

August 13, 2004

MEMORANDUM TO: Richard J. Barrett, Director  
Division of Engineering  
Office of Nuclear Reactor Regulation

Bruce A. Boger, Director  
Division of Inspection Program Management  
Office of Nuclear Reactor Regulation

Ledyard Marsh, Director  
Division of Licensing Project Management  
Office of Nuclear Reactor Regulation

David B. Matthews, Director  
Division of Regulatory Improvement Programs  
Office of Nuclear Reactor Regulation

FROM: Suzanne C. Black, Director */RA/*  
Division of Systems Safety and Analysis  
Office of Nuclear Reactor Regulation

SUBJECT: DRAFT DESIGN CRITERIA FOR THE HYDROGEN IGNITER BACKUP  
POWER TO SUPPORT THE RESOLUTION OF GSI-189 REGARDING  
SUSCEPTIBILITY OF ICE CONDENSER AND MARK III CONTAINMENT  
TO EARLY FAILURE FROM HYDROGEN COMBUSTION DURING A  
SEVERE ACCIDENT (TAC No. MB7245)

Attached is a draft of the proposed design criteria for the backup power to the hydrogen igniters to be used in the resolution of GSI-189 for your review and comment. The design criteria were developed in coordination with staff from the Division of Systems Safety and Analysis, Division of Engineering, and Division of Inspection Program Management. This draft incorporates the changes made in response to the comments and input on GSI-189 alternatives and draft design criteria received from the industry at the public meeting of March 31, 2004.

The overall focus of the design criteria is to establish a minimal set of requirements to ensure high reliability of the backup power system during a station blackout. These design criteria were developed and will be used to ensure that an adequate backup power supply exists regardless of whether it is installed as a result of rulemaking or through voluntary industry initiative. They provide the flexibility for licensees to choose specific plant fixes. We have considered different aspects in the design criteria listed in the attached table including: timing for H<sub>2</sub> igniter initiation and operator response time; portable versus pre-staged

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generator; use of Emergency Operator Procedure (EOPs) versus Severe Accident Management Guidelines (SAMG); remote indication; testing; maintenance rule implications; seismic qualifications; tornado, hurricanes and high winds protection; igniter coverage/number of igniters; power requirements; independence; backup power to air return fans or hydrogen analyzers; fuel type; fire protection; fuel storage and quality; security requirements; 50.59 requirements; safety/non-safety interface; operator training/job performance measures; and environmental qualification.

Please provide your comments on the proposed design criteria to Ruth C. Reyes-Maldonado by August 31, 2004.

Attachment: As stated



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Design Criteria for the Backup Power to the Containment Hydrogen Igniters  
GSI-189, "Susceptibility of Ice Condenser and Mark III Containments to Early Containment Failure Due to Hydrogen Combustion During a Severe Accident"

<b>Design Criteria</b>	<b>Draft NRC Staff View/Position</b>	<b>Rationale for Staff Position</b>
Timing for H <sub>2</sub> Igniter Initiation/Operator Response Time	System shall be designed such that igniters can be loaded onto backup power source following accident initiation within 1 hour for BWRs, or 2 hours for PWRs, or as justified by frequency dominant station blackout (SBO).	The time at which igniters are needed is plant specific and varies based on plant type and which SBO accidents are most likely. Typical times to the onset of core damage are: - BWR - fast SBO: ~ 1h; slow SBO: >3 h - PWR - fast SBO: ~ 2h; slow SBO: >4 h
Portable versus Pre-Staged Generator	Not specified.	Provide flexibility while still meeting the functional requirements. Utility may determine that pre-staging is necessary to meet the functional requirement for igniter initiation time. Multi-unit sites can use either a single generator located and sized to supply both units, or one generator per unit.
Emergency Operator Procedures (EOPs) versus Severe Accident Management Guidelines (SAMG)	Guidance on igniter actuation should be entered sufficiently early in an event that necessary actions can be completed prior to the onset of core damage. In general, it should include guidance within EOPs or other plant procedures that would be entered following immediate actions that are taken to prevent core damage.	Actions to provide backup power to igniters are less critical than immediate actions to prevent core damage, and should be prioritized accordingly. SAMG would not be entered until core damage is imminent, and would not be expected to result in timely igniter actuation (unless system is designed to be actuated from the control room).

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Remote Indication	Not required. Utility may determine that remote indication is desirable.	Local manual operation and indication is acceptable provided that the functional requirement for igniter initiation time is met. Remote indication may be necessary if the backup power system is designed to be actuated from the control room.
Testing	Backup power source shall be started and brought to operating conditions that are consistent with its function as a power source at intervals not longer than three months. Once every refueling outage, a timed start (within the time period specified under SBO conditions) and rated load capacity test shall be performed.	Testing should include (i) demonstration of startup operation within acceptable limits and time as well as full load carrying capability, and (ii) demonstration of the proper functionality of the cooling, lubrication, exhaust, fuel supply and control systems during fully loaded operation. Test data shall be maintained and made available to the inspectors as needed.
Maintenance Rule	The licensee shall evaluate the system against the scoping criteria of 10 CFR 50.65(b). Because the system is expected to be relied upon to mitigate accidents, or may be used in the plant emergency operating procedures, the staff anticipates that the system would be within the scope of the Maintenance Rule.	Monitoring the performance of the system under the Maintenance Rule will provide additional assurance that the system is capable of performing its intended function. In accordance with the Maintenance Rule, the licensee should either demonstrate that the preventative maintenance program effectively controls system performance or monitor the performance of the system against licensee established goals in a manner sufficient to provide reasonable assurance that the system can perform its intended functions.

