BURNS AND ROE, INC.

THREE MILE ISLAND NUCLEAR STATION UNIT 2

RECOVERY PROGRAM

PRELIMINARY SYSTEM DESCRIPTION TASK TS-27

MINI DECAY HEAT REMOVAL SYSTEM

(B&R DWG. M041, REV. 6) 4

(B&R DWG. M043, REV. 9)

(B&R DWG. M044, REV. 1)

(B&R DWG. M045, REV. 1)

(B&R DWG. M227, REV. 0) 4

REV. 4 4
10/07/80

8011070358

PT&O DOCUMENT

APPROVAL RECORD

Mini Decay Heat Removal System Description — TS-27, Rev. 4

Title — Document Number

1. Written By: R. Brownewell — 10/7/80
   PT&O Engineer

2. Preliminary Approval: R. Brownewell — 10/7/80
   PT&O Group Supervisor

3. Transmitted for Technical Review

4. Technically Approved By:

	(Name)	(Signature)	(Date)
Mech.	A. Asarpota	[illegible]	10/22/80
Nuclear	R. Seibert	CW Hm M.R. Seibert	10/22/80
HVAC	M. Muray	Harold W Young for M. Muray	10/22/80
I&C	S. Fox	Stan Fox	10/21/80
Elect.	R. Gagliardo	R Gagliardo	10/21/80
Stress	J. Kiven	J Kiven	10/21/80
Civil	S. Chou	S Chou	10/21/81

5. Final Approval PT&O — E T English — 10/22/80

REVISION RECORD

PRELIMINARY SYSTEM DESCRIPTION TASK TS-27 MINI DECAY HEAT REMOVAL SYSTEM

Rev.	Date	Project Manager Approval	Rev.	Date	Project Manager Approval
0	11/16/79	H.R. Lane			
1	1/21/80	R. Brownewell for H.R. Lane			
2	7/24/80	R. Brownewell for J.N. Maciejewski			
3	8/13/80	J.N. Maciejewski			
4	10/23/80	R. Brownewell for J.N. Maciejewski			

LIST OF EFFECTIVE PAGES
PRELIMINARY SYSTEM DESCRIPTION
MINI DECAY HEAT REMOVAL SYSTEM TASK TS-27

Page Number	Revision Number				
	0	1	2	3	4
i	*	*	*	*	*
ii	*	*	*	*	*
iii	*	*	*	*	*
iv	*	*	*	*	*
v	*	*	*	*	*
1	*	*	*	*	*
2	*	*	*	*	*
3	*	*	*	*	*
4	*	*	*	*	*
5	*	*	*	*	*
6	*	*	*	*	*
7	*	*	*	*	*
8	*	*	*	*	*
9	*	*	*	*	*
10	*	*	*	*	*
11	*	*	*	*	*
12	*	*	*	*	*
13	*	*	*	*	*
14	*	*	*	*	*
15	*	*	*	*	*
16	*	*	*	*	*
17	*	*	*	*	*
18	*	*	*	*	*
19	*	*	*	*	*
20	*	*	*	*	*
21	*	*	*	*	*
22	*	*	*	*	*
23	*	*	*	*	*
24	*	*	*	*	*
25	*	*	*	*	*
26	*	*	*	*	*
27	*	*	*	*	*
28	*	*	*	*	*
29	*	*	*	*	*
30	*	*	*	*	*
31	*	*	*	*	*
32	*	*	*	*	*
33	*	*	*	*	*
34		*	*	*	*
35		*	*	*	*
36		*	*	*	*
37		*	*	*	*
38		*	*	*	*
39		*	*	*	*
40		*	*	*	*
41		*	*	*	*
42		*	*	*	*
43		*	*	*	*

LIST OF EFFECTIVE PAGES
PRELIMINARY SYSTEM DESCRIPTION
MINI DECAY HEAT REMOVAL SYSTEM TASK TS-27

Page Number	Revision Number				
	0	1	2	3	4
44		*	*	*	*
45		*	*	*	*
46			*	*	*
47			*	*	*
48			*	*	*
49			*	*	*
50			*	*	*
51			*	*	*
52			*	*	*
53			*	*	*
54			*	*	*
55			*	*	*
56			*	*	*

TABLE OF CONTENTS

FOR

MINI DECAY HEAT REMOVAL SYSTEM

2

APPENDIX

1.0 INTRODUCTION

1.1 System Functions

The functions of the Mini Decay Heat Removal System (MDHR) are as follows:

a. Remove heat from the reactor coolant system by forced circulation through the core.

b. Provide a method of removing heat from the reactor coolant system during reactor vessel head removal and vessel defueling.

c. Provide piping connections for future cleanup of the reactor coolant system.

d. Provide a means of sampling the reactor coolant system utilizing the Mini Decay Heat Removal System.

e. Provide a means of controlling ambient temperature and airborne radiation levels in the pump and heat exchanger enclosures.

The Mini Decay Heat Removal System has an interface with the following systems:

a. Alternate Decay Heat Removal System, ADH, (Westinghouse DWG. WTM1-1019-2).

b. Temporary Nuclear Sampling System, SNS, (Burns & Roe DWG. M044 & M045).

c. "Temporary" Nuclear Services Closed Cooling Water System, TNSCCW, (Burns & Roe DWG. M041).

d. Decay Heat Removal System, DH, (Burns & Roe DWG. 2026).

e. Heating and Ventilation Fuel Handling Building (Burns & Roe Dwg. 2343).

f. H&V Mini Decay Heat Removal System Fuel Handling Building (Burns & Roe Dwg. M227). 4

1.2 Summary Description of the System (Refer to Burns & Roe DWGS. M043 Rev. 9, M041 Rev. 6 and M227 Rev. 0)

When it is desirable t switch from the natural circulation mode of the Reactor Coolant System to forced circulation for decay heat removal, the

Mini Decay Heat Removal System will be put into service until the reactor has been completely defueled. The Mini Decay Heat Removal System takes suction from the "B" loop reactor outlet (hotleg) via a connection to the Alternate Decay Heat Removal System (ADH) which connects to the original plant Decay Heat System (DH). After passing through one of the MDHR system's parallel heat exchangers and one of the MDHR pumps, the coolant is returned to the reactor through the "B" Core Flooding injection nozzle via a connection to the ADH and DH systems.

Within the Mini Decay Heat Removal System, the reactor coolant first passes through a filter to remove possible debris in the Decay Heat Drop Leg. The filter may then be bypassed and can be removed in its lead shielded portable cask or replaced by a back-up filter. 2

The flow proceeds to the selected heat exchanger (MDH-HX-1A or MDH-HX-1B) where the heat is transferred to the shell side cooled by the "Temporary" Nuclear Services Closed Cooling System (TNS). (The TNS System is supplied by the existing plant Nuclear Service Closed Cooling System via a tie into the "A" Spent Fuel Cooler supply and return lines.)

The discharge from the MDHR heat exchangers combines into a common line and is routed to the selected Mini Decay Heat Removal Pump suction (MDH-P-1A or MDH-P-1B). The suction line contains the Temporary Nuclear Sampling System return sample connection. The MDH pumps discharge thru individual check valves and discharge isolation valves before combining into a common header containing a manually operated throttle valve to regulate flow to the reactor coolant system. This discharge header is provided with a full flow recirculation line and throttling valve running back to the heat exchanger suction to facilitate system testing, startup, and meet the minimum flow requirements during system operation.

Double valved tie-in connections are installed upstream and downstream of the system's outlet isolation valve (MDH-V15) to provide the capability to connect to a future system for RC water clean-up. 4

Prior to the coolant being returned to the ADH/DH system the flow rate can be measured and an RC water sample can be taken by the Temporary Nuclear Sampling System. Remotely operated valves are provided for flushing, venting and draining of the system to reduce area radiation levels for equipment maintenance.

Since two parallel pumps and heat exchangers have been installed in the system for redundancy, either pump can be operated with either heat exchanger. However, pump MDH-P-1B is to be preferentially used as the primary MDHR pump because of its superior access for maintainability. A "cross connect" line located downstream of the "A" heat exchanger but upstream of the "B" heat exchanger allows a series flow arrangement if additional heat removal capacity be required.

Redundant motor operated isolation valves are installed at the Mini Decay Heat Removal System tie-in points to the Alternate Decay Heat Removal System piping. These remote operated isolation valves function to separate the MDHR system from the safety grade Decay Heat Removal System and establish the interface with the RC system pressure boundary. The first MDHR system outlet isolation valve is provided with jog control capability and will be the normal method of flow control.

Radiation shielding of the MDHR system piping, pumps and heat exchangers has been provided by either utilizing existing shield walls or the construction of additional walls to minimize the exposure to operating personnel. The MDHR heat exchangers are located in the southern most portion of the 280'-6" elevation of the Fuel Handling building and are separated from the MDHR pumps on the north side by an existing 2' thick shield wall. A curb is provided around the perimeter of the MDHR heat exchangers to contain any flange leakage and direct it to a floor drain. The MDHR pumps are shielded on their north side and between the A & B pumps by 2' thick 7'-4" high seismically constructed concrete block walls. The pump cubicle is surrounded by 16" thick, 7'-4" high seismic block walls on the east and west sides. An entrance doorway exists on the east wall of the pump enclosure and a sheetmetal roof completes the cubicle to form a controlled HVAC environment. The supply and return sample lines from the MDHR pump's discharge and suction connection points to the Temporary Nuclear Sampling System on the 305'-0" elevation of the Fuel Handling Bldg. have continuous shielding installed. This shielding is either in the form of 2" lead brick, 1" lead sheet or 8" solid concrete block to prevent an excessive increase in area radiation levels during the sampling evolution. 4

Additionally these supply and return sample lines have demineralized water flush connections at the SNS system sample sink to backflush both lines to the MDHR system connection points if the area radiation levels should become excessive as a result of repeated sampling. For a detailed description and operating requirements of this sampling evolution refer to the S.D. & O.P. for Task WG-19, Temporary Nuclear Sampling System. 4

As mentioned above the MDHR pumps are enclosed in a shielded and environmentally controlled cubicle to prevent the spread of airborne contamination should a leak develop at the pump's seals or piping flanges. The cubicles are ventilated by redundant HEPA fan/filtration units with a capacity of 2200 cfm each and are located on the 280'-6" elevation of the F.H. Building between the Decay Heat Service Coolers. The fan(s) (MDH-E-1A and MDH-E-1B) discharge to the general area after an air flow sample passes through the Particulate, Iodine and noble gas monitor (PIG).

1.3 System Design Requirements

1.3.1 Overall System Performance Requirements

The Mini Decay Heat Removal System is designed to remove 2.25 x 10^6 BTU/hr from the Reactor Coolant System using one pump and one heat exchanger. This is sufficient to remove the decay heat generated on August 1, 1979 or any lower heat load thereafter and transfer it to the ultimate heat sink (i.e. river water) via the Nuclear Services Closed Cooling Water and Nuclear Services River Water Systems. This heat removal rate is satisfied by a MDHR system flow rate of 120 gpm @ 175°F with a T.N.S. system flow of 200 gpm and maximum TNS system temperature of 100°F. The MDHR system design temperature is 200°F and design pressure is 235 psig.

