HATCH™

60% Design Level
Independent Engineer Peer Review (IEPR)
for the Dorena Hydroelectric Project

Table of Contents

Disclaimer

Riverbank Inc, the parent company of Symbiotics and Dorena Hydro, LLC ("Client") has retained Hatch Associates Consultants Inc. ("Hatch") to perform the Safety Assurance Review of the Dorena Lake Hydroelectric Project (DLHP). This report contains opinions made by Hatch, using its professional judgment and reasonable care. Use of or reliance upon this report is subject to the following conditions:

(a) the report being read in the context of and subject to the terms of the Engagement Letter Agreement between Hatch and the Client (the "Agreement"), including any methodologies, procedures, techniques, assumptions and other relevant terms or conditions that were specified or agreed therein;

(b) the report being read as a whole, with sections or parts hereof read or relied upon in context;

(c) the conditions of the sites may change over time (or may have already changed) due to natural forces or human intervention, and Hatch takes no responsibility for the impact that such changes may have on the accuracy or validity or the observations, conclusions and recommendations set out in this report; and

(d) the report is based on information made available to Hatch by the Client or by certain third parties and, unless stated otherwise in this report, Hatch has not verified the accuracy, completeness or validity of such information, makes no representation regarding its accuracy and hereby disclaims any liability in connection therewith.

1. INTRODUCTION

Presented herein is the 60% Design Level Independent Engineer Peer Review (IEPR) for the Dorena Hydroelectric Project. This report describes our review and analyses of the technical and environmental aspects of the proposed Applegate Hydroelectric Project as part of the Safety Assurance Review (SAR) requirements for Symbiotics Energy, LLC (Symbiotics) Dorena Lake Dam Hydroelectric Project, FERC#11945, as required by Section 2035 in the Water Resource Development Act (WRDA) of 2007 as described in the U.S. Army Corps Engineer's EC: 1165-2-209, Civil Works Review Policy. This review is presented in the context of opinions of the Independent Engineer Peer Review (IEPR) team as to current status of the design with the understanding that additional review and comments will be exchanged at the 100% design stage.

Symbiotics is in the process of designing a hydroelectric power plant on the existing USACE Dorena Lake Dam near Cottage Grove, Oregon. These designs are collectively called the Dorena Lake Hydroelectric Project (DLHP) under 33 USC 408 (Section 408). Safety Assurance Reviews ensure that good science, sound engineering, and public health, safety, and welfare are the most important factors in guiding the engineering design and implementation of the DLHP. Symbiotics plans to initiate construction of DLHP in 2011.

This review evaluated the design documents to consider whether the interpretations of the analysis and the conclusions based on that analysis are reasonable and inform the design team on the adequacy, appropriateness, and acceptability of the design and construction activities for the purpose of assuring public health, safety, and welfare.

The 60% IEPR is focused on the adequacy of critical components of the DLHP and their interactions with the existing facilities of the Dorena Lake Dam. The main concern is adequate dam safety, adequacy of analysis for proof of concept, definition of major load cases and analysis to indicate adequate load transfer for critical components. Additionally; the review addresses the potential for the project to cause an uncontrolled release of water. Other elements of the project have been examined and commented upon; however it is assumed that there will be time for a more complete review at subsequent review cycles to confirm that these comments have been adequately addressed.

The review process led to comments that were addressed in subsequent design report submittals. Included in this review is a discussion of 100% design review, particularly as they relate to the dam stability and penstock analysis. While the review of elements comprising the 100% design was performed in a limited number of areas to examine the viability of the project, this report does not represent a review of the 100% design.

1.1 Hatch Role as Independent Engineer

Hatch is uniquely positioned to take on this role due to an existing role for the DLHP as Independent Engineer (IE), which is being financed by private investors through a bond offered by Crédit Agricole Corporate and Investment Bank ("CA-CIB"). The two roles are similar in that they involve a group of technical experts providing a technical and environmental review of the Project features, taking into account the dam safety qualifications of DLHP participants, including Symbiotics, the Design Engineer and Construction Contractors. As the IE, Hatch visited the Dorena Lake Dam site in March 2011, met with the project developer several times, and conducted several meetings to discuss our review of DLHP design with Symbiotics and other representatives of the Design Engineer team.

Hatch has received design information at various stages of development. None of the companies, or individuals involved with these reviews have any conflict of interests.

Notable events for IE and IEPR review:

- March 2011, Hatch engaged as IE;
- March 3, 2011, Visit to Dorena Lake Dam Site, and discussion with Design Engineer representative;
- May 25, 2011 Meeting with Symbiotics to discuss DLHP (Portland);
- June 1, 2011 Meeting with Design Engineer to discuss comments (Salt Lake City);
- July 6, 2011 Follow-up conference call with Symbiotics and Design Engineer;
- July 7, 2011 Approved as IEPR by USACE;
- August 11, 2011 Follow-up conference call with Symbiotics and Design Engineer to discuss penstock analysis; and
- August 15, 2011, Follow-up conference call with Design Engineer to discuss stability analysis.

As part of the IE assignment, Hatch provided comments on the design that were influential in the overall design process. The comments from the IE phase of the project that we feel are relevant to the IEPR are included in "DrChecks" record shown in Attachment A, along with comments as part of the IEPR review.

1.2 SAR Team

The Symbiotics independent panel of experts, or Board of Senior Consultants (BOSC) includes:

- Mr. Keith Moen, P.E.
- Mr. Steve Hart, P.E.
- Mr. John McClung, P.E.
- Mr. Steven Perrett, P.E.
- Chris May, P.E.
- Jim Rutherford, P.E.
- Carl Mannheim, P.E.
- John Groeneveld, P.E.
- Dr. John J. Pizzimenti, PhD
- Steven Rainey, P.E.

BOSC members, Keith Moen (Civil/Structural Engineer, Project Engineer) and Steven Perrett (Geotechnical Engineer) visited the site as part of the IE exercise on March 3rd, 2011.

2. THE PROJECT

2.1 General Description

The Dorena Lake Dam is located on the Row River near Cottage Grove, Oregon. The dam is an earth-filled, gravel embankment structure with a crest length of 2,600 feet and a structural height of 145 feet. Appurtenant features of the dam include a concrete spillway with a 200-foot crest length at El 835 feet that discharges into a stilling basin constructed with concrete retaining walls and located within the concrete tailrace channel. The dam effectively raises the water level 114.5 feet above the stream bed of the Row River, creating a 1,749-acre reservoir that provides 70,500 acre-feet of storage. The Dorena Lake project was completed in 1949 and is maintained and operated by the USACE. The current condition of the project appears to be good with no indication of circumstances that could limit the useful life of the project.

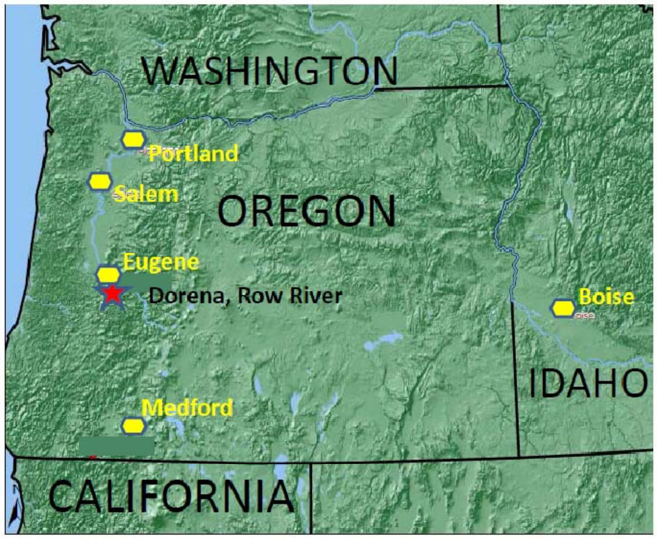

Figure 2.1 - 1 – Location Map

During the course of our review, we visited the Project Site and made field observations. The field observations were visual, above ground examinations of selected areas and were of limited scope, so our review will not be sufficient to reveal all possible conditions with respect to safety; the conformance to agreements, codes, permits, rules, or regulations of any party having jurisdiction with respect to construction, operation and maintenance of the Project; or to assess subsurface or geological conditions.

Figure 2.1 - 2 - Photo of Dorena Lake Dam

2.2 The Proposed Project

The arrangement to accommodate a water passageway to the powerhouse structure is comprised of the following elements:

- A submerged intake trashrack structure that is to be installed underwater.
- A 10-foot-diameter penstock, extending from the intake trashrack approximately 95 feet to a butterfly valve located immediately upstream of the dam face.
- Excavation of a bore through the existing concrete dam and installation of the penstock through the bore.
- A siphon house located immediately downstream of the dam that will house a 10-foot diameter butterfly valve and vacuum equipment to initiate a siphon in the penstock when lake levels are below the siphon elevation.
- A buried 10-foot penstock approximately 180 feet long between the siphon house and the powerhouse, including a 10-foot to 56-inch diameter bifurcation and approximately 130 feet of 56-inch-diameter penstock between the bifurcation and the powerhouse.

3. GENERAL

3.1 General Project Acceptability

(To what extent has it been shown that the project is technically sound, environmentally acceptable, and operationally functional?)

Areas of Interest: Definition of technical and operational issues and demonstration of the Project's ability to perform are covered in detail Sections 4-9.

DrChecks References and Discussion: Reference DrChecks numbers: 4116130 and 4116153. The environmental process for the DLHP is well organized and meeting important deadlines. Major environmental water quality issues include: dissolved oxygen (DO) and total dissolved gas (TDG). The major fishery-related project feature is a tailrace fish barrier. The water quality standards to which the project is being held to are unrealistically stringent considering the fisheries resource.

Conclusion: The majority of issues have been addressed to demonstrate the viability of the project. There remain a few important issues to be resolved. Several important aspects of the design that involve the critical components of dam safety are not yet complete or are being revised. This includes:

- Refinement of the dam stability analysis in the modified condition;
- Confirmation of the adequacy of the upstream butterfly valve to transfer loading and maintain functionality; and
- More detailed review of the FEA analysis and load transfer.

The methods of design, construction and operation of DLHP are in general accordance with good engineering practices and accepted industry practices.

3.2 Assumptions for Analysis

(Are the assumptions that underlying engineering and environmental analyses is sound and complete?)

Areas of Interest: The engineering assumptions are covered in more detail by topic (engineering discipline) in Sections 4-8. The following discussion focuses on the environmental analysis.

DrChecks References and Discussion: Reference DrChecks numbers: 4116171, 4116416, 4116417, 4116418 and 4116419. The DLHP shall be designed, constructed, and operated in accordance with the applicable regulations, laws, policies, guidelines, standards, and codes. FERC issued original License for the DLHP on October 17, 2008. The License authorize construction of the Projects at the USACE. Several articles of the License require that specific activities be completed within a specified period from License issuance, while others do not establish a specific deadline.

The current status of key permits and approvals required from the various federal, state and local agencies is listed in the following table.

Table 3.2-1 Status of Key Permits and Approvals

Permit or Approval	Responsible Agency	Current Status	Comments
FEDERAL			
License	FERC	10/17/2008	Required for construction and operation of hydroelectric projects and interconnecting transmission lines.
Regional Engineer Approval	FERC	Anticipated early Oct 2011	Authorizes start of construction / ground breaking activities. Will be initiated upon receipt of 408 certification.
Section 408 Approval	USACE	Intend to receive Sept 15	Required for construction of project at USACE facility.
Section 404 Permit	USACE	NWP 18 submitted, pending 408 approval	Authorizes discharges of dredged or fill material associated with hydropower projects.
STATE			
Water Quality Certification	OR – DEQ	1/18/2008	Required by FERC in order to issue License. Establishes WQ requirements on Projects.
Water Rights	OR – OWRD	12/17/2009	Authorizes diversion of water for hydropower production.
Removal / Fill Permit	OR – ODSL	10/15/2009	Authorizes removal of or fill material in waters.
Storm Water Discharge Plan and Permit	OR – DEQ	Scheduled to submit 7/1/2011	Authorizes storm water discharges associated with construction.
LOCAL/OTHER IDENTIFIED			
Transmission Line Permit	County	8/12/2009	Required for transmission line.
SUA & Riparian Modification	County	8/2009	Required for land use or alteration.

Symbiotics has identified and obtained the key environmental permits and approvals, which are necessary to commence construction of the Project. While not all required permits and approvals have been issued or completed, based on our review, we are not aware of any technical or engineering circumstances that would prevent the issuance of the remaining permits and approvals. Additionally, the environmental management plans as developed or as required to be developed for the Project are found to adequately protect environmental resources.

Conclusion: Basic assumptions for engineering analysis are addressed below. The basic assumptions for the environmental analyses are sound and complete. There will be aspects of the water quality mitigation that will likely require some tuning in order to meet the required water quality standard after the project is in operation. However, given the low value of the river as habitat (see DrChecks comment 4116418) the Project is not expected to have significant adverse affects on the environment.

3.3 Assumptions and Precedence

(Has it been demonstrated quantitatively that the assumptions underlying engineering, and environmental analyses are reasonable, sound and complete? Have the assumptions been confirmed based on experience with similar projects?)

Areas of Interest: Discussed below.

DrChecks References and Discussion: The majority of the Project features are conventional and have been confirmed based on experience with similar projects. Several features are unusual, but not unique.

- The intake structure is founded on "spuds" that penetrate the sediment and rest on the rock excavated from the forebay during original construction. These spuds are not fixed to the foundation;
- The penstock is unsupported between the intake structure and the Dorena Lake Dam;
- The water passage passes through a hole bored through the existing dam;
- The penstock operates as a siphon for the low reservoir months;
- Water is diverted approximately 180 degrees from the tailrace into a stilling basin to allow dissipation of TDG to improve water quality.

Demonstrating functionality of features that do not have significant precedence places higher dependence on the analysis. This is described in more detail by topic in following section of the report.

A significant environmental mitigation feature of the DLHP relates to aeration of the flow and diversion and retention of the aerated water to abate potential TDG. The aeration facility is based on designs that were used in similar situations that have been successful. The aeration and turbulence in the tailrace creates a mechanism that takes air bubbles to depth and go into solution in the water to create the conditions where TDG may occur. The TDG abatement solution involves use of a rubber dam structure to divert water upstream into the existing stilling basin increasing the time for the water to de-gas upstream of the compliance point.

Conclusion: No fatal flaws have been identified to date. The assumptions underlying engineering and environmental analyses are for the most part reasonable and sound. There remains some question regarding the assumptions used in the stability analysis (see Section 7.4 and 8.1). These items in question have been discussed with the Design Engineer and revisions to address these are expected in the near future.

Our understanding of the design features being modified indicate that they will be similar to the originally proposed design, with potentially some difference in the details.

The performance of the aeration and TDG dissipation scheme is experimental, and will likely required refinements after commencement of operation.

3.4 Methods Models and Analysis

(Are the engineering, and environmental methods, models, and analyses used adequate and acceptable for the complexity of the project?)

Areas of Interest: The methods models and analysis are discussed in greater detail by engineering discipline (Section 4: – Structural, Section 5: – Hydraulic, Section 6: – Mechanical, and Section 7: – Geotechnical).

Conclusion: In general, our review indicates that the engineering and environmental methods, models, and analyses used are adequate and acceptable for the complexity of the project and exceed the 60% design level. There is some question as to the adequacy of some aspects of the penstock analysis (bifurcation stiffener, see Section 5.2); however this is not a critical feature and can be addressed as the design progresses.

3.5 Analysis Interpretation

(Are the interpretations of analysis and conclusions based on the analysis reasonable, sound and complete?)

Areas of Interest: The interpretation is discussed in greater detail in the more detailed questions by engineering discipline (Section 4: – Structural, Section 5: – Hydraulic, Section 6: – Mechanical, Section 7: – Geotechnical, Section 8: – Dam Safety and Section 9: – Project Operations & Reservoir Regulation).

Conclusion: The interpretations of analysis and conclusions based on the analysis that have been presented to date are reasonable with the proviso of the elements mentioned in Sections 3.3 and 3.4.

3.6 Dam Safety

(Has the overall Dam safety concerns changed with the addition of the proposed design? (See Dam Safety section below))

Areas of Interest and Discussion: Major dam safety concerns are discussed in Section 7; - Geotechnical and Section 8: - Dam Safety.

Conclusion: Our review has questioned several assumptions of the dam stability analysis, which is discussed in more detail in Sections 7.4 and 8.1.

3.7 Operational Functionality and Flexibility

(Has the overall operational functionality and flexibility of the Dam changed with the addition of the proposed new project features?)

Areas of Interest: Changes in functionality and flexibility of Dam Operations.

Discussion: The operational concerns are discussed in Section 9; - Project Operations & Reservoir Regulation.

Conclusion: The overall operational functionality and flexibility is not expected to be impaired with the addition of the proposed new Project features. The DLHP will be fully automated. Flow that normally would have been released through the regulating outlet (RO) will instead pass through the hydro turbines in a run-of-river mode as prescribed by the USACE. We initially reviewed the O&M manual, and will continue in more depth as part of the 100% IEPR review.

3.8 Environmental Functionality

(Has the overall Environmental functionality or characteristics of the Dam changed with the addition of the proposed new project features?)

Areas of Interest: Main areas of interesting include:

- Water quality; and
- Fish passage.

DrChecks References and Discussion: Reference DrChecks numbers: 4116421, 4116422 and 4116423.

The current project does not always meet the requirements for water quality imposed on the DLHP. The current scheme to balance TDG and DO requirements based on use of the aeration device in the tailrace and TDG dissipation in the stilling basin. The DLHP will provide additional methods of addressing DO and TDG that will likely improve water quality over the existing condition. The extent of water quality effects and optimal use (or lack of use) of the equipment would best be determined through experience and additional testing during operation.

Conclusion: The review indicates that the environmental functionality is not changed in a negative way by the DLHP.

3.9 Load Cases and Assumptions

(Have all load cases and assumptions been clearly identified and adequate for the proposed designs. Does the Design Manual or Design Memorandum reflect this?)

Areas of Interest: Specific load case issues are discussed below.

DrChecks References and Discussion: Reference DrChecks number: 4116147 and 4116177.

Where there is some uncertainty of structural behavior, consider all load cases that bracket the actual loading case to ensure that there is adequate strength for the entire structure.

Use of hand calculations to check numeric analysis.

Conclusion: Load cases and assumptions have been clearly identified and are adequate for the proposed designs. The Design Report reflects this. The adequacy of load cases is discussed in the following Section 4-8.

