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SUBJECT: Responds to Insp 50-244/90-24 on 910114 re "Review of RG&E Actions Taken in Response to NRC Bulletin Number 88-04, Potential Safety Related Pump Loss."

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March 27, 1991

U.S. Nuclear Regulatory Commission
Document Control Desk
Attn: Allen R. Johnson
Project Directorate I-3
Washington, D.C. 20555

Subject: Response to Inspection No. 50-244/90-24, dated January 14, 1991
Review of RG&E Actions Taken in Response to NRC Bulletin No. 88-04, Potential Safety Related Pump Loss
R.E. Ginna Nuclear Power Plant
Docket No. 50-244

Dear Mr. Johnson:

The subject inspection report concluded that the engineering resolution and documentation for those systems that were susceptible to the concerns of the bulletin were detailed and technically sound. However, it was noted that the documentation for the evaluation of those systems that were acceptable, was not adequately maintained.

Additionally, it was noted that the as-built recirculation line for the High Head Safety Injection System did not agree with that proposed in our response to NRC Bulletin 88-04, dated July 7, 1988. Modification (EWR) 3881 was implemented in 1989 to provide a 1½-inch recirculation line for each pump. Our response had indicated a 1-inch line would be installed.

The use of the 1½-inch line was documented in modification package for EWR 3881 and a description was also provided in our December 1989 update of the UFSAR in Section 6.3.2.2.1. The as-built system configuration is shown on the Piping and Instrumentation Drawing provided as Figure 6.3-1 of the UFSAR.

As agreed during the exit meeting, RG&E agreed to review these documentation issues in a timely manner. A document entitled "Basis of Design for the Minimum Flow Recirculation Systems for Residual Heat Removal, High Head Safety Injection, and Auxiliary

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Feedwater Pumps as Related to NRC Bulletin 88-04" was transmitted to the Region I Office on October 31, 1990. An updated copy of that document is provided as Attachment 1.

Very truly yours,

Robert C. Mecredy

GAH/146
Attachment

xc: Mr. Allen R. Johnson (Mail Stop 14D1)
Project Directorate I-3
Washington, D.C. 20555

U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406

Ginna Senior Resident Inspector

ATTACHMENT 1

BASIS OF DESIGN FOR THE MINIMUM FLOW RECIRCULATION SYSTEMS FOR RESIDUAL HEAT REMOVAL, HIGH HEAD SAFETY INJECTION, AND AUXILIARY FEEDWATER PUMPS AS RELATED TO NRC BULLETIN 88-04

REV. 1

Rochester Gas and Electric Corporation
89 East Avenue
Rochester, NY 14649

EWR 3881 SI PUMPS RECIRCULATION
EWR 4675 RHR PUMP RECIRCULATION

FEBRUARY 13, 1991

BASIS OF DESIGN FOR THE MINIMUM FLOW RECIRCULATION SYSTEMS FOR RESIDUAL HEAT REMOVAL, HIGH HEAD SAFETY INJECTION, AND AUXILIARY FEEDWATER PUMPS AS RELATED TO NRC BULLETIN 88-04

PURPOSE

The purpose of this document is to provide additional clarification of the design basis for the minimum flow recirculation systems for the safety related pumps applicable to NRC Bulletin 88-04 concerns at the R. E. Ginna Nuclear Power Plant. Systems applicable are as follows:

- Residual Heat Removal (RHR)
- High Head Safety Injection (SI)
- Main Auxiliary Feedwater, both motor driven and turbine driven (MDAFW, TDAFW)
- Standby Auxiliary Feedwater (SBAFW)

INTRODUCTION

Several letters and correspondence (Refs. c, d, g) documented concerns relative to the adequacy of miniflow in safety related pumps. NRC Bulletin 88-04 (ref. g) specifically requested license evaluation and actions to be taken. The concerns were as follows:

1) Systems where pumps may operate in parallel with both pumps recirculating through a common recirculation line that does not preclude pump-to-pump interaction during miniflow operation.

2) The adequacy of minimum flow bypass lines with respect to damage resulting from operation and testing in the minimum flow mode.

