UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
612 EAST LAMAR BLVD, SUITE 400
ARLINGTON, TEXAS 76011-4125

January 18, 2011

Rafael Flores, Senior Vice President
and Chief Nuclear Officer
Attention: Regulatory Affairs
Luminant Generation Company LLC
Comanche Peak Nuclear Power Plant
P.O. Box 1002
Glen Rose, TX 76043

SUBJECT: SUMMARY OF MEETING WITH LUMINANT GENERATION COMPANY LLC REGARDING A PRELIMINARY FINDING WITH MODERATE SAFETY SIGNIFICANCE

Dear Mr. Flores:

This refers to the public regulatory conference meeting conducted in Arlington, Texas on January 13, 2011, between the U.S. Nuclear Regulatory Commission and your staff. The participants discussed the circumstances associated with a preliminary finding with moderate safety significance regarding potential failure to incorporate into station procedures information necessary to ensure continued operability of a safety-related water storage tank.

This meeting was classified as a Category 1 public meeting, as communicated in the meeting notice (ADAMS ML103570288). This provided an opportunity for members of the public to discuss regulatory issues with the Nuclear Regulatory Commission (NRC) after the business portion of the meeting, but before the meeting adjourned. No comments were brought forward by the public.

The attendance list for the meeting is enclosed with this summary (Enclosure 1). A copy of the Luminant Generation Company LLC presentation slides is also enclosed (Enclosure 2).

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, and its enclosures, will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web Site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Should you have any questions concerning this matter, we will be pleased to discuss them with you.

Sincerely,

/RA/

Thomas R. Farnholtz, Chief
Engineering Branch 1
Division of Reactor Safety

Dockets: 50-445; 50-446
Licenses: NPF-87; NPF-89

Enclosures:
1. Attendance List
2. Luminant Generation Company LLC Presentation Slides

cc w/enclosures:

Rafael Flores, Senior Vice President
and Chief Nuclear Officer
Luminant Generation Company LLC
Comanche Peak Steam Electric Station
P.O. Box 1002
Glen Rose, TX 76043

Honorable Walter Maynard
County Judge
P.O. Box 851
Glen Rose, TX 76043

Mr. Fred W. Madden, Director
Oversight and Regulatory Affairs
Luminant Generation Company LLC
P.O. Box 1002
Glen Rose, TX 76043

Mr. Richard A. Ratliff, Chief
Bureau of Radiation Control
Texas Department of Health
P.O. Box 149347, Mail Code 2835
Austin, TX 78714-9347

Ms. Susan M. Jablonski
Office of Permitting, Remediation, & Registration
Texas Commission on Environmental Quality
MC-122
P.O. Box 13087
Austin, TX 78701-3087

Anthony Jones, Chief Boiler Inspector
Texas Department of Licensing and Regulation
Boiler Division
E.O. Thompson State Office Building
P.O. Box 12157
Austin, TX 78711

Timothy P. Matthews, Esq.
Morgan Lewis
1111 Pennsylvania Avenue, NW
Washington, DC 20004

Mr. Brian Almon
Public Utility Commission
William B. Travis Building
P.O. Box 13326
Austin, TX 78711-3326

County Judge
P.O. Box 851
Glen Rose, TX 76043

Environmental and Natural Resources Policy Director
Office of the Governor
P.O. Box 12428
Austin, TX 78711-3189

Chief, Technological Hazards Branch
FEMA Region VI
800 North Loop 288
Federal Regional Center
Denton, TX 76209

Institute of Nuclear Power Operations (INPO)
Records Center
700 Galleria Parkway SE, Suite 100
Atlanta, GA 30339

Electronic distribution by RIV:
Regional Administrator (Elmo.Collins@nrc.gov)
Deputy Regional Administrator (Art.Howell@nrc.gov)
DRP Director (Kriss.Kennedy@nrc.gov)
DRP Deputy Director (Troy.Pruett@nrc.gov)
DRS Director (Anton.Vegel@nrc.gov)
DRS Deputy Director (Vacant)
Senior Resident Inspector (John.Kramer@nrc.gov)
Resident Inspector (Brian.Tindell@nrc.gov)
Branch Chief, DRP/A (Wayne.Walker.nrc.gov)
Senior Project Engineer, DRP/A (David.Proulx@nrc.gov)
Project Engineer, DRP/A (Nicholas.Hernandez@nrc.gov)
Project Engineer, DRP/A (Laura.Micewski@nrc.gov)
CP Administrative Assistant (Sue.Sanner@nrc.gov)
Public Affairs Officer (Victor.Dricks@nrc.gov)
Public Affairs Officer (Lara.Uselding@nrc.gov)
Project Manager (Balwant.Singal@nrc.gov)
Branch Chief, DRS/TSB (Michael.Hay@nrc.gov)
RITS Coordinator (Marisa.Herrera@nrc.gov)
Regional Counsel (Karla.Fuller@nrc.gov)
Congressional Affairs Officer (Jenny.Weil@nrc.gov)
OEMail Resource
OEDO RIV Coordinator (James.Trapp@nrc.gov)
DRS/TSB STA (Dale.Powers@nrc.gov)

