

Section 6 Taum Sauk Upper Reservoir Breach Time Line

Date	Event
January 3, 2002	<ul style="list-style-type: none"> • AmerenUE sends plans and specs and design calculations for installation of a geomembrane liner to FERC for review. The design documents cover installation of a geomembrane liner, no designs or computations were provided regarding installation of new instrumentation. Demolition notes on the construction drawing directs removal of the original monitoring system and concrete supports. • In the letter, AmerenUE proposes starting construction on March 25, 2002.
March 1, 2002	<ul style="list-style-type: none"> • FERC sends letter stating it has no comments on the plans and specs. The letter asks for an erosion control plan and states inspections will be performed in conjunction with the Operation Inspection and a final inspection near the end of construction.
March 14, 2002	<ul style="list-style-type: none"> • FERC performs Operation Inspection of the project. According to the June 13, 2002 Operation Report, the licensee was planning to start installation of the geomembrane. The contractor will install anchors on the parapet wall (bolts and batten strips), and install an anchorage system near the toe of the slope. The geomembrane was to be installed during the summer 2002. The licensee was planning to replace the float level indicator at the upper reservoir with an electronic system. The old float indicator will be maintained as a backup.
April 22, 2002	<ul style="list-style-type: none"> • AmerenUE informs FERC by phone that budget of the liner has been exceeded and work has not been completed within schedule. AmerenUE states the geomembrane installation will take place in Fall 2003. • Work completed to date includes installation of the toe sill and GSE Polylock anchor around the interior perimeter, patching of critical areas with gunite, and pouring concrete in an area that has the most severe leakage. • FERC construction inspection planned for May 6, 2002 is postponed to Fall 2003.
September 25, 2002	<ul style="list-style-type: none"> • Richard Cooper of AmerenUE sends an email to FERC stating that Unit 1 seal was damaged and the unit cannot be used for pump-back operation. A two-week outage was planned to start the following weekend.

October 29-30, 2002	<ul style="list-style-type: none"> • MWH performs Part 12D inspection of project.
November 5, 2002	<ul style="list-style-type: none"> • AmerenUE sends letter to FERC stating between September 26 and October 18 of that year, the upper reservoir and penstocks were drained to do maintenance work on the units. During this time an inspection of the liner revealed cracks in the floor of the tunnel liner about 1500 feet up from the plant. Repairs were made at that time. The repairs consisted primarily of welding and are documented in photographs attached to the letter report dated November 5, 2002
November 19, 2002	<ul style="list-style-type: none"> • AmerenUE sends letter to FERC that Richard Cooper replaced David Fitzgerald as plant superintendent.
December 3, 2002	<ul style="list-style-type: none"> • Richard Cooper of AmerenUE sends an email to FERC that a second outage is planned for March 2, 2003 through March 22, 2003 to repair the Unit 2 inlet valve seal. The seal was reportedly damaged the previous month. The licensee planned to dewater the tunnel completely during this planned outage.
March 6, 2003	<ul style="list-style-type: none"> • AmerenUE sends letter to FERC stating liner project is being postponed to start in September 2004 and be completed by the end of the year. • FERC construction inspection planned for Fall 2003 is postponed to 2004.
April 24, 2003	<ul style="list-style-type: none"> • FERC sends letter to AmerenUE regarding postponement of liner installation. The letter notes leakage is steadily increasing from an average of 30 cfs during 2000 to about 65 cfs during the first quarter of 2003. Some of the leakage has been attributed to leaky seals in the units. The revised schedule is accepted because AmerenUE is continually monitoring leakage and making underwater repairs to the concrete liner in the interim. The licensee was asked to notify FERC of any change in leakage.
July 3, 2003	<ul style="list-style-type: none"> • AmerenUE submits 6-month leakage report.
August 1, 2003	<ul style="list-style-type: none"> • FERC sends letter regarding the 6-month leakage report and notes leakage averaged 58 cfs in the first half of 2003. A portion of the leakage was attributed to leakage at the hydroplant and repairs were scheduled for the fall 2004.
August 26, 2003	<ul style="list-style-type: none"> • Part 12D Report filed with the FERC. The consultants observed that the original float level controls had been replaced and that the current controls are not well documented on drawings. Drawings of the new instruments were requested within one year. • Licensee's plan and schedule to address the Part 12D

