Document: IR 90-04, PWR Pressure Vessel Industry Report
Reviewed by: Omesh K. Chopra, ANL

Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Loss of pressure boundary.	Not stated	Not stated		Not susceptible to potential boric acid leak	4-21 -24	103
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	104
Loss of pressure boundary.	Not stated	Not stated		Non significant because not subject to relative motion	4-26, 4-27	105
Loss of pressure boundary.	Not stated	Not stated		Non significant because operating temp. <427 C (<800 F)	4-20	106
Loss of pressure boundary.	Not stated	Not stated		Non significant because of proper material selection & relatively low operating temp.	4-18 to 4-20	107
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	108
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 of 10CFR 50	4-2 to 4-6	109
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	110
Loss of pressure boundary.	Not stated	Not stated		Non significant because SS is resistant to CORR	4-21 to 4-24	111
Loss of pressure boundary.	Not stated	Not stated		Not susceptible to potential boric acid leak	4-21 -24	112
Loss 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	113
Loss of pressure boundary.	Not stated	Not stated		Non significant because not subject to relative motion	4-26, 4-27	114
Loss of pressure boundary.	Not stated	Not stated		Non significant because operating temp. <538 C (<1000 F)	4-20	115
Loss of pressure boundary.	Not stated	Not stated		Non significant because of proper material selection & relatively low operating temp.	4-18 to 4-20	116
Loss 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	117
Loss of pressure boundary.	Not stated	Not stated			4-2 to 4-6	118
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	119

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Item	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 of 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, loss of material
132	PWR Pressure Vessel	Bottom Head Dome	Not stated	SA302 Gr B, SA533 Gr B	Not stated	WEAR	Fretting
133	PWR Pressure Vessel	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 Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Loss of pressure boundary.	Not stated	Not stated		Non significant because Ni alloy is resistant to CORR	4-21 to 4-24	120
Loss of pressure boundary.	Not stated	Not stated		Not susceptible to potential boric acid leak	4-21 -24	121
Loss 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	122
Loss of pressure boundary.	Not stated	Not stated		Non significant because not subject to relative motion.	4-26, 4-27	123
Loss of pressure boundary.	Not stated	Not stated		Non significant because operating temp. <538 C (<1000 F)	4-20	124
Loss of pressure boundary.	Not stated	Not stated		Non significant because of proper material selection & relatively low operating temp.	4-18 to 4-20	125
Loss 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	126
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 of 10CFR 50	4-2 to 4-6	127
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 conditions.	4-11 to 4-18	128
Loss of pressure boundary.	Not stated	Not stated		Non significant because cladding is resistant to CORR, removal of cladding results in very low corrosion rates	4-21 to 4-24	129
Loss of pressure boundary.	Not stated	Not stated		Not susceptible to potential boric acid leak	4-21 -24	130
Loss of pressure boundary.	Not stated	Not stated		Non significant because SS or Ni alloy cladding are resistant to ERO/CORR, single phase & low flow, & control of water chemistry	4-25	131
Loss of pressure boundary.	Not stated	Not stated		Non significant because not subject to relative motion	4-26, 4-27	132
Loss of pressure boundary.	Not stated	Not stated		Non significant because operating temp. <427 C (<800 F)	4-20	133
Loss of pressure boundary.	Not stated	Not stated		Non significant because of proper material selection & relatively low operating temp.	4-18 to 4-20	134
Loss 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
Core support loss, impair reactor shutdown.	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
Core support loss, impair reactor shutdown.	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
Core support loss, impair reactor shutdown.	Not stated	Not stated		Non significant because Ni alloy is resistant to CORR	4-21 to 4-24	138

Table B.1 Gall Report for NUMARC Industry Reports

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
139	PWR Pressure Vessel	Core Support Pads (Lugs)	Not stated	SB 166, SB 167	Not stated	CORR/BA	Loss of material
140	PWR Pressure Vessel	Core Support Pads (Lugs)	Not stated	SB 166, SB 167	Not stated	ERO/CORR	Wall thinning, loss of material
141	PWR Pressure Vessel	Core Support Pads (Lugs)	Not stated	SB 166, SB 167	Not stated	WEAR	Fretting
142	PWR Pressure Vessel	Core Support Pads (Lugs)	Not stated	SB 166,SB 167	Not stated	CREEP	Change in dimension
143	PWR Pressure Vessel	Core Support Pads (Lugs)	Not stated	SB 166, SB 167	Not stated	EMBR/TE	Loss of fracture toughness
144	PWR Pressure Vessel	Core Support Pads (Lugs)	Not stated	SB 166, SB 167	Not stated	FAT	Cumulative fatigue damage
145	PWR Pressure Vessel	Instrumentation Tubes*/Penetrations (* Includes the vent pipe on closure head dome.)	Not stated	SB 166, SB 167	Not stated	EMBR/IR	Loss of fracture toughness
146	PWR Pressure Vessel	Instrumentation Tubes*/Penetrations (* Includes the vent pipe on closure head dome.)	Not stated	SB 166, SB 167	Not stated	CORR/IGSCC Unresolved	Crack initiation & growth
147	PWR Pressure Vessel	Instrumentation Tubes*/Penetrations (* Includes the vent pipe on closure head dome.)	Not stated	SB 166, SB 167	Not stated	CORR	Loss of material, corrosion product buildup
148	PWR Pressure Vessel	Instrumentation Tubes*/Penetrations (* Includes the vent pipe on closure head dome.)	Not stated	SB 166, SB 167	Not stated	CORR/BA	Loss of material
149	PWR Pressure Vessel	Instrumentation Tubes*/Penetrations (* Includes the vent pipe on closure head dome.)	Not stated	SB 166, SB 167	Not stated	ERO/CORR	Wall thinning, loss of material
150	PWR Pressure Vessel	Instrumentation Tubes*/Penetrations (* Includes the vent pipe on closure head dome.)	Not stated	SB 166, SB 167	Not stated	WEAR	Fretting
151	PWR Pressure Vessel	Instrumentation Tubes*/Penetrations (* Includes the vent pipe on closure head dome.)	Not stated	SB 166, SB 167	Not stated	CREEP	Change in dimension
152	PWR Pressure Vessel	Instrumentation Tubes*/Penetrations (* Includes the vent pipe on closure head dome.)	Not stated	SB 166, SB 167	Not stated	EMBR/TE	Loss of fracture toughness
153	PWR Pressure Vessel	Instrumentation Tubes*/Penetrations (* Includes the vent pipe on closure head dome.)	Not stated	SB 166, SB 167	Not stated	FAT	Cumulative fatigue damage

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Core support loss, impair reactor shutdown.	Not stated	Not stated		Not susceptible to potential boric acid leak	4-21 -24	139
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	140
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 manage effects of WEAR	5-25, 5-26	141
Core support loss, impair reactor shutdown.	Not stated	Not stated		Non significant because operating temp. <538 C (<1000 F)	4-20	142
Core support loss, impair reactor shutdown.	Not stated	Not stated		Non significant because of proper material selection & relatively low operating temp.	4-18 to 4-20	143
Core support loss, impair reactor shutdown.	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		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 of 10CFR 50	4-2 to 4-6	145
Loss of pressure boundary.	Not stated	ASME Sect. XI, Subsect. IWB, examination category B E & 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	146
Loss of pressure boundary.	Not stated	Not stated		Non significant because Ni alloy is resistant to CORR	4-21 to 4-24	147
Loss of pressure boundary.	Not stated	Not stated		Not susceptible to potential boric acid leak	4-21 -24	148
Loss 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
Loss of pressure boundary.	Not stated	Not stated		Non significant because not subject to relative motion	4-26, 4-27	150
Loss of pressure boundary.	Not stated	Not stated		Non significant because operating temp. <538 C (<1000 F)	4-20	151
Loss of pressure boundary.	Not stated	Not stated		Non significant because of proper material selection & relatively low operating temp.	4-18 to 4-20	152
Loss of pressure boundary.	Not stated	ASME Sect. III, Subsect. NB fatigue analysis; ASME Sect. XI, Subsect. IWB (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	153

Table B.1 Gall Report for NUMARC Industry Reports

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Reviewed by: Omesh K. Chopra, ANL

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
1	Upper Internals Assembly	CE: Upper Guide Structure Support Plate, or B&W: Plenum Cover & Plenum Cylinder	Not stated	SS	Not stated	EMBR/IR	Loss of fracture toughness
2	Upper Internals Assembly	CE: Upper Guide Structure Support Plate, or B&W: Plenum Cover & Plenum Cylinder	Not stated	SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
3	Upper Internals Assembly	CE: Upper Guide Structure Support Plate, or B&W: Plenum Cover & Plenum Cylinder	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth
4	Upper Internals Assembly	CE: Upper Guide Structure Support Plate, or B&W: Plenum Cover & Plenum Cylinder	Not stated	SS	Not stated	CORR,CORR/PIT	Loss of material, corrosion product buildup
5	Upper Internals Assembly	CE: Upper Guide Structure Support Plate, or B&W:Plenum Cover & Plenum Cylinder	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss of material
6	Upper Internals Assembly	CE: Upper Guide Structure Support Plate, or B&W:Plenum Cover & Plenum Cylinder	Not stated	SS	Not stated	WEAR	Attrition
7	Upper Internals Assembly	CE: Upper Guide Structure Support Plate, or B&W:Plenum Cover & Plenum Cylinder	Not stated	SS	Not stated	CREEP	Change in dimension
8	Upper Internals Assembly	CE: Upper Guide Structure Support Plate, or B&W:Plenum Cover & Plenum Cylinder	Not stated	SS	Not stated	RELAX	Loss of preload
9	Upper Internals Assembly	CE: Upper Guide Structure Support Plate, or B&W:Plenum Cover & Plenum Cylinder	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
10	Upper Internals Assembly	CE: Upper Guide Structure Support Plate, or B&W:Plenum Cover & Plenum Cylinder	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
11	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	EMBR/IR	Loss of fracture toughness
12	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	CORR/SCC,CORR/CREV	Crack initiation & growth, loss of material

Table B.1 Gall Report for NUMARC Industry Reports

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	1
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	2
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	3
Core support loss, prevent control rod insertion.	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	4
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	5
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	6
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	7
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	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	9
Core support loss, prevent control rod insertion.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress rept.		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4-30	10
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	11
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	12

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
13	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	CORR/IASCC	Crack initiation & growth
14	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	CORR, CORR/PIT	Loss of material, corrosion product buildup
15	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	ERO/CORR	Wall thinning, loss of 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 Cover & Plenum Cylinder	Not stated	SS	Not stated	CREEP	Change in dimension
18	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	RELAX	Loss of preload
19	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	EMBR/TE	Loss of fracture toughness
20	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	FAT	Cumulative fatigue damage
21	Upper Internals Assembly	W: RCCA Guide Tube Assembly	RCCA Guide Tube	SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)	Not stated	EMBR/IR	Loss of fracture toughness
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,CORR/CREV	Crack initiation & 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 Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	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	14
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	15
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	16
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	17
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non significant because components do not depend on preload	4-16, 4-17	18
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	19
Core support loss, prevent control rod insertion.	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	20
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	21
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 to4-9	22
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	23

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
24	Upper Internals Assembly	W: RCCA Guide Tube Assembly	RCCA Guide Tube	SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)	Not stated	CORR,CORR/PIT	Loss of material, 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 of 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 Assemblies	CEA Shrouds, CRA Guide Tubes	SS, Nicrobraze (Nicrobraze used only for CRA Guide tubes)	Not stated	CORR/IASCC	Crack initiation & growth
34	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, CORR/PIT	Loss of material, corrosion product buildup
35	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	Wall thinning, loss of material
36	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
37	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	CREEP	Change in dimension
38	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	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	Rel.progs	Report Recommendations	Page No.	Item
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	24
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	25
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	26
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	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 insertion.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 4-22	29
Core support loss, prevent control rod insertion.	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
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	32
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	33
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	34
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	35
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	36
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	37
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	38

Table B.1 Gall Report for NUMARC Industry Reports

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
39	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	EMBR/TE	Loss of fracture toughness
40	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	FAT	Cumulative fatigue damage
41	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes	CASS	Not stated	EMBR/IR	Loss of fracture toughness
42	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes	CASS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
43	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes	CASS	Not stated	CORR/IASCC	Crack initiation & growth
44	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes	CASS	Not stated	CORR,CORR/PIT	Loss of material, corrosion product buildup
45	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes	CASS	Not stated	ERO/CORR	Wall thinning, loss of material
46	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes	CASS	Not stated	WEAR	Attrition
47	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes	CASS	Not stated	CREEP	Change in dimension
48	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes	CASS	Not stated	RELAX	Loss of preload
49	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes	CASS	Not stated	EMBR/TE	Loss of fracture toughness
50	Upper Internals Assembly	CE: CEA Shroud Assembly, or B&W: CRA Guide Tube Assemblies	CEA Shrouds, CRA Guide Tubes	CASS	Not stated	FAT	Cumulative fatigue damage
51	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	EMBR/IR	Loss of fracture toughness
52	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	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	39
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	40
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	41
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	42
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	43
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	44
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	45
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	46
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	47
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	48
Core support loss, prevent control rod insertion.	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	49
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	50
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	51
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	52

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
53	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	CORR/IASCC	Crack initiation & growth
54	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	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 of material
56	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	WEAR	Attrition
57	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	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 Internals 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 fracture toughness
62	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
63	Upper Internals Assembly	CE: CEA Shroud Assemblies	CEA Shroud Bolts	SS, Ni alloy	Not stated	CORR/IASCC	Crack initiation & growth
64	Upper Internals Assembly	CE: CEA Shroud Assemblies	CEA Shroud Bolts	SS, Ni alloy	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
65	Upper Internals Assembly	CE: CEA Shroud Assemblies	CEA Shroud Bolts	SS, Ni alloy	Not stated	ERO/CORR	Wall thinning, loss of material
66	Upper Internals Assembly	CE: CEA Shroud Assemblies	CEA Shroud Bolts	SS, Ni alloy	Not stated	WEAR	Attrition
67	Upper Internals Assembly	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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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	53
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	54
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	55
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	56
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	57
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 for detecting cracked or missing bolts & corrective action includes root cause determination	5-7, 5-8	58
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	59
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	60
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	61
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	5-5, 5-6	62
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	63
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	64
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	65
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non significant because not subject to relative motion	4-19	66
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	67
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 for detecting cracked or missing bolts & corrective action includes root cause determination	5-7, 5-8	68

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
69	Upper Internals Assembly	CE: CEA Shroud Assemblies	CEA Shroud Bolts	SS, Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness
70	Upper Internals Assembly	CE: CEA Shroud Assemblies	CEA Shroud Bolts	SS, Ni alloy	Not stated	FAT	Cumulative fatigue damage
71	Upper Internals Assembly	W: RCCA Guide Tube Assemblies	RCCA Guide Tube Support Pins	SS, Ni alloy	Not stated	EMBR/IR	Loss of fracture toughness
72	Upper Internals Assembly	W: RCCA Guide Tube Assemblies	RCCA Guide Tube Support Pins	SS, Ni alloy	Not stated	CORR/SCC,CORR/CREV	Crack initiation & growth, loss of material
73	Upper Internals Assembly	W: RCCA Guide Tube Assemblies	RCCA Guide Tube Support Pins	SS, Ni alloy	Not stated	CORR/IASCC	Crack initiation & growth
74	Upper Internals Assembly	W: RCCA Guide Tube Assemblies	RCCA Guide Tube Support Pins	SS, Ni alloy	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
75	Upper Internals Assembly	W: RCCA Guide Tube Assemblies	RCCA Guide Tube Support Pins	SS, Ni alloy	Not stated	ERO/CORR	Wall thinning, loss of material
76	Upper Internals Assembly	W: RCCA Guide Tube Assemblies	RCCA Guide Tube Support Pins	SS, Ni alloy	Not stated	WEAR	Attrition
77	Upper Internals Assembly	W: RCCA Guide Tube Assemblies	RCCA Guide Tube Support Pins	SS, Ni alloy	Not stated	CREEP	Change in dimension
78	Upper Internals Assembly	W: RCCA Guide Tube Assemblies	RCCA Guide Tube Support Pins	SS, Ni alloy	Not stated	RELAX	Loss of preload
79	Upper Internals Assembly	W: RCCA Guide Tube Assemblies	RCCA Guide Tube Support Pins	SS, Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness
80	Upper Internals Assembly	W: RCCA Guide Tube Assemblies	RCCA Guide Tube Support Pins	SS, Ni alloy	Not stated	FAT	Cumulative fatigue damage
81	Upper Internals Assembly	W:Upper Support Columns	Not stated	SS	Not stated	EMBR/IR	Loss of fracture toughness
82	Upper Internals Assembly	W:Upper Support Columns	Not stated	SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
83	Upper Internals Assembly	W:Upper Support Columns	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth
84	Upper Internals Assembly	W:Upper Support Columns	Not stated	SS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup

