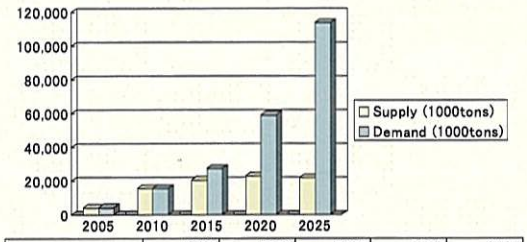
Coal supply-demand in Power sector: High case



	2005	2010	2015	2020	2025
Supply (1000tons)	4,161	15,650	20,570	23,107	21,918
Demand (1000tons)	4,286	15,707	27,357	59,080	113,582

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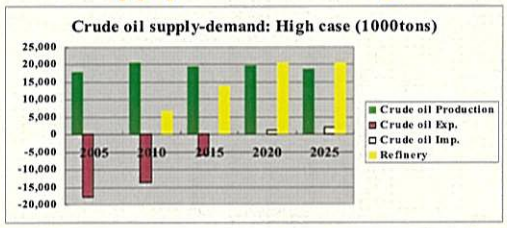
Balance of crude oil supply-demand : High case



	2005	2010	2015	2020	2025
Production	17,800	20,360	19,340	19,480	18,620
Export	-17,800	-13,860	-5,840	0	0
Import	0	0	0	1,020	1,880
Refinery	0	6,500	13,500	20,500	20,500

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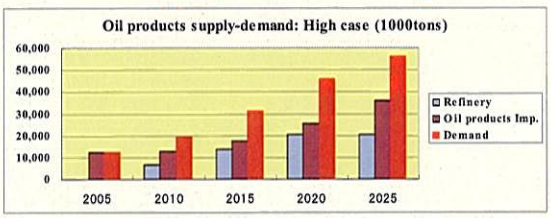
Balance of oil products supply-demand : High case



	2005	2010	2015	2020	2025
Refinery	0	6,500	13,500	20,500	20,500
Oil products Imp.	12,066	12,879	17,495	25,391	35,830
Demand	12,066	19,379	30,995	45,891	56,330

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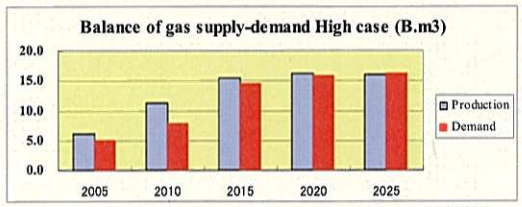
Balance of Gas supply-demand : High case



(BCM)

	2005	2010	2015	2020	2025
Production	6.0	11.2	15.5	16.1	16.0
Demand	4.9	7.8	14.6	15.9	16.3
Import	0.0	0.0	0.0	0.0	0.3

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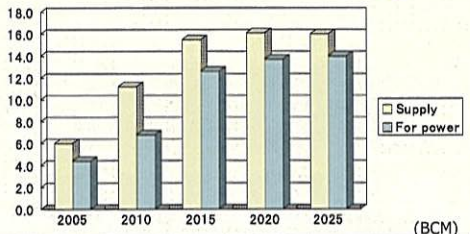
Gas supply-demand in Power sector : High case



(BCM)

	2005	2010	2015	2020	2025
Supply	6.0	11.2	15.5	16.1	16.0
For power	4.4	6.8	12.6	13.7	14.0

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Energy supply and demand

- Hydro power development
  keep target of 78% by 2020
- Fossil energy development (coal, gas and oil)
  keep on investigation of new exploitable site, import study and more production from 2015
- Other energy resources development
  prompt of renewable energy and nuclear utilization
- Power trade
  international network building and operation

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Energy prices study: Reference

