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 1	05000 498	1 OF 5

TITLE (4) Technical Specification 3.0.3 Entry Due to Potentially Undersized Fuses in the Solid State Protection System

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
02	17	93	93	009	01	05	20	93	South Texas, Unit 2	05000-499
									FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	5
POWER LEVEL (10)	0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

	20.402(b)		20.405(c)		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)	X	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 - Senior 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
	YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO				

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

On February 17, 1993, Unit 1 was in Mode 5 and Unit 2 was in Mode 4, both at 0% power. Plant personnel determined that a potentially unanalyzed condition existed in both units related to a failed fuse event that occurred on February 13, 1993. This unanalyzed condition involved suspected undersized fuses found in the Solid State Protection System (SSPS) in which an inrush current could cause the fuses to fail and prevent the fulfillment of the SSPS's intended safety function. In response to the inoperable SSPS actuation cabinets, Unit 2 entered Technical Specification Section 3.0.3 and plant cooldown to Mode 5 was initiated at 1030 on February 17, 1993. Unit 1 was already in Mode 5. The event was caused by the random age related failure of a SSPS fuse. In response to the event, the 10 amp fuses were replaced with 20 amp fuses in both Units, other 120 volt vital A.C. distribution and class 1E DC circuit panels were reviewed for similar conditions, field verification of selected protective devices was conducted, and a failure analysis of the blown fuse was performed by an independent laboratory and reviewed by the fuse manufacturer. Additionally, lessons learned will be formally factored into the design process.

DESCRIPTION OF EVENT:

On February 17, 1993, Unit 1 was in Mode 5 and Unit 2 was in Mode 4, both at 0% power. Plant personnel determined that an unanalyzed condition existed in both units related to a failed fuse event that occurred on February 13, 1993. This unanalyzed condition involved potentially undersized fuses found in the Solid State Protection System (SSPS) in which an inrush current could possibly cause the fuses to fail and prevent the fulfillment of SSPS's intended safety function.

On February 13, 1993, while performing SSPS Train S reactor trip breaker trip actuating device operational surveillance test in Unit 1, the power was lost to the Train A SSPS actuation cabinet. It was subsequently determined that a 10 amp fuse in the electrical distribution panel EDP 1201 which feeds the Train A SSPS actuation cabinet failed. The unit was in Mode 5 at 0% power at the time of the failure. Testing was suspended and the event was referred to engineering for investigation. Engineering concluded that the fuse, sized for steady state current conditions, may have been undersized based on inrush current. The review determined that Westinghouse had provided 20 amp fuses in the SSPS actuation cabinet but the fuses in the electrical distribution panel feeding this cabinet had been sized at 10 amps. The 10 amp fuses were also installed in Unit 2.

An initial operability review was performed to determine the impact of having 10 amp fuses feeding the SSPS actuation cabinet. The initial results concluded that all three SSPS actuation trains were inoperable, and as a result, Unit 2 entered Technical Specification 3.0.3. At 1030 on February 17, 1993, plant cooldown to Mode 5 was initiated in Unit 2. Unit 1 was already in Mode 5 so entry into Technical Specification 3.0.3 was not required. Concurrently, plant change forms were initiated to revise the fuse size from 10 amp to 20 amp. Unit 2 exited Technical Specification 3.0.3 when the 10 amp fuses were replaced with 20 amp fuses.

CAUSE OF EVENT:

The cause of this event was a random age related failure of the 10 amp fuse in the electrical distribution panel feeding Train A SSPS actuation cabinet.

ANALYSIS OF EVENT:

The SSPS contains three trains of Engineered Safety Features (ESF) actuation cabinets which actuate various ESF equipment via relays providing protection to mitigate the consequences of postulated accidents. When the correct logic requirements are met, master relays are energized which in turn energize a set of slave relays that operate the various ESF components.

ANALYSIS OF EVENT: (Cont'd)

The initial evaluation of the design was based on information available from Westinghouse (the actuation cabinets' vendor) that indicated a momentary inrush current of 46.5 amps may be experienced. Based on this, and the fact that Westinghouse had furnished 20 amp fuses in the SSPS actuation cabinets, it was concluded that the installed 10 amp fast acting fuses in the distribution panel feeding this equipment may blow on energization of the maximum number of relays during Modes 1 through 4. Therefore, the SSPS actuation cabinets were conservatively declared inoperable in these modes.

Further evaluation of the design determined that the worst case accident scenario was a main steam line break, which would initiate the slave relays associated with steam line isolation and safety injection. This condition energizes 45 relays (43 latching and 2 non-latching) in the Train A or B actuation cabinet; 33 (30 latching and 3 non-latching) in the Train C actuation cabinet. Calculated maximum circuit currents during relay inrush for these cabinets is less than the published time-current characteristic for 10 amp fuses (Gould Shawmut type A60X10). Therefore, the SSPS actuation cabinets were, in fact, operable with the originally installed (unblown) 10 amp fuses.