R:_REACTORS\CP MS Reg Conf 1-13-11.docx ADAMS ML

SUNSI Rev Compl.	☑ Yes ☐ No	ADAMS	☑ Yes ☐ No	Reviewer Initials	WCS
Publicly Avail	☑ Yes ☐ No	Sensitive	☐ Yes ☑ No	Sens. Type Initials	WCS

SRI:DRS/EB1				C:DRS/EB1
WSifre				TFarnholtz
1/18/11				1/18/11
/RA/				/RA/

OFFICIAL RECORD COPY T=Telephone E=E-mail F=Fax

Comanche Peak Regulatory Conference
January 13, 2011

Name	Title	Organization
Wayne Sifre	Sr. Reactor Insp	NRC
THOMAS R. FARNHOLTZ	BRANCH CHIEF	NRC
A VEGEL	DRS, RIV	NRC
E Collins	RA, RIV	NRC
W WALKER	DRP, RIV	NRC
M. Runyan	DRS, RIV	NRC
John Kramer	Comanche Peak SRI	NRC
Tim Hope	CPNPP Mgr, Nuc Licensing	Luminant Power
JAMES BOATWRIGHT	WESTINGHOUSE ENGR SVCS MGR	WESTINGHOUSE / COMANCHE PEAK
DAVE KROSS	CPNPP VP ENGRG (ACTING)	LUMINANT POWER
RAFAEL FLORES	Senior Vice President & CNO	Luminant Power
MITCH LUCAS	SITE VICE PRESIDENT	LUMINANT POWER
Ben Mays	Vice President, Nuc. Eng & Supp't	Luminant Power
FRED MADDEN	DIRECTOR OVERSIGHT & REG. AFFAIRS	LUMINANT POWER
KEN CUMMINS	SUPERVISOR, OE	LUMINANT POWER
BILL REPPA	SYSTEM ENG MGR	LUMINANT POWER
JACK HICKS	Principal Licensing Engineer	LUMINANT POWER
Ludwig Haber	Sr. Engineer	Alden Laboratory

Enclosure 1

Comanche Peak Regulatory Conference
January 13, 2011

Name	Title	Organization
Christi Maier	Enforcement Specialist	NRC RIV
GEORGE CRAWFORD	International Repr.	IBEW
David Proulx	Senior Project Eng	NRC RIV
Victor Dricks	Public Affairs	NRC R4
Kelly Clayton	Sr Ops Eng	NRC R4
JONATHAN BRAISTED	PROJECT ENGINEER	NRC RIV
Dustin Reinert	Reactor Inspector	NRC RIV
John Watkins	Reactor Inspector	NRC RIV
Alvin Fairbanks	Reactor Inspector	RIV
Laura Micewski	Project Engineer	NRC RIV
Nestor Makris	Project Engineer	NRC RIV
Steven Alferink	Reactor Inspector	NRC RIV
Greg Tutak	Project Engineer	NRC RIV
Blake Rice	Reactor Inspector	NRC RIV
Jeff Mitman	Risk Analyst.	NRC/NRR/DRA
Jim Barnette	Licensing Analyst	Luminant
GARY MERKA	LICENSING ANALYST	LUMINANT

Comanche Peak Regulatory Conference
January 13, 2011

Name	Title	Organization
Ronald Frantz	Pres-Vendor	Corrosion Control Service, Inc
Jacob Smith	System Engineer	Luminant
George Techentine	System Engineer	Luminant
Timothy Terryah	B.O.P. System Engineering	Luminant
Ken Nickerson	Director Site Engineering	Luminant
Dave Goodwin	Director Engineering Support	Luminant
Scott Maglio	Reg Affairs Mgr	Ameren Missouri
Nathan Larson	Sr Eng PRA	Luminant
Daniel Tirsun	Risk Analysis	Luminant
Carl Corbin	STARS Regulatory Affairs Manager	STARS Alliance

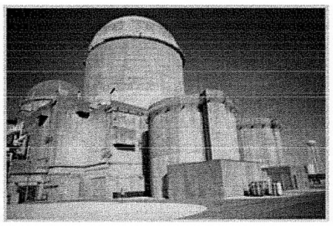
Attendees by telephone:

Sam Lee – Deputy Director NRR Division of Risk Assessment
Veronica Rodriguez – BC (acting) PRA Operational Support Branch
Donald Chung – Reliability/Risk Analyst - PRA Operational Support Branch
Jerry Purciarello - Senior Engineer – NRR Division of Safety Systems – BOP Branch
Jeff Circle – Senior Reliability/Risk Analyst – PRA Operational Support Branch

Luminant **Comanche Peak**

Regulatory Conference on CST Diaphragm

January 13, 2011



Opening Remarks

Ben Mays

- *Introductions*
- *Understanding and Acknowledgement*
- *CPNPP Perspective*
- *Review Agenda*

AGENDA

- OPENING REMARKS
- CST DIAPHRAGM INDUSTRY INFORMATION
- CST AND DIAPHRAGM DESIGN AND TESTING INSIGHTS
- AFW AND CST OPERABILITY/FUNCTIONALITY
- CLOSING REMARKS
- ATTACHMENTS

Luminant

CST DIAPHRAGM INDUSTRY INFORMATION

Ken Cummins

OE - Farley Event: "... while attempting to fill the Condenser using the Condensate Storage Tank no flow was obtained...There were three damaged locations...A small burr was found on the auxiliary feedwater suction line which could have caused the tears..."