3.10 Remote Controls

(Do the remote controls and operations plan meet the Army Corps of Engineers EC 1110-2-6071, Remote Control and Operation of Water Control Systems?)

Areas of Interest:

- Redundancy of facilities.

Discussion: The Design Engineer, Symbiotics and USACE are continuing to work out the details of the control system. EC 1110-2-6071 is referenced in the 100% Design Report (Ref. Bingham August 2011).

Conclusion: EC 1110-2-6071 was considered during the design process. A more comprehensive review will be included in subsequent IEPR reviews.

4. STRUCTURAL

4.1 Evaluation of Engineering Features

(Comment on the evaluation of engineering features. Is the scope, function and analysis of the engineering features clearly described?)

Areas of Interest: Report presentation.

Discussion: The 408 submittal and 100% report (Bingham July 2011 and August 2011) are a significant improvement over previous engineering document submittals and provide clear description of analysis and engineering features.

Conclusion: The evaluation of engineering features as described in the project documents clearly describes the scope, function and analysis of the engineering features and current level of design.

4.2 Analysis of Dam and Associated Structures

(Has the analysis been adequately performed and documented to support the proposed changes to the dam structure, associated structures and appurtenances? Has stability, buckling as well as strength of materials been considered?)

Areas of Interest: Penstock analysis through the dam, load transfer to the dam and buckling of the penstock due to external loads.

DrChecks References and Discussion: Reference DrChecks numbers: 4116144, 4116155, 4116194 and 4128800.

Stability analysis of the dam structure is discussed in Sections 7.4 and 8.1.

The project analysis is performed using finite element analysis (FEA) utilizing the ANSYS program in conjunction with supporting hand calculations and dam stability calculations. The loading cases have been expanded over the course of the IEPR review to include additional load cases to take into consideration the range of potential loading on the penstock.

Buckling of the penstock due to vacuum in the above ground portion of the penstock and through the dam penetration has not yet been completed (DrChecks comment 4128800). This has been communicated to the Design Engineer (via conference call August 12, 2011), who is currently updating the analysis in response to this comment. The size and/or spacing of pipe stiffener rings may be affected by the results of this analysis.

Conclusion: The analysis has been performed and documented adequately; however there remain some elements as discussed above that are currently being updated in response to comments. The analysis indicates the ability of the DLHP to adequately perform for the loading and transfer loads to the existing facilities. A more comprehensive review of the FEA analysis and structural details will be included in subsequent IEPR reviews.

4.3 Analysis of New Intake and Upstream Penstock

(Has the analysis been adequately performed and documented to support the new intake structure and upstream penstock structure?)

Areas of Interest: The new intake or upstream penstock for the Project.

DrChecks References and Discussion: Reference DrChecks number: 4116147.

The intake structure is founded on vertical piles (spuds) which rest on the excavated rock upstream of the RO valves. The spud design was developed to minimize disturbance of the sediment material that has been deposited over the excavation since construction. The spuds are not intended to be connected to the rock and were initially modeled as being free to move horizontally. The sediment will have some resistance, which will cause loading in the structure that needs to be accommodated by the spuds and the steel intake structure frame.

Conclusion: Initial review has led to additional load cases. Current review has focused on the critical structures which further downstream of the intake and upstream penstock. Initial review indicates that the intake analysis was performed adequately; a more complete review will be performed as part of the 100% design IEPR report.

4.4 Existing Gates

(Has the analysis been adequately performed and documented to support change in use of existing gate structures?)

Areas of Interest: Operation of the existing RO gate.

Discussion: Two of the five existing RO gates will be hard-wire controlled by the DLHP. It is anticipated that only one will be used at a time. The operation of the existing RO is expected to be reduced in favor of the hydroelectric plant for lower flow ranges. The generation equipment has been specified such that the rate of opening and closing the existing RO will not change. Typical operation of hydroelectric facilities are highly reliable, so the anticipated starting and stopping of the DLHP is not expected to be excessive.

Conclusion: From our review of the Design Report and Operation and Maintenance Manual (Symbiotics, July 2011), it is our opinion that the analysis been adequately performed and documented to support a change in the use of existing gate structures and exceed the 60% design level. This issue will be further considered in the 100% IEPR report.

4.5 Transient Analysis

(Has the analysis been adequately performed and documented to support all load cases associated with unit load rejection or water hammer?)

Areas of Interest: Load rejection case and siphon operation.

Discussion: The calculation used the program "WHAMO". All load cases were for high water level.

Conclusion: The calculations for water hammer and air demand are considered adequate to provide maximum pressure values and air intake requirements for the proposed structures. This issue will be further considered in the 100% IEPR report.

4.6 Flow Design

(Has the system be fully designed and provided sufficient redundancy to prevent uncontrolled flow?)

Areas of Interest: Uncontrolled release of water due to failure of water conveyance system.

DrChecks References and Discussion: Reference DrChecks number: 4116134.

The redundancy of the flow system includes three water conveyance closures located immediately upstream of the dam, immediately downstream of the dam, and upstream of the generation units. The upstream closure valve is discussed further in Section 6.3.

Conclusion: The flow system contains redundancy. Some issues remain with the upstream closure valve as discussed in Section 6.3. This issue will be further considered in the 100% IEPR report.

4.7 Penstock Analysis

(Has the analysis been adequately performed and documented to support the penstock design and size?)

Areas of Interest: Main concerns from review include:

- Penstock analysis;
- Penstock testing;
- Welding ; and
- Load transfer at thrust restraint.

DrChecks References and Discussion: Reference DrChecks numbers: 4116147, 4116178, 4116179, 4116180, 4116181, 4116191, 4116193, 4116195, 4116196, 4116199, 4116200, 4128801 4128804, 4128805, 4128806 and 4128812.

Issues discussed in the DrChecks comments include:

- Load cases that bracket areas where performance is uncertain (lateral movement of upstream spud penstock and intake support;
- Mitre angles for the bends, which are shown on drawings as 22.5 degrees but described in report as being. 15 degrees;
- Testing using hydrostatic method for pipelines with over 100 feet of head;
- Weld testing (radiographic vs. ultrasonic);
- Temperature effects for analysis;
- Load transfer at pipe beds to foundation;
- Manhole design; and
- Welding requirements for pipe 1.25 – 1.5 inch thick.

The referenced DrChecks comments contain discussion of these topics. Several other questions remain associated with the analysis, and design details of the penstock remain to be resolved in the 100% review.

The transfer of load to the controlled density fill (CDF) is not well described. The CDF will transfer load to the foundation. This assumption effects constraints in the FEA analysis which influences load transfer to the various project features.

In a conference call between Keith Moen, Chris May and John McClung of the IEPR team, and Spencer Uminski of Symbiotics and Judd Lawrence of Bingham Engineering on 08/12/11. The outstanding penstock design questions were discussed and the design team will address these issues in the near future.

Conclusion: Several questions remain open on the penstock analysis including thrust restraint at bends and approved testing procedures. These elements have been discussed with the Design Engineer and are currently being revised in response to comments. This issue will be further considered in the 100% IEPR report.

4.8 Construction Load Cases and Flow During Construction

(Has the analysis been adequately performed and documented to support and/or demonstrate the construction load cases and the projects ability to maintain flow requirements during the construction work?)

Areas of Interest: Main issues:

- DLHP affects on project RO valves during construction;
- Cofferdam loads; and
- Geotechnical construction load case as discussed in Section 7.3.

Discussion: The construction load case considered most relevant to dam stability and uncontrolled release of water is the ability of the upstream cofferdam to function in the event of a storm during the dam bore operation.

Conclusion: Initial review has not resulted in specific concerns. The DLHP should not impede the ability to maintain flow during construction through the existing ROs. This issue will be further considered in the 100% IEPR report.

4.9 Alternatives Constructability and Schedule

(Has the review noted that alternatives were considered and that the project is constructable in a straight-forward fashion? Does the Project Schedule reflect this?)

Areas of Interest: Issues discussed in the DrChecks comments include:

- Penstock installation methodology;
- Schedule sensitivity of penstock bore;
- Assembly of transition pieces for the penstock;
- Staging for dam penetration;
- Staging and stockpile and sedimentation pond area designation, and
- Penstock assembly.

DrChecks References and Discussion: Reference DrChecks numbers: 4116150, 4116157, 4116168, 4116203, 4116400, 4116407 4116408 and 416410.

An alternative analysis occurred at an earlier stage. Overall, the Project appears constructible within the schedule; however the schedule does not have significant float.

The construction contractor has been engaged and constructability input has been solicited and been integrated into submittals for construction sequencing. Our opinion is that the participation of the contractor at this stage is beneficial in facilitating construction within the proposed schedule.

The construction start-up is to occur in October 2011. The bore through the dam is a critical element due to reservoir levels. Delay of the bore will result a delay for the dam bore until the next annual low reservoir period, which in turn will have significant impact on the construction completion schedule.

The site has limited space and access to the bore location is constrained. The constructability of the tunnel bore has not been well-described. Concerns remain regarding the space available for the road header, and mucking equipment.

Conclusion: Based on our review the critical constructability/schedule issue is the dam bore. This activity will be dependent on receiving approval for commencing construction.

Given the lack of float, the potential exists that DLHP could be subject to delays for events such as material and equipment delivery delays, labor difficulties, unusually adverse weather influences, force majeure events, the untimely failure of major equipment components, or the occurrence of any other abnormal event that is prejudicial to normal construction or installation. We are of the opinion that the design and construction schedules for the Projects are aggressive but achievable and within the previously demonstrated capabilities of the contractors using generally accepted project and construction management practices. This issue will be further considered in the 100% IEPR report.

5. HYDRAULIC

5.1 Erosion, Environmental and Operational Considerations

(Has the analysis been adequately performed and documented for the change in hydraulic conditions in regards to erosion, environmental and operational considerations? As well as other items, i.e. lubricants, coatings, SPCC, oil control & containment, fish entrainment, etc?)

Areas of Interest: Issues discussed in the DrChecks comments include:

- Hydraulic performance of intake with regard to fish;
- Fish barrier flow; and
- Tailrace flow.

DrChecks References and Discussion: Reference DrChecks numbers:4116411, 4116412, 4116413 and 4116414.

Hydraulics of inlet screens are discussed in Section 5.3, outlet screens in Section 5.5 and erosion in Section 5.7, which includes fish entrainment.

The DLHP operates under the terms of several permits, including a Federal Energy Regulatory Commission (FERC) license, a Section 404 Clean Water Act permit from the USACE, a state-issued 401 water quality certification, state water rights, and other state and local permits, including SPCC plans. Section 13 of the O&M Manual discuses the water quality guidelines as well as a “Hazardous Materials Program” which includes MSDS requirements for materials used on site.

Conclusion: The construction plans that are required prior to construction as well as the protocols developed for documenting potentially hazardous materials allow review and control the potential for leaks of materials into the water.

5.2 Penstock Forces

(Has the analysis been adequately performed and documented to support the additional penstocks and all the forces associated with their configuration?)

Areas of Interest:

- High head loss at bifurcation.

DrChecks References and Discussion: Reference DrChecks numbers: 4116197 and 4128807.

Also refer to section 4.7 for discussion of the structural elements of penstock analysis.

The hydraulic analysis for the bifurcation may not be reliable, and higher than expected head losses could result.

Conclusion: The analysis may not accurately estimate the head loss. This issue is an economic issue and not related to dam safety. Any modification will be further considered in the 100% IEPR report.

5.3 Outlet Works Design

(Has all the outlet works been adequately evaluated and documented for all environmental aspects? Also to avoid vibration, cavitation, abrasion and excessive O&M?)

Areas of Interest:

- Operation of environmental aspects of outlet works.

DrChecks References and Discussion: Reference DrChecks numbers: 4116414, 4116415, 4116420, 4116421 and 4116420.

Refer to listed DrChecks comments and Section 3.3 and Section 3.8 for discussion of environmental aspects of the outlet.

The hydraulics of the upstream and downstream screens are expected to lead to non-uniform flow conditions through the screens which may include "hot spots" in some areas of the screens. This may cause concerns from regulatory agencies. The turbine will pass water with minimal residual energy, so water from the reservoir with low DO will be passed through the Project.

Conclusion: The review concerns are related to agency acceptance of the performance of the DLHP outlet scheme, which will be difficult to determine prior to installation with confidence. This issue will be further considered in the 100% IEPR report.

5.4 Outlet Works Design

(Has all the outlet works been adequately evaluated and documented for all flow conditions and the impact to structures and embankments?)

Areas of Interest: Main concerns are:

- Loading for tailrace and stilling basin walls;
- Rubber dam longevity;

- Erosion potential in stilling basin;
- Flood level for powerhouse design; and
- Operation of outlet works.

DrChecks References and Discussion: Reference DrChecks numbers: 4116158, 4116159, 4116169 and 4116192.

The loading for evaluation for tailrace and stilling basin have been established in accordance with USACE standards. The rubber dam is intended to be used in either inflated or deflated mode, which is preferable for longevity of the installation.

The stilling basin hydraulic performance was analyzed using computational fluid dynamics (CFD). The flow modifications occur primarily for lower flows during generation.

Conclusion: Initial review has not resulted in specific concerns. This issue will be further considered in the 100% IEPR report.

5.5 Inlet Works Design

(Has all the inlet works been adequately evaluated and documented for all environmental aspects?)

Areas of Interest:
- Flow for partially clogged trashrack;
- Increase fish impingement and entrainment due to higher flow velocities.

DrChecks References and Discussion: Reference DrChecks numbers: 4116411.

The major concern regarding the intake from the environmental side is increased velocity due to partial clogging of the trashrack with no provision for cleaning beyond measurement of pressure differential.

Conclusion: This issue has been brought to the attention of the Design Engineer. No provision for cleaning trashrack aside from divers cleaning the trashrack has been provided for. This issue will be further considered in the 100% IEPR report.

5.6 Inlet Works Design

(Has all the inlet works been adequately evaluated and documented for all flow conditions and compared to base line conditions prior to new project features?)

Areas of Interest: Main concerns from review of "DrChecks" documentation appear to be:
- Clogging of trashracks;
- Frequency of cleaning trashracks; and
- Submergence (vortex formation that could lead to loss of siphon).

DrChecks References and Discussion: Reference DrChecks numbers: 4116142, 4116166, 4116183, and 4116184.

Low approach velocity and availability of water level sensors for reservoir and penstock allow monitoring of head loss across the trashracks. Clogging of the trashrack is expected to be seasonal and of limited duration.

Conclusion: We feel this is mainly an economic concern which could result in periodic loss of generation income. The Design Engineer has confirmed the adequacy of submergence of these existing intakes to prevent air entraining vorticies. No provision for cleaning the trashrack aside from divers has been provided for. This issue will be further considered in the 100% IEPR report.

5.7 Erosion/Scour Potential

(Has the overall hydraulic erosion/scour potential increased with any part of the proposed design?)

Areas of Interest:

- Potential for scour at the tailrace entry into the stilling basin.

Discussion: Refer to Section 5.4 for discussion.

Conclusion: Initial review has not resulted in specific concerns. This issue will be further considered in the 100% IEPR report.

6. MECHANICAL

6.1 Adequacy of Analysis

(Has the analysis been adequately performed and documented for the change in load condition of the existing gates? Are emergency generators adequate and are gate lifting mechanisms/controls in reasonable condition?)

Areas of Interest:

- Regulating Outlet (RO).

Discussion: Initial review has not indicated conditions that will change loading conditions on existing gate. We have not seen information on emergency generators or gate lifting mechanisms.

Controls are discussed in Section 9.2.

Conclusion: Initial review has not resulted in specific concerns. This issue will be further considered in the 100% IEPR report.

6.2 Gate Controls

(Has the analysis been adequately performed and documented for the gate control systems? And is it adequately redundant to prevent misoperation and able to meet flow requirement and ramp rates? Is the alarming system adequate?)

Areas of Interest:

- Use of the existing ROs.

Discussion: Two of the five existing ROs will be available to DLHP for operation, though only one is intended to be used at a time.

Conclusion: Gate operations for the RO are being developed in collaboration with the USACE including evaluation of redundancy and alarming systems. No specific concerns have been identified with the use of the existing ROs. This issue will be further considered in the 100% IEPR report.

6.3 Gate Structures Assumptions and Analysis

(Are the assumptions and engineering analyses sound and complete for the gate structures and operating equipment?)

Areas of Interest:

- Upstream closure valve ability to transfer load;
- Upstream closure valve rated temperature and flow capacity;
- Underwater operation of upstream closure valve not designed for submerged use;
- Upstream closure valve operator stiffness given height of operation platform above valve; and
- Upstream closure valve operation if valve is under load from penstock.

DrChecks References and Discussion: Reference DrChecks numbers: 4116151, 4116187, 4116188, 4116190, and 4128811.

Discussion of the upstream closure valve has been ongoing for some time. The valve was purchased as a "surplus" valve that has been in storage, but not used. The questions listed above have been submitted to the valve manufacturer. Preliminary results from analysis (Attachment B e-mail 081511 Rodney Hunt to Judd Lawrence, Bingham Engineering) indicate that the valve can transmit the expected loading. The complete report is expected early in the week of August 23rd, 2011.

Conclusion: Questions remain regarding the upstream closure valve to operate as intended. This issue will be further considered in the 100% IEPR report.

7. GEOTECHNICAL

7.1 Analysis Adequacy

(Has the analysis been adequately performed and documented for the change in load condition of the dam structures and embankments?)

Areas of Interest:

- Excavation analysis for the stability analysis
- Seepage control and stability for the pre and post construction period

DrChecks References and Discussion: Reference DrChecks number: 4116404.

The DLHP is separate from the embankment structures of the existing facility. The stability of the combined rock and stability of the gravity structure is addressed in Section 7.4.

Conclusion: The rock slope analysis should consider additional load case. This issue will be further considered in the 100% IEPR report.

7.2 Seepage Analysis

(Are drainage facilities functioning and adequate?)

Areas of Interest:

- Seepage analysis for excavation during construction; and
- Seepage design for permanent structures.

Discussion: Reference DrChecks numbers:

Embankment dam not affected by the DLHP. Design report indicates minimal seepage observed at base of Blocks 12 and 13.

Conclusion: Initial review has not resulted in specific concerns. This issue will be further considered in the 100% IEPR report.

7.3 Construction Load Cases

(Has all construction load cases been adequately preformed and documented?)

Areas of Interest: Main concerns from review of "DrChecks" documentation appear to be:

- Drainage of foundation; and
- Temporary access roads.

DrChecks References and Discussion: Reference DrChecks numbers: 4116400, 4116403.

