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SUBJECT: Forwards action status update for NRC Bulletin 88-004 re potential safety-related pump loss.

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June 30, 1989

U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Document Control Desk

Subject: McGuire Nuclear Station
Catawba Nuclear Station
Oconee Nuclear Station
Docket Nos. 50-369, -370; 50-413, -414; and 50-269, -270, -287
NRC Bulletin No. 88-04
Potential Safety-Related Pump Loss
Action Status Update
(TACS 69934, 69935, 69898, 69899, 69944, 69945, and 69946)

Gentlemen:

NRC Bulletin No. 88-04 concerning potential safety related pump loss was issued May 5, 1988. This bulletin requested investigation and correction, as applicable, of two miniflow design concerns. One of the bulletin's requested actions (Action No. 4) was the submittal of a report within 60 days of receipt of the bulletin that (a) summarizes the problems and the systems affected, (b) identified the short-term and long-term modifications to plant operating procedures or hardware that have been or are being implemented to ensure safe plant operations, (c) identifies an appropriate schedule for long-term resolution of this and/or other significant problems that are identified as a result of this bulletin, and (d) provides justification for continued operation particularly with regard to General Design Criterion 35 of Appendix A to Title 10 of the Code of Federal Regulations (10 CFR 50), "Emergency Core Cooling" and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling System for Light Water Nuclear Power Reactors." Another report describing the actions taken is to be submitted within 30 days of completion of the long-term resolution actions in accordance with Bulletin Action No. 5 .

By letters dated July 11, August 31, December 1, 1988, and April 21, 1989 I submitted partial responses to NRC Bulletin 88-04 for the McGuire, Catawba, and Oconee Nuclear Stations. The August 31, 1988 interim response on the status of Duke's Bulletin 88-04 work provided a statement justifying continued operation for each pump based on information available at that time, and also a list of activities (and associated schedules where possible) that remained to be completed before a final Bulletin Action No. 4 response could be made for a station(s). Further status updates were provided by the December 1st and April 21st letters (including a justification of Duke's extended schedule for responding to the Bulletin), with another status update to be submitted by June 30, 1989. Note that the April 21, 1989 submittal contained errors in that its attachment inadvertently referred to the Catawba and McGuire Residual Heat Removal pumps as "Residential" Heat Removal pumps, and incorrectly referenced the July 11, 1988 submittal as July 13, 1988 in one place.

IE16
1/1

Accordingly, please find attached an updated interim response on the status of Duke's Bulletin 88-04 work for the McGuire, Catawba, and Oconee Nuclear Stations. The individual status sheets for each pump (originally provided in the August 31, 1988 response) have been updated as follows:

- All information has been sent to Ingersoll-Rand (I-R) and the updated schedule for final resolution/justification for continued operation (JCO) of these pumps is provided.

- Final resolution is being provided for pumps not manufactured by I-R with the exception of Oconee's SSFASW pump. An updated schedule/JCO is provided for final resolution of this pump.

- Long-term resolution is being provided for Catawba's Boric Acid Transfer Pumps and KC pumps, including scope and updated schedule/JCO.

Note that the information provided for Catawba's ND pumps, KC pumps, and Boric Acid Transfer pumps, McGuire's ND pumps, and Oconee's ASW pump and SSFASW pump identifies potential problems. Appropriately, final resolutions on these pumps are being pursued on an accelerated schedule (e.g. per Duke request these pumps are being given priority by the manufacturers with respect to providing the information needed, etc.). Note also that activities in addition to those identified to date may be required after all pump manufacturer information is received.

A final Bulletin Action No. 4 response will be submitted by November 30, 1989. That response will provide final resolution, or identify an appropriate schedule for long-term resolution if necessary, for those pumps still outstanding in this response. Note that no Bulletin Action No. 5 reports have been made to date since and no long term resolutions identified so far have been completed.

I declare under penalty of perjury that the statements set forth herein are true and correct to the best of my knowledge. Should there be any questions concerning this matter or if further information is desired, please advise.

Very truly yours,

J. W. Hampton

for

Hal B. Tucker

PBN172/lcs

Attachment

xc: (w/attachment)
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Oconee Nuclear Station

	Pumps	Manufacturer
Low Pressure Injection (LPI)	1A,1B,2A,2B,3A,3B	Ingersoll-Rand

Configuration:

Each LPI pump has a separate minimum flow recirculation line with an orifice between pump discharge and pump suction.

Continued operation of the LPI pumps is justified on the following basis:

- The LPI pumps do not interact during multiple pump operation because each pump is provided with a separate minimum flow recirculation line and the crossover pipe between discharge headers is isolated.

- The LPI pumps are normally operated above the manufacturer's recommended minimum flow. The pumps are required to operate below the recommended flow only during the following modes of operation:

  1) A single LPI pump is used to lower the level in the reactor vessel during unit outages. During this process, LPI pump flow is reduced to approximately 1/2 the recommended minimum flow for a short period of time. A test was performed 8/25/88 that ran LPI Pump 3C (spare pump) at or below the flow used during this process for 12 hours. There is no evidence in the test data to indicate that this limited mode of operation is detrimental to pump performance.

  2) The LPI pumps are started automatically by Engineered Safeguards (ES) signal on very low Reactor Coolant System (RCS) pressure or high Reactor Building pressure. Each pump has a minimum flow recirculation loop to protect the pumps if RCS pressure is above pump shut off head when pumps receive ES signal. The capacity of the minimum flow recirculation loop is sufficient to prevent cavitation due to pump heat for more than 30 minutes. Plant operators are required to secure the pumps if a flow demand is not established within 30 minutes. Three LPI pumps have each been tested for 28 minutes in the minimum flow recirculation mode. There is no evidence to indicate that this limited mode of operation is detrimental to pump performance.

Status/Planned Action:

1. Transmitted information requested by pump manufacturer.

2. Pump manufacturer to provide final minimum flow recommendations by 8/31/89.

3. Determine adequacy of existing minimum flow configuration based on manufacturer's final recommendations by 9/7/89.

4. Submit final response, or recommendations if necessary, by 11/30/89.

Oconee Nuclear Station

	Pumps	Manufacturer
High Pressure Injection (HPI)	1A,1B,1C,2A,2B,2C 3A,3B,3C	Ingersoll-Rand

Configuration:

The three HPI pumps per unit have separate minimum flow lines that contain block orifices supplied by the pump manufacturer. The minimum flow lines merge downstream of the orifices into a common line that returns to the Letdown Storage Tank through the Seal Return Coolers.

Continued operation of the HPI pumps is justified on the following basis:

- Flow is limited in each individual minimum flow line upstream of the common minimum flow return line. Therefore, pump interaction is not expected to affect individual pump performance.

- The capacity of each minimum flow line is greater than the manufacturer's recommendation.

Status/Planned Action:

1. Transmitted information requested by pump manufacturer.

2. Pump manufacturer to provide final minimum flow recommendations by 10/16/89.

3. Determine adequacy of existing minimum flow configuration based on manufacturer's final recommendations by 10/23/89.

4. Submit final response, or recommendations if necessary, by 11/30/89.

Oconee Nuclear Station

	Pumps	Manufacturer
Reactor Building Spray (RBS)	1A,1B,2A,2B,3A,3B	Ingersoll-Rand

Configuration:

The two RBS pumps per unit do not have minimum flow recirculation lines. They are lined up to discharge through spray nozzles to containment atmosphere.

Continued operation of the RBS pumps is justified on the following basis:

- The RBS pumps do not interact during multiple pump operation because the crossover pipe between discharge headers is isolated.

- The RBS pumps do not have minimum flow lines because they discharge through spray nozzles to containment atmosphere and therefore cannot be deadheaded. These pumps are operated above the manufacturer's recommended minimum flow by procedure.

Status/Planned Action:

1. Transmitted information requested by pump manufacturer.

2. Pump manufacturer to provide final minimum flow recommendations by 10/16/89.

3. Determine adequacy of existing minimum flow based on manufacturer's final recommendations by 10/23/89.

4. Submit final response, or recommendations if necessary, by 11/30/89.

Oconee Nuclear Station

	Pumps	Manufacturer
Motor Driven Emergency Feedwater (MDEFDW)	1A,1B,2A,2B,3A,3B	Bingham

Configuration:

The two MDEFDW pumps per unit are installed in parallel with a single TDEFDW pump. Each pump has a separate minimum flow line that merges into a relatively large common return line to the Upper Surge Tank. An autorecirculation check valve at the discharge of each MDEFDW pump opens on low flow.

Final Disposition:

- Friction losses in the relatively large common line are small during multiple pump operation because flow is limited in each individual line upstream of the tie-in. Therefore, pump interaction does not affect individual pump performance.

