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RS-01-052

April 6, 2001

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Dresden Nuclear Power Station, Units 2 and 3
Facility Operating License Nos. DPR-19 and DPR-25
NRC Docket Nos. 50-237 and 50-249

Quad Cities Nuclear Power Station, Units 1 and 2
Facility Operating License Nos. DPR-29 and DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: Additional Electrical Information Supporting the License Amendment Request to Permit Uprated Power Operation at Dresden Nuclear Power Station and Quad Cities Nuclear Power Station

Reference: (1) Letter from R.M. Krich (Commonwealth Edison Company) to U.S. NRC, "Request for License Amendment for Power Uprate Operation," dated December 27, 2000

(2) Letter from U.S. NRC to O.D. Kingsley (Exelon Generation Company), Quad Cities and Dresden – Extended Power Uprate , Electrical Request for Additional Information," dated March 2, 2001

In Reference 1, Commonwealth Edison (ComEd) Company, now Exelon Generation Company (EGC), LLC, submitted a request for changes to the operating licenses and Technical Specifications (TS) for Dresden Nuclear Power Station (DNPS), Units 2 and 3, and Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2, to allow operation at uprated power levels. In Reference 2, the NRC requested additional information regarding these requested changes. In a verbal conversation between Mr. L.W. Rossbach of the NRC and Mr. A.R. Haeger, it was agreed that this information would be provided by April 6, 2001. This letter provides the requested information.

A001

Should you have any questions related to this request, please contact Mr. Allan R. Haeger at (630) 663 6645.

Respectfully,

R.M. Krich
Director – Licensing
Mid-West Regional Operating Group

Attachments:

Affidavit
Attachment A: Additional Electrical Information Supporting the License Amendment Request to Permit Uprated Power Operation at Dresden Nuclear Power Station
Attachment B: Additional Electrical Information Supporting the License Amendment Request to Permit Uprated Power Operation at Quad Cities Nuclear Power Station

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Dresden Nuclear Power Station
NRC Senior Resident Inspector – Quad Cities Nuclear Power Station
Office of Nuclear Facility Safety – Illinois Department of Nuclear Safety

STATE OF ILLINOIS	**)**	
COUNTY OF DUPAGE	**)**	
IN THE MATTER OF	**)**	
EXELON GENERATION COMPANY, LLC	**)**	**Docket Numbers**
DRESDEN NUCLEAR POWER STATION UNITS 2 AND 3	**)**	**50-237 AND 50-249**
QUAD CITIES NUCLEAR POWER STATION UNITS 1 AND 2	**)**	**50-254 AND 50-265**

SUBJECT: **Additional Electrical Information Supporting the License Amendment Request to Permit Uprated Power Operation at Dresden Nuclear Power Station and Quad Cities Nuclear Power Station**

AFFIDAVIT

I affirm that the content of this transmittal is true and correct to the best of my knowledge, information and belief.

R. M. Krich
Director – Licensing

Subscribed and sworn to before me, a Notary Public in and for the State above named, this 6th day of April, 2001.

Notary Public

* OFFICIAL SEAL *
Timothy A. Byam
Notary Public, State of Illinois
My Commission Expires 11/24/2001

bcc Dresden Project Manager - NRR
Quad Cities Project Manager - NRR
Manager of Energy Practice - Winston & Strawn
Director – Licensing, Mid-West Regional Operating Group
Manager – Licensing, Dresden and Quad Cities Station
Site Vice President – Dresden Station
Site Vice President – Quad Cities Station
Regulatory Assurance Manager – Dresden Station
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ATTACHMENT A

Additional Electrical Information Supporting the License Amendment Request to Permit Uprated Power Operation at Dresden Nuclear Power Station

Question

1. *Provide details about the grid stability analysis including major assumptions and results and conclusions of the analysis.*

Response

General Electric (GE) Power Systems Energy Consulting was contracted to perform a study of the Exelon Energy Delivery Company (EDC) power grid to evaluate the impact of the Dresden Nuclear Power Station (DNPS) Units 2 and 3 extended power uprate (EPU). This study was performed in Summer 2000 to ensure that no significant barriers existed for the EPU. As the EPU implementation approaches, the Transmission and Distribution entity of EDC is reviewing the impact of the uprate on the power grid as currently configured. This review is being accomplished through the Transmission Service Request process, which is regulated by the Federal Energy Regulatory Commission (FERC). No significant changes in the conclusions of the GE study are expected.

The GE study used a relative approach to determine the impact of the proposed plant uprates on the performance of the power system. First, system performance with the current plant output was determined in order to establish the benchmark. Then system performance with both plant uprates was determined and compared to the benchmark. This relative approach removes any ambiguities as to the actual impact of the proposed plant uprates. Both power flow and stability analyses were performed. The power flow analyzed the branch (e.g., transmission line or transformer) loading and bus voltage levels under both normal and contingency (e.g., single line outage) operating conditions. The stability analysis evaluated both first swing stability and system damping. A variety of disturbance scenarios were analyzed, including single transmission line outages, single generating unit outages, double transmission line outages, double generating unit outages, and combined transmission line and generating unit outages.

The results of this study are described in the following sections.

Transient Stability Analysis Major Assumptions

The objective of this analysis was to evaluate both first swing stability and system damping for the benchmark system (i.e., with the existing DNPS power output) and for the uprated system. Fourteen single-phase fault scenarios and twenty-one three-phase fault scenarios were evaluated for DNPS. Each fault simulation was performed under a variety of initial system conditions, such as all lines in-service or one line out-of-service. Other fault scenarios included far-end faults with delayed clearing times and far-end stuck breaker faults. More than 150 fault simulations were performed

Transient Stability - Conclusions

For all fault scenarios, system performance was stable with damped oscillations.

Power Flow Analysis Major Assumptions and Results

The objective of this analysis was to determine the impact of the proposed uprates on steady-state system performance. The study approach was to test performance with the

DNPS units operating at the current power output level, then repeat the testing with the units at 912 megawatts (MW). Performance comparisons were made against the benchmark system and the system performance criteria.

The DNPS units were modeled at gross power output rather than net power output to bound the expected power output. In the existing system summer cases each Dresden unit was generating 820 MW. In the winter cases, DNPS Unit 2 was generating 844 MW and DNPS Unit 3 was generating 838 MW. In the uprated plant cases, both units were generating 912 MW.

Power flow results were examined for both normal (n-0), selected double (n-2) and greater contingency conditions. Loss of different units and lines were applied to cases representing the 100% summer and winter peaks. These cases were evaluated for the year 2002. In addition, a 105% summer peak case plus power transfer sensitivities to and from the Exelon grid were studied. A set of single (n-1) contingency conditions was also examined for each power flow case. The single contingencies include a line outage of each of the 138 kV and 345 kV circuits connected to DNPS.

The 100% summer and winter peak normal (i.e., pre-contingency) cases did not show any voltage violations. With contingencies, some branch overloads were observed. For the 105% and power transfer cases, a number of pre-contingency and post-contingency branch overloads were observed. Resolution of these will be accomplished following completion of the current study by the Transmission and Distribution entity of EDC.

The amount of reactive power (i.e., MVAR) support available in the system was also studied. It is expected that compensating measures will be required for MVAR support at certain times. Implementation of these compensating measures will be in accordance with the interconnection agreements and will be accomplished following completion of the current study by the Transmission and Distribution entity of EDC.

Power Flow Analysis - Conclusions
According to the GE study performed, the EDC power grid will accommodate the uprated power flows for the planned 100% summer and winter peaks. As the power uprate implementation approaches, the Transmission and Distribution entity of EDC is reviewing the impact of the uprate on the power grid as currently configured. Resolution of any issues discovered during these reviews will be accomplished prior to operation at uprated power.

The EDC System Planning and Operating Guide ensures that adequate voltage is maintained at the DNPS switchyard with either or both units shutdown. This assures that offsite power will be available to the units to meet the requirements of Appendix A to 10 CFR part 50, "General Design Criteria for Nuclear Power Plants."

