PDG Para.	Issue	Compliance description	Compliance Conclusion
Section 1: Purpose of the guidance			
1~12	**Background**	**-**	**-**
Section 2: Navigation			
13~19	**Background**	**-**	**-**
20~22	**The ship locks must be capable of raising transiting vessels from the downstream hydropower development level to the upstream hydropower development or water level, or correspondingly, lower transiting vessels from the upstream hydropower development level to the downstream hydropower development or water level, during all periods of authorized navigation on the Mekong River.**	**The minimum navigable flow is 1260 m^3/s after considering the impact of regulation and storage of Xiaowan and Nuozhadu reservoirs which corresponds to a downstream water level of 307.62m. The minimum water level is taken as the water level with 98% assurance rate.**	**OK**
23	**The lockage, or raising and lowering operations, shall be performed in one or two consecutive steps, depending on the total maximum lift of the lock, using chambers designed and constructed for this purpose. The maximum head (difference between Highest Operating Level and Lowest Navigable Level or Lowest Operating Level if there is a backwater effect from a downstream development) of one chamber shall be 30m. Locations that require the ability to traverse a height greater than 30 metres should use two locks in a series (tandem) arrangement.**	**According to China's *Overall design specification of navigation lock*, the design maximum navigation water level at downstream is taken as the maximum level in accordance with the maximum discharge at a 5~3 year return period flood event, provided that water level being higher than the design maximum water level will not last long; the occurrence probability of maximum water head of navigation lock is only 2%, so it won't last long.** **And after the next cascade dam is in commission the downstream water level will be EL.310m (water head will be 30m), so the navigation lock is under normal operation condition at most time. And based on the physical model results of navigation lock, the operation conditions under different conditions are reasonable, so when the maximum water head occurs the one step navigation lock can operate safely (physical model reports will be provided as appendix of updated FS report).** **And in China and abroad, navigation locks of water head exceeding 30m have been built and come into service, so the design of ship lock (water head exceeding 30m) can also operate well.**	**OK**
24~29	**Dimensions and design vessel; Lockage time and availability.**	**-**	**OK**

PDG Para.	Issue	Compliance description	Compliance Conclusion
30	The emptying/filling system shall be designed to conform to the requirements for maximum transit times and allow for the smooth and safe lockage of any type of boat smaller or equal to the dimensions of the design vessel. Regarding this objective, the design criterion shall be: Max hawser forces ≤ 1‰ x water displacement of the vessel (in tons).	During the design of hawser force we have completed the comparison of Chinese standard and American standard. According to regulations of USA's *Hydraulic Design Of Navigation Locks (1 May 2006)*: "(1) Barge tows. For various sizes and numbers of barges in any location in the lock chamber, the hawser stress as extrapolated from a model does not exceed 5 tons. "However, China's *Ship lock water conveyance system design specification（JTJ306-2001)* stipulates that longitudinal allowable mooring force is 25kN of 500t class ships berth in chamber lock. In comparison table 8.3-14, we can see Chinese hawser force criteria is more conservative than that of USA, so the design of hawser force is safe *according to Ship lock water conveyance system design specification（JTJ306-2001) standard* .And also the hawser force of 500t vessel is obtained from physical test, the maximum hawser force is 16.5KN, it is less than the allowable force (25KN), so the design is safe.	OK
31~52	Lockage time and availability; Location and alignment; Construction; Service life; Expansion; Chamber equipment; Design, operation, safety and maintenance.	-	OK
Section 3 : Fish passage			
53	The Mekong supports the world's largest inland fishery, with an average of approximately 2.6 million tonnes harvested annually from the Lower Mekong Basin (LMB). Fisheries supply 49 - 82 percent of the animal protein consumed in the LMB. The livelihood benefit of the resource, in terms of nutrition, income and employment is critical, particularly for millions of the rural poor, who have few other livelihood options. The Mekong is second only to the Amazon River in terms of biodiversity.	The ESIA has reported procedures for fish sampling, some characteristics of fishing gear used, market research and visiting fishermen. The study area has covered the main area of influence of the project with a clearly map of the sampling sites location. Many kinds of fish passage facilities have been compared and the bypass fish way has been chosen as the fish passage way. The fishery research station will also been built by the Project. And the more studies before the construction of the dam are planned. They will take great part in the protection of fish resource and biodiversity.	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
54	Migration between spawning and feeding habitats in different locations in the river system is an inherent part of the life history of many commercially important species in the Mekong. If these fish populations cannot complete their natural migrations, breeding is reduced and fish populations decline; in many cases this may lead to a complete loss of migratory fish.	Given the scenario regarding to the fish fauna and the reproductive cycle of the fish species in the area of influence of the future PAKBENG HPP, with a view to the management and conservation of fish species, it is recommended: 1) to study, monitor and control introductions of species (exotic and allochthonous); 2) to monitor the endemic species of fish in relation to the spatial and temporal abundance variations and reproduction, and; 3) to determine the preferred spawning habitats and initial development, and possible changes that may occur with enterprise.The determination of spawning areas and initial development of the fish species will be critical to the assessment of possible variations in reproductive activity by checking the possible impacts on recruitment with the formation of the reservoir. This information is essential to better understand the population dynamics and consequences of environmental variability, affecting the early stages of fish life and, subsequently, the variability of recruitment, reflected in the stocks of the species	OK
55	Fish migration occurs in both an upstream and downstream direction. Upstream migration generally consists of adults, actively swimming to spawning grounds. Downstream migration involves all life history stages, including eggs and larvae which drift in the current, juveniles of limited swimming ability and adult fish. This varies depending on the species concerned.	The EIA has done the investigations which meets the requirement. It will be done at the detailed design stage again to get the further information.	OK
56	Dams and falls are physical barriers across rivers that interrupt fish migrations both upstream and downstream. They also alter flow regimes in the river, which impacts on the capacity of fish to migrate.	It will impact the fishes just like the Falls in nature. But the mitigation measures such as fish way and fishery research station are planned to mitigate the adverse impacts to a minimum level.	OK
57	Not all Mekong fish species will be affected by dams. Grouping Mekong fishes into different behavioral guilds shows the different levels of vulnerability to the effects of dams, as listed below. Table 1 shows fish guilds in the Mekong and the likely impact of mainstream dams on migrations. 1 Highly vulnerable guilds are shaded grey. (see table 1 on page 10)	It has been done many works in EIA stage, which will be carried out further survey in detailed design stage.	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
58	The size of the migratory fish resource at risk from dams (guilds 2, 3, 8 and 9 above) on the Mekong mainstream has been estimated at 0.7 - 1.6 million tonnes per year (equivalent to approximately 30 - 60 percent of the annual catch in the Mekong). The analysis also indicates a first sale value for the resource of US$1.4 – 3 billion per year. This is a conservative estimate, because it does not take into account the economic benefits that flow through the economy from the trade and processing of fish products.	Fish resource is very important to the economic and biodiversity. The developer values great importance to the fish resource protection. For example, they plan to build the fish way, using the fish friendly turbine and so on.	OK
59	Movement of fish past the barriers may be possible only if effective fish ways can be designed to accommodate the biology and numbers of migratory fishes in the Mekong. On large volumes of migratory fish in the Mekong. Problems are also encountered for downstream migration, mainly because of the mortality of fish passing through turbines and over spillways. Consequently, a number of different options for fish passage upstream and downstream need to be considered for the range of species, volume of migrations and flow conditions encountered at a dam site.	After the comparison of different kinds of fish way, the bypass fish way is suitable to build at Pak Beng HPP.	OK
60	Fish passage facilities for both upstream and downstream passage must be incorporated into all dams on the mainstream.	Yes, it is incorporated in the left part of the dam.	OK
61	The developer should provide effective fish passage upstream and downstream. Effective fish passage is usually defined as "providing safe passage for 95% of the target species under all flow conditions." 2 The success rate for fish passage both upstream and downstream necessary to ensure continued population viability can be refined for the particular species concerned, based on its life history and the number of dams the species may have to pass to complete its life - cycle.	The bypass fish way was designed and will meet the passage efficiency requirements.	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
62	Where fish passage rates are unlikely to be adequate to maintain viable populations, the developers must develop and propose mitigation options as one element of compensation programs for lost fisheries resources.	Not only the fish way will be build, but also the fishery research station will be built to protect the fish resource. They will work together to make sure the fish passage rates.	OK
