NRC FORM 366 (5-92) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 5/31/95

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
South Texas Unit 2	05000 499	1 OF 7

TITLE (4) Inadvertent Test-Mode Starts of Standby Diesel Generators

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
06	07	94	94	-- 005 --	03	06	05	95	South Texas, Unit 1	05000 498
									FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)							
POWER LEVEL (10)	35		20.402(b)		20.405(c)	X	50.73(a)(2)(iv)		73.71(b)
			20.405(a)(1)(i)		50.36(c)(1)		50.73(a)(2)(v)		73.71(c)
			20.405(a)(1)(ii)		50.36(c)(2)		50.73(a)(2)(vii)		OTHER
			20.405(a)(1)(iii)		50.73(a)(2)(i)		50.73(a)(2)(viii)(A)		(Specify in Abstract below and in Text, NRC Form 366A)
			20.405(a)(1)(iv)		50.73(a)(2)(ii)		50.73(a)(2)(viii)(B)		
			20.405(a)(1)(v)		50.73(a)(2)(iii)		50.73(a)(2)(x)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Jairo Pinzon - Staff Engineer	(512) 972-8027

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
X	YES(If yes, complete EXPECTED SUBMISSION DATE).	NO		07	19	95

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On June 7, 1994, Unit 2 was in Mode 1 at 35% power. Standby Diesel Generator 22 had satisfactorily completed the monthly Standby Diesel Generator Operability test, been unloaded, and been placed in cooldown. Approximately three minutes into the cooldown cycle, the Standby Diesel Generator trouble alarm annunciated and generator voltage and frequency returned to normal operating parameters. Standby Diesel Generator 22 had received an unexpected test-mode start signal. An inadvertent test-mode start also occurred on Standby Diesel Generator 22 on July 25, 1994. Also, on August 1, 1994, Unit 1 Standby Diesel Generator 13, received a spurious test-mode start signal that resulted in a start of a portion of the Standby Diesel Generator auxiliaries with no actual start of the Standby Diesel Generator. Four additional test-mode starts occurred on May 4 and May 7 (Standby Diesel Generators 21 and 22, respectively) and May 18 (Standby Diesel Generators 13 and 22). The specific failure mechanism is under investigation. Inadvertent test-mode starts would not prevent any of the Standby Diesel Generators from performing their safety function. Corrective actions include: installation of noise suppression devices to reduce the susceptibility of inadvertent starts due to electronic noise; replacement of fiber optic boards; and physical separation of AC and DC cables on safety class and non-safety class circuits.

DESCRIPTION OF EVENT:

On June 7, 1994, Unit 2 was in Mode 1 at 35% power. Standby Diesel Generator 22 had satisfactorily completed performance of the monthly Standby Diesel Generator Operability test, been unloaded, and been placed in the cooldown cycle. Approximately three minutes into the cooldown cycle, the Standby Diesel Generator trouble alarm annunciated and generator voltage and frequency returned to normal operating parameters. Standby Diesel Generator 22 had experienced an unexpected start (with no operator action) while in the cooldown cycle. The start was verified to originate from a test-mode start signal and not an emergency start signal. At 1630 hours, the Standby Diesel Generator was again placed in the cooldown cycle and was secured after a five minute cooldown. This indicated that the voltage spike within the start circuit was intermittent or that it varied in magnitude sufficient to induce a start signal infrequently. The inadvertent start occurred when the first cooldown timer deenergized.

When the cooldown timers deenergized emergency fuel oil solenoid 20-F01 and energized emergency fuel oil solenoid 20-F02 (within the start circuit), a voltage spike was generated within the start circuit. Investigation indicates the fiber-optic isolation board allowed this voltage spike to induce a start. Previous modifications to reduce the magnitude of external voltage spikes were not intended or capable of eliminating voltage spikes generated within the start circuit.

