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

Docket No.: 70-1151 License No.: SNM-1107

Facility Name: Westinghouse Electric Corporation

Assessment Conducted: August 17-28, 1992

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ASSESSMENT SUMMARY

Scope:

This special, announced Operational Safety Assessment (OSA) was conducted by a team comprised of NRC representatives from the Office of Nuclear Materials Safety and Safeguards, Region I, Region II, Region IV, and Region V, and representatives from the United States Environmental Protection Agency, Region IV. The goal of the assessment was to assess the overall facility operation with regards to safety by increasing the emphasis on actual observations of ongoing facility activities and reducing the emphasis on document review. Facility activities such as process controls, operator activity, maintenance, engineering, and design control involve many individual activities that are important to the safe and reliable operation of the facility. Management awareness and oversight of these activities is also a key factor in the licensee's ability to achieve and maintain a safe operation. Therefore, the assessment team evaluated each of these activities and/or functions. Specifically, the team examined existing operating conditions to identify potential safety hazards which, when combined with site operations, could adversely impact public or employee health and safety.

Items identified during the assessment were placed into six categories. These categories were:

- Area for Improvement: An area where the program is functioning adequately; however, some inconsistencies were identified. No response will be necessary.

- Inspector Followup Item: A matter or item that should be further reviewed by an inspector, including an item pending specific action by the licensee. Inspector Followup Items (IFIs) are used to document, track, and ensure adequate followup by an inspector.

- Program Weakness: Items that are considered to be significant program deficiencies. A response to these items will be requested.

- Program Strength: An area or item that contributes significantly to the overall success of the program.

- Renewal Item: Program or programmatic issue which will require extensive work and can best be addressed during the renewal process.

- Unresolved Item: An item about which more information is required in order to ascertain whether it is an acceptable item, a deviation, or a violation.

Those items identified as program weakness, as well as those identified specifically as renewal items, may be reviewed by the NRC during the license renewal process.

Specific functional areas addressed during this assessment were management controls, nuclear criticality safety, material control and accountability, maintenance and surveillance testing, operations, training, radiation protection, emergency preparedness, chemical safety, and fire protection. A review of the Manufacturing Automation Project (MAP) vaporizer incident involving excessive water in the vaporizers was also conducted. The assessment was conducted using the guidance contained in Manual Chapter 2601 and the information provided in inspection procedures 83822, 88005, 88015, 88020, 83822, 88025, 88045, 88050, 88055, and 92701.

Results:

The team determined that the licensee was conducting operations in a manner sufficient to protect the health and safety of plant workers and the public. However, of concern were three weaknesses and one unresolved item identified in the area of criticality safety. The three weaknesses were as follows, the control of non-favorable geometry containers, the ability of process engineers to make substitution changes without proper training, and the evaluation of facility changes. The unresolved item dealt with consideration of an overflow condition in a Raschig ring filled tank. One weakness identified in the area of radiation protection dealing with the contamination control and survey program was significant in that numerous examples of failures of this program were found. These items are addressed in Paragraphs 4.c, 3.c, 3.g, 3.h.(2), and 7.e respectively.

In addition to the strengths and weaknesses, the team identified seven items to be addressed during the current license renewal, three unresolved items, and twenty-one areas for improvement. There were also seven additional items identified for IFIs. The aforementioned items are listed following the program strengths and the programs weaknesses.

The following program strengths were identified:

1. Management's involvement in the operations of the plant and plant safety on a day-to-day basis is evident as demonstrated by nearly daily area surveillance tours and backshift tours by upper and middle level managers, Paragraph 2.c.

2. The Regulatory Compliance Committee and the associated sub-committees and teams are having a positive impact on the safety of the plant, Paragraph 2.d.

3. The Configuration Control program is a well considered program used to identify and maintain the safety controls specified in criticality safety evaluations, Paragraph 3.c.

4. The Criticality Safety Assessment program initiated by the licensee provides a significant enhancement for the criticality safety program due to the consolidation of the area process descriptions and existing safety evaluations, Paragraph 3.d.

5. The Data Packs provide management with an effective tool which can be used to investigate events and to identify corrective actions and other potential problems, Paragraph 3.e.

6. The licensee has established a team to reduce airborne radioactivity and has developed as low as reasonably achievable (ALARA) reports which contain valuable information, Paragraph 7.c.

7. Determinations of fixed air sampler representativeness were well documented, Paragraph 7.f.(1).

8. The licensee had a good program for cleaning, maintaining, and testing respirators, Paragraph 7.f.(2).

9. The licensee had the capability to perform in-vivo counting both routinely and in response to unusual incidents, Paragraph 7.f.(4).

10. The independent audits performed by corporate staff in the areas of environmental protection and industrial safety and hygiene were thorough and substantive, Paragraph 8.d.

11. The establishment of a training program at the South Carolina Fire Academy and the licensee's relationship with the City of Columbia Fire Department greatly enhanced the fire protection program, Paragraph 11.h.

The following program weaknesses were identified:

1. Lack of sufficient personnel to support all aspects of the programs in the Regulatory Affairs Department, Paragraph 2.b.(2) (92-04-01).

2. Failure of management to perform adequate reviews of technical documents, Paragraphs 2.b.(3) and 3.a.(2) (92-04-02).

3 Lack of formal plant procedures: a) to be used during incident investigation, Paragraph 2.e.(2); b) for formal documentation of program objectives and criteria and administrative procedures for various aspects of the nuclear criticality safety program, Paragraph 3.a.(1); and, c) for the chemical safety program, Paragraph 10.a (92-04-03).

4. Lack of formal training in root cause analysis techniques for those who perform incident investigations, Paragraph 2.e.(3) (92-04-04).

5. Lack of a functioning system to track and trend incidents, prioritize corrective actions needed, and formally close out issues and problems noted during investigations, assessments, audits and verify completed actions, Paragraph 2.f.(1) (92-04-05).

6. Human factors problems associated with the Electronic Procedure System (EPS), Paragraph 2.g.(2) (92-04-06).

7. Inadequate control and implementation of the Supplemental Operating Instructions (SOIs), Paragraph 2.g.(3) (92-04-07).

8. Lack of special training for Process Engineers in criticality safety to enable them to make equipment changes by substitution, Paragraph 3.c (92-04-10).

9. Lack of descriptions of accident scenarios that were considered during Criticality Safety Assessments, Paragraph 3.d (92-04-11).

10. Lack of information in the Nuclear Criticality Safety Evaluations (NCSEs) regarding reference drawings, assessment of accident scenarios, independent reviews and limits, and controls. In particular, Regulatory Affairs Review Request (facility change requests) did not contain sufficient information to substantiate the acceptability of the change nor had verification reviews of requirements specified in facility change requests always been performed, Paragraph 3.g.(1) (92-04-14).

11. Transfers were being made from favorable geometry containers to non-favorable geometry containers solely on the basis of chemistry analyses results that were transmitted orally by telephone and were not verified, Paragraph 3.h.(1) (92-04-16).

12. Inappropriate, contradictory, or unclear postings regarding criticality conttrols, Paragraph 4.a (92-04-18).

13. Inconsistent application and use of the licensee's yellow painted exclusion zones in the production area, Paragraph 4.b (92-04-19).

14. Inadequate control of non-favorable geometry containers throughout the plant, Paragraph 4.c (92-04-20).

15. Lack of engineering controls or inadequate engineering controls for the storage of Special Nuclear Material (SNM), Paragraph 4.e (92-04-21).

16. Health Physics (HP) personnel were required to perform analyses of U235/liter of samples sent to them by operations and procedures did not require samples to be sent to the chemistry laboratory, Paragraph 4.f (92-04-22).

17. Pre- and post-job ALARA review checklists were not consistently documented as required per procedure, Paragraph 7.c (92-04-29).

18. Numerous weaknesses were noted in the licensee's survey and contamination control program including, failure to perform surveys of incoming shipments of radioactive material, inadequate surveys of food preparation, eating, and drinking areas, and inadequate HP coverage for some work performed under radiation work permits (RWPs), Paragraph 7.e (92-04-30).

19. There exists no proceduralized document control on Regulatory Operations procedure distribution, Paragraph 8.b (92-04-34).

20. There was no mechanism developed to provide an immediate and continuous assessment of the radiation levels at the Central Alarm Station in the event of a criticality emergency, Paragraph 9.b (92-04-36).

21. Inadequate annual retraining for Emergency Directors and Emergency Coordinators, Paragraph 9.d (92-04-37).

22. Inadequate procedure for Procedure RA-107 which does not give adequate directions to Emergency Coordinators on when to make different types of notifications following emergencies, Paragraph 9.f (92-04-38).

The following items were identified as license renewal issues:

1. There are no external audits performed in the areas of radiation protection, fire protection, and criticality safety, Paragraph 2.h.(1) (92-04-08).

2. The submittal of programs to implement the Branch Technical Positions (BTPs) from March 21, 1989, in the following areas: a) Management Controls/Quality Assurance for Fuel Cycle, b) Facilities Requirements for Operations for Fuel Cycle Facilities, c) Chemical Safety for Fuel Cycle Facilities, and d) Fire Protection for Fuel Cycle Facilities, Paragraph 2.i (92-04-09).

3. The following problems were noted with respect to the nuclear criticality safety training program: a) the licensee did not test employees immediately following initial training, b) the licensee's training program lacked written objectives and written lesson plans, c) the program lacked the contents recommended in ANS-8.20, d) the program did not provide for program evaluation, and e) the training program was not performance based, Paragraph 3.f (92-04-13).

4. There is no formally documented maintenance program for the Integrated Dry Route (IDR) area equipment, Paragraph 6.a (92-04-24).

5. Various weaknesses were noted in the licensee's preventive maintenance computer program including no independent overcheck to ensure the closeout of safety related work orders, Paragraph 6.b (92-04-25).

6. Numerous engineered controls including safety related interlocks have not been placed into any preventive maintenance program, Paragraphs 6.c. and 10.h (92-04-27).

7. The Site Emergency Plan (SEP) did not contain various provisions and/or information including preplanned initial protective active recommendations, a summary of stack heights, typical flow rates, and efficiencies of emission-control devices, and the requirement for an annual independent audit of the program, as described in Regulatory Guide (RG) 3.67, Paragraph 9.b (92-04-35).

The following items were identified as unresolved items:

1. Failure to maintain a complete NCSE file regarding the uranyl nitrate (UNH) tank farm sump, paragraph 3.g.(1) (92-04-15). Westinghouse was to determined if the evaluation was performed and if so to retrive it.

2. Failure to consider the upset condition of a tank overflow in one of the Raschig ring filled tanks, Paragraph 3.h.(2) (29-04-17). The licensee was to review the evaluation to determine if this was considered and if not, to perform the evaluation.

3. Possible intake of radioactive material in excess of the limits specified in 10 CFR Part 20, Paragraph 7.f.(4) (92-04-33). The licensee was to review the actual intakes.

The following items were documented as IFIs:

1. Followup on the licensee's evaluation of all Data Packs, Paragraph 3.e (92-04-12).

2. Followup on the development and implementation of a sampling program and replicate sampling program for criticality safety, Paragraph 5.c (92-04-23).

3. Followup on the completion and implementation of Procedure RA-109, Paragraph 6.c (92-04-26).

4. Followup on the adequacy of the HP technician training program, Paragraph 7.b (92-04-28).

5. Followup on the lack of air monitoring devices in the Honing Area of Waste Recovery and Disposal (WR&D), Paragraph 7.f.(1) (92-04-31).

6. Followup on the timeliness of urine sample analyses, Paragraph 7.g.(3) (92-04-32).

7. Follow up on the lack of a self-appraisal mechanism to assess chemical accident potentials and consequences, Paragraph 10.c (92-04-39).

8. Followup on the development and implementation of a Process Hazards Analysis program, Paragraph 10.c (92-04-40).

9. Followup on the construction of a fire barrier in the area between the incinerator and the solvent extraction equipment in the WR&D area, Paragraph 11.a (92-04-41).

The following items were identified as areas for improvement:

1. The development of specific guidance in the area of the site safety audit program to ensure that all aspects of each program are reviewed, Paragraph 2.h.(2).

2. Providing additional training for Regulatory Affairs engineers is required in the area of auditing techniques, Paragraph 2.h.(3).

3. The installation of back flow preventers where required, Paragraph 3.h.(3).

4. Review of procedures to assure following an inventory, that storage of unsafe arrays of containers (which were measured for SNM only by a qualitative measurement technique) is precluded, Paragraph 3.h.(4).

5. Review of specific areas and work stations of the plant where moderating materials could be present to ensure that they are adequately controlled, Paragrapn 4.d.(1).

6. Providing justification for procedure deletions on Forms RA-100-2 and RA-100-3 for safeguards procedures as required, Paragraph 5.a.

7. The development of an examination and question bank tied to radiation safety learning objectives, Paragraph 7.b.

8. The development of posting for those areas within the facility with a general area dose rate which is significantly higher than the dose rates found in adjacent areas, Paragraph 7.d.

9. Determination of the need for conducting beta-gamma surveys throughout the plant, Paragraph 7.d.

10. Provision of more contamination surveys of non-routine operations, Paragraph 7.e.

11. Consideration of consistent application of the management approval criteria for materials and equipment released for unrestricted use, Paragraph 7.e.(3).

12. Development of a program to better utilize lapel samplers, Paragraph 7.f.

13. Consideration of the background prediction equations at the same frequency as full calibrations of the in-vivo counting system, Paragraph 7.f.(4).

14. Development of a documented cross-check program for the in-vivo counting system, Paragraph 7.f.(4).

15. Documentation of calibration of environmental air samplers, Paragraph 8.c.(1).

16. Ensuring that environmental sample collection procedures are followed, Paragraph 8.c.(1).

17. Development of an operating procedure for the SAC-4 alpha counter, Paragraph 8.c.(1).

18. Assurance that environmental water samples are properly preserved at the time of collection, Paragraph 8.c.(3).

19. The SEP to assure the appropriate terminology for emergency classification, Paragraph 9.b.

20. Revision of the SEP with respect to the NRC and South Carolina Department of Health and Environmental Control notification requirements, Paragraph 9.b.

21. Review of the lack of a dike for the sulfuric acid storage tank, the dike for the nitric acid storage tank, and the lack of a scrubber for the vent line from the hydrofluoric acid storage tank for adequacy, Paragraph 10.g.