63	Consideration should be given to multiple systems at each site to cater for the large number of species and high biomass, especially given the variable flow regime and lack of biological knowledge on behavior of migrating species.	It was a systematic project to fish passage. The bypass fish way, fishery research station and monitoring plan was designed to work together, which must cater for the migrating species. The developer values more importance on it at the same time.	OK
64	The planning and design of the fish ways should be fully integrated into the dam design concept from the earliest stages of planning. Many aspects of dam design need to be accurately predict flow patterns, and hence dam and fish passage design. integrated with fish behavior and fish passage facilities, including the dam axis; abutments; training walls; gate design; hydro draft tubes; and sill level in tail waters. These elements need to be designed to ensure fish are guided to the fish ways by creating flows that are laminar and parallel with the river centre line and by minimizing lateral and rolling flows. Numeric and physical models of the dam and adjacent river are necessary to accurately predict flow patterns, and hence dam and fish passage design.	They have been done and will be further studied. The fish way is not only the engineering building; it is a building which has combined the biology and engineering.	OK
65	Developers are encouraged to utilize best international practice in fish passage design and be aware of the outputs of the MRC Fisheries Programme and ensure that a “core expert group” is retained.	Given the fish expertise, the developer must and will employ the core expert group to help carry out all kinds of fish protection activities.	OK
66	Facilities should be designed to cater for the upstream and downstream movement of the most important species at any site, under the seasonal flow conditions during the periods when the species migrate. Target species should be selected based on considerations of commercial and livelihood importance, broad coverage of ecological guilds, as well as conservation of threatened species.	The target species are selected based on considerations of commercial and livelihood importance, broad coverage of ecological guilds, as well as conservation of threatened species.	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
67	The maximum standard length of the target species moving upstream will vary from around 20cm to more than 100cm. For downstream migration, the size will vary from eggs ,larvae a few millimetres long, to adult fish. These variations will have significant implications for fish passage design, and will likely necessitate multiple systems at each site.	It has been designed and considered in the Design report of fish passage facilities, which will be studied further in detailed design stage.	OK
68	The preferences, tolerances and biological attributes of the target fish species relevant to successful movement through the facilities should be clearly established. Of particular importance are size at time of migration; swimming capabilities (prolonged and burst swimming speeds); depth and horizontal positioning in the river channel downstream or the impoundment upstream of the dam wall; diurnal movements; and cover, substrate and light preferences.	It has been designed and considered in the Design report of fish passage facilities, which will be studied further in detailed design stage.	OK
69	The peak biomass likely to be using the facilities must be determined and the appropriate structure sizing of fish ways, cycle time of fish locks and/or lifts, and water availability established.	It has been determined and will be studied more accurate in detailed design stage.	OK
70	Predation within the fish passages should be minimized. Therefore, predator - prey relationships within the target species and other species that may use the facilities, or benefit from the reduced fitness of fish that have traversed the pass, should be determined. Adequate shelter for smaller species while within the confines of the fish ways should be considered, and actual residence time in the fish ways should be minimized.	It designs the rest pool as a shelter and breathing space. As the predator - prey relationships within the target species and other species are so important to the fish passage. It has been considered in the designing process.	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
71	Fish exiting fish ways both upstream and downstream should be sufficiently healthy to continue their natural patterns and migration routes. Direct and indirect mortality combined, as a result of movement through the fish ways, should be less than 5 percent. Similarly, human fishing in the vicinity of the fish ways should be managed to ensure mortality caused by fishing is not excessive.	It is prohibited to fish in the vicinity of fish way and the design considers the mortality of fish way.	OK
72	The fish ways should cater for the largest operational ranges practical, within the biological and hydrological requirements of the fish species concerned. As a guideline, fish ways should be fully operational from minimum low season flow of up to the 1:20 year flood level	There are to exit gate to meet the water level variation, from 335-340m	OK
73	Particular attention must be given to ensuring that the entrances to fish ways effectively attract fish. This will require that adequate flows are available to attract fish to low flow seasons, and at all times are sufficient to ensure optimal effectiveness for fish passage targets. The entrances. Adequate flows must be directed through the fish ways to ensure they function effectively in both the high and low flow seasons, and at all times are sufficient to ensure optimal effectiveness for fish passage targets.	Adequate flows are directed through the fish ways to ensure they function effectively in both the high and low flow seasons.	OK
74	Dam and fish passage design should minimize fish injury or entrapment. Spillway design, aprons, stilling basins and dissipater design should seek to minimize fish injury, mortality and entrapment.	They are all considered, for example, the fish friendly turbine is used in Pak Beng HPP.	OK
75	Fish way entrances should be: Sited to take maximum advantage of the hydraulic conditions created by spillways, outlets and channel structures. Conversely, the entrance should not be located where water velocities or turbulence are likely to hamper fish attraction to the facility. Suitably located to be accessed by fish over the full operational range of the fish way. Consequently, it may be necessary to have multiple entrances to the one fish way. Located where the morphology of the river, as well as the substrate and cover, promote fish attraction to the facility.	The fish way entrance is located where the morphology of the river, as well as the substrate and cover, promote fish attraction to the facility, which takes maximum advantage of the hydraulic conditions created by spillways, outlets and channel structures	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
76	Spillways should be designed so that extra flows initiate and terminate adjacent to the fish way entrance(s) to maximize attraction to the fish ways.	-	OK
77	Fish attracted to the spillway need to be able to access the fish way entrance without needing to double back to find the entrance.	-	OK
78	Fish exiting upstream fish ways should not be drawn back over the spillway during overtopping. Exit conditions should be sufficient to provide stimulus for fish to exit the fish way. The combination of suitable attractive water flows, substrate and protection from predators is important.	-	OK
79	Barrier screens should be designed to guide downstream moving fish away from turbines and towards the fish passage facilities. The screens must be sized to ensure that fish cannot pass through or become trapped within the mesh, and water velocities at the screens must be low enough to prevent fish being trapped against the mesh surface. Self cleaning travelling or rotating screens should be used where there are high debris loads.	It will fix barrier net to prevent big fish get into the turbine.	OK
80	The use of fish friendly turbines should be investigated and adopted where feasible.	It has been planned to use the fish friendly turbines.	OK
81	The period of captivity and interruption to the normal movements of the fish should be as short as possible.	-	OK
82	Water quality should be maintained within any holding enclosures to ensure fish health. Oxygen levels should be maintained within the fish ways at >5 ppm.	It can be guaranteed according to the water quality status and forecasting result.	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
83	Where an environmental flow downstream of the dam is required, the appropriate volumes should be directed through the fish way as a first priority, thereby ensuring fish are attracted to the fish way entrance as well as maximizing operating time.	The environmental flow is regulated with the navigation lock, the turbine and sluice gate and so on, the fish way flow will not be impacted.	OK
84	Entrance slot velocities should be adjustable, such that feedback from monitoring and observation of fish behavior can lead to optimization of the fish way operation.	There are two gates to adjust the water velocities to make sure the flow in fish way.	OK
85	Provisions for monitoring facilities at fish ways are to be incorporated into the design and operation phase of environment management and monitoring programme. This should include the ability to sample fish safely from the fish ways as well as monitor fish movements and water quality.	There is monitoring room for monitoring.	OK
86	Monitoring programmes should be established to quantify the effectiveness of the fish ways. Determining their effectiveness requires sampling upstream of the dam wall, within the fish way, and downstream; such data will allow determination of the proportions of species and biomass attempting to migrate that successfully negotiated the fishway.	It has been formulated to confirm the fish way working normally.	OK
87	The monitoring programme should be funded by the developer for the duration of the concession period.	-	OK
88	Developers should utilize a core group of international experts to assist with the design and implementation of the monitoring programme, with all expenses covered by the developer.	-	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
89	Developers should set aside contingency funds for modification of the fish way facilities, which may be identified as necessary based on the results of the monitoring programme as well as new information from other Mekong fish way programs. The contingency fund is 20 percent of the initial cost of building the fish ways. A guideline figure for the contingency fund should be replenished as it is drawn down, to ensure that funds are always available for modification works.	-	OK
Section 4: Sediment transport and river morphology			
General requirements			
90~119	Background; Reservoir sedimentation; Strategies to sustain reservoir capacity; Mitigating downstream sediment starvation; Managing sediment in a cascade of dams	-	OK
