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DUKE POWER

December 13, 1990

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: McGuire Nuclear Station Unit 1 and 2
Docket No. 50-369
Licensee Event Report 369/90-29

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report 369/90-29 concerning the potential for the loss of a Residual Heat Removal Train because of a Design Deficiency. This report is being submitted in accordance with 10 CFR 50.73(a)(2)(i). This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

Tony D. McConnell

T.L. McConnell

DVE/ADJ/cbl

Attachment

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NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
McGuire Nuclear Station, Unit 1	0 5 0 0 0 3 6 9	1 OF 9

TITLE (4) Potential Exists For The Loss Of A Residual Heat Removal Train Because Of A Design Deficiency

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
1 1	0 9	9 0	9 0	- 0 2 9	- 0 0	1 2	1 3	9 0	McGuire, Unit 2	0 5 0 0 0 3 7 0
										0 5 0 0 0

OPERATING MODE (9)	0	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0 0 0	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	X 50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Alan Sipe, Chairman, McGuire Safety Review Group	AREA CODE 7 0 4 8 7 5 - 4 1 8 3

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	

SUPPLEMENTAL REPORT EXPECTED (14)

		EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

ABSTRACT (Limit to 1400 spaces, i.e. approximately fifteen single-space typewritten lines) (16)

On May 5, 1988, an NRC Bulletin, 88-04, Potential Safety-Related Pump Loss, was issued to all holders of operating licenses or construction permits for nuclear power reactors. The purpose of this bulletin was to alert utilities of the potential for one pump with a stronger developed head to cause the weaker parallel pump to deadhead and fail. This is caused by the piping arrangement for minimum flow (miniflow) recirculation. This potential problem has been the subject of an ongoing investigation by Design Engineering personnel since the NRC Bulletin was recei Upon receipt of Information Notice No. 90-61 on October 29, 1990, Desi ngineering, Operations, and Performance personnel reevaluated these concerns and on November 13, 1990, it was determined by Design Engineering personnel that this potential condition renders the Residual Heat Removal System (ND) conditionally operable. Unit 1 was in Mode 4 (Hot Shutdown) and Unit 2 was in Mode 5 (Cold Shutdown) on November 13, 1990. This event is assigned a cause of Design Deficiency because of the miniflow piping configuration for the ND pumps on Train A and B. Operations personnel revised the Unit 1 and will revise the Unit 2 procedures EP/1,2/A/5000/01, Reactor Trip Or Safety Injection, according to the Operability Evaluation. Even though it has not been demonstrated that a deadheading problem exists for the Unit 2 ND system pumps, interim measures were taken on Unit 2 to ensure a miniflow recirculation path exists.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
McGuire Nuclear Station, Unit 1	0 5 0 0 0 3 6 9	9 0	— 0 2 9	— 0 0	2 OF 9

TEXT (If more space is required, use additional NRC Form 366A's) (17)

EVALUATION:

Background

The primary function of the ND system [EIIS:BP] is to remove heat energy from the Reactor [EIIS:RCT] Core and the Reactor Coolant System (NC) [EIIS:AB] during plant cooldown and refueling operations. The system is also utilized as a part of the Emergency Core Cooling System (ECCS). It has a secondary function of transferring refueling water between the storage tank [EIIS:TK] and the refueling cavity at the beginning and end of refueling operations. To demonstrate the readiness and operability of the ECCS, the components are subjected to periodic tests and inspections. An initial pre-operational system flow test was performed to demonstrate the proper functioning of all of the components.

The ND system has two parallel flow paths sharing a common inlet from the Refueling Water Storage Tank and the NC system Loop C. Additionally, each ND system pump has a separate suction supply line from the Containment Sump. The return lines connect to the cold leg of each NC system loop. Each flow path contains an ND pump [EIIS:P], a heat exchanger [EIIS:HX], associated piping, miniflow recirculation path, valves [EIIS:V], and instrumentation required for operational control. During normal operation, the system is not in service but is aligned in readiness for operation as a part of the ECCS. ND pumps Train A and B start automatically on a Safety Injection signal and go into recirculation until NC system pressure drops low enough to permit injection into the cold legs of the NC system. Reference drawing on page 9 of 9.

Technical Specifications (TS) 3.5.2 and 3.5.3 specify the requirements for the operation of the ND Pumps with respect to their ECCS function. Both pumps are required to be operable in Modes 1 (Power Operation), 2 (Startup), and 3 (Hot Standby). During operation in Modes 1, 2, and 3, when one train of ECCS becomes inoperable, the inoperable train must be returned to operable status within 72 hours, or the unit must be shutdown to Mode 4.

