

SUMMARY OF FERC RECOMMENDATIONS AND DWR ACTION ITEMS FERC PART 12D 2010 INSPECTION REPORT

Note: Selected recommendations have been edited to protect Critical Energy Infrastructure Information.

All Part 12D reports for Oroville Dam ended with the conclusion that the project was suitable for continued operation.

The process for a Part 12D report is iterative. The Independent Consulting Board, required by FERC every five years, provides an independent inspection and evaluation of the facility, and provides recommendations to DWR in their Part 12D report. DWR then submits a plan and schedule to address those recommendations based on priority and risk. In some cases FERC provides feedback to DWR's plan and DWR responds with additional information and planned actions.

The summary provided for each Part 12D report is DWR's plan, approved by FERC, to address recommendations. It provides the latest action from DWR in response to the recommendations in the inspection process.

Summary of Recommendations – Oroville Dam (26 Total)

- R-1.** Prepare a plan and schedule for long-term phreatic surface monitoring of Oroville Dam and abandonment of Terminal S and House T. The plan and schedule should be completed by January 2013.

***July 2017 Status:** The original instrumentation installed during construction of the dam was intended to monitor the dam during construction and its early performance period. As expected, the instrumentation has become unreliable and thus abandoned over time. DWR continues to monitor piezometric pressures from the remaining two functional hydraulic piezometers as well as collect seepage measurements at numerous locations which provide information with respect to adequate drainage within the dam. The toe drain seepage collection system, which has an automated data collection system, remains an important location and provides good data to assess seepage within the dam's downstream embankment. To establish the need for additional instrumentation, DWR utilized the comprehensive 2014 Potential Failure Mode Analysis Workshop to inform dam safety engineers. The outcome of the 2014 PFMA led to recommendations by the 2014 Part 12D Safety Inspection Report to update seepage and stability analyses. DWR is currently performing these studies which will inform the need and location of new instrumentation within the dam's downstream shell. Replacement of all original instrumentation is not necessary, and if additional instrumentation is deemed warranted, installation will be thoughtfully planned and safely implemented.*

- R-2.** Conduct ultrasonic thickness measurements on the Palermo Tunnel Outlet pipe to establish a baseline for further surveillance and monitoring. This should be completed by January 2013.

*Status: **Completed** in 2011. DWR repeated the measurements in 2016. Test results match closely the original design thickness and do not indicate any metal loss from corrosion. Engineers determined the pipe is suitable for continued operation.*

- R-3.** Based upon favorable performance of the dam, the frequency of survey monitoring can be reduced from annual to every three years, or after an extreme event such as flooding, earthquakes, high water, or unsatisfactory visual observation.

*Status: **Completed.** DWR has elected to continue annual surveys of the dam. DWR also performed numerous surveys during the 2017 spillway incident that confirmed the dam's continued satisfactory performance.*

- R-4.** We recommend that quantitative turbidity measurements at the dam and the Embankment Toe Drain be discontinued in favor of qualitative assessment of the clarity of the flow.

*Status: **Completed.** DWR implemented this change to the Dam Safety Surveillance and Monitoring Plan (DSSMP) in 2011. Seepage clarity is very informative evidence to detect dam safety concerns, and DWR dam tenders are well trained to qualitatively observe the clarity of dam seepage.*

- R-5.** While we concur with the Threshold Levels outlined in the DSSMP, we recommend that DWR review their procedures for establishing these levels.

*Status: **Completed.** DWR updated its procedures for establishing the threshold limits in the DSSMP in 2011. These thresholds are currently used with dam safety performance evaluations.*

- R-6.** Underwater investigations should continue to locate the Palermo Tunnel intake for condition assessment purposes. This should be completed by January 2013.

*Status: **Completed.** DWR located the Palermo intake with a remotely operated vehicle in November 2009. In 2016, DWR utilized a remotely operated vehicle to inspect the intake structure and the interior of the Palermo tunnel and extracted the intake bulkhead gate for refurbishment. The inspection confirmed the gate's operability and its refurbishment will help ensure safe dewatering of the tunnel, if warranted for maintenance. DWR anticipates the intake bulkhead gate to be refurbished by early 2018 and plans to reinstall the bulkhead before the end of 2018.*

- R-7.** DWR should establish a regular plan and schedule for periodic inspection and evaluation of the radial gates (including the trunnion pins). Refer to FERC letter dated December 18, 2009 (Ref. 71) for FERC requirements. This plan and schedule should be completed by January 2011.

*Status: **Completed.** In 2012, the Flood Control Outlet radial gates were inspected by engineers via rope access methods. Subsequent inspections occurred in November 2016 for gate nos. 3 through 7 to monitor specific items.*

Inspections also occurred on three occasions during periods of “zero flow” on February 28 – March 6, March 29-30, and May 5-8, 2017 to verify conditions during the spillway emergency. Trunnion pins remain to be re-inspected as this requires removing a gate from service for a long-period of time and installing structural support to the gate while the pin is removed for inspection.

