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JAN - 3 2006

Mr. Takeshi Yamashita, P.E.
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Federal Energy Regulatory Commission
901 Market Street, Suite 350
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FERC Project No. 2100-CA, Review of Seventh Independent Consultant's Safety Inspection Report for Thermalito Diversion Dam

Dear Mr. Yamashita:

This is in reply to your September 30, 2005 letter regarding review of the Seventh Independent Consultant's Safety Inspection Report for Thermalito Diversion Dam, part of the Feather River Project, FERC Project No. 2100. We have addressed your comments and have included a status update of the Consultant's recommendations, a response for each potential risk reduction item identified in Thermalito Diversion Dam's 2004 Potential Failure Mode Analysis (PFMA), and a response and submittal for those items pertaining to the Supporting Technical Information Document (STID).

**Grout Gallery Piezometers**

After consulting with our design engineers, we have set the action level for dam uplift pressure at 20 psi. The measured uplift pressures at Stations 8+22 and 12+17, currently about 10 and 15 psi respectively, are well below the theoretical pressures of 62 psi and 36 psi, respectively, utilized in the Division of Engineering's 2003 Thermalito Diversion Dam stability analysis. The stability analysis indicates the concrete dam is stable under the Inflow Design Flood (IDF) of 700,000 cfs with the developed theoretical uplift pressures resulting from the IDF headwater. If any monitored gallery piezometer reaches the action level, cleaning will be initiated on all drain-holes. If cleaning does not adequately decrease uplift pressures, then we will determine what action is necessary to evaluate the cause of the increased pressures. We will continue to monitor the piezometers on a monthly basis. Please consider the recommendation addressed and completed.

**Feather River Fish Hatchery Raw Water Supply**

A walk-through, visual inspection of the 60-inch water supply line to the Feather River Fish Hatchery is currently scheduled for completion during the summer of 2006. If the inspection proceeds as scheduled, then the inspection findings and recommendations will be forwarded to your office by December 31, 2006.

**Radial Gate Full-Open Limit Test**

Oroville Field Division (OFD) staff will conduct a full-open limit test during the next full opening gate exercise. The testing will occur within the next two years. The full-open testing utilizing stop-logs is a considerable expense with an anticipated five day work-load involving five to six employees; therefore, OFD staff has initiated plans to conduct a full-open test for each of the 14 gates during a spill year that has a minimum release of 25,000 cfs at Oroville Dam. If the necessary spill does not occur prior to July 2007, then OFD will conduct the full-open gate tests utilizing stop-logs before December 2007.

**Seismic Stability Analysis**

We will conduct a new seismic stability analysis of the concrete gravity dam using a peak ground acceleration of 0.54g. The analysis will conform to Chapter III of the Engineering Guidelines and will be submitted for review to the Project No. 2100 Eighth Part 12 D Independent Consultant Board of Safety Review in 2008.

**Updated Section 7 of STID**

We have updated Section 7 of the STID to include methodology of grout gallery piezometer and seepage measurements. Enclosed for inclusion in FERC's three copies of the Thermalito Diversion Dam's STID are three copies of Section 7. Within the document, please replace the outdated pages, 7-1 and 7-2, with this submittal. Please consider the request addressed and completed.

**Update of STID Figure 6-1, Headwater and Tailwater Rating Curves**

The headwater and tailwater rating curves, STID Figure 6-1, developed in 1962 for the Thermalito Diversion Dam, are based on all 14 gates being open. There has been no change to the spillway configuration; therefore, the curves are still valid for flows up to 320,000 cfs. The rating curves also reflect overtopping conditions for flows up to 660,000 cfs, but those water elevations are recognized as being estimates and contain variability due to the actual flood operations conditions. Therefore, no action is planned.

**PFMA Potential Risk Reduction Actions**

We appreciate your comments on the potential risk reduction actions identified during the 2004 Thermalito Diversion Dam's PFMA. We recognize that the risk reduction actions are not included in the Part 12D Consultant recommendations, but address issues that are a low priority in the scope of dam safety and are intended to aid the Department of Water Resources (DWR) in assessing the continued safety of the dam. With this understanding, we will endeavor to address the applicable items prior to the next Project No. 2100 Eighth Part 12D Independent Consultant Board of Safety Review in 2008. We have provided our comments on the requested potential risk reduction actions. Our comments follow each enumerated action item in bold-type.

