Commonwealth Edison
1400 Opus Place
Downers Grove, Illinois 60515

May 8, 1992

Dr. Thomas E. Murley
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Dresden Nuclear Station Units 2 and 3
Quad Cities Nuclear Station Units 1 and 2
Response to Request for Additional Information
Assessment of ECCS Operability without
the Room Cooler Heat Removal Capability
NRC Docket Nos. 50-237/50-249 and 50-254/50-265

References:
(a) L.N. Olshan to T.J. Kovach letter dated March 4, 1992
(b) Conference on February 21, 1992, between CECo (J. Schrage et. al) and NRC (S. Jones)
(c) Teleconference on February 22, 1992 between CECo (M. Richter) and NRC (S. Jones)
(d) Teleconference on April 4, 1992 between CECo (J. Schrage) and NRC (L. Olshan)

Dear Dr. Murley:

Commonwealth Edison (CECo) has performed analyses to justify operability of ECCS Systems at Dresden and Quad Cities Stations when the associated ECCS Room Coolers are inoperable. The NRC is currently evaluating these analyses.

Reference (a) requested additional information (RAI) from CECo in order to complete the NRC evaluation. The requested information was discussed prior to the issuance of the March 4, 1992 during the February 21, 1992 CECo/NRC conference (Reference (b)). The response to the RAI, including the results of the February 21, 1992 conference, is described in Attachment 1.

In a subsequent teleconference (Reference (c)), the NRC presented six additional questions to CECo regarding the ECCS Room Cooler analyses. The response to these questions are described in Attachment 2.

In a teleconference on April 4, 1992 (Reference (d)), CECo requested an extension for submittal of the response to the RAI until May 8, 1992. This extension was verbally granted by the NRC.

A001

If there are any questions or comments on the enclosed information, please contact John L. Schrage at (708) 515-7283.

Sincerely,

John L. Schrage
Nuclear Licensing Administrator

Attachments
Enclosures

cc: A. Bert Davis, Regional Administrator, RIII
T. Taylor, Senior Resident Inspector, Quad Cities Station
L. Olshan, NRR Project Manager, Quad Cities Station
S. Jones, NRR Technical Staff

ATTACHMENT 1

Response to Request for Additional Information

Assessment of ECCS Operability without the Room Cooler Heat Removal Capability

1. The study states that heat loads used in the analysis are assumed to be equal to the room cooler capacities. It is not clear that this assumption provides a conservative measure of the heat generation within each ECCS pump room. The licensee is requested to provide heat load calculations identifying each individual heat load for each ECCS pump room for the Dresden and Quad Cities Stations. The licensee is also requested to provide the associated room cooler capacity for each affected pump room.

   The heat loads used in the analysis were assumed to be equivalent to the room cooler capacities. This is a conservative assumption, given that the heat load from large AC motors is on the order of 8% of the motor power. Calculations have been obtained (original design calculations) to verify these assumptions. The results of these calculations are described in Table 1. In addition to these calculations, CECo is currently performing confirmatory calculations to verify the original design calculations. These confirmatory calculations are expected to be completed by August, 1992.

TABLE 1

ECCS Room Heat Loads
Heat Load (BTU/hr)

ECCS Room	CECo Analysis Value	Room Cooler Capacity	Original Design Value
Dresden			
HPCi	200,000	200,000	168,000[1]
LPCi	440,000	440,000	n/a[2]
Quad Cities			
HPCi	200,000	200,000	168,000
LPCi	570,000	570,000	n/a[2]
LPCS	340,000	340,000	195,000 (1B/2A) 285,000 (1A/2B)

NOTES:

1. Original heat load calculations for Dresden HPCI rooms is based upon Quad Cities value.

2. Calculations are not available

2. Failure of certain potentially unqualified components, such as the High Pressure Coolant Injection (HPCI) turbine gland seal condenser, may cause a substantial increase in the heat load for an individual ECCS Pump Room. The licensee is requested to address the potential additional heat load imposed by failure of unqualified components within the ECCS pump rooms at Dresden and Quad Cities Stations.

