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Your ref: Docket No. 52-006
Our ref: DCP/NRC1647

October 31, 2003

SUBJECT: Transmittal of Revised Responses to AP1000 DSER Open Items

This letter transmits Westinghouse revised responses to Open Items in the AP1000 Design Safety Evaluation Report (DSER). A list of the revised DSER Open Item responses transmitted with this letter is Attachment 1. The non-proprietary responses are transmitted as Attachment 2.

Please contact me at 412-374-4728 if you have any questions concerning this submittal.

Very truly yours,

R. P. Vijuk

R. P. Vijuk, Manager
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/Attachments

1. List of the AP1000 Design Certification Review, Draft Safety Evaluation Report Open Item Responses transmitted with letter DCP/NRC1647
2. Non-Proprietary AP1000 Design Certification Review, Draft Safety Evaluation Report Open Item Responses dated October 31, 2003

D063

October 31, 2003

Attachment 1

List of

Non-Proprietary Responses

Table 1 **"List of Westinghouse's Responses to DSER Open Items Transmitted in DCP/NRC1647"**	
14.2-1f, Revision 1 15.2.7-1 Item 10 Revision 2	

DCP/NRC1647
Docket No. 52-006

October 31, 2003

Attachment 2

AP1000 Design Certification Review
Draft Safety Evaluation Report Open Item Non-Proprietary Responses

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 14.2-1.f (Response Revision 1)

Original RAI Number(s): None

Summary of Issue:

The staff requests that Westinghouse identify whether, during the initial test program, the combined license (COL) applicant will monitor (e.g., acoustic monitoring) the primary and secondary sides of the steam generator for indications of loose parts or anomalous internals vibration that can lead to tube degradation. If this type of monitoring will be performed, Westinghouse should make appropriate additions to the DCD. If this type of monitoring will not be performed, Westinghouse should identify the reasons such monitoring is not believed necessary.

Westinghouse Response:

A digital metal impact monitoring system, described in DCD 4.4.6.4, is included in the AP1000 Special Monitoring System (SMS). This system monitors the reactor coolant system for metallic loose parts. This system is installed prior to preoperational testing and is tested and calibrated during preoperational testing as described in DCD subsection 14.2.9.4.16. DCD 14.2.9.1.2 will be revised as shown below to clarify that the special monitoring system will be operational during the steam generator testing.

Design Control Document (DCD) Revision:

14.2.9.1.2 Steam Generator System Testing

Prerequisites

The construction tests of the as-installed system have been completed. The reactor coolant system as well as other systems used in power generation are functional since portions of the steam generator system testing is performed during the plant hot functional tests. Prerequisite testing of required interfacing systems are completed to the extent sufficient to support the specified testing and the appropriate system configuration. **Construction and installation testing of the special monitoring system has been completed to the extent necessary to support preoperational testing. Required electrical power supplies are energized and operational.**

PRA Revision:

None

NRC Additional Comments:

DSER OI 14.2-1.f states, "The staff requested that Westinghouse identify whether during the initial test program the COL applicant will monitor (e.g., acoustic monitoring) the primary and secondary sides of the steam generator for indications of loose parts or anomalous internals vibration that can lead to tube degradation."

Westinghouse responded that a digital metal impact monitoring system monitors the reactor coolant system for metallic loose parts. However, the system is installed on the primary side of the steam generator. The capability of this system to monitor the secondary sides of the steam generator for either loose parts or anomalous internals vibration is not addressed. Please address the secondary side steam generator monitoring.

Westinghouse Response: (Response Revision 1)

The digital metal impact monitoring system includes acoustic sensors above and below the tube sheet in each steam generator. The steam generator acoustic sensors provide acoustic monitoring of the steam generator primary side and the secondary side in the areas around the tube sheet. Thus, the acoustic monitoring system provides acoustic monitoring of both the primary and secondary sides of the steam generator.

Design Control Document (DCD) Revision:

No additional DCD revisions are required by Response Revision 1.

