UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

ENCLOSURE

SAFETY EVALUATION REPORT BY THE OFFICE OF NUCLEAR REACTOR REGULATION
SAN ONOFRE NUCLEAR GENERATING STATION UNIT NO. 1
DOCKET NO. 50-206
SECOND IMMEDIATE SOURCE OF OFFSITE POWER

1.0 INTRODUCTION AND BACKGROUND

On November 21, 1985, San Onofre Nuclear Generating Station , Unit No. 1 (SONGS-1) experienced a loss of offsite power event. This event was initiated by a cable fault in the 4160 volt side of the auxiliary transformer "C" as described in NUREG-1190 (Reference 1). Southern California Edison Company (SCE), the licensee for the San Onofre Nuclear Generating Station, provided information concerning the above related failures in their investigation report transmitted by letter dated April 8, 1986 (Reference 2). SCE provided additional information by letter dated October 14, 1986 (Reference 3) on the status of the installation of second immediate source of offsite power. This evaluation is based on the information presented in those references and addresses the SCE's revised position on the installation of a second immediate access source of offsite power to supply the 4KV buses.

The immediate access source of offsite power to the 4.16KV safety buses 1C and 2C is provided by auxiliary transformer C which is fed from the 220KV switchyard. The delayed access source is provided via auxiliary transformers A and B from the main unit step-up transformer which is connected to the 220KV switchyard. The delayed access source availability involves a semi-automatic operation. In case of loss of the immediate access source which results in loss of the safety buses 1C and 2C, the Loss of Voltage Auto Transfer Sequence (LOVATS) system automatically realigns the 4160 volt system so that power can be restored

by manual action from the delayed access source. During the loss of power event of November 21, 1985, this semi-automatic operation took approximately four minutes before power was restored. During the event, several equipment abnormalities and operator uncertainty regarding the switching of the 220kV circuit breakers contributed to the total time that it took to restore power.

The SONGS-1 electrical design is somewhat unique as compared to other nuclear power plants where the immediate access source is via a fast transfer scheme from the unit generator auxiliary transformer to the start-up transformer. Although, the SONGS-1 offsite power system is unique, it complies with NRC regulations. SCE has stated in their investigation report, (Reference 2, page 6-103) that "response to emergencies which involve the loss of bus 1C and 2C would be improved if the access to the second source of offsite power were immediate and automatic." The staff agreed with SCE assessment and believed that an automatic fast transfer access to a second immediate alternate source would indeed improve the reliability of the safety-related 4kV buses. SCE also had indicated in their report (Reference 2) that as a plant improvement to increase reliability of the electrical system, a modification would be implemented to enhance the availability of the second immediate source of offsite power.

The different options considered to provide the second immediate offsite source were studied by SCE. By letter dated October 14, 1986, SCE submitted the results of their study regarding the installation of measures to provide the second immediate source of offsite power to supply the 4kV buses.

2.0 EVALUATION

General Design Criterion (GDC) 17 requires two physically independent circuits to supply power to the onsite electric power distribution system. The requirement regarding transfer between the two offsite power sources is that "each of these circuits shall be designed to be available in sufficient time following a loss of all onsite alternating current power supplies and the other offsite electric power circuit, to assure that specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundry are not exceeded." The design of the SONGS 1 Electrical Power System is such that an immediate access circuit through auxiliary transformer C is provided to be available immediately; a delayed access circuit through auxiliary transformers A and B is provided to be available in sufficient time following a loss of all on-site electric power sources and the immediate access circuit.

For a loss of AC power without concurrent safety injection signal, the diesels (onsite electric power) are automatically started and run in standby; the Loss of Voltage Auto Transfer Sequence (LOVATS) system realigns the 4160V circuit breakers so that power can be restored from the alternate offsite source by manually closing one of the 220kV circuit breakers.

The diesel generators automatically start when their respective buses (1C and 2C) detect a loss of power. They are automatically loaded only when there is a loss of power coincident with a safety injection signal. When there is loss of offsite power without a safety injection signal, the diesel generators are started automatically but must be manually connected to their respective safety bus.

