SAR REGUL UNITED STATES NUCLEAR REGULATORY COMMISSION REGION II 101 MARIETTA STREET, N.W., SUITE 2900 ATLANTA, GEORGIA 30323-0199 Report No.: 70-1151/94-02 Licensee: Westinghouse Electric Corporation Commercial Nuclear Fuel Division Columbia, SC 29250 Docket No.: 70-1151 License No.: SNM-1107 Facility Name: Columbia Nuclear Fuel Plant Inspection Conducted: April 4-7, 1994 C. H. Bassett, Fuel Facility Project Inspector 5/3/94 Inspector: Date Signed Elm'alpine 5/3/94 Approved by: Date Signed E. J. McAlpine, Chief Radiation Safety Projects Section Nuclear Materials Safety and Safeguards Division of Radiation Safety and Safeguards

#### SUMMARY

Scope:

This routine, unannounced inspection involved onsite review of the licensee's nuclear criticality safety program. Specific subjects/issues reviewed included: change authorizations, nuclear criticality safety analyses, audits, calibration of criticality monitors, and procedures. This inspection also included observation of operations, floor storage, criticality signs, moderation control, fuel handling and storage, and housekeeping. One issue from the UF<sub>6</sub> release incident of January 26, 1994 was also reviewed.

Results:

As a result of the inspection, it was noted that the nuclear criticality safety analyses were completed as required and monthly inspections were being performed by various personnel. Operations appeared to be functioning well, and no problems were noted with floor storage, signs and postings, moderation control, fuel handling, or housekeeping. It appeared that the licensee had made progress in these areas.

Within the scope of the inspection, however, problems were noted in the area of procedural compliance. As a result, one apparent violation was noted with six examples. These dealt with relieving the pressure in the 401C pigtail, change authorizations, audits, and calibration of criticality monitors (Paragraphs 2.d and 3.a, c, d, e, and f).

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Licensee Employees

- \*R. Allen, Manager, Integrated Fuel Burnable Assembly (IFBA)
- \*D. Close, Supervisor, Maintenance
- R. Fuller, Plant Systems Engineer, Technical Services
- \*D. Goldbach, Manager, Chemical Process Engineering
- W. Goodwin, Manager, Regulatory Affairs \*J. Heath, Manager, Regulatory Operations
- R. Henry, Process Engineer, Chemical Process Engineering, Technical Services
- J. Hooper, Safety Engineer, Regulatory Affairs
- G. LaBruyere, Manager, Conversion Services
- G. Lowder, Manager, Maintenance
- \*S. McDonald, Manager, Technical Services and Acting Plant Manager
- \*T. McGuire, Supervisor, Maintenance
- \*D. Parker, Acting Manager, Nuclear Materials Management & Product Records, Regulatory Affairs
- \*E. Reitler, Manager, Regulatory Engineering, Regulatory Affairs
- \*T. Shannon, Technician, Regulatory Affairs \*R. Williams, Technical Coordinator and Regulatory Affairs Criticality Safety Engineer, Regulatory Affairs

Other licensee employees contacted during the inspection included operators, security personnel and office personnel.

\*Attended the exit interview on April 7, 1994.

Event Followup (88020, 88025) 2.

> Condition S-1 of Special Nuclear Material License Number 1107 (SNM-1107) requires that licensed material be used in accordance with statements, representations, and conditions contained in Chapters 2, 3, and 4 of the application dated March 26, 1984, and supplements thereto.

Chapter 2, Section 2.6 of the license application states that special nuclear material processing shall be conducted in accordance with approved written procedures or instructions.

Chemical Operating Procedure, COP-810101, "UF, Vaporizer", Revision 28, dated November 5, 1993, directs the operator in Part 7.2 to relieve the pressure in the pigtail through the eduction line.

a. Description of the Event

> At approximately 6:45 a.m. on January 26, 1994, a Conversion Area operator noted that uranium hexafluoride (UF<sub>6</sub>) was leaking from piping near the hydrolysis column of the ammonium diuranate (ADU) Line 4. The fire/emergency alarm was sounded, an announcement was

made to evacuate the Chemical Area, and all processing of  $UF_6$  gas was halted. Immediately following the sounding of the alarm, the Emergency Brigade was activated and began to assemble. Management was notified of the problem, an ALERT was declared, and notifications to State of South Carolina officials and to the NRC were made in accordance with the Site Emergency Plan. Emergency response personnel responded to the event and the release was terminated approximately ten minutes after it began.

