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ATTACHMENT 2
Complex Troubleshooting
(Troubleshooting Data Sheet)
Page 1 of 5 – Rev.4

IR No: 00907846 Station: Oyster Creek

WR or AR No: A2222268 System: 424 - Condensate Transfer System

WO No: C2021071, C2021073 Component/ETN: _____

Operating Conditions: 100% Power

Initial Problem Statement: Measurements from the ESW Vault and water well (MW-K15-1A) indicate that there is a leak of water from the CST.

A Troubleshooting Team was formed to identify sources of leaks from the CST to the ground. This was postulated because the measurements of tritium found in the well (MW-K15-1A) were 4.5 x 10^6 pCi/l. This measurement of activity it similar to the water found in the CST. Using Oyster Creek Topical Report 116 – "Oyster Creek Underground Piping Program Description and Status" a list of high probability piping locations were selected.

Involve Appropriate Personnel:

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☒	Engineering:	☐	Corporate: _____
☒	Op's: _____	☐	Work Week Manager: _____
☒	Maintenance: _____	☐	Project Manager: _____
☒	Vendor: Structural Integrity Assoc.	☐	Other Sites: _____

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Personnel Knowledgeable of the Problems:

NAME	DEPARTMENT	TELEPHONE NUMBER
_____	_____	_____
_____	_____	_____
_____	_____	_____

Is equipment Quarantine Req'd ☒NO ☐YES (if yes what equipment?)

_____

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Sequences of Events/Time Line:

REQ'D	☐ YES (Attach)	☒ NO
Critical Component Impacted	☒ YES	☐ NO

Reviewed By: _____ Approved By: _____

If the complex troubleshooting plan cannot be completed with high confidence document decision to continue operations in Operational Technical Decision Making (OTDM) in accordance with OP-AA-106-101-1006

Troubleshooting Team Lead _____OTDM # _____

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ATTACHMENT 2
Complex Troubleshooting
(Troubleshooting Data Sheet)
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Document troubleshooting results identifying failed component and failure mode and the basis for high confidence (How physical evidence supports defined failed components and failure modes and refutes other potential failures.

Troubleshooting Team Lead _____ Date _____

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ATTACHMENT 2
Complex Troubleshooting
(Troubleshooting Data Sheet)
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Data Gathering Checklist (Check box for data attached)

Internal Sources:

Documentation

- ☒ Interviews
- ☐ Correspondence
- ☐ Internal Sources
- ☐ Industry Bulletins
- ☐ EPIX Records
- ☐ OPEX Records
- ☒ Procedures and Instructions
- ☐ Vendor Manuals
- ☒ Drawings and Specifications
- ☒ Sample Analysis and Results
- ☐ Design Basis Information
- ☐ Previous CRs
- ☐ Written Statements
- ☐ PRA
- ☐ **Part 21 Records**
- ☐ Recent Mods to SSC

Recorded Data

- ☒ Operating Logs
- ☐ Maintenance Work Packages and Records
- ☒ Inspection Records
- ☐ Equipment History Records
- ☐ Strip Chart Recordings
- ☐ Trend Chart Recordings
- ☐ Sequence of Event Recorders
- ☒ Radiological Surveys
- ☐ Plant Parameter Readings
- ☒ Post Maintenance/Mod Test Results

