Nuclear Operating Company

South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

September 5, 2002
NOC-AE-02001401
File No.: G25
10CFR50.73
STI: 31488384

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

South Texas Project
Unit 2
Docket No. STN 50-499
Licensee Event Report 02-003
Automatic Reactor Trip Due to Turbine Trip Caused by High Water Level in 2B Steam Generator

Pursuant to 10CFR50.73, South Texas Project submits the attached Unit 2 Licensee Event Report 02-003 regarding the automatic reactor trip that occurred on July 7, 2002. The reactor trip was the result of a main turbine trip caused by high water level in the 2B steam generator. This event did not have an adverse effect on the health and safety of the public.

Corrective actions 5 and 6 are the only commitments contained in this event report.

If there are any questions on this submittal, please contact S. M. Head at (361) 972-7136 or me at (361) 972-7849.

E. D. Halpin
Plant General Manager

kaw

Attachment: LER 02-003 (South Texas, Unit 2)

IE22

cc:
(paper copy)

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NRC FORM 366 (7-2001) | U.S. NUCLEAR REGULATORY COMMISSION | APPROVED BY OMB NO. 3150-0104 | EXPIRES 7-31-2004

LICENSEE EVENT REPORT (LER)

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

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
South Texas Unit 2	05000 499	1 OF 4

4. TITLE

Automatic Reactor trip due to Main Turbine Trip caused by High Water Level in 2B Steam Generator

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
07	07	2002	2002	03	00	09	05	2002	FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE	1
10. POWER LEVEL	100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR ': (Check all that apply)

20 2201(b)	20.2203(a)(3)(ii)	50.73(a)(2)(ii)(B)	50 73(a)(2)(ix)(A)
20 2201(d)	20.2203(a)(4)	50.73(a)(2)(iii)	50 73(a)(2)(x)
20 2203(a)(1)	50.36(c)(1)(i)(A)	x 50.73(a)(2)(iv)(A)	73 71(a)(4)
20 2203(a)(2)(i)	50.36(c)(1)(ii)(A)	50.73(a)(2)(v)(A)	73 71(a)(5)
20.2203(a)(2)(ii)	50 36(c)(2)	50.73(a)(2)(v)(B)	OTHER Specify in Abstract below or in NRC Form 366A
20.2203(a)(2)(iii)	50 46(a)(3)(ii)	50.73(a)(2)(v)(C)	
20.2203(a)(2)(iv)	50 73(a)(2)(i)(A)	50.73(a)(2)(v)(D)	
20.2203(a)(2)(v)	50.73(a)(2)(i)(B)	50.73(a)(2)(vii)	
20.2203(a)(2)(vi)	50.73(a)(2)(i)(C)	50.73(a)(2)(viii)(A)	
20.2203(a)(3)(i)	50 73(a)(2)(ii)(A)	50.73(a)(2)(viii)(B)	

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
William R. Bealefield, Jr.	361-972-7696

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

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

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

On July 7, 2002 Unit 2 was operating in Mode 1 at 100% power. The Unit 2 main turbine generator tripped automatically due to a High-High level in the 2B steam generator (SG). The reactor tripped automatically as a result of the main turbine trip. The trips occurred shortly after the Channel II inverter and distribution panel de-energized. The loss of the distribution panel and inverter resulted in the loss of power to the instrumentation channels selected to control narrow range steam generator water level. This failure resulted in loss of SG level signal to all four SG Main Feedwater Regulating Valve (MFRV) control circuits because they were all selected to the same channel. This caused the MFRVs to go fully open. With the MFRVs fully open, water level increased in all four steam generators. Steam generator 2B reached its high-high level set point resulting in the main turbine trip and the feedwater isolation signal. The cause of the inverter failure and distribution panel loss of power was the blowing of the direct current (DC) input fuse which de-energized the inverter and power supply to the distribution panel. The second cause of the reactor trip was having all four steam generator level control switches aligned to a single control channel coupled with the loss of power to instruments on that channel. Corrective actions include splitting the SG level channels to two separate control channels and revising a procedure to deselect the channel affected by the battery swap at the SG level controls. This event resulted in no personnel injuries, offsite radiological releases or damage to safety related equipment. There were no challenges to plant safety and the plant responded as expected.

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

DESCRIPTION OF EVENT

On July 7, 2002, Unit 2 was operating at 100% reactor power. At approximately 2300, a pre-job brief was conducted in the control room in preparation for removing the Channel II battery charger number 1 from service and placing the number 2 battery charger in service. Following the pre-job brief, battery charger number 1 was removed from service and approximately one minute later battery charger number 2 was placed in service. When charger number 2 was placed in service, it exhibited an unexpectedly high float voltage of approximately 135 volts direct current (DC). The plant operator contacted the control room and received direction to secure the number 2 charger and return the number 1 charger to service. Channel II charger number 2 was secured and the charger number 2 DC output breaker was opened. Approximately four seconds later, inverter 1202 failed when the DC input fuse blew de-energizing distribution panel 1202. A voltage transient is believed to have been initiated when the battery charger's DC output breaker was opened. When the distribution panel lost power, it resulted in the loss of all Channel II instrumentation. The Unit Supervisor recognized a loss of distribution panel event, and directed the primary and secondary Reactor Operators to monitor the control boards to determine the impact to the plant. All steam generator level controls were selected to Channel II, which caused a loss of level signal to all steam generator (SG) main feedwater regulating valves (MFRV) control circuits and the SG level indicator/recorders which are the instruments operators normally use for SG level control. In response to the loss of the level signals, all MFRVs opened to the full open position. In response to the reduction of feedwater header pressure caused by the opening of the MFRVs, the main feedwater pumps went to maximum speed further increasing feedwater flow to the SGs. The Unit Supervisor observed SG water levels increasing and directed the secondary Reactor Operator to take manual control of MFRVs and control level. Failure of all the SG level indicator/recorders required the secondary Reactor Operator to use the analog indication. The secondary Reactor Operator noted the levels were highest in SG D and C. The operator took manual control of SG D and C MFRVs and adjusted demand to successfully reduce flow and halted the level increase in SG D and C. After adjusting the feedwater flow to SG D and C, the operator took manual control of SG A and B. Steam generator 2B reached its high-high level set point resulting in the main turbine trip and the feedwater isolation signal. At approximately 2313, the Unit 2 reactor tripped automatically as a result of the main turbine trip.

