June 1, 2004

MEMORANDUM TO: File

THROUGH: Terence L. Chan, Chief
Piping Integrity and NDE Section
Materials and Chemical Engineering Branch
Division of Engineering

FROM: Jay W. Collins, Materials Engineer ***/RA/***
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SUBJECT: SUMMARY REPORT BY THE OFFICE OF NUCLEAR REACTOR REGULATION ON THE STATUS OF REACTOR PRESSURE VESSEL HEAD AND ASSOCIATED PENETRATION NOZZLE INSPECTIONS

The following report is a summary of reactor pressure vessel (RPV) head and associated penetration nozzle inspection activities conducted by the 69 U.S. pressurized water reactor (PWR) facilities from February 2000 through December 2003. Three tables are attached identifying the inspections at each plant, RPV head penetration nozzle and associated J-groove weld cracking, and leaking indications. Table information is taken in part from MRP-110, Materials Reliability Program Reactor Vessel Closure Head Penetration Safety Assessment for U.S. PWR Plants, April 2004.

All U.S. PWR plants have verified the integrity of their reactor vessel heads through bare metal visual and/or under the head non-destructive examinations. Eleven plants have replaced their RPV head with an additional twenty-two plants scheduled for replacement thru 2007.

Attachment: As stated

Contact: Jay Collins, EMCB/DE
415-4038

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DATE	05/27/2004		06/01/2004	

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Table 1: Summary of Reactor Pressure Vessel Head Penetration Inspections Completed From November 2000 Through December 2003. (Information Taken In Part From Figure 4-2 of MRP-110)

Plant Name	CRDM/CEDM Inspection Method Since 11/2000 Through 12/2003				Replacing Head
	Note	Visual	Nozzle NDE	Weld NDE	
Arkansas Nuclear 1		BMV	UT, PT(3)	PT(3)	Fall 2005
Arkansas Nuclear 2	1	LFET	UT, ET(1)	PT(2)	
Beaver Valley 1		BMV	ET, UT(27)	ET	Spring 2006
Beaver Valley 2		BMV	UT		
Braidwood 1		BMV			
Braidwood 2		BMV			
Byron 1		BMV			
Byron 2		BMV			
Callaway		BMV			
Calvert Cliffs 1		BMV			Spring 2006
Calvert Cliffs 2		BMV	UT		Spring 2007
Catawba 1		BMV			
Catawba 2		BMV			
Comanche Peak 1		BMV			
Comanche Peak 2		BMV			
Crystal River 3		BMV	UT(9)		Fall 2003
Davis-Besse		BMV	UT		Fall 2002
DC Cook 1		BMV	UT(64), ET(22), PT(2)	ET(23), PT(2)	Fall 2006
DC Cook 2	2	BMV	UT(69), ET, PT(3)		Fall 2007
Diablo Canyon 1		BMV			
Diablo Canyon 2		BMV			
Farley 1		BMV	ET, UT		Fall 2004
Farley 2		BMV	UT		Fall 2005
Fort Calhoun		BMV			Fall 2006
Ginna	3				Fall 2003
Indian Point 2		BMV	UT(92), ET(56)	PT(1)	
Indian Point 3		BMV	ET(41), UT(41)		
Kewaunee		BMV			Fall 2004
McGuire 1		BMV			
McGuire 2		BMV			
Millstone 2		BMV	UT, PT(9)	PT(3)	Spring 2005
Millstone 3		BMV			
North Anna 1		BMV	ET(30), UT(8), PT(4)	ET(25), PT(4)	Spring 2003
North Anna 2		BMV	ET(63), UT(35)	ET(59), PT(6)	Fall 2002
Oconee 1		BMV	UT(23), ET(8), PT(2)	PT(3)	Fall 2003
Oconee 2		BMV	UT, PT(9), ET(4)	PT(9)	Spring 2004
Oconee 3		BMV	UT, ET(18), PT(12)	PT(12)	Spring 2003
Palisades	4	BMV			
Palo Verde 1		BMV	ET, UT	ET(13)	
Palo Verde 2		BMV (25)	ET, UT	ET(22)	
Palo Verde 3			ET, UT	ET(14)	
Point Beach 1		BMV	UT	PT(1)	Fall 2005
Point Beach 2		BMV	UT		Spring 2005
Prairie Island 1		BMV			Spring 2006
Prairie Island 2		BMV			Spring 2005

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Plant Name	CRDM/CEDM Inspection Method Since 11/2000 Through 12/2003				Replacing Head
	Note	Visual	Nozzle NDE	Weld NDE	
Robinson 2		BMV	ET, UT(17)	ET	Fall 2005
Salem 1		BMV			Fall 2005
Salem 2		BMV			Spring 2005
San Onofre 2		BMV	ET, UT	ET(46), PT(1)	Assessing
San Onofre 3		BMV	ET, UT	ET	Assessing
Seabrook 1		BMV			
Sequoyah 1		BMV	UT(6)	PT(1)	
Sequoyah 2		BMV			
Shearon Harris 1		BMV			
South Texas 1		BMV			
South Texas 2		BMV			
St. Lucie 1		BMV	UT		Fall 2005
St. Lucie 2		BMV	UT		Fall 2007
Summer		BMV			
Surry 1		BMV	UT(16)	PT(10)	Spring 2003
Surry 2		BMV			Fall 2003
Three Mile Island 1		BMV	UT(12), PT(12)	PT(12)	Fall 2003
Turkey Point 3		BMV	UT		Fall 2004
Turkey Point 4		BMV	UT		Spring 2005
Vogtle 1		BMV			
Vogtle 2		BMV			
Waterford 3		BMV	UT		
Watts Bar 1		BMV			
Wolf Creek 1		BMV			

