BGE Calvert Cliffs Nuclear Power Plant

License Renewal Project

Aging Management Review Report

for the

Radiation Monitoring System

(077/079)

Revision 1

May, 1996

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Page	Revision	Change Description
All	0	Initial issue
All	1	General update for CCNPP IPA Methodology, Revision 1, and revision to component pre-evaluation and aging management review

1.0 INTRODUCTION

1.1 Area and Process Radiation Monitoring System Description

This section describes the scope and boundaries of the Area and Process Radiation Monitoring System (RMS) as it was evaluated. Section 1.1.1 provides a brief synopsis of the system as described in existing plant documentation. System boundaries are provided in Section 1.1.2 to clarify the extent of the Area and Process Radiation Monitoring System considered in this evaluation. Section 1.1.3 is a detailed breakdown of the intended system functions within the scope of license renewal and is provided as the basis for the identification of components required to support those intended functions.

1.1.1 Area and Process Radiation Monitoring System Description

The purpose of the Area and Process Radiation Monitoring System is to warn operating personnel of an increasing radiation level or abnormal radioactivity concentration at selected points in the plant. This warning system may also indicate a system or component malfunction which needs operator action or it may perform automatic protective actions to correct and/or isolate an abnormal condition to prevent an uncontrolled release of radioactive material to the environment. The Area and Process Radiation Monitoring System includes various process radiation monitoring subsystems such as the plant main vent monitor, wide range gas monitor, containment atmosphere monitor, waste gas discharge monitor, liquid waste processing discharge monitor, condensate air removal discharge monitor, Component Cooling Water System monitor, Service Water System monitor, steam generator blowdown tank discharge monitor, steam generator recovery radiation monitor, control room ventilation monitor, atmosphere monitors and main steam effluent radiation monitor. It also includes area radiation monitors in 29 areas plus six monitors in each containment.

The Area and Process Radiation Monitoring System was determined to be within the scope of license renewal during the system level scoping process.

1.1.2 Area and Process Radiation Monitoring System Boundaries

The Area and Process Radiation Monitoring System is comprised of the following equipment:

Pumps	Several of the radiation monitor trains contain pumps which move the fluid being sampled.
Valves	Provide containment isolation and system alignment/isolation (control, check, hand, motor operated and solenoid valves).
Filters	Filter air to protect downstream components.

Instrumentation/ elements	Provides data to operators and automatic systems.
Piping/tubing	Provides flowpath and maintains pressure boundary.

The Area and Process Radiation Monitoring System interfaces with the following systems and components:

Plant vent
Containment vent
Component Cooling System
Service Water System
Control Room HVAC System

1.1.3 Area and Process Radiation Monitoring Intended System Functions

- Provide containment area radiation signal to ESFAS for containment isolation and radiological release control
- Provide containment high range radiation signal for containment environment monitoring and to isolate the containment vent/hydrogen purge lines
- Provide information to assess the environs and plant condition during and following an accident
- Maintain functionality of electrical equipment as addressed by the EQ Program
- Maintain the pressure boundary of the system
- Provide containment isolation of the containment atmosphere and purge air monitor sampling line
- Monitor and record wide range gaseous activity/release rate through the main plant vent and provide indications/alarms in the control room
- Monitor and record radiation levels indicative of effluent activity in the main steam lines and provide indications/alarms in the control room
- Provide testing capability and prevent spurious actuation of control room radiation monitoring circuitry
- Maintain electrical continuity and/or provide protection of the electrical system
- Provide seismic integrity and/or protection of SR components

1.2 Evaluation Methods

Area and Process Radiation Monitoring System components within the scope of license renewal were identified through the use of BGE procedure for Component Level Scoping of Systems. The results of the scoping process are discussed in Section 2.0 of this report.

Area and Process Radiation Monitoring System components subject to aging management review for license renewal were determined using the BGE procedure for Component Pre-Evaluation to identify passive, long-lived components that must be evaluated for management of the effects of age-related degradation. The results of the Pre-evaluation process are discussed in Section 3.0 of this report.

All components subject to aging management review are evaluated for the effects of aging in accordance with the BGE procedure for Component Aging Management Review. This procedure is performed to determine plausible aging effects and the appropriate methods to manage those effects. The results of the Aging Management Review (AMR) process are discussed in Section 4.0 of this report.

1.3 System-Specific Definitions

This section provides the definitions for any specific terms unique to the Area and Process Radiation Monitoring component aging evaluation.

No terms unique to the Area and Process Radiation Monitoring System were used.

1.4 System-Specific References

Several sources were used to determine potential and plausible ARDMs for the Area and Process Radiation Monitoring evaluation. These sources include NRC Draft Regulatory Guide DG-1009, "Standard Format and Content of Technical Information for Applications to Renew Nuclear Power Plant Operating Licenses". Detailed drawings and other controlled documents related to the Area and Process Radiation Monitoring System were utilized to verify materials, design configurations and location of components.

Table 1-1 lists the references utilized in the completion of the Area and Process Radiation Monitoring System Aging Management Review for license renewal.

Table 1-1
System Specific References

Document ID	Document Title	Revision	Date
12284-0026	P/L Temperature Probe Assembly	0	1981
12284-0028	Temperature Probe Assembly	A	1981
60722-E SH0001	"Auxiliary Building Ventilation Systems"	32	1995
60738-E SH0001	"Area and Process Radiation Monitoring System"	45	1995
60738-E SH0002	Operations Drawing "Area and Process Radiation Monitoring System"	10	1995
92767 SH HB-1	M-600 Piping Class Sheets for HB	54	1995
92769 SH HB-7	M-601 Piping Class Summary Sheets for HB-5	22	1995
92771 SH0001	M-602 Master Valve List	41	1995
ASM	ASM Specialty Handbook, Stainless Steels, Davis	-	1994
ASME	ASME Wear Control Handbook, Peterson and Winer	-	1980
CLSR	CCNPP Component Level Screening Results - System 077/079	01	1995
CP-204	Specification and Surveillance Primary Systems	4	1995
CP-206	Specifications and Surveillance Component Cooling / Service Water System	2	1995
DG-1009	Standard Format and Content of Technical Information for Applications to Renew Nuclear Power Plant Operating Licenses, Draft NRC Regulatory Guide	-	1990
ES-014	Summary of Ambient Environmental Service Conditions	0	1995

Table 1-1
System Specific References

Document ID	Document Title	Revision	Date
ES-024	10CFR50.49 Environmental Qualification Program	01	1996
ES-032	"Control of the Equipment Technical Databases (Nucleis - Master Equipment List and CCETS)"	0	1995
FSK-MP-1262	Non-Nuclear HB & HB-65 Nuclear Containment Atmosphere Radiation Monitor Line	14	1992
FSK-MP-3050	Containment Atmosphere Radiation Monitor Line Penetration Piping	3	1991
I-33	Maintenance Procedure, Thomas Air Pump Diaphragm Replacement Procedure	4	1995
IFI Standards	"Fastener Standards", Industrial Fastener Institute, 6th Edition (pg. A-13)	-	1988
IPM13101	Replace WRNGM Thomas Air Pump Diaphragms	-	1993
LCM-16	"Component Aging Management Review", LCM Procedure	4	1995
LCM-95-095	"Radiation Monitoring Systems Component Information", letter to J. Rycyna from M. Hotchkiss	-	3/21/95
LCM-95-112	"Boric Acid Corrosion", letter to file from J. Rycyna	-	3/29/95
LCM-96-044	BGE memorandum, Subject: Age Related Degradation Inspections, dated February 15, 1996, BMT to distribution		2/15/96
LCM 96-133	"Conversation with Bill Cartwright, Plant Engineering, to discuss minimum ambient temperature in East Piping Penetration Rooms"		5/17/96

Table 1-1
System Specific References

Document ID	Document Title	Revision	Date
LCM C-96-004	Circle Seal Controls vendor information file, Circle Seal Controls, Inc.	-	-
LCM S-96-009	"RE-5417/5418 WRGM Sample Chamber Details" telecon to file, M. Hothchkiss/ P. Newman	-	1/31/96
LCM S-96-019	Seelscrews vendor information file, Multiflex Seals	-	-
95-BGE-0086	Gilbert Commonwealth letter forwarding MIC Position Paper	-	8/29/95
N/A	CCNPP Pre-evaluation Results for the Radiation Monitoring System (077/079)	01	1996
N/A	CCNPP Aging Evaluation for System 011	00	1994
N/A	CCNPP Aging Evaluation for System 015	00	1994
NETD	CCNPP NUCLEIS Database	-	1996
N/A	Corrosion and Corrosion Control, An Introduction to Corrosion Science and Engineering, Uhlig, Third Edition	-	1985
N/A	Corrosion Engineering, Fontana and Greene	-	1978
N/A	Introduction to Physical Metallurgy, Avner, - Second Edition	-	1974
N/A	Structural Materials in Nuclear Power Systems	-	1981
N/A	The Structure and Properties of Materials, Volume I; Moffatt, Pearsall, and Wulff	-	1964
N/A	Materials Handbook; Brady and Clauser, Thirteenth Edition	-	-
N/A	Mark's Standard Handbook for Mechanical Engineers; Avallone and Baumeister, Ninth Edition	-	-

Table 1-1
System Specific References

Document ID	Document Title	Revision	Date
N/A	Thomas Industries, 727 Series Single Cylinder, Oil-less, Diaphragm Compressors, Bulletin/Data Sheets	-	1990
NP-2129	EPRI Report, Radiation Effects on Organic Materials in Nuclear Plants	-	1981
NP-3784	EPRI Report, A Survey of the Literature on Low-Alloy Steel Fastener Corrosion in PWR Power Plants	-	1984
NP-3944	EPRI Report, Erosion/Corrosion in Nuclear Plant Steam Piping	-	1985
NP-5461	EPRI Report, Component Life Estimation: LWR Structural Materials Degradation Mechanisms	-	1987
NP-5769	EPRI Report, Degradation and Failure of Bolting in Nuclear Power Plants	-	1988
NP-5775	EPRI Report, Environmental Effects on Components: Commentary for ASME Section III	-	1988
NP-5985	Boric Acid Corrosion of Carbon and Low Alloy Steel Pressure Boundary Materials, EPRI Report No. NP-5985	-	1988
NUREG/CR-5379	Nuclear Plant Service Water System Aging Degradation Assessment		
	• Volume 1	-	1989
	• Volume 2	-	1992
NUREG/CR-5419	Aging Assessment of Instrument Air Systems	-	1990
NUREG/CR-5643	Insights Gained from Aging Research	-	1992
OERDB	OER Database	-	1996

Table 1-1
System Specific References

Document ID	Document Title	Revision	Date
O&MR-132	"Particulate and Gaseous Radioactivity Monitoring System Failures Due to Excess Moisture", Operations and Maintenance Reminder, INPO	-	1983
OI-15	Service Water System Operating Instruction,		
	Unit 1	22	1994
	Unit 2	22	1994
OI-16	Component Cooling System Operating		
	Instruction, Unit 1	20	1993
	Unit 2	17	1993
OI-35	Radiation Monitoring System	1024	1995
OI- 48	Wide Range Noble Gas Monitor	7	1995
PIPEAMG	Aging Management Guideline for Commercial Nuclear Power Plants -- Non-Reactor Coolant Pressure Boundary Piping and Tubing, Draft	-	1995
STP-M-571E-1	Local Leak Rate Test, Penetrations 15, 16, 18, 38, 59, 60, 61, 62, 64, Unit 1	0	1991
STP-M-571E-2	Local Leak Rate Test, Penetrations 15, 16, 18, 38, 59, 60, 61, 62, 64, Unit 2	0	1991
STP-O-055-1	Containment Integrity Verification Mode 1-4, Unit 1	33	1992
STP-O-055-2	Containment Integrity Verification Mode 1-4, Unit 2	33	1992
TR-102204	EPRI Report, Service (Salt) Water System Life Cycle Management Evaluation	-	1993
UFSAR	Updated Final Safety Analysis Report	19	
VOL-1	Metals Handbook, Volume 1 - Properties and Selection: Irons and Steels, Ninth Edition, ASM International	-	1978

Table 1-1
System Specific References

Document ID	Document Title	Revision	Date
VOL-13	Metals Handbook, Volume 13 - Corrosion, Ninth Edition, ASM International	-	1987
VTM 12284-010	General Atomic - Wide Range Gas Monitor	21	1996

2.0 STRUCTURES AND COMPONENTS WITHIN THE SCOPE OF LICENSE RENEWAL

2.1 Component Level Scoping Methodology Overview

The scoping of the Area and Process Radiation Monitoring System components was performed in accordance with the process described in the Calvert Cliffs Nuclear Power Plant Integrated Plant Assessment Methodology as specified in the procedure for the component level scoping of systems. The purpose of component level scoping is to identify all system components that support the intended system functions identified in Section 1.1.3 for the Area and Process Radiation Monitoring System. These are the components that are within the scope of license renewal.

2.2 Component Level Scoping Results

A total of 33 device types in the Area and Process Radiation Monitoring System were designated as within the scope of license renewal. These device types are listed in Table 2-1.

The portion of the Area and Process Radiation Monitoring System within the scope of license renewal consists of piping, components, component supports, instrumentation, panels, and cables for the following sections of the system: control room ventilation radiation monitor; containment atmosphere, high range and area radiation monitors; service water and component cooling radiation monitors; main steam effluent radiation monitors; and wide range noble gas monitors.

Refer to the results of the Area and Process Radiation Monitoring System Component Level Scoping for the list of intended functions, the list of components within the scope of license renewal, and other scoping-related details.

Table 2-1

Area and Process Radiation Monitoring System Device Types Within the Scope of License Renewal

Device Type	Device Description
-HB	Piping, HB
AE	Analyzer Element
CKV	Check Valve
CV	Control Valve (& Operators)
E/I	Voltage/ Current Device
FE	Flow Element
FI	Flow Indicator
FIS	Flow Indicator Switch
FL	Filter
FT	Flow Transmitter
FU	Fuse
HS	Handswitch
HV	Hand Valve
JL	Power Lamp Indicator
M	Motor
MOV	Motor Operated Valve (& Operators)
PDT	Differential Pressure Transmitter
PI	Pressure Indicator
PNL	Panel
PUMP	Pump/Driver Assembly
RE	Radiation Element
RI	Radiation Indicator
RIC	Radiation Indicator Controller
RP	Radiation Test Point
RR	Radiation Recorder
RY	Relay
SV	Solenoid Valve
TC	Temperature Controller
TE	Temperature Element
U	Heater
XI	Eccentricity Indicator
ZL	Position Indicating Lamp
ZS	Position Switch

3.0 COMPONENT PRE-EVALUATION

3.1 Pre-Evaluation Methodology Overview

The component pre-evaluation procedure is used to determine which components are subject to an aging management review. This procedure is used to categorize intended system functions as active or passive, determine if the components supporting passive system functions are long-lived, and identify the set of components subject to aging management review.

The pre-evaluation also determines whether the components should be included in a commodity group AMR or the system AMR.

3.2 Pre-Evaluation Results

Table 3-1 summarizes the disposition of intended system functions for the Area and Process Radiation Monitoring System (RMS) as either active or passive. These functions are derived from the system functions identified and documented during the component level scoping process, which are listed in subsection 1.1.3.

Components supporting only active intended system functions (i.e., not passive components) and those that are subject to replacement based on qualified life (i.e., not long-lived components) do not require an aging management review.

Components that are evaluated as part of commodity evaluations are addressed in separate AMRs. The RMS components dispositioned as part of commodity evaluations include all component supports*, all cables*, and instrument devices without isolation valves (that are not subject to a replacement program) that support passive functions.

Several components included in the RMS pre-evaluation were previously evaluated in AMRs of other systems and are not included in the RMS AMR. The device types of these components are noted in Table 3-2.

Table 3-2 summarizes the disposition of the device types identified in Table 2-1 as within the scope of license renewal for the Area and Process Radiation Monitoring System.

Refer to the results of the Area and Process Radiation Monitoring System Component Pre-evaluation for the list of components subject to AMR and other details.

* Component supports and cables are not identified as Area and Process Radiation Monitoring system components in the Area and Process Radiation Monitoring system scoping results, but are generically included in the Component Supports and Cables Commodity AMRs, respectively.

Table 3-1
Area and Process Radiation Monitoring System Intended System Function Disposition

Function Description	Function Passive?
Provide containment area radiation signal to ESFAS for containment isolation and radiological release control	No
Provide containment high range radiation signal for containment environment monitoring and to isolate the containment vent/hydrogen purge lines	No
Provide information to assess the environs and plant condition during and following an accident	No
Maintain functionality of electrical equipment as addressed by the EQ Program	No
Maintain the pressure boundary of the system	Yes
Provide containment isolation of the containment atmosphere and purge air monitor sampling line	Yes
Monitor and record wide range gaseous activity/release rate through the main plant vent and provide indications/alarms in the control room	No
Monitor and record radiation levels indicative of effluent activity in the main steam lines and provide indications/alarms in the control room	No
Provide testing capability/prevent spurious actuation of control room radiation monitoring circuitry	No
Maintain electrical continuity and/or provide protection of the electrical system	Yes
Provide seismic integrity and/or protection of SR components	Yes

Table 3-2

Summary of RMS Device Types Requiring Aging Management Review

Device Type	Device Description	Components Support Passive Function(s)?	Components Subject to Replacement Program?	Components Evaluated in Commodity Evaluation?	Components in Other System AMR?	Components in Radiation Monitoring AMR?
-HB	Piping class HB	Yes	No	No	No	Yes
AE	Analyzer Element	No	No	No	No	No
CKV	Check Valve	Yes	No	No	Yes	Yes
CV	Control Valve (& OP)	Yes	No	No	No	Yes
E/I	Voltage/ Current Device	No	No	No	No	No
FE	Flow Element	Yes	No	No	No	Yes
FI	Flow Indicator	Yes	No	No	No	Yes
FIS	Flow Indicator Switch	Yes	No	Yes	No	No
FL	Filter	Yes	No	No	No	Yes
FT	Flow Transmitter	No	No	No	No	No
FU	Fuse	No	No	No	No	No
HS	Handswitch	No	No	No	No	No
HV	Hand Valve	Yes	No	No	Yes	Yes
JL	Power Lamp Indicator	No	No	No	No	No
M	Motor	No	No	No	No	No
MOV	Motor Operated Valve	Yes	No	No	No	Yes
PDT	Differential Pressure Transmitter	Yes	No	Yes	No	No
PI	Pressure Indicator	Yes	No	Yes	No	No

Table 3-2 (continued)

Device Type	Device Description	Components Support Passive Function(s)?	Components Subject to Replacement Program?	Components Evaluated in Commodity Evaluation?	Components in Other System AMR?	Components in Radiation Monitoring AMR?
PNL	Panel (Wide Range Gas Monitor Skids)	Yes	No	Yes	No	No
PUMP	Pump	Yes	Yes	No	Yes	No
RE	Radiation Element	Yes	No	No	Yes	Yes
RI	Radiation Indicator	No	No	No	No	No
RIC	Radiation Indicator Controller	No	No	No	No	No
RP	Radiation Test Point	Yes	No	No	No	Yes
RR	Radiation Recorder	No	No	No	No	No
RY	Relay	No	No	No	No	No
SV	Solenoid Valve	Yes	No	No	No	Yes
TC	Temperature Controller	No	No	No	No	No
TE	Temperature Element	No	No	No	No	No
U	Heater	No	No	No	No	No
XI	Eccentricity Indicator	No	No	No	No	No
ZL	Position Indicating Lamp	No	No	No	No	No
ZS	Position Switch	No	No	No	No	No

4.0 COMPONENT AGING MANAGEMENT REVIEW

4.1 Aging Management Review Methodology Overview

The aging management review of Area and Process Radiation Monitoring System components was performed in accordance with the process described in the Calvert Cliffs Nuclear Power Plant Integrated Plant Assessment Methodology as specified in the procedure for the component aging management review. This procedure requires the identification of plausible age related degradation mechanisms (ARDMs) for each component subject to aging management review, unless it can be demonstrated that the effects of aging can be managed without specifying ARDMs. The effects of the ARDMs on the ability of the components to support intended functions are identified and the ability of existing plant programs to adequately manage the effects of these ARDMs is evaluated.

The review accomplished the following:

- Determination of plausible component-ARDMs combinations:

  (1) Identified potential age-related degradation mechanisms (ARDMs) for Area and Process Radiation Monitoring System components.

  (2) Grouped Area and Process Radiation Monitoring System components based on device type and design/operating environment attributes. Sub-component groups were also determined when necessary based on design/operating environment attributes and supported component functions.

  (3) Identified plausible age-related degradation mechanisms ARDMs for each component or sub-component based on:

    - Industry and plant information
    - Material of construction
    - Environmental service factors
    - Intended functions

- Identification of methods to manage aging effects for plausible ARDMs and assessment of current plant programs to determine whether these aging effects are adequately managed. If current programs were not adequate to manage aging effects, program modifications or new program requirements were identified.

4.2 Age-Related Degradation Mechanisms

Area and Process Radiation Monitoring System components were evaluated to identify plausible ARDMs for which aging effects management activities are required to ensure that age related degradation does not affect the component intended function(s). The

identification of plausible ARDMs was completed in accordance with the process discussed below.

4.2.1 Potential ARDMs

This step of the aging evaluation identifies ARDMs that are potentially detrimental to Area and Process Radiation Monitoring system components. These potential ARDMs are determined on an equipment type (e.g., pipe, valve, instrument, element) basis. An ARDM is considered potential if the evaluation concludes that the ARDM could occur in generic applications of the equipment throughout the plant. The equipment types for which ARDMs were evaluated are listed below.

Pipe
Valve
Element
Indicator
Filter

A list of potential component ARDMs was developed for each of the equipment types. The list was developed through review of industry documents. The following are examples of sources of ARDM information:

Draft NRC Regulatory Guide DG-1009
NUMARC (NEI) Industry Reports
NRC NPAR Reports
EPRI Reports
DOE Reports

For each ARDM on the list, a determination was made whether it was applicable (i.e., potential) to the equipment type. The applicability of the ARDM was determined on the basis of a generic component of the equipment type in service in any system in the plant.

A summary of the potential ARDMs for each of the Area and Process Radiation Monitoring system equipment types is provided in Table 4-1. The specific description of each potential ARDM is included on the Attachment 7s in Appendix A.

4.2.2 Component Grouping

Similar components are grouped together for evaluation efficiency. The age-related degradation evaluations results completed for a group are applicable to each of the individual components within the group. Selection of grouping attributes was accomplished through consideration of the component characteristics that would most influence the age-related degradation that could occur. Typical grouping attributes utilized for the Area and Process Radiation Monitoring System included material of construction, component specific function, and process environment. Where these attributes varied among the sub-components within a given component, a sub-group was developed to

represent all similar sub-components of the parent group members. Typical sub-groups represented component pressure boundary parts and component internals. Component grouping is shown on Attachment 3s in Appendix A. Subcomponent breakdowns are shown on Attachment 4s in Appendix A.

4.2.3 Plausible ARDMs

The list of potential ARDMs is utilized for a Area and Process Radiation Monitoring System component-specific identification of plausible ARDMs. The plausibility determination is made through consideration of factors that influence component susceptibility to the ARDM. The ARDMs are assessed for plausibility on the basis of:

Material of construction
Internal (process) environment
External environment
Operational conditions/effects
Affect on the passive intended function

The results of the component-specific ARDM plausibility evaluation are included in Attachment 5s and 6s in Appendix A. These results are summarized by component Device Type, in matrix form, in Table 4-2.

4.3 Methods to Manage the Effects of Aging

The methods of managing the effects of plausible age related degradation mechanisms are determined in the final step of the aging management review process. These methods are compared to current plant programs and practices to determine whether aging effects are adequately managed for the period of extended operation, or whether program revisions or new programs are required. Additionally, plant modifications may be considered as a method to manage aging effects.

Applicable aging effects management methods are determined through consideration of the specific plausible ARDM, component configuration (material of construction, geometry, service conditions, etc.), and relative significance of the aging effects for the period of extended operation.

Site programs and processes associated with the Area and Process Radiation Monitoring system were reviewed to identify those that implemented the aging effects management methods determined to be necessary for the period of extended operation. These activities were reviewed with appropriate site program managers, system engineers, and others to gain concurrence on the site programs and processes that will become commitments for plant license renewal. Similarly, modifications to current programs and requirements for new programs, were identified and reviewed with the site to gain concurrence as these will also become commitments for plant license renewal.

Site programs, modifications to programs, and new programs are related to specific Area and Process Radiation Monitoring system components and plausible ARDMs on Attachments 1, 2, 8 and 10 in Appendix A.

Attachment 1 in Appendix A provides a summary of Area and Process Radiation Monitoring System components (by device type) subject to aging management review, applicable passive intended function(s), plausible ARDMs, and aging effects management programs.

Table 4-1
Potential Age-Related Degradation Mechanisms (ARDMs) Summary

Potential ARDMs	Area and Process Radiation Monitoring System Equipment Types				
	Pipe	Valve	Filter	Indicator	Element
Cavitation Erosion	x	x	x	x	x
Corrosion Fatigue	x	x	x	x	x
Creep/Shrinkage					
Crevice Corrosion	x	x	x	x	x
Erosion/Corrosion	x	x	x	x	x
Fatigue	x	x	x	x	x
Fouling	x	x	x	x	x
Galvanic Corrosion	x	x	x	x	x
General Corrosion	x	x	x	x	x
Hydrogen Damage	x	x	x	x	x
Intergranular Attack	x	x	x	x	x
Irradiation Embrittlement					
Microbiologically Influenced Corrosion (MIC)	x	x	x	x	x
Oxidation					
Particulate Wear Erosion	x	x	x	x	x
Pitting	x	x	x	x	x
Radiation Damage	x	x	x	x	x
Rubber Degradation	x	x	x	x	x
Saline Water Attack	x				
Selective Leaching	x	x	x	x	x
Stress Corrosion Cracking	x	x	x	x	x
Stress Relaxation	x	x	x	x	x
Thermal Damage	x	x	x	x	x
Thermal Embrittlement	x	x	x	x	x
Wear	x	x	x	x	x

x - indicates that the ARDM is potentially detrimental to the equipment type

Table 4-2
Plausible Age-Related Degradation Mechanisms Summary

Plausible ARDMs	Area and Process Radiation Monitoring System Device Types										
	-HB	CKV	CV	FE	FI	FL	HV	MOV	RE	RP	SV
Cavitation Erosion											
Corrosion Fatigue											
Crevice Corrosion	x						x				
Erosion Corrosion											
Fatigue											
Fouling											
Galvanic Corrosion											
General Corrosion	x						x				
Hydrogen Damage											
Intergrannular Attack											
MIC											
Particulate Wear Erosion											
Pitting	x						x				
Radiation Damage											
Rubber Degradation											
Saline Water Attack											
Selective Leaching											
Stress Corrosion Cracking											
Stress Relaxation											
Thermal Damage											
Thermal Embrittlement											
Wear			x								

x - indicates that the ARDM is plausible for component(s) within the Device Type

Appendix A
Area and Process Radiation Monitoring System Aging Management Review Results

Appendix A
Area and Process Radiation Monitoring System Aging Management Review Results

Equipment Type: FILTER

- Attachment 7, Potential ARDM List
- Device Type: FL
  - Attachment 3, Component Grouping Summary Sheet (077-FL-01)
  - Attachment 4, Sub-Component/Sub-Group Identification
  - Attachment 5, ARDM Matrix
  - Attachment 6, Matrix Code List

Equipment Type: PIPE

- Attachment 7, Potential ARDM List
- Device Type: -HB
  - Attachment 3, Component Grouping Summary Sheet (077-HB-01)
  - Attachment 4, Sub-Component/Sub-Group Identification
  - Attachment 5, ARDM Matrix
  - Attachment 6, Matrix Code List
  - Attachment 3, Component Grouping Summary Sheet (077-RP-01)
  - Attachment 4, Sub-Component/Sub-Group Identification
  - Attachment 5, ARDM Matrix
  - Attachment 6, Matrix Code List

Equipment Type: VALVE

- Attachment 7, Potential ARDM List
- Device Type: CKV
  - Attachment 3, Component Grouping Summary Sheet (077-CKV-01)
  - Attachment 4, Sub-Component/Sub-Group Identification
  - Attachment 5, ARDM Matrix
  - Attachment 6, Matrix Code List
- Device Type: CV
  - Attachment 3, Component Grouping Summary Sheet (077-CV-01)
  - Attachment 4, Sub-Component/Sub-Group Identification
  - Attachment 5, ARDM Matrix
  - Attachment 6, Matrix Code List

Appendix A
Area and Process Radiation Monitoring System Aging Management Review Results

Component Aging Management Review Summary (Revision 1)

System Number: 077/079
System Name: Area and Process Radiation Monitoring

Device Type	Group ID	Passive Intended Functions	Grouping Attributes	Subcomponents/ Subgroups Not Subject to Aging Mgt Review	Plausible ARDMs	Managed by Existing Programs ID	Modifications Needed	New Program Need
HB	077-HB-01	Maintain Press Bndry Integrity	HB Pipe	None	Crevice Corrosion - Pipe/Fittings/Welds (internal) General Corrosion - Pipe/Fittings/Welds (internal) Pitting - Pipe/Fittings/Welds (internal)	None	NA	Yes Age Related Degradation Inspection Program
CKV	077-CKV-01	Maintain Press Bndry Integrity	Check Valves	Internals 077-CKV-01B	None	NA	NA	NA
CV	077-CV-01	Cont Isolation	CVs	None	Wear - Plug & Seat	STP M-571-E-1 and STP M-571-E-2	NA	NA
FE	077-FE-01	Maintain Press Bndry Integrity	FEs	Nozzle 077-FE-01B	None	NA	NA	NA
FI	077-FI-01	Maintain Press Bndry Integrity	Brooks Instrument Model 1305	Float 077-FI-01C Float Stops 077-FI-01D Shield 077-FI-01F	None	NA	NA	NA
	077-FI-02	Maintain Press Bndry Integrity	Brooks Instrument Model 1355	Float 077-FI-02C Float Stops 077-FI-02D Shield 077-FI-02F	None	NA	NA	NA
FL	077-FL-01	Maintain Press Bndry Integrity	Filters	Internals 077-FL-01B	None	NA	NA	NA
HV	077-HV-01	Maintain Press Bndry Integrity	Jamesbury Model 21-3600-PP-3, Plant Vent Gases	Non-Press Bndry Parts 077-HV-01D	None	NA	NA	NA

Component Aging Management Review Summary (Revision 1)

System Number: 077/079
System Name: Area and Process Radiation Monitoring

Device Type	Group ID	Passive Intended Functions	Grouping Attributes	Subcomponents/ Subgroups Not Subject to Aging Mgt Review	Plausible ARDMs	Managed by Existing Programs ID	Modifications Needed	New Program Need
	077-HV-02	Cont Isolation	Mark 130, Containment Atmosphere	None	Crevice Corrosion - Body/Stem/Disk/Seat General Corrosion - Body Pitting - Body/Stem/Disk/Seat	None	NA	Yes Age Related Degradation Inspection Program
	077-HV-03	Maintain Press Bndry Integrity	Mark 19, Control Room Atmosphere	Disk & Seat 077-HV-03E	None	NA	NA	NA
	077-HV-04	Maintain Press Bndry Integrity	Mark 19, Comp Cooling and Service Water	None	Crevice Corrosion - Body/Stem/Disk/Seat General Corrosion - Body Pitting - Body/Stem/Disk/Seat	CP-206	NA	Yes Age Related Degradation Inspection Program
MOV	077-MOV-01	Maintain Press Bndry Integrity	Marpac Model SS-B325	Ball and Seat 077-MOV-01D	None	NA	NA	NA
	077-MOV-02	Maintain Press Bndry Integrity	Circle Seal Model 9562T-4CC	None	None	NA	NA	NA
PUMP	077-PUMP-01	Pumps in this group are now dispositioned in System 077/079 Pre-evaluation Results and have been removed from Aging Management Review						
	077-PUMP-02	Pumps in this group are now dispositioned in System 077/079 Pre-evaluation Results and have been removed from Aging Management Review						
RE	077-RE-01	Maintain Press Bndry Integrity	General Atomic Model RD-52-61	None	None	NA	NA	NA
	077-RE-02	Maintain Press Bndry Integrity	General Atomic Model RD-72-01	None	None	NA	NA	NA
	077-RE-03	Maintain Press Bndry Integrity	General Atomic Model RD-72-02	None	None	NA	NA	NA
RP	077-RP-01	Maintain Press Bndry Integrity	RPs	Supporting Members 077-RP-01B	None	NA	NA	NA

Component Aging Management Review Summary (Revision 1)

System Number: 077/079
System Name: Area and Process Radiation Monitoring

Device Type	Group ID	Passive Intended Functions	Grouping Attributes	Subcomponents/ Subgroups Not Subject to Aging Mgt Review	Plausible ARDMs	Managed by Existing Programs ID	Modifications Needed	New Program Need
SV	077-SV-01	Maintain Press Bndry Integrity	SVs	Internals 077-SV-01D	None	NA	NA	NA

Description of Programs Which Manage the Effects of Aging (Revision 1)

System Number: 077/079
System Name: Area and Process Radiation Monitoring

Date: May 21, 1996
Attachment 2

Program ID	Portions of System Managed By This Program & Passive Intended Function	ARDMs Managed by This Program	Description of Program
Age Related Degradation Inspection Program	CS pipes and HVs - 077-HB-01* - 077-HV-02** SRW and CC valve internal surfaces - 077-HV-04* Maintain Pressure Boundary Integrity* Maintain Containment Isolation**	Crevice Corrosion General Corrosion Pitting	Inspections will be conducted to confirm that the mitigation programs are effective in preventing or mitigating the aging effects which they were designed to control. The scope of such inspections would typically be a representative sample of the population of components of concern. Where practical and prudent, the sample would be biased to focus on bounding of leading components. If these inspections reveal little or no degradation, the conclusion could be reached that the mitigation programs are sufficient to manage the effects of aging during the period of extended operations. Significant degradation would trigger action under the existing corrective action program and the need for additional inspections would be evaluated. The inspection techniques would need to be capable of detecting the effects of Crevice Corrosion, General Corrosion, and Pitting. Acceptance criteria for these inspections would be consistent with current practices which account for the components' abilities to perform intended functions in accordance with the CLB.
CP-206	SRW and CC valve internal surfaces - 077-HV-04 Maintain Pressure Boundary Integrity	Crevice Corrosion General Corrosion Pitting	The chemistry control program provides requirements and criteria for monitoring system fluid chemical parameters including pH, hydrazine concentration, impurity concentrations, dissolved oxygen, and suspended solids. The program provides for appropriate corrective actions if parameters exceed action levels.
STP M-571E-1 STP M-571E-2	Cont Isolation valve plugs & seats - 077-CV-01 Maintain Containment Isolation	Wear	The Local Leak Rate Testing of Containment Penetrations as required by 10CFR50 Appendix J provides assurance of seat/disk leak tightness.

Development of Aging Management Alternatives (Revision 1)

Date: 5/21/96

SYSTEM NUMBER: 077 / 079

SYSTEM NAME: Area and Process Radiation Monitoring

COMPONENT ID: NA

GROUP ID: 077-HB-01, 077-HV-02

1 **PLAUSIBLE ARDM FROM ATTACHMENT 5**	2 **PLANT PROGRAM**	3 **REASON FOR THE FORM OF AGING MANAGEMENT ALTERNATIVE CHOSEN**
Crevice Corrosion General Corrosion Pitting	Age Related Degradation Program (new program)	The occurrence of crevice corrosion, general corrosion and pitting is expected to be limited and may not affect the intended function of the RMS components due to the air internal environment of the components which would result in a minimal amount of moisture. Inspections of representative plant components will provide assurance that significant corrosion is not occurring, or will result in appropriate corrective action if significant corrosion is occurring.

SYSTEM NUMBER: 077 / 079	SYSTEM NAME: Area and Process Radiation Monitoring
COMPONENT ID: NA	GROUP ID: 077-CV-01

1 PLAUSIBLE ARDM FROM ATTACHMENT 5	2 PLANT PROGRAM	3 REASON FOR THE FORM OF AGING MANAGEMENT ALTERNATIVE CHOSEN
Wear	Local Leak Rate Testing of Containment Penetrations in accordance with the requirements of 10CFR50, App. J. This testing requirement is implemented on the Containment Atmosphere Radiation Monitor penetration components by STP M-571E-1 and STP M-571E-2, "Local Leak Rate Test, Penetrations 15 (Purge Air Monitor), 16, ...(Unit Heaters)"	Wear of the seating surfaces of the containment penetration control valves in the Containment Atmosphere Radiation Monitor System can occur due to valve operation and is managed by periodic leak testing. Leak testing the penetration components per the requirements of 10CFR50, App. J provides assurance of seat/disk leak tightness. STP M-571E-1(2), "LLRT of Penetrations 15, 16, ..." performs the App. J Type C leak rate test of the penetration. This test is performed on a refueling outage frequency.

SYSTEM NUMBER: 077 / 079	SYSTEM NAME: Area and Process Radiation Monitoring
COMPONENT ID: NA	GROUP ID: 077-HV-04

1 PLAUSIBLE ARDM FROM ATTACHMENT 5	2 PLANT PROGRAM	3 REASON FOR THE FORM OF AGING MANAGEMENT ALTERNATIVE CHOSEN
Crevice Corrosion General Corrosion Pitting	Chemistry Control and Monitoring for the Service Water and Component Cooling systems. The program is implemented by CP-206, "Specifications and Surveillance of Component Cooling/Service Water"	Corrosion of the Service Water and Component Cooling Radiation Monitor isolation valve pressure boundary is plausible due to the service fluid (water). Control of service fluid chemistry provides an environment which minimizes the effects of corrosion. Corrosion is not expected to present a significant challenge to the pressure boundary function of the components due to treated and controlled chemistry internal environment.
Crevice Corrosion General Corrosion Pitting	Age Related Degradation Program (new program)	The occurrence of crevice corrosion, general corrosion and pitting is expected to be limited and may not affect the intended function of the RMS components due to the control of Component Cooling and Service Water chemistry. Inspections of representative plant components will provide assurance that significant corrosion is not occurring, or will result in appropriate corrective action if significant corrosion is occurring.

Development of Aging Management Alternatives (Revision 1)

Date: 5/21/96

SYSTEM NUMBER: 077/079		SYSTEM NAME: Area & Process Radiation Monitoring
PA/TASK ID and AFFECTED PORTION	**PRESENT DESCRIPTION**	**NEW/REVISED CORRECTIVE ACTION/RECOMMENDATION**
Age Related Degradation Inspection (ARDI) Program	N/A	The ARDI program must provide requirements for identification of representative plant components for inspection based on the results of this aging management review, including the inspection sample size, appropriate sample techniques, and requirements for reporting of results and corrective actions. See BGE memorandum LCM-96-044, dated 2-15-96 for further information.

