

### [3] Optimization study on network planning

Japan International Cooperation Agency (JICA)

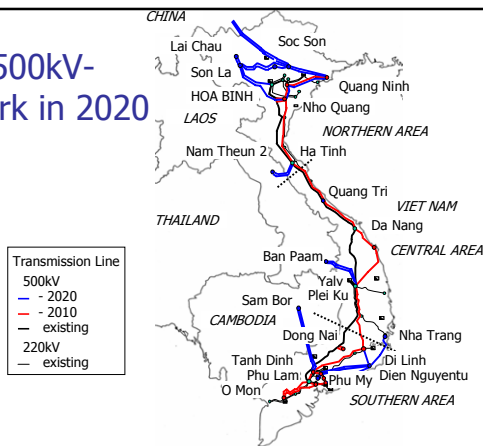
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### Base-500kV-network in 2020

- 2010: Double Circuits from North to South
- 2020: Power Grids in North and South Region
- Series Capacitors
- Power Flow
  - from North to Center & South Region tending to grow
  - uneven Distribution of Hydropower and Coal-fired Power Plants

2

### Base-500kV-network in 2020



### 500 kV series capacitors

- Possibility of Shaft-twist Vibration stopping Generators
- Necessary for EVN:
  - Interactive Studies between Series Capacitors and Generators
  - Determining Countermeasures

4

### Evaluation of system reliability

- Criteria
  - N-0
    - Power Supply is possible on Normal State of System.
  - N-1
    - Power Supply is still possible; even if a Circuit Fault happened.

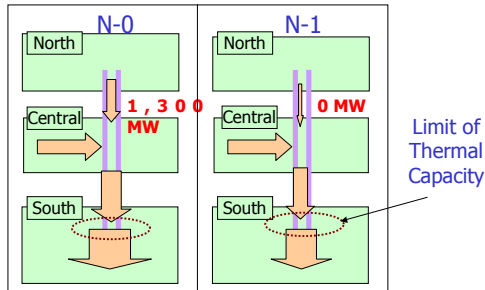
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### Permissible power flow in base-500kV-network in 2020

- Between North and Center Region
  - N-0
    - 1,300 MW
  - N-1
    - 0 MW
      - When a large Amount of Power is produced in Central Region

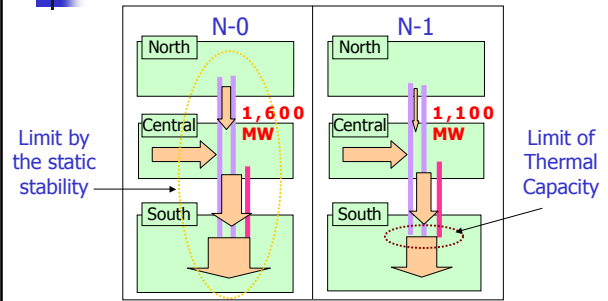
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## Permissible power flow in base-500kV-network in 2020



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## Permissible power flow in north-center 2 circuits center-south 3 circuits



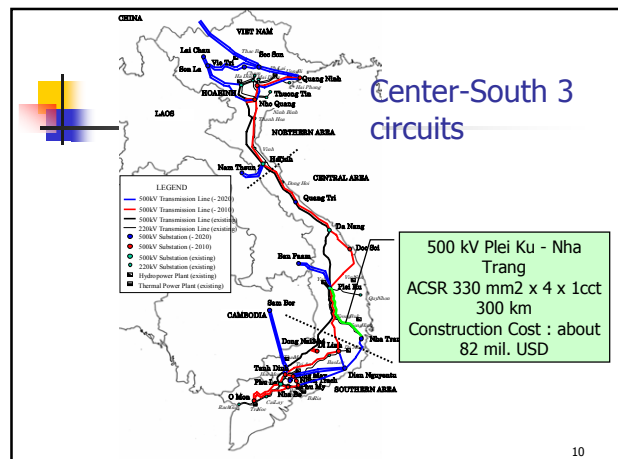
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## Summary of reinforcement scenarios of 500kV-network up to 2020