120	Developers should design mainstream dams to pass fine suspended sediment and coarse bed-load material in a way that most closely mimics the natural timing of sediment transport dynamics in the river.	According to the sediment characteristics of Mekong River, the sediment volume is mainly concentrated in the wet season, especially when flood occurs, when the incoming flow is more than rated flow 5961 m^3/s, bottom hole, sediment flushing gate and the flood gate opened gradually, reservoir water level maintains at 340m; when the incoming flow is more than 10000m^3/s, discharge volume of the flood gate increase gradually, reservoir water level reduce gradually from 340m. In order to ensure navigation the reservoir water level is maintained at 334m if the incoming flow is the P=33.3% flood discharge of 12,900m^3/s. If the incoming flow is higher than the P=33.3% discharge of 12,900m^3/s and lower than the P=20% flood discharge of 14,600m^3/s and inflows are higher than the standard for navigation of ship lock, use of ship locks shall be ceased, the discharging sluices open gradually and reservoir water level reduce gradually from 334m. If incoming flow is higher than the 5-year frequency flood discharge of 14,600m^3/s, all gate should be opened, the flood passing and sediment discharging are basically approached to the natural channel, the sediment is prevented from depositing in the reservoir, and partial sediment in the reservoir will be carried away at the same time. According to Preliminary DG of LMB Mainstream Dams, water level shall be lowered to transport sand and flush partial sediment in the reservoir area according to the sediment monitoring after the power station putting into operation. Detail design is shown in the report of "SEDIMENT MANAGEMENT". Refer to Fig.1 in Attachment.	OK
121	Dams and intake structures should be designed to minimize the deposition and entrainment of sediment near the dam ensures long-term safe operation. Particular care should be taken to avoid sediment eposition that poses risks for the safe working of the flood passage capacity of the dam.	To ensure "cleanness" of the power station intake, the sand-sluicing outlet is arranged on the powerhouse dam section, mainly used for discharging the suspended load sediment deposited before the powerhouse intake for protecting the water intake; a sand-sluicing outlet is arranged between every two units, 8 sand-sluicing outlets in total, with the opening size of 2.5m×6m opening size (width×height).	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
122	Owners / operators should develop and implement a sediment monitoring program. This would routinely monitor reservoir sedimentation, particularly for deposition at the head of the reservoirs during the operation phase, and take and adjust mitigation actions when needed.	Overall design report of sediment monitoring system have been complied, show in the report of "Overall design report of sediment monitoring system". Details regarding techniques, devices and survey frequency are include in the report, The total expense for sediment monitoring is also adjusted.	OK
123	All planned sediment management strategies should be thoroughly evaluated and subject to independent expert review for their likely effectiveness and impact prior to implementation at the developer's expense.	Sediment management report has been complied, Detail design of sediment management strategies is shown in the report of "SEDIMENT MANAGEMENT".	OK
Site Selection and Design			
124	Developers should consider alternative dam sites at the feasibility stage (within the general location),with a view to select sites whose natural attributes, combined with the hydraulics of the river flow at the site best facilitate passage of sediment.	On the feasibility study stage upstream dam site and downstream dam site have been compared and selected, the location of two available dam site is close, the discharge and sediment amount are the same. The river valley of upstream dam site is wide, with "U" shape valley, the river is bend , turn angle is close to 90°, the main channel located in the left side, water level during dry season is about 308m. The right bank is beach, the elevation is 310m～320m. The dam site located at upstream of river bend, powerhouse located at the main channel, where is advantageous to power generation, spillway located at the right beach, the elevation of the upstream dam site beach is lower than that of downstream dam site, which is advantageous to flood releasing and sediment discharging. The river valley of downstream dam site is wide, but it is narrower than upstream dam site, the river is a little bend, the main channel located in the right side, water level during dry season is about 307m. The left bank is terrace; the elevation is about 346m. Powerhouse located at the main channel, spillway located at the left terrace, the elevation of the terrace is high, the elevation of riverbed upstream of the spillway is about 330m, which is too high ,bed load cannot pass, and also not good for sediment discharging. Therefore, alternative dam sites have been considered. Refer to Fig. 2 and Fig. 3.	OK
126	The dam should be designed to allow for sediment routing (pass-through) and periodic drawdown to enhance sediment flushing. Sediment bypass channels and sediment traps may be considered as additional strategies for sediment management.	Two-dimensional Sediment Numerical Simulation of Pak Beng HPP have been carried out, during the design the project layout have considered the calculation results, "As the calculating results of the model, the sediment traps can effectively intercept coarse sediment from entering the turbine". After independent review by CNR, according to opinions of the review experts, basic information about hydrology, sediment, etc. has been updated, and the project layout has been adjusted. At present, the research institutes have be commissioned to recalculate the plane two-dimensional sediment mathematical model of the project area and three-dimensional sediment mathematic model according to the latest results. According to Preliminary DG of LMB Mainstream Dams, water level shall be lowered to transport sand and flush partial sediment in the reservoir area according to the sediment monitoring after the power station putting into operation. Detail design is shown in the report of "SEDIMENT MANAGEMENT".	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
127	Developers should employ the best possible technology for sediment investigation and modeling of sediment transport in 3-dimensional flow environments to assess how sediment deposition (and downstream erosion) problems can be minimized. In this respect: i. Mobile bed physical hydraulic models should be used (ideally at feasibility, but if not at the detailed design stage) because of their strength in simulating the complex nature of the hydraulic performance and flow passage past the dams and critical structures. ii. One focus in modeling should be minimizing deposition at or near the spillway gates, and on minimizing entrainment of sediment through the turbines (in addition to hydraulic modeling of fish passages, as noted previously in section 3, paragraph 64). iii. Physical hydraulic modeling with mobile bed simulation should also be used to clarify locations where scour and deposition will be most severe, and to identify practical mitigation solutions. iv. Detailed scenarios for reservoir sediment deposition and scour should be developed in the detailed design phase, based on an understanding of factors such as the extent of the flooded areas of the future reservoirs, their seasonal fluctuations, and presence of bed rock outcrops and the influence of tributaries. v. An approximate assessment of the depth of the deposits at the head of the reservoirs should be established. vi. Predicted locations where future development of mid channel islands and future changes to the river that will occur should be identified.	During FS design,1D,2D and 3D sediment mathematical model have been carried out, after Independent evaluation by CNR, according to the Expert opinion, Suspended load sampling was carried out at Pak Beng hydrologic station on 25 June 2015, show in the main report of "Hydrology and sediment". The result of CNR is coarser, Considering the uncertainty of the sediment gradation and the expert's opinion, CNR sampling result is adopted during the design. According to the result, a one-dimensional model has been corrected, and adds the parameter sensitivity analysis, show in the report of " Reservoir Sedimentation and Backwater". After independent review by CNR, according to opinions of the review experts, basic information about hydrology, sediment, etc. has been updated, and the project layout has been adjusted. At present, the research institutes have be commissioned to recalculate the plane two-dimensional sediment mathematical model of the project area and three-dimensional sediment mathematic model according to the latest results. Currently, this work has been carrying out and will provide the latest research results and report after the work complete. Physical model test have been commissioned to be conducted by Sichuan university, the work is in process now. After the work is completed, a research report will be provided. Sediment tour gauging are carrying out in Pak Ben station, Test item include sediment concentration and grading	OK
128	Appropriate gates should be incorporated into the dam design to allow sediment pass-through and periodic sediment flushing: i. The dam design should include not only bottom gates to pass/flush the sediment, but also releases from mid-level gates (or spillways) and to allow dilution of the highly concentrated bottom waters that are released. ii. Large bottom gates need to be included in the dam design for pass-through of density currents and flushing of coarse sediment. Bottom gates should be located as low in the dam as possible, as wide as possible, and in sufficient number. iii. Fail-safe provisions, such as stop logs or additional gates, for dewatering the structures immediately upstream and immediately downstream of the bottom gates should be provided, in order for cleanout in the event of blockage.	Sediment management report has been complied, Detail design of sediment management strategies is shown in the report of "SEDIMENT MANAGEMENT". Sediment management strategies include: Dam operation for sediment discharging, sediment flushing measures, time selection of sediment flushing and Eco-friendly flushing for sediment, etc. To ensure "cleanness" of the power station intake, the sand-sluicing outlet is arranged on the powerhouse dam section, mainly used for discharging the suspended load sediment deposited before the powerhouse intake for protecting the water intake; a sand-sluicing outlet is arranged between every two units, 8 sand-sluicing outlets in total, with the opening size of 2.5m×6m opening size (width×height).	OK
