FORTIS BC™

Diane Roy
Director, Regulatory Services

Gas Regulatory Affairs Correspondence
Email: gas.regulatory.affairs@fortisbc.com

Electric Regulatory Affairs Correspondence
Email: electricity.regulatory.affairs@fortisbc.com

FortisBC
16705 Fraser Highway
Surrey, B.C. V4N 0E8
Tel: (604) 576-7349
Cell: (604) 908-2790
Fax: (604) 576-7074
Email: diane.roy@fortisbc.com
www.fortisbc.com

September 15, 2016

Commercial Energy Consumers Association of British Columbia
c/o Owen Bird Law Corporation
P.O. Box 49130
Three Bentall Centre
2900 – 595 Burrard Street
Vancouver, BC V7X 1J5

Attention: Mr. Christopher P. Weafer

Dear Mr. Weafer:

Re: FortisBC Inc. (FBC)

Project No. 3698883

Application for the a Certificate of Public Convenience and Necessity for Replacement of the Corra Linn Dam Spillway Gates (the Application)

Response to the Commercial Energy Consumers Association of British Columbia (CEC) Information Request (IR) No. 1

On June 29, 2016, FBC filed the Application referenced above. In accordance with the British Columbia Utilities Commission (the Commission) Order G-107-16 setting out the Regulatory Timetable for the review of the Application, FBC respectfully submits the attached response to CEC IR No. 1.

FBC has redacted certain details in the attached responses because they contain financial information and contingency details that are based on certain identified Project risks. The public disclosure of this financial information could inform contract bidders and could result in higher bids and higher costs than may otherwise be achieved. FBC has filed the confidential version with the Commission and registered parties who have signed and filed Undertakings of Confidentiality.

If further information is required, please contact the undersigned.

Sincerely,

FORTISBC INC.

Original signed:

Diane Roy

Attachments
cc (email only): Commission Secretary
Registered Parties

1 Reference: Exhibit B-1, Page 2

> The replacement or rehabilitation of the spillway gates and associated equipment is essential for the Corra Linn Dam to align with industry standards, meet current regulation and minimize the risks to public and employee safety. Since 2007, there have been amendments to the Canadian Dam Association Dam Safety Guideline (CDSG) and the British Columbia Dam Safety Regulation (BCDSR), which are relevant to the Corra Linn Dam.
>
> These amendments revised the "Dam Failure Consequence Classification", a measure that classifies dams based on the severity of the potential consequences of a dam failure, resulting in the Corra Linn Dam being reclassified from a "Very High" consequence classification to an "Extreme" consequence classification. The amendments have also updated the magnitude of the "design flood" and "design earthquake", which are used to define the severity of hazards that the Corra Linn Dam is recommended to be able to withstand. The Corra Linn Dam spillway gates do not have the strength to withstand the recommended design earthquake for a dam with a consequence classification of "Extreme". The spillway gate system does not meet present day requirements of the BCDSR and the recommendations for withstand capability requirements under the latest edition of the CDSG. Accordingly, the spillway gates and the associated structures require either significant refurbishment or replacement, to align with these amendments and to be able to withstand the design earthquake.

1.1 Are there restrictions on the timing for this project, such that it must be completed prior to a particular deadline to ensure compliance? If so, please explain.

Response:

The BC Dam Safety Regulations (BCDSR) do not specify a particular deadline for ensuring compliance, but section 5 of the BCDSR is specific as to the responsibilities of a dam owner, as follows:

> 5 (1) An owner of a dam must properly inspect, maintain and repair the dam and related works in a manner that keeps the dam and works in good operating condition.
>
> (2) An owner of a dam must exercise reasonable care to avoid the risk of significant harm resulting from a defect, insufficiency or failure of the dam or other conditions at the dam or operations or actions at or in connection with the dam to any of the following:
>
> (a) public safety;
>
> (b) the environment;
>
> (c) land or other property.

To conform to the BCDSR, FBC is required to maintain the Corra Linn Dam in good operating condition (BCDSR, section 5), and to also minimize the likelihood of the Dam developing either a “Hazardous Condition” (BCDSR, section 14) or a “Potential safety hazard” (BCDSR, section 15). As the Spillway Gate system does not presently have the strength to withstand the Extreme classification loads, FBC must take steps to minimize the risks of failure and the potential consequences of a failure.

2 Reference: Exhibit B-1, Pages 2, Page 23 and Page 23 Footnote

> In order to validate the current structural conditions and the original design of the various spillway components, FBC recently completed inspections on three of the 14 spillway gates at the Corra Linn Dam. These inspections revealed that the spillway gates are in fair to poor condition, and FBC considers the gates to be approaching end of life, unless significant rehabilitation is performed. The findings of these inspections, therefore, have been used to establish the extent of the reinforcement requirements based on the existing structural integrity of each component.

> In January 2016, various inspections were performed both by FBC and external specialist consultants to assess the condition of the gates, to determine the extent of the refurbishment that would be required to reinforce or replace the components. The three major components inspected were the three spillway gates[24], the steel superstructure supporting the spillway gate hoists and the spillway gate hoists. The inspections included visual inspection, non-destructive testing, electrical testing and metallurgical testing. The inspections indicate that the condition of the spillway gates are in fair to poor condition. The inspection reports are presented in Confidential Appendix F and consist of:
>
> - Dam Visual Inspection;
> - Dam Electrical Visual Inspection;
> - Dam Gate Thickness; and
> - Electrical Site Visit.
>
> On this basis, FBC considers the gates to be approaching end of life unless significant rehabilitation is performed.
>
> [24] The three spillway gates that were selected for detailed inspection were chosen because they were assessed to be of the worst condition based on a visual inspection of the gates.

2.1 Why did FBC not complete inspections on all of the 14 spillway gates?

<u>Response:</u>

Please refer to the response to BCOAPO IR 1.5.1.

2.2 Which three of the spillway gates did FBC inspect?

Response:

As is described in more detail in the Report on the Corra Linn Dam Gate Thickness (Confidential Appendix F-3), spillway gates 10, 11 and 14 were inspected. For reference purposes, spillway gate 1 (located closest to the train tracks) is located on the spillway left abutment adjacent to the power intakes and spillway gate 14 is located on the spillway right abutment adjacent to the non-overflow section of the Dam.

2.3 What are the circumstances that likely caused the three spillway gates to have worse condition than other gates? Please explain.

Response:

During a visual inspection of the 14 spillway gates, three of the spillway gates 10, 11 and 14 were noted to be in worse condition than the other 11 spillway gates due to the level of corrosion observed. The rate of corrosion is not a linear phenomenon and over the 84 year life of the spillway gates, gates 10, 11 and 14 may have corroded faster than the other gates. The level of corrosion noted, however, was not significantly different between the 14 spillway gates, i.e. the three gates inspected only appeared visually different due to the non-linear corrosion rate.

2.4 What was the cost of inspecting three gates?

Response:

The cost of the three detailed gate inspections was not separated from the overall inspection costs. The overall inspection costs included everything outlined in the Report on the Corra Linn Dam Visual Inspection (Appendix F-1 to the Application), including inspection of the towers, bridges, electrical equipment, gantries, and gates, in addition to the detailed inspection of the three gates.

The cost for the overall inspection was approximately $40,000.

2.5 What would have been the cost of inspecting more spillway gates? Please provide quantification for any different options that FBC considered.

Response:

The cost to inspect the remaining 11 spillway gates is estimated to be approximately $100,000. No other options were considered.

2.6 Please provide FBC's understanding of the other 11 spillway gates' condition.

Response:

Please refer to the response to BCOAPO IR 1.5.1.

