XAYABURI HYDROELECTRIC POWER PROJECT

DEVELOPMENT AND STATUS OF XAYABURI HPP
VIENTIANE, 15 JULY 2015
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CONTENT OF PRESENTATION

- DEVELOPMENT HISTORY OF PROJECT
- 1995 MEKONG AGREEMENT
- MRC DESIGN GUIDANCE (2009)
- PRIOR CONSULTATION PROCESS
- KEY COMPONENTS OF PROJECT
  - Left Bank Facilities
  - Powerhouse
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  - Spillway
  - Navigation Lock
  - Transmission Line System
DEVELOPMENT HISTORY OF PROJECT

- PROJECT FEASIBILITY STUDY, 2007 to 2008
- MRC PRELIMINARY DESIGN GUIDANCE, August 2009
- OUTLINE DESIGN, June 2010
- ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIA), TEAM, August 2010
- CONCESSION AGREEMENT, October 2010
- POWER PURCHASE AGREEMENT EGAT, December 2010
- PRIOR CONSULTATION PROCESS (PNPCA), MRC, Sept 2010 to 22. April 2011
- PRIOR CONSULTATION PROJECT REPORT, MRC, March 2011
- PRIOR CONSULTATION PROJECT REPORT, Stakeholder Consultations, March 2011
- COMPLIANCE REPORT PÖYRY, August 2011
- START OF ADDITIONAL INVESTIGATIONS, August 2011 - ongoing
- PEER REVIEW REPORT CNR, March 2012
- START OF PERMANENT CONSTRUCTION WORK, November 2012
- COMPLETION STAGE 1, DIVERSION OF THE RIVER, January 2015
DETAILS OF THE 1995 MEKONG AGREEMENT

• Notification
  – For constructions in the tributaries
  – For developments of intra-basin water use in wet season in the tributaries

• Prior Consultation
  – For constructions in the Main River
  – For inter-basin diversion schemes
  – For inter-basin water use in the dry season

• Specific Agreement
  – For any scheme using inter-basin diversion in dry season outside of the Mekong Basin

• The MRC Preliminary Design Guidance for the Proposed Mainstream Dams in the Lower Mekong Basin deal with the following topics
  – Navigation
  – Fish migration
  – Sediments
  – Water quality and aquatic ecology
  – Safety of dams
MRC DESIGN GUIDANCE (2009)

- MEKONG RIVER COMMISSION issued in the document based on 1995 Mekong Agreement

- “Preliminary Design Guidance for Proposed Mainstream Dams in the Lower Mekong Basin”, 31 August 2009

The document deals with
  - Navigation
  - Fish Passage on Mainstream Dams
  - Sediment Transport and River Morphology
  - Walter Quality and Aquatic Ecology
  - Safety of Dams

The purpose of the document was to
  - The guidance is preliminary and advisory in nature
  - The intention is to provide and overview of issues that the MRC will be considering during the process of prior consultation under the 1995 Mekong Agreement.
GLOBAL RULES AND STANDARDS FOR THE DEVELOPMENT OF INTERNATIONAL RIVER BASINS

• Legal framework and international guidelines.
  – Legal framework of each country
  – Multinational agreements e.g. 1995 Mekong agreement, Rhine Convention, Indus Water Treaty
  – International guidance and guidelines e.g. ICOLD guidelines, IHA Sustainability Protocol

• National and multi-national bodies
  – National Ministries, Authorities and Agencies
  – Multinational bodies e.g. MRC, Danube Commission
  – International organizations,
INTERACTIONS BETWEEN THE VARIOUS STAKEHOLDERS

- This creates an entire web of various responsibilities for any private developer and planner.
- The various legal frameworks / design standards are not always conclusive in all points e.g. flood safety guidelines
- In the Mekong basin and especially in the mainstream limited experience concerning run-of-river hydropower plants is available
- The developers / engineers have to define practical details based on their experience, e.g. sustainable development
- The design principles need to be defined based on the MRC Design Guidance and the comments of the various stakeholders
- The Mekong basin is part of a fast developing region and hydropower schemes are only one of many users:
  - Water and waste water for population and industry
  - Tourism
  - Mining and agro-industry
  - and many more
XAYABURI AND OTHER HYDRO SCHEMES IN THE MEKONG

Upstream Hydropower developments UMB:

1. Manwan HPP, 1550 MW, 132 m high dam with seasonal storage
2. Jinghong HPP, 1750 MW, 108 m high dam
3. Nouzhadu HPP, 5850 MW, 261.5 m high dam, multi-annual storage
4. Xiaowan HPP, 4200 MW, 294.5 m dam, multi-annual storage

The schemes Xiaowan HPP and Nouzhadu HPP are storage schemes and are designed to trap large amounts of sediments to secure the operation of the lower situated power plants in China.