CAUSES: "...bladder inspection frequency was inadequate." (Once per 15 years)

Screen: CPNPP PMs required annual inspection.

CORRECTIVE ACTIONS: "...A bottle of nitrogen was added under the bladder to ensure the bladder material does not adhere to the sides of the tank during filling and draining operations."

Screen: CPNPP had been adding nitrogen on a continual basis.

SCREENING RESPONSE:
- No condition report required
- Provide copy of OE to system cognizant engineers

Performance Issue: Handling of Industry Information

The engineering organization failed to properly implement STA-206 procedure requirements.

- **Corrosion Control Service Inc. (CCSI) vendor documents were mishandled by engineering.**
- **There were three missed opportunities for engineering to initiate a condition report to formally evaluate the vendor document impact on the design and operation of the CST.**

Industry Information Performance Issue Root Cause Analysis

Problem Statement: "...relevant operating experience not incorporated in station procedures..."

Causes:

- **"...failed to properly implement [vendor correspondence] procedure..."**
- **Industry operating experience report "lacked a discussion of [the impact of] excessive evacuation of gas."**

Resolution Strategy

Identified Cause	Corrective Action	CA Type	Responsible Work Organization	Date
Root Cause #1	Conduct a training needs analysis associated with the performance deficiencies in Root Cause #1	—	Engineering Training	1/12/2011
Root Cause #1, Extent of Condition	• Revised STA-206, Review of Vendor Documents and Vendor Technical Manuals, to include a required 10CFR50.59 applicability determination. • Revised ECE-5.01, Design Control Program, to require review of operating experience when preparing design modification documents. • Revised STA-716, Station Modification Process, to require review of operating experience when preparing design modification documents. • Provided training to Engineering on the importance of vendor documentation and the use of the 10CFR50.59 process (MATCODE ET31CQT101). • Provided training to Engineering on the importance of engineering rigor in documentation (MATCODE ET31CQT091).	CAPR	Engineering	10/27/2010
Root Cause #1, Extent of Condition	Revised Unit 1 Chemistry Operating Procedure COP-303A: • Referenced the Farley OE and CCSI vendor letter • Added provisions for adding Nitrogen to the CST annulus.	Corrective	Chemistry	12/6/2010
Root Cause #1, Extent of Condition	Revised Unit 2 Chemistry Operating Procedure COP-303B: • Referenced the Farley OE and CCSI vendor letter • Added provisions for adding Nitrogen to the CST annulus.	Corrective	Chemistry	12/8/2010
Root Cause #1, Extent of Condition	FDA-2010-000187-01 revised DBD-ME-206 Auxiliary Feedwater, adding a precaution regarding excessive evacuation of the CST annulus.	Corrective	Engineering-Design	12/15/2010
Contributing Factor #2	In 2010, INPO implemented OE Grading Criteria for station analysts. The 100 point grading scale applies a combined 45 points to the OE description, causes and corrective action sections.	Corrective	—	12/7/2010

Resolution Strategy (continued)

Identified Cause	Corrective Action	CA Type	Responsible Work Organization	Date
Root Cause #1	Engineering to issue a Lessons Learned	Corrective	System Engineering	2/28/2011
Root Cause #1, Extent of Condition	• Revise RMWST PMs 315862 and 308521 to provide inspection criteria for the 10 year PM. • Create two new PMs to perform quarterly inspection to ensure diaphragm is freely hanging.	CAPR	System Engineering	2/28/2011
Root Cause #1, Extent of Condition	Revise DBD-ME-206 Auxiliary Feedwater section 5.1.1 to clarify purpose for maintaining sufficient nitrogen in the annulus (nitrogen ensures free movement of diaphragm, but does not prevent it from contacting tank wall).	Corrective	Engineering-Design	2/28/2011
Root Cause #1, Extent of Condition	Change CST PMs 338753 and 338754 from vendor recommendation PM bases to commitment PM bases. Commitment PM bases tasks require a documented engineering evaluation to change the PM.	CAPR	System Engineering	2/28/2011
Root Cause #1, Extent of Condition	Revise DBD-ME-242 De-Mineralized Water (i.e., RMWST) similar to DBD-ME-206 changes.	Corrective	Engineering-Design	2/28/2011
Root Cause #1, Extent of Condition	Revise RMWST operating procedures SOP-507 & CHM-140: • Reference the Farley OE and CCSI vendor letter to ensure nitrogen injection is not secured for an extended period.	Corrective	Operations Procedures	2/28/2011
Root Cause #1, Extent of Condition	Evaluate the need to perform the visual inspections of the RHUT recommended by CCSI in VL 05-00294.	Corrective	System Engineering	2/28/2011
Root Cause #1, Extent of Cause	Create new engineering scorecard in ObservationWay to review processed vendor letters to determine if they were properly reviewed IAW STA-206.	Corrective	System Engineering	2/28/2011
Root Cause #1, Extent of Cause	Create new engineering scorecard in ObservationWay to review TERI attachments to determine if vendor correspondence was properly processed and reviewed IAW STA-206.	Corrective	System Engineering	2/28/2011
Root Cause #1, Extent of Cause	Revise STA-206 to add a commitment designation next to requirement for 50.59 applicability determination.	CAPR	Engineering	2/28/2011