ARDM	POTENTIAL	DESCRIPTION/JUSTIFICATION	SOURCE
Cavitation Erosion	Yes	Localized material erosion caused by formation and collapse of vapor bubbles in close proximity to material surface. Requires fluid (liquid) flow and pressure variations which temporarily drop the liquid pressure below the corresponding vapor pressure. Most materials are susceptible to varying degrees depending upon the severity of the environmental factors.	[7]
Corrosion Fatigue	Yes	Plant equipment operating in a corrosive environment subjected to cyclic (fatigue) loading may initiate cracks and/or fail sooner than expected based on analysis of the corrosion and fatigue loadings applied separately. Fatigue-crack initiation and growth usually follows a transgranular path, although there are some cases where intergranular cracking has been observed. In some cases, crack initiation occurs by fatigue and is subsequently dominated by corrosion advance. In other cases, a corrosion mechanism (SCC) can be responsible for crack formation below the fatigue threshold, and the fatigue mechanism can accelerate the crack propagation. Corrosion-fatigue is a potentially active mechanism in both stainless steels as well as carbon and low alloy steels.	[7]
Creep/ Shrinkage	No	Not applicable to Equipment Type. The phenomenon results in dimensional changes in metals at high temperatures and in concrete subject to long term dehydration. This ARDM is not applicable to this equipment type since proper component specification and design prevents this ARDM from occurring (i.e., system and component design standards adequately address this ARDM).	[2]
Crevice Corrosion	Yes	Crevice corrosion is intense, localized corrosion within crevices or shielded areas. It is associated with a small volume of stagnant solution caused by holes, gasket surfaces, lap joints, crevices under bolt heads, surface deposits, designed crevices for attaching thermal sleeves to safe-ends, and integral weld backing rings or back-up bars. The crevice must be wide enough to permit liquid entry and narrow enough to maintain stagnant conditions, typically a few thousandths of an inch or less. Crevice corrosion is closely related to pitting corrosion and can initiate pits in many cases as well as leading to stress corrosion cracking. In an oxidizing environment, a crevice can set up a differential aeration cell to concentrate an acid solution within the crevice. Even in a reducing environment, alternate wetting and drying can concentrate aggressive ionic species to cause pitting, crevice corrosion, intergranular attack, or stress corrosion cracking.	[6] [7] [12]

Erosion Corrosion	Yes	Increased rate of attack on a metal because of the relative movement between a corrosive fluid and the metal surface. Mechanical wear or abrasion can be involved, characterized by grooves, gullies, waves, holes and valleys on the metal surface. Erosion is a mechanical action of a fluid and/or particulate matter on a metal surface, without the influence of corrosion. Erosion corrosion failures can occur in a relatively short time and are sometimes unexpected, since corrosion tests are usually run under static conditions. All equipment exposed to moving fluids is vulnerable; in particular, piping (bends, tees, etc.), Valves, pumps, propellers and impellers, heat exchanger tubing, turbine blades and wear plates are components which have experienced erosion corrosion. This is a serious problem in steam piping, heater drain piping, reheaters, and moisture separators due to high velocity particle impingement. Erosion corrosion has occurred in high and low pressure preheater tubes, low pressure preheaters, evaporators and feedwater heaters. Inlet tube corrosion occurs in heat exchangers, due to the turbulence of flow from the exchanger head into the smaller tubes, within the first few inches of the tube. Such corrosion has been especially evident in condenser tubes and feedwater heaters. The occurrence of erosion corrosion is highly dependent upon material of construction and the fluid flow conditions. Carbon or low alloy steels are particularly susceptible when in contact with high velocity water (single or two phase) with turbulent flow, low oxygen and fluid pH < 9.3. Maximum erosion corrosion rates are expected in carbon steel at 130-140°C (single phase) and 180°C (two phase).	[5] [6] [7]
Fatigue	Yes	Fatigue damage results from progressive, localized structural change in materials subjected to fluctuating stresses and strains. Associated failures may occur at either high or low cycles in response to various kinds of loads (e.g., Mechanical or vibrational loads, thermal cycles, or pressure cycles). Fatigue cracks initiate and propagate in regions of stress concentration that intensify strain. The fatigue life of a component is a function of several variables such as stress level, stress state, cyclic wave form, fatigue environment, and the metallurgical condition of the material. Failure occurs when the endurance limit number of cycles (for a given load amplitude) is exceeded. All materials are susceptible (with varying endurance limits) when subjected to cyclic loading. Vibration loads have also been the cause of recurring weld failures by the fatigue of small socket welds. Certain piping locations, such as charging lines, have been found to experience vibration conditions. In some cases these failures in pipe have been due to inadequately supported pipe or obturator induced vibratory loads.	[6] [7] [2]

Fouling	Yes	Unavoidable introduction of foreign substances that interact with and/or collect within system and components. Caused by failure or degradation of upstream removal process equipment, long term buildup, low flow, stagnant flow, infrequent operation, and/or contaminated inlet flow. Fouling refers to all deposits on system surfaces that increase resistance to fluid flow and/or heat transfer. Sources of fouling include the following: (1) organic films of micro-organisms and their products (microbial fouling) (2) deposits of macro-organisms such as mussels (macrobial fouling) (3) inorganic deposits, including scales, silt, corrosion products and detritus. Scales result when solubility limits for a given species are exceeded. Deposits result when coolant-borne particles drop onto surfaces due to hydraulic factors. The deposits result in reduced flow of cooling water, reduced heat transfer, and increased corrosion. Sediment deposits promote concentration cell corrosion and growth of sulfur-reducing bacteria. The bacteria can cause severe pitting after one month of service. Piping systems designed for 30 years have had their projected life reduced to five years due to under-sediment corrosion.	[9] [10] [11]
Galvanic Corrosion	Yes	Accelerated corrosion caused by dissimilar metals in contact in a conductive solution. Requires two dissimilar metals in physical or electrical contact, developed potential (material dependent), and conducting solution.	[12]
General Corrosion	Yes	Thinning (wastage) of a metal by chemical attack (dissolution) at the surface of the metal by an aggressive environment. The consequences of the damage are loss of load carrying cross-sectional area. General corrosion requires an aggressive environment and materials susceptible to that environment. An important concern for PWRs is boric acid attack of carbon steels. Borated water has been observed to leak from piping, valves, storage tanks, etc., and fall on other carbon steel components and attack the component from the outside. Wastage is not a concern for austenitic stainless steel alloys.	[7] [8] [2]

Hydrogen Damage	Yes	Two forms of hydrogen attack relevant to light water reactor materials and conditions are hydrogen blistering and hydrogen embrittlement. Both produce mechanical damage in the affected component. In each case, atomic hydrogen enters the metal, either as a result of a corrosion reaction at the surface or by cathodic polarization which results in the evolution of hydrogen gas. In blistering, molecular hydrogen within the metal causes high pressure and local damage in the form of "blistered" regions of the metal surface. Hydrogen embrittlement affects ferritic and martensitic iron-based alloys, and results in low ductility intergranular cracking (similar to stress corrosion cracking). The phenomenon of hydrogen cracking is usually manifested as delayed cracking, at or near room temperature, after stress is applied. A certain critical stress, which may take the form of weld residual stress, is required to cause cracking. Notches concentrate such stresses and tend to shorten the delay time for cracking. Cracking of welds due to hydrogen embrittlement and hydrogen-induced cracking is a common concern. This cracking is more of a problem in higher strength steels (yield strength >120 ksi). Ferritic and martensitic stainless steels, carbon steels, and other high strength alloys are susceptible. Austenitic stainless steels are relatively immune but could experience damage at sufficiently high hydrogen levels.	[6] [7]
Intergranular Attack	Yes	Intergranular Attack (IGA) is very similar to intergranular stress corrosion cracking (IGSCC) except that stress is not required for IGA. IGA is localized corrosion at or adjacent to grain boundaries, with relatively little corrosion of the material grains. It is caused by impurities in the grain boundaries, or the enrichment or depletion of alloying elements at grain boundaries, such as the depletion of chromium at austenitic stainless steel grain boundaries. A "sensitized" microstructure causes susceptibility to IGA. When austenitic stainless steels are heated into or slow cooled through the temperature range of approximately 750 to 1500°F, chromium carbides can be formed, thus depleting the grain boundaries of chromium and decreasing their corrosion resistance. High chromium ferritic stainless steels, such as Type 430, also experience susceptibility to IGA. Nickel alloys such as alloy 600 experience IGA in the presence of certain sulfur environments at high temperatures (by forming low melting sulfur compounds at grain boundaries) or when austenitic stainless steel weld filler metal is inadvertently used on Ni-Cr-Fe alloys. Susceptibility to intergranular attack (sensitization) usually develops during thermal processing such as welding or heat treatments.	[6] [7] [2] [12]
Irradiation Embrittlement	No	Not applicable to Equipment Type. The ARDM results in a decrease in steel fracture toughness due to long-term exposure to a fast flux of neutrons. This ARDM is not applicable to this equipment type since element components in the systems under evaluation are not located in areas where the neutron flux is high enough to cause this ARDM to occur.	[6] [7]

MIC	Yes	Accelerated corrosion of materials resulting from surface microbiological activity. Sulfate reducing bacteria, sulfur oxidizers, and iron oxidizing bacteria are most commonly associated with corrosion effects. Most often results in pitting followed by excessive deposition of corrosion products. Stagnant or low flow areas are most susceptible. Any system that uses untreated water, or is buried, is particularly susceptible. Consequences range from leakage to excessive differential pressure and flow blockage. Essentially all systems and most commonly-used materials are susceptible. Temperatures from about 50°F to 120°F are most conducive to MIC. Experience in virtually all large industries is common. Nuclear experience is relatively new, but also widespread. MIC is generally observed in service water applications utilizing raw untreated water. Sedimentation aggravates the problem.	[6] [7] [2]
Oxidation	No	Not applicable to Equipment Type. The ARDM results from a chemical reaction at the surface of a material when subjected to an oxidizing environment. Oxidation occurs at any temperature. Electrical components experience degradation related to oxidation and are considered separately. Oxidation generally is not considered a degradation mechanism in metals of fluid systems in mild environments since this mechanism serves to protect materials by formation of a passive layer. Other corrosion mechanisms (e.g. Corrosion fatigue, crevice corrosion, erosion corrosion, general corrosion and pitting) can result from oxidation/reduction reactions under specific aggressive mechanical and chemical environment and are addressed separately. It could be considered a degradation mechanism at high temperatures, where a more rapid reaction between metal and oxygen is likely to occur. These temperatures do not occur in power plant applications under evaluation. Therefore, oxidation is not considered a potential ARDM for element components.	[7] [12]
Particulate Wear Erosion	Yes	The loss of material caused by mechanical abrasion due to relative motion between solution and material surface. Requires high velocity fluid, entrained particles, turbulent flow regions, flow direction change, and/or impingement. Most materials are susceptible to varying degrees depending upon the severity of the environmental factors.	[7]

Pitting	Yes	A form of localized attack with greater corrosion rates at some locations than at others. Pitting can be very insidious and destructive, with sudden failures in high pressure applications (especially in tubes) occurring by perforation. This form of corrosion essentially produces "holes" of varying depth to diameter ratios in the steel. These pits are, in many cases, filled with oxide debris, especially for ferritic materials such as carbon steel. Deep pitting is more common with passive metals, such as austenitic stainless steels, than with non- passive metals. Pits are generally elongated in the direction of gravity. In many cases, erosion corrosion, fretting corrosion, and crevice corrosion can also lead to pitting. Corrosion pitting is an anodic reaction which is an autocatalytic process. That is, the corrosion process within a pit produces conditions which stimulate the continuing activity of the pit. High concentrations of impurity anions such as chlorides and sulfates tend to concentrate in the oxygen- depleted pit region, giving rise to a potentially concentrated aggressive solution in this zone. Pitting has been found on the outside diameter of tubes where sludge or tube scale was present. It can also occur at locations of relatively stagnant coolant or water, such as in carbon steel pipes for service water lines, and at crevices in stainless steel, such as at the stainless steel cladding between reactor pressure vessel closure flanges. Pitting can become passive in some metals such as aluminum.	[6] [7] [2] [12]
Radiation Damage	Yes	Non-metallics are susceptible to degradation caused by gamma radiation.	[4]
Rubber Degradation	Yes	Rubber can be used in specific applications of this device type. Long term exposure of rubber to water will result in water absorption and swelling, blistering, hardening, and eventual cracking. When utilized as a protective lining, moisture permeation of the rubber produces blisters beneath the lining and initiates corrosion of the lined surface.	[3]
Saline Water Attack	No	Not applicable to Equipment Type. Saline Water Attack has resulted in the degradation of reinforced concrete structures. The degradation mechanism involves water seepage into the concrete resulting in a high chloride environment for the reinforcing bars. The reinforcing bars corrode resulting in expansion that leads to cracking and spalling of the concrete. Of particular concern for structures that are inaccessible for routine inspection, and piping or other fluid components embedded in concrete. This ARDM is not applicable to element components since elements are not constructed of nor typically installed in concrete.	[2]

Selective Leaching	Yes	The removal of one element from a solid alloy by corrosion processes. The most common example is the selective removal of zinc in brass alloys (dezincification). Similar processes occur in other alloy systems in which aluminum, iron, cobalt, chromium, and other elements are removed. There are two types, layer-type and plug-type. Layer-type is a uniform attack whereas plug-type is extremely localized leading to pitting. Overall dimensions do not change appreciably. If a piece of equipment is covered by debris or surface deposits and/or not inspected closely, sudden unexpected failure may occur in high pressure applications due to the poor strength of the remaining material. Requires susceptible materials and corrosive environment. Materials particularly susceptible include zinc, aluminum, carbon and nickel. Environmental conditions include high temperature, stagnant aqueous solution, and porous inorganic scale. Acidic solutions and oxygen aggravate the mechanism.	[12] [13]
Stress Corrosion Cracking	Yes	Selective corrosive attack along or across material grain boundaries. Four particular mechanisms are known to exist: (1) Intergranular (IGSCC), between the material grain boundaries. (2) Transgranular (TGSCC), across the material grains along certain crystallographic planes. (3) Irradiation Assisted (IASCC), between the material grains after an incubation neutron dose which sensitizes the material. (4) Interdendritic (IDSCC), between the dendrite interfaces. SCC requires applied or residual tensile stress, susceptible materials (such as austenitic stainless steels, alloy 600, alloy x-750, SAE 4340, and ASTM A289), and oxygen and/or ionic species (e.g., Chlorides/sulfates).	[6] [7] [2] [12] [13]

Stress Corrosion Cracking (Continued)	Yes (Cont'd)	Common sources of residual stress include thermal processing and stress risers created during surface finishing, fabrication, or assembly. The heat input during welding can result in a localized sensitized region which is susceptible to SCC. IGSCC is a concern in stainless steel piping depending on material condition and process fluid chemistry and also is a potential concern in valve internals (PH steel). SCC of low alloy steel and carbon steel is not considered a credible aging mechanism for typical conditions encountered in a nuclear power plant. TGSCC may be a concern in stainless steel if aggressive chemical species (caustics, halogens, sulfates, especially if coupled with the presence of oxygen) are present. TGSCC was thought to be inactive in low alloy steel, however, recent data suggests that the mechanism may operate. IASCC is a potential concern only for reactor vessel internals and other stainless steel components, such as control rods, which are subject to very high neutron fluence levels. A fast neutron incubation fluence of at least 1.0E+20 is generally required to sensitize the material. IDSCC is a potential concern in stainless steel weld metal deposits based on microstructure and delta ferrite content. This mechanism is inactive in carbon and low alloy steel. Ammonia grooving in brass components can occur when the concentration of ammonia is greater than a few ppm. It is found most often in feedwater heaters that contain admiralty brass tubes and where morpholine, which breaks down into ammonia, is used to increase the pH of the condensate.	
Stress Relaxation	Yes	Stress Relaxation occurs under conditions of constant strain where part of the elastic strain is replaced with plastic strain. A material loaded to an initial stress may experience a reduction in stress over time at high temperatures. Bolted connections are most vulnerable. Relaxation of stress on packing due to stretching of gland follower studs under elevated temperatures may cause packing leakage.	[7]
Thermal Damage	Yes	Non-metallics are particularly susceptible with material dependent temperature limits.	[7] [2]
Thermal Embrittlement	Yes	Loss of material fracture toughness caused by thermally induced changes in the formation and distribution of alloying constituents. Requires high temperature 500°F to 700°F for metallic components. Ferrite containing stainless steels are susceptible as are materials with grain boundary segregation of impurities.	[7]

Wear	Yes	Wear results from relative motion between two surfaces (adhesive wear), from the influence of hard, abrasive particles (abrasive wear - see particulate erosion) or fluid stream (erosion), and from small, vibratory or sliding motions under the influence of a corrosive environment (fretting). In addition to material loss from the above wear mechanisms, impeded relative motion between two surfaces held in intimate contact for extended periods may result from galling/self-welding. Motions may be linear, circular, or vibratory in inert or corrosive environments. The most common result of wear is damage to one or both surfaces involved in the contact. Wear most typically occurs in components which experience considerable relative motion such as valves and pumps, in components which are held under high loads with no motion for long periods (valves, flanges), or in clamped joints where relative motion is not intended but occurs due to a loss of clamping force (e.g., Tubes in supports, valve stems in seats, springs against tubes). Wear may proceed at an ever- increasing rate as worn surfaces moving past one another will often do so with much higher contact stresses than the surfaces of the original geometry. Fretting is a wear phenomenon that occurs between tight-fitting surfaces subjected to a cyclic, relative motion of extremely small amplitude. Fretting is frequently accompanied by corrosion. Common sites for fretting are in joints that are bolted, keyed, pinned, press fit or riveted; in oscillating bearings, couplings, spindles, and seals; in press fits on shafts; and in universal joints. Under fretting conditions, fatigue cracks may be initiated at stresses well below the endurance limit of nonfretted specimens.	[1]

Attachment 7 Reference List

Source	Title
[1]	ASME Wear Control Handbook, Peterson and Winer, 1980
[2]	Standard Format and Content of Technical Information for Applications to Renew Nuclear Power Plant Operating Licenses, Draft NRC Regulatory Guide No. DG-1009, December 1990
[3]	Service (Salt) Water System Life Cycle Management Evaluation, EPRI Report No. TR-102204, April 1993
[4]	Radiation Effects on Organic Materials in Nuclear Plants, EPRI Report No. NP-2129, November 1981
[5]	Erosion/Corrosion in Nuclear Plant Steam Piping, EPRI Report No. NP-3944, 1985
[6]	Component Life Estimation: LWR Structural Materials Degradation Mechanisms, EPRI Report No. NP-5461, 1987
[7]	Environmental Effects on Components: Commentary for ASME Section III, EPRI Report No. NP-5775, April 1988
[8]	Boric Acid Corrosion of Carbon and Low Alloy Steel Pressure Boundary Materials, EPRI Report No. NP-5985, 1988
[9]	Nuclear Plant Service Water System Aging Degradation Assessment, NUREG/CR-5379, Volume 1 and 2, June 1989 and October 1992
[10]	Aging Assessment of Instrument Air Systems, NUREG/CR-5419, January 1990
[11]	Insights Gained from Aging Research, NUREG/CR-5643, March 1992
[12]	Corrosion Engineering, Fontana and Greene, 1978
[13]	Corrosion and Corrosion Control, An Introduction to Corrosion Science and Engineering, Uhlig, Third Edition, 1985

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 3**
Equipment Type:	**ELEMENT**	**Page 1 of 1**
Device Type:	**FE**	**March 29,1996**
Group ID:	**077-FE-01**	

Device Type: Flow Element
Vendor: General Atomics
Model Number: 03679060-014
Material: Stainless Steel
Internal Environment: Air
External Environment: Air
Function(s): Maintain System Pressure Boundary Integrity
Name Plate Data:

List of Grouped Components:

1FE5415A	1RE Low Range Sample Flow
1FE5415B	1RE High Range Sample Flow
2FE5415A	2RE Low Range Sample Flow
2FE5415B	2RE High Range Sample Flow

ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079 | SYSTEM NAME: Area & Process Radiation

EQUIPMENT ID: NA | GROUP ID: 077-FE-01 | Date: March 27, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Material (Source)	Model Number (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-FE-01A	Tube Assembly (None)	General Atomics (VTM 12284-010 Section 6, p.24 Appendix, pp.118-141)	Stainless Steel (VTM 12284-010 Section 6, p.24 Appendix, pp.118-141)	03679060-014 (VTM 12284-010 Section 6, p.24 Appendix, pp.118-141)	Maintain system pressure boundary (CLSR)	Y
077-FE-01B	Nozzle (None)	General Atomics (VTM 12284-010 Section 6, p.24 Appendix, pp.118-141)	Stainless Steel (VTM 12284-010 Section 6, p.24 Appendix, pp.118-141)	03679060-014 (VTM 12284-010 Section 6, p.24 Appendix, pp.118-141)	None (Provide flow to element) (CLSR)	N
077-FE-01C	Transducer (None)	General Atomics (VTM 12284-010 Section 6, p.24 Appendix, pp.118-141)	Stainless Steel (VTM 12284-010 Section 6, p.24 Appendix, pp.118-141)	03679060-014 (VTM 12284-010 Section 6, p.24 Appendix, pp.118-141)	Maintain system pressure boundary (CLSR)	Y

ARDM MATRIX (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 5**
Equipment Type:	**ELEMENT**	**Page 1 of 1**
Device Type:	**FE**	**March 29, 1996**
Group ID:	**077-FE-01**	

ARDM	077-FE-01A Tube Assembly	077-FE-01C Transducer
Cavitation Erosion	02	02
Corrosion Fatigue	12	12
Crevice Corrosion	06	06
Erosion Corrosion	21	21
Fatigue	12	12
Fouling	15	15
Galvanic Corrosion	07	07
General Corrosion	01.3	01.3
Hydrogen Damage	03	03
Intergranular Attack	22	22
MIC	15	15
Particulate Wear Erosion	17	17
Pitting	06	06
Radiation Damage	01.3	01.3
Rubber Degradation	01.3	01.3
Selective Leaching	01.3	01.3
Stress Corrosion Cracking	18	18
Stress Relaxation	04	04
Thermal Damage	01.3	01.3
Thermal Embrittlement	04	04
Wear	16	16

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: FE EQUIPMENT TYPE: ELEMENT

GROUP ID: 077-FE-01 Date: 4/11/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.3 STAINLESS STEEL	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS AIR, NOT THE LIQUIDS NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONO-ATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES.	ATTACH 7
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500° F ENSURE THIS ARDM IS NOT PLAUSIBLE.	ATTACH 7 ES-014 ES-024
06	PROCESS FLUID CHEMISTRY AND MOISTURE DO NOT PERPETUATE THE ARDM. INPO OPERATIONS AND MAINTENANCE REMINDER O&MR-132 DESCRIBES OPERATIONAL FAILURES OF RAD MONITORING SYSTEMS DUE TO EXCESS MOISTURE. CCNPP RECENT HISTORY SHOWS ONE CASE WHERE WATER WAS INTRODUCED TO THE SYSTEM DUE TO BLOWDOWN TANK VENT BEING ALIGNED TO THE MAIN PLANT VENT (MO 2199402504). HOWEVER, PER INPUT FROM THE SYSTEM ENGINEER THIS IS NOT A COMMON OCCURRENCE. THE SYSTEM HAS NOT EXPERIENCED THE MOISTURE RELATED PROBLEMS DESCRIBED IN O&MR-132. SYSTEM OPERATION IS ASSURED IN ACCORDANCE WITH O/I-35. THE LIMITED AMOUNT OF MOISTURE PREVENTS SIGNIFICANT EFFECT FROM THESE AGING MECHANISMS.	ATTACH 7 O/I-35 INPO O&MR-132

CODE	DESCRIPTION	SOURCE
07	MATERIAL SELECTION/SEPARATION AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THE ELEMENT IS MADE OF MATERIALS WITH LOW POTENTIAL DIFFERENCES AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION.	ATTACH 7 O/I-35
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM MAINTAINS A RELATIVELY LOW STEADY PRESSURE AND TEMPERATURES MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 12284-010
15	ARDMS DO NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. FOULING AND MIC MAY OCCUR TO A LIMITED EXTENT DUE TO CONDENSED HUMIDITY FROM THE VENT GASES, MICROBES AND AIRBORNE PARTICLES. PLANT EXPERIENCE HAS SHOWN FOULING HAS OCCURRED IN THIS SYSTEM. HOWEVER, FOULING DOES NOT AFFECT THE PRESSURE BOUNDARY FUNCTION. MIC ACTIVITY WILL NOT BE SIGNIFICANT TO PRESSURE BOUNDARY FUNCTION DUE TO LIMITED AMOUNT OF CONDENSATION.	ATTACH 7 O/I-35
16	COMPONENT DESIGN DOES NOT PERPETUATE THE ARDM. THE ELEMENT PRESSURE BOUNDARY SUBCOMPONENTS ARE NOT IN RELATIVE MOTION AGAINST OTHER SUB-COMPONENTS MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7
17	PARTICULATE WEAR EROSION IS NOT SIGNIFICANT. THE AIR VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF AIRBORNE PARTICLES WILL NOT LEAD TO SIGNIFICANT EROSION OF THE EROSION RESISTANT MATERIALS. FILTRATION OF AIR ON THE SAMPLE CONDITIONING SKID PREVENT SIGNIFICANT EFFECT FROM THIS AGING MECHANISM.	ATTACH 7 60738SH.2
18	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION.	ATTACH 7 O/I-35
21	PROCESS FLUID (AIR) AND MATERIAL SELECTION (SS) DO NOT PERPETUATE THE ARDM.	ATTACH 7

CODE	DESCRIPTION	SOURCE
22	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION.	ATTACH 7 O/I-35

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System: Area & Process Radiation Monitoring (077/079)
Equipment Type: ELEMENT
Device Type: RE
Group ID: 077-RE-01

Device Type:	Radiation Element
Vendor:	General Atomics
Model Number:	RD-52-61
Material:	SS
Internal Environment:	Air
External Environment:	Air
Function(s):	Maintain System Pressure Boundary Integrity
Name Plate Data:	

List of Grouped Components:

1RE5416	RE Wide Range Effluent Radiation Monitor
2RE5416	RE Wide Range Effluent Radiation Monitor

ATTACHMENT , SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA GROUP ID: 077-RE-01 Date: May 15, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Material (Source)	Model Number (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-RE-01A	Sample Chamber (None)	General Atomics (VTM 12284-010)	304 SS (VTM 12284-010 Appendix p.6)	RD-52-61 (VTM 12284-010 pp.1-15, 6-47)	Maintain system pressure boundary (CLSR)	Y
077-RE-01B	Cover (None)	General Atomics (VTM 12284-010)	304 SS (VTM 12284-010 Appendix p.6)	RD-52-61 (VTM 12284-010 pp.1-15, 6-47)	Maintain system pressure boundary (CLSR)	Y
077-RE-01C	Photomultiplier Tube (None)	General Atomics (VTM 12284-010)	SS (VTM 12284-010 Appendix p.6)	RD-52-61 (VTM 12284-010 pp.1-15, 6-47)	Maintain system pressure boundary (CLSR)	Y
077-RE-01D	Inlet/Outlet Tube (None)	General Atomics (VTM 12284-010)	SS (VTM 12284-010 Appendix p.6)	RD-52-61 (VTM 12284-010 pp.1-15, 6-47)	Maintain system pressure boundary (CLSR)	Y
077-RE-01E	Seal Screws (None)	General Atomics (VTM 12284-010)	SS (VTM 12284-010 p. 6-5 & LCM File S-96-019)	RD-52-61 (VTM 12284-010 pp.1-15, 6-47)	Maintain system pressure boundary (CLSR)	Y
077-RE-01F	Flange Screws (None)	General Atomics (VTM 12284-010)	CS/Alloy/SS (None)	RD-52-61 (VTM 12284-010 pp.1-15, 6-47)	Maintain system pressure boundary (CLSR)	Y

ARDM MATRIX (Revision 1)

System: **Area & Process Radiation Monitoring (077/079)** **Attachment 5**
Equipment Type: **ELEMENT** **Page 1 of 1**
Device Type: **RE** **May 15, 1996**
Group ID: **077-RE-01**

ARDM	077-RE-01A Sample Chamber	077-RE-01B Cover	077-RE-01C PM Tube	077-RE-01D Inlet/Outlet Tube	077-RE-01E Seal Screws	077-RE-01F Flange Screws
Cavitation Erosion	02	02	02	02	02	19
Corrosion Fatigue	12	12	12	12	12	12
Crevice Corrosion	06	06	06	06	06	19
Erosion Corrosion	21	21	21	21	21	19
Fatigue	12	12	12	12	12	12
Fouling	15	15	15	15	15	19
Galvanic Corrosion	07	07	07	07	07	07
General Corrosion	01.3	01.3	01.3	01.3	01.3	19
Hydrogen Damage	03	03	03	03	03	03
Intergranular Attack	22	22	22	22	22	22
MIC	15	15	15	15	15	19
Particulate Wear Erosion	17	17	17	17	17	19
Pitting	06	06	06	06	06	19
Radiation Damage	01.3	01.3	01.3	01.3	01.3	01.2
Rubber Degradation	01.3	01.3	01.3	01.3	01.3	01.2
Selective Leaching	01.3	01.3	01.3	01.3	01.3	01.2
Stress Corrosion Cracking	18	18	18	18	18	18
Stress Relaxation	04	04	04	04	04	04
Thermal Damage	01.3	01.3	01.3	01.3	01.3	01.2
Thermal Embrittlement	04	04	04	04	04	04
Wear	16	16	16	16	16	16

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: RE EQUIPMENT TYPE: ELEMENT

GROUP ID: 077-RE-01 Date: 5/15/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.2 CARBON STEEL/ALLOY/STAINLESS STEEL 01.3 STAINLESS STEEL	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS AIR, NOT THE LIQUIDS NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONO-ATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUID IS PLANT VENT GASES. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTHS OF TYPICAL 300 SERIES STAINLESS STEELS AND TYPICAL STEEL BOLTING MATERIALS ARE BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING.	ATTACH 7 VOL-13 FONTANA 60738 SH2 60722 SH1 AVNER ASM
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500°F ENSURE THIS ARDM IS NOT PLAUSIBLE.	ATTACH 7 ES-014

CODE	DESCRIPTION	SOURCE
06	PROCESS FLUID AND MOISTURE DO NOT PERPETUATE THE ARDM. INPO OPERATIONS AND MAINTENANCE REMINDER O&MR-132 DESCRIBES OPERATIONAL FAILURES OF RAD MONITORING SYSTEMS DUE TO EXCESS MOISTURE. CCNPP RECENT HISTORY SHOWS ONE CASE WHERE WATER WAS INTRODUCED TO THE SYSTEM DUE TO BLOWDOWN TANK VENT BEING ALIGNED TO THE MAIN PLANT VENT (MO 2199402504). HOWEVER, PER INPUT FROM THE SYSTEM ENGINEER THIS IS NOT A COMMON OCCURRENCE. THE SYSTEM HAS NOT EXPERIENCED THE MOISTURE RELATED PROBLEMS DESCRIBED IN O&MR-132. SYSTEM OPERATION IS ASSURED IN ACCORDANCE WITH O/I-35. THE LIMITED AMOUNT OF MOISTURE PREVENTS SIGNIFICANT EFFECT FROM THESE AGING MECHANISMS.	ATTACH 7 O/I-35 INPO O&MR-132 MO 2199402504
07	MATERIAL SELECTION/SEPARATION AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THE ELEMENT PRESSURE BOUNDARY PARTS ARE MADE OF MATERIALS WITH LOW POTENTIAL DIFFERENCES. THE FLANGE SCREWS (UNSPECIFIED MATERIAL) ARE NOT SEPARATED FROM THE 304 SS SAMPLE CHAMBER, BUT GALVANIC CORROSION WILL BE MINIMAL DUE TO LACK OF AN ELECTROLYTE (THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION). THE SCREWS EXPOSED TO AN EXTERNAL AIR ENVIRONMENT ONLY AND ARE NOT EXPOSED TO PROCESS AIR.	ATTACH 7 O/I-35 12284-010 ES-014
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM MAINTAINS RELATIVELY LOW STEADY PRESSURE AND TEMPERATURES MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 12284-010 ES-014
15	ARDMS DO NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. FOULING AND MIC MAY OCCUR TO A LIMITED EXTENT DUE TO CONDENSED HUMIDITY FROM THE VENT GASES, MICROBES AND AIRBORNE PARTICLES. PLANT EXPERIENCE HAS SHOWN FOULING HAS OCCURRED IN THIS SYSTEM. HOWEVER, FOULING DOES NOT AFFECT THE PRESSURE BOUNDARY FUNCTION. MIC ACTIVITY WILL NOT BE SIGNIFICANT TO PRESSURE BOUNDARY FUNCTION DUE TO LIMITED AMOUNT OF CONDENSATION WHICH IS REMOVED BY FILTRATION.	ATTACH 7 O/I-35 12284-010 MO 2199402189

CODE	DESCRIPTION	SOURCE
16	COMPONENT DESIGN DOES NOT PERPETUATE THE ARDM. THE ELEMENT PRESSURE BOUNDARY SUBCOMPONENTS ARE NOT IN RELATIVE MOTION AGAINST OTHER SUB-COMPONENTS MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 12284-010
17	PARTICULATE WEAR EROSION IS NOT SIGNIFICANT. THE AIR VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF AIRBORNE PARTICLES WILL NOT LEAD TO SIGNIFICANT EROSION OF THE EROSION RESISTANT MATERIALS. FILTRATION OF AIR ON THE SAMPLE CONDITIONING SKID PREVENTS SIGNIFICANT EFFECT FROM THIS AGING MECHANISM.	ATTACH 7 60738SH.2
18	STRESSES AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN TYPICAL 300 SERIES STAINLESS STEELS. THE LOW YIELD STRENGTHS OF TYPICAL 300 SERIES SS AND TYPICAL STEEL BOLTING MATERIALS MAKE THE MATERIALS LESS SUSCEPTIBLE TO THE ARDM.	ATTACH 7 O/I-35 12284-010 60738 SH.2 VOL-13 AVNER FONTANA 60722 SH1 ASM NP-5461
19	COMPONENT ENVIRONMENT DOES NOT PERPETUATE THE ARDM. THE SUBCOMPONENTS TYPICALLY ARE NOT EXPOSED TO THE PROCESS FLUID WHICH MAKES THE ARDM NON-PLAUSIBLE. THE EXTERNAL ENVIRONMENT IS NOT NORMALLY HARSH.	ATTACH 7 ES-014
21	PROCESS FLUID (AIR) AND MATERIAL SELECTION (SS) DO NOT PERPETUATE THE ARDM.	ATTACH 7

CODE	DESCRIPTION	SOURCE
22	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION, AND THE AIR ENVIRONMENT IS NOT THE AGGRESSIVE ENVIRONMENT NECESSARY FOR THE ARDM. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN TYPICAL 300 SERIES STAINLESS STEELS AND TYPICAL STEEL BOLTING MATERIALS.	ATTACH 7 O/I-35 12284-010 60738 SH.2 VOL-13 AVNER FONTANA 60722 SH1 ASM

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 3**
Equipment Type:	**ELEMENT**	**Page 1 of 1**
Device Type:	**RE**	**May 13, 1996**
Group ID:	**077-RE-02**	

Device Type:	Radiation Element
Vendor:	General Atomics
Model Number:	RD-72-01
Material:	304 SS, Steel, Anodized Aluminum, Cadmium-Plated Steel
Internal Environment:	Air
External Environment:	Air
Function(s):	Maintain System Pressure Boundary Integrity
Name Plate Data:	

List of Grouped Components:

1RE5417	RE Wide Range Effluent Radiation Monitor
2RE5417	RE Wide Range Effluent Radiation Monitor

WinWord File RM3RE02.DOC

ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA GROUP ID: 077-RE-02 Date: May 15, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Material (Source)	Model Number (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-RE-02A	Chamber Housing (None)	General Atomics (VTM 12284-010)	304 SS (LCM File S-96-009)	RD-72-01 (VTM 12284-010 pp.6-62, 6-25)	Maintain system pressure boundary (CLSR)	Y
077-RE-02B	Tubing Chamber (None)	General Atomics (VTM 12284-010)	304 SS (LCM File S-96-009)	RD-72-01 (VTM 12284-010 pp.6-62, 6-25)	Maintain system pressure boundary (CLSR)	Y
077-RE-02C	Tubing (None)	General Atomics (VTM 12284-010)	304 SS (LCM File S-96-009)	RD-72-01 (VTM 12284-010 pp.6-62, 6-25)	Maintain system pressure boundary (CLSR)	Y
077-RE-02D	Detector End Cover Screws (None)	General Atomics (VTM 12284-010)	Cadmium-Plated Steel (VTM 12284-010 p. 6-62D)	RD-72-01 (VTM 12284-010 pp.6-62, 6-25)	Maintain system pressure boundary (CLSR)	Y
077-RE-02E	Tubing Chamber Screws (None)	General Atomics (VTM 12284-010)	Steel (VTM 12284-010 p. 6-62D)	RD-72-01 (VTM 12284-010 pp.6-62, 6-25)	Maintain system pressure boundary (CLSR)	Y
077-RE-02F	Detector Cover (None)	General Atomics (VTM 12284-010)	304 SS (LCM File S-96-009)	RD-72-01 (VTM 12284-010 pp.6-62, 6-25)	Maintain structural integrity (CLSR)	Y
077-RE-02G	End Cover (None)	General Atomics (VTM 12284-010)	Anodized Aluminum (VTM 12284-010 p. 6-42A)	RD-72-01 (VTM 12284-010 pp.6-62, 6-25)	Maintain structural integrity (CLSR)	Y

ARDM MATRIX (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 5**
Equipment Type:	**ELEMENT**	**Page 1 of 1**
Device Type:	**RE**	**May 15, 1996**
Group ID:	**077-RE-02**	

