COMMENTS BY LAO PDR
ON THE MRCS TECHNICAL REVIEW REPORT
OF THE PROPOSED XAYABURI DAM PROJECT

4. Technical Review

4.1 Xayaburi Hydropower Dam Design and Operation

4.1.1 Basic information on project layout, design and construction sequence

(ii) Design of project facilities - **Page 12**

The stilling basin is designed for floods up to a return period of 50 years. This approach assumes that the stilling basin can be dewatered at intervals for inspection and repair of any damage that may occur as a result of larger floods.

Comments: The possibility to inspect / repair the stilling basin is foreseen in the design.

With the present design, the cofferdams must be closed with water flowing over the crest of the spillway, resulting in high velocity through the closure section.

Comments: This is not true. Three spillway bays are kept low during the river diversion operation.

The navigation lock arrangement appears generally consistent with the specific requirements of the Preliminary Design Guidance. Details should be confirmed as the detailed design is developed. The approaches to the locks upstream and downstream should be examined as part of hydraulic modelling to ensure that boat traffic is not endangered during plant or spillway operation.

Comments: The approach conditions were already checked in the hydraulic model, and the geometry optimised as needed.

(iii) Construction - **Page 13**

The Fisheries Expert Group therefore recommended that fish-passage facilities are implemented in a phased approach with a nature-like fish pass constructed during the first phase of the dam construction to be operational in the second phase.

Comments: This option was considered in the feasibility stage (nature-like fish pass on the left bank) but found extremely expensive because of the site morphology. Apart from the limited space available at the left river bank, there is no mean for a nature-like fish pass to cope with the high tail water and upstream water level fluctuations. The fish pass would be flooded with the rising tail water level and consequently the connection to the powerhouse collecting gallery would fail. This would make the nature-like fish pass and the whole collecting system ineffective for most of the year. However, the design of the present fish passage facilities should be refined during the following project stage as already recommended.

Conclusion:

1. The design of the project facilities have been confirmed by the hydraulic model test.
2. The design of the present fish passage facilities shall be refined during the following stage.

4.1.2 Overview of the dam operation plan

Page 14 - *Review recommendation: There is a need for information on operating constraints such as daily operating periods, ramping rates for starting and stopping units, minimum flows for environmental or navigation periods, and other details affecting the external impacts of the project.*

Page 15 - *The flow rate through the powerhouse would be varied to shift water into the peak periods by using the storage in the head pond, which is constrained to not more that 2.5 m in the Design Report*.

Page 18 - *Constraints on operations .*

The Design Report and Feasibility Study allude to some operating constraints but these do not appear to be formalized through the required concession agreement or power purchase agreement. Operating constraints need to be developed to include factors such as:

- *daily to weekly turbine operating ranges;*
- *permissible water levels changes with respect to (i) total water level (ii) ramping rates (rates of hourly water level changes). Ramping rates are commonly determined from power system needs but should be specified if there are environmental, navigation or other external constraints that should govern the plant operations. This has not yet been determined. It is noted also that China has established a ramping rate of 1 m/hr for the upper Mekong based on navigation needs;*
- *minimum flow rates;*
- *minimum number of navigation transits; and*
- *fish bypass operating conditions considering upstream and downstream migration and the differences in plant, sluice, and spillway flow rates from dry to wet season.*

Any operating constraints necessary for environmental, navigation, water supply or other external uses need to be defined for implementation in the power purchase agreement.

Comments: The daily operation of the plant, as studied and agreed in the PPA with EGAT considering environmental flow constrain by keeping a maximum daily fluctuation of 0.50 m in the reservoir and 1.0 m downstream. These means release for power generation will be made also during off peak hours in order to keep the fluctuation in head pond and downstream as low as possible. MRC was thinking that the Xayaburi HPP will be operated as peaking plant during primary period (16 hours only).

4.3 Fish Passage and Fisheries Ecology

4.3.5 Findings of the MRC technical review

The proposals / requirements in the MRC report include:

(i) Upstream migration – **Page 28**

- *To pass the high biomass and biodiversity, three fish-pass facilities (bypass channel, fish lift and navigation lock), passing a high flow, are required, combined with optimised dam operation*

  Comments: To be followed up and investigated. No scientific research has been conducted so far as regards the fish peak biomass and migration timing of the upper fish migration system and at the project site. These data are crucial for the proper sizing of the facilities. However, the MRC Preliminary Design Guidance (PDG) requires appropriate structure sizing of the fish passage facilities and does not require a certain number or type of facility.