Resolution Strategy (continued)

Identified Cause	Corrective Action	CA Type	Responsible Work Organization	Date
Extent of Cause #1	Perform a review of documents processed under STA-206 between the years 2005-2010. At a minimum, this review should include vendor letters and correspondence received from vendors. The review will determine if a CR should have been initiated by STA-206 review. Results of this review to be presented to CARB.	—	System Engineering	2/28/2011
Extent of Cause #1	Performance Improvement to work with System Engineering to develop a statistical analysis. This analysis should establish sampling criteria and evaluation methods for the above engineering review.	Corrective	Performance Improvement	1/18/2011
Extent of Cause #1	Quality Assurance to procure all correspondence from selected vendors between the years of 2005-2010 and perform a review to determine if all correspondence applicable to STA-206 IAW section 2.0 was properly processed. The task team recommends the following vendors: • Tyco – Fire Protection • Limitorque – MOVs • Vendor for Fuel Handling Bridge Crane • Vendor for Large Motors The results of this review to be submitted to CARB.	—	Quality Assurance	2/28/2011
Contributing Factor #2	Performance Improvement, with engineering assistance, to submit an IOER detailing the behavior of the diaphragm in-service based upon recent testing sponsored by Luminant.	Corrective	Performance Improvement	3/31/2011

Summary

- **We failed to properly implement our procedure for processing design information from the vendor.**
- **Based on the information in the Farley OE that was issued to the industry and our processes at the time, we reached a reasonable conclusion regarding the Farley OE.**
- **Numerous actions have been identified to correct the root cause, extent of condition, and extent of cause.**

Luminant

CST and Diaphragm Design and Testing Insights

Bill Reppa

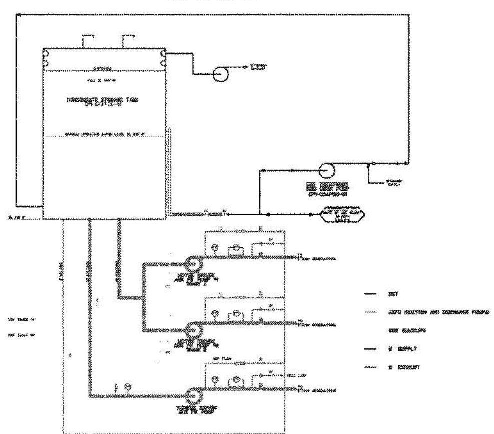
Agenda

- •Condensate Storage Tank (CST) Design
- •System Design
- •Bladder (Diaphragm) Design
- •Failure Mechanism
- •Test Scope
- •Test Results
- •Conclusions

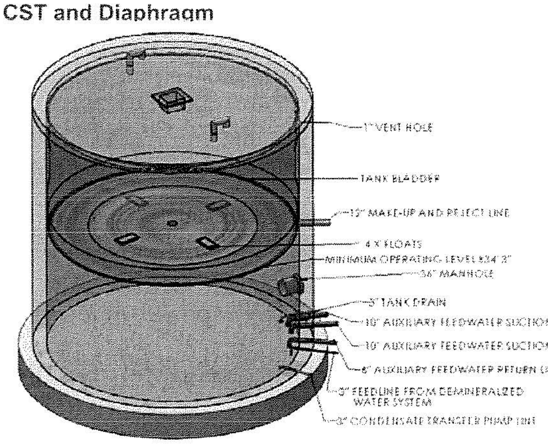
CST DESIGN

- **Specified Safety Function – The Condensate Storage Tank (CST) provides a safety grade source of water to the steam generators for removing decay and sensible heat from the Reactor Coolant System. The CST provides a passive flow of water, by gravity, to the Auxiliary Feedwater System.**
- ***53% = minimum Tech Spec (TS) level for required AFW inventory***
- ***10% = Empty***
- ***Normally used for Condenser Hotwell makeup. Connection above TS minimum level***
- ***A Service Water connection is provided to AFW pump suction as a backup water supply (manually initiated)***

CST/AFW



CST and Diaphragm



CST

- 45' diameter, 50' tall Stainless Steel lined concrete tank
- 538,000 gallon capacity
- Level cycled weekly between 90% and 70%.
- Diaphragm (bladder) plus nitrogen used to control dissolved oxygen. Excess gas is evacuated.
- AFW 10" suction lines 1-MDAFW/ 1-TDAFW end 6" from bottom
- 1- 8" common return line
- 3"diaphragm support angle iron 1' from underside of roof
- Space above diaphragm is vented to atmosphere