22. Review of the storage of combustible and flammable material in various areas of the facility, Paragraph 11.g.

DETAILS

1. Persons Contacted

*R. Allen, Manager, Chemical Process Engineering
W. Barber, Shift Supervisor, Solvent Extraction
*T. Bartman, Manager, Product Design
*D. Batsen, Manager, Plant Systems Engineering
*J. Bush, Manager, Product Assurance
D. Colwell, Measurement Control Coordinator
*A. Del Priore, Associate Manager, Engineering
H. Doctor, Shift Supervisor, IFBA
*J. Fici, Manager, Materials, Planning, and Control
*R. Fischer, Senior Regulatory Engineer
*R. Fuller, Plant Systems Engineering
A. Graves, Site Security Supervisor
*D. Goldbach, Manager, Waste Recovery and Disposal
*W. Goodwin, Manager, Regulatory Affairs
*J. Heath, Manager, Regulatory Operations
*J. Hooper, Safety Engineer
R. Jacobs, Manufacturing Supervisor, Conversion Area
*E. Keelen, Manager, Manufacturing
*N. Kent, Regulatory Engineer
*R. Koga, Plant Manager
G. LaBruyere, Manager, MAP Operations and Conversion Services
R. Lewis, Senior Supervisor, Conversion Area
*R. Likes, Regulatory Engineer
*G. Lowder, Manager, Maintenance
*D. McCarthy, Controller
*S. McDonald, Manager, Technical Services
C. Miles, Supervisor, Conversion Area
*R. Montgomery, Regulatory Engineer
*R. Peterson, Senior Supervisor, Conversion Area
*R. Pollard, Manager, Product Assurance Engineering
*D. Precht, Manager, Uranium, Planning, and Services
*E. Reuler, Manager, Regulatory Engineering
*G. Rice, Senior Engineer, Quality Assurance
*A. Sabo, Energy Systems Business Unit, Headquarters
*C. Sanders, Manager, Nuclear Materials Management & Product Records
L. Turner, Supervisor, Waste Recovery & Disposal
*W. Ward, Manager, Pellet and Rod Manufacturing
*D. Williams, Regulatory Engineer
*R. Williams, Technical Coordinator, Regulatory Affairs
G. Wilson, Supervisor, Analytical Services Laboratory
*C. Wu, Technical Services

Nuclear Regulatory Commission

*J. Hickey, Chief, Fuel Cycle Safety Branch, NMSS
*P. Stohr,Director Division of Radiation Safety and Safeguards, Region II

In addition to the individual noted above, the team members met with and held discussions with other members of the licensee's staff.

Other Organizations

H. Lederfind, Assistant Chief of Operations, Columbia Fire Department
S. Threatt, Manager, Radiological Emergency Planning, South Carolina Department of Health and Environmental Control

*Denotes those attending the exit interview on August 28, 1992.

2. Management Organization and Controls

The team assessed the effectiveness of the management organization and controls for operations, communications, safety committee activities, investigation and reporting of incidents or process upsets, quality assurance, procedures and documentation, and audits and independent assessments. The team assessed the licensee's management controls for the facility against the criteria and guidance specified in Section 3.1 of the approved license application for License No. SNM-1107 and the NRC Branch Technical Position, "Management Controls/Quality Assurance for Fuel Cycle Facilities," dated March 21, 1989. The assessment was also based on interviews with the Plant Manager, various upper and middle managers, staff professionals, and with shift supervisors and employees, as well as tours of the facility. Various corporate, division, and plant records were also reviewed including policies and procedures, and committee minutes and proceedings. The team concluded that the licensee had an effective management team that generally exhibited a safety first attitude.

a. Responsibility

A review of the assignment of safety responsibility by the NRC team indicated that this responsibility was defined very generally in Westinghouse Corporate Directive, CD3505, "Occupational Health and Safety," dated May 1991 (which superseded Management Directive MDS05 dated July 1984). The directive stipulated that each plant manager was responsible for assuring that an occupational health and safety program was developed and implemented. No division level policies or procedures existed which might further detail the assignment of safety responsibilities.

At the plant level, the Columbia Plant Site Safety Manual, Procedure SY-100, "Authority and Responsibility For Safety," Revision (Rev.) No. 3, dated March 1, 1988, contained a well defined statement of both the safety policy and assignment of safety responsibility. The procedure also assigned various responsibilities for safety to supervisors, the Regulatory Engineering organization, and ultimately to the individual to follow all safe-practice rules and cooperate with all phases of the safety program.

Through a review of these documents and through interviews with various managers and supervisors, the team concluded that the Plant Manager has overall responsibility for safety at the facility. Also, each member of management has the personal and individual responsibility for the safety of all persons who report to or are assigned to him.

b. Organization, Management Oversight, and Staffing

The plant organization consisted of a Plant Manager supported by seven Staff Managers in charge of various functions at the facility. The Manufacturing Department conducted the production portion of the operation with various other departments established to support that effort including: Technical Services, Product Assurance, Human Resources, Regulatory Affairs, Controller, and Materials, Planning, and Control. Because of the size of the Manufacturing Department, the team specifically reviewed that portion of the organization with regard to safety management and span of control.

(1) Manufacturing Department

The Manufacturing Department was comprised of six sections or areas, four of which were responsible for distinct aspects of production: 1) Integrated Fuel Burnable Assembly (IFBA) Manufacturing, 2) Mechanical Manufacturing, 3) Manufacturing Automation Project (MAP) Operations and Conversion Services, and 4) Pellet and Rod Manufacturing. Also included in the Manufacturing Department were sections or areas over: 1) Maintenance and 2) Waste Recovery and Disposal (WR&D) and Scrap Recovery. Each of these sections or areas was managed by an Area Manager.

The IFBA Area Manager had three direct reporting supervisors. Each of these supervisors in turn supervised approximately 14 workers on a three-shift per day, five-day per week operation. The Mechanical Area Manager supervised seven supervisors. Each of these supervisors was in charge of the activities of from 10 to 26 employees who worked on a two-shift per day, five-day per week operating schedule. The Pellet and Rod Area Manager was responsible for five supervisors. These supervisors directed the activities of approximately 12 operators during a three-shift per day, five-day per week cycle. The Maintenance Area Manager was in charge of five supervisors who directed the work of from 17 to 49 electricians, mechanics, and technicians during a three-shift per day, five-day per week schedule. Planners were also assigned to assist these supervisors to schedule and coordinate the work to be done on the various shifts. Four supervisors reported to the WR&D and Scrap Recover

Area Manager. These supervisors, two of which worked on day shift, were responsible for approximately 14 operators on a three-shift per day, five-day per week schedule.

The MAP and Conversion Services Area Manager's organization was basically split into two groups of workers who were organized in different manners. The 60 Conversion Services operators were supervised by four supervisors, two on day shift and one on each of the other two shifts during a five-day per week schedule. The MAP area personnel were organized into four teams with a Team Manager over each 16 person crew or team. The four teams rotated through a two-shift per day, seven-day per week schedule due to their work with the Indirect Dry Route (IDR) process and "pay for skills" team concept.

The team interviewed selected managers, operators, and technicians from various Manufacturing Department sections or areas. The team also reviewed various safety records associated with the department including lost time accident reports, management safety tour reports, and criticality safety tour reports. Although the department was large and appeared to present the possibility for lack of management attention, no significant safety or span of control problems were noted. Through observations of the Manufacturing Department's and other departments' operations, the team noted that management oversight was adequate and that the supervisor-to-worker ratio and manager-to-supervisor ratio generally was not excessive. In certain areas where the span of control and supervisor-to-worker ratio did appear to be excessive, the licensee used planners to provide a means of coordinating the work effort and supplementing the supervisory control. Based on the review of the organizational structure and interviews with managers and operators, the team determined that the licensee's span of control of activities was adequate to assure safety.

(2) Regulatory Affairs (RA) Department

The Regulatory Affairs Department was composed of three sections: 1) Regulatory Operations, 2) Regulatory Engineering, and 3) Nuclear Materials Management and Product Records. The Regulatory Operations Section was responsible for environmental monitoring, plant surveillance and contamination control, air monitoring, personnel dosimetry, respiratory protection, emergency response, and radiation protection. The Regulatory Engineering Section was responsible for nuclear criticality safety, emergency preparedness, environmental protection, industrial hygiene and safety, fire protection, licenses and permits, and workmen's compensation. The Nuclear Materials Management and Product Records Section was in charge of uranium

accountability, Special Nuclear Material (SNM) measurements, measurement control, SNM item control, product traceability and records, shipping containers, and the Electronic Procedures System (EPS).

Within the Regulatory Engineering Section there were eight professionals and one technician. The team reviewed the duties and responsibilities of each of these individuals. The following is a listing of some of their responsibilities. Three of the professionals were involved with the various aspects of nuclear criticality safety, although one individual had only recently been added in this area. One of the other professionals had responsibility for the environmental program, emergency planning, Environmental Protection Agency (EPA) regulations and compliance, and health physics reviews and inspections. Another professional was in charge of fire protection, industrial hygiene and safety, training in safety and fire protection, maintaining the Safety Manual, the Occupational Health and Safety Administration (OSHA) regulations, and Workmen's Compensation support. The other two professionals were involved with all aspects of the radiation protection program including external and internal dosimetry, Unusual Incident Investigations (due to high airborne activity), the ALARA program and results, respiratory protection, contamination control, radiation work permits, and Health Physics (HP) training. The technician in the section was involved with training, airborne activity investigations, HP surveillance followup, and notices and posting.

Through interviews with various managers, operators, and professionals, the team noted that there was inadequate staffing in the Regulatory Affairs Department. Two groups that both workers and management alike generally agreed were understaffed were the Regulatory Engineering group and the Regulatory Operations group. It was generally felt, and the team agreed, that there was a shortage of professionals in the areas of criticality safety, environmental protection, fire protection, industrial safety, and emergency planning. Managers and operators also indicated that the addition of more Health Physics technicians to the staff would allow the workers to more efficiently accomplish their various duties.

The team reviewed the duties of the nuclear criticality safety engineers and the other professionals in the Regulatory Engineering section. The licensee's criticality staff included one individual contributor that was qualified as an analyst/senior reviewer. The Manager, Regulatory Affairs, was acting as the senior reviewer for all change analyses at the time of the assessment. Two additional individuals were in training for the position of analyst. The analyst/senior reviewer had only limited participation

in professional activities such as DOE safety conferences or ANS meetings. During periods when problems arose with a production process, the nuclear criticality safety engineers were required to stop work on their routine duties and serve on teams formed to review the problem. Through review of investigation reports and interviews with managers and engineers, the NRC team determined that the nuclear criticality safety engineers' work on teams to investigate problems had become more time consuming than their regular routine activities, which frequently had to be placed on hold.

The team also reviewed the duties of two other professionals in the Regulatory Engineering Section: 1) the individual in charge of the major programs of environmental protection and emergency planning and 2) the individual in charge of fire protection and industrial hygiene and safety. Although no serious weaknesses were noted, improvements desired by the cognizant professionals were not implemented due to the individuals' workloads. In discussing this issue with licensee management, the NRC team determined that the two individuals mentioned above had brought their concerns to the attention of management and that the decision had been made that no additional help was needed at the time in these areas of the safety program.

The NRC assessment team also found the ratio of health physics technicians to radiation workers to be small as compared to the general fuel cycle industry. If one includes the contract health physics support, the licensee employed one health physics technician for approximately every 40 monitored radiation workers. Over the course of the assessment, the NRC team developed concerns over the adequacy of technician staffing levels and the ability to provide coverage for non-routine or reactive activities. While the staff had demonstrated capability to carry out an effective routine progra of surveys and monitoring, it was limited in its capacity to absorb transient workload increases for non-routine activities, or for tasks which required additional coverage or effort. Specific examples of how these concerns impacted certain areas are noted in association with the program weakness in surveys and contamination control, see Paragraph 7.f and improvement items, identified in Paragraphs 7.e and 7.f(1). In addition, the assessment team noted that health physics coverage for weekends and holidays is typically only one technician. Lack of sufficient personnel in various areas of the Regulatory Affairs Department was determined to be a program weakness (70-1151/92-04-01).

(3) Document Review by Management

During the assessment, the team identified several instances when management's review of a document failed to identify significant deficiencies. The following examples illustrate the problem noted:

(a) In Procedure RO-06-003, Rev. 5, "Ambient Environmental Air Monitoring for Radioactivity," the self absorption factor in the calculations for alpha activity had been eliminated even though three technical managers had reviewed the change.

(b) Some of the reviews of Regulatory Affairs Requests for Change (facility change requests) did not contain supporting information to document that the changes would not have an adverse effect on criticality safety.

(c) Procedure COP-814700, "Bulk Handling/Moderation Control," was revised and the step to perform one of the required confirmatory moisture samples was deleted.

The failure of management to perform adequate reviews of technical documents was identified as a program weakness (70-1151/92-04-02).

c. Management Communication

The team interviewed various managers, professionals, and operators to discuss communications and management involvement in day-to-day operations and safety issues.

The Plant Manager holds a weekly staff meeting on Monday mornings with the upper level or department managers, to discuss plant operations including safety items identified by the Regulatory Compliance Committee, status of previously identified safety significant items, and actions taken to correct problems noted. Upper level managers in turn meet with mid-level managers to discuss plant operations including safety issues. Meeting frequencies for these meetings depend upon the various department managers' schedules but are often conducted weekly on Tuesdays. Mid-level managers meet at unspecified frequencies with supervisors to discuss and review plant operations and safety issues. Supervisors and senior operating personnel routinely meet with their counterparts during shift change to discuss the operations of the previous shift and safety concerns identified during that period. Operations personnel are briefed by their supervisors on an as needed basis concerning current safety issues and problems that have been noted.

In addition to these formal meetings held among managers, between managers and supervisors, and between supervisors and workers, other mechanisms are used by management to communicate safety issues to the workers. Depending upon the area of the plant, supervisors hold periodic work place meetings to discuss operational and safety issues. During such meetings, which are held as often as weekly in some areas and as infrequently as every quarter in others, work place scripts are read. The scripts are developed by one of the safety professionals in the Regulatory Engineering Section whenever a significant safety problem is noted or has occurred. Following accidents or injuries, these meetings are also used to pass around "Red Sheets" which are written by the Regulatory Engineer in charge of industrial safety. The "Red Sheets" detail the type of accident or injury that has occurred and provides ways to avoid such problems in the future. (The "Red Sheets" were also posted on bulletin boards at various locations throughout the plant.)

