Nuclear Operating Company

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

November 16, 2006
NOC-AE-06002083
10CFR50.73

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

South Texas Project
Unit 1
Docket No. STN 50-498
Licensee Event Report 2006-04,
Multiple Main Steam Safety Valves Found Outside Acceptance Criteria

Pursuant to 10 CFR 50.73(a)(2)(i)(B), STP Nuclear Operating Company submits the attached Unit 1 Licensee Event Report 2006-04 regarding three Main Steam Safety Valves being found outside acceptance criteria on as-found surveillance testing.

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

There are no commitments contained in this event report. Resulting corrective actions will be implemented in accordance with the Corrective Action Program.

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

E. D. Halpin by K. Flores

E. D. Halpin
Site Vice President/
Plant General Manager

wem/

Attachment: South Texas Unit 1 LER 2006-04

IE22

STI: 32087507

cc:
(paper copy)

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NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 06/30/2007

Estimated burden per response to comply with this mandatory collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

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

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4. TITLE

Multiple Main Steam Safety Valves Found Outside Acceptance Criteria

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
										05000
09	25	2006	2006	- 004 -	00	11	27	2006	FACILITY NAME	DOCKET NUMBER
										05000

9. OPERATING MODE

1

10. POWER LEVEL

87

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

- ☐ 20.2201(b)
- ☐ 20.2201(d)
- ☐ 20.2203(a)(1)
- ☐ 20.2203(a)(2)(i)
- ☐ 20.2203(a)(2)(ii)
- ☐ 20.2203(a)(2)(iii)
- ☐ 20.2203(a)(2)(iv)
- ☐ 20.2203(a)(2)(v)
- ☐ 20.2203(a)(2)(vi)
- ☐ 20.2203(a)(3)(i)
- ☐ 20.2203(a)(3)(ii)
- ☐ 20.2203(a)(4)
- ☐ 50.36(c)(1)(i)(A)
- ☐ 50.36(c)(1)(ii)(A)
- ☐ 50.36(c)(2)
- ☐ 50.46(a)(3)(ii)
- ☐ 50.73(a)(2)(i)(A)
- ☒ 50.73(a)(2)(i)(B)
- ☐ 50.73(a)(2)(i)(C)
- ☐ 50.73(a)(2)(ii)(A)
- ☐ 50.73(a)(2)(ii)(B)
- ☐ 50.73(a)(2)(iii)
- ☐ 50.73(a)(2)(iv)(A)
- ☐ 50.73(a)(2)(v)(A)
- ☐ 50.73(a)(2)(v)(B)
- ☐ 50.73(a)(2)(v)(C)
- ☐ 50.73(a)(2)(v)(D)
- ☐ 50.73(a)(2)(vii)
- ☐ 50.73(a)(2)(viii)(A)
- ☐ 50.73(a)(2)(viii)(B)
- ☐ 50.73(a)(2)(ix)(A)
- ☐ 50.73(a)(2)(x)
- ☐ 73.71(a)(4)
- ☐ 73.71(a)(5)
- ☐ OTHER

Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
Willem E. Mookhoek (Licensing Engineer)	(361) 972-7274

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
B	MS	PSV	Dresser	N					

14. SUPPLEMENTAL REPORT 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)*

While testing the Unit 1 Main Steam Safety Valves (MSSVs) on 9/25/06 just prior to 1RE13, three valves failed the as found acceptance test. If a valve fails the lift test, then additional valves in the same unit are required to be tested. On 9/25/06 two of the six valves being tested in Unit 1 were greater than 3% above the setpoint on the initial lift (MSSVs 7440A and 7440B). Four additional valves were tested in Unit 1 per scope expansion guidance. All additional expanded scope valves passed testing. Two additional valves were tested to determine generic cause and one of these additional cause determination tested valves was high outside of the 3% band (7430C) and another valve came within 1.5 psi of being 3% high (7430). All of the valves tested were adjusted so that they lifted within +/- 1% of their setpoints.

It was determined that the primary cause of the MSSVs lifting high was due to the bonding of the oxide layers that grew on the nozzle seat and the disc after refurbishment. Corrective Actions include performing inservice conditioning lifts on all refurbished valves.