	<p>recommendations filed with the FERC. The licensee's plan and schedule was to provide the drawings of the modified Upper Reservoir level controls by the end of 2004.</p>
October 23, 2003	<ul style="list-style-type: none"> • FERC performs Operation Inspection of the project (report for the inspection is dated February 12, 2004). During the inspection, the FERC was informed that the old float system was removed and replaced with two pressure transducers, to provide better redundancy. The same tubing that housed the float had been reportedly used to mount the pressure transducers. The FERC engineer discussed with the plant superintendent proper notification and coordination procedures for certain unauthorized modifications that were performed during the previous year at the project.
October 24, 2003	<ul style="list-style-type: none"> • FERC sends letter requesting a crest survey be performed of the upper dam to supplement the Part 12D report.
December 24, 2003	<ul style="list-style-type: none"> • AmerenUE submits upper dam survey readings taken in November 2003 to FERC.
January 15, 2004	<ul style="list-style-type: none"> • AmerenUE submits 6-month leakage report and notes the leakage rate has not gone down since repair of the Unit 2 valve seal. The letter indicates the liner work will resume in September 2004.
January 20, 2004	<ul style="list-style-type: none"> • FERC sends letter to AmerenUE asking for plan and schedule to address routine maintenance and surveillance issued discovered during October 2003 Operation Inspection. The letter notes that liner repairs should be completed by the end of 2004 and flow into the seepage pond should be maintained at acceptable levels.
February 13, 2004	<ul style="list-style-type: none"> • Richard Cooper of AmerenUE sends email to FERC with plan and schedule for items discussed in January 20, 2004 letter.
March 15, 2004	<ul style="list-style-type: none"> • FERC sends letter to AmerenUE requiring a Quality Control and Inspection Program be submitted at least 60 days before doing liner work schedule for September 2004.
July 23, 2004	<ul style="list-style-type: none"> • AmerenUE submits QCIP for liner installation to FERC. Notes contractor proposes to start work on September 13, 2004.
September 9, 2004	<ul style="list-style-type: none"> • FERC sends letter to AmerenUE regarding liner installation. • States the work was authorized in FERC letter dated April 24, 2003.

	<ul style="list-style-type: none"> • States the original plans and specifications were reviewed in 2002 and no items that would adversely affect dam safety were found. • FERC reviewed the plans and specifications submitted in 2002 and QCIP and has no comments. • Requires monthly construction reports and certifications from the design engineer, QCIP manager, and licensee that project is constructed in accordance with design intent and plans and specs. • Notes if plans and specs are revised, the licensee must assure that changes are coordinated between the engineer, QCIP manager, FERC, and the licensee. • Notes any changes in operation must be authorized by the FERC and properly coordinated between the licensee, FERC, and the operators. • Requires a Final Construction Report within 45 days of completing construction.
<p>September 9, 2004 - November 15, 2004</p> <p>INSTALLATION OF GEOMEMBRANE LINER AND RESERVOIR CONTROLS</p>	<ul style="list-style-type: none"> • Liner installed on upstream slope of upper reservoir. • All of the upper reservoir level control and protection devices were replaced. Three GE Druck model no. 1230 pressure transducers were installed for normal shutdown of the pump/generators. The Low, Low/Low Warrick Conductivity sensors are replaced in kind. The High, High/High float switches were replaced with Warrick Conductivity sensors. The upper reservoir PLC was replaced with an Allen Bradley PLC. The pump/generator shutdown relays at the plant are replaced with Allen-Bradley PLCs. The level indicators, alarming, and data acquisition systems were replaced with a WonderWare Operator Interface. (source: Joe Raybuck's Draft Taum Sauk Upper Reservoir Level Control and Protection Systems - Information Sheet) • Instrumentation pipe supports are changed to cable support system (source: As-built Design Drawings). • AmerenUE replaced the existing staff gage, which had settled approximately one foot along with the parapet wall. The staff gage had been used to measure the normal operating level of the upper reservoir, which was 1596 ft. Due to the settling, AmerenUE believes that the upper reservoir was actually operating at 1595 ft. instead of 1596 ft. before the liner replacement project. (AmerenUE Chronology) • During the outage new visual level indications were painted on the liner reflecting true elevations. (AmerenUE Chronology)

