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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Gentlemen:

Subject: **Docket Nos. 50-361 and 50-362**
Emergency Loading of the Emergency Diesel Generators
San Onofre Nuclear Generating Station
Units 2 and 3

This letter is to request NRC approval of a change to the design bases for the San Onofre Units 2 and 3 emergency diesel generators (EDGs). The change affects the minimum EDG terminal voltage (75% of nominal) which Southern California Edison (Edison) is currently committed to maintain at all times during load sequencing.

Calculations show that with appropriate load margin retained in the EDG dynamic analysis to accommodate future load growth, the EDG voltage may dip below the 75% of nominal voltage for a very short period under unlikely accident conditions when two high pressure safety injection (HPSI) pumps are automatically started from the same emergency bus. The following paragraphs describe (1) the plant design, (2) the postulated accident conditions that create the potential for a voltage dip, (3) the current EDG testing and design basis for EDG terminal voltage, and (4) an evaluation using analytical and test results that demonstrates the voltage dip has no safety significance.

Plant Design

The engineered safety features (ESF) of San Onofre Units 2 and 3 include three high pressure safety injection (HPSI) pumps: a Train A primary pump; a Train B primary pump; and a swing pump, which can be aligned with either Train A or Train B. Each pump is capable of starting automatically in response to a safety injection actuation signal (SIAS). As explained in Section 6.3.2.5.2 of the Updated Final Safety Analysis Report (UFSAR), the function of the swing pump is to allow one of the primary HPSI pumps to be taken out for maintenance during plant operation. In this scenario, the two pumps switch functions. In the plant safety analysis, credit is taken for the operability of only one pump on each train.

The plant design automatically starts only the swing pump when both a primary pump and the swing pump are aligned to the same train and a SIAS is received. The swing pump breaker, when racked in, disables the SIAS start of the associated primary pump. This design feature is intended to ensure that no more than one HPSI pump would automatically start on either Train A or

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Train B. The reason for this restriction is that the original plant design, electrical analysis, and refueling interval ESF tests were all based on only one HPSI pump starting at time t=0. (t=0 refers to the time when EDG terminal voltage and frequency have reached their nominal values, the EDG breaker has been closed, and the associated ESF 4 KV bus undervoltage relays have been reset.)

Recently Identified Condition

As explained below, under certain accident conditions more than one HPSI pump could automatically start on the same train.

Certain plant evolutions, such as filling safety injection tanks, maintaining refueling water storage tank chemistry, testing check valves, and pump inservice testing, require a HPSI pump to be run during normal plant operation. Even though these evolutions occur infrequently, in some of these cases they require alignments that render the HPSI pump incapable of performing its safety injection function. For this reason, the preferred pump for these evolutions is the primary pump aligned to the same train as the swing pump. This arrangement keeps the swing HPSI pump and the primary pump on the opposite train operable, thus maintaining two HPSI trains operable. This satisfies the requirements in Section 3/4.5.2 of the existing Units 2 and 3 Technical Specifications (TSs) for plant operating Modes 1, 2, and 3, and the equivalent requirements in Section 3.5.2 of the new TSs that have been approved for implementation by Unit 2 Amendment No. 127 and Unit 3 Amendment No. 116. These new TSs will be replacing the existing TSs by August 9, 1996.

The HPSI pumps are not automatically stripped from their associated 4 KV buses on a Loss Of Voltage Signal (LOVS). As a result, if a HPSI pump is running during one of the infrequent evolutions discussed above, and a SIAS with LOVS occurs, the diesel for that train would be loaded with two HPSI pumps at time t=0. This particular scenario, postulating the simultaneous loading of two HPSI pumps on one train, was not considered in the original plant design, electrical analysis, or ESF tests. Conservative probabilistic risk analysis calculations show that this scenario has a very low probability of occurrence (about 1.0E-7 per year).

EDG Testing and Design Basis for EDG Terminal Voltage

The EDG terminal voltage is verified as part of the ESF test, which is conducted on both EDGs during every refueling outage. The ESF test requirements are specified in Section 4.8.1.1.2.d.7 of the existing TSs and Section 3.8.1.19 of the new TSs.

