PUBLIC SERVICE COMPANY OF COLORADO
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OSCAR R. LEE
VICE PRESIDENT

June 22, 1984
Fort St. Vrain
Unit No. 1
P-84183

50-267

RECEIVED
JUN 25 1984

Mr. Eric H. Johnson, Chief
Reactor Project Branch 1
Region IV
Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76011

SUBJECT: 10CFR50, Appendix R Fire Protection Regulatory Guidance

REFERENCE: 1) NRC Letter, Wagner to Lee, dated June 4, 1984 (G-84176)

Dear Mr. Johnson:

This letter responds to our June 8, 1984 meeting on application of 10CFR50 Appendix R fire protection requirements to the Fort St. Vrain Nuclear Generating Station (FSV). In the June 8th meeting the NRC requested that PSC submit a schedule for PSC's 10CFR50 Appendix R FSV fire protection review and PSC's proposed revisions to Enclosure 1 of the NRC's June 4, 1984 letter.

Attachment 1 to this letter is the "FSV Schedule for Appendix R Review and Submittal." Attachment 2 to this letter, "Fire Protection Safe Reactor Shutdown/Cooldown Capability for the Fort St. Vrain Nuclear Generating Station," is PSC's proposed revisions to Enclosure 1 of Reference 1.

Attachment 2 contains proposed fire protection regulatory guidance for the application of Sections III.G and III.J of 10CFR50 Appendix R to the Fort St. Vrain HTGR. In Attachment 2 PSC has addressed many of the problem areas discussed in our June 8th meeting and has proposed HTGR specific resolutions to these issues.

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Your early review and concurrence with the proposed regulatory guidance in Attachment 2 is requested. If you have any questions or wish to discuss the proposed guidance in Attachment 2, please contact Mr. M. H. Holmes at (303) 571-8409.

Very truly yours,

O. R. Lee, Vice President
Electric Production

ORL/JRJ:pa

Attachments

Attachment 1 to P-84183

FSV

Schedule for Appendix R Review and Submittals

Commitment Date	Commitment
June 8	PSC/NRC Meeting in Bethesda
June 22	PSC will submit schedule and rewritten Enclosure 1
2 weeks* after PSC submittal	NRC gives written concurrence and PSC will begin review upon receipt of written concurrence
12 weeks after written NRC approval of June 22 submittal	PSC will define staffing and prepare a detailed scope of work (4 weeks) PSC will submit "typical" packages for comment (8 weeks)
2 weeks* after PSC submittal of "typical" packages	PSC receives written NRC comments on "typical" packages
12 weeks after PSC receives NRC comments on "typical" packages	PSC will complete research portion of review and begin detailed report of exemptions (8 weeks) PSC will submit first formal report on III.G Compliance (4 weeks)
2 weeks* following PSC submittal of first formal report	PSC receives written NRC approval of first formal report
4 weeks following receipt of written NRC approval of first formal report	PSC will submit second formal report on III.G Compliance
4 week intervals following submittal of the second formal report	PSC will submit third, fourth and fifth formal report on III.G Compliance
4 weeks following submittal of fifth formal report	PSC will submit the sixth (final) formal report on III.J (Emergency Lighting) Compliance
2 weeks* following final PSC submittal	PSC receives written NRC approval (SER) for entire Appendix R Review
2 weeks following written NRC approval (SER) of entire Review	PSC will submit schedule for any proposed modifications not complete at that time

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* Assumed review period for scheduling purposes

Fire Protection Safe Reactor Shutdown/Cooldown Capability for the Fort St. Vrain Nuclear Generating Station

I. Applicability

The following regulatory guidance for compliance with the fire protection provisions of Sections III.G and III.J of 10CFR50, Appendix R are applicable to the Fort St. Vrain Nuclear Generating Station. It is hereby acknowledged that Sections III.L, III.O and the remaining portions of 10CFR50, Appendix R are not applicable to the Fort St. Vrain Nuclear Generating Station.

II. Background

Fort St. Vrain (FSV) has multiple systems capable of achieving and maintaining safe reactor shutdown and cooldown, including multiple configurations of these systems. The purpose of this regulatory fire protection guidance is: 1) to ensure that one means of achieving and maintaining safe reactor shutdown/cooldown would be available in the event of a single fire at any location in the FSV plant, and 2) to specify limiting acceptable consequences of a single fire.

There are twenty-six options for safe reactor shutdown/cooldown utilizing forced circulation at Fort St. Vrain (see footnote). In all twenty-six options forced circulation can be established and maintained using at least one helium circulator to provide primary coolant flow while directing cooling water flow to either the economizer/evaporator/superheater section or the reheater section of the associated loop's steam generator. Any one of the twenty-six options would provide adequate decay heat removal to prevent fuel damage.