Description of Event

On November 17, 1987, NRC Information Notice No. 87-59, Potential Residual Heat Removal Pump Loss, was issued to all holders of operating licenses or construction permits for nuclear power reactors. This Information Notice discussed the notification by Westinghouse Electric Corporation of two concerns they identified regarding the design of the miniflow recirculation line configuration for the ND pumps. These concerns involved the potential for deadheading one of two ND pumps in systems that have a common miniflow recirculation line serving both pumps. The second concern involved the adequacy of the miniflow recirculation line capacity even for single pump operation. McGuire Nuclear Station ND system pumps have separate miniflow recirculation lines.

On May 5, 1988, the NRC staff issued NRC Bulletin 88-04, Potential Safety-Related Pump Loss. This Bulletin addressed the issue of potential deadheading of the weaker pump during two pump miniflow operations. The NRC staff requested that all water-cooled reactor designs evaluate this potential condition for any safety-related systems with a pump and piping system configuration that does not preclude pump-to-pump interaction during miniflow operation and could, therefore, result in deadheading one or both of the pumps.

The NRC requested a written response from all applicable utilities to summarize the problems and the systems affected, identify the short-term and long-term modifications, identify an appropriate schedule for long-term resolution of this and/or other significant problems that are identified as a result of this bulletin and provide justification for continued operation particularly with regard to General Design Criterion 35 of Appendix A to Title 10 of the Code of Federal Regulations (10CFR50), Emergency Core Cooling and 10CFR50.46, Acceptance Criteria for Emergency Core Cooling System for Light Water Nuclear Power Reactors.

Duke Power Company sent several interim responses on July 11, 1988, August 31, 1988, December 1, 1988, April 21, 1989, and June 30, 1989 for McGuire, Catawba, and Oconee Nuclear Stations. Each response provided thorough information and schedules for ongoing evaluations. The ongoing evaluations were awaiting additional pump minimum flow recommendations from the manufacturers. The response dated June 30, 1989, stated that continued operation of the ND pumps is justified on the following basis:

> Quarterly inservice testing (IWP) of the ND pumps by Performance personnel shows that available miniflow meets manufacturer's requirements for single pump operation. The tests show an acceptable level of vibration and temperature rise. Also, these pumps are used during refueling outages (mid-loop operation) to remove residual heat. These operations have been continued with relatively low flow rates and have shown no pump degradation.

On September 20, 1989, the pump manufacturer sent a letter to Duke Power Company concerning ND Pump miniflow rates. This manufacturer's report of ND pump miniflow rates recommended the operation for the ND pumps: (1) Continuous operation (operation exceeding a 3 hour duration in a 24 hour time period) : 1000 gallons per minute (gpm). (2) Short period operation of 3 hours or less : 300 gpm. (3) Start/stop (operation of 30 minutes or less) : 100 gpm.

On February 7, 1990, a meeting was held with Performance, Operations, and Design Engineering personnel as part of the ongoing investigation to discuss the NRC Bulletin 88-04 and potential testing requirements of the ND pumps.

On February 15, 1990, Design Engineering personnel performed an evaluation of the impact of a failed open ND pump recirculation valve on single train ECCS injection flow. Both trains of ECCS pumps for each unit were evaluated and

the results of this evaluation indicated that the single train ECCS injection flow meets the current minimum safeguards assumptions with an ND pump recirculation valve failed open.

Several meetings were held between Design Engineering and Station personnel in June, 1990, to discuss the ND system miniflow concerns associated with NRC Bulletin 88-04. It was decided that a Nuclear Station Modification (NSM) should be generated for both Units to install new miniflow lines and change the miniflow valve to a 3 inch gate valve. On July 30, 1990, NSMs MG-12343 and MG-22343 were initiated requesting DE personnel to do this.

On September 20, 1990, NRC Information Notice No. 90-61 was issued. This information notice alerted addressees to the potential for flow stoppage caused by the interaction of the parallel pumps in the ND systems that have discharge check valves located upstream of the recirculation lines. This information described an event where in December 1989, the staff at Unit 1 of the Sequoyah Nuclear Power Plant found that one of the residual heat removal pumps was running without flow (deadheading) during simultaneous surveillance testing of both pumps. They determined that operating a pump with no flow longer than 11 minutes may cause pump damage.

NRC Information Notice 90-61, Potential For Residual Heat Removal Pump Damage Caused By Parallel Pump Interaction, was received by Design Engineering personnel on October 29, 1990, and heightened the awareness of the significance of the potential ND system condition. This led to further testing by Performance personnel and further evaluation by Design Engineering personnel.