Reinforcement Scenarios	Number of Circuits			Construction Cost (mil. USD) [Increased Expenditure] (mil. USD/y)	Limit Power Flow North - Central (MW)	
	North - Central	Central - South			[Reduced Expenditure] (mil. USD/y)	
Base-500 kV-Network	2	2	- [-]	1300 [-]	0	
Case 2	2	3	82 [+ about 10]	1,600 [- about 10]	1,100	
Case 3	3	3	350 [+ about 50]	2,200 [- about 20]	1,100	
Case 4	3	4	467	2,200	2,200	

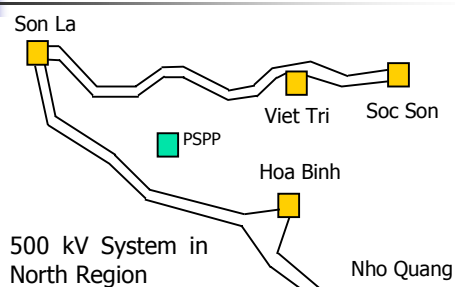
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## Center-South 3 circuits



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## Location of PSPP in north region



11

## Study conditions

- Two Routes Passing near PSPP Site
- 500kV for Transmission Lines of PSPP (economical)
- No Room for Installation of New Bays in Hoa Binh S/S

12

## Study conditions

### In Case of a Circuit Fault

- Remote Generator Shedding through Telecommunication System not allowed
- Power Control of PSPP allowed

13

## Study conditions

- A Drop of 1,000 MW during Off-peak Period is acceptable or not.



- Cases of Connection with:
  - One Circuit
  - Double Circuits

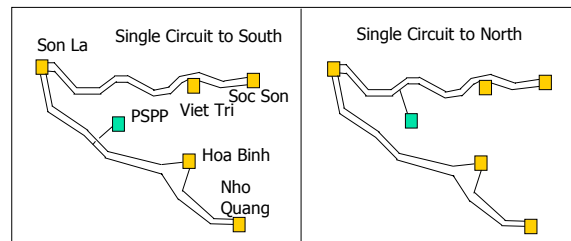
14

## Optimum method of connection

- In Comparison of Power Losses
- Possible Connections from the Viewpoint of System Reliability

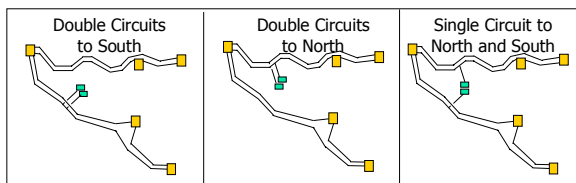
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## Transmission Line with a Single Circuit



16

## Transmission Line with Two Circuits



17

## Difficulty in Determining Optimum Connection

- No Detailed Route Design of Transmission Lines from Son La
  - Difference of Cost Merit of Power-Losses between South Route Case and North Route Case
- Least-loss-case depending on Operation of Generators during Off-peak Time

18



## Further Study

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- In comparison of:
  - Cost Merit of Power Losses
  - Construction Cost Differences among Five Cases
- In consideration with:
  - Admissibility of PSPP Drop in Case of a Single Circuit Fault
  - Route of Transmission Lines from Son La
  - Operation of Generators in North System

19



## The End of Session

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20

## [4] Financial study

Japan International Cooperation Agency (JICA)

1

## Approach for financial study

### ■ Study items

- > No.1: Financial situation of EVN
- > No.2: Financial prospects of EVN
- > No.3: Financial impact of the JICA study plan
- > No.4: Fund raising methods

2

## Study items No.1

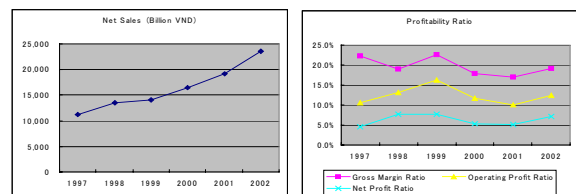
### ■ Financial situation of EVN

- > Past financial performance
  - ✓ Profitability
  - ✓ Financial stability
  - ✓ Cash flow

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## Major financial statistics