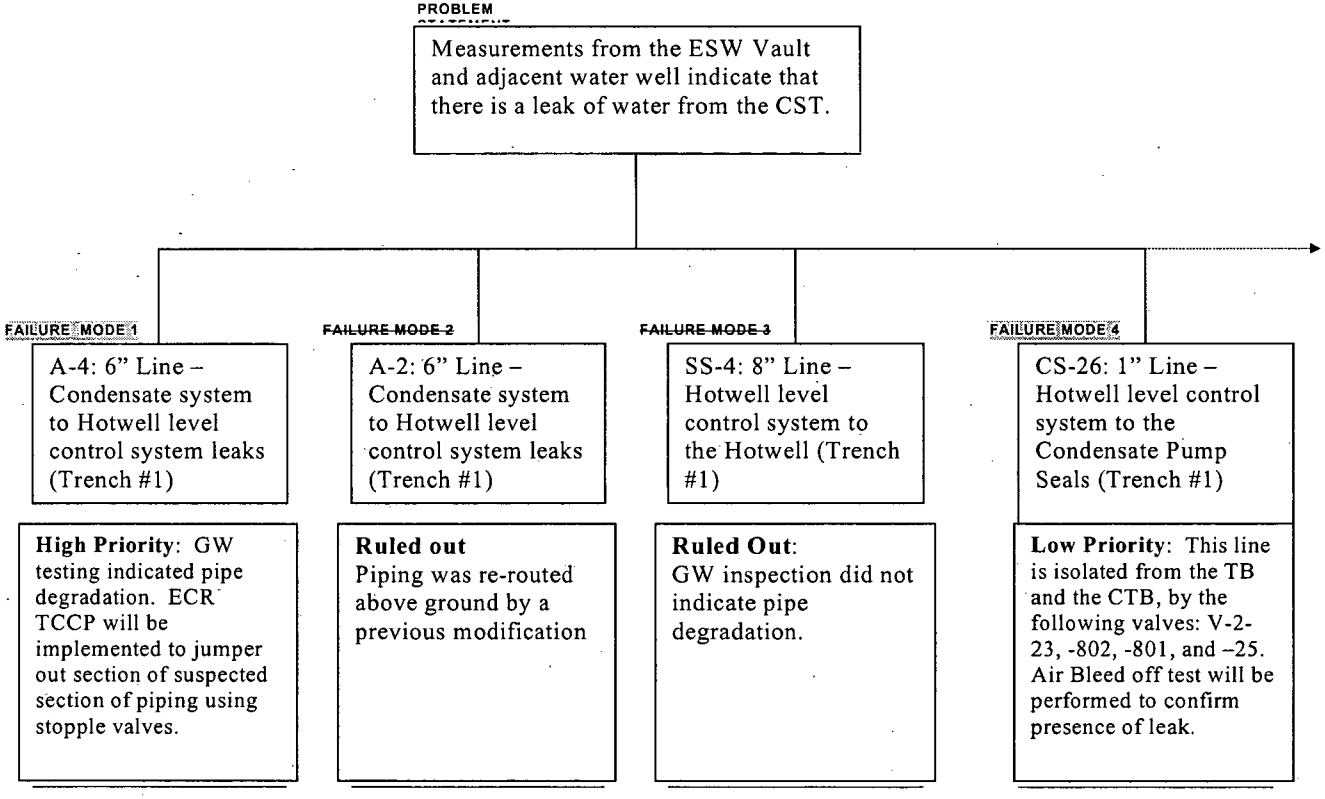
External Sources:

