October 22, 1985

Docket No. 50-267

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Mr. O. R. Lee, Vice President
Electric Production
Public Service Company of Colorado
P. O. Box 840
Denver, Colorado 80201

Dear Mr. Lee:

SUBJECT: FORT ST. VRAIN (FSV) - TECHNICAL SPECIFICATION UPGRADE - NRC RESPONSES TO ACTION ITEMS

Re: Memo from K. L. Heitner to P. C. Wagner - Summary of Meeting with Public Service Company of Colorado on Fort St. Vrain Technical Specification Upgrade dated August 20, 1985

From July 22 through July 26, 1985, the NRC staff held meetings with your staff concerning the Technical Specification Upgrade Program for Fort St. Vrain (Reference 1). At the meeting, the NRC staff agreed to supply responses to certain issues raised by your staff. These responses were discussed by telecon with the your staff on August 14, 1985. We are documenting this information at this time in an enclosure for your guidance in preparing the next draft of your Technical Specifications. A copy of North Anna's emergency diesel generator Technical Specification is also enclosed for guidance to you on this matter.

Any question on this material should be addressed to the assigned Project Manager, Kenneth L. Heitner. He may be reached at (301) 492-7364.

Sincerely,

Edward J. Butcher, Acting Chief
Operating Reactors Branch #3
Division of Licensing

Enclosures:
1. Response to NRC Action Items Resulting From FSV Technical Specification Upgrade
2. Amendment No. 48 to Facility Operating License No. NPF-7

cc w/enclosures:
See next page

ORB#3:DL	ORB#3:DL	ORB#3:DL
PKreutzer	KHeitner;ef	EButcher
10/18/85	/ /85	10/21/85

Mr. O. R. Lee
Public Service Company of Colorado

Fort St. Vrain

cc:

C. K. Millen
Senior Vice President
Public Service Company
of Colorado
P. O. Box 840
Denver, Colorado 80201

Mr. David Alberstein, 14/159A
GA Technologies, Inc.
P. O. Box 840
Denver, Colorado 80201

J. K. Fuller, Vice President
Public Service Company
of Colorado
P. O. Box 840
Denver, Colorado 80201

Senior Resident Inspector
U.S. Nuclear Regulatory Commission
P. O.Box 640
Platteville, Colorado 80651

Kelley, Stansfield & O'Donnell
Public Service Company Building
Room 900
550 15th Street
Denver, Colorado 80202

Regional Administrator, Region IV
U.S. Nuclear Regulatory Commission
Office of Executive Director
for Operations
611 Ryan Plaza Drive, Suite 1000
Arlington, Texas 76011

Chairman, Board of County Commissioners
of Weld County, Colorado
Greeley, Colorado 80631

Regional Representative
Radiation Programs
Environmental Protection Agency
1800 Lincoln Street
Denver, Colorado 80651

Albert J. Hazle, Director
Radiation Control Division
4210 East 11th Avenue
Denver, Colorado 80220

J. W. Gahm
Nuclear Production Manager
Public Service Company of Colorado
P. O. Box 368
Platteville, Colorado 80651

ENCLOSURE 1

RESPONSE TO NRC ACTION ITEMS RESULTING FROM THE

FSV TECHNICAL SPECIFICATION UPGRADE

GENERAL ACTIONS:

NRC Action

1. Provide guidance on the acceptability of using a document separate from the Technical Specifications for in-service inspection and testing (ISI/IST) requirements. This document would then be referenced in the Technical Specifications with NRC approval of its content called for in the Admin. Controls.

NRC Response

The staff would accept an approach similar to paragraph 4.0.5 of the Standard Technical Specifications (STS) which would reference a separate FSV ISI/IST document along with requirements for NRC review/approval. This acceptance is conditional on the development of a separate ISI/IST document that delineates the requirements of the ASME Code, Section XI. Due to the unique nature of FSV, and the fact that the staff has not accepted all portions of the ASME Code, Section XI, Division 2, the technical specifications may include specific provisions for augmented testing and inspection requirements.

NRC Action

2. Provide guidance on whether or not the Technical Specifications should include LCOs only on systems and components relied upon in the FSV-FSAR Chapter 14 analysis to protect the barriers to radiation release or should they also include LCOs on systems and components which provide an additional line of defense to prevent radiation release.

NRC Response

Current staff guidelines require Technical Specifications include:

- Systems/equipment necessary to mitigate the the DBA
- Systems/equipment that control expected transients
- Systems/equipment that control unexpected transients
- Systems/equipment that control external events (e.g., fire, flood)
- Operational safety limits
- Operational parameters assumed during accident analysis as initial conditions
- Early warning detection systems
- Equipment relied upon to achieve stable and safe shutdown status

These and other requirements are outlined in ANS Standard 58.4 (1979 Edition) and the STS for Westinghouse PWRs on which PSC's upgrade program is based. The staff's review of PSC's draft Technical Specifications was based in part on the ANS statement, "Technical Specifications shall be provided only for items relied upon in the safety analysis, and for other items specifically required by Federal regulations to be in the Technical Specifications." The staff, therefore, has focused its review on the entire FSV-FSAR (safety analysis) for this FSV technical specification upgrade program. This was not considered to be outside the scope of the FSV upgrade program as identified in the NRC's December 20, 1984, letter (E.H. Johnston to O.R. Lee). In general, the Technical Specification should include appropriate limiting conditions for operation to ensure sufficient systems or components are available to perform the required safety function assuming a single failure.

NRC Action

3. Provide guidance on whether components, which are required to function to maintain other equipment within an environment for which it is qualified, should also be in the Technical Specifications (for example, main steam isolation valves).

NRC Response

Where assumptions for equipment operability related to environmental qualification are based on the successful operation of active components in the event of an accident, the availability and reliability of these components should be ensured through Technical Specification requirements. Specific items of concern identified by the staff were the main steam isolation valve (MSIV) operability and closing time requirements as well as the hot reheat (HRH) valve operability requirements. Other EQ operability requirements should be identified by the licensee and incorporated as Technical Specification requirements to ensure equipment necessary to mitigate accidents function within the assumed environmental conditions.

In addition to the EQ analysis, other analysis which rely on equipment operability may also result in Technical Specification requirements. For example, the equipment operability requirements based on previous fire protection analysis (Appendix R Evaluation: FSV Reports 1 through 4) should be reflected in the Technical Specifications.

NRC Action

4. It is acceptable to include for completeness in Section 3/4.3 "Instrumentation," trip setpoints for non-safety related items? These would then not be subject to enforcement.

NRC Response

Nonsafety-related instrumentation trip setpoints should not be incorporated; however, if they were incorporated, they would be subject to enforcement. Process control or equipment protection items should not be in Technical Specifications. However, current staff policy is to incorporate items associated with the Plant Protective System (PPS) for which no credit was assumed in the safety analysis with very lenient action statements. Experience has shown that technical specifications on the associated equipment enhances the overall reliability of the PPS. If FSV's Rod Withdrawal Prohibits (RWP) are considered nonsafety-related and are physically and electrically isolated from the PPS, then this issue could be reviewed for possible deletion from the Technical Specifications. Deletion of a Technical Specification with marginal safety significance shall be supported by safety analysis.

NRC Action

5. PCS would like to have agreement that when in the Startup or Low Power modes it would be acceptable to proceed to the next higher power mode even if they have an LCO Action Statement. Currently, general LCO 3.0.6 prohibits this.

NRC Response

The staff would review deviations from LCO 3.0.6 on a case-by-case basis as was previously done for the control rod Technical Specification LCOs. The licensee should provide justification for any deviations by demonstrating that the action statements provide equivalent protection. For example, placing one instrument in trip for a two-out-of-four logic configuration would provide a conservative remedial action when the instrument channel is inoperable. Accordingly, a mode change would be permitted in this configuration.

NRC Action

6. Provide guidance on how much detail associated with the operability of a system (relief valve setpoints, valve position, water chemistry, etc.) goes into the Technical Specifications and how much is left to be picked up by procedures which implement the defined term "OPERABLE."

NRC Response

Operability requirements should be specified for those systems addressed in the licensee's proposed ISI/IST procedure discussed above in Action 1. The amount of detail specifically addressed within the body of the Technical Specification LCO or surveillance depends upon whether previously identified concerns necessitated inclusion of some details or whether engineering judgment was utilized in requiring details to be incorporated depending on

the safety significance of the details. For systems analogous to the Westinghouse PWR-SWTS, the STS should be used as guidance in regard to the level of detail. For systems that are not analogous (e.g., liner cooling, circulator and auxiliaries), the level of detail would be based on engineering judgement. However, it is the NRC staff's opinion that it would be to PSC's advantage to incorporate more detail for these systems to preclude system operability interpretation problems.

SPECIFIC ACTIONS:

NRC Action

1. Check whether or not adequate control on primary system He inventory is provided by LCO 3.3.1 (PPS) and LCO 3.2.4.

NRC Response

The combination of LCOs 3.3.1, 3.2.4 and 3.3.2.7 adequately control He inventory as follows:

a) LCO 3.3.1 requires a minimum He pressure (which varies as a function of primary system temperature) via a reactor protection system trip function whenever reactor power is $>$ 30%.

b) LCO 3.2.4 requires a minimum He flowrate (as a function of power level, core pressure and core orifice position) when in the 0-15% power range. Per discussion with PSC on 8/30/85 the He flowrate used in complying with this LCO is expressed on a mass flow basis.

c) LCO 3.3.2.7 requires monitoring of the reactor power to flow ratio over the range 5-100% power. Per discussion with PSC on 8/30/85 the He flowrate used as input to the power to flow recorder is a mass flow rate.

Therefore, based on the above no additional technical specification requirements are needed to ensure adequate He inventory.

NRC Action

2. Pg. 1-2 - Definition 1.9 - Is PSC original wording in 4/1/85 draft acceptable?

NRC Response

It is the NRC staff's position that the FSV Technical Specifications should be based on the STS definition for Core Alteration or similar definition (e.g., FSV draft definition marked-up by NRC) to preclude use of analysis or engineering judgment. An alternate would be to define what incore activities can be performed without the need for two-way communications with the control room as required by LCO 3/4.9.5 and support this by analysis.

NRC Action

3. Pg. 1-3 - Definition 1.14 - PSC wants to use the wording in their 4/1/85 draft since there is no iodine, only noble gas, in their primary coolant. Is this acceptable?

NRC Response

It is the NRC staff's position that the FSV Technical Specifications should be based on the STS definition. Ē consists of not only gamma emitters (e.g., noble gases Xe and Kr) but also consists of beta emitters (e.g., 35S, 3H, 89Sr, and 90Sr) which are FSV primary coolant radionuclides.

NRC Action

4. Pg. 3/4.2-9 - Surveillance b.2 Core Inlet Orifice Valves - Is the second sentence understandable?

NRC Response

The wording should be corrected to reflect the current Technical Specification SR 5.1.7.b)2).

NRC Action

5. Pg. 3/4.3-1 - Instrumentation - The basis for this entire section is contained in a PSC submittal of 6/21/85 (p-85214) covering instrumentation setpoints changes. NRC review and comment on the 6/21/85 PSC submittal is required.

NRC Response

This submittal will be evaluated separately from the upgrade program.

NRC Action

6. Pg. 3/4.3-7 - Note (k) - Is note (k) acceptable as is or should its requirements be included in Section 3/4.10 - "Special Test Exceptions?"

NRC Response

The use of a note is acceptable provided that explicit conditions (i.e., boundaries) under which this note is applicable are specified e.g., operating experience has indicated the need for bypassing the DPMMs to allow plant startup and primary coolant cleanup at certain power, temperature, and core flow conditions. During this bypass condition, the DPMM detector and sample lines are dried and the monitors returned to service. Existing Technical Specifications authorize a 72 hour time frame for this bypass condition. Additional clarification is also needed to ensure that when the observer alerts the reactor operator as to any moisture or pressure change, the reactor operator will perform the appropriate correction action.

Additional comments may be forthcoming upon completion of NRC's initial review of the PSC submittal of 6/21/85.

NRC Action

7. Pg. 3/4.3-8 - PSC would like to use their wording from the 4/1/85 draft for the action statements on this page as well as on pages 3/4.3-16, 23, and 31. Is this acceptable?

   NRC's suggested wording is based upon the STS; PSC's upon their existing Technical Specifications.

NRC Response

The NRC response is pending completion of NRC initial review as stated above.

NRC Action

8. Pg. 3/4.3-87 - LCO 3.3 Control Room Temperature Monitoring - PSC would like to revise the LCO along the lines of the BWR-STS. Is this acceptable?

NRC Response

Use of the BWR-STS Rev. 4 is acceptable to the staff.