On November 12, 1990, Design Engineering personnel prepared and completed an Operability Evaluation for Problem Investigation Report (PIR) No. 1-M90-0312. This Operability Evaluation justifies the operability of Unit 1 ND system (Both Pumps in Operation) during a Design Basis Event.

On November 13, 1990, Performance personnel tested the Unit 1 ND pumps in a special configuration by running both pumps in recirculation simultaneously. The Unit 1 Train B ND pump was measured at a 234 gpm flow rate with Unit 1 Train A ND pump measured at 620 gpm.

Conclusion

This event is assigned a cause of Design Deficiency because of the ND pumps piping configuration that was the original design from the ECCS designer. Each of the two ND system trains has a check valve located on the discharge side of the pump and upstream of the miniflow line. A normally open crossover line connects the two trains downstream of the miniflow recirculation line. Because of one pump having a higher discharge pressure than the other, with both pumps running, the differential pressure will equalize across the lines connecting both pumps which may increase the flow of one of the pumps and decrease the flow of the other pump based on their respective pump curves.

Westinghouse Electric Corporation indicated in the NRC Information Notice 87-59 that traditionally, the design criteria for miniflow lines have been based on the need to limit the temperature rise in the pumped liquid and pump casing. However, that design criteria should include consideration of the potential for pump operation at conditions close to the pump shutoff head. Also, miniflow lines have traditionally been designed for only 5 percent to 15 percent of pump design flow. Some pump manufacturers now are advising that their pumps should have minimum flow capacities of 25 percent to more than 50 percent of best efficiency flow for extended operation to protect against hydraulic instability or impeller recirculation problems.

The condition that could cause a loss of ND pumps is a large diff ce in pump performance causing deadheading of the weaker pump. Current the difference in pump performance is low enough (about 3 or 4 psid fo Unit 1 pumps) such that deadheading probably will not occur. The pressur difference for Unit 2 has been as high as 10 to 12 psid. The Unit 2 ND pumps will be tested during the transition from Mode 4 to Mode 3 to evaluate the pump performance difference for these pumps.

Normally, two identically designed pumps may not have the same pump differential pressure. Each ND pump run individually has had flow measured in the 350 gpm to 450 gpm range. This is normal and acceptable according to Performance personnel. Because of the NRC Bulletin, Information Notices and ongoing evaluations by Design Engineering personnel concerning this potential condition, Design Engineering personnel suggested that a test be run with both pumps running. When in this configuration with both pumps running, the differential pressure will equalize across the piping of both pumps which may cause an increase in the flow of one pump and a decrease in the flow for the other pump according to their respective pump curves. This condition of the weaker pump deadheading is manifested at low flow rates because of the flatness of the pump characteristic curve in this range.

NSMs MG-12343 and MG-22343 were initiated on July 30, 1990, and were already being designed to add a second miniflow recirculation line for the ND system pumps. These NSMs will add a new 3 inch miniflow recirculation line for each ND system pump recirculation flow path, plus change the existing 2 inch miniflow valves to 3 inch gate valves. The existing 3 inch miniflow line will remain allowing 2 flow paths. The new line will tie in upstream of the existing ND system pump discharge check valve and be routed to tie in upstream of the new miniflow valve. Reference page 9 of 9. Making the tie-in upstream of the check valve allows us to take advantage of the check valve to prevent weak pump deadheading when pump differential performance is far apart. These NSMs are still being designed and were not available for immediate implementation, therefore, the following actions were taken for Unit 1 and Unit 2.

According to the Operability Evaluation performed by Design Engineering personnel on December 12, 1990, Unit 1 is conditionally operable. The compensatory action required is for Operations personnel to close the cross tie valve 1ND-15B, Train 1B ND to Hot Leg Isolation, within 30 minutes but

not before 10 minutes of a Safety Injection actuation if each pumps flow does not exceed 300 gpm.

An interim second miniflow recirculation line was installed as an urgent modification MG-22365 for Unit 2. This modification is only required to be installed on the weaker Train B ND pump. This is to ensure there will be a minimum recirculation of flow through the pump per the manufacturers recommendations. This modification was installed as a precautionary measure since it has not been demonstrated that a deadheading problem exists for the Unit 2 ND system pumps. Testing can not be performed until the ND system pumps can be taken out of service at the end of Mode 4. When Unit 2 reaches the transition between Mode 4 and Mode 3, then Performance personnel will test the Unit 2 ND pumps Train A and B running in recirculation simultaneously. Operations personnel will evaluate what changes need to be made on the Unit 2 Reactor Trip Or Safety Injection emergency procedure based on the test results to ensure adequate action will be taken on the Unit 2 ND pumps to prevent potential deadheading of the weaker pump.