Question

2. *Provide details (test configuration, number of tests, repeatability verifications, vendor's involvement, laboratory involvement, etc.) regarding a test to upgrade the switchgear and breaker to a higher momentary current rating.*

Response

As noted in Section 6.1.2 of Reference 1, on-site power distribution ratings for safety related equipment are unchanged for EPU. However, under EPU conditions, operation on a single transformer exceeds the non-safety related 4160V switchgear short circuit rating. During normal operation the station's auxiliary loads are split between the unit auxiliary transformer (UAT) and the reserve auxiliary transformer (RAT). In the split bus configuration the current carrying and interrupting capability of the switchgear is maintained within the switchgear rating. The operation of three feedwater pumps under EPU conditions introduces a potential overduty condition (i.e., excessive short circuit current) on the switchgear when all the loads are fed from a single source - either the UAT or RAT. This would occur when either the UAT or RAT is unexpectedly lost during normal operation resulting in a transfer of loads to the remaining transformer. In that circumstance, if a three phase bolted short were to occur, the design momentary rating of the switchgear could be exceeded.

Description of the 4 kV Vertical Lift Load Switchgear and Breaker	
Manufacturer	General Electric Co.
Rated Voltage	4.16 kV rated operating voltage 4.76 kV rated maximum voltage
Continuous current rating	1200 A $_{Rms.}$
Interrupting	50 kA $_{RMS}$
Momentary rating	80 kA $_{RMS}$ asymmetrical

The above ratings are based on American Standards Association (ASA) Standard C37.6 – 1949, "Preferred Ratings for Power Circuit Breakers," and are on a total current basis.

The requirements under EPU conditions for the switchgear and breaker for the most limiting case are as follows.

1. Interrupting: 44.5 kA $_{RMS}$ symmetrical at pre-fault voltage of 4.2 kV. This exceeds the rating of the installed breaker, which was rated on a total current basis as noted above.

2. Momentary rating: 151.6 kA crest (i.e., first peak, including maximum offset).

   The above values are based on the symmetrical rating standard calculated per Institute of Electrical and Electronic Engineers (IEEE) C37.010 – 1979, "Standard Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis."

Since the interrupting and momentary rating requirements under EPU conditions are higher than the breaker and switchgear rating, the breaker and switchgear are being tested to higher values. Pacific Breaker Systems, Inc. was contracted to specify the testing, procure the equipment and perform the tests. The tests were performed at Powertech Labs Inc. in Surrey, British Columbia. Two sections of switchgear were tested to provide a representative test. One section was used as a bus feeder cubicle. The other section was used as a load breaker cubicle. Used equipment was purchased to the originally supplied breaker type and switchgear rating. The test procedures are

based on the values specified in American National Standards Institute (ANSI) C37.06-1987, "Standard for Switchgear – AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis – Preferred Ratings and Related Required Capabilities." Test methods are taken from ANSI/Department of Defense(DOD) C37.09-1979, "Standard Test Procedure For AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis," for the 100% condition and IEEE C37.20.2-1987, "Standard for Metal-Clad and Station-Type Cubicle Switchgear," for the momentary current withstand test and the short time current withstand test. The IEEE C37.20.2 - 1987 tests are designed to demonstrate the withstand capabilities of the switchgear assembly and are performed with the breaker closed. Testing in conformance with these industry standards using a test configuration that is reflective of the field configuration provides the appropriate assurance of accurate, repeatable results.

The tests and test configuration are being refined as electrical design information and test results become available. The testing has established the following.

1. An interrupting test at 47.2 kA_{RMS} established that breaker will interrupt 44.5 kA_{RMS} as specified. This test consisted of closing into a fault of 47.2 kA and opening the breaker. Following a wait of 3 minutes the breaker was closed and opened again.

2. A momentary test at 151 kA established that the breaker is likely to be able to meet momentary requirements, after refinements to the field configuration are made. During the test, there were no electrical failures of the breaker. The breaker closed into the fault and was tripped manually under no load as required by industry standards. However, as a result of the test some mechanical damage occurred to the porcelain bottles that are used as connection points for the breaker. The results indicate the need for changes to the bracing or connecting points, followed by a confirmatory test of the momentary rating.

We are currently working with the GE Industrial Systems Division to provide the modifications and perform the final momentary test. After successful tests, the bracing in the field will be modified.

Question

3. *Provide detail of 4160 volt bus and auxiliary transformer overcurrent relay set points for operation at extended power uprate (EPU) condition including coordination with upstream and downstream breakers.*

Response

Buses 21 & 22 for Unit 2 and Buses 31 & 32 for Unit 3 – Auxiliary Power Bus Configuration

The auxiliary power bus configuration for Unit 2 is as follows. 4160V Bus 21 is fed from UAT 21 and Bus 22 is fed from RAT 22 in the normal configuration. Each bus has the capability to be fed from the other transformer via the alternate bus feeder breaker. Bus 21 supplies power to Motor Generator (MG) Set 2A and Reactor Feed Pump (RFP) 2A. Bus 22 supplies power to MG Set 2B and RFP 2B. RFP 2C can be fed from Bus 21 or Bus 22.

The auxiliary power bus configuration for Unit 3 is as follows. 4160V Bus 31 is fed from UAT 31 and Bus 32 is fed from RAT 32 in the normal configuration. Each bus has the capability to be fed from the other transformer via the alternate bus feeder breaker. Bus 31 supplies power to MG Set 3A and RFP 3A. Bus 32 supplies power to MG Set 3B and RFP 3B. RFP 3C can be fed from Bus 31 or Bus 32.

Existing Breaker Settings:
All main and reserve feed breakers, relays and relay settings are identical. In addition to the over current protection, main feed breaker relays have a residual (i.e., ground) over current protection. The relays for all load breakers are similar. The relay settings are similar and the worst case (i.e., the most challenging to coordination between load and upstream breakers) pickup values are used for determining coordination.

Main and Reserve Feed Breaker Relay Settings. Both phase and ground overcurrent protection are GE time overcurrent (TOC) relays type IAC51. Phase TOC relay pickup is set at 9600A with a time dial set at 1.0. Ground protection relay pickup is set at 400A, with a time dial set at 1.0.

Load Breaker Relay Settings. Phase protection is provided by GE type IAC 66M TOC relays. Phase overcurrent pickup is set at 1500A with a time dial set at 2.0. Instantaneous High Dropout is set at 7800A. Instantaneous is set at 15300A. Ground protection is provided by GE type PJC11 instantaneous relays, set at 5A. Some load breakers contain redundant ground protection with GE type IAV51 TOC relays set at 400A with a time dial set at 1.0.

New Settings:
The existing settings will remain the same and there are no are changes required.

Coordination:
The setting values for the load breakers are lower than the upstream breakers to ensure coordination. The third RFP can be supplied from either source and it has similar over current protection that is coordinated with the upstream bus feed breakers.

Buses 23 & 24 for Unit 2 and Buses 33 & 34 for Unit 3 – Auxiliary Power Bus Configuration
4160V Bus 23 is fed from UAT 21 and Bus 24 is fed from RAT 22 in the normal configuration. Each bus has the capability to be fed from the other transformer via the alternate bus feed breaker. Bus 23 supplies power to Condensate/Condensate Booster Pumps 2A and 2B. Bus 24 supplies power to Condensate/Condensate Booster Pumps 2C and 2D.

4160V Bus 33 is fed from UAT 31 and Bus 34 is fed from RAT 32 in the normal configuration. Each bus has the capability to be fed from the other transformer via the alternate bus feed breaker. Bus 33 supplies power to Condensate/Condensate Booster Pumps 3A and 3B. Bus 34 supplies power to Condensate/Condensate Booster Pumps 3C and 3D.

Existing Breaker Settings:
All the main feed and reserve breakers have identical relays and settings are identical. In addition to phase overcurrent protection ground protection is also provided. The

relays and settings for all load breakers are identical.

Main and reserve feed Breaker Relay Settings. The phase and ground relays are GE Type IAC51 overcurrent. Phase overcurrent pickup is set at 4800A with the time dial set at 4.0. Ground overcurrent pickup is set at 240A with a time dial set at 4.0.

Load Breaker Relay Settings. The phase relays are GE type IAC 66B overcurrent relays set at 300A with a time dial set at 1.0. The ground relays are GE type PJC11 with the instantaneous set at 5.0A.

New Settings:
The existing settings will remain the same and no changes are required.

Coordination for Cond./Cond. Booster Pump 2A, 2B (Bus 23)
Upstream of the Condensate/Condensate Booster Pumps coordination exists with the main breaker and reserve breakers for phase overcurrents and ground currents. There are no overcurrent relays downstream and therefore no coordination is expected. The ground relays also coordinate.