Failure of the DC input fuse resulted in the loss of SG level signal to all four SG MFRV control circuits because they were all selected to the same channel. Operating the plant with all four steam generator level controls selected to the same channel allowed the SG level control function to be affected by a single point failure. STP design permits operation of SG level control from two separate channels to mitigate the effects of single point failures.

EVENT SIGNIFICANCE

This event resulted in no personnel injuries, radiation exposure, offsite radiological releases or damage to important safety related equipment. The event is reportable because it resulted in actuation of reactor protection system and a reactor trip. This was a normal reactor trip and the plant performed as expected. The SG B high-high level trip occurred at the expected setpoint.

The reactor trip resulted from main turbine trip following de-energization of vital Channel II instrumentation due to loss of power from its distribution panel. The probability of core damage is 5.7E-07 for an excessive feedwater initiating event with a non-functional instrument channel. The Conditional Core Damage Probability (CCDP) for an excessive feedwater event with all risk significant equipment available is 1.9E-07. The change in CCDP for this event is 3.8E-07. Based on these values for CCDP, the risk significance of this event is considered low.

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

CAUSE OF EVENT

1. The first cause and initiating event of the reactor trip was a blown DC input fuse which de-energized the distribution panel and caused a loss of SG level signal to all four steam generators during an evolution to shift electrical lineup from one battery charger to a second charger. The fuse blew during a voltage transient that affected the operation of the inverter's gating synchronizing circuit.
2. The second cause of the reactor trip was having all four steam generator level control switches aligned to a single control channel coupled with the loss of power to instruments on that channel, thus, allowing the SG level control function to be affected by a single point failure.

CORRECTIVE ACTIONS

1. The distribution panel power supply was transferred to the regulating transformer and Channel II instrumentation was restored to service. Completed July 7, 2002.
2. The blown fuse in the inverter was replaced. Completed July 8, 2002.
3. The inverter was returned to operable status. Completed July 8, 2002.
4. The SG level channels used for control of the MFRVs were split between two separate control channels to minimize plant impact when a loss of a distribution panel occurs. Completed July 11, 2002.
5. Operations procedure, ESF (Class 1E) DC Distribution System, will be revised to include a statement to make operators aware that the routine changing of battery chargers could result in the loss of the associated distribution panel and to deselect the channel affected by the charger swap at the steam generator level controls. Due date: September 12, 2002.
6. A trouble shooting plan is being developed to perform testing, during the next Unit 2 outage, to measure the effects of transferring battery chargers on inverter operation to determine the root cause of the fuse failure. Due date: December 31, 2002.

ADDITIONAL INFORMATION

A similar event occurred on August 7, 2002 during operations to change the battery charger. This blown fuse did not result in a reactor trip. The corrective actions associated with this event were effective in preventing a reactor trip.

The routine changing of battery chargers should not result in the loss of the distribution panel. The higher voltage (135.5 volts DC) experienced by the inverter DC section was within the inverter's design limits of 105 to 140 volts DC. According to the manufacturer, the nominal operating voltage of the inverter DC section is 135 volts DC. The 135.5 volts DC experienced when charger 2 was placed in service did not challenge any connected component or the charger itself. All normally energized components attached to the system are rated at 140 volts DC. The charger is designed to provide voltages as high as 142 volts DC during equalize mode.

Voltage transients are not unexpected when current is interrupted in an inductive circuit as occurred when battery charger 2's DC output breaker was opened. The electrical circuit affected by opening battery charger 2's DC breaker was primarily inductive due to a choke inducter at the output of the charger. The voltage transient initiated when this circuit was interrupted may have caused a pulse at

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

the gating synchronizing printed circuit board.

ADDITIONAL INFORMATION (cont.)

A voltage transient on the DC power input to the inverter would affect the gating synchronizing printed circuit board because this is also the power source for the low voltage power supply circuits on the board. The pulse transient at the gating synchronizing printed circuit board most likely resulted in two silicon control rectifiers (SCR) firing simultaneously which overloaded the inverter circuit. This current overload caused the DC input fuse to blow.

Analysis of the blown fuse supports the conclusion that a gating error occurred. Of the eight fuse elements, seven were open when the fuse was examined. The sand around the elements was melted and fused to the metal. This indicates that the fuse was subjected to a high current condition in excess of the fuse rating. The misfiring of the gating synchronizing printed circuit board is the most likely cause of the blown fuse. This was discussed with the inverter/rectifier manufacturer and this scenario is considered the most credible cause of the fuse blowing.

The potential for changing battery chargers to cause a loss of the inverter was also not recognized based on a prior STP event. The previous event in 1992 was not addressed as a station problem report because it occurred with the plant shutdown.

A supplement to this event report may be required if the component deficiency evaluation determines the cause to be other than as reflected in this event report.