Data source	2003	2010	2020	2030
WTI crude oil (U$/barrel)	31.2	35.0	35.0	35.0
IEA crude oil (U$/barrel)	27.0	22.0	26.0	29.0
Japan LNG imp. (U$/MMBtu)	4.6	3.9	4.4	4.8
OECD coal imp. (U$/ton)	38.0	40.0	42.0	44.0
Vietnam crude oil (U$/barrel)	31.2	40.0	40.0	40.0

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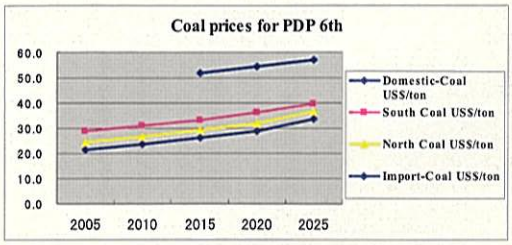
Coal prices forecast



	2005	2010	2015	2020	2025
Domestic-Coa	21.4	23.6	26.1	28.8	33.4
South Coal	28.5	30.7	33.2	35.9	39.8
North Coal	24.4	26.6	29.1	31.8	36.4
Import-Coal			51.7	54.3	57.1

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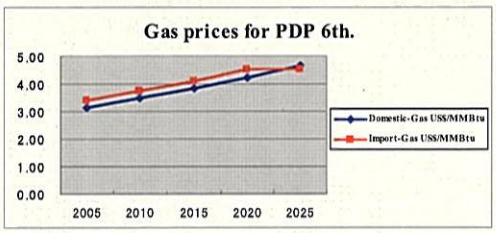
Gas prices forecast



	2005	2010	2015	2020	2025
Domestic-Gas	3.14	3.46	3.82	4.22	4.66
Import-Gas	3.37	3.72	4.11	4.54	4.54
Crude Oil	60.0	40.0	40.0	40.0	40.0

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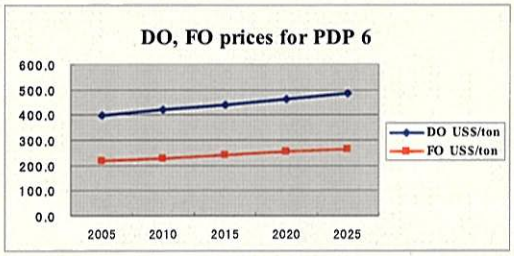
FO,DO prices forecast



	2005	2010	2015	2020	2025
DO	398	418	440	462	486
FO	217	228	240	252	265

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End of Session

Thank you for your attention!

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The Study on National Power Development Plan for the period of 2006-2015, perspective up to 2025 in Vietnam

Power Development Plan

December 2005

Japan International Cooperation Agency (JICA)

Tokyo Electric Power Co., Inc. (TEPCO)
Tokyo Electric Power Service Co., Ltd. (TEPSCO)

Contents

- Conditions of study
- Target level of System Reliability
- Least cost PDP in 2025

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Conditions of Study

- Target years
  - 2025, 2020
- PDP
  - Candidates are based on IE plan
- Demand Forecast

	2015	2020	2025
Peak (MW)	32,196	48,642	71,416
Energy(GWh)	190,047	294,012	431,664
North (MW)	13,480	20,285	29,959
Central (MW)	3,502	5,551	8,741
South (MW)	15,521	23,467	33,759

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System Configuration

- Divided into two systems

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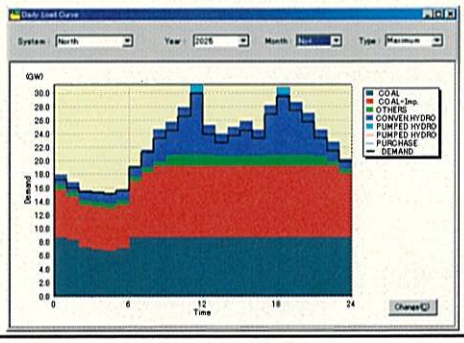
Load Profiles in 2025

