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OSCAR R. LEE
VICE PRESIDENT

August 17,1984
Fort St. Vrain
Unit No. 1
P-84281

50-267

RECEIVED
AUG 24 1984

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

DOCKET NO. 50-267

SUBJECT: 10CFR50, Appendix R Fire Protection Regulatory Guidance

REFERENCES: 1) NRC Letter, Wagner to Lee, dated June 4, 1984 (G-84176)
2) PSC Letter, Lee to Johnson, dated June 22, 1984 (P-84183)
3) NRC Letter, Johnson to Lee, dated July 18, 1984 (G-84257)

Dear Mr. Johnson:

This letter responds to your July 18, 1984 letter (reference 3) which transmitted NRC concerns/comments on the Fire Protection Regulatory Guidance submitted via reference 2.

Attachment 1 to this letter is the revised schedule for completion of our fire protection review and the modification requested in reference 3. Attachment 2 includes the revised "Fire Protection Safe Reactor Shutdown/Cooldown Capability for the Fort St. Vrain Nuclear Generating Station" which incorporates your concerns/comments. This regulatory guidance will be used for ensuring compliance with Section III.G of 10CFR50, Appendix R. In response to your comment 1 of reference 3, we have deleted the sentence as requested in order to expedite this document and because it did not affect this fire protection review. Deletion of that sentence does not imply that PSC concurs that the sentence is incorrect.

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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,

ORLee

O. R. Lee, Vice President
Electric Production

ORL/FWT:pa

Attachment

FSV
Schedule for Appendix R Review and Submittals and Plant Modifications

Commitment Date	Commitment
August 17, 1984	PSC will submit revised schedule and Fire Protection Regulatory Guidance
November 17, 1984	PSC will submit first portion of Fire Protection Review
December 17, 1984	PSC will submit second portion of Fire Protection Review
January 17, 1985	PSC will submit third portion of Fire Protection Review
February 17, 1985	PSC will submit final portion of Fire Protection Review
3 weeks following written NRC approval (SER) of entire Review	PSC will submit schedule for any proposed modifications not complete at that time
May 17, 1985	PSC will complete modification to automate J and G wall fixed water spray system

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 Section III.G of 10CFR50, Appendix R are applicable to the Fort St. Vrain Nuclear Generating Station.

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

A. Congested Cable Areas

1. Congested cable areas shall be defined as the Control Room, 480 Volt Switchgear Room, the Auxiliary Electric Room, and the congested cable areas along the J and G walls currently protected with a coating of Flamemastic and spray systems.

2. 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.

3. 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 (if required) 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.3.a through A.3.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 (i.e. maximum fuel particle temperature does not exceed 2900 degrees F). There shall be no simultaneous rupture of both a primary coolant boundary and the associated secondary containment boundary such that no unmonitored radiological releases of primary coolant occur.

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.

III. 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.

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. Water-filled mechanical components, such as piping 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. Water-filled 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.

IV. 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 II 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 exists 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 an interruption of forced circulation (IOFC) takes place followed by a firewater cooldown as analyzed in FSAR Section 14.4.2.2. Following the IOFC 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 as shown in FSAR Figure 14.4-6 and no fuel damage is predicted to occur.

Fuel damage will not occur so long as fuel temperatures do not exceed 2900 degrees F. At fuel temperatures in excess of 2900 degrees F the fuel failure mode has been determined to be fuel kernel migration through the fuel coating layers. As stated in the basis for Technical Specification SL 3.1, the Core Safety Limit has been established to assure that a fuel kernel migrating at the highest rate in the core will penetrate a distance less that the combined thickness of the buffer coating plus inner isotropic coating on the particle. It is further noted in the basis for SL 3.1 that the maximum fuel kernel migration expected for the fuel with the most damaging temperature history is less than 20 microns. Thus, out of a total inner coating thickness of 70 microns, only 50 microns is assumed to be available in establishing the limits in SL 3.1. Actual testing of TRISO coated fuel particles has shown that at 2900 degrees F fuel kernels will not migrate through the buffer and inner isotropic coatings for several hundred hours. Therefore, 2900 degrees F was chosen as a fuel safety limit (FSAR Section 3.2.3.3).

The FSV fuel testing program is described in FSAR Appendix A.1. Table A.1.9 shows that five of six samples of TRISO fuel particles had no evidence of fuel kernel migration after 250 hours at 1600 degrees C (2912 degrees F) while the sixth sample had only 5 microns of fuel kernel migration. These are all well below the 50 micron fuel kernel migration at which fuel particle damage is judged to occur. FSAR Figure 3.6-8 predicts that it would take approximately 300 hours at 2900 degrees F before the fuel kernel would migrate through the buffer and inner isotropic coating layers. This is consistent with the statement in FSAR Section 14.2.2.7 that "Data for the impact of time and temperature on fuel particle integrity indicate that failure could be expected for any fuel reaching 2500 degrees C, maintained above 2000 degrees C for almost an hour, or at 1600 degrees C for times up to several hundred hours." The 2900 degrees F limit to ensure no fuel damage in II. B of the Appendix R Fire Protection Acceptance Criteria at Fort St. Vrain is conservative since forced circulation decay heat removal results in a relatively fast cooldown such that fuel temperatures will not remain high for long periods of time, and only very limited, if any, fuel kernel migration will occur.

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 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 II 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 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 III 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 such that no unmonitored radiological releases of primary coolant occur. 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 dowstream 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 III 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 of Part III is based on the Staff's consideration that manually operable mechanical components containing water would not be damaged by a postulated fire.