2.7 Does FBC consider the three gates to be approaching the end of life unless significant rehabilitation is performed, or all the gates to be approaching end of life?

Response:

Please refer to the response to BCUC IR 1.4.2. Because all of the 14 gates are of identical vintage and design, FBC, in alignment with the U.S. Army Corps of Engineers recommended practice and 3rd party assessments, considers that all the gates are approaching end of life.

2.8 Could knowing the condition of the other spillway gates have any bearing on the alternative FBC selected for remediation? Please explain why or why not and provide quantification of any costs that would relate to the decision.

Response:

Completing inspections on the other 11 spillway gates would not impact the alternative FBC has selected for the remediation because all 14 spillway gates were designed, built and installed at the same time and have been subjected to the same operating environment. As a result, they would be of similar condition and strength.

Even if the remaining 11 gates were found to be in a better condition, they would still have to be either replaced or refurbished to meet present day requirements of the BC Dam Safety Regulation and the withstand capability requirements of a design earthquake event under the latest addition of the Canadian Dam Safety Guidelines. As described in the response to BCUC IR 1.4.2, refurbishment is not expected to extend the life of the gates beyond 15 years and replacement would be required at this time.

When also considering the cost to replace the spillway gates in 2032, the net present value of Alternative 3 is approximately $21 million more expensive than Alternative 4. As such, knowing the condition by completing a detailed inspection on all spillway gates would not change the alternative FBC has selected. Please also refer to the response to BCOAPO IR 1.5.1.

3 Reference: Exhibit B-1, Pages 5 and page 6

The Project was later discussed in FBC's 2014-2018 PBR Application (PBR Application) as a capital expenditure that would be the subject of a separate application for a CPCN. As is described in the PBR Application, the scope of the original project identified in the 2012 ISP had expanded due to a change in regulation. Specifically, section 5.4.2.2 of part C the PBR Application states:

As a result of the reclassification from "Very High" to "Extreme", and consistent with the information provided in the PBR Application, FBC's original plan of isolation, access, sandblasting and recoating the spill gates has now increased in scope to also include the work necessary to upgrade the strength of the spillway gates and associated equipment to withstand the design earthquake forces for a dam with a consequence classification of "Extreme".

3.1 Please confirm that neither the increase in scope nor other changes to the project result in a transfer to the CPCN of any expenditures that would otherwise have been covered by the formula spending under PBR. Please consider both current spending and future maintenance expense.

<u>Response:</u>

FBC confirms that none of the Project costs are for work that would normally be undertaken within the formula capital expenditures or the formula O&M expense under the PBR mechanism. There are no current or future capital expenditures planned for the spillway gate section of the Corra Linn Dam in addition to the Project expenditures during the PBR term. From an O&M perspective, because the Project is staged over a 4 year period, ongoing O&M activities have to continue on the spillway gate(s) and hoisting equipment while the Project is being executed. These costs will be captured through base O&M and not by the Project.

Therefore neither increases in scope nor other changes to the Project will result in CPCN expenditures that would have been covered by the formula spending under PBR.

3.1.1 If not confirmed, please provide details with quantification and forecast timing of the expenditures that will be included in the CPCN that would otherwise have been covered by formulaic spending.

<u>Response:</u>

Please refer to the response to CEC IR 1.3.1.

4 Reference: Exhibit B-1, Pages 8, 9, 21 and 27

> In addition, in recent years the Company has completed several major projects including the Advanced Metering Infrastructure project (total value of approximately $51 million) and the Okanagan Transmission Reinforcement project (total value of approximately $104 million). FBC proposes that the construction for the Project be done by a reputable contractor, with specialized experience in the design, supply and installation of spillway gate systems. FBC engaged HMI Construction, a firm specializing in spillway gate systems, to complete the

> preliminary engineering and to support the development of the Project Cost Estimate. Engaging a specialized constructor at this early stage of the Project lends to improved project risk identification, ensuring constructability of the proposed solution and increased confidence in the Project Cost Estimate.

> seismic withstand capability of the spillway gates, towers, bridges, and hoists. FBC also retained HMI to assist in developing the spillway gate and superstructures reinforcement requirements, if any. HMI's report (HMI Preliminary Engineering Report) is included as Confidential Appendix E to the Application.
>
> HMI's scope of work entailed reviewing the latest dam safety regulations and guidelines and determining if the current equipment meets the design withstand capacity. In the review process, the following equipment were analyzed and evaluated:
>
> - the capacity of the gates to withstand the "Extreme" classification design earthquake event;
> - the capacity of the gates to operate during the "Extreme" classification design flood event;
> - the capacity of the superstructures to remain operable after the "Extreme" classification design earthquake event; and
> - the capacity of the hoists to remain operable after the "Extreme" classification design earthquake event.
>
> HMI also evaluated the reliability of the facility and the following potential safety hazards:
>
> - structural failure of the spillway gates during a flood or seismic event which would lead to downstream water surges/uncontrolled release of water;
> - structural failure or overturning of the superstructure during a seismic event that would render the gates inoperable which may potentially make the Dam vulnerable to overtopping and potential catastrophic failure of the Dam;
> - structural failure or overturning of the travelling hoist during a seismic event would render the gates inoperable which may potentially make the Dam vulnerable to overtopping and potential catastrophic failure of the Dam; and
> - mechanical failure of the hoist preventing the spillway gates operation that could be hazardous to facilities and public downstream of the Dam.

> To further assess Alternative 3: Gate Refurbishment and Alternative 4: Gate Replacement, FBC sought HMI's assistance to conduct a detailed review of the risks for each feasible alternative. Project designs were developed to sufficient detail so that a fair comparison could be made with respect to overall risk reduction, project schedule risk, operational and maintenance considerations, reliability characteristics and potential environmental impacts. This analysis comprises the HMI Preliminary Engineering Report (PER) included as Confidential Appendix E.
>
> HMI was also engaged to assist in preparing an AACE Class 3 Project estimate for both Alternative 3: Gate Refurbishment and Alternative 4: Gate Replacement. No cost estimates were prepared for Alternative 1: Do Nothing or Alternative 2: Deferral because these alternatives did not achieve the Project objectives or meet the technical criteria identified in Section 4.1.1.

4.1 What was the total cost of the work undertaken to date by HMI?

Response:

The total cost of the work undertaken by HMI at the time the Application was submitted was approximately $325 thousand.

4.2 Did FBC undertake a competitive tendering process in the engagement of the engineering firm HMI?

Response:

FBC did not undertake a competitive tendering process in the engagement of HMI.

4.2.1 If not please explain why not.

Response:

As described in Section 6.1 of the Application, HMI was selected based on their experience as a contractor to BC Hydro for similar spillway gate rehabilitation project currently underway, their extensive experience and reputation within Canada on similar projects, and their ability to complete the scope of the project. FBC considered that they had appropriate engineering experience and qualified engineering resources necessary to complete the scope of work.

4.2.2 If so, how many firms did FBC consider and receive bids from?

Response:

Please refer to the response to CEC IR 1.4.2.

4.3 What is the total expected cost of the preliminary engineering and support for the development of the Project Cost Estimate?

Response:

The total expected cost of the preliminary engineering and support done by external consultants for the development of the Project Cost Estimate is approximately $507,000, which is line 1 from Table 6-2 of the Application.

4.4 Is it standard practice for FBC to engage a construction firm at the early stage of a major project?

Response:

It is not standard practice for FBC to engage a construction firm in the early stages of a project. Given the unique project challenges, such as the lifting required and site access, the Company decided to engage the support of an engineering and construction contractor with specialized expertise in replacing and rehabilitating spillway gates to define the scope and to develop an AACE Class 3 cost estimate.

