

**EXH. RPB-4
DOCKETS UE-22 ___/UG-22 ___
2022 PSE GENERAL RATE CASE
WITNESS: RYAN P. BLOOD**

**BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION**

**WASHINGTON UTILITIES AND
TRANSPORTATION COMMISSION,**

Complainant,

v.

PUGET SOUND ENERGY,

Respondent.

**Docket UE-22 ___
Docket UG-22 ___**

**THIRD EXHIBIT (NONCONFIDENTIAL) TO THE
PREFILED DIRECT TESTIMONY OF**

RYAN P. BLOOD

ON BEHALF OF PUGET SOUND ENERGY

JANUARY 31, 2022

January 29, 2018

**Project No. P-2150
Baker River Hydroelectric Project**

VIA EFILE AND FEDEX

Mr. David Capka, P.E.
Director, Division of Dam Safety and
Inspections
Federal Energy Regulatory Commission
888 First Street NE
Washington, DC 20426

Douglas L. Johnson, P.E.
Regional Engineer
Federal Energy Regulatory Commission
805 SW Broadway, Suite 550
Portland, OR 97205

**Re: BOC Meeting No. 6 (Lower Baker Dam), Plan and Schedule for BOC's
Recommendations**

Dear Mr. Capka and Mr. Johnson:

In accordance with the FERC letter dated April 15, 2013 that authorized the Board of Consultants (BOC) for the Baker River Project, PSE is submitting a plan and schedule to comply with the BOC recommendations resulting from BOC Meeting No.6 for Lower Baker Dam which was held from December 12 to December 14, 2017.

The purpose of BOC Meeting No. 6 was to formally present the findings and interpretations of the geologic, geotechnical, and hydrogeologic studies conducted to date and to get the opinion of the BOC on the adequacy and implications of those findings. The specific questions posed to the BOC and the BOC responses are included in BOC Meeting No. 6 - Final Report (Attachment 1) which PSE received on December 15, 2017.

Recommendations of the BOC have been incorporated into the recommendations log and this is included as Attachment 2. At the recommendation of the BOC the log has been modified to separate those recommendations that have been fully addressed from those that are not yet complete. BOC recommendations from Meeting No. 6 are identified below and the PSE plan and schedule for addressing immediately follow the recommendation.

BOC Recommendation LB-6-1

In section 2.1 and 2.2 of their report, the BOC states that PSE has sufficiently characterized the site geology and hydrogeology sufficiently to determine that:

- a) the seepage through the foundation and abutments is increasing in a stepped fashion with time,
- b) that mitigation of this seepage is required to ensure dam safety and, if unmitigated, could lead to PFM N-LB-6 (foundation leakage, under normal pool destabilizes either rock abutment, leading to loss of arch support, dam failure, and release of the reservoir) or PFM N-LB-7 (foundation leakage leading to internal erosion underneath the dam resulting in

uncontrollable increase in flow rate and release of the reservoir, though the dam may remain intact),

- c) a grout curtain constructed to contemporary standards is the most effective practical solution to mitigate seepage, and
- d) that a grout curtain of the design presented during the BOC meeting, properly designed and executed, will have only transient impacts to the dam foundation during construction and that these would not be of an intensity or magnitude to create a dam safety issue.

PSE Response LB-6-1

PSE takes the above points as a recommendation to pursue the design and, ultimately, the installation of a grout curtain at Lower Baker Dam to mitigate seepage through the foundation and abutments. In anticipation of the BOC recommendation, PSE is working with Shannon & Wilson (S&W) to generate the appropriate design documents to the 60% design level (both drawings and specifications). The design is currently on schedule for a mid-March, 2018 delivery. PSE proposes a potential failure modes analysis (PFMA) on the design be conducted April 4-6, 2018 at the Lower Baker Dam. Representatives from FERC, PSE, and PSE consultants will be encouraged to participate in the session.

Results of the PFMA will be addressed as the design progresses to the 99% design level by the last week of June, 2018. A BOC meeting (No. 7) will be scheduled for the second week of July to review the design effort and, providing the BOC is supportive, PSE will finalize the design and forward to FERC for authorization.

