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# Paradise Dam Consultation

Engineers Australia member feedback

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September 2020



Paradise Dam Consultation Feedback

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# 1. Introduction

Engineers Australia welcomes the opportunity to provide this submission to the Department of Natural Resources, Mines and Energy in response to its Consultation Paper *Paradise Dam Commission of Inquiry Report Proposals for Implementation of Recommendations*.

Engineers Australia is the peak member-based professional association for engineers. Established in 1919, Engineers Australia is constituted by Royal Charter to advance the science and practice of engineering for the benefit of the community. Our work is supported by around 100,000 individual members, including about 20,000 in QLD. Engineers Australia's response is guided by our Charter and Code of Ethics which states that engineers act in the interest of the community, ahead of sectional or personal interests towards a sustainable future. Engineers are members of the community and share the community's aspirations for Australia's future prosperity.

This submission has been prepared by a panel of Engineers Australia Queensland Division members with expertise in the area of dam safety management. This submission has two major components:

- Section 2 provides some overarching recommendations relating to dam safety management in Queensland
- Section 3 directly addresses the questions outlined in the Consultation Paper

Engineers Australia would welcome the opportunity to discuss these recommendations or provide further input. To discuss the contents of this submission further, please contact Stacey Rawlings, General Manager Qld, on (07) 3226 3041 or [srawlings@engineersaustralia.org.au](mailto:srawlings@engineersaustralia.org.au).

## 2. General recommendations for dam safety management

Engineers Australia appreciates this opportunity to contribute to the improvement of dam safety regulation and practice in Queensland. In the preparation of this submission two critical areas of improvement were identified that are not directly related to the 8 recommendations of the Paradise Dam Inquiry. These two areas of improvement are more holistic and relate to the overall ability of the regulation and practice of dam safety management in Queensland to protect the health, welfare and safety of Queenslanders.

Engineers Australia recommends the following actions for implementation.

### 2.1 Referable Dams and Regulated Dams

Lessons learned from the Paradise Dam Inquiry are of great value for improving the regulation, guidance and practice of dam safety in Queensland. Engineers Australia is pleased to see that referable dam guidance is being updated to improve management of referable dams.

However, dam safety in Queensland is managed under two key processes, the referable dam process for clean water dams, and the 'regulated' dam process for other dams, such as dams containing hazardous substances on mine sites.

Engineers Australia strongly recommends that the regulated dam regulations and guidelines are also updated to reflect the lessons learned from the Paradise Dam Inquiry.

Additionally, Engineers Australia recommend a combined review of the dam safety requirements in these two processes. With differing sets of guideline documents applying for each, and a different department providing oversight to these two sets of processes, there is the opportunity for inconsistencies. A review of both guidelines to ensure they are consistent and represent good practice would have significant benefits. One combined set of

guidelines might be an appropriate outcome, or at least a clear explanation in each set of guidelines as to how they work together.

Combining these two groups of regulator staff may also be beneficial. A combined government group providing oversight would improve dam safety practice and improve consistency, allowing the government to employ a larger pool of RPEQ engineers with expertise in dam safety to oversee dam safety on a holistic basis in Queensland.

## 2.2 Persons At Risk (PAR)

Engineers Australia recommends that both the referable dam guidelines and the regulated dam guidelines consider the safety risk to all people from dam failure in assessing whether the dam is regulated or referable.

Most casual readers of these guidelines may not realise that dams in Queensland can currently be constructed with the capability of killing many people if they fail without those dams being referable or regulated. If the dam is not referable or regulated, no dam safety conditions apply to ensure the dam is well designed, constructed and operated and that regular surveillance inspections are made to ensure the continued safety of the structure.

This can occur because both guidelines largely ignore or exclude the safety risk to people working for the dam owner on the same piece of land as the dam, and largely ignore or exclude the risk to itinerants downstream.

Itinerants include people who are downstream of the dam 'out of the house'. This might include drivers on roads that would be suddenly inundated by dam failure, or people playing sport, picnicking or otherwise having a day out on land which would be inundated by the dam break wave. The risk to itinerants is required to be assessed by the national guidelines on Consequence Category Assessment by ANCOLD, however Queensland guidelines specifically exclude these people from Persons At Risk (PAR) calculations. It is highlighted that dam break assessments consider all possible climatic conditions, from sunny daily failure up to failure in the most extreme events, and that the procedure involves the key assumptions that the probability of the dam failing is not relevant and that no warning is given or mitigation actions taken. There will be people downstream of dams 'out of the house' in the set of scenarios analysed, and it is thus considered good practice to account for that.

The referable dam guidelines specifically exclude any person on the same lot as the dam from PAR calculations, and the regulated dam guidelines specifically exclude site personnel. The stated logic for this exclusion is that workplace health and safety regulations cover dam safety concerns in these situations (with this explanation there are effectively three sets of dam safety regulation and guidance in Queensland, referable dams, regulated dams, and 'risky WH&S' dams). If this is the adopted model, then all three regulatory processes and guidelines require review to ensure they include lessons learned from the Paradise Dam Inquiry and to ensure all represent good practice and are consistent, as per the issue outlined above. As long as WH&S staff have the appropriate dam safety qualifications and experience this approach could work, but at first glance it appears more efficient for the Queensland Government's dam safety experts to regulate the risks specifically associated with dam safety issues for all significant consequence dams in Queensland.

These exclusions have been in place in Queensland guidelines for a long time, and the Semmelweis reflex is a difficult tendency to overcome. Nevertheless, Engineers Australia strongly recommends that all Queensland dam safety regulations and guidelines are updated to allow, encourage and require the potential risk to all people from dam failure to be counted in the determination of whether a dam is regulated or referable.

