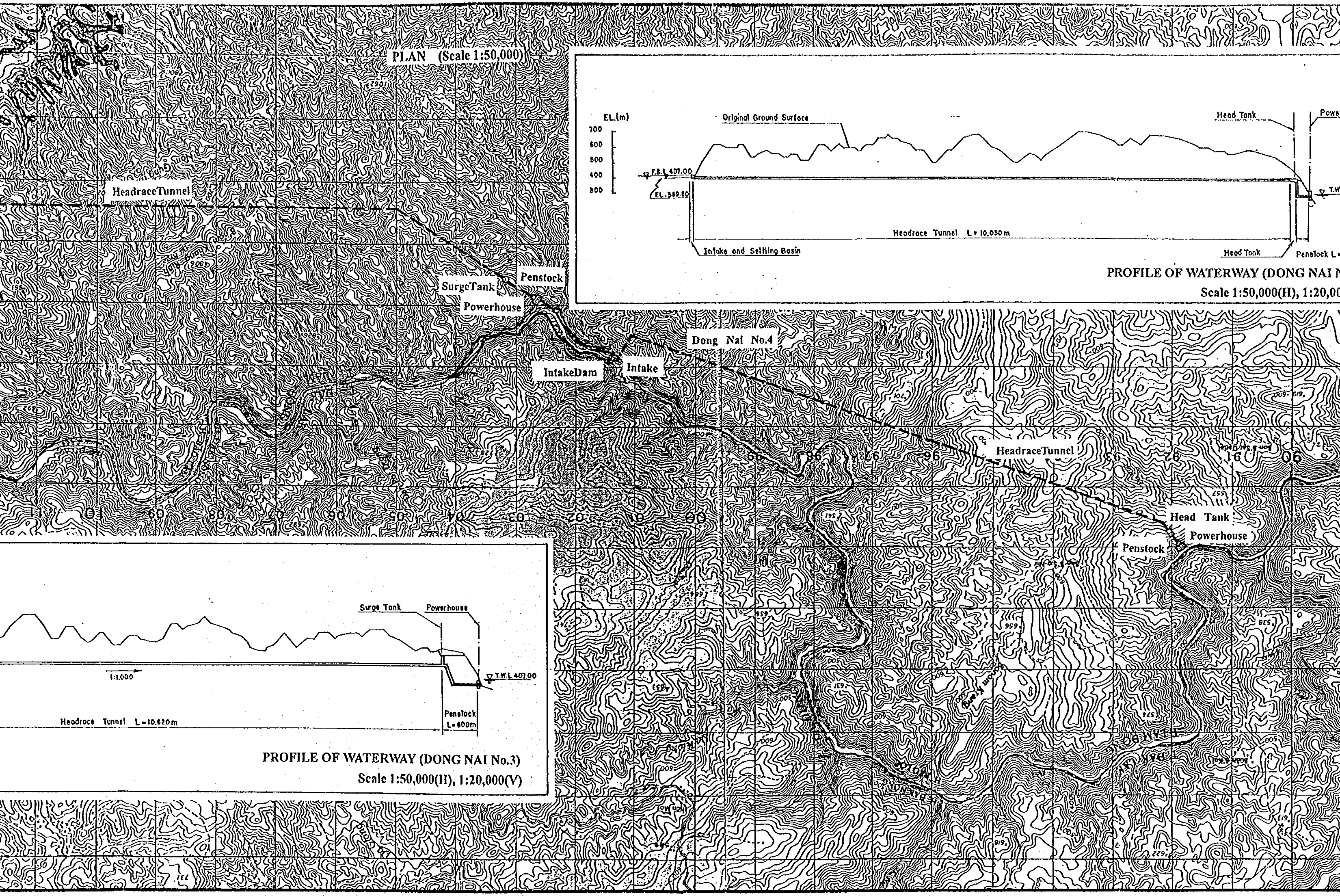
PLAN (Scale 1:50,000)
HeadraceTunnel
SurgeTank
Penstock
Powerhouse
IntakeDam
Intake
Dong Nai No.4
HeadraceTunnel
Head Tank
Powerhouse
Penstock
EL.(m)
700
600
500
400
300
Original Ground Surface
Head Tank
F.S.L 407.00
EL. 389.80
Headrace Tunnel L = 10,030m
Intake and Settling Basin
Head Tank
PROFILE OF WATERWAY (DONG NAI N
Scale 1:50,000(H), 1:20,00
Surge Tank
Powerhouse
T.W.L 407.00
1:1,000
Headrace Tunnel L=10,620m
Penstock L=600m
PROFILE OF WATERWAY (DONG NAI No.3)
Scale 1:50,000(H), 1:20,000(V)

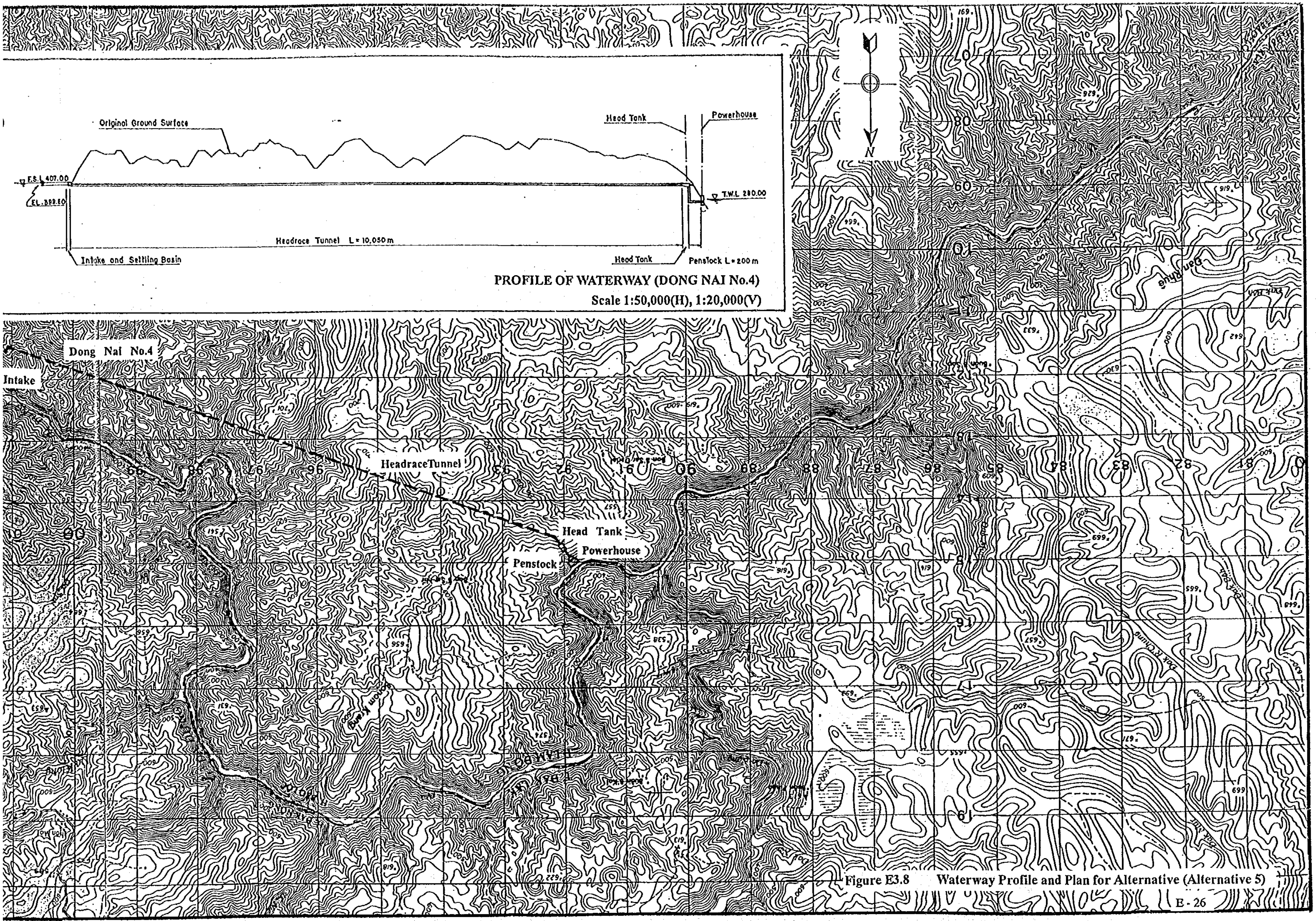

Figure E3.8 Waterway Profile and Plan for Alternative (Alternative 5)

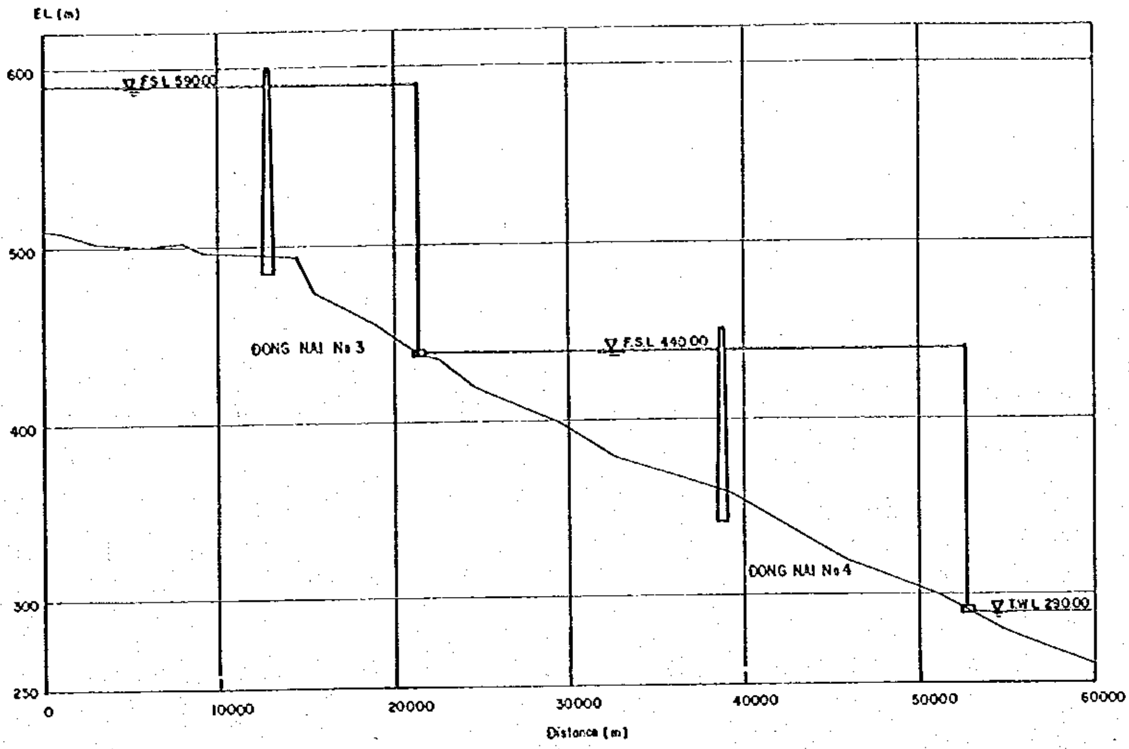

Figure E3.9 Longitudinal Profile of the Middle Reaches of Dong Nai River and Alternative Dam site (Alternative 1)