The first concern would result from the design of the piping system. The second concern relates to the system design as well as how the pumps are operated and tested, and the pump application and design. Damage to a pump may result from excessive heatup inside the pump which could as a worst case lead to seizure and failure. Damage may also result from hydraulic forces and instability while operating at low flows. This condition can in the worst case lead to pump failure, but can only occur when operating at low flows for extended periods or where the cumulative number of operating hours is relatively large. It can lead to accelerated degradation of pump internals and impeller cavitation damage. Cavitation so severe that it could cause damage in the short term would be detectible during testing. The required minimum flow design must, therefore, address both these conditions. The flow values

necessary to prevent pump damage due to heatup are much less than the flows necessary to prevent damage due to suction recirculation or instability. Since the latter requires operation at low flows for extended duration and generally provides indications of degrading conditions such as trends in pressure, vibration, and temperature of the bearings (ref. b), plant operating limits and testing can provide adequate assurance that this type of failure will not occur.

NRC found RG&E responses to Bulletin 88-04 (ref. h and j) acceptable (ref. l).

REFERENCES

(a) Letter from S. A. Herrick, Worthington (McGraw Edison) to M. P. Lilley, RG&E, Safety Injection Pump, dated October 25, 1982.

(b) NUREG/CR-4597-Vol. 1, Aging and Service Wear of Auxiliary Feedwater Pumps for PWR Nuclear Power Plants, July 1986.

(c) NRC Information Notice 87-59: Potential RHR Pump Loss, dated November 17, 1987.

(d) Letter from S. P. Swigert, Westinghouse Electric Corporation, to S. M. Spector, RG&E, Emergency Core Cooling System Pumps Miniflow Concern, RG&E-87-670, dated December 8, 1987.

(e) Letter from Bill McClaskey, Pacific Pumps/Dresser, to G. Hermes, RG&E, 6" SVC Residual Heat Removal Pumps, dated March 24, 1988 (Response to ref. f).

(f) Letter from G. Hermes, RG&E to William McClaskey, Dresser Pump Division, 6" SVC Residual Heat Removal Pumps, dated January 7, 1988.

(g) NRC Bulletin No. 88-04: Potential Safety Related Pump Loss, dated May 5, 1988.

(h) Letter from B. A. Snow, RG&E to C. Stahle, NRC, Response to NRC Bulletin 88-04, dated July 7, 1988.

(i) Telecon memorandum with M. P. Lilley, RG&E, and Frank Ferrarese, Dresser Pump, Turbine Driven Auxiliary Feedwater Pump, dated November 1, 1988.

(j) Letter from R. C. Mecredy, RG&E to A. R. Johnson, NRC, Status Report of Plant Modifications Pursuant to NRC Bulletin 88-04, dated July 24, 1989.

(k) Safety Evaluation 10CFR50.59 - RHR Pump Recirculation 1989 Installed Modification, EWR 4675, Rev. 0, dated May 25, 1989.

(l) Letter from A. R. Johnson, NRC to R. C. Mecredy, RG&E, NRC Bulletin 88-04 (TAC No. 69918), dated August 16, 1989.

(m) Interoffice Correspondence from E. K. Voci, RG&E, to D. R. Gent, RG&E, S.I. Pump Recirculation Flow, dated March 9, 1990.

(n) Kypipe Analysis, ECCS Hydraulic Analysis, file "ECCS 47", dated October 26, 1990.

(o) Letter from R. C. Mecredy, RG&E, to A. R. Johnson, NRC, NRC Bulletin 88-04, dated March 12, 1990.

(p) Letter from Carl Stahle, NRC to R. C. Mecredy, RG&E, Issuance of Amendment to Operating License, Amendment 33, dated March 30, 1990.

(q) Letter from R. E. Smith, RG&E, to Carl Stahle, NRC, Application for Amendment to Operating License, dated November 29, 1988.

(r) Telefax from R. Joines, Dresser Pump Division, to G. Hermes, RG&E, Minimum Flow, RHR pumps, dated October 25, 1990.

(s) NUS Report 0499-M-02, Rev. 0, dated December 20, 1989, Auxiliary Feedwater Hydraulic Analysis.

(t) Ingersoll Rand Drawing Line Notes, 29HMTA86X8A, Sheet 1, Rev. 2, for Ingersoll Rand order 016-36370, GAI order 55190 (date stamped April 26, 1976).

(u) ECCS Hydraulic Analysis Report, NUS 3S61-M-10, Rev. 0, dated September 6, 1990.

(v) Kypipe Analysis, AFW Hydraulic Model, file "TD100", dated February 13, 1991

(w) Safety Analysis, EWR 3881, SI Pump Recirculation, Rev. 4, dated December 5, 1989.

