Lao Mekong Sanakham Hydropower Project
introduction
✓ Design and investigation process
✓ Project layout
✓ Design standards
✓ Project study
Design and investigation process
Design and investigation process

MOU signed in 2007

The ESIA was approved by GoL

F/S for Peer Review complied with PDG 2009

The Updated F/S Report was finally acknowledged by Ministry of Energy and Mines, Lao PDR.
➢ Project Layout
Sanakham HPP is the 5th cascade project planned on the main stream of the Mekong River in Laos. The Mekong River at the project site is on border of Province Sayaburi and Province Vientiane. District Kenthao of Province Sayaburi is located at the right bank, District Sanakham of Vientiane Province is located at the left river bank. The dam site is located about 1737km away from the Mekong estuary, about 155km away from the downstream Vientiane, 81km away from the upstream of the Pak Lay project, and about 25km to the Sanakham county seat.

The normal water level is 220MSL, the total installed capacity is 684MW, the average annual energy output is 3803GW·h. The total construction duration is 85 months.

Furthermore, after completion, the project shall sale power to Thailand and it will help develop tourism and promote the social and economic development of the country.
Dam type: Concrete dam
Water retaining structure: Left auxiliary dam, ship lock, left flood sluice, powerhouse, right flood sluice, fish pass, right auxiliary dam
Dam crest length: 909.9m
Max. dam height: 56.2m
In order to improve sand flushing efficiency, the bottom elevation of the right four outlets has been lowered to 192.0m, from 198.0m.
➢ Design Standards
Updated FS Report is in compliance with following standards:

✓ Lao Electric Power Technical Standards;
✓ Preliminary Design Guidance for Proposed Mainstream Dams in the Lower Mekong Basin, and related MRC regulations;
✓ Periodic Technical Bulletins on the Safety of Dams issued by the International Commission on Large Dams (ICOLD);
✓ World Bank, Operational Policy 4.37;
✓ International standard: ACI, ASTM, US Army Corps of Engineers, United States Bureau of Reclamation, etc.
✓ China Power Industry Standard;
Project study

1. Hydrology
2. Sediment & Water quality
3. Dam safety
4. Navigation
5. Fish way
6. Resettlement
7. Transboundary study
## Project study

### 1. Hydrology

**Hydrological data**

<table>
<thead>
<tr>
<th></th>
<th>Previous FS Report</th>
<th>Updated FS Report</th>
<th>Latest Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Run off data</strong></td>
<td>1923~2004</td>
<td>1923~2019</td>
<td>1923~2019</td>
</tr>
<tr>
<td><strong>Flood data</strong></td>
<td>1923~2004</td>
<td>1923~2008</td>
<td>1923~2019</td>
</tr>
</tbody>
</table>

During 2009~2019, 4 sets of water gauges had been established at the damsite, mainly to measure water levels;
Project study

Hydrological data gauges location
## Project study

### Runoff

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
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<td>1150</td>
<td>1160</td>
<td>1670</td>
<td>3390</td>
<td>6860</td>
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<td>10900</td>
<td>6600</td>
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<td>2360</td>
<td>4400</td>
<td>This Review (1923-2008)</td>
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<tr>
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<td>Feasibility Study in 2011 (1923-2004)</td>
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<td>6590</td>
<td>3860</td>
<td>2360</td>
<td>4410</td>
<td>Latest Data (1923-2019)</td>
</tr>
</tbody>
</table>

It can be found that this review result of the long term monthly average discharge is similar to the result of the feasibility study in 2011.
### Flood

<table>
<thead>
<tr>
<th>Exceedance Probability(%)</th>
<th>T(years)</th>
<th>Flood Flows at Sanakham project</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1994 Study Estimations</td>
</tr>
<tr>
<td>50</td>
<td>2</td>
<td>16300</td>
</tr>
<tr>
<td>20</td>
<td>5</td>
<td>19400</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>23580</td>
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<td>5</td>
<td>20</td>
<td>22900</td>
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<tr>
<td>2</td>
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<td>25000</td>
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<td>0.5</td>
<td>200</td>
<td>29900</td>
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<td>500</td>
<td>31700</td>
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<td>33880</td>
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<tr>
<td>0.05</td>
<td>2000</td>
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<tr>
<td>0.01</td>
<td>10000</td>
<td>37300</td>
</tr>
</tbody>
</table>

It can be seen that the flood calculation method adopted by NWE is similar to the calculation method adopted by MRC-CNR and the difference between the developer estimations and MRC-CNR estimations is very small, the maximum of which is less than 3.87%, the minimum is only 0.86%.
Project study