NRC Action

9. Section 3/4.8 - Electrical Systems - PSC wants to revise all of their electrical system LCOs along the lines of the Technical Specifications for VEPCO's North Anna plants. Is this acceptable?

NRC Response

The NRC staff will provide the licensee with a copy of Amendment No. 48 to Facility Operating License No. DPR-7 for the North Anna Power Station, Unit No. 2, to be utilized as a guide in developing FSV's emergency diesel generator requirements. The licensee should provide confirmation that their proposed surveillance requirements were discussed with and approved by the diesel generator manufacturer to ensure compliance with the manufacturer recommendations for avoiding the detrimental effects of improper testing.

Depending on the type (manufacturer) of diesel generators utilized, the pre-lubrication, preheating, acceleration, and loading vary. A review of the SER for North Anna on this issue will provide examples and insight into the issues involved.

NRC Action

10. Pg. 3/4.7-1 - LCO 3.7.1.1 Boiler Feed Pumps - PSC relies on non-safety grade boiler feed pumps in their safety analysis for mitigating the

effects of design basis accidents. Is this acceptable and should there be a Technical Specification on these pumps? NRC will review this LCO for completeness and provide any comments to PSC.

NRC Response

The Technical Specification should address the BFPs since they are relied upon during DBA 2. The licensee must ensure that all surveillance requirements for the BFPs are either addressed in the surveillance requirements or in their proposed ISI/IST procedure since the ASME code does not address these pumps. The NRC will address the acceptability of the non-safety grade boiler feed pumps for accident mitigation in separate correspondence.

We have the following comments on this LCO:

a) The applicability statement should be revised to require this LCO be applicable at all times when the decay heat level or plant temperatures would require fast initiation of a boiler feed pump to supply water to drive the He circulators in a depressurized condition. This will help ensure the availability of the boiler feed pumps to drive the circulators in the event of a depressurization accident and will be consistent with the applicability requirements of LCOs 3.5.2.2., 3.5.2.3, 3.5.1.1 and 3.5.1.2.

b) The bases should be expanded to explain that a single auxiliary boiler has sufficient capacity to drive a single boiler feed pump at full capacity. A single boiler feed pump can then drive a circulator with sufficient rpm to cool the core.

   Also the bases should explain why an operating auxiliary boiler is not required in part (a) of this LCO.

NRC Action

11. Pg. 3/4.7-11 - LCO 3.7.3 "Instrument Air System" - Why was one hour chosen as the time limit in Action (b)?

NRC Response

The staff recommends deleting action statement (b) and relying on generic paragraph 3.0.5.

NRC Action

12. Pg. 3/4.6-37 - Surveillance 4.6.5.2-d "Reactor Bldg. Containment" - Do BWRs have a 4400 hr. surveillance interval for continuously operating charcoal adsorber exhaust filters?

NRC Response

The referenced 4400 hr. surveillance interval was previously approved by the staff in PSC's existing Technical Specification. Under the guidelines established for this upgrade program the surveillance interval is acceptable for the PSC upgraded Technical Specifications.

NRC Action

13. Pg. 3/4.7-43 - Surveillance 4.7.9-d, - Control Room Ventilation System - Is a control room positive pressure of 0.02 H_2O acceptable per NUREG-0737 requirements?

NRC Response

The NRC staff noted that SRP 6.4 requires a positive pressure of at least 1/8 inches of water. Separate considerations have been given for some plants depending on design and costs to upgrade. The proposed 0.02 inches is not considered positive pressure and does not meet the requirements of TMI Action Item III.D.3.4. The licensee will have to justify by supporting documentation/analysis why an upgrade to meet this requirement is not possible as part of the PSC action item 47.

NRC Action

14. Section 6.0 - "Admin Controls" - What is the latest standard admin controls section? PSC would like to use:

    a) LER for safety limit violation report,
    b) words from their current Technical Specifications for staff qualifications,
    c) words from their 4/1/85 draft for the shift technical advisor.

    Are these changes acceptable? Also PSC wants to delete words requiring an Independent Safety Engineering Group. FSV approved to not have one?

NRC Response

The NRC has informally provided PSC with the latest staff guidance on standard administrative controls.

a) In accordance with 10 CFR 50.36(c)(7), safety limit violation reports are to be provided as required by 10 CFR 50.73. Therefore, the LER report is acceptable.

b) FSV current Technical Specification wording for staff qualifications is the same as the STS except for compliance with the NRC March 28, 1980 letter. PSC should use the STS wording or reference their response to TMI action item I.A.2.1 and subsequent staff approval.

c) Existing FSV STA requirements were previously accepted by the staff due to the FSV plants unique design and, therefore, are acceptable for incorporation into the upgrade.

The licensee should provide sufficient justification to support the deletion of the Independent Safety Engineering Group.

ADDITIONAL COMMENTS ON FSV TECH SPEC UPGRADE PROGRAM

1) LCO 3.6.2 - Liner Cooling System - A requirement should be added to this LCO which addresses adequate coolant inventory in the LCS and requires monitoring of this inventory for leakage.

2) LCO 3.6.5.3 - Reactor Building Overpressure Protection - Surveillance requirement 4.6.5.3(b) should be expanded to include verification that:

   a) The reactor building louvers fully open within one second when reactor building pressure reaches 3 in. w.g. and fully close when building pressure falls below 2 in. w.g.

   b) The pneumatic cylinders for operation of each louver section have at least 1800 psig in their nitrogen backup supply.

   These requirements are contained in FSAR Section 6.2.3.4.

3) LCO 3.7.9 - Control room Emergency Ventilation System - Surveillance requirement 4.7.9-d specifies that the control room ventilation system, when operating in the recirculation mode, must maintain the control room at a 0.02 in. w.g. positive pressure. However, Section 7.4.1 of the FSAR, Rev. 3, specifies a positive pres[illegible]e of 1/8 in. w.g. when in the recirculation mode. As indicated in an August 28, 1985 telecon with PSC (D. Goss, S. Chestnut); the 1/8 in. w.g. FSAR value is a nominal value based on a full complement of equipment working. The 0.02 in. w.g. value is based on a single supply fan failure. Based on test data, this value could be increased to 0.05 in. w.g. With this clarification and the fact that the FSV control room emergency ventilation system is a single train nonsafety-related system, LCO 3.7.9 should be expanded to include verification that:

   a) Both the control room emergency filter fan (C-7506) and the control room supply fan (C-7504X) are operable in LCO 3.7.9.a.

   b) The control room emergency ventilation system is restored to OPERABLE status within 24 hours.

   c) With a full complement of equipment in service, a positive pressure of greater than or equal to 1/8 in. w.g. can be achieved.

   d) With a single supply fan in-service, a positive pressure of greater than or equal to 0.05 in. w.g. can be achieved.

4) The following FSAR discrepancies were identified:

   a) Section 5.12.2, Rev. 2 - The maximum helium leakage of 1 lb/hr = 100%/yr. does not appear to be consistent with existing LCO 4.2.9 which allows a secondary seal leakage of 400 lb/day. The staff recommends that the FSAR be revised to resolve this inconsistency.

b) Section 6.2.3.2.3, Rev. 3 - This section implies that the reactor building exhaust filters comply with R.G. 1.52, Revision 2. The staff recommends that the FSAR be revised to clarify the exception taken to R.G. 1.52, Revision 2, concerning the frequency (i.e. 4400 hrs. versus 720 hrs.) of laboratory analysis as outlined in the existing LCO SR 5.5.3, "Reactor Building Exhaust Filters, Surveillance."

c) Section 7.3.1.2.1, Page 7.3-9, Rev. 3 - This section refers to a Figure 7.3-24 which apparently was not incorporated into the FSAR. FSAR, List of Figures, Revision 3, does not list a Figure 7.3-24. The staff recommends that the FSAR be revised to correct this inconsistency.

d) Section 7.3.5.3, Rev. 2 - This section and the basis for the proposed LCO 3.3.2.2 refer to a FSAR Table 7.3-2 which was apparently not incorporated into the FSAR. FSAR, List of Tables, Revision 3, refers to a Table 7.3-2, "Process and Area Radiation Monitoring Systems... (Rev. 1)." The staff recommends that this table be incorporated into the FSAR.

e) Section 9.7, Rev. 2 - Figure 9.7-1 shows only one liner cooling system pump per loop whereas, Figure 9.7-2 shows the two liner cooling system pumps per loop. The staff recommends that the FSAR be revised to correct this inconsistency.

ENCLOSURE 2

April 25, 1985

Docket No. 50-339

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Mr. W. L. Stewart
Vice President - Nuclear Operations
Virginia Electric and Power Company
Post Office Box 26666
Richmond, Virginia 23261

Dear Mr. Stewart:

The Commission has issued the enclosed Amendment No. 48 to Facility Operating License No. NPF-7 for the North Anna Power Station, Unit No. 2 (NA-2). The amendment revises the emergency diesel generator Technical Specifications (TS) in response to your letters dated February 1 and March 13, 1985.

This amendment revises the NA-2 TS by reducing the required testing of emergency diesel generators. The changes reduce the parameters for each test, reduce the number of tests, and apply to both routine surveillance and special tests.

A copy of the Safety Evaluation is also enclosed. The notice of issuance will be included in the Commission's next monthly Federal Register notice.

Sincerely,

/S/

Leon B. Engle, Project Manager
Operating Reactors Branch #3
Division of Licensing

Enclosures:
1. Amendment No. 48 to NPF-7
2. Safety Evaluation

cc w/enclosures:
See next page

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PMKreutzer	LEngle	JRMiller		GCLainas
4/ /85	4/24/85	/ /85	/ /85	4/ /85

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Mr. W. L. Stewart
Virginia Electric & Power Company

North Anna Nuclear Power Station

Richard M. Foster, Esquire
Musick, Williamson, Schwartz,
Leavenworth & Cope, P.C.
P. O. Box 4579
Boulder, Colorado 80306

Michael W. Maupin, Esquire
Hunton, Williams, Gay and Gibson
P. O. Box 1535
Richmond, Virginia 23212

Mr. W. T. Lough
Virginia Corporation Commission
Division of Energy Regulation
P. O. Box 1197
Richmond, Virginia 23209

Ellyn R. Weiss, Esquire
Sheldon, Harman, Roisman and Weiss
1725 I Street, N.W., Suite 506
Washington, DC 20006

Mr. J. H. Ferguson
Executive Vice President - Power
Virginia Electric and Power Co.
Post Office Box 26666
Richmond, Virginia 23261

Mr. Anthony Gambardella
Office of the Attorney General
Supreme Court Building
101 North 8th Street
Richmond, Virginia 23219

Resident Inspector/North Anna
c/o U.S. NRC
Senior Resident Inspector
Route 2, Box 78
Mineral, Virginia 23117

Mrs. Margaret Dietrich
Route 2, Box 568
Gordonsville, Virginia 22042

Mr. Paul W. Purdom
Environmental Studies Institute
Drexel University
32nd and Chestnut Streets
Philadelphia, Pennsylvania 19104

Atomic Safety and Licensing Appeal
Board Panel
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Regional Administrator
USNRC, Region II
Office of Executive Director
for Operations
101 Marietta Street N.W., Suite 2900
Atlanta, Georgia 30323

Mr. E. W. Harrell
P. O. Box 402
Mineral, Virginia 23117

Old Dominion Electric Cooperative
c/o Executive Vice President
Innsbrook Corporate Center
4222 Cox Road, Suite 102
Glen Allen, Virginia 23060

Mr. Richard C. Klepper
Board of Supervisors
Louisa County Courthouse
P. O. Box 27
Louisa, Virginia 23093

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

VIRGINIA ELECTRIC AND POWER COMPANY

OLD DOMINION ELECTRIC COOPERATIVE

DOCKET NO. 50-339

NORTH ANNA POWER STATION, UNIT NO. 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 48
License No. NPF-7

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Virginia Electric and Power Company, et al., (the licensee) dated February 1 as supplemented March 13, 1985, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

8505070240

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. NPF-7 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 48, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

James R. Miller

James R. Miller, Chief
Operating Reactors Branch #3
Division of Licensing

Attachment:
Changes to the Technical
  Specifications

Date of Issuance: April 25, 1985

ATTACHMENT TO LICENSE AMENDMENT NO. 48

TO FACILITY OPERATING LICENSE NO. NPF-7

DOCKET NO. 50-339

Replace the following pages of the Appendix "A" Technical Specifications with the enclosed pages as indicated. The revised pages are identified by amendment number and contain vertical lines indicating the area of change. The corresponding overleaf pages are also provided to maintain document completeness.