Coordination for Cond./Cond. Booster Pump 2C, 2D, 3A, 3B, 3C and 3D (Bus 24,33 and 34)
The breakers, relays, and settings for all main and reserve breakers and all Condensate/Condensate Booster Pumps are identical to Bus 23. With this being the case coordination exists also for phase and ground relays. There are no over current relays downstream and therefore no coordination is expected. The ground relays also coordinate.

Under current conditions, the fourth condensate pump can be run when required and its breaker coordinates with the existing main and alternate feed breakers. Thus, no change is required for EPU conditions.

Question

4. *The initial conditions and assumptions for station blackout under EPU conditions shall include an operating history of 100 days at EPU power condition. Clarify that the assumption used for the maximum decay heat for station blackout (SBO) analysis is for EPU condition.*

Response

The EPU SBO analysis assumed end-of-cycle operation (i.e., greater than 100 days of operation) at the full uprated license power conditions of 2957 MWt prior to the SBO event.

Question

5. *The SBO evaluation did not provide any discussion about adequacy of the areas of concern evaluated. The SBO coping analysis includes an alternate ac power source which will be available within one hour. Provide a discussion about the adequacy of the areas of concern (drywell temperature, suppression pool temperature,*

condensate storage inventories, battery capacity, control room ventilation, auxiliary electric room ventilation, isolation condenser or reactor core isolation condenser area heatup, high pressure coolant injection room heatup) for one hour for the SBO event.

Response

Each area of concern is addressed separately below.

Drywell temperature
A pre-EPU calculation addressed the effects of loss of drywell cooling during the blackout transient. This calculation accounted for drywell heat loads as well as enhanced leakage from the recirculation pump seals. The total drywell leakage of 61 gpm was assumed. This included 25 gpm for the primary system leakage and 36 gpm for the recirculation pump seal leakage. This calculation demonstrated that drywell temperatures would remain below operator action levels for reactor emergency depressurization in accordance with the EOPs for a minimum of four hours. The drywell heat loads assumed were the full pre-EPU power operating loads, minus the recirculation pump heat load since the pumps are lost in the event. After one hour of a station blackout, it was determined that drywell bulk temperature would be less than 207° F, which is significantly below the drywell design temperature of 281° F.

Reactor Pressure Vessel (RPV) pressure and temperature remain the same at EPU conditions. There are no significant changes in the drywell heat sources. A slight increase occurs with EPU due to the increased (< 17° F) feedwater temperature. However, this change does not significantly impact the drywell temperature response, since feedwater flow stops at the onset of the SBO. Significant margin to the drywell design temperature is maintained for SBO under EPU conditions.

Suppression Pool Temperature/Condensate Inventory
A pre-EPU calculation addressed suppression pool temperature, RPV pressure, and RPV level response during a four-hour SBO coping period. A vessel model was included to allow the calculation of vessel level and pressure during the SBO in order to determine the required makeup flow and Condensate Storage Tank (CST) inventory. The evaluation included a representation of the isolation condenser, both in automatic actuation and under operator controlled cooldown. Reactor makeup requirements depended on the isolation condenser's ability to remove decay heat without removing RPV inventory.

The SBO calculation demonstrated that with an initial short duration High Pressure Coolant Injection (HPCI) run raising RPV level to the high level setpoint, the plant can sustain four hours of leakage at 61 gpm plus a limited cooldown at 25° F/hr while retaining the core in a covered condition. Following the restoration of AC power after one hour with the SBO Diesel Generators (DGs), there is ample water remaining in the CST to allow refill of the RPV to normal levels. Since the isolation condenser is the primary means of decay heat removal for the RPV, the suppression pool does not heat up significantly (i.e., less than 10° F) during the SBO.

For EPU conditions, the CST makeup needs are not significantly impacted. The initial HPCI run for makeup is slightly longer and uses approximately an additional 3500

gallons. Also, since system leakage, RPV system pressure, and RPV temperature remain the same, and the Isolation Condenser can remove the increased decay heat due to the EPU, the pre-EPU evaluations of suppression pool temperatures are not significantly affected. A slight increase in torus temperature occurs due to the longer HPCI operation, but this effect is not significant.

DC Battery Capacity
Pre-EPU battery cell sizing calculations were performed for the 24/48 volt DC, 125 volt DC and 250 volt DC batteries. These calculations considered a one-hour load profile with no load shedding, a battery cell electrolyte temperature of 65° F, and recovery loads. It was determined for the 24/48 volt DC and 125 volt DC batteries that at least 14% margin existed. For the 250 volt DC batteries, it was determined that at least 5% margin existed.

Under EPU conditions, HPCI will not initiate until about 45 seconds following the loss of AC power. The current battery calculation conservatively assumes HPCI initiates at the beginning of the event, resulting in a higher battery loading.

After initiation, HPCI operates for one cycle of low-low (i.e., initiation) level to high (i.e., shutoff) level in the SBO scenario. The pre-EPU battery analysis evaluated a duration for this cycle of 222 seconds. The time for HPCI operation following EPU is slightly longer than the pre-EPU value due to the increase in decay heat. A bounding value would be approximately 260 seconds (i.e., 1.17*222 seconds). However, the longer period of HPCI operation under EPU is bounded by the margin in the current calculation for the 250 volt DC battery.

The Isolation Condenser (IC) system is modeled to initiate at 15 seconds in the current battery calculation. This starting time also applies to the SBO scenario under EPU.

Given the above conditions, the pre-EPU battery calculations contain sufficient margin to bound the EPU case for SBO.

Control Room Ventilation
A pre-EPU calculation was performed to address the effects of the loss of the control room ventilation system during the SBO. The calculation considered control room heat loads as well as heat sinks. The temperature is acceptable one hour following the loss of ventilation. After one hour, ventilation is restored. Because the heat loads are related to indicating lights and other non-power dependent electrical equipment, the heat load demands in the control room during the first hour of a SBO at EPU are the same as before. Therefore, the pre-EPU evaluation still applies for EPU.

Auxiliary Electric Equipment Room Ventilation
A pre-EPU calculation was performed to address the effects of the loss of the Auxiliary Electric Equipment Room Ventilation system during the SBO. This calculation was performed using the methodology identified in Nuclear Management and Resources Council (NUMARC) 87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors." This calculation determined that with the boundary doors closed, the temperature would be acceptable after four hours. Therefore, the room temperature after one hour is acceptable.

Because the heat loads are related to indicating lights and other non-power dependent electrical equipment, the heat load demands in the Auxiliary Electric Equipment Room during the first hour of a SBO at EPU are the same as before. Therefore, the pre-EPU evaluation remains valid at EPU.

Isolation Condenser Area
A pre-EPU calculation was performed to address the effects of the loss of the reactor building ventilation system, which serves the IC area during the SBO transient. This calculation was performed using the methodology identified in NUMARC 87-00. This calculation determined that with the boundary doors closed, the temperature reached 167° F after four hours. A review of the SBO-required electrical components in the area was performed. It was determined that equipment operability would be assured if a qualified level transmitter for the Isolation Condenser was installed. The qualified level transmitter was installed and tested to assure the monitoring of IC level in the Control Room during the SBO event.

At EPU conditions, the heat loads during a SBO are not significantly impacted because they are dominated by the temperature of the steam piping heat source. This source does not change as a result of the EPU. The post-EPU Isolation condenser room temperatures remain bounded by the pre-EPU analysis for the one-hour period before AC power and room cooling are restored.

HPCI Room
A pre-EPU calculation was performed to address the effects of the loss of the ventilation system and room cooler serving the HPCI room. It was determined that after one hour, the HPCI room temperature will be 130° F. A review of the SBO-required electrical components in the room was performed. It was determined that equipment operability would be assured. Additionally, a manual calculation using the NUMARC 87-00 methods was performed. This determined that the heat loads utilized in the transient calculation were appropriate.

The single assumed HPCI operating cycle is slightly longer under EPU conditions, as discussed above. However, because the pre-EPU calculation made the conservative assumption of continuous HPCI operation, the pre-EPU analysis remains bounding for EPU.

