70-1151

Westinghouse
Electric Corporation

Commercial Nuclear
Fuel Division

Drawer R
Columbia SC 29250
(803) 776 2610

RA-WLG-97-052

November 6, 1997

U.S. Nuclear Regulatory Commission
ATTN: Ms. Liz Ten Eyck, Director
Division of Fuel Cycle Safety and Safeguards
Two White Flint North
11545 Rockville Pike
Rockville, MD 20852-2738

Dear Ms. Ten Eyck:

REF: October 29, 1997 Predecisional Enforcement Conference - Request for Additional Information from Westinghouse

At the conclusion of the NRC Predecisional Enforcement Conference held for the Westinghouse Columbia Fuel Fabrication Facility (CFFF) on October 29, 1997, you requested that Westinghouse provide additional information to support a certain statement made in the presentation. The specific statement in question was as follows:

> "W's nuclear criticality safety engineers confirmed and verified that the component could be operated safely in that double contingency protection, in reality, existed. This was the basis for system restart."

The specific "component" referred to in that statement was the Pellet Area Ventilation System Moisture Drop-Out Tank, which was involved in an incident on August 26, 1997. That same statement, however, is also applicable to the Pellet Area Granulator Hopper, which was involved in an incident on June 23, 1997, and also discussed during the subject conference.

Accordingly, the requested information is provided in the two attachments to this letter, which were prepared by the principal nuclear criticality safety (NCS) engineer who was directly involved in technical decision-making for both incidents. These attachments provide timelines of events following each incident, the basis upon which safety was re-established for each of the two affected components, and the nuclear criticality safety engineer's rationale and technical justification for allowing restart of system operations in each case.

NF04

From the information provided in these attachments, it is noteworthy that in each incident, the NCS engineers did not limit their investigation only to the affected components. In both cases, the respective components on all five (5) pellet lines were considered and addressed in their response and followup actions to re-establish and/or confirm system safety.

It is further noteworthy th[illegible] NCS engineer used a conservative approach and methodology for criticality safety evaluations and determination of safety margins (Keff's) in each case. For example, a conservative computer code (KENO) was used to calculate reactivity (Keff) values; and, initial reactivity calculations assumed spherical configurations, while optimum moderation and partial reflection were assumed in all reactivity calculations. In reality, even one such conservative condition would be considered unlikely, and the existence of all three simultaneously, is hardly credible.

It should also be noted that this information was discussed with NRC inspectors during their August 25-29, 1997 inspection. We trust this additional information will fulfill your needs and expectations, and help you in your deliberations and consideration of Westinghouse's position regarding the two subject incidents. If you should have any questions concerning this response, please telephone me at (803) 776-2610, Extension 3282.

