UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

SEP 20 1991

Report Nos.: 70-1151/91-02

Licensee: Westinghouse Electric Corporation
Commercial Nuclear Fuel Division (CNFD)
Columbia, SC 29250

Docket Nos.: 70-1151 License Nos.: SNM-1107

Facility Name: Westinghouse Electric Corporation

Inspection Conducted: July 15-19, 1991

Inspector: [signature] 9/19/91
D. Kasnicki, Fuel Facilities Inspector Date Signed

Approved by: [signature] 9/19/91
E. J. McAlpine, Chief Date Signed
Radiation Safety Projects Section
Nuclear Materials Safety and Safeguards Branch
Division of Radiation Safety and Safeguards

SUMMARY

Scope:

This routine, unannounced inspection was conducted in the areas of management organization and controls, training, nuclear criticality safety, operations review and maintenance and surveillance testing. Specific items of inspection included unusual incidents, the implementation of the Double Contingency Principle in specific operations, and CNFD's assessment of their systems which are similar to those involved in the May 29, 1991 criticality safety incident at GE-Wilmington.

Results:

In the areas inspected, violations or deviations were not identified.

Since January 1991, CNFD has had two unusual incidents, one of which was of criticality safety significance (paragraphs 5 and 8). Implementation of the Double Contingency Principle in the specific operations evaluated appeared to be adequate in that appropriate contingencies for the accident scenarios considered have been implemented. CNFD management agreed to re-evaluate the strength of the implementation of these contingencies to assure themselves that their failure is sufficiently unlikely to meet the intent of the Double Contingency Principle; corresponding Inspector Followup Items (IFI) have been

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identified (paragraphs 6 and 8). The status of CNFD's assessment of "GE analogous" systems and their efforts regarding rigorously performed and documented Double Contingency Analyses are discussed in Paragraph 9.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*T. Bartman, Manager, Product/Process Development
*J. Bush, Manager, Product Assurance
*S. Deller, Manager, Human Resources
*R. Fuller, Process Engineer - Fellow Engineer
*W. Goodwin, Manager, Regulatory Affairs
*R. Keelan, Manager, Manufacturing
N. Kent, Senior Regulatory Engineer
*R. Koga, Plant Manager
*S. McDonald, Manager, Technical Services
*R. Montgomery, Senior Regulatory Engineer
*E. Reitler, Manager. Regulatory Engineering
*R. Williams, Regulatory Affairs Technical Coordinator

Other licensee employees contacted during this inspection included craftsmen, engineers, operators, mechanics, security force members, technicians, and administrative personnel.

*Attended exit interview

2. Internal Criticality Safety Audits (88005, 88015, 88020)

The inspector reviewed monthly nuclear criticality safety audit documentation for January through June 1991. The reports reflected good, thorough audits, and findings appeared to have been addressed and resolved in an adequate, timely manner. These reports documented one or two findings per month with no findings for the month of April. All of the findings were minor in nature.

No violations or deviations were identified.

3. Training (88010)

The inspector discussed a particular aspect of general and area specific training with a CNFD Regulatory Engineer and reviewed a corresponding training lesson plan. CNFD has started a program of additional training to supplement the fundamental criticality safety and radiation protection training required by section 3.5.1 of the license application. The initiation of this additional training was motivated by a desire to enhance operators' understanding of the bases for safety rules and thereby improve compliance with safety rules. The scope of the training is criticality safety, selected license commitments, and health physics. To date, this supplemental training has been written for and given to MAP operations personnel. Discussion indicated that this training has been well received.

CNFD should be commended for this initiative to enhance operators' understanding. Previous NRC inspections had identified indications of a lack of operators' understanding of criticality safety and radiation safety fundamentals at CNFD (and other fuel facilities) in spite of existing training programs. Future inspections will ascertain the enhancement in understanding by operators.

No violations or deviations were identifi d.

4. Regulatory Compliance Committee (RCC) Meetings (88005, 88015, 88020)

 e RCC is CNFD's safety committee. The inspector reviewed minutes for meetings held on January 25, May 23, and June 27, 1991. The meeting minutes were informative and were otherwise indicative of meeting the intent of the corresponding license condition.

No violations or deviations were identified.