ARDM	077-RE-02A Chamber Housing	077-RE-02B Tubing Chamber	077-RE-02C Tubing	077-RE-02D Detector End Cover Screws	077-RE-02E Tubing Chamber Screws	077-RE-02F Detector Cover	077-RE-02G End Cover
Cavitation Erosion	02	02	02	19	19	19	19
Corrosion Fatigue	12	12	12	12	12	12	12
Crevice Corrosion	06	06	06	19	19	19	19
Erosion Corrosion	21	21	21	19	19	19	19
Fatigue	12	12	12	12	12	12	12
Fouling	15	15	15	19	19	19	19
Galvanic Corrosion	07	07	07	07	07	07	07
General Corrosion	01.3	01.3	01.3	01.1	19	01.3	01.4
Hydrogen Damage	03	03	03	19	19	19	19
Intergranular Attack	22	22	22	22	22	22	22
MIC	15	15	15	19	19	19	19
Particulate Wear Erosion	17	17	17	19	19	19	19
Pitting	06	06	06	19	19	19	19
Radiation Damage	01.3	01.3	01.3	01.1	01.1	01.3	01.4
Rubber Degradation	01.3	01.3	01.3	01.1	01.1	01.3	01.4
Selective Leaching	01.3	01.3	01.3	01.1	01.1	01.3	19
Stress Corrosion Cracking	18	18	18	18	18	18	18
Stress Relaxation	04	04	04	04	04	04	04
Thermal Damage	01.3	01.3	01.3	01.1	01.1	01.3	01.4
Thermal Embrittlement	04	04	04	04	04	04	04
Wear	16	16	16	16	16	16	16

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: RE EQUIPMENT TYPE: ELEMENT

GROUP ID: 077-RE-02 Date: 5/15/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.1 STEEL 01.3 STAINLESS STEEL 01.4 ALUMINUM	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS AIR, NOT THE LIQUIDS NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONO-ATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUID IS PLANT VENT GASES. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTH OF TYPICAL 300 SERIES STAINLESS STEELS AND TYPICAL STEEL BOLTING MATERIAL IS BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING. THE LOW YIELD STRENGTH OF ALUMINUM USED IN THE END COVER LESSENS ITS SUSCEPTIBILITY TO HYDROGEN CRACKING. SINCE BLISTERING OF ALUMINUM TYPICALLY OCCURS ONLY DURING MELTING OR HEAT TREATMENT (MANUFACTURING), ANOMOLIES WOULD BE DISCOVERED EARLIER IN COMPONENT LIFE DURING TUBE DISASSEMBLY.	ATTACH 7 VOL-13 FONTANA 60738 SH2 60722 SH1 AVNER 12284-010 ASM
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500° F ENSURE THIS ARDM IS NOT PLAUSIBLE.	ATTACH 7 ES-014

CODE	DESCRIPTION	SOURCE
06	PROCESS FLUID AND MOISTURE DO NOT PERPETUATE THE ARDM. INPO OPERATIONS AND MAINTENANCE REMINDER O&MR-132 DESCRIBES OPERATIONAL FAILURES OF RAD MONITORING SYSTEMS DUE TO EXCESS MOISTURE. CCNPP RECENT HISTORY SHOWS ONE CASE WHERE WATER WAS INTRODUCED TO THE SYSTEM DUE TO BLOWDOWN TANK VENT BEING ALIGNED TO THE MAIN PLANT VENT (MO 2199402504). HOWEVER, PER INPUT FROM THE SYSTEM ENGINEER THIS IS NOT A COMMON OCCURRENCE. THE SYSTEM HAS NOT EXPERIENCED THE MOISTURE RELATED PROBLEMS DESCRIBED IN O&MR-132. SYSTEM OPERATION IS ASSURED IN ACCORDANCE WITH O/I-35. THE LIMITED AMOUNT OF MOISTURE PREVENTS SIGNIFICANT EFFECT FROM THESE AGING MECHANISMS.	ATTACH 7 O/I-35 INPO O&MR-132 MO 2199402504
07	MATERIAL SELECTION AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. ELEMENT PRESSURE BOUNDARY IS OF UNIFORM MATERIAL OF CONSTRUCTION. THE ANODIZED ALUMINUM END COVER IS NOT SEPARATED FROM THE CADMIUM-PLATED STEEL SCREWS AND THE 304 SS DETECTOR COVER, AND THE 304 SS CHAMBER AND TUBING HOUSINGS ARE NOT SEPARATED FROM STEEL SCREWS, BUT GALVANIC CORROSION WILL BE MINIMAL DUE TO LACK OF AN ELECTROLYTE (THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION).	ATTACH 7 O/I-35 12284-010 ES-014 LCM S-96-009 UHLIG
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM MAINTAINS RELATIVELY LOW STEADY PRESSURE AND TEMPERATURES MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 12284-010 ES-014
15	ARDMS DO NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. FOULING AND MIC MAY OCCUR TO A LIMITED EXTENT DUE TO CONDENSED HUMIDITY FROM THE VENT GASES, MICROBES AND AIRBORNE PARTICLES. PLANT EXPERIENCE HAS SHOWN FOULING HAS OCCURRED IN THIS SYSTEM. HOWEVER, FOULING DOES NOT AFFECT THE PRESSURE BOUNDARY FUNCTION. MIC ACTIVITY WILL NOT BE SIGNIFICANT TO PRESSURE BOUNDARY FUNCTION DUE TO LIMITED AMOUNT OF CONDENSATION WHICH IS REMOVED BY FILTRATION.	ATTACH 7 O/I-35 12284-010 MO 2199402189
16	COMPONENT DESIGN DOES NOT PERPETUATE THE ARDM. THE ELEMENT PRESSURE BOUNDARY SUBCOMPONENTS ARE NOT IN RELATIVE MOTION AGAINST OTHER SUB-COMPONENTS MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 12284-010

CODE	DESCRIPTION	SOURCE
17	PARTICULATE WEAR EROSION IS NOT SIGNIFICANT. THE AIR VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF AIRBORNE PARTICLES WILL NOT LEAD TO SIGNIFICANT EROSION OF THE EROSION RESISTANT MATERIALS. FILTRATION OF AIR ON THE SAMPLE CONDITIONING SKID PREVENTS SIGNIFICANT EFFECT FROM THIS AGING MECHANISM.	ATTACH 7 60738SH.2
18	STRESSES AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION WHICH IS REMOVED BY FILTRATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN 304 SERIES STAINLESS STEEL TUBING AND CHAMBERS. THE LOW YIELD STRENGTH OF 304 SS MAKES IT LESS SUSCEPTIBLE TO THE ARDM. THE PARTS NOT EXPOSED TO PROCESS AIR ARE EXPOSED ONLY TO AN AIR ENVIRONMENT WHICH IS NOT CONDUCIVE TO THIS ARDM.	ATTACH 7 O/I-35 12284-010 60738 SH.2 VOL-13 AVNER FONTANA 60722 SH1 ASM NP-5461 ES-014
19	COMPONENT ENVIRONMENT DOES NOT PERPETUATE THE ARDM. THE SUBCOMPONENTS TYPICALLY ARE NOT EXPOSED TO THE PROCESS FLUID WHICH MAKES THE ARDM NON-PLAUSIBLE. THE EXTERNAL ENVIRONMENT IS NOT NORMALLY HARSH.	ATTACH 7 ES-014
21	PROCESS FLUID (AIR) AND MATERIAL SELECTION (SS) DO NOT PERPETUATE THE ARDM.	ATTACH 7

CODE	DESCRIPTION	SOURCE
22	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION WHICH IS REMOVED BY FILTRATION, AND THE AIR ENVIRONMENT IS NOT THE AGGRESSIVE ENVIRONMENT NECESSARY FOR THE ARDM. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN TYPICAL 300 SERIES STAINLESS STEELS. THE PARTS NOT EXPOSED TO PROCESS AIR ARE EXPOSED ONLY TO AN AIR ENVIRONMENT WHICH IS NOT CONDUCIVE TO THIS ARDM.	ATTACH 7 O/I-35 12284-010 60738 SH.2 VOL-13 AVNER FONTANA 60722 SH1 ASM ES-014

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System: Area & Process Radiation Monitoring (077/079)
Equipment Type: ELEMENT
Device Type: RE
Group ID: 077-RE-03

Device Type:	Radiation Element
Vendor:	General Atomics
Model Number:	RD-72-02
Material:	304 SS, Stainless Steel, Fiberglass
Internal Environment:	Air
External Environment:	Air
Function(s):	Maintain System Pressure Boundary Integrity
Name Plate Data:	

List of Grouped Components:

1RE5418	RE Wide Range Effluent Radiation Monitor
2RE5418	RE Wide Range Effluent Radiation Monitor

ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA GROUP ID: 077-RE-03 Date: May 15, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Material (Source)	Model Number (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-RE-03A	Chamber (None)	General Atomics (VTM 12284-010)	304 SS (LCM File S-96-009)	RD-72-02 (LCM File S-96-009, VTM 12284-010 p.6-25)	Maintain system pressure boundary (CLSR)	Y
077-RE-03B	Tubing (None)	General Atomics (VTM 12284-010)	304 SS (LCM File S-96-009)	RD-72-02 (LCM File S-96-009, VTM 12284-010 p.6-25)	Maintain system pressure boundary (CLSR)	Y
077-RE-03C	Cover (None)	General Atomics (VTM 12284-010)	304 SS (LCM File S-96-009)	RD-72-02 (LCM File S-96-009, VTM 12284-010 p.6-25)	Maintain structural integrity (CLSR)	Y
077-RE-03D	Spacers (None)	General Atomics (VTM 12284-010)	Fiberglass (LCM File S-96-009)	RD-72-02 (LCM File S-96-009, VTM 12284-010 p.6-25)	Maintain structural integrity (CLSR)	Y
077-RE-03E	Bolts (None)	General Atomics (VTM 12284-010)	SS/Alloy/CS (None)	RD-72-02 (LCM File S-96-009, VTM 12284-010 p.6-25)	Maintain system pressure boundary (CLSR)	Y

ARDM MATRIX (Revision 1)

System: Area & Process Radiation Monitoring (077/079)
Equipment Type: ELEMENT
Device Type: RE
Group ID: 077-RE-03

Attachment 5
Page 1 of 1
May 15, 1996

ARDM	077-RE-03A Chamber	077-RE-03B Tubing	077-RE-03C Cover	077-RE-03D Spacers	077-RE-03E Bolts
Cavitation Erosion	02	02	02	02	19
Corrosion Fatigue	12	12	12	01.5	12
Crevice Corrosion	06	06	06	01.5	19
Erosion Corrosion	21	21	21	19	19
Fatigue	12	12	12	12	12
Fouling	15	15	15	19	19
Galvanic Corrosion	07	07	07	01.5	07
General Corrosion	01.3	01.3	01.3	01.5	19
Hydrogen Damage	03	03	03	01.5	19
Intergranular Attack	22	22	22	01.5	19
MIC	15	15	15	19	19
Particulate Wear Erosion	17	17	17	19	19
Pitting	06	06	06	01.5	19
Radiation Damage	01.3	01.3	01.3	20	01.1
Rubber Degradation	01.3	01.3	01.3	01.5	01.1
Selective Leaching	01.3	01.3	01.3	01.5	01.1
Stress Corrosion Cracking	18	18	18	01.5	19
Stress Relaxation	04	04	04	04	04
Thermal Damage	01.3	01.3	01.3	04	01.1
Thermal Embrittlement	04	04	04	04	04
Wear	16	16	16	16	16

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: RE EQUIPMENT TYPE: ELEMENT

GROUP ID: 077-RE-03 Date: 5/15/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.1 STEEL 01.3 STAINLESS STEEL 01.5 FIBERGLASS	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS AIR, NOT THE LIQUIDS NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONO-ATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUID IS PLANT VENT GASES. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTH OF TYPICAL 300 SERIES STAINLESS STEELS AND TYPICAL STEEL BOLTING MATERIAL IS BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING.	ATTACH 7 VOL-13 FONTANA 60738 SH2 60722 SH1 AVNER LCM S-96-009 12284-010 ASM
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500°F ENSURE THIS ARDM IS NOT PLAUSIBLE. MAXIMUM DESIGN OPERATING TEMPERATURE OF 130°F FOR THE WIDE RANGE GAS MONITORS ENSURES THE FIBERGLASS SPACERS ARE NOT EXPOSED TO HIGH TEMPERATURES.	ATTACH 7 ES-014 12284-010

CODE	DESCRIPTION	SOURCE
06	PROCESS FLUID AND MOISTURE DO NOT PERPETUATE THE ARDM. INPO OPERATIONS AND MAINTENANCE REMINDER O&MR-132 DESCRIBES OPERATIONAL FAILURES OF RAD MONITORING SYSTEMS DUE TO EXCESS MOISTURE. CCNPP RECENT HISTORY SHOWS ONE CASE WHERE WATER WAS INTRODUCED TO THE SYSTEM DUE TO BLOWDOWN TANK VENT BEING ALIGNED TO THE MAIN PLANT VENT (MO 2199402504). HOWEVER, PER INPUT FROM THE SYSTEM ENGINEER THIS IS NOT A COMMON OCCURRENCE. THE SYSTEM HAS NOT EXPERIENCED THE MOISTURE RELATED PROBLEMS DESCRIBED IN O&MR-132. SYSTEM OPERATION IS ASSURED IN ACCORDANCE WITH O/I-35. THE LIMITED AMOUNT OF MOISTURE PREVENTS SIGNIFICANT EFFECT FROM THESE AGING MECHANISMS.	ATTACH 7 O/I-35 INPO O&MR-132 MO 2199402504
07	MATERIAL SELECTION AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. ELEMENT PRESSURE BOUNDARY IS OF UNIFORM MATERIAL OF CONSTRUCTION. THE BOLTS (UNSPECIFIED MATERIAL) ARE NOT SEPARATED FROM THE 304 SS COVER AND CHAMBER, BUT GALVANIC CORROSION WILL BE MINIMAL DUE TO LACK OF AN ELECTROLYTE AS THE BOLTS ARE NOT EXPOSED TO PROCESS FLUID AND THE EXTERNAL ENVIRONMENT IS NOT NORMALLY HARSH.	ATTACH 7 O/I-35 LCM S-96-009 ES-014 12284-010
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM MAINTAINS A RELATIVELY LOW STEADY PRESSURE AND TEMPERATURES MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 LCM S-96-009 ES-014 12284-010
15	ARDMS DO NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. FOULING AND MIC MAY OCCUR TO A LIMITED EXTENT DUE TO CONDENSED HUMIDITY FROM THE VENT GASES, MICROBES AND AIRBORNE PARTICLES. PLANT EXPERIENCE HAS SHOWN FOULING HAS OCCURRED IN THIS SYSTEM. HOWEVER, FOULING DOES NOT AFFECT THE PRESSURE BOUNDARY FUNCTION. MIC ACTIVITY WILL NOT BE SIGNIFICANT TO PRESSURE BOUNDARY FUNCTION DUE TO LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION.	ATTACH 7 O/I-35 LCM S-96-009 MO 2199402189 12284-010
16	COMPONENT DESIGN DOES NOT PERPETUATE THE ARDM. THE ELEMENT PRESSURE BOUNDARY SUBCOMPONENTS ARE NOT IN RELATIVE MOTION AGAINST OTHER SUB-COMPONENTS MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 LCM S-96-009 12284-010

CODE	DESCRIPTION	SOURCE
17	PARTICULATE WEAR EROSION IS NOT SIGNIFICANT. THE AIR VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF AIRBORNE PARTICLES WILL NOT LEAD TO SIGNIFICANT EROSION OF THE EROSION RESISTANT MATERIALS. FILTRATION OF AIR ON THE SAMPLE CONDITIONING SKID PREVENTS SIGNIFICANT EFFECT FROM THIS AGING MECHANISM.	ATTACH 7 60738SH.2
18	STRESSES AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN 304 SERIES STAINLESS STEELS. THE LOW YIELD STRENGTH OF THIS MATERIAL MAKES IT LESS SUSCEPTIBLE TO THE ARDM.	ATTACH 7 O/I-35 LCM S-96-009 12284-010 60738 SH.2 VOL-13 AVNER FONTANA 60722 SH1 ASM NP-5461
19	COMPONENT ENVIRONMENT DOES NOT PERPETUATE THE ARDM. THE SUBCOMPONENTS TYPICALLY ARE NOT EXPOSED TO THE PROCESS FLUID WHICH MAKES THE ARDM NON-PLAUSIBLE. THE EXTERNAL ENVIRONMENT IS NOT NORMALLY HARSH.	ATTACH 7 ES-014

CODE	DESCRIPTION	SOURCE
20	MATERIAL, PROCESS FLUID (PLANT VENT GASES), AND ENVIRONMENT DO NOT PERPETUATE ARDM. HIGH RANGE DETECTORS ARE DESIGNED FOR RADIATION HARDNESS OF 1.0E7 RADS AND ARE DESIGNED TO OPERATE DURING AND AFTER AN EVENT. BY DESIGN, THE HIGH RANGE DETECTOR WOULD OPERATE ONLY DURING AND AFTER AN EVENT WHEN RADIATION CONCENTRATIONS REACH 4000 μCi/cc. FIBERGLASS SPACERS TYPICALLY ARE NOT EXPOSED TO RADIATION LEVELS IN PLANT VENT GASES WHICH APPROACH THE RAD HARDNESS THRESHOLD. THE DETECTORS ARE ENCASED IN A 6-INCH THICK LEAD SHIELD WHICH PROTECTS EXTERNALLY AGAINST HIGH ENVIRONMENTAL RADIATION LEVELS, BUT THE LOCA DOSE RATE FOR ROOMS 524 AND 526 IS 1.54E2 RADS, WELL BELOW THE RAD HARDNESS THRESHOLD FOR THE DETECTOR. THE INTERNAL CHECKSOURCE DOES NOT PERPETUATE THE ARDM AS IT IS NORMALLY NOT ALIGNED WITH THE RE, AND IS THEREFORE SHIELDED BY THE LEAD CASING.	ATTACH 7 LCM S-96-009 O/I-48 12284-010 ES-014
21	PROCESS FLUID (AIR) AND MATERIAL SELECTION (SS) DO NOT PERPETUATE THE ARDM.	ATTACH 7
22	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION, AND THE AIR ENVIRONMENT IS NOT THE AGGRESSIVE ENVIRONMENT NECESSARY FOR THE ARDM. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN 304 SERIES STAINLESS STEELS.	ATTACH 7 O/I-35 LCM S-96-009 60738 SH.2 VOL-13 AVNER FONTANA 60722 SH1 ASM

ARDM	POTENTIAL	DESCRIPTION/JUSTIFICATION	SOURCE
Cavitation Erosion	Yes	Localized material erosion caused by formation and collapse of vapor bubbles in close proximity to material surface. Requires fluid (liquid) flow and pressure variations which temporarily drop the liquid pressure below the corresponding vapor pressure. Most materials are susceptible to varying degrees depending upon the severity of the environmental factors.	[7]
Corrosion Fatigue	Yes	Plant equipment operating in a corrosive environment subjected to cyclic (fatigue) loading may initiate cracks and/or fail sooner than expected based on analysis of the corrosion and fatigue loadings applied separately. Fatigue-crack initiation and growth usually follows a transgranular path, although there are some cases where intergranular cracking has been observed. In some cases, crack initiation occurs by fatigue and is subsequently dominated by corrosion advance. In other cases, a corrosion mechanism (SCC) can be responsible for crack formation below the fatigue threshold, and the fatigue mechanism can accelerate the crack propagation. Corrosion-fatigue is a potentially active mechanism in both stainless steels as well as carbon and low alloy steels.	[7]
Creep/ Shrinkage	No	Not applicable to Equipment Type. The phenomenon results in dimensional changes in metals at high temperatures and in concrete subject to long term dehydration. This ARDM is not applicable to this equipment type since proper component specification and design prevents this ARDM from occurring (i.e., system and component design standards adequately address this ARDM).	[2]
Crevice Corrosion	Yes	Crevice corrosion is intense, localized corrosion within crevices or shielded areas. It is associated with a small volume of stagnant solution caused by holes, gasket surfaces, lap joints, crevices under bolt heads, surface deposits, designed crevices for attaching thermal sleeves to safe-ends, and integral weld backing rings or back-up bars. The crevice must be wide enough to permit liquid entry and narrow enough to maintain stagnant conditions, typically a few thousandths of an inch or less. Crevice corrosion is closely related to pitting corrosion and can initiate pits in many cases as well as leading to stress corrosion cracking. In an oxidizing environment, a crevice can set up a differential aeration cell to concentrate an acid solution within the crevice. Even in a reducing environment, alternate wetting and drying can concentrate aggressive ionic species to cause pitting, crevice corrosion, intergranular attack, or stress corrosion cracking.	[6] [7] [12]

Erosion Corrosion	Yes	Increased rate of attack on a metal because of the relative movement between a corrosive fluid and the metal surface. Mechanical wear or abrasion can be involved, characterized by grooves, gullies, waves, holes and valleys on the metal surface. Erosion is a mechanical action of a fluid and/or particulate matter on a metal surface, without the influence of corrosion. Erosion corrosion failures can occur in a relatively short time and are sometimes unexpected, since corrosion tests are usually run under static conditions. All equipment exposed to moving fluids is vulnerable; in particular, piping (bends, tees, etc.), Valves, pumps, propellers and impellers, heat exchanger tubing, turbine blades and wear plates are components which have experienced erosion corrosion. This is a serious problem in steam piping, heater drain piping, reheaters, and moisture separators due to high velocity particle impingement. Erosion corrosion has occurred in high and low pressure preheater tubes, low pressure preheaters, evaporators and feedwater heaters. Inlet tube corrosion occurs in heat exchangers, due to the turbulence of flow from the exchanger head into the smaller tubes, within the first few inches of the tube. Such corrosion has been especially evident in condenser tubes and feedwater heaters. The occurrence of erosion corrosion is highly dependent upon material of construction and the fluid flow conditions. Carbon or low alloy steels are particularly susceptible when in contact with high velocity water (single or two phase) with turbulent flow, low oxygen and fluid pH < 9.3. Maximum erosion corrosion rates are expected in carbon steel at 130-140°C (single phase) and 180°C (two phase).	[5] [6] [7]
Fatigue	Yes	Fatigue damage results from progressive, localized structural change in materials subjected to fluctuating stresses and strains. Associated failures may occur at either high or low cycles in response to various kinds of loads (e.g., Mechanical or vibrational loads, thermal cycles, or pressure cycles). Fatigue cracks initiate and propagate in regions of stress concentration that intensify strain. The fatigue life of a component is a function of several variables such as stress level, stress state, cyclic wave form, fatigue environment, and the metallurgical condition of the material. Failure occurs when the endurance limit number of cycles (for a given load amplitude) is exceeded. All materials are susceptible (with varying endurance limits) when subjected to cyclic loading. Vibration loads have also been the cause of recurring weld failures by the fatigue of small socket welds. Certain piping locations, such as charging lines, have been found to experience vibration conditions. In some cases these failures in pipe have been due to inadequately supported pipe or obturator induced vibratory loads.	[6] [7] [2]

Fouling	Yes	Unavoidable introduction of foreign substances that interact with and/or collect within system and components. Caused by failure or degradation of upstream removal process equipment, long term buildup, low flow, stagnant flow, infrequent operation, and/or contaminated inlet flow. Fouling refers to all deposits on system surfaces that increase resistance to fluid flow and/or heat transfer. Sources of fouling include the following: (1) organic films of micro-organisms and their products (microbial fouling) (2) deposits of macro-organisms such as mussels (macrobial fouling) (3) inorganic deposits, including scales, silt, corrosion products and detritus. Scales result when solubility limits for a given species are exceeded. Deposits result when coolant-borne particles drop onto surfaces due to hydraulic factors. The deposits result in reduced flow of cooling water, reduced heat transfer, and increased corrosion. Sediment deposits promote concentration cell corrosion and growth of sulfur-reducing bacteria. The bacteria can cause severe pitting after one month of service. Piping systems designed for 30 years have had their projected life reduced to five years due to under-sediment corrosion.	[9] [10] [11]
Galvanic Corrosion	Yes	Accelerated corrosion caused by dissimilar metals in contact in a conductive solution. Requires two dissimilar metals in physical or electrical contact, developed potential (material dependent), and conducting solution.	[12]
General Corrosion	Yes	Thinning (wastage) of a metal by chemical attack (dissolution) at the surface of the metal by an aggressive environment. The consequences of the damage are loss of load carrying cross-sectional area. General corrosion requires an aggressive environment and materials susceptible to that environment. An important concern for PWRs is boric acid attack of carbon steels. Borated water has been observed to leak from piping, valves, storage tanks, etc., And fall on other carbon steel components and attack the component from the outside. Wastage is not a concern for austenitic stainless steel alloys.	[7] [8] [2]

Hydrogen Damage	Yes	Two forms of hydrogen attack relevant to light water reactor materials and conditions are hydrogen blistering and hydrogen embrittlement. Both produce mechanical damage in the affected component. In each case, atomic hydrogen enters the metal, either as a result of a corrosion reaction at the surface or by cathodic polarization which results in the evolution of hydrogen gas. In blistering, molecular hydrogen within the metal causes high pressure and local damage in the form of "blistered" regions of the metal surface. Hydrogen embrittlement affects ferritic and martensitic iron-based alloys, and results in low ductility intergranular cracking (similar to stress corrosion cracking). The phenomenon of hydrogen cracking is usually manifested as delayed cracking, at or near room temperature, after stress is applied. A certain critical stress, which may take the form of weld residual stress, is required to cause cracking. Notches concentrate such stresses and tend to shorten the delay time for cracking. Cracking of welds due to hydrogen embrittlement and hydrogen-induced cracking is a common concern. This cracking is more of a problem in higher strength steels (yield strength >120 ksi). Ferritic and martensitic stainless steels, carbon steels, and other high strength alloys are susceptible. Austenitic stainless steels are relatively immune but could experience damage at sufficiently high hydrogen levels.	[6] [7]
Intergranular Attack	Yes	Intergranular Attack (IGA) is very similar to intergranular stress corrosion cracking (IGSCC) except that stress is not required for IGA. IGA is localized corrosion at or adjacent to grain boundaries, with relatively little corrosion of the material grains. It is caused by impurities in the grain boundaries, or the enrichment or depletion of alloying elements at grain boundaries, such as the depletion of chromium at austenitic stainless steel grain boundaries. A "sensitized" microstructure causes susceptibility to IGA. When austenitic stainless steels are heated into or slow cooled through the temperature range of approximately 750 to 1500°F, chromium carbides can be formed, thus depleting the grain boundaries of chromium and decreasing their corrosion resistance. High chromium ferritic stainless steels, such as Type 430, also experience susceptibility to IGA. Nickel alloys such as alloy 600 experience IGA in the presence of certain sulfur environments at high temperatures (by forming low melting sulfur compounds at grain boundaries) or when austenitic stainless steel weld filler metal is inadvertently used on Ni-Cr-Fe alloys. Susceptibility to intergranular attack (sensitization) usually develops during thermal processing such as welding or heat treatments. IGA is generally not a concern in atmospheric exposures and is most commonly documented to occur in fluid systems.	[6] [7] [2] [12] [14]
Irradiation Embrittlement	No	Not applicable to Equipment Type. The ARDM results in a decrease in steel fracture toughness due to long-term exposure to a fast flux of neutrons. This ARDM is not applicable to this equipment type since indicator components in the systems under evaluation are not located in areas where the neutron flux is high enough to cause this ARDM to occur.	[6] [7]

MIC	Yes	Accelerated corrosion of materials resulting from surface microbiological activity. Sulfate reducing bacteria, sulfur oxidizers, and iron oxidizing bacteria are most commonly associated with corrosion effects. Most often results in pitting followed by excessive deposition of corrosion products. Stagnant or low flow areas are most susceptible. Any system that uses untreated water, or is buried, is particularly susceptible. Consequences range from leakage to excessive differential pressure and flow blockage. Essentially all systems and most commonly-used materials are susceptible. Temperatures from about 50°F to 120°F are most conducive to MIC. Experience in virtually all large industries is common. Nuclear experience is relatively new, but also widespread. MIC is generally observed in service water applications utilizing raw untreated water. Sedimentation aggravates the problem.	[6] [7] [2]
Oxidation	No	Not applicable to Equipment Type. The ARDM results from a chemical reaction at the surface of a material when subjected to an oxidizing environment. Oxidation occurs at any temperature. Electrical components experience degradation related to oxidation and are considered separately. Oxidation generally is not considered a degradation mechanism in metals of fluid systems in mild environments since this mechanism serves to protect materials by formation of a passive layer. Other corrosion mechanisms (e.g. Corrosion fatigue, crevice corrosion, erosion corrosion, general corrosion and pitting) can result from oxidation/reduction reactions under specific aggressive mechanical and chemical environment and are addressed separately. It could be considered a degradation mechanism at high temperatures, where a more rapid reaction between metal and oxygen is likely to occur. These temperatures do not occur in power plant applications under evaluation. Therefore, oxidation is not considered a potential ARDM for indicator components.	[7] [12]
Particulate Wear Erosion	Yes	The loss of material caused by mechanical abrasion due to relative motion between solution and material surface. Requires high velocity fluid, entrained particles, turbulent flow regions, flow direction change, and/or impingement. Most materials are susceptible to varying degrees depending upon the severity of the environmental factors.	[7]

Pitting	Yes	A form of localized attack with greater corrosion rates at some locations than at others. Pitting can be very insidious and destructive, with sudden failures in high pressure applications (especially in tubes) occurring by perforation. This form of corrosion essentially produces "holes" of varying depth to diameter ratios in the steel. These pits are, in many cases, filled with oxide debris, especially for ferritic materials such as carbon steel. Deep pitting is more common with passive metals, such as austenitic stainless steels, than with non- passive metals. Pits are generally elongated in the direction of gravity. In many cases, erosion corrosion, fretting corrosion, and crevice corrosion can also lead to pitting. Corrosion pitting is an anodic reaction which is an autocatalytic process. That is, the corrosion process within a pit produces conditions which stimulate the continuing activity of the pit. High concentrations of impurity anions such as chlorides and sulfates tend to concentrate in the oxygen- depleted pit region, giving rise to a potentially concentrated aggressive solution in this zone. Pitting has been found on the outside diameter of tubes where sludge or tube scale was present. It can also occur at locations of relatively stagnant coolant or water, such as in carbon steel pipes for service water lines, and at crevices in stainless steel, such as at the stainless steel cladding between reactor pressure vessel closure flanges. Pitting can become passive in some metals such as aluminum.	[6] [7] [2] [12]
Radiation Damage	Yes	Non-metallics are susceptible to degradation caused by gamma radiation.	[4]
Rubber Degradation	Yes	Rubber can be used in specific applications of this device type. Long term exposure of rubber to water will result in water absorption and swelling, blistering, hardening, and eventual cracking. When utilized as a protective lining, moisture permeation of the rubber produces blisters beneath the lining and initiates corrosion of the lined surface.	[3]
Saline Water Attack	No	Not applicable to Equipment Type. Saline Water Attack has resulted in the degradation of reinforced concrete structures. The degradation mechanism involves water seepage into the concrete resulting in a high chloride environment for the reinforcing bars. The reinforcing bars corrode resulting in expansion that leads to cracking and spalling of the concrete. Of particular concern for structures that are inaccessible for routine inspection, and piping or other fluid components embedded in concrete. This ARDM is not applicable to indicator components since indicators are not constructed of nor typically installed in concrete.	[2]

Selective Leaching	Yes	The removal of one element from a solid alloy by corrosion processes. The most common example is the selective removal of zinc in brass alloys (dezincification). Similar processes occur in other alloy systems in which aluminum, iron, cobalt, chromium, and other elements are removed. There are two types, layer-type and plug-type. Layer-type is a uniform attack whereas plug-type is extremely localized leading to pitting. Overall dimensions do not change appreciably. If a piece of equipment is covered by debris or surface deposits and/or not inspected closely, sudden unexpected failure may occur in high pressure applications due to the poor strength of the remaining material. Requires susceptible materials and corrosive environment. Materials particularly susceptible include zinc, aluminum, carbon and nickel. Environmental conditions include high temperature, stagnant aqueous solution, and porous inorganic scale. Acidic solutions and oxygen aggravate the mechanism.	[12] [13]
Stress Corrosion Cracking	Yes	Selective corrosive attack along or across material grain boundaries. Four particular mechanisms are known to exist: (1) Intergranular (IGSCC), between the material grain boundaries. (2) Transgranular (TGSCC), across the material grains along certain crystallographic planes. (3) Irradiation Assisted (IASCC), between the material grains after an incubation neutron dose which sensitizes the material. (4) Interdendritic (IDSCC), between the dendrite interfaces. SCC requires applied or residual tensile stress, susceptible materials (such as austenitic stainless steels, alloy 600, alloy x-750, SAE 4340, and ASTM A289), and oxygen and/or ionic species (e.g., Chlorides/sulfates).	[6] [7] [2] [12] [13] [15]

Stress Corrosion Cracking (Continued)	Yes (Cont'd)	Common sources of residual stress include thermal processing and stress risers created during surface finishing, fabrication, or assembly. The heat input during welding can result in a localized sensitized region which is susceptible to SCC. IGSCC is a concern in stainless steel piping depending on material condition and process fluid chemistry and also is a potential concern in valve internals (PH steel). SCC of low alloy steel and carbon steel is not considered a credible aging mechanism for typical conditions encountered in a nuclear power plant. TGSCC may be a concern in low alloy and stainless steel if aggressive chemical species (caustics, halogens, sulfates, especially if coupled with the presence of oxygen) are present. IASCC is a potential concern only for reactor vessel internals and other stainless steel components, such as control rods, which are subject to very high neutron fluence levels. A fast neutron incubation fluence of at least 1.0E+20 is generally required to sensitize the material. IDSCC is a potential concern in stainless steel weld metal deposits based on microstructure and delta ferrite content. This mechanism is inactive in carbon and low alloy steel. Ammonia grooving in brass components can occur when the concentration of ammonia is greater than a few ppm. It is found most often in feedwater heaters that contain admiralty brass tubes and where morpholine, which breaks down into ammonia, is used to increase the pH of the condensate.	
Stress Relaxation	Yes	Stress Relaxation occurs under conditions of constant strain where part of the elastic strain is replaced with plastic strain. A material loaded to an initial stress may experience a reduction in stress over time at high temperatures. Bolted connections are most vulnerable. Relaxation of stress on packing due to stretching of gland follower studs under elevated temperatures may cause packing leakage.	[7]
Thermal Damage	Yes	Non-metallics are particularly susceptible with material dependent temperature limits.	[7] [2]
Thermal Embrittlement	Yes	Loss of material fracture toughness caused by thermally induced changes in the formation and distribution of alloying constituents. Requires high temperature 500°F to 700°F for metallic components. Ferrite containing stainless steels are susceptible as are materials with grain boundary segregation of impurities.	[7]

Wear	Yes	Wear results from relative motion between two surfaces (adhesive wear), from the influence of hard, abrasive particles (abrasive wear - see particulate erosion) or fluid stream (erosion), and from small, vibratory or sliding motions under the influence of a corrosive environment (fretting). In addition to material loss from the above wear mechanisms, impeded relative motion between two surfaces held in intimate contact for extended periods may result from galling/self-welding. Motions may be linear, circular, or vibratory in inert or corrosive environments. The most common result of wear is damage to one or both surfaces involved in the contact. Wear most typically occurs in components which experience considerable relative motion such as valves and pumps, in components which are held under high loads with no motion for long periods (valves, flanges), or in clamped joints where relative motion is not intended but occurs due to a loss of clamping force (e.g., Tubes in supports, valve stems in seats, springs against tubes). Wear may proceed at an ever- increasing rate as worn surfaces moving past one another will often do so with much higher contact stresses than the surfaces of the original geometry. Fretting is a wear phenomenon that occurs between tight-fitting surfaces subjected to a cyclic, relative motion of extremely small amplitude. Fretting is frequently accompanied by corrosion. Common sites for fretting are in joints that are bolted, keyed, pinned, press fit or riveted; in oscillating bearings, couplings, spindles, and seals; in press fits on shafts; and in universal joints. Under fretting conditions, fatigue cracks may be initiated at stresses well below the endurance limit of nonfretted specimens.	[1]

Attachment 7 Reference List

Source	Title
[1]	ASME Wear Control Handbook, Peterson and Winer, 1980
[2]	Standard Format and Content of Technical Information for Applications to Renew Nuclear Power Plant Operating Licenses, Draft NRC Regulatory Guide No. DG-1009, December 1990
[3]	Service (Salt) Water System Life Cycle Management Evaluation, EPRI Report No. TR-102204, April 1993
[4]	Radiation Effects on Organic Materials in Nuclear Plants, EPRI Report No. NP-2129, November 1981
[5]	Erosion/Corrosion in Nuclear Plant Steam Piping, EPRI Report No. NP-3944, 1985
[6]	Component Life Estimation: LWR Structural Materials Degradation Mechanisms, EPRI Report No. NP-5461, 1987
[7]	Environmental Effects on Components: Commentary for ASME Section III, EPRI Report No. NP-5775, April 1988
[8]	Boric Acid Corrosion of Carbon and Low Alloy Steel Pressure Boundary Materials, EPRI Report No. NP-5985, 1988
[9]	Nuclear Plant Service Water System Aging Degradation Assessment, NUREG/CR-5379, Volume 1 and 2, June 1989 and October 1992
[10]	Aging Assessment of Instrument Air Systems, NUREG/CR-5419, January 1990
[11]	Insights Gained from Aging Research, NUREG/CR-5643, March 1992
[12]	Corrosion Engineering, Fontana and Greene, 1978
[13]	Corrosion and Corrosion Control, An Introduction to Corrosion Science and Engineering, Uhlig, Third Edition, 1985
[14]	ASM Specialty Handbook, Stainless Steels, Davis, 1994
[15]	A Survey of the Literature on Low-Alloy Steel Fastener Corrosion in PWR Power Plants, EPRI-NP-3784, 1984

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 3**
Equipment Type:	**INDCTR**	**Page 1 of 1**
Device Type:	**FI**	**May 14, 1996**
Group ID:	**077-FI-01**	

Device Type: Flow Indicator
Vendor: Brooks Instrument
Model Number: 1305
Material: Stainless Steel, Aluminum, Borosilicate Glass
Internal Environment: Air
External Environment: Air
Function(s): Maintain System Pressure Boundary Integrity
Name Plate Data:

List of Grouped Components:

1FI5415A	1RE Low Range Sample Flow Indicator
2FI5415A	2RE Low Range Sample Flow Indicator