A review of the Operating Experience Program data base for McGuire Technical Specification violations with a Design Deficiency because of an Equipment Configuration for the previous 24 months revealed no events involving the ND system. There were 2 events involving ventilation systems; however, neither of these events contained any similarities to this ND system event. Therefore, this is not considered to be a recurring problem.

This event is not Nuclear Plant Reliability Data System (NPRDS) reportable.

There were no personnel injuries, radiation overexposures, or uncontrolled releases of radioactive materials as a result of this event.

CORRECTIVE ACTIONS:

Immediate: None

Subsequent:

1) DE personnel prepared an Operability Evaluation for Unit 1 with conditions on how long the ND pumps can be run at different flow rates.

2) Operations personnel added a caution statement and a step to the Unit 1 procedure EP/1/A/5000/01, Reactor Trip Or Safety Injection. This caution statement and procedure step ensure the ND pump trains are isolated from each other 30 minutes after a Safety Injection, if the ND pump flows are less than 1500 gpm.

3) NSM MG-22365 was implemented on the Unit 2 ND system Train B pump as a precautionary measure to ensure a minimum recirculation of flow through the pump per the manufacturers recommendations.

Planned:

1) NSM MG-12343 will be implemented on Unit 1 to replace the miniflow valve and add a miniflow recirculation line to both trains of the ND pumps.

2) NSM MG-22343 will be implemented on Unit 2 to replace the miniflow recirculation valve and add a miniflow recirculation line to both trains of the ND pumps.

3) Performance personnel will test the Unit 2 ND pumps by running them simultaneously.

4) Operations personnel will revise the Unit 2 procedure EP/2/A/5000/01, Reactor Trip Or Safety Injection, based on the results of the test listed in planned corrective action 3). These conditions will be similar to the changes incorporated in the Unit 1 emergen " procedure.

SAFETY ANALYSIS:

The ND system transfers heat from the NC system to the Component Cooling [EIIS:CC] system to reduce the temperature of the reactor coolant water to the cold shutdown temperature at a controlled rate during the second part of normal unit cooldown and maintains this temperature until the unit is started up again. As a secondary function, the ND system also serves as part of the ECCS during the injection and recirculation phases of a loss of coolant accident (LOCA). The ND system also is used to transfer refueling water between the refueling water storage tank and the refueling cavity before and after the refueling operations. The heat load handled by the ND system during the cooldown transient includes residual and decay heat from the core and NC system pump heat.

The ND system functions in conjunction with the high head portion of the ECCS to provide injection of borated water from the refueling water storage tank into the NC system cold legs, during the injection phase following a LOCA. Should the NC system pressure fall below ND pump shutoff head, the ND system directly injects water into the NC system. A Safety Injection signal actuates the ND pumps. During the cold leg recirculation phase, water is pumped from the containment sump into the NC system.

The ND system pumps require protection from overheating and loss of suction flow by miniflow recirculation lines that assure flow to the pump suction. A control valve located in each miniflow line is operated based on measurement of pump discharge flow. Setpoints are chosen to ensure that the valves open before discharge flow falls below 750 gpm and close after flow rises above 1400 gpm. Once flow is established to the NC system, the miniflow recirculation line is automatically closed. The ND system also provides suction flow to the Safety Injection (NI) system [EIIS:BQ] and the Chemical and Volume Control (NV) system [EIIS:CB] pumps during Cold Leg recirculation. During Hot Leg recirculation, the ND pumps provide flow directly to the NC system.

The heat removal function of the ND system shall be performed during Station Blackout and Loss of Control Room design events. The emergency core cooling and reactivity control function of the ND system is required to mitigate Large Break LOCAs by injection and recirculation. The ND system shall be capable of performing this function with only on-site power available and following a seismic event. Due to the relatively low shutoff head of the ND pumps, the ND system does not inject directly to the core during Small Break LOCA mitigation; it shall provide flow to the suction of the NI and NV pumps under these circumstances.

The worse case that could potentially occur is that the ND pumps would start together due to a Safety Injection initiation and one pump deadheads and is damaged before Operations personnel can isolate it. Then the Small Break LOCA escalates to a Large Break LOCA and the only operable ND system pump becomes inoperable due to valve failure, pump failure, or diesel failure, then there would be a total loss of ND flow.

The ND pump manufacturer's (Ingersoll-Rand) report of ND pump minimum flow rates are recommended for the ND pumps:

1) Continuous operation (operation exceeding a 3 hour duration in a 24 hour time period : 1000 gpm.