### ■ Past profitability : generally stable



4

## Major financial statistics

### ■ Past financial stability : generally stable

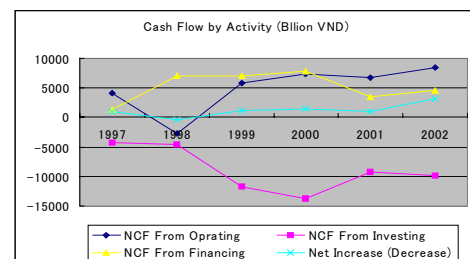


\* The balance sheet 2000 was restated in 2001

5

## Major financial statistics

### ■ Past cash flow : aggressive investment



6

## Study items No.2

- Financial prospects of EVN
  - EVN financial projection for the next 6 years
    - ✓ Overview of the financial projection
    - ✓ Profitability
    - ✓ Cash flow

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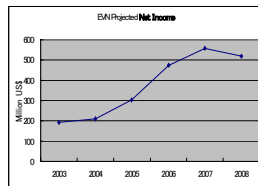
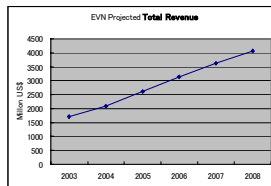
## Study items No.2

- Financial prospects of EVN
  - Overview of the financial projection
    - ✓ Prepared by EVN finance and accounting dept.
    - ✓ Projected period: 2003~2008
    - ✓ Revisions of the electricity tariff: 5.9¢ (4/2004~), 6.5¢ (4/2005~), 7.0¢ (4/2006~)
    - ✓ Electricity demand: base case of the revised 5<sup>th</sup> M/P

8

## Financial prospects of EVN

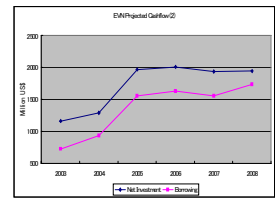
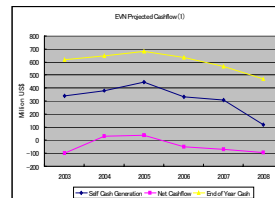
- Profitability : strong growth



9

## Financial prospects of EVN

- Cash flow
  - ✓ Net cash flow: continuously low level
  - ✓ Annual investment and borrowings: drastically increased from 2005



10

## Study items No.2

- Financial prospects of EVN
  - Analysis of the financial projection
    - ✓ Profitability: strong growth
    - ✓ Cash flow: negative trend from 2006
    - ✓ The difference of annual investment

Comparison of Annual Investment

	2003	2004	2005	2006	2007	2008	Total
a. EVN Projection	1,165	1,291	1,966	2,012	1,937	1,944	10,315
b. Revised 5 <sup>th</sup> M/P*	1,341	1,758	2,500	2,427	2,638	2,369	13,033
c. Diff. (a.-b.)	-176	-467	-534	-415	-701	-425	-2,718

\* Excluded IPP Investment

11

## Study items No.3

- Financial impact of the JICA study plan
  - Overview of the financial simulations
    - ✓ Projected period : 10 years (2003-2012)
    - ✓ Prepared statements :
      - income statement and cash flow statement
    - ✓ Electricity tariff : EVN tariff schedule
    - ✓ Long-term investment plan : the JICA study plan
    - ✓ Fuel, O&M, Power purchase costs :
      - estimated costs of the JICA study

12

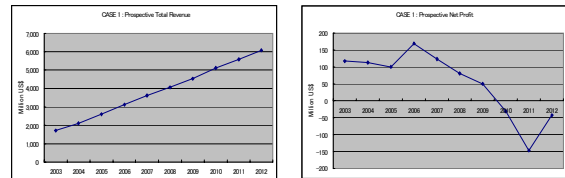
## Study items No.3

- Financial impact of the JICA study plan
  - Financial simulations focused on financing conditions
    - ✓ CASE 1 :
      - Same financing conditions used in EVN's financial projection
    - ✓ CASE 2 :
      - Revised financing conditions

13

## Financial simulation CASE 1

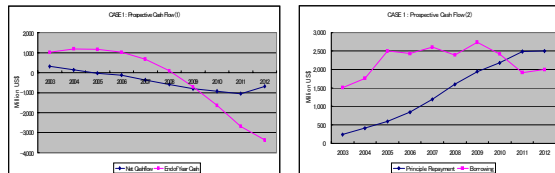
- Profitability
  - Revenue: steady growth
  - Net profit: steady profit for 2003-2007, decrease from 2007, deficit from 2010



