DRAFT MEETING SUMMARY

CALIFORNIA DEPARTMENT OF WATER RESOURCES

Oroville Dam Safety Comprehensive Needs Assessment Ad Hoc Group Meeting #3

January 10, 2019
8:00 a.m. to 11:00 a.m.
Oroville Field Division Conference Room
460 Glen Drive, Oroville

This meeting summary provides an overview of the January 10, 2019 Ad Hoc Group meeting and focuses primarily on capturing the questions posed by Ad Hoc Group members about the Oroville Dam Safety Comprehensive Needs Assessment (CNA) and the Independent Review Board (IRB) Memorandum Number 3. It also summarizes responses to questions provided by California Department of Water Resources (DWR) staff or IRB members. This document is not intended to serve as minutes of the meeting or a transcript of the discussion. A video of and materials from the January 10, 2019 meeting are available on the CNA website: https://water.ca.gov/Programs/State-Water-Project/Oroville-Dam-Safety-Comprehensive-Needs-Assessment.

MEETING AGENDA

- Introductions and Opening Remarks
- Overview of the 3rd IRB agenda
- Summary of IRB report and comment log
- Standard Project Flood and Probably Maximum Flood
- Part 12D Level 2 Risk Assessment
- Evaluation criteria
- Final report outline
- Progress Briefing for Task 4 (Low-Level Outlet Alternatives)
- Progress Briefing for Tasks 1, 2, and 6 (Spillways, Operations, & Instrumentation) (*Chairs decided to skip this item due to time constraints.*)
- Open Item

ATTENDEES

Co-chairs & Ad Hoc Group Members	IRB Members	DWR Staff	Meeting Support Staff & Others
• Assemblyman James Gallagher, Co-Chair • John Yarbrough, DWR, Co-Chair • Supervisor Bill Connelly • Derek Bell (representing Sheriff Honea) • Michael Bessette	• Betty Andrews, Environmental Sciences Associates • Bruce Muller Jr., Independent Consultant • Paul Schweiger, Gannett Fleming, Inc.	• Ted Craddock • Dave Duval • Sergio Escobar • John Leahigh • Joel Ledesma • Dave Sarkisian • Liza Whitmore	• David Ford, HDR • Les Harder, HDR • Rhonda Robins, HDR • Steve Verigin, GEI • Mary Beth Day, Kearns & West • Julie Leimbach, Kearns & West

- Sean Earley
- Curtis Grima
- Matt Mentink
- Rob Olmstead
- Laura Page
- Rune Storesund
- Ron Stork
- Daniel Wade, San Francisco Public Utilities Commission
- Liz Rettenmaier, Council Oak
- Nick Brubaker, Council Oak

ACTION ITEMS

- The Ad Hoc Group will provide a list of written questions and comments for DWR and IRB response by February 7, 2019.
- Kearns & West (meeting coordinators) will produce a draft meeting summary for review by the co-chairs, and distribute the revised version to the Ad Hoc Group by January 30, 2019 as well as posting it online.
- DWR will share a Glossary and the Level 2 Workshop Plan at the next Ad Hoc Group meeting.
- DWR will clarify the location of the daily reservoir reports on the DWR website.
- DWR will provide a redacted Level 2 Workshop Plan.
- DWR will provide a redacted Level 2 Risk Assessment Report after submission to FERC and an internal redaction process.
- DWR will circulate a schedule of upcoming important dates, including Ad Hoc Group Meeting #4.
- IRB will consider adding a column to their recommendation status table to reflect timing.

QUESTIONS FOR DWR and IRB

Overview of Information Presented

At the start of the meeting, the Ad Hoc Group co-chairs reviewed the meeting purpose. DWR explained that, as with previous Ad Hoc Group meetings, the presentations would be very similar to those given at the December 13-14, 2018 IRB meeting. This meeting would also incorporate some of DWR's initial responses to IRB feedback from that meeting. IRB members presented an overview of the recommendations they made to DWR in their third memo. DWR staff provided information on the following topics: flood risk reduction, including an explanation of how the Standard Project Flood and Probably Maximum Flood concepts are used to assess and manage flood risk; the Part 12D Safety Inspection and Level 2 Risk Assessment and how they would be used by the CNA; the latest draft CNA evaluation criteria; and an outline of the CNA Final Report. Due to time constraints, the Chairs decided to end the meeting before presenting on the status of Tasks 1, 2, and 6 as planned, but those presentation slides were shared along with the slides from the rest of the meeting as part of the materials.