4.4.1 If no, please explain why this project has received non-standard treatment.

Response:

Please refer to the response to CEC IR 1.4.4.

5 Reference: Exhibit B-1, Page 20

> In the Dam Stability Study, KP concluded that the Corra Linn Dam concrete structure is expected to perform satisfactorily under the maximum design earthquake (MCE) and Maximum Design Flood (PMF) event if all the potential stabilizing forces can be relied upon.[19]
>
> [19] Page 1 of Confidential Appendix D, Structural Stability Analysis – Corra Linn Dam.

5.1 If not confidential, please provide a brief description of the stabilizing forces which will be relied upon as identified above.

Response:

The stabilizing forces relied upon in the Structural Stability Analysis are the cohesion force between the concrete and foundation rock at the base of the Dam and the post tensioned rock anchors force installed in the 1990's.

5.2 Is there any reason to believe that all the potential stabilizing forces are unable to be relied upon? Please explain and provide quantification of any risks for which FBC has information that is available and not confidential.

Response:

FBC has no reason to believe that the stabilizing forces due to the cohesion between the Dam and the foundation rock and the post tensioned rock anchors cannot be relied upon.

As it is not possible to validate or calculate the cohesive forces, a conservative assumption of zero was made for the cohesion between the Dam's concrete and rock foundation, meaning the Dam has no cohesion between it and the rock foundation it sits on.

The Structural Stability Analysis recommends the condition of the rock anchors be investigated and cohesion not be relied upon (please refer to BCUC Confidential IR 1.2.3 for details).

6 Reference: Exhibit B-1, Page 21

> As summarized above, further studies were recommended by KP in the 2012 DSR which included a recommendation that FBC re-assess the seismic structural stability of the dam using the longer seismic return period and the increased ground motion acceleration associated with that return period (Dam Stability Study) and assess the seismic withstand capacity of the spillway gates and associated equipment to ensure they would be operable after an earthquake (Gate Withstand Study). These follow-up studies are discussed in the next sections.
>
> In 2015, as a follow-up to the recommendations in the 2012 DSR, FBC engaged KP to perform the Dam Stability Study to re-assess the structural stability of the Corra Linn Dam.[18] This assessment was focussed on the structure of the Dam itself, and did not include the spillway gates and associated equipment within the scope of the analysis. KP considered previous upgrades completed on the Dam, together with the new "Extreme" dam failure consequence classification and the associated requirements for the design flood and design earthquake values outlined in the CDSG. As an additional input into the Dam Stability Study, KP engaged Wutec Geotechnical International in May 2015 to create a technical report that provided the earthquake design loads which would inform the design criteria to be used for dam and spillway gates: *Corra Linn Dam – Seismic Hazard Assessment and Input Ground Motions* (Wutec Report). A copy of the Wutec Report is attached as Appendix C.

6.1 What was the total cost of the studies performed by KP?

Response:

The total cost for the Dam Stability Study (Confidential Appendix D to the Application) completed by KP was approximately $120 thousand and the cost for the Seismic Hazard Assessment (Appendix C to the Application) completed by WuTec was approximately $15 thousand.

6.2 Did FBC conduct a competitive bidding process in the hiring of KP?

Response:

No, FBC did not conduct a competitive bidding process in the hiring of KP for the Dam Stability Study because KP was familiar with the Dam and the relevant technical data through their completion of the 2012 Dam Safety Review (Confidential Appendix B). In addition, KP had the appropriate engineering experience and qualified engineering resources necessary to complete the scope of work.

6.2.1 If not, please explain why not.

Response:

Please refer to the response to CEC IR 1.6.2.

7 Reference: Exhibit B-1, Page 23

> The recommended design life of a new gate is 100 years as per the US Army Corps of Engineers,[22] assuming appropriate repairs and rehabilitation projects are performed during the gate service life. Further, the Corra Linn Dam was not constructed with a means of isolating the spillway gates, such as a bulkhead,[23] making routine maintenance difficult. As such, maintenance and refurbishment activities on the gates have been appropriate but minimal due to limited access.
>
> 150%. The dogging beam should be reinforced".
>
> [22] US Army Corps of Engineers (USACE) Engineer Technical Literature (USACE ETL) 1110-2-584 and Design of Hydraulic Steel Structures and Engineering Manual (USACE EM) 11100-2-8159 Life Cycle Design and Performance.

7.1 Is the US Army Corps of Engineers the standard Canadian reference source for gate service life?

Response:

There is no standard Canadian reference source for gate service life, so the publications of the US Army Corps of Engineers are typically used as a proxy.

The United States Army Corps of Engineers (USACE) is a U.S. federal agency under the Department of Defense and a major Army command made up of some 37,000 civilian and military personnel, making it one of the world's largest public engineering, design, and construction management agencies. The USACE owns and operates over 700 dams and has published engineering manuals for the design and analysis of hydraulic structures. These guidelines, which are also used by BC Hydro and Canadian engineering consultants specializing in hydropower, have been adopted by FBC for the design and analysis of spillway gates in the absence of any mandatory Canadian guidelines.

7.1.1 If no, what alternative Canadian reference material is typically relied upon for gate service life?

Response:

FBC is unaware of Canadian literature or reference material that provides a recommended service life for spillway gates.

7.1.2 If no, do other reference materials recommend different design lives? Please explain.

Response:

FBC is unaware of other North American literature recommending different design lives of spillway gates.

While there are some other international references, not all have been translated to English. Further, they are specific to the design codes and environmental/operating conditions of their respective origin.

8 Reference: Exhibit B-1, Page 23

> While FBC would have preferred to also conduct an inspection of the embedded parts[25] of the spillway gates, this is not possible due to the Corra Linn Dam's design, which makes it challenging to isolate and dewater the spillway gates. In order to assess the extent and type of rehabilitation required, FBC used the results from the inspection of the embedded parts of the spillway gates at another plant which FBC considers to be comparable to the Corra Linn Dam, based on spillway gate size, design and age. The dam used as a proxy for the embedded parts inspection is approximately 12 years newer than the Corra Linn Dam, therefore more corrosion

> may exist on the embedded parts at the Corra Linn Dam. This site was chosen because maintenance was underway and one of the gates was fully isolated, making a detailed inspection of the embedded parts, which are typically submerged in water, possible.
>
> The general conclusion from the inspection is that there was heavy corrosion observed in most areas in contact with water.

8.1 At what other plant did FBC conduct the inspection as a proxy for Corra Linn?

<u>Response:</u>

FBC does not have permission of the dam owner to publicly disclose the site used as an inspection proxy for the Corra Linn Dam embedded parts.

8.2 Are there any other material differences other than age which would factor into the corrosion levels? Please explain.

<u>Response:</u>

Yes, there are other factors influencing corrosion levels on the embedded parts, such as:

1. Gate usage;
2. Gate construction material;
3. Quantity and debris type in the water;
4. Water quality (i.e., the presence of corrosive elements and bacteria in the water); and
5. Differing maintenance practices.

FBC considers the Corra Linn Dam site and the proxy site to have sufficient similarities to allow meaningful comparisons to be made.

8.2.1 If yes, please provide a discussion of these differences and how they might result in different corrosion levels in Corra Linn.

Response:

1. Gate usage: Corrosion is accelerated when exposed to wet/dry cyclic exposure. For gates that are frequently opened, these embedded parts are subjected to a frequent and cyclic wet/dry condition, which can accelerate corrosion. FBC does not anticipate major differences in corrosion between the Corra Linn Dam and the proxy dam due to this operating condition.