1.3.2 Applicable Design Codes and Standards for Piping and Components.

Description	Manufacturing Code	Installation Code
Connection to the decay heat system downstream of DH-V3 up to and including the first isolation valve.	ASME-Section III Class 2	ANSI B31.7 Class 2
Connection to the decay heat system downstream of DH-V3 from the first isolation valve up to and including the second isolation valve.	ASME-Section III Class 3	ANSI B31.7 Class 2
Connection to the decay heat system upstream of DH-V4B up to and including the second isolation valve.	ASME-Section III Class 2	ANSI B31.7 Class 2

N.S.C.C.W. System Connections: piping up to isolation valve.	ANSI B31.1*	ANSI B31.1*
Isolation valves	ASME-Section III Class 3	ANSI B31.1*
Balance of Piping 2" Piping W/O. B.E. Seismic	ANSI B31.1	ANSI B31.1
4" Piping	ANSI B31.1	ANSI B31.1
Heat Exchangers	ASME-Section VIII TEMA Standard (ASME Section III if available) & supported for O.B.E. loads	----------
Pumps	Hydraulic Institute Standards (ASME Section III if available)	----------
Filter	ASME-Section VIII	

*Seismically supported for Category I loadings.

The portions of the system that are ANSI B31.7 Class 2 are seismic Category I. The remaining portions of the system that convey reactor coolant are designed to Operating Basis Earthquake (OBE) loads. The balance of the system is designed non-seismic except the NSCC tie-in lines up to the isolation valves which shall be Category I seismically supported.

All system process piping and tubing lines are constructed of stainless steel and the cooling water lines are fabricated using carbon steel.

2.0 DETAILED DESCRIPTION OF SYSTEM

2.1 Components

2.1.1 Mini-Decay Heat Removal Pumps, MDH-P-1A & MDH-P-1B

The Mini Decay Heat Removal Pumps (Table 1 and Figure 2) are single-stage centrifugal pumps rated at 120 gpm each with a developed head of 195 ft. The pumps are provided with mechanical shaft seals to minimize system leakage of radioactive water. Seal injection is provided from the pump discharge thru a cyclone separator. The separator drain is routed back to the pump's suction. The mechanical shaft seals are provided with a demineralized water flush capability between the cyclone separator outlet and the seal inlet. This demineralized water connection will permit flushing of the durametallic seal faces just prior to securing the operating pump. The pre-shutdown flushing functions to remove the borated water from the closed loop seal injection system and thus prevents boron from crystalizing on the seal faces. The crystalized boron on the mechanical sealing components could result in seal face damage and subsequent leakage of radioactive water when the pump is restarted. The demineralized water seal supply comes from a local station quick disconnect via a removable hose. This supplies an isolation valve, flow meter and check valve (located outside the shielded MDHR pump cubical) before it ties into the outlet of the cyclone separator.

A failed seal's leakage is directed to the pump's base plate where it is drained to the floor drain system. This floor drain system is part of the plant's Radwaste Disposal Miscellaneous Liquids system shown on B&R Dwg. 2045. Consequently all floor drains in the MDHR area empty into the Auxiliary Building sump from which it is pumped into the Auxiliary Building Sump Tank. From this tank, the liquids can be directed to almost any other part of the plant's radwaste liquid system. Existing traps in the floor drains prevent gases from leaking out of the drain lines and into areas which are not ventilated by the MDHR Pump Cubicle Ventilation system. Airborne radiation monitors will detect gross leakage indicating a seal failure.

The pump's are supplied with a constant level oiler in the bearing frame. Each MDHR pump casing drain plug has been provided with a 1/2" SS pipe nipple and screwed cap. This will permit "bagged" draining of the pump casing following system flush and pump isolation for subsequent maintenance.

The pumps have minimum flow protection thru a common recirculation line back to the heat exchangers suction (i.e. Recirculation line Throttle Valve, MDH-V20, is always cracked open). The MDHR pumps are located on the 280'6" level of the Fuel Handling Building to assure adequate NPSH during operation of the system when the reactor vessel head is removed.

The MDHR pumps are interlocked with the existing plant Decay Heat Removal Pumps, DH-P-1A and DH-P-1B, such that the MDH pumps will trip off if either DH pump starts. This prevents the possibility of overpressurizing the MDHR system if a decay heat pump is started when a Mini Decay Heat Removal Pump is in operation.

The power supply to the pump motors, which are non Class 1E, is 2
supplied by redundant Class 1E Motor Control Centers and will be manually loaded on the Class 1E diesels in the event of a loss of off site power. The 15 hp pump motors are not Class 1E qualified. MDH-P-1A and MDH-P-1B are powered from MCC-2-11EA compt. 3AR and MCC-2-21EA compt. 3AR respectively. Control (start/stop/spring return to normal) and indication for the pumps are on the local panel (MDH-PNL-1) in the 280'6" el. of the F.H. Bldg. and the remote panel (MDH-PNL-2) in the Unit II control room.

2.1.2 Heat Exchangers, MDH-HX-1A and MDH-HX-1B

The Mini Decay Heat Removal System Heat Exchangers (Table 2) transfer the primary coolant heat to the Temporary Nuclear Services Closed Cooling Water System circulating through the shell side. The Nuclear Services River Water System, in turn, removes the heat from the Nuclear Service Closed Cooling Water heat exchangers and transfers it to the Mechanical Draft Cooling Towers.

The MDHR heat exchangers are of the "U" tube design with Temporary Nuclear Service Closed Cooling Water on the shell side and the reactor coolant on the tube side. The heat exchanger is designed in accordance with the ASME Code, Section III, Class 3, 1971 Ed. The tubes have been seal welded into the tube sheet. The heat exchangers are located on the 280'6" elevation of the

Fuel Handling Building. The Temporary Nuclear Services Closed Cooling Water inlet isolation valve to the coolers is interlocked to close on a flow imbalance on the shell side of the cooler which would be indicative of a tube rupture or piping leak in the TNS system non-safety piping.

Relief valves are provided to prevent thermal over pressurization of either the shell or tube side when the MDHR heat exchangers are isolated.

2.1.3 MDHR Inlet Debris Filter, MDH-F-1

The Inlet Debris Filter (Table 3) has been designed to handle the debris that may be in the DH drop line when the system is started. It is a specially designed filter which fits into a lead shielded portable cask. The filter is considered a "one-shot" filter because the elements are not replaceable (however, the filter/cask unit is replaceable. The unit is constructed of Type 304 stainless steel with an all welded design having 3" inlet/outlet flanges and 1/2" vent/drain connectors. Additionally the inlet and outlet pipe stubs on the filter unit are provided with 1/2" tubing, valve and quick disconnect. These are located external to the cask and permit draining the inlet/outlet connections below the flange connections prior to filter removal or replacement. It is a pressure vessel designed in accordance with the ASME BPVC Sect. VIII Div. 1 requirements. The unit is located in the F.H. Bldg. on the 280'6" elevation within the shield cask. This cask has an exterior shell consisting of a pipe spool 28" O.D. with top and bottom plates all constructed of carbon steel. Four casters welded to the bottom plate provide mobility for filter change out and will facilitate easy removal from its installed location. Internal lead shielding of the cask consists of 2" top and bottom with 3" on the vertical cylinder portion. After the "one-shot" usage of the filter it will be isolated, bypassed, and properly disposed of. If additional filtration is required, the depleted filter will be replaced with a duplicate unit.

2.1.4 <u>MDHR Air Filtration Fans (MDH-E1A & MDH-E1B) and Pre-Filter/H.E.P.A. Filter Enclosures (MDH-F-1A/2A & MDH-F-1B/2B)</u>

These redundant MDHR air filtration units (see Table 4 for fans and Table 5 for filters) function to exhaust air from the cubicals, filter the air, and transfers the air to the general area. This maintains acceptable temperatures in the cubicles, limits the buildup of contamination in the cubicles to permit maintenance, and minimizes the spreading of contamination. The existing F.H. Building air supply duct discharges 2900 cfm to the MDHR heat exchanger room where 900 cfm is drawn from the room into the Reactor Building Chase and 2000 is directed to the MDHR Pump Cubicle. The operating MDHR fan will exhaust 2200 cfm from the pump cubicle. Two thousand cfm is transferred from the heat exchange room and 200 cfm infiltrates from the general area for the total of 2200 cfm. This flow passes thru a common inlet balancing damper (D-109) and the motor operated damper upstream the operating filtration unit. The air then flows through the filtration unit. Each filtration unit contains two filter housings in parallel, each containing a pre-filter and HEPA filter. The flow proceeds thru the fan and out the motor operated discharge damper where it combines into a common discharge from the idle fan/filtration unit. The air is then

exhausted to the general area at elevation 280'-6" after the 3
flow is measured/ alarmed and an airborne radiation sample is continuously monitored.

Each filtration unit is furnished with a differential pressure indication switch with a high d/p alarm. The fans (MDH-E-1A/1B) are controlled from local control switches on MDH-PNL-1 and are interlocked to open their respective motor operated supply and discharge dampers when the unit is started. Power for the fans is supplied by MCC - 2-11EA compt. 2ARR for MDH-E-1A and MCC - 2-21EA compt. 2ARR for MDH-E-1B.

2.1.5 Major System Valves

Mini Decay Heat Removal Suction Header Isolation Valves, MDH-V1 and MDH-V2

Two 600 psig (ANSI Rating), 2 inch stainless steel, electric 2
motor operated globe valves in series are provided in the inlet suction header to the MDHR system. These valves provide redundant isolation capability from the tie-in to the ADHR system and DH system. Both valves are closed except when the Mini-Decay Heat Removal System is in operation. The electrical power to the valve motors is supplied from the redundant Class 1E 2
buses. MDH-V1 receives its power from MCC-2-11EA compt. 2BF and is controlled from panel 8A in the control room (formerly used to control DC-V114). MDH-V2 receives its power from MCC-2-21EA compt. 8BR and is controlled from panel 15 in the control room (formerly used to control WDL-V271).

Mini Decay Heat Removal Discharge Header Isolation Valves, MDH-V18 and MDH-V19

Two 1500 psig (ANSI Rating), 2 inch stainless steel, electric motor 2 operated globe valves in series are provided in the discharge header [illegible] the MDHR system tie-in to the ADHR system. These valves provide redundant isolation capability from the DH system and primary system boundaries. Both valves are closed except when the Mini-Decay Heat Removal system is required to operate. The existing plant Class 1E buses provided redundant power to 2 the valve's motor operators. MDH-V19 receives its power from MCC-2-11EA compt. 3DF and is controlled from panel 15 in the control room (formerly used to control WDL-V1126). MDH-V18 receives its power from MCC-2 -21EA compt. 7BF and is controlled from panel 8A in the control room (formerly used to control DC-V115). MDH-V18 has the capability of jog control if it is deemed necessary to throttle MDHR system outlet flow from the control room.

<u>Nuclear Services Closed Cooling Water Supply Isolation Valve to Temporary NSCCW, TNS-V1007</u>

One 350 psig, 300°F, 4 inch, stainless steel, electric motor operated gate valve is installed in the NSCCW supply line upstream of the Mini Decay Heat Removal Heat Exchangers (Re-tagged from BS-V4A which was spared). This valve provides the system boundary change from Seismic I, SC piping to Seismic II, conventional piping. The valve motor operator has been provided with a Class 1E power supply from MCC-2-21EA, compt. 6BF and is 2 manually controlled from panel 8A in the Control Room (formerly used to control DC-V103). Additionally the valve is interlocked to close and isolate the NSCCW supply to the MDHR heat exchangers if the outlet flow exceeds the inlet flow to the heat exchangers or visa versa. The purpose of this is to prevent the spread of contamination to the NSCCW system in the event of a tube rupture in the MDHR heat exchangers or isolate the coolers if a piping leak occurs in the TNS system (i.e. isolates the safety portion of the NSC from the non-safety TNS piping). The valve's nuclear classification is N-3, quality level Q-3, Seismic I, and Cleanliness class D.