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 15.2.7-1 Item 10 Revision 2

Original RAI Number(s): None

Summary of Issue:

The NRC staff is attempting to modify the RELAP5 AP1000 model to evaluate LTC. The current model does not model sump recirculation into the DVI lines. Please provide the following information to enable the staff to perform LTC confirmatory analyses with RELAP5 for a postulated double DVI line break.

A. Containment temperature, pressure, water level and boric acid concentration versus time for 30 days.

B. Recirculation line lengths, areas, elevations and resistances. All elevations including containment water levels should be given relative to the reactor vessel DVI nozzle elevation.

C. Recirculation valve actuation setpoints and the WCOBRA/TRAC calculated time for sump recirculation following a double ended DVI line break.

D. Sump screen resistance as a function of flow blockage.

Westinghouse Response:

Revision 2 of this response is to change Figure 1 to show that the sump line MOV is normally open, and to add Figure 2 to show the DVI line relationship to the loop configuration more clearly.

A. The limiting LTC accident is a DVI LOCA in PXS room B. This accident is limiting because it results in the earliest initiation of recirc operation and has the lowest recirc water level. The containment pressure, water temperature and water level for this accident vary as follows:

Time	Pres (psia)	Temp. (F) [1]	Level (ft) [2]
2.6 hr	25.0	198/142 (240)	8.22 (107.8)
14.0 days	19.5	205 (226)	3.72 (103.3)
28.5 days	18.9	205 (225)	3.72 (103.3)

Notes:

[1] This column shows the temperature used in AP1000 LTC analysis and in parenthesis the saturation temperature at the total containment pressure. The

containment water temperature at the start of recirc is subcooled at 198 F in the loop compartments and is 142 F in the PXS B room (WGOTHIC analysis). The subcooling is primarily due to the spill of a large portion of the IRWST directly into the containment through the PXS-B room. For the 14 day LTC analysis performed for the DCD, we have used a containment water temperature of 205 F (WGOTHIC analysis).

[2] The containment water level is shown relative to the centerline of the reactor vessel DVI nozzle and in parenthesis in absolute containment elevations. The containment water level is for the level in the loop compartments, where the recirc screens are located. The level in the PXS B room is maintained by flow from the PXS-A recirc line. The PXS-A recirc line feeds flow to both the DVI-A connection and back through the bottom of the IRWST to the DVI-B line. The level in the PXS-B room will be somewhat lower; how much lower depends on exactly where the break in the DVI line is located. In order to simplify the LTC analysis, Westinghouse does not input a boundary condition into WCOBRA-TRAC for the water level in this room, but adds flow resistance to the DVI-B line to model the break by adding a pipe exit loss (out the break) and a pipe entrance loss (back into the DVI line on the reactor side); these exit / entrance losses account for the pressure losses associated with the recirculation flow exiting the DVI line into the PXS room and returning back into the DVI line.

B. The IRWST recirc line flow resistances, inside diameters and volumes are listed in Table 1. Figure 1 shows a sketch of the PXS IRWST / Containment Recirc lines.

C. The recirculation valves are calculated to open at about 2.6 hours after a DVI LOCA. This time would be greater for a non-DVI LOCA because none of the IRWST would spill into the containment. The recirculation valves open when the IRWST level drops to 7.0 feet above the tank floor.

D. The flow resistances of the recirculation and IRWST screens are included in the resistances provided in the response to item B. The flow resistance of these screens are negligible with up to 90% of the flow area blocked. Note that there is no fibrous material (such as fiberglass insulation) used in the AP1000 that will enter the recirculation water as a result of a LOCA and become trapped on the recirc screens. The impact of potential "resident" fibers / particles (pre-existing dust / dirt) has been evaluated for the AP1000 in response to RAI / DSER OI's and shown to be small.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

TABLE 1 - IRWST SAFEGUARDS DATA

The AP1000 has one IRWST with two injection lines. Each injection line is connected individually through separate direct vessel injection lines to the reactor vessel. These injection lines are shared with the CMT and Accumulator. The safeguards data for the IRWST and each injection/recirculation line is given below. The pipe routing is based on AP1000 line routings.