The geotechnical section of the 100% Design Report (Bingham August 2011) includes an analysis of the temporary slope. Analysis by Bishop's Method led to use of a 1.5H:1V temporary slope. A construction sequencing plan was developed by the Construction Contractor and is included as part of Chapter 18 of the 100% Design Report. The DLHP site will be accessed for construction via an extension of the existing Spillway Road on the north side of the Row River.

Conclusion: Construction load case analysis has been performed for temporary slopes. Care will be required to ensure the details developed for construction dewatering are compatible with materials being excavated, that a plan is implemented and that monitoring is performed to ensure proper performance of temporary dewatering facilities. Initial review has not resulted in specific concerns. This issue will be further considered in the 100% IEPR report.

7.4 Safety and Stability of the Dam Structure

(Is overall safety and stability of the dam structure been compromised with the new proposed features? i.e. slope stability, foundation liquefaction, piping, settlement?)

Areas of Interest:

- Change in stability of Block 12 and 13;
- Assumptions regarding foundation drainage;
- Geometry assumptions for typical blocks;
- Effects of removal of rock for siphon house downstream of Blocks 12 and 13; and
- Assumptions regarding rock characteristics.

DrChecks References and Discussion: Reference DrChecks numbers: 4128813, 4128815, 4128816, 4128817, 4128818 and 4128819.

Stability analysis is presented in Chapter 15 of 100% Design Report (Bingham August 2011). There were several questions regarding assumptions used for the stability analysis as described above.

There was a conference call on August 15, 2011 between Keith Moen and John McClung of the IEPR team and Judd Lawrence and Brent Bingham of the Design Engineer to discuss comments on the stability analysis. The Design Engineer agreed to check on the development of the geometry of the sections and examine the stability case for stability at a concrete lift joint located at approximately the spring line of the penstock.

As a check, the IEPR team ran several simplified check cases of the dam stability analysis using properties and geometry developed by the Design Engineer to examine the effect of modifying the friction angle. All cases in the simplified analysis were found to be stable.

Conclusion: The revised design will be reviewed after modified analyses are complete. This issue will be further considered in the 100% IEPR report.

7.5 Seepage control and Instrumentation

(Has the overall seepage control been compromised with the new proposed features?)

Areas of Interest:

- Protecting existing dam drainage facilities in the existing concrete dam during installation of penstock and grouting; and
- Seepage control for new facilities.

Discussion: Maintenance of the functionality of the drainage gallery in the concrete dam during grouting will may be challenging given the clearance with the tunnel bore and the potential for cracking of concrete.

Structures are concrete founded on rock. Seepage is not major concern at this site. Seepage during construction needs to be monitored for water quality.

Conclusion: Careful construction planning and monitoring during tunnel bore and grouting operation will be important to minimizing risk to existing facilities. This issue will be further considered in the 100% IEPR report.

7.6 Foundation Excavation Design

(Does the foundation excavation design adequately address stability, seepage, and dewatering concerns?)

Areas of Interest:

- Construction stability.

DrChecks References and Discussion: Reference DrChecks numbers: 4116133.

Foundation excavation sequencing with respect to flooding was addressed.

Conclusion: Temporary slopes and seepage are discussed above; construction dewatering planning should be performed after the 100% design is completed in consultation with the construction contractor to ensure adequate planning is performed prior to excavation. Initial review has not resulted in specific concerns. This issue will be further considered in the 100% IEPR report.

8. DAM SAFETY

8.1 Project and Dam Safety

(Has the analysis properly considered project safety and dam safety? Have the proposed changes not caused any increased level of risk to structures or people?)

Areas of Interest:

- Stability of blocks 12 and 13 after construction

- Load transfer from penstock to dam
- Ability of the e-valve to function as anticipated.

DrChecks References and Discussion: Reference DrChecks number: 4116398.

Section 7.4 includes description of dam stability analysis. The DLHP does not affect the spillway design or the capacity of the ROs. Major Dam Safety concerns have addressed or are currently being addressed by the Design Engineer.

Conclusion: The analysis currently being updated in response to comments. This issue will be further considered in the 100% IEPR report.

8.2 Seismic Information

(Has recent seismic information and codes been incorporated into analysis?)

Areas of Interest:

- Use of proper methodology for developing design seismicity;
- Use of proper USACE references; and
- Adequate attenuation relationships.

DrChecks References and Discussion: Reference DrChecks numbers: 4116165, 4116405.

Initial seismic criteria were developed that were questioned based on comparison with USGS data for the project location. The revised seismic criteria is taken from an unpublished report by the USACE with a much higher value for the MCE. This level exceeds the USGS estimate. The complete report is not available, so complete review is not possible. The levels appear conservative based general understanding of the regional seismicity and an e-mail provided indicates acceptability by the USACE staff reviewing the project (Attachment B e-mail Lawrence 8/3/11).

Conclusion: The proposed seismic levels appear conservative when compared to the USGS reference level. No further concerns have been expressed from the IEPR team with the higher seismic criteria. This issue will be further considered in the 100% IEPR report.

8.3 Geotechnical information

(Has the latest geotechnical information and drill logs been included?)

Areas of Interest:

- Geotechnical logs from initial construction; and
- Estimates of sediment depth.

Discussion: The drill information used for final design of structures were from the original construction of the dam. The explorations were completed prior to the excavation for the dam and associated structures. Logs of the drill holes and results of the seismic survey lines are provided as reference drawings in the design report.

Conclusion: Initial review has not resulted in specific concerns. This issue will be further considered in the 100% IEPR report.

8.4 Interim Risk Reduction and Potential Failure Mode Analysis

(Has IRR-Interim Risk Reduction considerations been included in the review? Also the PFMA if changed due to new project additions?)

Areas of Interest::

- PFMA is included as an element of EC1110-2-6071.

Discussion: The review of the project has been extensive including a group from the USACE, Independent Engineering review as well as the IEPR review. These reviews have uncovered multiple potential failure modes. The reviewers have included experts in civil, structural, mechanical, geotechnical, operation and maintenance staff. However; to our knowledge, no formal IRR or PFMA process has been performed for the DLHP. An internal USACE IRR or PFMA may have been performed; however we do not have documentation of the process.

Conclusion: While many of the elements of IRR and PFMA process have been accomplished, no formal IRR or PFMA have been performed to our knowledge, and there would be value to the project to perform these processes.

9. PROJECT OPERATIONS & RESERVIOR REGULATION

9.1 Project Operators Input

(Has the input from Project Operators been incorporated into drawings, specifications, operation manuals and other documents?)

Areas of Interest:

- Change in project operation, in particular with the RO gates;
- Environmental compliance;
- Downstream releases.

Discussion: O&M manual is intended to provide operation personnel with direction and guidance for day-to-day operation and maintenance of the plant. The plan is subject to continuous review and improvement. Changes in the plan, forms, reports, or any procedures intended to be covered under this plan will be made by DLHP after review and approval by USACE. The plant will have a customized maintenance plan based on the forms and documentation contained in this manual.

Conclusion: Input from Project Operators has been incorporated into drawings, specifications, operation manuals and other documents and includes instrumentation of monitoring DLHP by the Project Operators. Initial review has not resulted in specific concerns. This issue will be further considered in the 100% IEPR report.

9.2 Staff Operators Involvement

(Have the staff operators been consulted to insure proposed changes have not or will not impact their ability to run and maintain the facilities? This includes items related to environmental compliance, downstream releases, and recreation in the reservoir and downstream and fisheries in general.)

Areas of Interest:

- Change in project operation, in particular with the RO gates;
- Environmental compliance; and
- Downstream releases.

Discussion: It is apparent from the USACE review "DrChecks" documentation that staff familiar with facility operations have been consulted. The operational interfaces and procedures are addressed in the O&M manual (Symbiotics July 2011). There are some issues that are not completed due to the current stage of project development, and others that will likely change as experience is gained running the project. The framework of the O&M document and the communication protocols create an open process and collaborative attitude that we believe will result in continued consultation of operators and implementation of changes to address these concerns.

Conclusion: Staff operators have been consulted to insure proposed changes have not or will not impact their ability to run and maintain the facilities. Initial review has not resulted in specific concerns. This issue will be further considered in the 100% IEPR report.

9.3 Original Project Function

(Has the review considered insuring the original project function remains intact and is not compromised?)

Areas of Interest: Covered above.

Discussion: Our opinion is that the DH and their Design Engineer have considered the original project function in developing the proposed scheme.

Conclusion: Initial review has not resulted in specific concerns. This issue will be further considered in the 100% IEPR report.

10. REFERENCES

ACI 318-08, Building Code Requirements for Structural Concrete

ACI 318/318R-357, Alternate Design Method

ASCE Manual 79 Steel Penstocks

AWWA C08

Bingham Engineering, July, 2011, Dorena Lake Dam Hydroelectric Project Operations and Maintenance Manual

Bingham Engineering, Dorena Lake Dam Hydroelectric Project, FERC NO. 11945, 100% Review Design Report AUGUST, 2011,

Bingham Engineering, Dorena Lake Dam Hydroelectric Project, FERC NO. 11945, 408 Permit Submittal Design Report, July, 2011

Symbiotics, Dorena Lake Dam Hydroelectric Project, FERC NO. 11945, Operations and Maintenance Manual, July, 2011

USACE EM 1110-2-8157 Responsibility for Hydraulic Steel Structures, 15 June 2009

USACE EC 1110-2-6071 Remote Control and Operations of Water Control Systems, 31 July 2010

USACE EC 1165-2-209 Civil Works Review Policy, 31 January 2010

USACE EM 1110-2-2100 Stability Analysis of Concrete Structures

USACE EM 1110-2-2200 Gravity Dam Design

USACE EM 1110-2-3001 Planning and Design of Hydroelectric Power Plant Structures

USACE EM 1110-2-6050 Response Spectra and Seismic Analysis for Concrete Hydraulic Structures

USACE EM 1110-2-6051 Engineering and Design – Time History Dynamic Analysis of Concrete

USACE EM 1110-2-6053 Engineering and Design – Earthquake Design and Evaluation of Concrete

USACE ER 1110-2-1806 Earthquake Design and Evaluation for Civil Works Projects

USBR Engineering Monograph No. 3

Attachment A – IEPR DrChecks Review Comments

Comment Report: All Comments
Project: Dorena Lake Dam Hydroelectric Project
Review: IEPR
Displaying 99 comments for the criteria specified in this report.

Id	Discipline	DocType	Spec	Sheet	Detail
4116130	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design) [**This item is flagged as a critical issue.**]

Hatch Comment 5/25/11- Dorena Intake: Need stability calculations of structure. Also conduit from intake structure to dam penetration does not appear to be well supported. What is basis for underlying bedrock?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

Response: 5/27/11 The stability of the intake will be evaluated during the final design, including addressing lateral loads. The penstock between the intake and the dam face (isolation valve) is not currently planned to be supported, except at the intake and at the dam. This is due to the problems associated with creating support foundations within the reservoir basin. The foundation issues also have resulted in not transferring significant loads from the penstock into the intake structure. A detailed analysis of the penstock is being completed to assure that the penstock, valve and dam can adequately accommodate the moments created by the proposed arrangement. The basis for the underlying bedrock at the intake is USACE Drawing DO-210-10 and DO-212-1 which show the channel that was cut within the reservoir basin for the RO intakes.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

We will review stability when available.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 08-Aug-11

2-0 Evaluation **Concurred**

Response: 5/27/11 The stability of the intake will be evaluated during the final design, including addressing lateral loads. The penstock between the intake and the dam face (isolation valve) is not currently planned to be supported, except at the intake and at the dam. This is due to the problems associated with creating support foundations within the reservoir basin. The foundation issues also have resulted in not transferring significant loads from the penstock into the intake structure. A detailed analysis of the penstock is being completed to assure that the penstock, valve and dam can adequately accommodate the moments created by the proposed arrangement. The basis for the underlying bedrock at the intake is USACE Drawing DO-210-10 and DO-212-1 which show the channel that was cut within the reservoir basin for the RO intakes.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

2-1 Backcheck Recommendation **Close Comment**
Will review when complete.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11
Current Comment Status: **Comment Closed**

4116131	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Hatch Comment 5/25/11 - Dorena Penstock: Thrust block restraint is not shown between siphon and powerhouse. Please explain.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**
Response: 5/27/11 The thrust blocks were not included in the 60% drawings. Thrust will be addressed in the 90% submittal.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
We wil review when information is available.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 08-Aug-11
Current Comment Status: **Comment Closed**

4116133	Civil	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design) [**This item is flagged as a critical issue.**]

Steve Hart Comment 5/25/11- Dorena Powerhouse: What is flood protection level? To what level is reinforced concrete? Wall thickness appears to be insufficient. Stability calculations? Design did not appear to include dewatering sump. High water level of 72,500 cfs flood flow appears adequate. To what return period frequency does this flood flow represent.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

Response: 5/27/11 The powerhouse is designed to be 'waterproof' up to the 755 level. All openings are located above elevation 755 (surrounding ground elevation). The reinforced concrete walls will extend to elevation 755, with CMU walls located above that level. The water surface elevation at the tailrace for the 100-year flood is calculated to be 736.4. While the tailwater equation developed is likely not applicable for extreme flows, the flowrate derived from the tailwater equation at elevation 750 (5' of freeboard) is calculated at 72,500 cfs. The wall thicknesses shown on the 60% submittal are not intended to represent the actual wall thickness. The actual wall thickness will be determined during the structural design of the walls (90% design). The interior wall face will remain as shown, with any additional thickness extending out. The stability calculations are to be completed with the structural design. A dewatering sump for dewatering the tailrace and the Kaplan draft tube and penstock is provided. It is shown on drawing PH-2, and consists of a circular manhole section with a Flygt duplex pump system. The sump can be isolated from the tailrace via a slide gate located in the tailrace near the powerhouse. Bulkheads at the draft tube exit will allow the Kaplan unit to be dewatered while the Francis unit is in operation.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

The return period frequency of this flood flow should be discussed in future documents.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116134	Civil	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Steve Hart Comment 5/25/11 - Dorena Guard valve, How is penstock protected in the event of penstock rupture? What is rational for not having a TIV for the Kaplan Unit?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

Response: 5/27/11 There are three valves that can be used to stop flows in the event of a penstock failure. The penstock will be monitored at the siphon house for pressures and flows, and if there are excessive flows or reduced pressure based on reservoir elevation, the Emergency Closure Valve (E-Close Valve) located within the siphon house will be signaled to close. The E-Close valve will be DC operated utilizing a battery rack within the siphon house. This valve will isolate the section of penstock between the dam and the powerhouse. The final option to isolate the penstock consists of a 120" butterfly valve located at the upstream face of the dam. This valve will be used only in the event of a failure of the E-close valve, or to isolate the penstock through the dam for inspections or maintenance. A 120" butterfly valve (Kaplan Guard valve), is housed in a valve vault located approximately 80 feet upstream of the powerhouse will be used to isolate the Kaplan turbine. The guard valve will be closed whenever the turbine is not operating. The valve location was selected to keep the valve depth at a minimum. Due to the round to rectangular transition and the rectangular spiral case, locating the valve within the powerhouse was not practical.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

We appreciates the further explanation. Upon further review of valving configuration, we wish to discuss further the design of the upstream butterfly valve at upstream dam face. With long stem operator, operation/reliability could be at issue. It may be better to relocate this valve immediately downstream of the dam; such design revision would need to be discussed with COE and Symbiotics. We will examine the valve and operator in more detail as information is available.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

2-0 Evaluation **Concurred**

The upstream closure valve was required as a redundant valve to the E-close that is located immediately downstream of the dam. While the butterfly valve is unconventional, it was selected by the Owner as their first choice, as a surplus valve was available. The valve operator is unconventional for this application, but similarly operated valves exist. The actuator company that is designing the actuator, stem, and supports indicate that this configuration has been successfully completed at other locations. Submergence of the valve is not a concern to the manufacturer.

