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Document: IR 90-04, PWR Pressure Vessel Industry Report Reviewed by: Ornesh K. Chopra, ANL Effect of Aging on Component Function Contrib to Failure Reported progs

Effect of Aging on Component F Loss of pressure boundary.	Not stated	Not stated	el.progs Report Recommendations Not susceptible to potential boric	Page No.	1
Loss of pressure boundary.	NULSIALEU	NOTSTATED	acid leak	4-21-24	
Loss of pressure boundary.	Not stated	Not stated	Non significant because SS or Ni alloy cladding is resistant to ERO/ CORR, single phase & low flow, & control of water chemistry	4-25	10
Loss of pressure boundary.	Not stated	Not stated	Non significant because not subject to relative motion	4-26, 4-27	1
Loss of pressure boundary.	Not stated	Not stated	Non significant because operating temp. <427 C (<800 F)	4-20	10
Loss of pressure boundary.	Not stated	Not stated	Non significant because of proper material selection & relatively low operating temp.	4-18 to 4- 20	1(
Loss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB analysis; ASME Sect. XI, Subsect. IWB inspection; (More)	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	5-14 to 5- 19	1(
oss of pressure boundary.	Not stated	Not stated	Non significant because neutron fluence is low & is <10^17 n/cm^2 the level above which a surveillance program is required in Appendix H o 10CFR 50	4-2 to 4-6	10
Loss of pressure boundary.	Not stated	Implementation of RG 1.44 to avoid sensitization; control of halogens & (More)	NRC recommendation: Evaluate the effects of oxygen injection during cooldown	5-20 to 5- 22	11
oss of pressure boundary.	Not stated	Not stated	Non significant because SS is resistant to CORR	4-21 to 4- 24	11
oss of pressure boundary.	Not stated	Not stated	Not susceptible to potential boric acid leak	4-21 -24	1
oss of pressure boundary.	Not stated	Not stated	Non significant because SS is resistant to ERO/CORR, single phase & low flow, & control of water chemistry	4-25	11
oss of pressure boundary.	Not stated	Not stated	Non significant because not subject to relative motion	4-26, 4-27	11
oss of pressure boundary.	Not stated	Not stated	Non significant because operating temp. <538 C (<1000 F)	4-20	11
oss of pressure boundary.	Not stated	Not stated	Non significant because of proper material selection & relatively low operating temp.	4-18 to 4- 20	11
oss of pressure boundary.	Not stated	Fatigue usage factor is anticipated to be <1 for entire license renewal term	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-7 to 4- 11	11
oss of pressure boundary.	Not stated	Not stated		4-2 to 4-6	11
Loss of pressure boundary.	Not stated	ASME Sect. XI, Subsect. IWB & plant specific review of component materials (More)	NRC recommendation: Alloy 600 should be further evaluated; evaluate the potential of cracking of Inconel 182 based on recent experience of Arkansas Nuclear One Unit 1 described in LER 90 021 00	5-20 to 5- 22	11

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
120	PWR Pressure Vessel	Leakage Monitoring Tubes	Not stated	SB 166, SB 167	Not stated	CORR	Loss of material, corrosion product buildup
121	PWR Pressure Vessel	Leakage Monitoring Tubes	Not stated	SB 166, SB 167	Not stated	CORR/BA	Loss of material
122	PWR Pressure Vessel	Leakage Monitoring Tubes	Not stated	SB 166, SB 167	Not stated	ERO/CORR	Wall thinning, loss material
123	PWR Pressure Vessel	Leakage Monitoring Tubes	Not stated	SB 166, SB 167	Not stated	WEAR	Fretting
124	PWR Pressure Vessel	Leakage Monitoring Tubes	Not stated	SB 166, SB 167	Not stated	CREEP	Change in dimension
125	PWR Pressure Vessel	Leakage Monitoring Tubes	Not stated	SB 166, SB 167	Not stated	EMBR/TE	Loss of fracture toughness
126	PWR Pressure Vessel	Leakage Monitoring Tubes	Not stated	SB 166, SB 167	Not stated	FAT	Cumulative fatigue damage
127	PWR Pressure Vessel	Bottom Head Dome	Not stated	SA302 Gr B, SA533 Gr B	Not stated	EMBR/IR	Loss of fracture toughness
128	PWR Pressure Vessel	Bottom Head Dome	Not stated	SA302 Gr B, SA533 Gr B	Not stated	CORR/IGSCC	Crack initiation & growth
129	PWR Pressure Vessel	Bottom Head Dome	Not stated	SA302 Gr B, SA533 Gr B	Not stated	CORR	Loss of material, corrosion product buildup
130	PWR Pressure Vessel	Bottom Head Dome	Not stated	SA302 Gr B, SA533 Gr B	Not stated	CORR/BA	Loss of material
131	PWR Pressure Vessel	Bottom Head Dome	Not stated	SA302 Gr B, SA533 Gr B	Not stated	ERO/CORR	Wall thinning, los material
132	PWR Pressure Vessel	Bottom Head Dome	Not stated	SA302 Gr B, SA533 Gr B	Not stated	WEAR	Fretting
133	PWR Pressure	Bottom Head Dome	Not stated	SA302 Gr B, SA533 Gr B	Not stated	CREEP	Change in dimension
134	PWR Pressure Vessel	Bottom Head Dome	Not stated	SA302 Gr B, SA533 Gr B	Not stated	EMBR/TE	Loss of fracture toughness
135	PWR Pressure Vessel	Bottom Head Dome	Not stated	SA302 Gr B, SA533 Gr B	Not stated	FAT	Cumulative fatigue damage
136	PWR Pressure Vessel	Core Support Pads (Lugs)	Not stated	SB 166, SB 167	Not stated	EMBR/IR	Loss of fracture toughness
137	PWR Pressure Vessel	Core Support Pads (Lugs)	Not stated	SB 166, SB 167	Not stated	CORR/IGSCC	Crack initiation & growth
138	PWR Pressure Vessel	Core Support Pads (Lugs)	Not stated	SB 166, SB 167	Not stated	CORR	Loss of material, corrosion product buildup

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Effect of Aging on Component F Loss of pressure boundary.	Not stated	Not stated	Rel.progs	Report Recommendations	Page No.	_
		inor stated		Non significant because Ni alloy is resistant to CORR	4-21 to 4- 24	1
Loss of pressure boundary. Loss of pressure boundary.	Not stated	Not stated		Not susceptible to potential boric acid leak	4-21 -24	1:
	Not stated	Not stated		Non significant because Ni alloy is resistant to ERO/CORR, single phase & low flow, & control of wate chemistry	4-25	12
Loss of pressure boundary.	Not stated	Not stated	<u> </u>	Non significant because not subjector relative motion	t 4-26, 4-27	7 12
Loss of pressure boundary.	Not stated	Not stated		Non significant because operating temp. <538 C (<1000 F)	4-20	12
Loss of pressure boundary.	Not stated	Not stated		Non significant because of proper material selection & relatively low	4-18 to 4- 20	12
Loss of pressure boundary.	Not stated	Fatigue usage factor is anticipated to be <1 for entire license renewal term		operating temp. NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-7 to 4- 11	12
Loss of pressure boundary.	Not stated	Not stated		Non significant because neutron fluence is low & is <10^17 n/cm^2 the level above which a surveillance program is required in Appendix H c 10CFR 50	4-2 to 4-6	12
Loss of pressure boundary.	Not stated	Non significant because LAS & SS cladding (>5% ferrite) are not susceptible (More)		NRC recommendation: Low- temperature sensitization of SS cladding is possible. Evaluate the effects of oxygen injection during cooldown. SCC of low alloy steel is unlikely in typical PWR environment, it may not be true under crevice	4-11 to 4- 18	128
loss of pressure boundary.	Not stated	Not stated		conditions. Non significant because cladding is resistant to CORR, removal of cladding results in very low corrosion	4-21 to 4- 24	129
oss of pressure boundary.	Not stated	Not stated		rates Not susceptible to potential boric	4-21 -24	130
oss of pressure boundary.	Not stated	Not stated		acid leak Non significant because SS or Ni alloy cladding are resistant to ERO/CORR, single phase & low	4-25	131
oss of pressure boundary.	Not stated	Not stated		flow, & control of water chemistry Non significant because not subject to relative motion	4-26, 4-27	132
oss of pressure boundary.	Not stated	Not stated		Non significant because operating temp. <427 C (<800 F)	4-20	133
oss of pressure boundary.	Not stated	Not stated		Non significant because of proper material selection & relatively low operating temp.	4-18 to 4- 20	134
oss of pressure boundary.	Not stated	Fatigue usage factor is anticipated to be <1 for entire license renewal term		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-7 to 4- 11	135
ore support loss, impair reactor hutdown. ore support loss, impair reactor	Not stated	Not stated		Non significant because neutron fluence is low & is <10^17 n/cm^2 the level above which a surveillance program is required in Appendix H of 10CFR 50	4-2 to 4-6	136
ore support loss, impair reactor	Not stated	ASME Sect. XI, Subsect. IWB, examination category, B-N-2 & plant specific (More)		NRC recommendation: Alloy 600 should be further evaluated; evaluate the potential of cracking of Inconel 182 based on recent experience of Arkansas Nuclear One Unit 1 described in LER 90 021 00	5-20 to 5- 22	137
utdown.	Not stated	Not stated		Non significant because Ni alloy is	4-21 to 4- 24	138

		K. Chopra, ANL Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	System PWR Pressure		Not stated	SB 166, SB 167	Not stated	CORR/BA	LOSS OF MANIPINAL
139	Vessel	(Lugs)					Wall thinning, loss o
	PWR Pressure		Not stated	SB 166, SB 167	Not stated	ERO/CORR	material
40	Vessel	(Lugs)					(That let hav
	A82261	(CLgo)					
- 1						WEAR	Fretting
41	PWR Pressure	Core Support Pads	Not stated	SB 166, SB 167	Not stated	WEAR	110101.9
' - '	Vessel	(Lugs)					
				00.100.00.107	Not stated	CREEP	Change in
142	PWR Pressure	Core Support Pads	Not stated	SB 166,SB 167	NOLSIZIOU	0.122.	dimension
	Vessel	(Lugs)		00.000.007	Not stated	EMBR/TE	Loss of fracture
143	PWR Pressure	Core Support Pads	Not stated	SB 166, SB 167	NULSIALEU		toughness
	Vessel	(Lugs)					
			ALLA SALANA	SB 166, SB 167	Not stated	FAT	Cumulative fatigue
144	PWR Pressure	Core Support Pads	Not stated	SB 100, SD 107	itot onnos		damage
	Vessel	(Lugs)			· · .		
			Not stated	SB 166, SB 167	Not stated	EMBR/IR	Loss of fracture
145	PWR Pressure	Instrumentation Tubes*/Penetrations	NOT STATED				toughness
	Vessel	(* Includes the vent					
		pipe on closure head				1	
		dome.)					Oreals initiation &
	PWR Pressure	Instrumentation	Not stated	SB 166, SB 167	Not stated	CORR/IGSCC	Crack initiation &
140	Vessel	Tubes*/Penetrations				Unresolved	growth
	Vessei	(* includes the vent					
		pipe on closure head					
		dome.)					
	l.					CORR	Loss of material,
147	PWR Pressure	Instrumentation	Not stated	SB 166, SB 167	Not stated		corrosion product
	Vessel	Tubes*/Penetrations					buildup
		(* Includes the vent					
		pipe on closure head	1				
		dome.)		SB 166, SB 167	Not stated	CORR/BA	Loss of material
148	B PWR Pressure	instrumentation	Not stated	58 100, 58 107	1101 544104		
	Vessel	Tubes*/Penetrations					
	1	(* Includes the vent pipe on closure head					
	1 .	dome.)	1				
		Instrumentation	Not stated	SB 166, SB 167	Not stated	ERO/CORR	Wall thinning, loss
14	9 PWR Pressure	Tubes*/Penetration:					material
1	Vessel	(* Includes the vent					
		pipe on closure hea	d				
		dome.)					Fretting
15	0 PWR Pressure	Instrumentation	Not stated	SB 166, SB 167	Not stated	WEAR	Troung
	Vessel	Tubes*/Penetration					
		(* Includes the vent					
		pipe on closure hea	d	· · ·			
		dome.)		SB 166, SB 167	Not stated	CREEP	Change in
15	1 PWR Pressure	Instrumentation	Not stated	SB 100, SD 10/	NOT STATES		dimension
	Vessel	Tubes*/Penetration					
ł		(* includes the vent					
		pipe on closure hea					
		dome.)	Not stated	SB 166, SB 167	Not stated	EMBR/TE	Loss of fracture
11	52 PWR Pressure	Instrumentation Tubes*/Penetration					toughness
-	Vessel	(* Includes the ven					
	1	pipe on closure her	d				1
	1	dome.)					Ourselation fation
F	53 PWR Pressure	instrumentation	Not stated	SB 166, SB 167	Not stated	FAT	Cumulative fatigu
11	Vessel	Tubes*/Penetration					damage
	442341	(* includes the ven					
		pipe on closure he	ad				
1	1	dome.)	1		1	1	

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 Omesh K. Chopra, ANL

 Effect of Aging on Component Function Contrib to Failure
 Reported progs
 Rel.progs
 Report Recommendations

Effect of Aging on Component Fu Core support loss, impair reactor	Not stated	Not stated	I.progs Report Recommendations Not susceptible to potential boric	Page No.	_
Shutdown.			acid leak	4-21 -24	13
Core support loss, impair reactor shutdown.	Not stated	Not stated	Non significant because Ni alloy is resistant to ERO/CORR, single phase & low flow, & control of water chemistry	4-25 r	14
Core support loss, impair reactor shutdown.	Not stated	ASME Sect. XI, Subsect. IWB	ASME Sect. XI, Subsect. IWB, examination category B N 1 is current & effective program to	5-25, 5-26	14
Core support loss, impair reactor shutdown.	Not stated	Not stated	Non significant because operating	4-20	14
Core support loss, impair reactor shutdown.	Not stated	Not stated	temp. <538 C (<1000 F) Non significant because of proper material selection & relatively low	4-18 to 4- 20	14
Core support loss, impair reactor shutdown.	Not stated	Fatigue usage factor is anticipated to be <1 for entire license renewal term			144
Loss of pressure boundary.	Not stated	Not stated	Non significant because neutron fluence is low & is <10^17 n/cm^2 the level above which a surveillance program is required in Appendix H o	4-2 to 4-6	145
loss of pressure boundary.	Not stated	ASME Sect. XI, Subsect. IWB, examination category B E & plant specific (More)	10CFR 50 NRC recommendation: Alloy 600 should be further evaluated; evaluate the potential of cracking of Inconel 182 based on recent experience of Arkansas Nuclear One Unit 1 described in LER 90 021 00	5-20 to 5- 22	146
oss of pressure boundary.	Not stated	Not stated	Non significant because Ni alloy is resistant to CORR	4-21 to 4- 24	147
oss of pressure boundary.	Not stated	Not stated	Not susceptible to potential boric acid leak	4-21 -24	148
oss of pressure boundary.	Not stated	Not stated	Non significant because Ni alloy is resistant to ERO/CORR, single phase & low flow, & control of water chemistry	4-25	149
oss of pressure boundary.	Not stated	Not stated	Non significant because not subject to relative motion	4-26, 4-27	150
oss of pressure boundary.	Not stated	Not stated	Non significant because operating temp. <538 C (<1000 F)	4-20	151
ss of pressure boundary.	Not stated	Not stated		4-18 to 4- 20	152
ss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue analysis; ASME Sect. XI, Subsect. IWB (More)		5-14 to 5- 1 19	153

	wed by: Omesh System	K. Chopra, ANL Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
11	Upper Internals	CE: Upper Guide	Not stated	SS	Not stated	EMBR/IR	Loss of fracture
		Structure Support		1			toughness
	Assembly	Plate, or B&W:					
		Plenum Cover &					
		Plenum Cylinder			Not stated	CORR/SCC,	Crack initiation &
2	Upper Internals	CE: Upper Guide	Not stated	SS	Not stated		growth, loss of
	Assembly	Structure Support				CORR/CREV	material
1.		Plate, or B&W:					materia
		Pienum Cover &					
1		Plenum Cylinder					
		Pretruitti Cyta tuei					
				SS	Not stated	COBB/JASCC	Crack initiation &
3	Upper Internals	CE: Upper Guide	Not stated	33	Not Stated		growth
Ł	Assembly	Structure Support					3
	-	Plate, or B&W:					
		Plenum Cover &					
ļ		Plenum Cylinder					
-+	Linner Internals	CE: Upper Guide	Not stated	SS	Not stated	CORR,CORR/PIT	Loss of material.
4	Upper Internals		101 00000				corrosion product
- 1	Assembly	Structure Support					buildup
1		Plate, or B&W:					
		Plenum Cover &		1			
- 1		Plenum Cylinder			l		
ļ							Mall thinning for
	Upper Internals	CE: Upper Guide	Not stated	SS	Not stated	ERO/CORR	Wall thinning, ios
ာ		Structure Support				1	material
1	Assembly				1		
		Plate, or				ł	
- 1		B&W:Plenum Cover					
		& Plenum Cylinder			histoted	WEAR	Attrition
6	Upper Internals	CE: Upper Guide	Not stated	SS	Not stated	WEAR	
	Assembly	Structure Support					
	-washing	Plate, or					
1		B&W:Plenum Cover					
		& Plenum Cylinder		SS	Not stated	CREEP	Change in
7	Upper Internals	CE: Upper Guide	Not stated	55	NOTSIZIEG		dimension
	Assembly	Structure Support				1	
		Plate, or					
		B&W:Plenum Cover					
		& Plenum Cylinder					
		CE: Upper Guide	Not stated	SS	Not stated	RELAX	Loss of preload
8	Upper Internals		1101 5 2200				
	Assembly	Structure Support					
	1	Plate, or					
		B&W:Plenum Cover					
		& Plenum Cylinder				END TE	Loss of fracture
9	Upper Internals	CE: Upper Guide	Not stated	SS	Not stated	EMBR/TE	
	Assembly	Structure Support					toughness
	Assembly	Plate, or					
		B&W:Plenum Cove					
			1				
		& Plenum Cylinder			Not stated	FAT	Cumulative fatig
10	Upper Internals	CE: Upper Guide	Not stated	SS	. INOL STATED		damage
	Assembly	Structure Support	1				Call the go
		Plate, or					
	1	B&W:Plenum Cove	r				1
		& Plenum Cylinder	1				
				SS	Not stated	EMBR/IR	Loss of fracture
11	1 Upper Internals	W: Upper Support					toughness
	Assembly	Plate, or CE: Upper					
		Guide Structure					
		Support Plate, or			1		
	1	B&W: Plenum					
		Cover & Plenum	1				
	1	Cylinder		1			
		W: Upper Support	Not stated	SS	Not stated	CORR/SCC,COR	
1	2 Upper Internals			1		CREV	growth, loss of
	Assembly	Plate, or CE: Uppe	1				material
	1	Guide Structure	1				
	1	Support Plate, or		1			1
		B&W: Plenum					
		Cover & Plenum				1	
						1	
	1	Cylinder					
						1	1
				.1			
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Document: IR 90-05, PWR Vessel Internals Industry Report Reviewed by: Omesh K. Chopra, ANL Effect of Aging on Component Function Contrib to Failur

Effect of Aging on Component Func Core support loss, prevent control rod	Not stated	Not stated	Rel.progs	Report Recommendations	Page No	. 18
linsertion.	HUL SLAUBL	Not stated		Non significant because adequate fracture toughness at end of life fluence levels & low applied stresse	4-3, 4-4	T
Core support loss, prevent control rod insertion. Core support loss, prevent control rod	Not stated	Non significant because fabricated of SS; stress levels within design specs. (More)		NRC recommendation: Crevices ar known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry		
insertion.	Not stated	ASME Section XI, Subsection IWB		ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible.	4-11, 5-6, 5-7	
Core support loss, prevent control rod nsertion.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR envir.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	
Core support loss, prevent control rod nsertion.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	
ore support loss, prevent control rod asertion.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	
ore support loss, prevent control rod Isertion.	Not stated	Not stated		Non-significant because operating temps, are well below levels at which creep is a concern	4-15	
ore support loss, prevent control rod sertion.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	
ore support loss, prevent control rod sertion.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE.	4-21, 4-22	
ore support loss, prevent control rod sertion.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress rept.			4-26 to 4- 30	10
re support loss, prevent control rod ertion.	Not stated	Not stated		Non-significant because adequate 4 fracture toughness at end of life fluence levels & low applied stresses	1-3, 4-4	11
re support loss, prevent control rod ertion.	Not stated	Non-significant because fabricated of SS; stress levels within design specs; (More)		NRC recommendation: Crevices are 4 known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry	-6 to 4-9	12

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	wed by: Omesh System	K. Chopra, ANL Structure/Comp	Capoellipettett	Interest interest	Manufacturer	ARD mechanism CORR/IASCC	ARD effects Crack initiation &
	Upper Internals Assembly	W: Upper Support Plate, or CE: Upper Guide Structure	Not stated	SS	Not stated	CURHAASCU	growth
		Support Plate, or B&W: Plenum Cover & Plenum Cylinder					
14	Upper Internals Assembly	W: Upper Support Plate, or CE: Upper Guide Structure Support Plate, or B&W: Plenum Cover & Plenum	Not stated	SS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
15	Upper Internals Assembly	Cylinder W: Upper Support Plate, or CE: Upper Guide Structure Support Plate, or B&W: Plenum Cover & Plenum Cylinder	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss material
16	Upper Internals Assembly	W: Upper Support Plate, or CE: Upper Guide Structure Support Plate, or B&W: Plenum Cover & Plenum Cylinder	Not stated	SS	Not stated	WEAR	Attrition
17	Upper Internals Assembly	W: Upper Support Plate, or CE: Upper Guide Structure Support Plate, or B&W: Plenum	Not stated	SS	Not stated	CREEP	Change in dimension
		Cover & Plenum Cylinder			Not stated	RELAX	Loss of preload
18	B Upper Internals Assembly	W: Upper Support Plate, or CE: Upper Guide Structure Support Plate, or B&W: Plenum Cover & Plenum Cylinder	Not stated	SS			Loss of fracture
19	9 Upper Internals Assembly	W: Upper Support Plate, or CE: Upper Guide Structure Support Plate, or B&W: Plenum Cover & Plenum Cylinder		SS	Not stated	EMBR/TE	toughness
2	0 Upper Internals Assembly	W: Upper Support Plate, or CE: Upper Guide Structure Support Plate, or B&W: Plenum Cover & Plenum Cylinder		SS	Not stated	FAT	Cumulative fatigu damage
2	21 Upper Internals Assembly	W: RCCA Guide Tube Assembly	RCCA Guide Tube	SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)		EMBR/IR	Loss of fracture toughness
2	22 Upper Internals Assembly	W: RCCA Guide Tube Assembly	RCCA Guide Tube	SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)	Not stated	CORR/SCC,COR CREV	growth, loss of material
	23 Upper Internals Assembly	W: RCCA Guide Tube Assembly	RCCA Guide Tube	SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)	Not stated	CORR/IASCC	Crack initiation & growth

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Effect of Aging on Component Func Core support loss, prevent control rod	Not stated	ASME Section XI	Rel.progs	Report Recommendations	Page No.	_
linsertion.		Subsection IWB		ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	
Core support loss, prevent control rod insertion.	Not stated	Non-significant		NRC recommendation: There is no	4-24, 4-	
		because SS is not susceptible to CORR or CORR/PIT in PWR environ.		assurance that components made from SS are not exposed to locally corrosive environment	25	
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because SS is	4-14	1
				resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation		
Core support loss, prevent control rod	Not stated	Not stated	<u> </u>	Non-size in the		
nsertion.				Non-significant because not subject to relative motion	4-19	10
Core support loss, prevent control rod	Not stated	Not stated		Non significant because operating	4-15	
				temps, are well below levels at which creep is a concern	+13	17
ore support loss, prevent control rod	Not stated	Not stated				
isertion.				Non significant because components do not depend on preload	4-16, 4-17	18
ore support loss, prevent control rod	Not stated					
sertion.		Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	19
pre support loss, prevent control rod	Not stated	ASME Sect. XI,		NRC recommendation: Until an	1040 5	
sertion.		Subsect. IWB, & Sect. III, Subsect. NG-5200 reanalysis of usage factor			5-12 to 5- 15	20
ore support loss, prevent control rod vertion.	Not stated	Not stated		Non-significant because adequate fracture toughness at end of life fluence levels & low applied stresses	-3, 4-4	21
re support loss, prevent control rod ertion.	Not stated	Non-significant because fabricated of SS; stress levels within design specs; (More)		NRC recommendation: Crevices are 4 known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with gravices or	-6 to4-9	22

ASME Section XI,

Subsection IWB

Not stated

components with crevices or

ASME Section XI, Subsect. IWB is 4-11, 5-6,

effective for internals that are or can 5-7

23

creviced geometry

be rendered accessible

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insertion.

Core support loss, prevent control rod

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	wed by: Omesh System			Materials	Manufacturer	ARD mechanism	ARD effects Loss of material,
24	Upper Internals Assembly	W: RCCA Guide Tube Assembly		SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)	Not stated	CORR,CORR/PI	corrosion product buildup
25	Upper Internals Assembly	W: RCCA Guide Tube Assembly	RCCA Guide Tube	SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)	Not stated	ERO/CORR	Wall thinning, loss o material
26	Upper Internals Assembly	W: RCCA Guide Tube Assembly	RCCA Guide Tube	SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)	Not stated	WEAR	Attrition
27	Upper Internals Assembly	W: RCCA Guide Tube Assembly	RCCA Guide Tube	SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)	Not stated	CREEP	Change in dimension
28	Upper Internals Assembly	W: RCCA Guide Tube Assembly	RCCA Guide Tube	SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)	Not stated	RELAX	Loss of preload
29	Upper Internals Assembly	W: RCCA Guide Tube Assembly	RCCA Guide Tube	SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)	Not stated	EMBR/TE	Loss of fracture toughness
30	Upper Internals Assembly	W:RCCA Guide Tube Assembly	RCCA Guide Tube	SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)	Not stated	FAT	Cumulative fatigue damage
31	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes	SS, Nicrobraze*	Not stated	EMBR/IR	Loss of fracture toughness
32	Upper internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes	SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
33	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube	CEA Shrouds, CRA Guide Tubes	SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)	Not stated	CORRIASCC	Crack initiation & growth
34	Upper internals Assembly	Assemblies CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes		Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
3	5 Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes	SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)	Not stated	ERO/CORR	Wali thinning, loss material
3	6 Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes	 SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes) 	Not stated	WEAR	Attrition
3	7 Upper internals Assembly	CE: CEA Shroud Assembly, or B&W CRA Guide Tube Assemblies		(Nicrobraze used only for CRA Guide tubes)			Change in dimension
3	8 Upper internals Assembly	CE: CEA Shroud Assembly, or B&W CRA Guide Tube Assemblies	CEA Shrouds, CR/ Guide Tubes	A SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)	Not stated	RELAX	Luss of probab

Document: IR 90-05, PWR Vessel Internals Industry Report Reviewed by: Omesh K. Chopra, ANL Effect of Aging on Component Function Contrib to Failure

Effect of Aging on Component Func Core support loss, prevent control rod	Not stated		Rel.progs	Report Recommendations	Page No.	Ite
Core support loss, prevent control rod		Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is n assurance that components made from SS are not exposed to locally corrosive environment	0 4-24, 4-25	_
Core support loss, prevent control rod	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	2
insertion.		ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B N 3 is effective program for detection of WEAR	5-9	2
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because operating temps, are well below levels at whic creep is a concern	4-15 h	27
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non significant because components do not depend on preload	4-16, 4-17	28
Core support loss, prevent control rod nsertion.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	6 4-21, 4-22	29
Core support loss, prevent control rod nsertion.	Not stated	ASME Sect. XI, Subsect. IWB, & Sect. III, Subsect. NG 5200 reanalysis of usage factor		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	5-12 to 5- 15	30
Core support loss, prevent control rod Insertion.	Not stated	Not stated		Non-significant because adequate fracture toughness at end of life fluence levels & low applied stresses	4-3, 4-4	31
ore support loss, prevent control rod asertion.		Non-significant because fabricated of SS; stress levels within design specs (More)		NRC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or	4-6 to 4-9	32
ore support loss, prevent control rod sertion.		ASME Section XI, Subsection IWB		creviced geometry ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible.	4-11, 5-6, 5-7	33
ore support loss, prevent control rod sertion.		Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	34
ore support loss, prevent control rod sertion.		Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation.	4-14	35
ore support loss, prevent control rod sertion.		SME Sect. XI, Subsect. IWB		10148 4	5-9	36
ore support loss, prevent control rod sertion.	Not stated N	lot stated	1	Non-significant because operating a temps. are well below levels at which creep is a concern	4-15	37
re support loss, prevent control rod ertion.	Not stated N	lot stated	ic ic	Von-significant because components do not depend on preload	4-16, 4-17	38

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Page 36B

-	red by: Omesh	Structure/CompS	ubcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	System		EA Shrouds, CRA	SS, Nicrobraze	Not stated	EMBR/TE	Loss of tracture
	Jpper Internals Assembly	Assembly, or B&W: C CRA Guide Tube	auide Tubes	(Nicrobraze used only for CRA Guide tubes)			toughness
		Assemblies		SS, Nicrobraze	Not stated	FAT	Cumulative fatigue
	Jpper Internals Assembly		CEA Shrouds, CRA Guide Tubes	(Nicrobraze used only for CRA Guide tubes)			damage
					Not stated	EMBR/IR	Loss of fracture
	Upper Internals Assembly	Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes			CORR/SCC,	toughness Crack initiation &
	Upper Internals Assembly		CEA Shrouds, CRA Guide Tubes	CASS	Not stated	CORR/CREV	growth, loss of material
			CEA Shrouds, CRA	CASS	Not stated	CORR/IASCC	Crack initiation &
	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	Guide Tubes				growth
		CE: CEA Shroud	CEA Shrouds, CRA	CASS	Not stated	CORR,CORR/PIT	corrosion produc
44	Upper Internals Assembly	Assembly, or B&W: CRA Guide Tube Assemblies	Guide Tubes				buildup
					hist stated	ERO/CORR	Wall thinning, los
45	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes	CASS	Not stated		material
46	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W:	CEA Shrouds, CRA Guide Tubes	CASS	Not stated	WEAR	Attrition
	-	CRA Guide Tube Assemblies					Objects in
47	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W:	CEA Shrouds, CR/ Guide Tubes	CASS	Not stated	CREEP	Change in dimension
		CRA Guide Tube					
		Assemblies	CEA Shrouds, CR		Not stated	RELAX	Loss of preload
48	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies					Loss of fracture
49	9 Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CR Guide Tubes	A CASS	Not stated	EMBR/TE	toughness
5	0 Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W CRA Guide Tube Assemblies	CEA Shrouds, CR Guide Tubes	A CASS	Not stated	FAT	Cumulative fati damage
							Loss of fractur
5	51 Upper Internals Assembly	W: RCCA Guide Tube Assemblies o B&W: CRA Guide Tube Assemblies	Tube Bolts		Not stated	EMBR/IR	Crack initiation
-	52 Upper Internals Assembly	W: RCCA Guide Tube Assemblies of B&W: CRA Guide	RCCA Guide Tub Bolts, CRA Guide Tube Bolts		Not stated	CORR/SCC, CORR/CREV	growth, loss o material

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Document: IR 90-05, PWR Vessel internals Industry Report Reviewed by: Omesh K. Chopra, ANL Effect of Aging on Component Europian Contribute Estimation

Effect of Aging on Component Funct Core support loss, prevent control rod	Not stated	Not stated		Report Recommendations	Page No.	_
insertion.			8	on-significant because wrought St Ni alloys are not susceptible to MBR/TE	5 4-21, 4-22	2 3
Core support loss, prevent control rod insertion.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress reports	ag	RC recommendation: Until an greement is reached on the draft aff discussion paper on fatigue, e issue is unresolved	4-26 to 4- 30	4
Core support loss, prevent control rod insertion.	Not stated	Not stated	fta flu	on-significant because adequate acture toughness at end of life rence levels & low applied resses.	4-3, 4-4	4
Core support loss, prevent control rod insertion.	Not stated	Non-significant because fabricated of SS; stress levels within design specs (More)	kni the col	RC recommendation: Crevices are own promote SCC in SSs even in e absence of high stress. Evaluate e potential of CORR/SCC of mponents with crevices or eviced geometry		42
Core support loss, prevent control rod insertion.	Not stated	ASME Section XI, Subsection IWB	effe	SME Section XI, Subsect. IWB is ective for internals that are or can rendered accessible	4-11, 5-6. 5-7	43
Core support loss, prevent control rod nsertion.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.	ass from	C recommendation: There is no surance that components made m SS are not exposed to locally rosive environment	4-4, 4-25	44
Core support loss, prevent control rod nsertion.	Not stated	Not stated	res flow coo	n-significant because SS is istant to ERO/CORR, low fluid w, pH & particulate control in plant, & operating pressures clude cavitation	4-14	45
Core support loss, prevent control rod nsertion.	Not stated	ASME Sect. XI, Subsect. IWB	ASI exa	ME Sect. XI, Subsect. IWB, m. category B-N-3 is effective gram for detection of WEAR	5-9	46
Core support loss, prevent control rod nsertion.	Not stated	Not stated	tern	n-significant because operating ips. are well below levels at which ep is a concern	4-15	47
Core support loss, prevent control rod nsertion.	Not stated	Not stated	com	n-significant because nponents do not depend on load	4-16, 4-17	48
core support loss, prevent control rod nsertion.	Not stated	Ferrite content screening criteria & ASME Sect. XI, Subsect. IWB inspection	continad	C recommendation: Ferrite tent screening criteria is lequate & VT 3 can not reliably ect tight cracks	5-10, 5-11	49
ore support loss, prevent control rod isertion.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress reports	agre staff		4-26 to 4- 30	50
ore support loss, prevent control rod Isertion.	Not stated	Not stated	fract	-significant because adequate ture toughness at end of life nce levels & low applied stresses	4-3. 4-4	51
ore support loss, prevent control rod sertion.	Not stated	Non significant because fabricated of SS; stress levels within design specs (More)	knov the a the p com	Crecommendation: Crevices are wn promote SCC in SSs even in absence of high stress. Evaluate potential of CORR/SCC of ponents with crevices or iced geometry	4-6 to 4-9	52

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	Omesh K. Chopra, ANL

	wed by: Omest System	K. Chopra, ANL Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
53	Upper Internals Assembly	W: RCCA Guide Tube Assemblies or B&W: CRA Guide	RCCA Guide Tube Bolts, CRA Guide Tube Bolts	SS, Ni alloy	Not stated	CORR/IASCC	growth
54	Upper, internals Assembly	Tube Assemblies W: RCCA Guide Tube Assemblies or B&W: CRA Guide Tube Assemblies	RCCA Guide Tube Bolts, CRA Guide Tube Bolts	SS, Ni alloy	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
55	Upper Internals Assembly	W: RCCA Guide Tube Assemblies or B&W: CRA Guide Tube Assemblies	RCCA Guide Tube Bolts, CRA Guide Tube Bolts	SS, Ni alloy	Not stated	ERO/CORR	Wall thinning, loss c material
56	Upper internals Assembly	W: RCCA Guide Tube Assemblies or B&W: CRA Guide	RCCA Guide Tube Bolts, CRA Guide Tube Bolts	SS, Ni alloy	Not stated	WEAR	Attrition
57	Upper Internals Assembly	Tube Assemblies W: RCCA Guide Tube Assemblies or B&W: CRA Guide Tube Assemblies	RCCA Guide Tube Bolts, CRA Guide Tube Bolts	SS, Ni alloy	Not stated	CREEP	Change In dimension
58	Upper Internals Assembly	W: RCCA Guide Tube Assemblies or B&W: CRA Guide Tube Assemblies	RCCA Guide Tube Bolts, CRA Guide Tube Bolts	SS, Ni alloy	Not stated	RELAX	Loss of preload
59	Upper Internals Assembly	CRA Guide Tube Assemblies	RCCA Guide Tube Bolts, CRA Guide Tube Bolts	SS, Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness
60	Upper Internais Assembly	CRA Guide Tube Assemblies	RCCA Guide Tube Bolts, CRA Guide Tube Bolts	SS, Ni alloy	Not stated	FAT	Cumulative fatigue damage
61	Upper Internals Assembly	CE: CEA Shroud Assemblies	CEA Shroud Bolts	SS, Ni alloy	Not stated	EMBR/IR	Loss of tracture toughness
-62	2 Upper Internals Assembly	CE: CEA Shroud Assemblies	CEA Shroud Bolts	SS, Ni alloy	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
6	3 Upper Internals Assembly	CE: CEA Shroud Assemblies	CEA Shroud Bolts	SS, Ni alloy	Not stated	CORR/IASCC	Crack initiation & growth
6	4 Upper Internals Assembly	CE: CEA Shroud Assemblies	CEA Shroud Bolts	SS, Ni alloy	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
-6	5 Upper Internals Assembly	CE: CEA Shroud Assemblies	CEA Shroud Bolts	SS, Ni alloy	Not stated	ERO/CORR	Wall thinning, loss material
e	6 Upper Internals	CE: CEA Shroud	CEA Shroud Bolts	SS, Ni alloy	Not stated	WEAR	Attrition .
e	Assembly 57 Upper internals Assembly	Assemblies CE: CEA Shroud Assemblies	CEA Shroud Bolts	SS, Ni alloy	Not stated	CREEP	Change in dimension
•	68 Upper Internals Assembly	CE: CEA Shroud Assemblies	CEA Shroud Bolts	SS, Ni alloy	Not stated	RELAX	Loss of preload

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Document: IR 90-05, PWR Vessel Internals Industry Report Reviewed by: Omesh K. Chopra, ANL Effect of Aging on Component Function Contrib to Failure Reported progs

Effect of Aging on Component Func Core support loss, prevent control rod	Not stated	ASME Section XI,	Rel.progs	Report Recommendations	Page No.	
insertion.		Subsection IWB		ASME Section XI, Subsect. IWB is effective for internals that are or ca be rendered accessible	4-11, 5-6, n 5-7	Γ
Core support loss, prevent control rod insertion.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-4, 4-25	
Core support loss, prevent control rod insertion. Core support loss, prevent control rod	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation.	4-14	
insertion.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because operating temps. are well below levels at which creep is a concern	4-15	
Core support loss, prevent control rod nsertion. Core support loss, prevent control rod	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective for detecting cracked or missing bolts & corrective action includes root cause determination	1 1	
nsertion.	Not stated	Not stated		Non significant because wrought SS & Ni alloys are not susceptible to EMBR/TE.	4-21, 4-22	ł
Core support loss, prevent control rod nsertion. Core support loss, prevent control rod	Not stated	Non significant based on fatigue usage factor & review of plant design stress reports		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4- 30	e
isertion.	Not stated	Not stated		Non-significant because adequate fracture toughness at end of life fluence levels & low applied stresses	4-3, 4-4	6
sertion.	Not stated	ASME Sect. XI, Subsect. IWB, exam. category B N 3 is current & effective (More)		NRC recommendation: Augmented ISI of components when sensitized material, high residual stresses, crevices, or history of coolant	5-5, 5-6	6
ore support loss, prevent control rod sertion.	Not stated	ASME Section XI, Subsection IWB		contamination are present ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	4-11, 5-6. 5-7	6
ore support loss, prevent control rod sertion.	Not stated	Non significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NDO -	4-24. 4-25	64
ore support loss, prevent control rod sertion.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	-14	65
re support loss, prevent control rod ertion. re support loss, prevent control rod	Not stated	Not stated		Non significant because not subject 4 to relative motion	-19	66
ertion.	· 	Not stated		Non aim if an all	-15	67
re support loss, prevent control rod ertion.	Not stated	ASME Sect. XI, Subsect. IWB		ACLUE O LIVE O	-7, 5-8	68

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	ediby: Omeshi ystem	K. Chopra, ANL Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	Loss of fracture
<u>n 5</u>	ystem	CE: CEA Shroud	CEA Shroud Bolts	SS, Ni alloy	Not stated	EMBRAIE	toughness
	pper Internals ssembly	Assemblies					Cumulative fatigue
		CE: CEA Shroud	CEA Shroud Bolts	SS, Ni alloy	Not stated	FAT	damage
σU	pper Internals			•			damage
A	ssembly	Assemblies					
1							1 Afreshure
			RCCA Guide Tube	SS, Ni alloy	Not stated	EMBR/IR	Loss of fracture
71 1	Ipper internals	W: RCCA Guide		33, Ni aloy			toughness
A	ssembly	Tube Assemblies	Support Pins				
	_			CC Ni allav	Not stated	CORR/SCC,CORR/	Crack initiation &
72 1	Jpper Internals	W: RCCA Guide	RCCA Guide Tube	SS, Ni alloy	101 50000	CREV	growth, loss of
	sembly	Tube Assemblies	Support Pins				material
	,						
					Not stated	CORRAASCC	Crack initiation &
7311	Jpper Internals	W: RCCA Guide	RCCA Guide Tube	SS, Ni alloy	NOTSIZIOU		growth
	Assembly	Tube Assemblies	Support Pins		ļ		1-
1	ASSERIDIY					CORR, CORR/PIT	Loss of material,
-	Internals	W: RCCA Guide	RCCA Guide Tube	SS, Ni alloy	Not stated	CORR, CONTAIN	corrosion product
	Upper Internals	Tube Assemblies	Support Pins				buildup
1	Assembly	Tube Assembles					Dallaab
							Wall thinning, los
		W: RCCA Guide	RCCA Guide Tube	SS, Ni alloy	Not stated	ERO/CORR	
	Upper Internais						material
	Assembly	Tube Assemblies	Support Pins				
- 1							
			DODA Ovide Tube	SS, Ni alloy	Not stated	WEAR	Attrition
76	Upper Internals	W: RCCA Guide	RCCA Guide Tube	55, 14 alloy			
	Assembly	Tube Assemblies	Support Pins	DO Ni allant	Not stated	CREEP	Change in
77	Upper Internals	W: RCCA Guide	RCCA Guide Tube	SS, Ni alloy	NULSIAIOU		dimension
	Assembly	Tube Assemblies	Support Pins				
	Assembly					RELAX	Loss of preload
	Upper Internals	W: RCCA Guide	RCCA Guide Tube	SS, Ni alloy	Not stated	REDAN	
78		Tube Assemblies	Support Pins				
	Assembly	Tube Assertioned					Loss of fracture
		W: RCCA Guide	RCCA Guide Tube	SS, Ni alloy	Not stated	EMBR/TE	toughness
79	Upper Internals	Tube Assemblies	Support Pins				toughness
	Assembly	IUDE Assemblies	Support in				
_		THE BOOL OWING	RCCA Guide Tube	SS, Ni alloy	Not stated	FAT	Cumulative fatig
80	Upper Internals	W: RCCA Guide	Support Pins				damage
	Assembly	Tube Assemblies	Supportents				
				ss	Not stated	EMBR/IR	Loss of tracture
81	Upper Internals	W:Upper Support	Not stated	33			toughness
	Assembly	Columns					
					Not stated	CORR/SCC,	Crack initiation
8	2 Upper Internals	W:Upper Support	Not stated	SS	NOT STATED	CORR/CREV	growth, loss of
0.	Assembly	Columns	1. Contract (1997)				material
	7.336(110)						
				1			
							1
	1				81.4 ab ab and	CORRAASCC	Crack initiation
<u> </u>	3 Upper Internals	W:Upper Support	Not stated	SS	Not stated		growth
l °	Assembly	Columns	1				J
	Assembly		_			CORR, CORR/P	IT Loss of materia
┣		W:Upper Support	Not stated	SS	Not stated	CORR, CORR/P	corrosion prod
18	4 Upper Internals						buildup
l	Assembly	Columns					Dundup
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Core support loss, prevent control rod	Not stated	ilure Reported progs	Report Recommendations	Page No.	-
insertion.		NOI STATEO	Non-significant because wrought St & Ni alloys are not susceptible to EMBR/TE	S 4-21, 4-22	2 6
Core support loss, prevent control rod insertion.	Not stated	ASME Sect. XI, Subsect. IWB, & Sect. III, Subsect. NG-5200 reanalysis of (More)	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	5-12 to 5- 15	7
Core support loss, prevent control rod insertion.	Not stated	Not stated	Non-significant because adequate fracture toughness at end of life fluence levels & low applied stresses	4-3, 4-4	7
Core support loss, prevent control rod insertion.	Not stated	ASME Sect. XI, Subsect. IWB, exam. category B-N- 3 is current & effective (More)	NRC recommendation: Augmented ISI of components when sensitized material, high residual stresses, crevices, or history of coolant contamination are present		7
Core support loss, prevent control rod insertion.	Not stated	ASME Section XI, Subsection IWB	ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	7:
Core support loss, prevent control rod insertion.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.	NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	74
Core support loss, prevent control rod insertion.	Not stated	Not stated	Non significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	75
Core support loss, prevent control rod nsertion.	Not stated	Not stated	Non-significant because not subject to relative motion.	4-19	76
Core support loss, prevent control rod nsertion.	Not stated	Not stated	Non-significant because operating temps. are well below levels at which creep is a concern	4-15	77
Core support loss, prevent control rod nsertion.	Not stated	Not stated	Non-significant because components do not depend on preload	4-16, 4-17	78
Core support loss, prevent control rod nsertion.	Not stated	Not stated	 Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	79
Core support loss, prevent control rod nsertion.	Not stated	Non significant based on fatigue usage factor & review of plant design stress reports	 NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4- 30	80
Core support loss, prevent control rod nsertion.	Not stated	Not stated	Non-significant because adequate fracture toughness at end of life fluence levels & low applied stresses	4-3, 4-4	81
Core support loss, prevent control rod Insertion.	Not stated	Non-significant because fabricated of SS; stress levels within design specs (More)	NRC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry	4-6 to 4-9	82
core support loss, prevent control rod Isertion.	Not stated	ASME Section XI, Subsection IWB	ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	83
ore support loss, prevent control rod isertion.	Not stated	Non significant because SS is not susceptible to CORR or CORR/PIT in PWR	NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	84

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Reviewed by:	Omesh K. Chopra, ANL	

em	System	K. Chopra, ANL Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
85	Upper Internals Assembly	W:Upper Support Columns	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss o material
86	Upper Internals	W:Upper Support	Not stated	SS	Not stated	WEAR	Attrition
87	Assembly Upper Internals Assembly	Columns W:Upper Support Columns	Not stated	SS	Not stated	CREEP	Change in dimension
88	Upper Internals Assembly	W:Upper Support Columns	Not stated	SS	Not stated	RELAX	Loss of preload
89	Upper Internals Assembly	W:Upper Support Columns	Not stated	ss	Not stated	EMBR/TE	Loss of fracture toughness
90	Upper internals Assembly	W:Upper Support Columns	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
91	Upper Internals	W:Upper Support	Not stated	CASS	Not stated	EMBR/IR	Loss of fracture toughness
	Assembly	Columns					
92	Upper Internals Assembly	W:Upper Support Columns	Not stated	CASS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
93	Upper Internals Assembly	W:Upper Support Columns	Not stated	CASS	Not stated	CORR/IASCC	Crack initiation & growth
94	Upper Internals Assembly	W:Upper Support Columns	Not stated	CASS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
95	Upper Internals Assembly	W:Upper Support Columns	Not stated	CASS	Not stated	ERO/CORR	Wall thinning, loss (material
96	6 Upper Internals	W:Upper Support	Not stated	CASS	Not stated	WEAR	Attrition
9	Assembly 7 Upper Internals Assembly	Columns W:Upper Support Columns	Not stated	CASS	Not stated	CREEP	Change in dimension
9	B Upper Internals Assembly	W:Upper Support · Columns	Not stated	CASS	Not stated	RELAX	Loss of preload
9	9 Upper Internals Assembly	W:Upper Support Columns	Not stated	CASS	Not stated	EMBR/TE	Loss of fracture toughness
10	0 Upper Internals Assembly	W:Upper Support Columns	Not stated	CASS	Not stated	FAT	Cumulative fatigue damage
10	1 Upper Internals Assembly	W: Upper Support Column Bolts	Not stated	SS, Ni alloy	Not stated	EMBR/IR	Loss of fracture toughness

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 Document:
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 Effect of Aging on Component Function Contrib to Failure
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Effect of Aging on Component Funct Core support loss, prevent control rod	Not stated	Not stated	Rel.progs	Report Recommendations	Page No.	_
insertion.	1101312100	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	8
Core support loss, prevent control rod insertion.	Not stated	Not stated	1	Non-significant because not subject to relative motion	4-19	8
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because operating temps. are well below levels at which creep is a concern	4-15	8
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	7 8
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	2 8
Core support loss, prevent control rod insertion.	Not stated	Non significant based on fatigue usage factor & review of plant design stress reports		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4- 30	90
Core support loss, prevent control rod nsertion.	Not stated	Not stated		Non significant because adequate fracture toughness at end of life fluence levels & low applied stresses	4-3, 4-4	91
Core support loss, prevent control rod nsertion.	Not stated	Non-significant because fabricated of SS; stress levels within design specs (More)	· · · ·	NRC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or	4-6 to 4-9	92
Core support loss, prevent control rod nsertion.	Not stated	ASME Section XI, Subsection IWB		creviced geometry ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	93
Core support loss, prevent control rod Insertion	Not stated	Non significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	94
Core support loss, prevent control rod Insertion.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	95
Fore support loss, prevent control rod isertion.	Not stated	Not stated		Non significant because not subject to relative motion	4-19	96
ore support loss, prevent control rod isertion.	Not stated	Not stated		Non significant because operating temps, are well below levels at which creep is a concern	4-15	97
ore support loss, prevent control rod Isertion.	Not stated	Not stated		Non significant because components do not depend on preload	4-16, 4-17	98
ore support loss, prevent control rod isertion.	Not stated	Ferrite content screening criteria & ASME Sect. XI, Subsect. IWB inspection		NRC recommendation: Ferrite content screening criteria is inadequate & VT-3 can not reliably detect tight cracks	5-10, 5-11	99
ore support loss, prevent control rod serbon.	Not stated	Non significant based on fatigue usage factor & review of plant design stress reports			4-26 to 4- 30	100
ore support loss, prevent control rod sertion.	Not stated	Not stated		Non-significant because adequate fracture toughness at end of life fluence levels & low applied stresses	4-3, 4-4	101

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em	System		Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects Crack initiation &
	Upper Internals Assembly		Not stated	SS, Ni alloy	Not stated	CORR/SCC, CORR/CREV	growth, loss of material
103	Upper internals Assembly	W: Upper Support Column Bolts	Not stated	SS, Ni alloy	Not stated	CORR/IASCC	Crack initiation & growth
104	Upper Internals Assembly	W: Upper Support Column Bolts	Not stated	SS, Ni alloy	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
105	Upper Internals Assembly	W: Upper Support Column Bolts	Not stated	SS, Ni alloy	Not stated	ERO/CORR	Wall thinning, loss of material
106	Upper Internals	W: Upper Support	Not stated	SS, Ni alloy	Not stated	WEAR	Attrition
	Assembly Upper Internals Assembly	Column Bolts W: Upper Support Column Bolts	Not stated	SS, Ni alloy	Not stated	CREEP	Change in dimension
108	Upper Internals Assembly	W: Upper Support Column Bolts	Not stated	SS, Ni alloy	Not stated	RELAX	Loss of preload
109	Upper Internals Assembly	W: Upper Support Column Bolts	Not stated	SS, Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness
110	Upper Internals Assembly	W: Upper Support Column Bolts	Not stated	SS, Ni alloy	Not stated	FAT	Cumulative tatigue damage
111	Upper internals Assembly	W:Upper Core Plate, or B&W:Upper Grid Assembly	Not stated, Upper Grid Rib Section	SS	Not stated	EMBR/IR	Loss of fracture toughness
1.12	2 Upper Internals Assembly	W:Upper Core Plate, or B&W:Upper Grid Assembly	Not stated, Upper Grid Rib Section	SS	Not stated	CORR/SCC,CORR/ CREV	Crack Initation & growth, loss of material
113	3 Upper Internals Assembly	W:Upper Core Plate or B&W:Upper Grid Assembly		SS	Not stated	CORR/IASCC	Crack initiation & growth
114	4 Upper Internals Assembly	W:Upper Core Plate or B&W:Upper Grid Assembly	Not stated, Upper Grid Rib Section	SS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
11	5 Upper Internals Assembly	W:Upper Core Plate or B&W:Upper Grid Assembly		SS	Not stated	ERO/CORR	Wall thinning, loss (material
11	6 Upper Internals Assembly	W:Upper Core Plate or B&W:Upper Grid		SS	Not stated	WEAR	Attrition
11	7 Upper Internals Assembly	Assembly W:Upper Core Plate or B&W:Upper Grid Assembly		SS	Not stated	CREEP	Change in dimension

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Effect of Aging on Component Function Core support loss, prevent control rod			Rel.progs	Report Recommendations	Page No.	
Core support loss, prevent control rod	Not stated	Non significant because fabricated of SS; stress levels within design spec (More)		NRC recommendation: Crevices an known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry		10
insertion.	Not stated	ASME Section XI, Subsection IWB		ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible.	4-11, 5-6, 5-7	10
Core support loss, prevent control rod insertion.	Not stated	Non significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	5 10
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	10
Core support loss, prevent control rod nsertion.	Not stated	Not stated		Non-significant because not subject to relative motion.	4-19	106
Core support loss, prevent control rod nsertion.	Not stated	Not stated		Non-significant because operating temps, are well below levels at which creep is a concern	4-15	107
Core support loss, prevent control rod nsertion.	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective for detecting cracked or missing bolts & corrective action includes root cause determination	5-7, 5-8	108
Core support loss, prevent control rod nsertion.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE.	4-21, 4-22	109
Core support loss, prevent control rod nsertion.	Not stated	ASME Sect. XI, Subsect. IWB, & Sect. III, Subsect. NG-5200 reanalysis of (More)		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	5-12 to 5- 15	110
oss of support to fuel assembly.	Not stated	Not stated		Non-significant because adequate fracture toughness at end of life fluence levels & low applied stresses	4-3, 4-4	111
oss of support to fuel assembly.	Not stated	Non-significant because fabricated of SS; stress levels within design specs (More)	· · · · · · · · · · · · · · · · · · ·	NRC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry	4-6 to 4-9	112
oss of support to fuel assembly.	Not stated	ASME Section XI, Subsection IWB		ASME Section XI, Subsect. IWB is	4-11, 5-6, 5-7	113
oss of support to fuel assembly.		Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.			4-24, 4-25	114
oss of support to fuel assembly.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	115
oss of support to fuel assembly.	Not stated	Not stated			4-19	116
oss of support to fuel assembly.	Not stated	Not stated		Non significant because operating temps. are well below levels at which creep is a concern	4-15	117

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	System		Subcomponent	Materials	Manufacturer	ARD mechanism	Loss of preload
	Upper Internals Assembly	Grid Assembly	Not stated, Upper Grid Rib Section	SS	Not stated	RELAX	
119	Upper Internals Assembly	Grid Assembly	Not stated, Upper Grid Rib Section	SS	Not stated	EMBR/TE	Loss of fracture toughness
120	Upper Internals Assembly	Grid Assembly	Not stated, Upper Grid Rib Section	SS	Not stated	FAT	Cumulative fatigue damage
121	Upper Internals Assembly		Upper Grid Assembly Bolts	SS, Ni alloy	Not stated	EMBR/IR	Loss of fracture toughness
122	Upper Internals Assembly	B&W: Upper Grid Assembly	Upper Grid Assembly Bolts	SS, Ni alloy	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
123	Upper Internals Assembly	B&W: Upper Grid Assembly	Upper Grid Assembly Bolts	SS, Ni alloy	Not stated	CORRAASCC	Crack initiation & growth
124	Upper Internals Assembly	B&W: Upper Grid Assembly	Upper Grid Assembly Bolts	SS, Ni alloy	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
125	Upper Internals Assembly	B&W: Upper Grid Assembly	Upper Grid Assembly Bolts	SS, Ni alloy	Not stated	ERO/CORR	Wall thinning, loss material
126	Upper Internals	B&W: Upper Grid	Upper Grid	SS, Ni alloy	Not stated	WEAR	Attrition
127	Assembly Upper Internals Assembly	Assembly B&W: Upper Grid Assembly	Assembly Bolts Upper Grid Assembly Bolts	SS, Ni alloy	Not stated	CREEP	Change in dimension
128	Upper Internals Assembly	B&W: Upper Grid Assembly	Upper Grid Assembly Bolts	SS, Ni alloy	Not stated	RELAX	Loss of preload
129	Upper internals Assembly	B&W: Upper Grid Assembly	Upper Grid Assembly Bolts	SS, Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness
130	Upper Internals Assembly	B&W: Upper Grid Assembly	Upper Grid Assembly Bolts	SS, Ni alloy	Not stated	FAT	Cumulative fatigue damage
13	I Upper Internals Assembly	W:Upper Core Plate Fuel Pin, or CE: Fue Alignment Plate, or B&W: Upper Grid Assembly		SS, Ni alkoy (Ni alloy used only for Upper Core Plate Fuel Pins)	Not stated	EMBR/IR	Loss of fracture toughness
13	2 Upper Internals Assembly	W:Upper Core Plate Fuel Pin, or CE: Fue Alignment Plate, or B&W: Upper Grid Assembly		SS, Ni alkoy (Ni alloy used only for Upper Core Plate Fuel Pins)		CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material

Document: IR 90-05, PWR Vessel Internals Industry Report Reviewed by: Omesh K. Chopra, ANL Effect of Aging on Component Function Contrib to Failur

Effect of Aging on Component Fun Loss of support to fuel assembly.	Not stated	Not stated	Rel.progs	Report Recommendations	Page No.	
, , , , , , , , , , , , , , , , , , ,	NOUSIALED	NOT STATED		Non significant because components do not depend on preload	4-16, 4-17	11
Loss of support to fuel assembly.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	6 4-21, 4-22	2 11
Loss of support to fuel assembly	Not stated	Non-significant based on fatigue usage factor & review of plant design stress reports		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4- 30	12
Loss of support to fuel assembly.	Not stated	Not stated		Non significant because adequate fracture toughness at end of life fluence levels & low applied stresses	4-3, 4-4	12
Loss of support to fuel assembly.	Not stated	Non-significant because fabricated of SS; stress levels within design specs (More)		NRC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry	4-6 to 4-9	12
Loss of support to fuel assembly.	Not stated	ASME Section XI, Subsection IWB	• • <u> </u>	ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	123
Loss of support to fuel assembly.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	124
oss of support to fuel assembly.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	125
oss of support to fuel assembly.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	126
oss of support to fuel assembly.	Not stated	Not stated			4-15	127
oss of support to fuel assembly.	Not stated	ASME Sect. XI Subsect. IWB			5-7, 5-8	128
oss of support to fuel assembly.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	129
oss of support to fuel assembly.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress reports			4-26 to 4- 30	130
ore support loss, prevent control rod isertion.	Not stated	Not stated		Non-significant because adequate 4 fracture toughness at end of life fluence levels & low applied stresses	1-3, 4-4	131
ore support loss, prevent control rod sertion.	Not stated	Non significant because fabricated of SS; stress levels within design specs (More)	, <u></u> , <u></u> ,	NRC recommendation: Crevices are 4 known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry	I-6 to 4-9	132

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	wed by: Omesi System	K. Chopra, ANL Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
133	Upper Internals Assembly	Fuel Pin, or CE: Fuel Alignment Plate, or B&W: Upper Grid Assembly	Fuel Guide Pads	SS, Ni alloy (Ni alloy used only for Upper Core Plate Fuel Pins)	Not stated	CORR/IASCC	Crack initiation & growth
134	Upper internals Assembly	W:Upper Core Plate Fuel Pin, or CE: Fuel Alignment Plate, or B&W: Upper Grid Assembly	Fuel Guide Pads	SS, Ni alloy (Ni alloy used only for Upper Core Plate Fuel Pins)	Not stated	CORR, CORR/FI	corrosion product buildup
135	Upper Internals Assembly	W:Upper Core Plate Fuel Pin, or CE: Fuel Alignment Plate, or B&W: Upper Grid Assembly	Fuel Guide Pads	SS, Ni alloy (Ni alloy used only for Upper Core Plate Fuel Pins)	Not stated	ERO/CORR	Wall thinning, loss of material
136	Upper Internals Assembly	W:Upper Core Plate Fuel Pin, or CE: Fuel Alignment Plate, or B&W: Upper Grid Assembly	Fuel Guide Pads	SS, Ni alkoy (Ni alloy used only for Upper Core Plate Fuel Pins)	Not stated	WEAR	Attrition
137	Upper Internals Assembly	W:Upper Core Plate Fuel Pin, or CE: Fuel Alignment Plate, or B&W: Upper Grid Assembly		SS, Ni alloy (Ni alloy used only for Upper Core Plate Fuel Pins)	Not stated	CREEP	Change in dimension
138	Upper Internals Assembly	W:Upper Core Plate Fuel Pin, or CE: Fuel Alignment Plate, or B&W: Upper Grid Assembly		SS, Ni alloy (Ni alloy used only for Upper Core Plate Fuel Pins)	Not stated	RELAX	Loss of preload
139	Upper Internals Assembly	W:Upper Core Plate Fuel Pin, or CE: Fuel Alignment Plate, or B&W: Upper Grid Assembly		SS, Ni alloy (Ni alloy used only for Upper Core Plate Fuel Pins)	Not stated	EMBR/TE	Loss of fracture toughness
140	Upper Internals Assembly	W:Upper Core Plate Fuel Pin, or CE: Fuel Alignment Plate, or B&W: Upper Grid Assembly		SS, Ni alloy (Ni alloy used only for Upper Core Plate Fuel Pins)	Not stated	FAT	Cumulative fatgue damage
141	Core Support Assembly	W:Core Barrel or CE: Core Support Barrel, or B&W:Core Support Shield	Not stated	SS	Not stated	EMBR/IR	Loss of fracture toughness
142	Core Support Assembly	W:Core Barrel or CE: Core Support Barrel, or B&W:Core Support Shield	Not stated	SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
143	3 Core Support Assembly	W:Core Barrel or CE: Core Support Barrel, or B&W:Core Support Shield	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth
144	Core Support Assembly	W:Core Barrel or CE: Core Support Barrel, or B&W:Core Support Shield	Not stated	SS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
14	5 Core Support Assembly	W:Core Barrel or CE: Core Support Barrel, or B&W:Core Support Shield	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss of material

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Effect of Aging on Component Funct Core support loss, prevent control rod	Not stated		Rel.progs	Report Recommendations	Page No.	
insertion.		ASME Section XI, Subsection IWB		ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	13
Core support loss, prevent control rod insertion.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	134
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	135
Core support loss, prevent control rod insertion.	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B N 3 is effective program for detection of WEAR	5-9	136
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non significant because operating temps, are well below levels at which creep is a concern	4-15	137
Core support loss, prevent control rod nsertion.	Not stated	Not stated		Non significant because components do not depend on preload.	4-16, 4-17	138
Core support loss, prevent control rod nsertion.	Not stated	Not stated		Non significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	139
Core support loss, prevent control rod nsertion.		Non significant based on fatigue usage factor & review of plant design stress reports		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4- 30	140
ontrol rod insertion.	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective for internals that are or can be rendered accessible	5-4	141
ore support loss, impaired flow, prevent ontrol rod insertion.		Non-significant because fabricated of SS; stress leyels within design specs (More)		NRC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry	4-6 to 4-9	142
ore support loss, impaired flow, prevent ontrol rod insertion.		ASME Section XI, Subsection IWB			4-11, 5- 6, 5-7	143
ore support loss, impaired flow, prevent ontrol rod insertion.		Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	144
ore support loss, impaired flow, prevent ontrol rod insertion.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	145