Number IRWSTs		1			
Number injection lines		2			
IRWST	- Floor Surface Area	2588.3	ft^2 (min) to	2645.4	ft^2 (max)
	- Height (floor / roof)	30.25	ft		
	- Elev Inside Bottom	103.00	ft		

FLOW CASES:			Min Flow		Nominal Flow	Max Flow	
Water Volume (ft^3) (11)			73900		75300	76800	
Water Height (ft)			28.58		28.79	29.00	
Initial Water Temp (°F) (2)			120		85	50	
Boron Concentration (ppm)			2600		2700	2900	
Calc Injection Flow (lb/sec for line A/B, all valves open, assuming 2.30 psi net driving pres.)			105.0 / 99.0		-	-	
Calc Cont. Recirc. Flow (lb/sec for line A/B, all valves open, assuming 0.20 psi net driving pres.)			27.8 / 28.9		-	-	
Line Resistance: (3)							
- IRWST to Sump tee (points 61-63)		(9)					
- pipe size / sch pipe ID	10.02	in.	7.981	in.			
- minimum ID	10.02	in, in a pipe	7.981	in, in a pipe			
- friction factor	0.01343	(4)	0.01407	(4)			
- resistance (ft/gpm²)							
Line A			5.876E-07		4.701E-07	3.525E-07	ft/gpm2
Line B			1.054E-06		8.428E-07	6.321E-07	
- volume (ft^3)							
Line A			21.08		20.12	19.17	ft3
Line B			29.57		28.22	26.88	

Sump tee to MOV Isol Valve (points 63-64)

- pipe size / sch	8 in	sch. 40 (8)				
- pipe ID	7.981	in.				
- minimum ID	7.981	in, pipe				
- friction factor	0.01407	(4)				
- resistance (ft/gpm²)						
Line A			1.617E-08	1.294E-08	9.702E-09	ft/gpm2
Line B			2.291E-08	1.833E-08	1.374E-08	
- volume (ft³)						
Line A			0.42	0.40	0.38	ft3
Line B			0.59	0.56	0.54	

- MOV Isol Valve to Check/Squib Valve parallel paths (points 64-65)

- pipe size / sch	8 in	sch. 160 (8)				
- pipe ID	6.813	in.				
- minimum ID	5.110	in, gate valve				
- friction factor	0.01454	(4)				
- resistance (ft/gpm²)						
Line A			9.531E-07	7.625E-07	5.718E-07	ft/gpm2
Line B			1.739E-06	1.392E-06	1.044E-06	
- volume (ft³)						
Line A			2.84	2.71	2.59	ft3
Line B			6.44	6.15	5.85	

- Check/Squib Valves parallel paths (points 65-66)

- pipe size / sch	8 in	sch. 160 (8)				
- pipe ID	6.813	in.				
- minimum ID	5.110	in, squib valve				
- friction factor	0.01454	(4)				
- resistance (ft/gpm²)						
Line A			8.384E-07	6.707E-07	5.030E-07	ft/gpm2
Line B			8.674E-07	6.939E-07	5.205E-07	
- resistance with single failure (ft/gpm²)		(5)				
Line A			4.159E-06	n/a	n/a	ft/gpm2
Line B			3.470E-06	n/a	n/a	
- volume (ft³)						
Line A			8.97	8.56	8.15	ft3
Line B			9.12	8.71	8.29	
- volume with single failure (ft³)		(5)				
Line A			4.49	n/a	n/a	ft3
Line B			4.56	n/a	n/a	

- Check/Squib Valves parallel paths to DVI injection line tee (points 66-67)

