Exelon Generation
4300 Winfield Road
Warrenville, IL 60555

www.exeloncorp.com

Exelon Nuclear

RS-04-114

August 6, 2004

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 Information Supporting the Request for License Amendment Related to Application of Alternative Source Term

References:
1. Letter from K. R. Jury (Exelon Generation Company, LLC) to U. S. NRC, "Request for License Amendments Related to Application of Alternative Source Term," dated October 10, 2002
2. Letter from P. R. Simpson (Exelon Generation Company, LLC) to U. S. NRC, "Additional Information Supporting the Request for License Amendment Related to Application of Alternative Source Term," dated June 30, 2004

In Reference 1, Exelon Generation Company, LLC (EGC) requested an amendment to the facility operating licenses for Dresden Nuclear Power Station, Units 2 and 3, and Quad Cities Nuclear Power Station, Units 1 and 2. The proposed changes support application of an alternative source term methodology.

In Reference 2, EGC submitted a response to a request for additional information related to crediting the standby liquid control system for pH control of the suppression pool following a design basis loss-of-coolant accident. A partial response to Request 3 was provided in Reference 2, and EGC indicated that information related to the adequacy of recirculation of suppression pool liquid would be addressed in a separate submittal by July 9, 2004. During the week of July 5, 2004, EGC informed the NRC that the date for submittal of this information would be delayed. The attachment to this letter provides the requested information.

EGC has reviewed the information supporting a finding of no significant hazards consideration that was previously provided to the NRC in Attachment C of Reference 1. The supplemental information provided in this submittal does not affect the bases for concluding that the proposed license amendment does not involve a significant hazards consideration.

A001

If you have any questions concerning this letter, please contact Mr. Kenneth M. Nicely at (630) 657-2803.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 6th day of August 2004.

Respectfully,

Patrick R. Simpson
Manager – Licensing

Attachment:
Response to Request for Additional Information

cc: Regional Administrator - NRC Region III
NRC Senior Resident Inspector - Dresden Nuclear Power Station
NRC Senior Resident Inspector - Quad Cities Nuclear Power Station
Illinois Emergency Management Agency - Division of Nuclear Safety

ATTACHMENT
Response to Request for Additional Information

Request

Please provide a description of the analysis assumptions, inputs, methods, and results that show that a sufficient quantity of sodium pentaborate can be injected to raise and maintain the suppression pool greater than pH 7 within 24 hours of the start of the event. (See also Position 2 of Appendix A to RG 1.183.) In your response, please discuss the adequacy of recirculation of suppression pool liquid via emergency core cooling systems through the reactor vessel and the break location and back to the suppression pool in meeting the transport and mixing assumptions in the chemical analyses. Assume a large break LOCA.

Addition to question:

The staff is interested in assuring that the core ECCS flow does not bypass the region of the vessel that contains sodium pentaborate and that sufficient sodium pentaborate will be transported to the suppression pool. In responding to question three, please indicate the source and volume flow rate of water that mixes with the sodium pentaborate and washes it from the vessel to the suppression pool. A diagram showing the injection point of the sodium pentaborate, the flow path through the core, and the exit path from the vessel would be helpful.

Response

In Response to Request 3 of Reference 1, Exelon Generation Company, LLC (EGC) submitted information describing the analysis assumptions, inputs, methods, and results that show that a sufficient quantity of sodium pentaborate can be injected to raise and maintain the suppression pool greater than pH 7 within 24 hours of the start of a Reactor Recirculation (RR) pump suction piping large-break loss of coolant accident (LOCA). The information provided below addresses the remaining portions of the NRC request above.

The Dresden Nuclear Power Station (DNPS) and Quad Cities Nuclear Power Station (QCNPS) emergency operating procedures (EOPs) for reactor pressure vessel (RPV) control are entered at the outset of a LOCA based on low reactor water level or high drywell pressure entry conditions. The Low Pressure Coolant Injection (LPCI) and Core Spray (CS) systems are among the preferred systems for maintaining reactor water level above the top of active fuel thereby ensuring adequate core cooling. The EOPs direct operators to manually initiate the Standby Liquid Control (SLC) system as an alternate injection system when reactor water level cannot be maintained above the top of active fuel. In the event that these EOP actions are unable to maintain adequate core cooling, the EOP directs entry into the severe accident management guidelines (SAMGs). Upon entry into the SAMGs, operators are directed to manually initiate SLC with no qualifying or conditional restrictions. Therefore, whenever there are symptoms of imminent core damage due to inadequate core cooling, operators are required by procedure to initiate SLC as well as ensure available low pressure emergency core cooling systems (i.e., CS and LPCI) are injecting.