Failure of additional components leading to the release of steam to the pump rooms was not considered in the analysis. This type of consideration would only affect the HPCI rooms (D/QC) and possibly the RCIC/Core spray pump rooms (QC). In general, the design basis of the plant is that the systems are properly maintained and small steam leaks are fixed quickly, and extra leakage related heat loads are not considered. This was also the understanding reached in discussion of SBO analysis methods. It should be noted that the HPCI room takes extended time to reach high temperature assuming constant operation. HPCI is not required for extended time after design basis events since depressurization to LP systems is generally encouraged by procedure as soon as practicable.

Failure of the gland exhaust condenser is not considered likely since it is a simple mechanical heat exchanger. Postulating failure of the gland exhaust fan would lead to a situation in which non-condensibles would be able to collect in the gland exhaust condenser, degrading the performance of the condenser over time. Given the cyclic nature of HPCI operation as well as normal HPCI casing pressures decreasing with time due to RPV depressurization, the potential for significant releases of gland seal exhaust to the room is considered very limited.

UFSAR section 6.2.5.3.3.5 discusses the maximum gland seal leakage with a locked turbine rotor and full reactor pressure to the casing coupled with failure of the gland seal condenser system. The leakage under these conditions was determined to be 0.6 lbm/sec or less. For the locked rotor case, the availability of coolers is of limited concern since the HPCI is already in faulted condition.

For an operating HPCI Turbine, the steam pressure seen by the low pressure end gland seal would be significantly reduced (relative to the high pressure end gland seal). A failure of the gland seal condenser under these normal operating conditions would lead to significantly less leakage than the locked rotor scenario. Therefore, postulating seal leakage in the room heatup calculations does not appear to be warranted.

3. The study states that wall and ceiling concrete structures were modeled as heat sinks. The licensee is requested to identify the specific location of these heat sinks and describe the structure which constituted the ultimate heat sink for the Dresden model. The licensee is also requested to describe how solar heat loads on exterior structures were accounted for in the model. The corresponding study and similar information is also requested for the Quad Cities Station.

The only heat sinks assumed were the wall and ceiling areas of the pump rooms. These sinks were modelled as single sided structures one foot thick. Through wall heat transport was not credited. The areas of the heat slab models and ECCS room penetrations are listed in Table 2. The models of the corner rooms used boundary conditions for regions adjacent to he rooms based on the EQ envelopes for the areas. Since the full reactor building was not modelled in this study, solar heating on the building external surfaces was not modelled. The solar heating issue was discussed and dispostioned in the February 21, 1992 CECo/NRC conference.

TABLE 2

ECCS Room Wall/Ceiling Surface Areas

ECCS Room Wall and Ceiling Surface Area (FT **2)

	Wall	Ceiling
Dresden		
HPCI	6640	1450
LPCI	5053	645
Quad Cities		
HPCI	6640	1450
LPCI	5053	645
LPCS	4374	613

ECCS Room Penetrations (FT**2)

	To Torus	To Upper Room
Dresden		
HPCI	0.1	1
LPCIA	16.0	44
LPCIB	30.0	44
Quad Cities		
HPCI	0.1	1
LPCI	25.0	40
LPCS	0.1	30

4. A constant convection heat transfer coefficient was used in the Dresden model. The licensee is requested to provide the basis for the values selected for each facility. The licensee is also requested to describe how the lower rate of heat transfer to horizontal surfaces with respect to vertical surfaces, under natural circulation conditions, was addressed by the models.

In-plant testing was performed in the Quad Cities RHR rooms in 1986 and is documented in RSA-Q-86-01, Revision 0 (copy provided during February 21, 1992 CECo/NRC conference, and as Enclosure 1). The purpose of this testing was to provide a basis for model validation. In addition this testing demonstrated that treating the rooms as a homogeneous volume is appropriate. Different heat transfer coefficients were investigated and it was determined that a modelling value of 6.5 BTU/HR-FT2-F provided the best match to plant data. In the licensing calculations a value of 5.0 BTU/HR/FT2-F was used for conservatism.

A comparison calculation for the HPCI room was performed using the GOTHIC analysis package to determine the impact of reduced heat transfer coefficients on long term temperature behavior. A turbulent natural convection correlation was utilized which resulted in a value of 0.7 B/HR-FR2-F for the surface heat transfer coefficient. The GOTHIC model predicted a temperature after 24 hours of 185 F, compared to 150 F for the original RELAP calculation. While the 24 hour temperature increases from prior calculations, the conclusions that the HPCI will be operable for the duration of the time needed remains valid.