- *Revise left-bank fishway concept to pass sufficient flow for the pass to function under different flows with sufficient space for large-bodied fish and high biomass, and maximum water velocities of 1.4 m/s and turbulence less than 30 W/m3 for the passage of small-bodied fish. Potential options are a nature-like bypass on a low gradient (< 1:100), which will potentially allow upstream migration of Mekong giant catfish, or two large fish locks.*

  Comments: The slope actually applied by other projects and which is recommended ranges between 1:10 and 1:20 for temperate regions and between 1:20 and 1:30 for tropical regions. For other type of fish passage facilities, e.g. Denil fish passage facilities or nature-like fish passes, the slope range is different. However, the design of the fish ladder shall be refined during the following project stage as already recommended. As a potential refinement, the adjustment of the slope of the fish passage facilities from 1:20 to about 1:30 would open the range of possible hydraulic designs and is therefore recommended. The maximum water velocity of 1.4 m/s fits in the criteria range defined in the design criteria, which shall be refined during the following project phase. The fish ladder needs to be a technical fish pass at least up to the elevation of the max tail water level, in order to maintain the hydraulic patterns inside the ladder during different tail water levels and to guarantee the permanent connection to the powerhouse collecting gallery, where fish are being collected. A nature-like fish pass would be flooded with the rising tail water level and the connection to the powerhouse collecting gallery would fail. This would make the nature-like fish pass and the whole collecting system ineffective for most of the year.

It is supposed that the proposed technical fish pass, which includes among others natural bottom substrate and the vital water depth of 6m, is appropriate for large-and small bodied species and is the closest possible to nature for that specific location in terms of vital water depth and the possibilities for adjusting hydraulic patterns.

- *Add solutions for mid-water, benthic and thalweg migrating fishes, including a benthic collection gallery underneath the draft tubes, or vertical slots between the draft tubes.*

  Comments: Space presently taken by the sediments flushing outlets, there are already three main entrances with 9m width each, which are connected to the river bottom, providing at least a total of 27m entrance width for benthic, mid-water and thalweg fishes.

- *Include a high capacity fish pass in the intermediate block; most likely a fish lift or possibly two large fish locks. May need multiple entrances and/or shaping of the abutment for low, medium and high flows; to be refined in physical modelling.*

  Comments: Not required according the PDG. The PDG requires appropriate structure sizing of the fish passage facilities and does not require a certain number or type of facility at a specific location. Once the peak biomass has been investigated, the size or/and the number of facilities shall be refined. A fish passage facility in the intermediate block has been proposed in the past, but has been omitted in favour of a larger, 6m deep, fish ladder on the left river bank. Furthermore we identified difficulties in finding a suitable location for the fish facility exit. It is very likely that fish will be drawn back into the tail water when releasing them at the upstream face of the intermediate block and into the middle of the river.

- *Modify the navigation lock to provide fish passage as well as navigation. Add gates, valves and possibly multiple entrances for low, medium and high flows.*

  Comments: It has to be noted that fish occasionally enter navigation locks and find their way out. However, a systematic use of navigation locks by migrating fish is only proved in some cases. At the Xayaburi site, during dry season, migrating fish will be primarily attracted by the powerhouse discharge, and the chance, that fish will enter the approach channel of the navigation lock will depend on its attractiveness in terms of discharge and velocity, compared to the powerhouse discharge. During wet season and in combination with certain spill patterns on the right side of the powerhouse, the approach channel probably may become more attractive. However, in order to raise the chance to attract fish to the lower lock gate, the discharge through the lower approach channel has to be of about 85-185 m3/s during wet season (and 30-85 m3/s during dry season), in order to provide a sufficient attraction velocity of about 0.5 m/s)

- *Optimise dam operation (turbines, attraction flow, fish-pass flow, spillway gates) for periods with high fish migration, based on physical model and 2d/3d CFD (Computational Fluid Dynamics) hydraulic model at different discharges and turbine operations.*

  Comments: This is considered in the design criteria as regards adjustable spillway patterns, adjustable fish entrance gates and attraction flow. Furthermore, it has been recommended that fish migration timing shall be investigated. It is obvious that the fish passage facilities shall be in operation when fish are migrating.

