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

January 30, 2012
NOC-AE-12002791
File No.: G25
10 CFR 50.73
STI: 33280371

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

South Texas Project
Unit 2
Docket No. STN 50-499
Licensee Event Report 2-2011-002
Unit 2 Reactor Trip on Main Generator Lockout

Pursuant to 10 CFR 50.73, STP Nuclear Operating Company (STPNOC) submits the attached Unit 2 Licensee Event Report (LER) 2-2011-002 to address the Unit 2 Reactor trip that occurred on November 29, 2011.

This condition is considered reportable under 10 CFR 50.73(a)(2)(iv)(A), any event or condition that resulted in manual or automatic actuation of any of the systems listed in paragraph (a)(2)(iv)(B) of this section.

This event did not have an adverse effect on the health and safety of the public.

There are no commitments contained in this LER. Corrective actions will be implemented in accordance with the STP Corrective Action Program.

If there are any questions on this submittal, please contact either Jamie Paul at (361) 972-7344 or me at (361) 972-7566.

G. T. Powell
VP Generation

JLP

Attachment: LER 2-2011-002

IE22
NRR

cc:
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NRC FORM 366 (10-2010) U.S. NUCLEAR REGULATORY COMMISSION

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	05000499	1 OF 5

4. TITLE

Unit 2 Reactor Trip on Main Generator Lockout

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									N/A	N/A
11	29	2011	2011	002	0	01	30	2012	N/A	N/A

9. OPERATING MODE

1

10. POWER LEVEL

100%

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

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☒ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER *(Include Area Code)*
Jamie Paul, Licensing Engineer	361-972-7344

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 RESPONSE EXPECTED

☐ YES (If yes, complete 15. EXPECTED SUBMISSION DATE) ☑ NO

15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR

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

On 11/26/11 at 2121 hours, Unit 2 received the Stator Coil Water (SCW) Differential Temperature high alarm. The crew determined generator thermocouple T6144 on the SCW outlet of Coil 33T was reading higher than the other thermocouples. I&C Technicians conducting a local check subsequently reported the Coil 33T thermocouple was reading within the differential temperature band. On 11/27 multiple Generator Condition Monitoring (GCM) alarms were received. The operating crew subsequently removed the Coil 33T thermocouple from service by substituting a known value. At 0310 on 11/29/11 a Stator Cooling Water trouble alarm was received. The Unit 2 Reactor tripped at 0329 hours on 11/29/11 due to Main Generator Lockout. An initial inspection of the main generator revealed significant stator coil damage. Approximately three feet of stator Coil 33T (top coil in slot 33) was melted or missing on the exciter end.

The failure analysis determined the most likely cause was a very small leak in a hollow strand in Coil 33T. Analysis supports that this leak existed for a long time and allowed moisture to travel inside the coil. The moisture degraded the resin in the coil allowing the conductor bundle to come loose. This condition allowed some individual conductor strands to move and vibrate. The strand-to-strand vibrations wore away the insulation and created shorts. The shorts caused excessive heating. The affected area grew due to thermal damage until the coil arced across the missing melted area. The potential exists that the small leak was located in the portion of the coil that is melted/missing. If so, it will not be possible to ascertain the root cause of the leak. After the final failure analysis reports are received, the root cause report and LER will be evaluated and revised if warranted.

This condition is considered reportable under 10 CFR 50.73(a)(2)(iv)(A), any event or condition that resulted in manual or automatic actuation of any of the systems listed in paragraph 10 CFR 50.73(a)(2)(iv)(B). There were no personnel injuries, no offsite radiological releases, and no damage to safety-related equipment associated with this condition. This condition did not have an adverse effect on the health and safety of the public.

I. DESCRIPTION OF EVENT

A. REPORTABLE EVENT CLASSIFICATION

This event is reportable pursuant to 10 CFR 50.73(a)(2)(iv)(A), any event or condition that resulted in manual or automatic actuation of any of the systems listed in paragraph (a)(2)(iv)(B) of this section.

