	2 × 15
19	Phu My - My Xuan	2 × 3
20	Ba Ria - Vung Tau	2 × 18
21	Branch Phu My 2 industrial zone	2 × 4
22	Phu My - Ba Ria	2 × 25
23	Ham Thuan - Phan Thiet	2 × 50
24	Song May - Uyen Hung	2 × 20
25	Uyen Hung - Tan Dinh	2 × 20
26	Branch Cu Chi vao – Tan Dinh – Trang Bang	4 × 1
27	Cau Bong 500kV - Hoc Mon	2 × 10
28	Cau Bong 500kV - Binh Tan	2 × 10
29	ND Nhon Trach - Cat Lai	2 × 20
30	ND Nhon Trach - Nha Be	2 × 10
31	Tam Phuoc - ND Nhon Trach – Song May	2 × 36
32	Nha Be - Phu Lam	2 × 15
33	Phu Lam - Hoc Mon	2 × 19
34	Cat Lai - Thu Duc	2 × 9
35	ND O Mon - Soc Trang	1 × 73
36	ND Ca Mau - Rach Gia	2 × 110
37	ND Ca Mau - Bac Lieu	2 × 76
38	ND O Mon - Thot Not	2 × 22
39	Kien Luong - Chau Doc	1 × 72
40	Soc Trang - Bac Lieu	2 × 50
41	Branch - Cao Lanh	2 × 3
42	Thot Not - Chau Doc	2 × 70
43	My Tho - Ben Tre	2 × 21
44	ND O Mon - Vinh Long	2 × 40
45	Vinh Long - Tra Vinh	2 × 70
46	ND O Mon - Tra Noc	2 × 10

Table 4.5-9 Construction or Rehabilitation Plan of 220kV Substations in the South (2007-2010)

No.	Name of substation	Number of transformer × MVA	Rating-MVA
1	Soc Trang	1 × 125	125
2	My Phuoc	2 × 250	500
3	My Tho	1 × 125	125
4	My Xuan	1 × 250	250
5	Song May	1 × 125	125
6	Vung Tau	2 × 250	500
7	The south Sai Gon	2 × 250	500
8	Xuan Loc	1 × 250	250
9	Bac Lieu	1 × 125	125
10	Nhon Trach Power Plant	1 × 250	250
11	O Mon	2 × 125	250
12	Tan Dinh	1 × 250	250
13	Ben Tre	2 × 125	250
14	Tan Rai	2 × 125	250
15	Binh Long	2 × 125	250
16	Binh Tan	2 × 250	500
17	Tao Dan	1 × 250	250
18	Hiep Binh Phuoc	2 × 250	500
19	Phan Thiet	1 × 125	125
20	Dai Ninh	1 × 63	63
21	Cao Lanh	2 × 125	250
22	Cat Lai	1 × 250	250
23	Chau Doc	2 × 125	250
24	Phu My 2 industrial zone	1 × 250	250
25	Cu Chi	2 × 250	500
26	Kien Luong	1 × 125	125
27	Thot Not	1 × 125	125
28	Da Lat	1 × 125	125
29	Thaun An	1 × 250	250
30	Tra Vinh	2 × 125	250
31	Long An	2 × 125	250
32	Trang Bang	1 × 250	250
33	Long THanh	1 × 250	250
34	Uyen Hung	1 × 250	250

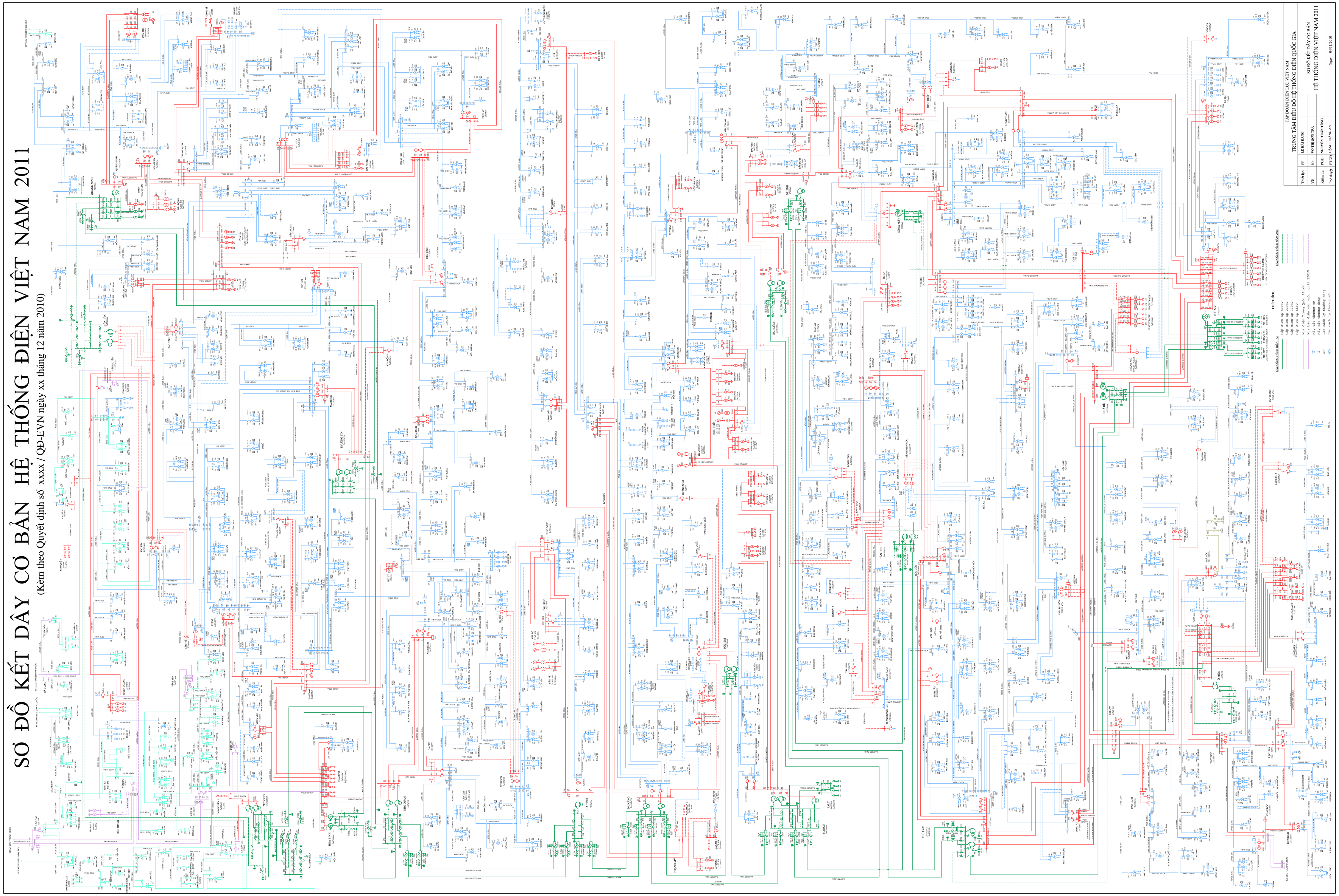


Fig. 4.5-3 National Power Grid Duagram of Vietam (2011)

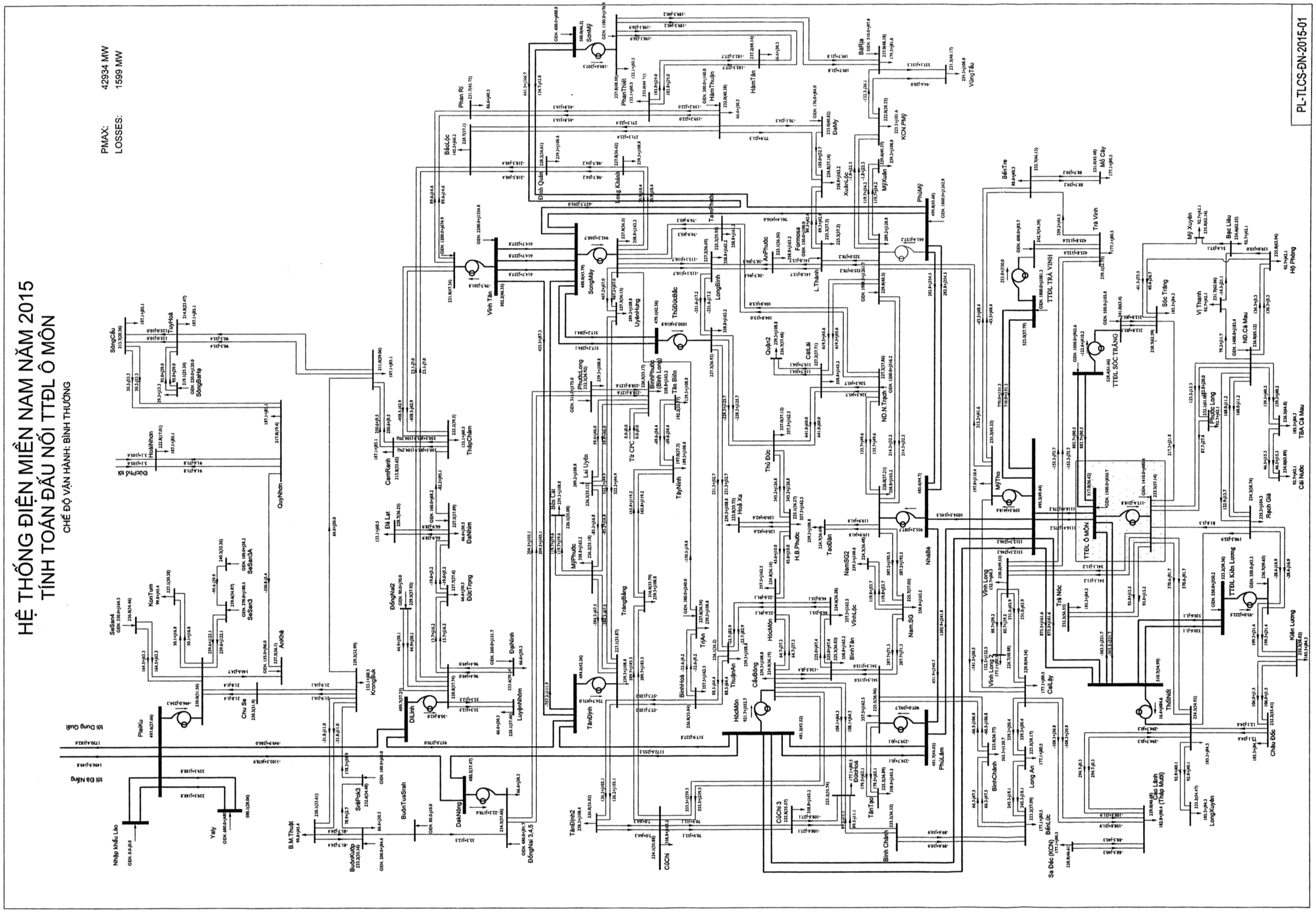


Fig. 4.5-4 Power Flow Diagram in the Southern Region (2015)

(3) Model of O Mon Power Complex

O Mon power complex will consist of four power plants, as shown in Table 4.5-2, O Mon 1 power plant and O Mon 2 power plant will be connected to 220kV bus, and O Mon 3 power plant and O Mon 4 power plant will be connected to 500kV bus, respectively.

The model of O Mon power complex for power flow analysis and system stability analysis is shown in Fig. 4.5-5.

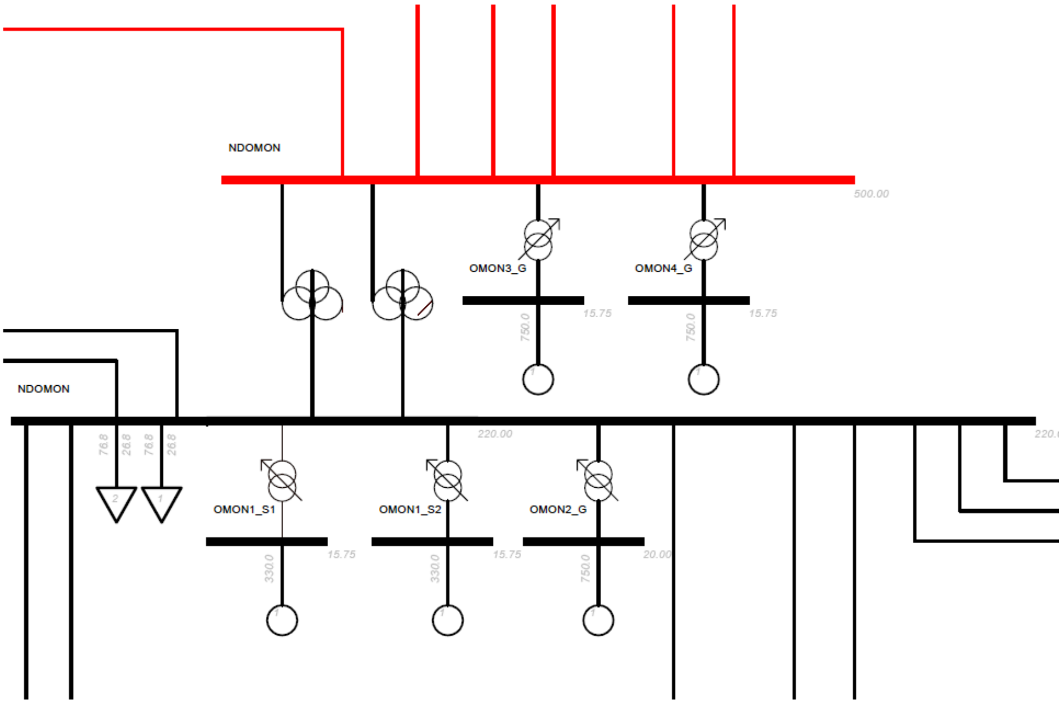


Fig. 4.5-5 Model of O Mon Power Complex

(4) Operation Criteria of Power System

As the operation criteria of power system, frequency and voltage standard are specified in Transmission System Regulation. The detailed values of criteria are shown in Table 4.5-10.

Table 4.5-10 Operation Criteria for Frequency and Voltage

		Normal operation	Emergency condition
Frequency[Hz]		49.8 - 50.2	49.5 – 50.5
Voltage	500kV	475 - 525	450 - 550
	220kV	209 - 242	198 - 242
	110kV	104 - 121	99 - 121

(5) Power Flow Analysis

Base on the acquisition data shown in Table 4.5-3 and the interview result of PECC2, power flow analysis was carried out for 2016 when O Mon 3 power station would operate. PSS/E Version32 made of Siemens Power Technologies International was used for power flow analysis.

1) Assumptions

When making the data for power flow analysis, the following assumptions were carried out.

(a) Transmission line

The line constants of transmission line were assumed by voltage class as follows.

a) 500kV
4 × ACSR330
R : 0.000010 pu/km, X : 0.000114 pu/km, B : 0.009724 pu/km (100MVA Base)

b) 220kV
ACSR795
R : 0.000166 pu/km, X : 0.000836 pu/km, B : 0.001337 pu/km (100MVA Base)

(b) Transformers

a) 500/220kV Transformers
Impedance: X = 14% (Machine base)

b) Power supply transformers (Step up transformers)
Impedance: X = 12% (100MVA base)

(c) Demand

The demand data which PECC2 had assumed base on the 7th master plan was used. The demand of whole Vietnam was 34,662MW

2) Result of power flow analysis

The result of having carried out power flow analysis on the basis of assumption in 1) is shown in Fig. 4.5-6.

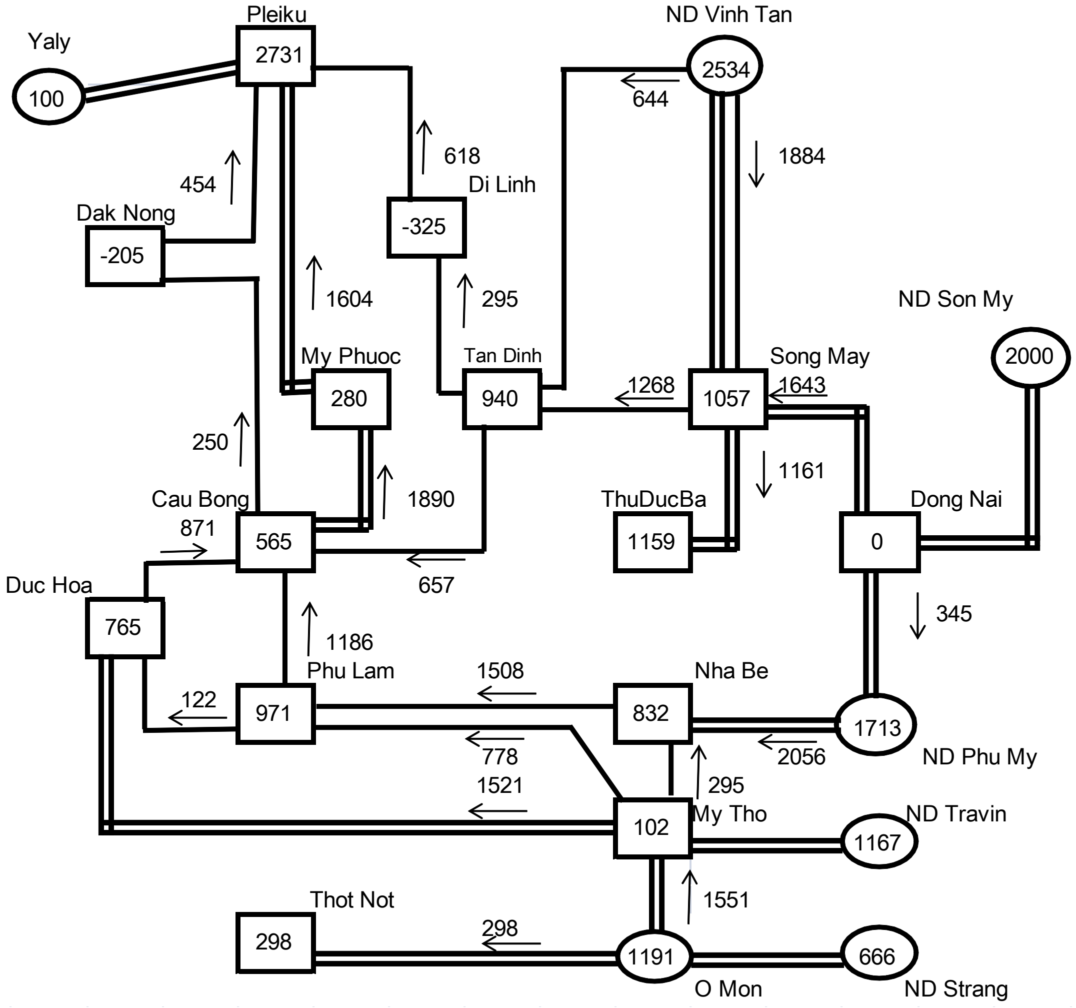


Fig. 4.5-6 Result of Power Plow Analysis

(5) System Stability Analysis

System stability analysis in the power flow profile shown in (4) was carried out using PSS/E Version32 made of Siemens Power Technologies International. In addition, it was presumed that the 500kV substation, Pleiku which existed in the central area was an infinite bus (a slack bus).

1) Assumptions

(a) Models

The models for dynamic stability analysis of PSS/E are as follows for every generator classification of hydro power, thermal power and infinite bus. In addition, it was assumed that the generator of infinite bus has no AVR and governor.

a) Generators
The generator model and constant which were used are shown in Table 4.5-11.

b) AVRs
The AVR model and constant which were used are shown in Table 4.5-12.

c) Governers
The governer model and constant which were used are shown in Table 4.5-13.

Table 4.5-11 Generator Model and Constant

	Infinite bus	Hydro	Thermal
Model	GENCLS	GENSAL	GENROU
T’do	-	5.0	6.0
T’’do	-	0.05	0.05
T’qo	-	-	1.0
T’’qo	-	0.06	0.5
H	1,000	5.0	3.0
D	0	1.0	0.0
Xd	-	1.5	2.5
Xq	-	1.2	2.5
X’d	-	0.4	0.227
X’q	-	-	0.6
X’’d=X’’q	-	0.25	0.141
Xl	-	0.12	0.1
S (1.0)	-	0.03	0.03
S (1.2)	-	0.25	0.4

Table 4.5-12 AVR Model and Constant

	Hydro	Thermal
Model	SCRX	SEXS
TA/TB	0.1	0.1
TB	10.0	10.0
K	200.0	100.0
TE	0.05	0.1
EMIN	0.0	0.0
EMAX	5.0	4.0
CSWITCH	0.0	-
rc/rfd	0.0	-

Table 4.5-13 Governer Model and Constant

	Hydro		Thermal
Model	HYGOV		TGOV1
R	0.05	R	0.05
r	0.07	T1	0.5
Tr	8.0	VMAX	1.0
Tf	0.05	VMIN	0.3
Tg	0.5	T2	1.0
+=VELM	0.2	T3	1.0
GMAX	1.0	Dt	0.0
GMIN	0.0		
TW	1.3		
At	1.1		
Dturb	0.5		
qNL	0.08		

(b) Fault sequence

The fault sequence of dynamic stability analysis was assumed as follows by the voltage class of the fault point.

a) 500kV
2sec : Occurring the fault (3 phases short circuit at 1 cct)
2.08sec : Opening of the faulted circuit
10sec : End of calculation

b) 220kV
2sec : Occurring the fault (3 phases short circuit at 1 cct)
2.10sec : Opening of the faulted circuit
10sec : End of calculation

2) Result of system stability analysis

Stability analysis about the cases shown in Table 4.5-14 was carried out at the basis of assumption shown in 1). The cases are equivalent to the open circuit of N-1 analysis in the feasibility study.

For each case, the graphs of the system frequency, 500kV bus voltages and the phase angle, active power and reactive power of the main generators are shown in Fig. 4.5-7 – Fig. 4.5-36*, and the result of stability analysis is shown in Table 4.5-14.

*Notes: Those figures are attached to the final report.

Table 4.5-14 Cases of System Stability Analysis and Results

Case	Fault line	Voltage	Stability
1	O Mon – My Tho	500kV	
2	O Mon – Thot Not	500kV	
3	My Tho – Thot Not	500kV	
4	O Mon – Thot Not	220kV	
5	O Mon – Vinh Long	220kV	
6	Interchange transformer at O Mon	500kV	

*Fault point is located near the left-side bus in the above fault line

4.6 ARCHITECTURAL AND CIVIL FACILITY

4.6.1 Outline of Facility

(1) Facility Plan of O Mon 3 Thermal Power Plant

The main architectural and civil facilities for O Mon 3 Power Plant are shown as follows.

1) Turbine and generator buildings
2) Administration Building
3) Warehouse and other buildings
4) CW water intake channel and discharge channel (Common facilities between O Mon 3 and 4 out of intake structure and discharge channel are constructed in the O Mon 4 project.)
5) Foundation Works
6) Road Works

(2) Architectural and Civil Works in O Mon 1-A Power Plant

The construction works for the O Mon 1-A Power Plant were implemented from January, 2006 to February, 2009, for 38 months. The major works are summarized below.

Table 4.6-1 Major Architectural and Civil Works in O Mon 1-A Power Plant

No.	Name	Quantity	Length (m)	Width (m)	Height (m)
1	Steam Turbine Building	1	70	33	29
2	Center Control Building	1	53	24	24
3	Administration Building	1	45	19	19
4	Stuck	1	Dia D=16-13 m		140
5	Gypsum Storage Tank		73	27	33
6	Warehouse	1	64	32	10
7	Pump Pit		45	24	13
8	CW Discharge Culvert	1	300	5	5
9	CW Discharge Channel	1	800	34	8.6
10	CW Intake Tower (in the River)	1	Dia D = 20m		10.5
11	CW Intake Pipe (in the River)	1	Dia D = 3.6m		120
12	Fuel Oil Port	1	For 10,000 DWT		
13	River Bank Protection	1			800
14	Foundation for Boiler, Electric Precipitator, Flue Gas Desulfurization Device, etc.	1			

Note) DWT means Dead Weight Tonnage

A main feature for the construction works in O Mon 1-A power plant is that the Cement Deep Mixing (CDM) Method to build foundation for the pump pits, discharge channel (culvert and open channel) and river revetment was applied to improve soft ground in the Mekong delta and ensure the required safety. Although the construction materials for the CDM method and few appurtenant facilities were procured in Vietnam, main facilities and construction management system were from Japan. The foundation improvement works by the CDM method were completed within the planned schedule for 7 months.

The intake tower (Dia. 20m, Height 15.5m, total weight 300t) and conduit (Dia. 4.6m, Length 120m) were planned to be installed as intake structures in the Hau River. The diving works were required for this work, therefore the construction works were implemented immediately before the coming rainy season. It was planned to utilize the floating crane with hoisting capacity of 400t, however it was difficult to procure it in Vietnam. Therefore, the intake tower was divided into two parts and installed with the floating crane with hoisting capacity of 150t.

(Source: Civil and Architectural Works of O Mon Power Plant in Vietnam, Electric Power Civil Engineering, Sep.,2009)

4.6.2 Natural and Design Conditions

(1) Topography and Geology

The site of O Mon Power Complex is 18 km away from the center of Can Tho City in the direction of south west. The coordination of the plant is 10°07'07"N and 105°40'00"E.

The north-east boundary of the power complex faces the Hau River whose width is about 900m and maximum depth is 22m at the power complex and the plant site is about 90km far from the river mouth. In addition, Vau canal and Chanh canal run in south west and south east of the power complex, respectively. Both canals have a river width of about 50m and depth of about 6 to 7 m.

O Mon Power Complex is located in the downstream area of the Mekong River (Mekong Delta), therefore the plant site is quite flat and its elevation is about EL. 0.3～1.5m. Land use around the power complex is mainly for paddy field and residences are found along the river and canals.

The geology of Vietnam is generally classified into two as the boundary of 16° N, and many major faults have been found and geological structures are complex in its northern part.

O Mon thermal power plant is located on the broad Mekong delta formed by deposition of soft clays in the southern part of Vietnam. The surface geology of the Mekong delta is alluvium deposit in Cainozoic era. These geological structures belong to Dalat Strungtreng which is the same as those in most areas of Cambodia.

PEEC2 conducted the geological survey at site in 2009. The main items of the geological survey were drilling survey with core sampling, penetration test, grain size analysis, physical characteristics test, direct shear test, compressive test and so on. Total number of drilling surveys was 24.

Based on the survey results, the soil layers are composed of clay which is main, clayey sand, clayey mud and sand, the layers are generally classified 6 ones as shown in Table 4.6-2. These layers accumulate horizontally, Layer 6 is found below EL-70m. According to Table 4.6-2, Layer 1 and 2 and minimum N values from Layer 1 to Layer 5 are not expected as a supporting layer of power plant facilities
Generally, N values of 30 and more for sandy soil and 20 and more for clay soil are expected as a supporting layer.

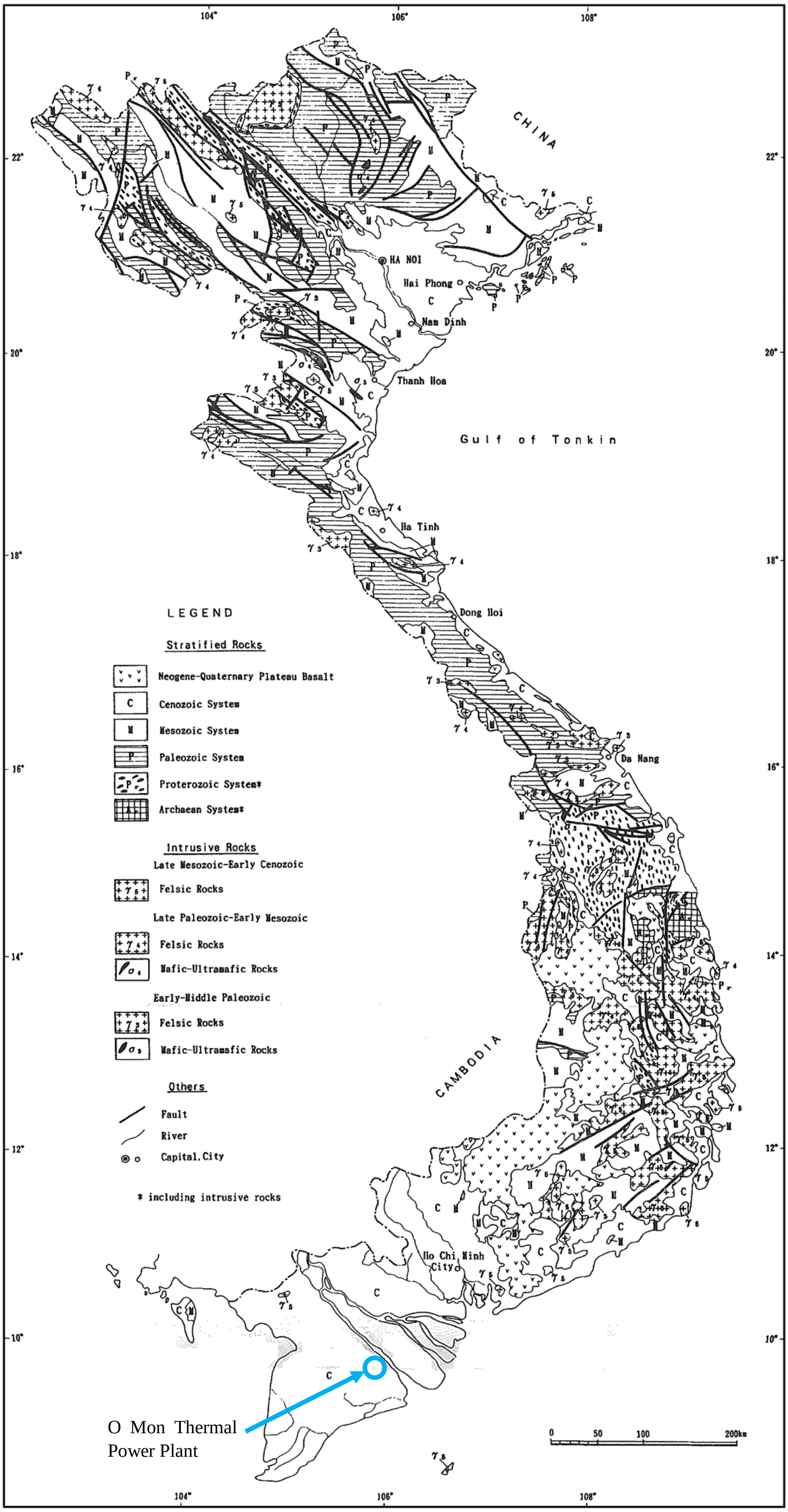


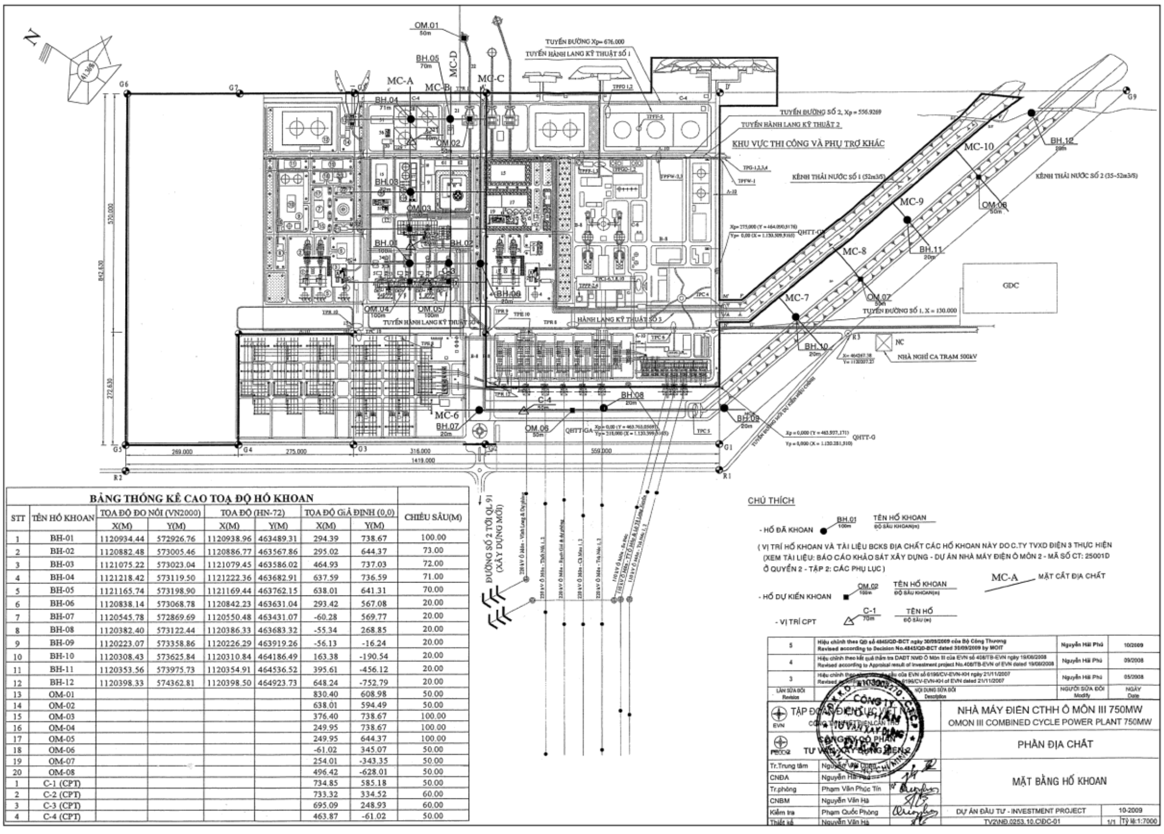
Fig. 4.6-1 Geological Map of Vietnam

(Source: Resources Development Environment Research in Vietnam, Japan Oil, Gas and Metals National Corporation)

Table 4.6-2 Geological Survey for O Mon 3 Power Plant

No.	Location	Depth	Test Items								
			In-situ Test			Physical Test		Mechanical Test			
		(m)	Core Sampling	Standard Penetration Test	Cone Penetration Test	Grain Size Distribution	Physical Property Test	Direct Share Test	Unconfined Stress Test	Triaxial Test	Consoli-dation Test
BH- 01	GT System	100	☑	☑							
BH- 02	GT System	73	☑	☑							
BH- 03	Water Treatment Facility	72	☑	☑							
BH- 04	Fuel Tank	71	☑	☑							
BH- 05	Intake (Old)	70	☑	☑							
BH- 06	Road between No.2 and 3	20	☑	☑							
BH- 07	Discharge Channel (Culvert)	20	☑	☑							
BH- 08	Discharge Channel (Culvert)	20	☑	☑							
BH- 09	Discharge Channel (Open)	20	☑	☑							
BH- 10	Discharge Channel (Open)	20	☑	☑							
BH- 11	Discharge Channel (Open)	20	☑	☑							
BH- 12	Discharge Channel (Open)	20	☑	☑							
OM- 01	Intake (Old) In the Hau River	50	☑	☑		☑	☑	☑	☑	☑	☑
OM- 02	Intake (Old)	50	☑	☑		☑	☑	☑	☑	☑	☑
OM- 03	GT System	100	☑	☑		☑	☑	☑	☑	☑	☑
OM- 04	GT System	100	☑	☑		☑	☑	☑	☑	☑	☑
OM- 05	GT System	100	☑	☑		☑	☑	☑	☑	☑	☑
OM- 06	Discharge Channel (Culvert)	50	☑	☑		☑	☑	☑	☑	☑	☑
OM- 07	Discharge Channel (Open)	50	☑	☑		☑	☑	☑	☑	☑	☑
OM- 08	Discharge Channel (Open)	50	☑	☑		☑	☑	☑	☑	☑	☑
C- 01	Fuel Tank	50	☑		☑						
C- 02	GT System	60	☑		☑						
C- 03	GT System	60	☑		☑						
C- 04	Discharge Channel (Culvert)	50	☑		☑						

(Source: NHA MAY DIEN CTHH OMON III、PECC 2, 2009)



BẢNG THỐNG KÊ CAO TOẠ ĐỘ HỐ KHOAN

STT	TÊN HỐ KHOAN	TOẠ ĐỘ ĐO NỐI (VN2000)		TOẠ ĐỘ (HN-72)		TOẠ ĐỘ GIẢ ĐỊNH (0,0)		CHIỀU SÂU(M)
		X(M)	Y(M)	X(M)	Y(M)	X(M)	Y(M)	
1	BH-01	1120934.44	572926.76	1120938.96	463489.31	294.39	738.67	100.00
2	BH-02	1120882.48	573005.46	1120886.77	463567.86	295.02	644.37	73.00
3	BH-03	1121075.22	573023.04	1121079.45	463586.02	464.93	737.03	72.00
4	BH-04	1121218.42	573119.50	1121222.36	463682.91	637.59	736.59	71.00
5	BH-05	1121165.74	573198.90	1121169.44	463762.15	638.01	641.31	70.00
6	BH-06	1120838.14	573068.78	1120842.23	463631.04	293.42	567.08	20.00
7	BH-07	1120545.78	572869.69	1120550.48	463431.07	-60.28	569.77	20.00
8	BH-08	1120382.40	573122.44	1120386.33	463683.32	-55.34	268.85	20.00
9	BH-09	1120223.07	573358.86	1120226.29	463919.26	-56.13	-16.24	20.00
10	BH-10	1120308.43	573625.84	1120310.84	464186.49	163.38	-190.54	20.00
11	BH-11	1120353.56	573975.73	1120354.91	464536.52	395.61	-456.12	20.00
12	BH-12	1120398.33	574362.81	1120398.50	464923.73	648.24	-752.79	20.00
13	OM-01					830.40	608.98	50.00
14	OM-02					638.01	594.49	50.00
15	OM-03					376.40	738.67	100.00
16	OM-04					249.95	738.67	100.00
17	OM-05					249.95	644.37	100.00
18	OM-06					-61.02	345.07	50.00
19	OM-07					254.01	-343.35	50.00
20	OM-08					496.42	-628.01	50.00
1	C-1 (CPT)					734.85	585.18	50.00
2	C-2 (CPT)					733.32	334.52	60.00
3	C-3 (CPT)					695.09	248.93	60.00
4	C-4 (CPT)					463.87	-61.02	50.00

CHÚ THÍCH

- HỐ ĐÃ KHOAN BH.01 100m TÊN HỐ KHOAN / ĐỘ SÂU KHOAN(m)

(VỊ TRÍ HỐ KHOAN VÀ TÀI LIỆU BCKS ĐỊA CHẤT CÁC HỐ KHOAN NÀY DO C.TY TVXD ĐIỆN 3 THỰC HIỆN (XEM TÀI LIỆU: BÁO CÁO KHẢO SÁT XÂY DỰNG - DỰ ÁN NHÀ MÁY ĐIỆN Ô MÔN 2 - MÃ SỐ CT: 25001D Ở QUYỂN 2 - TẬP 2: CÁC PHỤ LỤC)

- HỐ DỰ KIẾN KHOAN OM.02 100m TÊN HỐ KHOAN / ĐỘ SÂU KHOAN(m)

- VỊ TRÍ CPT C-1 70m TÊN HỐ / ĐỘ SÂU (m)

MC-A MẶT CẮT ĐỊA CHẤT

LẦN SỬA ĐỔI Revision	NỘI DUNG SỬA ĐỔI Description	NGƯỜI SỬA ĐỔI Modify	NGÀY Date
5	Hiệu chỉnh theo QĐ số 4845/QĐ-BCT ngày 30/09/2009 của Bộ Công Thương Revised according to Decision No.4845/QĐ-BCT dated 30/09/2009 by MOIT	Nguyễn Hải Phú	10/2009
4	Hiệu chỉnh theo kết quả thẩm tra DADT NMĐ Ô Môn III của EVN số 408/TB-EVN ngày 19/08/2008 Revised according to Appraisal result of investment project No.408/TB-EVN of EVN dated 19/08/2008	Nguyễn Hải Phú	09/2008
3	Hiệu chỉnh theo [illegible] của EVN số 6196/CV-EVN-KH ngày 21/11/2007 Revised [illegible] 6196/CV-EVN-KH of EVN dated 21/11/2007	Nguyễn Hải Phú	05/2008

TẬP ĐOÀN ĐIỆN LỰC VIỆT NAM
CÔNG TY NHIỆT ĐIỆN CẦN THƠ
CÔNG TY CỔ PHẦN TƯ VẤN XÂY DỰNG ĐIỆN 2

Tr.Trung tâm	Nguyễn Văn Dong	
CNĐA	Nguyễn Hải Phú	
Tr.phòng	Phạm Văn Phúc Tín	
CNBM	Nguyễn Văn Hà	
Kiểm tra	Phạm Quốc Phòng	
Thiết kế	Nguyễn Văn Hà	

NHÀ MÁY ĐIỆN CTHH Ô MÔN III 750MW
OMON III COMBINED CYCLE POWER PLANT 750MW
PHẦN ĐỊA CHẤT
MẶT BẰNG HỐ KHOAN
DỰ ÁN ĐẦU TƯ - INVESTMENT PROJECT 10-2009
TV2\NĐ.0253.10.C\ĐC-01 1/1 Tỷ lệ:1:7000

Fig. 4.6-2 Location of Drilling Survey

(Source: NHA MAY DIEN CTHH OMON III, PECC 2, 2009)

Table 4.6-3 Soil Layer at O Mon Power Complex

Layer	Category	Thickness	Material	Color	N-Value	Remarks
1	CH	2.5m (1.3-5.6m)	Clay	Yellow-spotted Gray-brown	5 (2-10)	Surface
2	CL/CH	10.4m (3.5-13.7m)	Liquid Clay	Dark-gray	0	Physico-mechanical properties are low.
2a	CL	2m (0.5-5.5m)	Clayed sand mud	Dark-gray	0	Liquidity, Mixed with shell and organic impurities
2b	CH	1.1m (0.5-6.0m)	Clay mud	-	0	Distributed under or above Layer 2
3	CL	10.3m (3-37m)	Clay	Gray-brown	16 (3-37)	Medium dense, mixing with 5% hard lacerit curdles
3a	CL	2.1m (0.7-5m)	Clayed loam	Yellowish brown	18 (13-28)	Mixed with thin lenses of fine sand
4	SP/SM	10.4m (4.5-15m)	Fine sand	Yellowish brown	17 (9-58)	Medium dense to dense
4a	CL/CH	2m (0.5-5m)	Clay	Greenish Brown (Yellowish and Red brown Spot)	17 (11-33)	Among and below layer 4, 5% organic impurities
5	CL/CH	29.9m (23-34.2m)	Loam	Purple brown (Black gray spot)	17 (11-48)	Semi-hard to hard
5a	CL/ML	> 26m	Loam dust	Light gray	19 (16-28)	Distributed in Layer 5
6	SP/SC	10.4m (4.5-15m)	Fine sand	Yellowish grey	60 (32-103)	Dense to very dense
6a	CL/ML	1.4m (0.5-2.5m)	Loam dust	Black spotted Purple gray	58 (54-61)	There are thin lenses in Layer 6.

(Source: O Mon Combined Cycle Power Project Feasibility Study Report, Sep., 2010, PECC2, P4-5 -)

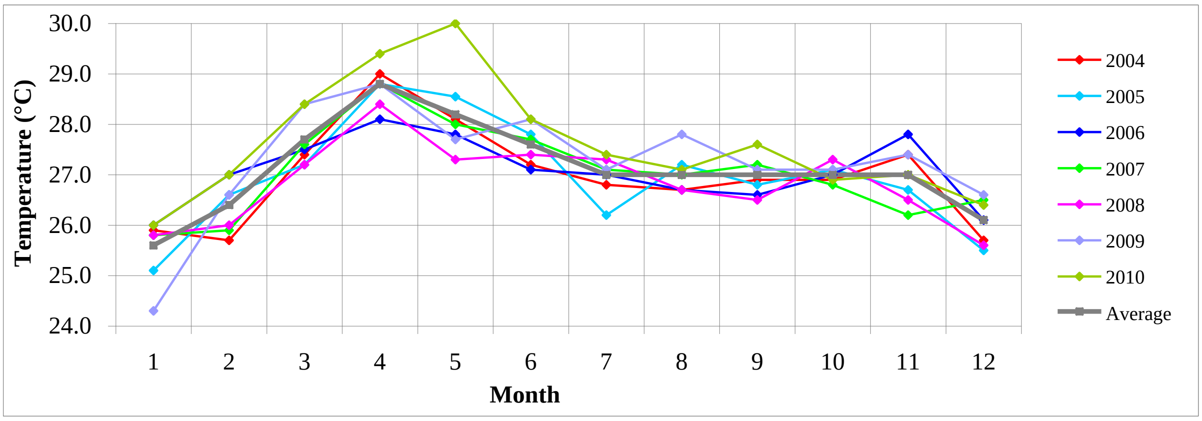
(2) Meteorology

The O Mon Thermal Power Plant site belongs to a tropical monsoon climate region in which annual air temperature change is small and rainy season and dry season are clearly distinguished. The dry season starts from November and the rainy season does from May.

1) Ambient temperature

Monthly average ambient temperature at Can Tho station is shown in Fig.4.6-3. According the monthly average temperature in the figure, the air temperature varies by 3 to 4 °C through a year and air temperatures in December and January are low and those in April and May are high.

Name of Station:	***Can Tho***	
Location:	10°02' N	105°45' E
Altitude:	EL.2m	



(in °C)

Season		Dry Season				Rainy Season						Dry Season		
Month		1	2	3	4	5	6	7	8	9	10	11	12	Average
Year	2004	25.9	25.7	27.4	29.0	28.1	27.2	26.8	26.7	26.9	26.9	27.4	25.7	27.0
	2005	25.1	26.6	27.2	28.8	28.6	27.8	26.2	27.2	26.8	27.1	26.7	25.5	27.0
	2006	26.0	27.0	27.5	28.1	27.8	27.1	27.0	26.7	26.6	27.0	27.8	26.1	27.1
	2007	25.8	25.9	27.6	28.8	28.0	27.7	27.1	27.0	27.2	26.8	26.2	26.5	27.1
	2008	25.8	26.0	27.2	28.4	27.3	27.4	27.3	26.7	26.5	27.3	26.5	25.6	26.8
	2009	24.3	26.6	28.4	28.8	27.7	28.1	27.1	27.8	27.1	27.1	27.4	26.6	27.3
	2010	26.0	27.0	28.4	29.4	30.0	28.1	27.4	27.1	27.6	26.9	27.0	26.4	27.6
Average		25.6	26.4	27.7	28.8	28.2	27.6	27.0	27.0	27.0	27.0	27.0	26.1	27.1

Fig. 4.6-3 Monthly Average Temperature

(Source: Statistical Annual of Can Tho City)

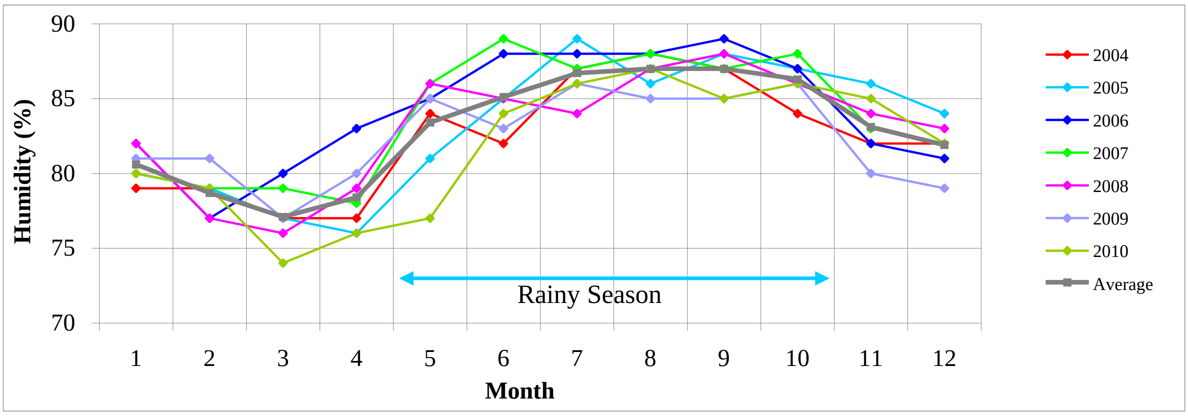
The historical observed data in ambient temperature at Can Tho station are summarized below.

- Yearly averaged temperature	:	27.1°C (25.6 - 28.8°C)
- Maximum Temperature	:	40°C
- Minimum Temperature	:	14.8°C

2) Humidity

Humidity at O Mon Thermal Power Plant is high through a year and not less than 75%. Monthly average relative humidity from June to October during rainy season is high and exceeds 85%.

Name of Station:	*Can Tho*	
Location:	10°02' N	105°45' E
Altitude:	EL.2m	



(in %)

Season		Dry Season				Rainy Season						Dry Season		
Month		1	2	3	4	5	6	7	8	9	10	11	12	Average
Year	2004	79	79	77	77	84	82	87	88	87	84	82	82	82.3
	2005	80	79	77	76	81	85	89	86	88	87	86	84	83.2
	2006	82	77	80	83	85	88	88	88	89	87	82	81	84.2
	2007	80	79	79	78	86	89	87	88	87	88	83	82	83.8
	2008	82	77	76	79	86	85	84	87	88	86	84	83	83.1
	2009	81	81	77	80	85	83	86	85	85	86	80	79	82.3
	2010	80	79	74	76	77	84	86	87	85	86	85	82	81.8
Average		80.6	78.7	77.1	78.4	83.4	85.1	86.7	87.0	87.0	86.3	83.1	81.9	83.0

Fig. 4.6-4 Average Humidity

(Source 1: Statistical Annual of Can Tho City, 2006
Source 2: Can Tho Statistic Bureau, 2011）

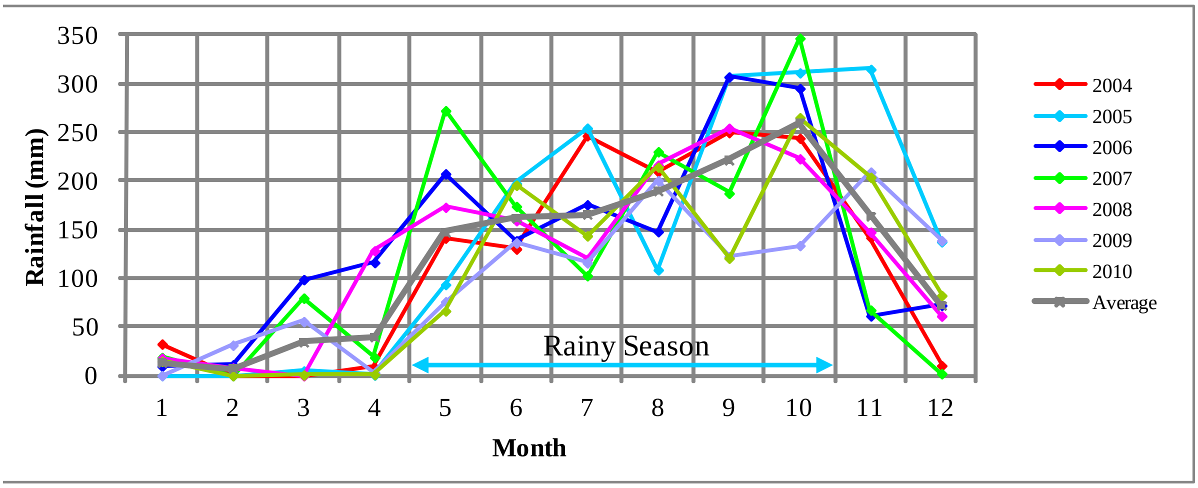
3) Rainfall

Monthly rainfall at Can Tho station is shown in Fig. 4.6-5.

Annual rainfall at Can Tho station reaches about 1,500 mm and more than 80% of the rainfall is observed in rainy season.

- Maximum Annual Rainfall	:	1,878 mm
- Minimum Annual Rainfall	:	1,257 mm
- Average Rainfall Days	:	130 days/year
- Maximum Rainfall Days	:	172 days/year
- Minimum Rainfall Days	:	111 days/year
- Maximum Monthly Rainfall	:	439 mm/month (August, 1988)
- Maximum Daily Rainfall	:	198 mm/day
- Maximum Hourly Rainfall	:	79.3 mm/hour

Name of Station: ***Can Tho***
Location: 10°02' N 105°45' E
Altitude: EL.2m



(in mm)

Season		Dry Season				Rainy Season						Dry Season		
Month		1	2	3	4	5	6	7	8	9	10	11	12	Total
Year	2004	32.5	0.0	0.0	8.3	141.5	130.3	246.8	209.8	250.1	244.2	141.9	10.3	1,415.7
	2005	0.0	0.0	4.8	0.5	93.7	197.8	254.6	108.8	307.4	311.5	315.1	137.7	1,731.9
	2006	9.5	11.1	98.8	116.3	207.6	138.7	175.8	148.1	307.3	295.4	61.4	72.2	1,642.2
	2007	18.6	0.0	79.7	18.7	272.6	174.1	102.8	230.4	187.6	347.2	67.4	2.0	1,501.1
	2008	17.8	8.0	0.0	128.4	173.2	159.5	119.8	216.5	254.5	223.1	147.6	61.3	1,509.7
	2009	0.0	31.3	55.6	2.9	76.0	136.6	116.0	200.6	122.5	133.8	209.5	138.8	1,223.6
	2010	14.7	0.0	0.6	1.1	66.5	195.9	143.8	214.5	120.9	265.4	204.0	82.4	1,309.8
Average		13.3	7.2	34.2	39.5	147.3	161.8	165.7	189.8	221.5	260.1	163.8	72.1	1,476.3
Percentage		0.9	0.5	2.3	2.7	10.0	11.0	11.2	12.9	15.0	17.6	11.1	4.9	100

Fig. 4.6-5 Monthly Rainfall

(Source 1: Statistical Annual of Can Tho City, 2006
Source 2: Can Tho Statistic Bureau, 2011)

4) Wind Speed

Wind observed around O Mon Power Complex is affected by the seasonal wind. The wind from June to October is from southwest, which cause much amount of rainfall, the wind from November to February is from Northeast, and the wind from March to May is from southeast. Annual average wind speed is about 3.5 m/s and the wind speed varies seasonally from 3.2 to 4.0m/s.

The wind direction at O Mon Power Complex changes remarkably because the site faces the big river and is topographically flat.

5) Water level

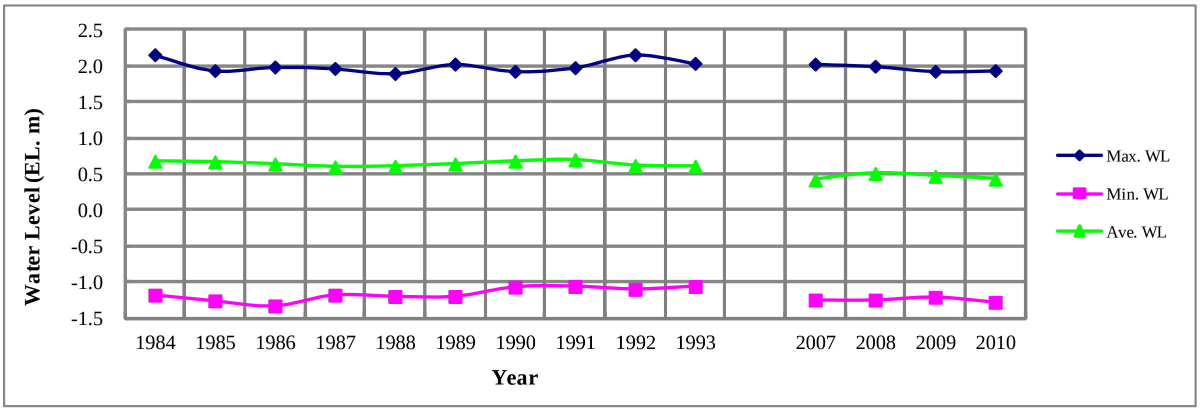
The Mekong River branches at the most downstream area, one is the Mekong main river and the other is the Hau River. The O Mon Power Complex site along the Hau River is located at about 90 km upstream from the river mouth of the Hau River. The river discharge of the Hau River is quite large and its annual average discharge reaches about 2,440m^3/s.

The water level from March to June is lower and that from September to October is higher. The historical highest water level at the Can Tho water level observation station reached at EL.2.16 m on October 26, 1984 and the historical lowest water level reached at EL.-1.33 m on May 18, 1986.

- Maximum Water Level : EL. 2.16 m
- Minimum Water Level : EL. -1.33 m
- Average Water Level : EL. 0.59 m

The water level records at the Can Tho station are shown in Fig. 4.6-4. According to Fig. 4.6-4, annual maximum water level reaches at about EL. 2 m, annual minimum water level reached at about EL. -1.2 m and annual average water level reached at about EL. 0.6 m.

Name of Station:* *Can Tho



(in m)

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993		2007	2008	2009	2010	Average
Max. WL	2.16	1.94	1.99	1.97	1.90	2.03	1.93	1.98	2.16	2.04		2.03	2.00	1.93	1.94	2.00
Month	10	9	11	10	10	10	10	10	9	10		10	10	11	11	
Min. WL	-1.18	-1.26	-1.33	-1.18	-1.20	-1.20	-1.07	-1.06	-1.10	-1.06		-1.25	-1.25	-1.21	-1.28	-1.19
Month	5	6	5	6	5	5	3	3	6	6		6	5	4	5	
Ave. WL	0.68	0.67	0.64	0.60	0.61	0.64	0.68	0.70	0.62	0.61		0.42	0.51	0.47	0.43	0.59
Difference (m)	3.34	3.20	3.32	3.15	3.10	3.23	3.00	3.04	3.26	3.10						3.19

Fig. 4.6-6 Annual Maximum, Minimum and Average Water Level at Can Tho Station

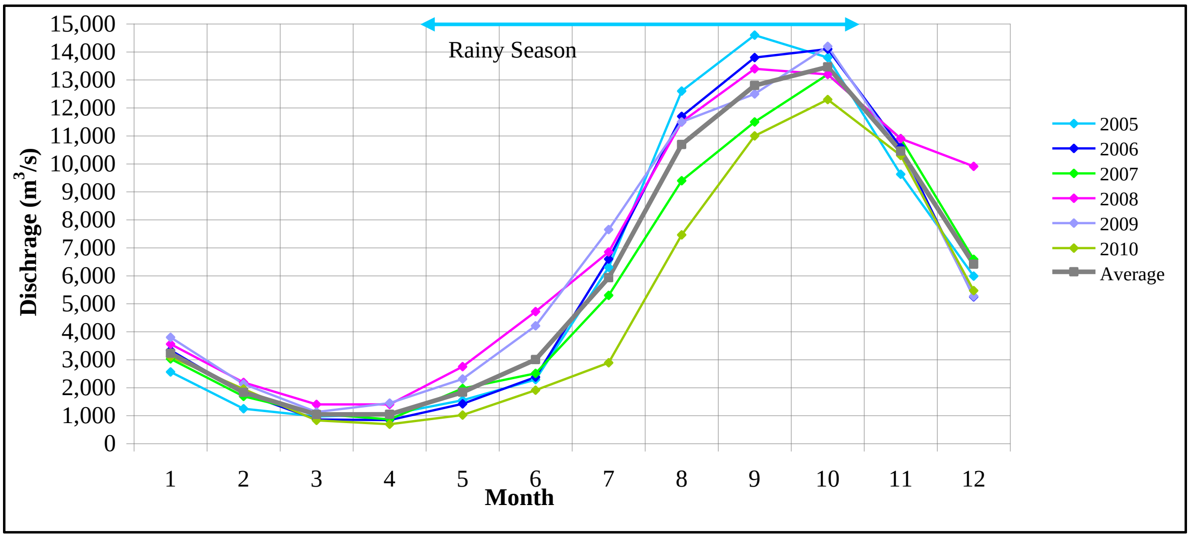
(Source 1: Resource and Environment Department of Can Tho City
Source 2: Can Tho Statistic Bureau, 2011)

6) River discharge

The river discharge of the Hau River at the Can Tho station is summarized in Fig. 4.6-7.

The river discharge of the Hau River seasonally varies from 800 to 15,000m^3/s and annual average river discharge is about 6,000m^3/s. The fluctuation of the water level is smaller comparing to that of the water discharge because it is supposed that water level at Can Tho is affected by sea water level.

Name of Station:	***Can Tho***	
Location:	10°02' N	105°45' E
Altitude:	EL.2m	



(in m^3/s)

Season		Dry Season				Rainy Season						Dry Season		
Month		1	2	3	4	5	6	7	8	9	10	11	12	Average
Year	2005	2,560	1,250	972	1,040	1,550	2,290	6,300	12,600	14,600	13,800	9,630	5,990	6,049
	2006	3,340	1,800	864	844	1,420	2,380	6,600	11,700	13,800	14,100	10,600	5,250	6,058
	2007	3,030	1,690	1,070	867	1,970	2,510	5,300	9,400	11,500	13,200	10,900	6,590	5,669
	2008	3,560	2,190	1,400	1,400	2,750	4,720	6,850	11,500	13,400	13,200	10,900	9,910	6,815
	2009	3,800	2,130	1,130	1,450	2,310	4,210	7,650	11,500	12,500	14,200	10,400	5,270	6,379
	2010	3,100	1,950	831	691	1,020	1,910	2,890	7,460	11,000	12,300	10,300	5,470	4,910
Average		3,232	1,835	1,045	1,049	1,837	3,003	5,932	10,693	12,800	13,467	10,455	6,413	5,980

Fig. 4.6-7 Monthly Average River Discharge

(Source: Cuu Long Hydrographic Center)

(3) Earthquake

1) Historical earthquake and earthquake risk

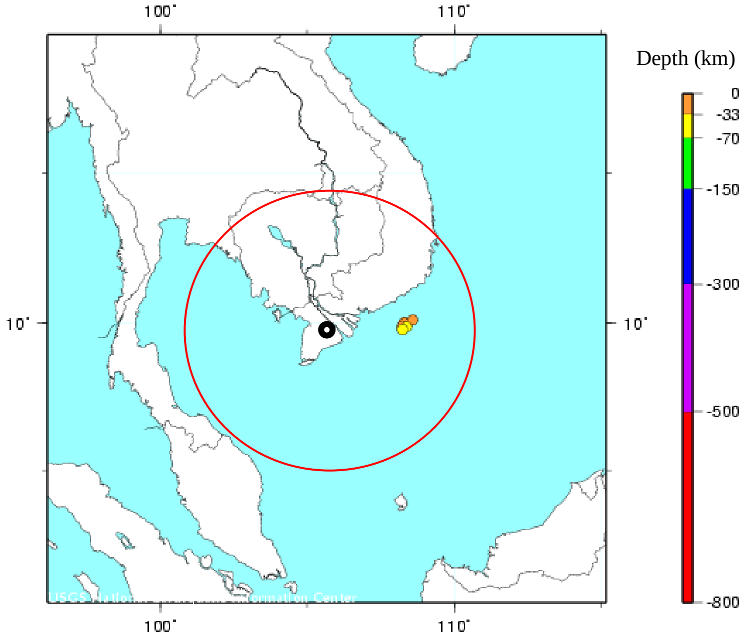
Historical earthquakes occurred around O Mon Power Complex are investigated below.

Historical earthquakes within the radius of 500 km from O Mon Power Complex and its intensity of not less than Magnitude 4.0 are extracted from earthquake database operated by United States Geological Survey (USGS) as shown in Fig. 4.6-8. The 10 earthquakes are observed and all of them are about 300 km away from the site.

Based on the above results, major earthquakes have not occurred for the past 40 years around the site and the earthquake intensity even observed in 300 km far from the site is nearly magnitude 5.0 which is moderate scale.

Moreover, earthquake epicenter map prepared by earthquake records observed in Vietnam is shown in Fig. 4.6-9. According to Fig. 4.6-9, it is found that the small scale earthquakes at the boundary of Cambodia occurred and no large scale earthquake has been observed.

The expected peak ground acceleration due to earthquake which might occur with the possibility of 10% for 50 years is shown in Fig. 4.6-10. The O Mon Power Complex belongs to the area classified as the lower peak ground acceleration range, therefore the earthquake risk is minor in the area.



No.	Date			Depth (km)	Magnitude	Distance (km)
	Year	Month	Day			
1	2005	8	5	16	4.4	295
2	2005	8	5	10	4.5	296
3	2005	11	7	10	4.0	288
4	2005	11	7	10	5.2	297
5	2005	11	8	10	5.3	286
6	2006	07	3	55	4.3	297
7	2007	11	28	10	5.2	287
8	2010	6	23	42	4.4	282
9	2010	11	6	10	4.1	320
10	2011	1	26	10	4.7	281

Fig. 4.6-8 Depth and Distance of Earthquake Source (R=500km, 1973-2011)

(Source : UPGS Website)

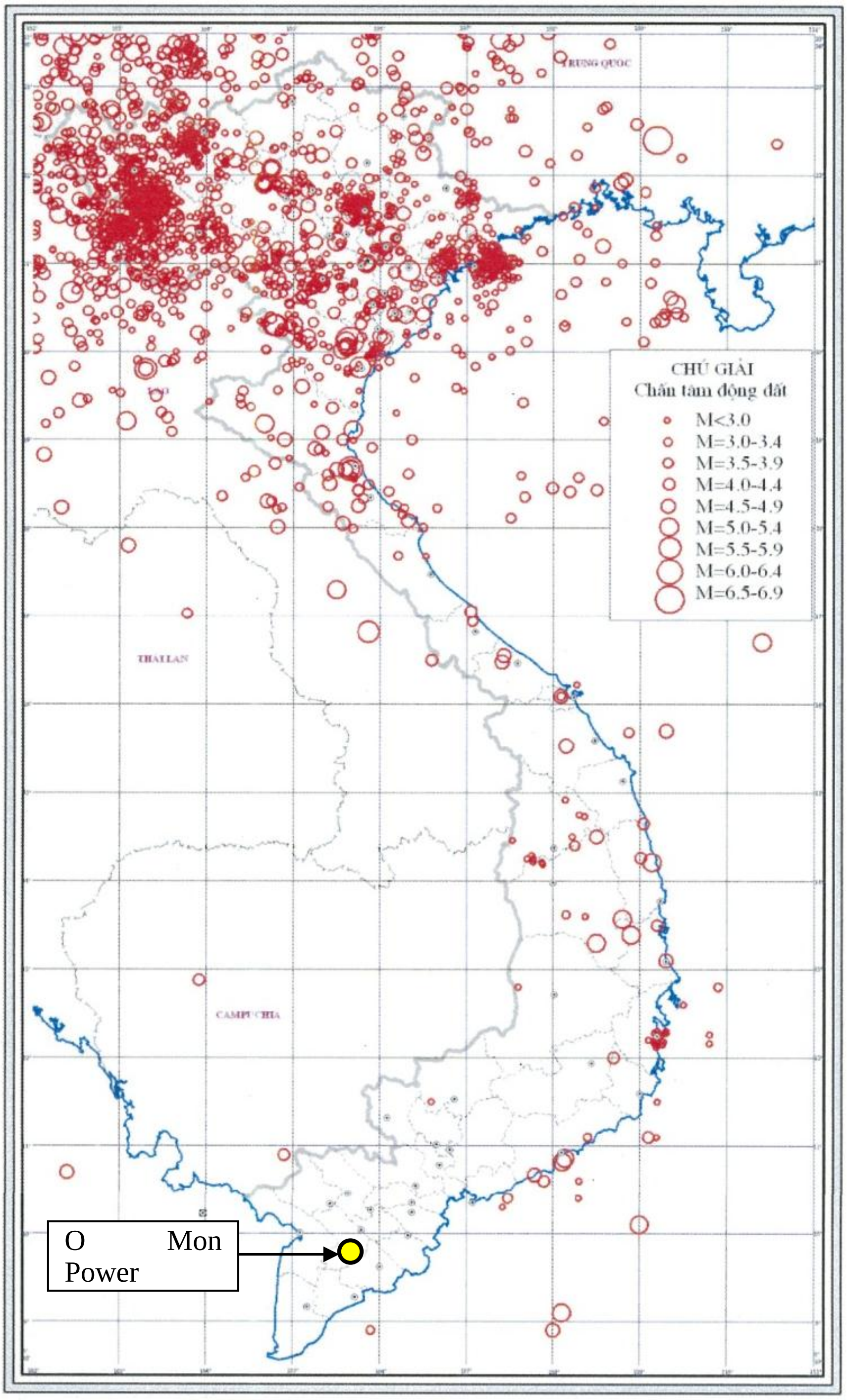


Fig. 4.6-9 Historical Earthquake in and around Vietnam (till year of 2005)

(Source：Seismic Hazard of the Territory of Vietnam, Vietnamese Academy of Science and Technology Institute of Geophysics)

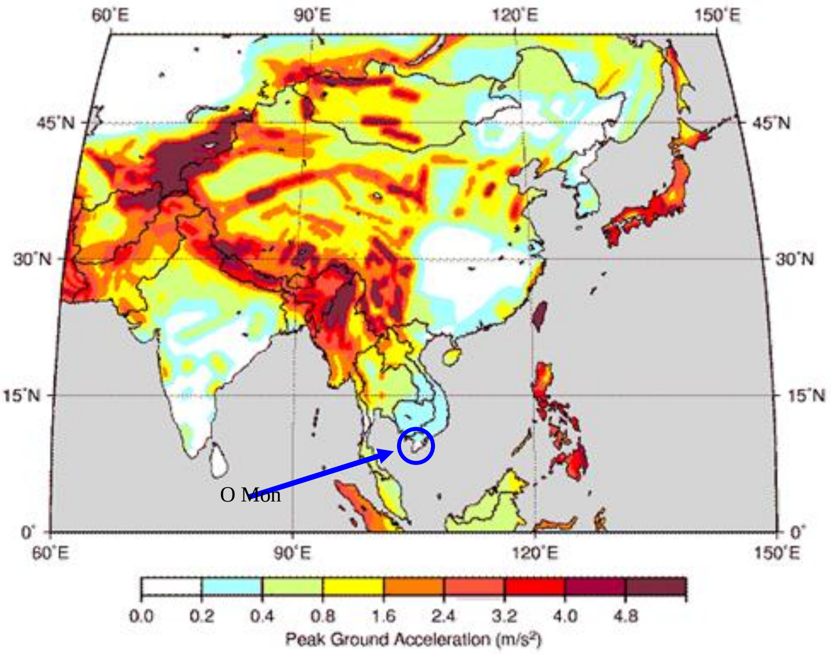


Fig. 4.6-10 Expected Peak Ground Acceleration in East Asia (Occurrence Probability: 10% for 50 years)

(Source: Global Seismic Hazard Assessment Program)

2) Fault

The Hau River, which O Mon Power Complex is facing, flows on the Hau River fault. It is identified by satellite image that this fault is running from eastside of Myanmar and its length is about 1,600 km. It is said that the activity started from Cretaceous or Cainozoic era and the fault is still active.

The active fault map in Vietnam is shown in Fig. 4.6-11. The Hau River fault is clearly shown on the active fault map.

In addition to the Hau River fault, the three faults, namely Vung Tau Fault, Rach Fault, and Thuan Hai Fault are cited as existing adjacent faults in the FS report.

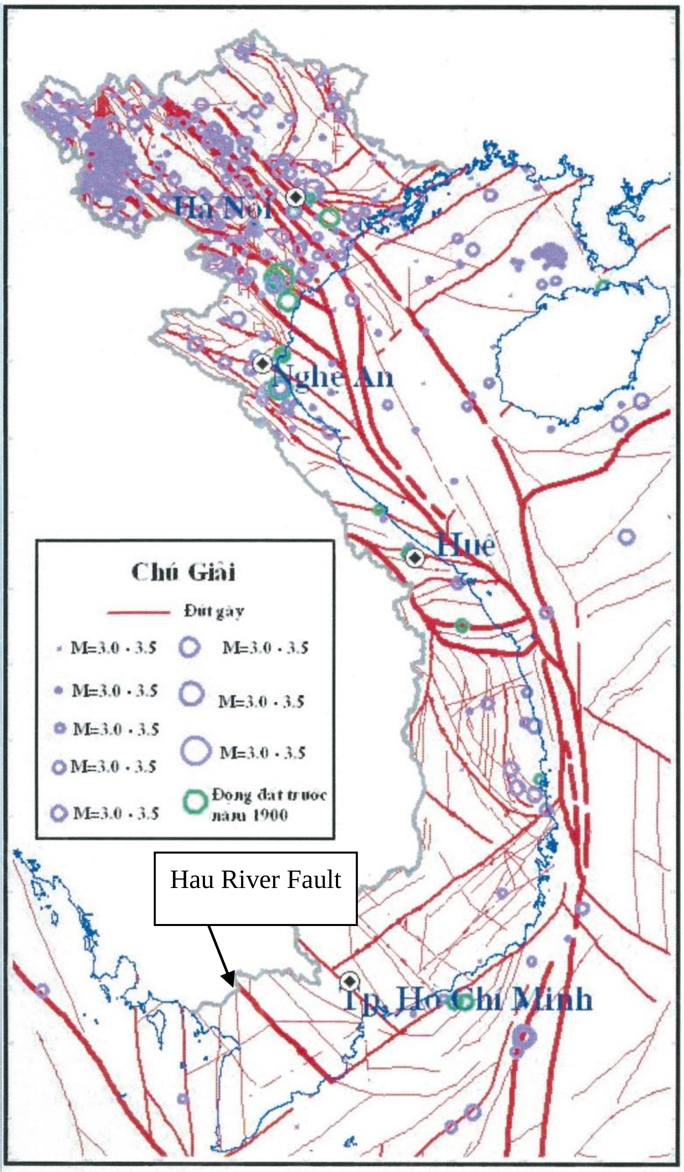


Fig. 4.6-11 Location of Active Faults and Source of Earthquakes in Vietnam

(Source: Seismic Hazard of the Territory of Vietnam, Vietnamese Academy of Science and Technology Institute of Geophysics)

3) Earthquake Risks and Seismic Design in Vietnam

The horizontal acceleration with occurrence probability of 10% in 50 years (once 475 years) in sound rocks, which is fundamental of seismic design in Vietnam, is shown in Fig. 4.6-12. According to Fig. 4.6-12, the horizontal acceleration of 0.04g to 0.08g is expected at O Mon Power Complex.

In addition, the earthquake risk map in Vietnam is shown in Fig. 4.6-13. Fig. 4.6-13 shows that the O Mon 3 is classified into Level 7 in Medvedev-Sponheur-Karnik (MSK-64) seismic intension scale, the intensity corresponds to Level 4 to 5 in Japan Meteorological Agency's seismic intensity scale.

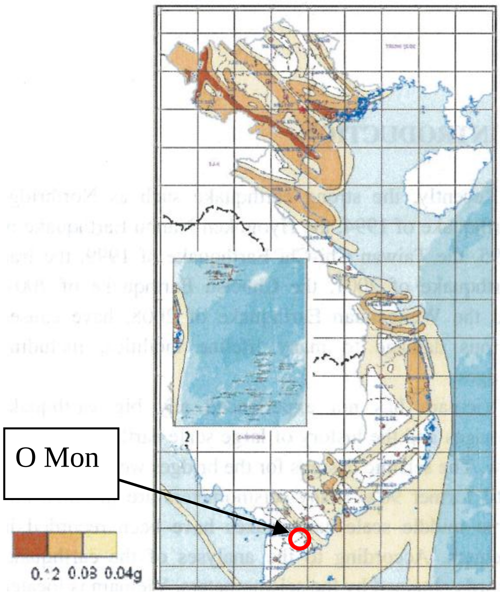


Fig. 4.6-12 Expected Ground Acceleration
(Probability: 10% in 50 years, once a 475 years)

(Source: Assessment of Seismic Design for Bridge in Vietnam、30th Seismic Engineering Research Paper of Civil Engineering Association)

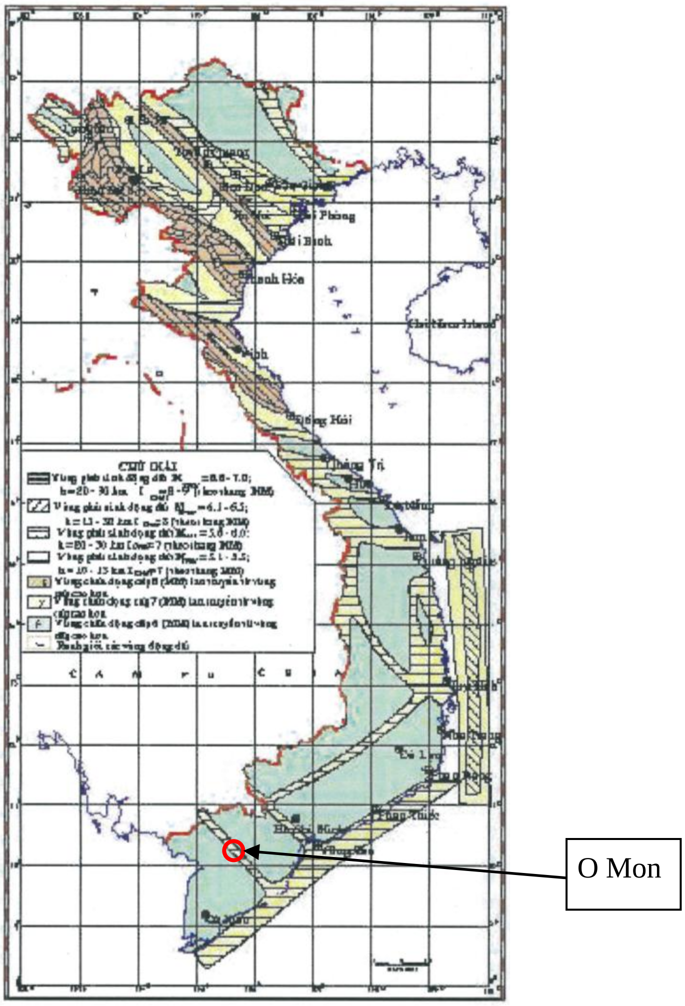


Fig. 4.6-13 Seismic Zoning Map of Vietnam

(Source: Seismic Hazard in Vietnam、Institute of Geographic)

(3) Design Conditions

1) Design conditions in FS report

(a) River water level

The high water level (WL) of 100-year-probability is applied for the design water level for the O Mon Power Complex. The ground elevation of the O Mon 3 power plant is determined by the high water level plus freeboard. The high water level is EL. +.2.28m estimated by Resource and Environment Department of Can Tho City,

Table 4.6-4 Probable High Water at O Mon Power Complex

P (%)	1	3	5	10	25	50
P (Year)	100	33.3	20	10	4	2
WL (cm)	228	247	212	203	191	180

(Source: O Mon Combined Cycle Power Project Feasibility Study Report, Sep., 2010, PECC2, P8-10)

The ground level of the O Mon Power Plant has been determined as follows in consideration of layout and elevation of C/W discharge system, drainage, high tide, flood, waves caused by wind or ship, and topography and geology.

Ground Level = Flood Water Level (P=1%) + Freeboard
= 2.28m + 0.4m = 2.68 m → EL.+2.7m

In addition, damages to the O Mon Complex due to flood have never occurred from time of construction to now.

(b) Seismic coefficient

In the F/S report, the seismic coefficient was set as follows based on Vietnamese standard of TCXDVN375-2006.

$$a_g = a_{gR} \times I$$

where, a_g : Design Acceleration
a_{gR} : Basic Acceleration
I : Important Factor of Structures (=1.25)

The regional basic acceleration is given as shown in Table 4.6-5. According to the regional basic acceleration, O Mon district has the value of 0.0546g and its surrounding districts have the values from 0.05 to 0.07g.

Therefore, the design acceleration for the O Mon Power plants become 0.068g (m/s^2).

The design acceleration of each level in MSK-64 seismic intension scale is specified as shown in Table 4.6-6 and the calculated design acceleration corresponds to Level 7.

