

Appendix A

IPOC Information Request Letter

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6 January 2006

Mr. Constantine Tjoumas
Director, Division of Dam Safety and Inspections
Federal Energy Regulatory Commission
888 First Street, NE, Room 6N-01
Washington, D.C. 20426

Re: Initial Information Request
FERC Independent Panel of Consultants (IPOC)
Taum Sauk Pumped Storage Project

Dear Mr. Tjoumas:

At your request we have agreed to serve as an Independent Panel of Consultants (IPOC) to investigate the breach of the Upper Reservoir of the Taum Sauk Pumped Storage Project that occurred the morning of December 14, 2005. Each panel member has visited the site, Hendron on 15 December, 2005, Ehasz and Paul on 29 December 2005. Members Ehasz and Paul visited the Osage and Saint Louis Ameren operation centers 30 December 2005. These visits were instructive and required to start our investigation. To further the Panel's investigation, the Panel has assembled the initial information request list, enclosed. If you have any questions regarding any of the requested items or tasks please call any of the Panel members.

Respectfully Submitted,

Alfred J. Hendron, Jr.

Joseph L. Ehasz

Kermit Paul

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1. As-built drawings of Upper Reservoir, cross sections, verification tests, etc
Also provide a detailed topo map of the upper reservoir site prior to construction.
2. Any board of consultant reports during design and construction and thereafter.
3. Any design memos, design criteria, design drawings or field reports during construction
4. Any construction photos or construction videos
5. Embankment instrumentation plots, settlement readings, movement readings, weir readings (also provide weir designation, location and zone of embankment measured by each weir). History of leakage as related to face slab/parapet wall movements between January 1999 and January 2000.
6. FERC annual reports, part 12 inspection reports, and Utility/Owner inspection reports/sheets filled out between FERC annual and part 12 inspections.
7. Parapet wall design and calculations
8. Parapet wall and embankment crest elevations and movements along entire perimeter.
 - a. Top elevation at both ends of each parapet panel
 - b. x-y movements of parapet walls (horizontal movements if known)
 - c. Elevation and x-y movements of top of embankment.
 - d. Openings measured at parapet wall joints, also document direction of relative movement between panels.

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9. Operation criteria with respect to reservoir water levels, i.e. summer (1596) verses winter (1589). Original design water levels and most recent target levels. What was the previous method for controlling water levels?
10. Locations and elevation of piezometer water level indicators and settings
11. Locations and settings for high and high-high water trip devices
12. Describe types of QC checks of water level instrumentation that were conducted, both physical and electrical
13. Computer plots with data tables of upper reservoir water levels for the seven days prior to December 14, 2005 as well as the day of December 14, 2005. Also request this data and plots for as far back as possible.
14. Since November 2004, how often were the upper reservoir piezometer and high level trip devices tested. How often were they adjusted with respect to placement within the PVC pipes?
15. Document grain size distribution of embankment rock fill.
16. Document foundation materials of the embankment, define/characterize the clayey type material zone and weathered bedrock zone.
17. Location, purpose and logs of any boring done on the upper reservoir site since initial construction was completed.

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18. Chronology of all maintenance/repairs and changes to upper reservoir, including but not limited to parapet wall, face slab, crest road, access road, embankment instrumentation, reservoir instrumentation, etc.

19. Design and construction reports from Geo-Synthetics, Inc. related to membrane liner assessment and placement. Any documents/photos related to assessment or surveys (crack mapping, identification/characterization of offsets, etc.) of the concrete face slab and parapet walls or their joints prior to placement of the membrane liner. Any documents/photos related to details on how concrete face slab and parapet walls or their joints were prepared/treated prior to membrane liner placement.

20. Document locations/extent the parapet wall was over topped.

21. Flow chart of personnel that interact with the project.

- a. Name
- b. Title, physical location of work office or area.
- c. Job/task description, decisions made during work period. What do you control and observe? Who do you report to?
- d. List other personnel that you communicate with? What information is shared during the communication? Purpose of the information? How often is this done during a work period?

22. Who has walked along/inspected the dam crest when the reservoir was full? How often was this done? What has been observed? If possible we would like to review what ever was written about each inspection. Who receives this information? How is the information assessed?

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23. If the Panel members feel certain information is lacking with respect to characterization of foundation conditions or concrete face slab joints or parapet wall joints, the panel may request, excavation of trenches, exploratory borings or to view concrete face slab or parapet wall joints at certain locations.

24. Names and locations of Utility personnel associated with the Taum Sauk Project on duty at the time of the 14 December Dam breach.

