



# **OBSERVATIONS AND COMMENTS ON THE PÖYRY REPORT ON THE XAYABURI HYDROPOWER PROJECT**

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**Prepared by:**

Mekong River Commission Secretariat



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## ACRONYMS AND ABBREVIATIONS

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BDP	Basin Development Plan (MRC)
CA	Concession Agreement
CODS	Committee on Dam Safety (ICOLD)
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EG	Expert Group
EP	Environment Programme (MRC)
FEG	Fisheries Expert Group
FS	Feasibility Study
ICOLD	International Commission on Large Dams
ICCS	International Cooperation and Communication Section (MRC)
IKMP	Information and Knowledge Management Programme (MRC)
ISH	Initiative on Sustainable Hydropower (MRC)
IWRM	Integrated Water Resources Management
JC	Joint Committee
JCWG	Joint Committee Working Group
LMB	Lower Mekong Basin
MRC	Mekong River Commission
MRCS	Mekong River Commission Secretariat
PC	Prior Consultation
PC	Project Review Report MRCs Prior Consultation Project Review Report
PDG	MRC Preliminary Design Guidance for Proposed Mainstream Dams in the Lower Mekong Basin
PNPCA	Procedures for Notification, Prior Consultation and Agreement
PWUM	Procedures for Water Use Monitoring
PWQ	Procedures for Water Quality
SEA	Strategic Environmental Assessment
SEG	Sediment Expert Group
TG	Task Group
WG	Working Group

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## Executive Summary

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**On 19 April 2011, the Mekong River Commission convened a special session of its Joint Committee to complete “prior consultation” for the proposed Xayaburi hydropower dam project in northern Lao PDR.** The dam, the third in a potential cascade of six proposed mainstream dams upstream from Vientiane, is the first subject to Notification, Prior Consultation and Agreement under procedures agreed to by Cambodia, Lao PDR, Thailand and Viet Nam in 2003. Due to different opinions of the MRC Member Countries on the proposed Xayaburi Project, the Joint Committee meeting forwarded prior consultation issues to the Ministerial level for further discussion by the MRC Council.

**On 5 May 2011, the Government of Lao PDR commissioned Pöyry Energy AG to carry out a report to determine whether Xayaburi Power Company, the dam owner, had complied with and satisfied the MRC Preliminary Design Guidance for Proposed Mainstream Dams in the Lower Mekong Basin.** Pöyry was also asked to determine whether the Lao government and dam owner had taken into consideration comments by other Member Countries and whether they had complied with and satisfied the terms of the Prior Consultation Project Review Report of the MRC Secretariat dated 24 March 2011.

**On 26 October 2011, the Viet Nam National Mekong Committee – in its role as MRC Joint Committee member – forwarded the Pöyry Report to the MRC Secretariat with a request to study it and comment on its conclusions and recommendations.** The observations and comments outlined in this document and its annexes, respond to the request from Viet Nam.

**In reviewing the Pöyry Report, the observations by the MRC Secretariat Review Team are divided into five groups of issues, namely (i) fish passage and fisheries ecology, (ii) sediment transport, morphology and nutrient balance (iii) water quality, aquatic ecosystem health and environmental flows (iv) navigation and (v) safety of dams.** The MRCS Review Team’s observations focus on the Pöyry Report’s findings and recommendations with respect to the Xayaburi Hydropower Project Proposal’s compliance with the MRC Preliminary Design Guidance, the Project Proposal’s alignment with the MRC Prior Consultation Project Review Report and whether the concerns of Member Countries are adequately addressed.

**In general, the Pöyry Report review of the proposed Xayaburi Hydropower Project, and its recommendations for dam design adaptations and further investigations, is seen by the MRCS Review Team as constructively adding to the information on and advice to the Xayaburi Project.** The Pöyry Report provides a clear overview on the compliance of the proposed Xayaburi Hydropower Project to the MRC Preliminary Design Guidance, and its alignment to the MRC Prior Consultation Project Review Report from the perspective of Pöyry Energy AG. The Pöyry Report also states how the concerns of the Member Countries can be considered and it suggests several adaptations and modifications to improve compliance of the proposed project with the MRC requirements as well as international standards. However, it is the MRCS Review Team’s opinion that specific concerns in regard to complying with these requirements remain.

**It is the MRC Review Team’s opinion that if the recommendations in the Pöyry Report are incorporated in the proposed Xayaburi Hydropower Project the compliance with the MRC Preliminary Design Guidance will improve.** In the areas of sediment and related issues, the Xayaburi Project would then be viewed as more or less compliant to the MRC Preliminary Guidance, and for navigation, the Project would be almost fully compliant with no key shortcomings. With respect to water quality, aquatic system health and environmental flows the Project would be more or less compliant with the MRC Preliminary Guidance, if

the recommendations in the Pöyry Report are implemented. However, due to the major challenges involved it is the MRC Review Team's observation that even if the recommendations in the Pöyry Report are followed, the Xayaburi Project would be considered only partly compliant in the area of fish bypass facilities and fisheries ecology as well as in terms of dam safety.

**The Pöyry Report foresees that substantial investigations, monitoring and modelling – required to reduce uncertainties and inadequacies in relation to issues such as sediment, fisheries, water quality and aquatic ecosystem health as well as transboundary/cumulative aspects – will take place during the construction phase and not prior to dam construction. The MRCS review team observes that this approach poses difficulties for all relevant thematic topics.** Whilst the procedure proposed by Pöyry could be feasible for some aspects of the investigations, it would not be prudent for many others. Outstanding issues need to be followed up as soon as possible to ensure compliance and alignment with MRC documents/guidelines, and the timing and sequencing of those investigations need to be set in a transparent way. The MRC Review Team observes that attention should be given to the adaptation of the fish bypass facilities, sediment, issues regarding water quality and nutrients as well as the safety of dams.

**It is the opinion of the MRC review team that conducting specific investigations before (rather than in parallel with) dam construction will reduce risks, including those of transboundary and cumulative impacts, and avoid “regret measures”, actions that may ultimately be inappropriate and lead to expensive and/or irreversible unintended negative impacts.** The MRC review team observes that collecting and analysing baseline data as well as adapting the design of the fish bypass facilities should be initiated **at least two years** before dam construction starts (as to be able to provide inputs to the final design of the dam).

**Outstanding issues and questions remain pertaining to gaps, uncertainty, sequencing and timing.** The MRC review team observes that in order to address these issues it would be prudent to develop a detailed programme of studies to fill gaps plus a road map for monitoring, modelling and detailed design of the proposed dam, together with a timeline for construction. This should be undertaken in close cooperation between the MRC, the Government of Lao PDR and the Developer.

**The MRC Review Team noted that, even if all the recommendations in the Pöyry Report were incorporated in the Xayaburi Project, the concerns of the Member Countries would not be fully addressed, especially with reference to the request to defer the construction of all mainstream dams (until knowledge gaps are filled).** Concerns expressed by the Member Countries during the prior consultation process have been listed in the Pöyry Report. The concerns mainly centre on fisheries and sediments. Concerns have also been expressed about possible transboundary and cumulative effects as well as knowledge gaps that need to be filled.

**The MRCS Review Team notes that in particular, aspects of possible impacts on the Tonle Sap Lake in Cambodia and the Mekong Delta in Viet Nam need to be investigated.** As proposed in the Pöyry Report, further investigations need to be undertaken to reduce uncertainties about the possible impact risks stemming from the proposed Xayaburi dam not only as a stand-alone-project but also as part of all other planned hydropower developments. Supporting the proposal of the Pöyry Report, it is recommended that those investigations are coordinated via the MRC cooperation platform in close cooperation with all Member Countries and the Developer.

## 1. Background

### 1.1 General Context

Cambodia, Lao PDR, Thailand and Viet Nam established the Mekong River Commission (MRC) by signing the Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin on 5 April 1995. The Agreement defines principles and processes in cases where one or more countries propose to use waters of the Mekong or its tributaries within the boundaries of the Lower Mekong Basin (LMB). The types of water use include mainstream hydropower developments.