BOC Recommendation LB-6-2

In section 2.3 the BOC states that PSE has sufficiently characterized the site geology and hydrogeology sufficiently to determine that:

- a) attempting to reduce the velocity of the seepage under the dam by filling the forebay depression with aggregate or other similar, non-cementitious medium would not introduce additional hazards to the dam, and
- b) that intervention to reduce the velocity of seepage prior to and during grouting will increase the likelihood of the successful installation of an effective grout curtain.

PSE Response LB-6-2

Once again, PSE takes the above points as a recommendation to pursue the design and execution of measures to reduce flow into the forebay depression. This mitigation measure is an integral part of the larger seepage reduction plan and is being developed concurrently with the grout curtain design. This mitigation measure will follow the design, PFMA, and authorization schedule outlined in the response to LB-6-1.

BOC Recommendation LB-6-3

In section 2.4 the BOC agrees with and adopts the following recommendations proposed by the PSE design team during the BOC meeting:

- a) installation of additional piezometers on the east side of the Left Abutment Block (defined by structures SH2 and C6) to better characterize groundwater conditions and to monitor the effectiveness of any future depressurization measures (i.e., drains),

- b) the institution of LiDAR surveys to monitor and record the amount of rockfall experienced by the left abutment

PSE Response LB-6-3

PSE concurs with the BOC recommendation (LB-6-3a) and has identified a number of boring locations to the east of SH2 and a proposal to drill those borings will be to FERC by mid-February. Drilling and piezometer installation and automation is to take place as soon as possible thereafter and no later than the end of summer. The drilling proposal will also include borings and instrumentation on the right abutment. Instrumentation (piezometers) within the proposed borings will be used to better characterize the groundwater conditions behind SH2 (left abutment) and the effectiveness of the grout curtain (both abutments).

Should drilling and instrumentation data within the left abutment support our current understanding of the groundwater conditions, we will go forward with the method of developing mitigation measures as discussed during the BOC meeting. Specifically, setting the factor of safety at a minimum value of 1.15 and developing the appropriate mitigation measures (likely drains) to get the factor of safety to 1.5. Should the piezometers show groundwater conditions significantly different than anticipated the design team will need to evaluate the significance of the differing conditions and propose a plan for moving forward.

PSE also concurs with the BOC recommendation (LB-6-3b) and will begin monitoring the left abutment through the use of LiDAR surveys. Surveys will be conducted from the southwestern most point on the dam crest and will use a to-be-determined location on the southeastern face of the dam as a reference location for the differential rockfall calculations. Similar surveys are conducted annually at Upper Baker Dam during the summer and the left abutment surveys at Lower Baker Dam will be scheduled to occur concurrently. The initial survey will be scheduled for this summer and the surveys will continue annually until PSE deems them no longer necessary and receives concurrence for discontinuing from the BOC and/or FERC.

BOC Recommendation LB-6-4

In section 2.5 the BOC supports PSE's intent to conduct all further structural modeling of the dam based on the proposed conditions associated with the Lower Baker Dam Crest Improvements Project and with the evaluation of the structural stability based on the use of the 84% response spectrum of a random crustal event as outlined in the United States Army Corps of Engineers draft guidance. The BOC then makes several recommendations regarding the approach to identifying and evaluating potential failure modes for the dam configuration proposed as part of the Lower Baker Dam Crest Improvement Project. These are included here:

- a) The seismically-initiated PFMs should be identified for the dam body, abutments, spillway, gates and associated equipment and form the basis of the seismic analyses.
- b) Dam body PFMs should address failure within the arch-gravity section, possibly a "Smiley Face" mode, or other credible failure mode. The interaction of the dam body and abutments should be considered.
- c) PFMs for the new spillway piers and gates should consider whether the piers and/or gates may fail allowing uncontrolled discharge through the spillway openings, or whether the gates jam and cannot be operated as required to manage floods.