2. Gate construction materials: Differences in steel quality and composition may affect corrosion rates. FBC does not anticipate major differences in corrosion between the Corra Linn Dam and the proxy dam due to differences in steel composition or quality.

3. Quantity and type of debris in the water: Impacts between the embedded parts and debris entrained within flowing water may wear away protective coatings, increasing corrosion. The Corra Linn dam is located on a similar river system to the proxy dam and, as such, both dams would be subjected to a similar quantity and type of debris. FBC does not anticipate any differences in corrosion levels due to debris.

4. Water quality: Water pH levels, the presence of corrosive chemicals (such as chlorides and sulphates) and certain types of bacteria within the water (specifically sulphate reducing and Fe/Mn oxidizing bacteria) can affect the corrosion rate of steel structures. The Corra Linn Dam is located on a similar river system to the proxy dam and, as such, both dams would be subjected to a similar array and concentrations of chemical components and bacteria. FBC does not anticipate any differences in corrosion levels due to water quality.

5. Differing maintenance practices: Variances in maintenance and inspections due to accessibility issues may contribute to differences in corrosion levels of the embedded part. FBC does not anticipate any differences in corrosion levels between the Corra Linn Dam and the proxy dam due to maintenance practices as both dams having similar issues regarding accessibility.

9 Reference: Exhibit B-1, Pages 26 and 32

4.2.3 Alternative 3: Gate Refurbishment

Alternative 3: Gate Refurbishment would include: refurbishment of the spillway gates structure, painting of all exposed steel to provide corrosion protection, replacement of the roller bushings, rehabilitation of the embedded parts,[28] refurbishment of the spillway gate hoists, reinforcement of the towers and bridges that support the spillway gate hoist, and upgrades to the power distribution and control systems for the spillway gates.

The Gate Refurbishment alternative would retain the majority of the spillway gate structure, with repairs and replacements to the various structural components of the spillway gate being done as needed. Each spillway gate would be thoroughly inspected to identify damage, determine the reduction in skin plate thickness and to determine the actual surface area to be repaired. Repairs would be completed through the removal of damaged or corroded areas and the addition of similar components such as structural steel shapes and structural steel plates. The actual percentage of skin plate replacement would vary from gate to gate. To increase the

spillway gate capacity and to increase the stiffness to meet the strength required, the addition of new structural steel components would also be required; these additions would include both new horizontal and vertical structural members.

The associated spillway gate equipment would also be inspected to determine the actual condition, and repairs or replacement undertaken to upgrade the original design to meet current day design requirements.

4.2.4 Alternative 4: Gate Replacement

Alternative 4: Gate Replacement would include the construction of 14 new gates. The new gates would be manufactured offsite in a factory environment to present day design requirements. The existing embedded parts would be inspected and repaired or upgraded as required to support the new spillway gate. The towers and bridges that support the spillway gate hoist would require reinforcement. The spillway gate hoists would be inspected to determine the actual condition and any repairs or replacement would be done to upgrade the original design to meet current day design requirements. In addition, upgrades to the power distribution and control systems for the spillway hoists would be completed.

- Replacement would provide the most reliable flow control system of the identified alternatives through replacing aging and obsolete equipment significantly reducing the risk of future spillway gate failures (Criteria 4);
    - This approach would replace the entire spillway gate with a new gate and would therefore fully incorporate the 85 years of engineering development that has occurred since the original gate construction;

9.1 Did FBC consider an alternative of conducting further inspections prior to making a determination regarding Replacement or Refurbishment? Please explain why or why not.

Response:

FBC considers that it has conducted sufficient inspections required to make a determination regarding either Spillway Gate Replacement or Refurbishment. As indicated in the Application and Appendix F of the Application, thorough inspections of all the key components, excluding the embedded parts, were conducted at the Corra Linn Dam by both FBC and external specialist consultants. With respect to the embedded parts, an inspection was completed at a similar facility by both FBC and external consultants.

9.2 Would it be feasible to replace some of the spillway gates and refurbish others? Please explain why or why not.

Response:

It is possible to replace some spillway gates and refurbish others. However, FBC has determined that full implementation of Alternative 4: Gate Replacement is the preferred option due to the inherent disadvantages associated with refurbishing only some or all of the spillway gates, as summarized below:

1. Complete gate replacement is the only alternative that achieves each of the four technical criteria set out for the Project, as summarized in Table 4-1 of Section 4.3.1.5.
2. As outlined in Table 4-2 of Section 4.3.1.5, over a 70 year period, replacing the gates is the most cost effective solution.
3. Refurbishing the gates would not alleviate the disadvantages outlined in Section 4.3.1.3 of the application, including:
   a. Complex construction methods required for the gate refurbishment, which could negatively impact the construction schedule;
   b. The actual condition of the 14 gates cannot be ascertained until the gates are fully removed from service, and therefore, increased project scope could result;
   c. Environmental risks due to the in situ removal of lead paint;
   d. Safety risks associated with work being conducted above or in close proximity to water; and
   e. Cost variances resulting from the above factors.

4. Latent defects may remain following refurbishment of the components (please refer to the response to CEC IR 1.10.1 for further information regarding latent defects).

As noted in the response to BCUC IR 1.4.2, Refurbishment of the spillway gates would still require replacement within approximately the next 15 years.

9.2.1 If yes, did FBC consider such an alternative and please explain why or why not.

Response:

Please refer to the response to CEC IR 1.9.2.

10 Reference: Exhibit B-1, Page 31

> electrical power supply, hoists and towers (Criteria 4), however, there is the potential for latent defects to remain following refurbishment[35]; and
>
> - Maintenance would be simplified through the installation of low maintenance equipment.
>
> [35] the skin plate stresses are inversely proportional to the square of the thickness and significantly increase as the material loss increases

10.1 Please elaborate further on the latent defects that could remain and explain how these could affect the integrity of the dam.

Response:

Potential latent defects in the refurbished gates include any undetected effects caused by pre-existing corrosion on structural components leading to material loss and eventual loss of strength that could cause fatigue failure in the main structural members of the gate. Further details are provided below:

- Corrosion:
  - Gate and tower inspections (Confidential Appendix F of the Application) have noted corrosion and subsequent material loss on many structural components. Although the refurbished gate will be sandblasted and painted, the refurbished gate will still largely comprise of the original main structural members (refer to Section 4.2.3, page 26 lines 26 to 28 of the Application). Structural members with pre-existing corrosion related material loss that are deemed acceptable during the refurbishment will most likely have higher than designed stress levels making them more susceptible to failure. These members would also be more susceptible to additional corrosion caused by any failures of the coating systems (from coating defects and/or impacts with debris).
- Fatigue:
  - The refurbished gate will still largely comprise of the original main structural members (refer to Section 4.2.3, page 26 lines 26 to 28 of the Application). Eventual failure of these members from fatigue is likely given the age of the gates. It is noted by the US Army Corps of Engineers (USACE), which operates and maintains approximately 700 dams, that “several USACE structures [hydraulic gates such as spillway gates and navigation gates] have exhibited fatigue and fracture failures, and many others may be susceptible to fatigue and

fracture problems" (refer to the USACE publication EM 1110-2-6054 Inspection, Evaluation and Repair of Hydraulic Steel Structures).