EDG Testing per Existing TSs:

Surveillance requirement 4.8.1.1.2.d.7 of the existing TSs requires that EDG operability be demonstrated at least once per refueling interval by

> "Simulating a loss of offsite power in conjunction with an ESF test signal, and

" a) Verifying de-energization of the emergency busses and load shedding from the emergency busses.

" b) Verifying the diesel starts on the auto-start signal, energizes the emergency busses with permanently connected loads within 10 seconds, energizes the auto connected emergency (accident) loads through the load sequence and operates for greater than or equal to 5 minutes while its generator is loaded with the emergency loads. After loading, the steady state voltage and frequency of the emergency bus shall be maintained at 4360 ± 436 volts and 60 + 1.2/-0.3 Hz during this test."

Section B 3/4.8 of the Bases to the existing TS and Appendix 3A, Section 3A.1.9 and Section 8.1.4.3.2 of the UFSAR commit Units 2 and 3, with exceptions, to the ESF test acceptance criteria contained in Regulatory Guide (RG) 1.9, Revision 0, entitled "Selection of Diesel Generator Set Capacity for Standby Power Supplies." Section 8.1.4.3.2 of the UFSAR provides details of our existing commitment and describes exceptions taken to RG 1.9, Revision 0.

According to Regulatory Position C4 of RG 1.9, Revision 0, at no time during the EDG loading sequence should the voltage decrease to less than 75% of nominal and voltage should be restored to within 10% of nominal in less than 40% of each load sequence time interval.

EDG Testing per New TS:

Future EDG ESF tests will be conducted in accordance with the new TS. Surveillance Requirement (SR) 3.8.1.19 of the new TS requires that the ESF test be conducted as follows:

"Verify on an actual or simulated loss of offsite power signal in conjunction with an actual or simulated ESF actuation signal:

a. De-energization of emergency buses;

b. Load shedding from emergency buses;

c. DG auto-starts from standby condition and:

1. energizes permanently connected loads in ≤ 10 seconds;

2. energizes auto-connected emergency loads through the programmed time interval load sequence;

3. achieves steady state voltage ≥ 3924 V and ≤ 4796 V;

4. achieves steady state frequency ≥ 58.8 Hz and ≤ 61.2 Hz; and

5. supplies permanently connected and auto-connected emergency loads for ≥ 5 minutes.

As explained in Section B 3.8.1 of the Bases for the new TS, the new ESF test acceptance criteria will be based on the recommendations of RG 1.9, Revision 3.

Regulatory Position C1.4 of RG 1.9, Revision 3, states in part:

> "Section 5.1.2, "Mechanical and Electrical Capabilities," of IEEE Std 387-1984 pertains, in part, to the starting and load-accepting capabilities of the diesel generator unit. In conformance with Section 5.1.2, each diesel generator unit should be capable of starting and accelerating to rated speed, in the required sequence, all the needed engineered safety feature and emergency shutdown loads. The diesel generator unit design should be such that at no time during the loading sequence should the frequency decrease to less than 95 percent of nominal nor the voltage decrease to less than 75 percent of nominal (a larger decrease in voltage and frequency may be justified for a diesel generator unit that carries only one large connected load). Frequency should be restored to within 2 percent of nominal in less than 60 percent of each load-sequence interval for steploat increase and in less than 80 percent of each load-sequence interval for disconnection of the single largest load, and voltage should be restored to within 10 percent of nominal within 60 percent of each load-sequence time interval."

Thus, RG 1.9, Revision 0 and Revision 3, both contain the same EDG minimum terminal voltage criterion of 75% of nominal, while Revision 3 allows 60% of the sequencing interval (versus 40% allowed by Revision 0) for voltage restoration.

During the past refueling outages of San Onofre Units 2 and 3, Train A and Train B have generally been tested by running a combined ESF test on both trains. With the single exception of the special ESF test conducted last year on Unit 3 for voltage verification purposes (see discussion below), the concurrent loading of the primary pump and the swing pump has not been considered in the ESF tests. The reason for this is that when the swing pump and a primary pump are both aligned to Train A or Train B during normal plant operation (Modes 1 through 3), the design of the HPSI pumps control circuitry prevents the automatic start of both pumps from one diesel. The ESF test method described above is consistent with this design feature and with the plant safety analyses, where credit is taken for the operability of only one pump on each train.