September 30, 2004	<ul style="list-style-type: none"> • FERC performs Operation Inspection of the project (report for the inspection is dated December 23, 2004).
October 6, 2004	<ul style="list-style-type: none"> • Geo-Synthetic, Inc. (“GSI”), the installation contractor, installs the membrane in the area of the water level instruments at Panel 58. • GSI raised concerns that the March 7, 2003 gage piping design did not provide for adequate anchoring and could compromise the integrity of the liner and gage piping. In response, Emcon/OWT, Inc. (“Emcon”), an engineering firm retained to design the liner and gage piping, provided a new design drawing (8304-X-155099, Rev. 5, dated 10/5/04) proposing a new gage piping anchoring system. (AmerenUE Chronology - <i>See Exhibit 8</i>).
October 19, 2004	<ul style="list-style-type: none"> • Steve Bluemner of AmerenUE sends email to FERC documenting construction progress from start of construction (September 2, 2004) through September 30, 2004.
October 20-23, 2004	<ul style="list-style-type: none"> • Assembly of the gage piping on the reservoir floor starts on October 20 and is finished on October 23. (GSI daily construction progress reports.) • GSI installed the gage piping. (AmerenUE Chronology - <i>See Exhibit 9</i>). During installation, AmerenUE determined that Emcon’s design (8304-X-155099, Rev. 5, dated 10/5/04) for the gage piping could not be installed as shown due to field conditions. In consultation with Emcon and with its approval, AmerenUE made field changes to the anchoring system in order to adapt the design to field conditions and to make it more robust. • Subsequently, on November 12, 2004, Emcon and AmerenUE performed a walk-through inspection of the liner and gage piping installation.
November 6, 2004	<ul style="list-style-type: none"> • AmerenUE field notes reported that the top of panel 72, the lowest known point on the upper reservoir parapet wall, was measured at elevation 1596.99 ft. (AmerenUE Chronology - <i>See Exhibit 10</i>).
November 8, 2004	<ul style="list-style-type: none"> • AmerenUE field notes reflected that the level protection sensors were intended to be installed at the following elevations: Lo-Lo sensor: 1524 ft.; Lo sensor: 1524.5 ft.; Hi sensor: 1596 ft.; Hi-Hi sensor: 1596.2 ft. (AmerenUE Chronology - <i>See Exhibit 11</i>.)
Mid-November 2004	<ul style="list-style-type: none"> • The Druck pressure transducers and Warrick conductivity sensors were lowered into the gage pipes. Wiring from the transducers and sensors to the upper

	<p>reservoir gage house was marked with colored tape to distinguish one from another and to provide a visual elevation reference. AmerenUE believes the colored tape reflects the as-designed and installed elevations of the level protection sensors. These elevations approximate those indicated in AmerenUE field notes. (AmerenUE Chronology.)</p>
<p>November 15, 2004</p>	<ul style="list-style-type: none"> • AmerenUE released the upper reservoir for operation. (AmerenUE Chronology - <i>See</i> Exhibit 12.) The normal operating level remained at 1596 ft., but now was being measured by the new level control transducers and visual level indications. As a result, the actual normal operating water level was 1596 ft. and not 1595 ft. as it had been prior to the liner replacement project, as further described in the September 10 2004 entry.
<p>November 19, 2004</p>	<ul style="list-style-type: none"> • FERC sends letter accepting Part 12D Report and requesting the following: <ul style="list-style-type: none"> ○ Perform a new crest survey before the end of 2004 to determine correct elevations. The data should be provided to the next Part 12D consultant and he should review and comment on the data. ○ Explain cause of penstock liner buckling in next Part 12D report. ○ Reevaluate post-seismic deformation and stability of the Upper Reservoir for the next Part 12D report. ○ Survey both the offset and deformation movement of the parapet panels and compare it to the measurements taken in 1987 or 1988, provide interpretation of the data. ○ Provide a plan and schedule to address these comments.
<p>November 23, 2004</p>	<ul style="list-style-type: none"> • Reference comment logged into the Upper Reservoir Programmable Logic Controller (“PLC”) program indicated that the Hi sensor was at elevation 1596 ft. (AmerenUE Chronology - <i>See</i> Exhibit 13.) • AmerenUE believes, but has been unable to verify, that Tony Zamberlan of Laramore, Douglass, and Popham Consulting Engineers (“LDP”), entered the comments. LDP was retained by AmerenUE to provide engineering services related to the new level control and protection instrumentation.
<p>November 30, 2004</p>	<ul style="list-style-type: none"> • The Hi sensor actuated. An Osage operator recorded a trip of unit 2 with the upper reservoir level measuring elevation 1595.0 ft. (AmerenUE Chronology - <i>See</i>

	<p>Exhibits 15 and 16.)</p> <ul style="list-style-type: none">• Later that day, the Lo Lo sensor relay lost DC power and shut down both generators. (AmerenUE Chronology - <i>See</i> Exhibits 15 and 16.)• An email from Taum Sauk’s plant superintendent listed the shut down setpoints for the upper reservoir. (AmerenUE Chronology - <i>See</i> Exhibit 16.) When the average of the three level control transducer readings reflects that the upper reservoir level is at the following elevations, the corresponding pump shut downs will occur: <p style="text-align: center;"><u>Elevation 1592 ft.</u> Normal shut down for first pump.</p><p style="text-align: center;"><u>Elevation 1596 ft.</u> Normal shut down for second or last pump.</p><p style="text-align: center;"><u>Elevation 1596.5 ft.</u> All pumps shut down.</p> <ul style="list-style-type: none">• The superintendent also stated that the setpoint for the level protection sensors is above elevation 1596.5 ft.
November 30, 2004	<ul style="list-style-type: none">• Steve Bluemner of AmerenUE sends email to FERC documenting construction progress for October 1 2004 through completion of the project. Photographs of the new instrumentation gage piping are included.
December 1, 2004	<ul style="list-style-type: none">• To prevent intermittent trips, Tony Zamberlan added a one minute time delay to the PLC logic for all level protection sensor relays. (AmerenUE Chronology - <i>See</i> Exhibits 17 and 18.)• According to Mr. Zamberlan’s Dec. 2nd email, he also was at the upper reservoir to “pull up the Hi level Warrick sensors to 1596.5.” (AmerenUE Chronology - <i>See</i> Exhibit 17.) Mr. Zamberlan does not recall, and has been unable to explain why he set the sensors at elevation 1596.5 ft., or how he determined that elevation. (Note: According to the interview of Mr. Zamberlan of February 10, 2006, any modifications that were made by him were directed to the union workers at the Taum Sauk Plant and he did not make any physical changes. Mr. Zamberlan only modified the PLC programs himself.)• Reference comment logged into the Upper Reservoir PLC program indicated that the Hi sensor was at elevation 1596.7 ft. AmerenUE believes, but has been unable to verify, that Mr. Zamberlan entered the