Question

6. *Discuss how the temperature and pressure profiles will change using EPU rated thermal power condition and whether they will change for the first hour and after the first hour after the postulated steam line break for the drywell.*

Response

Table 10-2 of the Power Uprate Safety Analysis Report (PUSAR), which is Attachment E of Reference 1, indicates that the peak temperature for the enveloping EQ profile increases by 4° F for accident conditions inside containment. The steam line break analysis performed under EPU thermal power conditions caused this temperature increase. The steam line break did not result in a pressure increase because the current (i.e., pre-EPU) containment EQ enveloping pressure profile remains bounding for EPU thermal power conditions. The specific profiles are discussed in the response to question 7 below.

Question

7. *In Section 10.3.1.1, the licensee stated that the current accident conditions for temperature and pressure are modified for the EPU conditions. Provide a discussion regarding the effect of modified temperature and pressure for the EPU conditions on environmental qualification (EQ) of electrical equipment inside containment.*

Response:

The drywell pressure and temperature conditions are impacted for EPU as follows.

1. The present drywell peak pressure for qualification of 63 psia is bounding for the EPU condition.
2. The present and EPU drywell temperature profiles used for EQ are shown in the table and figure on the following page.

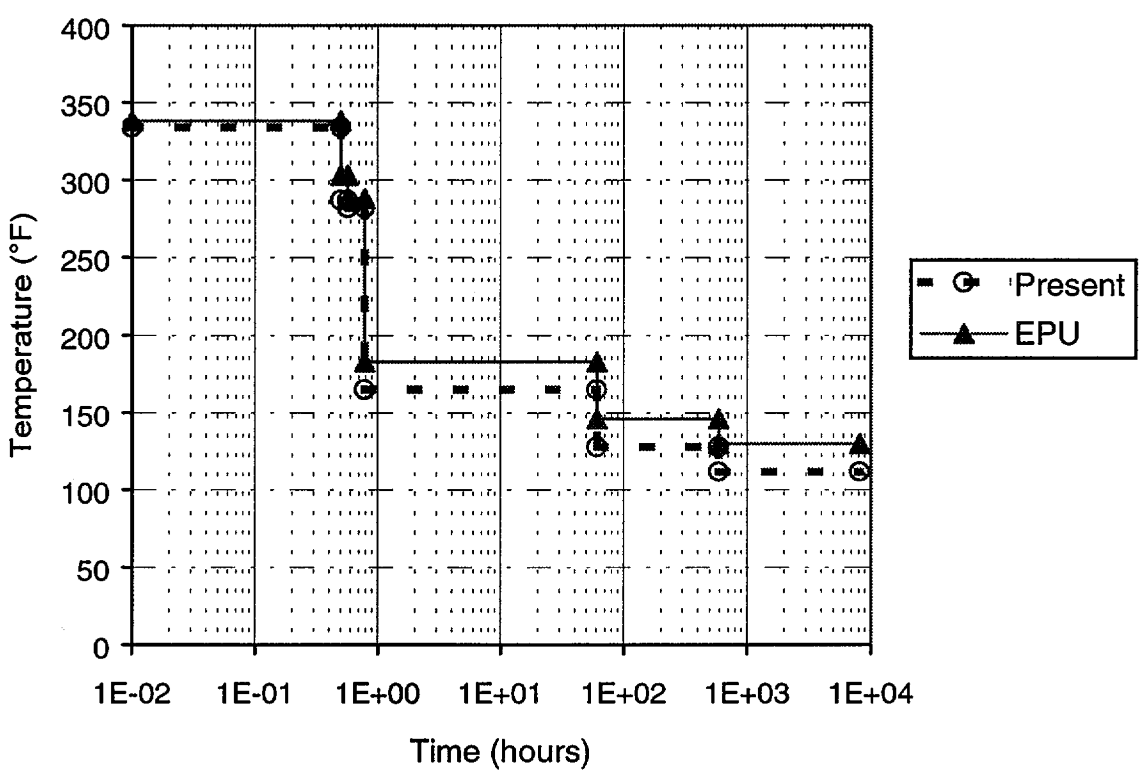
For all equipment inside the containment within the EQ program, evaluations were performed to demonstrate that the existing environmental documentation was adequate to meet the revised temperature and pressure values due to EPU. Evaluations were done for each equipment type using the following approach.

1. The qualification test temperature conditions for the required operability period during the first 24 hours following a LOCA were shown to envelop the corresponding EPU temperature profile.
2. The qualification test temperature conditions for the required operability period beyond 24 hours to 1 year following a LOCA were shown to meet the revised EPU temperature profile using Arrhenius methodology.
3. Maximum test pressure was shown to envelop the revised peak pressure for EPU.

EPU did not result in any changes to operating times for equipment required to operate following an accident.

Drywell – Present & EPU EQ Temperature Profile

Time (hours)	Present Temperature (°F)	EPU Temperature (°F)
0.01	334	338
0.5	334	338
0.57	287	303
0.8	282	288
61	165	183
588	128	146
8760	112	130



An example showing that the qualification test meets the revised EPU EQ profile for containment is given below.

ASCO Solenoid Valves

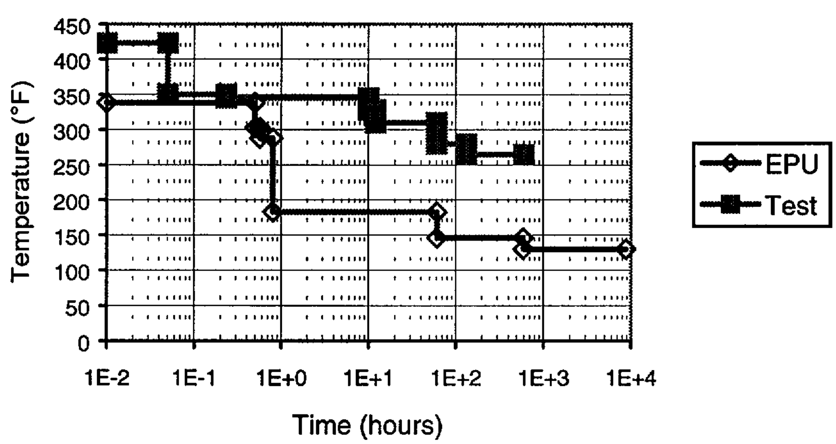
Test Conditions

Time (hours)	Temperature (°F)
0.01	423
0.05	350
0.233	345
10	328
12	310
60	310
132	280
600	265

Revised EPU EQ Containment Profile

Time (hours)	Temperature (°F)
0.01	338
0.5	338
0.57	303
0.8	288
61	183
588	146
8760	130

Test Conditions Envelop Revised EPU EQ Containment Profile:



Question:

8. *Provide a discussion regarding the effect of humidity for the EPU condition on EQ of electrical equipment.*

Response:

The EQ of electrical equipment is based on a normal relative humidity of 20% to 90% and an accident relative humidity of 100% for affected areas. The EPU condition has not created any additional moisture for normal conditions, nor has it created any new areas affected by accident conditions. Therefore, the EQ of electrical equipment for normal or accident relative humidity has not changed.

Question:

9. *In Section 10.3.1.2, the licensee stated that the accident temperature, pressure and humidity conditions outside containment, resulting from a loss-of- coolant accident inside containment, may change with power levels as a result of the increased suppression pool temperature. How will the licensee verify the adequacy of EQ of electrical equipment without evaluating the effects of changes?*

Response:

Changes for temperature environments outside containment for a loss-of-coolant accident inside containment are being determined and evaluated for effects on qualification of electrical equipment within the EQ program. No changes to pressure or humidity environments result in areas outside containment for a LOCA inside containment. Evaluations will be done to show that the existing environmental documentation is adequate to meet the revised temperature profile due to EPU. Evaluations will be done for each equipment type using the following approach.

1. Existing documentation will be used to show that the qualification test temperature profile envelops the revised peak temperature for EPU, and
2. The qualification test will be shown to meet the revised Post LOCA conditions outside containment for EPU using Arrhenius methodology.

Upon completion of the EQ reviews for equipment outside the drywell, EGC will provide the NRC with a summary of the results. This is expected to be completed by May 25, 2001.

Question:

10. *Identify the equipment potentially affected by the EPU condition and discuss how this equipment will be requalified. (The staff would like to have a meeting with the licensee regarding the new temperature, pressure and radiation profile and equipment test profiles.)*

Response:

Operation at EPU conditions changes the temperature, pressure and radiation environments for certain plant areas in which electrical equipment is located. Relative humidity does not change for EPU (see response to question 8).