10.2 Please confirm or otherwise explain that Maintenance would also be simplified in Alternative 4.

Response:

Maintenance will be simplified in Alternative 4 because of the low maintenance requirements of the new gate main rollers as described in Section 4.3.1.4 Alternative 4 (Gate Replacement) and Section 5.1.1 Details of the Replacement Spillway Gates. The most frequent maintenance requirement would be the greasing of the main roller anti-friction bearings, which would be performed via a centralized greasing lubrication station located at the gate deck level. This easily accessible lubrication station will eliminate the need to climb down the spillway gate or raise the spillway gate to access the individual main roller lubrication port. Please also refer to the response to BCUC IR 1.1.3 in which FBC notes that O&M costs are not expected to be materially impacted by the Project.

11 Reference: Exhibit B-1, Page 31

Disadvantages:

- The Project risks related to unexpected conditions are highest for this alternative (Criteria 3). Project risks would include:
  - The schedule could be negatively impacted because the construction method is expected to be more complex due to refurbishment activities of the spillway gates that are required to be undertaken in the field;
  - The Project scope could potentially be impacted once the actual extent of refurbishment work required is determined; the potential for scope variation during the construction period is more likely because the condition of each gate cannot be confirmed until it is be removed from service and inspected. While this risk is partially mitigated by the inspections done on three of the Corra Linn spillway gates, there continues to be uncertainty associated with each individual spillway gate and hence to the overall required refurbishment scope.
  - Refurbishment of the gates in situ requires removal of lead paint, repainting, and millwork in close proximity to or immediately above water and would require environmental mitigation measures;
  - Refurbishment of the gates in situ increases the safety risk to workers because this work would be performed at locations above or in close proximity to water or in constrained areas that are not easily accessible (i.e. the lower bay of the gate which is 1.1 m high and 1.4 m deep and where a significant amount of reinforcing steel would need to be installed). As a result, these activities would require extensive temporary scaffolding and associated complex work procedures; and
  - Cost variances could result from any of the above factors.
- It is expected that this alternative would extend the expected life of the existing gate by approximately 11-25 years, therefore replacement of the spillway gates would need to be considered within the next 15 years.

11.1 Please confirm that the project scope under Alternative 3 could be reduced if the gates are in better condition than anticipated, and that cost variances could result in significantly lower costs than presently anticipated.

<u>Response:</u>

The project scope under Alternative 3 could be reduced if the gates are in better condition than anticipated. Please refer to the response to Gabana IR 1.9.

As noted in Section 3.2.3 of the Application, FBC conducted detailed inspections on three spillway gates. The inspections indicated that the three spillway gates were in similar, fair to poor condition (line 21 and 22). Considering the results of the inspection, the similarity of the spillway gates and the current age of the gates, FBC considers the gates to be approaching end of life and does not anticipate that the remaining, uninspected gates will be in substantially different condition (better or worse) than as described in the Application.

11.2 What is the cost variance that could occur under a best case scenario with Alternative 3? Please quantify and provide both a figure and a percentage cost difference.

Response:

Please refer to the response to Gabana IR 1.9.

11.3 What is the cost variance that could occur under a worst case scenario with Alternative 3? Please quantify and provide both a figure and a percentage cost difference.

Response:

Please refer to the response to Gabana IR 1.9.

12 Reference: Exhibit B-1, Pages 3 and 35

To further compare the two feasible alternatives, a financial criterion of minimizing the financial impacts of the Project was used. While Alternative 3: Gate Refurbishment had lower initial capital costs than Alternative 4: Gate Replacement, this did not take into account the fact that the existing gates are 84 years old, and that, even with extensive refurbishment, the current gates are likely to need replacement by 2032, when they will be 100 years old. Taking into account the refurbishment costs and the estimated capital costs associated with this replacement in 2032 associated with Alternative 3: Gate Refurbishment, Alternative 4: Gate Replacement minimizes the financial impacts of the Project and is the most long term cost-effective solution.

Table 4-2: Comparison of Initial Capital Costs between Alternative 3 and 4 ($ millions)

	Alternative 3: Gate Refurbishment		Alternative 4: Gate Replacement	
	2015 $	As-Spent $	2015 $	As-Spent $
Engineering	2.492	2.665	2.349	2.506
Supply, Installation & Testing	20.278	21.687	18.098	19.302
Site-Support Work	7.732	8.269	9.443	10.071
Indirect Costs	0.720	0.770	0.624	0.666
Project Management	6.375	6.818	4.322	4.610
Subtotal Construction	*37.596*	*40.209*	*34.837*	*37.155*
Removal Cost[39]	-	-	5.331	5.804
Construction Contingency	2.255	2.412	2.008	2.148
Subtotal Construction & Removal	*39.851*	*42.620*	*42.177*	*45.108*
FBC – Project Management	2.920	3.155	2.920	3.155
Generation Admin Overhead	0.543	0.589	0.543	0.589
Project Contingency[40]	6.497	6.955	6.846	7.328
Pre-Approval Project Costs[41]	1.062	1.081	1.062	1.081
Subtotal (incl. Construction & Removal)	*50.873*	*54.400*	*53.548*	*57.260*
AFUDC	n/a	5.394	n/a	5.434
TOTAL Project Capital Costs	***50.873***	***59.794***	***53.548***	***62.694***

12.1 Please confirm that Alternative 3 has a greater likelihood of changes in Project Scope than Alternative 4.

Response:

As described in Section 4.3.1.3 of the Application, FBC does consider Project risks to be highest for Alternative 3; however, FBC considers the change to the project scope an unknown risk. As noted on page 61 of the Application, and in the response to CEC IR 1.12.1.1, FBC has established a contingency for those unknown risks to account for possible scope changes or unknown future events which cannot be anticipated and which were not quantified in the risk register.

12.1.1 If confirmed, please explain why the Project contingency is larger for Alternative 4 than it is for Alternative 3, given that Alternative 3 has greater likelihood of changes in project scope.

Response:

Please refer to the response to CEC IR 1.12.1 and BCUC IR 1.3.2.1. As stated in response to CEC IR 1.12.1, the project scope risk is considered to be an unknown risk. FBC could not quantify the unknown risks for Alternatives 3 and 4 because they cannot be identified at this point in time, and therefore, to determine the Total Project Contingency, FBC instead selected a 15% contingency to be applied to both Alternatives. The 15% contingency was applied to the sum of the Total Construction & Removal Costs, FBC Project Management Costs, and the Generation Admin Overhead (i.e. Line 2, 4, and 5, respectively, of Table 4-2 of the Application). A larger Total Project Contingency amount resulted for Alternative 4 since it has a higher total Construction & Removal Cost.

While Alternative 3 has a smaller “Total Project Contingency” in dollar value, which is $6.955 million for Alternative 3 vs. $7.328 million for Alternative 4 (i.e. Line 8 of the Table 4-2), it has a larger Construction Contingency than Alternative 4 due to the potential for the identified known risks to materialize during construction (i.e. Construction Contingency is shown as $2.412 million as-spent for Alternative 3 vs. $2.148 million as-spent for Alternative 4). As described in the response to CEC IRs 1.19.1 and 1.19.2, the Construction Contingency is based on the known risks more likely to be held by the contractor under an ECI model and as identified in Risk Register (Confidential Appendix H).

The following Table shows the calculation of the 15% Project Contingency and the breakdown of all contingencies applied to both Alternatives.

Portions of Table 1 are being filed confidentially under separate cover as it contains financial information and contingency details that are based on certain identified Project risks. The public disclosure of this financial information could inform contract bidders, and could result in higher bids and higher total costs than may otherwise be achieved.