- MDEFDW Pumps 1A and 1B have minimum flow capacity greater than the manufacturer's short and long term minimum flow requirements. MDEFDW Pumps 2A,2B,3A, and 3B have minimum flow capacity greater than the manufacturer's short term requirement and are not required to operate below the long term requirement in any mode of operation. Therefore, none of the MDEFDW pumps are required to operate below the manufacturer's minimum flow requirements during any mode of operation including test and emergency modes.

Status/Planned Action:

Review is complete; no furthur action or response is necessary.

Oconee Nuclear Station

	Pumps	Manufacturer
Turbine Driven Emergency Feedwater (TDEFDW)	1A,2A,3A	Bingham

Configuration:

The single TDEFDW pump per unit is installed in parallel with two MDEFDW pumps. Each pump has a separate minimum flow line that merges into a relatively large common return line to the Upper Surge Tank. A block orifice limits flow in the TDEFDW minimum flow recirculation line.

Final Disposition:

- Friction losses in the relatively large common line are small during multiple pump operation because flow is limited in each individual line upstream of the tie-in. Therefore, pump interaction does not affect individual pump performance.

- The TDEFDW pumps are tested at a flow greater than the manufacturer's final minimum flow requirements. The pumps are not required to operate below the final minimum flow requirements during any mode of operation.

Status/Planned Action:

Review is complete; no furthur action or response is necessary.

Oconee Nuclear Station

	Pumps	Manufacturer
Auxiliary Service Water (ASW)	1A	Ingersoll-Rand

Configuration:

The ASW pump has a separate minimum flow path that is manually opened before the pump is started.

Continued operation of the ASW pump is justified on the following basis:

- Single pump; no interaction potential.
- Conservative analysis shows that the pump may not meet a preliminary minimum flow value recently provided by the vendor. Since the value is being re-evaluated, and since the pump is used only for a very low probability tornado event, continued operation until final results are available is considered justified.

Status/Planned Action:

1. Transmitted information requested by pump manufacturer.
2. Pump manufacturer to provide final minimum flow recommendations by 8/31/89.
3. Determine adequacy of existing minimum flow configuration based on manufacturer's final recommendations by 9/7/89.
4. Submit final response, or recommendations if necessary, by 11/30/89.

Oconee Nuclear Station

	Pumps	Manufacturer
Low Pressure Service Water	1A,1B,1C,3A,3B	Ingersoll-Rand

Configuration:

Three LPSW pumps provide cooling water to units 1 & 2 and two LPSW pumps provide cooling water to unit 3. These pumps do not have minimum flow lines.

Continued operation of the LPSW pumps is justified on the following basis:

- Pump interaction is not expected to affect individual pump performance because pumps are not operated in the low flow range on the pump curve.

- The LPSW pumps do not have minimum flow lines because normal and emergency flow demand is greater than manufacturer's minimum flow recommendation except when multiple loads are isolated during maintenance. Guidance has been given to operators to divert flow during maintenance activities to maintain manufacturer's recommended minimum flow.

Status/Planned Action:

1. Transmitted information requested by pump manufacturer.

2. Pump manufacturer to provide final minimun flow recommendations by 8/31/89.

3. Determine adequacy of existing minimum flow configuration based on manufacturer's final recommendations by 9/7/89.

4. Submit final response, or recommendations if necessary, by 11/30/89.

Oconee Nuclear Station

	Pumps	Manufacturer
SSF Auxiliary Service Water (SSFASW)	1	Bingham

Configuration:

The SSFASW pump has a minimum flow recirculation line with a block orifice between pump discharge and pump suction.

Continued operation of the SSFASW pump is justified on the following basis:

- Single pump; no interaction potential.
- The SSFASW pump has minimum flow capacity greater than the manufacturer's short term minimum flow requirement. The pump may be required to operate slightly below the manufacturer's long term minimum flow requirement during worst case SSF events. During a loss of AC power, the pump may be required to operate 90 gpm below the manufacturer's long term requirement of 690 gpm for a maximum of 2 hours. During decay heat removal, the pump may be required to operate no more than 25 gpm below the required 690 gpm for a maximum of 48 hours. Since these operating margins are slight, and because of the low probability of these events and the conservative conditions under which they were evaluated, continued operation is justified. The manufacturer has been asked to verify pump operation under these conditions and respond within 1 month.

Status/Planned Action:

1. Transmitted letter requesting verification from manufacturer.
2. Manufacturer to provide final resolution by 7/31/89.
3. Determine adequacy of manufacturer's final resolution by 8/7/89.
4. Submit final response, or recommendations if necessary, by 11/30/89.

Oconee Nuclear Station

	Pumps	Manufacturer
SSF HVAC Cooling Water (SSFHVAC)	1,2	Ingersoll-Rand

Configuration:

Either of the two SSFHVAC pumps is capable of providing cooling water flow to two condensers that have bypass lines. Pump interlocks prevent operation of SSFHVAC Pump 2 while SSFHVAC Pump 1 is operating. The ability to provide adequate cooling water flow with only one SSFHVAC pump is the result of a recent modification which replaced the two 1750 RPM SSFHVAC pump motors with two 3600 RPM motors. This modification was performed to allow the system to be operable for lake water temperatures up to 90 F. Three-way regulating valves open to bypass the condensers during periods of low demand.

Continued operation of the SSFHVAC pumps is justified on the following basis:

- Due to pump interlocks and operating procedures, only one SSFHVAC pump may be operated at a time. Therefore, pump interaction will not occur.
- The SSFHVAC pumps supply condensers which are provided with bypass capacity greater than manufacturer's recommended minimum flow. Plant operating procedures do not allow pump operation below manufacturer's recommendation.

Status/Planned Action:

1. Transmitted information requested by pump manufacturer.
2. Pump manufacturer to provide final minimum flow recommendations by 10/16/89.
3. Determine adequacy of existing minimum flow configuration based on manufacturer's final recommendations by 10/23/89.
4. Submit final response, or recommendations if necessary, by 11/30/89.

Oconee Nuclear Station

	Pumps	Manufacturer
SSF Diesel Engine Cooling Water (SSFDECW)	1	Ingersoll-Rand

Configuration:

The SSFDECW does not have a minimum flow line. It is lined up to supply cooling water through two heat exchangers.

Continued operation of the SSFDECW pump is justified on the following basis:

- Single pump; no interaction potential.
- The SSFDECW pump does not have minimum flow protection because it is operated at best efficiency point during its only mode of operation.

Status/Planned Action:

1. Transmitted information requested by pump manufacturer.
2. Pump manufacturer to provide final minimum flow recommendations by 10/16/89.
3. Determine adequacy of existing minimum flow based on manufacturer's final recommendations by 10/23/89.
4. Submit final response, or recommendations if necessary, by 11/30/89.

McGuire Nuclear Station

	Pumps	Manufacturer
Centrifugal Charging (NV)	1A, 1B, 2A, 2B	Pacific

Configuration:

Each of the Centrifugal Charging pumps per unit has a separate miniflow line and orifice. Downstream of these orifices the miniflow lines merge into a common line which returns to the Volume Control Tank. These orifices are supplied by the pump manufacturer to control the minimum flow for the associated pump.

Final Disposition:

- Miniflow orifices meter miniflow to meet the manufacturer's requirements. Pumps are tested quarterly (IWP program) in miniflow mode. Quarterly tests show acceptable levels of vibration and temperature rise.

- Above mentioned miniflow orifices preclude pump interaction, since the back pressure in the common line portion of the miniflow line downstream of the orifices is low and will therefore preclude discharge pressure communication between the pumps.

Status/Planned Action:

Review is complete; no further action or response is necessary.

McGuire Nuclear Station

	Pumps	Manufacturer
Boric Acid Transfer (NV)	1A, 1B, 2A, 2B	Crane-Chempump

Configuration:

Each pair of pumps has a common miniflow line. Normally, one pump is aligned with Boric Acid Tank and miniflow from this pump flows back to the tank and helps maintain thermal equilibrium. The design miniflow is in accordance with manufacturer's recommendation.

Final Disposition:

- Pumps are operated one pump at a time and the operation is manual. Miniflow requirements provided by the manufacturer are met for one or both pumps running per unit by flow rates several times higher than miniflow requirements.

- Two pump operation is for recirculating the Boric Acid Tank prior to sampling. Pump curves (characteristics) are similar, therefore the interaction will not be a problem. They are not expected to dead-head each other.

Status/Planned Action:

Review is complete; no further action or response is necessary.