<u>MDHR System Remote Flushing, Draining and Vent Valves</u>: MDH-V21, MDH-V22, MDH-V29, MDH-V30, MDH-V32, MDH-V34, MDH-V35, and MDH-V36. The primary side of the MDH system has been designed with the capability for remote isolation, draining, flushing and venting to minimize radiation exposure to maintenance personnel. Eight 235 psig, 200^{o}F, 2 inch, stainless steel, air operated Tufline plug valves, which fail close on loss of air or electric power, have been incorporated into the system to accomplish this. All the valves have their key lock control switches and indication on the local control panel, MDH-PNL-1, located on the 280'6" elevation of the Fuel Handling Building. The valves are classified conventional, quality level Q-3, Seismic I, and cleanliness class C. Valves MDH-V21 and MDH-V34 are the demineralized water flush supply valves for system flushing and debris filter flushing respectively. Check valves are located downstream of the above valves immediately adjacent to the MDHR system to prevent contamination of the D.W. system. Additionally, quick disconnects upstream of the remote flush valve are only installed when required for flushing.

Valves MDH-V30 and MDH-V35 located upstream of the debris filter (MDH-F-1) and valves MDH-V36 and MDH-V29 located downstream of the filters provide the capability to isolate the filter from the system and flush the connections to the floor drains before removal.

MDHR system remote venting is facilitated by opening MDH-V32 remotely during system draining. The Air & Gas Vent, MDH-U-1, located downstream of MDH-V32 prevents overflowing the MDHR system. Valve MDH-V32 will be opened when the system is to be refilled to 3
ensure a solid system.

The solenoids for the above eight valves and MDH-V28 receive their power from Misc. Power Panel MPF-1 supplied from MCC 2
2-32A, compt. 9 ARF thru a 30 KVA transformer.

Debris Filter Bypass Valve, MDH-V28

A remote operated 235 psig, 200°F, 2 inch, stainless steel, air operated Tufline plug valve, which fails open on loss of air or electric power, is provided as a bypass around the inlet debris filter (MDH-F-1). The valve has its keylock control switch and indicating lights on the local control panel, MDH-PNL-1, 2
and is opened when flow thru the Inlet Debris Filter is no longer required. MDH-V28 is a conventional valve, quality level Q-3, Seismic I, and cleanliness class C.

Relief Valves

Relief valves are installed where necessary to protect the system's heat exchangers and piping from overpressurization. The shell side of the MDHR Heat Exchangers, MDH-HX-1A and MDH-HX-1B, have Crosby 3/4" x 1" relief valves installed (TNS-V1002 and TNS-V1008). These relief valves

have setpoints of 150 psig at 200°F with a capacity rating of
12 gpm. The tube side of MDH-HX-1A and 1B, have Vapor Corp. 3
3/4" x 1" relief valves installed (MDH-V4A and MDH-V4B). These
reliefs have setpoints of 235 psig with a capacity rating of
53.5 gpm.

The MDH pumps, MDH-P-1A and 1B, each have Vapor Corp. 3/4" x 1"
relief valves (MDH-V8A and MDH-V8B) installed on the pump's
discharge. The reliefs have a setpoint of 235 psig with a
discharge capacity of 53.5 gpm.

<u>Manual Operated Valves With Extension Handwheels</u>

The MDHR Heat Exchangers shell side (TNS) cooling water supply and
return line isolation valves (4" gates) are provided with extension
handwheels that penetrate an existing 2' thick shield wall on the
H.X. North side. MDH-HX-1A and 1B have their inlet valve handwheels
(TNS-V1004 & TNS-V1006) located in the vicinity of the shielded
debris filter (MDH-F-1). The outlet valve handwheels (TNS-V1001
and TNS-1003) are located within the MDHR pumps cubicle enclosure 2
and the manipulation will require the operating pump to be
shutdown and the primary side lines flushed before the valves
can be operated.

The primary side of the MDHR Heat Exchangers is provided with 2"
diaphragm valves operated with remote handwheels on the inlet,
outlet and cross connect valves. Inlet valves MDH-V-3A and 3B
and outlet valves MDH-V-6A and 6B have their extension handwheels
located in the pump cubicle. MDHR crossconnect valve, MDH-V5, 2
also has it's remote handwheel located in the pump cubicle.
Operation of these valves MDH-V3A/3B, MDH-V5, and MDH-V6A/6B

will require the system to be shutdown and the primary lines flushed to reduce radiation levels before entrance to the MDHR pump cubicle.

MDHR Pump Suction and Discharge 2" diaphragm valves, MDH-V7A/B and MDH-V12A/B respectively, have their remote handwheels located on the 2' thick north shield wall of the pump cubicle for pump isolation should a flange or seal leak occur. The MDHR system's minimum recirculation throttling valve, MDH-V20, and outlet isolation valve, MDH-V15, are 2" globe type with their extension handwheels located on the north shield wall of the pump cubicle. 4

The manual remote valve associated with the MDHR system remote draining is MDH-V33, which functions to drain the entire system. This 1" plug valve has its extension handwheel located on the pump cubicle's 2' thick north shield wall at the eastern corner.

2.2 Instrumentation, Controls, Alarms and Protective Devices

As indicated on Table 6, the Mini Decay Heat Removal System is largely controlled from the local (MDH-PNL-1) and remote (MDH-PNL-2) panels located on the 280'6" el. of the F.H. Bldg. and the Control Room respectively. System isolation capability of both the primary coolant side and NSCCW side have their controls on C.R. panels 8A and 15. These isolation valves (MDH-V1, MDH-V2, MDH-V18, MDH-V19 and TNS-V1007) are powered from Class 1E Motor Control Centers using existing starter circuits spared as a result of system inoperability. The valves previously powered by the MCC starters will not be required to operate until their respective systems are repaired during the recovery operation (i.e. WDL-V0271, WDL-V-1126, DC-V-103, DC-V-114, DC-V115).

Controls for valves used during remote flushing, venting and draining operations are located on the local control panel, MDH-PNL-1, in the F.H. Bldg. 280'6" elevation.

Multi-function process monitors on the local and remote panels are used to display pressure, temperature and flowrate.

MDH-P-1A/B have on/off/spring return to normal switches on the local and remote panels. Suction and discharge pressure indications for each pump are available on the local instrument rack and on the process monitors. The pumps are interlocked with the main decay heat pumps to trip if DH-P-1A or B is inadvertently started.

The heat exchanger's primary side instrumentation consists of inlet and outlet temperatures and is displayed at the process monitors. High individual heat exchanger outlet temperature is also alarmed in each process monitor. Local inlet pressure to each heat exchanger is available on the local instrument rack.

Primary side system flow rate readout is available on both process monitors with low flow being alarmed.

The heat exchanger's secondary side instrumentation consists of inlet and outlet flow indication on the local and remote panels. The flow differences are used to signal the automatic closing of TNS-V1007 (i.e. outlet flow greater than inlet flow or visa versa) and alarm the condition on the local and remote panels.

Three area gamma radiation monitors are provided on the 280'6" elevation of the Fuel Handling Building. They are located in the vicinity of MDH-P-1A, MDH-P-1B, and the MDH heat exchangers. Each one has indication adjacent to the local panel and on the remote panel with a common alarm annunciator on each panel.

The controls and indication associated with the MDHR air filtration system are located at the equipment or on the local control panel, MDH-PNL-1. MDH-E-1A/1B have on/off control switches on the local panel with interlocks to their respective suction and discharge motor operated dampers to open them when the fan is running. The prefilter and HEPA filter assemblies are provided with local differential pressure indication, a local high alarm and a common high d/p alarm on the remote panel. Exhaust air flow from the fans is indicated/alarmed locally with a low flow alarm on the remote panel. Additionally an airborne radiation monitor samples the air after the filters to alarm an abnormal condition locally and remotely. Valving is provided to allow an air sample to be taken before the filters. 2

A closed circuit TV system is provided to aid in system surveillance during operation such as monitoring the system for fluid leakage; pump seal failure; relief valve lifting or system flushing and draining to floor drains. The system consists of two TV cameras strategically located in the MDHR pump enclosure and heat exchanger room. The TV monitors and necessary controls are mounted on separate racks in the Cable Room at the 305′ 0" elevation of the control building. Camera MDH-TVC-1 is mounted on the south wall of the MDHR PUMP enclosure, opposite the centerline of the shield wall dividing the pumps and is approximately 4 feet off the floor. It is provided with a PAN-Tilt mechanism to allow remote movement of the camera to permit scanning both pump's areas. Additionally the camera is fitted with a 30-150 mm zoom lens with remote focusing to facilitate detailed inspection of the pump 2 components and piping. The camera is normally left pointed away from any direct line view of a radiation source. This will lengthen the life of the lense.

Camera MDH-TVC-2 is mounted on an I-beam near column AF & A67, approximately 7 feet above the floor facing east towards the MDHR heat exchangers to view relief valve sight glasses/valve positions. It is provided with the same remote control features as MDH-TVC-1. Each pump cubicle is provided with 4-100 watt incandescent lamps and the heat exchange rooms existing plant lighting has been augmented by three additional fluorescent fixtures having 3-40 watt lamps to insure adequate lighting for the TV cameras. All lighting fixtures in these areas were lamped or relamped with the longest life bulbs/tubes available to lengthen or eliminate relamping requirements since these areas will be inaccessible during normal operation.

The Mini-Decay Heat Removal Pumps, MDH-P-1A & 1B, are provided with a "Vibralarm" vibration monitoring system to continuously monitor the pump's bearing housings for impending failure so that corrective action can be taken. Each pump has two single axis accelerometer sensors attached to the bearing housing to sense vibration in the vertical radial and horizontal radial direction (see Table 6 for details). The acceleration levels measured by the sensors are transmitted to the locally mounted Vibralarm Monitors near MDH-PNL-1 and are converted to velocity levels in inches/sec. One monitor for each pump indicates "alarm" and "shutdown" levels for each sensor via white and red indicator lights on the face of the panel. Also an amber indicating light is provided on the face of the panel to alarm: sensor, cable or input electronics failure. Internal to each monitor panel are the calibration controls and a velocity level indicating meter which can be selected to read channel 1 or 2 (i.e. vertical or horizontal sensor). These local monitors are tied to the control room panel, MDH-PNL-2, via a common trouble alarm which will annunciate if any of the local alarms actuate.

The Mini-Decay Heat Removal Filter (MDH-F-1) is provided with differential pressure indication and high d/p alarm on the local panel (MDH-PNL-1) while the control room panel (MDH-PNL-2) is provided with a high d/p alarm only. This instrumentation will provide guidance as to when to bypass the filter or replace it.