Table 4.6-5 Expected Acceleration around O Mon Power Complex

No.	District	Expected Acceleration (a_{gR})
1	**O Mon**	**0.0546g**
2	Binh Thuy	0.0685g
3	Ninh Kieu	0.0662g
4	Cai Rang	0.0515g

Table 4.6-6 Design Acceleration of Each Level in MSK-64 Seismic Intension Scale

Level	Design Acceleration (a_g)
5	0.012 - 0.03
6	> 0.03 - 0.06
7	**> 0.06 - 0.12**
8	> 0.12 - 0.24
9	> 0.24 - 0.48
10	> 0.48

2) Design condition

(a) Ground level

The design philosophy in the F/S report is widely applied for the design of the thermal power plant in Vietnam as well as for that in O Mon 1-A Power Plant. In addition, damages caused by high tides have never occurred

Therefore, it can be judged that the design condition to determine the ground level showing in the F/S report is applicable.

(b) Design wind

Wind loads in Vietnam are stipulated in TCVN 2737 (Loads and Actions - Design Code). Map of wind speed as shown in Fig.4.6-14 shows that the O Mon Power Complex is classified into II-A zone and the design wind speed in the zone is about 37m/s. TVCN regulates that the design wind roads should be determined with the wind pressures from the classified design wind speed and coefficient taking lifetime, surrounding conditions and shape of facility into account

(c) Design seismic coefficient

The design seismic coefficient is based on the Vietnamese Standards. This corresponds to the seismic hazard of 10% in 50 years.

Fig. 4.6-14 Design Wind Speed in Vietnam

(Source: Damage Cause by Strong Wind & Wind Loads Standard for Building in Vietnam, June 2005)

4.6.3 Cooling Water(C/W) Discharge Channel

(1) Required Water Volume

The required water discharge for the O Mon Power Plants are planned as follows.

Table 4.6-7 Required Water Discharge for O Mon Power Plants

No.	Plant	Plant Type	Capacity (MW)	Owner	Year in Operation	Total Demand for Cooling Water (m^3/s)[*1]
1	O Mon I	Conventional Steam Power Plant	660 (330+330)	EVN	2009(#1) 2014(#2)	32.0
2	O Mon II	Combined Cycle	750	BOT		18
1 & 2	-	-	1,410	-	-	50.0
3	O Mon III	Combined Cycle	750	EVN	2017	18
4	O Mon IV	Combined Cycle	750	EVN	2016	18
3 & 4	-	-	1,500	-	-	36.0
Total	-	-	2,910	-	-	86.0

(Source: Information by CTTP)

(2) Intake

Intake structure is a common facility between O Mon 3 and 4, therefore it should be installed between both plants. The intake structure will be constructed in the O Mon 4 Project.

The water way from the intake to the power house should be constructed by each project respectively. The water way is to be constructed with

4.6.4 CW Water Discharge Channel

(1) Existing Channel

The CW discharge channel for the O Mon 1 and 2 power plants is composed of culvert and channel.

The design in the CW discharge channel for the O Mon 1 and 2 was made as follows.

Structure	:	Open Channel (1 No.) and Culvert (2 Nos. for O Mon 1 and O Mon2) *
Power Generation Facility	:	Conventional Type in both 1 and 2 (4 units of 1-A, 1-B, 2-A, and 2-B)
Power Output	:	300MW × 4 Units
Design Discharge	:	Open Channel (52 m^3/s, 13m^3/s × 4), Culvert (26m^3/s × 2)
Dimension of Channel	:	Shown in Fig. 4.6-15

*The design concept of CW discharge channel has been changed as follows.

Stage		O Mon 1 F/S	Construction of O Mon 1-A	Planning of O Mon 3 & 4
Output		1,200MW	1,410MW	2,910MW
		(300MW × 4 Units) for O Mon 1&2	O Mon 1: 660MW (330MW × 2) O Mon 2: 750MW	O Mon 1: 660MW O Mon 2-4: 750MW
CW Discharge		52m^3/s: 13 × 4 Units	50m^3/s: O Mon 1: 16 m^3/s × 2 O Mon 2: 18m^3/s	86m^3/s O Mon 1: 32 m^3/s O Mon 2-4: 18 × 3 m^3/s
Water Channel	Open	1 Nos (Q=52m^3/s)	1 Nos (Q=52m^3/s)	2 Nos No.1: O Mon 1 & 2 (Q=52m^3/s) No.2: O Mon 3 & 4 (Q=36m^3/s)
	Culvert (Common)	1 Nos (Q=52m^3/s) for O Mon 1&2	2 Nos No.1: O Mon 1 (Q=32m^3/s) No.2: O Mon 2	3 Nos No.1: O Mon 1 (Q=32m^3/s) No.2: O Mon 2 No.3: O Mon 3 & 4 (Q=36m^3/s)

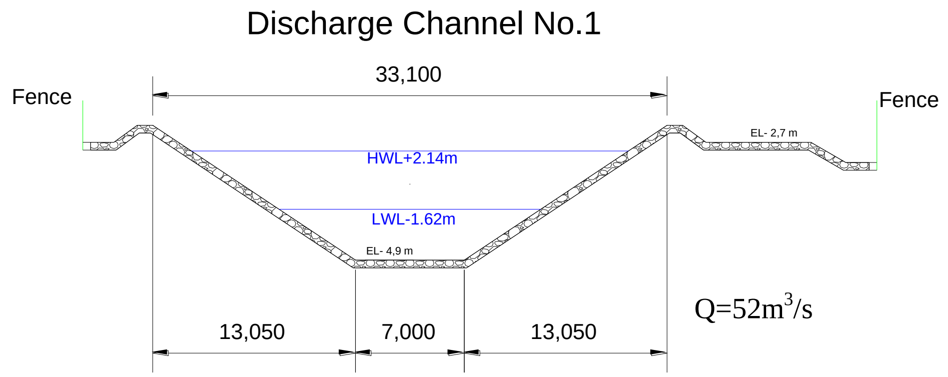
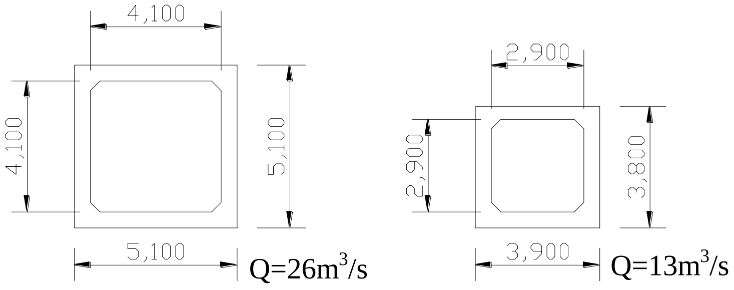


Fig. 4.6-15 No.1 Section of the CW Discharge Canal



(1-A, 1-B Junction to Canal) (1-A(B) Culvert)

Fig. 4.6-16 No.1 Section of CW Discharge Culvert at the Construction of O Mon 1-A

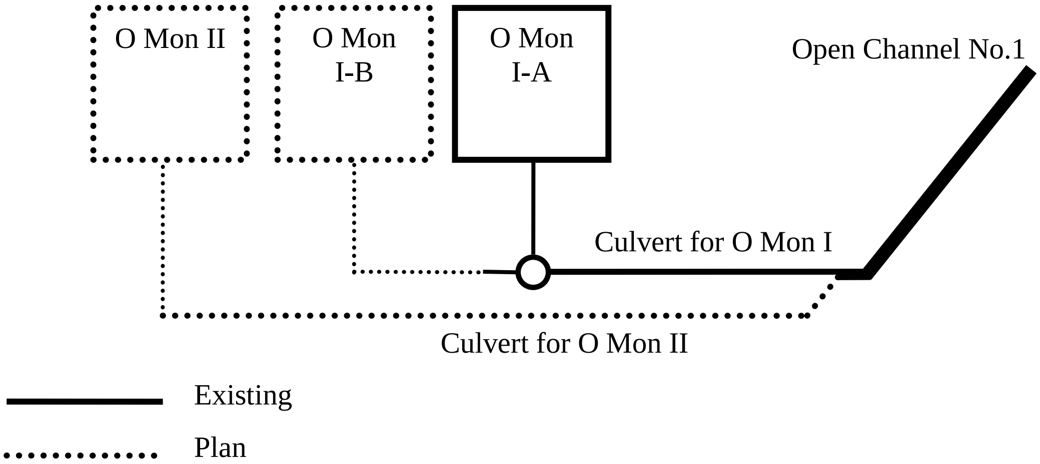


Fig. 4.6-17 Layout Plan of CW Discharge Channel

In the F/S report of O Mon 1, the CW discharge channel is designed to meet the criterion that water level is not more than 2.7m at the upstream end of the culvert. (Calculation results; 2.659m)

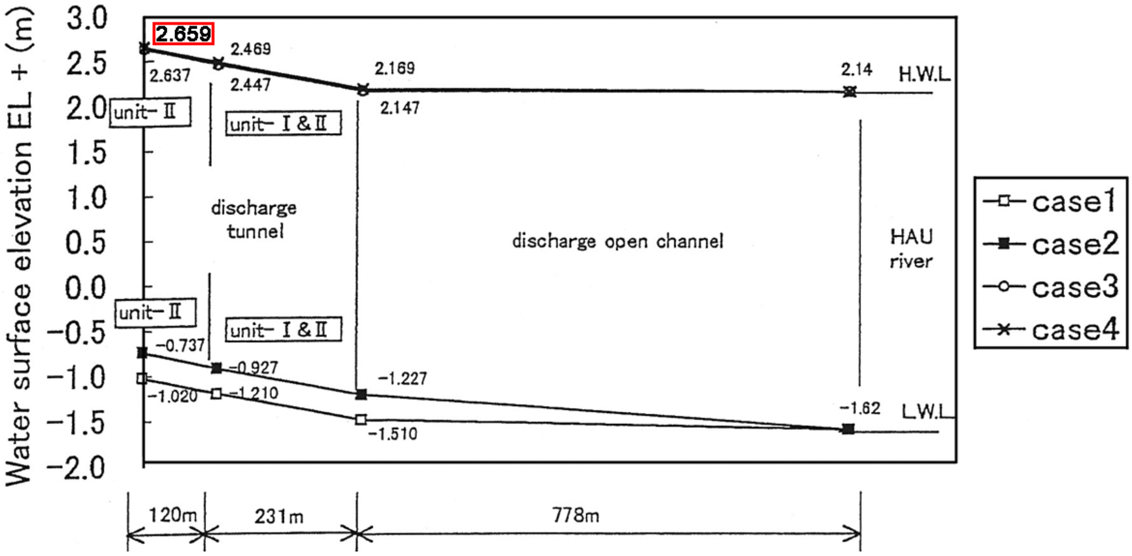


Fig. 4.6-18 Results of Hydraulic Analysis in the FS of O Mon 1

Note: Unit-I and II in Fig. 4.6-18 correspond to 1-A and 1-B at present. (Source: Design on O Mon Thermal Power Plant)

The water level of O Mon 1 has a margin and the design of CW discharge canal for O Mon 2 Power Plant has not made yet. Therefore, the CW of O Mon 3 can be flown through the CW culvert No.2 (Common use between O Mon 2 and 3) and the open channel (Common use among O Mon 1, 2 and 3).

In addition, the foundation of the CW discharge channels has been improved by means of the CDM Method. The CDM Method is a method to improve the ground strength up to designed one by mixing soft ground and cement water mixture at site. The mixing machine was procured from Japan, because it could not be gotten in Vietnam.

(2) New Discharge Channel

Based on the present design such as F/S reports of O Mon 3 and O Mon 4, a new discharge canal for O Mon 3 and O Mon 4 is to be constructed and the syphon type discharge canal has been designed in the F/S report of O Mon 3.

As mentioned above, the O Mon 4 project is responsible for most of newly constructed CW discharge canal and the culvert from powerhouse to connection points to common culvert, which is 80m long, shall be constructed in the project of the O Mon 3 development. The pipe water way from the turbine to the siphon, about 40m long, and the rectangular culvert from the siphon to the connection point, about 40m long, are planned.

On the other hand, the culvert shall pass under the existing transmission lines (220kV/110kV). The clearance between the transmission line to the ground is less than 10m, which is lower than the height of pile driver and mixing machine. Therefore, the power transmission should be suspended in the construction area and the special attention should be paid during the construction. The power generation of the O Mon 1-A Power Plant is suspended in rainy season having enough water discharge, because hydropower plants are prior to thermal power plants in such season due to their lower generation cost comparing to that of thermal power plants. Therefore, the social impacts due to the suspension of the power generation during construction works can be minimized, if the construction works under the transmission line are done in such season. Moreover, CTTP has already understood the suspension of the power generation during the construction works and intends to cooperate such construction works.

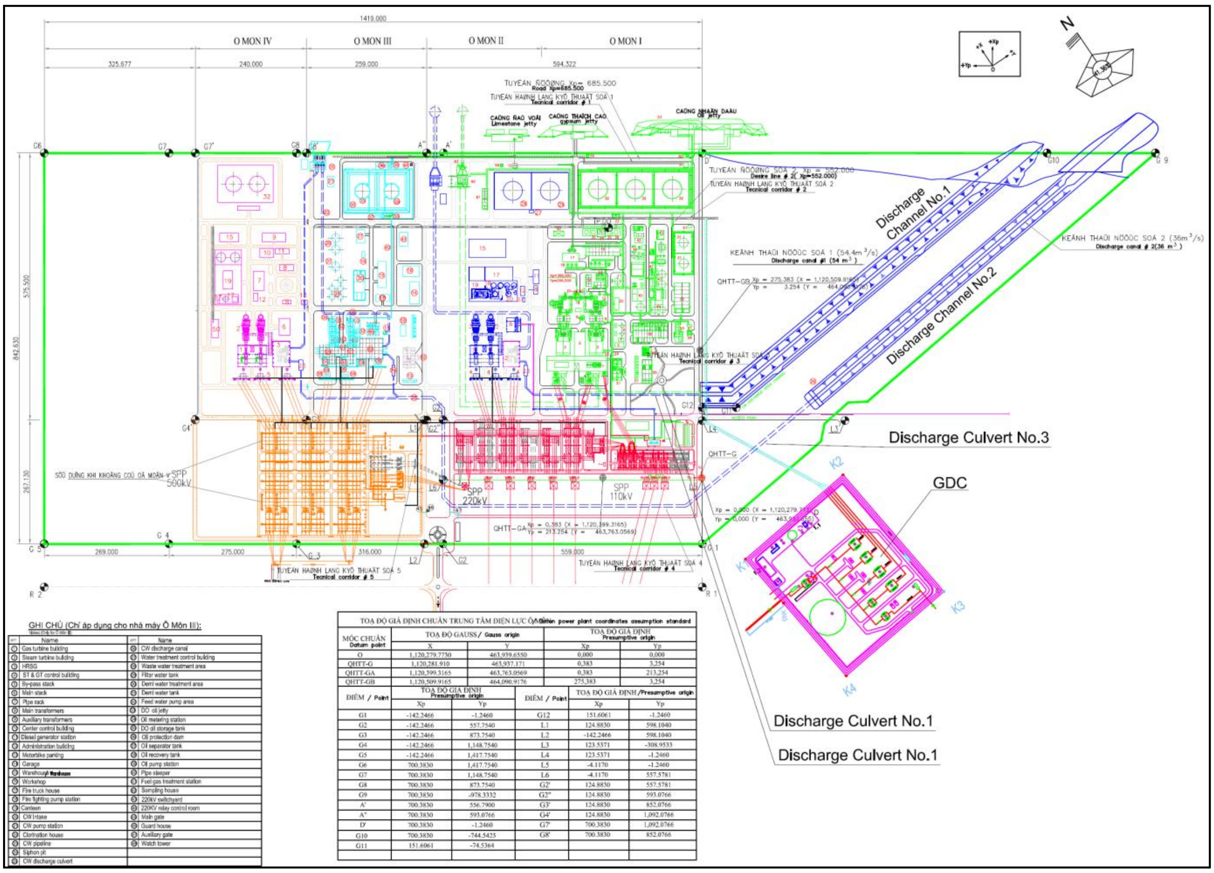


Fig. 4.6-19 Layout of CW Discharge Channel

Photo 4.6-1 Route of CW Discharge Cannel for O Mon 3 and 4

(3) Plan of CW Discharge Canal

As mentioned above, there are two possibilities for the plan of CW discharge canal.

1) The culvert is commonly used with O Mon 2 and the open channel is commonly used with O Non 1 and 2. The open channel No.2 and culvert No.3 are solely used by O Mon 4.
2) The open channel No.2 and culvert No.3 are commonly used with O Mon 4.

For these two plans, the rough hydraulic analysis is carried out and the results are summarized in Table 4.6-8. Based on the results, it is identified that the common culvert No.3 can be lessen by 1 m in width and height when the CW culvert of O Mon 2 is commonly used with O Mon 3.

Herein, it is recommended that the CW discharge canal of O Mon 4 should be commonly used with O Mon 3.

1) It would be difficult to construct the culvert under the transmission line, however it can be done in consideration with appropriate construction method applying not continuous CDM Method but piling works and so on.

2) In the advanced O Mon 4 Project, the CW discharge canal with the dimensions for O Mon 2 as well as O Mon 4 will be constructed and the plan is approved by ADB. In addition, the intake structure for both O Mon 4 and 3 will be constructed in the O Mon 4 Project.

3) When being commonly used with the O Mon 2 Plant, the O Mon 3 should construct the CW discharge culvert. The O Mon 2 Plant will be developed by IPP, therefore EVN doesn’t want to take more responsibility than the present status.

Table 4.6-8 Results of Hydraulic Analysis for CW Discharge Culvert

Culvert of O Mon 3		Common use with O Mon 2			Common use with O Mon 4		
Culvert (Conditions)	No.	No.1	No.2	No.3	No.1	No.2	No.3
	Used by	O Mon 1	O Mon 2 & 3	O Mon 4	O Mon 1	O Mon 2	O Mon 3 & 4
	Discharge (m^3/s)	32	36	18	32	18	36
Open Channel (Conditions)	No.	1		2	1		2
	Discharge (m^3/s)	68		18	50		36
Open Channel	Water Level at Upstream End (EL.m)	2.17 (V=0.5m/s at HWL)		2.14	2.16 (V=0.4m/s at HWL)		2.15
Culvert	Water Level at Pond or Siphon (EL.m)	O Mon 1-A:2.6 O Mon 1-B: 2.7	O Mon 2: - O Mon 3: 3.4	3.8	O Mon 1-A:2.6 O Mon 1-B: 2.7	3.9	O Mon 3: 3.9 O Mon 4: 4.3
Dimension of Culvert (B × H × L)	Common	4.1m × 4.1m	4.1m × 4.1m	-	4.1m × 4.1m	-	4.1m × 4.1m
		210m	360 m	-	210 m		1,200 m
	To each plant	2.9m × 2.9m	2.9m × 2.9m	3.2m × 3.2m	2.9m × 2.9m	2.8m × 2.8m	2.9m × 2.9m
		O Mon 1-A:26m O Mon 1-B: 100m	O Mon 2:50m O Mon 3: 340m	1,460 m	O Mon 1-A:26 m O Mon 1-B: 100 m	410 m	O Mon 3: 50 m O Mon 4: 260 m
Remarks		Existing	Common Culvert is done by O Mon III		Existing		Common Culvert is done by O Mon IV

4.6.5 Architectural Structures

The main specifications required for the O Mon 3 power plant are summarized in Table 4.6-9. In addition, the common facilities of the O Mon 3 and 4 power plants are cited and those allotments are also mentioned.

Table 4.6-9 Architectural Structures for the O Mon 3 Power Plant

Structure	Specification	Allotment
Powerhouse(including Gas & Steam Turbine Building)	- Steel structure equipping with cranes of 140t and 10t class - Side walls are constructed with corrugated plates and steel plates and roof structures are constructed with steel truss. - Structures are designed in consideration with the life time for 20 to 30 years.	O Mon 3
HRSG, Bypass Stack and Main Stack	- Support structures for HRSG and air cooling tower are constructed with steel. - The required height of bypass stack and main stack will be 40m and 60m, respectively. They shall take EIA into account.	O Mon 3
Control Building	- Reinforced concrete structure (25MPa) with three floors. The grade of the reinforcement is CII-CIII. - The walls are constructed with bricks with holes, cement block or concrete.	O Mon 3
Administration Building	- It is desirable to be column structures with reinforced concrete (25MPa). Walls are constructed with cement block. - For fire prevention, exit shall be installed by the stairs. - It is expected to be of 3 stories.	O Mon 4
Auxiliary Building		
Workshop	- The structure is normally of one span and one story. - Steel structure equipping with a crane of 10t class.	O Mon 3
Warehouse	- The same structure as the workshop is applied. - It equips with a crane of 10t class.	O Mon 3
Vehicle Maintenance and Garage Building	- The structure of one span and one story is constructed with steel. It is expected that the insulation roof is installed and the walls are constructed with bricks - It is required to have areas for parking lot of bus and cars, washing and repair works, rest room, tool storage and so on.	O Mon 4
Motorbike Parking	- It is constructed with steel and of one span and one story. - The roof is composed of an insulation material and it has no walls.	O Mon 4
Foundation of DO Tanks and Dike	- The embankment (boundary walls) to protect concrete surface due to outflow of oil is installed around the tanks.	O Mon 3
Fuel Oil Measurement Station	- Outdoor type of the fuel oil counter station is applied.	O Mon 3
Fuel Oil Pump House	- It is planned to be installed along the fuel oil pipeline. - It has two types, namely outdoor type and indoor type. The type will be proposed by the Contractor.	O Mon 3
Fuel Gas Treatment and Fuel Gas Distribution Center	- They are installed along the gas supply pipeline and those structures are constructed with steel. The necessity of walls will be proposed by the Contractor. - The steel roof is installed to prevent from infiltration of rain water.	O Mon 3
Pre-Treatment Water Plant	- It is required to install raw water tanks, water tanks during filtration, storage tanks including sedimentation tanks, filtration ponds, and water treatment system for sewage from offices and so on for Pre-Treatment Water Plant.	O Mon 3
Raw Water Tank	- Two tanks are necessary. - It is constructed with reinforced concrete and equips stairs for maintenance works.	O Mon 3
Sediment Basin	- The structure is the same as the raw water tank.	O Mon 3
Emergency Diesel Generator Building	- It is of one story and flat roof and constructed with reinforced concrete. - Main materials are of concrete (25MPa) and reinforcement (CII-CIII).	O Mon 3
Main Transformer	- In architectural works, there are foundation works for transformer and oil separator,	O Mon 3

Structure	Specification	Allotment
	and construction works for fire division walls (6 to 12m), oil tank, oil separator, oil pipes, fence and so on. - Oil separator and oil pipeline are constructed with reinforced concrete. - Main materials are of concrete (25MPa) and reinforcement (CII-CIII).	
Auxiliary Transformer	- The structure is the same as the main transformer.	O Mon 3
Cable Trench and Cable Duct System	- The cable trench is constructed with reinforce concrete and equips removable concrete cover. - In case that the cable trench is installed across roads, the trench is of underground culvert and PVC pipes are installed in the culvert. - Main materials are of concrete (25MPa) and reinforcement (CII-CIII).	O Mon 3
Fire Fighting System	- The fire fighting system includes fire pump area and fire water pipes for fire fighting.	O Mon 3
Transportation Road System (Internal Road)	- Roads are classified into four (A-10, B-8, C-6, C-4). - All roads shall be paved and equip sidewalks with 1.5m wide for A-10 and 1.0m wide for the others. - The A-10 road is classified into the Grade III whose design transportation capacity is 300-1000 cars/day and design speed is 80km/h, and the others are classified into the Grade V whose design transportation capacity is 50-300 cars/day and design speed is 40km/h.	O Mon 3
Security Facility		
Fence	- Fences are constructed with concrete walls or wire nets. - Outside fences is more than 3m high and take impulse and eyes from outside into account. - Fence at gates is 2 to 3 m high. - Main materials are of concrete (25MPa), reinforcement (CII-CIII) and steel (CT3 or B40).	O Mon 4
Guard House	- It is of one story and flat roof, constructed with reinforced concrete and located around the gates of the complex. - It equips an office, a watch room, a kitchen, toilets, etc.	O Mon 4
Gate of Power Plant	- It is desirable to install two gate, main and sub gates. - The main gate is for vehicles and is expected to be electric movable steel frame structure. - The sub gate is for bikes and pedestrians.	O Mon 4
Security Tower	- It is desirable that the security tower is installed at the center of the complex and around the outside fences - It is constructed with reinforced concrete and has a watch room at the height of 6-9m.	O Mon 4
Cooling Water System		
CW Head Intake and CW Pump Station	- The cooling water is taken from the Hau River. - The capacity of pump for the cooling water is 18m^3/s. - It is desirable that the building for the CW pump station should be of steel structure and insulation steel roof and equips 20t class crane. - It is necessary to install 10t class gantry crane for outdoor apparatus such as screen and so on. - The CW pump station should have an enough space for 4 units of pumps and other required facilities.	O Mon 4 However, pump and screen should also be installed in O Mon 3.
Pipeline from CW Pump Station to Condenser and from Condenser to Siphon Pit	- Pipe diameter will be about 2.2m and its material is to be steel, Glassfiber Reinforced Plastic GRP), or High-density Polyethylene (HDPE). On the other hand, the steel pipes shall be utilized after condenser taking into consideration of water temperature. - Manholes for maintenance works should be installed.	O Mon 3
Siphon Pit	- It is constructed with reinforced concrete (25MPa) and its reinforcement is CII-CIII class.	O Mon 3

Structure	Specification	Allotment
CW Discharge Culvert	- It is desirable for the culvert to be reinforced concrete (25MPa) structures. - Joints every 12 to 20m and manholes every 50 -70 m should be installed in the culvert.	O Mon 4
CW Open Discharge Cannel	- The capacity of the canal is 36m^3/s for O Mon 3 and 4 plants.	O Mon 4
Chlorination Building	- It equips facilities required to store chlorite and put it into the pump station. - The building is of one story and flat roof and constructed by reinforced concrete. The sidewalls are constructed with bricks with holes.	O Mon 3

(Reference: O Mon Combined Cycle Power Project Feasibility Study Report, Sep., 2009, PECC2)

4.6.6 Foundation Work

The geological conditions in the O Mon complex are very loose and its bearing capacity is expected to be 50～150 kN/m^2 (0.5～1.5kgf/cm^2), therefore the improvement of foundation is necessary. The survey results in geology are summarized in Table 4.6-10.

Table 4.6-10 Geology in the O Mon 3 Site

<table>
<tr><td colspan="3">No.</td><td>OM-01</td><td>OM-02</td><td>OM-03</td><td>OM-04</td><td>OM-05</td><td>OM-06</td><td>OM-07</td><td>OM-08</td><td rowspan="5">Soil Classification</td><td rowspan="5" colspan="2">N Value</td></tr>
<tr><td colspan="3" rowspan="2">Location</td><td rowspan="2">Hau River</td><td rowspan="2">Intake (Old)</td><td rowspan="2" colspan="3">GT System</td><td colspan="3">Discharge Channel</td></tr>
<tr><td>(Culvert)</td><td colspan="2">(Open Channel)</td></tr>
<tr><td colspan="3">Length</td><td>50</td><td>50</td><td>100</td><td>100</td><td>100</td><td>50</td><td>50</td><td>50</td></tr>
<tr><td colspan="3">Ground Level</td><td>-20.6</td><td>0.21</td><td>1.08</td><td>1.01</td><td>1.71</td><td>-0.10</td><td>1.53</td><td>1.30</td></tr>
<tr><td colspan="3">WL</td><td>-2.60</td><td>-1.29</td><td>-1.85</td><td>-1.49</td><td>-1.09</td><td>-0.40</td><td>1.03</td><td>0.80</td><td></td><td colspan="2"></td></tr>
<tr><td rowspan="6">Elevation (EL.m)</td><td>Layer-</td><td>1</td><td></td><td>0.2</td><td>1.1</td><td>1.0</td><td>1.7</td><td>-0.1</td><td>1.5</td><td>1.3</td><td>Clay</td><td>5</td><td>(2-10)</td></tr>
<tr><td>Layer-</td><td>2</td><td></td><td>-1.6</td><td>-1.1</td><td>-1.0</td><td>-0.1</td><td>-1.7</td><td>-1.7</td><td>-0.7</td><td>Clay</td><td>0</td><td>(0)</td></tr>
<tr><td>Layer-</td><td>3</td><td>-20.6</td><td>-13.7</td><td>-10.4</td><td>-11.5</td><td>-11.2</td><td>-12.1</td><td>-16.1</td><td>-16.9</td><td>Clay</td><td>16</td><td>(3-37)</td></tr>
<tr><td>Layer-</td><td>4</td><td>-26.6</td><td>-26.0</td><td>-29.1</td><td>-29.7</td><td>-27.0</td><td>-27.8</td><td>-27.2</td><td>-27.5</td><td>Sand</td><td>17</td><td>(9-58)</td></tr>
<tr><td>Layer-</td><td>5</td><td>-37.2</td><td>-33.2</td><td>-33.2</td><td>-34.4</td><td>-32.0</td><td>-38.1</td><td>-39.0</td><td>-39.7</td><td>Clay</td><td>17</td><td>(11-48)</td></tr>
<tr><td>Layer-</td><td>6</td><td>-57.7</td><td>-76.8</td><td>-75.9</td><td>-73.0</td><td>-70.8</td><td></td><td></td><td></td><td>Sand</td><td>60</td><td>(32-103)</td></tr>
</table>

In general, foundation with more than 30 of N-Value for sand or more than 20 of N-Value for clay is defined to have enough strength. From this viewpoint, supporting layer will be Layer-3 or deeper. In the construction works in the O Mon 1-A, the supporting layer for light structure was Layer-3 or 4 and that for heavy equipment/structure was Layer-5. Because the geological conditions of the O Mon 3 site are very similar to those of the O Mon 1-A site and the problems in foundation have not occurred, it is desirable that the design philosophy of the O Mon 3 should be the same as that of the O Mon 1-A.

The minor settlement can be allowed for the main structure, therefore the Pre-stressed High Strength Concrete Pile (PHC Pile) is normally applied for the main heavy structures. The following types of foundation works are expected in the plant.

1) PHC Pile Foundation (L=42~48m)
2) PHC Pile Foundation or RC Pile Foundation (L=24~30m)
3) Direct Foundation

The expected specifications for foundation works are shown in Table 4.6-11.

Table 4.6-11 Foundation of Main Structures for O Mon 3

No.	Structure	Foundation
1	Gas turbine, Steam turbine, HRSG, By pass Stack, Stack, Transformer	Reinforces Concrete PHC Pile, D600, L=42m
2	Oil tank foundation, Pure water tank, Dematerialize water tank	Reinforces Concrete PHC Pile, D600, L=42m
3	Siphon pit	Reinforces Concrete PHC Pile, D600, L=42m
4	Dematerialize water plant	Reinforces Concrete PHC or RC Pile, D400, L=24m
5	Gas treatment and supply station, Oil pump station, Oil recovery pit	Reinforces Concrete PHC or RC Pile, D400, L=24m
6	Oil metering station	Reinforces Concrete PHC or RC Pile, D300, L=24m
7	Workshop, Warehouse	Reinforces Concrete PHC or RC Pile, D400, L=24m
8	Cable trench, Road, Side ditch	Direct foundation

In addition, it was reported that the Cement Deep Mixing (CDM) Method applied for the foundation improvement works of pump pits, discharge channel (both open canal and culvert) and river revetment in O Mon 1-A plant was effective way. The CDM Method can improve the foundation to 400 to 750 kN/m^2 in baring capacity without piling works.

4.6.7 Plan for Material Transportation and Temporary Facility

(1) Plan for Material Procurement and Transportation

1) Construction materials

Construction materials for architectural and civil works are basically procured in Vietnam, except main steel materials for structures.
The steel for O Mon 1-A and Non Trech Thermal Power Plant were procured out of Vietnam, because required quality and quantity were not satisfied. Therefore, the steels are to be procured from out of Vietnam.

2) Construction equipment

The main construction equipment used in O Mon 3 Thermal Power Plant is expected as follows.

- Dump Truck
- Bulldozer
- Backhaus
- Compaction Roller
- Crane (Truck Crane, Cruller Crane, barge with crane, etc)
- Pile drivers with excavation/drilling equipment
- Concrete mixing plant, etc.

They can be procured in Vietnam. As mentioned above, the EPC contractor for O Mon 1-A procured the mixing machine for the CDM method from Japan.

3) Plan for material transportation

Much amount of construction materials will be necessary for the O Mon No.3 construction works. Moreover, in general, the sufficient construction schedule will not be proposed by the Owner to follow the rush National Development Plan. Therefore, the proper transportation plan will be a key to finalize construction works within the given deadline.

Under the site conditions such as the O Mon, the material will be generally transported with a barge for heavy equipment and materials and with a load for light materials procured nearby.

The temporary jetty, which was used for the construction works in the O Mon 1-A, has been constructed in the northeast side of O Mon 1-A Power Plant. Therefore, the temporary jetty is available for the transportation for construction works in the O Mon 3, including heavy equipment such as a gas turbine and a generator. In addition, the broad area in the southwest of the O Mon 4 planned area has been acquired and the temporary jetty for the construction works of the O Mon 3 can be newly constructed here.

Using a road, the way to the O Mon 3 will be through National Road No.91 and O Mon 1-A Road (Access road to O Mon 1-A) or No.2 Road (Access road to center of the O Mon power complex whose construction will be completed in March, 2012.

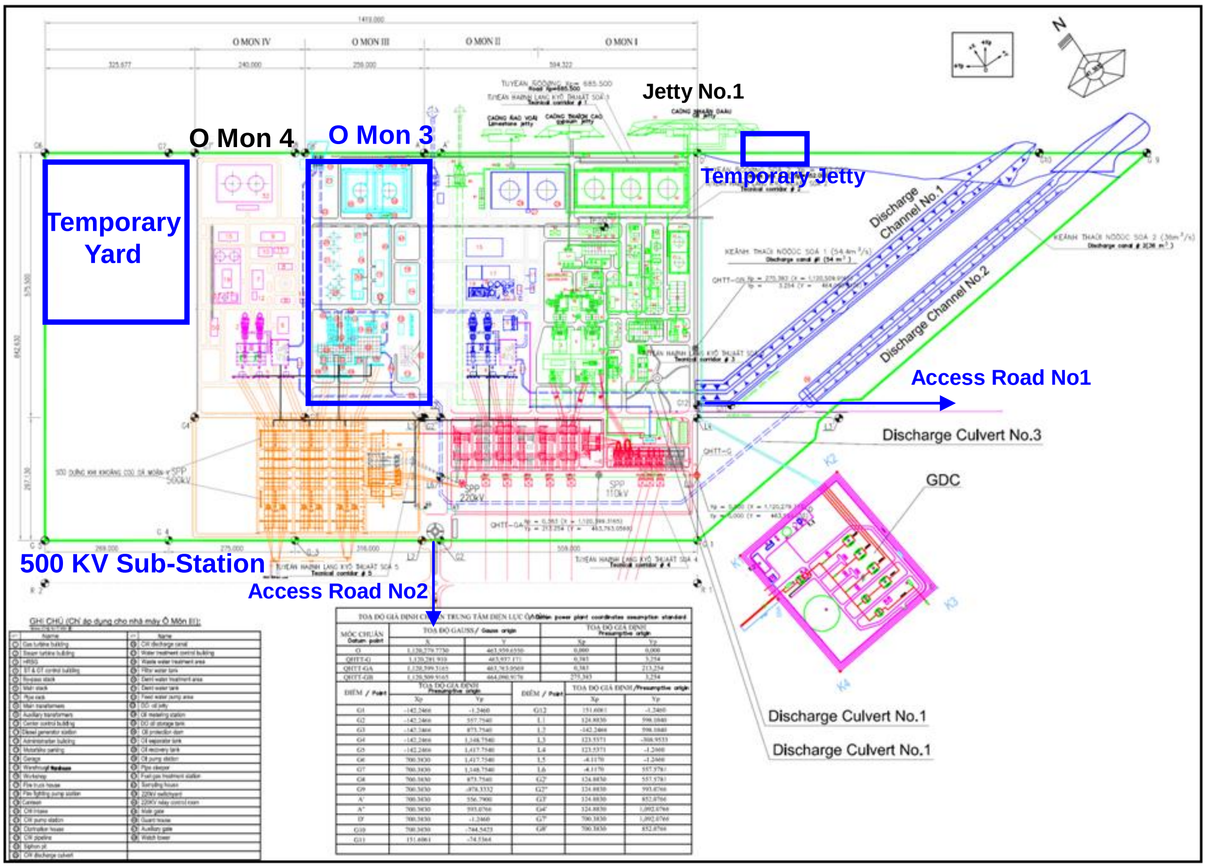


Fig. 4.6-20 Location Map of Temporary Yard

(2) Plan of Temporary Yard

The planned temporary yard is located in the area in the river side of north-eastern area of O Mon 4 power plant site, whose land acquisition has been completed. The location is shown in Fig. 4.6-20.

The area of the temporary yard is about 147,000m^2 (350m × 420 m).

The main advanced and temporary works are summarized in Table 4.6-12.

Table 4.6-12 Main Advanced and Temporary Works

Structure	Explanation
Temporary Works for Construction	
Site Preparation Works	
Sand filling and Leveling	- To carry out filling and smoothing to secure required elevation for the power plant. The landfill works has been finished.
Sheet Pile Revetment Work	- The riverbank protection works such as riprap works is necessary, because the power plant faces the Hau River. The riverbank protection is to protect any damages caused by river flow, land slide, infiltration of river water and construction works. - Based on the results of the geological investigations, geological structures at the site are very loose and the layer with the N-value of 0 widely exists upto 10 to 20m depth from the surface. - To ensure stability of the protection works, the sheet pile can be utilized.
Temporary Unloading Jetty	- The temporary jetty used in construction works of O Mon 1 is available. - When it is desirable that the temporary jetty should be constructed nearby the plant site, it can be installed in the upstream area of the O Mon 4 plant site - The above mentioned 2 options are selected by a contractor.
Power for Construction	- The expected power for construction will be about 20kW x 40 for welding machine, 100kW x 2 for concrete plants, 300kV x 1 for workshop, 1,500kW x 1 for water and power supply for contractor, consultant and owner and so on. The total power will be about 2,800kW. For this power demand, the power supply facilities of 2,500kVA are required.
Water for Construction	- The expected water demand will be about 5.72m^3/h for concrete plant, 0.06m^3/h for architectural works, 0.6m^3/h for plastering, 20m^3/h for material wash, 8.34m^3/h for office use and so on, total required water will be about 40m^3/h. - Water source will be the Hau River, the water for the office will be filtered and sterilized, The water supply facilities will be raw water tank of 60m3, slow filtration equipment, pump of 40-50m^3/h, water supply facilities in offices and so on.
Site Office	
Site Office for Owner and Consultant	- Site office for Owner will be utilized by Project Management Board and consultant. - The insulation roof and brick wall will be applied for the office.
Site Office for Constructor	- The size of the site office for the Contractor depends on the number of the EPC Contractor's staff.

(Source: O Mon Combined Cycle Power Project Feasibility Study Report, Sep., 2009, PECC2)

In addition, the required area for the temporary yard is summarized in Table 4.6-13.

The area of the available temporary yard in Table 4.6-13 is now two times as large as that of the required temporary yard due to the cancellation of construction of O Mon 5 power plant, and it is broad enough.

Table 4.6-13 Temporary Yard Plan

No.	Items	Dimension
1	Equipment Gathering Yard	200m × 100m
2	Trial Assembling Yard	150m × 100m
3	Equipment Warehouse	100m × 50m
4	Steel Warehouse	25m × 50m
5	Cement Warehouse	25m × 50m
6	Sand Storage	50m × 60m
7	Rock Pile of 1 × 2, 4 × 6 in size	50m × 60m
8	Reinforcement Warehouse	25m × 50m
9	Steel Processing Workshop	50m × 50m
10	Reinforced Concrete Placing Area	100m × 50m
11	Site for Prefabricated Reinforced Concrete Component	75m × 50m
12	Wood Processing Workshop	25m × 25m
13	Vehicle Garage	75m × 50m
14	Construction Equipment Repairing Workshop	25m × 25m
15	Construction Site Steering Committee	50m × 50m
16	Camps for Construction Workers	50m × 100m
17	200m^3 Raw Water Tank	-
18	Domestic Water Tank of 10m^3/tank	-
Total Area of Construction Site (Larger than the total area of above items)		73,500m^3

(Source: O Mon Combined Cycle Power Project Feasibility Study Report, Sep., 2009, PECC2)

4.7 CURRENT STATUS OF COMMON FACILITIES AND THEIR AVAILABILITY

Change of Surroundings of the Project

(1) Construction of par of common facilities for O Mon 3 power plant has been already done.

(2) Commencement of commercial operation and construction of O Mon 4 power plant becomes earlier than those of O Mon 3 power plant.

Based on the above change of surroundings of the Project, availability of common facilities for O Mon 3 power plant was discussed and confirmed between CTTP, ADB and JICA Study Team.

4.7.1 Current Status of Common Facilities and their Availability

(1) Current Status of Common Facilities

18 common facilities are available for O Mon 3 power plant as shown in Table 4.7-1, and out of 18 facilities, 6 facilities has been already constructed and the remaining 12 facilities are newly constructed.

(2) Allocation of Construction Cost for Common Facilities

As shown in Table 4.7-1, the construction cost for two common facilities is allocated to O Mon 3 project, although the construction cost for the remaining fifteen common facilities are out of expense of O Mon 3 project.

Table 4.7-1 Allocation of Construction Cost for Common Facilities

No.	Common facilities for O Mon 3 and O Mon 4 of which construction cost of 100 % is allocated to O Mon 4 project	No.	Common facilities for O Mon 3 and O Mon 4 of which construction cost of 100 % is allocated to EVN
1	Administration Building	1	Construction Power
2	500KV Switchyards(Common Civil Work)	2	Land leveling for operating Staff Quarter
3	CW Intake & CW Pump Station	3	Road for common use between O Mon 3 & 4
4	CW Discharge Canal No.2	4	Disarming the explosion and bomb
5	CW Discharge Culvert (to Tie-Point)	5	Compensation and clearance for site layout, operation and management compound infrastructure
6	Fire Fighting Trucks		
7	Piping Rack & Sleeper for DO/Gas		
No.	Common facilities for of which construction cost of 100 % is allocated to O Mon 3 project	No.	Other Common facilities
1	Guard House & Gate (main & sub): for O Mon 3 and O Mon 4	1	DFO Unloading Jetty: 100% allocated to O Mon 1
2	Watch Tower：for O Mon 1 ~ O Mon 4	2	500kV Station (including Switchyards Control House): Constructed by National Transmission Co.
		3	200kV Relay Control Room：Constructed by O Mon1

In addition to the above, Table 4.7-2 shows the cost allocation relating to the common facilities in the O Mon Power Complex.

Table 4.7-2 Cost Allocation of Common Facilities in O Mon Power Complex

No.	Common facilities	Related power plants	New	Existing	Cost Allocation (%)			
					O Mon 1	O Mon 2	O Mon 3	O Mon 4
1	Administration Building	O Mon 3 & O Mon 4	○		0	0	0	100
2	500kV Switchyard (Common Civil Work)	O Mon 3 & O Mon 4	○		0	0	0	100
3	CW Intake and CW pump Station	O Mon 3 & O Mon 4	○		0	0	0	100
4	CW Discharge Culvert	O Mon 3 & O Mon 4	○		0	0	0	100
5	CW Discharge Canal No.1	O Mon 1 & O Mon 2		○	50	50	0	0
6	CW Discharge Canal No.2	O Mon 3 & O Mon 4	○		0	0	0	100
7	Construction Power	O Mon 3 & O Mon 4	○		EVN to be invested			
8	Land leveling for operating staff Quarter	O Mon 2、3 & 4	○		EVN to be invested			
9	Road for common use between O Mon III & O Mon IV	O Mon 3 & O Mon 4	○		EVN to be invested			
10	Disarming the explosion and bomb	O Mon 3 & O Mon 4		○	Completed by EVN			
11	DFO unloading Jetty	O Mon 1 ~ O Mon 4		○	100	0	0	0
12	Compensation and clearance for site layout area, operation and management compound infrastructure	O Mon 3 & O Mon 4		○	Completed by EVN			
13	Switchyard 220kV & 110kV (including switchyard control house)	O Mon 1 & O Mon 2		○	50	50	0	0
14	500kV station (including switchyard control house)	O Mon 3 & O Mon 4	○		Constructed by National Transmission Company			
15	Fire fighting trucks	O Mon 3 & O Mon 4	○		0	0	0	100
16	200kV Relay Control Room	O Mon 1 ~ O Mon 4		○	100	0	0	0
17	Piping Rack & Sleeper for DO/Gas	O Mon 1 ~ O Mon 4	○					100
18	Guard House & Gate (main & sub)	O Mon 3 & O Mon 4	○				100	0
19	Watch Tower	O Mon 1 ~ O Mon 4	○		0	0	100	0

4.7.2 Other Equipment and Facilities

CTTP informed that the following equipment and facilities were not common use and to be constructed by each project.

No.	Equipment and Facilities	No.	Equipment and Facilities
1	Warehouse	5	Canteen
2	Workshop	6	Fire fighting pump Station
3	Vehicle maintenance Garage Building	7	Fire fighting water Pipeline
4	Motorbike shed		

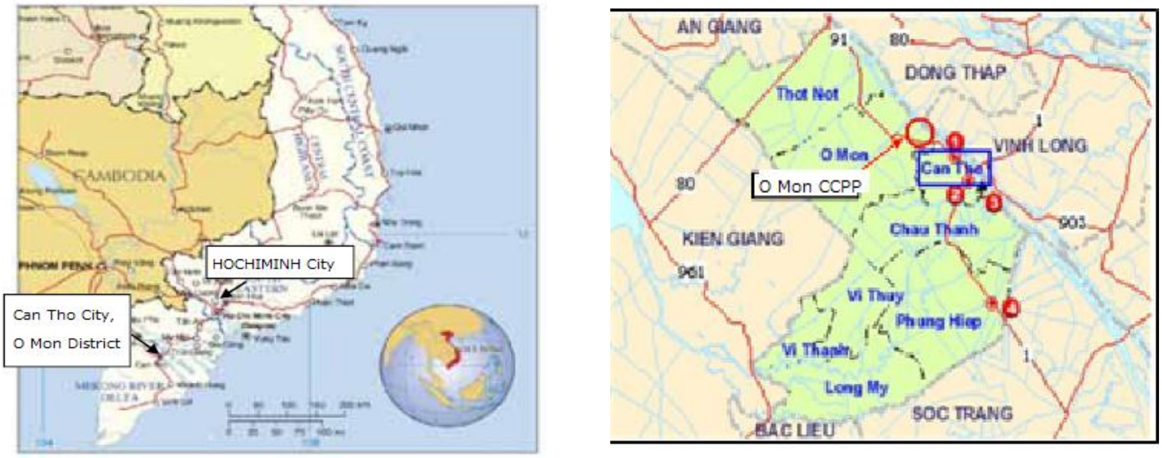
Note) - Electric fire water will be installed by O Mon 4 project.
- Outer fence will be installed by CTTP by his own finance.

CHAPTER 5 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

5.1 OVERVIEW OF THE PROPOSED PROJECT SITE (NATURAL AND SOCIAL ENVIRONMENT)

5.1.1 Location

O Mon 3 combined cycled power plant (CCPP) project will be constructed within O Mon Power Complex, which is located at O Mon District, Can Tho City. O Mon 3 power plant is located at approximately 18 km on north-northwest from the center of Can Tho City. North-east side of the Complex faces Haw River, with O Mon Canal surrounding the west side and National Road No. 91 running the south-east side, which makes the project site being located at a convenient place in terms of transportation and infrastructure. The land has mainly been used for agriculture (O Mon 3 EIA 1.3, p.6).



Source: http://www.jica.go.jp/environment/advice/pdf/giji/advice15_data.pdf Source: http://www.hotelVietnamonline.com/cantho/index.html

Fig. 5.1-1 Location of the O Mon Power Complex

5.1.2 Natural Environment

(1) Topography

O Mon Power Complex is encompassed by Hau River and Chanh - Vam arroyos. Hau River is straight in this area, flowing from north-west to south-east, 900m width and the maximum depth of 22 - 23m. River banks are stable without any landslide. O Mon District is located in the center of Mekong Delta, on the right bank of Hau River. The ground is generally flat, with average altitude of 1.2 - 1.4m above sea level, tilted toward the inland area (O Mon 3 EIA, p.33).

(2) Geology

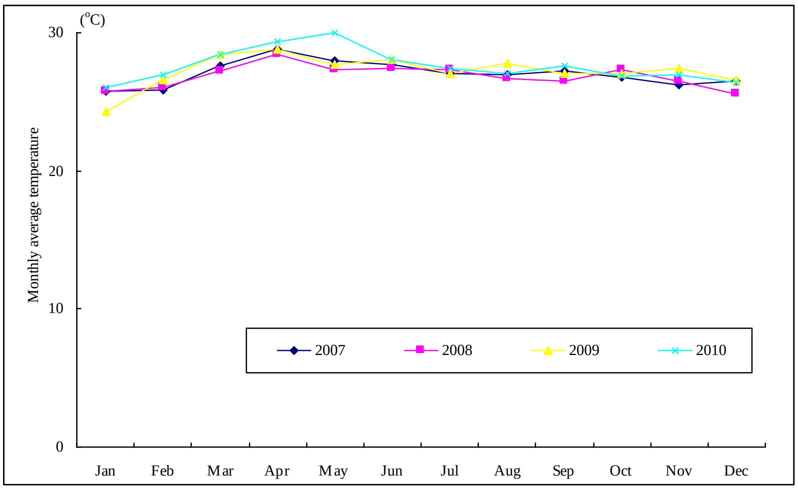
O Mon area has the geological feature of western region of Hau River, a stripped marsh deposit, associated with yearly sediment deposition of Hau River flood on the ancient deposit. The deposit layer is thinner in the inland area. The geology of the area consists of three layers: clay layer, clayed silt, and spotted clay. The clay layer is 1-2m thick and has bearing capacity of 1.2kg/cm^2. The clayed silt layer has bearing capacity of 0.3kg/cm^2, and the spotted clay layer has the highest thickness with bearing capacity of 1.5kg/cm^2, suitable for usage for the project basement (O Mon 3 EIA 3 2.2.2, p.33-34).

(3) Climate

O Mon district is situated in the central Mekong Delta, in the typical tropical climate zone. The climate is strongly affected by two monsoon regimes: north-west monsoon and south-west monsoon, making two clearly distinct seasons (dry season and wet season). The meteorological survey result by Can Tho City Statistic Bureau is shown in the figures below (O Mon 3 EIA 2.2.3, p.34).

1) Temperature

The annual average temperature in Can Tho City is 27°C, the lowest monthly average temperature being 26.2°C (December) and the highest monthly average temperature being 29°C (April). The highest temperature observed is 40.0°C, and the lowest temperature observed is 14.8°C. Fig.5.1-2 indicates the monthly average temperature in Can Tho City in 2007-2010 (O Mon 3 EIA 2.2.3, p.34).

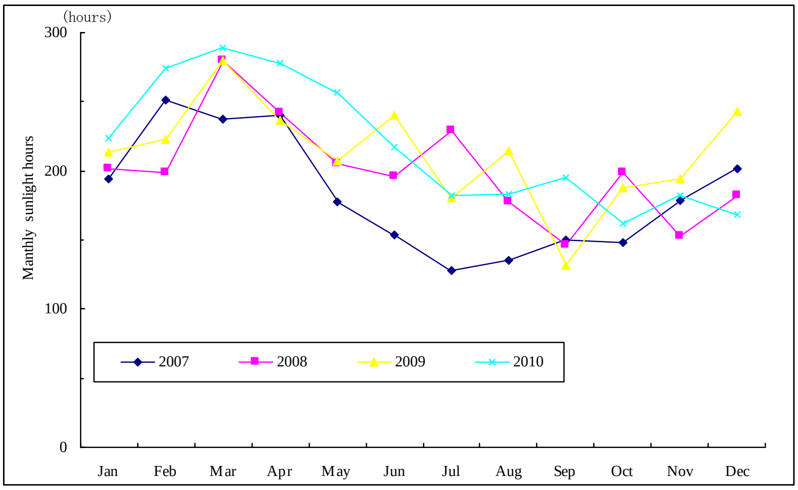


Prepared based on Cantho Statistic Bureau, 2011

Fig. 5.1-2 Monthly Average Temperature in Can Tho City (2007-2010)

2) Solar Radiation

Can Tho City is located at low latitude, with constant solar altitude throughout the year and the solar radiation is also stable. The monthly average solar radiation quantity is about 430.6 cal/cm^2, the maximum being 521 cal/cm^2 (March) and the minimum being 391 cal/cm2 (September). Solar radiation quantity is relatively high in dry season (March to April) and low in rainy season (September to October). The annual average total radiation calorie is 5.17kcal/cm^2. Fig. 5.1-3 shows the monthly average sunshine hours in Can Tho City in 2007-2010 (O Mon 3 EIA 2.2.3, p.35).



Prepared based on Cantho Statistic Bureau, 2011

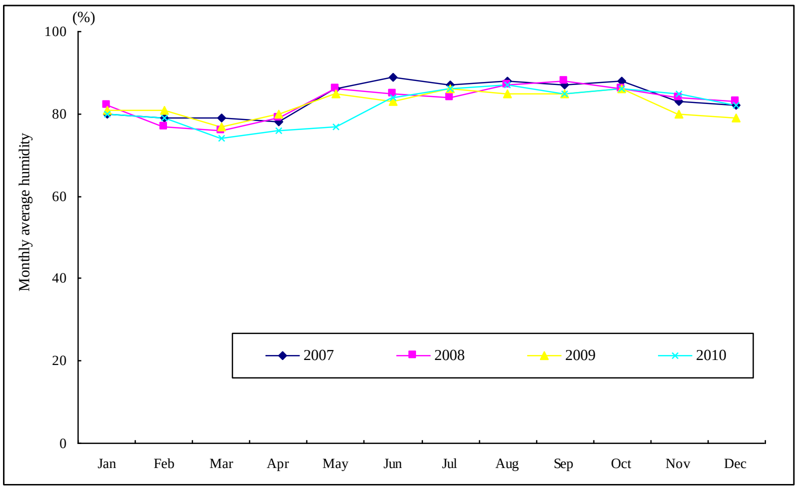
Fig. 5.1-3 Monthly Average Sunlight Hours in Can Tho City

3) Air pressure

Air pressure in the area fluctuates a bit, depending on the season. The annual average air pressure is 1009.6 hPa, the maximum monthly average being 1019.6 hPa, and the minimum monthly average being 1000.0 hPa (O Mon 3 EIA 2.2.3, p.35).

4) Humidity

The humidity of Can Tho City does not become below 75%. The yearly average relative humidity is 82.3%. The humidity is high from July to November and low from February to April. Fig. 5.1-4 indicates the monthly average humidity in Can Tho City in 2007-2010 (O Mon 3 EIA 2.2.3, p.35-36).

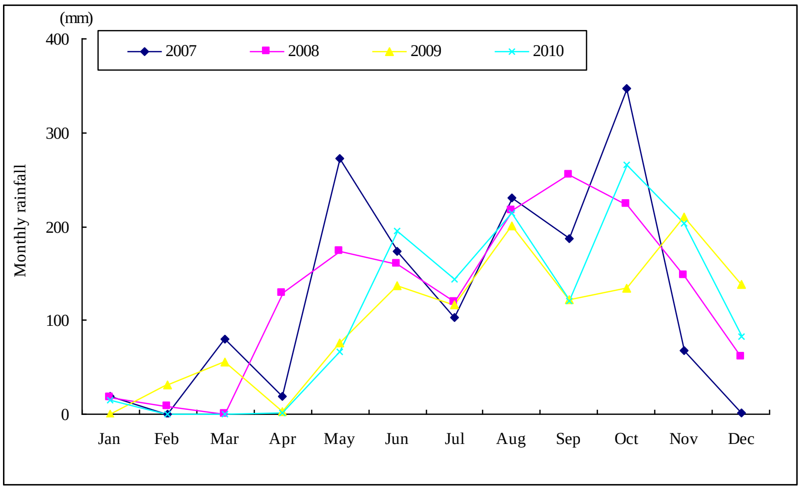


Prepared based on Cantho Statistic Bureau, 2011

Fig. 5.1-4 Monthly Average Humidity in Can Tho City in 2007-2010

5) Precipitation

The rainfall in Can Tho City is concentrated from May to September, accounting for about 80% of total annual rainfall. The average total rainfall in a year is 1415.7mm. The average rainy days per year is 130 days, with the maximum rainy days of 171 days and the minimum of 111 days. The maximum monthly rainfall amount is 439mm in August, 1988. Fig. 5.1-5 indicates the monthly rainfall in Can Tho City from 2007 to 2010 (O Mon 3 EIA 2.2.3, p.35-36).



Prepared based on Cantho Statistic Bureau, 2011

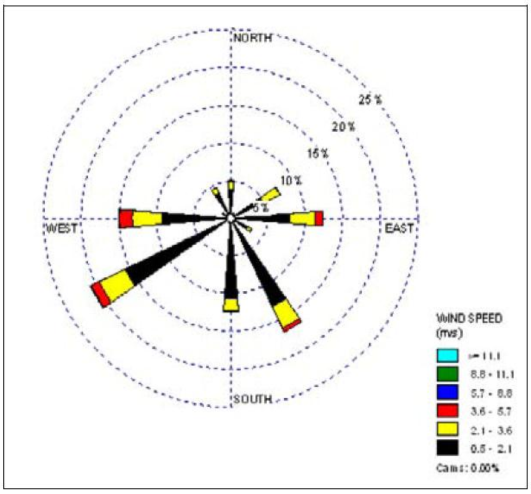
Fig. 5.1-5 Monthly Rainfall in Can Tho City in 2007-2010

6) Evaporation

The annual average evaporation is 750mm. The monthly average evaporation is 50-55mm in rainy season and 60mm in dry season (O Mon 3 EIA 2.2.3, p.37).

7) Wind direction and wind speed

The annual average wind speed in Can Tho City is 3.5m/sec and the maximum wind speed is 31m/sec. The main wind direction in dry season is south-east, and in dry season south-west, bringing humidity from the sea and causes rainfall (Fig. 5.1-6). The area is rarely affected by tropical typhoon, but storm phenomenon occurs rather often (O Mon 3 EIA 2.2.3, p.37-38).



Source: O Mon 4 EIA Figure 36, p. 83

Fig. 5.1-6 Wind regimes in Can Tho City (2006)

8) Atmospheric Stability

The atmosphere stability in the project area is A or B in sunny days with low wind speed (2-4m/sec), C or D in cloudy days and E or F at night (O Mon 3 EIA 2.2.3, p.38).

(3) Hydrology

1) Ground water

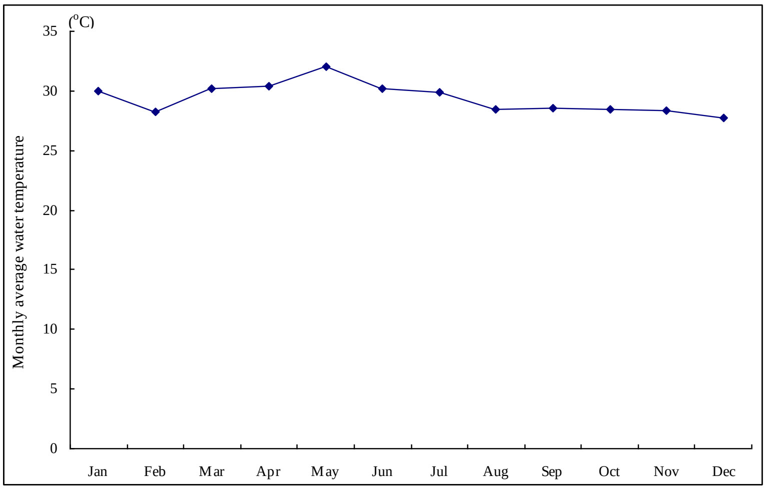
The ground water layer in the project area is rather shallow, about 2.5 ~ 2.93m depth under the ground level. The reserves of the ground water is about 55 ~ 84m^3/sec. The ground water has been exploited by the local people for domestic use. There is not a big project to exploit ground water in the area (O Mon 3 EIA 2.2.4, p.38-39).

2) Hydrologic Features of Hau River

Hau River is one of the downstream branches of Mecong River and flows into the South China Sea by two estuaries named Dinh An and Tran De. Hau River has high amount of flow and is free from salinity, although it is a tidal river. Most of the water usage is consumed in Can Tho City for domestic and industrial purpose (O Mon 3 EIA 2.2.4, p.39).

(a) Water Temperature

The monthly average water temperature of Hau River does not fluctuate much with 27.7 ~ 32.0°C (Fig. 5.1-7) (O Mon 3 EIA Table 2.8, p.40).

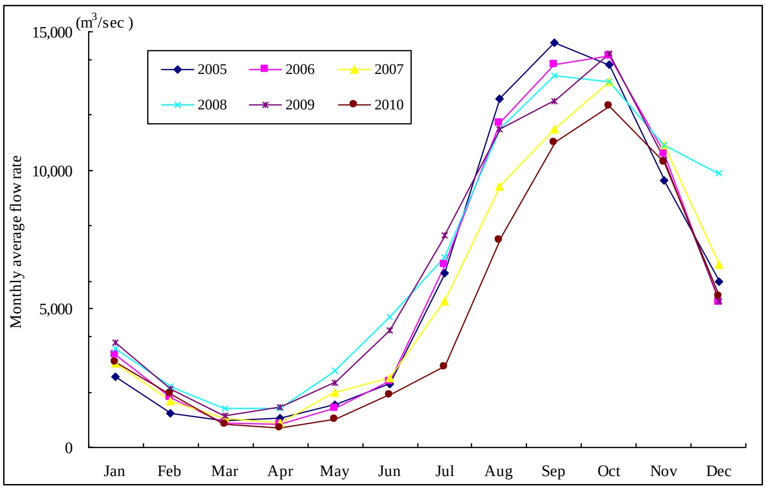


Prepared based on O Mon 3 EIA Table 2.8, p.40

Fig. 5.1-7 Monthly Average Water Temperature of Hau River

(b) Flow Rate

The average flow rate of Hau River in 2005 is 2,440m^3/sec. The maximum flow rate reaches 18,000m^3/sec, and the minimum is 800m^3/sec (May). In rainy season where rainfall volume is at the maximum (September to November), the discharge of Hau River accounts for one half of the total annual discharge. The drainage capacity of the area is relatively low due to flat topography. The flood recorded at peak time in Can Tho City is 2.09m (25 October, 1961), 2.00m (26 October, 1991) and 2.12m (6 October, 1994) (O Mon 3 EIA 2.2.4, p.39-40). Fig. 5.1-8 describes the monthly average discharge in 2007-2010.



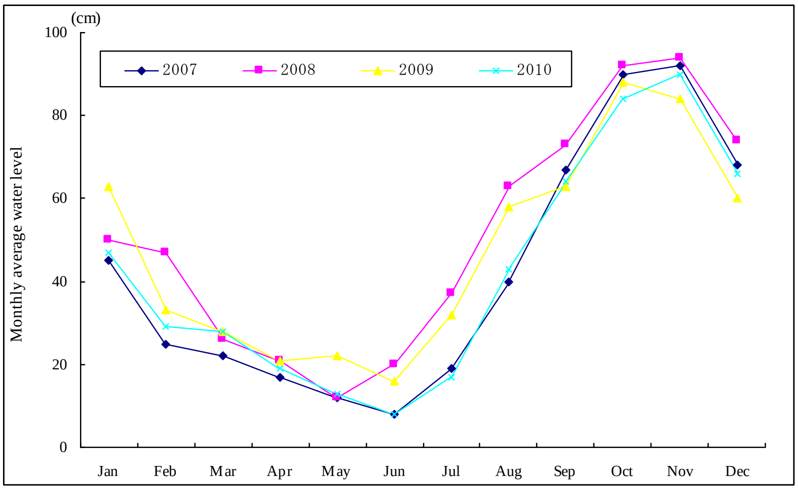
Prepared based on the data from Cuu Long Hydrographic Center

Fig. 5.1-8 Monthly Average Flow Rate of Hau River in 2007-2010

(c) Water level of Hau River

Hau River is a tidal river and water level fluctuates depending on the tidal level. In rainy season with high flow volume, the variation of water level is as small as 0.5m, whereas it is as large as 2.16m in dry season. The minimum water level is observed between March and June, whereas the maximum water level occurs between September and November (O Mon 3 EIA 2.2.4, p-39-40).

Due to the inclined topographical condition by a little bit from north to south, from east to west, the flood water flows in one direction in rainy season. In the downstream of Mekong river, the rainy season lasts from June to November due to the influence of the South-west monsoon, resulting in increased water level in Hau River and other canals with the maximum water velocity of 1.5 - 1.7m/sec. The fluctuation of water level affected by tide is large in rivers and smaller in the inland canals. On the other hand, less amount of rainfall in dry season (from December to May) results in decreased water level in the canals, and affects the agricultural production and daily life of the local people (O Mon 3 EIA 2.2.4, p.41). Thus, the average water level of the Howe river also has an about 1m seasonal variation (O Mon 3 EIA 2.2.4, p.39-40). Fig. 5.1-9 describes the monthly average water level of Hau River in 2007-2010.

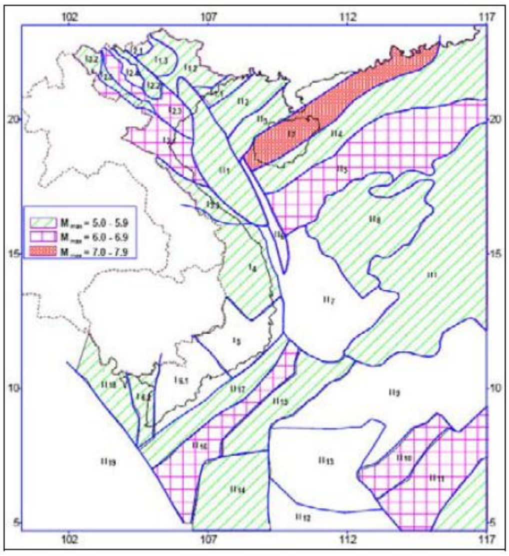


Prepared based on Cantho Statistic Bureau, 2011

Fig. 5.1-9 Monthly Average Water Level of Hau River in 2007-2010

(5) Earthquake

Fig. 5.1-10 describes the maximum estimated earthquake zone. The largest earthquake anticipated in the project area is below 4.9 of magnitude, belonging to the lowest risk category (O Mon 4 EIA 4.B.5.a, p.74).



Source: O Mon 4 EIA Figure 32, p.74

Fig. 5.1-10 Maximum Estimated Earthquake Zones in Vietnam

(6) Air quality, Water Quality, and Soil

1) Air quality

The air quality survey was conducted in and around the O Mon Power Complex in 5 locations in April 2008 (O Mon 3 EIA 2.3.3, p.53) and 10 locations in 2005 (O Mon 4 EIA 4.B.8.b, p.87). The result of the survey is shown in Table 5.1-1. The Vietnamese air quality standards (QCVN-05/ 2009) and the guideline value (EHS: Environmental, Health, and Safety Guidelines) by International Finance Corporation (IFC) are also shown for reference.

The survey results, compared with 1 hr average value in the standards, do not exceed the air quality standards except in dust (TSP and PM_{10}) measured in the survey point along the road.

Table 5.1-1 Air Quality Survey Result

Parameter	Result(1 hr average value) (minimum value - maximum value)		QCVN-05/ 2009	EHS Guideline (General: 2007)
	April 2008	2005		
TSP (mg/m^3)	0.10 - 0.28	0.100 - 0.310	0.30 (1 hr) 0.20 (24 hr) 0.14 (year)	-
PM_{10} ($\mu g/m^3$)	ND - 120	-	150 (24hr) 50 (year)	150 (24 hr, Interim*) -
CO (mg/m^3)	2.3 - 4.8	1.0 - 6.2	30 (1 hr) 10 (8 hr) 5 (24 hr)	-
SO_2 ($\mu g/m^3$)	39 - 69	17 - 92	- 350 (1 hr) 125 (24 hr) 50 (year)	500 (10 min) - 125 (24 hr, Interim*) -
NO_2 ($\mu g/m^3$)	41 - 79	12 - 46	200 (1 hr) 100 (24 hr) 40 (year)	200 (1hr) - 40 (year)

*: IFC Guideline quotes the value in WHO Guideline. WHO establishes their own interim target value for PM_{10} and SO_2.

Source: O Mon 3 EIA Table 2.22, p.53, O Mon 4 EIA Table 30, p.87

2) Noise

Noise level was measured in April 2008 and 2005, at the same survey points as the air quality survey. The result is shown in Table 5.1-2. The Vietnamese noise standard (QCVN-26/ 2010) and the IFC/EHS guideline value are also shown for reference. The noise level exceeded the environmental standard in the roadside survey point, but only for a temporary period (O Mon 3 EIA 2.3.3, p.55).

Table 5.1-2 Noise Survey Result

Parameter	Survey period	Range(Minimum - Maximum)			QCVN-26/ 2010	EHS Guideline (General: 2007)
		LAeq	LAmin	LAmax		
Noise (dBA)	April 2008	52.4 - 62.2	41.6 - 52.7	67.7 - 78.2	Hospital and schools 06:00 - 21:00: **55** 21:00 - 06:00: **45**	Residential and educational area 07:00 - 22:00: **55** 22:00 - 07:00: **45**
	2005	57.8 - 73.2	46.3 - 54.2	80.3 - 100.1	Apartment and residence 06:00 - 21:00: **70** 21:00 - 06:00: **55**	Industrial and commercial area 07:00 - 22:00: **70** 22:00 - 07:00: **70**

Source: O Mon 3 EIA 2.23, p.55, O Mon 4 EIA Table 32, p.89

3) River water quality

Surface water quality analysis has been conducted in and around the project area: 5 points at the rivers (Hau River, Chanh Canal) (O Mon 3 EIA 2.3.1, p.44-48) and the surrounding area in April 2008 (dry season); 14 points at Hau River near the project site in May 2007 (dry season); 10 points at the channels around the Power Complex in August 2005 (rainy season) (O Mon 4 EIA 4.B.5.c, p.77). The survey result is shown in Table 5.1-3. The Vietnamese surface water quality standard (QCVN-08/ 2008) is also shown for reference. The surface water is classified into 4 categories based on the water usage, and Hau River corresponds to Category A2 (O Mon 4 EIA Table 6, p.24).

The survey result exceeding the environmental standard is highlighted in yellow. The value pf E.Coli at certain survey points exceeds the environmental standard. From the high value of NH_4-N, this may be resulted from the domestic waste water, especially lavatory waste water, flowing into the environment. The low value of DO (dissolved oxygen) in April 2008 may be attributed to high oxygen consumption due to eutrophication, considering the relatively high value of BOD and COD.

Table 5.1-3 River Water Quality Analysis

Parameter	Unit	Survey result(Minimum value – Maximum value)				QCVN-08/ 2008 (Category A2)
		April 2008(Dry season)		May 2007 (Dry season)	August 2005 (Wet season)	
		Hau River	Canals	Hau River	Canals	
pH	-	6.4. - 7.04	6.43	6.9 - 7.2	6.8 - 7.5	6 - 8.5
EC	µS/cm	185 – 187	225	162 - 199	84 - 147	-
Turbidity	NTU	16.01 - 28.82	100	12 - 28	-	-
SS	mg/L	8 – 25	98	7 - 67	81 - 128	30
TDS	mg/L	-	-	102 - 108	-	-
DO	mg/L	2.7 - 3.8	2.5	4.8 - 7.4	-	>5
BOD_5	mg/L	6 – 13	17	1.0 - 8.0	2.0 - 4.2	6
COD	mg/L	11 – 22	26	3 - 13	-	15
NO_3	mg/L	0.46 - 0.65	0.88	-	-	5
NO_2	mg/L	0.009 - 0.014	0.007	-	-	0.02
NH_4	mg/L	0.56 - 0.85	1.34	0.12 - 0.41	0.05 - 0.10	0.2
T-N	mg/L	1.69 - 2.85	3.36	-	-	-
T-P	mg/L	0.22 - 0.46	0.78	0.51 - 0.92	0.07 - 0.15	-
Cl^-	mg/L	11.5 - 13.6	14.1	-	-	400
Fe	mg/L	0.29 - 0.82	0.43	0.11 - 0.61	0.34 - 0.74	1
Oil	mg/L	0.02 - 0.06	0.04	0.00 - 0.17	0.02 - 0.10	0.02
E.coli	MPN/100mL	630 – 21000	34000	$430 - 2.4 \times 10^6$	3500 - 11000	5000
Coliform	MPN/100mL	-	-	0 - 11	-	50

Source: O Mon 3 EIA Table 2.16, p.46, O Mon 4 EIA Table 27, p.78

4) Ground water quality

Ground water quality analysis has been conducted: 5 points in and around the project area in April 2008 (O Mon 3 EIA 2.3.1, p.48-50), and 5 points around the O Mon Power Complex in 2007 (O Mon 4 EIA 4.B.2, p.71). The result is shown in Table 5.1-4. The Vietnamese ground water quality standard (QCVN-09/2008) is also shown for reference. The survey result exceeding the environmental standard is highlighted in yellow. NH_4^- exceeds the environmental standard at the survey point near the residential area, which is considered to be resulted from domestic waste water. Arsenic concentration, which is a common issue in South and South-east Asia, is below the environmental standard.

Table 5.1-4 Ground Water Quality Analysis

Parameter	Unit	Survey result (Minimum value – Maximum value)		QCVN-09/ 2008
		April 2008	2007	
Temperature	°C	-	28.88 - 29.53	-
pH	-	6.46 - 7.02	6.77 -7.18	5.5 - 8.5
EC	µS/cm	586 - 988	570 – 1213	-
Turbidity	NTU	4.04 - 8.98	0.9 - 65.6	-
Salinity	-	-	57.0 - 401.8	-
SS	mg/L	7 - 23	-	-
BOD_5	mg/L	1 - 6	-	-
NH_4^-	mg/L	0.047 - 1.054	0.6 - 3.1	0.1
NO_3^-	mg/L	0.06 - 0.16	0.02 - 0.02	15
NO_2^-	mg/L	ND - 0.010	0.008 - 0.008	1.0
Al	mg/L	-	0.027 – 0.071	-
As	µg/L	0.48 - 1.46	0.0 – 6	50
Cd	µg/L	-	0.012 - 0.012	5
Cr	µg/L	-	0.08 – 0.8	50 (Cr^{6+})
Fe	mg/L	0.05 - 0.16	0.063 - 3.77	5
Hg	µg/L	-	0.16 - 0.16	1
Mn	mg/L	-	0.059 - 0.14	0.5
Zn	mg/L	-	0.005 - 0.012	3.0
Cl^-	mg/L	14.62 - 25.31	-	-
T-N	mg/L	0.29 - 3.25	-	-
T-P	mg/L	0.10 - 0.21	-	-
Oil & Grease	mg/L	-	0.016 - 0.016	-
Total Coliform	MPN/100mL	2 - 14	-	3

Source: O Mon 3 EIA Table 2.18, p.49, O Mon 4 EIA 25, p.76

(7) Organisms

1) Vegetation

Due to the agricultural activities of the local people, the ecosystem of the O Mon Power Complex is a mixture of natural and agricultural vegetation. The inland ecosystem survey of the project area was conducted in April 2008 and 157 species of flora were observed. 154 species belong to angiosperm, and 3 species belong to Polypodiophyta branch. Various flora species are observed in the area including 16 species of Fabaceae, 13 species of Poaceae, 11 species of Asteraceae, 8 species of Amaranthaceae, 7 species of Euphorbiaceae, and 6 species of Rutaceae, but fruit trees including mangoes and longans are dominant in number (O Mon 3 EIA 2.4.1, p.56-57).

According to the composition of flora in the area, 82 species of herbaceous species, 48 species of timber and 27 species of shrub, of which 110 species are the wild origin and 47 species are crop plants (O Mon 3 EIA 2.4.1, p.57).

Along the Hau river bank, one species of mangrove, water hyacinth and wild pineapple are distributed and they are playing roles of protecting the river bank from erosion. The ecosystem along the canals is a mixture of various flora including cybreass and water hyacinth (O Mon 3 EIA 2.4.1, p.57).

2) Terrestrial Fauna

The survey of the terrestrial fauna was conducted in 2007-2008 and 2010 at the project site. Results obtained from interviews with local residents in 2008 found that fauna in the Project area is similar to the one observed in other rural areas of Mekong Delta such as amphibian species (e.g. frogs and toads), reptiles (e.g. snakes and lizards), and birds (O Mon 4 EIA 4.A.c, p.55).

3) Aquatic organisms

The ecosystem in this area is established on the high water temperature environment in the tropical climate, typical of the downstream of Mekong River, and affected by domestic waste water (O Mon 3 EIA 2.4.2, p.60).

According to the survey of the aquatic ecosystem of the area in April 2008, 73 species of phytoplankton was collected, of which Bacillariophyta was the largest both in number of species (29 species) and number of cells (2,500 - 8,800 cells/L) (O Mon 3 EIA 2.4.2, p.58-61). 29 species of zooplankton was collected, of which Cladocera and Copepoda were the largest in number of species (9 species). The quantity of Zooplankton in Hau River is 1500-6500 individuals/m^3 and 6,500 - 14,000 individuals/m^3 in Vam canal and Chanh canal, and Copepoda was the largest in number. 19 species of benthos were observed, and Bivalvia was the largest in species number (8 species) and individual number (90-900 individuals/m^2) (O Mon 3 EIA 2.4.2, p.58-61).

There are many crustacean species living in the Hau River but only species of Green shrimps (genus Machrobrachium) have high economic value. The mother shrimps migrate to brackish water of the river close to sea for spawning. After metamorphosis, the larvae migrate back to freshwater areas of the Hau River (O Mon 4 EIA 4.A.2.b.iv, p.66).

4) Fish

The recent studies have defined, out of 217 species of fish in Hau River, Cyprinidae (67 species), Siluriformes (51 species), Gobiidae (10 species), Clupeidae (7 species), Anabantidae (6 species), Engraulidae (5 species), Mastacembelidae (4 species), and Ophiocephalidae (4 species) . The species are classified into 3 groups: fresh water fish (*Puntius*, Cirrhinus, Pangasius, *Leptobarbus*, *Osteochilus*), field fish (eel, catfish, jewfish), and sea fish (Clupeidae, Mugilidae, Scaenidae, Soleidae) (O Mon 3 EIA 2.4.6, p.61-62). There are also some imported species (*Oreochromis mossambicus*, *O. niloticus*, *Helostoma teminckii*, *Osphronemus goramy*, *Cyprinus carpio*, *Aristhichthys nobilis*) (O Mon 3 EIA 2.4.6, p.62).

In the 2007 survey, 55 species of stationary fish were observed, most of which belong to the taxonomic groups Perciformes, Cypriniformes and Siluriformes. The shallow areas of the Hau River covered with water hyacinth are used as spawning and nursery areas for many fish species. The north side of the river has larger areas of shallow water covered with vegetation compared to the south side. Shallow areas in general, and especially on the north side of the river are important spawning and nursery areas for fish (O Mon 4 EIA 4.A.2.b.iv, p.65).

The survey found that 21 migratory fish species, most of which belonging to the same taxonomic groups Perciformes, Cypriniformes, Siluriformes as the stationary species. There are two groups of migratory species: the fresh water group migrating into the O

Mon area from upstream areas in the Mekong River; and the brackish water group migrating from estuarine areas in the Mekong River delta near the sea. Examples of the species from the fresh water group are *Pangasius*, *Labiobarbus lineate*, *L. siamensis*, *Cirrhinus jullieni*, *Osteochilus microcephalus*, while the species of brackish water group are *Plotosus canius*, *Nibea soldado*, *Lates calcarifer* (O Mon 4 EIA 4.A.2.b.iv, p.65-66).

