

APPENDIX B
ON-SITE AUDIT CHECKLIST

Plant Name:	Dresden Generating Station
Containment Type:	Mark II
Vendor for Strainer:	Performance Contracting, Inc.
Vendor for ΔH Analysis:	Innovative Technology Solutions (ITS)
Vendor for Loads Analysis:	Duke Engineering Services (DES)

Inventory of Major Insulations In the Plant

	Fibrous	Particulate	RMI	Other
	<i>(Type/ft³)</i>	<i>(Type/lbm)</i>	<i>(Type/ft²)</i>	<i>(Type/ft³)</i>
Primary Piping	Nukon/100 ft ³	Cal-Sil	ss-1/ss-2/Al	
Reactor Shielding Cavity			SS-2.5 mil	
Special Structure/Component				
Miscellaneous (<u>Flued Penet</u>)				Asbestos

(Units: Volume in ft³ and Foil Area in ft²)

Debris Generation Model Used in the Study

Method #1 -- All Debris In the Containment	Cal-Sil	
Method #2	Fibrous	
Method #3		
Method #4 -- Not approved for use by Staff		

Drywell Transport Factors Used in the Study

Transport Factor is assumed equal to 1		
Used URG Transport Factors	<input checked="" type="checkbox"/>	
Plant Specific Calculations		

Suppression Pool Transport Factors Used in the Study

Transport Factor is assumed equal to 1

Used BLOCKAGE Calculations

☒

Plant Specific Calculations

Miscellaneous Debris**Location****Basis for Estimates**

Other Fibrous		
Paint Dust (IOZ-Filler)	Dry Well	IOZ estimate of 85 lb from URG.
Rust	Sup_Pool	50 lbm from URG
Paint-Chips (IOZ-Alkyd)	Drywell	85 lbm fom plant estimate
Dirt and Dust	Drywell	150 lbm rom URG
Sludge	Pool	Measured 370 lb in Outage 13 (2 year cycle)
Other (<u>FOAM</u>)		

Head Loss Estimation

Vendor Correlation and Analysis Used

☒

Vendor LTR Enclosed

Yes

Vendor LTR Previously Reviewed by Staff

No

Vendor tested Exact Strainers with Insulation

No

Plant Specific Analysis (e.g., URG Correlations)

NPSH Estimation (Comparison with GL 97-04 Response)

Operator Throttling of ECCS Assumed

Yes

Time at which throttled

10**minutes**

Percentage Flow Reduction from Rated Flow

50%

Maximum Pool Temperature

172 °F

Assumed Containment Overpressure

Yes

Staff reviewed the licensing basis (GL 97-04 Res.)

Reference No:

Docket No. 50-237 and 50-249

Date of Approval:

Codes and Standards (Comparison with Licensing Basis/UFSAR)

Quality Assurance Requirements		
10 CFR Appendix-B		<input checked="" type="checkbox"/>
ASME Certificate Required		
Materials		
Conform to ASTM Specifications		<input checked="" type="checkbox"/>
Certified Material Test Reports are Provided		<input checked="" type="checkbox"/>
Design/Fabrication	Not pressure stamped/pressure tested	
Qualified ASME Section III, Subsection NC		<input checked="" type="checkbox"/>
Qualified ASME Section III, Class 2		
Other (Bolts per Sub-section NF_)		<input checked="" type="checkbox"/>
Welding		
Qualified to ASME Section IX		<input checked="" type="checkbox"/>
Other (<u>Qualified Welder</u>)		<input checked="" type="checkbox"/>
NDE per ASME Section III		
Critical welds examined by liquid penetrant		<input checked="" type="checkbox"/>
All Other Welds Visually Examined		<input checked="" type="checkbox"/>
Other (_____)		

Structural Evaluation addressed

Loads on strainer components and welds evaluated	<input checked="" type="checkbox"/>	
Loads on torus penetrations reevaluated	<input checked="" type="checkbox"/>	
Added strainer supports to the torus	<input checked="" type="checkbox"/>	
Effect on structures in close proximity	<input checked="" type="checkbox"/>	
Effect on increased water level in supp-pool	Yes (No effect)	
Seismic Loads	Yes	
Hydrodynamic loads method basis		
Vendor analyses	Yes	
Methods and Assumptions same as original	Drag coefficients decreased by 15%	
Substantial changes in methods	No	

