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Exelon Nuclear

10 CFR 50.90

November 13, 2007

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Limerick Generating Station, Units 1 and 2
Facility Operating License Nos. NPF-39 and NPF-85
NRC Docket Nos. 50-352 and 50-353

SUBJECT: License Amendment Request
Proposed Changes to Technical Specifications
Surveillance Requirement 4.4.1.2 - Jet Pumps

Pursuant to 10 CFR 50.90, "Application for amendment of license or construction permit," Exelon Generation Company, LLC (Exelon), proposes changes to the Technical Specifications (TS), Appendix A of Operating License Nos. NPF-39 and NPF-85 for Limerick Generating Station (LGS), Units 1 and 2, respectively.

The proposed changes delete a footnote from TS Surveillance Requirement (SR) 4.4.1.2 which requires using data recorded from the original startup test program for the parameters listed in the TS SR to provide a basis for establishing the relationships specified in the TS SR. Consistent with NUREG-1433, "Standard Technical Specifications, General Electric Plants, BWR/4," the TS Bases for TS SR 4.4.1.2 will be revised to indicate that, based on various reasons, the relationships specified in the TS SR may need to be re-established each operating cycle rather than using relationships that were established based on data obtained from original startup testing.

Exelon has concluded that the proposed changes present no significant hazards consideration under the standards set forth in 10CFR 50.92.

This amendment request contains no regulatory commitments.

Exelon requests approval of the proposed amendment by November 13, 2008. Upon NRC approval, the amendment shall be implemented within 60 days of issuance.

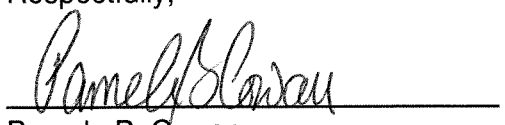
These proposed changes have been reviewed by the Plant Operations Review Committee and approved in accordance with Nuclear Safety Review Board procedures.

We are notifying the State of Pennsylvania of this application for changes to the Technical Specifications by transmitting a copy of this letter and its attachments to the designated State Official.

If you have any questions or require additional information, please contact Glenn Stewart at 610-765-5529.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 13th day of November, 2007.

Respectfully,

DGH 

Pamela B. Cowan
Director, Licensing & Regulatory Affairs
Exelon Generation Company, LLC

Attachments:
1. Evaluation of Proposed Changes
2. Markup of Proposed Technical Specifications Pages
3. Markup of Proposed Technical Specifications Bases Page

cc: Regional Administrator - NRC Region I w/ attachments
NRC Senior Resident Inspector - Limerick Generating Station "
NRC Project Manager, NRR - Limerick Generating Station "
Director, Bureau of Radiation Protection - Pennsylvania Department of Environmental Protection "

ATTACHMENT 1

License Amendment Request

Limerick Generating Station, Units 1 and 2

Docket Nos. 50-352 and 50-353

EVALUATION OF PROPOSED CHANGES

Subject: Proposed Changes to Technical Specifications Surveillance Requirement 4.4.1.2 - Jet Pumps

1.0 DESCRIPTION

Pursuant to 10 CFR 50.90, “Application for amendment of license or construction permit,” Exelon Generation Company, LLC (Exelon), proposes a change to the Technical Specifications (TS), Appendix A of Operating License Nos. NPF-39 and NPF-85 for Limerick Generating Station (LGS), Units 1 and 2, respectively.

The proposed change deletes a footnote from TS Surveillance Requirement (SR) 4.4.1.2 which requires using data recorded from the original startup test program for the parameters listed in the TS SR to provide a basis for establishing the relationships specified in the TS SR. Consistent with NUREG-1433 (Reference 1), the TS Bases for TS SR 4.4.1.2 will be revised to indicate that, based on various reasons, the relationships specified in the TS SR may need to be re-established each operating cycle rather than using relationships that were established based on data obtained from original startup testing.

2.0 PROPOSED CHANGES

The changes requested by this amendment application are described below.