Submitted By: spencer uminski (208-745-0834) Submitted On: 10-Aug-11

Backcheck not conducted

Current Comment Status: **Comment Closed**

4116137	Civil	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Steve Hart Comment 5/25/11 - Dorena Access Road. Where is it to the siphon building? To what flood level is road accessible to the powerhouse. Has Hatch received drawing C-10.1; this was not provided in document that was provided for Hatch review.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

Response: 5-27-11 The access road to the siphon house is shown on Drawing C-10.1. The access to both the powerhouse and siphon house parallels the river from Spillway Road. The elevation of the road at the start of the road improvements is at elevation 740. The projected flows at a tailwater elevation of 738 (2' of freeboard) is 15,915 cfs, which is in excess of a 100-year flow. We do not have topography of the road downstream of the connection point, but it generally parallels the river. Raising the access road between the powerhouse and the existing pavement is a possibility, particularly as a means of utilizing the excess material excavated from the project.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 08-Aug-11

Current Comment Status: **Comment Closed**

4116138	Civil	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design) [**This item is flagged as a critical issue.**]

Keith Moen Comment 5/25/11 - Dorena Dam stability. Where are calculations to show dam stability with new penetration? As part of Section 408 permit, such analysis will be required to illustrate that mass reduction from penetration will not substantially reduce stability of dam section.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

Response: 5-27-11 Dam stability analysis has not been required by the Corps and has not been performed. This was addressed in initial meetings with the Corps and de-stabilizing (driving) forces or reductions in resistance forces were not anticipated. Additional discussion of this could be provided.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Dam stability analysis should be performed.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11
Current Comment Status: **Comment Closed**

4116139	Civil	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Keith Moen Comment 5/25/11 - FEA model information - Information on FEA analysis of Dam at pipe penetration (software, model development, assumptions)

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**
Response: 5-27-11 The software being used for the FEA is ANSYS Structural. The features are being imported into ANSYS from AutoCAD geometry using ANSYS DesignModeler. The mesh is created by ANSYS to fit the anticipated with a denser mesh in the areas of particular interest. The different features (dam, penstock, grout zone, stiffeners and subsets of each) are subsequently "zipped" together using an ANSYS geometry interface. Bingham will prepare additional detail on the assumptions and conditions being analyzed and forward to Symbiotics.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Analysis will be reviewed further after presentation of calculation package.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 08-Aug-11
Current Comment Status: **Comment Closed**

4116140	Civil	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Keith Moen Comment 5/25/11 - Hydraulic Calculations. Calculations for head loss and TDG dissipation for tailrace at Dorena Lake project

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**
Response: 5-27-11 These will be assembled and forwarded to Symbiotics by Friday, April 1.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Thank you.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 08-Aug-11

Current Comment Status: **Comment Closed**

4116142	Civil	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Steve Perret Comment 5/25/11 - Foundation Calculations for Intake at DL, Analysis of horizontal loading for intake structure at the Dorena Lake project

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**
Response: 5/27/11 The final design of the intake structure has not been completed. Horizontal loading will be addressed. Horizontal loads from seismic accelerations on the penstock will be determined from the FEA.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Will review when analysis is complete.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116143	Structural	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Keith Moen Comment 6/01/11 - Present additional information related to the assumptions, loads, load transfer and modeling techniques associated with the Finite Element Analysis (FEA) as it relates to the dam, penstock and intake structure. This will include addressing all loads and development of simplified free-body diagrams showing the location and the nature of the various loads.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**
Response 6/6/11: Will be included in 408 Submittal.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Will review when submitted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11
Current Comment Status: **Comment Closed**

4116144	Structural	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Keith Moen Comment 6/01/11 - Evaluate loading conditions to assure that the worst case scenarios are evaluated. The worst case conditions may not be any of the required conditions (per USACE guidelines) due to the complexity of the project. This will include: 1. Typical summer reservoir levels combined with OBE and MCE events. 2. Other reasonably possible combinations that may become evident.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**
Response 6/6/11: We understand your concerns and will investigate the worst case conditions and include them in our load conditions

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Will review when sumbitted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11
Current Comment Status: **Comment Closed**

4116147	Structural	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Keith Moen Comment 6/01/11 - Perform an additional load condition where the intake 'spuds' are modeled with a pinned connection at the foundation (they are currently constrained vertically, but free to move horizontally). It is intended that this analysis, along with the non-pinned condition, will bracket load transfer conditions and resulting stresses, deformations, and deflections. Review the support conditions at the upstream end of the penstock, and revise the model to better reflect the actual support conditions.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

Response 6/6/11 The connection detail was re-evaluated based on our conversation with you. We have adjusted the model to reflect this new condition. We will model both a pinned connection and a free connection and evaluate the results.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Will review when submitted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116149	Structural	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Jim Rutherford Comment 6/01/11 - Review the joint at the intake structure/penstock to provide additional flexibility in mating up the two elements.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

Response 6/6/11: The connection detail was re-evaluated based on our conversation with you. The joint will consist of two half pipes that clamp over the intake and penstock, creating a better load distribution.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Will review when submitted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 12-Aug-11

Current Comment Status: **Comment Closed**

4116150	Structural	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Jim Rutherford Comment 6/01/11 - Develop, in conjunction with the contractor, a method for installing the penstock section between the intake trash rack and the upstream closure valve.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**
We have discussed with the contractor, and they are looking at options. The current plan is to install in two pieces using a barge-mounted crane.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**
WIll review construction plan when submitted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116151	Structural	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Chris May Comment 6/01/11 - Upstream Closure Valve 1. Address the ability of the upstream closure valve to adequately function under the loads and moments being transmitted through the valve. This will include discussions with the valve manufacturer, assessment of deformation of the critical shapes and clearances. 2. Address the adequacy of the bolts and flanges to effectively transmit the loads across the valve. 3. Address the suitability of the upstream closure butterfly valve to be used in submerged conditions. Identify any remedial actions required to assure it will function properly in the submerged condition. 4. Work with the valve and operator manufacturers to develop the final operator configuration for the upstream closure valve, and provide complete designs for the operator platform, valve orientation, shaft supports, bearings and connections to assure a fully functional operator.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**
Owner has initiated a study by the manufacturer to evaluate the valve for the loads acting on it.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Will review when submitted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116153	Structural	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Jim Rutherford Comment 6/01/11 - Complete the dam stability evaluation and submit.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

response 6/6/11 Owner has initiated a study by the manufacturer to evaluate the valve for the loads acting on it. We have requested that they include the flange and bolts in the analysis.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**

This response does not correspond to the question. Stability will be examined when completed.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116155	Structural	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Jim Rutherford Comment 6/01/11 - Refine the detail for the rubber seal, seal plate and shear reinforcement at the upstream face of the dam at the bore.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

response 6/6/11: Preliminary discussions with the manufacturer indicate that the valve is suitable for submerged operation. A seal will need to replaced on the actuator, and body should be coated to resist corrosion.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Will review when submitted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116157	Structural	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Keith Moen Comment 6/01/11 - Confirm with the contractor the design assumptions on the bore and adjust the bore and penstock guide/supports as required to be in concert with the proposed method of constructing the bore.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

Repsonse 6/6/11 Discussed construction methods, and the current plan is to proceed as designed, with road header, supports and installation of the pipe in sections, with welding of the penstock outside of the bore.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Will review construction plan when submitted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116158	Structural	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Steve Perret Comment 6/01/11 - Provide the soil loading conditions used for the powerhouse, siphon house and tailrace wall designs.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

The soil loading will be identified in the geotechnical section of the 408 Submittal design report.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Will review when submitted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116159	Structural	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Keith Moen Comment 6/01/11 - Provide the design loads used for the training wall to be constructed in the existing outlet channel.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**
Response 6/6/11 Per USACE requirements the wall is to be designed as if water is on one side of the wall only. The design will include the embedded reinforcement in the existing concrete, and will be included in the 408 Submittal design report.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Wil review when submitted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11
Current Comment Status: **Comment Closed**

4116161	Hydraulics	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Carl Mannheim Comment 6/01/11 - Provide the completed CFD model report.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**
The CFD report will be included in the 408 Submittal design report.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Will review when submitted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11
Current Comment Status: **Comment Closed**

4116164	Cost Engineering	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Steve Hart Comment 6/01/11 - Potential maintenance and capital cost impacts to the hydroelectric project 1. Service life of the rubber dam will be investigated. 2. Fine bubble diffusers have been used at a similar project and have recently been replaced after 18 years of service. 3. If a separate TDG de-gassing channel is required, it is probable that construction costs would increase. 4. Submerged nature and service life of the upstream valve. This is being investigated as described above. 5. It is expected that blowers will have a service life of less than 20 years. We will inquire of the manufaturer about projected service life given probable operating schedules. 6. Turbines and generators are likely to have a normal service life and required maintenance, based on our perceived quality of fabrication by the manufacturer. The operating personnel are experienced in maintaining and operating hydroelectric projects. 7. Required dewatering during construction has been discussed with the contractor since the meeting with Hatch. The contractor appeared to understand the extent of necessary dewatering. 8. Additional soil excavation may be required for temporary excavation slopes as necessary for slope stability. 9. Additional rock excavation is always possible, but is likely to be minimal if required by the proposed construction. 10. If it is required to provide a "fixed" foundation for the intake structure, construction costs would increase for drilling, placing and grouting pile-like pipe inserts in the spuds. 11. If intermediate supports for the upstream penstock section are required, additional construction costs would be incurred. 12. In conversations yesterday, the contractor indicated that he intends to use a large barge-mounted crane for installation of the upstream penstock and intake structure, greatly reducing the potential for cost increases related to that element of construction.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

We are a bit confused by this comment.

Submitted By: spencer uminski (208-745-0834) Submitted On: 10-Aug-11

1-1 Backcheck Recommendation **Close Comment**

This issue has been address as part of independent engineer financial review process.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116165	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design) [**This item is flagged as a critical issue.**]

Steve Perret Comment 6/6/11 - Dorena Seismic Design. Dorena Project seismic criterion appears to be too low and final design will need to reflect a criterion consistent with the USACE

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

Response: 8-1-11 Bingham Engineering (Bingham) generated three response spectra: 1."MCE" for building structures 2.MCE for critical strucures (dam) and used in the FEA. (In our case the MDE equals the MCE, so the acronyms may have been used interchangeably.) 3.OBE for load combination with "coincident pool" and for construction condition and used in the FEA. The "MCE" Bingham developed for building structures (powerhouse and siphon house) is controlled or influenced by building codes. Our MCE used probabilistic methods associated with the USGS hazard maps with the IBC or ASCE option and resulted in a max SA of 0.62 g at 0.2 seconds, very much like the 2009 NEHRP MCE on the Hatch derived response spectrum. Our structural engineers then factored the Sds and Sd1 values for structure ductility. This resulted in a coefficient for base shear of less than 0.1 g for the powerhouse and greater than 0.1g for the siphon house due to its critical nature of housing the E-close valve. The plots presented during your visit, and subsequently transmitted in our June 3 memo, were those for use in the FEA not in design of the buildings. They were developed using deterministic methods as recommended and outlined in EM 1110-2-6050, EM-1110-2-6053, and EM 1110-2-1806. This is the "traditional" method using relationships of magnitude, distance to the site, type of fault, and attenuation for the near and large capable faults. However, much more sophisticated attenuation models are currently available than we used 30 and 40 years ago or even 15 years ago. We used 3 models (Idriss, Abrahamson & Silva, and Geomatrix) of which Abramasona & Silva was most critical. The coefficients and equations of these models produce the complete response spectrum. The "capable" faults were generated by the USGS website.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

The response spectrum was from the USGS, not Hatch derived. Suggest consultation with USACE to determine is seismicity is adequate in their view.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116166	Hydraulics	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Carl Mannheim Comment 6/6/11 - Dorena Intake Design 1. Hatch needs to see the analysis for checking the Dorena Intake against air entraining vortices, which can impact generation, e.g. breaking siphon. Froude number? 2. Debris loading is an issue as the intake is front of the spillway structure. Need to address expected debris loading; how the intakes will be cleaned (or if trashraking equipment might later be required or even be effective); and means and cost of cleaning the trashrack/fishscreens.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

Response 6-8-11: 1. The vortex analysis has been e-mailed separately. Based on the analysis, vortex formation should not be an issue at the low pool, maximum flow condition (worst case). 2. Debris loading has not been considered a major issue for multiple reasons: a) the approach velocity to the screens is very low (less than one-foot-per second during peak flows); b) the screen shape (peaked) will shed debris that is not held in place by the through-screen velocity; c) there is 'storage' below the intake trash rack - the trash rack is approximately 8 feet above the bottom of the reservoir, allowing any shed debris to fully clear the trash rack; d) the intake structure is inside the log boom. Submerged, semi-buoyant debris may be experienced by the intake trash rack. Due to the low approach velocities for both the intake and the ROs, impact forces have been assumed to be minimal. Due to the low approach velocity, there will be minimal headloss across the trash rack, so detection of debris on the trash rack will not be likely until a significant blockage is present. The degree of blockage on the intake trash rack will be monitored by comparing the penstock pressure with the reservoir level, and an alarm tripped should an excessive difference be determined. The area of the trash rack has been increased approximately 20% over the required area to provide some 'cushion' in meeting the required approach velocities. It has been assumed that the trash rack would be inspected on a routine basis (annually, likely in February, while reservoir is low, and the winter flood flows are over) and cleaning performed as necessary. Cleaning the trash rack will be manually performed utilizing divers. While the effectiveness is unknown, some cleaning is anticipated whenever the siphon is broken and flows are reversed through the trash rack. Should excessive headloss across the trash rack be detected, plant operations would have to cease until the screens are cleaned in order to prevent damage to the trash rack and structure.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Thanks

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116168	Construction Phasing	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Steve Hart Comment 6/6/11 - Dorena Dam bore. What is the impact to the construction schedule if the dam bore work is not completed prior to the USACE permitted schedule, e.g. to what date would the plant be commissioned, if a delay occurred?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

Response.6-8-11 If the bore is not completed prior to the beginning of the fill cycle on the rule curve (February 1), the bore work could not be completed until the following November. Impacts to the Commissioning date would be dependent on the work completed prior to November. A commissioning date has not been estimated due to the number of factors that would affect the date.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Thanks for the clarification.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116169	Civil	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Steve Hart Comment 6/6/11 - Powerhouse Design flood, what is it?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

Response: 6-8-11 The 10,000-year release at Dorena has been estimated at 19,500 cfs based on the Log-Pearson analysis performed on the 59 years of reservoir releases . The estimated tailwater level at 19,500 cfs is 739.1 feet. The threshold elevation of the powerhouse is 755.0. Note that the threshold level is above the maximum spillway capacity of 97,500 cfs (estimated tailwater level 753.3).

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Thanks.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 12-Aug-11

Current Comment Status: **Comment Closed**

4116171	Regulatory	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 60% Design)

Steve Hart Comment 6/6/11 - Dorena Tailrace Fish Barrier. The deadline for submitting the final design to FERC was April 11, 2011. Did this occur? Please provide submittal.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

Response 6-8-11 A draft of this plan was filed with the FERC on December 10, 2009. Comments were received from the Oregon Department of Fish and Wildlife (ODFW) and National Marine Fisheries Service (NMFS) on January 29, 2010. The applicant met with biologists and engineers from the U.S. Fish and Wildlife Service (USFWS), ODFW, and NMFS on March 5, 2010 to discuss revisions to the plan that addressed their written comments. A revised plan was filed with the FERC on April 19, 2010. Comments from the FERC on this revised plan were received on April 11, 2011. These comments requested additional consultation and revision of the Tailrace Barrier Design and Post-Construction Monitoring Plan. A revised draft plan was circulated on April 21, 2011 to provide resource agencies with another opportunity to comment on the revisions made in response to the concerns outlined and addressed during consultation in 2010. Symbiotics met with biologists and engineers from ODFW, and NMFS on May 18, 2011 to discuss revisions to the plan. Consultation is ongoing and a final plan, will be submitted to the agencies in late June. Once NMFS approves the monitoring plan component, a final version will be submitted to the FERC.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Thanks for the clarification. Will review once plan is submitted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116174	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report) [**This item is flagged as a critical issue.**]

Chris May Comment 7/28/11 - How is in intended that the siphon be started? A procedure is required. Which valves are open and which valves are closed? Is it the intention to close the 120" Kaplan isolation valve to pull the vacuum? Is water drawn up through the 56" bifurcation as well as the intake? Are all fittings air tight? What extent of piping is subject to vacuum?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

The both the Francis and Kaplan TSVs will have to be closed in order to prevent air from being sucked in through the air valves located downstream of the valves. At siphon initiation both valves will be closed, since whenever a turbine is not being operated, the TSV is closed. The automated butterfly below the air valve at the E-Close valve will have to be closed. All fittings, valves and flanges will have to be water tight to allow the siphon to be created. The maximum vacuum required to prime the pump is 19' of water, or 16.77" Hg. The penstock has been evaluated for this negative pressure.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Note that all fittings will need to be air tight not just water tight. See comment regarding the negative pressure.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116177	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report) [**This item is flagged as a critical issue.**]

Chris May Comment 7/28/11- It is noted that FEA will be used to check strength of penstock for external pressure. This should be backed by a manual analysis.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

A manual analysis of the penstock has been performed, please refer to Section 9 of the DSR.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

At present both Section 9 and Appendix D do not address buckling due to external/vacuum pressure. The vacuum is simply treated as a hoop stress. Suggest future calculation include these analyses.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116178	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report)

3. Chris May Comment 7/28/11- Some of the bend miter angles look to be very severe. Upstream of the butterfly valve the 45 deg angle has two miters for an angle of 22.5 deg. This may be a bit high for a penstock. USBR Engineering Monograph No 3 recommends 5 to 10 degrees so we would usually use around 7.5 degrees. However, AWWA C208 limits the angle to 15 degrees while ASCE Manual 79 "Steel Penstocks" limits it to 22.5 degrees. It is recommended that more miter joints be provided to comply with USBR while also reducing head loss. It is noted that 3.2.2 of the report states that miter bends would be fabricated with a maximum deflection angle of 15 degrees per AWWA C208. This is not what it shown on the drawings.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

Points taken. We will review the upstream bends and assess their adequacy

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116179	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report) [**This item is flagged as a critical issue.**]

Chris May Comment 7/28/11- Is it intended that the penstock be hydrostatically tested as required by Em1110-2-3001 for penstocks with operating head greater than 100 feet? If not, then need justification. In this respect it is noted that ASCE Manual 79 considers hydrostatic testing to be non-mandatory.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

In order to meet EM 3001 requirements, the penstock will be hydrostatically tested to 150% of working pressure. Since we will be testing against valves, pressurizing to 150% of allowable stresses is likely not achievable.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

This sounds contradictory and needs more consideration. Either 150% is achieved or a waiver is needed. It would be up to the design engineer to propose a waiver of the testing, with justification, to USACE for acceptance.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116180	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report) [**This item is flagged as a critical issue.**]

Chris May Comment 7/28/11- It is noted that Em1110-2-3001 requires radiographic testing of all longitudinal seams. It also appears that this requirement is intended to be complied with. There is a concern, however, that such testing does not pick up on laminar defects. Typically, in our experience, it is more common place to test welds by the ultrasonic method using certified welding inspectors. ASCE Manual 79 allows either radiographic testing OR ultrasonic testing to achieve a joint factor of 1.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

In order to comply with EM 3001, all welds will be 100% radiographically tested. The longitudinal welds will be shop welds, and could be ultrasonically tested if necessary. If the USACE will accept ultrasonically tested welds, the ultrasonic welds could be substituted for the radiographic method.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Suggest consultation with USACE.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116181	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report) [**This item is flagged as a critical issue.**]

Chris May Comment 7/28/11- Have temperature effects been fully considered for the penstock? It is noted that there are no expansion joints or Dresser couplings. The bend downstream of the siphon house is exposed and could see a temperature range of +/-100 degF when dewatered. The buried penstock can see temperature variation due to water temperature variability. Need to fully consider thermal movement.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

Temperature affects have been included in the analysis. We assumed a 60 degree variation, which with an assumed installation pressure of 50 degrees, covers -10 to 110 degrees, which we felt covered the normal range. Water temperature is expected to vary by no more than 10 degrees.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

It is noted that the calculations contained in Appendix D use a temperature range of 60 degrees. The analysis considers longitudinal thermal stress which can only occur if there is no movement. If there is no movement then high thrust loads result. Can the CDF resist these high thrust loads? Please consider in future analysis.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116182	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report)

Chris May Comment 7/28/11- 30 ft radius on the 55" diameter penstock bend is perhaps excessive. Typically the radius should be 3 to 5 times the diameter. This would mean a bend radius of 14.0 ft to 23.3 ft for the 56 inch pipe.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

The 3 to 5 diameters recommendation is for minimum radii. Exceeding the limitation should pose no additional issues.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Agreed but why make larger than needed?

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116183	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report) [**This item is flagged as a critical issue.**]

Chris May Comment 7/28/11- ¼" thick steel bars for the trashrack seems thin. Typically we would use 3/8" minimum. Has a corrosion allowance been assumed? Have HDPE plastic racks been considered?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

The ¼" bars increase the porosity of the screens. The screens will be galvanized, and are replaceable, so no corrosion allowance was made. HDPE or other plastic screens were not considered. Stainless steel and aluminum screens were discussed, but not advanced due to perceived higher costs by the Owner. If this issue is leading to problems, we can increase thickness of bars, and reassess supports for the additional weight.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

So no corrosion allowance? No consideration of HDPE?