Due to the heat absorption capacity of the FSV graphite moderated reactor core, upon loss of forced circulation decay heat removal an extended period of time is available to reestablish forced circulation cooling before fuel damage begins to occur. FSAR Section 14.4.2.2 evaluates a 90 minute loss of forced circulation (LOFC), with subsequent forced circulation provided by a helium circulator driven by boosted firewater, and concludes that no fuel damage would occur.

These are described in Safe Shutdown and Cooling with Highly Degraded Conditions dated December 23, 1974 prepared by The S.M. Stoller Corporation.

In addition to the multiple options for providing forced circulation, FSV has the capability to achieve and maintain safe reactor shutdown/cooldown upon permanent loss of forced circulation utilizing systems which provide for depressurization of the PCRV and PCRV liner cooling. The Alternate Cooling Method (ACM) was installed to provide a means of supplying electrical power to those equipment items necessary to achieve and mainta reactor shutdown, depressurization and PCRV liner cooling. For a re in a congested cable area which causes a permanent LOFC, the ACM would be utilized to provide electrical power to the equipment items necessary to shut down the reactor and establish PCRV liner cooling. Safe reactor shutdown/cooldown utilizing PCRV liner cooling following a permanent LOFC results in fuel damage but not in unacceptable consequences to the health and safety of the public. A permanent LOFC with subsequent reactor shutdown and cooldown by PCRV liner cooling (Design Basis Accident No. 1) is analyzed in FSAR Appendix D (Rev. 1). Radiation doses at the low population zone outer boundary are 0.37 mrem whole body gamma, 36 mrem thyroid dose and 1 mrem bone dose.

Fires in congested cable areas have the potential for more severe consequences than fires outside these areas. The Acceptance Criteria which follow are designed to discriminate between such fires and ensure not only that the consequences of fires in congested cable areas pose no threat to the health and safety of the public, but also to ensure that fires in non-congested cable areas result in no fuel damage, and no simultaneous rupture of both a primary coolant boundary and the associated secondary containment boundary, and hence, no radiation dose consequences due to primary coolant releases.

III. Appendix R Fire Protection Acceptance Criteria at Fort St. Vrain

A. Congested Cable Areas

1. Limiting consequences of a fire in a congested cable area:

   For any single fire in a congested cable area means shall be available to shut down and cool down the reactor in a manner such that the consequences of DBA-1, as defined in FSAR Appendix D (Rev. 1), are not exceeded.

2. Performance goals for safe reactor shutdown/cooldown functions for a fire in a congested cable area shall be:

   a. The reactivity control function shall be capable of achieving and maintaining a subcritical reactivity condition.

   b. The pressure control function shall be capable of achieving depressurization through the helium purification system.

   c. The PCRV liner cooling function shall be capable of maintaining the PCRV integrity, and shall be capable of achieving and maintaining decay heat removal.

   d. The process monitoring function shall be capable of providing direct readings (local or remote) of the process variables necessary to perform and control the above functions.

   e. The supporting functions shall be capable of providing the process cooling, lubrication, etc. necessary to permit operation of the equipment used for safe reactor shutdown/cooldown functions A.2.a through A.2.c above.

B. Non-Congested Cable Areas

1. Limiting consequences of a fire in non-congested cable areas:

   For any single fire in a non-congested cable area means shall be available to shut down and cool down the reactor in a manner such that no fuel damage occurs. There shall be no simultaneous rupture of both a primary coolant boundary and the associated secondary containment boundary.

2. Performance goals for safe reactor shutdown/cooldown functions for a fire in non-congested cable areas shall be:

   a. The reactivity control function shall be capable of achieving and maintaining subcritical reactivity conditions.

   b. Maintain the PCRV liner integrity and PCRV structural and pressure containment integrity.

   c. The reactor heat removal function shall be capable of achieving and maintaining forced circulation decay heat removal.

   d. The process monitoring function shall be capable of providing direct readings (local or remote) of the process variables necessary to perform and control the above functions.

   e. The supporting functions shall be capable of providing the process cooling, lubrication, etc. necessary to permit operation of the equipment used for safe reactor shutdown/cooldown functions B.2.a through B.2.c above.

IV. Specific Criteria

A. The congested cable areas at the G and J walls shall be protected with automatic sprinkler or spray systems which comply with either NFPA Standard No. 13 or with NFPA Standard No. 15.

B. The safe reactor shutdown/cooldown capability for specific fire locations may be unique for each such area, room or zone, or it may be one unique combination of systems for all such locations. In either case the redundant or alternate safe reactor shutdown/cooldown capability shall be physically and electrically independent of the specific fire location.