1. LGS, Unit 1 - Delete footnote "*To be determined from the startup test program data." from the bottom of TS pages 3/4 4-4 and 3/4 4-4a, and remove the associated asterisk (*) from the word "established" in TS SRs 4.4.1.2.a.1, 4.4.1.2.a.2, 4.4.1.2.a.3, 4.4.1.2.b.1, 4.4.1.2.b.2, and 4.4.1.2.b.3. These proposed changes are shown in Attachment 2.

2. LGS, Unit 2 - Delete footnote "*During the startup test program, data shall be recorded for the parameters listed to provide a basis for establishing the specified relationships. Comparisons of the actual data in accordance with the criteria listed shall commence upon the conclusion of the startup test program." from the bottom of TS pages 3/4 4-4 and 3/4 4-4a, and remove the associated asterisk (*) from the word "established" in TS SRs 4.4.1.2.a.1, 4.4.1.2.a.2, 4.4.1.2.a.3, 4.4.1.2.b.1, 4.4.1.2.b.2, and 4.4.1.2.b.3. These proposed changes are shown in Attachment 2.

3. Revise TS Bases 3/4.4.1, "Recirculation System," consistent with NUREG-1433 to indicate that, based on various reasons, the relationships specified in TS SR 4.4.1.2 may need to be re-established each operating cycle. These proposed changes are provided in Attachment 3 for information only.

The proposed changes are consistent with NUREG-1433.

3.0 BACKGROUND

In February, 1980, a jet pump hold-down beam failed at Dresden 3 resulting in jet pump disassembly which caused an orderly plant shutdown. Subsequent visual inspection by TV camera and ultrasonic examination, conducted at the direction of General Electric (GE), disclosed that hold-down beams on other jet pumps at Dresden 3, Quad Cities 2 and Pilgrim 1 contained cracks in the ligament zone at the center of the beams. Investigation determined that these cracks were caused by intergranular stress corrosion, which in the case of these jet pump beams, progressed very slowly over a period of years.

The jet pumps are essential to efficient normal operation for GE BWR/3 and later reactors, in that they increase core flow over that provided by the recirculation loop pumps by the jet pump action of adding in-vessel recirculation. This results in an increase of reactor output capacity over that produced by boiling water reactors without jet pumps.

Construction of the jet pumps is such that they can be disassembled remotely for inservice inspection. The break which occurred at Dresden 3 allowed the inlet mixer section to lift off causing pump section decoupling, severely impairing the jet pump functional ability. Unbalanced jet pump loop flow and reduced core flow occur as a result of pump disassembly. Also, loss of preload and excessive deflection of the hold-down beam allow changes in indicated flow in the pump and recirculation loop which can be detected, as found by GE studies, as the beam cracks progress, and before complete failure of the beam occurs. In other words, indicated flow readings can be used to predict failure before it occurs and as in the case of Dresden 3, can be use to diagnose jet pump disassembly when it occurs.

The resultant reduction in core flow capacity which occurs with a jet pump failure could reduce the margin of safety for emergency core cooling for postulated accidents. On this basis, such an occurrence was judged safety-related, and of sufficient concern to warrant the issue of a bulletin.

On April 4, 1980, IE Bulletin 80-07 (Reference 2) was issued to all operating GE BWR/3s and BWR/4s to initiate daily surveillance of jet pump and recirculation loop flow, if not already performed, to provide for early identification of jet pump degradation or failure. Specifically, Item B.2.b of IE Bulletin 80-07 required the following daily surveillances be performed and eventually added to licensee TS: (1) comparison of recirculation pump flow versus established pump speed-loop flow characteristics, (2) comparison of total core flow versus the core flow value derived from established power-core flow relationships, and (3) comparison of diffuser-to-lower plenum differential pressure versus established characteristics. IE Bulletin 80-07 was also issued for information purposes to BWR facilities with construction permits. Even though the LGS facility was under construction at the time IE Bulletin 80-07 was issued, TS Section 4.4.1.2 for both LGS, Units 1 and 2, incorporates daily jet pump surveillance requirements consistent with those required by IE Bulletin 80-07.