# 3. Consultation questions and responses

## 3.1 Commission Recommendation 1 – Testing

**The materials used to construct a dam and the dam as-built should be subjected to inspection and physical testing to confirm the values adopted for critical design parameters. It is preferable that those responsible for the dam's design and construction organise and oversee such testing.**

### Question 1:

*Is it already your practice to perform (or require, depending on your role) the recommended inspections and testing? If yes, are you able to indicate the cost implication of carrying out such inspections and testing? If no, are you able to indicate what would be the cost implication of doing so?*

### Response:

Engineers Australia as an association representing engineering professionals does not directly perform roles in the design, construction and operation of dam infrastructure. Our members feedback on this matter provides industry insight into performance practices relating to the question of recommended inspection & testing.

Cost is dependent on the particular project, type of structure and 'mandatory' requirements. It is difficult to broadly state cost implications.

From a design perspective, the designer(s) can develop a Specification that considers the 'mandatory' requirements for performance testing of products that can then lead to the testing requirements that are 'specified' to the constructor/builder. This should be considered at the beginning of a project.

From a construction perspective, the constructor will perform the 'required' testing that is spelled out in the 'specification' and/or drawings that is applied to the works.

The regulator should have the powers to review and endorse the Specification and test plan proposed; ensure that testing is performed and maintained as required, including specifying required testing, regular on-site auditing, etc. All testing results and/or records must be maintained and remain accessible whilst the referable dam is in place.

### Question 2:

*Do you agree that the recommended inspections and testing are good engineering practice?*

### Response:

Yes. It is important that the recommended testing and inspections are carried out. It is recommended that review of the testing as it occurs is explicitly part of the task undertaken by the technical review panel, and also that the regulator should undertake spot audits during project construction, as well as the end of construction, to ensure the required testing is appropriately carried out.

### Question 3:

*Should the recommended inspections and testing apply to all or only some referable dam projects – either new dams or upgrades to existing dams or both?*

### Response:

Each referable dam project will have its unique challenges. Varying the scope of the inspection and testing requirements depending on the assessed consequences (e.g. PAR) makes sense. This should apply across both new and upgraded dams.

### Question 4:

*Are there any situations or specific dams where testing would be unnecessary? Please discuss.*

**Response:**

There are situations where testing could cause concerns with the overall integrity of the design such as undertaking multiple test pits in an earth embankment or proof testing of fusegates/fuseplugs.

If a project owner decides there is a good reason not to apply a 'must' or 'should' under the guideline, then as long as they carefully document why they have gone another way (and apply for exemption if legally required) that would also be reasonable.

**Question 5:**

*Is the level of detail in the proposed update to the guideline appropriate and, if not, what should be added, removed or clarified? Discuss.*

**Response:**

It is important that the testing of materials associated with dam construction is integrated with and in parallel to the dam construction. Engineers Australia recommends that this aspect is highlighted in the guideline. This could be achieved by adding a statement such as the following to the guideline:

"Such testing must be integrated into the dam construction process, with all reasonable efforts expended to ensure test materials accurately reflect the as-constructed structure."

A definition of *reasonable efforts* warrants consideration and could include a requirement such as "physical test samples prepared under the same climatic conditions and using the same materials, techniques and construction staff as the referable dam".

**Question 6:**

*Is there a relevant industry guideline that currently includes guidance consistent with the recommendation? If so, please provide details. If not, what would be the process for incorporating the recommendation into the guideline?*

**Response:**

Engineers Australia supports the development of Queensland/Australian specific industry guidelines covering key areas of practice associated with dam design and construction, such as materials inspection and testing.

**Additional Comment on Recommendation 1**

It is suggested that Department of Natural Resources Mines and Energy (DNMRE) should review the existing guideline to determine whether the need for the Engineer to have adequate resource and expertise on site to oversee and monitor all construction activities carried out by the Contractor is addressed. The Engineer should have their own Resident Site Staff (RSS) in addition to the site staff (including the Construction Engineer and the Superintendent) engaged by the Contractor.

It is proposed that the RSS should be comprised of engineers, inspectors, surveyors, draughtsmen, and laboratory technicians on site. An on-site laboratory is also recommended to perform the large number of urgent testing sometimes required. At the commencement of the project, the Owner is required to submit the proposed establishment of the Engineer's RSS and the Contractor's establishment to the Regulator for approval. The cost of the RSS will be borne by the Owner.

## 3.2 Commission Recommendation 2 – Technical Review

**The commission encourages consideration by the Regulator of mandating the independent technical review of referable dam projects.**

**Question 1:**

*Is it already your practice to engage (or require, depending on your role) the recommended independent technical review for referable dam (or equivalent interstate) construction, upgrade and/or remediation projects? Discuss why it is or is not your practice. What are the cost implications of doing so relative to the overall costs of a dam project?*

**Response:**

Engineers Australia considers that using independent technical reviewers (ITR) in design engineering workshops is good practice. The presence of ITR for the project lifecycle leads to a clear understanding of reasons for decisions. At key decision points the designer and owner can be challenged by the ITR. ITR on referable dam projects provides a very good investment for the dam owner, providing a defensible and robust design and saving considerable costs in repairs and required upgrades.

**Question 2:**

*Do you agree that the recommended proper and transparent process of independent technical review is already good engineering practice? Discuss.*

**Response:**

Yes, independent technical review is excellent engineering practice. It is a powerful tool to ensure commitment to Quality Assurance. Having an independent technical review panel providing oversight for the course of the project will ensure important decisions are challenged and crucial reasoning underpinning decisions are documented.

