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September 29, 2008

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Hope Creek Generating Station
Facility Operating License No. NPF-57
NRC Docket No. 50-354

Subject: Responses to Requests for Additional Information Regarding Proposed License Amendment - Technical Specification Requirements for Inoperable Inverters

References: 1) Letter from George P. Barnes (PSEG Nuclear LLC) to USNRC, July 30, 2008
2 U.S. Nuclear Regulatory Commission e-mail dated September 17, 2008, Hope Creek Generating Station, Draft Request for Additional Information (TAC No. MD9355), Accession No. ML082660402

In Reference 1, PSEG Nuclear LLC (PSEG) requested an amendment to Facility Operating License No. NPF-57 for Hope Creek Generating Station (HCGS). The proposed license amendment would revise TS 3.8.3.1, "Distribution - Operating," to establish a separate TS Action statement for inoperable inverters in Operational Conditions 1, 2 and 3.

In Reference 2, the NRC transmitted a draft request for additional information concerning PSEG's request. Attachment 1 to this letter provides PSEG's responses.

PSEG has determined that the information provided in response to this request for additional information does not alter the conclusions reached in the 10 CFR 50.92 no significant hazards determination previously submitted.

There are no regulatory commitments contained within this letter or attachment.

A001
NRR

Should you have any questions regarding this submittal, please contact Mr. Paul Duke at 856-339-1466.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on September 29, 2008
(date)

Sincerely,

Christine T. Neely
Director - Regulatory Affairs
PSEG Nuclear LLC

Attachment
1. Response to Request for Additional Information

cc: S. Collins, Regional Administrator – NRC Region I
R. Ennis, Project Manager - USNRC
NRC Senior Resident Inspector - Hope Creek
P. Mulligan, Manager IV, NJBNE

ATTACHMENT 1

Hope Creek Generating Station

Facility Operating License NPF-57
Docket No. 50-354

Response to Request for Additional Information

Action for Inoperable Inverters

In Reference 1, PSEG Nuclear LLC (PSEG) submitted a license amendment request for Hope Creek Generating Station. The proposed amendment would revise Technical Specification (TS) 3.8.3, "Onsite Power Distribution Systems," to establish a separate TS Action statement for inoperable inverters associated with the 120 volt alternating current (VAC) distribution panels. The intent of the proposed amendment is to extend the allowed outage time for inoperable inverters from 8 hours to 24 hours.

In Reference 2, the NRC transmitted a draft request for additional information concerning PSEG's request. PSEG's responses are provided below.

1. As stated in Regulatory Guide 1.177, a TS change may be requested to reduce unnecessary burdens in complying with current TS requirements, based on the operating history of the plant or the industry in general. Provide justification for the extended outage time of 24 hours, including maintenance and operating data (i.e., power supply and inverter failure rates).

    Response

    The proposed 24 hour allowed outage time would support on-line maintenance. The current 8-hour allowed outage time for an inoperable inverter does not provide sufficient time to perform on-line troubleshooting, corrective maintenance and post-maintenance testing. Many inverter components cannot be replaced and retested within 8 hours. While some inverter circuit cards are rack mounted and require minimal post maintenance retests, the majority of the circuit cards and capacitor banks are mounted semi-permanently, have terminal board connections and require extensive post maintenance re-tests.

    A review of plant operating data for the last five years identified six instances in which an inverter became inoperable due to an emergent issue, typically as the direct result of a blown main power fuse. In each instance, the associated 120 VAC distribution panel remained energized or was re-energized promptly from the backup Class 1E AC power supply until the inverter was restored to operable status. A review of plant operating data for the last five years identified three instances in which a regulating transformer has failed. In each case, an age related failure of a circuit card was the cause. In each instance, the inverter continued to supply power to its associated 120 VAC distribution panel without interruption.

In addition to providing additional time for corrective maintenance and post maintenance testing, reducing the potential for an unnecessary forced plant shutdown, the proposed 24-hour allowed outage time would permit additional on-line preventive maintenance to enhance inverter reliability.

2. When an inverter is taken out of service, and upon a loss-of-offsite power (LOOP) or LOOP/loss-of-coolant-accident (LOCA) event, the 120 VAC instrument bus that is being powered by its maintenance power supply will lose its power for ten seconds until the associated emergency diesel generator (EDG) re-energizes the bus. Describe the impacts of the extended outage time if a short-term loss of power occurs, in terms of inadvertent equipment operation and required contingency operator actions. As a result of the extended outage time, explain the effects, if any, of a short-term loss of power caused by a LOOP or LOOP/LOCA and a subsequent restoration of power to the motor control centers by the EDG.