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em	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	Core Support		Not stated	SS	Not stated	WEAR	Attrition
	Assembly	CE: Core Support		1			
	,	Barrel, or B&W:Core					
		Support Shield					Change in
47	Core Support	W:Core Barrel or	Not stated	SS	Not stated	CREEP	Change in dimension
	Assembly	CE: Core Support					dimension
		Barrel, or B&W:Core					
		Support Shield				RELAX	Loss of preload
148	Core Support	W:Core Barrel or	Not stated	SS	Not stated	RELAX	Loss of protout
	Assembly	CE: Core Support					
		Barrel, or B&W:Core					
		Support Shield			Not stated	EMBR/TE	Loss of fracture
149	Core Support		Not stated	SS	NOTSIALED		toughness
	Assembly	CE: Core Support					
		Barrel, or B&W:Core					
		Support Shield	A		Not stated	FAT	Cumulative fatigu
150	Core Support	W:Core Barrel or	Not stated	SS	NULSIALOU		damage
	Assembly	CE: Core Support					
		Barrel, or B&W:Core					
		Support Shield					
		11/0	Not stated	ss	Not stated	EMBR/IR	Loss of fracture
151	Core Support	W:Core Barrel	Not stated	33	THUI STELLOU		toughness
	Assembly	Nozzies					
		W Osea Barral	Not stated	ss	Not stated	CORR/SCC,	Crack initiation &
152	Core Support	W:Core Barrel	NOTSTATED	33	NOT STATED	CORR/CREV	growth, loss of
	Assembly	Nozzies					material
150	1 Ocean Summert	W:Core Barrel	Not stated	ss	Not stated	CORR/IASCC	Crack initiation &
153	Core Support	Nozzles	1101 3121.00				growth
	Assembly	14022185					
		W:Core Barrel	Not stated	ss	Not stated	CORR, CORR/PIT	Loss of material,
154	Core Support	Nozzles	HOI SILLEG				corrosion product
	Assembly	NUZZIOS					buildup
155	Core Support	W:Core Barrel	Not stated	SS	Not stated	ERO/CORR	Wall thinning, los
	Assembly	Nozzles					material
							{
							A 44 14 14
156	Core Support	W:Core Barrel	Not stated	SS	Not stated	WEAR	Attrition
	Assembly	Nozzles					
157	7 Core Support	W:Core Barrel	Not stated	SS	Not stated	CREEP	Change in
	Assembly	Nozzles					dimension
	,	· · · ·					
15	B Core Support	W:Core Barrel	Not stated	SS	Not stated	RELAX	Loss of preload
	Assembly	Nozzles					
	1						
15	9 Core Support	W:Core Barrel	Not stated	SS	Not stated	EMBR/TE	Loss of fracture
	Assembly	Nozzies	1	1			toughness
	,						
16	0 Core Support	W:Core Barrel	Not stated	SS	Not stated	FAT	Cumulative fatig
	Assembly	Nozzies					damage
			1				
							ł
			·				
16	1 Core Support	W:Upper Core	Not stated	SS	Not stated	EMBR/IR	Loss of fracture
	Assembly	Barrel Flange or CE	:				toughness
		Core Support Barrel					
	1	Upper Flange, or					
		B&W:Core Support					
			1	1	1		1
	1	Shield Flange					1

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Effect of Aging on Component Function Contrib to Failure Reported progs Rel.progs

Core support loss, impaired flow, prevent control rod insertion.	Not stated	Not stated	el.progs Report Recommendations Non-significant because not subject	Page No	<u>, </u>
			to relative motion	ct 4-19	
Core support loss, impaired flow, prevent	Not stated	Not stated			
control rod insertion.			Non-significant because operating temps, are well below levels at whic creep is a concern	4-15 ch	
Core support loss, impaired flow, prevent control rod insertion.	Not stated	Not stated	Non-significant because	4-16, 4-1	+
			components do not depend on preload	4-10, 4-1.	7
Core support loss, impaired flow, prevent control rod insertion.	Not stated	Not stated	Non-significant because wrought S & Ni alloys are not susceptible to EMBR/TE	S 4-21, 4-22	2 1
Core support loss, impaired flow, prevent control rod insertion.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress reports	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4- 30	1
Core support loss, impaired flow, prevent	Not stated	ASME Sect. XI,			
ontrol rod insertion.		Subsect, IWB	ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective for internals that are or can be rendered accessible	4-3, 4-4	1!
Core support loss, impaired flow, prevent ontrol rod insertion	Not stated	Non-significant	NRC recommendation: Crevices are	4-6 to 4-9	15
		because fabricated of SS; stress levels within design specs (More)	known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or		15
ore support loss, impaired flow, prevent	Not stated	ASME Section XI.	creviced geometry		_
ontrol rod insertion. ore support loss, impaired flow, prevent		Subsection IWB	ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible.	4-11, 5-6, 5-7	15
ontrol rod insertion.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.	NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	15
ntrol rod insertion.	Not stated	Not stated	Non significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	15
ore support loss, impaired flow, prevent I ntrol rod insertion.	Not stated	Not stated	Non-significant because not subject	4-10	156
an anna an le contra de la contra	Not stated		to relative motion		150
ntrol rod insertion.		Not stated	Non-significant because operating temps. are well below levels at which creep is a concern	4-15	157
ntrol rod insertion.	Not stated	Not stated		4-16, 4-17	158
ntrol rod insertion.	Not stated	Not stated	Non-significant because wrought SS 4 & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	159
ntrol rod insertion.	lot stated	ASME Sect. XI, Subsect. IWB, & Sect. III, Subsect. NG 5200 reanalysis of usage factor	NRC recommendation: Until an	5-12 to 5- 15	160
re support loss, impaired flow, prevent N trol rod insertion.	lot stated	ASME Sect. XI. Subsect. IWB	ASME Sect. XI, Subsect. IWB, exam. category B N 3 is effective for internals that are or can be rendered accessible	-4	161

em Support mbly Support ambly a Support ambly	W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange	ubcomponent ot stated lot stated	Materials SS SS SS SS	Not stated	CORR/SCC, CORR/CREV CORR/IASCC	Crack initiation & growth, loss of material Crack initiation & growth		
mbly Support ambly a Support ambly	Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support	lot stated	SS			material Crack initiation &		
Support mbly Support embly	Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support				CORR/IASCC	Crack initiation &		
ambly a Support ambly	Upper Flange, or B&W:Core Support Shield Flange W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support				CORR/IASCC			
ambly a Support ambly	B&W:Core Support Shield Flange W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support				CORR/IASCC			
ambly a Support ambly	Shield Flange W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support				CORR/IASCC			
ambly a Support ambly	W:Upper Core N Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange W:Upper Core W:Upper Core I Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support B&W:Core Support Barrel Upper Flange, or B&W:Core Support				CORRIAGE			
ambly a Support ambly	W:Opper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support		ss	Not stated		9,0,0		
e Support embly	Core Support Barrei Upper Flange, or B&W:Core Support Shield Flange W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support	Not stated	SS	Not stated				
əmbiy	Upper Flange, or B&W:Core Support Shield Flange W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support	Not stated	ss	Not stated		1		
əmbiy	B&W:Core Support Shield Flange W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support	Not stated	SS	Not stated				
əmbiy	Shield Flange W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support	Not stated	ss	Not stated				
əmbiy	W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support	Not stated	SS		CORR, CORR/PIT	Loss of material,		
əmbly	Core Support Barrel Upper Flange, or B&W:Core Support				001111	corrosion product		
	Core Support Barrel Upper Flange, or B&W:Core Support					buildup		
<u></u>	B&W:Core Support							
	Shield Flange							
				Not stated	ERO/CORR	Wall thinning, los		
e Support		Not stated	SS	Not Stated		material		
embly	Barrel Flange or CE:							
,	Core Support Barrel							
	Upper Flange, or							
	B&W:Core Support							
	Shield Flange	N. Assessed	SS	Not stated	WEAR	Attrition		
e Support	W:Upper Core	Not stated	33					
embly	Barrel Flange or CE:							
	Core Support Barrel							
	Upper Flange, or							
	B&W:Core Support							
	Shield Flange	Not stated	SS	Not stated	CREEP	Change in		
re Support	W:Upper Core	Notstated				dimension		
sembly	Barrel Flange or CE:							
	Core Support Barrel							
	Upper Flange, or							
	B&W:Core Support					Loss of preload		
	Shield Flange	Not stated	SS	Not stated	RELAX	Loss of prevoau		
re Support	W:Upper Core	NULSELEG						
sembly	Barrel Flange or CE: Core Support Barrel							
	Upper Flange, or							
	B&W:Core Support							
	Shield Flange				TUDD 775	Loss of tracture		
	W:Upper Core	Not stated	SS	Not stated	EMBR/TE	toughness		
ore Support	Barrel Flange or CE:					Duğimess		
sembly	Core Support Barrel							
	Upper Flange, or							
	B&W:Core Support	1						
	Shield Flange					Cumulative fatig		
	W:Upper Core	Not stated	SS	Not stated	FAT	damage		
ore Support	Barrel Flange or CE			1				
ssembly	Core Support Barrel							
	Upper Flange, or							
	B&W:Core Support							
	Shield Flange				EMBB/IB	Loss of fracture		
	B&W:Vent Valve	Not stated	SS	Not stated		toughness		
Soro Cupport								
Core Support								
Core Support	Assemblies			http://www.and	CORR/SCC,	Crack initiation		
				Not stated	CORR/CREV	growth; loss of		
ssembly	Assemblies	Not stated	SS	1	CORNORL*	material		
ssembly	Assemblies B&W:Vent Valve	Not stated	SS			1		
ssembly	Assemblies	Not stated	SS					
ssembly	Assemblies B&W:Vent Valve	Not stated	SS					
ssembly	Assemblies B&W:Vent Valve	Not stated	SS					
ssembly	Assemblies B&W:Vent Valve	Not stated			COPRIASCO	Crack initiation		
Sore Support Assembly	Assemblies B&W:Vent Valve Assemblies	Not stated	SS	Not stated	CORRAASCC			
Core Support Assembly Core Support	Assemblies B&W:Vent Valve Assemblies B&W:Vent Valve				CORRAASCC	Crack initiation growth		
Sore Support Assembly	Assemblies B&W:Vent Valve Assemblies				CORRAASCC	Crack initiation growth		
Core Support Assembly Core Support	Assemblies B&W:Vent Valve Assemblies B&W:Vent Valve				CORRAASCC			
\$\$	embly	Pr W/Vent Valve	DR W/Vent Valve Not stated	De W/Vont Valve NOI Stateg	a Support Davy vent vare	Support Barry Vent Vent Vent Vent Vent Vent Vent Vent		

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Effect of Aging on Component Func Core support loss, impaired flow, preven	nt Not stated	ailure Reported progs Non-significant	Rel.progs	Report Recommendations	Page N	
control rod insertion.		because fabricated of SS; stress levels within design specs (More)		NRC recommendation: Crevices known promote SCC in SSs even the absence of high stress. Evalue the potential of CORR/SCC of components with crevices or	in	9
Core support loss, impaired flow, prever	nt Not stated	ASME Section XI		creviced geometry		
control rod insertion.		Subsection IWB		ASME Section XI, Subsect. IWB is effective for internals that are or ca be rendered accessible.	s 4-11, 5-6 n 5-7	5, 1
Core support loss, impaired flow, preven	+ N = 4 = 4 = 1					
control rod insertion.		Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	0 4-24 , 4-2	5 1
Core support loss, impaired flow, prevent	Not stated	Not stated				
control rod insertion.		NUISLALEO		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	1
Core support loss, impaired flow, prevent ontrol rod insertion.	Not stated	ASME Sect. XI,		ASME Sect. XI, Subsect. IWB,		+
on or roa inserijon.		Subsect IWB		exam. category B-N-3 is effective program for detection of WEAR	5-9	10
ore support loss, impaired flow, prevent ontrol rod insertion.	Not stated	Not stated		Non-significant because operating	4-15	
				temps, are well below levels at which creep is a concern	4-13	16
ore support loss, impaired flow, prevent	Not stated	Not stated		Non-significant because	4-16, 4-17	16
			i	components do not depend on preload	,	
pre support loss, impaired flow, prevent	Not stated	Not stated		Non-significant hereit		
ntrol rod insertion.				Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	169
re support loss, impaired flow, prevent ntrol rod insertion.	Not stated	Non significant		NRC recommendation: Until an	4 -6 to 4-	
re cooling during LOCA.		based on fatigue usage factor & review of plant design stress reports			30	170
	Not stated	ASME Sect. XI, Subsect. IWB	e i	exam. category B-N-3 is effective for nternals that are or can be rendered	5-4	171
e cooling during LOCA.	Not stated	Non-significant				
e cooling during LOCA.		because fabricated of SS; stress levels within design specs (More)		NRC recommendation: Crevices are mown promote SCC in SSs even in he absence of high stress. Evaluate he potential of CORR/SCC of components with crevices or reviced geometry	4-6 to 4-9	172
	Not stated	ASME Section XI, Subsection IWB		SME Continue ML C. L.	1-11, 5-6, 5-7	173

System Core Support Assembly	Structure/Comp B&W:Vent Valve	Subcomponent Not stated	SS	Not stated		Loss of material, corrosion product
	Assemblies					buildup
Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss o material
						Attrition
Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	SS			Change in
Core Support Assembly	B&W Vent Valve Assemblies	Not stated	SS	Not stated		dimension
Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	SS	Not stated	RELAX	Loss of preload
Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	EMBR/IR	Loss of fracture toughness
Core Support Assembly	3&W:Vent Valve Assemblies	Not stated	CASS	Not stated	CORR/SCC,CORR/ CREV	Crack initiation & growth, loss of material
Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	CORR/IASCC	Crack initiation & growth
Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	ERO/CORR	Wall thinning, loss material
6 Core Support	B&W:Vent Valve	Not stated	CASS	Not stated	WEAR	Attrition
Assembly 7 Core Support Assembly	Assemblies B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	CREEP	Change in dimension
8 Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	RELAX	Loss of preload
9 Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	EMBR/TE	Loss of fracture toughness
	Assembly Core Support Assembly Core Support Core S	AssemblyAssembliesAssemblyAssembliesCore SupportB&W:Vent Valve AssemblyAssemblyAssembliesCore SupportB&W:Vent Valve AssembliesAssemblyB&W:Vent Valve AssembliesCore SupportB&W:Vent Valve AssembliesAssemblyB&W:Vent Valve AssembliesCore SupportB&W:Vent Valve AssembliesAssemblyB&W:Vent Valve AssembliesCore SupportB&W:Vent Valve AssembliesAssemblyB&W:Vent Valve AssembliesCore SupportB&W:Vent Valve AssembliesS Core SupportB&W:Vent Valve Assemblies </td <td>Core SupportAssembliesNot statedCore SupportB&W: Vent Valve AssembliesNot statedAssemblyAssembliesNot statedCore SupportB&W: Vent Valve AssembliesNot statedCore Support AssemblyB&W: Vent Valve AssembliesNot statedS Core Support AssemblyB&W: Vent Valve AssembliesNot stated</td> <td>Def Support Dearn. Venil Valve Not stated SS Sasembly Assemblies Not stated SS Core Support B&W:Vent Valve Not stated SS Assembly Assemblies Not stated SS Core Support B&W:Vent Valve Not stated CASS Core Support B&W:Vent Valve Not stat</td> <td>Core Support Assembly B&W: Vent Valve Assemblies Not stated SS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated SS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated SS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated SS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated SS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated SS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated CASS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated CASS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated CASS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated CASS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated CASS Not stated Core Support Assembly B&W: Vent Valve</td> <td>Core Support Assembly B&W.Vent Valve Assembly Not stated SS POLISAted SCIENT Core Support Assembly B&W.Vent Valve Assembly Not stated SS Not stated CREEP Core Support Assembly B&W.Vent Valve Assembly Not stated SS Not stated CREEP Core Support Assembly B&W.Vent Valve Assembles Not stated SS Not stated RELAX Core Support Assembly B&W.Vent Valve Assembles Not stated SS Not stated RELAX Core Support Assembly B&W.Vent Valve Assembles Not stated SS Not stated RELAX Core Support Assembly B&W.Vent Valve Assembles Not stated SS Not stated FAT Core Support Assembly B&W.Vent Valve Assembles Not stated CASS Not stated CORR/CC_CORR/ CREV Core Support Assembly B&W.Vent Valve Assembles Not stated CASS Not stated CORR/ASCC Core Support Assembly B&W.Vent Valve Assembles Not stated CASS Not stated CORR/ASCC Core Suppor</br></br></br></br></br></td>	Core SupportAssembliesNot statedCore SupportB&W: Vent Valve AssembliesNot statedAssemblyAssembliesNot statedCore SupportB&W: Vent Valve AssembliesNot statedCore Support AssemblyB&W: Vent Valve AssembliesNot statedS Core Support AssemblyB&W: Vent Valve AssembliesNot stated	Def Support Dearn. Venil Valve Not stated SS Sasembly Assemblies Not stated SS Core Support B&W:Vent Valve Not stated SS Assembly Assemblies Not stated SS Core Support B&W:Vent Valve Not stated CASS Core Support B&W:Vent Valve Not stat	Core Support Assembly B&W: Vent Valve Assemblies Not stated SS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated SS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated SS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated SS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated SS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated SS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated CASS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated CASS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated CASS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated CASS Not stated Core Support Assembly B&W: Vent Valve Assemblies Not stated CASS Not stated Core Support Assembly B&W: Vent Valve	Core Support Assembly B&W.Vent Valve Assembly Not stated SS POLISAted SCIENT Core Support Assembly B&W.Vent Valve Assembly Not stated SS Not stated CREEP Core Support Assembly B&W.Vent Valve Assembly Not stated SS Not stated CREEP Core Support Assembly B&W.Vent Valve Assembles Not stated SS Not stated RELAX Core Support Assembly B&W.Vent Valve Assembles Not stated SS Not stated RELAX Core Support

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Effect of Aging on Component F			Rel.progs	Report Recommendations	Page No.	_
Core cooling during LOCA.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	17
Core cooling during LOCA.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	17
Core cooling during LOCA.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	170
Core cooling during LOCA.	Not stated	Not stated		Non-significant because operating temps, are well below levels at which creep is a concern	4-15	17
Core cooling during LOCA.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	178
Core cooling during LOCA.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	179
Core cooling during LOCA.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress reports		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4- 30	180
Core cooling during LOCA.	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective for internals that are or can be rendered accessible	5-4	181
Core ∞oling during LOCA.	Not stated	Non-significant because fabricated of SS; stress levels within design specs (More)		NRC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry		182
Core cooling during LOCA.	Not stated	ASME Section XI, Subsection IWB		ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	183
Core cooling during LOCA.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	184
Core cooling during LOCA.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	185
Core cooling during LOCA.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	186
Core cooling during LOCA.	Not stated	Not stated		Non-significant because operating temps. are well below levels at which creep is a concern	4-15	187
Core cooling during LOCA.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	188
Core cooling during LOCA.	Not stated	Ferrite content screening criteria & ASME Sect. XI, Subsect. IWB inspection		NRC recommendation: Ferrite content screening criteria is inadequate & VT-3 can not reliably detect tight cracks	5-10, 5-11	189

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
190	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	FAT	Cumulative fatigue damage
191	Core Support Assembly	W: Batfle Former Assembly	Baffie/Former Assembly Bolts	SS, Ni alloy	Not stated	EMBR/IR	Loss of fracture toughness
192	Core Support Assembly	W: Baffle Former Assembly	Batfle/Former Assembly Bolts	SS, Ni alloy	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
193	Core Support Assembly	W: Baffle Former Assembly	Baffie/Former Assembly Bolts	SS, Ni alloy	Not stated	CORR/IASCC	Crack initiation & growth
194	Core Support Assembly	W: Baffle Former Assembly	Baffle/Former Assembly Bolts	SS, Ni alloy	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
195	Core Support Assembly	W: Baffle Former Assembly	Baffle/Former Assembly Bolts	SS, Ni alloy	Not stated	ÉRO/CORR	Wall thinning, loss i material
196	Core Support	W: Baffle Former	Baffle/Former	SS, Ni alloy	Not stated	WEAR	Attrition
197	Assembly Core Support Assembly	Assembly W: Baffle Former Assembly	Assembly Bolts Baffle/Former Assembly Bolts	SS, Ni alloy	Not stated	CREEP	Change in dimension
198	Core Support Assembly	W: Baffle Former Assembly	Baffle/Former Assembly Bolts	SS, Ni alloy	Not stated	RELAX	Loss of preload
199	Core Support Assembly	W: Baffle Former Assembly	Baffie/Former Assembly Bolts	SS, Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness
200	Core Support Assembly	W: Baffle Former Assembly	Baffle/Former Assembly Bolts	SS, Ni alloy	Not stated	FAT	Cumulative fatigue damage
201	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Assembly Bolts	SS, Ni alloy	Not stated	EMBR/IR	Loss of fracture toughness
202	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Assembly Bolts	SS, Ni atloy	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
203	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Assembly Bolts	SS, Ni alloy	Not stated	CORRASCC	Crack initiation & growth
204	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Assembly Bolts	SS, Ni alloy	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
205	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Assembly Bolts	SS, Ni alloy	Not stated	ERO/CORR	Wall thinning, loss material

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Effect of Aging on Component Func Core cooling during LOCA	Not stated	Non-significant	Rel.progs	Report Recommendations	Page No.	-
	NOT STATED	based on fatigue usage factor &		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue,	4-26 to 4- 30	19
		review of plant design stress repo		the issue is unresolved		
Impaired coolant flow, damage fuel	Not stated	ASME Sect. XI,		ASME Sect. XI, Subsect. IWB,	5-4	19
elements & instrumentation assembly.		Subsect. IWB		exam. category B-N-3 is effective for internals that are or can be rendered accessible		
Impaired coolant flow, damage fuel	Not stated	Non-significant		NRC recommendation: Crevices are	4-6 to 4-9	19
elements & instrumentation assembly.		because fabricated of SS; stress levels within design specs (More)		known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry		
Impaired coolant flow, damage fuel	Not stated	ASME Section XI,		ASME Section XI, Subsect. IWB is	4-11, 5-6,	19:
elements & instrumentation assembly.		Subsection IWB		effective for internals that are or can be rendered accessible		
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	194
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	195
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	196
Impaired coolant flow, damage fuel	Not stated	Not stated		Non-significant because operating	4-15	197
elements & instrumentation assembly.				temps. are well below levels at which creep is a concern	+13	197
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Management program to be justified on a plant specific basis		Current practices to be enhanced and requires further plant specific evaluation	5-7, 5-8	198
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	199
mpaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Select plant specific management program		This item was not the focus of this NRC review.	5-12 to 5- 15	200
mpaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective for internals that are or can be rendered accessible	5-4	201
mpaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Non-significant because fabricated of SS: stress levels within design specs (More)		NRC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry	4-6 to 4-9	202
mpaired coolant flow, damage tuel dements & instrumentation assembly.	Not stated	ASME Section XI, Subsection IWB			4-11, 5-6, 5-7	203
mpaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.			4-24, 4-25	204
mpaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	205

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tem	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
206	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Assembly Bolts	SS, Ni alloy	NOT STATED	WEAR	Attrition
207	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Assembly Bolts	SS, Ni alloy	Not stated	CREEP	Change in dimension
208	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Assembly Bolts	SS, Ni alkoy	Not stated	RELAX	Loss of preload
209	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Assembly Bolts	SS, Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness
210	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Assembly Bolts	SS, Ni alloy	Not stated	FAT	Cumulative fatigu damage
211	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Tie Rods	SS,	Not stated	EMBR/IR	Loss of tracture toughness
212	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Tie Rods	SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
213	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Tie Rods	SS	Not stated	CORR/IASCC	Crack initiation & growth
214	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Tie Rods	SS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
215	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Tie Rods	SS	Not stated	ERO/CORR	Wall thinning, los material
216	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Tie Rods	ss	Not stated	WEAR	Attrition
217	Assembly Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Tie Rods	SS	Not stated	CREEP	Change in dimension
218	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Tie Rods	SS	Not stated	RELAX	Loss of preload
219	Core Support Assembly	CE:Core Shroud Assembty	Core Shroud Tie Rods	SS	Not stated	EMBR/TE	Loss of fracture toughness
220	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Tie Rods	SS	Not stated	FAT	Cumulative fatigue damage
221	Core Support Assembly	B&W: Core Barrel Assembly	Baffle/Former Bolts	SS, Ni alloy	Not stated	EMBR/IR	Loss of fracture toughness
222	Core Support Assembly	B&W: Core Barrel Assembty	Baffie/Former Bolts	SS, Ni alloy	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material

Document: IR 90-05, PWR Vessel Internals Industry Report Reviewed by: Ornesh K. Chopra, ANL Effect of Aging on Component Function Contrib to Failure Reported progs Impaired coolant flow, damage fuel

Del

Impaired coolant flow, damage fuel elements & instrumentation assembly	Not stated	Not stated	Rel.progs Report Recommendations Page No. Non-significant because not subject 4-19
Impaired coolant flow damage fuel			to relative motion
elements & instrumentation assembly	/ NOT Stated	Not stated	Non-significant have
			terms are well between the terms are well between terms
Impaired coolant flow, damage fuel			temps. are well below levels at which
elements & instrumentation assembly	Not stated	Management	creep is a concern
assembly	·.	program to be	Current practices to be enhanced 5-7, 5-8
		justified on a plant	and requires further plant specific
Impaired coolant flow, damage fuel		specific basis	evaluation
elements & instrumentation assembly.	Not stated	Not stated	
a mar dimentation assembly.			Non-significant because wrought SS 4-21, 4-22
Impaired coolant format			
Impaired coolant flow, damage fuel	Not stated	ASME Sect. XI,	EMBR/IE
elements & instrumentation assembly.		Subsect. IWB, &	NRC recommendation: Until an 5-12 to 5-
		Sect. III, Subsect.	agreement is reached on the draft
1		NG 5000 stand	staff discussion paper on fatigue,
		NG 5200 reanalysis	the issue is unresolved
Impaired coolant flow, damage fuel	Not stated	of usage factor	
elements & instrumentation assembly.	Not Stated	ASME Sect. XI,	ASME Sect. XI, Subsect. IWB, 5-4
		Subsect. IWB	exam category D M a
			exam. category B-N-3 is effective for
Impaired coolant flow, damage fuel	NI-A		internals that are or can be rendered
elements & instrumentation assembly.	Not stated	Non-significant	
a solution assembly.		because fabricated	NRC recommendation: Crevices are 4-6 to 4-9 2
	1	of SS; stress levels	INTOWN Promote SCC in SSs even in 1
		within design spec	The absence of high stress Evaluated
		(More)	
Impaired coolant flow, damage fuel		,	components with crevices or
elements & instrum	Not stated	ASME Section XI.	creviced geometry
elements & instrumentation assembly.		Subsection IWB	ASME Section XI, Subsect IWB is 1411 F.C.
		Supsection IMB	leffective for internals that
Impaired coolant flow, damage fuel	Not stated		be rendered accessible
elements & instrumentation assembly.		Non-significant	NBC recommendation: There is
- ··· ·································		because SS is not	assurance that components made
		susceptible to	from SS are not an
		CORR or	from SS are not exposed to locally corrosive environment
		CORR/PIT in PWR	conosive environment
mpaired coolant flow, damage fuel		environ.	
elements & instrumentation assembly.	Not stated	Not stated	
and the solution assembly.			Non-significant because SS is 4-14 21
			resistant to ERO/CORR low fluid
			flow, pH & particulate control in
npaired coolant flow, damage fuel		_	coolant. & operating pressures
lements & instrumentation assembly.	Not stated	Not stated	preclude cavitation
npaired coolant flow, damage fuel			Non-significant because not subject 4-19 216
emonte Ringehunge fuel	Not stated	Not stated	to relative motion
ements & instrumentation assembly.			Non-significant because operating 4-15 217
			temps. are well below levels at which
paired coolant flow, damage fuel	Not stated		creep is a concern
ements & instrumentation assembly.		ASME Sect XI,	ASME Sect XI Subsect IMP
-	· · ·	Subsect. IWB	exam. category B N 3 is effective for
	1		detecting cracked or
	1		detecting cracked or missing bolts &
paired coolant flow, damage fuel	Not etct	<u></u>	corrective action includes root cause determination
ements & instrumentation assembly.	Not stated	Not stated	
and a semily.			Non-significant because wrought SS 4-21, 4-22, 219
paired coolant flow, damage fuel		_1 1	In alloys are not susceptible to 1
ments & instrumentation assembly.	Not stated	ASME Sect. XI,	EMBR/IE
a second assembly.		Subsect. IWB, &	NRC recommendation: Until an 5-12 to 5-220
!		Sect. III, Subsect	agreement is reached on the draft
		NG 5200 reanalysis	Statt discussion paper on fatigue
		of usage factor	the issue is unresolved
paired coolant flow, damage fuel	Not stated	ASME Sect. XI,	
ments & instrumentation assembly.		Subsect IND	ASME Sect. XI, Subsect. IWB, 5-4 221
-		Subsect. IWB	exam. category B-N-3 is effective for
		1 1	internals that are or can be rendered
aired coolant flow, damage fuel	Not stated	·	accessible
nents & instrumentation assembly.	NUL STALOO	Non-significant	NBC recommendation
a sembly		because fabricated	NRC recommendation: Crevices are 4-6 to 4-9 222
		of SS; stress levels	
		within design spec	ute absence of high stress Evaluate [
1		(More)	
		(More)	components with crevices or creviced geometry

Page 48B

		K. Chopra, ANL	Subcomponent	Materiais	Manufacturer	ARD mechanism	One els initiation &
	ystem		Baffle/Former Bolts	SS, Ni alloy	Not stated		Crack initiation &
	ore Support ssembly	B&W: Core Barrel I Assembly	Ballie/Folliter Dow				growth Loss of material,
	ore Support ssembly	B&W: Core Barrei Assembly	Baffie/Former Bolts	SS, Ni alloy	Not stated	CORN, CONTRACT	Loss of material, corrosion product buildup
		David David Perrol	Baffle/Former Bolts	SS, Ni alkoy	Not stated		Wall thinning, loss of
	ore Support ssembly	B&W: Core Barrel Assembly	Bame/Former Low				material
6 C	Core Support	B&W: Core Barrel	Baffle/Former Bolts	SS, Ni alloy	Not stated	WEAR	Attrition
A	ssembly	Assembly	Polto	SS, Ni alloy	Not stated	CREEP	Change in
27 C	Core Support Assembly	B&W: Core Barrel Assembly	Baffie/Former Bolts	SS, NI alloy			dimension
\perp		B&W: Core Barrel	Baffie/Former Bolts	SS, Ni alloy	Not stated	RELAX	Loss of preload
	Core Support Assembly	B&W: Core Barrel Assembly	Baller offici sol				
29 (Core Support Assembly	B&W: Core Barrel Assembly	Baffle/Former Bolts	SS, Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness
30 (Core Support Assembly	B&W: Core Barrel Assembly	Baffie/Former Bolts	SS, Ni alloy	Not stated	FAT	Cumulative fatigue damage
	Core Support Assembly	B&W: Core Barrel Assembly	Core Barrel Bolts	SS, Ni alloy	Not stated	EMBR/IR	Loss of fracture toughness
					Not stated	CORR/SCC.	Crack initiation &
:32	Core Support Assembly	B&W: Core Barrel Assembly	Core Barrel Bolts	SS, Ni alloy	NUCSIA	CORR/CREV	growth, loss of material
	ı		Core Barrel Bolts	SS, Ni alloy	Not stated	CORR/IASCC	Crack initiation &
233	Core Support Assembly	B&W: Core Barrel Assembly	Core Barrei Doits	55, 141 all - y			growth
234	Core Support Assembly	B&W: Core Barrel Assembly	Core Barrel Bolts	SS, Ni alloy	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
			Core Barrel Bolts	SS, Ni alloy	Not stated	ERO/CORR	Wall thinning, los
235	Core Support Assembly	B&W: Core Barrel Assembly	Cold Dares Done				material
23(6 Core Support	B&W: Core Barrel	Core Barrel Bolts	SS, Ni alloy	Not stated	WEAR	Attrition
	Assembly 7 Core Support	Assembly B&W: Core Barrel	Core Barrel Bolts	SS, Ni alloy	Not stated	CREEP	Change in dimension
	Assembly	Assembly	Core Barrel Bolts	SS, Ni alloy	Not stated	RELAX	Loss of preload
23	8 Core Support Assembly	B&W: Core Barrel Assembly					
	39 Core Support	B&W: Core Barre	el Core Barrel Bolts	s SS, Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness

Document: IR 90-05, PWR Vessel Internals Industry Report

Document: IR 90-05, PWR Vessel internals industry Report Reviewed by: Omesh K. Chopra, ANL Effect of Aging on Component Function Contrib to Failure Reported progs

Effect of Aging on Component Funct Impaired coolant flow, damage fuel	Not stated		Rel.progs	Report Recommendations	Page No.	
elements & instrumentation assembly.		ASME Section XI, Subsection IWB		ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible.	4-11, 5-6, 5-7	22
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	22
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	22!
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Not stated		Non significant because not subject to relative motion	4-19	226
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Not stated		Non-significant because operating temps, are well below levels at which creep is a concern	4-15	227
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Management program to be justified on a plant specific basis		Current practices to be enhanced and requires further plant specific evaluation	5-7, 5-8	228
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	229
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress reports		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4- 30	230
Impaired coolant flow, damage prevent control rod insertion.	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI. Subsect. IWB, exam. category B-N-3 is effective for internals that are or can be rendered accessible.	5-4	231
Impaired coolant flow, damage prevent control rod insertion.	Not stated	ASME Sect. XI, Subsect. IWB, exam. category B-N- 3 is current & effective (More)		NRC recommendation: Augmented ISI of components when sensitized material, high residual stresses, crevices, or history of coolant contamination are present	5-5, 5-6	232
Impaired coolant flow, damage prevent control rod insertion.	Not stated	ASME Section XI, Subsection IWB	<u></u>	ASME Section XI, Subsect, IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	233
Impaired coolant flow, damage prevent control rod insertion.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	234
mpaired coolant flow, damage prevent control rod insertion.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	235
mpaired coolant flow, damage prevent control rod insertion.	Not stated	Not stated	 ,	Non-significant because not subject to relative motion	4-19	236
mpaired coolant flow, damage prevent control rod insertion.	Not stated	Not stated		Non-significant because operating temps, are well below levels at which creep is a concern	4-15	237
mpaired coolant flow, damage prevent control rod insertion.	Not stated	ASME Sect. XI, Subsect. IWB			5-7, 5-8	238
mpaired coolant flow, damage prevent control rod insertion.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	239

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Reviewed by:	Omesh K. Chopra, ANL

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
240	Core Support Assembly	B&W: Core Barrel Assembly	Core Barrel Bolts	SS, Ni alloy	Not stated	FAT	Cumulative fatigue damage
241	Core Support Assembly	W: Baffle Former Assembly or B&W: Core Barrel Assembly	Baffle/Former Assembly Baffles, Baffle/Former Plates	SS	Not stated	EMBR/IR	Loss of fracture toughness
242	Core Support Assembly	W: Baffle Former Assembly or B&W: Core Barrel Assembly	Baffle/Former Assembly Baffles, Baffle/Former Plates	SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
243	Core Support Assembly	W: Baffle Former Assembly or B&W: Core Barrel Assembly	Baffie/Former Assembly Baffies, Baffie/Former Plates	SS	Not stated	CORR/IASCC	Crack initiation & growth
244	Core Support Assembly	W: Baffle Former Assembly or B&W: Core Barrel Assembly	Baffle/Former Assembly Baffles, Baffle/Former Plates	SS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
245	Core Support Assembly	W: Baffle Former Assembly or B&W: Core Barrel Assembly	Batfle/Former Assembly Batfles, Batfle/Former Plates	SS	Not stated	ERO/CORR	Wall thinning, loss of material
246	Core Support Assembly	W: Baffle Former Assembly or B&W: Core Barrel Assembly	Baffle/Former Assembly Baffles, Baffle/Former Plates	SS	Not stated	WEAR	Attrition
247	Core Support Assembly	W: Baffle Former Assembly or B&W: Core Barrel Assembly	Baffle/Former Assembly Baffles, Baffle/Former Plates	SS	Not stated	CREEP	Change in dimension
248	Core Support Assembly	W: Baffle Former Assembly or B&W: Core Barrel Assembly	Batfle/Former Assembly Batfles, Batfle/Former Plates	SS	Not stated	RELAX	Loss of preload
249	Core Support Assembly	W: Baffle Former Assembly or B&W: Core Barrel Assembly	Batfle/Former Assembly Batfles, Batfle/Former Plates	SS	Not stated	EMBR/TE	Loss of fracture toughness
250	Core Support Assembly	W: Baffle Former Assembly or B&W: Core Barrel Assembly	Baffle/Former Assembly Baffles, Baffle/Former Plates	SS	Not stated	FAT	Cumulative fatigue damage
251	Core Support Assembly	W:Upper Core Plate Alignment Pins	Not stated	SS, Ni alloy	Not stated	EMBR/IR	Loss of fracture toughness
252	Core Support Assembly	W:Upper Core Plate Alignment Pins	Not stated	SS, Ni alloy	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
253	Core Support Assembly	W:Upper Core Plate Alignment Pins	Not stated	SS, Ni alloy	Not stated	CORR/IASCC	Crack initiation & growth

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impaired coolant flow, damage prevent	Not stated	Non-significated	Rel.progs	Report Recommendations	Page No.	
control rod insertion.	NOT STATED	Non-significant based on fatigue usage factor &		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue,	4-26 to 4- 30	24
		review of plant design stress reports		the issue is unresolved		
Impaired coolant flow, damage fuel	Not stated	ASME Sect. XI.		ASME Sect. XI, Subsect. IWB,	5-4	<u> </u>
elements & instrumentation assembly.		Subsect. IWB		exam. category B N 3 is effective for internals that are or can be rendered accessible		241
Impaired coolant flow, damage fuel	Not stated	Non-significant		NRC recommendation: Crevices are	4-6 10 4-9	242
elements & instrumentation assembly.		because fabricated of SS; stress levels within design specs (More)		known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry	1	242
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	ASME Section XI, Subsection IWB		ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	243
Impaired coolant flow, damage fuel	Not stated	Non-significant		NRC recommendation: There is no	4-24, 4-25	244
elements & instrumentation assembly.		because SS is not susceptible to CORR or CORR/PIT in PWR environ.		assurance that components made from SS are not exposed to locally corrosive environment		
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	245
mpaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	246
mpaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Not stated		Non-significant because operating temps. are well below levels at which creep is a concern	4-15	247
mpaired coolant flow, damage fuel	Not stated	Not stated				
lements & instrumentation assembly.		Not stated		Non-significant because components do not depend on preload	4-16, 4-17	248
npaired coolant flow, damage fuel lements & instrumentation assembly.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	249
npaired coolant flow, damage fuel lements & instrumentation assembly.		Non-significant based on fatigue usage factor & review of plant design stress reports			4-26 to 4- 30	250
oss of core support during LOCA.		ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective for internals that are or can be rendered accessible.	5-4	251
oss of core support during LOCA.		Non-significant because fabricated of SS; stress levels within design specs (More)		NRC recommendation: Crevices are a known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or	4-6 to 4-9	252
oss of core support during LOCA.		ASME Section XI, Subsection IWB		creviced geometry	4-11, 5-6,	253

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Reviewed by:	Omesh K. Chopra, ANL

System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
Core Support Assembly	W:Upper Core Plate Alignment Pins	Not stated	SS, Ni alloy	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
Core Support Assembly	W:Upper Core Plate Alignment Pins	Not stated	SS, Ni alkoy	Not stated	ERO/CORR	Wall thinning, loss of material
Core Support Assembly	W:Upper Core Plate Alignment Pins	Not stated	SS, Ni alloy	Not stated	WEAR	Attrition
Core Support Assembly	W:Upper Core Plate Alignment Pins	Not stated	SS, Ni alloy	Not stated	CREEP	Change in dimension
Core Support Assembly	W:Upper Core Plate Alignment Pins	Not stated	SS, Ni alloy	Not stated	RELAX	Loss of preload
Core Support Assembly	W:Upper Core Plate Alignment Pins	Not stated	SS, Ni alloy	Not stated	EMBR/TE	Loss of tracture toughness
Core Support Assembly	W:Upper Core Plate Alignment Pins	Not stated	SS, Ni alloy	Not stated	FAT	Cumulative fatigue damage
Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	EMBR/IR	Loss of fracture toughness
Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	ss	Not stated	CORR/IASCC	Crack initiation & growth
Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss material
Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	WEAR	Attrition
Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	CREEP	Change in dimension
3 Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	RELAX	Loss of preload
Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
	Core Support Assembly Core Support Assembly	Core Support AssemblyW:Upper Core Plate Alignment PinsCore Support AssemblyCE: Fuel Alignment Plate Guide LugsCore Support AssemblyCE: Fuel Ali	Ore Support W:Upper Core Plate Not stated Assembly Alignment Pins Not stated Core Support W:Upper Core Plate Not stated Assembly Alignment Pins Not stated Core Support W:Upper Core Plate Not stated Assembly Alignment Pins Not stated Core Support W:Upper Core Plate Not stated Assembly Alignment Pins Not stated Core Support W:Upper Core Plate Not stated Assembly Alignment Pins Not stated Core Support W:Upper Core Plate Not stated Assembly CE: Fuel Alignment Not stated Core Support CE: Fuel Alignment Not stated Assembly CE: Fuel Alignment	System W:Upper Core Plate Alignment Pins Not stated SS, Ni alloy Core Support Assembly W:Upper Core Plate Alignment Pins Not stated SS, Ni alloy Core Support Assembly W:Upper Core Plate Alignment Pins Not stated SS, Ni alloy Core Support Assembly W:Upper Core Plate Alignment Pins Not stated SS, Ni alloy Core Support Assembly W:Upper Core Plate Alignment Pins Not stated SS, Ni alloy Core Support Assembly W:Upper Core Plate Alignment Pins Not stated SS, Ni alloy Core Support Assembly W:Upper Core Plate Alignment Pins Not stated SS, Ni alloy Core Support Assembly W:Upper Core Plate Alignment Pins Not stated SS, Ni alloy Core Support Assembly CE: Fuel Alignment Plate Guide Lugs Not stated SS Core Support Assembly CE: Fuel Alignment Plate Guide Lugs Not stated SS Core Support Assembly CE: Fuel Alignment Plate Guide Lugs Not stated SS Core Support Assembly CE: Fuel Alignment Plate Guide Lugs Not stated SS Core Support Assembly CE: Fuel Alignment Plate Gu	Spinition W:Upper Core Plate Not stated SS, Ni alloy Not stated Core Support Alignment Pins Not stated SS, Ni alloy Not stated Core Support W:Upper Core Plate Not stated SS, Ni alloy Not stated Core Support W:Upper Core Plate Not stated SS, Ni alloy Not stated Core Support W:Upper Core Plate Not stated SS, Ni alloy Not stated Core Support W:Upper Core Plate Not stated SS, Ni alloy Not stated Assembly W:Upper Core Plate Not stated SS, Ni alloy Not stated Assembly W:Upper Core Plate Not stated SS, Ni alloy Not stated Assembly W:Upper Core Plate Not stated SS, Ni alloy Not stated Core Support W:Upper Core Plate Not stated SS, Ni alloy Not stated Assembly Plate Guide Lugs Not stated SS Not stated Core Support CE: Fuel Alignment Not stated SS Not stated Core Support <td>Core Support Assembly Wupper Core Plate Alignment Pins Not stated SS. Ni alloy Not stated CORR, CORR/PTT Core Support Assembly Wupper Core Plate Alignment Pins Not stated SS. Ni alloy Not stated ERO/CORR Core Support Assembly Wupper Core Plate Alignment Pins Not stated SS. Ni alloy Not stated ERO/CORR Core Support Assembly Wupper Core Plate Alignment Pins Not stated SS. Ni alloy Not stated CREEP Core Support Assembly Wupper Core Plate Alignment Pins Not stated SS. Ni alloy Not stated CREEP Core Support Assembly Wupper Core Plate Alignment Pins Not stated SS. Ni alloy Not stated EMBR/TE Core Support Assembly Wupper Core Plate Alignment Pins Not stated SS. Ni alloy Not stated EMBR/TE Core Support Assembly Wupper Core Plate Alignment Pins Not stated SS. Ni alloy Not stated EMBR/TE Core Support Assembly CE: Fuel Alignment Plate Guide Lugs Not stated SS Not stated CORR/GCC, DORR/CREV Core Support Assembly CE:</td>	Core Support Assembly Wupper Core Plate Alignment Pins Not stated SS. Ni alloy Not stated CORR, CORR/PTT Core Support Assembly Wupper Core Plate Alignment Pins Not stated SS. Ni alloy Not stated ERO/CORR Core Support Assembly Wupper Core Plate Alignment Pins Not stated SS. Ni alloy Not stated ERO/CORR Core Support Assembly Wupper Core Plate Alignment Pins Not stated SS. Ni alloy Not stated CREEP Core Support Assembly Wupper Core Plate Alignment Pins Not stated SS. Ni alloy Not stated CREEP Core Support Assembly Wupper Core Plate Alignment Pins Not stated SS. Ni alloy Not stated EMBR/TE Core Support Assembly Wupper Core Plate Alignment Pins Not stated SS. Ni alloy Not stated EMBR/TE Core Support Assembly Wupper Core Plate Alignment Pins Not stated SS. Ni alloy Not stated EMBR/TE Core Support Assembly CE: Fuel Alignment Plate Guide Lugs Not stated SS Not stated CORR/GCC, DORR/CREV Core Support Assembly CE:

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tion Contrib to Failure		Rel.progs	Report Recommendations	Page No.	_
NOT STATED	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NHC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	5 25
Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	25
Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective program for detection of WEAR	4-19	25
Not stated	Not stated		Non significant because operating temps, are well below levels at which creep is a concern	4-15	25
Not stated	Not stated		Non-significant because components do not depend on preload.	4-16, 4-17	25
Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	259
Not stated	ASME Sect. XI, Subsect. IWB, & Sect. III, Subsect. NG 5200 reanalysis of usage factor		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	5-12 to 5- 15	260
Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective for internals that are or can be rendered accessible	5-4	261
Not stated	Non-significant because fabricated of SS; stress levels within design specificatio		known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or	4-6 to 4-9	262
Not stated	ASME Section XI, Subsection IWB		ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	263
Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	264
Not stated	Not stated		Non significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	265
Not stated	ASME Sect. XI, Subsect. IWB		exam. category B-N-3 is effective	4-19	266
Not stated	Not stated		Non-significant because operating temps. are well below levels at which	4-15	267
Not stated	Not stated			4-16, 4-17	268
Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to	4-21, 4-22	269
	Not stated Not stated	because SS is not susceptible to CORR or CORR/PIT in PWR environ. Not stated Not stated Not stated ASME Sect. XI, Subsect. IWB Not stated Not stated Not stated ASME Sect. XI, Subsect. IWB, & Sect. III, Subsect. NG 5200 reanalysis of usage factor Not stated ASME Sect. XI, Subsect. IWB Not stated Non-significant because fabricated of SS; stress levels within design specificatio Not stated ASME Section XI, Subsection IWB Not stated ASME Section XI, Subsection IWB Not stated Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ. Not stated Not stated Not stated Not stated Not stated ASME Sect. XI, Subsect. IWB Not stated Not stated Not stated Not stated Not stated Not stated Not stated Not stated	because SS is not susceptible to CORR or CORR or CORR/PT in PWR environ. Not stated Not stated Not stated ASME Sect. XI, Subsect. IWB Not stated Not stated Not stated ASME Sect. XI, Subsect. IWB, & Sect. III, Subsect. Not stated ASME Sect. XI, Subsect. IWB, & Sect. III, Subsect. Not stated ASME Sect. XI, Subsect. IWB Not stated Non-significant because fabricated of SS; stress levels within design specificatio Not stated Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ. Not stated Not stated Not stated Not stated Not stated Not stated Not stated Not stated Not stated Not stated	because SS is not susceptible to CORR/PT In PWR environ. assurance that components made from SS are not exposed to locally corrosive environment Not stated Not stated Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in cootant. & porariting pressures preclude cavitation Not stated ASME Sect. XI, Subsect. IWB ASME Sect. XI, Subsect. IWB ASME Sect. XI, Subsect. IWB Not stated Not stated Non significant because oprating temps. are well below levels at which creep is a concern Not stated Not stated Non significant because concern Non significant because concern Not stated Not stated Non-significant because wrought SS stat discusse preprint temps. are well below levels at which creep is a concern Not stated Not stated Non-significant because wrought SS stat discusse preprint temps. are well below levels at which creep is a concern Not stated Not stated Non-significant because wrought SS stat discusses napper on targue, the issue is unresolved Not stated ASME Sect. XI, Subsect. IWB, & Subsect. IWB, & Subsect. IWB Subsect. IWB is discusse there or an be rendered accessible Not stated Non-significant because fabricated of SS; stress levels the potential of CORR/SCC of components with crevices or creviced geometry CORR/PT in PWR envicon. Not stated N	because SS is not susceptible to CORR or CORR or CORR PIT in PWR environ assurance that components made from SS are not exposed to locally corrosive environment Not stated Not-significant because SS is nesistant to ERO/CORR, low fluid flow, pH & particulate control in cookint, & operating pressures 4-14 Not stated ASME Sect. XI, Subsect. IWB ASME Sect. XI, Subsect. IWB 4-19 Not stated Not stated Non-significant because operating is a concern 4-16 Not stated Not stated Non-significant because operating is a concern 4-16 Not stated Non-significant because wrought SS is a concern 4-16 4-17 Not stated Non-significant because wrought SS is a concern 4-16 4-17 Not stated Non-significant because wrought SS is a concern 4-16 4-17 Not stated Non-significant because wrought SS is a concern 4-16 4-17 Not stated Non-significant because wrought SS is a concern 5-2 5-2 Not stated ASME Sect. XI, Subsect IWB, is a large ement is reached on the draft is taff discussion paper on tabuye, in termals that are or can be readveed accessible 5-4 Not stated Non-significant because fabricated of SSS is tess levels the absence

Document: IR 9	90-05, PWR Vessel Internals in	ndustry Report
Reviewed by:	Omesh K. Chopra, ANL	
Item System	Structure/Comp	Subcompo

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
270	Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
271	Lower Internais Assembly	W: Lower Core Plate or CE: Core Support Plate	Not stated	ss	Not stated	EMBR/IR	Loss of fracture toughness
272	Lower Internals Assembly	W: Lower Core Plate or CE: Core Support Plate	Not stated	SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
273	Lower Internals Assembly	W: Lower Core Plate or CE: Core Support Plate	Not stated	ss	Not stated	CORR/IASCC	Crack initiation & growth
274	Lower Internals Assembly	W: Lower Core Plate or CE: Core Support Plate	Not stated	SS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
275	Lower Internals Assembly	W: Lower Core Plate or CE: Core Support Plate	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss of material
276	Lower Internals Assembly	W: Lower Core Plate or CE: Core Support Plate	Not stated	SS	Not stated	WEAR	Attrition
277	Lower Internals Assembly	W: Lower Core Plate or CE: Core Support Plate	Not stated	SS	Not stated	CREEP	Change in dimension
278	Lower Internals Assembly	W: Lower Core Plate or CE: Core Support Plate	Not stated	SS	Not stated	RELAX	Loss of preload
279	Lower Internals Assembly	W: Lower Core Plate or CE: Core Support Plate	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
280	Lower Internals Assembly	W: Lower Core Plate or CE: Core Support Plate	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
281	Lower Internals Assembly	B&W:Lower Grid Top Rib Section	Not stated	SS	Not stated	EMBR/IR	Loss of fracture toughness
282	Lower Internals Assembly	B&W:Lower Grid Top Rib Section	Not stated	SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
283	Lower internals Assembly	B&W:Lower Grid Top Rib Section	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth
284	Lower Internals Assembly	B&W:Lower Grid Top Rib Section	Not stated	SS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup

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 Document:
 IR 90-05, PWR Vessel Internals Industry Report

 Reviewed by:
 Omesh K. Chopra, ANL

 Effect of Aging on Component Function Contrib to Failure
 Reported progs

 Rel.progs

Not stated	based on fatigue usage factor & review of plant design stress	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4 30	4-
Not stated	usage factor & review of plant design stress	staff discussion paper on fatigue	30	
Not stated	review of plant design stress	staff discussion paper on fatigue		
Not stated	design stress	the issue is unresolved		- 1
Not stated				
Not stated				
Not stated	reports			1
	ASME Sect. XI			
		ASME Sect. XI, Subsect. IWB,	5-4	
	Subsect. IWB	exam. category B N 3 is effective to		1 4
		internals that are or can be rendered	<i>N</i>	
	_	acconstible		
Not stated	Non-significant			
		INFC recommendation: Crevices an	re 4-6 to 4-9	9 2
	because rabricated	known promote SCC in SSs even in	ni	· -
	or SS; stress levels	the absence of high stress Evaluat		1
	within design specs	the notential of CORP/SCC of	•	
	(More)	Ste persona of CORH/SCC of		
		components with crevices or		
Not stated	ASME Socher VI	creviced geometry		
		ASME Section XI, Subsect, IWB is	4-11 5-6	. 2
	Subsection IWB	effective for internals that are an		· 4
	.	the rendered assessit	15-7	
Not stated	Non-significant			
	been and and	NRC recommendation: There is no	4-24, 4-25	5 2
1		assurance that components made		1 1
		from SS are not exposed to locally	1	1
1	CORR or	corrosive environment	1	1
1	CORR/PIT in PWR	Sive environment	1	1
1			1	1
Not stated			1	1
I TOL SIGLOU	NOT STATED	Non-significant because SS is	A-14	2
1			4-14	2/
		Here all a EHO/COHH, IOW TUIC	1	
		now, pH & particulate control in	1	
		coolant, & operating pressures	1 1	1
Notated		preclude cavitation		1
Not stated	Not stated		 	<u> </u>
		to tolotive meting	4-19	27
Not stated	Not stated		11	1
	NOT STATED	Non-significant because operating	4-15	27
		temps, are well below levels at utrich		
		Creen is a concern	1 1	1
Not stated	Not stated		-	
	1 1	international Decause	4-16, 4-17	27
Not stated	Not stated			
	Not stated	Non-significant because wrought SS	4-21 4-22	27
		& Ni alloys are not susceptible to		
		EMBR/TE		
NOT STATED	ASME Sect. XI,	NDO		
	Subsect IWR &	nine recommendation: Until an	5-12 to 5-	280
	Sect III Subsect	agreement is reached on the draft	15	
	NG EDOD	staff discussion paper on fatigue	ł	
		the issue is unresolved	1	
	of usage factor		1	
Not stated	ASME Sect. XI	ASME Soot VI Out		
		NOWE SHOL XI, SUBSECT. IWB,	5-4	281
1		exam. category B-N-3 is effective for		
· ·		internals that are or can be rendered		
Not at-t	-+	accessible	1	
NOT STATED	Non-significant			
1		the sum and the function of the sum of the s	4-6 to 4-9	282
· ·	of SS: stress louis	Known promote SCC in SSs even in	1	
ł	within design	the absence of high stress	J	
1		Evaluate the potential of COBB/SCO		
1		of components with crevices or	1	
		creviced geometry		
NOT STATED	ASME Section XI.	ASME Section VI Subara HALE		
í	Subsection IWR	offective for in Subsect IWB is 4	-11, 5-6,	283
		effective for internals that are or can 5	-7	
Not stated		De rendered accessible	1	
	ivon-signincant	NRC recommendation. There is no. 14	-24 4-25	20.1
	Decause SS is not	assurance that components in 10 4	-27, 4-20 2	284
	susceptible to	from SS and a state with ponents made	1	
	CORR or	from SS are not exposed to locally	1	
		corrosive environment	1	
	CORR/PIT in PWR		1	- 1
	CORR/PIT in PWR			
	Not stated Not stated Not stated	Not stated ASME Section XI, Subsection IWB Not stated ASME Section XI, Subsection IWB Not stated Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ. Not stated Not stated Not stated ASME Sect. XI, Subsect. IWB, & Sect. IIV, Subsect. NG 5200 reanalysis of usage factor Not stated ASME Sect. XI, Subsect. IWB Not stated Non-significant because fabricated of SS; stress levels within design specs (More) Not stated Non-significant because SS is not	Not stated Non-significant because fabricated of SS, stress levels within design specs (More) NRC recommendation: the absence of high stress. Evaluat the potential of CORR/SCC of components with crevices or creviced geometry Not stated ASME Section XI, Subsection IWB Not stated Non-significant because SS is reclude cavitation cookant, & operating pressures preclude cavitation cookant, & operating pressures preclude cavitation Non-significant because operating lemps, are well below levels at which creep is a concern Not stated Not stated Non-significant because operating lemps, are well below levels at which creep is a concern Not stated Not stated Non-significant because operating lemps, are well below levels at which creep is a concern Not stated Not stated Non-significant because operating lemps, are well below levels at which creep is a concern Not stated Not stated Non-significant because operating lemps, are well below levels at w	Not stated Non-significant because fabricated of SS; stress levels (More) ANC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry. Not stated ASME Section XI, Subsecton IWB ASME Section XI, Subsect IWB is effective to internal stat are or can be rendered accessible 4-11.5-6 Not stated Non-significant because SS is not subsection in the state of CORR/PT IF IP WR environ. Non-significant because SS is resistant to ERO/CORR, Now fluid flow, pH & particulate, control in coolant, & operating pressures precube cavitation 4-14 Not stated Not stated Non-significant because SS is precube cavitation 4-14 Not stated Not stated Non-significant because SS is precube cavitation 4-14 Not stated Non-significant because operating to relative motion 4-14 Not stated Non-significant because operating to relative motion 4-15 Not stated Non-significant because operating to relative motion 4-16, 4-17 Not stated Non-significant because wrought SS sect. III, Subsect. 4-16, 4-17 Not stated Non-significant because wrought SS sect. III, Subsect. 4-16, 4-17 Not stated Non-significant because wrought SS set 2: 0; Subsect.