**Question 3:**

*Is the level of detail in the proposed update to the guideline appropriate and, if not, what should be added, removed or clarified? Discuss.*

**Response:**

Engineers Australia is broadly supportive of the guideline but request consideration of the following points:

- The section on governance focusses on three key parties to the process. However, there are 4 if the Government dam safety unit (representing the community) is considered. Adding the regulator to the framework, might assist in understanding and managing relationships. One benefit is clear in relation to the court expert witness model, where the expert witness is engaged and directed by a side in the action but has a duty to the court. Showing a similar review team/regulator relationship in the diagram would be beneficial.
- The PAR < 10 note seems to imply the wrong message – technical review of design and construction should be done in parallel with design and construction, not at the end, with consideration for a number of review stages and a number of specialists involved to reduce risk. Leaving until the end will be insufficient and ineffective.
- Those undertaking engineering in Qld must be RPEQ. Providing technical peer review of engineering topics is engineering. Such reviewers must therefore be RPEQ.
- The document indicates 5-10% of labour costs to the technical review process. It is noted that costs of review vary widely. For example, it has been suggested that the cost of an independent check is typically less than 0.5% of the construction cost for a project greater than about £6 million sterling.<sup>1</sup> With % costs of review potentially varying widely, perhaps the guideline should focus on the scope and technical requirements of the peer review process rather than the cost.

**Question 4:**

*When, in your view, should the recommended technical review panel/process be mandated?*

*Should it be mandated in all dam projects or only in certain dam projects, or based on a commercial or consequence criteria? For example, only for new dam infrastructure or upgrades to existing dam infrastructure or both. Discuss.*

**Response:**

All referable dam projects should be mandated to having a technical review panel. The composition of the review panel, and its Chair if more than one member, is to be proposed by the Owner and approved by the Regulator.

It is recommended that the Regulator reserves the right to request the Owner to change the composition of the Panel to ensure the technical review meets the requirements of the Regulator.

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<sup>1</sup> <http://thost-iabse-elearning.org/l12/data/downloads/reference.pdf>

Existing dam works can compound complexities due to legacy issues. If it becomes mandated for new referable dams, then it must be mandated for projects on existing referable dams, where those projects are affecting components contributing to the safety and function of the referable dam.

**Question 5:**

*What factors should be considered in making a decision to impose conditions mandating the recommended technical review panel/process for a referable dam (or equivalent interstate) project on a case-by-case basis?*

**Response:**

Factors to consider include the size, inherent risks (PAR, economic, environmental, social) and complexity of the project. The required number and experience of reviewers, the number of review stages and the depth of review required should be set based on those factors.

The Owner is required to build into the project schedule adequate time for this review to take place. Should the review result in a change of the original design, allowance should be made for the design change to be reviewed.

**Question 6:**

*How would mandating the recommended technical review panel impact upon your delivery of referable dam infrastructure in Queensland?*

**Response:**

As indicated in Q1, Engineers Australia considers that using an independent technical review panel on referable dam projects is a very good investment for the dam owner, saving considerable costs in repairs, required upgrades and lawsuits down the track.

**Question 7:**

*Do you envisage challenges identifying and engaging suitably qualified technical reviewers?*

**Response:**

Yes, the dam industry in Australia is suffering from a shortage of skills due to the boom/bust cycle of dam work. Having suitably qualified technical reviewers with RPEQ who are able to provide their time and expertise to Queensland Dam projects could be problematic. Ensuring that quality is not diluted due to future booms in this work will be a challenge for the Regulator. However, as discussed in Q1, the whole of life benefits are considered to significantly outweigh this difficulty, and thus the additional effort required to source suitably qualified reviewers is worthwhile.

Engineers Australia is well placed to work with the regulator, universities and our expert dam safety professional members to support the industry in addressing the skills shortfall through the development of additional specialist courses and training.

**Question 8:**

*Should technical reviewers be registered professional engineers Queensland (RPEQ)? What would be the likely benefits and consequences if RPEQ was a requirement for participation in technical review?*

**Response:**

The legislation of Queensland requires that registration with the Board of Professional Engineers of Queensland is required for those providing engineering services. Providing technical peer review of engineering topics should be considered as an engineering service. Engineers Australia thus considers that such reviewers must therefore be RPEQ.

As discussed in Q7, there are challenges involved in engaging suitably qualified RPEQs to serve on technical review panels. Options to address these challenges could include:

- Provision of additional training opportunities to upskill Engineers to fulfil this requirement. Experienced Australian or international engineers could be invited to pass their skills on to others, especially the next generation.
- Ensuring a level of diversity in future review panels. As discussed in the responses to Recommendation 3 and 5, there are significant benefits in the regulator having a role in ensuring that the same small group of experts are not repetitively engaged as dam designers and reviewers. Bringing some new blood into this

- pool will increase independence, provide a wider range of views, and increase the pool of engineers with experience in this area, all of which should improve the outcomes of this critical quality assurance process.
- Promoting the need for an expanded pool and supporting interstate and international specialists to become registered with BPEQ through existing pathways offered by Assessment Entities such as Engineers Australia
  - Consider how these individuals could be identified within the available Areas of Practice.

While RPEQ is the basic legal requirement for undertaking engineering in Queensland, Engineers Australia recommends that those engaged to provide engineering advice on Technical Review Panels are Chartered Professional Engineers and eligible for registration on international engineering registers such as the APEC Engineering Register or International Professional Engineer Register. These registers recognise the Chartered Engineer credential as the competency base and include a higher benchmark for experience and responsibility. They also represent a useful international benchmark when considering the competence of international engineers for such review panels. Such engineers are well equipped to provide the comprehensive and holistic professional engineering review that is required for complicated and risky projects such as major water supply dams.

Engineers Australia would be pleased to work with the regulator and BPEQ to upskill engineers to meet design, construction and peer review requirements associated with referable dams. We could also collaborate on resources to articulate pathways and timeframes for suitably experienced and qualified interstate and international engineering experts to become registered.