- ☐ Correspondence
- ☐ Industry Bulletins
- ☒ Vendor Contacts
- ☐ NRC NRR

Suggested Topics/Questions to Support Failure Modes Analyses

- ☐ What is the purpose/function of the system/component?
- ☐ How is the system/component designed to work?
- ☐ How does the system/component really work?
- ☐ What components are potentially involved?
- ☐ How is the system/component supposed to be operated?
- ☐ How is the system/component really operated?
- ☐ Are vendor operation and maintenance recommendations followed?
- ☐ Is there sufficient technical information for operating the component properly?
- ☐ What is the operating history for the system/component?
- ☐ What form of energy (e.g., motive power, control, power, instrument air, hydraulic fluid, etc.) caused the first component/subcomponent to fail?
- ☐ What form of energy (e.g., motive power, control power, instrument air, hydraulic fluid, etc.) caused the second, third, etc., component/subcomponent to fail?
- ☐ Was this energy (e.g., motive power, control power, instrument air, hydraulic fluid, etc.) supposed to be present or was it undesirable?
- ☐ What failed first?
- ☐ Could something have failed earlier than the time of the event?
- ☐ Did any thing else fail as a result of the first failure?
- ☐ What barriers existed between the energy (e.g., motive power, control power, instrument air, hydraulic fluid, etc.) and the first failure?
- ☒ When did the failure(s) occur? How do you know for sure?
- ☐ Could the unwanted energy (e.g., motive power, control power, instrument air, hydraulic fluid, etc.) have been deflected or evaded?
- ☒ Have all reasonable failure modes been identified?
- ☐ Were adequate human factors considered in the design of the equipment?
- ☒ Have similar failures occurred before at Exelon stations or the industry?
