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

Gentlemen:

Subject: **Docket No. 50-206**
Plant History Input for FTOL
San Onofre Nuclear Generating Station, Unit 1

This letter provides historical information on San Onofre Unit 1. The information was requested by the NRC Project Manager, Mr. G. Kalman, as input for the San Onofre Unit 1 Full Term Operating License. In response to this request, we have provided the enclosed descriptions of San Onofre Unit 1 spent fuel accumulation and capacity, significant modifications, significant events, and operating history and outages.

If you have additional questions, please do not hesitate to contact me.

Very truly yours,

Enclosure

cc: George Kalman, NRC Senior Project Manager, San Onofre Unit 1
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SAN ONOFRE UNIT 1 PLANT HISTORY

Provided below are descriptions of various aspects of the San Onofre Unit 1 plant history. The descriptions cover spent fuel accumulation and capacity, significant modifications, significant events, and operating history and outages. The full period of commercial operation, from 1968 to the present, was considered in developing the descriptions. As used below, the term "significant" denotes those events or conditions that substantially affected plant availability or expenditures, or were of safety or regulatory interest.

Spent Fuel Accumulation and Capacity

As of the completion of the Cycle 11 refueling outage, a total of 508 spent fuel assemblies have been removed from the San Onofre Unit 1 reactor. Of these, 270 have been shipped to the GE reprocessing facility in Morris, Illinois, 70 have been placed in the Unit 2 spent fuel pool, 69 have been placed in the Unit 3 spent fuel pool, and 99 are located in the Unit 1 spent fuel pool. The shipment of assemblies to Morris, Illinois occurred during the period from 1972 to 1980. The Unit 1 spent fuel pool has the capacity to store 216 spent fuel assemblies. This capacity has remained unchanged since the plant was built. The Unit 1 spent fuel pool currently has the capacity for an additional 117 fuel assemblies. Without the transshipment of Unit 1 assemblies to the Unit 2 and 3 spent fuel pools during 1988-1989, the Unit 1 spent fuel pool would have been unable to accommodate the full core off-load required during the 1990-1991 refueling outage. Upon completion of re-racking of the Unit 2 and 3 spent fuel pools, there will be sufficient capacity to permit operation of all three units until approximately 2004. As this date approaches, SCE will evaluate other options for the disposition of spent fuel, such as rod consolidation, additional on-site storage space, or shipment to a D.O.E. approved facility.

Significant Modifications

San Onofre Unit 1 was designed and built during the early to mid 1960s. Recognizing the refinements in nuclear related design criteria, the NRC has required SCE to modify San Onofre Unit 1 to meet revised criteria in specific areas. Some of the more significant modifications were; the Sphere Enclosure Project (a concrete shield building erected around the existing containment sphere), and the Standby Power Addition (an installation of redundant standby diesel generators capable of powering the emergency core cooling systems (ECCS)). Both of these modifications were performed during a 1976-1977 outage.

In 1977 the NRC initiated the Systematic Evaluation Program (SEP) to review the design of selected older nuclear plants. A group of eleven older plants, including San Onofre Unit 1, were the subject of a design review using modified Standard Review Plan criteria. The SEP review has resulted in plant upgrades to

bring San Onofre Unit 1 into closer compliance with current NRC criteria. Some of the more significant of these upgrades are as follows:

Seismic Modifications - Extensive seismic modifications were performed to enable structures and equipment to withstand a 0.67g earthquake. This resulted in significant increases in design forces in many areas. These modifications included the strengthening of component supports, installation of a new auxiliary feedwater storage tank, and strengthening of the protective sea wall.

Fire Protection Modifications - An extensive reanalysis was performed comparing the existing fire protection provisions with the requirements of 10CFR50, Appendix R. As a result of this reanalysis, modifications were performed to upgrade the San Onofre Unit 1 design to be consistent with current fire protection criteria. The modifications included installation of a Dedicated Shutdown Diesel to assure the ability to safely shut down the plant if vital power supplies were lost as the result of a fire. Fire barriers, detection systems, and suppression systems were also upgraded.

