UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

April 14, 1977

Honorable Marcus A. Rowden
Chairman
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: REPORT ON PERKINS NUCLEAR STATION, UNITS 1, 2, AND 3
AND CHEROKEE NUCLEAR STATION, UNITS 1, 2, AND 3

Dear Mr. Rowden:

At its 204th meeting, April 7-9, 1977, the Advisory Committee on Reactor Safeguards (ACRS) completed its review of the application of the Duke Power Company for authorization to construct Perkins Nuclear Station, Units 1, 2, and 3, and Cherokee Nuclear Station, Units 1, 2, and 3. Members of the ACRS Subcommittee visited the sites on October 22, 1976. A Subcommittee meeting was held on March 18, 1977, in Charlotte, North Carolina, to review the application. During its review, the Committee had the benefit of discussions with representatives and consultants of the Duke Power Company, Combustion Engineering Incorporated, and the Nuclear Regulatory Commission (NRC) Staff. The Committee also had the benefit of the documents listed.

The Perkins Station is located in Davie County, North Carolina, approximately seven miles southeast of Mocksville, North Carolina, and 48 miles north-northeast of Charlotte, North Carolina. The minimum exclusion area distance is 1960 feet; the low population zone radius is five miles. The nearest population center is the Salisbury-Spencer area (1970 population of 25,600) which is about ten miles south of the site.

The Cherokee Station is located in Cherokee County, South Carolina, approximately eight miles east of Gaffney, South Carolina, and 40 miles southwest of Charlotte, North Carolina. The minimum exclusion area distance is 1960 feet; the low population zone radius is five miles. The nearest population center is Spartanburg, South Carolina (1970 population of 45,000) which is about 21 miles west of the site.

The application for the Perkins and Cherokee Stations was submitted in accordance with the Commission's standardization policy as described in Appendix O to Part 50, "Licensing of Production and Utilization Facilities," and Section 2.110 of Part 2, "Rules of Practice," of Title 10 of the Code of Federal Regulations. For this application, the reference system is the Combustion Engineering Standardized Nuclear Steam Supply System known as

Standard Reference System-80. This design has been reviewed by the ACRS and was discussed in its report of September 17, 1975, "Combustion Engineering Standard Safety Analysis Report - CESSAR-80." The balance of plant designs will be identical for the two sites except for variations required by differences in site geometries.

Each Perkins and Cherokee reactor will use a spherical steel containment vessel with a minimum net free volume of 3,300,000 cubic feet. The containment will be designed for an internal pressure of 46.8 psig and temperature of 280°F. The containment vessel will be completely enclosed by a seismic Category I shield building. The annulus, between the containment and the shield building above the 92-foot elevation, will utilize a slightly negative pressure in order to control the release of radioactive materials in gaseous effluents following a loss-of-coolant accident. The spaces external to the containment vessel below the 92-foot elevation will not be maintained at a negative pressure but penetration and leak collection channels over the containment vessel welds will be vented to the annular space above the 92-foot elevation.

For the safe shutdown earthquake for both the Perkins and Cherokee Stations, an acceleration of 0.15g will be applied at the foundation level of rock-supported structures. For structures not supported on rock, the design ground motion will be applied at the level of continuous rock and propagated upward to the foundation level. The operating basis earthquake acceleration will be 0.08g, similarly applied.

The ultimate heat sink design for each Station uses two separate and redundant mechanical draft cooling towers and two independent sources of makeup water. The normal operating mode will use the cooling towers with makeup water supplied for the Cherokee Nuclear Station from the intake sedimentation basin or nuclear service water pond and for the Perkins Nuclear Station from either of the two nuclear service water ponds. As an available alternate operating mode in both cases, cooling water can be made to bypass the cooling towers and flow directly to a nuclear service water pond for cooling by surface evaporation. The NRC Staff is requiring that the chimney drain in the nuclear service water pond dams be increased from a width of three feet to a width of six feet and that an impervious embankment zone be provided upstream and adjacent to the chimney drain. This matter should be resolved in a manner satisfactory to the NRC Staff.

The NRC Staff has identified several outstanding issues in its safety evaluations of the Perkins and Cherokee Stations which will require resolution before issuance of a construction permit. The Committee recommends that these matters be resolved in a manner satisfactory to the NRC Staff.

The Committee recommended in its report of September 10, 1973, on acceptance criteria for emergency core cooling systems (ECCS), that significantly improved ECCS capability should be provided for reactors for which construction permit requests were filed after January 7, 1972. The construction permit request for the Perkins and Cherokee Stations is in this category. The CESSAR-80 nuclear steam supply system proposed for use at these Stations will use 16 X 16 fuel assemblies. Although calculated peak clad temperatures, in the event of a postulated LOCA, may be less for the proposed 16 X 16 array than for the 14 X 14 array used in earlier Combustion Engineering reactors, the Committee believes that the Applicant should continue studies that are responsive to the Committee's September 10, 1973 report. If studies, conducted with the best available techniques, establish that significant further ECCS improvements can be achieved, consideration should be given to incorporating them into the Perkins and Cherokee Stations.

The ACRS recommends that the NRC Staff and the Applicant review and evaluate the probability of loss of all AC power as a function of the duration of such power loss and develop criteria and a specific approach to assure that the plant can withstand such an event with acceptable reliability.