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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	69
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	70
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	71
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	5-5, 5-6	72
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	73
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 insertion.	Not stated	Not stated		Non-significant because not subject to relative motion.	4-19	76
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	77
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	78
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	79
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	80
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	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 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	83
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	84

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Item	System	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 of material
86	Upper Internals Assembly	W:Upper Support Columns	Not stated	SS	Not stated	WEAR	Attrition
87	Upper Internals Assembly	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 Assembly	W:Upper Support Columns	Not stated	CASS	Not stated	EMBR/IR	Loss of fracture toughness
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 of material
96	Upper Internals Assembly	W:Upper Support Columns	Not stated	CASS	Not stated	WEAR	Attrition
97	Upper Internals Assembly	W:Upper Support Columns	Not stated	CASS	Not stated	CREEP	Change in dimension
98	Upper Internals Assembly	W:Upper Support Columns	Not stated	CASS	Not stated	RELAX	Loss of preload
99	Upper Internals Assembly	W:Upper Support Columns	Not stated	CASS	Not stated	EMBR/TE	Loss of fracture toughness
100	Upper Internals Assembly	W:Upper Support Columns	Not stated	CASS	Not stated	FAT	Cumulative fatigue damage
101	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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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	85
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	86
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	87
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	88
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	89
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 insertion.	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 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	92
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	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
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non significant because not subject to relative motion	4-19	96
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	97
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non significant because components do not depend on preload	4-16, 4-17	98
Core support loss, prevent control rod insertion.	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
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	100
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	101

Table B.1 Gall Report for NUMARC Industry Reports

Document: IR 90-05, PWR Vessel Internals Industry Report
Reviewed by: Omesh K. Chopra, ANL

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
102	Upper Internals Assembly	W: Upper Support Column Bolts	Not stated	SS, Ni alloy	Not stated	CORR/SCC, CORR/CREV	Crack initiation & 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 Assembly	W: Upper Support Column Bolts	Not stated	SS, Ni alloy	Not stated	WEAR	Attrition
107	Upper Internals Assembly	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 fatigue 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
112	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 initiation & growth, loss of material
113	Upper Internals Assembly	W:Upper Core Plate, or B&W:Upper Grid Assembly	Not stated, Upper Grid Rib Section	SS	Not stated	CORR/IASCC	Crack initiation & growth
114	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
115	Upper Internals Assembly	W:Upper Core Plate, or B&W:Upper Grid Assembly	Not stated, Upper Grid Rib Section	SS	Not stated	ERO/CORR	Wall thinning, loss of material
116	Upper Internals Assembly	W:Upper Core Plate, or B&W:Upper Grid Assembly	Not stated, Upper Grid Rib Section	SS	Not stated	WEAR	Attrition
117	Upper Internals Assembly	W:Upper Core Plate, or B&W:Upper Grid Assembly	Not stated, Upper Grid Rib Section	SS	Not stated	CREEP	Change in dimension

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	Report Recommendations	Page No.	Item
Core support loss, prevent control rod insertion.	Not stated	Non significant because fabricated of SS; stress levels within design spec (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	102
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	103
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	104
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	105
Core support loss, prevent control rod insertion.	Not stated	Not stated		Non-significant because not subject to relative motion.	4-19	106
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	107
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 for detecting cracked or missing bolts & corrective action includes root cause determination	5-7, 5-8	108
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	109
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	110
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	111
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	112
Loss of support to fuel 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	113
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	114
Loss 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
Loss of support to fuel assembly.	Not stated	Not stated		Non significant because not subject to relative motion	4-19	116
Loss 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

Table B.1 Gall Report for NUMARC Industry Reports

Document: IR 90-05, PWR Vessel Internals Industry Report
Reviewed by: Omesh K. Chopra, ANL

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
118	Upper Internals Assembly	Grid Assembly	Not stated, Upper Grid Rib Section	SS	Not stated	RELAX	Loss of preload
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	B&W: Upper Grid 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	CORR/IASCC	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 of material
126	Upper Internals Assembly	B&W: Upper Grid Assembly	Upper Grid Assembly Bolts	SS, Ni alloy	Not stated	WEAR	Attrition
127	Upper Internals Assembly	B&W: Upper Grid Assembly	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
131	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	EMBR/IR	Loss of fracture toughness
132	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/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 Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Loss of support to fuel assembly.	Not stated	Not stated		Non significant because components do not depend on preload	4-16, 4-17	118
Loss 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	119
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	120
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	121
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	122
Loss of support to fuel 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	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
Loss 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
Loss of support to fuel assembly.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	126
Loss 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	127
Loss of support to fuel assembly.	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	128
Loss 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
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	130
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	131
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	132

Document: IR 90-05, PWR Vessel Internals Industry Report
Reviewed by: Omesh K. Chopra, ANL

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
133	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/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/PIT	Loss of material, 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 alloy (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	Fuel Guide Pads	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	Fuel Guide Pads	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	Fuel Guide Pads	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	Fuel Guide Pads	SS, Ni alloy (Ni alloy used only for Upper Core Plate Fuel Pins)	Not stated	FAT	Cumulative fatigue 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	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
145	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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Reviewed by: Omesh K. Chopra, ANL

Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	133
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 insertion.	Not stated	Not stated		Non significant because components do not depend on preload.	4-16, 4-17	138
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	139
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	140
Core support loss, impaired flow, 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	141
Core support loss, impaired flow, 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	142
Core support loss, impaired flow, 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	143
Core support loss, impaired flow, 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	144
Core support loss, impaired flow, 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	145

Document: IR 90-05, PWR Vessel Internals Industry Report
Reviewed by: Omesh K. Chopra, ANL

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
146	Core Support Assembly	W:Core Barrel or CE: Core Support Barrel, or B&W:Core Support Shield	Not stated	SS	Not stated	WEAR	Attrition
147	Core Support Assembly	W:Core Barrel or CE: Core Support Barrel, or B&W:Core Support Shield	Not stated	SS	Not stated	CREEP	Change in dimension
148	Core Support Assembly	W:Core Barrel or CE: Core Support Barrel, or B&W:Core Support Shield	Not stated	SS	Not stated	RELAX	Loss of preload
149	Core Support Assembly	W:Core Barrel or CE: Core Support Barrel, or B&W:Core Support Shield	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
150	Core Support Assembly	W:Core Barrel or CE: Core Support Barrel, or B&W:Core Support Shield	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
151	Core Support Assembly	W:Core Barrel Nozzles	Not stated	SS	Not stated	EMBR/IR	Loss of fracture toughness
152	Core Support Assembly	W:Core Barrel Nozzles	Not stated	SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
153	Core Support Assembly	W:Core Barrel Nozzles	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth
154	Core Support Assembly	W:Core Barrel Nozzles	Not stated	SS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
155	Core Support Assembly	W:Core Barrel Nozzles	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss of material
156	Core Support Assembly	W:Core Barrel Nozzles	Not stated	SS	Not stated	WEAR	Attrition
157	Core Support Assembly	W:Core Barrel Nozzles	Not stated	SS	Not stated	CREEP	Change in dimension
158	Core Support Assembly	W:Core Barrel Nozzles	Not stated	SS	Not stated	RELAX	Loss of preload
159	Core Support Assembly	W:Core Barrel Nozzles	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
160	Core Support Assembly	W:Core Barrel Nozzles	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
161	Core Support Assembly	W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange	Not stated	SS	Not stated	EMBR/IR	Loss of fracture toughness

Table B.1 Gall Report for NUMARC Industry Reports

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Core support loss, impaired flow, prevent control rod insertion.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	146
Core support loss, impaired flow, 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	147
Core support loss, impaired flow, prevent control rod insertion.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	148
Core support loss, impaired flow, 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	149
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	150
Core support loss, impaired flow, 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	4-3, 4-4	151
Core support loss, impaired flow, 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	152
Core support loss, impaired flow, 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	153
Core support loss, impaired flow, 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	154
Core support loss, impaired flow, 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	155
Core support loss, impaired flow, prevent control rod insertion.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	156
Core support loss, impaired flow, 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	157
Core support loss, impaired flow, prevent control rod insertion.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	158
Core support loss, impaired flow, 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	159
Core support loss, impaired flow, prevent control rod insertion.	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	160
Core support loss, impaired flow, 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	161

Table B.1 Gall Report for NUMARC Industry Reports

Document: IR 90-05, PWR Vessel Internals Industry Report
Reviewed by: Omesh K. Chopra, ANL

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
162	Core Support Assembly	W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange	Not stated	SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
163	Core Support Assembly	W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth
164	Core Support Assembly	W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange	Not stated	SS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
165	Core Support Assembly	W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss of material
166	Core Support Assembly	W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange	Not stated	SS	Not stated	WEAR	Attrition
167	Core Support Assembly	W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange	Not stated	SS	Not stated	CREEP	Change in dimension
168	Core Support Assembly	W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange	Not stated	SS	Not stated	RELAX	Loss of preload
169	Core Support Assembly	W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
170	Core Support Assembly	W:Upper Core Barrel Flange or CE: Core Support Barrel Upper Flange, or B&W:Core Support Shield Flange	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
171	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	SS	Not stated	EMBR/IR	Loss of fracture toughness
172	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth; loss of material
173	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth

Table B.1 Gall Report for NUMARC Industry Reports

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Reviewed by: Omesh K. Chopra, ANL

Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Core support loss, impaired flow, 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	162
Core support loss, impaired flow, 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	163
Core support loss, impaired flow, 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	164
Core support loss, impaired flow, 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	165
Core support loss, impaired flow, 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	166
Core support loss, impaired flow, 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	167
Core support loss, impaired flow, prevent control rod insertion.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	168
Core support loss, impaired flow, 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	169
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 -6 to 4-30	170
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	171
Core cooling 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	4-6 to 4-9	172
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	173

Table B.1 Gall Report for NUMARC Industry Reports

Document: IR 90-05, PWR Vessel Internals Industry Report
Reviewed by: Omesh K. Chopra, ANL

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
174	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	SS	Not stated	CORR,CORR/PIT	Loss of material, corrosion product buildup
175	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss of material
176	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	SS	Not stated	WEAR	Attrition
177	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	SS	Not stated	CREEP	Change in dimension
178	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	SS	Not stated	RELAX	Loss of preload
179	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
180	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
181	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	EMBR/IR	Loss of fracture toughness
182	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	CORR/SCC,CORR/CREV	Crack initiation & growth, loss of material
183	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	CORR/IASCC	Crack initiation & growth
184	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
185	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	ERO/CORR	Wall thinning, loss of material
186	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	WEAR	Attrition
187	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	CREEP	Change in dimension
188	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	RELAX	Loss of preload
189	Core Support Assembly	B&W:Vent Valve Assemblies	Not stated	CASS	Not stated	EMBR/TE	Loss of fracture toughness

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	174
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	175
Core cooling during LOCA.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	176
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	177
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 cooling 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	4-6 to 4-9	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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Item	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: Baffle Former Assembly	Baffle/Former Assembly Bolts	SS, Ni alloy	Not stated	EMBR/IR	Loss of fracture toughness
192	Core Support Assembly	W: Baffle Former Assembly	Baffle/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	Baffle/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	ERO/CORR	Wall thinning, loss of material
196	Core Support Assembly	W: Baffle Former Assembly	Baffle/Former Assembly Bolts	SS, Ni alloy	Not stated	WEAR	Attrition
197	Core Support Assembly	W: Baffle Former Assembly	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	Baffle/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 alloy	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	CORR/IASCC	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 of material

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Core cooling during LOCA.	Not stated	Non-significant based on fatigue usage factor & review of plant design stress repo		NRC recommendation: Until an agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4-30	190
Impaired 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	191
Impaired 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	192
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	193
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 elements & instrumentation assembly.	Not stated	Not stated		Non-significant because operating temps. are well below levels at which creep is a concern	4-15	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
Impaired 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
Impaired 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
Impaired 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
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	203
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	204
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	205

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Item	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 alloy	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 fatigue damage
211	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Tie Rods	SS,	Not stated	EMBR/IR	Loss of fracture 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, loss of material
216	Core Support Assembly	CE:Core Shroud Assembly	Core Shroud Tie Rods	SS	Not stated	WEAR	Attrition
217	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 Assembly	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 Assembly	Baffle/Former Bolts	SS, Ni alloy	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material

Table B.1 Gall Report for NUMARC Industry Reports

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	206
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	207
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	208
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	209
Impaired coolant flow, damage fuel elements & instrumentation assembly.	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	210
Impaired 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	211
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Non-significant because fabricated of SS; stress levels within design spec (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	212
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	213
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	214
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	215
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	216
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	217
Impaired 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 detecting cracked or missing bolts & corrective action includes root cause determination	5-7, 5-8	218
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	219
Impaired coolant flow, damage fuel elements & instrumentation assembly.	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	220
Impaired 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	221
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Non-significant because fabricated of SS; stress levels within design spec (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	222

Table B.1 Gall Report for NUMARC Industry Reports

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
223	Core Support Assembly	B&W: Core Barrel Assembly	Baffle/Former Bolts	SS, Ni alloy	Not stated	CORR/IASCC	Crack initiation & growth
224	Core Support Assembly	B&W: Core Barrel Assembly	Baffle/Former Bolts	SS, Ni alloy	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
225	Core Support Assembly	B&W: Core Barrel Assembly	Baffle/Former Bolts	SS, Ni alloy	Not stated	ERO/CORR	Wall thinning, loss of material
226	Core Support Assembly	B&W: Core Barrel Assembly	Baffle/Former Bolts	SS, Ni alloy	Not stated	WEAR	Attrition
227	Core Support Assembly	B&W: Core Barrel Assembly	Baffle/Former Bolts	SS, Ni alloy	Not stated	CREEP	Change in dimension
228	Core Support Assembly	B&W: Core Barrel Assembly	Baffle/Former Bolts	SS, Ni alloy	Not stated	RELAX	Loss of preload
229	Core Support Assembly	B&W: Core Barrel Assembly	Baffle/Former Bolts	SS, Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness
230	Core Support Assembly	B&W: Core Barrel Assembly	Baffle/Former Bolts	SS, Ni alloy	Not stated	FAT	Cumulative fatigue damage
231	Core Support Assembly	B&W: Core Barrel Assembly	Core Barrel Bolts	SS, Ni alloy	Not stated	EMBR/IR	Loss of fracture toughness
232	Core Support Assembly	B&W: Core Barrel Assembly	Core Barrel Bolts	SS, Ni alloy	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
233	Core Support Assembly	B&W: Core Barrel Assembly	Core Barrel Bolts	SS, Ni alloy	Not stated	CORR/IASCC	Crack initiation & 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
235	Core Support Assembly	B&W: Core Barrel Assembly	Core Barrel Bolts	SS, Ni alloy	Not stated	ERO/CORR	Wall thinning, loss of material
236	Core Support Assembly	B&W: Core Barrel Assembly	Core Barrel Bolts	SS, Ni alloy	Not stated	WEAR	Attrition
237	Core Support Assembly	B&W: Core Barrel Assembly	Core Barrel Bolts	SS, Ni alloy	Not stated	CREEP	Change in dimension
238	Core Support Assembly	B&W: Core Barrel Assembly	Core Barrel Bolts	SS, Ni alloy	Not stated	RELAX	Loss of preload
239	Core Support Assembly	B&W: Core Barrel Assembly	Core Barrel Bolts	SS, Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	223
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	224
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	225
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		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
Impaired 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
Impaired coolant flow, damage prevent control rod insertion.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	236
Impaired 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
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 detecting cracked or missing bolts & corrective action includes root cause determination	5-7, 5-8	238
Impaired 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