2. Water quality and Sediment sampling

- Taking samples twice per month.
➢ Project study

Calculation with mathematical model

Morphology for 2-D water-sediment mathematic model simulation
Research scope of the model test is: 2.5Km from the upstream of the dam site and 1.7 Km from the downstream of the dam site with the 1:100 of model test scale.
➢ Project study
Project study
3. Dam safety

1. Earthquake safety

- No earthquake above 5 magnitude has ever occurred within 100km of the dam site in 553 years;
- Seismic safety evaluation had been completed by the Earthquake engineering research institute of Yunnan (China);
- The horizontal seismic peak ground acceleration for standard of design and check is $0.063g \ (a_h)$ and $0.1g \ (a_h)$, respectively.
The proposed maximum navigable water level for navigation structures is based on 3-year frequency floods.

<table>
<thead>
<tr>
<th>Dam type</th>
<th>Work condition</th>
<th>Return period (year)</th>
<th>Flood discharge (m³/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravity dam</td>
<td>Design flood</td>
<td>2000</td>
<td>34700</td>
</tr>
<tr>
<td></td>
<td>Check flood</td>
<td>10000</td>
<td>38800</td>
</tr>
</tbody>
</table>
4. Navigation

- The envisaged second-stage ship lock arrangement and estimated cost are included.

- Navigation design during construction period is included.

- Sanakham HPP will be operated for power generation at inflow rate without consideration of reservoir capacity regulation and dead water level is designed for multiple operation choices. Generally, the normal operation level is maintained at EL.220.0m.

- The one-way lockage time: 
  \[ T = 5 \text{ (entrance)} + 2 \text{ (lock closing)} + 10 \text{ (filling or water release)} + 2 \text{ (lock opening)} + 4 \text{ (exit)} + 5 \text{ (interval)} = 28 \text{ min} < 30 \text{ min} \]
Ship lock scale: 500t level
Effective dimension of the lock chamber: $120 \times 12 \times 4m$
Max. flotilla: $1+2 \times 500t$ (two row in-line) compoundable ship
Max. overhead clearance for navigation: 8m
Number of ship lock lines: single-line ship lock is designed; second-line ship lock is reserved in appropriate place.
Guarantee rate of navigable stage: 95% for lowest navigable stage

The effect depth of riverbed incision is 1.0m
Project study

5. Fish way

With reference to the latest investigation on fish and historical data, we studied the kinds, quantity of fish resource, and living habit. And referring to the experience on the world, A natural-like fishway is selected.
Passages for fish passing through Sanakham dam: fishway, turbine, sluice. Turbine generators for Sanakham are bulb type units, which are environmental friendly. With 18 flat-bottom flood sluices arranged for Sanakham, the upstream-downstream level difference during the flood release period would be not much.
Project study

Fish way

- Flood sluice gate section
- Powerhouse section
- Exit

- Switchyard
- Entrance 1
- Entrance 2

- Fish pass
  - Width: 5m
  - Length: 2.39 km
  - Slope: 0.075%

- Blocking fish with electric screen

Namhueng
➢ Project study
Project study
6. Resettlement

NWH and NCG company have identified and assessed the potential positive and negative impacts of the project, by field investigations with topographic maps and GPS. The more detailed information is in ESIA documents.
In March 2013, company was entrusted to initiate the Cumulative Impact Assessment ("CIA") and Transboundary Environmental Impact Assessment ("TEIA") of Sanakham hydropower project. In September 2013, the TEIA report and CIA report were submitted to the Ministry of Natural Resources and Environment and approved by the GoL.

In Aug 2017, the updated “CIA” & “TEIA” were submitted to Ministry of Natural Resources and Environment and approved by the GoL.

Now developer hire external consultant to collect data information regarding to Thailand territory.
Northwest Institute was invited to cooperate with NCG to carry out the physical index investigation of Sanakham project. Meanwhile, Northwest Institute studied hydrology, fish migration and fishery, sediment subsidence, navigation, water quality and dam safety in cumulative and transboundary impacts that The National Mekong Committees ("NMCs") concerned. The results show that the Sanakham project will not have significant transboundary and cumulative impacts on the above areas.
We have fully considered the concerns of the NMCs and invited the Northwest Institute to conduct a detailed study on the above issues. At present, no specific scheme has been formulated. We will invite the Northwest Institute to offer detailed answers to relevant questions when the PNPCA is initiated.
Thank you for your attention!