



MEKONG RIVER COMMISSION

Concept Note – Final Draft Version

Review and Update of the MRC Preliminary Design Guidance for Proposed Mainstream and Significant Tributary Dams of the Lower Mekong Basin

Mekong River Commission Secretariat

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1 Summary

1.1 Objective

As per the SP2016-2020 the objective of the review is that:

⇒ *The PDG2009 is reviewed, updated and implementation supported.*

A broader objective of the review would be that:

The updated *Design Guidance for Proposed Mainstream (and Tributary) Dams on the Lower Mekong Basin (DG2018)* provides contemporary, research based performance standards, design and operating principles; which also cover compliance monitoring and adaptive management; endorsed by the Joint Committee by mid-2018.

The essential principles of the previous PDG2009 will be retained, as they are founded on IWRM principles, good practice, and relevant primary legislation of the Member Countries.

1.2 Purpose and Principles of the PDG 2009 to be Retained

The Purpose of the PDG was set out at the front of that document and certain important extracts are shown below that provide and insight into the approach taken to the development of the PDG:

This document provides preliminary design guidance in the form of performance targets, design and operating principles for mitigation measures, as well as compliance monitoring and adaptive management. Two broader aims are:

- *To ensure that developers have timely guidance in order to adopt a consistent approach to the design of individual dams, as well as the proposed mitigation and management measures. This is important, particularly where developments have significant trans-boundary impacts for people or the environment downstream.*
- *To ensure that the approach of offering performance targets allows developers the flexibility to identify and propose the best solutions.*

1.3 Knowledge Gained since the Initial Preparation of the PDG in 2009

Since the drafting of the PDG in 2009 three mainstream projects have come up for review under the PNPCA. In addition, as detailed in Appendix 1, a number of related studies have been completed that provide valuable additional regionally relevant information regarding the mainstream and tributary dams.

1.4 Outputs of the Update

The specific output from the review will be:

Design Guidance for Proposed Mainstream (and significant Tributary) Dams in the Lower Mekong Basin (DG2018) updated, consulted with Member Countries and agreed by the JC by mid 2018.

The review will be undertaken to ensure:

- ⇒ Guidance provided in the DG2018 is **more complete** and covers known gaps found in recent PNPCA reviews;
- ⇒ The DG2018 includes **contemporary performance targets, design and operating principles for mitigation measures** updated with information from recent MRC and regional studies;

- ⇒ A clear and **user-friendly link to the ISH0306 Guidelines** is provided;
- ⇒ Further guidance on compliance monitoring and **adaptive management** is included; and
- ⇒ Consideration is given to the applicability of the DG2018 to projects on the **significant tributaries** of the Mekong.

1.5 Steps and Timeline

The outline timing of the key steps is proposed to develop the DG2018 are shown in Table 1 below.

NOTE: It should be noted that this is an aggressive timeline and leaves no contingency for delays in consultation and additional negotiations that would be expected given the nature of some of the topics.

Table 1: Key Steps in the Review of the DG

Item	Estimated Date
1. Agree the Objectives and Scope of the Review internally with Secretariat (July 2017) brief the Joint Committee (August 2017)	July – August 2017
2. National Consultations with MC on the Concept Note	18-25 September 2017
3. Regional Consultation on Concept Note	6 th November 2017
4. Brief JC and the Council for Concepts	November 2017
5. Procure Technical Team	December 2017 to January 2018
6. Mobilise a Team of Key Experts;	January - February 2018
7. Gather inputs from other regional and national experts who have familiarity with the PDG2009.	February – March 2018
8. Draft revised and updated DG Clauses (DG2018 Draft V0.1);	By April 2018
9. Discussion of revised and updated Draft V0.1 DG2018 with MRC Secretariat experts and revise (V0.2 DG2018);	April 2018
10. Circulate Draft V0.2 of DG2018 to Member Countries for their National Review and consultation;	April/May 2018
11. Gather comments from National Consultations and include in Draft V0.3 DG2018 with marked up changes from each MC;	June 2018
12. Regional Meeting of MRC (JC Task Group- TBC) – to seek consensus on final wording of DG2018 V1.0; and	July 2018
13. Finalise DG2018 and report to JC for endorsement	July/August 2018

1.6 Team and Budget

A team of International, Regional and National experts will be called upon to carry out this review and update. A detailed Terms of Reference will be prepared. Candidates will need to have prior knowledge and experience with the Mekong and the use of the Preliminary Design Guidelines.

A budget will be prepared as along with the TOR. A preliminary budget of \$250,000 to \$300,000 (including contingency) is projected for this activity.

2 Introduction and Background

The MRC developed the *Preliminary Design Guidance for Proposed Mainstream Dams in the Lower Mekong Basin* (PDG) in 2009 in response to the imminent development of several hydropower dams on the mainstream and in the absence of any available regional guidance for developers and member countries on risk mitigation. To date the PDG has formed the basis for PNPCA submissions made by MRC Member countries and assessments made by the MRC Experts of three mainstream dams; Xayaburi (1285MW, 2011), Don Sahong (260MW, 2014) and Pak Beng (950MW, 2017). During these assessments, it has become clear that there are certain gaps in the PDG that may need to be filled and also areas of ambiguity that need to be clarified. In addition, the question of the applicability of the Guidelines to significant tributary projects, that may have trans-boundary impacts, has been raised by member countries.

The intent of this Concept Note paper (CN) is to confirm the need to review and update the Preliminary Design Guidance as stated in the MRC Basin Development Strategy and the Strategic Plan 2016-2020 and then to propose a methodology for the review.

The Secretariat will be consulted first on the content of this CN prior to submitting it to the four Member Countries (MCs) for their opinion, guidance and suggestions.

The content of this CN will serve as reference for the preparation of a Term of Reference (TOR) which will be used to recruit an experienced regional and international consultant team to assist with the review and content of the revised PDG by mid-2018. This TOR will be finalised only after the content of the CN has been accepted by the four Member Countries.

The CN covers the background to the development of the PDG and the hydropower development context in the Mekong Basin. A summary of the currently identified gaps and opportunities for improvement is included, based on preliminary feedback from its use in the three assessments thus far. An outline of the proposed approach to the review is described with an associated timeline and budget estimate.

The Concept Note and proposals are recommended to be considered by the JC in upcoming meetings to gain their guidance and support.

For a summary of the MRC role in sustainable hydropower please see Appendix 1.