Sincerely,

WESTINGHOUSE ELECTRIC CORPORATION

W. L. Goodwin

Wilbur L. Goodwin, Manager
Regulatory Affairs

Granulator Hopper Incident - June 23, 1997

No.	Time	Event
1	5:30 a.m.	Third Shift Team Manager called NCS Engineer at home and told him of the incident. Pellet Line #1 had been shut down and the material had been removed. The NCS Engineer recalled from the Criticality Safety Evaluation, which he had authored, that the granulator hopper had been evaluated as favorable volume. **At this point, the NCS Engineer believed that the hopper was favorable volume, and that this incident was "nothing more than a REDBOOK item."**
2	7:00-7:30 a.m.	NCS Engineer arrived at plant and went out to Pellet Line #1. Talked with third shift team manager and first shift operator. It was noted that Lines #1, #2, and #3 were operating normally, which indicated that there was no accumulation in those Lines. Lines #4 and #5 were not operating.
3	8:00 a.m.	NCS Engineer returned to the office and read through the CSE to reacquaint himself with the system. In that reading, he recognized that the granulator hopper analysis, from which it was concluded that the hopper was favorable volume, wasn't referenced. The NCS Engineer began to look for the original analysis.
4	8:00-12:00	The NCS Engineer informed Regulatory Affairs management and NCS personnel of the hopper incident. The NCS Engineer continued to search for original analysis, but was unable to find it.
5	~ 1:00 p.m.	After searching for several hours, the NCS Engineer decided to perform a new analysis of the granulator hopper. He began building computer model (KENO). The first model was a simple sphere, optimally moderated with partial reflection, whose volume was equal to the granulator hopper (42.8ℓ). Lines continued to run while re-analysis was performed.
6	3:09 p.m.	Received the first KENO results. Average $k_{eff} = 1.029 \pm 0.00227$. Hence, the spherical equivalent volume (most conservative) was critical. The NCS Engineer informed management, and it was decided to build a second model, one that would better represent the hopper in shape and size. (Note: All calculations associated with this incident are documented in CALCNOTE CRI-97-018.)
7	6:00 p.m.-1:00 a.m.	Process Engineering and Maintenance designed and fabricated volume reducers and installed in Lines #1, #2, #3, and #5.. Line #4 was not required, and so installation was accomplished the next day. The Line was not run.
8.	6:43 p.m.	Received results from second model. This was a coarse model, with 1 inch high cuboids stacked to represent the sloped hopper. Average $k_{eff} = 0.997 \pm 0.00878$. this model used several conservative assumptions, so the NCS Engineer believed that the results were conservative. **(IF HE HAD BEEN ASKED AT THE TIME, THE NCS ENGINEER WOULD SAY THAT "THE NOTIFICATION CLOCK" STARTED AT THIS POINT.)** **At this point, the NCS Engineer became convinced that the granulator hopper**

was probably just sub-critical @ 5.0 wt% enrichment (optimum moderation, partial reflection), but did not have analyses to substantiate.,.

Therefore, because these latest results were not clearly subcritical (i.e., avg. k_{eff} ≈ 1.00, the NCS Engineer concluded that the evaluation for the granulator hopper was inadequate, and that a contingency (loss of favorable volume at 5.0 wt% enrichment) had occurred.

The NCS Engineer realized that the hopper was still favorable volume for enrichments < 4.50 wt% (optimum moderation, partial reflection). The Lines were running enrichments ≤ 4.50 wt%.

Further, the NCS Engineer realized that the powder in the granulator hopper was "dry." The granulator hopper had the same criticality controls against the moderator contingency as the roll-compactor hopper because the two were in the same enclosure.

Therefore, for 5.0 wt% enrichment, (optimum moderation, partial reflection) the NCS Engineer believed that a single contingency protection remained as described in the CSE. The remaining contingency was the moderator contingency, by virtue of the fault tree that had been developed for the roll-compactor.

Note that the moderator process upset, though listed as a single contingency in the CSE fault tree, would still require two independent, unlikely, and concurrent changes in process condition before the granulator hopper could become optimally moderated. These are: water must become available in the vicinity of the hopper; and the integrity of the airborne enclosure containing the hopper would be violated. At no time during the entire event did the NCS Engineer think that the powder in the hopper might be moderated, or that it could easily become moderated.

9 7:38 p.m. Received results from a more refined model (¼ inch high cuboids) confirmed that the hopper was just critical (avg. k_{eff} = 0.998±0.00424) at 5.0% enrichment. Calculations showed that the volume was favorable for enrichments ≤ 4.5 wt%.

Management decided that lines would be allowed to operate at enrichments ≤ 4.5 wt%.

10 11:22 p.m. Regulatory Affairs issued a directive that Pellet Lines be shut down until the volume reducers were installed. Installation of Volume reducers established the granulator hoppers as favorable volume.

11 11:40 p.m. NRC notified in accordance with NRCB 9101.

12 02:00 a.m. Volume reducer installation complete.

The NCS Engineer assessed that the granulator hoppers had been returned to favorable volume with the installation. Double contingency, therefore, depended on maintaining the favorable volume (ensuring the reducers are in place) and controlling against moderator.