The proposed dam, the third in a potential cascade of six proposed mainstream dams upstream from Vientiane, is subject to the MRC's Procedures for Notification, Prior Consultation and Agreement (PNPCA) approved in 2003. The Mekong Agreement defines "prior consultation" as a process "that would allow the other member riparians to discuss and evaluate the impact of the Proposed use upon their uses of water and any other affects (sic)." The Lao National Mekong Committee (LNMC) submitted documents for prior consultation on the Xayaburi hydropower dam project to the MRC Secretariat on 20 September 2010.

After checks and clarifications, the submitted documents were circulated and received by all MRC Joint Committee members by 22 October 2010. The Joint Committee set up a Working Group, which met three times between October 2010 and March 2011. The MRC Secretariat set up an internal Task Group to analyse questions related to dam design and operations, hydrodynamic modeling, fisheries, sediment transport, river morphology and nutrient balance, water quality and aquatic ecosystems, dam safety, navigation and the social implications of the project. The Secretariat also set up two expert groups on fisheries and sediment and commissioned other individual experts including international engineering experts on dam layout and operation and on navigation locks.

Under this mechanism, the MRCS supported the JC by reviewing, analysing and providing technical advice during the prior consultation process. The final output of this support was the *MRCS Prior Consultation Project Review Report*, which addresses the relevant thematic topics of the submitted project. The report highlights areas of uncertainty regarding those topics and outlines the need for further investigations to fill knowledge gaps to align the proposed project to MRCS as well as international standards. Findings and recommendations included in the Project Review Report aimed to support MRC Member Countries in forming their views on the proposed water use and the next stages of the project's planning and design.

The MRCS provided the report to the MRC Joint Committee for a special session on 19 April 2011, which was scheduled to complete the prior consultation process. Due to different opinions of the Member Countries on the proposed Xayaburi dam project, including a request to defer all mainstream dam construction, the prior consultation issues were forwarded to the Ministerial level for further discussion.

On 5 May 2011, the Government of Lao PDR commissioned Pöyry Energy AG to develop a report on the submitted Xayaburi dam project documents, their compliance with MRC Preliminary Design Guidance for Proposed Mainstream Dams in the Lower Mekong Basin and the MRCS PC Project Review Report as well as to reflect upon the comments of Member Countries. The detailed aims of the Pöyry Report are outlined in Section 1.3 of this document.

On 26 October 2011, the Viet Nam National Mekong Committee – in its role as JC member – forwarded the Pöyry Report to the MRCS with the request to study it and comment on its conclusions and recommendations. These findings should serve and support preparations for and ministerial discussions at the MRC Council Meeting on 7-9 December 2011.

This document of MRCS Observations and Comments on the Pöyry Report follows the above request and aims to provide a sufficient overview for the upcoming Council discussion.

## **1.2 MRCS Prior Consultation Project Review Report**

The MRCS prepared the Prior Consultation Project Review Report to inform the Member Countries and the Joint Committee about the potential transboundary impacts, risks and consequences of the proposed Xayaburi dam project. The report was also an opportunity to reflect on the extent to which the project design incorporated the principles of sustainable hydropower and Integrated Water Resource Management (IWRM), which are central to MRC's mandate, and international best practice.

The report was developed following an agreed prior consultation road map and through the MRCS PNPCA Task Group, expert groups on Fisheries and Sediments as well as other individual experts. It was based on key MRC documents such as the Basin Development Strategy including its scenarios, the Strategic Environmental Assessment of Hydropower on the Mekong Mainstream (SEA) and the Preliminary Design Guidance for Proposed Mainstream Dams in the Lower Mekong Basin (PDG).

It addressed all MRC PDG topics and aimed to analyse questions in relation to dam design and operations, hydrodynamic modelling, fisheries, sediment transport, river morphology, nutrient balance, water quality and aquatic ecosystems, dam safety, navigation and social implications.

Taking into account the basin-wide scale, the Report also aimed to consider the potential for transboundary and cumulative impacts associated with the construction and operation of the Xayaburi dam as the third in a potential cascade and in relation to existing and planned Mekong tributary dams. This approach should enable guidance to proponents of many other projects being considered on the mainstream.

The report highlights areas of uncertainty on which further information is needed to address fully the extent of transboundary impacts and mitigation measures required. Findings and recommendations included in the report have implications for Member Countries regarding proposed use and for the next stages of planning and design. Besides the conclusions for all thematic topics, the MRCS also recommended – in case the project proceeds – that further discussion on the detailed recommendations of the report would be required to ensure relevant provisions are incorporated into the Concession Agreement and Power Purchase Agreement

All details, conclusions and recommendations can be found in the report itself.

## **1.3 Pöyry Report**

On 5 May 2011, the Government of Lao PDR commissioned Pöyry Energy AG, the Zurich-based subsidiary of Finnish consulting and engineering group Pöyry, to answer the following questions:

- whether the owner (Xayaburi Power Company) has complied with and satisfied the MRC Preliminary Design Guidelines;
- whether the Government of Lao PDR and the owner have taken into consideration the comments submitted by each of the Member Countries during the PC process;
- whether the Government of Lao PDR and the owner have complied with and satisfied the terms of the PC Project Review Report, dated 24 March 2011; and
- issues relating to the development, construction and implementation of the Xayaburi Hydropower Plant and any discrepancies, conflicts and the need for any changes thereto in connection with the comments of the Member Countries.

The Pöyry Report is based on the Xayaburi documents that were also submitted by the Lao National Mekong Committee to the MRCS in September 2010. In addition to the MRCS PC Project Review Report (PRR) and its annexes, the Pöyry Report made use of other key MRC documents including the (i) Preliminary Design Guidance for Proposed Mainstream Dams in the Lower Mekong Basin (PDG) (ii) Strategic Environmental Assessment of Hydropower on the Mekong Mainstream (iii) the Prior Consultation Reply Forms from all Member Countries and (iv) the comments by Lao PDR on the PC Project Review Report.

Besides a short outline of the general context and approach followed, the Pöyry Report provides a description of the Xayaburi hydropower dam as well as related reports. It addresses most thematic topics that are part of the PC Project Review Report and the MRC PDG, which include (i) Safety of Dams, (ii) Navigation Lock System, (iii) Fish Bypass Facilities, (iv) Water Quality and Aquatic Ecology and (v) Sediments.

The Pöyry Report summarises the compliance of the proposed Xayaburi dam project with the thematic topics and includes recommendations on how the project's design and implementation can be improved. In close relation to the PDG, Pöyry also investigates the Xayaburi project's alignment with the PC Review Report, paying specific attention to the comments and proposed alternative options regarding fish passage facilities. The Pöyry Report also reviews the key comments of Member Countries and gives recommendations on how they can be addressed.

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## **2. Scope and Approach of this MRCS Document on the Pöyry Report**

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### **2.1 Scope of this Document**

This document aims to inform Member Countries and the MRC Council of the content of the Pöyry Report, its relation to the MRC Preliminary Design Guidance (PDG) and the MRCS Prior Consultation Project Review Report (PRP), and how much consideration has been given to Member Country comments during the prior consultation process. Together with all other available information, this overview should support a joint discussion between the Member Countries on the report's implications for the MRC framework, the prior consultation process and the next steps regarding the proposed Xayaburi dam.

It should be noted that this document includes the first overall comments on the Pöyry Report. If needed, further details, which may be different from the scope of this document, can be elaborated in follow-up steps and as advised by the MRC Council.

The scope of this document is to address the five thematic topics for the MRC PDG and the prior consultation response forms submitted by Member Countries during the prior consultation process in order to reflect an overall impression of the Pöyry Report as well as its compliance with the PDG and subsequent alignment with the PC Project Review Report.

Based on the above scope, the following four key questions guided the overall development of this document addressing each thematic topic individually:

1. What is the general impression of the Pöyry Report?
2. Does the Pöyry Report comply with the PDG and is it therefore aligned with the PC Project Review Report? What are respective differences and possible contradictions?
3. Are the technical recommendations for the thematic topics realistic regarding their timing for implementation and are they technically practical?
4. Are all comments and concerns of the Member Countries as summarised in the MRC Prior Consultation Reply Forms well reflected and addressed in the Pöyry report?