(x) Kypipe Analysis, ECCS Hydraulic Analysis, file "ECCS 26", dated September 11, 1989.

DISCUSSION

Residual Heat Removal System

Performance Characteristics - 2 pumps
Model 6" - SVC Single Stage 0 Close-Coupled-Horizontal
RPM 1770
Rated Flow 1560 GPM P&ID 33013-1247
Rated Head 280ft. UFSAR Fig. 5.4-7
Rated Horsepower 200 HP
Flow at Best Efficiency Point (BEP) 1800 GPM
Pump S/N 43513 ('A'); 43514 ('B')
Manufacturer - Pacific Pump/Dresser
Original recirc. design - one recirc. line for both pumps; 200gpm if 1 pump operating; 100 gpm if operated in parallel

RG&E provided a response to NRC Bulletin 88-04 in ref. (h). Attachment B to ref. (h) provided a detailed evaluation and operability justification. It also described a planned modification (EWR 4675). The operability determination showed that a flow of 100 gpm per pump was adequate for short periods of time. The pump manufacturer supported this conclusion for durations of 30 minutes. This time is sufficient to perform monthly periodic testing (ref. e).

The concern raised in the NRC Bulletin, (ref. g), over parallel pump operation existed in the original R. E. Ginna design. consequently, RG&E took immediate corrective action through procedures to preclude parallel pump operation at flowrates that could conceivably result in the pump-to-pump interaction referenced earlier. The plant modification was designed and was planned to be installed in two phases (refer to Figure B-1 ref. h). First, the parallel pump operation concern would be eliminated by installing separate minimum flow recirculation lines. Each line would be provided with a pressure breakdown orifice to provide 200 gpm in the event that the discharge line was closed (Safety Evaluation in ref. k), or system pressure was above shutoff head. Although the recirculation lines came together in one common line, the system design, with orifices would preclude a pump-to-pump interaction, even if the pump performance characteristics between the two pumps were different by 10% or more, which they are not (ref. n). Therefore, the recirculation lines can be termed as independent of each other in the context of Bulletin 88-04. This modification was made during the 1989 outage. The second phase was the replacement of the 200 gpm orifice with a 100 gpm orifice and installation of an air operated control valve, in parallel with the 100 gpm orifice, sized to provide 350 gpm minimum recirculation flow, so that the total would be 450 gpm. This flowrate was chosen because it represented a value of 25% of BEP and satisfied the manufacturers recommendation for <u>continuous</u> operation (ref. e). Attachment B of (ref. h) showed, however, that only <u>short term</u> operation at low flows can occur.

The second phase of the above described modification has not been installed as described for the following reasons:

1) Continued delivery delays prevented obtaining the control valves (ref. j and o).

2) RG&E's plan to perform a revised 10CFR50.46 ECCS Analysis (ref. o) which could subsequently revise the recirculation flowrate.

3) Lack of approval of a change to an existing technical specification requirement to perform monthly periodic testing at other than 200 gpm. (An Amendment was later approved by ref. p).

4) Continued interest to utilize the fixed orifice type recirculation system which would provide the desired minimum flows, but with much less complexity than the originally proposed air operated control system.

The modification installed during the 1989 outage consisted of a fixed orifice sized for 200 gpm in lieu of the 100 gpm described in the original submittal (ref. h). Adequacy of this modification and the recirculation system was based on the safety evaluation, (ref. k) and as follows:

a) 200 gpm met the technical specification which existed prior to NRC approval of Amendment 33 by (ref. p).

b) 200 gpm was the value utilized in all previous monthly periodic testing and, therefore, provided the database for trending parameters such as developed pressure, temperature and vibration.

c) 200 gpm was the maximum value that still conservatively provided for adequate injected flow into the reactor vessel during LOCA events. This is described in detail in RG&E Amendment request (ref. q). Hydraulic Analyses (ref. x) showed that a maximum recirculation flow of 260 gpm (not including instrument uncertainty), a 5% degraded RHR pump and assuming the RWST level was at the switchover limit for RHR pumps of 28%, would meet the delivery requirements in the UFSAR Figure 15.6-13. A value of 200 gpm guaranteed margin over the delivery requirements considering instrument uncertainty.