3.0 PRINCIPAL MODES OF OPERATION

3.1 Startup

When it is desirable to switch cooling modes of the R.C.S. from any given mode ' forced circulation using the Mini Decay Heat Removal System, the following will be performed. One of the MDHR pump enclosure fan/filter units will be started to exhaust the air around the pumps thru HEPA filters. The operation of the fan/filter unit is required to minimize the potential spread of airborne contamination into the balance of the F.H. Building should a leak develop in the MDH system. The Fuel Handling Building H&V system should be operating prior to starting the system. 4

The MDHR system primary side will be filled and vented with borated water at a 3500 ppm Boron concentration. Nuclear Services Closed Cooling Water flow is established on the secondary side of the MDHR heat exchanger selected for service via the Temporary Nuclear Services Closed Cooling Water Subsystem tie-in to the "A" Spent Fuel Cooler (i.e. SF-C-1A is no longer operable). The "B" heat exchanger will normally be selected as the lead cooler with MDH-HX-1A isolated on the shell and tube sided by closed outlet valves. A minimum flowrate of 50 gpm will be set by throttling NS-V31A. The flowrate is not to exceed 245 gpm to prevent starving other components in the NSCCW system.

A valve line-up of the MDHR primary side will have the inlet and outlet remote isolation valves (MDH-V1, 2, 18 & 19) closed. The flow path will be arranged for flow thru the debris filter (MDH-F-1) with the bypass valve closed (MDH-V28). Heat Exchanger "A" will be isolated by its closed outlet valve (MDH-V6A) and the HX cross connect valve (MDH-V5) is closed to direct flow to the perferred "B" side heat exchanger. Similarily the "A" side MDHR pump is isolated by closed suction and discharge valves (MDH-V7A & 12A) to allow the "B" side MDHR pump to operate as the lead pump. The MDHR pumps minimum recirculation valve (MDH-V20) will be opened 1 full turn to allow a 10-15 gpm flow at shutoff head of the MDHR pump. 2

The Decay Heat Removal System will be aligned to interface with the MDHR system by verifying open DH-V2 and then opening DH-V1 (or DH-V171), DH-V3 and DH-V4B. The MDHR system suction isolation valves (MDH-V1 & 2) are opened to pressurize the system to Reactor Coolant System pressure which will result in a static pressure at the "B" pump's suction of approximately 100 ± 10 psig as indicated by MDH-PI-2B-2 or -3. If this static pressure exceeds 115 psi the MDHR system will be manually isolated by closing MDH-V1 & 2 and the RCS pressure decreased by increasing the letdown or RCS leakage.

The preferred MDHR pump (MDH-P-1B) will be started from the local (MDH-PNL-1) or remote (MDH-PNL-2) control panel and initial data will be taken to confirm proper operation while it is in the recirculation mode via MDH-V20. MDHR system outlet isolation valve MDH-V19, will be opened and MDH-V18 jogged open gradually till 100 gpm is indicated on the system outlet flow meter 3
(MDH-FIAL - 1-2 or 1-1). 2

During system startup the radiation levels on contact with the MDHR filter shield cask will be measured immediately and regularly thereafter to determine contact radiation levels. From then on contact readings will be taken periodically to identify trends in the buildup of contact radiation levels. The criteria for changeout of the MDHR filter cask assembly is based on an administrative radiological limit of 1 rem/hr. on contact with the cask and/or a differential pressure across the filter in excess of 65 psig above the clean filter d/p. Refer to section 3.4.2 for details on debris filter replacement.

3.2 Normal Operation

The MDHR system presents a forced flow option for core cooling. If the system is put into operation it may remain in service until complete defueling of the reactor core has taken place (approximately 3 years). Normal system fluid parameters may be monitored along with the area radiation levels in the 280'6" elevation of the F.H. Bldg. As decay heat generation rate is reduced with time, reactor coolant system temperature will slowly trend toward the TNSCCW temperature. Heat removal rate can be reduced to control the RCS cool down rate by throttling the TNSCCW flow with the "A" Spent Fuel Cooler outlet valve, NS-V31A. The primary coolant outlet temperature to the MDHR heat exchanger shall be maintained above 100°F. The Standby Reactor Coolant Pressure Control System (SPC) will be controlling the MDHR system pressure. If it becomes necessary to shift operating pumps, the standby pump will be placed in service prior to securing the operating pump. The operating pump's mechanical seal must be flushed with demineralized water prior to securing it per the method of section 3.4.5. MDH-P-1B is considered to be the normal operating pump because of its superior access for maintenance. Pump MDH-P-1A will be used only as a temporary backup while maintenance 4 is performed on the 1B pump. Heat Exchanger swapping will require shutting down the system, and flushing to reduce radiation levels to gain access to the H.X. isolation valves.

During the normal system operation, reactor coolant is taken from the "B" side 36" reactor outlet line through a 12" line with two high pressure electric motor operated valves in series, DH-V1 and DH-V2. The flow exits the Reactor Building through penetration R-525 and immediately passes through an electric motor operated valve, DH-V3. The 8" Westinghouse Alternate Decay Heat Removal System tie-in is located directly downstream of DH-V3. This tie-in is isolated by two Westinghouse electric motor operated valves ADH-V01 and ADH-V02 before the line terminates in the valve pit outside the west wall of the Unit 2 Fuel Handling Building. A 2" line connects to the 8" Westinghouse ADH system line downstream of DH-V3 to serve as the suction line for the MDHR system. Two electric motor operated isolation valves in series (MDH-V1 and MDH-V2) are installed in the 2" line upstream of the demineralized water flush connection and inlet debris filter (MDH-F-1) with bypass valve (MDH-V28). The line then connects to the suction header of the parallel MDH heat exchangers which are provided with inlet and outlet diaphragm valves with extension handwheels. A 2" heat exchanger cross connection line exists downstream of MDH-HX-1A but upstream of MDH-HX-1B to allow them to be operated in series. The 2" discharge lines from the HX outlets combine into a common header and are routed to the parallel MDHR pumps. Upstream of the pumps the sample return line ties in from the Temporary Nuclear Sampling System.

Each MDH pump is provided with suction and discharge manual diaphragm valves with remote handwheels and a discharge check valve to prevent reverse flow in the nonoperating pump. The pumps discharge into either a full flow recirculation line or the system's outlet isolation valve, MDH-V15, before proceeding to the system's electric motor operated outlet isolation valves, MDH-V18 and MDH-V19. MDH-V18 has been provided with jog control capability from the control room and will be the normal method of throttling MDHR system outlet flow. (Note : MDH-V15 and MDH-V20 have handwheel extensions for remote adjustment of flow.) Upstream of MDH-V18 & MDH-V19 are located the system's remote drain valves, sampling system supply line, and system flow element. Upstream and downstream of the system outlet isolation valve (MDH-V15) are located tie-in connections with double isolation valves for a future demineralization system. The 2" system discharge line connects to the 6" B return loop of the Westinghouse ADHR. The 6" line is isolated on the deadend side by ADH-V07B and ADH-V06B and connects into the 10" Decay Heat line upstream of DH-V-4B. Downstream of DH-V-4B the line penetrates the Reactor Building where it joins with the B side 14" Core Flooding line to the Reactor Vessel, completing the flow path. 2

3.3 Shutdown

The MDHR system is removed from service by closing the NSCCW supply to SF-C-1A via NS-V30A and closing the operating MDHR H.X. outlet valve (TNS-V1006 for B or TNS-V1004 for A). Primary side outlet valves MDH-V18 and MDH-V19 are closed from the control room. The operating MDHR pump (usually MDH-P-1B) will be tripped after the mechanical seals are flushed with demineralizer water per section 3.4.5. Inlet and Outlet isolation valves for the pump will be closed (MDH-V7B/12B or MDH-V7A/12A) along with the primary side inlet valves MDH-V1 and V2. The "A" Spent Fuel Cooler outlet valve (NS-V31A) is closed. If shutdown has occurred for maintenance purposes then refer to section 3.4.1 on Remote Flushing, Draining & Venting.

3.4 Special or Infrequent Operation

3.4.1 Flushing, Draining & Venting the System Remotely to Reduce Radiation Levels for Maintenance

Should it be required, for any reason, to enter the MDHR heat exchanger room and/or pump cubicle it may be necessary to shut down the system and drain/flush it to reduce the area radiation levels to an acceptable level. This evolution will consist of shutting down the MDHR System as described in Section 3.3. The system's following in-line process valves will be verified open or opened: inlet/outlet/bypass valves for MDH-F-1 (i.e. MDH-V30/-35/-36/-29/-28 from MDH-PNL-1), suction/discharge valves for MDH-P-1A/B (i.e. MDH-V7A/-7B/-12A/-12B from extension handwheels on pump cubicle's north shield wall), and MDHR system recirculation/discharge valves (i.e. MDH-V20/-15) from extension handwheels on pump cubicle's north shield wall). It is not feasible to open the primary side flow paths for both heat exchangers because of ALARA onsiderations (i.e. HX inlet/outlet/bypass valve extension handwheels are located in the MDHR pump cubicle). 4

The system is vented by opening vent valve MDH-V32 from local panel MDH-PNL-1. System drain valve MDH-V33 is opened only enough to prevent overflowing the floor drain using its manual remote handwheel. Filter inlet/outlet drains MDH-V47/48 are also partially opened. When draining is completed as determined by the TV monitor observing the MDH-P-1B pump cubical's northeast corner, where the floor drain is located, the above three drain valves are closed. If If the area radiation levels in the MDHR pump cubicles decrease sufficiently, the H.X. isolation/bypass valves (MDH-V3A/6A/5) should be opened prior to securing draining.

The system is refilled with demineralized water by installing the demineralized water quick disconnect hose at DW-V238 and opening DW-V238. The demineralized water supply valve, MDH-V21, is opened from panel MDH-PNL-1 and filling proceeds until air ceases flowing from the Air & Gas Vent (MDH-U-1) downstream of MDH-V-32. MDH-V32 & MDH-V28 are closed from panel MDH-PNL-1 and the system flushing valve, MDH-V22, is opened from panel MDH-PNL-1. Demineralized Water flushing of the system will commence and run for 5 minutes and be monitored by observing the drain in the southwest area of the heat exchanger room with the T.V. monitor. The inlet/outlet valves for MDH-F-1 (MDH-V30/29) are closed and the bypass valve opened (MDH-V28) to allow a new flush path for 5 minutes. Flushing will be secured by closing MDH-V21, V22 and DW-V238 (disconnecting supply hose). The system vent isolation valve (MDH-V32) and drain valve (MDH-V33) are reopened to allow complete draindown. 2

The system will be restored to startup status after maintenance by performing the MDHR primary side valve line-up then refilling with 3500 ppm borated water using a portable mix and fill apparatus.

3.4.2 Debris Filter Replacement

After initial operation of the MDHR system with the inlet debris filter, MDH-F-1, in service it may become necessary to install the backup filter due to a high pressure drop and/or contact radiation levels on cask exceeding 1 rem/hr. Installation and 2 operation with the backup filter which results in very little increase in d/p will indicate that debris from the Decay Heat Drop Line has been removed prior to bypassing the filter.

For MDH-F-1 replacement the MDHR system must be shutdown as detailed in Section 3.3. The filter's inlet and outlet isolation valves (MDH-V35 and MDH-V36) are closed from panel MDH-PNL-1. MDH-DPS-35 root valves (MDH-V43 & -V44) are closed and vent valves (MDH-V45 & 46) are opened locally. Hoses will be connected to the quick disconnect fittings located downstream of MDH-V47 & MDH-V48 and connected to a container with an absolute filter vent. The inlet/outlet filter drains (MDH-V47/48) are opened to allow the liquid between the filter isolation valves to drain down to below the flange disconnect elevation. When the filter inlet and outlet lines have stopped draining, valves MDH-V45, - V46, -V47 and -V48 are closed and drain hoses removed.