- ☐ Is the system/component properly labeled for ease of operation?
- ☐ How was the failed component maintained?
- ☐ What is the maintenance history for the system/component?
- ☐ Is there sufficient technical information for maintaining the component properly?
- ☒ Did the environment (e.g., humidity, vibration, etc.) have an effect on the problem?
- ☐ Could the commercial grade dedication process have contributed to the failure(s)?
- ☐ Could this failure affect the opposite train/unit? If **not**, why?
- ☐ Is this failure also on the opposite train/unit? What is the difference? Why is it different?

ATTACHMENT 2
Complex Troubleshooting
(Failure Mode Tree)
Page 4 of 5



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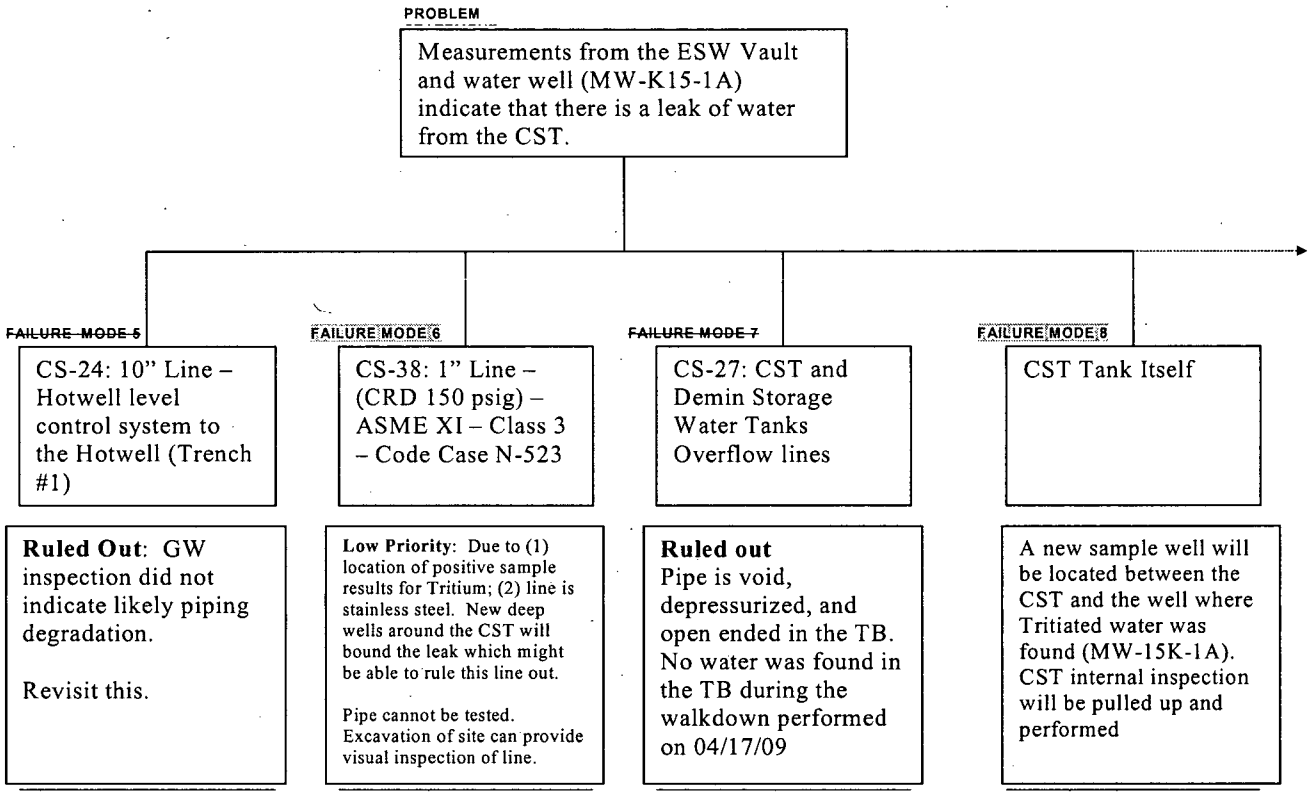
PROBLEM
Measurements from the ESW Vault and water well (MW-K15-1A) indicate that there is a leak of water from the CST.
FAILURE MODE 5
CS-24: 10" Line – Hotwell level control system to the Hotwell (Trench #1)
Ruled Out: GW inspection did not indicate likely piping degradation.
Revisit this.
FAILURE MODE 6
CS-38: 1" Line – (CRD 150 psig) – ASME XI – Class 3 – Code Case N-523
Low Priority: Due to (1) location of positive sample results for Tritium; (2) line is stainless steel. New deep wells around the CST will bound the leak which might be able to rule this line out.
Pipe cannot be tested. Excavation of site can provide visual inspection of line.
FAILURE MODE 7
CS-27: CST and Demin Storage Water Tanks Overflow lines
Ruled out
Pipe is void, depressurized, and open ended in the TB. No water was found in the TB during the walkdown performed on 04/17/09
FAILURE MODE 8
CST Tank Itself
A new sample well will be located between the CST and the well where Tritiated water was found (MW-15K-1A). CST internal inspection will be pulled up and performed