Item	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	Baffle/Former Assembly Baffles, Baffle/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	Baffle/Former Assembly Baffles, Baffle/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	Baffle/Former Assembly Baffles, Baffle/Former Plates	SS	Not stated	RELAX	Loss of preload
249	Core Support Assembly	W: Baffle Former Assembly or B&W: Core Barrel Assembly	Baffle/Former Assembly Baffles, Baffle/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

Document: IR 90-05, PWR Vessel Internals Industry Report
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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Impaired coolant flow, damage 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	240
Impaired 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	241
Impaired 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	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 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	244
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
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	246
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	247
Impaired coolant flow, damage fuel elements & instrumentation assembly.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	248
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	249
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	250
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.	5-4	251
Loss of core support 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	4-6 to 4-9	252
Loss of core support 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	253

Table B.1 Gall Report for NUMARC Industry Reports

Document: IR 90-05, PWR Vessel Internals Industry Report
Reviewed by: Omesh K. Chopra, ANL

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
254	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
255	Core Support Assembly	W:Upper Core Plate Alignment Pins	Not stated	SS, Ni alloy	Not stated	ERO/CORR	Wall thinning, loss of material
256	Core Support Assembly	W:Upper Core Plate Alignment Pins	Not stated	SS, Ni alloy	Not stated	WEAR	Attrition
257	Core Support Assembly	W:Upper Core Plate Alignment Pins	Not stated	SS, Ni alloy	Not stated	CREEP	Change in dimension
258	Core Support Assembly	W:Upper Core Plate Alignment Pins	Not stated	SS, Ni alloy	Not stated	RELAX	Loss of preload
259	Core Support Assembly	W:Upper Core Plate Alignment Pins	Not stated	SS, Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness
260	Core Support Assembly	W:Upper Core Plate Alignment Pins	Not stated	SS, Ni alloy	Not stated	FAT	Cumulative fatigue damage
261	Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	EMBR/IR	Loss of fracture toughness
262	Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
263	Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth
264	Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
265	Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss of material
266	Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	WEAR	Attrition
267	Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	CREEP	Change in dimension
268	Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	RELAX	Loss of preload
269	Core Support Assembly	CE: Fuel Alignment Plate Guide Lugs	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	254
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	255
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	4-19	256
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	257
Loss of core support during LOCA.	Not stated	Not stated		Non-significant because components do not depend on preload.	4-16, 4-17	258
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	259
Loss of core support during LOCA.	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
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	5-4	261
Loss of core support during LOCA.	Not stated	Non-significant because fabricated of SS; stress levels within design specificatio		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	262
Loss of core support 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	263
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	264
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	265
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	4-19	266
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	267
Loss of core support during LOCA.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	268
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	269

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Item	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 Internals 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

Table B.1 Gall Report for NUMARC Industry Reports

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	270
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 for internals that are or can be rendered accessible	5-4	271
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 creviced geometry	4-6 to 4-9	272
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	273
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	274
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	275
Damaged fuel assembly, impair reactor shut down, flow blockage.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	276
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	277
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	278
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	279
Damaged fuel assembly, impair reactor shut down, flow blockage.	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	280
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 for internals that are or can be rendered accessible	5- 4	281
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 creviced geometry	4-6 to 4-9	282
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	283
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	284

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
285	Lower Internals Assembly	B&W:Lower Grid Top Rib Section	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss of material
286	Lower Internals Assembly	B&W:Lower Grid Top Rib Section	Not stated	SS	Not stated	WEAR	Attrition
287	Lower Internals Assembly	B&W:Lower Grid Top Rib Section	Not stated	SS	Not stated	CREEP	Change in dimension
288	Lower Internals Assembly	B&W:Lower Grid Top Rib Section	Not stated	SS	Not stated	RELAX	Loss of preload
289	Lower Internals Assembly	B&W:Lower Grid Top Rib Section	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
290	Lower Internals Assembly	B&W:Lower Grid Top Rib Section	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
291	Lower Internals Assembly	W: Fuel Pins or CE: Fuel Alignment Pins	Not stated	SS, Ni alloy	Not stated	EMBR/IR	Loss of fracture toughness
292	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
293	Lower Internals Assembly	W: Fuel Pins or CE: Fuel Alignment Pins	Not stated	SS, Ni alloy	Not stated	CORR/IASCC	Crack initiation & growth
294	Lower Internals Assembly	W: Fuel Pins or CE: Fuel Alignment Pins	Not stated	SS, Ni alloy	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
295	Lower Internals Assembly	W: Fuel Pins or CE: Fuel Alignment Pins	Not stated	SS, Ni alloy	Not stated	ERO/CORR	Wall thinning, loss of material
296	Lower Internals Assembly	W: Fuel Pins or CE: Fuel Alignment Pins	Not stated	SS, Ni alloy	Not stated	WEAR	Attrition
297	Lower Internals Assembly	W: Fuel Pins or CE: Fuel Alignment Pins	Not stated	SS, Ni alloy	Not stated	CREEP	Change in dimension
298	Lower Internals Assembly	W: Fuel Pins or CE: Fuel Alignment Pins	Not stated	SS, Ni alloy	Not stated	RELAX	Loss of preload
299	Lower Internals Assembly	W: Fuel Pins or CE: Fuel Alignment Pins	Not stated	SS, Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness
300	Lower Internals Assembly	W: Fuel Pins or CE: Fuel Alignment Pins	Not stated	SS, Ni alloy	Not stated	FAT	Cumulative fatigue damage

Table B.1 Gall Report for NUMARC Industry Reports

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	285
Damaged fuel assembly, impair reactor shut down, flow blockage.	Not stated	Not stated		Non-significant because not subject to relative motion	4-19	286
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	287
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	288
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	289
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	290
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 for internals that are or can be rendered accessible	5-4	291
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 creviced geometry	4-6 to 4-9	292
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	293
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	294
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	295
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	296
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	297
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 for detecting cracked or missing bolts & corrective action includes root cause determination	5-7, 5-8	298
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	299
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	300

Table B.1 Gall Report for NUMARC Industry Reports

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
301	Lower Internals Assembly	B&W:Fuel Guide Pads	Not stated	SS	Not stated	EMBR/IR	Loss of fracture 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 Assembly	B&W:Fuel Guide Pads	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth
304	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, loss of 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	Lower Internals Assembly	B&W:Fuel Guide Pads	Not stated	SS	Not stated	RELAX	Loss of preload
309	Lower Internals Assembly	B&W:Fuel Guide Pads	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
310	Lower Internals Assembly	B&W:Fuel Guide Pads	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
311	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	EMBR/IR	Loss of fracture toughness
312	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	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
313	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	CORR/IASCC	Crack initiation & growth
314	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	CORR, CORR/PIT	Loss of material, corrosion product buildup

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Reviewed by: Omesh K. Chopra, ANL

Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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 for internals that are or can be rendered accessible	5-4	301
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 creviced geometry	4-6 to 4-9	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
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	313
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	314

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
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	Wall thinning, loss of material
316	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	WEAR	Attrition
317	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
318	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	RELAX	Loss of preload
319	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	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	Not stated	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	CORR/IASCC	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 of material
326	Lower Internals Assembly	W:Lower Support Plate	Not stated	CASS	Not stated	WEAR	Attrition

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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
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	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	Subcomponent	Materials	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 Columns	Not stated	SS	Not stated	EMBR/IR	Loss of fracture toughness
332	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
333	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth
334	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	CORR,CORR/PIT	Loss of material, corrosion product buildup
335	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss of material
336	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	WEAR	Attrition
337	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	CREEP	Change in dimension
338	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	RELAX	Loss of preload
339	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
340	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
341	Lower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	EMBR/IR	Loss of fracture toughness

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	327
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	328
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	329
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	330
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	331
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	332
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	341

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
342	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
343	Lower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	CORR/IASCC	Crack initiation & growth
344	Lower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	CORR, CORR/PIT	Loss of material, corrosion product buildup
345	Lower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	ERO/CORR	Wall thinning, loss of material
346	Lower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	WEAR	Attrition
347	Lower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	CREEP	Change in dimension
348	Lower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	RELAX	Loss of preload
349	Lower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	EMBR/TE	Loss of fracture toughness
350	Lower Internals Assembly	B&W:Lower Grid Assembly Support Posts	Not stated	SS	Not stated	FAT	Cumulative fatigue damage
351	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	CASS	Not stated	EMBR/IR	Loss of fracture toughness
352	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
353	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	CASS	Not stated	CORR/IASCC	Crack initiation & growth
354	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
355	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	CASS	Not stated	ERO/CORR	Wall thinning, loss of material
356	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	CASS	Not stated	WEAR	Attrition

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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	342
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	343
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	344
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	345
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	346
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	347
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	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	350
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		ASME Section XI, Subsect. IWB is effective for internals that are or can be rendered accessible	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
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	356

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
357	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	CASS	Not stated	CREEP	Change in dimension
358	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	CASS	Not stated	RELAX	Loss of preload
359	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	CASS	Not stated	EMBR/TE	Loss of fracture toughness
360	Lower Internals Assembly	W: Lower Support Columns or CE: Core Support Columns	Not stated	CASS	Not stated	FAT	Cumulative fatigue damage
361	Lower Internals Assembly	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	EMBR/IR	Loss of fracture toughness
362	Lower Internals Assembly	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	CORR/SCC, CORR/CREV	Crack initiation & growth, loss of material
363	Lower Internals Assembly	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	CORR/IASCC	Crack initiation & growth
364	Lower Internals Assembly	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	CORR, CORR/PIT	Loss of material, corrosion product buildup
365	Lower Internals Assembly	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	ERO/CORR	Wall thinning, loss of material
366	Lower Internals Assembly	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	WEAR	Attrition
367	Lower Internals Assembly	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	CREEP	Change in dimension
368	Lower Internals Assembly	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	RELAX	Loss of preload

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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	357
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	358
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	359
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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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
369	Lower Internals Assembly	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	EMBR/TE	Loss of fracture toughness
370	Lower Internals Assembly	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 of 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 Cylinder 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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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	369
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	370
Core support loss, LOCA.	Not stated	Not stated		Non-significant because adequate 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 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	372
Core support loss, 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	373
Core support loss, 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	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	4-14	375
Core support loss, 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	376
Core support loss, LOCA.	Not stated	Not stated		Non-significant because operating temps. are well below levels at which creep is a concern	4-15	377
Core support loss, LOCA.	Not stated	Not stated		Non-significant because components do not depend on preload	4-16, 4-17	378
Core support loss, LOCA.	Not stated	Not stated		Non-significant because wrought SS & Ni alloys are not susceptible to EMBR/TE	4-21, 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 agreement is reached on the draft staff discussion paper on fatigue, the issue is unresolved	4-26 to 4-30	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	5-4	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 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	382
Loss of core support 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	383

Document: IR 90-05, PWR Vessel Internals Industry Report
Reviewed by: Omesh K. Chopra, ANL

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
384	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 of 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

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
1	Class 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

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	Report Recommendations	Page No.	Item
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

Document: IR 90-06, Class 1 Structures Industry Report
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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	1
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

Table B.1 Gall Report for NUMARC Industry Reports

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
5	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, & loss of material
6	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CREEP	Deformation
7	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	SHRINK	Cracking
8	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	FAT	Cumulative fatigue damage
9	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
10	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	SETTLE (Applicable only to concrete foundations)	Cracking, in-crease in component stress level, distortion
11	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Exterior Concrete Above Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking, & spalling
12	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Exterior Concrete Above Grade	Concrete	Not stated	LEACH	Increase of porosity & permeability
13	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Exterior Concrete Above Grade	Concrete	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
14	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Exterior Concrete Above Grade	Concrete	Not stated	AGREAC	Expansion & cracking
15	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Exterior Concrete Above Grade	Concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, & loss of material

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	Report Recommendations	Page No.	Item
Lose shielding & protection of primary containment.	Not stated	Select plant-specific 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	5
Lose shielding & protection of primary containment.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	6
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	7
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	8
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
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	12
Lose shielding & protection of primary containment.	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	13
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	14
Lose shielding & protection of primary containment.	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	15

Table B.1 Gall Report for NUMARC Industry Reports

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
16	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Exterior Concrete Above Grade	Concrete	Not stated	CREEP	Deformation
17	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Exterior Concrete Above Grade	Concrete	Not stated	SHRINK	Cracking
18	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Exterior Concrete Above Grade	Concrete	Not stated	FAT	Cumulative fatigue damage
19	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Exterior Concrete Above Grade	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
20	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Interior Concrete Walls/Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
21	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Interior Concrete Walls/Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	AGREAC	Expansion & cracking
22	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	ELE-TEMP	Loss of strength & modulus
23	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	EMBR/IR	Loss of strength & modulus
24	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	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
25	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CREEP	Deformation
26	Class 1 Structures	BWR Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	SHRINK	Cracking

Document: IR 90-06, Class 1 Structures Industry Report
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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Lose shielding & protection of primary containment.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	16
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	17
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	18
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	19
Lose shielding & protection of primary containment	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	20
Lose shielding & protection of primary containment	Not stated	Not stated		Same as for foundation & exterior concrete above & below grade	4-16 to 4-19	21
Lose shielding & protection of primary containment	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	22
Lose shielding & protection of primary containment	Not stated	Not stated		Non-significant because radiation dose is low compared to the level causing degradation.	4-29 -41; 4-53 -59	23
Lose shielding & protection of primary containment	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	24
Lose shielding & protection of primary containment	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	25
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	26

Table B.1 Gall Report for NUMARC Industry Reports

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
27	Class 1 Structures	BWP Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	MASON-BLOC -Applicable only to masonry block walls	Cracking of masonry block walls
28	Class 1 Structures	BWP Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	FAT (Applicable only to concrete structures)	Cumulative fatigue damage
29	Class 1 Structures	BWP Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CATH	Cathodic protection effect on bond strength
30	Class 1 Structures	BWP Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Structural Steel, Metal Siding (Metal siding only for BWR Reactor Building with Steel Superstructure)	Carbon steel	Not stated	ELE-TEMP	Loss of strength & modulus
31	Class 1 Structures	BWP Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Structural Steel, Metal Siding (Metal siding only for BWR Reactor Building with Steel Superstructure)	Carbon steel	Not stated	EMBR/IR	Loss of fracture toughness
32	Class 1 Structures	BWP Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Structural Steel	Carbon steel	Not stated	CORR Unresolved	Loss of material
33	Class 1 Structures	BWP Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Structural Steel	Carbon steel	Not stated	FAT	Cumulative fatigue damage
34	Class 1 Structures	BWP Reactor Building & PWR Shielding Building & BWR Reactor Building with Steel Superstructure	Steel Piles	Carbon steel	Not stated	CORR	Loss of material
35	Class 1 Structures	BWR Reactor Building with Steel Superstructure	Metal Siding, Metal Roofing	Carbon steel	Not stated	CORR Unresolved	Loss of material
36	Class 1 Structures	Control Room/Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking, & spalling
37	Class 1 Structures	Control Room/Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	LEACH	Increase of porosity & permeability
38	Class 1 Structures	Control Room/ Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	AGR-CHEM Unresolved	Increase of porosity & permeability, cracking, & spalling

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	Report Recommendations	Page No.	Item
Lose shielding & protection of primary containment	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	27
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	28
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	29
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
Lose 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
Lose 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
Lose 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
Lose protection of safety related control equipment.	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

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

Item	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 fatigue 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 stress 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 porosity & permeability
48	Class 1 Structures	Control Room/Building	Exterior Concrete Above Grade	Concrete	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
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, & loss of material
51	Class 1 Structures	Control Room/Building	Exterior Concrete Above Grade	Concrete	Not stated	CREEP	Deformation
52	Class 1 Structures	Control Room/Building	Exterior Concrete Above Grade	Concrete	Not stated	SHRINK	Cracking
53	Class 1 Structures	Control Room/Building	Exterior Concrete Above Grade	Concrete	Not stated	FAT	Cumulative fatigue damage

Table B.1 Gall Report for NUMARC Industry Reports

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Lose protection of safety related control 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	39
Lose protection of safety related control 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	40
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	41
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	42
Lose 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	43
Lose 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	44
Lose 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	45
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	46
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	47
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	48
Lose protection of safety related control 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	49
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	50
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	51
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	52
Lose 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	53

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
54	Class 1 Structures	Control Room/Building	Exterior Concrete Above Grade	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
55	Class 1 Structures	Control 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
56	Class 1 Structures	Control 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
58	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
59	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
60	Class 1 Structures	Control Room/Building	Interior Concrete Walls/Columns; Interior Concrete Slabs/Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CREEP	Deformation
61	Class 1 Structures	Control Room/ Building	Interior Concrete Walls/Columns; Interior Concrete Slabs/Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	SHRINK	Cracking
62	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
63	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
64	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

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Lose 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	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
Lose 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
Lose 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 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	65

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Item	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, & spalling
71	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	LEACH	Increase of porosity & permeability
72	Class 1 Structures	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/ Piping Tunnels	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CORR/RE Unresolved	Cracking, spalling, loss of bond, & loss of material
75	Class 1 Structures	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	CATH	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 stress level, distortion.