Page 52B

System Lower Internals		Subcomponent				
	B&W:Lower Grid	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss of material
Assembly	Top Rib Section					
Lower Internals	B&W:Lower Grid	Not stated	SS	Not stated	WEAR	Attrition
Assembly	Top Rib Section B&W:Lower Grid	Not stated	ss	Not stated	CREEP	Change in dimension
Assembly	Top Rib Section					Loss of preload
Lower Internals Assembly	B&W:Lower Grid Top Rib Section	Not stated	SS	Not stated		Loss of fracture
Lower Internals Assembly	B&W:Lower Grid Top Rib Section	Not stated	SS	Not stated	EMBR/TE	toughness
Lower Internals Assembly	B&W:Lower Grid Top Rib Section	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
Lower internals		Not stated	SS, Ni alloy	Not stated	EMBR/IR	Loss of fracture toughness
Assembly	Fuel Alignment Pins					
Lower internals Assembly	W: Fuel Pins or CE Fuel Alignment Pins	Not stated	SS, Ni alloy	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
Lower Internals			SS, Ni alloy	Not stated	CORR/IASCC	Crack initiation & growth
Lower Internals Assembly			SS, Ni alloy	Not stated	CORR, CORR/PIT	Loss of material, corrosion produc buildup
Lower Internals Assembly			SS, Ni alloy	Not stated	ERO/CORR	Wall thinning, los material
S i over internals	W. Fuel Pins or C	Not stated	SS, Ni alloy	Not stated	WEAR	Attrition
Assembly						Change in
7 Lower Internals Assembly			SS, Ni alloy	Not stated	CREEP	dimension
8 Lower Internals Assembly			SS, Ni alloy	Not stated	RELAX	Loss of preload
9 Lower Internals Assembly			SS, Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness
00 Lower Internals Assembly			SS, Ni ali oy	Not stated	FAT	Cumulative tatig damage
	Assembly Lower Internals Assembly Lower Internals Assembly	AssemblyTop Rib SectionLower InternalsB&W:Lower GridAssemblyTop Rib SectionLower InternalsB&W:Lower GridLower InternalsW: Fuel Pins or CE:AssemblyFuel Alignment PinsLower InternalsW: Fuel Pins or CEAssemblyFuel Alignment PinsJ Lower InternalsW: Fuel Pins or CEAssemblyFuel Alignment Pins <td>Lower Internals AssemblyTop Rib SectionLower Internals AssemblyB&W:Lower Grid Top Rib SectionNot statedLower Internals AssemblyW: Fuel Pins or CE: Fuel Alignment PinsNot statedLower Internals<</td> <td>Dower Internals Dott Not Stated Not stated Lower Internals B&W:Lower Grid Not stated SS Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy</td> <td>Cover Internals BetWI: Lower Grid Not stated SS Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals W: Fuel Pins or CE Not stated SS, Ni alloy Not stated Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy Not stated Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy Not stated Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy Not stated Lower Internals W: Fuel Pins or CE: <td< td=""><td>Dower Internals Desk Section Not stated SS Not stated CREEP Cover Internals B&W/Lower Grid Not stated SS Not stated CREEP Cover Internals B&W/Lower Grid Not stated SS Not stated RELAX Lower Internals B&W/Lower Grid Not stated SS Not stated EMBR/TE Lower Internals B&W/Lower Grid Not stated SS Not stated EMBR/TE Lower Internals B&W/Lower Grid Not stated SS Not stated EMBR/TE Lower Internals B&W/Lower Grid Not stated SS Not stated EMBR/TE Lower Internals B&W/Lower Grid Not stated SS Not stated EMBR/R Lower Internals W: Fuel Pins or CE Not stated SS, Ni alloy Not stated CORR/GC, CORR/CC, CORR/CC, CORR/CC, CORR/CC, CORR/CREV Lower Internals W: Fuel Pins or CE Not stated SS, Ni alloy Not stated CORR/ASCC Lower Internals W: Fuel Pins or CE Not stated SS, Ni a</td></td<></td>	Lower Internals AssemblyTop Rib SectionLower Internals AssemblyB&W:Lower Grid Top Rib SectionNot statedLower Internals AssemblyW: Fuel Pins or CE: Fuel Alignment PinsNot statedLower Internals<	Dower Internals Dott Not Stated Not stated Lower Internals B&W:Lower Grid Not stated SS Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy	Cover Internals BetWI: Lower Grid Not stated SS Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals W: Fuel Pins or CE Not stated SS, Ni alloy Not stated Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy Not stated Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy Not stated Lower Internals W: Fuel Pins or CE: Not stated SS, Ni alloy Not stated Lower Internals W: Fuel Pins or CE: <td< td=""><td>Dower Internals Desk Section Not stated SS Not stated CREEP Cover Internals B&W/Lower Grid Not stated SS Not stated CREEP Cover Internals B&W/Lower Grid Not stated SS Not stated RELAX Lower Internals B&W/Lower Grid Not stated SS Not stated EMBR/TE Lower Internals B&W/Lower Grid Not stated SS Not stated EMBR/TE Lower Internals B&W/Lower Grid Not stated SS Not stated EMBR/TE Lower Internals B&W/Lower Grid Not stated SS Not stated EMBR/TE Lower Internals B&W/Lower Grid Not stated SS Not stated EMBR/R Lower Internals W: Fuel Pins or CE Not stated SS, Ni alloy Not stated CORR/GC, CORR/CC, CORR/CC, CORR/CC, CORR/CC, CORR/CREV Lower Internals W: Fuel Pins or CE Not stated SS, Ni alloy Not stated CORR/ASCC Lower Internals W: Fuel Pins or CE Not stated SS, Ni a</td></td<>	Dower Internals Desk Section Not stated SS Not stated CREEP Cover Internals B&W/Lower Grid Not stated SS Not stated CREEP Cover Internals B&W/Lower Grid Not stated SS Not stated RELAX Lower Internals B&W/Lower Grid Not stated SS Not stated EMBR/TE Lower Internals B&W/Lower Grid Not stated SS Not stated EMBR/TE Lower Internals B&W/Lower Grid Not stated SS Not stated EMBR/TE Lower Internals B&W/Lower Grid Not stated SS Not stated EMBR/TE Lower Internals B&W/Lower Grid Not stated SS Not stated EMBR/R Lower Internals W: Fuel Pins or CE Not stated SS, Ni alloy Not stated CORR/GC, CORR/CC, CORR/CC, CORR/CC, CORR/CC, CORR/CREV Lower Internals W: Fuel Pins or CE Not stated SS, Ni alloy Not stated CORR/ASCC Lower Internals W: Fuel Pins or CE Not stated SS, Ni a

Document: IR 90-05, PWR Vessel Internals Industry Report

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Document: IR 90-05, PWR Vessel Internals Industry Report Reviewed by: Omesh K. Chopra, ANL Effect of Aging on Component Function Contrib to Failure Reported progs

Effect of Aging on Component Func Damaged fuel assembly, impair reactor	Not stated	Not stated		Report Recommendations	Page No	_
shut down, flow blockage. Damaged fuel assembly, impair reactor				Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	2
shut down, flow blockage. Damaged fuel assembly, impair reactor	Not stated	Not stated		Non-significant because not subject	1 4-19	2
shut down, flow blockage.	Not stated	Not stated		Non-significant because operating temps, are well below levels at whic creep is a concern	4-15 h	2
Damaged fuel assembly, impair reactor shut down, flow blockage.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	7 2
Damaged fuel assembly, impair reactor shut down, flow blockage.	Not stated	Not stated	<u> </u>	Non-significant because wrought SS & Ni alloys are not susceptible to	6 4-21, 4-22	2 21
Damaged fuel assembly, impair reactor shut down, flow blockage.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress		EMBR/TE NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4- 30	29
Damaged fuel assembly, impair reactor shut down, flow blockage. Damaged fuel assembly, impair reactor	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective for internals that are or can be rendered accessible	5-4	29
hut down, flow blockage.	Not stated	Non-significant because fabricated of SS; stress levels within design specs (More)		NRC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry	1 1	29
hut down, flow blockage.	Not stated	ASME Section XI, Subsection IWB		ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	29
amaged fuel assembly, impair reactor nut down, flow blockage.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	294
amaged fuel assembly, impair reactor aut down, flow blockage.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	295
amaged fuel assembly, impair reactor ut down, flow blockage.	Not stated	ASME Sect. XI, Subsect. IWB			5-9	296
amaged fuel assembly, impair reactor ut down, flow blockage.	Not stated	Not stated		Non-size (Constant)	4-15	297
maged fuel assembly, impair reactor ut down, flow blockage.	Not stated	ASME Sect. XI, Subsect. IWB		10115 0	5-7, 5-8	298
ut down, flow blockage.	Not stated	Not stated		Non-significant because wrought SS 4 & Ni alloys are not susceptible to EMBR/TE	-21, 4-22	299
maged fuel assembly, impair reactor it down, flow blockage.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress reports		NRC recommendation: Until an 4	-26 to 4-	300

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em	System		Subcomponent	Materials	Manufacturer Not stated	ARD mechanism	Loss of tracture
301	Lower Internals Assembly	B&W:Fuel Guide Pads	Not stated	SS	NOT STATED	EMDIVITY	toughness
302	Lower Internals Assembly	B&W:Fuel Guide Pads	Not stated	SS	Not stated	CORR/SCC. CORR/CREV	Crack initiation & growth, loss of material
303	Lower Internals	B&W:Fuel Guide Pads	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth
304	Assembly Lower Internals Assembly	B&W:Fuel Guide Pads	Not stated	ss	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
305	Lower Internals Assembly	B&W:Fuel Guide Pads	Not stated	ss	Not stated	ERO/CORR	Wall thinning, los material
306	Lower internals Assembly	B&W:Fuel Guide Pads	Not stated	ss	Not stated	WEAR	Attrition
307	Lower Internals Assembly	B&W:Fuel Guide Pads	Not stated	SS	Not stated	CREEP	Change in dimension
308	3 Lower Internals Assembly	B&W:Fuel Guide Pads	Not stated	SS	Not stated	RELAX	Loss of preload
30	9 Lower Internals Assembly	B&W:Fuel Guide Pads	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
31	0 Lower Internals Assembly	B&W:Fuel Guide Pads	Not stated	SS	Not stated	FAT	Cumulative fatig damage
31	1 Lower internals Assembly	W: Lower Support Plate or CE: Lower Support Structure Beam Assembly, or B&W: Lower Grid Bottom Rib		SS	Not stated	EMBR/IR	Loss of fracture toughness
31	2 Lower Internals Assembly	Weldment W: Lower Support Plate or CE: Lower Support Structure Beam Assembly, of B&W: Lower Grid Bottom Rib		SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation growth, loss of material
3	13 Lower Internais Assembly	Weldment W: Lower Support Plate or CE: Lowe Support Structure Beam Assembly, o B&W: Lower Grid Bottom Rib	r	SS	Not stated	CORR/IASCC	Crack initiation growth
3	14 Lower Internals Assembly	Weldment W: Lower Suppor Plate or CE: Lowe Support Structure Beam Assembly, c B&W: Lower Grid Bottom Rib	r pr	SS	Not stated	CORR, CORR/PI	T Loss of materia corrosion prod buildup

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Document: IR 90-05, PWR Vessel Internals Industry Report Reviewed by: Ornesh K. Chopra, ANL Effect of Aging on Component Function Contrib to Failure Reported p

Effect of Aging on Component Functi Damaged fuel assembly, impair reactor	Not stated		Rel.progs	Report Recommendations	Page No.	_
shut down, flow blockage.	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B N 3 is effective for internals that are or can be rendered accessible		30
Damaged fuel assembly, impair reactor shut down, flow blockage.	Not stated	Non-significant because fabricated of SS; stress levels within design specs (More)		NRC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or		302
Damaged fuel assembly, impair reactor shut down, flow blockage.	Not stated	ASME Section XI, Subsection IWB		ASME Section XI, Subsect, IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	303
Damaged fuel assembly, impair reactor shut down, flow blockage.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	304
Damaged fuel assembly, impair reactor shut down, flow blockage.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	305
Damaged fuel assembly, impair reactor shut down, flow blockage.	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective program for detection of WEAR	5-9	306
Damaged fuel assembly, impair reactor shut down, flow blockage.	Not stated	Not stated		Non-significant because operating temps, are well below levels at which creep is a concern	4-15	307
Damaged fuel assembly, impair reactor shut down, flow blockage.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	308
Damaged fuel assembly, impair reactor shut down, flow blockage.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE.	4-21, 4-22	309
Damaged fuel assembly, impair reactor shut down, flow blockage.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress reports	····	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4- 30	310
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective for internals that are or can be rendered accessible	5-4	311
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Non-significant because fabricated of SS; stress levels within design specs (More)		NRC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry	4-6 to 4-9	312
oss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	ASME Section XI, Subsection IWB		ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	313
oss of core support, impair reactor shut lown, damaged fuel & instrumentation issemblies.		Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24. 4-25	314

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects Wall thinning, loss of
315	Lower Internals Assembly	W: Lower Support Plate or CE: Lower Support Structure Beam Assembly, or B&W: Lower Grid Bottom Rib Weldment	Not stated	SS	Not stated	ERO/CORR	Wali thinning, loss of material
	Lower Internals Assembly	Weldment W: Lower Support Plate or CE: Lower Support Structure Bearn Assembly, or B&W: Lower Grid Bottom Rib Weldment	Not stated	SS	Not stated	WEAR	Attrition
	Lower Internals Assembly	W: Lower Support Plate or CE: Lower Support Structure Beam Assembly, or B&W: Lower Grid Bottom Rib Weldment	Not stated	SS	Not stated	CREEP	Change in dimension
	Lower Internais Assembly	W: Lower Support Plate or CE: Lower Support Structure Beam Assembly, or B&W: Lower Grid Bottom Rib Weldment	Not stated	SS	Not stated	RELAX	Loss of preload
319	Lower Internals Assembly	Welchnent W: Lower Support Plate or CE: Lower Support Structure Beam Assembly, or B&W: Lower Grid Bottom Rib Weldment	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
320	Lower Internals Assembly	W: Lower Support Plate or CE: Lower Support Structure Beam Assembly, or B&W: Lower Grid Bottom Rib Weldment		SS	Not stated	FAT	Cumulative fatigue damage
321	Lower Internals Assembly	W:Lower Support Plate	Not stated	CASS	Not stated	EMBR/IR	Loss of fracture toughness
322	Lower Internals Assembly	W:Lower Support Plate	Not stated	CASS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
323	Lower Internals Assembly	W:Lower Support Plate	Not stated	CASS	Not stated	CORRAASCC	Crack initiation & growth
324	Lower Internals Assembly	W:Lower Support Plate	Not stated	CASS	Not stated	CORR,CORR/PIT	Loss of material, corrosion product buildup
325	Lower Internals Assembly	W:Lower Support Plate	Not stated	CASS	Not stated	ERO/CORR	Wall thinning, loss material
326	Cower Internals Assembly	W:Lower Support Plate	Not stated	CASS	Not stated	WEAR	Attrition

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Effect of Aging on Component Function	on Contrib to Failure		Rel.progs	Report Recommendations	Page No.	
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	315
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	316
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because operating temps. are well below levels at which creep is a concern	4-15	317
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non significant because components do not depend on preload	4-16, 4-17	318
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	319
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress reports		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4- 30	320
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective for internals that are or can be rendered accessible	5-4	321
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Non-significant because fabricated of SS; stress levels within design specs (More)		NRC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry	4-6 to 4-9	322
down, damaged fuel & instrumentation assemblies.	Not stated	ASME Section XI, Subsection IWB		ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	323
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	324
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	325
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	326

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Item System	Structure/Comp	Subcompo

Item	System	Structure/Comp	Subcomponent	Materiais	Manufacturer	ARD mechanism	ARD effects
327	Lower Internals Assembly	W:Lower Support Plate	Not stated	CASS	Not stated	CREEP	Change in dimension
328	Lower Internals Assembly	W:Lower Support Plate	Not stated	CASS	Not stated	RELAX	Loss of preload
329	Lower Internals Assembly	W:Lower Support Plate	Not stated	CASS	Not stated	EMBR/TE	Loss of fracture toughness
330	Lower Internals Assembly	W:Lower Support Plate	Not stated	CASS	Not stated	FAT	Cumulative fatigue damage
331	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support	Not stated	SS	Not stated	EMBR/IR	Loss of fracture toughness
332	Lower Internals Assembly	Columns W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	CORR/SCC, CORR/CREV	Crack initation & growth, loss of material
	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth
	Lower Internais Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	CORR,CORR/PIT	Loss of material, corrosion product buildup
- 1	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss (material
	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	WEAR	Attrition
	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns		SS	Not stated	CREEP	Change in dimension
1	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	RELAX	Loss of preload
	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
	ower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
- 1	ower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	EMBR/IR	Loss of fracture toughness

Document: IR 90-05, PWR Vessel Internals Industry Report Reviewed by: Omesh K. Chopra, ANL Effect of Aging on Component Function Contrib to Failur

Effect of Aging on Component Functio Loss of core support, impair reactor shut		فينفصه والمتعاد والمستعد المستعد	Rel.progs	Report Recommendations	Page No.	
down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because operating temps, are well below levels at which creep is a concern	4-15	32
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	
Loss of core support, impair reactor shut down, damaged fue! & instrumentation assemblies.	Not stated	Ferrite content screening criteria & ASME Sect. XI, Subsect. IWB inspection		NRC recommendation: Ferrite content screening criteria is inadequate & VT-3 can not reliably detect tight cracks	5-10, 5-11	32
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress reports		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4- 30	33
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective for internals that are or can be rendered accessible	5-4	33
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Non-significant because fabricated of SS; stress levels within design specs (More)		NRC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry	4-6 to 4-9	33
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	ASME Section XI, Subsection IWB		ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	333
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	334
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	335
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	336
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because operating temps, are well below levels at which creep is a concern	4-15	337
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	338
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	339
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	ASME Sect. XI, Subsect. IWB, & Sect. III, Subsect. NG-5200 reanalysis of usage factors		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	5-12 to 5- 15	340
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective for internals that are or can be rendered accessible	5-4	34

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System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
Lower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
Lower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth
Lower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
Lower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss o material
Lower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	WEAR	Attrition
Lower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	CREEP	Change in dimension
Lower Internais Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	RELAX	Loss of preload
Lower internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
Lower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	CASS	Not stated	EMBR/IR	Loss of fracture toughness
Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	CASS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	CASS	Not stated	CORR/IASCC	Crack initiation & growth
Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	CASS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	CASS	Not stated	ERO/CORR	Wall thinning, loss material
Lower Internals Assembly	W: Lower Support Columns or CE: Core Support	Not stated	CASS	Not stated	WEAR	Attrition
	Assembly Lower Internals Assembly	AssemblyAssembly Support PostsLower Internals AssemblyB&W:Lower Grid Assembly Support PostsLower Internals Lower Internals AssemblyB&W:Lower Grid Assembly Support PostsLower Internals Lower Internals AssemblyB&W:Lower Grid Assembly Support PostsLower Internals AssemblyB&W:Lower Grid Assembly Support PostsLower Internals AssemblyB&W:Lower Grid Assembly Support PostsLower Internals AssemblyB&W:Lower Grid Assembly Support PostsLower Internals AssemblyW: Lower Support Columns or CE: Core Support Columns or CE: Core Support ColumnsLower Internals AssemblyW: Lower Support ColumnsLo	AssemblyAssembly Support PostsLower Internals AssemblyB&W:Lower Grid Assembly Support PostsNot statedLower Internals AssemblyB&W:Lower Grid Assembly Support PostsNot statedLower Internals AssemblyB&W:Lower Grid Assembly Support PostsNot statedLower Internals AssemblyB&W:Lower Grid Assembly Support PostsNot statedLower Internals AssemblyB&W:Lower Grid Assembly Support 	AssemblyAssembly Support PostsNot statedSSLower Internals AssemblyB&W:Lower Grid Assembly Support PostsNot statedSSLower Internals Assembly Support PostsNot statedSSLower Internals Assembly Support PostsNot statedSSLower Internals Assembly Support PostsNot statedSSLower Internals Assembly Support PostsNot statedSSLower Internals Assembly Columns or CE: Core Support Columns	Assembly Assembly Support Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Assembly B&W:Lower Grid Not stated SS Not stated Assembly B&W:Lower Grid Not stated SS Not stated Assembly Assembly Support Posts Not stated SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated Assembly SS Not stated Assembly Assembly Support Posts Not stated SS Not stated Assembly SS Not stated Lower Internals B&W:Lower Grid Not stated SS Not stated SS Not stated Assembly SS <td< td=""><td>Assembly Assembly Support Posts Of stated CORR/CREV Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated CORR/CREV Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated CORR/CREV Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated CORR/CREV Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated ERO/CORR Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated ERO/CORR Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated REEP Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated RELAX Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated RELAX Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated RELAX Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated</td></td<>	Assembly Assembly Support Posts Of stated CORR/CREV Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated CORR/CREV Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated CORR/CREV Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated CORR/CREV Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated ERO/CORR Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated ERO/CORR Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated REEP Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated RELAX Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated RELAX Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated RELAX Lower Internals B&W.Lower Grid Assembly Not stated SS Not stated

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Document: IR 90-05, PWR Vessel Internals Industry Report Reviewed by: Omesh K. Chopra, ANL Effect of Aging on Component Function Contrib to Failur

Effect of Aging on Component Function Loss of core support, impair reactor shut	Not stated	Non significant	1	Report Recommendations	464040	
down, damaged fuel & instrumentation assemblies.		because fabricated of SS; stress levels within design specs (More)		NRC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry		34
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	ASME Section XI, Subsection IWB		ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	34
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	34
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	34
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	34
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because operating temps, are well below levels at which creep is a concern	4-15	34
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because components do not depend on preload	4-1 6, 4-17	348
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	349
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress reports		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4 26 to 4- 30	35(
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI. Subsect. IWB, exam. category B-N-3 is effective for internals that are or can be rendered accessible	5-4	351
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Non-significant because fabricated of SS; stress levels within design specificati		NRC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry	4-6 to 4-9	352
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	ASME Section XI, Subsection IWB			4-11, 5-6, 5-7	353
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	354
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	355
oss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	356

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Reviewed by:	Ornesh K. Chopra, ANL

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
357	Lower Internais	W: Lower Support	Not stated	CASS	Not stated	CREEP	Change in
	Assembly	Columns or CE:				1	dimension
		Core Support					
		Columns					
	Lower Internals	W: Lower Support	Not stated	CASS	Not stated	RELAX	Loss of preload
	Assembly	Columns or CE:					
		Core Support					
		Columns					
59	Lower Internals	W: Lower Support	Not stated	CASS	Not stated	EMBR/TE	Loss of fracture
	Assembly	Columns or CE:					toughness
		Core Support			x		
		Columns					
_							Ourselation to being
	Lower Internals	W: Lower Support	Not stated	CASS	Not stated	FAT	Cumulative fatgue
	Assembly	Columns or CE:					damage
		Core Support					
		Columns		1			
				CC Ni ollow	Not stated	EMBB/IB	Loss of fracture
	Lower Internals	W: Lower Support	Not stated	SS, Ni alloy	INOT STATED		toughness
	Assembly	Column Bolts or CE:					i wuyimess
		Core Support					1
		Column Bolts, or B&W [.] Lower Grid					
- 1							
	Lower internals	Assembly Bolts W: Lower Support	Not stated	SS, Ni alloy	Not stated	CORR/SCC.	Crack initiation &
			NOT STATED	SS, NI alloy	NOLSIAIOU	CORR/CREV	growth, loss of
	Assembly	Column Bolts or CE:				COnn/Onev	material
		Core Support Column Bolts, or		1	· ·		Thates iau
		B&W: Lower Grid					
		Assembly Bolts		I			
22	Lower Internals	W: Lower Support	Not stated	SS, Ni alloy	Not stated	CORB/IASCC	Crack initiation &
03		Column Bolts or CE:		i SS, Ni alioy	NUL SLAUBU	00111114000	growth
1	Assembly						giowa
		Core Support Column Bolts, or					
		B&W: Lower Grid					
		Assembly Bolts					
56.4	Lower Internals	W: Lower Support	Not stated	SS, Ni alloy	Not stated	CORR, CORR/PIT	Loss of material
04		Column Bolts or CE:	NOT STATED	33, Ni alioy	NUL SLAUGU		corrosion product
- 1	Assembly	Core Support					buildup
		Column Bolts, or					buildup
		B&W: Lower Grid					
		Assembly Bolts					
265	Lower Internals	W: Lower Support	Not stated	SS, Ni alloy	Not stated	ERO/CORR	Wall thinning, loss
	Assembly	Column Bolts or CE:			1010000		material
	Assembly	Core Support					IT RACOT ROL
		Column Bolts, or					
		B&W: Lower Grid					
		Assembly Bolts					
266	Lower Internals	W: Lower Support	Not stated	SS, Ni alloy	Not stated	WEAR	Attrition
300	Assembly	Column Bolts or CE:		00, 11 000	Not Stated		
- 1	Assembly	Core Support		i			
- 1		Column Bolts, or					
		B&W: Lower Grid					
		Assembly Bolts					
367	Lower internals	W: Lower Support	Not stated	SS, Ni alloy	Not stated	CREEP	Change in
3 0/	Assembly	Column Bolts or CE:					dimension
	/ Boolinery	Core Support					
		Column Bolts, or					
		B&W: Lower Grid					
		Assembly Bolts					
368	Lower Internals	W: Lower Support	Not stated	SS, Ni alloy	Not stated	RELAX	Loss of preload
	Assembly	Column Bolts or CE:	1				
		Core Support	1				
		Column Bolts, or					
	•	B&W: Lower Grid		1			
			1			1	1
		Assembly Bolts					
		Assembly Bolts					

Effect of Aging on Component Functio			Rel.progs	Report Recommendations	Page No.	
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because operating temps. are well below levels at which creep is a concern	4-15	35
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	35
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Ferrite content screening criteria & ASME Sect. XI, Subsect. IWB inspection		NRC recommendation: Ferrite content screening criteria is inadequate & VT-3 can not reliably detect tight cracks	5-10, 5-11	35
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress reports		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4- 30	360
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI. Subsect. IWB, exam. category B-N-3 is effective for internals that are or can be rendered accessible	5-4	361
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Non-significant because fabricated of SS; stress levels within design specs (More)		NRC recommendation: Crevices are known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry	4-6 to 4-9	362
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	ASME Section XI, Subsection IWB		ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	4-11, 5-6, 5-7	363
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	364
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	365
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	366
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	Not stated	· · · · ·	Non-significant because operating temps, are well below levels at which creep is a concern	4-15	367
Loss of core support, impair reactor shut down, damaged fuel & instrumentation assemblies.	Not stated	ASME Sect. XI. Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective for detecting cracked or missing bolts & corrective action includes root cause determination	5-7, 5-8	368

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Reviewed by:	Omesh K. Chopra, ANL	-	-
Marine Oscala -			

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
369	Dever Internals Assembly	W: Lower Support Column Bolts or CE: Core Support Column Bolts, or B&W: Lower Grid	Not stated	SS, Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness
370	Lower Internals Assembly	Assembly Bolts W: Lower Support Column Bolts or CE: Core Support Column Bolts, or B&W: Lower Grid Assembly Bolts	Not stated	SS, Ni alloy	Not stated	FAT	Cumulative fatigue damage
371	Lower internals Assembly	W:Radial Keys & Clevis Inserts	Not stated	SS	Not stated	EMBR/IR	Loss of fracture toughness
372	Lower internals Assembly	W:Radial Keys & Clevis Inserts	Not stated	SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
373	Lower Internals Assembly	W:Radial Keys & Clevis Inserts	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth
374	Lower Internals Assembly	W:Radial Keys & Clevis Inserts	Not stated	SS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
375	Lower Internals Assembly	W:Radial Keys & Clevis Inserts	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss (material
376	Lower Internals Assembly	W:Radial Keys & Clevis Inserts	Not stated	SS	Not stated	WEAR	Attrition
377	Lower Internals Assembly	W:Radial Keys & Clevis Inserts	Not stated	SS	Not stated	CREEP	Change in dimension
378	Lower Internals Assembly	W:Radial Keys & Clevis Inserts	Not stated	ss	Not stated	RELAX	Loss of preload
379	Lower Internals Assembly	W:Radial Keys & Clevis Inserts	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
380	Lower Internals Assembly	W:Radial Keys & Clevis Inserts	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
381	Lower Internals Assembly	CE: Core Support Barrel Snubber Assemblies or B&W: Lower Grid Cylinder Guide Blocks	Not stated	SS	Not stated	EMBR/IR	Loss of fracture toughness
382	Lower Internals Assembly	CE: Core Support Barrel Snubber Assemblies or B&W: Lower Grid Cyfinder Guide Blocks	Not stated	SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
383	Lower Internals Assembly	CE: Core Support Barrel Snubber Assemblies or B&W: Lower Grid Cylinder Guide Blocks	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth

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Effect of Aging on Component Function Loss of core support, impair reactor shut	Not stated	Not stated		Page No.	_
down, damaged fuel & instrumentation assemblies.		NOISLAIGU	& Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	36
Loss of core support, impair reactor shut	Not stated	Non-significant		1004-1	
down, damaged fuel & instrumentation assemblies.		based on fatigue usage factor & review of plant design stress reports		4-26 to 4- 30	370
Core support loss, LOCA.	Not stated	Not stated	Non-significant because adequate f fracture toughness at end of life fluence levels & low applied stresses	5-4	371
Core support loss, LOCA.	Not stated	Non-significant because fabricated of SS; stress levels within design specs (More)	NRC recommendation: Crevices are 4 known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or	4-6 to 4-9	372
Core support loss, LOCA.	Not stated	ASME Section XI, Subsection IWB	effective for internals that are or can 5	4-11, 5-6, 5-7	373
Core support loss, LOCA.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.	be rendered accessible NRC recommendation: There is no 4 assurance that components made from SS are not exposed to locally corrosive environment	1-24, 4-25	374
Core support loss, LOCA.	Not stated	Not stated	Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	-14	375
Core support loss, LOCA.	Not stated	ASME Sect. XI, Subsect. IWB		-9	376
Core support loss, LOCA.	Not stated	Not stated		-15	377
Core support loss, LOCA.	Not stated	Not stated		-16, 4-17	378
Core support loss, LOCA.	Not stated	Not stated	Non-significant because wrought SS 4 & Ni alloys are not susceptible to EMBR/TE	-21, 4-22	379
Core support loss, LOCA.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress reports	NRC recommendation: Until an 4	-26 to 4- 0	380
Loss of core support during LOCA.	Not stated	ASME Sect. XI, Subsect. IWB	ASME Sect. XI, Subsect. IWB. exam. category B-N-3 is effective for internals that are or can be rendered accessible	-4	381
Loss of core support during LOCA.	Not stated	Non-significant because fabricated of SS; stress levels within design spec (More)	NRC recommendation: Crevices are 4 known promote SCC in SSs even in the absence of high stress. Evaluate the potential of CORR/SCC of components with crevices or creviced geometry	-6 to 4-9	382
Loss of ∞re 'support during LOCA.	Not stated	ASME Section XI, Subsection IWB		-11, 5-6 , -7	383

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Reviewed by:	Omesh K. Chopra, ANL	

	wed by: Omesi System	h K. Chopra, ANL Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	Lower Internals Assembly	CE: Core Support Barrel Snubber Assemblies or B&W: Lower Grid Cylinder Guide Blocks	Not stated	SS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
385	Lower Internals Assembly	CE: Core Support Barrel Snubber Assemblies or B&W: Lower Grid Guide Blocks	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss (material
386	Lower Internals Assembly	CE: Core Support Barrel Snubber Assemblies or B&W: Lower Grid Guide Blocks	Not stated	SS	Not stated	WEAR	Attrition
387	Lower Internals Assembly	CE: Core Support Barrel Snubber Assemblies or B&W: Lower Grid Guide Blocks	Not stated	SS	Not stated	CREEP	Change in dimension
388	Lower Internals Assembly	CE: Core Support Barrel Snubber Assemblies or B&W: Lower Grid Guide Blocks	Not stated	SS	Not stated	RELAX	Loss of preload
389	Lower Internals Assembly	CE: Core Support Barrel Snubber Assemblies or B&W: Lower Grid Guide Blocks	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
390	Lower Internals Assembly	CE: Core Support Barrel Snubber Assemblies or B&W: Lower Grid Guide Blocks	Not stated	SS	Not stated	FAT	Cumulative fatigue damage

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eviewed b em Systei	•	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking, & spalling
2 Class	1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	LEACH	Increase of porosity & permeability
3 Class	1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
4 Class	1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	AGREAC	Expansion & cracking

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Effect of Aging on Component Fund			Rel.progs	Report Recommendations	Page No.	ltem
Loss of core support during LOCA.	Not stated	Non-significant because SS is not susceptible to CORR or CORR/PIT in PWR environ.		NRC recommendation: There is no assurance that components made from SS are not exposed to locally corrosive environment	4-24, 4-25	384
Loss of core support during LOCA.	Not stated	Not stated		Non-significant because SS is resistant to ERO/CORR, low fluid flow, pH & particulate control in coolant, & operating pressures preclude cavitation	4-14	385
Loss of core support during LOCA.	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. category B-N-3 is effective program for detection of WEAR	5-9	386
Loss of core support during LOCA.	Not stated	Not stated		Non-significant because operating temps, are well below levels at which creep is a concern	4-15	387
Loss of core support during LOCA.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	388
Loss of core support during LOCA.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	389
Loss of core support during LOCA.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress reports		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4- 30	390

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Effect of Aging on Component Functi			Rel.progs	Report Recommendations	Page No.	ltem
Lose shielding & protection of primary containment.	Not stated	Not stated		Non-significant for component located in a geographic region of weathering index <100 day-inch/yr or concrete mix design meets the air content and water-to-cement ratio requirements of ACI 318-63 or ACI 349-85.	4-3 to 4-8	
Lose shielding & protection of primary containment.	Not stated	Not stated		Non-significant for components not exposed to flowing water or constructed using ACI 201.2R-77 to ensure dense, well-cured concrete with low permeability.	4-8 to 4- 12	2
Lose shielding & protection of primary containment.	Not stated	Select plant-specific program that may include monitoring of ground water chem (More)		This item was not the focus of this NRC review.	5-7 to 5-9	3
Lose shielding & protection of primary containment.	Not stated	Not stated		Non-significant for aggregates from regions known not to cause reactions, or were tested in accordance with ASTM C295 or C227, or if found reactive provisions of ACI 201.2R were followed. (See IR90-01 & 90-10)	4-16 to 4- 19	4

	System		Subcomponent	Materials	Manufacturer		ARD effects Cracking, spalling,
		BWR Reactor	Foundation &	Concrete	Not stated		loss of bond, & loss
1		Building & PWR	Exterior Concrete			1 1	of material
		Shielding Building &	Below Grade				
		BWR Reactor					
	, i	Building with Steel					
_		Superstructure			Not stated	CREEP	Deformation
6	Class 1 Structures	BWR Reactor	Foundation &	Concrete	Not stated		
1		Building & PWR	Exterior Concrete				
		Shielding Building &	Below Grade				
	l	BWR Reactor					
		Building with Steel					
		Superstructure		L		SHRINK	Cracking
7	Class 1 Structures	BWR Reactor	Foundation &	Concrete	Not stated		
		Building & PWR	Exterior Concrete				
		Shielding Building &	Below Grade				
		BWR Reactor		1			
		Building with Steel		1			
		Superstructure		L			Cumulative tatigue
8 Ci	Class 1 Structures	BWR Reactor	Foundation &	Concrete	Not stated	FAT	damage
-		Building & PWR	Exterior Concrete				ualitage
		Shielding Building &	Below Grade	1			
		BWR Reactor		Į	1		
		Building with Steel					
		Superstructure					Cathodic protection
9	Class 1 Structures	BWR Reactor	Foundation &	Concrete	Not stated	CATH	effect on bond
5		Building & PWR	Exterior Concrete	1			
	1	Shielding Building &	Below Grade				strength
		BWR Reactor					
	1	Building with Steel					
		Superstructure		1			Cracking, in-crease
10	Class 1 Structures	BWR Reactor	Foundation &	Concrete	Not stated	SETTLE (Applicable	
.0		Building & PWR	Exterior Concrete	1		only to concrete	in component stress
		Shielding Building &				foundations)	level, distortion.
		BWR Reactor		1			
		Building with Steel	l				
		Superstructure					Scaling, cracking, &
11	Class 1 Structures	BWR Reactor	Exterior Concrete	Concrete	Not stated	FRZ-THAW	
•		Building & PWR	Above Grade				spalling
		Shielding Building &					
		BWR Reactor					
		Building with Steel	.]	1			
		Superstructure	1	Į.			
	1						Increase of porosity
12	2 Class 1 Structures	BWR Reactor	Exterior Concrete	Concrete	Not stated	LEACH	1
		Building & PWR	Above Grade				& permeability
		Shielding Building &		ł			
		BWR Reactor	1		I		1
		Building with Steel		1	1		1
	1	Superstructure					1
-	3 Class 1 Structures	BWR Reactor	Exterior Concrete	Concrete	Not stated	AGR-CHEM	Increase of porosity
1	Giassi Gudoidies	Building & PWR	Above Grade				& permeability,
		Shielding Building 8					cracking, & spalling
	1	BWR Reactor		1		1	1
		Building with Steel		1			
	1	Superstructure		1			4
		BWR Reactor	Exterior Concrete	Concrete	Not stated	AGREAC	Expansion &
1	4 Class 1 Structures		Above Grade		l		cracking
		Building & PWR		1		1	
		Shielding Building &	^		1		1
	1	BWR Reactor		1	l		1
		Building with Steel	1				
		Superstructure		ļ	ł		
			Exterior Concrete	Concrete	Not stated	CORR/RE	Cracking, spalling
1	15 Class 1 Structures	BWR Reactor			110, 044100		loss of bond, & los
		Building & PWR	Above Grade				of material
l		Shielding Building	×.	l I			
	1			1	1	1	1
		BWR Reactor		1			
		Building with Steel					

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Document: IR 90-06, Class 1 Structures Industry Report Reviewed by: D. C. Ma/O. Chopra, ANL Effect of Aging on Component Function Contrib to Failu

Effect of Aging on Component Funct Lose shielding & protection of primary	Not stated	Select plant-specific		Page No.	iter
containment.		program, e.g. ground water monitoring, inspection, & testing	This item was not the focus of this NRC review.(See IR90-01 & 90-10)	5-7 to 5-9	
Lose shielding & protection of primary containment.	Not stated	Not stated	Non-significant because the compressive stresses are low.	4-41 -43	
Lose shielding & protection of primary containment.	Not stated	Not stated	Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4-45	
Lose shielding & protection of primary containment.	Not stated	Not stated	Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	
Lose shielding & protection of primary containment.	Not stated	Not stated	Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft^2 level that cause degradation.	4-84, 4-85	9
Lose shielding & protection of primary containment.	Not stated	Plant settlement monitoring program.	Structure settlement monitoring during construction & continued during operation for soft soil or changes in ground water.(See IR90- 01 & 90-10)	5-4, 5-5	10
Lose shielding & protection of primary containment.	Not stated	Not stated	Non-significant for components located in a geographic region of weathering index <100 day-in./yr; or concrete mix design meets air content & water-to-cement ratio requirements of ACI 318-63 or ACI 349-85. (See IR 90-01 & 90-10)	4-3 to 4-8	11
ose shielding & protection of primary ontainment.	Not stated	Not stated	Non-significant for components not	4-8 to 4- 12	12
ose shielding & protection of primary ontainment.	Not stated	Not stated		4-13 to 4- 15	13
ose shielding & protection of primary ontainment.	Not stated	Not stated	Non-significant for aggregates from 4	4-16 to 4- 19	14
ose shielding & protection of primary ontainment.	Not stated	Not stated	Non-significant for concrete not exposed to aggressive environment 2	-20 to 4- 23 & 4-49 5 4-51	15

m	System	a/O. Chopra, ANL Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
16	Class 1 Structures	BWR Reactor	Exterior Concrete	Concrete	Not stated	CREEP	Deformation
		Building & PWR	Above Grade				
- 1		Shielding Building &					
1		BWR Reactor					
		Building with Steel					
		Superstructure					Cracking
17	Class 1 Structures	BWR Reactor	Exterior Concrete	Concrete	Not stated	SHRINK	Cracking
- 1		Building & PWR	Above Grade				
		Shielding Building &					
- 1		BWR Reactor					
		Building with Steel					
		Superstructure	Eutorica Ocarata	Concrete	Not stated	FAT	Cumulative fatigue
18	Class 1 Structures	BWR Reactor	Exterior Concrete	Conciete	NOTSTATED		damage
		Building & PWR	Above Grade				
		Shielding Building &					
ł		BWR Reactor Building with Steel					
		Superstructure					
-	Olara d Chuchura		Exterior Concrete	Concrete	Not stated	CATH	Cathodic protection
19	Class 1 Structures	BWR Reactor	Above Grade	Conciete	NOTStated	0,111	effect on bond
		Building & PWR Shielding Building &	ADOVE GIAGE				strength
		BWR Reactor					
		Building with Steel					
		Superstructure	Interior Concrete	Concrete, Mortar	Not stated	AGR-CHEM	Increase of porosity
20	Class 1 Structures	BWR Reactor	Walls/Columns;				& permeability,
		Building & PWR Shielding Building &	Interior Concrete				cracking, & spalling
		BWR Reactor	Slabs/ Beams; &		1		
			Masonry Block	-			
		Building with Steel	Walls	· ·			
		Superstructure	Interior Concrete	Concrete, Mortar	Not stated	AGREAC	Expansion &
21	Class 1 Structures	BWR Reactor	Walls/Columns:		NOT Stated	Adhead	cracking
		Building & PWR Shielding Building &	Interior Concrete				, and a set of the set
		BWR Reactor	Slabs/ Beams; &				
		Building with Steel	Masonry Block				
		Superstructure	Walls				
	Class 1 Structures	BWR Reactor	Interior Concrete	Concrete, Mortar	Not stated	ELE-TEMP	Loss of strength &
22	Class I Structures	Building & PWR	Walls/ Columns;		110104104		modulus
		Shielding Building &	Interior Concrete				
		BWR Reactor	Slabs/ Beams; &				
1		Building with Steel	Masonry Block				
		Superstructure	Walls				
23	Class 1 Structures	BWR Reactor	Interior Concrete	Concrete, Mortar	Not stated	EMBR/IR	Loss of strength &
	0.000	Building & PWR	Walls/ Columns:				modulus
1		Shielding Building &					
		BWR Reactor	Slabs/ Beams; &				1
		Building with Steel	Masonry Block				
ļ		Superstructure	Walls				
24	Class 1 Structures	BWR Reactor	Interior Concrete	Concrete, Mortar	Not stated	CORR/RE	Cracking, spalling,
		Building & PWR	Walls/ Columns;		1		loss of bond, & los
		Shielding Building &					of material
		BWR Reactor	Slabs/ Beams; &		1		1
		Building with Steel	Masonry Block				
		Superstructure	Walls				
25	Class 1 Structures	BWR Reactor	Interior Concrete	Concrete, Mortar	Not stated	CREEP	Deformation
		Building & PWR	Walls/ Columns;				
		Shielding Building &	Interior Concrete				
		BWR Reactor	Slabs/ Beams; &		1		
		Building with Steel	Masonry Block				1
		Superstructure	Walls				
26	Class 1 Structures	BWR Reactor	Interior Concrete	Concrete, Mortar	Not stated	SHRINK	Cracking
20		Building & PWR	Walls/ Columns;		1		
		Shielding Building &					
	1	BWR Reactor	Slabs/ Beams; &				
	1			1	1	1	
		Building with Steel	Masonry Block				1
		Building with Steel Superstructure	Walls				
		Building with Steel Superstructure					

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Rel.progs Lose shielding & protection of primary Report Recommendations Page No. Item Not stated Not stated containment. Non-significant because the 4-41 -43 16 compressive stresses are low. Lose shielding & protection of primary Not stated Not stated containment. Non-significant because most 4-44, 4-45 17 concrete shrinkage occurs in first five years of a structure's life. Lose shielding & protection of primary Not stated Not stated Non-significant because concrete containment. 4-72 to 4-18 structures are designed according to 83 ACI 318 or its equivalent. Lose shielding & protection of primary Not stated Not stated Non-significant because cathodic containment. 4-84, 4-85 19 protection systems operate at a level well below the 1000 mA/ft^2 level that cause degradation. Lose shielding & protection of primary Not stated Not stated Non-significant for components not ∞ntainment 4-13 to 4-20 exposed to aggressive environment 15 (pH <5.5, chloride >500 ppm, & sulfate >1500 ppm); or exposed to aggressive groundwater for Lose shielding & protection of primary intermittent periods only. Not stated Not stated Same as for foundation & exterior containment 4-16 to 4-21 concrete above & below grade 19 Lose shielding & protection of primary Not stated Not stated Non-significant for concrete containment 4-24 to 4-22 maintained at <66_C (150_F) & local 29 & 4-52, areas at <93_C (200_F), or plant-4-53 specific justification is provided in accordance with ACI 349-85; & for embedded steel or rebar maintained at <316 deg C Lose shielding & protection of primary Not stated Not stated Non-significant because radiation containment 4-29-41: 23 dose is low compared to the level 4-53 -59 causing degradation. Lose shielding & protection of primary Not stated Not stated containment Non-significant for concrete not 4-20 to 4-24 exposed to aggressive environment 23 & 4-49 (pH <11.5 chlorides >500 ppm); or to 4-51 concrete mix meets the requirements of ACI 318-63 or 349-85 (air content 3-6% water-tocement ratio 0.35-0.45). Lose shielding & protection of primary Not stated Not stated Non-significant because the containment 4-41 -43 25 compressive stresses are low. Lose shielding & protection of primary Not stated Not stated containment Non-significant because most 4-44, 4-45 26 concrete shrinkage occurs in first five years of a structure's life.

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n :			Subcomponent	Materials	Manufacturer Not stated	ARD mechanism MASON-BLOC	Cracking of masonry
27	Class 1 Structures	BWP Reactor	nterior Concrete	Concrete, Mortar	NOT STATED	-Applicable only to	block walls
		Building & PWR	Walls/ Columns;			masonry block walls	
		Shielding Building &	nterior Concrete			masonry blook nale	
		BWR Reactor	Slabs/ Beams; &				
		Building with Steel	Masonry Block				
	1		Walls				Cumulative fatigue
古			nterior Concrete	Concrete, Mortar	Not stated	FAT (Applicable only	
8			Walls/ Columns;			to concrete	damage
		Danang a tritter [Interior Concrete			structures)	
			Slabs/ Beams; &				
		Ditter in the second se	Masonry Block				
			•				
		Gaporetation	Walls	Concrete, Mortar	Not stated	CATH	Cathodic protection
9	Class 1 Structures		Interior Concrete	COncrete, Montal	1001 300100		effect on bond
		Dunungerrrrr	Walls/ Columns;				strength
			Interior Concrete				-
			Slabs/ Beams; &				
		Building with Steel	Masonry Block				
		Superstructure	Walls			ELE TEMP	Loss of strength &
5	Class 1 Structures	BWP Reactor	Structural Steel,	Carbon steel	Not stated	ELE-TEMP	modulus
2		Building & PWR	Metal Siding (Metal			1	
ļ		Shielding Building &	siding only for BWR		1	1	
		BWR Reactor	Reactor Building	1	1		
		-	with Steel				1
1		Building with Steel	Superstructure)				
		Superstructure		Carbon steel	Not stated	EMBR/IR	Loss of tracture
31	Class 1 Structures	BWP Reactor	Structural Steel,				toughness
į		Building & PWR	Metal Siding (Metal		1		
		Shielding Building &	siding only for BWR				
		BWR Reactor	Reactor Building				
		Building with Steel	with Steel				
		Superstructure	Superstructure)			CORR Unresolved	Loss of material
32	Class 1 Structures	BWP Reactor	Structural Steel	Carbon steel	Not stated		
20		Building & PWR		1			
		Shielding Building &					
	1	BWR Reactor		1			1
		Building with Steel					l
		1 -	1		Į		
		Superstructure	Church and Stool	Carbon steel	Not stated	FAT	Cumulative fatgu
33	Class 1 Structures	BWP Reactor	Structural Steel				damage
		Building & PWR	1				1
		Shielding Building &					1
		BWR Reactor	l.				1
		Building with Steel					
		Superstructure					Loss of material
2	4 Class 1 Structures	BWP Reactor	Steel Piles	Carbon steel	Not stated	CORR	Luss of material
ەد	I Class I Suuciaies	Building & PWR	· ·				
	1	Shielding Building &		1			
		BWR Reactor			1		
		Building with Steel		1			1
			ł				
		Superstructure	Metal Siding, Metal	Carbon steel	Not stated	CORR Unresolved	Loss of material
3	5 Class 1 Structures	BWR Reactor					1
	1	Building with Steel	Roofing				1
		Superstructure			1		
	1			1			
	_				Not stated	FRZ-THAW	Scaling, cracking
3	6 Class 1 Structures	Control	Foundation &	Concrete	INULSIALOO	1112-110311	spalling
9		Room/Building	Exterior Concrete	1			,
		Ţ	Below Grade				1
	1	1					1
				1			ļ
				_			
		Control	Foundation &	Concrete	Not stated	LEACH	Increase of poro
3	37 Class 1 Structures		Exterior Concrete			1	& permeability
		Room/Building	Below Grade				1
			Delow Giade				
			1				
				Capareta	Not stated	AGR-CHEM	increase of porc
		Control Room/	Foundation &	Concrete	THU SLOW	Unresolved	& permeability
	38 Class 1 Structures			1		1 0110001100	
	38 Class 1 Structures	Building	Exterior Concrete				Gradking & sha
	38 Class 1 Structures		Extenor Concrete Below Grade				cracking, & spa

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Effect of Aging on Component Funct Lose shielding & protection of primary	Not stated	I&E Bulletin 80-11 &	Rei.progs	Report Recommendations	Page No.	-
containment	Not stated	Information Notice No. 87-67.		Inspection of Bulletin 80-11 & monitoring & corrective action of Info. Notice 87-67.	5-14, 5-15	5 2
Lose shielding & protection of primary containment	Not stated	Not stated		Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	2
Lose shielding & protection of primary containment	Not stated	Not stated		Non-significant because cathodic protection systems operate at a leve well below the 1000 mA/ft^2 level that cause degradation.	4-84, 4-85	2
Lose shielding & protection of primary containment.	Not stated	Not stated		Degradation is non-significant for structural steel components, metal sidings, & liners maintained at temperatures <371 deg C (<700_F).	4-64, 4-65 & 4-70 4- 71	30
Lose shielding & protection of primary containment.	Not stated	Not stated		Non-significant because radiation dose is low compared to the level causing degradation.	4-65 -68 , 4- 71	31
Lose shielding & protection of primary containment.	Not stated	Select plant-specific program for below grade structural steel not period. (More)		This item was not the focus of this NRC review.	5-11, 5-12	32
Lose shielding & protection of primary containment.	Not stated	Not stated		Non-significant because steel structures are designed according to AISC Code or equivalent.	4-72 to 4- 83	33
ose shielding & protection of primary containment.	Not stated	Not stated		Non-significant because piles driven in undisturbed soil are unaffected & those driven in disturbed soil suffer minor corrosion in a small area of metal.	4-60, 4- 61	34
ose shielding & protection of primary containment.	Not stated	Pressure retaining capability testing in accordance with plant's technical specs.		NRC recommendation: Demonstrate how building pressurization test is effective in timely detection of corrosion degradation.	5-12, 5-13	35
ose protection of safety related control equipment.	Not stated	Not stated		Non-significant for component located in a geographic region of weathering index <100 day-inch/yr or concrete mix design meets the air content and water-to-cement ratio requirements of ACI 318-63 or ACI 349-85.	4-3 to 4-8	36
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant for components not exposed to flowing water or constructed using ACI 201.2R-77 to ensure dense, well-cured concrete with low permeability.	4-8 to 4- 12	37
ose protection of safety related control quipment.	Not stated	Select plant-specific program that may include monitoring of ground water chem (More)		This item was not the focus of this NRC review.	5-7 to 5-9	38

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Reviewed b	y:	D. C. Ma	/O. Chopr	a, ANL		

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
39	Class 1 Structures	Control Room/Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	AGREAC	Expansion & cracking
40	Class 1 Structures	Control Room/Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CORR/RE Unresolved	Cracking, spalling, loss of bond, & loss of material
41	Class 1 Structures	Control Room/Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CREEP	Deformation
42	Class 1 Structures	Control Room/Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	SHRINK	Cracking
43	Class 1 Structures	Control Room/Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	FAT	Cumulative :atigue damage
44	Class 1 Structures	Control Room/Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
45	Class 1 Structures	Control Room/Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	SETTLE (Applicable only to concrete foundations)	Cracking, in-crease in component stres level, distortion.
46	Class 1 Structures	Control Room/Building	Exterior Concrete Above Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking, spalling
47	Class 1 Structures	Control Room/Building	Exterior Concrete Above Grade	Concrete	Not stated	LEACH	Increase of porosit & permeability
48	Class 1 Structures	Control Room/Building	Exterior Concrete Above Grade	Concrete	Not stated	AGR-CHEM	Increase of porosit & permeability, cracking, & spallin
49	Class 1 Structures	Control Room/Building	Exterior Concrete Above Grade	Concrete	Not stated	AGREAC	Expansion & cracking
50	Class 1 Structures	Control Room/Building	Exterior Concrete Above Grade	Concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, & los of material
5	Class 1 Structures	Control	Exterior Concrete	Concrete	Not stated	CREEP	Deformation
52	2 Class 1 Structures	Room/Building Control Room/Building	Above Grade Exterior Concrete Above Grade	Concrete	Not stated	SHRINK	Cracking
5	3 Class 1 Structures	Control Room/Building	Exterior Concrete Above Grade	Concrete	Not stated	FAT	Cumulative fatigue damage

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Document: IR 90-06, Class 1 Structures industry Report Reviewed by: D. C. Ma/O. Chopra, ANL

eviewed by: D. C. Ma/O. Chopra, AN ffect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No. 1	39
ose protection of safety related control quipment.	Not stated	Not stated		Non-significant for components constructed from aggregate taken from regions other than those known to cause alkali-aggregate reactions, or aggregates tested in accordance with ASTM C295 or C227 were shown to be non-reactive.	4-16 to 4- 19	
ose protection of safety related control quipment.	Not stated	Select plant-specific program, e.g. ground water monitoring, inspection, & testing		This item was not the focus of this NRC review.	5-7 to 5-9	40
ose protection of safety related control quipment.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	41
ose protection of safety related control quipment.	Not stated	Not stated		Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4-45	42
ose protection of safety related control quipment.	Not stated	Not stated		Non-significant because concrete structures are designed according to ACI 318 or its equivalent.		4:
ose protection of safety related control quipment.	Not stated	Not stated		Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft^2 level that cause degradation.	4-84, 4-85	44
ose protection of safety related control equipment.	Not stated	Plant settlement monitoring program.		Structure settlement monitoring during construction & continued during operation for soft soil or changes in ground water.	5-4, 5-5	4
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant for components located in a geographic region of weathering index <100 day-in./yr; or concrete mix design meets air content & water-to-cement ratio requirements of ACI 318-63 or ACI 349-85.	4-3 to 4-8	4
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant for components not exposed to flowing water or constructed using ACI 201.2R-77 to ensure dense, well-cured concrete with low permeability.	4-8 to 4- 12	4
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant for components not exposed to aggressive environment (pH <5.5, chloride >500 ppm, & sulfate >1500 ppm); or exposed to aggressive groundwater for intermittent periods only.	4-13 to 4- 15	4
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant for components constructed from aggregate taken from regions other than those knowr to cause alkali-aggregate reactions, or aggregates tested in accordance with ASTM C295 or C227 were shown to be non-reactive.		4
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant for concrete not exposed to aggressive environment (pH <11.5 chlorides >500 ppm); or concrete mix meets the requirements of ACI 318-63 or 349- 85 (air content 3-6% water-to- cement ratio 0.35-0.45).	· .	
Lose protection of safety related control	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	
equipment. Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4-45	
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant because concrete structures are designed according ACI 318 or its equivalent.	4-72 to 4- to 83	

Document: IR 9	0-06, Class 1 Structures Indus	try Report
Reviewed by:	D. C. Ma/O. Chopra, ANL	
Item System	Structure/Comp	Subcon

	n System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	4 Class 1 Structures	Room/Building	Exterior Concrete Above Crade	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
	5 Class 1 Structures	Room/Building	Interior Concrete Walls/Columns; Interior Concrete Slabs/Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
	5 Class 1 Structures	Room/Building	Interior Concrete Walls/Columns; Interior Concrete Slabs/Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	AGREAC	Expansion & cracking
57	Class 1 Structures	Control Room/Building	Interior Concrete Walls/Columns; Interior Concrete Slabs/Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	ELE-TEMP	Loss of strength & modulus
	Class 1 Structures	Control Room/Building	Interior Concrete Walls/Columns; Interior Concrete Slabs/Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	EMBR/IR	Loss of strength & modulus
	Class 1 Structures	Control Room/Building	Interior Concrete Walls/Columns; Interior Concrete Slabs/Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CORR/RE	Cracking, spalling, loss of bond, & loss of material
	Class 1 Structures	Control Room/Building	Interior Concrete Walls/Columns; Interior Concrete Slabs/Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CREEP	Deformation
	Class 1 Structures	Control Room/ Building	Interior Concrete Walls/Columns; Interior Concrete Slabs/Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	SHRINK	Cracking
	Class 1 Structures	Control Room/Building	Interior Concrete Walls/Columns; Interior Concrete Slabs/Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	MASON-BLOC (Applicable to masonry block walls)	Cracking of masonry block walls
	Class 1 Structures	Control Room/ Building	Interior Concrete Walls/Columns; Interior Concrete Slabs/Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	FAT (Applicable only to concrete structures)	Cumulative fatigue damage
	Class 1 Structures	Control Room/Building	Interior Concrete Walls/Columns; Interior Concrete Slabs/Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CATH	Cathodic protection effect on bond strength
65	Class 1 Structures	Control Room/Building	Structural Steel	Carbon steel	Not stated	ELE-TEMP	Loss of strength & modulus

Effect of Aging on Component Functi Lose protection of safety related control	Not stated	Not stated	Rel.progs	Report Recommendations	Page No.	
equipment.	NOTSIALED	NOLSIZIEG		Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft^2 level that cause degradation.	4-84, 4-85	54
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant for components not exposed to aggressive environment (pH <5.5, chloride >500 ppm, & sulfate >1500 ppm); or exposed to aggressive groundwater for intermittent periods only.	4-13 to 4- 15	55
Lose protection of safety related control equipment.	Not stated	Not stated		Same as for foundation & exterior concrete above & below grade	4-16 to 4- 19	56
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant for concrete maintained at <66_C (150_F) & local areas at <93_C (200_F), or plant- specific justification is provided in accordance with ACI 349-85; & for embedded steel or rebar maintained at <316 deg C.	4-24 to 4- 29 & 4-52. 4-53	57
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant because radiation dose is low compared to the level causing degradation.	4-29 -41. 4-53 -59	58
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant for concrete not exposed to aggressive environment (pH <11.5 chlorides >500 ppm); or concrete mix meets the requirements of ACI 318-63 or 349- 85 (air content 3-6% water-to- cement ratio 0.35-0.45).	4-20 to 4- 23 & 4-49 to 4-51	59
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	60
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4-45	61
Lose protection of safety related control equipment.	Not stated	I&E Bulletin 80-11 & Information Notice No. 87-67.		Inspection of Bulletin 80-11 & monitoring & corrective action of Info. Notice 87-67,	5-14, 5-15	62
ose protection of safety related control equipment.	Not stated	Not stated		Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	63
ose protection of safety related control equipment.	Not stated	Not stated		Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft^2 level that cause degradation.	4-84, 4-85	64
Lose protection of safety related control aquipment.	Not stated	Not stated			4-64, 4-65 & 4-70, 4- 71	65

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Reviewed by:	D. C. Ma/O. Chopra, ANL			
Itom Sustam	Structure/Comp	Subcomponent	Materials	Manufacturer

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
66	Class 1 Structures	Control Room/Building	Structural Steel	Carbon steel	Not stated	EMBR/IR	Loss of fracture toughness
67	Class 1 Structures	Control Room/Building	Structural Steel	Carbon steel	Not stated	CORR Unresolved	Loss of material
68	Class 1 Structures	Control Room/Building	Structural Steel	Carbon steel	Not stated	FAT	Cumulative fatigue damage
69	Class 1 Structures	Control Room/Building	Steel Piles	Carbon steel	Not stated	CORR	Loss of material
70	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking, 8 spalling
71	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Bising Tunpole	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	LEACH	Increase of porosity & permeability
72	Class 1 Structures	Piping Tunnels Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	AGR-CHEM Unresolved	Increase of porosity & permeability, cracking, & spalling
73	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	AGREAC	Expansion & cracking
74	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CORR/RE Unresolved	Cracking, spalling, loss of bond, & los of material
75	Class 1 Structures	Piping Tunnels Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CREEP	Deformation
76	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	SHRINK	Cracking
77	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	FAT	Cumulative fatigue damage
78	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building: & Utility/ Piping Tunnels	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	САТН	Cathodic protection effect on bond strength
79	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	SETTLE (Applicable only to concrete foundations)	Cracking, increase in component stres level, distortion.

Effect of Aging on Component Function	Not stated	Reported progs	Rel.progs	Report Recommendations	Page No.	
equipment.		NOT STATED		Non-significant because radiation dose is low compared to the level causing degradation.	4-65 -68 . 4-71	66
Lose protection of safety related control equipment.	Not stated	Select plant-specific program for below grade structural steel not periodically (More)		This item was not the focus of this NRC review.	5-11, 5-12	2 67
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant because steel structures are designed according to AISC Code or equivalent.	4-72 to 4- 83	68
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant because piles driven in undisturbed soil are unaffected & those driven in disturbed soil suffer minor corrosion in a small area of metal.	4-60, 4- 61	69
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant for component located in a geographic region of weathering index <100 day-inch/yr or concrete mix design meets the air content and water-to-coment ratio requirements of ACI 318-63 or ACI 349-85.	4-3 to 4-8	70
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant for components not exposed to flowing water or constructed using ACI 201.2R-77 to ensure dense, well-cured concrete with low permeability.	4-8 to 4- 12	71
Lose protection of safety related equipment.	Not stated	Select plant-specific program that may include monitoring of ground water (More)		This item was not the focus of this NRC review.	5-7 to 5-9	72
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant for components constructed from aggregate taken from regions other than those known to cause alkali-aggregate reactions, or aggregates tested in accordance with ASTM C295 or C227 were shown to be non-reactive.	4-16 to 4- 19	73
Lose protection of safety related equipment.	Not stated	Select plant-specific program, e.g. ground water monitoring, inspection, & testing		This item was not the focus of this NRC review.	5-7 to 5-9	74
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	75
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4-45	76
Lose protection of safety related equipment.	Not stated	Not stated	<u> </u>	Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	77
Lose protection of safety related aquipment.	Not stated	Not stated		Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft^2 level that cause degradation.	4-84, 4-85	78
Lose protection of safety related equipment.	Not stated	Plant settlement monitoring program.		Structure settlement monitoring during construction & continued during operation for soft soil or changes in ground water.	5-4, 5-5	79

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Reviewed by:	D. C. Ma/O. Chopra, ANL	

		Subcomponent	Materials	Manufacturer	ARD mechanism	
Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Exterior Concrete Above Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking, 8 spalling
Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Exterior Concrete Above Grade	Concrete	Not stated	LEACH	Increase of porosity & permeability
Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Exterior Concrete Above Grade	Concrete	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Exterior Concrete Above Grade	Concrete	Not stated	AGREAC	Expansion & cracking
Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Exterior Concrete Above Grade	Concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, & loss of material
Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Exterior Concrete Above Grade	Concrete	Not stated	CREEP	Deformation
Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/	Exterior Concrete Above Grade	Concrete	Not stated	SHRINK	Cracking
Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/	Exterior Concrete Above Grade	Concrete	Not stated	FAT	Cumulative fatigue damage
Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine	Exterior Concrete Above Grade	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	AGREAC	Expansion & cracking
	Class 1 Structures Class 1 Structures	Class 1 Structures Auxiliary Building; Turbine Building; & Utility/ Piping Tunnels Class 1 Structures Auxiliary Building; Diesel Generator Building; & Utility/ Piping Tunnels Class 1 Structures Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels Class 1 Structures Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels Class 1 Structures Auxiliary Building; Diesel Generator Building; Turbine Building; Autility/ Piping Tunnels Class 1 Structures Auxiliary Building; Diesel Generator Building; Turbine Building; Autility/ Piping Tunnels Class 1 Structures Auxiliary Building; Diesel Generator Building; Turbine Building; Turbine Building; Turbine Building; Autility/ Piping Tunnels Oclass 1 Structures Auxiliary Building; Diesel Generator Building; Autility/ Piping Tunnels Oclass 1 Structures Auxiliary Building; Diesel Generator Building; Autility/ Piping Tunnels	Diesel Generator Building: Turbine Building: Turbine Building	Diesel Generator Building; A Utility/ Piping Tunnels Above Grade Class 1 Structures Auxiliary Building; Diesel Generator Building; A Utility/ Piping Tunnels Exterior Concrete Above Grade Concrete Class 1 Structures Auxiliary Building; Diesel Generator Building; A Utility/ Piping Tunnels Exterior Concrete Above Grade Concrete Class 1 Structures Auxiliary Building; Diesel Generator Building; Turbine Building; Turbine Building; Turbine Building; Turbine Building; Turbine Building; A Utility/ Piping Tunnels Exterior Concrete Above Grade Concrete Class 1 Structures Auxiliary Building; Diesel Generator Building; A Utility/ Piping Tunnels Exterior Concrete Above Grade Concrete Class 1 Structures Auxiliary Building; Diesel Generator Building; A Utility/ Piping Tunnels Exterior Concrete Above Grade Concrete Class 1 Structures Auxiliary Building; Diesel Generator Building; A Utility/ Piping Tunnels Exterior Concrete Above Grade Concrete Class 1 Structures Auxiliary Building; Diesel Generator Building; A Utility/ Piping Tunnels Exterior Concrete Above Grade Concrete Class 1 Structures Auxiliary Building; Diesel Generator Building; A Utility/ Piping Tunnels Exterior Concrete Above Grade Concrete Class 1 Structures Diesel Generator Building; A Utilit	Diesel Generator Building: A Utility/ Piping Tunnels Above Grade Interview Class 1 Structures Auxiliary Building: Diesel Generator Building: A Utility/ Piping Tunnels Exterior Concrete Above Grade Concrete Not stated Class 1 Structures Auxiliary Building: Building: A Utility/ Piping Tunnels Exterior Concrete Above Grade Concrete Not stated Class 1 Structures Auxiliary Building: Building: Turbine Building: A Utility/ Piping Tunnels Exterior Concrete Above Grade Concrete Not stated Class 1 Structures Auxiliary Building: Diesel Generator Building: A Utility/ Piping Tunnels Exterior Concrete Above Grade Concrete Not stated Class 1 Structures Auxiliary Building: Diesel Generator Building: A Utility/ Piping Tunnels Exterior Concrete Above Grade Concrete Not stated Class 1 Structures Auxiliary Building: Building: A Utility/ Piping Tunnels Exterior Concrete Above Grade Concrete Not stated Class 1 Structures Auxiliary Building: Building: A Utility/ Piping Tunnels Exterior Concrete Above Grade Concrete Not stated Class 1 Structures Auxiliary Building: Diesel Generator Building: A Utility/ Piping Tunnels Exterior Concrete Above Grade Concrete Not sta	Class 1 Structures Auxilary Building: Building: & Utility/ Piping Turnels Above Grade Concrete Not stated LEACH Class 1 Structures Auxilary Building: Building: & Utility/ Piping Turnels Exterior Concrete Building: & Utility/ Piping Turnels Concrete Not stated LEACH Class 1 Structures Auxilary Building: Building: & Utility/ Piping Turnels Exterior Concrete Building: & Utility/ Piping Turnels Concrete Not stated AGR-CHEM Class 1 Structures Auxilary Building: Building: & Utility/ Piping Turnels Exterior Concrete Above Grade Concrete Not stated AGREAC Class 1 Structures Auxilary Building: Building: & Utility/ Piping Turnels Exterior Concrete Above Grade Concrete Not stated CORR/RE Class 1 Structures Auxilary Building: Building: & Utility/ Piping Turnels Exterior Concrete Above Grade Concrete Not stated CREEP Class 1 Structures Auxilary Building: Building: & Utility/ Piping Turnels Exterior Concrete Above Grade Concrete Not stated CREEP Class 1 Structures Auxilary Building: Building: & Utility/ Piping Turnels Exterior Concrete Above Grade Concrete Not stated SHRINK Class 1 Structures Auxilary Building: Deset Generator Building: & Utility/ Piping Turnels Exterior Concrete Above Grade Concrete Not stated CAT

