PHILADELPHIA ELECTRIC COMPANY

2301 MARKET STREET

P.O. BOX 8699

PHILADELPHIA, PA. 19101

(215) 841-4500

V. S. BOYER
SR. VICE PRESIDENT
NUCLEAR POWER

October 19, 1984

Mr. A. Schwencer
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Limerick Generating Station, Units 1 and 2
Additional Information for Auxiliary Systems Branch

Reference:

1) NRC Safety Evaluation Report (NUREG-0991) Open Issue #2 (Tornado Missile Effects on Ultimate Heat Sink)

2) Letters - NRC (A. Schwencer) to PECo (E.G. Bauer, Jr.) dated 8/8/83 and 7/26/84

3) Letters - PECo (J.S. Kemper) to NRC (A. Schwencer) dated 3/22/84, 7/27/84, 9/4/84, 9/11/84 and 9/24/84.

4) Meeting between NRC (R. Bernero, T. Novak et al.) and PECo (V. Boyer, L.B. Pyrih et al.) on 10/19/84.

5) Limerick Generating Station FSAR - Response to NRC RAI 410.70.

Dear Mr. Schwencer:

This letter provides additional information to assist the NRC staff in resolving the reference 1 open item by documenting discussions at the reference 4 meeting.

First, the NRC asked, in the reference 2 letters, that Philadelphia Electric Company provide a Probabilistic Risk Assessment to demonstrate that the annual frequency of exceedence of 10CFR Part 100 limits due to missiles damaging the Ultimate Heat Sink is less than or equal to a median value (realistic) of $1X10^{-7}$ or a mean value (conservative) of $1X10^{-6}$. In response to these requests, PECo provided, via the reference 3 letters, the requested PRA and additional information thereon which showed that the conservative probability of such an event was less than $1X10^{-6}$.

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Although the target established by the staff for a conservative analysis was met, there are a number of conservatisms in the analysis which have not been quantified and therefore which are not reflected in the results. These include:

- the assumption that, if any single missile of sufficient velocity to cause failure of a spray arm or perforation of a distribution header enters any spray network, the entire heat removal capability of the spray network is lost.

- the assumption that damage to the spray networks is directly linked to exceedance of 10CFR100.

The discussions at the reference 4 meeting indicated the need for additional information on measures which would be taken in the highly improbable (less than $1X10^{-6}$ - conservative) event that all Ultimate Heat Sink cooling capability is lost. This additional information relates to:

1. The time available before mitigative measures to provide additional cooling capability are required,

2. The repair procedure which:
   a. would restore the UHS to its design capability, and
   b. temporary provisions of additional cooling capability until repairs are completed, and

3. Plant operating procedures which preclude core damage in the improbable event that the repair procedure discussed above is unsuccessful.

This information is contained in a revised response to the reference 5 RAI, a copy of which is attached.

The information in this letter and the reference 3 letters demonstrated that the probability of exceeding 10CFR Part 100 limits is less than $1X10^{-7}$ on a conservative basis and shows that the time and alternative measures available provide additional assurance that the required cooling can be maintained.

Very truly yours,

Vincent S. Boyer

cc: See attached service list.

Attachments

cc: Judge Helen F. Hoyt
Judge Jerry Harbour
Judge Richard F. Cole
Judge Christine N. Kohl
Judge Gary J. Edles
Judge Reginald L. Gotchy
Troy B. Conner, Jr., Esq.
Ann P. Hodgdon, Esq.
Mr. Frank R. Romano
Mr. Robert L. Anthony
Ms. Phyllis Zitzer
Charles W. Elliot, Esq.
Zori G. Ferkin, Esq.
Mr. Thomas Gerusky
Director, Penna. Emergency Management Agency
Angus R. Love, Esq.
David Wersan, Esq.
Robert J. Sugarman, Esq.
Martha W. Bush, Esq.
Spence W. Perry, Esq.
Jay M. Gutierrez, Esq.
Atomic Safety & Licensing Appeal Board
Atomic Safety & Licensing Board Panel
Docket & Service Section
Mr. James Wiggins
Mr. Timothy R. S. Campbell

QUESTION 410.70 (Section 9.2.6)

Provide the basis for concluding that the design temperature for the ESW and RHRSW will not be exceeded using only tornado and tornado missile protected structures, systems and components.