- pipe size / sch	8 in	sch. 160 (8)				
- pipe ID	6.813	in.				
- minimum ID	6.813	in, pipe				
- friction factor	0.01454	(4)				
- resistance (ft/gpm²)						
Line A			2.076E-06	1.661E-06	1.246E-06	ft/gpm2
Line B			1.387E-06	1.109E-06	8.320E-07	
- volume (ft³)						
Line A			4.16	3.97	3.78	ft3
Line B			2.08	1.99	1.89	

- IRWST injection line tee to DVI nozzle (points 67-68)

- pipe size / sch	8 in	sch. 160 (8)				
- pipe ID	6.813	in.				
- minimum ID	4.000	in, DVI venturi				
- friction factor	0.01454	(4)				
- resistance (ft/gpm²)						
Line A			4.735E-06	3.788E-06	2.841E-06	ft/gpm2
Line B			5.279E-06	4.223E-06	3.167E-06	
- volume (ft³)						
Line A			10.97	10.47	9.97	ft3
Line B			13.73	13.11	12.48	

- Sump recirculation paths to IRWST injection line tee (points 100/101-63) (9)

- pipe size / sch (8)	8 in	sch. 40 (ck)	8 in	sch. 40 (MOV)		
- pipe ID	7.981	in.	7.981	in.		
- minimum ID	5.986	in, squib	5.986	in, squib valve		
- friction factor	0.01407	(4)	0.01407	(4)		
- resistance (ft/gpm²)						
Line A			2.543E-06	2.035E-06	1.526E-06	ft/gpm2
Line B			1.040E-06	8.319E-07	6.239E-07	
- resistance with single failure (ft/gpm²)		(5)				
Line A			4.098E-06	n/a	n/a	ft/gpm2
Line B			2.584E-06	n/a	n/a	
- volume (ft³)						
Line A			34.03	32.49	30.94	ft3
Line B			20.30	19.38	18.45	
- volume with single failure (ft³)		(5)				
Line A			25.51	n/a	n/a	ft3
Line B			12.16	n/a	n/a	

- **IRWST Drain to Containment (points 61-100)**

- pipe size / sch (8)	10 in	sch. 40	8 in	sch. 40			
- pipe ID	10.02	in.	7.981	in.			
- minimum ID	10.02	in, pipe	5.99	in, squib valve			
- friction factor	0.01343	(4)	0.01407	(4)			
- resistance (ft/gpm²)							
Line A	(10)		4.071E-06	3.257E-06	2.442E-06	ft/gpm2	
- volume (ft³)							
Line A	(10)		45.14	43.09	41.04	ft3	

Notes for the IRWST safeguards data:

(1) Deleted

(2) These temperature values are those expected inside the IRWST and in its injection lines up to the tee connecting them to the DVI lines. The IRWST injection lines and the other injection lines from the CMT, Accumulator, are cold trapped. Inside the DVI lines the water temperature ranges between the downcomer temperature at the DVI nozzle to the environmental temperature (50 - 120 °F) in the cold traps.

(3) Line resistances are shown for both lines (A & B). Note that both lines have a 10" connection to the IRWST which changes to a 8" line before the sump tee. An orifice is not provided in these lines. The appropriate line resistance should be selected depending the case being analyzed.

(4) This friction factor is the fully turbulent friction factor. It may be slightly unconservative for
the Min flow case, however this effect is bounded by the 30% margin added to the line lengths and number of elbows.

(5) For the min flow case a single failure can be assumed to maximize the line resistance. The single failure could occur in one of the IRWST injection paths or in one of the sump recirculation paths. No single failure is assumed in the max and best estimate cases. The appropriate line resistance should be selected based on the single failure that is selected.

(6) Deleted

(7) Deleted

(8) Deleted

(9) The resistance of the IRWST and Containment Recirc screens is included in these resistances. The resistances of these screens are essentially zero even with up to 90% screen blockage.

(10) Line B has lower resistance, the resistance from line A is used to bound both lines.

(11) The Min Flow IRWST volume is based on the min surface area and min water height and is rounded down. The Max Flow IRWST volume is based on the max surface area and max water height and is rounded up.