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Effect of Aging on Component Fu	Not stated		Rel.progs	Report Recommendations	Page No.	Iter
equipment.		Not stated		Non-significant for components located in a geographic region of weathering index <100 day-in./yr; or concrete mix design meets air content & water-to-cement ratio requirements of ACI 318-63 or ACI 349-85.	4-3 to 4-8	8
equipment.	Not stated	Not stated		Non-significant for components not exposed to flowing water or constructed using ACI 201.2R-77 to ensure dense, well-cured concrete with low permeability.	4-8 to 4- 12	8
equipment.	Not stated	Not stated		Non-significant for components not exposed to aggressive environment (pH <5.5, chloride >500 ppm, & sulfate >1500 ppm); or exposed to aggressive groundwater for intermittent periods only.	4-13 to 4- 15	82
əquipment.	Not stated	Not stated		Non-significant for components constructed from aggregate taken from regions other than those known to cause alkali-aggregate reactions, or aggregates tested in accordance with ASTM C295 or C227 were shown to be non-reactive.	4-16 to 4- 19	83
ose protection of safety related quipment.	Not stated	Not stated		Non-significant for concrete not exposed to aggressive environment (pH <11.5 chlorides >500 ppm); or concrete mix meets the requirements of ACI 318-63 or 349- 85 (air content 3-6% water-to- cement ratio 0.35-0.45).	4-20 to 4- 23 & 4-49 to 4-51	84
quipment.		Not stated		Non-significant because the compressive stresses are low.	4-41 -43	85
ose protection of safety related quipment.	Not stated	Not stated		Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4-45	86
ose protection of safety related quipment.	Not stated	Not stated	 	Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	87
ose protection of safety related uipment.	Not stated	Not stated		Non-significant because cathodic protection systems operate at a level well below the 1000 mA/tt^2 level that cause degradation.	4-84 4-85	88
se protection of safety related uipment.	Not stated	Not stated		Non-significant for components not exposed to aggressive environment (pH <5.5, chloride >500 ppm, & sulfate >1500 ppm); or exposed to aggressive groundwater for intermittent periods only.	4-13 to 4- 15	89
se protection of safety related uipment	Not stated	Not stated		Same as for foundation & exterior 4	1-16 to 4- 19	90

	ewediby: D.C.Ma System	O. Chopra, ANL Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects	
	Class 1 Structures	Auxiliary Building;	Interior Concrete	Concrete, Mortar	Not stated	ELE-TEMP		
"	01255 1 00000000	Diesel Generator	Walls/ Columns:				modulus	
		Building; Turbine	Interior Concrete					
			Slabs/ Beams; &					
		Building; & Utility/	Masonry Block					
		Piping Tunnels	Walls					
			· · · · · · · · · · · · · · · · · · ·			ELOD #D	Loss of strength &	
92	Class 1 Structures	Auxiliary Building;	Interior Concrete	Concrete, Mortar	Not stated	EMBR/IR	modulus	
		Diesel Generator	Walls/ Columns;					
		Building; Turbine	Interior Concrete					
		Building; & Utility/	Slabs/ Beams; &					
i		Piping Tunnels	Masonry Block Walls					
93	Class 1 Structures	Auxiliary Building;	Interior Concrete	Concrete, Mortar	Not stated	CORR/RE	Cracking, spalling,	
55	Ciass i Ciacianos	Diesel Generator	Walls/ Columns;				loss of bond, & los	
	1	Building; Turbine	Interior Concrete	1			of material	
		Building; & Utility/	Slabs/ Beams; &					
			Masonry Block					
		Piping Tunnels						
			Walls					
94	Class 1 Structures	Auxiliary Building;	Interior Concrete	Concrete, Mortar	Not stated	CREEP	Deformation	
• ·		Diesel Generator	Walis/ Columns;					
		Building; Turbine	Interior Concrete					
		Building; & Utility/	Slabs/ Beams; &					
		Piping Tunnels	Masonry Block					
			Walls					
95	Class 1 Structures	Auxiliary Building;	Interior Concrete	Concrete, Mortar	Not stated	SHRINK	Cracking	
		Diesel Generator	Walls/ Columns;					
		Building: Turbine	Interior Concrete					
		Building; & Utility/	Slabs/ Beams; &					
		Piping Tunnels	Masonry Block					
			Walls					
96	Class 1 Structures	Auxiliary Building;	Interior Concrete	Concrete, Mortar	Not stated	MASON-BLOC	Cracking of masor	
90	Class I Stuciales	Diesel Generator	Walls/ Columns;			(Applicable only to	block walls	
			Interior Concrete			masonry block wall)		
	1	Building; Turbine	Slabs/ Beams; &					
		Building; & Utility/	Masonry Block					
		Piping Tunnels	Walls					
		Austiliant Duilding:	Interior Concrete	Concrete, Mortar	Not stated	FAT (Applicable only	Cumulative fatigue	
97	7 Class 1 Structures	Auxiliary Building;	Walls/ Columns:			to concrete	damage	
		Diesel Generator				structures)		
		Building; Turbine	Interior Concrete					
		Building; & Utility/	Slabs/ Beams; &					
		Piping Tunnels	Masonry Block					
_		A The Dellation	Walls Interior Concrete	Concrete, Mortar	Not stated	CATH	Cathodic protectio	
98	8 Class 1 Structures	Auxiliary Building;					effect on bond	
		Diesel Generator	Walls/ Columns;			ļ	strength	
		Building; Turbine	Interior Concrete				strength	
		Building; & Utility/	Slabs/ Beams; &					
		Piping Tunnels	Masonry Block					
	O Class 1 Structures	Availiant Building	Walls Structural Steel	Carbon steel	Not stated	ELE-TEMP	Loss of strength &	
9	9 Class 1 Structures	Auxiliary Building:					modulus	
		Diesel Generator Building; Turbine		1			1	
		Building; & Utility/	1					
		Piping Tunnels Auxiliary Building;	Structural Steel	Carbon steel	Not stated	EMBR/IR	Loss of fracture	
10	O Class 1 Structures	Diesel Generator					toughness	
		Building; Turbine						
		Building; & Utility/						
		Piping Tunnels	Chushural Charl	Carbon steel	Not stated	CORR Unresolved	Loss of material	
10	1 Class 1 Structures	Auxiliary Building;	Structural Steel	Carbon steel				
		Diesel Generator					1	
		Building; Turbine	1		1		I	
		Building; & Utility/			1			
		Piping Tunnels					Oursulation fation	
10	2 Class 1 Structures	Auxiliary Building;	Structural Steel	Carbon steel	Not stated	FAT	Cumulative fatigu	
``		Diesel Generator		. [damage	
ł	1	Building; Turbine					1	
		Louisen 19, Turbino		1	1	1		
		Building; & Utility/		•	1			

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Effect of Aging on Component Fu Lose protection of safety related	Not stated	Not stated	Rel.progs	Report Recommendations	Page No.	<u> </u>
equipment.				Non-significant for concrete maintained at <66_C (150_F) & loca areas at <93_C (200_F), or plant- specific justification is provided in accordance with ACI 349-85; & for embedded steel or rebar maintained at <316 deg C.	4-24 to 4- 29 & 4-52 4-53	- T
equipment.	Not stated	Not stated		Non-significant because radiation dose is low compared to the level causing degradation.	4-29 -41; 4-53 -59	
Lose protection of safety related equipment. Lose protection of safety related	Not stated	Not stated		Non-significant for concrete not exposed to aggressive environment (pH <11.5 chlorides >500 ppm); or concrete mix meets the requirements of ACI 318-63 or 349- 85 (air content 3-6% water-to- cement ratio 0.35-0.45).	4-20 to 4- 23 & 4-49 to 4-51	9
equipment.		Not stated		Non-significant because the compressive stresses are low.	4-41 -43	9
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4-45	9
ose protection of safety related equipment.	Not stated	I&E Bulletin 80-11 & Information Notice No. 87-67.		Inspection of Bulletin 80-11 & monitoring & corrective action of Info. Notice 87-67.	5-14, 5-15	96
ose protection of safety related quipment.	Not stated	Not stated		Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	97
ose protection of safety related quipment.	Not stated	Not stated		Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft^2 level that cause degradation.	4-84, 4-85	98
ose protection of safety related quipment.	Not stated	Not stated		structural steel components, metal	1-64, 4-65 & 4-70, 4- 71	99
ose protection of safety related quipment.	Not stated	Not stated			-65 -68, -71	100
ose protection of safety related upment.	Not stated	Select plant-specific program for below grade structural steel not (More)		This item was not the focus of this 5 NRC review.	-11, 5-12	101
se protection of safety related uipment.	Not stated	Not stated		Non-significant because steel 4 structures are designed according to 8 AISC Code or equivalent.	-72 to 4- 3	102

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	Loop of moder-int
03	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Steel Piles	Carbon steel	Not stated	CORR FRZ-THAW	Loss of material Scaling, cracking, &
04	Class 1 Structures	Radwaste Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	FRZ- I DAVY	spalling
05	Class 1 Structures	Radwaste Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	LEACH	Increase of porosity & permeability
06	Class 1 Structures	Radwaste Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	AGR-CHEM Unresolved	Increase of porosity & permeability, cracking, & spalling
107	Class 1 Structures	Radwaste Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	AGREAC	Expansion & cracking
108	Class 1 Structures	Radwaste Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CORR/RE Unresolved	Cracking, spalling, loss of bond, & los of material
109	Class 1 Structures	Radwaste Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CREEP	Deformation
110	Class 1 Structures	Radwaste Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	SHRINK	Cracking
111	Class 1 Structures	Radwaste Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	FAT	Cumulative fatigue damage
112	Class 1 Structures	Radwaste Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
113	Class 1 Structures	Radwaste Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	SETTLE (Applicable only to concrete foundations)	Cracking, in-crease in component stres level, distortion.
114	Class 1 Structures	Radwaste Building	Exterior Concrete Above Grade	Concrete /	Not stated	FRZ-THAW	Scaling, cracking, spalling
11!	5 Class 1 Structures	Radwaste Building	Exterior Concrete Above Grade	Concrete	Not stated	LEACH	Increase of porosi & permeability
11	6 Class 1 Structures	Radwaste Building	Exterior Concrete Above Grade	Concrete	Not stated	AGR-CHEM	Increase of porosi & permeability, cracking, & spallin

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Lose protection of safety related	Not stated	ure Reported progs R		Non-significant because pilos driven	4-60, 4-61	Iten 10
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant because piles driven in undisturbed soil are unaffected &	4-60, 4-61	10
				those driven in disturbed soil suffer minor corrosion in a small area of		
····				metal		
Radiation Release.	Not stated	Not stated		Non-significant for component	4-3 to 4-8	10
				located in a geographic region of weathering index <100 day-inch/yr or		
				concrete mix design meets the air		
				content and water-to-cement ratio requirements of ACI 318-63 or ACI		
				349-85.		
Radiation Release.	Not stated	Not stated		Non-significant for components not exposed to flowing water or	4-8 to 4- 12	10
				constructed using ACI 201.2R-77 to	12	
				ensure dense, well-cured concrete		
Radiation Release.	Not stated	Select plant-specific		with low permeability. This item was not the focus of this	5-7 to 5-9	10
Accaron neibase.	Not stated	program that may		NRC review.	51 10 5-5	
		include monitoring of				
Radiation Release.	Not stated	ground water (More) Not stated		Non-significant for components	4-16 to 4-	10
				constructed from aggregate taken	19	
				from regions other than those known		
				to cause alkali-aggregate reactions, or aggregates tested in accordance		
				with ASTM C295 or C227 were shown to be non-reactive.		
Radiation Release	Not stated	Select plant-specific		This item was not the focus of this	5-7 to 5-9	10
		program, e.g. ground		NRC review.		
		water monitoring, inspection, & testing				
Radiation Release.	Not stated	Not stated		Non-significant because the	4-41 -43	10
				compressive stresses are low.		
Radiation Release.	Not stated	Not stated		Non-significant because most	4-44, 4-45	11
				concrete shrinkage occurs in first five years of a structure's life.		
Radiation Release.	Not stated	Not stated		Non-significant because concrete	4-72 to 4-	11
				structures are designed according to ACI 318 or its equivalent.	83	
Radiation Release	Not stated	Not stated		Non-significant because cathodic	4-84, 4-85	11
				protection systems operate at a level		
				well below the 1000 mA/ft^2 level that cause degradation.		
Radiation Release.	Not stated	Plant settlement		Structure settlement monitoring	5-4, 5-5	11
		monitoring program.		during construction & continued		
				during operation for soft soil or changes in ground water.		
Radiation Release.	Not stated	Not stated		Non-significant for components	4-3 to 4-8	11
				located in a geographic region of weathering index <100 day-in./yr; or		
				concrete mix design meets air		
				content & water-to-cement ratio		
				requirements of ACI 318-63 or ACI 349-85.		
Radiation Release.	Not stated	Not stated	,	Non-significant for components not	4-8 to 4-	11
				exposed to flowing water or	12	
				constructed using ACI 201.2R-77 to ensure dense, well-cured concrete		
				with low permeability.		L
Radiation Release.	Not stated	Not stated		Non-significant for components not	4-13 to 4-	11
				exposed to aggressive environment (pH <5.5, chloride >500 ppm, &	15	
				sulfate >1500 ppm); or exposed to		l
				aggressive groundwater for		
				intermittent periods only.		
	1	1		1		l

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Reviewed by:	D. C. Ma/O. Chopra, ANL			
Item System	Structure/Comp	Subcomponent	Materials	Manufactur

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
117	Class 1 Structures	Radwaste Building	Exterior Concrete Above Grade	Concrete	Not stated	AGREAC	Expansion & cracking
118	Class 1 Structures	Radwaste Building	Exterior Concrete Above Grade	Concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, & loss of material
119	Class 1 Structures	Radwaste Building	Exterior Concrete	Concrete	Not stated	CREÉP	Deformation
20	Class 1 Structures	Radwaste Building	Above Grade Exterior Concrete Above Grade	Concrete	Not stated	SHRINK	Cracking
21	Class 1 Structures	Radwaste Building	Exterior Concrete Above Grade	Concrete	Not stated	FAT	Cumulative tatigue damage
8	Class 1 Structures	Radwaste Building	Exterior Concrete Above Grade	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
23	Class 1 Structures	Radwaste Building	Interior Concrete Walis/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walis	Concrete, Mortar	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
24	Class 1 Structures	Radwaste Building	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	AGREAC	Expansion & cracking
25	Class 1 Structures	Radwaste Building	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	ELÉ-TEMP	Loss of strength & modulus
26	Class 1 Structures	Radwaste Building	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	EMBR/IR	Loss of strength & modulus
27	Class 1 Structures	Radwaste Building	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CORR/RE	Cracking, spalling, loss of bond, & los of material
128	Class 1 Structures	Radwaste Building	Interior Concrete Waits/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CREEP	Deformation
129	Class 1 Structures	Radwaste Building	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Bearns; & Masonry Block Walls	Concrete, Mortar	Not stated	SHRINK	Cracking

Radiation Release.

Not stated

Not stated

Effect of Aging on Component Radiation Release	Not stated	Not stated	Rel.progs	Report Recommendations Non-significant for components	Page No. 4-16 to 4-	117
awayun nebase.	NOTSTATED	NOL STALOO		ron-significant for components constructed from aggregate taken from regions other than those known to cause alkali-aggregate reactions,	19	117
				or aggregates tested in accordance with ASTM C295 or C227 were shown to be non-reactive.		
adiation Release	Not stated	Not stated		Non-significant for concrete not	4-20 to 4-	118
				exposed to aggressive environment (pH <11.5 chlorides >500 ppm); or concrete mix meets the requirements of ACI 318-63 or 349- 85 (air content 3-6% water-to- cement ratio 0.35-0.45).	23 & 4-49 to 4-51	
Radiation Release.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	119
Radiation Release.	Not stated	Not stated		Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4-45	120
Radiation Release.	Not stated	Not stated		Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	121
Radiation Release.	Not stated	Not stated		Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft^2 level that cause degradation.	4-84, 4-85	122
Radiation Release.	Not stated	Not stated		Non-significant for components not exposed to aggressive environment (pH <5.5, chloride >500 ppm, & sulfate >1500 ppm); or exposed to aggressive groundwater for intermittent periods only.	4-13 to 4- 15	123
Radiation Release.	Not stated	Not stated		Same as for foundation & exterior concrete above & below grade	4-16 to 4- 19	124
adiation Release	Not stated	Not stated		Non-significant for concrete	4-24 to 4-	125
				maintained at <66_C (150_F) & local areas at <93_C (200_F), or plant- specific justification is provided in accordance with ACI 349-85; & for embedded steel or rebar maintained at <316 deg C.	29 & 4-52. 4-53	
Radiation Release.	Not stated	Not stated		Non-significant because radiation dose is low compared to the level causing degradation.	4-29 -41; 4-53 -59	126
Radiation Release.	Not stated	Not stated		Non-significant for concrete not exposed to aggressive environment (pH <11.5 chlorides >500 ppm); or concrete mix meets the	4-20 to 4- 23 & 4-49 to 4-51	127
			· · ·	requirements of ACI 318-63 or 349- 85 (air content 3-6% water-to- cement ratio 0.35-0.45).		
ladiation Release.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	128

4-44, 4-45 129

Non-significant because most concrete shrinkage occurs in first five years of a structure's life.

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Item System	Structure/Comp	Subcon

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	Class 1 Structures	Radwaste Building	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Bearns; & Masonry Block Walls	Concrete, Mortar	Not stated	MASON-BLOC -Applicable only to masonry block walls	Cracking of mason block walls
131	Class 1 Structures	Radwaste Building	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Bearns; & Masonry Block Walls	Concrete, Mortar	Not stated	FAT (Applicable only to concrete structures)	Cumulative fatigue damage
132	Class 1 Structures	Radwaste Building	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CATH	Cathodic protection effect on bond strength
133	Class 1 Structures	Radwaste Building	Structural Steel	Carbon steel	Not stated	ELE-TEMP	Loss of strength & modulus
134	Class 1 Structures	Radwaste Building	Structural Steel	Carbon steel	Not stated	EMBR/IR	Loss of fracture toughness
135	Class 1 Structures	Radwaste Building	Structural Steel	Carbon steel	Not stated	CORR Unresolved	Loss of material
136	Class 1 Structures	Radwaste Building	Structural Steel	Carbon steel	Not stated	FAT	Cumulative fatigue damage
137	Class 1 Structures	Radwaste Building	Steel Piles	Carbon steel	Not stated	CORR	Loss of material
138	Class 1 Structures	Switchgear Room	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
139	Class 1 Structures	Switchgear Room	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	AGREAC	Expansion & cracking
140	Class 1 Structures	Switchgear Room	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	ELE-TEMP	Loss of strength & modulus
141	Class 1 Structures	Switchgear Room	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	EMBR/IR	Loss of strength & modulus
142	Class 1 Structures	Switchgear Room	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated		Cracking, spalling, loss of bond, & loss of material

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Effect of Aging on Component Fu Radiation Release				Page No.	
Hacitation Helease.	Not stated	I&E Bulletin 80-11 & Information Notice No. 87-67.	Inspection of Bulletin 80-11 & monitoring & corrective action of Info. Notice 87-67.	5-14, 5-15	130
Radiation Release	Not stated	Not stated	Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	131
Radiation Release.	Not stated	Not stated	Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft^2 level that cause degradation.	4-84, 4-85	132
Radiation Release.	Not stated	Not stated	Degradation is non-significant for structural steel components, metal sidings, & liners maintained at temperatures <371 deg C (<700_F).	4-64 , 4-65 & 4-70, 4- 71	133
Radiation Release.	Not stated	Not stated	Non-significant because radiation dose is low compared to the level causing degradation.	4-65 -68 4-71	134
Radiation Release.	Not stated	Select plant-specific program for below grade structural steel not period. (More)	This item was not the focus of this NRC review.	5-11, 5-12	135
Radiation Release.	Not stated	Not stated	Non-significant because steel structures are designed according to AISC Code or equivalent.	4-72 to 4- 83	136
Radiation Release.	Not stated	Not stated	Non-significant because piles driven in undisturbed soil are unaffected & those driven in disturbed soil suffer minor corrosion in a small area of metal.	4-60, 4-61	137
Lose protection of safety related equipment.	Not stated	Not stated	Non-significant for components not exposed to aggressive environment (pH <5.5, chloride >500 ppm, & sulfate >1500 ppm); or exposed to aggressive groundwater for intermittent periods only.	4-13 to 4- 15	138
Lose protection of safety related equipment.	Not stated	Not stated	Non-significant for components constructed from aggregate taken from regions other than those known to cause alkali-aggregate reactions, or aggregates tested in accordance with ASTM C295 or C227 were shown to be non-reactive.	4-16 to 4- 19	139
Lose protection of safety related equipment.	Not stated	Not stated	Non-significant for concrete maintained at <66_C (150_F) & local areas at <93_C (200_F), or plant- specific justification is provided in accordance with ACI 349-85; & for embedded steel or rebar maintained at <316 deg C.	4-24 to 4- 29 & 4-52, 4-53	140
ose protection of safety related equipment.	Not stated	Not stated	Non-significant because radiation dose is low compared to the level causing degradation.	4-29 -41; 4-53 -59	141
Lose protection of safety related equipment.	Not stated	Not stated	Non-significant for concrete not exposed to aggressive environment (pH <11.5 chlorides >500 ppm); or concrete mix meets the requirements of ACI 318-63 or 349- 85 (air content 3-6% water-to- cement ratio 0.35-0.45).	4-20 to 4- 23 & 4-49 to 4-51	142

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Reviewed by:	D. C. Ma/O. Chopra, ANL	•
Item System	Structure/Comp	Subcon

-	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	Class 1 Structures	Switchgear Room	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CREEP	Deformation
144	Class 1 Structures	Switchgear Room	Interior Concrete Walls/ Columns; Interior Concrete Siabs/ Bearns; & Masonry Block Walls	Concrete, Mortar	Not stated	SHRINK	Cracking
145	Class 1 Structures	Switchgear Room	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	FAT (Applicable only to concrete structures)	Cumulative fatigue damage
146	Class 1 Structures	Switchgear Room	Interior Concrete Walis/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walis	Concrete, Mortar	Not stated	CATH	Cathodic protection effect on bond strength
147	Class 1 Structures	Switchgear Room	Masonry Block Walls	Concrete, Mortar	Not stated	MASON-BLOC	Cracking of masonn block walls
148	Class 1 Structures	Switchgear Room	Structural Steel	Carbon steel	Not stated	ELE-TEMP	Loss of strength & modulus
149	Class 1 Structures	Switchgear Room	Structural Steel	Carbon steel	Not stated	EMBR/IR	Loss of fracture toughness
150	Class 1 Structures	Switchgear Room	Structural Steel	Carbon steel	Not stated	FAT	Cumulative fatgue damage
151	Class 1 Structures	Switchgear Room	Steel Piles	Carbon steel	Not stated	CORR	Loss of material
152	Class 1 Structures	Auxiliary Feedwater Pump House	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking, & spalling
153	Class 1 Structures	Auxiliary Feedwater Pump House	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	LEACH	Increase of porosity & permeability
154	Class 1 Structures	Auxiliary Feedwater Pump House	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	AGR-CHEM Unresolved	Increase of porosity & permeability, cracking, & spalling
155	Class 1 Structures	Auxiliary Feedwater Pump House	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	AGREAC	Expansion & cracking
156	Class † Structures	Auxiliary Feedwater Pump House	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CORR/RE Unresolved	Cracking, spalling, loss of bond, & loss of material

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Effect of Aging on Component Fun			Rel.progs	Report Recommendations	Page No.	
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	14
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4-45	14
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	14
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft^2 level that cause degradation.	4-84, 4-85	14
Lose protection of safety related equipment.	Not stated	I&E Bulletin 80-11 & Information Notice No. 87-67.	<u> </u>	Inspection of Bulletin 80-11 & monitoring & corrective action of Info. Notice 87-67.	5-14, 5-15	14
Lose protection of safety related equipment.	Not stated	Not stated		Degradation is non-significant for structural steel components, metal sidings, & liners maintained at temperatures <371 deg C (<700_F).	4-64, 4-65 & 4-70, 4- 71	14
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant because radiation dose is low compared to the level causing degradation.	4-65 -68, 4-71	14
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant because steel structures are designed according to AISC Code or equivalent.	4-72 to 4- 83	150
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant because piles driven in undisturbed soil are unaffected & those driven in disturbed soil suffer minor corrosion in a small area of metal.	4-60, 4-61	15
Loss of feedwater.	Not stated	Not stated		Non-significant for component located in a geographic region of weathering index <100 day-inch/yr or concrete mix design meets the air content and water-to-cement ratio requirements of ACI 318-63 or ACI 349-85.	4-3 to 4-8	15
Loss of feedwater.	Not stated	Not stated		Non-significant for components not exposed to flowing water or constructed using ACI 201.2R-77 to ensure dense, well-cured concrete with low permeability.	4-8 to 4- 12	15
Loss of feedwater.	Not stated	Select plant-specific program that may include monitoring of ground water (More)		This item was not the focus of this NRC review.	5-7 to 5-9	15
Loss of feedwater.	Not stated	Not stated		Non-significant for components constructed from aggregate taken from regions other than those known to cause alkali-aggregate reactions, or aggregates tested in accordance with ASTM C295 or C227 were shown to be non-reactive.	4-16 to 4- 19	15
Loss of feedwater.	Not stated	Select plant-specific program, e.g. ground water monitoring, inspection, & testing		This item was not the focus of this NRC review.	5-7 to 5-9	15

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
157	Class 1 Structures	Auxiliary Feedwater Pump House	Foundation & Exterior Concrete Bolow Grado	Concrete	Not stated	CREEP	Deformation
158	Class 1 Structures	Auxiliary Feedwater Pump House	Below Grade Foundation & Exterior Concrete Below Grade	Concrete	Not stated	SHRINK	Cracking
159	Class 1 Structures	Auxiliary Feedwater Pump House	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	FAT	Cumulative fatigue damage
160	Class 1 Structures	Auxiliary Feedwater Pump House	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	САТН	Cathodic protectio effect on bond strength
161	Class 1 Structures	Auxiliary Feedwater Pump House	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	SETTLE (Applicable only to concrete foundations)	Cracking, in-creas in component strea level, distortion.
162	Class 1 Structures	Auxiliary Feedwater Pump House	Exterior Concrete Above Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking, spalling
163	Class 1 Structures	Auxiliary Feedwater Pump House	Exterior Concrete Above Grade	Concrete	Not stated	LEACH	Increase of porosit & permeability
164	Class 1 Structures	Auxiliary Feedwater	Exterior Concrete	Concrete	Not stated	AGR-CHEM	Increase of porosit
		Pump House	Above Grade				& permeability, cracking, & spalling
165	Class 1 Structures	Auxiliary Feedwater Pump House	Exterior Concrete Above Grade	Concrete	Not stated	AGREAC	Expansion & cracking
166	Class 1 Structures	Auxiliary Feedwater Pump House	Exterior Concrete Above Grade	Concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, & los of material
167	Class 1 Structures	Auxiliary Feedwater	Exterior Concrete	Concrete	Not stated	CREEP	Deformation
168	Class 1 Structures	Pump House Auxiliary Feedwater Pump House	Above Grade Exterior Concrete Above Grade	Concrete	Not stated	SHRINK	Cracking
169	Class 1 Structures	Auxiliary Feedwater Pump House	Exterior Concrete Above Grade	Concrete	Not stated	FAT	Cumulative fatigue damage
170	Class 1 Structures	Auxiliary Feedwater Pump House	Exterior Concrete Above Grade	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
171	Class 1 Structures	Auxiliary Feedwater Pump House	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	AGR-CHEM	Increase of porosit & permeability, cracking, & spalling

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Loss of feedwater. Rel.progs Report Recommendations Not stated Page No. Item Not stated Non-significant because the 4-41-43 157 compressive stresses are low. Loss of feedwater. Not stated Not stated Non-significant because most 4-44, 4-45 158 concrete shrinkage occurs in first Loss of feedwater. five years of a structure's life. Not stated Not stated Non-significant because concrete 4-72 to 4-159 structures are designed according to 83 Loss of feedwater. ACI 318 or its equivalent. Not stated Not stated Non-significant because cathodic 4-84, 4-85 160 protection systems operate at a level well below the 1000 mA/ft^2 level Loss of feedwater. that cause degradation. Not stated Plant settlement Structure settlement monitoring 5-4, 5-5 monitoring program. 161 during construction & continued during operation for soft soil or Loss of feedwater changes in ground water. Not stated Not stated Non-significant for components 4-3 to 4-8 162 located in a geographic region of weathering index <100 day-in /yr; or concrete mix design meets air content & water-to-cement ratio requirements of ACI 318-63 or ACI Loss of feedwater. 349-85 Not stated Not stated Non-significant for components not 4-8 to 4-163 exposed to flowing water or 12 constructed using ACI 201.2R-77 to ensure dense, well-cured concrete Loss of feedwater. with low permeability. Not stated Not stated

		NOT STATED	Non-significant for components not exposed to aggressive environment	4-13 to 4- 15	16
			(pH <5.5, chloride >500 ppm, & sulfate >1500 ppm); or exposed to aggressive groundwater for		
oss of feedwater.	Not stated		intermittent periods only.		
		Not stated	Non-significant for components constructed from aggregate taken from regions other than those known to cause alkali-aggregate reactions, or aggregates tested in accordance	4-16 to 4- 19	165
oss of feedwater.	Not stated	Not stated	with ASTM C295 or C227 were shown to be non-reactive.		
			Non-significant for concrete not exposed to aggressive environment (pH <11.5 chlorides >500 ppm); or concrete mix meets the requirements of ACI 318-63 or 349- 85 (air content 3-6% water-to-	4-20 to 4- 23 & 4-49 to 4-51	166
oss of feedwater.	Not stated	Not stated	Cement ratio 0.35-0.45). Non-significant because the		
oss of feedwater.	Not stated		compressive stresses are low.	4-41 -43	167
	NOLSTATED	Not stated	Non-significant because most concrete shrinkage occurs in first	4-44, 4-45	168
ss of feedwater.	Not stated	Not stated	five years of a structure's life.	_	
ss of feedwater			structures are designed according to a	4-72 to 4- 83	169
	Not stated	Not stated	ACI 318 or its equivalent. Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft^2 level	4-84, 4-85	170
ss of feedwater.	Not stated	Not stated	that cause degradation.		
			AYDOROT to account of the second seco	4-13 to 4- 15	171

9Vie		O. Chopra, ANL Structure/Comp	Subcomponent	Materials	Manufacturer		ARD effects Expansion &
m 72	System Class 1 Structures	Auxiliary Feedwater Pump House	nterior Concrete Walls/ Columns; Interior Concrete Stabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated		cracking
173	Class 1 Structures	Auxiliary Feedwater Pump House	Mais Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated		Loss of strength & modulus
174	Class 1 Structures	Auxiliary Feedwater Pump House	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block	Concrete, Mortar	Not stated		Loss of strength & modulus
175	Class 1 Structures	Auxiliary Feedwater Pump House	Walis Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CORR/RE	Cracking, spalling, loss of bond, & loss of material
17	6 Class 1 Structures	Auxiliary Feedwater Pump House	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CREEP	Deformation
17	7 Class 1 Structures	Auxiliary Feedwater Pump House	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block	Concrete, Mortar	Not stated	SHRINK	Cracking
17	78 Class 1 Structures	Auxiliary Feedwater Pump House	Walls Interior Concrete Walls/ Columns: Interior Concrete Slabs/ Beams; & Masonry Block	Concrete, Mortar	Not stated	MASON-BLOC (Applicable only to masonry block walls	Cracking of mason block walls
17	79 Class 1 Structures	Auxiliary Feedwater Pump House	Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block	Concrete, Mortar	Not stated	FAT (Applicable only to concrete structures)	damage
1	80 Class 1 Structures	Auxiliary Feedwater Pump House	Walls Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CATH	Cathodic protectic effect on bond strength
	81 Class 1 Structures	Auxiliary Feedwate Pump House		Carbon steel	Not stated	ELE-TEMP	Loss of strength & modulus
+	182 Class 1 Structure	s Auxiliary Feedwate Pump House	r Structural Steel	Carbon steel	Not stated	EMBR/IR	Loss of fracture toughness
+	183 Class 1 Structure	s Auxiliary Feedwate Pump House	r Structural Steel	Carbon steel	Not stated	CORR Unresolved	Loss of material
┝	184 Class 1 Structure	s Auxiliary Feedwate Pump House	er Structural Steel	Carbon steel	Not stated	FAT	Cumulative fatigu damage

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Effect of Aging on Component Fu			Rel.progs	Report Recommendations	Page No.	
Loss of feedwater.	Not stated	Not stated		Same as for foundation & exterior concrete above & below grade	4-16 to 4- 19	17:
Loss of feedwater.	Not stated	Not stated		Non-significant for concrete maintained at <66_C (150_F) & local areas at <93_C (200_F), or plant- specific justification is provided in accordance with ACI 349-85; & for embedded steel or rebar maintained at <316 deg C.	4-53	173
Loss of feedwater.	Not stated	Not stated		Non-significant because radiation dose is low compared to the level causing degradation.	4-29 -41; 4-53 -59	174
Loss of feedwater.	Not stated	Not stated		Non-significant for concrete not exposed to aggressive environment (pH <11.5 chlorides >500 ppm); or concrete mix meets the requirements of ACI 318-63 or 349- 85 (air content 3-6% water-to- cement ratio 0.35-0.45).	4-20 to 4- 23 & 4-49 to 4-51	175
Loss of feedwater.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	176
Loss of feedwater.	Not stated	Not stated	· · · · · · · · · · · · · · · · · · ·	Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4-45	177
Loss of feedwater.	Not stated	I&E Bulletin 80-11 & Information Notice No. 87-67.		Inspection of Bulletin 80-11 & monitoring & corrective action of Info. Notice 87-67.	5-14, 5-15	178
Loss of feedwater.	Not stated	Not stated		Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	179
Loss of feedwater.	Not stated	Not stated		Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft^2 level that cause degradation.	4-84, 4-85	180
Loss of feedwater.	Not stated	Not stated		Degradation is non-significant for structural steel components, metal sidings, & liners maintained at	4-64, 4-65 & 4-70, 4- 71	181
Loss of feedwater.	Not stated	Not stated	· · · · · · · · · · · · · · · · · · ·	temperatures <371 deg C (<700_F). Non-significant because radiation dose is low compared to the level	4-65 -68, 4-71	182
Loss of feedwater.	Not stated	Select plant-specific program for below grade structural steel not period. (More)		causing degradation. This item was not the focus of this NRC review.	5-11, 5-12	183
Loss of feedwater.	Not stated	Not stated		Non-significant because steel structures are designed according to AISC Code or equivalent.	4-72 to 4- 83	184

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Item System	Structure/Comp	Subcon

_	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
185	Class 1 Structures	Auxiliary Feedwater Pump House	Steel Piles	Carbon steel	Not stated	CORR	Loss of material
186	Class 1 Structures	Containment Internal Structures	Interior Concrete Walls/ Columns & Interior Concrete Slabs/ Beams	Concrete	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
187	Class 1 Structures	Containment Internal Structures	Interior Concrete Walls/ Columns & Interior Concrete Slabs/ Beams	Concrete	Not stated	AGREAC	Expansion & cracking
188	Class 1 Structures	Containment internal Structures	Interior Concrete Walls/ Columns & Interior Concrete Slabs/ Beams	Concrete	Not stated	ELE-TEMP	Loss of strength & modulus
189	Class 1 Structures	Containment Internal Structures	Interior Concrete Walls/ Columns & Interior Concrete Slabs/ Beams	Concrete	Not stated	EMBR/IR	Loss of strength & modulus
190	Class 1 Structures	Containment Internal Structures		Concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, & los of matenal
191	Class 1 Structures	Containment Internal Structures	Interior Concrete Walls/ Columns & Interior Concrete Slabs/ Beams	Concrete	Not stated	CREEP	Deformation
192	Class 1 Structures	Containment Internal Structures		Concrete	Not stated	SHRINK	Cracking
193	Class 1 Structures	Containment Internal Structures	Interior Concrete Walls/ Columns & Interior Concrete Slabs/ Beams	Concrete	Not stated	FAT	Cumulative fatigue damage
194	Class 1 Structures	Containment Internal Structures	Interior Concrete Walls/ Columns & Interior Concrete Slabs/ Beams	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
195	Class 1 Structures	Containment Internal Structures	Structural Steel & Stainless Steel Liner	Carbon steel & Stainless steel	Not stated	ELE-TEMP	Loss of strength & modulus
196	Class 1 Structures	Containment Internal Structures	Structural Steel & Stainless Steel Liner	Carbon steel & Stainless steel	Not stated	EMBR/IR	Loss of fracture toughness
197	Class 1 Structures	Containment Internal Structures	Structural Steel & Stainless Steel Liner	Carbon steel & Stainless steel	Not stated	CORR Unresolved	Loss of material
198	Class 1 Structures	Containment Internal Structures	Structural Steel & Stainless Steel Liner	Carbon steel & Stainless steel	Not stated	FAT	Cumulative fatigue damage
199	Class 1 Structures	Containment Internal Structures	Structural Steel & Stainless Steel Liner	Carbon steel & Stainless steel	Not stated	CORR/IGSCC & CORR/CREV Unresolved	Loss of material, crack initiation & growth

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	nt Function Contrib to Failure		Rel.progs	Report Recommendations	Page No.	
Loss of feedwater.	Not stated	Not stated		Non-significant because piles driven in undisturbed soil are unaffected & those driven in disturbed soil suffer minor corrosion in a small area of metal.	4-60, 4-61	18
Loss of shielding.	Not stated	Not stated		Non-significant for components not exposed to aggressive environment (pH <5.5, chloride >500 ppm, & sulfate >1500 ppm); or exposed to aggressive groundwater for intermittent periods only.	4-13 to 4- 15	18
Loss of shielding.	Not stated	Not stated		Non-significant for components constructed from aggregate taken from regions other than those known to cause alkali-aggregate reactions, or aggregates tested in accordance with ASTM C295 or C227 were shown to be non-reactive.	4-16 to 4- 19	18
Loss of shielding.	Not stated	Not stated		Non-significant for concrete maintained at <66_C (150_F) & local areas at <93_C (200_F), or plant- specific justification is provided in accordance with ACI 349-85; & for embedded steel or rebar maintained at <316 deg C.	4-24 to 4- 29 & 4-52, 4-53	18
Loss of shielding.	Not stated	Not stated		Non-significant because radiation dose is low compared to the level causing degradation.	4-29 -41; 4-53 -59	18
Loss of shielding.	Not stated	Not stated		Non-significant for concrete not exposed to aggressive environment (pH <11.5 chlorides >500 ppm); or concrete mix meets the requirements of ACI 318-63 or 349- 85 (air content 3-6% water-to- cement ratio 0.35-0.45).	4-20 to 4- 23 & 4-49 to 4-51	19
Loss of shielding.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	19
Loss of shielding.	Not stated	Not stated		Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4-45	19
Loss of shielding.	Not stated	Not stated		Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	19
Loss of shielding.	Not stated	Not stated	_	Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft^2 level that cause degradation.	4-84, 4-85	194
Loss of shielding.	Not stated	Not stated		Degradation is non-significant for structural steel components, metal sidings, & liners maintained at temperatures <371 deg C (<700_F).	4-64, 4-65 & 4-70, 4- 71	19
Loss of shielding.	Not stated	Not stated		Non-significant because radiation dose is low compared to the level causing degradation.	4-65 -68, 4-71	19
Loss of shielding.	Not stated	Select plant-specific program for below grade structural steel not period. (More)		This item was not the focus of this NRC review.	5-11, 5-12	19
Loss of shielding.	Not stated	Not stated		Non-significant because steel structures are designed according to AISC Code or equivalent.	4-72 to 4- 83	19
Loss of shielding.	Not stated	Select plant-specific program to address crevice corrosion & IGSCC.		This item was not the focus of this NRC review.	5-9 to 5- 11	19

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item System	Structure/Comp	Subcom

	System Class 1 Structures	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
200	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking, spalling
201	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	LEACH	Increase of porosi & permeability
202	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	AGR-CHEM Unresolved	Increase of porosi & permeability, cracking, & spallin
203	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	AGREAC	Expansion & cracking
204	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CORR/RE Unresolved	Cracking, spalling loss of bond, & los of material
205	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CREEP	Deformation
206	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	SHRINK	Cracking
207	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	FAT	Cumulative fatigue damage
208	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CATH	Cathodic protectic effect on bond strength
209	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	SETTLE (Applicable only to concrete foundations)	Cracking, in-creas in component stre level, distortion.
210	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Exterior Concrete Above Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking. spalling
211	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Exterior Concrete Above Grade	Concrete	Not stated	LEACH	Increase of porosi & permeability
212	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Exterior Concrete Above Grade	Concrete	Not stated	AGR-CHEM	Increase of porosi & permeability, cracking, & spallir
213	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Exterior Concrete Above Grade	Concrete	Not stated	AGREAC	Expansion & cracking

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Effect of Aging on Component Function	n contrib to Failure		Rel.progs	Report Recommendations	Page No.	
Release of Radiation/Hazardous Material.		Not stated		Non-significant for component located in a geographic region of weathering index <100 day-inch/yr or concrete mix design meets the air content and water-to-cement ratio requirements of ACI 318-63 or ACI 349-85.	4-3 to 4-8	20
	Not stated	Not stated		Non-significant for components not exposed to flowing water or constructed using ACI 201.2R-77 to ensure dense, well-cured concrete with low permeability.	4-8 to 4- 12	20
Release of Radiation/Hazardous Material.	Not stated	Select plant-specific program that may include monitoring of ground water (More)		This item was not the focus of this NRC review.	5-7 to 5-9	202
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant for components constructed from aggregate taken from regions other than those known to cause alkali-aggregate reactions, or aggregates tested in accordance with ASTM C295 or C227 were shown to be non-reactive.	4-16 to 4- 19	203
Release of Radiation/Hazardous Material.	Not stated	Select plant-specific program, e.g. ground water monitoring, inspection, & testing		This item was not the locus of this NRC review.	5-7 to 5-9	204
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	205
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4-45	206
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	207
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft^2 level that cause degradation.	4-84, 4-85	208
Release of Radiation/Hazardous Material.	Not stated	Plant settlement monitoring program.		Structure settlement monitoring during construction & continued during operation for soft soil or changes in ground water.	5-4, 5-5	209
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant for components located in a geographic region of weathering index <100 day-in./yr; or concrete mix design meets air content & water-to-cement ratio requirements of ACI 318-63 or ACI 349-85.	4-3 to 4-8	
Release of Radiation/Hazardous Material.	Not stated	Not stated		exposed to flowing water or constructed using ACI 201.2R-77 to ensure dense, well-cured concrete with low permeability.	4-8 to 4- 12	211
	Not stated	Not stated		exposed to aggressive environment (pH <5.5, chloride >500 ppm, & sulfate >1500 ppm); or exposed to aggressive groundwater for intermittent periods only.	4-13 to 4- 15	212
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant for components constructed from aggregate taken from regions other than those known to cause alkali-aggregate reactions, or aggregates tested in accordance with ASTM C295 or C227 were shown to be non-reactive.	4-16 to 4- 19	213

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Hem System	Structure/Comp	Subcomponent

_	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
214	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Exterior Concrete Above Grade	Concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, & loss of material
215	Class 1 Structures	Fuel Storage Facility	Exterior Concrete	Concrete	Not stated	CREEP	Deformation
216	Class 1 Structures	& Refueling Canal Fuel Storage Facility & Refueling Canal	Above Grade Exterior Concrete Above Grade	Concrete	Not stated	SHRINK	Cracking
217	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Exterior Concrete Above Grade	Concrete	Not stated	FAT	Cumulative fatigue damage
218	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Exterior Concrete Above Grade	Concrete	Not stated	САТН	Cathodic protection effect on bond strength
219	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
220	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	AGREAC	Expansion & cracking
21	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	ELE-TEMP	Loss of strength & modulus
22	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	EMBR/IR	Loss of strength & modulus
23	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Interior Concrete Walts/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walts	Concrete, Mortar	Not stated	CORR/RE	Cracking, spalling. loss of bond, & loss of material
224	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CREEP	Deformation
225	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	SHRINK	Cracking
226	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Interior Concrete Walis/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	MASON-BLOC (Applicable only to masonry block walls	Cracking of mason block walls

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Effect of Aging on Component Functio			Rel.progs	Report Recommendations	Page No.	
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant for concrete not exposed to aggressive environment (pH <11.5 chlorides >500 ppm); or concrete mix meets the requirements of ACI 318-63 or 349- 85 (air content 3-6% water-to- cement ratio 0.35-0.45).	4-20 to 4- 23 & 4-49 to 4-51	214
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	215
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4- 45	216
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	217
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft^2 level that cause degradation.	4-84, 4-85	218
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant for components not exposed to aggressive environment (pH <5.5, chloride >500 ppm, & sulfate >1500 ppm); or exposed to aggressive groundwater for intermittent periods only.	4-13 to 4- 15	219
Release of Radiation/Hazardous Material.	Not stated	Not stated		Same as for foundation & exterior concrete above & below grade	4-16 to 4- 19	220
Release of Raciation/Hazardous Material.	Not stated	Not stated		Non-significant for concrete maintained at <66_C (150_F) & local areas at <93_C (200_F), or plant- specific justification is provided in accordance with ACI 349-85; & for embedded steel or rebar maintained at <316 deg C.	4-24 to 4- 29 & 4-52, 4-53	221
Release of Raciation/Hazardous Material.	Not stated	Not stated		Non-significant because radiation dose is low compared to the level causing degradation.	4-29 -41; 4-53 -59	222
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant for concrete not exposed to aggressive environment (pH <11.5 chlorides >500 ppm); or concrete mix meets the requirements of ACI 318-63 or 349- 85 (air content 3-6% water-to- cement ratio 0.35-0.45).	4-20 to 4- 23 & 4-49 to 4-51	223
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	224
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4-45	225
Release of Radiation/Hazardous Material.	Not stated	I&E Bulletin 80-11 & Information Notice No. 87-67.		Inspection of Bulletin 80-11 & monitoring & corrective action of Info. Notice 87-67.	5-14, 5-15	226

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Reviewed by:	D. C. Ma/O. Chopra, ANL	
Item System	Structure/Comp	Subcon

	7 Class 1 Structures	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
		Fuel Storage Facility & Refueling Canal	Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	FAT (Applicable only to concrete structures)	Cumulative fatigue damage
22		Fuel Storage Facility & Refueling Canal	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CATH	Cathodic protection effect on bond strength
229	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Structural Steel & Stainless Steel Liner	Carbon steel & Stainless steel	Not stated	ELE-TEMP	Loss of strength & modulus
230	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Structural Steel & Stainless Steel Liner	Carbon steel & Stainless steel	Not stated	EMBR/IR	Loss of fracture toughness
231	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Structural Steel & Stainless Steel Liner	Carbon steel & Stainless steel	Not stated	FAT	Cumulative fatigue damage
232	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Structural Steel	Carbon steel	Not stated	CORR Unresolved	Loss of material
233	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Stainless Steel Liner	Stainless steel	Not stated	CORR/IGSCC & CORR/CREV	Loss of material, crack initiation & growth
234	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Steel Piles	Carbon steel	Not stated	CORR	Loss of material
235	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Foundation and Exterior Concrete Above & Below Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking, & spalling
236	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Foundation and Exterior Concrete Above & Below Grade	Concrete	Not stated	LEACH	Increase of porosity & permeability
237	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Foundation and Exterior Concrete Above & Below Grade	Concrete	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
238	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Encurdation and Exterior Concrete Above & Below Grade	Concrete	Not stated	AGREAC	Expansion & cracking
239	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Foundation and Exterior Concrete Above & Below Grade	Concrete	Not stated	CORR/RE	Cracking, loss of bond or material, spalling
240	Class 1 Structures	Spray Ponds	Foundation and Exterior Concrete Above & Below Grade	Concrete	Not stated	CREEP	Deformation
241	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Foundation and Exterior Concrete Above & Below Grade	Concrete	Not stated	SHRINK	Cracking

Document: IR 90-06, Class 1 Structures Industry Report Reviewed by: D. C. Ma/O. Chopra, ANL Effect of Aging on Component Function Contrib to Failu

Effect of Aging on Component Functio	n contrib to Failure		Rel.progs	Report Recommendations	Page No.	_
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	22
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft^2 level that cause degradation.	4-84, 4-85	22
Release of Radiation/Hazardous Material.	Not stated	Not stated		Degradation is non-significant for structural steel components, metal sidings, & liners maintained at temperatures <371 deg C (<700_F).	4-64, 4-65 & 4-70, 4- 71	22
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant because radiation dose is low compared to the level causing degradation.	4-65 -68, 4-71	23
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant because steel structures are designed according to AISC Code or equivalent.	4-72 to 4- 83	23
Release of Radiation/Hazardous Material.	Not stated	Select plant-specific program for below grade structural steel not period. (More)		This item was not the focus of this NRC review.	5-11, 5-12	23
Release of Radiation/Hazardous Material.	Not stated	Current leakage detection & inventory monitoring system.		Periodic monitoring of the leak chase system drain lines and/or the leak detection sump are effective for early detection-repair of leaks.	5-9 to 5- 11	23
Release of Radiation/Hazardous Material.	Not stated	Not stated		Non-significant because piles driven in undisturbed soil are unaffected & those driven in disturbed soil suffer minor corrosion in a small area of metal.	4-60, 4-61	23
Loss of Heat Sink.	Not stated	Not stated		Non-significant for component located in a geographic region of weathering index <100 day-in./yr or concrete mix design meets air content & water-to-cement ratio requirements of ACI 318-63 or ACI 349-85.	4-3 to 4-8	23
Loss of Heat Sink.	Not stated	Not stated			4-8 to 4- 12	23
Loss of Heat Sink.	Not stated	Reg. Guide 1.127.		Reg. Guide 1.127 requires periodic inspection & evaluation of concrete surfaces, structural cracking, settlement, & water passage.	5-5 to 5-7	23
.oss of Heat Sink.	Not stated	Not stated			4-16 to 4- 19	23
Loss of Heat Sink.	Not stated	On-site inspection program outlined in Reg. Guide 1.127.		Reg. Guide 1.127 requires periodic inspection of surface cracking, settlement & water passage.	5-5 to 5-7	23
Loss of Heat Sink.	Not stated	Not stated		Non-significant because the compressive stresses are low,	4-41 -43	24
Loss of Heat Sink.	Not stated	Not stated		Non-significant because most concrete shrinkage occurs in first five years of a structure's lite.	4-44, 4-45	24

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
242	Class 1 Structures	Intake Structures, Cooling Towers, &	Foundation and Exterior Concrete	Concrete	Not stated	ABRA	Loss of material
		Spray Ponds	Above & Below Grade				
243	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Foundation and Exterior Concrete Above & Below Grade	Concrete	Not stated	FAT	Cumulative fatigue damage
244	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Foundation and Exterior Concrete Above & Below Grade	Concrete	Not stated	САТН	Cathodic protection effect on bond strength
245	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Foundation and Exterior Concrete Above & Below Grade	Concrete	Not stated	SETTLE (Applicable only to concrete foundations)	Cracking, in-crease in component stres level, distortion.
246	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Interior Concrete Slabs/ Beams	Concrete	Not staled	FRZ-THAW	Scaling, cracking, & spalling
247	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Interior Concrete Slabs/ Beams	Concrete	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
248	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Interior Concrete Slabs/ Beams	Concrete	Not stated	AGREAC	Expansion & cracking
249	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Interior Concrete Slabs/ Beams	Concrete	Not stated	CORR/RE	Cracking, loss of bond or material, spalling
250	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Interior Concrete Slabs/ Bearns	Concrete	Not stated	ABRA	Loss of material
251	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds & Cooling Towers	Interior Concrete Walls/ Columns & Interior Concrete Slabs/ Beams (No interior walls for Intake Structures)	Concrete	Not stated	CREEP	Deformation
252	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds & Cooling Towers		Concrete	Not stated	SHRINK	Cracking
253	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds & Cooling Towers	Interior Concrete Walis/ Columns & Interior Concrete Slabs/ Beams (No interior walls for Interior walls for	Concrete	Not stated	FAT	Cumulative fatigue damage
254	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds & Cooling Towers	Interior Concrete Walls/ Columns & Interior Concrete Slabs/ Beams (No interior walls for Interior walls for	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
255	Class 1 Structures	Intake Structures & Cooling Towers	Masonry Block Walls	Mortar	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling

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Effect of Aging on Compone Loss of Heat Sink.	Not stated	Reg. Guide 1.127.	Progs Report Recommendations Reg. Guide 1.127 requires periodic	Page No. 5-5 to 5-7	_
			inspection of surface cracking, settlement & water passage.	5-5 10 5-7	244
Loss of Heat Sink.	Not stated	Not stated	Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	243
Loss of Heat Sink.	Not stated	Not stated	Non-significant because cathodic protection systems operate at a level well below the 1000 mA/tt^2 level that cause degradation.	4-84, 4-85	244
Loss of Heat Sink.	Not stated	Plant settlement monitoring program.	Structure settlement monitoring during construction & continued during operation for soft soil or changes in ground water.	5-4. 5-5	245
Loss of Heat Sink.	Not stated	Not stated	Non-significant for component located in a geographic region of weathering index <100 day-in./yr or concrete mix design meets air content & water-to-cement ratio requirements of ACI 318-63 or ACI 349-85.	4-3 to 4-8	246
Loss of Heat Sink.	Not stated	Reg. Guide 1.127.	Reg. Guide 1.127 requires periodic inspection & evaluation of concrete surfaces, structural cracking, settlement, & water passage.	5-5 to 5-7	247
Loss of Heat Sink.	Not stated	Not stated	Non-significant for components constructed from aggregate taken from regions other than those known to cause alkali-aggregate reactions, or aggregates tested in accordance with ASTM C295 or C227 were shown to be non-reactive.	4-16 to 4- 19	248
oss of Heat Sink.	Not stated	On-site inspection program outlined in Reg. Guide 1.127.	Reg. Guide 1.127 requires periodic inspection of surface cracking, settlement & water passage.	5-5 to 5-7	249
Loss of Heat Sink.	Not stated	Reg. Guide 1.127.	Reg. Guide 1.127 requires periodic inspection of surface cracking, settlement & water passage.	5-5 to 5-7	250
Loss of Heat Sink.	Not stated	Not stated	Non-significant because the compressive stresses are low.	4-41 -43	251
oss of Heat Sink.	Not stated	Not stated	Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4-45	252
oss of Heat Sink.	Not stated	Not stated	Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	253
oss of Heat Sink.	Not stated	Not stated	Non-significant because cathodic protection systems operate at a level well below the 1000 mA/tt^2 level that cause degradation.	4-84, 4-85	254
oss of Heat Sink.	Not stated	Not stated		4-13 to 4- 15	⁻ 255

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1211	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	Class 1 Structures	Intake Structures & Cooling Towers	Masonry Block Walls	Mortar	Not stated	AGREAC	Expansion &
207	Class 1 Structures	Intake Structures & Cooling Towers	Masonry Block Walls	Mortar	Not stated	CORR/RE	Cracking Cracking, spalling, loss of bond, & los of material
258	Class 1 Structures	Intake Structures & Cooling Towers	Masonry Block Walls	Mortar	Not stated	ELE-TEMP	Loss of strength & modulus
	Class 1 Structures	Intake Structures & Cooling Towers Intake Structures &	Masonry Block Walls Masonry Block	Mortar Mortar	Not stated		Deformation
		Cooling Towers	Walls			STAIR	Clacking
261	Class 1 Structures	Intake Structures & Cooling Towers	Masonry Block Walis	Mortar	Not stated	MASON-BLOC	Cracking of mason block walls
262	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Structural Steel	Carbon steel	Not stated	ELE-TEMP	Loss of strength & modulus
263	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Structural Steel	Carbon steel	Not stated	CORR	Cracking, loss of bond or material, spalling
264	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Steel Piles	Carbon steel	Not stated	CORR	Loss of material
265	Class 1 Structures	Concrete Tanks	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking, & spalling
266	Class 1 Structures	Concrete Tanks	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	LEACH	Increase of porosity & permeability
267	Class 1 Structures	Concrete Tanks	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	AGR-CHEM Unresolved	Increase of porosity & permeability, cracking, & spalling
268	Class 1 Structures	Concrete Tanks	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	AGREAC	Expansion & cracking
269	Class 1 Structures	Concrete Tanks	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CORR/RE Unresolved	Cracking, spalling, loss of bond, & loss of material
270	Class 1 Structures	Concrete Tanks	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CREEP	Deformation
271	Class 1 Structures	Concrete Tanks	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	SHRINK	Cracking

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Loss of Heat Sink.

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Rel.progs Report Recommendations Page No. Item Not stated Not stated Same as for foundation & exterior 4-16 to 4concrete above & below grade 19 Not stated Not stated Non-significant for concrete not 4-20 to 4exposed to aggressive environment 23 & 4-49 (pH <11.5 chlorides >500 npm); or

			concrete mix meets the requirements of ACI 318-63 or 349- 85 (air content 3-6% water-to-	to 4-51	
Loss of Heat Sink.	Not stated	Not stated		4-24 to 4- 29 & 4-52 4-53	25
Loss of Heat Sink.	Not stated	Not stated	embedded steel or rebar maintained at <316 deg C.		
Loss of Heat Sink.	Not stated	Not stated	Non-significant because most	4-41 -43 1-44, 4-45	259
Loss of Heat Sink.	Not stated	I&E Bulletin 80-11 &	concrete shrinkage occurs in first five years of a structure's life.		
Loss of Heat Sink.	Not stated	Information Notice No. 87-67.	monitoring & corrective action of Info. Notice 87-67.	-14, 5-15	261
Loss of Heat Sink		Not stated	structural steel components 6	-64, 4- 5, 4-70, -71	262
	Not stated	On-site inspection program outlined in Reg. Guide 1.127.		-5 to 5-7	263
Loss of Heat Sink.	Not stated	Not stated		-60, 4-61	264
Lose Water/Fossil Fuel	Not stated	Not stated	metal. Non-significant for component 4-: located in a geographic region of weathering index <100 day-inch/yr or concrete mix design meets the air content and water-to-cement ratio requirements of ACI 318-63 or ACI 349-85.	3 to 4-8	265
ose Water/Fossil Fuel.	Not stated	Not stated	Non-significant for components not 4-8 exposed to flowing water or 12 constructed using ACI 201.2R-77 to ensure dense, well-cured concrete	8 to 4-	266
ose Water/Fossil Fuel. ose Water/Fossil Fuel.	Not stated	Select plant-specific program that may include monitoring of ground water (More)	with low permeability. This item was not the focus of this 5-7 NRC review.	7 to 5-9	267
	Not stated	Not stated	constructed from aggregate taken 19 from regions other than those known to cause alkali-aggregate reactions, or aggregates tested in accordance with ASTM C295 or C227 were		268
ose Water/Fossil Fuel.	Not stated	Select plant-specific program, e.g. ground water monitoring, inspection, & testing	shown to be non-reactive. This item was not the focus of this 5-7 NRC review.	to 5-9	269
ose Water/Fossil Fuel.	Not stated	Not stated	Non-significant because the 4-4 compressive stresses are low.	1 -43	270
se Water/Fossil Fuel.	Not stated	Not stated	Non-significant because most 4-44 concrete shrinkage occurs in first five years of a structure's life.	4, 4-45	271

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	Cumulative fatigue
	Class 1 Structures	Concrete Tanks	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	FAT	damage
273	Class 1 Structures	Concrete Tanks	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
274	Class 1 Structures	Concrete Tanks	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	SETTLE (Applicable only to concrete foundations)	Cracking, in-crease in component stress level, distortion.
275	Class 1 Structures	Concrete Tanks	Exterior Concrete Above Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking, & spalling
276	Class 1 Structures	Concrete Tanks	Exterior Concrete Above Grade	Concrete	Not stated	LEACH	Increase of porosity & permeability
277	Class 1 Structures	Concrete Tanks	Exterior Concrete Above Grade	Concrete	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
278	Class 1 Structures	Concrete Tanks	Exterior Concrete Above Grade	Concrete	Not stated	AGREAC	Expansion & cracking
27	Class 1 Structures	Concrete Tanks	Exterior Concrete Above Grade	Concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, & loss of material
28	Class 1 Structures	Concrete Tanks	Exterior Concrete	Concrete	Not stated	CREEP	Deformation
_	1 Class 1 Structures	Our state Tanks	Above Grade Exterior Concrete Above Grade	Concrete	Not stated	SHRINK	Cracking
28	2 Class 1 Structures	Concrete Tanks	Exterior Concrete Above Grade	Concrete	Not stated	FAT	Cumulative fatigue damage
28	3 Class 1 Structures	Concrete Tanks	Exterior Concrete Above Grade	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
28	4 Class 1 Structures	Concrete Tanks	Interior Concrete Structures	Concrete	Not stated	AGR-CHEM	Increase of porosi & permeability, cracking, & spallin
2	35 Class 1 Structures	Concrete Tanks	Interior Concrete	Concrete	Not stated	AGREAC	Expansion & cracking
	B6 Class 1 Structures		Structures Interior Concrete Structures	Concrete	Not stated	ELE-TEMP	Loss of strength a

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Document: IR 90-06, Class 1 Structures Industry Report Reviewed by: D. C. Ma/O. Chopra, ANL Effect of Aging on Component Function Contrib to Failure Reported progs Rel.progs It ose Water/Fossil Fuel Number of Structures

Effect of Aging on Component Lose Water/Fossil Fuel.	Not stated	Not stated	Non-significant because concrete	Page No.	-
			structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	27
Lose Water/Fossil Fuel.	Not stated	Not stated	Non-significant because cathodic	4-84, 4-85	5 273
			protection systems operate at a level		1 21
			well below the 1000 mA/ft ^2 level	j	1
Lose Water/Fossil Fuel			that cause degradation.		
	Not stated	Plant settlement	Structure settlement monitoring	5-4, 5-5	274
		monitoring program.	during construction & continued		
			during operation for soft soil or		
Lose Water/Fossil Fuel	Not stated		changes in ground water.		
Leve tratent esen i der	NOT STATED	Not stated	Non-significant for components	4-3 to 4-8	275
			located in a geographic region of		
			weathering index <100 day-in./yr; or		
			concrete mix design meets air		
			content & water-to-cement ratio requirements of ACI 318-63 or ACI		
			349-85.		
ose Water/Fossil Fuel.	Not stated	Not stated		4-8 to 4-	276
			exposed to flowing water or	12	210
			constructed using ACI 201.2R-77 to	12	
			ensure dense, well-cured concrete		
			with low permeability.		
ose Water/Fossil Fuel.	Not stated	Not stated		4-13 to 4-	277
			exposed to aggressive environment	15	
			(pH <5.5, chloride >500 ppm, &	1	
			sulfate >1500 ppm); or exposed to	1	
			aggressive groundwater for		
ose Water/Fossil Fuel	Not stated		intermittent periods only.		
	NOTSTATED	Not stated		4-16 to 4-	278
				19	
			from regions other than those known		
			to cause alkali-aggregate reactions,		
			or aggregates tested in accordance with ASTM C295 or C227 were		
			shown to be non-reactive.		- 1
ose Water/Fossil Fuel.	Not stated	Not stated		4-20 to 4-	279
				23 & 4-49	2/9
			1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	b 4-51	
			concrete mix meets the	~ ~ ~ ~	
			requirements of ACI 318-63 or 349-		
			85 (air content 3-6% water-to-		
ose Water/Fossil Fuel	- Not every		cement ratio 0.35-0.45).		
	Not stated	Not stated	· · · · · · · · · · · · · · · · · · ·	4-41 -43	280
ose Water/Fossil Fuel.	Not stated	- Nint state of	compressive stresses are low.		
	NOUSIALOU	Not stated		4-44, 4-45	281
			concrete shrinkage occurs in first		
ose Water/Fossil Fuel	Not stated	Not stated	five years of a structure's life.		
		Not stated		1-72 to 4-	282
			structures are designed according to 8	13	
ose Water/Fossil Fuel.	Not stated	Not stated	ACI 318 or its equivalent.		
				-84, 4-85	283
			protection systems operate at a level well below the 1000 mA/ft^2 level		
			that cause degradation.		
ose Water/Fossil Fuel.	Not stated	Not stated		-13 to 4-	
				5	284
			(pH <5.5, chloride >500 ppm, &	°	
			sulfate >1500 ppm); or exposed to	1	
			aggressive groundwater for	1	
ose Water/Fossil Fuel	·		intermittent periods only.		
799 TTALBITEUSSII FUEL	Not stated	Not stated	Same as for foundation & exterior 4	-16 to 4-	285
se Water/Eossil Evel			concrete above & below grade 1	9	
ose Water/Fossil Fuel.	Not stated	Not stated	Non-significant for concrete 4	-24 to 4-	286
•			maintained at <66_C (150_F) & local 2	9 & 4-52	
		1	areas at <93_C (200_F), or plant- 4	-53	
		1	specific justification is provided in		
			specific justification is provided in accordance with ACI 349-85; & for embedded steel or rebar maintained		