For the EQ equipment, revised temperature, pressure and radiation values were compared to the existing posted qualified test values. This comparison identified some equipment where the EPU profile exceeded the current posted values. In some of these cases, additional test report data was available that demonstrated qualification to the EPU values. In other cases, location specific radiation analysis, material evaluations and Arrhenius calculations are used to qualify the equipment. No EQ electrical equipment will need re-testing to qualify for the EPU conditions.

EPU did not result in any changes to operating times for equipment required to operate following an accident.

Two flow transmitters per unit will be replaced to achieve qualification as shown in the table below.

Equipment ID No.	Location	Function
FT-2-1549-A FT-3-1549-A	LPCI/CS SE Corner Room	LPCI main supply header (Loop A) flow output to flow recorder
FT-2-1549-B FT-3-1549-B	LPCI/CS SW Corner Room	LPCI main supply header (Loop B) flow output to flow recorder

Examples of equipment that required more rigorous evaluation and the qualification method used or planned are shown in the table below. A small number of components related to the LPCI room equipment remain to be reviewed for EPU conditions.

Upon completion of the EQ reviews for the LPCI room equipment, EGC will provide the NRC with a summary of the results. This is expected to be completed by May 25, 2001.

Examples of Qualification Methods Used

Equipment	Qualification Parameter	Methodology Used or Planned to Qualify
Switchgear	Radiation exposure	Additional test report data demonstrated higher qualification levels than currently credited
Electrical Penetration Assembly	Radiation exposure	Additional test report data demonstrated higher qualification levels than currently credited
Cables (in drywell)	Radiation exposure	Refined radiation dose analysis performed to demonstrate adequacy of cables
Rosemount Transmitter	Temperature	Qualified by Arrhenius methodology using existing test report data

Question

11. Provide details of the isolated phase bus duct cooling system changes necessary for the extended power uprate (EPU).

Response

The isolated phase bus duct cooling system is not adequate for operation at EPU conditions during the warmer months of the year. The cooling system is not adequate to prevent the bus conductor or enclosure from reaching the respective temperature limits at EPU bus loads, and is being evaluated for improvement. The bus duct cooling upgrade is required even though the isolated phase bus duct electrical rating is listed as 33,000 amps in Table 6-1 of the PUSAR. This is because the isophase bus duct cooling system at DNPS is not performing at design capability. Required changes to the cooling system have not yet been finalized, but focus on providing cooler air to the bus duct enclosure. Potential options to achieve this result are dependent on the results of a heat transfer analysis, but include reducing the temperature of the cooling water supply to the cooling units and/or replacing the cooling coil(s) in each cooling unit with coils having a higher rating.

Improvement of the isolated phase bus duct cooling system is required for operation only during the warmer months of the year. During the cooler months of the year, the cooling system is adequate for operation at EPU conditions. The method for providing the additional cooling will be determined by May 2001. The changes to the isolated phase bus duct cooling system will be completed prior to the onset of warm weather conditions following the EPU outage.

Question

12. Clarify what is meant by "to restore the margin at the reactor building dc panels, the amperage capacity of the main feed cables to these panels will be increased." The discussion should include both original and revised margins at the reactor building dc panels, why the margin is changed, and how will the amperage of the main feed cables increased?

Response

The present design has two 1/C 250 MCM cables routed from the turbine 125 VDC buses to the reactor building buses. This cable length is quite long and during high current loading conditions (i.e., when load shedding occurs at the 4 kV buses), the voltage drop within the main feed cables is higher than desirable at pre-EPU conditions. Currently the voltage at the reactor building buses, with worst case loading, is 87.84 V for Unit 2 and 82.2 V for Unit 3. Specific calculations and modifications using an interposing relay design for some of the 4 kV breakers control circuits have been performed to address and resolve this issue.

At EPU conditions, additional loading will be present, resulting from tripping of the additional running feedwater and condensate pump breakers during a load shed. A modification to install another 250 MCM conductor per polarity will be implemented as part of the EPU project. This will reduce the total cable resistance by half and therefore

decrease the cable voltage drop of about 13 V for Unit 2 and 20 V for Unit 3 in half during high loading periods. This will raise the voltage at the reactor building buses with worst case loading to approximately 94 V for Unit 2 and 92 V for Unit 3.

Reference

1. Letter from R.M. Krich (Commonwealth Edison Company) to U.S. NRC, "Request for License Amendment for Power Uprate Operation," dated December 27, 2000

ATTACHMENT B

Additional Electrical Information Supporting the License Amendment Request to Permit Uprated Power Operation at Quad Cities Nuclear Power Station

Question

1. *Provide details about the grid stability analysis including major assumptions and results and conclusions of the analysis.*

Response

General Electric (GE) Power Systems Energy Consulting was contracted to perform a study of the Exelon Energy Delivery (EDC) power grid to evaluate the impact of the Quad Cities Nuclear Power Station (QCNPS) Units 1 and 2 extended power uprate (EPU). This study was performed in Summer 2000 to ensure that no significant barriers existed for the uprates. As the EPU implementation approaches, the Transmission and Distribution entity of EDC is reviewing the impact of the uprate on the power grid as currently configured. This review is being accomplished through the Transmission Service Request process, which is regulated by the Federal Energy Regulatory Commission (FERC). No significant changes in the conclusions of the GE study are expected.

The GE study used a relative approach to determine the impact of the proposed plant uprates on the performance of the power system. First, system performance with the current plant output was determined in order to establish the benchmark. Then system performance with both plant uprates was determined and compared to the benchmark. This relative approach removes any ambiguities as to the actual impact of the proposed plant uprates. Both power flow and stability analyses were performed. The power flow analyzed the branch (e.g., transmission line or transformer) loading and bus voltage levels under both normal and contingency (e.g., single line outage) operating conditions. The stability analysis evaluated both first swing stability and system damping. A variety of disturbance scenarios were analyzed, including single transmission line outages, single generating unit outages, double transmission line outages, double generating unit outages, and combined transmission line and generating unit outages.

The results of this study are described in the following sections.

Transient Stability Analysis Major Assumptions and Discussion of Results

The objective of this analysis was to evaluate both first swing stability and system damping for the benchmark system (i.e., with the existing QCNPS power output) and for the uprated system. Fifteen single-phase fault scenarios and fifteen three-phase fault scenarios were evaluated for the QCNPS plant. Each fault simulation was performed under a variety of initial system conditions, such as all lines in-service or one line out-of-service. Other fault scenarios included far-end faults with delayed clearing times and far-end stuck breaker faults. More than 150 fault simulations were performed.

Transient Stability Analysis - Conclusions

The system was determined to have adequate stability margin for all cases studied.

Power Flow Analysis

The objective of this analysis was to determine the impact of the proposed uprates on steady-state system performance. The study approach was to test performance with the QCNPS units operating at the current power output level, then repeat the testing with the

units at 912 megawatts (MW). Performance comparisons were made against the benchmark system and the system performance criteria.

The QCNPS units were modeled at gross power output rather than net power output to bound the expected output. In the existing system summer cases, QCNPS Unit 1 was operating at an output level of 817 MW and Unit 2 was operating at 809 MW. In the winter cases, QCNPS Unit 1 was operating at the output level of 831 MW and Unit 2 was generating 826 MW. In the uprated plant cases, units were generating 912 MW.

Power flow results were examined for both normal (n-0), selected double (n-2) and greater contingency conditions. Loss of different units and lines were applied to cases representing the 100% summer and winter peaks. These cases were evaluated for the year 2002. In addition, a 105% summer peak case plus power transfer sensitivities to and from the EDC grid were studied. A set of single (n-1) contingency conditions was also examined for each power flow case. The single contingencies includes a line outage of each of the 345 kV circuits connected to QCNPS.

The 100% summer and winter peak normal (i.e., pre-contingency) cases did not show any voltage violations. With contingencies, some branch overloads were observed. For the 105% and power transfer cases, a number of pre-contingency and post-contingency branch overloads were observed. Resolution of these will be accomplished following completion of the current study by the Transmission and Distribution entity of EDC.

The amount of reactive power (i.e., MVAR) support available in the system was also studied. It is expected that compensating measures will be required for MVAR support at certain times. Implementation of these compensating measures in accordance with the interconnection agreement will be accomplished following completion of the current study by the Transmission and Distribution entity of EDC.