The licensee used another means of reinforcing safety and communicating such issues to the workers. Through interviews with managers and workers and through observations of plant operations, the team noted that upper and mid-level managers were scheduled to visit the plant on backshift and tour assigned areas. This brought management out on the operations floor during backshift and made them accessible to the workers. The licensee had also established a program that required upper and mid-level managers to walk through a specific area of the plant with the Safety Observer from that area on a housekeeping tour. The team also noted that mid-level managers (and support organization engineers) visited the various work areas of the facility, typically on a daily basis, generally on day shift. This type of management involvement in the day-to-day operations of the facility was determined to be a program strength.

d. Safety Committees

(1) Regulatory Compliance Committee

The licensee formed the Regulatory Compliance Committee (RCC) to serve as the plant safety committee. The RCC was the organization that established plant policies in the areas of radiation protection, ALARA, fire protection, industrial safety, chemical safety, nuclear criticality safety, environmental protection, emergency preparedness, regulatory compliance, review and evaluation of safety hazards (10 CFR Part 21), and risk management. The Plant Manager (or his representative) served as the RCC chairman with members from his staff including the Manager of Regulatory Affairs. By charter, the committee was required to meet at least quarterly to review items or issues dealing with the areas specified above.

The team reviewed the RCC meeting minutes for the past year and concluded that the committee was reviewing and following issues pertinent to safety. Most of the issues reviewed by the RCC were being followed by the Regulatory Affairs (RA) Department and reviewed with the Plant Manager. Some of the issues were reviewed during the Plant Manager's weekly staff meetings by the Manager of RA as well as during the meetings of the RCC. The items brought up during staff meetings were a review of the previous week's "Red Book" entries, the number of events that were reportable to the RA Department, the number of events that were reportable to the NRC, and an outline of the reportable criticality safety events that had occurred during the past week.

(2) Safety Action Group

The RCC utilized various subcommittees or teams to develop programs to augment plant safety. One such subcommittee was the Safety Action Group (SAG). The SAG was chartered to review safety issues at the plant and to make recommendations to the RCC concerning ways to "create a culture of total safety consciousness within the work force through increased awareness and active participation. . ." The group consisted of a cross section of employees from the facility including hourly, professional, and management personnel with a Quality Control supervisor as the chair. The SAG met at least once per month to accomplish the stated goals.

Through a review of the SAG meeting minutes, the team determined that the organization was used to formulate ideas and programs on safety awareness. The SAG met once or twice each month and group members, who were also typically assigned as Safety Observers, provided suggestions on ways to improve and promote safety. The SAG monitored the Safety Observer program, the Management Safety and Housekeeping Surveillance program, and sponsored various promotional contests and specialized training sessions. A review of the SAG meeting minutes also indicated that the group had been effective in their efforts to promote safety in that some of their suggestions had been implemented by management. However, it was also noted that there was no formal tracking system for safety problems that were observed during safety tours of the facility (see Paragraph 2.f for further details).

(3) Airborne Reduction Team

The RCC had also authorized formulation of the Airborne Reduction Team (ART). The team, which had recently been combined with the Personnel Exposure Reduction Team, was chartered to perform ALARA analyses and establish targets

for implementing airborne and exposure reduction plans. The team was to accomplish their task through reviewing and suggesting process changes, facility modifications, personnel protective equipment utilization, and/or environmental controls. Team members were Area Managers from the Manufacturing Department, selected engineers from Process Engineering, the Health Physics Manager, Regulatory Engineering engineers, and selected supervisors from the operational areas of the chemical side of the plant. Meeting frequency depended upon the needs of the facility.

The NRC team reviewed ART meeting minutes and minutes from the previous Personnel Exposure Reduction Team meetings. Agenda items included the use of laminar flow hoods, respirators, HEPA filtered units, a review of automatic pellet boat loading operations, minimization of poly pack handling, and identification of sources of airborne activity in various areas. The NRC team also noted that the ART was working toward achieving compliance with the NRC's new 10 CFR Part 20 criteria. The ART also reviewed the ALARA reports that were generated every six months. The NRC assessment team determined that the activities of the Airborne Reduction Team have had a positive impact on safety in reducing exposures at the facility.

In general, the team determined that the Regulatory Compliance Committee (RCC) and the associated sub-committees or teams formed to implement safety are having a positive impact on the safety of the plant. The activities of the RCC, the SAG, and the ART were determined to be program strength.

e. Incident Investigation

(1) Procedure Review

Following a major problem or event, the licensee typically appointed a multidisciplined team of individuals to perform an investigation of the problem. The NRC assessment team reviewed the documents concerning incident investigation at the facility. There was only one procedure which dealt with investigating an event, Procedure SY-104, "Reporting and Investigating of Injuries, Illnesses, Accidents/Incidents and Near Misses," Rev. (Rev.) 4, dated March 1991. As the title indicates, this procedure was established for performing an investigation of physical injuries and accidents (or radiation exposures) which occur at the facility.

The procedure proved to be an effective tool for use in investigating industrial safety-type incidents as illustrated by an event which occurred during the course of the assessment. During disassembly of a solvent extraction

column on August 20, 1992, a worker received several cuts requiring medical attention. The solvent extraction column was being disassembled in order to replace gaskets and perform other maintenance work. The licensee immediately convened an investigation team to review the event and take corrective actions. During the initial investigation, it was noted that the column had been in place since the solvent extraction process had been placed into operation at the facility in 1982. Although the reason the column broke could not be determined immediately, the investigation demonstrated that wall thinning had not occurred and no discoloration or "frosting" of the glass was noted. The column manufacturer was contacted to determine if this type of problem had been noted at other facilities. The following day, a "Red Sheet" was issued by the Regulatory Affairs department which described the accident, the apparent problems, and what implications this accident had for others.

Although Procedure SY-104 was useful in investigating occupational safety-related accidents, the team noted that there were no other plant procedures which addressed investigating other types of events. Also, no procedure delineated the various other aspects of incident investigation such as: 1) the criteria for performing an incident investigation, 2) who would be qualified to serve on an investigation team, 3) how to determine the root cause of the problem, 4) who would be responsible to determine adequate corrective actions, and 5) how to track and formally close out any corrective actions deemed necessary.

(2) Program Implementation

Through reviews of other documents and interviews with RA personnel, the team determined that a Regulatory Engineering Section policy had been formulated which established the criteria to be used to investigate criticality safety events. A review of a memorandum from the Manager, Regulatory Engineering dated March 30, 1992, concerning Section Policy 900 (Rev. 2), "Establishing Protocol for Nuclear Criticality Safety Events," revealed that the policy contained all of the essential elements that would be helpful in establishing a plant procedure for incident investigation with the exception of detailing how to determine the root cause of an incident. The policy also established and charged the Criticality Safety Events Committee with reviewing the corrective actions and issuing a letter to formally close out the event.

Although the section policy was not binding upon the other departments of the plant, the policy was being implemented as if it were a plant procedure. The policy was used to

investigate significant criticality safety events that were determined to be such by the RA Manager with the concurrence of the Manager of Manufacturing and the Manager of Technical Services (the three individuals who comprised the Criticality Safety Events Committee). Lack of a formal plant procedure to be used during incident investigation was identified as a program weakness (70-1151/92-04-03).

The team was able to observe the implementation of the licensee's criticality safety event investigation policy. The incident involved problems noted with the ADU vaporizers and the possibility of water accumulation in the vaporizers. The licensee determined that the event was reportable to the NRC and subsequently implemented the section policy as outlined above.

(3) Root Cause Analysis Training

The NRC team also inquired about training that licensee personnel had received in root cause analysis techniques. The licensee indicated that some root cause analysis techniques were used during incident investigation but that no formal training had been provided. The licensee also stated that the need for such training had been recognized and that an individual had been tasked with formulating a proposal for acquiring this type of training. Lack of formal training in root cause analysis and failure to use formal root cause analysis techniques during incident investigation was noted as a program weakness (70-1151/92-04-04).

f. Corrective Action Program

(1) Tracking and Followup of Action Items

The NRC team reviewed the licensee's system that had been developed to follow the corrective actions identified and/or the recommendations made following the various types of formal and informal investigations and assessments conducted by the licensee (i.e. incident investigation, criticality safety assessments, SAG surveillance items, and facility change request reviews). The team also reviewed the system used to verify that corrective actions had been completed prior to close-out of those items.

Through discussions with licensee management, the team determined that, although corrective actions identified by investigation teams were being tracked by the Regulatory Affairs department, no formal tracking system was in place at the time of the assessment. Also, no formal system was used to verify that all the corrective actions had been completed prior to the event being formally closed.

The licensee had established Criticality Safety Assessment (CSA) teams to review various processes and assess the criticality safety of those operations (see Paragraph 3.d for further details concerning Criticality Safety Assessments). The recommendations for actions and further evaluations to enhance safety, which were made by the CSA teams following assessment of each area, were being maintained in the CSA packages. These recommendations were for the specific plant/ process area or for the entire chemical area. However, licensee management indicated that no action plan had been developed to respond to these numerous recommendations. Additionally, the team found that no tracking system had been established to accept or reject the CSA action items/recommendations, to assign responsibility for actions, to assign priority to the actions, or to track the actions to completion. A similar example was found in the control of the licensee's Data Pack (DP) program where some of the documentation for the management review of the status of corrective actions could not be located.

In another area, the SAG constituted a sub-committee of the plant Safety Committee. SAG was given the responsibility to monitor the Safety Observer and Housekeeping Surveillance programs. Although a program had been developed to document safety problems noted during tours of the plant by area Safety Observers, there was no formal tracking of safety problems noted during these tours and no formal close out of the issues.

Another example of the lack of a tracking and followup system for action items was noted during examination of facility change request forms, Form RA-104, "Regulatory Affairs Review Requests." The NRC team determined that adequate verification reviews of requirements specified in the request approvals were not always performed. These review requests are used by the licensee to document nuclear criticality safety evaluations performed prior to implementation of facility changes. In order to determine the status of specific review request requirements, the team examined implementation of Review Request No. RA-104-1-754 "Solvent Extraction, Product Concentrator Bay Filter," dated August 15, 1991.

Of ten requirements identified as necessary for startup, five were either not completed or were not adequately implemented. For example, Item #1 required that a 23 x 36 inch smear area, painted yellow be provided under each filter. The yellow painted smear area was not provided. Item #4 required an evaluation of the need to provide a catch pan (drip containment) under the filters. According to system operators, the filters leak periodically and no

drip containment was provided. Item #10 required that a written approved procedure be provided that addressed all operations, activities and safety requirements. No procedure that addresses filter bag changes was provided.

Lack of a functioning system for tracking and trending incidents, prioritizing the corrective actions that would need to be taken, verifying the actions were completed prior to closure, and formally closing out issues and problems noted during incident investigations and was noted as a program weakness (70-1151/92-04-05).

(2) "New" Tracking System

The licensee had developed a "new" system for tracking audit findings, the PRONET Commitment Tracking System. However, the system had not been implemented as of the date of the assessment. As a result, the audit findings were not being tracked to completion and formally closed out, although the RA engineers were tracking the items informally. The "old" tracking system dealt with tracking items and corrective actions generated as a result of NRC or other regulatory agency inspections.

g. Policies, Procedures, and Documentation

Selected administrative, operating, maintenance, and safety procedures, which were being used by licensee personnel at the plant, were reviewed by the team.

New operating and maintenance procedures and revisions to such procedures were normally originated by engineering staff members assigned to the different departments. Following development or revision of a procedure, the originating engineer was then responsible for coordinating the necessary reviews of the document. This would entail reviews by the manager of the originating organization, reviews by the managers affected by the change, reviews by first line supervisors (and senior operators in some cases), and review by the Plant Manager for all plant level procedures. When the procedural changes had safety implications, the appropriate RA engineer would also review the proposed changes. Operating procedures were required to be reviewed every two years.

(1) Administration

Procedure CA-002, Columbia Plant Policy and Procedure System," Rev. 5, dated January 8, 1992, was the document that established the policy and procedural system for the various departments at the facility. The procedure outlined the responsibilities of departmental managers to establish administrative and operating procedures, the requirements

for the review and approval of procedures, and detailed the controlled distribution of new and revised procedures. The procedure also provided format guidelines to be followed when preparing a new procedure.

Procedure CA-025, "Columbia Plant Electronic Procedure System," Rev.3, dated June 4, 1992, detailed the structure of the plant Electronic Procedure System (EPS) and defined the responsibilities for and methods of preparation, approval, distribution, revision, and control of departmental controlled procedures. Procedures maintained on the EPS were those dealing with mechanical, chemical, Manufacturing Automation Project (MAP) operations, maintenance and calibration procedures, Quality Control (QC) Instructions and administrative procedures. Regulatory Affairs procedures were not maintained on the EPS.

These procedures were adequate to delineate the responsibilities of line management who had been designated to provide procedures for use at the plant and to provide for the proper review of revisions.

(2) Procedure Use

The licensee had implemented a policy of not having "hard copies" of procedures out in the production areas of the plant approximately two years ago. This was done to eliminate the problems with maintaining current, revised, up-to-date copies of the procedures in numerous locations throughout the facility. The EPS was established to provide the needed procedures on the floor through the use of computer terminals and screens located at approximately 100 locations in the plant. A specific section in the Regulatory Affairs department was created and tasked with managing and controlling the procedures and ensuring that only the correct, revised editions are available for use. As changes are made to the procedures, the revisions are entered into the EPS. Approved procedures are issued on Thursdays of each week. Operators on the floor are instructed to ensure that they review the revisions applicable to their areas issued on Thursdays.

To ensure that the operators reviewed the procedural revisions, a sign-off sheet was maintained by the supervisors in the various areas of the facility and the operators signed the sheet when they had completed their review. Although this sign-off method indicated that the operators had read the revised procedures, it did not demonstrate whether or not they understood the changes. Through discussions with selected managers, supervisors, and

operators, the NRC team determined that informal training was usually given during workplace meetings to discuss any questions on procedural changes.

Although the EPS was an easily maintainable system from the standpoint of keeping procedures current and ensuring that out-dated copies were not in use on the floor, several problems were noted with the system. Most of the problems noted were in the area of Human Factors. The computer screens in various areas were in locations such that it was difficult to read the screen. Also, when a procedure referenced the operator to another procedure, the operator had to completely exit the first procedure before being able to enter the second. Lastly, lengthy procedures required the operator to make several trips between the terminal and the equipment in order to ensure the procedure was followed.

Even though the NRC team found no specific instances where this caused a problem or led to an event, these problems were identified as a program weakness in the licensee's management control system (70-1151/92-04-06).

(3) Supplemental Operating Instructions

As a means to facilitate implementation of the procedures on the EPS, the licensee made use of various other documents such as checklists, Process Information Forms (PIFs), and Supplemental Operating Instructions (SOIs). The licensee's method for utilizing SOIs was reviewed by the team. The review consisted of interviews with licensee personnel, a review of records, and field verification of procedural requirements.