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Reviewed by:	D. C. Ma/O.	Chopra, ANL	

ss 1 Structures ss 1 Structures	Concrete Tanks	Interior Concrete Structures Interior Concrete Structures Interior Concrete Structures Interior Concrete Structures Interior Concrete Structures Interior Concrete Structures St	Carbon steel & Stainless steel Carbon steel &	Not stated Not stated	EMBR/IR CORR/RE CREEP SHRINK FAT CATH ELE-TEMP EMBR/IR	Loss of strength & modulus Cracking, spalling, loss of bond, & loss of material Deformation Cracking Cumulative fatigue damage Cathodic protection effect on bond strength Loss of strength & modulus Loss of fracture toughness
ss 1 Structures ss 1 Structures ss 1 Structures ss 1 Structures ss 1 Structures ss 1 Structures ss 1 Structures	Concrete Tanks Concrete Tanks Concrete Tanks Concrete Tanks Concrete Tanks Concrete Tanks Concrete Tanks	Structures Interior Concrete Structures Interior Concrete Structures Interior Concrete Structures Interior Concrete Structures Struc	Concrete Concrete Concrete Concrete Carbon steel & Stainless steel Carbon steel & Stainless steel Carbon steel &	Not stated Not stated Not stated Not stated Not stated	CREEP SHRINK FAT CATH ELE-TEMP	loss of bond, & loss of material Deformation Cracking Cumulative fatigue damage Cathodic protection effect on bond strength Loss of strength & modulus Loss of fracture
ss 1 Structures ss 1 Structures ss 1 Structures ss 1 Structures iss 1 Structures iss 1 Structures	Concrete Tanks Concrete Tanks Concrete Tanks Concrete Tanks Concrete Tanks Concrete Tanks	Structures Interior Concrete Structures Interior Concrete Structures Interior Concrete Structures Structures Structural Steel & Stainless Steel Liner Structural Steel & Stainless Steel Liner	Concrete Concrete Concrete Carbon steel & Stainless steel Carbon steel & Stainless steel Carbon steel &	Not stated Not stated Not stated	SHRINK FAT CATH ELE-TEMP	Cracking Cumulative fatigue damage Cathodic protection effect on bond strength Loss of strength & modulus Loss of fracture
ss 1 Structures ss 1 Structures ss 1 Structures iss 1 Structures iss 1 Structures	Concrete Tanks Concrete Tanks Concrete Tanks Concrete Tanks Concrete Tanks	Interior Concrete Structures Interior Concrete Structures Interior Concrete Structures Structural Steel & Stainless Steel Liner Structural Steel & Stainless Steel Liner	Concrete Concrete Carbon steel & Stainless steel Carbon steel & Stainless steel Carbon steel &	Not stated Not stated Not stated	FAT CATH ELE-TEMP	Cumulative fatigue damage Cathodic protection effect on bond strength Loss of strength & modulus Loss of fracture
ss 1 Structures ss 1 Structures ss 1 Structures ss 1 Structures	Concrete Tanks Concrete Tanks Concrete Tanks Concrete Tanks	Structures Interior Concrete Structures Structural Steel & Stainless Steel Liner Structural Steel & Stainless Steel Liner Structural Steel &	Concrete Carbon steel & Stainless steel Carbon steel & Stainless steel Carbon steel &	Not stated	CATH ELE-TEMP	damage Cathodic protection effect on bond strength Loss of strength & modulus Loss of fracture
ss 1 Structures ss 1 Structures ss 1 Structures	Concrete Tanks Concrete Tanks Concrete Tanks	Structures Structural Steel & Stainless Steel Liner Structural Steel & Stainless Steel Liner Structural Steel &	Carbon steel & Stainless steel Carbon steel & Stainless steel Carbon steel &	Not stated	ELE-TEMP	effect on bond strength Loss of strength & modulus Loss of fracture
uss 1 Structures uss 1 Structures	Concrete Tanks Concrete Tanks	Stainless Steel Liner Structural Steel & Stainless Steel Liner Structural Steel &	Stainless steel Carbon steel & Stainless steel Carbon steel &			modulus Loss of fracture
ss 1 Structures	Concrete Tanks	Stainless Steel Liner Structural Steel &	Stainless steel Carbon steel &	Not stated	EMBR/IR	
						1
ass 1 Structures	Congreto Tentro		Stainless steel	Not stated	FAT	Cumulative fatigue damage
	Concrete Tanks	Structural Steel	Carbon steel	Not stated	CORR Unresolved	Loss of material
ass 1 Structures	Concrete Tanks	Stainless Steel Liner	Stainless steel	Not stated	CORR/IGSCC & CORR/CREV Unresolved	Loss of material, crack initiation & growth
ass 1 Structures	Concrete Tanks	Steel Piles	Carbon steel	Not stated	CORR	Loss of material
ass 1 Structures	Steel Tanks	Foundation	Concrete	Not stated	FRZ-THAW	Scaling, cracking, spalling
ass 1 Structures	Steel Tanks	Foundation	Concrete	Not stated	LEACH	Increase of porosi & permeability
ass 1 Structures	Steel Tanks	Foundation	Concrete	Not stated	AGR-CHEM Unresolved	Increase of porosi & permeability, cracking, & spallir
ass 1 Structures	Steel Tanks	Foundation	Concrete	Not stated	AGREAC	Expansion & cracking
a	ss 1 Structures	ss 1 Structures Steel Tanks ss 1 Structures Steel Tanks ss 1 Structures Steel Tanks	ss 1 Structures Steel Tanks Foundation	as 1 Structures Steel Tanks Foundation Concrete as 1 Structures Steel Tanks Foundation Concrete as 1 Structures Steel Tanks Foundation Concrete	Instructures Steel Tanks Foundation Concrete Not stated Iss 1 Structures Steel Tanks Foundation Concrete Not stated Iss 1 Structures Steel Tanks Foundation Concrete Not stated Iss 1 Structures Steel Tanks Foundation Concrete Not stated Iss 1 Structures Steel Tanks Foundation Concrete Not stated	is 1 Structures Steel Tanks Foundation Concrete Not stated FRZ-THAW iss 1 Structures Steel Tanks Foundation Concrete Not stated LEACH iss 1 Structures Steel Tanks Foundation Concrete Not stated LEACH iss 1 Structures Steel Tanks Foundation Concrete Not stated AGR-CHEM Unresolved

Document: IR 90-06, Class 1 Structures industry Report Reviewed by: D. C. Ma/O. Chopra, ANL Effect of Aging on Component Function Contrib to Failure Reported progs

Effect of Aging on Component Lose Water/Fossil Fuel	Not stated	Not stated	Rel.progs	Report Recommendations	Page No.	-
	NOTSIZIED			Non-significant because radiation dose is low compared to the level causing degradation.	4-29 -41; 4-53 -59	28
Lose Water/Fossil Fuel.	Not stated	Not stated		Non-significant for concrete not exposed to aggressive environment (pH <11.5 chlorides >500 ppm); or concrete mix meets the requirements of ACI 318-63 or 349- 85 (air content 3-6% water-to-	4-20 to 4- 23 & 4-49 to 4-51	
Lose Water/Fossil Fuel.	Not stated	Not stated		Cement ratio 0.35-0.45). Non-significant because the compressive stresses are low.	4-41 -43	28
Lose Water/Fossil Fuel.	Not stated	Not stated	· · · · · · · · · · · · · · · · · · ·	Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4-45	290
Lose Water/Fossil Fuel.	Not stated	Not stated		Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4- 83	291
Lose Water/Fossil Fuel.	Not stated	Not stated		Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft^2 level that cause degradation.	4-84, 4-85	292
Lose Water/Fossil Fuel.	Not stated	Not stated		Degradation is non-significant for structural steel components, metal sidings, & liners maintained at temperatures <371 deg C (<700_F).	4-64, 4-65 & 4-70, 4- 71	293
Lose Water/Fossil Fuel.	Not stated	Not stated		Non-significant because radiation dose is low compared to the level causing degradation.	4-65 -68, 4-71	294
Lose Water/Fossil Fuel.	Not stated	Not stated		Non-significant because steel structures are designed according to AISC Code or equivalent.	4-72 to 4- 83	295
Lose Water/Fossil Fuel.	Not stated	Select plant-specific program for below grade structural steel not period. (More)		This item was not the focus of this NRC review.	5-11, 5-12	296
Lose Water/Fossil Fuel.	Not stated	Select plant-specific program to address crevice corrosion & IGSCC.		This item was not the focus of this NRC review.	5-9 to 5- 11	297
Lose Water/Fossil Fuel.	Not stated	Not stated		Non-significant because piles driven in undisturbed soil are unaffected & those driven in disturbed soil suffer minor corrosion in a small area of metal.	4-60, 4-61	298
ose Water/Fossil Fuel.	Not stated	Not stated		located in a geographic region of weathering index <100 day-inch/yr or concrete mix design meets the air content and water-to-cement ratio requirements of ACI 318-63 or ACI 349-85.	4-3 to 4-8	299
.ose Water/Fossil Fuel.	Not stated	Not stated		Non-significant for components not exposed to flowing water or constructed using ACI 201.2R-77 to ensure dense, well-cured concrete with low permeability.	4-8 to 4- 12	300
ose Water/Fossil Fuel.	Not stated	Select plant-specific program that may include monitoring of ground water (More)		This item was not the focus of this NRC review.	5-7 to 5-9	301
.ose Water/Fossil Fuel.	Not stated	Not stated		Non-significant for components constructed from aggregate taken from regions other than those known to cause alkali-aggregate reactions, or aggregates tested in accordance with ASTM C295 or C227 were shown to be non-reactive.	4-16 to 4- 19	302

Document: IR 9	00-06, Class 1 Structures Indus	try Report
Reviewed by:	D. C. Ma/O. Chopra, ANL	
Item System	Structure/Comp	Subcon

em	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	Class 1 Structures	Steel Tanks	Foundation	Concrete	Not stated	CORR/RE Unresolved	Cracking, spalling, loss of bond, & loss of material
304	Class 1 Structures	Steel Tanks	Foundation	Concrete	Not stated	CREEP	Deformation
305	Class 1 Structures	Steel Tanks	Foundation	Concrete	Not stated	SHRINK	Cracking
306	Class 1 Structures	Steel Tanks	Foundation	Concrete	Not stated	FAT	Cumulative fatigue damage
307	Class 1 Structures	Steel Tanks	Foundation	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
308	Class 1 Structures	Steel Tanks	Foundation	Concrete	Not stated	SETTLE	Cracking, in-crease in component stress level, distortion.
309	Class 1 Structures	Steel Tanks	Foundation	Carbon steel & Stainless steel	Not stated	ELE-TEMP	Loss of strength & modulus
310	Class 1 Structures	Steel Tanks	Foundation	Carbon steel & Stainless steel	Not stated	EMBR/IR	Loss of fracture toughness
311	Class 1 Structures	Steel Tanks	Foundation	Carbon steel & Stainless steel	Not stated	FAT	Cumulative fatigue damage
312	Class 1 Structures	Steel Tanks	Foundation	Carbon steel	Not stated	CORR Unresolved	Loss of material
313	Class 1 Structures	Steel Tanks	Foundation	Stainless steel	Not stated	CORR/IGSCC & CORR/CREV Unresolved	Loss of material, crack initiation & growth
314	Class 1 Structures	Steel Tanks	Steel Piles	Carbon steel	Not stated	CORR	Loss of material
315	Class 1 Structures	BWR Unit Vent Stack	Foundation & Concrete Above & Below Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking, & spalling
316	Class 1 Structures	BWR Unit Vent Stack	Foundation & Concrete Above & Below Grade	Concrete	Not stated	LEACH	Increase of porosity & permeability
317	Class 1 Structures	BWR Unit Vent Stack	Foundation & Concrete Above & Below Grade	Concrete	Not stated	AGREAC	Expansion & cracking
318	Class 1 Structures	BWR Unit Vent Stack	Foundation & Concrete Above & Below Grade	Concrete	Not stated	CREEP	Deformation
319	Class 1 Structures	BWR Unit Vent Stack	Foundation & Concrete Above & Below Grade	Concrete	Not stated	SHRINK	Cracking

Document: IR 90-06, Class 1 Structures industry Report Reviewed by: D. C. Ma/O. Chopra, ANL

viewed by: D. C. Ma/O. Chopra, Ifect of Aging on Component Func	tion Contrib to Failure	Reported progs	Rel.progs		5-7 to 5-9	303
se Water/Fossil Fuel.	Not stated	Select plant-specific				
	1	program, e.g. ground		NRC review.		
	1	water monitoring,				
		inspection, & testing	i		4-41 -43	304
se Water/Fossil Fuel.	Not stated	Not stated		Non-significant because the	4-41-43	
Se vraler / USSII / del.				compressive stresses are low.	4 44 4 45	305
ose Water/Fossil Fuel.	Not stated	Not stated		Non-significant because most	4-44, 4-45	305
Se water/Fossil Fuel.	Norsanoa			concrete shrinkage occurs in first		
				five years of a structure's life.		
	Not stated	Not stated		Non-significant because concrete	4-72 to 4-	306
ose Water/Fossil Fuel.	NOLSTATED	100.0000		structures are designed according to	83	
				ACI 318 or its equivalent.		
		Not stated	+	Non-significant because cathodic	4-84, 4-85	307
ose Water/Fossil Fuel.	Not stated	NOT STATED		protection systems operate at a level		
				well below the 1000 mA/ft^2 level		
			1	that cause degradation.		
				Structure settlement monitoring	5-4 5-5	308
ose Water/Fossil Fuel.	Not stated	Plant settlement		during construction & continued		
		monitoring program.		during operation for soft soil or		
				changes in ground water.		
				changes in ground water	4-64, 4-65	309
ose Water/Fossil Fuel.	Not stated	Not stated		Degradation is non-significant for	& 4-70, 4-	
				structural steel components, metal	71	1
	1	1		sidings, & liners maintained at	11	
	i			temperatures <371 deg C (<700_F).	4-65 -68,	310
ose Water/Fossil Fuel.	Not stated	Not stated		Non-significant because radiation	1 · · ·	1 310
ose waterrossi ruei.			1	dose is low compared to the level	4-71	ļ
				causing degradation.		
	Not stated	Not stated		Non-significant because steel	4-72 to 4-	31
ose Water/Fossil Fuel.	Not stated	1101 322100		structures are designed according to	83	
				AISC Code or equivalent.		
		Select plant-specific		This item was not the focus of this	5-11, 5-12	312
ose Water/Fossil Fuel.	Not stated		ſĮ	NRC review.		
		program for below			1	
		grade structural stee	91			
		not period. (More)		This item was not the focus of this	5-9 to 5-	31
ose Water/Fossil Fuel.	Not stated	Select plant-specific			11	
		program to address	1	NRC review.	1	
		crevice corrosion &				
		IGSCC.		The second siles driver	4-60, 4-6	1 31
Lose Water/Fossil Fuel.	Not stated	Not stated		Non-significant because piles driver		1.
LUSE Watern Cost I don				in undisturbed soil are unaffected &		
				those driven in disturbed soil suffer		
				minor corrosion in a small area of		
				metal.	4-3 to 4-8	3 31
Damage of Class 1 Structures.	Not stated	Not stated		Non-significant for component	4-3 10 4-1	' ["]
Damage of Class F Structures.	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			located in a geographic region of		
		1		weathering index <100 day-inch/yr o	or i	
				concrete mix design meets the air		
				content and water-to-cement ratio	1	
				requirements of ACI 318-63 or ACI		
	1			349-85		+
	Not stated	Not stated		Non-significant for components not	4-8 to 4-	3
Damage of Class 1 Structures.	NOIStated	NOT STATES		exposed to flowing water or	12	
				constructed using ACI 201.2R-77 I	0	
	1			ensure dense, well-cured concrete		
1				with low permeability.		
		higt stated		Non-significant for components	4-16 to 4	- 3
Damage of Class 1 Structures.	Not stated	Not stated		constructed from aggregate taken	19	
-				from regions other than those know	vn	1
1			1	to cause alkali-aggregate reactions	.	
				or aggregates tested in accordance		
				with ASTM C295 or C227 were		1
				shown to be non-reactive.		
				Non-significant because the	4-41 -4	5 3
Damage of Class 1 Structures	Not stated	Not stated		compressive stresses are low.		
Damage of onder Foreiters						
					4-44.4	45 3
Damage of Class 1 Structures.	Not stated	Not stated		Non-significant because most		-¶ °
Damage of Class 1 Subcidies.				concrete shrinkage occurs in first five years of a structure's life.	1	ļ

Document: IR 90	0-06, Class 1 Structures Industry Report
Reviewed by:	D. C. Ma/O. Chopra, ANL

tem	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	Class 1 Structures	BWR Unit Vent Stack	Foundation & Concrete Above & Below Grade	Concrete	Not stated	FAT	Cumulative fatigue damage
321	Class 1 Structures	BWR Unit Vent Stack	Foundation & Concrete Above & Below Grade	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
322	Class 1 Structures	BWR Unit Vent Stack	Foundation & Concrete Above & Below Grade	Concrete	Not stated	SETTLE (Applicable only to concrete foundations)	Cracking, in-crease in component stress level, distortion.
323	Class 1 Structures	BWR Unit Vent Stack	Exterior Concrete Below Grade	Concrete	Not stated	AGR-CHEM Unresolved	Increase of porosity & permeability, cracking, & spalling
324	Class 1 Structures	BWR Unit Vent Stack	Exterior Concrete Below Grade	Concrete	Not stated	CORR/RE Unresolved	Cracking, spailing. loss of bond, & loss of material
325	Class 1 Structures	BWR Unit Vent Stack	Extenor Concrete Above Grade	Concrete	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
326	Class 1 Structures	BWA Unit Vent Stack	Exterior Concrete Above Grade	Concrete	Not stated	CORR/RE	Cracking, spalling loss of bond, & loss of material
327	Class 1 Structures	BWR Unit Vent Stack	Exterior Concrete Above Grade	Concrete	Not stated	ELE-TEMP	Loss of strength & modulus
328	Class 1 Structures	BWR Unit Vent Stack	Exterior Concrete Above Grade	Concrete	Not stated	EMBR/IR	Loss of strength & modulus

Document: IR 90-07, PWR Reactor Coolant System Industry Report Reviewed by: Omesh K. Chopra, ANL

lem	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
1	PWR Reactor Coolant System	Reactor Coolant Pump	Pump Casing & Pump Cover	CASS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	CORR/SCCUnresol ved	Crack initation & growth
2	PWR Reactor Coolant System	Reactor Coolant Pump	Pump Casing & Pump Cover	CASS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	EMBR/TEUnresolve d	Loss of fracture toughness
3	PWR Reactor Coolant System	Reactor Coolant Pump	Pump Casing & Pump Cover	CASS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	CORR/BA	Loss of material
4	PWR Reactor Coolant System	Reactor Coolant Pump	Pump Casing & Pump Cover	CASS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	ERO/CORR	Wall thinning, loss o material

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Document: IR 90-06, Class 1 Structures Industry Report Reviewed by: D. C. Ma/O. Chopra, ANL

Effect of Aging on Component Fu			Rel.progs	Report Recommendations	Page No.	وبمراجع والمراجع
Damage of Class 1 Structures.	Not stated	Not stated		Non-significant because concrete structures are designed according to ACI 318 or its equivalent.		320
Damage of Class 1 Structures.	Not stated	Not stated		Non-significant because cathodic protection systems operate at a level well below the 1000 mA/ft/2 level that cause degradation.	4-84, 4-85	321
Damage of Class 1 Structures.	Not stated	Plant settlement monitoring program.		Structure settlement monitoring during construction & continued during operation for soft soil or changes in ground water.	5-4, 5-5	322
Damage of Class 1 Structures.	Not stated	Select plant-specific program that may include monitoring of ground water (More)		This item was not the focus of this NRC review.	5-7 to 5-9	323
Damage of Class 1 Structures.	Not stated	Select plant-specific program, e.g. ground water monitoring, inspection, & testing		This item was not the focus of this NRC review.	5-7 to 5-9	324
Damage of Class 1 Structures.	Not stated	Not stated		Non-significant for components not exposed to aggressive environment (pH <5.5, chloride >500 ppm, & sulfate >1500 ppm); or exposed to aggressive groundwater for intermittent periods only.	4-13 to 4- 15	325
Damage of Class 1 Structures.	Not stated	Not stated		Non-significant for concrete not exposed to aggressive environment (pH <11.5 chlorides >500 ppm); or concrete mix meets the requirements of ACI 318-63 or 349- 85 (air content 3-6% water-to- cement ratio 0.35-0.45).	4-20 to 4- 23 & 4-49 to 4-51	326
Damage of Class 1 Structures.	Not stated	Not stated		Non-significant for concrete maintained at <66_C (150_F) & local areas at <93_C (200_F), or plant- specific justification is provided in accordance with ACI 349-85; & for embedded steel or rebar maintained at <316 deg C.	4-41 -43	327
Damage of Class 1 Structures.	Not stated	Not stated		Non-significant because radiation dose is low compared to the level causing degradation.	4-44, 4-45	328

Document: IR 90-07, PWR Reactor Coolant System Industry Report Reviewed by: Omesh K. Chopra, ANL

Effect of Aging on Component Fu	nction Contrib to Failu	are Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Loss of pressure boundary.	Not stated	Non-significant because CASS components with >5% ferrite have reduced (More)		NRC recommendation: CORR/IGSCC can occur under the operating conditions (water chemistry) during shutdown because oxygen is introduced to primary coolant during cool down to control CRUD-bursts, & coolant is exposed to air during many shutdowns.	4-16 to 4- 20	
Loss of pressure boundary.	Not stated	Ferrite content screening criteria & ASME Sect. XI, Subsect. IWB inspection.		NRC recommendation: Ferrite content screening criteria is inadequate,	4-10, 4- 11, 5-11 -13	2
Loss of pressure boundary.	Not stated	Implementation of Generic Letter 88- 05.		Recommendations of Generic Letter 88-05 are effective to monitor & control primary coolant leakage.	5-15 to 5- 17	3
Loss of pressure boundary.	Not stated	Not stated		Non-significant because SSs are resistant to ERO/CORR.	4-22	

Document: IR 9	90-07, PWR Reactor Coolant S	ystem Industry Report
Reviewed by:	Ornesh K. Chopra, ANL	
Item System	Structure/Comp	Subcomponent

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
5	PWR Reactor	Reactor Coolant	Pump Casing &	CASS	Byron Jackson;	EMBRAR	Loss of tracture
	Coolant System	Pump	Pump Cover		Klein, Schanzlin, &		toughness
					Becker (KSB);		
					Sulzer-Bingham; & Westinghouse		
- 6	PWR Reactor	Reactor Coolant	Pump Casing &	CASS	Byron Jackson;	CREEP	Change in
	Coolant System	Pump	Pump Cover		Klein, Schanzlin, &		dimension
			1		Becker (KSB);		
			}	1	Sulzer-Bingham; &		
					Westinghouse		
7	PWR Reactor	Reactor Coolant	Pump Casing &	CASS	Byron Jackson;	RELAX	Loss of preload
	Coolant System	Pump	Pump Cover		Klein, Schanzlin, &		
			1		Becker (KSB);	1	1
					Sulzer-Bingham; &		
	PWR Reactor	Reactor Coolant	Pump Casing &	CASS	Westinghouse Byron Jackson;	WEAR	Attrition
Ŭ	Coolant System	Pump	Pump Cover	0100	Klein, Schanzlin, &		
		1. minth			Becker (KSB);		
					Sulzer-Bingham; &		
				1	Westinghouse		
9		Reactor Coolant	Pump Casing &	CASS	Byron Jackson;	FAT Unresolved	Cumulative fatigue
1	Coolant System	Pump	Pump Cover		Klein, Schanzlin, &	1	damage
			1		Becker (KSB);		
					Sulzer-Bingham; &		
					Westinghouse		
10	PWR Reactor	Reactor Coolant	Nozzies	SS	Byron Jackson;	CORR/SCC	Crack initiation &
1	Coolant System	Pump			Klein, Schanzlin, &	Unresolved	growth
	•		1		Becker (KSB);		1
					Sulzer-Bingham; &		1
					Westinghouse		
·							
				1			
11	PWR Reactor	Reactor Coolant	Nozzies	ss	Byron Jackson;	EMBR/TE	Loss of fracture
	Coolant System	Pump			Klein, Schanzlin, &		toughness
	•	,			Becker (KSB);	1	
1			1		Sulzer-Bingham; &	1	
					Westinghouse	L	
12	PWR Reactor	Reactor Coolant	Nozzies	SS	Byron Jackson;	CORR	Loss of material
	Coolant System	Pump	}		Klein, Schanzlin, &	-	1
					Becker (KSB); Sulzer-Bingham; &		
			1		Westinghouse	4	
13	PWR Reactor	Reactor Coolant	Nozzles	SS	Byron Jackson;	ERO/CORR	Wall thinning, los
	Coolant System	Pump			Klein, Schanzlin, &		material
	·	,			Becker (KSB);		
					Sulzer-Bingham; &		1
	0.110 0	-	-	+	Westinghouse		+
14	PWR Reactor	Reactor Coolant	Nozzles	SS	Byron Jackson;	EMBR/IR	Loss of fracture
	Coolant System	Pump	1		Klein, Schanzlin, & Becker (KSB);	ł	toughness
		1	}	{	Sulzer-Bingham; &	{	
			1	}	Westinghouse		
15	PWR Reactor	Reactor Coolant	Nozzies	SS	Byron Jackson;	CREEP	Change in
	Coolant System	Pump		1	Klein, Schanzlin, &		dimension
	í í		1	1	Becker (KSB);	1	
	}			1	Sulzer-Bingham; &		
			- 		Westinghouse		4,
16	PWR Reactor	Reactor Coolant	Nozzles	SS	Byron Jackson;	RELAX	Loss of preioad
	Coolant System	Pump		1	Klein, Schanzlin, &		1
		1		1	Becker (KSB); Sulzer-Bingham; &	1	
	1			1	Westinghouse	1	
17	PWR Reactor	Reactor Coolant	Nozzies	ss	Byron Jackson;	WEAR	Attrition
.,	Coolant System	Pump		1	Klein, Schanzlin, &		
		1		1	Becker (KSB);	1	l
	1	ł		}	Sulzer-Bingham; &	}	
			·		Westinghouse		1.

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Document: IR 90-07, PWR Reactor Coolant System Industry Report Reviewed by: Ornesh K. Chopra, ANL Effect of Aging on Component Function Contrib to Failure. Reported progs.

Effect of Aging on Component Fur			Rei.progs	Report Recommendations	Page No.	nten
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	
Loss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue evaluation & ASME Sect. XI, Subsect. IWB (More)		NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.		
Loss of pressure boundary.	Not stated	Non-significant because concentrations of oxygen, halogens, & sulfates are (More)		NRC recommendation: CORR/IGSCC can occur under the operating conditions (water chemistry) during shutdown because oxygen is introduced to primary coolant during cool down to control CRUD-bursts, & coolant is exposed to air during many shutdowns.		10
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temperature.	4-12 to 4- 14	1
Loss of pressure boundary.	Not stated	Not stated		Non-significant because fabricated of SS & hydrogen overpressure provides protection against CORR/CREV.	4-22, 4-23	1:
Loss of pressure boundary.	Not stated	Not stated		Non-significant because SSs are resistant to ERO/CORR.	4-22	1:
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	14
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	15
oss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	11
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	1

Document: IR 9	90-07, PWR Reactor Coolant Sy	stem Industry Report
Reviewed by:	Omesh K. Chopra, ANL	
Item System	Structure/Comp	Subcomponent

	B PWR Reactor	Structure/Comp Reactor Coolant	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	Coolant System	Pump	Nozzles	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	FATUnresolved	Cumulative fatigue damage
19	PWR Reactor Coolant System	Reactor Coolant Pump	Closure bolting	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	CORR/SCC	Crack initiation & growth
20	PWR Reactor Coolant System	Reactor Coolant Pump	Closure bolting	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	EMBR/TE	Loss of fracture toughness
21	PWR Reactor Coolant System	Reactor Coolant Pump	Closure bolting	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	CORR	Loss of material
	PWR Reactor Coolant System	Reactor Coolant Pump	Closure bolting	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	ERO/CORR	Wali thinning loss material
23	PWR Reactor Coolant System	Reactor Coolant Pump	Closure bolting	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	EMBR/IR	Loss of fracture toughness
24	PWR Reactor Coolant System	Reactor Coolant Pump	Closure bolting	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	CREEP	Change in dimension
25	PWR Reactor Coolant System	Reactor Coolant Pump	Closure bolting	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	RELAX	Loss of preload
26	PWR Reactor Coolant System	Reactor Coolant Pump	Closure bolting	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	WEAR	Attrition
27	PWR Reactor Coolant System	Reactor Coolant Pump	Closure bolting	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	FATUnresolved	Cumulative fatigue damage
28	PWR Reactor Coolant System	Pressurizer	Top head	CS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
29	PWR Reactor Coolant System	Pressurizer	Top head	CS	Not stated	EMBR/TE	Loss of fracture toughness
30	PWR Reactor Coolant System	Pressurizer	Top head	cs	Not stated	CORR/BA	Loss of material

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Document: IR 90-07, PWR Reactor Coolant System Industry R	eport
Heviewed by: Omesh K. Chopra, ANL	
Effect of Aging on Component Function Contrib to Failure	Reported r

Effect of Aging on Component F Loss of pressure boundary	Not stated	ASME Sect. III.	Rel.progs	Report Recommendations	Page No.	
		Subsect. NB fatigue evaluation & ASME Sect. XI, Subsect. IWB (More)		NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.		
Loss of pressure boundary.	Not stated	ASME Sect. XI. Subsect. IWB		Implementation of ASME Sect. XI, Subsect. IWB exam. category B-G-1 & -2, are current & effective programs for detection, sizing, evaluation, & remediation.	5-13 to 5- 15	1
oss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4- 14	2
loss of pressure boundary.	Not stated	Not stated		Non-significant because not in contact with primary coolant.	4-22, 4-23	2
oss of pressure boundary.	Not stated	Not stated	<u> </u>	Non-significant because not in contact with primary coolant.	4-22	2
loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	2:
oss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	24
oss of pressure boundary.	Not stated	ASME Sect. XI, Subsect. IWB		ASME Sect. XI, Subsect. IWB, exam. categories B-G-1 & -2, & B-P, & corrective measure IWA-5250, acceptance criteria IWA-3142, are current & effective for detection &	5-15	25
oss of pressure boundary.	Not stated	ASME Sect. Xi, Subsect. IWB & ASME/ANSI OM Part 6.		correction of preload. ASME Sect. XI, Subsect. IWB, exam. categories B-G-1 & -2, & B-P for system leakage/testing. Functional testing of ASME/ANSI OM Part 6 are effective for detection & evaluation-repair of pump bolting elements.	5-17, 5-18	26
oss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue evaluation & ASME Sect. XI, Subsect. IWB (More)		NRC recommendation: Fatigue	4-2 to 4-9, 5-2 to 5- 10	27
oss of pressure boundary.	Not stated	Non-significant because SS cladding (>5% ferrite) has reduced susceptibility (More)		NRC recommendation:	4-16 to 4- 20	28
oss of pressure boundary.	Not stated	Not stated		Non-significant because of proper	4-12 to 4- 14	29
oss of pressure boundary.	Not stated	Implementation of Generic Letter 88- 05.		Recommendations of Generic Letter	5-15 to 5- 17	30

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects Wall thinning, loss o
31	PWR Reactor Coolant System	Pressurizer	Top head	CS	Not stated	ERO/CORR	material
32	PWR Reactor Coolant System	Pressurizer	Top head	CS	Not stated	EMBR/IR	Loss of fracture toughness
33	PWR Reactor Coolant System	Pressurizer	Top head	CS	Not stated	CREEP	Change in dimension
34	PWR Reactor Coolant System	Pressurizer	Top head	CS	Not stated	RELAX	Loss of preload
35	PWR Reactor Coolant System	Pressurizer	Top head	CS	Not stated	WEAR	Attrition
36	PWR Reactor Coolant System	Pressurizer	Top head	CS	Not stated	FAT Unresolved	Cumulative fatigue damage
37	PWR Reactor Coolant System	Pressurizer	Shell, Spray line nozzle, Valve nozzle, Marway, Instrum. nozzle, Surge line nozzle, & Support skirt	CS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
38	PWR Reactor Coolant System	Pressurizer	Shell, Spray line nozzle, Valve nozzle, Manway, Instrum. nozzle, Surge line nozzle, & Support skirt	CS	Not stated	EMBR/TE	Loss of fracture toughness
39	PWR Reactor Coolant System	Pressurizer	Skill, Spray line nozzle, Valve nozzle, Manway, Instrum. nozzle, Surge line nozzle, & Support skirt	CS	Not stated	CORR	Loss of material
40	PWR Reactor Coolant System	Pressurizer	Sheli, Spray line nozzle, Valve nozzle, Manway, Instrum. nozzle, Surge line nozzle, & Support skirt	CS	Not stated	ERO/CORR	Wall thinning, loss material
4	1 PWR Reactor Coolant System	Pressurizer	Skirt Shell, Spray line nozzle, Valve nozzle Manway, Instrum. nozzle, Surge line nozzle, & Support skirt	cs	Not stated	EMBR/IR	Loss of fracture toughness
4	2 PWR Reactor Coolant System	Pressurizer	Shell,Spray line nozzle, Valve nozzle Manway, Instrum. nozzle, Surge line nozzle, & Support skirt	CS	Not stated	CREEP	Change in dimension
4	3 PWR Reactor Coolant System	Pressurizer	Shell, Spray line nozzle, Valve nozzle Manway, Instrum. nozzle, Surge line nozzle, & Support skirt	CS	Not stated	RELAX	Loss of preload
4	4 PWR Reactor Coolant System	Pressurizer	Shell, Spray line nozzle, Valve nozzle Manway, Instrum. nozzle, Surge line nozzle, & Support skirt	cs	Not stated	WEAR	Attrition

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Reviewed by:	Omesh K. Chopra, ANL

Document: IR 90-07, PWR Reactor Coolant System Industry R	enort
Reviewed by: Ornesh K. Chopra, ANL	
Effect of Aging on Component Function Contrib to Failure	Reported prog

Effect of Aging on Component F Loss of pressure boundary.	Not stated	Not stated	Rel.progs	Report Recommendations	Page No.	. Iten
		Not stated		Non-significant because SS cladding is resistant to ERO/ CORF and/or relatively low flow, & pH control in environment.	4-22	3
Loss of pressure boundary.	Not stated	Not stated	<u> </u>	Non-significant because of low	4-14 -16	3
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <371 deg C (<700 deg F).	4-21	3
Loss of pressure boundary.	Not stated	Not stated	<u> </u>	Non-significant because these components do not depend on	4-21, 4-22	2 3
Loss of pressure boundary.	Not stated	Not stated		preload. Non-significant because not subject to relative motion or does not	4-24	3
Loss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue evaluation & ASME Sect. XI, Subsect.		incorporate clamped joints. NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing	4-2 to 4-9, 5-2 to 5- 10	31
Loss of pressure boundary	Not stated	IWB (More)		discussions on fatigue evaluation for license renewal between NUMARC and staff.		
	NOTSLALED	Non-significant because SS cladding (>5% ferrite) has reduced susceptibility (More)		operating conditions (water chemistry) during shutdown because oxygen is introduced to primary coolant during cool down to control CRUD-bursts, & coolant is exposed	4-16 to 4- 20	37
oss of pressure boundary	Not stated	Not stated		to air during many shutdowns. Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4- 14	38
oss of pressure boundary	Not stated	Not stated		Non-significant because SS cladding, hydrogen overpressure provides protection against CORR/CREV, or component not in contact with primary coolant.	4-22, 4-23	39
oss of pressure boundary	Not stated	Not stated		Non-significant because SS cladding is resistant to ERO/ CORR, and/or relatively low flow, & pH control in environment.	4-22	40
oss of pressure boundary	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	41
oss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <371 deg C (<700 deg F).	4-21	42
oss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	+21, 4-22	43
ss of pressure boundary.	Not stated	Not stated		Non-significant because not subject 4 to relative motion or does not incorporate clamped joints.	-24	44

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Reviewed by:	Ornesh K. Chopra, Al	NL