### 3.3 Commission Recommendation 3 – Review Capacity

**The panel or body established to conduct the independent technical review should have the authority to co-opt others with appropriate expertise to conduct peer review of matters beyond the collective expertise of the panel members or where obtaining additional views is considered advisable.**

**Question 1:**

*Do you foresee any issues with independent technical review panels being granted the recommended autonomy to co-opt additional experts where specific expertise is lacking amongst the panel's existing constituents? What are those issues?*

**Response:**

Yes. The scope of a technical review panel should be fairly broad in terms of being able to question and investigate a wide range of technical issues associated with the project, but hiring of additional staff and commissioning of additional studies, without dam owner approval should not be within the remit of the review panel.

The engagement of additional experts, if required, should be undertaken using a similar process as that applied for the initial set of experts. Recommendations on appropriate experts might come from any number of sources, but the dam owner would be responsible for sourcing and engaging the selected experts. If an alternate model is adopted where the dam safety regulator appoints the original experts to the panel, they would also then appoint any additional experts to be panel.

Briefing technical review panel members to specify their ability and responsibility to question and investigate a wide range of technical issues associated with the project will be essential. This scope must include the ability to recommend additional expertise, request additional studies or testing, go on site and physically inspect matters. As with any recommendation made by the panel, the dam owner may negotiate (based on cost or other implications), and a mutually acceptable alternative may be agreed. However, it is important that those on the review panel are empowered to provide frank and fearless advice in the public interest, and that dam owners are required to report on disputes.

The employment relationship between the dam owner and the technical review panel member is atypical, and is more akin to an expert witness role in a court proceeding. As such, ensuring technical review panels are aware that their highest duty is to the public, not the dam owner will be critical. Issuing a formal statement of responsibilities from the regulator to the technical reviewers, like the statement issued by courts to expert witnesses could assist in achieving this objective.

The suggested text related to dispute resolution is reasonable, provided the dam regulator is aware of the dispute. It is recommended that reporting disputes by dam owners be mandatory. At key major stages (end of design, end of construction, etc.) each technical reviewer should be required to provide a signed letter summarising their involvement and approving the report on the technical panel review process, with each reviewer individually able to document any and all residual concerns with the project. The chair of the review panel should provide their opinion on the quality of the technical review process, including the breadth of skills and experience applied and highlight any residual concerns with the project.

**Question 2:**

*Do you consider there are alternative means of ensuring that technical review processes have adequate expertise and experience to review all facets of the dam design and construction?*

**Response:**

Ensuring the scope of the project is reasonably defined at the start of the project should assist in selecting the initial group of peer reviewers.

Providing the names and expertise of the suggested review panel to the regulator, for information or for formal approval (see Q5) would allow the regulator to recommend or require additional expertise if considered appropriate. See Question 1 for the suggested process once the review panel is formed.

**Question 3:**

*What would be the cost implications (including resourcing and procurement) for your organisation if technical review panels were to be granted the recommended autonomy to co-opt their own additional experts?*

**Response:**

Please refer to the response to Q1.

**Question 4:**

*Is the level of detail in the proposed update to the guideline appropriate and, if not, what should be added, removed or clarified? Discuss.*

**Response:**

The detail is generally appropriate, but suggest the following addition:

- Specific detail regarding reviewer responsibilities. For example, clearly articulating that the primary duty is to the public and providing the 'expert witness' type briefing.
- Reporting and sign off requirements should be as outlined in Q1.

**Question 5:**

*Would a mechanism by which the regulatory framework provides an approval mechanism for the constitution of technical review panels be of assistance to dam owners, in lieu of granting the panel the autonomy to co-opt their own additional experts? Discuss.*

**Response:**

At minimum, Engineers Australia recommends the inclusion of a step for the Regulator to review and approve membership and raise any non-compliance or other issues. Inclusion of a hold point for timely regulator approval would allow explicit consideration of capacity and independence issues as discussed in Q8 and Recommendation 5 Q1.

The preferred approach to adding additional panel expertise is provided in Q1 (regulator approval of panel

membership does not negate the requirement for review panel members to consider the public their prime responsibility, and thus to recommend additional panel expertise if required).

**Question 6:**

*Would a mechanism by which the regulatory framework provides a mechanism to adjudicate in disputes between dam owner and technical review panels be of assistance to dam owners, in lieu of granting the panel the autonomy to co-opt their own additional experts? Discuss.*

**Response:**

The regulator should act as mediator.

However, as with Q5, the preferred approach to adding additional expertise to the panel is explained in Q1.

**Question 7:**

*Is there a relevant industry guideline that currently includes guidance consistent with the recommendation? If so, please provide details. If not, what would be the process for incorporating the recommendation into the guideline?*

**Response:**

As indicated in Recommendation 1 Q6, Engineers Australia would support development of Queensland/Australian specific industry guidelines covering key areas of practice associated with dam design and construction, such as peer review.

**Question 8:**

*How would you ensure diversity of technical capacity and views within a technical review panel?*

**Response:**

The panel should provide reasonable coverage of key specialities. Engaging 3+ technical experts in each speciality on the panel to obtain a diversity of views would only be necessary for highly complex projects, particularly when the guidelines allows panels with only 1 or 2 total members.

Technical review panels provide independent technical review to the project. The diversity is obtained at a project level, through the interaction between the team and review panel, rather than within the panel itself.

As such, it will be necessary to ensure a clear distinction between project team member expertise and that of the panel, with the panel not being a complete duplication of expertise on the project team. Similarly, the same group of experts should not repeatedly be drawn as project engineers and review engineers in repetitive projects. If group A reviews group B in project 1, and the reverse roles occur in project 2, that would limit independence. Some mixing and matching of review panel members will help to encourage diversity of views over multiple projects and will improve reviewer and project engineer capability over time.

The regulator should have responsibility for determining the appropriate composition of the review teams, due to visibility of the various review teams over a range of dam projects. The regulator may suggest and require alternate team members through the review panel formation process, as discussed in Q5.