Technical Services Administrative procedure TA-005, "S.O.I. and P.I.F. Preparation and Distribution," specifies the program requirements for preparation, control, and distribution of SOIs. SOIs may be prepared for the following reasons:

(a) An SOI may be prepared to issue preliminary operating procedures or to make interim changes to an operating procedure until the procedure can be revised, approved and issued. Such SOIs are effective until the operating procedure is issued, but not to exceed 60 days from the date of issue.

(b) An SOI may be prepared to provide contract-specific information necessary for fabrication and/or to comply with applicable process or product requirements. In this situation, an SOI is effective for the duration of the contract.

(c) A general SOI may be prepared to provide unique supplementary processing data related to contract or design specifications. These SOIs are not limited to the duration of a given contract.

(d) An SOI may be prepared when an operating procedure must be changed for a temporary period of time to meet a unique situation. The SOI should specify the time/quantity limit or expiration date.

The team reviewed the SOI log books in the Ammonium Diuranate (ADU) conversion control room, the IDR control room, the pellet area control room, and randomly selected SOI files from the rod loading area and IFBA. Each control room contained an SOI logbook for that area of the plant. Logbooks generally contained a copy of the SOI, SOI Acknowledgement Sheets (signature pages indicating the operators for that area had read and understood the SOI), and an index updated on a monthly basis. However, some inconsistencies were noted in use of the SOI acknowledgement sheets, and maintenance of SOIs for operator review.

In the ADU conversion area control room SOI log, three of the SOIs (C-142, C-143, C-144) contained no indication of the date of issue nor the expiration date as required by procedure TA-005, step 7.1.1.A.9.B. Additionally, several of the supervisor acknowledgement sheets were missing from the logbook despite the fact the SOI had not expired. When asked, the shift supervisor stated that SOI acknowledgement sheets were to be forwarded to document control immediately after all the crew had signed the sheet. TA-005, step 7.1.2.B.2 states that SOI acknowledgement sheets are to be forwarded to document control after expiration of the SOI.

The SOI acknowledgement sheet, step 1, states that the supervisor should sign the sheet within five days of receipt to signify that all crew members had read the SOI. During the review, many examples of acknowledgement sheets not receiving supervisor sign off within the five days were noted. For example; SOI I-087, issued on May 28, 1992, was not signed by the first shift supervisor until August 17, 1992; SOI I-123, issued on January 9, 1992, was not signed by the first shift supervisor until January 27, 1992 and by the second shift supervisor until January 23, 1992; SOI IDR-0100 was issued on August 8, 1992, and was not signed by the "B" shift supervisor as of August 24, 1992.

In the IDR area, the team noted that the area was divided into three separate "functional areas" designated FA-1, FA-2 and FA-3. Areas FA-1 and FA-2 were under the supervision of the same supervisor. The team reviewed the logbook for the

FA-1 area which was located in the IDR control room. However, the SOI logbook for FA-2 could not be located and a copy of the only SOI in effect for that functional area, SOI PEL-340, "Operating Stack 2 Green Scrap," could not be located. This was brought to the attention of the licensee and a logbook and a copy of the procedure were provided that day. The team also noted that several copies of SOI PEL-358, "ECO of FA-2 Area Prior to and Following Inventory," were at the operators table on August 24, 1992. The SOI had an expiration date of August 21, 1992. A check of the current SOI index indicated that SOI PEL-358 had expired and should have been removed for the floor.

The team found several SOIs that had been in effect longer than 60 days as specified in TA-005 step 2.1.A., SOIs that appeared to have been written to cover routine operations and SOIs that were written to specify contract specific information that were provided with an expiration date of "continuous." For example, SOI IDR-0100, "Blue M Furnace Oxidation," was last issued on August 7, 1992, as Rev. E; IDR-095, Charging Powder from Polypacks, was last issued on August 13, 1992, as Rev. C; SOI P-1319 for operation of the hydration press was on Rev. C despite the fact the press had been installed for approximately 2 years; and one SOI in the pellet area, PEL-0616, used to specify welding specifications for individual contracts, had been revised 185 times. Discussions with operations personnel indicated that the subject areas of the above noted SOIs, were operations routinely conducted in the normal course of business.

As noted above, the chemical operating procedures were not maintained as hard copy procedures on the operating floor. Instead, the licensee had instituted the EPS which consisted of computer terminals located throughout the chemical conversion area which the operators could reference. The team noted that the computerized procedures system did not contain a cross-reference to the corresponding SOI. Thus, during use of an electronic procedure there would be no indication to the operator that an SOI had been issued against the procedure.

Based upon the above results, the team concluded that the control and implementation of the SOI program was less than adequate. The use of the SOI to cover contract specifications, temporary procedures and immediate revisions to operating procedures appeared to be excessively broad and add confusion in the control of the SOIs. Additionally, SOIs were not cross-referenced to the electronic procedure system. The control, implementation and use of SOIs was identified as a program weakness (70-1151/92-04-07).

h. Audits and Independent Assessments

The Quality Assurance (QA) group at the facility does not perform compliance or performance based audits of the operations, rather, QA inspects almost exclusively the quality of the product. The team reviewed the audits that were conducted at the facility by the licensee. Basically two different types of audits were conducted; one type of audit (external) was conducted by a corporate group and another type of audit (internal) was conducted by the engineers and technicians in the Regulatory Affairs department at the site.

(1) Corporate/External Audits

Westinghouse Corporate Directive, Order No. CD3505, "Occupational Health and Safety," dated May 1991, stipulates that the Corporate Environmental Affairs group shall, for existing facilities, perform periodic occupational health and safety audits, report results, and follow-up to determine that recommended corrective actions have been taken.

The team reviewed the two most recent audits performed by Corporate Environmental Affairs, one from 1989 and one performed in February of 1992. Both corporate audits covered environmental safety extensively. Also covered were the areas of hazardous waste management, industrial safety, respiratory protection, and chemical safety, as well as some aspects of emergency planning and response, and safety policy and procedures. However, the audits did not cover the areas of radiation protection, fire protection, and criticality safety. No documentation was available which required that a corporate or other external group audit these areas.

When the team discussed this issue with licensee representatives, they indicated that their insurance carrier, American Nuclear Insurers (ANI) performs a comprehensive annual audit of the fire protection program at the facility. Also, the NRC performs periodic inspections of the radiation protection and criticality safety programs. And, other outside consultants are hired to perform audits and reviews of the programs as necessary. The team explained that the purpose of having a group external to the facility audit areas is to provide the licensee with the opportunity to identify areas requiring improvement and not to rely on outside regulatory agencies to perform that function.

Lack of a requirement for external audits in the areas of radiation protection, fire protection, and criticality safety was noted as a renewal item (70-1151/92-04-08).

(2) Westinghouse Columbia Plant Audits

Procedure RA-102, "Plant Inspection Program for Regulatory Compliance," Rev. 2, dated May 4, 1990, defined the program, schedule, and inspection checklist for the safety inspection plan. This procedure required monthly inspections, assignment of corrective actions, and documentation and transmittal of an inspection report to area management.

Procedure, RA-106, "Internal Program Audits," Rev. 2, dated March 11, 1992, states that the Manager, Regulatory Engineering: 1) designates programs to be audited and the audit frequencies, 2) monitors to assure timeliness, and 3) identifies programs where independent audits are necessary. The procedure also states that the Regulatory Engineers are to: 1) perform audits, 2) issue reports concerning their findings within 30 days of completion of the audits, and 3) place action items on PRONET (the computer based tracking system). The procedure further lists the areas to be audited but does not list emergency preparedness or chemical safety. Engineers are required to perform an audit of their program areas on an annual basis.

The audit program was also defined in the employee appraisal system. The specifics and frequencies of audits were stated in the annual performance objectives of individual employees.

Through discussions with the licensee and review of selected audits performed by Regulatory Engineering personnel, the team determined that the safety audit program was not well defined. Procedure RA-106 did not provide any specific guidance on how to conduct audits and did not provide a system to ensure that all areas of a particular program were audited. Audits were being performed by the engineers, including audits in the areas of emergency preparedness and chemical safety, but it was not evident that all aspects of each program had been reviewed. This was identified as an area for improvement.

(3) Auditor Training

The team reviewed the training that had been provided to the RA engineers in the area of performing audits. The Manager, Regulatory Engineering had provided some training/guidance for those engineers in his section several years previous and some of the engineers had attended a one-day course in auditing techniques sponsored by a Westinghouse corporate group. However, some of the engineers who had joined the Regulatory Engineering section more recently had not received such training. The lack of formal training of RA engineering auditors is an area for improvement.

i. Branch Technical Positions

On March 21, 1989, the NRC published four Branch Technical Positions (BTPs) in the Federal Register (54FR11590). The four BTPs addressed:

- Management Controls/Quality Assurance for Fuel Cycle Facilities
- Requirements for Operations for Fuel Cycle Facilities
- Chemical Safety for Fuel Cycle Facilities
- Fire Protection for Fuel Cycle Facilities

These BTPs were issued to provide guidance to applicants and licensees for preparation of applications for licenses and conduct of operations. Although the license renewal application for SNM-1151 was submitted approximately one year after the BTPs were published, the renewal application did not address the BTP.

As part of the current license renewal process, the licensee will be required to address the programs or methods for implementing the positions in the BTPs. The timing and method of submitting this information will be communicated from the Fuel Cycle Safety Branch, Office of NMSS. The submittal of programs to implement the BTPs is considered a license renewal item (70-1151/92-04-09).

3. Criticality Safety

The team assessed the criticality safety program against the provisions of Sections 2.2 and 2.3 of the approved license application for license number SNM-1107, the consensus standards contained in the ANSI/ANS-8 series, Regulatory Guides and accepted industry practices.

a. Nuclear Criticality Safety Program

The team assessed the management control programs associated with the establishment and implementation of practices related to nuclear criticality safety (NCS). Such practices include management oversight, design basis documentation, NCS evaluations, validation, process safety analyses, operating procedures, training, configuration control, incident investigations, audits, maintenance and surveillance, and functional testing.

Based upon the assessment, the team determined that program documentation lacked the detailed objectives and criteria necessary to establish practices and administrative procedures to accomplish such practices. Policies and procedures were general and required a considerable amount of interpretation. In

addition, the team determined that specific responsibilities and guidance for activities were not clearly defined in procedures or other guidance documents.

(1) Policies and Procedures

The Regulatory Affairs Procedures Manual and the Site Safety Manual contained procedures for the administration of the nuclear criticality safety program. Westinghouse policy and higher management directives allowed the line management component to further define and formalize plant policies and procedures related to nuclear criticality safety. Additionally, Regulatory Engineering Policy 700 established requirements for documenting procedures in sufficient detail that program elements could be fully and successfully executed.

Through reviews of the licensee's procedures related to NCS, the team determined that the procedures had not been formalized to the extent necessary to ensure detailed understanding and adequate performance of the requirements. Further, administrative procedures and guidelines did not adequately establish objectives and criteria for the Regulatory Engineering staff to perform duties such as conducting audits and appraisals, participating in training, and preparing and updating comprehensive safety analyses.

Specific examples of the deficiencies that the team identified in the content of some administrative procedures are as follows:

(a) RA-300, "NCS Design and Review Criteria," Rev. 1, dated January 12, 1990, established the procedure for applying NCS criteria when additions or modifications to process operations were proposed. Section 1.4 of this procedure stated that an analysis must take into consideration identified contributing causes of criticality accidents. However, the accident analysis methodology was not presented.

(b) RA-301, "Nuclear Criticality Control Procedure," Rev. 8, allowed generic authorization for non-favorable geometry (NFG) containers. For example, this procedure allowed slightly contaminated waste could be stored in 55-gallon drums without providing requirements for fissile material measurement.

(c) RA-303, "Control of Moderating Materials for Nuclear Criticality Safety," Rev. 1, dated July 10, 1989, attempted to formalize requirements for moderation control. RA-303 required management approval to use

moderating material during a fire but failed to address control of firefighting techniques that could result in reconfiguration of stored SNM.

The failure to have documented program objectives and criteria and administrative procedures was identified as another example of a program weakness in the area of lack of formal plant procedures (70-1151/92-04-03).

(2) Management Oversight

Management failed to establish the criteria to be satisfied by all NCS controls as specified by ANSI/ANS-8.1, Section 4.1.1. For example, the NCS program documentation system failed to describe administrative practices that would ensure plant management approval of control methods. Procedure RA-300 required that manufacturing justify the use of NFG containers. Administrative procedure RA-301-1 allowed generic authorization for non-favorable geometry containers. The team determined that the mechanism for ensuring that management was aware of NCS controls on non-favorable geometry containers was ineffective. A specific procedure had not been established that ensured management approval of designs in which favorable geometry was not used as the method for criticality control. This was identified as another example of management's failure to perform adequate review of technical documents as described in paragraph 2.b.(3) (70-1151/92-04-02).

b. Nuclear Criticality Safety Audits

(1) Policies and Procedures

As described above in Paragraph 2.h.(2), Procedures RA-102 and RA-106 were used as guidance in performing onsite audits. Through a review of these procedures the team determined that Procedure RA-102 did not identify a mechanism for tracking and closing corrective actions items. Procedure RA-106 did not provide guidance on how to conduct audits, lacked specifics regarding format and corrective actions, and did not contain audit priorities. Further, team examination of audit records associated with RA-106, indicated that audit findings were not always reported to management or that corrective actions were not always assigned.

With respect to nuclear criticality safety, the audit procedure also failed to specify the following responsibilities for: 1) review of maintenance and testing activities. 2) ensuring completion of corrective actions, and 3) developing written procedures and checklists to ensure adequate audits are conducted.

(2) Audit Results

Although the licensee's procedures required tracking and followup of corrective actions, repetitive findings existed in some audit records. In one particular case, corrective actions were taken and were effective. However, the corrective actions identified during the audit required several years to implement, despite repeat findings in subsequent audit reports. The team determined that repetitive findings in the audits denoted that adequate tracking and followup of corrective actions was not being performed. Further,the responsibility for review of findings and assignment of corrective actions was unclear. The responsibility for tracking corrective actions was also unclear. Tracking and closure of corrective actions was identified previously as a problem (see Paragraph 2.f). Also, no formal self-assessment was conducted to review and evaluate the effectiveness of the NCS program.

c. Configuration Control

The team reviewed the recently finalized configuration control program through discussions with licensee personnel and reviews of pertinent documents. Configuration control at the facility consists of a system of eight types of documents which provide information on the status of the chemical processing areas of the plant. The principal documents currently under development were updated piping and instrument drawings (P&IDs), procedures, and critical instrument loop sheets (instruments and logic functions). Other documents controlled by the system included specifications, criticality signs, and preventative maintenance and work orders.