 $UF_6$  gas, however, which had apparently become trapped in the insulation around the piping, continued to be released into the building. The gas leak was subsequently contained by placing a plastic "tent" over the piping and attaching a ventilation hose to the containment. The licensee initiated efforts to clean up the area affected by the release when the containment was in place over the piping and the ALERT was terminated at approximately 10:30 a.m. A Root Cause Analysis Team was immediately formed to investigate the event and determine the facts and circumstances of the UF<sub>6</sub> gas release.

b. Findings of the Root Cause Analysis Team

The team began investigating the event on the afternoon following the release. A time line was constructed and causal factors were developed. The team initially postulated that a high pressure excursion had occurred in the eduction line leading from the vaporizers to the hydrolysis column on ADU Line 4. The team believed that this was caused by a sudden build up of pressure in the eduction line which was exacerbated by the nozzle at the hydrolysis column being plugged. According to the team, this lead to a gasket failure in the flange area on the inlet side of an emergency block or shutoff valve in the eduction line and then to a release of UF<sub>6</sub>.

After studying the various scenarios that were developed as possible causes of the problem, the team determined that the likely cause was thermal expansion of solid UF<sub>6</sub> at the gasket on the emergency shutoff valve in the eduction line. This eventually lead to cracks developing in the gasket. When the eduction line was subsequently pressurized with hot nitrogen that had been valved in to pressure-test the pigtail in Vaporizer 401C, the cracked gasket failed and a release occurred.

The team developed a Root Cause Summary Table which outlined various Causal Factors, Presumptive Causal Factors, and Items of Note. One such Item of Note (Number 4) described an operating procedure deficiency. The team determined that an operator had tried to reduce the pressure on the Vaporizer 401C pigtail by venting the pressure through the eduction line to the hydrolysis column. This attempt was unsuccessful due to line/nozzle being plugged. The operator then vented the pressure through the UF<sub>e</sub> line after valving off the on-line chest or vaporizer. This action was not covered by procedure and thus had not received the appropriate safety review by licensee management.

Corrective Actions

Alarms were installed to detect and signal when the eduction and/or UF<sub>6</sub> lines were plugged, and procedure modifications were initiated to permit pressure relief through the UF<sub>6</sub> line if the eduction line became plugged. The procedure would also permit valving off the appropriate lines and the cylinder and venting the pressure in the pigtail into a ventilation tent and duct if both lines became plugged. At the time of the inspection, these changes had not been completed but were in process and being reviewed. Operating procedure, COP-810101, "UF<sub>6</sub> Vaporizer", Revision (Rev) 30, dated February 17, 1994, will be reviewed during a subsequent inspection to ensure that the changes were incorporated.

Failure to conduct operations in accordance with approved operating procedures on January 26, 1994 was identified as an example of an apparent violation of License Condition S-1 (VIO 70-1151/94-02-01).

3. Criticality Safety (88015)

Chapter 2, Section 2.3.1.1 of the license application states in part that written procedures describing general nuclear criticality control requirements shall be maintained and operations shall be conducted in accordance with these procedures.

a. Facility Modifications and Changes

Regulatory Affairs procedure, RA-104, "Regulatory Affairs Change Authorization", Rev 7, dated February 26, 1993, requires in Part 7.1 and Part 7.2 that regulatory affairs engineers complete Forms RAF-104-2, "Regulatory Affairs Change Verification/Release Forms" to identify required controls for the proposed change(s) and verify implementation of the controls.

The inspector reviewed procedure RA-104 with licensee representatives. The inspector determined that, following the Operational Safety Assessment (OSA) conducted by the NRC in August of 1992, the licensee had revised procedure RA-104 to provide rigorous controls to ensure that appropriate nuclear criticality safety analyses were performed for all new installations and for all modifications of existing installations at the facility. The revision, however, had produced unexpected delays in processing requests for new installations or changes because of all the reviews and sign-offs required. Also, the assignment of following the requests through the review chain and ensuring that the requests were completed had been removed from one of the Criticality Safety engineers but had not been reassigned. Therefore, the licensee had formed a team to look at the procedure and develop ways to streamline the process while keeping the appropriate level of rigorous review and approval. Also, another individual had been assigned the task of tracking the requests to ensure that they were reviewed, completed, and implemented as required. At the time of the inspection, the licensee was also in the process of revising the procedure but had not completed the revision. This procedure will be reviewed during a subsequent inspection.

The inspector reviewed various Change Authorizations to ensure that the steps of the licensee's process were being followed. The inspector reviewed Regulatory Affairs (RA) Change Authorization Forms, RAF-104-1, Review Number (No.) 93268, "AC-5", initiated August 5, 1993; RAF-104-1, Review No. 93300, "Dust Collector for ADU Pellet Lines", initiated September 10, 1993; RAF-104-1, Review No. 93272, "SOLX I & II Changes", initiated August 27, 1993; RAF-104-1, Review No. 93282, "Fire Barrier for Incinerator/SX Area", initiated December 15, 1993; and RAF-104-1, Review No. 93162, "Polypack Dump Enclosure for Charging the MAP Blenders", initiated September 28, 1993.