Environmental Qualification Modifications - Modifications were performed to replace equipment that could not be shown to meet current environmental qualification criteria. Numerous components were replaced including; elements of the control circuitry for the recirculation flow control valves, aging or unqualified electrical penetrations, terminal blocks inside containment, coaxial cabling to radiation and neutron monitoring instruments, and certain resistance temperature detectors, limit switches, valve actuators, solenoids, and pressure and flow transmitters.

In addition to the upgrades described above, San Onofre Unit 1 has been significantly modified in response to post-TMI requirements. The significant TMI modifications consist of the automation of the Auxiliary Feedwater System, the installation of a Post-Accident Sampling System, the installation of additional accident monitoring instrumentation, the installation of containment hydrogen recombiners, the installation of additional post-accident shielding, and the installation of emergency response facilities.

As the result of an ECCS Single Failure Analysis conducted in 1990, a number of plant modifications were performed during the 1990-1991 refueling outage. These modifications included; addition of a redundant means to trip the reactor coolant pumps, separation of power supplies to the loop B and C recirculation flow instruments, control circuit modifications to provide redundant letdown isolation capability, mechanical modifications to prevent runout and loss of NPSH for the charging, recirculation, and refueling water pumps, control circuit modifications to prevent spurious opening of recirculation pump discharge valves, modifications to control circuits and mechanical components to prevent gas binding of the charging pumps, modifications to the Safeguards Load Sequencing System (SLSS) logic to eliminate the potential for a unacceptable delay in initiation of ECCS flow, and modifications to improve separation in the SLSS circuitry.

Significant Events

During the first 2-3 years of operation the Unit experienced a number of rod-drop occurrences. These rod-drops resulted from various causes which were corrected following the specific occurrences.

In 1980, San Onofre Unit 1 was shutdown to assess the cause of a 270 gallon-per-day primary-to-secondary steam generator tube leak. Subsequent eddy current inspections and laboratory examinations of pulled tube specimens revealed an extensive pattern of caustic-induced intergranular attack where sludge had accumulated on the steam generator tube sheet. As a corrective action, 6508 of the 11,382 (i.e., 57%) total tubes in all three steam generators were sleeved on the hot leg side in the vicinity of the tube sheet. The sleeves create a supplemental pressure boundary in the degraded areas. The tube sleeves, combined with the previously installed plugs, and additional plugs installed during the sleeving outage, resulted in a primary system flow rate reduction of approximately 3.3% due to an assumed 15% effective flow blockage from the plugs and sleeves. Technical Specification operating limits were revised to recognize the effects on plant operation with this configuration. Additionally, the operational reactor coolant average temperature was lowered to reduce the rate of intergranular attack.

A severe water hammer event occurred following a plant trip on November 21, 1985. The cause was determined to be the failure of five feedwater system check valves. Examination of the check valves revealed that the nut holding the disc to the hinge arm had loosened allowing the disc to tilt relative to the hinge arm. This prevented the disc from seating properly. In some cases, the disc had become completely detached from the hinge arm. Either condition allowed steam from the steam generators to backflow into the feedwater piping. When auxiliary feedwater flow was initiated, condensation induced slug flow in the partially voided feedwater piping resulted in the water hammer. A failure analysis determined that the nuts had become loosened by repeated hard impacts with the stop during normal feed system operation. The impacting of the nut against the stop was attributed to: (a) the proximity of some upstream flow disturbance sources such as control valves and elbows, (b) the nut-stud design of the check valves, (c) reduced power, reduced flow operation, and (d) marginal valve design for the application.

The five failed check valves were replaced with check valves utilizing a single piece disc and hinge arm. This design prevents loosening or detachment of the two parts. Also, the flow characteristics of the new valves greatly reduces the frequency and magnitude of disc-to-stop impacts during normal operation.

Additional check valves of the new design were installed in new locations in the feedwater piping as close as practical to the steam generators. The additional check valves provide further assurance that a water hammer will not occur. Finally, modifications were made to the main feedwater flow control valve circuitry and the feedwater piping slope to further reduce the possibility of water hammer.

In 1986 the NRC issued a Notice of Violation for; failure to maintain the auxiliary feedwater system operable, inadequate testing to assure the check valves were functional, and inadequate corrective action for noises heard in the feed system five months prior to the event. The NRC imposed a Civil Penalty of \$180,000 for these violations.