<p>December 10, 2004</p>	<p>comment. (AmerenUE Chronology - <i>See Exhibit 18.</i>)</p> <ul style="list-style-type: none"> • LDP Consulting Engineers finalized and issued the schematic drawing for the upper reservoir level relaying and shut down controls (8303-P-26648, revision 15). (AmerenUE Chronology - <i>See Exhibit 19.</i>) The schematic indicated that the Hi sensor was at elevation 1596.7 ft. and the Hi-Hi sensor was at elevation 1596.9 ft. LDP personnel do not recall, and are unable to explain why the drawing reflects the stated elevations.
<p>December 14, 2004</p>	<ul style="list-style-type: none"> • Pump shutdown levels are indicated in the Taum Sauk PLC. When the average of the three level control transducer readings reflects that the upper reservoir level is at the following elevations, the corresponding pump shut downs will occur: <ul style="list-style-type: none"> <u>Elevation 1592 ft.</u> Normal shut down for first pump. <u>Elevation 1596 ft.</u> Normal shut down for second or last pump. <u>Elevation 1596.2 ft.</u> Normal all pumps shut down. <u>Elevation 1596.5 ft.</u> Non-configurable all pumps trip that, if activated, requires a reset. <p>(<i>AmerenUE Chronology - See Exhibit 20.</i>)</p> • Reference comment logged into the Taum Sauk Common PLC program indicated that the Hi-Hi sensor was set at elevation 1596.5 ft. AmerenUE believes, but has been unable to verify, that Mr. Zamberlan entered the comment. (AmerenUE Chronology - <i>See Exhibit 20.</i>)
<p>December 20, 2004</p>	<ul style="list-style-type: none"> • AmerenUE sends to letter to FERC in response to comments on the 8th Part 12D Report. As an attachment, AmerenUE includes the latest survey of the crest (taken November 2003 and corrected October 2004) and drawings and diagrams of the new Upper Reservoir Level Controls. The Schematic Diagram (revised on 12/10/2004) shows the Hi Warrick Sensor set at 1596.7 feet and the Hi-Hi Sensor set at 1596.9 feet. The design drawing of the instrument supports shows only three pipes attached to a Unistrut channel with spring nuts and no turnbuckles.
<p>December 27, 2004</p>	<ul style="list-style-type: none"> • A malfunctioning Lo-Lo sensor relay was replaced. (AmerenUE Chronology - <i>See Exhibit 21.</i>)

	<ul style="list-style-type: none">• The PLC historian software recorded a Hi-Hi sensor alarm at 3:38 p.m. PST, or 5:38 CST, at an upper reservoir level reading of elevation 1586.4 ft.³ (AmerenUE Chronology - <i>See Exhibit 22.</i>) At the time of the alarm, the units were neither pumping nor generating. (AmerenUE Chronology - <i>See Exhibit 23.</i>)• AmerenUE believes this alarm may have been associated with maintenance activities at Taum Sauk.
January 5, 2005	<ul style="list-style-type: none">• AmerenUE sends letter to FERC showing leakage rate has significantly decreased since installation of liner (from around 50 cfs to around 15 cfs).• Indicates diver will seal all remaining leaks in the floor area during the Spring or Summer 2005.
February 12, 2005	<ul style="list-style-type: none">• AmerenUE sends letter to FERC including the final construction report for the liner replacement. The report includes gage piping drawing (8304-X-155099, Rev. 5, dated 2/7/05) which does not identify the field changes made to the gage piping anchoring system. (AmerenUE Chronology - <i>See Exhibit 24.</i>)
February 14, 2005	<ul style="list-style-type: none">• The PLC historian software recorded a six-second Hi-Hi sensor alarm at 3:57 p.m. CST, at an upper reservoir level reading of elevation 1593.5 ft. (AmerenUE Chronology - <i>See Exhibit 22.</i>) At the time of the alarm, the units were neither pumping nor generating. (AmerenUE Chronology - <i>See Exhibit 25.</i>)• AmerenUE believes this alarm may have been associated with maintenance activities at Taum Sauk.
February 15, 2005	<ul style="list-style-type: none">• The PLC historian software recorded multiple Hi-Hi sensor alarms between 4:03 p.m. and 5:49 p.m. CST, at an upper reservoir level reading of elevation 1593.5 ft. (AmerenUE Chronology - <i>See Exhibit 22.</i>) At the time of the alarms, the units were neither pumping nor generating. (AmerenUE Chronology - <i>See Exhibit 25.</i>)• These alarms were associated with functional checks of the Hi-Hi sensor alarm that were performed by a contractor at the direction of AmerenUE personnel. The contractors lowered the Hi and Hi-Hi sensors into the water.• The generator trip logic for the Lo and Lo-Lo sensors