Table 1

Line	Particulars	Reference	Alternative 3: Gate Refurbishment		Alternative 4: Gate Replacement	
			2015 $	As-Spent $	2015 $	As-Spent $
1	Construction Contingency (Contractor's Known Risks)	Confidential Appendix H: Risk Register	2,255	2,412	2,008	2,148
2	Total Construction & Removal Costs	Table 4-2 of Application	39,851	42,620	42,177	45,108
3						
4	FBC - Project Management	Table 4-2 of Application	2,920	3,155	2,920	3,155
5	Generation Admin Overhead	Table 4-2 of Application	543	589	543	589
6	Total of Construction & Removal, FBC Project Management, and Generation Admin Overhead	Sum of Line 2 to Line 5	43,314	46,364	45,640	48,851
7						
8	TOTAL Project Contingency	15% of Line 6	6,497	6,955	6,846	7,328
9	Construction Contingency (FBC's Known Risk)	Confidential Appendix H: Risk Register	[redacted]	[redacted]	[redacted]	[redacted]
10	FBC Owner's Project Contingency (Unknown Risks)	Line 8 - Line 9				
11						
12	**Project Contingency Breakdown**					
13	Construction Contingency (Contractor's Known Risks)	Line 1	2,255	2,412	2,008	2,148
14	Construction Contingency (FBC's Known Risk)	Line 9	[redacted]	[redacted]	[redacted]	[redacted]
15	TOTAL Construction Contingency	Line 13 + Line 14	[redacted]	[redacted]	[redacted]	[redacted]
16	FBC Owner's Project Contingency (Unknown Risks)	Line 10				
17	TOTAL Contingency	Line 15 + Line 16	8,752	9,366	8,854	9,476

12.2 Please identify where in the application the costs associated with the possible need for replacement are evaluated and accounted for financially.

Response:

The costs associated with the possible need for replacing the existing gates in year 2032 for Alternative 3 are discussed in Section 4.3.2 of the Application (page 36, lines 19 to 21, and footnote 43). The estimated capital cost for installing new gates by year 2032 for Alternative 3: Gate Refurbishment is estimated to be $33.723 million (as-spent) and $7.729 million for removing the existing gates. The net present value of the incremental revenue requirement over 70 years for Alternative 3: Gate Refurbishment is shown in Table 4-3 and equals $105.808 million, which includes the cost of installing the new gates in 2032. Alternative 3 is approximately $21 million higher in present value revenue requirement than Alternative 4.

13 Reference: Exhibit B-1, Page 45

> **5.3.1 Contractor Selection and Award**
>
> Given the specialized nature of the Project, the Company is evaluating the merits of an alliance agreement with a contractor, as compared to using a traditional Design Build tender. Under this approach, the contractor is selected based on qualifications, experience and reputation. This process makes the contractor a member of the collaborative Project team, centralizing responsibility for design and construction under one contract, creating transparency in risk allocation, and leveraging the experience of the contractor to reduce schedule and cost. The Project achieves competitive market rates by tendering various construction and supply agreements, which are then subsequently evaluated and awarded by the collaborative Project team.
>
> Alternatively, the Company may select a contractor based on a more traditional tender process.

13.1 When will FBC make its determinations with respect to the 'Alliance' agreement or the Design Build tendering process?

Response:

Please refer to the response to BCUC IR 1.2.9.

13.2 What criteria will FBC use to determine the best methodology?

Response:

Please refer to the response to BCUC IR 1.2.3. As noted in that response, FBC is not contemplating a contractor alliance model but an ECI model.

A contracting model has not been selected for the Project; however FBC intends to further evaluate the merits of the ECI model by reviewing the financial capabilities, qualifications, performance and the safety and environmental record of the ECI contractor using standard FBC pre-qualification criteria for large contractors. If the contractor satisfies all of the pre-qualification criteria, FBC intends to conduct due diligence on works previously completed by the contractor for similar type works in Canada.

13.3 Has FBC utilized the alliance approach before?

Response:

Please refer to the response to BCUC IR 1.2.3. As noted in that response, FBC is not contemplating a contractor alliance model but an ECI model.

FBC has not used the ECI model that is described in the response to BCUC IR 1.2.3 before for construction projects. Given the specialized nature of the Project, this approach was chosen to leverage the experience of the contractor to reduce variations in schedule and cost.

13.3.1 If yes, please explain when this approach has been used and provide a discussion as to FBC's views of its cost-effectiveness.

Response:

Please refer to the responses to CEC IRs 1.13.2 and 1.13.3 and BCUC IR 1.2.3.

13.4 Please outline the differences in the activities that are performed by an Alliance partner versus a contractor selected through the tendered Design Build process.

Response:

Please refer to the response to BCUC IR 1.2.3.

13.5 Please outline the advantages and disadvantages of the two methodologies.

Response:

Please refer to the response to BCUC IR 1.2.3.

13.6 Would FBC agree that a tendering process is intended to select a contractor with the best mix of cost-effectiveness, qualifications, experience and reputation from several qualified alternatives?

Response:

FBC agrees that a tendering process is intended to select a contractor with the best mix of cost-effectiveness, qualifications, experience and reputation from several qualified alternatives. However, there are several benefits to implementing an ECI model for the Corra Linn Spillway Gate Replacement Project, as described in the response to BCUC IR 1.2.3.

13.6.1 If not, please explain why not.

Response:

Please refer to the response to CEC IR 1.13.6.

13.7 Would FBC agree that the selection of an 'alliance contractor' could result in greater costs than might be achieved under the tendering process? Please explain why or why not.

Response:

No, FBC does not agree. Please refer to the responses to BCUC IRs 1.2.3 and 1.2.3.3.

13.8 Are there regulations or other stipulations that FBC typically or is required to follow that recommend or require a tendering process for large contracts?

Response:

No, there are no governing regulations or stipulations that require FBC to undertake a tendering process for large contracts.

13.8.1 If yes, please identify the rules/regulations that recommend or require a tendering process for large contracts and provide access to those regulations either by way of website link or other means.

Response:

Please refer to the response to CEC IR 1.13.8.

13.9 How does an Alliance partner reduce FBC expenditures relative to the Design Build tendering process?

Response:

Please refer to the response to BCUC IR 1.2.3.

13.10 Does FBC have an "Alliance" partner identified already?

Response:

Please refer to the response to BCUC IR 1.2.3.

13.10.1 If yes, who is the anticipated 'Alliance' partner?

Response:

Please refer to the response to BCUC IR 1.2.3.

13.10.1.1 Is there any reason why the anticipated Alliance partner selected might not win in a Design Build tendering process? Please explain.

Response:

Please refer to the response to BCUC IR 1.2.3. As noted in that response, FBC is not contemplating a contractor alliance model but an ECI model.

No, there are no reasons why a prospective ECI partner might not win a Design Build tendering process. Please also refer to the responses to BCUC IR 1.2.5.

13.10.2 If no, how will FBC select the 'Alliance' partner?

Response:

Please refer to the response to CEC IR 1.13.10.1.1.

14 Reference: Exhibit B-1, Pages 49 and 59

5.5.1 Project Management

FBC will assign a Project manager who will manage the construction contractor on a daily basis throughout the Project. An FBC Construction Manager will lead the Project site team and is accountable to the FBC Project manager for all aspects of construction. The Construction Manager will have support for each of the following disciplines: contract administration, administrative support including document control, safety audits and environmental monitoring. In order to minimize disruptions with operations and to have clear communications between the Project team and the operation team, an operations liaison will be assigned to the Project.

The construction contractor will also have a Project management team composed of qualified personnel including a Project manager, discipline Project engineers, a superintendent, a construction safety officer, a shop quality inspector and other support personnel. The Contractor Project manager and Project engineers will be involved from the beginning of the Project to also manage the engineering and procurement phases before mobilization on site.