14

## Financial simulation CASE 1

- Cash flow
  - Net cash flow: negative from 2005
  - Yearend cash balance: negative from 2009
  - Annual debt repayment: increases every year



15

## Financial simulation CASE 1

- Results of CASE 1
  - Profit:
    - Decreases from 2007, deficit from 2010
  - Cash flow:
    - Cash balance becomes negative at 2009 yearend, cash shortage continues
    - Major cause of shortage is increase of annual debt repayment
  - Investment plan of the JICA study is not practical under the financing condition of EVN

16

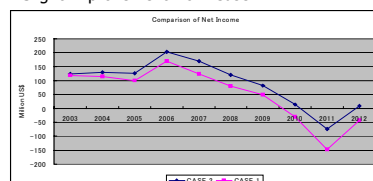
## Study items No.3

- CASE 2
  - Revised financing conditions:
    - ✓ Extension of repayment period
      - Network projects: extend 15 to 20 years
      - ODA projects: extend additional 5 years
    - ✓ Change of fund source
      - Several generation projects: change commercial borrowings to ODA

17

## Financial simulation CASE 2

- Profitability
  - Net profit:
    - ✓ Deficit on 2011 only
    - ✓ Slight improvement from Case 1

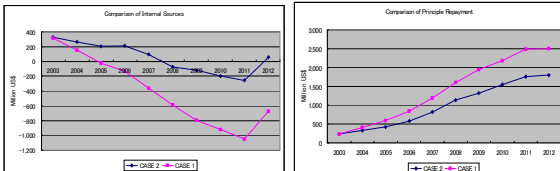


18

## Financial simulation CASE 2

### ■ Cash flow

- Internal sources: significant improvement from CASE 1
- Yearend cash balance: positive throughout projected period
- Annual debt repayment: reduced in later half of projected period



19

## Financial simulation CASE 2

### ■ Results of the CASE 2

- Profitability:
  - Slight improvement from CASE 1
  - Reduced interest expenses by use of ODA and internal source funds
- Cash flow:
  - Positive cash balance throughout projected period
  - Reduced annual debt repayment compared to CASE 1
- Use of ODA loan and extension of repayment period are effective for implementing the investment plan of the JICA study

20

## Study items No.4

### ■ Fund raising methods

- Use of ODA loan
- Extension of debt repayment period
- Change of the fund source from commercial borrowings to ODA loans for network projects

21

## The End of Session

22

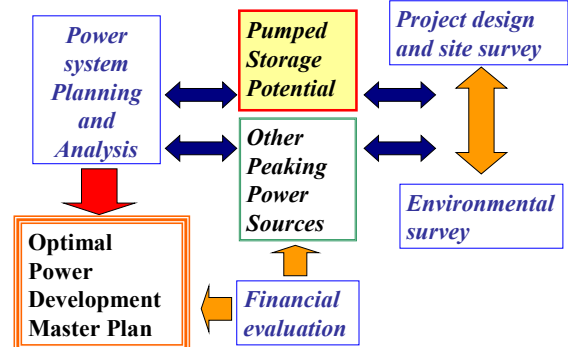


## [5] Peaking Power Sources Potential Study

Japan International Cooperation Agency (JICA)

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## Study Flow

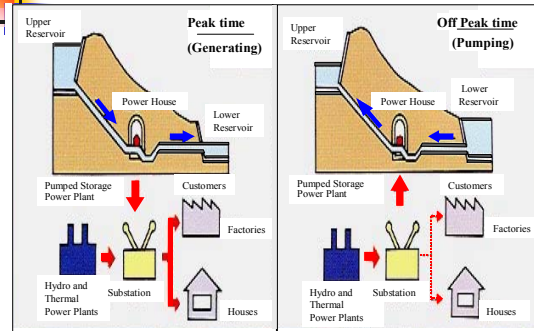


## Possibility of PSPP Installation

- What is PSPP ?
- Priority candidate sites selection
- Optimum installed capacity
- Preliminary design