The filter's inlet and outlet flanges can rapidly be disconnected, since the flange nuts are tack welded to the underside of the disconnect flanges. All flanges will be bagged to contain any dripping of radioactive liquid and the filter cask housing pulled out of its installed location. The flanges on the spent filter should be blind-flanged and suitable gaskets installed/torqued before any extensive movement of the filter cask. A new filter cask housing will be reinstalled and the flange connections leak tested prior to putting the MDHR system back in service.

3.4.3 <u>Reactor Coolant System Water Clean-up Using Demineralization Tie-In</u>

(TO BE SUPPLIED LATER).

3.4.4 <u>MDHR Pump/Piping Enclosure HVAC HEPA Filter Replacement</u>

HEPA filter replacement will be required when a high differential pressure is indicated across the prefilter/HEPA filter or the outlet airborne radiation monitor indicates the filters are not performing effectively. The standby fan/filtration unit (MDH-E-1A or MDH-E-1B) will be started from panel MDH-PNL-1 and the operating unit stopped. Remove and replace both sets of pre-filters and HEPA filters from the secured unit. The filtration unit can serve as a backup unit after DOP testing is performed and completed.

3.4.5 <u>MDHR Pump Mechanical Seal Flushing</u>

When an operating MDHR pump must be secured it is imperative the seals be flushed with demineralized water before it is isolated. This operation will consist of connecting the demineralized water quick disconnect downstream of DW-V238 and opening the valve. The operating pump [MDH-P1B(A)] should be tripped and its suction and discharged isolation valves [(MDH-V7B(A) and MDH-V12B(A)] verified open. Also verify MDH-V20 is in "Minimum Recirc" position and close the system isolation valves (MDH-V1, 2, 18 and 19). The system drain valve (MDH-V33) should be cracked open till suction pressure at the tripped pump decreases to less than 40 psig, then close MDH-V33. The demineralized water supply valve [MDH-V41B(A)] is opened for the MDHR pump which has been tripped. Restart the tripped pump [MDH-P1B(A)] and throttle open MDH-V33 until a flow of demineralized water of 1.5 to 2.5 gpm is seen on flow meter MDH-FI-7(6). After running the pump for 10 minutes, trip the pump and close MDH-V33. The demineralized water will have flushed out the borated water from the pump's seal block and the closed loop cyclone separator back to the process piping. Close D.W. supply valve MDH-V41B(A) when flow is no longer seen on MDH-FI-7(6). Close the tripped pump's suction/discharge isolation valves [MDH-V7B(A)/MDH-V12B(A)].

3.5 Emergency

3.5.1 Loss of Off-Site Power

In the event of loss of off-site power,the MDHR pump in operation will stop and the four system isolation valves will remain in their last position, but not energized. The air operated plug 2 valves associated with the system's remote flushing, draining and venting (MDH-V34, MDH-V21, MDH-V30, MDH-V35, MDH-V36, MDH-V29, MDH-V32, MDH-V22) will fail closed on both loss of electrical power and air, which will stop the operation in progress. The filter bypass valve (MDH-V28) fails open on loss of electrical power/air to ensure a flow path is maintained through the MDHR system. The MDHR HVAC Filter Unit in operation will also stop. Instrumentation indication will be lost. Once the site Class 1E diesel generator sets are in operation the 2 above loads will be sequenced on the 1E diesel generators manually to restore system operation and isolation capability.

3.5.2 Inadvertent Starting of Existing Plant Decay Heat Removal Pumps, DH-P-1A/or 1B

If either of the existing plant decay heat pumps, DH-P-1A or 1B, are inadvertently started, the operating MDHR pump will automatically trip to prevent overpressurizing the MDHR system. The DH pump should be secured and the desired MDHR pump restarted to restore system operation.

3.5.3 Loss of MDHR Pump(s) Cubicle Ventilation 2

If the operating HEPA fan/filter unit trips or becomes fouled the potential exists to spread airborne contamination into portions of the Fuel Handling Building not occupied by the MDHR system. The backup HEPA fan/filter unit should be immediately started to ventilate the MDHR Pump/Piping Enclosure so a negative pressure is maintained and any particulate airborne contamination is filtered.

3.5.4 <u>Mini Decay Heat Removal Tube Failure</u>

If a primary side tube failure occurs on the operating MDH heat exchanger, MDH-HX-1A or 1B, the inlet TNSCCW supply valve (TNS-V1007) will close due to the flow inbalance on the shell side. If operation must continue the affected cooler should be isolated and the backup cooler put into service. This will require system shutdown so the system can be flushed to reduce radiation levels and gain access to the heat exchanger isolation valves.

3.5.5 <u>Gross System Leakage</u>

In the event of gross system leakage, the system can be isolated from the RCS by shutting the remote operated isolation valves (MDH-V1, MDH-V2, MDH-V18, and MDH-V19).

4.0 HAZARDS AND PRECAUTIONS

4.1 Do not operate the Mini Decay Heat Removal pumps with the minimum recirculation valve, MDH-V20, closed. If the discharge path is blocked, shutoff head operation of the pump(s) should not exceed one minute.

4.2 Do not operate the pumps with the suction valves(s) throttled or closed.

4.3 Since the system is handling radioactive contaminated fluids and potential airborne contamination due to leakage, all appropriate health physics safety precautions must be observed during operation and maintenance.

4.4 Remote flushing capability exists for the system's primary side piping to provide a means for reducing the radiation levels in the piping. Flushing shall be performed before maintenance is begun.

4.5 Unless required for operation, a standby component (i.e. pump/heat exchanger/instrumentation) should be isolated by their outlet and/or 2
inlet isolation valves or root valves to eliminate potential leakage paths and/or crud traps.

4.6 The Fuel Handling Building Heating and Ventilation System should be operated in conjunction with the MDHR exhaust system when the MDHR System is operating. 2

4.7 Pump MDH-P-1B should always be considered the "PRIMARY" pump because of the ease of maintainability versus MDH-P-1A.

TABLE 1

MINI DECAY HEAT REMOVAL PUMPS

Pump Details	
Identification	MDH-P-1A, MDH-P-1B
Number Installed	Two
Manufacturer	Goulds Pumps, Inc.
Model No.	3196 ST (1 x 1-1/2-8)
Type	Single-Stage, Horizontal Shaft, Centrifigal
Rated Speed, rpm	3500
Rated Capacity, gpm	120
Developed Head, ft.	195
Design Pressure, Casing, psig	240
Design Temperature, F	200
Lubricant/Coolant	Oil/Air
Min. Flow Requirements	10 gpm for 15 minutes max.
Motor Details	
Manufacturer	Westinghouse
Type	Squirrel Cage
Enclosure	Open Drip Proof
Rated Horsepower, HP	15
Speed, rpm	3500
Lubricant/Coolant	Grease/Air
Power Requirements	460V, 3 Phase, 60 H_z, 18.5 amps (full load)
Power Source	MDH-P-1A, MCC-2-11EA compt. 3AR MDH-P-1B, MCC-2-21EA compt. 3AR

4

TABLE 1 (Con't.)

MINI DECAY HEAT REMOVAL PUMPS

Classification	
Code	N-3
Quality Control	3
Seismic	I
Cleanliness	B

TABLE 2

MINI DECAY HEAT REMOVAL COOLERS

Identification	MDH-HX-1A, MDH-HX-1B
Number Required	Two
Vendor	Babcock & Wilcox
Manufacturer	Atlas Industrial Mfg. Co.
Cleanliness Factor	0.85
Heat Transfer, BTU/hr	2.25×10^6 @ primary temp. = 175°F @ 120 gpm secondary temp. = 100°F @ 200 gpm
Tube Side:	
Fluid	Reactor Coolant
Fluid Flow, lbs/hr	60,000
Design Pressure	235 psig
Temperature	200F
Material	304 Stainless Steel
Pressure Drop, psig	1.3
Shell Side:	
Fluid	Nuclear Services Closed Cooling Water System
Fluid Flow, lbs/hr	100,000
Design Press. psig	175 psig
Design Temp. F	200F
Material	Carbon Steel
Pressure Drop, psig	8.3

TABLE 2 (Con't.)

MINI DECAY HEAT REMOVAL COOLERS

Classification	Shell	Tube
Code	ASME Section III, 1971 Ed. with Addenda thru 1971	
Quality Control	4	3
Seismic	I	I
Cleanliness	C	B

TABLE 3

MINI DECAY HEAT INLET DEBRIS FILTER

Filter Details

Identification	MDH-F-1	
No. Installed	1 & 3 Replacement Assemblies	
Manufacturer	Fabricated on site	
Type	Cartridge	
Casing Material	304 Stainless Steel	
Casing Dimensions	12-3/4" O.D. x 26-1/4" high	2
Size (Micron Removal Rate)	225	
Operating Conditions	125 gpm @ 100 psig/155'F	
Design Conditions	235 psig @ 200'F	
Hydrostatic Test	353 psig @ 70' F	
Code	ASME BPVC Section VIII Div. 1	
Seismic	Class 2 - OBE	

TABLE 4

MINI DECAY HEAT REMOVAL SYSTEM
AIR FILTRATION FANS

Fan Details

Identification	MDH-E-1A & MDH-E-1B
Number Installed	2
Manufacturer	New York Blower
Model No.	Size #12 S.W.S.I.
Type	Centrifugal - upblast
Rated Capacity, CFM	2200
Static Press in H_2O	6.5
Rated Speed, RPM	4200

Fan Motor Details

Manufacturer	
Type	Squirrel Cage Induction Motor
Enclosure	Open
Rated HP	5
Rated Speed, RPM	
Lubricant-coolant	Oil/Air
Power Requirements	460 V./3 Phase/60Hz
Power Source	MDH-E-1A - MCC-2-11EA compt. 2ARR MDH-E-1B - MCC-2-21EA compt. 2ARR

Classification

Code	C
Quality	4
Seismic	II
Cleanliness	D

TABLE 5

MDHR EXHAUST H.E.P.A. & PREFILTER FILTER ASSEMBLY

H.E.P.A. Filter Details

Identification	MDH-F-2A/MDH-F-2B
No. of Cells Installed/Train	2
Manufacturer	Mine Safety Appliance Company
Type	HEPA
Size	24" x 24" x 12"
Capacity, CFM	1100 CFM per filter/2200 CFM per train
Pressure Drop, Clean, in W.G.	1.1
Efficiency, %	99.97
Housing	2, Ultra-Lok Series "U", Bag-In, Bag-Out Filter Retaining System
Pressure Drop, Dirty, In W.C.	3.0

Prefilter Details

Identification	MDH-F-1A/MDH-F-1B
No. of Cells Installed/Train	2
Manufacturer	Mine Safety Appliances Company
Type	Air-O-J
Size	24" x 24" x 2"
Capacity, CFM	1100 per filter/2200 per train
Pressure Drop; Clean, in W.G.	0.15
Efficiency, %	30
Pressure Drop, Dirty, in W.G.	0.25