Power Flow Analysis - Conclusions
According to the GE study performed, the EDC power grid will accommodate the uprated power flows for the planned 100% summer and winter peaks. As the EPU implementation approaches, the Transmission and Distribution entity of EDC is reviewing the impact of the uprate on the power grid as currently configured. Resolution of any issues discovered during these reviews will be accomplished prior to operation at uprated power.

The EDC System Planning and Operating Guide ensures that adequate voltage is maintained at the QCNPS switchyard with either or both units shutdown. This assures that offsite power will be available to the units to meet the requirements of Appendix A to 10 CFR part 50, "General Design Criteria for Nuclear Power Plants."

Question

2. *Provide details (test configuration, number of tests, repeatability verifications, vendor's involvement, laboratory involvement, etc.) regarding a test to upgrade the switchgear and breaker to a higher momentary current rating.*

Response

As noted in Section 6.1.2 of Reference 1, on-site power distribution ratings for safety related equipment are unchanged for EPU. However, under EPU conditions, operation on a single transformer exceeds the non-safety related 4160V switchgear short circuit rating. During normal operation the station's auxiliary loads are split between the unit auxiliary transformer (UAT) and the reserve auxiliary transformer (RAT). In the split bus configuration the current carrying and interrupting capability of the switchgear is maintained within the switchgear rating. The operation of three feedwater pumps under EPU conditions introduces a potential overduty condition (i.e., excessive short circuit current) on the switchgear when all the loads are fed from a single source - either the UAT or RAT. This would occur when either the UAT or RAT is unexpectedly lost during normal operation resulting in a transfer of loads to the remaining transformer. In that circumstance, if a three phase bolted short were to occur, the design momentary rating of the switchgear could be exceeded.

Description of the 4 kV Vertical Lift Load Switchgear and Breaker	
Manufacturer	General Electric Co.
Rated Voltage	4.16 kV rated operating voltage 4.76 kV rated maximum voltage
Continuous current rating	1200 $A_{Rms.}$
Interrupting	50 kA_{RMS}
Momentary rating	80 kA_{RMS} asymmetrical

The above ratings are based on American Standards Association (ASA) Standard C37.6 – 1949, "Preferred Ratings for Power Circuit Breakers," and are on a total current basis.

The requirements under EPU conditions for the switchgear and breaker for the most limiting case are as follows.

1. Interrupting: 44.5 kA_{RMS} symmetrical at pre-fault voltage of 4.2 kV. This exceeds the rating of the installed breaker, which was rated on a total current basis as noted above.
2. Momentary rating: 151.6 kA crest (i.e., first peak, including maximum offset).

   The above values are based on the symmetrical rating standard calculated per Institute of Electrical and Electronic Engineers (IEEE) C37.010 – 1979, "Standard Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis."

Since the interrupting and momentary rating requirements under EPU conditions are higher than the breaker and switchgear rating, the breaker and switchgear are being tested to higher values. Pacific Breaker Systems, Inc. was contracted to specify the testing, procure the equipment and perform the tests. The tests are being performed at Powertech Labs Inc. in Surrey, British Columbia. Two sections of switchgear were tested to provide a representative test. One section was used as a bus feeder cubicle. The other section was used as a load breaker cubicle. Used equipment was purchased to the originally supplied breaker type and switchgear rating. The test procedures are based on the values specified in American National Standards Institute (ANSI) C37.06-

1987, "Standard for Switchgear – AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis – Preferred Ratings and Related Required Capabilities." Test methods are taken from ANSI/Department of Defense(DOD) C37.09-1979, "Standard Test Procedure For AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis," for the 100% condition and Institute of Electrical and Electronic Engineers (IEEE) C37.20.2-1987, "Standard for Metal-Clad and Station-Type Cubicle Switchgear," for the momentary current withstand test and the short time current withstand test. The IEEE C37.20.2 – 1987 tests are designed to demonstrate the withstand capabilities of the switchgear assembly and are performed with the breaker closed. Testing in conformance with these industry standards using a test configuration that is reflective of the field configuration provides the appropriate assurance of accurate, repeatable results.

The tests and test configuration are being refined based on test results and to better match the field configuration. The testing has established the following.

1. An interrupting test at 47.2 kA $_{RMS}$ established that breaker will interrupt 44.5 kA $_{RMS}$ as specified. This test consisted of closing into a fault of 47.2 kA and opening the breaker. Following a wait of 3 minutes the breaker was closed and opened again.

2. A momentary test at 151 kA established that the breaker is likely to be able to meet momentary requirements, after refinements to the field configuration are made. During the test, there were no electrical failures of the breaker. The breaker closed into the fault and was tripped manually under no load as required by industry standards. However, as a result of the test some mechanical damage occurred to the porcelain bottles that are used as connection points for the breaker. The results indicate the need for changes to the bracing or connecting points, followed by a confirmatory test of the momentary rating.

We are currently working with the GE Industrial Systems Division to provide the modifications and perform the final momentary test. After successful tests, the bracing in the field will be modified.

<u>Question</u>

3. *Provide detail of 4160 volt bus and auxiliary transformer overcurrent relay set points for operation at extended power uprate (EPU) condition including coordination with upstream and downstream breakers.*

<u>Response</u>

<u>Buses 11 & 12 for Unit 1 and Buses 21 & 22 for Unit 2 – Auxiliary Power Bus Configuration</u>
4160V Bus 11 is fed from UAT 11 and Bus 12 is fed from RAT 12 in the normal configuration. Each bus has the capability to be fed from the other transformer via the alternate bus feeder breaker. Bus 11 supplies power to MG Set 1A and RFP 1A. Bus 12 supplies power to MG Set 1B and RFP 1B. RFP 1C can be fed from either Bus 11 or Bus 12.

4160V Bus 21 is fed from UAT 21 and Bus 22 is fed from RAT 22 in the normal

configuration. Each bus has the capability to be fed from the other transformer via the alternate bus feeder breaker. Bus 21 supplies power to MG Set 2A and RFP 2A. Bus 22 supplies power to MG Set 2B and RFP 2B. RFP 2C can be fed from Bus 21 or Bus 22.

Existing Breaker Settings:
All main and reserve feed breaker relays are identical. In addition to the over current protection, main feed breaker relays have a residual (i.e., ground) over current protection. The relays for all load breakers are similar. The relay settings are similar and the worst case (i.e., the most challenging to coordination between load and up stream bus feed breakers) pickup values are used for determining coordination.

Main and Reserve Feed Breaker Relay Settings. Relays are GE Type IAC51. Phase overcurrent pickup is set at 9600A with a time dial set at 1.0. Ground protection pickup is set at 400A with time dial set at 2.0.

Load Breaker Relay Settings. Phase protection is provided by GE type IAC 66M Relays. Phase overcurrent pickup is set at 1500A with a time dial set at 2.0. Instantaneous High Dropout is set at 7800A. Instantaneous is set at 15300A. Ground protection is provided by GE type PJC11 and IAC51 relays set at 150A, with time dial set at 5.0. Settings vary but worst case is considered when coordination is determined or reviewed.

New Settings
The existing settings will remain the same and no changes are required.

Coordination
The settings for the load breakers are lower than the upstream bus feed breakers to attain coordination. The third RFP can be supplied from either source and it has similar over current protection that is coordinated with the upstream bus feed breakers.

Buses 13 & 14 for Unit 1 and Buses 23 & 24 for Unit 2 – Auxiliary Power Bus Configuration
4160V Bus 13 is fed from RAT 12 and Bus 14 is fed from UAT 11 in the normal configuration. Each bus has the capability to be fed from the other transformer via the alternate bus feed breaker. Bus 13 supplies power to Condensate/Condensate Booster Pumps 1A and 1B. Bus 14 supplies power to Condensate/Condensate Booster Pumps 1C and 1D.

4160V Bus 23 is fed from RAT 22 and Bus 24 is fed from UAT 21 in the normal configuration. Each bus has the capability to be fed from the other transformer via the alternate bus feed breaker. Bus 23 supplies power to Condensate/Condensate Booster Pumps 2A and 2B. Bus 24 supplies power to Condensate/Condensate Booster Pumps 2C and 2D.

Existing Breaker Settings
All the main and reserve feed breakers have similar relays. All relay settings are identical. All load breakers and their relays and settings are identical.

