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

December 15, 1981

Honorable Nunzio J. Palladino
Chairman
U. S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: ACRS REPORT ON THE PALO VERDE NUCLEAR GENERATING STATION UNITS 1, 2, AND 3

Dear Dr. Palladino:

During its 260th meeting, December 10-12, 1981, the Advisory Committee on Reactor Safeguards reviewed the application of the Arizona Public Service Company, the Salt River Project Agricultural Improvement and Power District, the El Paso Electric Company, the Public Service Company of New Mexico, and the Southern California Edison Company (Applicants) for a license to operate the Palo Verde Nuclear Generating Station Units 1, 2, and 3. The joint applicants have designated the Arizona Public Service Company as the Project Manager and Operating Agent with full authority to construct and operate the power station. The project was considered at a Subcommittee meeting in Phoenix, Arizona on November 23-24, 1981, and members of the Committee toured the facility on November 23, 1981. In its review the Committee had the benefit of discussions with representatives of the Arizona Public Service Company, Combustion Engineering, Inc., Bechtel Power Corporation, the NRC Staff, and members of the public. The Committee also had the benefit of the documents listed. The Committee commented on the construction permit application for the Palo Verde Nuclear Generating Station Units 1, 2, and 3 in a report dated November 12, 1975 to the NRC Chairman.

The Palo Verde application is submitted in accordance with the Commission's regulations 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. NRC policy stated in the Federal Register (42 FR 34395 and 43 FR 38954) allows for a reference system that involves an entire facility design or major fraction of a design outside the context of a license application. For this application the reference system is the Combustion Engineering standard nuclear steam supply system known as its Standard Reference System 80. This design has been reviewed by the ACRS and discussed in its report dated December 15, 1981, "Final Design Approval for Combustion Engineering, Inc. Standard Nuclear Steam Supply System (Standard Reference System 80)".

This power station is located in a sparsely populated section of Maricopa County, Arizona, about 36 miles west of the nearest boundary of Phoenix, Arizona. The nearest densely populated center is Sun City, Arizona, about 35 miles east-northeast of the site, which had a 1980 population of about 57,800 persons. Palo Verde is the first commercial nuclear power station to be operated by Arizona Public Service Company and the first in the state of Arizona.

The Palo Verde Nuclear Generating Station uses three System 80 pressurized water nuclear steam supply systems designed by Combustion Engineering, Inc. Each of these has a design core power output of 3800 MWt. The turbine generators are oriented so as to minimize plant damage should turbine failure occur. The containment is a steel-lined, prestressed concrete cylindrical structure with a hemispherical dome and a design pressure of 60 psig. The cooling tower makeup is supplied from treated sewage effluent from the city of Phoenix.

The Committee's review included consideration of the management organization and capability, and the operator training program. The organizational plan for technical support of the operating plant is still being formulated. The Committee notes that the Arizona Public Service Company management personnel have extensive experience in both commercial and other nuclear plant operation and construction. The utility anticipates using many of its installation surveillance staff members as part of the technical support team. The ACRS encourages this organizational arrangement, but believes the Applicant should promptly analyze the skill requirements needed to support operations and make certain that the necessary capabilities will be available when needed. In order that the Committee be kept informed, we request an update on the organizational arrangement in about one year from this date.

The Committee notes that Arizona Public Service Company has a training simulator in operation at the Palo Verde site. The Committee's review indicated that the training program is being developed and that use of the plant simulator is still in the process of being integrated into the program. The Committee recommends that Arizona Public Service Company examine industry-sponsored programs concerning effective use of simulators for training and make certain that its approach takes account of current understanding of simulator training limitations.

Discussion with the Arizona Public Service Company staff indicated that emergency operating procedures for dealing with off-normal plant behavior are incomplete. Development of such procedures should be expedited to provide maximum time to make use of them in the operational training program.

In the Palo Verde design the primary system does not include capability for rapid, direct depressurization when the plant has been shut down. This places extra importance on the reliability of the auxiliary feedwater system and makes it necessary that the NRC Staff and the Applicant assure the availability and dependability of this system for a wide variety of transients. It also places extra requirements on the continued integrity of the two steam generators as the only method of heat removal immediately after shutdown. The ACRS recommends that the NRC Staff and the Arizona Public Service Company give additional attention to the matter of shutdown heat removal for Palo Verde and develop a detailed evaluation and justification for the position judged to be acceptable. The Committee wishes to be kept informed.

Arizona Public Service Company should expand its studies on systems interactions and systems reliability.

A number of items have been identified as Outstanding Issues, Confirmatory Issues, and proposed License Conditions in the NRC Staff's Safety Evaluation Report dated November 1981. The ACRS is satisfied with the progress on these topics and believes that they should be resolved in a manner satisfactory to the NRC Staff.

Our approval of the operation of this plant is contingent upon the satisfactory completion of construction and preoperational testing. For this reason, we request that, prior to fuel loading on Unit 1, a report be provided to the Committee describing significant construction deficiencies and their disposition, effectiveness of the quality assurance program, and results of the preoperational test program. In addition, a review of the startup experience on Unit 1 should be made prior to fuel loading on Unit 2 and the Committee kept informed.