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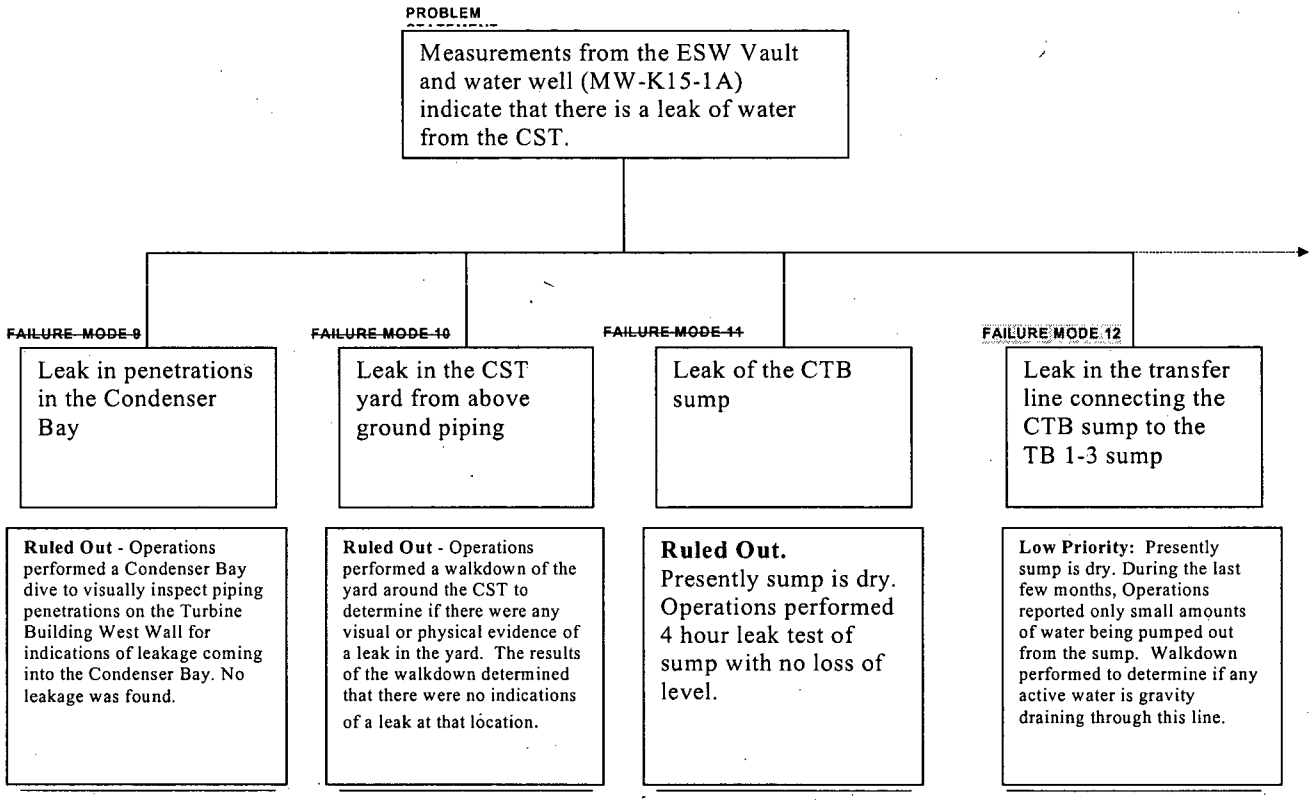
PROBLEM
Measurements from the ESW Vault and water well (MW-K15-1A) indicate that there is a leak of water from the CST.
FAILURE MODE 9
Leak in penetrations in the Condenser Bay
Ruled Out - Operations performed a Condenser Bay dive to visually inspect piping penetrations on the Turbine Building West Wall for indications of leakage coming into the Condenser Bay. No leakage was found.
FAILURE MODE 10
Leak in the CST yard from above ground piping
Ruled Out - Operations performed a walkdown of the yard around the CST to determine if there were any visual or physical evidence of a leak in the yard. The results of the walkdown determined that there were no indications of a leak at that location.
FAILURE MODE 11
Leak of the CTB sump
Ruled Out.
Presently sump is dry. Operations performed 4 hour leak test of sump with no loss of level.
FAILURE MODE 12
Leak in the transfer line connecting the CTB sump to the TB 1-3 sump
Low Priority: Presently sump is dry. During the last few months, Operations reported only small amounts of water being pumped out from the sump. Walkdown performed to determine if any active water is gravity draining through this line.