The LOCA analysis assumes a failure of one electrical division resulting in one loop of CS and one loop of LPCI being available for injection to the vessel. The flow paths for CS and LPCI are described below, and a simplified reactor vessel flow diagram is included in this attachment.

The CS flow injects directly above the core, inside the shroud. A portion of the CS flow removes the decay heat via a phase change to steam. The steaming effectively reduces the amount of CS system mixing flow through the lower plenum. The remaining water injected by the CS system flows down the fuel bundles, past the core plate to the lower plenum. In the lower plenum (i.e., just below the core plate) the perforated SLC injection sparger disperses the sodium pentaborate solution into the reactor. The sodium pentaborate mixes with the CS flow and travels axially down along the guide tubes in the lower plenum. This sodium pentaborate flow path into the lower plenum is driven by the higher density SLC injected water, which is colder and has a higher specific gravity, and the circulation flow path of the CS water.

The LPCI injection flow enters the reactor vessel through the RR pump discharge piping. The LPCI loop selection logic ensures that LPCI injection flow is directed to the unbroken RR loop. The injection flow is directed into the lower plenum through the 10 jet pumps associated with the unbroken RR loop. The LPCI flow traverses across the lower plenum, mixing with the CS/sodium pentaborate solution. The combined LPCI/CS/sodium pentaborate solution flows through the jet pumps of the broken loop in the reverse direction and into the annulus. Here the mixture flows out the RR pump suction pipe break into the containment.

The suppression pool volumes, CS pump flow rates, LPCI pump flow rates, and SLC tank minimum volumes, are not the same for DNPS and QCNPS. Therefore, worst-case values for each of these inputs are used such that each station is bounded.

EGC conservatively includes the initial maximum liquid volume of the suppression pool (i.e., 119,800 cubic feet), the total volume of coolant in the RPV and attached piping (i.e., 10,030 cubic feet), water added to containment/RPV (i.e., 10,000 cubic feet), and the volume of the SLC system injection credited for pH control (i.e., 3253 gallons). Additionally, an injection flow rate of 4500 gpm was assumed for the LPCI and CS pumps, based on Technical Specification required values. The decay heat produced steam flow is conservatively assumed to be equivalent to the QCNPS design basis Reactor Core Isolation Cooling (RCIC) system flow rate of 400 gpm.

To illustrate the adequacy of SLC solution mixing in the suppression pool, the following is considered. A 2 hour time delay before emergency core cooling system and SLC initiation to refill the RPV is assumed, consistent with the event timing as described in Section 3.3 of Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," dated July 2000 (i.e., Reference 2). This consideration is solely intended to maximize the source term.

After 2 hours, injection of sodium pentaborate solution and emergency core cooling system fill of the reactor vessel take place. As described in Reference 3, only 75 minutes are required to inject the mass of sodium pentaborate solution assumed in the pH analysis, with one SLC pump in operation. During this time, a portion of the sodium pentaborate will be transported out of the reactor vessel. However, in order to ensure sufficient time is allotted to transport injected sodium pentaborate out of the reactor vessel, an additional 75 minutes is considered. Therefore, the elapsed time between the event initiation and the start of credited suppression pool mixing is 4.5 hours (i.e., 2 hours plus 75 minutes for SLC injection and transport plus an additional 75 minutes). The bottom of the drywell would already be flooded from the blowdown following the LOCA.