## 3.4 Commission Recommendation 4 – Review Scope

**Matters for review should include but may not be limited to regulatory, safety and operational requirements, the principal components of the dam and its critical design parameters.**

**Question 1:**

*What do you consider should be the matters for review? Do you agree that independent technical review should include but may not be limited to the recommended regulatory, safety and operational requirements, the principal components of the dam and its critical design parameters? If not, should the scope be narrower or broader in its content?*

**Response:**

Yes, Engineers Australia agrees that independent technical review should include but may not be limited to the recommended regulatory, safety and operational requirements, the principal components of the dam and its critical design parameters. Technical reviewer panel members should have a broad remit, with limits to their scope only permitted for matters with very little public interest (where the safety, environmental or economic risk to the general public is minimal).

Engineers Australia recommends that the proposed addition to the Dam Safety Management Guideline be updated to explicitly state that consideration of all matters of public interest are within scope of the Technical Review Panel. Engineers Australia recommends that the second sentence is updated in line with the following suggested text.

*"The structural integrity and the identification and mitigation of risks associated with dam failure are addressed as a priority. Risks to be assessed include the safety, environmental and economic risks to the public from failure of the dam."*

It is also recommended that the Regulator outlines the minimum scope of the Technical Review Panel's work based on the dam's PAR in the Dam Safety Management Guideline. It is noted that the appropriate scope for technical review will also vary with several other factors, such as the type of construction and complexity of the structure. The requirements should be written as guidance, to be adapted for the individual project. The following list is preliminary, and the Regulator should review and amend accordingly as required.

**Typical Independent Technical Review Panel Tasks (PAR > =2)**

1. Review design criteria.
2. Review conceptual design and general design principles.
3. Review materials and workmanship specifications.
4. Review information such as proposals for and results from hydraulics tests, site investigations, river scour surveys etc.
5. Set up independent analysis models, deriving geometry, properties and loads from design drawings and design criteria.
6. Independent static and dynamic analysis and compare results.
7. Independent assessment of structure in permanent condition.
8. Independent analysis of erection procedures to check temporary conditions of permanent structure.
9. Check drawings for consistency with design.
10. Certification.
11. Check design changes during construction.
12. Check reinforcement bending schedules.
13. Check contractor's fabrication drawings.
14. Review contractor's erection procedure & method statements.
15. Independent analysis of erection procedure to check temporary works requirements, pre-cambers & all temporary conditions.
16. Additional specialist studies to confirm designer's proposals in the case of complex structures. (e.g. hydraulic modelling tests).
17. Supervision of construction.

Typical Additional Technical Review Panel Tasks (PAR >= 10)

18. Economic design review.
19. Security review.
20. Cost checks.

As the scope of good practice technical review varies significantly with a range of project factors, Engineers Australia recommends an additional clause requiring dam owners to submit their plan for technical review to the regulator for approval at key project stages, such as the commencement of design and at the commencement of construction.<sup>2</sup>

**Question 2:**

*When should independent technical review commence, continue and end? Discuss.*

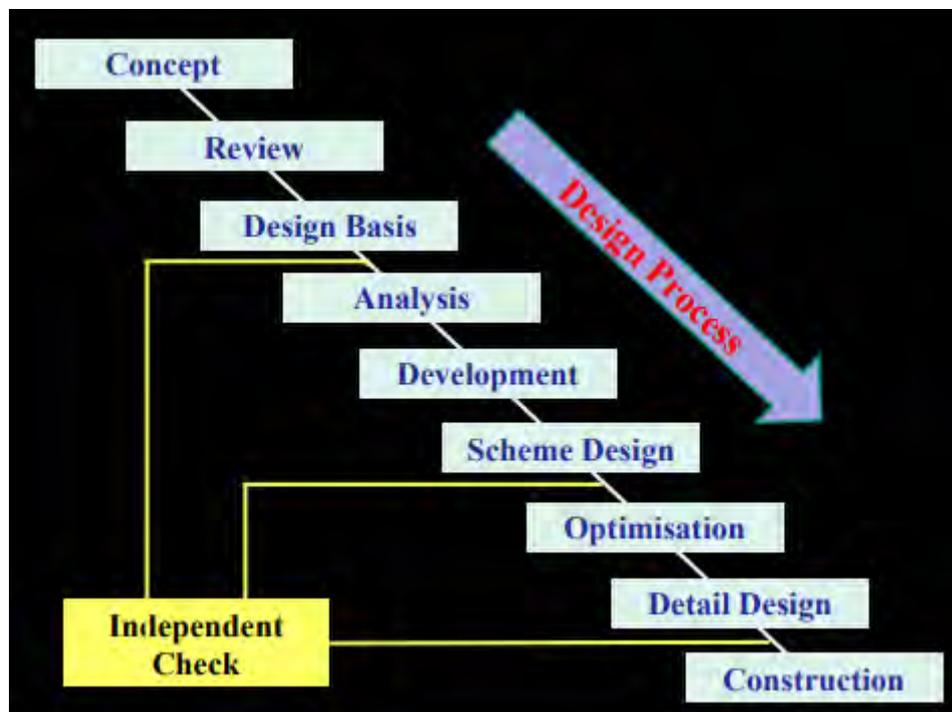
*If it is already your practice, discuss the advantages and disadvantages.*

*If not already your practice, discuss why not.*

**Response:**

The following diagram extracted from a keynote presentation by Ian Firth provides a good example showing a few hold points for independent checks.<sup>3</sup>

Should any design changes be made during construction, independent check on the same should be carried out.



**Question 3:**

*Is the level of detail in the proposed update to the guideline appropriate and, if not, what should be added, removed or clarified? Discuss.*

**Response:**

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<sup>2</sup> <http://thost-iabse-elearning.org/112/data/downloads/handouts%20per%20page.pdf> and <http://thost-iabse-elearning.org/112/data/downloads/reference.pdf>

<sup>3</sup> <http://thost-iabse-elearning.org/112/data/downloads/handouts%20per%20page.pdf>

While loss of life is a key concern for the public, there are a range of environmental and economic issues also of key interest to the public. Some broadening of the key concerns to be addressed would be of benefit. Even if no one dies, a massive economic cost from a design failure is unacceptable, and something a peer review process can reasonably address.