B. PLANT OPERATING CONDITIONS PRIOR TO EVENT

South Texas Project (STP) Unit 2 was in Mode 1, with Reactor Power at approximately 100%.

C. STATUS OF STRUCTURES, SYSTEMS, AND COMPONENTS THAT WERE INOPERABLE AT THE START OF THE EVENT AND THAT CONTRIBUTED TO THE EVENT

No structures, systems, or components were inoperable at the start of the event that contributed to the event.

D. NARRATIVE SUMMARY OF THE EVENT

On 11/26/11 at 2121 hours, Unit 2 received the Stator Coil Water (SCW) Differential Temperature high alarm. The crew responded by implementing 0POP09-AN-7M03 for the A-5 annunciator. The crew identified a differential temperature greater than 14.4 °F on the Integrated Plant Computer System (ICS). None of the ICS thermocouple points indicated greater than the 174 °F criteria for notifying the System Engineer. The crew determined generator thermocouple T6144 on the SCW outlet of Coil 33T was reading higher than the other thermocouples. The crew contacted the Integrated Maintenance Team for I&C support to verify the Coil 33T thermocouple reading in accordance with the annunciator response procedure.

On 11/27/11 at approximately 0200 hours, two I&C Technicians and their Supervisor arrived at the Generator Terminal Board at the east side of the Main Generator. The I&C Technicians reported to the Unit 2 Control Room that the Coil 33T thermocouple was reading 160.7 °F. Shortly after the I&C Technicians disconnected their equipment at approximately 0222 hours, thermocouple 33T rose to 168 °F and it continued rise unnoticed until it read greater than 175 °F. The crew mistakenly believed the higher temperature indicated a malfunctioning thermocouple due to I&C activities based on the report that the Coil 33T thermocouple was reading 160.7 °F at the generator. At 0235 hours, the Coil 33T thermocouple rose to 180.35 °F but the crew was not trending or monitoring the point because it was considered an invalid indicator.

At 0244 hours, the Control Room received multiple Generator Condition Monitor (GCM) alarms from the ICS. The Control Room directed a Plant Operator (PO) to adjust the analyzer's sample flow. Based on the behavior of the GCM alarms and other indicators, the crew determined the GCM was malfunctioning and a Condition Report (CR) was written on the GCM. At 0254 hours, the GCM Verified Alarm cleared. At 0342 hours, the crew removed the Coil 33T thermocouple from service by substituting a known value for the thermocouple data. When the Coil 33T thermocouple was removed from service it had trended down from 181.7 °F to 178.7 °F.

On 11/29/11 at 0216 hours, the GCM Warning Alarm began to cycle in and out. The Control Room was focused on other activities and believed the GCM was malfunctioning. Between 0217 and 0241 hours the GCM generated 105 GCM Warning and 3 GCM Verified Alarms. The Control Room dispatched a PO to check the GCM. The PO notified the Control Room that the GCM was erratic and cycling between safe and alarm. The PO left the GCM to obtain a copy of procedure 0POP02-GG-0001, Generator Hydrogen and Carbon Dioxide Gas System, Addendum 4, Generator Condition Monitoring Alarm Response to address the GCM alarms.

At 0310 hours, the Control Room received annunciator 7M03-A6, Stator Cooling System Trouble Alarm. The Control Room redirected the PO to check the Stator Cooling Water System. When the PO arrived at the Stator Cooling Water skid, he noted that the tank level was high and water conductivity was rising. The PO immediately contacted Chemistry to sample the cooling water for conductivity.

The Unit 2 Reactor tripped at 0329 hours on 11/29/11 due to Main Generator Lockout. A "crawl through" inspection was performed on the day after the Unit 2 Main Generator event and reactor trip and significant stator coil damage was found. Approximately three feet of stator Coil 33T (i.e., the Top coil in slot 33) was melted or missing on the exciter end.

The coils have hollow strands throughout the coil to allow Stator Cooling Water (SCW) to flow through the coils themselves. Each strand is covered with resin used as internal fillers and insulation inside the coil. The insulation surrounding the conducting portion of the coil is called groundwall insulation and it consists of mica covered glass backed tape. The resin bonds the mica tape in the groundwall and fill voids between the groundwall and the conductor stack.