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116184	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report)

Chris May Comment 7/28/11- Appendix N calculations have 3" deep bars whereas 2" deep bars are shown on drawing PS-2.1 Screen Detail 2 and Intake Picket 4. Calculations need to consider vibration of the bars due to vortex shedding which frequently dictates the spacing of the lateral bar restraints.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

The 2" is correct. New supporting calculations were prepared and will be included in the 100% DSR. The main intent of the 2" bars was to reduce weight. The frame will remain 3" x 3" angle. Vibration from vortex shedding was not considered. We will look into that condition.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Will review when available.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116185	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report)

Chris May Comment 7/28/11- Drawing PS-2. Intake connection 6 shows a fabricated ring around the 120" OD shell. Why is there a gap around this ring? Will it get filled with sediment/debris? Why not clamp with a seal?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

The detail has been modified, however the gap remains. The gap is to provide some limited range of misalignment between the intake structure and the penstock. The gap dimension is not to exceed 7/8", the same as the trash rack screen opening.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116187	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report)

Chris May Comment 7/28/11- Drawing PS-3.2. The flange for the Allis Chalmers Butterfly Valve appears to be non-standard. Need to ensure flange strength is adequate.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

You are correct, the AC valve flange dimensions do not match AWWA C207, Class B. We matched the flange of the butterfly valve. The thickness of the flange is also greater than the AWWA Class B flange (3 7/8" vs 3.5"). The O.D. of the companion flange is 138" – the drawing has been modified.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116188	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report)

Chris May Comment 7/28/11- The butterfly valve data sheet indicates the design temperature as 40 to 120. How are temperatures lower than 40 accommodated? Also the data sheet gives the design flow as 585cfs. Is the valve suitable for flow of 812cfs?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

The study being performed by Rodney Hunt will address the adequacy of the valves. We will have them address the temperature issue as well.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

We will review when submitted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116190	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report)

Chris May Comment 7/28/11- It is noted, from Appendix N, that Rodney Hunt are being asked to provide an analysis of the valve to determine whether it can "adequately function with the loads (vertical load and moment) that will be imposed by the upstream penstock". This should include the flanges and bolts. Most valves are not designed with this intent so there is some concern that the valve may not be able to transmit the required loading. In the event that it cannot transmit the load is there a "Plan B"? Could the upstream penstock be independently supported? Perhaps off the cofferdam? Also, if the applied penstock loads for final design are found to change, will Rodney Hunt be asked to recheck?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

The loads provided to Rodney Hunt are the final design loads. We will request that they model the flanges and bolts as well as the valve. 'Plan B' would be to support the butterfly valve, possibly via the modified coffer dam, or some other structure mounted to the face of the dam.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay, we will review when submitted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116191	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report)

Chris May Comment 7/28/11- Drawing PS-4.2 shows stiffeners 2.5" high contrary to drawing PS-4.2 which shows 2" high. The stiffener is noted to be an angle that is only ¼" thick. This does not seem adequate for a thrust ring. Normally thrust rings are continuously welded to uniformly transfer bending to the shell. It is suggested that the present stitch weld (2" in 12") be reconsidered. The calculation for the thrust ring included in Appendix D ignores bending. Ensure that the calculation of the thrust ring is in accordance with 9.6.2.1 of ASCE Manual 79.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

The dimension on PS-4.1 has been modified to the 2.5" dimension. Two of the proposed rings have been deleted. The detail has been modified to reflect the rings being continuously welded on both sides, and the angle increased to 2½"x2½"x ½". The calculations for thrust rings from ASCE No. 79 have been completed and are included in the 100% Design Report.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay, we will review when submitted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116192	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report)

Chris May Comment 7/28/11- Rubber dams are not well suited for flow control purposes. Will the rubber dam be used either fully inflated or fully deflated?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

The rubber dam will be either fully inflated or fully deflated. NO flow regulation is intended. Note that it is not truly a dam, the water level differential across the dam will be inches.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Okay

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11
Current Comment Status: **Comment Closed**

4116193	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report) [**This item is flagged as a critical issue.**]

Chris May Comment 7/28/11- The bifurcation crotch plate design contained in Appendix D does not take into consideration that the nomographs are based on a stress of 30,000 psi. It is necessary to multiply the working pressure by a factor equal to 30,000 / Fa, where Fa is the allowable stress. It should also be noted that there are a lot of uncertainties in the nomograph procedure that make the design not conservative enough. Typically an FEA analysis shows stresses higher than those from the nomograph method. Consequently it is highly recommended that an FEA be performed for this reinforcing plate. Is there a concrete anchor block at the bifurcation?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**
The analysis was reworked to meet the required stresses of EM 3001, using the working pressure factor method. The revised calculations will be included in the 100% DSR. If a FEA of the crotch plate is required, we can perform that analysis. We did not intend to perform a FEA on the crotch plate. The bifurcation will be encased in CDF.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
A finite element analysis is highly recommended.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11
Current Comment Status: **Comment Closed**

4116194	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report) [**This item is flagged as a critical issue.**]

Chris May Comment 7/28/11- A calculation is required for buckling of the penstock due to external pressure. There are three sources of external pressure that need consideration. (1) vacuum from siphon (2) grouting pressure and (3) soil loading. Any stiffener rings required for external pressure are required to meet the moment of inertia requirements of ASME Section VIII UG-28. Need a calculation. See also section 4.4 of ASCE Manual 79.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

External pressures were addressed in Section 9 of the DSR. We have not verified the requirements of ASME Section VIII, we will look into that. We did refer to Section 4.4 in sizing the stiffener rings.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Buckling has not been addressed by Section 9 or Appendix D.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116195	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report) [**This item is flagged as a critical issue.**]

Chris May Comment 7/28/11- How are all the thrust loads resolved for the buried portion of the penstock?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

Through soil support, a thrust ring in the valve vault, and the powerhouse.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

This does not appear to be shown in calculations to date. Suggest that this be looked at more closely with load diagrams for the entire penstock.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116196	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report) [**This item is flagged as a critical issue.**]

Chris May Comment 7/28/11- A calculation for buried penstock with soil loading is needed.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**
Refer to Section 9 of the DSR

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Both Section 9 and Appendix D do not presently address CDF properties or loading.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116197	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report)

Chris May Comment 7/28/11- Head loss calculation at bifurcation included in Appendix L uses extrapolation that may make the result unreliable. Consider using a taper at the branch to increase the area at the branch take off point. With a flow of 200cfs in the main pipe the velocity head at the branch is about 0.1ft. The determined loss coefficient of 7.6 amounts to 0.76ft of head loss which is quite considerable.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**
We will review our headlosses through the bifurcation, and if warranted, we will consider a taper section.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116198	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report)

Chris May Comment 7/28/11- Valve support bolts shown on PS-6.1 look unstable (too thin and too tall). Suggest this support be made more substantial.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**
The supports were designed to allow some adjustment post valve installation. We did look at the slenderness ratio, and the bolts are acceptable as designed. If the Owner desires, we can go with a 2½"x 2½"x¼" square tube inside a 3"x3"x 0.203" wall square tube with a welded joint. This detail provides no post construction adjustment, but will appear more robust.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
No further comment.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116199	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report)

Chris May Comment 7/28/11- Drawing PS-7. The support plate for the manhole hinge would be better supported off the 20" pipe spigot instead of the pipe shell, to avoid local stresses on the pipe shell.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**
The detail will work as designed. Aside from any weld stresses, the local stresses created by the opening and closing of the manhole will be minimal, and only be applied when the penstock is not pressurized. We could eliminate the hinge assembly completely if necessary, but we feel it is a nice feature.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
As a general rule it is never a good idea to make unnecessary attachments to a penstock.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 08-Aug-11

Current Comment Status: **Comment Closed**

4116200	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report)

Chris May Comment 7/28/11- Drawing PS-8. Suggest that fillet welded joints on the penstock be avoided. They have low efficiency. Also, single fillet lap joints are not suitable by Table UW-12 of ASME Code since the size limitation is exceeded.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

The lap joint will be used in one location only, the connection at the joint upstream of the Upstream Closure Valve where we have a telescoping section to facilitate the installation of the penstock. This weld is at the critical – non-critical boundary. All other penstock welds will be the double penetration butt welds.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116201	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report)

Chris May Comment 7/28/11- Drawing PS-9. 1428mm converts to 4.69ft not 4.58ft (56.2").

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**

You are correct. Now the drawings are too.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116203	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report)

Chris May Comment 7/28/11- Drawing PS-10. Transition development suggests the transition would be rolled out of one piece? This is probably too big to roll. Suggest welded construction between flat and curved plates.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 06-Aug-11

1-0 Evaluation **Concurred**
We will review the shop drawings from the fabrication shop selected by the Contractor. They may opt to fabricate as you suggest. They may have to fabricate in pieces for transportation purposes.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116395	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report STABILITY ANALYSES) [**This item is flagged as a critical issue.**]

John McClung Comment 7/31/11 Dam Stability Analysis No results for the sliding stability analyses of Dam Blocks 12 and 13 have been presented. No results for the overturning stability analyses of Blocks 12 and 13 have been presented. No results for the depth of tension during the design earthquake have been presented for Blocks 12 and 13, and therefore no analyses have been presented for a post-earthquake (cracked base) condition. No explanation of uplift pressure has been given.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**
Refer to Section 15 of the 100% Review Design Study Report

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 11-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Documents will be reviewed.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116396	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Section 15.4.1 Defined Loads)

John McClung Comment 7/31/11 No details are given of the grout curtain and drains. There is no direct evidence that the drains are effective. Without piezometric readings, we do not agree that it is appropriate to use a drain effectiveness factor of 90%. An absence of visible seepage does not necessarily mean an absence of piezometric pressure.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**
Refer to the 100% Review Design Study Report.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 11-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11
Current Comment Status: **Comment Closed**

4116397	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Section 15. Rock Strength and Friction Values)

John McClung Comment 7/31/11 The USACE trendline on Figure H-11 is not appropriate to the stress range that applies along the shear plane on Figure 15-10. A more acceptable interpretation would be to use the results from the tests at the expected in situ normal loads, which would give C close to zero rather than C = 950 psi. We do not agree that "Alternate interpretation of the data would result in higher apparent friction angle and greater cohesion".

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**
Will review and address in revised Section 15 - Dam Stability

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 11-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11
Current Comment Status: **Comment Closed**

4116398	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Section 15.6 Initial Estimate of Block 13 Stability)
[**This item is flagged as a critical issue.**]

John McClung Comment 7/31/11 We do not agree with the statement that "The high cohesion creates very large resisting forces" because we do not accept that there is a high cohesion. The orientation and spacing of jointing in the bedrock should be shown on the profile of Figure 15 10 and taken into account when selecting the trial failure surfaces to be analyzed.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**
We will review and revise Section 15 if necessary.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 11-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Okay, will review revised section when complete.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11
Current Comment Status: **Comment Closed**

4116399	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Section 4.6.2 Rock Strength Properties)

John McClung Comment 7/31/11 C=450 psi or 34,800 psf ......" cannot be correct. This error is repeated in Section 4.9.2.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**
You are correct. It weas a typo. THe correct value should be 64,800 psf.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 11-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11
Current Comment Status: **Comment Closed**

4116400	Construction Phasing	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Section 18.7.3 CONSTRUCTION ACCESS)

John McClung Comment 7/31/11 Reference is made in this Section and in Section 18.13.1 to a dam penetration work pad. This should be shown on a drawing to confirm that there will be space to back out a road header, muck out and load the tunnel spoil onto a truck, and contain any water emanating from the bore. It is not obvious how this can be fitted into the space that is available. This is a critical issue

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**
A note has been added to the drawings to construct a temporary pad to the dimensions required by the contractor. The pad will incorporate the siphon house pad. Material generated from on-site excavations will be used to construct the pad. The contractor is to submit the pad layout for approval prior to starting construction.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116401	Civil	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Section 3.8 POWERHOUSE)

John McClung Comment 7/31/11 Since there is no service bay within the powerhouse, an external laydown slab should be provided for future maintenance work.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**
The parking lot area is expected to be used as a staging area and laydown area. A concrete pad has not been included. If the Owner desires a concrete pad, one can easily be located within the parking area.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
A concrete pad is recommended.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116402	Civil	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Section 4.7.2 FLOOR SLABS)

John McClung Comment 7/31/11 Section 4.7.2 calls for 12" of structural fill, whereas Section 3.6.3 calls for 6" of crushed gravel under slabs.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**
The comment in Section 3 has been modified.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116403	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report,Section 4.7.3 LATERAL EARTH PRESSURES AND RESISTANCE)

John McClung Comment 7/31/11 We do not recommend reliance on the passive resistance of soil, because of the excessively large displacement of the footing that is required to mobilize full passive resistance. In this section all the pressures are erroneously given in pcf.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**
The values provided are equivalent fluid densities which are used to develop pressures. The language has been modified in the report to reflect this.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116404	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Section 4.9 EXCAVATION SLOPE STABILITY)

John McClung Comment 7/31/11 The excavation slopes have been analyzed using Bishop's Method. The rock face should also be checked using wedge analysis and taking into account the joint orientations.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**
Noted.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Will review when submitted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116405	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Section 14.9 SEISMIC LOADS)

John McClung Comment 7/31/11 It is not clear if the preliminary information used for calculating the standard OBE spectra came from building codes or from a site specific seismic hazard assessment. The Quaternary faults considered for the MCE evaluation have been presented in Table 14-5 to the maximum distance of 100 miles. The Cascadia subduction zone is located at a greater distance. However, regarding the potential for large earthquakes (over M = 8.5) and dip direction of the Cascadia Fault, it should be considered as one of the seismic sources for deterministic seismic hazard assessment. Considering of the previous comment, they referred to an unpublished USACE report that seems to evaluate the seismic hazard for dams in western Oregon. It is not clear what location was considered in the USACE report. This could directly affect the results for MCE and should be clearly addressed. The attenuation relations that have been used are out of date. A site specific probabilistic seismic hazard assessment should be carried out if there isn't one already.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**
The MCE developed by Bingham Engineering was not used in the FEA seismic analysis. The MCE data used was provided by the USACE from an unpublished seismic study for the Dorena Dam. We have requested the full seismic study that developed the MCE criteria used. The USACE has not provided the data. We have assumed that the USACE has accepted and approved of the methods used to develop the MCE data provided.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
It noted that - Matt Hansen and Dave Schofield (USACE) have indicated that the seismic criteria is acceptable.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116406	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Section 14.9.5 CASCADIA SUBDUCTION ZONE)

John McClung Comment 7/31/11 It has been assumed that Next Generation Attenuation (NGA) Relationships have been utilized in the USACE report. This would be inappropriate because the NGA relationships were developed for shallow crustal sources not for the subduction zones.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**

We have requested the full seismic study that developed the MCE criteria used. The USACE has not provided the data. We have assumed that the USACE has accepted and approved of the methods used to develop the MCE data provided.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Noted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116407	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Section 18.7 CONSTRUCTION APPROACH)

John McClung Comment 7/31/11 Staging areas, office and storage areas, stockpile area and desilting pond should all be shown on a drawing(s).

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**

Drawing C-1 shows areas identified for staging and stockpile areas. The contractor has advanced their own drawing to show all anticipated activities falling within the areas shown, with some additional office spaced located north of the powerhouse area.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Noted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116408	Construction Phasing	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Section 18.13.3 PENSTOCK INSTALLATION THROUGH THE DAM)

John McClung Comment 7/31/11 An explanation of how the length of penstock within the dam bore will be assembled so that the welds can be adequately tested. From the upstream face of the dam to the E-close valve, 100% x-ray testing is called for.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**

The penstock will be field welded at the portal to the bore, allowing full access for the double V butt weld and allowing full radiographic inspection of the weld. When the welding is complete, inspected and approved, the penstock will be advanced into the bore to the next section where the process will be repeated. Depending upon the capacity of the equipment utilized to install the penstock through the bore, multiple sections may be welded at once.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Noted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116409	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Section 18.21 SITE GRADING)

John McClung Comment 7/31/11 "Compaction requirements: 95% of maximum standard proctor density for structural areas, 95% modified proctor density in non-structural areas." This is the wrong way round.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**

Noted and modified in the Design Report. Thanks.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116410	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Section 18.22 RISK REGISTRY)

John McClung Comment 7/31/11 Regarding Risk 2 and Risk 3, comments have been made by others on the tight clearances of the bore and the risk of damage to the concrete. The 11 ft diameter bore (10 ft diameter penstock) has only 12" clearance from the gutter in the air vent gallery, about 24" from the edge of the steel box cofferdam, and 24" from the grouting tunnel. Risk could be reduced if the diameter of the approximately 85 ft length of penstock within the bore were reduced from 10 ft to 7 ft? That would increase the minimum clearance between the bore and the gutter in the air vent gallery from 12 inches to 30 inches, and other clearances from 24 inches to 42 inches. The upstream closure valve would also be reduced to 7 ft diameter and transitions from 10 ft to 7 ft diameter would be needed at each end. There would be a saving from the reduced cost of the smaller closure valve.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**

In order to meet the 2011 construction window we will have to proceed with the design and valves as planned. We do not believe there is adequate time to modify the design and procure different valves while still meeting an October 1 construction start date. While there are risks associated with the concrete bore, we do not believe them to be substantial enough to warrant a departure from the current design.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Noted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116411	Environmental Engineering	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Intake Structure with Trash Rack – Section 3.1 and Dwgs PS-1 to PS-2.1)

