TECHNICAL SPECIFICATIONS

LIST OF FIGURES

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iv. The analytical procedures now used result in a more logical answer than the alternative method of assuming a higher starting power in conjunction with the expected values for the parameters.

Trip Settings

The bases for individual trip settings are discussed in the following paragraphs.

A. Neutron Flux Trips

1. APRM High Flux Scram (Run Mode)

The average power range monitoring (APRM) system, which is calibrated using heat balance data taken during steady state conditions, reads in percent of rated thermal power (1658 MWt). Because fission chambers provide the basic input signals, the APRM system responds directly to average neutron flux. During transients, the instantaneous rate of heat transfer from the fuel (reactor thermal power) is less than the instantaneous neutron flux due to the time constant of the fuel. Therefore, during abnormal operational transients, the thermal power of the fuel will be less than that indicated by the neutron flux at the scram setting. Analyses demonstrate that with a 120 percent scram trip setting, none of the abnormal operational transients analyzed violate the fuel Safety Limit and there is a substantial margin to the threshold for fuel damage. Therefore, the use of flow referenced

INSERT A

scram trip provides additional margin. An increase in the APRM scram trip setting would decrease the margin present before the fuel cladding integrity Safety Limit is reached. The APRM scram trip setting was determined by an analysis of margins required to provide a reasonable range for maneuvering during operation. Reducing this operating margin would increase the frequency of spurious scrams which have an adverse effect on reactor safety because of the resulting thermal stresses. Thus, the APRM scram trip setting was selected because it provides adequate margin for the fuel cladding integrity Safety Limit yet allows operating margin that reduces the possibility of unnecessary scrams.

LIMITING CONDITIONS FOR OPERATION

4. If Specification 3.3.D.1, 2 or 3 cannot be met, be in COLD SHUTDOWN within 24 hours.

E. Reactivity Anomalies

The reactivity difference between the actual rod density and predicted rod density shall not exceed 1% Δk/k.

1. If the reactivity is different by more than 1% Δk/k, perform an analysis to determine and explain the cause of the reactivity difference; operation may continue if the difference is explained and corrected.

2. Otherwise be in COLD SHUTDOWN within 24 hours.

F. Recirculation Pumps

INSERT B

1. Whenever the reactor is in the STARTUP or RUN modes, the reactor shall not be operated in natural circulation (no recirculation pumps running).

INSERT C

2. A recirculation pump shall not be started or restarted while the reactor is in natural circulation during REACTOR POWER OPERATION.

INSERT D

3. Two Loop Operation

With two recirculation pumps in operation in Regions 1 or 2 of Figure 3.3-1, operation is permitted provided that:

a. APRM and LPRM* neutron flux levels are ≤ three times (3x) their established baseline values as determined by Surveillance Requirement 4.3.F.3.b.

b. If APRM and/or LPRM* neutron flux noise levels are > three times (3x) their established baseline values,

(i) immediately initiate corrective action by increasing core flow and/or inserting control rods in an orderly manner, and

INSERT E

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*Detector levels A and C of one LPRM string per core octant plus detector levels A and C of one LPRM string in the center of the core shall be monitored.

SURVEILLANCE REQUIREMENTS

E. Reactivity Anomalies

The rod density shall be predicted and compared to the actual rod density:

1. during the first startup following CORE ALTERATIONS and

2. at least once per full power month.

F. Recirculation Pumps

1. Not used

2. Not used

NOT USED

3. Two Loop Operation

a. With two recirculation pumps in operation in Regions 1 or 2 of Figure 3.3-1, establish baseline APRM and LPRM* neutron flux noise levels within 2 hours, provided that baseline values have not been previously established since the last core refueling.

b. While in Regions 1 or 2 of Figure 3.3-1, determine APRM and LPRM* neutron flux noise levels at the following intervals:

(i) within 2 hours of entering the region, and

(ii) at least once per 8 hours thereafter, and

(iii) within 30 minutes after the completion of a power increase of ≥ 5% of rated core thermal power.

JUN 2 4 1992

LIMITING CONDITIONS FOR OPERATION

(ii) restore the noise levels to ≤ three times (3x) baseline values within 2 hours.