5. Unusual Incident: May 6, 1991, Water line Leak (88005, 88015, 88020)

Discussions with CNFD personnel and the May 23, 1991 RCC meeting minutes indicated that on May 6, 1991, the lip seal on a groove lock coupling failed on a six-inch city water line supplying the office expansion and cafeteria. The failure occurred on a section of pipe located above a pellet grinding area (not a moderation control area), and resulted from insufficient support of the pipe on one side of the coupling. The one support hanger vibrated loose, causing the six-inch pipe to drop approximately one-half inch and causing the lip seal to fail. City water was shut off to the Columbia Plant for approximately thirty minutes. To correct the problem, the pipe at the groove lock coupling was realigned and supported with a chain hoist rig. Additional hangers will be installed during the August 1991 shutdown. Approximately 3,000 gallons of water were released to the Contamination Controlled Area, but there was no release outside the building, nor were there any personnel exposures.

No violations or deviations were identified.

6. Double Contingency Analysis of Interface Between Solvent Extraction (SOLX-I) (favorable geometry) and Uranyl Nitrate (UN) Product Tanks (unfavorable geometry) (88005, 88015, 88020, 88025)

The inspector investigated the above described interface by discussing the system with CNFD representatives and touring that portion of the plant.

Dilute aqueous UN product solution is batch fed from SOLX-I into a concentrator loop. The UN solution circulate in the concentrator loop until in-process instrumentation detects a pH corresponding to 4 percent free acid or 4-4.5g of U235/liter, whichever occurs first. Then the concentrated UN solution is transferred to four in-parallel holding columns; all four of these columns are fed simultaneously. When these four columns are "full," more acid is added (to achieve approximately 16 percent free acid) and that batch is then transferred to a 7,500 gallon aqueous UN solution product tank.

The 7,500 gallon UN product tank is unfavorable geometry and has a concentration limit of 5.0g U235/liter applied to it. The four in-parallel holding columns are favorable geometry, as is everything up stream of them.

The accident scenario that was analyzed is related to the transfer of UN solution between (1) the four in-parallel favorable geometry holding columns and (2) the 7,500 gallon unfavorable geometry tank. The scenario assumes, as an initial condition, that the concentration of the UN solution in the four in-parallel holding columns is more than 5.0g U235/liter; it does not matter how that excessive concentration occurred.

The first contingency that CNFD introduced into this transfer is a laboratory analysis of a sample of the UN solution in the four in-parallel holding columns. Operators must receive assay results which indicate an acceptable free acid content and a U235 concentration of 4-4.5g U235/liter before starting the transfer. The failure of this contingency must be judged unlikely based on the particulars of the manner in which it is implemented. During this inspection, the inspector did not investigate all of the particulars of this implementation; specifically, sample representativeness, number of samples, and analytical methods will be investigated during a subsequent inspection; this is IFI 91-02-01. Regarding another aspect of the implementation of this contingency, operators maintain a log in which they document the assay results. The purpose of this log is to provide a record of these UN solution transfers and make the corresponding assay results auditable at the operations control room. In reviewing this log, the inspector noted that it was a chronological listing of all laboratory assay results reported to the control room, and not just a listing of results for this nuclear safety contingency. Accordingly, the assay results for this contingency were not easily auditable. CNFD management agreed to consider creating a separate log for the assay results related to this nuclear safety contingency; this is IFI 91-02-02. A separate log, together with related discussion in the corresponding operations procedure, would improve the auditability of these transfers and serve to highlight these assay results as being related to a nuclear safety contingency; i.e., this would serve to enhance the unlikeliness of the failure of this contingency.

Discussions with a CNFD representative indicated that they had identified a weakness related to the laboratory sample taken from the four in-parallel columns. The time interval between sample pulling and the receipt of assay results is about one hour. During that time, the concentrator loop may complete the concentration of a batch and transfer that amount of UN solution to the four in-parallel holding columns. These columns are fed simultaneously and the laboratory sample which was taken from them would then no longer be representative of the UN solution in the columns. As described above, this transfer from the concentrator loop to the four in-parallel columns is initiated by in-process instrumentation detecting a U235 concentration of no more than 4.5g U235/liter; but this is process instrumentation, and the laboratory analysis, alone, related to the four in-parallel holding columns is perceived to be the first contingency. Accordingly, CNFD is considering modifying the piping configuration between the concentrator loop and the four in-parallel holding columns so that the columns would not all be filled simultaneously, but two at a time. Then, before taking a sample from the two "full" columns, they would be disconnected (valved out) from the concentrator loop and the other two columns would be connected (valved in) the concentrator loop. CNFD's decision in this regard will be followed up on during a subsequent inspection; this is IFI 91-02-03.