25. Will a High Definition 3D Laser Scanning Survey for the breach area and slope failure area near panels 71-72 be done? If so, consider some of the other areas that experienced severe embankment deformation/crest erosion as well.

26. Area/Capacity curve for the upper and lower reservoirs.

27. Any videos taken at any time showing pump discharge into reservoir especially near location of pressure transducers and conductivity probes and at various water elevations.

28. Power Plant;

- a. Pump/turbine head vs. capacity curve
- b. Elementary diagram(s) for generator/motor showing master relays and protective circuits including interface with high water level conductivity probes in upper reservoir.
- c. Alarm logs of December 14, 2005
- d. General arrangement drawings (plan and section).
- e. Description of normal pump shutdown sequence and emergency pump shutdown sequence with associated timings.

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29. Water Level Monitoring and Protective Systems;
- a. Specifications, drawings, catalog outs of components, photos, test and inspection records, operating manuals, calibration records. Include Programmable Logic Controllers and communication systems.
 - b. Design Criteria and any documentation related to discussions of logic used in conductivity probe system. For example, how/why was decision made to require both probes to remain "wet" for 60 seconds before tripping unit?
 - c. Data, photos, and description of older "skate" and float systems.
 - d. Results of post event calibrations of pressure transducers.
 - e. Date that "suspect" pressure transducer was removed from "averaging" use and any checks/tests made to determine problem with transducer.
 - f. Fault tree analysis of entire system from transducers to relay used in generator/motor shutdown circuit.
 - g. Description of intrusion/tampering detection system (if any) at upper reservoir equipment enclosure. Log of alarms from such a system.
 - h. What was elevation of conductivity probes when found after December 14, 2005 event.
 - i. Licensee's procedures for periodic testing/calibration of pressure transducer and conductivity probe system including logs of such results.

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30. Tasks for FERC Support Group;

- a. Prepare summary by date and time of all alarms and pumping shutdowns (if any) initiated by Hi and Hi-Hi conductivity probes and corresponding readings of upper reservoir water level from pressure transducers.
- b. Summarize weather conditions for December 14, 2005 (close as possible to site) and determine if worse conditions existed on other dates after pressure transducer and conductivity probes were installed.
- c. Request licensee to conduct tests on conductivity probe system to determine sensitivity to water conditions (clear vs. turbid), water temperature, supply voltage, ice, etc. FERC staff to witness test.
- d. Request licensee to conduct test to verify that placing both conductivity probes in pail of water for 60 seconds at upper reservoir will result in operation (drop-out or pick-up) of appropriate relay at power plant. Also test to verify that operation of that relay results in drop-out of the pump mode master relay (4P?). Conduct test by placing a variable resistance (decade box) across the two sensing elements on the conductivity probe(s) in air and determine the maximum resistance in ohms that will consistently actuate the output device. FERC staff to witness tests.
- e. Request licensee to conduct investigation into cause for movement of protective plastic pipes around the pressure transducer probes. If pipe clamp anchor bolts failed, did they shear off, fatigue or other? Is there evidence of tampering?
- f. Provide any information about over-pumping protection systems used by other pumped storage owners.

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- g. Review digital records of upper reservoir water level for evidence of vertical upward movement of pressure transducers. Was movement gradual, sudden, or a series of steps? If movements can be identified, what was status of pump/turbines (generating, pumping or shut-down)? Also review these records to identify change in water level readings resulting from licensee re-adjusting readings to match staff gauge in reservoir.
- h. When was licensee first aware of movements of protective pipes and what was their response?
- i. Calculate and plot upper reservoir rate of rise (in./min.) versus elevation using area/capacity curve and pump/turbine head vs. capacity curve.
- j. If we want to develop a possible reason for movement of the protective pipes around the transducers, we may need to have someone such as Voith-Siemens or American-Hydro do a CFD model of the velocity distribution around the intake/discharge opening at the upper reservoir for various water levels. The objective would be to evaluate the velocity magnitudes and directions next to the protective pipes. The location of the pipe movement at the lower rather than upper elevation in the reservoir and the direction of movement away from the intake/discharge opening appear consistent with the forces from the pump discharge. FERC should advise if a CFD model should be done. This may not be necessary if licensee can produce videos requested above.
- k. Purchase or borrow a conductivity probe with associated electronics box (relay). Place probe above a cold body of water to see if we can form an ice skin on the probes without triggering the electronics box. Then plunge the probe into a pail of water to see if the ice skin prevents the probe from triggering the electronics. The electronics may have a sensitivity adjustment so we need to set it at the same value that licensee had on their devices. This test will determine if the conductivity probe system can be defeated by cold weather conditions.