4. Single Loop Operation (SLO)

The reactor may be started and operated, or may continue operating in SLO provided the following restrictions are observed:

a. MAPLHGR multipliers and MCPR adjustment are used in accordance with the CORE OPERATING LIMITS REPORT.

b. Flow Biased APRM setpoints are adjusted for SLO per Specifications 3.1.A and 3.2.C.

c. The idle loop is isolated electrically by disconnecting the breaker to the recirculation pump motor generator (M/G) set drive motor prior to reactor startup, or if disabled during reactor operation, within 24 hours of entering SLO.**

d. Operation in Region 1 of Figure 3.3-1 is not permitted. If inadvertent entry into this region occurs, immediately initiate corrective action by inserting control rods in an orderly manner to exit the region.

e. Operation in Regions 2 or 3 of Figure 3.3-1 is permitted provided that:

(i) APRM and LPRM* neutron flux noise levels are ≤ three times (3x) their established baseline values as determined by Surveillance Requirement 4.3.F.4.c.

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*Detector levels A and C of one LPRM string per core octant plus detector levels A and C of one LPRM string in the center of the core shall be monitored.

**The breaker may be racked in and the M/G set and recirc. pump started under administrative control for testing provided Specification 3.3.F.5 is satisfied.

SURVEILLANCE REQUIREMENTS

4. Single Loop Operation (SLO)

a. Jet Pump baseline data for SLO shall be updated as soon as practical after entering SLO per Specification 4.6.E.4.

b. Prior to SLO operation in Regions 2 or 3 of Figure 3.3-1, establish baseline APRM and LPRM* neutron flux noise levels, provided that baseline values have not been previously established since the last core refueling. Baseline values shall be established during SLO and in the Regions below the 80% load line (Regions 4 or 5).

c. While in Regions 2 or 3 of Figure 3.3-1, determine APRM and LPRM* neutron flux noise levels at the following intervals:

(i) at least once per 8 hours, <u>and</u>

(ii) within 30 minutes after the completion of a power increase of ≥ 5% of rated core thermal power.

JUN 2 4 1992

LIMITING CONDITIONS FOR OPERATION

(ii) If APRM and/or LPRM* neutron flux noise levels are > three times (3x) their established baseline values,

(a) immediately initiate corrective action by increasing core flow and/or inserting control rods in an orderly manner, and

(b) restore the noise levels to ≤ three times (3x) baseline values within 2 hours.

(iii) If baseline APRM and LPRM* neutron flux noise levels have not been determined,

(a) immediately initiate corrective action by inserting control rods in an orderly manner, and

(b) exit the region (be ≤ 80% load line) within 4 hours.

(iv) If operating in Region 3, also comply with Specification 3.3.F.4.f.

f. Operation in Regions 3 or 4 of Figure 3.3-1 is permitted provided that:

(i) core plate ΔP noise level is ≤ 1.0 psid or < two times (2x) its established baseline value as determined by Surveillance Requirement 4.3.F.4.e.

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*Detector levels A and C of one LPRM string per core octant plus detector levels A and C of one LPRM string in the center of the core shall be monitored.

SURVEILLANCE REQUIREMENTS

d. Prior to SLO operation in Regions 3 or 4 of Figure 3.3-1, establish baseline core plate ΔP noise level, provided that the baseline value has not been previously established since the last core refueling. Baseline value shall be established during SLO and core flow ≤ 45% of rated.

e. While in Regions 3 or 4 of Figure 3.3-1, determine core plate ΔP noise level at the following intervals:

(i) at least once per 8 hours, and

(ii) within 30 minutes after the completion of a power increase of ≥ 5% of rated core thermal power.

LIMITING CONDITIONS FOR OPERATION | SURVEILLANCE REQUIREMENTS

(ii) If core plate ΔP noise level is > 1.0 psid and ≥ two times (2x) its established baseline value,

(a) immediately initiate corrective action by decreasing core flow and/or inserting control rods in an orderly manner, and

(b) restore the noise level to ≤ 1.0 psid or < two times (2x) baseline value within 2 hours.