3. dam operation			

PDG Para.	Issue	Compliance description	Compliance Conclusion
129	Use of the bottom flow gates should be optimized to pass coarse sediment in both dry and wet seasons, also taking into account the need to avoid sediment problems with operation of turbine intakes.	The bottom outlets, which located at powerhouse section are not use for flushing coarse bed materials, they are use for flushing suspension sediment only, and the flow velocity in the outlet big enough to bring suspension pass through. So the inlet elevation lower than the outlet is permit.	OK
130	Seasonal drawdown of the reservoir to minimum operating levels and opening of gates to allow sediment pass-through should be carried out when sediment concentrations and sediment transport rates are high (e.g. passing of suspended sediment from the start of, or early in the flood season before larger flood flows to limit settlement in the reservoir).	According to the sediment characteristics of Mekong River, the sediment volume is mainly concentrated in the wet season, especially when flood occurs, when the incoming flow is more than rated flow 5961 m^3/s, bottom hole, sediment flushing gate and the flood gate opened gradually, reservoir water level maintains at 340m; when the incoming flow is more than 10000m^3/s, discharge volume of the flood gate increase gradually, reservoir water level reduce gradually from 340m. In order to ensure navigation the reservoir water level is maintained at 334m if the incoming flow is the P=33.3% flood discharge of 12,900m^3/s. If the incoming flow is higher than the P=33.3% discharge of 12,900m^3/s and lower than the P=20% flood discharge of 14,600m^3/s and inflows are higher than the standard for navigation of ship lock, use of ship locks shall be ceased, the discharging sluices open gradually and reservoir water level reduce gradually from 334m. If incoming flow is higher than the 5-year frequency flood discharge of 14,600m^3/s, all gate should be opened, the flood passing and sediment discharging are basically approached to the natural channel, the sediment is prevented from depositing in the reservoir, and partial sediment in the reservoir will be carried away at the same time. According to Preliminary DG of LMB Mainstream Dams, water level shall be lowered to transport sand and flush partial sediment in the reservoir area according to the sediment monitoring after the power station putting into operation. Detail design is shown in the report of "SEDIMENT MANAGEMENT".	OK
131	For periodic flushing of fine sediment and flushing of coarse bed material: i. All sediment flushing should be planned and carried out in coordination with the operators of other dams in the cascade. ii. Flushing of fine sediments should be routinely carried out every year. Less frequent flushing may result in consolidation of fine materials on the reservoir bed, making future flushing efforts technically difficult and costly. iii. Where it is possible to manage coarse and fine sediments separately, flushing of coarse sediment should be carried out after flushing of fine material considering 'environmentally friendly flushing' techniques described in paragraphs that follow later in this section. iv. For the most effective flushing of coarse bed material, the reservoir should be drawn down to the maximum extent, at least every 2 to 5 years. Sediment monitoring (as described later in this Section) should be used to decide the frequency.	According to the sediment characteristics of Mekong River, the sediment volume is mainly concentrated in the wet season, especially when flood occurs, when the incoming flow is more than rated flow 5961 m^3/s, bottom hole, sediment flushing gate and the flood gate opened gradually, reservoir water level maintains at 340m; when the incoming flow is more than 10000m^3/s, discharge volume of the flood gate increase gradually, reservoir water level reduce gradually from 340m. In order to ensure navigation the reservoir water level is maintained at 334m if the incoming flow is the P=33.3% flood discharge of 12,900m^3/s. If the incoming flow is higher than the P=33.3% discharge of 12,900m^3/s and lower than the P=20% flood discharge of 14,600m^3/s and inflows are higher than the standard for navigation of ship lock, use of ship locks shall be ceased, the discharging sluices open gradually and reservoir water level reduce gradually from 334m. If incoming flow is higher than the 5-year frequency flood discharge of 14,600m^3/s, all gate should be opened, the flood passing and sediment discharging are basically approached to the natural channel, the sediment is prevented from depositing in the reservoir, and partial sediment in the reservoir will be carried away at the same time. Sediment management strategies include: Dam operation for sediment discharging, sediment flushing measures, time selection of sediment flushing and Eco-friendly flushing for sediment, etc. Sediment discharging and flushing shall combine with the operation situations of the upstream station. When the upstream power station operates sediment flushing, and the monitored incoming sediment concentration from Pak Beng HPP is high, the gate of Pak Beng HPP shall be opened for sediment discharging, to prevent the sediment discharged from the upstream power station depositing in the Pak Beng reservoir area. It is recommended to establish a coordinated operating mechanism between upstream and downstream power stations, to real-time communicate the	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
		operation situations of the power stations and facilitate the operating scheduling of all cascade power stations. **According to Preliminary DG of LMB Mainstream Dams, water level shall be lowered to transport sand and flush partial sediment in the reservoir area according to the sediment monitoring after the power station putting into operation.** **The above content is shown in Appendix4C-SEDIMENT MANAGEMENT.**	
132	**Where hydraulic flushing is not possible, or effective, alternatives to removing sediments accumulated in the reservoir should be considered including mechanical removal by dredging in critical areas, or in combination with the use of sediment traps.**	**Sediment management report has been complied, Detail design of sediment management strategies is shown in the report of "SEDIMENT MANAGEMENT". Sediment management strategies include: Dam operation for sediment discharging, sediment flushing measures, time selection of sediment flushing and Eco-friendly flushing for sediment, etc. Declare the sedimentation treatment measures of different character and different position. For the parts with poor flushing effect such as sediment barrier and approach channel, artificial or mechanical dredging measures shall be taken to clear the deposits.**	**OK**
Eco-friendly flushing for sediment			
134	**The sediment concentration of water released during flushing operations should be controlled and monitored to prevent negative impacts on downstream ecology (high sediment concentrations can lead to fish mortality and smothering of spawning areas – see also Section 5 on environmental flows).**	**Sediment management strategies include: Dam operation for sediment discharging, sediment flushing measures, time selection of sediment flushing and Eco-friendly flushing for sediment, etc. Which are shown in Appendix4C-SEDIMENT MANAGEMENT.** **Spawning period shall be avoided when flushing sediment, in doing so, and impact on the downstream fish spawning due to sediment flushing of the reservoir will be avoided. Monitoring of the outflow sediment concentration shall be strengthened during flushing sediment, and the gate shall be adjusted to control the outflow volume and sediment concentration according to the monitoring results during sediment flushing. The flowing-out sediment concentration shall be not allowed to exceed the maximum sediment concentration allowing fish to survive at the downstream channel.**	**OK**
135	**A maximum allowable downstream sediment concentration should be established based on ecological assessments. An initial limit can be based on the natural maximum sediment concentrations occurring during the flood season.**	**Because the sediment tests by the Hydrological Station in the territory of Laos in the Mekong River are used with tour gauging method, the annual test times for sediment are less; while the test times in the upstream Chiang Sean Hydrological Station are relative more, with annual sediment tests over 50 times. Due to less test times, the maximum annual sediment concentration may be failed to be tested. According to the actual testing information of the station, the maximum daily average sediment concentration is 2.78kg/m^3, which occurred on August 14, 1978; Annual sediment tests in Yunjinghong Hydrological Station are about 3000 times and it is more frequently during flood period, therefore, the information accuracy is relatively high. The maximum sediment concentration by actual test is 19.4kg/m^3, which occurred on July 27, 1986. As the station is far away from the Pak Beng HPP, and the characteristics of the sediment in the river reaches may differ, the maximum sediment concentration is for reference only.** **HYDROCHINA Kunming has been carrying out sediment tests at Pak Beng Hydrological Station, more detailed sediment information will be obtained.**	**OK**

PDG Para.	Issue	Compliance description	Compliance Conclusion
Monitoring and management			
136	Monitoring and mitigation is needed that would include monitoring for (i) deposition of sediment at the head of each reservoir, and (ii) the scour of sediment that will occur initially downstream of dams	Overall design report of sediment monitoring system have been complied, show in Appendix 4B. Additional details regarding techniques, devices and survey frequency are included in the report. The section measurement for the whole reservoir area should be carried out once in the early storage period of the reservoir, which should be taken as the initial data of the reservoir fixed section, and then the section observation of the reservoir area should be implemented once every year after the operation of the reservoir. Oriented to the main sediment problems of the reservoir, the main items of the sediment observation are as follows to monitor and analyze the impact of sediment deposition: 1. Monitoring water and sediment in/out the reservoir (including: sediment volume, sediment concentration and sediment gradation of the inflow station and outflow station); 2. Monitoring of water surface line in front of the dam and at the tail section of the reservoir; 3. Monitoring of sediment deposition in the reservoir area; 4. Monitoring of sediment deposition in the project area; 5. Monitoring of downstream river course; 6. Monitoring of bank deformation in the reservoir area.	OK
137	Annual topographic and bathymetric surveys should be undertaken, and the results mapped, to establish rates of sediment accumulation or scour.		