McGuire Nuclear Station

	Pumps	Manufacturer
Residual Heat Removal (ND)	1A, 1B, 2A, 2B	Ingersoll-Rand

Configuration:

Each pump has a separate minimum flow line which provides a path from the pump discharge downstream of the respective heat exchanger to the pump suction. A valve automatically opens on low flow to provide an adequate miniflow.

Continued operation of the residual heat removal pumps is justified on the following basis:

- Testing of pumps quarterly (IWP program) shows that available miniflow meets manufacturer's requirements for single pump operation. The tests show acceptable level of vibration and temperature rise. Also, the 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.

- Pumps have separate minimum flow lines. A review of the performance curves for the pumps actually installed shows that the pumps will be operating sufficiently out on their curves such that the stronger pump will not prevent the weaker pump from running at recommended minimum flow. However, with application of IWP acceptance criteria, the potential for interaction does exist.

Status/Planned Action:

1. Transmitted information requested by manufacturer.

2. Pump manufacturer to provide final recommendations by 8/31/89.

3. Determine adequacy of existing minimum flow configuration based on manufacturer final recommendations by 9/7/89.

4. Submit final response, or recommendations if necessary, by 11/30/89.

McGuire Nuclear Station

	Pumps	Manufacturer
Safety Injection (NI)	1A, 1B, 2A, 2B	Pacific

Configuration:

Each of the Safety Injection pumps per unit has a separate miniflow line and orifice. Downstream of these orfices the miniflow lines merge into a common line which returns to the Refueling Water Storage Tank. These orifices are supplied by the pump manufacturer to control the minimum flow for the associated pump.

Final Disposition:

- Miniflow orifices meter miniflow to meet the manufacturer's requirements. Pumps are tested quarterly (IWP program) in miniflow mode. Quarterly IWP tests show acceptable levels of vibrations and temperature rise.

- Above mentioned miniflow orifices preclude pump interaction, since the back pressure in the common line portion of the miniflow line downstream of the orifices is low and will therefore preclude discharge pressure communication between the pumps.

Status/Planned Action:

Review is complete; no further action or response is necessary.

McGuire Nuclear Station

	Pumps	Manufacturer
Containment Spray (NS)	1A, 1B, 2A, 2B	Ingersoll-Rand

Configuration:

Two identical pumps per unit are installed in separate flow paths without any interaction.

Continued operation of the containment spray pumps is justified on the following basis:

- Flows exceed miniflow requirements during normal system operations. During quarterly IWP testing of each pump a throttle valve in the minimum flow line is adjusted to achieve recommended minimum flow.

- Interaction is not a problem, since pumps discharge on separate paths. During the tests, only one pump is operated, hence pump to pump interaction is not a problem.

Status/Planned Action:

1. Transmitted information requested by manufacturer.

2. Pump manufacturer to provide final recommendations by 10/16/89.

3. Determine adequacy of existing minimum flow configuration based on manufacturer final recommendations by 10/23/89.

4. Submit final response, or recommendations if necessary, by 11/30/89.

McGuire Nuclear Station

	Pumps	Manufacturer
Motor Driven Aux. Feedwater (CA)	1A, 1B, 2A, 2B	Bingham-Willamette

Configuration:

The two Motor Driven pumps and the Turbine Driven pump per unit share a recirculation path to the upper surge tank. Flow and pressure at each pump suction are monitored in the control room. Automatic flow control is provided for pump protection during low flow operation. An air operated valve for each pump controls recirculation flow to the Upper Surge Tank. The two Motor Driven pumps feed separate sets of two steam generators. The Turbine Driven pump can feed all four steam generators.

Final Disposition:

- Miniflow requirements are set by Duke Power with manufacturer's recommendations. Travel stops (handwheels) are set on the minimum flow valves to provide the required flow. The handwheels can be adjusted to provide full pump flow during the testing.

- Motor Driven pump discharge flows are isolated from each other. Automatic actuation signal isolates miniflow valves (and remains closed) and pumps start to deliver full flow. If Motor Driven pumps are running, operators will shutdown Turbine Driven pump. Thus, there is no long-term interaction between the Turbine Driven pump and one of the two Motor Driven pumps. If interaction does occur in the main discharge header, one pump will not cause miniflow problems with the other pump due to large pressure drops before interaction. High pressure drop across the minimum flow control valves precludes pump interactions through the common recirculation line.

Status/Planned Action:

Review is complete; no further action or response is necessary.

McGuire Nuclear Station

	Pumps	Manufacturer
Turbine Driven Aux. Feedwater (CA)	1, 2	Bingham-Willamette

Configuration:

The two Motor Driven pumps and the Turbine Driven pump per unit share a recirculation path to the upper surge tank. Flow and pressure at each pump suction are monitored in the control room. Automatic flow control is provided for pump protection during low flow operation. An air operated valve for each pump controls recirculation flow to the Upper Surge Tank. The two Motor Driven pumps feed separate sets of two steam generators. The Turbine Driven pump can feed all four steam generators.

Final Disposition:

- Miniflow requirements are set by Duke Power with manufacturer's recommendations. Travel stops (handwheels) are set on the minimum flow valves to provide the required flow. The handwheels can be adjusted to provide full pump flow during the testing.

- Motor Driven pump discharge flows are isolated from each other. Automatic actuation signal isolates miniflow valves (and remains closed) and pumps start to deliver full flow. If Motor Driven pumps are running, operators will shutdown Turbine Driven pump. Thus, there is no long-term interaction between the Turbine Driven pump and one of the two Motor Driven pumps. If interaction does occur in the main discharge header, one pump will not cause miniflow problems with the other pump due to large pressure drops before interaction. High pressure drop across the minimum flow control valves precludes pump interactions through the common recirculation line.

Status/Planned Action:

Review is complete; no further action or response is necessary.

McGuire Nuclear Station

	Pumps	Manufacturer
Component Cooling Water (KC)	1A1, 1A2, 1B1, 1B2 2A1, 2A2, 2B1, 2B2	B&W Canada, Ltd.

Configuration:

Two identical pumps share miniflow lines to supply Component Cooling Heat Exchanger. Four identical pumps are supplied per unit.

Final Disposition:

- Flow instrumentation open and closes a valve in a common miniflow line in each train of the unit to assure adequate total minimum flow for each pair of pumps. Quarterly tests (IWP program) show acceptable levels of vibration and temperature rise.

- Pump characteristics are almost identical (heads differ by only a maximum of 3%), and pumps operate far out on their curves so interaction will not be a problem.

Status/Planned Action:

Review is complete; no further action or response is necessary.

McGuire Nuclear Station

	Pumps	Manufacturer
Nuclear Service Water (RN)	1A, 1B, 2A, 2B	Bingham-Willamette

Configuration:

RN pump miniflow path is established by an interlock which opens the corresponding train KC heat exchanger inlet isolation valve based on pump flow. Upon safety injection signal the control valves for the essential heat exchangers open to the valve travel stops. In this alignment, the pumps operate above minimum flow requirements.

Final Disposition:

- Minimum flow interlocks and valve failure positions are in place which provide sufficient flow paths to meet existing miniflow requirements during unfaulted operational modes with a minimum of operator action, and postulated accidents with or without operator action. IWP testing shows acceptable levels of vibration and temperature rise.

- There is no pump to pump interaction during a design base accident. On safety injection signal RN trains and pumps are automatically isolated from each other, along with isolation from all non-safety pumps.

Status/Planned Action:

Review is complete; no further action or response is necessary.

	Pumps	Manufacturer
Control Area Chilled Water (YC)	1, 2	Goulds

Configuration:

Each pump has a separate full-flow path.

Final Disposition:

- Each pump maintains a constant flowrate which is always greater than the required miniflow.
- The pumps are completely separated from each other, therefore interaction is not a problem.

Status/Planned Action:

Review is complete; no further action or response is necessary.

Catawba Nuclear Station

	Pumps	Manufacturer
Centrifugal Charging (NV)	1A, 1B, 2A, 2B	Pacific

Configuration:

Each of the two pumps per unit has a separate miniflow line and orifice. Downstream of these orifices the miniflow lines merge into a common miniflow line which returns to the Volume Control Tank. These orifices are supplied by the pump manufacturer to control the minimum flow for the associated pump.

Final Disposition:

- Miniflow orifices meter miniflow to meet the manufacturer's requirements.
- The above mentioned miniflow orifices preclude pump interaction, since the back pressure in the common line portion of the miniflow line downstream of the orifices is low and will, therefore, preclude discharge pressure communication between the pumps.

Status/Planned Action:

Review is complete; no further action or response is necessary.