(iii) If baseline core plate ΔP noise level has not been determined,

(a) immediately initiate corrective action by decreasing core flow, and

(b) exit the region (be ≤ 45% rated core flow) within 4 hours.

(iv) If operating in Region 3, also comply with Specification 3.3.F.4.e.

5. Restoration from SLO

a. Verify the thermal limitations of Specification 3.6.A are met prior to startup of the idle recirculation loop.

b. After startup of the idle recirculation pump, the discharge valve of the lower speed pump may not be opened unless the speed of the faster pump is less than 50% of its rated speed.

JUN 2 4 1992

The RBM bypass time delay is set low enough to assure minimum rod movement while upscale trips are bypassed.

A Limiting Control Rod Pattern for rod withdrawal error (RWE) exists when (a) core thermal power is greater than or equal to 30% of rated and less than 90% of rated (30% ≤ P < 90%) and the MCPR is less than 1.70, or (b) core thermal power is greater than or equal to 90% of rated (P≥90%) and the MCPR is less than 1.40.

During the use of such patterns, it is judged that testing of the RBM channel (when one channel is inoperable) prior to withdrawal of such rods to assure its operability will assure that improper withdrawal does not occur.

D. Scram Insertion Times

The control rod system is designed to bring the reactor subcritical at a rate fast enough to prevent fuel damage; i.e., to prevent the MCPR from becoming less than the safety limit.

After initial fuel loading and subsequent refuelings when operating above 950 psig, all control rods shall be scram tested within the constraints imposed by the Technical Specifications and before the 40% power level is reached. The requirements for the various scram time measurements ensure that any indication of systematic problems with rod drives will be investigated on a timely basis.

E. Reactivity Anomalies

During each fuel cycle excess operative reactivity varies as fuel depletes and as any burnable poison in supplementary control is burned. The magnitude of this excess reactivity may be inferred from the critical rod configuration. As fuel burnup progresses, anomalous behavior in the excess reactivity may be detected by comparison of the critical rod pattern at selected base states to the predicted rod inventory at that state. Power operating base conditions provide the most sensitive and directly interpretable data relative to core reactivity. Furthermore, using power operating base conditions permits frequent reactivity comparisons.

Requiring a reactivity comparison at the specified frequency assures that a comparison will be made before the core reactivity change exceeds 1% Δk/k. Deviations in core reactivity greater than 1% Δk/k are not expected and require thorough evaluation. One percent reactivity limit is considered safe since an insertion of the reactivity into the core would not lead to transients exceeding design conditions of the reactor system.

F. Recirculation Pumps

INSERT 6

APRM and/or LPRM oscillations in excess of those specified in section 3.3.F could be an indication that a condition of thermal hydraulic instability exists and that appropriate remedial action should be taken. Instability can occur in two loop or single loop operation. Therefore, instability monitoring is required in certain regions of Figure 3.3-1.

An evaluation has been provided for ECCS performance during SLO (Sec. 3.12, Ref. 4). Therefore, continuous operation under such conditions is appropriate. By restricting core flow to greater than or equal to 39% of rated in SLO, the region of the power/flow map where these oscillations are most likely to occur is avoided. Individual APRM and/or LPRM channels exhibiting excessive flux noise may be discounted upon verification that a true condition of thermal hydraulic instability does not exist by observation of the remaining available APRM and/or LPRM channels. These specifications are based upon the guidance of GE SIL #380, Rev. 1, 2/10/84.

Above 45% of rated core flow in SLO there is the potential to set up high flow-induced noise in the core. Thus, surveillance of core plate ΔP noise is required in this region of Figure 3.3-1 to alert the operators to take appropriate remedial action if such a condition exists.