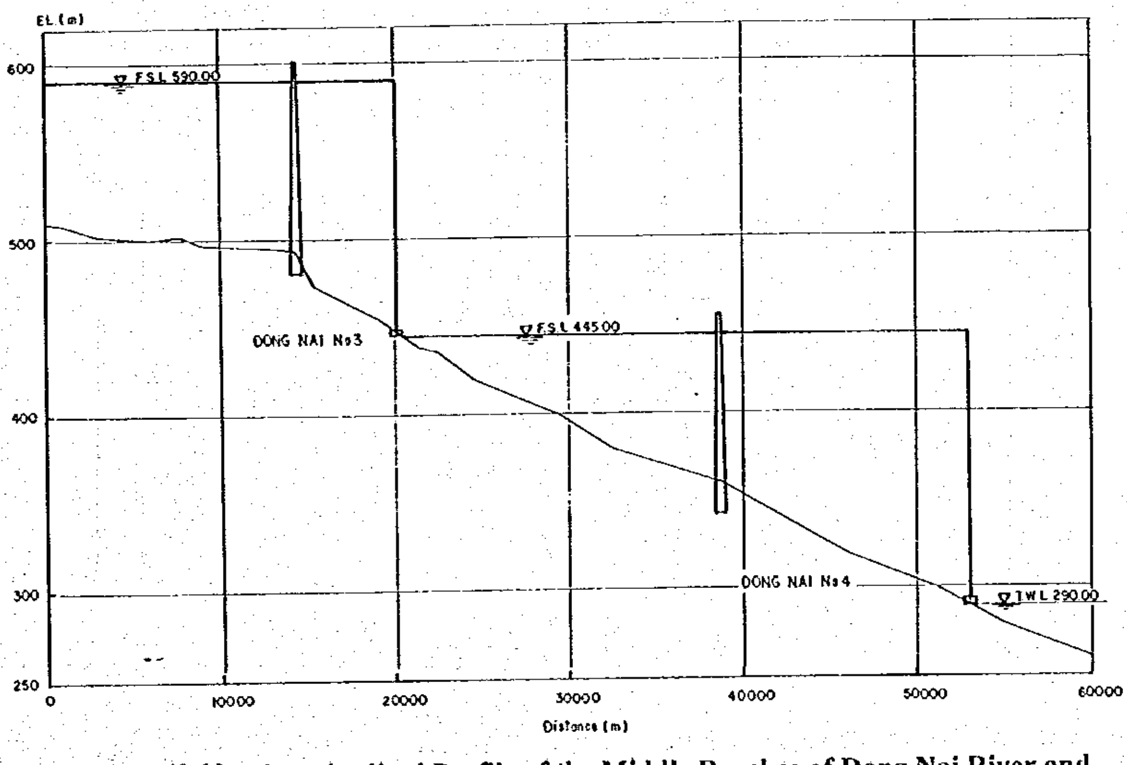

Figure E3.10 Longitudinal Profile of the Middle Reaches of Dong Nai River and Alternative Dam site (Alternative 2)

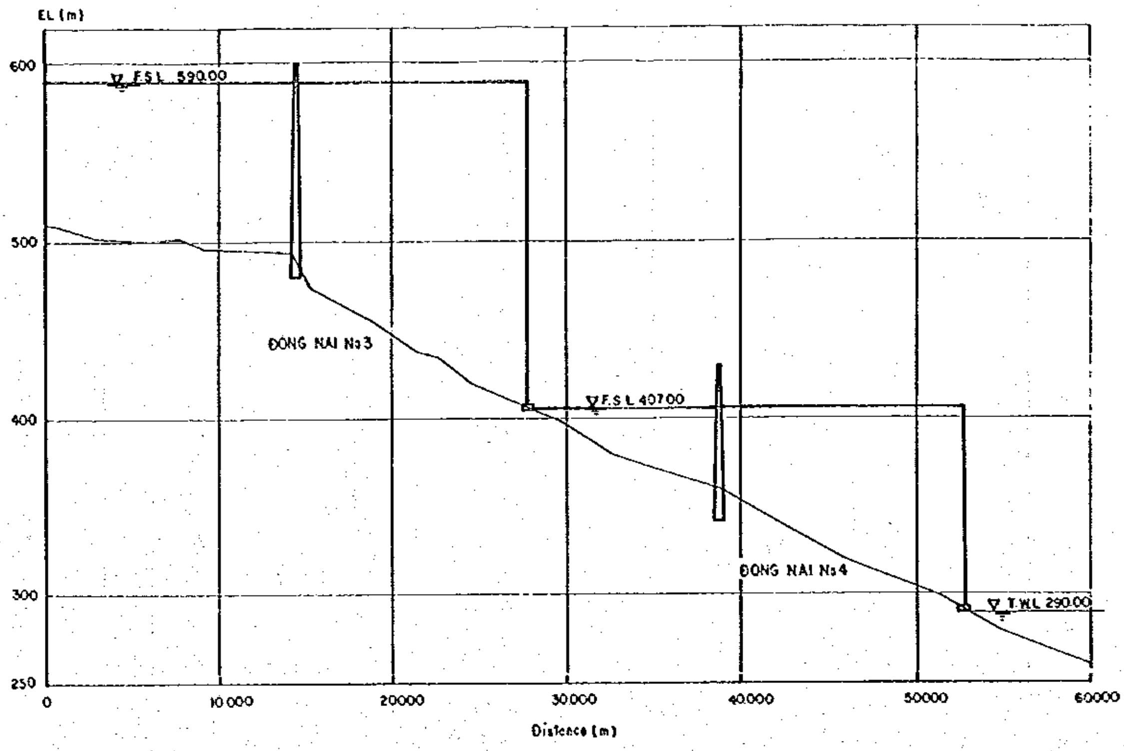

Figure E3.11 Longitudinal Profile of the Middle Reaches of Dong Nai River and Alternative Dam site (Alternative 3)

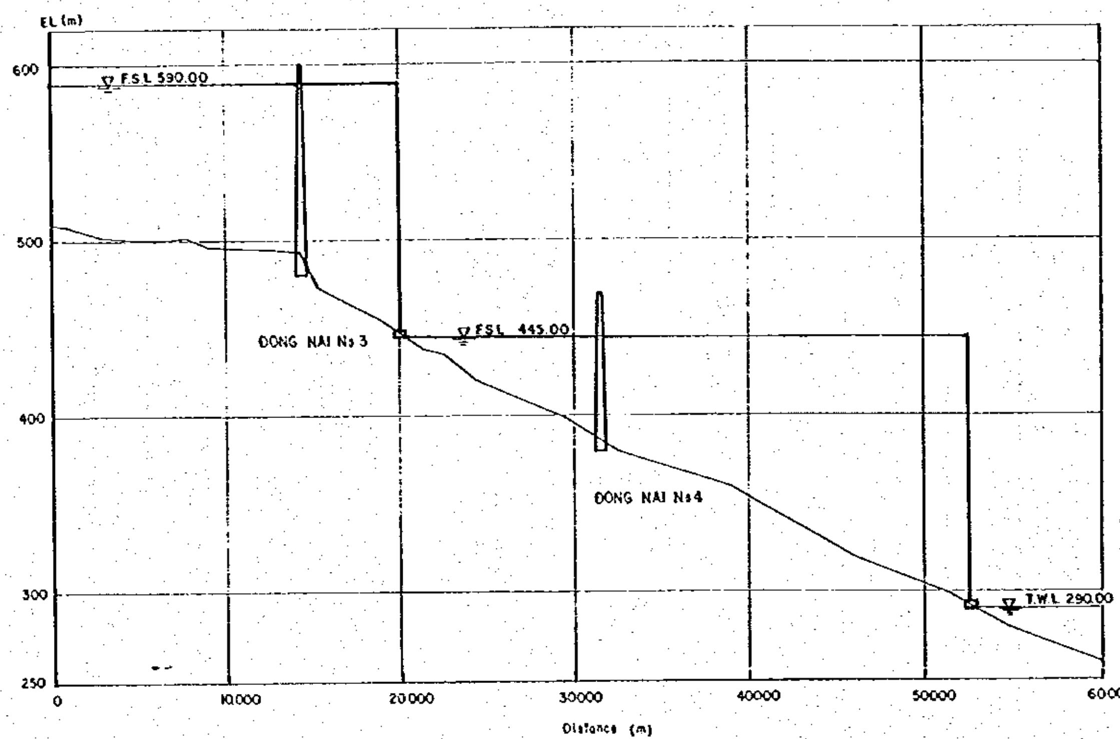

Figure E3.12 Longitudinal Profile of the Middle Reaches of Dong Nai River and Alternative Dam site (Alternative 4)