The fish species in the Mekong River generally move upstream in the dry season and downstream in the rainy season. Thus, more migratory species are observed in the O Mon area of the Hau River during the rainy season. In particular during the rainy season, eggs, larvae and young fish belonging to the shark catfish (Pangasiidae) and minnows (Cyprinidae) are drifted toward downstream from the O Mon area. This passive drifting is important for the production of mature fish. Similar to the stationary fish species, shallow areas of the Hau River are important nursery areas for migratory species as well. Some of the migratory fish species also move to inland waters through the O Mon River and Chanh Creek (O Mon 4 EIA 4.A.2.b.iv, p.65-66).

5) Rare Species

(a) Terrestrial organisms

- Flora
  Flooding soil ecosystem of sonnertia (mangrove) growing along Hau River is categorized as Vulnerable in Vietnam (O Mon 3 EIA 4.15, p.134), but is not observed around the project site (2nd field survey). Based on the ecological surveys conducted, one IUCN Red Listed plant species classified as VU (vulnerable) has been observed in the O Mon Power Complex, which is the Takian tree (Dipterocarpaceae). All of these species have been cultivated and not a wild species (O Mon 4 EIA 4.A.1.d, p.55-56).

- Fauna
  Fauna in the O Mon Power Complex is similar to the one observed in other rural areas of Mekong Delta such as Amphibian (e.g. frogs and toads), Reptile (e.g. snakes and lizards), and Aves (O Mon 4 EIA 4.A.c, p.55).

(b) Fish

The 2007 survey observed the six fish species listed in the Vietnamese Red List in the vicinity of the O Mon Power Complex (Table 5.1-1). Four species are listed as VU (vulnerable), which is the second highest risk category and a higher level than T (threatened). These species are the surface fishes, inhabiting below the temperature of 30°C. Their reproduction period is mainly during the rainy season (O Mon 4 EIA 4.A.2.b.v, p.67).

Table 5.1-5 Rare Fish Species

Family	Scientific name	English name	Category in Vietnam	IUCN 2011	CITES 2010/10
Notopteridae	*Chitala ornata*	Clown featherback	VU	-	-
Cyprinidae	*Labeo chrysophekadion*	Black sharkminnow	T	-	-
Datnioidide	*Datnioides microlepis*	Finescale tigerfish	VU	-	-
Datnioididae	*Datnioides polota*	Four-barred tigerfish	VU	-	-
Toxotidae	*Toxotes chatareus*	Spotted archerfish	VU	-	-
Channidae	*Channa micropeltes*	Giant snakehead	T	-	-

Note : VU=Vulnerable, T=Threatened

Source: O Mon 4 EIA Table 19, p.67

The giant bart (*Catlocarpio siamensis*) listed as EN (endangered; the highest risk category), the isok barb (Probarbus jullieni) and small scale mud carp (Cirrhinus microlepis) listed as VU are observed in a survey of a large area of Hau River. *Catlocarpio siamensis* is categorized as CR (Critically Endangered), *Probarbus jullieni* as EN (Endangered), and *Cirrhinus microlepis* as VU, according to IUCN Red List of 2011 (O Mon 4 EIA 4.A.2.b.v, p.67).

5.1.3 Socio-Economic Situation

(1) Population and industry

Surround the O Mon Power Complex is a rural region. O Mon District has the area of 125.4 km^2 with the population of 128,000 inhabitants (estimated in 2005). The main local industry is aquaculture and agriculture with not-mechanized, but only manually. The productivity highly depends on the weather, and the average per capita income is about 10,000,000 VND a year (O Mon 3 EIA 2.5.1, p.63).

Can Tho city has two industrial complexes (Tra Noc industrial complex with 300 ha and Hung Phu industrial complex with 488 ha) and a 150 ha of a center for industry and handicrafts in Thot Not district. In O Mon District, 2 cement factories, one pesticide factory, Tay Do garment industry and one shipyard are operating. Besides, there are more than 3,600 small-scale enterprises operating in different activities: industry, service, and processing. The Tra Noc industrial complex is expanding into Phuoc Thoi ward, O Mon district (O Mon 4 EIA 4.C.5, p.91-92).

The economic situation of Phuoc Thoi Ward and Thoi An Ward in 2007, where the proposed O Mon Power Complex is located, is described in Table 5.1-6 (O Mon 3 EIA 2.5.2, p.65-71).

Table 5.1-6 Economic Situation of Phuoc Thoi Ward and Thoi An Ward

Item	Phuoc Thoi ward	Thoi An Ward
Industry	- Total production of industry is 491,450million VND, consisting mainly of small scale industry. - There are 195 businesses, including construction material, agricultural material, variety stores and mechanical repair service. - The local People's Committee is making efforts to improve power supply to the poor.	- There are 1,007 enterprises with the total production of 202,758,000 VND. - The district has invested on 4 projects in the ward (road, market improvement, school, bridge).
Agriculture (rice)	- winter-spring: 1,169 ha, 7,014t (6t/ha) - summer-autumn: 612.4 ha, 2,572t (4.2t/ha) - autum-winter: 975 ha, 3,510t (3.6t/ha)	- winter-spring: 1,000 ha, 6,693 t (6.69t/ha) - summer-autumn: 656 ha, 2,811t (4.5 t /ha) - autumn-winter: 950 ha, 3,895 t (4.1 t /ha)
Agriculture (other products)	- total farm land: 470.7 ha - products: soy beans, sesame seeds, etc	- total farm land: 616 ha - products: soy beans, sesame seeds, etc (1,278t)
Aquaculture	- Culture pond area:73 ha including 6 ha for shrimp feeding	- Culture pond area 324.1 ha - Total production:97.230t, 1,361million VND, profit: 376millionVND
Livestock	- Poultry: 18,188 - Cow: 114 - Pig: 4,674, including 374 for breeding	- Poultry: 29,653 including 25,056 ducks - Cow: 24 (milk cow: 3, beef cattle: 21) - Pig: 2,816, including 375 for breeding - Total production: 317t
Finance	- Ward's budget: 2,707,283,031 VND - Subsidies: 4,378,138,931 VND	- Ward's budget: 1,983,000,000 VND - Subsidies: 1,295,000,000 VND

Source: O Mon 3 EIA 2.5.2, p.65-71

(2) Land Use

Table 5.1-7 describes the current land use of O Mon District, Phuoc Thoi ward, and Thoi An Ward (2006). There is almost no forest in the area (O Mon 4 EIA 4.C.4, p.90-91).

Table 5.1-7 Current Land Use

Land use type	O Mon District	Phuoc Thoi ward	Thoi An Ward
Total area (ha)	12,540	2,700	2,400
Agricultural land (ha)	9,300	1,500	1,700
- Forestry (ha)	0.14	-	-
Non agricultural land (ha)	3,250	1,200	700
- Residential land (ha)	550	58	150
- Special use land (ha)	1,300	800	75
- Others (ha)	1,400	310	

(3) Public Health Care

The public health care system around the O Mon Power Complex is generally well-organized around the project site. In 2007, 24,276 cases of medical examination and treatment took place in 2007. In 2006, 171 local officers worked for inoculation for prevention of infectious disease (O Mon 3 EIA 2.5.1, p.64).

In 2005, Can Tho City General Hospital, which has a capacity of 700 beds, and many private hospitals have started their operation. There are medical centers in each district and medical stations in each ward. Besides disease treatment tasks, these medical centers and stations are also responsible for free vaccination for infectious disease prevention (O Mon 4 EIA 4.C.3, p.90).

(4) Transportation

The main roads are National highway No.1, No.91B and No.61 connecting Can Tho City and other provinces in the region. These traffic ways are used for transporting goods and materials from Ho Chi Minh City. The national road No. 91 and 91B are connected with national road No.1, across O Mon district with a length of 20 km. The national road No.91 runs through the four provinces (O Mon 4 EIA 4.C.6. p.92).

Can Tho port has a jetty with the capacity of 10,000 ton. Cai Cui port (coast) in the first phase has 3 jetties with the capacity of 10,000 ton, in which 1 dock is used for containers specifically, including a container yard of 28,000 m^2, another commodity yard of 8,000 m^2 and a warehouse of 36,000 m^2 (O Mon 4 EIA 4.C.6. p.92).

There are plans to develop an international water transport system based on Hau river and a local waterways, linking Cai San, Can Tho, O Mon and Thot Not rivers. Tra Noc airport will be upgraded to have an international terminal (O Mon 4 EIA 4.C.6. p.92).

(5) Electricity and Water Sources

Tra Noc thermal power plant has a capacity of 200 MW supplying power for the whole region. There are two water plants, supplying 7,000 m^3 per day. A new water plants with the total capacity of 200,000 m^3 per day will be built in Hung Phu Industrial Complex to provide clean water for production and daily living (O Mon 4 EIA 4.C.7. p.92-93).

Electricity access on a household basis in O Mon district is over 99% according to the People’s Committee annual report. The figures for Thoi An ward and Phuoc Thoi ward are 99 % and 90 %, respectively. Service water access on a household basis in O Mon district is over 88 % according to the People’s Committee annual report. The figures for Thoi An ward and Phuoc Thoi ward are 98 % and 94 %, respectively (O Mon 4 EIA 4.C.7. p.92-93).

(6) Heritage

There are not any historical, cultural and religious monuments in the project site (O Mon 3 EIA 2.5.1, p.65).

(7) Fisheries

Based on the selling price in the market and fish product, about 57 species of fish of economic value living in Hau River are defined, including 19 species of Cyprinidae family, 7 species of Schilbeidae and 4 species of Anabantidae. Most of those fish weigh 0.1-1.0kg at the age of 1 year. Some species such as *Ophiocephalus*, *Micropeltes*, *Pangasius pangasius*, *P. micronemus*, *Plotosus canius* weighs over 10kg, but most of the individuals fishes sold in the market are 1-3kg/unit. About 15 species of fish are cultivated in Hau River (O Mon 3 EIA 2.4.6, p.62-63).

(8) Fishing Ground

Chauphu district in Angiang province has the largest fish catch in the whole Hau River area. Angiang Province is located upstream of Hau River near the boundary with Cambodia (O Mon 1 EIA 3.3.3, p.64).

Although small scaled, private fishery is not prohibited in the front area of the O Mon Power Complex, large scale fishery may obstruct the water traffic and is prohibited. 10 fishermen are currently in operation in Hau River near the O Mon Power Complex. They move upstream and downstream depending on the season and the growing of fish, so they have no fixed fishing ground (2nd field survey).

O Mon 3 EIA states that there is “fishery operated mainly by women”. Practically, in the common lifestyle of the local people living around the project site, the actual operation of fishing is mainly done by men, and women are only playing supporting roles (transportation and selling of fish), and “fishery operated mainly by women” has not been observed (2nd field survey).

5.2 INSTITUTIONS AND ORGANIZATIONS FOR ENVIRONMENTAL AND SOCIAL CONSIDERATIONS IN VIETNAM

5.2.1 Laws and Regulations regarding EIA

Law on Environmental Protection was enforced in 1994 and environmental standards for air, water and waste were regulated. In 2002, Ministry of Natural Resources and Environment (MONRE) was established for the purpose of strengthening of national management of the environment and resources. In 2003, Environmental Protection Strategy of Vietnam (Decision 256/2003/QD-TTg) was prepared which indicates the environmental subjects to be tackled till the year of 2010 and the directions of solution to environmental problems for 2020. Thus, Vietnam has been establishing a system for environmental administration.

Environmental Protection Strategy of Vietnam states the basic principle for managing the environment including the important and long-term subjects in environmental field. However, the strategies including specific measures to accomplish such principles have not yet been indicated. Improvement of the system and managing organization has been preceded the specific strategies.

Amended Law on Environmental Protection (No.52/2005/QH11) mainly deals with regulation and management, though it states specific requirement for political instruments and polluted facilities. Management tool such as EIA, EPC or EPP certification that is regulated under the law is pointed out to get improved to make it more effective.

The Table 5.2-1 shows the list of laws and regulations regarding environmental management in Vietnam.

Table 5.2-1 Laws and Regulations regarding Environmental Management in Vietnam

Category	Laws/Regulations	
General	Environmental Protection Strategy of Vietnam	Decision 256/2003/QD-TTg
	Law on Environmental Protection	No.52/2005/QH11
	Detailing and Guiding the Implementation of a Number of Articles of the Law on Environmental Protection	Decree No.80/2006/ND-CP
	Providing Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Commitment	Decree No.29/2011/ND-CP
	Sanctioning of Administrative Violations in the Domain of Environmental Protection	Decree No.81/2006/ND-CP
	Providing for the Environmental Protection at Stages of Elaboration, Evaluation, Approval and Implementation of Development Strategies, Plannings, Plans, Programs and Projects	Decree No.140/2006/ND-CP
	Amending and Supplementing a Number of Articles of the Government Decree No.80/2006/ND-CP	Decree No.21/2008/ND-CP
	Decree on River Basin Management	Decree No.120/2008/ND-CP
	Providing for Incentives and Supports for Environmental Protection Activities	Decree No.04/2009/ND-CP
	Law on Environmental Protection Tax	No.57/2010/QH12
Air quality	National Technical Regulation on Hazardous Substances in Ambient Air Quality	QCVN 05/2009/BTNMT
	National Technical Regulation on Hazardous Substances in Ambient Air	QCVN 06/2009/BTNMT
	National Technical Regulation on Industrial Emission of Inorganic Substances and Dusts	QCVN 19/2009/BTNMT
	National Technical Regulation on Industrial Emission of Organic Substances	QCVN 20/2009/BTNMT
	National Technical Regulation on Emission of Thermal Power Industry	QCVN 22/2009/BTNMT
Water quality	The Law on Water Resource	No.8/1998/QH10
	National Technical Regulation on Surface Water Quality	QCVN 08/2008/BTNMT
	National Technical Regulation on Underground Water Quality	QCVN 09/2008/BTNMT
	National Technical Regulation on Coastal Water Quality	QCVN 10/2008/BTNMT
	National Technical Regulation on Domestic Wastewater	QCVN 14/2008/BTNMT
	National Technical Regulation on Domestic Water Quality	QCVN 02/2009/BTNMT
	National Technical Regulation on Industrial Wastewater	QCVN 24/2009/BTNMT
Waste	Environmental Protection Charges for Solid Wastes	Decree 174/2007/ND-CP
	Solid Waste Management	Circular 59/2007/ND-CP
	National Technical Regulation on Hazardous Waste Thresholds	QCVN 07/2009/BTNMT
Noise	National Technical Regulation on Noise	QCVN 26/2010/BTNMT
Vibration	National technical Regulation on Vibration	QCVN 27/2010/BTNMT
Soil	National Technical Regulation on the Allowable Limits of Heavy Metals in the Soils	QCVN 03/2008/TNMT
Forest	The Law on Forest Protection and Development	No.29/2004/QH11
	Implementation of the Law on Forest Protection and Development	Decree No.23/2006/ND-CP
Biodiversity	Law on Biodiversity	No.20/2008/QH12
Environmental Assessment	Providing Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Commitment	Decree No.29/2011/ND-CP
Land Use, Resettlement, Compensation	Law on Land	No.13/2003/QH11
	Providing for Implementation of Law on Land	Decree No.181/2004/ND-CP
	Compensation, Support and Resettlement When Land is Recovered by the State	Decree No.197/2004/ND-CP
	Additionally Stipulating the Grant of Land Use Right Certificates, Recovery of Land, Exercise of Land Use Rights, Order and Procedures for Compensation, Support and Resettlement upon Land Recovery by the State, and Settlement of Land-Related Complaints	Decree 84/2007
	Price Determination Methods and Price Frameworks for All Types of Land	Decree No.123/2007/ND-CP
	Decree: Additionally Providing for Land Use Planning, Land Prices, Land Recovery, Compensation, Support and Resettlement	Decree No.69/2009/ND-CP

Source : Website of Ministry of the Environment, Government of Japan (Retrived on November, 21st, 2011) etc.

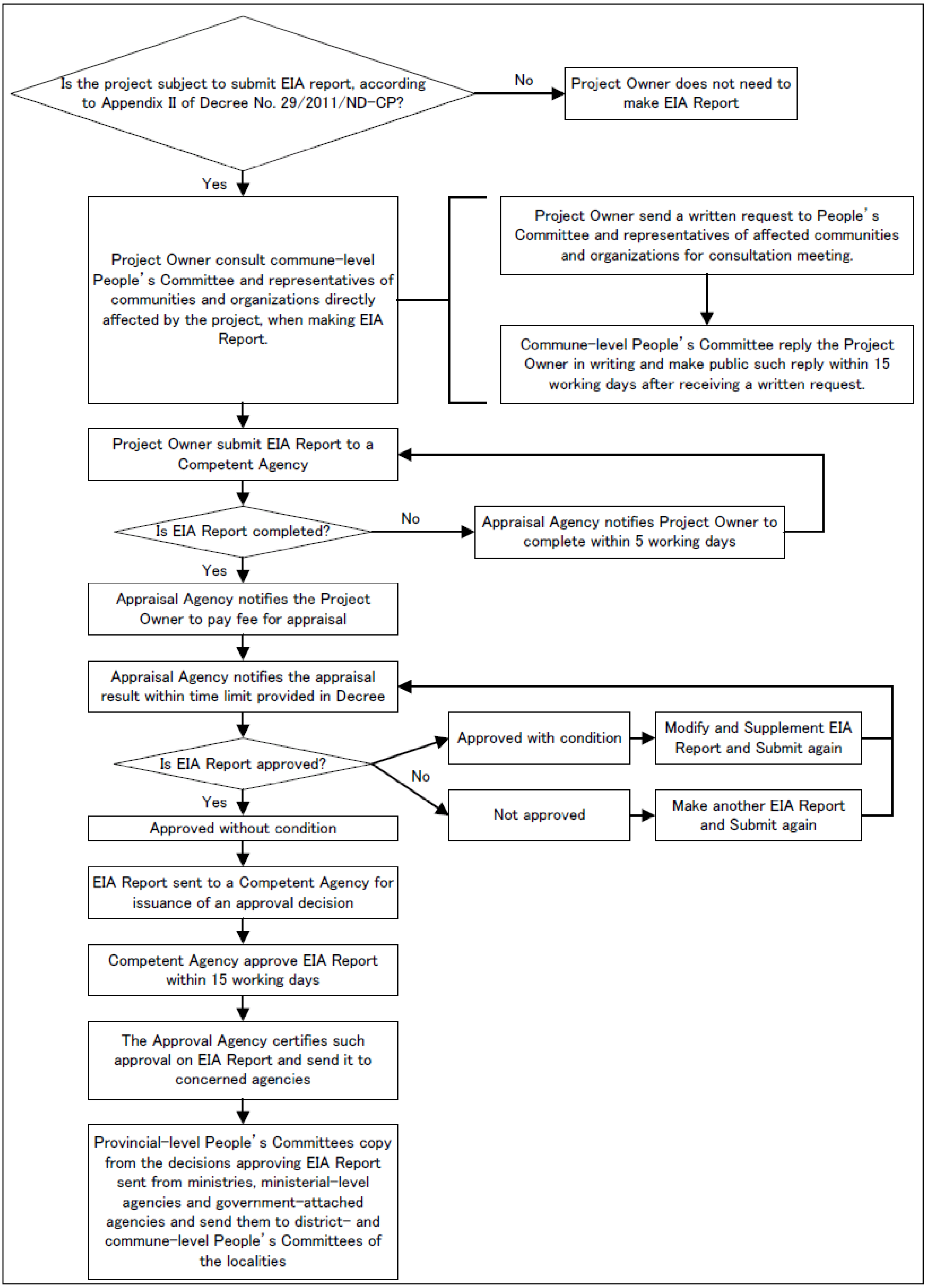
5.2.2 EIA-related Organizations and Process

Decree No.80/2006/ND-CP Appendix-II indicates the list of the projects that require EIA. Provincial People's Committee usually approves EIA, but it is MONRE that approves EIA in the case of nuclear power plant and large scale (more than 600MW) thermal power plant like this project.

Decree No.29/2011/ND-CP that became effective on June 5th, 2011 was partly amended from Decree No.80/2006/ND-CP. This Decree indicates the EIA approval process as well, and Fig. 5.2-1 was made based on this Decree. The project owner conducts consultation meetings with the representatives of People's Committee and Further Front Committee at commue-level. After that, EIA report is prepared and submitted to the competent agency. Appraisal agency notifies the project owner to complete and resubmit the EIA report, if it is found to be incomplete. If EIA report is evaluated as complete, appraisal agency notifies the project owner to pay fee for appraisal before examining the EIA report. Then the EIA report is examined, if conditions which some part of the EIA report should be changed are given, the project owner submits supplemental EIA. If EIA is not approved, another EIA report needs to be prepared and submitted again.

5.2.3 Diversion from JICA Guidelines for Environmental and Social Considerations (April, 2010)

Circular No.05/ 2008/ TT-BTNMT stipulates the contents of EIA. The Table below shows the comparison among JICA Guidelines for Environmental and Social Considerations, World Bank (OP 4.01 Annex B) and Vietnamese Guideline (Circular No. 05/2008) on the contents of EIA report. In accordance with this Circular, EIA report for O Mon III Power Plant Project was finalized in January, 2011 with corresponding to the comments from MONRE made on November 17th, 2008.



Prepared based on Decree No.29/2011/ND-CP

Fig. 5.2-1 Flow of EIA Process

Table 5.2-2 Comparison among JICA Guideline, World Bank (OP 4.01) and Vietnamese Guideline (Circular No. 05/2008) on the Contents of EIA Report

Content	JICA Guideline on Environmental and Social Consideration	World Bank (OP4.01, Annex B)	Circular No.05/2008(Guideline for Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Commitments)	Gap between JICA Guideline and Vietnamese Guideline/ Action to be taken
Executive Summary	This concisely discusses significant findings and recommended actions.	Concisely discusses significant findings and recommended actions.	N/A	There is a gap.
Policy, legal, and administrative framework	This is the framework within which the EIA report is to be carried out.	Discusses the policy, legal, and administrative framework within which the EA is carried out. Explains the environmental requirements of any co-financiers. Identifies relevant international environmental agreements to which the country is a party.	oN/A	There is a gap. We will prepare for Vietnamese policy, legal and administrative framework.
Project Description	This describes the proposed project and its geographic, ecological, social and temporal context, including any off-site investments that may be required (e.g. dedicated pipelines, access roads, power plants, water supply, housing, or raw material and product storage facilities). It also indicates the need for any resettlement or social development plan. It normally includes a map showing the project site and the area affected by the project.	Concisely describes the proposed project and its geographic, ecological, social, and temporal context, including any offsite investments that may be required (e.g., dedicated pipelines, access roads, power plants, water supply, housing, and raw material and product storage facilities). Indicates the need for any resettlement plan or indigenous peoples development plan. Normally includes a map showing the project site and the project's area of influence.	**Chapter 1: BRIEF DESCRIPTION OF PROJECT** 1.1 Name of project Name must be the same as the name that is indicated in the Investment report/ economic-technical report or equivalent document of project. 1.2 Project owner Full and accurate names， addresses and contacts of owner; and full names and working titles of head of owner. 1.3 Location of project Detail description of geographical configuration (inc1uding co-ordinates， boundaries.... in case of natural resource exploitation projects， use VN2000 coordinate system to reflect angular coordinates) of the project location in relation with natural factors (road network; system of rivers， streams， lakes and water ponds; mountains and hills...) ， social and economic factors (resident areas， urban living squares， production- business- service activities， cultural and religious constructions， historical relics...) and other factors around the project location; and attached by a geographical map with details of above factors and clear legends. 1.4 Main contents of project - Full list of details， describing scale and scope (spatial and temporal) of all construction components that need to be done during project implementation， attached by an overall ground map 1ocating all components or individual maps of each component. Components are classified into 2 following types: + Main components: Those serve the main objectives of project: production， business， or services; + Auxiliary components: that support and supplement the main components， such as: transportation， telecommunication, power supply, water supply, rain water drainage, waste water drainage, resident removing and resettlement, green coverage for environmental protection， waste water treatment stations， solid waste collection points or treatment stations (if there are) and other constructions. - Detail and specific description of production and operational technologies of project， and of individual components of project， attached by an illustrated diagram. In this diagram， there must be clear indication of environmental issued, which could occur， such as: wastes and other impacts (if there are). - Full list of machinery and equipment that are needed for project, attached by instructions of producers showing the country they are made in, year of manufacture, current condition (remaining percentage or new). - Full list of compound， nature of materials， fuels， input substances and instruction of trade mark and chemical formulas (if there are). - Detailed description of implementation process of project’s construction items from commencement to completion and operation. - Total investment and funding of project, specifying the sum for environmental protection activities. - Organization of project management and implementation.	There is no gap. We will add the most recent information in the Final Report.
Baseline Data	This assesses the dimensions of the study area and describes relevant physical, biological, and socio-economic conditions, including all changes anticipated to occur before the project commences. Additionally, it takes into account current and proposed development activities within the project area but not directly connected to the project. Data should be relevant to decisions about project site, design, operation, or mitigation measures, and it is necessary to indicate the accuracy, reliability, and sources of the data.	Assesses the dimensions of the study area and describes relevant physical, biological, and socioeconomic conditions, including any changes anticipated before the project commences. Also takes into account current and proposed development activities within the project area but not directly connected to the project. Data should be relevant to decisions about project location, design, operation, or mitigatory measures. The section indicates the accuracy, reliability, and sources of the data.	**Chapter 2:NATURAL， ENVIRONMENTAL， ECONOMIC AND SOCIAL CONDITIONS** 2.1 Natural and environmental condition: - Geographical and geological condition: Indication and description of only objects， phenomena， and processes that are impacted by project (for projects that make changes of geographical factors， landscapes; mining projects and others that relate to underground constructions， description needs to be more detail); and indicating what data sources and documents would be used or referred to. - Meteorological and hydrographical condition: Indication and description of only objects, phenomena， and processes that are impacted by project (for projects that make changes of meteorological and hydrographical factors, description needs to be more detail); and indicating what data sources and documents would be used or referred to. + Meteorology: Specify average data of months in many years in project site, for example, air temperature, humidity,	There is no gap. We will add the most recent information in the Final Report.

Content	JICA Guideline on Environmental and Social Consideration	World Bank (OP4.01, Annex B)	Circular No.05/2008(Guideline for Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Commitments)	Gap between JICA Guideline and Vietnamese Guideline/ Action to be taken
			speed, direction and frequency of wind, sun and radiation, rainfall, storm and other conditions; + Hydrography: Specify hydrographical parameters in project site such as water flow, water speed, level and other conditions. - Current condition of natural environmental factors: Indication and description of only environmental factors that are directly impacted by project, such as: air pollution or air waste emission of project (attention should be paid to areas that locate behind the project in the main wind direction), water sources that get waste water directly from project, land, sediment and animal environment that is impacted direct by wastes or other factors of project. 2.2. Economic and social condition: - Economic condition: Indication of only economic activities (industry, agriculture, transportation, mining, tourism, trade, services and others) in the project areas and neighboring areas; indication of data sources and documents for reference and use. - Social condition: Indication of only cultural, social, religious, belief constructions, historical relics, resident areas, urban living squares and other relating constructions in the project areas and neighboring areas; indication of data sources and documents for reference and use.	
Environmental Impacts	This predicts and assesses the project's likely positive and negative impacts in quantitative terms, to the extent possible. It identifies mitigation measures and any negative environmental impacts that cannot be mitigated, and explores opportunities for environmental enhancement. It identifies and estimates the extent and quality of available data, essential data gaps and uncertainties associated with predictions, and it specifies topics that do not require further attention.	Predicts and assesses the project's likely positive and negative impacts, in quantitative terms to the extent possible. Identifies mitigation measures and any residual negative impacts that cannot be mitigated. Explores opportunities for environmental enhancement. Identifies and estimates the extent and quality of available data, key data gaps, and uncertainties associated with predictions, and specifies topics that do not require further attention.	Chapter 3:ASSESSMENT OF ENVIRONMENTAL IMPACTS 3.1 Causes of impacts Assessment on project's impacts on natural and socio-economic environment is conducted by project stages (preparation, construction and operation) and must be specific on each source of impacts and each subject to be impacted. Each impact must be assessed in details in terms of level and volume of space and timing (detailed and specific assessments, not general theories as curriculum, procedure, regulation or guideline). - Impacts that relocate to waste: Detail list of all possibi1ities of producing solid, liquid, air wastes and other wastes during project implementation. Quantitative calculation and detail classification (on spatial and temporal aspects) all individual possibilities. Comparisons and matching with current criteria, norms and regulation (if there are). - Impacts that do not relate to wastes: Detail list of all impacts that do not relate to wastes, such as: eroded, slide, collapsed, sunk land; erosion of river, stream, lake and sea banks; raised level of river, stream, lake and sea bed; changes of surface water level and underground water; salt water invasion; alum water invasion; changes of micro climate; degrading of environmental factors; changes of bio-diversification and other causes. Detail estimation of extension, time and location of impacts. Comparisons and matching with current criteria, norms and regulation (if there are). - Forecasting environmental risks that project may take: Only risks that project may take during implementation and operation. - Subjects to be impacted: all natural, economic, cultural, social, religious subjects and historical monuments and others in project site and surrounding areas which are affected by sources relating/not relating to waste and by risks of environmental incidents in project stages (preparation, construction and operation). - Forecast of risks of environmental incidents by project: Only mention possible risks in stages of construction and operation. 3.2 Remarks on detailed level and reliability of assessments Objective remarks on detailed level and reliability of assessments on environmental impacts and risks of environmental incidents that likely occur in project implementation and not implementation. In case of insufficient reliability, raise objective and subjective reasons (shortage of information, data, material; obsolete data; inaccurate date; limited reliability of assessment methodology; limited capacity of EIA staffs; and other reasons.) 3.3 Impact assessment - Impact assessment must concretized by causes of impacts and objects of impacts. Each impact should be assessed at very detail extent in term of degree, scope, time and location. - Impact assessment of one project should be made detail and concretized; it must not be a general or theoretical assessment like textbooks, guidebooks or regulations. 3.4 Methodology assessment Assessment on reliability of EIA. methods used, reliability of available assessments; uncertain points in assessments and the reasons, what recommendation is needed. Chapter 4:SOLUTIONS AND MEASURES TO MINIMIZE NEGATIVE IMPACTS, TO PREVENT AND COPE WITH ENVIRONMENTAL PROBLEMS Measures to mitigate negative impacts, prevent and respond to environmental incidents must be presented in each project	There is no gap. We will add the most recent information in the Final Report.

Content	JICA Guideline on Environmental and Social Consideration	World Bank (OP4.01, Annex B)	Circular No.05/2008(Guideline for Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Commitments)	Gap between JICA Guideline and Vietnamese Guideline/ Action to be taken
			stage (preparation, construction and operation) and each subject to be impacted as mentioned in item 3.3. Measures should be specific and feasible to be applied during project implementation. 4.1 For negative impacts: - Each negative impact on natural, socio-economic objects that is already identified should go with relevant solutions to minimize it, with clear explanation of strength, weakness, feasibility, efficiency/ effectiveness of the solutions. If there are no solutions or there is but infeasible, reasons should be explained and recommendation should be made so that relating agencies can have consideration and decisions. - It needs to prove that after solutions have been applied to what extent the negative impacts are minimized, comparisons and matching with current criteria, norms and regulations. If it does not match with criteria, norms and regulations, reasons should be explained and recommendation should be made so that relating agencies can have consideration and decisions. 4.2 For environmental problems: Proposing a general solution to prevent and to cope with problems, in which the follows should be clearly indicated: - Contents and measures that project owners can proactively realize and implement within their capacity; evaluation on feasibility and effectiveness; - Contents and measures that project owners need cooperation and assistance of government agencies and other partners; - Unavoidable problems and proposed solutions.	
Analysis of Alternatives	This systematically compares feasible alternatives to the proposed project site, technology, design, and operation including the “without project” situation in terms of the following: the potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. For each of the alternatives, it quantifies the environmental impacts to the extent possible, and attaches economic values where feasible. It also states the basis for selecting the particular proposed project design, and offers justification for recommended emission levels and approaches to pollution prevention and abatement.	Systematically compares feasible alternatives to the proposed project site, technology, design, and operation--including the "without project" situation--in terms of their potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. For each of the alternatives, quantifies the environmental impacts to the extent possible, and attaches economic values where feasible. States the basis for selecting the particular project design proposed and justifies recommended emission levels and approaches to pollution prevention and abatement.	N/A	There is a gap. We will add information in the Final Report.
Environmental Management Plan	This describes mitigation, monitoring, and institutional measures to be taken during construction and operation in order to eliminate adverse impacts, offset them, or reduce them to acceptable levels.	Covers mitigation measures, monitoring, and institutional strengthening; see outline in OP 4.01, Annex C.	Chapter 5:PROGRAMME TO MANAGE AND MONITOR ENVIRONMENT 5.1. Environmental management programme Work out a programme to manage environmental protection issues in process of preparation and construction of project and during project’s operation. Environmental management programme is developed on the basis of Chapter 1, 3, 4 in forms of tables, including information about: project activities in preparation, construction and operation, environmental impacts, measures to mitigate negative impacts (waste management and treatment works together with detailed instructions on categories and technical specifications, treatment of non-waste factors; measures to prevent environmental incidents and to recover environment if any, environmental education programmes and measures to mitigate other harmful impacts), funding for implementation, timetable, implementing agency and monitoring agency of environmental management programmes. 5.2 Environmental monitoring programme Propose programme to monitor wastes produced in process of preparation, construction and operation of project. 5.2.1 Waste monitoring: It requires monitoring waste f1ow/volume and other specific parameters of waste disposals according to current criteria, norms and regulation of Vietnam, at a minimum frequency of one time every 03 (three) months. Monitoring points or stations must be mapped with clear legends. 5.2.2 Monitoring surrounding environment: Only monitoring specific parameters of waste disposals according to current criteria, norms and regulation of Vietnam if there are no monitoring points or stations of State in the project areas, at a minimum frequency of one time every 06 (six) months. Monitoring points or stations must be mapped with clear legends. 5.2.3 Other monitoring: Only monitoring such factors as: eroded, slide, collapsed, and sunk land, erosion of river, stream, lake and sea banks, raised level of river, stream, lake and sea bed; changes of surface water level and	There is no gap. In the Final Report, we will add information that we got from our discussion with the project owner.

Content	JICA Guideline on Environmental and Social Consideration	World Bank (OP4.01, Annex B)	Circular No.05/2008(Guideline for Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Commitments)	Gap between JICA Guideline and Vietnamese Guideline/ Action to be taken
			underground water; salt water invasion, alum water invasion; changes of micro climate; degrading of environmental factors; changes of bio-diversification and other causes (if there are) if there are monitoring points or stations of State in the project areas, at an appropriate frequency to monitor spatial and temporal changes of these factors. Monitoring points or stations must be mapped with clear legends.	
Community Consultation	This includes a record of consultation meetings (date, venue, participants, procedures, opinions of major local stakeholders and responses to them, and other items), including consultations for obtaining the informed views of the affected people, local NGOs, and regulatory agencies.	N/A (It is stated in Appendix)	Chapter 6: COMMUNITY CONSULTATION 6.1. Consultation with communal level People's Committees 6.2 Consultation with communal level National Father Front Committees (Point 6.l and 6.2 are presented according to the requirement mentioned in Point 2 of Part III of this Circular). 6.3 Feedbacks and commitments by project owner to opinions by commune-level People Committee and Fatherland Front Regarding each content commented, requested by commune-level people's committee, Fatherland front committee, project owner must clearly state viewpoints to agree/disagree to every opinion. In case of agreeing, express commitments to meet requirements and present in which contents (chapter, item) of project. In case of disagreeing, provide reasons.	There is no gap. We will add the most recent information in the Final Report.
Conclusion, Recommendation, Commitments	N/A	N/A	CONCLUSION, RECOMMENDATION AND COMMITMENT 1. Conclusion There must be conclusion on: impacts are fully recognized and assessed or not, what remains; overall assessment on scope and scale of identified impacts; feasibility of measures and solutions to minimize impacts and prevent environmental incidents and risks; what negative impacts cannot be minimized or have no solutions due to exceeding project owner's capacity, and what recommendation. 2. Recommendation Recommendation should be made to relating authorities and agencies, asking assistance to solve problems that exceed project owner's capacity. 3. Commitments Project owner makes commitments to implementation of environmental management and monitoring programmes as mentioned in Chapter 5 (composed of environmental standards and norms which project must comply with); realize commitments as stated in item 6.3 in Chapter 6; comply with general regulations on environmental protection in project stages: - Commitments to environmental protection are realized and completed in stages of preparation and construction prior to project's official operation; - Commitments to environmental protection are carried out in operation stage from project's commencement to finalization; - Commitments to environment recovery in compliance with law on environmental protection after project terminate.	JICA Guideline does not have any requirements for this section.
Appendix	N/A	(i) List of EA report preparers --individuals and organizations. (ii) References --written materials both published and unpublished, used in study preparation. (iii) Record of interagency and consultation meetings, including consultations for obtaining the informed views of the affected people and local nongovernmental organizations (NGOs). The record specifies any means other than consultations (e.g., surveys) that were used to obtain the views of affected groups and local NGOs. (iv) Tables presenting the relevant data referred to or summarized in the main text. (v) List of associated reports (e.g., resettlement plan or indigenous peoples development plan).	- Copies of legal documents relevant to project. - Diagrams (drawings, maps) relevant to project but not yet be presented in EIA report. - Analysis result papers of environmental parameters (air, noise, water, soil, sediment, bio-resources...) with signature, name, title of Head of analysis agency and stamps. - Copies of documents relating to community consultation and sociology questionnaires (if any). - Pictures of project site (if any). - Other relevant documents (if any).	JICA Guideline does not have any requirements for this section.

5.2.4 Effectiveness of EIA Report for O Mon III Power Plant Project

Decree No.29/2011/ND-CP Article 12 3.b states “An environmental impact assessment report shall be made when the project is not implemented within thirty-six (36) months after the issuance of a decision approving the environmental impact assessment report”. This project might have conflict with this regulation, since 36 months from the approval date of the EIA report, which is July 31st, 2009, is June 30th, 2012.

MONRE does not have a set definition of “the beginning of the project implementation” that determines the expiration date of EIA report, but MONRE made a comment at the meeting with JICA Team that the project is considered to begin if any construction activities start. As for this project for O Mon III Power Plant, MONRE judged that the project implementation has already begun because the construction of the access road was already started.

Decree No.29/2011/ND-CP Article 12 3.c states “An environmental impact assessment report shall be made when the size, capacity or technology of the project is changed, resulting in increased adverse environmental impacts or scope of impacts” This project may have conflict with this regulation if the capacity of gas turbine is to be increased from 750MW, since the EIA for this project was approved with 750MW.

According to MONRE, the project owner is expected to submit an official letter to MONRE if the project owner increases the capacity after EIA approval. By responding to the official letter from the project owner, MONRE makes an official judgment if additional EIA with the capacity increase is necessary or not. As of 28th February 2012, since an output is not decided, it is not confirmed whether additional EIA is required or not.

5.2.5 Role of the Relevant Organizations

With the reorganization of the Government of Viet Nam, MONRE was established in 2002 to make the environmental administration centralized. VEPA, in charge of environmental policy making at national level, was established under MONRE, and in 2008, VEPA became VEA to strengthen the role of the organization. The reorganization of the local government was also conducted and DONRE (Department of Natural Resource and Environment), in charge of environmental administration at regional level, was established at provincial government[1].
The Table below shows the list of the organizations other than MONRE that is related to environmental administration and their roles[2].

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[1] Retrieved from http://www.soci.ous.ac.jp/gs/study/files/I08VM05.pdf

[2] Environmental measures social responsibility of business entities in Viet Nam: Global Environmental Forum (2007)

Table 5.2-3 Environment-related Organizations except for MONRE

Organizations	Role
MARD: Ministry of Agriculture and Rural Development	Ministry of Agriculture and Rural Development (MARD) is a governmental agency performing state management functions in the fields of agriculture, forestry and rural development nationwide. Department of Water Resource Management that was belonged to this Ministry was transferred to MONRE in 2002, but water resource management of irrigation dams and reservoirs for agricultural production is still under the control of MARD. MARD is also in charge of regulating and managing the preserved areas of the specific-purpose forest and protecting the precious and endangered species, though the tasks relating to international treaties such as the Ramsar Convention and Convention on Biological Diversity are under MONRE.
MOFI: Ministry of Fishery	Ministry of Fishery examines and researches on fishing resources as well as establishes and manages the marine protected areas.
MOC: Ministry of Construction	Ministry of Construction performs the administration of water and sanitary facilities.
MOIT: Ministry of Industry and Trade	Ministry of Industry and Trade establishes nation-wide industrial development plan. Department of Industry and Trade at provincial government supervises the registration and pollutant discharges of each factory from the perspective of environmental preservation and pollution control. Also, Department of Industry and Trade assesses the environmental impacts caused by production activities at factories, reports to MOIT and take measures to solve the issues.
MOH: Ministry of Health	Ministry of Health performs the supervision of the spread of medical services and the administration regarding the public awareness for improvement of environmental sanitation.
MOST: Ministry of Science and Technology	MOST (Ministry of Science and Technology) was a section of science and technology of the former MOSTE (Ministry of Science, Technology and Environment). MOST supervises and guides the administration and research of domestic science and technology including social science, in addition to the natural science.

5.2.6 Environment-related Licenses other than EIA Needed for This Project

The Table below shows the list of the environment-related licenses other than EIA that is needed for this project. As of 28 February 2012, when these will be approved is unknown, because the time to apply for these permits is depending on the progress of the project. The future submission and acquirement of the required environmental approvals at an appropriate timing must be checked and ensured.

Table 5.2-4 Environment-related Licenses other than EIA

Permit	Authority	Approval Date/ Schedule	Remarks
Environmental License for the Entire Project	MONRE	Before Plant Operation	
Environment Approval for Surface Water Exploitation and Water Discharge	MONRE or DONRE of Can Tho City	Before taking discharge water	According to Decree No.149/ 2004/ ND-CP, MONRE is the approval organization, if water use is more than50,000m^3/day, and water discharge is more than 5,000m^3/day. DONRE is the approval organization if anything below.
Approval for Using Deep Well Water or River Water (for construction purpose)	MONRE or DONRE	Before using the construction water	According to Decree No.149/ 2004/ ND-CP, MONRE is the approval organization, if the use of the underground water is more than 3,000m^3/day. DONRE is the approval organization if anything below.
Permission for Toxic Chemical/ Gas Application	Competent Agency authorized under MONRE	Before using of any device.	
Final License for Whole Fire Fighting System	Fire Police Headquarter (Hanoi)	During starting the Reliability Test	

5.2.7 Environmental Standards Applied for This Project

(1) Air Quality

1) Ambient Air Quality

Table 5.2-5 Ambient Air Quality Standard

Pollutant	Average time	Vietnam (QCVN-05/ 2009/ BTNMT)	IFC/EHS Guideline (General:2007)
TSP	1hr	0.30 mg/m^3	-
	24hr	0.20 mg/m^3	
	year	0.14 mg/m^3	
PM_{10}	24hr	150 μg/m^3	150 μg/m^3 (Interim*)
	year	50 μg/m^3	-
CO	1hr	30 mg/m^3	-
	8hr	10 mg/m^3	
	24hr	5 mg/m^3	
SO_2	10min	-	500 μg/m^3
	1hr	350 μg/m^3	-
	24hr	125 μg/m^3	125 μg/m^3(Interim*)
	year	50 μg/m^3	-
NO_2	1hr	200 μg/m^3	200 μg/m^3
	24hr	100 μg/m^3	-
	year	40 μg/m^3	40 μg/m^3

*: General EHS Guidelines refers to WHO Air Quality Guidelines 2005. WHO sets Iterim for PM_{10} and SO_2.

2) Air Emission

Table 5.2-6 Air Emission Standards for Thermal Power Plants

(Unit：mg/m^3)

Pollutant	Vietnam (QCVN-22/ 2009/ BTNMT)Kp=0.7, Kv=1		EHS Guideline (Thermal Power Plant: 2008)	
	Diesel	Gas	Diesel	Gas
SOx	350 (500)	210 (300)	0.5% / 1%	-
NOx	420 (600)	175 (250)	152	51
Dust	105 (150)	35 (50)	30 / 50	-

Note: I) In Air Emission Standards, coefficient is multiplied to the regulation value, depending on Kp and Kv.
II) In EHS Guideline, the regulation value is different, depending on the air environment.
III) It is applied when the plant operates more than 500 hours/year.

(2) Noise and Vibration

1) Noise

Table 5.2-7 Noise Level Standards

Parameter	Vietnam (QCVN-26/ 2010/ BTNMT)	EHS Guideline (General: 2007)
Noise	Hospital, School etc 06:00 - 21:00: 55 dBA 21:00 - 06:00: 45 dBA Apartment, Residential areas etc. 06:00 - 21:00: 70 dBA 21:00 - 06:00: 55 dBA	Residential area, School etc 07:00 - 22:00: 55 dBA 22:00 - 07:00: 45 dBA Commercial Zone, Industrial Zone 07:00 - 22:00: 70 dBA 22:00 – 07:00: 70 dBA

Note: This noise level standard is not applied for factory, construction site and shopping district area.

2) Vibration

Table 5.2-8 Vibration Level Standards

Parameter	Vietnam（QCVN-27/ 2010/ BTNMT）	
	Construction	Manufacturing Industry
Vibration	Hospital, School etc. 06:00 - 18:00: 75 dB 18:00 - 06:00: **BG** Apartment, Residential areas etc. 06:00 - 18:00: 75 dB 18:00 – 06:00: **BG**	Hospital, School etc 06:00 - 21:00: 60 dB 21:00 - 06:00: 55 dB Apartment, Residential areas etc. 06:00 - 21:00: 70 dB 21:00 - 06:00: 60 dB

Note: **BG** indicates the value of the background.

(3) Water Quality

1) Surface Water

Table 5.2-9 Surface Water Quality Standards

Parameter and Substance	Unit	QCVN-08/ 2008/ BTNMT			
		A1	A2	B1	B2
pH	-	6 - 8.5	6 - 8.5	5.5 - 9	5.5 - 9
DO	mg/L	>6	>5	>4	>2
TSS	mg/L	20	30	50	100
COD	mg/L	10	15	30	50
BOD_5 (20^oC)	mg/L	4	6	15	25
NH_4-N	mg/L	0.1	0.2	0.5	1.0
Cl^-	mg/L	250	400	600	-
F	mg/L	1	1.5	1.5	2
NO_3-N	mg/L	2	5	10	15
NO_2-N	mg/L	0.01	0.02	0.04	0.05
PO_4-P	mg/L	0.1	0.2	0.3	0.5
CN	mg/L	0.005	0.01	0.02	0.02
As	mg/L	0.01	0.02	0.05	0.1
Cd	mg/L	0.005	0.005	0.01	0.01
Pb	mg/L	0.02	0.02	0.05	0.05
Cr^{3+}	mg/L	0.05	0.1	0.5	1
Cr^{6+}	mg/L	0.01	0.02	0.04	0.05
Cu	mg/L	0.1	0.2	0.5	1
Zn	mg/L	0.5	1.0	1.5	2
Ni	mg/L	0.1	0.1	0.1	0.1
Fe	mg/L	0.5	1	1.5	2
Hg	mg/L	0.001	0.001	0.001	0.002
Surfactants	mg/L	0.1	0.2	0.4	0.5
Oil & Grease	mg/L	0.01	0.02	0.1	0.3
Phenol	mg/L	0.005	0.005	0.01	0.02
Pesticide: organic chlorine					
Aldrin+Dieldrin	μg/L	0.002	0.004	0.008	0.01
Endrin	μg/L	0.01	0.012	0.014	0.02
BHC	μg/L	0.05	0.1	0.13	0.15
DDT	μg/L	0.001	0.002	0.004	0.005
Endosunfan	μg/L	0.005	0.01	0.01	0.02
Lindan	μg/L	0.3	0.35	0.38	0.4
Chlordane	μg/L	0.01	0,02	0,02	0,03
Heptachlor	μg/L	0,01	0.02	0,02	0,05
Pesticide: organic phosphrous					
Paration	μg/L	0.1	0.2	0.4	0.5
Malation	μg/L	0.1	0.32	0.32	0.4
Harbicides					
2,4D	μg/L	100	200	450	500
2,4,5T	μg/L	80	100	160	200
Paraquat	μg/L	900	1200	1800	2000
Total Radiation α	Bq/L	0.1	0.1	0.1	0.1
Total Radiation β	Bq/L	1.0	1.0	1.0	1.0
E. coli	MPN/100mL	20	50	100	200
Total Coliform	MPN/100mL	2500	5000	7500	10000

Note: The definition of each category is as follows. A2 is applied for Hau River.

(i) A1 is suitable for domestic water supply and other purpose such as A2, B1 and B2;

(ii) A2 is used for domestic water supply with the suitable treatment technology; preserve the aquatic flora and fauna or other purpose such as B1 and B2;

(iii) B1 is used for the irrigation or other purpose which required the same water quality or the purpose such as B2; and

(iv) B2 is used for transportation and other purpose which required low water quality.

2) Underground Water

Table 5.2-10 Underground Water Quality Standards

Parameter	Unit	QCVN-09/ 2008/ BTNMT
pH	-	5.5 - 8.5
$CaCO_3$	mg/L	500
Total residue	mg/L	1500
COD	mg/L	4
NH_4-N	mg/L	0.1
Cl^-	mg/L	250
F^-	mg/L	1.0
NO_2-N	mg/L	1.0
NO_3-N	mg/L	15
SO_4^{2-}	mg/L	400
CN^-	mg/L	0.01
Phenol	mg/L	0.001
As	mg/L	0.05
Cd	mg/L	0.005
Pb	mg/L	0.01
Cr^{6+}	mg/L	0.05
Cu	mg/L	1.0
Zn	mg/L	3.0
Mn	mg/L	0.5
Hg	mg/L	0.001
Fe	mg/L	5
Se	mg/L	0.01
Total Radiation α	Bq/L	0.1
Total Radiation β	Bq/L	1.0
E. Coli	MPN/100mL	ND
Total Coliform	MPN/100mL	3

3) Industrial Wastewater

Table 5.2-11 Industrial Wastewater Standards

Parameter and Substance	Unit	VIetnam (QCVN-24/ 2009/ BTNMT)		EHS Guideline (Thermal Power Plant: 2008)
		A (Kq=1.2, Kf=1.1)	B	
Temperature	℃	40	40	*[3]
pH	-	6 - 9	5.5-9	6 - 9
Odour	-	ND	ND	-
Colour (Co-Pt at pH = 7)	-	20	70	-
BOD_5 (20^{0}C)	mg/l	40 (30)	50	-
COD	mg/l	66 (50)	100	-
Suspended solids (TSS)	mg/l	66 (50)	100	50
Arsenic (As)	mg/l	0.07 (0.05)	0,1	0.5
Mercury (Hg)	mg/l	0.007 (0.005)	0,01	0.005
Lead (Pb)	mg/l	0.1 (0.1) 0.1	0,5	-
Cadimium (Cd)	mg/l	0.007 (0.005)	0,01	-
Chromium (VI) (Cr^{6+})	mg/l	0.07 (0.05)	0,1	0.5 (T-Cr)
Chromium (III) (Cr^{3+})	mg/l	0.3 (00.2)	1	-
Cooper (Cu)	mg/l	3 (2)	2	0.5
Zinc (An)	mg/l	4 (3)	3	1.0
Nickel (Ni)	mg/l	0.3 (0.2)	0,5	-
Manganese (Mg)	mg/l	0.7 (0.5)	1	-
Iron (Fe)	mg/l	1 (1)	5	1.0
Tin (Sn)	mg/l	0.3 (0.2)	1	-
Cyanide	mg/l	0.09 (0.07)	0,1	-
Phenol	mg/l	0.1 (0.1)	0,5	-
Mineral Oil and fat	mg/l	7 (5)	5	10
Animal-vegetable oil and fat	mg/l	13 (10)	20	-
Chlroine residual	mg/l	1 (1)	2	0.2
PCBs	mg/l	0.004 (0.003)	0,01	-
Pesticide: organic phosphrous	mg/l	0.4 (0.3)	1	-
Pesticide: organic chlorine	mg/l	0.1 (0.1)	0,1	-
Sunfide	mg/l	0.3 (0.2)	0,5	-
Fluoride	mg/l	7 (5)	10	-
Chloride	mg/l	660 (500)	600	-
Ammonia (as N)	mg/l	7 (5)	10	-
Total Nitrogen	mg/l	20 (15)	30	-
Total Phosphorous	mg/l	5 (4)	6	-
Total Coliform	MPN/100ml	4000 (3000)	5000	-
Total Radiation α	Bq/l	0.1 (0.1)	0,1	-
Total Radiation β	Bq/l	1.3 (1.0)	1,0	-

Note: I) The definition of each category is as follows. Category A is applied for Hau River.
II) In the standards, coefficient is multiplied to the regulation value, depending on Kq and Kf.

*A: discharge to water bodies used for domestic water supply
*B: discharge to water bodies not used for domestic water supply

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[3] EHS Guideline does not specify the regulation value. However, it is expected to design the facility to mitigate the temperature and diffusion of discharge water as much as possible in order to avoid giving impacts on the aquatic life caused by thermal effluent.

4) Domestic Wastewater

Table 5.2-12 Domestic Wastewater Standards

Parameter and Substance	Unit	Vietnam (QCVN-14/ 2008/ BTNMT)		EHS Guideline (General: 2007)
		A(K=1.0)	B	
pH	-	5- 9	5 - 9	6 - 9
BOD_5 (20^0C)	mg/l	30	50	30, (COD: 125)
Suspended solids (TSS)	mg/l	50	100	150
Total residue	mg/l	500	1000	
H_2S	mg/l	1.0	4.0	
NH_4-N	mg/l	5	10	
NO_3-N	mg/l	30	50	10 (T-N)
Animal-vegetable oil and fat	mg/l	10	20	10
Surfactants	mg/l	5	10	
PO_4-P	mg/l	6	10	2 (T-P)
Total Coliform	MPN/100ml	3000	5000	400

Note: I) The definition of each category is as follows. Category A is applied for Hau River.
II) In the standards, coefficient is multiplied to the regulation value, depending on Kq.
*A: Water bodies defined as A1 or A2 in the surface water quality standards
*B: Water bodies defined as B1 or B2 in the surface water quality standards

5.3 SCOPING OF ENVIRONMENTAL IMPACT

The table 5.3-1 shows the scoping result about the expected environmental impacts, which was conducted in accordance with JICA Guideline on Environmental Social Consideration.

Table 5.3-1 Scoping Result

No.	Item	Evaluation				Reason
		Construction Phase		Operation Phase		
		Positive	Negative	Positive	Negative	
[Pollution]						
1	Air Pollution	N	A	N	A	- Dust will be generated from the removal of vegetation and heavy earthmoving activities, giving an impact on air quality. As leveling time with only about 1 month, the impact will be small and can be reduced. - Air pollution can also occur due to gas emission from the machinery, equipment and heavy trucks. However, the value of the parameters of pollution is still lower than the Vietnamese emission standard (except for dust). - In the construction phase of the project, 100 workers is expected to work at the construction site and burn fuel such as oil, gas and charcoal for cooking. If a person uses fuel at the average of about 0.5kg fuel/person/day, the total use of fuel is expected to be about 500kg/day. The process of burning fuel mainly create ash, dust, SO_2, CO_2, etc, but their impacts will be limited to the area of the construction area only. - In the course of pre-construction activity, 10 ton truck will be operating at the frequency of 33-36 trips/week. - In the course of construction, 10 ton truck will be operating at the frequency of 20 trips/hour for transporting construction materials and 24-30 trips/week for transporting waste (2 trips/week for domestic waste only). - According to the prediction of the diffusion of air pollution substances for O Mon 3 only, gas emission will not exceed the Vietnamese emission standard (QCVN-05/ 2009). Even if the gas turbine capacity increases, the quality of the gas emission will not exceed the Vietnamese standard. - It is expected that maximum ground concentration of NOx at the average of 1 hour exceeds the Vietnamese air quality standards when all the power plants operate at the same time.
2	Water Pollution	N	A	N	A	- According to the estimate, the total amount of excavation soil and rock is about 65,100m^3. This impact is considered small because the scope of the pollution is only about a few dozen meters around the project area and only last for about 1 month period of the excavation. - The wastewater containing concrete and waste oil will be generated. - It is assumed that the pre-construction activities would require 100 workers respectively, generating 15m3/day of domestic wastewater. The number of workers in the project's area at the peak time is estimated about 1000 workers, generating 150m^3/day of domestic wastewater. - Leakage of the fuel from the construction machinery causes the underground water pollution. - The thermal effluent from O Mon 3 only will be discharged at 18m^3/sec with the temperature of +6°C at the outlet. If the gas turbine capacity increases, the amount of the thermal effluent will be 18.4m^3/sec, which remains as almost same. - The amount of the thermal effluent will be 78.4m^3/sec when all the power plants in O Mon Power Complex operate at the same time. - 719m^3/day of plant wastewater and 195m3/day of oil wastewater will be generated. - Domestic wastewater and human waste generated by 191 workers on site is estimated to be 35m^3 per day - Leakage of the diesel fuel from the construction machinery causes the underground water pollution.
3	Waste	N	A	N	B	- General waste and hazardous waste are generated during construction phase. - General waste and hazardous waste are generated from the O Mon 3 Power Plant.

No.	Item	Evaluation				Reason
		Construction Phase		Operation Phase		
		Positive	Negative	Positive	Negative	
4	Noise and Vibration	N	A	N	B	- Noise level decreases of 6dB as the distance from noise source doubles. It is known that noise level becomes 75 dBA at the distance of 38-121m from the heavy equipments and 45dB at the distance of 2-5km. The temporary noise effect in residential area may be occurred during construction period (1 month). - The truck is estimated to serve this phase of the project which circulate on the Nation Road 1 about 35-70 trips/hours (to ton's truck) in the rush hour. According to Canter (1996), the noises caused by the heavy-duty trucks can reach 90 dBA at 15 meters from the noise source and range of the area affected by the noise can reach hundreds of meters from the noise source. - Noise from the turbine, motor and fan will be generated.
5	Land Subsidence	N	N	N	N	- In the course of construction for O Mon 1-A, 10m^3/hour of the underground water was used, since it was difficult to take water from Hau river, but land subsidence was not occurred. As for the construction of O Mon 3, the fire-fighting facility will have been completed and the water from the facility will be able to be used for the O Mon 3 construction, so the amount of underground water to be used will be much lower. - Underground water will be used as the domestic water for the employees at the power plant. However, the project owner has not decided the source of domestic water, either taking water from Hau river or underground. The total amount of the domestic water needed for 191 employees for O Mon 3 Power Plant will be 35m3/day.
6	Odor	N	N	N	N	- De-NOx system (SCR and etc.), which uses ammonia, will not be installed at O Mon 3 Power Plant.
[Natural Environment]						
1	Hydrology	N	N	N	N	- Cooling water will be taken from the Hau river with 18m3/sec. The flow amount of the Hau river is 1,000 ~ 20,000m^3/sec. Thus, the impact caused by the water intake will not be significant.
2	Underground Water	N	N	N	N	- As for the construction of O Mon 1-A, 10m3/hour of the underground water was used, but impact on the residents was not seen. The amount of underground water to be used for O Mon 3 construction will be much lower. Thus, the impact will not be significant. - The total amount of the domestic water needed for 191 employees for O Mon 3 Power Plant will be 35m^3/day.
3	Protected Area	N	N	N	N	- There are no protected areas or special use forests in the project area or in O Mon district. The closest protected area to the site is the Ngoc Hoang valley, located at 40km southeast of the site. No impact on the water quality is expected, since Ngoc Hoang valley is not located at any basin of Hau river. - Ground concentration of the pollutants will become one tenth of the maximum ground concentration at the distance of 10km from the O Mon Power Complex. Ground concentration of the pollutants will be much lower at the distance of 40km from O Mon Power Complex. Thus, the impact will not be significant at all.
4	Terrestrial Ecosystem	N	B	N	N	- Air and noise pollution caused by construction activities have impacts on the terrestrial ecosystem. - There is no ecological sensitive place such as primeval forest at the O Mon 3 Power Plant. The land use of O Mon 3 site is a mix of weeds and field crops. - The size of the farmland of Phuoc Thoi ward and Thoi An ward is 3,200 ha in total. Of those, 95.5 ha of the farmlands have been acquired by the project for the purpose of constructing O Mon 3 to O Mon 5 and auxiliary facilities. (26.6 ha of them are for O Mon 3). Thus, the impact of alternation of farmlands by this project is not considered as significant.
5	River Ecosystem	N	B	N	B	- Water pollution caused by construction activities has impacts on the aquatic creatures. - Aquatic creature will be taken with the intake of cooling water. - At average, 719 m^3/day of plant wastewater, 195 m^3/day of oil wastewater and 35 m^3/day of domestic wastewater will be generated. - Spawning and nursing ground of fishes are mainly located at the north bank of the Hau river (the opposite side from O Mon Power Complex), but thermal effluent from O Mon 3 will not reach the opposite side of the Hau river. Moreover, the thermal effluent will not reach the other side even if all the power plants in O Mon Power Complex operate at the same time.

No.	Item	Evaluation				Reason
		Construction Phase		Operation Phase		
		Positive	Negative	Positive	Negative	
6	Rare Species	N	B	N	B	- There is flooding soil ecosystem of sonnertia along Hau river, which is very vulnerable, but the strip of sonnertia in the project area has already been disappeared. - Air and noise pollution caused by construction activities have impacts on the terrestrial ecosystem. - Water pollution caused by construction activities has impacts on the aquatic creatures. - At average, 719 m^3/day of plant wastewater, 195 m^3/day of oil wastewater and 35 m^3/day of domestic wastewater will be generated. - The 2007 survey found indications of six fish species that have some species of listing in the Vietnamese Red List in the vicinity of the project site and the survey found three additional species in a large area of the Hau river.
[Social Environment]						
1	Resettlement (O Mon Power Complex)	A	A	N	N	- The 95.5 ha of land have been acquired for O Mon 3 and 4 as well as some auxiliary facilities, and 226 households were relocated out of the 601 affected households. - Land acquisition for O Mon 3 only was 26.6 ha, the number of the affected household was 128, and the relocating household was 57.
2	Employment and Livelihood	B	B	B	B	- About 300 people will usually be employed in the course of construction and about 1000 people will be engaged in construction at the peak time. - O Mon 3 Power Plant will plan to employ 191 people. - Building and operation of O Mon 3 Power Plant will create positive impacts of developing economy society at the local level and improve employment opportunity around the area.
3	Regional Community	A	A	B	A	- The influx of the workers increases the risk of social evils as a drug addict, harlotry, thief, the risks of transmitting epidemic diseases and occurring conflict with worker and local inhabitant. - The influx of the big number of workers will increase the demand of public health and environmental sanitation facilities. - Construction activities increase the traffic density on Nation Road 91and internal roads in O Mon District leading to the increase of accidents on these roads. - Transporting activities can damage the roads in the area (National highway 91 and internal roads). - The 30 tons is the maximum weight for one overland transporting truck. Any heavy equipment or materials that are more than 30 tons will be transported by water. - There is a possibility that non-equal relations in the income difference between the local residents and power plant employees will arise. - Increase of the traffic may lead to the increase of the traffic accident and the damage of the road.
4	Cultural Heritage	N	N	N	N	- There are not any historical, cultural and religious monuments in the project area.
5	Landscape	N	B	N	B	- Construction activities of the plant and ancillary facilities, transporting of construction material and equipments, etc during construction stage of the project may give the project area and the transport roads a bad look, in terms of landscaping. - Environmental pollution including air pollution, water pollution and solid waste disposal, etc. caused by operation of the O Mon 3 Power Plant may affect the land use and landscape of the project area.
6	Minorities	N	N	N	N	- The composition structure of the local people is rather multiform but mainly is Kinh ethnic group, otherwise there are some Cham ethnic (about some tens of households). However, most of the life activities and productivity forms of Cham ethnic group are very similar to that of the Kinh ethnic group. - Most of the affected people of the O Mon Power Complex are Kinh ethnic group. Some of the Cham and Khmer ethnic groups are also included in the affected people, but their lives and livelihoods are almost same as the Kinh's one. Also, there has not been any traditional function conducting inside O Mon Power Complex. Thus, the impact on those minority ethnic groups is not considered as significant and special consideration to them is not considered to be necessary.

No.	Item	Evaluation				Reason
		Construction Phase		Operation Phase		
		Positive	Negative	Positive	Negative	
7	Working Environment	B	B	B	B	- There is a high possibility that accidents would occur in the course of construction. - The influx of the workers increases the risks of transmitting epidemic diseases. - There is a possibility that workers would experience work-related accidents. - There is a possibility that the security guards would violate the safety of the residents.
[Others]						
1	Global Climate Change	N	B	N	B	- CO_2 will be generated from O Mon 3 Power Plant, contributing to the global climate change, but speaking of the capacity of the project, the impact will not be significant.

Note) Blue-colored items indicate the construction phase only.
The definitions of the category are as follows:
A: Significant impact is expected
B: Impact is expected to some extent
N: No impact is expected

5.3.1 Items That Negative Impact is expected

The table 5.3-2 shows the list of items that negative impacts are expected based on the above scoping results.

Table 5.3-2 Items That Negative Impacts Is Expected

Item	Construction Phase	Operation Phase
Item categorized as “significant impact is expected”	**[Pollution Abatement]** - Air Pollution - Water Pollution - Waste - Noise and Vibration **[Social Environment]** - Resettlement - Regional Community	**[Pollution Abatement]** - Air Pollution - Water Pollution **[Social Environment]** - Regional Community
Item categorized as “Impact is expected to some extent”	**[Natural Environment]** - Terrestrial Ecosystem - River Ecosystem - Endangered Species **[Social Environment]** - Labor and Livelihood - Landscape - Working Environment **[Others]** - Global Climate Change	**[Pollution Abatement]** - Waste - Noise and Vibration **[Natural Environment]** - Hydrology - River Ecosystem - Endangered Species **[Social Environment]** - Labor and Livelihood - Landscape - Working Environment **[Others]** - Global Climate Change

5.3.2 Items That Negative Impacts are not expected

The Table 5.3-3 shows the list of items that negative impacts are NOT expected.

Table 5.3-3 Items That Negative Impacts Are NOT Expected

Item	Reason
Land Subsidence	**Construction period;** In the course of construction for O Mon 1-A, 10m^3/hour of the underground water was used, since it was difficult to take water from Hau river, but land subsidence was not occurred. As for the construction of O Mon 3, the fire-fighting facility will have been completed and the water from the facility will be able to be used for the O Mon 3 construction, so the amount of underground water to be used will be much lower.
	Operation phase; Underground water will be used as the domestic water for the employees at the power plant. However, the project owner has not decided the source of domestic water, either taking water from Hau river or underground. The total amount of the domestic water needed for 191 employees for O Mon 3 Power Plant will be 35m^3/day. Since the amount of using water is about 30% of O Mon 1-A construction, the influence of taking ground water is not significant.
Odor	**Construction period;** Any substances that causes odor will not be handled.
	Operation phase; Any substances that causes odor will not be handled.
Hydrology	**Construction period;** Large amounts of intake and discharge water will not be conducted.
	Operation phase; Cooling water will be taken from the Hau river with 18m^3/sec. The flow amount of the Hau river is 1,000~20,000m^3/sec. Thus, the impact caused by the water intake will not be significant.
Underground Water	Same as Land Subsidence
Protected Area	**Construction period;** There are no protected areas or special use forests in the project area or in O Mon district.
	Operation phase; The closest protected area to the site is the Ngoc Hoang valley, located at 40km southeast of the site. No impact on the water quality is expected, since Ngoc Hoang valley is not located at any basin of Hau river. Ground concentration of the pollutants will become one tenth of the maximum ground concentration at the distance of 10km from the O Mon Power Complex. Ground concentration of the pollutants will be much lower at the distance of 40km from O Mon Power Complex. Thus, the impact will not be significant at all
Terrestrial Ecosystem	**Construction period;** There is no ecological sensitive place such as primeval forest at the O Mon 3 Power Plant. The land use of O Mon 3 site is a mix of weeds and field crops. The size of the farmland of Phuoc Thoi ward and Thoi An ward is 3,200 ha in total. Of those, 95.5 ha of the farmlands have been acquired by the project for the purpose of constructing O Mon 3 to O Mon 5 and auxiliary facilities. (26.6 ha of them are for O Mon 3). Thus, the impact of alternation of farmlands by this project is not considered as significant.
Resettlement	**Construction period;** Resettlement has already been completed before the construction.
Cultural Heritage	**Construction period;** There are not any historical, cultural and religious monuments in the project area.
	Operation phase; Same as Construction period
Minorities	**Construction period;** Most of the affected people of the O Mon Power Complex are Kinh ethnic group. Some of the Cham and Khmer ethnic groups are also included in the affected people, but their lives and livelihoods are almost same as the Kinh's one. Also, there has not been any traditional function conducting inside O Mon Power Complex. Thus, the impact on those minority ethnic groups is not considered as significant and special consideration to them is not considered to be necessary.
	Operation phase; Same as Construction period

5.4 ENVIRONMENTAL IMPACT REVIEW AND ASSESSMENT FOR O MON POWER COMPLEX

5.4.1 Calculation of Air Pollutant Diffusion for O Mon 3

(1) Environmental Impact of 750 MW

The table below indicates the input data and emission standard for O Mon 3 (EIA 3.4.4.1, p108). The emission standards and EHS (Environmental, Health, and Safety Guidelines) guideline of IFC (International Finance Corporation) are also shown. As shown in the table, the emission standard in Vietnam, as well as EHS Guideline, will be satisfied.

Table 5.4-1 Concentration of Pollutant and Dust in Flue Gas in O Mon 3

Parameter	Concentration（mg/Nm^3）			Emission standard for power plant (QCVN-22/ 2009) Kp=0.7, Kv=1		EHS Guideline (Thermal power planu; 2008)	
	GT only	Gas fired	Oil fired	Gas	Oil	Gas	Oil
SOx	3.2	7.3	209.59	210 (300)	294 (500)	-	0.5% / 1%
NOx	16.16	37.9	98.85	175 (250)	420 (600)	51	152
Dust	1.62	3.69	6.6	35 (50)	105 (150)	-	30 / 50

Note: In emission standard calculation, coefficient is multiplied depending on power generation capacity (Kp) and region (Kv).
In EHS Guideline, different guideline value is applied depending on the atmospheric environment. The guideline value is applied for the power plant operating 500 hrs and more per year.. SOx concentration means sulfur concentration in fuel.

Other parameters are shown in the table below (EIA 3.4.3.1, p.108, Appendix 3-1).

Table 5.4-2 Parameter for Simulation of Air Pollutants Diffusion

Parameter	Case 1: GT only (Gas-fired: 500MW)	Case 2: Combined cycle (Gas-fired: 750MW)	Case 3: Combined Cycle (Oil-fired: 750MW)
Height of stack	30 m (Bypass Stack)	40 m (Main Stack)	40 m (Main Stack)
Inner diameter of stack	6.8m	6.8m	6.8m
Flue gas flow	1564.6 m^3/sec	685.39 m^3/sec	747.49 m^3/sec
Flue gas velocity	42.9 m/sec	18.8 m/sec	20.5 m/sec
Flue gas temperature	594°C	97°C	141°C
SOx	5.0 g/sec	5.0 g/sec	156.67 g/sec
NOx	25.29 g/sec	25.96 g/sec	73.89 g/sec
Dust	2.53 g/sec	2.53 g/sec	4.93 g/sec

The table below shows the result of Gaussian-model short-term diffusion model of air pollutants in O Mon 3 based on the meteorological data in Can Tho City. It shows the maximum ground concentration (EIA 3.4.3.1, p107-113).

The O Mon 3 power plant will be normally operated in gas-fired combined cycle (Case 2), and the table indicates that the maximum ground concentration for SO_2 and PM_{10} is 1/100 of the Vietnamese environmental standard (QCVN-05/ 2009), NOx also being 1/10. In case of oil-fired combined cycle (7 days of operation per year is anticipated for emergency case), the maximum ground concentration is also well below the environmental standard for each pollutant (EIA 3.4.3.1, p107-113, Appendix3.1, EIA 4.3.4, p148).

Table 5.4-3 Results of Simulation of Air Pollutants Diffusion

Rainy season (Wind direction: East, Wind velocity; 2.5m/s, Temperature; 30℃, Atmospheric stability; B)

(μg/m^3)

Parameter	Case 1	Case 2	Case 3	Air quality standards (QCVN-05/ 2009)	EHS Guideline (General: 2007)
SOx	- 0.7 (1 hr)** 0.4 (24 hr)**	- 3.6 (1 hr)** 1.9 (24 hr)**	- 66.3 (1 hr) 35.2 (24 hr)	- 350 (1 hr) 125 (24 hr)	500 (10 min) - 125 (24 hr: Interim*)
NOx	3.5 (1 hr) 1.9 (24 hr) -	18.6 (1 hr) 9.8 (24 hr) -	31.1 (1 hr) 16.6 (24 hr) -	200 (1 hr) 100 (24 hr) -	200 (1 hr) - 40 (year)
PM$_{10}$	0.186 (24 hr)	0.96 (24 hr)	1.1 (24 hr)	150 (24 hr)	150 (24 hr: Interim*)

* IFC/EHS Guideline quotes the value in WHO Guideline. WHO establishes their own interim target value for PM$_{10}$ and SO$_2$.

** As diffusion modeling for SOx has not been conducted in O Mon 3 EIA, SOx diffusion was calculated in proportion to NOx.

Dry season (Wind direction: South-West, Wind velocity; 2.7m/s, Temperature; 30℃, Atmospheric stability; B)

(μg/m^3)

Parameter	Case 1	Case 2	Case 3	Air quality standards (QCVN-05/ 2009)	EHS Guideline (General: 2007)
SOx	- 0.7 (1hr)** 0.4 (24hr)**	- 3.7 (1hr)** 1.9 (24hr)**	- 68.1 (1h) 36.1 (24h)	- 350 (1 hr) 125 (24 hr)	500 (10 min) - 125 (24 hr: Interim*)
NOx	3.6 (1h) 1.9 (24h) -	19.0 (1h) 10.0 (24h) -	32.1 (1h) 17.0 (24h) -	200 (1 hr) 100 (24 hr) -	200 (1 hr) - 40 (year)
PM$_{10}$	0.190 (24h)	0.98 (24h)	7.8 (24h)	150 (24 hr)	150 (24 hr: Interim*)

(2) In the Case of Increasing the Output of O Mon 3

The above -cited calculation was based on the generation capacity of 750 MW as estimated in the O Mon 3 EIA. However, as a result of the recent improvement of gas turbine technology, the turbine of much higher capacity will be installed for O Mon Power Complex, and consequently, the gas emission will also need to be modified. Additionally, as the composition of fuel gas has been also changed since the EIA preparation, air pollutant emission should be modified as well. The estimated emission of air pollutant is calculated on the assumption that the turbine of maximum generation capacity currently available is introduced. Table 5.4-4 shows the result of the estimated emission compared to the estimation in O Mon 3 EIA. Although the output of O Mon 3 will be increased, the emission of air pollutant will not exceed of the emission standards for thermal power plant.

Table 5.4-4 Comparison of Air Pollutant Emission (Gas-Fired Combined Cycle)

(unit: g/sec)

Parameter	Parameter in O Mon 3 EIA	Result of JICA survey (draft)	Emission standard for power plant (QCVN-22/ 2009) Kp=0.7, Kv=1
.SOx	5.0	3.7	210 (300)
NOx	25.96	32.4	175 (250)
Dust	2.53	6.3	35 (50)

As the temperature and emission rate of the emission gas are almost similar to the O Mon 3 EIA calculation result, the maximum ground concentration may be calculated by simple proportional calculation. Background value concentration of pollutants is quoted from O Mon 4 EIA (O Mon 4 EIA Table 45, p.128) and the maximum ground concentration and the estimated maximum concentration was calculated as cited in the table below. This result suggests no exceeding of the environmental standard. Consequently, the pollutant emission, even after the increase of output, will not exceed the environmental standard and the environmental impact will be insignificant.

Rainy season (unit; µg/m^3)

Parameter	Max. Concentration	Back-ground	Max. Conc. + Back-ground	Air quality standards (QCVN-05/ 2009)	EHS Guideline (General: 2007)
SOx	- 3.6 -> 2.7 (1 hr) 1.9 -> 1.4 (24 hr)	- 38.7 (1 hr) 22.1 (24 hr)	- 41.4 (1 hr) 23.5 (24 hr)	- 350 (1 hr) 125 (24 hr)	500 (10 min) - 125 (24 hr: Interim*)
NOx	18.6 -> 23.2 (1 hr) 9.8 -> 12.2 (24 hr)	27.7 (1 hr) 18.5 (24 hr)	50.9 (1 hr) 30.7 (24 hr) -	200 (1 hr) 100 (24 hr) -	200 (1 hr) - 40 (year)
PM$_{10}$	0.96 -> 2.4 (24 hr)	79.4 (24 hr)	81.8 (24 hr)	150 (24 hr)	150 (24 hr: Interim*)

Dry Season (unit; µg/m^3)

Parameter	Max. Concentration	Back ground	Max. Conc. + Back-ground	Air quality standards (QCVN-05/ 2009)	EHS Guideline (General: 2007)
SOx	- 3.7 -> 2.7 (1 hr) 1.9 -> 1.4 (24 hr)	- 38.7 (1 hr) 22.1 (24 hr)	- 41.4 (1 hr) 23.5 (24 hr)	- 350 (1 hr) 125 (24 hr)	500 (10 min) - 125 (24 hr: Interim*)
NOx	19.0 -> 23.7 (1 hr) 10.0 -> 12.5 (24 hr)	27.7 (1 hr) 18.5 (24 hr)	51.4 (1 hr) 31.0 (24 hr) -	200 (1 hr) 100 (24 hr) -	200 (1 hr) - 40 (year)
PM$_{10}$	0.98 -> 2.4 (24 hr)	79.4 (24 hr)	81.8 (24 hr)	150 (24 hr)	150 (24 hr: Interim*)

5.4.2 Calculation of Thermal Effluent Diffusion for O Mon 3

(1) Environmental Impact of 750 MW

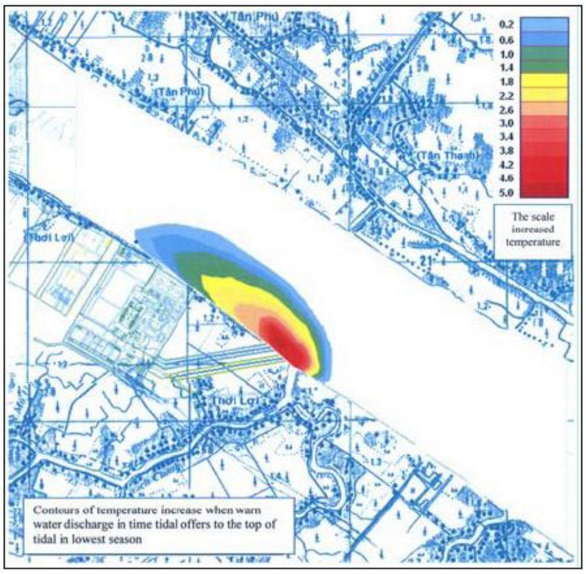
Cooling water is taken 18m^3/sec from Hau River (EIA 3.4.3.3, p114-115). The temperature of thermal effluent will be +7°C compared to intake water, but since its heat will be radiated in the cooling water discharge channel, the water temperature will be +6°C at the discharge mouse in Hau River. In dry season (river water temperature: 30 - 31°C), river water temperature will still below 40°C as permitted by Vietnam standard QCVN-24/ 2009 (EIA 3.4.3.3, p114).