1. **Analyze the spillway gates to see if they can take hydraulic load during overtopping.**

   The radial gates are not designed for an overtopping event. We recognize that the loss of one or more gates and the subsequent release of water are inconsequential in comparison to the overall damage, upstream and downstream, caused by the IDF event. Therefore, no action is planned.

2. **Look at operational considerations in light of potentially losing powerplant operation capability due to the Diversion Dam overtopping (gates would be damaged and be inoperative).**

   OFD has changed power configurations for Thermalito Diversion operations to address this issue. The new configuration does not include the Thermalito Diversion Powerplant. The primary power for the Diversion Dam control room, located on the right abutment, is supplied by a PG&E connection while the back-up power is fed from the Stand-by Emergency Generator located next to the control room. Please consider the recommendation addressed and completed.

3. **Determine whether or not a concrete section was constructed at the beginning of the Power Canal on the left side and just downstream of the Power Canal Headworks. (Personnel present at the construction recall such a feature but there is no photo documentation).**

   We have begun researching archived materials, but are still unable to verify the existence of the concrete section. We will continue our efforts and will submit our findings before the Project No. 2100 Eighth Part 12D Independent Consultant Board of Safety Review in 2008.

4. **Evaluate erosion potential (at Oroville) during spills and the effect of deposition of eroded material in the channel and Thermalito Diversion reservoir downstream.**

Our Division of Engineering's Project Geology Section has reviewed the erodibility of the emergency spillway's downstream area. There is only one to four feet of erodible top soil in the downstream area and erosion would not compromise the stability of the emergency spillway. The amount of material eroded is dependent on the volume and duration of a spill, but material transport in the Feather River is expected. Therefore, we will re-evalaute the Thermalito Diversion Dam stability analysis to account for additional lateral earth pressures on the concrete structure due to material deposited upstream of the dam prior to the Project No. 2100 Eighth Part 12D Independent Consultant Board of Safety Review in 2008. No other significant impacts are anticipated from material deposition in the Feather River channel upstream of the Thermalito Diversion Dam.

5. **Analyze Diversion Dam for normal water surface and earthquake loading including cracked-based analyses.**

We will re-evaluate the stability of Thermalito Diversion Dam under normal water levels with an earthquake loading that includes crack-based analysis prior to the Project No. 2100 Eighth Part 12D Independent Consultant Board of Safety Review in 2008.

6. **Determine why pressures are increasing in two piezometers.**

As discussed earlier, we have set the action level for dam uplift pressure at 20 psi. The measured uplift pressures at Stations 8+22 and 12+17, currently about 10 and 15 psi, respectively, are well below the theoretical pressures of 62 psi and 36 psi, respectively, utilized in the 2003 Division of Engineering's Diversion Dam stability analysis. We will continue to monitor the piezometers on a monthly basis. Please consider this risk reduction action addressed and completed.

7. **Document clearances between top of gates and hoist deck at maximum flow.**

   The designation of maximum flow implies that the measurement should be taken when a gate is completely open. We will measure distance from the top of the gate down to the deck on gate numbers 1, 6, 9 and 14 during the next full-open test to be conducted before December 2007.

8. **Verify the flood level that would lead to failure at railroad bridge.**

   The requested costly, technical investigation falls out of the scope of DWR's responsibility since the railroad bridge is not owned by DWR. Therefore no action is planned.

9. **Check relationship of gate opening to upstream nappe.**

   OFD staff indicate that the radial gates are always maintained to ensure orifice flow; therefore, no significant nappe is generated. The only exception would be during a 320,000 cfs or greater flow event where the gates would be opened to the fullest extent. In such a case, we would not be able to prevent debris from lodging against the dam's upstream face and inducing orifice flow nor could we prevent any resulting reduction in flow through the gates. No action is planned.

10. **Verify that gates can be opened 22.5 feet with the hoist cable support bracket on the gates hitting the edge of the deck opening.**

    OFD will conduct a full-limit test during the next full opening gate exercise to verify that the gates can opened to 22.5 feet. The testing will occur within the next two years, before December 2007.

11. **Examine means for protection for floods exceeding 320,000 cfs to reduce adverse consequences (such as parapet on dam crest at upstream rail, parapet to protect powerhouse; a few more feet of retained water results in higher levels of protection).**

    The dam as designed will overtop at flows greater than 320,000 cfs. We currently have no plans to raise the height of the dam or increase the diversion impoundment. Therefore no action is planned.

If you have any questions or would like to discuss these items further, please contact me at (916) 653-8043 or your staff may contact David Panec, Chief of DWR's Dam Safety Section at (916) 653-0772.