4.0 TECHNICAL ANALYSIS

LGS TS Sections 4.4.1.2.a and 4.4.1.2.b include a footnote which requires using data recorded during the original plant startup test program as the basis for the established patterns that are used for the comparisons required by the TS SR. Using startup test program data was necessary during the initial startup of the plant to establish a good database of expected characteristics which were then used as the basis for the comparison required by TS SRs 4.4.1.2.a and 4.4.1.2.b. However, over the course of time, various refueling activities, such as fuel assembly replacement or fuel shuffle, as well as physical changes to plant configuration, such as modifications to fuel support orifice size or core plate bypass flow, etc., can change the recirculation loop flow, jet pump flow, and core flow characteristics. Using startup test program data as the sole basis for the comparisons required by TS SRs 4.4.1.2.a and 4.4.1.2.b may not provide an accurate indication of the current performance characteristics of the jet pumps. Deleting the footnote allows the plant the flexibility to re-establish recirculation loop flow, jet pump flow, and core flow characteristics if there have been any plant changes that impact these characteristics. During startup after refueling or startup after changes that impact flow

characteristics, normal operating data will be obtained at several points along the startup path, i.e., the thermal power to core flow map, to characterize the change, if any, in the specified relationships. The data collected will be plotted against the existing acceptance criteria (curves) specified in the daily jet pump operability surveillance tests. A determination will be made whether or not to change the existing acceptance criteria. If necessary, the acceptance criteria in the daily jet pump operability surveillance tests will be revised based on the data collected to establish new baseline acceptance criteria. If no change is necessary, the existing daily jet pump operability surveillance tests will remain unchanged. This will ensure that up-to-date data is used as the established pattern for performing the jet pump surveillances, which in turn, will ensure that jet pump degradation is identified early before jet pump failure occurs, and will maintain the margin of safety during postulated accidents.

5.0 REGULATORY ANALYSIS

5.1 No Significant Hazards Consideration

Exelon has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Do the proposed changes involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No. The proposed changes provide the ability to re-establish recirculation pump flow, core flow, or diffuser-to-lower plenum differential pressure characteristics, provided as the basis for performing the Technical Specification (TS) jet pump surveillances, based on physical changes to the plant that could affect the accuracy of the TS SR required comparison. The proposed changes do not impact the physical configuration or function of plant structures, systems, or components (SSCs) or the manner in which SSCs are operated, maintained, modified, or inspected. The proposed changes do not impact the initiators or assumptions of analyzed events, nor do they impact mitigation of accidents or transient events.

Therefore, the proposed changes do not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Do the proposed changes create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No. The proposed changes provide the ability to re-establish recirculation pump flow, core flow, or diffuser-to-lower plenum differential pressure patterns or characteristics, provided as the basis for performing the TS jet pump surveillances, based on physical changes to the plant that could affect the accuracy of the TS SR required comparison. The proposed changes do not alter plant configuration, require that new plant equipment be installed, alter assumptions made about accidents previously evaluated, or impact the function

of plant SSCs or the manner in which SSCs are operated, maintained, modified, or inspected.

Therefore, the proposed changes do not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Do the proposed changes involve a significant reduction in a margin of safety?

Response: No. The proposed changes provide the ability to re-establish recirculation pump flow, core flow, or diffuser-to-lower plenum differential pressure patterns or characteristics, provided as the basis for performing the TS jet pump surveillances, based on physical changes to the plant that could affect the accuracy of the TS SR required comparison. The proposed changes do not involve any physical changes to plant SSCs or the manner in which SSCs are operated, maintained, modified, or inspected. The proposed changes do not involve a change to any safety limits, limiting safety system settings, limiting conditions of operation, or design parameters for any SSC. The proposed changes do not impact any safety analysis assumptions and do not involve a change in initial conditions, system response times, or other parameters affecting an accident analysis.

Therefore, the proposed changes do not involve a significant reduction in a margin of safety.

Based on the above, Exelon concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of “no significant hazards consideration” is justified.