A configuration control procedure, TA-500, "Uranium Chemical Manufacturing Process Configuration Control," Rev. 0, dated August 6, 1992, had been written to formalize changes to process equipment. Except in emergencies, certain management functions, (i.e., operations, process engineering, and safety), would have to approve the change before the change could be initiated. In the configuration control program, process engineers were permitted to make equipment changes-in-kind and changes by substitution without obtaining Regulatory Affairs' approval. However, the process engineers have not been specifically trained to make changes by substitution. The Regulatory Affairs engineers stated that the training provided for implementing procedures to satisfy NRC Bulletin No. 91-01 was intended to qualify the engineers for making changes by substitution. Because the training, for NRC Bulletin No. 91-01, focused on reporting and not on the criticality safety controls required for the processes, the NRC team did not consider the training to be adequate. Failure to provide specialized training to the process engineers in criticality safety controls required for the processes is considered a program weakness (70-1151/92-04-10).

The team was informed by the Configuration Control program manager that configuration control was being established for liquid processing areas first. These areas were perceived as having the higher risk simply because of the nature of solution processing. The program will eventually cover the IDR-MAP line with a similar system being developed for the mechanical area.

Overall, the team found that Configuration Control was an excellent, well defined program which provided the licensee with the capability of identifying and maintaining the safety controls specified in nuclear criticality safety evaluations. The program was being implemented such that regard for the higher risk areas of the plant, i.e., the uranium solution processing and the moderation-controlled areas were the first to be incorporated into the system. The Configuration Control program provided a sound data base for maintaining the plant as designed, for future plant changes, and for trouble shooting plant problems. Licensee management was committed to completing and maintaining this effort at the cost of significant resources. Configuration Control was considered a program strength.

d. Criticality Safety Assessment

After the General Electric (GE) incident in 1991, the Plant Manager established a Criticality Safety Assessment (CSA) program. The program consists of teams that were established to review various processes,(e.g. solvent extraction), evaluate the criticality safety of the operation and document the findings in a CSA. The CSAs are a qualitative safety assessment that bring together in one cohesive document all of the safety evaluations that have been produced over the lifetime of the plant for a particular process. The CSA priority areas were the chemical areas of the plant. As the program developed, it was revised appropriately to include the limited and controlled moderation areas as well.

One of the first steps in the CSA process was to assemble and evaluate the safety barriers and controls and create double contingency tables. In reviewing these tables, the team noted that some of the barriers were not properly identified, engineering controls were not properly defined, and that the quality of controls was overrated when compared to consensus standard guidance. For example, barriers were identified to prevent more than 100 kg of precipitates from accumulating or to prevent releases of uranium in water such that the uranium would not exceed a specified concentration. The team also noted that the use of alarms and company policy as active engineering controls did not meet the definition in the consensus standard guidance of active engineered controls. In addition, a few safety limits for homogeneous systems had been erroneously used for heterogeneous systems in the CSAs. These limits were obtained from the double contingency tables specified in section 2.3 of the

approved licensed application. Finally, the CSAs indicated that there were no safety concerns for some tanks, however, no justification was provided for this conclusion.

The NRC team also determined that the safety acceptance criteria in the CSA did not contain those items that were included in section I of the license application. Licensee representatives, including CSA team members, stated that compliance with Sections II and III of the application, as specified in the license, was the basis for NRC inspection, Section I was not a basis for NRC inspection. The assessment team noted that the description of process equipment in Section I is the basis for NRC inspections, but not formal enforcement until the licensee has gone through a formal facility change process which results in a new nuclear safety evaluation.

Besides evaluating the safety barriers and controls, the CSA teams verified the accuracy of the P&IDs developed in the Configuration Control program. This was accomplished by ensuring that engineered controls, identified in the earlier safety evaluations, were in place and operational and by ensuring that the engineered controls were identified on the P&IDs and were entered into the Preventative Maintenance (PM) program. Other aspects of the CSA program were the development of lists of equipment, drawings, procedures, forms, and criticality instrument loop sheets for each area. Areas or processes excluded from the area CSA document were also listed so that CSA boundaries were easily recognized.

The team noted that the CSAs did not contain a description of the accident scenarios used in the assessment as stipulated in the consensus standard guidance. The licensee's staff reported that they planned to develop accident scenarios at a later date for all processes described in the CSAs. Failure to have the description of accident scenarios in the CSA is a program weakness (70-1151/92-04-11).

The team found the CSA program to be a significant enhancement for the criticality safety program due to the consolidation of the area process descriptions and existing safety evaluations. CSA teams had identified some unresolved safety issues and had made recommendations for action. For example, evaluation of moderation-controlled areas was elevated to a high priority because of the perceived risk. However, no plan had been developed to resolve these recommendations and they were not being prioritized or tracked to completion (see Paragraph 2.f.(1) for further details).

The program is also interactive with the Configuration Control program. This is significant for improvement of P&IDs and the PM program. The CSA program is likewise significant for highlighting some weaknesses in the Nuclear Criticality Safety Evaluation

program (discussed in Paragraph 3.g). Even though, weaknesses were identified in the criticality safety assessments, the CSA program was viewed by the NRC team as a strength.

e. Data Packs

DPs were used by licensee management to collect information related to specific events and document the results of any investigation of the event. When an event occurred, it was reviewed for nuclear criticality safety significance by the Regulatory Affairs Manager. If deemed significant, a DP was established and the Manufacturing Manager appointed an investigation team to review the event. The team was typically charged with the responsibility to determine the probable causes, identify the restart actions, and recommend long-term corrective actions.

Periodically, the status of corrective actions was reviewed by the Criticality Safety Events committee. When the NRC team reviewed the DPs, it was noted that some of the documentation of these reviews and other documents were missing from the files. For example, the status of DP 92-10 was not known, and could not be resolved during the assessment. DP 92-10 concerned uranyl nitrate (UNH) in vent pipes which also contained ammonia fumes. This situation was similar to the experience of Siemens-Germany which was documented in NRC Information Notice 90-70, "Pump Explosion Involving Ammonium Nitrate," issued November 6, 1990. The licensee indicated that they had evaluated this problem but the evaluation was not in the files. This item has been identified as an inspector followup item (IFI) (70-[illegible]/92-04-12).

Even though some of the documentation was missing from files, the team determined that the DP program provides licensee management with a management tool to investigate events, to identify and take restart actions, and to identify other potential actions. This is a program strength.

f. Nuclear Criticality Safety Training

The team assessed the entrance training program for all employees and the criticality safety training provided to process engineers. There was no lesson plan available for the new employee training; however, the view graphs used by the trainer were available and were reviewed by the team. New employees were given training at the time of their employment but were not tested. Six months later, the employees were provided the same training and were tested at that time as part of the follow up training program. Thereafter, employees were provided work place training which focused on plant events and related corrective actions.
The team also reviewed view graphs used to train process engineers on the reporting requirements of NRC Bulletin No. 91-01. This training was more comprehensive than initial training or work

place training in that some nuclear criticality accidents were discussed with the engineers. The team noted however, that some control parameters discussed in the training were not technically correct. For example, the word "water" was used in place of the phrase "hydrogenous materials" when describing moderators and the phrase "non-interacting containers" was used for "sp[illegible]ed containers to allow neutron leakage." Some wording on criticality posting used in the training was not clear. For example, moderation controlled area signs excluded moderators but allowed dry UO_2 polypacks. The polypacks which were made from moderating materials were allowed without any explanation. In addition, limits were provided [illegible] specified low enrichment material, but not for higher [illegible]ents.

The NRC team talked to several operators and supervisors and, with one exception, found them to be quite conversant in the area of criticality safety as trained by the licensee.

Through document review and interviews with licensee personnel, the NRC team noted the following problems with respect to the nuclear criticality safety training program: 1) the licensee did not evaluate the entrance training given to new employees following initial training, 2) the licensee's training program lacked written objectives and written lesson plans, 3) the program lacked contents recommended in ANS-8.20, 4) the program did not provide for program evaluation, and 5) the training program was not performance based. Overall, the training program was considered to be a license renewal item (70-1151/92-04-13).

g. Nuclear Criticality Safety Evaluations (NCSEs)

(1) Implementing Procedure Review

Procedure RA-104, "Regulatory Affairs Review Requests," Rev. 6, dated March 3, 1992, was used for the evaluation of NCS for new processes or changes to existing processes. Through a review of the procedure the team determined that the program failed to identify: 1) who was to provide a request for an NCSE, 2) who had the responsibility for determining whether an NCSE was required or not, 3) who had the responsibility for reviewing and approving documents for limits and requirements established in NCSEs, 4) who had the responsibility for ensuring that limits were incorporated into documents, 5) how NCS staff was made aware of process characteristics necessary for performance of an NCSE, 6) implementing procedures for performing NCSEs, and 7) who had the responsibility for documenting, periodically reviewing and updating NCSEs.

Although RA-104 required the originator of the request to provide sufficient information to describe the proposed change, no guidance existed for submitting adequate technical support information. For example, no requirements existed to provide the necessary information for assessing and documenting accident scenarios. Documentation of the safety basis was lacking. Therefore, limits and controls were not clearly identified.

NCSEs were not documented with sufficient detail and clarity to facilitate independent review. Documentation associated with NCSEs was present in several files and was not readily accessible. A program for identifying and collecting pertinent documents had not been established. The quality of documentation hindered independent review of analyses.

Requirements had not been established to ensure appropriate documentation of each evaluation and independent review and to identify personnel responsible for documentation.

Criteria that ensured documentation of a comprehensive and formal safety analysis did not exist. Requirements had not been established to: 1) prepare a formal and comprehensive safety analysis, 2) provide guidance for preparation of a safety analysis to control format and content, and 3) update and revalidate the safety analysis and associated design basis documentation to ensure consistency with current process. The safety analysis methodology had not been formalized and described within a controlled document.

The team determined that requirements had not been established for identifying accident scenarios in the safety analysis, for providing technical support information to the NCS staff in the preparation and review of safety analyses, and documenting information in prepared safety documents. In addition, the team observed that technical support information used as a basis for safety was not formally documented.

(7) Regulatory Affairs Request for Approval

The team reviewed several randomly selected Nuclear Criticality Safety Evaluations (NCSEs) to determine content and the adequacy of the documentation of facility change approvals. NCSEs were used whenever the licensee desired to change plant equipment or processes. Regulatory Engineering staff used a four-part form, Form RA-104, "Regulatory Affairs Request for Approval," for documentation of facility change approvals.

During the review of the NCSEs, the NRC team noted that the RA-104 Forms were not being completed in their entirety. The forms were intended to document the safety evaluation, the pre-operational inspection, start up surveillance, and follow-up inspections of a facility change. None of the forms from the limited sampling of files were completed in their entirety. Sections 2, 3, and 4 of the forms that were filled out only contained initials and dates, but no indication of actions taken.

The team specifically reviewed Forms RA-104-1-749 dated January 21, 1991, and RA-104-1-754 dated August 15, 1991, for content. This review disclosed that the proposed changes were not fully described by Process Engineering; references to drawings were omitted, assessment of accident scenarios were not documented; independent reviews by a senior engineer were not documented; limits and controls for incorporation into operating procedures were not clearly specified; the bases for some limits were not given; and non-specific conditions such as "maintain spacing" or past "applicable limits" were stated on the forms. The team also noted that there was no tracking and followup system for action items identified during initiation of the facility change requests (see Paragraph 2.f for further details).

The NCSEs also lacked information with regard to reference drawings, assessment of accident scenarios, independent reviews and limits and controls. Specifically, Regulatory Affairs Review Request (facility change requests) did not contain sufficient information to substantiate the acceptability of the change nor had verification reviews of requirements specified in facility change requests always been performed These problems were identified as a program weakness (70-1151/92-04-14).

The team also reviewed other files picked at random. One such file was for the UNH tank farm to determine the safety basis of the tank farm sump. The team noted that a non-favorable slab thickness could be generated in the uranium nitrate tank farm sump if a uranium nitrate tank (7500 gallon tank) leaked or failed. The sump was about a 3 foot x 3 foot x 1 foot depression that was interconnected with a 15 inch curbed area located underneath the tanks. The total of about 27 inches formed an unsafe slab in the sump area. The team requested the licensee to provide a documented criticality safety evaluation to show that the sump would be safe in the event of a tank leak. Neither the team nor the Regulatory Engineering (RE) staff could locate the NCSE. The failure to maintain a NSCE for the UNH tank farm sump was identified as an unresolved item (70-1151/92-04-15).

(2) KENO

The team determined, through a review of licensee records, that instructions to the NCS staff on code validation was incomplete. The licensee lacked a formal policy for validation guidance. Despite this administrative deficiency, the licensee had documented the results of its validation calculations in a report.

Members of the assessment team participated in a discussion with nuclear criticality engineers concerning review of computer input files and calculational results. This review indicated that validation work had been performed and that auditable documentation for validation of KENO Va existed.

The team looked at selected KENO calculations used in some NCSEs. The KENO analysts had documented the assumptions which were used in making the KENO calculations. This effort, while only a small portion of a NCSE, was better controlled and could be given an independent review by a senior engineer. The senior reviewer for several KENO calculations had written a paragraph on the scope of his review. This small portion of the NCSE program was considered to be adequate.

The team reviewed the validation reports for the KENO code and the solid angle (SA) method. The validation reports were considered to be adequate for low-enriched uranium solutions and homogeneous or heterogeneous uranium oxide systems.

h. Nuclear Criticality Safety Program Implementation

During the examination of the plant and review of the licensee's nuclear criticality safety program documents the team made the following observations.

(1) UNH Sample Analyses

Through discussions with operators and area supervisors, the team determined that UNH transfers were being made from favorable geometry containers or equipment to non-favorable geometry containers (e.g., tanks) on the basis of chemistry analyses results that were transmitted orally by telephone. No attempt was being made to verify the sample results or sample identification. The team noted that since all transfers were being made through calibrated in-line gamma monitors, the safety of the transfers did not appear to be compromised. However, the team expressed concern that, because there was no verification of analytical results, chemical analyses were being used as a weak administrative]

control. Failure to verify sample results or sample identification was identified as a nuclear criticality safety program weakness (70-1151/92-04-16).