Main Feed Breaker Relay Settings. The phase and ground relays are GE Type IAC51 overcurrent. Phase overcurrent pickup is set at 4800A with the time dial set at 3.5.

Ground overcurrent pickup is set at 240A with a time dial set at 3.5.

Load Breaker Relay Settings. The phase relays are GE type IAC 66B overcurrent relays. The phase relay overcurrent pickup is set at 300A with a time dial set at 1.0. The instant relay pickup is set at 3600A. The ground relays are GE type PJC11 instantaneous set at 5.0A.

New Settings
The existing settings will remain the same no changes are required.

Coordination for Cond./Cond. Booster Pump 1A, 1B (Bus 13)
Upstream of the Condensate/Condensate Booster Pumps coordination exists with the main breaker and reserve breakers for phase overcurrents and ground currents. There are no overcurrent relays downstream and therefore no coordination is expected. The ground relays also coordinate.

Coordination for Cond./Cond. Booster Pump 1C, 1D, 2A, 2B, 2C and 2D (Bus 14, 23 and 24)
The breakers, relays and settings for all main and reserve breakers and all Condensate/Condensate Booster Pumps are all identical to Bus 13. With this being the case coordination exists also for phase and ground relays. There are no overcurrent relays downstream and therefore no coordination is expected. The ground relays also coordinate.

Under current conditions, the fourth condensate pump can be run when required and its breaker coordinates with the existing main and alternate feed breakers. Thus, no change is required for EPU conditions.

Question

4. *The initial conditions and assumptions for station blackout under EPU conditions shall include an operating history of 100 days at EPU power condition. Clarify that the assumption used for the maximum decay heat for station blackout (SBO) analysis is for EPU condition.*

Response

The EPU SBO analysis assumed end-of-cycle operation (i.e., greater than 100 days of operation) at the full uprated license power conditions of 2957 MWt prior to the SBO event.

Question

5. *The SBO evaluation did not provide any discussion about adequacy of the areas of concern evaluated. The SBO coping analysis includes an alternate ac power source which will be available within one hour. Provide a discussion about the adequacy of the areas of concern (drywell temperature, suppression pool temperature, condensate storage inventories, battery capacity, control room ventilation, auxiliary electric room ventilation, isolation condenser or reactor core isolation condenser area heatup, high pressure coolant injection room heatup) for one hour for the SBO event.*

Response

Each area of concern is addressed separately below.

Drywell temperature
A pre-EPU calculation addressed the effects of loss of drywell cooling during the blackout transient. This calculation accounted for drywell heat loads as well as enhanced leakage from the recirculation pump seals. The total drywell leakage of 61 gpm was assumed. This included 25 gpm for the primary system leakage and 36 gpm for the recirculation pump seal leakage. This calculation demonstrated that drywell temperatures would remain below operator action levels for reactor emergency depressurization in accordance with the EOPs for a minimum of four hours. The drywell heat loads assumed were the full pre-EPU power operating loads, minus the recirculation pump heat load since the pumps are lost in the event. After one hour of a station blackout, it was determined that drywell bulk temperature would be less than 207° F, which is significantly below the drywell design temperature of 281° F.

RPV pressure and temperature remain the same at EPU conditions. There are no significant changes in the drywell heat sources. A slight increase occurs with EPU due to the increased (< 17° F) feedwater temperature. However, this change does not significantly impact the drywell temperature response, since feedwater flow stops at the onset of the SBO. Significant margin to the drywell design temperature is maintained for SBO under EPU conditions.

Suppression Pool Temperature/Condensate Inventory
A pre-EPU calculation addressed suppression pool temperature, RPV pressure, and RPV level response during a four-hour SBO coping period. A vessel model was included to allow the calculation of vessel level and pressure during the SBO in order to determine the required makeup flow and CST inventory usage. The model also allowed for the simulation of operator actions to depressurize the RPV, based on suppression pool temperature requirements. This calculation demonstrated that with appropriate operator response the plant can meet the requirements of the EOPs over the four hour coping period, with manual operation of the reactor core isolation cooling (RCIC) pump and manual operation of the Electromatic Relief Valves. The amount of water injected by the RCIC system in the four hour calculation was within the minimum required volume in the CST, which bounds the usage during the one hour SBO loss of all AC.

RPV system pressure and temperature remain the same under EPU conditions. Thus, the CST level and system leakage results in the four-hour pre-EPU evaluations remain bounding for the EPU one-hour case.

Pre-EPU evaluations also determined that the suppression pool temperature did not exceed 130° F in the one-hour period without AC power. At EPU conditions, the suppression pool temperature is increased by less than 6° F during the first hour due to the higher decay heat. This temperature increase is bounded by the results of the EPU containment analysis for LOCA conditions, and significant margin to design limits remains. The suppression pool temperature remains well within the heat capacity limit curve.

DC Battery Capacity
Pre-EPU battery cell sizing calculations were performed for the 125 volt DC and 250 volt DC batteries. These calculations considered a four-hour load profile based on a combined set of loads from a variety of events. It was determined for both the 125 volt DC and for the 250 volt DC batteries that adequate margin exists.

The battery load demands during the one-hour SBO duration are slightly increased under EPU conditions. However, the current pre-EPU battery load profile remains bounding because it assumes a more restrictive scenario of multiple HPCI initiations during a 4-hour duration.

Control Room Ventilation
A pre-EPU calculation was performed to address the effects of the loss of the Control Room ventilation system during the SBO. This calculation considered control room heat loads as well as available heat sinks. This calculation determined that with the boundary doors closed, the peak one hour temperature is acceptable. Because the heat loads are primarily related to indicating lights and other non-power dependent electrical equipment, the heat load demands in the control room during the first hour of a SBO at EPU are approximately the same. Therefore, the pre-EPU evaluation still applies for EPU.

Auxiliary Electric Equipment Room Ventilation
A pre-EPU calculation was performed to address the effects of the loss of the Auxiliary Electric Equipment Room Ventilation system during the SBO. This calculation was performed using the methodology identified in NUMARC 87-00. This calculation determined that with the boundary doors closed, the temperature would be acceptable after four hours. Therefore, the room temperature after one hour is acceptable.

Because the heat loads are primarily related to indicating lights and other non-power dependent electrical equipment, the heat load demands in the Auxiliary Electric Equipment Room during the first hour of a SBO at EPU are the same as before. Therefore, the pre-EPU evaluation remains valid for EPU.

RCIC Room
A pre-EPU calculation was performed to address the effects of the loss of the HVAC system and room cooler serving the RCIC room. It was determined that after one hour, RCIC room temperature will be less than 120° F. Additionally, a manual calculation using the NUMARC 87-00 methods was performed. This determined that the heat loads utilized in the transient calculation were conservative.

The RCIC operation time to restore reactor vessel level is slightly increased at EPU. However, because the current calculation assumes a constant heat load from RCIC operation, the pre-EPU evaluation remains valid for EPU.

Question

6. *Discuss how the temperature and pressure profiles will change using EPU rated thermal power condition and whether they will change for the first hour and after the first hour after the postulated steam line break for the drywell.*

Response

Table 10-2 of the Power Uprate Safety Analysis Report (PUSAR), which is Attachment E of Reference 1, indicates that the peak temperature for the enveloping EQ profile increases by 4° F for accident conditions inside containment. The steam line break analysis performed under EPU thermal power conditions caused this temperature increase. The steam line break did not result in a pressure increase because the current (i.e., pre-EPU) containment EQ enveloping pressure profile remains bounding for EPU thermal power conditions. The specific profiles are discussed in the response to question 7 below.

Question:

7. *In Section 10.3.1.1, the licensee stated that the current accident conditions for temperature and pressure are modified for the EPU conditions. Provide a discussion regarding the effect of modified temperature and pressure for the EPU conditions on environmental qualification (EQ) of electrical equipment inside containment.*

Response:

The drywell pressure and temperature conditions are impacted for EPU as follows.

1. The present drywell peak pressure for qualification of 63 psia is bounding for the EPU condition.
2. The present and EPU drywell temperature profiles used for EQ are shown in the table and figure below.

For all equipment inside the containment within the EQ program, evaluations were performed to demonstrate that the existing environmental documentation was adequate to meet the revised temperature and pressure values due to EPU. Evaluations were done for each equipment type using the following approach.