Throughout and following these presentations, Ad Hoc Group members posed questions and comments to DWR staff and IRB members; these are organized by agenda topic below. The respondent (i.e. DWR or IRB) is indicated in parentheses before each response.

Questions on Summary of IRB report and comment log

- Question (Q): Can the status descriptions for past recommendations include a time component, perhaps mapping the recommendation to a specific task? It would be helpful to track if a comment is still timely.
    - Response (R) (IRB): We can add a column to our recommendation status table for the next meeting.
- Q: Is there a place where Ad Hoc Group members can go to see what language and terminology DWR is using and how they are using them? Has DWR shared a glossary?
    - R (DWR): DWR has not shared a glossary yet, but we can prepare one and share it at the next meeting.
        - Comment (C): Understanding how people are using terms [language and terminology] is an important first step in effective risk communication, especially for a group like this that incorporates a range of perspectives and backgrounds. Effective communications need a common starting point. It would be helpful if the glossary was posted on the website and updated regularly.
- Q: Is the asset management framework an effective strategy for risk assessment?
    - R (IRB): Yes, it provides a good fundamental framework to start from in an evaluation process.
- Q: With regard to Task 1 and the need to establish performance standards for the flood control outlet and emergency spillway, I would assume the current spillway system was constructed to exceed current standards. Do we know if the spillway meets or exceeds current standards at this point?
    - R (IRB): The chute downstream of the control structure has been updated to meet or exceed current standards. The control structure itself will be addressed by Task 3, but it has not been updated yet. The results of the risk analysis will provide a better sense of whether the work done to date has sufficiently reduced risk.
- C: I support the IRB's recommendation for Task 1 to obtain additional geologic data downstream of the secant pile wall.
- Q: What do you mean when you say "safety?" What are the criteria or metrics that are being evaluated?
    - R (IRB): The presentation on evaluation criteria later today may answer your question. We also anticipate that DWR will provide a final draft of the evaluation criteria at Ad Hoc Group Meeting #4.
- C: The addition of time relevance to the IRB recommendations will help prioritize what needs to be done first.
    - R (IRB): This is a complex project and DWR is doing a good job of working on tasks in parallel as much as possible.
- C: The IRB's recommendation to revise the title of Task 1 makes sense, as it removes the exclusive focus on meeting the Probable Maximum Flood (PMF). However, I would recommend the following instead: "Evaluating Measures to Enhance Spillway Competence to Meet Project Objectives, Reliability, and Resilience."

- R (IRB): DWR is open to considering a suggested revision from the Ad Hoc Group.

Questions on Standard Project Flood (SPF) and Probable Maximum Flood (PMF)

- C: Some degree of uncertainty needs to be built into any risk analysis. Part of this uncertainty includes how the reliability of a structure will vary with time. Risk analysis needs to incorporate aging and time dependence, such as the reliability of a structure over 10, 50, or 100 years, as well as uncertainty in loads and inflows. Climate change will impact the uncertainty of loads. The uncertainty band for a risk assessment will expand as you look farther into the future.
    - R (IRB): Trying to forecast the condition of a structure in the future is highly uncertain. This is why structures are evaluated on a cyclical basis, as in the Federal Energy Regulatory Commission's (FERC's) requirement for structural evaluations every five years. Incorporating information from a series of points in time allows analyses to take time dependence into consideration.
- C: The Independent Forensic Team noted deficiencies in the methods used for previous risk analyses. Have there been any updates or revisions that address those deficiencies?
    - R (DWR): The Forensic Report noted they were pleased to see that DWR was beginning to update their asset management program to meet international standards (ISO 55001). One of the key benefits to using an asset management framework for risk assessment is that it tracks the entire lifecycle of an asset and can take factors like climate change into account.
- C: The facility was designed to meet SFP and PMF, but those designs assume everything in the facility works as it is meant to. The 2017 event was not as large as other historic floods, but there was a slip somewhere because the facility did not function according to its design. How do we develop a framework that will ensure an asset will always perform as designed?
    - R (DWR): That is why DWR is undertaking this CNA and getting the industry involved. It is not common for an asset management framework and dam safety program to be embedded together. We are learning a great deal and starting to push the industry into a better place as a result.
- Q: Infrastructure assets are getting old, and there is risk associated with that. How do we address this? This is an issue we'll be facing in many sectors.
    - C: Adopting international risk assessment standards are part of the solution, but they are not a complete solution in and of themselves. Being diligent and observant is also important. An entire organization needs a clear understanding of the metrics used in risk assessment in order to effectively manage infrastructure.
    - R (IRB): The condition of a dam causes risk; the age alone is not what causes risk. Periodic assessment of condition provides a time-based assessment.
    - C: The Independent Forensic Team noted that the periodic analyses done previously did not catch the problems with the facility.
    - R (IRB): It is common to become complacent when things are going extremely well. When dam safety is most successful, people sometimes start to question why resources are being spent when nothing is going wrong.