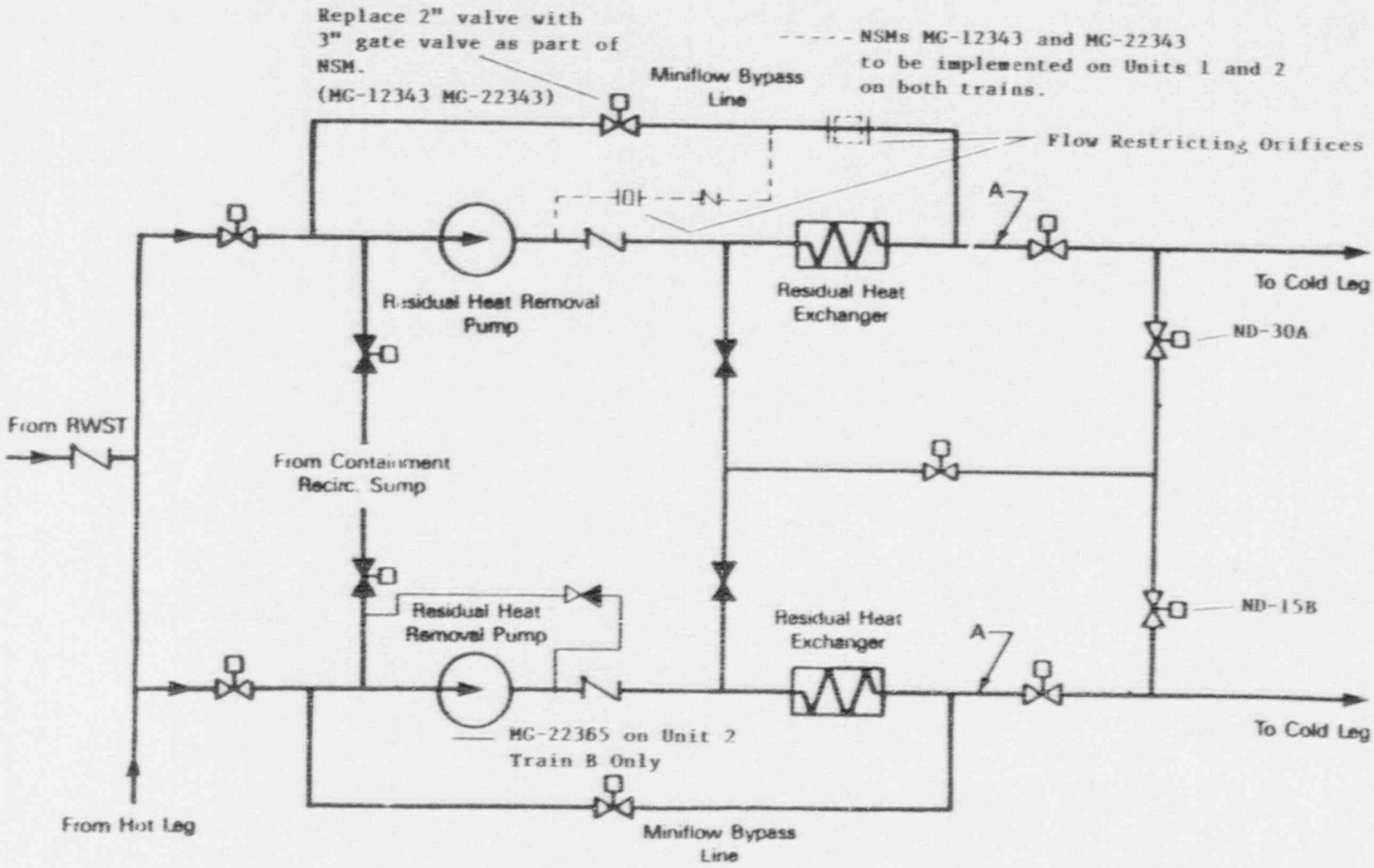
2) Short period (operation of 3 hours or less) : 300 gpm.

3) Start/stop (operation of 30 minutes or less) : 100 gpm.

The ND system meets the required design flow of 3975 gpm from one pump, supplying all required loads.

The compensatory measures that will be taken by Operations personnel to close the cross tie valve 1ND-15B, Train 1B ND to Hot Leg Isolation, or 1ND-30A, Train 1A ND to Hot Leg Isolation, within 30 minutes after a Safety Injection actuation if the ND pump flows are less than 1500 gpm, will ensure the weaker ND pump would not be damaged during this type of event and would be available provided the small break LOCA escalates to a worse event.

The health and safety of the public were not affected by this event.



Residual Heat Removal System - Minimum Flow Lineup