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4.3 Modifications to the Distribution of Flows

The review suggests that the economic viability of the DSHPP is “vulnerable” to any reduction in dry season flows as the plant is operating at below its 1,600 m³/s maximum capacity for 6-7 months of the year, and must maintain a minimum flow over the Phapheng Falls. The economic viability of any run-of-river hydropower scheme is dependent on dry season flows which without exception mean that the generating plant in such a scheme operates for a substantial period of time below its maximum capacity. In fact the separate generation modelling studies carried out have demonstrated a consistent dry season generation pattern and a higher utilization overall than a “typical” run of river scheme. Accordingly the relevance or purpose of the TRR references to dry season “vulnerability” is not clear, and is unfounded.

The basis of the statement relating to diverting a greater proportion of flow into Hou Xang Pheuak is similarly unclear and speculative, as hydraulic and generation modelling and corresponding sensitivity analyses have fully accounted for an appropriate flow regime to Hou Xang Pheuak.

5.2.3 Fish Passage Design (p.21)

The review claims that the success of fish passage in channels other than Hou Sahong is entirely dependent on detailed hydraulic modelling, an assessment of channel morphology, and further modelling to optimize the attraction flow into Hou Xang Pheuak with respect to the powerhouse discharge.

Hydraulic modelling is a tool for understanding flow conditions, but can offer no insight into the suitability of these flow conditions for the myriad migrating fish species at Khone Falls. The Developer’s proposed approach is to combine appropriate modelling with field observations and monitoring, and adaptive mitigation measures. Given the complex physical and biological environment, with associated uncertainties, this approach is considered more effective than adherence to detailed hydraulic modelling.

5.5.1 [Hydrology] Background (p.31)

The review states that “*While the 2D headwater model is considered adequate, further modelling studies are recommended to confirm extent of headwater excavation needed.*” Further modelling studies, including 3D computational modelling have been carried out, as described in Section 5.5.3 of the review.

The review states that “*The results from the HECRAS model should therefore be regarded as tentative.*” No justification for this statement is provided. Furthermore the HEC-RAS model was not relied upon to determine the extent of headwater excavation.

5.5.2 Hydrology (p.32)

The review states that *"There may be diurnal changes due to small differences between inflow and outflows, but these would be inconsequential given the small volume of water stored in the head pond."* It is important to note that the station is intended to operate as run-of-river with no peaking changes to operation, meaning diurnal flow changes would not be present do not need to be considered.

The review also appears concerned that the hydrological analyses undertaken do not provide sufficient evidence of flow reliability for generation, in particular relating to the possibility of reduced flows. We can assure the reviewers that daily flows and annual/seasonal variations have been appropriately considered in generation modelling and environmental studies. Furthermore the many detailed studies carried out by MRCS consistently indicate that dry season flows are increasing now and will continue to do so. Accordingly the basis for the reviewers' concern over the possibility of an unaccounted for reduction in the flow regime is unclear.

5.5.3 Hydraulics (p.32)

The opening sentences of this section of the review do not provide a clear description of the potential changes in flow distribution and mitigation measures. The following change is suggested:

"Modelling of the distribution of flows between the channels showed that increased flows in the Hou Sahong channel would lead to a corresponding reduction in the flows in the other channels, particularly the Hou Phapheng, but also in Hou Sadam and Hou Xang Pheuak. This could affect the efficacy of Hou Sadam and Hou Xang Pheuak for fish passage, and will be addressed through excavation works at the upstream ends of these two channels to divert more flow."

The review states *"there is a risk that the Contractor would aim on the safe side to avoid the penalties – hence doing more excavation than needed, perhaps to the detriment of flows in the alternative fish passage channels."* DSHPP station flows will be limited by the turbines, so it is unclear how additional excavation can be to the detriment of flows in the alternative fish passage channels.

Describing the trans-boundary hydraulic modelling, the review states *"given the constraints of 1 dimensional modelling, that these conclusions should be considered preliminary."* it is agreed that the model is exploratory (as stated in Section 5.5.4) and results should not be considered precise, but the conclusions are considered valid - that there are only modest changes, and that further investigation is not warranted. Refer also to further related comments in section 5.6.5 below.

5.5.4 Considerations for the Joint Committee (p.33)

The review claims *"It is doubtful whether the flows in the Hou Phapheng or other channels can be actively managed by changing the headpond levels through backwater effects, by only managing turbine operations."* No justification for this claim is provided, and the technology to manage turbine flows by water level setpoint control is well established and readily achievable. If flow is not passed through Hou Sahong, it must instead pass through Hou Phapheng and other channels, the division of which has been the subject of extensive computational hydraulic modelling.