- North: Two peaks



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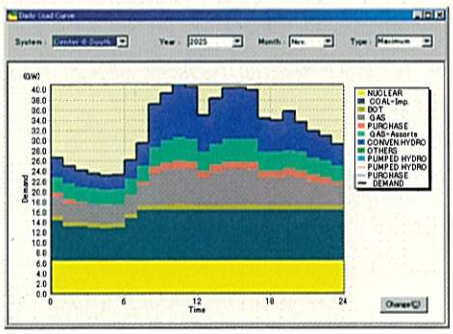
Load Profiles in 2025

- Central & South: Three peaks



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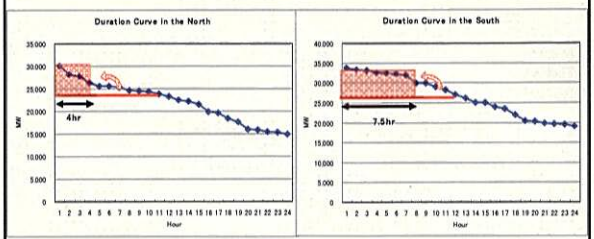
Peak Duration

- North: 4hours in a day
- South: 8huors in a day



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Tools for analysis

- System Reliability — RETICS
- Annual Costs
- Balance between Demand and Supply — PDPAT II

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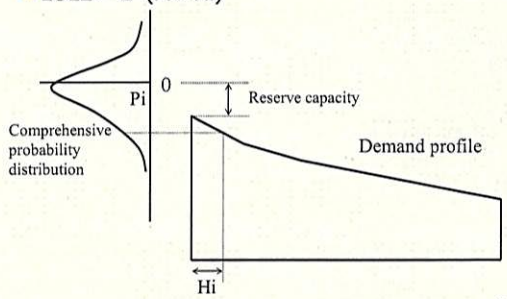
Checking System Reliability

- Reliability; LOLE Loss of Load Expectation
- LOLE = Σ (Pi × Hi)



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Simulation of Supply & Demand Balance by PDPAT II

- Computation of Balance between Demand and Supply (Economic Dispatch)
  - Most Economical Energy Balance (Fuel Balance)
  - Optimal Power Balance
  - Reserve Margin
  - Fuel Consumption
- Computation of Power Exchange
  - Quantity & Frequency of Exchange
  - Economical Power Exchange

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Conditions for Simulation

- Reliability Simulation conditions
  - Demand deviation: 3%
  - Hydropower FOR: 2%
  - Thermal : depending on each generator
- Simulation of optimal operation
  - N-1 criteria applied after 2016: 800MW until 2020, 1300MW until 2025 of Interconnection capacity
  - 500kV TL losses: 6%

  Assuming from the system analysis

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Characteristics of generators

Plant type	Capital cost (USD per kW)	Heat efficiency (%)	Fuel cost (dollars)	Lifetime (years)	O&M cost factor	Capital recovery factor	Calorie	Station service rate (per kWh)
Gas fired combined cycle	660	48	4.66per mmBtus	25	4.5%	11.02%		2.5%
Coal fired in the north	980	40	36.4 per ton	25	2.0%	11.02%	5500kcal/kg	7.0%
Coal fired in the south (coal from the north)	1100	40	39.4 per ton	25	2.0%	11.02%	5500kcal/kg	7.0%
Coal fired in the south (imported coal)	1100	40	63 per ton	25	2.0%	11.02%	6500kcal/kg	7.0%
Gas Turbine	400	37	4.66per mmBtus	20	5.0%	11.75%		5.0%
Diesel	800	38	466 per ton	25	2.0%	11.02%	10150kcal/l	5.0%
Pumped storage PP	750	70		40	1.0%	10.23%		0.5%
Nuclear	1700	33	0.124cent/10^3kcal	25	5.0%	11.02%		5.0%

Note:Discount rate of 10%.
Note:Capital costs of coal fired in the south and nuclear power include construction cost of its own port.
Note:All generation costs are culicurated at sending end