138	Deep holes in the reservoir reach that were previously present in the river bed should be monitored, to establish rates of infilling.		
139	River banks along the new flood level line should be monitored to establish rates of erosion. Reaches associated with formation of (1) new mid-channel islands at the head of reservoirs, and (2) positions where tributary sediment deposits start intruding into reservoirs should be emphasized, as there may be scour associated with changes in these reaches.		
140	The developers / owner should be responsible to provide river bank erosion control with structures such as gabions if needed, for situations affected by changes in river channel position in the reservoir zones. See also paragraph 119 that relates to government consideration to have dam owners to set aside contingency funds, in case additional expenditures for bank protection works are needed to arrest problems attributed to the operation of the dam – or to provide an undertaking in the Concession Agreement to ensure that sufficient financial resources are available for such work.	Water level fluctuation of the upstream and downstream caused by impounding and operation scheduling and discharging clear water may have a certain impact on the stability of the bank slope of the upstream and downstream channels. a perfect sediment monitoring system is designed for Pak Beng HPP, with the monitoring concentration specifically for deformation of the bank slope in the system. After putting into operation of the power station, especially the early years of operation, monitoring the bank slopes at upstream and downstream shall be strengthened. When found instability occurs in partial bank slope, engineering measures such as block protection, gabion protection shall be taken. Specific measures shall be determined according to the actual situations of the instability of the bank slope, and it is recommended that the Employer shall reserve certain of emergency treatment fees annually as the treatment fees of bank slope instability. shown in the report of "SEDIMENT MANAGEMENT".	
Section 5:Water quality and aquatic ecology			

PDG Para.	Issue	Compliance description	Compliance Conclusion
141	Hydropower operations influence temporal flow patterns of rivers, which in turn, can influence instream water quality and the health, functioning and productivity of riverine ecosystems and flood plain ecosystems.	It requires the management for conservation of tributaries upstream the reservoir and its flooding areas in FS report. They are Nam Tha, Nam Ngao and Nam Ing and Nam Beng, which are prepared the overviews. In order to attenuate the potential impacts from the dam to the fishes, water quality, the health, functioning and productivity of riverine ecosystems and flood plain ecosystems, it is strongly recommended to strengthen the management for conservation of tributaries upstream the reservoir and its flooding areas. They are Nam Tha, Nam Ngao and Nam Ing and Nam Beng. The overview of the tributaries is shown as follows. 1. Nam Ngao and Nam Ing are tributaries of Mekong river in Thailand, in which the Nam Ngao is 174km long and 5.45‰ in slope with the annual average flow of 176m^3/ s, and the corresponding number to Nam Ing is 190km, 3.74‰ and 73.2 m^3/s respectively. 2. Nam Tha and Nam Beng are tributaries up and down stream the dam respectively in Laos. Nam Tha is about 279 km long, with the river average gradient of 1.1 ‰, and the annual average flow is 168m^3/s. Nam Beng is a tributary down the dam. The whole river basin area is 2108 km2. There is a hydropower station named Nam Beng Hydropower project, which is located 4 km above the confluence of Nam Tale river. It is 14 km straight line distance from the Pak Beng county.	
142	Healthy riverine ecosystems support the livelihoods of many people living along the banks of Mekong River (e.g. nutrition and income). At the same time they provide a variety of “ecosystem services” that contribute to water resource and water quality protection. River floodplains, wetlands and riparian vegetation trap silt and nutrients, provide fertile soils, and protect the upland areas from flooding and erosion. The regulation of river flow affects the complex food‐web and aquatic ecosystem dynamics that support fish productivity, especially changes in flow pulses.	① there are several plans on the biodiversity conservation including the biodiversity conservation area, forest protection area and so on. For example, we have a map of national biodiversity conservation area, with which we will analyze the hotspots around the Mekong mainstreams. And pay more attention to the impacts affected by the HPP such as river floodplains, wetlands and riparian vegetation trapping silt and nutrients, providing fertile soils, and protecting the upland areas from flooding and erosion. And we will design or plan some measurements to mitigate these impacts. The regulation of river flow affects the complex food‐web and aquatic ecosystem dynamics that support fish productivity, especially changes in flow pulses. ② In the process of formulating tributaries protection plan, we will point out the key tributaries that is important the ecosystem integrity and health of the Mekong and those affected by Pak Beng dams. ③ We will screen the key points for the protection of relative factors with systematic perspective, not only the spawning area or brooding area but also some area directly affecting the people’s lives and so on. The natural habitats of fishes will be inundated in reaches of reservoir after the project is impounded and operates. The confluences area of Nam Ngao and Nam Ing with Mekong River will be inundated near the reservoir tail of Pak Beng. But the residual tributaries without been inundated, the natural reaches above the reservoir and down the dam are still being natural habitats. It should be protected and managed well. The reservoir will operate at the water level of 340m in rainy season, while it is 335m in dry season. Considering the life circle of fishes, we believe that the operation water level from 335 to 340m is acceptable. And it is relative stable in the periods of spawning and breeding, which is similar with the nature condition in the hydrologic perspective. So it can be acceptable to the fishes.	OK
143	Impacts on dams on riverine water quality and aquatic ecology are interrelated. The degree and significance of the impacts depends on many factors, especially the volume of the reservoir impoundment in relation to river flows, water retention times and the depth of the impoundment and the patterns of land use in catchments.	Retention time according to the runoff calculation and the content of reservoir and get the depth profile by measuring of the river topography. The water retention time of reservoir is about 2 days.	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
144	The focus of this guidance is the current proposals for a series of low - head dams that would span part of, or the entire mainstream channel in the Lower Mekong Basin. The changes to water quality in the long reservoirs that will be formed behind these dams (mainly in the existing river channel) may be less than changes that might occur in large, deeper storage dams, such as those in the Lancang - Mekong portion of the basin in China. This is due to the short retention time of the water in the proposed impoundments of the mainstream dams in the lower basin (expected to be in the range of about four days). But it also depends on the amount of mixing that occurs between water column above and below the dead water levels and the number of dams.	It will supply the natural habitats where the area is not affected by the inundation that includes the stretch above the reservoir, tributaries not been inundated and the mainstream reaches down the dam. For the river stretches down the dam, the reduction in nutrient and sediment loads will happen in the initial stage of impoundment because the sediment is intercepted by the dam and it will lose some habitats and possible reduction on the primary productivity of the river. But in the reservoir area, considering the increasing of nutrient and sediment, the primary productivity will increase. Pak Beng HPP is a low-head dam, operated as a Run-off River (ROR) scheme. According the regulation rules of sediment, when it operates normally, the backwater is low and its implication on blocking the sediment is weak, especially the upstream dams intercepting masses of sands. Most of suspended load in fine particle (nearly 80%) will flow into the downstream through the turbine. There is little sediment left in the reservoir. So the primary productivity decreases in the reservoir and increases in the river reach down the dam.	OK