Debris Estimates (Plant and Staff Evaluations)

(If saturation thickness assumption is used got to end)

A) Destruction Pressures Used (in . psi)

Insulation Type	Plant	Staff	Comment
Transco RMI		190	Limited Quantities (Sat. Thickness)
Cal-Sil with Al Jacket	1	160	100% Destruction and Transport
K-Wool		40	
Temp-Mat with ss wire retainer		17	
Knaupf		10	
Jacketed Nukon	10	10	
Unjacketed Nukon		10	
Koolphen-K		6	
MIRROR from Diamond		4	Saturation thickness used for RMI
Min-K		4	
Other:			
(Asbestos-- Flued Pent)	1		100% for breaks inside flued pent
(Foam)			DRE97-0154: Ignore foam; floats
()			
()			

B) Volume of Zone of Influence Used (ft³ or Equivalent L/D Value for Sphere Radius)

Insulation Type	Break #1		Break #2		Break #3		Break #4	
	Plant	Staff	Plant	Staff	Plant	Staff	Plant	Staff
Transco RMI	--	--	--	--	--	--	--	--
Cal-Sil with Al Jacket	12.9	6.2	12.9	6.2	12.9	6.2	12.9	6.2
K-Wool	--	--	--	--	--	--	--	--
Temp-Mat with ss wire retainer	--	--	--	--	--	--	--	--
Knauf	--	--	--	--	--	--	--	--
Jacketed Nukon	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
Unjacketed Nukon	--	--	--	--	--	--	--	--
Koolphen-K	--	--	--	--	--	--	--	--
MIRROR from Diamond	--	--	--	--	--	--	--	--
Min-K	--	--	--	--	--	--	--	--
Other:	--	--	--	--	--	--	--	--
(Asbestos-- Flued Pent)	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
()	--	--	--	--	--	--	--	--
()	--	--	--	--	--	--	--	--
()	--	--	--	--	--	--	--	--

C) Volume of Debris Generated by Break (in ft³)

Insulation Type	Unit 2 Estimate		Staff Estimate		Unit 3 Estimate		Staff Estimate	
	Above Grate	Below Grate	Above Grate	Below Grate	Above Grate	Below Grate	Above Grate	Below Grate
Transco RMI	--	--	--	--	--	--	--	--
Cal-Sil with Al Jacket	0	0			8.24	0		
K-Wool	--	--	--	--	--	--	--	--
Temp-Mat with ss wire retainer	--	--	--	--	--	--	--	--
Knauf	--	--	--	--	--	--	--	--
Jacketed Nukon	65	0			66	0		
Unjacketed Nukon	--	--	--	--	--	--	--	--
Koolphen-K	--	--	--	--	--	--	--	--
MIRROR from Diamond	--	--	--	--	--	--	--	--
Min-K	--	--	--	--	--	--	--	--
Other:	--	--	--	--	--	--	--	--
(Asbestos-- Flued Pent)	14	0	14	0	14	0	14	0
()	--	--	--	--	--	--	--	--
()	--	--	--	--	--	--	--	--
()	--	--	--	--	--	--	--	--

If breaks < 2, then

Vendor Data supports screening out rest of breaks



Plant has undocumented analyses reviewed by staff

D) Drywell Debris Transport Fractions Used in the Analysis

Insulation Type	Unit 2 Estimate		Staff Estimate		Unit 3 Estimate		Staff Estimate	
	Above Grate	Below Grate	Above Grate	Below Grate	Above Grate	Below Grate	Above Grate	Below Grate
Transco RMI	0.5		--		0.5		--	
Cal-Sil with Al Jacket	1	1			1	1		
K-Wool	0.27	0.78	--		0.27	0.78	--	
Temp-Mat with ss wire retainer	0.21	0.76	--		0.21	0.76	--	
Knaupf	--	--	--	--	--	--	--	--
Jacketed Nukon	0.28	0.78			0.28	0.78		
Unjacketed Nukon	0.28	0.78	--		0.28	0.78	--	
Koolphen-K	0.45	0.45	--		0.45	0.45	--	
MIRROR from Diamond	0.5	0.5	--		0.5	0.5	--	
Min-K	1	1	--		1	1	--	
Other:								
(Asbestos-- Flued Pent)	0.24	0.54	1	1	0.24	0.54	1	1
()	--	--	--	--	--	--	--	--
()	--	--	--	--	--	--	--	--
()	--	--	--	--	--	--	--	--