JUN 2 4 1992

3.3 and 4.3 REFERENCES

1. Banked Position Withdrawal Sequence, NEDO-21231, January 1977.

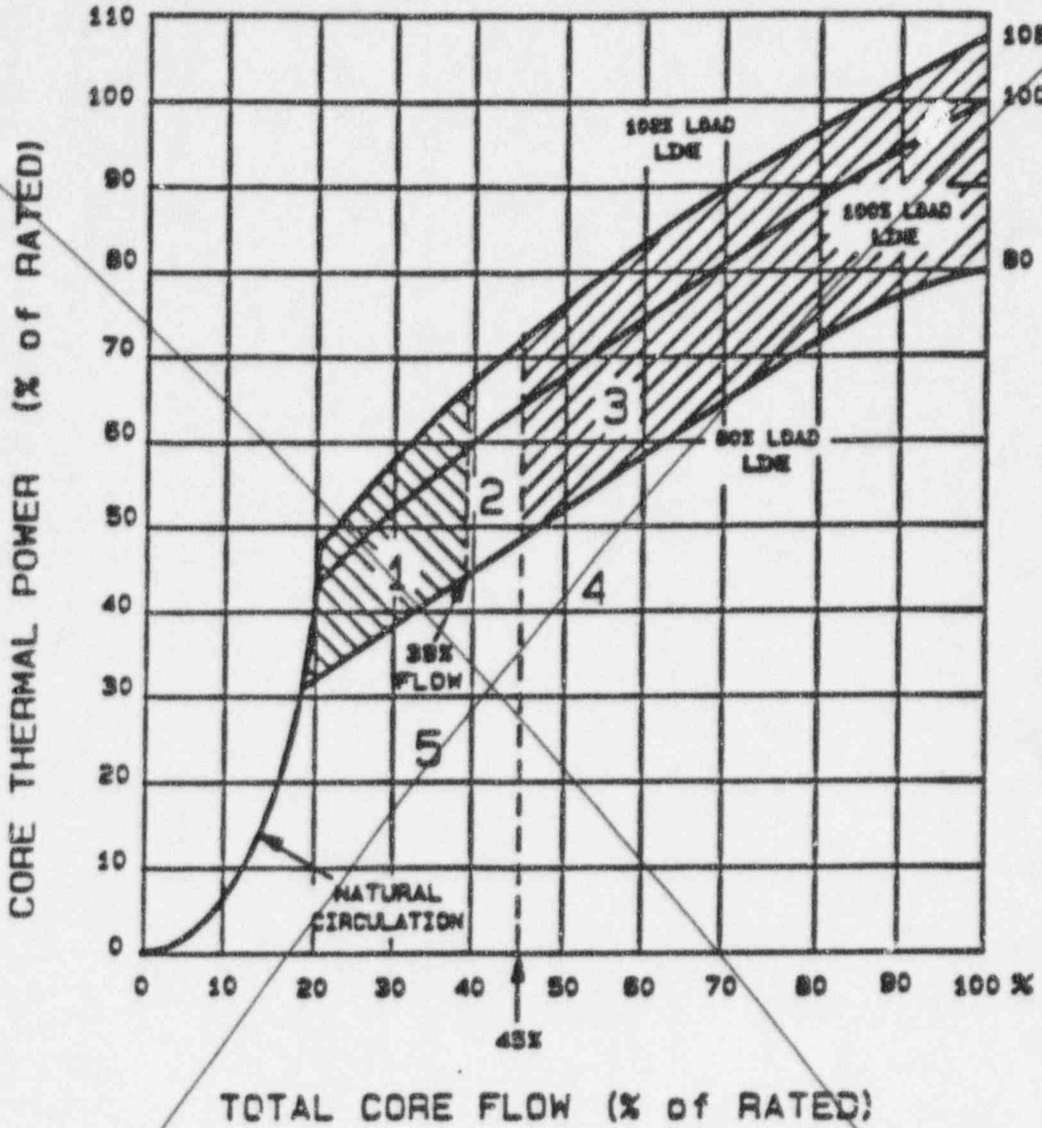
2. General Electric Standard Application for Reactor Fuel, NEDE-24011-P-A*.

3. General Electric Service Information Letter (SIL) No. 316, Reduced Notch Worth Procedure, November 1979.

4. Average Power Range Monitor, Rod Block Monitor and Technical Specification Improvement (ARTS) Program for the Duane Arnold Energy Center, NEDC-30813-P, December, 1984.

5. Application of the "Regional Exclusion with Flow-Biased APRM Neutron Flux Scram" Stability Solution (Option I-D) to the Duane Arnold Energy Center GENE-A00-04021-01

*Latest NRC-approved revision.