Three Unit 1 MSSVs that lift outside of the range specified in Technical Specification 3.7.1.1 is considered to be a multiple test failure and is reportable under 10CFR50.73(a)(2)(i)(B).

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

I. DESCRIPTION OF REPORTABLE EVENT

A. REPORTABLE EVENT CLASSIFICATION

This event is reportable pursuant to 10 CFR 50.73(a)(2)(i)(B) as a condition prohibited by Technical Specifications (TS). The Limiting Condition for Operation (LCO) for TS 3.7.1.1 states that All main steam line Code safety valves associated with each steam generator shall be OPERABLE in Modes 1, 2, and 3.

B. PLANT OPERATING CONDITIONS PRIOR TO THE EVENT

Unit 1 was operating at ~87% power in coast down for refueling outage 1RE13 at the time of discovery.

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

None.

D. NARRATIVE SUMMARY OF THE EVENT, INCLUDING DATES AND APPROXIMATE TIMES

A portion of the twenty MSSVs per unit are tested prior to each outage to meet the Technical Specifications requirements such that all valves get tested in a five year period. If a MSSV lifts outside of the +/- 3% band on the initial as found test, then the valve is declared inoperable. The valve must be restored to operable status within 24 hours or else the Power Range Neutron Flux High Trip Setpoint must be reduced. In addition, if a valve fails the initial lift test, then additional valves in the same unit are required to be tested per ASME/ANSI OMa-1988 Addenda to ASME/ANSI OM-1987, "Operation and Maintenance of Nuclear Power Plants." All valves are adjusted if necessary to be left at +/- 1% of their setpoints on the final as left lifts.

On 9/25/06 two of the six valves being tested in Unit 1 were greater than 3% above the setpoint on the initial lift (MSSVs 7440A and 7440B). Four additional valves were selected for Code sample expansion testing based upon the length of time since their last surveillance test and all four lifted within the +/- 3% acceptance band. After further evaluation showed that the two failed valves had been overhauled during the previous outage (1RE12), it was decided that we should test the other two valves that were overhauled in the last Unit 1 outage in an attempt to understand the cause of the two test failures. One of the two valves lifted high outside of the 3% band (7430C) and the other valve came within 1.5 psi of being 3% high (7430). All of the valves tested were adjusted so that they lifted within +/- 1% of their setpoints.

Because the three failures and the one near failure in Unit 1 were all valves that had been overhauled during the previous outage (1RE12), it was decided to also test the four valves in Unit 2 that had been overhauled during the previous outage based on generic implications. One of the valves in Unit 2 lifted high outside of the 3% band. The other three valves in Unit 2 lifted high above their setpoints but they were within the 3% band. These valves were also

adjusted to within +/- 1% of their setpoints.

Fault tree analysis was performed to determine the cause of the recent test failures at South Texas Project (STP). It was determined that the primary cause of the STP MSSVs lifting high out of tolerance (OOT) was due to the bonding of the oxide layers that grew on the nozzle seat and the disc. This "oxide bonding" mechanism results in an increased pressure being required to separate the disc and seat during the first lift. This lift then breaks the oxide bond such that successive lifts require less pressure. Destructive examination of a disc from a failed MSSV performed by the NRG Material Analysis Group confirmed that oxide bonding had occurred between the seat and disc.

The following facts and conclusions are based on our Fault Tree Analysis, NRG lab analysis, review of EPRI technical reports, operating experience at STP and in the industry, and discussions with industry contacts and vendors:

- Oxide layers develop on both the stainless steel nozzle seat and the preoxidized Inconel X-750 disc while the plant is at normal operating pressure and temperature.
- The use of preoxidized Inconel discs has resulted in fewer testing failures in the industry but failures can still occur, especially if the unit has a long run after an outage where the valves were overhauled.
- Oxide layers develop much more rapidly on new parts and on newly lapped seats. Some utilities showed binding in as little as 30 to 90 days. Initial oxide growth is rapid but it decreases to a more linear and predictable growth as the thickness of the oxide layers increase.
- MSSVs that have new discs and seats or that have been lapped are less likely to experience high out of tolerance test failures if the oxide layers are "broken" by lifts and/or cooldowns before a strong bond is formed. The thicker oxide layers that remain then help to minimize the formation of strong bonds between the disc and seat.
- All of the MSSVs that recently failed high OOT at STP were lapped during the previous outage and had not been lifted or been through a cooldown cycle since the previous outage.
  - The valves with stainless steel discs that have not yet been replaced with preoxidized Inconel discs have gone through multiple lifts and cooldowns and they are exhibiting satisfactory behavior when tested.
  - We have had no evidence of oxide bonding of valves beyond their initial cycle and subsequent cooldown.
  - There are 5 cases in our history where a valve was in service for one cycle after an overhaul, inservice during a cooldown (outage), and then tested SAT during the next cycle. This demonstrates that valves that have gone through a cycle and then a cooldown have built up a sufficiently thick oxide layer.

E. THE METHOD OF DISCOVERY OF EACH COMPONENT OR SYSTEM FAILURE, OR PROCEDURAL OR PERSONNEL ERROR

This failure was discovered during normal surveillance testing of the MSSVs.

II. COMPONENT OR SYSTEM FAILURES

A. FAILURE MODE, MECHANISM, AND EFFECTS OF EACH FAILED COMPONENT

It was determined that the primary cause of the MSSVs lifting high was due to the bonding of the oxide layers that grew on the nozzle seat and the disc after refurbishment.

B. CAUSE OF EACH COMPONENT OR SYSTEM FAILURE

The root cause of the MSSVs lifting high OOT is due to oxide bonding between the seat and disc. Because of this bonding, additional pressure was needed on the initial valve lifts. The nozzle seats of each of the valves that lifted high had been lapped during the previous outage so the oxide layers grew quickly at a parabolic rate. No valve lifts or cooldowns had occurred during the long runs in both units so the oxide bonds weren't broken prior to them becoming strong enough to make the valves lift high OOT.

C. SYSTEMS OR SECONDARY FUNCTIONS THAT WERE AFFECTED BY FAILURE OF COMPONENTS WITH MULTIPLE FUNCTIONS

None.

D. FAILED COMPONENT INFORMATION

The MSSVs are Dresser 3700 Series Steam Safety Valves. The valve setpoints for each valve are specified in Technical Specification 3.7.1 on Table 3.7-2.

III. ANALYSIS OF THE EVENT

A. SAFETY SYSTEM RESPONSES THAT OCCURRED

No safety system responses occurred.

B. DURATION OF SAFETY SYSTEM TRAIN INOPERABILITY

Each MSSV was returned to an Operable status within two hours from time of discovery by resetting the lift setpoint. The OOT condition developed at some time prior to testing, but there is no firm indication as to when this occurred.

C. SAFETY CONSEQUENCES AND IMPLICATIONS

The MSSVs lifting slightly above the required setpoint was not risk significant. Two sensitivity studies analyzed by the Probabilistic Risk Analysis (PRA) model showed that there was no change in core damage frequency for either analysis. This event did not have an adverse effect on the health and safety of the public.

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

IV. CAUSE OF THE EVENT

The event being reported is a condition prohibited by TS in that three MSSVs tested outside the allowable setpoint tolerance. The cause of the failure was stated in Section II.B above.

V. CORRECTIVE ACTIONS

Based on the above conclusions and based on an evaluation of the maintenance and testing history of all 40 MSSVs, inservice disc and seat conditioning lifts will be performed on the Unit 1 and 2 valves that had been lapped during the previous outage and on Unit 1 MSSV 7420C that was lapped during 1RE13. These inservice conditioning lifts will ensure that sufficiently thick oxide layers are formed on the nozzle seat and disc seat surfaces. Corrective action document 06-12124 is tracking these additional lifts.

A "decision tree" will be incorporated into procedure 0PSP11-MS-0001, "Main Steam Safety Valve Inservice Test" to provide inservice seat conditioning lifts for MSSVs that are lapped in the future. Corrective action document 06-12124 will track the revision to procedure 0PSP11-MS-0001 that will incorporate this change.

VI. PREVIOUS SIMILAR EVENTS

There have been no other MSSV failures in the past three years.