We believe that if due consideration is given to the recommendations above, and subject to satisfactory completion of construction, staffing, and preoperational testing, there is reasonable assurance that Palo Verde Nuclear Generating Station Units 1, 2, and 3 can each be operated at power levels up to the design core power output of 3800 MWt without undue risk to the health and safety of the public.

Additional comments by ACRS member M. Bender and ACRS members H. W. Lewis and M. S. Plesset are presented below.

Sincerely yours,

J. Carson Mark

J. Carson Mark
Chairman

Additional Comments by ACRS Member M. Bender

The NRC requirements for instrumentation to follow the course of an accident have been generally outlined in Regulatory Guide 1.97. The ACRS has concentrated most of its attention on instrumentation to detect inadequate core cooling, sometimes called pressure vessel coolant level measuring instrumentation. The Regulatory Guide 1.97 requirements and the emphasis on measurement of vessel coolant levels both seem to have confused the real accident diagnosis requirements.

The proposed coolant level indicators could only have value under quiescent conditions. The proposed devices, differential pressure indicators and heated junction thermocouples, require considerable information about hydraulic conditions, pressure distribution, and density variations in the primary coolant circuit to be useful for unambiguous interpretation of changing coolant inventory in the reactor core. A full understanding of mass and energy distribution and related physical behavior of the nuclear system would be needed to make such information diagnostically useful under most accident conditions. The main value would appear to be for conditions where the system has been depressurized and the coolant state is known, for example, prior to refueling. Such knowledge does not appear relevant to the circumstances of primary concern such as accident conditions comparable to the TMI-2 event.

Regulatory Guide 1.97 has a mixture of requirements, some directed to pre-accident symptom identification, some to actual surveillance of rapidly changing transients, and some to surveillance of accident recuperation conditions. Although all of these requirements could be justified under some circumstances, it is likely that, if everything listed in the guide were provided, the operators could be overwhelmed by the informational detail and their diagnostic capability actually impaired.

At a time when unambiguous accident diagnostic information is urgently needed, a maze of indicating and analytical devices that might confuse the operators hardly makes sense. I propose the following criteria as a basis for determining accident diagnostics adequacy.

1. Does the operator have a well-defined set of signals to guide his emergency response to important accidents?

2. Do the emergency procedures enable the operator to avoid misinterpretation of those signals under circumstances where accident diagnosis is needed in conjunction with emergency actions?

3. In accident recovery is the sensor capability adequate to enable the operators to establish whether a stable and safe operating condition is being maintained until the system can be brought to cold shutdown and reliable decay heat removal functions assured?

4. If fuel failures occur, is there capability to determine whether the failures are of minor or major significance (clad reaction

with water and fuel melting); whether bulk quantities of radioactive nuclides have been released to the primary coolant circuitry, the containment interior, or are leaking from containment; and whether the containment boundary is jeopardized by overpressure or overtemperature?

Only a few additions to the pre-TMI-accident instrumentation appear necessary to address these considerations. However, to be certain that necessary information is available, the actions required of operators during accidents must be thoroughly examined. Emergency procedure guidance is now being developed by the nuclear steam supply equipment vendors. This guidance must be converted into usable procedures that may be testable on nuclear plant simulators. Palo Verde and a few other installations have simulators that might be used for this purpose. Those operating organizations having appropriate simulation equipment should give priority attention to proving the effectiveness of the diagnostic equipment in conjunction with proposed emergency procedures in order to verify diagnostic adequacy. No serious effort in this direction appears to have been initiated up to this time.

Additional Comments by ACRS Members H. W. Lewis and M. S. Plesset

We do not wish to belabor the points we made in our addendum to the ACRS letter dated November 17, 1981 on the St. Lucie Plant Unit 2, but they are as relevant here as there. The Staff continues to accept instruments that do not provide an unambiguous measure of liquid level in the pressure vessel, and continues to lack an adequate rationale therefor. We do not find fault with the Applicants for their efforts to be responsive to the Staff, but are concerned about the proliferation of inadequately considered requirements, of which this is only one example. To sanctify an ambiguous indication of core water level is to play with fire. In this particular case (heated thermocouples in a separator tube), not only dynamic effects, but a pressure vessel full of high-void-fraction water will spoof the instrument, and tend to lull the operator into a false sense of security about the coolant inventory. In that specific case, the instrument will indicate that the vessel is nearly full.

None of the above is meant to suggest that we oppose the provision of instrumentation to follow the course of an accident or to detect the onset of inadequate core cooling - unambiguous diagnosis of accident conditions through improved instrumentation and training is a high priority. Our concern is a piecemeal and incoherent approach to the problem, as exemplified here.

References:

1. Arizona Public Service Company, "Palo Verde Nuclear Generating Station, Final Safety Analysis Report," with Amendments 1 through 6.
2. U.S. Nuclear Regulatory Commission, "Safety Evaluation Report Related to the Operation of Palo Verde Nuclear Generating Station, Units 1, 2, and 3," NUREG-0850, dated November 1981.

3. Combustion Engineering, Inc., "System 80 CESSAR FSAR," with Amendments 1 through 5.
4. U.S. Nuclear Regulatory Commission, "Safety Evaluation Report Related to the Final Design of the Standard Nuclear Steam Supply Reference System CESSAR System 80," NUREG-0852, dated November 1981.