(2) Use of Neutron Absorbers

The team reviewed the licensee's records pertaining to the use of borated glass Raschig rings as neutron absorbers in non-favorable-geometry tanks. The records indicated that the boron content of the Raschig rings was analyzed annually, as required, between July 1988 and July 1991. Results of the July 1992 analyses were not yet available during this assessment. In addition, the licensee inspected the tanks annually to ensure that significant settling had not occurred.

However, during examination of one of the Raschig ring filled tanks, the team noted that the Raschig rings were located about nine inches below the top of the lower end of the manhole cover attachment ring and the top of the tank was about 9 inches above this point. Since the tank over flow pipe extended up over the top of the tank, filling of the tank with liquid to the overflow pipe would generate an unfavorable slab thickness of about 18 inches. Licensee representatives stated that, on the basis of an evaluation to be conducted, the tanks would either be filled with Raschig rings or the overflow pipe would be moved to coincide with the top surface of the Raschig rings.

This failure to consider the upset condition of a tank overflow is considered to be an unresolved item (70-1151/92-04-17).

(3) Installation of Backflow Preventers

During a review of piping and instrumentation diagrams (P&IDs) for each of the special nuclear material (SNM) processing systems the team noted that backflow preventers had not been installed on all sources of deionized water (e.g., IFBA scrap dissolver, WRD scrap dissolvers) to the uranium nitrate tanks. These devices should be installed where necessary to preclude significant changes to the acidity (pH) within the tanks. Increasing the pH of liquid in the tanks could cause precipitation that could form an unsafe concentration of uranium in the bottom of the tanks.

In addition, the NRC team noted that several process water systems were not equipped with backflow preventers to preclude contamination of non-process (potable) water systems within the plant.

Licensee representatives stated that backflow preventers would be installed where required. This has been identified as an area for improvement.

(4) Uranium Measurements

During examination of the plant, the team observed numerous green signs that stated "No Uranium." When questioned, licensee representatives indicated that these signs were placed on containers and equipment for inventory purposes. A "measurement" was performed with a geiger counter to determine if these containers held large quantities of SNM. No attempt was made to quantify the SNM in any of these containers. On the basis of this "measurement" up to 15 containers located in the waste processing area of the plant were stacked in an unsafe array pending completion of the SNM inventory. No actions were taken subsequent to the end of the inventory to further quantify the otherwise unmeasured quantity of uranium present in these containers or to process the containers. Without quantification of the amount of uranium in these containers, the team determined that this practice was less than adequate. This was identified as an area for improvement.

4. Review of Operations

The team assessed the criticality safety program against the criteria and guidance specified in Sections 2.2, 2.3, and 2.4 of the approved license application for License Number SNM-1107, the consensus standards contained in the ANSI N8 series, Regulatory Guides and NUREGs, the BTP entitled, "Requirements for Operation for Fuel Cycle Facilities," dated March 21, 1989, and accepted industry practices. The team also made numerous tours of the licensee's plant during this assessment to observe various operational and maintenance activities in progress. These tours were performed to assure that; (1) the plant was being operated safely; (2) the licensee's management control system was effectively used to ensure continued safe operation; and, (3) specific operations were conducted in accordance with good industry practice. The team also interviewed and observed operators to determine if specific operations were performed in accordance with approved procedures and posted requirements.

a. Posting

During examination of internal and external plant areas, the team noted that several nuclear criticality safety instructions on signs appeared to be inappropriate, contradictory or unclear. In other cases, the signs were non-existent or improperly located. For example, a sign at the entrance to the UO_2 powder blending room stated that only UO_2 powder was allowed in the room. Inside the powder blending room, a sign on a storage rack authorized the

storage of containers of pellets. It was also observed that signs on several work stations and/or hoods were posted on the back or sides and as a result, were not available to the workers for rereference when required. In addition, one work station, the Reject Rod Unloading Station, was in use and was not posted with nuclear criticality safety signs. The problem noted with the consistency and clarity of the posting was identified as a program weakness (70-1151/92-04-18).

b. Special Nuclear Material Exclusion Zones

The team observed that the licensee used yellow painted areas on the floor of the plant to identify special nuclear material exclusion zones for nuclear criticality safety purposes. The size of the exclusion zones was established on the basis of criticality safety analyses performed by the surface density technique. However, application and use of these exclusion zones was not consistent throughout the plant. For example, in the conversion area of the plant, there was a work table used for the repair and cleaning of pumps and other pieces of equipment. Adjacent to this table was a vertical safe geometry slab tank. The exclusion zone for this slab tank extended under the table. However, the criticality safety sign posted on the table did not restrict the placement of special nuclear material in the exclusion area on the top of the table or on a shelf located about six inches off the floor.

When questioned about this situation, licensee representatives stated that the operators were only restricted from placing SNM in the yellow area on the floor. SNM could be placed anywhere on the table. In addition, the team noted that signs posted in the conversion areas of the plant indicated that no SNM was to be placed in the yellow painted areas; in the adjacent scrap recovery area, SNM was to be placed in black painted areas located inside the yellow painted areas; and in the pellet fabrication area of the plant, unmeasured contaminated trash and other materials were to be stored only in the yellow painted areas.

Inconsistent application and use of yellow painted exclusion zones was identified as a weakness in the licensee's criticality safety program (70-1151/92-04-19).

c. Control of Non-Favorable Geometry Containers

During examination of chemical areas of the plant (i.e. waste handling, conversion, and pelletizing areas), the team observed that controls for use of non-favorable geometry containers (55 gallon drums, combustible waste receptacles, trash carts, etc.) were not in accordance with Section 2.3.1.10 of the approved license application of license number SNM-1107. Use of these containers was generically approved by the licensee in Regulatory Affairs Procedure No. RA-301-1, Rev. 8, "Nuclear Criticality

Control Criteria." This generic approval did not provide adequate evaluation of accident scenarios as required by Section 2.3.1.10 of their license. Many of these containers were open and unattended and controlled only through signs. Because of the number of containers observed, especially in wet areas of the plant, the team expressed concern that one failure (i.e., a pipe break or leak) could potentially cause a nuclear safety incident.

Another example of the lack of control over the use of non-favorable geometry containers dealt with the non-favorable geometry containers attached to processing equipment (i.e., hoods). Unmeasured quantities of special nuclear material were being placed into these containers in accordance with approved procedures. Much of this material being placed into these containers had the potential to contain substantial quantities of uranium and were not measured until the containers were full. Many of the full containers were observed to contain between 200 and 800 grams of uranium.

The team's concern about the control of non-favorable geometry containers was discussed with the licensee's Regulatory Affairs criticality safety personnel during the assessment and was identified as a significant weakness in the licensee's criticality safety program at the exit interview (70-1151/92-04-20).

Subsequent to the assessment, on September 2, 1992, licensee representatives provided Region II with a corrective action plan aimed at minimizing the number and controlling the use of non-favorable geometry containers in the plant. Initial actions on this plan were completed by September 4, 1992.

d. Moderation Control

1. Implementation of Moderation Controls

The team examined all areas of the plant to review the licensee's implementation of moderation controls. Moderating materials (water, plastics, etc.) were being adequately controlled in those areas of the plant where bulk quantities of uranium oxide powder were handled (IDR bulk handling areas and the ADU area moderation controlled bulk blending room). However, appropriate controls on moderating materials were not imposed at other specifically identified work or storage stations. For example, at the Rotary Blending Station used to blend recycle U_3O_8 powder and the Fuel Rod Tray Storage Racks which were identified as moderation controlled areas, city water lines traversed these work or storage stations overhead. An inadvertent water line break would violate the moderation control requirements specified for these areas.

The team determined that the licensee maintained adequate control of moderating materials in areas of the plant where bulk quantities of SNM were handled but needed to review specific areas and work stations. The review of these work stations has been identified as an area for improvement.

2. Moisture Determinations

The assessment examined the licensee's control program for operating bulk handling system in compliance with nuclear criticality safety moderation control. A review of moisture control in UO_2 powder was conducted with respect to the following current practices:

(1) Sampling plan for UO_2 powder in Ammonium Diuranate (ADU) and Integrated Dry Route (IDR) conversion processes.

(2) Two different methods for controlling moisture limits (% H_2O and Oxygen/Uranium ratio analyses) in Analytical Services Laboratory.

(3) Application of moisture seal tape for interim storage before bulk blending.

(4) Moisture result verification before blending.

In addition, various procedures pertaining to moderation control were reviewed:

(1) RA-303, "Control of Moderating Materials for Nuclear Criticality Safety," Rev. 1, effective date July 10, 1989

(2) COP-814700, "Bulk Handling/Moderation Control," Rev. 12, issue date May 21, 1992

(3) MAP-KN004, "Check Hopper Switching, Sampling, and Discharging," Rev. 5, issue date April 4, 1991

(4) Supplementary Operating Instructions (SOIs) No. C-1039, Rev. B, effective date July 17, 1992

Major changes had been incorporated in the latest revision of Procedure COP-814700, but these changes did not reflect the actual operating practices. In addition, a number of inconsistencies on moisture samples, limits, and determination methods exist between the controlling Regulatory Affairs procedure, the SOI, and the operating ADU and IDR procedures. It was determined that the licensee did not follow their regulatory intent in procedure control, and

allowed the extensive use of SOI's with contradictory operating procedures. In order to correct these deficiencies, the licensee stated they will revise all related procedures to ensure consistency and uniformity in the program.

e. Special Nuclear Material Storage

During tours of the plant throughout the assessment, the NRC team identified several incidents of improper storage of special nuclear material. For example, 9.5 inch diameter polypacks containing 3.8 percent enriched uranium "hardscrap" were stored on a rack in the Rotary Blender Area which was limited to 3.7 percent enriched "hardscrap." The team observed several instances of failure to maintain a 12 inch spacing between SNM on storage racks and in an array of drums containing SNM standards. A storage rack in the fuel rod loading area contained trays of fuel pellets and was limited to a 4 inch slab. Several instances of the slab thickness exceeding 4 inches (4.5 inches or more) were observed by the team.

These observations indicated the existence of a program weakness with regard to the establishment of engineered controls, inconsistent terminology of postings and failure of personnel to follow criticality safety postings. Lack of appropriate engineering controls or the establishment of appropriate engineering controls for the storage of SNM was considered to be a program weakness (70-1151/92-04-21).

f. Use of Health Physics Resources for Operational Uranium Analyses

During examination of several SNM processing procedures, the team noted that procedural steps required submission of various uranium-bearing solutions to Regulatory Affairs (Health Physics) for analysis. Through discussions with Regulatory Affairs personnel, the team determined that these samples were to be used as an overcheck on the Chemistry Laboratory results. However, the team noted that several procedures (e.g. COP-836015, Rev. 0, dated August 6, 1992, and COP-836015, Rev. 0, dated August 6, 1992), required operations personnel to send samples for analyses of U^{235}/liter only to Regulatory Operations and not to the chemistry laboratory. The Chemistry Laboratory was required to analyze these samples only for percent free nitric acid. The team questioned the use of Regulatory Operations personnel for process control purposes in that this was contrary to standard industry practice of separation and independence of Health Physics personnel from the pressures of plant operations. This was identified as a weakness in the licensee's management control practices (70-1151/92-04-22).

5. Material Control and Accountability

a. Plan and Procedures

The NRC team reviewed selected procedures from the Safeguards Section (RA-500) of the Regulatory Affairs Procedures Manual. Procedure RA-503, "Calculation of Total Uranium Nuclide Activity Level for Purposes of Transaction Documentation," Rev. 4, effective date May 14, 1991, was found to be clearly written, properly approved by licensee management, and contained sufficient details. The program for reporting radionuclide activity levels in uranium material processed at Columbia plant was fully implemented and maintained under a computerized system by the Nuclear Material Management (NMM), Waste Recovery and Disposal (WR&D), and Shipping/Receiving organizations.

Procedure RA-502 pertaining to calculations of isotopic mass distribution was deleted and consolidated in Regulatory Affairs Procedure RA-503 and Safeguards Procedure NMM-CP-410. A cross-check with NMM safeguards procedure was conducted and found to be acceptable. Both procedures RA-500 and RA-501 pertaining to IAEA safeguards activities were deleted from the Manual. Justification for procedure deletions should have been reported in Forms RA-100-2 and RA-100-3; however, no hard copy had been maintained by the licensee. This was determined to be an area for improvement in the licensee's program of procedure control.

No significant safeguards issues were identified in the review of this program.

b. Low Level Waste

The licensee had in place an adequate program for handling low level waste material through the incinerator system. Procedure COP-830210, "Incinerator Operation," and SOI-WRD-014 were found to be adequate in terms of both scope and level of detail. The Q2 Canberra non-destructive assay system was well controlled and utilized by the licensee.

c. Laboratory Analysis and Sampling Systems

The licensee did not have a formal and current sampling program and replicate sampling plan for criticality safety. Regulatory Affairs is in the process of developing and formalizing a sampling system which will be based on the already implemented safeguards program. This issue can be tracked as IFI (70-1151/92-04-23).

6. Maintenance Programs

The team examined the licensee's implementation of corrective and preventive maintenance programs against the guidance provided in Branch Technical Positions, "Management Controls/Quality Assurance for Fuel

Cycle Facilities" and "Requirements for Operations for Fuel Cycle Facilities," dated March 21, 1989, Section 2.2.1.1 of the license and as described in the following Maintenance and Calibration Operating Procedures:

- MCP-108000, "Preventive Maintenance," Rev. 1, dated November 26, 1991
- MCP-108103, "Work Order Handling," Rev. 1, Undated
- MCP-108105, "Equipment Setup," Rev. 0, dated December 11, 1991
- MCP-108106, "Equipment Failure and Maintenance Analysis," Rev. 0, dated November 26, 1991

On the basis of this examination, the team determined that programmatic elements and requirements were in place to provide reasonable assurance that maintenance activities at the site will be performed in a timely and satisfactory manner. However, the following weaknesses in implementation of the maintenance program were identified.

a. Applicability of Maintenance Program Documents

The team determined through discussions with licensee representatives that the Maintenance and Calibration Operating Procedures discussed previously applied to the plant site, plant buildings, mechanical areas equipment, and ADU conversion area equipment. These procedures did not apply to IDR area equipment. The IDR area equipment maintenance activities were covered by an independent maintenance program which, although generally successful, had not been formally documented. This was identified as a license renewal item (70-1151/92-04-24).

b. MAPCON Computer Program

The licensee had developed a computer program designed as an integrated relational database system used to collect and report maintenance costs, assist in scheduling maintenance activities, to order and track equipment parts and components, etc. This computer program had been designated as "MAPCON," Maintenance Planning and Control. This system appeared to be comprehensive and applicable to all areas of the plant except the IDR area. The team noted that the licensee initiated incorporation of mechanical maintenance activities for the IDR area into the MAPCON system. This action was expected to be completed by October 1, 1992. Electrical maintenance activities in the IDR area were completed but had not been placed into a formal maintenance program. Through a review of available computer program documentation, the team determined that:

(1) The computer program did not provide for the specific identification of safety related items or equipment on the work order listing.

