

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
UNITED STATES ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

December 20, 1967

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

Subject: REPORT ON PACIFIC GAS AND ELECTRIC COMPANY NUCLEAR UNIT --
DIABLO CANYON SITE

Dear Dr. Seaborg:

At its ninety-second meeting, on December 7-9, 1967, the Advisory Committee on Reactor Safeguards completed a review of the application by the Pacific Gas and Electric Company for authorization to construct a nuclear unit at its Diablo Canyon Site, in San Luis Obispo County, California. This project had previously been considered at the Committee's ninetieth meeting, on October 5-7, 1967, and at Subcommittee meetings on October 4, 1967 and December 1, 1967. Some members of the Committee visited the site on July 19, 1967. During its review, the Committee had the benefit of discussions with representatives of the Pacific Gas and Electric Company, the Westinghouse Electric Corporation, and the AEC Regulatory Staff and their consultants. The Committee also had the benefit of the documents listed below.

The Diablo Canyon site comprises approximately 800 acres adjacent to the Pacific Ocean on an isolated promontory between Morro Bay and Pismo Beach. Eighteen people live within six miles of the site; the nearest boundary of the City of San Luis Obispo (1965 population of 25,750) is 10 miles distant; and only three cities of more than 10,000 population are located within 60 miles.

The containment structure, which encloses the reactor and steam generators, will consist of a steel-lined concrete shell in the form of a reinforced-concrete vertical cylinder with a flat base and a hemispherical dome. This and all other Class I structures and components have been designed not to exceed normal working stress or deflection limits during a design earthquake of 0.2 g acceleration and to assure no loss of function at twice this ground acceleration. In addition, protection will be afforded against seismic sea

waves to an elevation of 30 feet above mean-low-low-water. Extensive trenching and other geological investigations at the site indicate that no faulting has occurred in at least 100,000 years. The Committee believes that questions related to seismic design have been resolved satisfactorily.

The applicant has proposed to build a four-loop pressurized water reactor similar to Indian Point Unit No. 2 but with an 18-percent increase in core average power density. The initial reactor core rating has been established as 3250 MWt, the highest power level for any PWR for which a construction permit has been requested.

The Diablo Canyon facility is to be provided with an emergency core cooling system (ECCS), including four high-pressure accumulators, two high-pressure injection pumps, and two low-pressure injection pumps. The applicant proposes not to operate the reactor with an accumulator tank valved off except for brief periods for testing. The Committee recommends that the Regulatory Staff review the detailed design of the ECCS and the analysis of its performance for the entire spectrum of break sizes. In this connection:

1. The Regulatory Staff should review analyses of possible effects upon pressure vessel integrity, arising from thermal shock induced by ECCS operation.*
2. The effects of blowdown forces on core and other primary system components should be analyzed more fully as detailed design proceeds.*
3. Further evidence should be obtained to show that fuel-rod failures in loss-of-coolant accidents will not significantly affect the ability of the ECCS to prevent clad melting.*

The applicant proposes to achieve the higher core average power density without decreasing the minimum DNB (departure from nucleate boiling) ratio by optimization of inlet enthalpy and by the use of part-length control rods to flatten the axial power distribution and to suppress xenon oscillations.

Fixed burnable poison in the form of borosilicate glass encapsulated in stainless steel tubes will be used during the first fuel cycle to assure that the moderator temperature coefficient will always be negative. The reactivity worth and in-core performance of these borosilicate glass rods are still being investigated by the Westinghouse Electric Corporation. The adequacy of performance of these rods should be reviewed by the Regulatory Staff.

The higher power and increased power density of this reactor, compared to similar PWR's previously approved, place increased dependence on correct manipulation of control rods. The information available to the operator (rod positions, neutron flux and temperature profiles) must be sufficiently reliable, complete, and comprehensible that the proposed procedural control can be effective in achieving the predicted flux peaking factors. When information becomes available from large PWR's scheduled for operation earlier than Diablo Canyon, the applicant and the Regulatory Staff should review carefully whether the adequacy of the proposed system for high-power-density operation is justified by the data. The applicant indicated that a system of fixed in-core neutron detectors and continuously operating readouts could be added, if later shown to be necessary, with protection functions if needed. Additionally, the Committee believes that the operator should have available to him readouts of the positions of all the control rods, without the necessity of switching a single indicator to each of 61 rods.