It should be noted that the above evaluation and conclusion was based on Gould Shawmut product information for their A60X10 fuses which indicates an average melting current versus time value of approximately 29 amps at 10 msec. Recently received product information for these same fuses shows an average melting current versus time value of approximately 69 amps at 10 msec. Gould Shawmut attributes this change to improved equipment and techniques used in testing and developing fuse time-current characteristic curves. The results of this improved technology are particularly apparent at short time (millisecond) values. This curve significantly increases the SSPS fuse application design margin and supports that the SSPS actuation cabinets were operable with the originally installed (unblown) 10 amp fuses.

In addition to the design evaluation, Southwest Research Institute (SwRI), an independent laboratory, was contracted to evaluate the blown fuse in order to determine the cause of failure, if possible. During this evaluation SwRI examined the blown fuse, several unblown companion fuses and a new fuse. SwRI concluded:

- The blown fuse did not open as a result of a high current fault.
- It was not possible to determine whether the blown fuse link had a defect that caused it to open.
- Thermal damage to unopened links in both the blown fuse and the unblown companion fuses indicate that they had been subjected to greater than rated current.

ANALYSIS OF EVENT: (Cont'd)

- Cracks in ferrules of the blown fuse had no apparent impact on its electrical performance and no apparent role in the fuse opening.

Gould Shawmut reviewed the SwRI Failure Analysis Report and in general agreed with the SwRI report. Gould Shawmut agreed that the fuses had been subjected to greater than rated current (eg. 10 amps), however, this is not unusual and fuses are designed for such service. That is, fuses are designed to accept a certain amount of "overcurrent" due to conditions such as inrushes. Gould Shawmut concluded that the thermal damage observed in both the blown SSPS fuse and the unblown companion fuses was indicative of stress cracking of the zinc element caused by thermal cycling. As such, the most probable cause of the fuse opening was mechanical stressing (aging) of the element. That is, the fuse reached the end of its life.

STP has concluded that the SSPS fuse opening was a random age related failure event. This conclusion is based on the circuit analysis discussed above and is supported by the fact that the SSPS actuation system has in the past operated properly on safety injection actuations wherein the currents experienced by the subject fuses closely approach those of a main steam line break scenario. The design of STP accounts for single random failures and, therefore, this fuse failure was within the plant's design basis.

Entry into Technical Specification 3.0.3 is reportable pursuant to 10CFR50.73 (a)(i)(B).

CORRECTIVE ACTIONS:

1. The electrical distribution panel fuses feeding the three trains of SSPS actuation cabinets in both units were replaced with 20 amp fuses. A 20 amp fuse provides adequate protection for this design and provides additional margin to reduce the probability of nuisance fuse blowing due to random age related failure mechanisms.

2. A comparative evaluation of vital 120 VAC distribution panel fuses and selected DC circuit breakers and the main incoming protective devices in the panels fed by them has been done to determine if other problems exist. Vendor panels were found in which the panel protection is larger than the distribution panel protection but these cases were determined to be acceptable after review of the supplied load currents. One case was identified (6 similar radiation monitors per unit) where the increased margin provided by a larger size fuse was warranted. These 15 amp fuses have been replaced with 30 amp fuses in Unit 1 and an identical change has been designed for Unit 2.

CORRECTIVE ACTIONS: (Cont'd)

3. A review has been performed by Engineering to determine the adequacy of the station design related to the size selection of fuses and/or circuit breakers within the original architect engineer's design scope which interfaced with vendor designed safety systems. This review was initially conducted on a random sample basis and was later expanded in stages to include 100% of power distribution fuses in Class 1E distribution panels. This review resulted in the conclusion that the potential for undersized protective devices relative to inrush currents appears to be isolated to fast acting fuses. As a result, fast acting power distribution fuses in Class 1E distribution panels have been reviewed and no operability impacts have been identified, and fast acting fuses feeding the SSPS actuation cabinets and fast acting fuses in the radiation monitors have been upsized for increased margin.

4. A fuse and breaker field verification was performed to assess the accuracy of the documentation used in the engineering review. This effort was initially conducted on a random sample basis and was later expanded in stages to include 100% of the fast acting power distribution fuses in Class 1E distribution panels. The assessment resulted in the conclusion that the molded case circuit breakers agreed with the design documentation while the fuses had some size/type discrepancies with design documentation. However, all of the identified fuse discrepancies were minor in nature, were acceptable for use as is and presented no operability concerns.

5. To reduce the potential of random age related fuse failures affecting critical systems, fuses in selected equipment were replaced during the fuse and breaker field verification effort.

6. Interim guidance has been issued to the STP Electrical Design Staff to sensitize them to several fuse sizing considerations highlighted by the investigation of this event. STP design practices will be revised to formally incorporate this interim guidance by December 31, 1993.

ADDITIONAL INFORMATION:

There have been no previously reported events concerning fuses being undersized causing an unanalyzed event.