Catawba Nuclear Station

	Pumps	Manufacturer
Boric Acid Transfer (NV)	1A, 1B, 2A, 2B	Crane-Chempump

Configuration:

Each pair of pumps has a common miniflow line and orifice. Normally, the pumps are aligned in the recirculation path of the Boric Acid Tank (BAT). Minimum flow from these pumps flows back to the BAT. A single pump is used to help maintain thermal and chemical equilibrium of tank contents.

Continued operation of the boric acid transfer pumps is justified on the following basis:

- Miniflow requirements provided by the manufacturer are met for one or both pumps running per unit by flow rates several times higher than miniflow requirements.

- Normally one Boric Acid Transfer Pump is run continuously to preclude thermal stratification and maintain chemical uniformity in the tank. A second pump is maintained in "auto" and starts on demand from the Reactor Makeup Control System to provide emergency makeup to the Volume Control Tank (VCT) (this is a non-ECCS function). Presently both pumps are setup to start (or stay on) upon receipt of a Safety Injection signal (SI) or upon entering Blackout. During the emergency makeup mode a flow path to the VCT is open such that minimum flow requirements are met. Currently actual pump curves are nearly identical, consequently interaction is not a problem, however compliance with IWP acceptance criteria forces the possibility of interaction such that only one pump can be run until such time when an operator aligns the pumps to the charging pumps suction following an SI or Blackout.

Status/Planned Action:

1. A Station Problem Report will be written by 8-1-89 to initiate a change to delete auto-start of pumps on SI and Blackout.

2. Submit Bulletin Action Item #5 response within 30 days of implementation.

Catawba Nuclear Station

	Pumps	Manufacturer
Residual Heat Removal (ND)	1A, 1B, 2A, 2B	Ingersoll-Rand

Configuration:

Each pump has a separate minimum flow line which provides a path from the pump discharge, downstream of the respective heat exchanger, to the pump suction. A valve automatically opens on low flow to provide an adequate miniflow path.

Continued operation of the residual heat removal pumps is justified on the following basis:

- Testing of pumps quarterly (IWP program) shows that available miniflow meets manufacturer's requirements for single pump operation. The tests show acceptable levels of vibration and temperature rise. Also, the 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.

- Pumps have separate minimum flow lines. A review of the performance curves for the pumps actually installed shows that the pumps will be operating sufficiently out on their curves such that the stronger pump will not preclude the weaker from running at minimum recommended flow. However, review in light of IWP acceptance criteria shows potential for interaction.

Status/Planned Action:

1. Transmitted information requested by pump manufacturer.

2. Pump manufacturer to provide final recommendations by 8-31-89.

3. Determine adequacy of existing minimum flow configuration based on manufacturer's final recommendations by 9-7-89.

4. Submit final response, or recommendations if necessary, by 11-30-89.

Catawba Nuclear Station

	Pumps	Manufacturer
Safety Injection (NI)	1A, 1B, 2A, 2B	Pacific

Configuration:

Each of the two Safety Injection pumps per unit has a separate miniflow line and orifice. Downstream of these orifices the miniflow lines merge into a common line which returns to Refueling Water Storage Tank. These orifices are supplied by the pump manufacturer to control the minimum flow for the associated pump.

Final Disposition:

- Miniflow orifices meter miniflow to meet the manufacturer's requirements.
- The above mentioned miniflow orifices preclude any pump interaction, since the back pressure in the common line portion of the miniflow line downstream of the orifices is low and will, therefore, preclude discharge pressure communication between the pumps.

Status/Planned Action:

Review is complete; no further action or response is necessary.

Catawba Nuclear Station

	Pumps	Manufacturer
Containment Spray (NS)	1A, 1B, 2A, 2B	Bingham

Configuration:

Two identical pumps per unit are installed in separate flow paths without any interaction.

Final Disposition:

- Flows exceed minimum flow requirements during accident operations. During quarterly IWP testing of each pump a throttle valve in the minimum flow line is adjusted to achieve recommended flow.

- Interaction is not a problem during accident operations since pumps discharge on separate paths. During the tests only one pump is operated, hence pump to pump interaction is not a problem.

Status/Planned Action:

Review is complete; no further action or response is necessary.

Catawba Nuclear Station

	Pumps	Manufacturer
Motor Driven Aux. Feedwater (CA)	1A, 1B, 2A, 2B	Bingham

Configuration:

An auto-recirculation check valve at the discharge of each pump opens on low flow to provide a miniflow path.

Final Disposition:

- Recommended minimum flow is provided by the auto-recirculation check valves.
- The auto-recirculation check valves preclude interaction.

Status/Planned Action:

Review is complete; no further action or response is necessary.

	Pumps	Manufacturer
Turbine Driven Aux. Feedwater (CA)	1, 2	Bingham

Configuration:

An auto-recirculation check valve at the discharge of each pump opens on low flow to provide a miniflow path.

Final Disposition:

- Recommended minimum flow is provided by the auto-recirculation check valves.
- The auto-recirculation check valves preclude interaction.

Status/Planned Action:

Review is complete; no further action or response is necessary.

Catawba Nuclear Station

	Pumps	Manufacturer
Component Cooling Water (KC)	1A1, 1A2, 1B1, 1B2, 2A1, 2A2, 2B1, 2B2	Goulds

Configuration:

Each pair of component cooling pumps share a common minimum flow line which has a valve that automatically opens upon low flow to provide total minimum flow for both pumps. When the flow rate has increased to an adequate flow, the minimum flow valve closes to avoid pump runout.

Continued operation of the component cooling water pumps is justified on the following basis:

- The minimum flow path is needed for faulted, normal operation (non-Engineered Safeguards) only. During unfaulted normal operation and all modes of Engineered Safeguards (safety injection, high containment pressure, high-high containment pressure) there are sufficient flow paths open to exceed the pump minimum flow requirements determined by the manufacturer. Automatic action will open the minimum flow path upon the detection of low flow and control room alarms/indications will keep operators informed of system status. The current flow setpoints provide adequate protection against vibration damage to the pumps and pump runout for both one pump and two pump (per train) operation. This has been verified by testing.

- The Component Cooling Miniflow Verification tests are conducted at a flow rate lower than the low flow setpoint (The flow rate used is higher than the manufacturer recommended minimum flow). There has been no evidence of pump degradation as a result of operation at the lower flow rate; however, the low flow setpoint used to open the minimum flow line will be increased to provide better protection against pump interaction during two pump (per train) operation, especially when considering IWP acceptance criteria.

Status/Planned Action:

1. A Station Problem Report will be written by 8-1-89 to initiate action to increase the low flow setpoints used to open the minimum flow line for each train.

2. Submit Bulletin Action Item #5 response within 30 days of implementation.

Catawba Nuclear Station

	Pumps	Manufacturer
Nuclear Service Water (RN)	1A, 1B, 2A, 2B	Bingham

Configuration:

Catawba is a two-unit station with four RN pumps, one powered from each redundant train (two per unit). The 1A and 2A pumps feed into a common (i.e., shared between units) loop A supply header, and the 1B and 2B pumps feed into a common loop B supply header. Inside the Auxiliary Building, crossovers between loops permit flow from any RN pump to serve any open header under normal circumstances. Flow instrumentation is provided at the discharge of each RN pump to alarm on low flow setpoint.

During normal operation, the minimum flow path for all four pumps is through one or more component cooling heat exchangers. When in the "minimum flow" mode, the pneumatic valve on the discharge side of the affected component cooling heat exchanger is automatically throttled on flow from the operating RN pump with the smallest flow rate. On receipt of an ESF signal (from its respective unit), the pneumatic miniflow valves fail open and other valves align to assure sufficient flow for the RN pumps. During normal operation, a loss of energy (such as loss of offsite power or loss of instrument air) will also cause the minimum flow valves to fail open.

Final Disposition:

- During ESF operation, valve interlocks and failure positions are in place which provide sufficient flow paths to meet minimum flow requirements.
- During unfaulted normal operation, system interlocks and postulated alignments provide adequate minimum flow for operating RN pumps. During faulted normal operation, flow instruments and station procedures are in place to detect and correct low flow conditions.
- At the RN pump flow ranges anticipated during ESF or unfaulted normal operation, pump characteristics are such that interaction is not a problem.

Status/Planned Action:

Review is complete; no further action or response is necessary.

Catawba Nuclear Station

	Pumps	Manufacturer
Control Area Chilled Water (YC)	1, 2	Goulds

Configuration:

Each pump has a separate full-flow path.

Final Disposition:

- Each pump maintains a relatively constant flowrate which is always greater than the required minimum flow. The full-flow path for each pump precludes the need for dedicated minimum flow lines.
- The pumps are completely separated from each other, therefore interaction is not a problem.

Status/Planned Action:

Review is complete; no further action or response is necessary.