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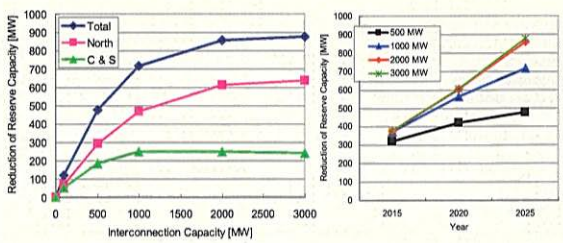
Interconnected System Reliability

- Around 1000MW is economical



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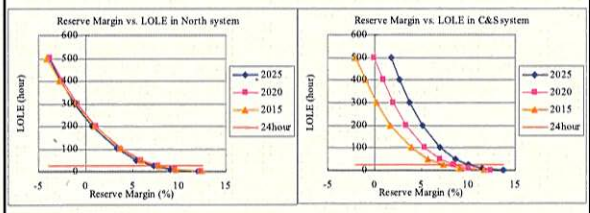
Target Level of System Reliability

- System reliability conditions in 2025
  - N:7-8%, C&S: 10% for 24-hour LOLE

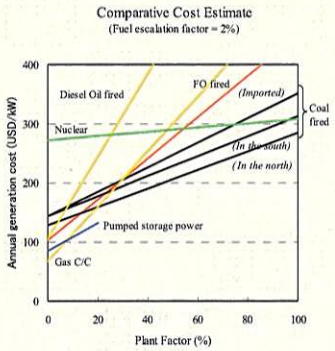


Least Cost PDP in 2025

- Setting Base Scenarios to 2025
  - Based on IE base scenario
  - Considering Gas supply limitation
- Considering Risks
  - Drought effect
  - Fuel price hike
  - Power Imports
  - BOT upper limitation

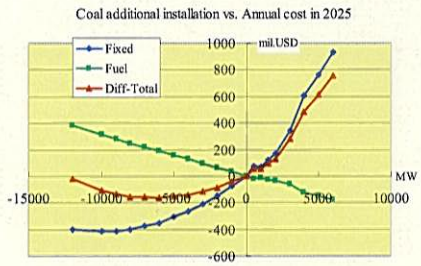
Screening

- Generation costs are different by Capacity Factors



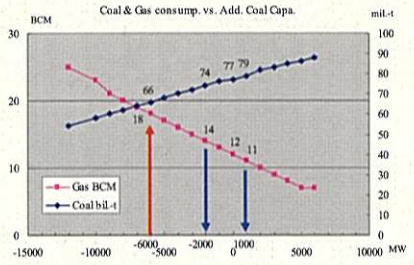
Least Cost Composition (1)

- The economical composition in 2025
  - Least cost PDP: Coal 37%, Gas 24%, 6000MW changing coal to gas from the base scenario



Least Cost Composition (2)

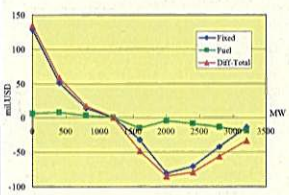
- Available economical composition in 2025
  - Coal 45%, Gas 18%, 2000MW changing coal to gas considering **the gas supply limitation**



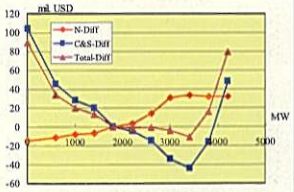
Least Cost Composition (3)

- PSPP composition in 2025
  - 2000MW in the North, 1800MW in the C&S

North system in 2025

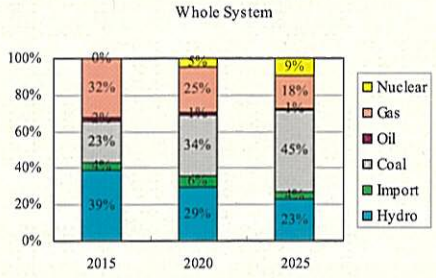


C&S system in 2025



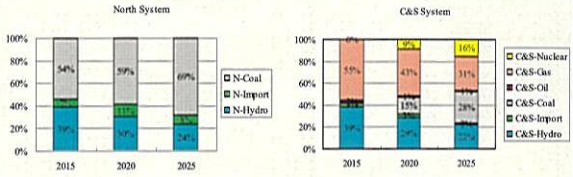
Base Scenario (1)