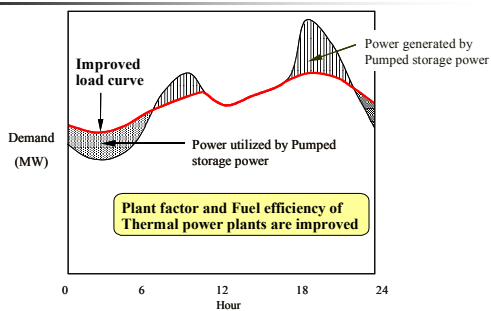
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## What is PSPP? (1)



4

## What is PSPP? (2)



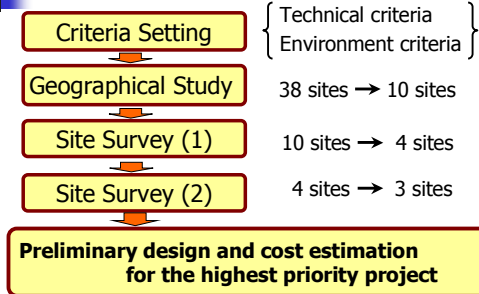
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## Possibility of PSPP Installation

- What is PSPP ?
- Priority candidate sites selection
- Optimum installed capacity
- Preliminary design

6

## (1) Flow of PSPP Potential Study



7

## Prioritization according to the 1st Site Survey Results

Project Site Name	(P5)	(P11B)	(JN1)	(JN3)	(JN18)	(JN5)	(JN9)	(JN6)	(JS6)	(JS11)
Economic Value (US\$/kW)	750	770	910	760	790	680	820	760	730	820
B / C	1.10	1.08	0.93	1.09	1.05	1.20	1.02	1.09	1.13	1.02
Tentative evaluation scores of Environmental Assessment	1.0	1.0	2.0	1.2	1.9	1.2	1.7	1.4	2.0	1.4
Priority Rank	<b>AA</b>	<b>A</b>	<b>C</b>	<b>AA</b>	<b>B</b>	<b>AA</b>	<b>B</b>	<b>A</b>	<b>A</b>	<b>B</b>

8

## Criteria for Prioritization

Priority Rank	Criteria				
	Economy	and /or	Technical problems	and /or	Natural/Social Environmental negative impacts
<b>AA</b>	superior	and	no significant	and	no significant
<b>A</b>	superior	and	some	or	some
<b>B</b>	feasible	and	ditto	or	ditto
<b>C</b>	uneconomical	or	significant	or	significant

9

## Prioritization according to the 2nd Site Survey Results

Items	Phu Yen East	Phu Yen West	Bac Ai
Installed Capacity(MW)	1000	1000	1000
Design Discharge (m3)	230	240	360
Effective Head (m)	560	520	360
Environmental Impacts	Social	Impacted directly : 74households (385people)	Impacted directly : 800households (1700people)
	Natural	Limited direct impacts	Significant impacts on aquatic system
Economy	Project cost	630 US\$ / kW	700 US\$ / kW
	T/L cost	40 mln.US\$	45 mln.US\$
Environmental rank	1	2	3
Economical rank	1	3	2
Comprehensive rank	1	2	2

10



## Locations of priority PSPPs

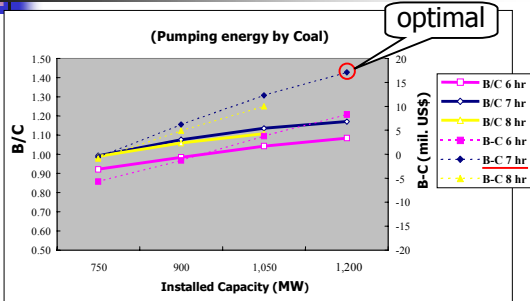
11

## Possibility of PSPP Installation

- What is PSPP ?
- Priority candidate sites selection
- Optimum installed capacity
- Preliminary design

12

## Optimal Installed capacity (Phu Yen East)



13

## Possibility of PSPP Installation

- What is PSPP ?
- Priority candidate sites selection
- Optimum installed capacity
- Preliminary design