Hydropower Developments in the LMB:

1. All schemes proposed are run-of-river power plants
2. None of this schemes have any pond larger then a few hours of operation
3. Dam heights are below 30m
The Prior Consultation Process was performed between Oct. 2010 and Apr. 2011 in accordance with agreed procedures.

The final meeting concerning the Prior Consultation Process was held on 19 Apr. 2011.

No extension of the Prior Consultation process was agreed between the Member countries.

Therefore the Prior Consultation Process was ended in Apr. 2011.

Lao PDR agreed to take into account all legitimate comments of the member countries.
PRIOR CONSULTATION PROCESS REVIEW REPORT

MRC issued on 24 March 2011 the report “Prior Consultation Project Review Report” Volume 1, Main Report and Volume 2, Stakeholder Consultations

The document deals with:

- Hydrology
- Fish Passage and Fisheries Ecology
- Sediment Transport, Morphology and Nutrient Balance
- Water Quality and Aquatic Ecosystem and Environmental Flows
- Navigation
- Safety of Dams
- Social Issues

The main concerns of the riparian countries were:

- Trans-boundary issues
- Certain impacts not addressed appropriately in the submitted Project Documents:
  - Sediment trapping
  - Nutrients
  - Fishery
  - Biodiversity
  - Socio-economic aspects
COMPLIANCE REPORT

Pöyry has performed in 2011 a Compliance Report based on the issues raised during the Prior Consultation Process:

- Following the “Prior Consultation Process” according to the MRC Guidance, the MRC and Stakeholder Countries issued comments on Xayaburi project
- Critical comments were raised by Vietnam, Cambodia and Thailand
- Main items of concern and potential improvements were:
  - Retention of sediment
  - Migration of fish
- Pöyry carried out a Compliance Report with the objective to:
  - Assess comments made by Stakeholders and MRC on the Project Documents
  - Evaluate these comments against the MRC Guidance
  - Identify points where the current design does not fully follow the MRC Guidance
  - Propose measures to make the Xayaburi project compliant with the MRC Guidance
- The Compliance Report was issued to the Government of Lao in August 2011
CHANGES INTRODUCED TO THE XAYABURI SCHEME

- Seismic design parameters adapted based on the Seismic Hazard Study used in the design of the structures to achieve dam safety of the highest international standards

- Adaptation in the Navigation Lock,
  - To allow fish migration through the Navigation Lock
  - Design changes to increase the safety of navigation

- Introduction of Low Level outlets
  - 4 large low level outlets to allow pass through sediments
  - Spillway, low level outlets and turbines to allow environmental friendly sediment routing

- Adaptations of Fish Passing Facilities
  - Additional basic investigations of aquatic fauna and especially fish migration cycles
  - Swimming performance tests on site with local fish species
  - Introduction of multiple fish pass facilities, fish locks / fish ladder, navigation lock and provision for a fish lift
  - Fish friendly turbine technology
  - Selecting an adaptive approach provides the possibilities of later changes to the system
MAIN FEATURES OF THE XAYABURI SCHEME

Country: Lao PDR
Location: Xayaburi town, Approximate 80 km south of Luang Prabang
Commercial operation: October 2019
Construction cost: $3.8 billion
Owner(s): Xayaburi Power Company Limited (XPCL)

**Dam and Spillways**
- Height: 32.6 m
- Length: 820 m
- Type of spillway: 7 x radial gates, 4 low level outlets
- Spillway capacity: 47'500 m³/s
- Pond Capacity: 726 Mio m³, filling time with mean Mekong flow about 50 hours
- Catchment area: 272,000 km²
- Full supply level: 275 m a.s.l.

**Power station**
- Hydraulic rated head: 18 m
- Turbines: 7 x 175 MW Kaplan-type, 1 x 60 MW Kaplan-type
- Maximum capacity: 1'285 MW
- Energy Production: 7'405 GWh
- Export to Thailand: 6'985 GWh supplies electricity for 3 Mio people or 750'000 families
- For Lao PDR: 420 GWh supplies electricity for 1 Mio people or 200'000 families
KEY COMPONENTS OF PROJECT
LEFT BANK FACILITIES

- FISH LADDER
- LEFT JUNCTION POOL
- FISH LOCK SYSTEM
- UPSTREAM FISH CHANNEL
- AUXILIARY POWERHOUSE
- POWER TAKEOFF FACILITY (500 kV)
- EdL SWITCHYARD
LEFT BANK FACILITIES