On July 25, 1994, while Unit 2 was in Mode 1 at 100% power, Standby Diesel Generator 22 experienced a test-mode start for no apparent reason. No testing, maintenance, or other work activities were in progress at the time of the start. On August 1, 1994, while Unit 1 was in Mode 1 at 100% power, Standby Diesel Generator 13 received an apparent test-mode start signal resulting in a start of a portion of the Standby Diesel Generator auxiliaries with no start of the Standby Diesel Generator. Current indication is a "spurious" start command occurred in the non-class portion of one of the two start circuits.

The June 7, July 25, and August 1 test-mode starts noted above are the first starts from the standby mode since filtering network and circuit modifications to reduce susceptibility of the fiber-optic boards to voltage spikes were made on each of the diesels. Testing has shown the fiber-optic boards are sensitive to high temperatures. The higher the ambient temperature, the more likely voltage spikes will trigger the fiber-optic board to start the Standby Diesel Generator. The filtering network reduces the magnitude of the spikes; however, voltage spikes cannot be totally eliminated.

CAUSE OF EVENT:

The suspected cause of the June 7, 1994, event was electronic noise generated by the emergency fuel oil solenoid deenergizing that was interpreted by the fiber-optic test circuit to be a "Start" signal.

The cause of the July 25, 1994 and August 1, 1994 starts are believed to be the fiber-optic board's susceptibility to noise in conjunction with transient spikes. This caused the fiber-optic test circuits to sense a "Start" signal.

ANALYSIS OF EVENT:

The inadvertent test-mode starts of Standby Diesel Generators are classified Engineered Safety Feature Actuations and are reportable pursuant to 10CFR50.73(a)(2)(iv).

The Standby Diesel Generators are part of the Class 1E 4.16 KV AC Power System. The Class 1E 4.16 KV AC Power System is composed of three trains designed to provide a reliable source of power to the safety-related equipment essential to all modes of plant operation including emergency shutdown following any design basis event. Upon a loss of offsite power, each of the three Standby Diesel Generators supply backup power to the associated 4.16 KV bus to mitigate the consequences of postulated accidents. These inadvertent Standby Diesel Generator test-mode starts did not affect the ability of the Standby Diesel Generators to perform their intended safety function.

CORRECTIVE ACTIONS:

The following corrective actions have been taken to prevent unintentional starts (most of these corrective actions have been previously described in Unit 2 Licensee Event Report 94-003):

1. Equipment repair, which replaced parts found to be weak or non-functioning.

2. Electronic noise reduction by adding:

   a) filters to the DC power supplies to reduce the magnitude of external circuit electronic noise detected in the engine control panel, and

   b) ceramic capacitors across the Allen Bradley "Run" relays to reduce the inductive response contributing to the noise-induced starts.

The electronic noise reduction modifications will lower the probability but not eliminate the possibility of additional unexpected test-mode starts.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
South Texas, Unit 2	05000 499	94	-- 005 --	03	4 OF 7

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

CORRECTIVE ACTIONS: (Continued)

3. As a result of an ongoing assessment of the Diesel Generator Control Panel reliability, an evaluation will be performed to determine the feasibility of replacing the entire control panel with Programmable Logic Control (current state-of-the-art technology). This evaluation will be completed by December 31, 1995.

4. Preventive maintenance activities for replacement of the fiber-optic boards on a five year frequency have been approved and scheduled.

Should another test-mode start occur on any of the South Texas Project Standby Diesel Generators, a revision to this License Event Report will be submitted.

ADDITIONAL INFORMATION:

The Standby Diesel Generators are type KSV-20-T, four stroke, turbocharged engines manufactured by Cooper Energy Services.

During the past three years, four test mode starts were reported regarding inadvertent starts of Standby Diesel Generators:

Unit 2 Licensee Event Report 93-015 documented the inadvertent start of Standby Diesel Generator 22. The cause was attributed to a spurious failure of a transistor.