    - R (DWR): Traditional risk assessments are based on uncontrolled release, but this risk assessment will incorporate the features of the dam performing as intended.
- Q: How often are SPF and PMF values revised? Are dams designed in such a way to adjust for increased SPF and/or PMF values? What happens to dam operations if levees downstream are found to be less competent than originally believed? If there is a known problem downstream, dam operations should be adjusted accordingly.
- Q: Can you explain how the wetness index is calculated? I know you multiply the total rainfall for the year by 0.97 and add in the previous day's precipitation, but what gauge or gauges do you use for that calculation? There can be significant variability across the region (e.g. eight inches of rain in Marysville and 25 inches in Strawberry Valley recently).
    - R (DWR): There are eight stations in the Feather River Basin. The average value from those stations are used in the calculation.
        - Q: DWR is required to report target elevations for the reservoir based on those calculations on a daily basis. For interested citizens downstream, is this information that could be shown on the Oroville page of DWR's website?
            - R (DWR): That information is already available online, but it may not be clear where to find it. We will try to clarify the location of this information and share the location with this group.
- Q: Has DWR had a chance to run the numbers on Atlas 14 and consider how that might change the hydrology? Is the PMF of 3.1 million acre-feet coming from the Atlas dataset?
    - R (DWR): FERC asked DWR the same question, and we recently responded to them that we will be looking into this. We will have an answer within 90 days.
- C: If we are investing $500 million in a new spillway, it would be helpful to have a target PMF to use for dam design. Reports from NOAA and the Scripps Institution of Oceanography indicate we could see 10% to 12% increases in hydrology every 10 years going forward. Do the designs account for these future increases in hydrology?
    - R (DWR): Climate change scenarios require us to look at other flexibilities and technological improvements, as dam design is fixed. For example, DWR is partnering with the Yuba Water Agency to implement forecast-based operations. DWR will also engage with the US Army Corps of Engineers on a new flood control manual that will incorporate additional flexibilities.

<u>Questions on Part 12D Level 2 Risk Assessment</u>

- Q: Can the Ad Hoc Group have access to the Level 2 Risk Analysis Workshop Plan?
    - R (DWR): Yes, with minor redactions.
- Q: When will the Level 2 Risk Assessment be complete?
    - R (DWR): The workshops will be over by the end of March, but the Report will not be complete until August.
        - Q: Can the Ad Hoc Group get a copy of the report?

- R (DWR): After DWR submits the report to FERC and goes through an internal redaction process, DWR will provide the report to the Ad Hoc Group.

- C: I have concerns about the effectiveness of the Part 12 inspections. In the 2014 inspection, three candidates for failure modes were ruled out and never considered: F2 (a PMF event occurred, spillways overtopped, and head-cutting occurred at Feather River), F5 (loss of spillway channel lining resulting in erosion of channel rock underlying the spillway), and F6 (scouring of soil and debris during overflow of the emergency spillway blocking the Feather River). Please review the recommendations from the Independent Forensic Team in Appendix F3 of the Forensic Report and incorporate them into this process. Additionally, the Independent Forensic Team mentioned the voting process for the potential failure modes analysis (PMFA) team. Can you clarify what this process will be and if it will involve independent consultants or DWR?
    - R (DWR): The Level 2 team has spent a lot of time incorporating recommendations from the Independent Forensic Team. As a result those recommendations, there is no longer a vote on PMFs. Instead, there is an estimation of risk. An independent team develops a plan and identifies subject matter experts that will estimate the risk for PMFs. Additionally, participants will be extremely careful about ruling out any PMFs. PMFs that do not include loss of life will be assessed in a separate matrix.
- Q: Is it part of FERC's regulations to allow community members to attend?
    - R (DWR): We do not know where FERC stands on this, and we would need to take that back to FERC..
- C: We should capture concerns and assumptions to help operators and maintenance workers know what to think about. This should be built into the process and revisited every five years.