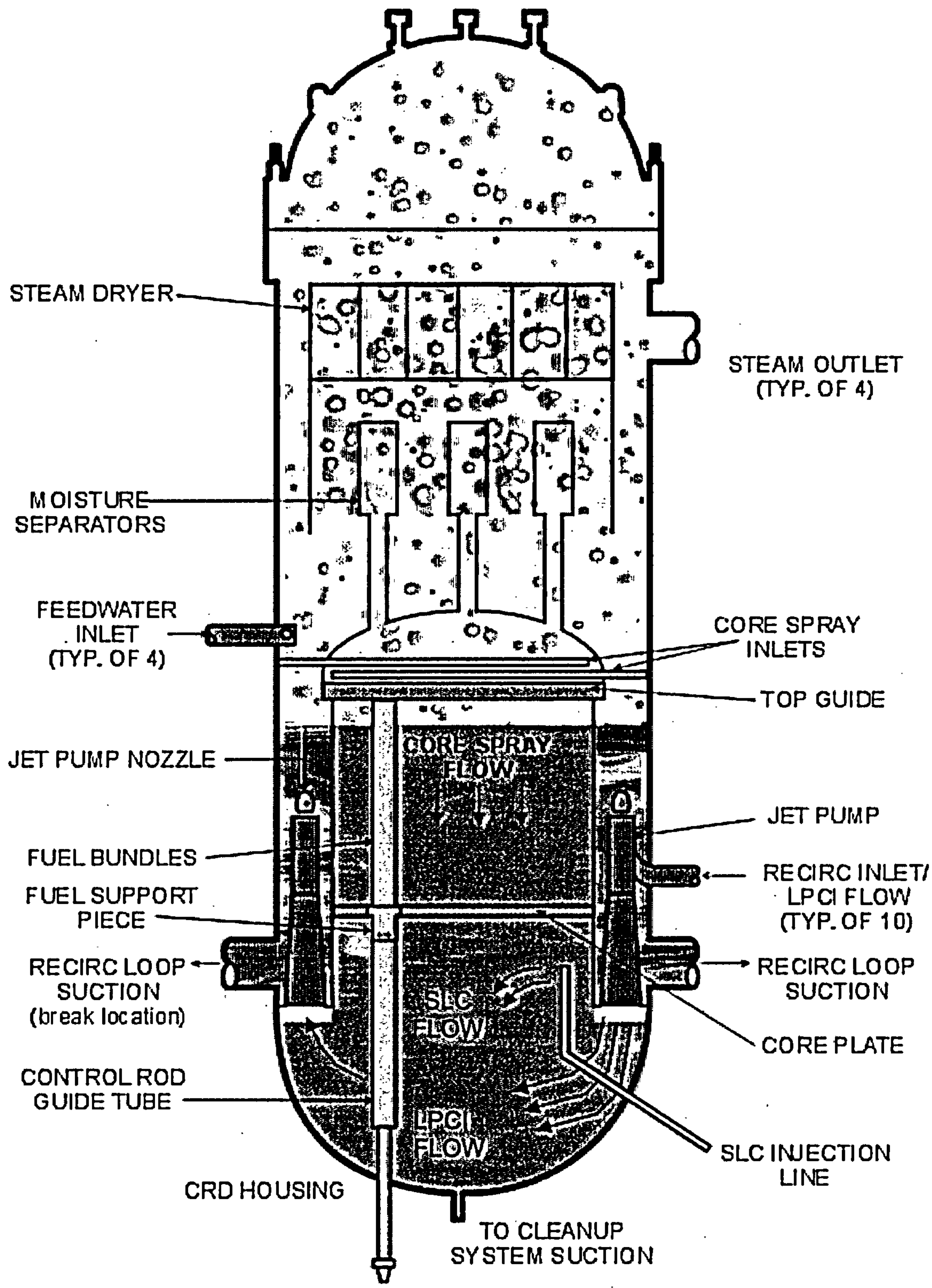
Both CS and LPCI/Residual Heat Removal (RHR) are expected to be operated during the first 24 hours following a design basis LOCA event. The CS and LPCI/RHR systems directly contribute to the SLC solution mixing action because their suction source is the suppression pool. In the case of RHR, this mixing occurs in various modes of operation (e.g., LPCI, containment cooling, or containment spray) since these modes take suction from the suppression pool and return the water to the suppression pool. With a CS flow rate of 4100 gpm (i.e., 4500 gpm injection less 400 gpm boil off) and a LPCI/RHR flow rate of 4500 gpm (i.e., 68,979 cubic feet per hour) a complete suppression pool turnover takes place every 2 hours. In 24 hours, a minimum of 9 turnovers of the suppression pool would be achieved. This assures that the transport and mixing assumptions in the chemical analyses are met.

Reference

1. Letter from P. R. Simpson (Exelon Generation Company, LLC) to U. S. NRC, "Additional Information Supporting the Request for License Amendment Related to Application of Alternative Source Term," dated June 30, 2004

2. Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," dated July 2000

3. Letter from P. R. Simpson (Exelon Generation Company, LLC) to U. S. NRC, "Additional Information Supporting the Request for License Amendment Related to Application of Alternative Source Term," dated March 21, 2003


STEAM DRYER
STEAM OUTLET
(TYP. OF 4)
MOISTURE
SEPARATORS
FEEDWATER
INLET
(TYP. OF 4)
CORE SPRAY
INLETS
TOP GUIDE
JET PUMP NOZZLE
CORE SPRAY
FLOW
JET PUMP
FUEL BUNDLES
RECIRC INLET/
LPCI FLOW
(TYP. OF 10)
FUEL SUPPORT
PIECE
RECIRC LOOP
SUCTION
(break location)
RECIRC LOOP
SUCTION
SLC
FLOW
CORE PLATE
CONTROL ROD
GUIDE TUBE
LPCI
FLOW
SLC INJECTION
LINE
CRD HOUSING
TO CLEANUP
SYSTEM SUCTION