ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

UNITED STATES ATOMIC ENERGY COMMISSION

WASHINGTON, D.C. 20545

June 15, 1967

Honorable Glenn T. Seaborg
Chairman
U. S. Atomic Energy Commission
Washington, D. C.

Subject: REPORT ON VERMONT YANKEE NUCLEAR POWER STATION

Dear Dr. Seaborg:

At its eighty-sixth meeting, on June 8-10, 1967, the Advisory Committee on Reactor Safeguards completed its review of the application by Vermont Yankee Nuclear Power Corporation for authorization to construct the Vermont Yankee Nuclear Power Station. This project was previously considered at ACRS Subcommittee meetings held in Washington, D. C. on May 10, 1967, and in Vermont on June 7, 1967. On the latter date, the Subcommittee also visited the reactor site. During its review, the Committee had the benefit of discussions with representatives of Vermont Yankee Nuclear Power Corporation, General Electric Company, EBASCO Services Incorporated, Chicago Bridge and Iron Company, and the AEC Regulatory Staff. The Committee also had the benefit of the documents listed below.

The Vermont Yankee Nuclear Power Station is to be located in southern Vermont, on the west bank of the Connecticut River in the town of Vernon. The Vermont Yankee reactor will be a single cycle, forced circulation boiling water unit with a design power level of 1593 MW(t). The average core power density of the Vermont Yankee unit is essentially the same as that of the previously reviewed Browns Ferry reactors, and the complex of emergency core cooling systems is similar to that proposed for the Browns Ferry reactors. The Committee believes that several of the comments made in the March 14, 1967 report on Browns Ferry apply to the Vermont Yankee application:

1. Analysis indicates that a large fraction of the reactor fuel elements may be expected to fail in certain loss-of-coolant accidents. The applicant states that the principal mode of failure is expected to be by localized perforation of the clad, and that damage within the fuel assembly of such nature or extent as to interfere with heat removal sufficiently to cause clad melting would not occur. The Committee believes that additional evidence, both analytical and experimental, is needed and should be obtained to demonstrate that this model is adequately conservative for the power density and fuel burnup proposed.*

2. The applicant considers the possibility of melting and subsequent disintegration of a portion of a fuel assembly, by inlet coolant orifice blockage or by other means, to be remote. However, the resulting effects in terms of fission product release, local high pressure production, and possible initiation of failure in adjacent fuel elements are not well known. Information should be developed to show that such an incident will not lead to unacceptable conditions.*

3. A linear heat generation rate of 28 KW/ft is used by the applicant as a fuel element damage limit. Experimental verification of this criterion is incomplete, and the applicant plans to conduct additional tests. The Committee recommends that such tests include heat generation rates in excess of those calculated for the worst anticipated transient and fuel burnups comparable to the maximum expected in the reactor.*

4. In a loss-of-coolant accident, the core spray and flooding systems are required to function effectively under circumstances in which some areas of fuel clad may have attained temperatures higher than those at which such cooling mechanisms have been tested to date. The applicant is conducting tests of these devices at increased temperatures and has reported preliminary results which are promising. The Committee again urges that these tests be extended to temperatures as high as practicable. The use of stainless steel in these tests for simulation of the Zircaloy clad appears suitable, but some corroborating tests employing Zircaloy should be included.

The reactor vessel for Vermont Yankee will be a field-fabricated vessel quite similar to that proposed for the previously reviewed Monticello Nuclear Generating Plant. The Committee recommends that great care and diligence be exercised in the quality control program for this vessel to ensure the soundness of this important plant component.

The Committee continues to emphasize the importance of quality assurance in fabrication of the primary system and of inspection during service life. The Committee recommends that the applicant implement those improvements in primary system quality which are practical with current technology.*

The integrity of Vernon Dam, just downstream of the plant site, is essential to maintain the normal cooling water supply to the plant. The applicant has examined the design of the dam and states that it should withstand, without gross failure, the maximum hypothetical earthquake selected for the site.

He has proposed, however, to provide an alternate means of removing shutdown heat from the plant in the event that the river level should fall below the normal cooling water inlet. The Committee believes that shutdown heat removal can be accomplished by one of the several methods being considered by the applicant.

The Committee recommends that the applicant give special attention to the design of critical elements of the plant piping, including the drywell-torus connections, to ensure that these elements are not overstressed under maximum earthquake forces.

The applicant proposes to use sensing devices in the recirculation loops of the reactor to detect the location of a pipe break. Signals from these devices would be used automatically to select various valve actions that are essential to the proper operation of the emergency core cooling systems. In view of the importance of the proper valve actions in the unlikely event of a major pipe break, the Committee recommends that the sensing instrumentation and valve control system be designed to full reactor protection syste standards, and that consideration be given to providing more than one type of sensing device in the system.

Fuel clad temperatures following a steam line break should be further evaluated during detailed design, with due attention to using conservative assumptions and methods in calculating these temperatures. Steam line isolation valve closure times as short as three seconds may be required to maintain acceptably low fuel clad temperatures in this accident. The applicant has stated that isolation valves with closure times adjustable from 3 to 10 second will be obtained for the plant.

The rod block monitor system for the Vermont Yankee reactor is a two-channel system, with one channel required for rod blocking action. The applicant has proposed that, if one channel is bypassed for maintenance, an appropriately short interval between tests will be used for the operating channel. The Committee believes that, if one channel of the rod block monitor system is to be out of service for a long period of time, other measures, in addition to frequent testing of the operative channel, should be taken to ensure that improper rod withdrawal is not allowed to occur.

In view of the high design power density of the core, an especially careful and extensive start-up program will be required for this plant. If the start-up program or the additional information on fuel behavior referred to above should fail to confirm adequately the designer's expectations, plant modifications or restrictions on operation may be appropriate.

The Advisory Committee on Reactor Safeguards believes that the items mentioned above can be resolved during construction of the reactor and should be followed by the Regulatory Staff. On the basis of the foregoing comments, and in view of the favorable characteristics of the site, the Committee believes that the proposed reactor can be constructed at the Vernon site with reasonable assurance that it can be operated without undue risk to the health and safety of the public.

Sincerely yours,

/s/
N. J. Palladino
Chairman

* The Committee believes that these matters are of significance for all large water-cooled power reactors, and warrant careful attention.

References:

1. Letter from Vermont Yankee Nuclear Power Corporation, dated November 30, 1966, including License Application.
2. Vermont Yankee Nuclear Power Station Plant Design and Analysis Report, Volumes I, II, and III.
3. Letter from Vermont Yankee Nuclear Power Corporation, dated January 10, 1967, with Amendment No. 1 to License Application.
4. Letter from Vermont Yankee Nuclear Power Corporation, dated January 23, 1967, with Amendment No. 2 to License Application.
5. Letter from Vermont Yankee Nuclear Power Corporation, dated April 12, 1967, with Amendment No. 3 to License Application.
6. Letter from Vermont Yankee Nuclear Power Corporation, dated April 28, 1967, with Amendment No. 4 to License Application.
7. Letter from Vermont Yankee Nuclear Power Corporation, dated May 19, 1967, with Amendment No. 5 to License Application.
8. Letter from Vermont Yankee Nuclear Power Corporation, dated May 24, 1967, with Amendment No. 6 to License Application.
9. Amendment No. 7 to License Application, dated June 2, 1967.