Unit 1 Licensee Event Report 93-023 documented an inadvertent start of Standby Diesel Generator 12 during testing. The cause of this event was most likely the result of an electrical arc between the Standby Diesel Generator panel and test equipment.

Unit 2 Licensee Event Report 94-001 documented an inadvertent start of Standby Diesel Generator 21. The inadvertent start was caused by a combination of two component failures: a weakened transistor in the Non-Class 1E fiber-optic start circuits and a faulty power supply external to the start circuit that induced spikes into the fiber-optic start circuits.

Unit 2 Licensee Event Report 94-003 documented the inadvertent test-mode starts of Standby Diesel Generators 21, 22, and 13. The cause of these test-mode starts was determined to be the fiber-optic boards' susceptibility to noise in conjunction with transient DC spikes.

ADDENDUM 1

INADVERTENT STANDBY DIESEL GENERATOR TEST-MODE STARTS IN MAY, 1995

PAGE 1 OF 1

DESCRIPTION OF MAY 1995 TEST-MODE STARTS:

Unit 1 and Unit 2 were both in Mode 1 at 100% power.

On May 4, 1995, at 0848 hours, Standby Diesel Generator 21 experienced a test-mode start. On May 7, 1995, at 2022 hours, Standby Diesel Generator 22 experienced a test-mode start. On May 18, 1995, Standby Diesel Generators 13 and 22 experienced test-mode starts, at 0404 hours and 1407 hours, respectively. No work activities were in progress at the time of the starts which could have resulted in an inadvertent start of a Standby Diesel Generator. During these test-mode starts, no abnormal annunciator alarms were discovered in the Control Rooms or at each individual Standby Diesel Generator control panel. The cause of these starting signals is attributed to electronic noise sensed by the fiber optic circuits as being a start signal.

A team was assembled to investigate and resolve the inadvertent start problems. This team consisted of both Houston Lighting & Power personnel and outside experts in electronic noise reduction and failure analysis.

Attached is a table which shows the history of inadvertent starts of the South Texas Project Standby Diesel Generators since September, 1993.

CAUSE OF MAY 1995 TEST-MODE STARTS:

Test-mode starts are due to electronic noise which is sensed by the fiber optic circuits as being a start signal. The specific failure mechanism is under investigation. A supplement to this Licensee Event Report will be submitted upon determination of the failure mechanism.

NEW CORRECTIVE ACTIONS:

Houston Lighting & Power is evaluating modifications to minimize Standby Diesel Generator start circuitry susceptibility to inadvertent actuation. A supplement to this Licensee Event Report will be submitted by July 19, 1995, documenting the investigative findings of the failure mechanism and proposed corrective actions.

STANDBY DIESEL GENERATOR INADVERTENT START HISTORY SINCE 9/93

Date	SDG #	Description	Corrective Actions Taken	Diesel Condition Category*	Start Cause Category*
9-17-93	11	While replacing a fiber-optic cable on Standby Diesel Generator 11, the diesel experienced an unplanned start.	Implemented specialized Standby Diesel Generator maintenance crew.	M	M
10-11-93	12	Standby Diesel Generator 12 experienced a start signal which does not appear to have been initiated by any personnel.	Replaced fiber optic boards B,D. Replaced certain varistors.	M	E
10-19-93	22	Standby Diesel Generator 22 started inadvertently. **- Unit 2 LER 93-015**	1)Revised vendor manual to incorporate varistor characteristics. 2) Installed vent fans in control cabinets. 3)Initiated installation of varistors on 4X1, 4EX3, and 3UP. 4)Tested/replaced varistors and transistors in all diesel control cabinets. 5) Initiated varistor failure mode evaluation.	S	E
12-31-93	12	Standby Diesel Generator 12 auto started in test mode while I&C was connecting a Graphtec recorder in preparation for surveillance procedure performance. **- Unit 1 LER 93-023**	Checked all test equipment - all satisfactory.	S	M
2-16-94	21	During performance of simulated run on Standby Diesel Generator-21, a start signal was received when control was taken out of "Pull to Lock". Problem was narrowed to 4X2 "start relay" circuit, including "D" board transistor circuit Q26.	Cleaned connection on fiber optic board D.	M	E
3-1-94	21	Standby Diesel Generator 21 auto started in normal mode for no apparent reason. When Standby Diesel Generator 21 was placed in cooldown mode, the Standby Diesel Generator unexpectedly returned to the normal mode. **- Unit 2 LER 94-001**	1) Replaced fiber optic boards G,C, & J. 2) Put Warning signs on Standby Diesel Generator Control Panels. 3) Initiated fiber optic board replacement PMs. 4) Installed T-Mod to monitor control circuitry. 5) Reduced control panel interior lights' wattage. 6)Replaced fiber optic cable to fiber optic board D, circuit 2.	S	S
3-5-94	21	Standby Diesel Generator 21 started in test mode without an apparent start signal. An I&C tech was inside the Standby Diesel Generator control panel inspecting relays and circuit cards with a flashlight. **- Unit 2 LER 94-001**		S	M

