NO ACTION

GE Nuclear Energy

70-1113

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December 11, 1996

Dr. Bruce S. Mallett, Director
Division of Nuclear Materials Safety
US Nuclear Regulatory Commission, Region II
101 Marietta St., NW, Suite 2900
Atlanta, Georgia 30323

Subject: Summary of Actions for Line 3 Calciner Tube Reportable Event
Reference: NRC License SNM-1097, Docket # 70-1113

Dear Bruce,

Pursuant to our telephone conversations, the following information is provided regarding the Line 3 Calciner event. This event was called into the NRC Operations Center in Washington, DC, shortly after noon on December 3, 1996, stating:

At approximately 0900 a.m. on December 3, 1996 38.77 kgs of 4.90% enriched material was observed between the Line 3 Calciner inner tube and the outer heat shield. The material was promptly placed into safe geometry 3-gallon containers. The active engineered interlock on tube rotation failed to minimize the accumulation.

We are reporting this condition pursuant to NRC bulletin 91-01. This report is required within 4 hours since the active engineered control minimizing accumulation outside of the calciner tube was lost and the time required for calciner tube replacement is greater than 4 hours. The Line 3 Calciner operation has been shutdown pending alloy tube replacement and implementation of corrective actions.

The remaining calciners were shutdown later in the afternoon of December 3rd (see the timeline in Attachment I). Separate GENE Root Cause and Corrective Action teams were immediately chartered to investigate this incident. (See Attachment II for the Tap Root Summary and Attachment III for the Corrective Action Matrix).

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On December 4, 1996, Mr. Ed McAlpine, Chief - Fuel Facilities Branch, arrived to lead the NRC's "GE Special Inspection Team", which included Messrs. David Ayres (Region II), Garrett Smith (NMSS), Donald Stout (NMSS), and Chris Tripp (NMSS).

At the entrance meeting with the Special Inspection Team, the 'margin of safety' of the 'as found' condition and the 'worst credible' condition were discussed. Calculations show that a wide margin of safety existed, and the system was 'deeply subcritical' (see Attachment IV).

On Friday December 6, 1996, GE and NRC personnel in Wilmington participated in a conference call with NRC Region II and NRC Headquarters to review the root causes and corrective actions for this incident. During this discussion GE detailed the root causes and the NRC Special Inspection Team concurred. Also during this discussion, it was determined that GE would work to develop an agreed upon restart plan detailing short-term corrective actions which would specifically address the root causes. The checklist of short term corrective actions was finalized on the afternoon of December 6th (see Attachment V). All short-term corrective actions are being applied to each process line prior to re-start.

All short-term corrective actions for Line 3 were implemented by Saturday evening (12/7/96), with inspection verification performed by on-site NRC personnel. These corrective actions are summarized in the following main categories:

- Tighten the tolerance of the tube rotation timer AEC
- Enhance the isolation of ADU to the calciner
- Correct stack monitoring system
- Provox Operator Action Request for calciner stack data
- Formalize calciner tube Preventative Maintenance programs

On Saturday night (12/7/96) I spoke to you over the telephone about completion of the checklist items. Following our telephone conversation, I gave the approval to restart Line 3 Calciner, when ready. Feed to Line 3 Calciner was introduced at ~10:50 AM on Sunday December 8, 1996.

Long-term corrective actions have also been developed (see Attachment III) and are summarized as follows:

- Revise Criticality Safety Analysis to improve the accident condition model

- Revise design specifications for the calciner tubes

- Revise change control process

- Evaluate measurement methodology for the detection of material accumulations

I hope that this letter provides you with the information you require and that our response to the event demonstrates our commitment to safety and open communications. Please contact me at (910) 675-5666 if you have any questions or would like to discuss this matter further.

Sincerely,

David Snell for C. Kipp 12/11/96

Craig P. Kipp
General Manager
Nuclear Energy Production

cc: M.A. Lamastra - Washington, DC
P. Ting - Washington, DC
M.F. Weber - Washington, DC

<u>Attachment I</u>

TIMELINE

Date	Time	Event
11/30/96	1150	Smoke observed in Controlled Area - Investigation Began
	1200	Squirt Tube pulled Line 3
	1300	Line 3 shut down. Stack sampler changed.
12/1/96	Calciner - Cool Down	
	1200	Experienced contractor crew organized for Calciner disassembly
12/2/96	0700	Front and rear end Calciner removed
12/3/96	0900	Removed calciner heat shield top. Accumulation observed
	1250	NRC notified (Ops Center)
	1745	All ADU lines shut down. Investigation Teams initiated.
12/4/96	0830	NRC Special Investigation Team onsite
12/6/96	0930	Root Causes and Corrective Actions Identified
	1300	Restart Checklist Developed
12/7/96	1800	Checklist Items Completed
	2000	Restart Initiated - Line 3
12/8/96	1050	Wet Feed to Calciner - Line 3

Attachment II

Taproot Investigation
Excessive accumulation of UO_2 outside #3 defluorinator tube

Causal Factor #1 : Failure of Active Engineered Control (AEC) to prevent UO_2 accumulation

Changes to tube material and design indirectly impacted integrity of AEC

Equipment reliability Less Than Adequate (LTA) : Problem not anticipated

Causal Factor #2 : Broken Tube / Design Control

A. Final anneal impact on rolled tube lifetime was not recognized, nor 360 degree welding of flight sections;inadequate design control

Equipment Reliability LTA : Specs LTA
Equipment Reliability : Problem not anticipated