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SUBJECT: Forwards action status update for NRC Bulletin 88-004 re potential safety-related pump loss.Continued operation of Ingersoll-Rand LPI pumps justified since pumps do not interact during multiple pump operation.

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June 30, 1989

U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Document Control Desk

Subject: McGuire Nuclear Station
Catawba Nuclear Station
Oconee Nuclear Station
Docket Nos. 50-369, -370; 50-413, -414; and 50-269, -270, -287
NRC Bulletin No. 88-04
Potential Safety-Related Pump Loss
Action Status Update
(TACS 69934, 69935, 69898, 69899, 69944, 69945, and 69946)

Gentlemen:

NRC Bulletin No. 88-04 concerning potential safety related pump loss was issued May 5, 1988. This bulletin requested investigation and correction, as applicable, of two miniflow design concerns. One of the bulletin's requested actions (Action No. 4) was the submittal of a report within 60 days of receipt of the bulletin that (a) summarizes the problems and the systems affected, (b) identified the short-term and long-term modifications to plant operating procedures or hardware that have been or are being implemented to ensure safe plant operations, (c) identifies an appropriate schedule for long-term resolution of this and/or other significant problems that are identified as a result of this bulletin, and (d) provides justification for continued operation particularly with regard to General Design Criterion 35 of Appendix A to Title 10 of the Code of Federal Regulations (10 CFR 50), "Emergency Core Cooling" and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling System for Light Water Nuclear Power Reactors." Another report describing the actions taken is to be submitted within 30 days of completion of the long-term resolution actions in accordance with Bulletin Action No. 5 .

By letters dated July 11, August 31, December 1, 1988, and April 21, 1989 I submitted partial responses to NRC Bulletin 88-04 for the McGuire, Catawba, and Oconee Nuclear Stations. The August 31, 1988 interim response on the status of Duke's Bulletin 88-04 work provided a statement justifying continued operation for each pump based on information available at that time, and also a list of activities (and associated schedules where possible) that remained to be completed before a final Bulletin Action No. 4 response could be made for a station(s). Further status updates were provided by the December 1st and April 21st letters (including a justification of Duke's extended schedule for responding to the Bulletin), with another status update to be submitted by June 30, 1989. Note that the April 21, 1989 submittal contained errors in that its attachment inadvertently referred to the Catawba and McGuire Residual Heat Removal pumps as "Residential" Heat Removal pumps, and incorrectly referenced the July 11, 1988 submittal as July 13, 1988 in one place.

IE

Accordingly, please find attached an updated interim response on the status of Duke's Bulletin 88-04 work for the McGuire, Catawba, and Oconee Nuclear Stations. The individual status sheets for each pump (originally provided in the August 31, 1988 response) have been updated as follows:

- All information has been sent to Ingersoll-Rand (I-R) and the updated schedule for final resolution/justification for continued operation (JCO) of these pumps is provided.

- Final resolution is being provided for pumps not manufactured by I-R with the exception of Oconee's SSFASW pump. An updated schedule/JCO is provided for final resolution of this pump.

- Long-term resolution is being provided for Catawba's Boric Acid Transfer Pumps and KC pumps, including scope and updated schedule/JCO.

Note that the information provided for Catawba's ND pumps, KC pumps, and Boric Acid Transfer pumps, McGuire's ND pumps, and Oconee's ASW pump and SSFASW pump identifies potential problems. Appropriately, final resolutions on these pumps are being pursued on an accelerated schedule (e.g. per Duke request these pumps are being given priority by the manufacturers with respect to providing the information needed, etc.). Note also that activities in addition to those identified to date may be required after all pump manufacturer information is received.

A final Bulletin Action No. 4 response will be submitted by November 30, 1989. That response will provide final resolution, or identify an appropriate schedule for long-term resolution if necessary, for those pumps still outstanding in this response. Note that no Bulletin Action No. 5 reports have been made to date since and no long term resolutions identified so far have been completed.

I declare under penalty of perjury that the statements set forth herein are true and correct to the best of my knowledge. Should there be any questions concerning this matter or if further information is desired, please advise.

Very truly yours,

J. W. Hampton

for

Hal B. Tucker

PBN172/lcs

Attachment

xc: (w/attachment)
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Oconee Nuclear Station

Oconee Nuclear Station

	Pumps	Manufacturer
Low Pressure Injection (LPI)	1A,1B,2A,2B,3A,3B	Ingersoll-Rand

Configuration:

Each LPI pump has a separate minimum flow recirculation line with an orifice between pump discharge and pump suction.

Continued operation of the LPI pumps is justified on the following basis:

- The LPI pumps do not interact during multiple pump operation because each pump is provided with a separate minimum flow recirculation line and the crossover pipe between discharge headers is isolated.

- The LPI pumps are normally operated above the manufacturer's recommended minimum flow. The pumps are required to operate below the recommended flow only during the following modes of operation:

  1) A single LPI pump is used to lower the level in the reactor vessel during unit outages. During this process, LPI pump flow is reduced to approximately 1/2 the recommended minimum flow for a short period of time. A test was performed 8/25/88 that ran LPI Pump 3C (spare pump) at or below the flow used during this process for 12 hours. There is no evidence in the test data to indicate that this limited mode of operation is detrimental to pump performance.

  2) The LPI pumps are started automatically by Engineered Safeguards (ES) signal on very low Reactor Coolant System (RCS) pressure or high Reactor Building pressure. Each pump has a minimum flow recirculation loop to protect the pumps if RCS pressure is above pump shut off head when pumps receive ES signal. The capacity of the minimum flow recirculation loop is sufficient to prevent cavitation due to pump heat for more than 30 minutes. Plant operators are required to secure the pumps if a flow demand is not established within 30 minutes. Three LPI pumps have each been tested for 28 minutes in the minimum flow recirculation mode. There is no evidence to indicate that this limited mode of operation is detrimental to pump performance.

Status/Planned Action:

1. Transmitted information requested by pump manufacturer.

2. Pump manufacturer to provide final minimum flow recommendations by 8/31/89.

3. Determine adequacy of existing minimum flow configuration based on manufacturer's final recommendations by 9/7/89.

4. Submit final response, or recommendations if necessary, by 11/30/89.

Oconee Nuclear Station

	Pumps	Manufacturer
High Pressure Injection (HPI)	1A,1B,1C,2A,2B,2C 3A,3B,3C	Ingersoll-Rand

Configuration:

The three HPI pumps per unit have separate minimum flow lines that contain block orifices supplied by the pump manufacturer. The minimum flow lines merge downstream of the orifices into a common line that returns to the Letdown Storage Tank through the Seal Return Coolers.

Continued operation of the HPI pumps is justified on the following basis:

- Flow is limited in each individual minimum flow line upstream of the common minimum flow return line. Therefore, pump interaction is not expected to affect individual pump performance.
- The capacity of each minimum flow line is greater than the manufacturer's recommendation.

Status/Planned Action:

1. Transmitted information requested by pump manufacturer.
2. Pump manufacturer to provide final minimum flow recommendations by 10/16/89.
3. Determine adequacy of existing minimum flow configuration based on manufacturer's final recommendations by 10/23/89.
4. Submit final response, or recommendations if necessary, by 11/30/89.

Oconee Nuclear Station

	Pumps	Manufacturer
Reactor Building Spray (RBS)	1A,1B,2A,2B,3A,3B	Ingersoll-Rand

Configuration:

The two RBS pumps per unit do not have minimum flow recirculation lines. They are lined up to discharge through spray nozzles to containment atmosphere.

Continued operation of the RBS pumps is justified on the following basis:

- The RBS pumps do not interact during multiple pump operation because the crossover pipe between discharge headers is isolated.

- The RBS pumps do not have minimum flow lines because they discharge through spray nozzles to containment atmosphere and therefore cannot be deadheaded. These pumps are operated above the manufacturer's recommended minimum flow by procedure.

Status/Planned Action:

1. Transmitted information requested by pump manufacturer.

2. Pump manufacturer to provide final minimum flow recommendations by 10/16/89.

3. Determine adequacy of existing minimum flow based on manufacturer's final recommendations by 10/23/89.

4. Submit final response, or recommendations if necessary, by 11/30/89.

Oconee Nuclear Station

	Pumps	Manufacturer
Motor Driven Emergency Feedwater (MDEFDW)	1A,1B,2A,2B,3A,3B	Bingham

Configuration:

The two MDEFDW pumps per unit are installed in parallel with a single TDEFDW pump. Each pump has a separate minimum flow line that merges into a relatively large common return line to the Upper Surge Tank. An autorecirculation check valve at the discharge of each MDEFDW pump opens on low flow.