45PWR Reactor Coolant SystemPressurizerShell, Spray line nozzle, Valve nozzle, Marway, Instrum. nozzle, Surge line nozzle, & Support skirtCSNot statedFATUrres46PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedCORR/SC46PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedCORR/SC47PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedEMBR/TE48PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedCORR49PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedERO/COI50PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedEMBR/TE51PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedCREEP52PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedRELAX53PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedRELAX53PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedRELAX53PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedWEAR	damage C Crack initiation & growth Loss of fracture toughness Loss of material
Manway, Instrum. nozzle, Surge line nozzle, & Support skirtManway, Instrum. nozzle, Surge line nozzle, & Support skirtManway, Instrum. nozzle, & Support46PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedCORR/SC47PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedEMBR/TE48PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedCORR49PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedERO/COI50PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedEMBR/IR51PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedCREEP52PWR Reactor Coolant SystemPressurizerSafe endsSSNot statedRELAX	C Crack initiation & growth Loss of fracture toughness Loss of material
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52 PWR Reactor Pressurizer Safe ends SS Not stated RELAX Coolant System Relation Re	Change in
Coolant System	dimension
	Loss of preload
53 PWR Reactor Pressurizer Safe ends SS Not stated WEAR	
53 PWR Reactor Pressurizer Sale ends [55 [100 stated Pressurizer	Attrition
	,
Coolant System	
54 PWB Reactor Pressurizer Safe ends SS Not stated FAT Unre	solved Cumulative fatigue
	damage
Coolant System	g-
55 PWR Reactor Pressurizer Instrum. nozzle & Ni alloy Not stated CORR/S	CC Crack initiation &
Coolant System Heater sleeves	growth
Coolan System	
56 PWR Reactor Pressurizer Instrum. nozzle & Ni alloy Not stated EMBR/T	
Coolant System Heater sleeves	toughness
0000	
57 PWR Reactor Pressurizer Instrum. nozzle & Ni alloy Not stated CORR	Loss of material
Coolant System Heater sleeves	
58 PWB Beactor Pressurizer Instrum. nozzle & Ni alloy Not stated ERO/CO	RR Wall thinning, loss
So FWH Headloi Pressuizer internet internet	material
Coolant System Heater sleeves	
59 PWR Reactor Pressurizer Instrum. nozzle & Ni alloy Not stated EMBR/IF	Loss of fracture
Coolant System Heater sleeves	toughness
60 PWR Reactor Pressurizer Instrum. nozzle & Ni alloy Not stated CREEP	Change in
Coolant System Heater sleeves	dimension
61 PWR Reactor Pressurizer Instrum. nozzle & Ni alloy Not stated RELAX	Loss of preload
Coolant System Heater sleeves	
	Attrition
2 PWR Reactor Pressurizer Instrum. nozzle & Ni alloy Not stated WEAR	Auruon
Coolant System Heater sleeves	1
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Effect of Aging on Component F			Rel.progs	Report Recommendations	Page No.	-
Loss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue		NRC recommendation: Fatigue issues are unresolved until an	4-2 to 4-9, 5-2 to 5-	45
		evaluation & ASME		agreement is reached in the ongoing discussions on fatigue evaluation for	10	
		IWB (More)		license renewal between NUMARC		
``````````````````````````````````````				and staff.		
Loss of pressure boundary.	Not stated	ASME Sect. XI,		ASME Sect. XI, Subsect. IWB,	5-13 to 5-	46
		Subsect, IWB.		exam. category B-F are current &	15	
				effective programs for detection, sizing, evaluation, & remediation.		
Loss of pressure boundary.	Not stated	Not stated	<u> </u>	Non-significant because of proper	4-12 to 4-	47
				material selection & relatively low operating temp.	14	
Loss of pressure boundary.	Not stated	Not stated		Non-significant because fabricated	4-22,4-23	48
			}	of SS & hydrogen overpressure		
				provides protection against		
oss of pressure boundary.	Not stated	Not stated	<u> </u>	CORR/CREV. Non-significant because SSs are	4-22	49
tees of pressure boundary.		NOT STATED	1	resistant to ERO/CORR, and/or		
				relatively low flow, & pH control in		
				environment.		
Loss of pressure boundary.	Not stated	Not stated	1	Non-significant because of low	4-14 -16	50
Loss of pressure boundary.	Not stated	Not stated	ļ	fluence level. Non-significant because operating	4-21	51
coss of pressure boundary.	Not stated	NOCSIZIOU		temp. <538 deg C (<1000 deg F).	<del>4</del> -21	5.
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these	4-21,4-22	52
			1	components do not depend on		1
				preioad.		
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not	4-24	53
			1	incorporate clamped joints.		
oss of pressure boundary.	Not stated	ASME Sect III,	1	NRC recommendation: Fatigue	4-2 to 4-9.	54
		Subsect. NB fatigue	[	issues are unresolved until an	5-2 to 5-	
		evaluation & ASME		agreement is reached in the ongoing	10	
		Sect. XI, Subsect.	1	discussions on fatigue evaluation for		
		IWB (More)		license renewal between NUMARC and staff.		
oss of pressure boundary	Not stated	ASME Sect. XI.		ASME Sect. XI, Subsect. IWB	5-13 to 5-	55
		Subsect. IWB &		exam. category B-E augmented	15	
		NRC Information		based on information in NRC Inf.		
		Notice No. 90-10.		notice No. 90-10 are current & effective inspection procedures for		
				detection, sizing, evaluation, &		
				remediation.		
Loss of pressure boundary	Not stated	Not stated		Non-significant because of proper	4-12 to 4-	56
			1	material selection & relatively low operating temp.	14	
Loss of pressure boundary	Not stated	Not stated			4-22, 4-23	57
				of Ni alloy & hydrogen overpressure		
				provides protection against		
				CORR/CREV		
Loss of pressure boundary	Not stated	Not stated		Non-significant because Ni alloys are resistant to ERO/CORR, and/or	4-22	58
				relatively low flow, & pH control in		
			1	environment		
Loss of pressure boundary	Not stated	Not stated		Non-significant because of low	4-14 -16	59
Loss of pressure boundary	Not stated	Not stated		fluence level. Non-significant because operating	4-21	60
Loss of pressure boundary		NOT Stated	}	temp. <538 deg C (<1000 deg F).	4-21	
Loss of pressure boundary	Not stated	Not stated		Non-significant because these	4-21, 4-22	61
				components do not depend on		
Loss of pressure boundary.	Not stated	Not stated		preload. Non-significant because not subject	4-24	62
Loss of pressure boundary.		HUL SLEED		to relative motion or does not	, <b>™</b> ⊒"⊊	02
	}		1	incorporate clamped joints.		
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	Omesh K. Chopra, ANL	_

m	wed by: Omesh System	K. Chopra, ANL Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	PWR Reactor Coolant System	Pressurizer	Instrum. nozzle & Heater sieeves	Ni alloy	Not stated	FAT Unresolved	damage
	Coolain Cystein						
64	PWR Reactor	Pressurizer	Surge line nozzle	CASS	Not stated	CORR/SCC	Crack initiation &
04	Coolant System					Unresolved	growth
		Pressurizer	Surge line nozzle	CASS	Not stated	EMBR/TE	Loss of tracture
65	PWR Reactor Coolant System	Flessuizei				Unresolved	toughness
66	PWR Reactor	Pressurizer	Surge line nozzle	CASS	Not stated	CORR	Loss of material
•••	Coolant System						
67	PWR Reactor Coolant System	Pressurizer	Surge line nozzle	CASS	Not stated	ERO/CORR	Wall thinning, loss o material
68	PWR Reactor	Pressurizer	Surge line nozzle	CASS	Not stated	EMBR/IR	Loss of fracture toughness
69	PWR Reactor	Pressurizer	Surge line nozzle	CASS	Not stated	CREEP	Change in dimension
70	Coolant System PWR Reactor Coolant System	Pressurizer	Surge line nozzle	CASS	Not stated	RELAX	Loss of preload
7'	1 PWR Reactor	Pressurizer	Surge line nozzle	CASS	Not stated	WEAR	Attribon
	Coolant System 2 PWR Reactor	Pressurizer	Surge line nozzle	CASS	Not stated	FAT Unresolved	Cumulative fatgue
	Coolant System	r jesschizer					damage
7	3 PWR Reactor	Pressurizer	Manway bolting	ss	Not stated	CORR/SCC	Crack initiation & growth
	Coolant System						
7	74 PWR Reactor Coolant System	Pressurizer	Manway bolting	SS	Not stated	EMBR/TE	Loss of fracture toughness
7	75 PWR Reactor	Pressurizer	Manway bolting	ss	Not stated	CORR	Loss of material
7	Coolant System 76 PWR Reactor	Pressurizer	Manway bolting	ss	Not stated	ERO/CORR	Wall thinning, loss material
	Coolant System 77 PWR Reactor	Pressurizer	Manway bolting	SS	Not stated	EMBR/IR	Loss of fracture toughness
-	Coolant System 78 PWR Reactor	Pressurizer	Manway bolting	ss	Not stated	CREEP	Change in dimension
	Coolant System 79 PWR Reactor Coolant System	Pressurizer	Manway bolting	SS	Not stated	RELAX	Loss of preload
$\left  \right $	80 PWR Reactor Coolant System	Pressurizer	Manway bolting	SS	Not stated	WEAR	Attrition

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Effect of Aging on Component I	Not stated	ASME Sect. III.	Rel.progs	Report Recommendations	Page No.	
		Subsect. NB fatigue evaluation & ASME Sect. XI, Subsect. IWB (More)		NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.	4-2 to 4-9, 5-2 to 5- 10	. 6
Loss of pressure boundary.	Not stated	Non-significant because CASS components with >5% ferrite have reduced (More)		operating conditions (water chemistry) during shutdown because oxygen is introduced to primary coolant during cool down to control CRUD-bursts, & coolant is exposed to air during many shutdowns.	4-16 to 4- 20	64
	Not stated	Ferrite content screening criteria & ASME Sect. XI, Subsect. IWB inspection.		NRC recommendation: Ferrite content screening criteria is inadequate.	4-10, 4- 11, 5-11 -13	65
Loss of pressure boundary.	Not stated	Not stated		Non-significant because fabricated of SS & hydrogen overpressure provides protection against CORR/CREV.	4-22, 4-23	66
Loss of pressure boundary.	Not stated	Not stated		Non-significant because SSs are resistant to ERO/CORR, and/or relatively low flow, & pH control in environment.	4-22	67
Loss of pressure boundary.	Not stated	Not stated	-	Non-significant because of low fluence level.	4-14 -16	68
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	69
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	70
Loss of pressure boundary.	Not stated	Not stated			4-24	71
Loss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue evaluation & ASME Sect. XJ, Subsect. IWB (More)			4-2 to 4-9, 5-2 to 5- 10	72
Loss of pressure boundary.	Not stated	ASME Sect. XI, Subsect. IWB		Implementation of ASME Sect. XI, Subsect. IWB exam. category B-G-1 & -2, are current & effective programs for detection, sizing, evaluation, & remediation.	5-13 to 5- 15	73
Loss of pressure boundary.	Not stated	Not stated			4-12 to 4- 14	74
Loss of pressure boundary.	Not stated	Not stated		contact with coolant environment.	4-22, 4-23	75
oss of pressure boundary.	Not stated	Not stated			4-22	76
oss of pressure boundary.	Not stated	Not stated			4-14 -16	77
loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	78
oss of pressure boundary.	Not stated	ASME Sect. XI. Subsect. IWB			5-15	79
loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion.	4-24	80

Document: IR 9	0-07, PWR Reactor Coolant S	ystem industry Report
Reviewed by:	Ornesh K. Chopra, ANL	
ltem System	Structure/Comp	Subcomponent

	System 1 PWR Reactor	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
δı	Coolant System	Pressurizer	Manway bolting	SS	Not stated	FAT Unresolved	Cumulative fatigue damage
82	2 PWR Reactor Coolant System	Safety and Relief Valves	Valve body &Bonnet	SS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
83	PWR Reactor Coolant System	Safety and Relief Valves	Valve body &Bonnet	ss	Not stated	EMBR/TE	Loss of fracture toughness
84	PWR Reactor Coolant System	Safety and Relief Valves	Valve body &Bonnet	SS	Not stated	CORR/BA	Loss of material
85	PWR Reactor Coolant System	Satety and Relief Valves	Valve body &Bonnet	SS	Not stated	ERO/CORR	Wall thinning, loss material
	PWR Reactor Coolant System	Safety and Relief Valves	Valve body & Bonnet		Not stated	EMBR/IR	Loss of fracture toughness
87	PWR Reactor Coolant System	Safety and Relief Valves	Valve body & Bonnet	SS	Not stated	CREEP	Change in dimension
88	PWR Reactor Coolant System	Safety and Relief Valves	Valve body &Bonnet	SS	Not stated	RELAX	Loss of preload
89	PWR Reactor Coolant System	Safety and Relief Valves	Valve body &Bonnet	SS	Not stated	WEAR	Attrition
90	PWR Reactor Coolant System	Safety and Relief Valves	Valve body &Bonnet	SS	Not stated	FAT Unresolved	Cumulative fatigue damage
	PWR Reactor Coolant System	Satety and Relief Valves	Valve body & Bonnet	CASS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
	PWR Reactor Coolant System	Safety and Relief Valves	Valve body & Bonnet	CASS	Not stated	EMBR/TE Unresolved	Loss of fracture toughness
	PWR Reactor Coolant System	Safety and Relief Valves	Valve body & Bonnet	CASS	Not stated	CORR/BA	Loss of material
	PWR Reactor Coolant System	Safety and Relief Valves	Valve body & Bonnet	CASS	Not stated	ERO/CORR	Wall thinning, loss material
	PWR Reactor Coolant System	Safety and Relief Valves	Valve body & Bonnet	CASS	Not stated	EMBR/IR	Loss of fracture toughness
	PWR Reactor Coolant System	Safety and Relief Valves	Valve body & Bonnet	CASS	Not stated	CREEP	Change in dimension
97	PWR Reactor Coolant System	Safety and Relief Valves	Valve body & Bonnet	CASS	Not stated	RELAX	Loss of preload

**Document:** IR 90-07, PWR Reactor Coolant System industry Report Reviewed by: Omesh K. Chopra, ANL Effect of Aging on Component Europion Contribute Failure, Report

Effect of Aging on Component Fund			Rel.progs	Report Recommendations	Page No.	-
Loss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue evaluation & ASME Sect. XI, Subsect. IWB (More)		NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.	4-2 to 4-9, 5-2 to 5- 10	
Loss of pressure boundary.	Not stated	Non-significant because concentrations of oxygen, halogens, & sulfates are (More)		NRC recommendation: CORR/IGSCC can occur under the operating conditions (water chemistry) during shutdown because oxygen is introduced to primary coolant during cool down to control CRUD-bursts, & coolant is exposed to air during many shutdowns.	4-16 to 4- 20	8
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4- 14	8
Loss of pressure boundary.	Not stated	Implementation of Generic Letter 88- 05.		Recommendations of Generic Letter 88-05 are effective to monitor & control primary coolant leakage.	5-15 to 5- 17	8
Loss of pressure boundary.	Not stated	Not stated		Non-significant because SSs are resistant to ERO/CORR, and/or relatively low flow, & pH control in environment.	4-22	8
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	80
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	87
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	88
Loss of pressure boundary.	Not stated	Not stated			4-24	89
Loss of pressure boundary.	Not stated	ASME Sect III, Subsect NB fatigue evaluation & ASME Sect XI, Subsect IWB (More)		NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.	4-2 to 4-9, 5-2 to 5- 10	90
Loss of pressure boundary.	Not stated	Non-significant because CASS components with >5% ferrite have reduced (More)		NRC recommendation: CORR/IGSCC can occur under the operating conditions (water chemistry) during shutdown because oxygen is introduced to primary coolant during cool down to control CRUD-bursts, & coolant is exposed to air during many shutdowns.	4-16 to 4- 20	91
Loss of pressure boundary.	Not stated	Ferrite content screening criteria & ASME Sect. XI, Subsect. IWB inspection.		NRC recommendation: Ferrite content screening criteria is inadequate.	4-10, 4- 11, 5-11 -13	92
Loss of pressure boundary.	Not stated	Implementation of Generic Letter 88- 05.		Recommendations of Generic Letter 88-05 are effective to monitor & control primary coolant leakage.	5-15 to 5- 17	93
Loss of pressure boundary.	Not stated	Not stated		Non-significant because SSs are resistant to ERO/CORR, and/or relatively low flow, & pH control in environment.	4-22	94
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	95
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	96
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	97

Document: IR 9	0-07, PWR Reactor Coolant Sy	stem Industry Report
Reviewed by:	Omesh K. Chopra, ANL	•••
Item System	Structure/Comp	Subcomponent

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
98	PWR Reactor Coolant System	Safety and Relief Valves	Valve body & Bonnet	CASS	Not stated	WEAR	Attrition
99	PWR Reactor Coolant System	Safety and Relief Valves	Valve body & Bonnet	CASS	Not stated	FAT Unresolved	Cumulative fatigue damage
100	PWR Reactor Coolant System	Safety and Relief Valves	Nozzies	SS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
101	PWR Reactor Coolant System	Safety and Relief Valves	Nozzies	SS	Not stated	EMBR/TE	Loss of fracture toughness
102	PWR Reactor Coolant System	Safety and Relief Valves	Nozzles	SS	Not stated	CORR	Loss of material
103	PWR Reactor Coolant System	Safety and Relief Valves	Nozzies	SS	Not stated	ERO/CORR	Wall thinning, loss c material
	PWR Reactor Coolant System	Safety and Relief Valves	Nozzles	SS	Not stated	EMBR/IR	Loss of fracture toughness
105	PWR Reactor Coolant System	Salety and Relief Valves	Nozzles	SS	Not stated	CREEP	Change in dimension
106	PWR Reactor Coolant System	Satety and Relief Valves	Nozzies	SS	Not stated	RELAX	Loss of preload
107	PWR Reactor Coolant System	Safety and Relief Valves	Nozzles	SS	Not stated	WEAR	Attrition
108	PWR Reactor Coolant System	Satety and Relief Valves	Nozzies	SS	Not stated	FAT Unresolved	Cumulative faogue damage
109	PWR Reactor Coolant System	Safety and Relief Valves	Closure flange	CS, SS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
110	PWR Reactor Coolant System	Safety and Relief Valves	Closure flange	CS, SS	Not stated	EMBR/TE	Loss of fracture toughness
111	PWR Reactor Coolant System	Safety and Relief Valves	Closure flange	CS, SS	Not stated	CORR/BA	Loss of material
112	PWR Reactor Coolant System	Safety and Relief Valves	Closure flange	CS, SS	Not stated	ERO/CORR	Wall thinning, loss o material
113	PWR Reactor Coolant System	Safety and Relief Valves	Closure flange	CS, SS	Not stated	EMBR/IR	Loss of fracture toughness
	PWR Reactor Coolant System	Safety and Relief Valves	Closure flange	CS, SS	Not stated	CREEP	Change in dimension
115	PWR Reactor Coolant System	Safety and Relief Valves	Closure flange	CS, SS	Not stated	RELAX	Loss of preload

Document: IR 90-07, PWR Reactor Coolant System Industry Report		
Reviewed by: Ornesh K. Chopra, ANL		
Effect of Aging on Component Function Contrib to Failure Reported progs	Rel.progs	Report Recommendations

Effect of Aging on Component F Loss of pressure boundary.	Not stated	Iure Reported progs Rel.pro	ogs Report Recommendations Non-significant because not subject	Page No. 4-24	5
			to relative motion or does not incorporate clamped joints.	-24	
Loss of pressure boundary.	Not stated	ASME Sect III.	NRC recommendation: Fatigue	4-2 to 4-9.	5
		Subsect. NB fatigue	issues are unresolved until an	5-2 to 5-	
		evaluation & ASME	agreement is reached in the ongoing		1
		Sect. XI, Subsect	discussions on fatigue evaluation for		
		IWB (More)	license renewal between NUMARC		1
			land staff.		
oss of pressure boundary.	Not stated	Non-significant	NRC recommendation:	4-16 to 4-	10
·		because	CORR/IGSCC can occur under the	20	1 "
		concentrations of	operating conditions (water	20	
		oxygen, halogens, &	chemistry) during shutdown because	J	
		sulfates are (More)	oxygen is introduced to primary		[
			coolant during cool down to control		ļ
			CRUD-bursts, & coolant is exposed		
			to air during many shutdowns.		
oss of pressure boundary.	Not stated	Not stated	Non-significant because of proper	4-12 to 4-	10
. ,			material selection & relatively low	14	
			operating temp.		
oss of pressure boundary.	Not stated	Not stated	Non-significant because fabricated	4-22, 4-23	10
		, to, outed	S.	+-22, 4-23	
			of SS & hydrogen overpressure		
			provides protection against CORR/CREV.		
oss of pressure boundary.	Not stated	Not stated	Non-significant because SSs are	4-22	10
,			resistant to ERO/CORR, and/or	****	
			relatively low flow, & pH control in environment		
oss of pressure boundary.	Not stated	Not stated	Non-significant because of low	4-14 -16	10
iere el presente Bourlaary.	NOT States	Not stated	fluence level.	4-14-10	10
oss of pressure boundary.	Not stated	Not stated		4.01	10
ses of pressure boundary.	NOT STATED	NOUSIAIOO	Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	10
oss of pressure boundary.	Not stated	Not stated		4 21 4 22	
to be an procedure boundary.	1401 312100	NOTStated	Non-significant because these	4-21, 4-22	10
			components do not depend on preload.		
oss of pressure boundary.	Not stated	Not stated	Non-significant because not subject	4.34	10
······································		Not Statist	to relative motion or does not	4-24	10
			incorporate clamped joints.		
oss of pressure boundary.	Not stated	ASME Sect. III,	NRC recommendation: Fatigue	4-2 to 4-9.	10
······································		Subsect. NB fatigue	issues are unresolved until an	5-2 to 5-	10
		evaluation & ASME		10	
		Sect. XI. Subsect.	agreement is reached in the ongoing	10	
			discussions on fatigue evaluation for		
		IWB (More)	license renewal between NUMARC and staff.		
oss of pressure boundary.	Not stated	Non-significant	NRC recommendation:	4-16 to 4-	
oss of pressure boundary.	NOT STATED				10
		because concentrations of		20	
			operating conditions (water	1	
		oxygen, halogens, &	chemistry) during shutdown because		
		sulfates are (More)	oxygen is introduced to primary		
			coolant during cool down to control		
			CRUD-bursts, & coolant is exposed		
oss of pressure boundary.	Not stated	Not stated	to air during many shutdowns.	4 10 10 4	
our or pressure boundary.	NOT STATED	1101 312100		4-12 to 4-	11
			material selection & relatively low	14	
oss of pressure boundary	Not stated	limplomontation of	operating temp.	-	
oss of pressure boundary.	Not stated	Implementation of		5-15 to 5-	11
		Generic Letter 88-	88-05 are effective to monitor &	17	
		05.	control primary coolant leakage.		
oss of pressure boundary.	Not stated	Not stated		4-22	11
		l i	resistant to ERO/CORR, and/or	1	
			relatively low flow, & pH control in	1	
			environment		
oss of pressure boundary.	Not stated	Not stated	Non-significant because of low	4-14 -16	11
			fluence level.		
oss of pressure boundary.	Not stated	Not stated		4-21	114
			temp. <538 deg C (<1000 deg F).		
oss of pressure boundary.	Not stated	Not stated	Non-significant because does not	4-21, 4-22	11
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Document: IR	90-07, PWR Reactor Coolant S	ystem Industry Report
Reviewed by:	Ornesh K. Chopra, ANL	
Item System	Structure/Comp	Subcomponent

	n System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
11	6 PWR Reactor Coolant System	Satety and Reliet Valves	Closure flange	CS, SS	Not stated	WEAR	Attrition
11	7 PWR Reactor Coolant System	Safety and Relief Valves	Closure flange	CS, SS	Not stated	FAT Unresolved	Cumulative fatigue damage
118	8 PWR Reactor Coolant System	Safety and Relief Valves	Bellows	Ni alloy	Not stated	CORR/SCC	Crack initiation & growth
119	PWR Reactor Coolant System	Safety and Relief Valves	Bellows	Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness
120	PWR Reactor Coolant System	Safety and Relief Valves	Bellows	Ni alloy	Not stated	CORR	Loss of material
121	PWR Reactor Coolant System	Safety and Relief Valves	Bellows	Ni alloy	Not stated	ERO/CORR	Wall thinning, loss material
	PWR Reactor Coolant System	Safety and Relief Valves	Bellows	Ni alloy	Not stated	EMBR/IR	Loss of fracture toughness
23	PWR Reactor Coolant System	Safety and Relief Valves	Bellows	Ni alloy	Not stated	CREEP	Change in dimension
24	PWR Reactor Coolant System	Safety and Relief Valves	Bellows	Ni alloy	Not stated	RELAX	Loss of preload
25	PWR Reactor Coolant System	Salety and Relief Valves	Bellows	Nialloy	Not stated	WEAR	Attrition
26	PWR Reactor Coolant System	Safety and Relief Valves	Bellows	Ni alloy	Not stated	FAT Unresolved	Cumulative fatigue damage
127	PWR Reactor Coolant System	Safety and Relief Valves	Seats and Disks	Stellite, SS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
28	PWR Reactor Coolant System	Safety and Relief Valves	Seats and Disks	Stellite, SS	Not stated	EMBR/TE	Loss of fracture toughness
29	PWR Reactor Coolant System	Safety and Relief Valves	Seats and Disks	Stellite, SS	Not stated	CORR	Loss of material
30	PWR Reactor Coolant System	Safety and Relief Valves	Seats and Disks	Stellite, SS	Not stated	ERO/CORR	Wall thinning, loss material
	PWR Reactor Coolant System	Safety and Relief Valves	Seats and Disks	Stellite, SS	Not stated	EMBR/IR	Loss of fracture toughness
32	PWR Reactor Coolant System	Safety and Relief Valves	Seats and Disks	Stellite, SS	Not stated	CREEP	Change in dimension

Document: IR 90-07, PWR Reactor Coolant System Industry Report Reviewed by: Omesh K. Chopra, ANL Effect of Aging on Component Function Contrib to Failure. Report

Effect of Aging on Component Loss of pressure boundary.	Not stated	ASME Sect. XI.	Rel.progs	Report Recommendations	Page No.	_
		Subsect. IWB & ASME/ANSI OM Part 1.		ASME Sect. XI, Subsect. IWB, exam. categories B-G-1 & -2, & B-P for system leakage/testing. Functional testing of ASME/ANSI OM Part 1 are effective for detection & evaluation-repair.		8 11
Loss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue evaluation & ASME Sect. XI, Subsect. IWB (More)		NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.		11
Loss of pressure boundary.	Not stated	ASME Sect. XI, Subsect. IWB		Implementation of ASME Sect. XI, Subsect. IWB exam. category B-G-1 & -2, are current & effective programs for detection, sizing, evaluation, & remediation.	5-13 to 5- 15	11
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4- 14	11
Loss of pressure boundary.	Not stated	Not stated		Non-significant because fabricated of Ni alloy & hydrogen overpressure provides protection against CORR/CREV.	4-22, 4-23	3 120
Loss of pressure boundary.	Not stated	Not stated		Non-significant because Ni alloys are resistant to ERO/ CORR, and/or relatively low flow, & pH control in renvironment.	4-22	12.
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	122
Loss of pressure boundary.	Not stated	Not stated	·	Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	123
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	124
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	125
Loss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue evaluation & ASME Sect. XI, Subsect. IWB (More)	<u> </u>	NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff	4-2 to 4-9, 5-2 to 5- 10	126
oss of pressure boundary.	Not stated	Non-significant because concentrations of oxygen, halogens, & sulfates are (More)		NRC recommendation: CORR/IGSCC can occur under the operating conditions (water chemistry) during shutdown because oxygen is introduced to primary coolant during cool down to control CRUD-bursts, & coolant is exposed to air during many shutdowns.	4-16 to 4- 20	127
oss of pressure boundary.	Not stated	Not stated		Non-significant because of proper	4-12 to 4- 14	128
oss of pressure boundary.	Not stated	Not stated			4-22, 4-23	129
oss of pressure boundary.	Not stated	Not stated			4-22	130
oss of pressure boundary.	Not stated	Not stated			4-14 -16	131
oss of pressure boundary.	Not stated	Not stated			4-21	132

Document: IR 9	0-07, PWR Reactor Coolant System Industry Report	
Reviewed by:	Omesh K. Chopra, ANL	

	wed by: Omesh System	K. Chopra, ANL Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	PWR Reactor Coolant System	Safety and Relief Valves	Seats and Disks	Stellite, SS	Not stated	RELAX	Loss of preload
134	PWR Reactor Coolant System	Safety and Relief Valves	Seats and Disks	Stellite, SS	Not stated	WEAR	Attrition
135	PWR Reactor Coolant System	Safety and Relief Valves	Seats and Disks	Stellite, SS	Not stated	FAT Unresolved	Cumulative fatigue damage
136	PWR Reactor Coolant System	Safety and Relief Valves	Closure bolting	CS, SS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
137	PWR Reactor Coolant System	Safety and Relief Valves	Closure bolting	CS, SS	Not stated	EMBR/TE	Loss of fracture toughness
138	PWR Reactor Coolant System	Safety and Relief Valves	Closure bolting	CS, SS	Not stated	CORR	Loss of material
139	PWR Reactor Coolant System	Safety and Relief Valves	Closure bolting	CS, SS	Not stated	ERO/CORR	Wall thinning, loss ( material
140	PWR Reactor	Safety and Relief Valves	Closure bolting	CS, SS	Not stated	EMBR/IR	Loss of fracture toughness
141	Coolant System PWR Reactor	Safety and Relief	Closure bolting	CS, SS	Not stated	CREEP	Change in dimension
142	Coolant System PWR Reactor Coolant System	Valves Satety and Relief Valves	Closure bolting	CS, SS	Not stated	RELAX	Loss of preload
143	PWR Reactor Coolant System	Satety and Relief Valves	Closure bolting	CS, SS	Not stated	WEAR	Attrition
14	PWR Reactor	Safety and Relief	Closure bolting	CS, SS	Not stated	FAT Unresolved	Cumulative fatigue
	Coolant System	Valves					damage
14	5 PWR Reactor Coolant System	Piping & Fittings	Cold leg, & Hot leg	CS, SS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
14	6 PWR Reactor	Piping & Fittings	Cold leg, & Hot leg	CS, SS	Not stated	EMBR/TE	Loss of fracture
ļ	Coolant System				Ni-A card	CORR	Loss of material
14	7 PWR Reactor Coolan't System	Piping & Fittings	Cold leg, & Hot leg	CS, SS	Not stated		Loss of material

Page	93B
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Document: IR 90-07, PWR Reactor Coolant System Industry Report Reviewed by: Ornesh K. Chopra, ANL Effect of Aging on Component Function Contrib to Failure Reported p

Effect of Aging on Component F Loss of pressure boundary.	Not stated	Not stated	Rel.progs	Report Recommendations	Page No.	
		not stated		Non-significant because components do not depend on preload.	4-21, 4-22	2 1:
Loss of pressure boundary.	Not stated	ASME Sect. XI, Subsect. IWB & ASME/ANSI OM Part 1.		ASME Sect. XI, Subsect. IWB, exam. categories B-G-1 & -2, & B-P for system leakage/testing. Functional testing of ASME/ANSI OM Part 1 are effective for detection & evaluation-repair.		3 13
Loss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue evaluation & ASME Sect. XI, Subsect. IWB (More)		NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.	4-2 to 4-9, 5-2 to 5- 10	. 13
Loss of pressure boundary.	Not stated	ASME Sect. XI. Subsect. IWB		Implementation of ASME Sect. XI, Subsect. IWB exam. category B-G-1 & -2, are current & effective programs for detection, sizing, evaluation, & remediation,	5-13 to 5- 15	13
	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4- 14	13
oss of pressure boundary.	Not stated	Not stated		Non-significant because fabricated of SS and/or hydrogen overpressure provides protection against CORR/CREV.	4-22, 4-23	13
oss of pressure boundary.	Not stated	Not stated		Non-significant because SSs are resistant to ERO/CORR, and/or relatively low flow, & pH control in environment.	4-22	139
oss of pressure boundary.	Not stated	Not stated			4-14 -16	140
oss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	141
oss of pressure boundary.	Not stated	ASME Sect. XI, Subsect. IWB			5-15	142
ss of pressure boundary.	Not stated	ASME Sect. XI, Subsect. IWB & ASME/ANSI OM Part 1.		1	5-17, 5- 18	143
	Not stated	ASME Sect. III, Subsect. NB fatigue evaluation & ASME Sect. XI, Subsect. IWB (More)		NRC recommendation: Fatigue	4-2 to 4-9, 5-2 to 5- 10	144
ss of pressure boundary.	Not stated	Non-significant because SS cladding (>5% ferrite) has reduced susceptibility (More)		CODD40000	1-16 to 4- 20	145
ss of pressure boundary.	Not stated	Not stated		Non-significant because of proper 4	-12 to 4- 4	146
ss of pressure boundary.	Not stated	Not stated			-22, 4-23	147

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
148	PWR Reactor Coolant System	Piping & Fittings	Cold leg, & Hot leg	CS, SS	Not stated	ERO/CORR	Wall thinning, loss material
149	PWR Reactor	Piping & Fittings	Cold leg, & Hot leg	CS, SS	Not stated	EMBR/IR	Loss of fracture toughness
150	Coolant System PWR Reactor Coolant System	Piping & Fittings	Cold leg, & Hot leg	CS, SS	Not stated	CREEP	Change in dimension
151	PWR Reactor Coolant System	Piping & Fittings	Cold leg, & Hot leg	CS, SS	Not stated	RELAX	Loss of preload
152	PWR Reactor Coolant System	Piping & Fittings	Cold leg, & Hot leg	CS, SS	Not stated	WEAR	Attrition
153	PWR Reactor Coolant System	Piping & Fittings	Cold leg, & Hot leg	CS, SS	Not stated	FAT Unresolved	Cumulative fatigue damage
154	PWR Reactor Coolant System	Piping & Fittings	Surge line & Spray line	SS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
155	PWR Reactor Coolant System	Piping & Fittings	Surge line & Spray line	SS	Not stated	EMBR/TE	Loss of fracture toughness
156	PWR Reactor Coolant System	Piping & Fittings	Surge line & Spray line	SS	Not stated	CORR	Loss of material
157	PWR Reactor Coolant System	Piping & Fittings	Surge line & Spray line	SS	Not stated	ERO/CORR	Wall thinning, loss material
158	PWR Reactor Coolant System	Piping & Fittings	Surge line & Spray	SS	Not stated	EMBR/IR	Loss of fracture toughness
159	PWR Reactor Coolant System	Piping & Fittings	Surge line & Spray line	SS	Not stated	CREEP	Change in dimension
160	PWR Reactor Coolant System	Piping & Fittings	Surge line & Spray line	SS	Not stated	RELAX	Loss of preload
161	PWR Reactor Coolant System	Piping & Fittings	Surge line & Spray line	SS	Not stated	WEAR	Attrition
162	PWR Reactor Coolant System	Piping & Fittings	Surge line & Spray line	SS	Not stated	FATUnresolved	Cumulative fatigue damage
163	PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
164	PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	EMBR/TE Unresolved	Loss of fracture toughness

#### Document: IR 90-07, PWR Reactor Coolant System Industry Report Reviewed by: Omesh K. Chopra, ANL

Document: IR 90-07, PWR Reactor Coolant System Industry Report
Reviewed by: Omesh K. Chopra, ANL
Effect of Aging on Component Function Contrib to Failure Reported progs

Effect of Aging on Component F Loss of pressure boundary.	Not stated		Rel.progs	Report Recommendations	Page No.	-
	INOT STATED	Not stated		Non-significant because SSs are resistant to ERO/CORR.	4-22	14
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	14
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F) for SS & <371 deg C (<700 deg F). for CS.	4-21 r	150
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21,4-22	15
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not	4-24	152
Loss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue evaluation & ASME Sect. XI. Subsect. IWB (More)		incorporate clamped joints. NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.		153
Loss of pressure boundary.	Not stated	Non-significant because concentrations of oxygen, halogens, & sulfates are (More)		NRC recommendation: CORR/IGSCC can occur under the operating conditions (water chemistry) during shutdown because oxygen is introduced to primary coolant during cool down to control CRUD-bursts, & coolant is exposed	4-16 to 4- 20	154
Loss of pressure boundary.	Not stated	Not stated		to air during many shutdowns. Non-significant because of proper material selection & relatively low	4-12 to 4- 14	155
Loss of pressure boundary.	Not stated	Not stated		operating temp. Non-significant because fabricated of SS & hydrogen overpressure provides protection against CORR/CREV.	<b>4-2</b> 2, 4-23	156
oss of pressure boundary.	Not stated	Not stated		Non-significant because SSs are resistant to ERO/CORR.	4-22	157
oss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	158
oss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	159
loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	160
oss of pressure boundary.	Not stated	Not stated	<u> </u>	Non-significant because not subject to relative motion or does not	4-24	161
oss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue evaluation & ASME Sect. XI, Subsect. IWB (More)		agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.	4-2 to 4-9, 5-2 to 5- 10	162
oss of pressure boundary.	Not stated	Non-significant because CASS components with >5% ferrite have reduced (More)			4-16 to 4- 20	163
oss of pressure boundary.	Not stated	Ferrite content screening criteria & ASME Sect. XI, Subsect. IWB inspection.		NRC recommendation: Ferrite content screening criteria is	4-10, 4- 11, <del>5</del> -11 -13	164

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Document: IR 9	0-07, PWR Reactor Coolant S	ystem Industry Report
Reviewed by:	Omesh K. Chopra, ANL	
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em	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
165	PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	CORR	Loss of material
166	PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	ERO/CORR	Wall thinning, loss of material
167	PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	EMBR/IR	Loss of fracture toughness
68	PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	CREEP	Change in dimension
69	PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	RELAX	Loss of preload
170	PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	WEAR	Attrition
171	PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	FAT Unresolved	Cumulative fatigue damage
172	PWR Reactor Coolant System	Auxiliary Piping	Decay Heat Removal System & Core Flood System	SS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
173	PWR Reactor Coolant System	Auxiliary Piping	Decay Heat Removal System & Core Flood System	SS	Not stated	EMBR/TE	Loss of fracture toughness
174	PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	CORR	Loss of material
175	PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	ERO/CORR	Wall thinning, loss material
176	S PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	EMBR/IR	Loss of fracture toughness
177	7 PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	CREEP	Change in dimension
178	PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	RELAX	Loss of preload
179	PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	WEAR	Attrition
180	D PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	FAT Unresolved	Cumulative fatigue damage
18	1 PWR Reactor Coolant System	Auxiliary Piping	Decay Heat Remova System & Core Flood System	I CASS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
18	2 PWR Reactor Coolant System	Auxiliary Piping	Decay Heat Remova System & Core Flood System	II CASS	Not stated	EMBR/TE Unresolved	Loss of fracture toughness

Document: IR 90-07, PWR Reactor Coolant System Industry Report	
Reviewed by: Omesh K. Chopra, ANL	
Effect of Aging on Component Function Contrib to Failure Reported progs	
reported progs	Rel.progs

Effect of Aging on Component Loss of pressure boundary.	Not stated	Not stated	Rel.progs Report Recommendations Non-significant because fabricated	Page No.	_
			of SS & hydrogen overpressure provides protection against CORR/CREV.	4-22, 4-2:	3 1
Loss of pressure boundary.	Not stated	Not stated	Non-significant because SSs are resistant to ERO/CORR.	4-22	1
Loss of pressure boundary.	Not stated	Not stated	Non-significant because of low	4-14 -16	1
Loss of pressure boundary.	Not stated	Not stated	Non-significant because operating	4-21	1
Loss of pressure boundary.	Not stated	Not stated	temp. <538 deg C (<1000 deg F). Non-significant because these components do not depend on	4-21, 4-22	1
Loss of pressure boundary.	Not stated	Not stated	preload. Non-significant because not subject to relative motion or does not	4-24	1
Loss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue evaluation & ASME Sect. XI, Subsect. IWB (More)	incorporate clamped joints. NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC	4-2 to 4-9, 5-2 to 5- 10	17
oss of pressure boundary.	Not stated	Non-significant because concentrations of oxygen, halogens, & sulfates are (More)	and staff. NRC recommendation: CORR/IGSCC can occur under the operating conditions (water chemistry) during shutdown because oxygen is introduced to primary coolant during cool down to control CRUD-bursts, & coolant is exposed	4-16 to 4- 20	17
oss of pressure boundary.	Not stated	Not stated	to air during many shutdowns. Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4- 14	17
oss of pressure boundary.	Not stated	Not stated		4-22, 4-23	17
oss of pressure boundary.	Not stated	Not stated		4-22	17
oss of pressure boundary.	Not stated	Not stated		4-14 -16	176
oss of pressure boundary.	Not stated	Not stated	Non-significant because operating	4-21	177
ss of pressure boundary.	Not stated	Not stated	temp. <538 deg C (<1000 deg F). Non-significant because these components do not depend on preload.	4-21, 4-22	178
ss of pressure boundary.	Not stated	Not stated	Non-significant because not subject a to relative motion or does not incorporate clamped joints.	1-24	179
ss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue evaluation & ASME Sect. XI, Subsect. IWB (More)	NRC recommendation: Fatigue 4 issues are unresolved until an 5	-2 to 4-9, -2 to 5- 0	180
ss of pressure boundary.	Not stated	Non-significant because CASS components with >5% ferrite have reduced (More)	NRC recommendation: 4	-16 to 4- 0	181
s of pressure boundary.	Not stated	Ferrite content screening criteria & ASME Sect. XI, Subsect. IWB inspection.	NRC recommendation: Ferrite 4 content screening criteria is 1	-10, 4- 1 1, 5-11  3	182

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Document: IR 9	0-07, PWR Reactor Coolant System Industry Report
Reviewed by:	Omesh K. Chopra, ANL

System PWR Reactor Coolant System PWR Reactor Coolant System PWR Reactor	Auxiliary Piping	Decay Heat Removal System & Core Flood System	CASS	Not stated	CORR	Loss of material
Coolant System PWR Reactor Coolant System PWR Reactor		1 / 1				
PWR Reactor Coolant System PWR Reactor	Auxiliary Piping	1 / 1				•
Coolant System	Auxiliary Piping					1
Coolant System	Auxiliary Piping					
Coolant System	Auxiliary Piping	Decay Heat Removal	CASS	Not stated	ERO/CORR	Wall thinning, loss
PWR Reactor		System & Core	0100		-	material
		Flood System				
		Decay Heat Removal	CASS	Not stated	EMBR/IR	Loss of fracture
O 1 - 1 1 O 1 - 1	Auxiliary Piping		CASS	NOT STATES	Ling	toughness
Coolant System		System & Core				wig
		Flood System		Ni a state d	CREEP	Change in
PWR Reactor	Auxiliary Piping	Decay Heat Removal	CASS	Not stated	CREEP	dimension
Coolant System		System & Core				Cimension
		Flood System				
PWR Reactor	Auxiliary Piping	Decay Heat Removal	CASS	Not stated	RELAX	Loss of preload
	,			1		
Coolant System						
	Auvilian Dining		CASS	Not stated	WEAR	Attrition
	Autonary Piping		0,100			
Coolant System						
			0.100	Not stated	EAT Upresolved	Cumulative fatigue
PWR Reactor	Auxiliary Piping		CASS	NOTSIALED		damage
Coolant System		1 - 1				Galinage
-		Flood System				
						Crack initiation &
PWB Reactor	Integral Support	Not stated	CS, SS	Not stated	1	
					Unresolved	growth
	Integral Support	Not stated	CS, SS	Not stated	EMBR/TE	Loss of fracture
	I megra Support	100000000				toughness
Coolant System						
	Late and Cumport	hist stated	CS 55	Not stated	CORR	Loss of material
	Integral Support	Not stated				
Coolant System					ERO/CORR	Wall thinning, loss
PWR Reactor	Integral Support	Not stated	CS, SS	NOT STATED	ERO/OONIN	material
Coolant System						Loss of fracture
	Integral Support	Not stated	CS, SS	Not stated	EMBR/IR	_
	J					toughness
	Integral Support	Not stated	CS SS	Not stated	CREEP	Change in
	Integral Support		1			dimension
Coolant System						
		Net stated	CS 55	Not stated	RELAX	Loss of preload
	Integral Support	INOT STAUGO		1101 000100		
Coolant System			1			1
				Net stated	WEAR	Attrition
PWR Reactor	Integral Support	Not stated	CS, SS	NOT STATED	WEAR	
			l			0
DWB Reactor	Integral Support	Not stated	CS, SS	Not stated	FAT Unresolved	Cumulative fatigue
1	"" and a copport					damage
Coolant System			1			
1			1			
1	1		i i			
	PWR Reactor Coolant System PWR Reactor Coolant System	PWR Reactor Coolant SystemAuxiliary PipingPWR Reactor Coolant SystemAuxiliary PipingPWR Reactor Coolant SystemAuxiliary PipingPWR Reactor Coolant SystemAuxiliary PipingPWR Reactor Coolant SystemIntegral SupportPWR Reactor Coolant SystemIntegral Support	Flood SystemPWR Reactor Coolant SystemAuxiliary PipingDecay Heat Removal System & Core Flood SystemPWR Reactor Coolant SystemIntegral SupportNot statedPWR Reactor Coolant SystemIntegral SupportNot stated	Flood SystemPWR Reactor Coolant SystemAuxiliary PipingDecay Heat Removal System & Core Flood SystemCASSPWR Reactor Coolant SystemIntegral SupportNot statedCS, SSPWR Reactor C	Flood SystemFlood SystemPWR Reactor Coolant SystemAuxiliary PipingDecay Heat Removal System & Core Flood SystemCASSNot statedPWR Reactor Coolant SystemAuxiliary PipingDecay Heat Removal System & Core Flood SystemCASSNot statedPWR Reactor Coolant SystemAuxiliary PipingDecay Heat Removal System & Core Flood SystemCASSNot statedPWR Reactor Coolant SystemAuxiliary PipingDecay Heat Removal System & Core Flood SystemCASSNot statedPWR Reactor Coolant SystemIntegral SupportNot statedCS, SSNot statedPWR Reactor Coolant SystemIntegral Sup	Flood SystemFlood SystemFlood SystemPWR Reactor Coolant SystemAuxiliary Piping Decay Heat Removal SystemCASS Rod SystemNot statedRELAXPWR Reactor Coolant SystemAuxiliary Piping Decay Heat Removal SystemCASS CASSNot statedWEARPWR Reactor Coolant SystemAuxiliary Piping Decay Heat Removal SystemCASS Not statedNot statedWEARPWR Reactor Coolant SystemAuxiliary Piping Decay Heat Removal SystemCASS Not statedNot statedFAT UnresolvedPWR Reactor Coolant SystemIntegral SupportNot statedCS, SSNot statedCORR/SCC UnresolvedPWR Reactor Coolant SystemIntegral SupportNot statedCS, SSNot statedEMBR/TEPWR Reactor Coolant SystemIntegral SupportNot statedCS, SSNot statedCORRPWR Reactor Coolant SystemIntegral SupportNot statedCS, SSNot statedERO/CORRPWR Reactor Coolant SystemIntegral SupportNot statedCS, SSNot statedERO/CORRPWR Reactor Coolant SystemIntegral SupportNot statedCS, SSNot statedCREEPPWR Reactor Coolant SystemIntegral SupportNot statedCS, SSNot statedCREEPPWR Reactor Coolant SystemIntegral SupportNot statedCS, SSNot statedRELAXPWR Reactor Coolant SystemIntegral SupportNot statedCS, SSNot statedRELAX

Document: IR 90-09, BWR Primary Coolant Pressure Boundary Industry Report Reviewed by: O. Chopra/D. Gavenda, ANL

	ewed by: O. Cho System	pra/D. Gavenda, ANL Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	BWR Primary Coolant Pressure	Piping & Fittings	Feedwater & Main Steam	CS	Not stated	EMBR/IR	Loss of fracture toughness
2	Boundary BWR Primary Coolant Pressure Boundary	Piping & Fittings	Feedwater & Main Steam	CS	Not stated	CORR/IGSCC	Crack initiation & growth
3	BWR Primary Coolant Pressure Boundary	Piping & Fittings	Feedwater & Main Steam	CS	Not stated	CORR/TGSCC	Crack initiation & growth

Document: IR 90-07, PWR Reactor Coolant System Industry Report
Reviewed by: Ornesh K. Chopra, ANL
Effect of Aging on Component Function Contrib to Failure Benorted proces

Effect of Aging on Component Fi			Rel.progs	Report Recommendations	Page No.	
Loss of pressure boundary.	Not stated	Not stated		Non-significant because fabricated of SS & hydrogen overpressure provides protection against CORR/CREV.	4-22, 4-23	183
Loss of pressure boundary.	Not stated	Not stated		Non-significant because SSs are resistant to ERO/CORR.	4-22	184
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	185
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	186
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	187
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	188
Loss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue evaluation & ASME Sect. XI, Subsect. IWB (More)		NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.	4-2 to 4-9, 5-2 to 5- 10	189
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subjected to corrosive environment.	4-16 to 4- 20	190
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4- 14	191
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not in contact with primary coolant.	4-22, 4-23	192
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not in contact with primary coolant.	4-22	193
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	194
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F) for SS & <371 deg C (<700 deg F), for CS.	4-21	195
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	196
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	197
Loss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue evaluation & ASME Sect. XI, Subsect. IWB (More)		NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.	4-2 to 4-9, 5-2 to 5- 10	198

Document: IR 90-09, BWR Primary Coolant Pressure Boundary Industry Report Reviewed by: O. Chopra/D. Gavenda, ANL

Effect of Aging on Component Fu	Inction Contrib to Fail	ure Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Loss of pressure boundary.	Not stated	Not stated		Non-significant because total fast neutron fluence within the license renewal term is<10^17 n/m^2.	4-39	1
Loss of pressure boundary.	Not stated	Not stated		Non-significant because wrought and cast CS are resistant to sensitization, and/or applied & residual stresses are low.	4-18, 4- 19, 5-8 -16	2
Loss of pressure boundary.	Not stated	Not stated		Non-significant because CSs do not suffer TGSCC under BWR operating conditions of temperature, dissolve oxygen, & stress.	4-22 to 4- 28	3

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Charm/D Gavenda AN		-

		/D. Gavenda, ANL Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects Crack initiation &
B			Feedwater & Main Steam	CS	Not stated	CORR/IASCC	growth
	oundary				Not stated	COBB	Loss of material,
C	WR Primary coolant Pressure coundary	Piping & Fittings	Feedwater & Main Steam	CS	NUL STRIBUT		corrosion product buildup
		Piping & Fittings	Feedwater & Main	CS	Not stated	ERO/CORR	Wall thinning, los material
	WR Primary Coolant Pressure Boundary	Fibling & Fittings	Steam				
			Feedwater & Main	l cs	Not stated	CREEP	Change in
	BWR Primary Coolant Pressure	Piping & Fittings	Steam				dimension Loss of preload
8	Boundary BWR Primary Coolant Pressure	Piping & Fittings	Feedwater & Main Steam	CS	Not stated	RELAX	Loss of preload
	Boundary BWR Primary	Piping & Fittings	Feedwater & Main	CS	Not stated	WEAR	Attrition
	Coolant Pressure		Steam			FAT	Cumulative fatig
10	Boundary BWR Primary Coolant Pressure Boundary	Piping & Fittings	Feedwater & Main Stearn	CS	Not stated		damage
11	BWR Primary	Piping & Fittings	RCIC, HPCI, RHR, LPCI, LPCS, &	CS	Not stated	EMBR/IR	Loss of fracture toughness
	Coolant Pressure Boundary		HPCS RCIC, HPCI, RHR		Not stated	CORR/IGSCC	Crack initiation
12	BWR Primary Coolant Pressure Boundary	Piping & Fittings	LPCI, LPCS, & HPCS	, 65			growth
13	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RCIC, HPCI, RHR LPCI, LPCS, & HPCS	, CS	Not stated	CORR/TGSCC	Crack initiation growth
14	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RCIC, HPCI, RHF LPCI, LPCS, & HPCS	a cs	Not stated	CORR/IASCC	Crack initiation growth
15	5 BWR Primary Coolant Pressure Boundary	Piping & Fittings	RCIC, HPCI, RHF LPCI, LPCS, & HPCS	a CS	Not stated	CORR	Loss of materi
1	6 BWR Primary Coolant Pressure	Piping & Fittings	RCIC, HPCI, RH LPCI, LPCS, & HPCS	R, CS	Not stated	ERO/CORR	Wall thinning
1	7 BWR Primary	Piping & Fittings	RCIC, HPCI, RH	IR, CS	Not stated	CREEP	Change in dimension
	Coolant Pressure Boundary	Piping & Fittings	HPCS	IR, CS	Not stated	RELAX	Loss of prelo
1	18 BWR Primary Coolant Pressure		LPCI, LPCS, & HPCS			WEAR	Attrition
	Boundary 19 BWR Primary Coolant Pressure Boundary	Piping & Fittings		IR, CS	Not stated		

**Document:** IR 90-09, BWR Primary Coolant Pressure Boundary Industry Report Reviewed by: O. Chopra/D. Gavenda, ANL Effect of Aging on Component Function Contrib to Failure. Reported progs.

Effect of Aging on Component Fu			Rel.progs	Report Recommendations	Page No.	-
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the total fast neutron fluence within the license renewal term is <10^20 n/m^2.	4-28, 4-29	
Loss of pressure boundary.	Not stated	Not stated		Non-significant because water quality & chemistry are controlled according to technical specifications requirements and corrosion allowances are defined according to the pressure integrity requirements.		1
Loss of pressure boundary.	Not stated	Appendix A of NUREG-1344 for single-phase lines, CHECMATE Code for two-phase lines.		NUREG-1344 recommends industry program for control of E/C in the single-phase systems & CHECMATE predicts E/C in two- phase systems.	& 5-17 -19	(
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <371_C (<700_F).	4-44,4-45	
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload for functionality.	4-45, 5-26 -28	
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subjected to relative motion or does not incorporate clamped joints.	4-47, 5- 28, 5-29	ç
Loss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue reanalysis & ASME Sect. XI, Subsect. IWB inspect.		NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.		10
Loss of pressure boundary.	Not stated	Not stated		Non-significant because total fast neutron fluence within the license renewal term is<10^17 n/m^2.	4-39	11
Loss of pressure boundary.	Not stated	Not stated		Non-significant because wrought and cast CS are resistant to sensitization, and/or applied & residual stresses are low.	4-18, 4- 19, <del>5-</del> 8 -16	12
Loss of pressure boundary.	Not stated	Not stated		Non-significant because CSs do not suffer TGSCC under BWR operating conditions of temperature, dissolve oxygen, & stress.	4-22 to 4- 28	13
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the total fast neutron fluence within the license renewal term is <10^20 n/m^2.	4-28, 4-29	14
Loss of pressure boundary.	Not stated	Not stated		Non-significant because water quality & chemistry are controlled according to technical specifications requirements and corrosion allowances are defined according to the pressure integrity requirements.	4-30 to 4- 32	15
Loss of pressure boundary.	Not stated	Not stated		Non-significant because components operate in low temperature (<79_C) and/or low flow rate.	4-33 -35, & 5-17 -19	16
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <371_C (<700_F).	4-44,4-45	17
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload for functionality.	4-45, 5-26 -28	18
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subjected to relative motion or does not incorporate clamped joints.	4-47, 5- 28, 5-29	19

Document: IR 9	0-09, BWR Primary Coolant Pre	essure Boundary Indu	stry Report
Reviewed by:	O. Chopra/D. Gavenda, ANL	•	
Item System	Structure/Comp	Subcomponent	Meteriale

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
20	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RCIC, HPCI, RHR, LPCI, LPCS, & HPCS	CS	Not stated	FATUnresolved	Cumulative fatigue damage
	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RHR, LPCI, LPCS, Recirc., & HPCS	SS	Not stated	EMBR/IR	Loss of fracture toughness
22	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RHR, LPCI, LPCS, Recirc., & HPCS	SS	Not stated	CORR/IGSCC	Crack initiation & growth
23	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RHR, LPCI, LPCS, Recirc., & HPCS	SS	Not stated	CORR/TGSCC	Crack initiation & growth
24	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RHR, LPCI, LPCS, Recirc., & HPCS	SS	Not stated	CORR/IASCC	Crack initiation & growth
25	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RHR, LPCI, LPCS, Recirc., & HPCS	SS	Not stated	CORR	Loss of material
26	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RHR, LPCI, LPCS, Recirc., & HPCS	SS	Not stated	ERO/CORR	Wall thinning
27	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RHR, LPCI, LPCS, Recirc., & HPCS	SS	Not stated	CREEP	Change in dimension
28	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RHR, LPCI, LPCS, Recirc., & HPCS	SS	Not stated	RELAX	Loss of preload
29	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RHR, LPCI, LPCS, Recirc., & HPCS	SS	Not stated	WEAR	Attrition
30	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RHR, LPCI, LPCS, Recirc., & HPCS	SS	Not stated	FAT	Cumulative fatigue damage
31	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Bonnet	CS	Not stated	EMBR/IR	Loss of fracture toughness
32	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Bonnet	CS	Not stated	CORR/IGSCC	Crack initiation & growth
33	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Bonnet	CS	Not stated	CORR/TGSCC	Crack initiation & growth
34	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Bonnet	CS	Not stated	CORRAASCC	Crack initiation & growth

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Document: IR 90-09, BWR Primary Coolant Pressure Boundary Reviewed by: O. Chopra/D. Gavenda, ANL	
Effect of Aging on Component Function Contrib to Failure	Demonts d

Loss of pressure boundary.	Not stated	ASME Sect. III,	Rel.progs Report Recommendations	Page No.	_
		Subsect. NB fatigue reanalysis & ASME	NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing	4-2 to 4-9, 5-4 to 5-6	
Loss of pressure boundary.		Sect. XI, Subsect. IWB inspect.	discussions on fatigue evaluation for license renewal between NUMARC and staff.		
	Not stated	Not stated	Non-significant because total fast neutron fluence within the license	4-39	
Loss of pressure boundary.	Not stated	Program delineated	renewal term is<10^17 n/m^2		
		in NUREG-0313, Rev. 2, and implemented through NRC Generic letter	Implementation of effective inspection, mitigation, & repair techniques.	4-18, 4- 19, 5-8 -16	
oss of pressure boundary.	Not stated	88-01 Not stated			Į
oss of pressure boundary.		NOI STATEO	Non-significant because SSs (N<0.12%) do not suffer TGSCC under BWR operating conditions of temp., DO, impurity level, & design stress. N concentrations of >0.12% are not in BWR application.	4-22 to 4- 28	2
oss of pressure boundary.	Not stated	Not stated	Non-significant because the total	4.29 4.20	<u> </u>
oss of pressure boundary.			tast neutron fluence within the license renewal term is $<10^{-20}$ n/m/2.	4-28, 4-29	2
bes of pressure boundary.	Not stated	Not stated	Non-significant because water	4-30 to 4-	2
				32	2.
oss of pressure boundary.			the pressure integrity requirements.	[	
er prosouro boundary.	Not stated	Not stated		4-33 -35,	26
ss of pressure boundary.	Not stated	Net state of	components are resistant to E/C.	& 5-17 •19	•••
		Not stated	Non-significant because operating conditions are <538_C (<1000_F).	4-44,4-45	27
ss of pressure boundary.	Not stated	Not stated	components do not depend on	1-45, 5-26 28	28
ss of pressure boundary.	Not stated	Not stated	preload for functionality.		
				-47, 5- 8, 5-29	29
ss of pressure boundary.	Not stated	ASME Sect. III,		-2 to 4-9	
		Subsect. NB fatigue reanalysis & ASME	issues are unresolved until an 5 agreement is reached in the ongoing	-4 to 5-6	30
ss of pressure boundary.		Sect. XI, Subsect. IWB inspect.	discussions on fatigue evaluation for license renewal between NUMARC and staff.		
·	Not stated	Not stated	Non-significant because total fast 4 neutron fluence within the license renewal term is<10^17 n/m^2.	-39	31
s of pressure boundary.	Not stated	Not stated	Non-significant because wrought 4-	-20, 5-8 6	32
s of pressure boundary.	Not stated	Not stated	Non-significant because CSs do not 4- suffer TGSCC under BWR 28 operating conditions of temperature.		33
s of pressure boundary.	Not stated	Not stated	dissolve oxygen, & stress.		
			Non-significant because the total 4- fast neutron fluence within the license renewal term is <10^20 n/m^2.	28, 4-29	34
				,	- 1

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Document: IR 90-09, BWR Primary Coolant Pressure Boundary Industry Report Reviewed by: O. Chopra/D. Gavenda, ANL

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	Loss of material
35	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Bonnet	CS	Not stated	CORR	Loss of material
36	BWR Primary	Relief & In-Line	Bonnet	CS	Not stated	ERO/CORR	Wall thinning
	Coolant Pressure Boundary	Valves					
37	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Bonnet	CS	Not stated	CREEP	Change in dimension
38	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Bonnet	CS	Not stated	RELAX	Loss of preload
ł	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Bonnet	cs	Not stated	WEAR	Attrition
	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Bonnet	cs	Not stated	FAT	Cumulative fatigue damage
41	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	CS	Not stated	EMBR/IR	Loss of fracture toughness
42	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	CS	Not stated	CORR/IGSCC	Crack initiation & growth
43	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	CS	Not stated	CORR/TGSCC	Crack initiation & growth
44	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	CS	Not stated	CORR/IASCC	Crack initiation & growth
45	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	CS	Not stated	CORR	Loss of material
46	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	CS	Not stated	ERO/CORR	Wall thinning
47	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	CS	Not stated	CREEP	Change in dimension
48	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	CS	Not stated	RELAX	Loss of preioad
49	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	CS	Not stated	WEAR	Attrition
50	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	CS	Not stated	FATUnresolved	Cumulative fatigu damage
51	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Valve Body	cs	Not stated	EMBR/IR	Loss of fracture toughness
52	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Valve Body	CS	Not stated	CORR/IGSCC	Crack initiation 8 growth

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 Document:
 IR 90-09, BWR Primary Coolant Pressure Boundary Industry Report

 Reviewed by:
 O. Chopra/D. Gavenda, ANL

 Effect of Aging on Component Function Contrib to Failure
 Reported progs

Effect of Aging on Component l Loss of pressure boundary.	Not stated	Not stated	Rel.progs	Report Recommendations	Page No	_
				Non-significant because water quality & chemistry are controlled according to technical specification requirements and corrosion allowances are defined according to		. 3
Loss of pressure boundary.	Not stated	Not stated		the pressure integrity requirements Non-significant because components operate in low	4-36, & 5-	. 3
				temperature (<79_C) and/or low flor rate.	N	
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <371_C (<700_F).	4-44,4-45	3
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on	4-45, 5-26 -28	3
oss of pressure boundary.	Not stated	Not stated		preload for functionality. Non-significant because not subjected to relative motion or does	4-47, 5- 28, 5-29	3
oss of pressure boundary.	Not stated	Non-significant	······	not incorporate clamped joints.	20, 5-29	
		because no operating experience of flaws induced by fatigue, (More)		NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC	4-10, 4-11	4:
oss of pressure boundary.	Not stated	Not stated		and staff. Non-significant because total fast neutron fluence within the license	4-39	41
oss of pressure boundary.	Not stated	Not stated		renewal term is<10^17 n/m^2. Non-significant because not subjected to corrosive environment.	•	42
oss of pressure boundary.	Not stated	Not stated		Non-significant because not subjected to corrosive environment.	4-22 to 4- 28	43
oss of pressure boundary.	Not stated	Not stated		Non-significant because the total fast neutron fluence within the icense renewal term is <10^20	4-28, 4-29	44
oss of pressure boundary.	Not stated	Not stated		n/m^2. Non-significant because not subjected to corrosive environment.	4-30 to 4- 32	45
oss of pressure boundary.	Not stated	Not stated	N	Von-significant because components not in contact with	4-38	46
oss of pressure boundary.	Not stated	Not stated	P	primary coolant.		
oss of pressure boundary.			C	Non-significant because operating conditions are <371_C (<700_F).	4-44, 4-45	47
oss of pressure boundary.	Not stated	Not stated	0	Non-significant because these components do not depend on preload for functionality.	4-45, 5-26 -28	48
	Not stated	Not stated	N	Ion-significant because not	4-47, <del>5-</del> 28, 5-29	49
ss of pressure boundary.	Not stated	Non-significant because no operating experience of flaws induced by fatigue, (More)	N is ai di lic		4-13	50
ss of pressure boundary.	Not stated	Not stated	N	on-significant because total fast	1-39	51
ss of pressure boundary.	Not stated	Not stated	N ar se		1-20, 5-8 16	52

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Document: IR 9	0-09, BWR Primary Coolant Pressure Boundary Industry Report
Reviewed by:	O. Chopra/D. Gavenda, ANL

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
53	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Valve Body	CS	Not stated	CORRITESCC	Crack initiation & growth
54	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Valve Body	CS	Not stated	CORRIASCC	Crack initiation & growth
55	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Valve Body	CS	Not stated	CORR	Loss of material
56	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Valve Body	CS	Not stated	ERO/CORR	Wall thinning
57	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Valve Body	CS	Not stated	CREEP	Change in dimension
58	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Valve Body	ĊS	Not stated	RELAX	Loss of preload
59	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Valve Body	CS	Not stated	WEAR	Attrition
60	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Valve Body	cs	Not stated	FATUnresolved	Cumulative fatigue damage
61	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Valve Body & Bonnel	CASS	Not stated	EMBR/IR	Loss of fracture toughness
62	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Bowl, & Cover (Bingham)	CASS	Not stated	CORR/IGSCC	Crack initiation & growth
63	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Valve Body & Bonnet	CASS	Not stated	CORR/TGSCC	Crack initiation & growth
64	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Bowl, & Cover (Bingham)	CASS	Not stated	CORR/IASCC	Crack initiation & growth
65	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Bowl, & Cover (Bingham)	CASS	Not stated	CORR	Loss of material
66	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Bowl, & Cover (Bingham)	CASS	Not stated	ERO/CORR	Wall thinning
67	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Bowl, & Cover (Bingham)	CASS	Not stated	CREEP	Change in dimension
68	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Bowl, & Cover (Bingham)	CASS	Not stated	RELAX	Loss of preload

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 Document:
 IR 90-09, BWR Primary Coolant Pressure Boundary Industry Report

 Reviewed by:
 O. Chopra/D. Gavenda, ANL

 Effect of Aging on Component Function Contrib to Failure
 Reported progs
 Rel.progs

Loss of pressure boundary.	Not stated	ilure Reported progs Rei	.progs Report Recommendations Non-significant because CSs do no	Page No.	-
			suffer TGSCC under BWR operating conditions of temperature	28	5
Loss of pressure boundary.			dissolve oxygen, & stress.	·	
Loss of pressure boundary.	Not stated	Not stated	Non-significant because the total fast neutron fluence within the license renewal term is <10^20	4-28, 4-29	5
			n/m^2.		
Loss of pressure boundary.	Not stated	Not stated	Non-significant because water	4-30 to 4-	5
			quality & chemistry are controlled according to technical specifications requirements and corrosion allowances are defined according to	32	
oss of pressure boundary.	Not stated	ASME Sect. XI,	ASME Sect. XI requires VT-3 of	4.00 9.5	
		Subsect. IWB, exam. categories B- M-1 & -2, & B-P; and guidelines of NEDC- 31743.	valve body internal surfaces & VT-2 of pressure retaining boundary & system leakage & hydrostatic tests. Also, compliance with NEDC 31743 is necessary.		56
Loss of pressure boundary.	Not stated	Not stated	Non-significant because operating conditions are <371_C (<700_F).	4-44,4-45	57
oss of pressure boundary.	Not stated	Not stated	Non similar the		
oss of property have de			Non-significant because these components do not depend on preload for functionality.	4-45, 5-26 -28	58
loss of pressure boundary.	Not stated	Not stated	Non-significant because not	4-47, 5-	59
oss of pressure boundary.			subjected to relative motion or does not incorporate clamped joints.	28, 5-29	
ood of pressure boundary.	Not stated	Non-significant	NRC recommendation: Fatigue	4-10, 4-11	60
		because no	issues are unresolved until an		
		operating experience of flaws induced by	agreement is reached in the ongoing		
		fatigue, (More)	discussions on fatigue evaluation for license renewal between NUMARC	1 1	
			and staff.	1 1	
oss of pressure boundary.	Not stated	Not stated	Non-significant because total fast neutron fluence within the license	4-39	61
oss of pressure boundary.	Not stated	CASS material has	renewal term is<10^17 n/m^2.		
		reduced	NRC recommendation: CASS	4-20, 4-	62
		susceptibility to	materials that meet the NUREG- 0313, Rev. 2 guidelines of _0.035%	21, 5-8 to	
		IGSCC if C & ferrite	C & _7.5% ferrite have reduced	5-16	1
		content meet (More)	susceptibility to IGSCC		
oss of pressure boundary.	Not stated	Not stated	Non-significant because SSs	4-22 to 4-	63
			(N<0.12%) do not suffer TGSCC	28	~
			under BWR operating conditions of		
			temp., DO, impurity level, & design	1	
			stress. N concentrations of >0.12%		
oss of pressure boundary.	Not stated	Not stated	are not in BWR application.		
			Non-significant because the total fast neutron fluence within the	4-28, 4-29	64
			license renewal term is <10^20		
			n/m^2.		1
oss of pressure boundary.	Not stated	Not stated	Non-significant because water	4-30 -32	65
			quality & chemistry are controlled		
			according to technical specifications		
			requirements and corrosion	1	
			allowances are defined according to		
ss of pressure boundary.	Not stated	Not stated	the pressure integrity requirements. Non-significant because		
			components are resistant to E/C.	4-36, 5-20	66
ss of pressure boundary.	Not stated	Not stated	Non-significant because operating	4-44,4-45	
			conditions are <538_C (<1000_F).	4-44,4-45	67
ss of pressure boundary.	Not stated	Not stated	Non-significant because these	4-45, 5-26	
				-28 -28	68

Document: IR 9	0-09, BWR Primary Coolant Pressure Boun	dary Industry Report
	O. Chopra/D. Gavenda, ANL	

m	wed by: O. Chop System	ra/D. Gavenda, ANL Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	BWR Primary Coolant Pressure Boundary		Bowt, & Cover (Bingham)	CASS	Not stated	WEAR	Loss of fracture
70	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Bowl, & Cover (Bingham)	CASS	Not stated	EMBR/TE	toughness
71	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Valve Body & Bonnet	CASS	Not stated	FAT	Cumulative fatigue damage
72	BWR Primary Coolant Pressure	Recirculation Pump	Bowl, & Cover (Bingham)	CASS	Not stated	EMBR/IR	Loss of fracture toughness
73	Boundary BWR Primary Coolant Pressure Boundary	Recirculation Pump	Cover (Byron Jackson)	CASS	Not stated	CORR/IGSCC	Crack initiation & growth
74	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Cover (Byron Jackson)	CASS	Not stated	CORR/TGSCC	Crack initiation & growth
75	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Cover (Byron Jackson)	CASS	Not stated	CORR/IASCC	Crack initiation & growth
76	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Cover (Byron Jackson)	CASS	Not stated	CORR	Loss of material
77	BWR Primary Coolant Pressure	Recirculation Pump	Cover (Byron Jackson)	CASS	Not stated	ERO/CORR	Wall thinning
78	Boundary BWR Primary Coolant Pressure	Recirculation Pump	Cover (Byron Jackson)	CASS	Not stated	CREEP	Change in dimension
79	Boundary BWR Primary Coolant Pressure Boundary	Recirculation Pump	Cover (Byron Jackson)	CASS	Nof stated	RELAX	Loss of preload
8	Boundary BWR Primary Coolant Pressure Boundary	Recirculation Pump	Cover (Byron Jackson)	CASS	Not stated	WEAR	Attrition
8	1 BWR Primary Coolant Pressure Boundary	Recirculation Pump	Cover (Byron Jackson)	CASS	Not stated	EMBR/TE	Loss of fracture toughness
8	2 BWR Primary Coolant Pressure Boundary	Recirculation Pump	) Cover (Byron Jackson)	CASS	Not stated	FAT	Cumulative fatig damage
ε	3 BWR Primary Coolant Pressure	Recirculation Purn	Heat Exchanger (Bingham)	ss	Not stated	EMBR/IR	Loss of fracture toughness
8	Boundary BWR Primary Coolant Pressure Boundary	integral Support	Not stated	SS	Not stated	CORR/IGSCC	Crack initiation a growth

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 Document:
 IR 90-09, BWR Primary Coolant Pressure Boundary Industry Report

 Reviewed by:
 O. Chopra/D. Gavenda, ANL

 Effect of Aging on Component Function Contrib to Failure
 Reported progs

Effect of Aging on Component F Loss of pressure boundary.	Not stated		Rel.progs	Report Recommendations	Page No.	-
	NOT STATED	Not stated		Non-significant because not subjected to relative motion or does not incorporate clamped joints.	4-47, 5- 28, 5-29	69
Loss of pressure boundary.	Not stated	Ferrite content screening criteria & ASME Sect. XI, Subsect. IWB inspection.		NRC recommendation: Ferrite criteria is inadequate tool for screening & VT-3 cannot reliably detect tight cracks. Fracture toughness may be estimated based on NUREG/CR-4513, Rev. 1.	4-40 to 4- 44, 5-22 to 5-25	70
Loss of pressure boundary.	Not stated	Non-significant because no operating experience of flaws induced by fatigue, (More)		NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.		71
Loss of pressure boundary.	Not stated	Not stated		Non-significant because total fast neutron fluence within the license renewal term is<10^17 n/m^2.	4-39	72
Loss of pressure boundary.	Not stated	CASS material has reduced susceptibility to IGSCC if C & ferrite content meet (More)		NRC recommendation: CASS materials that meet the NUREG- 0313, Rev. 2 guidelines of _0.035% C & _7.5% ferrite have reduced susceptibility to IGSCC	4-20, 4- 21, 5-8 to 5-16	73
Loss of pressure boundary.	Not stated	Not stated		Non-significant because SSs (N<0.12%) do not suffer TGSCC under BWR operating conditions of temp., DO, impurity level, & design stress. N concentrations of >0.12% are not in BWR application.	4-22 to 4- 28	74
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the total fast neutron fluence within the license renewal term is <10^20 n/m^2.	4-28, 4-29	75
Loss of pressure boundary.	Not stated	Not stated		Non-significant because water quality & chemistry are controlled according to technical specifications requirements and corrosion allowances are defined according to the pressure integrity requirements.	4-30 -32	76
oss of pressure boundary.	Not stated	Not stated		Non-significant because components are resistant to E/C.	4-37	77
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <538_C (<1000_F).	4-44, 4-45	78
oss of pressure boundary.	Not stated	Not stated	.=	Non-significant because these components do not depend on preload for functionality.	4-45, 5-26 -28	79
loss of pressure boundary.	Not stated	Not stated		Non-significant because not subjected to relative motion or does not incorporate clamped joints.	4-47, 5- 28, 5-29	80
oss of pressure boundary.	Not stated	Ferrite content screening criteria & ASME Sect. XI, Subsect. IWB inspection.		NRC recommendation: Ferrite criteria is inadequate tool for screening & VT-3 can not reliably detect tight cracks. Fracture toughness may be estimated based on NUREG/CR-4513Rev. 1.	4-40 to 4- 44, 5-22 to 5-25	81
oss of pressure boundary.	Not stated	ASME Sect. XI, Subsect. IWB inspection & ASME Code Case N-481 flaw evaluation.		NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.	4-12, 4- 13, 5-6, 5- 7	82
oss of pressure boundary.	Not stated	Not stated		Non-significant because total fast neutron fluence within the license renewal term is<10^17 n/m^2.	4-39	83
oss of pressure boundary.	Not stated	Not stated		Non-significant because applied and residual stresses are low and/or not subjected to corrosive environment.	21, 5-8 to	84

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	System BWR Primary	Structure/Comp Integral Support	Subcomponent Not stated	ISS	Not stated	ARD mechanism	ARD effects Crack initiation &
	Coolant Pressure Boundary			55			growth
86	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth
87	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	SS	Not stated	CORR	Loss of material
88	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	SS	Not stated	ERO/CORR	Wall thinning
	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	SS	Not stated	CREEP	Change in dimension
90	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	SS	Not stated	RÉLAX	Loss of preioad
91	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	SS	Not stated	WEAR	Attrition
92	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Heat Exchanger (Byron Jackson)	ss	Not stated	EMBR/IR	Loss of fracture toughness
	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Heat Exchanger (Byron Jackson)	SS	Not stated	CORR/IGSCC	Crack initiation & growth
95	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Heat Exchanger (Byron Jackson)	SS	Not stated	CORR/TGSCC	Crack initiation & growth
96	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Heat Exchanger (Byron Jackson)	SS	Not stated	CORR/IASCC	Crack initiation & growth
97	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Heat Exchanger (Byron Jackson)	SS	Not stated	CORR	Loss of material
	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Heat Exchanger (Byron Jackson)	SS	Not stated	ERO/CORR	Wall thinning
99	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Heat Exchanger (Byron Jackson)	SS	Not stated	CREEP	Change in dimension
100	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Heat Exchanger (Byron Jackson)	SS	Not stated	RELAX	Loss of preload

Document: IR 90-09, BWR Primary Coolant Pressure Boundary Industry Report							
Reviewed by:	O. Chopra/D. Gavenda, ANL		• •				
Mann Chankann	Christian IC area	Cub a serie series					

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Document: IR 90-09, BWR Primary Coolant Pressure Boundary Industry Report Reviewed by: O. Chopra/D. Gavenda, ANL Effect of Aging on Component Function Contrib to Failure Reported progs

Loss of pressure boundary.	Not stated	Not stated	Rel.progs Report Recommendations Non-significant because SSs	Page No	
1			(Non-significant because SSs	4-22 to 4	
			(N<0.12%) do not suffer TGSCC	28	
	1		under BWR operating conditions o	f	
			temp., DO, impurity level, & design		
			stress. N concentrations of >0.12%	•	
	1		are not in BWR application, &		
			integral support not subjected to	1	
Loss of pressure boundary.	Not stated	Not stated	corrosive environment.		
	, inter of allog	NOT STATED	Non-significant because the total	4-28, 4-2	9
		[	fast neutron fluence within the		
			license renewal term is <10^20		
Loss of pressure boundary.	Not stated		n/m^2.		
, , , , , , , , , , , , , , , , , , ,	Not stated	Not stated	Non-significant because water	4-30 -32	+
			quality & chemistry are controlled	1.00 05	
			according to technical specification		1
			requirements; corrosion allowances		
		ļ	are defined according to the	1	
Loss of pressure boundary.			pressure integrity requirements.	1	
Loss of pressure boundary.	Not stated	Not stated	Non-significant because		1
	[		non-significant because	4-37	
	1		components are resistant to E/C &		1
			integral support is not in contact with	า	
oss of pressure boundary.	Not stated	Not stated	primary coolant.		
-		NOT STATED	Non-significant because operating	4-44, 4-45	
			conditions are <538_C (<1000_F).		1
oss of pressure boundary.	Not stated			1	1
,	NOT STATED	Not stated	Non-significant because these	4-45, 5-26	<u>+</u>
			components do not depend on	-28	1
oss of pressure boundary.			preload for functionality.	-20	1
oss of pressure boundary.	Not stated	Not stated	Non-significant because not		
	4		interesting and the selection of	4-47, 5-	
		1	subjected to relative motion or does	28, 5-29	
oss of pressure boundary.	Not stated	Non-significant	not incorporate clamped joints.		
			NRC recommendation: Fatigue	4-12, 4-	
	1	because no	issues are unresolved until an	13, 5-6, 5-	
		operating experience	agreement is reached in the ongoing	7	
		of flaws induced by	discussions on fatigue evaluation for	ľ	
		fatigue, (More)	license renewal between NUMARC		
oss of pressure boundary.			and staff.		
es el presente boundary.	Not stated	Not stated	Non-significant because total fast	4-39	
			neutron fluence within the license	4-39	9
			renewal term is<10^17 n/m^2.		
oss of pressure boundary.	Not stated	Not stated	Non significant based based		
			Non-significant because applied and	4-20, 4-	9
			residual stresses are low.	21, 5-8 to	
ss of pressure boundary.	Not stated	Not stated		5-16	
		Not stated	Non-significant because SSs	4-22 to 4-	9
			(N<0.12%) do not suffer TGSCC	28	
	J		under BWR operating conditions of		
		1 1	temp., DO, impurity level, & design	1	
		1	stress. N concentrations of >0.12%	1	
ss of pressure boundary.	Not at-t-		are not in BWR application.	l l	
i procede boundary.	Not stated	Not stated		4-28, 4-29	~
		j i	fast neutron fluence within the	20, 4-29	9
		1	license renewal term is <10^20		
of of processing the second			n/m^2.		
ss of pressure boundary.	Not stated	Not stated			
			Non-significant because water	4-30 -32	9
		1 1	quality & chemistry are controlled	1	
			according to technical specifications	1	
			requirements and corrosion	I	
		1 1	allowances are defined according to	1	
ss of pressure boundary.	Not stated		the pressure integrity requirements.	1	
	INOU STATED	Not stated		1-37	98
			components are resistant to E/C.		90
s of pressure boundary.					
o or pressure boundary.	Not stated	Not stated	Non-significant because operating		
			conditions are <538_C (<1000_F).	-44,4-45	99
			<pre></pre>		
s of pressure boundary.	Not stated	Not stated	Non airrife		
			Non-significant because these 4	-45, 5-26	100
	1		components do not depend on	28	

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
101	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Heat Exchanger (Byron Jackson)	SS	Not stated	WEAR	Attrition
102	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Heat Exchanger (Byron Jackson)	SS	Not stated	FAT	Cumulative fatigue damage
103	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Nuts & Bolts	cs	Not stated	EMBR/IR	Loss of fracture toughness
104	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Nuts & Bolts	CS	Not stated	CORR/IGSCC	Crack initiation & growth
105	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Nuts & Bolts	CS	Not stated	CORR/TGSCC	Crack initiation & growth
106	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Nuts & Bolts	cs	Not stated	CORR/IASCC	Crack initiation & growth
107	BWR Primary Coolant Pressure	Relief & In-Line Valves	Nuts & Bolts	CS	Not stated	CORR	Loss of material
108	Boundary BWR Primary Coolant Pressure	Relief & In-Line Valves	Nuts & Bolts	CS	Not stated	ERO/CORR	Wall thinning
109	Boundary BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Nuts & Bolts	CS	Not stated	CREEP	Change in dimension
110	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Nuts & Bolts	CS	Not stated	RELAX	Loss of preload
111	BWR Primary Coolant Pressure	Relief & In-Line Valves	Nuts & Bolts	ĊS	Not stated	WEAR	Attrition
112	Boundary 2 BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Nuts & Bolts	CS	Not stated	FAT	Cumulative fatigu damage
11:	3 BWR Primary Coolant Pressure	Relief & In-Line Valves	Nuts & Bolts	SS	Not stated	EMBR/IR	Loss of fracture toughness
114	Boundary 4 BWR Primary Coolant Pressure	Recirculation Pump	Nuts & Bolts	SS	Not stated	CORR/IGSCC	Crack initiation & growth
11:	Boundary 5 BWR Primary Coolant Pressure	Recirculation Pump	Nuts & Botts	SS	Not stated	CORR/TGSCC	Crack initiation & growth
11	Boundary 6 BWR Primary Coolant Pressure Boundary	Recirculation Pump	Nuts & Bolts	SS	Not stated	CORR/IASCC	Crack initiation 8 growth
11	7 BWR Primary Coolant Pressure Boundary	Recirculation Pump	Nuts & Bolts	SS	Not stated	CORR	Loss of material
11	8 BWR Primary Coolant Pressure Boundary	Recirculation Pump	Nuts & Bolts	SS	Not stated	ERO/CORR	Wall thinning
11	9 BWR Primary Coolant Pressure Boundary	Recirculation Pump	Nuts & Bolts	SS	Not stated	CREEP	Change in dimension

**Document:** IR 90-09, BWR Primary Coolant Pressure Boundary Industry Report **Reviewed by:** O. Chopra/D. Gavenda, ANL Effect of Aging on Component Europien Contribute Failure Reported progs

Effect of Aging on Component Funct	tion Contrib to Failure		Rel.progs	Report Recommendations	Page No.	
oss of pressure boundary.	Not stated	Not stated		Non-significant because not subjected to relative motion or does not incorporate clamped joints.	4-47, 5- 28, 5-29	101
Loss of pressure boundary.	Not stated	ASME Sect. XI, Subsect. IWB inspection & ASME Code Case N-481 flaw evaluation.		NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.	4-12, 4- 13, 5-6, 5- 7	102
Loss of pressure boundary.	Not stated	Not stated		Non-significant because total fast neutron fluence within the license renewal term is<10^17 n/m^2.	4-39	103
Loss of pressure boundary.	Not stated	Not stated		Non-significant because components are not subjected to corrosive environment.	4-20, 5-8 -16	104
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subjected to coolant environment.	4-22 to 4- 28	105
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the total fast neutron fluence within the license renewal term is <10^20 n/m^2.	4-28, 4-29	
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subjected to coolant environment.	4-30 to 4- 32	107
Loss of pressure boundary.	Not stated	Not stated		Non-significant because components not in contact with primary coolant	4-36, & 5- 20	108
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <371_C (<700_F).	4-44, 4-45	109
Loss of pressure boundary.	Not stated	ASME Sect. XI, Subsect. IWB, exam. categoriesB- G-1 & -2, & testing category B-P for system leakage.		ASME Sect. XI, Table IWB-2500-1, ISlincludes VT-1 of nuts, bushing, and washer surfaces, & volumetric exam. of bolts & studs, corrective measureIWA-5250, & acceptance criteria IWA-3142.	4-45, 5-26 -28	110
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subjected to relative motion or does not incorporate clamped joints.	<b>4-47</b> , 5- 28, 5-29	111
Loss of pressure boundary.	Not stated	Non-significant because no operating experience of flaws induced by fatigue, (More)		NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.		112
Loss of pressure boundary.	Not stated	Not stated		Non-significant because total fast neutron fluence within the license renewal term 15<10/17 n/m/2.	4-39	113
Loss of pressure boundary.	Not stated	Not stated		Non-significant because components are not subjected to corrosive environment.	4-20, 4- 21, 5-8 to 5-16	114
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subjected to coolant environment.	4-22 to 4- 28	115
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the total fast neutron fluence within the license renewal term is <10^20 n/m^2.	4-28, 4-29	9 116
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subjected to coolant environment.	4-30 -32	117
Loss of pressure boundary.	Not stated	Not stated		Non-significant because components are not in contact with primary coolant.	4-36, 5-20	0 118
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <538_C (<1000_F).	4-44, 4-4	5 11

	BWR Primary	Structure/Comp Recirculation Pum	Subcomponent P Nuts & Bolts	Materials ISS	Manufacturer	ARD mechanism	ARD effects
	Coolant Pressure Boundary			55	Not stated	RELAX	Loss of preload
121	BWR Primary Coolant Pressure Boundary	Recirculation Pum	Nuts & Bolts	SS	Not stated	WEAR	Attrition
122	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Nuts & Bolts	SS	Not stated	FATUnresolved	Cumulative fatigu damage
123	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	cs	Not stated	EMBR/IR	Loss of fracture toughness
	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	CORR/IGSCC	Crack initiation & growth
	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	CORR/TGSCC	Crack initiation & growth
	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	CORRIASCO	Crack initiation & growth
	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	CORR	Loss of material
	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	ERO/CORR	Wall thinning
	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	CREEP	Change in dimension
	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	RELAX	Loss of preload
	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	WEAR	Attrition
	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	FAT	Cumulative fatigue damage
B	BWR Primary Soolant Pressure Soundary	Relief & In-Line Valves	Seal Flange	SS	Not stated	EMBR/IR	Loss of fracture toughness
C B	BWR Primary Coolant Pressure Joundary	Recirculation Pump	Seal Flange	SS	Not stated	CORR/IGSCC	Crack initiation & growth
	WR Primary coolant Pressure coundary	Recirculation Pump	Seal Flange	SS	Not stated	CORR/TGSCC	Crack initiation & growth

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Document: IR 90-09, BWR Primary Coolant Pressure Boundary Industry Report Reviewed by: O. Chopra/D. Gavenda, ANL
Effect of Aging on Component Function Contrib to Failure Reported proces

Loss of pressure boundary.	Not stated	ASME Sect. XI.	Rel.progs Rep	port Recommendations	Page No	_
1		Subsect. IWB,	ASN	IE Sect. XI, Table IWB-2500-	1, 4-45, 5-2	26
			ISI n	ncludes VT-1 of nuts, bushing	, -28	
	1	exam. categoriesB-	and	washer surfaces, & volumetric		
		G-1 & -2, & testing	exan	n. of bolts & studs, corrective	1	
		category B-P for	mea	surelWA-5250, & acceptance		
Loss of pressure boundary.	Not stated	system leakage.	criter	ia IWA-3142		
,	Not stated	Not stated	Non-	significant because not	4-47, 5-	
			subie	ected to relative motion or doe		
Loss of pressure boundary.			not in	corporate clamped joints.	s 28, 5-29	
Loss of pressure boundary.	Not stated	Non-significant	NBC	recommendation: Fatigue	-	
		because no	line	recommendation: Fangue	4-10 to 4-	
		operating experience	ISSUE	s are unresolved until an	13, 5-6, 5	۶I
		of flaws induced by	agree	ement is reached in the ongoir	ng 7	
		fatigue, (More)	aiscu	ssions on fatigue evaluation f	or	
		(more)	licens	e renewal between NUMARC	;	
Loss of pressure boundary.	Not stated	Not stated	and s			
		NOUSLAIDO	Non-s	significant because total fast	4-39	
			neutro	on fluence within the license		
oss of pressure boundary.			renew	/al term is<10^17 n/m^2.		1
presente boundary.	Not stated	Not stated	Non-s	ignificant because CS are	4-20, 5-8	+
			resist	ant to sensitization, and/or		1
OSS OF PRODUING h			annia	d & residual stresses are low.	-16	1
oss of pressure boundary.	Not stated	Not stated	Nor -	a residual suesses are low.	1	L
			livon-s	ignificant because CSs do no		1
			suffer	TGSCC under BWR	28	1
			operat	ing conditions of temperature		
oss of pressure boundary.	Not stated	Not stated	dissolv	/e oxygen, & stress.	1	
2		INUT SLATED	Non-si	gnificant because the total	4-28, 4-29	1
			fast ne	utron fluence within the		
			license	renewal term is <10^20		
oss of pressure boundary.			n/m^2.		1 1	
bee of pressure boundary.	Not stated	Not stated	Non-si	gnificant because water	1.00 1. 1	
			quality	Schemistry and Water	4-30 to 4-	12
			quality	& chemistry are controlled	32	
			accord	ing to technical specifications	1 1	
			require	ments and corrosion	1	
	1		allowar	nces are defined according to	1 1	
oss of pressure boundary.	Not stated	Not stated	the pre	ssure integrity requirements.	1 1	
•		NOLSTATED	Non-sig	nificant because	4-36. & 5-	12
			compor	nents operate in low	20	
		1	tempera	ature (<79_C) and/or low flow		
ss of pressure boundary.			rate.			
er er presedie bodildely.	Not stated	Not stated	Non-sic	nificant because operating	4-44, 4-45	-
			conditio	ins are <371_C (<700_F).	4-44, 4-45	12
ss of pressure boundary.	Not stated	Not stated				
			Non-sig	nificant because	4-45, 5-26	13
			compon	ents do not depend on	-28	
ss of pressure boundary.	Not stated	ASME Sect. XI,	preioad	for functionality.		
-			ASME S	Sect. XI, Table IWB-2500-1,	4-47, 5-	13
		Subsect. IWB, ISI	ISI inclu	des VT-1 of flange surfaces.	28.5-29	
		exam. categories B-	1	<u> </u>	,	
		G-1 & -2, and testing				
		category B-P for			l l	
ss of pressure boundary.		(More)			1	
o or pressure boundary.	Not stated	Non-significant	NRC rec	commendation: Fatigue		
	1	because no	issues a		4-10, 4-11	132
		operating experience	ISSUES a	re unresolved until an	l l	
		of flaws induced by	agreeme	int is reached in the ongoing		
		fatigue, (More)		ons on fatigue evaluation for	1	
				enewal between NUMARC		
s of pressure boundary.	Not stated	Not stated	and staff			
		TOL SUBIOU	Non-sign	ificant because total fast	4-39	133
			neutron f	luence within the license	1	
s of pressure boundary	Not etch-		renewal f	term is<10^17 n/m^2.		
proceedio boundary.	Not stated	Not stated	Non-sign	if an at t	1-20 4	107
			residual			134
			- Savud :		21, 5-8 to	
s of pressure boundary.	Not stated	Not stated	<del></del>		<u>5-16</u>	
-			Non-sign	ificant because SSs	1-22 to 4-	135
			(N<0.129	6) do not suffer TGSCC	28	
			under BV	VR operating conditions of		
			temp. Do	D, impurity level, & design		
		1 1				
			Stress N	concentrations of >0.12%	1	

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	wed by: O. Choj System	ora/D. Gavenda, ANL Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects Crack initiation &
136	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Seal Flange	SS	Not stated	CORR/IASCC	growth
	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Seal Flange	SS	Not stated	CORR	Loss of material
			Cool Flores	ISS	Not stated	ERO/CORR	Wall thinning
138	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Seal Flange				
139	BWR Primary Coolant Pressure	Recirculation Pump	Seal Flange	SS	Not stated	CREEP	Change in dimension
140	Boundary BWR Primary Coolant Pressure	Recirculation Pump	Seal Flange	SS	Not stated	RELAX	Loss of preload
141	Boundary BWR Primary Coolant Pressure Boundary	Recirculation Pump	Seal Flange	SS	Not stated	WEAR	Attrition
142	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Seal Flange	SS	Not stated	FAT	Cumulative fatigu damage

# Document: IR 90-09, BWR Primary Coolant Pressure Boundary Industry Report

# Document: IR 90-10, BWR Reactor Containment Structures Industry Report Reviewed by: David C. Ma, ANL

	C. Ma, ANL Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
System Mark I Steel Containment	Drywell Interior Surface	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
Mark I Steel Containment	Drywell Interior Surface	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigu damage
3 Mark I Steel Containment	Drywell Interior Surface	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
4 Mark   Steel Containment	Drywell Interior Surface	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
5 Mark I Steel Containment	Drywell Exterior Surface	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
6 Mark I Steel Containment	Drywell Exterior Surface	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatig damage

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 Document:
 IR 90-09, BWR Primary Coolant Pressure Boundary Industry Report

 Reviewed by:
 O. Chopra/D. Gavenda, ANL

 Effect of Aging on Component Function Contrib to Failure
 Reported progs

Loss of pressure boundary.			Rel.progs	Report Recommendations	Page No.	ltem
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the total fast neutron fluence within the license renewal term is <10^20 n/m^2.	4-28, 4-29	136
	Not stated	Not stated		Non-significant because water quality & chemistry are controlled according to technical specifications requirements and corrosion allowances are defined according to the pressure integrity requirements.	4-30 -32	137
Loss of pressure boundary.	Not stated	Not stated		Non-significant because SS components are resistant to E/C.	4-36, 5-20	138
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <538_C (<1000_F).	4-44, 4-45	139
Loss of pressure boundary.	Not stated	Not stated		Non-significant because components do not depend on preload for functionality.	4-45, 5-26 -28	140
Loss of pressure boundary.		ASME Sect. XI, Subsect. IWB, ISI exam. categories B- G-1 & -2, and testing category B-P for (More)			4-47, 5- 28, 5-29	141
Loss of pressure boundary.		Non-significant because no operating experience of flaws induced by fatigue, (More)		NRC recommendation: Fatigue issues are unresolved until an agreement is reached in the ongoing discussions on fatigue evaluation for license renewal between NUMARC and staff.	4-10 to 4- 13, 5-6, 5- 7	142

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Effect of Aging on Component F Loss of pressure boundary.	Not stated		Rel.progs	Report Recommendations	Page No.	Iter
·		Not stated		Non-significant for stainless steel components, and for components having intact protective coatings, and for components having a corrosion allowance >= 1/32 inch.	4-3 to 4-8	
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-16 to 4- 22	
Loss of pressure boundary.	Not stated	Not stated		Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4- 28	:
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-34 to 4- 36	
Loss of pressure boundary.	Not stated	The Examination Categories E-A, E-P, & E-C of ASME Sect. XI, Subsect. IWE in conjunction with 10CFR5		Not stated	5-9 to 5- 11	
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.			4-16 to 4- 22	

Document: IR 90	0-10, BWR Reactor Containment Structures Industry Report
Reviewed by:	David C. Ma, ANL

System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	A
Mark I Steel Containment	Drywell Exterior Surface	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
	Drywell Exterior Surface	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
Mark   Steel Containment	Drywell Head	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
Mark I Steel Containment	Drywell Head	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatgue damage
Mark   Steel Containment	Drywell Head	Not stated	Carbon Steel	Not stated	WEAR	Lockup
Mark I Steel Containment	Drywell Head	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
Mark   Steel Containment	Drywell Head	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
Mark I Steel Containment	Embedded Shell Region, Drywell Support Skirt, and Sand Pocket Region	Not stated	Carbon Steel, concrete	Not stated	CORR/PIT	Loss of material
Mark I Steel Containment	Embedded Shell Region, Drywell Support Skirt, and Sand Pocket Region	Not stated	Carbon Steel, concrete	Not stated	FAT	Cumulative fatigu damage
Mark I Steel Containment	Embedded Shell Region, Drywell Support Skirt, and	Not stated	Carbon Steel, concrete	Not stated	EMBR/SA	Loss of fracture toughness
Mark I Steel Containment	Embedded Shell Region, Drywell Support Skirt, and	Not stated	Carbon Steel, concrete	Not stated	EMBR/IR	Loss of fracture toughness
Mark   Steel Containment	Torus Interior Surface	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
Mark I Steel Containment	Torus Interior Surface	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatige damage
	Containment Mark   Steel Containment	ContainmentSurfaceMark I SteelDrywell ExteriorContainmentSurfaceMark I SteelDrywell HeadContainmentDrywell HeadMark I SteelDrywell HeadContainmentRegion, DrywellMark I SteelEmbedded ShellContainmentRegion, DrywellSupport Skirt, and Sand Pocket RegionMark I SteelTorus InteriorContainmentSand Pocket RegionMark I SteelTorus InteriorMark I SteelTorus InteriorMark I SteelTorus InteriorMark I SteelTorus Interior	Containment       Surface         Mark I Steel       Drywell Exterior         Containment       Drywell Exterior         Mark I Steel       Drywell Head         Not stated         Mark I Steel       Drywell Head         Containment       Region, Drywell         Mark I Steel       Embedded Shell         Containment       Region, Drywell         Support Skirt, and       Sand Pocket Region         Mark I Steel       Embedded Shell         Containment       Region, Drywell         Support Skirt, and       Sand Pocket Region         Mark I Steel       Embedded Shell         Containment       Region, Drywell         Support Skirt, and       Sand Pocket Region <td>Containment       Surface       Not stated       Carbon Steel         Mark I Steel       Drywell Exterior       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Embedded Shell       Not stated       Carbon Steel         Containment       Begion, Drywell       Not stated       Carbon Steel, concrete         Mark I Steel       Embedded Shell       Not stated       Carbon Steel, concrete         Containment       Region, Drywell       Not stated       Carbon Steel, concrete         Mark I Steel       Embedded Shell<!--</td--><td>Mark I Steel         Drywell Exterior         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Containment         Drywell Head         Not stated         Carbon Steel         Not stated           Containment         Drywell Head         Not stated         Carbon Steel         Not stated           Containment         Region, Drywell         Not stated         Carbon Steel         Not stated           Containment         Region, Drywell         Not stated         Carbon Steel         Not stated           Containment         Region,</td><td>Mark I Steel         Drywell Exercice         Not stated         Carbon Steel         Not stated         EMBR/IR           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         CORR/UA           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         CORR/UA           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         FAT           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         WEAR           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         EMBR/IA           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         EMBR/IA           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         EMBR/IA           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         EMBR/IA           Containment         Brygon, Drywell         Not stated         Carbon Steel         Not stated         EMBR/IA           Containment         Region, Drywell         Not stated         Carbon Steel         Not</td></td>	Containment       Surface       Not stated       Carbon Steel         Mark I Steel       Drywell Exterior       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Drywell Head       Not stated       Carbon Steel         Mark I Steel       Embedded Shell       Not stated       Carbon Steel         Containment       Begion, Drywell       Not stated       Carbon Steel, concrete         Mark I Steel       Embedded Shell       Not stated       Carbon Steel, concrete         Containment       Region, Drywell       Not stated       Carbon Steel, concrete         Mark I Steel       Embedded Shell </td <td>Mark I Steel         Drywell Exterior         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Containment         Drywell Head         Not stated         Carbon Steel         Not stated           Containment         Drywell Head         Not stated         Carbon Steel         Not stated           Containment         Region, Drywell         Not stated         Carbon Steel         Not stated           Containment         Region, Drywell         Not stated         Carbon Steel         Not stated           Containment         Region,</td> <td>Mark I Steel         Drywell Exercice         Not stated         Carbon Steel         Not stated         EMBR/IR           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         CORR/UA           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         CORR/UA           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         FAT           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         WEAR           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         EMBR/IA           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         EMBR/IA           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         EMBR/IA           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         EMBR/IA           Containment         Brygon, Drywell         Not stated         Carbon Steel         Not stated         EMBR/IA           Containment         Region, Drywell         Not stated         Carbon Steel         Not</td>	Mark I Steel         Drywell Exterior         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated           Containment         Drywell Head         Not stated         Carbon Steel         Not stated           Containment         Drywell Head         Not stated         Carbon Steel         Not stated           Containment         Region, Drywell         Not stated         Carbon Steel         Not stated           Containment         Region, Drywell         Not stated         Carbon Steel         Not stated           Containment         Region,	Mark I Steel         Drywell Exercice         Not stated         Carbon Steel         Not stated         EMBR/IR           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         CORR/UA           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         CORR/UA           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         FAT           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         WEAR           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         EMBR/IA           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         EMBR/IA           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         EMBR/IA           Mark I Steel         Drywell Head         Not stated         Carbon Steel         Not stated         EMBR/IA           Containment         Brygon, Drywell         Not stated         Carbon Steel         Not stated         EMBR/IA           Containment         Region, Drywell         Not stated         Carbon Steel         Not

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Effect of Aging on Component F Loss of pressure boundary.	Not stated	Not stated	Rel.progs	Report Recommendations	Page No.	nen
	norstated	NOT STATED		Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4- 28	
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-34 to 4- 36	
Loss of pressure boundary.	Not stated	Not stated		Non-significant for stainless steel components, and for components having intact protective coatings, and for components having a corrosion allowance >=1/32 inch.	4-3 to 4-8	
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-16 to 4- 22	10
Loss of pressure boundary.	Not stated	Conduct inspection and mitigation of mechanical wear in accordance with the provisions of ASME Sect.		Not stated	<b>4-2</b> 3, 4 24, 5-18, 5- 19	
Loss of pressure boundary.	Not stated	Not stated		Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4- 28	12
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-34 to 4- 36	13
Loss of pressure boundary.	Not stated	Not stated		A plant-specific aging program is required to manage the local corrosion of inaccessible and/or embedded carbon steel containment components.	4-9 to 4- 15, 5-12 to 5-5-14	14
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-16 to 4- 22	15
Loss of pressure boundary.	Not stated	Not stated		Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4- 28	16
loss of pressure boundary.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-34 -36	17
oss of pressure suppression.	Not stated	Not stated		Non-significant for stainless steel components, and for components having intact protective coatings, and for components having a corrosion allowance >=1/32 inch.	4-3 to 4-8	18
oss of pressure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an	4-16 to 4- 22	19

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
20	Mark I Steel Containment	Torus Interior Surface	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
21	Mark I Steel Containment	Torus Interior Surface	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
22	Mark   Steel Containment	Torus Interior Surface at Waterline	Not stated	Carbon Steel	Not stated	CORR/PIT	Loss of material
23	Mark I Steel Containment	Torus Interior Surface at Waterline	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
24	Mark   Steel Containment	Torus Interior Surface at Waterline	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
25	Mark   Steel Containment	Torus Interior Surface at Waterline	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
26	Mark I Steel Containment	Torus Exterior Surface, Torus Ring Girder, and Vent Lines	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
27	Mark I Steel Containment	Torus Exterior Surface, Torus Ring Girder, and Vent Lines	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
28	Mark I Steel Containment	Torus Exterior Surface, Torus Ring Girder, and Vent Lines	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
29	Mark I Steel Containment	Torus Exterior Surface, Torus Ring Girder, and Vent Lines	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
30	Mark   Steel Containment	Vent Line Bellows	Not stated	Carbon Steel, Stainless Steel	Not stated	CORR/UA	Loss of material
31	Mark I Steel Containment	Vent Line Bellows	Not stated	Carbon Steel, Stainless Steel	Not stated	FAT	Cumulative fatigu damage
32	Mark I Steel Containment	Vent Line Bellows	Not stated	Carbon Steel, Stainless Steel	Not stated	EMBR/SA	Loss of fracture toughness

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Effect of Aging on Component Fu Loss of pressure suppression.	Not stated	Not stated	progs Report Recommendations Non-significant for a component	Page No. 4-25 to 4-	
			having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4- 28	
Loss of pressure suppression.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-34 to 4- 36	2
Loss of pressure suppression.	Not stated	Periodically examined by the Exam. Category E-C under the provisions of IWE-1240 of ASME (More)	IWE-1240 of ASME Sect. XI, Subsect. IWE provides for the identification of accessible surface areas likely to experience accelerated corrosion.	4-9 to 4- 15, 5-12 to 5-14	22
Loss of pressure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-16 to 4- 22	23
Loss of pressure suppression.	Not stated	Not stated	Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4- 28	24
Loss of pressure suppression.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-34 to 4- 36	25
Loss of pressure suppression.	Not stated	Not stated	Non-significant for stainless steel components, and for components having intact protective coatings, and for components having a corrosion allowance .>=1/32 inch.	4-3 to 4-8	26
oss of pressure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-16 to 4- 22	27
oss of pressure suppression.	Not stated	Not stated	Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4- 28	28
oss of pressure suppression.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-34 to 4- 36	29
loss of pressure suppression.	Not stated	Not stated	Non-significant for stainless steel components, and for components having intact protective coatings, and for components having a corrosion allowance >= 1/32 inch.	4-3 to 4-8	30
oss of pressure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-16 to 4- 22	31
oss of pressure suppression.	Not stated	Not stated	Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4- 28	32

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NUMARC Industry Reports		

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
33	Mark I Steel Containment	Vent Line Bellows	Not stated	Carbon Steel, Stainless Steel	Not stated	CORR/SCC	Crack initiation and growth
34	Mark I Steel Containment	Vent Line Bellows	Not stated	Carbon Steel, Stainless Steel	Not stated	EMBR/IR	Loss of fracture toughness
35	Mark I Steel Containment	Vent Header	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
36	Mark I Steel Containment	Vent Header	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
37	Mark I Steel Containment	Vent Header	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
38	Mark I Steel Containment	Downcomers and Bracing	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
39	Mark I Steel Containment	Downcomers and Bracing	Not stated	Carbon Steel	Not stated	CORR/PIT	Loss of material
40	Mark I Steel Containment	Downcomers and Bracing	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
41	Mark   Steel Containment	Downcomers and Bracing	Not stated	Carbon Steel	Not stated	WEAR	Lockup
42	Mark I Steel Containment	Downcomers and Bracing	Not stated	Carbon Steel	Carbon Steel	EMBR/IR	Loss of fracture toughness
43	Mark   Steel Containment	Vent System Supports and Torus Seismic Restraints	Not stated	Carbon Steel	Carbon Steel	CORR/UA	Loss of material
44	Mark I Steel Containment	Vent System Supports and Torus Seismic Restraints	Not stated	Carbon Steel	Carbon Steel	FAT	Cumulative fatigue damage

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Effect of Aging on Component Fu Loss of pressure suppression.	Not stated	Not stated	progs Report Recommendations	Page No.	_
	NOTSIALED	NOT STATED	Non-significant for components	4-28 to 4-	:
			exposed to containment or Reactor	33	
			Building environment, or normal		1
			operational stress levels are less		1
			than the material yield strength, or a		
			fracture mechanics analysis has	}	
			established that cracks do not		
			propagate.		
oss of pressure suppression.	Not stated	Not stated	Non-significant because the	4-34 to 4-	<u>† ;</u>
					1
			maximum neutron fluence levels and	30	
			gamma doses incurred in license		
			renewal period do not exceed the		
			level at which measurable		
			degradation occurs.		
oss of pressure suppression.	Not stated	Not stated	Non-significant for stainless steel	4-3 to 4-8	T
			components, and for components		
			having intact protective coatings, and		
			for components having a corrosion	1	
			allowance >= 1/32 inch.		
oss of pressure suppression.	Not stated	ASME Sect. III	NRC recommendation: Until an	4-16 to 4-	
		fatigue analysis and	agreement is reached on the draft	22	
		Sect. XI, Subsect.	staff discussion paper on fatigue,		1
		IWE inspection	the issue is unresolved.	1	1
oss of pressure suppression.	Not stated	Not stated		4-34 to 4-	┢
	NOT STATED	Norstaled	Non-significant because the		1
			maximum neutron fluence levels and	36	
			gamma doses incurred in license	1	1
			renewal period do not exceed the		i i
			level at which measurable	1 1	l l
			degradation occurs.		1
oss of pressure suppression.	Not stated	Not stated		4 3 40 4 8	
	NOT STATED	NOUSLALEU	Non-significant for stainless steel	4-3 to 4-8	1
			components, and for components		1
			having intact protective coatings, and	(	1
			for components having a corrosion		1
			allowance >=1/32 inch.	1 1	1
oss of pressure suppression.	Not stated	Periodically	IWE-1240 of ASME Sect. XI.	4-9 to 4-	
		examined by the			í `
			Subsect. IWE provides for the	15, 5-12	l l
		Exam. Category E-C	identification of accessible surface	to 5-14	
		under the provisions	areas likely to experience		1
		of IWE-1240 of	accelerated corrosion.		1
		ASME (More)			1
oss of pressure suppression.	Not stated	ASME Sect. III	NRC recommendation: Until an	4-16 to 4-	4
		fatigue analysis and	agreement is reached on the draft	22	1
		Sect. XI, Subsect.		<u>"</u>	1
	1		staff discussion paper on fatigue,		1
		IWE inspection	the issue is unresolved.		L
oss of pressure suppression.	Not stated	Conduct inspection	Not stated	4-23, 4-	4
		and mitigation of		24, 5-18,	1
		mechanical wear in		5-19	
		accordance with		Ů.Ů	
		provisions of ASME			
		(More)			
	Alot stated				
oss of pressure suppression.	Not stated	Not stated	Non-significant because the	4-34 to 4-	4
			maximum neutron fluence levels and	36	
			gamma doses incurred in license		
			renewal period do not exceed the		
			level at which measurable		
			degradation occurs.		
oss of pressure suppression.	Not stated	Not stated		4.044.4.0	<u> </u>
si prococio suppressivit.	INUT SIGNO		Non-significant for stainless steel	4-3 to 4-8	4
	1		components, and for components		
			having intact protective coatings, and		1
			for components having a corrosion		
			allowance >= 1/32 inch.		
oss of pressure suppression.	Not stated	Non-significant	NRC recommendation: Until an	4-16 to 4-	4
		because			_ <b>^</b>
			agreement is reached on the draft	22	
		components are	staff discussion paper on fatigue,		
		designed according	the issue is unresolved.	i l	
4					
4		to ACI 318 or ASME			
÷.		Code.			

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	Mark I Steel	Vent System	Not stated	Carbon Steel	Carbon Steel	WEAR	Lockup
	Containment	Supports and Torus Seismic Restraints					
46	Mark I Steel	Vent System	Not stated	Carbon Steel	Carbon Steel	EMBR/IR	Loss of fracture
	Containment	Supports and Torus Seismic Restraints					toughness
47	Mark I Steel Containment	Torus Support Columns/ Saddles	Not stated	Carbon Steel, graphite	Not stated	CORR/UA	Loss of material
48	Mark I Steel Containment	Torus Support Columns/ Saddles	Not stated	Carbon Steel, graphite	Not stated	FAT	Cumulative fatgue damage
49	Mark I Steel Containment	Torus Support Columns/ Saddles	Not stated ,	Carbon Steel, graphite	Not stated	WEAR	Lockup
	oonaan ment			graphice	·		
50	Mark I Steel Containment	Torus Support Columns/ Saddles	Not stated	Carbon Steel, graphite	Not stated	EMBR/SA	Loss of fracture toughness
51	Mark I Steel	Torus Support	Not stated	Carbon Steel,	Not stated	EMBR/IR	Loss of fracture
	Containment	Columns/ Saddles		graphite			toughness
52	Mark I Steel Containment	ECCarbon Steel Suction Header	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
53	Mark I Steel	ECCarbon Steel	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue
	Containment	Suction Header					damage
54	Mark I Steel Containment	ECCarbon Steel Suction Header	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
55	Mark i Steel Containment	Ocean Plant with Uncoated Carbon Steel Surfaces and Uncoated Submerged Carbon Steel Surfaces	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
56	Mark I Steel Containment	Ocean Plant with Uncoated Carbon Steel Surfaces and Uncoated Submerged Carbon Steel Surfaces	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage

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Effect of Aging on Component Fu Loss of pressure suppression.	Not stated	Conduct inspection	Rel.progs Report Recommendations	Page No.	<u>. na</u>
		and mitigation of	INOT STATED	4-23, 4-	
		mechanical wear in		24, 5-18,	
		accordance with		5-19	
		provisions of ASME			1
		(More)			
Loss of pressure suppression.	Not stated	Not stated	Non-significant because the	4-34 to 4-	┢
			maximum neutron fluence levels an	4-34 10 4-	
			gamma doses incurred in license	0 30	
			renewal period do not exceed the		
			level at which measurable		
		_	degradation occurs.		1
Loss of pressure suppression.	Not stated	Not stated	Non-significant for stainless steel	4-3 to 4-8	+
			components, and for components	4-3 (0 4-8	
			having intact protective coatings, and	4	
			for components having a corrosion	٦	
			allowance >= 1/32 inch.		
oss of pressure suppression.	Not stated	Non-significant	NRC recommendation: Until an	4-16 to 4-	+-
		because	agreement is reached on the draft	22	
		components are	staff discussion paper on fatigue,	<b>–</b>	
		designed according	the issue is unresolved.	1	
		to ACI 318 or ASME		1	
oss of prospure events		Code.			1
oss of pressure suppression.	Not stated	Conduct inspection	Not stated	4-23, 4-	1
		and mitigation of		24, 5-18,	
		mechanical wear in		5-19	
		accordance with the			
		provisions of ASME		1	
oss of pressure suppression.		Sect.		1 1	
cas of pressure suppression.	Not stated	Not stated	Non-significant for a component	4-25 to 4-	
			having service stress in the elastic	28	
			region and without severely cold		
oss of pressure suppression.			working in the forming process.	1 1	
ses of pressure suppression.	Not stated	Not stated	Non-significant because the	4-34 -36	:
			maximum neutron fluence levels and		
			gamma doses incurred in license		
			renewal period do not exceed the		
			level at which measurable	1 1	
oss of pressure suppression.	Notatat		degradation occurs.		
	Not stated	The Examination	Not stated	5-9 to 5-	Ę
		Categories E-A, E-P,		11	
		& E-C of ASME			
		Sect. XI, Subsect.			
		IWE in conjunction with (More)			
oss of pressure suppression.	Not stated				
e presente cappiocoloni,	NOT STATED	Non-significant because	NRC recommendation: Until an	4-16 to 4-	5
			agreement is reached on the draft	22	
		components are designed according	staff discussion paper on fatigue,		
		to ACI 318 or ASME	the issue is unresolved.		
		Code.			
oss of pressure suppression.	Not stated	Not stated	Non cignificant ha		_
. ,,			Non-significant because the	4-34 to 4-	5
		1	maximum neutron fluence levels and	36	
			gamma doses incurred in license		
			renewal period do not exceed the	1	
		l l	level at which measurable degradation occurs.		
ss of pressure boundary, loss of	Not stated	The Examination			
essure suppression	-	Categories E-A, E-P,		5-9 to 5-	5
		& E-C of ASME		11	
		Sect. XI, Subsect.			
		IWE in conjunction			
		with (More)			
ss of pressure boundary, loss of	Not stated	Non-significant	NRC recommendation: Until an		<u> </u>
essure suppression.		because		4-16 to 4-	5
		components are	agreement is reached on the draft	22	
		designed according	staff discussion paper on fatigue,		
		to ACI 318 or ASME	the issue is unresolved.		
		Code.		[	

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em	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	Mark I Steel	Ocean Plant with	Not stated	Carbon Steel	Not stated	EMBR/SA	
	Containment	Uncoated Carbon Steel Surfaces and Uncoated Submerged Carbon					toughness
		Steel Surfaces					
58	Mark I Steel Containment	Ocean Plant with Uncoated Carbon Steel Surfaces and Uncoated	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
		Submerged Carbon					
59	Mark I Concrete Containment	Steel Surfaces Drywell Liner Interior Surface, Drywell Liner Exterior	Not stated	Carbon Steel	Not stated	CORR	Loss of material
		Surface, and Torus					
60	Mark   Concrete Containment	Liner Interior Surface Drywell Liner Interior Surface, Drywell Liner Exterior Surface, and Torus Liner Interior Surface	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
61	Mark I Concrete Containment	Drywell Liner Interior Surface, Drywell Liner Exterior Surface, and Torus Liner Interior Surface		Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
62	Mark I Concrete Containment	Torus Liner Interior Surface at Waterline	Not stated	Carbon Steel	Not stated	CORR	Loss of material
63	Mark I Concrete Containment	Torus Liner Interior Surface at Waterline	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigu damage
64	Mark I Concrete Containment	Torus Liner Interior Surface at Waterline	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
6	5 Mark I Concrete	Torus Liner Exterior	Not stated	Carbon Steel	Not stated	CORR	Loss of material
	Containment	Surface and Liner Anchors					
6	6 Mark I Concrete Containment	Torus Liner Exterior Surface and Liner Anchors	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigu damage
6	7 Mark I Concrete Containment	Torus Liner Exterior Surface and Liner Anchors	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
6	8 Mark I Concrete Containment	Drywell Concrete and Torus Concrete	Not stated e	Concrete	Not stated	LEACH	Increase of poro and permeability

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Effect of Aging on Component Functi Loss of pressure boundary, loss of	Not stated	Iure Reported progs Rel.pr Not stated		Page No. 4-25 to 4-	
pressure suppression.	NUTSIAIOU	Not stated	Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4- 28	57
Loss of pressure boundary, loss of pressure suppression.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-34 to 4- 36	58
Loss of pressure boundary/suppression.	Not stated	Not stated	Non-significant for liner plate having protective coatings on the interior surface and having the alkaline environment on the exterior surface.	4-42 to 4- 44	59
Loss of pressure boundary/suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	60
Loss of pressure boundary/suppression.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 to 4- 71	61
Loss of pressure suppression.	Not stated	Periodical exam under the provisions of IWE-1240 (Exam. Category E-C) of ASME Sect. XI, Subsect. IWE	Underwater surfaces are considered as accessible by the rules of IWE- 1240 of ASME Sect. XI.	5-23, 5-24	62
Loss of pressure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	63
Loss of pressure suppression.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 to 4- 71	64
oss of pressure suppression.	Not stated	Not stated	Non-significant for liner plate having protective coatings on the interior surface and having the alkaline environment on the exterior surface.	4-42 to 4- 44	65
Loss of pressure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	66
oss of pressure suppression.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 -71 :	67
Loss of pressure boundary, loss of pressure suppression.	Not stated	Not stated	Non-significant for components not exposed to flowing water or constructed using ACI 201.2R-77 to ensure dense, well-cured concrete with low permeability.	4-74 to 4- 77	68

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	Mark I Concrete Containment	Drywell Concrete and Torus Concrete	Not stated	Concrete	Not stated	AGR-CHEM	Increase of porosity and permeability, cracking, and spalling
70	Mark   Concrete Containment	Drywell Concrete and Torus Concrete	Not stated	Concrete	Not stated	AGREAC	Expansion and cracking
71	Mark I Concrete Containment	Drywell Concrete and Torus Concrete	Not stated	Concrete	Not stated	ELE-TEMP	Loss of strength and modulus
72	Mark I Concrete Containment	Drywell Concrete and Torus Concrete	Not stated	Concrete	Not stated	FAT	Cumulative fatigue damage
• 73	Mark I Concrete Containment	Drywell Concrete and Torus Concrete	Not stated	Concrete	Not stated	EMBR/IR	Loss of fracture toughness
74	Mark I Concrete Containment	Drywell Concrete Reinforcing Steel and Torus Concrete Reinforcing Steel	Not stated	Rebar and embedded Carbon Steel in concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, loss of material
75	Mark I Concrete Containment	Drywell Concrete Reinforcing Steel and Torus Concrete Reinforcing Steel	Not stated	Rebar and embedded Carbon Steel in concrete	Not stated	ELE-TEMP	Loss of strength and modulus
76	Mark I Concrete Containment	Drywell Concrete Reinforcing Steel and Torus Concrete Reinforcing Steel	Not stated	Rebar and embedded Carbon Steel in concrete	Not stated	FAT	Cumulative fatigue damage
77	Mark I Concrete Containment	Drywell Concrete Reinforcing Steel and Torus Concrete Reinforcing Steel	Not stated	Rebar and embedded Carbon Steel in concrete	Not stated	EMBR/IR	Loss of fracture toughness
78	Mark I Concrete Containment	Vent Lines	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material

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Loss of pressure barrent Function	Contrib to Failure	Reported progs	Del

Effect of Aging on Component Fu Loss of pressure boundary, loss of pressure suppression.	Not stated	Not stated	Rel.progs Report Recommendations	Page No.	
Loss of pressure boundary, loss of			Non-significant for components not exposed to aggressive environment (pH <5.5, chloride >500 ppm, and sulfate >1500 ppm); or exposed to aggressive groundwater for intermittent periods only.	4-56 to 4- 60	
pressure suppression.	Not stated	Not stated	Non-significant for aggregate taken from regions other than those known to cause alkali-aggregate reactions, or aggregates was tested in accordance with ASME Section III, Division 2, Class CC, ASTM C295, or ASTM C227. (See IR90-01 & 90-	4-71 to 4- 74	
Loss of pressure boundary, loss of pressure suppression.	Not stated	Not stated	and the second	4-45 to 4- 51	
Loss of pressure boundary, loss of pressure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an	4-52 to 4- 56	
oss of pressure boundary, loss of ressure suppression.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and 7 gamma doses incurred in license renewal period do not exceed the level at which measurable	1-62 to 4- 1	7
oss of pressure boundary, loss of ressure suppression.	Not stated	Not stated	structures not exposed to aggressive 4 environment (pH <11.5 or chlorides >500 ppm); or for concrete having low water-to-cement ratio (0.35-0.45) and adequate air entrainment (3-	-37 to 4- 1	7.
oss of pressure boundary, loss of essure suppression.	Not stated	Not stated	6%). Non-significant for components 4- maintained at operating 51 temperatures <66_C (150_F) and local area temperatures <93_C (200_F) or justification is provided in accordance with ACI 349-85, or ASME Sect. III, Division 2, Class CC.	45 to 4-	75
ss of pressure boundary, loss of assure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	LUDO		76
ss of pressure boundary, loss of ssure suppression.	Not stated	Not stated	Non-significant because the 4-6 maximum neutron fluence levels and 71 gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	52 to 4-	77
ss of pressure boundary, loss of ssure suppression.	Not stated	Not stated	Non airmit	to 4-8	78

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	wed by: David C System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects Cumulative fatigue
79	Mark   Concrete Containment	Vent Lines	t ated	Carbon Steel	Not stated		damage
	Mark I Concrete Containment	Vent Lines	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
81	Mark I Concrete Containment	Vent Lines	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
82	Mark I Concrete Containment	Vent Line Bellows	Not stated	Carbon Steel, Stainless Steel	Not stated	CORR/UA	Loss of material
					Not stated	FAT	Cumulative fatigu
83	Mark I Concrete Containment	Vent Line Bellows	Not stated	Carbon Steel, Stainless Steel			damage
84	Mark I Concrete Containment	Vent Line Bellows	Not stated	Carbon Steel, Stainless Steel	Not stated	EMBR/SA	Loss of fracture toughness
85	Marr Concrete Containment	Vent Line Bellows	Not stated	Carbon Steel, Stainless Steel	Not stated	CORR/SCC	Crack initiation a growth
86	6 Mark I Concrete Containment	Vent Line Bellows	Not stated	Carbon Steel, Stainless Steel	Not stated	EMBR/IR	Loss of fracture toughness
	7 Mark   Concrete	Vent Headers	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
Ū	Containment						
8	88 Mark I Concrete Containment	Vent Headers	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatig damage
8	39 Mark I Concrete Containment	Vent Headers	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
	90 Mark I Concrete Containment	Downcomers and Bracing	Not stated	Carbon Steel	Not stated	CORR/PIT	Loss of materia

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Effect of Aging on Component Func	tion Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	_
Loss of pressure boundary, loss of pressure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	79
oss of pressure boundary, loss of pressure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4- 28	8
Loss of pressure boundary, loss of pressure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 -71	8
Loss of pressure suppression.	Not stated	Not stated		Non-significant for stainless steel components, and for components having intact protective coatings, and for components having a corrosion allowance >=1/32 inch.		
Loss of pressure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	
Loss of pressure suppression.	Not stated	Not stated		Non-significant for a component having service stress in the elastic region and without severety cold working in the forming process.	4-25 to 4- 28	8
Loss of pressure suppression.	Not stated	Not stated		Non-significant for components exposed to containment or Reactor Building environment, or normal operational stress levels are less than the material yield strength, or a fracture mechanics analysis has established that cracks do not propagate.	4-28 to 4- 33	8
Loss of pressure suppression.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 to 4- 71	8
Loss of pressure suppression.	Not stated	Not stated		Non-significant for stainless steel components, and for components having intact protective coatings, and for components having a corrosion allowance >=1/32 inch.	4-3 to 4-8	3 8
Loss of pressure suppression.	Not stated	ASME Sect. III fatigue analysis and Sect. XI, Subsect. IWE inspection.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	- 8
Loss of pressure suppression.	Not stated	ASME Sect. III fatigue analysis and Sect. XI, Subsect. IWE inspection.		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 to 4- 71	
Loss of pressure suppression.	Not stated	Exam. by the Exam. Category E-C under the provisions of IWE-1240 of ASME Sect. XI, Subsect. IWE.		IWE-1240 of ASME Sect. XI, Subsect. IWE provides for the identification of accessible surface areas likely to experience accelerated corrosion.	4-9 to 4- 15 ,5-12 to 5-14	

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 Item System
 Structure/Comp
 Subcomponent
 Mater

rk I Concrete ntainment rk I Concrete ntainment k I Concrete Itainment	Downcomers and Bracing Downcomers and Bracing Downcomers and Bracing	Not stated	Carbon Steel	Not stated	FAT WEAR	ARD effects Cumulative fatigue damage Lockup
k i Concrete tainment	Bracing Downcomers and		Carbon Steel	Not stated	WEAR	Lockup
ntainment		Not stated			1	1
k I Concrete			Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
	Vent System Supports	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
k I Concrete	Vent System Supports	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatgue damage
( I Concrete	Vent System Supports	Not stated	Carbon Steel	Not stated	WEAR	Lockup
( I Concrete	Vent System Supports	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
l Concrete ainment	Drywell Head	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
: I Concrete ainment	Drywell Head	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatgue damage
I Concrete ainment	Drywell Head	Not stated	Carbon Steel	Not stated	WEAR	Lockup
I Concrete ainment	Drywell Head	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
I Concrete ainment	Drywell Head	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
	I Concrete I Concrete ainment I Concrete ainment I Concrete ainment I Concrete ainment	Supports         I Concrete       Vent System         I Concrete       Vent System         I Concrete       Drywell Head         I Concrete       Drywell Head	Supports       Not stated         I Concrete       Vent System         I Concrete       Vent System         I Concrete       Vent System         Supports       Not stated         I Concrete       Drywell Head         I Concrete       Drywell Head	Supports     Not stated     Carbon Steel       I Concrete     Vent System Supports     Not stated     Carbon Steel       I Concrete     Vent System Supports     Not stated     Carbon Steel       I Concrete     Vent System Supports     Not stated     Carbon Steel       I Concrete     Drywell Head     Not stated     Carbon Steel	Supports       Not stated       Carbon Steel       Not stated         I Concrete       Vent System       Not stated       Carbon Steel       Not stated         I Concrete       Vent System       Not stated       Carbon Steel       Not stated         I Concrete       Vent System       Not stated       Carbon Steel       Not stated         I Concrete       Drywell Head       Not stated       Carbon Steel       Not stated         I Concrete       Drywell Head       Not stated       Carbon Steel       Not stated         I Concrete       Drywell Head       Not stated       Carbon Steel       Not stated         I Concrete       Drywell Head       Not stated       Carbon Steel       Not stated         I Concrete       Drywell Head       Not stated       Carbon Steel       Not stated         I Concrete       Drywell Head       Not stated       Carbon Steel       Not stated         I Concrete       Drywell Head       Not stated       Carbon Steel       Not stated         I Concrete       Drywell Head       Not stated       Carbon Steel       Not stated	Supports     Not stated     Carbon Steel     Not stated     WEAR       I Concrete     Vent System     Not stated     Carbon Steel     Not stated     EMBR/IR       I Concrete     Vent System     Not stated     Carbon Steel     Not stated     EMBR/IR       I Concrete     Vent System     Not stated     Carbon Steel     Not stated     EMBR/IR       I Concrete     Drywell Head     Not stated     Carbon Steel     Not stated     CORR/UA       I Concrete     Drywell Head     Not stated     Carbon Steel     Not stated     CORR/UA       I Concrete     Drywell Head     Not stated     Carbon Steel     Not stated     FAT       I Concrete     Drywell Head     Not stated     Carbon Steel     Not stated     FAT       I Concrete     Drywell Head     Not stated     Carbon Steel     Not stated     WEAR       I Concrete     Drywell Head     Not stated     Carbon Steel     Not stated     EMBR/SA       I Concrete     Drywell Head     Not stated     Carbon Steel     Not stated     EMBR/SA

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Effect of Aging on Component F Loss of pressure suppression.	Not stated	ASME Sect. III	I.progs Report Recommendations NRC recommendation: Until an		<u>, i</u>
		fatigue analysis and		4-52 to 4	-
		Sect. XI, Subsect.	agreement is reached on the draft	56	
		IWE inspection.	staff discussion paper on fatigue,	1	
Loss of pressure suppression.	Not stated	Conduct inspection	the issue is unresolved.		
		and mitigation of	Not stated	4-23, 4-	
		mechanical wear in		24, 5-18,	
		accordance with		5-19	
		provisions of ASME			
		(More)			
oss of pressure suppression.	Not stated	Not stated			╇
			Non-significant because the	4-62 to 4-	
			maximum neutron fluence levels an gamma doses incurred in license	aj /1	
			renewal period do not exceed the		
			level at which measurable		
		1	degradation occurs.		
oss of pressure suppression.	Not stated	Not stated	Non-significant for stainless steel	4-3 to 4-8	┢
			components, and for components	4-3 10 4-8	E.
			having intact protective coatings, an	1	
			for components having a corrosion	9	
			allowance >=1/32 inch.		1
oss of pressure suppression.	Not stated	Non-significant	NRC recommendation: Until an	4-52 to 4-	┝
		because	agreement is reached on the draft		
	ĺ	components are	staff discussion paper on fatigue,	56	
		designed according	the issue is unresolved.	1	
	1	to ACI 318 or ASME		}	
		Code.		1	
oss of pressure suppression.	Not stated	Conduct inspection	Not stated	4-23. 4-	<u> </u>
		and mitigation of		1	
		mechanical wear in		24, 5-18, 5-19	
		accordance with		2-19	
	[	provisions of ASME			
		(More)			
oss of pressure suppression.	Not stated	Not stated	Non-significant because the	4-62-71	
			maximum neutron fluence levels and	4-02 -7 1	
			gamma doses incurred in license		
			renewal period do not exceed the		
			level at which measurable		
ss of pressure boundary.			degradation occurs.		
ss of pressure boundary.	Not stated	Not stated	Non-significant for stainless steel	4-3 to 4-8	
			components, and for components	401040	
			having intact protective coatings, and		
			for components having a corrosion		
ss of pressure boundary.			allowance >=1/32 inch.		
ss of pressure boundary.	Not stated	Non-significant	NRC recommendation: Until an	4-52 to 4-	
		because		56	
		components are	staff discussion paper on fatigue,	30	
		designed according	the issue is unresolved.		
		to ACI 318 or ASME			
ss of pressure boundary.		Code.			
ss of pressure boundary.	Not stated	Conduct inspection	Not stated	4-23, 4-	10
		and mitigation of		24, 5-18	10
		mechanical wear in		5-19	
		accordance with		5-13	
		provisions of ASME			
s of pressure boundary.		(More)			
s of pressure boundary.	Not stated	Not stated	Non-significant for a component	4-25 to 4-	10
				28	10
			region and without severely cold		
of processo hour de-			working in the forming process.	l	
s of pressure boundary.	Not stated	Not stated		4-62 to 4-	10
			maximum neutron fluence levels and 7	71	10
			gamma doses incurred n license		
	1		renewal period do not exceed the		
			level at which measurable		
			degradation occurs.		
			1	1	

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em	wed by: David System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
103	Mark II Steel Containments	Drywell Interior Surface	Not stated	Carbon Steel	Not stated	CORR/UA	
104	Mark II Steel Containments	Drywell Interior Surface	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
105	Mark II Steel Containments	Drywell Interior Surface	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
106	Mark II Steel Containments	Drywell Interior Surface	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
107	Mark II Steel Containments	Drywell Exterior Surface	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
108	Mark II Steel Containments	Drywell Exterior Surface	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
109	Mark II Steel Containments	Drywell Exterior Surface	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
110	Mark II Steel Containments	Drywell Exterior Surface	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
111	Mark II Steel Containments	Drywell Head	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
112	2 Mark II Steel Containments	Drywell Head	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
11	3 Mark II Steel Containments	Drywell Head	Not stated	Carbon Steel	Not stated	WEAR	Lockup
11	4 Mark II Steel	Drywell Head	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness

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Effect of Aging on Component F Loss of pressure boundary.			Rel.progs	Report Recommendations	Page No.	-
· · ·	Not stated	Not stated		Non-significant for stainless steel components, and for components having intact protective coatings, and for components having a corrosion allowance >=1/32 inch.		10
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-16 to 4- 22	104
Loss of pressure boundary.	Not stated	Not stated		Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4- 28	105
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred n license renewal period do not exceed the level at which measurable degradation occurs.	4-34 to 4- 36	106
Loss of pressure boundary.	Not stated	The Examination Categories E-A, E-P, & E-C of ASME Sect. XI, Subsect. IWE in conjunction with (More)		Not stated	5-9 to 5- 11	107
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	- <u> </u>	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-16 to 4- 22	108
Loss of pressure boundary.	Not stated	Not stated		Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4- 28	109
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-34 to 4- 36	110
Loss of pressure boundary.	Not stated	Not stated			4-3 to 4-8	111
oss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an	4-16 to 4- 22	112
loss of pressure boundary.	Not stated	Conduct inspection and mitigation of mechanical wear in accordance with provisions of ASME (More)			4-23, 4- 24, 5-18, 5-19	113
oss of pressure boundary.	Not stated	Conduct inspection and mitigation of mechanical wear in accordance with provisions of ASME (More)			4-25 to 4- 28	114

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
115	Mark II Steel	Drywell Head	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture
	Containments						toughness
116	Mark II Steel	Suppr. Chamber	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
	Containments	Exterior Surface					
117	Mark II Steel Containments	Suppr. Chamber Exterior Surface	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
118	Mark II Steel Containments	Suppr. Chamber Exterior Surface	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
119	Mark II Steel Containments	Suppr. Chamber Exterior Surface	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
120	Mark II Steel Containments	Suppr. Chamber Interior Surface	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
121	Mark II Steel Containments	Suppr. Chamber Interior Surface	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
122	Mark II Steel Containments	Suppr. Chamber Interior Surface	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
123	Mark II Steel Containments	Suppr. Chamber Interior Surface	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
124	Mark II Steel Containments	Suppr. Chamber Interior Surface at Waterline	Not stated	Carbon Steel	Not stated	CORR/PIT	Loss of material
125	Mark II Steel Containments	Suppr. Chamber Interior Surface at Waterline	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
	Mark II Steel Containments	Suppr. Chamber Interior Surface at Waterline	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness

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NOT STATED	and mitigation of mechanical wear in accordance with provisions of ASME	maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable		11
Not stated	The Examination Categories E-A, E-P, & E-C of ASME Sect. XI, Subsect. IWE in conjunction	Not stated	5-9 to 5- 11	11
Not stated	Non-significant because components are designed according to ACI 318 or ASME	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-16 to 4- 22	11
Not stated	Not stated	Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4- 28	111
Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable	4-34 to 4- 36	119
Not stated	Not stated	Non-significant for stainless steel components, and for components having intact protective coatings, and for components having a corrosion	4-3 to 4-8	120
Not stated	Non-significant because components are designed according to ACI 318 or ASME Code	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-16 to 4- 22	121
Not stated	Not stated	Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process	4-25 to 4- 28	122
Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable	4-34 to 4- 36	123
Not stated	Period. exam. by the Exam. Category E-C under provisions of IWE-1240 of ASME Sect. XI, Subsect. IWE.	IWE-1240 of ASME Sect. XI, Subsect. IWE provides for the identification of accessible surface areas likely to experience accelerated corrosion.	4-9 to 4- 15, 5-12 to 5-14	124
Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-16 to 4- 22	125
Not stated	Not stated	region and without severely cold	4-25 to 4- 28	126
	Not stated         Not stated	Not stated       Conduct inspection and mitigation of mechanical wear in accordance with provisions of ASME (More)         Not stated       The Examination Categories E-A, E-P. & E-C of ASME Sect. XI, Subsect. IWE in conjunction with (More)         Not stated       Non-significant because components are designed according to ACI 318 or ASME Code.         Not stated       Not stated         Not stated       Non-significant because components a	Not stated         Conduct inspection mechanical wear in accordance with provisions of ASME (More)         Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.           Not stated         The Examination Categories E-A, E-P, & E-C of ASME Sect XI, Subsect. IWE in conjunction         Not stated           Not stated         Non-significant because omponents are designed according to ACI 316 or ASME Code.         NRC recommendaton: Unbil an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.           Not stated         Not stated         Non-significant tor a component having service stress in the elastic region and without severely cold working in the forming process.           Not stated         Not stated         Non-significant tor a component having service stress in the elastic region and without severely cold working in the forming process.           Not stated         Not stated         Non-significant tor accuse the evel at which measurable degradation occurs.           Not stated         Non-significant tor stainless steel components are designed according to ACI 318 or ASME Code.         Non-significant tor stainless steel components are designed according to ACI 318 or ASME Code.           Not stated         Non-significant tor a component having area est 122 inch.           Not stated         Non-significant tor a component having area est 122 inch.           Not stated         Non-significant tor a component having area est 122 inch. <td>Not stated         Conduct inspection and migration of mechanical wear in accordance with provisions of ASME (More)         Not-significant because the maximum neutron fluence level degradation occurs.         4-36 - 36           Not stated         ASME (More)         Importance degradation occurs.         5-9 to 5- 11           Not stated         The Examination Catagories E-A, E-P, &amp; E-C of ASME Sect XI, Subsect (Wein conjunction with (More)         Not stated         5-9 to 5- 11           Not stated         Non-significant because components are designed according to AC 13 to ar ASME Code.         Non-significant for a component having service stress in the elastic region and without servery cold working in the forming process.         4-36 to 4- 22           Not stated         Not stated         Non-significant for a component having service stress in the elastic region and without servery cold working in the forming process.         4-36 to 4- 22           Not stated         Not stated         Non-significant for a component having service stress in the elastic region and without servery cold working in the forming process.         4-36 to 4- 22           Not stated         Not stated         Non-significant for statiles steel degradation occurs.         4-36 to 4- 36 components having a corrosion allowance &gt;= 172 indn.           Not stated         Non-significant because components are designed according to AC 1316 or ASME Code.         Not stated         Non-significant for a component having service stress in the elastic region and without serverely cold to AC 1316 or ASME Code.</td>	Not stated         Conduct inspection and migration of mechanical wear in accordance with provisions of ASME (More)         Not-significant because the maximum neutron fluence level degradation occurs.         4-36 - 36           Not stated         ASME (More)         Importance degradation occurs.         5-9 to 5- 11           Not stated         The Examination Catagories E-A, E-P, & E-C of ASME Sect XI, Subsect (Wein conjunction with (More)         Not stated         5-9 to 5- 11           Not stated         Non-significant because components are designed according to AC 13 to ar ASME Code.         Non-significant for a component having service stress in the elastic region and without servery cold working in the forming process.         4-36 to 4- 22           Not stated         Not stated         Non-significant for a component having service stress in the elastic region and without servery cold working in the forming process.         4-36 to 4- 22           Not stated         Not stated         Non-significant for a component having service stress in the elastic region and without servery cold working in the forming process.         4-36 to 4- 22           Not stated         Not stated         Non-significant for statiles steel degradation occurs.         4-36 to 4- 36 components having a corrosion allowance >= 172 indn.           Not stated         Non-significant because components are designed according to AC 1316 or ASME Code.         Not stated         Non-significant for a component having service stress in the elastic region and without serverely cold to AC 1316 or ASME Code.

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
127	Mark II Steel Containments	Suppr. Chamber Interior Surface at Waterline	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
128	Mark II Steel Containments	Region Shielded by Diaphragm Floor, Embedded Shell Region, Sand Pocket Region, and Support Skirt	Not stated	Carbon Steel, concrete	Not stated	CORR/PIT	Loss of material
129	Mark II Steel Containments	Region Shielded by Diaphragm Floor, Embedded Shell Region, Sand Pocket Region, and Support Skirt	Not stated	Carbon Steel, concrete	Not stated	FAT	Cumulative fatigue damage
130	Mark II Steel Containments	Region Shielded by Diaphragm Floor, Embedded Shell Region, Sand Pocket Region, and Support Skirt	Not stated	Carbon Steel, concrete	Not stated	EMBR/SA	Loss of fracture toughness
131	Mark II Steel Containments	Region Shielded by Diaphragm Floor, Embedded Shell Region, Sand Pocket Region, and Support Skirt	Not stated	Carbon Steel, concrete	Not stated	EMBR/IR	Loss of fracture toughness
132	Mark II Steel Containments	Downcomer Pipes and Bracing	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
133	Mark II Steel Containments	Downcomer Pipes and Bracing	Not stated	Carbon Steel	Not stated	CORR/PIT	Loss of material
134	Mark II Steel Containments	Downcomer Pipes and Bracing	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
135	Mark II Steel Containments	Downcomer Pipes and Bracing	Not stated	Carbon Steel	Not stated	WEAR	Lockup
136	Mark II Steel Containments	Downcomer Pipes and Bracing	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
137	Mark II Steel Containments	Ocean Plant with Uncoated Carbon Steel Surfaces and Uncoated Submerged Carbon	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
138	Mark II Steel Containments	Steel Surfaces Ocean Plant with Uncoated Carbon Steel Surfaces and Uncoated Submerged Carbon Steel Surfaces	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage

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Effect of Aging on Component Fun Loss of pressure suppression.	Not stated	Not stated	Rel.progs Report Recommendations	Page No.	_
	NOT STATED		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable	d 36	12
Loss of pressure boundary.	Not stated	Not stated	degradation occurs. A plant-specific aging program is	4-9 to 4-	12
			required to manage the local corrosion of inaccessible and/or embedded carbon steel containment components.	15, 5-12 to 5-5-14	
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-16 to 4- 22	123
Loss of pressure boundary.	Not stated	Not stated	Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4- 28	130
Loss of pressure boundary.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-34 to 4- 36	131
Loss of pressure suppression.	Not stated	Not stated	Non-significant for stainless steel components, and for components having intact protective coatings, and for components having a corrosion allowance >=1/32 inch.	4-3 to 4-8	132
Loss of pressure suppression.	Not stated	Period. exam. by the Exam. Category E-C under provisions of IWE-1240 of ASME Sect. XI, Subsect. IWE.	IWE-1240 of ASME Sect. XI, Subsect. IWE provides for the identification of accessible surface areas likely to experience accelerated corrosion.	4-9 to 4- 15, 5-12 to 5-14	133
Loss of pressure suppression.	Not stated	ASME Sect. III fatigue analysis and Sect. XI, Subsect. IWE inspection.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-16 to 4- 22	134
Loss of pressure suppression.	Not stated	Conduct inspection and mitigation of mechanical wear in accordance with provisions of ASME (More)	Not stated	4-23, 4- 24, 5-18, 5- 19	135
Loss of pressure suppression.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-34 to 4- 36	136
Loss of pressure boundary, loss of pressure suppression.	Not stated	The Examination Categories E-A, E-P, & E-C of ASME Sect. XI, Subsect. IWE in conjunction with (More)	Not stated	5-9 to 5- 11	137
oss of pressure boundary, loss of pressure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-16 to 4- 22	138

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
139	Mark II Steel Containments	Ocean Plant with Uncoated Carbon Steel Surfaces and Uncoated Submerged Carbon Steel Surfaces	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
140	Mark II Steel Containments	Ocean Plant with Uncoated Carbon Steel Surfaces and Uncoated Submerged Carbon Steel Surfaces	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
141	Mark II Concrete Containments	Drywell Linear Interior Surface and Drywell Linear Exterior Surface	Not stated	Carbon Steel	Not stated	CORR	Loss of material
142	Mark II Concrete Containments	Drywell Linear Interior Surface and Drywell Linear Exterior Surface	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
143	Mark II Concrete Containments	Drywell Linear Interior Surface and Drywell Linear Exterior Surface	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
144	Mark II Concrete Containments	Suppr. Chamber Liner Interior Surface	Not stated	Carbon Steel or Stainless Steel	Not stated	CORR	Loss of material
145	Mark II Concrete Containments	Suppr. Chamber Liner Interior Surface	Not stated	Carbon Steel or Stainless Steel	Not stated	FAT	Cumulative fatigue damage
146	Mark II Concrete Containments	Suppr. Chamber Liner Interior Surface	Not stated	Carbon Steel or Stainless Steel	Not stated	CORR/SCC	Crack initiation and growth
147	Mark II Concrete Containments	Suppr. Chamber Liner Interior Surface	Not stated	Carbon Steel or Stainless Steel	Not stated	EMBR/IR	Loss of fracture toughness
148	Mark II Concrete Containments	Suppr. Chamber Liner Interior Surface at Waterline	Not stated	Carbon Steel	Not stated	CORR	Loss of material
149	Mark II Concrete Containments	Suppr. Chamber Liner Interior Surface at Waterline	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
150	Mark II Concrete Containments	Suppr. Chamber Liner Interior Surface at Waterline	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness

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Effect of Aging on Component Fund Loss of pressure boundary, loss of	Not stated	Not stated	rogs Report Recommendations Non-significant for a component	Page No. 4-25 to 4-	13
pressure suppression.			having service stress in the elastic region and without severely cold working in the forming process.	28	
Loss of pressure boundary, loss of pressure suppression.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-34 to 4- 36	14
Loss of pressure boundary, loss of pressure suppression.	Not stated	Not stated	Non-significant for liner plate having protective coatings on the interior surface and having the alkaline environment on the exterior surface.	4-42 to 4- 44	14
Loss of pressure boundary, loss of pressure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on tatigue, the issue is unresolved.	4-52 to 4- 56	142
Loss of pressure boundary, loss of pressure suppression.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 to 4- 71	14:
Loss of pressure suppression.	Not stated	Not stated	Non-significant for liner plate having protective coatings on the interior surface and having the alkaline environment on the exterior surface.	4-42 to 4- 44	144
Loss of pressure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	145
Loss of pressure suppression.	Not stated	Detection of liner leakage through 10CFR50, Appendix J integrated leak rate test to ensure (More)	Not stated	5-20, 5-21	146
Loss of pressure suppression.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 to 4- 71	147
Loss of pressure suppression.	Not stated	Period. exam. under the provisions of IWE-1240 (Exam. Category E-C) of ASME Sect. XI, Subsect. IWE.	Underwater surfaces are considered as accessible by the rules of IWE- 1240 of ASME Sect. XI.	5-23, 5-24	148
Loss of pressure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	149
Loss of pressure suppression.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 to 4- 71	150

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 System
 Structure/Comp
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	System	Structure/Comp	Subcomponent	Materials	Monufactures		
-	1 Mark II Concrete Containments	Suppr. Chamber Liner Exterior Surface	Not stated	Carbon Steel or Stainless Steel	Manufacturer Not stated	ARD mechanis FAT	m ARD effects Cumulative fatigue damage
15	2 Mark II Concrete Containments	Suppr. Chamber Liner Exterior Surface	Not stated	Carbon Steel or Stainless Steel	Not stated	EMBR/IR	Loss of fracture toughness
153	Mark II Concrete Containments	Liner Anchors	Not stated	Carbon Steel	Not stated	CORR	Loss of material
154	Mark II Concrete Containments	Liner Anchors	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
155	Mark II Concrete Containments	Liner Anchors	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
	Mark II Concrete Containments	Linear Region Shielded by Diaphragm Floor	Not stated	Carbon Sileel	Not stated	CORR	Loss of material
157	Mark II Concrete Containments	Linear Region Shielded by Diaphragm Floor	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
158	Mark II Concrete Containments	Linear Region Shielded by Diaphragm Floor	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
159	Mark II Concrete Containments	Containment Concrete	Not stated	Concrete	Not stated	LEACH	Increase of porosity and permeability
160	Mark II Concrete Containments	Containment Concrete	Not stated	Concrete	Not stated	AGREAC	Expansion and cracking
161	Mark II Concrete Containments	Containment Concrete	Not stated	Concrete	Not stated	ELE-TEMP	Loss of strength and modulus
	Mark II Concrete Containments	Containment Concrete	Not stated	Concrete	Not stated	RELAX	Reduction of design margin

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Effect of Aging on Component Fun Loss of pressure suppression.	Not stated	Non-significant	Rel.progs Report Recommendations NRC recommendation: Until an	Page No.	_
Loss of prossure events		because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	1
Loss of pressure suppression. Loss of pressure boundary, loss of	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.		1
pressure suppression.		Not stated	Non-significant for liner plate having protective coatings on the interior surface and having the alkaline environment on the exterior surface.	4-42 to 4- 44	1!
pressure suppression.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	15
Loss of pressure boundary, loss of pressure suppression.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 to 4- 71	15
oss of pressure boundary.	Not stated	Not stated	Plant-specific management program is required for management corrosion in the inaccessible areas.	5-24	15
oss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	15
oss of pressure boundary.	Not stated	Not stated	maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable	4-62 to 4- 71	15
oss of pressure boundary.	Not stated	Not stated		4-74 to 4- 77	159
oss of pressure boundary.	Not stated	Not stated	Non-significant for components constructed from aggregate taken from regions other than those known to cause alkali-aggregate reactions, or aggregates was tested in accordance with ASME Section III, Division ASTM C227.(See IR90-01	4-71 to 4- 74	160
ss of pressure boundary.	Not stated	Not stated		1-45 to 4- 51	161
ss of pressure boundary.	Not stated	Monitoring of pre- stressing losses in accordance with the tendon lift-off test provisions of RG 1.35	Not stated 4	-79 to 4- 1, 5-25	162

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em 🗄	wed by: David C System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects Cumulative fatigue
63	Mark II Concrete Containments	Containment Concrete	Not stated	Concrete	Not stated	FAT	cumulative fatigue damage
	Mark II Concrete Containments	Containment Concrete	Not stated	Concrete	Not stated	EMBR/IR	Loss of fracture toughness
165	Mark II Concrete Containments	Concrete Containment Reinforcing Steel	Not stated	Rebar and embedded Carbon Steel in concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, loss of material
66	Mark II Concrete Containments	Concrete Containment Reinforcing Steel	Not stated	Rebar and embedded Carbon Steel in concrete	Not stated	ELE-TEMP	Loss of strength and modulus
167	Mark II Concrete Containments	Concrete Containment Reinforcing Steel	Not stated	Rebar and embedded Carbon Steel in concrete	Not stated	FAT	Cumulative fatigue damage
168	Mark II Concrete Containments	Concrete Containment Reinforcing Steel	Not stated	Rebar and embedded Carbon Steel in concrete	Not stated	EMBR/IR	Loss of fracture toughness
169	Mark II Concrete Containments	Drywell Head	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
170	Mark II Concrete Containments	Drywell Head	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
171	Mark II Concrete Containments	Drywell Head	Not stated	Carbon Steel	Not stated	WEAR	Lockup
17:	2 Mark II Concrete Containments	Drywell Head	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
17	3 Mark II Concrete Containments	Drywell Head	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness

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Effect of Aging on Component F Loss of pressure boundary	Not stated	Non-significant	ogs Report Recommendations NRC recommendation: Until an	4-52 to 4-	1 16
Loss of pressure boundary.	NOT Stated	because components are designed according	NHC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	16
		to ACI 318 or ASME Code.			
Loss of pressure boundary.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 to 4- 71	16
Loss of pressure boundary.	Not stated	Not stated	Non-significant for concrete structures not exposed to aggressive environment (pH <11.5 or chlorides >500 ppm); or for concrete having low water-to-cement ratio (0.35-0.45) and adequate air entrainment (3- 6%).		16
Loss of pressure boundary.	Not stated	Not stated	Non-significant for components maintained at operating temperatures <66_C (150_F) and local area temperatures <93_C (200_F) or justification is provided in accordance with ACI 349-85, or ASME Sect. III, Division 2, Class CC,	4-45 to 4- 51	166
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	167
oss of pressure boundary.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	<b>4-62 to 4-</b> 71	168
oss of pressure boundary.	Not stated	Not stated	Non-significant for stainless steel components, and for components having intact protective coatings, and for components having a corrosion allowance >=1/32 inch.	4-3 to 4-8	169
loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.	NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	170
Loss of pressure boundary.	Not stated	Conduct inspection and mitigation of mechanical wear in accordance with provisions of ASME (More)	Not stated	4-23, 4- 24, 5-18, 5-19	171
Loss of pressure boundary.	Not stated	Not stated	Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4- 28	172
oss of pressure boundary.	Not stated	Not stated	Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 to 4- 71	173

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	Mark II Concrete	Downcomer Pipes	Not stated	Carbon Steel	Not stated	CORR/PIT	Loss of material
	Containments	and Bracing			, lot ballou		Loss of malenal
						1	
ļ							
175	Mark II Concrete	Downcomer Pipes	Not stated	Carbon Steel	Not stated	FAT	
	Containments	and Bracing	NOTSTATED	Carbon Steel	NOTSTATED		Cumulative fatigue damage
							Garnage
176	Mark II Concrete	Downcomer Pipes	Not stated	Carbon Steel	Not stated	WEAR	Lockup
	Containments	and Bracing					
				·			
		_					
77	Mark II Concrete	Downcomer Pipes	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture
	Containments	and Bracing					toughness
78	Mark II Concrete	Concrete Basemat	Not stated	Concrete	Not stated	LEACH	Increase of porosity
	Containments						and permeability
79	Mark II Concrete	Concrete Basemat	Not stated	Concrete	Not stated	AGR-CHEM	Increase of porosity
	Containments				Not Stated		and permeability
							cracking, and
							spalling
_				<u> </u>			
во	Mark II Concrete Containments	Concrete Basemat	Not stated	Concrete	Not stated	AGREAC	Expansion and
	Containments						cracking
91	Mark II Concrete	Concrete Basemat	Not stated	Concrete	Not stated	ELE-TEMP	Loss of strength and
"	Containments	Concrete Dasernat	NOT STATED	Concrete	NOLSTATED		modulus
							Inculus
						1	
82	Mark II Concrete	Concrete Basemat	Not stated	Concrete	Not stated	FAT	Cumulative fatgue
	Containments						damage
					1		1
83	Mark II Concrete	Concrete Basemat	Not stated	Concrete	Not stated	SETTLE	Cracking, distortion,
	Containments						increase in
							component stress
		1					level
							1
84	Mark II Concrete	Concrete Basemat	Not stated	Concrete	Not stated	EMBR/IR	Loss of fracture
	Containments						toughness
			}				
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Effect of Aging	On Component Europian Contrib to Eather Described

Loss of pressure suppression.	Not stated	Period even hutha I	BALE 1040 ALAONAE OF A MA	1.0.	Iten
		Period. exam. by the	IWE-1240 of ASME Sect. XI,	4-9 to 4-	17
		Exam. Category E-C	Subsect. IWE provides for the	15, 5-12	
		under provisions of	identification of accessible surface	to 5-14	
		IWE-1240 of ASME	areas likely to experience		
		Sect. XI, Subsect.	accelerated corrosion.		
		IWE.			
Loss of pressure suppression.	Not stated	ASME Sect. III	NRC recommendation: Until an	4-52 to 4-	17
		fatigue analysis and	agreement is reached on the draft	56	1
		Sect. XI, Subsect.	staff discussion paper on fatigue.	120	
		IWE inspection.	the issue is unresolved.		
Loss of pressure suppression.	Not stated	Conduct inspection		1.00.1	
		and mitigation of	Not stated	4-23, 4-	17
	1			24, 5-18,	
		mechanical wear in		5-19	
		accordance with			
		provisions of ASME			
		(More)			
oss of pressure suppression.	Not stated	Not stated	Non-significant because the	4-62-71	17
			maximum neutron fluence levels and		
			gamma doses incurred in license		
			1-		
	1		renewal period do not exceed the		
			level at which measurable		
oss of pressure boundary.	Not stated	Not stated	degradation occurs.		
er presente boundary.	INOL STALED	Not stated	Non-significant for components not	4-74 10 4	170
			exposed to flowing water or	77	
	1		constructed using ACI 201.2R-77 to	<b>j</b> (	
		] [	ensure dense, well-cured concrete	[ ]	
· · · · · · · · · · · · · · · · · · ·			with low permeability.		
oss of pressure boundary.	Not stated	Not stated	Management for the effects of	5-21, 5-22	
				5-21. 5-24	179
			aggressive chemical of concrete		
			surfaces that are not periodically		
			examined due to inaccessibility		
			requires plant-specific program.		
oss of pressure boundary.	Not stated	Not stated	Non-significant for components	4-71 to 4-	180
			constructed from aggregate taken	74	
			from regions other than those known		
			to cause alkali-aggregate reactions,		
			or aggregates was tested in		
	1		accordance with ASME Section III,		
			Division ASTM C227.(See IR90-01		
oss of pressure boundary.	-		& 90-06)		
oss of pressure boundary.	Not stated	Not stated	Non-significant for components	4-45 to 4-	181
			maintained at operating	51	
			temperatures <66_C (150_F) and	-	
			local area temperatures <93_C		
			(200_F) or justification is provided in	(	
			accordance with ACI 349-85, or		
			ASME Sect. III, Division 2, Class CC.		
oss of pressure boundary.	Not stated	Non-significant			
· · · · · · · · · · · · · · · · · · ·			NRC recommendation: Until an	4-52 to 4-	182
		because	agreement is reached on the draft	56	
		components are	staff discussion paper on fatigue,		
		designed according	the issue is unresolved.		
		to ACI 318 or ASME			
		Code.			
oss of pressure boundary.	Not stated	Plant settlement	For BWR containments bearing on	4.074-	
			FOI BYVE containments bearing on	4-87 to 4-	183
		monitoring program	soil or piles, current plant settlement	89, 5-28,	
			monitoring program is required to	5-29	
	1		ensure that the differential		
			settlement does not exceed the		
			design criteria throughout the license		
			renewal term.(See IR90-01 & 90-06)		
	Not stated	Not stated		4-62 to 4-	184
oss of pressure boundary.			maximum neutron fluence levels and	71	
oss of pressure boundary.		1 1	gamma doses incurred in license		
oss of pressure boundary.	1		renewal period do not exceed the		
uss of pressure boundary.			URUBAWAI DECICI DO DOT AVODACI THA		
oss of pressure boundary.				. 1	1
uss of pressure boundary.			level at which measurable		
uss of pressure boundary.					
ss of pressure boundary.			level at which measurable		
oss of pressure boundary.			level at which measurable		

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Document: IR 1	90-10, BWR Reactor Containm	ent Structures Industry	Report
Reviewed by:	David C. Ma, ANL		
Item Sustem	Structure/Comp	Subcomponent	Mater

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
185	Mark II Concrete	Basemat Liner	Not stated	Carbon Steel	Not stated	CORR	Loss of material
	Containments						
86	Mark II Concrete	Basemat Liner	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
	Containments						Camage
87	Mark II Concrete	Basemat Liner	Not stated	Carbon Steel	Not stated	EMBR/IB	Loss of fracture
	Containments						toughness
88	Mark II Concrete	Basemat Reinforcing	Not stated	Rebar and	Not stated	CORR/RE	Cracking, spalling,
	Containments	Steel		embedded carbon steel in concrete			loss of bond, loss of (more)
89	Mark II Concrete	Basemat Reinforcing	Not stated	Rebar and	Not stated	AGR-CHEM	Increase of porosity
	Containments	Steel		embedded carbon steel in concrete			and permeability, cracking, and spalling
90	Mark II Concrete	Basemat Reinforcing	Not stated	Rebar and	Not stated	ELE-TEMP	Loss of strength and
	Containments	Steel		embedded carbon stæel in concrete			modulus
91	Mark II Concrete Containments	Basemat Reinforcing Steel	Not stated	Rebar and embedded carbon steel in concrete	Not stated	FAT	Cumulative fatigue damage
192	Mark II Concrete Containments	Basemat Reinforcing Steel	Not stated	Rebar and embedded carbon	Not stated	EMBR/IR	Loss of fracture toughness
				steel in concrete			
193	Mark II Concrete Containments	Prestressing Tendons and Ducts	Not stated	Carbon Steel, concrete	Not stated	CORR	Loss of material
				Carbon Steel,	Not stated	FAT	Cumulative fatigue
194	Mark II Concrete Containments	Prestressing Tendons and Ducts	Not stated	concrete	NUCSIAIBU		damage
105	Mark II Concrete	Prestressing	Not stated	Carbon Steel,	Not stated	ELE-TEMP	Loss of strength an
130	Containments	Tendons and Ducts		concrete			modulus
196	Mark II Concrete Containments	Prestressing Tendons and Ducts	Not stated	Carbon Steel, concrete	Not stated	RELAX	Reduction of design margin
197	Mark II Concrete Containments	Prestressing Tendons and Ducts	Not stated	Carbon Steel, concrete	Not stated	EMBR/IR	Loss of fracture toughness

Document: IR 90	-10, BWR Reactor Containment Structures Industry Report
	David C. Ma, ANL
Effect of Aging a	Component Europian Contrib to Follow Departed

Effect of Aging on Component F Loss of pressure boundary	Not stated	Not stated	Rel.progs	Report Recommendations Non-significant for liner plate having	Page No. 4-42 to 4-	
				protective coatings on the interior surface and having the alkaline environment on the exterior surface.	44	
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	18
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 to 4- 71	187
Loss of pressure boundary.	Not stated	Not stated		Plant-specific program is required for management of inaccessible areas.(See IR90-01 & 90-06)	5-21, 5-22	188
Loss of pressure boundary.	Not stated	Not stated		Management for the effects of aggressive chemical of concrete surfaces that are not periodically examined due to inaccessibility requires plant-specific program.	5-21, 5-22	189
Loss of pressure boundary.	Not stated	Not stated		Non-significant for components maintained at operating temperatures <66_C (150_F) and local area temperatures <93_C (200_F) or justification is provided in accordance with ACI 349-85, or ASME Sect. III, Division 2, Class CC.	4-45 to 4- 51	190
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	191
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 to 4- 71	192
Loss of pressure boundary.	Not stated	Examined in accordance with the provisions of RG 1.35.		Corrosion of prestressed tendons can be managed by periodic visual examination of the tendon anchor heads and corrosion protection medium to ensure absence of corrosive fluids as prescribed in RG 1.35.	5-26 to 5- 28	193
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	194
oss of pressure boundary.	Not stated	Not stated		Non- significant because temperatures are <60 deg C (<140 deg F).	4-84 -86	195
oss of pressure boundary.	Not stated	Monitoring of pre- stressing losses in accordance with the tendon lift-off test provisions of RG 1.35		Not stated	4-79 to 4- 81, <del>5</del> -25	196
oss of pressure boundary.	Not stated	Not stated		Non-significant because cumulative radiation exposure is <4x10^19 n/cm^2 which has been shown to produce negligible degradation.	4-86, 4-87	197

#### Table B.1

1 G	all Report for NUMARC Industry Reports
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System	Structure/Comp	Subcomponen		Manufacturer	ARD mechanism	
Mark III Steel Containments	Containment Shell Interior Surface and Containment Shell Exterior Surface	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
Mark III Steel Containments	Containment Shell Interior Surface and Containment Shell Exterior Surface	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
Mark III Steel Containments	Containment Shell Interior Surface and Containment Shell Exterior Surface	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
Mark III Steel Containments	Containment Shell Interior Surface and Containment Shell Exterior Surface	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
Mark III Steel Containments	Suppr. Chamber Shell Interior Surface	Not stated	Carbon Steel, Stainless Steel	Not stated	CORR/UA	Loss of material
Mark III Steel Containments	Suppr. Chamber Shell Interior Surface	Not stated	Carbon Steel, Stainless Steel	Not stated	FAT	Cumulative fatigue damage
Mark III Steel Containments	Suppr. Chamber Shell Interior Surface	Not stated	Carbon Steel, Stainless Steel	Not stated	EMBR/SA	Loss of fracture toughness
Mark III Steel Containments	Suppr. Chamber Shell Interior Surface	Not stated	Carbon Steel, Stainless Steel	Not stated	CORR/SCC	Crack initiation and growth
Mark III Steel Containments	Not stated	Not stated	Carbon Steel, Stainless Steel	Not stated	EMBR/IR	Loss of fracture toughness
Mark III Steel Containments	Suppr. Chamber Shell Exterior Surface	Not stated	Carbon Steel, Stainless Steel	Not stated	CORR/UA	Loss of material
Mark III Steel Containments	Suppr. Chamber Shell Exterior Surface	Not stated	Carbon Steel, Stainless Steel	Not stated	FAT	Cumulative fatigue damage
Mark III Steel Containments	Suppr. Chamber Shell Exterior	Not stated	Carbon Steel, Stainless Steel	Not stated	EMBR/SA	Loss of fracture toughness
	Mark III Steel Containments Mark III Steel Containments	ContainmentsInterior Surface and Containment Shell Exterior SurfaceMark III Steel ContainmentsContainment Shell Interior Surface and Containment Shell Exterior Surface and Containment Shell Interior Surface and Containment Shell Exterior Surface and Containment Shell Interior Surface and Containment Shell Interior Surface and Containment Shell Exterior Surface and Containment Shell Interior Surface and Containment Shell Exterior SurfaceMark III Steel ContainmentsContainment Shell Interior SurfaceMark III Steel ContainmentsSuppr. Chamber Shell Interior SurfaceMark III Steel ContainmentsSuppr. Chamber Shell Exterior SurfaceMark III Steel ContainmentsSuppr. Chamber Shell Exterior SurfaceMark III Steel ContainmentsSuppr. Chamber Shell Exterior Surface	ContainmentsInterior Surface and Containment Shell Exterior Surface and ContainmentsNot statedMark III Steel ContainmentsContainment Shell Interior Surface and Containment Shell Exterior Surface and Containment Shell Interior Surface and Containment Shell Exterior Surface and Containment Shell Exterior Surface and Containment Shell Interior Surface and Containment Shell Exterior Surface and Containment Shell Exterior Surface and Containment Shell Exterior SurfaceNot statedMark III Steel ContainmentsSuppr. Chamber Shell Interior SurfaceNot statedMark III Steel ContainmentsSuppr. Chamber Shell Exterior SurfaceNot stated	ContainmentsInterior Surface and Containment Shell Exterior SurfaceNot statedCarbon SteelMark III Steel ContainmentsContainment Shell Interior Surface and Containment Shell Exterior SurfaceNot statedCarbon SteelMark III Steel ContainmentsContainment Shell Interior Surface and Containment Shell Exterior Surface and Containment Shell Exterior Surface and Containment Shell Exterior SurfaceNot statedCarbon SteelMark III Steel ContainmentsContainment Shell Exterior SurfaceNot statedCarbon SteelMark III Steel ContainmentsSuppr. Chamber Shell Interior SurfaceNot statedCarbon SteelMark III Steel ContainmentsSuppr. Chamber Shell Interior SurfaceNot statedCarbon Steel, Stainless SteelMark III Steel ContainmentsNot statedNot statedCarbon Steel, Stainless SteelMark III Steel ContainmentsNot statedCarbon Steel, Stainless SteelMark III Steel ContainmentsSuppr. Chamber Shell Exterior SurfaceNot statedCarbon Steel, Stainless SteelMark III Steel ContainmentsSuppr. Chamber Shell Exterior SurfaceNot stated<	Containments       Interior Surface and Containment Shell       Not stated       Carbon Steel       Not stated         Mark III Steel       Containment Shell Interior Surface and Containment Shell       Not stated       Carbon Steel       Not stated         Mark III Steel       Containment Shell Interior Surface and Containment Shell       Not stated       Carbon Steel       Not stated         Mark III Steel       Containment Shell Interior Surface and Containment Shell       Not stated       Carbon Steel       Not stated         Mark III Steel       Containment Shell Interior Surface and Containments       Not stated       Carbon Steel       Not stated         Mark III Steel       Containment Shell Interior Surface       Not stated       Carbon Steel       Not stated         Mark III Steel       Suppr. Chamber Shell Interior Surface       Not stated       Carbon Steel       Not stated         Mark III Steel       Suppr. Chamber Shell Interior Surface       Not stated       Carbon Steel       Not stated         Mark III Steel       Suppr. Chamber Shell Interior Surface       Not stated       Carbon Steel       Not stated         Mark III Steel       Suppr. Chamber Shell Interior Surface       Not stated       Carbon Steel       Not stated         Mark III Steel       Suppr. Chamber Shell Interior Surface       Not stated       Carbon Steel	Containments       Interior Surface and Containment Shell Exterior Surface and Containment Shell       Not stated       Carbon Steel       Not stated       FAT         Mark III Steel       Containment Shell Exterior Surface and Containment Shell       Not stated       Carbon Steel       Not stated       EMBR/SA         Mark III Steel       Containment Shell Exterior Surface and Containment Shell       Not stated       Carbon Steel       Not stated       EMBR/SA         Mark III Steel       Containment Shell Exterior Surface and Containment Shell       Not stated       Carbon Steel       Not stated       EMBR/SA         Mark III Steel       Containment Shell Exterior Surface       Not stated       Carbon Steel       Not stated       EMBR/R         Mark III Steel       Suppr. Chamber Shell Interior Surface       Not stated       Carbon Steel       Not stated       CORR/UA         Mark III Steel       Suppr. Chamber Shell Interior Surface       Not stated       Stanless Steel       Not stated       FAT         Mark III Steel       Suppr. Chamber Shell Interior Surface       Not stated       Carbon Steel, Stanless Steel       Not stated       EMBR/SA         Mark III Steel       Suppr. Chamber Shell Interior Surface       Not stated       Carbon Steel, Stanless Steel       Not stated       CORR/VA         Mark III Steel       Suppr. Chamber Shell In

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Not stated				
	Not stated	Non-significant for stainless steel	4-3 to 4-8	19
		components, and for components	1	1
		having intact protective coatings, and	9	
				1
Not stated	Non-significant		4 10 10 4	19
	-			1 19
		-	~~~	
			1	
	Code.			
Not stated	Not stated	Non-significant for a component	4-25 to 4-	20
Not stated	Not stated	Non-significant because the	4-34 to 4-	20
		maximum neutron fluence levels and	36	
		gamma doses incurred in license		1
		renewal period do not exceed the		
		level at which measurable		
		degradation occurs.		
Not stated	Not stated	Non-significant for stainless steel	4-3 to 4-8	202
		components, and for components		
1				
Black interest of				
NOT STATED			4-16 to 4-	203
		agreement is reached on the draft	22	
		the issue is unresolved.		
Not stated				
NOT STATED	Not stated			204
			28	
Not stated	Not stated			
NOT Stated	NOT STATED			205
		exposed to containment or Reactor	33	
		then the motorial vield are ress		
		fracture mechanics applying her		
			1	
Not stated	Not stated		4-34 to 4-	206
				200
			30	
			F	
			1	
		degradation occurs.		
Not stated	Not stated	Non-significant for stainless steel	4-3 to 4-8	207
		having intact protective coatings, and		
	i i	for components having a corrosion		
		allowance >=1/32 inch.		
Not stated	Non-significant	NRC recommendation: Until an	4-16 to 4-	208
		agreement is reached on the draft	22	
	1 · ·	staff discussion paper on fatigue,		
		the issue is unresolved.		
			1	{
Not atata -				
INOT STATED	NOT STATED		4-25 -28	209
	1	having service stress in the elastic		
		region and without severely cold		1
		working in the forming process.		- 1
		working in the forming process.		
		working in the forming process.		
		working in the forming process.		
	Not stated         Not stated	Not stated       Not stated         Not stated       N	Not stated         Non-significant because components are designed according to AC1318 or ASME Code.         NRC recommendation: Unbit an agreement is reached on the draft staff discussion paper on tabgue.           Not stated         Not stated         Non-significant for a component having service stress in the elastic region and without severely cold working in the formula process.           Not stated         Not stated         Non-significant because the ever at which measurable degradation occurs.           Not stated         Not stated         Non-significant to ratiness steel components and for components having service stress in the elastic region and without severely cold working in the formula process.           Not stated         Not stated         Non-significant for stainless steel components, and for components having a corrosion allowance >= 1/32 inch.           Not stated         Non-significant because components are designed according to AC1318 or ASME Code.         Non-significant for stainless steel components are designed according to AC1318 or ASME Code.           Not stated         Not stated         Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.           Not stated         Not stated         Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.           Not stated         Not stated         Non-significant for a component having service stress in the elastic           Not stated         Not stated <td>for components having a corrosion allowance &gt; 1/2 inch.         4-16 to 4- 22           Not stated         Non-significant because components are designed according to ACI 318 or ASME Code         Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.         4-25 to 4- 28           Not stated         Not stated         Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.         4-34 to 4- maximum neutron fluence levels and gamma does incurred in license renewal period do not exceed the level at which masurability and a does incurred in license renewal period do not exceed the level at which masurability and a does incurred in license renewal period do not exceed the level at which masurability and a does incurred in license renewal period do not exceed the level at which masurability and a does incurred in license renewal period do not exceed the level at which masurability and a does incurred in license renewal period do not exceed the level at which masurability and does and a does incurred in license renewal period do not exceed the level at which severely cold working in the forming process.         4-31 to 4-8 22           Not stated         Non-significant because components are designed according to ACI 318 or ASME Code.         Non-significant for a component having infact for a component at a does incurred in license treewal period do not acceed the level at which measurabile degradation occurs.         4-28 to 4- 28 4-34 to 4- 33           Not stated         Non-significant for components and according to ACI 318 or ASME code.         Non-significant for a components having infact protective coatings, a</td>	for components having a corrosion allowance > 1/2 inch.         4-16 to 4- 22           Not stated         Non-significant because components are designed according to ACI 318 or ASME Code         Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.         4-25 to 4- 28           Not stated         Not stated         Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.         4-34 to 4- maximum neutron fluence levels and gamma does incurred in license renewal period do not exceed the level at which masurability and a does incurred in license renewal period do not exceed the level at which masurability and a does incurred in license renewal period do not exceed the level at which masurability and a does incurred in license renewal period do not exceed the level at which masurability and a does incurred in license renewal period do not exceed the level at which masurability and a does incurred in license renewal period do not exceed the level at which masurability and does and a does incurred in license renewal period do not exceed the level at which severely cold working in the forming process.         4-31 to 4-8 22           Not stated         Non-significant because components are designed according to ACI 318 or ASME Code.         Non-significant for a component having infact for a component at a does incurred in license treewal period do not acceed the level at which measurabile degradation occurs.         4-28 to 4- 28 4-34 to 4- 33           Not stated         Non-significant for components and according to ACI 318 or ASME code.         Non-significant for a components having infact protective coatings, a