C. The redundant or alternate safe reactor shutdown/cooldown capability shall accommodate post fire conditions where offsite power is available and where offsite power is not available for 72 hours.

D. Redundant and alternate equipment and systems performing safe reactor shutdown/cooldown functions shall, prior to considering any postulated fire damage, be capable of being powered either by both an off-site and an on-site power source, or by two independent on-site power sources. The station main turbine generator shall be considered to be an off-site power source.

E. Procedures shall be in effect to implement the capability to safely shut down and cool down the reactor in the event of any single fire.

F. The number of operating shift personnel, exclusive of fire brigade members, required to operate the safe reactor shutdown/cooldown equipment and systems shall be onsite at all times the reactor is not shutdown. All other personnel required for any resulting emergency shall respond within required time limits.

G. Systems used to ensure the post fire safe reactor shutdown/cooldown capability need not be designed to meet seismic Category I criteria, single failure criteria, or other design basis accident criteria, except where required for other reasons, e.g., because of interface with or impact on existing safety systems, or because of adverse valve actions due to fire damage.

H. The safe reactor shutdown/cooldown equipment and systems for each location shall be known to be isolated from associated circuits in that location so that hot shorts, open circuits, or shorts to ground in the associated circuits will not prevent operation of the safe reactor shutdown/cooldown equipment.

I. Mechanical components, such as piping, tubing and valves, necessary for safe reactor shutdown/cooldown which are within the area, room or zone encompassed by a single postulated fire shall not be considered damaged by the fire. Valves and mechanical components with manual operators in the fire area, room, or zone shall be considered to be manually operable within one hour after the start of the fire.

J. Section III.J of 10CFR50 Appendix R requires emergency lighting in areas needed for operation of safe reactor shutdown/cooldown equipment and in access and egress routes thereto. The requirements of Section III.G of 10CFR50 Appendix R, as well as the Acceptance Criteria contained in Part III of this document, shall apply to any power supplies, cables and fixtures used to provide FSV emergency lighting for the actual required safe reactor shutdown/cooldown equipment to be employed,including access and egress routes thereto, to ensure the requirements of III.J are met for any single postulated fire.

V. Exemptions

When detailed features of the FSV station do not permit compliance with the requirements of III.G or III.J and the Acceptance Criteria contained herein, the Licensee shall submit requests for exemption to the NRC Staff for approval. These exemption requests shall contain sufficient justification to support the Licensee's contention that the health and safety of the public is protected. Justification shall include a description of the fire area, room or zone, the safe reactor shutdown/cooldown capability to be employed, a fire hazards analysis, and a description of any existing or committed fire protection features in the area, room or zone.

VI. Basis

Section III.L of Appendix R to 10CFR50 provides the performance criteria for Alternative and Dedicated Shutdown Capability for light water reactors. Because of the unique design features of Fort St. Vrain, a gas-cooled reactor, all criteria of Section III.L are not applicable and revised acceptance criteria have been developed. The Acceptance Criteria in Part III of this document provide limiting consequences for single fires in congested cable areas and in non-congested cable areas for determination of acceptable safe reactor shutdown/cooldown systems and equipment under either Section III.G.2 or Section III.G.3 of 10CFR50 Appendix R. These limiting consequences ensure that public health and safety will not be threatened for any single fire in the FSV Nuclear Generating Station.

FSV has two primary means of achieving and maintaining safe reactor shutdown/cooldown. For either means the control rods and/or the reserve shutdown system is utilized to shutdown the reactor and maintain a subcritical reactivity condition. The decay heat removal function can be performed by 1) forced circulation cooling or by 2) PCRV liner cooling. There exist multiple redundant and/or alternate means for achieving and maintaining either of these two cooldown modes. The consequences of both of these cooldown modes have been analyzed, reviewed by the NRC Staff, and found acceptable.

The limiting event involving forced circulation cooldown occurs when a 90 minute interruption of forced circulation takes place followed by a firewater cooldown as analyzed in FSAR Section 14.4.2.2. Following the 90 minute interruption of forced circulation, forced circulation is resumed when firewater is supplied to either the reheater or the economizer/evaporator/superheater section of one steam generator and boosted firewater is supplied to the water turbine drive of one helium circulator. Fuel temperatures remain below 2900 degrees F and no fuel failure is predicted to occur. Longer times are available to reestablish forced circulation with no fuel damage if a higher energy water source, or steam, can be used to drive a helium circulator. In a LOFC accident maximum core temperature would reach 2900 degrees F at approximately 6 hours into the accident, at which time limited fuel failure would be anticipated (FSAR Figure 14.10-1). The limiting event involving PCRV liner cooldown occurs when forced circulation is lost and cannot be restored. This permanent loss of forced circulation is referred to as Design Basis Accident No. 1 and is analyzed in Appendix D of the FSAR. In this accident reactivity is maintained subcritical by insertion of the control rods, followed by insertion of the reserve shutdown system's boron carbide balls within 5 hours. PCRV liner cooling is established utilizing any one of the four PCRV liner cooling water pumps or by utilizing one of the firewater pumps to supply either one of the two PCRV liner cooling loops. The radiological consequences of Design Basis Accident No. 1 (stated in Part II of this document) are only a small fraction of the guidelines established in 10CFR100. The NRC SER dated June 21, 1969 concludes that the doses resulting from Design Basis Accident No. 1 are insignificant and acceptable.