The second contingency that CNFD introduced into this transfer is a gamma monitor and automatic diversion valve in the transfer line between the four in-parallel columns and the 7,500 gallon UN product tank. If the gamma monitor detects a concentration in excess of 5.0g U235/liter, it actuates the diversion valve which returns the UN solution to the four in-parallel columns. This gamma monitor is calibrated at a regular frequency and the calibration results are received and reviewed by a CNFD criticality safety engineer. Functional testing of this gamma monitor/diversion valve contingency will be reviewed during a subsequent inspection; this is IFI 91-02-04.

The above analysis, together with the follow-up on the IFIs identified, will be used to ascertain whether the failure of the two contingencies identified is sufficiently unlikely to meet the intent of the Double Contingency Principle.

No violations or deviations were identified.

7. Double Contingency Analysis of an Array of Favorable Geometry Components (88015)

An individual favorable geometry component may still need a concentration limit applied to it, regardless of the fact that it is favorable geometry. Further, an interacting array of favorable geometry components may need a concentration limit applied to all of the components contained in the interacting system. Discussions with a CNFD representative indicated that they have such systems and do have a concentration limit applied to them. The performance of a Double Contingency Analysis on such systems was briefly discussed but not pursued further during this inspection. CNFD is in the process of performing comprehensive Double Contingency Safety Analyses as discussed in paragraph 9 below. Future inspections will followup on their analyses of favorable geometry components and component systems (IFI 91-02-09).

No violations or deviations were identified.

8. Unusual Incident: June 12, 1991, Loss of Circulation in Concentration Monitoring Loop on 7,500 Gallon Unfavorable Geometry Uranyl Nitrate (UN) Product Tank (88005, 88015, 88020, 88025)

CNFD representatives informed the inspector of the above unusual incident. It had been determined that flow had been severely restricted by a stainless steel nut which was found lodged in the suction side of the concentration monitoring loop line. The loss of flow, with the pump running, caused the UN solution in the monitoring line to heat and thereby concentrate to the point where the gamma monitor in the line triggered a high concentration alarm in the control room. The concentration limit applied to the tank is 5.0g U235/liter. The operator responded to the high concentration alarm by pulling a sample from the tank for laboratory analysis, the results of which indicated a concentration of 4.0g U235/liter, which was contrary to the high concentration alarm.

This incident scenario began with the observation of a problem with one of the two in-parallel pumps in the monitoring line. The operating pump was observed leaking and smoking. A technician turned off the problem pump and turned on the redundant pump. He noted that the pressure gauge on the discharge side of the pump confirmed that the pump was operating, and mistakenly also interpreted that as a positive indication of flow in the monitoring loop. Approximately two hours later, the gamma monitors alarmed, and it was when the lab sample was being pulled from the tank that it was observed that the second pump was leaking and smoking. These observed problems with the pumps, together with the lab analysis results, caused CNFD engineers and management to conclude that the problem was a loss of the flow in the monitoring line, and not excessive U235 concentration in the tank.

At the time of this inspection, several changes were being considered as corrective actions for this incident, but discussion indicated that the following two changes would likely be the ones made: (1) they plan to install a flow meter in the line as a direct indicator of flow; (2) they plan to install different fasteners for the manway cover at the top of the tank; these new fasteners would preclude the dropping of a fastener nut into the tank. The first change would preclude a false high concentration alarm due to a blockage in the monitoring loop; the second change would prevent the recurrence of the same blockage. Final corrective actions taken will be followed up on during a subsequent inspection (IFI 91-02-05).

This unusual incident involved the temporary loss of a criticality safety control on a large unfavorable geometry vessel. However, in discussing the incident with CNFD representatives, it was not readily evident whether or not the loss of the continuous monitoring of UN concentration in the tank constituted the loss of a criticality safety contingency per se. Accordingly, the inspector analyzed the operation of the 7,500 gallon UN product tank; this Double Contingency analysis is discussed below.

This 7,500 gallon tank is the same tank discussed in paragraph 6, above. Concentration (or density) is the criticality safety parameter which is controlled in the tank; the concentration limit which is applied to the tank is 5.0g U235/liter.

UN product solution is fed to the 7,500 gallon tank from the SOLX-1 solvent extraction process and "through" the two criticality safety contingencies as described in paragraph 6. Assuming that these two contingencies are (1) adequate and (2) have not failed, then the concentration in the 7,500 gallon tank is a given. And the only credible accident scenario which could then change the concentration (density) of U235 is precipitation, caused by the introduction of a chemical precipitating agency or by low temperature (the tanks are located out-of-doors).