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
210	Mark III Steel Containments	Suppr. Chamber Shell Exterior Surface	Not stated	Carbon Steel, Stainless Steel	Not stated	EMBR/IR	Loss of fracture toughness
211	Mark III Steel Containments	Basemat Liner	Not stated	Stainless Steel	Not stated	CORR/UA	Loss of material
212	Mark III Steel Containments	Basemat Liner	Not stated	Stainless Steel	Not stated	FAT	Cumulative fatigue damage
213	Mark III Steel Containments	Basemat Liner	Not stated	Stainless Steel	Not stated	EMBR/IR	Loss of fracture toughness
214	Mark III Steel Containments	Liner Anchors	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatgue damage
215	Mark III Steel Containments	Liner Anchors	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
216	Mark III Steel Containments	Concrete Basemat	Not stated	Concrete	Not stated	LEACH	Increase of porosity and permeability
217	Mark III Steel Containments	Concrete Basemat	Not stated	Concrete	Not stated	AGR-CHEM	Increase of porosit and permeability, cracking, and spalling
218	Mark III Steel Containments	Concrete Basemat	Not stated	Concrete	Not stated	AGREAC	Expansion and cracking
219	Mark III Steel Containments	Concrete Basemat	Not stated	Concrete	Not stated	ELE-TEMP	Loss of strength ar modulus
220	Mark III Steel	Concrete Basemat	Not stated	Concrete	Not stated	FAT	Cumulative fatigue
	Containments						damage