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Lose protection of safety related control equipment.	Not stated	Not stated		Non-significant because radiation dose is low compared to the level causing degradation.	4-65 -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	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-cement 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		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 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	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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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
80	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Exterior Concrete Above Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking, & spalling
81	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
82	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
83	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Exterior Concrete Above Grade	Concrete	Not stated	AGREAC	Expansion & cracking
84	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
85	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Exterior Concrete Above Grade	Concrete	Not stated	CREEP	Deformation
86	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Exterior Concrete Above Grade	Concrete	Not stated	SHRINK	Cracking
87	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Exterior Concrete Above Grade	Concrete	Not stated	FAT	Cumulative fatigue damage
88	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Exterior Concrete Above Grade	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
89	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
90	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

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Lose protection of safety related 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	80
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	81
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	82
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	83
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	84
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	85
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	86
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	87
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	88
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	89
Lose protection of safety related equipment.	Not stated	Not stated		Same as for foundation & exterior concrete above & below grade	4-16 to 4-19	90

Table B.1 Gall Report for NUMARC Industry Reports

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
91	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	ELE-TEMP	Loss of strength & modulus
92	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	EMBR/IR	Loss of strength & modulus
93	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	CORR/RE	Cracking, spalling, loss of bond, & loss of material
94	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	CREEP	Deformation
95	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	SHRINK	Cracking
96	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	MASON-BLOC (Applicable only to masonry block wall)	Cracking of masonry block walls
97	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	FAT (Applicable only to concrete structures)	Cumulative fatigue damage
98	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	CATH	Cathodic protection effect on bond strength
99	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Structural Steel	Carbon steel	Not stated	ELE-TEMP	Loss of strength & modulus
100	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Structural Steel	Carbon steel	Not stated	EMBR/IR	Loss of fracture toughness
101	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Structural Steel	Carbon steel	Not stated	CORR Unresolved	Loss of material
102	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Structural Steel	Carbon steel	Not stated	FAT	Cumulative fatigue damage

Table B.1 Gall Report for NUMARC Industry Reports

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	91
Lose 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	92
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	93
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	94
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	95
Lose 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
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	97
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	98
Lose protection of safety related equipment.	Not stated	Not stated		Degradation is non-significant for structural steel components, metal sidings, & liners maintained at temperatures <371C (<700_F).	4-64, 4-65 & 4-70, 4-71	99
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	100
Lose protection of safety related equipment.	Not stated	Select plant-specific program for below grade structural steel not (More)		This item was not the focus of this NRC review.	5-11, 5-12	101
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	102

Table B.1 Gall Report for NUMARC Industry Reports

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
103	Class 1 Structures	Auxiliary Building; Diesel Generator Building; Turbine Building; & Utility/ Piping Tunnels	Steel Piles	Carbon steel	Not stated	CORR	Loss of material
104	Class 1 Structures	Radwaste Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking, & spalling
105	Class 1 Structures	Radwaste Building	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	LEACH	Increase of porosity & permeability
106	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, & loss 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 stress level, distortion.
114	Class 1 Structures	Radwaste Building	Exterior Concrete Above Grade	Concrete	Not stated	FRZ-THAW	Scaling, cracking, & spalling
115	Class 1 Structures	Radwaste Building	Exterior Concrete Above Grade	Concrete	Not stated	LEACH	Increase of porosity & permeability
116	Class 1 Structures	Radwaste Building	Exterior Concrete Above Grade	Concrete	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	103
Radiation Release.	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	104
Radiation Release.	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	105
Radiation Release.	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	106
Radiation Release.	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	107
Radiation Release.	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	108
Radiation Release.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	109
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	110
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	111
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	112
Radiation Release.	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	113
Radiation Release.	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	114
Radiation Release.	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	115
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	116

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Item	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 Above Grade	Concrete	Not stated	CREEP	Deformation
120	Class 1 Structures	Radwaste Building	Exterior Concrete Above Grade	Concrete	Not stated	SHRINK	Cracking
121	Class 1 Structures	Radwaste Building	Exterior Concrete Above Grade	Concrete	Not stated	FAT	Cumulative fatigue damage
122	Class 1 Structures	Radwaste Building	Exterior Concrete Above Grade	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
123	Class 1 Structures	Radwaste Building	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
124	Class 1 Structures	Radwaste Building	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	AGREAC	Expansion & cracking
125	Class 1 Structures	Radwaste Building	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	ELE-TEMP	Loss of strength & modulus
126	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
127	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, & loss of material
128	Class 1 Structures	Radwaste Building	Interior Concrete Walls/ 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/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	SHRINK	Cracking

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Radiation Release.	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	117
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 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	118
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
Radiation Release.	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	125
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 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	127
Radiation Release.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	128
Radiaton 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	129

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
130	Class 1 Structures	Radwaste Building	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	MASON-BLOC -Applicable only to masonry block walls	Cracking of masonry block walls
131	Class 1 Structures	Radwaste 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
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	CORR/RE	Cracking, spalling, loss of bond, & loss of material

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Radiation Release.	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
Lose 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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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
143	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 Slabs/ Beams; & 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 Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	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 masonry 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 fatigue 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 1 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 Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Lose protection of safety related equipment.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	143
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	144
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	145
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	146
Lose 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	147
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	148
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	149
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	151
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	152
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	153
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	154
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	155
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	156

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
157	Class 1 Structures	Auxiliary Feedwater Pump House	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	CREEP	Deformation
158	Class 1 Structures	Auxiliary Feedwater Pump House	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	CATH	Cathodic protection 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-crease in component stress 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 porosity & permeability
164	Class 1 Structures	Auxiliary Feedwater Pump House	Exterior Concrete Above Grade	Concrete	Not stated	AGR-CHEM	Increase of porosity & 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, & loss of material
167	Class 1 Structures	Auxiliary Feedwater Pump House	Exterior Concrete Above Grade	Concrete	Not stated	CREEP	Deformation
168	Class 1 Structures	Auxiliary Feedwater Pump House	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 porosity & permeability, cracking, & spalling

Table B.1 Gall Report for NUMARC Industry Reports

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Loss of feedwater.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	157
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	158
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	159
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	160
Loss of feedwater.	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	161
Loss of feedwater.	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	162
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	163
Loss of feedwater.	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	164
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	165
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	166
Loss of feedwater.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	167
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	168
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	169
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	170
Loss of feedwater.	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	171

Table B.1 Gall Report for NUMARC Industry Reports

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
172	Class 1 Structures	Auxiliary Feedwater Pump House	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	AGREAC	Expansion & cracking
173	Class 1 Structures	Auxiliary Feedwater Pump House	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	ELE-TEMP	Loss of strength & modulus
174	Class 1 Structures	Auxiliary Feedwater Pump House	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	EMBR/IR	Loss of strength & modulus
175	Class 1 Structures	Auxiliary Feedwater Pump House	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
176	Class 1 Structures	Auxiliary Feedwater Pump House	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CREEP	Deformation
177	Class 1 Structures	Auxiliary Feedwater Pump House	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	SHRINK	Cracking
178	Class 1 Structures	Auxiliary Feedwater Pump House	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	MASON-BLOC (Applicable only to masonry block walls	Cracking of masonry block walls
179	Class 1 Structures	Auxiliary Feedwater Pump House	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	FAT (Applicable only to concrete structures)	Cumulative fatigue damage
180	Class 1 Structures	Auxiliary Feedwater Pump House	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	CATH	Cathodic protection effect on bond strength
181	Class 1 Structures	Auxiliary Feedwater Pump House	Structural Steel	Carbon steel	Not stated	ELE-TEMP	Loss of strength & modulus
182	Class 1 Structures	Auxiliary Feedwater Pump House	Structural Steel	Carbon steel	Not stated	EMBR/IR	Loss of fracture toughness
183	Class 1 Structures	Auxiliary Feedwater Pump House	Structural Steel	Carbon steel	Not stated	CORR Unresolved	Loss of material
184	Class 1 Structures	Auxiliary Feedwater Pump House	Structural Steel	Carbon steel	Not stated	FAT	Cumulative fatigue damage

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Loss of feedwater.	Not stated	Not stated		Same as for foundation & exterior concrete above & below grade	4-16 to 4-19	172
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.	4-24 to 4-29 & 4-52, 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 temperatures <371 deg C (<700_F).	4-64, 4-65 & 4-70, 4-71	181
Loss of feedwater.	Not stated	Not stated		Non-significant because radiation dose is low compared to the level causing degradation.	4-65 -68, 4-71	182
Loss of feedwater.	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	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	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	Interior Concrete Walls/ Columns & Interior Concrete Slabs/ Beams	Concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, & loss of material
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	Interior Concrete Walls/ Columns & Interior Concrete Slabs/ Beams	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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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	185
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	186
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	187
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	188
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	189
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	190
Loss of shielding.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	191
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	192
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	193
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	195
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	196
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	197
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	198
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	199

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Item	System	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 porosity & permeability
202	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	AGR-CHEM Unresolved	Increase of porosity & permeability, cracking, & spalling
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, & loss 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 protection 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-crease in component stress 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 porosity & permeability
212	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Exterior Concrete Above Grade	Concrete	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
213	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Exterior Concrete Above Grade	Concrete	Not stated	AGREAC	Expansion & cracking

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Release of Radiation/Hazardous Material.	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	200
Release of Radiation/Hazardous Material.	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	201
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 focus 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	210
Release of Radiation/Hazardous Material.	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	211
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	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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Item	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 & Refueling Canal	Exterior Concrete Above Grade	Concrete	Not stated	CREEP	Deformation
216	Class 1 Structures	Fuel Storage Facility & Refueling Canal	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	CATH	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
221	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
222	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
223	Class 1 Structures	Fuel Storage Facility & Refueling Canal	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
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 Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	MASON-BLOC (Applicable only to masonry block walls	Cracking of masonr block walls

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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 Radiation/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 Radiation/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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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
227	Class 1 Structures	Fuel Storage Facility & Refueling Canal	Interior Concrete Walls/ Columns; Interior Concrete Slabs/ Beams; & Masonry Block Walls	Concrete, Mortar	Not stated	FAT (Applicable only to concrete structures)	Cumulative fatigue damage
228	Class 1 Structures	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	Foundation 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	Intake Structures, Cooling Towers, & 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

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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	227
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	228
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	229
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	230
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	231
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	232
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	233
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	234
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	235
Loss of Heat Sink.	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	236
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	237
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	238
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	239
Loss of Heat Sink.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	240
Loss 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	241

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
242	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Foundation and Exterior Concrete Above & Below Grade	Concrete	Not stated	ABRA	Loss of material
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	CATH	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 stress level, distortion.
246	Class 1 Structures	Intake Structures, Cooling Towers, & Spray Ponds	Interior Concrete Slabs/ Beams	Concrete	Not stated	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/ Beams	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	Interior Concrete Walls/ Columns & Interior Concrete Slabs/ Beams (No interior walls for Intake Structures)	Concrete	Not stated	SHRINK	Cracking
253	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	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 Intake Structures)	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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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	242
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/ft^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
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	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
Loss 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
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	253
Loss of Heat Sink.	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	254
Loss of Heat Sink.	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	255

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Item	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 & cracking
257	Class 1 Structures	Intake Structures & Cooling Towers	Masonry Block Walls	Mortar	Not stated	CORR/RE	Cracking, spalling, loss of bond, & loss of material
258	Class 1 Structures	Intake Structures & Cooling Towers	Masonry Block Walls	Mortar	Not stated	ELE-TEMP	Loss of strength & modulus
259	Class 1 Structures	Intake Structures & Cooling Towers	Masonry Block Walls	Mortar	Not stated	CREEP	Deformation
260	Class 1 Structures	Intake Structures & Cooling Towers	Masonry Block Walls	Mortar	Not stated	SHRINK	Cracking
261	Class 1 Structures	Intake Structures & Cooling Towers	Masonry Block Walls	Mortar	Not stated	MASON-BLOC	Cracking of masonry 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

Table B.1 Gall Report for NUMARC Industry Reports

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	Report Recommendations	Page No.	Item
Loss of Heat Sink.	Not stated	Not stated		Same as for foundation & exterior concrete above & below grade	4-16 to 4-19	256
Loss of Heat Sink.	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	257
Loss of Heat Sink.	Not stated	Not stated		Non-significant for structures 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	258
Loss of Heat Sink.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	259
Loss 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	260
Loss of Heat Sink.	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	261
Loss of Heat Sink.	Not stated	Not stated		Degradation is non-significant for structural steel components maintained at temperatures <371 deg C (<700_F).	4-64, 4-65, 4-70, 4-71	262
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	263
Loss of Heat Sink.	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	264
Lose Water/Fossil Fuel.	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	265
Lose 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	266
Lose 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	267
Lose 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	268
Lose Water/Fossil Fuel.	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	269
Lose Water/Fossil Fuel.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	270
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	271

Table B.1 Gall Report for NUMARC Industry Reports

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
272	Class 1 Structures	Concrete Tanks	Foundation & Exterior Concrete Below Grade	Concrete	Not stated	FAT	Cumulative fatigue 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
279	Class 1 Structures	Concrete Tanks	Exterior Concrete Above Grade	Concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, & loss of material
280	Class 1 Structures	Concrete Tanks	Exterior Concrete Above Grade	Concrete	Not stated	CREEP	Deformation
281	Class 1 Structures	Concrete Tanks	Exterior Concrete Above Grade	Concrete	Not stated	SHRINK	Cracking
282	Class 1 Structures	Concrete Tanks	Exterior Concrete Above Grade	Concrete	Not stated	FAT	Cumulative fatigue damage
283	Class 1 Structures	Concrete Tanks	Exterior Concrete Above Grade	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
284	Class 1 Structures	Concrete Tanks	Interior Concrete Structures	Concrete	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
285	Class 1 Structures	Concrete Tanks	Interior Concrete Structures	Concrete	Not stated	AGREAC	Expansion & cracking
286	Class 1 Structures	Concrete Tanks	Interior Concrete Structures	Concrete	Not stated	ELE-TEMP	Loss of strength & modulus

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	Report Recommendations	Page No.	Item
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	272
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	273
Lose Water/Fossil Fuel.	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	274
Lose Water/Fossil Fuel.	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	275
Lose 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	276
Lose Water/Fossil Fuel.	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	277
Lose 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	278
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-cement ratio 0.35-0.45).	4-20 to 4-23 & 4-49 to 4-51	279
Lose Water/Fossil Fuel.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	280
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	281
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	282
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	283
Lose Water/Fossil Fuel.	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	284
Lose Water/Fossil Fuel.	Not stated	Not stated		Same as for foundation & exterior concrete above & below grade	4-16 to 4-19	285
Lose Water/Fossil Fuel.	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	286