The Alternate Cooling Method (ACM) provides an independent source of power to specific safe reactor shutdown/cooldown equipment using the PCRV liner cooling method. PCRV liner cooling can be achieved and maintained using the ACM power source for a postulated fire in a congested cable area which causes a LOFC accident and/or disables the normal power supply cables to the equipment items necessary for PCRV liner cooling. In the SER to Amendment No. 21 to FSV's operating license, dated June 6, 1979, the NRC Staff concluded: "This alternative cooling method (ACM) will ensure that conditions and public health and safety consequences, analyzed and presented in Design Basis Accident number 1 in the FSAR, are not exceeded in the case of such disruptive faults or events (these include a major fire) in congested cable areas." The ACM thus provides an acceptable source of power to the equipment necessary to achieve and maintain PCRV liner cooling.

The Acceptance Criteria specified in Part III of this document apply to either III.G.2 or III.G.3, whichever the Licensee chooses to comply with for a postulated single fire in a specific area, room or zone of FSV. The Staff has imposed more stringent acceptance criteria for fires in non-congested cable areas than for fires in congested cables areas. The Acceptance Criteria for both areas are in accordance with 10CFR50 Appendix A General Design Criterion 3, which states "Structures, systems and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires..."

Based on the consequences of DBA-1, the staff concludes that for a postulated fire in the three room control complex or in congested cable areas at the the G and J walls, the substitution of acceptance criteria of DBA-1 in place of the criteria in III.L relating to cold shutdown and limits on reactor coolant system process variables is acceptable, provided that the fire protection features in these areas are enhanced over the minimum requirements of Section III.G.3 of Appendix R as required by Specific Criterion A in Part IV of this document.

The acceptance criteria for a postulated fire in a non-congested cable area are: no fuel damage shall occur; there shall be no simultaneous rupture of both a primary coolant boundary and the associated secondary containment boundary. At FSV the primary coolant boundary includes the PCRV liner, the PCRV penetration primary closures, the steam generator tubes inside the PCRV, the PCRV rupture discs, and piping which contains primary coolant. The secondary containment boundary includes the PCRV itself; the PCRV penetration secondary closures; feedwater piping, main steam piping, and reheat steam piping up to the first isolation valves; the PCRV liner cooling water tubes; lines open to a PCRV penetration interspace; the PCRV safety relief valves downstream of the rupture discs; and the PCRV safety relief valve tank.

These criteria ensure that the PCRV helium coolant inventory will be maintained and no significant release of primary coolant will occur. The performance goals for a fire in a non-congested cable area specify that forced circulation shall be achieved and maintained for the reactor heat removal function. This requirement is based on the fact that the establishment of forced circulation cooling, within a time dependent on reactor power history, is necessary to prevent fuel damage.

The criteria in III.L relating to cold shutdown and limits on reactor coolant process variables such that there is no fuel clad damage nor rupture of any primary coolant or containment boundary, apply to light water reactors and are not directly applicable to the Fort St. Vrain HTGR. The FSV Acceptance Criteria for a fire in non-congested cable areas, which require no fuel damage and no simultaneous rupture of both a primary coolant boundary and the associated secondary containment boundary, are considered to be as effective as the III.L light water reactor criteria for ensuring the public health and safety is protected.

The Specific Criteria B through H, in Part IV of this document, parallel the criteria for light water reactors contained in III.L. Specific Criterion C requires that the redundant or alternate safe reactor shutdown/cooldown capability accommodate post fire conditions where offsite power is not available for 72 hours. FSV is required by the Technical Specifications to have sufficient diesel fuel on-site to permit operation of both standby generators under required loading conditions for at least seven days (LCO 4.6.1) and operation of the ACM diesel generator for 108 hours with full ACM load (LCO 4.2.17). Specific Criterion I is based on the Staff's consideration that manually operable mechanical components would not be damaged by a postulated fire. Specific Criterion J ensures that the Acceptance Criteria which apply to safe reactor shutdown/cooldown equipment shall also be applied, in conjunction with Section III.J of 10CFR50 Appendix R, to the emergency lighting necessary to operate this equipment.