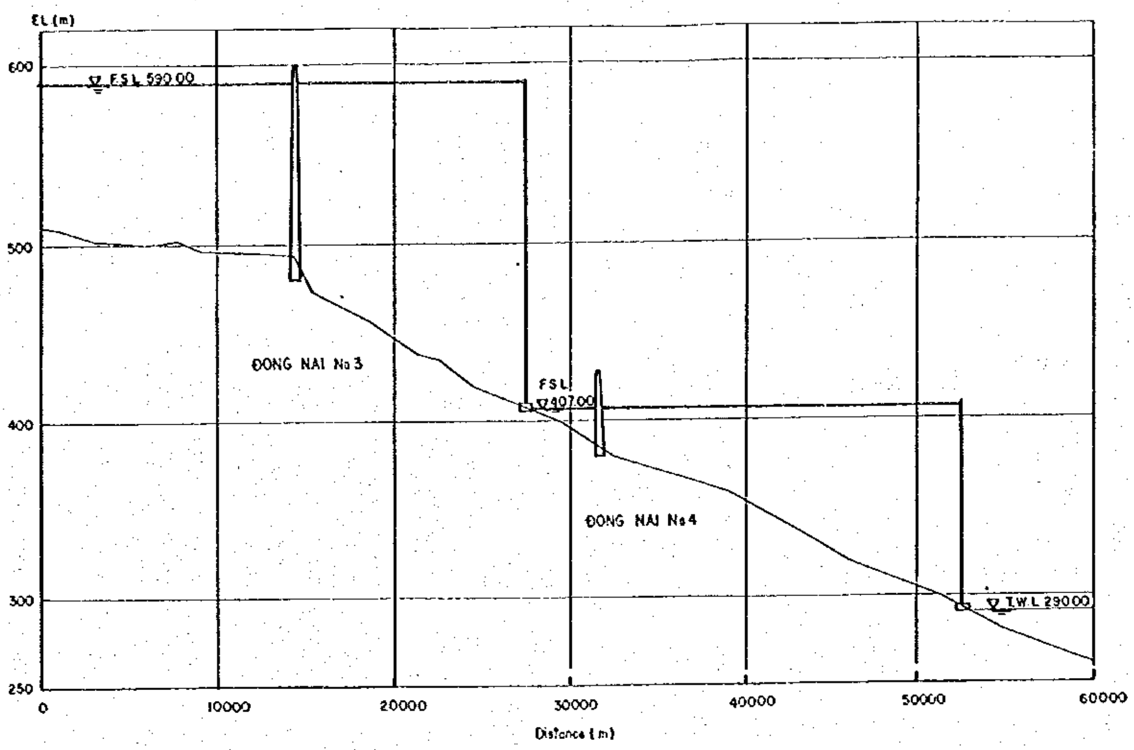

Figure E3.13 Longitudinal Profile of the Middle Reaches of Dong Nai River and Alternative Dam site (Alternative 5)

Note : This Figure shows the results of the preliminary optimization study to select the optimum project layout plan, which was carried out in the First Field Investigation Study (January - March 1999).

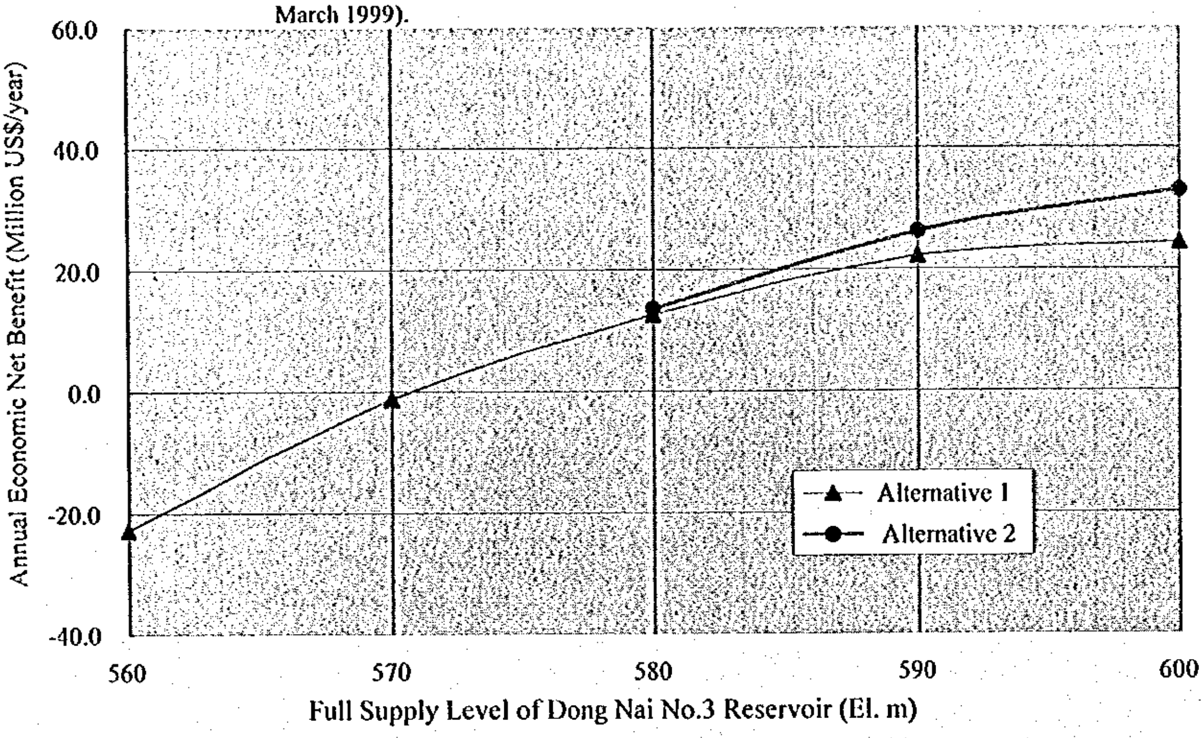

Figure E4.1 Comparison of Development Cases for Alternative-I and Alternative-II in Terms of Annual Net Benefit

Note : This Figure shows the results of the preliminary optimization study to select the optimum project layout plan, which was carried out in the First Field Investigation Study (January- March 1999).

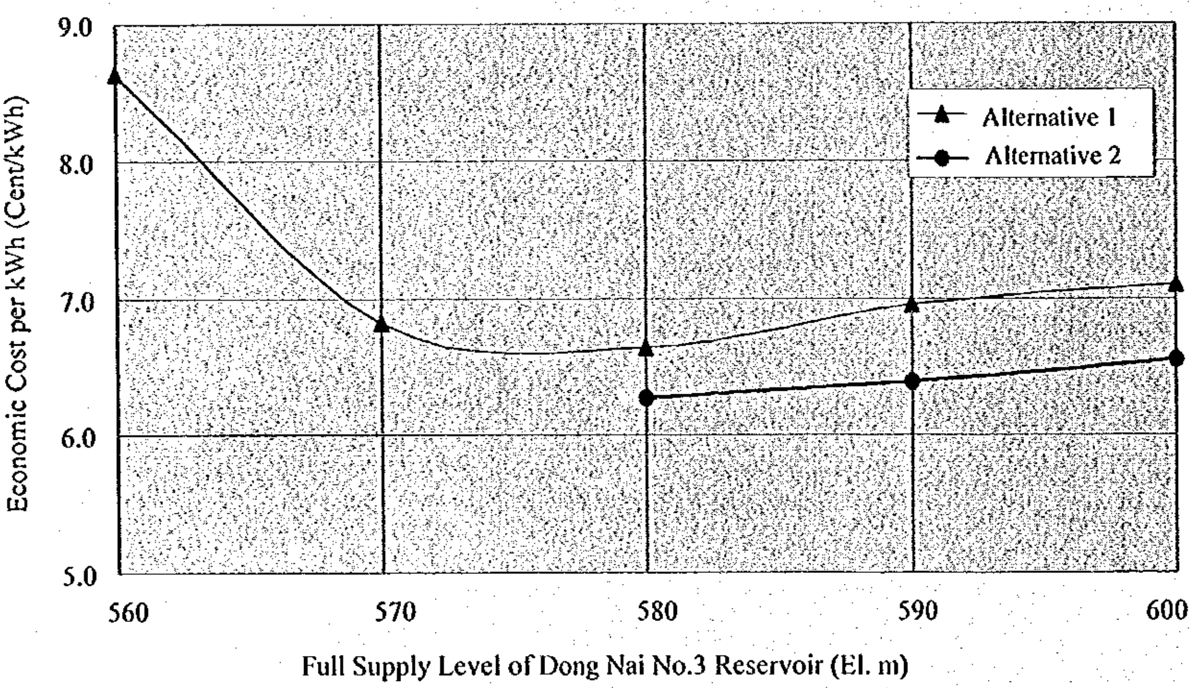

Figure E4.2 Comparison of Development Scales for Altertanative 1 and Alternative 2 in Terms of Economic Cost per kWh

Appendix F :

Data Related to Power Transmission System and Explanation of EGEAS

Appendix F : Data Related to Power Transmission System and Explanation of EGEAS

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Appendix F: Data Related to Power Transmission System and Explanation of EGEAS

F1 INTRODUCTION

This Appendix F compiles explanation of the software, EGEAS, which has been used in this feasibility study in order to determine the optimum installation timing of the Dong and No.3 and No.4 Combined Hydropower Project and the most appropriate daily minimum plant factor (daily minimum peak operation hours) born by the Project, taking into account cost of the whole power system over a long time span up to the year 2015. The results of these examinations with the EAGEAS are discussed in the corresponding Sections of Chapter 6 in the Main Report of this Draft Final Report.

In addition to the explanation of EAGEAS, this Appendix F compiles the results of analyses Related to the power transmission methods for the Project, which are presented in Section 7.4 of Chapter 7 of Main Report.

F2 EXPLANATION OF EGEAS

The software, EGEAS, is designed to be undertake the computation of power system cost for a wide range of capacity expansion options, and Dynamic Programming (DP) is applied to handle the sub-year production costing and reliability analysis for the Study. DP is capable of enumerating all of the possible planning alternative combinations in each year of the planning horizon and selecting the minimum cost transitions from one year to the next by utilizing the coarse grid DP technique. The overview of the model is summarized below:

(1) Objective Function

The objective function is to seek the least cost of capital and operating costs invested during the planning and extension periods. All the costs are discounted to the base year 1998. Capital costs of existing and committed units are not included since they are treated as sunk costs for the planning purposes. Operating costs of existing and committed as well as new units are determined in the program via detailed probabilistic production cost simulation and are included as part of costs.

(2) Constraints and Reliability

There are three reliability constraints implemented on each year of the planning horizon as follows:

a) Minimum reserve margin : 25 % of peak load
b) Loss of load probability : 10 days in a year
c) Expected unserved energy : 1 % of customer demand

(3) Decision and Input Variables

Decision variables in the DP program are integer variables representing the number of units of each alternative installed in each year of the planning period. Thus, the optimal plan consists of whole unit capacity additions.