d) 200 gpm exceeds the manufacturers recommendation of 100 gpm for short term operation of 30 minutes (time generally sufficient to conduct monthly testing). It also exceeds a value recommended by the manufacturer for longer term operation when using an interpolation technique as described below. The manufacturers recommendation for operation up to 100 hours per month (1200 hours/year) is 260 gpm and for continuous operation

(24 hours/day) is 520 gpm (ref. e). The only modes where RHR pumps could operate at recirculation flow are:

1) Accidents initiating a safety injection; small break LOCA, steam line breaks and others
2) Monthly periodic testing
3) Inadvertent safety injection

Based upon emergency operating procedures, operation at recirculation flow for 1) and 3) above would not be expected to exceed 1 hour. Operation in mode 2) above is generally about 30 minutes. Mode 3) is expected only infrequently and mode 1) is not expected during the life of the plant. Therefore, operation at recirculation flow for all modes can be represented as <u>short term operation</u>. When interpolated between the manufacturers suggested operating time for 100 gpm and 260 gpm, a flow of 200 gpm would result in an operating guideline of 140 minutes/day or 2.3 hours/day to assure reasonable trouble free operation.

e) The manufacturer concurred (ref. r) that operation for periods on the order of 1 hour at 200 gpm are not injurious to the pump. The manufacturer also recommended that once per year the pump be tested at a higher flow than minimum flow to trend data. RG&E has been performing a yearly test at 700 gpm during the refueling outage which satisfies this recommendation.

f) The RHR pump design provides operation at very moderate speed, temperature, brake horsepower, and with ambient temperature water. Catastrophic failure is not a concern (ref. e). Periodic test data has not indicated a degrading trend, since the initial plant operation in 1970.

SAFETY INJECTION SYSTEM

Performance characteristics - 3 pumps
Model 3-WT-811 11 stage horizontal - coupled to A.C. motor
RPM 3550
Rated Flow 300 gpm — P&ID 33013-1262
Rated Head 2700 ft. — UFSAR Fig. 6.3-1
Rated Horsepower 350 HP
Flow at BEP 425 gpm
Pump S/N 1613234,5,&6 (Curves E-207328,E-207348, E-207340)
Manufacturer - Worthington/McGraw Edison
Original recirc design - 30 gpm per pump

Attachment A to ref. (h) provided a detailed evaluation and operability justification for continued operation. It also described a planned modification (EWR 3881). The operability determination showed that for short periods of operation a flow of 30 gpm met the design basis and no significant difference could be detected in pump vibration between 30 gpm and 100 gpm. The plant modification was installed during the 1989 outage. The safety evaluation was ref. (w).

The pump manufacturers recommendation is to provide 1/3 of BEP flow or 150 gpm (ref. a). This value was applicable for continuous operation. The manufacturer noted that operation at flows less than 150 gpm is a function of owner experience, since the manufacturer did not possess substantial testing at low flows. The manufacturer did not provide a recommended flow for short term operation or testing.

RG&E designed and installed the plant modification (EWR 3881) so as to provide a recirculation flow of 100 gpm for each pump through a fixed orifice. The modification replaced the 3/4" recirculation piping with 1 1/2" pipe. (See Figure A-2 attached). Each pumps recirculation piping comes together in a common 2" header. Since the tie-in is downstream of the fixed pressure breakdown orifices, there will not be a pump-to-pump interaction as described in Bulletin 88-04. Hence, the systems are independent in the context of Bulletin 88-04. (The original design depicted in ref. (h) contained 1" lines in lieu of 1 1/2" as described above).

The SI system is equipped with a test line in addition to the recirculation lines. During monthly periodic testing it is, therefore, possible to obtain the flow of 150 gpm even though this testing duration is only about 30 minutes (ref. m). The value of 150 gpm, recommended for continuous operation, provides assurance that accelerated internal wear will not result due to monthly tests. (Refer to ref. h, Attachment A).