Sincerely,

Raphael A. Torres
Acting Deputy Director

Enclosures

cc: Mr. Gerry Maloney
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# 7. INSTRUMENTATION

The instrumentation at Thermalito Diversion Dam and Thermalito Diversion Dam Powerplant is described and evaluated in Performance Report No. 11 for the period of January 1, 2000 through June 30, 2004.

## 7.1 Plans, Sections and Details of Instrumentation

**Figure 7-1** is a plan of Thermalito Diversion Dam and the Thermalito Power Canal Headworks. Precipitation is measured at a rain gage located near the Hyatt Powerplant Switchyard. Reservoir level is monitored continuously from the Oroville Area Control Center.

Sixty six drain holes, spaced at 10 feet between Stations 5+67 and 12+25, were originally installed in the grout gallery. Two additional drains, at Stations 7+88 and 9+88, were installed in February 1994 as part of an underdrain study. The location of the gallery drain holes is shown on **Figures 7-2 and 7-3**. Seepage is measured at each gallery drain and at the grout gallery sump. Pressures are monitored in six drain holes at Stations 7+33, 7+88, 8+22, 8+72, 9+88, and 12+17.

**Figure 7-4** shows the locations of survey monuments on the dam. There are seven monuments on the crest bridge, six on the spillway piers, and two on the dam abutments. However, the Safety Review conducted in 1999 indicates that reading of the crest bridge monuments was discontinued in 1979.

There are fourteen monuments located in the powerplant area of the left abutment as shown on **Figure 7-5**. Four are on the corners of the powerhouse, nine are on the adjacent retaining walls, and one is on the pavement above the penstock.

## 7.2 Reading Frequency

**Table 1** shows the reading frequency of the instrumentation. Seepage measurements are taken quarterly and the settlement and deflection survey is performed annually. Pressures in the six drain holes are monitored quarterly.

## 7.3 Procedure for Resolving Spurious Readings

Any detected spurious readings will prompt a site visit and inspection of the instruments, a repeat of field measurements, and visual observations.

## 7.4 Tabulated Data for Each Instrument

Tabulated data for each instrument is maintained in an Excel database by the Project Surveillance Section.

## 7.5 Type of Instrument

Gallery seepage through the uplift pressure relief drains is measured at each drain with a collection-cup and a stop-watch. The total flow is determined by summing together the readings. The total seepage into the grout gallery drain, from the drain holes and other sources,

is determined by measuring the change in the sump water level within a time interval. The volume change in the sump is divided by the time interval then converted to flow in gpm.

Uplift pressure measurements are read in psi via an analog gage imbedded into each of the six plugged drain hole. To test the gage, a drain bypass valve is opened until pressure stabilizes to atmospheric, then the drain is closed again. A second reading is taken 15 to 30 minutes later and compared to the initial reading. Gages found to be malfunctioning are replaced.

Thermalito Diversion impoundment elevation is measured by a float elevation sensor within a stilling well located on the dam's upstream face near the right abutment. The elevation measurement is transmitted and continuously monitored at the Oroville Area Control Center.

## 7.6 Predicted Value for Each Instrument

Readings of the grout gallery drain are expected to be about 2 gpm. The foundation pressures should remain in the 1 psi to 2 psi range except the readings at Stations 8+22 and 12+17 will probably continue the increasing trend.

The current trends of the survey data are expected to continue. For the dam, the monuments show variation in vertical readings, but no clear trends. However, monument No. 11 continues a downward trend. Horizontal movement readings show variations over time, but recent readings show minimal movement. The powerplant monuments show variation in vertical movement readings but no clear trends.

## 7.7 Historic Range of Readings for Each Instrument

The historic ranges of readings for the precipitation gage and reservoir elevation are shown in **Tables 2 and 3**, respectively.

The grout gallery drainage has ranged from 27 gpm right after construction to 1 gpm.

Foundation pressures as measured by at the drain holes have ranged from 0 psi to 10 psi except the drains at Station 8+22 and Station 12+17 show an increasing trend to 13 psi.

The historic range of vertical movement of the dam has been 0.2 inch up and 0.09 inch down. Horizontal movement has ranged from 0.3 inch downstream to 0.28 inch upstream.

The powerplant monuments show a maximum vertical movement of 0.2 inch up and 0.08 inch down.

## 7.8 Action Level for Each Instrument

No action levels have been determined for the instrumentation at Thermalito Diversion Dam or the Powerplant.