The Committee believes that further consideration is required of the procedures and bases by which the possible implementation of new regulatory requirements and improved safety features are considered for plants whose scheduled initial operation is much more than the normal time period beyond a construction permit. A proper balance between the advantages of standardization and the value of safety improvements needs to be obtained The Committee believes this matter should be resolved generically.

Various generic problems are discussed in the Committee's report, "Status of Generic Items Relating to Light Water Reactors: Report No. 5," dated February 24, 1977 (Attached). Those problems relevant to the Perkins and Cherokee Stations should be dealt with by the NRC Staff and the Applicant as solutions are found. The relevant items are: II-1, 2, 3, 4, 6, 7, 9; II.A-3, 4, 5, 6, 7; II.B-1, 2; II.C-1, 2, 3, 4, 5, 6; II.D-1, 2.

The Advisory Committee on Reactor Safeguards believes that the items mentioned above can be resolved during construction and that, if due consideration is given to the foregoing and to items mentioned in its CESSAR-80 report of September 17, 1975, the Perkins Nuclear Station, Units 1, 2, and 3, and the Cherokee Nuclear Station, Units 1, 2, and 3, can be constructed with reasonable assurance that they can be operated without undue risk to the health and safety of the public.

Sincerely,

M. Bender

M. Bender
Chairman

ATTACHMENT:
[*] Advisory Committee on Reactor Safeguards Status of Generic Items Relating to Light-Water Reactors: Report No. 5

ADDITIONAL REMARKS BY ACRS MEMBER D. OKRENT

I believe that the philosophy and criteria of Appendix A of 10 CFR 100, and their application by the NRC Staff in setting SSE values, should be reevaluated as part of an early overall reassessment of the current approach to seismic safety design. I believe that the estimates of the contribution of earthquakes to overall nuclear reactor safety risk, as given in the Reactor Safety Study (WASH-1400) are not without fault, and that seismic contribution to risk is underestimated in that study.

I find the Applicant's estimate of the return frequency of the SSE at the Cherokee and Perkins sites of greater than 10^{-4} per year to be unsatisfactorily large, particularly in view of his arbitrary cutoff at MM VII of the earthquakes permitted to contribute to this probabilistic assessment. For Cherokee/Perkins, I find the proposed SSE of 0.15g marginally acceptable and would prefer that a value of 0.2g be employed at the foundation level on rock.

With regard to design improvements in ECCS, as recommended by the ACRS in its reports on ECCS acceptance criteria of December 18, 1972, and September 10, 1973, the last of the Cherokee/Perkins units are currently scheduled for commercial operation nearly 20 years after the above ACRS recommendation, but include improvement in only one area of the several recommended by the ACRS, and exhibit predicted maximum clad temperatures near the limits of Appendix K, 10 CFR 50. I believe the pace of improvement is too slow, and that much of this can be attributed to the current NRC Staff approach which attempts only to judge that the proposed systems meet Appendix K.

References:

1. Duke Power Company: "Preliminary Safety Analysis Report for the Perkins Nuclear Station, Units 1, 2, and 3 and the Cherokee Nuclear Station Units 1, 2, and 3," with Amendments 1-28.
2. U.S. Nuclear Regulatory Commission: "Safety Evaluation Report by the Office of Nuclear Reactor Regulation, Related to Duke Power Company Construction of Perkins Nuclear Station, Units 1, 2 and 3, Docket Nos. STN 50-488, STN 50-489 and STN 50-490," NUREG-0188, dated March 1977.
3. U.S. Nuclear Regulatory Commission: "Safety Evaluation Report by the Office of Nuclear Reactor Regulation, Related to Duke Power Company Construction of Cherokee Nuclear Station, Units 1, 2 and 3, Docket Nos. STN 50-491, STN 50-492 and STN 50-493," NUREG-0189, dated March 1977.
4. Letter from Isabel Bittinger, Yadkin River Committee, to the ACRS, concerning safety of nuclear facilities, dated March 11, 1977.
5. Letter from Mary Jo Pribble to the ACRS, concerning safety of the Cherokee Nuclear Station, dated March 8, 1977.

[*] See pages 2287-2330, Volume IV

References Cont'd:

6. Letter from Jesse L. Riley, The Carolina Environmental Group, to the ACRS, concerning questions on safety of Duke Power Company nuclear plants, dated March 6, 1977.
7. Letter from Duke Power Company to Nuclear Reactor Regulation, NRC, concerning results of evaluation of a fuel handling accident inside containment, dated March 4, 1977.
8. Letter from Duke Power Company to Nuclear Reactor Regulation, NRC concerning commitments on outstanding items, dated February 8, 1977.
9. Letter from Duke Power Company to Nuclear Reactor Regulation, NRC concerning response to ACRS Generic Items, dated December 7, 1976.
10. Letter from Duke Power Company to Nuclear Reactor Regulation, NRC, concerning Fire Protection Evaluation, dated November 23, 1976.
11. Letter from Duke Power Company to Nuclear Reactor Regulation, NRC, concerning response to NRC request for additional information on electrical systems, dated February 13, 1976.
12. Letter from Duke Power Company to Nuclear Reactor Regulation, NRC, concerning containment external pressure and stresses, dated October 10, 1975.