The cumulative hours logged by the SI pumps occurs almost solely during these monthly tests. For the first 18 years of operation of

R. E. Ginna, the cumulative operating time for all three pumps was about 600 hours; pump 'c' logged the most hours, 280.

During power operation the test line is closed. Therefore, if the pump were called upon to operate at recirculation flow during accident scenarios or due to an inadvertent safety injection signal, a maximum of 100 gpm would be provided. This value is based upon the following:

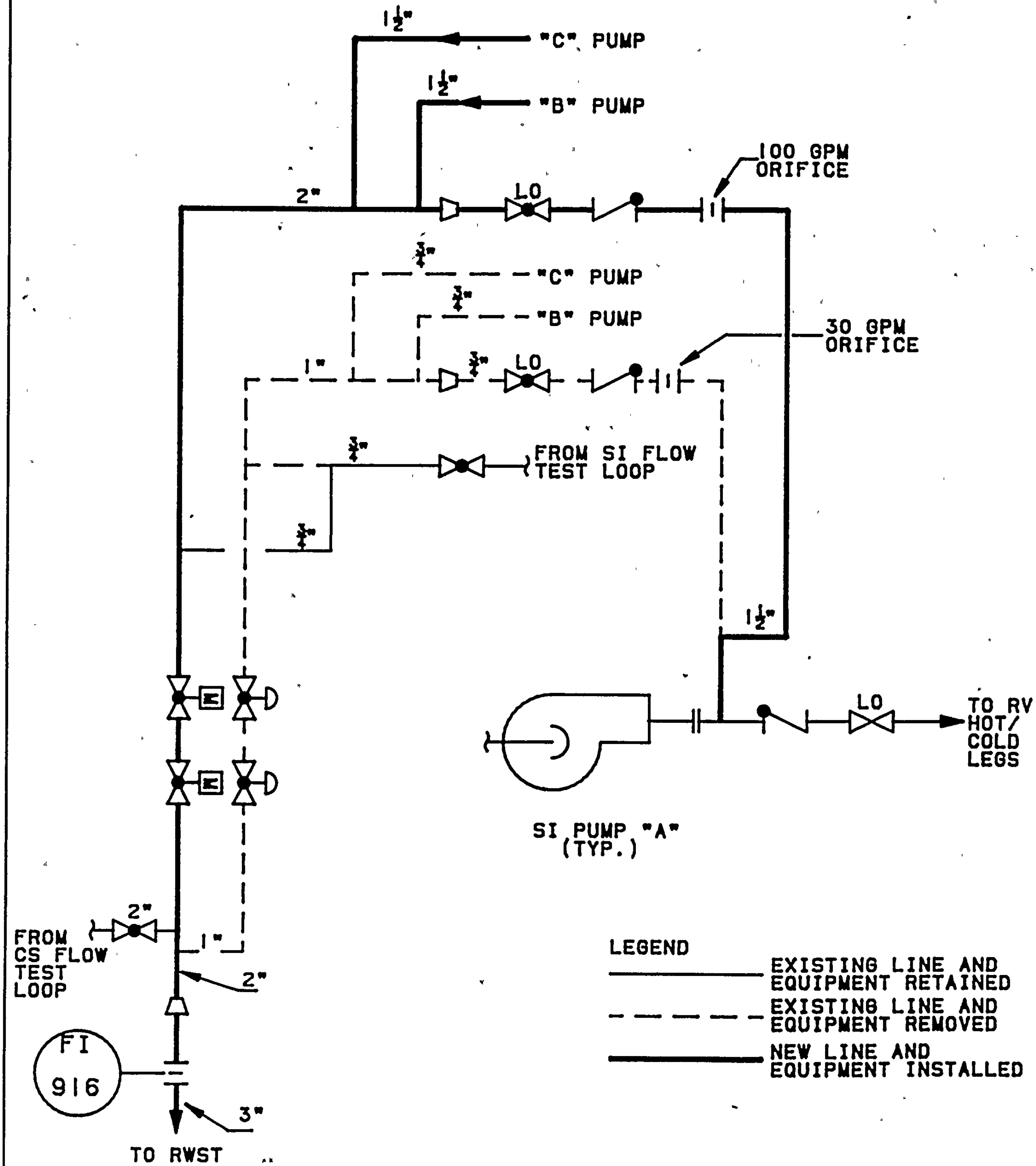
a) 100 gpm is the maximum flow that can be recirculated while still meeting the delivery flow required by the Accident Analysis Figure 15.6-12 of the UFSAR.

b) 100 gpm represents 25% of BEP which has been generally regarded as a conservative design value for low flow operation. (Ref. b, Section 6.3.1).

c) 100 gpm recirculation flow has been shown by calculation to reduce the internal fluid temperature rise through the pump four fold, to a 10°F temperature rise, as compared to 30 gpm.

d) The operating modes wherein 100 gpm would exist would not be expected to exceed 1 hour. An inadvertent SI would be terminated prior to this duration. Accident scenarios are not postulated to occur throughout the life of the plant. Consequently, accelerated wear due to operation at 100 gpm is not possible.