5.2 Applicable Regulatory Requirements/Criteria

10 CFR 50.36 specifies the requirements for what should be included in TS. In particular, 10 CFR 50.36(c)(3) specifies that TS shall include Surveillance Requirements (SRs). SRs are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met. IE Bulletin 80-07 required the addition of several jet pump surveillances that would provide for early detection of jet pump degradation based on the experience of jet pump failures that occurred at several utilities. LGS TS Sections 4.4.1.2.a and 4.4.1.2.b specify jet pump surveillances for detecting jet pump degradation that are consistent with the TS SRs required by IE Bulletin 80-07. The proposed changes do not alter the jet pump surveillances specified in LGS TS SR 4.4.1.2.a and 4.4.1.2.b but rather delete a footnote associated with the surveillances that contains a requirement to use startup test program data for recirculation pump flow, core flow, and diffuser-to-lower plenum differential pressure as the basis for the comparisons required by this TS SR. Deleting this footnote provides the ability to re-establish the baseline characteristics for these parameters based on physical changes to the plant that could impact the characteristics for these parameters, and therefore, affect the accuracy of the results of the TS SR. The

proposed changes continue to ensure that jet pump degradation is detected prior to jet pump failure, and that the margin of safety is maintained during postulated accidents.

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

6.0 ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

7.0 REFERENCES

1. NUREG-1433, "Standard Technical Specifications, General Electric Plants. BWR/4," Revision 3.1, dated December 1, 2005.

2. IE Bulletin 80-07, "BWR Jet Pump Assembly Failure," dated April 4, 1980.

ATTACHMENT 2

License Amendment Request

Limerick Generating Station, Units 1 and 2
Docket Nos. 50-352 and 50-353

Proposed Changes to Technical Specifications
Surveillance Requirement 4.4.1.2 - Jet Pumps

Markup of Proposed Technical Specifications Pages

Unit 1 TS Pages

3/4 4-4
3/4 4-4a

Unit 2 TS Pages

3/4 4-4
3/4 4-4a

REACTOR COOLANT SYSTEM

JET PUMPS

LIMITING CONDITION FOR OPERATION

3.4.1.2 All jet pumps shall be OPERABLE.

APPLICABILITY: OPERATIONAL CONDITIONS 1 and 2.

ACTION:

With one or more jet pumps inoperable, be in at least HOT SHUTDOWN within 12 hours.

SURVEILLANCE REQUIREMENTS

4.4.1.2 All jet pumps shall be demonstrated OPERABLE as follows:

a. During two recirculation loop operation, each of the above required jet pumps shall be demonstrated OPERABLE prior to THERMAL POWER exceeding 25% of RATED THERMAL POWER and in accordance with the Surveillance Frequency Control Program while greater than 25% of RATED THERMAL POWER by determining recirculation loop flow, total core flow and diffuser-to-lower plenum differential pressure for each jet pump and verifying that no two of the following conditions occur when both recirculation loop indicated flows are in compliance with Specification 3.4.1.3.

1. The indicated recirculation loop flow differs by more than 10% from the established* pump speed-loop flow characteristics. delete

2. The indicated total core flow differs by more than 10% from the established* total core flow value derived from recirculation loop flow measurements. delete

3. The indicated diffuser-to-lower plenum differential pressure of any individual jet pump differs from the established* patterns by more than 10%. delete

~~*To be determined from the startup test program data.~~ delete

SURVEILLANCE REQUIREMENTS (Continued)

b. During single recirculation loop operation, each of the above required jet pumps shall be demonstrated OPERABLE in accordance with the Surveillance Frequency Control Program by verifying that no two of the following conditions occur:

1. The indicated recirculation loop flow in the operating loop differs by more than 10% from the established* pump speed-loop flow characteristics.

2. The indicated total core flow differs by more than 10% from the established* total core flow value derived from single recirculation loop flow measurements.

3. The indicated diffuser-to-lower plenum differential pressure of any individual jet pump differs from established* single recirculation loop patterns by more than 10%.

c. The provisions of Specification 4.0.4 are not applicable provided that this surveillance is performed within 24 hours after exceeding 25% of RATED THERMAL POWER and upon entering single recirculation loop operation.

~~*To be determined from the startup test program data.~~

REACTOR COOLANT SYSTEM

JET PUMPS

LIMITING CONDITION FOR OPERATION

3.4.1.2 All jet pumps shall be OPERABLE.

APPLICABILITY: OPERATIONAL CONDITIONS 1 and 2.