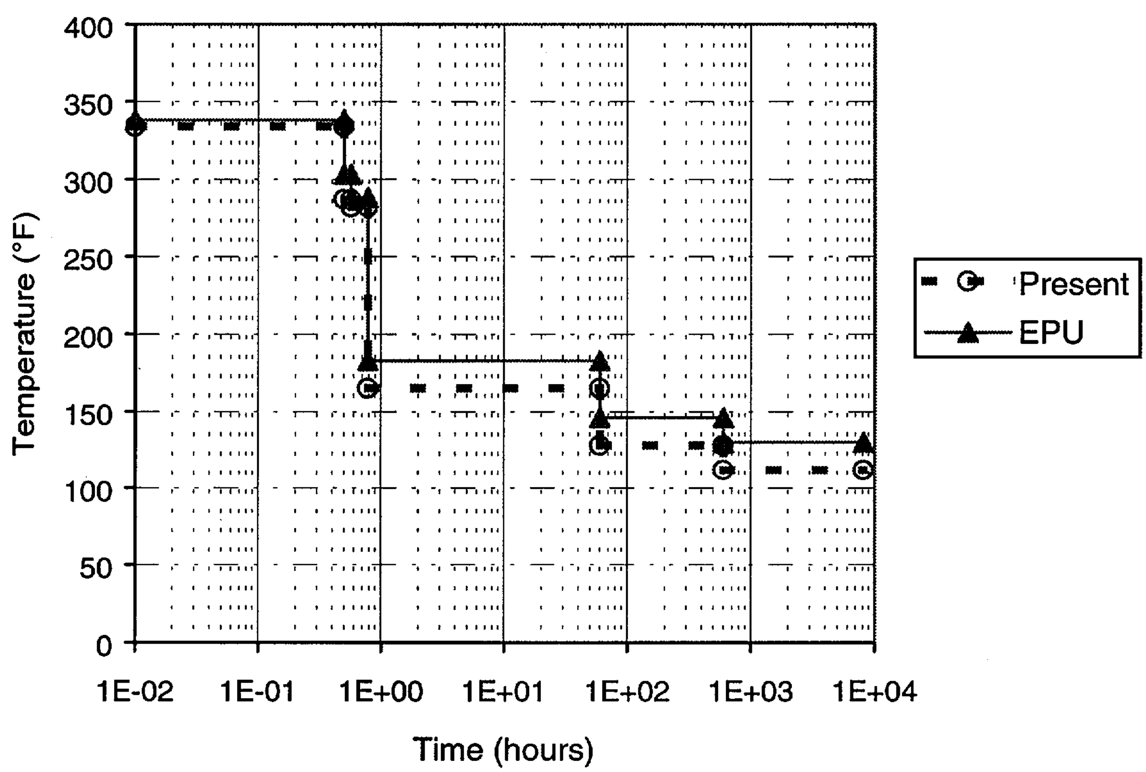
1. The qualification test temperature conditions for the required operability period during the first 24 hours following a LOCA were shown to envelop the corresponding EPU temperature profile.
2. The qualification test temperature conditions for the required operability period beyond 24 hours to 1 year following a LOCA were shown to meet the revised EPU temperature profile using Arrhenius methodology.

3. Maximum test pressure was shown to envelop the revised peak pressure for EPU.

EPU did not result in any changes to operating times for equipment required to operate following an accident.

Drywell – Present & EPU EQ Temperature Profile

Time (hours)	Present Temperature (°F)	EPU Temperature (°F)
0	334	338
0.5	334	338
0.57	287	303
0.8	282	288
61	165	183
588	128	146
8760	112	130



An example showing that the qualification test meets the revised EPU EQ profile for containment is given below:

ASCO Solenoid Valves

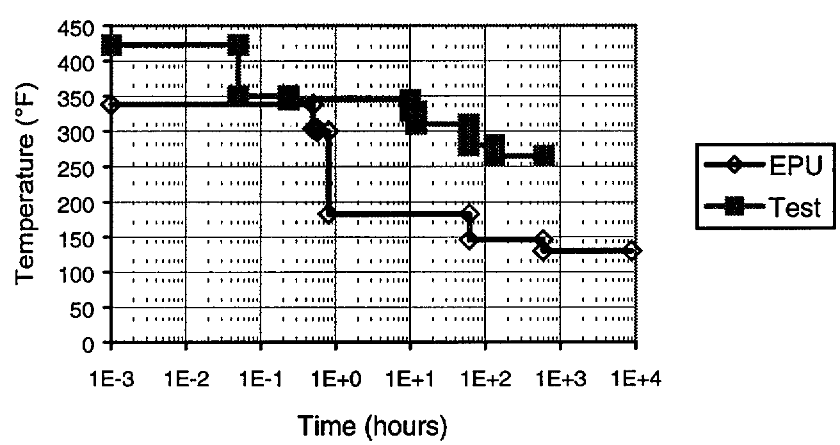
Test Conditions

Time (hours)	Temperature (°F)
0.01	423
0.05	350
0.233	345
10	328
12	310
60	310
132	280
600	265

Revised EPU EQ Containment Profile

Time (hours)	Temperature (°F)
0	338
0.5	338
0.57	303
0.8	300
61	183
588	146
8760	130

Test Conditions Envelop Revised EPU EQ Containment Profile



Question:

8. *Provide a discussion regarding the effect of humidity for the EPU condition on EQ of electrical equipment.*

Response:

The EQ of electrical equipment is based on a normal relative humidity of 20% to 90% and an accident relative humidity of 100% for affected areas. The EPU condition has not created any additional moisture for normal conditions, nor has it created any new areas affected by accident conditions. Therefore, the EQ of electrical equipment for normal or accident relative humidity has not changed.

Question:

9. *In Section 10.3.1.2, the licensee stated that the accident temperature, pressure and humidity conditions outside containment, resulting from a loss-of- coolant accident inside containment, may change with power levels as a result of the increased suppression pool temperature. How will the licensee verify the adequacy of EQ of electrical equipment without evaluating the effects of changes?*

Response:

Changes for temperature environments outside containment for a loss-of-coolant accident inside containment are being determined and evaluated for effects on qualification of electrical equipment within the EQ program. No changes to pressure or humidity environments result in areas outside containment for a LOCA inside containment. Evaluations will be done to show that the existing environmental documentation is adequate to meet the revised temperature profile due to EPU. Evaluations will be done for each equipment type using the following approach.

1. Existing documentation will be used to show that the qualification test temperature profile envelops the revised peak temperature for EPU.
2. The qualification test will be shown to meet the revised Post LOCA conditions outside containment for EPU using Arrhenius methodology.

Upon completion of the EQ reviews for equipment outside the drywell, EGC will provide the NRC with a summary of the results. This is expected to be completed by May 25, 2001.

Question:

10. *Identify the equipment potentially affected by the EPU condition and discuss how this equipment will be requalified. (The staff would like to have a meeting with the licensee regarding the new temperature, pressure and radiation profile and equipment test profiles.)*

Response:

Operation at EPU conditions changes the temperature, pressure and radiation environments for certain plant areas in which electrical equipment is located. Relative humidity does not change for EPU (see response to question 8).

For the EQ equipment, revised temperature, pressure and radiation values were compared to the existing posted qualified test values. This comparison identified some equipment where the EPU profile exceeded the current posted values. In some of these cases, additional test report data was available that demonstrated qualification to the EPU values. In other cases, location specific radiation analysis, material evaluations and Arrhenius calculations are used to qualify the equipment. No EQ electrical equipment will need re-testing to qualify for the EPU conditions.

EPU did not result in any changes to operating times for equipment required to operate following an accident.

Examples of equipment requiring more rigorous evaluation and the qualification method used or planned are shown in the table below.

Examples of Qualification Methods Used

Equipment	Qualification Parameter	Methodology Used or Planned to Qualify
Pressure Transmitter	Radiation exposure	Location specific radiation dose calculation to determine specific total integrated dose for the transmitter
Electrical Penetration Assemblies	Radiation exposure	Additional test report data demonstrated higher qualification levels than currently credited
Cables (in drywell)	Radiation exposure	Refined radiation dose analysis performed to demonstrate adequacy of cables
Target Rock SRV	Temperature	Qualified by Arrhenius methodology using existing test report data

Reference

1. Letter from R.M. Krich (Commonwealth Edison Company) to U.S. NRC, "Request for License Amendment for Power Uprate Operation," dated December 27, 2000