³ On the date of the alarm, the PLC Historian software was programmed to Pacific time. In June 2005, the PLC Historian software was reprogrammed to Central time. Throughout this chronology, all noted alarms recorded by the PLC Historian software are expressed in Central time.

	<p>was modified from parallel logic to series logic by Tony Zamberlan. (AmerenUE Chronology - <i>See</i> Exhibits 26 and 27.) In series logic, the generators would only shut off if both the Lo and Lo-Lo sensors actuate. A similar change was made by Mr. Zamberlan to the pump trip logic for the Hi and Hi-Hi sensors. AmerenUE believes the generator trip logic for the Lo and Lo-Lo sensors was modified to prevent spurious actuations.</p> <ul style="list-style-type: none"> • In his February 10, 2006 interview (pg 30), Tony Zamberlan addressed this issue and stated that "...a hypothesis of as to why." He believed the change may have been due to maintaining consistency between how the sensors were handled, and since the Lo and Lo-Lo sensors were placed in series to avoid spurious shut offs the Hi and Hi-Hi sensors were similarly placed. "My hypothesis would be that being that this is half of the same system, the lower half of the, the backup protection scheme, that we did the same thing to the upper reservoir code, just to match it up so that it operated the same way, ...".
<p>March 14, 2005</p>	<ul style="list-style-type: none"> • FERC sends letter accepting final construction report with no comments.
<p>June 22, 2005</p>	<ul style="list-style-type: none"> • FERC sends letter notifying licensee of upcoming Operation Inspection, copied to Missouri Dam and Reservoir Safety Program Chief Engineer so that he could arrange to participate in the inspection.
<p>June 27, 2005</p>	<ul style="list-style-type: none"> • Missouri Department of Natural Resources sends letter to FERC acknowledging operation inspection notice and providing updated contact information for the director of the Missouri Department of Natural Resources.
<p>July 5, 2005</p>	<ul style="list-style-type: none"> • AmerenUE provides 6-month leakage report that shows leakage from Upper Reservoir averaged less than 6 cfs during the first half of 2005 (as opposed to 65 cfs prior to installation of the geomembrane liner).
<p>July 20, 2005</p>	<ul style="list-style-type: none"> • The PLC historian software recorded a one-second Hi-Hi sensor alarm at 5:15 p.m. CDT, at an upper reservoir level reading of elevation 1573.8 ft. (AmerenUE Chronology - <i>See</i> Exhibit 22.) At the time of the alarm, the units were generating. (AmerenUE Chronology - <i>See</i> Exhibit 28.) • AmerenUE has been unable to determine why this alarm was recorded, but around the time of the alarm, a storm, likely accompanied by lightning, moved through the area of the project works. The storm may have caused momentary induced voltages on the wiring running between the Hi-Hi sensor relay and the plant PLC input

	<p>card resulting in the PLC Historian recording a false Hi-Hi sensor alarm.</p>
August 14, 2005	<ul style="list-style-type: none">• The PLC historian software recorded a one-second Hi-Hi sensor alarm at 3:50 p.m. CDT, at an upper reservoir level reading of elevation 1591.6 ft. (AmerenUE Chronology - <i>See Exhibit 22.</i>) At the time of the alarm, the units were generating. (AmerenUE Chronology - <i>See Exhibit 29.</i>)• AmerenUE has been unable to determine why this alarm was recorded, but at the time of the alarm, a storm, accompanied by lightning, moved through the area of the project works. The storm may have caused momentary induced voltages on the wiring running between the Hi-Hi sensor relay and the plant PLC input card resulting in the PLC Historian recording a false Hi-Hi sensor alarm.
September 25, 2005	<ul style="list-style-type: none">• Remnants of Hurricane Rita pass through area.• Workers witness overtopping, referred to as “Niagara Falls at the Northwest corner of the reservoir”• Units are immediately put on generate mode to lower reservoir. (source: 9/27/2005 email from Richard Cooper)• Refer to September 24-26 Operations Time Line
September 27, 2005	<ul style="list-style-type: none">• The plant superintendent notes the visual level of the reservoir (as measured down from the crest of the parapet wall) does not match the average Druck pressure transducer level. The visual level was about 4 inches from the top of the parapet wall near “a couple of wet areas on the west side of the reservoir parapet walls”, even though the transducers were showing elevation 1596 feet. (<i>Note: if the referred to west area was around panel 72, which is the lowest panel on the west side of the dam – 4 inches from the top of the crest would be elevation 1596.66 feet.</i>)• One Druck pressure transducer is found to be reading “a foot higher than the other two” and is eliminated from the average. When the one pressure transducer was taken out of the average, the reading was 1596.2 feet. Since this did not match the elevation in the field, a 0.4 ft programming adjustment was made to the two remaining pressure transducer readings, making the level read 1596.6 ft.• The plant superintendent states they would “check on what this does to the actual level the next several mornings.” (source 9/27/2005 email from Richard Cooper)