Comments from Steve Rainey July 27, 2011 Trash Rack lacks adequate small debris cleaning plan and facilities – During winter flood control low pool operation, storm events will send coarse and fine debris into the reservoir, and some will accumulate near the R.O. and new intake. Top of current Corps of Engineers RO trash rack elevation is approximately El 753. (Low winter pool elevation is 770.5.) It is angled approximately 10-15 degrees from vertical, and thus can be raked from above, but with difficulty. Existing trash rack clearance is 2'3", so smaller debris currently readily passes trash racks. Past Debris removal challenges may already have been coordinated with the Corps. Potential problem: With a 7/8-inch clear spacing between new trash rack bars, it is expected that far more small debris (such as currently passes the coarse trash rack) may accumulate. The following are potential needs and concerns: A. Far more debris could accumulate during low-pool periods, due to finer trash rack openings. B. As there is currently no fine trash rack in place, it is improbable that the Corps has any idea or experience of potential small debris loadings. This always leads to under-estimation of the potential problem. C. Manual debris removal (such as by divers) is never a good option if there does prove to be greater accumulation of fine debris D. There is currently not a sufficient plan to detect debris accumulation. Divers may not be able to detect magnitude of problem after turbid storm event, and total system head loss monitoring is inadequate to detect elevated debris-related trash rack differential unless it is appreciable (feet). E. Recommend monitoring trash rack differential separately. F. Recommend development of an adequate new trash rack small debris removal plan. G. Recommend at a minimum, that the intake design incorporate ability to readily add small debris-removal capability based on future need. H. Targeted fish for protection relating to trash rack design are non-anadromous and non-Endangered Species Act listed trout species residing in the lake. With average 1.0 fps average velocity through trash racks (assuming no debris accumulation), and 7/8-inch clear opening between bars, only trout seeking reservoir egress are expected to pass, and should be able to do so safely. Conversely, if there is excessive accumulation of small debris, fish could be impinged or entrained, and injured/killed at a higher rate. Visual evidence would be observed accumulation on the tailrace barrier.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**

There is a potential for fine debris collection on the trash racks, depending upon the buoyancy of the debris. The quantity of fine debris is unknown, and is expected to vary by seson and year. Cleaning by divers was our last practical choice. Mechanical cleaning of the screens is impractical. The trashrack differential is being monitored, however, as indicated, the losses through the screens are going to be small and difficult to detect. It ahs been recommended that data on the system losses be collected immediately (clean screen condtions) to develop a basis for determining when the losses increase to the point of needing to be cleaned. Note that additional screen area has been provided to reduce approach velocities to allowable even with 20% of the screen blocked. A small debris removal plan, aside from divers cleaning the rack, has not been developed. No provisions have been made to accommodate a future screening system.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 11-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Noted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 16-Aug-11

Current Comment Status: **Comment Closed**

4116412	Environmental Engineering	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Tailrace with Aeration, Fish Barrier screen, and Bulkheads – Section 3.10, Section 7, and Dwgs. TR-1 to TR – 9)

Comments from Steve Rainey July 27, 2011 Hydraulic conditions upstream of fish barrier screen were investigated by CFD modeling (Section 11) primarily in the context of regulating outlet gates, spillway stilling basin, spillway apron, and downstream armored and natural channels. The following comments address the tailrace channel, in the context of fisheries and aeration concerns. Radial length of the center guidewall (tailrace partition between the two Kaplan draft tube outlet tailrace channels) from the draft tube bulkhead slot to the tailrace barrier is approximately 47 ft. (Dwg. TR–2). Deflection angle for the two channels is approximately 33 degrees. Discharge velocity from the two draft tubes (each approximately 7 ft x 7 ft) averages near 8 fps at full Kaplan hydraulic capacity of 812 cfs. Each draft tube opening has a slight upward orientation. As flow through a fish barrier is supposed to be nearly uniform over the surface area of a diffuser-type barrier, the following are potential needs and concerns: A. Tailrace hydraulic conditions between the powerhouse and tailrace barrier, and downstream of the barrier, may be harmful to both anadromous and non-anadromous upstream migrating salmonids, for the following reasons: • Discharge from each draft tube will be highly unstable, and includes a spiraling jet that will result in an upwelling in the tailrace downstream of the powerhouse. Loss of nearly all of the draft tube velocity head in the tailrace upstream of the tailrace barrier will result in turbulence. Although the draft tube discharge jets will expand, a visible upwelling may occur 20 ft or more downstream of the powerhouse (approximately half way to or nearer the tailrace barrier). At full Kaplan unit capacity of 812 cfs, tailrace tailwater elevation increases from a minimum of 726 to 731, thereby incrementally reducing turbulence.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**

There will be some turbulence in the tailrace between the powerhouse and tailrace barrier as the approximately one-foot of velocity head is lost. Some upwelling and localized reverse flows may be experienced. Note that aeration may be occuring in this same area.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 11-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Noted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 16-Aug-11

Current Comment Status: **Comment Closed**

4116413	Environmental Engineering	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Tailrace with Aeration, Fish Barrier screen, and Bulkheads – Section 3.10, Section 7, and Dwgs. TR-1 to TR – 9)

Comments from Steve Rainey July 27, 2011 Tailrace hydraulic conditions between the powerhouse and tailrace barrier, and downstream of the barrier, may be harmful to both anadromous and non-anadromous upstream migrating salmonids, for the following reasons: • The approximate 33 degree tailrace (horizontal) deflection angle in each tailrace channel means that the draft tube discharge jet and water surface upwelling will be deflected leftward by the outside tailrace wall for each channel, toward the tailrace barrier. This bend in the flow channel will add incrementally to tailrace turbulence. Distinct upwelling will occur at these outside walls, and will be less noticeable at lower turbine discharges. However, surface flow in an upstream direction (toward the powerhouse) may be noticeable directly above the draft tube outfall at near the 812 cfs Kaplan turbine capacity.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**

Acknowledged that there will be some tubulence in the tailrace downstream of the powerhouse. There is approximately 1 foot of velocity head that must be lost. In addition to the turbulence, aeration may be taking place within the same area. There will be some variation of depth across the tailrace due to the training wall and curved tailrace configuration. The tailrace configuration was constrained due to the License. The training wall was installed to obtain more uniform flows at the tailrace barrier.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 11-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Noted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116414	Environmental Engineering	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Tailrace with Aeration, Fish Barrier screen, and Bulkheads – Section 3.10, Section 7, and Dwgs. TR-1 to TR – 9)

Steve Rainey Comment 7/27/11 Tailrace hydraulic conditions between the powerhouse and tailrace barrier, and downstream of the barrier, may be harmful to both anadromous and non-anadromous upstream migrating salmonids, for the following reasons: • Average barrier screen velocity (ratio of total flow to gross wetted diffuser area) should not exceed 1.0 fps (see NOAA Anadromous Salmonid Passage Facility Design Criteria and Guidelines, 2008). The proposed 1.19 fps average barrier velocity at Kaplan turbine capacity of 812 cfs exceeds the velocity criterion, but is close enough to potentially be acceptable to the state and federal fish agencies. • There is expected to be inadequate length of channel between the surface upwelling locations and the tailrace barrier for an adequate transition from turbulent unstable flow conditions to more stable and uniform flow to occur (recognizing that the outside tailrace channel entails a greater distance to the tailrace barrier). This is expected to result in an excessive range of point velocities across the tailrace barrier. At Kaplan turbine capacity flow of 812 cfs, and average barrier velocity of 1.19 fps, point velocities may range from a high near the outside wall of over 3 ft per second (fps) to a low near the inside bend of the tailrace channel nearer zero fps. (Section 11, CFD modeling, is not specific but generally affirms this velocity range.) This is inconsistent with NOAA Design criteria, which requires more uniform velocity distribution across the entire diffuser barrier. Reason: Upstream migrating salmonids, especially anadromous salmon and steelhead, often jump at diffuser bar racks with excessive point velocities, thereby potentially becoming injured or killed.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**

THe NMFS and ODFW have approved the design velocity of 1.19 fps at design flows. The normal flow releases during the critical periods are less than the maximum, and the velocities during the critical period are less than the 1.0 fps required. Measurement of actual velocities is required, and if excessive velocities are found, measures will be taken to mitigate the high velocities.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 11-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Noted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11

Current Comment Status: **Comment Closed**

4116415	Environmental Engineering	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Tailrace with Aeration, Fish Barrier screen, and Bulkheads – Section 3.10, Section 7, and Dwgs. TR-1 to TR – 9)

Comments from Steve Rainey July 27, 2011 1.5-inch clearance for the 3 ft wide panel at the outside of the tailrace diffuser barrier (TR-1) is greater than the 1-inch maximum NOAA diffuser barrier design, and may result in "gilling" smaller adult salmon or steelhead trying to pass the barrier, but becoming wedged between bars with the excessive clearance. Reason for the single larger-clearance panel is unclear.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**

The section of screen with 1.5" openings was requested by the Agencies (ODFW) to permit an escape route for ay fish that may become trapped wiith the tailrace section upstream of the tailrace barrier.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 11-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Noted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11
Current Comment Status: **Comment Closed**

4116416	Regulatory	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Water Quality)

Comments from John J. Pizzimenti 07/28/11 Water Quality Criteria The applicants design is attempting to meet a water quality criterion for dissolved oxygen and total dissolved gas (DO and TDG) that would be a worst case occurrence and assumes the highest standard that may apply for DO and a TDG that is already near and sometimes in violation with the existing facilities . The regulatory standards are as questionable as is the applicant's ability to meet them with the proposed designs.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**
The system is designed to meet the worst case DO requirements. While we tend to agree with your statement regarding the standards, we are bound by the License and must provide a design to mitigate DO.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Noted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11
Current Comment Status: **Comment Closed**

4116417	Regulatory	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Water Quality)

Comments from John J. Pizzimenti 07/28/11 Dissolved Oxygen Oregon Department of Environmental Quality (ODEQ) DO criteria are designed for protecting salmon and steelhead redds (eggs in gravel). The options are 11 mg/l. from Oct 15-May 15 or 95% saturation; or 9 mg/l. if intergravel DO exceeds 8 mg/l. The applicant has set the Dorena goal for 100% DO saturation at 16.5C or ~10 mg/l. Comment: It will be easier to achieve the lower standard of 9 mg and this may be worth considering because there will be a direct conflict of elevating DO with reducing TDG. Setting a higher the DO standard will make it difficult to achieve the TDG standard. It is unlikely that the project will be able to meet the DO standard without violating the TDG standard.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**

Your observations are noted. We recognize the dual standard, and are attempting to address both with the design presented.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116418	Regulatory	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Water Quality)

Comments from John J. Pizzimenti 07/28/11 Dissolved Oxygen The Biological Opinion indicates that there is no evidence that salmon or steelhead, wild or hatchery origin, have used the project tailwaters for spawning (or any other use) for a half century. The causes are many but all related to a mixture of mostly downstream human impacts including the existence of Dorena dam and upstream watershed degradation. Prior to settlement, it is believed that the area was marginal habitat for these species (BiOp, August 2008). Thus, my first conclusion is that the criteria for both DO and TDG will be difficult to meet as a paired goal. My second conclusion, that a primary benefit of trading the cost of this public benefit (fish protection) for another public benefit (renewable energy with no net impact to existing conditions), is a dubious trade. These societal tradeoffs can be measured in equivalent metrics (CEATI, 2010: Non-energy benefits of hydroelectric power); but a calculator is not needed for this comparison since one appears to be near zero.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**

While we agree with your statement, we are bound by the License and must provide a design to mitigate DO. Your observations are noted. We recognize the dual standard, and are attempting to address both with the design presented. Elimination of the requirements of the License is not a practical solution.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116419	Regulatory	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Water Quality)

Comments from John J. Pizzimenti 07/28/11 Dissolved Oxygen The existing facilities violate ODEQ water quality standards at times because at low summer flows, the DO levels are likely below 8 mg/l. as measured at depth in the reservoir by the applicant. At higher flows, although the Regulating Outlets (RO) raise DO levels, they do so at the cost of elevating TDG above 110% due to turbulence in the stilling basin. Since higher flows occur mostly when DO levels are high, the benefit of turbulence in the existing ROs is equivocal at best and likely an net impact which the hydropower turbine will mitigate.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**

The existing facilities likely do not meet specified criteria, but the hydro project is being held to the higher standards. We recognize the dual standard, and are attempting to address both with the design presented.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116420	Regulatory	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Water Quality)

Comments from John J. Pizzimenti 07/28/11 Dissolved Oxygen Since the proposed hydropower intake is located at the same depth and approximate location of the ROs, the withdrawn water for hydropower will be nearly identical as that for the existing RO facility. The hydropower facility however, unlike the RO will not create much turbulence in the stilling basin or tailrace because the turbine will remove the majority of the energy. This has the upside of not exacerbating TDG and in fact possibly mitigating the RO condition, which at times is above 100% in the reservoir (cause and source unknown). But the hydroelectric turbine has the downside of potentially passing discharge with dissolved oxygen levels less than 8 mg/l., during summer months (Figure 16-1, 408 Design Report).

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**
Agreed

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116421	Regulatory	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Water Quality)

Comments from John J. Pizzimenti 07/28/11 Dissolved Oxygen The applicant proposes to solve the DO problem with disk aeration in the tailrace of the hydro project. He presents theoretical evidence that this is possible (Figure 16-2, 408 Design Report). His estimate that he will need to add 5000 scfm (standard cubic feet per minute) is in agreement with a general rule of thumb, that it takes 1% air mixture to raise DO by 1 mg/l (Pat March, HPPi, personal communication). Applicant's figure of 5000 scfm in fact meets that rule to raise the DO by 10% (812 cfs x 10% = 82 cfs x 60 seconds = 4920 scfm). But this assumes that aeration of this volume in fact is 100% absorbed into the water. In general, oxygen is dissolved into water by increasing exposure time and pressure. This is why the most common method of aeration usually begins in the reservoir or at least in the turbines because it has longer times to dissolve and is under much higher pressures. Empirical evidence bears this out in the many DO trials of the TVA and others (Hopping, March and Wolff, 1999 In 408 Design Report) where even the location of aeration in the turbine and draft tubes produce variable results. Although the applicant is proposing to use fine bubbles in the tailrace, there are no known cases in the literature where such a system of introducing air at shallow depth (22 feet) and short residence time (less than a minute) has been effective. Contrariwise, there is and strong evidence that dissolution of oxygen is best achieved upstream of the tailrace with enhanced outcomes where bubbles have longer times at greater pressure to dissolve. If the applicant has evidence that such a system has been tested and shown to be effective, he does not present the case or data in the 408 Design Report.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**
The aeration system at the Island Park Hydroelectric Facility in Idaho is very similar in many regards to the Dorena project, and they have successfully used fine bubble diffusers to mitigate DO deficiencies.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 09-Aug-11

Current Comment Status: **Comment Closed**

4116422	Regulatory	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Water Quality, Total Dissolved Gas)

Comments from John J. Pizzimenti 07/28/11 The applicant claims that TDG is a function of discharge but that seems equivocal. The first observation is that TDG is not lower than 105% at any discharge. The second observation is that the relationship is weak; statistical significance of the slope was not revealed and Applicant acknowledges the wide scatter in the data. Eyeballing the data suggest there is no relationship between TDG and discharge at flows less than 1200 cfs (see drawing). At flows above of 1500 cfs, TDG asymptotes at about 115% until flows exceed 3400 cfs, a flow expected less than 20% of the time (BiOp, 2008, Figure 4-3A) and most likely to occur when the reservoir is drawn down for flood control in January and February (see Figure 3-4A). The flow duration curve explains why most of the TDG data points are less than 2000 cfs. The weak slope (if one believes there is a cause and effect relationship) shows that TDG on average increases 1% for every 312 cfs between 250 and 1500 cfs. Since the hydro project only operates between 250 and 812 cfs, and will not be adding TDG (except if aeration is added in the tailrace), by itself, the project is a net benefit to TDG. And at these flows, if the RO is elevating TDG, it is only exacerbating it by a small amount. The question of how much TDG is actually being added by the ROs is simply assumed by the readings and the explanation is that RO turbulence is adding about 10% bulk (i.e. 10% aeration) which is consistent with higher DO readings. But without upstream data (TDG readings in the forebay), there is no solving of this equation and it is just a hypothetical guess as to the exact effect of RO's on TDG. This tenuous conclusion and relationship forms the basis for Applicant's assumption that turbulence in the stilling basin is driving bubbles deep into the water where it is absorbed (16.7.1). This may also support the concept that DO levels will achieve those estimated in Figure 16-2. This seems to also set up the case for the proposed solution to "de-gas" TDG using the stilling basin to divert hydropower discharges by running the tailrace backwards toward the dam using a rubber dam and training wall. Stilling basin behavior was characterized using CFD numerical models, however, no reference to the models was used to support this mixing, submergence behavior that assumed in the "degassing" concept. For every unit of oxygen added to water, add 4 units of nitrogen. Thus one step forward for DO is four steps backward for TDG. To accept the differential that the same hydraulics will treat nitrogen differently than oxygen is not supported by any assertions, data or models in the applicants design.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**

The available data was used to the extent possible. The current scheme was developed to provide additional time to degass TDG. Excessive TDG is a concern. As noted, the current RO discharges result in high TDG.

Submitted By: spencer uminski (208-745-0834) Submitted On: 09-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Noted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11
Current Comment Status: **Comment Closed**

4116423	Regulatory	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 408 Design Report, Water Quality)

Comments from John J. Pizzimenti 07/28/11 Recommendations 1. Most water quality problems have been attacked after they are understood locally under specific hydraulic conditions. The hydroelectric project should be constructed if it has merits on all other criteria of safety, economics, public interest etc. 2. After the project is built, a rigorous program of water quality monitoring should be developed for TDG and DO both upstream and downstream of the dam as required by FERC. Such data will define exactly what impacts are being attributed by the hydro and the RO by operating levels and ambient environmental conditions. This was the condition imposed by FERC and accepted in the BiOp. NMFS also noted in the BiOp: "The Dorena Lake Dam Project would use only the available water released from the reservoir by the USACE and would not change the operation of the USACE's facility [emphasis added]. Timing of project outflow on an hourly, daily, and seasonal basis would be determined by the USACE's plan to pass inflow or release stored water from Dorena Dam in conformance with USACE-specified rule curves. Using historical reservoir elevations and stream flows, the monthly estimated power generation indicates that the lowest monthly power production would occur in July and August (0 MWh) and the highest production in February (2,300 MWh). On average, the annual production would be 17,500 MWh. 3. Dorena Hydro is estimated to generate (zero) 0 MWh in months of July and August or at least add the least value for energy/capacity. These are the primary times when low DO levels may exist in the reservoir and when most of the water would be released by the RO facilities. ROs will likely elevate DO and cover the primary impact of the proposed Dorena Hydroelectric Project. It may also be necessary in some years to extend RO operations to the adjacent months of June and September when DO levels may be below ODEQ standards. 4. Once there are about three years of data, the Applicant can develop subsequent plans to address low DO levels that are real and exist with the project in place. They can also choose to shut hydropower operations when DO levels are below threshold at the intake and rely on the ROs for mitigation. This will simply be a cost: benefit driven decision.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 07-Aug-11

1-0 Evaluation **Concurred**
This is a logical approach, however, it is not acceptable to the Agencies, or practical for the project Owners.