Pages

3/4 8-1

3/4 8-2

3/4 8-3

3/4 8-4

3/4 8-5

3/4 8-6

3/4 8-6a

3/4 8-9

3/4 8-10

B 3/4 8-1

3/4.8.1 A.C. SOURCES

OPERATING

LIMITING CONDITION FOR OPERATION

3.8.1.1 As a minimum, the following A.C. electrical power sources shall be OPERABLE:

a. Two physically independent circuits between the offsite transmission network and the onsite Class 1E distribution system, and

b. Two separate and independent diesel generators:

   1. Each with a separate day tank containing a minimum of 750 gallons of fuel, and

   2. A fuel storage system containing a minimum of 45,000 gallons of fuel, and

   3. A separate fuel transfer pump.

APPLICABILITY: MODES 1, 2, 3 and 4.

ACTION:

a. With one offsite circuit of 3.8.1.1.a inoperable, demonstrate the OPERABILITY of the remaining A.C. sources by performing Surveillance Requirement 4.8.1.1.1.a within 1 hour and at least once per 8 hours thereafter. If either EDG has not been successfully tested within the past 24 hours, demonstrate its OPERABILITY by performing Surveillance Requirement 4.8.1.1.2.a.4 separately for each such EDG within 24 hours. Restore the offsite circuit to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and COLD SHUTDOWN within the following 30 hours.

b. With one diesel generator of 3.8.1.1.b inoperable, demonstrate the OPERABILITY of the A.C. offsite sources by performing Surveillance Requirement 4.8.1.1.1.a within 1 hour and at least once per 8 hours thereafter; and if the EDG became inoperable due to any cause other than preplanned preventative maintenance or testing, demonstrate the OPERABILITY of the remaining OPERABLE EDG by performing Surveillance Requirement 4.8.1.1.2.a.4 within 24 hours*; restore the diesel generator to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

*This test is required to be completed regardless of when the inoperable EDG is restored to OPERABILITY.

SURVEILLANCE REQUIREMENTS

4.8.1.1.1 Each of the above required physically independent circuits between the offsite transmission network and the onsite Class 1E distribution system shall be:

a. Determined OPERABLE at least once per 7 days by verifying correct breaker alignment indicating power availability.

b. Demonstrated OPERABLE at least once per 18 months during shutdown by manually transferring the onsite Class 1E power supply from the normal circuit to the alternate circuit.

4.8.1.1.2 Each diesel generator shall be demonstrated OPERABLE:

a. In accordance with the frequency specified in Table 4.8.2 on a STAGGERED TEST BASIS by:

1. Verifying the fuel level in the day tank.

2. Verifying the fuel level in the fuel storage tank.

3. Verifying the fuel transfer pump can be started and transfers fuel from the storage system to the day tank.

4. Verifying the diesel generator can start** and gradually accelerate to synchronous speed (900 rpm) with generator voltage and frequency at 4160 ± 420 volts and 60 ± 1.2 Hz. Subsequently, verifying the generator is synchronized, gradually loaded** to an indicated 2500-2600 kW*** and operates for at least 60 minutes.

5. Verifying the diesel generator is aligned to provide standby power to the associated emergency buses.

b. At least once per 92 days by verifying that a sample of diesel fuel from the fuel storage tank obtained as a DRAIN sample in accordance with ASTM-D270-65, is within the acceptable limits specified in Table 1 of ASTM D975-74 when checked for viscosity, water and sediment.

c. At least once per 184 days the diesel generator shall be started** and accelerated to at least 900 rpm in less than or equal to 10 seconds. The generator voltage and frequency shall be 4160 ± 420 volts and 60 ± 1.2 Hz within 10 seconds after the start signal.

**This test shall be conducted in accordance with the manufacturer's recommendations regarding engine prelube and warmup procedures, and as applicable regarding loading recommendations.

***This band is meant as guidance to avoid routine overloading of the engine. Loads in excess of this band for special testing under direct monitoring of the manufacturer or momentary variations due to changing bus loads shall not invalidate the test.

4.8.1.1.2 (Continued)

5. Verifying that on an ESF actuation test signal (without loss of power) the diesel generator starts** on the auto-start signal and operates on standby for greater than or equal to 5 minutes.

6. Simulating a loss of offsite power in conjunction with an ESF actuation test signal, and

   a) Verifying de-energization of the emergency busses and load shedding from the emergency busses.

   b) Verifying the diesel starts** on the auto-start signal, energizes the emergency busses with permanently connected loads within 10 seconds, energizes the auto-connected emergency (accident) loads through the sequencing timers and operates for greater than or equal to 5 minutes and maintains the steady state voltage and frequency at 4160 ± 420 volts and 60 ± 1.2 Hz.

   c) Verifying that all diesel generator trips, except engine overspeed, generator differential and breaker overcurrent are automatically bypassed upon loss of voltage on the emergency bus and/or a safety injection actuation signal.

7. Verifying the diesel generator operates** for at least 24 hours. During the first 2 hours of this test, the diesel generator shall be loaded to an indicated target value of 2950 kW (between 2900-3000 kW)*** and during the remaining 22 hours of this test, the diesel generator shall be loaded to an indicated 2500-2600 kW***. Within 5 minutes after completing this 24-hour test, perform Surveillance Requirement 4.8.1.1.2.d.4.

8. Verifying that the auto-connected loads to each diesel generator do not exceed the 2000 hour rating of 3000 kW.

9. Verifying the diesel generator's capability to:

   a) Synchronize with the offsite power source while the generator is loaded with its emergency loads upon a simulated restoration of offsite power.
   b) Transfer its loads to the offsite power source, and
   c) Proceed through its shutdown sequence.

**This test shall be conducted in accordance with the manufacturer's recommendations regarding engine prelube and warmup procedures, and as applicable regarding loading recommendations.

***This band is meant as guidance to avoid routine overloading of the engine. Loads in excess of this band for special testing under direct monitoring of the manufacturer or momentary variations due to changing bus loads shall not invalidate the test.

4.8.1.1.3 (Continued)

c. At least once per 18 months by verifying that:

1. The cells, cell plates and battery racks show no visual indication of physical damage or abnormal deterioration.

2. The cell-to-cell and terminal connections are clean, tight and coated with anti-corrosion material.

3. The resistance of each cell-to-cell and terminal connection is less than or equal to 0.01 ohms.

4. The battery charger will supply at least ten amperes at 125 volts for at least 4 hours.

d. At least once per 60 months, during shutdown, by verifying that the battery capacity is at least 80% of the manufacturer's rating when subjected to a performance discharge test.

TABLE 4.8-2

DIESEL GENERATOR TEST SCHEDULE

Number of Failures in Last 20 Valid Tests*	Number of Failures in Last 100 Valid Tests*	Test Frequency
≤ 1	≤ 4	Once per 31 days
≥ 2**	≥ 5	Once per 7 days

*Criteria for determining number of failures and number of valid tests shall be in accordance with Regulatory Position C.2.e of Regulatory Guide 1.108, but determined on a per diesel generator basis.

For the purposes of determining the required test frequency, the previous test failure count may be reduced to zero if a complete diesel overhaul to like-new conditions is completed, provided that the overhaul including appropriate post-maintenance operation and testing, is specifically approved by the manufacturer and if acceptable reliability has been demonstrated. The reliability criterion shall be the successful completion of 14 consecutive tests in a single series. Ten of these tests shall be in accordance with Surveillance Requirement 4.8.1.1.2.a.4; four tests, in accordance with Surveillance Requirement 4.8.1.1.2.c. If this criterion is not satisfied during the first series of tests, any alternate criterion to be used to transvalue the failure count to zero requires NRC approval.

**The associated test frequency shall be maintained until seven consecutive failure free demands have been performed and the number of failures in the last 20 valid demands has been reduced to one.

3/4.8.1 and 3/4.8.2 A.C. and D.C. POWER SOURCES AND DISTRIBUTION

The OPERABILITY of the A.C. and D.C. power sources and associated distribution systems during operation ensures that sufficient power will be available to supply the safety related equipment required for 1) the safe shutdown of the facility and 2) the mitigation and control of accident conditions within the facility. The minimum specified independent and redundant A.C. and D. C. power sources and distribution systems satisfy the requirements of General Design Criteria 17 of Appendix "A" to 10 CFR 50.

The ACTION requirements specified for the levels of degradation of the power sources provide restriction upon continued facility operation commensurate with the level of degradation. The OPERABILITY of the power sources are consistent with the initial condition assumptions of the accident analyses and are based upon maintaining at least one of each of the onsite A.C. and D.C. power sources and associated distribution systems OPERABLE during accident conditions coincident with an assumed loss of offsite power and single failure of the other onsite A.C. source.

The OPERABILITY of the minimum specified A.C. and D.C. power sources and associated distribution systems during shutdown and refueling ensures that 1) the facility can be maintained in the shutdown or refueling condition for extended time periods and 2) sufficient instrumentation and control capability is available for monitoring and maintaining the facility status.

The Surveillance Requirements for demonstrating the OPERABILITY of the diesel generators are in accordance with the recommendations of Regulatory Guides 1.9 "Selection of Diesel Generator Set Capacity for Standby Power Supplies", March 10, 1971, and 1.108 "Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants", Revision 1, August 1977 as modified by Amendment No. 48 issued April 25, 1985.

Containment electrical penetrations and penetration conductors are protected by either de-energizing circuits not required during reactor operation or be demonstrating the OPERABILITY of primary and backup overcurrent protection circuit breakers during periodic surveillance.

The surveillance frequency applicable to molded case circuit breakers and/or fuses provides assurance of breaker and/or fuse reliability by testing at least one representative sample of each manufacturers brand of circuit breaker and/or fuse. Each manufacturer's molded case circuit breakers and/or fuses are grouped into representative samples which are then tested on a rotating basis to ensure that all breakers and/or fuses are tested. If a wide

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 48 TO

FACILITY OPERATING LICENSE NO. NPF-7

VIRGINIA ELECTRIC AND POWER COMPANY

OLD DOMINION ELECTRIC COOPERATIVE

NORTH ANNA POWER STATION, UNIT NO. 2

DOCKET NO. 50-339

1. INTRODUCTION

By letter dated February 1, 1985, the Virginia Electric and Power Company (VEPCO), the licensee for the North Anna Unit 2 nuclear power station, requested a change to the plant Technical Specifications to reduce the required testing of the emergency diesel generators (EDGs). During December 1984 and January 1985, the plant had experienced two failures of each EDG. In one case (December 9, 1984), both EDGs became inoperable at the same time and a forced plant shutdown was necessary with several days of lost electrical power generation. On January 13, 1985, the total number of EDG failures for Unit 2 reached the number that requires that all Unit 2 EDGs be tested every three days. As a result of its investigation into the causes of these failures, with the assistance of the EDG manufacturer, the licensee has concluded that the frequent and harsh test starts and rapid loading rate required by the Technical Specifications are a "significant contributor" to the EDG failures.

Subsequent to the February 1, 1985 submittal, the licensee experienced an engine failure of one of the Unit 1 EDGs, and another major engine failure of one of the Unit 2 EDGs. Because repairs of this Unit 2 EDG failure could not be completed within the 72-hour limit, Unit 2 had to be shut down. On March 23, 1985, the North Anna Station experienced an actual partial loss of offsite power event that affected some safety buses on Unit 1 and some on Unit 2. In this event, the EDGs successfully started automatically and powered the safety buses.

In addition to the licensee's submittal dated February 1, 1985, our evaluation included information gained from a meeting with the licensee in Bethesda, Maryland on February 8, 1985, a visit to the plant on February 13, 1985, and the licensee's supplementary submittal dated March 13, 1985.

2. BACKGROUND

2.1.1 General Description

The North Anna Nuclear Power Station is a two nuclear unit station with a total of four EDGs. Two EDGs are fully dedicated to each nuclear plant, with one EDG assigned to each of the redundant electrical power divisions of each nuclear plant. There is no sharing of EDGs between the nuclear plants at the

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North Anna Station. Power from one EDG to one electrical division of each plant is sufficient to provide either for safe shutdown loads or for accident loads. The EDGs at the North Anna Station are manufactured by the Fairbanks Morse Engine Division of Colt Industries. The EDGs are powered by model 38TD8-1/8, 12-cylinder, opposed-piston, turbocharged engines. These EDGs are rated for continuous duty at 2750 kW, for 2000 hours/year at 3000 kW, and for 30 minutes at 3300 kW. The plant design basis accident loads are conservatively calculated to be less than 3000 kW. As shown in Figure 1, the general design is characterized by a pair of pistons in each cylinder, operating in opposite directions and with a common combustion space formed by the pistons. Therefore there are no cylinder heads, and there are no intake valves and no exhaust valves. Pressurized, clean air enters the cylinder, via ports encircling the top of the cylinder liner, when the upper piston is in a position to uncover these ports. Following the ignition of the compressed air-fuel mixture, the downward motion of the lower piston uncovers the exhaust ports which encircle the bottom of the cylinder liner. The turbocharger, driven by the exhaust gas, provides fresh, compressed, cooled air directly into the engine intake manifold. The extra power provided via the turbocharger raises the power output a considerable degree.