FIGURE A-2
MODIFICATION SCHEMATIC
AS INSTALLED PER EWR 3881



AUXILIARY FEEDWATER SYSTEM

This system consists of three different systems and pump types: Motor Driven Auxiliary Feedwater (MDAFW); Turbine Driven Auxiliary Feedwater (TDAFW); Standby Auxiliary Feedwater (SBAFW)

MDAFW

Performance Characteristics - 2 pumps

Model 2 WTF-87	7-stage horizontal-coupled to 1800 rpm A.C. Motor through gear box
RPM 4650	
Rated Flow 200 gpm	P&ID 33013-1237
Rated Head 2850 ft.	UFSAR Fig. 10.5-1 & 10.7-5
Rated Horsepower 250 (motor)	Bill of Material, Gilbert, GAI WO 4155, Item RC-9

Flow at BEP 230 gpm
Pump S/N 1614811, 1614812 (Curves E-195763, 4)
Manufacturer - Worthington/Dresser Pump Division
Original and current recirculation design - Minimum flow line designed for 40 gpm through control valve and orifice

Attachment C of ref. (h) provided a detailed discussion of the current configuration and design of the recirculation system. There were no changes made as a result of Bulletin 88-04. The recirculation flow through the pump is the combined flow through the minimum flow piping plus the main discharge line to the steam generator. The MDAFW system is designed and operated so that the discharge line is always open to provide flow to the steam generator. Depending on the steam generator pressure, flow through the discharge line to the steam generator is 200 gpm against a pressure of 1100 psia. This design value is based upon meeting accident conditions.

The minimum flow line, which has an air operated control valve and pressure breakdown orifice, is designed so that if the discharge line pressure were to increase to minimum flow, the control valve would be fully open as well. The control valve would be fully closed when the discharge pressure decreases to a value corresponding to a flow of 125 gpm discharge flow. This control scheme is to assure that water is not unnecessarily recirculated during conditions when the flowrate into the steam generated is critical. Since the pump would still "see" a high flowrate (125 gpm), there is no purpose in recirculating flow for pump protection. The minimum flow control valve is designed with a fail open position. The minimum flow lines for each of two pumps come together in a common 2" header downstream of the pressure breakdown orifices, therefore, there is no potential for the parallel flow deadheading concern discussed in Bulletin 88-04.

The minimum flow pressure breakdown orifice and piping system is designed to provide 40 gpm (control valve fully open) when the discharge flow is throttled to 80 gpm. Hence, a pump flow of 120 gpm would exist. This represents 50% of BEP flow. If it were postulated that the discharge line were closed, the pump flow has been shown by analysis (ref. s) to be 41 gpm or 17% of BEP. (The fact that the minimum flow recirculation piping has a substantial pressure drop leads to a recirculation line flow being just slightly higher at shutoff conditions as compared to the 80 gpm discharge flow condition).

Monthly periodic testing is performed at full discharge line flow (200 gpm) and pressure, flow and vibration data are recorded and trended. Therefore, RG&E is confident that long term wear could be identified and corrected well before any undue risk of failure of the pump results.

The pump manufacturer's most recent recommendation regarding minimum flow for the pump is 25% of BEP (ref. i). The original specified value was 53 gpm (23% BEP) in Gilbert Associates Bill of Material. These are consistent with ref. (b) recommendations also.

During plant startup at low decay heat levels it is necessary to throttle the valves in the discharge flow lines to the steam generators, while continuing to maintain the minimum flow through the recirculation path. Since the recirculation flow path provides 17% of BEP flow to protect the pump, it is preferable to throttle the discharge line to a closed position rather than to continually stop and restart the pump in order to maintain steam generator level. The startup evolution is conducted infrequently and is of relatively short duration. The recirculation flow of 17% of BEP flow also limits water temperature rise within the pump to a modest 18°F.

Based on the above, the MDAFW system design is adequate to prevent pump damage due to thermal temperature rise as well as the potential for long term accelerated wear for which the 25% BEP value given by the manufacturer and discussed in ref. (b) were specifically provided.