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ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA GROUP ID: 077-FI-01 Date: May 15, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Material (Source)	Model Number (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-FI-01A	Metering Tube (None)	Brooks Instrument (VTM 12284-010 Section 6 pp. 43-52)	Borosilicate Glass (VTM 12284-010 Appendix pp. 80-81)	1305 Size 8 (VTM 12284-010 Section 6 pp. 43-52 & Appendix p.84)	Maintain system pressure boundary (CLSR)	Y
077-FI-01B	End Fittings (None)	Brooks Instrument (VTM 12284-010 Section 6 pp. 43-52)	316 Stainless Steel (VTM 12284-010 Appendix pp. 80-81 & NETD)	1305 Size 8 (VTM 12284-010 Section 6 pp. 43-52 & Appendix p.84)	Maintain system pressure boundary (CLSR)	Y
077-FI-01C	Float (None)	Brooks Instrument (VTM 12284-010 Section 6 pp. 43-52)	316 Stainless Steel (VTM 12284-010 Appendix pp. 80-81)	1305 Size 8 (VTM 12284-010 Section 6 pp. 43-52 & Appendix p.84)	None (Provide indication) (CLSR)	N
077-FI-01D	Float Stops (None)	Brooks Instrument (VTM 12284-010 Section 6 pp. 43-52)	316 Stainless Steel (VTM 12284-010 Appendix pp. 80-81)	1305 Size 8 (VTM 12284-010 Section 6 pp. 43-52 & Appendix p.84)	None (Provide indication) (CLSR)	N
077-FI-01E	Side Plates (None)	Brooks Instrument (VTM 12284-010 Section 6 pp. 43-52)	Anodized Aluminum (VTM 12284-010 Appendix pp. 80-81)	1305 Size 8 (VTM 12284-010 Section 6 pp. 43-52 & Appendix p.84)	Provide structural integrity (CLSR)	Y
077-FI-01F	Shield (None)	Brooks Instrument (VTM 12284-010 Section 6 pp. 43-52)	Plastic (VTM 12284-010 Appendix pp. 80-81)	1305 Size 8 (VTM 12284-010 Section 6 pp. 43-52 & Appendix p.84)	None (Provide indication) (CLSR)	N
077-FI-01G	Side Plate Screws (None)	Brooks Instrument (VTM 12284-010 Section 6 pp. 43-52)	8-18 Stainless Steel (VTM 12284-010 Appendix pp. 80-81)	1305 (VTM 12284-010 Section 6 pp. 43-52 & Appendix p.84)	Provide structural integrity (CLSR)	Y

ARDM MATRIX (Revision 1)

System: Area & Process Radiation Monitoring (077/079)
Equipment Type: INDCTR
Device Type: FI
Group ID: 077-FI-01

ARDM	077-FI-01A Metering Tube	077-FI-01B End Fittings	077-FI-01E Side Plates	077-FI-01G Side Plate Screws
Cavitation Erosion	02	02	19	19
Corrosion Fatigue	01.5	12	12	12
Crevice Corrosion	01.5	06	19	19
Erosion Corrosion	21	21	19	19
Fatigue	12	12	12	12
Fouling	15	15	19	19
Galvanic Corrosion	07	07	07	07
General Corrosion	01.5	01.3	01.4	01.3
Hydrogen Damage	01.5	03	19	19
Intergranular Attack	01.5	22	22	22
MIC	15	15	19	19
Particulate Wear Erosion	17	17	19	19
Pitting	01.5	06	19	19
Radiation Damage	20	01.3	01.4	01.3
Rubber Degradation	01.5	01.3	01.4	01.3
Selective Leaching	01.5	01.3	01.4	01.3
Stress Corrosion Cracking	01.5	18	18	18
Stress Relaxation	04	04	04	04
Thermal Damage	05	01.3	01.4	01.3
Thermal Embrittlement	04	04	04	04
Wear	16	16	16	16

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: FI EQUIPMENT TYPE: INDCTR

GROUP ID: 077-FI-01 Date: 5/15/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.3 STAINLESS STEEL 01.4 ALUMINUM 01.5 BOROSILICATE GLASS	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS AIR, NOT THE LIQUIDS NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONO-ATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUID IS PLANT VENT GASES. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTH OF 316 STAINLESS STEELS IS BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING.	ATTACH 7 VOL-13 FONTANA 60738 SH2 60722 SH1 AVNER ASM
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500° F ENSURE THIS ARDM IS NOT PLAUSIBLE FOR METALLICS AND GLASS. BOROSILICATE GLASS HAS A LOW COEFFICIENT OF THERMAL EXPANSION, AS WELL AS HIGH TEMPERATURE AND THERMAL SHOCK RESISTANCE CAPABILITIES.	ATTACH 7 ES-014 MOFFATT BRADY AVALLONE

CODE	DESCRIPTION	SOURCE
05	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE ARDM. BOROSILICATE GLASS HAS A LOW COEFFICIENT OF THERMAL EXPANSION, AS WELL AS HIGH TEMPERATURE AND THERMAL SHOCK RESISTANCE CAPABILITIES. ARDM IS NOT PLAUSIBLE BECAUSE OF LOW PROCESS FLUID AND AMBIENT TEMPERATURES.	MOFFATT BRADY AVALLONE ES-014
06	PROCESS FLUID AND MOISTURE DO NOT PERPETUATE THE ARDM. INPO OPERATIONS AND MAINTENANCE REMINDER O&MR-132 DESCRIBES OPERATIONAL FAILURES OF RAD MONITORING SYSTEMS DUE TO EXCESS MOISTURE. CCNPP RECENT HISTORY SHOWS ONE CASE WHERE WATER WAS INTRODUCED TO THE SYSTEM DUE TO BLOWDOWN TANK VENT BEING ALIGNED TO THE MAIN PLANT VENT (MO 2199402504). HOWEVER, PER INPUT FROM THE SYSTEM ENGINEER THIS IS NOT A COMMON OCCURRENCE. THE SYSTEM HAS NOT EXPERIENCED THE MOISTURE RELATED PROBLEMS DESCRIBED IN O&MR-132. SYSTEM OPERATION IS ASSURED IN ACCORDANCE WITH O/I-35. THE LIMITED AMOUNT OF MOISTURE PREVENTS SIGNIFICANT EFFECT FROM THESE AGING MECHANISMS.	ATTACH 7 O/I-35 INPO O&MR-132 MO 2199402504
07	MATERIAL SELECTION AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THE STAINLESS STEEL END FITTINGS AND SCREWS ARE NOT SEPARATED FROM THE ANODIZED ALUMINUM SIDE PLATES, BUT GALVANIC CORROSION WILL BE MINIMAL DUE TO LACK OF AN ELECTROLYTE (COMPONENT EXTERNAL SURFACES EXPOSED ONLY TO AIR WITH MAXIMUM DESIGN RELATIVE HUMIDITY OF 90%).	ATTACH 7 O/I-35 12284-010 ES-014
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM MAINTAINS A RELATIVELY LOW STEADY PRESSURE AND TEMPERATURES MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 12284-010 ES-014
15	ARDMS DO NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. FOULING AND MIC MAY OCCUR TO A LIMITED EXTENT DUE TO CONDENSED HUMIDITY FROM THE VENT GASES, MICROBES AND AIRBORNE PARTICLES. PLANT EXPERIENCE HAS SHOWN FOULING HAS OCCURRED IN THIS SYSTEM. HOWEVER, FOULING DOES NOT AFFECT THE PRESSURE BOUNDARY FUNCTION. MIC ACTIVITY WILL NOT BE SIGNIFICANT TO PRESSURE BOUNDARY FUNCTION DUE TO LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION.	ATTACH 7 O/I-35 12284-010 MO 2199402189

CODE	DESCRIPTION	SOURCE
16	COMPONENT DESIGN DOES NOT PERPETUATE THE ARDM. THE ELEMENT PRESSURE BOUNDARY SUBCOMPONENTS ARE NOT IN RELATIVE MOTION AGAINST OTHER SUB-COMPONENTS MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 12284-010
17	PARTICULATE WEAR EROSION IS NOT SIGNIFICANT. THE AIR VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF AIRBORNE PARTICLES WILL NOT LEAD TO SIGNIFICANT EROSION OF THE EROSION RESISTANT MATERIALS. FILTRATION OF AIR ON THE SAMPLE CONDITIONING SKID PREVENTS SIGNIFICANT EFFECT FROM THIS AGING MECHANISM.	ATTACH 7 60738SH.2 12284-010
18	STRESSES AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN 316 STAINLESS STEELS (SIDE PLATES AND SCREWS EXPOSED ONLY TO NORMAL AMBIENT AIR). THE LOW YIELD STRENGTHS OF THESE MATERIALS MAKE THEM LESS SUSCEPTIBLE TO THE ARDM.	ATTACH 7 O/I-35 60738 SH.2 ES-014 VOL-13 AVNER FONTANA 60722 SH1 ASM NP-5461 12284-010
19	COMPONENT ENVIRONMENT DOES NOT PERPETUATE THE ARDM. THE SUBCOMPONENTS TYPICALLY ARE NOT EXPOSED TO THE PROCESS FLUID WHICH MAKES THE ARDM NON-PLAUSIBLE. THE EXTERNAL ENVIRONMENT IS NOT NORMALLY HARSH.	ATTACH 7 ES-014

CODE	DESCRIPTION	SOURCE
20	COMPONENT ENVIRONMENT AND PROCESS FLUID (PLANT VENT GASES) DO NOT PERPETUATE ARDM. THE LOCA DOSE RATE FOR ROOM 524 AND 526 IS 1.54E2 RADS. THIS IS WELL BELOW THE THRESHOLD DOSE RATES OF 1.0E4 RADS, WHERE OPTICAL PROPERTIES OF SOME GLASS CHANGES, AND 1.0E6 RADS, WHERE FRAGILITY OF SOME GLASS INCREASES. BY DESIGN, THE LOW RANGE INDICATOR OPERATES ONLY BEFORE AN EVENT (WHEN RADIATION CONCENTRATIONS IN PLANT VENT GASES ARE LESS THAN 4000 μCi/cc). THE COMPONENT WAS EVALUATED BY THE VENDOR FOR RADIATION HARDNESS, DURING WHICH METALLICS AND CERAMICS WERE SHOWN TO INCUR LITTLE DAMAGE BELOW 1.0E6 RADS. ALL COMPONENTS WERE SHOWN TO OPERATE AT THE SPECIFIED INTEGRATED DOSE OF 5.0E5 RADS.	ATTACH 7 ES-014 NP-2129 O/I-48 12284-010
21	PROCESS FLUID (AIR) AND MATERIAL SELECTION (SS) DO NOT PERPETUATE THE ARDM.	ATTACH 7
22	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION, AND THE AIR ENVIRONMENT IS NOT THE AGGRESSIVE ENVIRONMENT NECESSARY FOR THE ARDM. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN 316 STAINLESS STEELS (SIDE PLATES AND SCREWS ARE EXPOSED ONLY TO NORMAL AMBIENT AIR).	ATTACH 7 O/I-35 60738 SH.2 VOL-13 ES-014 AVNER FONTANA 60722 SH1 ASM 12284-010

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 3**
Equipment Type:	**INDCTR**	**Page 1 of 1**
Device Type:	**FI**	**May 14, 1996**
Group ID:	**077-FI-02**	

Device Type: Flow Indicator

Vendor: Brooks Instrument

Model Number: 1355 Sho-Rate 150

Material: Stainless Steel, Borosilicate Glass, Aluminum

Internal Environment: Air

External Environment: Air

Function(s): Maintain System Pressure Boundary Integrity

Name Plate Data:

List of Grouped Components:

1FI5415B	1RE High Range Sample Flow Indicator
2FI5415B	2RE High Range Sample Flow Indicator

ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA GROUP ID: 077-FI-02 Date: May 15, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Material (Source)	Model Number (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-FI-02A	Metering Tube (None)	Brooks Instrument (VTM 12284-010 Section 6 pp. 43-52)	Borosilicate Glass (VTM 12284-010 Appendix pp. 90-91)	1355 Sho-Rate 150 (VTM 12284-010 Section 6 pp. 43-52)	Maintain system pressure boundary (CLSR)	Y
077-FI-02B	End Fittings (None)	Brooks Instrument (VTM 12284-010 Section 6 pp. 43-52)	316 Stainless Steel (VTM 12284-010 p.6-48 & Appendix pp. 90-91)	1355 Sho-Rate 150 (VTM 12284-010 Section 6 pp. 43-52)	Maintain system pressure boundary (CLSR)	Y
077-FI-02C	Float (None)	Brooks Instrument (VTM 12284-010 Section 6 pp. 43-52)	316 Stainless Steel (VTM 12284-010 Appendix pp. 90-91)	1355 Sho-Rate 150 (VTM 12284-010 Section 6 pp. 43-52)	None (Provide indication) (CLSR)	N
077-FI-02D	Float Stops (None)	Brooks Instrument (VTM 12284-010 Section 6 pp. 43-52)	Teflon (VTM 12284-010 Appendix pp. 90-91)	1355 Sho-Rate 150 (VTM 12284-010 Section 6 pp. 43-52)	None (Provide indication) (CLSR)	N
077-FI-02E	Side Plates (None)	Brooks Instrument (VTM 12284-010 Section 6 pp. 43-52)	Anodized Aluminum (VTM 12284-010 p. 4-7 & Appendix pp. 90-91)	1355 Sho-Rate 150 (VTM 12284-010 Section 6 pp. 43-52)	Provide structural integrity (CLSR)	Y
077-FI-02F	Shield (None)	Brooks Instrument (VTM 12284-010 Section 6 pp. 43-52)	Plastic (VTM 12284-010 Appendix pp. 90-91)	1355 Sho-Rate 150 (VTM 12284-010 Section 6 pp. 43-52)	None (Provide indication) (CLSR)	N
077-FI-02G	Side Plate Screws (None)	Brooks Instrument (VTM 12284-010 Section 6 pp. 43-52)	Stainless Steel (VTM 12284-010 Appendix pp. 87-88)	1355 Sho-Rate 150 (VTM 12284-010 Section 6 pp. 43-52)	Provide structural integrity (CLSR)	Y

ARDM MATRIX (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 5**
Equipment Type:	**INDCTR**	**Page 1 of 1**
Device Type:	**FI**	**May 15, 1996**
Group ID:	**077-FI-02**	

ARDM	077-FI-02A Metering Tube	077-FI-02B End Fittings	077-FI-02E Side Plates	077-FI-02G Side Plate Screws
Cavitation Erosion	02	02	19	19
Corrosion Fatigue	01.5	12	12	12
Crevice Corrosion	01.5	06	19	19
Erosion Corrosion	21	21	19	19
Fatigue	12	12	12	12
Fouling	15	15	19	19
Galvanic Corrosion	07	07	07	07
General Corrosion	01.5	01.3	01.4	01.3
Hydrogen Damage	01.5	03	19	19
Intergranular Attack	01.5	22	22	22
MIC	15	15	19	19
Particulate Wear Erosion	17	17	19	19
Pitting	01.5	06	19	19
Radiation Damage	20	01.3	01.4	01.3
Rubber Degradation	01.5	01.3	01.4	01.3
Selective Leaching	01.5	01.3	01.4	01.3
Stress Corrosion Cracking	01.5	18	18	18
Stress Relaxation	04	04	04	04
Thermal Damage	05	01.3	01.4	01.3
Thermal Embrittlement	04	04	04	04
Wear	16	16	16	16

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: FI EQUIPMENT TYPE: INDCTR

GROUP ID: 077-FI-02 Date: 5/15/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.3 STAINLESS STEEL 01.4 ALUMINUM 01.5 BOROSILICATE GLASS	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS AIR, NOT THE LIQUIDS NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONO-ATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUID IS PLANT VENT GASES. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTH OF 316 STAINLESS STEELS IS BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING.	ATTACH 7 VOL-13 FONTANA 60738 SH2 60722 SH1 AVNER ASM
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500^{o}F ENSURE THIS ARDM IS NOT PLAUSIBLE FOR METALLICS AND GLASS. BOROSILICATE GLASS HAS A LOW COEFFICIENT OF THERMAL EXPANSION, AS WELL AS HIGH TEMPERATURE AND THERMAL SHOCK RESISTANCE CAPABILITIES.	ATTACH 7 ES-014 MOFFATT BRADY AVALLONE

CODE	DESCRIPTION	SOURCE
05	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE ARDM. BOROSILICATE GLASS HAS A LOW COEFFICIENT OF THERMAL EXPANSION, AS WELL AS HIGH TEMPERATURE AND THERMAL SHOCK RESISTANCE CAPABILITIES. ARDM IS NOT PLAUSIBLE BECAUSE OF LOW PROCESS FLUID AND AMBIENT TEMPERATURES.	MOFFATT BRADY AVALLONE ES-014
06	PROCESS FLUID AND MOISTURE DO NOT PERPETUATE THE ARDM. INPO OPERATIONS AND MAINTENANCE REMINDER O&MR-132 DESCRIBES OPERATIONAL FAILURES OF RAD MONITORING SYSTEMS DUE TO EXCESS MOISTURE. CCNPP RECENT HISTORY SHOWS ONE CASE WHERE WATER WAS INTRODUCED TO THE SYSTEM DUE TO BLOWDOWN TANK VENT BEING ALIGNED TO THE MAIN PLANT VENT (MO 2199402504). HOWEVER, PER INPUT FROM THE SYSTEM ENGINEER THIS IS NOT A COMMON OCCURRENCE. THE SYSTEM HAS NOT EXPERIENCED THE MOISTURE RELATED PROBLEMS DESCRIBED IN O&MR-132. SYSTEM OPERATION IS ASSURED IN ACCORDANCE WITH O/I-35. THE LIMITED AMOUNT OF MOISTURE PREVENTS SIGNIFICANT EFFECT FROM THESE AGING MECHANISMS.	ATTACH 7 O/I-35 INPO O&MR-132 MO 2199402504
07	MATERIAL SELECTION AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THE STAINLESS STEEL END FITTINGS AND SCREWS ARE NOT SEPARATED FROM THE ANODIZED ALUMINUM SIDE PLATES, BUT GALVANIC CORROSION WILL BE MINIMAL DUE TO LACK OF AN ELECTROLYTE (COMPONENT EXTERNAL SURFACES EXPOSED ONLY TO AIR WITH MAXIMUM DESIGN RELATIVE HUMIDITY OF 90%).	ATTACH 7 O/I-35 12284-010 ES-014
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM MAINTAINS A RELATIVELY LOW STEADY PRESSURE AND TEMPERATURES MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 12284-010 ES-014
15	ARDMS DO NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. FOULING AND MIC MAY OCCUR TO A LIMITED EXTENT DUE TO CONDENSED HUMIDITY FROM THE VENT GASES, MICROBES AND AIRBORNE PARTICLES. PLANT EXPERIENCE HAS SHOWN FOULING HAS OCCURRED IN THIS SYSTEM. HOWEVER, FOULING DOES NOT AFFECT THE PRESSURE BOUNDARY FUNCTION. MIC ACTIVITY WILL NOT BE SIGNIFICANT TO PRESSURE BOUNDARY FUNCTION DUE TO LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION.	ATTACH 7 O/I-35 12284-010 MO 2199402189

CODE	DESCRIPTION	SOURCE
16	COMPONENT DESIGN DOES NOT PERPETUATE THE ARDM. THE ELEMENT PRESSURE BOUNDARY SUBCOMPONENTS ARE NOT IN RELATIVE MOTION AGAINST OTHER SUB-COMPONENTS MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 12284-010
17	PARTICULATE WEAR EROSION IS NOT SIGNIFICANT. THE AIR VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF AIRBORNE PARTICLES WILL NOT LEAD TO SIGNIFICANT EROSION OF THE EROSION RESISTANT MATERIALS. FILTRATION OF AIR ON THE SAMPLE CONDITIONING SKID PREVENTS SIGNIFICANT EFFECT FROM THIS AGING MECHANISM.	ATTACH 7 60738SH.2 12284-010
18	STRESSES AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN 316 STAINLESS STEELS (SIDE PLATES AND SCREWS EXPOSED ONLY TO NORMAL AMBIENT AIR). THE LOW YIELD STRENGTH OF THIS MATERIAL MAKE IT LESS SUSCEPTIBLE TO THE ARDM.	ATTACH 7 O/I-35 60738 SH.2 VOL-13 ES-014 AVNER FONTANA 60722 SH1 ASM NP-5461 12284-010
19	COMPONENT ENVIRONMENT DOES NOT PERPETUATE THE ARDM. THE SUBCOMPONENTS TYPICALLY ARE NOT EXPOSED TO THE PROCESS FLUID WHICH MAKES THE ARDM NON-PLAUSIBLE. THE EXTERNAL ENVIRONMENT IS NOT NORMALLY HARSH.	ATTACH 7 ES-014

CODE	DESCRIPTION	SOURCE
20	COMPONENT ENVIRONMENT AND PROCESS FLUID (PLANT VENT GASES) DO NOT PERPETUATE ARDM. THE LOCA DOSE RATE FOR ROOMS 524 AND 526 IS 1.54E2 RADS. THIS IS WELL BELOW THE THRESHOLD DOSE RATES OF 1.0E4 RADS, WHERE OPTICAL PROPERTIES OF SOME GLASS CHANGES, AND 1.0E6 RADS, WHERE FRAGILITY OF SOME GLASS INCREASES. BY DESIGN, THE MID/HIGH RANGE INDICATOR WOULD OPERATE ONLY DURING AND AFTER AN EVENT WHEN RADIATION CONCENTRATIONS IN PLANT VENT GASES REACH 4000 μCi/cc. THE COMPONENT WAS EVALUATED BY THE VENDOR FOR RADIATION HARDNESS, DURING WHICH METALLICS AND CERAMICS WERE SHOWN TO INCUR LITTLE DAMAGE BELOW 1.0E6 RADS. ALL COMPONENTS WERE SHOWN TO OPERATE AT THE SPECIFIED INTEGRATED DOSE OF 5.0E5 RADS.	ATTACH 7 ES-014 NP-2129 O/I-48 12284-010
21	PROCESS FLUID (AIR) AND MATERIAL SELECTION (SS) DO NOT PERPETUATE THE ARDM.	ATTACH 7
22	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION, AND THE AIR ENVIRONMENT IS NOT THE AGGRESSIVE ENVIRONMENT NECESSARY FOR THE ARDM. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN 316 STAINLESS STEELS (SIDE PLATES AND SCREWS ARE EXPOSED ONLY TO NORMAL AMBIENT AIR).	ATTACH 7 O/I-35 60738 SH.2 VOL-13 ES-014 AVNER FONTANA 60722 SH1 ASM 12284-010

ARDM	POTENTIAL	DESCRIPTION/JUSTIFICATION	SOURCE
Cavitation Erosion	Yes	Localized material erosion caused by formation and collapse of vapor bubbles in close proximity to material surface. Requires fluid (liquid) flow and pressure variations which temporarily drop the liquid pressure below the corresponding vapor pressure. Most materials are susceptible to varying degrees depending upon the severity of the environmental factors.	[7]
Corrosion Fatigue	Yes	Plant equipment operating in a corrosive environment subjected to cyclic (fatigue) loading may initiate cracks and/or fail sooner than expected based on analysis of the corrosion and fatigue loadings applied separately. Fatigue-crack initiation and growth usually follows a transgranular path, although there are some cases where intergranular cracking has been observed. In some cases, crack initiation occurs by fatigue and is subsequently dominated by corrosion advance. In other cases, a corrosion mechanism (SCC) can be responsible for crack formation below the fatigue threshold, and the fatigue mechanism can accelerate the crack propagation. Corrosion-fatigue is a potentially active mechanism in both stainless steels as well as carbon and low alloy steels.	[7]
Creep/ Shrinkage	No	Not applicable to Equipment Type. This phenomenon results in dimensional changes in metals at high temperatures and in concrete subject to long term dehydration. This ARDM is not applicable to this equipment type since proper component specification and design prevents this ARDM from occurring (i.e., system and component design standards adequately address this ARDM).	[2]
Crevice Corrosion	Yes	Crevice corrosion is intense, localized corrosion within crevices or shielded areas. It is associated with a small volume of stagnant solution caused by holes, gasket surfaces, lap joints, crevices under bolt heads, surface deposits, designed crevices for attaching thermal sleeves to safe-ends, and integral weld backing rings or back-up bars. The crevice must be wide enough to permit liquid entry and narrow enough to maintain stagnant conditions, typically a few thousandths of an inch or less. Crevice corrosion is closely related to pitting corrosion and can initiate pits in many cases as well as leading to stress corrosion cracking. In an oxidizing environment, a crevice can set up a differential aeration cell to concentrate an acid solution within the crevice. Even in a reducing environment, alternate wetting and drying can concentrate aggressive ionic species to cause pitting, crevice corrosion, intergranular attack, or stress corrosion cracking.	[6] [7] [12]

Erosion Corrosion	Yes	Increased rate of attack on a metal because of the relative movement between a corrosive fluid and the metal surface. Mechanical wear or abrasion can be involved, characterized by grooves, gullies, waves, holes and valleys on the metal surface. Erosion is a mechanical action of a fluid and/or particulate matter on a metal surface, without the influence of corrosion. Erosion corrosion failures can occur in a relatively short time and are sometimes unexpected, since corrosion tests are usually run under static conditions. All equipment exposed to moving fluids is vulnerable; in particular, piping (bends, tees, etc.), Valves, pumps, propellers and impellers, heat exchanger tubing, turbine blades and wear plates are components which have experienced erosion corrosion. This is a serious problem in steam piping, heater drain piping, reheaters, and moisture separators due to high velocity particle impingement. Erosion corrosion has occurred in high and low pressure preheater tubes, low pressure preheaters, evaporators and feedwater heaters. Inlet tube corrosion occurs in heat exchangers, due to the turbulence of flow from the exchanger head into the smaller tubes, within the first few inches of the tube. Such corrosion has been especially evident in condenser tubes and feedwater heaters. The occurrence of erosion corrosion is highly dependent upon material of construction and the fluid flow conditions. Carbon or low alloy steels are particularly susceptible when in contact with high velocity water (single or two-phase) with turbulent flow, low oxygen and fluid pH < 9.3. Maximum erosion corrosion rates are expected in carbon steel at 130-140°C (single phase) and 180°C (two phase).	[5] [6] [7]
Fatigue	Yes	Fatigue damage results from progressive, localized structural change in materials subjected to fluctuating stresses and strains. Associated failures may occur at either high or low cycles in response to various kinds of loads (e.g., Mechanical or vibrational loads, thermal cycles, or pressure cycles). Fatigue cracks initiate and propagate in regions of stress concentration that intensify strain. The fatigue life of a component is a function of several variables such as stress level, stress state, cyclic wave form, fatigue environment, and the metallurgical condition of the material. Failure occurs when the endurance limit number of cycles (for a given load amplitude) is exceeded. All materials are susceptible (with varying endurance limits) when subjected to cyclic loading. Vibration loads have also been the cause of recurring weld failures by the fatigue of small socket welds. Certain piping locations, such as charging lines, have been found to experience vibration conditions. In some cases these failures in pipe have been due to inadequately supported pipe or obturator induced vibratory loads.	[6] [7] [2]

Fouling	Yes	Unavoidable introduction of foreign substances that interact with and/or collect within system and components. Caused by failure or degradation of upstream removal process equipment, long term buildup, low flow, stagnant flow, infrequent operation, and/or contaminated inlet flow. Fouling refers to all deposits on system surfaces that increase resistance to fluid flow and/or heat transfer. Sources of fouling include the following: (1) organic films of micro-organisms and their products (microbial fouling) (2) deposits of macro-organisms such as mussels (macrobial fouling) (3) inorganic deposits, including scales, silt, corrosion products and detritus. Scales result when solubility limits for a given species are exceeded. Deposits result when coolant-borne particles drop onto surfaces due to hydraulic factors. The deposits result in reduced flow of cooling water, reduced heat transfer, and increased corrosion. Sediment deposits promote concentration cell corrosion and growth of sulfur-reducing bacteria. The bacteria can cause severe pitting after one month of service. Piping systems designed for 30 years have had their projected life reduced to five years due to under-sediment corrosion.	[9] [10] [11]
Galvanic Corrosion	Yes	Accelerated corrosion caused by dissimilar metals in contact in a conductive solution. Requires two dissimilar metals in physical or electrical contact, developed potential (material dependent), and conducting solution,.	[12]
General Corrosion	Yes	Thinning (wastage) of a metal by chemical attack (dissolution) at the surface of the metal by an aggressive environment. The consequences of the damage are loss of load carrying cross-sectional area. General corrosion requires an aggressive environment and materials susceptible to that environment. An important concern for PWRs is boric acid attack of carbon steels. Borated water has been observed to leak from piping, valves, storage tanks, etc., And fall on other carbon steel components and attack the component from the outside. Wastage is not a concern for austenitic stainless steel alloys.	[7] [8] [2]

Hydrogen Damage	Yes	Two forms of hydrogen attack relevant to light water reactor materials and conditions are hydrogen blistering and hydrogen embrittlement. Both produce mechanical damage in the affected component. In each case, atomic hydrogen enters the metal, either as a result of a corrosion reaction at the surface or by cathodic polarization which results in the evolution of hydrogen gas. In blistering, molecular hydrogen within the metal causes high pressure and local damage in the form of "blistered" regions of the metal surface. Hydrogen embrittlement affects ferritic and martensitic iron-based alloys, and results in low ductility intergranular cracking (similar to stress corrosion cracking). The phenomenon of hydrogen cracking is usually manifested as delayed cracking, at or near room temperature, after stress is applied. A certain critical stress, which may take the form of weld residual stress, is required to cause cracking. Notches concentrate such stresses and tend to shorten the delay time for cracking. Cracking of welds due to hydrogen embrittlement and hydrogen-induced cracking is a common concern. This cracking is more of a problem in higher strength steels (yield strength >120 ksi). Ferritic and martensitic stainless steels, carbon steels, and other high strength alloys are susceptible. Austenitic stainless steels are relatively immune but could experience damage at sufficiently high hydrogen levels.	[6] [7]
Intergranular Attack	Yes	Intergranular Attack (IGA) is very similar to intergranular stress corrosion cracking (IGSCC) except that stress is not required for IGA. IGA is localized corrosion at or adjacent to grain boundaries, with relatively little corrosion of the material grains. It is caused by impurities in the grain boundaries, or the enrichment or depletion of alloying elements at grain boundaries, such as the depletion of chromium at austenitic stainless steel grain boundaries. A "sensitized" microstructure causes susceptibility to IGA. When austenitic stainless steels are heated into or slow cooled through the temperature range of approximately 750 to 1500°F, chromium carbides can be formed, thus depleting the grain boundaries of chromium and decreasing their corrosion resistance. High chromium ferritic stainless steels, such as Type 430, also experience susceptibility to IGA. Nickel alloys such as alloy 600 experience IGA in the presence of certain sulfur environments at high temperatures (by forming low melting sulfur compounds at grain boundaries) or when austenitic stainless steel weld filler metal is inadvertently used on Ni-Cr-Fe alloys. Susceptibility to intergranular attack (sensitization) usually develops during thermal processing such as welding or heat treatments. IGA is generally not a concern in atmospheric exposures and is most commonly documented to occur in fluid systems.	[6] [7] [2] [12] [14]

Irradiation Embrittlement	No	Not applicable to Equipment Type. This ARDM results in a decrease in steel fracture toughness due to long-term exposure to a fast flux of neutrons. This ARDM is not applicable to this equipment type since filter components are not located in areas where the neutron flux is high enough to cause this ARDM to occur.	[6] [7]
MIC	Yes	Accelerated corrosion of materials resulting from surface microbiological activity. Sulfate reducing bacteria, sulfur oxidizers, and iron oxidizing bacteria are most commonly associated with corrosion effects. Most often results in pitting followed by excessive deposition of corrosion products. Stagnant or low flow areas are most susceptible. Any system that uses untreated water, or is buried, is particularly susceptible. Consequences range from leakage to excessive differential pressure and flow blockage. Essentially all systems and most commonly-used materials are susceptible. Temperatures from about 50°F to 120°F are most conducive to MIC. Experience in virtually all large industries is common. Nuclear experience is relatively new, but also widespread. MIC is generally observed in service water applications utilizing raw untreated water. Sedimentation aggravates the problem.	[6] [7] [2]
Oxidation	No	Not applicable to Equipment Type. The ARDM results from a chemical reaction at the surface of a material when subjected to an oxidizing environment. Oxidation occurs at any temperature. Electrical components experience degradation related to oxidation and are considered separately. Oxidation generally is not considered a degradation mechanism in metals of fluid systems in mild environments since this mechanism serves to protect materials by formation of a passive layer. Other corrosion mechanisms (e.g. Corrosion fatigue, crevice corrosion, erosion corrosion, general corrosion and pitting) can result from oxidation/reduction reactions under specific aggressive mechanical and chemical environment and are addressed separately. It could be considered a degradation mechanism at high temperatures, where a more rapid reaction between metal and oxygen is likely to occur. These temperatures do not occur in power plant applications under evaluation. Therefore, oxidation is not considered a potential ARDM for filter components.	[7] [12]
Particulate Wear Erosion	Yes	The loss of material caused by mechanical abrasion due to relative motion between solution and material surface. Requires high velocity fluid, entrained particles, turbulent flow regions, flow direction change, and/or impingement. Most materials are susceptible to varying degrees depending upon the severity of the environmental factors.	[7]

Pitting	Yes	A form of localized attack with greater corrosion rates at some locations than at others. Pitting can be very insidious and destructive, with sudden failures in high pressure applications (especially in tubes) occurring by perforation. This form of corrosion essentially produces "holes" of varying depth to diameter ratios in the steel. These pits are, in many cases, filled with oxide debris, especially for ferritic materials such as carbon steel. Deep pitting is more common with passive metals, such as austenitic stainless steels, than with non- passive metals. Pits are generally elongated in the direction of gravity. In many cases, erosion corrosion, fretting corrosion, and crevice corrosion can also lead to pitting. Corrosion pitting is an anodic reaction which is an autocatalytic process. That is, the corrosion process within a pit produces conditions which stimulate the continuing activity of the pit. High concentrations of impurity anions such as chlorides and sulfates tend to concentrate in the oxygen- depleted pit region, giving rise to a potentially concentrated aggressive solution in this zone. Pitting has been found on the outside diameter of tubes where sludge or tube scale was present. It can also occur at locations of relatively stagnant coolant or water, such as in carbon steel pipes for service water lines, and at crevices in stainless steel, such as at the stainless steel cladding between reactor pressure vessel closure flanges. Pitting can become passive in some metals such as aluminum.	[6] [7] [2] [12]
Radiation Damage	Yes	Non-metallics are susceptible to degradation caused by gamma radiation.	[4]
Rubber Degradation	Yes	Rubber can be used in specific applications of this device type. Long term exposure of rubber to water will result in water absorption and swelling, blistering, hardening, and eventual cracking. When utilized as a protective lining, moisture permeation of the rubber produces blisters beneath the lining and initiates corrosion of the lined surface.	[3]
Saline Water Attack	No	Not applicable to Equipment Type. Saline Water Attack has resulted in the degradation of reinforced concrete structures. The degradation mechanism involves water seepage into the concrete resulting in a high chloride environment for the reinforcing bars. The reinforcing bars corrode resulting in expansion that leads to cracking and spalling of the concrete. Of particular concern for structures that are inaccessible for routine inspection, and piping or other fluid components embedded in concrete. This ARDM is not applicable to filter components since filters are not constructed of nor typically installed in concrete.	[2]

Selective Leaching	Yes	The removal of one element from a solid alloy by corrosion processes. The most common example is the selective removal of zinc in brass alloys (dezincification). Similar processes occur in other alloy systems in which aluminum, iron, cobalt, chromium, and other elements are removed. There are two types, layer-type and plug-type. Layer-type is a uniform attack whereas plug-type is extremely localized leading to pitting. Overall dimensions do not change appreciably. If a piece of equipment is covered by debris or surface deposits and/or not inspected closely, sudden unexpected failure may occur in high pressure applications due to the poor strength of the remaining material. Requires susceptible materials and corrosive environment. Materials particularly susceptible include zinc, aluminum, carbon and nickel. Environmental conditions include high temperature, stagnant aqueous solution, and porous inorganic scale. Acidic solutions and oxygen aggravate the mechanism.	[12] [13]
Stress Corrosion Cracking	Yes	Selective corrosive attack along or across material grain boundaries. Four particular mechanisms are known to exist: (1) Intergranular (IGSCC), between the material grain boundaries. (2) Transgranular (TGSCC), across the material grains along certain crystallographic planes. (3) Irradiation Assisted (IASCC), between the material grains after an incubation neutron dose which sensitizes the material. (4) Interdendritic (IDSCC), between the dendrite interfaces. SCC requires applied or residual tensile stress, susceptible materials (such as austenitic stainless steels, alloy 600, alloy x-750, SAE 4340, and ASTM A289), and oxygen and/or ionic species (e.g., Chlorides/sulfates).	[6] [7] [2] [12] [13]

Stress Corrosion Cracking (Continued)	Yes (Cont'd)	Common sources of residual stress include thermal processing and stress risers created during surface finishing, fabrication, or assembly. The heat input during welding can result in a localized sensitized region which is susceptible to SCC. IGSCC is a concern in stainless steel piping depending on material condition and process fluid chemistry and also is a potential concern in valve internals (PH steel). SCC of low alloy steel and carbon steel is not considered a credible aging mechanism for typical conditions encountered in a nuclear power plant. TGSCC may be a concern in low alloy and stainless steel if aggressive chemical species (caustics, halogens, sulfates, especially if coupled with the presence of oxygen) are present. IASCC is a potential concern only for reactor vessel internals and other stainless steel components, such as control rods, which are subject to very high neutron fluence levels. A fast neutron incubation fluence of at least 1.0E+20 is generally required to sensitize the material. IDSCC is a potential concern in stainless steel weld metal deposits based on microstructure and delta ferrite content. This mechanism is inactive in carbon and low alloy steel. Ammonia grooving in brass components can occur when the concentration of ammonia is greater than a few ppm. It is found most often in feedwater heaters that contain admiralty brass tubes and where morpholine, which breaks down into ammonia, is used to increase the pH of the condensate.	
Stress Relaxation	Yes	Stress Relaxation occurs under conditions of constant strain where part of the elastic strain is replaced with plastic strain. A material loaded to an initial stress may experience a reduction in stress over time at high temperatures. Bolted connections are most vulnerable. Relaxation of stress on packing due to stretching of gland follower studs under elevated temperatures may cause packing leakage.	[7]
Thermal Damage	Yes	Non-metallics are particularly susceptible with material dependent temperature limits.	[7] [2]
Thermal Embrittlement	Yes	Loss of material fracture toughness caused by thermally induced changes in the formation and distribution of alloying constituents. Requires high temperature 500°F to 700°F for metallic components. Ferrite containing stainless steels are susceptible as are materials with grain boundary segregation of impurities.	[7]