(2) There was no independent overcheck method established to ensure closeout of safety related work orders.

(3) Procedure MCP-108000 allows for the automatic premature elimination of preventive maintenance work orders from the computer system if the work order completion was delayed three times and the delay duration was in excess of one-half the interval between the established frequencies. Not only was that work order deleted from the system but the need for the preventive maintenance on that piece of equipment was also eliminated.

These problems were identified as license renewal items (70-1151/92-04-25).

c. Safety Related Interlocks

Procedure RA-108, "Safety Significant Interlocks," Rev. 0, dated April 1, 1992, required identification of safety interlocks and assignment of responsibilities for functional testing. Draft Procedure RA-109 required documentation of functional testing and review of functional test records by Regulatory Engineering. The development of functional test requirements was governed by the progress of developing and implementing RA-109. Since RA-109 had not yet been implemented, the team determined that this issue was an IFI (70-1151/92-04-26).

The licensee had identified all safety significant interlocks and controls specified in the NRC license in a single document, RA-108, "Safety Significant Interlocks," Rev. 0, dated April 1, 1992. A total of 48 interlocks were identified in this document. The NRC team verified that all identified safety related interlocks except for those associated with the IDR areas of the plant had been placed into the preventive maintenance program described above. However, the inspector also verified that the interlocks associated with the IDR area had been placed into an independent preventive maintenance program developed and administered by IDR personnel.

Through discussion with licensee representatives, the team determined that approximately 300 additional interlocks and controls, important to safety, had been identified but had not, as yet, been placed into any preventive maintenance program. For example, there was no evidence that the interlocks indicating low nitrogen flow or high pressure inside the check hoppers located at the end of the UF_6 to UO_2 conversion kilns were placed into a preventive maintenance program. These controls are needed to

prevent moderator (water) from entering the check hopper. Moderated powder could be inadvertently transferred to a non-favorable geometry blender. This was identified as a license renewal item (70-1151/92-04-27).

7. Radiation Protection Program

a. Program Overview

The NRC assessment team reviewed the license, documents referenced in the license, and previous NRC inspection reports to determine the scope of the licensee's radiation protection program, and prior areas of concern. Requirements and commitments for radiation protection are specified in Sections 2 and 3 of the license application, and 10 CFR Part 20.

b. Training

In order to assess general employee radiation safety training, the assessment team reviewed training materials and documentation, met with individuals responsible for conducting radiation safety training, and observed and discussed radiation safety practices with plant workers. According to licensee representatives and a review of selected records, all plant workers, contractors, and long term visitors had been given general radiation safety training initially and every two years thereafter to meet the requirements of Sections 3.1.5.1 and 3.1.5.5 of the license and 10 CFR 19.12. This training included a video, coverage of a training manual, and instructions in accordance with Regulatory Guide (Reg Guide) 8.13. To augment general radiation safety training, new plant workers were given a supervisor's orientation which included detailed tours of plant areas and explanation of safety rules in effect. The assessment team reviewed the training manual and found it to be well written and comprehensive. General safety training was adequate and met the requirements of the license and 10 CFR 19.12.

The general radiation safety training was followed by a multiple choice examination as a means of determining successful retention of training material. The assessment team noted that there was no examination or question bank, and that only one version of the test had been given to all employees. Development of an examination or question bank tied to radiation safety learning objectives was identified as an area for improvement.

The assessment team reviewed specific training for health physics technicians and found that it consisted of a training qualification checklist involving self-study and sign-off for specified documents and materials. The use of self-study in the health physics technician training was determined to be an IFI (70-1151/92-04-28).

c. ALARA Policy and Implementation

The NRC team discussed ALARA program implementation with licensee representatives and reviewed documentation of efforts aimed at reducing radiation exposure. The licensee had developed an active ALARA program which was addressed in management directives and Regulatory Affairs procedures RA-219-A and B. The team found strong management support for ALARA as evidenced by establishing teams directed at reducing hazards such as airborne radioactivity in the workplace.

The team also reviewed activities of one of the sub-committees of the plant "Safety Committee," the Airborne Reduction Team (ART), and noted a good focus on its mission. The team also determined that ALARA reports, which were required to be compiled semi-annually, were detailed and contained excellent trending, statistical analyses, and graphical representation of parameters subject to ALARA provisions. The team found the ALARA reports and the involvement of the ART to be a program strength.

The team reviewed implementation of ALARA considerations as they related to work performed under radiation work permits. Procedure RA-207, "Radiation Work Permits," called for the evaluation of ALARA with the completion of pre- and post-job ALARA review checklists. Records reviewed by the team indicated that such reviews were not consistently documented. The completion and documentation of ALARA reviews associated with radiation work permits was identified as a program weakness (70-1151/92-04-29).

d. External Exposure Monitoring

The NRC team reviewed personnel dosimetry records and discussed external exposure monitoring with licensee representatives to determine whether such activities had been conducted in accordance with sections 2.2.3.1 of the license application, and whether external exposures had been maintained below the limits specified in 10 CFR 20.101. The licensee's external exposure monitoring program had been proceduralized in RA-206,"Personnel Dosimetry Program."

All personnel working within the controlled areas were issued personal thermoluminescent dosimeters (TLDs) which were exchanged quarterly for males and monthly for females. This difference in exchange frequency was due to a licensee policy to better control exposures to fertile females. At the employees' request, dosimetry was also provided to those not working or frequenting the controlled areas. The team reviewed a number of personnel files and determined that previous exposure histories were on file for personnel being monitored in accordance with 10 CFR 20.102. In addition, annual summary reports of exposures, and employee termination exposure reports had been completed as required by 10 CFR 20.407 and 20.408.

In response to a violation cited by the NRC in 1990, the licensee had begun monitoring extremity exposures for employees in the pellet manufacturing areas and the quality control pellet inspection areas. Following a trial study of extremity exposures using TLDs imbedded in gloves, the licensee determined that extremities could be adequately monitored using ring TLDs and a scaling factor for each individual based on the study to determine the thumb exposure. The team reviewed the documentation of this evaluation and determined that the licensee's approach was reasonable.

The team reviewed external dosimetry monitoring results and determined that exposures had been maintained below the limits specified in 10 CFR 20.101. One elevated quarterly whole body exposure of 1.644 Rem during the second quarter 1992, had been investigated as an unusual incident and was determined to have been caused by a spill of uranyl nitrate on the individual's badge. Despite the poor dosimetry control practices following this event, the licensee's investigation and conclusions were reasonable. The licensee's lost badge procedures were also determined to be adequate. The procedures required the assignment of compensatory doses to individuals whose badges had been lost based upon department averages. The team concluded that the licensee's external exposure monitoring program was appropriate and well documented. In general, employee external exposures correlated well with area dose rate survey results.

Routine beta-gamma survey results were reviewed by the team to determine the adequacy of these surveys. During the assessment, it was determined that the general area dose rate in the storage area for finished fuel assemblies, referred to as the "forest," measured up to 8 millirem per hour (mR/h). This dose rate was significantly higher than those found in other areas of the licensee's facility. It was noted that the licensee's entire production facility was posted as a Radiation Area pursuant to 10 CFR 20.203 despite the fact that most areas typically measured only a few tenths mR/h. Prior to the end of the assessment, the licensee had developed an informational posting and placed the posting at all entrances to the "forest." Development of postings for those areas within the facility with general area dose rates that were significantly higher than the dose rates adjacent areas was identified as an area for improvement.

e. Surveys and Contamination Control

The NRC team toured processing facilities, observed plant operations, accompanied technicians performing surveys, and reviewed procedures and historical survey records to evaluate the adequacy of the licensee's survey and contamination control program. The requirements for the licensee's program for contamination control and surveys are specified in Sections 2 and 3 of the license application. These requirements, and how they

are intended to be implemented, were proceduralized in Regulatory Affairs and Regulatory Operations procedures. In addition, contamination control practices and responsibilities were an integral part of the conduct of operations, engineering design, and maintenance activities.

During examination of the plant, the team observed several questionable contamination control practices. For example, at pellet presses Nos. 2 and 4, UO_2 pellets were being handled in a manner that allowed UO_2 powder to fall on the floor. Measurements made by the licensee's Health Physics group, at the request of the NRC team, indicated the presence of about 320,000 disintegrations per minute alpha per one hundred square centimeters (dpm alpha/ 100 cm^2) direct and 32,000 dpm alpha/100 cm^2 removable contamination on the floor. In addition, the left arms of two operators were covered with uranium oxide powder in the space between the operators' coverall sleeves and the operators' gloves. No attempt was made by the operators to tape the gloves to the coverall sleeve. One of the operators wore a watch which appeared to be contaminated.

The NRC team noted that "surface" beta contamination surveys were not a feature of the licensee's routine survey program. However, routine beta-gamma "area" surveys were performed throughout process areas of the facility. Records of these surveys showed that only five locations were routinely surveyed in the IFBA facility. The team questioned whether this number of survey locations could properly characterize the area radiation levels in a facility the size of the IFBA extension. It was also noted that routine beta-gamma area surveys had not been performed in the packaged radioactive waste storage area or in the water glass treatment area. This was identified as an area for improvement.

During the assessment of various licensee activities, several individual problems were noted which related either directly, or indirectly to the adequacy of surveys or contamination control practices. When these concerns were considered in the aggregate, the team identified them together as a programmatic weakness in the area of surveys and contamination control. The following paragraphs identify the individual concerns which contributed to this programmatic weakness.

(1) Contamination Prevention and Control

The team observed engineering controls to be a noteworthy feature of most processing systems. In general, containment and ventilation systems were well designed and maintained. Operations personnel were assigned responsibilities for maintaining their processing areas clean and the team observed housekeeping practices to be generally adequate.

In order to prevent the spread of contamination from chemical process areas, the licensee controlled access and egress from these areas by the use of step-off pads and change rooms, and had instituted contamination control procedures for personnel and materials leaving the controlled areas. Normal access/egress points to the controlled areas were noted to have one or more calibrated and operable alpha survey instruments for personnel contamination monitoring. The main step-off pad access had an installed television surveillance capability. However, licensee representatives stated that the system was neither maintained nor used routinely.

Personnel whose work locations were within the controlled area used change rooms for access and egress. NRC team members toured the change rooms and noted the general layouts to be good. Personnel exiting the change rooms typically used acceptable survey techniques during personal surveys. Records of weekly overcheck surveys performed by health physics of personnel leaving the controlled areas were reviewed by the team and were determined to have been an indicator of the effectiveness of personnel monitoring prior to leaving the controlled areas.

On August 18, 1992, the team toured the UF_6 cylinder hydrostatic test facility which is outside of the radiological controlled area. The team noted that no access controls existed for this facility even though, according to the workers, the facility floor had been identified by health physics to be contaminated. In reviewing the records of surveys in this facility, it was noted that contamination had been identified within this area on several occasions in the past from the spillage of liquids used to test the cylinders. The records also indicated that on July 23 and 24, 1992, when contamination above action levels specified in the license was identified in this area, prompt decontamination within three working shifts had not been achieved as specified in Section 3.2.5.3 of the license. Further, following the July 24 survey which still showed the facility was contaminated above action levels, the facility was not resurveyed again until July 28, 1992. The team was also concerned that the health physics group did not appear to have been involved in evaluating the conditions leading to the recurring contamination problems within this area. These observations, related to the cylinder hydrostatic test facility, were considered to be a component of the programmatic weakness in the area of surveys and contamination control.

The team reviewed records of radiation work permits (RWPs) for 1992 to determine the adequacy of health physics coverage provided for work or maintenance activities not covered by procedure. The provisions for radiation work permits were specified in Section 3.1.8.1 of the license and in procedure RA-207. The licensee apparently reduced the need for radiation work permits significantly by proceduralizing recurring radiation work activities. At the time of the assessment, 18 RWPs had been issued in 1992, some of which were still in effect.

The team determined that responsibilities for reviewing and issuing RWPs were appropriate. Designated work precautions and worker acknowledgements were adequate. However, the records indicated that health physics coverage had not been provided in all cases or documented as specified in the RWP. Specifically, the team noted four completed RWPs for which no documented health physics coverage had been provided initially, or at the completion of the work as specified in the RWP (01,14,17,18). Another RWP specified special surveys of equipment; however, no such surveys had been performed (05). Two of the RWPs, which had been in effect essentially for all of 1992, had not had any health physics coverage provided as specified in the RWP (02,11). The failure to provide adequate health physics coverage for radiation work permit activities was identified as a component of the programmatic weakness in the area of surveys and contamination control.

Procedure RO-05-055, "Surveillance of Non-routine Operations" was used to provide documentation of coverage of radiation work permit activities. The team reviewed this procedure and selected completed copies of the surveillance forms. It was noted that the airborne monitoring aspects of the coverage was emphasized and that the procedure did not specify the use of survey equipment or the performance of contamination surveys. Few of the completed surveillances reviewed contained any information concerning contamination surveys. Providing more contamination surveys of non-routine operations was identified as an area for improvement.

The NRC team also reviewed the contamination control and prevention practices used in the health physics laboratory. Each day, approximately 20 chemical process samples of uranyl nitrate were counted in the laboratory in instrumentation located within feet of the licensee's instruments which were used for counting air and contamination samples. Located in an adjoining room was the low level counter which was used for counting environmental air samples. Through discussions with licensee representative the team determined that several spills had

NFG	Non-favorable Geometry
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NIOSH	National Institute of Occupational Safety and Health
NMM	Nuclear Materials Management
NMSS	Office of Nuclear Materials Safety & Safeguards - NRC
NRC	Nuclear Regulatory Commission
OSA	Operational Safety Assessment
OSHA	Occupational Safety and Health Administration
PC	Personal Computer
PHA	Process Hazards Analysis
P&ID	Piping and Instrument Drawings
PIF	Process Information Form
PIP	Performance Improvement Program
PM	Preventive Maintenance
QA	Quality Assurance
QC	Quality Control
RA	Regulatory Affairs
RCC	Regulatory Compliance Committee
RE	Regulatory Engineering
RO	Regulatory Operations
RWP	Radiation Work Permit
SA	Solid Angle
SAG	Safety Action Group
SARA	Superfund Amendments Reauthorization Act of 1986
SCBA	Self-contained Breathing Apparatus
SEP	Site Emergency Plan
SGTR	Division of Safeguards and Transportation
SNM	Special Nuclear Material
SOI	Supplemental Operating Instruction
uCi/ml	MicroCuries per milliliter
ug/l	Micrograms per liter
UNH	Uranyl Nitrate
URI	Unresolved Item
WR&D	Waste Recovery and Disposal

occurred in the Health Physics lab which necessitated shutdown of the lab for decontamination. The team concluded that handling process samples of uranium in a health physics and low-level counting area was a poor practice. This observation was considered to be a component of the programmatic weakness in the area of surveys and contamination control.