Figure 1 – IRWST / Containment Recirc Sketch

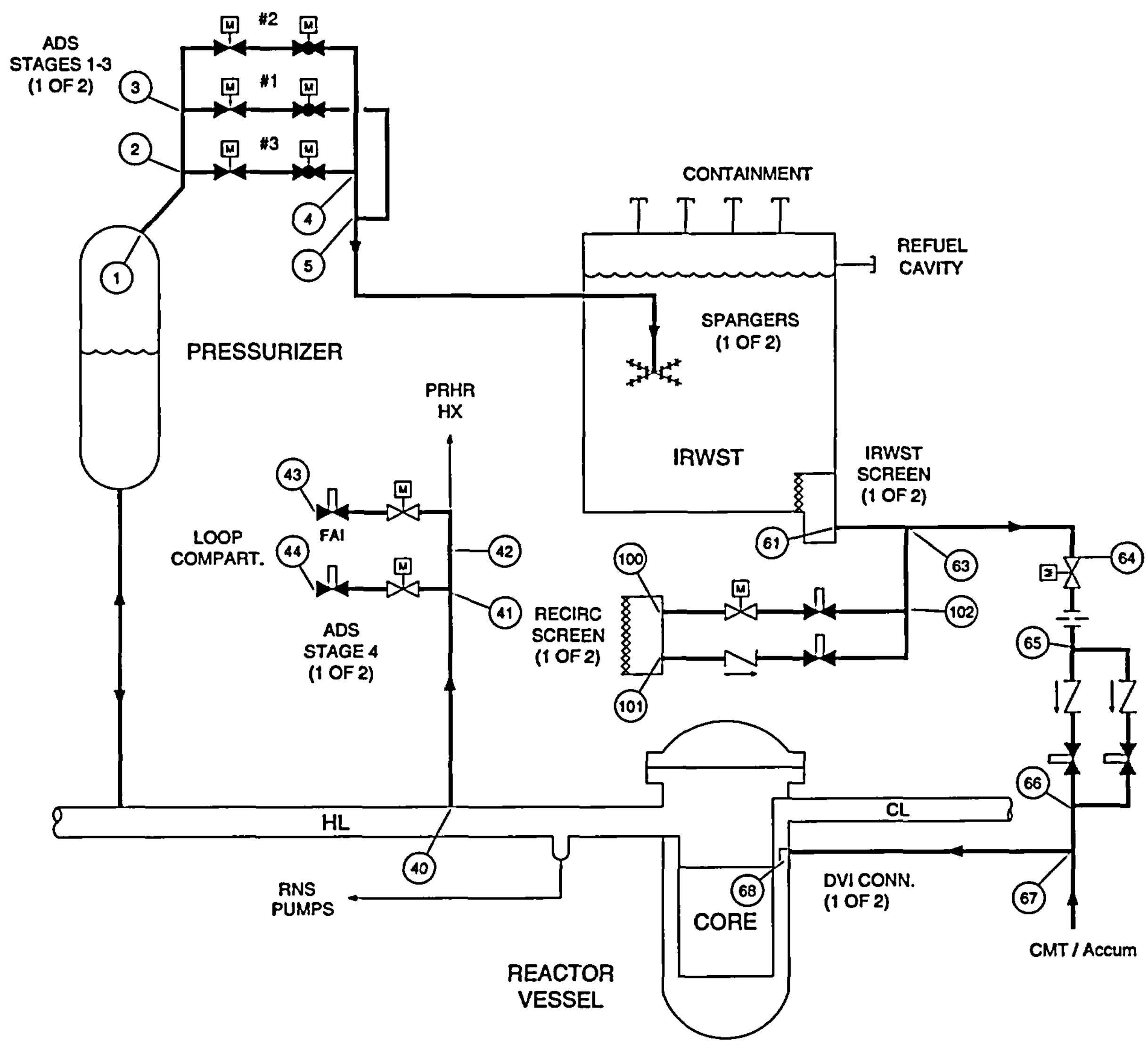

Figure 2 – RCS Sketch