(ii) Downstream migration – **Page 29**

- *During periods of abundant larvae drift and downstream migration:*
  - *the primary mitigation is to use the sediment sluice gates, with no differential head, which provides passage of larvae through the impoundment mitigating the hydrodynamic barrier of the impoundment and passage bypassing the turbines and spillway.*

    Comments: This means emptying the reservoir and stopping energy production?

  - *the secondary mitigation is to maximise spill flow and minimize turbine passage by reducing power generation.*

    Comments: There is no clear evidence that reducing power generation is necessary for save larvae drift in this case. It is assumed that larvae drift occurs during wet season, when the spillway and the surface bypass collector system are in operation.

- *Use benthic, as well as surface, screens.*

  Comments: It is recommended that the trash racks and their possible effect on the different fish species as mechanical or behavioural barrier are verified and exclusion screens are investigated. Adult fish species of a certain size shall physically be excluded from entrainment during the period of downstream migration. For example, this can be done by temporally lowering specific exclusion screens along the trash racks. This would require as a first step to deepen the knowledge (e.g. fish size and shape) on the fish species concerned and to specify these screens. Subsequently, rack angles, bar spacing and approach velocities shall be verified against fish species requirements.

- *Use physical and 2d/3d CFD model to optimise screens. Screen spacing of 2 cm is required.*

  Comments: It is recommended to investigate the appropriate exclusion screen design. The requirement of 2 cm screen spacing is not proved and is not specifically required in the PDG. Anyhow, for downstream passage through the turbines, runner diameter, fish body size and width are critical design criteria. This information along with swimming performance data provides the criteria and design basis for entrainment and downstream passage elements, including the exclusion screens.

- *Provide one or multiple overshot gates on the spillway for fish passage.*

  Comments: It is recommended to investigate the possible implementation of overshot gates. Such gates may help surface oriented fish migrating downstream. However, the mitigating effect of overshot gates is not applicable in every case and is not yet proved for the current spillway design. Furthermore, it has to be taken into account the increased tail water level and reduced head difference during the wet season, when the spillway is in operation, thus facilitating downstream migration for these fish species. In order to investigate among others the behaviour of surface oriented fish species, investigation of the vertical and horizontal positioning of fish in the water column has been proposed to CK for the hydro acoustic survey.

- *Design deflectors and endsill to eliminate impact areas and minimise shear stress for fish.*

  Comments: This possibility may be investigated. However, it has to be taken into account the increased tail water level and reduced head difference during the wet season, when the spillway is in operation, thus already reducing the impact on downstream migration to some extent.

- *Get baseline data on larval drift to assess risk and mitigation strategies.*

  Comments: Noted. At the finalizing stage of the tender design, the baseline data on larval drift were not yet available

(iii) Fish passage during construction – **Page 29**

- *Incorporate a fish-passage plan into the construction sequence*

  Comments: 1st stage cofferdam, fish will pass through the natural river located left side. And 2nd stage cofferdam during powerhouse construction, fish will pass the right side of the river where the spillway locates.

<u>Conclusion:</u>

During the feasibility and environmental impact assessment study, the information on the ecology and fisheries of the Mekong river was collected from various sources, i.e. MRC extensive surveys, concerned publications, interviewed the fishermen along the Mekong river, and the fish samplings in 2007-2008. The collected information was

utilized to support the design of the proposed fish passing facilities for Xayaburi Hydroelectric power project.

However, the additional studies for specific information on fish biology, peak biomass, and fish swimming performance need to be undertaken and was already recommended in the environmental impact assessment to refine the design of the fish passing facilities and the fishery management in the future.

It has to be stated that some substantial requirements mentioned in the MRC review are probably based on the wrong assumption that water levels would not fluctuate, making these requirements more than questionable (e.g. nature-like fish pass). Some requirements have an experimental character and others are based on assumptions like fish biomass and fish species behaviour. Such requirements are difficult to negotiate as long as the recommended fish studies have not been carried out. However the investigations on fish behaviour have been recommended by the Consultant and the fish passage facilities might be refined.