The 7,500 gallon tanks are large cylindrical tanks with a conical bottom, except that the apex of the cone is replaced by a cylindrical favorable geometry "pot." If precipitation occurred when the tank was 40 percent full or less, the precipitate would fit in the volume of the favorable geometry pot. If precipitation occurred when the tank was more than 40 percent full, the tank is equipped with a mechanical stirrer which is manually turned on when the tank reaches that level. The stirrer presumably would maintain the same U235 density as existed before precipitation occurred. A "ram" is positioned at the level of the favorable geometry pot. This ram can be activated to punch out a disc near the bottom of the tank, dumping the contents into a favorable geometry diked slab. All non-product (non-UN) lines to the tank are physically "broken" from the tank in that flanged "spool pieces" must be inserted to make the connection. UN solution is continuously pumped through a monitoring loop which runs from the bottom of the tank, through two redundant gamma monitors, and back into the top side of the tank.

Discussion with CNFD representatives indicated that precipitation by low temperature is precluded by the adjustment of free acid concentration before the UN solution is released to the 7,500 gallon tank. This is a criticality safety contingency. The adequacy of this contingency (sampling, analysis, procedures) will be followed up on during a subsequent inspection (IFI 91-02-06). This adjustment of free acid concentration is the first contingency in an accident scenario involving precipitation by low temperatures.

The use of the flanged spool pieces to preclude the inadvertent introduction of a chemical precipitating agent is the first criticality safety contingency for that accident scenario. The adequacy of the administrative controls associated with the implementation of this contingency will be followed up on during a subsequent inspection (IFI 91-02-07).

The second criticality safety contingency for both of the above precipitation accident scenarios is either the favorable geometry pot or the operation of the stirrer, depending on the level of the solution in the tank. Regarding the operation of the stirrer, a technician walks through the UN tank farm every four hours. During these tours, he verifies that stirrers are turned on, and manually turns on stirrers in tanks which have reached the 40 percent capacity level since the preceding tour. Particulars of what the technician checks and how he checks them will be followed up on during a subsequent inspection (IFI 91-02-08); e.g., is stirrer operation verified by noting position of on/off switch or some other observation of stirrer motor or stirrer operation?

From the above analysis, then, the concentration monitoring loop is not a criticality safety contingency, but rather is a control which enables operations to detect the failure of the first contingency. In the unusual incident which occurred, operations temporarily lost its ability to detect the failure of the first contingency (for a period of about four hours). The gamma detectors in the monitoring loop alarmed, indicated high U235 concentration in the tank (more than 5.0g U235/liter). Operations responded by pulling a sample of solution from the tank for laboratory analysis and concurrently observed the continuing problem with the pumps. Analysis results indicated below limit U235 concentration in the tank. Loss of flow in the monitoring loop line was concluded and later substantiated with the discovery of the stainless steel nut in the line. While the monitoring loop was out of operation, the UN solution was transferred to another 7,500 gallon tank.

No violations or deviations were identified.

9. CNFD's Addressing of Concerns Raised by GE-Wilmington Criticality Safety Incident of May 29, 1991 (88005, 88015, 88020, 88025)

Discussions with CNFD criticality safety engineers and management indicated that they have always considered the Double Contingency Principle in the performance of their criticality safety analyses. However, CNFD does not have documented, rigorously performed, comprehensive double contingency analyses which explicitly identify and formally establish contingency pairs for all credible accident scenarios for all fuel handling/processing operations. This same observation has been made at other fuel facilities.

Discussions with CNFD representatives and a review of documentation indicated that CNFD had initiated plans to perform and document double contingency analyses as described above prior to the GE-Wilmington incident. Their action in this regard was prompted by their awareness of related criticality safety problems at other fuel facilities and NRC Information Notices. RCC meeting minutes for a May 23, 1991 meeting addressed the performance and documentation of double contingency analyses and the implementation of the contingencies identified therein in subsequent criticality safety analyses, training, audits, and operating procedures.

Shortly following the GE-Wilmington incident, interest in the performance of comprehensive double contingency analyses intensified further as indicated by a letter dated June 6, 1991, by the CNFD plant manager. The letter formally establishes a Criticality Safety Assessment Team (CSAT). The charter of the CSAT is to conduct a thorough, comprehensive evaluation and assessment of criticality control systems, giving particular consideration to unfavorable geometry systems. The CSAT is comprised of six members with multi-disciplinary areas of expertise, including criticality safety. The Project Manager of the CSAT is a CNFD Fellow Engineer with extensive operations engineering experience. The Regulatory Affairs Manager is designated as Project Mentor and another Fellow Engineer serves as Technical Consultant to provide additional criticality safety expertise. The Regulatory Compliance Committee (RCC) is charged with project oversight.