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
287	Class 1 Structures	Concrete Tanks	Interior Concrete Structures	Concrete	Not stated	EMBR/IR	Loss of strength & modulus
288	Class 1 Structures	Concrete Tanks	Interior Concrete Structures	Concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, & loss of material
289	Class 1 Structures	Concrete Tanks	Interior Concrete Structures	Concrete	Not stated	CREEP	Deformation
290	Class 1 Structures	Concrete Tanks	Interior Concrete Structures	Concrete	Not stated	SHRINK	Cracking
291	Class 1 Structures	Concrete Tanks	Interior Concrete Structures	Concrete	Not stated	FAT	Cumulative fatigue damage
292	Class 1 Structures	Concrete Tanks	Interior Concrete Structures	Concrete	Not stated	CATH	Cathodic protection effect on bond strength
293	Class 1 Structures	Concrete Tanks	Structural Steel & Stainless Steel Liner	Carbon steel & Stainless steel	Not stated	ELE-TEMP	Loss of strength & modulus
294	Class 1 Structures	Concrete Tanks	Structural Steel & Stainless Steel Liner	Carbon steel & Stainless steel	Not stated	EMBR/IR	Loss of fracture toughness
295	Class 1 Structures	Concrete Tanks	Structural Steel & Stainless Steel Liner	Carbon steel & Stainless steel	Not stated	FAT	Cumulative fatigue damage
296	Class 1 Structures	Concrete Tanks	Structural Steel	Carbon steel	Not stated	CORR Unresolved	Loss of material
297	Class 1 Structures	Concrete Tanks	Stainless Steel Liner	Stainless steel	Not stated	CORR/IGSCC & CORR/CREV Unresolved	Loss of material, crack initiation & growth
298	Class 1 Structures	Concrete Tanks	Steel Piles	Carbon steel	Not stated	CORR	Loss of material
299	Class 1 Structures	Steel Tanks	Foundation	Concrete	Not stated	FRZ-THAW	Scaling, cracking, & spalling
300	Class 1 Structures	Steel Tanks	Foundation	Concrete	Not stated	LEACH	Increase of porosity & permeability
301	Class 1 Structures	Steel Tanks	Foundation	Concrete	Not stated	AGR-CHEM Unresolved	Increase of porosity & permeability, cracking, & spalling
302	Class 1 Structures	Steel Tanks	Foundation	Concrete	Not stated	AGREAC	Expansion & 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 Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Lose Water/Fossil Fuel.	Not stated	Not stated		Non-significant because radiation dose is low compared to the level causing degradation.	4-29 -41; 4-53 -59	287
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-cement ratio 0.35-0.45).	4-20 to 4-23 & 4-49 to 4-51	288
Lose Water/Fossil Fuel.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	289
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
Lose Water/Fossil Fuel.	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	299
Lose 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
Lose 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
Lose 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 90-06, Class 1 Structures Industry Report
Reviewed by: D. C. Ma/O. Chopra, ANL

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
303	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

Table B.1 Gall Report for NUMARC Industry Reports

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	Report Recommendations	Page No.	Item
Lose Water/Fossil Fuel.	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	303
Lose Water/Fossil Fuel.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	304
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	305
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	306
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	307
Lose Water/Fossil Fuel.	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	308
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	309
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	310
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	311
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	312
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	313
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	314
Damage of Class 1 Structures.	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	315
Damage of Class 1 Structures.	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	316
Damage of Class 1 Structures.	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	317
Damage of Class 1 Structures.	Not stated	Not stated		Non-significant because the compressive stresses are low.	4-41 -43	318
Damage of Class 1 Structures.	Not stated	Not stated		Non-significant because most concrete shrinkage occurs in first five years of a structure's life.	4-44, 4-45	319

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
320	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, spalling, loss of bond, & loss of material
325	Class 1 Structures	BWR Unit Vent Stack	Exterior Concrete Above Grade	Concrete	Not stated	AGR-CHEM	Increase of porosity & permeability, cracking, & spalling
326	Class 1 Structures	BWR 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

Item	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/SCCUnresolved	Crack initiation & growth
2	PWR Reactor Coolant System	Reactor Coolant Pump	Pump Casing & Pump Cover	CASS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	EMBR/TEUnresolved	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 of material

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	Report Recommendations	Page No.	Item
Damage of Class 1 Structures.	Not stated	Not stated		Non-significant because concrete structures are designed according to ACI 318 or its equivalent.	4-72 to 4-83	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 Function	Contrib to Failure	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	1
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	4

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
5	PWR Reactor Coolant System	Reactor Coolant Pump	Pump Casing & Pump Cover	CASS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	EMBR/IR	Loss of fracture toughness
6	PWR Reactor Coolant System	Reactor Coolant Pump	Pump Casing & Pump Cover	CASS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	CREEP	Change in dimension
7	PWR Reactor Coolant System	Reactor Coolant Pump	Pump Casing & Pump Cover	CASS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	RELAX	Loss of preload
8	PWR Reactor Coolant System	Reactor Coolant Pump	Pump Casing & Pump Cover	CASS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	WEAR	Attrition
9	PWR Reactor Coolant System	Reactor Coolant Pump	Pump Casing & Pump Cover	CASS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	FAT Unresolved	Cumulative fatigue damage
10	PWR Reactor Coolant System	Reactor Coolant Pump	Nozzles	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	CORR/SCC Unresolved	Crack initiation & growth
11	PWR Reactor Coolant System	Reactor Coolant Pump	Nozzles	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	EMBR/TE	Loss of fracture toughness
12	PWR Reactor Coolant System	Reactor Coolant Pump	Nozzles	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	CORR	Loss of material
13	PWR Reactor Coolant System	Reactor Coolant Pump	Nozzles	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	ERO/CORR	Wall thinning, los material
14	PWR Reactor Coolant System	Reactor Coolant Pump	Nozzles	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	EMBR/IR	Loss of fracture toughness
15	PWR Reactor Coolant System	Reactor Coolant Pump	Nozzles	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	CREEP	Change in dimension
16	PWR Reactor Coolant System	Reactor Coolant Pump	Nozzles	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	RELAX	Loss of preloac
17	PWR Reactor Coolant System	Reactor Coolant Pump	Nozzles	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	WEAR	Attrition

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	5
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	6
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	7
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	8
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	9
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	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	11
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	12
Loss of pressure boundary.	Not stated	Not stated		Non-significant because SSs are resistant to ERO/CORR.	4-22	13
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
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	16
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	17

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
18	PWR Reactor Coolant System	Reactor Coolant 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
22	PWR Reactor Coolant System	Reactor Coolant Pump	Closure bolting	SS	Byron Jackson; Klein, Schanzlin, & Becker (KSB); Sulzer-Bingham; & Westinghouse	ERO/CORR	Wall thinning loss of 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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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	18
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	19
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4-14	20
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not in contact with primary coolant.	4-22, 4-23	21
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not in contact with primary coolant.	4-22	22
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	23
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	24
Loss 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 & correction of preload.	5-15	25
Loss of pressure boundary.	Not stated	ASME Sect. XI, Subsect. IWB & ASME/ANSI OM Part 6.		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
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	27
Loss of pressure boundary.	Not stated	Non-significant because SS cladding (>5% ferrite) has reduced susceptibility (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	28
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4-14	29
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	30

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
31	PWR Reactor Coolant System	Pressurizer	Top head	CS	Not stated	ERO/CORR	Wall thinning, loss of 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, Manway, 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	Shell, 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	Shell, Spray line nozzle, Valve nozzle, Manway, Instrum. nozzle, Surge line nozzle, & Support skirt	CS	Not stated	ERO/CORR	Wall thinning, loss of material
41	PWR Reactor Coolant System	Pressurizer	Shell, Spray line nozzle, Valve nozzle, Manway, Instrum. nozzle, Surge line nozzle, & Support skirt	CS	Not stated	EMBR/IR	Loss of fracture toughness
42	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
43	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
44	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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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Loss 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	31
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	32
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <371 deg C (<700 deg F).	4-21	33
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	34
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	35
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	36
Loss of pressure boundary	Not stated	Non-significant because SS cladding (>5% ferrite) has reduced susceptibility (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	37
Loss of pressure boundary	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4-14	38
Loss 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
Loss 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
Loss of pressure boundary	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	41
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <371 deg C (<700 deg F).	4-21	42
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	43
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	44

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
45	PWR Reactor Coolant System	Pressurizer	Shell,Spray line nozzle, Valve nozzle, Manway, Instrum. nozzle, Surge line nozzle, & Support skirt	CS	Not stated	FATUnresolved	Cumulative fatigue damage
46	PWR Reactor Coolant System	Pressurizer	Safe ends	SS	Not stated	CORR/SCC	Crack initiation & growth
47	PWR Reactor Coolant System	Pressurizer	Safe ends	SS	Not stated	EMBR/TE	Loss of fracture toughness
48	PWR Reactor Coolant System	Pressurizer	Safe ends	SS	Not stated	CORR	Loss of material
49	PWR Reactor Coolant System	Pressurizer	Safe ends	SS	Not stated	ERO/CORR	Wall thinning, loss of material
50	PWR Reactor Coolant System	Pressurizer	Safe ends	SS	Not stated	EMBR/IR	Loss of fracture toughness
51	PWR Reactor Coolant System	Pressurizer	Safe ends	SS	Not stated	CREEP	Change in dimension
52	PWR Reactor Coolant System	Pressurizer	Safe ends	SS	Not stated	RELAX	Loss of preload
53	PWR Reactor Coolant System	Pressurizer	Safe ends	SS	Not stated	WEAR	Attrition
54	PWR Reactor Coolant System	Pressurizer	Safe ends	SS	Not stated	FAT Unresolved	Cumulative fatigue damage
55	PWR Reactor Coolant System	Pressurizer	Instrum. nozzle & Heater sleeves	Ni alloy	Not stated	CORR/SCC	Crack initiation & growth
56	PWR Reactor Coolant System	Pressurizer	Instrum. nozzle & Heater sleeves	Ni alloy	Not stated	EMBR/TE	Loss of fracture toughness
57	PWR Reactor Coolant System	Pressurizer	Instrum. nozzle & Heater sleeves	Ni alloy	Not stated	CORR	Loss of material
58	PWR Reactor Coolant System	Pressurizer	Instrum. nozzle & Heater sleeves	Ni alloy	Not stated	ERO/CORR	Wall thinning, loss of material
59	PWR Reactor Coolant System	Pressurizer	Instrum. nozzle & Heater sleeves	Ni alloy	Not stated	EMBR/IR	Loss of fracture toughness
60	PWR Reactor Coolant System	Pressurizer	Instrum. nozzle & Heater sleeves	Ni alloy	Not stated	CREEP	Change in dimension
61	PWR Reactor Coolant System	Pressurizer	Instrum. nozzle & Heater sleeves	Ni alloy	Not stated	RELAX	Loss of preload
62	PWR Reactor Coolant System	Pressurizer	Instrum. nozzle & Heater sleeves	Ni alloy	Not stated	WEAR	Attrition

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	45
Loss of pressure boundary.	Not stated	ASME Sect. XI, Subsect. IWB.		ASME Sect. XI, Subsect. IWB, exam. category B-F are current & effective programs for detection, sizing, evaluation, & remediation.	5-13 to 5-15	46
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4-14	47
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	48
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	49
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	50
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	51
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21,4-22	52
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	53
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	54
Loss of pressure boundary	Not stated	ASME Sect. XI, Subsect. IWB & NRC Information Notice No. 90-10.		ASME Sect. XI, Subsect. IWB exam. category B-E augmented based on information in NRC Inf. notice No. 90-10 are current & effective inspection procedures for detection, sizing, evaluation, & remediation.	5-13 to 5-15	55
Loss of pressure boundary	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4-14	56
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	57
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 environment.	4-22	58
Loss of pressure boundary	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	59
Loss of pressure boundary	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	60
Loss of pressure boundary	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	61
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	62

Table B.1 Gall Report for NUMARC Industry Reports

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
63	PWR Reactor Coolant System	Pressurizer	Instrum. nozzle & Heater sleeves	Ni alloy	Not stated	FAT Unresolved	Cumulative fatigue damage
64	PWR Reactor Coolant System	Pressurizer	Surge line nozzle	CASS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
65	PWR Reactor Coolant System	Pressurizer	Surge line nozzle	CASS	Not stated	EMBR/TE Unresolved	Loss of fracture toughness
66	PWR Reactor Coolant System	Pressurizer	Surge line nozzle	CASS	Not stated	CORR	Loss of material
67	PWR Reactor Coolant System	Pressurizer	Surge line nozzle	CASS	Not stated	ERO/CORR	Wall thinning loss of material
68	PWR Reactor Coolant System	Pressurizer	Surge line nozzle	CASS	Not stated	EMBR/IR	Loss of fracture toughness
69	PWR Reactor Coolant System	Pressurizer	Surge line nozzle	CASS	Not stated	CREEP	Change in dimension
70	PWR Reactor Coolant System	Pressurizer	Surge line nozzle	CASS	Not stated	RELAX	Loss of preload
71	PWR Reactor Coolant System	Pressurizer	Surge line nozzle	CASS	Not stated	WEAR	Attrition
72	PWR Reactor Coolant System	Pressurizer	Surge line nozzle	CASS	Not stated	FAT Unresolved	Cumulative fatigue damage
73	PWR Reactor Coolant System	Pressurizer	Manway bolting	SS	Not stated	CORR/SCC	Crack initiation & growth
74	PWR Reactor Coolant System	Pressurizer	Manway bolting	SS	Not stated	EMBR/TE	Loss of fracture toughness
75	PWR Reactor Coolant System	Pressurizer	Manway bolting	SS	Not stated	CORR	Loss of material
76	PWR Reactor Coolant System	Pressurizer	Manway bolting	SS	Not stated	ERO/CORR	Wall thinning, loss of material
77	PWR Reactor Coolant System	Pressurizer	Manway bolting	SS	Not stated	EMBR/IR	Loss of fracture toughness
78	PWR Reactor Coolant System	Pressurizer	Manway bolting	SS	Not stated	CREEP	Change in dimension
79	PWR Reactor Coolant System	Pressurizer	Manway bolting	SS	Not stated	RELAX	Loss of preload
80	PWR Reactor Coolant System	Pressurizer	Manway bolting	SS	Not stated	WEAR	Attrition

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	63
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	64
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	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		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	71
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	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		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4-14	74
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not in contact with coolant environment.	4-22, 4-23	75
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not in contact with coolant environment.	4-22	76
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	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
Loss 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 & correction of preload.	5-15	79
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion.	4-24	80

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
81	PWR Reactor Coolant System	Pressurizer	Manway bolting	SS	Not stated	FAT Unresolved	Cumulative fatigue damage
82	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	Safety and Relief Valves	Valve body &Bonnet	SS	Not stated	ERO/CORR	Wall thinning, loss of material
86	PWR Reactor Coolant System	Safety and Relief Valves	Valve body &Bonnet	SS	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
91	PWR Reactor Coolant System	Safety and Relief Valves	Valve body & Bonnet	CASS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
92	PWR Reactor Coolant System	Safety and Relief Valves	Valve body & Bonnet	CASS	Not stated	EMBR/TE Unresolved	Loss of fracture toughness
93	PWR Reactor Coolant System	Safety and Relief Valves	Valve body & Bonnet	CASS	Not stated	CORR/BA	Loss of material
94	PWR Reactor Coolant System	Safety and Relief Valves	Valve body & Bonnet	CASS	Not stated	ERO/CORR	Wall thinning, loss of material
95	PWR Reactor Coolant System	Safety and Relief Valves	Valve body & Bonnet	CASS	Not stated	EMBR/IR	Loss of fracture toughness
96	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

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	81
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	82
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4-14	83
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	84
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	85
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	86
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		Non-significant because not subject to relative motion or does not incorporate clamped joints.	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