EdL SWITCHYARD
US FISH CHANNEL
FISH LOCKS
FISH LADDER
POWER TAKEOFF
POWERHOUSE
LEFT BANK FACILITIES

- RCC CLOSURE STRUCTURE
- FISH LOCKS
- 500 kV TRANSMISSION LINE
- AUXILIARY POWERHOUSE
LEFT BANK FACILITIES

- FISH LADDER

*Fish ladder, concrete pouring 22.05.2015*

*Example of Fish Ladder, Geesthacht, Elbe River, Germany*
LEFT BANK FACILITIES

- FISH LADDER

Plan view
POWERHOUSE

- 7 EGAT Units
  - 175 MW rated capacity
- 1 EdL Unit
  - 62.2 MW rated capacity
- Max powerhouse flow: 5'140 m3/s, exceeded during ~110 days/year
- Average river flow: 3'955 m3/s
- Annual energy production: 7'700 GWh

Runner blade 4, excavation map, after casting
POWERHOUSE

- Cross section Unit 1 (EGAT)
POWERHOUSE

- Section along axis of units
POWERHOUSE

- Layout, Generator Floor
Powerhouse, July 2015
POWERHOUSE

- Status construction works, May 2015

Powerhouse Area, Mekong gorge at the upstream part
May 2015

Powerhouse excavation, Units 1–5, view from left bank towards Intermediate Block
May 2015
POWERHOUSE

Aerial view, July 15

LEFT BANK FACILITIES

DOWNSTREAM COFFERDAM

POWERHOUSE

UPSTREAM COFFERDAM

INTERMEDIATE BLOCK
POWERHOUSE

- Status production works

*Draft tube assembly, Andritz Tianbao Workshop, Chengdu, China, Oct 14*
INTERMEDIATE BLOCK

• PURPOSE OF STRUCTURE
  – To separate hydraulically the powerhouse block from the spillway block
  – To accommodate
    – various elements of the fish passing scheme and the
    – unloading and erection bay serving the powerhouse

• ERECTION BAY

• COMPONENTS OF FISH PASS FACILITIES
  – Pumping Station 1
  – Pumping Station 2
  – Zig-zag Chute
  – Water supply gallery
  see also separate presentation
INTERMEDIATE BLOCK

- LAYOUT OF STRUCTURE
INTERMEDIATE BLOCK

- 3D - Overview
INTERMEDIATE BLOCK

- CROSS SECTION PUMPING STATION 2

Erection bay, view from unloading bay, April 2015
INTERMEDIATE BLOCK

- Pump Station No.1
INTERMEDIATE BLOCK
SPILLWAY

- **7 SURFACE SPILLWAY OPENINGS**
  - Radial gates, 23 m × 19 m (H x W)

- **4 LOW LEVEL OUTLET OPENINGS**
  - Radial gates, 16 m × 12 m (H x W)
  - Will also be used for sand flushing operations

- **INFLOW PEAKS:**
  - Q 1’000 37’100 m3/s
  - Q 10’000 45’000 m3/s
  - PMF 47’500 m3/s

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*LLO Gate No 1, closed position*
SPILLWAY

- 7 SURFACE OPENING
- 4 LOW LEVEL OUTLETS
**SPILLWAY**

- Longitudinal Section through Surface Spillway
SPILLWAY

- Longitudinal Section through Low Level Outlet
Spillway from upstream, January 2015
Spillway from downstream, July 2015
SPILLWAY
NAVIGATION LOCK

• 2 CHAMBER NAVIGATION LOCK SYSTEM
  – Designed for convoy of 2 x 500 t boats
  – Width of lock chambers: 12 m
  – Length of lock chambers: 144 m (upper), 139 m (lower)
  – Operation range upper chamber: 19.5 m
  – Operation range lower chamber: 29.5 m

• NAVIGATION LOCK ALSO ACTING AS FISH PASS
  – The system also serves as a fish pass
    – During construction phase and see separate presentation
    – During operation phase

• SYSTEM OPERATIONAL
  – The system came into operation in May 2015
Looking downstream, October 14

Upper lock chamber, looking downstream, March 15
NAVIGATION LOCK

Middle mitre gate

Lock in operation, May 15
TRANSMISSION LINE SYSTEM

- 500 kV double circuit line
  - to transport the energy produced in up to 7 EGAT units to Thailand (EGAT)
  - ~ 200 km up to Lao/Thai Border
  - the Transmission Line is currently under construction
  - on Thai side continuation of the line to EGAT substation

- 115 kV line
  - to transport the energy produced by the EdL unit to the Lao grid
  - will be realized by EdL

Tower 34 A-3, April 2015

Tower 31-14, April 2015
BIRDSEYE VIEW OF XAYABURI CONSTRUCTION SITE
THANK YOU!

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