3 Purpose and Principles of the PDG 2009

The Purpose of the PDG was set out at the front of that document and certain important extracts are shown below that provide an insight into the approach taken to the development of the PDG:

9. *This document provides preliminary design guidance in the form of **performance targets, design and operating principles for mitigation measures, as well as compliance monitoring and adaptive management**. Two broader aims are:*
 - i *To ensure that developers have timely guidance in order to adopt **a consistent approach** to the design of individual dams, as well as the proposed mitigation and management measures. This is important, particularly where developments have significant trans-boundary impacts for people or the environment downstream.*
 - ii *To ensure that the approach of offering performance targets allows developers the **flexibility to identify and propose the best solutions**.*

10. The guidance is founded on a set of basic Integrated Water Resource Management (IWRM) principles, international best practice and the relevant primary legislation of Member States, namely:

- i Avoidance over mitigation: Emphasis on the avoidance of impacts is preferable to the mitigation of impacts - or compensation for unmitigated impacts; taking care to avoid permanent loss of environmental assets, in particular permanent biodiversity loss.
- ii Water as an economic good: Responsibility for mitigation measures and economic compensation for unmitigated impacts is born by the project and users of services it provides, consistent with national policies and interpretation of the 1995 Mekong Agreement. Because it is not always possible to attribute losses to any one particular dam in a cascade, a procedure may be required to ensure that all projects contribute to mitigation measures, particularly for major impacts on the communities that have their livelihoods affected. The extent of such contributions would depend on the scope, extent and valuation of potential impacts.
- iii Adaptive management: Given uncertainty, there will be a need for adaptive management. In the past, potentially significant impacts have often been omitted from concession agreements and power purchase agreements, as operations were dictated predominantly by power dispatch arrangements, i.e. the needs of the power purchaser. Hence it will be necessary to include appropriate provisions for adaptive management in both concession agreements and power purchase agreements.
- iv Good practice and safe operations: Implementing designs, operation and maintenance regimes, and institutional arrangements according to international good practice and safety standards. It may also be useful to specify consistent minimum quality standards for the transfer of the assets at the end of the concession period.

In this review, it is proposed to follow this general philosophy while enhancing the DG. It is proposed to provide additional technical guidance in the form of Manuals on Mitigation and regionally relevant Case Studies that may support developers to improve the mitigation approach they may employ in the basin as a separate supporting set of documents.

Definitions (to be later included in a Glossary of the DG):

Performance Standard

Performance Standard focuses on specific measurable outputs, quality standards, or outcomes. This is different from specifying particular designs, physical characteristics or methods. The Developer must design the project to his/her own designs that meet the measurable standards.

Compliance Monitoring

Once a set of Performance Standards are agreed between MC, then an agreed Joint Monitoring program may be set up (similar to current MRC monitoring activities). This monitoring may allow MCs to consider revised management options based on compliance (or non-compliance) with the agreed performance standard.

Good Practice

“Good Practice” means the exercise of the degree of skill and care, diligence, prudence and foresight which would reasonably and ordinarily be expected from a skilled and experienced developer engaged in any jurisdiction on hydropower projects of a similar scope and complexity to those that are the subject of this Guidance and all applicable (National) Law and Regulatory Requirements.

4 The need for a Review of the MRC Design Guidance for Proposed Mainstream Dams (DG2018)

4.1 Knowledge Gained since the Initial Preparation of the PDG in 2009

The PDG was developed while a number of important MRC studies, to understand the impact of mainstream dams, were in progress. The PDG therefore referenced these studies and noted that further guidance would be forthcoming once they were completed that would further enhance the depth of the guidance provided. However, it was deemed important to have the document available to ensure the developers had “timely guidance” for the mainstream projects that were imminent. Hence the Design Guidance was termed “Preliminary” pending additional detailed investigations.

Since the drafting of the PDG in 2009 three mainstream projects have come up for review under the PNPCA. In addition, as detailed in Appendix 1, a number of related studies have been completed that provide valuable additional regionally relevant information regarding the mainstream and tributary dams.

4.1.1 Lesson Learned from PNPCA Review of Mainstream Dams

The three mainstream dams that have been reviewed under the PNPCA over the last 6 years have used the PDG as the primary guidance to assess the proposed design and operations of the hydropower project (**Xayaburi (in 2011), Don Sahong (in 2014) and Pak Beng (in 2017)**). In each case there have been useful lessons learned concerning the areas of the PDG that may need to be clarified, enhanced and improved. Detailed comments from the international and Regional Experts as well as the hydropower developers and their consultants will be gathered in the course of the finalisation of this CN.

Following from the PNPCA reviews, some initial areas of improvements in the DG have already been highlighted. Some major points that have arisen include:

- ⇒ Guidance on **minimum primary data requirements** for ESIA and operations;
- ⇒ Additional guidance pertaining to **good social impact assessment and resettlement practices**;
- ⇒ Emphasis on the **avoidance** of impacts (through strategic planning) is preferable to the mitigation of impacts - or compensation for unmitigated impacts
- ⇒ Consideration of options for **joint planning, joint coordination and joint monitoring**, particularly at trans-boundary level;
- ⇒ The need to elaborate on **Adaptive Management** given the limited system monitoring prior to construction and limited understanding of the effects on the environment;
- ⇒ Guidance as to the **quality of the EIA** to avoid delays in the provision of adequate information for assessment.
- ⇒ **Operating rules** for projects are often not provided in the PNPCA documents;
- ⇒ **Inclusion of the need for Trans-boundary CIA requirements** – with reference to the current MRC preparation of guidance for TbEIA.

A more detailed consideration of the areas for review and update of the PDG2009 is set out in the Sections below and Appendix 2.

NOTE: Notwithstanding the additional guidance that could enhance the PDG as shown above, the current document has been found to be a very sound basis from which to work and has provided good primary source of guidance to developers.

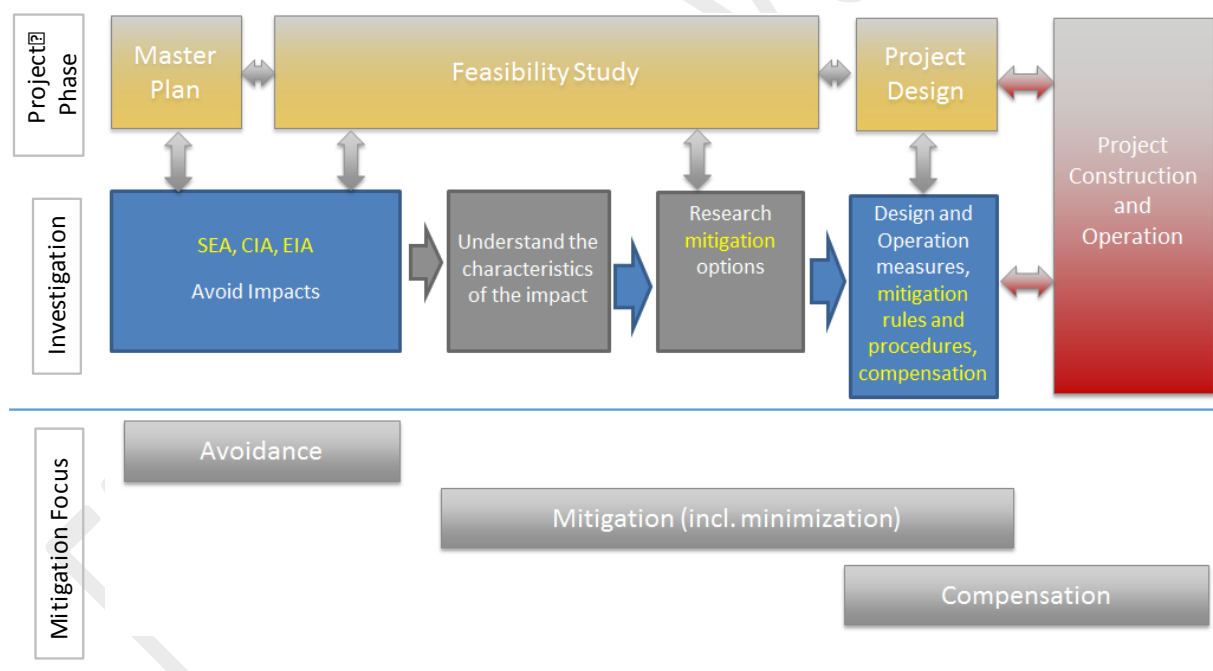
4.1.2 Guidelines for Hydropower Environmental Impact Mitigation and Risk Management in the Lower Mekong Mainstream and Tributaries (ISH0306)