- Available economical composition in 2025
  Coal 45%, Gas 18%, Hydro 23%



Base Scenario (2)

- Available economical composition in 2025



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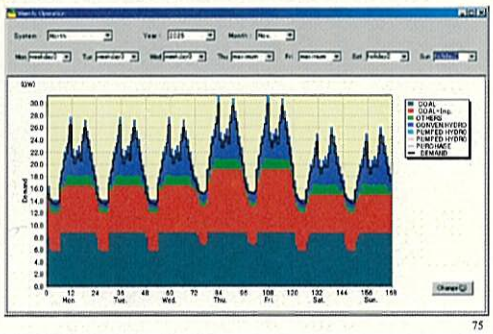
Simulation result (1)

- Result of simulation in North in Nov. 2025



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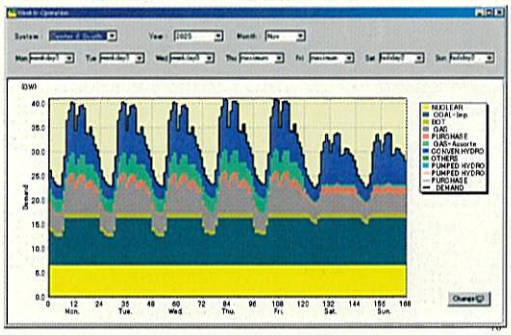
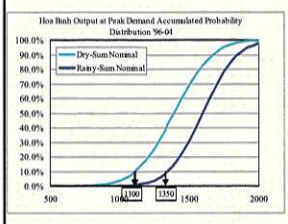
Simulation Result (2)

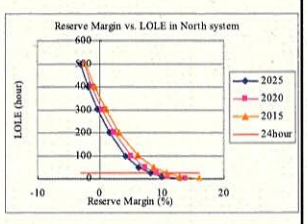
- Result of simulation in C&S in Nov. 2025



Risk analysis: Drought Effect

- Actual records -400MW in Dry season
- Reserve capacity affected around +1% in North





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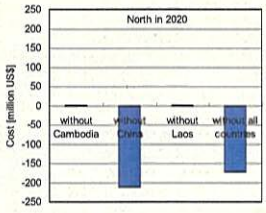
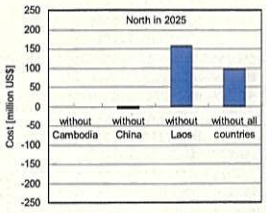
Risk analysis: Import power

- Import power price should compare marginal costs





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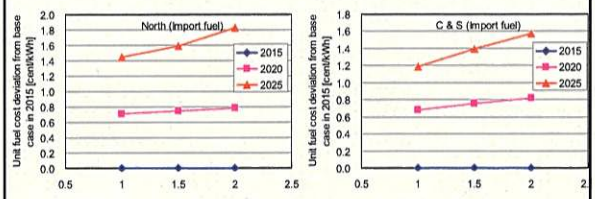
Risk analysis: Fuel price hike

- Import fuel price hike +0.4 c/kWh in 2025



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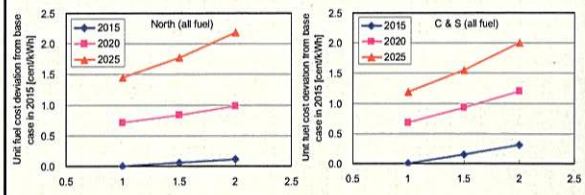
Fuel price hike (2)