E) Wetwell Debris Transport Fractions Used in the Analysis

Insulation Type	Unit 2 Estimate		Staff Estimate		Unit 3 Estimate		Staff Estimate	
	Above Grate	Below Grate	Above Grate	Below Grate	Above Grate	Below Grate	Above Grate	Below Grate
Transco RMI	--		--		--		--	
Cal-Sil with Al Jacket	0.28	0.28	1	1	0.28	0.28	1	1
K-Wool	--		--		--		--	
Temp-Mat with ss wire retainer	--		--		--		--	
Knaupf	--		--		--		--	
Jacketed Nukon	1	1			1	1		
Unjacketed Nukon	--		--		--		--	
Koolphen-K	--		--		--		--	
MIRROR from Diamond	--		--		--		--	
Min-K	1	1	--		1	1	--	
Other:	--	--	--	--	--	--	--	--
(Asbestos-- Flued Pent)	1	1	1	1	1	1	1	1
()	--	--	--	--	--	--	--	--
()	--	--	--	--	--	--	--	--
()	--	--	--	--	--	--	--	--

F) Net Insulation Debris Volume on the Strainer (ft³)

Insulation Type	Unit 2 Estimate		Staff Estimate		Unit 3 Estimate		Staff Estimate	
	Above Grate	Below Grate	Above Grate	Below Grate	Above Grate	Below Grate	Above Grate	Below Grate
Transco RMI	--	--	--	--	--	--	--	--
Cal-Sil with Al Jacket	0	0	0	0	2.27193	0	6.7	0
K-Wool	--	--	--	--	--	--	--	--
Temp-Mat with ss wire retainer	--	--	--	--	--	--	--	--
Knauf	--	--	--	--	--	--	--	--
Jacketed Nukon	18.26	0	18.4		18.4	0	18.4	0
Unjacketed Nukon	--	--	--	--	--	--	--	--
Koolphen-K	--	--	--	--	--	--	--	--
MIRROR from Diamond	--	--	--	--	--	--	--	--
Min-K	--	--	--	--	--	--	--	--
Other:	--	-	-	-	--	-	-	-
(Asbestos-- Flued Pent)	3.36	0	7	0	3.36	0	7	0
()	-	-	-	-	--	-	-	-
()	-	-	-	-	--	-	-	-
()	-	-	-	-	--	-	-	-

G) Miscellaneous Debris

Debris Type	Unit 2 Estimate		Unit 3 Estimate		Staff Estimate		Units	Status
	Gen	T.F	Gen	T.F	Gen	T.F.		
Other Fibrous							ft ³	O.K.
Paint Dust (IOZ-Filler)	85	0.32	85	0.32	85	0.8	lbm	O.K.
Rust	50	0.12	50	0.12	50	0.1	lbm	O.K.
Paint-Chips (IOZ-Alkyd)	85	0.09	85	0.09	85	0.1	lbm	O.K.
Dirt and Dust	150	0.28	150	0.28	150	0.8	lbm	O.K.
Sludge	370	0.27	370	0.27	370	0.8	lbm	O.K.
Other (FOAM)							ft ³	O.K.
Total							lbm	O.K.

Enter Qualified Coatings Type for Containment

What is Done about Unqualified Coating

Enter Number of Years for Suppression Pool Clean-Up =

Inorganc Zinc with Epoxy Top Coat

Plant estimated approximately 85 lbm.