The work most immediately relevant to the PDG review is the Study undertaken by the MRC/ISH entitled “Guidelines for Hydropower Environmental Impact Mitigation and Risk Management in the Lower Mekong Mainstream and Tributaries” (MRC, 2017 in progress). This study was set up specifically to:

- Thoroughly document regionally relevant hydropower impact avoidance, minimisation and mitigation options for development of sustainable hydropower on the Mekong mainstream and tributaries;
- Scope and commission specific research to improve technical and scientific understanding towards improved mitigation options and the adaptation of existing methods to the region; and
- Document, in consultation with regional agencies and developers, engineering and scientific options, for the avoidance, minimisation and mitigation of risks of mainstream hydropower dams.

The mitigation guidelines are proposed to cover all stages of the development cycle as shown in Figure 1 below.

Figure 1: Risk Mitigation Across the Project Life Cycle¹



The ISH0306 Guidelines therefore provide concrete evidence based options for the design of impact mitigation for mainstream and tributary dams. This evidence base may be updated as further information and research is undertaken across the basin.

¹ Guidelines for Hydropower Environmental Impact Mitigation and Risk Management in the Lower Mekong Mainstream and Tributaries (MRC, 2017 in progress)

These detailed technical Guidelines for Mitigation will be directly connected to the DG2018 through references and annotations.

The ISH0306 study has also provided a Discussion Paper on implications for the DG2018 arising from the detailed investigations in that project. Certain of these draft observations are included below.

4.1.3 Use of other ISH, MRCS Studies and international practice

There are a number of important and relevant studies that will also be used as background for the review of the PDG. These will include:

- Pilot Assessments using the Rapid Basin-wide Hydropower Sustainability Assessment Tool (RSAT)
- Relevant aspects of ISH studies on Information Requirements for HP management in the Mekong (ISH11), HP Planning in Ecologically Sensitive Sub-Basins (ISH01), Multi-Purpose Evaluation of HP projects (ISH02)
- International Hydropower Association (IHA) Hydropower Sustainability Assessment Protocol (HSAP)
- IFC, World Bank and ADB related Environmental and Social Safeguards.

4.2 Potential Sections to be Added to DG2018

The sections below indicate the current view on additional sections to be added to the DG. However, during the review process further matters may arise in consultation with MC and practitioners.

4.2.1 Socio-Economics and Livelihood

This area is not covered in the current PDG2009 but it has been considered in all the PNPCA reviews. In the absence of any guidance from the PDG, reviewers were required to refer to “Good Practice” and other national and international safeguards. As for all the aspects of the PDG, any additional section on this topic will need to take account of national legal frameworks and requirements first. In addition, the content of the PDG should relate to the MRC’s mandate and be specific to basin scale and transboundary matters.

Given that socio-economic development and river based livelihoods are closely interwoven with the status of the Mekong ecosystem, it is recommended that the inclusion of this topic in the DG2018 be considered.

At project and basin level DG2018 could provide guidance on livelihood restoration and compensation as well as mechanisms for sharing of benefits from the project development.

4.2.2 Water Flows and Hydrology

Hydrology and Flows are not treated as a separate theme in the PDG of 2009, but guidance and requirements for assessment, provision and monitoring of environmental flows-downstream releases is considered under the theme Water Quality and Aquatic Ecology. Currently this is largely focused at project scale and under feasibility, design and operation phases; requirements during construction should also be included in any update.

A separate theme on Hydrology and Flows is suggested to be included in DG2018; the environmental flow section would potentially be moved under this theme.

The suggested Hydrology and Flows theme should consider catchment and basin scale planning; hence DG2018 should also include reference to the Procedures for Maintenance of Flow on the Mainstream (PMFM).

The updated PDG will need guidance on requirements for *annual/inter-annual changes* to flow as follows:

- Development of flow rules for catchments, cascades and individual projects (at master plan, pre-feasibility and feasibility stages)
- Climate change considerations may also be considered
- Development of joint operation rules for releases, especially where considering cascade development (pre-feasibility and feasibility stages)
- Maintaining seasonal patterns through HP operations (operation stage)
- Mimicking natural flow regime through artificial releases and environmental flows (operation stage)

And for *short-term flow fluctuations/hydro-peaking* as follows:

- Development of flow rules to minimize flow changes (feasibility and design stage)
- Joint hydropeaking rules in cascades (feasibility and design stage)
- Avoidance of flow fluctuations during construction
- Ramp rates and use of re-regulation facilities.

4.2.3 Transboundary EIA

Given the mandate of the MRC, the inclusion of transboundary impact assessment would be considered to be an important. A Trans-boundary EIA Guideline is currently in draft form² and is being discussed between member countries. The PNPCA reviews to date have highlighted the need for transboundary considerations to be more thoroughly considered in the documents submitted by the notifying country.

While the TbEIA draft remains under discussion, it is proposed to include only a short reference to this document in the PDG once it is approved by all MC. **The TbEIA process will not be replicated or duplicated in the DG.**

4.3 Inclusion of Tributary Dams in the Guidance

The 2009 PDG is specifically drafted for the mainstream dams in the Lower Mekong Basin and more specifically run-of-river dams. However, significant transboundary environmental impacts and dam safety issues relevant to the mainstream may arise from the design and operation of tributary dams. It would therefore be beneficial for DG2018 to address major tributary developments.

The recommendations in PDG2009 will be relevant to tributary dams that are low head run of river barrages with the same characteristics as the mainstream dams. However, many tributary dams are significantly different in terms of environmental impact and may have one or more of the following characteristics:

- The creation of a bypassed river reach that requires an environmental compensation flow;
- A scheme comprising an inter basin transfer that imposes significant flow regime and morphological changes in both river basins;
- A high dam that constitutes a complete barrier to fish migration and sediment transport;
- The creation of a large reservoir that creates stratification and water quality issues;
- Introduction of regulating storage that attenuates floods and reduces seasonality in the downstream discharge.