Response

Inadvertent Equipment Operation and Operator Actions
Loss of the backup power supply while an inverter is removed from service results in de-energization of the associated 120 VAC distribution panel. Depending upon the extent of the loss of power, automatic plant response can include:

- Closure of turbine auxiliaries cooling isolation valves and automatic swapover to the other loop of the standby auxiliary cooling system (SACS).
- Closure of reactor water cleanup (RWCU) suction isolation valves and trip of the RWCU pumps.
- Trip of the fuel pool cooling and cleanup (FPCC) pumps.
- Primary containment isolation system (PCIS) initiation/actuation signals.
- Suction swap (from the condensate storage tank to the torus) for high pressure coolant injection (HPCI) and reactor core isolation cooling (RCIC) systems.

Abnormal operating procedures provide direction for operator actions in response to the loss of a 120 VAC inverter. Restoration of power to the associated 120 VAC distribution panels and restoration of affected plant components to normal lineup are also controlled by plant procedures.

Effects of Loss of Power and Subsequent Restoration by EDG
With the 1A, B, C or D482 inverter inoperable, the associated EDG will not respond to a loss of power associated with a LOOP or a LOOP/LOCA. Power to

the motor control centers would be restored after the inoperable inverter was restored and the associated 120 VAC distribution panel was re-energized.

With the 1A, B, C or D481 inverter inoperable, a loss of power caused by a LOOP or a LOOP/LOCA results in de-energization of the associated 120 VAC distribution panel supplying the channel emergency load sequencer. The associated EDG would start and the backup Class 1E power supply to the 120 VAC distribution panel would be re-energized. If the sequencer did not respond properly when re-powered, operations personnel have procedural guidance for manual actions required to ensure the associated channel loads are started.

3. Describe in detail why there is minimal safety consequence and very small risk changes associated with increasing the allowed outage time to 24 hours. In addition, describe any compensatory measures that would be taken before and during the time the instrument bus inverter is removed for an extended outage.

Response

There is minimal safety consequence and very small risk changes associated with increasing the 120 VAC inverter allowed outage time to 24 hours due to the available defense-in-depth from redundant plant equipment and the relatively short period of time during which one or both inverters in a single channel would be permitted to be inoperable.

Backup Class 1E 120 VAC Distribution Panel Power Supplies

The 120 VAC distribution panels have multiple power supplies. These supplies include the following:

- Inverter normally powered by a Class 1E 480 VAC MCC with a secondary power source from a Class 1E 125 VDC Bus
- Given loss of output from the inverter, a static switch automatically switches to a backup power supply from another Class 1E 480 VAC MCC

Unavailability of a Class 1E inverter due to random failure or a scheduled maintenance outage does not fail power to the 120 VAC distribution panel itself. If a loss of inverter output is indicated, a static switch automatically shifts to a backup power supply that is supplied by a Class 1E 480 VAC MCC different than the one normally supplying power to the inverter, but in the same Class 1E channel.

The defense-in-depth for the Class 1E 120 VAC distribution panel power supplies helps minimize the safety significance of unavailability of a Class 1E inverter.

Effect on HPCI and RCIC
The High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC) systems are supported by 120 VAC distribution panels in separate channels. Thus, inoperability of one or both inverters in a single channel would not cause the loss of both HPCI and RCIC in the event of a LOOP.

Multiple Emergency Diesel Generators
Hope Creek has four (4) emergency diesel generators (EDGs) that support four (4) separate channels of AC power during Loss of Offsite Power (LOOP) events. Unavailability of power from a Class 1E 120 VAC distribution panel can result in unavailability of the respective EDG. However, three (3) EDGs remain available to support mitigation equipment during LOOP events.

The safety significance of unavailability of a single EDG is minimized due to the level of redundancy in the onsite AC power system.

Offsite AC Power Reliability
Given that unavailability of a Class 1E 120 VAC distribution panel can impact the availability of the respective EDG, the reliability of offsite AC power is significant for preventing LOOP scenarios where the EDGs are required to support mitigation equipment. Offsite power grid stability and availability is maximized because Hope Creek is part of the Pennsylvania-New Jersey-Maryland (PJM) interconnected network. There are three 500-kV sources to the HCGS switchyard, all of which are physically independent sources of offsite power to the HCGS unit.

The safety significance of unavailability of a 120 VAC distribution panel leading to unavailability of a single EDG is minimized due to the level of redundancy in the offsite AC power system.

Compensatory Measures
PSEG procedures (OP-AA-101-112-1002, Online Risk Assessment, and WC-AA-101, On-Line Work Control Process) address the actions for evaluating the risk of planned and emergent work at Hope Creek Generating Station. The Shift Manager and the Site Risk Management Engineer are responsible to evaluate the risk and determine if any compensatory actions are to be performed for a given condition.

Planned work activities are assessed for risk and scheduled in accordance with the PSEG work management process. Risk is re-assessed if equipment failure/malfunction or emergent conditions during planned maintenance produce a plant configuration that has not been previously assessed.