Submitted By: spencer uminski (208-745-0834) Submitted On: 08-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Noted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 13-Aug-11
Current Comment Status: **Comment Closed**

4128800	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 100% Design) [**This item is flagged as a critical issue.**]

Chris May Comment Aug 12, 2011 The calculation for the buckling of the penstock due to vacuum is not complete. Vacuum is considered for the buried portion only. Need calculation for portion above ground and in tunnel. Calculate the vacuum on the shell per ASCE Manual 79, Section 4.4 which requires analysis using ASME Section VIII Division 1, Section UG-28.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

1-0 Evaluation **Concurred**
We are reviewing the analysis to make sure we have addressed all conditions.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 15-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Okay, will review any additional analysis when completed.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 16-Aug-11
Current Comment Status: **Comment Closed**

4128801	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 100% Design Report, Section 9.4)

Chris May Comment Aug 12, 2011 Section 9.4 of the report indicates that penstock would be increased to 1.5" thickness. This thickness should be included as part of the calculation contained in Appendix D. It should be noted that ASME requires thicknesses greater than 1¼" to be preheated to 200 deg F for welding.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

1-0 Evaluation **Concurred**
Upon review of teh stresses, we will need the full 1.5" thickness. Any preheating required per the code must be addressed.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 15-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 16-Aug-11
Current Comment Status: **Comment Closed**

4128802	Mechanical	Design Memorandum or Report	n/a'	Drawing PS-4.2 Detail 2	n/a

(Document Reference: 100% Design Report)

Chris May Comment Aug 12, 2011 Drawing PS-4.2 Detail 2 indicates 121"OD penstock with 1.5" wall thickness. Should this be 123" OD?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

1-0 Evaluation **Concurred**
The penstock section in question will have a 1.5" wall thickness, an I.D. of 119" and an O.D. of 122". The drawing is being modified to make this clear.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 15-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 16-Aug-11
Current Comment Status: **Comment Closed**

4128803	Mechanical	Design Memorandum or Report	n/a'	Drawing PS-4.3 Section 3	n/a

(Document Reference: 100% Design Report)

Chris May Comment Aug 12, 2011 Drawing PS-4.3 Section 3 indicates 122" OD penstock with 1.5" wall thickness. Should this be 123" OD?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

1-0 Evaluation **Concurred**
No. The 122" OD is correct, and with the 1.5" wall thickness we match the 119" I.D. of the remainder of the penstock.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 15-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 16-Aug-11

Current Comment Status: **Comment Closed**

4128804	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 100% Design Report)

Chris May Comment Aug 12, 2011 Miter angles still shown as 22.5 degrees not 15 degrees.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

1-0 Evaluation **Concurred**

We are evaluating whether to revise these angles. We will modify the drawings if a change is made.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 15-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 16-Aug-11

Current Comment Status: **Comment Closed**

4128805	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 100% Design Report) [**This item is flagged as a critical issue.**]

Chris May Comment Aug 12, 2011 Still advise that the bifurcation stiffener be subject to FEA.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

1-0 Evaluation **Concurred**

We will discuss this with the Owner to determine if they would like to proceed with the FEA.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 15-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Noted.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 16-Aug-11

Current Comment Status: **Comment Closed**

4128806	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 100% Design Report)

Chris May Comment Aug 12, 2011 20" manhole is a bit small. Typically 24". Size the nozzle to use standard seamless pipe per ASTM A53? It is noted that manhole elevation is above the grate – is this a tripping hazard?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

1-0 Evaluation **Concurred**

We will discuss the use of 24" manholes with the Owner. We will size to match standard pipe and flanges. The top of teh manhole should be 1' above the grating, and should stick up enough not to be a tripping hazard.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 15-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 16-Aug-11

Current Comment Status: **Comment Closed**

4128807	Hydraulics	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 100% Design Report)

Chris May Comment Aug 12, 2011 Head loss at bifurcation high?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

1-0 Evaluation **Concurred**

We are going to evaluate the headloss savings that could be creataed by using a conical transition.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 15-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 16-Aug-11

Current Comment Status: **Comment Closed**

4128809	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 100% Design Report) [**This item is flagged as a critical issue.**]

Keith Moen and Cris May Comment Aug 12, 2011 Many of the calculations have no checking done? No sign off.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

1-0 Evaluation **Concurred**

We are in the process of reviewing all calculations, and will adjust any calculations if necessary, and add checked by initials.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 15-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 16-Aug-11

Current Comment Status: **Comment Closed**

4128810	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 100% Design Report)

Chris May Comment Aug 12, 2011 Will hydrostatic testing of penstock be performed? If not, has an exception to this requirement been discussed with USACE?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

1-0 Evaluation **Concurred**

We will petition the USACE to see if the hydrostatic testing can be waived. The low head and field testing of the welds will be used as arguments for waiving the hydrostatic testing.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 15-Aug-11

1-1 Backcheck Recommendation **Close Comment**

Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 16-Aug-11

Current Comment Status: **Comment Closed**

4128811	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 100% Design Report)

Chris May Comment Aug 12, 2011 Noted that Rodney Hunt is not yet complete with their analysis. When? Is valve suited for 812cfs?

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

1-0 Evaluation **Concurred**
Preliminary results have been submitted. It appears that the moment and shear values are allowqable, with a factor of safety of 1.9 over AWWA specifications. The maximum recommended flow rate is 1235 cfs (16 feet per second). Additional analysis of the flanges and bolts is forthcoming.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 15-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 16-Aug-11

Current Comment Status: **Comment Closed**

4128812	Mechanical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 100% Design Report)

Chris May Comment Aug 12, 2011 I do not have high confidence in the FEA analysis of the penstock. Has this been thoroughly checked by a Senior Engineer? DISP 4, for soil restraint, does not allow perpendicular movement of the penstock. Is this realistic? Is it preventing expansion of the shell under pressure? Surely the soil will compress and allow movement. On the other hand longitudinal soil friction is a relevant restricting load that appears to be missing. The FE analysis of the penstock does not show displacement or stress plots so it is difficult to see where the stresses are and how restraints are restricting the movement.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

1-0 Evaluation **Concurred**
We re-ran the analysis withoout the soil constraints (free) and the stresses were still acceptable. We will evaluate the longitudinal soil friction. We will continue to review the FEA completed to date.

Submitted By: Judd Lawrence (801-532-2520) Submitted On: 15-Aug-11

1-1 Backcheck Recommendation **Close Comment**
Okay.

Submitted By: Keith Moen ((206) 352-5730) Submitted On: 16-Aug-11

Current Comment Status: **Comment Closed**

4128813	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 100% Design Report)

John McClung Comment Aug 12, 2011 - Stability Analysis Dam Blocks 12 and 13. The friction angle used in the analyses for the concrete to bedrock interface is beyond precedent in our experience. The analyses are presented in a series of Tables in Appendix J of the report, in which a phi value of 61 degrees is used for the sliding surface friction angle.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

Evaluation not conducted

4128815	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 100% Design Report)

John McClung Comment Aug 12, 2011 - Stability Analysis Dam Blocks 12 and 13. The sliding friction angle is derived on Figure 15-10 of the report. Section 15.6.2 of the report says "Rock strength data were found on USACE Sheet D1-5-23/1 which is presented as Figure H-11 in Appendix H. It appears that these tests were compression tests and shear strength determined from "angle of fracture" as noted on the figure". Figure H-11 can be found on the 1017th page of the report. Figure H-11 is a plot of "shear resistance" against "normal load". There is no explanation as to how the stresses that are plotted on the figure have been obtained from "angle of fracture".

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

Evaluation not conducted

4128816	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 100% Design Report)

John McClung Comment Aug 12, 2011 - Stability Analysis Dam Blocks 12 and 13. A clearer explanation is needed as to how and why the 15 points on Figure H-11 have been reduced to 6 data points on Figure 15-10.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

Evaluation not conducted

4128817	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 100% Design Report)

John McClung Comment Aug 12, 2011 - Stability Analysis Dam Blocks 12 and 13. Figure 15-10 of the report makes a different interpretation of the strength test data than Figure H-11. Figure 15-10 draws a lower bound line for six data points in the normal stress range of zero to 2,000 psi that gives a phi angle of 60.9 degrees. Figure H-11 interprets the data with a trend line through 12 of the 15 points that gives a shear resistance = 950 psi + 0.75 x normal load. The slope of this trend line corresponds to a friction angle of 36.9 degrees. The apparent cohesion of 950 psi is likely an effect of interlocking of the two sides of the shearing surface. We would be more comfortable assuming a value of 37 degrees for the friction angle along a surface within the rock mass. We would recommend an even lower value for the friction angle for the concrete/ bedrock interface.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

Evaluation not conducted

4128818	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 100% Design Report)

John McClung Comment Aug 12, 2011 - Stability Analysis Dam Blocks 12 and 13. It is common practice to add an amount to the intrinsic friction angle to allow for irregularities in the sliding surface. Commonly in hard rock this value will be between 10 and 15 degrees. This is analogous to a dilation angle. In the stability analyses this would provide 37 + 13 = 50 degrees. When using this approach, we recommend neglecting any apparent cohesion.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

Evaluation not conducted

4128819	Geotechnical	Design Memorandum or Report	n/a'	n/a	n/a

(Document Reference: 100% Design Report)

John McClung Comment Aug 12, 2011 - Stability Analysis Dam Blocks 12 and 13. In the tabular calculations in Appendix J, the base of the dam has been taken as a smooth profile with a slope of sliding surface that is inclined at 16 degrees, down to the upstream. No substantiation for this is provided. On the 310th page of the report, Drawing DO-222-3 shows an as-built cross-section of Block 12 (Section A). The inclination of the base scales approximately 5 degrees. The bedrock contours shown on Figure H-7 of Appendix H of the report (1,013th page) labels the bedrock as "platy andesite" and shows the bedrock surface as being almost level from upstream to downstream. The report needs to explain how the 16 degree inclination was determined.

Submitted By: Keith Moen ((206) 352-5730). Submitted On: 13-Aug-11

Evaluation not conducted

Attachment B – Reference e-mails

Moen, Keith

From: Judd Lawrence [jlawrence@binghamnet.com]
Sent: Wednesday, August 03, 2011 12:32 PM
To: Brent S. Bingham; Moen, Keith
Cc: Spencer Uminski
Subject: Fwd: FW: Dorena Dam hydropower Seismic
Attachments: jlawrence.vcf

FYI

-------- Original Message --------
Subject: FW: Dorena Dam hydropower Seismic
Date: Wed, 3 Aug 2011 09:42:18 -0700
From: Hanson, Matthew D NWP <Matthew.D.Hanson@usace.army.mil>
To: Spencer <spencer.uminski@symbioticsenergy.com>, Judd Lawrence <jlawrence@binghamnet.com>
CC: Duyck, Patrick L NWP <Patrick.L.Duyck@usace.army.mil>

The information for the seismic criteria does use the NGA (Next Generation Attenuation) for ground motions. You can find it below. This is a confirmation from Dave Scofield with respect to his feelings on the subject.

Let me know if this does not satisfy your needs.

Matthew Hanson
503-808-4934

-----Original Message-----
From: Scofield, David H NWP
Sent: Wednesday, August 03, 2011 9:34 AM
To: Hanson, Matthew D NWP
Subject: RE: Dorena Dam hydropower

Matt
AMEC-Geomatrix used the NGA relationships for the shallow crustal earthquakes in the western US as those relationships supersede their pre-existing relationships.

I am comfortable with the study. It was prepared by AMEC-Geomatrix who are experts in the field using the latest methodologies. The report covers the 13 U.S. Army Corps of Engineers dams in the Willamette Valley of Oregon. The procedures are industry standard for probabilistic and deterministic assessments for dam and will be used by the Corps of Engineers in the future

Below is the table of contents of the Regional Seismic Hazard Assessment: Willamette Valley in the Pacific Northwest Region.

David Scofield

TABLE OF CONTENTS

From the Attachment

"1.0 INTRODUCTION
This report presents a regional seismic analysis that identifies and quantifies seismic hazards for 13 U.S. Army Corps of Engineers dams in the Willamette Valley of Oregon.
The locations of the dams are shown on Figure 1-1. The study was conducted in accordance with the procedures described in draft EC 1110-2-6000, titled "Selection of Design Earthquakes." A probabilistic seismic hazard analysis and deterministic assessments are described in this report.

1.1 SCOPE OF WORK
The scope of work is divided into two tasks: (1) development of the seismic hazard model, and (2) development of seismic hazard assessments and ground motions for the region of the dam sites."

Task 1: Seismic Hazard Model
A seismic hazard model was developed to encompass a study region within 100 km of the dam sites, approximately latitude 42.8 to 45.7 and longitude 121 to 124.5. The seismic hazard model incorporates explicit characterization of uncertainties in seismic sources and ground-motion attenuation through the use of logic trees.

The starting point in the development of the seismic hazard model is a characterization of the tectonic framework and seismicity of the region. These are discussed in Section 2.

The development of the seismic source model is described in Section 3. Two groups of seismic sources are important to the assessment of seismic hazard in the study region.

The first group consists of sources of earthquakes occurring in the North American Plate in western Oregon; these are known as crustal sources. Two types of crustal sources are characterized: fault sources and source zones. There are a limited number of potentially active faults identified in western Oregon and few of these are in the immediate vicinity of the dams. Characterization of the fault sources is based on available published information and discussions with researchers who have conducted fault investigations in the region. Source zones are used to model the occurrence of future distributed seismicity that is not linked to specific fault sources. Alternative source zones and modeling approaches are used to represent the spatial distribution of future distributed seismicity.

The rate of earthquake activity for these sources is defined based on an analysis of the historical seismicity.

The second group of seismic sources is related to the subduction of the Juan de Fuca Plate beneath the North American Plate along the coast. The most significant of these sources is the Cascadia megathrust, representing the interface between the North American Plate and the subducting Juan de Fuca Plate; this is known as the subduction interface source. The second type of subduction-related earthquakes is those occurring with the subduction Juan de Fuca Plate; this is known as the intraslab source. These earthquakes are modeled by a source zone analogous to the use of source zones to model distributed seismicity in the North American Plate.

The other major input to the analysis is the characterization of ground motions. The Pacific Earthquake Engineering Research Center (PEER) Next Generation Attenuation (NGA) project models are used to model ground motions from earthquakes occurring in the North American Plate (crustal earthquakes). Separate ground-motion models are used to assess the ground shaking from the subduction zone interface and intraslab earthquakes. The ground-motion models are discussed in Section 5.

Task 2: Seismic Hazard Assessment

Assessment of the ground shaking hazard at the 13 dam sites was performed based on both deterministic and probabilistic approaches. The seismic hazard assessment is presented in Section 5.

The ground shaking hazard at the 13 dam sites was assessed probabilistically by performing a probabilistic seismic hazard analysis (PSHA) for each site using the seismic hazard model developed in Task 1. The hazard results were deaggregated to identify the contributions from various seismic sources by magnitude and distance. In addition, the sensitivity of the results to key modeling uncertainties was identified. The PSHA was conducted for peak ground acceleration (PGA) and pseudo-spectral acceleration (PSA) at spectral periods of 0.075, 0.1, 0.2, 0.3, 0.5, 1.0, 2.0, and 4.0 seconds. The results of the PSHA were used to construct uniform hazard response spectra (UHRS) for annual frequencies of exceedance of 6.8×10^{-3}, 2×10^{-3}, 10^{-3}, 4×10^{-4}, 2×10^{-4}, and 10^{-4} (return periods of 144, 500, 1,000, 2,500, 5,000, and 10,000 years). Deterministic ground- motion assessments were also performed using the seismic hazard model developed in Task 1 for comparison with the PSHA results and for development of Maximum Credible Earthquake (MCE) spectra (defined as “the greatest earthquake that can reasonably be expected to be generated by a specific source” [U.S. Army Corps of Engineers, 1995]).

The final component of the assessment of the hazard at the dam sites was the selection of representative ground-motion acceleration time histories that may be used for seismic analyses of the dams and related structures.

The second component of the seismic hazard assessment is the development of seismic hazard maps for the region surrounding the dam sites. These were developed using PSHA calculation for a grid of points. Seismic hazard maps were developed for PGA and PSA for spectral periods of 0.2 and 1.0 seconds. Maps were prepared for return periods of 144, 500, 2,500, and 10,000 years.

3.0 SEISMIC SOURCE CHARACTERIZATION

A description of the seismic source model is provided in this section. Aspects of the general assessment are given in the first section, followed by descriptions of the seismic sources relevant to the dam sites in the Willamette Valley.

3.1 SEISMIC HAZARD MODEL

The seismic hazard model for the study region contains the characterization of the sources of potential future earthquakes and the ground motions that they may produce.

An important component of the seismic hazard model is the characterization of the uncertainties in identifying seismic sources and defining their parameters. A logic tree formulation is used to represent these uncertainties in the hazard model. The logic tree structure provides a convenient formulation for incorporating alternative hypotheses about the sources of earthquakes and alternative characterizations of the occurrence of earthquakes as a function of time, location, and size.

4.0 GROUND MOTION MODELS

Ground motion models are needed for three types of earthquake sources: crustal earthquakes (depth range 0 to ~20 km, $5 \leq M \leq 7.5$); subduction zone interface earthquakes ($M \geq 8$); and subduction zone intraslab earthquakes (depth range 30 to 100 km, $5 \leq M \leq 7.5$).

4.1 GROUND MOTION MODELS FOR CRUSTAL EARTHQUAKES

The Pacific Earthquake Engineering Research Center (PEER) sponsored a project to develop updated ground-motion models (Next Generation Attenuation, or NGA) for California. The results of this project are five ground-motion models for the randomly oriented average horizontal component of ground motions: Abrahamson and Silva (2008), Boore and Atkinson (2008), Campbell and Bozorgnia (2008), Chiou and Youngs (2008), and Idriss (2008). The models provide estimates of spectral accelerations in the period range of 0.01 seconds to 10 seconds (spectral periods of 0.1 to 100 Hz). Four of the models provide ground motion estimates as a function of the average shear-wave velocity of the top 30 meters of the site, VS30. The fifth model, Idriss (2008), provides estimates for soft rock sites with VS30 greater than or equal to 450 m/sec. Each of the PEER-NGA model developers consider that their model replaces previous models that they have developed. These models are also being used by the USGS to develop the current version of the national seismic hazard maps.

4.2 GROUND MOTION MODELS FOR SUBDUCTION ZONE EARTHQUAKES

Most past assessments of the ground motions produced by subduction zone earthquakes have concluded that there are differences between the motions produced by earthquakes that occur on the interface between the subducting and overriding plates (interface earthquakes) and those produced by earthquakes occurring within the subducting oceanic plate (intraslab earthquakes). As a result, two sets of ground motion models are selected to assess the ground motions from these two types of subduction zone earthquakes.