² Guidelines for Transboundary Environmental Impact Assessment in the Lower Mekong Basin; MRC, Draft June 2017

These characteristics are addressed in the ISH0306 Guidelines and do not need to be repeated in detail in the revised DG2018.

During the review, it is proposed to discuss with Member Countries the value of applying the DG2018 to significant tributary infrastructure and cascades of hydropower dams to mitigate these impacts. Clearly, any considerations in this regard will need to take into account the national laws and regulations that are relevant in each tributary. The ISH0306 Guidelines may be readily adopted for both mainstream and tributary developments.

Any consideration of tributary dams would be at the discretion of the Member Country/Countries concerned and will need to be in line with National Laws and Regulations. In addition, the process for linkage to the notification of projects under PNPCA will need to be clarified.

5 Objective, Scope and Outputs of the Review

5.1 Objective

As per the SP2016-2020 the objective of the review is that:

⇒ *The PDG2009 is reviewed, updated and implementation supported.*

The updated *Design Guidance for Proposed Mainstream (and Tributary) Dams on the Lower Mekong Basin (DG2018)* provides contemporary, research based performance standards, design and operating principles; which also cover compliance monitoring and adaptive management; endorsed by the Joint Committee by Mid-2018.

A broader objective of the review would be that:

The essential principles of the previous PDG2009 will be retained, as they are founded on IWRM principles, good practice, and relevant primary legislation of the Member Countries.

5.2 Scope

The approach proposed will provide for a thorough review to bring the document up to date and provide a sound technical platform for these contemporary standards and principles for mitigation and operations. The intention is that the DG2018 standards remain appropriate for development that may take place in the next five to ten years.

Section 4.1 above indicated the lessons learned from the previous PNPCA review and the ISH0306 study.

In summary:

- All sections of the PDG2009 will be reviewed and selectively updated;
- The philosophy to use “performance standards” rather than prescriptive designs will be retained. This means that the DG2018 should remain a tight guidance document allowing developers the ability to innovate and proposed alternative mitigation and operational options.
- New sections may be added to cover areas of agreed gaps as highlighted above. These sections should take account of National Standards where they exist and avoid duplication with MRC Procedures and other guidance documents. Reference to documented “Good Practice” is preferred where possible.
- Clear links to the supporting Mitigation Guidelines (ISH0306) Manual and Case Studies will be provided in all clauses where appropriate.
- Stakeholder inputs and ideas will be gathered where possible.
- Consultation with, and endorsement of, MRC Member Countries will be vital to gain an agreed set of guidelines in DG2018.

5.3 Outputs

The specific output from the review will be:

Design Guidance for Proposed Mainstream (and significant Tributary) Dams in the Lower Mekong Basin by mid 2018 (DG2018) updated, consulted with Member Countries and agreed by the JC.

The review will be undertaken to ensure:

- ⇒ Guidance provided in the DG2018 is **more complete** and covers known gaps found in recent PNPCA reviews;
- ⇒ The DG2018 includes **contemporary performance targets, design and operating principles for mitigation measure** updated with information from recent MRC and regional studies;
- ⇒ A clear and **user-friendly link to the ISH0306 Guidelines** is provided;
- ⇒ Further guidance on compliance monitoring and **adaptive management** is included; and
- ⇒ Consideration is given to the applicability of the DG2018 to projects on the **significant tributaries** of the Mekong.

6 Methodology and Steps to Review the Design Guidance

The following steps for the review process are proposed:

1. Agree the Objectives and Scope of the Review internally with Secretariat (July 2017) then with the Joint Committee (August 2017) in order for expectations to be clear;
2. Mobilise a Team of Key Experts involved in recent PNPCA and/or other related MRC studies to cover all the specific thematic areas of the DG2018 including those that may be suggested to be added (e.g. Hydrology and Flows, Socio-economics);
3. Gather inputs from other regional and national experts who have familiarity with the PDG2009. This will include developers and designer who have been involved in the three PNPCA submissions to date;
4. Draft revised and updated Clauses based on the feedback, PNPCA lessons learned and experience from recent studies;
5. Discussion of revised and updated Draft V0.1 DG2018 with MRC Secretariat experts (Expert Team and MRC Secretariat) and revise draft where required;
6. Circulate Draft of DG2018 to Member Countries for their National Review and consultation;
7. Gather comments from National Consultations and include in next Draft with marked up changes from each MC;
8. Final Draft to be reviewed by the MC before submission to the JC;
9. Regional Meeting of MRC (JC Task Group- TBC) – to seek consensus on final wording of Final DG2018; and
10. Finalise DG2018 and report to JC for consideration.

6.1 Discussion and Agreement on the Objectives and Scope of the Review

The need for the review of the PDG2009 and the Objectives and Scope should be discussed and agreed first internally by the MRC Secretariat. The support of the Secretariat management will be essential to facilitate the discussion with Member Countries and other stakeholders

It is proposed that the Joint Committee be informed of progress in August 2017 and that agreement/guidance on the Objectives and Scope be requested in November 2017 after National and Regional Consultations.

6.2 Team mobilisation

A suitably qualified team of international, regional and national team of subject matter experts will be assembled to carry out this review. There is potential to use experts who have either been closely involved in the original drafting of the PDG2009 and/or those involved in the intervening three PNPCA reviews.

The proposed Team composition will reflect the topics in the PDG and will include: Hydrology and Environmental flows, Fisheries, Sediment, Water Quality and Aquatic Ecology, Dam Safety, Socio-economics and TbEIA. Some of the expertise may be combined in one individual.

6.3 Consultation on the Lessons Learned with the use of the PDG2009

As shown above, there are a number of lessons learned from the use of the PDG2009 to date. The Review will gather input from all those who have been involved in the use of the PDG2009 so far including:

- ⇒ NMCs and National agencies who have been directly involved in either the use of the PDG for project design or the use of the PDG for project review;
- ⇒ Mainstream hydropower project developers and their advisors and consultants;
- ⇒ International experts who have been involved in the PNPCA review processes for the three hydropower projects to date;
- ⇒ The original authors of the PDG2009 where possible; and
- ⇒ Wider group of MRC relevant stakeholders;

These consultations may occur at or around a range of suitable forums as required. Including:

- ⇒ MRC's Hydropower Developers Forum (Vientiane - 10/11 August 2017)
- ⇒ Water Land and Ecosystem Forum: (Yangon - Date to be confirmed – either October 2017 or February/March 2018);
- ⇒ MRC Stakeholder Platform (Venue TBA – November/December 2017)

In addition, online surveys may be designed for particular stakeholders to allow comments on the specific clauses in the PDG2009.

A number of rounds of consultations and negotiation are likely to be necessary.