4.4 Sediment Transport, Morphology and Nutrient Balance

4.4.7 Transboundary and cumulative impacts – Page 55 – 62

(i) Sediment and morphology: impacts on the transboundary scale
Sediment and morphological impacts were assessed for each of five scenarios.
Sediment and morphological impacts were assessed for each of the following six scenarios:

*1. **Scenario 1: Baseline 2000 –** Three existing Chinese mainstream dams (Manwan, Dachaoshan, and Jinghong), plus fifteen tributary dams.*

*2. **Scenario 2: Definite Future 2015 –** Eight existing and planned mainstream Chinese dams, plus twenty-six tributary Dams.*

*3. **Scenario 3: Definite Future 2015 + six upper Lao dams –** Eight existing and planned mainstream Chinese dams, plus twenty-six tributary dams, plus six mainstream dams in Lao PDR.*

*4. **Scenario 4: Foreseeable Future (i)** – Eight existing and planned mainstream Chinese dams, plus seventy-one tributary dams.*

*5. **Scenario 5: Foreseeable Future (ii)** – Eight existing and planned mainstream Chinese dams, six mainstream dams in Lao PDR, plus seventy-one tributary dams.*

6. ***Scenario 6: Foreseeable Future (iii)*** *– Eight existing and planned mainstream Chinese dams, six mainstream dams in Lao PDR, five Cambodia dams, plus seventy-one tributary dams.*

Limitations of data and time availability have precluded consideration by the SEG of the potential for designing and operating the additional mainstream dams in this scenario in ways that optimise sediment management and support the attainment of multipurpose objectives for hydropower generation and environmental protection. There is a significant risk that these large reservoirs will act as significant sediment traps – as has occurred with many other hydropower dams worldwide. Evidence to support this view comes from the Upper Mekong River, where the large Chinese reservoirs (especially that behind Manwan Dam) already appears to have lead to measurable reductions in the supply of sediment and nutrients to the river reaches downstream.

These findings emphasize the importance of optimising sediment management capabilities and operations at all existing and planned dams, including Xayaburi. It places a duty on the nations in the Lower Mekong Basin to construct and manage dams and reservoirs in a sustainable manner that minimises their tendency to trap and retain sediment. This can be best accomplished by designing, constructing and operating dams to generate hydropower sustainably, while managing sediments and nutrients to minimize the contribution of each dam to cumulative effects. This will not only reduce impacts on the environment and agricultural productivity, it will also reduce potential liability for compensation payments to transboundary stakeholders

Key points:

- The impact assessment mentioned in the PNPCA's document on nutrient impact is not only the impact from the Xayaburi HPP but also the overall impacts caused by all hydropower power projects in the Mekong basin. In case of consider only the impact from the Xayaburi HPP which is the run-of-river type project, it would result that the impact from the Xayaburi HPP on the nutrient in the Mekong would be only insignificant impact.
- Some loss of reservoir capacity could be expected; this has no impact on the project itself
- Sediment flushing through the flushing outlets will not impact on sediments deposited in the reservoir, will only clean the sediments deposited in front of the intakes. As already stated in the project documents.
- Sediments deposited in the reservoir are expected to be re-mobilised and flushed downstream through the spillway, especially when the reservoir level is lowered to protect Luang Prabang from high floods.
- There are 45% sediment contributions from the Upper Mekong, upstream of Manwan Dam, and only 5% sediment contribution from Manwan Dam to Pak Chom Dam.
- Since the Xayaburi HPP is the run-of -the –river type, the storage is the channel storage which is very small compared with the natural flows, therefore, it can change the flow character similar to the natural waterfall. Change to flow velocity will not be

as much as the storage reservoir. Therefore the sedimentation in the reservoir will be not as large as the storage reservoir.

- Monitoring: The MRC's report recommends more intensive establishment of comprehensive baseline assessment for the monitoring in the future during the operation. As inter-governmental body and with extensive monitoring experience, MRC should be appointed to be the responsible agency for the monitoring. Trust fund, as discussed in the report, shall be set up to obtain financial support from the potential developers of the hydropower projects on the main stream, including China.

Conclusion:

1. The Mekong basin covers 6 countries from China to Vietnam. One fifth of the catchment area is in China at where 5 hydropower projects are located. Refer to the draft PRIOR CONSULTATION PROJECT REVIEW REPORT on March 2011; it mentioned that 45% sediment contribution coming from steep area at the Upper Mekong in China and 5% sediment contribution occurring between Manwan Dam to Pak Chaom Dam. The Xayburi HPP is located between the river reach of Manwan Dam to Pak Chaom Dam it would imply that the sediment contribution between Manwan Dam to the Xayaburi site is approximately 2.5%. Therefore the Xayaburi HPP will cause very small effect to the sediment in the Mekong Basin.