Some time prior to the creation of the CSAT with its charter, CNFD had established a Configuration Control Team (CCT). The charter of the CCT is to establish a formal, rigorous system for controlling and maintaining current documentation of changes to the facility, manufacturing systems, and procedures. This control system is now also seen as the mechanism by which the integrity of the Double Contingency Analyses, the contingencies identified therein, and the implementation of those contingencies will be maintained.

Discussions with CNFD representatives, a review of RCC meeting minutes for a June 27, 1991 meeting, and a review of a draft CSAT report on their "Preliminary Criticality Safety Assessment of GE Analogous Systems" provided a characterization of the status of the CSAT's assessment to the date of this inspection. The CSAT is reviewing systems, identifying existing controls and otherwise identifying the criticality safety characteristics of the systems reviewed. They are identifying potential weaknesses. Those weaknesses which lend themselves to immediate correction are being corrected accordingly. Other, more complex weaknesses are being put onto an open items list to track intended corrective actions. After all identified weaknesses are corrected or otherwise addressed, the result will be "cleaned up" systems with possibly altered criticality safety characteristics. At that point, the systems will be ready to have rigorous double contingency analyses performed on them. Examples of potential weaknesses are: (1) two lines which provide the potential for inadvertent transfers to unfavorable geometry tanks; (2) use of 55-gallon drums; (3) abandoned piping and vessels which need to be removed (also lines with blinds and no record of why they are blinded); and (4) lack of line identification coding.

At the time of this inspection, the CSAT was still in the process of determining the magnitude and scope of the project with which they had been tasked, including the double contingency analyses per se. Accordingly, they had not yet established any schedules or estimated completion dates. Progress will be followed up on during subsequent inspections.

While discussing the activity of the CSAT, discussion also ensued regarding the nature and characteristics of double contingency analyses and criticality safety contingencies. The following points were discussed within the context of good practice.

- A criticality safety assessment is not the same as a double contingency analysis. Rather the information from a criticality safety assessment is used as a basis for analyzing credible accident scenarios which thereby identify and define contingencies.

- A contingency is often a control that is deliberately inserted into a process solely for the purpose of being a contingency. And the failure of that control is the "accident," i.e., process upset; the integrity or strength of that control must be such that its failure is "unlikely."

- It should be highly unlikely that a failed contingency will not be quickly recognized. Otherwise it is not a good contingency.

- The performance of an administrative contingency, or the maintenance of the integrity of an engineering contingency, should be easily auditable.

- Contingencies should be highlighted as such in operating procedures or criticality safety postings, and maintenance procedures.

No violations or deviations were identified.

10. Exit Interview

The inspection scope and results were summarized on July 19, 1991, with those persons indicated in paragraph 1. The inspector described the areas inspected and discussed in detail the inspection results, including the items listed below. Although reviewed during this inspection, proprietary information is not contained in this report. Dissenting comments were not received from the licensee.

Item Number	Description and Reference
(Open) IFI-91-02-01	1087 product columns to 7500 gal. product tanks: check implentation of lab analysis contingency. (Paragraph 6).
(Open) IFI-91-02-02	1087 product columns to 7500 gal. product tanks: followup on auditability of log of assay results. (Paragraph 6).
(Open) IFI-91-02-03	1087 product columns: followup on CNFD decision regarding modification of input configuration. (Paragraph 6).

(Open) IFI 91-02-04	1087 product columns to 7500 gal. product tanks: followup on functional testing of gamma monitor/diversion valve contingency. (Paragraph 6).
(Open) IFI 91-02-05	6/12/91 Unusual Incident: followup on final corrective actions taken. (Paragraph 8).
(Open) IFI 91-92-06	7500 gal. product tank: followup on adequacy of final acid addition contingency. (Paragraph 8).
(Open) IFI 91-02-07	7500 gal. product tank: followup on adequacy of administrative control on "spool piece" contingency. (Paragraph 8).
(Open) IFI 91-02-08	7500 gal. product tank: followup on particulars of technician verification of stirrer operation. (Paragraph 8).
(Open) IFI 91-02-09	Followup om CNFD's analyses of favorable geometry components and component systems. (Paragraph 7).