Diaphragm

- Cylindrical (with open end at top) to fit inside dimensions of CST
- Supported from near the top of the wall
- Reinforced thermoplastic with 250lb tensile strength for a one inch strip 0.045 inches thick
- Dielectrically welded at seams
- 5' panels run vertically from top of CST to bottom then taper into a center section in the middle of the bottom
- Four floats in bottom in "shirt" pockets (subsequently sealed in on fourth side)
- The diaphragm without the floats is 15% greater than the density of water
- Folds as level increases and floats near the water surface (buoyancy)

Nitrogen Injection/Evacuation

- Nitrogen is "injected" into the CST in a circulated water flow near the bottom of the tank
- Nitrogen displaces oxygen in the water and excess gas bubbles to the top surface
- Excess gas collects above the water surface and is evacuated by a vacuum pump attached to a 1" connection just below the angle iron
- Nitrogen flow rates verified twice per shift when injecting. In flow balanced with out flow
- With nitrogen injection the bladder is subject to bubble formation in the middle or evacuation of gasses at the tank wall

Potential Failure Mechanism

- Complete evacuation of gas in the space above water.
- Bladder can sink if punctured or torn. If floats remain in place, center of bladder will remain floating on water surface.
- Bladder does not fail in "pieces." Due to the nature of the material (reinforced thermoplastic), it tears or punctures.

Test Purpose

Large and small scale testing to study the behavior of the bladder under various conditions. Provide insights into the likelihood of bladder failure in the conditions that existed in the Unit 1 CST.

<u>As found condition of Unit 1 CST bladder on 6/11/10</u> :

- **Gas evacuated from sidewalls**
- **48" bubble in the middle of the surface**
- **Floatation devices in place**

The specific purpose of the test was to verify that the gas in the bubble would release to the tank wall as level decreased allowing the bladder to descend freely.

Test

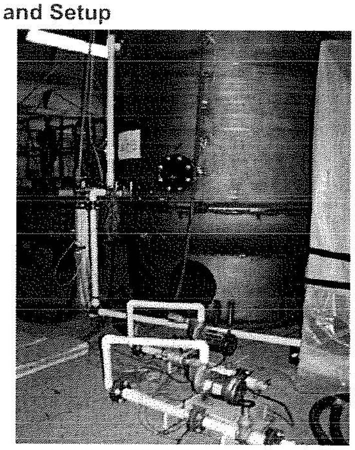
<u>Large Scale Model</u>

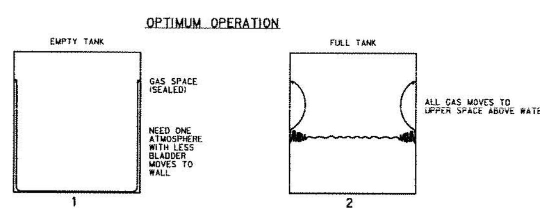
- **10' diameter X 20' high steel tank with CST penetrations, AFW Pumps, Vacuum Pump**
- **Test instrumentation**
- **Data acquisition system**

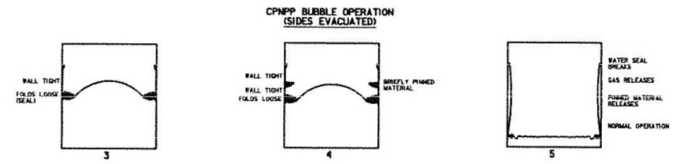
<u>Small Scale Model</u>

Test report to be provided for CPNPP, Vendor and Industry use.