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Item	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	Nozzles	SS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
101	PWR Reactor Coolant System	Safety and Relief Valves	Nozzles	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	Nozzles	SS	Not stated	ERO/CORR	Wall thinning, loss of material
104	PWR Reactor Coolant System	Safety and Relief Valves	Nozzles	SS	Not stated	EMBR/IR	Loss of fracture toughness
105	PWR Reactor Coolant System	Safety and Relief Valves	Nozzles	SS	Not stated	CREEP	Change in dimension
106	PWR Reactor Coolant System	Safety and Relief Valves	Nozzles	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	Safety and Relief Valves	Nozzles	SS	Not stated	FAT Unresolved	Cumulative fatigue 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 of material
113	PWR Reactor Coolant System	Safety and Relief Valves	Closure flange	CS, SS	Not stated	EMBR/IR	Loss of fracture toughness
114	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

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Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	98
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	99
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	100
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4-14	101
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	102
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	103
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	104
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	105
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	106
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	107
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	108
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	109
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4-14	110
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	111
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	112
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	113
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	114
Loss of pressure boundary.	Not stated	Not stated		Non-significant because does not depend on preload.	4-21, 4-22	115

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
116	PWR Reactor Coolant System	Safety and Relief Valves	Closure flange	CS, SS	Not stated	WEAR	Attrition
117	PWR Reactor Coolant System	Safety and Relief Valves	Closure flange	CS, SS	Not stated	FAT Unresolved	Cumulative fatigue damage
118	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 of material
122	PWR Reactor Coolant System	Safety and Relief Valves	Bellows	Ni alloy	Not stated	EMBR/IR	Loss of fracture toughness
123	PWR Reactor Coolant System	Safety and Relief Valves	Bellows	Ni alloy	Not stated	CREEP	Change in dimension
124	PWR Reactor Coolant System	Safety and Relief Valves	Bellows	Ni alloy	Not stated	RELAX	Loss of preload
125	PWR Reactor Coolant System	Safety and Relief Valves	Bellows	Ni alloy	Not stated	WEAR	Attrition
126	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
128	PWR Reactor Coolant System	Safety and Relief Valves	Seats and Disks	Stellite, SS	Not stated	EMBR/TE	Loss of fracture toughness
129	PWR Reactor Coolant System	Safety and Relief Valves	Seats and Disks	Stellite, SS	Not stated	CORR	Loss of material
130	PWR Reactor Coolant System	Safety and Relief Valves	Seats and Disks	Stellite, SS	Not stated	ERO/CORR	Wall thinning, loss of material
131	PWR Reactor Coolant System	Safety and Relief Valves	Seats and Disks	Stellite, SS	Not stated	EMBR/IR	Loss of fracture toughness
132	PWR Reactor Coolant System	Safety and Relief Valves	Seats and Disks	Stellite, SS	Not stated	CREEP	Change in dimension

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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.	5-17, 5-18	116
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	117
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	118
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4-14	119
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	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 environment.	4-22	121
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)		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
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	127
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4-14	128
Loss of pressure boundary.	Not stated	Not stated		Non-significant because materials resistant to CORR & hydrogen overpressure provides protection against CORR/CREV.	4-22, 4-23	129
Loss of pressure boundary.	Not stated	Not stated		Non-significant because materials are resistant to ERO/CORR, and/or relatively low flow, & pH control in environment.	4-22	130
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	131
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	132

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
133	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 of material
140	PWR Reactor Coolant System	Safety and Relief Valves	Closure bolting	CS, SS	Not stated	EMBR/IR	Loss of fracture toughness
141	PWR Reactor Coolant System	Safety and Relief Valves	Closure bolting	CS, SS	Not stated	CREEP	Change in dimension
142	PWR Reactor Coolant System	Safety and Relief Valves	Closure bolting	CS, SS	Not stated	RELAX	Loss of preload
143	PWR Reactor Coolant System	Safety and Relief Valves	Closure bolting	CS, SS	Not stated	WEAR	Attrition
144	PWR Reactor Coolant System	Safety and Relief Valves	Closure bolting	CS, SS	Not stated	FAT Unresolved	Cumulative fatigue damage
145	PWR Reactor Coolant System	Piping & Fittings	Cold leg, & Hot leg	CS, SS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
146	PWR Reactor Coolant System	Piping & Fittings	Cold leg, & Hot leg	CS, SS	Not stated	EMBR/TE	Loss of fracture toughness
147	PWR Reactor Coolant System	Piping & Fittings	Cold leg, & Hot leg	CS, SS	Not stated	CORR	Loss of material

Table B.1 Gall Report for NUMARC Industry Reports

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Loss of pressure boundary.	Not stated	Not stated		Non-significant because components do not depend on preload.	4-21, 4-22	133
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.	5-17, 5-18	134
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	135
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	136
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4-14	137
Loss 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	138
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	139
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	140
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	141
Loss 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 & correction of preload.	5-15	142
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.	5-17, 5-18	143
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	144
Loss of pressure boundary.	Not stated	Non-significant because SS cladding (>5% ferrite) has reduced susceptibility (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	145
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4-14	146
Loss 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	147

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Item	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 of material
149	PWR Reactor Coolant System	Piping & Fittings	Cold leg, & Hot leg	CS, SS	Not stated	EMBR/IR	Loss of fracture toughness
150	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 of material
158	PWR Reactor Coolant System	Piping & Fittings	Surge line & Spray line	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

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Loss of pressure boundary.	Not stated	Not stated		Non-significant because SSs are resistant to ERO/CORR.	4-22	148
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	149
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	150
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21,4-22	151
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	152
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	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 to air during many shutdowns.	4-16 to 4-20	154
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4-14	155
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	156
Loss of pressure boundary.	Not stated	Not stated		Non-significant because SSs are resistant to ERO/CORR.	4-22	157
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	158
Loss 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
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	161
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	162
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	163
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	164

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

Item	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
168	PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	CREEP	Change in dimension
169	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 of material
176	PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	EMBR/IR	Loss of fracture toughness
177	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	PWR Reactor Coolant System	Piping & Fittings	Cold leg, Hot leg, & Surge line	CASS	Not stated	FAT Unresolved	Cumulative fatigue damage
181	PWR Reactor Coolant System	Auxiliary Piping	Decay Heat Removal System & Core Flood System	CASS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
182	PWR Reactor Coolant System	Auxiliary Piping	Decay Heat Removal System & Core Flood System	CASS	Not stated	EMBR/TE Unresolved	Loss of fracture toughness

Table B.1 Gall Report for NUMARC Industry Reports

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	Rel.progs	Report Recommendations	Page No.	Item
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	165
Loss of pressure boundary.	Not stated	Not stated		Non-significant because SSs are resistant to ERO/CORR.	4-22	166
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	167
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	168
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	169
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	170
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	171
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	172
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of proper material selection & relatively low operating temp.	4-12 to 4-14	173
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	174
Loss of pressure boundary.	Not stated	Not stated		Non-significant because SSs are resistant to ERO/CORR.	4-22	175
Loss of pressure boundary.	Not stated	Not stated		Non-significant because of low fluence level.	4-14 -16	176
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating temp. <538 deg C (<1000 deg F).	4-21	177
Loss of pressure boundary.	Not stated	Not stated		Non-significant because these components do not depend on preload.	4-21, 4-22	178
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subject to relative motion or does not incorporate clamped joints.	4-24	179
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	180
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	181
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	182

Table B.1 Gall Report for NUMARC Industry Reports

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
183	PWR Reactor Coolant System	Auxiliary Piping	Decay Heat Removal System & Core Flood System	CASS	Not stated	CORR	Loss of material
184	PWR Reactor Coolant System	Auxiliary Piping	Decay Heat Removal System & Core Flood System	CASS	Not stated	ERO/CORR	Wall thinning, loss of material
185	PWR Reactor Coolant System	Auxiliary Piping	Decay Heat Removal System & Core Flood System	CASS	Not stated	EMBR/IR	Loss of fracture toughness
186	PWR Reactor Coolant System	Auxiliary Piping	Decay Heat Removal System & Core Flood System	CASS	Not stated	CREEP	Change in dimension
187	PWR Reactor Coolant System	Auxiliary Piping	Decay Heat Removal System & Core Flood System	CASS	Not stated	RELAX	Loss of preload
188	PWR Reactor Coolant System	Auxiliary Piping	Decay Heat Removal System & Core Flood System	CASS	Not stated	WEAR	Attrition
189	PWR Reactor Coolant System	Auxiliary Piping	Decay Heat Removal System & Core Flood System	CASS	Not stated	FAT Unresolved	Cumulative fatigue damage
190	PWR Reactor Coolant System	Integral Support	Not stated	CS, SS	Not stated	CORR/SCC Unresolved	Crack initiation & growth
191	PWR Reactor Coolant System	Integral Support	Not stated	CS, SS	Not stated	EMBR/TE	Loss of fracture toughness
192	PWR Reactor Coolant System	Integral Support	Not stated	CS, SS	Not stated	CORR	Loss of material
193	PWR Reactor Coolant System	Integral Support	Not stated	CS, SS	Not stated	ERO/CORR	Wall thinning, loss of material
194	PWR Reactor Coolant System	Integral Support	Not stated	CS, SS	Not stated	EMBR/IR	Loss of fracture toughness
195	PWR Reactor Coolant System	Integral Support	Not stated	CS, SS	Not stated	CREEP	Change in dimension
196	PWR Reactor Coolant System	Integral Support	Not stated	CS, SS	Not stated	RELAX	Loss of preload
197	PWR Reactor Coolant System	Integral Support	Not stated	CS, SS	Not stated	WEAR	Attrition
198	PWR Reactor Coolant System	Integral Support	Not stated	CS, SS	Not stated	FAT Unresolved	Cumulative fatigue damage

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
1	BWR Primary Coolant Pressure Boundary	Piping & Fittings	Feedwater & Main Steam	CS	Not stated	EMBR/IR	Loss of fracture toughness
2	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: Omesh K. Chopra, ANL

Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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 Function	Contrib to Failure	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

Table B.1 Gall Report for NUMARC Industry Reports

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
4	BWR Primary Coolant Pressure Boundary	Piping & Fittings	Feedwater & Main Steam	CS	Not stated	CORR/IASCC	Crack initiation & growth
5	BWR Primary Coolant Pressure Boundary	Piping & Fittings	Feedwater & Main Steam	CS	Not stated	CORR	Loss of material, corrosion product buildup
6	BWR Primary Coolant Pressure Boundary	Piping & Fittings	Feedwater & Main Steam	CS	Not stated	ERO/CORR	Wall thinning, loss of material
7	BWR Primary Coolant Pressure Boundary	Piping & Fittings	Feedwater & Main Steam	CS	Not stated	CREEP	Change in dimension
8	BWR Primary Coolant Pressure Boundary	Piping & Fittings	Feedwater & Main Steam	CS	Not stated	RELAX	Loss of preload
9	BWR Primary Coolant Pressure Boundary	Piping & Fittings	Feedwater & Main Steam	CS	Not stated	WEAR	Attriton
10	BWR Primary Coolant Pressure Boundary	Piping & Fittings	Feedwater & Main Steam	CS	Not stated	FAT	Cumulative fatigue damage
11	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RCIC, HPCI, RHR, LPCI, LPCS, & HPCS	CS	Not stated	EMBR/IR	Loss of fracture toughness
12	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RCIC, HPCI, RHR, LPCI, LPCS, & HPCS	CS	Not stated	CORR/IGSCC	Crack initiation & 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, RHR, LPCI, LPCS, & HPCS	CS	Not stated	CORR/IASCC	Crack initiation & growth
15	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RCIC, HPCI, RHR, LPCI, LPCS, & HPCS	CS	Not stated	CORR	Loss of material
16	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RCIC, HPCI, RHR, LPCI, LPCS, & HPCS	CS	Not stated	ERO/CORR	Wall thinning
17	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RCIC, HPCI, RHR, LPCI, LPCS, & HPCS	CS	Not stated	CREEP	Change in dimension
18	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RCIC, HPCI, RHR, LPCI, LPCS, & HPCS	CS	Not stated	RELAX	Loss of preload
19	BWR Primary Coolant Pressure Boundary	Piping & Fittings	RCIC, HPCI, RHR, LPCI, LPCS, & HPCS	CS	Not stated	WEAR	Attrition

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	Report Recommendations	Page No.	Item
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	4
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	5
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.	4-33 -35, & 5-17 -19	6
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <371_C (<700_F).	4-44,4-45	7
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	8
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	9
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.	4-2 to 4-9, 5-4 to 5-6	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, 5-8 -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 90-09, BWR Primary Coolant Pressure Boundary Industry Report
Reviewed by: O. Chopra/D. Gavenda, ANL

Item	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
21	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	CORR/IASCC	Crack initiation & growth

Table B.1 Gall Report for NUMARC Industry Reports

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	Report Recommendations	Page No.	Item
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.	4-2 to 4-9, 5-4 to 5-6	20
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	21
Loss of pressure boundary.	Not stated	Program delineated in NUREG-0313, Rev. 2, and implemented through NRC Generic letter 88-01.		Implementation of effective inspection, mitigation, & repair techniques.	4-18, 4-19, 5-8 -16	22
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	23
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	24
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	25
Loss of pressure boundary.	Not stated	Not stated		Non-significant because SS components are resistant to E/C.	4-33 -35, & 5-17 -19	26
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <538_C (<1000_F).	4-44,4-45	27
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	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	29
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.	4-2 to 4-9, 5-4 to 5-6	30
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	31
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.	4-20, 5-8 -16	32
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	33
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	34

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
35	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Bonnet	CS	Not stated	CORR	Loss of material
36	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Bonnet	CS	Not stated	ERO/CORR	Wall thinning
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
39	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Bonnet	CS	Not stated	WEAR	Attrition
40	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 preload
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 fatigue 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 & growth

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	Report Recommendations	Page No.	Item
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	35
Loss of pressure boundary.	Not stated	Not stated		Non-significant because components operate in low temperature (<79_C) and/or low flow rate.	4-36, & 5-20	36
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <371_C (<700_F).	4-44,4-45	37
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	38
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	39
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.	4-10, 4-11	40
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	41
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subjected to corrosive environment.	-	42
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subjected to corrosive environment.	4-22 to 4-28	43
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	44
Loss of pressure boundary.	Not stated	Not stated		Non-significant because not subjected to corrosive environment.	4-30 to 4-32	45
Loss of pressure boundary.	Not stated	Not stated		Non-significant because components not in contact with primary coolant.	4-38	46
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <371_C (<700_F).	4-44, 4-45	47
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	48
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	49
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.	4-13	50
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	51
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.	4-20, 5-8 -16	52

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

Item	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	CORR/TGSCC	Crack initiation & growth
54	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Valve Body	CS	Not stated	CORR/IASCC	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	CS	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 & Bonnet	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

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	Report Recommendations	Page No.	Item
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	53
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	54
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	55
Loss of pressure boundary.	Not stated	ASME Sect. XI, Subsect. IWB, exam. categories B-M-1 & -2, & B-P; and guidelines of NEDC-31743.		ASME Sect. XI requires VT-3 of valve body internal surfaces & VT-2 of pressure retaining boundary & system leakage & hydrostatic tests. Also, compliance with NEDC 31743 is necessary.	4-36, & 5-20	56
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <371_C (<700_F).	4-44,4-45	57
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	58
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	59
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.	4-10, 4-11	60
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	61
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	62
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	63
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	64
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	65
Loss of pressure boundary.	Not stated	Not stated		Non-significant because components are resistant to E/C.	4-36, 5-20	66
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <538_C (<1000_F).	4-44,4-45	67
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	68