Attention is also given to basin-wide implications of the Pöyry Report addressing transboundary and cumulative aspects as those are central to the MRC's mandate and mission. Chapter 3 of this document provides an overview regarding the four key questions above addressing each thematic topic. Key conclusions, recommendations and proposed next steps are part of Chapter 4.

### **2.2 Approach for Preparing this Document**

The MRC Secretariat with external support developed this document. Both the PNPCA Task Group as well as the Expert Groups for Fisheries and Sediment, which was set up during the development of the MRCS PC

Project Review Report, were reactivated to contribute to this document.

Navigation and Dam Safety topics have been screened and analysed by members of the Task Group from the MRC Navigation Programme (NAP) and the MRC Initiative for Sustainable Hydropower (ISH). The Fisheries and Sediment Expert Groups have addressed Fisheries and Fish Bypass Facilities as well as Sediments, River Morphology and Nutrient Balance. The MRC Information and Knowledge Management Programme (IKMP), also part of the Task Group, supported the reflections on sediments. Water Quality, Aquatic Ecology and Ecosystem Health have been analysed by an individual expert who was formerly employed in the MRC Environment Programme. The experts listed above formed the MRCS Review Team for this document.

The key documents that have been used to develop this document include the

- Pöyry Report (dated 9 August 2011),
- MRC Preliminary Design Guidance and
- MRCS Prior Consultation Project Review Report (24 March 2011).

The essence of expert reports on each thematic topic are summarised in Chapter 3 below. Further details can be found in **Annexes 1-4** that include the full individual expert reports.

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### **3. MRC Review Team’s observations and comments on the Pöyry Report’s findings on and recommendations for compliance with the MRC PDG and PRR**

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#### **3.1 Fish Passage and Fisheries Ecology**

##### **3.1.1 General Impression of the Pöyry Report**

Regarding Fisheries and Fish Passage Facilities, the Pöyry Report responds partly to the findings of the PC Project Review Report and PDG. It accepts many of recommendations and identifies shortcomings in the submitted Xayaburi documents. The Expert Group on Fisheries highlights outstanding concerns regarding the Xayaburi project’s compliance toward the PDG and PC Project Review Report.

##### **3.1.2 Findings in the Pöyry Report with respect to compliance of the Xayaburi Project with the MRC PDG and MRCS PC Project Review Report**

Based on the findings in the Pöyry Report, compliance gaps are identified including aspects of upstream and downstream migration, fish passage design, fisheries baseline data, monitoring and timing of support studies. Details can be found in the Fisheries Expert Group Report in **Annex 1**. Several key issues are highlighted below:

###### **Upstream Fisheries Migration - Pöyry Report Section 2.2.2.1**

- The proposals of the PC Project Review Report for modifying upstream fish passage facilities are not taken up fully in the Pöyry Report although it generally follows its recommendation including three proposed upstream fish passage facilities with an additional fish lock (modified navigation lock) on the right-hand side and an additional fish lift.
- The Pöyry Report proposes to place the fish lift at the same location as the left-hand entrance to the main fish bypass. It is not clear why the fish lift is doubled up. The Fisheries Expert Group proposes a lift at the central structure to enhance passage of high biomass and multiple locations of fish attraction.
- The fish passage schemes proposed in the Pöyry Report are not adapted to the fisheries scenarios (fish species diversity, sizes and biomasses) relevant for the Mekong and the Xayaburi region in particular. The report does mention that fisheries baselines need to be developed for improvement.
- Regarding the fish passage design in the PC Project Review Report, the Pöyry Report recommends that

(i) the gradient of 4.5% is probably “*too much for Mekong species*” (ii) the drop height between pools should not exceed 15 cm and (iii) daylight should be provided in the collection gallery which is a generic fishway design criterion. It is re-emphasised here, that the Fisheries Expert Group commented on these proposals in the PC Project Review Report before stating that the fish passage is too steep and recommended a drop heights of less than 10 cm.

- The nature-like fish bypass on the left side – proposed in the PC Project Review Report – is not rated feasible in the Pöyry Report because it is believed there is not sufficient space. It is recommended that this view is revisited because the Fisheries Expert Group specifically highlights the unique opportunity to construct such a pass using the valley of the tributary downstream of the dam.
- The Pöyry Report acknowledges the need for flow optimisation models to ensure sufficient flows are made available for fishery purposes, under both low and high flow conditions. MRC emphasises that the necessary hydraulic modelling should be carried out before construction starts to ensure that needs for appropriate fish bypass facilities are embedded in the dam design.
- The Pöyry Report acknowledges that no upstream migration facility is included in the original design of the submitted Xayaburi documents for the second part of the construction period (years 3-7), which will compromise fish recruitment. MRC proposes that the fish lock is used to help overcome this limitation and multiple bypass options to fully resolve this challenge.

#### **Downstream Fisheries Migration - Pöyry Report Section 2.2.2.2**

- No new initiatives are proposed in the Pöyry Report to address the concerns over downstream fish passage raised in the PC Project Review Report. The downstream fish collection arrangements and screen proposals urgently need to be revisited, as design of efficient downstream fish migration arrangements is a challenge for which there is no generic solution.
- The suggestion that downstream mortality through the powerhouse can be minimised by using fish-friendly turbines is a common misconception. Such turbines reduce mortality rates by a small margin. Overall mortality still exceeds 95% because of pressure changes, shear stress and strike damage. Experimental studies enabling adequate solutions for downstream migration are urgently recommended.
- The proposal in the PC Project Review Report to optimise the spillway design to facilitate downstream fish migration is not reflected nor taken up in the Pöyry Report.

#### **Baseline data - Pöyry Report Sections 2.2.4.1**

- The Pöyry Report recognises the gaps in knowledge and the uncertainties as expressed in the PC Project Review Report. Its proposal to fill such gaps during the early construction phase is not in line with the Review Report. To ensure appropriate measures and design options as well as to prevent “regret measures” (actions that could ultimately be regretted as they may be inappropriate and cause expensive as well as irreversible effects), some assessments need to be performed before the dam is built.

#### **Monitoring - Pöyry Report Sections 2.2.4.3**

- The Pöyry Report’s proposal for monitoring generally follows the PC Project Review Report recommendation, although its timing and scale need reconsideration. Based on MRC studies, the sampling frequency will need to be increased to daily for aspects such as larval drift and fish catch statistics as it can vary considerably depending on environmental conditions and biology of species.

#### **3.1.3 Adequacy in Addressing Member Country Concerns**

- The Pöyry Report included comments and concerns by the MRC Member Countries with respect to Fisheries and Fish Passage Facilities under the broader ecological and environmental issues.
- The Pöyry Report recognises the lack of knowledge and/or baseline data concerning biodiversity and overall ecology including fisheries and the minimal information on the social and economic impacts on livelihoods.

- Similarly, the Pöyry Report recognises that transboundary issues and impacts have not been adequately assessed.
- The Pöyry Report recommends baseline and regular monitoring surveys as well as reassessment of mitigation and compensation measures.
- The concerns regarding transboundary and cumulative effects are addressed in Chapter 2 of the Pöyry Report, which proposes further studies and investigations allowing for improved assessment. The proposal to undertake such studies and adapt the design as well as the operation of the dam and fish passage facilities during construction is not aligned with the request that all mainstream dam construction should be deferred to allow the opportunity to accommodate gaps in knowledge and address concerns over potential impacts.

## **3.2 Sediment Transport, Morphology and Nutrient Balance**

### **3.2.1 General Impression of the Pöyry Report**

In general, the Pöyry Report supports the conclusions and recommendations of the PC Project Review Report while introducing some new and original suggestions that would enhance the capability and adaptability of the proposed Xayaburi Dam with respect to managing sediments. The conceptual design proposed in the Pöyry Report increases compliance with the MRC PDG with respect to sediments, morphology and nutrients. The Sediment Expert Group expresses some concerns about recommendations of the Pöyry Report, especially regarding the timing and sequencing of monitoring to fill gaps in knowledge, modelling to reduce uncertainty and support detailed design, and construction should the project go ahead. The Pöyry Report suggests the necessary investigations and assessments can be undertaken during the early phases of construction. While this would be feasible for some aspects of the investigations, it would not be prudent for others. Also the proposal to undertake all investigations during construction does not respond sufficiently to concerns expressed by the Member Countries.