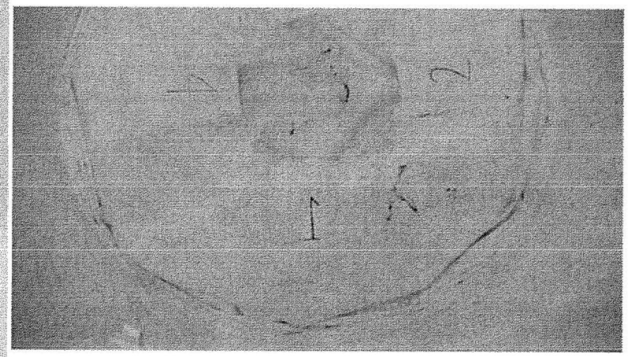
Test Tank and Setup



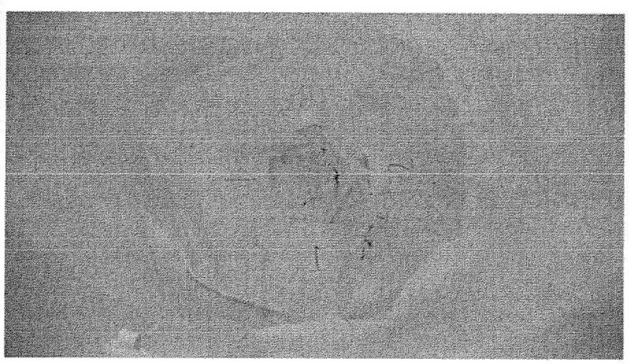


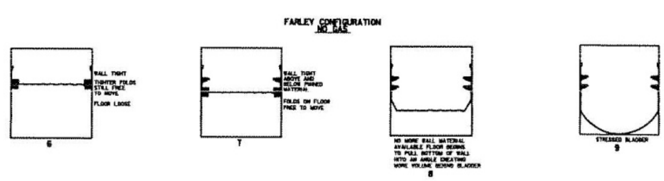


Tank Full with Bubble

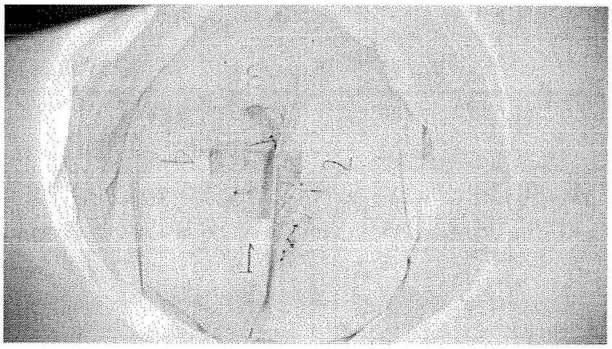


Tank Empty after Bubble Release

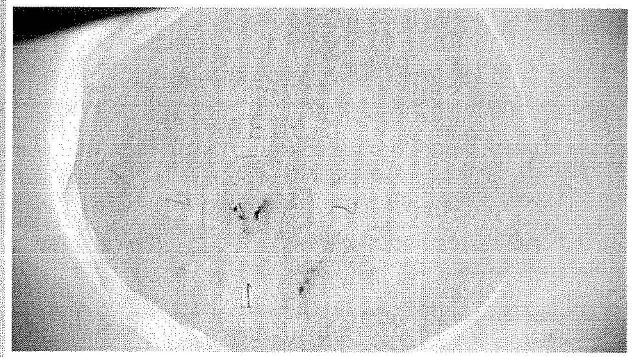




Tank Partially Drained – No Gas



Tank Empty – No Gas



CONCLUSIONS

- The bladder is very well suited for its intended purpose. Material and seams are strong and the connection to the tank wall is air tight .
- There is no resistance to bladder movement and it unfolds easily across the water surface.
- Bubbles consistently release to the walls as tank level drops.
- CPNPP had sufficient gas in the bubble to allow the bladder to move freely from 90% level (full) to empty. This is based on the measured size of our bubble compared to the volume of space between the bladder and the wall. This provided additional confirmation that the CST was fully capable of performing its safety function.

Additional information on testing is provided in Attachment A.

Luminant

AUXILIARY FEEDWATER SYSTEM & CONDENSATE STORAGE TANK

OPERABILITY/FUNCTIONALITY

Fred W. Madden

CST Safety Function

The Condensate Storage Tank (CST) provides a safety grade source of water to the steam generators for removing decay and sensible heat from the Reactor Coolant System. The CST provides a passive flow of water, by gravity, to the Auxiliary Feedwater System.

Operable/Operability

A system, subsystem, train, component, or its device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified safety functions, and when all necessary attendant instrumentation, controls, normal or emergency electrical power, cooling and seal water, lubrication and other auxiliary equipment that are required for the system, subsystem, train, component, or device to perform its function(s) are also capable of performing their related support function(s).

In order to be considered operable, an SSC must be capable of performing the safety functions specified by its design, within the required range of design physical conditions, initiation times, and mission times.

Ref: RIS 2005-20, Rev. 1

Reasonable Expectation

- The discovery of a degraded or nonconforming condition may call the operability of one or more SSCs into question.
- A subsequent determination of operability should be based on the licensee's "reasonable expectation," from the evidence collected, that the SSCs are operable and that the operability determination will support that expectation.
- Reasonable expectation does not mean absolute assurance that the SSCs are operable.
- The SSCs may be considered operable when there is evidence that the possibility of failure of an SSC has increased, but not to the point of eroding confidence in the reasonable expectation that the SSC remains operable.

Ref: RIS 2005-020, Rev.1

Assessment of CST Operability

- The Unit 1 AFW system and Condensate Storage Tank remained capable of performing their specified safety function between March 4th and June 11th 2010.
- The diaphragm was cycled between about 65% and 90% tank level eleven times from March 4th to June 11th without incident. These cycles included a rapid draw down associated with AFW System surveillance testing.
- Comanche Peak conservatively entered the CST LCO on June 11th. Exited after injecting nitrogen in the annulus region.
- Vendor and plant staff inspections on July 13th and 14th found:
  - The diaphragm to be in good condition with water-tight integrity and no material stretching or distortion,
  - All diaphragm floatation devices to be in their pockets,
  - Folds in the diaphragm were easily manipulated by hand, releasing gas from the bubble to the annulus around the tank wall.