4

Classification

Code	C
Quality	3
Seismic	II
Cleanliness	D

TABLE 6
INSTRUMENTATION CONTROLS & ALARMS

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
TNS-FE-1	Flow Element	Temporary NSCCW Inlet Flow to Heat Exchangers MDH-HX-1A/1B	Piping	Orifice Plate	0-400 gpm	0-400" W.C.	N/A
TNS-FT-1	D/P Transmitter	Temporary NSCCW Inlet Flow to Heat Exchangers MDH-HX-1A/1B	Local MTG	Fox Bor E13DM	0-400" W.C.	10-50 MADC	N/A
TNS-FDSH-1	Flow Diff. Alarm	T.N.S.C.C.W Flow imbalance between inlet and outlet flow to MDH-HX-1A/1B	PNL. 1	Fox Bor 63U-ET-OHAR	10-50 MADC	N/A	7.0 gpm
TNS-FDAH-1	Annunciator Light	T.N.S.C.C.W Flow imbalance between inlet and outlet flow to MDH-HX-1A/1B	PNL. 1	G.E. CR 2940	N/A	N/A	7.0 gpm
TNS-FI-1A	Flow Indicator	T.N.S.C.C.W Inlet flow to MDH-HX-1A/1B	PNL 1	Vertical Millia-meter West VX252	10-50 MADC	0-400 gpm	N/A
TNS-FI-1B	Flow Indicator	T.N.S.C.C.W Inlet flow to MDH-HX-1A/1B	PNL. 2	Vertical Millia-meter West VX252	10-50 MADC	0-400 gpm	N/A
TNS-HS-1	Push Button	T.N.S.C.C.W Flow Inbalance - Alarm Acknowledge	PNL. 1	G.E. CR2940 WA202B	N/A	N/A	N/A
TNS-FE-2	Flow Element	Temporary NSCCW Outlet Flow from Heat Exchangers MDH-HX-1A/1B	Piping	Orifice Plate	0-400 gpm	0-400" W.C.	N/A
TNS-FT-2	D/P Transmitter	Temporary NSCCW Outlet Flow from Heat Exchangers MDH-HX-1A/1B	Local Mtg.	Fox Bor E130M	0-400" W.C.	10-50 MADC	N/A

TABLE 6

INSTRUMENTATION CONTROLS & ALARMS

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
TNS-FDSH-2	Flow Diff. Alarm	Temporary NSCCW Flow Inbalance between Inlet & Outlet Flow to MDH-HX-1A/1B	PNL. 1	Fox Bor 63U-ET-OHAR	10-50 MADC	N/A	7.0 gpm
TNS-FDAH-2	Annunciator Light	Temporary NSCCW Flow Inbalance between Inlet & Outlet Flow to MDH-HX-1A/1B	PNL. 2	G.E. CR2940	N/A	N/A	7.0 gpm
TNS-FI-2A	Flow Indicator	T.N.S.C.C.W Outlet flow from MDH-HX-1A/1B	PNL. 1	Vertical Millia-meter West. VX252	10-50 MADC	0-400 gpm	N/A
TNS-FI-2B	Flow Indicator	T.N.S.C.C.W Outlet flow from MDH-HX-1A/1B	PNL. 2	Vertical Millia-meter West VX252	10-50 MADC	0-400	N/A
TNS-HS-2	Pushbutton	T.N.S.C.C.W Flow Inbalance Alarm Acknowledge	PNL. 2	G.E.P.B. CR2940 WA202B	N/A	N/A	N/A
TNS-FHS-7	Hand Switch W/ Ind. Lights	Operates Temporary NSCCW Valve TNS-V-1007 Flow to HT Exch. MDH-HX-1A/1B	PNL. 8A	P.B. W/R & G. Lights	N/A	N/A	N/A
MDH-RE-1	Area Rad. Monit.	MDH-P-1A Area Radiation	Local	Gamma Ion Chamber	0-1x10^7 MR/HR		N/A
MDH-RMI-1A	Indication/Alarm	MDH-P-1A Area Radiation	Adjacent to PNL. 1	Alarm Rate-meter Victo-reen 848-5		0.1-1x10^7 MR/HR	2.5 R/HR.

TA' 6
INSTRUMENTATION ..NTROLS & ALARMS

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
MDH-RMI-1B	Indication/Alarm	MDH-P-1A Area Radiation	PNL. 2	Alarm Rate-meter Victo-reen 848-5		0.1-1x10^7 MR/HR	2.5 R/HR.
MDH-RE-2	Area Rad. Monit.	MDH-P-1B Area Radiation	Local	Gamma Ion Chamber	0-1x10^7 MR/HR		N/A
MDH-RMI-2A	Indication/Alarm	MDH-P-1B Area Radiation	Adjacent to PNL. 1	Alarm Rate-meter Victo-reen 848-5		0.1-1x10^7 MR/HR	2.5 R/HR.
MDH-RMI-2B	Indication/Alarm	MDH-P-1B Area Radiation	PNL. 2	Alarm Rate-meter Victo-reen 848-5		0.1-1x10^7	2.5 R/HR.
MDH-RE-3	Area Rad. Monit.	HT.EXCH.COMPT.AREA Radiation	Local	Gamma Ion Chamber	0-1x10^7 MR/HR		N/A
MDH-RMI-3A	Indication/Alarm	HT.EXCH.COMPT.AREA Radiation	Adjacent to PNL. 1	Alarm Rate-Meter Victo-reen 848-5		0.1-1x10^7 MR/HR	1.0 R/HR.
MDH-RMI-3B	Indication/Alarm	HT.EXCH.COMPT.AREA Radiation	PNL. 2	Alarm Rate-meter		0.1-1x10^7 MR/HR	1.0 R/HR.

TABLE 6
INSTRUMENTATION CONTROLS & ALARMS

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
MDH-RAH-4	Alarm LT./Horn	Common Alarm for MDH-RE-1/2/3	PNL. 1	Light	N/A	N/A	2.5 or 1.0 R/HR
MDH-RAH-5	Alarm LT./Horn	Common Alarm for MDH-RE-1/2/3	PNL. 2	Light	N/A	N/A	2.5 or 1.0 R/HR
MDH-HS-4	Pushbutton	Common Alarm for MDH-RE-1/2/3 Acknowledge Button	PNL. 1	P.B.	N/A	N/A	N/A
MDH-HS-5	Pushbutton	Common Alarm for MDH-RE-1/2/3 Acknowledge Button	PNL. 2	P.B.	N/A	N/A	N/A
MDH-FE-1	Flow Element	Mini Decay Heat System Flow	Piping	Orifice Plate	0-200 gpm	0-750" W.C.	N/A
MDH-FT-1	D/P Transmitter	Mini Decay Heat System Flow	Local Rack	Bailey BQ75221	0-750" W.C.	4-20 MADC	N/A
MDH-FIAL-1-1	Indication/Alarm	Mini Decay Heat System Flow & Low Flow Alarm	PNL. 1	Process Monitor	4-20 MADC	0-200 gpm	80 gpm
MDH-FIAL-1-2	Indication/Alarm	Mini Decay Heat System Flow & Low Flow Alarm	PNL. 2	Process Monitor	4-20 MADC	0-200 gpm	80 gpm
MDH-FI-2	Sight Flow Indicator	Indicate Relief Valve MDH-V4A has lifted	Piping	Flapper Type Ametek #20-6120	N/A	N/A	N/A
MDH-FI-3	Sight Flow Indicator	Indicate Relief Valve MDH-V4B has lifted	Piping	Flapper Type Ametek #20-6120	N/A	N/A	N/A
MDH-FI-4	Sight Flow Indicator	Indicate Relief Valve MDH-V8A has lifted	Piping	Flapper Type Ametek #20-6120	N/A	N/A	N/A
MDH-FI-5	Sight Flow Indicator	Indicate Relief Valve MDH-V8B has lifted	Piping	Flapper Type Ametek #20-6120	N/A	N/A	N/A

TABLE 6
INSTRUMENTATION, CONTROLS & ALARMS

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
MDH-FHS-1	Hand Switch	Controls MDH-V1 (was tagged DC-FHS-7086)	PNL. 8A	Pushbutton W/R&G Ltgs.	N/A	N/A	N/A
MDH-FHS-2	Hand Switch	Controls MDH-V2 (was tagged WDL-FHS-3189)	PNL. 15	Pushbutton W/R&G Ltgs.	N/A	N/A	N/A
MDH-PI-1A	Press. Indication	MDH-HX-1A Inlet Pressure	Local Rack	Press. Gauge	0-200 psig	0-200 psig	N/A
MDH-PI-1B	Press. Indication	MDH-HX-1B Inlet Pressure	Local Rack	Press. Gauge	0-200 psig	0-200 psig	N/A
MDH-TE-1A	Temperature Element	MDH-HX-1A Inlet Temperature	Piping	RTD	0-200°F	92.93-136.49 ohms	N/A
MDH-TI-1A-1	Temperature Indicator	MDH-HX-1A Inlet Temperature	PNL. 1	Process Monitor	92.93-136.49 ohms	0-200°F	175°F
MDH-TI-1A-2	Temperature Indicator	MDH-HX-1A Inlet Temperature	PNL. 2	Process Monitor	92.93-136.49 ohms	0-200°F	175°F
MDH-TE-2A	Temperature Element	MDH-HX-1A Outlet Temperature	Piping	RTD	0-200°F	92.93-136.49 ohms	N/A
MDH-TIAH-2A-1	Temperature Indicator/ Alarm	MDH-HX-1A Outlet Temperature	PNL. 1	Process Monitor	92.93-136.49 ohms	0-200°F	170°F
MDH-TIAH-2A-2	Temperature Indicator/ Alarm	MDH-HX-1A Outlet Temperature	PNL. 2	Process Monitor	92.93-136.49 ohms	0-200°F	170°F
MDH-TE-1B	Temperature Element	MDH-HX-1B Inlet Temperature	Piping	RTD	0-200°F	92.93-136.49 ohms	N/A

TABLE 6
INSTRUMENTATION CONTROLS & ALARMS

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
MDH-TI-1B-1	Temperature Indication	MDH-HX-1B Inlet Temperature	PNL. 1	Process Monitor	92.93-136.49 ohms	0-200°F	175°F
MDH-TI-1B-2	Temperature Indication	MDH-HX-1B Inlet Temperature	PNL. 2	Process Monitor	92.93-136.49 ohms	0-200°F	175°F
MDH-TE-2B	Temperature Element	MDH-HX-1B Outlet Temperature	Piping	RTD	0-200°F	92.93-136.49 ohms	N/A
MDH-TIAH-2B-1	Temp. Ind. & Alarm	MDH-HX-1B Outlet Temperature	PNL. 1	Process Monitor	92.93-136.49 ohms	0-200°F	170°F
MDH-TIAH-2B-2	Temp. Ind. & Alarm	MDH-HX-1B Outlet Temperature	PNL. 2	Process Monitor	92.93-136.49 ohms	0-200°F	170°F
MDH-PI-2A-1	Press. Ind.	MDH-P-1A Suction Pressure	Local Rack	Bourdan Tube	0-200 psig	0-200 psig	N/A
MDH-PT-2A	Press. Transmitter	MDH-P-1A Suction Pressure	Local Rack	Bailey KS67221	0-200 psig	4-20 MADC	N/A
MDH-PI-2A-2	Pressure Indication	MDH-P-1A Suction Pressure	PNL. 1	Process Monitor	4-20 MADC	0-200 psig	Low 16 psig
MDH-PI-2A-3	Pressure Indication	MDH-P-1A Suction Pressure	PNL. 2	Process Monitor	4-20 MADC	0-200 psig	Low 16 psig
MDH-PI-3A-1	Pressure Indication	MDH-P-1A Discharge Pressure	Local Rack	Bourdon Tube	0-300 psig	0-300 psig	N/A
MDH-PT-3A	Pressure Transmitter	MDH-P-1A Discharge Pressure	Local Rack	Bailey KS67221	0-300 psig	4-20 MADC	N/A
MDH-PI-3A-2	Pressure Indication	MDH-P-1A Discharge Pressure	PNL. 1	Process Monitor	4-20 MADC	0-300 psig	Hi 220 psig