- d) Analyses of PFMs that may lead to a dam breach and present a life safety risk should be based on the controlling deterministic “Maximum Credible Earthquake” (MCE) which was identified by Hatch as the random Mw 6.5 shallow crustal event. The 84-percentile response spectrum for this event should be used as the basis for selection of time histories for analyses.
- e) Analyses and design for PFMs for the piers and/or gates that will not lead to a dam breach or life safety risk may be based on response spectra for an “Operating Basis Earthquake” (OBE) of lesser magnitude and return period than the MCE. The selected OBE, analyses and design should use criteria consistent with the desired post-earthquake operability requirements.

PSE Response LB-6-4

The BOC recommendations regarding the PFMs are consistent with FERC guidance and PSE’s plan of action for the Lower Baker Dam Capital Projects. Multiple PFMA’s are planned for the Lower Baker Dam structures. The potential failures modes associated with the abutments and gravity arch dam body are planned to be addressed through the geologic model and finite element analysis being completed by Hatch and will include the seismic response of the dam during the defined MCE. The schedule for completion of the seismic analysis is late May, 2018. The finite element model is also planned to be used in the design of the crest improvement structures utilizing a maximum design earthquake MDE with a lower return period of 2,500 years. Once the structural demands for the MDE are understood from the finite element model the design of the crest will be further detailed to a 60% level documenting expected behavior of the gates and piers and post-earthquake operability. The 60% design is scheduled to be completed mid-June 2018 with a required supplemental PFMA to follow. The crest project PFMA will include PSE, FERC, and PSE consultants to critically evaluate the modifications for potential failure modes and to determine if construction may adversely impact other structures.

In addition to the capital project specific PFMA’s the Eleventh Part 12 Report is required to be completed in 2019 and will include a review of the potential failure modes by the Part 12 independent consultants. FERC has identified the need to include a further discussion of operational related issues and updating the category III PFMA’s to current understanding during the eleventh Part 12 in their correspondence accepting the tenth Part 12 report.

BOC Recommendation LB-6-5

In section 2.6 the BOC recommends that the development of the geologic model be thoroughly documented, that the details of the documentation be designed by an IT specialist or Archivist, and that the documentation should include the following:

- a) hard copies of all reports upon which the model is based,
- b) hard copies of a series of closely-spaced geologic sections perpendicular and parallel to the axis of the dam, and
- c) model object coordinates output in spreadsheet format for importing into other software modeling programs

PSE Response LB-6-5

PSE recognizes that the geologic model represents a significant investment in our understanding of the geologic and geotechnical conditions within the foundation and abutments of the Lower Baker Dam and that this model is the foundation for the hydrogeologic model. As such, PSE recognizes the importance of memorializing the model for future reference and will work with our archivist to develop a framework for capturing the data in the recommendations above. This framework will be complete and available for review at the next Lower Baker Dam BOC meeting (tentatively set for early July). Finalized reports will be captured within the framework. As noted by the BOC, however, the geologic model is a living-document that will be updated with the extensive volume of data anticipated from the execution of the grout curtain. The hard copies of the sections and the model object coordinates spreadsheets will not be memorialized until the grout curtain is complete and the construction report is finalized.

While not recommendations, the BOC did note a number of items or issues that PSE will likely need to address or will be of assistance moving forward. These comments are paraphrased here:

- A very strong environmental protection program will likely be required during construction of the grout curtain given the strong hydraulic connectivity between the foundation/abutments and the river.
- Employing the 'best-value' contracting method and the early contractor input concept will help manage the construction, environmental, and transient (construction) dam safety risks.
- When filling the forebay depression, the use of materials that won't adversely impact drilling for the grout curtain or negatively impact the ability to get a positive seal between the dam and the grout curtain would be advantageous.

PSE appreciates the BOC input and will heed the advice moving forward.

If you have any questions concerning PSE's plan and schedule to address the BOC's additional remarks, please contact me at (360) 766-5460, or at thomas.danielson@pse.com.

Sincerely,



Thomas Danielson
Senior Project Manager

Enclosures:

BOC Meeting No. 6 - Final Report
BOC Recommendations Log - 20171228

cc: Board of Consultants:
Dr. Robin Charlwood
Dr. Donald Bruce
Dr. Brendan Fisher