Figure 4-9 compares the ground motions predicted by the selected models for interface earthquakes. The models developed by Atkinson and Boore (2003) and Youngs et al.
(1997) are based on a global database of subduction-zone earthquake ground motions, while the model of Zhao et al. (2006) is based primarily on data from Japanese earthquakes. All of these models provide estimates of ground motions on rock sites. A model for interface earthquakes in Cascadia was also developed by Gregor et al. (2002) based on numerical simulations. This model, however, was developed for a softer weathered rock site condition than rock conditions near the NEHRP BC boundary that are assumed for the crustal earthquake models. Consequently, the model of Gregor et al.
(2002) was not used.

The selected set of models for interface earthquakes is the same set used by the U.S.
Geological Survey to develop the 2008 national seismic hazard maps. In applying these models, the Zhao et al. (2006) relationships for rock (SC I) were used and the Atkinson and Boore (2003) relationships were interpolated to the BC boundary (VS30 = 760 m/sec) by using an SC factor of 0.5 (midway between site class B and site class C). There is a large degree of variability among the three interface models. This is not surprising, as ground motion estimates of interest (those for M 8.5 and larger earthquakes) represent extrapolations to larger earthquakes than those represented in the recorded strong-motion data. The variability is also larger at shorter distances, reflecting the fact that most data for subduction-zone interface earthquakes have been recorded at distances greater than 50 km. It should be noted that the model of Atkinson and Boore (2003) does not predict an increase in ground motions for earthquakes larger than magnitude M 8.5.

5.0 HAZARD ANALYSIS
The seismic hazard model developed in Sections 3 and 4 is used to produce two sets of results. The first set is hazard results for the 13 dam sites shown on Figure 1-1. The products of these analyses are response spectra for each dam for a range of return periods and suggested sets of time histories that may be used for dynamic analyses. The second set of results is hazard maps encompassing the region around the dam sites.

5.1 ANALYSIS APPROACH
Two types of analyses were conducted for each dam site. The primary analysis was a PSHA providing an assessment of the annual frequency of exceedance of ground motions for a range of amplitudes. In addition, deterministic calculations are performed for each dam site. The hazard is calculated for a reference rock condition with a VS30 of 760 m/sec.

5.1.1 PSHA Analysis Approach
The mathematical formulation used in most PSHAs assumes that the occurrence of damaging earthquakes can be represented as a Poisson process. Under this assumption, the probability that a ground motion parameter, Z, will exceed a specified value, z, in time period t is given by:

[Expression did not copy over into Outlook]

where $\nu(z)$ is the average frequency during time period t at which the level of ground motion parameter Z exceeds value z at the site from all earthquakes on all sources in the region. Equation (5-1) is valid provided that $\nu(z)$ is the appropriate average value for time period t. In this study, the hazard results are reported in terms of the frequency of exceedance $\nu(z)$.
The frequency of exceedance, $\nu(z)$, is a function of the frequency of earthquake occurrence, the randomness of size and location of future earthquakes, and the randomness in the level of ground motion they may produce at the site. It is computed by the expression:

[Expression did not copy over into Outlook]

where αn(m0) is the frequency of earthquakes on source n above a minimum magnitude of engineering significance, m0; f(m) is the probability density of earthquake size between m0 and a maximum earthquake the source can produce, mu; f(r□m) is the probability density function for distance to an earthquake of magnitude m occurring on source n; and
P(Z>z□m,r) is the probability that, given an earthquake of magnitude m at distance r from the site, the peak ground motion will exceed level z. The frequency of earthquake occurrence, αn(m0), and the size distribution of earthquakes, f(m), were determined by the earthquake recurrence relationships developed in Section 3. The distribution for the distance between the earthquake rupture and the site was determined by the geometry of the seismic sources defined in Section 3. The conditional probability of exceedance, P(Z>z□m,r), was determined using the ground-motion attenuation relationships defined in Section 4. The attenuation relationships defined the level of ground motion in terms of a lognormal distribution.

In the hazard computations, the fault-specific sources were modeled by segmented planar surfaces. The source zones that are considered to have uniform seismicity were modeled by closely spaced pseudo-faults filling the entire zone, and those that have spatially varying seismicity were modeled with a grid spacing of 2 km. At each epicentral location, earthquake ruptures were placed either with preferred orientations consistent with geologic structures in the source (e.g., N45°W in the Portland source zone) or with random orientations if there is no preferred orientation. The depth distribution for earthquakes was assumed to peak at midcrustal levels based on observed depth distributions for well-located earthquakes. Earthquake ruptures were represented by a rectangular rupture area for a given size earthquake. The rupture size of an event was specified by the relationship ln(area) = 2.095 M – 7.883 developed from the results presented in Wells and Coppersmith (1994). The specified relationship gives the mean rupture area for a specific magnitude rather than the median (mean log) rupture area. Studies by Bender (1984) have shown that the use of mean estimates of rupture size in the computation of hazard yields results nearly equal to those obtained when the statistical uncertainty in the size of individual ruptures is incorporated in the analysis.
Distributions for the annual frequency of exceeding various levels of PGA and PSA at spectral periods of 0.075, 0.1, 0.2, 0.3, 0.5, 1, 2, and 4 seconds were developed by performing hazard computations using Equation (5-2) with the input parameters defined by each end branch of the logic trees shown in Section 3. The hazard was computed considering the contributions of earthquakes of magnitude M 5 and larger (m0 = 5). At each ground motion level, the complete set of results forms a discrete distribution for frequency of exceedance, v(z). The computed distributions were used to obtain the mean frequency of exceeding various levels of peak ground motion (mean hazard curve) as well as hazard curves representing various percentiles of the distributions. The logic trees represent a best judgment as to the uncertainty in defining the input parameters and thus the computed distributions represent the implied confidence in the output, the estimated hazard.

5.1.2 Deterministic Seismic Hazard Analysis (DSHA) Approach Along with the PSHA conducted for each site, deterministic calculations were made.
These calculations used as sources the maximum magnitude earthquake on the nearby faults. Individual sources were examined and those that produced the largest ground motions at a site were used for this analysis. The DSHA is typically used to assess ground motions from the MCE, defined as “the greatest earthquake that can reasonably be expected to be generated by a specific source” (U.S. Army Corps of Engineers, 1995).
Like the PSHA, the inputs to a DSHA are usually uncertain. Alternative source geometries may lead to alternative source to site distances and there usually

is a distribution of possible maximum magnitudes. These uncertainties lead to alternative choices for the MCE event. In addition there is usually a set of applicable ground motion models that may be used to compute the motions for the MCE event. These uncertainties are often dealt with implicitly by selecting an “appropriately conservative value” of magnitude and distance for the MCE and then averaging the ground motion predictions from the set of applicable models. The results of the DSHA are typically defined as median, mean, or 84th percentile ground motion response spectra for the selected event, depending upon the level of conservatism desired.

5.3 SEISMIC HAZARD MAPS
The seismic hazard model developed in Sections 3 and 4 was used to compute the ground motion hazard for a grid of points covering the region surrounding the 13 dam sites. The hazard results at these points were interpolated to obtain PGA, 0.2-second PSA, and 1.0-second PSA values for return periods of 144, 500, 2,500, and 10,000 years. These values, together with results from the 13 dam sites were then used to construct contour maps of seismic hazard levels. These maps are shown on Plates 1 through 12. The 144- year return period maps show a gradual increase in hazard from south to north, reflecting the higher rate of crustal earthquakes to the north of the study region. The maps for the remaining return periods all show a smooth surface with gradually decreasing hazard from west to east. The smooth hazard results from the dominance of the ground motion hazard by the Cascadia interface source for return periods of 500 years and greater.

-----Original Message-----
From: Hanson, Matthew D NWP
Sent: Wednesday, August 03, 2011 8:04 AM
To: Scofield, David H NWP
Subject: RE: Dorena Dam hydropower

Dave,
Bingham has to answer some questions to satisfy FERC. The actual questions are that Bingham has are:
How was the criteria developed?
What attenuation model was used in developing the criteria (specifically was the "new generation" model from 2007 used?)?
Is the COE comfortable with the criteria?

Any answer would be great.
Thanks

Matthew Hanson
503-808-4934

-----Original Message-----
From: Scofield, David H NWP
Sent: Wednesday, August 03, 2011 7:22 AM
To: Hanson, Matthew D NWP
Subject: Dorena Dam hydropower

Matt
This is the engineering circular that is finished and awaiting final approval in HQ.

EC 1110-2-6000 Selection of Design Earthquakes and Associated Ground Motions: Prepared by AMEC-Geomatrix, Inc and Quest Structures, Inc. for US Army Corps of Engineers. Final Draft is dated 24 August 2009.

It includes Circular and Appendices. One of the Attachment is for developing seismic ground motion for Willamette Valley dams as an example of how to do it.

My understanding is that it is in HQ awaiting final approval.

David Scofield

Moen, Keith

From: Judd Lawrence [jlawrence@binghamnet.com]
Sent: Monday, August 15, 2011 4:34 PM
To: Spencer Uminski; Moen, Keith
Cc: David Boyter; 'Brent Smith'; Jef Krohn
Subject: Fwd: RE: Dorena Butterfly Valve
Attachments: jlawrence.vcf

Keith - I wanted to get this to you ASAP. I have not spoken with Spencer, but I'm sure he would want it forwarded to you.

The results are favorable. It appears the 1.9 factor of safety should be adequate, since there is a healthy reduction in allowable stresses per AWWA specifications (1/3 of yield or 1/5 of tensile).

Note that Kurt did not have time to evaluate the bolts and flanges. As discussed last week, he is pretty confident that the bolt and flange issue can be resolved by using tie bolts (threaded rods) going through the valve to transmit more load to the upstream flanges. Kurt will evaluate this condition later this week.

The recommended maximum flow is based on the 16 fps that AWWA specifies for the valves. We believe that the 1235 cfs is acceptable, since the runaway conditions of the two units is on the order of 1,115 cfs, if both were operating during failure. Since the two units will only overlap during transitions, it is doubtful that we will ever see the 1,115 cfs condition. We will present our limitations on flows the USACE for review.

The operating torques will be forwarded to the actuator designers to begin designing the actuators, supports and operator deck.

Please call with any questions.

-------- Original Message --------
Subject: RE: Dorena Butterfly Valve
Date: Mon, 15 Aug 2011 16:52:06 -0400
From: Kurt Graeff <kurtg@rodneyhunt.com>
To: Jef Krohn <jef.krohn@symbioticsenergy.com>
CC: Judd R. Lawrence <jlawrence@binghamnet.com>, Brent Smith <brent.smith@symbioticsenergy.com>, David Boyter <David.Boyter@symbioticsenergy.com>, Rob Cetto Jr <robc@rodneyhunt.com>, Rick Scott <ricks@rodneyhunt.com>, George Maston <georgem@rodneyhunt.com>

SO#: 110772-4

Jef,

The purpose of this e-mail is to provide you with preliminary result and findings of our investigation to determine if the existing 120-100FR AC Stream Seal Butterfly Valves (sold to Washington Public Power Supply System in 1976 – AC Order #42108) are adequate for the intended use at the Dorena Lake Dam Hydroelectric Project. These results are based on the operating conditions and additional external loading supply to us by Bingham Engineering, Inc., the existing project specific AC Drawings for the 120-100FR BFV and AWWA C504.

The following table contains the Maximum Operating Torques for the specified operating conditions:

TABLE I: Maximum Operating Torques

Flow – cfs [FPS]	Upstream Closure Valve Δ Pressure (psi)	Upstream Closure Valve Operating Torque (ft-lbs)	E-Close Valve Δ Pressure (psi)	E-Close Valve Operating Torque (ft-lbs)	Kaplan TSV Δ Pressure (psi)	Kaplan TSV Operating Torque (ft-lbs)
812 [10.52]	65	116748	75	128113	80	133390
853 [11.06]	65	120518	75	132669	80	138336
1200 [15.55]	33	127266	33	127266	110	215437
*1235 [16.01]	33	131515	33	131515	110	222400
1350 [17.50]	33	144846	33	144846	110	245312
2000 [25.92]	33	228091	33	228091	110	380306

* This is the recommended maximum flow allowed to operate the valve and is based on the shaft size (Ø11.25) allowable torque (per AWWA).

The body "factor of safety" is approximately 1.9 (by hand calculation and confirmed by FEA), which is based on the maximum operating conditions combined with the applicable external loads (i.e. – Overturning Moment = 2850 ft-kips and shear load = 275 kips). The maximum combined is approximately 5600 psi with a maximum shear stress of 425 psi.

These valves are being evaluated based on the requirements of AWWA C504 which allowable stresses are based on the lesser of 1/3 the materials yield strength of 1/5 the materials ultimate strength. In the case of the body, the allowable stress is 10,667 psi which is based on the material (ASTM A516, Gr 60) yield strength.

Therefore, based on these results the valves are adequate to maintain the maximum operating pressure along with the applicable external loads but must be limited to a maximum operating flow of 1235 CFS. In addition, the existing valves were hydro-tested at 1.5 times the design pressure (150 psi for 10 minutes) and leak tested at design pressure (100 psi for 5 minutes). Because the valves are being used for pressures (and flows) greater than their original intent, and the approval of use will be made based on analytical methods, Rodney Hunt recommends that the valves be retested at the new desired design pressure.

I will continue to work on the analysis and am hoping to have the report to you by early next week (Aug. 23, 2011). In the meantime, if you have any questions, comments or concerns regarding this analysis, please do not hesitate to contact me. Thanks.

Kurt R. Graeff
Project Engineer
RODNEY HUNT, CO.
(978)544-2511, Ext. 288

From: Jef Krohn [mailto:jef.krohn@symbioticsenergy.com]
Sent: Wednesday, August 10, 2011 2:28 PM
To: Rob Cetto Jr
Cc: Kurt Graeff; Judd R. Lawrence; Brent Smith; David Boyter
Subject: Re: Dorena Butterfly Valve

Rob,

Do you have any preliminary results? We are currently in a design review meeting with USACE and they would like some indication of how it's going. Is there anything you can tell me at this point?

Sincerely,
Jef M. Krohn
Senior Project Manager
Symbiotics, LLC
371 Upper Terrace Dr., Suite 2
Bend, OR 97702
p. 541.330.8779
f. 541.330.8780
c. 208.821.1413
jef.krohn@symbioticsenergy.com

On 8/10/2011 8:35 AM, Rob Cetto Jr wrote:
Jef,

The good news is I checked with Kurt and he is working on this project, bad news is I cannot give you a completion date or time, however, we do recognize the urgency for this report and will direct our efforts accordingly.

Regards,
Rob

From: Jef Krohn [mailto:jef.krohn@symbioticsenergy.com]
Sent: Wednesday, August 10, 2011 10:59 AM
To: Rob Cetto Jr
Cc: Kurt Graeff; Judd R. Lawrence; Brent Smith; David Boyter
Subject: Re: Dorena Butterfly Valve

Rob,

Thank you for the update. I completely understand a heavy workload. In this case, the entire 100% USACE/FERC review/approvals is being held up based on Kurt's findings. In other words, we have many eager people awaiting this report, so I am sure you can understand the sense of urgency. Any help you can offer to get this report sooner would be greatly appreciated. Please let me know if there is anything I can do.

Sincerely,
Jef M. Krohn
Senior Project Manager
Symbiotics, LLC
371 Upper Terrace Dr., Suite 2
Bend, OR 97702
p. 541.330.8779
f. 541.330.8780
c. 208.821.1413
jef.krohn@symbioticsenergy.com

On 8/9/2011 7:26 AM, Rob Cetto Jr wrote:
Jef,

Kurt Graeff is currently working on your request, unfortunately he has many competing interests. Hopefully in a day or two Kurt can give you a better update as to his progress and estimated completion date.

Regards,
Rob

From: Jef Krohn [mailto:jef.krohn@symbioticsenergy.com]
Sent: Monday, August 01, 2011 4:48 PM
To: Rob Cetto Jr
Cc: Judd R. Lawrence; Spencer Uminski; Brent Smith; David Boyter
Subject: Fwd: Dorena Butterfly Valve

Rob,

Please see below.

Sincerely,

Jef Krohn

-------- Original Message --------
Subject: Dorena Butterfly Valve
Date: Mon, 01 Aug 2011 13:39:04 -0600
From: Judd Lawrence <jlawrence@binghamnet.com>
To: Jef Krohn <jef.krohn@symbioticsenergy.com>, Spencer Uminski <Spencer.Uminski@symbioticsenergy.com>

Hatch had a couple of comments related to the butterfly valves that should be addressed by Rodney Hunt. Below are the Hatch comments and our response:

1. Drawing PS-3.2. The flange for the Allis Chalmers Butterfly Valve appears to be non-standard. Need to ensure flange strength is adequate.

	AWWA C207 Class B	Allis Chalmers	Drawing PS-3.2
Number of bolts	76	84	84
Flange OD	140.25"	138"	133" ???
Bolt diameter	2¾"	2¼"	2¼"
Bolt circle	132.75"	132.75"	132.75"

> You are correct, the AC valve flange dimensions do not match AWWA C207, Class B. We matched the flange of the butterfly valve. The thickness of the flange is also greater than the AWWA Class B flange (3 7/8" vs 3.5"). The O.D. of the companion flange is 138" – the drawing has been modified.

2. The butterfly valve data sheet indicates the design temperature as 40 to 120. How are temperatures lower than 40 accommodated? Also the data sheet gives the design flow as 585cfs. Is the valve suitable for flow of 812cfs?

The study being performed by Rodney Hunt will address the adequacy of the valves. We will have them address the temperature issue as well.

3. It is noted, from Appendix N, that Rodney Hunt are being asked to provide an analysis of the valve to determine whether it can “adequately function with the loads (vertical load and moment) that will be imposed by the upstream penstock”. This should include the flanges and bolts. Most valves are not designed with this intent so there is some concern that the valve may not be able to transmit the required loading. In the event that it cannot transmit the load is there a “Plan B”? Could the upstream penstock be independently supported? Perhaps off the cofferdam? Also, if the applied penstock loads for final design are found to change, will Rodney Hunt be asked to recheck?

The loads provided to Rodney Hunt are the final design loads. We will request that they model the flanges and bolts as well as the valve. ‘Plan B’ would be to support the butterfly valve, possibly via the modified coffer dam, or some other structure mounted to the face of the dam.