Operating History and Outages

Southern California Edison (SCE) Company was issued Provisional Operating License No. DPR-13 for SONGS-1 on March 27, 1967 and San Onofre Unit 1 began commercial operation on January 1, 1968. From commercial operation through the end of 1990 there have been 158 outages. Of these, 79 were forced outages and 79 were scheduled outages. The San Onofre Unit 1 Capacity Factor through fuel cycle 10 operations was approximately 51%. This Capacity Factor was significantly affected by extended outages to perform plant modifications, some of which are discussed above. For the same period, the Production Factor, which excludes outage time allocated to modifications, was approximately 81%. Significant outages are summarized in the following table:

**SAN ONOFRE UNIT 1
SIGNIFICANT OUTAGE HISTORY**

CAUSE	DATES	FORCED OR SCHEDULED	HOURS
The unit was manually tripped following observation of a fire in a cable tray leading to a sphere electrical penetration.	02/07/68 - 02/19/68	Forced	287
The unit was removed from the line as a result of a control rod subgroup slipping into the core during cyclor checkout after routine maintenance of the cyclor.	03/04/68 - 03/04/68	Forced	6
The unit was brought to hot shutdown when it was determined that control rod F-10 was in the core.	03/09/68 - 03/10/68	Forced	43
The unit was manually tripped due to a fire in the cable trays of the No. 2 480V switchgear room.	03/12/68 - 09/12/68	Forced	4433
The reactor was manually tripped when the control rods in subgroup 8 dropped into the core.	09/26/68 - 09/30/68	Forced	87

**SAN ONOFRE UNIT 1
SIGNIFICANT OUTAGE HISTORY**

CAUSE	DATES	FORCED OR SCHEDULED	HOURS
The unit was removed from service for an inspection of the turbine and generator and steam generator modification.	06/21/69 - 08/09/69	Scheduled	1193
The reactor was manually tripped when the control rods associated with subgroup 7 dropped into the core.	08/14/69 - 08/18/69	Forced	98
CYCLE 2 REFUELING OUTAGE, in-service inspection, maintenance and relocation of the existing 220 kV and 138 kV switchyards.	10/02/70 - 11/20/70	Scheduled	1156
The unit tripped due to loss of Chino and Santiago 220 kV lines.	06/22/71 - 06/22/71	Forced	6
CYCLE 3 REFUELING OUTAGE, in-service inspection, maintenance and containment vessel integrated leak rate testing.	12/25/71 - 02/24/72	Scheduled	1457
The unit was removed from service to repair primary to secondary leakage and to perform miscellaneous maintenance work.	07/19/72 - 07/28/72	Scheduled	210
The unit was removed from service to repair primary to secondary leakage.	10/13/72 - 10/20/72	Scheduled	152
The unit was removed from service to repair primary to secondary leakage.	01/06/73 - 01/10/73	Scheduled	108
CYCLE 4 REFUELING OUTAGE, and maintenance.	06/01/73 - 07/24/73	Scheduled	1248
The unit was removed from service due to salt water leakage to the condenser and turbine vibration. Investigation revealed turbine blade failure.	10/21/73 - 01/22/74	Forced	2244

**SAN ONOFRE UNIT 1
SIGNIFICANT OUTAGE HISTORY**

CAUSE	DATES	FORCED OR SCHEDULED	HOURS
The unit was removed from service to accomplish reheater repairs and miscellaneous maintenance.	04/27/74 - 05/20/74	Scheduled	546
The reactor manually tripped when subgroup 8 control rods dropped.	10/01/74 - 10/22/74	Forced	7
CYCLE 5 REFUELING OUTAGE, and reheater steam dump test.	03/14/75 - 04/23/75	Scheduled	950
The unit tripped from turbine overspeed when the Santiago-San Onofre 220 Kv transmission lines were lost due to a brush fire beneath them.	01/21/76 - 01/21/76	Forced	7
The unit was taken off line to repair primary to secondary leakage.	07/30/76 - 08/03/76	Forced	101
CYCLE 6 REFUELING OUTAGE, turbine maintenance and plant modifications.	09/30/76 - 04/11/77	Scheduled	4633
The reactor was manually tripped when a failed relay in Shutdown Group 2 circuitry allowed four control rods to drop into the core.	05/18/77 - 05/18/77	Forced	14
The reactor was manually tripped when a relay failed in Shutdown Group 1 and allowed four control rods to drop into the core.	06/09/77 - 06/10/77	Forced	10
The unit was removed from the line to inspect reactor coolant pump "C" motor bearings, repair the turbine control oil system, plug tube leaks in the reheaters, inspect the steam generators, and for tube plugging in the steam generators.	09/09/77 - 10/06/77	Scheduled	646