145	Potentially, the more significant impacts of these dams will be related to physical and chemical water quality parameters (such as in relation to sediment concentrations in water released from the dam), which will impact on downstream aquatic ecology and the associated river morphology that results in aquatic ecosystem habitat changes.	In the phase of initial impoundment, the sediment settles in the reservoir and the nutrient and sediment loads will increase, while it decreases in the river reaches down the dam. With the further operating and management of sediment in the dam, the sediment and nutrient load will have the different trend both above and down the dam. Considering the feature of the project and operation rule without the peak adjustment, it will achieve a new balance in normal. The hydrologic and sediment dynamic data are shown in the paragraph of sediment management.	OK
146	Water related diseases should be foreseen and prevented at all potential dam sites in the mainstream. A particular concern is the known presence of the parasitic and eye disease schistosomiasis, at the proposed locations of the Ban Koum, Lat Sua, Don Sahong and Stung Treng projects.	Relative measures have been designed according to the monitoring of the parasitic and eye disease schistosomiasis to make sure that the construction will not results in the adverse impacts on the diseases.	OK
147	Water quality is one of the environmental factors to be considered as part of the project - specific EIAs. Water quality parameters to be considered are generally cited in national regulations and include temperature, concentration of dissolved oxygen, PH, phosphorus, nitrogen, biological oxygen demand and fecal coliform bacteria concentrations.	There will be a new monitoring plan in the operation phase, including the water quality parameters such as temperature, concentration of dissolved oxygen, PH, phosphorus, nitrogen, biological oxygen demand and fecal coli form bacteria concentrations.	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
148	Overall the water quality and the ecological heath of the Lower Mekong River Basin in its present unregulated state ranges from high to good quality (See MRC Technical Paper no. 19 and MRC Technical Paper no. 20). The MRC Procedures on Water Quality and the associated Technical Guidelines that are currently under development express the wish of Member Countries to maintain acceptable/good water quality of the Mekong River. The Technical Guidelines will provide criteria and thresholds to determine acceptable/good water quality considering the protection of human health as well as aquatic life. These standards would provide valuable guidance to assess river flows including run - of - river impoundments.	The water quality ongoing monitoring plan has been applied the Laos standards in the phase of FS because the technical guideline on the water quality has not officially published now. Water quality monitoring plan is one part of EMMP which has emphasized in EMMP	OK
149	Stagnant water in impoundments behind dams can lead to a stratification of the water in the reservoir during parts of the year, with cold water at the bottom and warmer water at the top. In deeper impoundments the temperature difference can be as much as 510 degrees Celsius. This stratification phenomenon generally occurs during the dry season and lasts until the onset of the wet season. The measured average dissolved oxygen concentration in the running water of the Mekong mainstream is in the range from 5.5 - 8.5 mg/l (1985 - 2005 data). Generally, lower oxygen concentrations can be observed in stagnant water during the dry season with high temperatures, but very low and anoxic conditions rarely occur unless the water is stratified such as in a deep impoundment	The bulk of the vegetation in the reservoir area is cut, cleared and burnt before impoundment. Monitor the water quality monthly taking at least the temperature, PH and dissolved oxygen each one meter in the water column before the dam for check the possible occurrence of thermal or chemical stratification. And it will adjust the regulation rules of the reservoir according to the monitoring results if it is stratified, and it will be over until to find that it will never develop stratified in reservoir.	OK
150	Another aspect of reservoir water quality is temperature alteration and variation which may affect fish species. Cold water released from the impoundment may affect organisms (e.g. affect fish species negatively and also pose the potential for thermal shock of irrigated crops if very cold water is withdrawn for irrigated agriculture with no provision for warming during conveyance).	The bulk of the vegetation in the reservoir area is cut, cleared and burnt before impoundment. Monitor the water quality monthly taking at least the temperature, PH and dissolved oxygen each one meter in the water column before the dam for check the possible occurrence of thermal or chemical stratification. And it will adjust the regulation rules of the reservoir according to the monitoring results if it is stratified, and it will be over until to find that it will never develop stratified in reservoir. Add the measurement of fish passage in order to protect the biodiversity and reducing risk of establishment of the invasive and pest species.	OK
151	Subject to designs, the mainstream reservoirs proposed in the Lower Mekong Basin may have weak, large - scale turbulence associated with the flow of water through the reservoirs (rapid transit time for all reservoirs, speed of movement in the range 0.1 to 1 m/s). This would enhance the likelihood of mixing from surface to bottom and impacts on dissolved oxygen concentrations. Developers would need to verify the expected conditions in the EIAs that are prepared for each project.	The water quality ongoing monitoring plan has been applied the Laos standards in the phase of FS because the technical guideline on the water quality has not officially published now. Water quality monitoring plan is one part of EMMP which has emphasized in EMMP	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
152	Aquatic biodiversity and biodiversity in the riparian zones can be affected by impoundments for a range of reasons. The impoundment may block migration routes and lead to fragmentation of habitats (as discussed in Section 3). The hydrological changes and water quality changes may change habitats and the basis for ecosystems. The changes in hydrology, water quality and ecological conditions can change the ecological balance and pave the way for invasive and pest species affecting the biodiversity negatively.	The bulk of the vegetation in the reservoir area is cut, cleared and burnt before impoundment. Monitor the water quality monthly taking at least the temperature, PH and dissolved oxygen each one meter in the water column before the dam for check the possible occurrence of thermal or chemical stratification. And it will adjust the regulation rules of the reservoir according to the monitoring results if it is stratified, and it will be over until to find that it will never develop stratified in reservoir.	OK
155	It widely recognized that the allocation of water for hydropower operations must take into account other beneficial uses of water. Today there is increasing recognition that modifications to river flows also need to be systematically balanced with the maintenance of essential water - dependent ecosystems. These ecosystems include not just river fauna and flora, but also the floodplains and wetlands watered by floods, groundwater - dependent ecosystems replenished through river seepage, and where applicable, estuaries. Flow assessments are becoming integrated with other tools such as EIA and water allocation planning for guiding decisions on sustainable water resource developments (balancing economic, social and environmental considerations) in hydropower development.	Make an integrated planning to conserve water resources and its environmental, social and economic benefits in Environmental management plan in the operation phase. Release the environmental flows according to the world bank methods. So as to avoid the reduction in fish, vegetables, vegetation, animal forage, firewood, timber for other uses and water supply for people, livestock and other uses from direct and indirect changes in the amount, quality of downstream river stretches. Develop an ongoing program of water quality monitoring including the phases of preconstruction, construction and operation.	OK
156	Compensation and mitigation programs can also be developed on the basis of specific consideration of downstream issues, which are often different to upstream issues. Downstream impacts relate not only to the reduction in water flows, but also the associated transformation to the aquatic environment induced by the dam operation, including any daily and seasonal fluctuations in water levels. 13 Downstream issues that may form part of the compensation and mitigation programs for riverine resource losses may include reduction in fish, vegetables, vegetation, animal forage, firewood, timber for other uses and water supply for people, livestock and other uses from direct and indirect changes in the amount, quality, and timing of flows.	The bulk of the vegetation in the reservoir area is cut, cleared and burnt before impoundment. Monitor the water quality monthly taking at least the temperature, PH and dissolved oxygen each one meter in the water column before the dam for check the possible occurrence of thermal or chemical stratification. And it will adjust the regulation rules of the reservoir according to the monitoring results if it is stratified, and it will be over until to find that it will never develop stratified in reservoir.	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