<u>Questions on Evaluation Criteria</u>

- Q: Assumptions are a critical component of this analysis. Can the Ad Hoc Group review an inventory of assumptions?
    - R (DWR): An inventory of assumptions is an outcome of the Level 2 Risk Assessment. That set of assumptions will be tabulated in the Level 2 Risk Assessment.
- Q: What is the level of detail included in the documentation?
    - R (DWR): The Level 2 Workshop participants will provide their best reasoning for the probabilities they estimate. The documentation will include an explanation of why a given value was used.
- Q: How will the analysis address interdependencies?
    - R (DWR): As part of the Part 12D process, the mechanism that leads to failure for each failure mode is explained in the documentation. Part of this documentation would include recording secondary effects and subevents that would lead to failure as well as assigning a probability to each of these.
- Q: According to research on catastrophic situations, only about 25 percent of risk is quantifiable and can be analyzed, while approximately 75 percent of vulnerability is not included in scenarios or analysis. This unaccounted-for portion is known as residual risk. Undertaking the Part 12D

inspections and quantitative analyses is very helpful, but how do you address the qualitative issues?

  - R (DWR): By having a large number of attendees with broad expertise at the Level 2 Workshops, DWR intends to maximize the likelihood that relevant hazard and performances issues are identified and considered in the Part 12D evaluation and incorporated in the risk analyses. The Part 12D evaluation and the risk analyses will be both quantitative and qualitative.

- C: DWR should track and log any near-misses or unexpected occurrences and incorporate that information into their analyses.
  - R (DWR): Setting up an asset management program involves identifying metrics, service levels, how to take measurements, how to include processes, plans, and procedures, and checks and balances. Those components then feed into each comprehensive assessment that occurs every 5 years.
- C: You could test the effectiveness of the Part 12D process by selecting approximately five people highly familiar with the structure to form a team and see if they can find scenarios or possibilities the subject matter experts did not consider. The key takeaway from these discussions seems to point a process that we are used to. We have things we know, subject matter experts, and different perspectives, but even putting all those pieces together, we are still within the realm of what is known. Perhaps there are other, currently unknown, things that are not captured by the current process. Catastrophic events occur as a result of circumstances that were not considered – otherwise the catastrophe probably would not have occurred in the first place.
  - R (DWR): In response to the Forensic Report, FERC requested that DWR develop a plan for how to address all of the recommendations in the Report. DWR sent them a letter over the summer, but FERC asked for more detail. DWR will be sending a more in-depth response soon. As part of this process, an audit team made up of external experts engaged by FERC audited our program. They reviewed DWR's approach to asset management and provided recommendations on that program (e.g. how to improve inspections and evaluations). We are currently implementing those recommendations. The industry as a whole still needs to improve, but this is our first attempt at addressing the Independent Forensic Report beyond the project design. Doing so will be a multi-year process, but DWR has already begun the initial steps. On the operations and maintenance side of this process, all the data collected (from inspections, visual monitoring, etc.) is being assembled in a central system that can be accessed by subject matter experts so they can catch things that are happening. We are trying to put many pieces together, and not all of them are part of the CNA.
- C: DWR should aim to move from state of the process, i.e. doing what FERC requires, to state of the art, i.e. going beyond FERC requirements and advancing the state of the practice.
  - R (IRB): The Level 2 analysis that FERC has asked DWR to undertake goes far beyond anything done in the sense of a traditional engineering analysis of dams. This whole risk assessment process is designed to tease out issues beyond just those we can calculate

or have models for. If we have information, we can factor that into the estimate of risk. This framework proposes a set-up that will allow people to bring in notional factors that encompass the non-quantitative issues. Going back to the documentation issue, every estimate for probability in an event tree will have listings of factors that make an event more or less likely and will identify which were the primary factors that the estimating group based their estimate on.