The diffusion of the thermal effluent was calculated by the 2D Surface Water Flow and Solute Transport Program. In calculation, it carried out on condition of the dry season of which the influence of thermal effluent is larger than the rainy season because of the river flow. As the results, the diffusion extent of thermal effluent (1°C of temperature rise) is approximately 1,000m up and down-stream from the discharge mouse, and 300m toward the middle of the river (EIA 3.4.3.3, p115-126, Appendix-3.2, Appendix-4).

The northern bank of Hau River is more vegetated than the southern bank on which O Mon power complex is located, and constitutes a main spawning and nursery area for fish. The 2-D surface layer diffusion calculation takes into account only the diffusion of thermal waste water on surface layer and thus the resulted diffusion area tends to be more extended than the actual diffusion, but it indicates that the thermal water still does not reach the opposite bank. Additionally, fishermen move upstream and downstream to fish depending on the season and the growing of fish, so they have no fixed fishing place (2nd field survey), and therefore there is no specific place in which fishes gather. Thermal effluent diffuses on a surface layer and will not affect the benthic fish and animals and surface fish can also avoid thermal effluent. Since fishermen move the fishing ground depending on the movement of fish, the impact of thermal effluent to fishery is not significant.

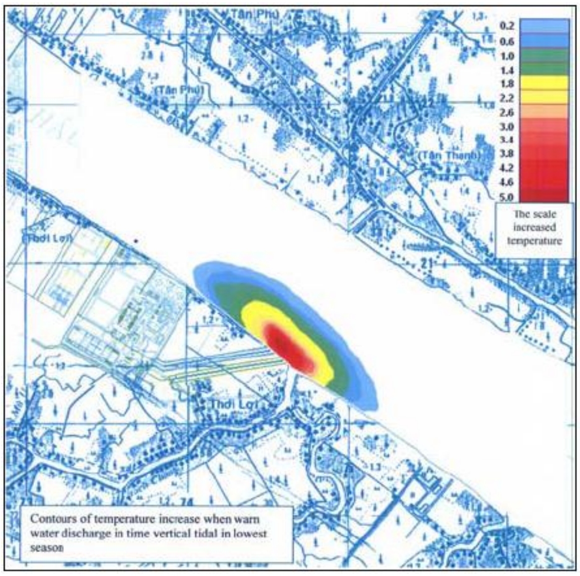
(2) In the Case of Increasing the Output of O Mon 3

An introduction of a turbine of much higher capacity is anticipated for O Mon Power Complex, which will bring higher generation capacity of the steam turbine and increased thermal waste water compared to the time of the EIA preparation. However, in the case where the turbine of maximum generation capacity currently available is introduced, the estimated thermal waste water discharge is 18.4 m^3/sec, slightly higher than 18 m^3/sec at the O Mon 3 EIA preparation (calculation based on the similar waste water temperature: 7°C higher than intake water). Consequently, the diffusion area of thermal waste water will remain almost unchanged. Therefore, it is not necessary to review the impact forecast and significant impact is not anticipated.



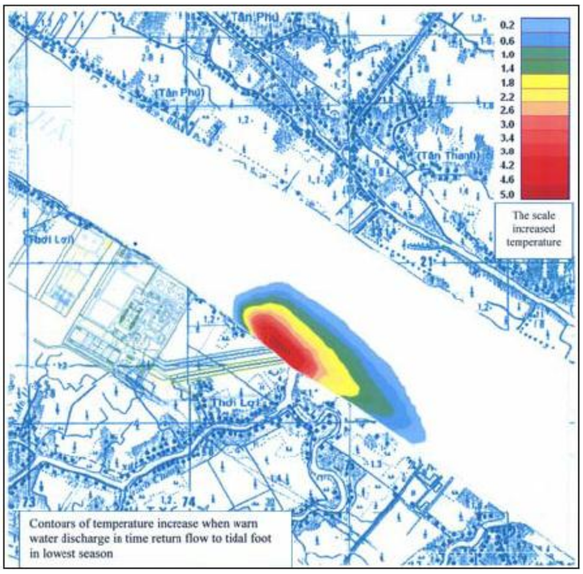
Flood tide

(Source; O Mon 3 EIA Figure 3.6, p.117)



Slack tide

(Source; O Mon 3 EIA Figure 3.10, p.121)



Ebb tide

(Source; O Mon 3 EIA Figure 3.9, p.119)

Fig. 5.4-1 Results of Thermal Effluent Diffusion of 750 MW (2-D Surface Layer Model)

5.4.3 Calculation of Air Pollutant Diffusion in the Operation Phase of All the Thermal Plants in O Mon Power Complex

In O Mon 4 EIA report, the diffusion of air pollutants was calculated in case that all the power plants in O Mon Complex (including O Mon 5) are in operation. In this case that all power plant operate by gas fired, O Mon 1 is the conventional power plant and O Mon 2 to 4 are the combined power plant. The calculation was made using U.S EPA (Environmental Protection Agency) recommended CALPUFF modeling system, 8760 times using hourly meteorological data of 2006. The table below shows the input parameters (O Mon 4 EIA 6.C.3, p.123-141).

Table 5.4-5 Parameters for Air Pollution Diffusion Modeling

Parameter	O Mon 1	O Mon 2 - 5
Stack height	140 m	40 m
Stack inner diameter	6.4 m	6.6 m
Flue gas flow	20.0 m/sec	19.3 m/sec
Flue gas temperature	90°C	95.3°C
Emission concentration and rate		
Nox	51.3 mg/Nm^3 (109.4 g/sec)	50 mg/Nm^3 (24.4 g/sec)
Sox	1.3 mg/Nm^3 (0.6 g/sec)	0.44 mg/Nm^3 (0.6 g/sec)
PM_{10}	10.32 mg/Nm^3 (0.2 g/sec)	10.32 mg/Nm^3 (5.0 g/sec)

As described above, construction of O Mon 5 is not planned, and O Mon 3 will be equipped with a gas turbine of considerably higher power. Table 5.4-6 shows the comparison of air pollutant emission of the power plant with high-power gas turbine (estimation based on the calculation in Chapter 5.4.1) with the emission calculated for the EIA preparation. As Sox value varies depending on the gas type, Sox emission in O Mon 1 is assumed to be similar to O Mon 2 to 4. The result indicates that the total pollutant emission at the full operation of the power complex is lower than at the time of O Mon 4 EIA preparation except for SOx.

Table 5.4-6 Comparison of Air Pollutant Emission

(Unit：g/sec)

Parameter	Parameter in O Mon 4 EIA			Result of JICA survey		
	Total Emission Rate	O Mon 1	O Mon 2 - 5	Total Emission Rate	O Mon 1	O Mon 2 - 4 (draft)
SOx	3.0	0.6	0.6	14.8	3.7	3.7
NOx	207.5	109.4	24.4	206.6	109.4	32.4
PM_{10}	20.5	0.2	5.0	19.1	0.2	6.3

As the temperature and the emission rate of gas emission is approximate to the O Mon 4 EIA, the maximum ground concentration may be calculated by simple proportional calculation, as cited in Table 5.4-7.

The summary of diffusion model is shown in the table below. No exceedance of air quality standard is predicted in yearly average and 24 hrs average. Exceedance of NOx concentration in 1-hour is predicted a maximum of 2 hours per year on 2 separate days, which is a very rare case (O Mon 4 EIA 6.C.3.e.4, p.127-128).

Regarding the NOx emission of the respective power plant, emission from O Mon 1, which is a conventional-type thermal plant, is three times higher than O Mon 3. Accordingly, the development of environmental mitigation measure for O Mon 1 power plant will be the most effective option. The realistic measure can consider reduction of operation of O Mon 1 in which it is inefficient and an environmental impact is larger than O Mon 3, when NOx concentration around the O Mon Power Complex is exceed with the air quality standards.

Table 5.4-7 Results of Air Pollutant Diffusion in the Operation Phase of All the Thermal Plants in O Mon Power Complex

(Unit : μg/m^3)

Parameter	Max. Concentration	Back-ground	Max. Conc. + Back-ground	Air quality standards (QCVN-05/ 2009)	EHS Guideline (General: 2007)
SOx	- 10.9 -> 53.8 (1 hr) 1.0 -> 4.9 (24 hr) 0.08 -> 0.4 (year)	- 38.7 (1 hr) 22.1 (24 hr) 5.5 (year)	- 92.5 (1 hr) 27.0 (24 hr) 5.9 (year)	- 350 (1 hr) 125 (24 hr)	500 (10 min) - 125 (24 hr: Interim*)
NOx	198 -> 197.1 (1 hr) 38 -> 37.8 (24 hr) 4.3 -> 4.3 (year)	27.7 (1 hr) 18.5 (24 hr) 10.3 (year)	224.8 (1 hr) 56.3 (24 hr) 14.6 (year)	200 (1 hr) 100 (24 hr) -	200 (1 hr) - 40 (year)
PM_{10}	9.2 -> 8.6 (24 hr) 0.7 -> 0.7 (year)	79.4 (24 hr) 41.7 (year)	88.0 (24 hr) 42.4 (year)	150 (24 hr)	150 (24 hr: Interim*)

5.4.4 Calculation of Thermal Effluent Diffusion in the Operation Phase of All the Thermal Plants in O Mon Power Complex

In O Mon 4 EIA report, it calculated the diffusion of the thermal effluent in case that all the power plants in O Mon Complex (including O Mon 5) are in operation. In this case, the thermal effluent (38.6m^3/sec) from O Mon 1 and O Mon 2 is discharged from the Cooling water discharge channel 1, and the thermal effluent (46.2m^3/sec) from O Mon 3 to 5 is discharged from the Cooling water discharge channel 2 (PPTA4845 EIA Table 36, p.75). The water temperature is +6℃ (the temperature at intake mouse is 31.5°C and the temperature at discharge mouse is 37.5°C). The calculation was made using 3D model (MIKE 3 model). The condition of the calculation is in dry season and 28 days as one cycle of tidal (O Mon 4 EIA 6.C1.c.i, p.115).

Table 5.4-8 shows the comparison of thermal waste water discharge of the power plant with high-power gas turbine (estimation based on the calculation in Chapter 5.4.2) with the discharge calculated for the EIA preparation.

Table 5.4-8 Comparison of Thermal Waste Water Discharge

(Unit: m^3/sec)

Parameter	Parameter of O Mon 4 EIA			Result of JICA study		
	Amount of thermal effluent	O Mon 1	O Mon 2 - 5	Amount of thermal effluent	O Mon 1	O Mon 2 - 4 (draft)
No.1	38.6	23.2	15.4	41.6	23.2	18.4
No.2	46.2	-	15.4	36.8	-	18.4

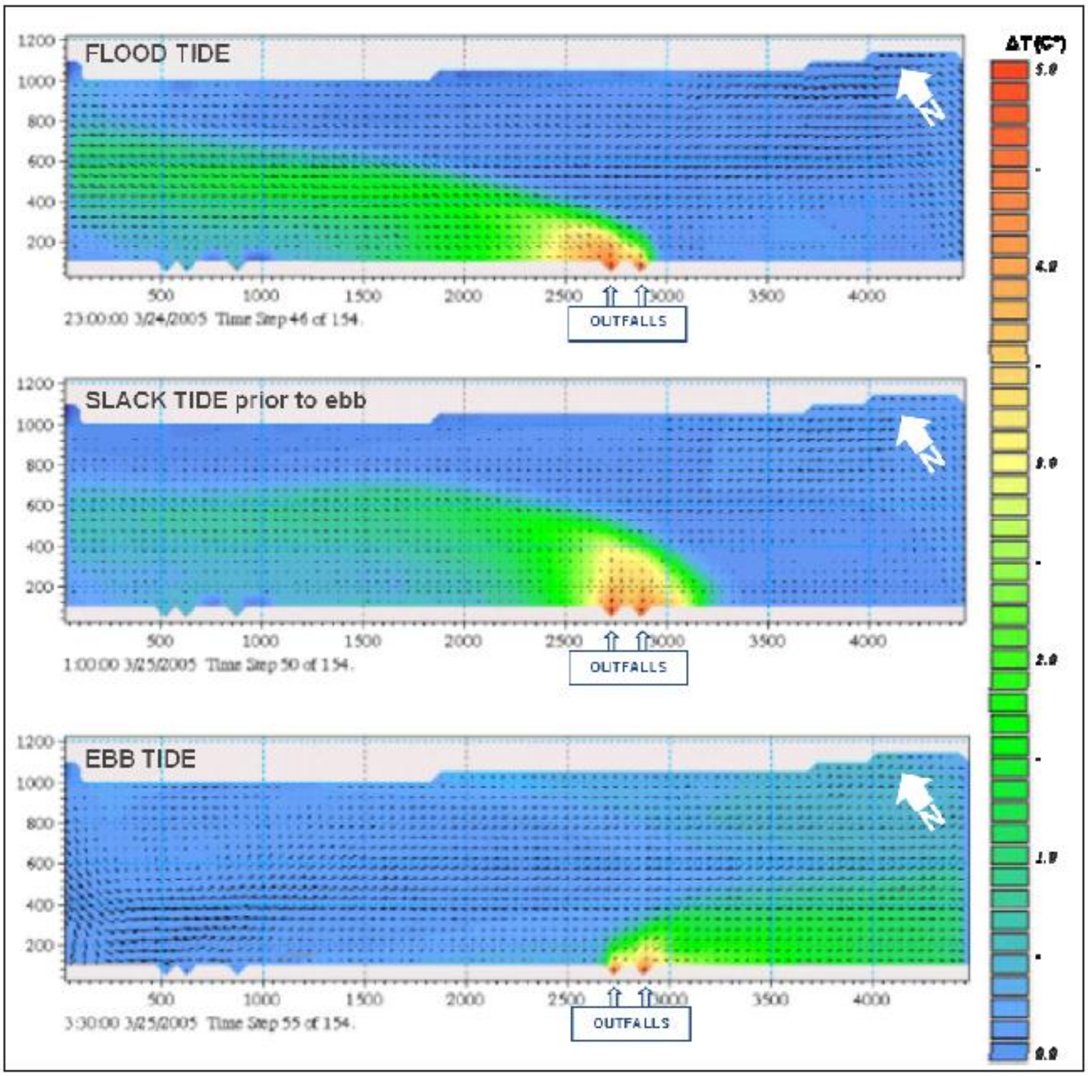
The water discharge from the discharge channel No.1 and No.2 slightly varies, but the total thermal water discharge is 78.4m^3/sec, which is lower than 85m^3/sec of O Mon 4 EIA case. Consequently, the diffusion area of thermal water discharge will not exceed the diffusion modeling of O Mon 4 EIA (as described below).

In flood tide, thermal water horizontally extends upstream toward the river center, with the 1°C warming area extending 2km upstream of the outfall and 600m toward river center. In slack tide prior to ebb, thermal water extends to the river center in upstream direction, with the area of 1°C warming area extending 1km upstream of the outfall and 600m toward river center. In ebb tide, thermal water extends along the bank toward downstream, with the 1°C warming area extending 1km downstream of the outfall and 400m toward river center (Appended Figure-3(1)).

Thermal water vertically extends to 3m deep around the mouse of the cooling water discharge channel 2, maintaining the depth up to 150m toward the river center, slightly extending toward the deeper area. The same occurs in channel 1, only with smaller extension toward the center and the deeper area of the river, as discharge rate is smaller (Appended Figure-3(2)).

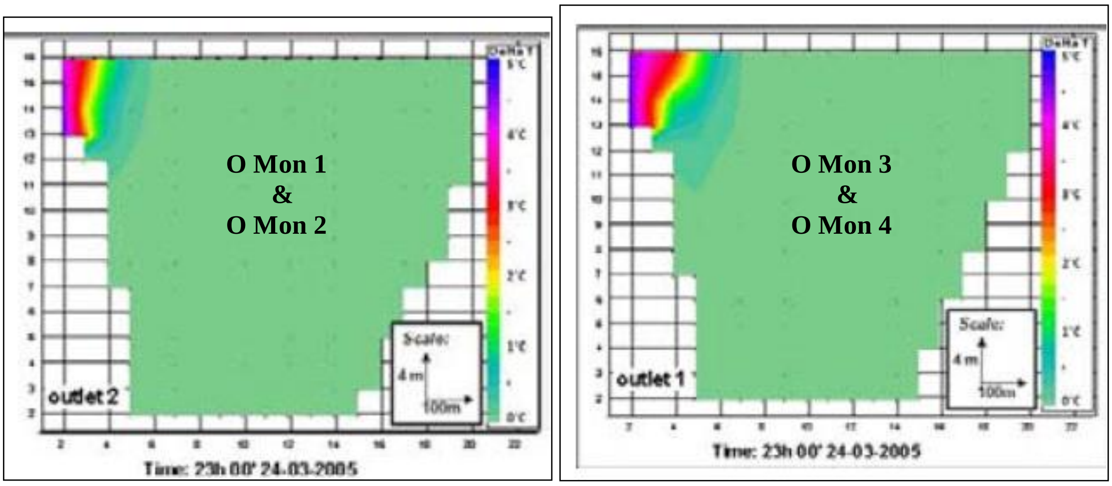
In O Mon 4 EIA report, the diffusion of the thermal effluent is calculated: 38.6m^3/sec in channel No.1, 46.2m^3/sec in channel No.2. In the JICA survey, the result was 41.6m^3/sec in channel No.1, 36.8m^3/sec in channel No.2. From the fact that the gradient at the outfall of the channel No.1 and No.2 is approximately the same, although the thermal water discharge of channel No.1 and No.2 is reversed in the latest survey result, the vertical diffusion of thermal waste water will not significantly change.

In this manner, thermal waste water extends 150m toward the river center with layer of 3m thick, but at the point distant from the outfall, thermal water extends only on the surface layer and not in deeper layer. Accordingly, benthic fish and organisms will not be affected. In addition, thermal water will not reach the main spawning and nursery area for fish located on the opposite bank even in dry season. On the other hand, the river water is abundant in wet season which is a high season for fish spawning and nursing. Consequently, the impact of thermal water to river organisms will be insignificant. Moreover, as the fishers in Hau River have no fixed fishing place, the thermal water will not adversely affect the fishery.



(Source; O Mon 4 EIA Figure 40, p.118)

Fig. 5.4-2 (1) Result of Thermal Effluent Diffusion (Horizontal Chart)



(Source; O Mon 4 EIA Figure 42, p.120)

Fig.5.4-2 (2) Result of Thermal Effluent Diffusion (Vertical Chart)

5.4.5 Environmental Impact Assessment for O Mon 3 and Alternative Analysis including Zero Option

(1) Environmental Assessment

The Table 5.4-1 shows the result of environmental impact assessment for O Mon III Power Plant. The details are described in the Table 5.9-1.

Table 5.4-9 Result of Environmental Assessment

No.	Item	Impact Assessment at Scoping		Impact Assessment based on the Study Result		Reason
		C	O	C	O	
[Pollution]						
1	Air Pollution	A^-	A^-	A^-	B^-	- Dust will be generated from the removal of vegetation and heavy earthmoving activities, giving an impact on air quality. As leveling time with only about 1 month, the impact will be small and can be reduced. - Air pollution can also occur due to gas emission from the machinery, equipment and heavy trucks. However, the value of the parameters of pollution is still lower than the Vietnamese emission standard (except for dust). - In the construction phase of the project, 100 workers are expected to work at the construction site and burn fuel such as oil, gas and charcoal for cooking. If a person uses fuel at the average of about 0.5kg fuel/person/day, the total use of fuel is expected to be about 500kg/day. The process of burning fuel mainly create ash, dust, SO2, CO_2, etc, but their impacts will be limited to the area of the construction area only. - In the course of pre-construction activity, 10 ton truck will be operating at the frequency of 33-36 trips/week. - In the course of construction, 10 ton truck will be operating at the frequency of 20 trips/hour for transporting construction materials and 24-30 trips/week for transporting waste (2 trips/week for domestic waste only). - Emission gas from O Mon III will meet the Vietnamese gas emission standard (QCVN-22/2009) and IFC Guideline. According to the prediction of the pollutant diffusion, maximum ground concentration of the pollutant will not exceed the gas emission standard (QCVN-5, 2009) and IFC Guideline, even if the capacity of gas turbine increases. When all the power plants in O Mon Power Complex operate at the same time, the concentration of NOx for 1 hour value may possibly exceed the air quality standard. However, the degree of air pollution from O Mon 1-A is still much higher.
2	Water Pollution	A^-	A^-	A^-	B^-	- According to the estimate, the total amount of excavation soil and rock is about 65,100m^3. This impact is considered small because the scope of the pollution is only about a few dozen meters around the project area and only last for about 1 month period of the excavation. - The wastewater containing concrete and waste oil will be generated. - It is assumed that the pre-construction activities would require 100 workers respectively, generating 15m3/day of domestic wastewater. The number of workers in the project's area at the peak time is estimated about 1000 workers, generating 150m^3/day of domestic wastewater. - Leakage of the fuel from the construction machinery causes the underground water pollution. - Temperature of the thermal effluent from O Mon III will be 7°C higher than the temperature of intake water, but will be decreased by 1°c by the time that the effluent is discharged into Hau river due to heat radiation at discharge channel. The diffusion range of the thermal effluent (defined as 1°c higher than the river water temperature) will be 1000m to the up and downstream and 300m to the center, and will not reach the opposite side of Hau river. The diffusion range will remain the same even with the capacity increase of gas turbine. When all the power plants in O Mon Power Complex operate at the same time, diffusion range will be 2km to the upstream, 1.5km to the downstream and 600m to the center, and will not reach the opposite side even in the dry season, resulting in not giving any impacts on spawning and nursing ground of fishes. Also, the thermal effluent does not give significant impact on fishery, since there is no designated fishing ground along Hau river.

No.	Item	Impact Assessment at Scoping		Impact Assessment based on the Study Result		Reason
		C	O	C	O	
						- Industrial wastewater and domestic wastewater will be treated at the central wastewater treatment facility to meet the discharge standard prior to be discharged. - Leakage of the diesel fuel causes the underground water pollution.
3	Waste	A^-	A^-	A^-	A^-	- General waste and hazardous waste are generated during construction phase. - General waste and hazardous waste are generated from the O Mon 3 Power Plant.
4	Noise and Vibration	A^-	B^-	B^-	N	- Noise level decreases of 6dB as the distance from noise source doubles. It is known that noise level becomes 75 dBA at the distance of 38-121m from the heavy equipments and 45dB at the distance of 2-5km. The temporary noise effect in residential area may be occured during construction period (1 month). - The truck is estimated to serve this phase of the project which circulate on the Nation Road 1 about 35-70 trips/hours (to ton's truck) in the rush hour. According to Canter (1996), the noises caused by the heavy-duty trucks can reach 90 dBA at 15 meters from the noise source and range of the area affected by the noise can reach hundreds of meters from the noise source. - The closest residential area from O Mon 3 is located at about 300m away from the power plant. Noise level is decreased by 50dBA at the distance of 300m. If the level of noise source is 90dBA, the noise level at the residential area will be 40dBA, which is not considered as significant impact.
[Natural Environment]						
4	Terrestrial Ecosystem	B^-	N	B^-	N	- Air and noise pollution caused by construction activities have impacts on the terrestrial ecosystem. - There is no ecological sensitive place such as primeval forest at the O Mon 3 Power Plant. The land use of O Mon 3 site is a mix of weeds and field crops. - The size of the farmland of Phuoc Thoi ward and Thoi An ward is 3,200 ha in total. Of those, 95.5 ha of the farmlands have been acquired by the project for the purpose of constructing O Mon 3 to O Mon 5 and auxiliary facilities. (26.6 ha of them are for O Mon 3). Thus, the impact of alternation of farmlands by this project is not considered as significant.
5	River Ecosystem	B^-	B^-	B^-	B^-	- Water pollution caused by construction activities has impacts on the aquatic creatures. - Aquatic creature will be taken with the intake of cooling water. - At average, 719 m3/day of plant wastewater, 195 m^3/day of oil wastewater and 35 m^3/day of domestic wastewater will be generated. - The thermal effluent is diffused at the surface of the river, so that the impact on benthic organisms is not expected. When all the power plants in O Mon Power Complex operate at the same time, the diffusion range of the thermal effluent is 2km to the upstream, 1.5km to the downstream and 600m to the center, and will not reach the opposite side even in the dry season, resulting in not giving any impacts on spawning and nursing ground of fishes. Impact caused by the thermal effluent will also not significant since spawning and nursing season of the fishes are mainly in rainy season where the river water volume is abundant.
6	Rare Species	B^-	B^-	B^-	B^-	- There is flooding soil ecosystem of sonnertia along Hau river, which is very vulnerable, but the strip of sonnertia in the project area has already been disappeared. - Air and noise pollution caused by construction activities have impacts on the terrestrial ecosystem. - Water pollution caused by construction activities has impacts on the aquatic creatures. - At average, 719 m^3/day of plant wastewater, 195 m^3/day of oil wastewater and 35 m^3/day of domestic wastewater will be generated. - The 2007 survey found indications of six fish species that have some species of listing in the Vietnamese Red List in the vicinity of the project site and the survey found three additional species in a large area of the Hau river.
[Social Environment]						
1	Resettlement (O Mon Power Complex)	$A^{\pm}$	N	$A^{\pm}$	N	- The 95.5 ha of land have been acquired for O Mon 3 and 4 as well as some auxiliary facilities, and 226 households were relocated out of the 601 affected households. - The life level of the affected people improve by compensation

No.	Item	Impact Assessment at Scoping		Impact Assessment based on the Study Result		Reason
		C	O	C	O	
2	Labor and Livelihood	$B^{\pm}$	$B^{\pm}$	$B^{\pm}$	$B^{\pm}$	- About 300 people will usually be employed in the course of construction and about 1000 people will be engaged in construction at the peak time. - O Mon 3 Power Plant will plan to employ 191 people. - Building and operation of O Mon 3 Power Plant will create positive impacts of developing economy society at the local level and improve employment opportunity around the area.
3	Regional Community	A^{+}, B^{-}	$A^{\pm}$	A^{+}, B^{-}	$A^{\pm}$	- The influx of the workers increases the risk of social evils as a drug addict, harlotry, thief, the risks of transmitting epidemic diseases and occurring conflict with worker and local inhabitant. - The influx of the big number of workers will increase the demand of public health and environmental sanitation facilities. - Construction activities increase the traffic density on Nation Road 91and internal roads in O Mon District leading to the increase of accidents on these roads. - Transporting activities can damage the roads in the area (National highway 91 and internal roads). - The 30 tons is the maximum weight for one overland transporting truck. Any heavy equipment or materials that are more than 30 tons will be transported by water. - Local economy is improved by creation of employment and starting a business around the area. - There is a possibility that non-equal relations in the income difference between the local residents and power plant employees will arise. - Increase of the traffic may lead to the increase of the traffic accident and the damage of the road.
5	Landscape	B^{-}	B^{-}	B^{-}	B^{-}	- Construction activities of the plant and ancillary facilities, transporting of construction material and equipments, etc during construction stage of the project may give the project area and the transport roads a bad look, in terms of landscaping. - Environmental pollution including air pollution, water pollution and solid waste disposal, etc. caused by operation of the O Mon 3 Power Plant may affect the land use and landscape of the project area.
7	Working Environment	B^{-}	B^{-}	B^{-}	B^{-}	- There is a high possibility that accidents would occur in the course of construction. - The influx of the workers increases the risks of transmitting epidemic diseases. - There is a possibility that workers would experience work-related accidents. - There is a possibility that the security guards would violate the safety of the residents.
[Others]						
1	Global Climate Change	B^{-}	B^{-}	B^{-}	B^{-}	- CO_2 will be generated from O Mon III Power Plant, contributing to the global climate change, but speaking of the capacity of the project, the impact will not be significant.

Note) Blue-colored items indicate the construction phase only.
The definition of the category is as follows:
A: Significant positive/negative impact is expected (+: positive, -: negative)
B: Positive/negative impact is expected to some extent (+: positive, -: negative)
N: No impact is expected

(2) Comparison of Alternative Technologies including a Zero Option

1) Zero option

The O Mon Power Complex project will play important roles in providing the necessary power supply in southern area of Vietnam. Without implementation of The O Mon Power Complex project, the current shortfall of 1,100 MW in the power system as well as the electricity demand growing at 15% to 17% per annum will not be met (O Mon 4 EIA 5.A, p.95). According to EVN, in view of the present situation of electricity supply in Vietnam, zero-option of the O Mon Power Complex is inconceivable, and the early action toward the project implementation, including land acquisition, is essential (2nd field survey).

2) Selection of the project site

The project plan of O Mon Power Complex has been developed in 1996. O Mon district was selected as the power complex project site for various reasons (O Mon 4 EIA 5.G, p.100-101). The construction plan of the O Mon 3 and 4 power plants in O Mon Power Complex has been approved by the Ministry of Industry and Trade (PPTA-4845 SIA 5.1, p.22), and O Mon Power Complex is the only alternative construction site conceivable for the new power plant around O Mon district.

Technical	Geographical	Social and environmental
- sufficient area for a 750 MW CCGT and associated facilities - access to reliable gas source - access to road and water transportation networks - access to national power grid - access to existing O Mon I infrastructure - available water supply - available cooling water - proposed use is in compliance with relevant land use plans and regulations	- geologically stable, low earthquake risk - reasonable site leveling and compaction costs - reasonable foundation construction costs	- not located close to any sensitive environmental receptors (communities, hospitals, schools, etc). - no physical cultural resources on site - relatively low resettlement and socioeconomic impacts

3) Consideration of fuel (F/S Chapter 5)

The reason for not using coal, LNG, and domestic oil is explained below.

Coal	LNG	Oil
- Coal development takes time and cost. - There is a construction plan of coal-fired power plant in northern Vietnam near coal mine in energy strategy in Vietnam.	- LNG plant needs high cost, and acceptance of the site and construction of storage facility is necessary.	- Domestic oil contains low sulfur. Export price of domestic oil is 1.5 times higher than import price of heavy oil, and oil export is economically more valuable than consuming as fuel for power generation.

The comparison of gas, DO and HO is described below.

< Comparison of gas, DO and HO >

Items	Gas	DO	HO
Atmospheric impact	Base	Significant	Very significant
Cost of fuel	Base	Expensive	Expensive

Consequently, gas is the most feasible fuel to be used for O Mon 3.

4) Comparison of electricity generation techniques (F/S Chapter 6.2)

Items	Combined Cycle	Conventional
Fuel	Gas, DO, (HO) HO need pretreatment.	Gas, DO, HO
Efficiency	51 ~ 60%	39 ~ 44%
Development cost (Calculation by F/S; 2009)	650 ~ 850 US$/kW	800 ~ 1,200US$/kW (Gas, Oil) 1,000 ~ 1,400US$/kW (Coal)
Running cost (O&M) (Calculation by F/S; 2009)	12 US$/kW/year	9 US$/kW/year
Total area of the plant	70 ~ 80%	Base (100%)
Operating life	25 years	30 years
Construction period	Base	10 ~ 12 months longer
Cooling water	Base	1.5 ~ 1.8 times more needed

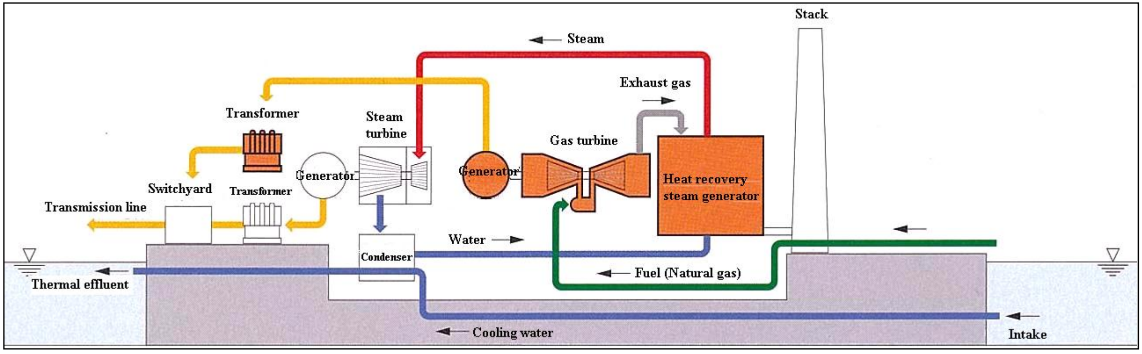
Combined cycle thermal power generation, despite high running cost and short life compared to conventional power generation, has the advantage of low development cost and short construction period. In addition, it generates less NOx (air pollutant), which is not noted in F/S. It needs less cooling water and accordingly generates less thermal waste water. As a consequence, the environmental impact is significantly smaller than thermal power generation.

From the above reasons, combined cycle power generation should be adopted to for O Mon 3.

5) Consideration of cooling method (F/S Chapter 7.6)

Steam used for power generation is cooled and return to water in the condenser, then sent back to the boiler. There are plural cooling methods of steam, such as heat release into water or air, and use of vaporization heat. Five cooling method including water-intake method are considered in the F/S.

Option 1: One-through method



(Source: "Outline of an environmental impact assessment", The Chugoku Electric Power Co., Inc.)

In one-through method, the steam is cooled by releasing heat into water. Cooling water is taken from the sea or river, and discharged again to sea or river after passing through the condenser.

Option 2: Cooling method using pond or lake

An artificial pond is constructed to temporarily store water, and cooling water is taken from/discharged into the pond. The scale of the artificial pond is determined depending on the capacity of the power plant, climate of the area, and the shape of the pond. In case of O Mon 3, a pond of 2.5km^2 will be needed, which is not a feasible option.

(Source: http://www.nucpros.com/node/6083)

Option 3: Natural circulation air-cooling tower method

In air-cooling tower method, steam is cooled by vaporization heat of water inside the tower. Here, air warmed by steam rises from the upper part of the stack, and cool air flows in from the lower part of the stack to fill the space. The size of the cooling tower is determined depending on the climate and the expected heat removal efficiency. In case of O Mon 3, a significantly large cooling tower will be needed.

(Source: http://www.wort.lu/wort/web/en/europe_and_world/articles/2011/12/169293/index.php)

Option 4: Forced-circulation air-cooling tower method

A similar cooling tower is used as that of "natural-circulation method", but with a fan installed at the lower part of the tower to force air into the tower.

Option 5: Air-cooling condenser method

In air-cooling condenser method, wind of a fan is used for cooling steam. A cooling tower is not necessary, which is convenient in the area where supply of cooling water is not assured, in desert area for example. As the fan is operated with electricity generated in the power plant, it will decrease certain amount of electricity supply. Cooling water supply is abundant in O Mon Power Complex and this method is not an appropriate option.

As a result of the comparison of the above-described 5 options, Option 2 and Option 5 are not feasible. Option 3 and Option 4 require construction cost for installation of cooling tower, and are lower in power generation efficiency compared to One-through method. Consequently, Option 1 "One-through method" is the most feasible and appropriate option.

5.4.6 Result of Consideration of Environmental Mitigation Measures

The result of consideration of environmental mitigation measures is described in Table 5.5-1.

5.5 ENVIRONMENTAL MANAGEMENT PLAN AND MONITORING PLAN

5.5.1 Environmental Management Plan

Environmental Management Plan (EMP) for O Mon 3 has been prepared and specified in the EIA report of O Mon 3. EMP for O Mon 4 has also been prepared, but it is not the same as the EMP for O Mon 3. Considering that O Mon 3 Power Plant and O Mon 4 Power Plant are very similar in design and capacity, it would be better to make the EMP for O Mon 3 same as the one for O Mon 4. Thus, any effective environmental management measures, which specified in EMP for O Mon 4 and not specified in EMP for O Mon 3, are to be recommended as "proposal for addition" as shown in the Table 5.5-1.

Table 5.5-2 shows the frequency, responsible organization and cost for the environmental management plan.

Table 5.5-1 Proposal for Addition to Environmental Management Plan

Item	Environmental Management Plan (EIA of O Mon 3)	Proposal for Addition
Construction Phase		
Air Pollution	- Spraying water at construction area and disposal site. - Minimizing size and occupied time of disposal heap. - Sodding and planting of trees that grow strongly on disposal heaps. - Covering vehicle during transportation time. - Limiting operation of vehicle at daytime if possible. - Ensuring vehicles running in the project area in good condition. - Spraying water in construction and disposal areas in dry and sunny days.	- Monitoring the local air quality on a regular basis during the construction phase and taking actions to address project related impacts. - Using modern equipment that is in compliance with relevant Vietnamese vehicle emissions regulations (QCVN 22: 2009/BTNMT). - Developing vegetation cover for the piles that are not going to be used in the short-term.
Water Pollution	- Constructing temporary rain drainage ditches to prevent accumulating water in the leveling area in the course of construction. Maintaining this water drainage system regularly to increase rain discharge capacity of the region. - Minimizing all petroleum and lubricant leakages and dropped construction materials and collecting them daily in order to prevent sweeping them away to the arroyos and changing flows. - Reducing the restoration of ground water artery by a layer of waterproofing materials such as concrete and asphalt after construction. - Preparing and implementing land erosion control plan. - Implementing sedimentation and oil collection from waste water prior to discharge to environment. - Installing septic tank at the construction areas for treating domestic wastewater. - Treating oil polluted waste water by oil separation system. - Storing chemicals at area with roof and concrete floor. - Training workers on cleaning measures in case of chemical spill accident. - Prohibiting disposal of waste into Hau River as well as surroundings of the project area. - Installing setting basin of overflow rainwater at outlet prior to discharge into Hau River.	- Monitoring the river water and ground water quality on a regular basis during the construction phase and taking actions to address project related impacts. - Installing temporary toilets at a rate of one for every twenty workers on site. - Collecting and treating the effluent from portable toilets by an appropriately licensed company in accordance with relevant Vietnamese regulations. - Preparing and implementing a Construction Phase Erosion and Runoff Control Plan (ERCP) - Treating the wastewater from supply ships in accordance with the local regulations, not discharging into the river.
Waste	- Designing and constructing of temporary disposal area at camp area of workers. - Classifying waste into harmful waste and normal waste prior to transport for re-usage or burying. - Arranging garbage can surrounding construction and worker camp areas. - Using information of solid waste treatment to training program	- Monitoring soil quality - Utilizing construction wastes on site to the maximum extent possible. That which cannot be used should be collected by an appropriately licensed company for recycling and/or final disposal in a licensed waste facility. - Installing solid waste refuses receptacles at a rate of

Item	Environmental Management Plan (EIA of O Mon 3)	Proposal for Addition
	of construction workers including classification of harmful waste and waste possibly harmful waste. - Contracting with Urban Works Enterprise of Can Tho City on collection of construction waste from project site to district disposal landfill at least one time in a week.	one for every twenty workers on site and having solid waste collected regularly and disposed at a licensed waste disposal facility. - Requiring all the supply ships to maintain good hazardous waste management practices and have spill response plans in place.
Noise and Vibration	- Installing sound insulating wall. - Restricting all transport means to operate from 21:00pm to 6:00am of the next day. - Maintaining construction machines, equipment and vehicles in the best operation conditions. - Repairing and maintaining regularly construction machines, equipment and vehicles. - Implementing high noise activities in the daytime. - Announcing widely in community the time period and construction plan of the project. - Constructing a noise wall or installing noise reducer at noise affected area.	- Monitoring sound levels periodically to ensure compliance with relevant Vietnamese regulations (QCVN-26/ 2010) and IFC EHS Guidelines (General: 2007) - Using modern equipment in compliance with relevant Vietnamese vehicle emissions regulations (TCVN 6438-2001) and regularly maintaining machinery and trucks. - Using “noise reduction skirts” on pneumatic hammers”. - Restricting pile-driving to week-days and daytime hours (6am to 6pm).
Terrestrial Ecosystem	- Taking mitigation measures for the impacts of air pollution, noise and vibration. - Greening 11.1% of the project site area during construction phase and more than that during operation phase.	None
River Ecosystem	- Mitigating impacts to the aquatic creature by taking mitigation measures for water pollution.	None
Rare Species	- Mitigating impacts on the rare species by taking mitigation measures for water pollution, since the rare species around the O Mon Power Complex is only fishes.	None
Resettlement	- Providing adequate compensation and support for livelihood restoration. - Conducting monitoring activities on the resettled residents. - Establishing grievance mechanism.	Corrective Action Plan (2011) by ADB
Employment and Livelihood	- Employing local people, especially project affected people on construction activities.	None
Local Community	- Propagandizing and educating the construction workers to establish relations with inhabitants. - Organizing exchange meeting with People’s Committee of wards and O Mon District on matters related to the relation between workers and inhabitants. - Having good management measure for workers. - Installing light and sigh system on section of National highway 91 crossing over the project site. - Repairing the damaged road section by the contractor after construction completion, since National highway 91 could be damaged by operation of heavy trucks. - Maintaining environmental sanitation and living conditions and ensuring community health on camp area of workers. - Supplying sufficient fresh water and sanitary food to workers. - Supplying sufficient garbage can and periodical collection of garbage. - Improving awareness of construction workers on environmental sanitation at camp area. - Constructing or providing suitable sanitary equipment such as removable WCs, waste bins, etc at the worker’s camps by the construction contractor. Constructing one septic tank system at each camping area to treat domestic sewage water. - Classifying waste into harmful waste and normal waste prior to transport for re-usage or burying. - Contracting with Urban Works Enterprise of Can Tho City on	- Prior to the commencement of civil works, developing a Occupational Health and Safety Plan (OHSP) that is consistent with the relevant requirements of Vietnamese law and with good international practice as reflected in internationally recognized standards such as the World Bank Group’s Environment, Health and Safety Guidelines. - Having Community Health and Safety Plan (CHSP) included procedures for posting warning signs and fences as required to protect local community members from dangerous work areas.

Item	Environmental Management Plan (EIA of O Mon 3)	Proposal for Addition
	collection of construction waste from project site to district disposal landfill at least one time in a week. - Training workers on cleaning measures in case of chemical spill accident.	
Landscape	- Greening 11.1% of the project site area during construction phase and more than that during operation phase.	None
Working Environment	- Constructing clinic for health care of workers. - Arranging clinics at the construction site and nurses and providing timely all medicines, health care services and first aid to the workers when they are sick or engage in industrial accidents. Establishing a system where the construction contractor coordinates closely with clinic of Phuoc Thoi ward in taking care of health and disease prevention.	- Prior to the commencement of civil works, developing a Occupational Health and Safety Plan (OHSP) that is consistent with the relevant requirements of Vietnamese law and with good international practice as reflected in internationally recognized standards such as the World Bank Group’s Environment, Health and Safety Guidelines.
Global Climate Change	None	- Minimizing the number of machine operation and material transportation by making an efficient construction schedule.
Operation Phase		
Air Pollution	- Designing and installing stack in accordance with the standards.	- Complying gas emissions with QCVN 22: 2009/BTNMT emission standards and EHS Guidelines. Monitoring the compliance through CEMS (Continuous Emission Monitoring System). - In the case that the monitoring results indicate non-compliance with QCVN 22: 2009/BTNMT emission standards, scaling down the capacity of the power plant operation and identifying meteorological conditions around O Mon Power Complex.
Water Pollution	- Separating rainwater running through polluted area from rainwater drainage system of the power plant. - Determining potential oil spill area. Collecting rainwater overflowing through that area to the oil separation system before treating directly or discharging into receipt source. - Treating all domestic waste water from staffs building according to waste standards prior to discharge. - Treating all the wastewater properly by the general waste water treatment facility to meet the industrial wastewater standard (QCVN-24/2009, Type-A) prior to discharge to the environment.	- Monitoring the quality of the effluent from the central treatment plant at the discharge point. - Directing the runoff to a sedimentation basin by the drainage system and then to discharge channel No.2. - Putting DFO tanks within a secondary containment system consisting of a 1.5m high reinforced concrete oil-proof containment wall (bund). - The oily water should be directed to a gravity-type oil-water separator. The oil-water separator will remove up to 99% of waste oil, which should be collected, stored and either reused, reprocessed, or sold. Sludge from the oil-separator should be dredged periodically and land-filled by a private waste contractor. The treated effluent from the oil-water separator should be directed to the general waste water treatment system for further treatment. - Implementing an operation phase spill control plan (SPC) to deal with the risk of fuel spills. - Treating wastewater from all the supply ships at facilities on land in accordance with the regulations, not discharging into the river. - Monitoring the river water quality. - Monitoring temperature of intake and discharge of cooling water continuously.
Waste	- Designing collection system of domestic waste and transporting domestic waste periodically to the general local disposal area. - Classifying wastes into harmful waste and normal waste prior to transport and dumping it to the general disposal area of district. - Selecting a waste disposal contractor by bid for every waste type every year. The selected contractor deals with the disposal of the specific waste type generated from the whole O Mon Power Complex.	- Monitoring the soil quality. - Including a hazardous waste management system in the operation phase OHS plan. - Requiring all supply ships to maintain good hazardous waste management practices and having spill response plans in place.
Noise and Vibration	- In case of noise in the power plant or local surrounding residential areas exceeding permit standard due to operation of	- Monitoring the noise level. - Selecting equipment with lower sound power levels

Item	Environmental Management Plan (EIA of O Mon 3)	Proposal for Addition
	power plant, installing noise reducer and noise wall, etc. around the big noise sources.	- Installing silencers for fans or suitable mufflers on engine exhausts and compressor components. - Installing acoustic barriers without gaps and with a continuous minimum surface density of 10kg/m^2.
River Ecosystem	- Mitigating impacts on the rare fish species by taking mitigation measures for water pollution. - Installing mesh and river-return system for aquatic creature at inlet. - Arranging cooling water outlet far away from cooling water inlet in order to ensure temperature of water flow below 40℃ prior to discharge into river. - Considering the feasibility of increasing pump speed in order to decrease flow velocity of cooling water in waste canal.	- Monitoring temperature of intake and discharge of cooling water continuously. - Monitoring the aquatic creature.
Rare Species	- Mitigating impacts on the rare species by taking mitigation measures for water pollution, since the rare species around the O Mon Power Complex is only fishes.	- Monitoring the aquatic creature.
Employment and Livelihood	- Creating job in the power plant for local people.	None
Regional Community	- Supplying sufficient fresh water, safety food and electricity to staffs building area. - Collecting and transporting domestic wastes from workers' building area with frequency of 1 time/week. - Equipping building area of workers with sufficient lavatory and other sanitary equipment. - Preventing epidemic diseases.	- Prior to the commencement of plant operation, preparing operation phase OHS and CHS plans by the EHS Team in accordance with relevant requirements of Vietnamese law and with good international practice as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines.
Landscape	- Greening 11.1% of the project site area during construction phase and more than that during operation phase.	None
Working Environment	- Providing noise-protective capsules and plugs to the engineers and workers working at workplace with noise exceeding 90dBA. - Providing specialized clothing, shoes, gloves and cap to the engineers and workers working in high and medium voltage areas to prevent electric shock. - Taking measures for fires. - Placing equipment of protection and fire-fighting and other first aid at fuel tank area in accordance with regulations.	- Prior to the commencement of plant operation, preparing operation phase OHS and CHS plans by the EHS Team in accordance with relevant requirements of Vietnamese law and with good international practice as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines.
Global Climate Change	- Reducing the emission amount of CO2 per power generation unit by applying the combined-cycle power.	- Monitoring GHG (Green House Gas) and reporting regularly.

Table 5.5-2 Frequency, Responsible Organization and Cost for the Implementation of Environmental Management Plan

Item	Environmental Management Plan	Frequency	Responsible Organization	Cost ($)
Construction Phase				
Air Pollution	- Monitoring the local air quality on a regular basis during the construction phase and taking actions to address project related impacts.	Monthly	Researcher: EPC Contractor Supervisor: CTTP	15,000 (equipment purchase, 7,500 each; primary monitor + backup) 500/yr calibration and maintenance, based on 250/yr/monitor (O Mon 4 EIA Table 51, p.174-179)
	- Spraying water at construction area and disposal site. - Minimizing size and occupied time of disposal heap. - Sodding and planting of trees that grow strongly on disposal heaps. - Covering vehicle during transportation time. - Limiting operation of vehicle at daytime if possible. - Ensuring vehicles running in the project area in good condition. - Spraying water in construction and disposal areas in dry and sunny days. - Using modern equipment that is in compliance with relevant Vietnamese vehicle emissions regulations (QCVN 22: 2009/BTNMT). - Developing vegetation cover for the piles that are not going to be used in the short- term.	Continuously	Implementer: EPC Contractor Supervisor: CTTP	Included in Construction Cost
Water Pollution	- Monitoring the river water and ground water quality on a regular basis during the construction phase and taking actions to address project related impacts.	Quarterly (Sampling)	Sampling: EPC Contractor Analysis: Environmental Consultant (O Mon 4 EIA Table 51, p.174-179) Supervisor: CTTP	4,640 (based on $75 sample) (O Mon 4 EIA Table 51, p.174-179)
		Monthly (Portable water quality analyzer)	Researcher: EPC Contractor (O Mon 4 EIA Table 51, p.174-179) Supervisor: CTTP	3,500 (equipment purchase) (O Mon 4 EIA Table 51, p.174-179)
	- Constructing temporary rain drainage ditches to prevent accumulating water in the leveling area in the course of construction. Maintaining this water drainage system regularly to increase rain discharge capacity of the region. - Minimizing all petroleum and lubricant leakages and dropped construction materials and collecting them daily in order to prevent sweeping them away to the arroyos and changing flows. - Reducing the restoration of ground water artery by a layer of waterproofing materials such as concrete and asphalt after construction. - Preparing and implementing land erosion control plan. - Implementing sedimentation and oil collection from waste water prior to discharge to environment. - Installing septic tank at the construction areas	Continuously	Implementer: EPC Contractor Supervisor: CTTP	Included in Construction Cost

Item	Environmental Management Plan	Frequency	Responsible Organization	Cost ($)
	for treating domestic wastewater. - Treating oil polluted waste water by oil separation system. - Storing chemicals at area with roof and concrete floor. - Training workers on cleaning measures in case of chemical spill accident. - Prohibiting disposal of waste into Hau River as well as surroundings of the project area. - Installing setting basin of overflow rainwater at outlet prior to discharge into Hau River. - Installing temporary toilets at a rate of one for every twenty workers on site. - Collecting and treating the effluent from portable toilets by an appropriately licensed company in accordance with relevant Vietnamese regulations. - Preparing and implementing a Construction Phase Erosion and Runoff Control Plan (ERCP) - Treating the wastewater from supply ships in accordance with the local regulations, not discharging into the river.			
Waste	- Designing and constructing of temporary disposal area at camp area of workers. - Classifying waste into harmful waste and normal waste prior to transport for re-usage or burying. - Arranging garbage can surrounding construction and worker camp areas. - Using information of solid waste treatment to training program of construction workers including classification of harmful waste and waste possibly harmful waste. - Contracting with Urban Works Enterprise of Can Tho City on collection of construction waste from project site to district disposal landfill at least one time in a week. - Utilizing construction wastes on site to the maximum extent possible. That which cannot be used should be collected by an appropriately licensed company for recycling and/or final disposal in a licensed waste facility. - Installing solid waste refuses receptacles at a rate of one for every twenty workers on site and having solid waste collected regularly and disposed at a licensed waste disposal facility. - Requiring all the supply ships to maintain good hazardous waste management practices and have spill response plans in place.	Continuously	Implementer: EPC Contractor Supervisor: CTTP	Included in Construction Cost
Noise and Vibration	- Monitoring sound levels periodically toensure compliance with relevant Vietnamese regulations (QCVN-26/ 2010) and IFC EHS Guidelines (General: 2007)	Daily for three days during start of new stage of construction, once weekly thereafter	Researcher: EPC Contractor Supervisor: CTTP	1,500 (O Mon 4 EIA Table 51, p.174-179)
	- Installing sound insulating wall. - Restricting all transport means to operate from 21:00pm to 6:00am of the next day. - Maintaining construction machines, equipment and vehicles in the best operation conditions. - Repairing and maintaining regularly construction machines, equipment and vehicles. - Implementing high noise activities in the	Continuously	Implementer: EPC Contractor Supervisor: CTTP	Included in Construction Cost

Item	Environmental Management Plan	Frequency	Responsible Organization	Cost ($)
	daytime. - Announcing widely in community the time period and construction plan of the project. - Constructing a noise wall or installing noise reducer at noise affected area. - Using modern equipment in compliance with relevant Vietnamese vehicle emissions regulations (TCVN 6438-2001) and regularly maintaining machinery and trucks. - Using "noise reduction skirts" on pneumatic hammers". - Restricting pile-driving to week-days and daytime hours (6am to 6pm).			
Terrestrial Ecosystem	- Taking mitigation measures for the impacts of air pollution, noise and vibration. - Greening 11.1% of the project site area during construction phase and more than that during operation phase.	Continuously	Implementer: EPC Contractor Supervisor: CTTP	Re-vegetation cost is Included in Construction Cost
River Ecosystem	- Mitigating impacts to the aquatic creature by taking mitigation measures for water pollution.	Continuously	Implementer: EPC Contractor Supervisor: CTTP	-
Rare Species	- Mitigating impacts on the rare species by taking mitigation measures for water pollution, since the rare species around the O Mon Power Complex is only fishes.	Continuously	Implementer: EPC Contractor Supervisor: CTTP	-
Resettlement	- Conducting monitoring activities on the resettled residents. - Providing adequate compensation and support for livelihood restoration. - Establishing grievance mechanism.	Continuously	CTTP	Discuss with Can Tho City People's Committee
Employment and Livelihood	- Employing local people, especially project affected people on construction activities.	Continuously	Implementer: EPC Contractor Supervisor: CTTP	Included in Construction Cost
Local Community	- Propagandizing and educating the construction workers to establish relations with inhabitants. - Organizing exchange meeting with People's Committee of wards and O Mon District on matters related to the relation between workers and inhabitants. - Having good management measure for workers. - Installing light and sigh system on section of National highway 91 crossing over the project site. - Repairing the damaged road section by the contractor after construction completion, since National highway 91 could be damaged by operation of heavy trucks. - Maintaining environmental sanitation and living conditions and ensuring community health on camp area of workers. - Supplying sufficient fresh water and sanitary food to workers. - Supplying sufficient garbage can and periodical collection of garbage. - Improving awareness of construction workers on environmental sanitation at camp area. - Constructing or providing suitable sanitary equipment such as removable WCs, waste bins, etc at the worker's camps by the construction contractor. Constructing one septic tank system	Continuously	Implementer: EPC Contractor Supervisor: CTTP	Included in Construction Cost

Item	Environmental Management Plan	Frequency	Responsible Organization	Cost ($)
	at each camping area to treat domestic sewage water. - Classifying waste into harmful waste and normal waste prior to transport for re-usage or burying. - Contracting with Urban Works Enterprise of Can Tho City on collection of construction waste from project site to district disposal landfill at least one time in a week. - Training workers on cleaning measures in case of chemical spill accident. - Prior to the commencement of civil works, developing a Occupational Health and Safety Plan (OHSP) that is consistent with the relevant requirements of Vietnamese law and with good international practice as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines. - Having Community Health and Safety Plan (CHSP) included procedures for posting warning signs and fences as required to protect local community members from dangerous work areas.			
Landscape	- Greening 11.1% of the project site area during construction phase and more than that during operation phase.	Continuously	Implementer: EPC Contractor Supervisor: CTTP	Re-vegetation cost is Included in Construction Cost
Working Environment	- Constructing clinic for health care of workers. - Arranging clinics at the construction site and nurses and providing timely all medicines, health care services and first aid to the workers when they are sick or engage in industrial accidents. Establishing a system where the construction contractor coordinates closely with clinic of Phuoc Thoi ward in taking care of health and disease prevention. - Prior to the commencement of civil works, developing a Occupational Health and Safety Plan (OHSP) that is consistent with the relevant requirements of Vietnamese law and with good international practice as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines.	Continuously	Implementer: EPC Contractor Supervisor: CTTP	Included in Construction Cost
Global Climate Change	- Minimizing the number of machine operation and material transportation by making an efficient construction schedule.	Before Construction	Implementer: EPC Contractor Supervisor: CTTP	-
Operation Phase				
Air Pollution	- Complying gas emissions with QCVN 22: 2009/BTNMT emission standards and EHS Guidelines. Monitoring the compliance through CEMS (Continuous Emission Monitoring System).	Continuously (Stack)	Researcher: CTTP (O Mon 4 EIA Table 51, p.174-179)	To be calculated at the construction stage by EPC Contractor
		Semi-annually (Sampling)	Sampling: CTTP Analysis: Environmental Consultant (O Mon 4 EIA Table 51, p.174-179)	2,000 (based on 2,000/yr) (O Mon 4 EIA Table 51, p.174-179)
	- In the case that the monitoring results indicate non-compliance with QCVN 22: 2009/BTNMT emission standards, scaling down the capacity of the power plant operation and identifying meteorological conditions around O Mon Power Complex.	Continuously for a week per one station	Researcher: CTTP	30,000 (equipment purchase, shipping and training, 30,00 each; primary monitor + backup) 3,000/yr maintenance and calibration based on

Item	Environmental Management Plan	Frequency	Responsible Organization	Cost ($)
				3,000/yr/monitor
	- Designing and installing stack in accordance with the standards.	At the designing stage	CTTP	To be calculated at the construction stage by EPC Contractor
Water Pollution	- Monitoring the river water quality.	Quarterly	Sampling：CTTP Analysis：Environmental Consultant (O Mon 4 EIA Table 51, p.174-179)	1,800 (based on $75 sample) (O Mon 4 EIA Table 51, p.174-179)
	- Monitoring temperature of intake and discharge of cooling water continuously. - Treating all the wastewater properly by the general waste water treatment facility to meet the industrial wastewater standard (QCVN-24/2009, Type-A) prior to discharge to the environment. - Monitoring the quality of the effluent from the central treatment plant at the discharge point.	Continuously	CTTP	To be calculated at the construction stage by EPC Contractor
	- Separating rainwater running through polluted area from rainwater drainage system of the power plant. - Determining potential oil spill area. Collecting rainwater overflowing through that area to the oil separation system before treating directly or discharging into receipt source. - Treating all domestic waste water from staffs building according to waste standards prior to discharge. - Directing the runoff to a sedimentation basin by the drainage system and then to discharge channel No.2. - Putting DFO tanks within a secondary containment system consisting of a 1.5m high reinforced concrete oil-proof containment wall (bund). - The oily water should be directed to a gravity-type oil-water separator. The oil-water separator will remove up to 99% of waste oil, which should be collected, stored and either reused, reprocessed, or sold. Sludge from the oil-separator should be dredged periodically and land-filled by a private waste contractor. The treated effluent from the oil-water separator should be directed to the general waste water treatment system for further treatment. - Implementing an operation phase spill control plan (SPC) to deal with the risk of fuel spills. - Treating wastewater from all the supply ships at facilities on land in accordance with the regulations, not discharging into the river.	Continuously	CTTP	-
Waste	- Including a hazardous waste management system in the operation phase OHS plan. - Requiring all supply ships to maintain good hazardous waste management practices and having spill response plans in place. - Designing collection system of domestic waste and transporting domestic waste periodically to the general local disposal area. - Classifying wastes into harmful waste and normal waste prior to transport and dumping it to the general disposal area of district.	Continuously	CTTP	-

Item	Environmental Management Plan	Frequency	Responsible Organization	Cost ($)
	- Selecting a waste disposal contractor by bid for every waste type every year. The selected contractor deals with the disposal of the specific waste type generated from the whole O Mon Power Complex.	Continuously	CTTP	To be decided at contract agreement
Noise and Vibration	- Monitoring the noise level.	Quarterly	Researcher: CTTP	1,500 (O Mon 4 EIA Table 51, p.174-179)
	- In case of noise in the power plant or local surrounding residential areas exceeding permit standard due to operation of power plant, installing noise reducer and noise wall, etc. around the big noise sources. - Selecting equipment with lower sound power levels - Installing silencers for fans or suitable mufflers on engine exhausts and compressor components. - Installing acoustic barriers without gaps and with a continuous minimum surface density of 10kg/m^2.	At the designing stage	CTTP	To be calculated at the construction stage by EPC Contractor
River Ecosystem	- Monitoring the aquatic creature.	Quarterly	Researcher: Environmental consultant (O Mon 4 EIA Table 51, p.174-179) Supervisor: CTTP	24,000 (based on 6,000 per quarter) (O Mon 4 EIA Table 51, p.174-179)
	- Installing mesh and river-return system for aquatic creature at inlet.	At the designing stage	CTTP	20,000 (O Mon 3 EIA Table 4.5, p.153-167)
	- Mitigating impacts on the rare fish species by taking mitigation measures for water pollution. - Arranging cooling water outlet far away from cooling water inlet in order to ensure temperature of water flow below 40℃ prior to discharge into river. - Considering the feasibility of increasing pump speed in order to decrease flow velocity of cooling water in waste canal.	Continuously	CTTP	To be calculated at the construction stage by EPC Contractor
Rare Species	- Monitoring the aquatic creature. - Mitigating impacts on the rare species by taking mitigation measures for water pollution, since the rare species around the O Mon Power Complex is only fishes.	Continuously	CTTP	-
Employment and Livelihood	- Creating job in the power plant for local people.	Continuously	CTTP	-
Local Community	- Supplying sufficient fresh water, safety food and electricity to staffs building area. - Collecting and transporting domestic wastes from workers' building area with frequency of 1 time/week. - Equipping building area of workers with sufficient lavatory and other sanitary equipment. - Preventing epidemic diseases. - Prior to the commencement of plant operation, preparing operation phase OHS and CHS plans by the EHS Team in accordance with relevant requirements of Vietnamese law and with good international practice as reflected in internationally recognized standards such as	Continuously	CTTP	-

Item	Environmental Management Plan	Frequency	Responsible Organization	Cost ($)
	the World Bank Group's Environment, Health and Safety Guidelines.			
Landscape	- Greening 11.1% of the project site area during construction phase and more than that during operation phase.	At the designing stage	CTTP	Re-vegetation cost is Included in Construction Cost
Working Environment	- Providing noise-protective capsules and plugs to the engineers and workers working at workplace with noise exceeding 90dBA. - Providing specialized clothing, shoes, gloves and cap to the engineers and workers working in high and medium voltage areas to prevent electric shock. - Taking measures for fires. - Placing equipment of protection and fire-fighting and other first aid at fuel tank area in accordance with regulations. - Prior to the commencement of plant operation, preparing operation phase OHS and CHS plans by the EHS Team in accordance with relevant requirements of Vietnamese law and with good international practice as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines.	Continuously	CTTP	-
Global Climate Change	- Reducing the emission amount of CO2 per power generation unit by applying the combined-cycle power.	At the designing stage	CTTP	To be calculated at the construction stage by EPC Contractor
	- Monitoring GHG (Green House Gas) and reporting regularly.	Annually	CTTP	-

5.5.2 Monitoring Plan

The Table 5.5-3 shows the monitoring plans for O Mon 3 and 4 that are mentioned in the EIA reports. Monitoring Plan for O Mon 3 only focuses on air and water quality during operation phase, and EPC Contractor will prepare for the monitoring plan during construction phase. However, monitoring plan for O Mon 4 mentions about all the categories in detail. Sharing the equipment and staff, O Mon 3 will be able to conduct the same monitoring as the O Mon 4. Therefore, JICA Team recommends to conduct the monitoring O Mon 3 power plant with the same items, sampling locations, frequency, and method as the ones for O Mon 4.

The Table 5.5-4 shows the monitoring parameters, locations, method, frequency and responsible organization that JICA Team has recommended for O Mon 3 Power Plant. JICA Team has also recommended the monitoring of GHG emission which is calculated by fuel consumption per a year.

Table 5.5-3 Monitoring Plan for O Mon 3 and 4

Item	Monitoring plan for O Mon 3 (O Mon 3 EIA 6.3, p.173-178)	Monitoring plan for O Mon 4 (O Mon 4 EIA Table 51, p.174-179)
Construction phase		
Air pollutant	- Planning by EPC constructor	- Ambient air quality (16 points) Parameter: PM_{10} Location: Within 500m of construction area. 16 sampling points. Continuously for a week per 4 points Frequency: The monitors will be rotated among 4 sampling points on a weekly basis such that there is at least one week of continuous
Water pollutant	- Planning by EPC constructor	- Ground water (2 points) Parameter: Heavy metals (Zn, Cd, As, Pb, Hg, Cr, Cu, Mn), Total fecal coliform, NH_4^+, T-N, T-P, TDS, TSS, Conductivity, pH, DO, Salinity Location: Two existing wells Frequency: Quarterly (Heavy metals, Total fecal coliform, NH_4^+, T-N, T-P, TDS, TSS) Monthly (Conductivity, pH, DO, Salinity)
		- River water (6 points and 12 points) Parameter: Heavy metals (Zn, Cd, As, Pb, Hg, Cr, Cu, Mn), Total fecal coliform, NH_4^+, T-N, T-P, TDS, TSS, Conductivity, pH, DO, Salinity Location: 6 points (Heavy metals, Total fecal coliform, NH_4^+, T-N, T-P, TDS, TSS) 12 points (Conductivity, pH, DO, Salinity) Frequency: Quarterly (Heavy metals, Total fecal coliform, NH_4^+, T-N, T-P, TDS, TSS) Monthly (Conductivity, pH, DO, Salinity)
Noise	- Planning by EPC constructor	- Noise (2 points) Parameter: Noise level Location: Power Complex boundary, Nearest residences Frequency: Daily for three days during start of new stage of construction
Resettlement	- Living environment and livelihood of affected people	- Affected people
Local community	- Planning by Community health and safety plan	- As defined in Community health and safety plan
		- Grievance Parameter: Grievance from resident Location: Villages around Power Complex Frequency: Continuously
Working Environment	- Planning by Occupational health and safety plan	- As defined in Occupational health and safety plan
Operation phase		
Air pollutant	- Emission concentration (1 point) Parameter: CO, SO_2, NO_2, TSP, Noise Location: Top of stack Frequency: Semi-annually	- Emission concentration (1 point) Parameter: NOx, SO_2, PM_{10} Location: Top of stack Frequency: Continuously (CEMS: Continuous. Emission Monitoring System)
	- Ambient air quality (10 points) Parameter: CO, CO_2, SO_2, NO_2, TSP, Temperature, humidity, Noise Location: DO storage, Boiler area, In power plant according to wind direction, Cooling water outlet, In take, Surrounding residential areas according to wind direction (500m, 1000m, 1200m, 2000m, 2500m from power plant) Frequency: Semi-annually	- Ambient air quality (4 points) Parameter: NOx, SO_2, PM_{10} Location: 16 sampling points surrounding Power Complex. Continuously for a week per 4 points Frequency: The monitors will be rotated among 4 sampling points on a weekly basis such that there is at least one week of continuous
Water pollutant	- Ground water (2 points) Parameter: pH, SS, Fe, NH_3, NO_2, Coliforms Location: Local houses surrounding power plant	- Ground water (2 points) Parameter: Heavy metals (Zn, Cd, As, Pb, Hg, Cr, Cu, Mn), Total fecal coliform, NH_4^+, T-N, T-P, TDS, TSS Location: Two existing wells

Item	Monitoring plan for O Mon 3 (O Mon 3 EIA 6.3, p.173-178)	Monitoring plan for O Mon 4 (O Mon 4 EIA Table 51, p.174-179)
	Frequency: Semi-annually	Frequency: Semi-annually
	- River water (6 points) Parameter: pH, Turbidity, BOD$_5$, COD, Oil & grease, Heavy metals, Water temperature, Coliforms Location: Behind general waste water treatment system, Behind domestic waste water treatment system, Thermal effluent outlet and 100m from outlet, pump station Frequency: Semi-annually	- River water (12 points) Parameter: Water temperature, Conductivity, pH, Do, Salinity Location: 3 points each along 3 lines perpendicular the shoreline (at 0, 150, and 500m from shore), and 3 around the mixing plume boundary) Frequency: Monthly
	- General waste water treatment system Parameter: pH, Turbidity, BOD$_5$, COD, Oil & grease, Heavy metals, water temperature, Coliforms Location: Behind and front of general waste water treatment system Frequency: Semi-annually	- Waste water (1 point) Parameter: Water temperature, Chlorine, pH, BOD$_5$, COD, Oil & grease, Heavy metals (Zn, Cd, As, Pb, Hg, Cr, Cu, Mn), Pesticides, Total fecal coliforms Location: Discharge channel outlet Frequency: Quarterly
		- Cooling water (2 points) Parameter: Water temperature Location: Intake and discharge channel outlet Frequency: Continuous
Noise	Including the parameter of air pollutant	- Noise (2 points) Parameter: Noise level Location: Power Complex boundary adjacent to the power plant, nearest residences at different directions from the power plant Frequency: Quarterly (night)
River Ecosystem	None	- Fisheries (3 points) Parameter: Species, Fish catches Location: Water Intake, outlet and Hau River Frequency: Quarterly (During the first 2 years of operation. Results to be evaluated at the end of 2 years and a decision will be made at that time if additional monitoring is required)
Local community	None	- As defined in Community health and safety plan
		- Grievance Parameter: Grievance from resident Location: Villages around Power Complex Frequency: Continuously
Working Environment	None	- As defined in Occupational health and safety plan
Global Climate Change	None	None

Table 5.5-4 Parameter, Location, Method, Frequency, and Responsible Organization of Environmental Management Plan

Items	Parameter	Location	Method	Frequency	Responsible Organization
Construction phase					
Air pollutant	PM_{10}	Within 500m of construction area. 16 sampling points. Continuously for a week per 4 points	Automatic mobile ambient air quality analyzers	Continuous	EPC Contractor
		Monitoring at every sampling point every month	Analysis by sampling (for calibration)	Monthly	- Sampling: EPC Contractor - Analysis: Environmental Consultant
Water Pollution	Ground water Heavy metals (Zn, Cd, As, Pb, Hg, Cr, Cu, Mn), Total fecal coliform, NH_4^+, T-N, T-P, TDS, TSS	Two existing wells surrounding construction area	Analysis by sampling	Quarterly	- Sampling: EPC Contractor - Analysis: Environmental Consultant
	Ground water Conductivity, pH, DO, Salinity	Same as above	Portable water quality analyzer	Monthly	EPC Contractor
	River water Oil & grease, Heavy metals (Zn, Cd, As, Pb, Hg, Cr, Cu, Mn), Total fecal coliform, NH_4^+, T-N, T-P, TDS, TSS	Along river front, the 150m point at each of three lines (at 0, 150, and 500m from shore), and 3 points at others	Analysis by sampling	Quarterly	- Sampling: EPC Contractor - Analysis: Environmental Consultant
	River water Conductivity, pH, DO, Salinity	Same as above	Portable water quality analyzer	Monthly	EPC Contractor
Noise	Noise	2 points (Power Complex boundary, Nearest residences)	Sound-level meter	Daily for three days during start of new stage of construction	EPC Contractor
Resettlement	Living environment and livelihood of affected people	Affected people	Interview	Yearly	CTTP
Local community	As defined in Community health and safety plan	Villages around Power Complex	As defined in Community health and safety plan	Continuously	CTTP
	Grievance	Villages around Power Complex	Grievance from resident	Continuously	CTTP
Working Environment	As defined in Occupational health and safety plan	Construction area	As defined in Occupational health and safety plan	Continuously	CTTP
Operation phase					
Air pollution	Emission concentration NOx, SO_2, PM_{10}	Top of stack	CEMS: Continuous. Emission Monitoring System	Continuously	CTTP
			Analysis by sampling	Yearly	Environmental consultant
	Ambient air quality NO_2, SO_2, PM_{10}	16 sampling points surrounding Power Complex. Continuously for a week per 4 points	Automatic mobile ambient air quality analyzers	Continuous	CTTP
		Same as above	Analysis by sampling (for calibration)	Monthly	Environmental consultant
Water pollution	Ground water Heavy metals (Zn, Cd,	Two existing wells	Analysis by sampling	Semi-annually (Dry and rainy season)	- Sampling: CTTP - Analysis:

Items	Parameter	Location	Method	Frequency	Responsible Organization
	As, Pb, Hg, Cr, Cu, Mn), Total fecal coliform, NH_4^+, T-N, T-P, TDS, TSS				Environmental Consultant
	River water Water temperature, Conductivity, pH, Do, Salinity	3 points each along 3 lines perpendicular the shoreline (at 0, 150, and 500m from shore), and 3 points at other	Portable water quality analyzer	- Monthly	- CTTP
	Waste water Water temperature, Chlorine, pH, BOD_5, COD, Oil & grease, Heavy metals (Zn, Cd, As, Pb, Hg, Cr, Cu, Mn), Pesticides, Total fecal coliforms	Discharge channel outlet	Analysis by sampling	- Quarterly	- Sampling: CTTP - Analysis: Environmental Consultant
	General waste water treatment system pH, Turbidity, BOD_5, COD, Oil & grease, Heavy metals(Zn, Cd, As, Pb, Hg, Cr, Cu, Mn), water temperature, Coliforms	Behind and front of general waste water treatment system	Analysis by sampling	Semi-annually	- Sampling: CTTP - Analysis: Environmental Consultant
	Cooling water	Intake and discharge channel outlet	Thermistor	Continuous	CTTP
Noise	- Noise level	Power Complex boundary adjacent to the power plant, nearest residences at different directions from the power plant	Sound-level meter	Quarterly (Night)	CTTP
River Ecosystem	Fisheries Species, Fish catches	Water Intake, outlet, Hau River	Visual inspection	Quarterly (During the first 2 years of operation. Results to be evaluated at the end of 2 years and a decision will be made at that time if additional monitoring is required)	Environmental Consultant
		Fisherman	Interview		
Local community	As defined in Community health and safety plan	Villages around Power Complex	As defined in Community health and safety plan	Continuously	CTTP
	Grievance	Villages around Power Complex	Grievance from resident	Continuously	CTTP
Working Environment	As defined in Occupational health and safety plan	Construction area	As defined in Occupational health and safety plan	Continuously	CTTP
Global Climate Change	CO_2 gas yield	-	CO_2 gas yield is calculated by fuel consumption per a year.	Yearly	CTTP

5.5.3 Implementation System

Chemical Test Department will be in charge of the environmental issues of O Mon 3 Power Plant. (Fig.5.5-1) Technical Department belongs to EVNTPC CAN THO which operates O Mon 3 Power Plant will also be involved in dealing with environmental issues, if necessary. (2nd Field Survey)

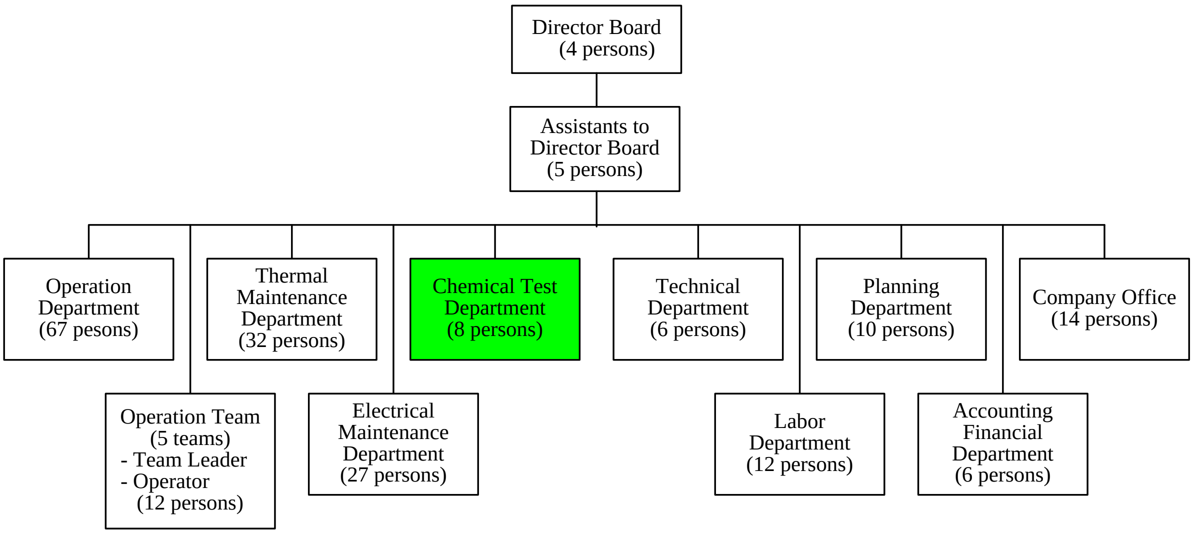


Fig. 5.5-1 Organization Structure for O Mon 3 Power Plant

5.6 ASPECT OF RESETTLEMENT OF LOCAL PEOPLE

5.6.1 Resettlement Process

The development plan of O Mon Power Complex has been planned in 1996, and the starting of operation of O Mon 1 and 2 power plants (1,200MW in total) and the development of transmission and transformation facility was planned in the Master Plan No.5 (2nd field survey). The land acquisition for O Mon 1 and 2 power plants was conducted as a consequence. The land acquisition for O Mon 1, O Mon 2 and the related facilities (access road No.1 and discharge channel No.1) has been started in November 1999, affects 112 households and 1 company, with the scope of 47.7 ha, and has been completed on June 29, 2000 (PPTA-4845 SIA 5.1, p.22).

The construction plan of the thermal power plants O Mon 3 and 4 power plants in the O Mon Thermal Power Complex has been approved on 27 September 2004 by the Ministry of Industry and Trade (Decision No.2523/ QD/ NLDK). The process of the land acquisition for O Mon 3, O Mon 4 and the related facilities (access road No.2 and discharge channel No.2) is described in Table 5.6-1.

Table 5.6-1 Process of Land Acquisition for O Mon Power Complex (O Mon 3& 4)

No.	Date	Events
1	27/ September/ 2004	The construction plan of the thermal power plant O Mon 3 and 4 power plants in the O Mon Power Complex has been approved on 27 September 2004 by the Ministry of Industry and Trade (Decision No.2523/ QD/ NLDK).
2	11/ April/ 2005	The policy for resettlement, compensation and allowance on land acquisition in Can Tho City was determined by Can Tho City People's Committee Decision No. 53/2005QD-UB (RRP 8.1.1, p.44-46).
3	23/ July/ 2005	Public meeting was held concerning the construction of O Mon Power Complex (4O Mon 4 EIA Chp.7, p.147).
4	23& 26/ December/ 2005	Public meetings were held concerning the compensation of acquired land, and the cut-off date was set to 23 December, 2005 (RRP 4.1, p.29).
5	March/ 2006	Compensation and Land Clearance Council (hereinafter referred to as "Compensation Committee" was established (Decision No.1026/ QD-UBND) (PPTA-4845SIA 5.1.2, p.24).
6	Form March/ 2006	The evaluation teams of the Compensation Committee set about assessing and evaluating the plot of land, houses and constructions, crops and trees (PPTA-4845SIA 5.1.2, p.24).
7	4/ April/ 2006 - 11/ May/ 2007	The compensation plan of O Mon 3, O Mon 4 and related facilities was sequentially approved by Can Tho City People's Committee (approval was segmented to19 times: 4 times for O Mon 3 from 4 April 2006 to 14 August 2006).
8	5/ May/ 2006	Start of land acquisition (transfer).
9	June/ 2007	Socio-economical survey was conducted by Vattenfall Power Consultant (Consultant company for ADB) for 105 households (RRP 3.3, p.21).
10	9/ October/ 2007	Vattenfall Power Consultant sent a letter to Can Tho City People' Committee requesting modification of resettlement process (follow-up letter of the former meeting) (RRP Annex-5, p.81-83).
11	7/ January/ 2008	Answer letter from Can Tho City People' Committee to the follow-up letter from VPC (RRP Annex-6, p.84).
12	April/ 2008	Preparation of Retrofit Resettlement Plan (Resettlement Due Diligence Report 2007)
13	16/ October/ 2009	Completion of land acquisition (transfer) for O Mon 3.
14	December/ 2009	Special assistance cash grant of 15 ~ 20MVND was provided to poor or vulnerable people (RDDR p.22 & p.33).
15	March - September/ 2010	Household survey was conducted for 145 compensated households (24%) for carrying out due diligence (RDDR, p.13).
16	February/ 2011	Preparation of resettlement Due Diligence Report and Corrective Action Plan.
17	25/ November/ 2011	The board approval was issued to ADB financing for O Mon 4.