Final Disposition:

- Friction losses in the relatively large common line are small during multiple pump operation because flow is limited in each individual line upstream of the tie-in. Therefore, pump interaction does not affect individual pump performance.

- MDEFDW Pumps 1A and 1B have minimum flow capacity greater than the manufacturer's short and long term minimum flow requirements. MDEFDW Pumps 2A,2B,3A, and 3B have minimum flow capacity greater than the manufacturer's short term requirement and are not required to operate below the long term requirement in any mode of operation. Therefore, none of the MDEFDW pumps are required to operate below the manufacturer's minimum flow requirements during any mode of operation including test and emergency modes.

Status/Planned Action:

Review is complete; no furthur action or response is necessary.

Oconee Nuclear Station

	Pumps	Manufacturer
Turbine Driven Emergency Feedwater (TDEFDW)	1A,2A,3A	Bingham

Configuration:

The single TDEFDW pump per unit is installed in parallel with two MDEFDW pumps. Each pump has a separate minimum flow line that merges into a relatively large common return line to the Upper Surge Tank. A block orifice limits flow in the TDEFDW minimum flow recirculation line.

Final Disposition:

- Friction losses in the relatively large common line are small during multiple pump operation because flow is limited in each individual line upstream of the tie-in. Therefore, pump interaction does not affect individual pump performance.

- The TDEFDW pumps are tested at a flow greater than the manufacturer's final minimum flow requirements. The pumps are not required to operate below the final minimum flow requirements during any mode of operation.

Status/Planned Action:

Review is complete; no furthur action or response is necessary.

Oconee Nuclear Station

	Pumps	Manufacturer
Auxiliary Service Water (ASW)	1A	Ingersoll-Rand

Configuration:

The ASW pump has a separate minimum flow path that is manually opened before the pump is started.

Continued operation of the ASW pump is justified on the following basis:

- Single pump; no interaction potential.
- Conservative analysis shows that the pump may not meet a preliminary minimum flow value recently provided by the vendor. Since the value is being re-evaluated, and since the pump is used only for a very low probability tornado event, continued operation until final results are available is considered justified.

Status/Planned Action:

1. Transmitted information requested by pump manufacturer.
2. Pump manufacturer to provide final minimum flow recommendations by 8/31/89.
3. Determine adequacy of existing minimum flow configuration based on manufacturer's final recommendations by 9/7/89.
4. Submit final response, or recommendations if necessary, by 11/30/89.

Oconee Nuclear Station

	Pumps	Manufacturer
Low Pressure Service Water	1A,1B,1C,3A,3B	Ingersoll-Rand

Configuration:

Three LPSW pumps provide cooling water to units 1 & 2 and two LPSW pumps provide cooling water to unit 3. These pumps do not have minimum flow lines.

Continued operation of the LPSW pumps is justified on the following basis:

- Pump interaction is not expected to affect individual pump performance because pumps are not operated in the low flow range on the pump curve.
- The LPSW pumps do not have minimum flow lines because normal and emergency flow demand is greater than manufacturer's minimum flow recommendation except when multiple loads are isolated during maintenance. Guidance has been given to operators to divert flow during maintenance activities to maintain manufacturer's recommended minimum flow.

Status/Planned Action:

1. Transmitted information requested by pump manufacturer.
2. Pump manufacturer to provide final minimun flow recommendations by 8/31/89.
3. Determine adequacy of existing minimum flow configuration based on manufacturer's final recommendations by 9/7/89.
4. Submit final response, or recommendations if necessary, by 11/30/89.

Oconee Nuclear Station

	Pumps	Manufacturer
SSF Auxiliary Service Water (SSFASW)	1	Bingham

Configuration:

The SSFASW pump has a minimum flow recirculation line with a block orifice between pump discharge and pump suction.

Continued operation of the SSFASW pump is justified on the following basis:

- Single pump; no interaction potential.
- The SSFASW pump has minimum flow capacity greater than the manufacturer's short term minimum flow requirement. The pump may be required to operate slightly below the manufacturer's long term minimum flow requirement during worst case SSF events. During a loss of AC power, the pump may be required to operate 90 gpm below the manufacturer's long term requirement of 690 gpm for a maximum of 2 hours. During decay heat removal, the pump may be required to operate no more than 25 gpm below the required 690 gpm for a maximum of 48 hours. Since these operating margins are slight, and because of the low probability of these events and the conservative conditions under which they were evaluated, continued operation is justified. The manufacturer has been asked to verify pump operation under these conditions and respond within 1 month.

Status/Planned Action:

1. Transmitted letter requesting verification from manufacturer.
2. Manufacturer to provide final resolution by 7/31/89.
3. Determine adequacy of manufacturer's final resolution by 8/7/89.
4. Submit final response, or recommendations if necessary, by 11/30/89.

Oconee Nuclear Station

	Pumps	Manufacturer
SSF HVAC Cooling Water (SSFHVAC)	1,2	Ingersoll-Rand

Configuration:

Either of the two SSFHVAC pumps is capable of providing cooling water flow to two condensers that have bypass lines. Pump interlocks prevent operation of SSFHVAC Pump 2 while SSFHVAC Pump 1 is operating. The ability to provide adequate cooling water flow with only one SSFHVAC pump is the result of a recent modification which replaced the two 1750 RPM SSFHVAC pump motors with two 3600 RPM motors. This modification was performed to allow the system to be operable for lake water temperatures up to 90 F. Three-way regulating valves open to bypass the condensers during periods of low demand.

Continued operation of the SSFHVAC pumps is justified on the following basis:

- Due to pump interlocks and operating procedures, only one SSFHVAC pump may be operated at a time. Therefore, pump interaction will not occur.

- The SSFHVAC pumps supply condensers which are provided with bypass capacity greater than manufacturer's recommended minimum flow. Plant operating procedures do not allow pump operation below manufacturer's recommendation.

Status/Planned Action:

1. Transmitted information requested by pump manufacturer.

2. Pump manufacturer to provide final minimum flow recommendations by 10/16/89.

3. Determine adequacy of existing minimum flow configuration based on manufacturer's final recommendations by 10/23/89.

4. Submit final response, or recommendations if necessary, by 11/30/89.

Oconee Nuclear Station

	Pumps	Manufacturer
SSF Diesel Engine Cooling Water (SSFDECW)	1	Ingersoll-Rand

Configuration:

The SSFDECW does not have a minimum flow line. It is lined up to supply cooling water through two heat exchangers.

Continued operation of the SSFDECW pump is justified on the following basis:

- Single pump; no interaction potential.
- The SSFDECW pump does not have minimum flow protection because it is operated at best efficiency point during its only mode of operation.

Status/Planned Action:

1. Transmitted information requested by pump manufacturer.
2. Pump manufacturer to provide final minimum flow recommendations by 10/16/89.
3. Determine adequacy of existing minimum flow based on manufacturer's final recommendations by 10/23/89.
4. Submit final response, or recommendations if necessary, by 11/30/89.

McGuire Nuclear Station

	Pumps	Manufacturer
Centrifugal Charging (NV)	1A, 1B, 2A, 2B	Pacific

Configuration:

Each of the Centrifugal Charging pumps per unit has a separate miniflow line and orifice. Downstream of these orifices the miniflow lines merge into a common line which returns to the Volume Control Tank. These orifices are supplied by the pump manufacturer to control the minimum flow for the associated pump.

Final Disposition:

- Miniflow orifices meter miniflow to meet the manufacturer's requirements. Pumps are tested quarterly (IWP program) in miniflow mode. Quarterly tests show acceptable levels of vibration and temperature rise.

- Above mentioned miniflow orifices preclude pump interaction, since the back pressure in the common line portion of the miniflow line downstream of the orifices is low and will therefore preclude discharge pressure communication between the pumps.

Status/Planned Action:

Review is complete; no further action or response is necessary.

McGuire Nuclear Station

	Pumps	Manufacturer
Boric Acid Transfer (NV)	1A, 1B, 2A, 2B	Crane-Chempump

Configuration:

Each pair of pumps has a common miniflow line. Normally, one pump is aligned with Boric Acid Tank and miniflow from this pump flows back to the tank and helps maintain thermal equilibrium. The design miniflow is in accordance with manufacturer's recommendation.

Final Disposition:

- Pumps are operated one pump at a time and the operation is manual. Miniflow requirements provided by the manufacturer are met for one or both pumps running per unit by flow rates several times higher than miniflow requirements.

- Two pump operation is for recirculating the Boric Acid Tank prior to sampling. Pump curves (characteristics) are similar, therefore the interaction will not be a problem. They are not expected to dead-head each other.

Status/Planned Action:

Review is complete; no further action or response is necessary.