1 outage

ECCS Flow Rate and Design Details

	LPCI3A	LPCI3B	LPCI3C	LPCI3D	LPCS3A	LPCS3B	Total
Before Throttling							
Flow Rate (GPM)	5,150	5,150	5,150	5,150	5,800	5,800	32,200
Pool Temperature (oF)	149	149	149	149	149	149	
Wetwell Pressure (psia)	16.6	16.6	16.6	16.6	16.6	16.6	
NPSH _{Required} (ft-water)	31.5	31.5	31.5	31.5	38.5	38.5	
NPSH _{Available} (ft-water)	43.9	43.9	43.9	43.9	43.9	43.9	
Piping Frictional (ft-water)	18.7	18.7	18.7	18.7	17.9	17.9	
After Throttling (Time: 10 min)							
Flow Rate (GPM)	2500	2500	2500	2500	4500	4500	19000
Pool Temperature (oF)	172	172	172	172	172	172	
Wetwell Pressure (psia)	17.2	17.2	17.2	17.2	17.2	17.2	
NPSH _{Required} (ft-water)	30	30	30	30	27	27	
NPSH _{Available} (ft-water)	46.09	46.09	46.09	46.09	40.33	40.33	
Piping Frictional (ft-water)	16.09	16.09	16.09	16.09	13.33	13.33	

Strainer Flow Rates and Design Details

	A	B	C	D
Previous Strainer				
Flow Rate Data				
Full Design (GPM)	8,050	8,050	8,050	8,050
Single Failure (GPM)	N/A	N/A	N/A	N/A
Throttle Design (GPM)	4750	4750	4750	4750
Throttle Sing Fail (GPM)	N/A	N/A	N/A	N/A
Outer Diameter (in.)	14.5	14.5	14.5	14.5
Active Length (ft)	0.8	0.8	0.8	0.8
Flange Diameter (in.)	18.3	18.3	18.3	18.3
Plate Area (ft ²)	4.7	4.7	4.7	4.7
Clean ΔH (ft-water)	5.8	5.8	5.8	5.8
Replacement Strainer				
Flow Rate Data				
Full Design	8,050	8,050	8,050	8,050
Full Single Failure	N/A	N/A	N/A	N/A
Throttle Design	4750	4750	4750	4750
Throttle Single Failure	N/A	N/A	N/A	N/A
Outer Diameter (in.)	32.5	32.5	32.5	32.5
Active Length (in.)	54.0	54.0	54.0	54.0
Flange Diameter (in.)	24.25	24.25	24.25	24.25
Plate Area (ft ²)	118.8	118.8	118.8	118.8
Gap Volume (ft ³)	6.4	6.4	6.4	6.4
Circumscribed Area (ft ²)	38.3	38.3	38.3	38.3
Circum+ends Area (ft ²)	48.0	48.0	48.0	48.0
Clean Head Loss	1.28	1.28	1.28	1.28

Note: 5.8 ft-water
with one strainer
blocked and other
strainers 4% blocked

Strainer Performance Results

	A	B	C	D
Plate Area Increase	25.2	25.2	25.2	25.2
A _{circ} Increase	10.2	10.2	10.2	10.2
Hole Dimension Change	N/A	N/A	N/A	N/A
Volume of Gap	6.4	6.4	6.4	6.4
Loading (Design-Full Flow)				
Load Factor	0.25	0.25	0.25	0.25
Fiber Volume (ft ³)	4.6	4.6	4.6	4.6
Fiber Mass (lbm)	11	11	11	11
Volume Inside Gap	4.6	4.6	4.6	4.6
Gap Occupancy	0.72	0.72	0.72	0.72
Thickness Inside Gap	0.46	0.46	0.46	0.46
Volume Outside Gap	--	--	--	--
Thickness Outside Gap	--	--	--	--
Loading (Throttled)				
Load Factor	0.25	0.25	0.25	0.25
Fiber Volume (ft ³)	4.6	4.6	4.6	4.6
Fiber Mass (lbm)	11	11	11	11
Volume inside Gap	4.6	4.6	4.6	4.6
Gap Occupancy	0.72	0.72	0.72	0.72
Thickness Inside Gap	0.46	0.46	0.46	0.46
Volume Outside Gap	-	-	-	-
Thickness Outside Gap	-	-	-	-
Plate Velocity (ft/s)				
Design Full	0.151	0.151	0.151	0.151
Throttled Flow	0.089	0.089	0.089	0.089
CircumScribed Velocity (ft/s)				
Design Full	0.469	0.469	0.469	0.469
Throttled Flow	0.276	0.276	0.276	0.276

RMI Head Loss Based on Saturation Thickness

	Design	Throttled			
Settling Velocity (ft/s)	0.39	0.39			
Saturation Thickness (in.)	11.11	3.68	1.000	0.000	0.853
Head Loss (ft-water)	1.22	0.14			