ACTION:

With one or more jet pumps inoperable, be in at least HOT SHUTDOWN within 12 hours.

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delete

1. The indicated recirculation loop flow differs by more than 10% from the established* pump speed-loop flow characteristics.

delete

2. The indicated total core flow differs by more than 10% from the established* total core flow value derived from recirculation loop flow measurements.

delete

3. The indicated diffuser-to-lower plenum differential pressure of any individual jet pump differs from the established* patterns by more than 10%.

*During the startup test program, data shall be recorded for the parameters listed to provide a basis for establishing the specified relationships. Comparisons of the actual data in accordance with the criteria listed shall commence upon the conclusion of the startup test program.

delete

SURVEILLANCE REQUIREMENTS (Continued)

b. During single recirculation loop operation, each of the above required jet pumps shall be demonstrated OPERABLE in accordance with the Surveillance Frequency Control Program by verifying that no two of the following conditions occur:

1. The indicated recirculation loop flow in the operating loop differs by more than 10% from the established pump speed-loop flow characteristics. delete

2. The indicated total core flow differs by more than 10% from the established total core flow value derived from single recirculation loop flow measurements. delete

3. The indicated diffuser-to-lower plenum differential pressure of any individual jet pump differs from established single recirculation loop patters by more than 10%. delete

c. The provisions of Specification 4.0.4 are not applicable provided that this surveillance is performed within 24 hours after exceeding 25% of RATED THERMAL POWER and upon entering single recirculation loop operation.

*During the startup test program, data shall be recorded for the parameters listed to provide a basis for establishing the specified relationships. Comparisons of the actual data in accordance with the criteria listed shall commence upon the conclusion of the startup test program. delete

ATTACHMENT 3

License Amendment Request

Limerick Generating Station, Units 1 and 2
Docket Nos. 50-352 and 50-353

Proposed Changes to Technical Specifications
Surveillance Requirement 4.4.1.2 - Jet Pumps

Markup of Proposed Technical Specifications Bases Page

Unit 1 TS Page

B 3/4 4-1

Unit 2 TS Page

B 3/4 4-1

BASES

3/4.4.1 RECIRCULATION SYSTEM

The impact of single recirculation loop operation upon plant safety is assessed and shows that single-loop operation is permitted if the MCPR fuel cladding safety limit is increased as noted by Specification 2.1.2, APRM scram and control rod block setpoints are adjusted as noted in Tables 2.2.1-1 and 3.3.6-2, respectively.

Additionally, surveillance on the pump speed of the operating recirculation loop is imposed to exclude the possibility of excessive internals vibration. The surveillance on differential temperatures below 30% RATED THERMAL POWER or 50% rated recirculation loop flow is to mitigate the undue thermal stress on vessel nozzles, recirculation pump and vessel bottom head during the extended operation of the single recirculation loop mode.

An inoperable jet pump is not, in itself, a sufficient reason to declare a recirculation loop inoperable, but it does, in case of a design-basis-accident, increase the blowdown area and reduce the capability of reflooding the core; thus, the requirement for shutdown of the facility with a jet pump inoperable. Jet pump failure can be detected by monitoring jet pump performance on a prescribed schedule for significant degradation.

INSERT

Recirculation pump speed mismatch limits are in compliance with the ECCS LOCA analysis design criteria for two recirculation loop operation. The limits will ensure an adequate core flow coastdown from either recirculation loop following a LOCA. In the case where the mismatch limits cannot be maintained during two loop operation, continued operation is permitted in a single recirculation loop mode.

In order to prevent undue stress on the vessel nozzles and bottom head region, the recirculation loop temperatures shall be within 50°F of each other prior to startup of an idle loop. The loop temperature must also be within 50°F of the reactor pressure vessel coolant temperature to prevent thermal shock to the recirculation pump and recirculation nozzles. Sudden equalization of a temperature difference > 145°F between the reactor vessel bottom head coolant and the coolant in the upper region of the reactor vessel by increasing core flow rate would cause undue stress in the reactor vessel bottom head.