For emergent conditions resulting in the loss of an inverter, Operations would take actions in accordance with PSEG procedure, HC.OP-AB.ZZ-136, "Loss of 120 VAC Inverter," and would subsequently reassess overall plant risk associated with the emergent condition. The result of this risk analysis will determine any corrective actions and/or protected equipment requirements, commensurate with the risk significance of the work being performed.

These procedures also detail the limitations for work on equipment that is in a "protected" status due to either planned or emergent work activities. The limitations include a prohibition of any maintenance, work activities or training operations on the protected equipment to minimize the increase in risk to the plant of the planned or emergent work.

If one of the inverters in LCO 3.8.3.1 were removed from service (i.e., de-energized), the action requirements of the proposed TS revision would be applicable, which are to energize the associated 120 VAC distribution panel within 8 hours, or be in at least HOT SHUTDOWN within the next 12 hours and in COLD SHUTDOWN within the following 24 hours.

If the inverter is inoperable but still providing electrical power to the associated 120 VAC distribution panel, then the proposed TS revision will require restoration of the inverter to an operable status within 24 hours, or be in at least HOT SHUTDOWN within the next 12 hours and in COLD SHUTDOWN within the following 24 hours. For this situation, compensatory measures will be taken if required, in accordance with the guidelines established in plant procedures.

4. Discuss any impacts of the increased allowed outage time to load sequencers, EDGs, radiation monitoring, and vital buses.

<u>**Response**</u>

The impact of the increased allowed outage time on load sequencers, EDGs and vital buses are addressed in the response to NRC Question 2, above.

A loss of offsite power (LOOP) with an inoperable inverter (i.e., 120 VAC distribution panel being powered by the backup Class 1E AC power supply) will result in a loss of power to the associated 120 VAC distribution panel. The effect on radiation monitoring systems is discussed below.

<u>Drywell Atmosphere Post Accident (DAPA) Radiation Monitoring System (RMS)</u>
The DAPA RMS monitors the atmosphere in the drywell in case of a postulated accident that could release a large amount of fission products into the drywell (primary containment). There are two DAPA RMS channels, powered from 120 VAC distribution panels in separate Class 1E power supply channels. There would be no adverse impact from the increased allowed outage time, because the redundant instrument channel would not be expected to be inoperable during this time, with the exception of routine surveillances.

Refueling Floor Exhaust (RFE) and Reactor Building Exhaust (RBE) RMS
The RBE and RFE RMS monitor the radiation concentration in the Reactor Building and Refuel Floor exhaust during normal and refueling conditions and isolate selected systems when radiation levels increase to a predetermined setpoint for two out of three refueling floor exhaust radiation monitoring channels or for two out of three reactor building exhaust radiation monitoring channels. The systems consist of three channels, powered from separate Class 1E power supply channels. There would be no adverse impact from the increased allowed outage time, because the redundant instrument channels would not be expected to be inoperable or in a tripped condition during this time, with the exception of routine surveillances. Loss of a single channel of RBE/RFE RMS will not prevent the systems from performing their required functions.

Control Room Ventilation Radiation Monitoring System
The CRV RMS monitors the control room intake plenum radiation levels and isolates the outside air intake when radiation levels increase to a predetermined setpoint. This isolation maintains control room habitability following a loss of coolant accident/radioactivity release.

The CRV RMS consists of two redundant, separated instrument channels. Each channel consists of two local detector assemblies. One detector from each of the two channels is located in each of the two inlets for a total of four detectors. Power for one channel, C, is supplied from Class 1E 120 VAC distribution panel 1CJ481 and for the other channel, D, from Class 1E 120 VAC distribution panel 1DJ481. Channels C and D are physically and electrically independent.

Each radiation monitor provides contact actuation on upscale (high) radiation. Any one of the four detectors upscale trips initiates closure of the main control room ventilation isolation valves and starts recirculation and filtration of the main control room air. There would be no adverse impact from the increased allowed outage time, because the redundant instrument channel would not be expected to be inoperable or in a tripped condition during this time, with the exception of routine surveillances.

5. The Note in NUREG-1433, "Standard Technical Specifications General Electric Plants, BWR/4" Limiting Condition for Operation (LCO) 3.8.7, "Inverters - Operating," and the associated Standard Technical Specification (STS) Bases indicate that the outage time of 24 hours for the Class 1E inverters is limited only to those inverters associated with the single battery undergoing an equalizing charge provided that: (a) the associated AC vital bus[es] [is/are] energized and (b) all other AC vital buses are energized from their associated OPERABLE inverters. The amendment request states that the proposed changes are consistent with NUREG-1433, however, the request does not reflect this limitation. The proposed changes do not appear to meet the intent of the Note in the STS LCO 3.8.7 for the inverter outages. Provide justification for the deviation from STS.

