Consultancy for the Development of Guidelines for Hydropower Environmental Impact Mitigation and Risk Management in the Lower Mekong Mainstream and Tributaries

ISH0306 – Mitigation Guidelines for Sustainable Hydropower Practice - Overview

Bangkok, Thailand,
Venue: Grand Sukhumvit Hotel
October 25 – 26th 2016
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Introduction - Study objectives

Providing measures, GUIDELINES and good industrial practice and state of the art insight into the sustainable development of hydropower in the Lower Mekong Basin by studying, investigate and document, as expressed in the ToR;

1. Regionally relevant hydropower impact avoidance, minimization and mitigation options for development of hydropower on the Mekong mainstream:

2. Specific research scoped and commissioned to improve technical and scientific understanding towards improved mitigation options and the adaption of existing methods in the region; and

3. Engineering and scientific options, for the avoidance, minimization and mitigation of risks of mainstream hydropower dams in consultation with regional agencies and developers.
Introduction - Process for for Risk and Impact Mitigation Assessment

Article 7 – Mekong Agreement (1995) «To make every effort to avoid, minimize and mitigate harmful effects……»

Mitigation Hierarchy

**Avoidance** = Identifying alternative sites or technology to eliminate Impacts (Master plans, Pre-feasibility, Feasibility)

**Minimization** = most often used prescribing actions during design, construction and operation stage to minimize or eliminate impacts

**Compensation** = used to offset residual impacts identified at different stages
Introduction - Process for Risk and Impact Mitigation Assessment

MRC Generic Practical Process for Risk and Impact Mitigation - Project Life Cycle

- **Master Plan**
- **Feasibility Study**
  - Understand the characteristics of the impact
- **Research mitigation options**
- **Project Design**
  - Design and Operation measures, rules and procedures, offsets, conditions
- **Project Construction and Operation**

**Avoidance**
- SEA, CIA, EIA
- Avoid Impacts

**Minimization**

**Compensation**
Study Scoping and Planning Geographic Scope

Twofold:

1) A general assessment at the basin level for the Lower Mekong, including its tributaries

2) A more detailed assessment of the 5 mainstream cascade dams planned to be constructed in Lao PDR
Study Phases - ISH0306 Regional and National Consultation

Output 1, 2a, 2b: Inception Report
May 2015

Outputs 3 & 4: Interim report #1
September 2015

Outputs 5a, 5b: Interim report #2
October 2016

Output 6a, 6b, 6c, 7, 8: Final Report Training Communication
June 2017

We are here!
Overview of 2\textsuperscript{nd} Interim Phase

Constitutes the following:

1. Case Study – Testing of Mitigation Options and analysis of scenarios – Impacts on Environment and Economics

2. Update Guidelines and Manual with Basis in Case Study Results

3. 2\textsuperscript{nd} Interim Phase Knowledge Base (Report, Data Inventory Sheet, ISH0306 Library): Structure, Usage and - Update on Regional and International Practice
Overview of 2\textsuperscript{nd} Interim Phase

**Overall Guiding Principles**
(Mekong 1995 Agreement supported by Strategic Planning Guides and PDG)

**General Principles**
- Sustainability
- Holistic approach
- Consideration of hydropower types
- Weighing public interest
- Public participation
- Adaption to Climate Change

**Guidelines and Recommendations** for planning, design and construction of new hydropower

**Guidelines and Recommendations** for operation of existing and new hydropower

**General Mitigation Options** (including impacts, risks and vulnerabilities)
- Theme
- Project life cycle

Updated
Tested in Case Study
Case Study Context

1. UMB Hydropower Development

2. Tributary Hydropower Development

3. Basin Scale Development (irrigation, urbanization, climate change e.g.)
Case Study Context

Historic and BDP 2030 Scenarios (MRC, 2011)

BDP 2030 Contains most of the Lancang and tributary dams relevant for the assessment of the mainstream cascade

These dams has also been modelled using the MRC - DSF
Case Study Context

Historic, BDP 2030 to Cascade Scenario

Sediment loads at Sanakham
Case Study Context

Historic, BDP 2030 to Cascade Scenario

Connectivity Indices (DCI) – Fish

Cascade scenarios with fish pass back to 37%
Overview of Environmental Risks

Based on the results from the Guidelines and Manual (to be presented in detail by the team members)

1. Hydrology and Flows (flow regime change, flood peaks and low flows, changes in daily flows)

2. Sediments and Geomorphology and Water Quality (erosion and seepage processes, bed incision, changes in sediment deposition, loss of sediment pulse, changes in grain size distribution, e.g.)