The inspector noted that the first package reviewed, RAF-104-1 Review No. 93268, had all the forms, reviews, and other documentation required by the procedure including the Forms RAF-104-2, "Regulatory Affairs Change Verification/Release Forms". The inspector also noted that the controls that had been identified by the Regulatory Affairs engineers (those contained on the RAF-104-2 forms which had been completed by the engineers) were summarized on a separate, newly developed form. The summary was beneficial for reviewing what new controls would need to be added before the change or new installation could be approved for operation. The other packages reviewed, Review Nos. 93300, 93272, 93282, and 93162, had all the required documentation except the Forms RAF-104-2, "Regulatory Affairs Change Verification/Release Forms". These RAF-104-2 forms had not been completed but the newly developed form summarizing the controls was included.

When this issue was discussed with licensee representatives, they indicated that the old, original RAF-104-2 forms were cumbersome and that the new "RAF-104-2 Summary" saved time. The inspector informed the licensee that, even though the new form may have been more efficient, it was not covered by procedure. Failure to follow procedure by not using the proper RAF-104-2 forms as required by procedure was identified as another example of an apparent violation of License Condition S-1 (VIO 70-1151/94-02-01).

# b. Nuclear Criticality Safety (NCS) Analyses

Included with the aforementioned change/modification packages were NCS analyses for each application. The inspector reviewed the analyses associated with each. The inspector determined that the analytical methods used had been validated previously. The conditions considered and assumptions made appeared to be appropriate for the applications involved. Safety factors, when used and applicable, were in accordance with the license application. The NCS analyses appeared to have been completed in accordance with the current procedure, RA-300, "Nuclear Criticality Safety Evaluations", Rev 2, dated February 26, 1993.

No violations or deviations were identified.

c. Nuclear Criticality Safety Audits

Procedure RA-106, "Internal Program Audits", Rev. 3, dated March 4, 1993, requires in Part 7.1, that Regulatory Affairs managers identify specific programs to be audited and audit frequencies during the Personnel Management System (PMS) Objectives Development Process at the beginning of each calendar year.

The inspector reviewed procedure RA-102, "Regulatory Compliance Inspections", Rev 3, dated September 16, 1993, and discussed the inspections with licensee representatives. The procedure required that regulatory inspections be conducted at least monthly and that all manufacturing areas be inspected at least semi-annually. A review of the inspection records for 1993 and to date for 1994 indicated that the inspections were being conducted monthly as required and were covering all the manufacturing areas at least semi-annually. When problems were noted by the Regulatory Affairs inspectors, the issues were brought to the attention of the area supervisor and the problems were resolved. If the problem could not be resolved immediately, a report was made of the problem and sent to the area supervisor and the area manager. These issues were tracked until the problems were resolved.

The inspector also reviewed procedure RA-106, "Internal Program Audits", Rev 3, dated March 4, 1993, and discussed the audits with licensee representatives. As noted above, the procedure requires that Regulatory Affairs managers identify specific programs to be audited and audit frequencies during the PMS objectives development process at the beginning of each calendar year. The audits are to be assigned to the various engineers in the group for completion.

When reviewing these audits, the inspector noted that, in 1992 the Nuclear Criticality Safety engineers were assigned various areas to audit. Some of the audits were not completed due to reassignment of priorities to such issues as Criticality Safety Analyses and NRC OSA response. In 1993, and so far in 1994, the Nuclear Criticality Safety engineers have not been assigned audits to perform during the PMS Objectives Development Process at the beginning of each calendar year.

When this issue was discussed with the licensee, the point was made that the manager in charge of the NCS engineers had made the conscious decision not to assign the engineers audits to complete because they were involved in higher priority work. Some of this work involved completing Nuclear Criticality Safety Evaluations (NCSEs) which were even more rigorous and in-depth than an audit of the area or system would be. The licensee stated that, because this work was being accomplished and the various areas and systems of the plant would be reviewed, there was no current need for the audits. The inspector informed the licensee that, even though the NCSEs were very rigorous, the procedure required that audits be performed. No provisions were made in the procedure which would allow the manager to take credit for other work performed to replace the required audits. The inspector noted that it was within the licensee's ability to modify the procedure when program modifications were needed, but that this had not been done. Failure to follow procedure by not assigning audits to be performed during the PMS Objectives Development Process at the beginning of each calendar year was identified as another example of an apparent violation of License Condition S-1 (VIO 70-1151/94-02-01).