The applicant has proposed using signals from protection instruments for control purposes. The Committee believes that control and protection instrumentation should be separated to the fullest extent practicable.* The Committee believes that the present design is unsatisfactory in this respect but that a satisfactory protection system can be designed during the construction of this reactor. The Committee wishes to review an improved design prior to installation of the protection system.

Consideration should also be given to the development and utilization of instrumentation for prompt detection of gross failure of a fuel element.*

During the course of final design and construction, studies will be made to determine the vibration characteristics of the major reactor components and the response of safety instrumentation to seismic loadings. Consideration should be given to obtaining experimental verification, to the extent practical, of the anticipated behavior in earthquakes of important components and instruments. It is also desirable that, prior to reactor operation, means be developed and provided to guide or implement decisions concerning reactor operation in the event of a large earthquake in the region of the site.

The Committee continues to emphasize the importance of quality assurance in fabrication of the primary system and of inspection during service life.* Because of the higher power level and advanced thermal conditions in the Diablo Canyon reactor, these matters assume even greater importance. The Committee recommends that the applicant implement those improvements in primary system quality which are practical with current technology.

Considerable information should be available from operation of large pressurized water reactors prior to operation of the nuclear power unit at the Diablo Canyon site. However, because the Diablo Canyon facility is to operate at a substantially higher power level and power density than those on which such experience will have been obtained, a careful start-up program will be required. If the start-up program or the additional information on fuel behavior referred to earlier should fail to confirm adequately the designer's expectations, system modifications or restrictions on operation may be appropriate.

The Advisory Committee on Reactor Safeguards believes that the above items can be resolved during construction. The Committee believes that with due consideration to the foregoing items, and in view of the isolated site, the nuclear plant proposed for the Diablo Canyon site can be constructed 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 attached.

References - Diablo Canyon

1. Letter from Pacific Gas and Electric Company dated September 30, 1966; Preliminary Site Report, Diablo Canyon, dated September 30, 1966.
2. Letter from Pacific Gas and Electric Company dated January 16, 1967; Nuclear Power Plant, Diablo Canyon Site, License Application, dated January 16, 1967; Preliminary Safety Analysis Report, Volumes 1 and 2.
3. Letter from Pacific Gas and Electric Company dated July 10, 1967; Amendment No. 1 to License Application, First Supplement to Preliminary Safety Analysis Report.
4. Letter from Pacific Gas and Electric Company dated July 24, 1967; Amendment No. 2 to License Application, Second Supplement to Preliminary Safety Analysis Report.
5. Pacific Gas and Electric Company letter dated July 31, 1967; Amendment No. 3 to License Application, Third Supplement to Preliminary Safety Analysis Report.
6. Pacific Gas and Electric Company letter dated October 18, 1967; Amendment No. 4 to License Application.
7. Pacific Gas and Electric Company letter dated October 18, 1967; Amendment No. 5 to License Application, Fourth Supplement to Preliminary Safety Analysis Report.
8. Pacific Gas and Electric Company letter dated November 6, 1967; Amendment No. 6 to License Application, Fifth Supplement to Preliminary Safety Analysis Report.
9. Pacific Gas and Electric Company letter dated November 9, 1967; Amendment No. 7 to License Application, Sixth Supplement to Preliminary Safety Analysis Report.
10. Pacific Gas and Electric Company letter dated November 30, 1967; Amendment No. 8 to License Application, Seventh Supplement to Preliminary Safety Analysis Report.
11. Pacific Gas and Electric Company letter dated December 6, 1967; Amendment No. 9 to License Application, Eighth Supplement to Preliminary Safety Analysis Report.