Input variables can be grouped into three categories; general and load data, generating unit data, and DP program-specific data. The general data include specifications of the base year for cost discounting and system reliability requirement. In this study, all the costs are discounted to the base year 1998 by applying a discount rate of 10 %. The load data include load curves of each year and system demand data. The generating unit data specify capabilities and costs of generating units. The DP program-specific data include information on the years included in the planning horizon (the year 1998 to 2015), the length of extension period (17 years) that accounts for terminal effects, maximum number of States to be analyzed in DP, maintenance scheduling and other relevant data.

(4) Handling of Terminal Effects

Terminal effects arise because of the finite planning horizon in the expansion planning model. The costs and benefits associated with plans continue to accrue in the years beyond the planning horizon. A consideration of total costs beyond the planning horizon could well lead to an expansion plan different from the one indicated by analysis based on the only costs accrued in the planning horizon. These and related factors constitute the terminal effects which should be taken into account in the search for an optimal expansion plan.

In EGEAS, an extension period is formulated as the period that units installed during the planning horizon are replaced in kind. Committed and existing units that are not retired by the end of the planning horizon are assumed to operate throughout the extension period of 17 years. All of the years in the extension period are assumed to have the same load characteristics as those of the last year of the planning horizon. Operating costs during the extension period are discounted to the base year. Likewise, fixed charges for capacity installed during the extension period are discounted to the base year.

EGEAS calculates the present worth cost in the base year in the manners mentioned above.

F3 DATA RELATED TO POWER TRANSMISSION SYSTEM

As discussed in Section 7.4 of Main Report, the power transmission methods for the Dong Nai No.3 and No.4 Combined Hydropower Project have been examined in detail, taking up the 3 alternative methods.

Out of the three alternatives, the power system analyses including the power flow calculation, stability calculation, transmission loss calculation were carried out for the two alternatives, Alternative 1 and Alternative 3.

(1) Power System Analysis Calculation

The analyses adopt the size of the whole power system of Vietnam to be 14,000 MW that will be connected by the 500kV/220kV transmission system, referring to the plan by IOE. The results of the power system analyses are summarized below:

(i) Analysis Results in case of Alternative 1 (transmission line consisting two 220 kV circuits)

The power flow diagram in case of the Alternative 1 is shown in Figures F3.1 to F3.4. The transient stability swing curve is illustrated in Figures F3.9 and F3.10.

(ii) Analysis Results in case of Alternative 3 (Direct step-up to 500 kV at each substation of Dong Nai No.3 and No.4, and connect Dong Nai No.4 to the existing 500kV transmission line)

The power flow diagram in case of the Alternative 3 is shown in Figures F3.5 to F3.8. The transient stability swing curve is illustrated in Figures F3.11 and F3.12.

As a result of the power system analysis above, it is clarified that, with regard to both Alternative 1 and Alternative 2, any technical problems related to the power flow, power voltage and power stability will not take place.

(2) Comparison of the Three Alternative Transmission Methods in Terms of Annual Cost

The three transmission methods, the Alternative 1, Alternative 2 and Alternative 3, which are discussed in Section 7.4 of Main Report of this Draft Final Report, were compared from economic aspect in terms of their annual costs. In the economic comparison, the transmission loss was also taken into account. The economic amount loosed by the transmission loss was measured with the kW and kWh values that are adopted in Chapter 9 of Main Report of this Draft Final Report. The economic comparison is made on the following basic conditions and assumptions:

- The life time of equipment to be installed in switchyard and transmission line are 15 years and 20 yeas, respectively. Therefore, the capital recovery factors for these are derived at 13.2% and 11.8%, respectively.
- Annual maintenance and operation cost is equivalent to 1.5% of capital cost.

The cash flow for each of the three alternatives was prepared for the project life of 20 years as shown in Table F3.1. The Table shows that the Alternative 3 is the most economical among the three alternative transmission methods.

Appendix F

Table

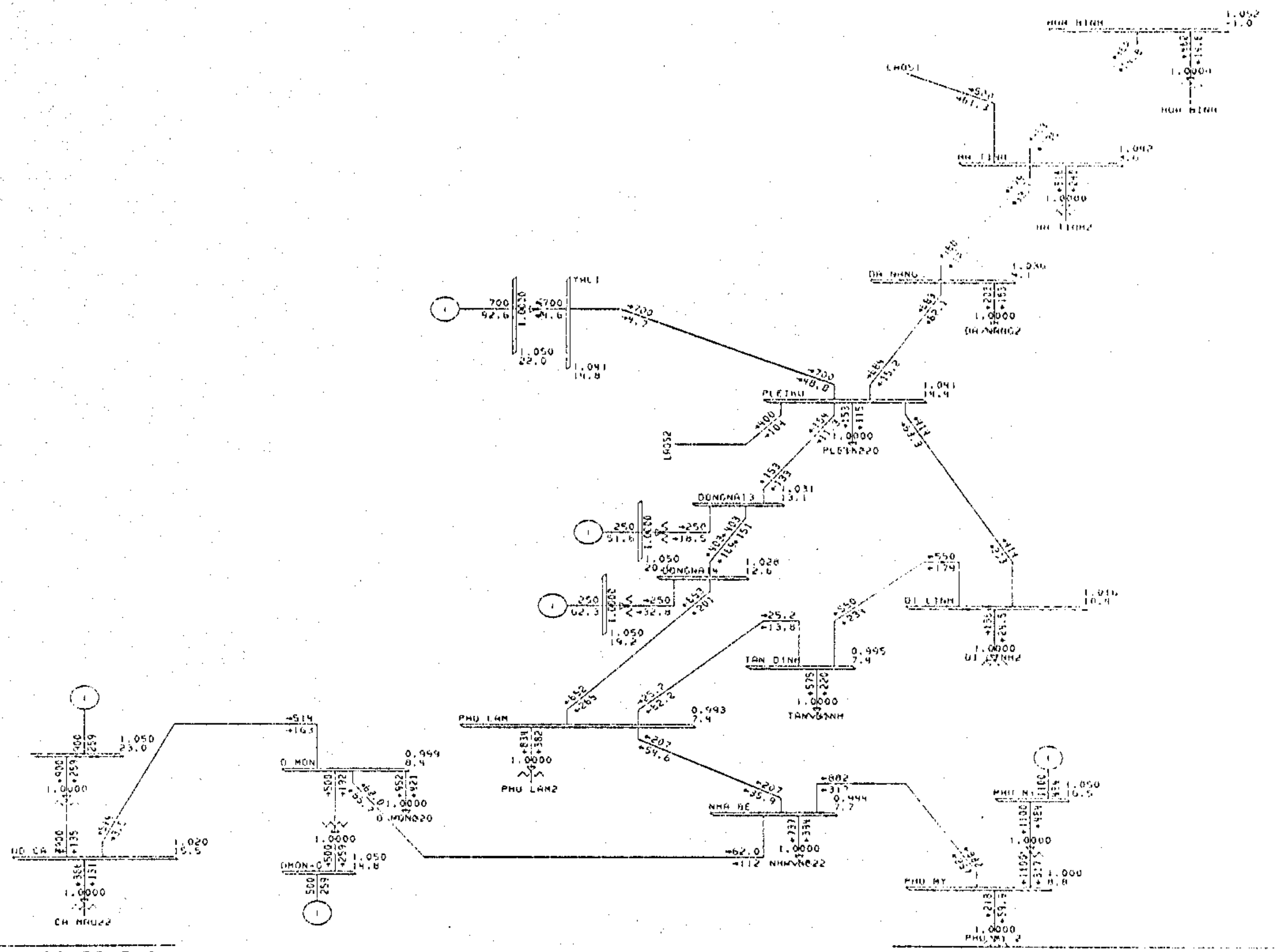
Table F3.1 Cash Flow of Annual Cost

Unit: millionUS$

Year	Alternative 1						Alternative 2				Alternative3			
	S/S	T/L	O/M	kW Loss	kWh Loss	Total	S/S	T/L	O/M	Total	S/S	T/L	O/M	Total
1	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
2	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
3	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
4	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
5	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
6	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
7	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
8	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
9	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
10	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
11	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
12	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
13	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
14	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
15	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
16	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
17	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
18	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
19	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646
20	4.015	0.958	0.578	2.745	2.498	10.794	5.837	0.819	0.767	7.423	4.792	1.162	0.692	6.646