Conclusion on Operability

- Comanche Peak performed periodic inspections of the CST diaphragms. These inspections confirmed that a volume of gas was present between the diaphragm and water between March 4th and June 11th 2010.
- Evaluation by an independent research institute – Southwest Research Institute – concluded that there is no mechanism that will cause the diaphragm material to adhere to the tank wall after nitrogen in the bubble region is released to the annular space.
- There have been no known diaphragm failures where a gas bubble was present such as in the Comanche Peak CST configuration.
- Testing demonstrated that there was sufficient gas in the bubble to permit the diaphragm to unfold freely as the tank level decreased.
- The Comanche Peak Unit 1 AFW system and CST were capable of performing their specified safety function and were OPERABLE between March 4th and June 11th 2010.

SDP Phase 1 Conclusion

Initial Screening and Characterization:

Table 4a contains 5 questions related to Operability & Functionality.

Answers to the questions determine if the issue can be screened as Green, or further review is required under Appendix A.

Based on our review of the 5 questions and the additional knowledge gained from testing,

CPNPP believes that the significance is GREEN.

SDP Phase 3 Comments

Comanche Peak perspectives are provided in Attachment B.

Closing Remarks

Ben Mays

- ***We understand our shortcomings in learning from industry information.***
- ***We gained insight from our testing into diaphragm operation and potential failure mechanisms.***
- ***We believe the CST/AFW was always OPERABLE.***
- ***We believe the Safety Significance is GREEN.***

ATTACHMENTS

Attachment A	CST and Diaphragm Testing Insights
Attachment B	CST Configuration Risk Significance Determination – Comanche Peak Perspective

Luminant

ATTACHMENT B

CST Configuration Risk Significance Determination – Comanche Peak Perspective

SDP Scenario

- An initiating event occurs that requires the AFW system
- If MDAFW pumps are running, the TDAFW pump is secured
- AFW initiation causes a decrease in CST inventory
- As level decreases, the diaphragm is postulated to adhere, tear, fall to the bottom of the tank and block the two AFW suction lines.
- If CST suction to the AFW pumps becomes unavailable, suction source will be transferred to Station Service Water to continue secondary heat removal
- If secondary heat removal is unavailable, operators will transition to feed and bleed cooling

SDP Evaluation

As described in the NRC Phase 3 evaluation, 2 damage states will be examined:

Damage State 1:

- the diaphragm fabric falls to the bottom of the tank
- the 2 AFW suctions are blocked, effectively isolating the CST from the AFW pumps
- If the AFW pumps are secured before they are damaged from overheating from loss of suction, the operators re-align the AFW suction to the Service Water System.

Damage State 2:

- all AFW pumps are lost because of either
  - overheating from a loss of suction, or
  - because fabric pieces from the diaphragm are drawn into the suction pipes and migrate to the pumps
- Use of the Service Water System is precluded due to the loss of AFW pumps.

Results of SDP Evaluations

Case	Final Adjusted ΔCDF
NRC Attachment 2 Calculation*	1.28E-05
CPNPP SDP Case**	3.38E-07

*This value is taken directly from the NRC Inspection Report Attachment 2 Calculation

**This value is based on the CPNPP assessment of the SDP Condition, in absence of testing insights

Key Model Differences

Explicitly defined in the SPAR/PRA model

Success Criteria for Feed and Bleed

Operator Actions Values

Failure Probabilities

AFW pump out of service times and component unavailability

Postulated CST diaphragm failure probability

Summary of Key Model Differences

Assumptions	NRC	CPNPP
Success Criteria for Feed & Bleed cooling	2 PORV	1 PORV & 1 CCP & 1 SIP
HEP for Swap-over of AFW suction from CST to SSW	7.7E-02	1.47E-03
HEP Operators Inappropriately Start and Run TDAFWP to Failure	15%	5%
MDAFWP Out of Service or Unavailable	5%	0.4%
TDAFWP Out of Service or Unavailable	5%	3.2%
Postulated CST Bladder Failure	*1.0%*	*0.2%*

Key Model Differences

Success Criteria for Feed and Bleed Cooling

- *NRC states that 2 PORVs required for Feed and Bleed*
- *CPNPP has additional success criteria:*
  - *1 PORV and 1 CCP and 1 SIP for Feed and Bleed for LOOP and general transients*
    - *CPNPP success criteria based on plant specific thermal-hydraulic analyses*
  - *Additional Feed and Bleed success criteria provides significant reduction in core damage risk when secondary heat removal is unavailable*
  - *Furthermore, if after a period of 4 hours AFW were to fail, a single CCP and 1 PORV would be successful for feed and bleed cooling.*
    - *Also based on plant specific thermal-hydraulic analyses.*

Key Model Differences

Human Error Probability

- *Operator would restart and then run the TDAFWP to failure after the failure of both MDAFWPs*
  - *NRC states a 15% probability that TDAFWP would be lost in response to the postulated event.*
  - *CPNPP judged the probability that TDAFWP would be lost in response to the postulated event to be a conservative 5% based on the following:*
    - *Discussion with operations personnel revealed investigation of the failure and questioning attitude would reduce the likelihood that the operator would restart and then run the pump to failure.*
    - The loss of or stopping of the MDAFWP would generate multiple indications to support proper diagnosis: low suction pressure, low discharge pressure, low discharge flow, and motor current.
    - Similar indications for the TDAFWP exist and would be closely monitored during the restart of the TDAFWP following the failures of the MDAFWPs

  As these cues would reveal the potential condition, it is deemed unlikely that the operators would ignore them and run the TDAFWP to failure.