Table 5.6-2 describes the content of the compensation plan approved by the Can Tho City People' Committee. The content is divided by land section, and inhabitants owning land in plural sections are over wrapped in counting. The table suggests that land acquisition plan for O Mon 3 was the earliest to be developed in the Power Complex.

Table 5.6-2 Decision on Compensation of Acquired Land for the O Mon Power Complex

Items	Number of affected household	Compensation plan	Date
O Mon 3 (No.1)	33	No.1038 /QD-UBND	4 / April/2006
O Mon 3 (No.2)	52	No.1279 /QD-UBND	9/ May/ 2006
O Mon 3 (No.3)	37	No.1536 /QD-UBND	22/ June/ 2006
O Mon 3 (No.4)	29	No.1831 /QD-UBND	14/ August/ 2006
Affected household	151		
O Mon 4 (No.1)	46	No.1605 /QD-UBND	5/ July/ 2006
O Mon 4 (No.2)	58	No.1792 /QD-UBND	8/ August/ 2006
O Mon 4 (No.3)	36	No.2098 /QD-UBND	20/ September/ 2006
O Mon 4 (No.4)	22	No.2552 /QD-UBND	28/ November/ 2006
O Mon 4 (No.5)	32	No.134 /QD-UBND	23/ January/ 2007
O Mon 4 (No.6)	9	No.1156 /QD-UBND	11/ May/ 2007
Affected household	203		
Access road No.2 (No.1)	33	No.2554 /QD-UBND	12/ September/ 2006
Access road No.2 (No.2)	23	No.2554 /QD-UBND	28/ November/ 2006
Access road No.2 (No.3)	21	No.2764 /QD-UBND	18/ December/ 2006
Access road No.2 (No.4)	2	No.134 /QD-UBND	23/ January/ 2007
Affected household	79		
Discharge channel No.2 (No.1)	50	No.1606 /QD-UBND	5/ July/ 2006
Discharge channel No.2 (No.2)	65	No.1631 /QD-UBND	10/ July/ 2006
Discharge channel No.2 (No.3)	40	No.1791 /QD-UBND	8/ August/ 2006
Discharge channel No.2 (No.4)	32	No.2555 /QD-UBND	28/ November/ 2006
Discharge channel No.2 (No.5)	31	No.2766 /QD-UBND	18/ December/ 2006
Discharge channel No.2 (No.6)	3	No.134 /QD-UBND	23/ January/ 2007
Discharge channel No.2 (No.7)	5	No.773 /QD-UBND	28/ March/2007
Affected household	226		
Total affected household	659		

5.6.2 Compensation Content

(1) Selection of Project Site

The plan of O Mon Thermal Power Complex was developed in 1996 (2nd field survey). The construction plan of the thermal power plant O Mon 3 and 4 power plants in the O Mon Power Complex has been approved by the Ministry of Industry and Trade (PPTA-4845 SIA chp.5, p.22-25). Consequently, O Mon Power Complex is the only alternative construction site conceivable for the new power plant around O Mon district.

The site for O Mon Power Complex was selected for the reason that, in addition to topographical reason, not being located close to any sensitive environmental receptors (communities, hospitals, schools, etc), no physical cultural resources exist on site, relatively small number of resettled people and socioeconomic impacts (O Mon 4 EIA 5.G, p.100-101). The project site is selected to minimize the number of resettled inhabitants.

Table 5.6-2 describes the area of acquired land and the details of acquisition in O Mon 3, 4 and related facilities (RRP Table 19, p.37). Although the total area cited here is different from that of RDDR, it encompasses the aspect of the land before acquisition. The fruit trees accounts for the largest area of O Mon 3, farm land the second largest. The proportion of farm land is higher compared to other power plants (accounts for 60% of the total farm land of the O Mon Power Complex). The number of the household to be compensated (resettled) is shown in Table 5.6-3 (RDDR Table-2, p.14). The RDDR describes only the number of household, whereas the ADB survey result includes the average number of person per household (4.8 persons), from which the number of people to be compensated was estimated (PPTA-4845 SIA Table 28, p.34). There are 5 industries to be compensated (RRP 2.1, p.14).

Table 5.6-3 Acquired Land Area and Households Subject to Compensation concerning Construction of the O Mon Power Complex (O Mon 3, O Mon 4)

(Unit: m^2)

Subject	O Mon 3	O Mon 4, switchyard, material yard	Access road No.2	Discharge channel No.2	Total
Farm land	87,669	5,962	14,351	23,629	131,611
Fruit farm	119,613	256,719	37,481	308,620	722,433
Aquaculture pond	0	0	0	4,579	4,579
Residential area	4,848	6,540	3,873	4,151	19,412
Others	0	12,311	0	864	13,175
Total	212,130	281,532	55,705	341,843	891,210
Area in RDDR Table 2	26.6 ha	24.7 ha	6.2 ha	38.0 ha	95.5 ha
Household subject to compensation (HHs)	128	183	77	213	601
Resettled household (HHs)	57	95	27	47	226
Person subject to compensation	614	878	370	1,022	2,884
Resettled persons	274	456	130	226	1,086

(2) Entitlement and Policy for Compensation

Table 5.6-4 describes the legal documents concerning the compensation process of land and houses and the compensation target[4].

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[4] The updated information that has been received from CTTP will be added in the Final Report.

Table 5.6-4 Legal Documents concerning the Compensation and the Compensation Target

Date	Compensation in farmland		Households lived in the river bank	Legislation & Document	Contents	Remarks
	farmland	house & superstructure				
	0	0	＊			
15/October/1993				Land law amended in 1993	The law stipulated the lawful protection (Article 3 clause 1) of Land Use Right by Vietnam and the right of the exchange, transfer, lease, inheritance, and a mortgage.	＊: Households who lived in the river bank and built the house on farming land between 15th Oct. 1993 and 1st July 2004 did not receive the compensation of land and house
	X	＊	＊	For "＊", Official letter No.02/2008 (Can Tho People's Committee)	Official letter No.02/2008: Those who marked "＊" would recieved the resetttlement benefits (65 million VND or plot of land in the resettlement areas)	
1/July/2004				Land and construction law amended in 2003	Since the categoly of the land (farmland, residential land etc) were strict, no house were permitted on farmland. If a house is built on farmland, the farmland may be re-registered as residential land. (RRP, p.31) 。	$: Households who lived in the river bank and built the house on farming land between 1st July 2004 and 23 Dec. 2005 did not receive the compensation of land and house
	X	$	$	For "$", official letter to the related departments for support proposal, and ADB's recommendation	Official letter: resettlement support (RRP, p.84) ADB's recommendation: payment up to 50% of full replacement cost (RDDR, p.12)	Construction of illegal houses in late 2004 started when people learned that in the nearby project, Tra Noc Industrial Zone, that people were paid for houses built on farmland. (RRP, p.31) 。
23/December/2005				Cut-off date		
	X	X	X			

According to the amended Land Law in 1993, people who settled before Oct 15, 1993, have received compensation for the land as well as for the house. Households who have settled on river bank before 15 October 1993 without land use right certificate (LURC) are considered as illegal and not eligible for compensation for both land and house. According to the revision of Land Law and Construction Law on 2003, building a house on a land registered as farm land is prohibited since July 1st, 2004, and if one wishes to build a house, farm land should be re-registered as residential land upon payment of a fee. In case of O Mon Power Complex, re-registration was permitted until the cut-off date (23 December, 2005) (RRP 4.2, p.31).

In this manner, the initial condition for compensation was whether household had settled before or after 15 October, 1993. As per official letter No 02/VPUB-QH issued by PC Can Tho, a decision for providing cash assistance to settlers on state land who had settled from 15 October 1993 to 1 July 2004 (65 MVND in cash or plot of land in the resettlement areas) was taken. Additionally, people who had settled illegally on river bank before 1 July 2004 and not eligible for compensation also shall be eligible for compensation (65 MVND in cash or plot of land in the resettlement areas) (RRP Table 25, p.44-46). Also, ADB has proposed that people inhabiting on farm land and river bank after 1st July 2004 shall be paid up to 50% of the full replacement cost (RDDR, p.12).

According to the RDDR (RDDR, p.15),

- People who lived on state-owned land before October 15, 1993 are compensated with living land in an approved area and resettlement is taken into consideration;
- People who lived on state-owned land after October 15, 1993 were not compensated for the land but their crops or superstructures on such land were eligible for compensation.

It is assumed that people inhabiting after 1st July 2004 had also received compensation[5].

According to the government regulation, (1) informal business, and (2) workers having no labor contract shall not be eligible for compensation or support. No workers corresponded to

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[5] The updated information that we have received indicates that the residents called "speculator" are not subject to compensation.

(1) informal business workers, but those working in the brick kiln have no labor contract and are not eligible for compensation. Those brick kiln employees (7 households, RDDR Table 22, p.56) will be given priority in employment in construction site or in the power plant (RDDR, p.49).

As described above, the building owners regarded as illegal in Vietnamese law, as well as land users, are allowed for compensation or resettlement support. All the affected people will be provided with compensation or any other form of living support, such as brick kiln employees who are not to be compensated according to the regulation but will be employed in either construction site or the power plant.

According to Decree No.147/ 2004/ ND-CP stipulating the basic policy of land acquisition, the compensation includes land, house, temporarily- affected property, trees and crops. Based on the Decree, the Can Tho City People's Committee established a Decision stipulating resettlement, compensation and allowance for land expropriation within Can Tho City (Decision No.53/ 2005/ QD-UB) (RRP 8.1.1, p.44-46). In Vietnam, compensation payment includes the options of "land to land", "partly land and partly cash", "cash only", "cash and job training", and the people to be compensated have the choice. Most of the 226 relocating households selected cash payment, and only 9 households selected relocation to the designated resettlement area. O Mon district authority has acquired 100 sections of land in Phuoc Thoi ward in 2009, of which 30 sections has been obtained by the project owner as a resettlement land for O Mon Power Complex. The organization bought the land use right certificate for 9 relocating households from the local People's Committee and handed it to them to allow them for building house and relocation at their convenience. The resettlement land is located 500m from school and 3km from a hospital (1st field survey).

The comparison of above-described project entitlements and ADB policy requirements (Involuntary Resettlement Policy; 1995) is shown in Table 5.6-5 (RRP Table 27, p.50). As shown below, the compensation policy satisfies the ADB policy requirement.

Table 5.6-5 Comparison of Project Entitlements and ADB Policy Requirements

Types of Losses	Project Entitlements (From PPC Decisions)	Meet ADB Policy and Requirements (Involuntary Resettlement Policy; 1995) (Yes or No)	If no, Project entitlements to meet ADB Policy and Requirements
Compensation			
I. farm land			
A. With LURC (or in the process of acquiring LURC)	Current market value or various types of land	Yes. The category of land has been classified to a higher level which benefited the affected households by getting higher compensation for their land.	
B No LURC	Poor/landless people get support according to PCCT decision. Resettlement benefits accorded (65 MVND payment or resettlement to designated area).	Yes.	
II. Residential land			
A With LURC (or in the process of acquiring LURC)	Current market value for various types of land	Yes.	
B No LURC	Resettlement benefits accorded (65 MVND payment or resettlement to designated area).	Yes.	
III. River bank			
A Houses on State Land	Resettlement benefits accorded (65 MVND payment or resettlement to designated area).	Yes.	

Types of Losses	Project Entitlements (From PPC Decisions)	Meet ADB Policy and Requirements (Involuntary Resettlement Policy; 1995) (Yes or No)	If no, Project entitlements to meet ADB Policy and Requirements
B Houses built on Farm Land	a) If before 1993 Resettlement benefits accorded (65 MVND payment or resettlement to designated area).	Yes.	
	b) Built 1993-2004 Resettlement benefits accorded (65 MVND payment or resettlement to designated area)	Yes.	
	Built after 1 July 2004; no compensation, but special support (up to 50% of the full replacement cost) is being considered.[6]	No.	People's Committee of Can Tho has sent a letter to consider support for these
C Houses renting on Land	No cases.		
Allowance			
Severely Affected household (losing 10% of land)	Resettlement benefits accorded (65 MVND payment or resettlement to designated area).	Yes.	
Temporary Loss of Job	Job-change assistance: If households, individuals directly engaged in agricultural production have over 30% of their assigned agricultural land areas expropriated, they shall receive supports for job change if they are still within the working age. In case a vocational training course can not be held, the support will be paid in cash, at a level of 1 MVND/person in labour age. When households or individuals directly engaged in agricultural production have over 30% of their assigned agricultural land areas expropriated, they shall receive life stabilization supports for 3 months if they must not be relocated and for 6 months if they must be relocated; if they are to be relocated to places with difficult socio-economic conditions, they shall receive supports for 12 months at most. The level of monetary support household member per month shall be equivalent to the value of 30 kg of rice, calculated at the average local price (4000 VND/kg).	Yes.	
APs who move on time	Timely movement incentive (5% of the full replacement cost (up to 5 MVND)).	Yes.	
Moving allowance	Transportation allowance Permanently relocated within Can Tho city: -Multi-stories, concrete houses: 3 MVND/household -Brick houses: 2 MVND/household -Others: 1 MVND/household Permanently relocated to another province or city -Multi-stories, concrete houses: 5 MVND/household -Brick houses: 4 MVND/household -Others: 3 MVND/household	Yes.	
Subsistence	Rehabilitation allowance: When households or individuals directly engaged in agricultural production have over 30% of their assigned agricultural land areas expropriated, they shall receive life stabilization supports for 3 months if they must not be relocated and for 6 months if they must be relocated; if they are to be relocated to places with difficult socio-economic conditions, they shall receive supports for 12 months at most. The level of monetary support per household member per month shall be equivalent to the value of 30 kg of rice, calculated at the average local price (4000 VND/kg).	Yes.	
Vulnerable households	Special support program (15 MVND per household)	Yes.	

(Reference:RRP Table 27, p.50)

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[6] The updated information that we have received indicates that the residents called "speculator" are not subject to compensation.

(3) Implementation System

Table 5.4-6 indicates the role of the relevant organizations for implementing compensation process (RRP Table 26, p.47).

Table 5.6-6 Actors in the Compensation and Resettlement Process

Organization	Responsibilities
EVN	- Provide of funds for compensation - Participate in the O Mon district compensation committee。
TPPMU3 (The responsibilities are now being taken over by Can Tho Power Company)	- A subsidiary of EVN. - Delegated by EVN to sit on O Mon district compensation committee. Information sharing, compensation payment and internal supervision.
People’s Committee of Can Tho City	- Approve the RP, and assign responsibilities for its implementation to relevant institutions. - Approve and decide on compensation prices, allowances. - Establishment of Resettlement and Compensation Committee at local administrative levels. - Approve land recovery and transfer within the province. - Redress complaints and grievances.
PECC2, PECC3	- Consultancy companies, subsidiaries of EVN. - To carry out community consultation, and coordinate with the Resettlement and Compensation Committee
Department of Finance of Can Tho City	- Investigation and assessment of compensation prices, in conjunction with Dept of Construction, Dept. of Natural Resources, Dept. of Agriculture and Rural development, People’s Committees of districts.
People’s Committee of O Mon District	- Guiding compensation and resettlement activities, implement loss investigation, public consultation, dissemination of information on RP and policies. - Establishment of district Resettlement and Compensation Committee. - Resolving complaints and queries of affected people.
O Mon district Compensation Committee (DCC)	- Manage and organize census, inventory of assets, implementation of affected people - Issuing Detailed Measurement Survey (DMS) document for each affected person. - Checking compensation prices. - Organizing meetings with affected people, local authorities. - Disseminating entitlement forms DMS results and resettlement schedule to affected people. - Prepare detailed implementation plan. - Settling complaints and grievances. - Proposing solutions to solving problems.
People’s Committee of the affected wards	- Provide information for surveys and census. - Cooperate with Compensation Committee in organizing public meetings, information dissemination etc. - Resolve complaints and propose solutions, communicate to Compensation Committee
Affected People	- Provide relevant information and documents on ownership of property. - Clearing land and moving in a timely manner.

A Compensation Committee of O Mon district (DCC) was established to take the formal responsibility for resettlement and compensation, consisting of 1 chairman, 2 deputy chairmen, 1 permanent commissioner, 11 commissioners and 3 persons invited to represent the Fatherland Front Committee, the Women's Organization and the Farmers' organization (PPTA-4845 SIA 5.1.2, p.24).

(4) Compensation and rehabilitation of livelihood

Price for land compensation was based on Decision No.104/2005/QD-UBND, house compensation was based on Decision No.53/2005/QD-UB, and crop compensation was based on Decision No.53/2005/QD-UB of the Can Tho City People's Committee (RDDR, p.16).
The contents of cash compensation are as follows.

- Land (RDDR, p.16)

* Land for planting annual trees : 108,000 VND/m^2
* Land for planting perennial trees : 126,000 VND/m^2
* Rural living land : 400,000 VND/m^2
* Non-agriculture land : 200,000 VND/m^2
* Land for living at Road 934 area : 600,000 VND/m^2 (from the power plant to Thoi An ward)
* Public land or alluvial ground : 108,000 VND/m^2
* Agriculture land inside 50m from the protection slope of Road 934: in addition to compensation for agriculture land, 20% of living land cost was paid.

- Houses (RRP 12.1, p.59-61)

* Grade 1 (Villa) : no cases
* Grade 2 (Concrete floor, high quality of materials) : no cases
* Grade 3 (Concrete floor, average quality of materials) : 1,400,000 VND/m^2
* Grade 4 (Brick wall, concrete frame with titled roof) : 990,000 VND/m^2
* Grade 5 (Wooden frame with palm roof) : 150,000 VND/m^2

- Secondary structures (RRP 12.1, p.59-61)

* Kitchen, toilet : classified as the rates of houses
* Tomb: Normal 1,000,000 VND/unit; Cement : 3,000,000 VND/Unit
* Water tank : 380,000/m^3

- Resettlement benefit (RRP 12.1, p.59-61)

* If a household is required to relocate due to the project, and has the legal rights and titles to land and property, they will be compensated for that property, and they will be eligible to move to a resettlement area. If the household selects not to go to the resettlement area, a monetary payment of 65 MVND will be paid.
* The initial condition for compensation was whether household had settled before or after 15 October, 1993. As per official letter No 02/VPUB-QH issued by PC Can Tho, a decision for providing cash assistance to settlers on state land who had settled from 15 October 1993 to 1 July 2004 (65 MVND in cash or plot of land in the resettlement areas) was taken (RRP Table 25, p.44-46).
* ADB has proposed that people inhabiting on farm land and river bank after 1st July 2004 shall be paid up to 50% of the full replacement cost (RDDR, p.12).

- Allowance for timely moving (RRP 12.1, p.59-61)

- The affected people who have to be relocated and voluntarily hand the affected land to the project in accordance of the time regulated and announced by the project will be entitled to a bonus of 5% of the total compensation amount, but not more than 5 MVND.

- Transportation allowance (RRP 12.1, p.59-61)

a) Permanently relocated within Can Tho City:

* Multi-stories, concrete houses	: 3 MVND/household
* Brick houses	: 2 MVND/household
* Others	: 1 MVND/household

b) Permanently relocated to another province or city

* Multi-stories, concrete houses	: 5 MVND/household
* Brick houses	: 4 MVND/household
* Others	: 3 MVND/household

- Temporary relocation allowance (RRP 12.1, p.59-61)

If persons who have their residential land expropriated and have no other residences; pending the time of creating new residences (arrangement for resettlement), they shall be arranged to live in temporary shelters or receive monetary supports for renting dwelling house according to the following rates: households with:

* less than 4 persons	: 0.5 MVND/household/month
* from 5-6 persons	: 0.6 MVND/household/month
* from 7-8 persons	: 0.7 MVND/household/month
* from 9-10 persons	: 0.8 MVND/household/month
* more than 11 persons	: 1.0 MVND/household/month

- Supports for subsistence and production stabilization (RRP 12.1, p.59-61)

When households or individuals directly engaged in agricultural production have over 30% of their assigned agricultural land areas expropriated, they shall receive life stabilization supports for 3 months if they must not be relocated and for 6 months if they must be relocated; where they must be relocated to places with difficult socio-economic conditions, they shall receive supports for 12 months at most. The level of monetary support per household member per month shall be equivalent to the value of 30 kg of rice, calculated at the average local price (4000 VND/kg).

- Supports for job change and job creation (RRP 12.1, p.59-61)

- If households, individuals directly engaged in agricultural production have over 30% of their assigned agricultural land areas expropriated, they shall receive supports for job change if they are still within the working age.
- In case a vocational training course can not be held, the support will be paid in cash, at a level of 1 MVND/person in labour age.

- Others: For "policy" households who have to be relocated (RRP 12.1, p.59-61)

- Military Heroes, Vietnamese Hero Mothers, Labor Hero are entitled to assistance of 5

MVND/household.

* Wounded soldiers, relatives of military martyr are entitled to assistance of 3 MVND /household

* Households who formerly helped revolutionaries, retired civil servants, households who are currently receiving other social assistance, are entitled to assistance of 1 MVND/household.

Decree No.147/ 2004/ ND-CP indicates the compensation policy for crops as follows:

- Rice and annual crops: the largest crop in the past 3 years will be paid at the average price in the area at the time of land acquisition (Article 24-1).

- Fruit trees and other perennial crops: the average price of the area at the time of land acquisition will be paid (Article 24-2).

Job training course is proposed for livelihood rehabilitation (RRP 12.1, p.59-61). The job training course provided or planned in 2007-2008 is listed below (RRP Annex 4, p.79-80).

In 2007

- Total established courses : 12.
- Total students : 435.

Among them:

- Small scale industry (60 days/course) has 5 courses consist of hair dressing, household electric, motorbike repairing and household tailoring.
- Industry (15 days/course) has 7 courses, consist of aquaculture, livestock and veterinary, cultivation.

In 2008

O Mon district has proposed to DOLISA (Department of Labour, Invalids and Social Affairs) of Can Tho City to fund for organizing 19 courses as follows:

- Cultivation : 02 courses.
- Livestock and veterinary : 02 courses.
- Aquaculture : 02 courses.
- Motorbike repairing : 02 courses.
- Household electric : 02 courses.
- Household tailoring : 04 courses.
- Diesel engine repairing : 01 course.
- Industrial tailoring : 01 course.
- Hair dressing : 03 courses

(5) Compensation Price

ADB, when preparing resettlement action plan (RAP), determines the compensation price (i.e. replacement) based on the market price. However, in the due diligence step after the affected inhabitants have resettled, the basic compensation policy should focus on “assuring a living standard equal or even better than before resettlement for relocated people”, and the interview survey was conducted to collect data on the change in living and livelihood standard from as many relocated people as possible. The result shows that most of the relocated people think the standard of their life and livelihood is “equal to the life standard before relocation” or “even better than the former life level” (see Appended Table 3(2) of the check list). For several relocated households who answered differently, an additional proposal is suggested in the CAP (Corrective Action Plan) attached to RDDR (being checked in 6 March 2012) (2nd field survey).

The land price survey was also conducted by ADB around O Mon district, and it became clear that it is possible with the compensation payment to purchase an equal grade of land with equal or even larger area than the former land. Consequently, it is determined that the compensation payment satisfies the “replacement cost” (2nd field survey).

(6) Public consultation meeting

Public consultation meeting was held on 23 and 26/ December/ 2005 to explain the extension plan of O Mon Power Complex. The basis for calling these meetings was the decision No 4066/QD-UBND dated 8 Dec 2005 by the People's Committee of Can Tho City and notified through the press and Phuoc Thoi ward and Thoi An ward People’s Committee. The meetings were primarily focused on resettlement and compensation issues (O Mon 4 EIA 7.B, p.145, RRP Table 13, p.30, RRP 6.1, p.39).

Date	Venue	Participants
23/ December/ 2005; 2:00 PM	Loi Villege, Phoc Thoi ward	Unknown, numerous
26/ December/ 2005; 8:00 AM	Loi Villege, Phoc Thoi ward	Unknown, numerous

The meeting on 23/ November/ 2005 was determined as appropriate for cut-off day through an interview with compensated people (RRP 4.1, p.29).

Following the public meeting in December 2005, public consultations were held as described below for the local people and stakeholders as a part of “PPTA : Project Preparation Technical Assistance” by ADB (RRP 6.2, p.39).

Date	Object person	Venue	Participants
21/ July/ 2007	Affected peoples	Thoi An ward	130
22/ July/ 2007	Affected peoples	Phoc Thoi ward	232
14/ September/ 2007	Organizations and institutions (Stakeholder)	Can Tho city	40
8/ October/ 2007	Can Tho people’s committee	Can Tho city	10
4/ January/ 2008	Stakeholder	O Mon district people’s committee	14

During the public participation meetings in July 2007, several representatives of the AP’s felt poorly treated by lack of compensation for houses that were built on farm land in violation of the construction law of 2004. There are also complaints against the fairness, transparency and speed of the process (RRP 6.2, p.39-40).

The meeting with People's Committee of Can Tho City on 8th October 2007 was to request certain modifications to the resettlement process as observed by Vattenfall Power Consultant. This was followed up by a letter on 9th October from Vattenfall Power Consultant to Can Tho City People’s Committee (RRP 6.2, p.40).

At the stakeholder workshop in O Mon on 4th January 2008, the main issues discussed were related to the capacity, proficiency and usefulness of vocational training for income restoration. At the meeting, some issues were raised (RRP 6.2, p.40):

- Farmer’s Union: Young people do not want to continue farming. They need training to find other jobs, but training has to be organized near their place of stay. The main issue is what is a useful training, job consultancy is necessary on an individual basis.
- Women’s Union and Youth union have organized vocational classes especially for people in working age. They are ready to gather affected people for careers consultancy.
- Vocational training center of O Mon is directly under O Mon Domestic Affairs. It is funded by DOLISA (Department of Labour, Invalids and Social Affairs) to hold classes at wards. According to DOLISA‘s policy, they provide students with a tool set after graduating course instead of daily allowance.
- O Mon domestic affairs have previously planned courses, but there have been problems in raising funds to meet the costs of courses.
- There are 4 classes in Thoi An majoring in home electricity and sewing-machine consisting of 20 participants per class for the duration of 2 months with the cost of 48 - 50 million VND/class. In order for participants to perform well, prequalification classes are required in some cases. So, ADB (or the project owner) should support for organizing advance classes. With 80 persons eligible for training, this means for 4 classes, local government offer 200 million VND for basic knowledge. The remaining 300 MVND need to be supported for advanced level.
- The type of training that can be given includes: Seamstress, Diesel engine maintenance, Motorbike repair, Construction, Electrician, and Electronics. Motorbike repair trainees are given a toolbox at a value of 10 million VND in order to start their own business.
- There is a need for small loans especially to women for starting small business. But there is a problem with collateral.

As described above, the public hearing has been held several times to collect local people’s opinion and concern, and we believe that the scope of compensation is well understood by them. Vocational training has been provided since establishment of O Mon district in 2004, and extended from 4 initial courses to 19 courses in 2008 (RRP Annex 4, p.79-80).

(7) Support to Vulnerable People

Vulnerable people are defined as people who might suffer disproportionately or face the risk of being further marginalized by the effects of resettlement and specifically include: (i) female headed households with dependents, (ii) disabled household heads, (iii) households falling under the generally accepted indicator for poverty, (iv) children and the elderly households who are landless and with no other means of support, and (v) landless households, (vi) indigenous people or ethnic minorities . 8 vulnerable households inhabit the O Mon 3 site and are affected by land acquisition, of which 4 households are “(iii) poor households, 2 are “(iv) children and elderly households”, and 2 are “(v) landless households” (RRP 4.5, p.33).

The total number of poor or unemployed vulnerable households in O Mon Power Complex was 17 in 2010, which decreased from 64 households at the time of survey in 2005. However, the resettlement committee did identify 24 households who are still vulnerable. The 17 or 24 vulnerable households were provided with special support of 15 MVND per household from the project owner (RDDR, p.22 & p.30). There were two displaced vulnerable households who had moved in to the project area after the cut-off date and set up temporary houses along the river bank, and they had been provided the assistant of 20MVND/household by CTTP from their company charity fund to build the permanent house (RDDR, p.21).

Many people appear to have moved away from the immediate area after receiving compensation and not all of the households could be identified. If within 3 months of disclosure of the CAP addition vulnerable DPs are identified and requested by the relevant local People's Committees and referred to the CTTP by the O Mon District People's Committee then additional assistance will be provided as needed (RDDR, p.21).

As described above, vulnerable households are appropriately taken care of, including provision of additional support.

(8) Monitoring and a grievance redress mechanism (GRM)

A grievance redress mechanism (GRM) has been established as a local administrative system (O Mon 4 EIA 8.B, p.149-150).

Stage 1 - District Level - CTTP and O Mon District People's Committee

- The AP lodges an oral or written complaint with either CTTP or the O Mon District People's Committee. CTTP will identify a focal point for receiving complaints.

- If the complaint is received by CTTP, the GRM procedure will be explained to the complainant, and the complaint will be recorded and forwarded to the O Mon District People's Committee.

- If the complaint is received by the O Mon District People's Committee, the complaint will be recorded. In order to assess the nature and validity of the complaint the O Mon District People's Committee will consult with CTTP and other relevant parties, fact-find and investigate, and within 15 days of receipt of the complaint will issue a decision:
  - * if the O Mon District People's Committee agrees in favor of the complainant, then in consultation with CTTP and in compliance with relevant decrees, circulars and stipulations, a course of action and/or compensation to address the complaint will be agreed upon;
  - * if the O Mon District People's Committee does not agree in favor of the complainant, and the complainant is satisfied and does not wish to proceed further, then the process ends; and,
  - * if the O Mon District People's Committee does not agree in favor of the complainant, and the complainant is not satisfied, the complainant has 45 days from the date of issuance the O Mon District People's Committee decision to take his/her complaint to either the Can Tho People's Committee (Stage 2) or the Can Tho People's Court of Justice (Stage 3).

Stage 2 - Province Level – Can Tho City People's Committee

- If the complainant is not satisfied with the decision in Stage 1, the complainant has 45 days from the date of issuance the O Mon District People's Committee decision to take his/her complaint to the attention of the Inspection Department of the Can Tho People's Committee.

- In order to assess the nature and validity of the complaint the Can Tho People’s Committee will consult with the O Mon District People’s Committee, CTTP and other relevant parties; fact-find and investigate; and, within 15 days of receipt of the complaint will issue a decision:
  - * If the Can Tho People’s Committee agrees in favor of the complainant, then in consultation with CTTP and in compliance with relevant decrees, circulars and stipulations, the decision of the O Mon District People’s Committee will be overturned, and a course of action and/or compensation to address the complaint will be agreed upon.
  - * If the Can Tho People’s Committee does not agree in favor of the complainant, then the process ends.

Stage 3 -Court Case - Tho People’s Court of Justice

- If the complainant is not satisfied with the decision in Stage 1, he/she can also bring a case to the Can Tho People’s Court of Justice. The Court shall consider the complaint in accordance with laws on civil procedures and shall render a decision:
  - * If the Can Tho People’s Court of Justice agrees in favor of the complainant, the court will request the Can Tho People’s Committee to overturn the decision of the O Mon District People’s Committee, and a course of action and/or compensation to address the complaint will be agreed upon.
  - * If the Can Tho People’s Court of Justice does not agree in favor of the complainant, then the process ends.

A sign will be erected at the Project site that summarizes the Grievance Redress Mechanism and provide contact details (address, phone number, fax, and email address) for the CTTP grievance focal point, the O Mon District People’s Committee, the Can Tho People’s Committee, and the Can Tho People’s Court of Justice. CTTP will instruct the EPC contractor as to the Grievance Redress Mechanism such that they can inform any person who might approach them directly as to the appropriate steps to file a grievance (O Mon 4 EIA 8, C, p.152).

The project owner also handles complaints at the Company Office having a lawyer, with assistance of Labor Department in supporting role (2nd field survey). In fact, 400 complaints have been expressed until 2000, and it is judged that the Grievance Mechanism which it is suitable and easy to use is built.

Monitoring system consists of internal and external monitoring. At present, the internal monitoring activities include only decision letters and minutes of meetings issued by the authorities, and which are not generally made public. The DCC is an executive body, and applies the decisions, rules and regulations issued by the People's Committee of Can Tho City (RRP, p.67). External monitoring can be made only of the part of the process that is governed by ODA agreements. It includes restoration of livelihood, providing training and other supports to affected people and vulnerable groups (RRP, p.67).

The monitoring is planned by Project Implementation Consultant in ADB, and the result will be reported to ADB (RDDR, p.45).

5.6.3 Comparison of compensation of the project with JICA guideline

Table 5.6-7 describes the comparison of compensation of the project with JICA guideline.

Land acquisition process was initially carried out following the Vietnamese regulation and the survey for a preparation of the list of households to be relocated and the compensation plan have been developed in this context. Also, Can Tho City People's Committee has developed a rehabilitation measures for livelihood. In this manner, the compensation plan has been focused on determination of the compensation target and the compensation method (only 9 out of 222 households wished relocation) and provision of supporting measures for livelihood rehabilitation (provision of assistance cash and job training), and we believe that the project compensation plan is pursuant to the principle of JICA guideline saying "assuring a living standard equal or even better than before resettlement for relocated people". The result of ADB's survey indicates that the life of the compensated households after compensation has improved (compared to around 2005), and that they own larger rice field than they used to have before compensation. We believe that the compensation was appropriately implemented. ADB has carried out socio-economical survey and Retrofit Resettlement Plan (2007)as a part of PPTA (Project Preparation Technical Assistance)that has proposed the modification of entitlement for receiving compensation.

Table 5.6-7 Comparison of Compensation of the Project with JICA Guideline.

No.	JICA Guidelines	Compensation implemented in O Mon Project	Gap with JICA Guideline	Judgments
1.	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICA GL)	- The project plan of O Mon Power Complex has been developed in 1996 (2nd field survey). The construction plan of the O Mon 3 and O Mon 4 power plants in O Mon thermal power complex has been approved on 27th September by the Ministry of Industry (Decision No.2523/ QD/ NLDK) (PPTA-4845 SIA 5, p.22-25), and O Mon Power Complex is the only alternative construction site conceivable for the new power plant around O Mon district. - The site for O Mon Power Complex was selected for the reason that, in addition to topographical reason, not being located close to any sensitive environmental receptors (communities, hospitals, schools, etc), no physical cultural resources exist on site, relatively small number of resettled people and socioeconomic impacts (O Mon 4 EIA 5.G p.100-101).	None.	O Mon Power Complex site, where O Mon 3 will be constructed, was selected as the project site in consideration that the potential number of inhabitants to be resettled is less than other location, in addition to topographic reason. The minimization of the affected people is given sufficient consideration in this manner, as well as the appropriate compensation for land, house, trees and crops.
2.	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken. (JICA GL)	- The basic policy of land acquisition is stipulated by Decree No.147/ 2004/ ND-CP. The compensation includes land, house, temporarily- affected property, trees and crops. Based on the Decree, the Can Tho City People's Committee established a Decision stipulating resettlement, compensation and allowance for land expropriation within Can Tho City (Decision No.53/ 2005/ QD-UB) (RRP Table 25, p.44-46). - Price for land compensation was based on Decision No.104/2005/QD-UBND, house compensation was based on Decision No.53/2005/QD-UB, and crop compensation was based on Decision No.53/2005/QD-UB of the Can Tho City People's Committee (RDDR, p.16). - According to the revision of Land Law and Construction Law on 2004, building a house on a land registered as farm land is prohibited, and houses on non-re-registered land are not compensated (RRP 4.2, p.31). As per official letter No 02/VPUB-QH issued by PC Can Tho, a decision for providing cash assistance to settlers on state land who had settled from 15 October 1993 to 1 July 2004 (65 MVND in cash or plot of land in the resettlement areas) was taken (RRP Table 25, p.44-46). - According to the national government regulation, (1) informal business, (2) workers having no labor contract shall not be eligible for compensation or support. Those working in the brick kiln have no labor contract and are not eligible for compensation. Those brick kiln employees (7 households; RDDR Table 22, p.56) will be given priority in employment in construction site or in the power plant (RDDR, p.49).	None	Price for land compensation was based on Decision No.104/ 2005/ QD-UBND, house compensation was based on Decision No.53/ 2005/ QD-UB, and crop compensation was based on Decision No.53/ 2005/ QD-UB of the Can Tho City People's Committee. Land, houses and farm crops were compensated. The building owners regarded as illegal in Vietnamese law are allowed for compensation or resettlement support. All the affected people will be provided with compensation or any other form of living support, such as brick kiln employees who are not to be compensated according to the regulation but will be employed in either construction site or the power plant.
3.	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels. (JICA GL)	- Price for land compensation was based on Decision No.104/2005/QD-UBND, house compensation was based on Decision No.53/2005/QD-UB, and crop compensation was based on Decision No.53/2005/QD-UB of the Can Tho City People's Committee (RDDR, p.16). - The land price survey was conducted by ADB around O Mon District, and it became clear that it is possible with the compensation payment to purchase an equal grade of land with equal or even larger area than the former land. Consequently, it is determined that the compensation payment satisfies the "replacement cost" (2nd field survey). - Those working in the brick kiln have no labor contract and are not eligible for compensation. Those brick kiln employees (7 households) will be given priority in employment in construction site or in the power plant (RDDR, p.49). - The households losing farm land will be provided with a vocational training course or support in cash, at a level of 1 MVND/person (RDDR, p.21).	None	Land, houses and crops will be compensated according to the decision of People's Committee, and the compensation is appropriately carried out. The households losing farm land will be provided with a vocational training course or support in cash, and the brick kiln employees not compensated according to the government regulation will be given priority in employment in construction site or in the power plant. These measures assure a living standard equal or even better than before resettlement for relocated people
4.	Compensation must be based on the full replacement cost as much as possible. (JICA GL)	- The land price survey was also conducted by ADB around O Mon District, and it became clear that it is possible with the compensation payment to purchase an equal grade of land with equal or even larger area than the former land. Consequently, it is determined that the compensation payment satisfies the "replacement cost" (2nd field survey). - The survey showed that the compensated households purchased larger rice field than they used to have before compensation with compensation money. This is because of limited availability of replacement land to buy in the immediate vicinity, and that garden and orchard land was valued much higher than paddy land (RDDR, p.17). - Resettled households are entitled to receive moving allowance, transitional support, job training (RDDR, p.15-16).	None	The land price survey was conducted by ADB in the context of due diligence around O Mon District, and it became clear that it is possible with the compensation payment to purchase an equal grade of land with equal or even larger area than the former land. The survey showed that the compensated households purchased larger rice field than they used to have before compensation with compensation money. Consequently, it is determined that the compensation payment satisfies the "replacement cost". Resettled households are provided, other than land, moving allowance, transitional support, job training and compensation based on the replacement cost is appropriately carried out.
5.	Compensation and other kinds of assistance must be provided prior to displacement. (JICA GL)	At the time of land transfer, the certificate of land transfer should be signed in the attendance of the person to be resettled, the project owner, land use right registration office, and the People's Committee. The land use right certificate for O Mon 3 was verified and it was confirmed that payment was conducted prior to land transfer.	None	Payment of compensation was conducted prior to land transfer.
6.	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. (JICA GL)	- The compensation plan of O Mon 3, O Mon 4 and related facilities was sequentially approved by Can Tho City People's Committee (approval was segmented to19 times: 4 times for O Mon 3 from 4 April to 14 August, 2006). - Resettlement Due Diligence Report has been prepared in 2008 and 2011. CAP was prepared as well in 2011. The documents are available on ADB website. The disclosure in the local district is being checked (6 March 2012).	None	Land acquisition process was initially carried out following the Vietnamese regulation and the survey for a preparation of the list of households to be relocated and the compensation plan have been developed in this context. Later, ADB has carried out socio-economical survey and Retrofit Resettlement Plan (2007)as a part of PPTA (Project Preparation Technical Assistance) that encourages modification of entitlement for receiving compensation. The comparison of the compensation policy with OP4.12 Annex A of WB safeguard policy is shown in Table 5.6-8. The survey of the households to be compensated was conducted prior to resettlement.

No.	JICA Guidelines	Compensation implemented in O Mon Project	Gap with JICA Guideline	Judgments
				Socio-economical survey was conducted in the process of land acquisition. The gap is being filled although it may take some time.
7.	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. (JICA GL)	- Public consultation meeting was held on 23 and 26 December, 2005 to explain the extension plan of O Mon Power Complex. The basis for calling these meetings was the decision No 4066/QD-UBND dated 8 Dec 2005 by the People's Committee of Can Tho City and notified through the press and Phuoc Thoi ward and Thoi An ward People's Committee. The meetings were primarily focused on resettlement and compensation issues (O Mon 4 EIA 7.B, p.145, RRP Table 13, p.30, RRP 6.1, p.39). - A Compensation and Land Clearance Council (DCC) of O Mon district was established to take the formal responsibility for resettlement and compensation, consisting of 1 chairman, 2 deputy chairmen, 1 permanent commissioner, 11 commissioners and 3 persons invited to represent the Fatherland Front Committee, the Women's Organization and the Farmers' organization (PPTA-4845 SIA 5.1.2, p.24).	None	As land acquisition process was initially carried out following the Vietnamese regulation, the compensation plan was developed. Public meeting was held prior to the land acquisition and the cut-off date was set. The public hearing has been held several times to collect local people's opinion and concern, and we believe that the scope of compensation is well understood by them. A Compensation and Land Clearance Council (DCC) of O Mon district consists of 1 chairman, 2 deputy chairmen, 1 permanent commissioner, 11 commissioners and 3 persons invited to represent the Fatherland Front Committee, the Women's Organization and the Farmers' organization, and the opinion of the local people as well as the local government is reflected.
8.	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (JICA GL)	- Public consultation meeting was held on 23 and 26 December, 2005 to explain the extension plan of O Mon Power Complex. The basis for calling these meetings was the decision No 4066/QD-UBND dated 8 Dec 2005 by the People's Committee of Can Tho City. It was notified through the press and Phuoc Thoi ward and Thoi An ward People's Committee. The meetings were primarily focused on resettlement and compensation issues (O Mon 4 EIA 7.B, p.145, RRP Table 13, p.30, RRP 6.1, p.39). - When holding the public meeting, the project owner submits the project summary to the local People's Committee, and the People's Committee notifies the meeting on the public notice board for the local people to view freely. The local people may express their opinion and concern to the project owner through the People's Committee (2nd field survey).	None	The opening of the first public meeting was notified through the press. In Vietnam, when holding the public meeting, the project owner submits the project summary to the local People's Committee, and the People's Committee notifies the meeting on the public notice board for the local people to view freely. The local people may express their opinion and concern to the project owner through the People's Committee. In this manner, the opening of public meeting is appropriately notified to the local people.
9.	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans. (JICA GL)	A Compensation and Land Clearance Council (DCC) was established to take the formal responsibility for resettlement and compensation, consisting of 1 chairman, 2 deputy chairmen, 1 permanent commissioner, 11 commissioners and 3 persons invited to represent the Fatherland Front Committee, the Women's Organization and the Farmers' organization (PPTA-4845 SIA 5.1.2, p.24).	None	A Compensation and Land Clearance Council (DCC) of O Mon district consists of 1 chairman, 2 deputy chairmen, 1 permanent commissioner, 11 commissioners and 3 persons invited to represent the Fatherland Front Committee, the Women's Organization and the Farmers' organization, and the opinion of the local people as well as the local government is reflected.
10.	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. (JICA GL)	- A grievance redress mechanism (GRM) has been established as a local administrative system (O Mon 4 EIA 8.B, p.149-150). - A sign board will be erected at the Project site that summarizes the GRM and provide contact details (address, phone number, fax, and email address) for the CTTP grievance focal point, the O Mon District People's Committee, the Can Tho People's Committee, and the Can Tho People's Court of Justice. CTTP will instruct the EPC contractor as to the GRM such that they can inform any person who might approach them directly as to the appropriate steps to file a grievance (O Mon 4 EIA Chap.8, C, p.150). - The project owner also handles complaints at the Company Office having a lawyer, with assistance of Labor Department in supporting role (2nd field survey). - 400 complaints have been expressed until 2000, many of which relate to compensation of houses (RDDR, p.22).	None	A grievance redress mechanism (GRM) has been established as a local administrative system. The project owner also establishes a department to handle complaints and a sign board will be installed in the project site. 400 complaints have been expressed until 2000, and we believe that an appropriate and accessible GRM is established.
11.	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12 Para.6)	- The evaluation teams of the District Compensation Committee set about assessing and evaluating the plot of land, houses and constructions, crops and trees from March 2006, prior to land acquisition (PPTA-4845 SIA 5.1.2, p.24). - In June 2007, during the process of land acquisition, socio-economical survey was conducted by Vattenfall Power Consultant (VPC, consultant company for ADB) for 105 households (RRP 3.3, p.21). - The current resettlement due diligence study was conducted in 2010. The interview included questionnaire on current income, livelihood, assets other than house, housing area, water supply and sewage system, sanitation, and change in fuel in comparison with 2005. The survey sample represented 24% of the DP population. A total of 145 DP households were interviewed (RDDR, p.24-30).	Socio-economical survey of the households to be compensated has not been conducted before land acquisition.	Land acquisition process was initially carried out following the Vietnamese regulation and the survey of compensation target was conducted, whereas socio-economical survey was not conducted. ADB has carried out socio-economical survey as a part of PPTA (Project Preparation Technical Assistance). Also, the household survey before and after compensation was carried out at the end of land acquisition and the status of the compensated inhabitants is appropriately understood.
12.	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12 Para.15)	- The policy of compensation of land and structure is as follows (RDDR, p.15). * According to the revised Land Law in 1993, people who settled before Oct 15, 1993, have received compensation for the land as well as for the house. * Households who have settled on river bank before 15 October 1993 without land use right certificate (LURC) are considered as illegal and not eligible for compensation for both land and house. - The compensation is implemented under the principle and conditions following the Decree No.197/ 2004/ NĐ-CP and Decision No.53/ 2005/ QD-UB of Can Tho City People's Committee (RDDR, p.15). - On 9 October, 2007, Can Tho City People' Committee received a letter from Vattenfall Power Consultant requesting modification of compensation and resettlement process, and Can Tho City People' Committee sent a replying letter in 2	None	The building owners regarded as illegal in Vietnamese law, as well as land users, are allowed for compensation or resettlement support. All the affected people will be provided with compensation or any other form of living support, such as brick kiln employees who are not to be compensated according to the regulation but will be employed in either construction site or the power plant.

No.	JICA Guidelines	Compensation implemented in O Mon Project	Gap with JICA Guideline	Judgments
		January, 2008, saying: * As for households who have settled on river bank before 15 October 1993 and households who built their houses on farmland for the purpose of settle for living (who had been considered illegal) and subsistence between 15 October 1993 and 1 July, 2004 (who have received compensation on house and land) PC Can Tho has directed PC O Môn to consider for them to go to resettlement area. As for households who built the houses on farmland after 1 July, 2004 but before the day of plan promulgation, PC Can Tho has sent an official letter to related departments for support proposal (RRP Annex 6, p.84). - "…as for 2 households settled on farm land (including river bank) before 1980, 9 households who built their houses on self-exploited riverbank before 15 October 1993 and 30 households who built their house on farmland for settlement between 15 October 1993 and 1 July 2004 and have received compensation on land, house, the Compensation Committee decided on 17th January, 2008 that all households listed above were approved for resettlement benefits in the meeting." (RRP Annex 7, p.85). - Brick kiln employees who are not to be compensated according to the regulation will be preferentially employed in either construction site or the power plant (RDDR, p.49).		
13.	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP4.12 Para.11)	In Vietnam, compensation payment includes the options of "land to land", "partly land and partly cash", "cash only", "cash and job training", and the people to be compensated have the choice. They will have consultation with the district level People's Committee as many times as necessary to come to agreement on compensation condition. Land price on which compensation payment is calculated will be determined by state level People's Committee (PC Can Tho) (1st field survey).	None	Most of the 226 relocating households selected cash payment, and only 9 households selected resettlement. Accordingly, compensation in this project is mainly paid in money at the request of affected households.
14.	Provide support for the transition period (between displacement and livelihood restoration). (WB OP4.12 Para.6)	- The survey result suggests that the standard of living and income of the relocated households has improved. Livelihood support measures are also prepared (RDDR, p.21). - The households losing farm land will be provided with a vocational training course or support in cash, at a level of 1 MVND/person (RDDR, p.21). - Resettled households are entitled to receive moving allowance, transitional support, job training (RDDR, p.15-16).	None	Resettled households are entitled to receive job training in addition to cash payment, and we believe that the support was appropriately implemented.
15.	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP4.12 Para.8)	- The total number of poor or unemployed vulnerable households in O Mon Power Complex was 17 in 2010, which decreased from 64 households at the time of survey in 2005. However, the resettlement committee did identify 24 households who are still vulnerable. The 17 or 24 vulnerable households were provided with special support of 15 MVND per household (RDDR p.30). - If within 3 months of disclosure of the CAP addition vulnerable DPs are identified and requested by the relevant local People's Committees and referred to the CTTP by the O Mon District People's Committee then additional assistance will be provided as needed (RDDR, p.22). - Most of the compensated people belong to Kinh group, but some belong to Cham or Khmer troops. As their lifestyle and livelihood are similar to Kinh group, they are not considered as minority groups (1st field survey).	None	Socially vulnerable people in the area consist of poor households, and they are provided with special allowance. In addition, if within 3 months of disclosure of the CAP addition vulnerable DPs are identified, additional assistance will be provided as needed. In this manner, consideration for vulnerable people has been appropriately carried out.
16.	For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP4.12 Para.25)	N/A	None	N/A

Table 5.6-8 Comparison of Compensation of the Project with WB OP 4.12 Annex A

Requirement specified in OP 4.12 Annex A	Implemented compensation	Gap
Project summary	The project owner submits the project summary to the local People's Committee, and the People's Committee notifies the meeting on the public notice board for the local people to view freely. The local people may express their opinion and concern to the project owner through the People's Committee (2nd field survey).	None
Potential impact of resettlement	The site for O Mon Power Complex was selected for the reason that, in addition to topographical reason, not being located close to any sensitive environmental receptors (communities, hospitals, schools, etc), no physical cultural resources exist on site, relatively small number of resettled people and socioeconomic impacts. The project site is selected to minimize the number of resettled inhabitants (O Mon 4 EIA 5.G p.100-101)).	None
The aim of developing RAP	The aim is included in the project summary.	None
Socio-economical survey	- The evaluation teams of the District Compensation Committee set about assessing and evaluating the plot of land, houses and constructions, crops and trees from March 2006, prior to land acquisition (PPTA-4845 SIA 5.1.2, p.24). - In June 2007, during the process of land acquisition, socio-economical survey was conducted by Vattenfall Power Consultant (VPC, consultant company for ADB) for 105 households (RRP 3.3, p.21).	The comparison of the compensation policy with OP4.12 Annex A of WB safeguard policy is shown in Table 5.6-8. The survey of the households to be compensated was conducted prior to resettlement. Socio-economical survey was conducted in the process of land acquisition. The gap is being filled although it may take some time.
Legal framework	- The basic policy of land acquisition is stipulated by Decree No.147/ 2004/ ND-CP. - Price for land compensation was based on Decision No.104/ 2005/ QD-UBND, house compensation was based on Decision No.53/ 2005/ QD-UB, and crop compensation was based on Decision No.53/ 2005/ QD-UB of the Can Tho City People's Committee (RDDR, p.16). - A grievance redress mechanism (GRM) has been established as a local administrative system (O Mon 4 EIA 8.B, p.149-150).	None
Implementation framework	See Table 5.6-4.	None
Requirement of eligibility (compensation)	- The requirement of eligibility (compensation) is described in Article 5.6.2(2). - Due Diligence survey was conducted by ADB, and as for 2 households settled on farm land (including river bank) before 1980, 9 households who built their houses on self- exploited riverbank before 15 October 1993 and 30 households who built their house on farmland for settlement between 15 October 1993 and 1 July 2004 and have received compensation on land, house, the Compensation Committee decided on 17th January, 2008 that all households listed above were approved for resettlement benefits in the meeting." (RRP Annex 7, p.85). - Brick kiln employees who are not to be compensated according to the regulation will be preferentially employed in either construction site or the power plant (RDDR, p.49).	None
Compensation calculation	- Price for land compensation was based on Decision No.104/ 2005/ QD-UBND, house compensation was based on Decision No.53/ 2005/ QD-UB, and crop compensation was based on Decision No.53/ 2005/ QD-UB of the Can Tho City People's Committee (RDDR, p.16). - In Vietnam, compensation payment includes the options of "land to land", "partly land and partly cash", "cash only", "cash and job training", and the people to be compensated have the choice. They will have consultation with the district level People's Committee as many times as necessary to come to agreement on compensation condition. Land price on which compensation payment is calculated will be determined by state level People's Committee (PC Can Tho) (1st field survey). - The land price survey was also conducted by ADB around O Mon District, and it became clear that it is possible with the compensation payment to purchase an equal grade of land with equal or even larger area than the former land. Consequently, it is determined that the compensation payment satisfies the "replacement cost" (2nd field survey). - The households losing farm land will be provided with a vocational training course or support in cash, at a level of 1 MVND/person (RDDR, p.21).	None

Requirement specified in OP 4.12 Annex A	Implemented compensation	Gap
Compensation of lost property, compensation basis, livelihood rehabilitation	- Price for land compensation was based on Decision No.104/ 2005/ QD-UBND, house compensation was based on Decision No.53/ 2005/ QD-UB, and crop compensation was based on Decision No.53/ 2005/ QD-UB of the Can Tho City People's Committee (RDDR, p.16). - The land price survey was also conducted by ADB around O Mon District, and it became clear that it is possible with the compensation payment to purchase an equal grade of land with equal or even larger area than the former land. Consequently, it is determined that the compensation payment satisfies the "replacement cost" (2nd field survey). - Resettled households are entitled to receive (RDDR, p.15-16): * Transportation allowance Permanently relocated within a province or city: * Multi-stories, concrete houses: 3 MVND/household * Brick houses: 2 MVND/household * Others: 1 MVND/household Permanently relocated to another province or city * Multi-stories, concrete houses: 5 MVND/household * Brick houses: 4 MVND/household * Others: 3 MVND/household * Temporary relocation allowance * Supports for subsistence and production stabilization * Supports for job change and job creation * Allowance for timely moving(5% of the total compensation, up to 5 MVND) - Brick kiln employees who are not to be compensated according to the regulation will be preferentially employed in either construction site or the power plant (RDDR, p.49). - When households or individuals directly engaged in agricultural production have over 30% of their assigned agricultural land areas expropriated, they shall receive life stabilization supports for 3 months if they must not be relocated and for 6 months if they must be relocated; where they must be relocated to places with difficult socio-economic conditions, they shall receive supports for 12 months at most. The level of monetary support per household member per month shall be equivalent to the value of 30 kg of rice, calculated at the average local price (4000 VND/kg) (RRP 12.1, p.59-61).	None
Selection and development of resettlement land, and transfer of land use right	O Mon district authority has acquired 100 sections of land in Phuoc Thoi ward in 2009, of which 30 sections has been obtained by the implementing organization as a resettlement land for O Mon Power Complex. The organization bought the land use right certificate for 9 relocating households from the local People's Committee and handed it to them to allow them for building house and relocation at their convenience (1st field survey).	None
Housing and social infrastructure in the resettlement area	- The resettlement land is still farm land and the land owner is also subject to compensation of O Mon Project. The resettlement land is located 500m from school and 3km from a hospital (1st field survey). - People relocated to resettlement area make contract with electricity company to purchase electricity, and the transmission system is installed by the electricity company based on Electricity Law. As for water supply, the main water pipe will be installed by the water supply company (2nd field survey).	None
Environmental conservation and management of the resettlement area	O Mon district authority has acquired 100 sections of land in Phuoc Thoi ward in 2009, of which 30 sections has been obtained by the implementing organization as a resettlement land for O Mon Power Complex. The resettlement land is currently a flat farm land and natural forest, primary forest, or ecologically valuable habitat are not included (Appended Figure-4, Photos) (1st field survey).	None
Resident participation	A Compensation and Land Clearance Council (DCC) of O Mon district was established to take the formal responsibility for resettlement and compensation, consisting of 1 chairman, 2 deputy chairmen, 1 permanent commissioner, 11 commissioners and 3 persons invited to represent the Fatherland Front Committee, the Women's Organization and the Farmers' organization (PPTA4845 SIA 5.1.2, p.24).	None
Integration of the resettled people and the existing inhabitants of the resettlement area	- O Mon district authority has acquired 100 sections of land in Phuoc Thoi ward in 2009, of which 30 sections has been obtained by the implementing organization as a resettlement land for O Mon Power Complex (1st field survey). - The land owner is also subject to compensation of O Mon Project (1st field survey).	None

Requirement specified in OP 4.12 Annex A	Implemented compensation	Gap
Grievance redress mechanism	- A grievance redress mechanism (GRM) has been established as a local administrative system (O Mon 4 EIA 8.B, p.149-150). - A sign board will be erected at the Project site that summarizes the GRM and provide contact details (address, phone number, fax, and email address) for the CTTP grievance focal point, the O Mon District People's Committee, the Can Tho People's Committee, and the Can Tho People's Court of Justice. CTTP will instruct the EPC contractor as to the GRM such that they can inform any person who might approach them directly as to the appropriate steps to file a grievance (O Mon 4 EIA chp.8, C, p.150). - The project owner also handles complaints at the Company Office having a lawyer, with assistance of Labor Department in supporting role (2nd field survey). - About 400 complaints have been expressed until 2000, many of which relate to compensation of houses (RDDR, p.22).	None
Responsibility of the project owner	See Table 5.6-4.	None
Implementation schedule	See Table 5.6-1.	None
Budget and financial resource	All the compensation cost was paid by EVN (see Table 5.7-4).	None
Monitoring and assessment	- The measures required under the Corrective Action Plan are to be monitored and reported on by the Project Implementation Consultant and be included within their regular reporting to ADB (RDDR, p.45). - The issue about the submission of the Report of Grievance and the monitoring result of life and livelihood of relocated household was consulted to ADB, and ADB required to consult CTTP, the project owner (2nd field survey). - The current resettlement due diligence study was conducted in 2010. The interview included questionnaire on current income, livelihood, assets other than house, housing area, water supply and sewage system, sanitation, and change in fuel in comparison with 2005. The survey sample represented 24% of the DP population. A total of 145 DP households were interviewed (RDDR, p.24-30). - According to the household survey there has been a significant overall improvement in livelihood stability and incomes of the affected households. Livelihood support measures are also prepared (RDDR, p.21).	None

5.7 ASSOCIATED FACILITIES

5.7.1 Consideration of Associated Facilities

The indivisibility of the associated facilities related to O Mon Thermal Power Complex was reviewed (Table 5.7-1). The facilities include the power plants in O Mon Complex excluding O Mon 3, the substation (500 kV), the switch yard, access roads, discharge channels, transmission line, gas pipeline, administration building, cooling water intake system, power for construction, and DFO unloading jetty.

Table 5.7-1 Consideration of Indivisible Business

No.	Facility	Result	Reason
1	O Mon Power Plant 1 & 2	Not associated facility	O Mon 1-A is already in operation in O Mon Power Complex. O Mon 1-B is scheduled for construction and O Mon 2 is still in a planning stage. These will be constructed regardless of O Mon 3.
2	O Mon Power Plant 4	Not associated facility	O Mon 4 will also be constructed regardless of O Mon 3. The acquisition of the construction site was processed at the same time as O Mon 3 as part of O Mon Power Complex.
3	O Mon Stage 5	Not associated facility	Construction of O Mon 5 is not yet determined, and has no relation with O Mon 3 plan. The acquisition of the construction site was processed at the same time as O Mon 3 as part of O Mon Power Complex.
4	Substation (500kV)	Not associated facility	It is already in operation and connected to O Mon 1-A. Not only O Mon 3 but other power plants will also be connected. The acquisition of the construction site was processed at the same time as O Mon 3 as part of O Mon Power Complex.
5	Switchyard	Not associated facility	It is already in operation and connected to O Mon 1-A. Not only O Mon 3 but other power plants will also be connected. The acquisition of the construction site was processed at the same time as O Mon 3 as part of O Mon Power Complex.
6	Access Road No.1	Not associated facility	It has been constructed for O Mon 1 and O Mon 2 which are not associated with O Mon 3, and is already in use.
7	Access Road No.2	Not associated facility	It will be used for O Mon 4 as well as O Mon 3, and the substation which are not associated with O Mon 3. The acquisition of the construction site will be processed at the same time as O Mon 3 as part of O Mon Power Complex.
8	Discharge channel No.1	Not indivisible	It was constructed for O Mon 1 and O Mon 2 which are not associated with O Mon 3, and is already in use.
9	Discharge channel No.2	Not associated facility	It is constructed for common use of O Mon 3 and O Mon 4 which is not associated with O Mon 3. The acquisition of the construction site will be processed at the same time as O Mon 3 as part of O Mon Power Complex.
10	500KV Transmission Line	Not associated facility	It is connected to the switchyard, the substation, and transmission line which are not associated with O Mon 3. Construction plan depends on the electricity demand and not on O Mon 3.
11	Gas pipeline	Not associated facility	It supplies gas to O Mon Thermal Power Complex, which includes Mon 1, O Mon 2, and O Mon 4 which are not associated with O Mon 3.
12	Gas Distribution Complex	Not associated facility	Same as above.
13	Administration building	Indivisible	It is constructed for O Mon 3. The acquisition of the construction site will be processed at the same time as O Mon 3 as part of O Mon Power Complex.
14	CW Intake & CW Pump Station	Indivisible	The cooling water intake is constructed for O Mon 3 onto Hau River. A pump station will also be constructed for O Mon3, and the acquisition of the construction site will be processed at the same time as O Mon 3 as part of O Mon Power Complex.
15	Power for Construction	Not associated facility	Electricity will be supplied from O Mon 1 which is associated with O Mon 3. Installation of a new power supply facility is not planned.
16	DFO Unloading Jetty	Not associated facility	A jetty constructed for O Mon 1 which is not associated with O Mon 3 will be used.

5.7.2 Result of Confirmation of Socio-Economical Consideration of the Associated Facilities

In the above-described consideration, only the administration building and the cooling water intake are determined to be indivisible facilities of O Mon 3. They are constructed within O Mon 3 site, and are considered as one facility in the EIA (concerning domestic waste water of the power plant workers, adverse effect of water intake to ecosystem, etc).

5.8 STAKEHOLDER MEETINGS

After the construction approval was issued by the Ministry of Industry, public consultation meetings were held a number of times for the inhabitants living around the O Mon Power Complex.

Table 5.8-1 Public Meeting and Consultation related to O Mon Thermal Power Complex

No.	Date	Venue	Type	No. of participant
(i)	23/ July/ 2005	Thoi An Ward People’s Committed office	Public participation meeting	AM:43, PM:28
(ii)	23/ December/ 2005, 26/ December/ 2005	Phuoc Thoi Ward	Public participation meeting	Many
(iii)	21/ July/ 2007	Thoi An Ward	Public participation meeting	130
(iv)	22/ July/ 2007	Phuoc Thoi Ward	Public participation meeting	232
(v)	14/ September/2007	Can Tho City	Workshop	40
(vi)	April/ 2008	-	Information disclosure through official document and opinion hearing	All the inhabitants of the affected area
(vii)	April/ 2008	Project site area	Personal interview	10 households of potential serious impact

The basis for calling (ii) was the decision No 4066/QD-UBND dated 8 December 2005 by the People's Committee of Can Tho City and notification was made through the press and Phuoc Thoi ward and Thoi An ward People’s Committee. The meetings were primarily focused on resettlement and compensation issues (O Mon 4 EIA 7.B, p.145).
(iii) - (v) were held based on PPTA (Project Preparation Technical Assistance) by ADB (O Mon 4 EIA 7, D, p.148).

5.8.1 Implementation Process

In Vietnam, when holding the public meeting, the project owner submits the project summary to the local People’s Committee, and the People’s Committee notifies the meeting on the public notice board for the local people to view freely. The local people may express their opinion and concern to the project owner through the People’s Committee (2nd field survey). The public meeting is held in Vietnamese language, as well as the records of the meeting (O Mon 3 EIA Appendix13-A, 2nd field survey).

5.8.2 Implementation Result

(1) Public participation meeting held in 23 July 2005 prior to EIA preparation ....(i)

The Thermal Power Project Management Unit No 3 (TPPMU3) of EVN and their consultants undertook public consultations in relation to the O Mon IV Project in July 2005. Participants included persons to be displaced by the expansion of the complex, ward and district People's Committees, and women, farmer, youth and veterans organizations (O Mon 4 EIA Appendix 13-A p.257).

Comments received in the meeting include:

- The resettlement area for the affected people will be located in what place.
- During the construction period, it is expected by the people to construct the access road for their transportation, the speaker hoped to construction a new road which the local people can use.
- The displace allowance of VND 8,000,000 proposed by the compensation committee is rather low and the speaker hoped to receive a higher rate.
- A speaker requested to be granted with land in the case that some households could not buy land lot in the resettlement.
- A speaker requested for reasonable rate of compensation and for compensation in case of trees, crops.

Of these, resettlement area was specified two places (and eventually one place), and the road is constructing access road No.2. The compensation was carried out by the compensation committee of O Mon district. The compensation for trees and crops was made (2nd field survey).

(2) Public Participation Meetings held in April 2008 after EIA Preparation .... (vi and vii)

According to the provision of the Circular No.08/ 2000/ BTNMT08 by Ministry of Environment and Natural Resources, the project owner of O Mon 3 thermal power plant had issued Official Letter No.1282/ CV-NDCT-AOM on 18 April 2008 to People's Committee and Fatherland Front Committees of Phuoc Thoi Ward and Thoi An Ward. The Official Letter No.1282 was attached the EIA summary describing the environmental impact survey result and environmental management plan (O Mon 3 EIA 8, p.181).

Official letter No.14/ UBND-NC on 09 May 2008 issued by People's Committee and Fatherland Front Committees of Phuoc Thoi Ward, official letter No.16/ CV-UBND on 22 May 2008 by People's Committee and Fatherland Front Committees of Thoi An Ward, Official Letter No.03/ CV-MT.VT of 12 May 2008 by Fatherland Front Committee of Thoi An Ward, sent in reply to the Official Letter No.1282 (O Mon 3 EIA 8, p.181), require the implementation of the following measures (O Mon 3 EIA 8, p.182).

a To manage labor effectively to preserve security and social order as well as spiritual life of the inhabitants.

b The project owner has to implement adequately all measures of environmental protection, noise and vibration generated during construction and operation of the project, to ensure water drainage and avoid obstacles to production and daily activities of inhabitants.

c If it is allowable, the project should provide work opportunities and make use of local labor force.

d The project owner shall responsible for compensating and settling satisfactorily in accordance with the laws of Social Republic of Vietnam in case of environment pollution during project implementation.

In response to the requirement of the People's Committee and Fatherland Front Committee, the project owner (EVN) submitted the following answer in the EIA (O Mon 3 EIA 8.4, p.182-183).

- To commit to implement perfectly all measures of environmental protection, waste treatment from the project. At the same time, technical methods and management should be executed to prevent and minimize negative effects on natural and socio-economic environments of the local area as forecasted in this Environmental Impact Assessment Report.
- To commit to comply with all provisions on environmental protection as regulated in the law on environmental protection passed by National Assembly, Session XI, 8th meeting on 29 November 2005 and declared on 12 December 2005 according to Order No.29/ 2005/ L/ CTN by President.
- To commit to comply with all Vietnam standards on environment issued together with Decision No.22/ 2006/ QD-BTNMT on 18 December 2006 by Ministry of Environment and Natural Resources on compulsory to apply Vietnam standards.
- To commit to take full responsibility before the Laws of the Socialist Republic of Vietnam for occurrence of environmental pollution affecting to the health of local inhabitants in the course of project implementation.

In the personal interview of the inhabitants in April 2008(vii), there were questions concerning compensation and re-employment, and no complaints regarding environmental issue or living environment were posed (2nd field survey).

5.8.3 Result of Consideration on the Gap with JICA Guideline and the Implementation of the Stakeholders' Meeting in Future

JICA Guideline stipulates that the stakeholders' meeting should be held at the stage of: (1) completion of the draft scoping document preparation, and (2) completion of the draft report. At the stage of completion of the draft scoping document (1), the meeting shall discuss the understanding of the needs of the local people and other stakeholders concerning the project, and the alternative plan. At the stage of completion of the draft report reflecting the result of socio-environmental consideration survey, the meeting should discuss the survey result and reflect it to the final report.

In this project, the EIA has been completed by the project owner, and the public consultation was held prior to the preparation of the EIA (i) and after the preparation of the draft EIA (vi and vii). The time and frequency of public meeting satisfy the JICA Guideline.

The main concern of the affected people before preparation of the EIA is compensation for land acquisition. There were questions concerning compensation and employment in the personal interview of the inhabitants carried out for EIA explanation, and no complaints regarding environmental issue or living environment were posed. Requests concerning environmental issues were proposed from ward-level People's Committee and Fatherland

Front Committee, and they are appropriately addressed in the EIA. In addition, public consultation is frequently held and the project implementation agency understands well the local people’s opinion.

Consequently, it is determined that there is no gap between the implementation of public consultation concerning this project and JICA Guideline. In case the generation capacity of the gas turbine of O Mon 3 is to be increased, the project owner should, as soon as the new output is determined, notify MONRE of the modification by official document and ask whether an additional EIA is required. At the same time, JICA survey team proposes implementation of public consultation to explain the modification and the potential environmental impact thereof to the local people.

5.9 OTHERS

5.9.1 Environmental Checklist (draft)

Table 5.9-1 shows the result of environmental and social consideration reviewed according to the checklist attached to JICA Guideline.

Table 5.9-1 Result of Environment Social Consideration

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)
1 Permits and Explanation	**(1) EIA and Environmental Permits**	
	(a) Have EIA reports been officially completed?	**Review: The EIA report was completed.** - The EIA report was prepared on January, 2009 by PECC2. This report was edited according to the comments of the assessment Council of MONRE (the Ministry of the Natural Resources and Environment) on 17th November, 2008 (EIA Report Cover).
	(b) Have EIA reports been approved by authorities of the host country's government?	**Review: The EIA report and other related documents have been approved by the Vietnamese government. MONRE has an understanding that the project has already started operation and that a new EIA is not necessary. In case the generation capacity of O Mon 3 is to be increased, the project owner should, as soon as the new output is determined, notify MONRE of the modification by official document and ask whether an additional EIA is required. If an additional EIA is needed, the modified part of the project should not be operated until the additional EIA is approved, according the relevant regulation in Vietnam (Decree No.29/2011 and Circuler No.26/2011).** - The EIA report was approved by MONRE on 31th July, 2009 (Decision No.1492/ QD-BTNMT). - According to the Decree No.29/ 2011/ND-CP issued on 5th June, 2011, Article 12.3.b, if the project is not undertaken within 36 months after the EIA approval, a new EIA should be prepared. However, MONRE has no precise rule for determining the start of the project: any construction activity in action is recognized by MONRE as the start of the project (1st Field Survey). - It happened in several power stations that the generating power is increased after EIA approval as a result of engineering design change from F/S. In that case, the official document is revised including the recalculation of gas emission and others and submitted from EVN to MONRE, if no fundamental change in engineering (from gas-fired to coal-fired, for example) is involved. MONRE reviews the document as to whether the EIA has to be corrected, and sends the official document to EVN in response (1st Field Survey). - The detailed calculation value, simulation result, etc., should be included in the official document, but they are not required if it was certified that the corrected value is equal or less than the EIA report even after the increase in power generation (1st Field Survey). - If MONRE judged an additional EIA is needed, the modified part of the project should not be operated until the additional EIA is approved, according the relevant regulation in Vietnam (Decree No.29/2011 and Circuler No.26/2011) (2nd field survey). - In O Mon Power Complex, heavy oil-fired O Mon 1 Power Plant A is currently in operation. The heavy oil will be replaced by natural gas once gas supply is in operation, which will reduce impact by gas emission. Additionally, the EIA result indicates that the environmental effect of gas emission from gas-fired O Mon 3 is insignificant, and MONRE considers that no significant environmental impact will occur even after a certain degree of increase in power generation (1st Field Survey).
	(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	**Review: Twelve requirements were determined as a condition for EIA approval, all of which have to be complied with by the project owner** - According to Article 2 in Decision No.1492/ QD-BTNMT, The Owner shall be responsible to implement exactly the contents stated in the EIA report and the following obligatory requirements: 1. Cooperate with the local authorities to carry out the compensation and resettlement according to the current regulations in order to stabilize life of the affected households in the project area. 2. Apply appropriate measures of management and technique during construction phase, in order to limit as mush as possible the adverse impacts on aquatic life in the project area; to collect and treat mud, soil and waste of construction activities and other wastes during construction and operation phases in order to meet environmental sanitation requirements. 3. Design, construct and operate the exhausted gas treatment system for boiler in order to meet TCVN 7440:2005[7] with Kp = 0.7, Kv = 1, TCVN 5937:2005[8] and other related mandatory Vietnamese Standards and Technical Regulations applied to the gas emitted into the environment. 4. Design, construct and operate the wastewater collection and treatment system (domestic wastewater, productive wastewater) in order to meet TCVN 5945:2005[9] in column A with Kf = 1.1, Kf = 1.0. 5. Take suitable solutions in cooling water intake and discharging so that there is no adverse impact on aquatic life and the river water source. 6. Strictly implement the current regulations on licensing of water resources exploitation, extraction and utilization and waste water discharge to the surrounding water sources. 7. Design, construct and operate the receiving systems of gas, oil and other material, which are supplied to O Mon III plant, in accordance with the technical regulations and ensure that these systems are safe and will not cause any pollution on the surrounding area. 8. Manage and control waste discharge of ships and carriers at the jetty entrance and exit in order to ensure that water resource shall not be polluted. 9. Fully and strictly implement technical procedures of operation of pipeline, valves and equipment system to ensure that there is no leakage of organic substances, dust and flue gas to the environment. 10. Strictly comply with regulations on navigation, fire prevention and fighting against fire, immediate rescue, labor safety and other related technical stipulations in the process of the project implementation. 11. Install the automatic monitoring system to control the dust, SO2, NOx, CO2 compositions before these substances emits out of the stack. 12. Comply with Decree No. 149/2004/ND-CP dated July 27, 2004 from the Government on stipulations of granting permits to exploit and use the water resource and discharge the waste water to the river and Circular No.02/2005/TT-BTNMT of June 24, 2005 by MONRE to instruct the implementation of this decree.

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[7] The standards has been changed into QCVN-22/ 2009 (Kp=0.7, Kv=1)

[8] The standards has been changed into QCVN-05/ 2009

[9] The standards has been changed into QCVN-24/ 2009 (Column A, Kq=1.2, Kf=1.1)

Main Check Items	Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)

1 Permits and Explanation

(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?

Review: Environmental approvals other than EIA have not been obtained yet, and when these will be approved is unknown as of 28 February 2012, because the time to apply for these permits is depending on the progress of the project. The future submission and acquirement of the required environmental approvals at an appropriate timing must be checked and ensured.

- The table below shows the environmental licenses required in addition to EIA (1st Field Survey).

Permit	Authority	Approval Date/Schedule	Remarks
Environmental License for the Entire Project	MONRE	Before Plant Operation	
Environment Approval for Surface Water Exploitation and Water Discharge	MONRE or DONRE (Department of Natural Resource and Environment) of Can Tho City	Before taking discharge water	According to Decree No.149/2004/ND-CP, the approval for water use of 50,000m^3/day and more and water discharge of 5,000m^3/day and more is given by MONRE, and for less quantity of use and discharge is approved by DONRE.
Approval for Using Deep Well Water or River Water (for construction purpose)	MONRE or DONRE	Before using the construction water	According to Decree No.149/2004/ND-CP, the approval for groundwater use of 3,000m^3/day or more is given by MONRE, and for less quantity of use is approved by DONRE.
Permission for Toxic Chemical/ Gas Application	Competent Agency authorized under MONRE	Before using of any device.	
Final License for Who e Fire Fighting System	Fire Police Headquarter (Hanoi)	During starting the Reliability Test	

- Since the time to apply for these permits is depending on the progress of the project, these approvals will be unknown as of 28 February 2012. (1st Field Survey).

(2) Explanation to the Stakeholder

(a) Are contents of the project and the potential impacts adequately explained to the stakeholder based on appropriate procedures, including information disclosure? Is understanding obtained from the stakeholder? **(1/2)**

Review: According to the regulation in Vietnam, the public consultation shall be conducted only prior to EIA preparation. In the case of O Mon Power Complex, the pubic consultation was held before and after the EIA preparation, providing the local people the opportunity to discuss and understand various issues of the project, such as social-environmental impact of the project and the mitigation measures. The public meeting is held in Vietnamese language, and its date and place is notified through the local People's Committee, according to the regulation in Vietnam. In this manner, we believe that understanding of the local people on the matter of the environmental impact of the project and the mitigation measures was achieved.

Prior to EIA

- After the construction approval was issued by the Ministry of Industry and Trade, public consultations were held prior to making the EIA report (EIA Appendix 13 A p.261, 2nd field survey).

Date	Venue	Form	Participant
July/ 2005	Office of People's Committee of Thoi An Ward	Public Consultation	AM: 43 person PM: 28 person
23/ December/ 2005 26/ December/ 2005	PhucThoi Ward	Public Consultation	Unknown, numerous Unknown, numerous

- In Vietnam, when holding the public meeting, the project owner submits the project summary to the local People's Committee, and the People's Committee notifies the meeting on the public notice board for the local people to view freely. The local people may express their opinion and concern to the project owner through the People's Committee (2nd field survey).
- The public meeting is held in Vietnamese language, as well as the records of the meeting (EIA Appendix 3-A, 2nd field survey).
- The Thermal Power Project Management Unit No 3 (TPPMU3) of EVN and their consultants undertook public consultations in relation to the O Mon Power Complex in July 2005. Participants included persons to be displaced by the expansion of the complex, ward and district People's Committees, and women, farmer, youth and veterans organizations (O Mon 4 EIA 7.A, p.147).
- Public consultation meeting was held on 23 and 26 December, 2005 to explain the extension plan of O Mon Power Complex. The basis for calling these meetings was the decision No 4066/QD-UBND dated 8 Dec 2005 by the People's Committee of Can Tho City and notified through the press and Phuoc Thoi ward and Thoi An ward People's Committee. The meetings were primarily focused on resettlement and compensation issues (O Mon 4 EIA 7.B, p.145, RRP Table 13, p.30, RRP 6.1, p.39).

After EIA

- After making EIA report, public consultations were held (EIA 8, p.181).