Each EDG is equipped with lube oil keep-warm system, a prelube system, and a lube oil booster for the upper crankshaft lube oil line. In the keep-warm system, an electric heater and thermostat keep the lube oil at 130-135°F to maintain a desired viscosity. The keep-warm circulating pump sends the warmed lube oil through the lower crankshaft line, maintaining lubrication of the bearings in the lower portion of the engine, and back to the oil sump. Due to the possibility of getting oil into the firing chamber of these opposed-piston engines, the keep-warm system is carefully adjusted so as not to circulate lube oil to the upper crankshaft line.

In the prelube system, a separate dc-powered lube oil pump is started automatically (for manual EDG starts) and run for two minutes prior to the actual starting of the engine. The prelube system provides lube oil to both the lower and upper crankshaft lines. For all test starts of an EDG at North Anna, the prelube system is used prior to the actual diesel start, i.e. for those simulated engineered safety feature (ESF) actuation/loss-of-power tests where prelube is not activated automatically, the prelube system is started manually prior to actually simulating the need for an emergency auto start. In the case of actual emergency starts, the diesel starts immediately and is not delayed in order to provide prelube.

The lube oil booster system includes a two-gallon supply in an accumulator that has a piston operated by engine starting air. As the engine first begins to rotate, the 2 gallons of lube oil is fed immediately to the bearings along the upper crankshaft line. This booster oil to the upper crankshaft line supplements the prelube system. (At another nuclear station, the practice of prelubing prior to each test start was discontinued when the booster system was added; at North Anna, prelubing was not discontinued. Therefore, the engine failures at the other station do not appear to be directly related to the failures being experienced at North Anna).

The term "fast, cold start" has developed as jargon in reference to the Technical Specifications to start within 10 seconds from ambient conditions. These ambient conditions are not necessarily "cold" in one sense, but the internal engine temperatures are obviously far below the operating conditions of the combustion process. For plants in general, if a licensee elects to

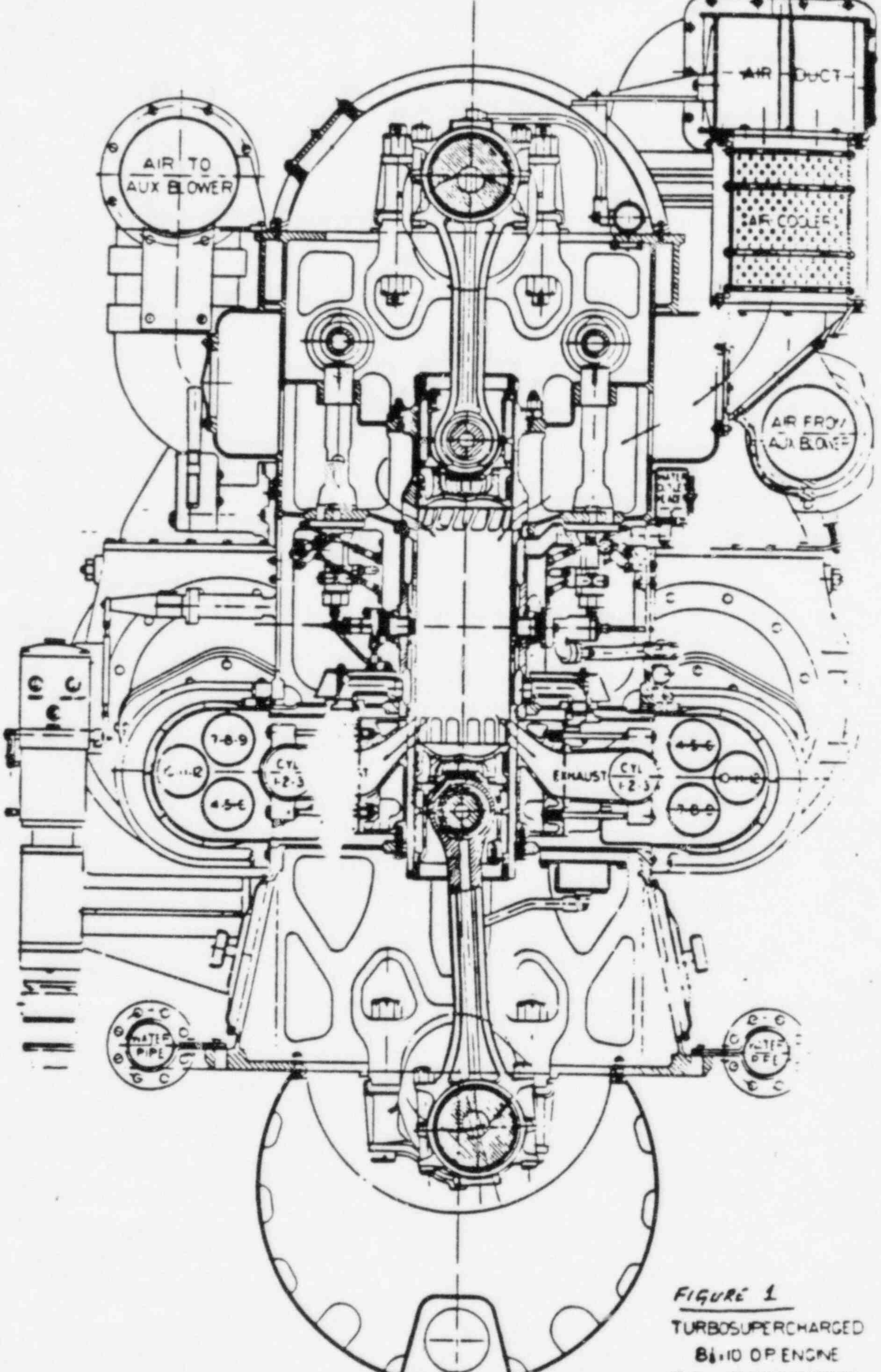

FIGURE 1

TURBOSUPERCHARGED

8½ x 10 O.P. ENGINE

12 CYL. CROSS SECTION

provide a keep-warm system for either the jacket coolant system or the lube oil system or both, such a system may become part of the "ambient conditions" if the system is also considered vital in determining the operability status of the EDG. Most licensees, we understand, have elected to add such modifications to the EDGs. If however, the licensee is not willing to accept the loss of operability of the EDG when such keep-warm systems are not operating properly and to perform necessary repair actions, such keep-warm systems should not be allowed in determining what the ambient conditions should be for the required test starts. For North Anna Unit 2 specifically, the keep-warm system was part of the original licensing basis and is required for EDG operability.

The concept of "fast loading" during EDG testing may also deserve some explanation. If the total loads of the safety bus were applied immediately as a single block load onto the EDG, it would surely trip. Therefore, the loads are divided into a number of smaller loads and, during an accident situation, these smaller loads are applied in a pre-determined sequence. At intervals of about 5-seconds, another set of loads is added onto the EDG. After a total of 20-60 seconds, the sequencing of the loads would be complete. During monthly testing, the EDG is paralleled to the grid and the load is increased more-or-less continuously by the control room operator. If the load is increased to full load in 60 seconds, this ramp increase would approximate the sequenced loading that would occur in a similar time during an accident situation. Therefore, the present Technical Specifications require that the monthly test of the EDG include an increase to full load in 60 seconds. The test loading has been referred to as "fast loading." The fast loading could be contrasted with a "staircase" loading wherein the load is increased slowly over a few minutes to the first plateau; after several minutes, the load is again slowly increased to the next plateau. After 3-5 plateaus, the EDG would have been "staircased" to full load.

2.2 North Anna EDG Failure Experience

At North Anna, the two EDGs for Unit 2 are designated "2H" and "2J", based on the designation of the electrical bus that the EDG provides power to. The "2H" EDG had previously experienced some spurious trips (see Reference 4, LER 84-11). On December 7, 1984, the "2H" EDG was taken out-of-service in order to perform troubleshooting and maintenance in order to prevent an actual failure. Due to one EDG being out-of-service, the plant Technical Specifications Action Statement requires that the other EDG be test started within 1 hour and every 8 hours thereafter. During one of these Action Statement test starts, the "2J" EDG tripped and was declared to be inoperable. The maintenance of "2H" was immediately halted; the "2H" EDG was test started (successfully) and placed on the 8-hour test cycle, since the "2J" EDG was inoperable. During one of these Action Statement test starts on December 9, 1984, the "2H" EDG tripped and was declared to be inoperable. Because both EDGs were inoperable at this point, the Technical Specifications required the plant to be shut down. Following maintenance actions, assisted by the EDG manufacturer, the second of the EDGs was returned to service on December 11, 1984. The details of the repairs may be found in Reference 6 (LER 84-11 Revision 1). The plant was brought back on line on December 16, 1984.

On January 13, 1985, the "2J" EDG suffered another test failure, due to high crankcase pressure. Excessive wear was found on the rings of one piston; the piston and associated rings were replaced. At this point, the total number of EDG failures for the nuclear unit had reached the point that the Technical Specifications require both EDGs to be tested every 3 days. At this time, one EDG is being fast cold tested every day and a half.

On February 4, 1984, the North Anna Unit 1 EDG "1H" was declared inoperable because it had suffered an engine failure. The seals of the number 3 cylinder liner were leaking cooling and engine damage resulted.

On March 15, 1985, the North Anna Unit 2 EDG "2J" suffered an engine failure in conjunction with a high crankcase pressure trip during testing. A large number of parts were replaced (cylinders, pistons, insert bushings, and lower rod bearings). Because the repair actions and subsequent testing could not be completed within the 72-hour Technical Specification requirement, Unit 2 was shutdown on March 18, 1985. The plant was restarted the next day.

2.3 Regulatory Background

On a generic basis, the NRC has been and continues to be interested in achieving and maintaining a high reliability level for EDGs. In 1975, an NRC technical report (then as part of the U.S. Atomic Energy Commission, Reference 10) evaluated EDG failure experiences reported during the period of 1959-1973. During this period, EDG testing was conducted on a monthly basis and during refuelings. This report concluded that one specific problem dominated the failure experiences and identified it as the starting of the engine. This experience spawned the general perception that if the EDG could start, it would likely continue on to accept load and operate in a reliable manner. Other contributing failures included the engine governor.

In 1977, Revision 1 to Regulatory Guide 1.108 "Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants" was issued. This revision of Regulatory Guide 1.108 was an effort to improve the routine testing schedule by relating the testing frequency to the number of failures being experienced. At that time, the optimal test interval was believed to be between 31 days and 3 days. With the emphasis on EDG starts, Regulatory Guide 1.108 indicates that EDGs be "fast, cold" started on test intervals that ranged from 31-3 days in 4 steps. Under Regulatory Guide 1.108, if the total number of failures for 100 tests of all EDGs for the plant was greater than 1, the frequency of start tests was increased for all the EDGs for the plant. An objective of this testing schedule was to encourage utilities with high failure rate EDGs to take major repair actions to avoid the costs of very frequent EDG tests.

Subsequent reviews of EDG failure experience (for the 3-year period of 1976-1978) indicated that engine starting was no longer the dominant failure mechanism. Apparently industry efforts in this area were becoming effective.

In July 1982, the first EDG failure occurred that was clearly identified as being caused by testing. One of the Nordberg 3500 kW EDGs at the Brunswick Nuclear Station had failed. The licensee reported that the metallurgical examination determined the failure cause to be fatigue due to excessive starts. Inspection of the other EDGs revealed that two of the three also had indications of similar fatigue. This reactor operating experience confirmed concerns expressed earlier that excessive tests would be detrimental.

In September 1982, a staff summary of EDG experience presented to the ACRS suggested that: (a) routine test starts on a 3-day frequency should be eliminated; (b) testing should be focused on identifying unreliable EDGs, and then major repair action should be pursued, rather than just more testing; (c) when an EDG failure has occurred, an initial test of redundant EDG(s) should be conducted with a followup test about every 3 days to provide increased assurance that a new failure has not occurred.