	<ul style="list-style-type: none"> At 10:11 a.m., an Osage operator noted in the operator log a “high upper resv. alarm [and] small gate setting changed to 7.7% by itself. HPTs (Hydro Plant Technicians) are working on something @ Sauk.” (AmerenUE Chronology - <i>See Exhibit 31.</i>) At the time the notation was made, the units were neither pumping nor generating. AmerenUE believes this alarm is related to work being done on the PLC at approximately the same time. (AmerenUE Chronology - <i>See Exhibit 22.</i>) Between 10:03 and 10:05 a.m., the elevation level readings for the upper reservoir were not recorded, suggesting that the PLC was offline so that an adjustment to the logic could be made. The adjustment may have resulted in an alarm indication once the PLC came back online.
September 28, 2005	<ul style="list-style-type: none"> The PLC historian software recorded a one-second Hi-Hi sensor alarm at 6:18 p.m. CDT, at an upper reservoir level reading of elevation 1544.1 ft. (AmerenUE Chronology - <i>See Exhibit 22.</i>) At the time of the alarm, the units were neither pumping nor generating. (AmerenUE Chronology - <i>See Exhibit 31.</i>) AmerenUE has been unable to determine why this alarm was recorded, but at the time of the alarm, a storm, accompanied by lightning, moved through the area of the project works. The storm may have caused momentary induced voltages on the wiring running between the Hi-Hi sensor relay and the plant PLC input card resulting in the PLC Historian recording a false Hi-Hi sensor alarm.
September 30, 2005	<ul style="list-style-type: none"> The Hi and Hi-Hi Warrick Sensors are verified to be 7 inches and 4 inches below the crest of the wall, respectively. (<i>Note: This results in elevations 1597.417 ft and 1597.667 ft, respectively, based on the recent survey of the parapet wall near the instrumentation.</i>) (Source: 10/7/2005 email from Thomas Pierie and AmerenUE Chronology.)
October 3-4, 2005	<ul style="list-style-type: none"> A visual inspection of the upper reservoir revealed that portions of the gage piping support system had failed, allowing the gage piping to move. The piping was observed to be bent. AmerenUE operators recognized that a bend in the piping would produce an elevation reading that is lower than the actual elevation of the upper reservoir. (AmerenUE Chronology - <i>See Exhibit 33.</i>)
October 6, 2005	<ul style="list-style-type: none"> The plant superintendent notes the HDPE pipes have come loose from the cables and are bowing at least 5

	<p>feet out at about 50 feet down.</p> <ul style="list-style-type: none"> • In the evening, Unit 1 tripped in the generate mode due to high vibrations. (Source: 10/7/2005 email from Richard Cooper)
October 7, 2005	<ul style="list-style-type: none"> • The maximum operating level is set at 1594 feet instead of the normal 1596 feet. • The set point for the “all pumps” shutdown was lowered from elevation 1596.2 ft. to elevation 1594.2 ft. (AmerenUE Chronology) • Arrangements are made to have a diver evaluate whether the piping could be straightened and reattached without draining the reservoir (AmerenUE Chronology – See Exhibit 34). • Plans were made to add redundancy to the upper reservoir level protection system. A wind speed measurement transmitter and alarm, were ordered for installation at the upper reservoir. AmerenUE also planned to install an additional sensor 2” below the normal last pump shut down setpoint (<i>i.e., at elevation 1595.83 ft.</i>) so that the water level pressure transducers could be checked. (AmerenUE Chronology - See Exhibit 32.) • In the morning, Unit 2 tripped on high vibration in the pump mode. • The plant superintendent believes some epoxy material is coming loose from the tunnel liner that was installed last fall. The epoxy was installed in the tunnel to cover cracks in the steel liner. The size of the epoxy patch was about 1 inch thick, 6 feet wide and 100 feet long. The tunnel drains were found to be flowing at full pipe like they were before the epoxy patch was installed. The vibration protection trips on the units were set to normal levels and the superintendent believed these would protect the units if more material is released. (Source: 10/7/2005 email from Richard Cooper)
October 11, 2005	<ul style="list-style-type: none"> • A diver visits the site and says the pipes can be straightened out but AmerenUE needs to develop/manufacture a new tie down system. (Source: 10/11/2005 email from Richard Cooper)
October 25, 2005	<ul style="list-style-type: none"> • The preliminary design was completed and materials were ordered for the gage piping support retrofit. (AmerenUE Chronology - See Exhibit 35.)
October 28, 2005	<ul style="list-style-type: none"> • FERC sends letter providing results of August 25, 2005 Operation Inspection. No follow-up actions required.
November 2, 2005	<ul style="list-style-type: none"> • The PLC historian software recorded a nine-second Hi-