S/S: Substation
T/L: Transmission Line
O/M: Operation and Maintenance

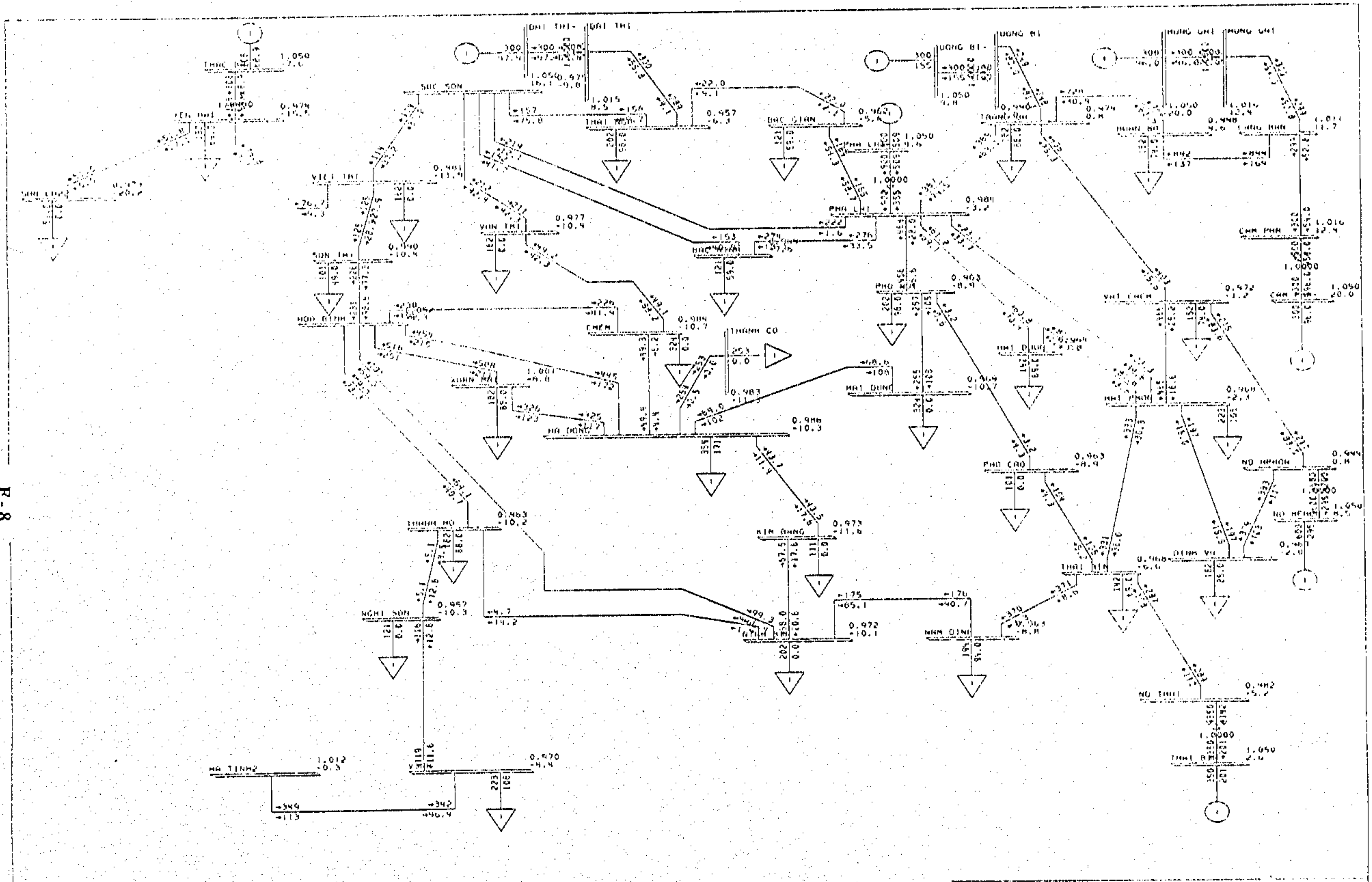
Appendix F
Figures



VIETNAM 2010 POWER FLOW
DONG NAI 500KV-NEW
SAT. NOV 13 1999 17:15

JS - VOLTAGE (PU)/ANGLE
RANCH - MW/MVAR
UIPMENT - MW/MVAR

Figure F3.1 Power Flow Diagram of 500kV System
(Dong Nai 500kV Transmission)



VIETNAM 2010 POWER FLOW	
DONG NAI 500KV-NEW	
TUE, JAN 04 2000	15:17

Figure F3.2 Power Flow Diagram of 220kV North System
(Dong Nai 500kV Transmission)

IS - VOLTAGE(PU)/ANGLE
ANCH - MW/MVAR
UIPMENT - MW/MVAR

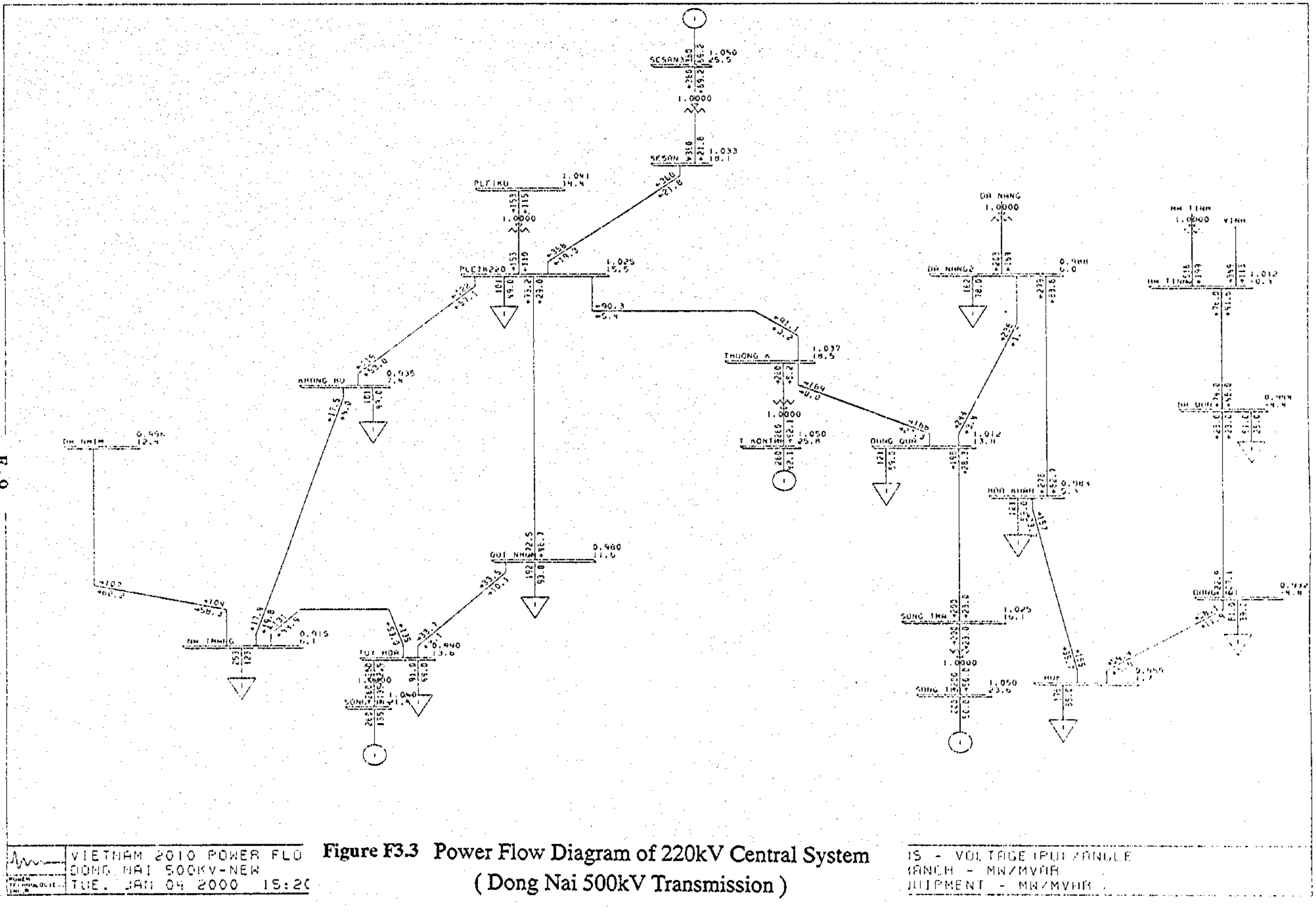
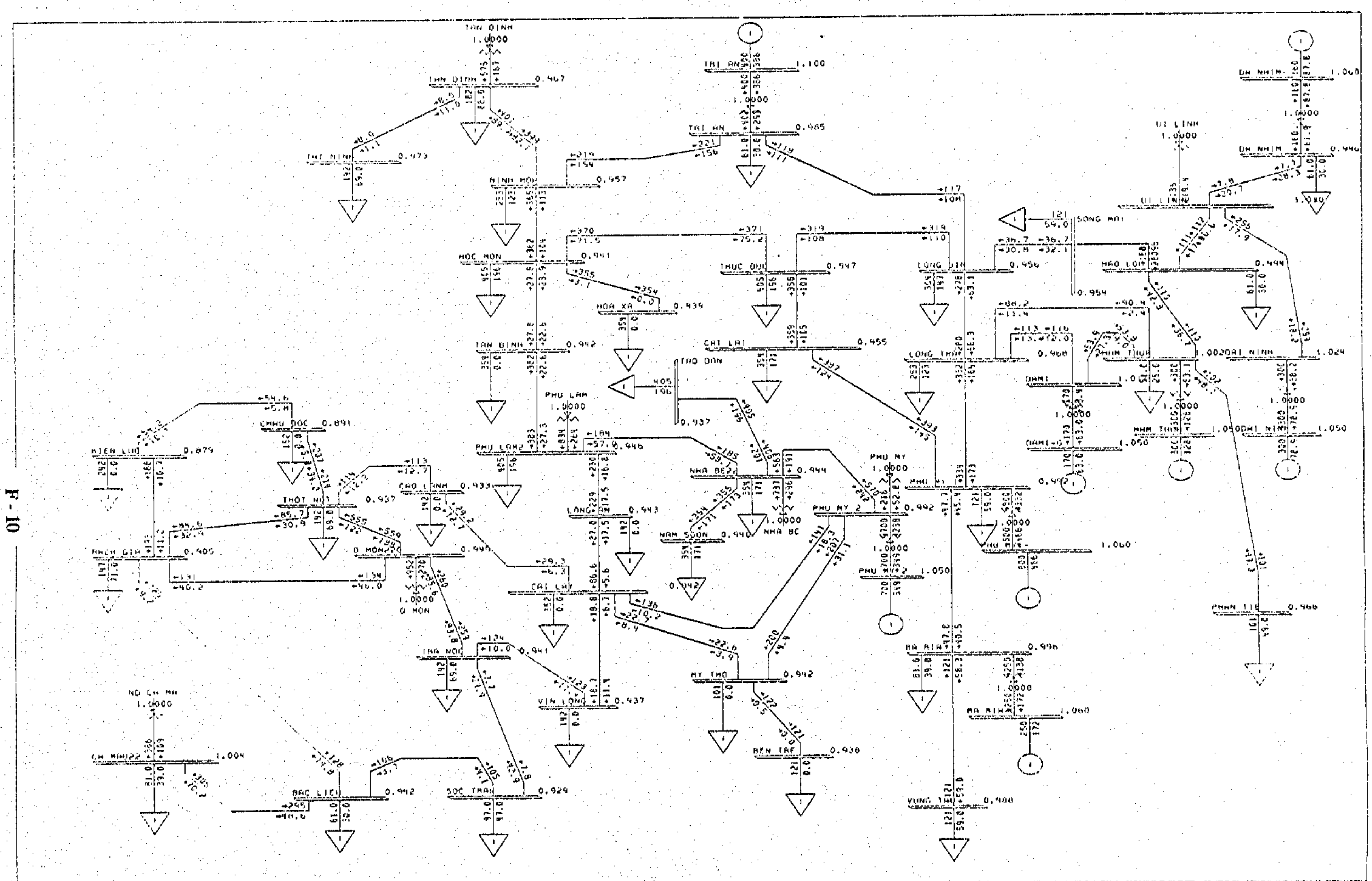
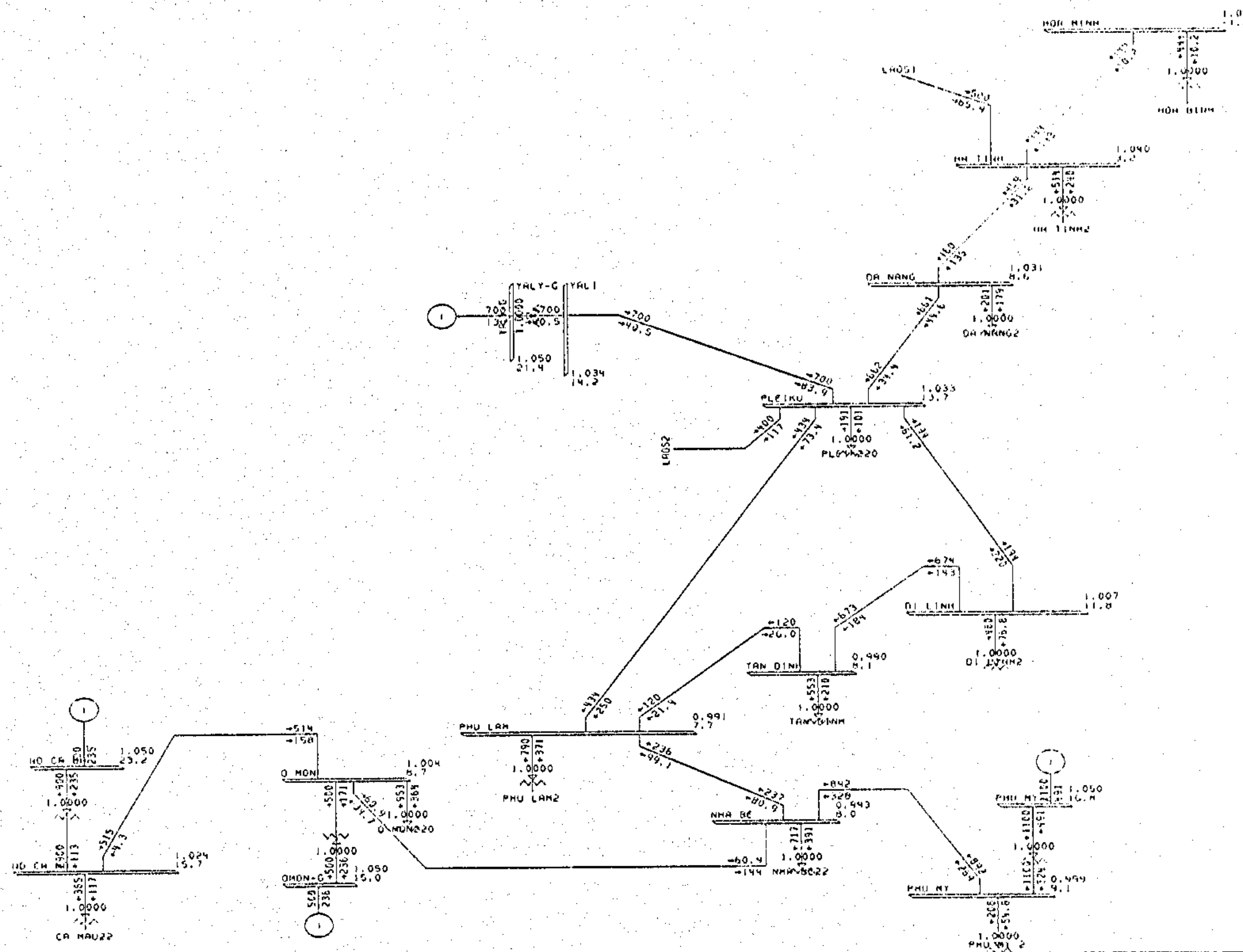