### **3.2.2 Findings in the Pöyry Report with respect to compliance of the Xayaburi Project with the MRC PDG and MRCS PC Project Review Report**

Concerns about the compliance of Pöyry Report suggestions with the MRC PDG and PC Project Review Report regarding Sediments, River Morphology and Nutrient Balance are detailed in **Annex 2**. The key issues are highlighted below:

#### **Initial conditions - Pöyry Report Section 2.3.1.1**

- The Pöyry Report states: *“The total sediment load between the Manwan Dam at the Chinese border and Pak Chom is around 5% of the total sediment load arriving at the Mekong Delta. Therefore in the theoretical case if 100% of the incoming sediments at Xayaburi are trapped, the total sediment loads at the Mekong Delta would be reduced by a maximum of 5%.”* Although consistent with Table 5.1 in the PC Project Review Report, the 5% figure should not be quoted out of context.
  - The Project Review Report finds that reductions in sediment loads supplied to the Lower Mekong mainstream due to sediment trapping behind existing and proposed dams will increasingly reduce sediment and attached nutrients.
  - This could amplify the potential impacts of any trapping at Xayaburi and other mainstream dams in sediment-sensitive areas like the Tonle Sap Lake and the Mekong Delta.
  - Avoiding unacceptable long-term, cumulative sediment and morphological impacts will require collective action to ensure that adequate reservoir sediment-management technologies are implemented to minimise sediment-related transboundary risks.

#### **Effect of routing and flushing scenarios on sediment trapping - Pöyry Report Section 2.3.2.4**

- The MRC Sediment Expert Group doubts the validity of the Pöyry Report suggestion that a 7-day period of flushing would be sufficient to reduce sediment trapping to an acceptable level. In fact, modelling based on sufficient data sets is needed to estimate the timing and duration of flushing

operations and, in any case, adaptive sediment-management approaches will be essential to continuously optimise the effectiveness of sediment flushing.

**Mitigation against erosion processes downstream - Pöyry Report Section 2.3.2.5**

- The Pöyry Report’s findings that, even under optimal conditions, some sediment will be trapped are in line with those of the PC Project Review Report. Mitigating the effects of what is termed “hungry water” in the Pöyry Report will require bank-protection measures in some (mainly alluvial) reaches of the river.
- Although foreseen by the Developer, contrary to the Pöyry Report, the Sediment Expert Group believes that protection may need to be more extensive than allowed for by the Developer.

**Design requirements and recommended design changes - Pöyry Report Sections 2.3.3 and 2.3.4**

- In general, the information of the Pöyry Report is aligned with the PC Project Review Report. However, the timing of the further investigations necessary to redesign the dam contradicts previous MRCS findings. Designing a dam sufficiently ‘transparent’ to sediment in order to prevent unacceptable transboundary and cumulative impacts is extremely demanding. Sufficient time must be allowed to deliver a feasible design. Assuming that data gaps can be filled, the modelling completed and the design optimised within a timeframe dictated by construction can increase the risk of negative transboundary impacts that are unacceptable. MRCS recommends that design and associated data collection and analyses are concluded before starting the construction phase.

**Proposed solution - Pöyry Report Section 2.3.4.3**

- The technical suggestions of the Pöyry Report move dam design discussions considerably compared to the initial design proposed.
- MRCS agrees that the intermediate opening positions of flushing gates are problematic and either open or closed positions are preferable to allow both (i) free flow of water through the gates and (ii) effective free-flow flushing.

**Flushing procedures - Pöyry Report Section 2.3.4.4**

- The Pöyry Report makes a valuable contribution to discussing the effects of flushing flows.
- However, the modelling required to resolve questions about flushing operations, the degree of drawdown and free-flow flushing at lower discharges to remobilise sediments and the spillway design assessment all have to begin immediately and be completed before the construction phase starts. This is necessary to demonstrate the degree to which the dam will be “transparent” to sediment and assess the degree to which transboundary impacts on sediments, morphology and nutrients can be avoided through optimising the design of the dam.

**Impact of drawdown for routing and flushing on power production - Pöyry Report Section 2.3.4.6**

- It is important that all stakeholders understand and accept that the need to drawdown the water surface for essential sediment passing and flushing operations, as part of dam operations, will affect the understandable desire for constant power production.

**Additional investigations and modelling - Pöyry Report Section 2.3.5**

- The Pöyry Report is in accordance with the conclusions of the PC Project Review Report in recommending that additional investigations and modelling are needed.
- Unlike the Pöyry report, MRCS recommends that the monitoring programme must be agreed and implemented urgently to generate the understanding and baseline necessary to show that it is possible to build a dam that avoids the risk of unacceptable transboundary and cumulative impacts.
- The Pöyry Report suggests that the monitoring, numerical and physical modelling needed to support detailed design of the dam and, particularly, the spillway could be undertaken during the early phases of construction. While this would be feasible for some aspects of the investigations, it would not be prudent for others. Further, it will take some time to compile the data records and perform the necessary model runs. This rules-out completing the modelling as proposed by Pöyry within 4 to 6 months. The procedure to undertake all investigations during the project’s construction would also not

respond to the concerns that have been expressed by Member Countries.

- The Pöyry Report makes no suggestions about the frequency of monitoring and does not mention nutrient monitoring explicitly. This must be included to increase understanding of nutrient balances/cycling and evaluate trends of change. Proposals can be found in Annex 2 of this report.

**Summary of the recommended solution concerning sediment issues - Pöyry Report Section 2.3.7**

- The PC Project Review Report emphasised that by optimising the design of the dam, it should be possible to reduce sediment retention to close to 30% of reservoir volume, down from the 60% predicted for the original design.
- Rather than relying on the preliminary calculations of the Sediment Expert Group, it is recommended to commission the studies necessary to produce specific, achievable performance standards to control reservoir sedimentation at the proposed Xayaburi dam.

**PC Review Report Findings of the SEG - Pöyry Report Section 4.6**

- The Pöyry Report states that the PC Project Review Report findings on sediments go beyond the MRC PDG requirements. MRCS reconfirms that the recommendations made in the PC Review Report are consistent with the spirit and intent of the MRC Preliminary Design Guidance.
- The recommendation of the Pöyry Report to address the management of sediments from the outset of construction in and around the river should be taken up.
- The Pöyry Report statement that sediment impacts of multiple, proposed dams cannot be estimated by Xayaburi Power Company alone is in line with the spirit of the PC Project Review Report. The MRC would be the appropriate coordination platform for investigations.

**3.2.3 Adequacy in Addressing Member Country Concerns**

- The Pöyry Report states that the main concern of the Member Countries centres on sediments and many of the other sediment-related concerns covered in the PNPCA.
- The studies and investigations recommended in Chapter 2 of the Pöyry Report would allow improved assessment of the transboundary and cumulative impacts of the dam. Before thought is given to designing measures to mitigate these impacts, the MRCS strongly recommends that every effort should be made to design and operate the dam in ways that avoid adverse impacts in the first place.
- The relatively high level of uncertainty about the future of the Lower Mekong Basin necessarily leads to designing a dam with the greatest possible adaptive capacity so that it can avoid or minimise adverse impacts. Whilst avoiding significant negative impact through design and operation rules is preferred, it is recognised that mitigation as an impact management tool is also necessary.
- The MRCS Review Team strongly recommends integrative sediment management at the proposed Xayaburi Dam considering the relationships and interactions of sediments with channel and floodplain morphology, nutrient balances, fisheries, seasonal flooding and ecosystems in the Lower Mekong Basin, especially the Tonle Sap Lake, the Mekong Delta and the surrounding coastal area.
- The Pöyry Report’s recommendations address comments by Member Countries about lack of knowledge, baseline data and assessments regarding transboundary and cumulative effects from hydropower dams. However, the suggestion that collection of baseline information could be performed during construction does not, in the opinion of the MRCS Review Team, sufficiently respond to their concerns, especially in relation to deferring mainstream dams.