	<p>Hi sensor alarm at 12:49 p.m. CST, at an upper reservoir level reading of elevation 1578.4 ft. <i>See Exhibit 22.</i> At the time of the alarm, the units were neither pumping nor generating. (AmerenUE Chronology - <i>See Exhibit 36.</i>) AmerenUE has been unable to determine why this alarm was recorded.</p>
November 23, 2005	<ul style="list-style-type: none">• All materials are on hand to make repairs.• Emails indicate AmerenUE is having trouble scheduling repairs and notes the diver may not be available through the end of the year. (Source: 11/23/2005 email from Steven Bluemner)
November 29, 2005	<ul style="list-style-type: none">• AmerenUE sends letter to FERC stating that the annual drill of the Taum Sauk EAP will be conducted on December 14, 2005.
December 13, 2005	<ul style="list-style-type: none">• Operations data shows the Druck pressure transducer elevations drop about 1.9 feet at about 11:20 pm although both units are pumping. (Source: AmerenUE's Operation Data)• See December 13-14 Operations Time Line
December 14, 2005	<ul style="list-style-type: none">• Dam Overtops and Breaches• See December 13-14 Operations Time Line

**September 24-26 Operations Time Line
Taum Sauk Project, P-2277**

Date	Time	Druck Pressure Transducer Elev. (ft)*	Unit Info.	Weather at Farmington, MO	Coincident Events
Sept. 24	13:00	1595.82	Generator 1 on-line	Wind 8 knots coming from 110 degrees of North, Clear	
	13:11	1595.03	Generator 2 on-line	Wind 6 knots coming from 110 degrees of North, Clear	
	18:01	1544.91	Generator 1 off-line	Wind 5 knots coming from 100 degrees of North, Clear	
	18:02	1544.91	Generator 2 off-line	Same	
	18:58	1544.75	Generator 2 on-line	Wind 6 knots coming from 100 degrees of North, Clear	
	19:01	1544.20	Generator 1 on-line	Same	
	20:01	1532.00	Generators 1 & 2 off-line	Wind 5 knots coming from 110 degrees of North	
Sept. 25	00:27	1531.65	Pump 2 on-line	Wind 3 knots coming from 110 degrees of North	
	01:57	1539.80	Pump 1 on-line	Wind 5 knots coming from 30 degrees of North	
	08:03	1592.11	Pump 2 off-line	Wind 10 knots (gust to 18 knots) coming from 100 degrees of North, precip.	
	9:03	1595.96	Pump 1 off-line	Wind 10 knots (gust to 18 knots) coming from 80 degrees of North, precip.	AmerenUE hydroplant technicians note overtopping during this period.
	11:03	1595.97	Generator 2 on-line	Wind 14 knots (gust to 22 knots) coming from 90 degrees of North, precip.	
	12:15	1590.92	Generator 2 off-line	Wind 10 knots (gust to 16 knots) coming from 100 degrees of North, precip.	
	13:56	1590.85	Generators 1 & 2 on-line	Wind 9 knots coming from 100 degrees of North, precip.	
	18:03	1547.91	Generators 1 & 2 off-line	No wind	
	18:59	1547.78	Generator 1 on-line	No wind	
	19:01	1547.68	Generator 2 on-line	Same	
	20:35	1528.18	Generator 2 off-line	Wind 5 knots coming from 320 degrees of	

Date	Time	Druck Pressure Transducer Elev. (ft)*	Unit Info.	Weather at Farmington, MO	Coincident Events
				North	
	20:59	1525.80	Generator 1 off-line	Same	
	21:58	1525.42	Pump 2 on-line	Wind 3 knots coming from 310 degrees of North	
	23:01	1531.49	Pump 1 on-line	Wind 8 knots coming from 350 degrees of North	
Sept. 26	05:53	1591.96	Pump 2 off-line	Wind 5 knots coming from 310 degrees of North, Clear	
	06:43	1594.9	Pump 1 off-line	Wind 3 knots coming from 310 degrees of North, Clear	

* Druck pressure transducer readings are not the true elevations of reservoir.

** Information for this chart is from AmerenUE's operation data & trice-hourly weather information at Farmington Airport.