RESPONSE

As described in Section 9.2.6, the ultimate heat sink at Limerick is an excavated spray pond with a surface area of 9.9 acres. Four spray networks, each having 50% capacity for shutdown of two units, are provided.

Details of the spray pond excavation and finished grading are shown in Figures 3.8-55, 3.8-56, and 3.8-57. The general arrangement of the spray pond, spray networks, and spray pond pump structure is shown in Figure 9.2-6. The layout of the spray networks is shown in Figure 9.2-7.

As discussed in Section 3.5.1.4, all essential structures, systems, and components related to the ESW system, RHRSW system, and the UHS are protected from the effects of tornadoes and tornado missiles. Protection of the spray networks from tornado missiles is provided by location of the network piping and sprays below the surrounding grade and by physical separation of the networks:

a. In all but the spillway area, the surrounding grade is in excess of El. 260 ft. while the top of the sprays are at El. 258 ft and the spray network piping is between El. 253 ft 05 in. and El. 256 ft 8 in.

b. The closest branches of adjacent spray networks are separated by 65 ft.

c. The supply piping to adjacent networks is separated by 215 ft.

d. The networks are located at a minimum distance of 72 ft from the edge of the pond.

The use of elevational differences and physical separation to provide protection of the spray pond networks from tornado missiles is justified by the following considerations:

a. Only two spray networks are required for the safe shutdown of both units.

b. The only active failure that can compromise the operability of a spray network is failure cf its supply valve (HV-57-032A, B, C, or D). These valves may be manually operated to isolate damaged networks or to initiate the use of undamaged networks if their controls or motors are inoperable.

c. The physical arrangement of the spray networks precludes the possibility that large missiles can damage more than one spray network due to trajectory considerations. Multiple missiles of sufficient energy and distribution to substantially damage multiple networks are unlikely. Network piping varies in size from the 30-in. diameter supply headers to the 2-in. diameter piping at the extreme ends of the distribution branches. Network piping wall thickness varies from 0.337 to 0.500 in.

d. The loss of some sprays in a network does not result in substantial loss of heat removal capability for the entire network (each network contains 240 spray nozzles).

e. The design thermal performance of the spray pond is based on conservative design values of initial pond temperature and meteorology as described in Section 9.2.6.4. For all expected conditions, the margin in thermal performance would be considerably greater than the 10% margin demonstrated under design conditions. In fact, for average meteorological conditions, a single spray network is sufficient for the removal of the heat rejected from both units for at least a 24-hour period.

f. Interconnections are provided that allow the use of the cooling towers as a heat sink for ESW and RHRSW systems. Such operation may be initiated from the control room or locally by manual operation.

It is unlikely that tornado winds would compromise the heat removal capability of the spray pond networks, or the cooling towers, to the extent that safe shutdown of the units would be affected. As described in Section 3.5.1.4, the spray networks have been designed to withstand design basis tornado winds. While not specifically designed to withstand design basis tornado winds, the cooling tower shell and supporting structure have been designed to withstand the following wind loading when either operating or dry:

Elev. Above Grade (ft)	Wind Velocity (mph)
30	90
150	113
200	118
300	125
400	130
500	135

The cooling towers are expected to provide sufficient heat removal capability for the safe shutdown of the units even in the event that the tower fill is extensively damaged.

g. The loss of more than two spray networks and the coincident loss of the cooling towers due to tornado missiles is unlikely due to physical separation of the cooling towers and the spray pond. The cooling towers are located approximately 600 feet from the nearest portion of a spray network.

The likelihood of tornado winds and/or missiles affecting the safe shutdown capability of the cooling towers and spray networks at the same time is quite remote when the above described design factors are considered together with the variation in tornado intensity along its path length and width (NUREG/CR-2944, Tornado Damage Risk Assessment, Reinhold & Ellingwood, Brookhaven National Labs., Sept. 82).

h. Tornado missiles are an insignificant contributor to plant risk because of the low frequency of occurrance of tornadoes in this region (EROL Section 2.3.1.2.2) and the low likelihood of damaging missiles if one were to occur.