TA. . 6
INSTRUMENTATION CONTROLS & ALARMS

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
MDH-PI-3A-3	Pressure Indication	MDH-P-1A Discharge Pressure	PNL. 2	Process Monitor	4-20 MADC	0-3C0 psig	Hi 220 psig
MDH-PI-2B-1	Pressure Indication	MDH-P-1B Suction Pressure	Local Rack	Bourdon Tube	0-200 psig	0-200 psig	N/A
MDH-PT-2B	Pressure Transmitter	MDH-P-1B Suction Pressure	Local Rack	Bailey KS67221	0-200 psig	4-20 MADC	N/A
MDH-PI-2B-2	Pressure Indication	MDH-P-1B Suction Pressure	PNL. 1	Process Monitor	4-20 MADC	0-200 psig	Low 16 psig
MDH-PI-2B-3	Pressure Indication	MDH-P-1B Suction Pressure	PNL. 2	Process Monitor	4-20 MADC	0-200 psig	Low 16 psig
MDH-PI-3B-1	Pressure Indication	MDH-P-1B Discharge Pressure	Local Rack	Bourdon Tube	0-300 psig	0-300 psig	N/A
MDH-PT-3B	Pressure Transmitter	MDH-P-1B Discharge Pressure	Local Rack	Bailey K567221	0-300 psig	4-20 MADC	N/A
MDH-PI-3B-2	Pressure Indicator	MDH-P-1B Discharge Pressure	PNL. 1	Process Monitor	4-20 MADC	0-300 psig	Hi 220 psig
MDH-PI-3B-3	Pressure Indicator	MDH-P-1B Discharge Pressure	PNL. 2	Process Monitor	4-20 MADC	0-300 psig	Hi 220 psig
MDH-CS-1	Hand Switch W/Ind. Lights	Controls MDH-P-1A	PNL. 1	GE CR2940 US203E	N/A	N/A	INTLK with Pumps DH-P-1A, 1B
MDH-CS-2	Hand Switch W/Ind. Lights	Controls MDH-P-1A	PNL. 2	GE CR2940 US203E	N/A	N/A	INTLK with Pumps DH-P-1A, 1B

T/ E 6
INSTRUMENTATIO ONTROLS & ALARMS

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
MDH-CS-3	Hand Switch W/Ind. Lights	Controls MDH-P-1B	PNL. 1	GE CR2940 US203E	N/A	N/A	INTLK with Pumps DH-P-1A, 1B
MDH-CS-4	Hand Switch W/Ind. Lights	Controls MDH-P-1B	PNL. 2	GE CR2940 US203E	N/A	N/A	INTLK with Pumps DH-P-1A, 1B
MDH-FHS-18	Pushbutton w/R&G Lights	Controls MDH-V18 (was tagged DC-FHS-7069)	PNL. 8A	Mercury E-30	N/A	N/A	N/A
MDH-FHS-19	Pushbutton w/R&G Lights	Controls MDH-V19 (was tagged WDL-FHS-1332)	PNL. 15	Mercury E-30	N/A	N/A	N/A
MDH-FHS-21	Handswitch Keylock	Controls MDH-V21 (Demineralized Water Supply Valve)	PNL. 1	GE CR2940 UN200D	N/A	N/A	N/A
MDH-FHS-22	Handswitch Keylock	Controls MDH-V22 (drain valve)	PNL. 1	GE CR2940 UN200D	N/A	N/A	N/A
MDH-FHS-28	Handswitch Keylock	Controls MDH-V28 (MDH-F-1 Bypass Valve)	PNL. 1	GE CR2940 UN200D	N/A	N/A	N/A
MDH-FHS-29	Handswitch Keylock	Controls MDH-V29 (MDH-F-1 Downstream Isolation Valve)	PNL. 1	GE CR2940 UN200D	N/A	N/A	N/A
MDH-FHS-30	Handswitch Keylock	Controls MDH-V30 (MDH-F-1 Upstream Isolation Valve)	PNL. 1	GE CR2940 UN200D	N/A	N/A	N/A

TA' 6
INSTRUMENTATION ..NTROLS & ALARMS

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
MDH-FHS-32	Handswitch Keylock	Contro.s MDH-V32 (MDHR System Vent Valve)	PNL. 1	GE CR2940 UN200D	N/A	N/A	N/A
MDH-FHS-34	Handswitch Keylock	Controls MDH-V34 (Demineralized Water Supply Valve)	PNL. 1	GE CR2940 UN200D	N/A	N/A	N/A
MDH-FHS-35	Handswitch Keylock	Controls MDH-V35 (MDH-F-1 Upstream Isolation Valve)	PNL. 1	GE CR2940 UN200D	N/A	N/A	N/A
MDH-FHS-36	Handswitch Keylock	Controls MDH-V36 (MDH-F-1 Downstream Isolation Valve)	PNL. 1	GE CR2940 UN200D	N/A	N/A	N/A
MDH-DPIS-103	Differential Pressure Indicating Switch	Indicate & Alarm high differential pressure across MDH-F-1A and MDH-F-2A filters	F.H. Bldg El. 280′ 6" A66 + 13′ AH + 4′	Magnahelic gage (3006SR)	--	0-6" H_2O	3.3" W.G.
MDH-DPAH-103	Differential Pressure Alarm High (Amber Lt.)	Annunicate high D/P across MDH-F-1A and MDH-F-2A filters	PNL. 1	G.E. CR2940	N/A	N/A	3.3" W.G.
MDH-DPIS-104	Differential Pressure Indicating Switch	Indicate & Alarm high differential pressure across MDH-F-1B and MDH-F-2B filters	F.H. Bldg El 280′ 6" A66 + 17′ AH + 19′	Magnahelic gage (3006SR)	--	0-6" H_2O	3.3" W.G.
MDH-DPAH-104	Differential Pressure Alarm (Amber Lt.)	Annunicate high D/P across MDH-F-1B and MDH-F-2B filters	PNL. 1	G.E. CR2940	N/A	N/A	3.3" W.G.
MDH-FHS-105	Handswitch Keylock	Provide control of MDH-E-1A and supply/ discharge dampers (MDH-MV-101/110)	PNL. 1	G.E. [illegible]S 203E	N/A	N/A	--

2

TABLE 6
INSTRUMENTATION CONTROLS & ALARMS

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
MDH-FHS-106	Handswitch Keylock	Provide control of MDH-E-1B and supply/discharge dampers (MDH-MV-102/111)	PNL. 1	G.E. CR2940 US203E	N/A	N/A	N/A
MDH-FE-107	Annubar Flow Element	Measure discharge flow from MDH-E-1A and MDH-E-1B	Ducting	--	--	--	N/A
MDH-FISL-107	Flow Indicating Switch (Low)	Indicating discharge flow from MDH-E-1A and MDH-E-1B and alarm low flow	Ducting A66 + 11' AK + 2'	Magnahelic gage (3001SR)	--	0-1" H_2O	1760 SCFM
MDH-FAL-107	Flow Alarm Low (Amber Lt.)	Annunicate low discharge flow from MDH-E-1A or MDH-E-1B	PNL. 1	G.E. CR2940	N/A	N/A	1760 SCFM
MDH-UA-107	Annunicator	Alarm low discharge flow from MDH-E-1A or 1B and high DP across filter trains "HVAC TROUBLE"	PNL. 2	G.E. C2940	N/A	N/A	1760 SCFM Manual 3.3" W.G.
MDH-RAH-108	Annunicator	Alarms high airborne radiation from MDHR Pump Cubical Filtration System	Adjacent to PNL. 1	--	N/A	N/A	Later
MDH-UA-108	Annunicator	Alarms high airborne radiation from MDHR Pump Cubical Filtration System	PNL. 2	--	N/A	N/A	Later
MDH-RMI-108P	Radiation Monitor with Indicator/ Alarm	Indicate particulate air-borne radiation from MDHR Pump Cubical Filtration System + Alarms: Hi-Red, Alert-Amber, Fail-Green	F.H. 280' el. Local	Victoreen 842-[illegible]	--	$10-10^6$ cpm	
MDH-RMI-108I	Radiation Monitor with Indicator/ Alarm	Indicate iodine airborne radiation from MDHR pump Cubical Filration System + Alarms: Hi-Red, Alert-Amber, Fial-Green	F.H. 280' el. Local	Victoreen 842-31	--	$10-10^6$ cpm	

TA 6

INSTRUMENTATION CONTROLS & ALARMS

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
MDH-RMI-108G	Radiation Monitor with Indicator/ Alarm	Indicate Noble gas airborne radiation from MDHR Pump Cubical Filtration System Alarms: Hi-Red, Alert-Amber, Fail-Green	F.H. 280′ el. Local	Victoreen 842-11	--	$10-10^6$ cpm	
MDH-RIA-108P-1	Radiation Indicator/ Alarm	Indicate particulate airborne radiation from MDHR Pump Cubical Filtration System + Alarms for High-Red, Alert-Amber, and Fail-Green	Adj Pnl.1 A66 + 4′ AP + 0′	Victoreen 844-18			
MDH-RIA-108I-1	Radiation Indicator/ Alarm	Indicate iodine airborne radiation from MDHR Pump Cubical Filtration System + Alarms for High-Red, Alert-Amber, and Fail-Green	Adj. Pnl.1 A66 + 4′ AP + 0′	Victoreen 844-18			
MDH-RIA-108G-1	Radiation Indicator/ Alarm	Indicate Noble gas airborne radiation from MDHR Pump Cubical Filtration System + Alarms for High-Red, Alert-Amber, and Fail-Green	Adj. Pnl.1 A66 + 4′ AP + 0′	Victoreen 844-18			
MDH-RIA-108P-2	Radiation Ratemeter/ Alarm	Indicate particulate airborne radiation from MDHR Pump Cubical Filtration System + Alarms for High-Red, Alert-Amber, and Fail-Green	Pnl.2	Victoreen 908428		$10-10^6$ cpm	
MDH-RIA-108I-2	Radiation Ratemeter/ Alarm	Indicate iodine airborne radiation from MDHR Pump Cubical Filtration System + Alarms for High-Red, Alert-Amber, and Fail-Green	Pnl.2	Victoreen 908428		$10-10^6$ cpm	