A review of the FSAR HPCI performance for small break LOCA demonstrates that reactor depressurization occurs within approximately 10 minutes for breaks of 0.1 FT2 or larger. For breaks smaller than 0.1 FT2, it would be possible to balance break flow with HPCI, but RPV depressurization would still occur fairly rapidly. The limiting case would be a blackout scenario, with HPCI being used to supply makeup to the RPV to balance leakage and shrinkage due to cooldown via the isolation condenser. Dresden and Quad Cities are 4-hour coping plants, with altenate AC capabilities in a one-hour period. Therefore, HPCI is not required for mitigation of any postulated scenario beyond approximately one hour if alternate AC is available, or four hours if alternate AC was unavailable. The analysis of the HPCI room heatup demonstrates that EQ concerns on HPCI components is not an issue for extended periods of time, greater than 24 hours, well in excess of any likely HPCI operation equipment.

5. The analysis assumes a homogeneous mixing of air throughout the pump room. The licensee is requested to describe the motive force which produces this mixing and provide the results of any testing performed which verified this assumption.

   Testing performed at Quad Cities Station (see Enclosure 1) demonstrated that fairly complete mixing occurs in the pump rooms. This is attributed to the motor cooling fans on the large motors. These fans provide a relatively high air flow that causes mixing and also leads to good heat transfer to the structures.

6. The results of the study indicate that bulk room temperature closely approaches or exceeds the equipment qualification temperature in certain ECCS pump room at Dresden Station. The licensee is requested to describe and provide the results of any testing or analysis which demonstrates that the local component temperature will not exceed the equipment qualification temperature and render the affected equipment inoperable when its service is required. The licensee is also requested to provide the temperature versus time profile utilized for qualification of affected electrical equipment.

   The applicable environmental zone data tables identify the ECCS rooms as Zones 3, 4, 5, and 6. This table lists the post-LOCA EQ temperature for these zones as 114° F. CECo has performed an evaluation (Enclosure 2) which concludes that components in the ECCS rooms at Quad Cities Station will continue to operate for at least 24 hours following a LOCA/LORC (Loss of Residual Cooling). This assumes a post-LOCA/LORC temperature of 185° F in the LPCI rooms. Tested time/temperature profiles for all applicable equipment in the ECCS rooms is provided in this evaluation. This calculation bounds the Dresden application based upon similarity of equipment in the respective ECCS pump rooms.

7. The study states that LOCA environmental conditions for the adjacent areas are assumed throughout the transient at Dresden. The licensee is requested to describe the assumed temperature verses time LOCA profiles for the relevant adjacent areas. Of particular interest to the staff is the response of the torus area temperature to a LOCA.

   The zone boundary conditions (temperature and humidity) are taken from a document entitled, "Response to IE Bulletin 79-01B Procedure for Use of Environmental Zone Maps for QCNPS Units 1 and 2". The torus area temperature used in the RSA-Q-90-02 was 104° F. The EQ LOCA zone temperature for that area is 135° F. The lower value was employed based on engineering judgment that the lower elevations of the torus area would be at reduced temperature due to stratification effects inherent in a stagnant area, comparable to the general building temperature.

8. The conclusion of the study recommends that the ECCS room cooler systems be restored to service as soon as possible if continuous full capacity ECCS operation is deemed necessary. The licensee is requested to describe results of any testing performed which demonstrates that DGCW is capable of supplying adequate flow to the emergency diesel generator and ECCS room coolers simultaneously. The licensee is also requested to address how this recommendation is intended to be implemented.

Industry experience at U.S. nuclear plants has indicated that the frequency and duration of events involving a Loss-Of-Offsite Power (LOOP) is small relative to the timeframe associated with the Dresden and Quad Cities ECCS room cooler analyses. NSAC Document 182 "Losses of Off-Site Power at U.S. Nuclear Power Plants Through 1991" (March 1992), documented 11 events with a loss of all off-site power from 1980 through 1992. The average duration of outage for these events was 4.3 hours, with a median duration of approximately two hours. Based upon industry data, CECo concludes that ECCS room cooler operation can be restored within the timeframe defined by analyses.