Wear	Yes	Wear results from relative motion between two surfaces (adhesive wear), from the influence of hard, abrasive particles (abrasive wear - see particulate erosion) or fluid stream (erosion), and from small, vibratory or sliding motions under the influence of a corrosive environment (fretting). In addition to material loss from the above wear mechanisms, impeded relative motion between two surfaces held in intimate contact for extended periods may result from galling/self-welding. Motions may be linear, circular, or vibratory in inert or corrosive environments. The most common result of wear is damage to one or both surfaces involved in the contact. Wear most typically occurs in components which experience considerable relative motion such as valves and pumps, in components which are held under high loads with no motion for long periods (valves, flanges), or in clamped joints where relative motion is not intended but occurs due to a loss of clamping force (e.g., Tubes in supports, valve stems in seats, springs against tubes). Wear may proceed at an ever- increasing rate as worn surfaces moving past one another will often do so with much higher contact stresses than the surfaces of the original geometry. Fretting is a wear phenomenon that occurs between tight-fitting surfaces subjected to a cyclic, relative motion of extremely small amplitude. Fretting is frequently accompanied by corrosion. Common sites for fretting are in joints that are bolted, keyed, pinned, press fit or riveted; in oscillating bearings, couplings, spindles, and seals; in press fits on shafts; and in universal joints. Under fretting conditions, fatigue cracks may be initiated at stresses well below the endurance limit of nonfretted specimens.	[1]

Attachment 7 Reference List

Source	Title
[1]	ASME Wear Control Handbook, Peterson and Winer, 1980
[2]	Standard Format and Content of Technical Information for Applications to Renew Nuclear Power Plant Operating Licenses, Draft NRC Regulatory Guide No. DG-1009, December 1990
[3]	Service (Salt) Water System Life Cycle Management Evaluation, EPRI Report No. TR-102204, April 1993
[4]	Radiation Effects on Organic Materials in Nuclear Plants, EPRI Report No. NP-2129, November 1981
[5]	Erosion/Corrosion in Nuclear Plant Steam Piping, EPRI Report No. NP-3944, 1985
[6]	Component Life Estimation: LWR Structural Materials Degradation Mechanisms, EPRI Report No. NP-5461, 1987
[7]	Environmental Effects on Components: Commentary for ASME Section III, EPRI Report No. NP-5775, April 1988
[8]	Boric Acid Corrosion of Carbon and Low Alloy Steel Pressure Boundary Materials, EPRI Report No. NP-5985, 1988
[9]	Nuclear Plant Service Water System Aging Degradation Assessment, NUREG/CR-5379, Volume 1 and 2, June 1989 and October 1992
[10]	Aging Assessment of Instrument Air Systems, NUREG/CR-5419, January 1990
[11]	Insights Gained from Aging Research, NUREG/CR-5643, March 1992
[12]	Corrosion Engineering, Fontana and Greene, 1978
[13]	Corrosion and Corrosion Control, An Introduction to Corrosion Science and Engineering, Uhlig, Third Edition, 1985
[14]	ASM Specialty Handbook, Stainless Steels, Davis, 1994

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 3**
Equipment Type:	**FILTER**	**Page 1 of 1**
Device Type:	**FL**	**April 11, 1996**
Group ID:	**077-FL-01**	

Device Type: Filter

Vendor:

Model Number:

Material:

Internal Environment:

External Environment:

Function(s): Maintain System Pressure Boundary Integrity

Other Parameters:

List of Grouped Components:

1FL5416A	WRGM Filter Assembly Low Range
1FL5416B	WRGM Filter Assembly Low Range
1FL5416G1	WRGM Filter Assembly Low Range
1FL5418C	WRGM Filter Assembly Mid/High Range
1FL5418D	WRGM Filter Assembly Mid/High Range
1FL5418G2	WRGM Filter Assembly Mid/High Range
1FL5483	Filter Assembly WRGM Mid/High Range Pump
2FL5416A	WRGM Filter Assembly Low Range
2FL5416B	WRGM Filter Assembly Low Range
2FL5416G1	WRGM Filter Assembly Low Range
2FL5418C	WRGM Filter Assembly Mid/High Range
2FL5418D	WRGM Filter Assembly Mid/High Range
2FL5418G2	WRGM Filter Assembly Mid/High Range
2FL5483	Filter Assembly WRGM Mid/High Range Pump

ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA GROUP ID: 077-FL-01 Date: April 11, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Model Number (Source)	Material (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-FL-01A	HOUSING (NONE)	GENERAL ATOMIC (12284-010)	P/N 03661121-001,2,3 (LCM 95-095)	STAINLESS STEEL (LCM 95-095)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-FL-01B	INTERNALS (N/A)	GENERAL ATOMIC (12284-010)	N/A	N/A	NONE. NO LR INTENDED FUNCTION. COMPONENT IN LR SCOPE FOR PRESSURE BOUNDARY ONLY. (CLSR)	N

ARDM MATRIX (Revision 1)

System:	**Area and Process Radiation Monitoring (077/079)**	**Attachment 5**
Equipment Type:	**FILTER**	**Page 1 of 1**
Device Type:	**FL**	**April 11, 1996**
Group ID:	**077-FL-01**	

ARDM	077-FL-01A Housing
Cavitation Erosion	02
Corrosion Fatigue	12
Crevice Corrosion	06
Erosion Corrosion	21
Fatigue	12
Fouling	15
Galvanic Corrosion	07
General Corrosion	01.3
Hydrogen Damage	03
Intergranular Attack	22
MIC	15
Particulate Wear Erosion	17
Pitting	06
Radiation Damage	01.3
Rubber Degradation	01.3
Selective Leaching	01.3
Stress Corrosion Cracking	18
Stress Relaxation	04
Thermal Damage	01.3
Thermal Embrittlement	04
Wear	16

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: FL EQUIPMENT TYPE: FILTER

GROUP ID: 077-FL-01 Date: 5/10/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.3 STAINLESS STEEL	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS AIR, NOT THE LIQUIDS NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7 60738 SH2
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONO-ATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUID IS PLANT VENT GASES. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTH OF TYPICAL 300 SERIES STAINLESS STEELS IS BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING.	ATTACH 7 VOL-13 FONTANA 60738 SH2 60722 SH1 AVNER ASM
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500°F ENSURE THIS ARDM IS NOT PLAUSIBLE.	ATTACH 7 ES-014

CODE	DESCRIPTION	SOURCE
06	PROCESS FLUID AND MOISTURE DO NOT PERPETUATE THE ARDM. INPO OPERATIONS AND MAINTENANCE REMINDER O&MR-132 DESCRIBES OPERATIONAL FAILURES OF RAD MONITORING SYSTEMS DUE TO EXCESS MOISTURE. CCNPP RECENT HISTORY SHOWS ONE CASE WHERE WATER WAS INTRODUCED TO THE SYSTEM DUE TO BLOWDOWN TANK VENT BEING ALIGNED TO THE MAIN PLANT VENT (MO 2199402504). HOWEVER, PER INPUT FROM THE SYSTEM ENGINEER THIS IS NOT A COMMON OCCURRENCE. THE SYSTEM HAS NOT EXPERIENCED THE MOISTURE RELATED PROBLEMS DESCRIBED IN O&MR-132. SYSTEM OPERATION IS ASSURED IN ACCORDANCE WITH O/I-35. THE LIMITED AMOUNT OF MOISTURE PREVENTS SIGNIFICANT EFFECT FROM THESE AGING MECHANISMS.	ATTACH 7 O/I-35 INPO O&MR-132 MO 2199402504
07	MATERIAL SELECTION/SEPARATION AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. FILTER PRESSURE BOUNDARY IS OF UNIFORM MATERIAL OF CONSTRUCTION AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION.	ATTACH 7 O/I-35 LCM 95-095 12284-010
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM MAINTAINS A RELATIVELY LOW STEADY PRESSURE, FLOW, AND TEMPERATURES MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 12284-010 60738 SH2 ES-014
15	ARDMS DO NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. FOULING AND MIC MAY OCCUR TO A LIMITED EXTENT DUE TO CONDENSED HUMIDITY FROM THE VENT GASES, MICROBES AND AIRBORNE PARTICLES. PLANT EXPERIENCE HAS SHOWN FOULING HAS OCCURRED IN THIS SYSTEM. HOWEVER, FOULING DOES NOT AFFECT THE PRESSURE BOUNDARY FUNCTION. MIC ACTIVITY WILL NOT BE SIGNIFICANT TO PRESSURE BOUNDARY FUNCTION DUE TO LIMITED AMOUNT OF CONDENSATION.	ATTACH 7 O/I-35
16	COMPONENT DESIGN DOES NOT PERPETUATE THE ARDM. THE FILTER PRESSURE BOUNDARY SUBCOMPONENTS ARE NOT IN RELATIVE MOTION AGAINST OTHER SUB-COMPONENTS MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 12284-010

CODE	DESCRIPTION	SOURCE
17	PARTICULATE WEAR EROSION IS NOT SIGNIFICANT. THE AIR VELOCITY SLOWS INSIDE THE LARGER VOLUME OF THE FILTER HOUSING. THE PROCESS FLUID IS PLANT VENT GASES AND IS NOT THE AGGRESSIVE ENVIRONMENT NEEDED TO ERODE THE EROSION RESISTANT STAINLESS STEEL COMPONENTS, MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 60738 SH.2 LCM 95-095 12284-010
18	STRESSES AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES, AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN TYPICAL 300 SERIES STAINLESS STEELS. THE LOW YIELD STRENGTH OF 300 SERIES SS MAKES THE MATERIAL LESS SUSCEPTIBLE TO THE ARDM.	ATTACH 7 O/I-35 60738 SH.2 VOL-13 AVNER FONTANA 60722 SH1 ASM NP-5461
21	PROCESS FLUID (AIR) AND MATERIAL SELECTION (SS) DO NOT PERPETUATE THE ARDM.	ATTACH 7
22	ENVIRONMENT DOES NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL AND AN APPROPRIATE ENVIRONMENT.. THIS ARDM IS NOT PLAUSIBLE SINCE THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, AND THE AIR ENVIRONMENT IS NOT THE AGGRESSIVE ENVIRONMENT NECESSARY FOR THE ARDM. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN TYPICAL 300 SERIES STAINLESS STEELS.	ATTACH 7 O/I-35 60738 SH.2 VOL-13 AVNER FONTANA 60722 SH1 ASM

ARDM	POTENTIAL	DESCRIPTION/JUSTIFICATION	SOURCE
Cavitation Erosion	Yes	Localized material erosion caused by formation and collapse of vapor bubbles in close proximity to material surface. Requires fluid (liquid) flow and pressure variations which temporarily drop the liquid pressure below the corresponding vapor pressure. Most materials are susceptible to varying degrees depending upon the severity of the environmental factors.	[7]
Corrosion Fatigue	Yes	Plant equipment operating in a corrosive environment subjected to cyclic (fatigue) loading may initiate cracks and/or fail sooner than expected based on analysis of the corrosion and fatigue loadings applied separately. Fatigue-crack initiation and growth usually follows a transgranular path, although there are some cases where intergranular cracking has been observed. In some cases, crack initiation occurs by fatigue and is subsequently dominated by corrosion advance. In other cases, a corrosion mechanism (SCC) can be responsible for crack formation below the fatigue threshold, and the fatigue mechanism can accelerate the crack propagation. Corrosion-fatigue is a potentially active mechanism in both stainless steels as well as carbon and low alloy steels.	[7]
Creep/ Shrinkage	No	Not applicable to Equipment Type. The phenomenon results in dimensional changes in metals at high temperatures and in concrete subject to long term dehydration. This ARDM is not applicable to this equipment type since proper piping system design prevents this ARDM from occurring (i.e., piping design standards adequately address this ARDM).	[2]
Crevice Corrosion	Yes	Crevice corrosion is intense, localized corrosion within crevices or shielded areas. It is associated with a small volume of stagnant solution caused by holes, gasket surfaces, lap joints, crevices under bolt heads, surface deposits, designed crevices for attaching thermal sleeves to safe-ends, and integral weld backing rings or back-up bars. The crevice must be wide enough to permit liquid entry and narrow enough to maintain stagnant conditions, typically a few thousandths of an inch or less. Crevice corrosion is closely related to pitting corrosion and can initiate pits in many cases as well as leading to stress corrosion cracking. In an oxidizing environment, a crevice can set up a differential aeration cell to concentrate an acid solution within the crevice. Even in a reducing environment, alternate wetting and drying can concentrate aggressive ionic species to cause pitting, crevice corrosion, intergranular attack, or stress corrosion cracking.	[6] [7] [12]

Erosion Corrosion	Yes	Increased rate of attack on a metal because of the relative movement between a corrosive fluid and the metal surface. Mechanical wear or abrasion can be involved, characterized by grooves, gullies, waves, holes and valleys on the metal surface. Erosion is a mechanical action of a fluid and/or particulate matter on a metal surface, without the influence of corrosion. Erosion corrosion failures can occur in a relatively short time and are sometimes unexpected, since corrosion tests are usually run under static conditions. All equipment exposed to moving fluids is vulnerable; in particular, piping (bends, tees, etc.), Valves, pumps, propellers and impellers, heat exchanger tubing, turbine blades and wear plates are components which have experienced erosion corrosion. This is a serious problem in steam piping, heater drain piping, reheaters, and moisture separators due to high velocity particle impingement. Erosion corrosion has occurred in high and low pressure preheater tubes, low pressure preheaters, evaporators and feedwater heaters. Inlet tube corrosion occurs in heat exchangers, due to the turbulence of flow from the exchanger head into the smaller tubes, within the first few inches of the tube. Such corrosion has been especially evident in condenser tubes and feedwater heaters. The occurrence of erosion corrosion is highly dependent upon material of construction and the fluid flow conditions. Carbon or low alloy steels are particularly susceptible when in contact with high velocity water (single or two phase) with turbulent flow, low oxygen and fluid pH < 9.3. Maximum erosion corrosion rates are expected in carbon steel at 130-140°C (single phase) and 180°C (two phase).	[5] [6] [7]
Fatigue	Yes	Fatigue damage results from progressive, localized structural change in materials subjected to fluctuating stresses and strains. Associated failures may occur at either high or low cycles in response to various kinds of loads (e.g., Mechanical or vibrational loads, thermal cycles, or pressure cycles). Fatigue cracks initiate and propagate in regions of stress concentration that intensify strain. The fatigue life of a component is a function of several variables such as stress level, stress state, cyclic wave form, fatigue environment, and the metallurgical condition of the material. Failure occurs when the endurance limit number of cycles (for a given load amplitude) is exceeded. All materials are susceptible (with varying endurance limits) when subjected to cyclic loading. Vibration loads have also been the cause of recurring weld failures by the fatigue of small socket welds. Certain piping locations, such as charging lines, have been found to experience vibration conditions. In some cases these failures in pipe have been due to inadequately supported pipe or obturator induced vibratory loads.	[6] [7] [2]

Fouling	Yes	Unavoidable introduction of foreign substances that interact with and/or collect within system and components. Caused by failure or degradation of upstream removal process equipment, long term buildup, low flow, stagnant flow, infrequent operation, and/or contaminated inlet flow. Fouling refers to all deposits on system surfaces that increase resistance to fluid flow and/or heat transfer. Sources of fouling include the following: (1) organic films of micro-organisms and their products (microbial fouling) (2) deposits of macro-organisms such as mussels (macrobial fouling) (3) inorganic deposits, including scales, silt, corrosion products and detritus. Scales result when solubility limits for a given species are exceeded. Deposits result when coolant-borne particles drop onto surfaces due to hydraulic factors. The deposits result in reduced flow of cooling water, reduced heat transfer, and increased corrosion. Sediment deposits promote concentration cell corrosion and growth of sulfur-reducing bacteria. The bacteria can cause severe pitting after one month of service. Piping systems designed for 30 years have had their projected life reduced to five years due to under-sediment corrosion.	[9] [10] [11]
Galvanic Corrosion	Yes	Accelerated corrosion caused by dissimilar metals in contact in a conductive solution. Requires two dissimilar metals in physical or electrical contact, developed potential (material dependent), and conducting solution,.	[12]
General Corrosion	Yes	Thinning (wastage) of a metal by chemical attack (dissolution) at the surface of the metal by an aggressive environment. The consequences of the damage are loss of load carrying cross-sectional area. General corrosion requires an aggressive environment and materials susceptible to that environment. An important concern for PWRs is boric acid attack of carbon steels. Borated water has been observed to leak from piping, valves, storage tanks, etc., And fall on other carbon steel components and attack the component from the outside. Wastage is not a concern for austenitic stainless steel alloys.	[7] [8] [2]

Hydrogen Damage	Yes	Two forms of hydrogen attack relevant to light water reactor materials and conditions are hydrogen blistering and hydrogen embrittlement. Both produce mechanical damage in the affected component. In each case, atomic hydrogen enters the metal, either as a result of a corrosion reaction at the surface or by cathodic polarization which results in the evolution of hydrogen gas. In blistering, molecular hydrogen within the metal causes high pressure and local damage in the form of "blistered" regions of the metal surface. Hydrogen embrittlement affects ferritic and martensitic iron-based alloys, and results in low ductility intergranular cracking (similar to stress corrosion cracking). The phenomenon of hydrogen cracking is usually manifested as delayed cracking, at or near room temperature, after stress is applied. A certain critical stress, which may take the form of weld residual stress, is required to cause cracking. Notches concentrate such stresses and tend to shorten the delay time for cracking. Cracking of welds due to hydrogen embrittlement and hydrogen-induced cracking is a common concern. This cracking is more of a problem in higher strength steels (yield strength >120 ksi). Ferritic and martensitic stainless steels, carbon steels, and other high strength alloys are susceptible. Austenitic stainless steels are relatively immune but could experience damage at sufficiently high hydrogen levels.	[6] [7]
Intergranular Attack	Yes	Intergranular Attack (IGA) is very similar to intergranular stress corrosion cracking (IGSCC) except that stress is not required for IGA. IGA is localized corrosion at or adjacent to grain boundaries, with relatively little corrosion of the material grains. It is caused by impurities in the grain boundaries, or the enrichment or depletion of alloying elements at grain boundaries, such as the depletion of chromium at austenitic stainless steel grain boundaries. A "sensitized" microstructure causes susceptibility to IGA. When austenitic stainless steels are heated into or slow cooled through the temperature range of approximately 750 to 1500°F, chromium carbides can be formed, thus depleting the grain boundaries of chromium and decreasing their corrosion resistance. High chromium ferritic stainless steels, such as Type 430, also experience susceptibility to IGA. Nickel alloys such as alloy 600 experience IGA in the presence of certain sulfur environments at high temperatures (by forming low melting sulfur compounds at grain boundaries) or when austenitic stainless steel weld filler metal is inadvertently used on Ni-Cr-Fe alloys. Susceptibility to intergranular attack (sensitization) usually develops during thermal processing such as welding or heat treatments. IGA is generally not a concern in atmospheric exposures and is most commonly documented to occur in fluid systems.	[6] [7] [2] [12] [14]

Irradiation Embrittlement	No	Not applicable to Equipment Type. The ARDM results in a decrease in steel fracture toughness due to long-term exposure to a fast flux of neutrons. This ARDM is not applicable to this equipment type since piping components are not located in areas where the neutron flux is high enough to cause this ARDM to occur.	[6] [7]
MIC	Yes	Accelerated corrosion of materials resulting from surface microbiological activity. Sulfate reducing bacteria, sulfur oxidizers, and iron oxidizing bacteria are most commonly associated with corrosion effects. Most often results in pitting followed by excessive deposition of corrosion products. Stagnant or low flow areas are most susceptible. Any system that uses untreated water, or is buried, is particularly susceptible. Consequences range from leakage to excessive differential pressure and flow blockage. Essentially all systems and most commonly-used materials are susceptible. Temperatures from about 50°F to 120°F are most conducive to MIC. Experience in virtually all large industries is common. Nuclear experience is relatively new, but also widespread. MIC is generally observed in service water applications utilizing raw untreated water. Sedimentation aggravates the problem.	[6] [7] [2]
Oxidation	No	Not applicable to Equipment Type. The ARDM results from a chemical reaction at the surface of a material when subjected to an oxidizing environment. Oxidation occurs at any temperature. Electrical components experience degradation related to oxidation and are considered separately. Oxidation generally is not considered a degradation mechanism in metals of fluid systems in mild environments since this mechanism serves to protect materials by formation of a passive layer. Other corrosion mechanisms (e.g. Corrosion fatigue, crevice corrosion, erosion corrosion, general corrosion and pitting) can result from oxidation/reduction reactions under specific aggressive mechanical and chemical environment and are addressed separately. It could be considered a degradation mechanism at high temperatures, where a more rapid reaction between metal and oxygen is likely to occur. These temperatures do not occur in power plant applications under evaluation. Therefore, oxidation is not considered a potential ARDM for piping.	[7] [12]
Particulate Wear Erosion	Yes	The loss of material caused by mechanical abrasion due to relative motion between solution and material surface. Requires high velocity fluid, entrained particles, turbulent flow regions, flow direction change, and/or impingement. Most materials are susceptible to varying degrees depending upon the severity of the environmental factors.	[7]

Pitting	Yes	A form of localized attack with greater corrosion rates at some locations than at others. Pitting can be very insidious and destructive, with sudden failures in high pressure applications (especially in tubes) occurring by perforation. This form of corrosion essentially produces "holes" of varying depth to diameter ratios in the steel. These pits are, in many cases, filled with oxide debris, especially for ferritic materials such as carbon steel. Deep pitting is more common with passive metals, such as austenitic stainless steels, than with non- passive metals. Pits are generally elongated in the direction of gravity. In many cases, erosion corrosion, fretting corrosion, and crevice corrosion can also lead to pitting. Corrosion pitting is an anodic reaction which is an autocatalytic process. That is, the corrosion process within a pit produces conditions which stimulate the continuing activity of the pit. High concentrations of impurity anions such as chlorides and sulfates tend to concentrate in the oxygen- depleted pit region, giving rise to a potentially concentrated aggressive solution in this zone. Pitting has been found on the outside diameter of tubes where sludge or tube scale was present. It can also occur at locations of relatively stagnant coolant or water, such as in carbon steel pipes for service water lines, and at crevices in stainless steel, such as at the stainless steel cladding between reactor pressure vessel closure flanges. Pitting can become passive in some metals such as aluminum.	[6] [7] [2] [12]
Radiation Damage	Yes	Non-metallics are susceptible to degradation caused by gamma radiation.	[4]
Rubber Degradation	Yes	Rubber can be used in specific applications of this device type. Long term exposure of rubber to water will result in water absorption and swelling, blistering, hardening, and eventual cracking. When utilized as a protective lining, moisture permeation of the rubber produces blisters beneath the lining and initiates corrosion of the lined surface.	[3]
Saline Water Attack	Yes	Saline Water Attack has resulted in the degradation of reinforced concrete structures. The degradation mechanism involves water seepage into the concrete resulting in a high chloride environment for the reinforcing bars. The reinforcing bars corrode resulting in expansion that leads to cracking and spalling of the concrete. Of particular concern for structures that are inaccessible for routine inspection, and piping or other fluid components embedded in concrete.	[2]

Selective Leaching	Yes	The removal of one element from a solid alloy by corrosion processes. The most common example is the selective removal of zinc in brass alloys (dezincification). Similar processes occur in other alloy systems in which aluminum, iron, cobalt, chromium, and other elements are removed. There are two types, layer-type and plug-type. Layer-type is a uniform attack whereas plug-type is extremely localized leading to pitting. Overall dimensions do not change appreciably. If a piece of equipment is covered by debris or surface deposits and/or not inspected closely, sudden unexpected failure may occur in high pressure applications due to the poor strength of the remaining material. Requires susceptible materials and corrosive environment. Materials particularly susceptible include zinc, aluminum, carbon and nickel. Environmental conditions include high temperature, stagnant aqueous solution, and porous inorganic scale. Acidic solutions and oxygen aggravate the mechanism.	[12] [13]
Stress Corrosion Cracking	Yes	Selective corrosive attack along or across material grain boundaries. Four particular mechanisms are known to exist: (1) Intergranular (IGSCC), between the material grain boundaries. (2) Transgranular (TGSCC), across the material grains along certain crystallographic planes. (3) Irradiation Assisted (IASCC), between the material grains after an incubation neutron dose which sensitizes the material. (4) Interdendritic (IDSCC), between the dendrite interfaces. SCC requires applied or residual tensile stress, susceptible materials (such as austenitic stainless steels, alloy 600, alloy x-750, SAE 4340, and ASTM A289), and oxygen and/or ionic species (e.g., Chlorides/sulfates).	[6] [7] [2] [12] [13]

Stress Corrosion Cracking (Continued)	Yes (Cont'd)	Common sources of residual stress include thermal processing and stress risers created during surface finishing, fabrication, or assembly. The heat input during welding can result in a localized sensitized region which is susceptible to SCC. IGSCC is a concern in stainless steel piping depending on material condition and process fluid chemistry and also is a potential concern in valve internals (PH steel). SCC of low alloy steel and carbon steel is not considered a credible aging mechanism for typical conditions encountered in a nuclear power plant. TGSCC may be a concern in low alloy and stainless steel if aggressive chemical species (caustics, halogens, sulfates, especially if coupled with the presence of oxygen) are present. IASCC is a potential concern only for reactor vessel internals and other stainless steel components, such as control rods, which are subject to very high neutron fluence levels. A fast neutron incubation fluence of at least 1.0E+20 is generally required to sensitize the material. IDSCC is a potential concern in stainless steel weld metal deposits based on microstructure and delta ferrite content. This mechanism is inactive in carbon and low alloy steel. Ammonia grooving in brass components can occur when the concentration of ammonia is greater than a few ppm. It is found most often in feedwater heaters that contain admiralty brass tubes and where morpholine, which breaks down into ammonia, is used to increase the pH of the condensate.	
Stress Relaxation	Yes	Stress Relaxation occurs under conditions of constant strain where part of the elastic strain is replaced with plastic strain. A material loaded to an initial stress may experience a reduction in stress over time at high temperatures. Bolted connections are most vulnerable. Relaxation of stress on packing due to stretching of gland follower studs under elevated temperatures may cause packing leakage.	[7]
Thermal Damage	Yes	Non-metallics are particularly susceptible with material dependent temperature limits.	[7] [2]
Thermal Embrittlement	Yes	Loss of material fracture toughness caused by thermally induced changes in the formation and distribution of alloying constituents. Requires high temperature 500°F to 700°F for metallic components. Ferrite containing stainless steels are susceptible as are materials with grain boundary segregation of impurities.	[7]

Wear	Yes	Wear results from relative motion between two surfaces (adhesive wear), from the influence of hard, abrasive particles (abrasive wear - see particulate erosion) or fluid stream (erosion), and from small, vibratory or sliding motions under the influence of a corrosive environment (fretting). In addition to material loss from the above wear mechanisms, impeded relative motion between two surfaces held in intimate contact for extended periods may result from galling/self-welding. Motions may be linear, circular, or vibratory in inert or corrosive environments. The most common result of wear is damage to one or both surfaces involved in the contact. Wear most typically occurs in components which experience considerable relative motion such as valves and pumps, in components which are held under high loads with no motion for long periods (valves, flanges), or in clamped joints where relative motion is not intended but occurs due to a loss of clamping force (e.g., Tubes in supports, valve stems in seats, springs against tubes). Wear may proceed at an ever- increasing rate as worn surfaces moving past one another will often do so with much higher contact stresses than the surfaces of the original geometry. Fretting is a wear phenomenon that occurs between tight-fitting surfaces subjected to a cyclic, relative motion of extremely small amplitude. Fretting is frequently accompanied by corrosion. Common sites for fretting are in joints that are bolted, keyed, pinned, press fit or riveted; in oscillating bearings, couplings, spindles, and seals; in press fits on shafts; and in universal joints. Under fretting conditions, fatigue cracks may be initiated at stresses well below the endurance limit of nonfretted specimens.	[1]

Attachment 7 Reference List

Source	Title
[1]	ASME Wear Control Handbook, Peterson and Winer, 1980
[2]	Standard Format and Content of Technical Information for Applications to Renew Nuclear Power Plant Operating Licenses, Draft NRC Regulatory Guide No. DG-1009, December 1990
[3]	Service (Salt) Water System Life Cycle Management Evaluation, EPRI Report No. TR-102204, April 1993
[4]	Radiation Effects on Organic Materials in Nuclear Plants, EPRI Report No. NP-2129, November 1981
[5]	Erosion/Corrosion in Nuclear Plant Steam Piping, EPRI Report No. NP-3944, 1985
[6]	Component Life Estimation: LWR Structural Materials Degradation Mechanisms, EPRI Report No. NP-5461, 1987
[7]	Environmental Effects on Components: Commentary for ASME Section III, EPRI Report No. NP-5775, April 1988
[8]	Boric Acid Corrosion of Carbon and Low Alloy Steel Pressure Boundary Materials, EPRI Report No. NP-5985, 1988
[9]	Nuclear Plant Service Water System Aging Degradation Assessment, NUREG/CR-5379, Volume 1 and 2, June 1989 and October 1992
[10]	Aging Assessment of Instrument Air Systems, NUREG/CR-5419, January 1990
[11]	Insights Gained from Aging Research, NUREG/CR-5643, March 1992
[12]	Corrosion Engineering, Fontana and Greene, 1978
[13]	Corrosion and Corrosion Control, An Introduction to Corrosion Science and Engineering, Uhlig, Third Edition, 1985
[14]	ASM Specialty Handbook, Stainless Steels, Davis, 1994

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 3**
Equipment Type:	**PIPE**	**Page 1 of 1**
Device Type:	**-HB**	**April 12, 1996**
Group ID:	**077-HB-01**	

Device Type: Pipe Line with Piping Code HB
Vendor:
Model Number:
Material:
Internal Environment:
External Environment:
Function(s): Maintain System Pressure Boundary Integrity
Other Parameters:

List of Grouped Components:

1-HB65-CARM5291	Pipe Spool between 1CV5291 & 1CV5292
2-HB65-CARM5291	Pipe Spool between 2CV5291 & 2CV5292

ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079 | SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA | GROUP ID: 077-HB -01 | Date: May 10, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Model Number (Source)	Material (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-HB-01A	PIPE (NONE)	N/A (N/A)	N/A (N/A)	A-106 GR B, SMLS CARBON STEEL (92767)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-HB- 01B	FITTINGS (NONE)	N/A (N/A)	N/A (N/A)	FORGED: A-181 (92767)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-HB-01C	WELDS (NONE)	N/A (N/A)	N/A (N/A)	CS WELD MATERIAL (TYPICAL)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y

ARDM MATRIX (Revision 1)

System: Area and Process Radiation Monitoring (077/079)
Equipment Type: PIPE
Device Type: -HB
Group ID: 077-HB-01

ARDM	077-HB-01A Pipe	077-HB-01B Fittings	077-HB-01C Welds
Cavitation Erosion	02	02	02
Corrosion Fatigue	12	12	12
Crevice Corrosion	A	A	A
Erosion Corrosion	02	02	02
Fatigue	12	12	12
Fouling	06	06	06
Galvanic Corrosion	07	07	07
General Corrosion	A	A	A
Hydrogen Damage	03	03	03
Intergranular Attack	01.1	01.1	01.1
MIC	06	06	06
Particulate Wear Erosion	15	15	15
Pitting	A	A	A
Radiation Damage	01.1	01.1	01.1
Rubber Degradation	01.1	01.1	01.1
Saline Water Attack	18	18	18
Selective Leaching	01.1	01.1	01.1
Stress Corrosion Cracking	01.1	01.1	01.1
Stress Relaxation	04	04	04
Thermal Damage	01.1	01.1	01.1
Thermal Embrittlement	04	04	04
Wear	16	16	16

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: -HB EQUIPMENT TYPE: PIPE

GROUP ID: 077-HB-01 Date: 5/10/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.1 CARBON STEEL	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS AIR, NOT THE LIQUIDS NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONOATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUID IS CONTAINMENT ATMOSPHERE. THE NORMAL HYDROGEN CONCENTRATION IS NOT SUFFICIENT TO MAKE THIS ARDM PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTH OF PIPING MILD CARBON STEELS IS BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING.	ATTACH 7 VOL-1 VOL-13 FONTANA 60738 SH1
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500° F ENSURE THIS ARDM IS NOT PLAUSIBLE.	ATTACH 7 ES-014
06	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. THE FLUID IS AIR WITH THE POTENTIAL FOR SOME HUMIDITY. HUMIDITY DOES NOT SUBJECT THE COMPONENTS TO THE AGGRESSIVE ENVIRONMENT NORMALLY ASSOCIATED WITH THE ARDM.	ATTACH 7

CODE	DESCRIPTION	SOURCE
07	MATERIAL SELECTION/SEPARATION AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. MATERIALS USED THROUGHOUT THE SYSTEM GENERALLY HAVE LOW POTENTIAL DIFFERENCES AND, WHERE APPROPRIATE, ARE SEPARATED BY APPROPRIATE TRANSITION MATERIALS. THE COMPONENTS ARE ONLY EXPOSED TO HUMID AIR, WITH NO EXPECTED CONDENSATION.	ATTACH 7 92767 O/I-35 LCM-96-133
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM MAINTAINS RELATIVELY LOW STEADY PRESSURE, FLOW, AND TEMPERATURES MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 ES-014 O/I-35
15	ARDM NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. THE AIR VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF IMPINGEMENT PARTICLES (CARBON PIPE CORROSION PARTICLES) WILL NOT LEAD TO SIGNIFICANT EROSION OF THE PIPE WALL.	ATTACH 7 O/I-35
16	WEAR IS NOT A PLAUSIBLE ARDM SINCE THE SUBCOMPONENTS ARE DESIGNED TO ELIMINATE ANY RELATIVE MOTION BETWEEN THE PARTS. THE SUBCOMPONENTS ARE DESIGNED SO THEY ARE NOT ADJACENT TO OTHER SUBCOMPONENTS OR THEY ARE RESTRAINED SUCH THAT THERE IS NOT RELATIVE MOTION.	ATTACH 7
18	COMPONENT MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM: 1) COMPONENT IS NOT BURIED IN EARTH, CONCRETE, OR OTHER POROUS MATERIAL SUCH THAT EXTERIOR ENVIRONMENT DOES NOT PERPETUATE THE ARDM.	ATTACH 7 UFSAR FIG.5-10
A	THE ARDM IS PLAUSIBLE BECAUSE CARBON STEEL MATERIAL OF CONSTRUCTION IS EXPOSED TO POTENTIALLY WARM HUMID AIR. THERE ARE TWO GENERAL POSSIBLE EFFECTS: A UNIFORM CORROSION OF THE INTERNAL SURFACES OF THE PIPE CAUSING WALL THINNING, AND LOCALIZED ATTACK RESULTING IN PITS AND CRACK INITIATION - MOST LIKELY AT LOW POINTS IN THE PIPE AND IN CREVICES BETWEEN SOCKET WELDED FITTINGS AND PIPE. AGING MANAGEMENT RECOMMENDATIONS: (1) INCLUDE THE COMPONENTS IN THE AGE RELATED DEGRADATION INSPECTION PROGRAM.	ATTACH 7 NP-3784 NP-5769 NP-5985

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System: Area & Process Radiation Monitoring (077/079)
Equipment Type: PIPE
Device Type: RP
Group ID: 077-RP-01

Device Type: Radiation Test Point
Vendor:
Model Number:
Material: Stainless steel pipe/tube isokinetic nozzle (Ref. 60738 sh 2)
Internal Environment:
External Environment:
Function(s): Maintain System Pressure Boundary Integrity
Other Parameters:

List of Grouped Components:

1RP6905	1 HVAC/A Plant Vent Radiation Monitoring RP
2RP6905	2 HVAC/A Plant Vent Radiation Monitoring RP

ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA GROUP ID: 077-RP-01 Date: May 10, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Model Number (Source)	Material (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-RP-01A	TUBES (NONE)	GENERAL ATOMIC	N/A	STAINLESS STEEL (60738SH0002)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-RP-01B	SUPPORTING MEMBERS (N/A)	GENERAL ATOMIC	N/A	N/A	NONE. NO LR INTENDED FUNCTION. COMPONENT IN LR SCOPE FOR PRESSURE BOUNDARY ONLY. (CLSR)	N

ARDM MATRIX (Revision 1)

System: Area and Process Radiation Monitoring (077/079)
Equipment Type: PIPE
Device Type: RP
Group ID: 077-RP-01

March 13, 1996

ARDM	077-RP-01A Tubes
Cavitation Erosion	02
Corrosion Fatigue	12
Crevice Corrosion	06
Erosion Corrosion	21
Fatigue	12
Fouling	15
Galvanic Corrosion	07
General Corrosion	01.3
Hydrogen Damage	03
Intergranular Attack	22
MIC	15
Particulate Wear Erosion	17
Pitting	06
Radiation Damage	01.3
Rubber Degradation	01.3
Saline Water Attack	19
Selective Leaching	01.3
Stress Corrosion Cracking	18
Stress Relaxation	04
Thermal Damage	01.3
Thermal Embrittlement	04
Wear	16

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: PIPE EQUIPMENT TYPE: PIPE

GROUP ID: 077-RP-01 Date: 5/10/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.3 STAINLESS	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS AIR, NOT THE LIQUIDS NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONOATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUID IS PLANT VENT GASES. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTH OF TYPICAL 300 SERIES TUBING STAINLESS STEELS IS BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING.	ATTACH 7 VOL-13 FONTANA 60738 SH2 60722 SH1 AVNER ASM
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500° F ENSURE THIS ARDM IS NOT PLAUSIBLE.	ATTACH 7 ES-014