Further detail on our recommendations on the proposed update is provided in Q1.

**Question 4:**

*How will the implementation of this recommendation impact upon your delivery of referable dam infrastructure in Queensland?*

**Response:**

N/A

**Question 5:**

*Is there a relevant industry guideline that currently includes guidance consistent with the recommendation? If so, please provide details. If not, what would be the process for incorporating the recommendation into the guideline?*

**Response:**

Several organisations have published guidance associated with independence requirements for engineering review and certification, which may be of use in improving dam safety guidance in this area. For example:

- WA Dept of Health\_Guidance note for independent third-party engineering verification ([https://ww2.health.wa.gov.au/Articles/F\\_1/Guidance-note-for-independent-third-party-engineering-verification](https://ww2.health.wa.gov.au/Articles/F_1/Guidance-note-for-independent-third-party-engineering-verification))
- S2.1.4 to 2.1.7 in the Main Roads Manual on Design Criteria for Bridges and Other Structures (<https://www.tmr.qld.gov.au/-/media/busind/techstdpubs/Bridges-marine-and-other-structures/Bridge-design-and-assessment-criteria-manual/DesignCriteriaforBridgesandOtherStructures.pdf?la=en>)
- Structures Design Manual for Highways and Railways, Section 2.4 provides some good guidelines for independent checking.  
[https://www.hyd.gov.hk/en/publications\\_and\\_publicity/publications/technical\\_document/structures\\_design\\_manual\\_2013/doc/SDM2013.pdf](https://www.hyd.gov.hk/en/publications_and_publicity/publications/technical_document/structures_design_manual_2013/doc/SDM2013.pdf)
- The document 'Documented Independent Review of Structural Designs, Engineers and Geoscientists, British Columbia' seems comprehensive in terms of defining independent review and what needs to happen. [https://www.eqbc.ca/getmedia/c1092255-6f81-40c7-8a3c-73b9067623d1/V1-4-Documented-Indep-Rev-of-Structural-Designs-FINAL\\_2018-01-09-Web.pdf.aspx](https://www.eqbc.ca/getmedia/c1092255-6f81-40c7-8a3c-73b9067623d1/V1-4-Documented-Indep-Rev-of-Structural-Designs-FINAL_2018-01-09-Web.pdf.aspx)

**Additional Comments Recommendation 4**

**Definition of a Dam**

Engineers Australia suggests the definition of the term 'dam' in the document be reviewed. It is important to ensure 'dam' is broadly defined – it's not just the dam wall, but also downstream erosion protection and upstream slope stabilisation works.

The following sentence:

"The term includes all components contributing to the safety and function of the referable structure."

Should replace:

"The term includes an embankment or other structure that controls the flow of water and is incidental to works mentioned above."

This definition would allow reference to 'dam' instead of 'dam and associated works' in the remainder of the document. A more inclusive definition of the dam will assist in minimising risks such as the lack of peer review of the apron that occurred at Paradise Dam.

## 3.5 Commission Recommendation 5 – Independence

**The Regulator should consider how best to ensure the independence of the persons chosen to conduct peer reviews and whether guidelines to assist and direct those in peer reviewing dam projects would be useful.**

### **Question 1:**

*Do you agree with the recommendation that independent technical reviewers should be completely independent from the project and from the project participants (individuals and companies)? If not, why not?*

### **Response:**

Engineers Australia supports the principle that review panels must have a high degree of independence, and as part of this recommend consideration of the following actions to improve review panel independence:

- As discussed in Rec 3 Q5, an explicit requirement for the regulator to approve members of the review panel.
- An alternate model where reviewers are directly engaged and paid by the regulator (although the ultimate funding continues to be sourced from the dam owner). This sort of model is applied by some local governments, where the proponent of the development funds the Council to engage independent reviewers.
- As discussed in Rec 3 Q8, that the regulator seeks to promote independence by selecting review panel members from different companies and backgrounds to those engaged on the project team, and by appointing different review panel members to different projects over time. The upskilling encouraged by this process also assists in providing a wider pool of skilled staff for future project teams and review panels. For example, it is understood that the new International Council on Mining & Metal (ICMM) standard on tailings dams<sup>4</sup> requires that when subsequent reviews of a particular dam they should be undertaken by a different party. Using the same technical review panel through the preliminary planning, concept design, detailed design and construction of a dam can provide valuable direct knowledge to the later stages of the project but can also limit the ability for fresh independent review as the project progresses. This may also occur if reviewers for later stages are drawn from the project team on earlier stages. It is recommended that dam owners and the regulator consider ensuring that technical review panels include some new members who can provide a fresh perspective to the review of detailed design and construction stages.

As discussed in Rec 3 Q1, clearly briefing each review panel member on their role and responsibilities, including their primary responsibility to the public, perhaps through mirroring the model used in Court proceedings for expert witnesses.

### **Question 2:**

*Do you agree that it is undesirable for technical reviewers and designers (and the companies they work for) on one project to assume reverse roles on another concurrent project given the potential for conflicts of interest? If not, why not?*

### **Response:**

Yes, see Q1

### **Question 3:**

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<sup>4</sup> <https://www.icmm.com/en-gb/news/2020/new-global-industry-standard-on-tailings-management>

*Do you already ensure that your independent technical reviewers are completely independent of the project and its participants? If not, why not?*

**Response:**

N/A

**Question 4:**

*Is the level of detail in the proposed update to the guideline appropriate and, if not, what should be added, removed or clarified? Discuss.*

**Response:**

In addition to the changes necessary to implement the recommendations provided in response to other questions, Engineers Australia recommends that the primary responsibility of the technical reviewer to community health, welfare and safety is emphasized and listed first in the list of principles for technical reviewers.