Notes:

1. No bare metal visual inspection (BMV), but low frequency eddy current testing (LFET) of the head from the inside diameter (ID) of the nozzles.
2. Axial cracks detected on ID of Nozzle 75 in October 1994.
3. Because of cemented head insulation performed special inspections in spring 2002: 100% visual above insulation, removed insulation in two suspect areas, no evidence of leakage. 100% visual of seal weld joint between CRDM adaptor and CRDM, no indications, and UT at center of head and four instrument port penetration locations, through thickness direction of head to assure no voids similar to Davis-Besse experience. Also 100% inspection of ID surface of all head penetrations by ET in 1999 with no recordable indications.
4. ET for all ICI nozzles in 1995.

Table 2: Summary of Plants with Detected Reactor Pressure Vessel Head Penetration Cracking (Information Taken In Part From Figure 4-3 of MRP-110)

Unit	NSSS Supplier	No of CRDM/CEDM Nozzles on Head	Number of Cracked Penetrations Detected (Note 1)			Notes
			Total	Due to Tube Cracking	Due to Weld Cracking	
Arkansas Nuclear 1	B&W	69	8	7	2	
Beaver Valley 1	W	65	4	4	0	
DC Cook 2	W	78	3	3	0	
Crystal River 3	B&W	69	1	1	1	
Davis-Besse	B&W	69	5	5	0	
Millstone 2	CE	69	14	14	0	
North Anna 1	W	65	6	6	1	
North Anna 2	W	65	42	8	42	
Oconee 1	B&W	69	5	5	2	2
Oconee 2	B&W	69	19	18	4	
Oconee 3	B&W	69	14	14	2	
St. Lucie 2	CE	91	2	2	0	
Surry 1	W	65	6	0	6	
Three Mile Island 1	B&W	69	8	7	4	2
Unique Penetration Totals			137	94	64	

Notes:

1. The totals reflect CRDM and CEDM nozzles that were found to have cracks requiring repairs. In addition, the 8 small diameter B&W thermocouple nozzles each at Oconee 1 and TMI 1 were found to be cracked. No other types of reactor vessel head penetrations have been reported to have PWSCC indications. Not that NDE of the welds is often not as complete as for the tubes, so some weld cracks may have not been found during inspections and thus not reflected in this table.
2. Also all 8 small diameter B&W thermocouple nozzles were found to be cracked.

Table 3: Summary of Plants with Reactor Pressure Vessel Head Penetration Leakage (Information Taken In Part From Figure 4-4 of MRP-110)

Unit	NSSS Supplier	No of CRDM/CEDM Nozzles on Head	Number of Leaking Penetrations Detected (Note 1)			Notes
			Total	Due to Tube Cracking	Due to Weld Cracking	
Arkansas Nuclear 1	B&W	69	2	2	0	2
Crystal River 3	B&W	69	1	1	0	
Davis-Besse	B&W	69	3	3	0	3
North Anna 1	W	65	1	0	1	
North Anna 2	W	65	9	0	9	4, 5
Oconee 1	B&W	69	4	2	0	6, 7, 8
Oconee 2	B&W	69	14	11	3	
Oconee 3	B&W	69	14	14	0	
Surry 1	W	65	4	0	4	
Three Mile Island 1	B&W	69	5	1	4	9
Unique Penetration Totals			55	33	22	

Notes:

1 No CEDM, ICI, or other types of reactor vessel head nozzles have been found to be leaking (other than the B&W thermocouple nozzles at the two units that have this type of nozzle). Note that NDE of the welds is often not as complete as for the tubes, so some leak path cracks through the weld metal from the wetted weld surface to the nozzle annulus may not have been found during inspections and thus not reflected in this table.

2. The leaking nozzle that was repaired in March 2001 was found to be leaking again in October 2002.

3. Detailed destructive examinations of the original Davis-Besse head have been performed to characterize the extent of wastage. The destructive examinations showed an axial crack through most of the weld cross section at the location of the long axial tube crack in Nozzle #3, which was adjacent to the large wastage cavity.

4. One of the leaking nozzles that was repaired in late 2001 was found to be leaking again in September of 2002.

5. Some cracked nozzles have been extracted from the original North Anna 2 head for destructive testing including characterization of tube and weld cracks, among other tests.

6. Five (5) of the eight (8) small diameter B&W thermocouple nozzles were found to be leaking.

7. It is assumed in the table that two of these penetrations were found to be leaking due to base metal cracking although no inspections were performed to investigate before head replacement.

8. One small diameter thermocouple penetration that was previously repaired with an Alloy 690 plug was found to be leaking. The cause of the leakage (incomplete weld coverage, cracking, etc.) was not determined as the head was replaced.

9. All eight (8) small diameter B&W thermocouple nozzles were found to be leaking.