3. Fisheries and Aquatic Ecology (impact on migration, fish damages, loss of habitats fish stranding, reduction in biomass and diversity (e.g.)
Overview of Mitigation Options and Scenarios

Mitigation Options Tested:

• Lower Dry Seasons Flows at Pak Beng

• Flood Protection at Xayabury

• Connectivity Restoration – Uppstream and downstream fish passages similar to Xayabury
Overview of Mitigation Options and Scenarios

Mitigation Options Tested:

- Sediment flushing and sllicing
  - Sediment movement through reservoirs
  - Ecological considerations of flushing

- Hydropeaking with minimum flow and limitations to ramping rate
### Overview of Mitigation Options and Scenarios

#### Scenarios

- **Scenario Group 1.1 – Run-of-River**
- **Scenario Group 1.2 – Sediment Flushing**
- **Scenario Group 1.3 – Hydropower Peaking**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Lower dry-season WL at Pak Beng</th>
<th>Flood drawdown of Xayaburi</th>
<th>Fish pass (40 m³/s)</th>
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<table>
<thead>
<tr>
<th>Scenario</th>
<th>Lower dry-season WL at Pak Beng</th>
<th>Flood drawdown of Xayaburi</th>
<th>Minimum flow (Q95)</th>
<th>Fish pass (40 m³/s)</th>
<th>Start of flushing</th>
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<td>-</td>
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<td>X</td>
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<td>X</td>
<td>X</td>
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<tr>
<td>1.2.D</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1. Nov (fast flushing)</td>
</tr>
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</table>
Overview of Mitigation Options and Scenarios

Map over cascade reach and impact zones where scenarios were tested in detail.
# Overall Methodology to Assess Mitigation and Economic Impacts

## Multicriteria Assessment and Indicator Framework

<table>
<thead>
<tr>
<th>Desired generic outcomes</th>
<th>Indicators</th>
<th>Measures</th>
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</thead>
<tbody>
<tr>
<td>Net economic benefit</td>
<td>Energy revenue</td>
<td>* USD</td>
</tr>
<tr>
<td></td>
<td>Investment in mitigation</td>
<td>* USD</td>
</tr>
<tr>
<td></td>
<td>Value of fishery products</td>
<td>* USD</td>
</tr>
<tr>
<td></td>
<td>Value of sand &amp; gravel downstream</td>
<td>* Million USD Sand &amp; gravel</td>
</tr>
<tr>
<td></td>
<td>Value of silt &amp; clay downstream</td>
<td>* Million USD silt &amp; clay</td>
</tr>
<tr>
<td>Maintain flows (flood pulse)</td>
<td>Near natural river flows</td>
<td>* flow volume of the wet season (Mio m³)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* duration of the wet season (days)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* onset of wet seasons (date)</td>
</tr>
</tbody>
</table>

### Mitigation measures
- Dry season drawdown at Pak Beng
- Flood protection at Luang Prabang Town
- Minimum flow
- Connectivity restoration/Fish pass
- Reservoir flushing
- 50 cm operation limit
- Ramping rates
Combined Evaluation of Scenarios – Results

Cumulatively added scoring for most promising scenarios

In general scenarios which include a combination of fish passes, minimum flows, provisions of flushing/sluicing and for hydropeaking limitations on ramping rates will benefit the widest array of indicators – E.g. benefits environment most widely and then also livelihood
Combined Evaluation of Scenarios – Results

Cumulatively added scoring for most promising scenarios

- Zone 1: Run-of-River with fish pass and flood protection
- Zone 2: Run-of-River with flushing, fish pass and flood protection
- Zone 3: Peaking with ramping restrictions, fish pass and flood protection
- Zone 1: All mitigation options combined

Legend:
- Energy Revenue (USD)
- Value of Fishery Products (USD)
- Sediment Transfer
- Nutrient Transport
- River connectivity (DCI)
- Overall biodiversity
General Findings, Conclusions and Recommendations

Avoidance, Minimisation and Compensation at Basin Scale – With Inputs to Guidelines and Manual

- The impacts and mitigation approaches for the Lao cascade must be seen in a basin wide context. Lancang and tributary dams have substantial impact on the hydrological, biological and sediment inputs to the cascade.
- Impacts cannot be mitigated by measures in the cascade alone, but must be dealt with either at the Lancang and tributary dams themselves OR through use of basin scale offsets, management and transboundary approaches.
General Findings, Conclusions and Recommendations

Avoidance, Minimisation and Compensation at Basin Scale – With Inputs to Guidelines and Manual

More Joint Action and Benefit Sharing?
General Findings, Conclusions and Recommendations

Avoidance, Minimisation and Compensation at Basin Scale – With Inputs to Guidelines and Manual

Example early avoidance on the LMB (from Wild and Loucks, 2015)

Original and alternative Sambor Dam

Also to be studied in Phase 4 of ISH0306 in conjunction with the Council Study
Deliveries 2nd Interim Phase

- Vol 1 - Updated Guidelines Version 2.0 (with Inputs from the Case Study)
- Vol 2 - Updated Manual Version 2.0 (with inputs inputs from the Case Study)
- Vol 3 – Knowledge Base (Structure, Usage and Update on regional and international practise)
- Vol 4 - Case Study Report Version 1.0