**SAN ONOFRE UNIT 1
SIGNIFICANT OUTAGE HISTORY**

CAUSE	DATES	FORCED OR SCHEDULED	HOURS
The reactor tripped from a loss of coolant flow signal. The low flow condition occurred when a fault on the San Diego Gas and Electric Company power grid, which is intertied with Southern California Edison Company at San Onofre, resulted in low voltage at the reactor coolant pump motors.	03/08/78 - 03/08/78	Forced	4
The unit was removed from service for steam generator inspection.	04/05/78 - 04/25/78	Scheduled	472
CYCLE 7 REFUELING OUTAGE	09/15/78 - 11/05/78	Scheduled	1211
The unit was removed from the line for maintenance activities including steam generator tube plugging and eddy current examination, turbine stop valve overhaul, condenser tube plugging and eddy current examination, and steam generator feedwater nozzle NDE and repair.	06/01/79 - 06/18/79	Scheduled	394
The unit was brought off line to complete TMI plant modifications.	01/26/80 - 02/10/80	Scheduled	372
CYCLE 8 REFUELING OUTAGE (Outage was extended for steam generator sleeving)	04/09/80 - 06/17/81	Scheduled	10417
The unit was removed from service in accordance with technical specifications following a fire in No. 1 diesel generator.	07/17/81 - 08/10/81	Forced	741
The unit was taken off line to complete modifications related to TMI and fire protection (10CFR50, Appendix R). The outage was extended for seismic modifications.	02/27/82 - 11/27/84	Scheduled	24107

**SAN ONOFRE UNIT 1
SIGNIFICANT OUTAGE HISTORY**

CAUSE	DATES	FORCED OR SCHEDULED	HOURS
The unit was manually tripped when Aux. Transformer "C" relayed, causing loss of power to Vital Bus No. 4. During the recovery, a severe water hammer occurred in the feedwater system.	11/21/85 - 11/29/85	Forced	199
CYCLE 9 REFUELING OUTAGE, including EQ, fire protection, and seismic modifications.	11/29/85 - 07/26/86	Scheduled	5743
Main feedwater pump lube oil shaft failure.	09/05/86 - 10/01/86	Forced	638
MID-CYCLE 9 MAINTENANCE OUTAGE	05/09/87 - 07/02/87	Scheduled	1295
SECOND MID-CYCLE 9 MAINTENANCE OUTAGE	02/14/88 - 08/05/88	Scheduled	4167
CYCLE 10 REFUELING OUTAGE, including Nuclear Instrument System, Aux Feedwater System, ESF, Diesel Generator, and Steam/Feed flow mismatch modifications.	11/28/88 - 05/25/89	Scheduled	4270
Repair erroneous steam generator level indicators.	05/26/89 - 06/28/89	Forced	773
Manual trip due to shutdown bank Group 2 rods dropping to the bottom of the core.	09/18/89 - 09/20/89	Forced	51
EQ modifications to Hot Leg Recirculation System.	11/01/89 - 11/21/89	Scheduled	487
CYCLE 11 REFUELING OUTAGE AND THERMAL SHIELD SUPPORT REPL., including ATWS, 480v system, Charging System, EQ, Component Cooling Water System, and refueling water level indication modifications.	06/30/90 - 03/23/91	Scheduled	6381
The unit was shut down to repair primary to secondary leakage.	04/21/91 - 05/21/91	Forced	720

SAN ONOFRE UNIT 1
SIGNIFICANT OUTAGE HISTORY

CAUSE	DATES	FORCED OR SCHEDULED	HOURS
Manual trip due to two rods dropping to the bottom of the core.	05-28-91 - 05-30-91	Forced	39