# d. Criticality Monitoring System - Records Audits

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Procedure RA-304. "Criticality Accident Alarm System", Rev. 3, dated March 9, 1990, requires in Part 6.5.2 that Regulatory Engineering conduct routine audits of records and activities to ensure continued operability of the (criticality accident alarm) system.

The inspector asked to review the 1992 and 1993 records of the audits performed by Regulatory Engineering of the records and activities to ensure that the criticality accident alarm system was functioning as required. Licensee representatives indicated that the audits were performed prior to 1992 but that they had not been completed in 1992 or 1993. One reason given was that the engineers were required to focus more on performance and less on records audits.

The inspector reviewed the records concerning the criticality monitoring system. The records indicated that the alarms had been checked during this period and that they were functioning as required. There were problems noted, however, with documentation of the audibility audits and with the calibration of the system (see Paragraphs 3.e and 3.f below).

Since routine audits of records and activities to ensure the operability of the criticality accident alarm system were not

conducted, the inspector informed the licensee that this appeared to be another example of failure to follow procedure. Failure to perform audits of the records and activities to ensure that the criticality alarms were functioning as required was identified as another example of an apparent violation of License Condition S-1 (VIO 70-1151/94-02-01).

#### e. Criticality Monitoring System - Audibility Audits

Procedure RA-304, "Criticality Accident Alarm System", Rev. 3, dated March 9, 1990, requires in Part 7.6.2 requires that Regulatory Engineering conduct routine siren audibility audits and document the results on Form RA-304-4, "Audibility of Criticality Detection and Alarm System Sirens".

The inspector reviewed the records of the routine siren audibility audits completed by the licensee during the past year. It was noted that Regulatory Operations personnel were conducting the audibility audits and the results were being recorded on Form RA-304-3 not Form RA-304-4. Consequently, while the audibility audits were being conducted, they were not being conducted as required by procedure. Failure to perform routine siren audibility audits and document the results on Form RA-304-4 was identified as another example of an apparent violation of License Condition S-1 (VIO 70-1151/94-02-01).

### f. Criticality Monitoring System - Calibration

Section 2.6 of the license application states that special nuclear material processing shall be conducted in accordance with approved written procedures or instructions.

Procedure MCP-202037, "GA-6M Criticality Alarm Calibration", Rev. 2, dated May 7, 1992, and Rev. 3, dated May 13, 1993, requires in Part 7.4.4 that the calibration frequency of the monitors not exceed 26 weeks.

The inspector noted that 26 weeks is 182 days and reviewed the results of the calibrations performed on the criticality alarms. This operation was completed by personnel in the maintenance department. In reviewing the records, the inspector noted that the criticality monitors were calibrated as required in 1991 and 1992. The monitors however, which were calibrated on July 7, 1992, were not calibrated again until February 22, 1993, a span of 230 days. Following the calibration in February 1993, the criticality monitors were not calibrated again until November 10, 1993, a span of 261 days.

When this issue was discussed with licensee representatives in the maintenance department, they indicated that they were not aware of the limitation or "drop dead" date for this type of operation. The general procedure used for calibrating instruments indicated

that, if an instrument could not be calibrated within the prescribed period, the instrument supervisor was to be informed. Then a "red tag (calibration overdue card)" would be generated, which was required to be signed off by the operations supervisor. The red tag was to be placed on the instrument case control panel to authorize the use of the instrument beyond the calibration due date.

The inspector reviewed this process further and noted that, in the case of the criticality monitors, the red tag was generated and was signed off by the criticality engineer who "owned" or was responsible for ensuring proper functioning of the monitors. The red tag, in this case, was not signed off by the operations supervisor. The inspector noted that getting the criticality engineer involved, in this case, was appropriate even though the procedure did not require it.

The inspector also noted was that the maintenance personnel were under the impression that the red tag gave the instrument a unlimited use time before the next calibration was due. Neither the computer program established to track due dates for instrument calibrations nor the procedure indicated that there was a "drop dead" date at which time the instrument would be required to be calibrated or completely taken out of service. This problem was reviewed with the maintenance personnel who initiated changes to the procedure and the computer program before the end of the inspection to include "drop dead" dates. This procedure, MCP-202002, "Industrial Instrument Calibration" (with a revision number of 7 and dated September 16, 1993 before the latest revision), will be reviewed during a subsequent inspection.

The licensee was informed that failure to complete the required calibrations of the criticality monitors within the time frame specified in the procedure was another example of an apparent violation of License Condition S-1 (VIO 70-1151/94-02-01).