The licensee has stated that without a coincident transient or accident, greater than 2 hours is available prior to restoration of AC power with no detrimental effect on the safe shutdown capability of the unit. The SONGS-1 electrical power system design meets the regulatory criteria and the licensee has adequately addressed the manual transfer to the delayed-access offsite power source or to the onsite source to supply power to the 4160 volt safety buses for accidents and non-accident conditions.

Regarding further enhancement of the reliability of the 4kV buses, SCE has completed their study of providing a second immediate source of offsite power. This design evaluated consisted of a second auxiliary transformer which would remain in standby and would replace auxiliary transformer C by automatic fast

transfer upon failure of the power supply circuit from the switchyard to the 4kV buses via auxiliary transformer C. In addition, the design requires that the switchyard line configuration be changed in order to allow for the additional supply circuit. The modifications necessary to implement this new power source would be very extensive and would cost approximately $14 million according to SCE cost estimates. SCE conducted a cost benefit analysis to justify the installation of the second immediate source of offsite power. The conclusion derived from this analysis is stated in SCE's letter to NRC dated October 14, 1986. SCE has concluded that except for the November 21, 1985 loss of power/water hammer event, a second immediate access offsite source of power would have had no beneficial impact on previous operational events. The licensee reached this conclusion after reviewing plant transients that occurred at SONGS-1 during past 19 years of plant operation. With respect to the water hammer event where the second immediate offsite circuit would have been beneficial, SCE contends that this modification would yield only minimal safety improvements over and above those already obtained by corrective actions already taken at SONGS 1. SCE has based their conclusions on the following improvements and modifications already implemented at SONGS 1:

1. The major contributors to the water hammer event were the five failed check valves. The significant improvements made in the area of enhanced system capabilities to isolate the feedwater lines provides the most important improvement for preventing water hammer in the future.

2. The modifications provided to assure the operability of the LOVATS system will enhance the operator capabilities in restoring the delayed source of offsite power or in re-establishing power from the onsite diesels.

3. The material improvements resulting from the Material Condition Review Program and the continued assurance of acceptable material condition resulting from the Area Monitoring program will minimize the likelihood that equipment degradation will lead to the type of failure which initiated the event.

4. Specific event related repairs to the failed cables were made and in addition, all equivalent cable was replaced.

5. The improvements in plant procedures will provide a more effective response to system conditions similar to those which occurred on November 21, 1985.

6. Finally, the improvements made to plant programs will significantly reduce the likelihood of the development of conditions which led to the water hammer event. These improvements apply to historical trending as part of the maintenance and inservice testing programs as well as the review of plant conditions associated with the safety review

process. In addition, specific improvements were made within each of these programs to upgrade the effectiveness of the programs.

The staff has reviewed the information contained in the SCE letter dated October 14, 1986, and finds SCE's position tenable. The present offsite power supply design of SONGS 1 meets all regulatory requirements. The water hammer event of November 21, 1985 was not a direct result of power supply failure but was due to coincident failure of the five check valves in the feedwater system. The staff agrees with SCE's position that it is not a requirement to install another immediate access source of offsite power at SONGS 1.

3.0 CONCLUSION

The offsite power supply design of SONGS 1 in its present condition meets all regulatory requirements. The licensee has shown that acceptable plant system response can be demonstrated for transients and accidents when the safety systems function as designed. Since the proposed second immediate access source is not required by regulations and if installed would provide only minimal safety improvements, the staff finds the SCE's position for not implementing this modification acceptable.

REFERENCES

4.0 ACKNOWLEDGEMENTS

This evaluation was prepared by P. Gill.

5.0 REFERENCES

1. Loss of Power and Water Hammer Event at San Onofre, Unit 1 on November 21, 1985. NUREG-1190, U.S. Nuclear Regulatory Commission, January 1986.

2. Southern California Edison Company letter; M. O. Medford to A. E. Chafee, NRC Region V, "Investigation Report of November 21, 1985, Water Hammer Event, San Onofre Nuclear Generating Station, Unit 1", April 8, 1986.

3. Southern California Edison Company letter; M. O. Medford to G. E. Lear, PWR Project Directorate #1, "Third Edition of the Integrated Living Schedule San Onofre Nuclear Generating Station, Unit 1," October 14, 1986.