CODE	DESCRIPTION	SOURCE
06	PROCESS FLUID AND MOISTURE DO NOT PERPETUATE THE ARDM. INPO OPERATIONS AND MAINTENANCE REMINDER O&MR-132 DESCRIBES OPERATIONAL FAILURES OF RAD MONITORING SYSTEMS DUE TO EXCESS MOISTURE. CCNPP RECENT HISTORY SHOWS ONE CASE WHERE WATER WAS INTRODUCED TO THE SYSTEM DUE TO BLOWDOWN TANK VENT BEING ALIGNED TO THE MAIN PLANT VENT (MO 2199402504). HOWEVER, PER INPUT FROM THE SYSTEM ENGINEER THIS IS NOT A COMMON OCCURRENCE. THE SYSTEM HAS NOT EXPERIENCED THE MOISTURE RELATED PROBLEMS DESCRIBED IN O&MR-132. SYSTEM OPERATION IS ASSURED IN ACCORDANCE WITH O/I-35. THE LIMITED AMOUNT OF MOISTURE PREVENTS SIGNIFICANT EFFECT FROM THESE AGING MECHANISMS.	ATTACH 7 O/I-35 INPO O&MR-132 MO 2199402504
07	MATERIAL SELECTION/SEPARATION AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. MATERIALS USED THROUGHOUT THE SYSTEM GENERALLY HAVE LOW POTENTIAL DIFFERENCES AND, WHERE APPROPRIATE, ARE SEPARATED BY APPROPRIATE TRANSITION MATERIALS. THIS CONDITION IN CONJUNCTION WITH A GENERAL LACK OF AN ELECTROLYTE (CONDENSATION) TO COMPLETE THE GALVANIC CIRCUIT MAKES THIS ARDM NOT PLAUSIBLE.	ATTACH 7 O/I-35
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM SAMPLES PLANT VENT GASES AT ATMOSPHERIC PRESSURES AND TEMPERATURES, AND MAINTAINS A RELATIVELY LOW STEADY PRESSURE, FLOW, AND TEMPERATURES MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 60722 SH1 60738 SH2
15	ARDMS DO NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. FOULING AND MIC MAY OCCUR TO A LIMITED EXTENT DUE TO CONDENSED HUMIDITY FROM THE VENT GASES, AND AIRBORNE PARTICLES AND MICROBES. PLANT EXPERIENCE HAS SHOWN FOULING HAS OCCURRED IN THIS SYSTEM. HOWEVER, FOULING DOES NOT AFFECT THE PRESSURE BOUNDARY FUNCTION. MIC ACTIVITY WILL NOT BE SIGNIFICANT TO PRESSURE BOUNDARY FUNCTION DUE TO LIMITED AMOUNT OF CONDENSATION.	ATTACH 7 O/I-35 MO 2199402189

CODE	DESCRIPTION	SOURCE
16	COMPONENT DESIGN DOES NOT PERPETUATE THE ARDM. WEAR IS NOT A PLAUSIBLE ARDM SINCE THE SUB-COMPONENTS ARE DESIGNED TO ELIMINATE ANY RELATIVE MOTION BETWEEN THE PARTS. THE SUB-COMPONENTS ARE DESIGNED SO THEY ARE NOT ADJACENT TO OTHER SUB-COMPONENTS OR THEY ARE RESTRAINED SUCH THAT THERE IS NOT RELATIVE MOTION.	ATTACH 7
17	PARTICULATE WEAR EROSION IS NOT SIGNIFICANT. THE AIR VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF AIRBORNE PARTICLES WILL NOT LEAD TO SIGNIFICANT EROSION OF THE EROSION RESISTANT MATERIALS.	ATTACH 7 60738 SH2
18	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN TYPICAL 300 SERIES TUBING STAINLESS STEELS.	ATTACH 7 O/I-35 60722 SH1 AVNER VOL-13 FONTANA 60738 SH2 ASM
19	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. COMPONENT IS MOUNTED IN THE VENT STACK AND NOT BURIED IN EARTH, CONCRETE, OR OTHER POROUS MATERIAL SUCH THAT EXTERIOR ENVIRONMENT DOES NOT PERPETUATE THE ARDM.	ATTACH 7 60722 SH1
21	PROCESS FLUID (AIR) AND MATERIAL SELECTION (SS) DO NOT PERPETUATE THE ARDM.	ATTACH 7
22	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN TYPICAL 300 SERIES TUBING STAINLESS STEELS.	ATTACH 7 O/I-35 60722 SH1 AVNER VOL-13 FONTANA 60738 SH2 ASM

ARDM	POTENTIAL	DESCRIPTION/JUSTIFICATION	SOURCE
Cavitation Erosion	Yes	Localized material erosion caused by formation and collapse of vapor bubbles in close proximity to material surface. Requires fluid (liquid) flow and pressure variations which temporarily drop the liquid pressure below the corresponding vapor pressure. Most materials are susceptible to varying degrees depending upon the severity of the environmental factors.	[7]
Corrosion Fatigue	Yes	Plant equipment operating in a corrosive environment subjected to cyclic (fatigue) loading may initiate cracks and/or fail sooner than expected based on analysis of the corrosion and fatigue loadings applied separately. Fatigue-crack initiation and growth usually follows a transgranular path, although there are some cases where intergranular cracking has been observed. In some cases, crack initiation occurs by fatigue and is subsequently dominated by corrosion advance. In other cases, a corrosion mechanism (SCC) can be responsible for crack formation below the fatigue threshold, and the fatigue mechanism can accelerate the crack propagation. Corrosion-fatigue is a potentially active mechanism in both stainless steels as well as carbon and low alloy steels.	[7]
Creep/ Shrinkage	No	Not applicable to Equipment Type. The phenomenon results in dimensional changes in metals at high temperatures and in concrete subject to long term dehydration. This ARDM is not applicable to this equipment type since proper component specification and design prevents this ARDM from occurring (i.e., system and component design standards adequately address this ARDM).	[2]
Crevice Corrosion	Yes	Crevice corrosion is intense, localized corrosion within crevices or shielded areas. It is associated with a small volume of stagnant solution caused by holes, gasket surfaces, lap joints, crevices under bolt heads, surface deposits, designed crevices for attaching thermal sleeves to safe-ends, and integral weld backing rings or back-up bars. The crevice must be wide enough to permit liquid entry and narrow enough to maintain stagnant conditions, typically a few thousandths of an inch or less. Crevice corrosion is closely related to pitting corrosion and can initiate pits in many cases as well as leading to stress corrosion cracking. In an oxidizing environment, a crevice can set up a differential aeration cell to concentrate an acid solution within the crevice. Even in a reducing environment, alternate wetting and drying can concentrate aggressive ionic species to cause pitting, crevice corrosion, intergranular attack, or stress corrosion cracking.	[6] [7] [12]

Erosion Corrosion	Yes	Increased rate of attack on a metal because of the relative movement between a corrosive fluid and the metal surface. Mechanical wear or abrasion can be involved, characterized by grooves, gullies, waves, holes and valleys on the metal surface. Erosion is a mechanical action of a fluid and/or particulate matter on a metal surface, without the influence of corrosion. Erosion corrosion failures can occur in a relatively short time and are sometimes unexpected, since corrosion tests are usually run under static conditions. All equipment exposed to moving fluids is vulnerable; in particular, piping (bends, tees, etc.), Valves, pumps, propellers and impellers, heat exchanger tubing, turbine blades and wear plates are components which have experienced erosion corrosion. This is a serious problem in steam piping, heater drain piping, reheaters, and moisture separators due to high velocity particle impingement. Erosion corrosion has occurred in high and low pressure preheater tubes, low pressure preheaters, evaporators and feedwater heaters. Inlet tube corrosion occurs in heat exchangers, due to the turbulence of flow from the exchanger head into the smaller tubes, within the first few inches of the tube. Such corrosion has been especially evident in condenser tubes and feedwater heaters. The occurrence of erosion corrosion is highly dependent upon material of construction and the fluid flow conditions. Carbon or low alloy steels are particularly susceptible when in contact with high velocity water (single or two phase) with turbulent flow, low oxygen and fluid pH < 9.3. Maximum erosion corrosion rates are expected in carbon steel at 130-140°C (single phase) and 180°C (two phase).	[5] [6] [7]
Fatigue	Yes	Fatigue damage results from progressive, localized structural change in materials subjected to fluctuating stresses and strains. Associated failures may occur at either high or low cycles in response to various kinds of loads (e.g., Mechanical or vibrational loads, thermal cycles, or pressure cycles). Fatigue cracks initiate and propagate in regions of stress concentration that intensify strain. The fatigue life of a component is a function of several variables such as stress level, stress state, cyclic wave form, fatigue environment, and the metallurgical condition of the material. Failure occurs when the endurance limit number of cycles (for a given load amplitude) is exceeded. All materials are susceptible (with varying endurance limits) when subjected to cyclic loading. Vibration loads have also been the cause of recurring weld failures by the fatigue of small socket welds. Certain piping locations, such as charging lines, have been found to experience vibration conditions. In some cases these failures in pipe have been due to inadequately supported pipe or obturator induced vibratory loads.	[6] [7] [2]

Fouling	Yes	Unavoidable introduction of foreign substances that interact with and/or collect within system and components. Caused by failure or degradation of upstream removal process equipment, long term buildup, low flow, stagnant flow, infrequent operation, and/or contaminated inlet flow. Fouling refers to all deposits on system surfaces that increase resistance to fluid flow and/or heat transfer. Sources of fouling include the following: (1) organic films of micro-organisms and their products (microbial fouling) (2) deposits of macro-organisms such as mussels (macrobial fouling) (3) inorganic deposits, including scales, silt, corrosion products and detritus. Scales result when solubility limits for a given species are exceeded. Deposits result when coolant-borne particles drop onto surfaces due to hydraulic factors. The deposits result in reduced flow of cooling water, reduced heat transfer, and increased corrosion. Sediment deposits promote concentration cell corrosion and growth of sulfur-reducing bacteria. The bacteria can cause severe pitting after one month of service. Piping systems designed for 30 years have had their projected life reduced to five years due to under-sediment corrosion.	[9] [10] [11]
Galvanic Corrosion	Yes	Accelerated corrosion caused by dissimilar metals in contact in a conductive solution. Requires two dissimilar metals in physical or electrical contact, developed potential (material dependent), and conducting solution,	[12]
General Corrosion	Yes	Thinning (wastage) of a metal by chemical attack (dissolution) at the surface of the metal by an aggressive environment. The consequences of the damage are loss of load carrying cross-sectional area. General corrosion requires an aggressive environment and materials susceptible to that environment. An important concern for PWRs is boric acid attack of carbon steels. Borated water has been observed to leak from piping, valves, storage tanks, etc., and fall on other carbon steel components and attack the component from the outside. Wastage is not a concern for austenitic stainless steel alloys.	[7] [8] [2]

Hydrogen Damage	Yes	Two forms of hydrogen attack relevant to light water reactor materials and conditions are hydrogen blistering and hydrogen embrittlement. Both produce mechanical damage in the affected component. In each case, atomic hydrogen enters the metal, either as a result of a corrosion reaction at the surface or by cathodic polarization which results in the evolution of hydrogen gas. In blistering, molecular hydrogen within the metal causes high pressure and local damage in the form of "blistered" regions of the metal surface. Hydrogen embrittlement affects ferritic and martensitic iron-based alloys, and results in low ductility intergranular cracking (similar to stress corrosion cracking). The phenomenon of hydrogen cracking is usually manifested as delayed cracking, at or near room temperature, after stress is applied. A certain critical stress, which may take the form of weld residual stress, is required to cause cracking. Notches concentrate such stresses and tend to shorten the delay time for cracking. Cracking of welds due to hydrogen embrittlement and hydrogen-induced cracking is a common concern. This cracking is more of a problem in higher strength steels (yield strength >120 ksi). Ferritic and martensitic stainless steels, carbon steels, and other high strength alloys are susceptible. Austenitic stainless steels are relatively immune but could experience damage at sufficiently high hydrogen levels.	[6] [7]
Intergranular Attack	Yes	Intergranular Attack (IGA) is very similar to intergranular stress corrosion cracking (IGSCC) except that stress is not required for IGA. IGA is localized corrosion at or adjacent to grain boundaries, with relatively little corrosion of the material grains. It is caused by impurities in the grain boundaries, or the enrichment or depletion of alloying elements at grain boundaries, such as the depletion of chromium at austenitic stainless steel grain boundaries. A "sensitized" microstructure causes susceptibility to IGA. When austenitic stainless steels are heated into or slow cooled through the temperature range of approximately 750 to 1500°F, chromium carbides can be formed, thus depleting the grain boundaries of chromium and decreasing their corrosion resistance. High chromium ferritic stainless steels, such as Type 430, also experience susceptibility to IGA. Nickel alloys such as alloy 600 experience IGA in the presence of certain sulfur environments at high temperatures (by forming low melting sulfur compounds at grain boundaries) or when austenitic stainless steel weld filler metal is inadvertently used on Ni-Cr-Fe alloys. Susceptibility to intergranular attack (sensitization) usually develops during thermal processing such as welding or heat treatments. IGA is generally not a concern in atmospheric exposures and is most commonly documented to occur in fluid systems.	[6] [7] [2] [12] [14]

Irradiation Embrittlement	No	Not applicable to Equipment Type. The ARDM results in a decrease in steel fracture toughness due to long-term exposure to a fast flux of neutrons. This ARDM is not applicable to this equipment type since valve components are not located in areas where the neutron flux is high enough to cause this ARDM to occur.	[6] [7]
MIC	Yes	Accelerated corrosion of materials resulting from surface microbiological activity. Sulfate reducing bacteria, sulfur oxidizers, and iron oxidizing bacteria are most commonly associated with corrosion effects. Most often results in pitting followed by excessive deposition of corrosion products. Stagnant or low flow areas are most susceptible. Any system that uses untreated water, or is buried, is particularly susceptible. Consequences range from leakage to excessive differential pressure and flow blockage. Essentially all systems and most commonly-used materials are susceptible. Temperatures from about 50°F to 120°F are most conducive to MIC. Experience in virtually all large industries is common. Nuclear experience is relatively new, but also widespread. MIC is generally observed in service water applications utilizing raw untreated water. Sedimentation aggravates the problem.	[6] [7] [2]
Oxidation	No	Not applicable to Equipment Type. The ARDM results from a Chemical reaction at the surface of a material when subjected to an oxidizing environment. Oxidation occurs at any temperature. Electrical components experience degradation related to oxidation and are considered separately. Oxidation generally is not considered a degradation mechanism in metals of fluid systems in mild environments since this mechanism serves to protect materials by formation of a passive layer. Other corrosion mechanisms (e.g. Corrosion fatigue, crevice corrosion, erosion corrosion, general corrosion and pitting) can result from oxidation/reduction reactions under specific aggressive mechanical and chemical environment and are addressed separately. It could be considered a degradation mechanism at high temperatures, where a more rapid reaction between metal and oxygen is likely to occur. These temperatures do not occur in power plant applications under evaluation. Therefore, oxidation is not considered a potential ARDM for valve components.	[7] [12]
Particulate Wear Erosion	Yes	The loss of material caused by mechanical abrasion due to relative motion between solution and material surface. Requires high velocity fluid, entrained particles, turbulent flow regions, flow direction change, and/or impingement. Most materials are susceptible to varying degrees depending upon the severity of the environmental factors.	[7]

Pitting	Yes	A form of localized attack with greater corrosion rates at some locations than at others. Pitting can be very insidious and destructive, with sudden failures in high pressure applications (especially in tubes) occurring by perforation. This form of corrosion essentially produces "holes" of varying depth to diameter ratios in the steel. These pits are, in many cases, filled with oxide debris, especially for ferritic materials such as carbon steel. Deep pitting is more common with passive metals, such as austenitic stainless steels, than with non- passive metals. Pits are generally elongated in the direction of gravity. In many cases, erosion corrosion, fretting corrosion, and crevice corrosion can also lead to pitting. Corrosion pitting is an anodic reaction which is an autocatalytic process. That is, the corrosion process within a pit produces conditions which stimulate the continuing activity of the pit. High concentrations of impurity anions such as chlorides and sulfates tend to concentrate in the oxygen- depleted pit region, giving rise to a potentially concentrated aggressive solution in this zone. Pitting has been found on the outside diameter of tubes where sludge or tube scale was present. It can also occur at locations of relatively stagnant coolant or water, such as in carbon steel pipes for service water lines, and at crevices in stainless steel, such as at the stainless steel cladding between reactor pressure vessel closure flanges. Pitting can become passive in some metals such as aluminum.	[6] [7] [2] [12]
Radiation Damage	Yes	Non-metallics are susceptible to degradation caused by gamma radiation.	[4]
Rubber Degradation	Yes	Rubber can be used in specific applications of this device type. Long term exposure of rubber to water will result in water absorption and swelling, blistering, hardening, and eventual cracking. When utilized as a protective lining, moisture permeation of the rubber produces blisters beneath the lining and initiates corrosion of the lined surface.	[3]
Saline Water Attack	No	Not applicable to Equipment Type. Saline Water Attack has resulted in the degradation of reinforced concrete structures. The degradation mechanism involves water seepage into the concrete resulting in a high chloride environment for the reinforcing bars. The reinforcing bars corrode resulting in expansion that leads to cracking and spalling of the concrete. Of particular concern for structures that are inaccessible for routine inspection, and piping or other fluid components embedded in concrete. This ARDM is not applicable to valve components since valves are not constructed of nor typically installed in concrete.	[2]

Selective Leaching	Yes	The removal of one element from a solid alloy by corrosion processes. The most common example is the selective removal of zinc in brass alloys (dezincification). Similar processes occur in other alloy systems in which aluminum, iron, cobalt, chromium, and other elements are removed. There are two types, layer-type and plug-type. Layer-type is a uniform attack whereas plug-type is extremely localized leading to pitting. Overall dimensions do not change appreciably. If a piece of equipment is covered by debris or surface deposits and/or not inspected closely, sudden unexpected failure may occur in high pressure applications due to the poor strength of the remaining material. Requires susceptible materials and corrosive environment. Materials particularly susceptible include zinc, aluminum, carbon and nickel. Environmental conditions include high temperature, stagnant aqueous solution, and porous inorganic scale. Acidic solutions and oxygen aggravate the mechanism.	[12] [13]
Stress Corrosion Cracking	Yes	Selective corrosive attack along or across material grain boundaries. Four particular mechanisms are known to exist: (1) Intergranular (IGSCC), between the material grain boundaries. (2) Transgranular (TGSCC), across the material grains along certain crystallographic planes. (3) Irradiation Assisted (IASCC), between the material grains after an incubation neutron dose which sensitizes the material. (4) Interdendritic (IDSCC), between the dendrite interfaces. SCC requires applied or residual tensile stress, susceptible materials (such as austenitic stainless steels, alloy 600, alloy x-750, SAE 4340, and ASTM A289), and oxygen and/or ionic species (e.g., Chlorides/sulfates).	[6] [7] [2] [12] [13]

Stress Corrosion Cracking (Continued)	Yes (Cont'd)	Common sources of residual stress include thermal processing and stress risers created during surface finishing, fabrication, or assembly. The heat input during welding can result in a localized sensitized region which is susceptible to SCC. IGSCC is a concern in stainless steel piping depending on material condition and process fluid chemistry and also is a potential concern in valve internals (PH steel). SCC of low alloy steel and carbon steel is not considered a credible aging mechanism for typical conditions encountered in a nuclear power plant. TGSCC may be a concern in low alloy and stainless steel if aggressive chemical species (caustics, halogens, sulfates, especially if coupled with the presence of oxygen) are present. IASCC is a potential concern only for reactor vessel internals and other stainless steel components, such as control rods, which are subject to very high neutron fluence levels. A fast neutron incubation fluence of at least 1.0E+20 is generally required to sensitize the material. IDSCC is a potential concern in stainless steel weld metal deposits based on microstructure and delta ferrite content. This mechanism is inactive in carbon and low alloy steel. Ammonia grooving in brass components can occur when the concentration of ammonia is greater than a few ppm. It is found most often in feedwater heaters that contain admiralty brass tubes and where morpholine, which breaks down into ammonia, is used to increase the pH of the condensate.	
Stress Relaxation	Yes	Stress Relaxation occurs under conditions of constant strain where part of the elastic strain is replaced with plastic strain. A material loaded to an initial stress may experience a reduction in stress over time at high temperatures. Bolted connections are most vulnerable. Relaxation of stress on packing due to stretching of gland follower studs under elevated temperatures may cause packing leakage.	[7]
Thermal Damage	Yes	Non-metallics are particularly susceptible with material dependent temperature limits.	[7] [2]
Thermal Embrittlement	Yes	Loss of material fracture toughness caused by thermally induced changes in the formation and distribution of alloying constituents. Requires high temperature 500°F to 700°F for metallic components. Ferrite containing stainless steels are susceptible as are materials with grain boundary segregation of impurities.	[7]

Wear	Yes	Wear results from relative motion between two surfaces (adhesive wear), from the influence of hard, abrasive particles (abrasive wear - see particulate erosion) or fluid stream (erosion), and from small, vibratory or sliding motions under the influence of a corrosive environment (fretting). In addition to material loss from the above wear mechanisms, impeded relative motion between two surfaces held in intimate contact for extended periods may result from galling/self-welding. Motions may be linear, circular, or vibratory in inert or corrosive environments. The most common result of wear is damage to one or both surfaces involved in the contact. Wear most typically occurs in components which experience considerable relative motion such as valves and pumps, in components which are held under high loads with no motion for long periods (valves, flanges), or in clamped joints where relative motion is not intended but occurs due to a loss of clamping force (e.g., Tubes in supports, valve stems in seats, springs against tubes). Wear may proceed at an ever- increasing rate as worn surfaces moving past one another will often do so with much higher contact stresses than the surfaces of the original geometry. Fretting is a wear phenomenon that occurs between tight-fitting surfaces subjected to a cyclic, relative motion of extremely small amplitude. Fretting is frequently accompanied by corrosion. Common sites for fretting are in joints that are bolted, keyed, pinned, press fit or riveted; in oscillating bearings, couplings, spindles, and seals; in press fits on shafts; and in universal joints. Under fretting conditions, fatigue cracks may be initiated at stresses well below the endurance limit of nonfretted specimens.	[1]

Attachment 7 Reference List

Source	Title
[1]	ASME Wear Control Handbook, Peterson and Winer, 1980
[2]	Standard Format and Content of Technical Information for Applications to Renew Nuclear Power Plant Operating Licenses, Draft NRC Regulatory Guide No. DG-1009, December 1990
[3]	Service (Salt) Water System Life Cycle Management Evaluation, EPRI Report No. TR-102204, April 1993
[4]	Radiation Effects on Organic Materials in Nuclear Plants, EPRI Report No. NP-2129, November 1981
[5]	Erosion/Corrosion in Nuclear Plant Steam Piping, EPRI Report No. NP-3944, 1985
[6]	Component Life Estimation: LWR Structural Materials Degradation Mechanisms, EPRI Report No. NP-5461, 1987
[7]	Environmental Effects on Components: Commentary for ASME Section III, EPRI Report No. NP-5775, April 1988
[8]	Boric Acid Corrosion of Carbon and Low Alloy Steel Pressure Boundary Materials, EPRI Report No. NP-5985, 1988
[9]	Nuclear Plant Service Water System Aging Degradation Assessment, NUREG/CR-5379, Volume 1 and 2, June 1989 and October 1992
[10]	Aging Assessment of Instrument Air Systems, NUREG/CR-5419, January 1990
[11]	Insights Gained from Aging Research, NUREG/CR-5643, March 1992
[12]	Corrosion Engineering, Fontana and Greene, 1978
[13]	Corrosion and Corrosion Control, An Introduction to Corrosion Science and Engineering, Uhlig, Third Edition, 1985
[14]	ASM Specialty Handbook, Stainless Steels, Davis, 1994

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 3**
Equipment Type:	**VALVE**	**Page 1 of 1**
Device Type:	**CKV**	**April 15, 1996**
Group ID:	**077-CKV-01**	

Device Type: Check Valve

Vendor:

Model Number:

Material:

Internal Environment:

External Environment:

Function(s): Maintain System Pressure Boundary Integrity

Other Parameters:

List of Grouped Components:

1CKVRE-5416P	RE Low Range Outlet CKV
1CKVRE-5418P	RE Mid-High Outlet CKV
2CKVRE-5416P	RE Low Range Outlet CKV
2CKVRE-5418P	RE Mid-High Outlet CKV

ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA GROUP ID: 077-CKV-01 Date: May 16, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Model Number (Source)	Material (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-CKV-01A	BODY (NONE)	NUPRO (VTM 12284-010 Section 6 pp. 44-48)	SS-4CP2-1/3 (VTM 12284-010 Section 6 pp. 44-48)	316 SS (VTM 12284-010 Appendix pp.94-96, LCM File 95-095)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-CKV-01B	INTERNALS (N/A)	NUPRO (VTM 12284-010 Section 6 pp. 44-48)	SS-4CP2-1/3 (VTM 12284-010 Section 6 pp. 44-48)	316 SS (VTM 12284-010 Appendix pp.94-96)	NONE. NO LR INTENDED FUNCTION. COMPONENT IN LR SCOPE FOR PRESSURE BOUNDARY ONLY. (CLSR)	N

ARDM MATRIX (Revision 1)

System: Area & Process Radiation Monitoring (077/079)
Equipment Type: VALVE
Device Type: CKV
Group ID: 077-CKV-01

ARDM	077-CKV-01A Body
Cavitation Erosion	02
Corrosion Fatigue	12
Crevice Corrosion	06
Erosion Corrosion	21
Fatigue	12
Fouling	15
Galvanic Corrosion	07
General Corrosion	01.3
Hydrogen Damage	03
Intergranular Attack	22
MIC	15
Particulate Wear Erosion	17
Pitting	06
Radiation Damage	01.3
Rubber Degradation	01.3
Selective Leaching	01.3
Stress Corrosion Cracking	18
Stress Relaxation	04
Thermal Damage	01.3
Thermal Embrittlement	04
Wear	16

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: CKV EQUIPMENT TYPE: VALVE

GROUP ID: 077-CKV-01 Date: 5/16/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.3 STAINLESS STEEL	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS AIR, NOT THE LIQUIDS NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONO-ATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUID IS PLANT VENT GASES. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTH OF 316 STAINLESS STEEL IS BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING.	ATTACH 7 VOL-13 FONTANA 60738 SH2 60722 SH1 AVNER ASM
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500° F ENSURE THIS ARDM IS NOT PLAUSIBLE.	ATTACH 7 ES-014

CODE	DESCRIPTION	SOURCE
06	PROCESS FLUID AND MOISTURE DO NOT PERPETUATE THE ARDM. INPO OPERATIONS AND MAINTENANCE REMINDER O&MR-132 DESCRIBES OPERATIONAL FAILURES OF RAD MONITORING SYSTEMS DUE TO EXCESS MOISTURE. CCNPP RECENT HISTORY SHOWS ONE CASE WHERE WATER WAS INTRODUCED TO THE SYSTEM DUE TO BLOWDOWN TANK VENT BEING ALIGNED TO THE MAIN PLANT VENT (MO 2199402504). HOWEVER, PER INPUT FROM THE SYSTEM ENGINEER THIS IS NOT A COMMON OCCURRENCE. THE SYSTEM HAS NOT EXPERIENCED THE MOISTURE RELATED PROBLEMS DESCRIBED IN O&MR-132. SYSTEM OPERATION IS ASSURED IN ACCORDANCE WITH O/I-35. THE LIMITED AMOUNT OF MOISTURE PREVENTS SIGNIFICANT EFFECT FROM THESE AGING MECHANISMS.	ATTACH 7 O/I-35 INPO O&MR-132 MO 2199402504
07	MATERIAL SELECTION DO NOT PERPETUATE THE ARDM. THE VALVE IS MADE OF UNIFORM MATERIALS.	ATTACH 7 O/I-35
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM PRESSURES AND TEMPERATURES ARE LOW AND RELATIVELY STEADY MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 12284-010 ES-014
15	ARDMS DO NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. FOULING AND MIC MAY OCCUR TO A LIMITED EXTENT DUE TO CONDENSED HUMIDITY FROM THE VENT GASES, MICROBES AND AIRBORNE PARTICLES. PLANT EXPERIENCE HAS SHOWN FOULING HAS OCCURRED IN THIS SYSTEM. HOWEVER, FOULING DOES NOT AFFECT THE PRESSURE BOUNDARY FUNCTION. MIC ACTIVITY WILL NOT BE SIGNIFICANT TO PRESSURE BOUNDARY FUNCTION DUE TO LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION.	ATTACH 7 O/I-35 12284-010 MO 2199402189
16	NORMAL OPERATIONAL CYCLES DO NOT PERPETUATE THE ARDM. ALTHOUGH RELATIVE MOTION EXISTS, WEAR IS NOT A PLAUSIBLE ARDM SINCE THE VALVE DOES NOT NORMALLY OPERATE AT A HIGH CYCLE RATE AND METAL TO METAL FORCES OF VALVE SUBCOMPONENTS ARE LOW, RESULTING IN INSIGNIFICANT WEAR OF PRESSURE BOUNDARY SUBCOMPONENTS.	ATTACH 7 12284-010 O/I-48

CODE	DESCRIPTION	SOURCE
17	PARTICULATE WEAR EROSION IS NOT SIGNIFICANT. THE AIR VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF AIRBORNE PARTICLES WILL NOT LEAD TO SIGNIFICANT EROSION OF THE EROSION RESISTANT MATERIALS. FILTRATION OF AIR ON THE SAMPLE CONDITIONING SKID PREVENTS SIGNIFICANT EFFECT FROM THIS AGING MECHANISM.	ATTACH 7 60738 SH.2
18	STRESSES AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN 316 STAINLESS STEEL. THE LOW YIELD STRENGTH OF 316 SS MAKES THE MATERIAL LESS SUSCEPTIBLE TO THE ARDM.	ATTACH 7 O/I-35 12284-010 60738 SH.2 VOL-13 AVNER FONTANA 60722 SH1 ASM NP-5461
21	PROCESS FLUID (AIR) AND MATERIAL SELECTION (SS) DO NOT PERPETUATE THE ARDM.	ATTACH 7
22	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION, AND THE AIR ENVIRONMENT IS NOT THE AGGRESSIVE ENVIRONMENT NECESSARY FOR THE ARDM. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN 316 STAINLESS STEEL.	ATTACH 7 O/I-35 12284-010 60738 SH.2 VOL-13 AVNER FONTANA 60722 SH1 ASM

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 3**
Equipment Type:	**VALVE**	**Page 1 of 1**
Device Type:	**CV**	**April 15, 1996**
Group ID:	**077-CV-01**	

Device Type: Control Valve
Vendor:
Model Number:
Material:
Internal Environment:
External Environment:
Function(s): Maintain Containment Isolation
Other Parameters:

List of Grouped Components:

1CV5291	Containment Atmosphere Sample Isolation Valve
1CV5292	Containment Atmosphere Sample Isolation Valve
2CV5291	Containment Atmosphere Sample Isolation Valve
2CV5292	Containment Atmosphere Sample Isolation Valve

ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA GROUP ID: 077-CV-01 Date: May 16, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Model Number (Source)	Material (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-CV-01A	BODY/BONNET (NONE)	MASONEILAN INT INC (NUCLEIS/BOMID 349)	38-20521 (NUCLEIS/BOMID 349)	STAINLESS STEEL (316) (NUCLEIS/BOMID 349)	MAINTAIN CONTAINMENT ISOLATION (CLSR)	Y
077-CV-01B	STEM (NONE)	MASONEILAN INT INC (NUCLEIS/BOMID 349)	38-20521 (NUCLEIS/BOMID 349)	STAINLESS STEEL (316) (NUCLEIS/BOMID 349)	MAINTAIN CONTAINMENT ISOLATION (CLSR)	Y
077-CV-01C	STUDS/NUTS (NONE)	MASONEILAN INT INC (NUCLEIS/BOMID 349)	38-20521 (NUCLEIS/BOMID 349)	ALLOY STEEL, HT (NUCLEIS/BOMID 349)	MAINTAIN CONTAINMENT ISOLATION (CLSR)	Y
077-CV-01D	PLUG AND SEAT (NONE)	MASONEILAN INT INC (NUCLEIS/BOMID 349)	38-20521 (NUCLEIS/BOMID 349)	STAINLESS STEEL (316) (NUCLEIS/BOMID 349)	MAINTAIN CONTAINMENT ISOLATION (CLSR)	Y

ARDM MATRIX (Revision 1)

System: Area & Process Radiation Monitoring (077/79)
Equipment Type: VALVE
Device Type: CV
Group ID: 077-CV-01

ARDM	077-CV-01A Body/Bonnet	077-CV-01B Stem	077-CV-01C Studs/Nuts	077-CV-01D Plug & Seat
Cavitation Erosion	02	02	19	02
Corrosion Fatigue	12	12	12	12
Crevice Corrosion	06	06	06	06
Erosion Corrosion	21	21	19	21
Fatigue	12	12	12	12
Fouling	15	15	19	15
Galvanic Corrosion	07	07	07	07
General Corrosion	01.3	01.3	01.3	01.3
Hydrogen Damage	03	03	03	03
Intergranular Attack	22	22	01.3	22
MIC	15	15	19	15
Particulate Wear Erosion	17	17	19	17
Pitting	06	06	06	06
Radiation Damage	01.3	01.3	01.3	01.3
Rubber Degradation	01.3	01.3	01.3	01.3
Selective Leaching	01.3	01.3	01.3	01.3
Stress Corrosion Cracking	18	18	18	18
Stress Relaxation	04	04	04	04
Thermal Damage	01.3	01.3	01.3	01.3
Thermal Embrittlement	04	04	04	04
Wear	16	20	16	P

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: CV EQUIPMENT TYPE: VALVE

GROUP ID: 077-CV-01 Date: 5/10/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.3 ALLOY/STAINLESS STEEL	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS AIR, NOT THE LIQUIDS NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONOATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUID IS CONTAINMENT ATMOSPHERE. THE NORMAL HYDROGEN CONCENTRATION IS NOT SUFFICIENT TO MAKE THIS ARDM PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTHS OF 316 STAINLESS STEELS AND TYPICAL BOLTING MATERIALS ARE BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING. THE EXTERNAL ENVIRONMENT (AIR) DOES NOT CONTAIN SUFFICIENT HYDROGEN OR PRESSURE TO MAKE THIS ARDM PLAUSIBLE. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN NORMAL CONTAINMENT MAXIMUM TEMPERATURE OF120°F, NORMAL AMBIENT TEMPERATURES IN THE EAST PIPING PENETRATION ROOMS OF 140°F, AND DRYING EFFECTS OF WARMER TEMPERATURES, HYDROGEN DAMAGE DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 VOL-1 VOL-13 FONTANA ES-014 60738 SH1 CH-1-100 NP-5769

CODE	DESCRIPTION	SOURCE
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500°F ENSURE THIS ARDM IS NOT PLAUSIBLE.	ATTACH 7 ES-014
06	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. THE FLUID IS AIR WITH THE POTENTIAL FOR SOME HUMIDITY. OCCASIONAL HUMIDITY DOES NOT SUBJECT THE COMPONENTS TO THE AGGRESSIVE ENVIRONMENT NORMALLY ASSOCIATED WITH THE ARDM.	ATTACH 7 O/I-35 LCM 95-112 LCM 96-133
07	MATERIAL SELECTION/SEPARATION AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THE VALVE IS MADE OF MATERIALS WITH LOW POTENTIAL DIFFERENCES AND THE COMPONENTS ARE ONLY EXPOSED TO OCCASIONAL HUMIDITY WITH NO EXPECTED CONDENSATION.	ATTACH 7 O/I-35
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM PRESSURES, FLOW, AND TEMPERATURES ARE LOW AND RELATIVELY STEADY MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 ES-014 O/I-35
15	ARDMS DO NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. FOULING AND MIC MAY OCCUR TO A LIMITED EXTENT DUE TO CONDENSED HUMIDITY FROM THE WARM CONTAINMENT GASES, MICROBES AND AIRBORNE PARTICLES. FOULING DOES NOT AFFECT THE PRESSURE BOUNDARY FUNCTION. MIC WILL NOT OCCUR AS THE ENVIRONMENT IS ONLY HUMID AIR, WITH NO STANDING WATER.	ATTACH 7 O/I-35
16	COMPONENT DESIGN DOES NOT PERPETUATE THE ARDM. WEAR IS NOT A PLAUSIBLE ARDM SINCE THE SUBCOMPONENTS ARE DESIGNED TO ELIMINATE ANY RELATIVE MOTION BETWEEN THE PARTS. THE SUBCOMPONENTS ARE DESIGNED SO THAT THEY ARE NOT ADJACENT TO OTHER SUBCOMPONENTS OR THEY ARE RESTRAINED SUCH THAT THERE IS NO RELATIVE MOTION.	ATTACH 7 M120-0001
17	PARTICULATE WEAR EROSION IS NOT SIGNIFICANT. THE AIR VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF AIRBORNE PARTICLES WILL NOT LEAD TO SIGNIFICANT EROSION OF THE VALVE MATERIALS.	ATTACH 7 O/I-35

CODE	DESCRIPTION	SOURCE
18	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE COMPONENTS ARE ONLY EXPOSED TO HUMID AIR WITH NO EXPECTED CONDENSATION. THE EXTERNAL ENVIRONMENT (AIR) IS NOT EXPECTED TO CONTAIN SUFFICIENT ATMOSPHERIC CONTAMINANTS TO MAKE THIS ARDM PLAUSIBLE IN 316 STAINLESS STEEL AND TYPICAL ALLOY STEEL. THE LOW YIELD STRENGTHS OF THESE MATERIALS MAKES THEM LESS SUSCEPTIBLE TO THE ARDM. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN NORMAL CONTAINMENT MAXIMUM TEMPERATURE OF120°F, NORMAL AMBIENT TEMPERATURES IN THE EAST PIPING PENETRATION ROOMS OF 140°F, AND DRYING EFFECTS OF WARMER TEMPERATURES, SCC DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 O/I-35 ES-014 FSK-MP-1262 FSK-MP-3050 CH-1-100 NP-5769 VOL-13 AVNER FONTANA ASM NP-5461
19	COMPONENT ENVIRONMENT DOES NOT PERPETUATE THE ARDM. THE SUBCOMPONENTS TYPICALLY ARE NOT EXPOSED TO THE PROCESS FLUID WHICH MAKES THE ARDM NON-PLAUSIBLE.	ATTACH 7
20	WEAR DOES NOT SIGNIFICANTLY AFFECT COMPONENT INTENDED FUNCTION. VALVE OPERATION RESULTS IN STEM/PACKING CONTACT IN RELATIVE MOTION AND POTENTIALLY ABRASIVE WEAR. WEAR OF PACKING WILL NOT RESULT IN LEAKAGE OF PRESSURE BOUNDARY SUBCOMPONENTS.	ATTACH 7 M120-0001
21	PROCESS FLUID (AIR) AND MATERIAL SELECTION (SS) DO NOT PERPETUATE THE ARDM.	ATTACH 7