Data	Venue	Form	Participant
April/ 2008	-	Information disclosure through official document and opinion hearing	All the inhabitants of the affected area
April/ 2008	Project site area	Personal interview	10 households of potential serious impact

<table>
<tr><th colspan="2">Main Check Items</th><th>Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)</th></tr>
<tr><td rowspan="2">1 Permits and Explanation</td><td>(a) Are contents of the project and the potential impacts adequately explained to the stakeholder based on appropriate procedures, including information disclosure? Is understanding obtained from the stakeholder? (2/2)</td><td>
- According to the provision of the Circular No.08/ 2000/ BTNMT08 by Ministry of Environment and Natural Resources, the project owner of O Mon 3 thermal power plant had issued Official Letter No.1282/ CV-NDCT-AOM on 18 April 2008 to People's Committee and Fatherland Front Committees of Phuoc Thoi Ward and Thoi An Ward. The Official Letter No.1282 was attached the EIA summary describing the environmental impact survey result and environmental management plan (EIA 8, p.181).
- Official letter No.14/ UBND-NC on 09 May 2008 issued by People's Committee and Fatherland Front Committees of Phuoc Thoi Ward, official letter No.16/ CV-UBND on 22 May 2008 by People's Committee and Fatherland Front Committees of Thoi An Ward, Official Letter No.03/ CV-MT.VT of 12 May 2008 by Fatherland Front Committee of Thoi An Ward, sent in reply to the Official Letter No.1282 (EIA 8, p.181), require the implementation of the following measures (EIA 8.3.1, p.182).
(a) To manage labor force effectively to preserve security and social order as well as spiritual life of the inhabitants.
(b) The project owner has to implement adequately all measures of environmental protection, noise and vibration generated during construction and operation of the project, to ensure water drainage and avoid obstacles to production and daily activities of inhabitants.
(c) If it is allowable, the project should provide work opportunities and make use of local labor force.
(d) The project owner shall be responsible for compensating and settling satisfactorily in accordance with the laws of Socialist Republic of Vietnam in case of environment pollution during project implementation.
- At the same time as sending of the Official Letters, PECC2 conducted individually the interview to 10 households of potential serious impact, to explain the environmental impact of the O Mon Power Complex (especially socio-economic field) based on the results of the EIA (2nd field survey).
- In the personal interview of the inhabitants in April 2008, there were questions concerning compensation and re-employment, and no complaints regarding environmental issue or living environment were posed (2nd field survey).

Other
- In addition to the public meetings above, public consultations relating to environment and social influence were held in Thoi An ward and Phouc Thoi ward on 21 and 22 July 2007, a stakeholder workshop was held at the O Mon Power Complex on 14 September 2007. They were held based on PPTA (Project Preparation Technical Assistance) by ADB (O Mon 4 EIA 7, D, p.148).
<table>
<tr><th>Date</th><th>Venue</th><th>Form</th><th>Participant</th></tr>
<tr><td>21/ July/ 2007</td><td>Thoi An Ward</td><td>Public Consultation</td><td>130 persons</td></tr>
<tr><td>22/ July/ 2007</td><td>Phouc Thoi Ward</td><td>Public Consultation</td><td>232 persons</td></tr>
<tr><td>14/ September/ 2007</td><td>Can Tho City</td><td>Workshop</td><td>40 persons</td></tr>
</table>
- In the meeting on 21th and 22th July, 2007, most of the attendants were representatives of households affected by the Project. The meetings included a presentation on the O Mon Power Complex construction, an address by the O Mon District Compensation Committee regarding the status of the compensation process, and disclosure by the consultant of the social assessment survey. Discussion groups were subsequently formed to discuss these issues in detail (O Mon 4 EIA 7, D, p.147-148).
- In the stakeholder workshop on 14th September, 2007, involved 40 representatives from the People's Committees of Can Tho City, O Mon District, and Thoi An and Phuoc Thoi wards; the Department of Foreign Affairs, Can Tho City; the Department of Planning and Investment, Can Tho City; the Fatherland Front of Can Tho; the Women's Union of Can Tho; the Farmer's Union of Can Tho; affected peoples of Thoi An and Phuoc Thoi wards; the Belgian NGO Leader Voor Allen (IVA); and representatives from TPPMU3, PECC2 and PECC3. The interest in environmental issues was stronger in this meeting, and specific environmental and technical issues were raised. Nonetheless, resettlement and compensation issues continued to have a very prominent role in the meeting, and representatives of the District Compensation Committee explained the process in detail. Below is an excerpt of the statements related specifically to environmental issues (O Mon 4 EIA 7, D, p.150-151).
</td></tr>
<tr><td>(b) Are proper responses made to comments from the stakeholder and regulatory authorities? (1/2)</td><td>
Review: The comments of the local people collected at the public consultation before and after the EIA preparation was properly addressed and reflected to the project plan.

Public Consultation prior to EIA
- The Thermal Power Project Management Unit No 3 (TPPMU3) of EVN and their consultants undertook public consultations in relation to the O Mon IV Project in July 2005. Participants included persons to be displaced by the expansion of the complex, ward and district People's Committees, and women, farmer, youth and veterans organizations (O Mon 4 EIA Appendix 13-A p.257).
- The resettlement area for the affected people will be located in what place.
* During the construction period, it is expected by the people to construct the access road for their transportation, the speaker hoped to construction a new road which the local people can use.
* The displace allowance of VND 8,000,000 proposed by the compensation committee is rather low and the speaker hoped to receive a higher rate.
* A speaker requested to be granted with land in the case that some households could not buy land lot in the resettlement.
* A speaker requested for reasonable rate of compensation and for compensation in case of trees, crops.
- Of these, resettlement area was specified two places (and eventually one place), and the road is constructing access road No.2. The compensation was carried out by the compensation committee of O Mon district. The compensation for trees and crops was made (2nd field survey).
</td></tr>
</table>

Main Check Items	Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)

1 Permits and Explanation

(b) Are proper responses made to comments from the stakeholder and regulatory authorities? **(2/2)**

Public Consultation after EIA

- The project owner (EVN) explained to the above-mentioned requirements posed by the Official Letter No.14/ UBND-NC (Phuoc Thoi Ward People's Committees; 9th May 2008) , the Official Letter No.16/ CV-UBND (Thoi An Ward People's Committees; 22th May 2008), and the Official Letter No.03/ CV-MT.VT (Thoi An ward Fatherland Front Committees; 22th May 2008) as follows (EIA 8.4, p.182-183);
- To commit to implement perfectly all measures of environmental protection, waste treatment from the project. At the same time, technical methods and management should be executed to prevent and minimize negative effects on natural and socio-economic environments of the local area as forecasted in this EIA report.
- To commit to comply with all provisions on environmental protection as regulated in the law on environmental protection passed by National Assembly, Session XI, 8th meeting on 29 November 2005 and declared on 12 December 2005 according to Order No.29/ 2005/ L/ CTN by President.
- To commit to comply with all Vietnam standards on environment issued together with Decision No.22/ 2006/ QD-BTNMT on 18 December 2006 by Ministry of Environment and Natural Resources on compulsory to apply Vietnam standards.
- To commit to take full responsibility before the Laws of the Socialist Republic of Vietnam for occurrence of environmental pollution affecting to the health of local inhabitants in the course of project implementation.

(3) Alternatives

(a) Were any alternatives of the project plan, including the environmental social items, examined? **(1/2)**

Review: Although consideration of the alternative plan is not a requirement for the EIA in Vietnam, O Mon 3 F/S report provides consideration of alternatives concerning the zero option, fuel, power generation technology, cooling system, etc.

1) Zero option
The O Mon Power Complex project will play important roles in providing the necessary power supply in southern area of Vietnam. Without implementation of The O Mon Power Complex project, the current shortfall of 1,100 MW in the power system as well as the electricity demand growing at 15% to 17% per annum will not be met (O Mon 4 EIA 5.A, p.95). According to EVN, in view of the present situation of electricity supply in Vietnam, zero-option of the O Mon Power Complex is inconceivable, and the early action toward the project implementation, including land acquisition, is essential (2nd field survey).

2) Selection of the project site
The project plan of O Mon Power Complex has been developed in 1996. O Mon district was selected as the power complex project site for various reasons (O Mon 4 EIA 5.G, p.100-101). The construction plan of the O Mon 3 and 4 power plants in O Mon Power Complex has been approved by the Ministry of Industry and Trade (PPTA-4845 SIA 5.1, p.22), and O Mon Power Complex is the only alternative construction site conceivable for the new power plant around O Mon district.

Technical	Geographical	Social and environmental
- sufficient area for a 750 MW CCGT and associated facilities - access to reliable gas source - access to road and water transportation networks - access to national power grid - access to existing O Mon I infrastructure - available water supply - available cooling water - proposed use is in compliance with relevant land use plans and regulations	- geologically stable, low earthquake risk - reasonable site leveling and compaction costs - reasonable foundation construction costs	- not located close to any sensitive environmental receptors (communities, hospitals, schools, etc). - no physical cultural resources on site - relatively low resettlement and socioeconomic impacts

3) Consideration of fuel (F/S Chapter 5)
The reason for not using coal, LNG, and domestic oil is explained below.

Coal	LNG	Oil
- Coal development takes time and cost. - There is a construction plan of coal-fired power plant in northern Vietnam near coal mine in energy strategy in Vietnam.	- LNG plant needs high cost, and acceptance of the site and construction of storage facility is necessary.	- Domestic oil contains low sulfur. Export price of domestic oil is 1.5 times higher than import price of heavy oil, and oil export is economically more valuable than consuming as fuel for power generation.

Main Check Items

Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)

1 Permits and Explanation

(a) Were any alternatives of the project plan, including the environmental social items, examined? **(2/2-)**

The comparison of gas, DO and HO is described below.

< Comparison of gas, DO and HO >

Items	Gas	DO	HO
Atmospheric impact	Base	Significant	Very significant
Cost of fuel	Base	Expensive	Expensive

Consequently, gas is the most feasible fuel to be used for O Mon 3.

4) Comparison of electricity generation techniques (F/S Chapter 6.2)

Items	Combined Cycle	Conventional
Fuel	Gas, DO, (HO) HO need pretreatment.	Gas, DO, HO
Efficiency	51 - 60%	39 - 44%
Development cost (Calculation by F/S; 2009)	650~850 US$/kW	800~1200US$/kW (Gas, Oil) 1000~1400US$/kW (Coal)
Running cost (O&M) (Calculation by F/S; 2009)	12 US$/kW/year	9 US$/kW/year
Total area of the plant	70~80%	Base(100%)
Operating life	25 years	30 years
Construction period	Base	10 - 12 months longer
Cooling water	Base	1.5~1.8 times more needed

Combined cycle thermal power generation, despite high running cost and short life compared to conventional power generation, has the advantage of low development cost and short construction period. In addition, it generates less NOx (air pollutant), which is not noted in F/S. It needs less cooling water and accordingly generates less thermal waste water. As a consequence, the environmental impact is significantly smaller than thermal power generation.

From the above reasons, combined cycle power generation should be adopted to for O Mon 3.

5) Consideration of cooling method (F/S Chapter 7.6)
Steam used for power generation is cooled and return to water in the condenser, then sent back to the boiler. There are plural cooling methods of steam, such as heat release into water or air, and use of vaporization heat. Five cooling method including water-intake method are considered in the F/S (Appended Figure-1).

Option 1: One-through method
In one-through method, the steam is cooled by releasing heat into water. Cooling water is taken from the sea or river, and discharged again to sea or river after passing through the condenser.

Option 2: Cooling method using pond or lake
An artificial pond is constructed to temporarily store water, and cooling water is taken from/discharged into the pond. The scale of the artificial pond is determined depending on the capacity of the power plant, climate of the area, and the shape of the pond. In case of O Mon 3, a pond of 2.5km2 will be needed, which is not a feasible option.

Option 3: Natural circulation air-cooling tower method
In air-cooling tower method, steam is cooled by vaporization heat of water inside the tower. Here, air warmed by steam rises from the upper part of the stack, and cool air flows in from the lower part of the stack to fill the space. The size of the cooling tower is determined depending on the climate and the expected heat removal efficiency. In case of O Mon 3, a significantly large cooling tower will be needed.

Option 4: Forced-circulation air-cooling tower method
A similar cooling tower is used as that of “natural-circulation method”, but with a fan installed at the lower part of the tower to force air into the tower.

Option 5: Air-cooling condenser method
In air-cooling condenser method, wind of a fan is used for cooling steam. A cooling tower is not necessary, which is convenient in the area where supply of cooling water is not assured, in desert area for example. As the fan is operated with electricity generated in the power plant, it will decrease certain amount of electricity supply. Cooling water supply is abundant in O Mon Power Complex and this method is not an appropriate option.

As a result of the comparison of the above-described 5 options, Option 2 and Option 5 are not feasible. Option 3 and Option 4 require construction cost for installation of cooling tower, and are lower in power generation efficiency compared to One-through meth

Main Check Items	Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)

2 Mitigation Measures

(1) Air Quality

(a) Do air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust emitted by power plant operations comply with the country's emission standards? Is there a possibility that air pollutants emitted from the project will cause areas that do not comply with the country's ambient air quality standards? **(1/4)**

Review: The gas emission from O Mon 3 meets the gas emission standard in Vietnam (QCVN-22/ 2009) and satisfies the IFC guideline. According to the atmospheric diffusion modeling, the maximum ground concentration of the pollutant is below the national air quality standard and the IFC guideline in both the gas-fired and oil-fired turbine. Even if a higher-power gas turbine is introduced, the gas emission will not exceed the environmental standard or IFC guideline.

On the other hand, in the case all of the power plants in O Mon power complex are in operation, NOx concentration in 1-hour exceeds the environmental standard, but in a very rare case. Regarding the NOx emission of the respective power plant, emission from O Mon 1, which is a conventional-type thermal plant, is three times higher than O Mon 3. Accordingly, the development of environmental mitigation measure for O Mon 1 power plant will be the most effective option.

[Environmental impact of 750 MW]

<Parameter>

- The table below indicates the input data and emission standard for O Mon 3 (EIA 3.4.4.1, p108). The emission standards and EHS (Environmental, Health, and Safety Guidelines) guideline of IFC (International Finance Corporation) are also shown. As shown in the table, the emission standard in Vietnam, as well as EHS Guideline, will be satisfied.

Concentration of pollutant and dust in flue gas

Parameter	Concentration(mg/Nm^3)			Emission standard for power plant (QCVN-22/ 2009) Kp=0.7, Kv=1		EHS Guideline (Thermal power planu; 2008)	
	GT only	Gas fired	Oil fired	Gas	Oil	Gas	Oil
SOx	3.2	7.3	209.59	210 (300)	294 (500)	-	0.5% - 1%
Nox	16.16	37.9	98.85	175 (250)	420 (600)	51	152
Dust	1.62	3.69	6.6	35 (50)	105 (150)	-	30 / 50

Note: In emission standard calculation, coefficient is multiplied depending on power generation capacity (Kp) and region (Kv).
In EHS Guideline, different guideline value is applied depending on the atmospheric environment. The guideline value is applied for the power plant operating 500 hrs and more per year..SOx concentration means sulfur concentration in fuel.

- Other parameters are shown in the table below (EIA 3.4.3.1, p.108、Appendix 3-1).

Parameter	Case 1: GT only (500MW)	Case 2: Gas fired (750MW)	Case 3: Oil fired (750MW)
Height of stack	30m (Bypass Stack)	40m (Main Stack)	40m (Main Stack)
Inner diameter of stack	6.8m	6.8m	6.8m
Flue gas flow	1564.6 m^3/sec	685.39 m^3/sec	747.49 m^3/sec
Flue gas velocity	42.9 m/sec	18.8 m/sec	20.5 m/sec
Flue gas temperature	594 ^{o}C	97 ^{o}C	141 ^{o}C
SOx	5.0 g/sec	5.0 g/sec	156.67 g/sec
NOx	25.29 g/sec	25.96 g/sec	73.89 g/sec
Dust	2.53 g/sec	2.53 g/sec	4.93 g/sec

<Result and review>

- The table below shows the result of Gaussian-model short-term dispersion model of air pollutants in O Mon 3 based on the meteorological data in Can Tho City. It shows the maximum ground concentration. (EIA 3.4.3.1, p107-113).

Rainy season (Wind direction: East, Wind velocity; 2.5m/s, Temperature; 30°, Atmospheric stability; B)

(Unit; μg/m^3)

Parameter	Case 1	Case 2	Case 3	Air quality standards (QCVN-05/ 2009)	EHS Guideline (General: 2007)
SO_2	- 0.7 (1 hr)** 0.4 (24 hr)**	- 3.6 (1 hr)** 1.9 (24 hr)**	- 66.3 (1 hr) 35.2 (24 hr)	- 350 (1 hr) 125 (24 hr)	500 (10 min) - 125 (24 hr: Interim*)
NO_2	3.5 (1 hr) 1.9 (24 hr) -	18.6 (1 hr) 9.8 (24 hr) -	31.1 (1 hr) 16.6 (24 hr) -	200 (1 hr) 100 (24 hr) -	200 (1 hr) - 40 (year)
PM_{10}	0.186 (24 hr)	0.96 (24 hr)	1.1 (24 hr)	150 (24 hr)	150 (24 hr: Interim*)

* IFC/EHS Guideline quotes the value in WHO Guideline. WHO establishes their own interim target value for PM_{10} and SO_2.

**: As diffusion modeling for SOx has not been conducted in O Mon 3 EIA, SOx diffusion was calculated in proportion to NOx.

Main Check Items	Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)

2 Mitigation Measures

(a) Do air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust emitted by power plant operations comply with the country's emission standards? Is there a possibility that air pollutants emitted from the project will cause areas that do not comply with the country's ambient air quality standards? **(2/4)**

Dry season (Wind direction: South-West, Wind velocity; 2.7m/s, Temperature; 30℃, Atmospheric stability; B)

(Unit; μg/m^3)

Parameter	Case 1	Case 2	Case 3	Air quality standards (QCVN-05/ 2009)	EHS Guideline (General: 2007)
SO_2	- 0.7 (1hr)** 0.4 (24hr)**	- 3.7 (1hr)** 1.9 (24hr)**	- 68.1 (1h) 36.1 (24h)	- 350 (1 hr) 125 (24 hr)	500 (10 min) - 125 (24 hr: Interim*)
NO_2	3.6 (1h) 1.9 (24h) -	19.0 (1h) 10.0 (24h) -	32.1 (1h) 17.0 (24h) -	200 (1 hr) 100 (24 hr) -	200 (1 hr) - 40 (year)
PM_{10}	0.190 (24h)	0.98 (24h)	7.8 (24h)	150 (24 hr)	150 (24 hr: Interim*)

- The O Mon 3 power plant will be normally operated in gas-fired combined cycle (Case 2), and the table indicates that the maximum ground concentration for SO_2 and PM_{10} is 1/100 of the Vietnamese environmental standard (QCVN-05/ 2009), NOx also being 1/10. In case of oil-fired combined cycle (7 days of operation per year is anticipated for emergency case), the maximum ground concentration is also well below the environmental standard for each pollutant.

[In the case of increasing the output of O Mon 3]

- The calculation was based on the generation capacity of 750 MW as estimated in the O Mon 3 EIA. However, as a result of the recent improvement of gas turbine technology, the turbine of much higher capacity will be installed for O Mon Power Complex, and consequently, the gas emission will also need to be modified. Additionally, as the composition of fuel gas has been also changed since the EIA preparation, air pollutant emission should be modified as well. The estimated emission of air pollutant is calculated on the assumption that the turbine of maximum generation capacity currently available is introduced. Table below shows the result of the estimated emission compared to the estimation in O Mon 3 EIA. Although the output of O Mon 3 will be increased, the emission of air pollutant will not exceed of the emission standards for thermal power plant.

(unit; g/sec)

Parameter	Parameter in O Mon 3 EIA	Result of JICA survey (draft)	Emission standard for power plant (QCVN-22/ 2009) Kp=0.7, Kv=1
SOx	5.0	3.7	210 (300)
NOx	25.96	32.4	175 (250)
Dust	2.53	6.3	35 (50)

- As the temperature and emission rate of the emission gas are almost similar to the O Mon 3 EIA calculation result, the maximum ground concentration may be calculated by simple proportional calculation. Background value concentration of pollutants is quoted from O Mon 4 EIA (O Mon 4 EIA Table 45, p.128) and the maximum ground concentration and the estimated maximum concentration was calculated as cited in the table below. This result suggests no exceeding of the environmental standard. Consequently, the pollutant emission, even after the increase of output, will not exceed the environmental standard and the environmental impact will be insignificant.

Rainy season (unit; μg/m^3)

Parameter	Max. Concentration	Back-ground	Max. Conc. + Back-ground	Air quality standards (QCVN-05/ 2009)	EHS Guideline (General: 2007)
SO_2	- 3.6 -> 2.7 (1 hr) 1.9-> 1.4 (24 hr)	- 38.7 (1 hr) 22.1 (24 hr)	- 41.4 (1 hr) 23.5 (24 hr)	- 350 (1 hr) 125 (24 hr)	500 (10 min) - 125 (24 hr: Interim*)
NO_2	18.6 -> 23.2 (1 hr) 9.8 -> 12.2 (24 hr)	27.7 (1 hr) 18.5 (24 hr)	50.9 (1 hr) 30.7 (24 hr) -	200 (1 hr) 100 (24 hr) -	200 (1 hr) - 40 (year)
PM_{10}	0.96 -> 2.4 (24 hr)	79.4 (24 hr)	81.8 (24 hr)	150 (24 hr)	150 (24 hr: Interim*)

	Main Check Items	Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)
2 Mitigation Measures	(a) Do air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust emitted by power plant operations comply with the country's emission standards? Is there a possibility that air pollutants emitted from the project will cause areas that do not comply with the country's ambient air quality standards? **(3/4)**	

Dry Season (unit; µg/m³)

Parameter	Max. Concentration	Back ground	Max. Conc. + Back-ground	Air quality standards (QCVN-05/ 2009)	EHS Guideline (General: 2007)
SO_2	- 3.7 -> 2.7 (1 hr) 1.9-> 1.4 (24 hr)	- 38.7 (1 hr) 22.1 (24 hr)	- 41.4 (1 hr) 23.5 (24 hr)	- 350 (1 hr) 125 (24 hr)	500 (10 min) - 125 (24 hr: Interim*)
NO_x	19.0 -> 23.7 (1 hr) 10.0 -> 12.5 (24 hr)	27.7 (1 hr) 18.5 (24 hr)	51.4 (1 hr) 31.0 (24 hr) -	200 (1 hr) 100 (24 hr) -	200 (1 hr) - 40 (year)
PM_{10}	0.98 -> 2.4 (24 hr)	79.4 (24 hr)	81.8 (24 hr)	150 (24 hr)	150 (24 hr: Interim*)

[The cumulative environmental impact by all power plant operated]

<Parameter>

- In O Mon 4 EIA report, it calculated the the dispersion of air pollutants in case that all the power plants in O Mon Complex (including O Mon 5) are in operation. In this case that all power plant operate by gas fired, O Mon 1 is the conventional power plant and O Mon 2 to 4 are the combined power plant. The calculation was made using US EPA (Environmental Protection Agency) recommended CALPUFF modeling system, 8760 times using hourly meteorological data of 2006. The table below shows the input parameters (O Mon 4 EIA 6.C.3, p.123-141).

- Parameter -

Parameter	O Mon 1	O Mon 2 - 5
Stack height	140m	40m
Stack inner diameter	6.4m	6.6m
Flue gas flow	20.0 m/sec	19.3 m/sec
Flue gas temperature	90 °C	95.3 °C
Emission concentration and rate		
NOx	51.3 mg/Nm³ (109.4 g/sec)	50 mg/Nm³ (24.4 g/sec)
SOx	1.3 mg/Nm³ (0.6 g/sec)	0.44 mg/Nm³ (0.6 g/sec)
PM_{10}	10.32 mg/Nm³ (0.2 g/sec)	10.32 mg/Nm³ (5.0 g/sec)

- As described above, construction of O Mon 5 is not planned, and O Mon 3 will be equipped with a gas turbine of considerably higher power. Table blow shows the comparison of air pollutant emission of the power plant with high-power gas turbine (estimation based on the calculation above) with the emission calculated for the EIA preparation. As SOx value varies depending on the gas type, Sox emission in O Mon 1 is assumed to be similar to O Mon 2-4. The result indicates that the total pollutant emission at the full operation of the power complex is lower than at the time of O Mon 4 EIA preparation except for SOx. The result indicates that the total pollutant emission at the full operation of the power complex is lower than at the time of O Mon 4 EIA preparation except for SOx.

(Unit; g/sec)

Para meter	Parameter in O Mon 4 EIA			Result of JICA survey		
	Total Emission Rate	O Mon 1	O Mon 2 - 5	Total Emission Rate	O Mon 1	O Mon 2 - 4 (draft)
SOx	3.0	0.6	0.6	14.8	3.7	3.7
NOx	207.5	109.4	24.4	206.6	109.4	32.4
PM_{10}	20.5	0.2	5.0	19.1	0.2	6.3

< Result and Review >

- As the temperature and the emission rate of gas emission is approximate to the O Mon 4 EIA, the maximum ground concentration may be calculated by simple proportional calculation, as cited in Table blow.
- The summary of dispersion model is shown in the table below. No exceedance of air quality standard is predicted in yearly average and 24 hrs average. Exceedance of NOx concentration in 1-hour is predicted a maximum of 2 hours per year on 2 separate days, which is a very rare case (O Mon 4 EIA 6.C.3.e.4, p.127-128). - Regarding the NOx emission of the respective power plant, emission from O Mon 1, which is a conventional-type thermal plant, is three times higher than O Mon 3. Accordingly, the development of environmental mitigation measure for O Mon 1 power plant will be the most effective option. The realistic measure can consider reduction of operation of O Mon 1 in which it is inefficient and an environmental impact is larger than O Mon 3, when NOx concentration around the O Mon Power Complex is exceed with the air quality standards.

<table>
<tr><th colspan="2">Main Check Items</th><th>Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)</th></tr>
<tr><td rowspan="4">2 Mitigation Measures</td><td>(a) Do air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust emitted by power plant operations comply with the country's emission standards? Is there a possibility that air pollutants emitted from the project will cause areas that do not comply with the country's ambient air quality standards? **(4/4)**</td><td>**The simulation result of the dispersion model in case all the power plants are in operation** (μg/m³)
<table>
<tr><th>Para meter</th><th>Max. Concentration</th><th>Back-ground</th><th>Max. Conc. + Back-ground</th><th>Air quality standards (QCVN-05/ 2009)</th><th>EHS Guideline (General: 2007)</th></tr>
<tr><td>SO_2</td><td>-
10.9 -> 53.8 (1 hr)
1.0 -> 4.9 (24 hr)
0.08 -> 0.4 (year)</td><td>-
38.7 (1 hr)
22.1 (24 hr)
5.5 (year)</td><td>-
92.5 (1 hr)
27.0 (24 hr)
5.9 (year)</td><td>-
350 (1 hr)
125 (24 hr)</td><td>500 (10 min)
-
125 (24 hr: Interim*)</td></tr>
<tr><td>NO_2</td><td>198 -> 197.1 (1 hr)
38 -> 37.8 (24 hr)
4.3 -> 4.3 (year)</td><td>27.7 (1 hr)
18.5 (24 hr)
10.3 (year)</td><td>224.8 (1 hr)
56.3 (24 hr)
14.6 (year)</td><td>200 (1 hr)
100 (24 hr)
-</td><td>200 (1 hr)
-
40 (year)</td></tr>
<tr><td>PM_{10}</td><td>9.2 -> 8.6(24 hr)
0.7 -> 0.7(year)</td><td>79.4 (24 hr)
41.7 (year)</td><td>88.0 (24 hr)
42.4 (year)</td><td>150 (24 hr)</td><td>150 (24 hr: Interim*)</td></tr>
</table></td></tr>
<tr><td>(b) In the case of coal-fired power plants, is there a possibility that fugitive coal dust from coal piles, coal handling facilities, and dust from coal ash disposal sites will cause air pollution? Are adequate measures taken to prevent the air pollution?</td><td>**Review: O Mon 3 is not a coal-fired power plant.**</td></tr>
<tr><td>**(2) Water Quality**</td><td></td></tr>
<tr><td>(a) Do effluents including thermal effluents from the power plant comply with the country's effluent standards? Is there a possibility that the effluents from the project will cause areas that do not comply with the country's ambient water quality standards or cause a significant temperature rise in the receiving waters? **(1/3)**</td><td>**Review: The temperature of thermal effluent from O Mon 3 will be +7 oC compared to intake water, but since its heat will be radiated in the cooling water discharge channel, the water temperature will be +6 oC at the discharge mouse in Hau River. The diffusion extent of thermal effluent (1oC of temperature rise) is approximately 1,000m upstream from the discharge mouse, and 300m toward the middle of the river, and does not reach the opposite bank. Also, even if the output increased from the time of EIA preparation, thermal water discharge will not increase significantly and the diffusion area of thermal waste water will remain almost unchanged.**

In the case all of the power plants in O Mon power complex are in operation, thermal water extends 2km upstream, 1.5km downstream, and 600m toward river center、and thermal water will not reach the main spawning and nursery area for fish located on the opposite bank even in dry season. Moreover, as the fishers in Hau River have no fixed fishing place, the thermal water will not adversely affect the fishery.

Industrial and domestic waste water will be finally treated at the general waste water treatment system to meet the discharge standards (QCVN-24/2009), and in consequence, water pollution will not occur.

Chlorine will be added to cooling water to prevent the biofouling, and no residual chlorine was detected by the monthly water monitoring survey at the water outlet on Hau River at O Mon 1-A.

Thermal effluent

[Environmental impact of 750 MW]
- Cooling water is taken 18m³/sec from Hau River (EIA 3.4.3.3, p114-115). The temperature of thermal effluent will be +7 °C compared to intake water, but since its heat will be radiated in the cooling water discharge channel, the water temperature will be +6 °C at the discharge outlet in Hau River. In dry season (river water temperature: 30 - 31°C), river water temperature will still below 40℃ as permitted by Vietnam standard QCVN-24/ 2009 (EIA 3.4.3.3, p114).
- The diffusion of the thermal effluent was calculated by the 2D Surface Water Flow and Solute Transport Program. In calculation, it carried out on condition of the dry season of which the influence of thermal effluent is larger than the rainy season because of the river flow. As the results, the diffusion extent of thermal effluent (1°C of temperature rise) is approximately 1,000m up and down-stream from the discharge outlet, and 300m toward the middle of the river (Appended Figure-2) (EIA 3.4.3.3, p115-126, Appendix-3.2, Appendix-4).
- The northern bank of Hau River is more vegetated than the southern bank on which O Mon power complex is located, and constitutes a main spawning and nursery area for fish. The 2-D surface layer diffusion calculation takes into account only the diffusion of thermal waste water on surface layer and thus the resulted diffusion area tends to be more extended than the actual diffusion, but it indicates that the thermal water still does not reach the opposite bank. Additionally, fishermen move upstream and downstream to fish depending on the season and the growing of fish, so they have no fixed fishing place (2nd field survey), and therefore the impact of thermal waste water to fishery is not significant.

[In the case of increasing the output of O Mon 3]
- An introduction of a turbine of much higher capacity is anticipated for O Mon Power Complex, which will bring higher generation capacity of the steam turbine and increased thermal waste water compared to the time of the EIA preparation. However, in the case where the turbine of maximum generation capacity currently available is introduced, the estimated thermal waste water discharge is 18.4m³/sec, slightly higher than 18m³/sec at the O Mon 3 EIA preparation (calculation based on the similar waste water temperature: 7℃ higher than intake water). Consequently, the diffusion area of thermal waste water will remain almost unchanged.</td></tr>
</table>

	Main Check Items	Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)
2 Mitigation Measures	(a) Do effluents including thermal effluents from the power plant comply with the country's effluent standards? Is there a possibility that the effluents from the project will cause areas that do not comply with the country's ambient water quality standards or cause a significant temperature rise in the receiving waters? **(2/3)**	See below

[The cumulative environmental impact by all power plant operated]

- In O Mon 4 EIA report, it calculated the diffusion of the thermal effluent in case that all the power plants in O Mon Complex (including O Mon 5) are in operation. In this case, the thermal effluent (38.6m^3/sec) from O Mon 1 and O Mon 2 is discharged from the cooling water discharge channel 1, and the thermal effluent (46.2m^3/sec) from O Mon 3 to 5 is discharged from the cooling water discharge channel 2 (PPTA4845 EIA Table 36, p.75). The water temperature is +6^{o}C (the temperature at the intake is 31.5^{o}C and the temperature at the discharge outlet is 37.5^{o}C). The calculation was made using 3D model (MIKE 3 model). The condition of the calculation is in dry season and 28 days as one cycle of tidal (O Mon 4 EIA 6.C1.c.i, p.115).
- Table blow shows the comparison of thermal waste water discharge of the power plant with high-power gas turbine (estimation based on the calculation above) with the discharge calculated for the O Mon 4 EIA preparation.

(Unit; m^3/sec)

Parameter	Parameter of O Mon 4 EIA			Result of JICA study		
	Amount of thermal effluent	O Mon 1	O Mon 2 - 5	Amount of thermal effluent	O Mon 1	O Mon 2 - 4
No.1	38.6	23.2	15.4	41.6	23.2	18.4
No.2	46.2	-	15.4	36.8	-	18.4

- The water discharge from the discharge channel No.1 and No.2 slightly varies, but the total thermal water discharge is 78.4m^3/sec, which is lower than 85m^3/sec of O Mon 4 EIA case. Consequently, the diffusion area of thermal water discharge will not exceed the diffusion modeling of O Mon 4 EIA (as described below).
- In flood tide, thermal water horizontally extends upstream toward the river center, with the 1^{o}C warming area extending 2km upstream of the outfall and 600m toward river center. In slack tide prior to ebb, thermal water extends to the river center in upstream direction, with the area of 1^{o}C warming area extending 1km upstream of the outfall and 600m toward river center. In ebb tide, thermal water extends along the bank toward downstream, with the 1^{o}C warming area extending 1km downstream of the outfall and 400m toward river center (Appended figure-3(1)).
- In O Mon 4 EIA report, the diffusion of the thermal effluent is calculated: 38.6m^3/sec in channel 1, 46.2m^3/sec in channel 2. In the latest survey, the result was 41.6m^3/sec in channel 1, 36.8m^3/sec in channel 2. From the fact that the gradient at the outfall of the channel No.1 and No.2 is approximately the same, although the thermal water discharge of channel No.1 and No.2 is reversed in the latest survey result, the vertical diffusion of thermal waste water will not significantly change.
- Thermal water vertically extends to 3m deep around the outlet of the cooling water discharge channel 2, maintaining the depth up to 150m toward the river center, slightly extending toward the deeper area. The same occurs in channel 1, only with smaller extension toward the center and the deeper area of the river, as discharge rate is smaller (Appended figure-3(2)).
- In this manner, thermal waste water extends 150m toward the river center with layer of 3m thick, but at the point distant from the outfall, thermal water extends only on the surface layer and not in deeper layer. Accordingly, benthic fish and organisms will not be affected. In addition, thermal water will not reach the main spawning and nursery area for fish located on the opposite bank even in dry season. On the other hand, the river water is abundant in wet season which is a high season for fish spawning and nursing. Consequently, the impact of thermal water to river organisms will be insignificant. Moreover, as the fishers in Hau River have no fixed fishing place, the thermal water will not adversely affect the fishery.

[Mitigation measures]

- The discharge channel is 2 km long (open ditch; around 1 km). Thermal effluent takes around 2 hours and a half before thermal effluent comes out to Howe River because the flow velocity of the thermal effluent is 0.2 m/sec or less (18m^3/sec/ (26.6m*4m)). Thereby, the heat of thermal effluent radiates heat to the atmosphere, and the thermal effluent goes down about 1 ^{o}C (EIA 4.3.2.1, p138, EIA 4.3.2.2, p139).

Waste water

[Prediction and design]

- The kind and its amount of assumed discharge of the waste water with operation of the O Mon 3 power plant are as follows (EIA Table 4.1, p.140-141).

No.	Description	Value (Max)	Value (Regular)	No.	Description	Value (Max)	Value (Regular)
I. Chemical polluted water				II. Oil polluted waste water			
1	Waste water from blowdown of HRSG	309 m^3/day		1	Waste water from main machine hall of STG, GTG, and HRSG	170 m^3/day	
2	Waste water from deionized water treatment system	222 m^3/day		2	Waste water from transformer, distribution switchyard	216 m^3/day	
3	Waste water from domestic filtering chamber	20 m^3/day		3	Waste water from other auxiliary area	20 m^3/day	
4	Waste water from primary treatment zone	188 m^3/day		4	Waste water from of oil tanks	324 m^3/day	
5	Waste water from chemical and HRSG feeding area	10 m^3/day			Total oil polluted waste water	-	195 m^3/day
6	Waste water from gas turbine compressor cleaning water	10 m^3/day		III. Domestic waste water			
7	Waste water from boiler cleaning water	600 m^3/day		1	Waste water from septic tank	-	35 m^3/day
	Total chemical polluted waste water	-	759 m^3/day		Total waste water	-	989 m^3/day

Main Check Items | **Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)**

2 Mitigation Measures

(a) Do effluents including thermal effluents from the power plant comply with the country's effluent standards? Is there a possibility that the effluents from the project will cause areas that do not comply with the country's ambient water quality standards or cause a significant temperature rise in the receiving waters? **(3/3)**

- Chlorine will be added to cooling water to prevent the biofouling. Chlorine inject into intake water in front of bar screens. Its concentration is 4 mg/L. The thermal effluent from the condenser is less than 1.0 mg/L which is the waste water standards of Vietnam. Although O Mon 1-A has same chlorine dosing system, the concentration of chlorine is less than 1.0 mg/L at the discharge channel. Moreover, chlorine decreases while flowing through the discharge channel. No residual chlorine was detected by the monthly water monitoring survey at the water outlet on Hau River at O Mon 1-A (2nd field survey).

[Mitigation measures]

- All residual solution and chemical contaminated washing water is collected into neutralizing pit for primary treatment, and then the preliminarily treated waste water is conveyed to the general waste water treatment station (F/S 10.3.2.2., p.10-8 - 9).
- Oil polluted waste water shall separates oil at oil separator with capacity 10m^3/hour, then the preliminarily treated waste water shall be conveyed to the general waste water treatment station (EIA 4.3.3.6, p.144). The oil separated by waste water is retained as waste oil. (F/S 10.3.2.3, p.10-10).
- Domestic wastewater and human waste produced by 191 workers on site is estimated to be 35m^3 per day (200L/person. day). Domestic wastewater is treated in BASTAF (Baffled Septic Tank with Anaerobic Filter). In BASTAF, the wastewater is first settled by a precipitation chamber and a supernatant fluid is sent to the decomposition chamber of anaerobic bacteria. Sludge occurs at this time. Neutralization processing is made with acid and alkali after that (EIA 4.3.3.5, p142-143).

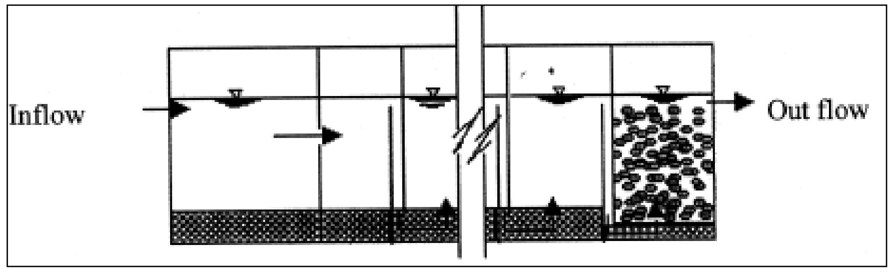


Diagram of BASTAF

- The concentration of domestic wastewater after processing of BASTAF is as follows. The preliminarily treated waste wate processed by BASTAF is conveyed to the general waste water treatment station (EIA 4.3.3.5, p.143).

(unit; mg/L)

Parameter	Prior to BASTAF	After treatment	Domestic wastewater standards (QCVN 14/ 2008)
BOD	294.7	103.1	30
COD	645.9	229.2	-
SS	791.3	276.9	50
T-N	65.5	22.9	-
T-P	21.8	7.64	-

- The treatment process in the general waste water treatment station is as follows (EIA Figure 4.3, p.146). The treated water satisfie the industrial wastewater standards (QCVN-24/ 2009 Type-A), and it discharges into the Hau River (EIA 4.3.3.2, p141). The poir of discharge outlet of the general waste water treatment station will be decided by an EPC contractor's design (2nd Field survey).
- In operation phase, chemical substances (Chlorine, HCl, NaOH, NaClO, etc) are kept by closed storage tanks, it warns against leaking out in the vicinity when using it, and after use is treated with the general waste water treatment station (2nd Field survey).

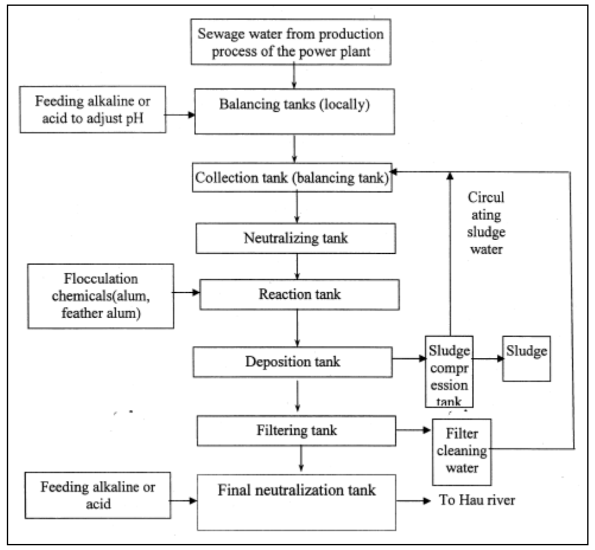


Diagram of the general waste water treatment station

(b) In the case of coal-fired power plants, do leachates from coal piles and coal ash disposal sites comply with the country's effluent standards?

Review: O Mon 3 is not a coal-fired power plant.

(c) Are adequate measures taken to prevent contamination of surface water, soil, groundwater, and seawater by the effluents?

Review: Waste water will be appropriately treated by introducing a treatment system or other mitigation measure and serious water pollution is not predicted.

[Mitigation measures]

- All the wastewater will be properly treated by the general waste water treatment station with capacity 50m^3/hour to meet the industry wastewater standard before discharge to environment (EIA 4.3.3, p141-147).
- Drain system will be introduced to gather rain water and prevent overflow (EIA 3.4.3.6, p129).

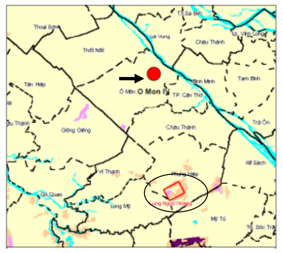
(3) Wastes

(a) Are wastes, (such as waste oils, and waste chemical agents), coal ash, and by-product gypsum from flue gas desulfurization generated by the power plant operations properly treated and disposed of in accordance with the country's standards? **(1/2)**

Review: Industrial waste generated from the power plant operation will be correctly collected and treated by authorized treatment business according to the Vietnamese regulation, so no significant environmental impact is predicted.

[Mitigation measures]

- Waste type and disposal method in operation phase are as follows (2nd field survey)

<table>
<tr><th colspan="2">Main Check Items</th><th>Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)</th></tr>
<tr><td rowspan="7">2 Mitigation Measures</td><td>(a) Are wastes, (such as waste oils, and waste chemical agents), coal ash, and by-product gypsum from flue gas desulfurization generated by the power plant operations properly treated and disposed of in accordance with the country's standards? (2/2)</td><td>
<table>
<tr><th>Category</th><th>Waste Type</th><th>Disposal Method</th></tr>
<tr><td>General Waste</td><td>Kitchen Waste, Paper etc</td><td>Collected and delivered to the final disposal site by Urban Facilities Enterprise</td></tr>
<tr><td></td><td>Sewage Sludge</td><td>Appropriate sanitation and waste collection facilities shall be equipped for collecting regularly, disposing finally and treating fully sewage sludge by natural microbiological condition or by microbiological chemicals. In case of inability of collection facilities, as an alternative option, sewage sludge and solid waste should be collected, treated and disposed at a licensed waste disposal facility by an appropriately licensed company in accordance with relevant Vietnamese regulations.</td></tr>
<tr><td>Hazardous Waste</td><td>Waste Oil</td><td>Waste oil can be re-used by mixing with the service oil by the owner for power generation. In case of non-recycle, it can be treated in the same manner as harmful waste below.</td></tr>
<tr><td></td><td>Sludge</td><td>Sludge generated by water treatment should be dredged periodically, land-filled and appropriately disposed by a licensed private waste contractor.</td></tr>
<tr><td></td><td>Harmful waste*</td><td>Harmful waste will be incinerated in accordance with the gas emission standards, or finally disposed in a licensed waste facility by an appropriately licensed harmful waste management company.</td></tr>
<tr><td></td><td>Burned Ash</td><td>Burned ash will be treated or finally disposed by an appropriately licensed harmful waste management company.</td></tr>
</table>
* "Harmful Waste" mean waste oil, papers and clothing containing oil, batteries, used fluorescent lights and so on
- A waste disposal services is selected by bid for every waste type every year. Selected services contracts the waste disposal in the whole O Mon Power Complex (2nd field survey).</td></tr>
<tr><td>(4) Noise and Vibration</td><td></td></tr>
<tr><td>(a) Do noise and vibrations generated by the power plant operations comply with the country's ambient standards, and occupational health and safety standards?</td><td>Review: Mitigation measures for noise will be conducted. In addition, the residential area is located distant from the project site, and the impact of noise will be insignificant.
[Prediction and review]
- Noise from the turbine, motor, fan will reach 80-90dBA. According to the similar case (Phu My 3), noise can be decreased to 75dBA or less near the boundary fence by an appropriate noise-controlling measure. In this project, gas turbines will be put within the building equipped with insulation cover, and low-noise pumps will be introduced. Thus, noise level at 100m from noise generation source will be kept to 60 dBA (EIA 3.4.3.2, p114, 4.3.5, p148).
- The noise source of O Mon 3 is located more than 300m from the residential area (EIA 3.4.3.2, p114) and the noise level will be decreased to 50dBA, causing very little impact.</td></tr>
<tr><td>(5) Subsidence</td><td></td></tr>
<tr><td>(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?</td><td>Review: There is no possibility that land subsidence may arise.
[Prediction]
- Ground water will be used only as domestic water for the power plant's employee during operation phase. River water from Hau River will also be taken to use as domestic water, and it has not been decided which water source will be used for domestic purpose (2nd field survey). It will be only 35m3/day (191 people x 200 liters) even if ground water will be taken for domestic purpose (EIA 4.3.3.1, p.141).
- In the course of construction for O Mon 1-A, 10m^3/hour of the underground water was used, since it was difficult to take water from Hau river, but land subsidence and the impacts of surrounding wells was not occurred (2nd field survey). Therefore, although groundwater will be used every day during operation phase, because it is not quantitatively large, land subsidence is not anticipated.</td></tr>
<tr><td>(6) Odor</td><td></td></tr>
<tr><td>(a) Are there any odor sources? Are adequate odor control measures taken?</td><td>Review: Odor source is ammonia, but O Mon 3 power plant will not use ammonia.
[Design]
- Gas turbine applies the low-NOx combustion technology. Generation of NOx will be reduced by water injection even when operating by DO fired in the emergency case. Therefore, O Mon 3 power plant will not install denitrizer in which ammonia, the source of odor, will be used (1st field survey).</td></tr>
<tr><td rowspan="2">3 Natural Environment</td><td>(1) Protected Areas</td><td></td></tr>
<tr><td>(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?</td><td>Review: The closest protected area from O Mon Power Complex is 40km away, and the adverse effect of the project is not assumed to reach there.
[Current status]
- There are no protected areas or special use forests in O Mon district. The closest protected area to the site is at the Ngoc Hoang valley, 40 km southeast of the site (O Mon 4 EIA 4.A.1.e, p.56).
- No impact on the water quality is expected, since Ngoc Hoang valley is not located at any basin of Hau River
- Ground concentration of the pollutants will become one tenth of the maximum ground concentration at the distance of 10km from the O Mon Power Complex. Ground concentration of the pollutants will be much lower at the distance of 40km from the O Mon Power Complex. Thus, the impact will not be significant at all.
</td></tr>
</table>

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)
3 Natural Environment	**(2) Ecosystem and biota**	
	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	**Review: The O Mon Power Complex does not encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats.** [Current status] - The flora in the project site is a mixture of many types of biosystems. The biosystems of perennial fruit trees, in which dominant species are special product plants such as orange, lemon and coconut. The biota of flooding area, in which *Sonneratia Caeseonilis* is dominant, is developing alongside the Hau River. *Sonneratia Caeseonilis* is big wood tree, forming a coastline defensive belt together other species such as water Hyacinth and wild pineapple, etc. They reduce the pressure of wave on the banks (O Mon 1 EIA 3.3.1, p.43). - Due to the agricultural activities of the local people, the vegetation of the O Mon Power Complex was the mixture of wild flora and agricultural plants prior to the land acquisition around 2004 (EIA 2.4.1, p.57). - The project site has been cleared and leveled (as of December, 2011) (1st field survey).
	(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	**Review: One vulnerable plant species listed in the international regulations or convention is observed in and around the project site, but it is a cultured species and has no specific environmental value. Some valuable fish species are also found in the area, but, as explained later, the impact of the thermal waste water is insignificant. The water pollution mitigation measure will be taken as well, and the serious effect of the project is not predicted.** [Current status] - There grows mangrove species, such as *Sonnertia*, in the flooding soil ecosystem along Hau River (EIA 4.15, p.134), but it has not grown in and around the O Mon Power Complex (2nd field survey). - Takian trees, IUCN (International Union for Conservation of Nature and Natural Resources) Red Listed, VU-listed (vulnerable) plant species, are observed in and around the O Mon Power Complex. But they are all cultivated and do not form a part of natural ecosystem, and they are very rare (O Mon 4 4.A.1.d, p.55-56).. - Four VU(vulnerable) -listed fish species and Two T(Threatened)-listed species are observed in the rivers around the O Mon Power Complex. Also, One EN(Endangered)-listed (CR in IUCN) species and Two VU species (EN or VU in IUCN) are observed in the larger area of Hau River (O Mon 4 EIA 4.A.2.b.v, p.67). [Mitigation measures] - Numbers of precious fish species are observed within the project area. Fish are sensitive to water quality degradation and implementation of mitigation measure against water pollution is essential (1st field survey).
	(c) If significant ecological impacts are anticipated, are adequate environmental protection measures taken to reduce the impacts on ecosystem?	**Review: The agricultural land in Phuoc Thoi ward and Thoi An ward where O Mon Complex will be constructed has the total area of 3,200ha, of which 95.5ha has been altered for the construction of O Mon power complex (26.6ha for O Mon 3). The altered area accounts for a very small area of the total farm, and consequently, the environmental impact is very limited.** [Current status] - Due to the agricultural activities of the local people, the vegetation of the O Mon Power Complex was the mixture of wild flora and agricultural plants prior to the land acquisition around 2004 (EIA 2.4.1, p.57). - The project site has been cleared and leveled (as of December, 2011) (1st field survey).
	(d) Is there a possibility that the amount of water (e.g., surface water, groundwater) used by the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	**Review: The main spawning and nursery area for fish is located on the Hau River bank opposite of the O Mon power complex. As the river water is abundant in wet season which is a high season for fish spawning and nursing, the impact of water intake will be insignificant. Other mitigation measures will be taken such as installation of a screen and lowering of the water intake rate, and the environmental impact of water intake will be insignificant.** [Prediction] - Since the main spawning and nursery area for fish is located on the Hau River bank opposite of the O Mon power complex, the impact of thermal effluent will be insignificant (O Mon 4 EIA 4.C.c.3, p.121). The season for breeding and growing of fry fish is primarily in rainy season (May to July) with abundant river flow, suction of young fish will be insignificant (EIA 3.4.3.3, p.115). - The abundance of fish larvae and eggs are highest during wet season when the area affected by discharge of cooling water should be insignificant (O Mon 4 EIA 4.C.c.3, p.121). [Mitigation measures] - In order to reduce suction of young fish and prawns with cooling water intake, intake water velocity is as slow as possible (less than 0.2m/sec) (F/S, p.10-7). - In order to prevent suction of young fish and prawns with cooling water, movable trash rack will be installed. The system, which is successfully functioning in some power plants, consists of small cells of 1cm×1cm, preventing small organisms from entering the cooling pump. The trash rack is periodically withdrawn and washed with water from front and back (EIA 4.3.1.1, p.138).
	(e) Is there a possibility that discharge of thermal effluents, intake of a large volume of cooling water or discharge of leachates will adversely affect the ecosystem of surrounding water areas? **(1/2)**	**Review: Thermal effluent diffuses on a surface layer and will not affect the benthic fish and animals. In the operation phase of all of the power plants in O Mon power complex, thermal water extends 2km upstream, 1.5km downstream, and 600m toward river center、and thermal water will not reach the main spawning and nursery area for fish located on the opposite bank even in dry season. Moreover, as the river water is abundant in wet season which is a high season for fish spawning and nursing, the impact of water intake will be insignificant. Waste water will be appropriately treated by introducing a treatment system or other mitigation measure and serious water pollution is not predicted.**

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)
3 Natural Environment	(e) Is there a possibility that discharge of thermal effluents, intake of a large volume of cooling water or discharge of leachates will adversely affect the ecosystem of surrounding water areas? **(2/2)**	[Prediction] - Since the diffusion extent of the thermal effluent is limited and the abundance of phyto- and zoo- plankton is rich, the impact to phyto- and zoo- plankton due to cooling water intake and thermal effluent diffusion is not significant (O Mon 4 EIA 4.C.c.3, p.120-121). - No increase in the abundance of toxic blue green algae is expected because a temperature exceeding 30 oC is unfavorable for these organisms. Since the thermal effluent diffuses the surface layer, benthos lived on the bottom of the river not affected by the thermal effluent (O Mon 4 EIA 4.C.c.3, p.121). - The abundance of fish larvae and eggs are highest during wet season when the area affected by discharge of cooling water should be insignificant. In addition, juvenile and adult fishes have the ability to swim away from the heated water (O Mon 4 EIA 4.C.c.3, p.121). - Migration fish mainly occurs in the rainy season. Since main spawing and nursery area is the northern side of the Hau River (opposite side of the O Mon Power Complex) without the influence of thermal wastewater, the impact of the thermal effluent is not significant (O Mon 4 EIA 4.C.c.3, p.121) - There is only a maximum decrease of 0.54 mg/L in content of dissolved oxygen, and such area is limited around the outlet of the the cooling water discharge channel. Therefore, the impact of the thermal effluent is not significant (O Mon 4 EIA 4.C.c.3, p.121) - Chlorine will be added to cooling water to prevent the biofouling. Chlorine inject into intake water in front of bar screens. Its concentration is 4 mg/L. The thermal effluent from the condenser is less than 1.0 mg/L which is the waste water standards of Vietnam. Although O Mon 1-A has same chlorine dosing system, the concentration of chlorine is less than 1.0 mg/L at the discharge channel. Moreover, chlorine decreases while flowing through the discharge channel. No residual chlorine was detected by the monthly water monitoring survey at the water outlet on Hau River at O Mon 1-A (2nd field survey). [Mitigation measure] - The discharge channel is 2 km long (open ditch; around 1 km). Thermal effluent takes around 2 hours and a half before thermal effluent comes out to Howe River because the flow velocity of the thermal effluent is 0.2 m/sec or less ($18m^3$/sec/ (26.6m*4m)). Thereby, the heat of thermal effluent radiates heat to the atmosphere, and the thermal effluent goes down about 1 ^{o}C (EIA 4.3.2.1, p138, EIA 4.3.2.2, p139).
4 Social Environment	**(1) Resettlement**	
	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? **(1/2)**	**Review: O Mon Power Complex, where O Mon 3 will be constructed, was selected as the project site in consideration that the potential number of inhabitants to be resettled is less than other location, in addition to topographic reason. The minimization of the affected people is given sufficient consideration in this manner, as well as the appropriate compensation for land, house, trees and crops.** [Plan] - The development plan of O Mon Power Complex has been planned in 1996, and the starting of operation of O Mon 1 and 2 power plants (1,200MW in total) and the development of transmission and transformation facility was planned in the Master Plan No.5 (2nd field survey). The land acquisition for O Mon 1 and 2 power plants was conducted as a consequence. The land acquisition for O Mon 1, O Mon 2 and the related facilities (access road No.1 and discharge channel No.1) has been started in November 1999, affects 112 households and 1 company, with the scope of 47.7ha, and has been completed on June 29, 2000 (PPTA-4845 SIA 5.1, p.22). - The approval of the master plan for O Mon Power Complex by the Ministry of Industry (Decision No.2523/ QD/ NLDK) on 27 th September 2004 (PPTA-4845 SIA 5, p.22-25). The progress of land acquisition is Appended Table-1. - The site for O Mon Power Complex was selected for the reason that, in addition to topographical reason, not being located close to any sensitive environmental receptors (communities, hospitals, schools, etc), no physical cultural resources exist on site, relatively small number of resettled people and socioeconomic impacts (O Mon 4 EIA 5.G, p.100-101). The project site is selected to minimize the number of resettled inhabitants. - Table below describes the area of acquired land and the details of acquisition in O Mon 3, 4 and related facilities (RRP Table 19, p.37). Although the total area cited here is different from that of RDDR, it encompasses the aspect of the land before acquisition. The fruit trees accounts for the largest area of O Mon 3, farm land the second largest. The proportion of farm land is higher compared to other power plants (accounts for 60% of the total farm land of the O Mon Power Complex). The number of the household to be compensated (resettled) is shown in the Table blow (RDDR Table-2, p.14). The RDDR describes only the number of household, whereas the ADB survey result includes the average number of person per household (4.8 persons), from which the number of people to be compensated was estimated (PPTA-4845 SIA Table 28, p.34). There are 5 industries to be compensated (RRP 2.1, p.14). (Unit; m^3)

Subject	O Mon 3	O Mon 4, switchyard, material yard	Access road No.2	Discharge channel No.2	Total
Farm land	87,669	5,962	14,351	23,629	131,611
Fruit farm	119,613	256,719	37,481	308,620	722,433
Aquaculture pond	0	0	0	4,579	4,579
Residential area	4,848	6,540	3,873	4,151	19,412
Others	0	12,311	0	864	13,175
Total	212,130	281,532	55,705	341,843	891,210
Area in RDDR Table 2	26.6 ha	24.7 ha	6.2 ha	38.0 ha	95.5 ha
Household subject to compensation (HHs)	128	183	77	213	601
Resettled household (HHs)	57	95	27	47	226
Person subject to compensation	614	878	370	1,022	2,884
Resettled persons	274	456	130	226	1,086

<table>
<tr><th colspan="2">Main Check Items</th><th>Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)</th></tr>
<tr><td rowspan="2">4 Social Environment</td><td>(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (2/2)</td><td>[Compensation]
- According to Decree No.147/ 2004/ ND-CP stipulating the basic policy of land acquisition, the compensation includes land, house, temporarily- affected property, trees and crops.
- Based on the Decree, the Can Tho City People’s Committee established a Decision stipulating resettlement, compensation and allowance for land expropriation within Can Tho City (Decision No.53/ 2005/ QD-UB) (RRP 8.1.1, p.44-46). The comparison of the Decision above and ADB policy requirements (Involuntary Resettlement Policy; 1995) is shown in Appended Table-2 (RRP Table 27, p.50).
- Of the 100 land sections acquired by Can Tho Education Union Project to Phuoc Thoi Ward in 2009, CTTP has obtained 30 sections. 9 households out of 226 to be relocated wished to move there, and CTTP acquired “Land Use Certificate” from Can Tho City’s People’s Committee and provided to them. Currently, the resettlement land is still farm land, as the landowner is also subject for compensation of the O Mon project. The elementary school is located in 500m, a hospital 3km from the resettlement area (Appended Figure-4, Photos) (1 field survey).
- With regard to compensation for the building materials of the structures, transmission line and other electrical facilities such as electric meter attached to the residential house are the assets of the transmission company, not the individual resident. Therefore, those are not subject to compensation. As the relocated residents resettled in the resettlement area and have a contract on purchase of electricity with the transmission company, transmission company is responsible for installing transmission line and other electrical facility including electric meter, following with the Electricity Law. Regarding water service, water company is also responsible for constructing and installing water pipeline upon the contract on purchase of water (2nd field survey)</td></tr>
<tr><td>(b) Is adequate explanation on relocation and compensation given to affected persons prior to resettlement? (1/2)</td><td>Review: Public consultations were held prior to the start of land acquisition and cutoff date was settled. The public hearing has been held several times thereafter to collect local people’s opinion and concern, and we believe that the scope of compensation is well understood by them.
- The compensation in Vietnam has four options such as “land to land”, “partly land and partly money”, “money only”, and “money and job training”, the choice of which is left to the affected people. In the compensation procedure, the People’s Committee of the district level takes charge of negotiation with the affected people. The compensation plan should be corrected until compensation condition comes to an agreement. The compensation price for land and others are determined by province-level People’s Committee (1st field survey).
- Additional information on plans to extend the O Mon Thermal Power Complex was given to the inhabitants of the area in two meetings held on 23 and 26/ December/ 2005. The basis for calling these meetings was the decision No.4066/ QD-UBND dated 8/ December/ 2005 by the People's Committee of Can Tho City, the meeting were announced in the press and through the People’s Committees of Thoi An and PhuocThoi wards. The meetings were primarily focused on resettlement and compensation issues (O Mon 4 EIA 7.B, p.147, RRP Table 13, p.30, 6.1, p.39).
<table>
<tr><th>Date</th><th>Venue</th><th>Participants</th></tr>
<tr><td>23/ December/ 2005; 2:00 PM</td><td>Loi Villege, Phoc Thoi ward</td><td>Unknown, numerous</td></tr>
<tr><td>26/ December/, 2005; 8:00 AM</td><td>Loi Villege, Phoc Thoi ward</td><td>Unknown, numerous</td></tr>
</table>
- Summary of key articles from Decision No.4066/ QD-UBND is as follows (O Mon 4 EIA 7.B, p.145).
Article 1: Agree to plan the area of 99 ha for construction investment O Mon Power Complex, Can Tho City. Land position shown in Map No.3 of Thoi An Ward, and Map No.7, 8 of Phuoc Thoi Ward
Article 2: TPPMU3, owned by EVN, has to contact PC of O Mon and related Departments for carrying out compensation, ground clearance and resettlement for land users as stipulated.
- The meeting on 23/ December/ 2005 was the effective cut-off date for compensation for property legally entitled to compensation. This was also the opinion of the affected people, confirmed though interviews (RRP 4.1, p.29).
- Following the public meeting in December 2005, public consultations were held as described below for the local people and stakeholders as a part of “PTA:Project Preparation Technical Assistance” by ADB (RRP 6.2, p.39)
<table>
<tr><th>Date</th><th>Object person</th><th>Venue</th><th>Participants</th></tr>
<tr><td>21/ July/ 2007</td><td>Affected peoples</td><td>Thoi An ward</td><td>130</td></tr>
<tr><td>22/ July/ 2007</td><td>Affected peoples</td><td>Phoc Thoi ward</td><td>232</td></tr>
<tr><td>14/ September/ 2007</td><td>Organizations and institutions (Stakeholder)</td><td>Can Tho City</td><td>40</td></tr>
<tr><td>8/ October/ 2007</td><td>Can Tho people’s committee</td><td>Can Tho City</td><td>10</td></tr>
<tr><td>4/ January/ 2008</td><td>Stakeholder</td><td>O Mon district people’s committee</td><td>14</td></tr>
</table>
- At the meeting in July 2007, several representatives of the affected peoples felt poorly treated by lack of compensation for houses that were built on farm land in violation of the construction law of 2004. There was also concern that information dissemination and participation by the affected people have been inadequate, and that there are complaints against the fairness, transparency and speed of the process (RRP 6.2, p.39-40).
- At the meeting with People's Committee of Can Tho on 8th October 2007, was to request certain modifications to the resettlement process as observed by Vattenfall Power Consultant (VPC). On 9/ January/ 2008, VPC send a letter (follow up) to Can Tho people’s committee (RRP 6.2, p.39-40).</td></tr>
</table>

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)
4 Social Environment	(b) Is adequate explanation on relocation and compensation given to affected persons prior to resettlement? **(2/2)**	- At the stakeholder workshop in O Mon on 4th January 2008, the main issues discussed were related to the capacity, proficiency and usefulness of vocational training for income restoration. At the meeting, some issues were raised (RRP 6.2, p.40); * Farmer's Union: Young people do not want to continue farming. They need training to find other jobs, but training has to be organized near their place of stay. The main issue is what is a useful training, job consultancy is necessary on an individual basis. * Women's Union and Youth union have organized vocational classes especially for people in working age. They are ready to gather affected people for careers consultancy. * Vocational training center of O Mon is directly under O Mon Domestic Affairs. It is funded by DOLISA (Department of Labour, Invalids and Social Affairs) to hold classes at wards. According to DOLISA's policy, they provide students with a tool set after graduating course instead of daily allowance. * O Mon domestic affairs have previously planned courses, but there have been problems in raising funds to meet the costs of courses. * There are 4 classes in Thoi An majoring in home electricity and sewing-machine consisting of 20 participants per class for the duration of 2 months with the cost of 48 - 50 million VND/class. In order for participants to perform well, prequalification classes are required in some cases. So, ADB (or the project owner) should support for organizing advance classes. With 80 persons eligible for training, this means for 4 classes, local government offer 200 million VND for basic knowledge. The remaining 300 MVND need to be supported for advanced level. * The type of training that can be given includes: Seamstress, Diesel engine maintenance, Motorbike repair, Construction, Electrician, and Electronics. Motorbike repair trainees are given a toolbox at a value of 10 million VND in order to start their own business. * There is a need for small loans especially to women for starting small business. But there is a problem with collateral. - As mentioned, public consultation has been held several times, and it can be said that compensation policy and plan are fully informed to the residents (RRP Annex 4, p.79-80). - Since establishing of the O Mon District in 2004, vocational training has been focused as one of solutions for employment creating, hunger erasing and poverty reducing. Three courses of the vocational training were opened in 2004, and expanded to 19 courses in 2008 (RRP Annex 4, p.79-80).
	(c) Is the resettlement plan, including compensation by the replacement cost, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? **(1/2)**	**Review: Land acquisition was initially conducted following the Vietnamese regulation, and later, based on the land price survey of the O Mon area, it became clear that it is possible with the compensation fee to purchase an equal grade of land with equal or even larger area than the former land. Consequently, it is determined that the "replacement cost" is satisfied.** [Survey] - After the O Mon district compensation committee establishment in March 2006, the evaluation team of the compensation committee set about assessing the land and property in the O Mon Power Complex. This process was very detailed, with each plot of land, each house and construction, and all crops and trees determined and evaluated (PPTA 4845 SIA 5.1.2, p.24-25). - In June 2007, during the process of land acquisition, socio-economical survey was conducted by Vattenfall Power Consultant for 105 households (the results shown in Appended Table-3(1)) (RRP 3.3, p.21). - The current resettlement due diligence study was conducted in 2010. The interview included questionnaire on current income, livelihood, assets other than house, housing area, water supply and sewage system, sanitation, and change in fuel in comparison with 2005. The survey sample represented 24% of the DP population. A total of 145 DP households were interviewed (the results shown in Appended Table-3(2)) (RDDR, p.24-30). - According to the survey in 2010, the resettled households tend to purchase paddy land much larger than their former land. One reason is they purchase the replacement land away from the project area, the other reason is that orchard and garden land was valued much higher so that these are replace by paddy land (RDDR, p.17). [Compensation] - Price for land compensation is based on Decision No.104/2005/QD-UBND dated December 23, 2005 issued by Can Tho City People's Committee, price for houses and superstructures is based on Decision No.53/2005/QD.UB, and price for crops is based on Decision No.53/2005/QD.UB (RDDR, p.16). < Cash compensation > - The contents of cash allowance are shown in Appended Table-4(1) (RDDR, p.16, RRP 12.1, p.59-61). < Household rehabilitation > - According to the government regulation, (1) informal business, and (2) workers having no labor contract shall not be eligible for compensation or support. No workers corresponded to (1) informal business workers, but those working in the brick kiln have no labor contract and are not eligible for compensation. Those brick kiln employees (7 households, RDDR Table 22, p.56) will be given priority in employment in construction site or in the power plant (RDDR, p.49). - Some vocational training courses for rehabilitation of livelihood are established. The courses which were conducted and planned in 2007 and 2008 are shown in Appended Table-4(2) (RRP 12.1, p.59-61). <Compensation to fisherfolks> - There were 11 fisherfolks around the O Mon Power Complex. All of them have built the new houses by their own compensation or shared from parent's compensation. In the future, In the future, when the fishery affected by power plant, they hope to receive loan to buy the boat for trading service (RRP 11, p.57)

	Main Check Items	Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)
4 Social Environment	(c) Is the resettlement plan, including compensation by the replacement cost, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? **(2/2)**	<Compensation price> - ADB, when preparing resettlement action plan (RAP), determines the compensation price (i.e. replacement price) based on the market price. However, in the due diligence step after the affected inhabitants have resettled, the basic compensation policy should focus on “assuring a living standard equal or even better than before resettlement for relocated people”, and the interview survey was conducted to collect data on the change in living and livelihood standard from as many relocated people as possible10. The result shows that most of the relocated people think the standard of their life and livelihood is “equal to the life standard before relocation” or “even better than the former life level” (Appended Table 2(2)). For several relocated households who answered differently, an additional proposal is suggested in the CAP (Corrective Action Plan) attached to RDDR (being checked in 6 March 2012) (2nd field survey). - The land price survey was also conducted by ADB around O Mon district, and it became clear that it is possible with the compensation payment to purchase an equal grade of land with equal or even larger area than the former land. Consequently, it is determined that the compensation payment satisfies the “replacement cost” (2nd field survey).
	(d) Is payment of compensation made prior to resettlement?	**Review: Compensation payment for land was done prior to the transfer of the land.** - At the time of land transfer, the certificate of land transfer should be signed in the attendance of the person to be resettled, the project owner, land use right registration office, and the People’s Committee. The land use right transfer certificate for O Mon 3 was verified and it was confirmed that payments were conducted prior to land transfer.
	(e) Is the compensation plan formulated in documents? **(1/2)**	**Review: The compensation policy is regulated under the related law, and the content of the compensation is specified in the Decisions.** - The most important legal documents in the resettlement and compensation are ”Land law (2003)”, “Decree 197/ 2004/ ND-CP” and “Decree 17/ 2006/ ND-CP” (RRP 8.1, p.43-44). - The compensation plan of O Mon 3, O Mon 4 and related facilities was sequentially approved by Can Tho City People’s Committee (approval was segmented to19 times: 4 times for O Mon 3 from 4 April 2006 to 14 August 2006, Appended Table-5). - Table blow describes the legal documents concerning the compensation process of land and houses and the compensation target[11].

Date	Compensation in Farmland		Households lived in the river bank	Legislation & Document	Contents	Remarks
	Farmland	House & superstructure				
	O	O	*			
15/October/ 1993				Land law amended in 1993	The law stipulated the lawful protection (Article 3 clause 1) of Land Use Right by Vietnam and the right of the exchange, transfer, lease, inheritance, and a mortgage.	* Households who lived in the river bank and built the house on farming land between 15th Oct. 1993 and 1st July 2004 did not receive the compensation of land and house
	X	*	*	For “*”, Official letter No.02/2008 (Can Tho People’s Committee)	Official letter No.02/2008: Those who marked “*” would received the resettlement benefits (65 million VND or plot of land in the resettlement areas)	
1/July/2004				Land and construction law amended in 2993	Since the category of the land (farmland, residential land etc.) were strict, no house were permitted on farmland. If a house is built on farmland, the farmland may be re-registered as residential land. (RRP, p.31)	$: Households who lived in the river bank and built the house on farming land between 1st July 2004 and 23 Dec. 2005 did not receive the compensation of land and house
	X	$	$	For “$”, official letter to the related departments for support proposal, and ADB’s recommendation	Official letter: resettlement support (RRP, p.84) ADB’s recommendation: payment up to 50% of full replacement cost (RDDR, p.12)	Construction of illegal houses in late 2004 started when people learned that in the nearby project, Tra Noc Industrial Zone, that people were paid for houses built on farmland. (RRP, p.31).
23/December / 2005				Cut-off date		
	X	X	X			

- According to the revised Land Law in 1993, people who settled before Oct 15, 1993, have received compensation for the land as well as for the house. Households who have settled on river bank before 15 October 1993 without land use right certificate (LURC) are considered as illegal and not eligible for compensation for both land and house. According to the revision of Land Law and Construction Law on 2003, building a house on a land registered as farm land is prohibited since July 1st, 2004, and if one wishes to build a house, farm land should be re-registered as residential land upon payment of a fee. In case of O Mon Power Complex, re-registration was permitted until the cut-off date (23 December, 2005) (RRP 4.2, p.31).
- In this manner, the initial condition for compensation was whether household had settled before or after 15 October, 1993. As per official letter No 02/VPUB-QH issued by PC Can Tho, a decision for providing cash assistance to settlers on state land who had settled from 15 October 1993 to 1 July 2004 (65 MVND in cash or plot of land in the resettlement areas) was taken. Additionally, people who had settled illegally on river bank before 1 July 2004 and not eligible for compensation also shall be eligible for compensation (65 MVND in cash or plot of land in the resettlement areas) (RRP Table 25, p.44-46).

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[10] Since many people appear to have moved away from the immediate area after receiving compensation a total of 145 households who moved to surrounding the O Mon Power Complex were interviewd (RDDR, p.13, 1st field survey).
[11] The updated information that has been received from CTTP will be added in the Final Report.

<table>
<tr><th colspan="2">Main Check Items</th><th>Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)</th></tr>
<tr><td rowspan="4">4 Social Environment</td><td>(e) Is the compensation plan formulated in documents? (2/2)</td><td>- Also, ADB has proposed that people inhabiting on farm land and river bank after 1st July 2004 shall be paid up to 50% of the full replacement cost (RDDR, p.12). According to the RDDR (RDDR, p.15), “People who lived on state-owned land after October 15, 1993 were not compensated for the land but their crops or superstructures on such land were eligible for compensation” (RDDR, p.15). Therefore, It is assumed that people inhabiting after 1st July 2004 had also received compensation[12] .</td></tr>
<tr><td>(f) Does the resettlement plan pay particular attention to vulnerable groups or persons, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?</td><td>Review: Vulnerable households are appropriately taken care of, including provision of additional support.
- Vulnerable people are defined as people who might suffer disproportionately or face the risk of being further marginalized by the effects of resettlement and specifically include: (i) female headed households with dependents, (ii) disabled household heads, (iii) households falling under the generally accepted indicator for poverty, (iv) children and the elderly households who are landless and with no other means of support, and (v) landless households, (vi) indigenous people or ethnic minorities . 8 vulnerable households inhabit the O Mon 3 site and are affected by land acquisition, of which 4 households are “(iii) poor households, 2 are “(iv) children and elderly households”, and 2 are “(v) landless households” (RRP 4.5, p.33).
- The total number of poor or unemployed vulnerable households in O Mon Power Complex was 17 in 2010, which decreased from 64 households at the time of survey in 2005. However, the resettlement committee did identify 24 households who are still vulnerable. The 17 or 24 vulnerable households were provided with special support of 15 MVND per household from the project owner (RDDR, p.22 & p.30).
- There were two displaced vulnerable households who had moved in to the project area after the cut-off date and set up temporary houses along the river bank. The CTTP used their own funds from their company charity fund to resettle these families in Thoi An Ward giving them secure tenure (but not ownership) of land and houses. Additional two displaced vulnerable households had been provided the assistant of 20,000,000 VND/household by CTTP from their company charity fund to build the permanent house (RDDR, p.21).
- Many people appear to have moved away from the immediate area after receiving compensation and not all of the households could be identified. If within 3 months of disclosure of the CAP (Corrective Action Plan) addition vulnerable DPs are identified and requested by the relevant local People’s Committees and referred to the CTTP by the O Mon District People’s Committee then additional assistance will be provided as needed (RDDR, p.22).
- Most of the compensated people belong to Kinh group, but some belong to Cham or Khmer troops. As their lifestyle and livelihood are similar to Kinh group, they are not considered as minority groups (1st field survey).</td></tr>
<tr><td>(g) Are agreements with the affected persons obtained prior to resettlement?</td><td>Review: The agreement for receiving compensation was achieved prior to land acquisition.
- At the time of land transfer, the certificate of land transfer should be signed in the attendance of the person to be resettled, the project owner, land use right registration office, and the People’s Committee. The land use right transfer certificate for O Mon 3 was verified and it was confirmed that agreements were conducted prior to land transfer.</td></tr>
<tr><td>(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (1/2)</td><td>Review: Compensation was conducted by the Compensation committee of O Mon district cooperating with relevant organizations. The amount of compensation was approved and determined by Can Tho City People’s Committee, and compensation fund was provided by EVN.
- Actors in the compensation and resettlement process is as follows (RRP Table 26, p.47);
<table>
<tr><th>Organization</th><th>Responsibilities</th></tr>
<tr><td>EVN</td><td>・Provide of funds for compensation
・Participate in the O Mon district compensation committee。</td></tr>
<tr><td>TPPMU3 (The responsibilities are now being taken over by Can Tho Power Company)</td><td>・A subsidiary of EVN.
・Delegated by EVN to sit on O Mon district compensation committee. Information sharing, compensation payment and internal supervision.</td></tr>
<tr><td>People’s Committee of
Can Tho City</td><td>・Approve the RP, and assign responsibilities for its implementation to relevant institutions.
・Approve and decide on compensation prices, allowances.
・Establishment of Resettlement and Compensation Committee at local administrative levels.
・Approve land recovery and transfer within the province.
・Redress complaints and grievances.</td></tr>
<tr><td>PECC2、PECC3</td><td>・Consultancy companies, subsidiaries of EVN.
・To carry out community consultation, and coordinate with the Resettlement and Compensation Committee</td></tr>
<tr><td>Department of Finance of Can Tho City</td><td>・Investigation and assessment of compensation prices, in conjunction with Dept of Construction, Dept. of Natural Resources, Dept. of Agriculture and Rural development, People’s Committees of districts.</td></tr>
<tr><td>People’s Committee of O Mon District</td><td>・Guiding compensation and resettlement activities, implement loss investigation, public consultation, dissemination of information on RP and policies.
・Establishment of district Resettlement and Compensation Committee.
・Resolving complaints and queries of affected people.</td></tr>
</table>
- The compensation committee, which , consisted of 1 chairman, 2 deputy chairmen, 1 permanent commissioner, 11 commissioners and 3 persons invited to represent the Fatherland Front Committee, the Women’s organization and the Famer’s organization (PPTA-4845 SIA 5.1.2, p.24).
- The budget relating to land acquisition for O Mon Power Complex approved by MOIT (Ministry of Industry and Trade) was 188,892 million VND (US$ 10,214,796). Among these, the gross expenditure as of November 2010 was 111,273,421,267 VND (US$ 6,017,382), and the remainder was 77,618,578,733 VND (US$ 4,197,414) (RDDR Table 20, p.44).</td></tr>
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[12] The updated information that we have received indicates that the residents called “speculator” are not subject to compensation.

<table>
<tr><th colspan="2">Main Check Items</th><th>Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)</th></tr>
<tr><td rowspan="3">4 Social Environment</td><td>(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (2/2)</td><td>
<table>
<tr><th>Organization</th><th>Responsibilities</th></tr>
<tr><td>O Mon district Compensation Committee (DCC)</td><td>・ Manage and organize census, inventory of assets, implementation of affected people
・ Issuing Detailed Measurement Survey (DMS) document for each affected person.
・ Checking compensation prices.
・ Organizing meetings with affected people, local authorities.
・ Disseminating entitlement forms DMS results and resettlement schedule to affected people.
・ Prepare detailed implementation plan.
・ Settling complaints and grievances.
・ Proposing solutions to solving problems.</td></tr>
<tr><td>People's Committee of the affected wards</td><td>・ Provide information for surveys and census.
・ Cooperate with Compensation Committee in organizing public meetings, information dissemination etc.
・ Resolve complaints and propose solutions, communicate to Compensation Committee</td></tr>
<tr><td>Affected People</td><td>・ Provide relevant information and documents on ownership of property.
・ Clearing land and moving in a timely manner.</td></tr>
</table>
</td></tr>
<tr><td>(i) Is a plan developed to monitor the impacts of resettlement?</td><td>Review: Environmental monitoring will be conducted (the monitoring items and details is being confirmed by the implementing organization)
- Internal monitoring activities include only decision letters and minutes of meetings issued by the authorities, and which are not generally made public. The DCC is an executive body, and applies the decisions, rules and regulations issued by the People's Committee of Can Tho City (RRP, p.67).
- External monitoring can be made only of the part of the process that is governed by ODA agreements. It includes restoration of livelihood, providing training and other supports to affected people and vulnerable groups (RRP, p.67).
- The monitoring is planned by Project Implementation Consultant in ADB, and the result will be reported to ADB (RDDR, p.45).
- Report of Grivance as well as the result of monitoring on the living and livelihood of the residents who received compensation will be submitted by CTTP to ADB. It is recommended by ADB to request CTTP to acquire the Report of Grivance and monitoring results if necessary (2nd field survey).</td></tr>
<tr><td>(j) Is the structure of grievance mechanism established? (1/2)</td><td>Review: A grievance redress mechanism is established as a local administrative system. The project owner also handles complaints at the department having a lawyer.
- The Grievance Redress Mechanism is established as part of administration (O Mon 4 EIA 8.B, p.151-152).