6.4 Drafting of Revised clauses in the DG2018 V0.1 and linkage to the Mitigation Guidelines and Manual

Based on the feedback received from the users and stakeholders above, the Team will draft proposals for revised performance targets, design and operations principles, mitigation measures and monitoring and adaptive management approaches where necessary.

Importantly these revisions will be informed by the ISH0306 mitigation guidelines work. While it is not intended to include detailed descriptions of mitigation options in the DG2018 it will be important to make a clear and user friendly link between the DG2018 and the detailed Mitigation Manual developed under ISH0306. This Manual will be completed in December 2017 and the intention is that training will be provided to National Agency staff, developers and their advisors at that time.

Volume 5 of the ISH0306 Mitigation Guidelines Study will provide that team's view on the necessary modifications to the PDG2009 and also will provide some views on the content of the Sustainable Hydropower Strategy generally. This Volume is due in Draft form 30 June 2017.

6.5 National Consultations and Regional Consultations

The Update of the PDG will potentially raise some issues that will need to be discussed both at a National and Regional level to try to come to consensus on the DG2018. The MRC should make available the Expert Team for these national and regional consultations so that the explanation of the basis for any changes to the PDG2009 can be clearly stated and understood.

It is likely that each MC will have proposals for alteration to the drafted clauses. These alterations will need to be negotiated on a clause by clause basis. This will need proper facilitation and guidance from the Secretariat.

7 Team Structure and Stakeholder Groups

7.1 Technical Review Team Leader

The review will need to be led by a competent and technically qualified Team Leader who will engage with the selected experts in particular fields as required. The Team Leader will direct and develop the details of the review process and facilitate relevant consultations sessions and surveys with DG users. They will be primarily responsible for delivery of the draft DG2018.

7.2 Technical Support Team

Terms of Reference for the Technical Support Team will be developed to carry out the Review that will cover the topics in the PDG2009 and also areas that may be missing from that document. This technical team will be made up of suitable international and regional experts covering the social, hydropower, hydrological system modelling, ecological, environmental skills needed to support this process. Linkage to, and knowledge of, ISH tools and guidelines, past Basin Planning processes and the Council Study would be beneficial to make the analytical process more efficient.

It is expected that each expert will need 10 to 15 days effort to draft clauses and then attend relevant consultations.

7.3 Stakeholder Engagement

7.3.1 Internal Secretariat Support

The Concept should be fully understood and approved by the Secretariat senior management so that it may be supported by them in discussions at the JC and with external stakeholders at every opportunity.

7.3.2 Joint Committee and Council

It will be very beneficial and even essential to get early support and agreement from the JC for the Objective, Principles and Process proposed in this Concept Note. This will greatly improve the cooperation of national agency staff to contribute constructively to the process and support them when they report alternative development pathways back to their national agencies.

It is proposed to get this support from the JC in August and November 2017. Regular update to the JC will be provided.

Depending on the progress of consultation and negotiation, the Final Draft DG2018 may be presented to the JC for endorsement in mid 2018.

7.3.3 National Mekong Committees

Clearly the engagement and support of the NMCs will be critical to the success of this process. The JC consideration and support for this process should facilitate this engagement from the NMCs.

7.3.4 External Stakeholders

MRC relevant external stakeholders may be involved in the review process as required.

It is proposed that the MRC Secretariat nominates **stakeholder representatives** for the Review Process.

The selection of stakeholders should recognize the sensitivity of some project issues but allow for sufficient stakeholders to join the Stakeholder Group so that representation is inclusive and comprehensive.

It is proposed to present a summary of this concept note at the Stakeholder Platform planned for December 2017.

8 Proposed Schedule - outline

The outline timing of the key steps is proposed to develop the DG2018 are shown in Table 1 below.

NOTE: It should be noted that this is an aggressive timeline and leaves no contingency for delays in consultation and additional negotiations that would be expected given the contentious nature of some of the topics.

Table 2: Key Steps in the Review of the DG

Item	Estimated Date
1. Agree the Objectives and Scope of the Review internally with Secretariat (July 2017) brief the Joint Committee (August 2017)	July – August 2017
2. National Consultations with MC on the Concept Note	18-25 September 2017
3. Regional Consultation on Concept Note	6 November 2017
4. Brief JC on the Concepts	November 2017
5. Procure Technical Team	December 2017 to January 2018
6. Mobilise a Team of Key Experts;	January- February 2018
7. Gather inputs from other regional and national experts who have familiarity with the PDG2009.	February –March 2018
8. Draft revised and updated DG Clauses (DG2018 Draft V0.1);	By April 2018
9. Discussion of revised and updated Draft V0.1 DG2018 with MRC Secretariat experts and revise (V0.2 DG2018);	April 2018
10. Circulate Draft V0.2 of DG2018 to Member Countries for their National Review and consultation;	April/May 2018
11. Gather comments from National Consultations and include in Draft V0.3 DG2018 with marked up changes from each MC;	June 2018
12. Regional Meeting of MRC (JC Task Group- TBC) – to seek consensus on final wording of DG2018 V1.0; and	July 2018
13. Finalise DG2018 and report to JC for endorsement	July/August 2018

Figure 2: Proposed Timeline for Updated Design Guidance by 2018

YEARS	2017						2018												2019											
	Q3			Q4			Q1			Q2			Q3			Q4			Q1		Q2		Q3		Q4					
STEPS	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
PDG Review Timeline	Sec	JC																												
Agree Objectives, Scope & Secretariat (July 17); IC (Aug 17)																														
National and Regional Consultation																														
Joint Committee and Council Informed																														
Procure Technical Team																														
Mobilise Team																														
Gather Inputs and Lesson Learned from PNPCA and SH0306																														
Draft Revised Clauses V0.1																														
Intrnal Secretariat Discussion and Draft V0.2																														
National Review and Consultation of DG2018 V0.2																														
Include National Comments Draft V0.3 DG2018																														
Regional Meeting of MRC (JC Task Group - BC)																														
Finalise DG2018 and Report to IC for endorsement																														

Appendix 1: MRC Role in Sustainable Hydropower Development in the Mekong Basin

The Mekong Agreement of 1995 (MA95)

The role of the MRC, in promoting Sustainable Hydropower, must be to facilitate co-operation in this sector as guided by the articles of the MA95.

Article 1 of the Agreement expresses the intention of the four states to cooperate in all fields of sustainable development, utilisation, management and conservation of water and related resources of the Mekong river basin, including: irrigation, hydropower, navigation, flood control, fisheries, timber floating, recreation and tourism.

The article also states that activities should be carried out in a manner that optimises multiple-use and mutual benefits, and minimises harmful effects.

The latter is reinforced in **Article 3** which speaks of protection of the environment and ecological balance.

Article 2 emphasises joint and/or basin-wide development projects and basin programmes through the formulation of a Basin Development Plan which would be used to identify, categorise and prioritise the projects and programmes to seek assistance for and to implement at the Basin level.