**3.3 Water Quality, Aquatic Ecosystem Health and Environmental Flows**

**3.3.1 General Impression of the Pöyry Report**

The Pöyry Report comprehensively considers most relevant aspects on water quality, aquatic ecosystems health and environmental flows. With regard to water quality, it considers the Xayaburi EIA report more or less compliant with the MRC PDG and PC Project Review Report. The Pöyry Report does not consider nutrients and nutrient dynamics, important concerns in the Review Report. Regarding aquatic ecology and

environmental flows, it states that current assessments in the Xayaburi EIA report need to be improved by being more detailed and comprehensive. As with fisheries and sediment issues, the need for investigations to enable more detailed and comprehensive assessments is clearly highlighted. The Pöyry Report recommendations for water quality, aquatic ecosystems health and environmental flows (see Chapter 2.4.3) are not very specific and insufficient for detailed assessment of their quality and feasibility.

### **3.3.2 Findings in the Pöyry Report with respect to compliance of the Xayaburi Project with the MRC PDG and MRCS PC Project Review Report**

The Pöyry Report identifies compliance gaps of the Xayaburi EIA report with the PDG and the PC Project Review Report. Details are in the Report on Water Quality, Aquatic Ecosystem Health and Environmental Flows in **Annex 3**. Key compliance issues are highlighted below:

#### **Biological/ecological and habitat aspects as well as environmental flows - Pöyry Report Sections 2.4.2:**

- The Pöyry Report findings are in line with the PC Project Review Report in the sense that they highlight the need for more detailed and comprehensive assessments to be undertaken, particularly for biological/ecological and habitat aspects as well as environmental flows.
- In relation to this, the Pöyry Report makes it clear that investigations need to be carried out and data need to be sourced to fulfil these tasks. In particular, improved baselines for biological, ecological and habitat aspects as well as environmental flows need to be established.
- Sections in the Pöyry Report on sediments, water quality and aquatic ecology seem to be decoupled from social assessments. For example, some of the investigations mentioned for social assessments (mapping of the use of other aquatic animals, river bank gardens etc.) concern the same habitats and species that would be in focus for the aquatic ecology parts. However, this is not reflected in the Pöyry Report.
- The Pöyry Report foresees investigations taking place during the construction phase, which is not aligned with the PC Project Review Report. It is strongly recommended to undertake baseline investigations before construction.

#### **Water quality, nutrients and nutrient dynamics - Pöyry Report Sections 2.4.2:**

- The Pöyry Report does not fully agree with the PC Project Review Report in recognising impacts on water quality. This includes the potential impacts regarding changes in water clarity due to sediment settling in the reservoir causing subsequent changes in nutrient concentrations and dynamics.
- The Pöyry Report does not reflect specific aspects on nutrients and nutrient dynamics, a shortcoming since these were identified in the PC Project Review Report.
- The recommendations of the Pöyry Report do not clearly reflect the linkages between aquatic ecology/ecosystems and sediment transport, nutrient transport and water transparency. Although the PC Project Review Report highlights the need to improve baseline knowledge on water quality particularly regarding nutrients, the Pöyry Report considers the knowledge sufficient.

#### **Flow regime and environmental flows - Pöyry Report Sections 2.4.2:**

- The Pöyry Report recognises that the flow regime and potential impacts on it need to be monitored and further assessed. It states that a baseline needs to be established, that flows need to be assessed through modelling of potential fluctuations in the flow and that assessments need to be made of the possible impacts upstream and downstream the dam.

#### **Establishment of baselines - Pöyry Report Sections 2.4.2:**

- Both the PC Project Review Report and the Pöyry Report recognise that flora, fauna and habitats need to be studied and assessed in more detail including a baseline and designing a monitoring programme.
- Concerning the studies and investigations needed to comply with MRC Guidance, it is stated that: *'There is still enough time to carry out all the investigations and studies and to develop more detailed and effective monitoring plan to be in compliance with the MRC Guidance.'* This is not in compliance

with the PC Project Review Report. The following reflections on time consumption and timing are made as findings of this document:

- Baseline surveys for water quality, ecological/biological quality elements and environmental flows need to be undertaken before any construction activities start.
- All baselines need to be established before the more detailed assessments can take place and before mitigation measures can be designed.
- The biological/ecological and habitat baselines need to cover the fundamentally different flow regimes of the Mekong River during both wet and dry season. This is also very relevant for the socio-economic survey suggested in the PC Project Review Report (see section 4.5.1, page 61).
- The importance of the deep pools as habitats is mentioned, but not the consequences of drowning sand bars due to higher water levels. The sand bars serve as important habitats for flora, fauna and biodiversity.

**Monitoring - Pöyry Report Sections 2.4.2:**

- Like the PC Project Review Report, the Pöyry Report proposes to improve monitoring programmes to enhance the knowledge of chemical, biological and discharge parameters.
- Proposals for monitoring programmes are included in the Pöyry Report. Contrary to the PC Project Review Report, these refer only to monitoring during dam construction and not before construction starts. This needs to be revised and improved in order to ensure best possible pre-requisites and to minimise the risk of regret measures.
- The Pöyry Report suggests reducing the number of monitoring stations for chemical and biological parameters during the construction phase and to use automatic monitoring equipment for some parameters. It is recommended that this proposal be further studied to consider whether automatic sampling would be feasible and cost-efficient given the extreme conditions of the river.
- Nutrients and nutrient dynamics need to be added to the monitoring programme.
- The Pöyry Report addresses monitoring of aquatic ecology and environmental flows only in general terms. It suggests monitoring flora, fauna and habitats at three stations once a year during the operational phase, without specifying frequency during the construction phase. The PC Project Review Report indicates that the aspect of frequency needs to be considered carefully, particularly recognising the very different flow regimes in the Mekong River (wet, dry and transition periods from dry to wet and from wet to dry). The number of sampling sites also needs to be considered carefully as these should cover flora, fauna and habitats including at least the deep pools and sandbars.
- The monitoring of environmental flows proposed in the Pöyry Report does not reflect the aspect of hydropeaking which needs to be considered.

**3.3.3 Adequacy of Addressing Member Country Concerns**

- The key concerns of Member Countries are transboundary impacts and the absence of any evidence that mitigation measures proposed are sufficient to address concerns about fish migration, sediment and nutrient transport and navigation.
- It is the MRC Review Team’s opinion that the Pöyry Report’s recommendations do not address the issue of nutrient transport and dynamics and how these could be affected by the proposed dam project.
- The Pöyry Report mentions that assessments of transboundary impacts need to be the responsibility of governments not the Developer. Proposals for some investigations are made in the report.
- It is the opinion of the MRC Review Team that possible transboundary and cumulative impacts on both the Tonle Sap Lake and the Mekong Delta need to be investigated to reduce uncertainties and improve existing knowledge gaps.
- To be in line with the PC Project Review Report, specific investigations need to be undertaken before

construction starts.

### 3.4 Navigation

#### 3.4.1 General Impression of the Pöyry Report

In general, the Pöyry Report responds well to the MRC PDG and PC Project Review Report. It considers the proposed navigation lock system to be almost fully in compliance with MRC documents. The PC Project Review Report also concluded that the submitted Xayaburi documents generally addressed provisions for navigation under MRC Guidance. Still, changes and adaptations have been proposed and requested. In response, the Pöyry Report outlines and confirms adaptations and concludes that their implementation will allow the proposed Xayaburi dam project to be fully aligned with MRC PDG.