APPROVED BY OMB NO. 3150-0104
EXPIRES 5/31/95

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
South Texas, Unit 2	05000 499	94	-- 005 --	03	7 OF 7

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

STANDBY DIESEL GENERATOR INADVERTENT START HISTORY SINCE 9/93

Date	SDG #	Description	Corrective Actions Taken	Diesel Condition Category*	Start Cause Category*
4-29-94	21	Standby Diesel Generator 21 started for no apparent reason. **- Unit 2 LER 94-003**	1)Installed filters on DC power supplies to control panels. 2)Installed capacitors on 4X1, 4EX3, 3UP. 3)Initiated action to reroute DC power cables away from control circuitry. 4) Initiated action to remove fiber optic boards from starting circuitry.	S	S
5-12-94	13	Standby Diesel Generator 13 started for no apparent reason. **- Unit 2 LER 94-003**		S	S
5-15-94	2	Standby Diesel Generator 22 started for no apparent reason. **- Unit 2 LER 94-003**		S	S
6-7-94	22	Standby Diesel Generator 22 started for no apparent reason. **- Unit 2 LER 94-005, Rev. 0**	Replaced the 3 fiber optic boards in the test mode start circuit with new (factory fresh) boards on 8-2-94.	R	S
7-25-94	22	Standby Diesel Generator 22 started for no apparent reason. **- Unit 2 LER 94-005, Rev, 1**			
8-1-94	13	Standby Diesel Generator 13 received a partial test mode start signal. Some auxiliaries started and one receiver partially blew down, but the diesel did not start **- Unit 2 LER 94-005, Rev. 1**	Replaced 3 fiber optic boards.	S	S
5-4-95	21	Standby Diesel Generator 21 started for no apparent reason. **- Unit 2 LER 94-005, Rev. 3**	Replaced 3 fiber optic boards (B,D,G).	S	S
5-7-95	22	Standby Diesel Generator 22 started for no apparent reason. **- Unit 2 LER 94-005, Rev. 3**	None at this time	S	S
5-18-95	13	Standby Diesel Generator 1 3 started for no apparent reason. **- Unit 2 LER 94-005, Rev. 3**	Replaced 3 fiber optic boards (B,D,G).	S	S
5-18-95	22	Standby Diesel Generator 22 started for no apparent reason. **- Unit 2 LER 94-005, Rev. 3**	Replaced 3 fiber optic boards (B,D,G).	S	S
5-20-95	22	Standby Diesel Generator 22 started due to newly installed faulty fiber optic board.	Replaced faulty fiber optic board	M	E

* Diesel Condition Category: The diesel status prior to start. M = In Maintenance, S = In Standby, R = Running
Start Cause Category: The cause of the start: M = Maintenance induced, O = Operations induced, E = Equipment failure induced, S = Assumed due to known circuit susceptibility to electronic noise