Even if the safe shutdown capability of the cooling towers and spray networks were compromised by tornado effects, use of the cooling tower basins and/or UHS in a "cooling pond type" mode would allow substantial time for spray network repair.

SEE INSERT (1), ATTACHED

Insert 1 to RAI 410.70

A plant procedure (which will be approved and implemented prior to exceeding 5% power) will govern such repair activities. This procedure will contain, at a minimum, the following elements:

1. Repair work on damaged spray networks will begin immediately, utilizing materials, equipment and personnel which have been verified to be available. Procedure verification will be made each year.

2. Upon loss of all UHS/CT cooling capability, the spray pond will be operated as a closed cycle cooling pond until the temperature of the water reaches the design limit of 95° F. In this mode, water will be returned to the pond via the winter bypass line to promote thermal mixing and minimize the likelihood of recirculation. (Under design basis conditions of initial pond temperature and meteorology, it would take approximately 6 hours for the pond to reach its 95°F limit. Under average conditions, it would take approximately 10 hours to reach this limit. Both numbers are for two unit, full power operation. For single unit operation, these times would be approximately 12 hours and 20 hours respectively. The heat rejection rate can be further reduced by depressurizing the reactor at a slower rate than 100°F/hr assumed in the design basis analysis.)

3. When the pond reaches the design temperature limit, the sluice gates between the spray pond pumphouse wet wells and the spray pond will be closed. Water will then be released from the cooling tower basins into the wet wells and pumped through the plant to service the required heat loads. The water will be returned to the spray pond and will be allowed to discharge over the blowdown weir and storm spillway. (The two cooling tower basins contain a total of 14 million gallons. If it is conservatively assumed that only one half of this volume of water is available, there is sufficient water to provide makeup for the ESW and RHRSW pumps, operating in a once through mode, for an additional 4 hours. In the unlikely event that the cooling tower basin walls have failed due to tornado missiles, the additional time of four hours would not be available. However, the spray pond PRA demonstrates that it is extremely improbably that the four spray pond networks would not be available.)

4. Sufficient makeup water can be supplied to the cooling tower basins to sustain continuous operation in this mode from a number of sources as described in i. below.

i. The Schuylkill River makeup pumphouse is located approximately 1500 ft. from the nearest cooling tower, making it unlikely that the pumphouse would be damaged by a tornado which would also compromise the spray pond networks and the cooling towers. This pumphouse is powered from the 2300 V plant services switchgear. This switchgear can be fed using offsite power from either of the two plant substations via underground lines. The two substations are approximately 2000 ft. apart, making it highly unlikely that both substations would be disabled by a tornado which would also compromise the spray pond networks and the cooling towers.

While an additional source of water is available from the pump station providing the Perkiomen makeup supply located at a distance of approximately 8 miles from the plant site, no reliance is being placed on this intake for the purpose of safety analysis or the safety licensing basis for the facility.

If existing sources of makeup cannot be made available in a timely manner, makeup will be provided using available portable pumps of required size and capacity to pump water from the Schuylkill River to the spray pond pumphouse wet wells. The water would be pumped via a tie-in to the existing underground water pipeline which runs from the Schuylkill River Intake Pumphouse to the cooling tower basins. It would then flow via gravity to the pump pits. If a tie-in to the existing pipeline is not possible, then the water would be pumped directly to the wet well through temporary lines. The portable pumps which will be used are either PECo owned pumps or rental pumps. The required pumps will be verified to be available prior to exceeding 5% power and yearly thereafter.

j. Plant emergency procedures address the various contingency actions available to the operators to deal with degraded UHS conditions. As indicated in the above discussions, substantial time is available for corrective operator actions. If UHS capability should be lost for such a long period of time that conditions degraded considerably, the plant emergency procedures would direct the use of equipment which would achieve a safe stable state regardless of UHS capability. Information on these plant emergency procedures was provided at the request of the NRC Procedures & Systems Review Branch in a letter from PECo (J.S. Kemper) to the NRC (A. Schwencer) dated August 2, 1984.