McGuire Nuclear Station

	Pumps	Manufacturer
Residual Heat Removal (ND)	1A, 1B, 2A, 2B	Ingersoll-Rand

Configuration:

Each pump has a separate minimum flow line which provides a path from the pump discharge downstream of the respective heat exchanger to the pump suction. A valve automatically opens on low flow to provide an adequate miniflow.

Continued operation of the residual heat removal pumps is justified on the following basis:

- Testing of pumps quarterly (IWP program) shows that available miniflow meets manufacturer's requirements for single pump operation. The tests show acceptable level of vibration and temperature rise. Also, the 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.

- Pumps have separate minimum flow lines. A review of the performance curves for the pumps actually installed shows that the pumps will be operating sufficiently out on their curves such that the stronger pump will not prevent the weaker pump from running at recommended minimum flow. However, with application of IWP acceptance criteria, the potential for interaction does exist.

Status/Planned Action:

1. Transmitted information requested by manufacturer.

2. Pump manufacturer to provide final recommendations by 8/31/89.

3. Determine adequacy of existing minimum flow configuration based on manufacturer final recommendations by 9/7/89.

4. Submit final response, or recommendations if necessary, by 11/30/89.

McGuire Nuclear Station

	Pumps	Manufacturer
Safety Injection (NI)	1A, 1B, 2A, 2B	Pacific

Configuration:

Each of the Safety Injection pumps per unit has a separate miniflow line and orifice. Downstream of these orfices the miniflow lines merge into a common line which returns to the Refueling Water Storage Tank. These orifices are supplied by the pump manufacturer to control the minimum flow for the associated pump.

Final Disposition:

- Miniflow orifices meter miniflow to meet the manufacturer's requirements. Pumps are tested quarterly (IWP program) in miniflow mode. Quarterly IWP tests show acceptable levels of vibrations and temperature rise.

- Above mentioned miniflow orifices preclude pump interaction, since the back pressure in the common line portion of the miniflow line downstream of the orifices is low and will therefore preclude discharge pressure communication between the pumps.

Status/Planned Action:

Review is complete; no further action or response is necessary.

McGuire Nuclear Station

	Pumps	Manufacturer
Containment Spray (NS)	1A, 1B, 2A, 2B	Ingersoll-Rand

Configuration:

Two identical pumps per unit are installed in separate flow paths without any interaction.

Continued operation of the containment spray pumps is justified on the following basis:

- Flows exceed miniflow requirements during normal system operations. During quarterly IWP testing of each pump a throttle valve in the minimum flow line is adjusted to achieve recommended minimum flow.

- Interaction is not a problem, since pumps discharge on separate paths. During the tests, only one pump is operated, hence pump to pump interaction is not a problem.

Status/Planned Action:

1. Transmitted information requested by manufacturer.

2. Pump manufacturer to provide final recommendations by 10/16/89.

3. Determine adequacy of existing minimum flow configuration based on manufacturer final recommendations by 10/23/89.

4. Submit final response, or recommendations if necessary, by 11/30/89.

McGuire Nuclear Station

	Pumps	Manufacturer
Motor Driven Aux. Feedwater (CA)	1A, 1B, 2A, 2B	Bingham-Willamette

Configuration:

The two Motor Driven pumps and the Turbine Driven pump per unit share a recirculation path to the upper surge tank. Flow and pressure at each pump suction are monitored in the control room. Automatic flow control is provided for pump protection during low flow operation. An air operated valve for each pump controls recirculation flow to the Upper Surge Tank. The two Motor Driven pumps feed separate sets of two steam generators. The Turbine Driven pump can feed all four steam generators.

Final Disposition:

- Miniflow requirements are set by Duke Power with manufacturer's recommendations. Travel stops (handwheels) are set on the minimum flow valves to provide the required flow. The handwheels can be adjusted to provide full pump flow during the testing.

- Motor Driven pump discharge flows are isolated from each other. Automatic actuation signal isolates miniflow valves (and remains closed) and pumps start to deliver full flow. If Motor Driven pumps are running, operators will shutdown Turbine Driven pump. Thus, there is no long-term interaction between the Turbine Driven pump and one of the two Motor Driven pumps. If interaction does occur in the main discharge header, one pump will not cause miniflow problems with the other pump due to large pressure drops before interaction. High pressure drop across the minimum flow control valves precludes pump interactions through the common recirculation line.

Status/Planned Action:

Review is complete; no further action or response is necessary.

McGuire Nuclear Station

	Pumps	Manufacturer
Turbine Driven Aux. Feedwater (CA)	1, 2	Bingham-Willamette

Configuration:

The two Motor Driven pumps and the Turbine Driven pump per unit share a recirculation path to the upper surge tank. Flow and pressure at each pump suction are monitored in the control room. Automatic flow control is provided for pump protection during low flow operation. An air operated valve for each pump controls recirculation flow to the Upper Surge Tank. The two Motor Driven pumps feed separate sets of two steam generators. The Turbine Driven pump can feed all four steam generators.

Final Disposition:

- Miniflow requirements are set by Duke Power with manufacturer's recommendations. Travel stops (handwheels) are set on the minimum flow valves to provide the required flow. The handwheels can be adjusted to provide full pump flow during the testing.

- Motor Driven pump discharge flows are isolated from each other. Automatic actuation signal isolates miniflow valves (and remains closed) and pumps start to deliver full flow. If Motor Driven pumps are running, operators will shutdown Turbine Driven pump. Thus, there is no long-term interaction between the Turbine Driven pump and one of the two Motor Driven pumps. If interaction does occur in the main discharge header, one pump will not cause miniflow problems with the other pump due to large pressure drops before interaction. High pressure drop across the minimum flow control valves precludes pump interactions through the common recirculation line.

Status/Planned Action:

Review is complete; no further action or response is necessary.

McGuire Nuclear Station

	Pumps	Manufacturer
Component Cooling Water (KC)	1A1, 1A2, 1B1, 1B2 2A1, 2A2, 2B1, 2B2	B&W Canada, Ltd.

Configuration:

Two identical pumps share miniflow lines to supply Component Cooling Heat Exchanger. Four identical pumps are supplied per unit.

Final Disposition:

- Flow instrumentation open and closes a valve in a common miniflow line in each train of the unit to assure adequate total minimum flow for each pair of pumps. Quarterly tests (IWP program) show acceptable levels of vibration and temperature rise.

- Pump characteristics are almost identical (heads differ by only a maximum of 3%), and pumps operate far out on their curves so interaction will not be a problem.

Status/Planned Action:

Review is complete; no further action or response is necessary.

McGuire Nuclear Station

	Pumps	Manufacturer
Nuclear Service Water (RN)	1A, 1B, 2A, 2B	Bingham-Willamette

Configuration:

RN pump miniflow path is established by an interlock which opens the corresponding train KC heat exchanger inlet isolation valve based on pump flow. Upon safety injection signal the control valves for the essential heat exchangers open to the valve travel stops. In this alignment, the pumps operate above minimum flow requirements.

Final Disposition:

- Minimum flow interlocks and valve failure positions are in place which provide sufficient flow paths to meet existing miniflow requirements during unfaulted operational modes with a minimum of operator action, and postulated accidents with or without operator action. IWP testing shows acceptable levels of vibration and temperature rise.

- There is no pump to pump interaction during a design base accident. On safety injection signal RN trains and pumps are automatically isolated from each other, along with isolation from all non-safety pumps.

Status/Planned Action:

Review is complete; no further action or response is necessary.

	Pumps	Manufacturer
Control Area Chilled Water (YC)	1, 2	Goulds

Configuration:

Each pump has a separate full-flow path.

Final Disposition:

- Each pump maintains a constant flowrate which is always greater than the required miniflow.
- The pumps are completely separated from each other, therefore interaction is not a problem.

Status/Planned Action:

Review is complete; no further action or response is necessary.

Catawba Nuclear Station

	Pumps	Manufacturer
Centrifugal Charging (NV)	1A, 1B, 2A, 2B	Pacific

Configuration:

Each of the two pumps per unit has a separate miniflow line and orifice. Downstream of these orifices the miniflow lines merge into a common miniflow line which returns to the Volume Control Tank. These orifices are supplied by the pump manufacturer to control the minimum flow for the associated pump.

Final Disposition:

- Miniflow orifices meter miniflow to meet the manufacturer's requirements.
- The above mentioned miniflow orifices preclude pump interaction, since the back pressure in the common line portion of the miniflow line downstream of the orifices is low and will, therefore, preclude discharge pressure communication between the pumps.

Status/Planned Action:

Review is complete; no further action or response is necessary.