The review continues *"This could be addressed through a gated control structure at the entrance to the Hou Sahong, which would have benefits for both fisheries and sediment control."* A gated control structure at the Hou Sahong inlet is not necessary, and any perceived benefits to fisheries and sediment control are not clear. It is noted that the powerhouse itself is effectively a 'gated control structure' to the extent that it is the wicket gates within the turbine assembly that comprehensively and precisely provide the control of flow into the Hou Sahong.

The review states that *"The impact studies for the immediate cross border area undertaken thus far, based on 1D modeling, should be viewed as exploratory and the conclusions preliminary."* As per the comment on 5.5.3 above, it is agreed the modelling may be considered exploratory in terms of precision, but the conclusions are considered valid.

5.6.5 Considerations for the Joint Committee (p.37)

The report notes:

- *The transboundary flow regime in the immediate vicinity of the Lao-Cambodia border shows moderate to minor changes in flow, with a slight increase in the western channels, especially the Chheuteal Pool, and a corresponding decrease in flows in the eastern channels.*
- *This would be verified through both improved 2D modelling and water level monitoring, and the ecological impacts upon the habitats in these southern channels also monitored regularly.*

The completed 1D modelling demonstrates that changes are so minor that the additional accuracy obtainable by 2D modelling is not warranted. 2D modelling would require an intensive data-collection campaign, with associated potential risk to the vulnerable dolphin population.

Seasonal water level differences of less than 0.2m will be difficult to distinguish by monitoring in channels with an annual variation of around 12.0m.

5.7.2 Potential impacts of sedimentation in the headpond (p.38)

The review states *"While the developer has proposed the development of a sill at the entrance to the Hou Sahong, this would only capture bed load sediments, and would rapidly fill up rendering it ineffective."* The sill proposed to reduce bed load ingress is not seen to 'fill up' in sedimentation modelling undertaken. It is noted that deep channels and pools exist in the main channel above the Hou Sahong inlet. These do not fill with sediment, but are maintained by wet season flows, which will be largely unchanged by DSHPP.

5.7.3 Considerations for the Joint Committee (p.39)

The review states *"some local impacts on the transboundary islands and dolphin pool are plausible if drawdown flushing is used."* As is clearly identified in the developer's published report "Son Sahong Hydropower Project - Sediment Deposition Modelling" (Revision E), drawdown flushing is not proposed, with dredging proving a technically, environmentally and economically more attractive option to manage sedimentation if required. In the event a dredging option was found to be needed,

the quantities would be relatively minor (i.e. sufficient to retain inter-annual equilibrium only) and therefore the timing and volume of disposal or reuse of dredged sands can be readily controlled to prevent transboundary impacts.

6.5 Alternative Hydropower Options at the Site

The review claims that the Thakho and Hou Xang Pheuak generation alternatives are likely to have lower impacts on the "critical" Hou Sahong channel than the DSHPP, and hence fewer transboundary impacts. This claim is speculative and potentially misleading as it relies on an assumption by the reviewers that the Hou Sahong channel is more linked to trans-boundary impacts than the other channels. This has not been demonstrated.

7.2 Summary of the Impacts (p.45)

The review questions *"The extent to which flows in the other channels can be regulated only by turbine operations."* As noted in the response to section 5.5.4 above, precise control of Hou Sahong flow will occur at the turbines. These flows will be modulated based on water level setpoint control in the Hou Phapheng channel, ensuring that flow in this channel is always above the minimum mandated level. Distribution of flows in the other channels has been the subject of extensive monitoring and computational modelling, and may be modified by targeted clearing and/or minor modification of the inlets to such channels as necessary.

7.3.1 Key Recommendations from Expert Groups (p.47)

The review recommends that *"The developer investigates the option of a gated inlet structure and grids at the upstream end of the Hou Sahong and establishes operating rules for the structure which allow for the diversion of flows into the Hou Phapheng and Hou Xang Pheuak."*

As per 5.5.4 and 7.2 above, an additional gate structure is not necessary to control DSHPP flows, which are controlled by the turbines to ensure sufficient flow rates in Hou Phapheng. It is not clear why the EG consider that flow control would be improved with an additional gated structure at the inlet as opposed to the proposed flow control gates (wicket gates) at the turbines. We advise that the developer's specialist hydropower engineer sees no technical or ecological merit in having a gated structure at the inlet. Any perceived benefits to fisheries and sediment control have not been explained in the Technical Review and are not apparent.