- R-8.** DWR conducted a structural inspection of the Flood Control Outlet radial gates in 1997 and several recommendations were made. A follow-up of these recommendations should be investigated and a schedule of actions prepared by January 2011, if necessary.

*Status: **Completed.** Recommendations from the 1997 structural inspection were addressed.*

- R-9.** As discussed in Section 7.5, we recommend that an updated seismic hazard assessment be performed for the Oroville-Thermalito Complex. This should be completed by January 2013.

*Status: **Completed** in 2012. DWR has on-going faulting and seismicity studies, many of which will be completed in 2017, that will result in updated ground motions utilizing the state of knowledge and current best practices. The new ground motions will inform current and future seismic stability evaluations.*

- R-10.** We recommend an evaluation of the adequacy of the spillway to pass the design flood event (PMF) be presented in a single volume report considering the comments made in Section 7.6.1. This should be completed by January 2014.

*Status: **Completed** in 2013.*

- R-11.** We recommend a comprehensive review of the stability analyses on record, considering the factors listed in Section 7.8, to determine whether the existing studies remain valid in view of modern practices. Based on this review, the need for updated seismic stability analyses should be determined. This should be completed by January 2014.

*Status: **Completed.** In 2012, DWR engineers reviewed the 1979 and 2005 stability analyses on record for Oroville Dam, considering the currently recommended ground motions. They concluded that the prior analyses and the seismic ground motions utilized remain reasonably conservative when compared to currently recommended levels and estimated earthquake event return periods. In addition, the 1979 analysis exceeded the state-of-practice at its time, and in many ways continues to meet the state-of-practice today. Subsequently, the 2014 Part 12D Board recommended that DWR perform additional stability studies. DWR plans to update the stability analyses on record utilizing the latest ground motions generated in 2017.*

- R-12.** We recommend structural evaluation of the Flood Control Outlet radial gates for PMF loading conditions for two scenarios indicated in Section 7.9. This should be completed by January 2013.

*Status: **Completed** in 2011. Subsequently, DWR addressed a series of comments from FERC on the analysis. DWR plans to revisit the structural analyses again utilizing the 2017 updated ground motions.*

- R-13.** The 2009 PFMA supplement should be inserted into Section 1 of the STID for documentation purposes.

*Status: **Completed** in 2011. DWR updated Section 1 again in 2015.*

- R-14.** Further description of the penstocks, turbines, and other facilities should be included in Section 2. Also, we suggest that drawings of the penstocks and Hyatt Powerhouse layout be added to the figures in Section 2.

*Status: **Completed** in 2011.*

- R-15.** The construction chronology in Section 3.7 of the STID should be updated to include project-safety related events and/or repairs since the last Part 12D safety inspection report (as listed in Section 2.4 of this report).

*Status: **Completed** in 2011.*

- R-16.** Section 4 of the STID should be revised to reflect that DWR's security-related surveillance of the dam.

*Status: **Completed** in 2011.*

- R-17.** Section 5 of the STID should be updated to include a summary of the 1975 Oroville earthquakes and impacts on the Oroville-Thermalito complex (see Section 7.5).

*Status: **Completed** in 2012.*

- R-18.** Section 5 of the STID should be updated pending the results of recommended seismic hazard assessments (see Section 7.5).

*Status: **Completed** in 2012.*

- R-19.** Section 5 of the STID should be updated with the correct location of the construction spoil placed upstream from the spillway chute.

*Status: **Completed** in 2012.*

- R-20.** The location of several instruments (including the toe drain weir, the drainholes, and House T) are not shown in plan in the DSSMP (Section 7 of the STID) or 2008 DSSMR (Ref. 69). We recommend that location figures be developed for these documents.

*Status: **Completed** in 2011.*

- R-21.** According to DWR, the survey monuments on the Bidwell Bar Canyon and Parish Camp Saddle Dams are offset on the downstream shoulders of the crest roads and therefore readings do not reflect the dam crest elevations. This is not indicated in the monument location drawings (Figures 1.7 and 1.8 in Appendix D) or mentioned in the DSSMP. We recommend that the DSSMP (STID Section 7)

be updated to include this information and a procedure developed to convert and compare the surveyed monument elevation data to the design dam crest elevations.

Status: **Completed** in 2011.

R-22. The DSSMP (Section 7 of the STID) should be revised to include the procedures for taking the instrumentation readings.

Status: **Completed** in 2011

R-23. Section 9 of the STID should be revised to include information on the radial gate stress analyses.

Status: **Completed** in 2011.

R-24. Section 9 of the STID should be revised to include the status of the recommendations from the 1997 structural inspection of the spillway gates.

Status: **Completed** in 2011.

R-25. Section 10 should be updated to include correspondence with FERC and DSOD since the 2005 Part 12D Report and the most recent FERC annual inspection report.

Status: **Completed** in 2011.

R-26. Section 11 of the STID should be revised to include new documents relating to Oroville Dam prepared since the STID was initially drafted (References 58 to 71).

Status: **Completed** in 2011.