Stage 1 - District Level - CTTP and O Mon District People's Committee
- The AP lodges an oral or written complaint with either CTTP or the O Mon District People's Committee. CTTP will identify a focal point for receiving complaints.
- If the complaint is received by CTTP, the GRM procedure will be explained to the complainant, and the complaint will be recorded and forwarded to the O Mon District People's Committee.
- If the complaint is received by the O Mon District People's Committee, the complaint will be recorded. In order to assess the nature and validity of the complaint the O Mon District People's Committee will consult with CTTP and other relevant parties, fact-find and investigate, and within 15 days of receipt of the complaint will issue a decision:
* f the O Mon District People's Committee agrees in favor of the complainant, then in consultation with CTTP and in compliance with relevant decrees, circulars and stipulations, a course of action and/or compensation to address the complaint will be agreed upon;
* if the O Mon District People's Committee does not agree in favor of the complainant, and the complainant is satisfied and does not wish to proceed further, then the process ends; and,
* if the O Mon District People's Committee does not agree in favor of the complainant, and the complainant is not satisfied, the complainant has 45 days from the date of issuance the O Mon District People's Committee decision to take his/her complaint to either the Can Tho People's Committee (Stage 2) or the Can Tho People's Court of Justice (Stage 3).
Stage 2 - Province Level – Can Tho City People's Committee
- If the complainant is not satisfied with the decision in Stage 1, the complainant has 45 days from the date of issuance the O Mon District People's Committee decision to take his/her complaint to the attention of the Inspection Department of the Can Tho People's Committee.
- In order to assess the nature and validity of the complaint the Can Tho People's Committee will consult with the O Mon District People's Committee, CTTP and other relevant parties; fact-find and investigate; and, within 15 days of receipt of the complaint will issue a decision:
* If the Can Tho People's Committee agrees in favor of the complainant, then in consultation with CTTP and in compliance with relevant decrees, circulars and stipulations, the decision of the O Mon District People's Committee will be overturned, and a course of action and/or compensation to address the complaint will be agreed upon.
* If the Can Tho People's Committee does not agree in favor of the complainant, then the process ends.
Stage 3 -Court Case - Tho People's Court of Justice
- If the complainant is not satisfied with the decision in Stage 1, he/she can also bring a case to the Can Tho People's Court of Justice. The Court shall consider the complaint in accordance with laws on civil procedures and shall render a decision:
* If the Can Tho People's Court of Justice agrees in favor of the complainant, the court will request the Can Tho People's Committee to overturn the decision of the O Mon District People's Committee, and a course of action and/or compensation to address the complaint will be agreed upon.</td></tr>
</table>

<table>
<tr><th colspan="2">Main Check Items</th><th>Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)</th></tr>
<tr><td rowspan="4">4 Social Environment</td><td>(j) Is the structure of grievance mechanism established? (2/2)</td><td>* If the Can Tho People’s Court of Justice does not agree in favor of the complainant, then the process ends.
- A sign will be erected at the Project site that summarizes the Grievance Redress Mechanism and provide contact details (address, phone number, fax, and email address) for the CTTP grievance focal point, the O Mon District People’s Committee, the Can Tho People’s Committee, and the Can Tho People’s Court of Justice. CTTP will instruct the EPC contractor as to the Grievance Redress Mechanism such that they can inform any person who might approach them directly as to the appropriate steps to file a grievance (O Mon 4 EIA 8, C, p.152).
- Company Office to which the lawyer belongs in CTTP will accept complaints mainly. Labor Department is responsible for supporting (2nd field survey).
- By 2010, the Grievance Redress Mechanism appeared to had been accessible with 400 grievances having been submitted regarding various issues covering O Mon 3 (91), O Mon 4 (118), Discharge Channel (147) and Road No. 2 (17); At the time the due diligence survey was completed it was noted that there was one grievances pending resolution. The majority of grievances appear related to eligibility for housing compensation (RDDR, p.22).</td></tr>
<tr><td>(2) Living and Livelihood</td><td></td></tr>
<tr><td>(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?</td><td>Review: The loss of agricultural land in O Mon project site did not affect the livelihood of local people remaining on their land. The local people will have the priority in employment to the possible extent. The employment activity will be conducted through public labor center to assure fairness of job opportunity, and the conflict with local people will be prevented
[Prediction]
- The operation of the O Mon project will cause significant change in the local economy. The workers will obtain higher income than the average local people, which may cause conflict due to inequality and contradiction between project workers and the local people (EIA 3.4.3.8, p.129)
[Mitigation measures]
- Employing local people, especially project affected people on construction activities (EIA Table 4.5, p.153-167).
- Having good management measure for workers in construction period (EIA Table 4.5, p.153-167)
- Creating job in the power plant for local people in operation phase (EIA Table 4.5, p.153-167).
- Employing local residents at the rate of about 90% of the total number of 225 workers just like O Mon 1-A, following with the government policy (1st field survey).
- Recruiting workers through public recruitment center established under People’s Committee of Can Tho City and O Mon district (2nd field survey).</td></tr>
<tr><td>(b) Is sufficient infrastructure (e.g., hospitals, schools, roads) available for the project implementation? If existing infrastructure is insufficient, is a plan developed to construct new infrastructure or improve existing infrastructure?</td><td>Review: Local people will be given the maximum priority in employment to minimize hiring external people. The residential area of workers coming from outside of the area will be separated, and the problem with social infrastructure such as hospitals and schools will not be an issue.
[Planning and mitigation measure]
- The transportation construction plan in Phou Toi ward and Thoi An ward is as follows (EIA 2.5.2, p.66-67, p.70):
<table>
<tr><th>Item</th><th>Phou Toi ward</th><th>Thoi An ward</th></tr>
<tr><td>Road</td><td>- 3 roads (7km) were under improvement in 2008. The one in Thoi Trinh was invested by the district authorities, and those in Thoi Nguon Barea and Binh Phuoc area have just started for construction. The repairmen of the remaining 4,650ｍ of road are funded by the local people.</td><td>- Gravel road of 11km will be constructed in early 2008 by contribution from local people.
- In the District, 4.0km from Vam Channel to Ba Diem bridge will be paved.</td></tr>
<tr><td>Bridge</td><td>- 3 bridges are under construction (Binh Lap area, between Binh Phuoc and Binh Hoa A zone, between Thoi Binh and Thoi Nguon A zone), 3 bridges under improvement, and canal and 2 channels under construction.</td><td>14 concrete bridges, with the total length of 331m is under construction. The local people contributed in most of the construction expenditure and construction work as well.</td></tr>
</table>
- The table below shows the estimated number of workers in the power plant in operation phase (1st field survey).
<table>
<tr><th>Power plant</th><th>No. of workers</th></tr>
<tr><td>O Mon 1-A + 1-B</td><td>341 workers</td></tr>
<tr><td>O Mon 2</td><td>191 workers</td></tr>
<tr><td>O Mon 3</td><td>191 workers</td></tr>
<tr><td>O Mon 4</td><td>186 workers</td></tr>
</table>
- Local people will be hired in the project site to the possible extent following the government policy. The policy of priority employment of local people will be respected as of the case in O Mon 1-A where 90% of 225 workers are local people. Workers coming from outside of the area will be settled separately in Can Tho City and other area, and there will be no serious issue on social infrastructure such as hospital and schools (1st field survey)</td></tr>
</table>

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)
4 Social Environment	(c) Is there a possibility that large vehicle traffic associated with the project will affect road traffic in the surrounding areas? Are adequate measures considered to reduce the impacts on traffic, if necessary?	**Review: Mitigation measures for traffic issue will be introduced.** [Prediction] - Increased traffic and traffic accident caused by transport of materials and fuel oil for the project may occur along the National Road No.91 and river way (EIA 3.2.2.3, p.89). - National Road No.91 may be damaged by traffic of many trucks (EIA 3.3.2, p.91). [Mitigation measures] - The construction contractor shall coordinate with Transport and Public Works Department, Police Department of Can Tho City to execute measures such as installation of light and sign system on section of National Road No.91 at potential accident places (EIA 4.2.5, p.137). - The maximum speed shall be specified on the sign at each road section (EIA 4.2.5, p.137). - Transport police shall control strictly traffic safety along the road when transporting materials and equipment for the project (EIA 4.2.5, p.137). - The contractor shall undertake the repairmen of the damaged road section (EIA 4.2.5, p.137).
	(d) Is there a possibility that diseases (including communicable diseases, such as HIV) will be introduced due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?	**Review: Sanitation plan including medical checkup and sanitation program for workers will be conducted to minimize epidemics.** [Mitigation measure] - Project workers should have medical checkup every year. Sanitation plan should be established compliant to the policy of MOLISA (Ministry of Labour, Invalids and Social Affairs) (1st field survey).
	(e) Is there a possibility that the amount of water used (e.g., surface water, groundwater) and discharge of thermal effluents by the project will adversely affect existing water uses and uses of water areas (especially fishing)?	**Review: The main spawning and nursery area for fish is located on the opposite bank of the O Mon Power Complex. As the river water is abundant in wet season which is a high season for fish spawning and nursing, the impact of water intake will be insignificant. Thermal effluent diffuses on a surface layer and will not affect the benthic fish and animals. Waste water will be appropriately treated by introducing a treatment system or other mitigation measure and serious water pollution is not predicted. Additionally, there is no specific fixed fishing place in Hau River in front of the complex, and the adverse effect of thermal and normal waste water for fishery is not predicted.** [Prediction] - Quality of local water may be affected by increased temperature, turbidity, oil/grease, chlorine caused by wastewater and cooling water from the power plant. This may affect the aquaculture of the local area (EIA 3.3.2, p.91). - The abundance of fish larvae and eggs are highest during wet season when the area affected by discharge of cooling water should be insignificant. In addition, juvenile and adult fishes have the ability to swim away from the heated water (O Mon 4 EIA 4.C.c.3, p.121). - Migration fish mainly occurs in the rainy season. Since main spawing and nursery area is the northern side of the Hau River (opposite side of the O Mon Power Complex) without the influence of thermal wastewater, the impact of the thermal effluent is not significant (O Mon 4 EIA 4.C.c.3, p.121) - Although small scaled, private fishery is not prohibited in the front area of the O Mon Power Complex, large scale fishery may obstruct the water traffic and is prohibited. 10 fishermen are currently in operation in Hau River near the O Mon Power Complex. They move upstream and downstream depending on the season and the growing of fish, so they have no fixed fishing ground (2nd field survey). [Mitigation Measures] - The discharge channel is 2 km long (open ditch; around 1 km). Thermal effluent takes around 2 hours and a half before thermal effluent comes out to Howe River because the flow velocity of the thermal effluent is 0.2 m/sec or less ($18m^3$/sec/ (26.6m*4m)). Thereby, the heat of thermal effluent radiates heat to the atmosphere, and the thermal effluent goes down about 1 ^{o}C (EIA 4.3.2.1, p138, EIA 4.3.2.2, p139). - Eventually industrial waste water and domestic waste water is processed with the general waste water treatment station, and waste water after treatment is comply with waste water discharged standards.
	(3) Heritage	
	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with the country's laws?	**Review: There is no historical, cultural, religious monument in the O Mon Power Complex.** [Current status] - There is no historical, cultural, religious monument in the O Mon Power Complex (EIA 2.5.1, p.65).
	(4) Landscape	
	(a) Is there a possibility that the project will adversely affect the local landscape, if there is any aesthetic landscape near the site? Are necessary measures taken? **(1/2)**	**Review: The serious influence on a scene is not assumed** [Current status] - There is no scenic site around the O Mon Power Complex (1 field survey)

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)
4 Social Environment	(a) Is there a possibility that the project will adversely affect the local landscape, if there is any aesthetic landscape near the site? Are necessary measures taken? **(2/2)**	[Prediction and mitigation measures] - Environmental pollution including air pollution, water pollution and solid waste disposal may affect the landscape of the area (EIA 3.2.2.3 p. 89), but the mitigation measures will be conducted to minimize environmental impact. - Surround the O Mon Power Complex is a rural region, and there is no aesthetic landscape. During the construction phase, 11.1% of the construction area of O Mon 3 power plant is planed to greening. While in operation phase, more size of the area in the O Mon Power Complex is planed to greening (2nd field survey).
	(5) Ethnic Minorities and Indigenous Peoples	
	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	**Review: There are some minority groups living in O Mon district. However, their lifestyle and livelihood are similar to Kinh group and no traditional event takes place in the project area. Accordingly, the project will not affect their life and culture and they are not necessarily to be taken care as minority groups.** [Current status] - The composition structure of the local people is rather multiform but mainly is Kinh ethnic group, otherwise there are some Cham ethnic (some tens of households). Life activities, productivity form are similar to the Kinh group (EIA 2.5.1, p.64). - Most of the local people belong to Kinh group, but some belong to Cham or Khmer group. Their life activities are similar to Kinh group (1st field survey). - There are no known current use of lands by Indigenous Peoples in the Project area (O Mon 4 EIA 4.C.8, p.93).
	(b) Are the rights about the land and resources of an ethnic minority and indigenous people respected?	**Review: There are some minority groups living in O Mon district. However, their lifestyle and livelihood are similar to Kinh group and no traditional event takes place in the project area. Accordingly, It is understood that they do not possess their own land or right for resources in the O Mon project site.** [Current status] - There are no known current use of lands by Indigenous Peoples in the Project area (O Mon 4 EIA 4.C.8, p.93).
	(6) Working conditions	
	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	**Review: Laws and ordinances associated with the working conditions of the country will be enforced.** - The power plant will conform to the standards on working environment issued by the Ministry of Health on light, air ventilation, temperature, noise, humidity, etc (EIA 4.3.9, p.152). - Safety measures during operation phase will be conducted by the project owner, CTTP, following with the safety management document issued by MOIT (2nd field survey).
	(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?	**Review: Measures to individuals involved in the project on tangible safety considerations will be developed and conducted.** [Mitigation measures] - Engineers, workers working at workplace with noise exceeding 90dBA will be equipped with noise-protective capsules and plugs (EIA 4.3.9, p.152）). - Engineers, workers working in high and medium voltage areas or subject to electric shock will be equipped with special clothing, shoes, gloves, cap to prevent electric shock (EIA 4.3.9, p.152). - The following measures will be applied to eliminate fire and explosion (EIA 4.2.6, p.137). * To plan fuel storage area with guard, protection and water spraying in the hot days. * To inspect and maintain regularly and prevent leakage. * To plan and make available of fire and explosion fighting and response means and materials in case of fire and explosion events. * To raise awareness of workers and train hazard response. * To follow labor principles and regulations on labor safety. - Design of protection and fire-fighting system shall comply with Vietnamese and international standards on fire prevention as well as the provision issued by Can Tho City fire agency (EIA 4.3.8.4, p.152).
	(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public sanitation) for workers etc.?	**Review: Measures to individuals involved in the project on intangible safety considerations will be planed and conducted.** [Mitigation measures] - The labor safety will be promoted following labor principles and regulations on labor safety (EIA 4.2.6, p.137). - Measures will be taken to raise awareness of workers and train hazard response (EIA 4.2.6, p.137). - The contractor organize training course on labor safety for the construction workers (EIA 4.2.4, p.136).
	(d) Are appropriate measures being taken to ensure that security guards involved in the project do not violate safety of other individuals involved, or local residents?	**Review: O Mon Power Complex site will be separated from outer area by a fence, and security guards will be placed from the security company under the control of Can Tho City Police and City authority.** [Mitigation measures] - The fence will be installed around the project site to strictly separate the project site and the surrounding area prior to construction activity. Security guards will be hired from the security company under the control of Can Tho City Police and City authority throughout the construction and operation phase (1st field survey).

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)
5 Others	**(1) Impacts during Construction**	
	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? **(1/3)**	**Review: Adequate measures are provided during construction period.** **[Air quality]** [Prediction] < Construction area > - Construction activity including vegetation removal or land clearance may generate dust pollution higher than the standard value of 0.3mg/m^3 (QCVN-05/ 2009). The construction work will be in a limited period (about 1 month) and environmental impact of dust may be minimized by conducting mitigation measures such as limiting the area of construction work as much as possible, watering of the construction site, etc (EIA 3.4.13, p.94). - Generation of air pollutant (Sox, NOx, and others) from operation of heavy machines and trucks is predicted, but the emission amount is low (except dust) and environmental impact to the area will be insignificant (EIA 3.4.13, p.94). - About 1000 workers will work during construction phase and consume 500kg per day of fossil fuel, generating air pollutant such as Sox and NOx. The affected area will be only around the construction area (EIA 3.4.2.2, p.104). < Traffic route > - Along National Road No.91, about 20 trips per day of 10t trucks for material transportation, and 2 trips per day of 10t trucks for waste transportation is predicted (4,000-5,000 trips in 16 months) (EIA 3.4.2.2, p.104). [Mitigation measures] - During the ground leveling proceee, attention should be paid to balance the excavated and filed volumes to minimize disposal quantity (EIA 4.1.4, p.133). - To spraying water at construction area and disposal site (EIA Table 4.5, p.153-167). - To minimize size and occupied time of disposal heap (EIA Table 4.5, p.153-167). - Sodding and planting of tree that grow strongly on disposal heaps (EIA Table 4.5, p.153-167). - Covering vehicle during transportation time (EIA Table 4.5, p.153-167). - Limiting operation of vehicle at daytime if possible (EIA Table 4.5, p.153-167). - Maintaining vehicle in the best operation condition and ensuring vehicles running in the construction area in good condition (EIA Table 4.5, p.153-167). - Rock and material transporting trucks shall be covered during travel in order to eliminate dust. The construction unit shall have suitable plan avoiding concentration of vehicles at one place and at same time in order to eliminate dust (EIA 4.2.1, p.134). - Spraying water in construction and disposal areas in dry and sunny days (EIA Table 4.5, p.153-167). **[Noise]** [Prediction] < Construction area > - Noise level decreases of 6dB as the distance from noise source doubles. It is known that noise level becomes 75 dBA at the distance of 38-121m from the heavy equipments and 45dB at the distance of 2-5km. The temporary noise effect in residential area may be occurred during construction period (1 month) (EIA 3.4.14, p.97). < Traffic route > -35-70 trips per hour of 10t trucks for material transportation are predicted. The noise level at 15m from the heavy machine is 90dBA, noise-affected distance being several hundreds of meters (EIA 3.4.2.3, p.104). [Mitigation measures] - Installation of sound insulation wall and use of heavy machines compliant to the noise standards (EIA4.1.4, p.133, EIA 4.2.1, p.134). - Traffic of trucks will be prohibited in night time to early morning (21PM to 6 AM) (EIA 4.2.1, p.134). - Maintaining construction machines and equipment in the best operation condition (EIA Table 4.5, p.153-167). - Repairing and maintaining regularly construction machines. Equipment and vehicles (EIA Table 4.5, p.153-167). - Implementing high noise activities in the daytime (EIA Table 4.5, p.153-167). - Announced widely in community the time period and construction plan of the project (EIA Table 4.5, p.153-167). - Constructing a noise wall or installing noise reducer at noise affected area (EIA Table 4.5, p.153-167). - Maintaining vehicle in the best operation condition and ensuring vehicles running in the construction area in good condition (EIA Table 4.5, p.153-167). - Since 30 tons per a track on roads are the maximum weight, heavier machines and materials than it will deliver by river transportations. Therefore, the impact on the noise from construction vehicles is decreased (2nd field survey).

Main Check Items	Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)

5 Others

(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? **(2/3)**

[Water quality]

[Prediction]

- Excavation work (65,100m3) will increase the content of suspended solid in river and valley water around the project site. Total of TSS content will exceed the standards QCVN-08/ 2008 (regulation SS=50mg/l) on waste water. However, excavation activity will last only 1 month and the affected area will be only dozens of meters from the construction area (EIA 3.4.15, p.98). Besides, wastewater from concrete fabrication line and oil-containing wastewater may be generated (EIA 3.4.15, p.98-99).
- Since the workers is estimated 100 persons for the earth work and 1,000 persons for the highest construction period, volume of domestic waste water may be 15m^3/day during the earth work and 150m^3/day during the highest construction period (EIA 3.4.2.4, p105).

[Mitigation measures]

- In construction phase, temporary rain drainage ditches will be constructed and slopes around the project area will be reinforced to eliminate rock and soil sliding into rivers. All waste petroleum and lubricant will be treated on the day to the possible extent (EIA 3.4.2.4, p135).
- After construction, alayer of waterproofing materials such as concrete or asphalt shall prevent corrosion and reduce the restoration of ground water artery (EIA 4.2.3, p135).
- Preparing and implementing land erosion control plan at construction area (EIA Table 4.5, p.153-167).
- Implementing sedimentation and oil collection from waste water prior to discharge to environment (EIA Table 4.5, p.153-167).
- Treating oil polluted waste water by oil separation system (EIA Table 4.5, p.153-167).
- Storing chemicals at area with roof and concrete floor (EIA Table 4.5, p.153-167).
- Training workers on cleaning measures in case of chemical spill accident (EIA Table 4.5, p.153-167).
- Prohibiting disposal of waste into Hau River as well as surroundings of the O Mon 3 power plant (EIA Table 4.5, p.153-167).
- Installing setting basin of overflow rainwater at outlet prior to discharge it into Hau River (EIA Table 4.5, p.153-167).
- In construction period, chemical substances (Chlorine, HCl, NaOH, NaClO, Organic acid etc) are kept by closed storage tanks, it warns against it leaking out in the vicinity when using it, and after use is treated with a waste water treatment system (2nd Field survey).

[Solid waste]

[Mitigation measures]

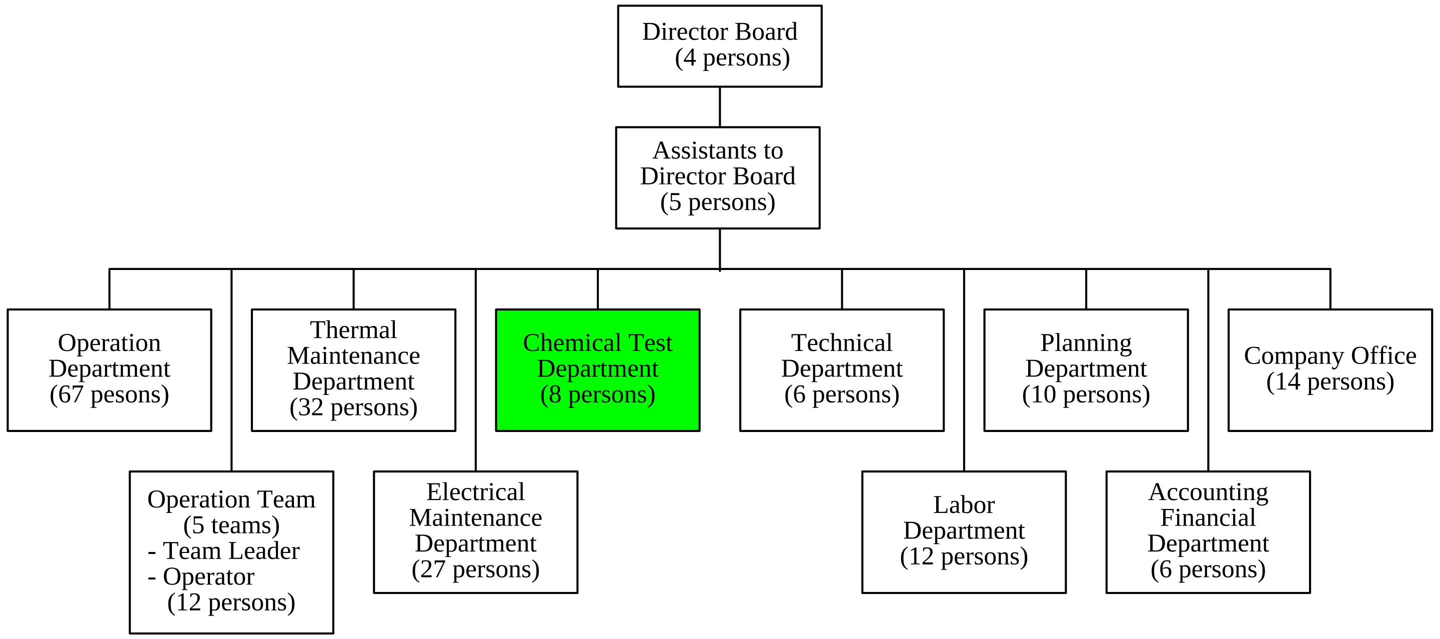
- Designing and construction of temporary disposal area at camp area of workers (EIA Table 4.5, p.153-167).
- Classifying waste into harmful waste and normal waste prior to transport for reusage or burying (EIA Table 4.5, p.153-167).
- Arranging garbage can surrounding construction and workers camp (EIA Table 4.5, p.153-167).
- Using information of solid waste treatment to training program of construction workers including classification of harmful waste and waste possibly harmful waste (EIA Table 4.5, p.153-167)
- Everyday, solid waste shall be collected from construction area and worker’s camp (EIA 4.3, p.136).
- Contracting with Urban Work Enterprise of Can Tho City on collection of construction waste at least in a week (EIA Table 4.5, p.153-167).
- Waste type and disposal method during construction period are as follows (2nd field survey);

Category	Waste Type	Disposal Method
General Waste	Kitchen Waste, Paper etc	Collected and delivered to the final disposal site by Urban Facilities Enterprise
	Construction Waste	Construction wastes such as fill and various building materials should be utilized on site to the maximum extent possible. That which cannot be used should be collected by an appropriately licensed company for recycling (e.g. metals, salvageable wood and building materials, etc) and/or final disposal in a licensed waste facility (e.g. for non-recyclable materials such as hazardous wastes).
	Sewage Sludge	Appropriate sanitation and waste collection facilities should be provided, including: - Temporary toilets at a recommended rate of one for every twenty workers on site. The effluent from the portable toilets should be collected and treated by an appropriately licensed company in accordance with relevant Vietnamese regulations, and toilet facilities should be regularly cleaned and disinfected so as to avoid breeding of flies and mosquitoes. - Access to a clean water source. - Solid waste refuse receptacles at a recommended rate of one for every twenty workers on site. Solid waste should be collected regularly and disposed at a licensed waste disposal facility. In addition, the construction camp, canteen, etc, should be maintained in a clean and orderly manner.
	Excavated Soil	Fill should be assessed for quality based on source and a visual inspection, and if necessary should be tested for contamination before being accepted onto site. Cut and fill should be balanced to the maximum extent possible in order to minimize the need for fill and for spoil disposal. Soil and temporary spoil piles should be covered or sprayed if generating dust. Piles that are not going to be used in the short-term should be allowed to develop vegetation cover. Spoil should be utilized on site to the maximum extent possible, and that which cannot be used should be delivered to a contractor with the approval. The contractor will dispose the spoil in an environmentally sound manner in an approved site licensed for the disposal of construction spoil.

<table>
<tr><th colspan="2">Main Check Items</th><th>Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)</th></tr>
<tr><td rowspan="3">5 Others</td><td>(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (3/3)</td><td>
<table>
<tr><th>Category</th><th>Waste Type</th><th>Disposal Method</th></tr>
<tr><td rowspan="2">Hazardous Waste</td><td>Waste Oil</td><td>Waste Oil can be re-used by the contractor and a construction phase spill control plan (SPC) to be implemented by the contractor, including the following key elements:
- A hard surface parking protected by berms should be established. Runoff from the parking lot should be collected and treated in a bioswale prior to discharge.
- A roofed fuel, oil and chemical storage area should be established that includes an impermeable floor, a protective berm to contain any spills, and an oil-water separator.
- Oil absorbents should be readily accessible in marked containers.
- Good housekeeping procedures should be established to avoid the risk of spills in the first place.
Spills should be dealt with immediately, and personnel should be trained and tasked with this responsibility.</td></tr>
<tr><td>Construction Waste</td><td>Construction waste which cannot be used should be collected by an appropriately licensed company for final disposal in a licensed waste facility (e.g. for non-recyclable materials such as hazardous wastes).</td></tr>
</table>
[Land Subsidence]
- The amount of the groundwater used for the construction will be dependent on an EPC contractor's plan. In the course of construction for O Mon 1-A, 10m^3/hour of the underground water was used, since it was difficult to take water from Hau river, but land subsidence and and the impacts of surrounding wells was not occurred. As for the construction of O Mon 3, the fire-fighting facility will have been completed and the water from the facility will be able to be used for the O Mon 3 construction, so the amount of underground water to be used will be much lower (2nd field survey).
</td></tr>
<tr><td>(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?</td><td>
Review: The agricultural land in Phuoc Thoi wardand Thoi An ward where O Mon Complex will be constructed has the total area of 3,200ha, of which 95.5ha has been altered for the construction of O Mon power complex (26.6ha for O Mon 3). The altered area accounts for a very small area of the total farm, and consequently, the adverse effect to terrestrial ecosystem will be insignificant. The environmental impact to river ecosystem will also be minimized by implementing water pollution mitigation measures.
[Terrestrial ecosystem]
- Due to the agricultural activities of the local people, the vegetation of the project site is the mixture of wild flora and agricultural plants. No adverse effect to environmental predicted (EIA 2.4.1, p.57).
[River ecosystem]
- River biota are sensitive to water quality degradation and implementation of mitigation measure against water pollution is essential (1st field survey).
</td></tr>
<tr><td>(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (1/2)</td><td>
Review: Local inhabitants will be given priority to the maximum extent for simple work employment. The employment activity will be conducted through public labor center to assure fairness of job opportunity. The social impact of migration of workers will be minimized through implementation of appropriate education and management plan of the workers and cooperation with the local Police. An appropriate traffic operation plan shall be developed to reduce the adverse effect for the access road, as well as installation of traffic signs and light, repairmen of the damaged road section caused by operation of heavy trucks. Sanitation, landscape, and safety of the area will be also protected with appropriate consideration.
[Employment]
[Prediction]
- About 300 workers, 1000 workers in maximum, will gather during construction period (EIA 4.2.4, p.135, EIA 3.4.2.6, p.105).
[Mitigation measures]
- To employ local inhabitants to the maximum extent for simple work (EIA 4.2.4, p.136).
- Can Tho City and O Mon district have Public Employment Security Offices, and when the project owner is looking for talented people, it carries out through the Offices (2nd field survey).

[Local community]
[Prediction]
- The increased number of workers will cause social problems such as drug addict, epidemics, social conflict with local inhabitants (EIA 3.4.1.8, p.102).
- O Mon 3 EIA states that women are engaged in aquaculture and fishery around the O Mon 3 Power Complex, therefore the construction work may have significant impact on their job and income (EIA 3.4.1.8, p.102). Practically, in the common lifestyle of the local people living around the project site, the actual operation of fishing is mainly done by men, and women are only playing supporting roles (transportation and selling of fish), and “fishery operated mainly by women” has not been observed (2nd field survey).
[Mitigation measures]
- To educate the construction workers to establish good relation with local people (EIA 4.2.4, p.136).
- To organize exchange meeting with People’s Committee of wards and O Mon District on matters related to the relation between workers and inhabitants (EIA 4.2.4, p.136).
- Workers are managed appropriately and complication with a local resident will be prevented (EIA 3.4.1.8, p.102）。
</td></tr>
</table>

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)
5 Others	(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? **(2/2)**	**[Transportation]** [Prediction] - Increased traffic and traffic accident may occur along the National Road No.91 and roads in O Mon district (EIA 3.2.2.2 p. 87). - National Road No.91 and the surrounding roads may be damaged by traffic of many trucks during construction (EIA 3.4.1.8, p.103) - During construction phase, increase of traffic accident resulted from increased waterway traffic is predicted. Especially during 1 month of foundation work, the vessel traffic of Hau River is predicted with about 34 trips per hours of vessel (EIA 3.4.1.7, p.101). However, although the vessel increased for river transportation during the construction of O Mon 1-A, accidents did not occur (2nd field survey). - In order to transport solid waste in foundation work, 33-36 trips of 10t trucks per week are predicted (EIA 3.4.1.7, p.101). Since the traffic volume in surrounding road is a little, it is not expected that traffic congestion and a traffic accident increase (2nd field survey). - During the construction period, 20 trips of 10t trucks per hour, 24 - 30 trips per week for transporting solid waste (2 trips per week for transporting domestic solid waste) are predicted (EIA3.4.2.2, p.104). [Mitigation measures] - Traffic management plan which consider surrounding traffic is established, and a signal and a sign board are installed on an access road. The contractor undertakes to repair the dameged road section (EIA 4.2.5, p.137). **[Sanitation]** [Prediction] - The migration of workers will increase the needs for social infrastructure including local medical facility, water, and sanitation facility (EIA 3.4.1.8, p.102-103). - The migration of more than 1,000 workers may cause to spead epidemic diseases (EIA 3.4.2.6, p.105-106). [Mitigation measures] - Maintaining environmental sanitation and living conditions and ensureing community health on camp area of workers (EIA Table 4.5, p.153-167). - Supplying sufficiently fresh water and sanitary food to workers (EIA Table 4.5, p.153-167). - Constructing clinic for health care of workers (EIA Table 4.5, p.153-167). - Supplying sufficiently garbage can and periodical collection of gaebage (EIA Table 4.5, p.153-167). - Improving awareness of construction workers on environmental sanitation at camp area (EIA Table 4.5, p.153-167). - Installation of movable toilet and dust box, and septic tank in the worker's camp (EIA 4.2.4, p.136). - The construction contractor shall sign contract with Urban Facilities Enterprise of can Tho City to collect waste periodically (at least once a week) at worker's camp and transport to the local disposal site. Domestic waste and construction waste, hazardous waste (oil and chemicals) should be separated (EIA 4.2.4, p.136). - Workers should be provided with education of epidemics preventive measure (EIA 4.2.4, p.136). - Clinics and nurses should be arranged on the project site to enable timely first aid and medical care. The construction contractor should organize close cooperation system with the clinic in Phuoc Thoi ward (EIA 4.2.4, p.136). **[Landscape]** [Prediction] - The increased number of workers will cause social problems such as drug addict, epidemics, and social conflict with local inhabitants. Application of appropriate management plan for workers will mitigate the problem (EIA 3.2.2.2 p. 87). [Mitigation measures] - Preparing and implementing landscape rehabilitation plan of the O Mon 3 power plant will be established (EIA Table 4.5, p.153-167). - Surround the O Mon Power Complex is a rural region, and there is no aesthetic landscape. In O Mon 3 power plant, 11.1% of construction area is planed to greening during the construction phase (2nd field survey). **[Safety]** - With regard to the safety measures during construction phase, EPC contractor is required to include safety management document and the selected EPC contractor will conduct construction following the safety management document that they proposed (2nd field survey).

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)
5 Others	**(2) Accident Prevention Measures**	
	(a) In the case of coal-fired power plants, are adequate measures planned to prevent spontaneous combustion at the coal piles? (e.g., sprinkler systems).	**Review: O Mon 3 power plant is not a coal-fired power plant.**
	(3) Monitoring	
	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	**Review: The project owner has developed an environmental monitoring plan, and the JICA team has given recommendation on the details of the monitoring (Table 5.5-4).** - The environmental monitoring during construction period should include the confirmation of implementation of pollution countermeasure, as well as the survey of environmental impact, and shall be conducted by the contractor (EIA 6.3.1, p.173). The monitoring items are not determined. - The JICA team proposed about the items of the environmental monitoring plan (parameter, measure stations, methods, frequency, and enforcement responsibility) (Table 5.5-4).
	(b) How are the item of a monitoring plan, a method, frequency, etc. defined?	**Review: The JICA team has given recommendation on the item of the monitoring plan, a method, frequency, etc..** - The JICA team proposed about the items of the environmental monitoring plan (parameter, measure stations, methods, frequency, and enforcement responsibility) (Table 5.5-4).
	(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	**Review: It is determined that the framework for conducting the monitoring has been established by the project owner.** - Monitoring activity will be conducted in responsibility of the construction conductor during construction period (EIA 6.2.3, p.172), and by the Chemical Test Department of the O Mon 3 power plant during operation phase (2nd field survey).  Organization chart of O Mon 3 power plant - The cost for the monitoring program during construction is estimated to be 480 million VND, 720 million VND in the first 3 year of operation. The cost is included in the project investment cost (EIA 6.3.2.3, p.178). But the JICA team proposed about the items of the environmental monitoring plan (Table 5.5-4).
	(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	**Review: The reporting scheme and frequency of the monitoring result to the relevant authorities has been established.** - Summary of the monitoring result shall be reported to Can Tho City's DONRE(Department of Natural Resources and Environment). (EIA 6.2.3, p.172). - The monitoring report should be conducted 4 times per year in construction phase, and twice a year in operation phase, as with the monitoring activity (EIA 6.2.3, p.172).

Main Check Items		Confirmation of Environmental Considerations (Reason, Justify, Counter Measures, etc.)
6 Note	**Reference to Checklist of Other Sectors**	
	(a) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	O Mon 3 power plant will be connected through existing transmission line network (1st field survey).
	(b) Where necessary, pertinent items described in the Ports and Harbors checklist should also be checked (e.g., projects including construction of port and harbor facilities).	The DO unload jetty will be used in common for O Mon 1 power plant.
	Note on Using Environmental Checklist	
	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, and global warming).	Waste is treated and disposaled appropriately. Air pollutant which causes acid rain and CO_2 which leads to global warming will be generated, but considering the scale of the project, cross-boundary or global environmental impact is not predicted

5.9.2 Monitoring Form

The Implementation has the responsibility of submitting the results of the monitoring to JICA. Table 5.9-2 shows monitoring forms (draft) which record the results of the monitoring.

Table 5.9-2 Monitoring Form (Draft)

(1) Environmental Permits

Permit	Authority	Approval Date/ Schedule
Environmental License for the Entire Project	MONRE	
Environment Approval for Surface Water Exploitation and Water Discharge	MONRE or DONRE (Department of Natural Resource and Environment) of Can Tho City	
Approval for Using Deep Well Water or River Water (for construction purpose)	MONRE or DONRE	
Permission for Toxic Chemical/Gas Application	Competent Agency authorized under MONRE	
Final License for Whose Fire Fighting System	Fire Police Headquarter (Hanoi)	

(2) Construction phase

1) Air pollution

Location: St- (Date: / / 201? - / / 201?)

Parameter	Unit	Measured Value (24hr Average)	Ambient air quality standards (QCVN-05/2009)	IFC/ EHC Guideline (General; 2007)	Remarks (Measurements method)
PM_{10}	$\mu g/m^3$		150	150	

2) Water pollutant

a. Ground water

Sampling

(Date:)

Parameter	Unit	Well No.1 (Place;)	Well No.2 (Place;)	Ground water quality standards (QCVN-19/2008)	Remarks (Measurements method)
TDS	mg/L			1500	
TSS	mg/L			-	
NH_4^+	mg/L			0.1	
T-N	mg/L			-	
T-P	mg/L			-	
Zn	mg/L			3.0	
Cd	mg/L			0.005	
As	mg/L			0.05	
Pb	mg/L			0.01	
Hg	mg/L			0.001	
Cr	mg/L			0.05 (Cr^{6+})	
Cu	mg/L			1.0	
Mn	mg/L			0.5	
Total fecal coliform	MPN/100mL			3	

Portable water quality analyzer

(Date:)

Parameter	Unit	Well No.1 (Place;)	Well No.2 (Place;)	Ground water quality standards (QCVN-19/2008)	Remarks
Conductivity	mS/cm			-	
pH	-			5.5 - 8.5	
DO	Mg/L			-	
Salinity	PSU			-	

b. River water quality

Sampling

(Date:)

Parameter	Unit	Average (6 points)	Max (St.)	River water quality standards (QCVN-08/2008) A2	Remarks (Measurements method)
Oil & Grease	mg/L		(St.)	0.02	
TDS	mg/L		(St.)	-	
TSS	mg/L		(St.)	30	
NH_4^+	mg/L		(St.)	0.2	
T-N	mg/L		(St.)	-	
T-P	mg/L		(St.)	-	
Zn	mg/L		(St.)	1.0	
Cd	mg/L		(St.)	0.005	
As	mg/L		(St.)	0.02	
Pb	mg/L		(St.)	0.02	
Hg	mg/L		(St.)	0.001	
Cr	mg/L		(St.)	0.1 (Cr^{3+}) 0.02 (Cr^{6+})	
Cu	mg/L		(St.)	0.2	
Mn	mg/L		(St.)	-	
Total fecal coliform	MPN/100mL		(St.)	5000	

Portable water quality analyzer

(Date:)

Parameter	Unit	Average (9 points)	Max (St.)	Surface water quality standards (QCVN-08/2008) A2	Remarks
Conductivity	mS/cm		(St.)	-	
pH	-		(St.)	6 - 8.5	
DO	Mg/L		(St.)	>5	
Salinity	PSU		(St.)	-	

3) Noise

Date; (Unit: dBA)

Place	Average	Max (St.)	Noise standards (QCVN-26/2010)	IFC/ EHC Guideline (General; 2007)	Remarks
Power Complex boundary		(St.)	06:00-21:00: 70 21:00-06:00: 55	07:00-22:00: 55 22:00-07:00: 45	
Nearest residences		(St.)			

(3) Operation phase

1) Air pollution

a. Emission concentration

Gas fired (Date:)

Parameter	Unit	Excess period of the standard	Emission gas standards (QCVN-22/2009) Kp=0.7, Kv=1	IFC/ EHC Guideline (Thermal Power Plant; 2008)	Remarks
SO_2	mg/Nm^3		210	-	Gas
NOX	mg/Nm^3		175	51	Gas
PM_{10}	mg/Nm^3		35	-	Gas

DO fired (Date:)

Parameter	Unit	Excess period of the standard	Emission gas standards (QCVN-22/2009) Kp=0.7, Kv=1	IFC/ EHC Guideline (Thermal Power Plant; 2008)	Remarks
SO_2	mg/Nm^3		350	-	DO
NOX	mg/Nm^3		420	152	DO
PM_{10}	mg/Nm^3		105	50	DO

b. Ambient air quality

Location: St- (Date: / / 201? - / / 201?)

Parameter	Unit	Measured Value (1hr and24hr Average)	Ambient air quality standards (QCVN-05/2009)	IFC/ EHC Guideline (General; 2007)	Remarks (Measurements method)
SO_2	$\mu g/m^3$	(1hr) (24hr)	350 (1hr) 125 (24hr)	- 125 (24hr)	
NO_2	$\mu g/m^3$	(1hr) (24hr)	200 (1hr) 100 (24hr)	200 (1hr) -	
PM_{10}	$\mu g/m^3$	(24hr)	150 (24hr)	150 (24hr)	

2) Water pollutant

a. Ground water

Sampling

(Date:)

Parameter	Unit	Well No.1 (Place;)	Well No.2 (Place;)	Ground water quality standards (QCVN-19/2008)	Remarks (Measurements method)
TDS	mg/L			1500	
TSS	mg/L			-	
NH_4^+	mg/L			0.1	
T-N	mg/L			-	
T-P	mg/L			-	
Zn	mg/L			3.0	
Cd	mg/L			0.005	
As	mg/L			0.05	
Pb	mg/L			0.01	
Hg	mg/L			0.001	
Cr	mg/L			0.05 (Cr^{6+})	
Cu	mg/L			1.0	
Mn	mg/L			0.5	
Total fecal coliform	MPN/100mL			3	

b. River water quality

Portable water quality analyzer

(Date:)

Parameter	Unit	Average (12 points)	Max (St.)	Surface water quality standards (QCVN-08/2008) A2	Remarks
Temperature	^oC		(St.)		
Conductivity	mS/cm		(St.)	-	
pH	-		(St.)	6 - 8.5	
DO	Mg/L		(St.)	>5	
Salinity	PSU		(St.)	-	

c. Waste water

Sampling

(Date:)

Parameter	Unit	Average (12 points)	Max (St)	Industrial wastewater standards (QCVN-24/2009) Kq=1.2, Kf=1.1	IFC/ EHC Guideline (Thermal Power Plant; 2008)	Remarks (Measurements method)
Temperature	^{o}C		(St.)	40	-	
Chlorine	mg/L		(St.)	1	0.2	
pH	-		(St.)	6 - 9	6 - 9	
BOD_5	mg/L		(St.)	40	-	
COD	mg/L		(St.)	66	-	
Oil & Grease	mg/L		(St.)	7	5	
Zn	mg/L		(St.)	-	-	
Cd	mg/L		(St.)	0.007	-	
As	mg/L		(St.)	0.07	0.5	
Pb	mg/L		(St.)	0.1	-	
Hg	mg/L		(St.)	0.007	0.005	
Cr	mg/L		(St.)	0.07 (Cr^{6+}) 0.3 (Cr^{3+})	0.5	
Cu	mg/L		(St.)	3	0.5	
Mn	mg/L		(St.)	-	-	
Pesticides	mg/L		(St.)	0.4 (Org-Phos.) 0.1 (Org-Chlo.)	-	
Total fecal coliform	MPN/ 100mL		(St.)	4000	-	

d. General waste water treatment system

Sampling

(Date:)

Parameter	Unit	Before treatment	After treatment	Industrial wastewater standards (QCVN-24/2009) Kq=1.2, Kf=1.1	IFC/ EHC Guideline (Thermal Power Plant; 2008)	Remarks (Measurements method)
Temperature	^{o}C			40	-	
pH	-			6 - 9	6 - 9	
Turbidity	NTU			-	-	
BOD_5	mg/L			40	-	
COD	mg/L			66	-	
Oil & Grease	mg/L			7	5	
Zn	mg/L			-	-	
Cd	mg/L			0.007	-	
As	mg/L			0.07	0.5	
Pb	mg/L			0.1	-	
Hg	mg/L			0.007	0.005	
Cr	mg/L			0.07 (Cr^{6+}) 0.3 (Cr^{3+})	0.5	
Cu	mg/L			3	0.5	
Mn	mg/L			-	-	
Pesticides	mg/L			0.4 (Org-Phos.) 0.1 (Org-Chlo.)	-	
Total fecal coliform	MPN/ 100mL			4000	-	

e. Cooling water

(Date:)

Parameter	Unit	Intake	Discharge channel outlet	Industrial wastewater standards (QCVN-24/2009)	IFC/ EHC Guideline (Thermal Power Plant; 2008)	Remarks
Temperature	^{o}C			40	-	

3) Noise

Date; (Unit: dBA)

Place	Average	Max (St.)	Noise standards (QCVN-26/2010)	IFC/ EHC Guideline (General; 2007)	Remarks
Power complex boundary		(St.)	06:00-21:00: 70 21:00-06:00: 55	07:00-22:00: 55 22:00-07:00: 45	
Nearest residences		(St.)			

4) River Ecosystem

a. Visual inspection

Date, Time	Species	Number	Remarks (Size etc.)
Date: Time:			
Date: Time:			
Date: Time:			

b. Interview

(Date: , Name:)

Fishing gear	Location of fisheries	Species	Amount of catch (Number)	Remarks

(4) Social environment

1) Resettlement

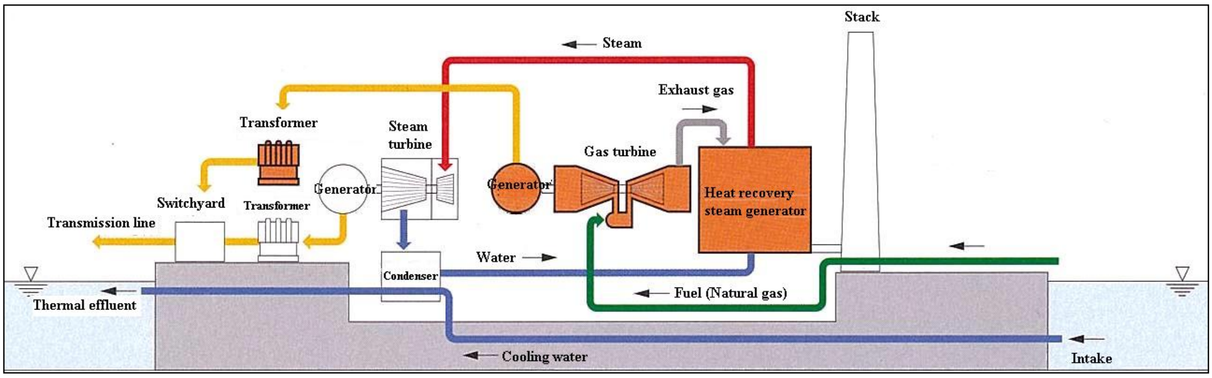
Name	Mr.				
Address					
Sex of household head					
Family size and composition					
Grade of house					
Size and category of used land					
Property					
Occupation					
Income					
Remarks (Date of interview)					

2) Grievance

Date	Name	Address	Contents of grievance	Response	Remarks
	Mr.				

CHAPTER 5

APPENDIX



(Source: “Outline of an environmental impact assessment”, The Chugoku Electric Power Co., Inc.)

Option 1: One-through method

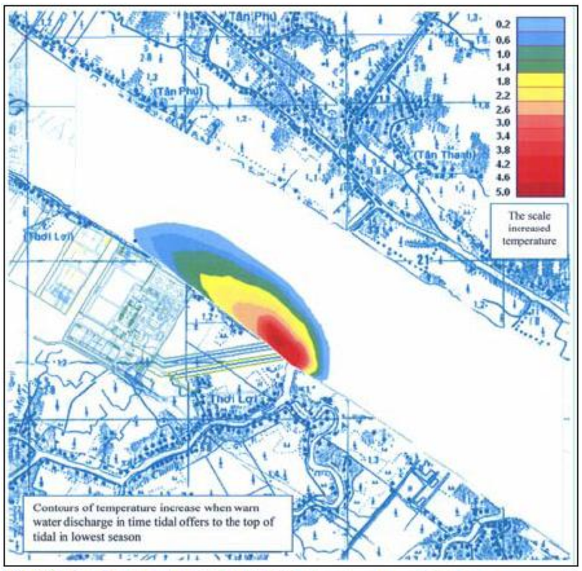
(Source: http://www.nucpros.com/node/6083)

Option 2: Cooling method using pond or lake

(Source: http://www.wort.lu/wort/web/en/europe_and_world/articles/2011/12/169293/in dex.php)

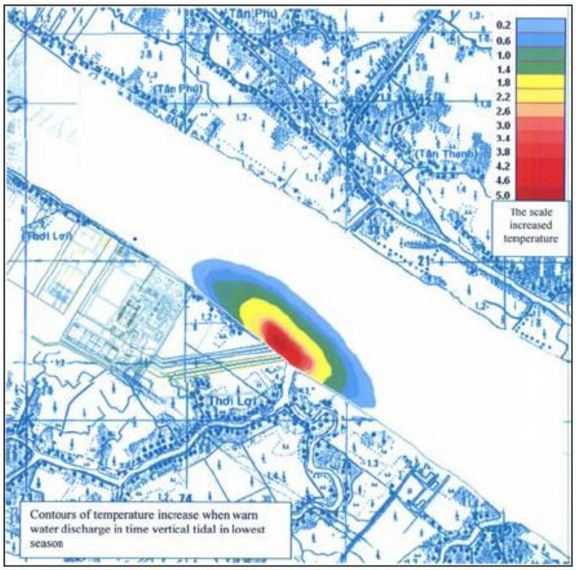
Option 3: Natural circulation air-cooling tower method

Figure-1 Overview of Cooling Method



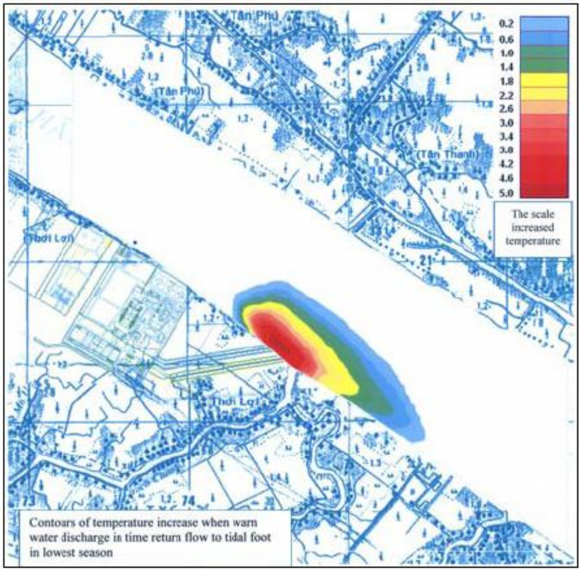
(Source; O Mon 3 EIA Figure 3.6, p.117)

Flood tide



(Source; O Mon 3 EIA Figure 3.10, p.121)

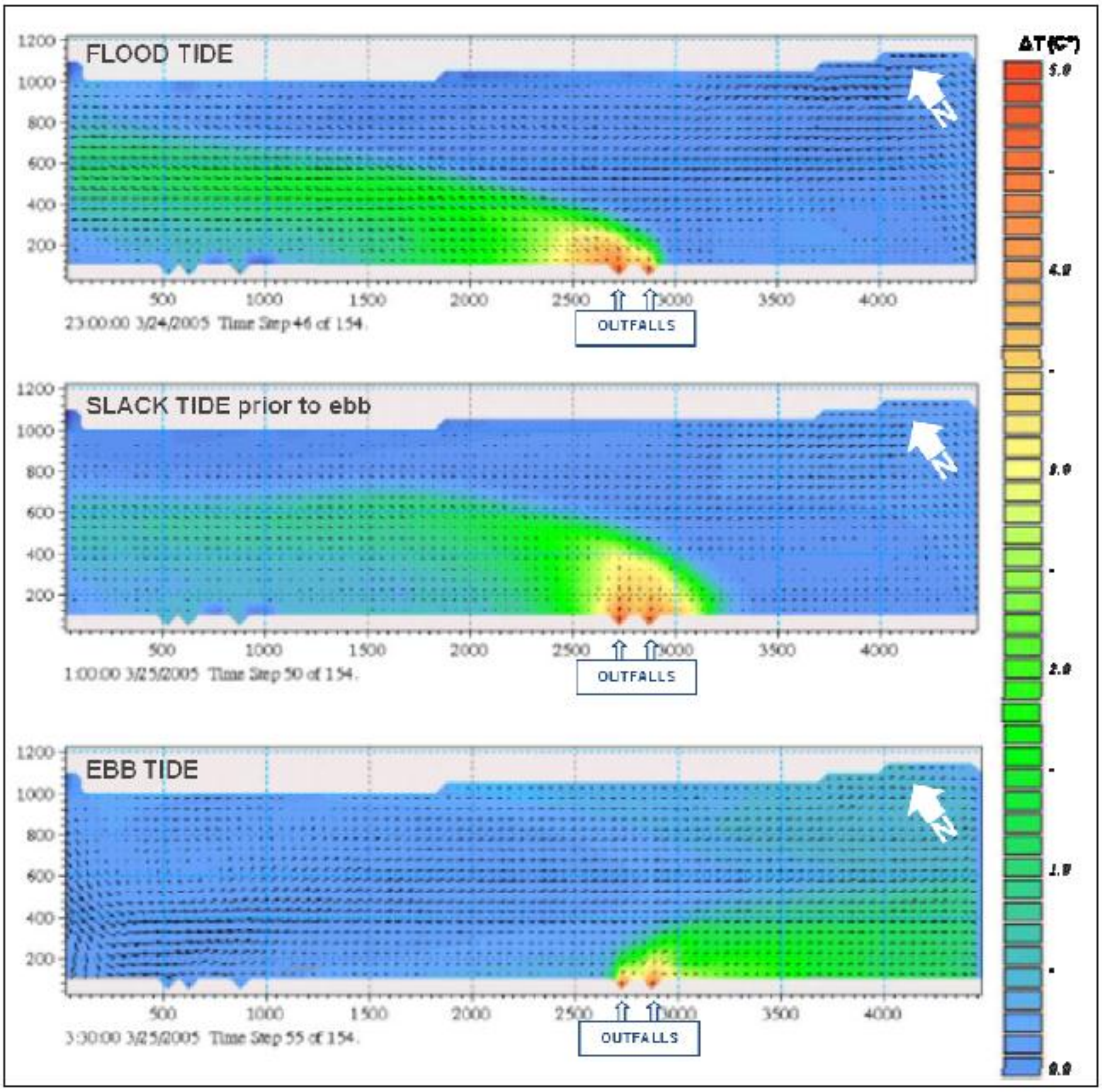
Slack tide



(Source; O Mon 3 EIA Figure 3.9, p.119)

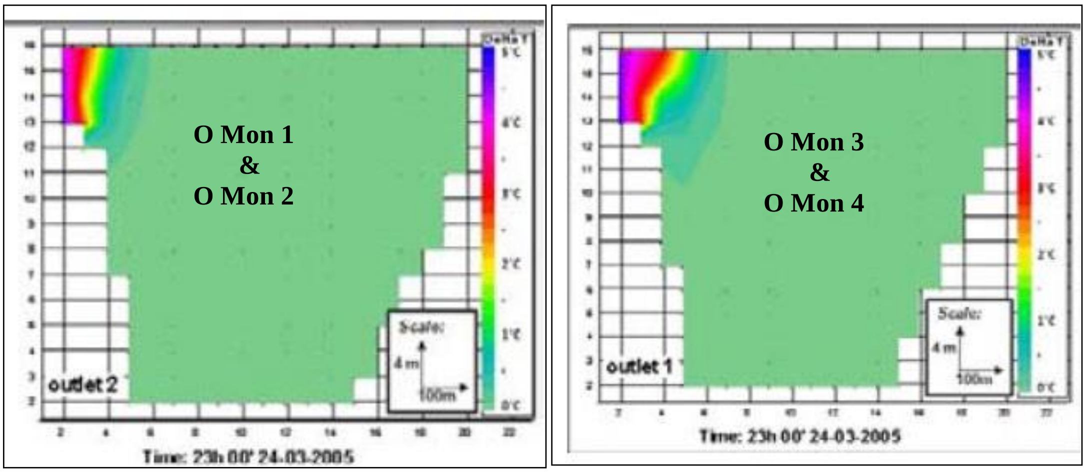
Ebb tide

Figure-2 Results of Thermal Effluent Diffusion of 750 MW (2-D Surface Layer Model)



(Source; O Mon 4 EIA Figure 40, p.118)

Figure-3(1) Result of Thermal Effluent Diffusion (Horizontal Chart)

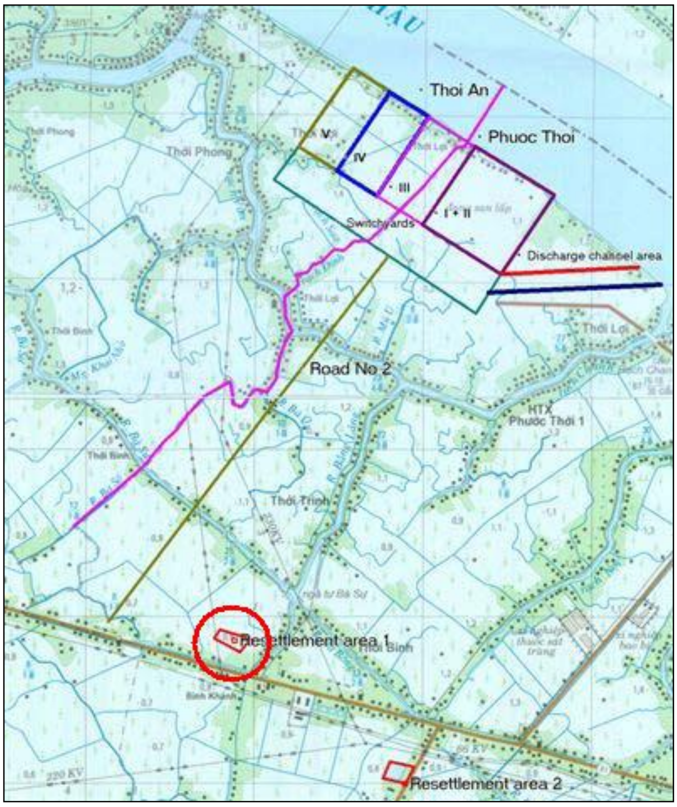


(Source; O Mon 4 EIA Figure 42, p.120)

Figure-3(2) Result of Thermal Effluent Diffusion (Vertical Chart)

Table-1 Process of Land Acquisition for O Mon Power Complex (O Mon 3& 4)

No.	Date	Events
1	27/ September/ 2004	The construction plan of the thermal power plant O Mon 3 and 4 power plants in the O Mon Power Complex has been approved on 27 September 2004 by the Ministry of Industry and Trade (Decision No.2523/ QD/ NLDK).
2	11/ April/ 2005	The policy for resettlement, compensation and allowance on land acquisition in Can Tho City was determined by Can Tho City People's Committee Decision No. 53/2005QD-UB (RRP 8.1.1, p.44-46).
3	23/ July/ 2005	Public meeting was held concerning the construction of O Mon Power Complex (4O Mon 4 EIA Chp.7, p.147).
4	23& 26/ December/ 2005	Public meetings were held concerning the compensation of acquired land, and the cut-off date was set to 23 December, 2005 (RRP 4.1, p.29).
5	March/ 2006	Compensation and Land Clearance Council (hereinafter referred to as "Compensation Committee" was established (Decision No.1026/ QD-UBND) (PPTA-4845SIA 5.1.2, p.24).
6	Form March/ 2006	The evaluation teams of the Compensation Committee set about assessing and evaluating the plot of land, houses and constructions, crops and trees (PPTA-4845SIA 5.1.2, p.24).
7	4/ April/ 2006 - 11/ May/ 2007	The compensation plan of O Mon 3, O Mon 4 and related facilities was sequentially approved by Can Tho City People's Committee (approval was segmented to19 times: 4 times for O Mon 3 from 4 April 2006 to 14 August 2006).
8	5/ May/ 2006	Start of land acquisition (transfer).
9	June/ 2007	Socio-economical survey was conducted by Vattenfall Power Consultant (Consultant company for ADB) for 105 households (RRP 3.3, p.21).
10	9/ October/ 2007	Vattenfall Power Consultant sent a letter to Can Tho City People' Committee requesting modification of resettlement process (follow-up letter of the former meeting) (RRP Annex-5, p.81-83).
11	7/ January/ 2008	Answer letter from Can Tho City People' Committee to the follow-up letter from VPC (RRP Annex-6, p.84).
12	April/ 2008	Preparation of Retrofit Resettlement Plan (Resettlement Due Diligence Report 2007)
13	16/ October/ 2009	Completion of land acquisition (transfer) for O Mon 3.
14	December/ 2009	Special assistance cash grant of 15～20MVND was provided to poor or vulnerable people (RDDR p.22 & p.33).
15	March - September/ 2010	Household survey was conducted for 145 compensated households (24%) for carrying out due diligence (RDDR, p.13).
16	February/ 2011	Preparation of resettlement Due Diligence Report and Corrective Action Plan.
17	25/ November/ 2011	The board approval was issued to ADB financing for O Mon 4.



(Source: RRP Map 1, p.18)

Figure-4
Position of the Resettlement Area
(the resettlement area is only No.1)

Photo-1 Current Situation of the Resettlement Area (13/ December/ 2011)

Table-2 Comparison of Project Entitlements and ADB Policy Requirements

Types of Losses	Project Entitlements (From PPC Decisions)	Meet ADB Policy and Requirements (Involuntary Resettlement Policy; 1995) (Yes or No)	If no, Project entitlements to meet ADB Policy and Requirements
Compensation			
I. farm land			
A With LURC (or in the process of acquiring LURC)	Current market value or various types of land	Yes. The category of land has been classified to a higher level which benefited the affected households by getting higher compensation for their land.	
B No LURC	Poor/landless people get support according to PCCT decision. Resettlement benefits accorded (65 MVND payment or resettlement to designated area).	Yes.	
II. Residential land			
A With LURC (or in the process of acquiring LURC)	Current market value for various types of land	Yes.	
B No LURC	Resettlement benefits accorded (65 MVND payment or resettlement to designated area).	Yes.	
III. River bank			
A Houses on State Land	Resettlement benefits accorded (65 MVND payment or resettlement to designated area).	Yes.	
B Houses built on Farm Land	a) If before 1993 Resettlement benefits accorded (65 MVND payment or resettlement to designated area)..	Yes.	
	b) Built 1993-2004 Resettlement benefits accorded (65 MVND payment or resettlement to designated area)	Yes.	
	Built after 1 July 2004; no compensation, but special support (up to 50% of the full replacement cost) is being considered.[1]	No.	People's Committee of Can Tho has sent a letter to consider support for these
C Houses renting on Land	No cases.		
Allowance			
Severely Affected household (losing 10% of land)	Resettlement benefits accorded (65 MVND payment or resettlement to designated area).	Yes.	
Temporary Loss of Job	Job-change assistance: If households, individuals directly engaged in agricultural production have over 30% of their assigned agricultural land areas expropriated, they shall receive supports for job change if they are still within the working age. In case a vocational training course can not be held, the support will be paid in cash, at a level of 1 MVND/person in labour age. When households or individuals directly engaged in agricultural production have over 30% of their assigned agricultural land areas expropriated, they shall receive life stabilization supports for 3 months if they must not be relocated and for 6 months if they must be relocated; if they are to be relocated to places with difficult socio-economic conditions, they shall receive supports for 12 months at most. The level of monetary support household member per month shall be equivalent to the value of 30 kg of rice, calculated at the average local price (4000 VND/kg).	Yes.	
APs who move on time	Timely movement incentive (5% of the full replacement cost (up to 5 MVND)).	Yes.	

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[1] The updated information that we have received indicates that the residents called “speculator” are not subject to compensation.

Types of Losses	Project Entitlements (From PPC Decisions)	Meet ADB Policy and Requirements (Involuntary Resettlement Policy; 1995) (Yes or No)	If no, Project entitlements to meet ADB Policy and Requirements
Moving allowance	Transportation allowance Permanently relocated within Can Tho city: -Multi-stories, concrete houses: 3 MVND/household -Brick houses: 2 MVND/household -Others: 1 MVND/household Permanently relocated to another province or city -Multi-stories, concrete houses: 5 MVND/household -Brick houses: 4 MVND/household -Others: 3 MVND/household	Yes.	
Subsistence	Rehabilitation allowance: When households or individuals directly engaged in agricultural production have over 30% of their assigned agricultural land areas expropriated, they shall receive life stabilization supports for 3 months if they must not be relocated and for 6 months if they must be relocated; if they are to be relocated to places with difficult socio-economic conditions, they shall receive supports for 12 months at most. The level of monetary support per household member per month shall be equivalent to the value of 30 kg of rice, calculated at the average local price (4000 VND/kg).	Yes.	
Vulnerable households	Special support program (15 MVND per household)	Yes.	

(Source: RRP Table 27, p.50)

Table-3(1) Living Conditions of Affected People (June, 2007)

Source of income

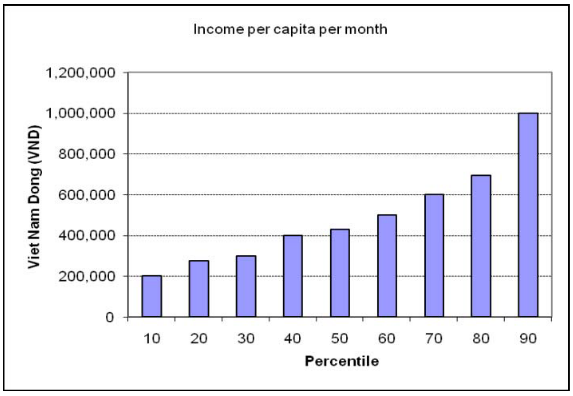
Day labour is the main source of income in the households, while the dependence on agriculture income is only 21 % (RRP 3.3, p.21).

Source of income

Job category	Percent of Respondents (%)
Day labour	37
Agriculture	21
Formal employment	15
Bisiness and service	15
Other	12
Source: Socio-economic survey, June 2007	

Monthly income

About 10 % of the respondents have income of less than 200,000 VND per month, about 10% of income per month is higher than 1,000,000 VND. The median is about 420,000 VND in (RRP 3.3, p.22). 10-20% of the population would be considered as poor according to the criteria at the time 2007 (earning less than VND 220,000 per person per month) (RRP 3.3, p.22).



Monthly income

House wealth

The literary interest is very low, with on 6% of households having anything to read, but with a great interest in television. In spite of only 72% (see below) of households being connected to the electricity grid, 85% have a television set (RRP 3.3, p.22-23).

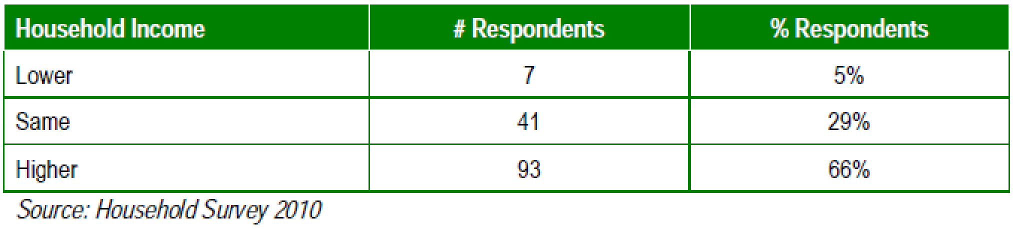
House wealth

Durable items	Percent of Respondents (%)
Television set	85
Motorcycle	80
Bicycle	61
Mobile phone	36
Telephone	34
Boat	26
Room where nobody sleeps	15
Glass windows	8
Books/ newspepars	6
Spfa in house	4
Source: Socio-economic survey, June 2007	

Table-3(2) Changes in the Living Conditions of the Affected People before and after Compensation (2010)

Changes in the household income

Most (95%) of household respondents reported their overall income levels being higher (66%) or the same (29%) as before the compensation with 5% reporting lower household income levels (RDDR, p.24).

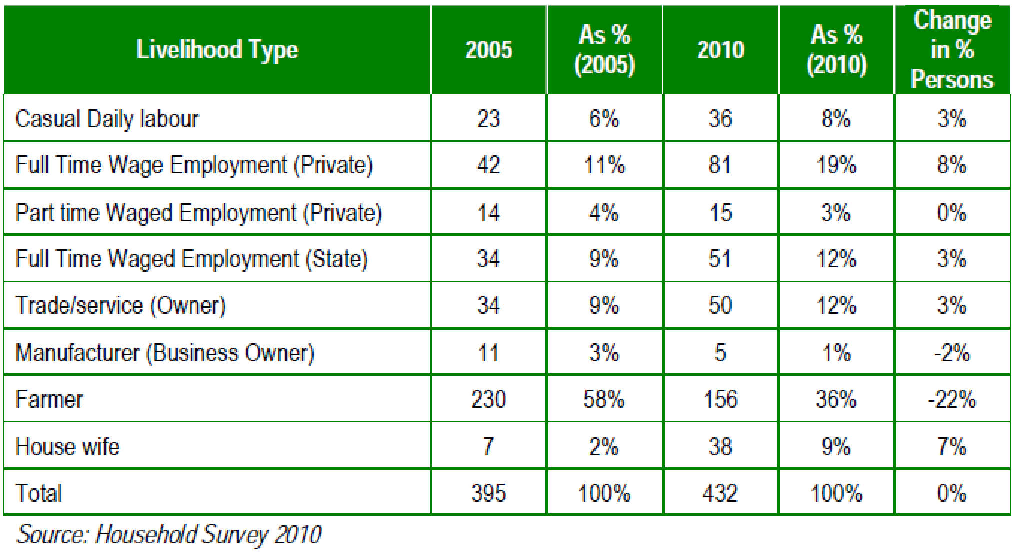


Household Income	# Respondents	% Respondents
Lower	7	5%
Same	41	29%
Higher	93	66%

Source: Household Survey 2010

Changes in Livelihoods

There were increases in non-farm employment, while there were decreases in agriculture and owner-operated manufacturing (RDDR, p.24).

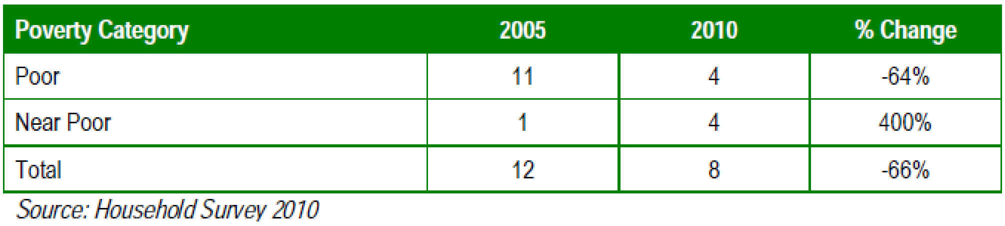


Livelihood Type	2005	As % (2005)	2010	As % (2010)	Change in % Persons
Casual Daily labour	23	6%	36	8%	3%
Full Time Wage Employment (Private)	42	11%	81	19%	8%
Part time Waged Employment (Private)	14	4%	15	3%	0%
Full Time Waged Employment (State)	34	9%	51	12%	3%
Trade/service (Owner)	34	9%	50	12%	3%
Manufacturer (Business Owner)	11	3%	5	1%	-2%
Farmer	230	58%	156	36%	-22%
House wife	7	2%	38	9%	7%
Total	395	100%	432	100%	0%

Source: Household Survey 2010

Change in Incidence of Poverty

Poverty in the area is currently based on an average monthly per capita income of 250,000 VND to be classed as poor and 350,000 VND to be classed as near poor. This standard is based on criteria provided by the Ministry of Labour, War Invalids and Social Affairsat the time 2010. Based on this standard there were there was a 66% overall decrease in the number of poor households (RDDR, p.25).



Poverty Category	2005	2010	% Change
Poor	11	4	-64%
Near Poor	1	4	400%
Total	12	8	-66%

Source: Household Survey 2010

Ownership of Household Assets

There were increases in all asset types with the exception of boats which is attributable to households either moving away from near the river/canal or are no longer reliant on boats (RDDR, p.25).

Household Asset Item	2005	2010	Total
Bicycle	68%	68%	0%
Small boat	37%	30%	-7%
Telephone set	17%	48%	31%
Rice- cooker	51%	90%	39%
Motorcycle	57%	90%	34%
Boat	4%	6%	2%
TV	76%	97%	21%
Fan	69%	94%	26%
CD/DVD player	47%	83%	37%
Car			0%
Truck	0%	1%	1%
Mobile phone	24%	87%	63%
Refrigerator	9%	46%	37%
Computer	2%	19%	17%
Sofa	22%	64%	42%
Separate living room	35%	71%	36%

Source: Household Survey 2010

Housing Standards

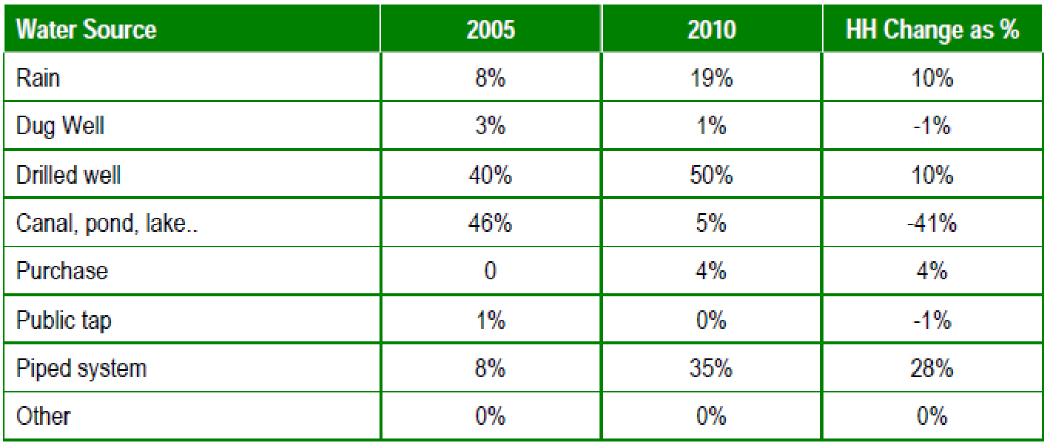
There has been an overall increase in housing standards with 88% now having permanent structures with an average floor area of 170m^2. There was a small change in total floor area of 9.5m^2 (5% decrease) attributable to those upgrading their house standards. Also as noted below most houses now have toilets (RDDR, p.26-27).

Structure Area/Category	2005	2010	% Change
Ave Floor Area (m2)	180	170.59	-9.46
Structure Category			0.00
• 1			0.00
• 2			0.00
• 3	0	1%	1%
• 4	61%	88%	27%
• 5 (Temporary)	39%	11%	-28%

Source: Household Survey 2010

Change in Water Sources -Drinking

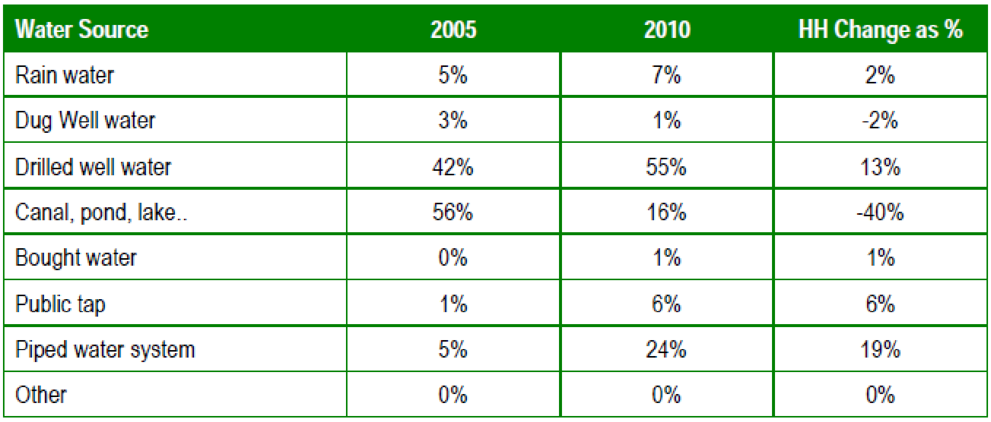
There is now a greater reliance on safer water sources with increased use of piped water (35% from 8%); drilled well (50% from 40%) and decreased use of surface water (5% from 46%) (RDDR, p.27).