Region 1: Two Loop Surv. Region, SLO Prohibited Region
- requires APRM/LPRM noise monitoring

Region 2: Two Loop & SLO Surv. Region
- requires APRM/LPRM noise monitoring

Region 3: SLO Surv. Region
- requires APRM/LPRM & Core Plate D/P noise monitoring

Region 4: Extended SLO Surv. Region
- requires Core Plate D/P noise monitoring

Region 5: Unrestricted Two Loop & SLO Region

DUANE ARNOLD ENERGY CENTER
IES UTILITIES INC.
TECHNICAL SPECIFICATIONS

THERMAL POWER Vs CORE FLOW LIMITS
FOR THERMAL HYDRAULIC STABILITY
SURVEILLANCE
FIGURE 3.3-1

(2) Results of the last isotopic analysis for radioiodine performed prior to exceeding the limit, results of analysis while limit was exceeded and results of one analysis after the radioiodine activity was reduced to less than limit. Each result should include date and time of sampling and radioiodine concentrations;

(3) Cleanup system operating status starting 48 hours prior to the first sample in which the limit was exceeded;

(4) Graph of the I-131 concentration and one other radioiodine isotope concentration in microcuries per gram as a function of time for the duration of the specific activity above the steady-state level; and

(5) The time duration when the specific activity of the primary coolant exceeded the radioiodine limit.

6.11.2 CORE OPERATING LIMITS REPORT

a. Core cycle-dependent limits shall be established prior to each reload cycle, or prior to any remaining part of a reload cycle, for the following:

1) Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) - Specification 3.12.A.

2) Linear Heat Generation Rate (LHGR) - Specification 3.12.B.

3) Minimum Critical Power Ratio (MCPR) - Specification 3.12.C.

4) $MAPFAC_f$ and $MAPFAC_P$ Factors which multiply the MAPLHGR limits - Specification 3.3.F.4.a.

INSERT F

These limits shall be documented in the CORE OPERATING LIMITS REPORT.

b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC in General Electric Standard Application for Reactor Fuel, NEDE-24011-P-A, (GESTAR II).*

c. The core operating limits shall be determined such that all applicable limits (e.g. fuel thermal-mechanical limits, core thermal hydraulic limits, ECCS limits, nuclear limits such as shutdown margin, and transient and accident analysis limits) of the safety analysis are met.

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*Approved revision number at time reload fuel analyses are performed.

INSERT A

Analyses are performed to demonstrate that the APRM flux scram over the range of settings from a maximum of 120% to the minimum flow biased setpoint of 62% provide protection from the fuel safety limit for all abnormal operational transients including those that may result in a thermal hydraulic instability.

INSERT B

Operation in natural circulation* is not permitted. If operation in natural circulation occurs, the reactor shall be scrammed.

INSERT C

No recirculation pump shall be placed in operation while the reactor is in natural circulation.*

INSERT D

Operation in the Exclusion Region of the power/flow map described in the Core Operating Limits Report is not permitted. If entry into this region occurs, immediately insert control rods or increase core flow to exit the region.

INSERT E

* no recirculation pumps running and two or more control rods withdrawn and the reactor in STARTUP or RUN.

INSERT F

5) Exclusion Region in the power/flow map - Specification 3.3.F.3.

INSERT G

Not allowing startup of an idle recirculation pump from a natural circulation condition prevents the reactivity insertion transient that would occur due to the sudden flow of cold stratified water into the core. In addition, operation in natural circulation could place the plant in or near the exclusion region. Restarting a recirculation pump while in the exclusion region could result in the initiation of thermal hydraulic instability. Manually scramming the reactor is the recommended method of exiting the exclusion region when the plant is operating in natural circulation.