#### 3.4.2 Findings in the Pöyry Report with respect to compliance of the Xayaburi Project with the MRC PDG and MRCS PC Project Review Report

A detailed report regarding navigation as described in the Pöyry Report can be found in **Annex 4**. The following provides an overview on the key findings and outlines some issues for further clarification:

##### Water levels, range of operation of the locks - Pöyry Report Sections 2.1.2:

- The PC Project Review Report requested that the maximum navigable discharge be fixed according to hydrological conditions. The Pöyry Report concludes that the two years return period flow (14,580 m<sup>3</sup>/s) – as proposed in the Review Report – seems appropriate. It also proposes that the high operating level for the downstream lock – now at 260.0 m – could be considerably lower, in which case it is suggested to obtain the operating curve for details.
- The Pöyry Report responds to the request for an operation curve by indicating water levels upstream from the lock corresponding to the discharges in all dam operating conditions (normal, during peak flows, during flood events). It concludes that the magnitude of fluctuating reductions of the downstream level should be evaluated in the different operating scenarios considered. The timing of this investigation should be indicated.
- The Pöyry Report indicates the need to investigate how navigation would be affected by surges generated by special dam operations (e.g. emergency stops of the turbines). The timing of such investigations should be indicated.
- MRCS Review Team observes the need for a general table (data sheet) of the right highest and minimum navigable flows and levels (for water and structures) under different stages (natural, construction, after commissioning) and a scenario (with and without Pak Lay), for upstream and downstream water levels.

##### Design vessels and navigation standards - Pöyry Report Sections 2.1.3:

- The Pöyry Report states that the proposed Xayaburi dam project must take into account MRC Guidance and confirms all figures accordingly.

##### Nautical accessibility and approaches for the locks - Pöyry Report Sections 2.1.4:

- Regarding the access and approach of the lock, the Pöyry Report provides recommendations which responds to the PC Project Review Report with details. It is emphasised that the upstream as well as downstream approach channels are wide enough to allow large barges crossing with barges going in the other direction. It further notes that the proposed removal of the outcrop situated 800 m upstream of the lock on the right bank will be considered.
- The MRC Review Team observes that details should be provided on the dredging of the bed in the low water channel that might be undertaken during the first phase of construction to reduce increased average velocity (e.g. how much will be dredged and will this be part of the infrastructure draft book?).

- The MRCS Review Team recommends that a physical model is constructed to perform a more in-depth investigation of the navigation access upstream and downstream of the lock. Confirmation of this would be useful.

**Lock design - 2.1.5:**

- The Pöyry Report's recommendations fully respond to the PC Project Review Report and the recommendations that have been taken expressed.
- It is re-emphasised that the maximum air clearance of 12 m is very important for the Lao Government to consider not only on the ship locks but also for other bridges along the river.

**Emptying and filling system of the locks - 2.1.6:**

- The Pöyry Report fully responds to the MRCS PC Review Report and proposed respective adaptations.

**3.4.3 Adequacy of Addressing Member Countries Concerns**

- The Member Countries expressed concerns regarding freedom of navigation. Adaptations proposed in Chapter 2 of the Pöyry Report should ensure adequate conditions for navigation.
- The MRC Review Team notes that in the case of multiple mainstream dam developments, the possible transboundary effects on freedom of navigation have to be further investigated.

**3.5 Safety of Dams**

**3.5.1 General Impression of the Pöyry Report**

In general, the section on Safety of Dams in the Pöyry Report is very short and indicates that compliance with the PDG would be readily achieved. There is no indication in the Pöyry Report that dam safety is a major risk to be managed. The Pöyry Report's recommendations do not fully respond to the recommendations of the PC Project Review Report and therefore the MRC PDG. The PC Project Review Report recommended an independent panel of experts (Dam Safety Review Panel) from the early design phase through to the construction and operation phases. Considered international best practice, such a panel is not mentioned in the Pöyry Report. The concerns of Member Countries regarding transparency and transboundary effects are therefore not taken into account in relation to relevant dam safety issues.

**3.5.2 Compliance of the Pöyry Report with the MRC PDG and MRCS PC Project Review Report**

Based on the findings of the Pöyry Report, compliance gaps of the Xayaburi project documents with the PDG and PC Project Review Report are identified and these are highlighted below:

- The Pöyry Report does not mention if there is any indication that the dam is defective in design. Regarding dam safety hazards, it states that those "*should be rather straight forward*" and that no hazards are foreseen that cannot be resolved.
- As mentioned above, the Pöyry Report does not mention the independent panel of experts (Dam Safety Review Panel) proposed by the MRC PDG and PC Project Review Report as international best practice, particularly applicable for dams on the Mekong mainstream. It is re-emphasised here to commission an independent Dam Safety Review Panel from the early design phase to the construction and operation phases. The panel would provide transparent monitoring, reviewing, reporting and reassurance to downstream communities and countries that necessary provisions for dam safety are in place (e.g. international safety standards, dam breaks).
- The PC Project Review Report recommended observing international standards for dam safety including the consideration of a Maximum Credible Earthquake. The Pöyry Report mentions there is ongoing investigation on the earthquake design and seismic elements including the location of the Dien Bien Phu fault relative to the dam site. It is recommended that this issue also be investigated in the framework of the Dam Safety Review Panel as this could represent an additional hazard that will need to be considered in the design.

- The Pöyry Report states that a dam break analysis as well as the consideration of a cascade dam break scenario analysis is a matter yet to be completed. Details on those investigations would need to be reviewed by the Dam Safety Review Panel.
- The failure of spillway gate equipment is raised as a hazard in the Pöyry Report but is not dealt with in detail. It is recommended here that a thorough risk analysis and a systems backup approach should be in place, to ensure gate operations during major floods. It is recommended that these topics should also be investigated and discussed in the framework of the independent Dam Safety Review Panel.

### **3.5.3 Adequacy of Addressing Member Country Concerns**

- Member Countries expressed concerns regarding dam safety including the request for respective information transparency.
- The concern expressed could be addressed by commissioning an independent Dam Safety Review Panel as proposed by the MRC PDG and PC Project Review Report and as re-emphasised in this document.
- Possible transboundary effects in relation to dam safety – considering the Xayaburi dam as a stand alone project or part of multiple mainstream dam developments – have to be further addressed and investigated to respond to the concerns expressed by the Member Countries.

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## 4. Key Conclusions, Recommendations and Next Steps

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### 4.1 Introduction

Based on a request to the MRC Secretariat from the Viet Nam National Mekong Committee – in its role as a Joint Council member – the observations and comments in this document provides an overview of the content of the Pöyry Report. It also includes an assessment of the Pöyry Report’s findings regarding the proposed Xayaburi project and its compliance with the MRC Preliminary Design Guidance (PDG) and alignment with the MRCS PC Consultation Project Review Report. It also reflects on how far the Pöyry Report considers the comments provided by Member Countries during the prior consultation process.

This chapter summarises the technical findings and recommendations for each of the five thematic topics covered in the PC Project Review Report and the MRC Preliminary Design Guidance. Overall key conclusions are provided (see Sub-Chapter 4.3), that should further support a joint discussion between Member Countries on the Pöyry Report’s implications for the MRC framework, the prior consultation process and related next steps regarding the proposed Xayaburi dam.

### 4.2 Technical Findings on the Pöyry Report Compliance and Recommendations

The below summarises the technical findings for each of the five thematic topics and recommendations to be followed up:

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#### *Fish Passage and Fisheries Ecology*

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##### **MRCS Findings**

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The various options proposed in the Pöyry Report show increased but still partly compliance with the MRC PDG with respect to fish passage and fisheries. It outlines the main design requirements to ameliorate fisheries issues, such as fish passage. However, the detail provided and strategy to adapt the design during the construction phase in the light of information from concurrent studies is of concern.

Key issues on the thematic topic regarding Fisheries and Fish Bypass Facilities are not fully addressed by the suggestions made in the Pöyry Report, including the design of the fish passage facilities in both upstream and downstream direction, socio-economic aspects in relation to fisheries and the proposed mitigation measures. Consideration of transboundary impacts is limited.

The Pöyry Report proposes various design options regarding the fish passage facilities to comply with the MRC PDG. However, the detail provided and strategy to develop and adapt the detailed design during the project’s construction phase does not satisfy the proposals of the PC Project Review Report nor the PDG.