Table 6-1: Summary of Estimated Project Capital Costs ($ millions)

	2015 $	As-Spent $
Contractor's Costs		
Engineering	2.349	2.506
Supply, Installation & Testing	18.098	19.302
Site-Support Work	9.443	10.071
Indirect Costs	0.624	0.666
Project Management	4.322	4.610
Subtotal	*34.837*	*37.155*
Removal Cost[50]	5.331	5.804
Construction Contingency	2.008	2.148
Total Contractor Costs	*42.177*	*45.108*
FBC Owner's Costs		
FBC – Project Management	2.920	3.155
Generation Admin Overhead	0.543	0.589
Project Contingency[51]	6.846	7.328
Pre-Approval Project Costs	1.062	1.081
Subtotal (Contractor & Owner's Costs)	*53.548*	*57.260*
AFUDC	n/a	5.434
TOTAL Project Capital Costs	*53.548*	*62.694*

14.1 Please confirm that FBC owners' costs including project management and general admin are included in the CPCN costs, and are therefore tracked outside of PBR.

Response:

Confirmed. All of the owners' costs identified in Table 6-1 are specific to this Project; therefore, they do not impact the formula capital envelope and are tracked outside of the PBR formula.

14.2 Are the 'FBC owner's costs' expenditures that would normally be covered by or tracked within PBR formulaic spending?

Response:

As stated in the response to CEC IR 1.14.1, all of the owners' costs identified in Table 6-1 are specific to this Project. These are not costs that would normally be included in the formula capital expenditures envelope.

14.3 If so, how does FBC adjust its formulaic O&M and capital spending under PBR?

Response:

Please refer to the response to CEC IR 1.14.1. No adjustments to formulaic O&M or capital expenditures are required.

14.4 How is the Project Contingency treated under PBR, to the extent that contingency covers costs that would otherwise be covered by the PBR formulaic spending allowance? Please explain.

Response:

All of the contingency costs identified in Table 6-1 are specific to this Project. None of these costs impact the formula capital spending and therefore they are tracked outside of the PBR formula.

15 Reference: Exhibit B-1, Pages 51 and 52

5.7.2 Risk Identification Planning

The risks were identified through a collaborative process between HMI and FBC. The first step of the process was the identification of the general risks categories that are applicable to the various phases of the Project. These categories are: design, procurement, fabrication, construction, environment and transportation. A comprehensive list of risks was then identified in each category. This list forms the basis of the risk register. The next step of the process was to establish the context for the risk identification in terms of:

- Proposed mitigation measure;
- Risk likelihood and consequence scales; and
- Responsibility for each risk (FBC or Contractor).

The appropriate risk likelihood and consequence (probability and exposure) scales relevant to the Project are based on the 5x5 risk assessment matrix recommended in the AACE 62R-11 illustrated in the following figure.

FBC then allocated the responsibility for each risk to either FBC or a contractor using the principle that risks are typically allocated to the party best able to manage a particular risk. The concept behind this principle is based on the fact that the party that manages the risk must also bear the financial cost, so as to provide that party an incentive to mitigate the risk.

15.1 Please confirm or otherwise explain that the responsibility for each risk, either FBC or Contractor would not necessarily have to change under either the Alliance option or the tendered Design Build option.

<u>Response:</u>

Please refer to the responses to BCOAPO IRs 1.10.1 and 1.10.2.

15.2 If not confirmed, please explain which option is being presented as the default option in this application.

Response:

Please refer to the responses to BCOAPO IRs 1.10.1 and 1.10.2. The ECI model, as described in the response to BCUC IR 1.2.3, is being presented as the default option for this Project.

16 Reference: Exhibit B-1, Pages 56 and 57

> In the case of BC Hydro, HMI successfully responded to an international call for tender for the first phase of BC Hydro's Spillway Gate Rehabilitation Program. The first phase consisted of the rehabilitation of three spillways. After successfully completing the first phase of this project, HMI was then selected by BC Hydro for the rehabilitation of BC Hydro's remaining 19 sites including inspection, design, procurement as well as implementation. To date, HMI has completed spillway gate rehabilitation work at several of the BC Hydro dams; several of which are similar to the scope of work at the Corra Linn Dam with increased seismic loads.

16.1 Please confirm that FBC did not issue a call for tender for HMI's present roll in this this application.

Response:

Confirmed.

17 Reference: Exhibit B-1, Page 58

1. Front End Engineering costs have been included for all mechanical, electrical and civil components of the Project scope.
2. Supplies and fabrications costs have been evaluated based on HMI database prices which are premised on recent awarded tenders.
3. Transportation costs have been evaluated by allocating transportation costs to all the supplies and fabricated items to be delivered to site.
4. Construction costs have been evaluated based on HMI's experience and are composed of the following costs:
   i. Direct labor, which was estimated in detail for each activity part of the WBS. Labor cost is calculated on the number of hours per trade times the associated labor rate;
   ii. Supervision costs, which was evaluated as a percentage of the direct labor based on construction industry standards;
   iii. Lifting equipment, which was evaluated based on the various scenarios; and
   iv. Temporary access equipment such as scaffolding and temporary roads, which was evaluated based on the various scenarios analyzed.
5. Site establishment costs are composed of the equipment and temporary installations required to support construction. Site trailers, rest rooms, etc. were evaluated based on the number of workers estimated for the work and the duration of the work on site.
6. Commissioning and Start-up costs were evaluated based on HMI's experience and are mainly composed of the personnel, equipment and tools required for performing dry testing and wet testing activities.
7. Quality Assurance and Quality Control costs were evaluated based on the Project team's experience with other similar type projects. They involve shop inspections, laboratories (shop and site) and consultants required to ensure the delivery of a quality product.
8. Financial costs such as bonding and insurance have been included.
9. Project Management and Owner costs have been based on the proposed organizational chart, list of deliverables and contractual deliverables.

17.1 Are the 'recent awarded tenders' those tenders that HMI has awarded?

Response:

Yes, the 'recent awarded tenders' are tenders that HMI awarded for other similar projects.

17.1.1 If not, please clarify.

Response:

Please refer to the response to CEC IR 1.17.1.

17.1.2 If so, please provide the practices and criteria that HMI uses to award its tenders.

Response:

HMI has confirmed the following response:

HMI's practices and criteria to award tenders are similar to those of any contracting firm. First a determination is made of work that can be performed using internal resources and subcontracting the rest. HMI's capacity to perform work in a certain area depends on the location and availability of supervision. For the work to be subcontracted the work is generally split into work/bid packages. The bid packages (Request for Quotations) are sent to a list of qualified suppliers and subcontractors (which were previously pre-qualified for, among other things, quality, financial soundness, past performance and ability to deliver on time). The bids are then evaluated using common and standard evaluation criteria with the most important being lowest price for equivalent quality. A determination is then made to enter into a contract or a PO based on the value of contract, risk and schedule, amongst other considerations.

17.1.3 What steps, if any, has FBC taken to verify the cost-effectiveness of HMI's estimates relative to the market?

Response:

The cost estimate was prepared based on AACE Class 3 specifications as defined by AACE International Recommended Practice No 69-R12 and in accordance with CPCN Guidelines by both FBC and HMI who is a qualified engineering and construction firm. If an estimate qualifies as an AACE Class 3 estimate it reflects current market prices and has been validated.

17.1.4 Please provide the total dollar value of the estimates that have been made based on HMI's experience and database

Response:

The total dollar value of the Project AACE Class 3 cost estimate provided by HMI is $42.177 million (2015$) (see Table 6-1 of the Application).