CODE	DESCRIPTION	SOURCE
22	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE PROCESS FLUID IS HUMID AIR WITH NO EXPECTED CONDENSATION, AND THE EXTERNAL ENVIRONMENT (AIR) IS NOT EXPECTED TO CONTAIN SUFFICIENT ATMOSPHERIC CONTAMINANTS TO MAKE THIS ARDM PLAUSIBLE IN 316 STAINLESS STEEL AND TYPICAL ALLOY STEEL. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN NORMAL CONTAINMENT MAXIMUM TEMPERATURE OF120°F, NORMAL AMBIENT TEMPERATURES IN THE EAST PIPING PENETRATION ROOMS OF 140°F, AND DRYING EFFECTS OF WARMER TEMPERATURES, IGA DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 O/I-35 ES-014 CH-1-100 NP-5769 VOL-13 AVNER FONTANA ASM NP-5461
P	THIS ARDM IS PLAUSIBLE SINCE VALVE PLUG AND SEAT WEAR OCCUR WHEN THE VALVE IS OPERATED. THE LEAK TIGHTNESS OF THE VALVE WILL DECREASE WITH TIME AND THE FREQUENCY OF OPERATION. THIS ARDM CAN BE MANAGED BY A PROGRAM WHICH PERFORMS REGULAR LEAK TESTS.	ATTACH 7

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System: Area & Process Radiation Monitoring (077/079)
Equipment Type: VALVE
Device Type: HV
Group ID: 077-HV-01

Device Type: Hand Valve
Vendor: Jamesbury
Model Number: 1/4 and 1/2-21-3600-PP-3
Material:
Internal Environment: Plant Vent Gases
External Environment:
Function(s): Maintain System Pressure Boundary Integrity
Other Parameters:

List of Grouped Components:

1HVRE-5416-A	Low Range Inlet Isolation
1HVRE-5416-B	Filter "B" Inlet Isolation
1HVRE-5416-C	Filter "B" Inlet Disconnect
1HVRE-5416-D	Filter "B" Outlet Disconnect
1HVRE-5416-E	Filter "B" Outlet Isolation
1HVRE-5416-F	Filter "A" Inlet Isolation
1HVRE-5416-G	Filter "A" Inlet Disconnect
1HVRE-5416-H	Filter "A" Outlet Disconnect
1HVRE-5416-J	Filter "A" Outlet Isolation
1HVRE-5416-K	Grab 1 Inlet Isolation
1HVRE-5416-L	Grab 1 Inlet Disconnect
1HVRE-5416-M	Grab 1 Outlet Disconnect
1HVRE-5416-N	Grab 1 Outlet Isolation
1HVRE-5416-Q	Low Range Outlet Isolation
1HVRE-5418-A	Mid-High Inlet Isolation
1HVRE-5418-B	Filter "D" Inlet Isolation
1HVRE-5418-C	Filter "D" Inlet Disconnect
1HVRE-5418-D	Filter "D" Outlet Disconnect
1HVRE-5418-E	Filter "D" Outlet Isolation
1HVRE-5418-F	Filter "C" Inlet Isolation
1HVRE-5418-G	Filter "C" Inlet Disconnect
1HVRE-5418-H	Filter "C" Outlet Disconnect
1HVRE-5418-J	Filter "C" Outlet Isolation
1HVRE-5418-K	Grab 2 Inlet Isolation
1HVRE-5418-L	Grab 2 Inlet Disconnect
1HVRE-5418-M	Grab 2 Outlet Disconnect
1HVRE-5418-N	Grab 2 Outlet Isolation

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System: Area & Process Radiation Monitoring (077/079)
Equipment Type: VALVE
Device Type: HV
Group ID: 077-HV-01

1HVRE-5418-Q	Mid-High Outlet Isolation
2HVRE-5416-A	Low Range Inlet Isolation
2HVRE-5416-B	Filter "B" Inlet Isolation
2HVRE-5416-C	Filter "B" Inlet Disconnect
2HVRE-5416-D	Filter "B" Outlet Disconnect
2HVRE-5416-E	Filter "B" Outlet Isolation
2HVRE-5416-F	Filter "A" Inlet Isolation
2HVRE-5416-G	Filter "A" Inlet Disconnect
2HVRE-5416-H	Filter "A" Outlet Disconnect
2HVRE-5416-J	Filter "A" Outlet Isolation
2HVRE-5416-K	Grab 1 Inlet Isolation
2HVRE-5416-L	Grab 1 Inlet Disconnect
2HVRE-5416-M	Grab 1 Outlet Disconnect
2HVRE-5416-N	Grab 1 Outlet Isolation
2HVRE-5416-Q	Low Range Outlet Isolation
2HVRE-5418-A	Mid-High Inlet Isolation
2HVRE-5418-B	Filter "D" Inlet Isolation
2HVRE-5418-C	Filter "D" Inlet Disconnect
2HVRE-5418-D	Filter "D" Outlet Disconnect
2HVRE-5418-E	Filter "D" Outlet Isolation
2HVRE-5418-F	Filter "C" Inlet Isolation
2HVRE-5418-G	Filter "C" Inlet Disconnect
2HVRE-5418-H	Filter "C" Outlet Disconnect
2HVRE-5418-J	Filter "C" Outlet Isolation
2HVRE-5418-K	Grab 2 Inlet Isolation
2HVRE-5418-L	Grab 2 Inlet Disconnect
2HVRE-5418-M	Grab 2 Outlet Disconnect
2HVRE-5418-N	Grab 2 Outlet Isolation
2HVRE-5418-Q	Mid-High Outlet Isolation

ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079 | SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA | GROUP ID: 077-HV-01 | Date: May 16, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Model Number (Source)	Material (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-HV-01A	BODY (NONE)	JAMESBURY (12284-010 Section 6 pp. 25-35 & 48)	1/4 OR 1/2-21-3600-PP-3 (12284-010 Section 6 pp. 25-35 & 48)	STAINLESS STEEL (TYPE 316) (12284-010 Section 6 pp. 25-35 & 48)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-HV-01B	STEM (NONE)	JAMESBURY (12284-010 Section 6 pp. 25-35 & 48)	1/4 OR 1/2-21-3600-PP-3 (12284-010 Section 6 pp. 25-35 & 48)	STAINLESS STEEL (316) (12284-010 Section 6 pp. 25-35 & 48)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-HV-01C	BOLTS AND NUTS (NONE)	JAMESBURY (12284-010 Section 6 pp. 25-35 & 48)	1/4 OR 1/2-21-3600-PP-3 (12284-010 Section 6 pp. 25-35 & 48)	STAINLESS STEEL (300 SERIES) (12284-010 Section 6 pp. 25-35 & 48)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-HV-01D	NON-PRESSURE BOUNDARY PARTS (NONE)	JAMESBURY (12284-010 Section 6 pp. 25-35 & 48)	1/4 OR 1/2-21-3600-PP-3 (12284-010 Section 6 pp. 25-35 & 48)	N/A (N/A)	NONE. NO LR INTENDED FUNCTION. COMPONENT IN LR SCOPE FOR PRESSURE BOUNDARY ONLY. (CLSR)	N

ARDM MATRIX (Revision 1)

System: Area & Process Radiation Monitoring (077/079)
Equipment Type: VALVE
Device Type: HV
Group ID: 077-HV-01

ARDM	077-HV-01A Body	077-HV-01B Stem	077-HV-01C Bolt/Nut
Cavitation Erosion	02	02	19
Corrosion Fatigue	12	12	12
Crevice Corrosion	06	06	19
Erosion Corrosion	21	21	19
Fatigue	12	12	12
Fouling	15	15	19
Galvanic Corrosion	07	07	07
General Corrosion	01.3	01.3	01.3
Hydrogen Damage	03	03	19
Intergranular Attack	22	22	22
MIC	15	15	19
Particulate Wear Erosion	17	19	19
Pitting	06	06	19
Radiation Damage	01.3	01.3	01.3
Rubber Degradation	01.3	01.3	01.3
Selective Leaching	01.3	01.3	01.3
Stress Corrosion Cracking	18	18	18
Stress Relaxation	04	04	04
Thermal Damage	01.3	01.3	01.3
Thermal Embrittlement	04	04	04
Wear	16	14	16

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: HV EQUIPMENT TYPE: VALVE

GROUP ID: 077-HV-01 Date: 5/16/9[illegible]

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.3 STAINLESS STEEL	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS AIR, NOT THE LIQUIDS NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONO-ATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUID IS PLANT VENT GASES. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTH OF 300 SERIES STAINLESS STEELS IS BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING. THE EXTERNAL ENVIRONMENT (AIR) DOES NOT CONTAIN SUFFICIENT HYDROGEN OR PRESSURE TO MAKE THIS ARDM PLAUSIBLE. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN THE MAXIMUM AMBIENT DESIGN TEMPERATURE OF120°F, MAXIMUM FLUID DESIGN TEMPERATURES OF 130°F, AND DRYING EFFECTS OF WARMER TEMPERATURES, HYDROGEN DAMAGE DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 VOL-13 FONTANA 60738 SH2 60722 SH1 AVNER ASM 12284-010 CH-1-100 NP-5769

CODE	DESCRIPTION	SOURCE
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. METALLIC SUBCOMPONENTS ARE NOT SUBJECTED TO TEMPERATURES APPROACHING OR IN EXCESS OF 500° F.	ATTACH 7 ES-014
06	PROCESS FLUID AND MOISTURE DO NOT PERPETUATE THE ARDM. INPO OPERATIONS AND MAINTENANCE REMINDER O&MR-132 DESCRIBES OPERATIONAL FAILURES OF RAD MONITORING SYSTEMS DUE TO EXCESS MOISTURE. CCNPP RECENT HISTORY SHOWS ONE CASE WHERE WATER WAS INTRODUCED TO THE SYSTEM DUE TO BLOWDOWN TANK VENT BEING ALIGNED TO THE MAIN PLANT VENT (MO 2199402504). HOWEVER, PER INPUT FROM THE SYSTEM ENGINEER THIS IS NOT A COMMON OCCURRENCE. THE SYSTEM HAS NOT EXPERIENCED THE MOISTURE RELATED PROBLEMS DESCRIBED IN O&MR-132. SYSTEM OPERATION IS ASSURED IN ACCORDANCE WITH O/I-35. THE LIMITED AMOUNT OF MOISTURE PREVENTS SIGNIFICANT EFFECT FROM THESE AGING MECHANISMS.	ATTACH 7 O/I-35 INPO O&MR-132 MO 2199402504
07	MATERIAL SELECTION/SEPARATION DOES NOT PERPETUATE THE ARDM. THE VALVE IS MADE OF MATERIALS WITH LOW POTENTIAL DIFFERENCES AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION.	ATTACH 7 O/I-35
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM PRESSURES AND TEMPERATURES ARE LOW AND RELATIVELY STEADY MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 12284-010 ES-014
14	WEAR DOES NOT SIGNIFICANTLY AFFECT COMPONENT INTENDED FUNCTION AND IS NOT CONSIDERED PLAUSIBLE. VALVE OPERATION RESULTS IN STEM/PACKING CONTACT IN RELATIVE MOTION AND POTENTIALLY ABRASIVE WEAR. BALL VALVE DESIGN RESULTS IN MINIMAL STEM WEAR. IF PACKINGS LEAK, IT WILL BE MINOR (MINIMAL IMPACT ON INTENDED FUNCTION) AND DETECTABLE DURING VALVE OPERATION/INSPECTION.	ATTACH 7 12284-010

CODE	DESCRIPTION	SOURCE
15	ARDMS DO NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. FOULING AND MIC MAY OCCUR TO A LIMITED EXTENT DUE TO CONDENSED HUMIDITY FROM THE VENT GASES, AIRBORNE PARTICLES AND MICROBES. PLANT EXPERIENCE HAS SHOWN FOULING HAS OCCURRED IN THIS SYSTEM. HOWEVER, FOULING DOES NOT AFFECT THE PRESSURE BOUNDARY FUNCTION. MIC ACTIVITY WILL NOT BE SIGNIFICANT TO PRESSURE BOUNDARY FUNCTION DUE TO LIMITED AMOUNT OF CONDENSATION.	ATTACH 7 O/I-35 MO 2199402189
16	COMPONENT DESIGN DOES NOT PERPETUATE THE ARDM. WEAR IS NOT A PLAUSIBLE ARDM SINCE THE SUBCOMPONENTS ARE DESIGNED TO ELIMINATE ANY RELATIVE MOTION BETWEEN THE PARTS. THE SUBCOMPONENTS ARE DESIGNED SO THEY ARE NOT ADJACENT TO OTHER SUBCOMPONENTS OR THEY ARE RESTRAINED SUCH THAT THERE IS NO RELATIVE MOTION.	ATTACH 7
17	PARTICULATE WEAR EROSION IS NOT SIGNIFICANT. THE AIR VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF AIRBORNE PARTICLES WILL NOT LEAD TO SIGNIFICANT EROSION OF THE EROSION RESISTANT MATERIALS.	ATTACH 7 60738 SH.2 12284-010
18	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN TYPICAL 300 SERIES STAINLESS STEELS. THE LOW YIELD STRENGTH OF TYPICAL 300 SERIES STAINLESS STEELS MAKES THE ARDM NOT PLAUSIBLE. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN THE MAXIMUM AMBIENT DESIGN TEMPERATURE OF120°F, MAXIMUM FLUID DESIGN TEMPERATURES OF 130°F, AND DRYING EFFECTS OF WARMER TEMPERATURES, SCC DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 O/I-35 60722 SH1 AVNER VOL-13 FONTANA 60738 SH2 ASM CH-1-100 NP-5769

CODE	DESCRIPTION	SOURCE
19	COMPONENT ENVIRONMENT DOES NOT PERPETUATE THE ARDM. THE SUBCOMPONENTS TYPICALLY ARE NOT EXPOSED TO THE PROCESS FLUID WHICH MAKES THE ARDM NON-PLAUSIBLE. THE EXTERNAL ENVIRONMENT IS NOT NORMALLY HARSH.	ATTACH 7
21	PROCESS FLUID (AIR) AND MATERIAL SELECTION (SS) DO NOT PERPETUATE THE ARDM.	ATTACH 7
22	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN TYPICAL 300 SERIES STAINLESS STEELS. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN THE MAXIMUM AMBIENT DESIGN TEMPERATURE OF120°F, MAXIMUM FLUID DESIGN TEMPERATURES OF 130°F, AND DRYING EFFECTS OF WARMER TEMPERATURES, IGA DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 O/I-35 60722 SH1 AVNER VOL-13 FONTANA 60738 SH2 ASM CH-1-100 NP-5769

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 3**
Equipment Type:	**VALVE**	**Page 1 of 1**
Device Type:	**HV**	**April 15, 1996**
Group ID:	**077-HV-02**	

Device Type:	Hand Valve
Vendor:	
Model Number:	
Material:	
Internal Environment:	Containment Atmosphere
External Environment:	
Function(s):	Maintain Containment Isolation
Other Parameters:	Mark 130

List of Grouped Components:

1HVRE-102	Containment RMS Test Connector Isolation Valve
2HVRE-102	Containment RMS Test Connector Isolation Valve

ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA GROUP ID: 077-HV-02 Date: May 17, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Model Number (Source)	Material (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-HV-02A	BODY/BONNET (NONE)	N/A (N/A)	MARK 130 (60738SH0001)	CAST A216 GR WCB OR FORGED A105 GR II CARBON STEEL (92771)	MAINTAIN CONTAINMENT ISOLATION (CLSR)	Y
077-HV-02B	STEM (NONE)	N/A (N/A)	MARK 130 (60738SH0001)	ALLOY STEEL (NONE)	MAINTAIN CONTAINMENT ISOLATION (CLSR)	Y
077-HV-02C	BOLTS (NONE)	N/A (N/A)	MARK 130 (60738SH0001)	ALLOY/CS (NONE)	MAINTAIN CONTAINMENT ISOLATION (CLSR)	Y
077-HV-02D	NUTS (NONE)	N/A (N/A)	MARK 130 (60738SH0001)	ALLOY/CS (NONE)	MAINTAIN CONTAINMENT ISOLATION (CLSR)	Y
077-HV-02E	DISK & SEAT (NONE)	N/A (N/A)	MARK 130 (60738SH0001)	ALLOY STEEL/STELLITE (NONE/92771)	MAINTAIN CONTAINMENT ISOLATION (CLSR)	Y

ARDM MATRIX (Revision 1)

System:	**Area & Process Radiation Monitoring (077/79)**	**Attachment 5**
Equipment Type:	**VALVE**	**Page 1 of 1**
Device Type:	**HV**	**May 20, 1996**
Group ID:	**077-HV-02**	

ARDM	077-HV-02A Body/Bonnet	077-HV-02B Stem	077-HV-02C Bolts	077-HV-02D Nuts	077-HV-02E Disk & Seat
Cavitation Erosion	02	02	19	19	02
Corrosion Fatigue	12	12	12	12	12
Crevice Corrosion	G	G	19	19	G
Erosion Corrosion	02	02	19	19	02
Fatigue	12	12	12	12	12
Fouling	15	15	19	19	15
Galvanic Corrosion	07	07	07	07	07
General Corrosion	G	01.3	19	19	01.3
Hydrogen Damage	03	03	03	03	03
Intergranular Attack	01.1	22	22	22	22
MIC	06	06	19	19	06
Particulate Wear Erosion	20	20	19	19	20
Pitting	G	G	19	19	G
Radiation Damage	01.1	01.3	01.2	01.2	01.3
Rubber Degradation	01.1	01.3	01.2	01.2	01.3
Selective Leaching	01.1	01.3	01.2	01.2	01.3
Stress Corrosion Cracking	01.1	18	18	18	18
Stress Relaxation	04	04	04	04	04
Thermal Damage	01.1	01.3	01.2	01.2	01.3
Thermal Embrittlement	04	04	04	04	04
Wear	16	21	16	16	17

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: HV EQUIPMENT TYPE: VALVE

GROUP ID: 077-HV-02 Date: 5/20/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.1 CARBON STEEL 01.2 CARBON STEEL/ALLOY 01.3 ALLOY/STAINLESS STEEL	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS AIR, NOT THE LIQUIDS NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONO-ATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUID IS CONTAINMENT ATMOSPHERE. THE NORMAL HYDROGEN CONCENTRATION IS NOT SUFFICIENT TO MAKE THIS ARDM PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTHS OF TYPICAL CARBON STEELS AND BOLTING MATERIALS ARE BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING. THE EXTERNAL ENVIRONMENT (AIR) DOES NOT CONTAIN SUFFICIENT HYDROGEN OR PRESSURE TO MAKE THIS ARDM PLAUSIBLE. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN NORMAL CONTAINMENT MAXIMUM TEMPERATURE OF120°F, NORMAL AMBIENT TEMPERATURES IN THE EAST PIPING PENETRATION ROOMS OF 140°F, AND DRYING EFFECTS OF WARMER TEMPERATURES, HYDROGEN DAMAGE DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 VOL-1 VOL-13 FONTANA 60738 SH1 CH-1-100 NP-5769 AVNER ASM

CODE	DESCRIPTION	SOURCE
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500° F ENSURE THE ARDM IS NOT PLAUSIBLE.	ATTACH 7 ES-014
06	PROCESS FLUID AND MOISTURE DOES NOT PERPETUATE THE ARDM. THE FLUID IS AIR WITH THE POTENTIAL FOR SOME HUMIDITY. OCCASSIONAL HUMIDITY DOES NOT SUBJECT THE COMPONENTS TO THE AGGRESSIVE ENVIRONMENT NORMALLY ASSOCIATED WITH THE ARDM.	ATTACH 7 ES-014
07	PROCESS FLUID (AIR WITH SOME HUMIDITY) DOES NOT PERPETUATE THE ARDM. THE GENERAL LACK OF ELECTROLYTE TO COMPLETE A GALVANIC CIRCUIT MAKES THIS ARDM NOT PLAUSIBLE.	ATTACH 7 O/I-35 ES-014
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM PRESSURES AND TEMPERATURES ARE LOW AND RELATIVELY STEADY MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 ES-014 O/I-35
15	ARDMS DO NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. FOULING MAY OCCUR TO A LIMITED EXTENT DUE TO HUMIDITY IN THE WARM CONTAINMENT GASES AND AIRBORNE PARTICLES. THE VALVES ARE OPERATED INFREQUENTLY, MINIMIZING THE POSSIBILITY OF THIS ARDM. FOULING DOES NOT DIRECTLY AFFECT THE PRESSURE BOUNDARY FUNCTION.	ATTACH 7 O/I-35
16	COMPONENT DESIGN DOES NOT PERPETUATE THE ARDM. WEAR IS NOT A PLAUSIBLE ARDM SINCE THE SUBCOMPONENTS ARE DESIGNED TO ELIMINATE ANY RELATIVE MOTION BETWEEN THE PARTS. THE SUBCOMPONENTS ARE DESIGNED SO THEY ARE NOT ADJACENT TO OTHER SUBCOMPONENTS OR THEY ARE RESTRAINED SUCH THAT THERE IS NO RELATIVE MOTION.	ATTACH 7
17	THE ARDM IS NOT PLAUSIBLE. COBALT ALLOYS SUCH AS STELLITE HAVE EXCELLENT WEAR RESISTANCE. ADDITIONALLY, THE VALVES ARE OPERATED ONLY TO TEST THE CONTAINMENT ISOLATION CONTROL VALVES FOR LEAKAGE AND ARE NORMALLY LOCKED SHUT.	ASME O-055-1/2 M-571E-1/2

CODE	DESCRIPTION	SOURCE
18	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE PROCESS FLUID IS HUMID AIR. THE EXTERNAL ENVIRONMENT (AIR) IS NOT EXPECTED TO CONTAIN SUFFICIENT ATMOSPHERIC CONTAMINANTS TO MAKE THIS ARDM PLAUSIBLE IN TYPICAL CARBON STEELS AND BOLTING MATERIALS. THE LOW YIELD STRENGTHS OF THESE MATERIALS MAKES THEM LESS SUSCEPTIBLE TO THE ARDM. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN NORMAL CONTAINMENT MAXIMUM TEMPERATURE OF120°F, NORMAL AMBIENT TEMPERATURES IN THE EAST PIPING PENETRATION ROOMS OF 140°F, AND DRYING EFFECTS OF WARMER TEMPERATURES, SCC DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 O/I-35 FSK-MP-1262 FSK-MP-3050 CH-1-100 NP-5769 VOL-13 AVNER FONTANA ASM NP-5461
19	COMPONENT ENVIRONMENT DOES NOT PERPETUATE THE ARDM. THE SUBCOMPONENTS TYPICALLY ARE NOT EXPOSED TO THE PROCESS FLUID WHICH MAKES THE ARDM NON-PLAUSIBLE. THE EXTERNAL ENVIRONMENT IS NOT NORMALLY HARSH.	ATTACH 7
20	PARTICULATE WEAR EROSION IS NOT SIGNIFICANT. THE AIR VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF AIRBORNE PARTICLES AND INFREQUENT OPERATION WILL NOT LEAD TO SIGNIFICANT EROSION OF THE VALVE MATERIALS.	ATTACH 7 O/I-35
21	WEAR DOES NOT SIGNIFICANTLY AFFECT COMPONENT INTENDED FUNCTION. VALVE OPERATION MAY RESULT IN STEM/PACKING CONTACT IN RELATIVE MOTION, BUT THE INFREQUENT OPERATION OF THE VALVE REDUCES THE OCCURRANCE OF THE ARDM TO A MINIMUM . WEAR OF PACKING WILL NOT RESULT IN LEAKAGE OF PRESSURE BOUNDARY SUBCOMPONENTS.	ATTACH 7

CODE	DESCRIPTION	SOURCE
21	WEAR DOES NOT SIGNIFICANTLY AFFECT COMPONENT INTENDED FUNCTION. VALVE OPERATION MAY RESULT IN STEM/PACKING CONTACT IN RELATIVE MOTION, BUT THE INFREQUENT OPERATION OF THE VALVE REDUCES THE OCCURRANCE OF THE ARDM TO A MINIMUM . WEAR OF PACKING WILL NOT RESULT IN LEAKAGE OF PRESSURE BOUNDARY SUBCOMPONENTS.	ATTACH 7
22	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE PROCESS FLUID IS ONLY HUMID AIR, AND THE ENVIRONMENT (AIR) IS NOT EXPECTED TO CONTAIN SUFFICIENT ATMOSPHERIC CONTAMINANTS TO MAKE THIS ARDM PLAUSIBLE IN TYPICAL ALLOY STEEL AND BOLTING MATERIAL. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN NORMAL CONTAINMENT MAXIMUM TEMPERATURE OF120°F, NORMAL AMBIENT TEMPERATURES IN THE EAST PIPING PENETRATION ROOMS OF 140°F, AND DRYING EFFECTS OF WARMER TEMPERATURES, IGA DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 O/I-35 ES-014 CH-1-100 NP-5769 VOL-13 AVNER FONTANA ASM NP-5461
G	THE ARDM IS PLAUSIBLE BECAUSE STEEL MATERIALS OF CONSTRUCTION ARE EXPOSED TO HUMID AIR. THERE ARE TWO GENERAL POSSIBLE EFFECTS; A UNIFORM CORROSION OF THE INTERNAL SURFACES OF THE VALVE CAUSING BODY WALL THINNING, AND LOCALIZED ATTACK RESULTING IN PITS AND CRACK INITIATION - MOST LIKELY AT CREVICES IN THE BODY/BONNET JOINT, STEM TO BONNET/PACKING AREA, AND AT THE VALVE SEAT AREA. AGING MANAGEMENT RECOMMENDATIONS INCLUDE: (1) INCLUDE THE COMPONENTS IN THE AGE RELATED DEGRADATION INSPECTION PROGRAM.	ATTACH 7 LCM 96-133

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 3**
Equipment Type:	**VALVE**	**Page 1 of 1**
Device Type:	**HV**	**April 15, 1996**
Group ID:	**077-HV-03**	

Device Type:	Hand Valve
Vendor:	
Model Number:	
Material:	
Internal Environment:	Control Room Atmosphere
External Environment:	
Function(s):	Maintain System Pressure Boundary Integrity
Other Parameters:	Mark 19

List of Grouped Components:

0HVRE-5350-H	Control Room Radiation Monitor Inlet
0HVRE-5350-I	Control Room Radiation Monitor Inlet
0HVRE-5350-L	Control Room Radiation Monitor Outlet

ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA GROUP ID: 077-HV-03 Date: May 17, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Model Number (Source)	Material (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-HV-03A	BODY/BONNET (NONE)	N/A (N/A)	MARK 19 (60738SH0001)	CAST A216 GR WCB OR FORGED A105 GR II CARBON STEEL (92771)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-HV-03B	STEM (NONE)	N/A (N/A)	MARK 19 (60738SH0001)	ALLOY STEEL (NONE)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-HV-03C	BOLTS (NONE)	N/A (N/A)	MARK 19 (60738SH0001)	ALLOY/CS (NONE)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-HV-03D	NUTS (NONE)	N/A (N/A)	MARK 19 (60738SH0001)	ALLOY/CS (NONE)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-HV-03E	DISK & SEAT (NONE)	N/A (N/A)	MARK 130 (60738SH0001)	ALLOY STEEL/STELLITE OR SS (NONE/92771)	NONE. NO LR INTENDED FUNCTION. COMPONENT IN LR SCOPE FOR PRESSURE BOUNDARY ONLY. (CLSR)	N

ARDM MATRIX (Revision 1)

System: Area & Process Radiation Monitoring (077/79)
Equipment Type: VALVE
Device Type: HV
Group ID: 077-HV-03

ARDM	077-HV-03A Body/Bonnet	077-HV-03B Stem	077-HV-03C Bolts	077-HV-03C Nuts
Cavitation Erosion	02	02	19	19
Corrosion Fatigue	12	12	12	12
Crevice Corrosion	06	06	06	06
Erosion Corrosion	02	02	19	19
Fatigue	12	12	12	12
Fouling	06	06	19	19
Galvanic Corrosion	07	07	07	07
General Corrosion	06	01.3	06	06
Hydrogen Damage	03	03	03	03
Intergranular Attack	01.1	22	22	22
MIC	06	06	19	19
Particulate Wear Erosion	15	15	19	19
Pitting	06	06	06	06
Radiation Damage	01.1	01.3	01.2	01.2
Rubber Degradation	01.1	01.3	01.2	01.2
Selective Leaching	01.1	01.3	01.2	01.2
Stress Corrosion Cracking	01.1	18	18	18
Stress Relaxation	04	04	04	04
Thermal Damage	01.1	01.3	01.2	01.2
Thermal Embrittlement	04	04	04	04
Wear	16	17	16	16

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: HV EQUIPMENT TYPE: VALVE

GROUP ID: 077-HV-03 Date: 5/21/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.1 CARBON STEEL 01.2 CARBON STEEL/ALLOY 01.3 ALLOY/STAINLESS STEEL	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS AIR, NOT THE LIQUIDS NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONO-ATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUID IS CONTROL ROOM HVAC AIR. THE NORMAL HYDROGEN CONCENTRATION IS NOT SUFFICIENT TO MAKE THIS ARDM PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTHS OF TYPICAL CARBON STEELS AND BOLTING MATERIALS ARE BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING. THE EXTERNAL ENVIRONMENT (AIR) DOES NOT CONTAIN SUFFICIENT HYDROGEN OR PRESSURE TO MAKE THIS ARDM PLAUSIBLE. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN MILD CONDITIONS INSIDE THE CONTROL ROOM, NORMAL AMBIENT TEMPERATURES IN THE MAIN PLANT EXHAUST ROOM OF 110°F MAXIMUM, AND THE DRYING EFFECTS OF WARMER TEMPERATURES, HYDROGEN DAMAGE DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 VOL-1 VOL-13 FONTANA 60738 SH1 CH-1-100 NP-5769 AVNER ASM

CODE	DESCRIPTION	SOURCE
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500° F ENSURE THIS ARDM IS NOT PLAUSIBLE.	ATTACH 7 ES-014
06	THE PROCESS FLUID AND EXTERNAL ENVIRONMENT DO NOT PERPETUATE THIS ARDM. THE CONTROL ROOM ATMOSPHERE IS CONDITIONED (REDUCED HUMIDITY AND FILTERED). THE FOULING AND HUMIDITY EFFECTS ARE THEREFORE INSIGNIFICANT. THE VALVE PRESSURE BOUNDARY FUNCTION FOR THE VERY LOW SYSTEM PRESSURES WILL NOT BE AFFECTED. BORIC ACID CORROSION OF THIS SYSTEM IS ALSO NOT CONSIDERED PLAUSIBLE AS THE PROCESS FLUID IS NOT BORATED WATER.	ATTACH 7 LCM 95-112 UFSAR 9.8.2.3
07	PROCESS FLUID (HVAC AIR WITH LOW HUMIDITY) DOES NOT PERPETUATE THE ARDM. THE GENERAL LACK OF ELECTROLYTE TO COMPLETE A GALVANIC CIRCUIT MAKES THIS ARDM NOT PLAUSIBLE.	ATTACH 7 O/I-35 ES-014
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM PRESSURES AND TEMPERATURES ARE LOW AND RELATIVELY STEADY MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 ES-014 O/I-35
15	PARTICULATE WEAR EROSION DOES NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. THE AIR VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF AIRBORNE PARTICLES WILL NOT LEAD TO SIGNIFICANT EROSION OF THE EROSION RESISTANT MATERIALS.	ATTACH 7 O/I-35 UFSAR 9.8.2.3
16	COMPONENT DESIGN DOES NOT PERPETUATE THE ARDM. WEAR IS NOT A PLAUSIBLE ARDM SINCE THE SUBCOMPONENTS ARE DESIGNED TO ELIMINATE ANY RELATIVE MOTION BETWEEN THE PARTS. THE SUBCOMPONENTS ARE DESIGNED SO THEY ARE NOT ADJACENT TO OTHER SUBCOMPONENTS OR THEY ARE RESTRAINED SUCH THAT THERE IS NO RELATIVE MOTION.	ATTACH 7
17	WEAR DOES NOT SIGNIFICANTLY AFFECT COMPONENT INTENDED FUNCTION. VALVE OPERATION RESULTS IN STEM/PACKING CONTACT IN RELATIVE MOTION, BUT WEAR OF PACKING WILL NOT RESULT IN LEAKAGE OF PRESSURE BOUNDARY SUBCOMPONENTS.	ATTACH 7

CODE	DESCRIPTION	SOURCE
18	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE PROCESS FLUID IS HVAC AIR WITH LOW HUMIDITY. THE EXTERNAL ENVIRONMENT (AIR) IS NOT EXPECTED TO CONTAIN SUFFICIENT ATMOSPHERIC CONTAMINANTS TO MAKE THIS ARDM PLAUSIBLE IN TYPICAL CARBON STEELS AND BOLTING MATERIALS. THE LOW YIELD STRENGTHS OF THESE MATERIALS MAKES THEM LESS SUSCEPTIBLE TO THE ARDM. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN MILD CONDITIONS INSIDE THE CONTROL ROOM, NORMAL AMBIENT TEMPERATURES IN THE MAIN PLANT EXHAUST ROOM OF 110°F MAXIMUM, AND DRYING EFFECTS OF WARMER TEMPERATURES, SCC DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 O/I-35 FSK-MP-2028 CH-1-100 ES-014 NP-5769 VOL-13 AVNER FONTANA ASM NP-5461
19	COMPONENT ENVIRONMENT DOES NOT PERPETUATE THE ARDM. THE SUBCOMPONENTS TYPICALLY ARE NOT EXPOSED TO THE PROCESS FLUID WHICH MAKES THE ARDM NON-PLAUSIBLE.	ATTACH 7

CODE	DESCRIPTION	SOURCE
22	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE PROCESS FLUID IS HVAC AIR WITH LOW HUMIDITY. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN MILD CONDITIONS INSIDE THE CONTROL ROOM, NORMAL AMBIENT TEMPERATURES IN THE MAIN PLANT EXHAUST ROOM OF 110°F MAXIMUM, AND DRYING EFFECTS OF WARMER TEMPERATURES, IGA DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 O/I-35 FSK-MP-2028 CH-1-100 ES-014 NP-5769 VOL-13 AVNER FONTANA ASM NP-5461

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 3**
Equipment Type:	**VALVE**	**Page 1 of 1**
Device Type:	**HV**	**April 15, 1996**
Group ID:	**077-HV-04**	

Device Type: Hand Valve
Vendor:
Model Number:
Material:
Internal Environment: Component Cooling / Service Water
External Environment:
Function(s): Maintain System Pressure Boundary Integrity
Maintain Isolation Boundary
Other Parameters: Mark 19

List of Grouped Components:

1HVRE-1595-H	SRW RMS Inlet
1HVRE-1595-J	1-FIS-1595 Bypass
1HVRE-1595-M	1-FIS-1595 Outlet Isolation
1HVRE-3819-K	PRM CC Radiation Monitoring Unit 1 HV
2HVRE-1595-H	SRW RMS Inlet
2HVRE-1595-J	2-FIS-1595 Bypass
2HVRE-1595-M	2-FIS-1595 Outlet Isolation
2HVRE-3819-K	PRM CC Radiation Monitoring Unit 2 HV

ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079　　SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA　　GROUP ID: 077-HV-04　　Date: May 20, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Model Number (Source)	Material (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-HV-04A	BODY/BONNET (NONE)	N/A (N/A)	MARK 19 (60738SH0001)	CAST A216 GR WCB OR FORGED A105 GR II CARBON STEEL (92771)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-HV-04B	STEM (NONE)	N/A (N/A)	MARK 19 (60738SH0001)	ALLOY STEEL (NONE)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-HV-04C	BOLTS (NONE)	N/A (N/A)	MARK 19 (60738SH0001)	ALLOY/CS (NONE)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-HV-04D	NUTS (NONE)	N/A (N/A)	MARK 19 (60738SH0001)	ALLOY/CS (NONE)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-HV-04E	DISK & SEAT (NONE)	N/A (N/A)	MARK 130 (60738SH0001)	ALLOY STEEL/STELLITE OR SS (NONE/92771)	MAINTAIN PRESSURE BOUNDARY INTEGRITY. ISOLATION FUNCTION. (CLSR)	Y

ARDM MATRIX (Revision 1)

System:	**Area & Process Radiation Monitoring (077/79)**	**Attachment 5**
Equipment Type:	**VALVE**	**Page 1 of 1**
Device Type:	**HV**	**May 20, 1996**
Group ID:	**077-HV-04**	

ARDM	077-HV-04A Body/Bonnet	077-HV-04B Stem	077-HV-04C Bolts	077-HV-04D Nuts	077-HV-04E Disk /Seat
Cavitation Erosion	02	02	19	19	02
Corrosion Fatigue	12	12	12	12	12
Crevice Corrosion	G	G	19	19	G
Erosion Corrosion	02	02	19	19	02
Fatigue	12	12	12	12	12
Fouling	06	06	19	19	19
Galvanic Corrosion	07	07	07	07	07
General Corrosion	G	01.3	19	19	01.3
Hydrogen Damage	03	03	03	03	03
Intergranular Attack	01.1	06	01.2	01.2	06
MIC	06	06	19	19	06
Particulate Wear Erosion	15	15	19	19	15
Pitting	G	G	19	19	G
Radiation Damage	01.1	01.3	01.2	01.2	01.3
Rubber Degradation	01.1	01.3	01.2	01.2	01.3
Selective Leaching	01.1	01.3	01.2	01.2	01.3
Stress Corrosion Cracking	01.1	18	18	18	18
Stress Relaxation	04	04	04	04	04
Thermal Damage	01.1	01.3	01.2	01.2	01.3
Thermal Embrittlement	04	04	04	04	04
Wear	16	17	16	16	17

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: HV EQUIPMENT TYPE: VALVE

GROUP ID: 077-HV-04 Date: 5/20/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.1 CARBON STEEL 01.2 ALLOY/CARBON STEEL 01.3 ALLOY/STAINLESS STEEL	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS NOT THE TYPE NORMALLY ASSOCIATED WITH THIS ARDM (HIGH VELOCITY AND/OR RAPID PRESSURE VARIATIONS).	ATTACH 7 O/I-35

CODE	DESCRIPTION	SOURCE
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONO-ATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUIDS ARE COMPONENT COOLING WATER AND SERVICE WATER, WHICH ARE TREATED UNDER STRICT ADMINISTRATIVE CONTROLS TO LIMIT HYDRAZINE. THE NORMAL HYDROGEN CONCENTRATION IS NOT SUFFICIENT TO MAKE THIS ARDM PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTHS OF TYPICAL CARBON STEELS AND BOLTING MATERIALS ARE BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING. THE EXTERNAL ENVIRONMENT (AIR) DOES NOT CONTAIN SUFFICIENT HYDROGEN OR PRESSURE TO MAKE THIS ARDM PLAUSIBLE. ONLY LUBRICANTS WITHIN STRICT ADMINISTRATIVE CONTROLS ARE PERMITTED BY PROCEDURE TO BE USED ON RESTRICTED SYSTEMS SUCH AS CCW/SRW. SINCE CHEMICAL CONTROL OF THESE SYSTEMS MUST BE PERFORMED TO PROTECT THEM AGAINST CHEMICAL ATTACK, HYDROGEN DAMAGE DUE TO LUBRICANTS IS NOT A CONCERN.	ATTACH 7 CP-206 VOL-1 VOL-13 FONTANA 60738 SH1 CH-1-100 NP-5769 AVNER ASM
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500^{O} F ENSURE THIS ARDM IS NOT PLAUSIBLE.	ATTACH 7 ES-014
06	THE PROCESS FLUID CHEMISTRY DOES NOT PERPETUATE THIS ARDM. THE COMPONENT COOLING AND SERVICE WATER SYSTEMS ARE CLOSED SYSTEMS WITH TREATED WATER UNDER STRICT ADMINISTRATIVE CONTROLS TO LIMIT CHLORIDES, SUSPENDED SOLIDS AND DISSOLVED OXYGEN.	ATTACH 7 CP-206 95-BGE-0086