Downstream fisheries migration is addressed only briefly in the Pöyry Report and needs more attention as overall fisheries production will be significantly impacted if the downstream migration becomes dysfunctional. The operation of ‘fish friendly’ turbines does not solve the challenge of downstream migration and as a stand-alone mitigation measure needs reconsideration.

The nature-like bypass channel as proposed in the Project Review Report needs further investigation as its design is rated feasible by the Fisheries Expert Group.

While the Pöyry Report proposes to undertake much-needed investigations during the construction phase of the dam if it goes ahead, it is recommended that most investigations (e.g. assessment of fisheries baselines) need to be performed before the construction phase. A revision of the timing and sequencing is therefore proposed.

Member Countries’ comments concerning (i) lack of knowledge, baseline data regarding fisheries as well as related socio-economic implications and (ii) lack of assessments regarding transboundary and cumulative effects from hydropower dams are addressed in the Pöyry Report. The collection of baseline information during the construction is not considered to respond sufficiently to the countries’ concerns, especially when it comes to the request to defer construction.

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## **MRC Recommendations**

A minimum of two years before the construction phase is advised and will be required to collect and analyse baseline data regarding fisheries and to adapt the design of the fish passage facilities.

The development of a detailed programme of studies to fill gaps plus a road map outlining the timing for investigations prior to and during the construction phase is recommended.

Workshops between the Lao Government, the Developer, the Fisheries Expert Group and the MRC are recommended to review the technical issues regarding the fish passage facilities, different design options and wider experience available.

Transboundary and cumulative effects should be – as also suggested in the Pöyry Report – covered and assessed in cooperation between MRC, Member Countries and the Developer. Possible transboundary and cumulative effects on the Tonle Sap Lake and the Mekong Delta should be addressed in detail.

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## ***Sediment, River Morphology and Nutrient Balance***

### **MRC Findings**

The Pöyry Report findings regarding the proposed Xayaburi dam project increased compliance with the MRC PDG and supported recommendations in the MRC PC Project Review Report. Some new and original suggestions initiated would enhance the capability and adaptability of the proposed dam with respect to managing sediments. Some concerns are still expressed in this document.

The proposed modifications to the design and operation of the structure include elements that could be used to successfully minimise sediment trapping upstream from and at Xayaburi Dam.

The Pöyry Report states that the proposed design elements require additional study to ensure that the intended goal of making the dam as “transparent to sediment” as possible can be achieved in practice.

If the Lao Government and the Developer accept the recommendations in the Pöyry Report, including the design modifications and additional studies necessary to ensure that sediment can be successfully managed between Luang Prabang and the proposed Xayaburi Dam, an exemplary run of river hydropower project can result – at least for the thematic topic of sediments.

*Concerns can still be expressed regarding some issues and these refer to:*

Timing and sequencing of monitoring to fill gaps in knowledge, modelling to reduce uncertainty and support detailed design and construction should the project go ahead.

The Pöyry Report suggests that the monitoring as well as numerical and physical modelling needed to support detailed design of the dam and, particularly, the spillway could be undertaken during the early phases of construction. While this would be feasible for some aspects of the investigations, it would not be prudent for others.

The Pöyry report suggests that the modelling studies necessary to support detailed design can be initiated immediately and completed within 4 to 6 months. Experience suggests that 4 to 6 months would be insufficient to build the model and execute the multiple experiments necessary to establish and optimise the structure’s performance with respect to passing water, sediment and debris. This is due to the multiple, highly varied combinations of discharge and tail elevation to be simulated. Revisiting this issue is proposed.

The challenge of designing and building a dam sufficiently ‘transparent’ to sediment that the risks of it generating unacceptable transboundary and cumulative impacts are effectively eliminated, is no mean task. Time must be allowed for the work necessary to deliver a feasible design.

Member Countries’ comments centre on sediment with respect to addressing lack of knowledge, baseline data, and assessments regarding transboundary and cumulative effects from hydropower dams. These issues are addressed in the Pöyry Report, which recommends further investigations. The report’s suggestion to collect essential information, including baseline data on sediments, during the construction phase is not considered to respond sufficiently to countries’ concerns, particular when referring to the request to defer the proposed project.

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## **MRC Recommendations**

It is proposed here that outstanding issues and questions pertaining to gaps, uncertainty, sequencing and timing will only be resolved when a road map for monitoring, modelling and detailed design of the proposed dam, together with a timeline for construction, have been discussed and agreed between the Lao Government, the Developer and the MRC.

This approach would also fully respond to Member Country concerns. Countries could be confident that the proposed design solution has been tested and proven fit for purpose beyond reasonable doubt before construction begins. Commencing construction any earlier would not ensure this.

The possible effects of sediment flushing on the aquatic environment, especially downstream, should be taken into account.

It is also proposed – as in the Pöyry Report - to tackle transboundary and cumulative issues, which include the investigations of impacts regarding sediments in the Tonle Sap Lake and the Mekong Delta, with the MRC providing the coordination platform for collaboration with the Lao Government and the Developer.

### ***Water Quality, Aquatic Ecosystem Health and Environmental Flows***

#### **MRC Findings**

The Pöyry Report considers the submitted Xayaburi EIA report more or less compliant with the MRC PDG and largely in accordance with the MRCS PC Project Review Report with regards to water quality. Some relevant issues summarised below are not addressed.

Aspects on nutrients and nutrient dynamics, considered as very important in the PC Project Review Report, are not addressed at all in the Pöyry Report.

Concerning environmental flows, the Pöyry Report recognises that the flow regime and potential changes in the flow regime need to be further assessed.

The issue of environmental flows and hydropeaking is not sufficiently addressed in the Pöyry Report.

Concerning aquatic ecology, the Pöyry Report recognizes that the assessments need to be more detailed and comprehensive.

The Pöyry Report specifically notes that an improved baseline covering the relevant aspects (flora, fauna, habitats, flow conditions) is a prerequisite for the improved assessments and should be established.

The Pöyry Report also recognizes the need for a monitoring programme during both construction and operation.

The above findings of the Pöyry Report are not aligned with the PC Project Review Report when it comes to timing of necessary investigations, which are foreseen to take place during the project's construction. It is strongly recommended to undertake baseline investigations before construction.

The key concerns expressed by Member Countries regard transboundary impacts and that there is no evidence that mitigation measures proposed are effective to address concerns about fish migration, sediment and nutrient transport and navigation. Pöyry states that more investigations and assessments are needed. To be in line with the Project Review Report and address the concern of countries, the issues to be investigated need to be identified before construction to prevent "regret measures".

#### **MRC Recommendations**

A road map is recommended to complete the outstanding issues including information on nutrients and nutrient dynamics as well as environmental flows.

The road map should be elaborated in close cooperation between the Developer, the Lao Government and the MRC and also outline if timing of necessary investigations and assessments should be performed before and/or during construction.

Investigations into transboundary and cumulative effects on water quality, aquatic ecosystem health and environmental flows should be coordinated by MRC.

### ***Navigation***

#### **MRC Findings**

The Pöyry Report responds well to the proposals and recommendations of the MRCS PC Project Review

Report. If all adaptations are performed as proposed in the report, full alignment with MRC PDG will be achieved.

Design and planning modifications as part of the Pöyry Report refer to the hydraulic conditions for navigation, the lock design itself, principal navigation standards, accessibility and approaches of the locks as well as the emptying/filling system of the lock.

Still, this document includes some requests for more detailed information that would be considered useful to obtain a complete picture.

### **MRCO Recommendations**

The outstanding issues outlined in the Pöyry Report and in this document should be followed up to ensure MRC PDG compliance indicating the foreseen timing.

Investigations into transboundary and cumulative effects on free navigation should be coordinated by MRC.

### **Safety of Dams**

#### **MRCO Findings**

The section on Safety of Dams is brief in the Pöyry Report and does not fully respond to the recommendations of the MRCO PC Project Review Report and therefore the MRC PDG.

The Pöyry Report does not envisage any major dam safety issues that cannot be readily resolved in the design.

The PDG as well as the Project Review Report calls for the establishment of an independent Dam Safety Review Panel. The Pöyry Report does not mention this proposed body, which is considered as international best practice.