**December 13-14 Operations Time Line
Taum Sauk Project, P-2277**

Date	Time	Druck Pressure Transducer Elev. (ft)*	Unit Info.	Weather at Farmington, MO	Coincident Events
Dec. 13	06:05	1591.52	Generator 1 on-line	27° , No Wind	
	06:06	1591.54	Generator 2 on-line	Same	
	7:08	1581.57	Generators 1 & 2 off-line	25° , No wind	
	16:43	1581.29	Generator 1 on-line	43° , Wind at 11 knots coming from 160 degrees from North	
	16:50	1580.63	Generator 2 on-line	Same	
	20:06	1548.08	Generator 1 off-line	39° , Wind at 10 knots coming from 150 degrees from North	
	20:27	1546.39	Generator 2 off-line	39° , Wind at 11 knots coming from 170 degrees from North	
	22:33	1546.85	Pump 1 on-line	39° , Wind at 10 knots coming from 150 degrees from North	
	23:13	1548.59	Pump 2 on-line	39° , Wind at 16 knots coming from 160 degrees from North	At about 23:20 there is a 1.9 foot drop in the transmitter readings, although both pumps are operating.
Dec. 14	04:43	1591.85	Pump 2 off-line	36° , Wind at 13 knots (Gusts to 16 knots) coming from 170 degrees from North	
	05:16	1593.39	Pump 1 off-line	36° , Wind at 13 knots (Gusts to 16 knots) coming from 170 degrees from North	Upper Reservoir water levels start falling at 5:16. Between 5:15 and 5:30, USGS Gage 07061270 (East Fork Black River Near Lesterville) located near Highway N was damaged by the flood surge.
	05:20	1581.59		Same	
	05:25	1548.09		Same	
	05:30	1522.52		Same	
	05:35	1510.78		37° , Wind at 13 knots coming from 170 degrees from North	At 5:38, the Osage Operator logs that the upper reservoir indication, tailwater level indication, and

Date	Time	Druck Pressure Transducer Elev. (ft)*	Unit Info.	Weather at Farmington, MO	Coincident Events
					generate permissives were not reading normal on the LDS and SCADA System
	05:40	1507.00		Same	At 5:40, Osage Operator notifies Taum Sauk Superintendent of unusual readings. At 5:41, the Reynolds County 911 dispatcher receives a call about water on Highway N.
	05:45	1505.72		Same	
	05:50	1505.12		Same	
	05:55	1504.77		Same	
	06:00	1504.55		37°, Wind at 14 knots (gust to 19 knots) coming from 170 degrees from North	At 6:00, the plant superintendent confirms tailrace is muddy. The Lesterville Fire Department and Reynolds County Sheriff contact the Plant Superintendent to confirm the upper reservoir dam has breached. The plant superintendent begins contacting others on EAP.
	08:00	1503.52		37°, Wind at 9 knots coming from 180 degrees from North	

* Druck pressure transducer readings are not the true elevations of reservoir.

** Information for this chart is from AmerenUE's operation data, thrice hourly surface climate data for Farmington, MO Airport Station, AmerenUE's 12.10 letter, an interview with Reynolds County Sheriff, and a 1/23/2006 email from USGS.

Section 7 Meteorology

7.1 General

The Taum Sauk area is located in Southeast Missouri near the geographical center of the United States. Its position in the middle latitudes allows it to be affected by warm, moist air masses from the Gulf of Mexico and cold, dry air masses that originate in Canada. The alternate invasion of these air masses produces a wide variety of weather conditions and allows for the region to enjoy a true four-season climate. The average annual temperature is 54 degrees. The average annual high temperature is 65 degrees, the average annual low temperature is 42 degrees.

By letter data January 19, 2006, AmerenUE provided weather information for most of 2005 as recorded at Farmington Regional Airport located about 1 mile south of Farmington, MO. The airport is at elevation 947 ft and at latitude 37.7610792 and longitude -90.4285972. The airport is about 27 miles northeast of the upper reservoir.

This section discusses the meteorology preceding and during three events:

1. September 25, 2005 - when overtopping occurred at the northwest corner of the reservoir.
2. September 27, 2005 - when a wet area was noted on the downstream side of parapet panel 72.
3. December 14, 2005 - when the upper reservoir breached.

Figure 7.1 contains a weather radar image of the United States at 10:00 a.m. on September 25. Appendix C shows thrice hourly weather data for the period September 24-27 and December 13-14, 2005.

7.2 September 25, 2005

The weather conditions in the Taum Sauk area (Farmington, MO Station), prior to and on September 25, 2005, as reported by the NWS, St. Charles, MO, were as follows:

“... Periods of rain and an occasional thunderstorm will continue over eastern Missouri and most of Illinois for the rest of this morning and into the afternoon hours. This precipitation is associated with the northern periphery of tropical depression Rita. Expect brief periods of heavy rain ... up to half an inch at times.