Figure F3.3 Power Flow Diagram of 220kV Central System
(Dong Nai 500kV Transmission)



VIETNAM 2010 POWER FLOW
DONG NAI 500KV-NEW
TUE. JAN 04 2000 15:32

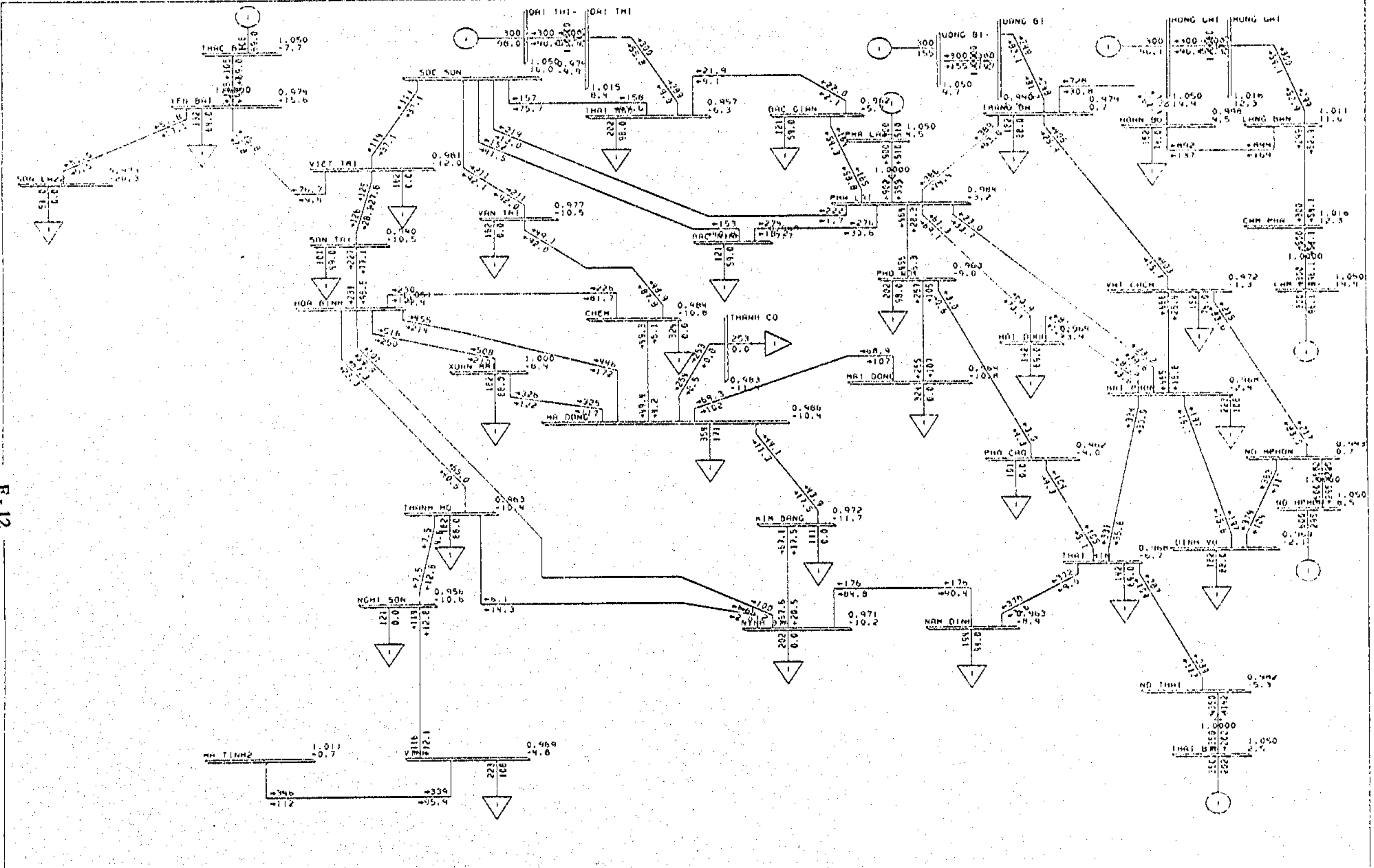
Figure F3.4 Power Flow Diagram of 220kV South System
(Dong Nai 500kV Transmission)



VIETNAM 2010 POWER FLC
DONG NAI 220KV-NEW
MON. NOV 15 1999 15:1

Figure F3.5 Power Flow Diagram of 500kV System
(Dong Nai 220kV Transmission)

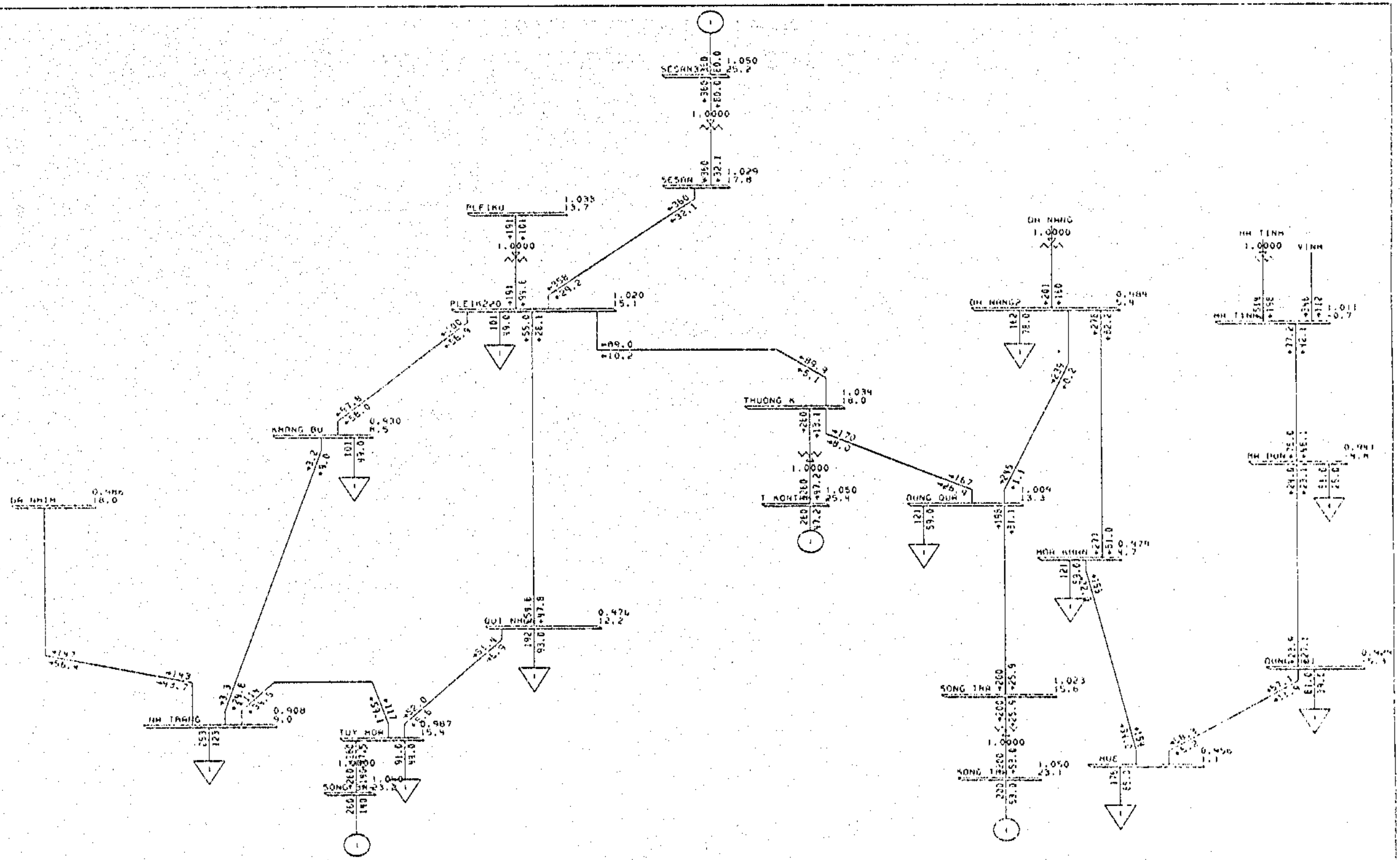
BUS - VOLTAGE (PU) / ANGLE
BRANCH - MW/MVAR
EQUIPMENT - MW/MVAR