158	The monitoring program for water quality and aquatic ecology (identified in environmental flow assessment or as part of the EIA) must be designed in compliance with national standards and maintain appropriate communication with concerned local governments, municipalities and agencies and downstream communities. This is important to enable stakeholders to provide essential feedback on whether: that targets specified in the monitoring program (e.g. for water quality, wetlands protection, river morphology, impacts on fish habitat, etc.) are being achieved; the agreed - upon flow regime is being provided, in this case recognizing the run - of-river nature of the mainstream projects, the fact there may be peaking operation and taking into account the position of the dam in the potential cascade; and the operation of the reservoir and water releases downstream needs to be modified in the light of the observed responses.	Make an integrated planning to conserve water resources and its environmental, social and economic benefits in Environmental management plan in the operation phase. Release the environmental flows according to the world bank methods. So as to avoid the reduction in fish, vegetables, vegetation, animal forage, firewood, timber for other uses and water supply for people, livestock and other uses from direct and indirect changes in the amount, quality of downstream river stretches. Develop an ongoing program of water quality monitoring including the phases of preconstruction, construction and operation. We budget the funds about 322.58 thousands as contingency funds for additional water quality management measures, which may be identified as necessary based on the results of the water monitoring programme. 1. The water quality was assessed by the criteria of Laos in the environmental baseline assessment phase. 2. In environmental impacts section, Pak Beng Hydropower is daily regulating and run-off-river hydropower project. The water-quality of reservoir and downstream river affected by upper reaches. As the water quality of upper reaches is good, it can meet the criteria of MRC's after the reservoir impoundment. And it will be monitoring all the time and regulate timely.	OK
159	Governments may also give consideration to requiring the dam owner to set aside contingency funds for additional water quality management measures, which may be identified as necessary based on the results of the water monitoring programme.		OK
161	Optimization of operation of the reservoir to meet water quality objectives should aim to maintain sufficiently high levels of dissolved oxygen and sufficiently low levels of phosphorus, nitrogen, biological and oxygen demand. Criteria for optimization can be derived from the MRC Technical Guidelines for Procedures on Water Quality		OK
162	Developers should consider the impact of the dam and operating policies of any cascade on the 1995 Mekong Agreement as regard to water levels. Developers should demonstrate the projects meet the Mekong Agreement requirements (in the EIA).	In hydrological situation section, according to hydrological data, monthly averaged flux of low flow years is 219m^3/s. The least water release of reservoir is 1260m^3/s, which is greater than minimum flux. Pak Beng Hydropower Project is daily regulating, for the downstream navigation (mainly smaller ships), regardless of peak-clipping operation. Produce electricity depends on water head. The water release of reservoir is inflow. It has small impacts on the hydrological situation of downstream in a year.	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
163	Minimum flow releases as well as restrictions on changes to natural variability need to be assessed using appropriate environmental flows assessment (EFA) techniques and approaches).	The Tennant methods have been adopted to assess the environmental flow, which was recommended by the World Bank.	OK
164	Because the proposed mainstream dams are run - of - river with peaking or daily operation cycles for hydropower generation, the focus of the EFA would be on systematically looking at the localized impacts on river morphological processes, erosion and bank stability and aquatic ecosystem functions, as well as impacts on natural habitat such as riverine wetlands, fish habitat and related social and livelihood aspects.	1. In environment monitoring program section, some monitoring requirement on the soil erosion, silt content, aquatic ecosystems, stability of reservoir banks were raised. 2. In environmental influences section, Pak Beng reservoir operation ways depends on demand of produce electricity and shipping, and the less influence on reservoir tail. After the Pak Beng reservoir reserves water, slope protection and other engineering measures could be adopt for the most vulnerable village, which is used to prevent adverse effects of bank scour in settlements and farmland. 3. In the environmental impacts section, both the construction and operation periods, sewage will be treated in the whole plant, so the impacts of waste water will be mitigated. It is forbidden to pour sewage in reservoir. The vegetation and water resource around reservoir must be protected. Water quality surveillance should be valued for mastering the water quality situations in time.	OK
165	Developers should utilize a core group of independent international experts to assist with the design and implementation of water quality compliance monitoring programs and environmental flow assessment and provision, with all expenses covered by the developer.	Conduct the monitoring plan on the water quality and environmental flows, which will be entrusted to professional agencies and carried out the assessment on the flow, respectively.	OK
166	The monitoring systems need to be designed to facilitate the optimization of hydropower operation with respect to water quality and ecological health. The MRC Water Quality Monitoring Network and ecological Health Monitoring Network can provide the general trends and status of the water quality and ecological health, whereas monitoring of impacts of hydropower operations need to have targeted and localized monitoring systems.	In environment monitoring plan section, water quality monitoring plan was raised. Professional units will be entrusted for assist in developing and implementing monitoring program, and work on the environment quality evaluating work at same time. In environment monitoring plan section, monitoring should be carried out for river of reservoir and upper dam.	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
169	At the detailed design stage, the environmental flow regime would be established for average and low hydrology years (flow regime of quantity, quality, duration, and seasonality). An integrated approach should be used that takes into account the combined effect and coordination of water releases for electricity generation (i.e., turbine releases) sediment management (i.e., flushing, density current venting, etc. through low level outlets or partially open spillway gates), navigation and fish passage, as well as the relative dominance or influence of spillway releases on downstream conditions.	In hydrological situation section, Pak Beng Hydropower is exploited mainly for power generation and shipping. The normal water level is 340m, the dead water level is 334m, and the regulating storage is 0.196 billion m^3. The reservoir is daily regulating. Pak Beng reservoir operation ways depends on demand of sediment regulation, shipping, and the less influence on reservoir tail. A lot of water in flood season, little head for producing electricity. Flood control operation depends on shipping safety, reducing sedimentation in reservoir and inundated area of Laos and Thailand, and generator operation of Pak Beng Hydropower. When the inflow is 10000 m^3/s in flood season, the water level reduces steadily from 340 m. When the inflow is smaller than 13200m^3/s, upstream water levels should no less than 334m. When the inflow is larger than 14900m^3/s, all the gates will be opened. Pak Beng Hydropower is a run-of-river hydropower plant. According to sediment property of Mekong, the main concentration of sediment is in the flood season, especially during floods. According to the reservoir operation mode and regulation mode, when the inflow is larger than 10000m^3/s, sand sluicing at bottom and flood-discharging and sand-sluicing gate will open step by step, the water lever before the dam will reduce. When the inflow is 13200m^3/s (the severest flood in 3 years), the water lever before the dam should maintain 334m. When the inflow is 14900m^3/s (the severest flood in 5 years), all the gates opening, and the flood and drainage will close to natural river course, which can prevent sediments in rivers. Sand Cleanout should be avoided in spawning and breeding periods (from March to June usually), so as to avoid the impacts on fish spawning in downstream.	OK