Table B.1 Gall Report for NUMARC Industry Reports

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
69	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Bowl, & Cover (Bingham)	CASS	Not stated	WEAR	Attrition
70	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Bowl, & Cover (Bingham)	CASS	Not stated	EMBR/TE	Loss of fracture 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 Boundary	Recirculation Pump	Bowl, & Cover (Bingham)	CASS	Not stated	EMBR/IR	Loss of fracture toughness
73	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 Boundary	Recirculation Pump	Cover (Byron Jackson)	CASS	Not stated	ERO/CORR	Wall thinning
78	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Cover (Byron Jackson)	CASS	Not stated	CREEP	Change in dimension
79	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Cover (Byron Jackson)	CASS	Not stated	RELAX	Loss of preload
80	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Cover (Byron Jackson)	CASS	Not stated	WEAR	Attrition
81	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Cover (Byron Jackson)	CASS	Not stated	EMBR/TE	Loss of fracture toughness
82	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Cover (Byron Jackson)	CASS	Not stated	FAT	Cumulative fatigue damage
83	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Heat Exchanger (Bingham)	SS	Not stated	EMBR/IR	Loss of fracture toughness
84	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	SS	Not stated	CORR/IGSCC	Crack initiation & growth

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	Report Recommendations	Page No.	Item
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	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.	4-10to 4-13, 5-6, 5-7	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
Loss 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
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	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
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 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
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	82
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	83
Loss of pressure boundary.	Not stated	Not stated		Non-significant because applied and residual stresses are low and/or not subjected to corrosive environment.	4-20, 4-21, 5-8 to 5-16	84

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
85	BWR Primary Coolant Pressure Boundary	Integral Support	Not stated	SS	Not stated	CORR/TGSCC	Crack initiation & 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
89	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	RELAX	Loss of preload
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
93	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Heat Exchanger (Byron Jackson)	SS	Not stated	EMBR/IR	Loss of fracture toughness
94	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
98	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

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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, & integral support not subjected to corrosive environment.	4-22 to 4-28	85
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	86
Loss of pressure boundary.	Not stated	Not stated		Non-significant because water quality & chemistry are controlled according to technical specification requirements; corrosion allowances are defined according to the pressure integrity requirements.	4-30 -32	87
Loss of pressure boundary.	Not stated	Not stated		Non-significant because components are resistant to E/C & integral support is not in contact with primary coolant.	4-37	88
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <538_C (<1000_F).	4-44, 4-45	89
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	90
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	91
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.	4-12, 4-13, 5-6, 5-7	92
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	93
Loss of pressure boundary.	Not stated	Not stated		Non-significant because applied and residual stresses are low.	4-20, 4-21, 5-8 to 5-16	94
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	95
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	96
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	97
Loss of pressure boundary.	Not stated	Not stated		Non-significant because components are resistant to E/C.	4-37	98
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <538_C (<1000_F).	4-44,4-45	99
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	100

Table B.1 Gall Report for NUMARC Industry Reports

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

Item	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 Boundary	Relief & In-Line Valves	Nuts & Bolts	CS	Not stated	CORR	Loss of material
108	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Nuts & Bolts	CS	Not stated	ERO/CORR	Wall thinning
109	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 Boundary	Relief & In-Line Valves	Nuts & Bolts	CS	Not stated	WEAR	Attrition
112	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Nuts & Bolts	CS	Not stated	FAT	Cumulative fatigue damage
113	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Nuts & Bolts	SS	Not stated	EMBR/IR	Loss of fracture toughness
114	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Nuts & Bolts	SS	Not stated	CORR/IGSCC	Crack initiation & growth
115	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Nuts & Bolts	SS	Not stated	CORR/TGSCC	Crack initiation & growth
116	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Nuts & Bolts	SS	Not stated	CORR/IASCC	Crack initiation & growth
117	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Nuts & Bolts	SS	Not stated	CORR	Loss of material
118	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Nuts & Bolts	SS	Not stated	ERO/CORR	Wall thinning
119	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 Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	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	106
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, ISIincludes 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.	4-47, 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.	4-10, 4-11	112
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	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	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	118
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <538_C (<1000_F).	4-44, 4-45	119

Table B.1 Gall Report for NUMARC Industry Reports

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
120	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Nuts & Bolts	SS	Not stated	RELAX	Loss of preload
121	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Nuts & Bolts	SS	Not stated	WEAR	Attrition
122	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Nuts & Bolts	SS	Not stated	FATUnresolved	Cumulative fatigue damage
123	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	EMBR/IR	Loss of fracture toughness
124	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	CORR/IGSCC	Crack initiation & growth
125	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	CORR/TGSCC	Crack initiation & growth
126	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	CORR/IASCC	Crack initiation & growth
127	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	CORR	Loss of material
128	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	ERO/CORR	Wall thinning
129	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	CREEP	Change in dimension
130	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	RELAX	Loss of preload
131	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	WEAR	Attrition
132	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	CS	Not stated	FAT	Cumulative fatigue damage
133	BWR Primary Coolant Pressure Boundary	Relief & In-Line Valves	Seal Flange	SS	Not stated	EMBR/IR	Loss of fracture toughness
134	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Seal Flange	SS	Not stated	CORR/IGSCC	Crack initiation & growth
135	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Seal Flange	SS	Not stated	CORR/TGSCC	Crack initiation & growth

Table B.1 Gall Report for NUMARC Industry Reports

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	Report Recommendations	Page No.	Item
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, ISI includes 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	120
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	121
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.	4-10 to 4-13, 5-6, 5-7	122
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	123
Loss of pressure boundary.	Not stated	Not stated		Non-significant because CS are resistant to sensitization, and/or applied & residual stresses are low.	4-20, 5-8 -16	124
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	125
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	126
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	127
Loss of pressure boundary.	Not stated	Not stated		Non-significant because components operate in low temperature (<79_C) and/or low flow rate.	4-36, & 5-20	128
Loss of pressure boundary.	Not stated	Not stated		Non-significant because operating conditions are <371_C (<700_F).	4-44, 4-45	129
Loss of pressure boundary.	Not stated	Not stated		Non-significant because components do not depend on preload for functionality.	4-45, 5-26 -28	130
Loss of pressure boundary.	Not stated	ASME Sect. XI, Subsect. IWB, ISI exam. categories B-G-1 & -2, and testing category B-P for (More)		ASME Sect. XI, Table IWB-2500-1, ISI includes VT-1 of flange surfaces.	4-47, 5-28, 5-29	131
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.	4-10, 4-11	132
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	133
Loss of pressure boundary.	Not stated	Not stated		Non-significant because applied & residual stresses are low.	4-20, 4-21, 5-8 to 5-16	134
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	135

Table B.1 Gall Report for NUMARC Industry Reports

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
136	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Seal Flange	SS	Not stated	CORR/IASCC	Crack initiation & growth
137	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Seal Flange	SS	Not stated	CORR	Loss of material
138	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Seal Flange	SS	Not stated	ERO/CORR	Wall thinning
139	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Seal Flange	SS	Not stated	CREEP	Change in dimension
140	BWR Primary Coolant Pressure Boundary	Recirculation Pump	Seal Flange	SS	Not stated	RELAX	Loss of preload
141	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 fatigue damage

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
1	Mark I Steel Containment	Drywell Interior Surface	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
2	Mark I Steel Containment	Drywell Interior Surface	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
3	Mark I Steel Containment	Drywell Interior Surface	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
4	Mark I 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 fatigue damage

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	Report Recommendations	Page No.	Item
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
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	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.	Not stated	ASME Sect. XI, Subsect. IWB, ISI exam. categories B-G-1 & -2, and testing category B-P for (More)		ASME Sect. XI, Table IWB-2500-1, ISI includes VT-1 of flange surfaces.	4-47, 5-28, 5-29	141
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.	4-10 to 4-13, 5-6, 5-7	142

Document: IR 90-10, BWR Reactor Containment Structures Industry Report
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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	1
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	2
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	3
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	4
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	5
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	6

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
7	Mark I Steel Containment	Drywell Exterior Surface	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
8	Mark I Steel Containment	Drywell Exterior Surface	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
9	Mark I Steel Containment	Drywell Head	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
10	Mark I Steel Containment	Drywell Head	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
11	Mark I Steel Containment	Drywell Head	Not stated	Carbon Steel	Not stated	WEAR	Lockup
12	Mark I Steel Containment	Drywell Head	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
13	Mark I Steel Containment	Drywell Head	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
14	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
15	Mark I Steel Containment	Embedded Shell Region, Drywell Support Skirt, and Sand Pocket Region	Not stated	Carbon Steel, concrete	Not stated	FAT	Cumulative fatigue damage
16	Mark I Steel Containment	Embedded Shell Region, Drywell Support Skirt, and Sand Pocket Region	Not stated	Carbon Steel, concrete	Not stated	EMBR/SA	Loss of fracture toughness
17	Mark I Steel Containment	Embedded Shell Region, Drywell Support Skirt, and Sand Pocket Region	Not stated	Carbon Steel, concrete	Not stated	EMBR/IR	Loss of fracture toughness
18	Mark I Steel Containment	Torus Interior Surface	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
19	Mark I Steel Containment	Torus Interior Surface	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	7
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	8
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	9
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	4-23, 4-24, 5-18, 5-19	11
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
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	18
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	19

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

Item	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 I 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 I Steel Containment	Torus Interior Surface at Waterline	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
25	Mark I 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 I 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 fatigue 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 Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	20
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	21
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
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	27
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	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	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
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	31
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	32

Document: IR 90-10, BWR Reactor Containment Structures Industry Report
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Item	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 I 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 I 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 Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	33
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	34
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	35
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	36
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	37
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	38
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	39
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	40
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	41
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	42
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	43
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	44

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
45	Mark I Steel Containment	Vent System Supports and Torus Seismic Restraints	Not stated	Carbon Steel	Carbon Steel	WEAR	Lockup
46	Mark I Steel Containment	Vent System Supports and Torus Seismic Restraints	Not stated	Carbon Steel	Carbon Steel	EMBR/IR	Loss of fracture 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 fatigue damage
49	Mark I Steel Containment	Torus Support Columns/ Saddles	Not stated	Carbon Steel, graphite	Not stated	WEAR	Lockup
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 Containment	Torus Support Columns/ Saddles	Not stated	Carbon Steel, graphite	Not stated	EMBR/IR	Loss of fracture 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 Containment	ECCarbon Steel Suction Header	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue 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 Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	45
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	46
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	47
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	48
Loss of pressure suppression.	Not stated	Conduct inspection and mitigation of mechanical wear in accordance with the provisions of ASME Sect.		Not stated	4-23, 4-24, 5-18, 5-19	49
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	50
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 -36	51
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	52
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	53
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	54
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	55
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.	4-16 to 4-22	56

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
57	Mark I Steel Containment	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
58	Mark I Steel Containment	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
59	Mark I Concrete Containment	Drywell Liner Interior Surface, Drywell Liner Exterior Surface, and Torus Liner Interior Surface	Not stated	Carbon Steel	Not stated	CORR	Loss of material
60	Mark I Concrete Containment	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	Not stated	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 fatigue damage
64	Mark I Concrete Containment	Torus Liner Interior Surface at Waterline	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
65	Mark I Concrete Containment	Torus Liner Exterior Surface and Liner Anchors	Not stated	Carbon Steel	Not stated	CORR	Loss of material
66	Mark I Concrete Containment	Torus Liner Exterior Surface and Liner Anchors	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
67	Mark I Concrete Containment	Torus Liner Exterior Surface and Liner Anchors	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
68	Mark I Concrete Containment	Drywell Concrete and Torus Concrete	Not stated	Concrete	Not stated	LEACH	Increase of porosity and permeability

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
Loss of pressure boundary, 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	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
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	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
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 -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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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
69	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 I 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 boundary, loss of pressure suppression.	Not stated	Not stated		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	69
Loss of pressure boundary, loss of 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 & 90-06)	4-71 to 4-74	70
Loss of pressure boundary, loss of pressure suppression.	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	71
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	72
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	73
Loss of pressure boundary, loss of pressure suppression.	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%).	4-37 to 4-41	74
Loss of pressure boundary, loss of pressure suppression.	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	75
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	76
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	77
Loss of pressure boundary, 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	78

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
79	Mark I Concrete Containment	Vent Lines	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
80	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
83	Mark I Concrete Containment	Vent Line Bellows	Not stated	Carbon Steel, Stainless Steel	Not stated	FAT	Cumulative fatigue damage
84	Mark I Concrete Containment	Vent Line Bellows	Not stated	Carbon Steel, Stainless Steel	Not stated	EMBR/SA	Loss of fracture toughness
85	Mark I Concrete Containment	Vent Line Bellows	Not stated	Carbon Steel, Stainless Steel	Not stated	CORR/SCC	Crack initiation and growth
86	Mark I Concrete Containment	Vent Line Bellows	Not stated	Carbon Steel, Stainless Steel	Not stated	EMBR/IR	Loss of fracture toughness
87	Mark I Concrete Containment	Vent Headers	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
88	Mark I Concrete Containment	Vent Headers	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
89	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 material

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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
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 for a component having service stress in the elastic region and without severely cold working in the forming process.	4-25 to 4-28	80
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	81
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	82
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	83
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	84
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	85
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	86
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	87
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	88
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	89
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	90

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
91	Mark I Concrete Containment	Downcomers and Bracing	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
92	Mark I Concrete Containment	Downcomers and Bracing	Not stated	Carbon Steel	Not stated	WEAR	Lockup
93	Mark I Concrete Containment	Downcomers and Bracing	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
94	Mark I Concrete	Vent System Supports	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
95	Mark I Concrete	Vent System Supports	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
96	Mark I Concrete	Vent System Supports	Not stated	Carbon Steel	Not stated	WEAR	Lockup
97	Mark I Concrete	Vent System Supports	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
98	Mark I Concrete Containment	Drywell Head	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
99	Mark I Concrete Containment	Drywell Head	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
100	Mark I Concrete Containment	Drywell Head	Not stated	Carbon Steel	Not stated	WEAR	Lockup
101	Mark I Concrete Containment	Drywell Head	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
102	Mark I Concrete Containment	Drywell Head	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness

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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	91
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	92
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	93
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	94
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	95
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	96
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 -71	97
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	98
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	99
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	100
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	101
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.	4-62 to 4-71	102

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Item	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	Loss of material
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	Mark II Steel Containments	Drywell Head	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
113	Mark II Steel Containments	Drywell Head	Not stated	Carbon Steel	Not stated	WEAR	Lockup
114	Mark II Steel Containments	Drywell Head	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	103
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.		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		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	111
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	112
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	113
Loss of pressure boundary.	Not stated	Conduct inspection and mitigation of mechanical wear in accordance with provisions of ASME (More)		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	114

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
115	Mark II Steel Containments	Drywell Head	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
116	Mark II Steel Containments	Suppr. Chamber Exterior Surface	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
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
126	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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Loss of pressure boundary.	Not stated	Conduct inspection and mitigation of 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.	4-34 -36	115
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	116
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	117
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	118
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	119
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	120
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	121
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	122
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	123
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	124
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	125
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	126

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Item	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 Steel Surfaces	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
138	Mark II Steel Containments	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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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	127
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	128
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	129
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
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.	4-16 to 4-22	138

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Item	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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Loss of pressure boundary, 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	139
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	140
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	141
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	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	143
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

Table B.1 Gall Report for NUMARC Industry Reports

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
151	Mark II Concrete Containments	Suppr. Chamber Liner Exterior Surface	Not stated	Carbon Steel or Stainless Steel	Not stated	FAT	Cumulative fatigue damage
152	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
156	Mark II Concrete Containments	Linear Region Shielded by Diaphragm Floor	Not stated	Carbon Steel	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
162	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 Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	151
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	152
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	153
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	154
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	155
Loss of pressure boundary.	Not stated	Not stated		Plant-specific management program is required for management corrosion in the inaccessible areas.	5-24	156
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	157
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	158
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	159
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	160
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	161
Loss 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, 5-25	162

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
163	Mark II Concrete Containments	Containment Concrete	Not stated	Concrete	Not stated	FAT	Cumulative fatigue damage
164	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
166	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
172	Mark II Concrete Containments	Drywell Head	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
173	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 Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	163
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	164
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%).	4-37 to 4-41	165
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
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	168
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	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
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	173