**Question 5:**

*How will the implementation of this recommendation impact upon your delivery of referable dam infrastructure in Queensland?*

**Response:**

N/A

**Additional Comments Recommendation 5**

See references provided in response to Q5 of R4.

## 3.6 Commission Recommendation 6 – Erosive Forces

**The designer of a dam should give proper consideration to the erosive force of water and the capacity of the riverbed to withstand such force. This may include testing and simulation using computational and hydraulic modelling, as well as geotechnical investigations (and the interaction between those disciplines).**

**Question 1:**

*Is it your current practice to meet the requirements of this recommendation? Discuss.*

**Response:**

Assessment of erosive forces is complex, involving the interaction between the proposed design, hydraulic forces and the underlying geotechnical conditions. It is important that suitable modelling of all aspects and their interactions are completed.

Engineers Australia supports the inclusion of this requirement as documented on page 24 of the consultation paper.

**Question 2:**

*If you do not already comply with this recommendation, what would be the cost implications of doing so?*

**Response:**

N/A

**Question 3:**

*Is the level of detail in the proposed update to the guideline appropriate and, if not, what should be added, removed or clarified? Discuss.*

**Response:**

The guideline indicates to calibrate flood models with historic data where possible. This is strongly supported, but often only limited or no calibration information is available.

Engineers Australia suggests the inclusion of guidance on appropriate factors of safety to be used depending on the quality of the data, methodology and calibration behind the flood models. The absence of comprehensive historic data to calibrate models introduces a huge element of uncertainty.

Sensitivity testing, as mentioned in the draft guideline text, is one method to provide an appreciation of uncertainty. Stochastic methods, such as described in Engineers Australia's Australian Rainfall and Runoff, is another way to assess uncertainty. Calibration to multiple historic events is a third method that assists in the assessment of uncertainty. If all these methods are applied comprehensively, the factor of safety may be relatively small, in keeping with the uncertainty indicated by these methods. In situations where none of these methods are applied, a large factor of safety should be mandated, to reflect the significant uncertainty involved with the application of uncalibrated flood models.

**Question 4:**

*Is there a relevant industry guideline that currently includes guidance consistent with the recommendation? If so, please provide details. If not, what would be the process for incorporating the recommendation into the guideline?*

**Response:**

Engineers Australia notes that scour and erosive forces are a key problem in other areas of civil engineering. Similar guidance exists in Australian Rainfall and Runoff and AustRoads/DTMR guidance on Bridge Scour.

**Question 5:**

*At present, does the dam industry give proper consideration to the erosive force of water and the capacity of the riverbed to withstand such force?*

**Response:**

Aspects of hydrology and geology are incredibly uncertain in their own right. Erosive forces at spillway and riverbeds is the interplay of geology, hydrology and hydraulic forces, this is a very difficult area to do well. It is hard to model and therefore hard to design well.

Engineers Australia therefore recommends that a Queensland or national guideline on assessing and designing for erosion and scour for referable dams be developed and published, based on the latest research and existing professional practice guidelines worldwide.

As indicated in Rec 1 Q6, Engineers Australia would welcome the opportunity to contribute to the development of guidelines that will benefit the profession.

**Additional Comments Recommendation 6**

Long periods of historical gauged data are critical for efficient dam design. Such long-term thinking may be beyond the means of many dam proponents.

It is thus recommended that the dam safety group reviews the current stream gauging network and install gauges near dam sites that might be developed in the next ~200 years.

## 3.7 Commission Recommendation 7 - Compliance

**The Regulator should consider suitable means of routinely monitoring compliance with conditions of development permits and other approval relating to the construction of dams, including by audits and checks during construction.**

**Question 1:**

*How would the proposed implementation of this recommendation impact upon your delivery of referable dam infrastructure in Queensland?*

**Response:**

While the regulator conducting more frequent reviews and audits during design and construction will add some time and expense to the design and construction process, the short term impact is considered minor, while the long

terms benefits are considered to be major, and thus we strongly support the active regulation of dam safety by the regulator.

**Question 2:**

*Is the level of detail in the proposed update to the guideline appropriate and, if not, what should be added, removed or clarified? Discuss.*

**Response:**

The detail in the proposed update appears to be generally fine. However, with the strong QA role of the technical review panel, Engineers Australia would recommend adding an additional task in the regulator audit scope to meet with / interview the technical review panel and obtain their views on current issues and progress.

**Question 3:**

*Do you consider a technical review process during construction activities to be good practice?*

**Response:**

Yes, the application of an independent technical review process, as discussed in Recommendations 2 to 5, is considered to be good practice.

The application of regular audits and checks by the regulator, to monitor compliance with dam safety requirements, is also considered to be good practice.

**Question 4:**

*Do you think the regulatory framework should provide for engineering site audits to be conducted that monitor technical compliance beyond those required by dam safety or development permit conditions, during construction activities at a dam?*

**Response:**

Engineers Australia advises of the need to strike a balance in seeking additional monitoring of compliance in order to avoid future issues such as have arisen with Paradise Dam and creating a giant checklist. Perhaps if the dam works captured by the dam safety permit is comprehensive less will fall outside and can be captured in this single process.

**Question 5:**

*Certification upon completion of construction activities by a registered professional engineer of Queensland (RPEQ) is required. Do you think construction activities should also be certified by an RPEQ at periodic intervals during the construction process?*

**Response:**

It is understood that there should be as many RPEQs as required to cover the various technical competencies required for the dam project. It is expected that in these complex projects that many engineering decisions are made during construction. If the construction professionals are making decisions that will have a material effect on the design outcomes, then they are undertaking an engineering service and therefore need to be registered. An alternative may be to have the non-RPEQ construction professional liaise with the relevant design RPEQ about any matters which are a departure from the design and seek advice as to the way forward.