Article 5 provides for the reasonable and equitable use of the waters of the river system with reference to rules for water utilisation to be prepared.

Role of the MRC in Sustainable Hydropower

With the signing of the MA95, the Mekong River Commission (MRC) in its present form was established. The mandate of the Commission since 1995 is to co-operate and promote sustainable development, utilisation, management and conservation of the water and related resources of the Mekong River Basin for the economic and social well-being of the people in all the riparian countries. The awareness of the environmental and social consequences of major infrastructure development were becoming evident and were renewed following the World Commission on Dams (WCD) recommendations.

The MRC Hydropower Principles 1998

To accommodate the changes in the MRC mandate and in the prevailing conditions in the Lower Mekong Basin, the Council of MRC in 1998 approved five principles to guide national and regional cooperation on hydropower. These principles promoted information exchange among member states and close cooperation with international agencies. They emphasised the need for integrated water resource planning and the use of good practice cumulative impact assessment techniques and public participation to guide the effective use of natural resources. The private sector was encouraged to participate in the development of the hydropower sector while properly taking into consideration the social and environmental consequences.

These principles will need to be re-considered and re-confirmed as part of development of the MRC SHDS2019.

MRC Basin Plans and Initiative for Sustainable Hydropower (ISH)

The rapid development of the hydropower and other sectors in the LMB has continued to put pressure on the natural resources of the basin making integrated water and power planning even

more vital. The concept of the “nexus between water, food and energy” has become commonly debated emphasising the need for integrated planning as per the MRC mandate.

The formulation and implementation of the Initiative for Sustainable Hydropower (ISH) was a key strategic intervention by the MRC toward fulfilment of the MRC role in the hydropower sector.

During the period 2008-2015 some progress was made towards fulfilment of the role of MRC in the hydropower sector particularly with the implementation of:

- ⇒ the Strategic Environment Assessment for the proposed Mainstream Hydropower dams (ICEM, 2011)
- ⇒ **the drafting (in 2009) of the Preliminary Design Guidance (PDG) and its application, through the PNPCA process, on three Mainstream dams project namely Xayabury (in 2011), Don Sahong (in 2014) and Pak Beng (in 2017)**
- ⇒ extensive training and trial of the Rapid Sustainability Assessment Tool (RSAT) for hydropower development in a Basin Wide context.
- ⇒ Development of a comprehensive range of hydropower planning and development tools to raise the capacity of developers and member country government departments to better implement hydropower in a more sustainable manner.

In addition, the MRC has embedded this knowledge in the Basin Development Plan 2011 to 2015 (BDP2) and associated Scenario Analysis to understand the integrated costs and benefits of multi sector development in the Mekong Basin.

The MRC Council Study (*Study on the Sustainable Management and Development of the Mekong River including Impacts of Hydropower Projects (MRC, 2017, in progress)*) is investigating the integrated cumulative impacts of all development in the Mekong Basin to be completed in 2017. The outputs of this study will be an important input to the SHDS2019.

Status of Hydropower Development in the Lower Mekong Basin

Over the past decade, the national policies of member countries have emphasised the need to extend access to electricity to underpin poverty reduction strategies, improve regional energy security, reduce vulnerability to international energy price shocks and generate export earnings in countries such as Cambodia and Laos. In addition, the economies of the LMB countries have been developing at between 5-10% with industrial sector growth and demand for power increasing substantially (Thailand and Vietnam). These factors have led to accelerated development of hydropower and large investment in electrical infrastructure in the Lower Mekong Basin. Hydropower development is expanding on the Mekong mainstream and in tributaries and it is likely to intensify in the near future.

In 2001 there were approximately 17 hydropower projects in operation in the LMB with a capacity of less than 1,400 MW. During the period from 2002 to 2015 there were additional 40 hydropower projects built to provide a generation capacity of 6,442 MW. While some 14 dams with a total capacity around 3,000 MW are planned for commissioning during the period 2016-2020, another series of 30 dams with a total capacity around 6,653 MW are under planning status with the majority finalising Feasibility Studies.

Three mainstream dams have been submitted to the MRC under the PNPCA. The construction of the 1250MW Xayaburi Project is 80% complete and is expected to be commissioned in 2019, while the Don Sahong (260MW) will be commissioned in 2019. The Pak Beng project (912 MW) has recently completed the PNPCA review and, while there are substantial issues to be dealt with in a Joint Action Plan, the expectation is that this project will be commissioned by 2023.

There are significant major hydropower investments planned in the LMB:

- ⇒ Lao PDR has signed agreements with its neighbours to supply power, as follows:

- 9000 MW to Thailand by 2025
- 5000 MW to Vietnam by 2030
- 1500 MW to Cambodia by 2025
- Cambodia is progressing with feasibility studies on the major mainstream developments in the Mekong floodplain (e.g. Sambor 2000 to 3000MW)

China has completed nine major hydropower dams on the upper Mekong (Lancang) with a capacity of 15,700 MW and large inter-annual storage. A further 11 projects are under construction with a capacity of 11,800MW. In addition, there are another 10 projects planned in the upper basin with a capacity of approximately 3800MW.

Impacts of Mainstream and Major Tributary Dams

The rapid and large-scale development of hydropower in the Upper and Lower Mekong Basin, as detailed in Appendix 1, is forecast to have a substantial impact on the economic, social and environmental condition in the Mekong basin. The net economic benefits of these developments, once fully developed, is estimated to have a Net Present Value (NPV) of over \$100bn to the regional economies³. However, it is also known that hydropower and other basin developments (e.g. irrigation) impact the natural resources across the basin. For example, the loss in capture fisheries alone is estimated to be of the order of NPV \$25bn. The resulting socio-economic impacts are not equally shared across the MRC Member Countries and are inevitably borne by those who are most dependent on river fisheries and are vulnerable to these major changes to their livelihoods.

The MRC has studied alternative development pathways as part of the *Assessment of Basin-wide Development Scenarios*⁴. In this analysis a range of Hydropower Development Scenarios were considered and the benefits and costs analysed. Focusing particularly on main stream dams, this analysis allowed a comparison of the relative impacts of the alternative Scenarios on environmental and socio-economic indicators. Under the “LMB Long Term Development Scenario” with the Lancang hydropower development and all planned LMB mainstream dams in place, the loss in capture fisheries was estimated to be approximately 1000kt/year, or 40% of the yield. The majority of this loss was shown to be affecting Cambodia.

Importantly, the Scenario Assessments of the MRC also show that some mainstream hydropower developments have more impact on the fisheries than others⁵. The development of the hydropower projects in the Cambodian floodplain was shown to be a major contributor to this loss in capture fisheries. The MRC report indicates that, basin-wide 4.5million people would be at risk of losing livelihoods with a “Severely Negative” impact on livelihoods to those riparian residents.