Document: IR 90-10, BWR Reactor Containment Structures Industry Report Reviewed by: David C. Ma, ANL Effect of Aging on Component Europian Contribute Failure Depart

Effect of Aging on Component Fi	Not stated	Ilure Reported progs Rel.pr		Page No.	_
	INOL STATED	NOT STATED	Non-significant because the	4-34 -36	21
			maximum neutron fluence levels and		
			gamma doses incurred in license		
			renewal period do not exceed the		
			level at which measurable	ļ	1
Loss of pressure boundary.			degradation occurs.	ł	
Loss of pressure boundary.	Not stated	Not stated	Non-significant for stainless steel	4-3 to 4-8	21
			components, and for components		
			having intact protective coatings, and	1	
			for components having a corrosion		
	1		allowance >=1/32 inch.	1	
Loss of pressure boundary.	Not stated	Non-significant	NRC recommendation: Until an	4-16 to 4-	
		because			21
		components are	agreement is reached on the draft	22	
			staff discussion paper on fatigue,	1	
		designed according	the issue is unresolved.		
		to ACI 318 or ASME			
		Code.			
oss of pressure boundary.	Not stated	Not stated	Non-significant because the	4-34 to 4-	213
			maximum neutron fluence levels and		'`
	1			30	
			gamma doses incurred in license	1	1
			renewal period do not exceed the		
		1	level at which measurable		
oss of prossure boundary			degradation occurs.		
oss of pressure boundary.	Not stated	Non-significant	NRC recommendation: Until an	4-16 to 4-	214
		because	1	22	
		components are	staff discussion paper on fatigue,	-	
		designed according	the issue is unresolved.	1	
•		to ACI 318 or ASME		1	
	1	Code.			
oss of pressure boundary.					
oss of pressure boundary.	Not stated	Not stated	Non-significant because the	4-34 to 4-	215
			maximum neutron fluence levels and	36	
	1		gamma doses incurred in license	~	
			renewal period do not exceed the		
			level studiet		
			level at which measurable		
oss of pressure boundary.	Not stated		degradation occurs.		
our of pressure boundary.	NOT STATED	Not stated	Non-significant for components not	4-74 to 4-	216
			exposed to flowing water or	77	
			constructed using ACI 201.2R-77 to		
			ensure dense, well-cured concrete	1	
-			with low permeability.		
oss of pressure boundary.	Not stated	Not stated			
· · · · · · · · · · · · · · · · · · ·		not stated		5-21, 5-22	217
	1		aggressive chemical of concrete		
			surfaces that are not periodically		
			examined due to inaccessibility		
			requires plant-specific program.	1	
oss of pressure boundary.	Not stated	Not stated		4-71 to 4-	218
				- I	210
				74	
	1		from regions other than those known	1	
			to cause alkali-aggregate reactions,	1	
			or aggregates was tested in	1	
		1 I	accordance with ASME Section III,		
			Division ASTM C227.(See IR90-01		
		<u> </u>	& 90-06)	1	
oss of pressure boundary.	Not stated	Not stated		45.45	
-				4-45 to 4-	219
		f		51	
			temperatures <66_C (150_F) and		
			local area temperatures <93_C		
			(200_F) or justification is provided in	- I	
			accordance with ACI 349-85, or	I	
			ASME Sect. III, Division 2, Class		
			CC.		
ss of pressure boundary.	Not stated	Non-significant			
		- I			220
		because	agreement is reached on the draft 2	22	
		components are	staff discussion paper on fatigue,		
	1	designed according	the issue is unresolved.		I
		giller develaing			
		to ACI 318 or ASME			I
		to ACI 318 or ASME Code.			
		to ACI 318 or ASME			
		to ACI 318 or ASME			

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	Mark III Steel Containments	Concrete Basemat	Not stated	Concrete	Not stated	SETTLE	Cracking, distortion, increase in component stress level
222	Mark III Steel Containments	Concrete Basemat	Not stated	Concrete	Not stated	EMBR/IR	Loss of fracture toughness
223	Mark III Steel Containments	Concrete Fill in Annulus	Not stated	Concrete	Not stated	LEACH	Increase of porosity and permeability
224	Mark III Steel Containments	Concrete Fill in Annulus	Not stated	Concrete	Not stated	AGREAC	Expansion and cracking
225	Mark III Steel Containments	Concrete Fill in Annulus	Not stated	Concrete	Not stated	ELE-TEMP	Loss of strength and modulus
226	Mark III Steel Containments	Concrete Fill in Annulus	Not stated	Concrete	Not stated	FAT	Cumulative fatigue damage
227	Mark III Steel Containments	Concrete Fill in Annulus	Not stated	Concrete	Not stated	ÉMBR/IR	Loss of fracture toughness
228	Mark III Steel Containments	Embedded Shell Region	Not stated	Carbon Steel, concrete	Not stated	CORR/PIT	Loss of material
<u>.</u> 29	Mark III Steel Containments	Embedded Shell Region	Not stated	Carbon Steel, concrete	Not stated	FAT	Cumulative fatigue damage
230	Mark III Steel Containments	Embedded Shell Region	Not stated	Carbon Steel, concrete	Not stated	EMBR/SA	Loss of fracture toughness
231	Mark III Steel Containments	Embedded Shell Region	Not stated	Carbon Steel, concrete	Not stated	EMBR/IR	Loss of fracture toughness

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 IR 90-10, BWR Reactor Containment Structures Industry Report

 Reviewed by:
 David C. Ma, ANL

 Effect of Aging on Component Function Contrib to Failure
 Reported progs

Loss of pressure boundary.	Not stated	Plant settlement	Rel.progs	Report Recommendations	Page No.	
, , , , , , , , , , , , , , , , , , ,	Hor stated	monitoring program		For BWR containments bearing on soil or piles, current plant settlement	it 89, 5-28,	
				monitoring program is required to ensure that the differential	5-29	
				settlement does not exceed the		1 .
			e.	design criteria throughout the licens	θ	
				renewal term. (See IR90-01 & 90- 06)		Į
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the	4-34 to 4-	22
,				maximum neutron fluence levels and		4
				gamma doses incurred in license		
				renewal period do not exceed the		
		1 1		level at which measurable		
oss of pressure boundary.	Not stated	Alatatata		degradation occurs.		
	NOT STATED	Not stated		Non-significant for components not	4-74 to 4-	22
		1 1		exposed to flowing water or	77	
		Í		constructed using ACI 201.2R-77 to	· [	1
				ensure dense, well-cured concrete with low permeability.		
loss of pressure boundary.	Not stated	Not stated		Non-significant for components	4-71 to 4-	
				constructed from aggregate taken	4-/1 to 4-	22
				from regions other than those known		ľ
				to cause alkali-aggregate reactions,	1	
				or aggregates was tested in	1	
				accordance with ASME Section III,	!	
				Division ASTM C227.(See IR90-01		
oss of pressure boundary.	Not stated			& 90-06)	1	
ere er pressure bouridally.	NOT STATED	Not stated		Non-significant for components	4-45 to 4-	225
				maintained at operating	51	
				temperatures <66_C (150_F) and		
				local area temperatures <93_C	í l	
				(200_F) or justification is provided in accordance with ACI 349-85, or		
				ASME Sect. III, Division 2, Class		
				CC.		
oss of pressure boundary.	Not stated	Non-significant		NRC recommendation: Until an	4-16 to 4-	226
		because		agreement is reached on the draft	22	
		components are		staff discussion paper on fatigue,	- I	
		designed according		the issue is unresolved.		
		to ACI 318 or ASME Code.				
oss of pressure boundary.	Not stated	Not stated		Non significant because the		
				Non-significant because the maximum neutron fluence levels and	4-34 to 4-	227
				gamma doses incurred in license	36	
				renewal period do not exceed the		
				level at which measurable		
oss of pressure boundary.				degradation occurs.		
iss of pressure boundary.	Not stated	Not stated		A plant-specific aging program is	4-9 to 4-	228
				required to manage the local	15, 5-12	
				corrosion of inaccessible and/or	to 5-5-14	
				embedded carbon steel containment		
ss of pressure boundary.	Not stated	Non-significant		components.		_
		because			4-16 to 4-	229
		components are		agreement is reached on the draft	22	j
		designed according		staff discussion paper on fatigue, the issue is unresolved.	l	
		to ACI 318 or ASME				
		Code.				ſ
ss of pressure boundary.	Not stated	Not stated		Non-significant for a component	4-25 to 4-	230
					28	2.30
				region and without severely cold		I
ss of procedure boundary				working in the forming process.	1	
ss of pressure boundary.	Not stated	Not stated		Non-significant because the	4-34 to 4-	231
				maximum neutron fluence levels and	36	'
				gamma doses incurred in license		- 1
	1	1		renewal period do not exceed the		
				level at which measurable		
				level at which measurable degradation occurs.		

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
232	Mark III Steel Containments	Basemat Reinforcing Steel	Not stated	Rebar	Not stated	CORR/RE	Cracking, spalling, loss of bond, loss o (More)
233	Mark III Steel Containments	Basemat Reinforcing Steel	Not stated	Rebar	Not stated	AGR-CHEM	Increase of porosity and permeability, cracking, and spalling
234	Mark III Steel Containments	Basemat Reinforcing Steel	Not stated	Rebar	Not stated	FAT	Cumulative fatigue damage
235	Mark III Steel Containments	Basemat Reinforcing Steel	Not stated	Rəbar	Not stated	EMBR/IR	Loss of fracture toughness
236	Mark III Concrete Containments	Containment Liner Interior Surface and Containment Liner Exterior Surface	Not stated	Stainless Steel in pool region, Carbon Steel rest	Not stated	CORR	Loss of material
237	Mark III Concrete Containments	Containment Liner Interior Surface and Containment Liner Exterior Surface	Not stated	Stainless Steel in pool region, Carbon Steel rest	Not stated	FAT	Cumulative fatigue damage
238	Mark III Concrete Containments	Containment Liner Interior Surface and Containment Liner Exterior Surface	Not stated	Stainless Steel in pool region, Carbon Steel rest	Not stated	EMBR/IR	Loss of fracture toughness
239	Mark III Concrete Containments	Suppr. Chamber Liner or Cladding Interior Surface and Suppr. Chamber	Not stated	Stainless Steel	Not stated	CORR	Loss of material
240	Mark III Concrete Containments	Liner Exterior Surface	Not stated	Stainless Steel	Not stated	FAT	Cumulative fatigue damage
241	Mark III Concrete Containments	Suppr. Chamber Liner or Cladding Interior Surface and Suppr. Chamber Liner Exterior Surface	Not stated	Stainless Steel	Not stated	CORR/SCC	Crack initiation and growth
242	Mark III Concrete Containments	Suppr. Chamber Liner or Cladding Interior Surface and Suppr. Chamber Liner Exterior Surface	Not stated	Stainless Steel	Not stated	EMBR/IR	Loss of fracture toughness
243	Mark III Concrete Containments	Concrete Containment Wali Above Grade	Not stated		Not stated	FRZ-THAW	Surface spalling, local cracking

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Effect of Aging on Component F			Rel.progs	Report Recommendations	Page No.	
Loss of pressure boundary.	Not stated	Not stated		Plant-specific program is required for management of inaccessible areas.(See IR90-01 & 90-06)	5-21, 5-22	2 23
Loss of pressure boundary.	Not stated	Not stated		Management for the effects of aggressive chemical of concrete surfaces that are not periodically examined due to inaccessibility requires plant-specific program.	5-21, 5-22	23:
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-16 to 4- 22	234
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.		235
Loss of pressure boundary.	Not stated	Not stated		Non-significant for liner plate having protective coatings on the interior surface and having the alkaline environment on the exterior surface.	4-42 to 4- 44	236
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	237
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	<b>4-62 to 4-</b> 71	238
Loss of pressure boundary.	Not stated	Not stated		Non-significant for liner plate having protective coatings on the interior surface and having the alkaline environment on the exterior surface.	4-42 to 4- 44	239
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	240
Loss of pressure suppression.	Not stated	Detection of liner leakage through 10CFR50, Appendix J integrated leak rate test to ensure (More)		Not stated	5-20, 5- 21	241
∟oss of pressure suppression.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 to 4- 71	242
oss of pressure suppression.	Not stated	Not stated		Non-significant for component located in a geographic region of weathering index <100 day-inch/ yr or concrete mix design meets air content & water-to-cement ratio requirements of ASME Sect. III, Division 2, CC-2231.7.1.(See IR90- 01 & 90-06)	4-77 to 4- 79	243

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Item Svetem	Structure/Comp	Subsemperant	Mataziala

System	Structure/Comp	Subcomponent	Materiais	Manufacturer	ARD mechanism	ARD effects
	Concrete Containment Wall Above Grade	Not stated	Concrete	Not stated	LEACH	Increase of porosity and permeability
Mark III Concrete Containments	Concrete Containment Wall Above Grade	Not stated	Concrete	Not stated	AGR-CHEM	Increase of porosity and permeability, cracking, and spalling
Mark III Concrete Containments	Concrete Containment Wall Above Grade	Not stated	Concrete	Not stated	AGREAC	Expansion and cracking
Mark III Concrete Containments	Concrete Containment Wall Above Grade	Not stated	Concrete	Not stated	ELE-TEMP	Loss of strength and modulus
Mark III Concrete Containments	Concrete Containment Wall Above Grade	Not stated	Concrete	Not stated	FAT	Cumulative fatigue damage
Mark III Concrete Containments	Concrete Containment Wall	Not stated	Concrete	Not stated	EMBR/IR	Loss of fracture toughness
Mark III Concrete Containments	Concrete Containment Wall Below Grade	Not stated	Concrete	Not stated	FRZ-THAW	Surface spalling, local cracking
Mark III Concrete Containments	Concrete Containment Wall Below Grade	Not stated	Concrete	Not stated	LEACH	Increase of porosity and permeability
Mark III Concrete Containments	Concrete Containment Wall Below Grade	Not stated	Concrete	Not stated	AGR-CHEM	Increase of porosity and permeability, cracking, and spalling
Mark III Concrete Containments	Concrete Containment Wall Below Grade	Not stated	Concrete	Not stated	AGREAC	Expansion and cracking
Mark III Concrete Containments	Concrete Containment Wall Below Grade	Not stated	Concrete	Not stated	ELE-TEMP	Loss of strength and modulus
	Mark III Concrete Containments Mark III Concrete Containments	Mark III Concrete ContainmentsConcrete Containment Wall Above GradeMark III Concrete ContainmentsConcrete Containment Wall Below Grade	Mark III Concrete ContainmentsConcrete Containment Wall Above GradeNot statedMark III Concrete ContainmentsConcrete Concrete Containment Wall Below GradeNot statedMark III Concrete ContainmentsConcrete Containment Wall 	Mark III Concrete Containments       Concrete Containment Wall Above Grade       Not stated       Concrete         Mark III Concrete Containments       Concrete Containment Wall Above Grade       Not stated       Concrete         Mark III Concrete Containments       Concrete Containment Wall Above Grade       Not stated       Concrete         Mark III Concrete Containments       Concrete Containment Wall Above Grade       Not stated       Concrete         Mark III Concrete Containments       Concrete Containment Wall Above Grade       Not stated       Concrete         Mark III Concrete Containments       Concrete Containment Wall Above Grade       Not stated       Concrete         Mark III Concrete Containments       Concrete Containment Wall Above Grade       Not stated       Concrete         Mark III Concrete Containments       Concrete Containment Wall Above Grade       Not stated       Concrete         Containments       Concrete Containment Wall Below Grade       Not stated       Concrete         Containments       Concrete Containment Wall Below Grade       Not stated       Concrete         Containments       Concrete Containment Wall Below Grade       Not stated       Concrete         Mark III Concrete Containment       Concrete Containment Wall Below Grade	Mark III Concrete Containments     Concrete Containment Wall Above Grade     Not stated     Concrete     Not stated       Mark III Concrete Containments     Concrete Containment Wall Above Grade     Not stated     Concrete     Not stated       Mark III Concrete Containments     Concrete Containments     Concrete Containment Wall Above Grade     Not stated     Concrete     Not stated       Mark III Concrete Containments     Concrete Containment Wall Above Grade     Not stated     Concrete     Not stated       Mark III Concrete Containments     Concrete Containment Wall Above Grade     Not stated     Concrete     Not stated       Mark III Concrete Containments     Concrete Containment Wall Above Grade     Not stated     Concrete     Not stated       Mark III Concrete Containments     Concrete Containment Wall Above Grade     Not stated     Concrete     Not stated       Mark III Concrete Containment Wall Below Grade     Not stated     Concrete Containment Wall Below Grade     Not stated     Concrete     Not stated       Mark III Concrete Containment Wall Below Grade     Not stated     Concrete Containment Wall Below Grade     Not stated     Concrete Containment Wall Below Grade     Not stated     Concrete Concrete Containment Wall Below Grade     Not stated     Not stated       Mark III Concrete Containment Wall Below Grade     Not stated     Concrete Containment Wall Below Grade     Not stated <t< td=""><td>Mark III Concrete Containments     Not stated Containment Wall Above Grade     Not stated Not stated     Not stated Concrete Containments     Not stated Concrete Containment Wall Above Grade     Not stated Not stated     Concrete Concrete Containment Wall Above Grade     Not stated Not stated     FAT       Mark III Concrete Containments     Concrete Containment Wall Above Grade     Not stated     Concrete Containment Wall Above Grade     Not stated     Concrete Concrete     Not stated     FAT       Mark III Concrete Containments     Concrete Containment Wall Above Grade     Not stated     Concrete Concrete     Not stated     FRZ-THAW       Mark III Concrete Containments     Concrete Containment Wall Below Grade     Not stated     Concrete Concrete     Not stated     LEACH       Mark III Concrete Containments     Concrete Containment Wall Below Grade     Not stated     Concrete Concrete     Not stated     AGR-CHEM       Mark III Concrete Containments     Concrete Containment Wall Below Grade     Not stated     Concrete Concrete     Not stated     AGR-CHEM       Mark III Concrete Co</td></t<>	Mark III Concrete Containments     Not stated Containment Wall Above Grade     Not stated Not stated     Not stated Concrete Containments     Not stated Concrete Containment Wall Above Grade     Not stated Not stated     Concrete Concrete Containment Wall Above Grade     Not stated Not stated     FAT       Mark III Concrete Containments     Concrete Containment Wall Above Grade     Not stated     Concrete Containment Wall Above Grade     Not stated     Concrete Concrete     Not stated     FAT       Mark III Concrete Containments     Concrete Containment Wall Above Grade     Not stated     Concrete Concrete     Not stated     FRZ-THAW       Mark III Concrete Containments     Concrete Containment Wall Below Grade     Not stated     Concrete Concrete     Not stated     LEACH       Mark III Concrete Containments     Concrete Containment Wall Below Grade     Not stated     Concrete Concrete     Not stated     AGR-CHEM       Mark III Concrete Containments     Concrete Containment Wall Below Grade     Not stated     Concrete Concrete     Not stated     AGR-CHEM       Mark III Concrete Co

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Effect of Aging on Com	Conent Europion Contrib to Eailure Deserted and

Effect of Aging on Component Fi	Not stated	Not stated	Non-significant for components not	Page No.	
	,	Not stated	exposed to flowing water or	4-74 to 4-	24
			constructed using ACI 201.2R-77 to	77	
			ensure dense, well-cured concrete		
			with low permeability.		
Loss of pressure boundary.	Not stated	Not stated	Non-significant for components not	4-56 to 4-	24
		1	exposed to aggressive environment	60	1 ~
			(pH <5.5, chloride >500 ppm &	100	
			sulfate >1500 ppm); or exposed to		1
			aggressive groundwater for		
			intermittent periods only.		
oss of pressure boundary.	Not stated	Not stated	Non-significant for components	4-71 to 4-	24
			constructed from aggregate taken	74	
			from regions other than those known		
			to cause alkali-aggregate reactions,		i i
			or aggregates was tested in		
			accordance with ASME Section III,		
			Division ASTM C227 (See IR90-01		1
oss of pressure boundary.	Not stated		& 90-06)		
ere er procedio Douridary:	Not stated	Not stated	Non-significant for components	4-45 to 4-	24
			maintained at operating	51	
			temperatures <66_C (150_F) and		
			local area temperatures <93_C		
			(200_F) or justification is provided in		
			accordance with ACI 349-85, or		
			ASME Sect. III, Division 2, Class CC.		
oss of pressure boundary.	Not stated	Non-significant			
. ,		because	NRC recommendation: Until an	4-52 to 4-	24
		components are	agreement is reached on the draft	56	
		designed according	staff discussion paper on tatigue, the issue is unresolved.		
		to ACI 318 or ASME			
		Code.			
oss of pressure boundary.	Not stated	Not stated	Same as item #242	4-6271	249
					240
oss of pressure boundary.	Not stated	Not stated	Non-significant for component	4-77 to 4-	250
			located in a geographic region of	79	
			weathering index <100 day-inch/yr or		
• -		1	concrete mix design meets air	Í	
			content & water-to-cement ratio	1	
			requirements of ASME Sect. III,		
oss of pressure boundary.			Division 2, CC-2231.7.1.		
ss of pressure boundary.	Not stated	Not stated		4-74 to 4-	251
			exposed to flowing water or	77	
			constructed using ACI 201.2R-77 to		
			ensure dense, well-cured concrete		
oss of pressure boundary.	Not stated	Net state of	with low permeability.		
ere er pressure bouridary.	INCL STREED	Not stated		5-21, 5-22	252
			aggressive chemical of concrete		
			surfaces that are not periodically		
		1	examined due to inaccessibility		
oss of pressure boundary.	Not stated	Not stated	requires plant-specific program.		
	THUL SLAUBU	INOT STATED		4-71 to 4-	253
			constructed from aggregate taken	74	
		1	from regions other than those known		
			to cause alkali-aggregate reactions,	1	
			or aggregates was tested in		
			accordance with ASME Section III, Division ASTM C227.(See IR90-01		
			& 90-06)		
oss of pressure boundary.	Not stated	Not stated		4-45-1-4	057
				4-45 to 4-	254
			temperatures <66_C (150_F) and	51	
			local area temperatures <93_C		
			(200_F) or justification is provided in		
			accordance with ACI 349-85, or		
			ASME Sect. III, Division 2, Class	1	
		1	Province Geocetria, Division 2, Class		
			ICC.		

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	Mark III Concrete	Concrete	Not stated	Concrete	Not stated	FAT	Cumulative fatigue
	Containments	Containment Wall Below Grade					damage
256	Mark III Concrete Containments	Concrete Containment Wall Below Grade	Not stated	Concrete	Not stated	EMBR/IR	Loss of fracture toughness
257	Mark III Concrete Containments	Concrete Dome	Not stated	Concrete	Not stated	FRZ-THAW	Surface spalling, local cracking
258	Mark III Concrete Containments	Concrete Dome	Not stated	Concrete	Not stated	LEACH	Increase of porosity and permeability
259	Mark III Concrete Containments	Concrete Dome	Not stated	Concrete	Not stated	AGR-CHEM	Increase of porosity and permeability, cracking, and spalling
260	Mark III Concrete Containments	Concrete Dome	Not stated	Concrete	Not stated	AGREAC	Expansion and cracking
- 001				0			
201	Mark III Concrete Containments	Concrete Dome	Not stated	Concrete	Not stated	ELE-TEMP	Loss of strength and modulus
262	Mark III Concrete Containments	Concrete Dome	Not stated	Concrete	Not stated	FAT	Cumulative fatigue damage
263	Mark III Concrete Containments	Concrete Dome	Not stated	Concrete	Not stated	EMBR/IR	Loss of fracture toughness
264	Mark III Concrete Containments	Basemat Liner	Not stated	Stainless St <del>oo</del> l	Not stated	CORR	Loss of material
265	Mark III Concrete Containments	Basemat Liner	Not stated	Stainless Steel	Not stated	FAT	Cumulative fatigue damage

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Effect of Aging	on Component Eurotion Contrib to Foilure Deported and

Effect of Aging on Component F Loss of pressure boundary.	Not stated	Non-significant	Rel.progs	Report Recommendations NRC recommendation: Until an	Page No. 4-52 to 4-	25
,		because components are designed according to ACI 318 or ASME Code.		agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 10 4- 56	25
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 to 4- 71	25
Loss of pressure boundary.	Not stated	Not stated		Non-significant for component located in a geographic region of weathering index <100 day-inch/ yr or concrete mix design meets air content & water-to-cement ratio requirements of ASME Sect. III, Division 2, CC-2231.7.1.(See IR90- 01 & 90-06)	4-77 to 4- 79	25
Loss of pressure boundary.	Not stated	Not stated		Non-significant for components not exposed to flowing water or constructed using ACI 201.2R-77 to ensure dense, well-cured concrete with low permeability.	4-74 to 4- 77	258
Loss of pressure boundary.	Not stated	Not stated		Non-significant for components not exposed to aggressive environment (pH <5.5, chloride >500 ppm & sulfate >1500 ppm); or exposed to aggressive groundwater for intermittent periods only.	4-56 to 4- 60	259
Loss of pressure boundary.	Not stated	Not stated		Non-significant for components constructed from aggregate taken from regions other than those known to cause alkali-aggregate reactions, or aggregates was tested in accordance with ASME Section III, Division ASTM C227.(See IR90-01 & 90-06)	4-71 to 4- 74	260
oss of pressure boundary.	Not stated	Not stated		Non-significant for components maintained at operating temperatures <66_C (150_F) and local area temperatures <93_C (200_F) or justification is provided in accordance with ACI 349-85, or ASME Sect. III, Division 2, Class CC.	4-45 to 4- 51	261
oss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	262
oss of pressure boundary.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62-71	263
oss of pressure boundary.	Not stated	Not stated			4-42 to 4- 44	264
oss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code,		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	265

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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
266	Mark III Concrete Containments	Basemat Liner	Not stated	Stainless Steel	Not stated	EMBR/IR	Loss of fracture toughness
267	Mark III Concrete Containments	Concrete Basemat	Not stated	Concrete	Not stated	LEACH	Increase of porosity and permeability
268	Mark III Concrete Containments	Concrete Basemat	Not stated	Concrete	Not stated	AGR-CHEM	Increase of porosity and permeability, cracking, and spalling
269	Mark III Concrete Containments	Concrete Basemat	Not stated	Concrete	Not stated	AGREAC	Expansion and cracking
270	Mark III Concrete Containments	Concrete Basemat	Not stated	Concrete	Not stated	FAT	Cumulative fatigue damage
271	Mark III Concrete Containments	Concrete Basemat	Not stated	Concrete	Not stated	SETTLE	Cracking, distortion increase in component stress level
272	Mark III Concrete Containments	Concrete Basemat	Not stated	Concrete	Not stated	EMBR/IR	Loss of fracture toughness
273	Mark III Concrete Containments	Liner Anchors	Not stated	Carbon Steel	Not stated	CORR	Loss of material
274	Mark III Concrete Containments	Liner Anchors	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
275	Mark III Concrete Containments	Liner Anchors	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
276	Mark III Concrete Containments	Containment Wall Below Grade Reinforcing Steel	Not stated	Rebar and Embedded Carbon Steel in concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, loss of material

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Effect of Aging on Component F Loss of pressure boundary.	Not stated	Not stated	Rel.progs Report Recommendations	Page No.	
,	Notstated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license	4-62 to 4- d 71	26
			renewal period do not exceed the level at which measurable		
Loss of pressure boundary.	Not stated	Not stated	degradation occurs. Non-significant for components not	4-74 to 4-	26
			exposed to flowing water or	77	1 20
			constructed using ACI 201.2R-77 to		
			ensure dense, well-cured concrete		
Loss of pressure boundary.	Not stated	Not stated	with low permeability.		ļ
	Not stated	Not stated	Management for the effects of	5-21, 5-22	2 26
			aggressive chemical of concrete surfaces that are not periodically		
		1	examined due to inaccessibility		1
			requires plant-specific program.		
Loss of pressure boundary.	Not stated	Not stated	Non-significant for components	4-71 -74	26
			constructed from aggregate taken		
			from regions other than those known		
			to cause alkali-aggregate reactions,		
			or aggregates was tested in		
		1	accordance with ASME Section III,		
			Division ASTM C227.(See IR90-01 & 90-06)	1	1
oss of pressure boundary.	Not stated	Non-significant	NRC recommendation: Until an	4-52 to 4-	270
		because	agreement is reached on the draft	56	<i>~</i> /`
		components are	staff discussion paper on fatigue,		
		designed according	the issue is unresolved.		
		to ACI 318 or ASME			
oss of pressure boundary.	Not stated	Code.			
in proceed boundary.	NOTSTATED	Plant settlement	For BWR containments bearing on	4-87 to 4-	271
		monitoring program	soil or piles, current plant settlement	89, 5-28,	
			monitoring program is required to ensure that the differential	5-29	
			settlement does not exceed the		
			design criteria throughout the license		
			renewal term. (See IR90-01 & 90-		
			06)		
oss of pressure boundary.	Not stated	Not stated	Non-significant because the	4-6271	272
			maximum neutron fluence levels and		
			gamma doses incurred in license		
			renewal period do not exceed the level at which measurable		
			degradation occurs.		
oss of pressure boundary.	Not stated	Not stated	Non-significant for liner plate having	4-42 to 4-	273
			protective coatings on the interior	44	210
			surface and having the alkaline		
			environment on the exterior surface.		
oss of pressure boundary.	Not stated	Non-significant	NRC recommendation: Until an	4-52 to 4-	274
		because	agreement is reached on the draft	56	
		components are	staff discussion paper on fatigue,		
		to ACI 318 or ASME	the issue is unresolved.		
		Code.			
oss of pressure boundary.	Not stated	Not stated	Non-significant because the	4-62 to 4-	275
			maximum neutron fluence levels and		215
			gamma doses incurred in license	. 1	
			renewal period do not exceed the		
			level at which measurable		
oss of pressure boundary.	Not stated	Not stated	degradation occurs.		
i prostaro boancary.	Not stated	NOTSLAUG	Plant-specific program is required	5-21, 5-22	276
			for management of inaccessible		
			areas.(See iR90-01 & 90-06)		
	1		1		
		i i		1	

281

Mark III Concrete

Containments

282 Mark III Concrete

283 Mark III Concrete

284 Mark III Concrete

285 Mark III Concrete

286 Mark III Concrete

287 Mark III Concrete

Containments

Containments

Containments

Containments

Containments

Containments

tem	System	Structure/Comp	Subcomponent_	Materials	Manufacturer	ARD mechanism	ARD effects
277	Mark III Concrete Containments	Containment Wall Below Grade Reinforcing Steel	Not stated	Rebar and Embedded Carbon Steel in concrete	Not stated	ELE-TEMP	Loss of strength and modulus
278	Mark III Concrete Containments	Containment Wall Below Grade Reinforcing Steel	Not stated	Rebar and Embedded Carbon Steel in concrete	Not stated	FAT	Cumulative fatigue damage
279	Mark III Concrete Containments	Containment Wall Below Grade Reinforcing Steel	Not stated	Rebar and Embedded Carbon Steel in concrete	Not stated	EMBR/IR	Loss of fracture toughness
280	Mark III Concrete Containments	Dome Reinforcing Steel	Not stated	Rebar and embedded Carbon Steel in concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, loss of material

Rebar and

Rebar and

Rebar and

Rebar and

Rebar and Embedded Carbon

Rebar and Embedded Carbon

Rebar and

Steel in concrete

Embedded Carbon

Steel in concrete

embedded Carbon Steel in concrete

embedded Carbon

embedded Carbon

Embedded Carbon

Steel in concrete

Steel in concrete

Steel in concrete

Steel in concrete

Not stated

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**Dome Reinforcing** 

**Dome Reinforcing** 

**Dome Reinforcing** 

**Basemat Reinforcing Not stated** 

Basemat Reinforcing Not stated

Basemat Reinforcing Not stated

Basemat Reinforcing Not stated

Steel

Steel

Steel

Steel

Steel

Steel

Steel

Not stated

Not stated

Not stated

Loss of strength and

Cumulative fatigue

Loss of fracture

Cracking, spalling,

loss of bond, loss of

Loss of strength and

Cumulative fatigue

Loss of fracture

toughness

toughness

material

modulus

damage

modulus

damage

ELE-TEMP

FAT

EMBR/IR

CORR/RE

ELE-TEMP

FAT

EMBR/IR

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Effect of Aging on Component Function			Rei.progs	Report Recommendations	Page No.	
Loss of pressure boundary.	Not stated	Not stated		Non-significant for components maintained at operating temperatures <66_C (150_F) and local area temperatures <93_C (200_F) or justification is provided in accordance with ACI 349-85, or ASME Sect. III, Division 2, Class CC.	4-45 to 4- 51	277
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	278
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.		279
Loss of pressure boundary.	Not stated	Not stated		Non-significant for concrete structures not exposed to aggressive environment (pH <11.5 or chlorides >500 ppm); or for concrete having low water-to-cement ratio (0.35-0.45) and adequate air entrainment (3- 6%).		280
Loss of pressure boundary.	Not stated	Not stated		Non-significant for components maintained at operating temperatures <66_C (150_F) and local area temperatures <93_C (200_F) or justification is provided in accordance with ACI 349-85, or ASME Sect. III, Division 2, Class CC.	4-45 to 4- 51	281
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	282
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 to 4- 71	283
Loss of pressure boundary.	Not stated	Not stated		Plant-specific program is required for management of inaccessible areas. (See IR90-01 & 90-06)	5-21, 5-22	284
Loss of pressure boundary.	Not stated	Not stated		Non-significant for components maintained at operating temperatures <66_C (150_F) and local area temperatures <93_C (200_F) or justification is provided in accordance with ACI 349-85, or ASME Sect. III, Division 2, Class CC.		285
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-52 to 4- 56	286
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 71	28

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ARC industry Reports		

	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
286	All Type BWR Containments	Penetration Sleeves	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
289	All Type BWR Containments	Penetration Sleeves	Not stated	Carbon Steel	Not stated	CORR	Loss of material
290	All Type BWR Containments	Penetration Sleeves	Not stated	Carbon Steel	Not stated	ELE-TEMP	Loss of strength modulus
291	All Type BWR Containments	Penetration Sleeves	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigu damage
92	All Type BWR Containments	Penetration Sieeves	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
93	Ali Type BWR Containments	Penetration Sleeves	Not stated	Carbon Steel	Not stated	CORR/SCC	Crack initiation ar growth
	All Type BWR Containments	Fenetration Sleeves	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
	All Type BWR Containments	Dissimilar Metai Welds	Not stated	Carbon Steel welded with Stainless Steel	Not stated	CORR/PIT	Loss of material
	All Type BWR Containments	Dissimilar Metal Welds	Not stated	Carbon Steel welded with Stainless Steel	Not stated	CORR	Loss of material
	All Type BWR Containments	Dissimilar Mətal Wəlds	Not stated	Carbon Steel welded with Stainless Steel	Not stated	FAT	Cumulative fatigue damage
	NI Type BWR Containments	Dissimilar Mətal Wəlds	Not stated	Carbon Steel weided with Stainless Steel	Not stated	EMBR/IR	Loss of fracture toughness
	II Type BWR containments	Penetration Bellows	Not stated	Stainless and Carbon Steel	Not stated	CORR/UA	Loss of material

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Effect of Aging on Component Function Contrib to Failure Departed and

Effect of Aging on Component I Loss of pressure boundary.	Not stated	Not stated	Rel.progs Report Recommendations	Page No.	_
	, tot outou	Not stated	Non-significant for stainless steel	4-3 to 4-8	2
			components, and for components		
			having intact protective coatings, and	4	
			for components having a corrosion		
Loss of pressure boundary.	Not stated	Not stated	allowance >=1/32 inch.	L	
-		Not stated	Non-significant for liner plate having	4	2
		1 1	protective coatings on the interior	44	
			surface and having the alkaline		
Loss of pressure boundary.	Not stated	Not stated	environment on the exterior surface.	I	
	rior stated	Not stated	Non-significant for components	4-45 to 4-	2
			maintained at operating	51	1
			temperatures <66_C (150_F) and	l	
			local area temperatures <93_C		1
			(200_F) or justification is provided in		1
			accordance with ACI 349-85, or		1
			ASME Sect. III, Division 2, Class		
loss of pressure boundary.	Not stated		CC.		
,	NOT STATED	ASME Sect III	NRC recommendation: Damage of	4-52 to 4-	29
		fatigue analysis and	penetration sleeves and bellows is	56	
		Sect. XI, Subsect.	credible, especially when it is		
oss of pressure boundary.	Alex states of	IWE inspection.	environmentally assisted.		
tode of pressure boundary.	Not stated	Not stated	Non-significant for a component	4-25 to 4-	29
			having service stress in the elastic	28	
			region and without severely cold		
oss of prossure house			working in the forming process.		
oss of pressure boundary.	Not stated	Not stated	Non-significant for components	4-28 to 4-	29
			exposed to containment or Reactor	33	23
			Building environment, or normal	33	
			operational stress levels are less		
			than the material yield strength, or a		
			fracture mechanics analysis has	1	
			established that cracks do not		
			propagate.		
oss of pressure boundary.	Not stated	Not stated			
				4-62 to 4-	294
			maximum neutron fluence levels and	71 [	
			gamma doses incurred in license	1	
			renewal period do not exceed the		
			level at which measurable	1	
oss of pressure boundary.	Not stated	Period. exam. by the	degradation occurs.		
		Exam. Category E-C	IWE-1240 of ASME Sect. XI,	4-9 to 4-	295
	Į	under provisions of	Subsect IWE provides for the	15, 5-12	
		IWE-1240 of ASME	identification of accessible surface	0 5-14	
		Sect. XI, Subsect.	areas likely to experience	1	
		IWE.	accelerated corrosion.		
oss of pressure boundary.	Not stated	Period. exam. under			
			Underwater surfaces are considered 5	-23, 5-24	296
		the provisions of	as accessible by the rules of IWE-	ļ	
		IWE-1240 (Exam.	1240 of ASME Sect. XI.	ļ	
		Category E-C) of		- 1	
		ASME Sect. XI,		1	
ss of pressure boundary.	Not state =	Subsect. IWE.			
ee er pressure boundary.	Not stated	Non-significant	NRC recommendation: Until an 4	-16 to 4-	297
		because		2	
		components are	staff discussion paper on fatigue,	-	
		designed according	the issue is unresolved.		
		to ACI 318 or ASME			
		Code.			
ss of pressure boundary.	Not stated	Not stated	Non-significant because the 4	-34 to 4-	200
			maximum neutron fluence levels and 3	-34 (0 4- )	298
		1	gamma doses incurred in license	°	
			renewal period do not exceed the		
		<b>I</b> 1	level at which measurable		
			degradation occurs		
ss of pressure boundary.	Not stated	Not stated			
-			Non-significant for liner plate having 4	-3-8	299
			protective coatings on the interior		
			surface and having the alkaline		
			environment on the exterior surface.		
					- 1

Document: IR 90-10, BWR Reactor Containment Structures Industry Report Reviewed by: David C. Ma, ANL

	<b>System</b>	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
	All Type BWR Containments	Penetration Bellows	Not stated	Stainless and Carbon Steel	Not stated	FAT	Cumulative fatigue damage
301	All Type BWR Containments	Penetration Bellows	Not stated	Stainless and Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
302	All Type BWR Containments	Penetration Bellows	Not stated	Stainless and Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
303	All Type BWR Containments	Penetration Bellows	Not stated	Stainless and Carbon Steel	Not stated	CORR/SCC	Crack initiation and growth
304	All Type BWR Containments	Personnel Airlock, Equipment Hatches, and CRD Hatch	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
305	All Type BWR Containments	Personnel Airlock, Equipment Hatches, and CRD Hatch	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
306	All Type BWR Containments	Personnel Airlock, Equipment Hatches, and CRD Hatch	Not stated	Carbon Steel	Not stated	WEAR	Lockup
307	All Type BWR Containments	Personnel Airlock, Equipment Hatches, and CRD Hatch	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
308	All Type BWR Containments	Personnel Airlock, Equipment Hatches, and CRD Hatch	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness

Document: IR 90	0-10, BWR Reactor (	Containment Structures Industry Report
Reviewed by:	David C. Ma, ANL	

Reviewed by: David C. Ma, AN Effect of Aging on Component F	unction Contrib to Fail	ure Reported progs	Rel.progs	Report Recommendations	Page No.	
Loss of pressure boundary.	Not stated	ASME Sect. III fatigue analysis and Sect. XI, Subsect. IWE inspection.		NRC recommendation: Damage of penetration sleeves and bellows is credible, especially when it is environmentally assisted.	4-16 to 4- 22 4-25 to 4-	300
Loss of pressure boundary.	Not stated	Not stated		Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.	4-23 10 4- 28 4-62 -71	302
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.		
Loss of pressure boundary.	Not stated	Not stated		Non-significant for components exposed to containment or Reactor Building environment, or normal operational stress levels are less than the material yield strength, or a fracture mechanics analysis has established that cracks do not propagate.	4-28 to 4- 33	303
Loss of pressure boundary.	Not stated	Not stated		Non-significant for stainless steel components, and for components having intact protective coatings, and for components having a corrosion allowance >=1/32 inch.		
Loss of pressure boundary.	Not stated	Non-significant because components are designed according to ACI 318 or ASME Code.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved.	4-16 to 4- 22	
Loss of pressure boundary.	Not stated	Conduct inspection and mitigation of mechanical wear in accordance with provisions of ASME (More)		Not stated	4-23, 4- 24, 5-18, 5-19	30
Loss of pressure boundary.	Not stated	Not stated		Non-significant for a component having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4 28	
Loss of pressure boundary.	Not stated	Not stated		Non-significant because the maximum neutron fluence levels and gamma doses incurred in license renewal period do not exceed the level at which measurable degradation occurs.	4-62 to 4	30

Document: IR 90-08 R1, Low Voltage Environmentally-Qualified Cable License Renewal Industry Report, Rev. 1 Reviewed by: Jerry Edson, INEL

ltem	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
1		Electrical Cable	Conductor	Copper	34 Manutacturers Listed	CORR	Failure of the conductor
2		Electrical Cable	Insulation	XPLE, E-CTFÉ, EPR/EPDM, SR, CSPE, ETFE, PVC, PE, Neoprene, Polyalkene	34 Manufacturers Listed	ELETEMP, RAD, MOIST-EL	Decreased dielectreic strength, treeing, corona
3		Electrical Cable	Insulation	XPLE, E-CTFE, EPR/EPDM, SR, CSPE, ETFE, PVC, PE, Neoprene, Polyalkene	34 Manufacturers Listed	ELETEMP, RAD, MOIST-EL	Embrittled insulation
4		Electrical Cable	Insulation	XPLE, E-CTFE, EPR/EPDM, SR, CSPE, ETFE, PVC, PE, Neoprene, Polyalkene	34 Manufacturers Listed	ELETEMP, RAD	Loss of fire retardants
5		Electrical Cable	Shield	Copper	34 Manufacturers Listed	CORR	Failure of the shield
6		Electrical Cable	Jacket	Polymer, metal	34 Manufacturers Listed	ELETEMP, RAD	Embrittled jacket
7		Electrical Cable	Jacket	Polymer, metal	34 Manufacturers Listed	ELETEMP, RAD	Loss of fire retardants
8		Electrical Cable	Filler	Bulk material and binder tape	34 Manufacturers Listed	Not stated	Not stated

## **B.2 Electrical Components and Systems**

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Document: IR 90-08 R1, Low Voltage Environmentally-Qualified Cable License Renewal Industry Report, Rev. 1 Reviewed by: Jerry Edson, INEL Effect of Aging on Component Function Contrib to Failure Reported progs. Rel progs. Report.

Effect of Aging on Component Function	n Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	ltem
Failure to transmit voltage or current	Occasional	Not discussed in report	No specific program	Not stated	2-4, 3-8, 3-12, 4- 10, 4-11, B-1 thru B-10	1
Failure to accurately transmit voltage or current. Primarily a small siganal problem.	Occasional	Not discussed in report	No specific program	Not stated	2-4, 3-8, 4-1 thru 23, B-1 thru 10	2
Embrittled insulation leads to cracking and introduction of impurities that can significantly degrade the insulation. Embrittled insulation that breaks can allow conductors to contact each other resulting in short circuits.		Not discussed in report	No specific program	Not stated	2-4, 3-8, 4-1 thru 23, B-1 thru 10	3
Increased vulnerability to fire. This does not affect the normal function of the cable	Rare	Not discussed in report	No specific program	Not stated	2-4, 3-8, 3-12, 4- 12, 4-13, 4-14, B-1 thru 10	4
Increased noise in small signal applications.	Rare	Not discussed in report	No specific program	Not stated	2-4, 3-8, 3-12, 4- 10, 4-11, B-1 thru 10	5
Embrittled jackets lead to cracking and introduction of contamination and moisture. This can result in corrosion of the shield. Usually the cable insulation is not degraded except when the jacket is bonded to the insulation.	Frequent	Not discussed in report	No specific program	Not stated	2-4, 3-8, 3-12, 4-14 thru 17, B-1 thru 10	6
Increased vulnerability to fire. This does not affect the normal function of the cable	Rare	Not discussed in report	No specific program	Not stated	2-4, 3-8, 3-12, 4- 12, 4-13, 4-14, B-1 thru 10	7
Fillers do not affect the function of the cable. They only serve to enhance the roundness of a multiconductor cable	Rare	Not discussed in report	No specific program	Not stated	3-6, 3-8	8

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SUPPLEMENTARY NOTES		<u></u>	
ABSTRACT (200 words or less)			
Argonne National Laboratory and Idaho National Engineering Laboratory in support of the Licens the U.S. Nuclear Regulatory Commission (NRC) performed a comprehensive review of literature aging effects. This generic aging lessons learned (GALL) effort was a systematic review of p assess materials and component aging issues related to continued operation and license renewal on mechanical, structural, thermal-hydraulic, and electrical components and systems reviews Aging Research Reports, 31 NRC Generic Letters, 265 Information Notices, 82 Licensee Eve Nuclear Management and Resources Council Industry Reports. The results of these reviews standardized GALL tabular format and standardized definitions of aging related degradation r computerized data base has also been developed for all review tables and can be used to sea components, and relevant aging effects. A survey of the GALL tables reveals that all significar issues are currently being addressed by the regulatory process. However, aging of what are structures has been highlighted for continued scrutiny.	pertaining to nuclea lant aging information of operating reactors at consisted of 163 int reports, 5 Bulletin were systematized mechanisms and effi- rch for information at component and st	ar power plant on in order to rs. Literature Nuclear Plant is, and 10 using a fects. A on structures, tructure aging	
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