In 1983, as part of its investigation into Station Blackout, the NRC published NUREG/CR-2989, "Reliability of Emergency Onsite AC Power Systems at Nuclear Power Plants." This study, based upon data for 1976-1980, concluded that the industry average EDG failure rate is 2.5×10^{-2} per demand (with a range of 0.8×10^{-2} to 10×10^{-2}), i.e., an average reliability of 0.975. Major contributors to this failure rate are: (1) EDG being out-of-service (due to testing or maintenance) at about 0.6×10^{-2}, (2) human-error-related and hardware-related common mode failures at about 0.2×10^{-2}, and (3) service water system (EDG cooling) unavailabilities at about 0.4×10^{-2}. The study found that, while the average time to repair an EDG is 20 hours, it varies quite widely. No one cause of EDG failures was dominant. The causes varied widely, led by control and logic problems (14.7%), and followed closely by governor (12.3%), cooling water (11.9%), output breaker and sequencer (10.3%), air start problems (9.1%), and several other causes.

This same report shows that between 1976 and 1980, North Anna Unit 1 had an apparent fail-to-start rate of 1.05×10^{-2} (based upon a reported two failures in 191 tests). During this period, these EDGs were unavailable (due to test and maintenance) at a rate of 1.3×10^{-2}.

NUREG/CR-2989 also recommended several actions that could be taken to improve EDG reliabilities. These varied from having the governor overhauled on a periodic basis, review of repeat failures to determine root causes, use of corrosion inhibitors in jacket water coolants and upgrading EDG-related procedures, to the installation of an additional EDG.

In December 1983, the NRC issued Generic Letter 83-41, which requested licensees to provide information related to the potential detrimental effects of "fast, cold" test starts. The licensee's response dated January 18, 1984 stated that: "A review of the maintenance records for the Unit 2 diesels showed no detrimental effects due to fast cold starts." The response also stated that design changes had been implemented which alleviated problems associated with fast cold starts.

In July 1984, the NRC issued Generic Letter 84-15 which described changes in staff requirements to improve EDG reliability. This NRC action requested that licensees take actions to reduce "fast, cold" test starts, including encouraging them to propose Technical Specification changes. The generic letter also described a reliability-goal-oriented EDG program developed by the staff and requested licensees to provide comments on this program. The North Anna licensee provided a partial response to the generic letter in their letter of September 28, 1984. This response did not request a Technical Specification change related to fast cold starts, but instead described the EDG lube oil keep-warm system, prelube system, and lube oil booster. North Anna provided a supplemental response to this generic letter on February 28, 1985 which provided the requested data on EDG test failures in the last 100 starts, and provided the licensee's comments on the staff's proposed EDG reliability performance specification. The data indicate that, in the 3-month period between December 5, 1984 and February 27, 1985, the "2H" EDG experienced three test/engine failures and the "2J" EDG experienced two test/engine failures. The comments provided basically reflected the information included in the February 1, 1985 submittal (which is the subject of this evaluation).

3. EVALUATION

With assistance from the EDG manufacturer (Fairbanks Morse Engine Division of Colt Industries), the licensee launched an investigation of EDG failures that have occurred recently. Based upon the preliminary findings of this investigation (as reported in the February 1, 1985 submittal), the licensee identified several factors of the plant Technical Specifications as "significant contributors" to the engine failures. The factors identified are: (1) the fast start (10-second), (2) the fast loading (60-second), and (3) the frequency of such tests. The licensee believes that such stringent tests induce severe thermal transients within the engine and that, when repeated very frequently lead to the types of failures that have been experienced. The licensee has stated that the EDG manufacturer concurs.

Accordingly, the licensee has proposed a set of changes that would accomplish the following general objectives. First, for routine testing and Action Statement tests, fast starts (10-second) and fast loadings (60-second) would be deleted, except for once per 6 months and during the 18-month (refueling) tests. Second, the accelerated frequency for routine tests (based upon accumulated number of test failures) would be changed to reduce the amount of accelerated testing by basing such testing on a reliability goal of 0.95 per EDG. Third, an additional incentive would be added to encourage major engine overhauls. Fourth, for Action Statement tests, the number of EDG tests would be reduced.

The March 13, 1985 supplemental submittal states that the root cause(s) of the engine failures have not yet been identified. Further, electrical overloading is identified as a potential cause. The submittal indicates that Technical Specification language such as "greater than or equal to ____ kw" forces the operators to operate the EDGs slightly above the specified value to ensure compliance. Further, the licensee has recognized that instrumentation inaccuracies and meter reading errors can contribute significantly to inadvertent overload conditions.

The licensee has therefore proposed also to reduce the specified load value to ensure that operations at the upper limit of the uncertainty value do not result in exceeding the engine ratings and to specify a non-open-ended operating band for such tests.

The licensee's proposed changes constitute its determination as to those licensing actions that are necessary to minimize EDG degradation and additional engine failures. The licensee has committed to developing a reliability improvement program that includes not only the involvement of the EDG manufacturer, but also a direct interchange with the Japan Atomic Power Company. This interchange will include review of the Technical Specifications, test procedures, and other maintenance information associated with the exemplary EDG reliability experienced by the Japanese. After sufficient information and experience is acquired, the licensee intends to propose additional Technical Specification changes to increase the reliability of the EDGs for both nuclear plants at the North Anna Station.

The licensee has proposed a large number of specific changes to the Technical Specifications to accomplish his objective of reducing EDG testing. In the submittals, the licensee discusses the changes in the order they occur in the Technical Specifications. For convenience, we have re-sorted these changes into an order that facilitates ease of understanding and review. Similarly, this evaluation report is structured as follows:

In each section, we discuss the present requirements, the licensee's proposed changes and its basis, our evaluation thereof, and our conclusion for the specific item.

3.1 General Considerations

The licensee's technical argument for the case that the required testing is a "significant contributor" to EDG failures seems to be based upon two general points: first, the advice of the EDG manufacturer; second, the contrast between the engine damaging failures at Unit 2 and the experience at Unit 1, with the only identified difference being the testing requirements.

3.1.1 Manufacturer's Recommendation

In recent years, we have had technical discussions specifically with Colt Industries on how testing relates to long-term EDG reliability and nuclear plant safety. We agree that any fast start, fast loading, and operating an EDG at or above its 100% rated value may have an adverse affect on EDG reliability in the long term. Such operations may cause normal maintenance to be needed sooner than originally scheduled or, if the engine is not properly maintained, may lead to premature failures. However, testing of this nature on some frequency is necessary to demonstrate that the EDG continues to be able to perform as originally specified and as assumed in the accident analysis of the plant's FSAR. Furthermore, we believe that Colt Industries has come to agree with the staff that, when the plant offsite or onsite electrical system is in a degraded state, the immediate concern for nuclear safety must take priority over longer term equipment reliability considerations and therefore special testing of the EDGs is appropriate.

Specifically for North Anna, the licensee states that the manufacturer has stated that the types of wear patterns found on the engine components is the result of either engine overload or excessive fast cold starts.

There is, however, some uncertainty as to specifically which engine components are most adversely affected by fast, cold test starts and fast loadings. There is also some uncertainty regarding the manufacturer's review of the wear patterns experienced at North Anna. We conclude, therefore, that the manufacturer's advice appears to be based primarily on general experience and may have limited applicability to the specific situation at North Anna.

3.1.2 Failure Causes (Experience at Unit 2 vs. Unit 1)

The second part of the licensee's basis for the request for relief from the Technical Specifications testing of EDGs is the contrast between the failures at North Anna Unit 2 and those at Unit 1. North Anna Unit 1 was licensed to operate in November 1977, with Technical Specifications that were standard at that time. The Technical Specifications therefore did not reflect the testing requirements of Regulatory Guide 1.108. The requirements for Unit 1 routine tests are basically that each EDG is "fast, cold" started on a monthly basis and loaded to >60% of rated output. The Technical Specifications do not include a rapid loading rate and do not require an accelerated test frequency based upon test failures experienced. (It is interesting to note that the Unit 1 EDGs have been tested nonetheless at the full-load rated load of 2750 kW in virtually every test).

The licensee states in the February 1, 1985 submittal that the Unit 1 EDGs have "not experienced similar failures." In another part of the submittal, the licensee states the Unit 1 EDGs have "experienced no failures to date." However, information provided previously by the licensee and reported in Reference 10 indicates that between 1976 and 1980 there were two failures of the EDGs at Unit 1 to start during required tests. On February 4, 1985, the Unit 1 EDG "1H" was found to have suffered significant engine damage, apparently due to cooling water getting into the number 3 firing cylinder.

During a meeting with the staff in Bethesda on February 8, 1985, the licensee provided clarification regarding the history for the Unit 1 EDGs. During the period of November 1977 to April 1980, the "1H" EDG experienced 10 trips. Three of these occurred in 1979 and seven during February and March of 1980. Based upon the 1980 test trips, the licensee increased the setpoint for the high crankcase pressure trip. In August 1984 the "1H" EDG was inadvertently overloaded to about 3600 kW for about a half hour (i.e., 31% over the 2750 kW rating and 9% over the 30 minute rating). Subsequent to this event, the engine was inspected with assistance from the manufacturer; however, on February 4, 1985, the same EDG ("1H") suffered significant engine damage. Between November 1977 and February 8, 1985, the other Unit 1 EDG ("1J") had only one test failure. This failure (November 14, 1984) involved the spurious tripping of the EDG output breaker and not a trip of the EDG itself. During this meeting, the licensee also clarified the language of the February 1, 1985 submittal. The intent was that up to that time, while there had been "test failures," there had been no "engine failures," as had become the case for the Unit 2 EDGs, where internal engine components were replaced.

During our February 8, 1985 meeting, the licensee stated that the EDG manufacturer had informed him that high crankcase pressure trips (on the Unit 2 EDGs) could be caused by less than optimal performance of the crankcase eductor system, which uses air from the turbocharger blower. The licensee has not fully investigated this yet.

The licensee's February 1, 1985 submittal indicates that the only difference between the Unit 1 EDG experience and the Unit 2 experience is the Technical Specifications testing requirements. Therefore, by deduction the licensee claims that the testing is a "significant contributor" to the December 1984 - January 1985 EDG failures.

This argument is attractive by virtue of its simplicity and relationship to ongoing generic NRC activities to reduce the severity of test starts. However, as discussed below, we are not convinced that the testing requirements are a primary contributor to the Unit 2 EDG failures.

In an attempt to assess the impact that the required testing may have had, we have considered the nature of the corrective actions taken after the October, November, and December 1984 failures. On October 19, 1984, "2H" EDG tripped on indicated high jacket coolant temperature; the temperature switch was re-calibrated. On October 20, 1984, the "2H" EDG tripped on high crankcase pressure; a leaking air start valve gasket was replaced. On October 22, 1984, the "2H" EDG tripped after 11 hours, again on high crankcase pressure; the lube oil strainer was cleaned, and "2H" successfully completed a 24 hour full-load test run. On November 2, 1984, the "2H" tripped again on high crankcase

pressure; after the crankcase air ejector was cleaned, the EDG tested satisfactorily. The licensee reported that none of these four failures were considered to be "valid" test failures (because both high jacket coolant temperature and high crankcase pressure trips are bypassed for any actual emergency start) and that all were due to spurious instrumentation problems. On December 3, 1984, the "2H" failed to start within the required time due to a problem with the air start distributor. Also, the crankcase pressure switch was found to trip randomly at various points and was replaced. The licensee then reported that this malfunctioning pressure switch could explain the earlier EDG trips. On December 9, 1984, "2H" tripped again on high crankcase pressure; the Number 10 lower piston rings were found to be shattered. Shattered rings suggest an original problem with the rings, which allowed some blow by and thus generating an abnormal crankcase pressure. Even though it did occur on the sixth Action Statement test within 48 hours, shattered rings does not seem to suggest fast start or fast loading rates as likely causes. Also on December 9, 1984, the "2J" EDG tripped on high crankcase pressure. The number 2 and number 3 upper pistons were found to be leaking and the number 11 liner seal was leaking. Such failures do not suggest "excessive fast cold test starts" as the cause.

During our visit to the North Anna Station on February 13, 1985, we examined the parts that had been removed from EDG "1H" subsequent to the February 4, 1985 engine failure and photographs were made. The licensee stated that the manufacturer's analysis of the failure had not been completed. In our technical judgement, the most likely cause of the failure does not appear to be related to fast cold test starts, but rather appears to have been inadequate or degraded lubrication. It appears that the cylinder water jacket seal failed, causing dilution of the lube oil. Consequently, the pistons and cylinder liner became overheated and scored; there was excessive wear on the piston pin bushings and the main bearings. Finally, due to thermal stresses, the cylinder liner cracked in several places. In a telephone conference on March 26, 1985, the licensee said that the manufacturer has said orally that the recent failure of EDG "1H" is most likely related to the inadvertent overload of this engine in August 1984.