18 Reference: Exhibit B-1, Pages 60 and 61

To determine the Project contingency, a risk register (Confidential Appendix H) as described in Section 5.7 was established by FBC and HMI collaboratively for the risk elements that could be identified for the Project. These risks are commonly termed known risks and they were identified based on HMI's extensive experience in recent similar spillway rehabilitation work in the Province and FBC's experience on past projects. Examples of these known risks are: delay in obtaining necessary permits/approvals, unforeseen conditions of embedded structure, parts and concrete, unforeseen project management resourcing requirements, construction delays and re-work.

Table 6-3: Format of Risk Register Established for Project

Probability rating (1 to 5)	Impact rating (1 to 5)	Overall Risk Level (1 to 25)	Estimated Financial impact of risk event ($)	Amount to add to project contingency (prob x cost)
Estimate based on experience and analysis	Estimate based on experience and analysis	*Probability rating* x *Impact rating*	HMI estimate based on experience and current analysis	*Probability (%)* x *Estimated Financial impact ($)*

18.1 Is HMI able to provide evidence of a strong track record in appropriately estimating project contingencies?

Response:

HMI is unable to disclose specific contingency estimates and actuals from other projects that it has been involved in because of the confidentiality of their customers' information. However, HMI is an established engineering and construction firm that has successfully executed complex projects in the past that are similar to the Corra Linn Project. FBC selected HMI to complete the AACE class 3 estimate based on their current experience with BC Hydro as explained in the Application, Section 6.1. HMI was first selected by BC Hydro in 2008 with the contract extended in 2010 and again renewed in 2016. FBC also sought the opinion of the consulting firm Hatch Ltd. whose personnel have worked closely with HMI over the past 10 years on the BC Hydro's spillway gate project. Hatch confirmed the technical and design capabilities of HMI.

18.1.1 If yes, please provide.

Response:

Please refer to the response to CEC IR 1.18.1.

18.1.2 If no, why not?

Response:

Please refer to the response to CEC IR 1.18.1.

19 Reference: Exhibit B-1, Pages 59 and 61

Table 6-1: Summary of Estimated Project Capital Costs ($ millions)

	2015 $	As-Spent $
Contractor's Costs		
Engineering	2.349	2.506
Supply, Installation & Testing	18.098	19.302
Site-Support Work	9.443	10.071
Indirect Costs	0.624	0.666
Project Management	4.322	4.610
Subtotal	*34.837*	*37.155*
Removal Cost[50]	5.331	5.804
Construction Contingency	2.008	2.148
Total Contractor Costs	*42.177*	*45.108*
FBC Owner's Costs		
FBC – Project Management	2.920	3.155
Generation Admin Overhead	0.543	0.589
Project Contingency[51]	6.846	7.328
Pre-Approval Project Costs	1.062	1.081
Subtotal (Contractor & Owner's Costs)	*53.548*	*57.260*
AFUDC	n/a	5.434
TOTAL Project Capital Costs	*53.548*	*62.694*

The risk register also determined which of these known risks are most likely held by a contractor and the financial impacts of these contractor related risks. The sum of these financial impacts were included to the construction cost as contingency (i.e. Construction Contingency) in the AACE Class 3 cost estimate developed by HMI (Confidential Appendix L). This contingency is also shown in Table 6-1 above as Construction Contingency. All of the other known risks identified in the risk register that are not to be held by a contractor will be likely held by the owner (owner's known risks). The financial impact of these owner's known risks was included to the Project Contingency shown in Table 6-1 of Section 6.3.1 above.

19.1 Why is the Construction Contingency less than 5% of the Contractor's costs, when the project contingency is over 12% of the total project cost? Please explain and provide quantification where available.

Response:

To clarify, the Construction Contingency amount included in Table 6-1 of the Application is specific to the known risks identified in the risk register (Confidential Appendix H) that are presumed to be held by the contractor. The Construction Contingency amount does not account for all known risks. Please refer to the response to CEC IR 1.19.2 for a summary of the total contingency amounts related to known risks.

The Construction Contingency is appropriately less than the Project Contingency as it is specifically for known construction risks related to the Project and presumed to be held by the contractor under an ECI model. This amount (Construction Contingency) is 5% of the Contractor Costs shown in Table 6-1 and the cost estimate provided as Confidential Appendix L. The Project Contingency (discussed in Section 6.3.1.2 of the Application and in the response to BCUC IR 1.3.2.1) is higher because it is comprised of contingency to account for unknown risks applicable to the Project and the portion of known risks presumed to be held by the Owner. Please refer to BCUC IR 1.3.2.1 for details about how the Project Contingency is determined.

19.2 Is it typical for the Construction Contingency to be less than a quarter of the overall project contingency? Please explain and provide examples from other construction projects.

Response:

Please refer to the response to CEC IR 1.19.1.

As discussed in Section 6.3.1.2 of the Application and also shown in the preamble to the question, the Risk Register identified which of the known risks are presumed to be held by the contractor and which are presumed to be held by the owner under an ECI model. The portion of known risks estimated to be held by the contractor totals $2.148 million as-spent and is titled "Construction Contingency" under Contractor's Costs in Table 6-1 of the Application. The portion of known risks that are estimated to be held by the owner is embedded in the "Project Contingency" under FBC Owner's Costs, shown in Confidential Table 1 below.

Accounting for all known risks, as shown in the table below, the Total Construction Contingency for the Project is approximately 41% of the overall Total Contingency for the Project, which is not less than a quarter as suggested by the question. FBC considers the Construction Contingency as determined by the risk register to be appropriate.

Portions of the Table are being filed confidentially under separate cover as it contains financial information and contingency details that are based on certain identified Project risks. The public disclosure of this financial information could inform contract bidders, and could result in higher bids and higher total costs than may otherwise be achieved.

Table 1

Table CEC IR 1.19.2a	As-spent ($ million)	Percent (%)
Construction Contingency (known risks) (Contractor)	$2.148	[redacted]
Construction Contingency (known risks) (FBC)	[redacted]	[redacted]
TOTAL Construction Contingency	[redacted]	**41%**
FBC Owner's Project contingency (unknown risks)	[redacted]	[redacted]
TOTAL Contingency	**$9.476**	**100%**

Note: Project Contingency as shown in Table 6-1 of the Application is the sum of the FBC Construction Contingency (known risks) and the FBC Owner's Project contingency (unknown risks) as shown in the table above.

Previous FBC CPCN applications for construction related projects did not utilize a risk register to develop the contingency amounts and as such did not separate the contingency into known and unknown components.

20 Reference: Exhibit B-1, Page 61

> It is worthwhile noting that there is no AACE standard that outlines the "correct" or "appropriate" level of contingency to include in a project. There are studies however, that suggest an appropriate contingency for projects with high complexity and medium technology in the process industry[55] and in 2014 AACE published a technical paper which presented a case study of estimating in the Canadian Hydropower Industry indicating that contingency and reserves estimated were lower than required[56].
>
> [55] Hollmann, J. "Improve Your Contingency Cost Estimates For More Realistic Budgets", Chemical Engineering, Dec 2014. http://www.chemengonline.com/improve-your-contingency-estimates-for-more-realistic-project-budgets/?printmode=1.

20.1 The CEC is unable to access the cited document. Please indicate what the appropriate contingencies might be, and provide copies of the articles.

Response:

The contingency applied to the Project is appropriate and the methodology used is outlined in Section 6.3.1.2.

The cited document is proprietary and is available to members of a chemical engineering organization.

http://www.chemengonline.com/improve-your-contingency-estimates-for-more-realistic-project-budgets/?printmode=1.