Key Model Differences

Model Operator Action Value

- *Human Error Probability (HEP) for 'Swap-over' of AFWP suction from CST to Station Service Water*
  - *NRC stated HEP value of 7.7E-02*
  - *CPNPP uses HEP value of 1.47E-03 based on analysis using EPRI HRA calculator and the following:*
    - **Both HEP evaluations assumed high stress**
    - **NRC stated evolution was complex and that the experience/training is low.**
    - **CPNPP considered simple action with all critical steps controlled from the control room and that training is provided.**
      - **2 MOVs required to be opened, by procedure, from the control room**
      - **2 small valves, one vent valve and one drain valve, required to be closed locally, by procedure, within 30 minutes.**

Key Model Differences

AFW Pump Out of Service Time and Unavailability Values

- ***NRC states a 5% probability that one of the MDAFWP would be out of service or otherwise fail and a 5% probability that the TDAFWP would be out of service or otherwise fail***
- ***CPNPP plant specific values for the MDAFWP out of service or otherwise failing to start and run on demand is ~0.4% while the TDAFWP probability is ~3.2%***

Sequence of Events Required for Total Loss of AFW due to CST Diaphragm Failure

Sequence of Events	CPNPP Condition
No nitrogen maintained in the CST	Bubble maintained during SDP time frame
- AND -	
Long-term tear occurs below water level	Diaphragm found in good condition with no tears, holes or material degradation
- Which leads to -	
All four diaphragm floats fail to remain secured	Floats found in their pockets and not degraded
- AND -	
Portion of torn diaphragm falls in a manner to block both AFW suctions lines	No tears in CPNPP diaphragm. Further, no industry / vendor reported failures of the diaphragm tearing into pieces.
- AND -	
Diaphragm blockage is sufficient to provide total loss of AFW flow	CPNPP AFW suction piping is angled 90 degrees downwards and 6" above the floor of the CST

Probability of Diaphragm Failure Sequence Occurring

NRC states a 1% probability of this failure mechanism. This failure is defined in the inspection report for the diaphragm to rip, sink and be drawn to the AFW suction piping.

CPNPP suggests a more appropriate probability can be defined based on operating experience. CPNPP concluded a conservative estimation for only the diaphragm tearing can be determined and would bound the diaphragm failure sequence probability.

The bounded value does not account for the reduction in probability for the additional steps in the sequence that would be required to occur; e.g. floats failing, material being drawn to suction, etc.

Therefore, as these additional probabilities would further reduce the estimated probability, the following estimate for the diaphragm is considered to be a very conservative approximation.

Probability of Diaphragm Failure Sequence Occurring (continued)

Assuming worst case tank usage without nitrogen:

- Currently 83 bladders installed across a time frame of 19 years of operation in various tank applications (CST, RMUW, RHUT, etc.)
- Not all bladders that have been installed have been operating over the 19 years; however, first 10 years were without vendor nitrogen guidance and many tank applications still do not use nitrogen.
- Based on this information, an estimate of approximately 900 operating years of diaphragm operation can be developed.

Probability of Diaphragm Failure Sequence Occurring (continued)

As these diaphragms are installed in many applications, their demand usage that could potentially cause a diaphragm to have tearing failure can vary greatly. The potential demands are caused by normal operating conditions, reactor trips, plant outages, etc. based on the tank and conditions of use in which these diaphragms have been installed.

Therefore, as these tanks may be operated multiple times a year or as infrequently as once a year, an estimate of one demand per year per tank was deemed appropriate and the estimated 900 operating years can be conservatively equated to 900 demands.

With only two significant diaphragm tears having been reported in the industry with this type of diaphragm material (Callaway and Farley Events), a diaphragm tearing probability of 0.2% probability was estimated (2 failures / 900 years).

Luminant

ATTACHMENT A

CST and Diaphragm Testing Insights

Test Scope/Results

- ***Fill and drain tank to observe normal bladder function – Variety of tank levels and flow rates including accident flow rates.***
  - *Observed that it takes little differential pressure to move the bladder to the wall. The new bladder in the test tank had a stiffness that caused it to bunch up even when it was not pinned to the wall by differential pressure. The test tank and water were cold.*
- ***Establish bubble under center of bladder.***
  - *We were consistently able to develop a bubble that was isolated from the volume of gas in the wall annulus*
- ***Evacuate gas at perimeter of tank while maintaining the center bubble. Verify seal.***
  - *This was done repeatedly. On one occasion we maintained the bubble overnight.*
- ***Drain tank to observe bladder function with sealed bubble present.***
  - *With sufficient gas in the bubble, the bubble released to the wall annulus high in the tank and the bladder unfolded freely as tank level moved down. As noted above with the tank empty the walls still had one or two loose folds that did not drop down straight.*