CODE	DESCRIPTION	SOURCE
07	THE ARDM DOES NOT SIGNIFICANTLY IMPACT THE PRESSURE BOUNDARY FUNCTION OF THE SUBCOMPONENTS. THERE MAY BE SIGNIFICANT GALVANIC COUPLES BETWEEN VARIOUS SUBCOMPONENT MATERIALS, HOWEVER: 1) THE CHEMISTRY CONTROL OF THE SYSTEM FLUID RESULTS IN VERY LOW (PPB) LEVELS OF DISSOLVED OXYGEN AND CHLORIDES, GREATLY REDUCING RATES AND EFFECTS OF ANY GALVANIC CORROSION WHICH MIGHT OCCUR. 2) THE RATIO OF THE WETTED CARBON STEEL AREA TO THE CATHODIC MATERIALS WETTED AREAS IS LARGE, LIMITING THE EFFECTS ON THE CARBON STEEL PB SUBCOMPONENTS. 3) GALVANIC CORROSION IN CLOSED LOOP COOLING SYSTEM COMPONENTS HAS NOT BEEN IDENTIFIED AS AN ISSUE AT CCNPP OR IN THE INDUSTRY GENERICALLY.	ATTACH 7 CP-206 OERDB PIPE AMG VOL-13
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM PRESSURES AND TEMPERATURES ARE LOW AND RELATIVELY STEADY MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 O/I-15 O/I-16
15	PARTICULATE WEAR EROSION DOES NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. THE WATER VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF PARTICLES IN THIS CLOSED/TREATED WATER SYSTEM WILL NOT LEAD TO SIGNIFICANT EROSION OF THE VALVE MATERIALS.	ATTACH 7
16	COMPONENT DESIGN DOES NOT PERPETUATE THE ARDM. WEAR IS NOT A PLAUSIBLE ARDM SINCE THE SUBCOMPONENTS ARE DESIGNED TO ELIMINATE ANY RELATIVE MOTION BETWEEN THE PARTS. THE SUBCOMPONENTS ARE DESIGNED SO THEY ARE NOT ADJACENT TO OTHER SUBCOMPONENTS OR THEY ARE RESTRAINED SUCH THAT THERE IS NO RELATIVE MOTION.	ATTACH 7
17	WEAR DOES NOT SIGNIFICANTLY AFFECT COMPONENT INTENDED FUNCTION. VALVE OPERATION RESULTS IN STEM/PACKING CONTACT IN RELATIVE MOTION AND POTENTIALLY ABRASIVE WEAR. WEAR OF PACKING WILL NOT RESULT IN LEAKAGE OF PRESSURE BOUNDARY SUBCOMPONENTS. THE DISC/SEAT WEAR DUE TO PERIODIC OPERATION IS CONSIDERED MINIMAL AND WILL NOT AFFECT THE SYSTEM INTENDED FUNCTION.	ATTACH 7

CODE	DESCRIPTION	SOURCE
18	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE COMPONENT COOLING AND SERVICE WATER SYSTEMS ARE CLOSED SYSTEMS WITH TREATED WATER UNDER STRICT ADMINISTRATIVE CONTROLS TO LIMIT CHLORIDES, SUSPENDED SOLIDS AND DISSOLVED OXYGEN. ONLY LUBRICANTS WITHIN STRICT ADMINISTRATIVE CONTROLS ARE PERMITTED BY PROCEDURE TO BE USED ON RESTRICTED SYSTEMS SUCH AS CCW/SRW. SINCE CHEMICAL CONTROL OF THESE SYSTEMS MUST BE PERFORMED TO PROTECT THEM AGAINST CHEMICAL ATTACK, SCC DUE TO LUBRICANTS IS NOT A CONCERN. THE EXTERNAL ENVIRONMENT (AIR) IS NOT EXPECTED TO CONTAIN SUFFICIENT ATMOSPHERIC CONTAMINANTS TO MAKE THIS ARDM PLAUSIBLE IN TYPICAL CARBON STEELS AND BOLTING MATERIALS. THE LOW YIELD STRENGTHS OF THESE MATERIALS MAKES THEM LESS SUSCEPTIBLE TO THE ARDM.	ATTACH 7 CP-206 95-BGE-0086 CH-1-100 ES-014 NP-5769 VOL-13 AVNER FONTANA ASM NP-5461
19	COMPONENT ENVIRONMENT DOES NOT PERPETUATE THE ARDM. THE SUBCOMPONENTS TYPICALLY ARE NOT EXPOSED TO THE PROCESS FLUID WHICH MAKES THE ARDM NON-PLAUSIBLE. THE EXTERNAL ENVIRONMENT IS NOT NORMALLY HARSH.	ATTACH 7

CODE	DESCRIPTION	SOURCE
G	THE ARDM IS PLAUSIBLE BECAUSE STEEL MATERIALS OF CONSTRUCTION ARE EXPOSED TO THE PROCESS FLUID DURING STAGNANT CONDITIONS. THERE ARE SEVERAL POSSIBLE EFFECTS. A UNIFORM CORROSION OF THE INTERNAL SURFACES OF THE VALVE CAUSING BODY WALL THINNING. LOCALIZED ATTACK RESULTING IN PITS AND CRACK INITIATION - MOST LIKELY AT CREVICES IN THE BODY/BONNET JOINT, STEM TO BONNET/PACKING AREA, AND AT THE VALVE SEAT AREA. AGING MANAGEMENT RECOMMENDATIONS INCLUDE: (1) MAINTAINING THE WATER CHEMISTRY CONTROLS WHICH MINIMIZE THE REQUIRED CONDITIONS FOR THEIR OCCURRENCE. (2) INCLUDE THE COMPONENTS IN THE AGE RELATED DEGRADATION INSPECTION PROGRAM.	ATTACH 7

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 3**
Equipment Type:	**VALVE**	**Page 1 of 1**
Device Type:	**MOV**	**May 20, 1996**
Group ID:	**077-MOV-01**	

Device Type: Motor Operated Valve
Vendor: Marpac
Model Number: 1/2-SS-B325
Material:
Internal Environment:
External Environment:
Function(s): Maintain System Pressure Boundary Integrity
Other Parameters:

List of Grouped Components:

1MOV5415AVLV	RE Low Range Sample PP Suction
2MOV5415AVLV	RE Low Range Sample PP Suction

ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA GROUP ID: 077-MOV-01 Date: May 20, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Model Number (Source)	Material (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-MOV-01A	BODY AND END ADAPTORS (NONE)	MARPAC (12284-010 Section 6 pp. 43-52)	1/2-SS-B325-J-EX-08 (12284-010 Section 6 pp. 43-52)	FORGED STAINLESS STEEL (12284-010 Appendix pp. 27-34)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-MOV-01B	STEM (NONE)	MARPAC (12284-010 Section 6 pp. 43-52)	1/2-SS-B325-J-EX-08 (12284-010 Section 6 pp. 43-52)	STAINLESS STEEL (316) (12284-010 Appendix pp. 27-34)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-MOV-01C	BOLTS/NUTS (NONE)	MARPAC (12284-010 Section 6 pp. 43-52)	1/2-SS-B325-J-EX-08 (12284-010 Section 6 pp. 43-52)	CARBON STEEL GR 8 (12284-010 Appendix pp. 27-34)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-MOV-01D	BALL AND SEAT (NONE)	MARPAC (12284-010 Section 6 pp. 43-52)	1/2-SS-B325-J-EX-08 (12284-010 Section 6 pp. 43-52)	N/A (N/A)	NONE. NO LR INTENDED FUNCTION. COMPONENT IN LR SCOPE FOR PRESSURE BOUNDARY ONLY. (CLSR)	N

ARDM MATRIX (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 5**
Equipment Type:	**VALVE**	**Page 1 of 1**
Device Type:	**MOV**	**May 20, 1996**
Group ID:	**077-MOV-01**	

ARDM	077-MOV-01A Body	077-MOV-01B Stem	077-MOV-01C Bolt/Nut
Cavitation Erosion	02	02	19
Corrosion Fatigue	12	12	12
Crevice Corrosion	06	06	19
Erosion Corrosion	21	21	19
Fatigue	12	12	12
Fouling	15	15	19
Galvanic Corrosion	07	07	07
General Corrosion	01.3	01.3	19
Hydrogen Damage	03	03	19
Intergranular Attack	22	22	01.1
MIC	15	15	19
Particulate Wear Erosion	17	19	19
Pitting	06	06	19
Radiation Damage	01.3	01.3	01.1
Rubber Degradation	01.3	01.3	01.1
Selective Leaching	01.3	01.3	01.1
Stress Corrosion Cracking	18	18	01.1
Stress Relaxation	04	04	04
Thermal Damage	01.3	01.3	01.1
Thermal Embrittlement	04	04	04
Wear	16	20	16

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: MOV EQUIPMENT TYPE: VALVE

GROUP ID: 077-MOV-01 Date: 5/21/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.1 CARBON STEEL 01.3 STAINLESS STEEL	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS NOT THE TYPE NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7

CODE	DESCRIPTION	SOURCE
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONO-ATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUID IS PLANT VENT GASES. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THIS ARDM TO BE PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTHS OF 316 AND TYPICAL FORGED STAINLESS STEELS ARE BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING. THE EXTERNAL ENVIRONMENT (AIR) DOES NOT CONTAIN SUFFICIENT HYDROGEN OR PRESSURE TO MAKE THIS ARDM PLAUSIBLE. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN MAXIMUM WRGM SKID DESIGN TEMPERATURE OF 120°F, NORMAL AMBIENT TEMPERATURES IN THE MAIN PLANT EXHAUST ROOMS OF 110°F, AND DRYING EFFECTS OF WARMER TEMPERATURES, HYDROGEN DAMAGE DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 VOL-13 ES-014 FONTANA 60738 SH2 60722 SH1 CH-1-100 NP-5769 AVNER ASM
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500° F ENSURE THIS ARDM IS NOT PLAUSIBLE.	ATTACH 7 ES-014

CODE	DESCRIPTION	SOURCE
06	PROCESS FLUID AND MOISTURE DO NOT PERPETUATE THE ARDM. INPO OPERATIONS AND MAINTENANCE REMINDER O&MR-132 DESCRIBES OPERATIONAL FAILURES OF RAD MONITORING SYSTEMS DUE TO EXCESS MOISTURE. CCNPP RECENT HISTORY SHOWS ONE CASE WHERE WATER WAS INTRODUCED TO THE SYSTEM DUE TO BLOWDOWN TANK VENT BEING ALIGNED TO THE MAIN PLANT VENT (MO 2199402504). HOWEVER, PER INPUT FROM THE SYSTEM ENGINEER THIS IS NOT A COMMON OCCURRENCE. THE SYSTEM HAS NOT EXPERIENCED THE MOISTURE RELATED PROBLEMS DESCRIBED IN O&MR-132. SYSTEM OPERATION IS ASSURED IN ACCORDANCE WITH O/I-35. THE LIMITED AMOUNT OF MOISTURE PREVENTS SIGNIFICANT EFFECT FROM THESE AGING MECHANISMS.	ATTACH 7 O/I-35 INPO O&MR-132 MO 2199402504
07	PROCESS FLUID (AIR WITH SOME MOISTURE) DOES NOT PERPETUATE THE ARDM. MOST OF THE MOISTURE IS FILTERED OUT OF THE PROCESS FLUID. THE CARBON STEEL BOLTS AND NUTS ARE IN CONTACT WITH THE STAINLESS STEEL BODY AND END FITTINGS, BUT THE GENERAL LACK OF ELECTROLYTE TO COMPLETE A GALVANIC CIRCUIT MAKES THIS ARDM NOT PLAUSIBLE.	ATTACH 7 O/I-35 ES-014 12284-010
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM PRESSURES AND TEMPERATURES ARE LOW AND RELATIVELY STEADY MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 12284-010
15	ARDMS DO NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. FOULING AND MIC MAY OCCUR TO A LIMITED EXTENT DUE TO CONDENSED HUMIDITY (MOST OF WHICH IS FILTERED FROM THE PROCESS FLUID) FROM THE VENT GASES, MICROBES AND AIRBORNE PARTICLES. PLANT EXPERIENCE HAS SHOWN FOULING HAS OCCURRED IN THIS SYSTEM. HOWEVER, FOULING DOES NOT AFFECT THE PRESSURE BOUNDARY FUNCTION. MIC ACTIVITY WILL NOT BE SIGNIFICANT TO PRESSURE BOUNDARY FUNCTION DUE TO LIMITED AMOUNT OF CONDENSATION.	ATTACH 7 O/I-35
16	COMPONENT DESIGN DOES NOT PERPETUATE THE ARDM. WEAR IS NOT A PLAUSIBLE ARDM SINCE THE SUBCOMPONENTS ARE DESIGNED TO ELIMINATE ANY RELATIVE MOTION BETWEEN THE PARTS. THE SUBCOMPONENTS ARE DESIGNED SO THEY ARE NOT ADJACENT TO OTHER SUBCOMPONENTS OR THEY ARE RESTRAINED SUCH THAT THERE IS NO RELATIVE MOTION.	ATTACH 7 12284-010

CODE	DESCRIPTION	SOURCE
17	PARTICULATE WEAR EROSION IS NOT SIGNIFICANT. THE AIR VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF AIRBORNE PARTICLES WILL NOT LEAD TO SIGNIFICANT EROSION OF THE EROSION RESISTANT MATERIALS. FILTRATION OF AIR ON THE SAMPLE CONDITIONING SKID PREVENT SIGNIFICANT EFFECT FROM THIS AGING MECHANISM.	ATTACH 7 60738SH.2
18	STRESSES AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN 316 AND FORGED STAINLESS STEELS. THE LOW YIELD STRENGTH OF THESE MATERIALS MAKE THEM LESS SUSCEPTIBLE TO THE ARDM. THE EXTERNAL ENVIRONMENT (AIR) DOES NOT CONTAIN SUFFICIENT CONTAMINANTS OR PRESSURE TO MAKE THIS ARDM PLAUSIBLE. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN MAXIMUM WRGM SKID DESIGN TEMPERATURE OF 120°F, NORMAL AMBIENT TEMPERATURES IN THE MAIN PLANT EXHAUST ROOMS OF 110°F, AND DRYING EFFECTS OF WARMER TEMPERATURES, HYDROGEN DAMAGE DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 O/I-35 12284-010 60738 SH.2 VOL-13 ES-014 AVNER FONTANA 60722 SH.1 ASM NP-5461 CH-1-100 NP-5769
19	COMPONENT ENVIRONMENT DOES NOT PERPETUATE THE ARDM. THE SUBCOMPONENTS TYPICALLY ARE NOT EXPOSED TO THE PROCESS FLUID WHICH MAKES THE ARDM NON-PLAUSIBLE. THE EXTERNAL ENVIRONMENT IS NOT NORMALLY HARSH.	ATTACH 7

CODE	DESCRIPTION	SOURCE
20	WEAR DOES NOT SIGNIFICANTLY AFFECT COMPONENT INTENDED FUNCTION. VALVE OPERATION RESULTS IN STEM/PACKING CONTACT IN RELATIVE MOTION AND POTENTIALLY ABRASIVE WEAR. BALL VALVE DESIGN RESULTS IN MINIMAL STEM WEAR. WEAR OF PACKING WILL NOT RESULT IN LEAKAGE OF PRESSURE BOUNDARY SUBCOMPONENTS.	ATTACH 7 12284-010
21	PROCESS FLUID (AIR) AND MATERIAL SELECTION (SS) DO NOT PERPETUATE THE ARDM.	ATTACH 7
22	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN 316 AND FORGED STAINLESS STEELS. THE EXTERNAL ENVIRONMENT (AIR) DOES NOT CONTAIN SUFFICIENT CONTAMINANTS OR PRESSURE TO MAKE THIS ARDM PLAUSIBLE. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN MAXIMUM WRGM SKID DESIGN TEMPERATURE OF 120°F, NORMAL AMBIENT TEMPERATURES IN THE MAIN PLANT EXHAUST ROOMS OF 110°F, AND DRYING EFFECTS OF WARMER TEMPERATURES, HYDROGEN DAMAGE DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 O/I-35 12284-010 60738 SH.2 VOL-13 ES-014 AVNER FONTANA 60722 SH.1 ASM NP-5461 CH-1-100 NP-5769

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 3**
Equipment Type:	**VALVE**	**Page 1 of 1**
Device Type:	**MOV**	**May 21, 1996**
Group ID:	**077-MOV-02**	

Device Type: Motor Operated Valve

Vendor: Circle Seal

Model Number: 9562T-4CC

Material:

Internal Environment:

External Environment:

Function(s): Maintain System Pressure Boundary Integrity

Other Parameters:

List of Grouped Components:

1MOV5415BVLV	RE High Range Sample PP Suction
2MOV5415BVLV	RE High Range Sample PP Suction

ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079

SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA

GROUP ID: 077-MOV-02

Date: May 21, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Model Number (Source)	Material (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-MOV-02A	BODY AND PLUG (NONE)	CIRCLE SEAL (12284-010 Section 6 pp. 43-52)	9562T-4CC (12284-010 Section 6 pp. 43-52)	STAINLESS STEEL (12284-010 Section 6 pp. 43-52, LCM File C-96-004)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y

ARDM MATRIX (Revision 1)

System: Area & Process Radiation Monitoring (077/079)
Equipment Type: VALVE
Device Type: MOV
Group ID: 077-MOV-02

ARDM	077-MOV-02A Body
Cavitation Erosion	02
Corrosion Fatigue	12
Crevice Corrosion	06
Erosion Corrosion	21
Fatigue	12
Fouling	15
Galvanic Corrosion	07
General Corrosion	01.3
Hydrogen Damage	03
Intergranular Attack	22
MIC	15
Particulate Wear Erosion	17
Pitting	06
Radiation Damage	01.3
Rubber Degradation	01.3
Selective Leaching	01.3
Stress Corrosion Cracking	18
Stress Relaxation	04
Thermal Damage	01.3
Thermal Embrittlement	04
Wear	20

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: MOV EQUIPMENT TYPE: VALVE

GROUP ID: 077-MOV-02 Date: 5/21/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.3 STAINLESS STEEL	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID IS NOT THE TYPE NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONO-ATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUID IS PLANT VENT GASES. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THIS ARDM TO BE PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTHS OF 300 SERIES STAINLESS STEELS ARE BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING.	ATTACH 7 VOL-13 FONTANA 60738 SH2 60722 SH1 LCM C-96-004 AVNER ASM
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500° F ENSURE THIS ARDM IS NOT PLAUSIBLE.	ATTACH 7 ES-014

CODE	DESCRIPTION	SOURCE
06	PROCESS FLUID AND MOISTURE DO NOT PERPETUATE THE ARDM. INPO OPERATIONS AND MAINTENANCE REMINDER O&MR-132 DESCRIBES OPERATIONAL FAILURES OF RAD MONITORING SYSTEMS DUE TO EXCESS MOISTURE. CCNPP RECENT HISTORY SHOWS ONE CASE WHERE WATER WAS INTRODUCED TO THE SYSTEM DUE TO BLOWDOWN TANK VENT BEING ALIGNED TO THE MAIN PLANT VENT (MO 2199402504). HOWEVER, PER INPUT FROM THE SYSTEM ENGINEER THIS IS NOT A COMMON OCCURRENCE. THE SYSTEM HAS NOT EXPERIENCED THE MOISTURE RELATED PROBLEMS DESCRIBED IN O&MR-132. SYSTEM OPERATION IS ASSURED IN ACCORDANCE WITH O/I-35. THE LIMITED AMOUNT OF MOISTURE PREVENTS SIGNIFICANT EFFECT FROM THESE AGING MECHANISMS.	ATTACH 7 O/I-35 INPO O&MR-132 MO 2199402504
07	MATERIAL SELECTION/SEPARATION AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THE VALVE IS MADE OF MATERIALS WITH LOW POTENTIAL DIFFERENCES AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION.	ATTACH 7 O/I-35 12284-010
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM PRESSURES AND TEMPERATURES ARE LOW AND RELATIVELY STEADY MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 12284-010
15	ARDMS DO NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. FOULING AND MIC MAY OCCUR TO A LIMITED EXTENT DUE TO CONDENSED HUMIDITY FROM THE VENT GASES, MICROBES AND AIRBORNE PARTICLES. PLANT EXPERIENCE HAS SHOWN FOULING HAS OCCURRED IN THIS SYSTEM. HOWEVER, FOULING DOES NOT AFFECT THE PRESSURE BOUNDARY FUNCTION. MIC ACTIVITY WILL NOT BE SIGNIFICANT TO PRESSURE BOUNDARY FUNCTION DUE TO LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION.	ATTACH 7 O/I-35 12284-010
17	PARTICULATE WEAR EROSION IS NOT SIGNIFICANT. THE AIR VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF AIRBORNE PARTICLES WILL NOT LEAD TO SIGNIFICANT EROSION OF THE EROSION RESISTANT MATERIALS. FILTRATION OF AIR ON THE SAMPLE CONDITIONING SKID PREVENTS SIGNIFICANT EFFECT FROM THIS AGING MECHANISM.	ATTACH 7 60738SH.2

CODE	DESCRIPTION	SOURCE
18	STRESSES AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN 300 SERIES STAINLESS STEELS. THE LOW YIELD STRENGTH OF THESE MATERIALS MAKE THEM LESS SUSCEPTIBLE TO THE ARDM.	ATTACH 7 O/I-35 12284-010 LCM C-96-004 60738 SH.2 VOL-13 AVNER FONTANA 60722 SH.1 ASM NP-5461
20	WEAR DOES NOT SIGNIFICANTLY AFFECT COMPONENT INTENDED FUNCTION. VALVE OPERATION RESULTS IN STEM/PACKING CONTACT IN RELATIVE MOTION AND POTENTIALLY ABRASIVE WEAR. VALVE DESIGN RESULTS IN MINIMAL STEM WEAR. WEAR OF PACKING WILL NOT RESULT IN LEAKAGE OF PRESSURE BOUNDARY SUBCOMPONENTS.	ATTACH 7 12284-010 LCM C-96-004
21	PROCESS FLUID (AIR) AND MATERIAL SELECTION (SS) DO NOT PERPETUATE THE ARDM.	ATTACH 7
22	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN 300 SERIES STAINLESS STEELS.	ATTACH 7 O/I-35 12284-010 LCM C-96-004 60738 SH.2 VOL-13 AVNER FONTANA 60722 SH.1 ASM

COMPONENT GROUPING SUMMARY SHEET (Revision 1)

System:	**Area & Process Radiation Monitoring (077/079)**	**Attachment 3**
Equipment Type:	**VALVE**	**Page 1 of 1**
Device Type:	**SV**	**April 15, 1996**
Group ID:	**077-SV-01**	

Device Type:	Solenoid Valve
Vendor:	ASCO
Model Number:	HB-8262-A153, HB-8262-A231, HB-8211-C87, HTX-8211-B-30
Material:	
Internal Environment:	
External Environment:	
Function(s):	Maintain System Pressure Boundary Integrity
Other Parameters:	

List of Grouped Components:

1SV5415A	1 RE Filter Outlet Isolation SV
1SV5415B	1 RE Filter Outlet Isolation SV
1SV5416A	1 RE Filter Outlet Isolation SV
1SV5416B	1 RE Filter Outlet Isolation SV
1SV5417A	1 RE Filter Outlet Isolation SV
1SV5417B	1 RE Filter Outlet Isolation SV
1SV5418A	1 RE Sample Detection Skid Inlet SV
1SV5418B	1 RE Sample Detection Skid Isolation SV
1SV5419A	1 RE Sample Detection Skid Purge SV
1SV5419B	1 RE Sample Detection Skid Purge SV
2SV5415A	2 RE Filter Outlet Isolation SV
2SV5415B	2 RE Filter Outlet Isolation SV
2SV5416A	2 RE Filter Outlet Isolation SV
2SV5416B	2 RE Filter Outlet Isolation SV
2SV5417A	2 RE Filter Outlet Isolation SV
2SV5417B	2 RE Filter Outlet Isolation SV
2SV5418A	2 RE Sample Detection Skid Inlet SV
2SV5418B	2 RE Sample Detection Skid Inlet SV
2SV5419A	2 RE Sample Detection Skid Purge SV
2SV5419B	2 RE Sample Detection Skid Purge SV

ATTACHMENT 4, SUBCOMPONENT/SUB-GROUP IDENTIFICATION (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: Area & Process Radiation Monitoring

EQUIPMENT ID: NA GROUP ID: 077-SV-01 Date: May 21, 1996

Sub-Group ID	Sub-Component/Name (Replacement Pgm)	Manufacturer (Source)	Model Number (Source)	Material (Source)	Passive Intended Function(s) (Source)	Subject to AMR (Y or N)
077-SV-01A	BODY (NONE)	ASCO (12284-010 Section 6 pp. 25-35, 43-52)	8211, 8262 (12284-010 Section 6 pp. 25-35, 43-52)	STAINLESS STEEL (300 SERIES) (12284-010 Appendix pp. 18-26)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-SV-01B	CORE TUBE (NONE)	ASCO (12284-010 Section 6 pp. 25-35, 43-52)	8211, 8262 (12284-010 Section 6 pp. 25-35, 43-52)	STAINLESS STEEL (305) (12284-010 Appendix pp. 18-26)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-SV-01C	BOLTS (NONE)	ASCO (12284-010 Section 6 pp. 25-35, 43-52)	8211, 8262 (12284-010 Section 6 pp. 25-35, 43-52)	ALLOY/SS STEEL (NONE)	MAINTAIN PRESSURE BOUNDARY INTEGRITY (CLSR)	Y
077-SV-01D	INTERNALS (NONE)	ASCO (12284-010 Section 6 pp. 25-35, 43-52)	8211, 8262 (12284-010 Section 6 pp. 25-35, 43-52)	STAINLESS STEEL (12284-010 Appendix pp. 18-26)	NONE. NO LR INTENDED FUNCTION. COMPONENT IN LR SCOPE FOR PRESSURE BOUNDARY ONLY. (CLSR)	N

ARDM MATRIX (Revision 1)

System: Area & Process Radiation Monitoring (077/079)
Equipment Type: VALVE
Device Type: SV
Group ID: 077-SV-01

ARDM	077-SV-01A Body	077-SV-01B Core Tube	077-SV-01C Bolts
Cavitation Erosion	02	02	19
Corrosion Fatigue	12	12	12
Crevice Corrosion	06	06	19
Erosion Corrosion	21	21	19
Fatigue	12	12	12
Fouling	15	15	19
Galvanic Corrosion	07	07	07
General Corrosion	01.3	01.3	19
Hydrogen Damage	03	03	19
Intergranular Attack	22	22	01.3
MIC	15	15	19
Particulate Wear Erosion	17	17	19
Pitting	06	06	19
Radiation Damage	01.3	01.3	01.3
Rubber Degradation	01.3	01.3	01.3
Selective Leaching	01.3	01.3	01.3
Stress Corrosion Cracking	18	18	18
Stress Relaxation	04	04	04
Thermal Damage	01.3	01.3	01.3
Thermal Embrittlement	04	04	04
Wear	16	20	16

Matrix Code List (Revision 1)

SYSTEM NUMBER: 077/079 SYSTEM NAME: AREA & PROCESS RADIATION MONITORING

DEVICE TYPE: SV EQUIPMENT TYPE: VALVE

GROUP ID: 077-SV-01 Date: 5/21/96

CODE	DESCRIPTION	SOURCE
01	MATERIAL IS NOT APPLICABLE TO THE ARDM. MATERIAL OF CONSTRUCTION IS NOT SUSCEPTIBLE TO THIS ARDM: 01.3 STAINLESS STEEL/ALLOY STEEL	ATTACH 7
02	PROCESS FLUID TYPE DOES NOT PERPETUATE THE ARDM. THE PROCESS FLUID (AIR) IS NOT THE TYPE NORMALLY ASSOCIATED WITH THIS ARDM.	ATTACH 7

CODE	DESCRIPTION	SOURCE
03	PROCESS FLUID DOES NOT PERPETUATE THE ARDM. HYDROGEN DAMAGE REQUIRES SURFACE CORROSION WHICH CREATES A SOURCE OF MONO-ATOMIC HYDROGEN THAT ENTERS THE GRAIN STRUCTURE OF THE METAL. THE PROCESS FLUID DOES NOT CREATE THE REQUIRED CORROSION SITES. THE PROCESS FLUID IS PLANT VENT GASES. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THIS ARDM TO BE PLAUSIBLE. MATERIALS DO NOT PERPETUATE THE ARDM. THE LOW YIELD STRENGTHS OF 300 SERIES STAINLESS STEELS AND TYPICAL BOLTING MATERIALS ARE BELOW THE THRESHOLD OF 120 KSI TYPICALLY NECESSARY FOR HYDROGEN CRACKING. THE EXTERNAL ENVIRONMENT (AIR) DOES NOT CONTAIN SUFFICIENT HYDROGEN OR PRESSURE TO MAKE THIS ARDM PLAUSIBLE. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN MAXIMUM WRGM SKID DESIGN TEMPERATURE OF 120°F, NORMAL AMBIENT TEMPERATURES IN THE MAIN PLANT EXHAUST ROOMS OF 110°F, AND DRYING EFFECTS OF WARMER TEMPERATURES, HYDROGEN DAMAGE DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 VOL-1 VOL-13 FONTANA 60738 SH2 60722 SH1 CH-1-100 NP-5769 AVNER ASM
04	PROCESS FLUID TEMPERATURE DOES NOT PERPETUATE THE ARDM. OPERATING TEMPERATURES LESS THAN 500° F ENSURE THIS ARDM IS NOT PLAUSIBLE.	ATTACH 7 ES-014

CODE	DESCRIPTION	SOURCE
06	PROCESS FLUID AND MOISTURE DO NOT PERPETUATE THE ARDM. INPO OPERATIONS AND MAINTENANCE REMINDER O&MR-132 DESCRIBES OPERATIONAL FAILURES OF RAD MONITORING SYSTEMS DUE TO EXCESS MOISTURE. CCNPP RECENT HISTORY SHOWS ONE CASE WHERE WATER WAS INTRODUCED TO THE SYSTEM DUE TO BLOWDOWN TANK VENT BEING ALIGNED TO THE MAIN PLANT VENT (MO 2199402504). HOWEVER, PER INPUT FROM THE SYSTEM ENGINEER THIS IS NOT A COMMON OCCURRENCE. THE SYSTEM HAS NOT EXPERIENCED THE MOISTURE RELATED PROBLEMS DESCRIBED IN O&MR-132. SYSTEM OPERATION IS ASSURED IN ACCORDANCE WITH O/I-35. THE LIMITED AMOUNT OF MOISTURE PREVENTS SIGNIFICANT EFFECT FROM THESE AGING MECHANISMS.	ATTACH 7 O/I-35 INPO O&MR-132 MO 2199402504
07	MATERIAL SELECTION AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THE ALLOY STEEL BOLTS AND NUTS ARE IN CONTACT WITH THE STAINLESS STEEL BODY, BUT THE GENERAL LACK OF ELECTROLYTE TO COMPLETE A GALVANIC CIRCUIT MAKES THIS ARDM NOT PLAUSIBLE.	ATTACH 7 ES-014 12284-010
12	SERVICE LOADING AMPLITUDES/FREQUENCIES DO NOT PERPETUATE THE ARDM. THE SYSTEM PRESSURES AND TEMPERATURES ARE LOW AND RELATIVELY STEADY MAKING THIS ARDM NOT PLAUSIBLE.	ATTACH 7 12284-010
15	ARDMS DO NOT SIGNIFICANTLY AFFECT COMPONENT FUNCTION. THE FOLLOWING RECOGNIZES THAT PARTS ON THE CORE SIDE OF THE DIAPHRAGM ARE ONLY SUBJECTED TO PROCESS FLUID ENVIRONMENTS IF A LEAK DEVELOPS IN THE NON-PRESSURE BOUNDARY DIAPHRAGM. FOULING AND MIC MAY OCCUR TO A LIMITED EXTENT DUE TO CONDENSED HUMIDITY FROM THE VENT GASES, MICROBES AND AIRBORNE PARTICLES. PLANT EXPERIENCE HAS SHOWN FOULING HAS OCCURRED IN THIS SYSTEM. HOWEVER, FOULING DOES NOT AFFECT THE PRESSURE BOUNDARY FUNCTION. MIC ACTIVITY WILL NOT BE SIGNIFICANT TO PRESSURE BOUNDARY FUNCTION DUE TO LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION.	ATTACH 7 O/I-35 12284-010

CODE	DESCRIPTION	SOURCE
16	COMPONENT DESIGN DOES NOT PERPETUATE THE ARDM. WEAR IS NOT A PLAUSIBLE ARDM SINCE THE SUB-COMPONENTS ARE DESIGNED TO MINIMIZE ANY RELATIVE MOTION BETWEEN THE PARTS. THE SUB-COMPONENTS ARE DESIGNED SO THEY ARE NOT ADJACENT TO OTHER SUB-COMPONENTS OR THEY ARE RESTRAINED SUCH THAT THERE IS NO RELATIVE MOTION.	ATTACH 7 12284-010
17	PARTICULATE WEAR EROSION IS NOT SIGNIFICANT. THE AIR VELOCITY IS SUFFICIENT TO CARRY PARTICLES, HOWEVER, THE LIMITED SOURCE OF AIRBORNE PARTICLES WILL NOT LEAD TO SIGNIFICANT EROSION OF THE EROSION RESISTANT MATERIALS. FILTRATION OF AIR ON THE SAMPLE CONDITIONING SKID PREVENTS SIGNIFICANT EFFECT FROM THIS AGING MECHANISM. PARTS ON THE CORE SIDE OF THE DIAPHRAGM ARE ONLY SUBJECTED TO PROCESS FLUID ENVIRONMENTS IF A LEAK DEVELOPS IN THE NON-PRESSURE BOUNDARY DIAPHRAGM.	ATTACH 7 60738 SH.2 12284-010
18	STRESSES AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL, TENSILE STRESSES AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE SYSTEM IS NOT HIGHLY STRESSED AND THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN 300 SERIES STAINLESS STEELS AND TYPICAL BOLTING MATERIALS. THE LOW YIELD STRENGTHS OF THESE MATERIALS MAKE THEM LESS SUSCEPTIBLE TO THE ARDM. THE EXTERNAL ENVIRONMENT (AIR) DOES NOT CONTAIN SUFFICIENT CONTAMINANTS OR PRESSURE TO MAKE THIS ARDM PLAUSIBLE. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN MAXIMUM WRGM SKID DESIGN TEMPERATURE OF 120°F, NORMAL AMBIENT TEMPERATURES IN THE MAIN PLANT EXHAUST ROOMS OF 110°F, AND DRYING EFFECTS OF WARMER TEMPERATURES, HYDROGEN DAMAGE DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 O/I-35 12284-010 60738 SH.2 VOL-13 ES-014 AVNER FONTANA 60722 SH.1 ASM NP-5461 CH-1-100 NP-5769

CODE	DESCRIPTION	SOURCE
19	COMPONENT ENVIRONMENT DOES NOT PERPETUATE THE ARDM. THE SUB-COMPONENTS TYPICALLY ARE NOT EXPOSED TO THE PROCESS FLUID WHICH MAKES THE ARDM NON-PLAUSIBLE. THE EXTERNAL ENVIRONMENT IS NOT NORMALLY HARSH.	ATTACH 7
20	WEAR DOES NOT SIGNIFICANTLY AFFECT COMPONENT INTENDED FUNCTION. VALVE OPERATION RESULTS IN CORE AND CORE TUBE RELATIVE MOTION AND POTENTIALLY ABRASIVE WEAR. HOWEVER, SOLENOID VALVE DESIGN MAGNETICALLY CENTERS THE CORE IN THE CORE TUBE, RESULTING IN INSIGNIFICANT WEAR.	ATTACH 7 12284-010
21	PROCESS FLUID (AIR) AND MATERIAL SELECTION (SS) DO NOT PERPETUATE THE ARDM.	ATTACH 7
22	MATERIAL AND ENVIRONMENT DO NOT PERPETUATE THE ARDM. THIS ARDM REQUIRES A SUSCEPTIBLE MATERIAL AND AN APPROPRIATE ENVIRONMENT. THIS ARDM IS NOT PLAUSIBLE SINCE THE ONLY MOISTURE RESULTS FROM A LIMITED AMOUNT OF CONDENSATION, MOST OF WHICH IS REMOVED BY FILTRATION. FLOW FROM SYSTEMS INTO THE PLANT VENT IS NOT EXPECTED TO CONTAIN CONCENTRATIONS OF ATMOSPHERIC CONTAMINANTS WHICH WOULD CAUSE THE ARDM TO BE PLAUSIBLE IN 300 SERIES STAINLESS STEELS. THE EXTERNAL ENVIRONMENT (AIR) DOES NOT CONTAIN SUFFICIENT CONTAMINANTS OR PRESSURE TO MAKE THIS ARDM PLAUSIBLE. MOLY DISULFIDE LUBRICANTS ARE PERMITTED BY PROCEDURE TO BE USED ON NON-RESTRICTED SYSTEMS SUCH AS RMS. HOWEVER, MOLY DISULFIDE LUBRICANTS REQUIRE MOISTURE AND TEMPERATURE (>150°F) TO DECOMPOSE INTO HYDROGEN SULFIDE. GIVEN MAXIMUM WRGM SKID DESIGN TEMPERATURE OF 120°F, NORMAL AMBIENT TEMPERATURES IN THE MAIN PLANT EXHAUST ROOMS OF 110°F, AND DRYING EFFECTS OF WARMER TEMPERATURES, HYDROGEN DAMAGE DUE TO MOLY DISULFIDE LUBRICANTS IS NOT A CONCERN.	ATTACH 7 O/I-35 12284-010 60738 SH.2 VOL-13 ES-014 AVNER FONTANA 60722 SH.1 ASM NP-5461 CH-1-100 NP-5769