The failure analysis determined the most likely cause was that a very small leak existed in a hollow strand in Coil 33T. Analysis supports that this leak existed for a long time and allowed moisture to travel inside the coil. The moisture degraded the resin in the coil over time allowing the conductor bundle to come loose from the ground wall and allow some individual conductor strands to move and vibrate. The strand-to-strand vibrations and movement eventually wore away the insulation between the strands and created strand-to-strand shorts. The shorts caused excessive heating. The affected area grew as the coil insulation was thermally damaged and failed. As the affected area grew, more heat was created until the coil melted and eventually arced violently across the missing melted area eventually causing the 33T coil to catastrophically fail.

The leak in a hollow strand wall could have been caused by several different mechanisms. Inspections did not identify the leak location. The exact cause of the leak cannot be ascertained without being able to examine the leak location. Although the final analysis report is not yet available, it is likely that the small leak was located in the portion of the coil that is melted/missing. If so it will not be possible to identify the root cause of the leak. After the final failure analysis reports are received, the root cause report will be evaluated and revised if warranted based upon the findings. The LER will be supplemented if the evaluation results affect the substance of this report.

The failure of 33T coil itself did not cause the ground fault relay due to its position to neutral (first coil from neutral) and its low voltage, but when 33T failed, melted copper was expelled from the ground wall of 33T and flowed down on 33B. The melted copper degraded the groundwall insulation on 33B and a ground fault occurred.

E. METHOD OF DISCOVERY

The generator failure, reactor trip, and automatic actuation of the systems listed below were self-revealing.

II. EVENT-DRIVEN INFORMATION

A. SAFETY SYSTEMS THAT RESPONDED

All required safety systems responded as expected including the following actuations:

1. Reactor Coolant Pump Undervoltage Reactor Trip
2. Reactor Protection System P-16, Turbine Trip
3. Feedwater Isolation Actuation
4. CRE HVAC Emergency Recirculation (C Train LOOP)
5. Reactor Containment Fan Coolers (C Train LOOP)
6. Auxiliary Feedwater Actuation (All AFW pumps actuated)
7. Primary Pressure Control (Pressurizer Spray and Heaters actuated as required)
8. Secondary Pressure Control Actuation (Steam Dumps Actuated)

B. DURATION OF SAFETY SYSTEM INOPERABILITY

N/A

C. SAFETY CONSEQUENCES AND IMPLICATIONS OF THE EVENT

There was no impact to radiological safety, safety of the public, or safety of station personnel during this event.

The Incremental Conditional Core Damage Probability (ICCDP) for the Reactor Trip in Unit 2 on November 29, 2011 is 2.65E-07. The resulting Incremental Conditional Large Early Release Probability (LERP) is 5.99E-09.

III. CAUSE OF THE EVENT

Although the final analysis report is not yet available, it is likely that the small leak was located in the portion of the coil that is melted/missing. If so the root cause of the leak will not be determined. After the final failure analysis reports from ElectroMechanical Engineering (EME) and Kinectrics are received, the root cause report will be revised and the corrective action plan addressing the technical aspects of this event will be changed if warranted based upon the findings. The LER will be supplemented if the evaluation results affect the substance of this report.

IV. CORRECTIVE ACTIONS

Corrective actions will be implemented in accordance with the STP Corrective Action Program.

Enhancement actions are planned to improve control room annunciation and indication of generator conditions.

Repairs to the Unit 2 Main Generator stator, rotor, exciter, hydrogen cooler, and associated auxiliary equipment are in progress.

As discussed above, following receipt of the final failure analysis reports, the root cause report will be revised and the corrective action plan addressing the technical aspects of this event will be changed if warranted based upon the findings.

V. PREVIOUS SIMILAR EVENTS

There have been no similar reportable events at STP within the last three years.

VI. ADDITIONAL INFORMATION

N/A