# g. Use of containers

The inspector reviewed the use of containers in the controlled area of the facility. The applicable procedure, RA-305, "Movable Non-favorable Geometry (NFG) Containers in the Chemical Area", Rev 1, dated November 18, 1993, was also reviewed. No examples of improper use of NFG containers was noted. All of the NFG containers in use were approved for use and authorized by the form RAF-306-1, "Movable Non-favorable Geometry (NFG) Container List."

#### 4. Operations Review (88020)

During the inspection, the inspector toured various areas of the facility to observe the conduct of operations, housekeeping, fuel storage and handling, and safety limit implementation/postings. The inspector also reviewed the licensee's procedures dealing with some of

these subjects: RA-301, "Floor Storage of Special Nuclear Material", Rev 9, dated December 2, 1993, RA-302, "Criticality Signs", Rev 6, dated April 1, 1993, and RA-303, "Control of Moderating Material for Nuclear Criticality Safety", Rev 2, dated February 26, 1993.

No problems were noted in these areas. Workers were observed to be performing their jobs or tasks safely and in compliance with procedures. Arrays of containers on carts and in storage were in compliance with applicable procedures and postings. Postings were readily apparent and posted in a location so that the workers could see them but not be an obstruction. Housekeeping was adequate with solvents and paints stored in appropriate and approved lockers. No accumulations of refuse, rags, paper, or other materials were noted. The licensee was using the small 5-gallon waste containers as required by procedure and it appeared that the containers were being emptied on a frequency that prevented build-up of material. Fuel handling and storage was noted to be adequate and at the distances required by postings.

No violations or deviations were identified.

5. Followup on Previous Inspection Findings (88015)

(Closed) VIO 70-1151/93-03-01 - Failure to follow procedures for working in a ventilation hood, for handling combustible scrap, and for posting a storage rack.

During an NRC inspection in April 1993, three examples of failure to follow procedure were noted. These involved improper spacing of polypacks inside a hood, storage of materials in polypacks on a storage rack which was not authorized by the posted criticality sign, and not placing rags and other materials in 5-gallon scrap cans as required. In the licensee's response, dated July 12, 1993, they indicated that ineffective operations training in the specific areas of criticality postings and floor storage was the reason for the violation. Also, some of the criticality postings were noted to be ambiguous. Actions planned to correct the problems included comprehensive training of all Chemical Area operations personnel, creating teams to evaluate floor storage, and review and revision, as appropriate, of all criticality signs in the facility.

As noted in NRC Inspection Report 70-1151/93-10, dated December 17, 1993, training had been conducted for facility personnel. Teams had been created to evaluate floor storage, various problems had been identified, and a list of recommendations had been generated. Also, the postings in the facility had been reviewed and new postings had been generated.

During the inspection in December 1993 and during this inspection, the inspector reviewed the storage of material, postings, and general housekeeping and waste disposal. No problems were noted with storage of materials. All items observed were stored in compliance with applicable procedures and postings. Postings had been revised, new signs had been

posted and the postings were readily visible. Housekeeping was adequate with material stored in appropriate and approved containers. No accumulations of refuse, rags, paper, or other materials were noted. The licensee was using the small 5-gallon waste containers as required by procedure and it appeared that the containers were being emptied on a frequency that prevented build-up of material. This item is considered closed.

# 6. Exit Interview

The scope and results of this followup inspection were summarized on April 7, 1994, with those persons indicated in Paragraph 1 above. The inspector described the issues reviewed and discussed in detail the inspection results and observations. No dissenting comments were received from the licensee. Although proprietary material was reviewed and discussed during this inspection, proprietary information is not contained in this report.

As a result of the inspection, it was noted that the NCS analyses were completed as required and monthly inspections were being performed by various personnel. Operations appeared to be functioning well, and no problems were noted with floor storage, signs and postings, moderation control, fuel handling, or housekeeping. It appeared that the licensee had made progress in these areas.

Within the scope of the inspection, however, problems were noted as outlined below:

Item Number

#### Description and Reference

70-1151/94-02-01

VIO - Failure to follow procedures: 1) for relieving the pressure in the 401C pigtail, 2) for not using the proper RAF-104-2 forms as required, 3) by not assigning audits to be performed during the PMS Objectives Development Process at the beginning of each calendar year, 4) for performing audits of the records and activities to ensure that the criticality alarms were functioning, 5) for performing routine siren audibility audits and document the results on Form RA-304-4, and 6) for completing the required calibrations of the criticality monitors within the time frame specified in the license application (Paragraph 2.d and 3.a, c, d, e, and f).