TABLE 6
INSTRUMENTATION CONTROLS & ALARMS

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
MDH-RIA-108G-2	Radiation Ratemeter/ Alarm	Indicate Noble Gas airborne radiation from MDHR Pump Cubical Filtration System + Alarms for High-Red, Alert-Amber, and Fail-Green	Pnl.2	Victoreen 908428		$10\text{-}10^6$ cpm	
MDH-VE-1A	Accelerometer Senser	MDH-P-1A bearing housing vertical radial vibration	MDH-P-1A brg. housing	Vibra-Metrics #6022	0 - 25 g	0 - 2500 mv	N/A
MDH-VE-2A	Accelerometer Senser	MDH-P-1A bearing housing horizontal radial vibration	MDH-P-1A brg. housing	Vibra-Metrics #6022	0 - 25 g	0 - 2500 mv	N/A
MDH-VE-1B	Accelerometer Senser	MDH-P-1B bearing housing vertical radial vibration	MDH-P-1B brg. housing	Vibra-Metrics #6022	0 - 25 g	0 - 2500 mv	N/A
MDH-VE-2B	Accelerometer Senser	MDH-P-1B bearing housing horizontal radial vibration	MDH-P-1B brg. housing	Vibra-Metrics #6022	0 - 25 g	0 - 2500 mv	N/A
MDH-VIAH-1	Annunciator Lights & Velocity Indication	A) CHANNEL 1 - MDH-P-1A bearing vertical radial vibration "ALERT" LIGHT (Low Alarm-White Lt.)	Adjacent to PNL.1 A66 + 3′ AM + 6′	Vibralarm Model No. VA 102-2	N/A	N/A	2-3 time above initial level
		CHANNEL 1 - MDH-P-1A bearing housing vertical radial vibration "SHUTDOWN" LIGHT (High Alarm-Red Lt.)	Adjacent to PNL.1 A66 + 3′ AM + 6′	Vibralarm Model No. VA 102-2	N/A	N/A	4-5 time above initial level
		B) CHANNEL 2 - MDH-P-1A bearing horizontal radial vibration "ALERT" LIGHT (Low Alarm-White Lt.)	Adjacent to PNL.1 A66 + 3′ AM + 6	Vibralarm Model No. VA 102-2	N/A	N/A	2-3 time above initial level

TA. . 6

INSTRUMENTATION CONTROLS & ALARMS

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
MDH-VIAH-1	Annunciator Lights & Velocity Indication	CHANNEL 2 - MDH-P-1A bearing housing <u>horizontal</u> radial vibration "SHUTDOWN" LIGHT (High Alarm-Red Lt.)	Adjacent to PNL.1 A66 + 3′ AM + 6′	Vibralarm Model No. VA 102-2	N/A	N/A	4-5 times above initial level
		C)System Malfunction Light (amber)	Adjacent to PNL.1 A66 + 3′ AM + 6′	Vibralarm Model No. VA 102-2	N/A	N/A	N/A
		D) CHANNEL 1 & 2 Velocity meter	Adjacent to PNL1 A66 + 3′ AM + 6′	Vibralarm Model No. VA 102-2	0 - 2500 mv	0.0.7 in/sec	N/A
MDH-VIAH-2	Annunciator Lights & Velocity Indication	A) CHANNEL 1 - MDH-P-1B bearing housing <u>vertical</u> radial vibration "ALERT" LIGHT (low/alarm-White Lt.)	Adjacent to PNL1 A66 + 3′ AM + 8′	Vibralarm Model No. VA 102-2	N/A	N/A	2-3 times above initial level
		CHANNEL 1 - MDH-P-1B bearing housing <u>vertical</u> radial vibration "SHUT-DOWN" LIGHT (High Alarm-RED LT.)	Adjacent to PNL1 A66 + 3′ AM + 8′	Vibralarm Model No. VA 102-2	N/A	N/A	4-5 times above initial level
		B) CHANNEL 2 - MDH-P-1B bearing housing <u>horizontal</u> radial vibration "ALERT" LIGHT (low alarm- white lt.)	Adjacent to PNL1 A66 + 3′ AM + 8′	Vibralarm Model No. VA 102-2	N/A	N/A	2-3 times above initial level
		CHANNEL 2 - MDH-P-1B bearing housing <u>horizontal</u> axial vibration "SHUTDOWN" LIGHT (High Alarm - Red lt.)	Adjacent to PNL1 A66 + 3′ AM + 8′	Vibralarm Model No. VA 102-2	N/A	N/A	4-5 times above initial level

TA 6
INSTRUMENTATION CONTROLS & ALARMS

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
MDH-VIAH-2	Annunciator Lights & Velocity Indication	C)System Malfunction Light (amber)	Adjacent to PNL.1 A66 + 3′ AM + 8′	Vibralarm Model No. VA 102-2	N/A	N/A	N/A
		D) CHANNEL 1 & 2 Velocity Meter	Adjacent to PNL1 A66 + 3′ AM + 8′	Vibralarm Model No. VA 102-2	0 - 2500 mv	0.0.7 in/sec	N/A
MDH-VAH-1	Annunicator Light	High Vibration of MDH-P-1A or 1B bearing housing or system malfunction	Pnl.2		N/A	N/A	See MDH-VIAH-1&2
MDH-DPT-37	D/P Transmitter	Measure Differential Pressure across MDH-F-1	Piping A66′ + 12′ AF + 8′	Foxboro N-E11DM-HAB2	0-120 psid	10-50 ma	N/A
MDH-DPS-37	D/P Pressure Switch	High D/P Alarm Signal across MDH-F-1 to MDH-DPAH-37	Pnl.1	Foxboro 63U-BT-OHER	10-50 ma	N/A	__ma
MDH-DPAH-37-1 & 2	Annunicator Light/H[illegible]n	Alarm High D/P across MDH-F-1 (Amber Lt.)	Pnl.1 & Pnl.2	G.[illegible] Type CR2940	N/A	N/A	65 psid above initial filter clean d/
MDH-DPI-37	D/P Indicator	Indicate Differential Pressure Across MDH-F-1	Pnl.1	Westing-house VX252	10-50 ma	0-120 psid	N/A
MDH-FI-6	Flowmeter	Indicate Demineralized water flow to MDH-P-1A seal block	Piping	Matheson FM-1100	0.3-3.0 gpm	0.3-3.0 gpm	1 to 1.5 gpm
MDH-FI-7	Flowmeter	Indicate Demineralized Water Flow to MDH-P-1B Seal Block	Piping	Matheson FM-1100	0.3-3.0 gpm	0.3-3.0 gpm	1 to 1.5 gpm

TABLE 6
INSTRUMENTATION CONTROLS & ALARMS

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
MDH-TVC-1	T.V. Camera	Monitor MDH-P-1A & 1B pump cubicles	F.H. Bldg. El. 280'-6" A66 + 18' AF + 3'	Diamond Elec. ST-11 Camera PT-1050-L Pan/ Tilt 30-150, MM Zoom Lens	N/A	N/A	N/A
MDH-TVC-2	T.V. Camera	Monitor MDH-HX-1A & 1B heat exchange room	F.H. Bldg. El. 280'-6" A67 & AF	Diamond Elec. ST-11 Camera PT-1050-L Pan/ Tilt, 30-150, MM Zoom Lens	N/A	N/A	N/A
MDH-RACK-TV1	T.V. Monitor & Controls	Monitor for MDH-TVC-1 and controls for Pan-Tilt mechanism with zoom/focus controls	Cont. Bldg. El. 305'-0" C47 + 0' CC + 9'	Con-Rack 14" B & W Receivers and Control Modules	N/A	N/A	N/A
MDH-RACK-TV2	T.V. Monitor & Controls	Monitor for MDH-TVC-2 and controls for Pan-Tilt mechanism with zoom/focus controls	Cont. Bldg. El. 305'-0" C47 + 0' CC + 9'	Con-Rack 14" B & W Receivers and Control Modules	N/A	N/A	N/A

2

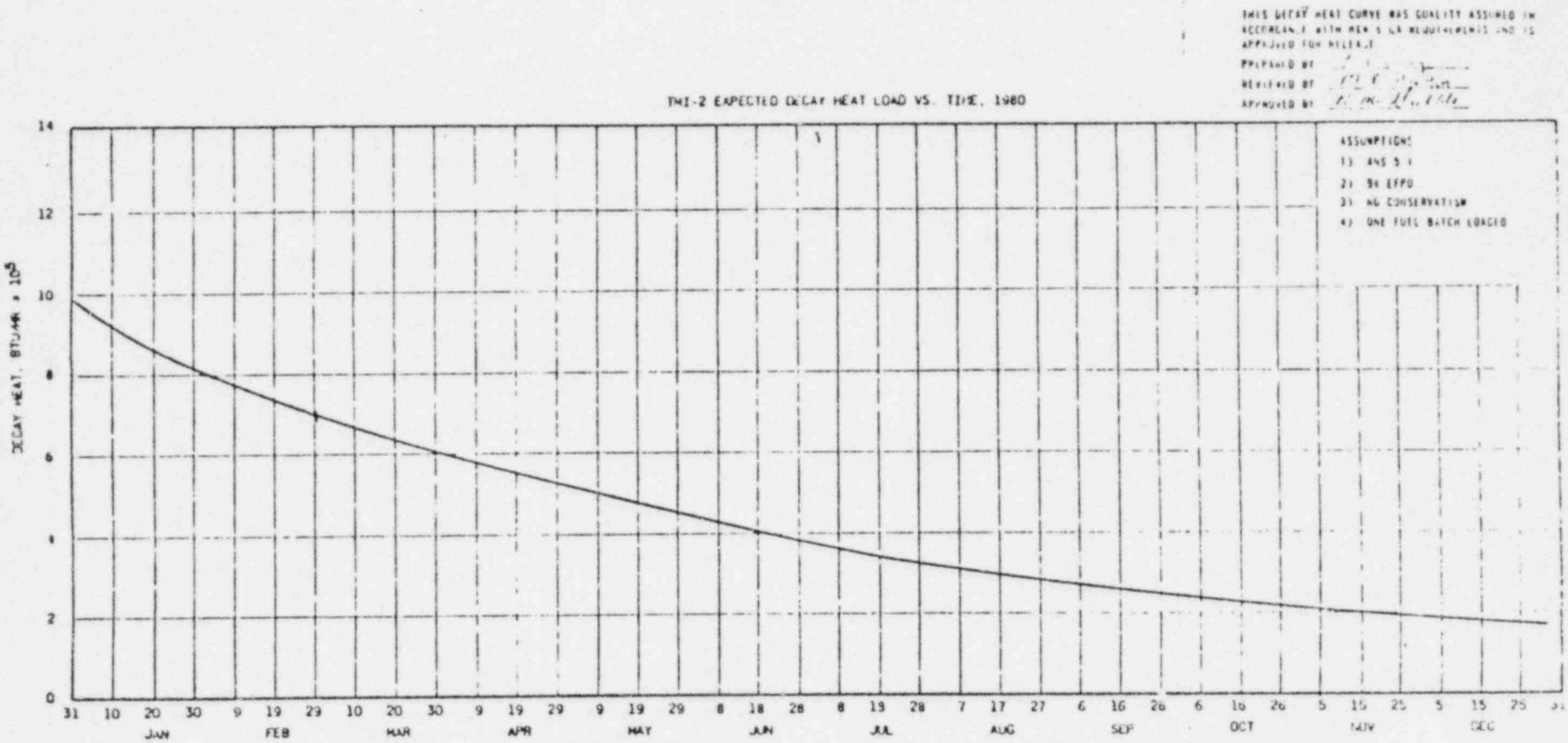
TMI-2 EXPECTED DECAY HEAT LOAD VS. TIME, 1980
PREPARED BY
REVIEWED BY
APPROVED BY
ASSUMPTIONS
3) NO CONSERVATISM
4) ONE FUEL BATCH LOADED
DECAY HEAT, BTU/HR x 10^5
0
2
4
6
8
10
12
14
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

FIGURE 1

2

TYPICAL MDHR PUMP CHARASTERISTIC CURVE (MDH- ..A & MDH-P-1B)
FIGURE #2