Response

The 24-hour proposed Allowed Outage Time is consistent with the 24-hour Completion Time for an inoperable inverter in NUREG-1433, TS 3.8.7, Condition A.

The Note modifying NUREG-1433 LCO 3.8.7 is an allowance to perform an equalizing charge on one battery with the associated inverters disconnected from the DC bus. Without the Note, LCO 3.8.7 would not be met and entry into Condition A would be required.

PSEG does not propose to add a similar Note to HCGS LCO 3.8.3.1. If an inverter is disconnected from the battery for an equalizing charge, LCO 3.8.3.1 is not met, and proposed TS Action 3.8.3.1.d would be entered. The proposed change to the HCGS TS requirements is more restrictive than NUREG-1433.

6. Discuss in detail any impacts of the increased allowed outage time on 10 CFR Part 50 Appendix R requirements and post-accident monitoring instrumentation.

Response

Fire Protection Requirements
As part of the power distribution system, inverters 1AD481, 1BD481, 1CD481, 1DD481, 1AD482, 1BD482, 1CD482, 1DD482, and the associated distribution panels function to support the HCGS safe shutdown during and following a postulated fire event. These components are identified in HCGS UFSAR Tables 9A-2 (Shutdown Component List by System) and 9A-3 (Shutdown Component List by Fire Area).

The HCGS safe shutdown analysis as documented in UFSAR Appendix 9A demonstrates the plant capability to achieve and maintain safe shutdown during and following a postulated fire event. The safe shutdown systems consist of two divisions of mechanical equipment (Division I and II). The two mechanical divisions are supported by four electrically independent channels (A, B, C, and D). The electrical channels A and C supply Division I, and B and D, supply Division II. Safe shutdown is achieved by either Shutdown Method I or II as follows:

- Method I (Mechanical Division I) – Division I electrical channels A and C (1AD481, 1AD482, 1CD481, 1CD482)
- Method II (Mechanical Division II) – Division II electrical channels B and D (1BD481, 1BD482, 1DD481, 1DD482)

One division of electrical distribution system including the inverters would remain free of fire damage during and following a postulated fire event at HCGS.

Consistent with Branch Technical Position CMEB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants," Revision 2, HCGS assumptions in the safe shutdown analysis as documented in Appendix 9A of the UFSAR (Appendix R Comparison) include the following:

> There will be no random single failures (other than a single fire and its effects). All equipment not affected by a fire and LOP are assumed to be working normally.

The HCGS fire protection program is designed to prevent fire from starting by using noncombustible and fire resistant materials where practicable in the plant. In the unlikely event that a fire were to occur, the HCGS fire protection program provides for prompt detection and suppression to protect equipment and assure the performance of necessary safe shutdown functions. The rooms containing the inverters and the associated distribution panels are equipped with detection. Manual fire suppression is available in the vicinity of these rooms as well. All the rooms are protected by fire barriers that protect equipment of the redundant division. The combustible loading in these areas is considered low and maintained in accordance with administrative controls. This along with inherent electrical separation and demonstrated separation for Appendix R provides defense in depth to minimize the potential for a fire event that could affect one channel of 120 VAC electrical distribution system.

Therefore, the proposed change in the AOT for the inverters does not affect the current assumptions or strategy for achieving and maintaining safe shutdown during and following a fire event at HCGS.

Post-Accident Monitoring Instrumentation
The post accident monitoring instrumentation meets the intent of Regulatory Guide 1.97 Revision 2. Each Type A, Category 1 instrument loop is energized from a Class 1E power source through one of four inverters [1(A-D)D482]. Additionally, each Type A, Category 1 instrument is provided with a redundant indicating loop that is energized by a different 1E channel. Therefore, in case of a single failure of one 482 inverter, post accident monitoring instrumentation will not be impacted since another indicating channel will be available to Operations.

7. Describe the impacts of the extended outage time if a voltage transient (due to delayed fault clearing in the switchyard or overvoltage due to a sudden loss of load, etc.) occurs on the plant electrical system including the load sequencers when the instrument bus is fed by the maintenance power supply.

Response

When an inverter is removed from service for maintenance, plant operations personnel bypass the inverter in accordance with station procedures by aligning the static switch of the UPS output to a maintenance power supply. This connects the downstream loads to a line regulator. The maintenance power bypass circuitry which will be utilized when an inverter is taken out of service is an electronically controlled AC voltage line regulator. The regulator output voltage is comparable to the inverter output voltage in terms of regulation and all connected loads will operate properly while connected to the regulator. The regulator is designed for an input voltage of 480 VAC ± 10% and an output of 120 VAC ± 2%. It includes an output voltage boost circuit on load application. This enables the maintenance bypass circuitry to withstand some amount of line voltage transients, and the UPS output to downstream loads would remain functional for transients within the specified input voltage range.