Head Loss Estimates for Various Postulated Cases: Licensing Basis (32,200 GPM)

Steady State Reaches at 3 hours (172 oF)

Head Loss Across Strainer at 10 min (149 oF)

Case ID	Nukon	Sludge	Paint	Rust	Dust	Cal-Sil	Flow	ΔH_{clean}	ΔH_{RMI}	K_{bumpup}	ΔH_{fib}	ΔH_{total}	Fraction	ΔH_{RMI}	ΔH_{fib}	ΔH_{total}
	ft ³	lbm	lbm	lbm	lbm	ft ³	(GPM)	ft-water	ft-water		ft-water	ft-water	Reaching	ft-water	ft-water	ft-water
1: Unit 2, Normal Paint, 1 Cycle	18.6	370	170	50	120	0.0	8,050	1.28	1.22	1.79	4.03	6.53	0.30	0.37	1.97	3.61
2: Unit 2, Unqual Coats, 1 Cycle	18.6	370	700	50	120	0.0	8,050	1.28	1.22	2.37	5.34	7.83	0.30	0.37	2.61	4.25
3: Unit 3, Normal Paint, 1 Cycle	18.6	370	170	50	120	6.8	8,050	1.28	1.22	2.50	5.63	8.13	0.30	0.37	2.75	4.40
4: Unit 3, Unqual Coats, 1 Cycle	18.6	370	700	50	120	6.8	8,050	1.28	1.22	3.08	6.94	9.44	0.30	0.37	3.39	5.04
5: Unit 2, Normal Paint, 2 Cycle	18.6	833	170	50	120	0.0	8,050	1.28	1.22	1.48	8.57	11.06	0.30	0.37	4.58	6.22
6: Unit 2, Unqual Coats, 2 Cycle	18.6	833	700	50	120	0.0	8,050	1.28	1.22	1.77	10.28	12.78	0.30	0.37	5.50	7.14
7: Unit 3, Normal Paint, 2 Cycle	18.6	833	170	50	120	6.8	8,050	1.28	1.22	1.84	10.68	13.17	0.30	0.37	5.71	7.35
8: Unit 3, Unqual Coats, 2 Cycle	18.6	833	700	50	120	6.8	8,050	1.28	1.22	2.14	12.39	14.89	0.30	0.37	6.62	8.26

Head Loss Estimates for Various Postulated Cases (LPCI: 5150 and 2500)

RHR Head LossCalcs

Case ID	Nukon	Sludge	Paint	Rust	Dust	Cal-Sil	Flow	ΔH_{clean}	ΔH_{RMI}	K_{bumpup}	ΔH_{fib}	ΔH_{total}
	ft ³	lbm	lbm	lbm	lbm	ft ³	(GPM)	ft-water	ft-water		ft-water	ft-water
1: Unit 2, Normal Paint, 1 Cycle	18.6	370	170	50	120	0.0	4,750	0.44	0.14	1.79	3.76	4.35
2: Unit 2, Unqual Coats, 1 Cycle	18.6	370	700	50	120	0.0	4,750	0.44	0.14	2.37	4.98	5.56
3: Unit 3, Normal Paint, 1 Cycle	18.6	370	170	50	120	6.8	4,750	0.44	0.14	2.50	5.26	5.84
4: Unit 3, Unqual Coats, 1 Cycle	18.6	370	700	50	120	6.8	4,750	0.44	0.14	3.08	6.48	7.06
5: Unit 2, Normal Paint, 2 Cycle	18.6	833	170	50	120	0.0	4,750	0.44	0.14	1.48	12.22	12.80
6: Unit 2, Unqual Coats, 2 Cycle	18.6	833	700	50	120	0.0	4,750	0.44	0.14	1.77	14.66	15.24
7: Unit 3, Normal Paint, 2 Cycle	18.6	833	170	50	120	6.8	4,750	0.44	0.14	1.84	15.22	15.81
8: Unit 3, Unqual Coats, 2 Cycle	18.6	833	700	50	120	6.8	4,750	0.44	0.14	2.14	17.67	18.25

Head Loss (Pure Fiber + Sludge)

Head Loss (10 minutes)