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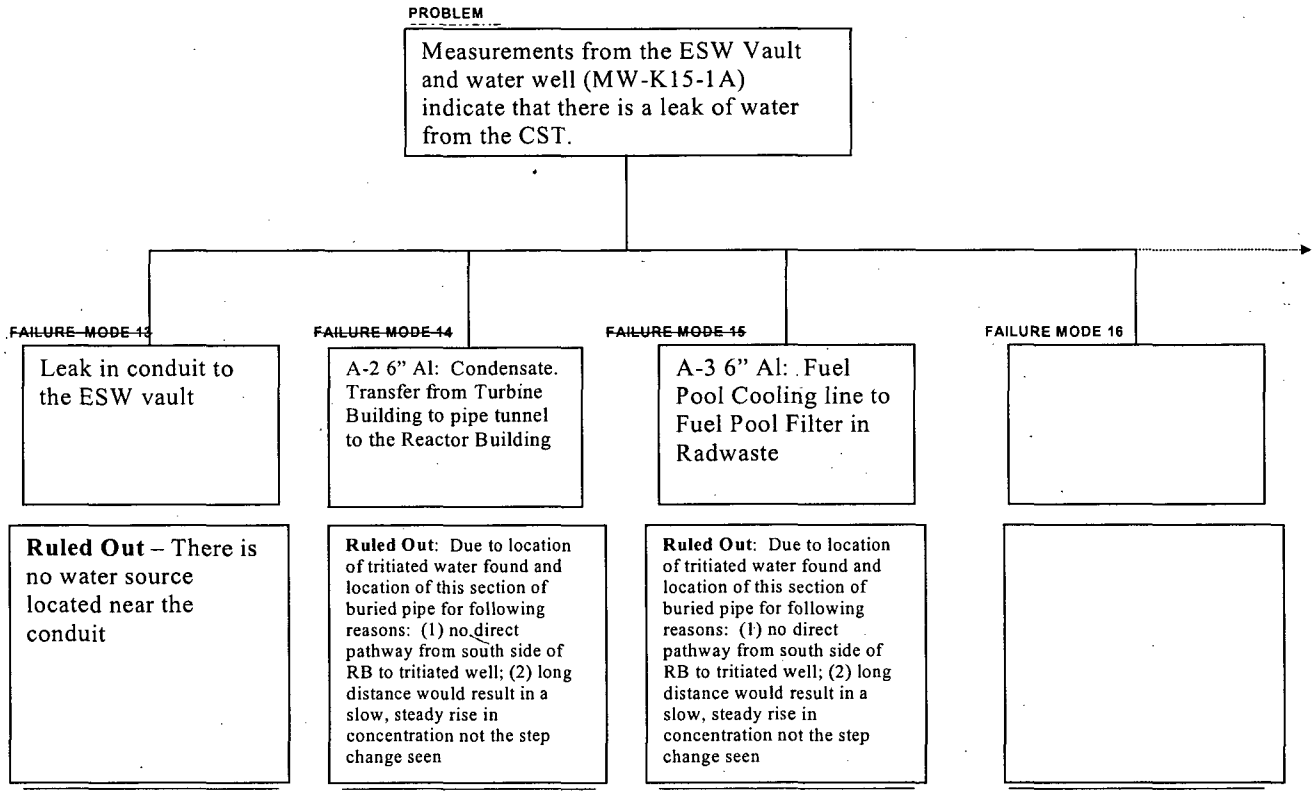
PROBLEM
Measurements from the ESW Vault and water well (MW-K15-1A) indicate that there is a leak of water from the CST.
FAILURE MODE 13
Leak in conduit to the ESW vault
Ruled Out – There is no water source located near the conduit
FAILURE MODE 14
A-2 6" Al: Condensate. Transfer from Turbine Building to pipe tunnel to the Reactor Building
Ruled Out: Due to location of tritiated water found and location of this section of buried pipe for following reasons: (1) no direct pathway from south side of RB to tritiated well; (2) long distance would result in a slow, steady rise in concentration not the step change seen
FAILURE MODE 15
A-3 6" Al: Fuel Pool Cooling line to Fuel Pool Filter in Radwaste
Ruled Out: Due to location of tritiated water found and location of this section of buried pipe for following reasons: (1) no direct pathway from south side of RB to tritiated well; (2) long distance would result in a slow, steady rise in concentration not the step change seen
FAILURE MODE 16