In the supplemental submittal of March 13, 1985, the licensee states that the conclusions of the previous submittal remain unchanged, and that the root cause(s) of the engine failure have not yet been identified and that electrical overloading is now considered to be a potential cause.

We remain unconvinced that the primary contributor to these type failures is test starts. It seems to us that the primary cause may be yet to be identified. The number and types of different weaknesses found on the Unit 2 EDGs (i.e., temperature switch out of calibration, dirty lube oil strainer, dirty crankcase air ejector, air start distributor "problem") may suggest the need for more stringent maintenance. The repeated failures at North Anna wherein cooling water has entered the firing cylinger suggests that the cylinder liner to the water jacket O-rings may be failing. This EDG vendor has recommended to another nuclear licensee that these seals be changed from Buna-N to a high temperature Viton material, which has been successful in reducing seal damage due to overheating and overloads. We understand that

the same change has been suggested to the North Anna licensee, but that most of the North Anna EDG O-rings are still Buna-N. Also we believe that, as shown in the licensee's supplemental submittal of March 13, 1985, when potential inaccuracies and meter reading errors are added to the reported test power levels, significant inadvertent engine overloads may have occurred. Therefore, we believe that the primary cause of the engine failures could be any of the three items above, or a combination, or some items yet to be identified.

3.1.3 Relation to Generic Letter 84-15

The relationship between the changes proposed by the licensee at this time and NRC Generic Letter 84-15 needs to be made clear. Generic Letter 84-15 has three distinct parts, the first and third of which are relevant. The first part encouraged licensees to reduce fast cold test starts; the second asked for data regarding the present reliability of each EDG; the third asked for comments on staff-proposed new testing requirements. As they relate to Generic Letter 84-15, the changes proposed by the licensee can be grouped into three categories. The first category of the licensee's proposed changes is essentially identical to the first part of the generic letter. The second category of the licensee's proposed changes is some of the features from the staff's proposed new requirements described in the third part of the generic letter. The third category of the licensee's proposed changes are not related to the generic letter.

The NRC has an ongoing generic action that relates to improving EDG reliability (GI B-56). In fact, Generic Letter 84-15 is one of the elements of this action. The staff has not yet completed its review and determined the optimal changes that should be made to the Technical Specifications on a generic basis. Since this matter is still under review, the staff response to a request for Technical Specification changes at this time typically would be to defer the request pending the completion of the generic action. However, if the plant-specific situation is unique and warrants prompt treatment, plant-specific action can be taken. We believe this to be the case for North Anna. When the decisions on the generic action are made and are being implemented on all plants, any final optimization changes can be made for North Anna at that time.

3.1.4. Reliability Improvement Program

In our review, we considered the question of the potential adverse effect of reducing the test frequency in the situation where failures are occurring. If the tests are conducted less frequently, latent failures may not be detected for a longer time. Also, considering the nature of typical repair actions, the root causes may not be identified. Although not fully developed, the licensee has proposed that a reliability improvement program will be implemented upon approval of the requested Technical Specification changes with the following major elements:

1. Performance Monitoring Surveillance
2. Discrete Frequency Spectra Analysis
3. Evaluation of Past and Present Practices
4. Slow Start Testing Training
5. Japanese Experience
6. Nuclear Guidelines for EDG Operation
7. Maintenance Training

We note particularly that these elements include trend analyses of key performance parameters, that lube oil will be analyzed quarterly, and that the services of an independent consultant have been acquired to determine the root causes of past failures. We have concluded that any potential adverse effect of reduced testing will be offset by the licensee's reliability improvement program.

3.2 Routine Test Starts

Routine surveillance tests can be considered to be those tests conducted periodically when all redundant systems or equipment (in this case, the EDGs) are believed to be operable. The purposes of routine tests are: (1) to confirm that the equipment remains operable or to detect previously unknown failures, and (2) to gather additional statistical data to improve our confidence in the value we believe to be the intrinsic reliability of the equipment, or to refine this value. Routine tests would also encompass accelerated testing required because of failures that have occurred previously. Routine tests are contrasted to special tests performed because the plant is in a degraded state.

The proposed changes to the routine tests may be divided into two groups. The first group deals with how (the method by which) each test start of an EDG is to be conducted. The second group deals with how often such a test start is to be conducted.

The relevant portions of the present North Anna Unit 2 Technical Specifications that are significant are Sections 4.8.1.1.2.a (wherein the test frequency Table 4.8.2 is specified); 4.8.1.1.2.a.4 (wherein a 10-second engine acceleration is specified); 4.8.1.1.2.a.5 (wherein a 60-second loading to full rated load is specified along with a 60-minute full-load run); and Table 4.8.2 and associated notes (wherein an accelerated test frequency is specified, based upon the total number of EDG test failures in the previous 100 tests, on a per-nuclear-unit basis).

3.2.1 How Each Test Is To Be Conducted

3.2.1.1 Test Starts and Loading

The licensee has proposed that these specifications be revised to provide that each test start be preceded by "prelubrication and any other starting warmup procedure recommended by the EDG manufacturer." The licensee has stated that the current practice at North Anna is to either automatically or manually prelube the EDG prior to every planned test start. The current Technical Specifications do not prohibit such prelubrication, etc. However, the licensee has proposed to state the practice as an explicit statement in Section 4.8.1.1.2.a.4. We concur with this approach. However, we believe that the statement is applicable to all planned test starts, including those that are part of the 18-month surveillance tests (Section 4.8.1.1.2.d).

Some may be concerned that, in order to simulate accident conditions more closely, at least the 18-month tests should be conducted without any preconditioning. In our experience reviewing reactor operating events on a daily basis, we find that a number of actual demands do occur that are not planned but are either due to actual loss-of-power situations or are due to ESF actuations.

It has been suggested that the rate at which a complete loss of offsite power occurs at a nuclear plant averages out to be on the order of 0.1 per year. Losses of power to a single bus and ESF actuations that cause EDG starts seems to be even more frequent. During a recent 12-month period at North Anna, the EDGs were fast cold started on two occasions due to ESF actuations. We believe that "test credit" should be given for these events as demonstrating that the EDGs can start without any preconditioning. Therefore, we believe that the preconditioning statement should be a footnote that is made applicable to all planned test starts at North Anna.

The licensee has proposed to delete the requirement in Section 4.8.1.1.2.a.4 that every routine test start be a fast (10-second) start (i.e., acceleration to full engine speed, and generator voltage and frequency). The licensee is developing procedures, in consultation with the manufacturer, that would have the engine start and accelerate to an initial setting of 450 rpm followed by manual increase of the speed setting to the full 900 rpm over a period of 1 to 2 minutes. As a practical matter, the actual conduct of the test is expected to require the EDG to continue at full speed but not loaded for several minutes (e.g., 15 minutes). During this time the internal engine temperature begins to equilibriate.

The licensee has also proposed to delete the requirement that every test loading be at a rate such that full load is reached within 60 seconds after synchronization to the bus. The licensee proposes to replace the "fast load" requirement with a test loading rate of about 10 minutes, in accordance with the manufacturer's recommendation for routine tests.

To supplement these more gradual accelerations and loadings, the licensee has proposed a new section (4.8.1.1.2.a.6) which requires that a fast (10-second) start to full speed and loading to full load in 60 seconds be performed every 6 months. The requirement to stagger the fast starts amongst the various types of automatic EDG start signals has been put with the fast start tests every 6 months. The design is such that a simulated auto start signal and a "slow" start are incompatible.

The original intent of the fast cold start specification was to simulate the fast start of loss-of-power/accident conditions. The manufacturer has recommended slowing the engine acceleration time anytime the EDG is routinely operated, in order to reduce unnecessary wear and to minimize the thermal transients within the engine. The NRC Generic Letter 84-15 included as a proposed new requirement that "fast cold" starts be conducted only every 6 months rather than a monthly test. We agree that the primary purpose of routine (monthly) testing should be to implement the manufacturer's recommended testing and to verify starting and load handling capability, rather than to simulate the design basis accident conditions. We believe that it is not necessary to define the specifics of this test, but it is sufficient to regulate at the level of requiring only that the manufacturer's recommendations be followed in this case. In view of these considerations, we find this portion of the licensee's proposal to be acceptable.

The licensee has also proposed to combine Section 4.8.1.1.2.a.5 (the 1-hour load run) into Section 4.8.1.1.2.a.4 (the start test). The purpose of this change is to acknowledge that EDG operation at no-load or light-loads (less than 25%) has been shown to be detrimental. The manufacturer has recommended that every EDG start be followed by at least 60 minutes at at least 60% load. The effect of this change is to disallow surveillance test starts without a subsequent power run. We find this portion of the licensee's proposal to be acceptable.

Although not an explicit part of the proposed Technical Specifications, the licensee has stated that, as part of this periodic power run, engine performance data will be collected after temperature stabilization and the data will be trended across similar tests. The licensee states that the manufacturer has stated that this method is the best type of trend analysis to detect problems. Further, routine testing without fast starts will still be adequate to establish trends in starting times which would be indicative of the need to initiate preventative maintenance. We concur with the concept of trend analysis of critical parameters as a tool to indicate the need for maintenance.

3.2.1.2 Full-Load Tests and Accident Loads

The licensee has proposed to change the required full load values for the "monthly" and 18-month tests. The present Technical Specifications specify the EDG load for the monthly test to be "greater than or equal to 2750 kW." Every 18 months, a 24-hour load run is required, the first 2 hours of which are at the 110% value and the next 22 hours are at the 100% (continuous duty) load value; specifically, at "greater than or equal to 3025 kW" and "greater than or equal to 2750 kW." The licensee proposes that the required load for the monthly test be "2500-2600 kW" and that the required loads for the 18-month load run be "2800-2900 kW" and "2500-2600 kW," respectively.

The licensee believes that the open-ended language "greater than or equal to" has the potential for routine overloading of the EDGs. Specifying an upper limit would eliminate this potential. The licensee believes, moreover, that instrumentation inaccuracies and meter reading errors introduce an uncertainty of ±200 kW. The licensee states that if the tests are conducted at levels above 2750 kW and the uncertainty is adverse, the time until the next routine maintenance is needed would actually be reduced but this change would not be realized by operations or maintenance personnel. On this basis, the licensee proposed a non-open-ended operating band that is reduced by an amount approximating the potential adverse uncertainty but rounded off to the nearest 100kW. The rounding off is intended to be consistent with the markings on the kW output meter, the smallest divisions of which are 100 kW increments. Therefore, the "greater than or equal to 2750 kW" would be replaced by "2500-2600 kW" and the "greater than or equal to 3025 kW" would be replaced by "2800-2900 kW."

In our review of this proposed change, we have reconsidered the general matter of the magnitude of the electrical loads that could occur during the design basis accident as compared to the electrical loads specified for periodic tests. During the accident situation, the initial electrical loads may be large but typically are required only for a short time - a few seconds or few minutes. Further, in a typical load profile, the loads decrease significantly after the first hour. During plant licensing, we have found an EDG sizing to be acceptable if the short-term 2-hour rating of the EDG is greater than the initial peak accident loads and if the long-term 2000-hour rating of the EDG is greater than the long-term accident loads.

From a hardware viewpoint, EDGs in general have multiple load ratings, based on an anticipated annual maintenance schedule. The 100% "nameplate," or continuous duty load rating, indicates that the EDG can be operated at this value continuously for one year (about 8000 hours) prior to performing routine maintenance. The 2000-hour rating generally indicates that the EDG can be operated at this higher load for up to 2000 hours during the year (i.e., about one quarter of the time) without having to perform routine maintenance until the end of the year. The 2-hour rating generally indicates that the EDG can be operated at this even higher load for any 2 hours out of 24 hours without having to perform maintenance on a special schedule.

Specifically for North Anna Unit 2, the FSAR reports that the greatest predicted accident load is calculated to be 2938 kW. The EDGs are each rated as follows:

8000 hours	2750 kW
2000 hours	3000 kW
168 hours	3100 kW
4 hours	3150 kW
½ hour	3300 kW

It should be noted that while the accident loads are greater than the continuous duty (8000 hours) rating, they are less than both the short-term 4-hour rating and the 2000-hour rating.

Regarding periodic surveillance testing, the general requirements are established by Regulatory Guide 1.108 and the Standard Technical Specifications. These specify that, during the monthly test, the EDG is to be loaded to the continuous duty rating. Further, during the 24-hour load run conducted on an 18-month basis, the EDG is to be loaded to the 2-hour rating for the first 2 hours, followed by 22 hours at the continuous duty rating. For the monthly test, the intent is to avoid exceeding the continuous duty rating on a frequent basis but to detect performance degradation prior to a failure. We believe that the monthly test should exercise the EDG, confirm its operability, and detect degradation or a failure before a second EDG failure is likely to occur. During the 18-month testing, the test loads envelope the calculated accident loads. It is our position that it is not necessary or desirable to envelope the design basis accident loads, which might occur once in 10,000 years, by a test that is repeated 12 times each year. We have determined that simulation, or enveloping, the accident loads every 18 months is sufficient.