- Q: Is the current FERC Part 12D process complete, i.e. does it encompass everything we need to be concerned about?
    - R (IRB): The current 12D process is not the Level 2 Risk Assessment.
- Q: Does the IRB recommend that DWR do the Part 12D process?
    - R (IRB): The Level 2 Risk Assessment is a far more complete process. Its results will inform both the FERC Part 12D and CNA.
        - Q: The Level 2 process encompasses everything we need to be concerned about?
            - R (IRB): Yes.
- C: I recommend DWR not stop their work at the end of the Level 2 analysis, but continue to challenge their assumptions and build this into the current process.
    - R (IRB): That is already part of the planned review process.
        - C: FERC conducted an after-incident panel and one of their recommendations was to bring in another team to look at the results with another set of eyes. This seems like a good approach.
            - R (IRB): At the Bureau of Reclamation, we found that if we were on the fence with our results, it was helpful to bring in a second team to confirm the results one way or the other. In cases where the probability of risk clearly indicated the need to take particular action, getting a second opinion was unlikely to yield different results.
- C: It is good that DWR will undertake the Level 2 Risk Analysis, as it is more comprehensive than anything else that has been done before. Can DWR incorporate some of the suggestions developed by Ad Hoc member Rune Storesund and the Center for Catastrophic Risk Management (CCRM), or have a member of the CCRM participate in the Level 2 Risk Analysis? DWR carried out Part 12D inspections prior to the 2017 incident. Those inspections found cracks on the spillway, which were then repaired every 10 years. Rather than recognizing the cracks as something indicative of a fundamental problem, they were normalized. Additionally, the geological data in the inspection reports was not probed sufficiently. In both instances, action should have been taken, but was not. How do we ensure the new processes being developed will catch issues like these going forward?
    - R (DWR): This is a living process. Over the coming months, the Level 2 process will provide DWR with significant updates over the coming months. As part of this, PMFs and risks will be tracked. In five years, everything will be brought back to the table to be looked at again and reassessed. Operators will attend the Level 2 Workshops so their concerns can be included. DWR will also brief staff at the Field Division so that the

nuances of the boots-on-the-ground perspective can be shared with experts in the Workshops. With each cycle, DWR expects to assemble a larger portfolio of factors it will monitor over the long term.

Questions on Progress Briefing for Task 4 (Low-Level Outlet Alternatives)

- Q: Is money a constraint?
    - R (DWR): All resources are a constraint. Cost will be a consideration.
- C: Please be sure to identify constraints to recreation, including the spillway facility and other launching facilities around the lake. Recreation should be considered under the "additional physical constraints" category.
    - R (DWR): As DWR is developing the evaluation criteria, one of the categories is "other benefits" and that would include recreation. As we are evaluating different measures, the impact on recreation is one aspect that will be considered. Also, part of the evaluation criteria is looking for positive outcomes and enhancements, and recreation will certainly be captured as part of this as well.
- Q: A lot of input was received as part of the 2005 licensing effort. Is DWR going back and incorporating that input into the evaluation process? Some of the suggestions given at the time may have been ruled out due to the limitations of the current facility. As we look at and evaluate alternative designs, perhaps DWR could incorporate some of those ideas as secondary benefits.
    - R (DWR): DWR will need to discuss this. Recreation is a required part of DWR's license, so we will address recreation with FERC through that process. While DWR wants to look for any benefits, including those related to recreation, as part of the CNA process, if we get to a point where we can to add recreation or current recreation would be impacted, that has to be addressed by the FERC process.

IMPORTANT DATES

- Ad Hoc Group Meeting #3 presentations and video published to website – 1/11/19
- Ad Hoc Group questions and comments due to DWR and IRB – 2/7/19
- Ad Hoc Group Meeting #3 summary posted to website – 1/30/19
- IRB Meeting #4 – 3/14/19 –3/15/19
- Ad Hoc Group Meeting #4 material posted online – 3/29/19
- Ad Hoc Group Meeting #4 – 4/5/19