- Import fuel price hike +0.7 c/kWh in 2025



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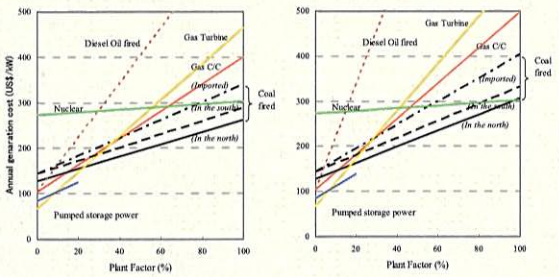
Fuel price hike (3)

- Fuel price affects a unit economical order



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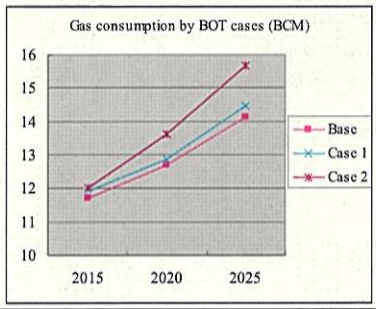
BOT upper limitation (1)

- Base scenario reaches 14 BCM of gas consumption in 2025
- Base 1440MW, Case1 3990MW, Case2 9030MW, CF=75%



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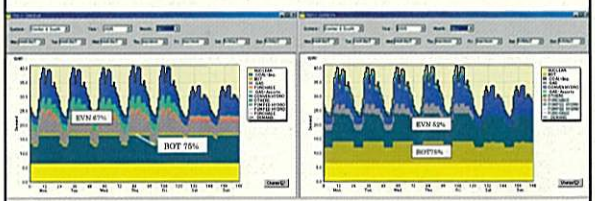
BOT upper limitation (2)

- EVN units decrease operation
  CF 67% →52%



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BOT upper limitation (3)

- Changing Contract Method
  - If BOT Contract Method is changed from Generation Energy charge base, which capacity factor is fixed, to Capacity charge and Fuel charge base, BOT's Power Plants could operate as well as EVN units.

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Comments & Recommendations

- Reliability criteria could be applied RM criteria. N 7-8%, C&S 10%
- Economical Interconnection capacity around 1000MW
- Review Firm Peak Capacity of Hydropower in dry season based on actual records
- BOT scheme has limitation up to 1440MW due to fuel limitation, if CF=75% contract remaining

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End of Session

Thank you for your attention!

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The Study on National Power Development Plan for the period of 2006-2015, perspective up to 2025 in Vietnam

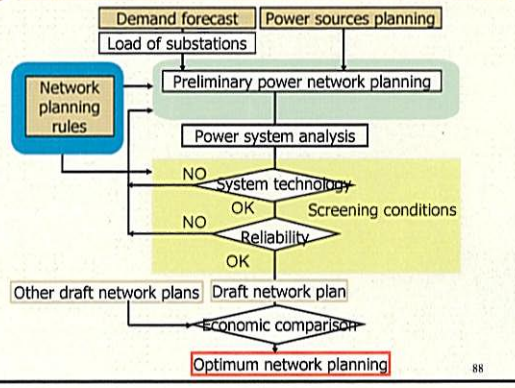
Power Network Development Plan

December 2005

Japan International Cooperation Agency (JICA)

Tokyo Electric Power Co., Inc. (TEPCO)
Tokyo Electric Power Service Co., Ltd. (TEPSCO)

Power Network Planning Procedure



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N-1 Criteria

- Assuming a lack of a unit of facilities such as transmission lines or transformers
- Stable and continuous power transmission
  - Power system analysis

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Power Supply In/around Large Cities

- Future Hanoi and Ho Chi Min City
  - Huge power demand densities
  - Large power flow

- Larger size facilities considered
- 500 kV multi circuits required from large power plants
- 500 kV multi-ring shaped systems
- Countermeasures against large fault current
  - Causing frightening of fault-breaking ability of circuit breakers

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