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ATTACHMENT 2
Complex Troubleshooting
(Failure Mode / Cause Table)
Page 5 of 5

Failure Mode No. 1 **Description** A-4: 6" Line – Condensate system to Hotwell level control system leaks (Trench #1)

Cause(s)	Refer to Attachment 4 for examples of risk and rigor determination for steps below Validation/Action Steps	Results *Expected results are based on system operation as designed, not as failed Expected	 Actual	Owner Status Engineering
Degradation / Failure of the A-4 6" Piping	1) Perform Guide Wave Testing from excavation 2) Perform Guided Wave from Inside Condensate Building 3) Excavate below the Condensate Transfer Building 4) ECR will jumper out the suspected length of piping and then perform and pressure drop test on the line.	No Leakage identified	GW indicates potential leakage	**OPEN**

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Failure Mode No. 2	Description A-2: 6" Line – Condensate system to Hotwell level control system leaks (Trench #1)			
	Refer to Attachment 4 for examples of risk and rigor determination for steps below	**Results** *Expected results are based on system operation as designed, not as failed		**Owner Status**
Cause(s)	**Validation/Action Steps**	**Expected**	**Actual**	**Maintenance**
Degradation/Failure of the A-2: 6" line	Ruled Out Piping was re-routed above ground by a previous modification	No Leakage identified	No Leakage identified	**CLOSED**

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Failure Mode No. 3	Description SS-4: 8" Line – Hotwell level control system to the Hotwell (Trench #1)			
	Refer to Attachment 4 for examples of risk and rigor determination for steps below	**Results** *Expected results are based on system operation as designed, not as failed		**Owner Status**
Cause(s)	**Validation/Action Steps**	**Expected**	**Actual**	**Maintenance**
Degradation/Failure of the SS-4 8" line	1) Perform Guide Wave Testing from excavation 2) Perform Guided Wave from Inside Condensate Building	1) No Indications of Pipe wall degradation. 2) No Indications of Pipe wall degradation.	GW testing showed no strong evidence of pipe wall degradation	**CLOSED**

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Failure Mode No. 4	Description CS-26: 1" Line – Hotwell level control system to the Condensate Pump Seals (Trench)			
	Refer to Attachment 4 for examples of risk and rigor determination for steps below	**Results** *Expected results are based on system operation as designed, not as failed		**Owner Status**
Cause(s)	**Validation/Action Steps**	**Expected**	**Actual**	**Maintenance**
Degradation of the CS-26 1" line	1) Pressure test the Line	No leakage identified		**OPEN**

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Failure Mode No. 5	Description CS-26: 1" Line – Hotwell level control system to the Condensate Pump Seals (Trench)			
	Refer to Attachment 4 for examples of risk and rigor determination for steps below	**Results** *Expected results are based on system operation as designed, not as failed		**Owner Status**
Cause(s)	**Validation/Action Steps**	**Expected**	**Actual**	**Maintenance**
Degraded/Failed CS-24 10" line	1) Perform Guide Wave Testing from excavation 2) Perform Guided Wave from Inside Condensate Building	No Indications of Pipe wall degradation.	GW testing showed no strong evidence of pipe wall degradation	**CLOSED**

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Failure Mode No. 6	Description CS-38: 1" Line – (CRD 150 psig) – ASME XI – Class 3 – Code Case N-523			
	Refer to Attachment 4 for examples of risk and rigor determination for steps below	**Results** *Expected results are based on system operation as designed, not as failed		**Owner Status**
Cause(s)	**Validation/Action Steps**	**Expected**	**Actual**	**Engineering**
Degraded/Failed CS-38 1" line	1) Excavate and perform visual inspection 2) Perform ECR to re-route flow to water quality line (potential)	No leakage identified		**OPEN**

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Failure Mode No. 7	Description CS-27: CST and Demin Storage Water Tanks Overflow lines			
	Refer to Attachment 4 for examples of risk and rigor determination for steps below	**Results** *Expected results are based on system operation as designed, not as failed		**Owner Status**
Cause(s)	**Validation/Action Steps**	**Expected**	**Actual**	**Operations**
Degraded/Failed demin storage water tanks overflow lines	Ruled out Line is void and open ended in the TB. No water found in the TB Basement during walkdown.	No Leakage identified	No Leakage identified	**CLOSED**

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Failure Mode No. 8	Description CST Tank Itself			
	Refer to Attachment 4 for examples of risk and rigor determination for steps below	Results *Expected results are based on system operation as designed, not as failed		Owner Status
Cause(s)	Validation/Action Steps	Expected	Actual	
Tank degradation	1) Two new sample wells located:1) directly west of the CST; 2) SW of the CST.	Low Tritium levels	1) New well directly west of the tank shows high level of tritium consistent with CST	OPEN

Failure Mode No. 8	Description CST Tank Itself			
	Refer to Attachment 4 for examples of risk and rigor determination for steps below	Results *Expected results are based on system operation as designed, not as failed		Owner Status
Cause(s)	Validation/Action Steps	Expected	Actual	