TDAFW

Performance characteristic - one pump
Model 3WTL-87 . 7 stage horizontal - coupled to variable speed turbine driver
RPM Turbine driven through govenor set between 4350 and 4400 rpm
Rated Flow 400 gpm P&ID 33013-1237
Rated Head 3000 ft. @ 4675rpm UFSAR Fig. 10.5-1 and 10.7-5
Rated Horsepower 449bhp @ 400 gpm
Flow at BEP 450 gpm
Pump S/N 1614756
Manufacturer - Worthington/Dresser Pump Division
Original and recirculation design - minimum flow line designed for 95 gpm through control valve and orifice
Bill of materials, Gilbert Assoc., GAI WO 4155, Item RC-6

Attachment C of ref. (h) provided a detailed discussion of the current configuration and the design of the recirculation system. There were no changes made as a result of Bulletin 88-04. The conceptual design and operation of the recirculation system, air-operated valve, and pressure breakdown orifice is similar to that of the MDAFW. The numerical values are different, since the TDAFW pump is rated at a higher flow. The air operated control valve will move to the full open position when the discharge line flow is decreased to 100 gpm. (The control valve is controlled by flow in the discharge line whereas the MDAFW valves are controlled by discharge line pressure). Thus, the pump flow is about 190 gpm, 100 through the discharge and about 90 gpm through the minimum flow line (ref. v). This represents over 42% of BEP and is substantially higher than that recommended by the manufacturer, ref. (i). The value of 25% BEP flow is based on long term operation to reduce the potential for accelerated wear. As is the case with the MDAFW pumps, there are no modes of operation which subject this equipment to long term operation at reduced flows.

Since there is only one pump in the system, the parallel pump operation concern is not applicable.

In the event that the discharge line were closed with the pump operating, the minimum flow would be 94 gpm (ref. s). This condition is beyond the design, operating, and accident modes. The minimum flow would represent a value of 21% of BEP, in this case, but for the short time that such a condition could be reasonably assumed to exist the flowrate is acceptable based on it being close to 25% and demonstrated acceptability of test results during the 48 hour endurance test conducted in 1981. [See ref. (b) of Attachment C to ref. (h)].

SBAFW

Performance characteristics - 2 pumps
Model 2HMTA9 9-stage horizontal - coupled to A.C. motor
RPM 3560
Rated Flow 200 gpm P&ID 33013-1238
Rated Head 3000 ft. UFSAR Fig. 10.5-2
Rated Horsepower 300 HP
Flow at BEP 450 gpm
Pump S/N 0275156, 0275157 (Curve N-775)
Manufacturer - Ingersoll Rand
Original and Current recirculation design - minimum flow line designed for 40 gpm through control valve and orifice
Bill of Material - Gilbert Assoc., GAI WO 044594-011, order N-GAI-55190

Attachment C of ref. (h) provided a detailed discussion of the current configuration and the design of the recirculation system. There were no changes made as a result of Bulletin 88-04. A recirculation line, air-operated control valve, and pressure breakdown orifice is provided for each pump. The lines come together into one common header downstream of the orifices leading back to a 10,000 gal. test tank. Therefore, the parallel pump operation concern raised in the bulletin does not exist, due to the de-sensitization of any strong weak pump interaction.

Similar to the main motor driven auxiliary feedwater system, the air-operated control valves are configured so that they will be full open when the discharge line flow to the steam generator is 80 gpm. The minimum flow line is designed to provide 40 gpm under this condition. Hence, the pump flow would be 120 gpm or 27% of BEP. The pump manufacturers recommendation (ref. t) was 40 gpm to prevent heating of the fluid during operation.

Periodic testing (PT-16Q) conducted on the pumps must show that with a discharge flow of 50 gpm, the control valve must be in the full open position. Periodic tests are conducted quarterly and are of short duration. By procedure the flow allowed could be as low as 90 gpm (20% of BEP). Therefore, there is no concern over long term accelerated wear in the test mode, because the cumulative operating hours are very low. Stable peration at low flow conditions was also demonstrated during a 48 hour endurance test [ref. (c) of Attachment C to ref. (h)].

The standby AFW pumps would only be operated as a backup if the main motor driven or turbine driven AFW pumps were inoperable. The standby pumps are operated manually and have no automatic actuation. It is unlikely that the discharge lines to the steam generators would ever be closed inadvertently when the pumps were called upon (discharge valves are normally open). Therefore, there are no known modes of operation, testing or accident conditions which would allow operation at low flows below 90 gpm (when utilizing the flow value established in PT-16Q procedure) for other than short period of time.