It is interesting to note in passing that in Japan the design basis accident loads on the EDGs are simulated similarly on a refueling basis (i.e., 12-18 months).

In view of the general considerations discussed above, we conclude that the monthly EDG tests should avoid exceeding the continuous duty rating. We concur with the licensee that, in view of past enforcement actions, the open-ended "greater than or equal to" load requirement creates a situation wherein operators will tend to operate the EDGs at a load for which the meter indicates a value greater than the specified value. Therefore, we agree with the licensee that a non-open-ended load would be more appropriate. Further, for human factors engineering reasons, we agree that an operating band equal to the smallest meter graduation (100 kW) is appropriate for North Anna.

Since the exact value of the load during the monthly test is not critical and since overloading has been identified as a possible cause of the engine failures experienced recently at North Anna, we agree with the licensee that the specified load should be the continuous duty value less an amount approximating the uncertainties. The licensee has presented an analysis of the instrument inaccuracies and potential meter reading errors. The analysis includes consideration of a 1.5% allocation for potential inaccuracy in the turns ratio of each of the voltage and current sensors, 0.3% inaccuracy in the kW transducer, 1.5% (kw) meter inaccuracy, 1.0% allocation for to calibration drift, and 0.6% (±25 kW) for errors in reading the meter due to parallax affects. When these factors are accumulated, the overall uncertainty is 5.23% or ±220 kW. The licensee has rounded this value to ±200 kW. We note that the 1.5% allotment for possible deviation in the voltage sensor and another 1.5% for the current sensor are estimated values because the turns ratios have not been measured. It seems that, once this determination is made and this offset is incorporated into the calibration process for the instrument channel, this inaccuracy is in effect nulled out and no longer a factor. Inaccuracy in the power level measurement is an obvious source of potential overload. Therefore, it appears that, while the output meter may have been calibrated, the licensee has not taken much initiative to avoid this source of overload. We conclude that, unfortunately, the present uncertainties at North Anna are not trivial. Corrective actions to reduce this uncertainty are desirable, but have not been proposed and are beyond the scope of this review. Considering the magnitude of these uncertanties, an operating band of an indicated 2500-2600 kW is acceptable for the monthly test and the longer portion of the 18-month load run.

However, for the first 2 hours of the 18-month load run, we cannot accept the proposed band of 2800-2900 kW. The 18-month test is not a frequent test, and special calibrated equipment could be used if the licensee believes it is vital not to exceed 3025 kW. The primary consideration is that the specified load must envelope the design basis accident loads of 2938 kW. We would find an operating band of an indicated 2900-3000 kW to be acceptable. At the worse case, if the indicated load were to be 3000 kW and if the licensee's value of uncertainty of 200 kW were to be actually adverse, the true load would be 3200 kW. If one interpolates the ratings on these EDGs, 3200 kW is at or

below an equivalent 2-hour rating. In view of our understanding of the ratings, we find that even at worse case an indicated range of 2900-3000 kW does not appear to be intolerable or unjustified. At the other hand, when the indicated load is 2900 kW, the actual load could be as low as 2700 kW, which is below the accident loads. However, it is most likely that the uncertainties will not be all in either direction and to some extent will cancel each other. In view of the potential hazard of engine overloading, we conclude that the range of 2900-3000 kW is a better choice than any other similar band. However, we are requiring that the target value of 2950 kW be specified. Therefore, we conclude that a relaxation from "greater than or equal to 3025 kW" to the indicated band of "2900-3000 kW" is acceptable.

3.2.1.3 Observation of Slow Start"

As part of our review of this proposed change, we visited the North Anna Station on February 13, 1985 to observe the performance of a required "fast cold" test start, and to observe the performance of the more gradual test start and loading being proposed. During the "slow start" test, we noted a few potential problem areas which we asked the licensee to address and improve as appropriate:

1. EDG inoperability during the test.
2. Critical engine speeds during the acceleration phase.
3. Electrical loading sequence.

There has been considerable effort over the years to assure that the EDGs remain operable during testing; i.e. able to respond to automatic or manual emergency start signals. To conduct the "slow start," the control of the EDG is switched to "local, manual" which makes the EDG inoperable. This action is taken prior to reducing the engine governor setting to 450 rpm. After the engine has reached full speed, the control is switched back to the control room. The licensee addressed this matter only to the extent of saying that the test procedure will be revised to alert operations personnel of the inoperability. We require that: (a) the licensee confirm that the inoperability is identified in the control room in accordance with Regulatory Guide 1.47, (b) the test procedure be reviewed and revised as necessary to minimize the duration of the inoperability, and (c) operating procedures be revised to include appropriate steps to promptly regain EDG control in the control room without risk to personnel near the EDG, to be used during a loss of power situation. With these improvements, the unavailability would be less than 30 minutes/test and we would expect a typical time of about 10 minutes. Considering that this brief period would occur only 1-4 times per month, the added availability (about 4x10-4) is minimal and is more than offset by the expected benefits of the "slow start."

The licensee has investigated the question of critical engine speeds between 450-900 rpm. Based upon information from the manufacturer, the licensee reports that this is not a significant problem.

The demonstration test performed for the NRC on February 13, 1985 did not agree with the EDG manufacturer's recommendation regarding the sequential increases in EDG loading. The licensee did not address this item in the March 13, 1985 supplemental submittal. We require that the loading sequence be revised to agree with the manufacturer's recommendation.

3.2.2 How Often Routine Test Starts Are Conducted

3.2.2.1 Reliability Goals and Accelerated Testing

The licensee's proposals in this area relate to Table 4.8-2 which specifies how routine testing should be accelerated based upon test failure experience. This present table originated from Regulatory Guide 1.108, Revision 1. The licensee's proposal is to continue along the same general approach as Regulatory Guide 1.108, but to add certain upgrades based upon recent EDG experience.

The first specific proposal is to change the reliability goal from a per-nuclear-unit basis to a per-EDG basis. The primary purpose is to avoid test starting <u>all</u> EDGs due to the failures experienced on <u>one</u> EDG that has brought the plant total into a range which requires significantly accelerated testing. We concur with this purpose. Having agreed to shift from a per plant basis to a per EDG basis, an appropriate value must then be selected. The revised reliability goal is proposed at 0.95/EDG. The proposed staff requirements described in Generic Letter 84-15 include a reliability goal of 0.95/EDG. This portion of the licensee's proposal is acceptable.

Along the line of the 0.95/EDG goal, the accelerated testing frequency table has been revised such that when an EDG has experienced five or more failures in the past 100 tests, the testing schedule would be advanced from monthly to weekly. The intermediate step of bi-weekly testing is omitted and the 3-day test interval is deleted. These changes are acceptable.

Previously the EDG manufacturer had stated that testing on a 31-day interval was too infrequent. The reason given at that time was the need to turn over the machine periodically to assure that oil film was maintained on critical parts. The licensee states that the manufacturer has now revised his position and concurs in 31-day testing. We understand this revised position is based upon the modification that added the lube oil keep warm and prelube systems.

The licensee has also proposed to expand the accelerated test frequency table to provide that accelerated engine testing (weekly) may be required based also on the number of failures of that engine in the last 20 starts. If two failures have occurred in the last 20 starts, this could be a point indication of a failure rate of 0.1 (or 0.90 reliability). To enter accelerated testing at this point would provide a better sensitivity to the possibility of abrupt EDG degradation and provide a timely response. Increasing the test frequency would provide a faster accumulation of test data upon which to judge the reliability of the EDG. This additional data can be used to distinguish between failures which occur close together simply due to random chance and such failures that are indicative of an abrupt decline in the actual reliability. The weekly test schedule would be continued until two conditions have been satisfied. First, seven consecutive successful tests have been accumulated. Second, the failures in the most recent 20 tests have been reduced to one. Seven successful tests indicate a reliability of at least 0.90/demand but at only the 50% confidence level. Continuing the accelerated testing until the number of failures is 1 out of 20 adds further assurance that the EDG has not degraded below the 0.90/demand level. Furthermore, the proposed staff requirements described in Generic Letter 84-15 include accelerating the test frequency based upon two EDG failures in the last 20 tests. In view of these various considerations, this portion of the licensee's proposal is acceptable.

3.2.2.2 Incentive for Engine Overhaul

The final change proposed by the licensee is in relation to Table 4.8-2 and would provide an explicit direct incentive for the utility to take major corrective action on the EDG. If the licensee performs a thorough and comprehensive complete overhaul of the EDG that is approved by the EDG manufacturer, the EDG would be rebuilt to like-new conditions. Following such an overhaul, the EDG would become operable after it successfully passed the appropriate surveillance tests one time. However, in return for the overhaul, the utility would receive the benefit of wiping the slate clean of all previous failures on that EDG if an acceptable reliability can be demonstrated. With "no previous failures" in the past 20 or 100 tests, the EDG would re-enter the test schedule at the monthly test frequency. Accelerated testing (weekly) would not become required until either 2 failures in 20 tests or 5 failures in 100 tests occur. In contast, when one considers how long it could take to work back up the table after having a series of failures (i.e., many months and possibly years), the magnitude of this incentive becomes more obvious. An engine overhaul would focus on the internal components and therefore not necessarily address the statistically most prevalent failures. Nonetheless, this overhaul is considered worthwhile. In that major repair action for an EDG that has experienced excessive failures has long been the goal, this concept is acceptable.

The question that remains is how does one demonstrate that the rebuilt EDG actually has an improved and acceptable reliability. The licensee has proposed that the reliability criterion be the successful completion of 14 consecutive tests, at least 4 of which would be "fast cold" starts. Statistically, the probability that an EDG with an actual reliability of less than 0.90/demand will satisfy this 14-test criterion is no greater than 20% and decreases rapidly

with the actual reliability. The probability that an EDG with an actual reliability of less than 0.95 will satisfy the 14-test criterion is 42% or less. Said in the converse, if the rebuilt EDG passes the 14-test criterion, the statistics say that the probability that the actual reliability of the EDG is 0.95 or better is about 50% and that the probability that the actual reliability is 0.90 or better is about 90%. We, therefore, find the proposed 14-test criterion to be acceptable. One should be careful however about repeated attempts to satisfy the 14-test criterion. In such a case the statistical situation changes. If an EDG passes the criterion on a second attempt, the probability that the actual reliability is 0.95 would be reduced to only about 25%. Therefore, if the 14-test criterion is not passed on the first attempt, the previous test failures could not be disposed of until some new criterion is negotiated with the NRC.

In addition to the post-overhaul test starts and 1-hour load runs (T.S. 4.8.1.1.2.a.4), we would like to see a full-load test run for a significant duration be a part of the required reliability demonstration. The licensee has stated that both break-in load runs and full-load runs will be included (via the manufacturer's requirements); however, the duration would be case-dependent and related to the degree to which major parts were replaced. For example, following the replacement of a couple of pistons in December 1984 (which was not even a complete overhaul), the manufacturer required a 12-hour full-load run of this EDG. Therefore, based upon this information and a desire to provide for an appropriate degree of flexibility, we find the condition that each overhaul, including post-maintenance testing, be specifically approved by the manufacturer to be acceptable.

3.3 Special EDG Tests (Action Statements)

When plant systems are in a degraded mode (i.e., certain equipment is temporarily inoperable), continued operation for a limited period of time may be acceptable, provided that certain additional or compensatory measures are performed. When the plant is in such a degraded mode, the routine surveillance program is not sufficient. For such situations, the Action Statements of the plant Technical Specifications specify the time limit for continued plant operation and the required special actions. Often the special actions are intentionally specified to be the additional instances of the same type of actions that are performed also as part of the routine surveillance program. Because of this close relationship, Action Statement special actions are sometimes confused with routine surveillance actions. Although they may be the same as routine actions, they are selected and performed (maybe on a special frequency) for quite different reasons. It is important to retain the distinction between routine tests and special tests conducted as part of an Action Statement. Further, as mentioned earlier, when some plant system is in a degraded mode, the immediate and more important concern for nuclear safety takes priority over any consideration of equipment reliability decrements that may occur in the longer term.