2. The Xayaburi HPP is a run-of-river type. There is no big reservoir only channel storage or a pondage to detain water in the upstream for power generation.
   The operation plan of the Xayaburi HPP is to operate continuously 24 hours and on a daily basis of inflow exactly equal to outflow. The small volume of water in the upstream pondage, only 25 MCM of 700 MCM at a full supply volume, is proposed for using in a peak operation to minimize the effects of water fluctuation. The peak operation will result to a fluctuation of water surface in the upstream channel storage limited at only 0.5 m.

4.5 Water Quality, Ecosystem Health and Environmental Flows

Recommendations toward the design of monitoring programmes **Page 67**
During the first 6-12 months of the construction period, the water-quality monitoring programme needs to operate more frequently than proposed in the EIA to ensure that mitigation measures work efficiently. The current proposal for monitoring every 3 months is insufficient to provide the necessary management information to allow for the establishment of effective and cost-efficient mitigation measures.

Agree for the monthly monitoring program, more detail please see the attached document.

4.6 Navigation - Page 71

The design of the second set of locks is not acceptable. It is recommended to design the second lock side by side with first one – **Page 74** :

We believe that leaving flexibility to a future design is better, also to keep navigation open during a future construction of a second locks system.

*The dimensioning of the arrester cables has to take into account the capacity of the largest ships or convoys (1,000 T). –***Page 74**

This is a new requirement (so far, 500 t capacity was the design criterion, convoys with two ships were not specified.)

Financing of Lock Operations: **- Page 75**

This would be a welcome new: so far, nothing in this respect was considered.

The removal of the outcrop situated 800 m upstream of the lock, on the right bank is to be seriously considered. – **Page 74**

The hydraulic model has shown that the outcrop on the right bank limits water velocity and improves navigation conditions at the upstream approach, although requiring a bend in the approach.

Conclusion: The design navigation lock has been designed in compliance with the MRC'Guidance and already reserve area for the second lock.

4.7 Safety of Dams - Page 77

4.7.4 Conclusions and recommendations – Page 81

The Xayaburi project documents state the PDG provisions on dam safety will be followed. The provisions are not onerous and have been applied on other dam projects in Lao PDR. The Scoping Assessment states: "it is likely that all the PDG requirements on the safety of dams could be met, but the information to give such assurances is still limited at this time, especially concerning the institutional arrangements and preparation of the five main sub-plans needed to systematically review and monitor dam safety."

- The hydraulic design of the spillway and of the stilling basin is initially developed by applying the formulas and guidelines given in USBR publications with later adjustments according to the results of hydraulic model tests.
- Freeboard on Water Retaining Structures: The freeboard is established according to the Lao Electric Power Technical Standards, Chapter 2 – Hydropower Civil Engineering Facilities.
- Design Floods for Crest Structure: The crest structure is designed to be able to able to pass:
    - The 1000 years flood with two gates out of operation (this criteria is more severe then the usual USACE criteria, which calls for one gate out of operation only); and
    - The 10 years flood with half the gates out of operation for maintenance works in the stilling basin;

  in both cases without exceeding the maximum upstream water level established for the PMF conditions.
- The spillway crest is designed according to the USBR (Design of Small Dams, third edition 1987).
- Crest pressures are calculated according to Cavitation Safety Curves (USACE. Coastal & hydraulics laboratory. Hydraulic Design Criteria.)
- The stilling basin is designed to pass without damages at least the 50 years flood.
- The stilling basin Type II according to the USBR "Design of Small Dams" is applied.
- The stability and structural analysis of the various structures considers the USACE standards.
- A Dam Safety Management System (DSMs) will be implemented at the end of the construction period
- The Operator will check for updates of the World Bank Operational Policy during operation stage

Conclusion

1. Scope of work of MRC Secretariat and MRC Expert Group shall be clearly defined and accepted for all participants.

2. There will be a shortage of the power supply situation in the future. The sources of firmed power shall be needed to supply for a power demand. The big power plants which cause a lot of pollution will be hardly developed in our region including the Nuclear Power Plant. Thus the hydropower project development which is a green energy shall be strongly promoted and supported.

3. The project development will improve a livelihood quality of the country. The navigation lock will be a valuable development for the Mekong transportation. However every project shall provide the navigation locks for their barrages.

4. The impact assessment expressed in the PNPCA's document is not only the impact from the Xayaburi HPP but also the overall impacts caused by all hydropower power projects, including in the tributaries and the Upper Mekong.