Evaluation of Recently Identified Condition

A review of the accident scenario discussed above in light of Regulatory Position C4 of RG 1.9, Revision 0, led Edison to evaluate the EDG voltage for Units 2 and 3, and also to perform a special ESF test on a Unit 3 EDG to verify the actual minimum voltage. The evaluation and the test considered the loading of two HPSI pumps on one train at time t=0.

The results of the evaluation were:

1. With no margin for future load growth included in the analysis, the calculated EDG terminal voltage stays above 75% of nominal voltage throughout load sequencing.

2. With margin included for future load growth, the calculated EDG terminal voltage dips below 75% of nominal voltage for approximately 0.2 secs. However, the associated ESF motor loads would still accelerate to their rated speeds in the required time without any safety implication or failure to meet TS required response times. Consistent with Regulatory Position C4 of RG 1.9, Revision 0, the EDG frequency remains within 2% of nominal (60 Hertz base) and the EDG voltage/frequency recovery times are less than the maximum limit (40% of load sequence time interval). The overall system performance is acceptable from an engineering as well as safety standpoint, and the safety analysis in the UFSAR is not affected by the short voltage dip below 75%.

The special ESF test was performed on Unit 3 in September 1995 during the Cycle 8 refueling outage. During this special test Edison started two HPSI pumps on Train A and a single HPSI pump on Train B at time t=0 (whereas previous ESF tests started only one HPSI pump on each train at time t=0). The acceptance criteria used for this test were a minimum Train A voltage equal to 75.5% of nominal bus voltage and a minimum Train B voltage equal to 82.5% of nominal bus voltage. The test demonstrated that these criteria were satisfied.

For Train A, which is more heavily loaded than Train B, the minimum voltage during the special ESF test was 86.33% of the nominal voltage (4.36 kV) and the minimum frequency was 98.25% of the nominal frequency (60 Hertz). The ESF test cannot simulate worst case accident conditions, and its results must be supplemented with analytical results. The results of our August 1993 dynamic analysis simulating the Unit 2 ESF test with one HPSI pump starting indicated a close match between the calculated voltage and frequency values and the actual test values. With the validity of our analytical model thus established, we have concluded that a close match exists between analytical values and actual test values under the two HPSI pumps starting scenario. Therefore, the special ESF test conducted in September 1995 need not be repeated in the future.

Conclusions

Based on analysis and testing, Edison concludes that, in the unlikely event of two HPSI pumps loading simultaneously during ESF load sequencing, the associated EDG will perform its intended safety function. Even if future loading results in a voltage dip below 75% of the EDG terminal voltage, there will be no safety implication as long as the analytic modeling demonstrates that the associated ESF motor loads accelerate to their rated speed in the required time. The ESF test procedure validates the analytic model which in turn demonstrates satisfactory EDG performance with simultaneous loading of two HPSI pumps.

Section 8.1.4.3.2 of the UFSAR describes our existing commitment to RG 1.9, Rev. 0, concerning the Units 2 and 3 EDGs and takes two exceptions (numbered A and B) to RG 1.9, Rev. 0, recommendations. Based on a valid analytic model, it was concluded that a diesel generator voltage dip below 75% of nominal has no safety implication. Therefore, Edison proposes to add a third exception (C) as follows:

> "Electrical analyses demonstrate that each diesel generator can successfully accelerate all the required Engineered Safety Feature (ESF) motors to their rated speed in the required time sequence throughout the load sequencing duration, even if the diesel generator voltage dips below 75% of nominal. Refueling interval diesel testing, using available loads, revalidates the analytic model which demonstrates acceptable performance under worst case loading."

The NRC is requested to approve deviating from the UFSAR "75% of nominal minimum EDG voltage criterion," as recommended in RG 1.9, Revision 0 and Revision 3. If our request for deviation from RG 1.9, Revision 0 and Revision 3, is approved by the NRC, the next UFSAR revision (Revision 13) will reflect this deviation.

The next ESF tests will be conducted during the Cycle 9 refueling outages, which are scheduled to start in November 1996 and March 1997 for Units 2 and 3, respectively. Edison plans to conduct future ESF tests on the Units 2 and 3 EDGs as in the past, which is consistent with both the allowed loading of only one HPSI pump on each EDG and the analysis requiring the loading of only one HPSI pump on each train.

If you have any questions, please let me know.

Sincerely,

Harold C. Marsh

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