Catawba Nuclear Station

	Pumps	Manufacturer
Boric Acid Transfer (NV)	1A, 1B, 2A, 2B	Crane-Chempump

Configuration:

Each pair of pumps has a common miniflow line and orifice. Normally, the pumps are aligned in the recirculation path of the Boric Acid Tank (BAT). Minimum flow from these pumps flows back to the BAT. A single pump is used to help maintain thermal and chemical equilibrium of tank contents.

Continued operation of the boric acid transfer pumps is justified on the following basis:

- Miniflow requirements provided by the manufacturer are met for one or both pumps running per unit by flow rates several times higher than miniflow requirements.

- Normally one Boric Acid Transfer Pump is run continuously to preclude thermal stratification and maintain chemical uniformity in the tank. A second pump is maintained in "auto" and starts on demand from the Reactor Makeup Control System to provide emergency makeup to the Volume Control Tank (VCT) (this is a non-ECCS function). Presently both pumps are setup to start (or stay on) upon receipt of a Safety Injection signal (SI) or upon entering Blackout. During the emergency makeup mode a flow path to the VCT is open such that minimum flow requirements are met. Currently actual pump curves are nearly identical, consequently interaction is not a problem, however compliance with IWP acceptance criteria forces the possibility of interaction such that only one pump can be run until such time when an operator aligns the pumps to the charging pumps suction following an SI or Blackout.

Status/Planned Action:

1. A Station Problem Report will be written by 8-1-89 to initiate a change to delete auto-start of pumps on SI and Blackout.

2. Submit Bulletin Action Item #5 response within 30 days of implementation.

Catawba Nuclear Station

	Pumps	Manufacturer
Residual Heat Removal (ND)	1A, 1B, 2A, 2B	Ingersoll-Rand

Configuration:

Each pump has a separate minimum flow line which provides a path from the pump discharge, downstream of the respective heat exchanger, to the pump suction. A valve automatically opens on low flow to provide an adequate miniflow path.

Continued operation of the residual heat removal pumps is justified on the following basis:

- Testing of pumps quarterly (IWP program) shows that available miniflow meets manufacturer's requirements for single pump operation. The tests show acceptable levels of vibration and temperature rise. Also, the 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.

- Pumps have separate minimum flow lines. A review of the performance curves for the pumps actually installed shows that the pumps will be operating sufficiently out on their curves such that the stronger pump will not preclude the weaker from running at minimum recommended flow. However, review in light of IWP acceptance criteria shows potential for interaction.

Status/Planned Action:

1. Transmitted information requested by pump manufacturer.

2. Pump manufacturer to provide final recommendations by 8-31-89.

3. Determine adequacy of existing minimum flow configuration based on manufacturer's final recommendations by 9-7-89.

4. Submit final response, or recommendations if necessary, by 11-30-89.

Catawba Nuclear Station

	Pumps	Manufacturer
Safety Injection (NI)	1A, 1B, 2A, 2B	Pacific

Configuration:

Each of the two Safety Injection pumps per unit has a separate miniflow line and orifice. Downstream of these orifices the miniflow lines merge into a common line which returns to Refueling Water Storage Tank. These orifices are supplied by the pump manufacturer to control the minimum flow for the associated pump.

Final Disposition:

- Miniflow orifices meter miniflow to meet the manufacturer's requirements.
- The above mentioned miniflow orifices preclude any pump interaction, since the back pressure in the common line portion of the miniflow line downstream of the orifices is low and will, therefore, preclude discharge pressure communication between the pumps.

Status/Planned Action:

Review is complete; no further action or response is necessary.

Catawba Nuclear Station

	Pumps	Manufacturer
Containment Spray (NS)	1A, 1B, 2A, 2B	Bingham

Configuration:

Two identical pumps per unit are installed in separate flow paths without any interaction.

Final Disposition:

- Flows exceed minimum flow requirements during accident operations. During quarterly IWP testing of each pump a throttle valve in the minimum flow line is adjusted to achieve recommended flow.

- Interaction is not a problem during accident operations since pumps discharge on separate paths. During the tests only one pump is operated, hence pump to pump interaction is not a problem.

Status/Planned Action:

Review is complete; no further action or response is necessary.

Catawba Nuclear Station

	Pumps	Manufacturer
Motor Driven Aux. Feedwater (CA)	1A, 1B, 2A, 2B	Bingham

Configuration:

An auto-recirculation check valve at the discharge of each pump opens on low flow to provide a miniflow path.

Final Disposition:

- Recommended minimum flow is provided by the auto-recirculation check valves.
- The auto-recirculation check valves preclude interaction.

Status/Planned Action:

Review is complete; no further action or response is necessary.

Catawba Nuclear Station

	Pumps	Manufacturer
Turbine Driven Aux. Feedwater (CA)	1, 2	Bingham

Configuration:

An auto-recirculation check valve at the discharge of each pump opens on low flow to provide a miniflow path.

Final Disposition:

- Recommended minimum flow is provided by the auto-recirculation check valves.
- The auto-recirculation check valves preclude interaction.

Status/Planned Action:

Review is complete; no further action or response is necessary.

Catawba Nuclear Station

	Pumps	Manufacturer
Component Cooling Water (KC)	1A1, 1A2, 1B1, 1B2, 2A1, 2A2, 2B1, 2B2	Goulds

Configuration:

Each pair of component cooling pumps share a common minimum flow line which has a valve that automatically opens upon low flow to provide total minimum flow for both pumps. When the flow rate has increased to an adequate flow, the minimum flow valve closes to avoid pump runout.

Continued operation of the component cooling water pumps is justified on the following basis:

- The minimum flow path is needed for faulted, normal operation (non-Engineered Safeguards) only. During unfaulted normal operation and all modes of Engineered Safeguards (safety injection, high containment pressure, high-high containment pressure) there are sufficient flow paths open to exceed the pump minimum flow requirements determined by the manufacturer. Automatic action will open the minimum flow path upon the detection of low flow and control room alarms/indications will keep operators informed of system status. The current flow setpoints provide adequate protection against vibration damage to the pumps and pump runout for both one pump and two pump (per train) operation. This has been verified by testing.

- The Component Cooling Miniflow Verification tests are conducted at a flow rate lower than the low flow setpoint (The flow rate used is higher than the manufacturer recommended minimum flow). There has been no evidence of pump degradation as a result of operation at the lower flow rate; however, the low flow setpoint used to open the minimum flow line will be increased to provide better protection against pump interaction during two pump (per train) operation, especially when considering IWP acceptance criteria.

Status/Planned Action:

1. A Station Problem Report will be written by 8-1-89 to initiate action to increase the low flow setpoints used to open the minimum flow line for each train.

2. Submit Bulletin Action Item #5 response within 30 days of implementation.

Catawba Nuclear Station

	Pumps	Manufacturer
Nuclear Service Water (RN)	1A, 1B, 2A, 2B	Bingham

Configuration:

Catawba is a two-unit station with four RN pumps, one powered from each redundant train (two per unit). The 1A and 2A pumps feed into a common (i.e., shared between units) loop A supply header, and the 1B and 2B pumps feed into a common loop B supply header. Inside the Auxiliary Building, crossovers between loops permit flow from any RN pump to serve any open header under normal circumstances. Flow instrumentation is provided at the discharge of each RN pump to alarm on low flow setpoint.

During normal operation, the minimum flow path for all four pumps is through one or more component cooling heat exchangers. When in the "minimum flow" mode, the pneumatic valve on the discharge side of the affected component cooling heat exchanger is automatically throttled on flow from the operating RN pump with the smallest flow rate. On receipt of an ESF signal (from its respective unit), the pneumatic miniflow valves fail open and other valves align to assure sufficient flow for the RN pumps. During normal operation, a loss of energy (such as loss of offsite power or loss of instrument air) will also cause the minimum flow valves to fail open.

Final Disposition:

- During ESF operation, valve interlocks and failure positions are in place which provide sufficient flow paths to meet minimum flow requirements.
- During unfaulted normal operation, system interlocks and postulated alignments provide adequate minimum flow for operating RN pumps. During faulted normal operation, flow instruments and station procedures are in place to detect and correct low flow conditions.
- At the RN pump flow ranges anticipated during ESF or unfaulted normal operation, pump characteristics are such that interaction is not a problem.

Status/Planned Action:

Review is complete; no further action or response is necessary.

	Pumps	Manufacturer
Control Area Chilled Water (YC)	1, 2	Goulds

Configuration:

Each pump has a separate full-flow path.

Final Disposition:

- Each pump maintains a relatively constant flowrate which is always greater than the required minimum flow. The full-flow path for each pump precludes the need for dedicated minimum flow lines.
- The pumps are completely separated from each other, therefore interaction is not a problem.

Status/Planned Action:

Review is complete; no further action or response is necessary.