B. The Preventative Maintenance (PM) program for newly designed, rolled alloy tubes was inadequate

PM for Equipment LTA

Causal Factor #3 : Delayed notification of stack results

A. The design of the stack reporting software did not flag data out-of-spec activity levels

Equipment Reliability LTA: Specs LTA

B. Personnel changes, Thanksgiving Holiday, computer network problems interfered with timely delivery of stack results

Management System: Administrative controls not strict enough
(Note: stack reporting system was intended for emissions reporting, not for safety control or tube integrity oversight)

Attachment III

CORRECTIVE ACTIONS

CORRECTIVE ACTIONS	MAN	MACHINE	PROCESS	SHORT TERM*	LONG TERM	ROOT CAUSE
1) Tighten tolerance on tube rotation limit switch • 30 seconds reduced to 19 seconds (tube rotates once every 17 seconds) • Educate all operations personnel on lessons learned from this rolled alloy tube failure.		X	X	X		1
2) Enhance the isolation of ADU to the Calciner.		X		X		1
3) Correct weaknesses in stack monitoring data collection/reporting	X		X	X		3
4) Modify the Provox control system such that the weekly stack result MUST be entered as an Operator Action Request (OAR) for each calciner. Failure to input will stop HUF flow.	X	X	X	X		3b
5) Evaluate and formalize Preventative Maintenance (PM) program for cast and rolled calciner tubes (Maintenance to own). Establish maximum throughput for both tube 'flip' and tube replacement.			X	X		2b
6) Revise Criticality Safety Analysis (CSA) - Improve on current neutronic model of the postulated 'tube break' accident condition. a) Explicitly model material accumulation external to calciner tube within refractory shell annulus (above and beyond 25 kg hemisphere now presently in the criticality safety basis). b) Evaluate addition of new independent mass/moderation parameter control to existing basis for safety. If new control adopted, define all required 'process controls' needed.			X		X	1
7) Revise vendor specification for Inconnel-600 (wrought) rolled-alloy calciner tubes, with emphasis on annealing of the rolled product. Ensure vender quality assurance certification meets new design specification.	X	X	X		X	2
8) Revise change control process with emphasis on the impacts of material property changes of equipment/processes. Conduct sensitivity training for all fuel manufacturing process engineers.	X		X		X	2
9) Evaluate new technology (e.g., Quantran Sensor) for applicability to gamma-scan detection of uranium accumulation within refractory annulus.		X	X		X	1

*** To be completed prior to restarting calciners***

Attachment IV

MARGIN OF SAFETY

When wet ADU is discharged from the end of a squirt tube, the material enters a rotary kiln operating at an atmosphere of 700 - 765 degrees C, thus the moisture immediately flashes to steam and is driven off with the offgas flow. As expected, the material removed from beneath the calciner tube contained less than 1000 ppm equivalent H_2O. An analysis was performed with a half full tube containing optimally moderated U_3O_8, with a half full refractory annulus containing 50,000 ppm equivalent H_2O. The resulting Keff (worst credible case) was determined to be 0.92 for this bare system. Another run was made in which a half full tube containing moderated U_3O_8 with 50,000 ppm equivalent H_2O, with half full refractory annulus containing 1,000 ppm equivalent H_2O. The resulting Keff (conservative 'as found' condition) was determined to be 0.67 for this bare system.

As discussed with the NRC Special Inspection Team, the existing analysis assumes a completely full tube, optimally moderated $U(5)O_2$, with a 25 kg hemisphere buildup beneath the tube (also optimally moderated $U(5)O_2$). The 'accident condition' contained a mass in excess of 700 kgs UO_2. The available feed mass in the event of the tube rotation interlock failure was conservatively estimated to be only 80 kgs UO_2. The mass in the existing criticality safety analysis is therefore 'very conservative' model of an accident condition (even if one accounts for the residence time of material throughput), as no credit is taken for moderation control. Even if the optimally moderated material modeled redistributed from inside the tube to outside within the refractory annulus, the surface area would increase which would increase neutron leakage, thereby decreasing the effective multiplication of the system.

Attachment V

POST LINE 3 TUBE BREAK - RESTART CHECKLIST

TO BE SIGNED OFF BY AREA COORDINATOR, AREA MANAGER, AND PRODUCT LINE MANAGER PRIOR TO EQUIPMENT RELEASE FOR START UP

This checklist should be appended to the startup checklist for each line (1-6)

SIGN OFF-ENTER INITIALS

		AC	AREA MANAGER	ChPL MANAGER	DATE	TIME	COMMENTS
	This Line Is Approved For Restart						
1	**Tighten Tolerance Tube Rotation Timer**						
1a	Reduce timer to 19 seconds						
1a1	Change Initiation Request Completed						
1a2	FTI Completed						
1a3	Timer setting changed on floor						
1a4	Lincoln Pump Recirc automated						
1a5	Functional test completed						
1a6	AEC list modified						
1a7	NSR/R Modified						
1a8	O.P. Modified						
1b	**Operating Personnel Trained**						
1b1	Training Plan Written						
1b2	Operators Trained						
2	**Correct Stack Monitoring Program**						
2a	Automated check for for results above action level						
2b	Data distribution coverd in procedure						
2c	Environmental Tech retrained - software, procedure						
	changes, sensitivity to results						
3	**ProVox Operator Action Request (OAR) for Calciner Stacks**						
3a	Change Initiation Request (CIR) Completed						
3b	Software Services Request (SSR) Completed						
3c	Functional Test Instruction (FTI) Completed						
3d	Modify ProVox and Perform Functional Test						
3e	Modify Operating Procedures						
4	**Formalize Calciner Tube PM Programs**						
4a	Establish Tube Flip and Repalcement criteria for						
4a1	Cast tubes						
4a2	Rolled tubes						
4a3	Rolled and Annealed tubes						
4b	Implemented into MPAC						
4c	Tube has been evaluated against PM Criteria						