The impact on water quality, biodiversity and ecological hotspots has been documented in a number of MRC and other studies⁶ including: reduction in flood plain productivity, river bank erosion, changed seasonality of flows and flood depths, reduction in nutrients through sediment trapping, increased saline intrusion, reduction in wetlands and consequentially the impact on the Mekong’s rich biodiversity.

³ MRC Council Study (Draft Macro-Economic Assessment) June 2017.

⁴ Assessment of Basin-wide Development Scenarios, Main Report April 2011

⁵ Figure 29, page 59, Assessment of Basin-wide Development Scenarios, Main Report April 2011

⁶ Assessment of Basin-wide Development Scenarios, Main Report April 2011

Appendix 2: Summary of findings from the PNPCA and the ISH0306 Study (Vol 5, Draft v1.0)

NOTE: PDG Clause numbers refer to the existing PDG numbering.

Section 1: “Purpose of the Guidance”

PDG Clauses 1 to 8 describe the background of the PDG2009 and the various studies that informed the content at the time. Many of these studies have been completed and in some cases additional detailed work has been commissioned and completed. These additional references are listed in the Appendix to this Concept Note. These PDG Clauses will need to be updated to reflect the new information that will form the basis of the DG2018. Among the important studies that will further inform the DG2018 are:

- Study on the Sustainable Management and Development of the Mekong River including Impacts of Hydropower Projects (MRC, 2017, in progress) – (The Council Study - to be completed in 2017)
- Strategic Environmental Assessment of Hydropower on the Mekong Mainstream (ICEM, 2011)
- Basin Development Plan (MRC, 2010); Assessment of Basin-wide Development Scenarios (MRC, 2011)
- Improved Socio-economic and Environmental Information for Hydropower Planning (MRC 2012)
- Identification of Ecologically Sensitive Sub-basins for Sustainable Development of Hydropower on Mekong Tributaries (MRC, 2015)
- Guidelines for Hydropower Environmental Impact Mitigation and Risk Management in the Lower Mekong Mainstream and Tributaries (MRC, 2017 in progress)
- Technical Review Reports for the PNPCA Processes for Xayabury, Don Sahong and Pak Beng.

PDG Clauses 9 and 10 cover the key principles and aims of the PDG2009 and these are reproduced in the Section 3 above. It is proposed to retain the core principles and approach set out in these two PDG Clauses.

PDG Clause 11 covers Dam Safety matters. It is likely that some additional elements will need to be included in the relevant section of the DG2018 to reflect the operation of cascades and the need for consistency of approach to these important issues.

PDG Clause 12 talks to the scope of the PDG2009 and the fact that diversion out of the Mekong mainstream are not covered. These issues will need to be re-considered, particularly where abstractions and related infrastructure may be planned in the LMB.

Section 2: “Navigation”

A Navigation Master Plan has been drafted for the LMB⁷. In addition, the PNPCA processes so far have raised a number of important issues that need consideration. It should be noted the the Navigation section of the PDG already has quite some detail on specific dimensions and design features. While this is helpful guidance, the philosophy of the DG2018 will be to remain with performance standards rather than the recommendation becoming too specific. It may be pertinent to include more detail in the supporting manual. Point raised in the PNPCA include:

⁷ Design of a Master Plan for Regional Waterborne Transport in the Mekong River Basin; (MRC, 2016)

- The needs for clarification of the design of ship locks with a lift of over 30 meters. Precautionary measures may be specified to reduce the hydraulic pressure on lock components, especially valves and gates.
- Hydraulic pressure reduction through e.g. water saving basins, manifolds, and recognized reliable systems;
- Special precautions to avoid cavitation, vibration, noise and other kinds of deteriorating phenomenon;
- Further focus on approach channels;
- Coordination of operations with other locks in terms of navigation fluency. Communication system for navigation in the stretches where dams and ship locks are built or will be built;
- There may be a need to revise the lockage time.
- Possibility to provide an additional fish passage through the lock chamber;

Section 3: “Fish Passage on Mainstream Dams”

Summary of findings of the ISH0306 Team

In general, the report found that the background section (Section 3.1 in the 2009 PDG) should describe more in detail the specific risks related to fish migration to allow for the definition of more specific fish passage requirements for upstream and downstream migration. In addition:

- Clarify Statements on maximum scale of fish passage (PDG Clause 51) to reflect recent research and learnings from PNPCA studies and ISH0306.
- Effectiveness of fish passage and mortality (PDG Clause 61 and PDG Clause 71): PDG suggests effective fish passage of 95% of target species under all flow conditions. This requires clarification to account for effectiveness of individual dams versus cascades of dams. This is reflected in the ISH0306 Case Study where reduced effectiveness occurs with multiple dams in a cascade. In addition, the “target species” needs to be defined.
- Standards for mortality across the structures should also account for mortality in the slow-moving reservoirs (for example in relation to larvae mortality in the impoundment).
- Turbine design issues are also discussed in some detail in the ISH0306 Manual which can be referenced in the DG2018.

In general, some recommendation from the study are to include suggestions for:

- Dam siting in master plans to avoid risks and impacts in fish migratory hotspot areas.
- Develop joint operation rules for flow releases, in periods important for migration, including maintaining seasonal patterns, artificial releases and environmental flows.
- Operating rules to minimize flow changes and management of re-regulation weirs to provide appropriate downstream flows
- Consider alternative hydropower siting and design to minimize impact on connectivity
- Design measures for fish protection, e.g. suitable rakes, adapted turbines etc.
- Ensure fish passage and connectivity during construction
- Avoid high retention time in reservoirs and plan and implement large bypass systems where possible

Summary of findings from the PNPCA Process

No comments received to date.

Sediment Transport and River Morphology

Summary of findings of the ISH0306 Team

The ISH0306 Guidelines do have some recommendations that could be considered with relation to sediment transport and river morphology in the update of the PDG as follows:

- Dam siting in master plans with regard to avoid sediment transport and river morphology hotspot areas.
- Design multiple large gated spillways/outlets at multiple levels, and low level sediment outlets
- Design sediment bypass channels.
- Under operation implement annual sediment sluicing to maintain seasonal pulse.
- Undertake riverbank stabilization works during construction.
- Introduction of annual sediments downstream of impoundments (however practically questionable on mainstream Mekong).
- Minimize sediment runoff through design of access roads and seasonal work schedules.
- Find mechanisms to support or implement catchment management measures to reduce sediment inputs.
- Limit rate of water level drop to prevent slope and dam instability

Summary of findings from the PNPCA Process to be added

Lack of catchment context of project: In general, the PDG provides clear guidance on the types of information and modelling that should be provided for the Prior Consultation process. However, the geographic extent that should be included in the investigations is not well described, and there is a lack of emphasis on considering the development in the ‘bigger’ catchment context. This could be improved by including some specific requirements about ‘setting the scene’ for the project.