The language of 'certification' is not an appropriate description of what an RPEQ does and has the potential to cause confusion. Engineers Australia recommends that the templates in Appendix K of the draft Queensland Dam Safety Guideline 2020 be reworded and are accompanied by a signed report, as each project is unique and the scope under which RPEQs are employed may vary. This would allow the RPEQ to outline the scope of works they have directly supervised, clearly indicate any limitations or assumptions that apply to the work, outline the methodology, present and discuss results and discuss how they have worked with other RPEQs on the project to appropriately address cross-discipline issues (if applicable).

The suggested rewording of the introductory statement on each template in Appendix K should be similar to as follows:

This <Annual / Comprehensive / Special> engineering inspection of **Dam** was undertaken by **Name of Company**. Details of the scope of this professional engineering service are outlined in the report, **Name of Report, Date, Version No** which must be read in conjunction with this statement to clearly understand the limitations that apply.

Templates are provided in Appendix K for engineering inspections, safety reviews, design reports, and as-constructed reports. A further template, for when the structure completes its maintenance period and the dam is ready to be handed over to the owner, is suggested.

For dam design and construction, and the 20 year safety reviews, the owner of the dam would need to arrange and supply as many reports as are required to cover all the relevant engineering technical areas. Each report would be accompanied by a statutory declaration in line with the Appendix K templates. (For reference, requirements for certification by different disciplines for highway structures are outlined on TMRs website.<sup>5</sup>)

Digital copies of testing documentation, data and other pertinent records should be supplied to the regulator as part of the reporting required by the regulator. However, it should be clear that the dam owner is required to manage and maintain the primary copy of all design, construction and testing records for the life of the structure. This material is to be stored in the databook as required by the guideline.

It is noted that certain test samples, such as rock cores, must be stored physically, and some historical data, such as video of hydraulic model studies, may be on superseded media. It is thus strongly recommended that

- The regulator audits and records all such records when the dam is built (as part of the review of the data book)
- The dam owner reviews such records (and translation to new media, etc) as part of the 5- or 20-year dam safety reviews, and
- the regulator regularly audits these records, physically viewing cores, etc, to ensure they are being maintained.

This way the information can be stored for the longer term and is available to the dam owner, the regulator and the public should questions or concerns arise during the dam's lifetime.

## 3.8 Commission Recommendation 8 – Project Delivery

**To the extent practicable, the entity that is ultimately to own or operate the dam after its commissioning should have an opportunity to influence its design and construction; and if there is an alliance, preferably as part of that structure.**

### Question 1:

*Do you agree that the dam owner should have specialised technical expertise available when managing a dam project?*

### Response:

Yes

### Question 2:

*Do you agree that, if practicable, the ideal party to offer the expertise is the owner of the dam subject of the works, given their vested interest in the specific project?*

### Response:

Involving the parties who accept and manage the long-term risks and costs of the completed infrastructure in the

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<sup>5</sup> S2.1.6 at <https://www.tmr.qld.gov.au/business-industry/Technical-standards-publications/Bridge-design-and-assessment-criteria>

design and construction is preferred. If the only goal of those building the project is to get it built, suboptimal outcomes often result.

The design and construction of dams should include mechanisms to encourage strong input from parties experienced in the day to day operation and maintenance of dams. This has two benefits – the eventual operator will better understand valid design/construction decisions which makes operation more time consuming and costly, and the designer/construction team will better understand operational requirements.

The only situation that needs further consideration is if the ultimate owner does not have relevant experience in the operation of a dam or type of dam infrastructure (eg gates) if changes to existing infrastructure is made. Pathways for support must be developed in this early instance to again ensure that suboptimal outcomes do not occur.

**Question 3:**

*Is the level of detail in the proposed update to the guideline appropriate and, if not, what should be added, removed or clarified? Discuss.*

**Response:**

Engineers Australia recommends the addition of 'operation and maintenance expertise' to the list of desirable expertise to be included in the project team and in the peer review panel (even if the eventual operator is not known, a party with operational expertise should be included in the project team, and operational aspects should be part of the scope of the technical review panel.)

**Question 4:**

*How will this recommendation impact upon your delivery of referable dam infrastructure in Queensland?*

**Response:**

N/A.

**Question 5:**

*Is there a relevant industry guideline that currently includes guidance consistent with the recommendation? If so, please provide details. If not, what would be the process for incorporating the recommendation into the guideline?*

**Response:**

WorkCover NSW (now known as SafeWork NSW) developed a safety in design tool known as the Construction Hazard Assessment Implication Review Process (CHAIR Process).

Designers can identify hazards to eliminate or minimise risk in design, construction and use of a structure by consulting with other duty holders through formal Safe Design Workshops.

An early workshop – during the design phase – can involve a brainstorming process where key stakeholders, led by a facilitator, consider potential hazards and evaluate the design.

Subsequent workshops can encourage stakeholders to participate and consult on detailed design issues relating to the construction, maintenance, use for purpose or demolition of the structure being designed.

**Question 6:**

*Discuss the value or otherwise of having the entity that is ultimately to own and operate the dam influence its design and construction; and by what means?*

**Response:**

There is significant value as they are the end user and have the ultimate obligation for the performance of the structure. Question 5 above addresses mechanisms for the involvement of owners.

## 4. Conclusion

Engineers Australia is pleased to have had this opportunity to contribute to the improvement of dam safety regulation and practice in Queensland. We trust that the recommendations we have provided in this document assist in improving the regulation and practice of dam safety management to protect the health, welfare and safety of Queenslanders.

Engineers Australia would welcome the opportunity to discuss these recommendations or to provide further input on other aspects related to dam safety in Queensland. To discuss the contents of this submission further, please contact Stacey Rawlings, General Manager Qld, on (07) 3226 3041 or [srawlings@engineersaustralia.org.au](mailto:srawlings@engineersaustralia.org.au).



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