9. Appendix B 10 CFR Part 50 requires that testing be performed which demonstrates that structures, systems and components will perform satisfactorily in service. The licensee is requested to provide results of any testing which demonstrates that the ECCS components will perform satisfactorily without ECCS pump room cooler heat removal capability.

In-plant testing was performed in the Quad Cities RHR Rooms in 1986, and is documented in RGA-Q-86-01, Revision 0 (copy provided during February 21, 1992 CECo/NRC conference, and as Enclosure 1). This test forms the basis for assumptions used in analysis of other ECCS rooms. A conservative analytical approach is utilized, with the predicted temperatures compared to equipment qualification temperatures, which demonstrates operability of the equipment.

ATTACHMENT 2

Additional Questions/Responses

1. The RHR 2B Room (Quad Cities) transient temperature would reach 185° F if the equipment hatch is not removed within 10 hours. What procedures are in place to direct removal of hatch under LOOP conditions? Alternatively, can the RHR system meet its Design Basis assuming failure of the pumps in this room with an additional single failure?

   Quad Cities Station currently has an abnormal operating procedure which describes actions to be taken in the event of a loss of ECCS Room Coolers. This procedure currently requires the station to evaluate operability of the equipment in the affected room if the room cooler is inoperable. Upon approval of the engineering analysis which shows that the room coolers are not required for operability of the RHR and HPCI room equipment, the results of the analysis will be incorporated into this procedure. In order to address the special circumstances involving the 2B RHR room, provisions will be incorporated into this procedure such that the 2C and 2D RHR pumps will continue to be considered inoperable if the room cooler is inoperable unless the equipment hatch plugs are removed.

2. What operation of the heat load is assumed in the model, and how is the heat transferred to the room air volume?

   The heat loads are defined in the RELAP code as being powered heat slabs, of typically cylindrical geometry. The thickness of the slab is purposefully kept small to minimize heat up delay times. The power deposited to the slabs is constant, and the slab temperatures are allowed to rise as necessary to achieve a quasi-steady state energy balance.

3. Ventilation was restored 25 minutes into 1986 test. How was this effect accounted for in the analysis?

   The benchmark analytical model for the 1986 test was designed to include the restoration of ventilation. This is described on Page 8 of the test results (Enclosure 1).

4. Relap 4 Mod 6 is understood to be more applicable for pipe flow analyses (rather than compartment analyses). Has CECo previously utilized Relap Mod 6 for compartment applications to demonstrate its validity for compartment analyses? If so, where?

Relap 4 Mod 6 was specifically selected for this work by CECo as opposed to other available codes such as CONTEMPT4 Mod5 or COMPARE. Relap was used based upon its ability to characterize buoyancy driven flows in the rooms where natural circulation flow paths exist. CECo has employed Relap 4 Mod 6 on a number of calculations, typically subcompartment heatup due to steam breaks. This code was used to perform the steam tunnel temperature due to the HELB with superheat for the Byron and Braidwood stations. This calculation was reviewed and accepted by NRC. Single compartment calculations have been run using CONTEMPT and virtually identical results were obtained as Relap. In addition, the GOTHIC computer code was installed at CECo and comparisons were made to the Relap4 calculations. The results indicated good agreement.

5. Were any scaling factors utilized in the code/analysis to account for any differences between pipe flow applications and compartment applications?

No special scaling was required for this analysis. Relap 4 Mod 6 has an equation of state for air, and determines momentum changes due to flow. The test comparison showed that the code was able to predict measured data fairly well, with adjustments made principally to the heat slab surface heat transfer coefficient. The value determined to provide the best match to the data was approximately 6.5 BTU/HR-FT2-F, whereas for the analysis, a value of 5.0 BTU/HR-FT2-F was employed. This added a conservatism of nearly 25% in the licensing calculation.

6. For the Dresden and Quad Cities mods which tied in Service Water to the ECCS Room Coolers, at what location does the piping/connection become safety related and seismatically qualified?

Piping and instrumentation diagrams (P & IDs) for Dresden and Quad Cities Stations are provided in Enclosure . These have been marked to highlight the boundary locations for safety related/seismatically qualified piping.

ENCLOSURE 1

Study of Thermodynamic Characteristics of the Quad Cities ECCS Pump Rooms

RSA-Q-86-01 Rev. 0