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Tank degradation	2) Install moisture sensing instrumentation in the tank. 3) UT Inspect the bottom with a diver 4) Bore a hole in the concrete based of the tank skirt base of the tanks and then sample any water under the tank.	Low Tritium levels	New well directly west of the tank shows high level sof troirum	**OPEN**

Failure Mode No. 11	**Description** Leak of the Condensate Transfer Building (CTB) sump			
	Refer to Attachment 4 for examples of risk and rigor determination for steps below	**Results** *Expected results are based on system operation as designed, not as failed		**Owner Status**
Cause(s)	**Validation/Action Steps**	**Expected**	**Actual**	

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Sump degradation	1) Sump inspection 2) Fill the sump and see if the level drops	Water level in sump unchanged.	Water level in sump unchanged.	**CLOSED**

Failure Mode No. 12	**Description** Leak in the transfer line connecting the CTB sump to the TB 1-3 sump		
	Refer to Attachment 4 for examples of risk and rigor determination for steps below	**Results** *Expected results are based on system operation as designed, not as failed		**Owner Status**
Cause(s)	**Validation/Action Steps**	**Expected**	**Actual**	

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Floor Drain Line leaks	1) Perform and tracer test 2) Inspect with Boroscope	No Degradation in the Pipe wall		**OPEN**

Failure Mode No. 13	**Description** Leak in conduit to ESW Vault			
	Refer to Attachment 4 for examples of risk and rigor determination for steps below	**Results** *Expected results are based on system operation as designed, not as failed		**Owner Status**
Cause(s)	**Validation/Action Steps**	**Expected**	**Actual**	

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Leakage into the conduit.	Ruled Out: there is no water source near the conduit.	No Leakage source near the conduit in the Condensate Transfer Building. No water entering the conduit in the Condensate Trasfer Building	No Leakage source near the conduit in the Condensate Transfer Building. No water entering the conduit in the Condensate Trasfer Building	**CLOSED**

Failure Mode No. 14	**Description** Leak in conduit to ESW Vault			
	Refer to Attachment 4 for examples of risk and rigor determination for steps below	**Results** *Expected results are based on system operation as designed, not as failed		**Owner Status**
Cause(s)	**Validation/Action Steps**	**Expected**	**Actual**	
A-2 6" AI: Condensate. Transfer from Turbine Building to pipe tunnel to the Reactor Building. Thi saline is about 6 feet below grade This line runs between the South Wall of the Reactor building and the Pipe Tunnel which runs east to west. Low Priority	Sample the wells on south of the Turbine Building	No High Tritium Levels		

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Failure Mode No. 15	Description Leak in conduit to ESW Vault			
	Refer to Attachment 4 for examples of risk and rigor determination for steps below	Results *Expected results are based on system operation as designed, not as failed		Owner Status
Cause(s)	Validation/Action Steps	Expected	Actual	
A-3 6" AI: Fuel Pool Cooling line to Fuel Pool Filter in Radwaste	Sample the wells on south of the Turbine Building	No High Tritium Levels		

Failure Mode No. 15	Description Leak in conduit to ESW Vault			
	Refer to Attachment 4 for examples of risk and rigor determination for steps below	Results *Expected results are based on system operation as designed, not as failed		Owner Status
Cause(s)	Validation/Action Steps	Expected	Actual	

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A-2 6" AI: Condensate. Transfer from Turbine Building to pipe tunnel to the Reactor Building Low Priority	Sample the wells on south of the Turbine Building	No High Tritium Levels		

Failure Mode No. 16	**Description** Leak in conduit to ESW Vault			
	Refer to Attachment 4 for examples of risk and rigor determination for steps below	**Results** *Expected results are based on system operation as designed, not as failed		**Owner Status**
Cause(s)	**Validation/Action Steps**	**Expected**	**Actual**	
Leak in the Offgas holdup Lines Low Priority	Sample the wells on south of the Turbine Building	No High Tritium Levels		

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