The present Technical Specifications provide Action Statements for the electric power systems (T.S. 3/4.8.1) to cover the following degraded conditions: (a) loss of either one offsite power circuit or one onsite power source (an EDG), (b) loss of both an offsite circuit and an onsite source, (c) loss of both of the two required offsite circuits, and (d) loss of both onsite sources. In general the specified special actions are: (1) for offsite power, verify proper breaker alignment and indication of power availability, and (2) for the onsite sources (EDGs), performing a "fast, cold" test start of every operable EDG. These actions are specified by reference to the corresponding routine surveillance test requirement. Both of these special actions are required to be conducted initially within the first hour and then every 8 hours thereafter. The allowed time to restore the equipment to operable status (i.e., recover from the degradation condition) ranges from 72 hours to 2 hours depending upon the severity of the situation. If either the special actions are not performed or the degraded condition is not recovered within the allowed time, the Action Statements required that the plant be shutdown.

In general, the technical changes proposed by the licensee can be characterized as: (1) The tests of the EDG would become pre-conditioned starts instead of fast cold starts and would include a 1-hour full-load run. This change is a consequence of specifying the test via a reference to the routine test, which is proposed to be revised as discussed earlier; (2) The time for the initial test of the EDGs would be increased to either 24 hours or 8 hours depending upon the severity of the degraded condition; (3) There would be no repeat testing of the EDGs. The licensee proposes no change regarding the special actions related to the offsite power circuits and no change to the period allowed for recovery from the degraded condition.

3.3.1 Initial EDG Test

In evaluating the proposed changes, the purposes of the original actions must be reviewed. The purpose of the initial test of the EDGs is twofold: to determine if the cause of the initial EDG failure (degradation) has also affected redundant equipment, possibly via some common mode failure mechanism; and to provide additional assurance that they remain operable and hence would be available if needed due to a further degradation of plant conditions. These test start requirements were developed at that point when it was perceived that if the EDG could start, it would most likely be able to accept load and operate satisfactorily. The test was envisioned as operating the manual start switch on the main control board and verifying 10 seconds later that the EDG has come up to proper speed, frequency, and voltage -- operations that could be accomplished easily in far less than 1 hour.

Since then, greater emphasis has been placed upon evaluating reactor operating experiences, increasing attention on human factors considerations regarding operator actions, and improving EDG reliabilities. As a result our beliefs regarding the optimal EDG test requirements during Action Statements have become refined. Especially since the accident at Three Mile Island, greater attention has been given to the more likely plant abnormalities. There is a heightened awareness that, for a large plant, an abnormal event tends to develop or unfold over several minutes or even a period of hours.

There is an increased consideration for the operator actions during plant abnormalities. Operator capabilities (instrumentation) to diagnose and track plant conditions have been increased and priority of operator actions has been given further attention. Actions to assure adequate reactor core cooling may continue over hours and have priority over the testing of redundant equipment. Operator actions that could distract the operator, or require his time to be spent on lower priority actions, or have the potential to unnecessarily generate doubts or operator confusion need to be minimized.

More specifically related to the EDGs, the potential adverse effects of no-load (or only lightly loaded) conditions have become more fully appreciated. With this comes the point that EDG test starts should be followed by a period of heavily-loaded operation (i.e., loaded to greater than 50-60% of full load). For the situation of one EDG failure, the redundant EDG should be inspected prior to a test start to detect any external conditions that would indicate that starting the EDG might cause further degradation or damage. Further, we are convinced that in general, fast cold starts have been detrimental and, in the worst case, could cause loss of the EDG when it may be needed most.

When these considerations are integrated, we find that the original purposes of the special EDG testing during Action Statements can be fulfilled without fast, cold starts on such a rapid basis. Therefore, as a general matter, the type of changes proposed for Action Statements are acceptable (the specific changes are discussed below).

The practice at nuclear plants is that, when the equipment that had been temporarily inoperable becomes restored to operable status, the degraded plant condition is terminated. Uncompleted and subsequent Action Statement requirements become non-applicable when the Action Statement is exited. In this practice, when an EDG is restored to operable status prior to conducting the initial test of the redundant EDG (i.e., in less than 8 or 24 hours), this test would not be required. If the EDG became inoperable for reasons other than preplanned preventative maintenance or testing, the determination of whether the failure affected the redundant EDG remains important regardless of how soon the first EDG is restored. The licensee agrees and says it intends to conduct this initial test. Therefore, appropriate text has been added to indicate this action explicitly.

<u>3.3.2 Followup EDG Tests</u>

The licensee's proposal does not include any followup EDG tests subsequent to the initial tests. In a 72-hour period, an initial test (within 1 hour) and a followup test every 8 hours thereafter would lead to a total of nine EDG tests. The licensee believes this number of tests is excessive.

We tend to agree with the license[illegible] some relief in this area is appropriate. The real question becomes: how oft[illegible]ould an EDG test be conducted to have reasonable assurance that a new failure does not render the EDG inoperable, when a plant system is already degraded. Our belief is that the optimal value might be every 3 days. If every 3 days were used, no repeat tests would be required in a 72-hour period after the initial test at the 24-hour mark. Followup EDG tests on a 3-day basis would become applicable only if the Action Statement recovery period were to be extended.

3.3.3 Specific Action Statements

Regarding the specific changes to the Action Statements of the Technical Specifications, the licensee has separated the first Action Statement into two statements (this change forces the re-numbering of the Action Statements). The first Action Statement deals with the loss of either an offsite power circuit or an onsite EDG. The present Technical Specifications require that all EDGs be tested initially within the first hour and every 8 hours thereafter, regardless of how recently they may have been previously tested. In that the loss of an offsite source does not directly imply a failure of the EDGs, the Action Statement tests for these two cases should be different. The proposal is that, when an offsite circuit is lost, the EDG would be tested on a special basis only if the most recent routine test of the EDG had not been within the previous 7 days. If such a test had been successful this recently, the little additional assurances to be gained by another test may not be worthwhile. Further, since the test would involve operating the EDG in parallel with a degraded system, the possibility of losing the EDG during such testing is increased. The EDGs are designed and intended to be standby power sources. Therefore, the negative implications of such tests are not trivial. On balance, we believe that, when a part of the offsite power system is lost, the EDGs do become more important and they should be tested if they have not been tested in the previous 24-hours. A period of 24-hours after the offsite power loss would be provided in which to conduct these EDG tests. If the offsite power is restored before the 24 hour period expires, the EDG test would not be necessary.

When an EDG is inoperable, the redundant EDG would be test started and loaded in accordance with the manufacturer's recommendations within 24 hours. In view of the general considerations discussed above, this portion of the licensee's proposal is acceptable.

When both an offsite power circuit and an onsite EDG are inoperable, the proposal is to initially test the other EDG within 8 hours. Since the allowable outage period for this Action Statement is only 12 hours, followup EDG tests are not applicable. The most likely actual situation is not that these would both be lost simultaneously but rather sequentially. As part of the equipment is restored, the plant returns to an earlier Action Statement. The licensee has added explicit language to highlight this transfer back to an earlier Action Statement (here, and as part of later Action Statements).

The transfer statement also prevents having to retest an EDG just because a new Action Statement is entered if the EDG has already been tested as part of this Action Statement. The transfer statement also clarifies the starting time for the requirements of the Action Statement being entered. This language provides desirable clarifications. These specific portions of the licensee's proposal are acceptable.

When two offsite power circuits are inoperable, the proposal is that, if the EDGs are not already operating as a result of the power loss, they would be tested within 8 hours. In view of the considerations discussed above, this specific portion of the licensee's proposal is acceptable.

The licensee has proposed no changes to the last Action Statement which deals with the loss of both EDGs.

4. SUMMARY

The licensee has proposed general reductions in the testing requirements for the onsite emergency diesel generators (EDGs) in the plant Technical Specifications. These changes involve both routine surveillance testing and special testing due to degraded plant conditions. These changes would reduce the severity of each EDG test start and reduce the number of test starts. These changes continue along the same general direction of existing regulatory guidance (e.g., Regulatory Guide 1.108 and Generic Letter 84-15) plus a few new proposals, and are viewed as a further optimization in the process of improving and maintaining EDG reliability.

These changes are plant-specific actions being taken at this time rather than waiting for inclusion in the NRC generic actions currently ongoing. The primary basis for this action is that, in addition to the belief that "fast, cold" test starts are generally detrimental, significant engine failures have occurred at this plant and testing requirements may have aggravated the causes of these failures. In our evaluation of this matter as stated above, we have concluded that there is an adequate basis for reducing the testing requirements at this time.

We believe that any potential adverse affect of reducing testing (that might reveal EDG weaknesses) at a time when significant failures are occurring will be offset by the reliability improvement program being implemented by the licensee. We find acceptable the licensee's proposal that EDG monthly tests be conducted with the more gradual engine acceleration and loading rate recommended by the EDG manufacturer, and at a lower indicated full-load value. However, as discussed earlier, improvements in the conduct of these "slow starts" are required. Further, we find acceptable the licensee's proposal to schedule accelerated routine EDG tests based upon the reliability goal of 0.95/EDG. The incentive for a major engine overhaul is also acceptable. During the 18-month EDG load run, we require that the first two hours be at an indicated load of 2900-3000 kW (vs. the 2800-2900 kW proposed by the licensee) to provide reasonable assurance that the FSAR accident loads of 2938 kW are enveloped. We find acceptable the proposed reductions in EDG testing during Action Statements with one exception. In the case that one of the offsite power circuits is lost and an EDG that has not been tested within the previous 24 hours, (vs. the 7 days proposed by the licensee) it must be tested in the next 24 hours.

As discussed earlier, certain minor clarifications to better convey the intent of the proposed Technical Specifications are necessary. The exact changes are therefore shown in Enclosure 1. We have discussed these clarifications with the licensee and he agrees with them. Based upon the information provided by the licensee and in view of the considerations discussed above, we conclude that the enclosed changes are acceptable.

ENVIRONMENTAL CONSIDERATION

This amendment involves a change in the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously published a proposed finding that the amendment involves no significant hazards consideration and there has been no public comment on such finding. Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR §51.22(c)(9). Pursuant to 10 CFR §51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

CONCLUSION

We have concluded, based on the considerations discussed above, that (1) this amendment will not, (a) significantly increase the probability or consequences of accidents previously evaluated, (b) create the possibility of a new or different accident from any previously evaluated or (c) significantly reduce a margin of safety, and, therefore, this amendment does not involve significant hazards considerations; (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations, and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Date: April 25, 1985

Principal Contributor:
J. T. Beard

5. REFERENCES

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2. Letter, W. L. Stewart (VEPCO) to Harold R. Denton (NRC), September 28, 1984 (response to NRC Generic Letter 84-15).

3. Engineering Report, Fairbanks Morse Engine Division (of Colt Industries), File Number VTS-985-082881-01R, dated August 28, 1981, "Engine Prelube/ Keepwarm System Requirements."

4. Letter, E. Wayne Harrell (VEPCO) to NRC, November 14, 1984 (LER 84-11) "2H EDG Trips" on October 19, 22, and November 2, 1984.

5. Letter, E. Wayne Harrell (VEPCO) to NRC, January 5, 1985 (LER 84-013) "Forced Shutdown Required by Technical Specifications Due to Two Inoperable Emergency Diesel Generators" on December 9, 1984.

6. Letter, E. Wayne Harrell (VEPCO) to NRC, December 28, 1984 (LER 84-11, Revision 1).

7. "Recent Operating Experience With Emergency Diesel Generators," a presentation to the NRC/ACRS Subcommittee on AC/DC Power Systems; J. T. Beard, September 8, 1982.

8. NRC Memorandum for R. Fraley (ACRS) to William Dircks (EDO), "Testing Requirements for Diesel Generators," September 16, 1982.

9. NRC letter from H. W. Lewis (ACRS) to William Dircks (EDO), "Diesel Generator Failures at North Anna Power Station, Unit 2," January 15, 1985.

10. AEC Technical Report, "Diesel Generator Operating Experience at Nuclear Power Plants," OOE-ES-002, June 1975.

11. NRC Technical Report, "Enhancement of Onsite Emergency Diesel Generator Reliability," NUREG/CR-0660, January 1979.

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17. NRC Memorandum from Steven Hanauer, Director DST, to D. Eisenhut, et al. "Diesel Generator Reliability of Operating Plants," May 6, 1982.

18. NRC Memordanum from J. T. Beard to Gary Holahan, "Testing of Emergency Diesel Generators in Japan," February 5, 1985.

19. Letter, W.L. Stewart (VEPCO) to Harold R. Denton, (NRC), February 28, 1985. (Supplemental response to Generic Letter 84-15)

20. Licensee Event Report 50-320/84-018, Rev. 1, February 27, 1985.

21. Letter, W.L. Stewart (VEPCO) to Harold R. Denton, (NRC), March 13, 1985 (Supplemental submittal to reference #1 above)