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Seismic Qualifications	The backup power source and the fuel need not be seismically qualified. Protection against natural phenomena, such as earthquakes, shall be provided by enclosing the backup power source within the structures that conform with the applicable non-nuclear building codes and the burying exposed electrical cable runs between buildings.	Benefits of seismic qualification would be site-specific. An industrial grade backup power source, appropriately stored/secured for seismic events, would have a high likelihood of surviving seismic events and would provide risk reduction benefits in the moderate seismic events. Qualification of the backup power source for seismic events would substantially increase the cost of implementation without a commensurate increase in risk reduction benefits.
Tornado, Hurricanes and High Winds Protection	The backup power source and the fuel need not be tornado qualified. Protection against natural phenomena, such as hurricanes and high winds, shall be provided by enclosing the backup power source within the structures that conform with the applicable non-nuclear building codes and burying exposed electrical cable runs between buildings.	Even though tornados and high winds contribute only a small fraction of total plant risk, tornadoes have a high likelihood of causing loss of offsite power. The licensee can increase the availability of the back-up power source in tornado and high wind events by considering these threats and their likely trajectories when determining the location(s) where the backup power source would be stored and/or staged.
Igniter Coverage/ Number of Igniters	To provide backup power to sufficient igniters (number and location) will prevent accumulation of significant concentrations of hydrogen in any major compartment within a containment.	Each compartment within a containment is equipped with at least one igniter from each train. Powering one of two full trains of igniters would provide igniter coverage in every compartment. Powering less than one full train can be acceptable if it is justified by analysis.

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Power Requirements	System shall be capable of generating sufficient electricity to supply AC backup power needed for the functioning of all hydrogen igniters determined necessary to prevent accumulation of hydrogen in any major compartments within a containment.	Provide flexibility while still meeting the functional requirements.
Independence	Backup power source shall be sufficiently independent of systems relied upon for prevention of core damage with high confidence that it will be available during station blackout (SBO) core melt accidents.	The backup power system, including the onsite electric distribution system, shall be sufficient independent of systems relied upon for preventing core damage to provide reasonable confidence that it will be able to perform its function during postulated core melt accidents involving a station blackout (SBO).
Backup Power to Air Return Fans or Hydrogen Analyzers	Not required.	Severe accident containment analyses performed for GSI-189 show that air return fans need not be supplied from backup power. Hydrogen analyzers need not be powered because sufficient hydrogen concentration information for decision-making can be inferred from plant parameters.
Fuel Type	Not specified.	Any type can be acceptable: propane, natural gas, gasoline or diesel.

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Fire Protection	10 CFR 50 Appendix R does not apply.	GSI-189 involves a beyond design basis accident for which the fire protection requirements do not directly apply. However, a preliminary review showed that minimal fire protection design criteria are required for the additional igniter power supply. One would be the IEEE Standard 383 cabling which would be required to minimize additional combustible material. The other would be the installation, location, type, and storage of items related to the power supply that should not adversely affect the ability to achieve safe shutdown in the event of a fire. Additional information in the pre-fire plans and training may be appropriate. Therefore, licensees may chose diesel over gasoline without storing fuel near safe shutdown equipment like the EDGs. This should be a normal part of the review within the existing plant change process.
Fuel Storage and Quality	Sufficient fuel to supply 24 hours of operation shall be stored on site.	Storage of fuel shall not adversely impact other systems required for safe shutdown. The installation, location, type, and storage of items related to the power supply (e.g., fuel supply) should not adversely affect the ability to achieve safe shutdown in the event of a fire. Fuel quality is expected to be covered by Maintenance Rule.
Security Requirements	No additional protection is required, provided that all associated modifications and operator actions are within the protected area.	System and components are expected to be located/stored within the protected area.
50.59 Requirements	Changes can be implemented under 10 CFR 50.59.	Implementation will have minimal impact, if any, on safety-related systems and licensing basis events.

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Safety/Non-safety Interface	The backup power system shall be designed such that their failure shall not prevent safety-related structures, systems and components to perform their safety-related function.	Cables and other components associated with the backup power source should be physically separated from the safety system.
Operator Training/ Job Performance Measures	Inclusion of the use of the backup power source within the training provided to the control room and equipment operators is required to commensurate with their responsibilities for operation.	Incorporation within the initial and recurring training is already provided to the control room and equipment operators. This would be expected to include system walk-downs and demonstration of the capability to position, start, and load the backup power supply in a timely manner.
Environmental Qualification	Not required. 10 CFR 50.49 does not apply.	Normal equipment quality envelops the environmental conditions associated with each plant.