One approach would be to:

- Include a requirement to provide a summary of large scale hydrologic and sediment transport processes occurring in the region proposed for hydropower development as part of the Prior Consultation submission. This should be at a much larger scale than the ‘project’ scale. The upstream extent should be far enough upstream to account for all major inflows reporting to the project, and the downstream extent should be defined where the flow regulated by the project contributes <25%? of the flow in the mainstem in both the wet and dry seasons. The following information should be recommended for inclusion:
 - Geomorphic and hydraulic characteristics of the channel in the area to be inundated and in the area downstream of the project. This should include the distribution of bedrock, alluvial and mixed areas, and the locations of features such as deep – pools, rapids and confluences with major tributaries;
 - A flow balance on a monthly time-step without the proposed project
 - A description of how flows are modified by other HPs (or irrigation dams) in the area, e.g., hydropeaking in tributary dams, daily run of river operations in mainstream, etc
 - A description of how flows will be further modified within the area with the project in place;
 - A sediment balance without the proposed project that includes estimates of existing sediment trapping in mainstream or tributary HPs, and describes sediment mitigation and management approaches used at other HPs. This should include a list of the types of sediment management infrastructure included in dams downstream of the

project, and justification should be given as to how the proposed project will not reduce the effectiveness of sediment mitigation at these other sites, e.g. due to having compatible or 'better' infrastructure or other sediment passage system;

- A description of the grain-size distribution of suspended and bedload sediment on a seasonal basis at the upstream extent of the proposed head pond, at the proposed dam site and downstream of every major tributary entering in the downstream area as defined above. A greater emphasis should be included in the PDG to address sediment mitigation by grain-size. Passing 80% of the silt will not maintain channel stability if only 2% of the sand is getting through the impoundment;
- A description of how sediment transport will change with implementation of the project, including:
 - Sediment budget by grain size into, through and downstream of the impoundment;
 - Sediment mitigation measures to be implemented, including timing of sediment releases and associated flow releases;

This 'big picture' should be used as the context for the more detailed project description.

Background regarding siting of project: PDG Clause 124 in the PDG deals with the siting of projects, but it is unclear at what scale this assessment should be completed. Ideally dams are sited during a Master Planning phase where sediment management is considered. Following on from the catchment description, an additional clause to PDG Clause 124 requesting justification of the dam location on a catchment scale with respect to sediment management would provide the developer the opportunity to present background as to how the dam location was initially identified. (e.g. the cascade was 'optimised' by CNR, but there was no regard to sediment management).

Data quality: A second area where the PDG does not provide extensive guidance is defining the types and quality of data that are appropriate for inclusion in the Prior Consultation documentation and for use in modelling exercises. The source of all flow and sediment data used in the above 'big-picture' and in the subsequent project description should be thoroughly documented and provided as annexes or electronically. If based on modelled results, detailed information about the models used and model calibrations should be provided. In all cases, data should be compared to the existing MRC databases and any differences should be identified, and justified;

Promoting 'joint operations' with other HPs: The PDG could provide more guidance as to how HPs should coordinate operations with respect to sediment and flow management. It is difficult to address this issue at the pre-feasibility stage, but a 'guidance' to identify what power stations will coordinate operations, and at least a description of how communication and cooperation will be managed would be useful. Water Quality and Aquatic Ecology

[Summary of findings of the ISH0306 Team](#)

Water Quality mitigation matters to be referenced:

- Design of aeration and re-regulation weirs to be referenced;
- Provision of environmental flows mimicking the natural flow regime
- Use of high/low level outlets to mimic seasonal temperature and manage dissolved oxygen;
- Avoid high retention time in reservoirs;
- Implement site specific (spatial level) water quality standards (e.g. TSS, oxygen, temperature)
- Plan and implement catchment management measures to reduce pollutants inputs

Aquatic Ecology matters to be referenced:

- Dam siting during master plans to avoid impacts on aquatic, wetlands and floodplain habitat hotspots, including assessment of sections sensible to river fragmentation and important habitats (no-go areas)
- Assessment of requirements and distribution of migratory aquatic species
- Assess and implement suitable turbidity thresholds with regard to natural floods for aquatic species
- Mimic natural flow regime through artificial releases and environmental flows
- Maintain seasonal patterns through HP operations
- Reconnecting floodplains and ensure connectivity during construction
- Creation of offsets of residual impacted areas and habitats
- Floodplain and wetland rehabilitation
- Implement river bank stabilization works
- Implement habitat improvement in head of impoundment

Summary of findings from the PNPCA Process to be added

No comments received to date.

Safety of Dams

Summary of findings of the ISH0306 Team

Published guidelines & regulations

- PDG to incorporate guidance provided by the most recent ICOLD publications on dam safety.
- Additional requirement for regional guidance and legislation to be reflected in the updated PDG document.
- The updated PDG should provide guidance on how differing national legislative design requirements can be accommodated consistently on a basin wide, transboundary basis.

Spillway design

- Provide more detailed guidance on the spillway design standards that should be adopted and how these risks can be effectively mitigated.
- The required minimum flood return periods for the design and check floods, and associated freeboards, should be specified so that a consistent approach is adopted on all mainstream projects.
- The requirement for redundancy of gates should be fixed with an n -1 criteria for the design event.
- Minimum response times for spillway gates should therefore be specified in terms of maximum acceptable changes, and rates of change, in upstream and downstream water level to lessen water level changes during machine trip events.
- The updated PDG should provide detailed guidance on the levels of power supply redundancy that are required.
- The PDG should additionally require 100% duty and standby hydraulic systems, and manual intervention systems, to ensure that the gates can always be opened when required.
- Finally, outline guidance should be provided on required maintenance regimes and test procedures.

Climate change resilience

- Resilience to climate change is not mentioned in the current PDG. This topic should be addressed when the document is updated..

Seismicity

- In order to achieve a consistent approach the PDG should provide guidance on the required methodology for assessing the Operating Basis and Maximum Credible Earthquake events and the required performance of the structure during such events.

Dam design

- Specific guidance is required for the design of dams.

Safety during river diversion

- The PDG should therefore provide guidelines on the minimum standards of security required in the design of river diversion works. Guidance should also be provided on the flood alert and evacuation thresholds that should be put in place.

Powerhouse

- Power station flooding is considerably more common than dam overtopping, essentially because inappropriately low factors of safety are often adopted. The revised PDG should specify the levels of security required both from tail water flooding and pressure conduit rupture.

Design review procedures

- The updated PDG should specify the required provisions for external design review and construction monitoring.
- The PDG should make recommendations that the Concession Agreement makes adequate provision for effective review and non-objection rights by the Dam Safety Review Panel and the Government Engineer throughout the design, construction and early operating period.

Operational safety

- A range of suggestions are proposed relating to power station ramp rates, and amplitudes for safety of river vessels; requirements for protecting the power intakes and spillway from being approached by lake craft; systems for warning downstream communities before power station and spillway releases are made, and security measures.
- Requirements for a cascade management system covering data sharing, operation protocols and general hydro safety should be defined.

[Summary of findings from the PNPCA Process to be added](#)

No comments received to date.