The reactor design criteria is such that thermal hydraulic oscillations are prevented or can be readily detected and suppressed without exceeding specified fuel design limits. To minimize the likelihood of an instability, a power/flow exclusion region to be avoided during normal operation is calculated using the approved methodology as stated in Specification 6.11.2.a.5. Since the exclusion region may change each fuel cycle, the limits are contained in the Core Operating Limits Report. Specific directions are provided to avoid operation in this region and to immediately exit upon an entry. Entries into the exclusion region are not part of normal operation. An entry may occur as a result of an abnormal event, such as a single recirculation pump trip. In these events, operation in the exclusion region may be needed to prevent equipment damage, but actual time spent inside the exclusion region is minimized. Though each operator action can prevent the occurrence and protect the reactor from an instability, the APRM flow-biased scram function is designed to suppress global oscillations, the most likely mode of oscillation, prior to exceeding the fuel safety limit. While global oscillations are the most likely mode, protection from out-of-phase oscillations are provided through avoidance of the exclusion region and administrative controls on reactor conditions which are primary factors affecting reactor stability.

SAFETY ASSESSMENT

By letter dated November 30, 1995, IES Utilities Inc. submitted a request for revision of the Technical Specifications (TS) for the Duane Arnold Energy Center (DAEC). The proposed amendment would implement the Boiling Water Reactor Owner's Group (BWROG) Option I-D long term thermal-hydraulic instability solution and eliminate the specifications and surveillance requirements based on the older General Electric (GE) SIL 380 Rev. 1 recommendations. In addition, the proposed amendment would specify that the reactor be scrammed during operation in natural circulation and that an idle recirculation pump not be restarted while in natural circulation. Natural circulation would be more clearly defined. Finally, the proposed amendment would eliminate certain requirements related to monitoring core plate differential pressure noise during single recirculation loop operation

Assessment:

Option I-D has been approved by the NRC as an acceptable long term thermal hydraulic instability solution and the attached topical report demonstrates the suitability of this solution to the DAEC. This solution supersedes the previous guidance provided by GE SIL 380 Rev. 1, which was incorporated into the DAEC TS.

Consequently, based upon the above, we conclude that the proposed implementation of Option I-D and the removal of previous requirements related to thermal hydraulic instability is acceptable.

The proposed requirement to explicitly require that a reactor scram be initiated in the event the plant enters natural circulation operation is conservative. Likewise, the proposed prohibition from starting a recirculation pump as a means of exiting the natural circulation mode of operation is also conservative.

Consequently, based upon the above, we conclude that the proposed prohibition from operating in natural circulation is acceptable.

The current requirements related to core plate differential pressure noise monitoring during single recirculation pump operation were added to the DAEC TS in response to an event at Brown's Ferry during the 1980's when larger than expected noise levels were generated while in single recirculation pump operation. High core plate noise was once thought to be linked to thermal hydraulic instability. Analysis by GE has since demonstrated that this noise is generated by factors unrelated to thermal hydraulic instability.

Consequently, based upon the above, we conclude that the proposed elimination of core plate differential pressure requirements is acceptable.

ENVIRONMENTAL CONSIDERATION

10 CFR Section 51.22(c)(9) identifies certain licensing and regulatory actions which are eligible for categorical exclusion from the requirement to perform an environmental assessment. A proposed amendment to an operating license for a facility requires no environmental assessment if operation of the facility in accordance with the proposed amendment would not: (1) involve a significant hazards consideration; (2) result in a significant change in the types or significant increase in the amounts of any effluents that may be released offsite; and (3) result in a significant increase in individual or cumulative occupational radiation exposure. IES Utilities Inc. has reviewed this request and determined that the proposed amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR Section 51.22(c)(9). Pursuant to 10 CFR Section 51.22(b), no environmental impact statement or environmental assessment needs to be prepared in connection with the issuance of the amendment. The basis for this determination follows:

Basis

The change meets the eligibility criteria for categorical exclusion set forth in 10 CFR Section 51.22(c)(9) for the following reasons:

1. As demonstrated in Attachment 3 to this letter, the proposed amendment does not involve a significant hazards consideration.

2. The proposed amendment implements an NRC approved methodology for the long-term solution to thermal-hydraulic instability concerns. The solution demonstrates that the fuel safety limits will not be exceeded during thermal hydraulic instability events. Thus, there will be no significant change in the types or significant increase in the amounts of any effluents that may be released offsite.

3. The proposed amendment will not result in a change to the plant source term or change the nature or frequency of activities that result in radiation exposure to the plant staff. Thus, there will be no significant increase in either individual or cumulative occupational radiation exposure.