There are outstanding matters that need consideration by the Dam Safety Review Panel including the consideration of a Maximum Credible Earthquake, dam break analysis and failure of spillway gate equipment.

#### **MRCO Recommendations**

Commissioning an independent Dam Safety Review Panel – as required by the PDG and according to the Project Review Report as well as to international standards – would seem to be an urgent priority to ensure necessary dam safety and transparency.

## **4.3 Key Conclusions**

### **General**

The Pöyry Report findings regarding the proposed Xayaburi dam project is seen by the MRCO Review Team as constructively adding to the information on and advice to the Xayaburi Project. The report provides an overview of the compliance of the proposed Xayaburi project with MRC PDG and alignment to the MRCO PC Project Review Report from the perspective of the Pöyry Energy AG. The report states how the concerns of the countries – expressed during the prior consultation process – will be considered. It suggests several adaptations and modifications to be undertaken to improve compliance of the proposed project with the MRC requirements as well as international standards. Specific concerns regarding the compliance with the MRC requirements are reflected in this document.

### **Compliance with the MRC PDG**

The assessment results of this document show that the level of compliance of the proposed Xayaburi project with the MRC PDG regarding the five thematic topics as well as their alignment to the MRCO PC Review Report is different. The table below provides a rough overview on the MRCO compliance statement with the MRC PDG regarding each of the five thematic topics. It also outlines *key* shortcomings that have not been or are insufficiently addressed in the Pöyry Report. Additional issues and further details are

reflected in Sub-Chapter 4.2 as well as in Chapter 3.

MRC PDG Thematic Topic	MRCS Compliance Statement	MRCS Key Shortcomings to Comply - Need for Further Improvement
Fish Bypass Facilities and Fisheries	Partly compliant although more compliant than April, 2011, when special session of Joint Committee convened.  Detailed data and proof of concept models needed	<ul style="list-style-type: none"> <li>• Proposed design of fish bypass facilities in both upstream and downstream directions only partly aligned with the MRC PDG PC Review Report;</li> <li>• Socio-economic aspects regarding fisheries not sufficiently addressed;</li> <li>• Timing and sequencing of planned investigations to reduce uncertainties including investigations regarding possible transboundary and cumulative effects are not aligned with PC Project Review Report philosophy (all investigations are currently foreseen during but not prior to construction);</li> </ul>
Sediment, River Morphology and Nutrient Balance	More or less compliant and more compliant than in April 2011, when special session of Joint Committee convened.  Detailed data and proof of concept models needed	<ul style="list-style-type: none"> <li>• Timing and sequencing of planned investigations to reduce uncertainties including investigations regarding possible transboundary and cumulative effects are not aligned with PC Project Review Report philosophy (all investigations are currently foreseen during but not prior to construction);</li> <li>• Insufficient time period (4-6 months) for necessary modelling studies foreseen;</li> </ul>
Water Quality, Aquatic Ecosystem Health and Environmental Flows	More or less compliant	<ul style="list-style-type: none"> <li>• Aspect of nutrients and nutrient dynamics are not considered;</li> <li>• Environmental flow during hydropeaking not addressed;</li> <li>• Timing and sequencing of planned investigations not aligned with PC Project Review Report philosophy;</li> </ul>
Navigation	Almost fully compliant	--
Safety of Dams	Partly compliant	<ul style="list-style-type: none"> <li>• Commissioning of an independent Dam Safety Review Panel is not foreseen;</li> <li>• Matters on Maximum Credible Earthquakes, dam break analysis and failure of spillway gate equipment are not yet fully addressed yet;</li> </ul>

**Follow-up of outstanding issues**

The outstanding issues listed in the Pöyry Report, the MRCS PC Project Review Report and this document need to be followed up as soon as possible to ensure compliance with MRC documents. The timing and sequencing of those investigations need to be set in a transparent way (this issue and related aspects are addressed below). Special attention should be given to the adaptation of the fish bypass facilities, sediments, issues regarding water quality and nutrients as well as the safety of dams.

**Timing and sequencing for investigations, monitoring and modelling**

The Pöyry Report foresees that investigations, monitoring and modelling – to reduce uncertainties in relation to various topics including sediments, fisheries, water quality and aquatic ecosystem health as well as transboundary/cumulative aspects – will take place during the construction phase of the proposed Xayaburi project and not before construction. This is significantly problematic for all relevant thematic topics. While this procedure proposed by Pöyry would be feasible for some aspects of the investigations, it would not be prudent for others.

Specific investigations are recommended before construction to reduce risks, including those of transboundary and cumulative impacts, and to avoid “regret measures”, actions that may ultimately be inappropriate and an expensive as well as irreversible mistake. A minimum of two years before the

project's construction phase is proposed to collect and analyse baseline data as well as to adapt the design of the fish bypass facilities.

Regarding outstanding issues and questions pertaining to gaps, uncertainty, sequencing and timing, it is recommended to develop a detailed programme of studies to fill gaps plus a road map for monitoring, modelling and detailed design of the proposed dam, together with a timeline for construction. This should be undertaken in close cooperation between the MRC, the Government of Lao PDR and the Developer.

**Establishment of baselines and respective monitoring programmes**

Baselines using factual data need to be urgently established for the topics of sediments, fisheries, water quality, nutrients and environmental flows to develop quality objectives that enable the assessment of current and future status of each topic as well as to assess possible impacts. This activity including the design of appropriate monitoring programmes is a key priority that should be implemented prior to the construction phase of the project and be initiated as soon as possible.

**Implementation of necessary modelling**

Modelling demand for topics like sediments, hydrology, hydraulics and fisheries are still needed and need to be followed-up as soon as possible.

**Response to the concerns of Member Countries**

The concerns expressed by the Member Countries during the prior consultation process have been listed in the Pöyry Report. The concerns mainly centre on fisheries and sediments. Concerns have also been expressed about possible transboundary and cumulative effects and knowledge gaps that need to be filled. The concerns are addressed with the technical findings and outlines in Chapter 2 of the Pöyry Report. The concerns of the countries are not fully addressed, especially when it comes to the country request to defer the construction of all mainstream dams until knowledge gaps are filled.

Investigations to fill knowledge gaps are currently proposed by Pöyry to be undertaken during the dam construction phase but not before. This challenge should be revisited and a road map – as proposed above – should be developed to respond to the concerns expressed.

**Transboundary and cumulative effects**

As proposed in the Pöyry Report, further investigations need to be undertaken to reduce uncertainties about the possible impact risks stemming from the Xayaburi dam not only as a stand-alone-project but also as part of all other planned hydropower developments. In particular, aspects of possible impacts on the Tonle Sap Lake and the Mekong Delta need to be investigated. Supporting the proposal of the Pöyry Report, it is recommended that those investigations are coordinated via the MRC cooperation platform in close cooperation with all Member Countries and the Developer.

**Commissioning an independent Dam Safety Review Panel**

To ensure necessary dam safety and transparency, the commissioning of an independent Dam Safety Review Panel – as required by the MRC PDG and according to the MRCS PC Project Review Report as well as to international standards – is urgently needed and therefore recommended.

**Cooperation between the MRC, the Government of Lao PDR, the Developer and other experts**

As already proposed in the MRCS PC Project Review Report, exchanges on technical issues, monitoring and modelling between the MRC, the MRC Secretariat, the Government of Lao PDR, the Developer and selected experts are recommended to ensure optimal solutions, mitigation measures and compliance with the MRC documents.

Workshops could serve as an effective tool to follow these recommendations. In particular the thematic topics of fish bypass facilities and fisheries as well as sediments should be followed up with such technical workshops to enable appropriate solutions as soon as possible.

**Coordination platform MRC and initiation of work**

It is recommended to make full use of the MRC coordination and facilitation platform especially for highest effectiveness especially when it comes to transboundary and cumulative issues. All outlined work and

investigations should be initiated and performed as soon as possible.

#### **4.4 Next Steps**

This document has been developed at the request of the Viet Nam National Mekong Committee (VNMC) in its role as MRC Joint Committee member. The MRC Secretariat will forward the findings and recommendations detailed in this document to the VNMC as per its request.