VIETNAM 2010 POWER FL	
DONG NAI 220KV-NEW	
MON, NOV 15 1999 18:	

Figure F3.6 Power Flow Diagram of 220kV North System
(Dong Nai 220kV Transmission)

BUS - VOLTAGE(PU)/ANGLE
BRANCH - MW/MVAR
EQUIPMENT - MW/MVAR



VIETNAM 2010 POWER FLO	
DONG NAI 220KV-NEW	
MON, NOV 15 1999 16:10	

Figure F3.7 Power Flow Diagram of 220kV Central System
(Dong Nai 220kV Transmission)

- VOLTAGE (PU) /ANGLE
NCH - MW/MVAR
IPMENT - MW/MVAR

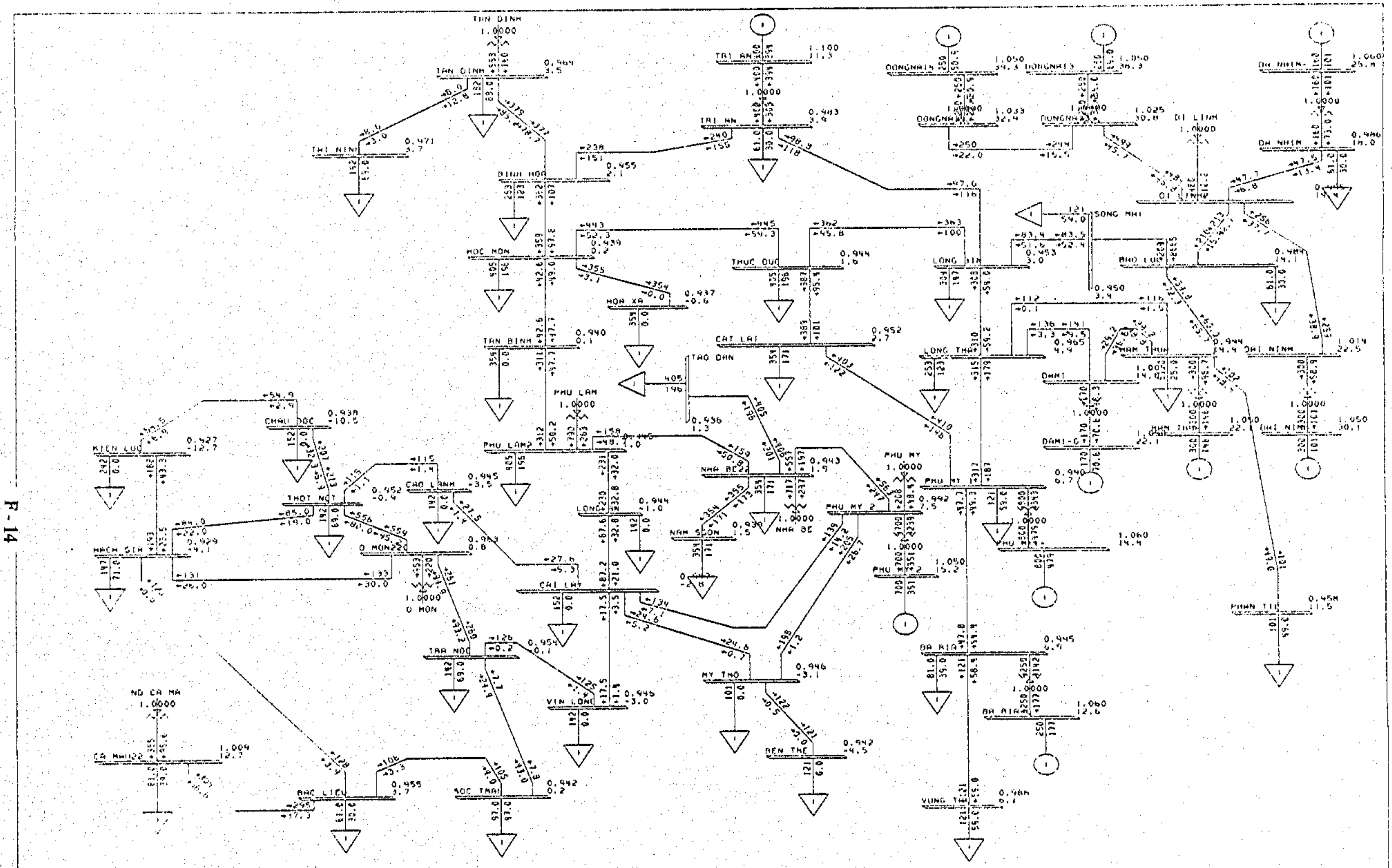


Figure F3.8 Power Flow Diagram of 220kV South System
(Dong Nai 220kV Transmission)

VIETNAM 2010 POWER FLOW
DONG NAI 220KV-NEW
MON, NOV 15 1999 15:03

S - VOLTAGE (PU) / ANGLE
ANCH - MW/MVAR
UIPMENT - MW/MVAR

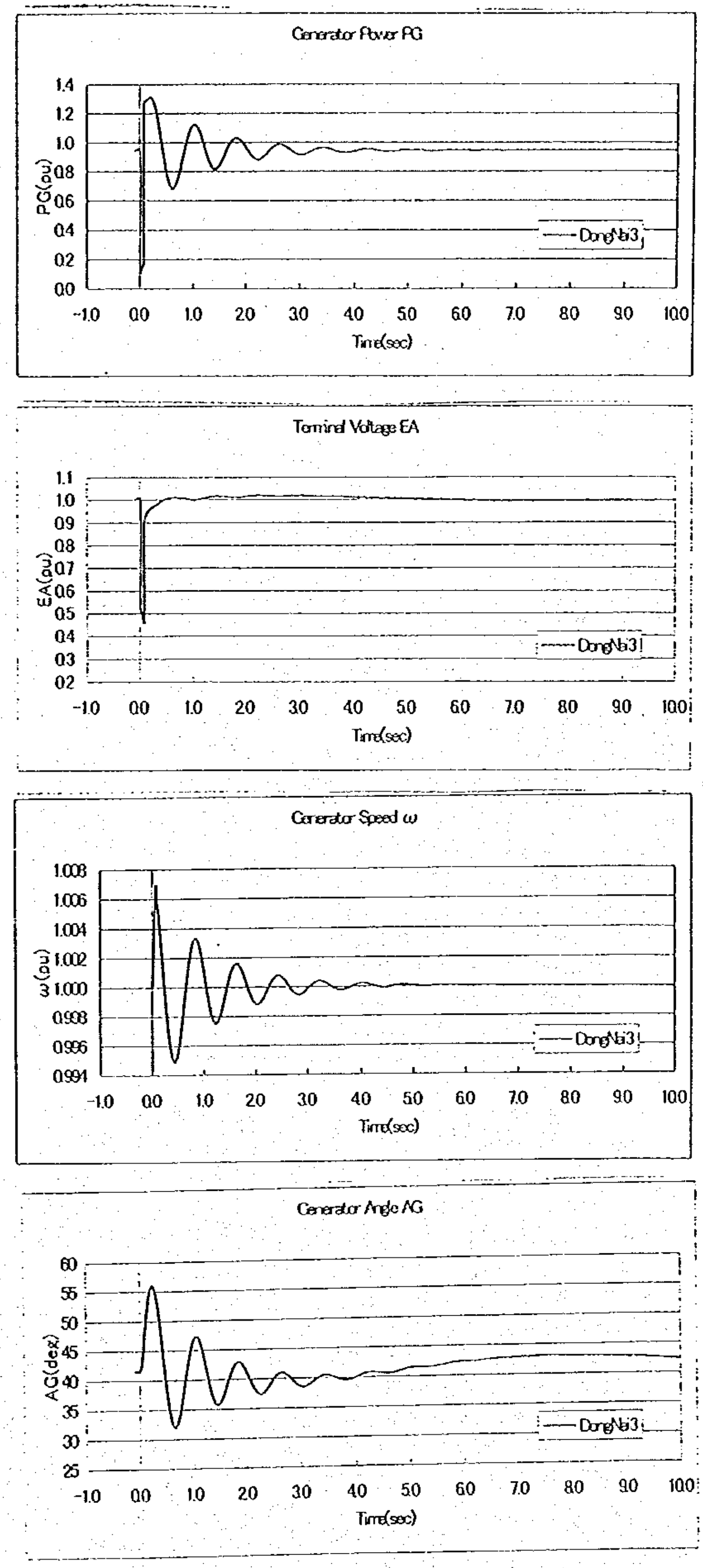


Figure F3.9 Stability Swing Curve of Dong Nai 3(Dong Nai 500kV Transmission)