14

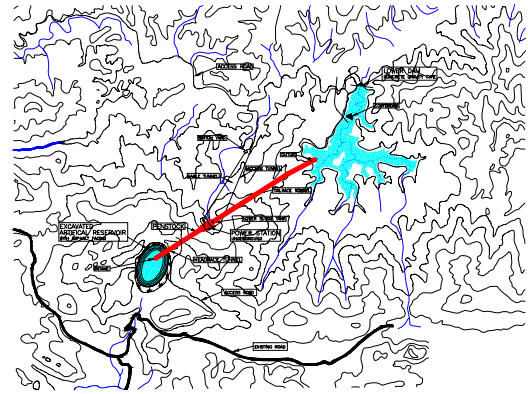
## Preliminary Design and Cost Estimation (Phu Yen East Optimum Case)

### Specifications

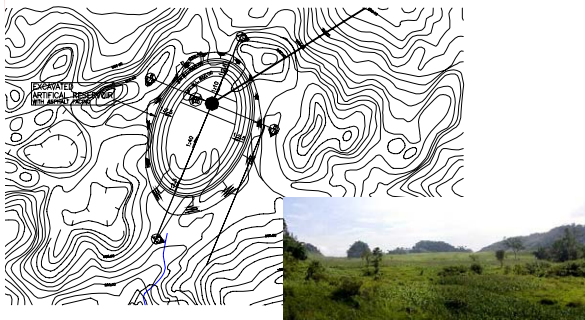
Installed Capacity (P)	: 1200 MW
Designed Discharge (Qd)	: 271 m <sup>3</sup> /s
Effective Head (Hd)	: 559 m
Peak Duration Time	: 7 hr
Effective Reservoir Capacity	: 6.9 x10 <sup>6</sup> m <sup>3</sup>
Upper Dam Type	: Full Faced Pond (Asphalt)
Lower Dam Type	: Concrete Gravity
Waterway total length (Lt)	: 3,700 m
Underground P/H Cavern Volume	: 185,000 m <sup>3</sup>
Pump-Turbine	: Single-Stage Francis (3 x 400MW)

15

## Design Drawings (General Outline)

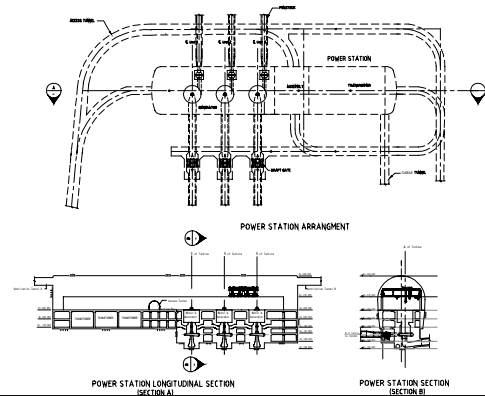


## Design Drawings (Upper reservoir)

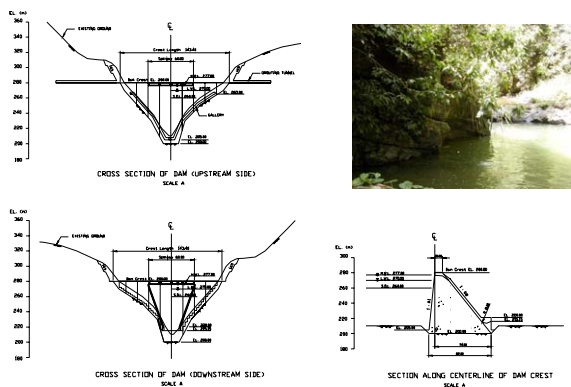


17

## Design Drawings (Powerhouse)



## Design Drawings (Lower reservoir)



## Preliminary Design and Cost Estimation (Phu Yen East)

### Economic Evaluation

Construction Cost	: 720 million US\$
Unit Construction Cost	: 600 US\$/kW
B / C	: 1.17 (1.47*)
F.I.R.R.	: 6.1 (7.8*) %

\* : in the case of Pumping Energy by Hydropower

20

## Development Schedule

Total Time Required : 14 years

- Preparation for F/S : 1 year
- F/S & EIA : 2 years
- Finance Procurement : 1 year
- Detail Design : 2 years
- Tender & Contract : 1 year
- Construction period : 7 years

21

## The End of Session

22