Moisture Drop-Out Tank Incident - August 25, 1997

No.	Time	Event
1	**Mon. - 8/25:** ~11:30 a.m.	NCS Engineer was informed of "melting" solenoid on the Pellet grinder ventilation system moisture drop-out tank drain valve control. NCS Engineer went to the scene and noted that the tanks appeared to be larger than 5 gallon. Measurement (14"x18"x18") confirmed that they were 20 gallon tanks. **The NCS Engineer decided to study the evaluation that had been performed in late 1993 to determine how the drop out tanks were analyzed.**
2	12:00- ~ 4:30 p.m.	NCS Engineer directed that all tanks be cleaned out, and that drain valves be verified operational. Returned to office and searched through files to locate Criticality Safety Analysis (CSA) in order to familiarize himself with it. Several hours were spent looking through the files containing the evaluation and the analyses, searching for an assessment of the drop-out tank. (The possibility existed that a revision existed and was not filed with the original). Beginning in afternoon, Lines were shut down sequentially in order to verify the tank clean, or clean-out as necessary, and to verify that the drain valves were operational. **It appeared that the CSA had understood the drop-out tank to be ≤ 5 gallons.**
3	~ 4:30 p.m.	Informed Regulatory Affairs management of situation, which was that the drop-out tank was an unanalyzed NFG. The technical assessment held by the NCS Engineer was that a criticality in the tank was not credible. (see bold paragraph below). Therefore, the incident there was not a safety issue but a compliance issue. **(IF HE HAD BEEN ASKED AT THE TIME, THE NCS ENGINEER WOULD SAY THAT "THE NOTIFICATION CLOCK" STARTED AT THIS POINT.)** Management directed that more information be gathered. The NCS Engineered continued search for additional information on the NCS evaluation of the drop-out tank. **During the afternoon search, it was the technical assessment of the NCS Engineer, having familiarized himself with the ventilation system as installed, that a criticality was not credible (1) because a critical mass of material could not accumulate, and (2) because there was no credible source of moderator to the tank. Hence, the engineer believed that the ventilation system was safe to operate from a nuclear criticality standpoint. It would require two independent, unlikely, concurrent process upsets to accumulate the minimum critical spherical mass (42 kg UO_2) and more than 20ℓ H_2O (minimum amount of water required) to form a critical configuration. The NCS Engineer allowed the system to continue to operate after verifying the tanks were empty and the drain valves functioned properly. He was certain that there was no safety issue. The ventilation system was an extremely low-risk system, in terms of the probability of accumulating material and moderator. The situation did, in his opinion however, constitute an unanalyzed component of the ventilation system.**
4	~ 5:00 p.m.-	All five tanks were cleaned out. Drains were cleared/verified clear. Valves were

	2:00 a.m. **8/26/97**	verified operational. Material removed: L#1- 4.2 kg; L#2-1.3 kg; L#3-1.6 kg; L#4-4.9 kg; L#5-unk. (It should be noted that these material accumulations occurred over a period of two-three years.)
5	**Tues. - 8/26/97** 8:00-12:00	NCS Engineer became certain that no additional information existed, and that the moisture drop-out tank, which had been assumed to be ≤ 5 gallons, was an unanalyzed vessel. NCS Engineer recommended to management that the NRC, onsite for a criticality safety inspection, be informed of the event. Management opted to delay informing NRC inspectors until more information could be ascertained.
6	3:30 - 11:30 p.m.	HI HI level probes (damper) verified operational all lines.
7	**Wed. - 8/27/97**	Calculations performed gave results of 98 kg UO_2 and 40ℓ H_2O to form a critical configuration in the drop-out tank. (Note: All calculations associate with this incident are documented in CALCNOTE CRI-97-021.)
8	**Thurs. - 8/28/97**	NRC informed of event late morning.