171	Releases via the turbines and the spillway gates need to be ramped so change in water surface downstream (and upstream) is sufficiently slow to minimize adverse effects on downstream river bank stability and does not pose a public safety hazard. In particular, if the mainstream dams are proposed as peaking projects, with anticipated hourly fluctuations in water flows, it will be important to find agreement on satisfactory rates of ramping.	In the environmental impact section, temporarily, peak load regulating operation for power station has not been considered. Power generation mainly depends on the upstream water. It is a run-of-river power plant and the discharge for the reservoir is the inflow. It is forbidden to occur the greatly change caused by discharged flow of Plant in a short time, which will cause greatly changes of the downstream river water level, flow velocity and water surface slope.	OK
172	The environmental flow provisions and the monitoring arrangements should be incorporated in the Environmental Management Plan (EMP), or its equivalent, for both the construction and operation phases, which is to be reviewed and approved by the relevant national authorities.	It carries out the drainage of environmental flow monitoring during the construction period and operation period in the environmental monitoring plan. Environmental monitoring plan has passed the Laos government censorship.	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
173	The developer and operator should ensure the environmental flow considerations are adequately reflected in the operating policies for the reservoir and sediment management strategy. Good practice is to adaptively manage the downstream releases from the dam based on continuous review of the monitored results in accordance with the environment management and monitoring plan (EMMP) for the operation phase, or its equivalent.	1. Environmental flows should be monitored in environment monitoring plan section. 2. In the environmental impact section，it considers synthetically various aspects requirements of design phase, power generation, navigation, flood control, sediment, slope stability in upstream and downstream and to minimize the impacts on the reservoir tail and so on. Setting the operation mode of operation of Pak Beng Hydropower according to early work. According to the environmental monitoring results, it shall be adjust drainage of environmental flow timely.	OK
174	The monitoring arrangements for environmental flows should be integrated with the overall environment monitoring system for the operations stage of the project that comprehensively incorporates impact monitoring of all parameters (e.g. sediment monitoring, impact on wetlands, impact on fisheries habitat, impact on river morphology and water quality, and socio - economic aspects related to these effects, etc.).	The monitoring of sediment, wetlands monitoring, fish habitat monitoring, rivers condition monitoring, water quality monitoring, discharged environmental flow monitoring and socio-economic surveys should be included in environment monitoring plan section.	OK
175	For the well - being of the natural aquatic downstream environment, the monitoring should provide an independent review of the flow release regime, including releases down the fish ladder and releases during daily cycling of the turbines for peak or daily generation and the daily water level changes. This should be reported, and submitted to government to check annually to ensure compliance with approved operating ranges.	The monitoring results of environmental flows that include fish way discharge water, peak load power generation turbine discharge water or power vent water day and daily water level changes should be reported to review annually to the Lao government in environment monitoring plan section.	OK
Section 6: Dam Safety			

PDG Para.	Issue	Compliance description	Compliance Conclusion
176~185	Background	-	OK
187	Developers should base the approach to safe design, implementation and operation of proposed mainstream dams: i. Relevant national standards that impact on different aspects of dam safety; ii. International best practice, as embodied the World Bank Operational Policy 4.37 on the Safety of Dams; and, iii. Periodic Technical Bulletins on the Safety of Dams issued by the International Commission on Large Dams (ICOLD) through the ICOLD Committee on Dam Safety(CODS).	The following standards are used or referenced: (1) Preliminary Design Guidance for Proposed Mainstream Dams in the Lower Mekong Basin (2) Lao Electric Power Technical Standards (3) ICOLD, Bulletin on Dam Safety Management, 2005 (4) ICOLD, Bulletin 59, Dam Safety -Guidelines, 1987 (5) ICOLD, Bulletin 130, on Risk Assessment in Dam Safety Management: A Reconnaissance of Benefits, Methods and Current Applications, 2005 (6) World Bank, Operational Policy 4.37	OK
188	All aspects of the World Bank Operational Policy (OD/GP 4.37) for the safety of dams should be reflected by developers and operators, including required reviews by an independent panel of experts of the investigation, design and construction of the dam and start of operations and sub-plans (i) a construction supervision plan (ii) a quality assurance plan (iii) an instrument plan (iv) an operation and maintenance (O&M) plan, and (v) an emergency preparedness plan (EPP).	1. The risk of over sedimentation at U/S for sluice gate can be avoided by opening the sluice gate frequently; 2.The result of calculation shows that If sand sluices and sand outlet don't work, and even one or two discharge sluices don't discharge, there is still freeboard for dam crest. In those cases, overtopping will not happen. 3.The Feasibility study report is revised, and the following content will be included:(i) a construction supervision plan (ii) a quality assurance plan (iii) an instrument plan (iv) an operation and maintenance (O&M) plan, and (v) an emergency preparedness plan (EPP).	OK
189	Developers, owners and operators should reflect the relevant International Commission on Large Dams (ICOLD) Dam Safety Bulletins in the project design, as well as the approach to project construction and operation.	The relevant International Commission on Large Dams (ICOLD) Dam Safety Bulletins have been referred in the project design for feasibility studies, and they will be reflected as well as in the construction and operation stages.	OK

PDG Para.	Issue	Compliance description	Compliance Conclusion
190	In particular, developers / owners / operators should prepare and implement a Dam Safety Management System (DSMS) that reflects ICOLD guidance on establishing a systems approach to the management of dam safety. This starts from design and continues through to operation. The DSMS incorporates the production of an annual report on dam safety during the operation phase that is submitted to governments and made public.	The initial plan of DSMS has been included in the revised feasibility study report, and the detail documentations will be formulated and carried out at construction and operation stage.	OK
191	Developers and owner/operators should be responsible to check for periodic updates of the World Bank Operational Policy (OD/GP 4.37) as well as updates, or new Technical Bulletins on the Safety of Dams issued by the International Commission on Large Dams (ICOLD). At minimum, this check for updates should be routinely done in preparation of the annual Dam Safety report.	The initial program of the strategy of communication will be included in the revised edition of feasibility study report. During the construction of main works, formulate the planning of cooperation with ICOLD. During the formulation of the annual report on dam safety, perform the routine inspection of the updating according to the dam safety technology announcement or updates newly issued by International Commission on Large Dams (ICOLD).	OK
192	Developers and owner/operators should be responsible to check for periodic updates of the World Bank Operational Policy (OD/GP 4.37) as well as updates, or new Technical Bulletins on the Safety of Dams issued by the International Commission on Large Dams (ICOLD). At minimum, this check for updates should be routinely done in preparation of the annual Dam Safety report.	The cost plan associated with implementing all aspects of this guidance on the safety of dams will be included in DSMS.	OK
193	Developers and owners should be responsible for all cost associated with implementing all aspects of this guidance on the safety of dams. Developers / owners / operators should clearly detail all such costs in the project budgets for the design, implementation and operation stages.	These costs have been clearly specified in the project budget.	OK

ATTACHMENT:

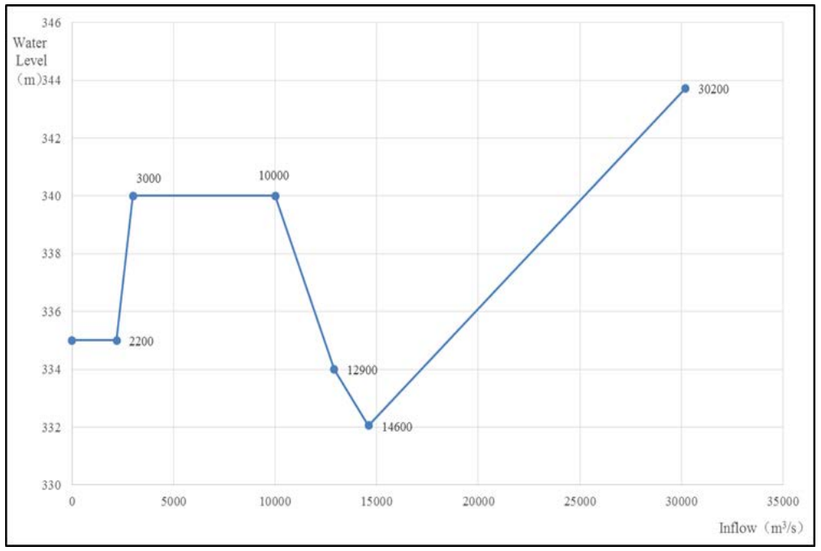

Fig.1 Operation mode

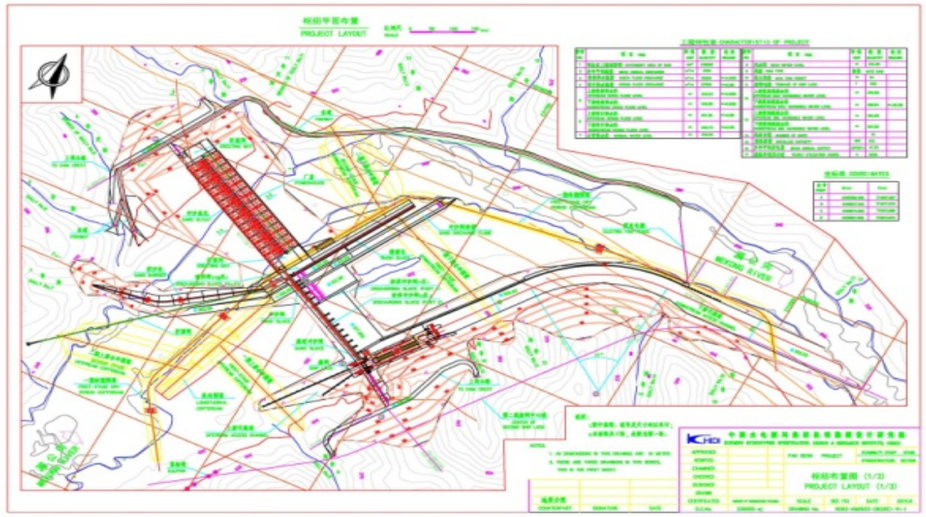

Fig.2 Upstream layout

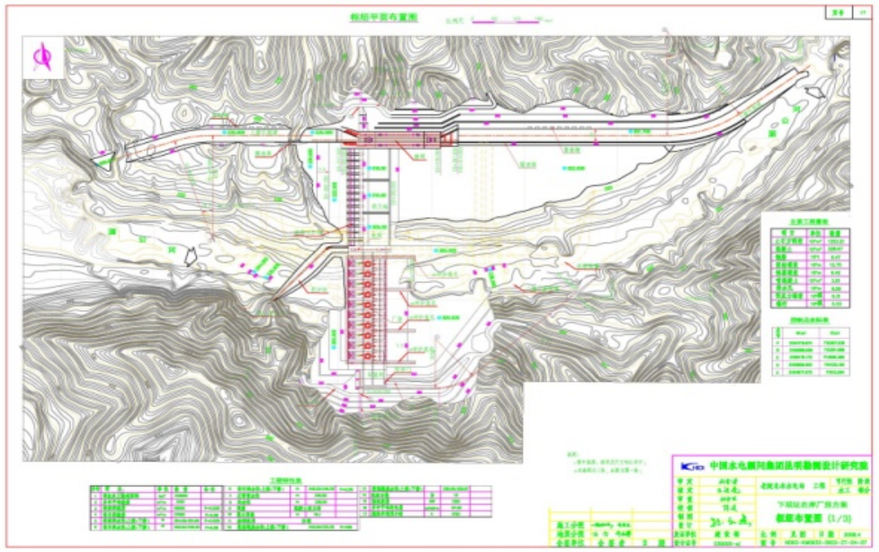

Fig.3 Downstream layout