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
174	Mark II Concrete Containments	Downcomer Pipes and Bracing	Not stated	Carbon Steel	Not stated	CORR/PIT	Loss of material
175	Mark II Concrete Containments	Downcomer Pipes and Bracing	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
176	Mark II Concrete Containments	Downcomer Pipes and Bracing	Not stated	Carbon Steel	Not stated	WEAR	Lockup
177	Mark II Concrete Containments	Downcomer Pipes and Bracing	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
178	Mark II Concrete Containments	Concrete Basemat	Not stated	Concrete	Not stated	LEACH	Increase of porosity and permeability
179	Mark II Concrete Containments	Concrete Basemat	Not stated	Concrete	Not stated	AGR-CHEM	Increase of porosity and permeability, cracking, and spalling
180	Mark II Concrete Containments	Concrete Basemat	Not stated	Concrete	Not stated	AGREAC	Expansion and cracking
181	Mark II Concrete Containments	Concrete Basemat	Not stated	Concrete	Not stated	ELE-TEMP	Loss of strength and modulus
182	Mark II Concrete Containments	Concrete Basemat	Not stated	Concrete	Not stated	FAT	Cumulative fatigue damage
183	Mark II Concrete Containments	Concrete Basemat	Not stated	Concrete	Not stated	SETTLE	Cracking, distortion, increase in component stress level
184	Mark II Concrete Containments	Concrete Basemat	Not stated	Concrete	Not stated	EMBR/IR	Loss of fracture toughness

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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	174
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	175
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	176
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 -71	177
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	178
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	179
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	180
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	181
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	182
Loss of pressure boundary.	Not stated	Plant settlement monitoring program		For BWR containments bearing on soil or piles, current plant settlement monitoring program is required to ensure that the differential settlement does not exceed the design criteria throughout the license renewal term.(See IR90-01 & 90-06)	4-87 to 4-89, 5-28, 5-29	183
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	184

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
185	Mark II Concrete Containments	Basemat Liner	Not stated	Carbon Steel	Not stated	CORR	Loss of material
186	Mark II Concrete Containments	Basemat Liner	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
187	Mark II Concrete Containments	Basemat Liner	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
188	Mark II Concrete Containments	Basemat Reinforcing Steel	Not stated	Rebar and embedded carbon steel in concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, loss of (more)
189	Mark II Concrete Containments	Basemat Reinforcing Steel	Not stated	Rebar and embedded carbon steel in concrete	Not stated	AGR-CHEM	Increase of porosity and permeability, cracking, and spalling
190	Mark II Concrete Containments	Basemat Reinforcing Steel	Not stated	Rebar and embedded carbon steel in concrete	Not stated	ELE-TEMP	Loss of strength and modulus
191	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 steel in concrete	Not stated	EMBR/IR	Loss of fracture toughness
193	Mark II Concrete Containments	Prestressing Tendons and Ducts	Not stated	Carbon Steel, concrete	Not stated	CORR	Loss of material
194	Mark II Concrete Containments	Prestressing Tendons and Ducts	Not stated	Carbon Steel, concrete	Not stated	FAT	Cumulative fatigue damage
195	Mark II Concrete Containments	Prestressing Tendons and Ducts	Not stated	Carbon Steel, concrete	Not stated	ELE-TEMP	Loss of strength and 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

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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	185
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	186
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
Loss of pressure boundary.	Not stated	Not stated		Non- significant because temperatures are <60 deg C (<140 deg F).	4-84 -86	195
Loss 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, 5-25	196
Loss 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

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
198	Mark III Steel Containments	Containment Shell Interior Surface and Containment Shell Exterior Surface	Not stated	Carbon Steel	Not stated	CORR/UA	Loss of material
199	Mark III Steel Containments	Containment Shell Interior Surface and Containment Shell Exterior Surface	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
200	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
201	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
202	Mark III Steel Containments	Suppr. Chamber Shell Interior Surface	Not stated	Carbon Steel, Stainless Steel	Not stated	CORR/UA	Loss of material
203	Mark III Steel Containments	Suppr. Chamber Shell Interior Surface	Not stated	Carbon Steel, Stainless Steel	Not stated	FAT	Cumulative fatigue damage
204	Mark III Steel Containments	Suppr. Chamber Shell Interior Surface	Not stated	Carbon Steel, Stainless Steel	Not stated	EMBR/SA	Loss of fracture toughness
205	Mark III Steel Containments	Suppr. Chamber Shell Interior Surface	Not stated	Carbon Steel, Stainless Steel	Not stated	CORR/SCC	Crack initiation and growth
206	Mark III Steel Containments	Not stated	Not stated	Carbon Steel, Stainless Steel	Not stated	EMBR/IR	Loss of fracture toughness
207	Mark III Steel Containments	Suppr. Chamber Shell Exterior Surface	Not stated	Carbon Steel, Stainless Steel	Not stated	CORR/UA	Loss of material
208	Mark III Steel Containments	Suppr. Chamber Shell Exterior Surface	Not stated	Carbon Steel, Stainless Steel	Not stated	FAT	Cumulative fatigue damage
209	Mark III Steel Containments	Suppr. Chamber Shell Exterior Surface	Not stated	Carbon Steel, Stainless Steel	Not stated	EMBR/SA	Loss of fracture toughness

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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	198
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	199
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	200
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	201
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	202
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	203
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	204
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	205
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	206
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	207
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	208
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 -28	209

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Item	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 fatigue 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 porosity 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 and modulus
220	Mark III Steel Containments	Concrete Basemat	Not stated	Concrete	Not stated	FAT	Cumulative fatigue damage

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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 -36	210
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	211
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	212
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	213
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	214
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	215
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	216
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	217
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	218
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	219
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	220

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
221	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	EMBR/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
229	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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Loss of pressure boundary.	Not stated	Plant settlement monitoring program		For BWR containments bearing on soil or piles, current plant settlement monitoring program is required to ensure that the differential settlement does not exceed the design criteria throughout the license renewal term. (See IR90-01 & 90-06)	4-87 to 4-89, 5-28, 5-29	221
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	222
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	223
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	224
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	225
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	226
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	227
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	228
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	229
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	230
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	231

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Item	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 of (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	Rebar	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 Wall Above Grade	Not stated	Concrete	Not stated	FRZ-THAW	Surface spalling, local cracking

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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	232
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	233
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.	4-34 to 4-36	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.	4-62 to 4-71	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
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	242
Loss 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	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
244	Mark III Concrete Containments	Concrete Containment Wall Above Grade	Not stated	Concrete	Not stated	LEACH	Increase of porosity and permeability
245	Mark III Concrete Containments	Concrete Containment Wall Above Grade	Not stated	Concrete	Not stated	AGR-CHEM	Increase of porosity and permeability, cracking, and spalling
246	Mark III Concrete Containments	Concrete Containment Wall Above Grade	Not stated	Concrete	Not stated	AGREAC	Expansion and cracking
247	Mark III Concrete Containments	Concrete Containment Wall Above Grade	Not stated	Concrete	Not stated	ELE-TEMP	Loss of strength and modulus
248	Mark III Concrete Containments	Concrete Containment Wall Above Grade	Not stated	Concrete	Not stated	FAT	Cumulative fatigue damage
249	Mark III Concrete Containments	Concrete Containment Wall Above Grade	Not stated	Concrete	Not stated	EMBR/IR	Loss of fracture toughness
250	Mark III Concrete Containments	Concrete Containment Wall Below Grade	Not stated	Concrete	Not stated	FRZ-THAW	Surface spalling, local cracking
251	Mark III Concrete Containments	Concrete Containment Wall Below Grade	Not stated	Concrete	Not stated	LEACH	Increase of porosity and permeability
252	Mark III Concrete Containments	Concrete Containment Wall Below Grade	Not stated	Concrete	Not stated	AGR-CHEM	Increase of porosity and permeability, cracking, and spalling
253	Mark III Concrete Containments	Concrete Containment Wall Below Grade	Not stated	Concrete	Not stated	AGREAC	Expansion and cracking
254	Mark III Concrete Containments	Concrete Containment Wall Below Grade	Not stated	Concrete	Not stated	ELE-TEMP	Loss of strength and modulus

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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	244
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	245
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	246
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	247
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	248
Loss of pressure boundary.	Not stated	Not stated		Same as item #242	4-62 71	249
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.	4-77 to 4-79	250
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	251
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	252
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	253
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	254

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Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
255	Mark III Concrete Containments	Concrete Containment Wall Below Grade	Not stated	Concrete	Not stated	FAT	Cumulative fatigue 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
261	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 Steel	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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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	255
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	256
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	257
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
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	261
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	262
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	263
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	264
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	265

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

Item	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 Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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	266
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	267
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	268
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 -74	269
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	270
Loss of pressure boundary.	Not stated	Plant settlement monitoring program		For BWR containments bearing on soil or piles, current plant settlement monitoring program is required to ensure that the differential settlement does not exceed the design criteria throughout the license renewal term. (See IR90-01 & 90-06)	4-87 to 4-89, 5-28, 5-29	271
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	272
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	273
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	274
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	275
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	276

Document: IR 90-10, BWR Reactor Containment Structures Industry Report
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Item	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
281	Mark III Concrete Containments	Dome Reinforcing Steel	Not stated	Rebar and embedded Carbon Steel in concrete	Not stated	ELE-TEMP	Loss of strength and modulus
282	Mark III Concrete Containments	Dome Reinforcing Steel	Not stated	Rebar and embedded Carbon Steel in concrete	Not stated	FAT	Cumulative fatigue damage
283	Mark III Concrete Containments	Dome Reinforcing Steel	Not stated	Rebar and embedded Carbon Steel in concrete	Not stated	EMBR/IR	Loss of fracture toughness
284	Mark III Concrete Containments	Basemat Reinforcing Steel	Not stated	Rebar and Embedded Carbon Steel in concrete	Not stated	CORR/RE	Cracking, spalling, loss of bond, loss of material
285	Mark III Concrete Containments	Basemat Reinforcing Steel	Not stated	Rebar and Embedded Carbon Steel in concrete	Not stated	ELE-TEMP	Loss of strength and modulus
286	Mark III Concrete Containments	Basemat Reinforcing Steel	Not stated	Rebar and Embedded Carbon Steel in concrete	Not stated	FAT	Cumulative fatigue damage
287	Mark III Concrete Containments	Basemat Reinforcing Steel	Not stated	Rebar and Embedded Carbon Steel in concrete	Not stated	EMBR/IR	Loss of fracture toughness

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Effect of Aging on Component Function	Contrib to Failure	Reported progs	Rel.progs	Report Recommendations	Page No.	Item
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.	4-62 to 4-71	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%).	4-37 to 4-41	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.	4-45 to 4-51	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	287

Table B.1 Gall Report for NUMARC Industry Reports

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
288	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 and modulus
291	All Type BWR Containments	Penetration Sleeves	Not stated	Carbon Steel	Not stated	FAT	Cumulative fatigue damage
292	All Type BWR Containments	Penetration Sleeves	Not stated	Carbon Steel	Not stated	EMBR/SA	Loss of fracture toughness
293	All Type BWR Containments	Penetration Sleeves	Not stated	Carbon Steel	Not stated	CORR/SCC	Crack initiation and growth
294	All Type BWR Containments	Penetration Sleeves	Not stated	Carbon Steel	Not stated	EMBR/IR	Loss of fracture toughness
295	All Type BWR Containments	Dissimilar Metal Welds	Not stated	Carbon Steel welded with Stainless Steel	Not stated	CORR/PIT	Loss of material
296	All Type BWR Containments	Dissimilar Metal Welds	Not stated	Carbon Steel welded with Stainless Steel	Not stated	CORR	Loss of material
297	All Type BWR Containments	Dissimilar Metal Welds	Not stated	Carbon Steel welded with Stainless Steel	Not stated	FAT	Cumulative fatigue damage
298	All Type BWR Containments	Dissimilar Metal Welds	Not stated	Carbon Steel welded with Stainless Steel	Not stated	EMBR/IR	Loss of fracture toughness
299	All Type BWR Containments	Penetration Bellows	Not stated	Stainless and Carbon Steel	Not stated	CORR/UA	Loss of material

Document: 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	Rel.progs	Report Recommendations	Page No.	Item
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	288
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	289
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	290
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.	4-52 to 4-56	291
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	292
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	293
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	294
Loss of pressure boundary.	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	295
Loss of pressure boundary.	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	296
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	297
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	298
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.	4-3 -8	299

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
300	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

Table B.1 Gall Report for NUMARC Industry Reports

Document: 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	Rel.progs	Report Recommendations	Page No.	Item
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	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.	4-25 to 4-28	301
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	302
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.	4-3 to 4-8	304
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	305
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	306
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	307
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	308

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

Item	System	Structure/Comp	Subcomponent	Materials	Manufacturer	ARD mechanism	ARD effects
1		Electrical Cable	Conductor	Copper	34 Manufacturers Listed	CORR	Failure of the conductor
2		Electrical Cable	Insulation	XPLE, E-CTFE, 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

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 Recommendations	Page No.	Item
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.	Frequent	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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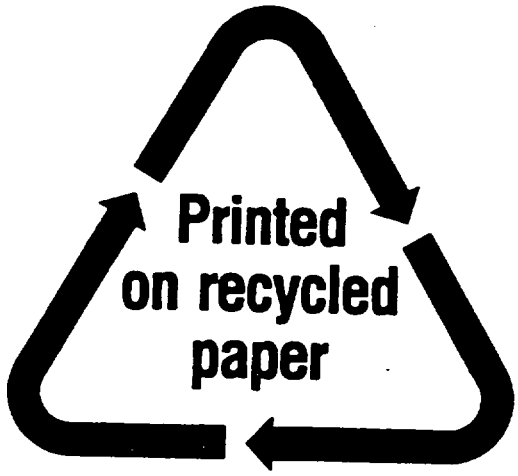

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BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

1. REPORT NUMBER (Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.)

NUREG/CR-6490
ANL-96/13
Vol. 2

2. TITLE AND SUBTITLE

Nuclear Power Plant Generic Aging Lessons Learned (GALL)
Appendix B

3. DATE REPORT PUBLISHED

MONTH	YEAR
December	1996

4. FIN OR GRANT NUMBER

J2076 and L1606

5. AUTHOR(S)

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6. TYPE OF REPORT

Technical

7. PERIOD COVERED *(Inclusive Dates)*

8. PERFORMING ORGANIZATION - NAME AND ADDRESS *(If NRC, provide Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)*

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9. SPONSORING ORGANIZATION - NAME AND ADDRESS *(If NRC, type "Same as above"; if contractor, provide NRC Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address.)*

License Renewal Project Directorate
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

10. SUPPLEMENTARY NOTES

11. ABSTRACT *(200 words or less)*

Argonne National Laboratory and Idaho National Engineering Laboratory in support of the License Renewal Project Directorate of the U.S. Nuclear Regulatory Commission (NRC) performed a comprehensive review of literature pertaining to nuclear power plant aging effects. This generic aging lessons learned (GALL) effort was a systematic review of plant aging information in order to assess materials and component aging issues related to continued operation and license renewal of operating reactors. Literature on mechanical, structural, thermal-hydraulic, and electrical components and systems reviewed consisted of 163 Nuclear Plant Aging Research Reports, 31 NRC Generic Letters, 265 Information Notices, 82 Licensee Event reports, 5 Bulletins, and 10 Nuclear Management and Resources Council Industry Reports. The results of these reviews were systematized using a standardized GALL tabular format and standardized definitions of aging related degradation mechanisms and effects. A computerized data base has also been developed for all review tables and can be used to search for information on structures, components, and relevant aging effects. A survey of the GALL tables reveals that all significant component and structure aging issues are currently being addressed by the regulatory process. However, aging of what are termed passive components and structures has been highlighted for continued scrutiny.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

Aging of Nuclear Power Plant Components and Systems
License Renewal
Age-Related Degradation Mechanisms
Component Aging Data Base
Structure Aging
Generic Aging Lessons Learned

13. AVAILABILITY STATEMENT

unlimited

14. SECURITY CLASSIFICATION

(This Page) unclassified

(This Report) unclassified

15. NUMBER OF PAGES

16. PRICE

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

SPECIAL STANDARD MAIL
POSTAGE AND FEES PAID
USNRC
PERMIT NO. G-67

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LICENSE RENEWAL APPLICATIONS

LICENSE RENEWAL ISSUES