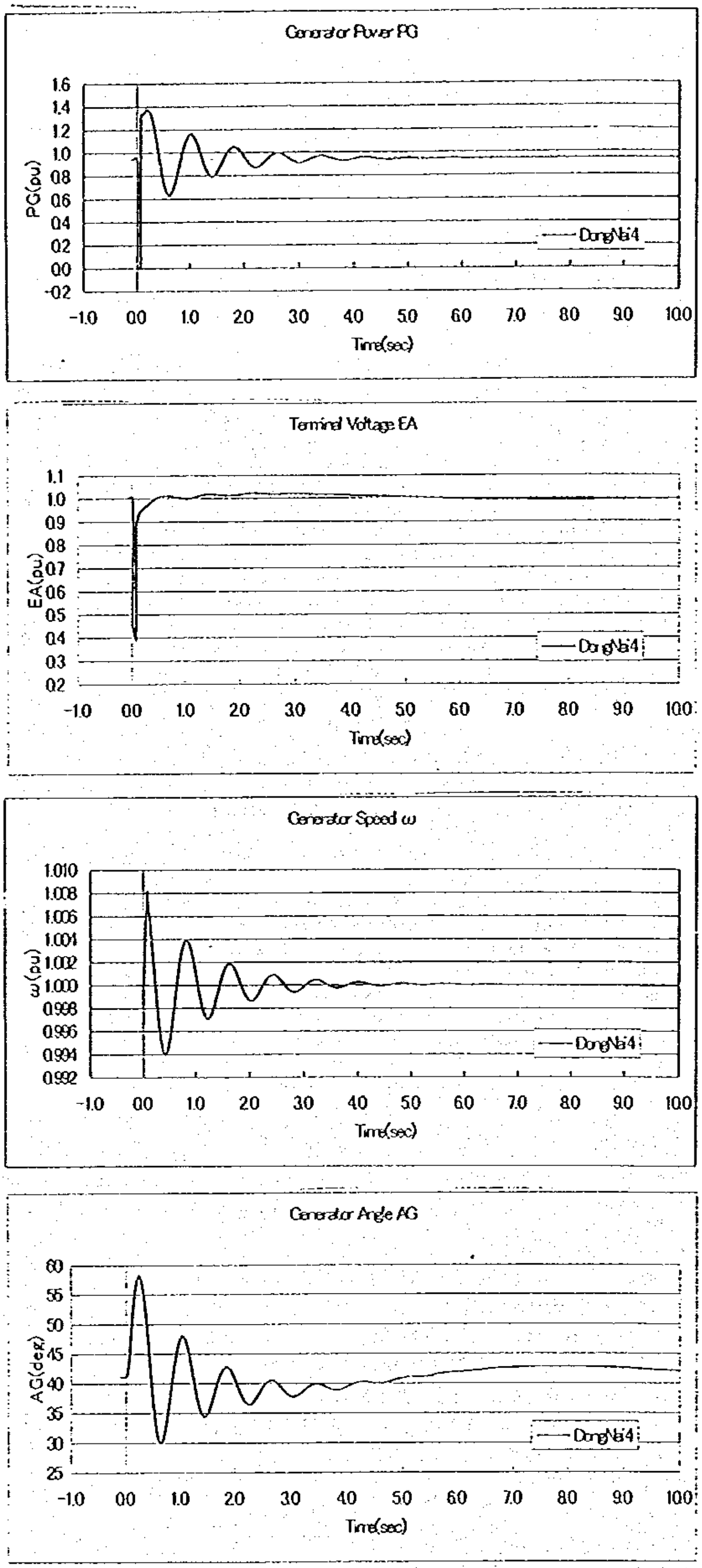


Figure F3.10 Stability Swing Curve of Dong Nai 4(Dong Nai 500kV Transmission)

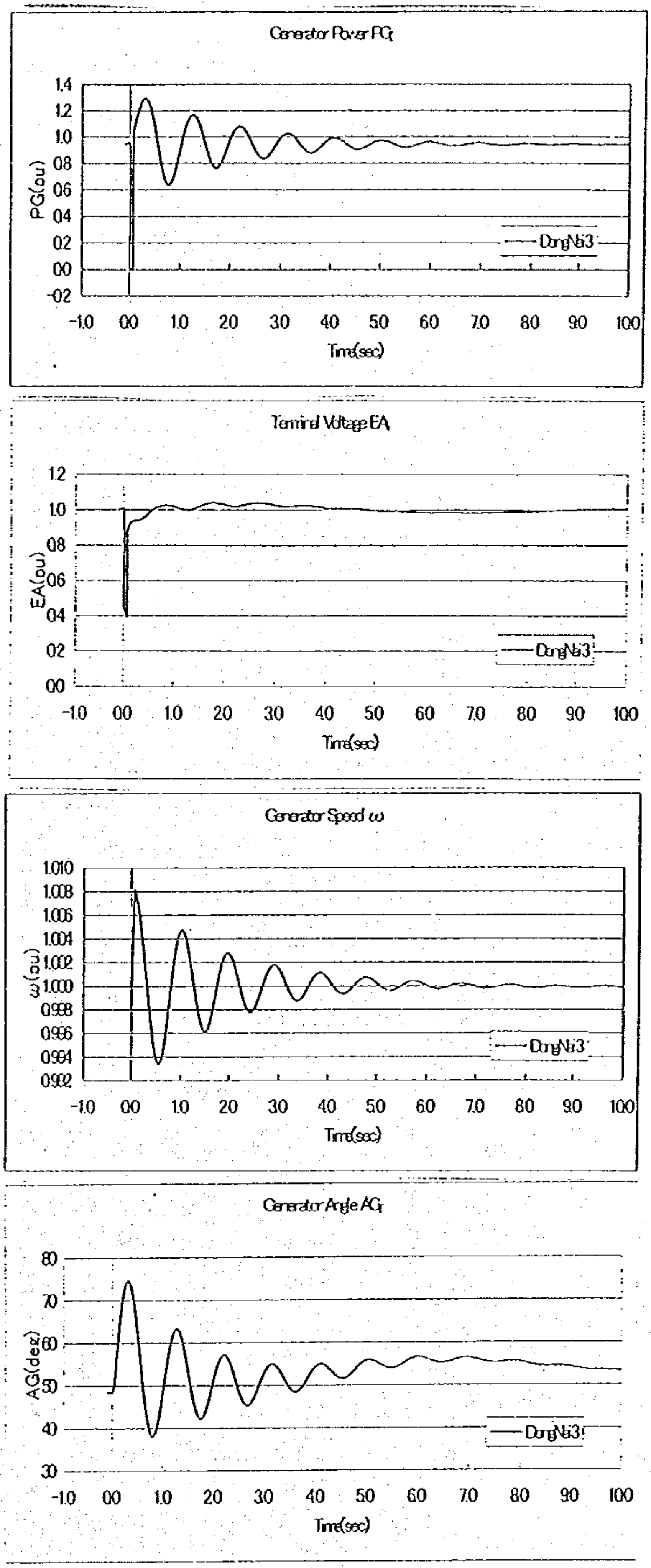


Figure F3.11 Stability Swing Curve of Dong Nai 3(Dong Nai 220kV Transmission)

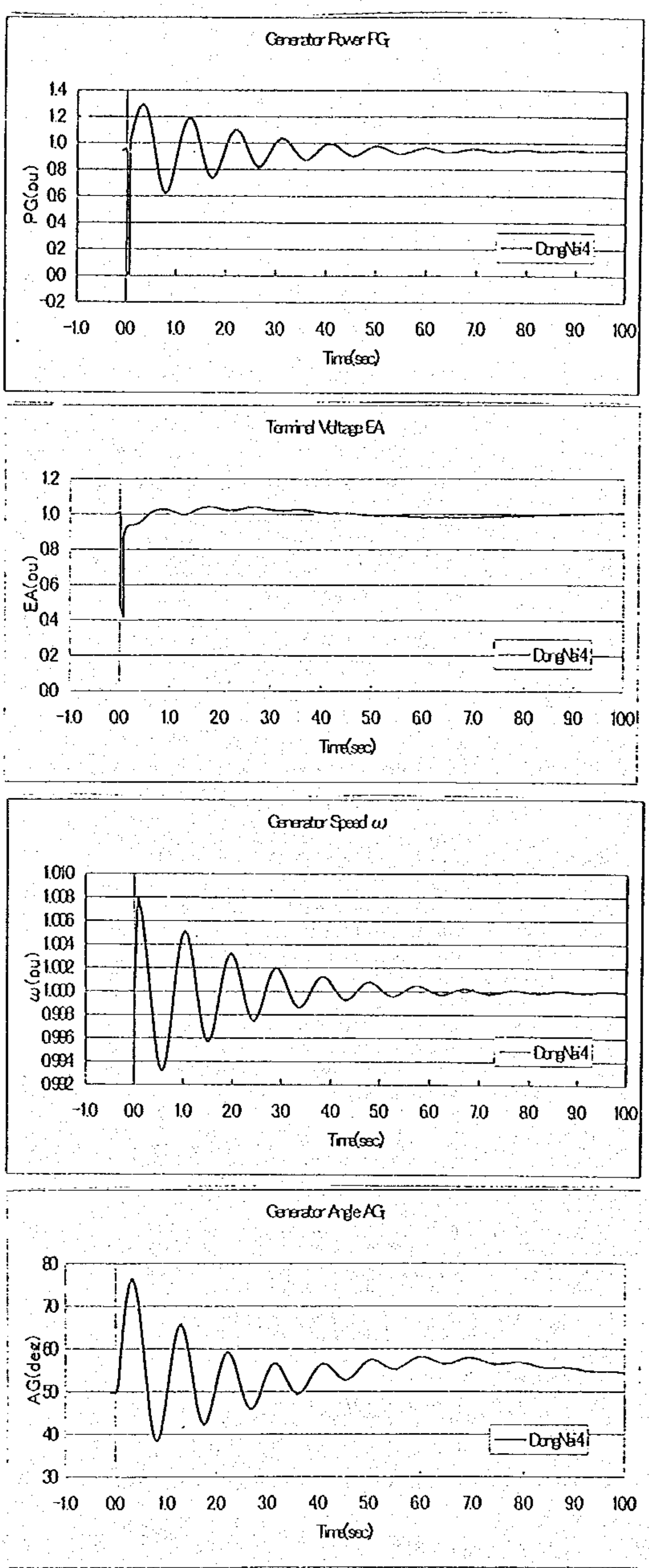


Figure F3.12 Stability Swing Curve of Dong Nai 4(Dong Nai 220kV Transmission)

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