INSERT

Surveillance of recirculation loop flow, total core flow, and diffuser-to-lower plenum differential pressure is designed to detect significant degradation in jet pump performance that precedes jet pump failure. This surveillance is required to be performed only when the loop has forced recirculation flow since surveillance checks and measurements can only be performed during jet pump operation. The jet pump failure of concern is a complete mixer displacement due to jet pump beam failure. Jet pump plugging is also of concern since it adds flow resistance to the recirculation loop. Significant degradation is indicated if the specified criteria confirm unacceptable deviations from established patterns or relationships. Since refueling activities (fuel assembly replacement or shuffle, as well as any modifications to fuel support orifice size or core plate bypass flow) can affect the relationship between core flow, jet pump flow, and recirculation loop flow, these relationships may need to be re-established each cycle. Similarly, initial entry into extended single loop operation may also require establishment of these relationships. During the initial weeks of operation under such conditions, while base-lining new "established patterns," engineering judgment of the daily surveillance results is used to detect significant abnormalities which could indicate a jet pump failure.

The recirculation pump speed operating characteristics (pump flow and loop flow versus pump speed) are determined by the flow resistance from the loop suction through the jet pump nozzles. A change in the relationship indicates a plug, flow restriction, loss in pump hydraulic performance, leakage, or new flow path between the recirculation pump discharge and jet pump nozzle. For this criterion, the pump flow and loop flow versus pump speed relationship must be verified.

Individual jet pumps in a recirculation loop normally do not have the same flow. The unequal flow is due to the drive flow manifold, which does not distribute flow equally to all risers. The flow (or jet pump diffuser to lower plenum differential pressure) pattern or relationship of one jet pump to the loop average is repeatable. An appreciable change in this relationship is an indication that increased (or reduced) resistance has occurred in one of the jet pumps. This may be indicated by an increase in the relative flow for a jet pump that has experienced beam cracks.

The deviations from normal are considered indicative of a potential problem in the recirculation drive flow or jet pump system. Normal flow ranges and established jet pump flow and differential pressure patterns are established by plotting historical data.

3/4.4.1 RECIRCULATION SYSTEM

The impact of single recirculation loop operation upon plant safety is assessed and shows that single-loop operation is permitted if the MCPR fuel cladding safety limit is increased as noted by Specification 2.1.2, APRM scram and control rod block setpoints are adjusted as noted in Tables 2.2.1-1 and 3.3.6-2, respectively.

Additionally, surveillance on the pump speed of the operating recirculation loop is imposed to exclude the possibility of excessive internals vibration. The surveillance on differential temperatures below 30% RATED THERMAL POWER or 50% rated recirculation loop flow is to mitigate the undue thermal stress on vessel nozzles, recirculation pump and vessel bottom head during the extended operation of the single recirculation loop mode.

An inoperable jet pump is not, in itself, a sufficient reason to declare a recirculation loop inoperable, but it does, in case of a design-basis-accident, increase the blowdown area and reduce the capability of reflooding the core; thus, the requirement for shutdown of the facility with a jet pump inoperable. Jet pump failure can be detected by monitoring jet pump performance on a prescribed schedule for significant degradation.

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The recirculation pump speed operating characteristics (pump flow and loop flow versus pump speed) are determined by the flow resistance from the loop suction through the jet pump nozzles. A change in the relationship indicates a plug, flow restriction, loss in pump hydraulic performance, leakage, or new flow path between the recirculation pump discharge and jet pump nozzle. For this criterion, the pump flow and loop flow versus pump speed relationship must be verified.

Individual jet pumps in a recirculation loop normally do not have the same flow. The unequal flow is due to the drive flow manifold, which does not distribute flow equally to all risers. The flow (or jet pump diffuser to lower plenum differential pressure) pattern or relationship of one jet pump to the loop average is repeatable. An appreciable change in this relationship is an indication that increased (or reduced) resistance has occurred in one of the jet pumps. This may be indicated by an increase in the relative flow for a jet pump that has experienced beam cracks.

The deviations from normal are considered indicative of a potential problem in the recirculation drive flow or jet pump system. Normal flow ranges and established jet pump flow and differential pressure patterns are established by plotting historical data.