Water Source	2005	2010	HH Change as %
Rain	8%	19%	10%
Dug Well	3%	1%	-1%
Drilled well	40%	50%	10%
Canal, pond, lake..	46%	5%	-41%
Purchase	0	4%	4%
Public tap	1%	0%	-1%
Piped system	8%	35%	28%
Other	0%	0%	0%

Source: Household Survey 2010

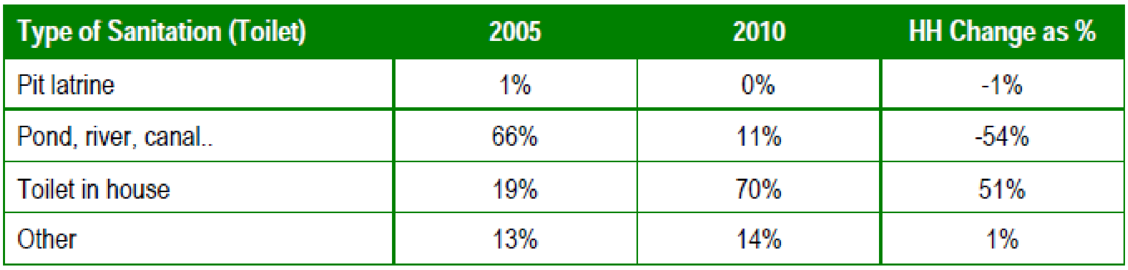
Change in Water Sources -Washing



Water Source	2005	2010	HH Change as %
Rain water	5%	7%	2%
Dug Well water	3%	1%	-2%
Drilled well water	42%	55%	13%
Canal, pond, lake..	56%	16%	-40%
Bought water	0%	1%	1%
Public tap	1%	6%	6%
Piped water system	5%	24%	19%
Other	0%	0%	0%

Source: Household Survey 2010

Change in Sanitation

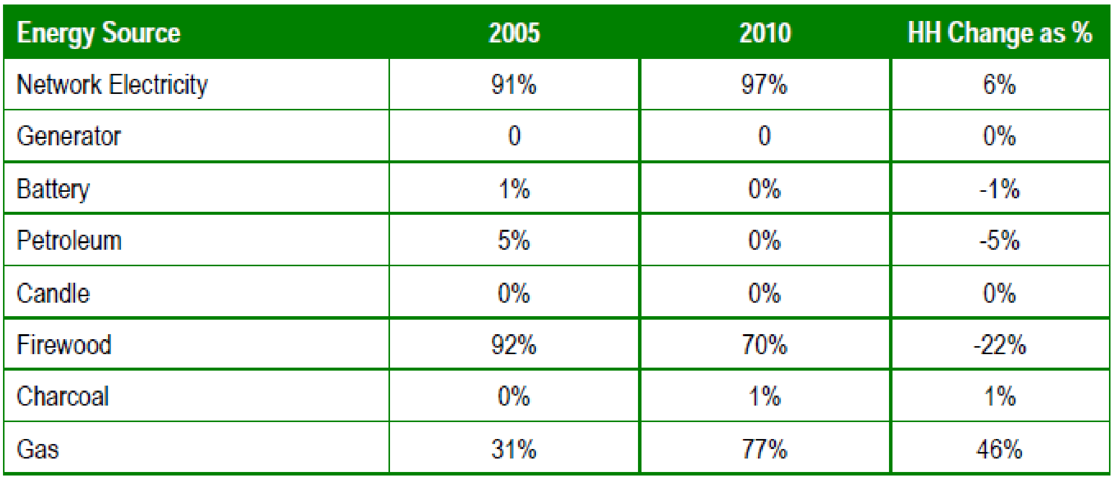


Type of Sanitation (Toilet)	2005	2010	HH Change as %
Pit latrine	1%	0%	-1%
Pond, river, canal..	66%	11%	-54%
Toilet in house	19%	70%	51%
Other	13%	14%	1%

Source: Household Survey 2010
"Other": most of these respondents reported using toilet of relative or neighbour

Change in Energy

There is significant decreases in use of firewood and charcoal in favour of gas as a cooking fuel source (77% compared to 46%).For sanitation 70% of households now have toilets in their homes (RDDR, p.29).



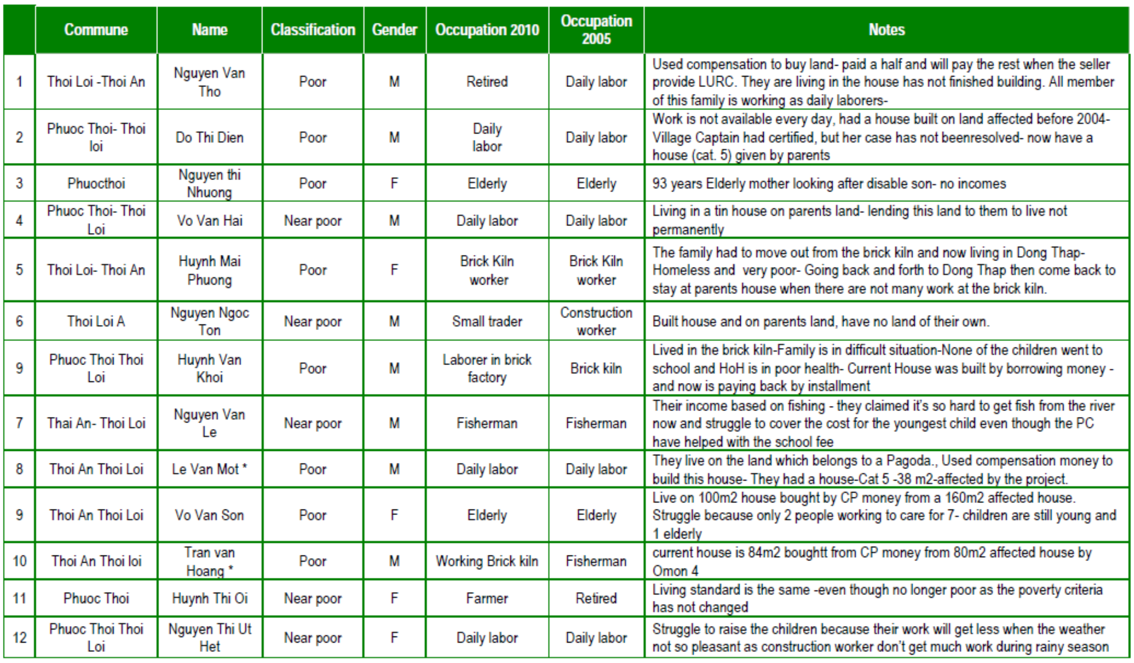
Energy Source	2005	2010	HH Change as %
Network Electricity	91%	97%	6%
Generator	0	0	0%
Battery	1%	0%	-1%
Petroleum	5%	0%	-5%
Candle	0%	0%	0%
Firewood	92%	70%	-22%
Charcoal	0%	1%	1%
Gas	31%	77%	46%

Source: Household Survey 2010

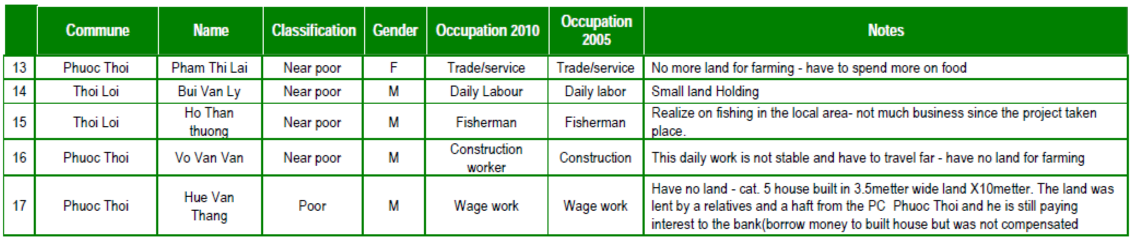
Vulnerable households

In 2010, there were 17 vulnerable households which did not have regular work poverty. This is a decrease when compared with 64 households in 2005.Apart from this, according to official investigation of O Mon Compensation Committee and approved by Can Tho people's Committee, there are 24 DP households who are still vulnerable. They were provided the special assistant of 15,000,000 VND/household by project owner (RDDR, p.30).

Vulnerable households at the time of 2010

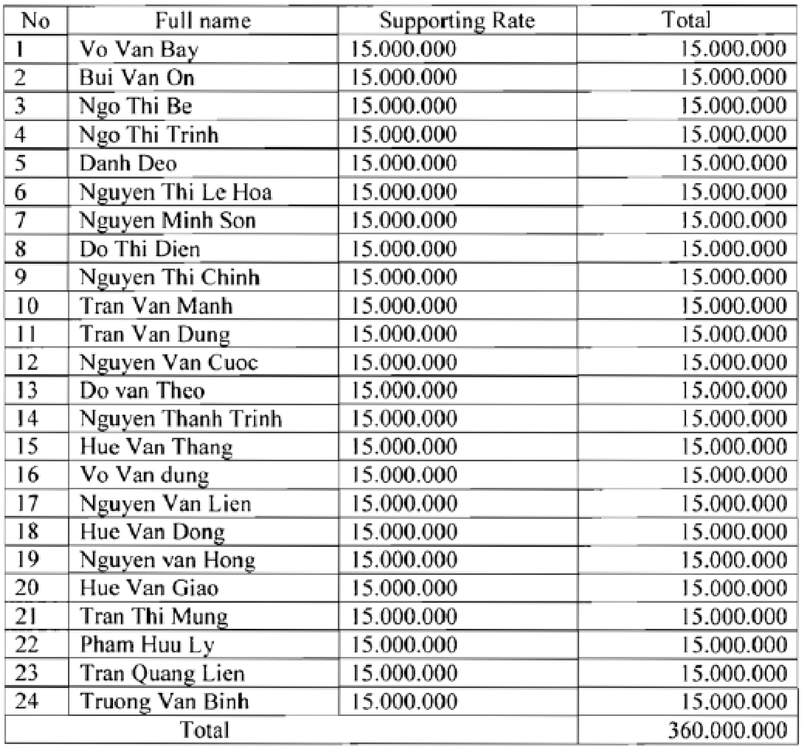


	Commune	Name	Classification	Gender	Occupation 2010	Occupation 2005	Notes
1	Thoi Loi -Thoi An	Nguyen Van Tho	Poor	M	Retired	Daily labor	Used compensation to buy land- paid a half and will pay the rest when the seller provide LURC. They are living in the house has not finished building. All member of this family is working as daily laborers-
2	Phuoc Thoi- Thoi loi	Do Thi Dien	Poor	M	Daily labor	Daily labor	Work is not available every day, had a house built on land affected before 2004- Village Captain had certified, but her case has not beenresolved- now have a house (cat. 5) given by parents
3	Phuocthoi	Nguyen thi Nhuong	Poor	F	Elderly	Elderly	93 years Elderly mother looking after disable son- no incomes
4	Phuoc Thoi- Thoi Loi	Vo Van Hai	Near poor	M	Daily labor	Daily labor	Living in a tin house on parents land- lending this land to them to live not permanently
5	Thoi Loi- Thoi An	Huynh Mai Phuong	Poor	F	Brick Kiln worker	Brick Kiln worker	The family had to move out from the brick kiln and now living in Dong Thap- Homeless and very poor- Going back and forth to Dong Thap then come back to stay at parents house when there are not many work at the brick kiln.
6	Thoi Loi A	Nguyen Ngoc Ton	Near poor	M	Small trader	Construction worker	Built house and on parents land, have no land of their own.
9	Phuoc Thoi Thoi Loi	Huynh Van Khoi	Poor	M	Laborer in brick factory	Brick kiln	Lived in the brick kiln-Family is in difficult situation-None of the children went to school and HoH is in poor health- Current House was built by borrowing money - and now is paying back by installment
7	Thai An- Thoi Loi	Nguyen Van Le	Near poor	M	Fisherman	Fisherman	Their income based on fishing - they claimed it's so hard to get fish from the river now and struggle to cover the cost for the youngest child even though the PC have helped with the school fee
8	Thoi An Thoi Loi	Le Van Mot *	Poor	M	Daily labor	Daily labor	They live on the land which belongs to a Pagoda., Used compensation money to build this house- They had a house-Cat 5 -38 m2-affected by the project.
9	Thoi An Thoi Loi	Vo Van Son	Poor	F	Elderly	Elderly	Live on 100m2 house bought by CP money from a 160m2 affected house. Struggle because only 2 people working to care for 7- children are still young and 1 elderly
10	Thoi An Thoi loi	Tran van Hoang *	Poor	M	Working Brick kiln	Fisherman	current house is 84m2 boughtt from CP money from 80m2 affected house by Omon 4
11	Phuoc Thoi	Huynh Thi Oi	Near poor	F	Farmer	Retired	Living standard is the same -even though no longer poor as the poverty criteria has not changed
12	Phuoc Thoi Thoi Loi	Nguyen Thi Ut Het	Near poor	F	Daily labor	Daily labor	Struggle to raise the children because their work will get less when the weather not so pleasant as construction worker don't get much work during rainy season



	Commune	Name	Classification	Gender	Occupation 2010	Occupation 2005	Notes
13	Phuoc Thoi	Pham Thi Lai	Near poor	F	Trade/service	Trade/service	No more land for farming - have to spend more on food
14	Thoi Loi	Bui Van Ly	Near poor	M	Daily Labour	Daily labor	Small land Holding
15	Thoi Loi	Ho Than thuong	Near poor	M	Fisherman	Fisherman	Realize on fishing in the local area- not much business since the project taken place.
16	Phuoc Thoi	Vo Van Van	Near poor	M	Construction worker	Construction	This daily work is not stable and have to travel far - have no land for farming
17	Phuoc Thoi	Hue Van Thang	Poor	M	Wage work	Wage work	Have no land - cat. 5 house built in 3.5metter wide land X10metter. The land was lent by a relatives and a haft from the PC Phuoc Thoi and he is still paying interest to the bank(borrow money to built house but was not compensated

Vulnerable households by investigation of O Mon Compensation Committee and special assistant



No	Full name	Supporting Rate	Total
1	Vo Van Bay	15.000.000	15.000.000
2	Bui Van On	15.000.000	15.000.000
3	Ngo Thi Be	15.000.000	15.000.000
4	Ngo Thi Trinh	15.000.000	15.000.000
5	Danh Deo	15.000.000	15.000.000
6	Nguyen Thi Le Hoa	15.000.000	15.000.000
7	Nguyen Minh Son	15.000.000	15.000.000
8	Do Thi Dien	15.000.000	15.000.000
9	Nguyen Thi Chinh	15.000.000	15.000.000
10	Tran Van Manh	15.000.000	15.000.000
11	Tran Van Dung	15.000.000	15.000.000
12	Nguyen Van Cuoc	15.000.000	15.000.000
13	Do van Theo	15.000.000	15.000.000
14	Nguyen Thanh Trinh	15.000.000	15.000.000
15	Hue Van Thang	15.000.000	15.000.000
16	Vo Van dung	15.000.000	15.000.000
17	Nguyen Van Lien	15.000.000	15.000.000
18	Hue Van Dong	15.000.000	15.000.000
19	Nguyen van Hong	15.000.000	15.000.000
20	Hue Van Giao	15.000.000	15.000.000
21	Tran Thi Mung	15.000.000	15.000.000
22	Pham Huu Ly	15.000.000	15.000.000
23	Tran Quang Lien	15.000.000	15.000.000
24	Truong Van Binh	15.000.000	15.000.000
Total			360.000.000

(Source: RDDR, p.24-30)

Table-4(1) Contents of Cash Compensation

Land (RDDR, p.16)

- Land for planting annual trees : 108,000 VND/m^2
- Land for planting perennial trees : 126,000 VND/m^2
- Rural living land : 400,000 VND/m^2
- Non-agriculture land : 200,000 VND/m^2
- Land for living at Road 934 area : 600,000 VND/m^2 (from the power plant to Thoi An ward)
- Public land or alluvial ground : 108,000 VND/m^2
- Agriculture land inside 50m from the protection slope of Road 934: in addition to compensation for agriculture land, 20% of living land cost was paid.

Houses (RRP 12.1, p.59-61)

- Grade 1 (Villa) : no cases
- Grade 2 (Concrete floor, high quality of materials) : no cases
- Grade 3 (Concrete floor, average quality of materials) : 1,400,000 VND/m^2
- Grade 4 (Brick wall, concrete frame with titled roof) : 990,000 VND/m^2
- Grade 5 (Wooden frame with palm roof) : 150,000 VND/m^2

Secondary structures (RRP 12.1, p.59-61)

- Kitchen, toilet: classified as the rates of houses
- Tomb: Normal 1,000,000 VND/unit; Cement: 3,000,000 VND/Unit
- Water tank: 380,000/m^3

Resettlement benefit

- If a household is required to relocate due to the project, and has the legal rights and titles to land and property, they will be compensated for that property, and they will be eligible to move to a resettlement area. If the household selects not to go to the resettlement area, a monetary payment of 65 MVND will be paid (RRP 12.1, p.59-61).
- The initial condition for compensation was whether household had settled before or after 15 October, 1993. As per official letter No 02/VPUB-QH issued by PC Can Tho, a decision for providing cash assistance to settlers on state land who had settled from 15 October 1993 to 1 July 2004 (65 MVND in cash or plot of land in the resettlement areas) was taken (RRP Table 25, p.44-46).
- ADB has proposed that people inhabiting on farm land and river bank after 1st July 2004 shall be paid up to 50% of the full replacement cost (RDDR, p.12).

Allowance for timely moving (RRP 12.1, p.59-61)

- The affected people who have to be relocated and voluntarily hand the affected land to the project in accordance of the time regulated and announced by the project will be entitled to a bonus of 5% of the total compensation amount, but not more than 5 MVND.

Transportation allowance (RRP 12.1, p.59-61)

a) Permanently relocated within Can Tho City:
  * Multi-stories, concrete houses : 3 MVND/household
  * Brick houses : 2 MVND/household
  * Others : 1 MVND/household

b) Permanently relocated to another province or city
  * Multi-stories, concrete houses : 5 MVND/household
  * Brick houses : 4 MVND/household
  * Others : 3 MVND/household

Temporary relocation allowance (RRP 12.1, p.59-61)

- If persons who have their residential land expropriated and have no other residences; pending the time of creating new residences (arrangement for resettlement), they shall be arranged to live in temporary shelters or receive monetary supports for renting dwelling house according to the following rates: households with:

* less than 4 persons	: 0.5 MVND/household/month
* from 5-6 persons	: 0.6 MVND/household/month
* from 7-8 persons	: 0.7 MVND/household/month
* from 9-10 persons	: 0.8 MVND/household/month
* more than 11 persons	: 1.0 MVND/household/month

Supports for subsistence and production stabilization (RRP 12.1, p.59-61)

- When households or individuals directly engaged in agricultural production have over 30% of their assigned agricultural land areas expropriated, they shall receive life stabilization supports for 3 months if they must not be relocated and for 6 months if they must be relocated; where they must be relocated to places with difficult socio-economic conditions, they shall receive supports for 12 months at most. The level of monetary support per household member per month shall be equivalent to the value of 30 kg of rice, calculated at the average local price (4000 VND/kg).

Supports for job change and job creation (RRP 12.1, p.59-61)

- If households, individuals directly engaged in agricultural production have over 30% of their assigned agricultural land areas expropriated, they shall receive supports for job change if they are still within the working age.
- In case a vocational training course can not be held, the support will be paid in cash, at a level of 1 MVND/person in labour age.

Others: For "policy' households who have to be relocated (RRP 12.1, p.59-61)

- Military Heroes, Vietnamese Hero Mothers, Labor Hero are entitled to assistance of 5 MVND/household.
- Wounded soldiers, relatives of military martyr are entitled to assistance of 3 MVND /household
- Households who formerly helped revolutionaries, retired civil servants, households who are currently receiving other social assistance, are entitled to assistance of 1 MVND/household.

Decree No.147/ 2004/ ND-CP indicates the compensation policy for crops as follows:

- Rice and annual crops: the largest crop in the past 3 years will be paid at the average price in the area at the time of land acquisition (Article 24-1).
- Fruit trees and other perennial crops: the average price of the area at the time of land acquisition will be paid (Article 24-2).

Table-4(2) Contents of Job Training

The job training course provided or planned in 2007-2008 is listed below (RRP Annex 4, p.79-80).

In 2007

- Total established courses: 12.
- Total students: 435.

Among them:

- Small scale industry (60 days/course) has 5 courses consist of hair dressing, household electric, motorbike repairing and household tailoring.
- Industry (15 days/course) has 7 courses, consist of aquaculture, livestock and veterinary, cultivation.

In 2008

O Mon district has proposed to DOLISA (Department of Labour, Invalids and Social Affairs) of Can Tho City to fund for organizing 19 courses as follows:

- Cultivation : 02 courses.
- Livestock and veterinary : 02 courses.
- Aquaculture : 02 courses.
- Motorbike repairing : 02 courses.
- Household electric : 02 courses.
- Household tailoring : 04 courses.
- Diesel engine repairing : 01 course.
- Industrial tailoring : 01 course.
- Hair dressing : 03 courses

The aoorived funding for 2008 is only sufficient for opening short-term courses.

Result of job training from 2004 to 2007

Since establishing of the district (2004), job training has been focused as one of solutions for employment creating, hunger erasing and poverty reducing.

- 2004: 3 courses
- 2005: 11 courses
- 2006: 13 courses
- 2007: 12 courses

Table-5 Decision on Compensation of Acquired Land for the O Mon Power Complex

Items	Number of affected household	Compensation plan	Date
O Mon 3 (No.1)	33	No.1038 /QD-UBND	4 / April/2006
O Mon 3 (No.2)	52	No.1279 /QD-UBND	9/ May/ 2006
O Mon 3 (No.3)	37	No.1536 /QD-UBND	22/ June/ 2006
O Mon 3 (No.4)	29	No.1831 /QD-UBND	14/ August/ 2006
Affected household	151		
O Mon 4 (No.1)	46	No.1605 /QD-UBND	5/ July/ 2006
O Mon 4 (No.2)	58	No.1792 /QD-UBND	8/ August/ 2006
O Mon 4 (No.3)	36	No.2098 /QD-UBND	20/ September/ 2006
O Mon 4 (No.4)	22	No.2552 /QD-UBND	28/ November/ 2006
O Mon 4 (No.5)	32	No.134 /QD-UBND	23/ January/ 2007
O Mon 4 (No.6)	9	No.1156 /QD-UBND	11/ May/ 2007
Affected household	203		
Access road No.2 (No.1)	33	No.2554 /QD-UBND	12/ September/ 2006
Access road No.2 (No.2)	23	No.2554 /QD-UBND	28/ November/ 2006
Access road No.2 (No.3)	21	No.2764 /QD-UBND	18/ December/ 2006
Access road No.2 (No.4)	2	No.134 /QD-UBND	23/ January/ 2007
Affected household	79		
Discharge channel No.2 (No.1)	50	No.1606 /QD-UBND	5/ July/ 2006
Discharge channel No.2 (No.2)	65	No.1631 /QD-UBND	10/ July/ 2006
Discharge channel No.2 (No.3)	40	No.1791 /QD-UBND	8/ August/ 2006
Discharge channel No.2 (No.4)	32	No.2555 /QD-UBND	28/ November/ 2006
Discharge channel No.2 (No.5)	31	No.2766 /QD-UBND	18/ December/ 2006
Discharge channel No.2 (No.6)	3	No.134 /QD-UBND	23/ January/ 2007
Discharge channel No.2 (No.7)	5	No.773 /QD-UBND	28/ March/2007
Affected household	226		
Total affected household	659		

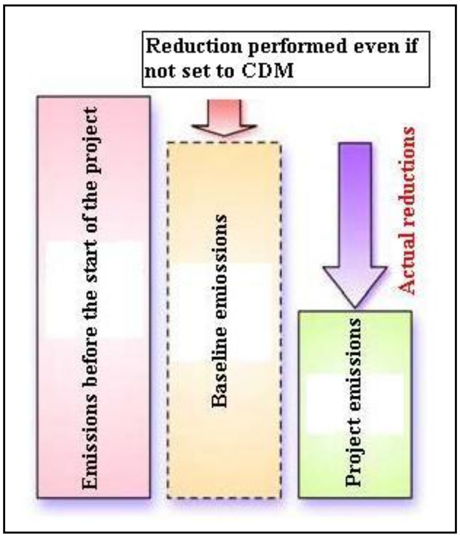
CHAPTER 6 CLIMATE CHANGE REMEDIES

6.1 CONSIDERING CDM METHODOLOGY

According to "CDM Methodology Guidebook[1]" Amount of Emissions Reductions for each project is defined as following formula (Fig.6.1-1).

Emissions Reduction
= Baseline Emissions - Project Emissions

"Project emissions" are the emissions from actual project activities. 'Baseline emissions' are the volume of emissions under theoretical conditions of 'scenario which reductions are not achieved if the project is not certified as CDM project'.
Monitoring methodology corresponding to the baseline scenario is required for actual PDD (Project Design Document). In addition to this, 'applicable condition' is required to be stated in the methodology, which is omitted in this document due to just trial calculation.



(Source: CDM Methodology Guidebook)

Fig. 6.1-1 Images of Emissions Reductions

As is shown in Fig.6.1-2, new electric power grid from O Mon 3 is connected to existing power network. In Vietnam, the network of electric power grid covers the whole country and the O Mon 3 new grid is to be connected to the network.

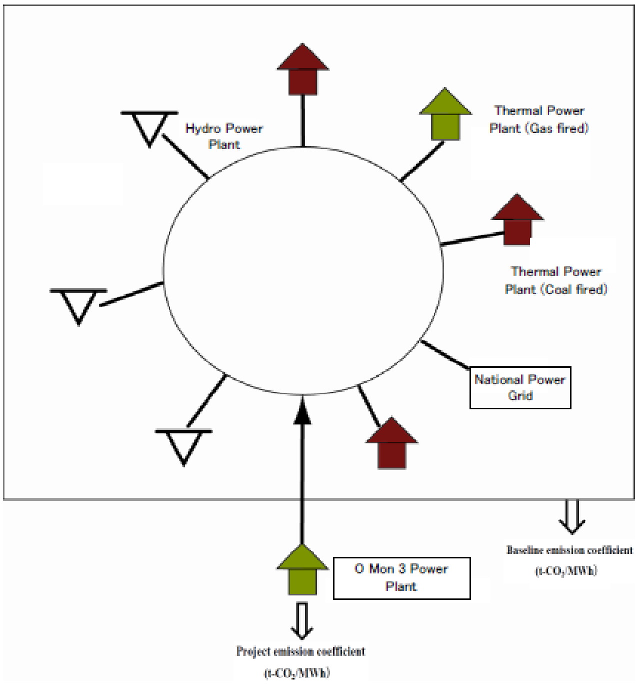


Fig. 6.1-2 Configuration of O Mon 3 Project

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[1] http://gec.jp/main.nsf/jp/Publications-Others-CDM_Meth_Guidebook

There are two ways of CDM methodology which are approved by UNFCC (United Nations Climate Change Conference), in case of connecting grid from new gas fired power plant to existing power grid network.

- AM0029:Connecting to existing power grid network
- AM0087:Connecting to existing power grid network, or supplying to individual operator

Though both ways are similar ideas, AM0029 seems to be more general. So the volume of emissions reductions is calculated through AM0029 methodology. Strictly speaking, however, the following cases of gas leaks or emissions should be considered, since main component of natural gas is methane (CH_4), which are regarded as greenhouse gas; 1) gas leaks during transportation from gas wells to power plant (the same applies to LNG), 2) if the gas does not burn up for 100%, the remaining gas is emitted to the atmosphere.
This time, as preliminary estimations, calculations are conducted in ideal situation, assuming that no leaks or emissions are generated.

6.2 ESTIMATION OF EFFECT OF GREENHOUSE GAS EMISSIONS REDUCTIONS BASED ON CDM METHODOLOGY

6.2.1 Flow of Calculation

(1) Project Emissions

Volume of Project Emissions (PE_y) is calculated by following formula.

$$PE_y = \sum_f FC_{f,y} * COEF_{f,y}$$

$FC_{f,y}$: annual consumption of fuels (gas (m^3/per year) and light gas oil (ton/per tear))
$COEF_{f,y}$: annual CO_2 emission coefficient (t-CO_2/m^3 and t-CO_2/ton)

(2) Baseline Emissions

Volume of Baseline Emissions (BE_y) is calculated by following formula.

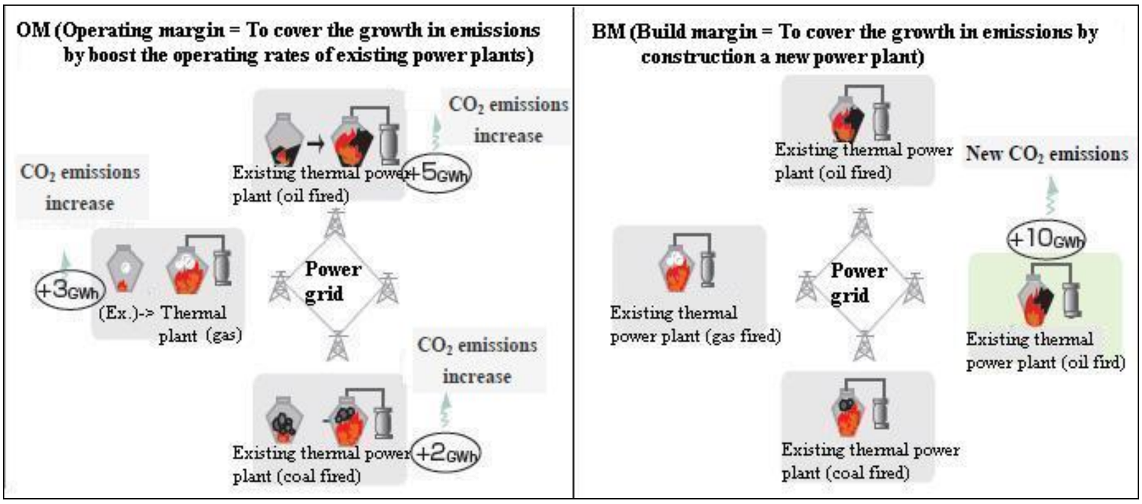
$$BE_y = EG_{PJ,y} \bullet EF_{BL,\ CO2,\ y}$$

$EGP_{J,\ y}$: volume of electricity supplying to the power grid network generated by the project activities (MWh/ year)
$EF_{BL,\ CO2,\ y}$: baseline emission coefficient (t-CO_2/MWh)

There are three options for calculations of baseline emission coefficient (t-CO_2/MWh)

Option 1 : the build margin emission coefficient (t-CO_2/MWh)
Option 2 : the combined margin emission coefficient (using a 50/50 operating margin/build margin weight)
Option 3 : emission coefficient (t-CO_2/MWh) identified as the most likely baseline scenario

The images of operating margin(OM) and build margin(BM) emissions coefficient are shown in the Fig.6.2-1.



(Source: http://gec.jp/gec/jp/Activities/cdm_meth/pACM0002-old-080414.pdf)

Fig. 6.2-1 Images of OM and BM

6.2.2 Preliminary Calculations of CO_2 Reductions in O Mon 3

(1) Baseline Emissions

In Vietnam, each emission coefficient within national electricity network is calculated for the sake of CDM project by electricity sector, cooperating MONRE, MOIT, and EVN (2nd field survey). Values of each emission coefficient from 2006 to 2008 are shown in Table 6.2-1.

Table 6.2-1 Each Emission Coefficient for Electricity Network in Vietnam

	Unit	2006	2007	2008
Build Margin (BM)	t-CO_2/ MWh	0.5961	0.5729	0.5064
Operation Margin (OM)	t-CO_2/ MWh	0.6960	0.6795	0.6465
Combined Margin (CM)	t-CO_2/ MWh	0.6461	0.6262	0.5764

According to the table, the values of emission coefficient are all decreased year by year. Thus, utilizing the 2008 values of emission coefficient is appropriate, instead of utilizing average values of these three years. As is described, there are three options for calculations of baseline emission coefficient. The combined margin emission coefficient is adopted for this trial calculation.

Baseline Emission Coefficient: 0.5764 (t-CO_2/ MWh)

(2) CO_2 Emission Factor of Type of Generation

Table 6.2-2 shows CO_2 emission factor of each type of generation studied by Central Research Institute of Electric Power Industry. The project emissions coefficient of the O Mon 3 is adopted for this trial calculation.

Project Emission Coefficient: 0.519 (t-CO_2/ MWh)

Table 6.2-2 CO_2 Emission Factor of Type of Generation

(Unit: t-CO_2/ MWh)

Type of power generation	Fuel fired	Facilities & Operation	Total
Thermal power plant (Coal fired)	0.887	0.088	0.975
Thermal power plant (Oil fired)	0.742	0.038	0.780
Thermal power plant (LNG fired)	0.478	0.130	0.608
Combined cycle power plant (LNG fired)	0.408	0.111	0.519
Photovoltaic power generation	0.000	0.053	0.053
Wind power generation	0.000	0.029	0.029
Nuclear power plant (PWR)	0.000	0.025	0.025
Geo-thermal generation	0.000	0.015	0.015
Hydro power plant	0.000	0.011	0.011

(Source: "Evaluation of Power Generation Technologies based on Life Cycle CO_2 Emissions", Central Research Institute of Electric Power Industry. 2009)

(3) Trial Calculation of CO_2 Reduction

Table 6.2-3 shows the net output of O Mon 3. Total power generation is expected to be 4,275,000MWh with the generation capacity of 750MW (F/S report) and 4,759,500MWh with the generation capacity of 824MW (New Technology). Table 6.2-4 shows the amount of CO_2 reduction, calculated based on the net output of O Mon 3, Emission Factor and Baseline Emission Coefficient and Project Emission Coefficient. According to the calculation result, the emission amount of 245,385 ton-CO_2 per year to 273,195 ton-CO_2 per year is expected to be reduced when O Mon 3 power plant operates with the advanced gas combined cycle technology.

Table 6.2-3 Net Output of O Mon 3 Power Plant

Item	Generation capacity (MW)	Operation time (hour)	Total power generation (MWh)	Rate of plant (%)	Net output (MWh)
F/S report	750	6,000	4,500,000	5.0	4,275,000
New technology	835	6,000	5,010,000	5.0	4,759,500

Table 6.2-4 Expected Amount of CO_2 Reduction

Item	Generation capacity (MW)	Net output (MWh)	Baseline Emission Coefficient (tCO_2/MWh)	Project Emission Coefficient (tCO_2/MWh)	Amount of CO_2 reduction (tCO_2/year)
F/S report	750	4,275,000	0.5764	0.519	245,385
New technology	835	4,759,500	0.5764	0.519	273,195

CHAPTER 7 PROJECT EXECUTION PLAN

7.1 PROJECT IMPLEMENTATION SCHEDULE

Two options (Option 1 & Option 2) are considered by TPPC as February 2012 as mentioned below. CTTP prepares project implementation schedule in case of option 1 which provides earlier operation of O Mon 3 provided that loan agreement become effective in October 2012.

Option 1: Selection of Foreign Consultant before Effectiveness of Loan Agreement

- GAS Turbine No.1 commissioning : Mar. 7, 2016
- GAS Turbine No.2 commissioning : Apr. 7, 2016
- Operation of the whole combined cycle power plant : Nov.14, 2016
-

Option 2: Selection of Foreign Consultant after Effectiveness of Loan Agreement

- GAS Turbine No.1 commissioning : Jul. 28, 2016
- GAS Turbine No.2 commissioning : Aug. 28, 2016
- Operation of the whole combined cycle power plant : Apr. 6, 2017

7.1.1 Appropriateness of Implementation Schedule for O Mon 3 Power Plant

The both construction periods for O Mon 3 power plant and O Mon 4 power plant are estimated 30 months at present by CTTP as shown in Table 7.1-1. Taking into consideration of actual manufacturing and installation periods of a gas turbine generator/ a steam turbine generator in Japan and overseas, the construction period of 30 months seems appropriate for O Mon 3 and O Mon 4. And the latest implementation schedules[1] as of February 2012 for O Mon 3 project and O Mon 4 project are shown in Table 7.1-2 and Table 7.1-3 respectively.

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[1] According to the last implementation schedules provided by CTTP in December 2011, O Mon 3 project was planned to be completed in August 2016 and O Mon 4 project was planned to be completed in November 2015.

Table 7.1-1 Milestones for O Mon 3 and O Mon 4 Projects

No.	Item	O Mon 3 Project			O Mon 4 Project		
		Start	End	days	Start	End	days
1	**Effectiveness of Loan Agreement**	15/10/12	15/10/12	1	05/10/11	05/10/11	1
2	**EVN'S Consultant Services**	01/01/12	15/08/12	228	08/10/10	31/12/11	450
1	Selection of EVN' Consultant	01/01/12	14/02/12	45	—	—	—
3	**Consulting Services**	15/06/12	21/05/13	341	23/02/11	04/05/12	443
1	Issuance of RFP and Consultant's Preparation	22/07/12	04/09/12	45	17/06/11	02/08/11	56
2	Contract Signing	06/01/13	06/01/13	1	20/01/12	20/01/12	1
4	**EPC Package/Bidding process**	22/05/13	14/11/16	1,273	20/02/12	16/11/15	1,366
1	Notice of invitation	22/05/13	05/06/13	15	16/03/12	30/03/12	15
2	Issuance of Bid Document and or PQ	06/06/13	(Bid) 03/09/13	90	31/03/12	(PQ) 29/04/12	30
3	Bid opening	04/09/13	04/09/13	1	12/10/12	12/10/12	1
4	Contract Signing	26/03/14	26/03/13	1	27/03/13	27/03/13	1
5	L/C opening and contract effectiveness	26/04/14	25/05/14	30	27/04/13	26/05/13	30
5	**EPC Package/Implementation process**	**26/05/14**	**14/11/16**	**904**	**27/05/13**	**16/11/15**	**904**
1	Ground breaking	26/05/14	26/05/14	1	27/05/13	27/05/13	1
2	Commissioning of Gas Turbine No.1	07/03/16	07/03/16	1	09/03/15	09/03/15	1
3	Commissioning of Gas Turbine No.2	07/04/16	07/04/16	1	09/04/15	09/04/15	1
4	Operation of the whole CCPP	14/11/16	14/11/16	1	16/11/15	16/11/15	1

(Source：CTTP)

Table 7.1-2 Implementation Schedule for O Mon 3 Power Plant Construction Project
(Loan Agreement Effectiveness in October 2012)
Option 1 : Selection of Foreign Consultant before Effectiveness of Loan Agreement

(Source: CTTP)

No.	Item		2012				2013				2014				2015				2016			
			1 3	4 6	7 9	10 12	1 3	4 6	7 9	10 12	1 3	4 6	7 9	10 12	1 3	4 6	7 9	10 12	1 3	4 6	7 9	10 12
1	**Effectiveness of Loan Agreement(expected)**	15/10/12				10/15 ▼																
2	**EVN'S Consultant Services**	15/08/12	1/1 ▼		8/15 ▼																	
1	Selection of EVN'Consultant	14/02/12	1/1 2/14 ▼▼																			
3	**Consulting Services**	21/05/13		5/21 ▼				5/21 ▼														
1	Issuance of RFP and Consultant's Preparation	04/09/12			7/22 9/4 ▼▼																	
2	Contract Signing	06/01/13					1/6 ▼															
4	**EPC Package/Bidding process**	14/11/16						5/22 ▼														11/14 ▼
1	Notice of invitation	05/06/13						5/23 6/5 ▼▼														
2	Issuance of Bid Document	03/09/13						6/6 ▼	9/3 ▼													
3	Bid opening	04/09/13							9/4 ▼													
4	Contract Signing	26/03/14									3/26 ▼											
5	L/C opening and contract effectiveness	25/05/14										4/26 5/25 ▼▼										
5	**EPC Package/Implementation process**	26/05/14										5/26 ▼										11/14 ▼
1	Ground breaking	26/05/14										5/26 ▼										
2	Commissioning of Gas Turbine No,1	07/03/16																	3/7 ▼			
3	Commissioning of Gas Turbine No,2	07/04/16																		4/7 ▼		
4	Operation of the whole CCPP	14/11/16																				11/14 ▼

Table 7.1-3 Implementation Schedule for O Mon 4 Power Plant Construction Project

(Source: CTTP)

No.	Item		2010	2011				2012				2013				2014				2015			
			10 12	1 3	4 6	7 9	10 12	1 3	4 6	7 9	10 12	1 3	4 6	7 9	10 12	1 3	4 6	7 9	10 12	1 3	4 6	7 9	10 12
1	**Loan Agreement Signing**	05/10/11			5/10 ▼																		
2	**EVN'Consultant**	31/12/11	10/8 ▼								12/31 ▼												
3	**Consulting Services**	04/5/12		2/23 ▼					5/4 ▼														
1	Issuance of RFP and Consultant's Preparation	02/8/11			6/17 ▼	8/2 ▼																	
2	Contract Signing	20/1/12						1/20 ▼															
4	**EPC Package/Bidding process**	16/11/15						2/20 ▼															11/16 ▼
1	Notice of invitation	30/03/12						3/30 ▼															
2	Issuance of PQ	29/04/12						3/31 ▼	4/29 ▼														
3	Bid opening	12/10/12									10/12 ▼												
4	Contract Signing	27/03/13										3/27 ▼											
5	L/C opening and contract effectiveness	26/05/13											4/27 5/26 ▼▼										
5	**EPC Package/Implementation process**	16/11/15											5/27 ▼										11/16 ▼
1	Ground breaking	27/05/13											5/27 ▼										
2	Commissioning of Gas Turbine No,1	09/03/15																		3/9 ▼			
3	Commissioning of Gas Turbine No,2	09/04/15																			4/9 ▼		
4	Operation of the whole CCPP	16/11/15																					11/16 ▼

CHAPTER 8 IMPLEMENTATION ORGANIZATION

8.1 ORGANIZATION AND TECHNICAL CAPABILITY OF EVN

8.1.1 EVN Organization

EVN organization chart as of the end of 2011 is shown in Fig.2.4-1 in Chapter 2. The council consists of the president and 6 vice presidents. Six (6) departments such as operation, business, power generation investment, nuclear power construction etc. are under controlled by the six vice presidents. Under the above six departments, there are six-teen (16) sections.

8.1.2 Technical Capability of EVN

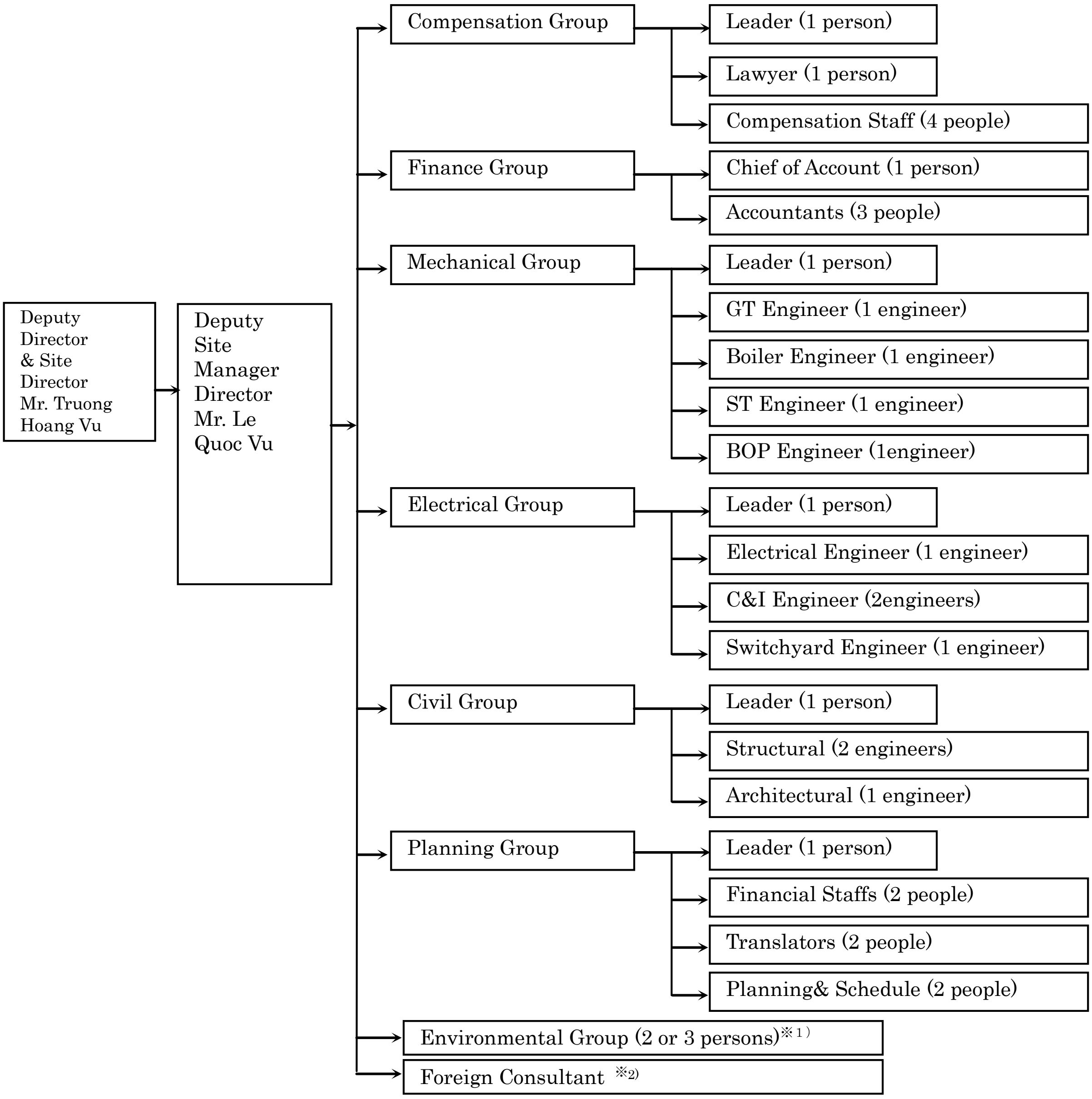
EVN has four (4) technical colleges and tries to improve the technical capability of EVN staffs. Moreover, EVN has an experience of implementation of Phu My 1 combined cycle power plant (1,090 MW, operation in 2002). Therefore, technical knowledge and skills acquired from Phu My 1 project seem to be applicable to the O Mon 3 project.

8.2 ORGANIZATION AND TECHNICAL ABILITIES OF CTTP FOR O MON 3 PROJECT

8.2.1 Organization Chart

CTTP is responsible for implementation of O Mon 3 power plant and planned to be in charge of designing, supervision, performance tests witness under the organization chart shown in Table 8.2-1. Following the government policy, job development of local region, the local resident will be employed and be set in the above organization as well as O Mon 1.

Table 8.2-1 Organization Chart of CTTP for Construction Stage



*1) Environmental group will carry out the requirements of environmental activities.

*2) Consultant will be included after final selection.

Note: During the construction stage, CTTP departments' specialists will be mobilized, if necessary.

8.2.2 Technical Abilities of CTTP

The total employees of CTTP are 418 personnel and some of them are in charge of operation and maintenance for Tra Noc gas turbine power plant, O Mon 1-A power plant. CTTP has three (3) experiences of construction of thermal power plants as shown in Table 8.2-2 and conducted the project management of O Mon 1-A as shown in Table 8.2-3 under the advisory service by the Japanese Consultant. Therefore, technical knowledge and skills acquired from O Mon 1-A project seem to be applicable to the O Mon 3 project.

Table 8.2-2 CTTP's Construction Experience of Thermal Power Plants

No.	Project Name	Owner	Output (MW)	Site	Operation Year
1	2 × F6 Gas Turbine Installation Project (Phase 1)	EVN	76.8	Tra Noc District Can Tho City	1996.10
2	2 × F6 Gas Turbine Installation Project (Phase 2)	EVN	78.2	Tra Noc District Can Tho City	1999.05
3	O Mon I Unit No.1 Thermal Power Plant Project	EVN	330	O MON District Can Tho City	2009.07

Table 8.2-3 Work Content in O Mon 1-A

Work Content
(1) All design works including operation and maintenance manuals (2) All construction works including site preparation, all equipment, consumables and electricity (3) All pre-commissioning works including temporary equipment (4) Complete set of turbine generator /boiler & associated auxiliaries (5) Fuel oil receiving facilities for two (2) units (6) Designing natural gas receiving and firing facilities for two (2) units (7) Power Transformers (8) Switchyard equipment for two (2) units (9) Witness to all performance tests (10) Supervision of all civil and architectural works (11) And others

In addition to the above construction experiences, CTTP has also experiences of response to initial machine troubles in O Mon 1-A as shown in Table 8.2-4. Therefore, CTTP seems to be enough technical abilities to supervise the construction stage of O Mon 3 power plant.

Table 8.2-4 Machine Troubles in O Mon 1-A for the last Three Years

Time	Hours in operation	No. of troubles	Hours in troubles	Outage hours for maintenance	Reasons of troubles
2009 (from July 09)	3,727.72	02	28.83	237.83	① The pressure of AUTO STOP OIL of turbine oil system was low during the process of condenser vacuum test, which caused turbine trip on August 13, 2009. ② Main transformer (MAT) oil flow relay failure (due to the high temperature of MAT windings) occurred and the MAT protection relay 86 was activated and caused turbine trip on November 11, 2009.
2010	8,295.47	01	1.75	462.78	① Boiler trip due to high pressure of combustion furnace, high pressure of flue gas duct and high pressure of flue gas at the outlet of Gas Air Heater 1A and 1B on May 11, 2010.
2011 (up to Dec. 12)	6,431.17	01	433.75	1,482.00	① The boiler tube leakage on March 07, 2011 and the plant was intentionally shutdown.
Total	**18,454.36**	**04**	**464.33**	**2180.61**	

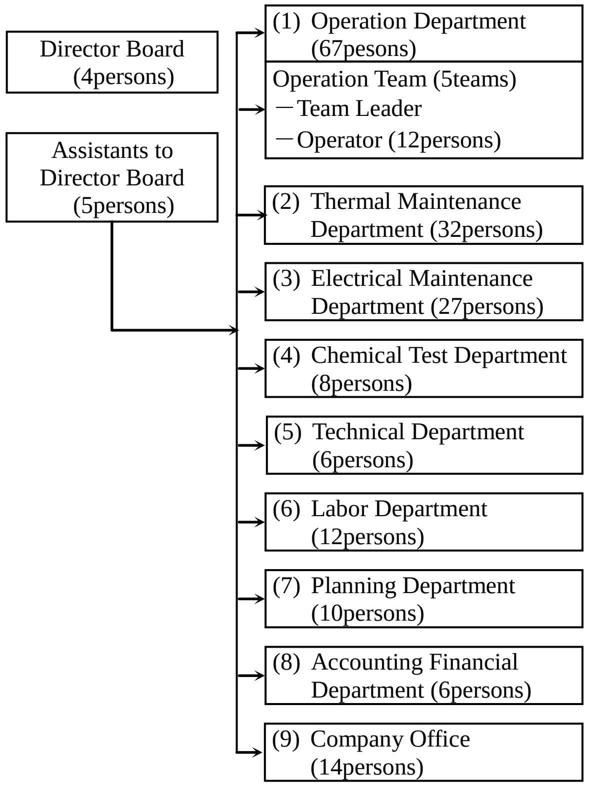
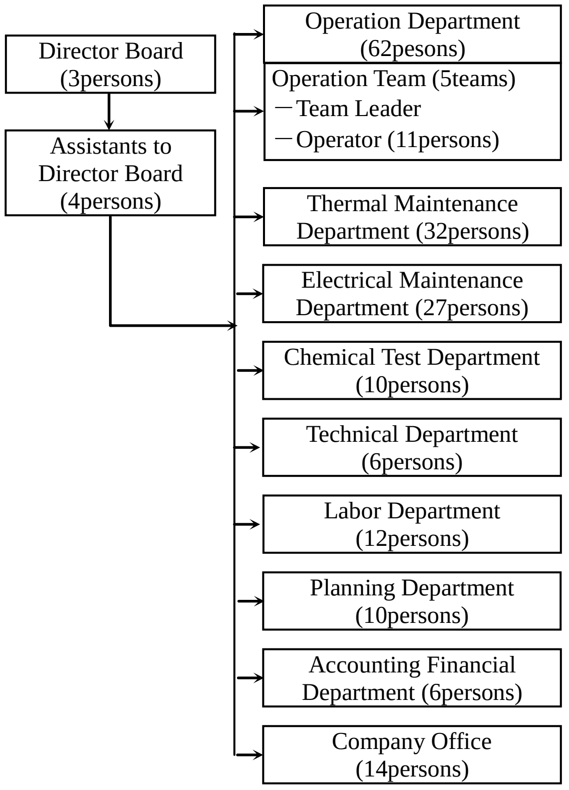
8.3 OPERATION AND MAINTENANCE ORGANIZATION FOR O MON 3 POWER PLANT

8.3.1 Organization

(1) Planned Organization

Table 8.3-1 shows the planned operation and maintenance organization for O Mon 3 power plant. The 191 staffs will be in charge of operation and maintenance for O Mon 3 power plant. Table 8.3-1 also shows the planned organization for O Mon 4 for reference.

Table 8.3-1 Planned Operation and Maintenance Organization for O Mon 3 Power Plant

O Mon 3 Power Plant	O Mon 4 Power Plant
	
Total Staffs: 191 Staffs	**Total: 186 Staffs**

As shown in Table 8.3-1, the organization for O Mon 3 power plant will consist of nine (9) departments and six (6) departments out of nine (9) departments are the departments related to operation and maintenance. The work content to be carried out by four (4) departments which are substantially in charge of operation and maintenance is as follows.

1) Operation department

Operation department will consist of 5 teams with 3 shifts and the total will be 67 staffs. The each team will consist of one team leader, one sift leader, and twelve operators. Operators are responsible for operation and monitoring of mechanical and electrical equipment, and inspection of equipment. And remote control and monitoring of mechanical and electrical equipment will be done in the Central Control Room.

2) Thermal maintenance department and electrical maintenance department

Thermal maintenance department will consist of 32 staffs and electrical maintenance department will consist of 27 staffs. The both departments will responsible for maintenance of all equipment.

The maintenance will be carried out by the Contractor (Manufacturer) during the guarantee period and by CTTP after guarantee period. The above maintenance departments are also responsible for preparation of maintenance and inspection manuals based on the instruction manuals provided by the Contractor.

3) Chemical test department

Chemical test department will consist of 8 staffs and be responsible for measurement, analyses, monitoring and tests based on the environmental requirements at the timing of normal operation, start-up and shutdown of the power plant. Technical department might be also involved in the above works in some cases.

(2) Comparison of Organization between O Mon 3 and O Mon 4 Power Plants

CTTP will be responsible for operation and maintenance of O Mon 3 power plant and O Mon 4 power plant. Table 8.3-2 shows the comparison of number of staffs between O Mon 3 power plant and O Mon 4 power plant based on Table 8.2-1.

Table 8.3-2 Number of Staffs of O Mon 3 and O Mon 4 Power Plants

No.	O Mon 3 Power Plant	Number of Staffs	No.	O Mon 4 Power Plant	Number of Staffs
I	**Board of Directors**	**4**	**I**	**Board of Directors**	**3**
II	**Group assistant**	**5**	**II**	**Group assistant**	**4**
II	**Operation department**	**67**	**III**	**Technical department**	**137**
1	Manager and deputy manager	2	3.1	Technical room	4
2	Team leader	5	3.2	Chemical workshop	10
3	Shift leader	5	1	Manager and deputy manager	2
4	Panel board GT1	5	2	The chemical test team	8
5	Panel board GT2	5	3.3	Operation workshop	62
6	Panel board ST	5	1	Manager and deputy manager	2
7	Generator room GT1	5	2	Foreman (screw)	5
8	Generator room GT2	5	3	Panel board GT1	5
9	Steam turbine room	5	4	Panel board GT2	5
10	Heat recovery No 1	5	5	Panel board ST	5
11	Heat recovery No 2	5	6	Generator room GT1	5
12	Circulation pump station	5	7	Generator room GT2	5
13	Water treatment systems	5	8	Steam turbine room	5
14	Storage and fuel supply	5	9	Heat recovery No 1	5
IV	**Maintenance and chemical test**	**67**	10	Heat recovery No 2	5
1	Thermal Maintenance Department	32	11	Circulation pump station	5
	Manager and deputy manager	2	12	Water treatment systems	5
	Team of stem turbine and HRSG	10	13	Storage and fuel supply	5
	Team of Gas Turbine	10	3.4	*Heat muscularis repair workshop*	32
	Mechanical Processing	10	1	Manager and deputy manager	2
2	Manager and deputy manager	2	2	TBK team (GT)	10
	Plant	10	3	TBH and LTHN team (ST&HRSG)	10
	C&I	10	4	Processing and repair workshop	10
	High Voltage	5	3.5	Electrical and C&I repair workshop	27
3	Chemical Test Department	1	1	Manager and deputy manager	2
	Manager	1	2	Electrical	10
	Team of Chemical	7	3	C&I	10
V	**Departments**	**48**	4	High voltage	5
	Technical Department	6	**IV**	**Economic and officer**	**42**
	Labor Department	12	4.1	Finance Accounting room	6
	Planning Department	10	4.2	Administrative organizations room	12
	Accounting financial Department	6	4.3	*Materials organizations room*	10
	Company office	14	4.4	*Company Security*	14
	-Office manager	1	1	Manager and deputy manager	2
	-Deputy office manager(fire fighting)	1	2	Staff	12
	-Staff	12			
	TOTAL	**191**		**TOTAL**	**186**

The result of comparison is as follows.

1) Organization

The both organizations for O Mon 3 power plant and for O Mon 4 power plant are approximately same ones, although the minor differences are observed like that O Mon 3 power plant is not equipped with a workshop and O Mon 4 power plant is equipped with a workshop. CTTP is recommended to reconsider the current organization for O Mon 3 power plant by reviewing the effectiveness of the organization in the operation stage of O Mon 4 power plant.

Number of staffs for O Mon 3 power plant is 191 personnel and that for O Mon 4 power plant is 186 personnel, although the both power plants have the same power output of 750 MW. Number of staffs for O Mon 3 power plant is recommended to be optimized in the operation stage of O Mon 3 power plant and by reviewing the effectiveness of the organization in the operation stage of O Mon 4 power plant.

2) Operation staff

Number of operation staffs for O Mon 3 power plant is five (5) more regarding the team leaders than those for O Mon 4 power plant as shown in Table 8.3-3.

Table 8.3-3 Number of Operation Staffs

(Unit: person)

No.	Position	O Mon 3 Power Plant	O Mon 4 Power Plant
1	Department chief and sub-chief	2	2
2	Team leader	5	0
3	Sift leader	5	0
4	Master workman	0	5
5	Operation staff	55	55
	Total	67	62

3) Maintenance department and technical department

The both maintenance department and technical department for O Mon 3 power plant and O Mon 4 power plants consist of the same number of staffs, such as 59 staffs for maintenance department (thermal: 32, electrical: 27) and 6 staffs for technical department.

4) Chemical test department

Number of staffs for chemical test department for O Mon 3 power plant is two (2) less than those for O Mon 4 power plant. The department consists of one (1) department chief and seven (7) chemical test staffs for O Mon 3 power plant and one (1) department chief, one (1) department sub-chief and eight (8) chemical test staffs for O Mon 4 power plant.

8.3.2 Technical Capabilities

Almost staffs for operation and maintenance for O Mon 3 power plant will be newly employed and CTTP intends to carry out a skill upgrading program and plan[1] for the newcomers in advance of the operation of O Mon 3 power plant.

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[1] In Japan, power utility companies carry out the skill upgrading program for 2 years. Considering the required period of 2 years, CTTP has to complete the skill upgrading program in October 2014, 2 years before of commercial operation of O Mon 3 power plant.

8.4 RECRUITMENT PLANNING FOR OPERATION AND MAINTENANCE STAFFS

8.4.1 Planned Number of Staffs in O Mon Power Complex

Number of staffs for each power plant in the O Mon Power Complex is planned as follows. The total number of staffs will be 909 personnel if the plan is implemented as planned.

O Mon 1 power plant:	341 staffs
O Mon 2 power plant:	191staffs
O Mon 3 power plant:	191staffs
O Mon 4 power plan:	186staffs (191 staffs in original plan)
Total	**909 staffs**

8.4.2 Recruitment Planning for O Mon 3 Power Plant and O Mon 4 Power Plant

The existing number of staffs in CTTP is 418 personnel and all of them are in charge of operation and maintenance of other power plants. Therefore, almost operation and maintenance staffs for O Mon 3 power plant are newly employed as mentioned above.
The resident being impacted by the O Mon 3 project, the relatives of existing staffs and the residents working at power related facilities will be employed on a preferential base.

The recruitment plan prepared by CTTP is shown in Table 8.4-1. The contents of recruitment plan for Mon 3 and O Mon 4 power plants are same, although operation year of O Mon 3 power plant is different from that of O Mon 4 power plant.

Table 8.4-1 Recruitment Plan for O Mon 3 Power Plant and O Mon 4 Power Plant

O Mon 3 Power Plant	O Mon 4 Power Plant
The recruitment plan for the Project is scheduled to be as follows: - From January 2013 to December 2013, 10 personnel will be employed and trained for environment impact assessment. - 60 personnel will be employed and trained at Ho Chi Minh City Power College for position of skilled workers from September 2014 to June 2016 for operation and maintenance of the O Mon 3 power plant. - 60 personnel will be employed and trained at Ho Chi Minh City Power College for position of workers from September 2014 to June 2016 for operation and maintenance of the O Mon 3 power plant. - From January 2016 to January 2017, on-site training for 56 university and college personnel will be conducted by the EPC Contractor. - 120 trained personnel graduated from Ho Chi Minh City Power College are to be trained at site by the EPC Contractor from January 2016 to January 2017.	The recruitment plan for the Project is scheduled to be as follows: - From January 2012 to December 2012, 10 personnel will employed and trained for environment impact assessment. - 60 personnel will be employed and trained at Ho Chi Minh City Power College for position of skilled workers from September 2013 to June 2015 for operation and maintenance of the O Mon 4 power plant. - 60 personnel will be employed and trained at Ho Chi Minh City Power College for position of workers from September 2013 to June 2015 for operation and maintenance of the O Mon 4 power plant. - From January 2015 to January 2016, on-site training for 56 university and college personnel will be conducted by the EPC Contractor. - 120 trained personnel graduated from Ho Chi Minh City Power College are to be trained at site by the EPC Contractor from January 2015 to January 2016.

(Source: CTTP）

8.5 TRAINING PROGRAM

(1) Training Program

The training program for skill upgrading of operation and maintenance staffs for O Mon 3 power plant and O Mon 4 power plant is prepared by CTTP based on the training program developed in O Mon 1-A power plant as shown in Table 8.5-1.

Table 8.5-1 Training Program for O Mon 3 and O Mon 4 Power Plants

Training Program
1. Training on environment impact assessment: Training on environment impact assessment will be conducted by the main consultant during the project implementation.
2. Training on construction quality management: The main consultant will train CTTP's engineers on construction quality management before start of plant construction.
3. Training on power plant management: To make the plant operate stably and economically, the EPC Contractor has to train the key personnel of CTTP in the field of operation organization maintenance, material tracking, financial issues, asset monitoring…. Time of training is about 30 days for 12 persons.
4. Training on operation: Training of operators will be made 4 months prior to the taking over time by the EPC Contractor to ensure that the trained operators can run the power plant safely and economically. The place for training shall be at on-site and off-site.
5. Training on maintenance of the plant: Training to troubleshoot the incidents or defects arisen during operation shall be made by the EPC Contractor to the maintenance staff. Maintenance of equipment (C&I equipment, control system, measuring equipment…) is required for the training program. Training shall be on-site and off-site, lasting in 30 days for 12 workers.

(Source: CTTP)

(2) Reinforcement of OJT (on-the-job training)

Aiming at earlier skill upgrading of the staffs, CTTP is recommended to prepare the following manuals with assistance by the foreign consultant after receiving the instruction manuals provided by the Contractor.

<Operation Department>
- Inspection manual for equipment
- Check list for operation equipment
- Operation manual for operation, start-up and shut down
- Operation manual for troubles and malfunctions
- Periodical replacement manual for equipment

<Maintenance Departments>
- Maintenance manual
- Construction manual and etc.

< Chemical Test Departments >
- Manual for measurement, analyses, monitoring and test relating to air pollution, thermal effluent, plant drainage water, noise and so on required by environmental monitoring and

control plans

< Chemical Test Departments and Technical Department >
- Execution manual for environmental monitoring and control plans

8.6 WORK SAFETY AND HEALTH

(1) The following activity plan relating to work safety and health is confirmed.

1) Work safety : Plan and execution of work safety activities based on the instruction by the Ministry of Labor, Invalids and Affairs

2) Health: Plan and execution of health activities such as health checking for all staffs

(2) Questionnaire investigation to CTTP was conducted relating to working environment for the implementation of the projects. The result of questionnaire is shown in Table 8.6-1 and CTTP will observe the related laws and degrees.

Table 8.6-1 Result of Questionnaire Investigation Relating to Working Environment

JICA Study Team's Questionnaires	YES or NO			
	O Mon 1	O Mon 2	O Mon 3	O Mon 4
1. Is the project proponent not violating any law and ordinances associated with the working conditions of the country which the project proponent should observe in the project? <Answer> Yes, the project proponent is not violating any law ordinances mentioned above.	Yes	(*)	Yes	Yes
2. Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? <Answer> Yes, tangible safety considerations are in place for individuals involved in the project as mentioned above.	Yes	(*)	Yes	Yes
3. Are tangible measure being planned and implemented for individuals involved in the project, such as the establishment of safety and health programs and safety training (including traffic safety and public sanitation) for workers etc.? <Answer> Yes, tangible measure being planned and implemented for individuals involved in the project as mentioned above.	Yes	(*)	Yes	Yes
4. Are appropriate measures being taken to ensure that security guards involved in the project do not violate safety of other individual involved, or local residents? <Answer> Yes, appropriate measures are being taken to ensure the above requirements.	Yes	(*)	Yes	Yes

Note: (*)O Mon 2 will be BOT project which does not belong to EVN.

CHAPTER 9 REVIEW OF PROJECT EFFECT

9.1 OPERATION AND EFFECT INDICATORS

JICA developed operation and effective indicators applicable to thermal power plants in March 2000 as shown in Table 9.1-2 for the objective ex-post evaluation of the project. According to Table 9.1-2, the maximum output (MW) and plant load factor (%) are set as the typical operation indicators and net electric energy production (GWh/year) is set as the typical effect indicator. Table 9.1-1 shows the operation and effect indicators for O Mon 1-A which are developed in the advance evaluation stage of O Mon 1-A.

Table 9.1-1 Operation and Effect Indicators for O Mon 1-A

Indicators		Planned values in the advance evaluation stage
Sending out energy	(GWh/year)	1,902.8 GWh
Maximum output	(MW)	330 MW
Plant load factor	(%)	68.5 %
Availability factor	(%)	89.0 %
Station use (own consumption)	(%)	3.9 %
Gross thermal efficiency	(%)	41.9 %

When developing the operation and effect indicators for O Mon 3 power plant, the following issues are envisaged.

- Installed capacity for O Mon 3 power plant in case of adoption of the advanced technology for a F-type gas turbine will exceed 750 MW which was planned in the F/S report in 2009 and the actual installed capacity for O Mon 3 is unknown until the result of bidding. Therefore, the net electric energy production is also unknown at the moment because the net electric energy production depends on the maximum output.

Based on the above issues, operation and effect indicators for O Mon 3 power plant are set as follows:

(a) The maximum out is set as 750 MW and more.
(b) The average operation hours per annum is set as 6,000 hours planned in the F/S report in 2009.
(c) Net electric energy production is set as 4,500 GWh/year and more (= 750 MW × 6,000 hours).
(d) Plant load factor is set as 68.5 % (= 4500 GWh/year / (750 MW × 8670 hours/year))
(e) Availability factor is also set as 68.5 % (= 6,000 hours / 8760 hours).

Table 9.1-2 Operation and Effect Indicators (JICA: ver.2)

Operation Indicator

Category	Name	Policy and method of establishing the indicator	Target		Purpose	Remarks
Basic	Maximum Output (actual value) (MW)	As shown by the name of the indicator	Maximum output planned at the time of appraisal		To assess if the plant performance has been maintained and exhibited	
Basic	Plant Load Factor (%)	= Electricity generated per year / (rated output × hours per year) × 100	About 70-90%		To confirm the adequacy of the original operation plan	On the assumption that the plant is operated for base load
Auxiliary	Availability Factor (%)	= Operating hours per year / hours per year) × 100	About 83-90%		To confirm the adequacy of the original operation plan	On the assumption that the plant is operated for base load: 83% in the regular examination for 2 months Can be substituted for by the operating hours per year
Auxiliary	Auxiliary Power ratio (%)	= (Auxiliary electricity consumption per year / gross electricity generated) × 100	Coal	About 8%	To check the conditions for maintaining performance	
			Gas combined	About 3-5%		
			Geothermal	About 8%		
			Oil	About 6-8%		
Basic	Gross Thermal Efficiency (%)	= (Gross electricity generated per year × 860) / (fuel consumption per year × heat release value of the fuel) × 100	Coal	35-40%	To check the conditions for maintaining performance and energy conservation levels	1 kWh = 860 kcal
			Gas combined	45% and over		
			Geothermal	About 10%		
			Oil	35-40%		
Basic	Outage Hours for Every Cause (Hours/Year or Days/Year)	As shown by the name of the indicator	Human error	0	To check this as the operating condition of the plant	Classified according to the causes: human error, machine trouble, and planned outage
			Machine trouble	Discussion		
			Planned outage	Regular inspection		
Auxiliary	Outage Times for Every Cause (Times/Year)	As shown by the name of the indicator	Human error	0	To check this as the operating condition of the plant	Classified according to the causes: human error, machine trouble, and planned outage
			Machine trouble	Discussion		
			Planned outage	Regular inspection		

Effect Indicator

Category	Name	Policy and method of establishing the indicator	Target	Purpose	Remarks
Basic	Maximum Output (actual value) (MW)	As shown by the name of the indicator	Maximum output planned at the time of appraisal	To assess if the plant performance has been maintained and exhibited	
Basic	Net Electric Energy Production (Gwh/Year)	As shown by the name of the indicator	Refer to the remarks	To check if the assumed electricity generated was actually produced	From the view that the fixed amount of electricity can be continuously generated, it is highly possible that this indicator is regarded as an operational indicator = Rated output × hours per year × plant load factor = Gross electricity generated - auxiliary electricity consumption

Table 9.1-3 shows the operation and effect indicators for O Mon 3 power plant based on the above considerations.

Table 9.1-3 Proposed Operation and Effect Indicators for O Mon 3 Power Plant

Item	Indicator	Setting value	Remarks
Operation Indicators	Plant factor	68.5 % and more	Plant factor does not change unless the average operation hours of 6,000 hours do not change.
	Availability factor	68.5 % and more	Excluding planned outage hours due to the overhaul maintenance period to be carried out for every 2~3 years generally.
	Station use	5% and less	Subject to the result of bidding
	Gross thermal efficiency	57.5% and more	Subject to the result of bidding
	Outage hours by human error	0 hour/year	
	Outage hours by machine trouble	240 hours/year and less	Subject to negotiation with EVN
	Planned outage hours	1176 hours/year and less	Subject to negotiation with EVN (7weeks/year)
Effect Indicators	Max output	750 MW and more	Subject to the result of bidding
	Net electric energy production	4,760 GWh/year and more	Subject to the result of bidding

CHAPTER 10 CONCLUSION AND CONSIDERATION

10.1 CONCLUSION

(1) Technical Evaluation

Technical specifications for O Mon 3 power plant explained in the F/S report seem nearly reasonable except the following items and these items are recommended to be reconsidered at the Tender stage.

1) Mechanical equipment

- It is recommended that the height of bypass stack will be at least 40 m as the same as the main stack (Gas Turbine)
- In the F/S report, “horizontal gas flow HRSG with natural circulation” and “vertical gas flow HRSG with forced circulation” were compared. However, many “vertical gas flow HRSG with natural circulation” have been used worldwide. Therefore, “vertical gas flow HRSG with natural circulation” should also be accepted. (HRSG)
- The condensate pumps and boiler feed water pumps are specified as 3 × 50% capacity in the F/S report. However, 2 × 100% capacity design is also acceptable. (Steam Turbine)
- The demineralized water plant is planned to be a combination of RO (Reverse Osmosis) filter and mixed bed polisher. It is required to explain clearly the reason why RO filter is selected. (Feed Water Supply System)
- There is no description about a tube cleaning device of the turbine steam condenser in the F/S report. It is recommended that a ball type tube cleaning device will be installed.
- The F/S report describes that the required cooling water for gas turbine system, steam turbine system and other ancillary equipment (except for steam turbine condenser) is supplied from this closed cooling water system. However, in case that the plant is constructed in two-stage, i.e. gas turbine simple cycle system and bottoming system, the cooling water for the gas turbines is necessary to be supplied other independent cooling water system. (Closed Cooling Water System)
- Pre-treatment of waste water (water/oil separation, primary neutralization, sewage treatment, etc.) will be done by each power plant (O MON 1 to 4), however, it is not clear whether the final treatment (aeration, final neutralization, sedimentation, etc.) is done by individual treatment system or by the common system. (Waste Water Treatment System)
- According to the plan described in the F/S report, 2 units of 100 % capacity compressors will supply total required air for both of instrumentation air and plant service air. However, this arrangement is not preferable for supplying the air to instruments at steady pressure condition. Because a demand of the service air is intermittent and large amount use, that may cause a pressure fluctuation of the air supply system. Therefore the compressed air supply system should be divided into the instrument air and plant service air supply systems. (Compressed Air Supply System)

- There is no description about auxiliary steam system, however, it is recommended that the auxiliary boiler, which supplies the steam necessary for start-up operation of the plant, is provided as common equipment for O MON 3 and 4. (Auxiliary Steam System)
- Although the F/S report does not provide any detail description about cranes and hoists, one unit of overhead crane for turbine hall is included in Equipment Cost Estimation. In case of multi-shaft configuration, gas turbine building and steam turbine building are built separately and each building requires one unit of overhead crane. Therefore, one unit of overhead crane for the steam turbine should be added.

2) Electrical Equipment

- JICA Study Team would recommend three diesel generators with 0.4kV output, each one (1) for each generator. As for the excitation system, brushless excitation system is recommendable, instead of static excitation. Because the emergency generator will be operated when all power are failed. During this time, there is no stable power supply to support the static exciter. (Emergency power supply system)
- F/S report plans that 24V (or 48V) shall be divided from DC220 busbar by DC/DC converters. JICA Study Team would recommend to install independent DC24V (or 48V) battery system and DC220V battery system from the view point of noise and voltage fluctuations. (Emergency power supply system)
- F/S report plans to install 6.6kV, 0.4kV and 220V systems for all gas turbine systems and steam turbine system. However, there is no large auxiliary equipment in gas turbine plant which needs to be fed from 6.6kV power supply. Therefore, 6.6kV switchgears for gas turbine plants can be deleted. (Switchgear Equipment)
- F/S report requests that fluorescent lamps, mercury high pressure luminaries, 250W high pressure sodium floodlight shall be provided. From the point of energy saving point of view, fluorescent lamp, mercury high pressure luminaries and 250W high pressure sodium floodlight shall be substituted for LED lamps and halogen gas lamps. (Lighting and small power system)
- F/S report does not mention about cables and/or cabling works except isolated phase bus duct (IPB) which connect between generator terminals and transformers. (Cables and cabling works)
- 7.25.10 Central electrical control room (CECR) of F/S report proposes that CECR will be expanded from the 500kV switchyard control room or new construction next to this control building or next to the central control room in the control building of the power plant. This concept of control of 500kV switchyard seems to contradict the existing control system of 500kV switchyard. The expansion for switchyard seems not necessary. (Control System)

(2) Review of the Project in terms of CDM

O Mon 3 combined cycle power plant is expected to reduce CO_2 emission of 245 ~ 270 thousand ton per annum by the preliminary estimation based on the CDM method. A combined cycle power plant is one of thermal power plants as well as a coal-fired thermal power plant and an oil-fired thermal power plant. However CO_2 emission from a combined cycle power plant is much less than those of other thermal power plants. Therefore, implementation of O Mon 3 project is recommended in terms of Climate Control.

(3) Necessity and Emergency of the Project

As mentioned in Chapter 3, it is envisaged that the reserve margin will be minus for the period from 2013 to 2014 and power supply shortage will occur in the Southern Region where O Mon 3 power plant is to be constructed, even though the other power sources are implemented by the year 2014 as planned in PDP7.

According to SPC data, planned blackouts constantly occurred for the past three years, such as 345 times in 2009, 341 times in 2010 and 340 times in 2011 due to the absolute shortage of power plants. Number of planned blackouts of 340 ~ 345 divided by 365 days is 0.93 ~ 0.96, which indicates that blackout almost occurs every day in some places of SPC's supply area. Hours per one planned blackout are always seven (7) hours from 8:00 am to 16:00 pm except 12:00 am to 13:00 pm, which covers operation hours of manufactures.

For the above circumstances, the O Mon 3 project should be implemented as soon as possible.

(4) Finance Source of the O Mon 3 Project

WB has no intention to finance power sources development in future. Therefore, applicable public finance sources are limited to ADB and JICA, and ADB already committed implementation of two power plant projects.

For the above reasons, Japanese Yen Credit seems the only finance source applicable to implementation of the O Mon 3 project and the O Mon 3 project should be implemented by Japanese Yen Credit.

10.2 CONSIDERATION RELATING TO IMPLEMENTATION OF O MON 3 PROJECT

(1) Internal Factor

1) Management Capabilities of EVN

EVN is responsible for further development of power sources in future. If the limited manpower of EVN is distributed to each power source project, EVN might be lack of management capability of projects and delays of implementation are envisaged as occurred in PDP6. To avoid the same situation in PDP6, EVN should employ the highly capable consultant for the O Mon 3 project and the consultant should fully support EVN.

2) Power Tariff Setting

EVN’s financial condition becomes worse in comparison to that in 2002. EVN has to burden 15 % of the total investment cost. However, under the current financial condition of EVN, worsening of cash management of EVN might cause payment delay to the Contractor and the construction work is delayed or suspended consequently. To avoid such situation, EVN should review the current power tariff periodically and set the appropriate power tariff which contributes to the soundness of EVN’s business base.

3) Additional EIA and Disclosure of Information

Increase of environmental impact due to the increase of installed capacity (about 10%[1] more) will be minor in comparison to the impact in case of 750 MW. EVN has an opinion that additional EIA is not necessary because no technical condition is changed as long as adoption of F-type turbine. However, EVN is recommended to issue the official letter to MONRE and confirm whether additional EIA is necessary or not officially. Even if the additional EIA is required, civil work and foundation work can be commenced without the approval of additional EIA report by MONRE because additional EIA will be carried out for change of installed capacity related.

In addition to above, EVN is recommended to disclose information of changes of installed capacity and environmental impact to the stakeholders regardless of the additional EIA.

4) Gas Supply Volume

EVN promised that gas will be provided to O Mon 3 power plant on a priority base by suspension of fuel conversion from oil to gas for O Mon 1-A and 1-B power plants when gas supply volume is not enough for all power plants in the O Mon Complex. By virtue of cancellation of O Mon 5 power plat, gas supply volume seems enough for all power plants at the moment. However, when gas supply volume is not enough, EVN is expected to put his promise into practice.

(2) External Factor

1) Gas Price

Gas price of 7.5 USD/MMBTU used in the financial evaluation is based on the information by EVN. On the other hand, it is said that the gas price proposed by the gas

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[1] 835 MW/750 MW = 1.113

developer to the government of Vietnam is 10 USD/MMBTU. The government of Vietnam is expected to conclude the gas price of 7.5 USD/MMBTU from financial viewpoint of the O Mon 3 project.

2) Gas Development Schedule

Commencement of gas supply in this report is anticipated in 2015. Since the construction of the gas pipeline takes 42 months, FID (Financial Investment Decision) should be concluded by June 2012 among the related parties in order to complete the gas pipeline in November 2015 because the commencement of operation of O Mon 4 power plant is expected in November 2015.

3) Construction schedule of Common Facilities for O Mon 3 and O Mon 4 power plants

As described in Chapter 4.7, most common facilities for O Mon 3 power plant and O Mon 4 power plant, such as No.2 cooling water discharge channel, cooling water intake and cooling water intake pump etc., are to be constructed by the O Mon 4 project. The common facilities are expected to be constructed by May 2014 which is the planned start month for the construction of O Mon 3 power plant. To attain the above target, O Mon 4 power plant is required to start the construction in May 2015 as planned.