(2) Personnel Contamination Control Practices

During tours of the chemical process areas, members of the assessment team observed instances where personnel were not implementing good contamination control practices. As noted in Paragraph 7.e. above, on one occasion adequate use of protective clothing was not made in the pellet press area. An operator was observed in this area handling uranium pellets without protective clothing covering his wrists which appeared to be heavily contaminated. (This individual showered before a survey could be performed).

In another instance, the team observed a filter bag change at the Conversion Area ADU Drier. In this case, the operators broke into a contaminated system (the filterbag holder) while wearing respirators to protect them from airborne activity. However, no apparent contamination control zone was established around the drier system. Also, the operators left the area several times to obtain wet rags or tools and no contamination surveys were conducted prior to leaving the work area. In addition, preplanning for this work was inadequate since the operators had to leave the work area several times to obtain items that should have been available in the work area.

On yet another occasion, a team member noted that a fork lift was operated in succession by two operators. The first operator was wearing contaminated gloves while the second operator had no gloves. These instances of poor personnel contamination control practices were identified as a component of the programmatic weakness in the area of surveys and contamination control.

(3) Control of Materials and Equipment Upon Release from Controlled Areas

The team reviewed the licensee's control of material and equipment removed from the radiologically controlled areas to ensure that proper measures were being implemented to survey such material. Procedures in effect governing these controls included RA-201, "Contamination Control," and RO 02-004, "Abandonment or Disposition of Material or

Equipment." These procedures required monitoring of all potentially contaminated items to be removed from the controlled areas.

While observing licensee activities during the assessment, team members noted instances where potentially contaminated materials were not being routinely surveyed prior to being removed from controlled areas. One example involved nylon bags containing used respirators routinely being removed from the controlled area to the respirator cleaning and testing trailer located outside of the controlled area. Another example involved some 20-30 drums of used protective clothing and laundry which were removed from the controlled areas each day to be sent off-site for cleaning. These drums were surveyed for contamination and assayed for U-235 before being shipped from the facility. However, they were not being surveyed for surface contamination before being transferred from the change rooms and placed in an uncontrolled hallway outside of the laundry room. The only contamination surveys conducted were those performed in the hallway prior to loading for shipment. A further concern was that the hallway and exit door to the loading dock, where the surveys were being performed, was also the receiving area for food and supplies for the licensee's kitchen and cafeteria. Failure to properly control and survey certain materials prior to removal from controlled areas was identified as a component of the programmatic weakness in the area of surveys and contamination control.

The NRC team also reviewed records of surveys performed as specified by RO 02-004 of equipment and scrap material which had been surveyed for release to unrestricted areas. It was noted that these surveys had been properly performed and documented on attachment A of the procedure. However, a procedural inconsistency was noted in the approvals needed for release of these materials. In one section, the procedure required signature approval by the Managers of Regulatory Operations and Regulatory Affairs for potentially contaminated items to be released for unrestricted use. Another section of the procedure addressed items which had been decontaminated using techniques such as liquid honing. For these items, the procedure only specified surveys by Regulatory Operations technicians and was silent on the requirement of management approvals. The team noted that these items were, at times, not successfully decontaminated below release limits and were withheld from release. In addition, management signature blocks on forms that cleared successfully decontaminated materials for release were frequently left blank, indicating no management approval prior to release. The team determined that the consistent

application of a management approval mechanism for materials and equipment released for unrestricted use was an area for improvement.

(4) Adequacy of Contamination Surveys

The assessment team reviewed routine survey results performed throughout the licensee's facility, and observed technicians performing surveys to determine the adequacy of techniques, frequencies, and instrumentation utilized. Routine contamination surveys had been performed in accordance with Section 3.2.5.1 of the license application.

Procedure RO 02-008, "Surveys of Incoming Shipments of Radioactive Material" required that certain shipments, including UF_6 cylinders and overpacks, be surveyed for removable alpha contamination within a specified time frame following receipt. The team reviewed a representative sample of these surveys and noted that, on several occasions, the records indicated that alpha surveys were not performed of incoming shipments of UF_6 cylinders or overpacks because of rain or wet conditions. No effort had been made in these cases to survey the shipments after they were dry. Additionally, the procedure did not address wet conditions. The licensee's failure to perform alpha contamination surveys on all incoming shipments of UF_6 cylinders or overpacks was identified as a component of the programmatic weakness in the area of surveys and contamination control.

The team did note that the licensee was performing a large number of routine surveys at the frequencies specified in the license. A review of instrument calibration records was performed and no concerns were noted. Records of surveys were generally complete. However, the team also noted that, in many survey applications, the technicians were recording the result as "background" without indicating what background levels were with the instruments used.

The team raised concerns over the performance and frequency of contamination surveys of eating and drinking areas. The cafeteria area had been surveyed monthly and was designated as an uncontrolled area. However, as noted in Paragraph 7.e.(3) above, the kitchen shares a common shipping area with the laundry facility. Surveys of the kitchen were not denoted on the monthly records of cafeteria surveys. The team also found that water fountains in the chemical process facility were not routinely surveyed. Reg Guide 8.24, "Health Physics Surveys During Enriched Uranium Processing and Fuel Fabrication," recommends daily contamination surveys of lunch rooms, cafeterias, snack bars

and vending areas. The licensee's lack of contamination surveys of water fountains and the kitchen area, and the inappropriate frequency of surveys of the cafeteria area was identified as a component of the programmatic weakness in the area of surveys and contamination control.

(5) Conclusions

During tours of the facility, various problems were noted in the area of surveys and contamination control. The problems identified as a result include the following:

- Adequate contamination control had not been applied to the UF_6 cylinder hydrostatic test facility.
- Adequate health physics coverage was not provided for work performed under RWPs.
- Several instances of workers utilizing poor personnel contamination control practices were observed.
- Potentially contaminated materials were not adequately controlled and surveyed prior to being removed from radiologically controlled areas.
- Contamination surveys of incoming shipments of radioactive material had not always been performed as specified in procedures.
- Adequate surveys were not performed of food preparation, eating, and drinking areas.
- Process samples of uranium were routinely handled in low-level counting areas.

As indicated above, based on several observations and specific indicators, the assessment team concluded that the area of surveys and contamination control was a program weakness (70-1151/92-04-30).

f. Internal Exposure Control

The assessment team reviewed the licensee's programs to control and monitor internal exposures to uranium including air sampling and exposure determination, respiratory protection, and bioassay to determine whether these programs were appropriate in scope, and had been adequately implemented. Requirements for these programs are contained in Sections 2.2.6, 3.2.3, and 3.2.4 of the license application, and 10 CFR 20.103.

(1) Air Sampling and Exposure Determinations

To estimate worker exposure to airborne uranium, the licensee made use of approximately 270 fixed continuous air samplers located throughout the areas where uncontained uranium was processed. In general, the samplers were located near operator work locations in orientations approximating the worker's breathing zone. The sample filters were changed once per shift, and were promptly screened by a 1 second count using gas proportional counters. The screening was used to alert health physics and operations to the need for corrective actions due to leaks or loss of function of engineering controls. Following a 10-12 hour decay of radon daughters, the samples were counted again for one minute in order to establish the airborne levels to be recorded for exposure estimation. Results of the previous day's air samples were routinely provided to operations.

During examination of the plant, the team noted that there were no ventilation system stack radioactive material monitoring devices installed on ventilation stacks that discharge into the room at the Honing Area Wash Table or the Rotary Blending Station. In one of these areas, the Honing Area, there were also no general air samplers available that could monitor airborne contamination discharged from the stack into the room. This was identified as an IFI (70-1151/92-04-31).

The team reviewed a random sample of air sampling results and found that they were consistently below the Maximum Permissible Concentration (MPC). (Note: The licensee uses the more restrictive insoluble value for uranium specified in 10 CFR Part 20 of MPC=1.0E-10 microCuries per milliliter [uCi/ml]). Documentation was also reviewed of past licensee efforts to characterize the uranium particle size distribution in various areas of the plant. The team examined records of determinations of air sampler representativeness which had been performed according to procedure RO 06-008-A. These studies were noted to have been performed more frequently than the two year frequency specified in Section 2.2.6.3 of the license. In the last study, about 15 of the samplers did not meet the representativeness criteria and corrective actions were taken. The licensee's determinations of fixed air sampler representativeness were well documented and were identified as a program strength.

The team noted that the licensee possesses over 50 lapel samplers. However, it was noted that these samplers had been used sparingly and only in some special work

applications. No defined program had been developed to utilize these samplers. Through discussions with licensee representatives the team also determined that previous attempts to correlate lapel sampler results to fixed sampler results had been unsuccessful even for side by side operation. Development of a program to better utilize lapel samplers was identified as an area for improvement.

Worker internal exposures were calculated daily using the area air sample results for each shift multiplied by the hours spent by each worker in each area and factoring in any respiratory protection factor applicable. The hours spent in each area, and the type of respiratory protection used, were logged by the worker into a computer based tracking system accessible by means of 30 consoles located in the production areas. According to licensee representatives, data logged by the workers had been checked for accuracy by the workers' supervision.

The team noted that the internal exposure reports calculated intake estimates in two sets of units, consistent with both the current 10 CFR Part 20, and the proposed new Part 20. The team audited the paper trail of values and calculations for several worker internal exposure estimations and found no discrepancies. However, it was noted that some workers appeared to be working major proportions of their shift in respirators. The team determined, through discussions with the licensee personnel, that the data logged was apparently correct and that, on occasion, workers did spend the entire shift wearing a respirator.

The licensee used a program of placing workers on work restraint or restriction based on calculated or potential internal exposures determined by the previous day's air sample results, elevated bioassay results, or unusual incident reports. The team reviewed documentation of work restraints and restrictions issued and found that they were generally timely and proper.

(2) Respiratory Protection

The NRC team reviewed the licensee's administration of its respiratory protection program to determine whether adequate procedures and practices were in use. Responsibility for the respiratory protection program was assigned to the Regulatory Operations group with several contract technicians providing support services. The respiratory protection program was implemented through RA-205, "Respiratory Protection," as well as several Regulatory Operations procedures. A review of representative records verified that respiratory protection training had been conducted and that users had been given pulmonary medical

examinations by staff medical personnel. Fit testing of users had been performed at least every two years utilizing a fit testing booth located in the health physics laboratory.

Respirator cartridges in use by the licensee were determined to be NIOSH approved for radionuclides. In addition to full-face cartridge respirators, the licensee utilized supplied air, and self contained breathing apparatus (SCBA). Licensee policy directs that respirators must be surveyed before each use. Licensee representatives reported that normal plant operations requires approximately 3000 respirator uses per month. The team observed respirator cleaning, maintenance, and testing operations conducted in a trailer adjacent to the process facility. A review of the applicable procedures governing respirator maintenance identified no concerns. Cartridge and facepiece testing equipment had been well maintained. Technicians were well trained and the facility was adequately monitored and controlled for contamination. Maintenance of SCBAs was performed by a local safety equipment company certified by the equipment's manufacturer for such maintenance. The team noted that test results were on file certifying that the bottled air utilized in the licensee's supplied air systems met the specifications of grade "D" breathing air.

The team reviewed records and discussed overcheck programs implemented by the licensee to ensure the adequacy of respirator cleaning and maintenance. It was noted that the licensee performed documented weekly spot checks of respirators for contamination and integrity in accordance with RO 05-018, "Respirator Overchecks." A separate spot check was performed monthly by the supervisory technician of the respiratory maintenance group. The team identified the area of respirator cleaning, maintenance, and testing to be a program strength.

(3) In-Vitro Bioassay

The NRC team discussed with licensee representatives the implementation of the routine urine bioassay program and reviewed records pertaining to the program to determine the effectiveness of urine bioassay and procedures. Requirements for the urine bioassay program were found in Section 3.2.4 of the license application. The program was implemented in accordance with procedure RA-223, "Routine Urine Sampling Program."

The licensee's routine urine bioassay program included a sampling program encompassing employees, visitors, and contractors who work in the contamination controlled areas of the facility. Predesignated frequencies were established

for sample collection from individuals based on average area air sample results. The team reviewed documentation of the December 1991 review of bioassay frequency and determined that it had been performed in accordance with the guidance established in Reg. Guide 8.11. The shortest assigned frequencies were monthly in areas such as Conversion, maintenance, MAP Line, and waste reduction, and ranged to quarterly, semi-annually, and annually for other working areas of the facility.

Based on the scope and minimum frequencies of the licensee's urine bioassay program, the team concluded that it could be used principally for prospective purposes to detect intakes of uranium in order to validate the effectiveness of engineering controls and air monitoring. However, even the prospective purpose of the licensee's program was hindered by long turnaround times for obtaining sample results.

The routine program's value for retrospective purposes as a means of estimating internal exposures was limited because of relatively long sample frequencies and turnaround time on results. This limitation was compensated for, in part, by the licensee's program for followup of unusual incidents which frequently specified total urine sampling for 48 hours, and daily samples thereafter for seven days for individuals involved in incidents with a known potential for intake of soluble uranium. Licensee representatives also stated that a recent initiative required that daily samples be obtained from two individuals per shift from areas of the plant known to contain soluble forms of uranium. The results of this study validated air sampling results in those areas. Another compensatory measure to the relatively long sample frequencies, was a staggered schedule for employees working in the soluble uranium areas such that a significant leak or high airborne problem would be more likely to be detected.

Urine samples and voidings were collected together from individuals while onsite. However, this practice introduced a higher risk of sample contamination than if the samples were voided and sealed offsite. The team noted that the licensee had implemented effective controls to ensure timely collection of samples by placing individuals who missed providing scheduled samples on a mandatory two day work restriction. Measurements of urine samples were performed by an out of state contractor laboratory. The team discussed timeliness of receiving sample results and learned that typical reporting times range from 15 to 20 days after sample collection. According to the licensee, the contractor laboratory would call in, or send by facsimile any elevated results measured. The licensee had no accelerated method of sending out samples or receiving back

results. As a result, high intakes of soluble uranium could possibly result in untimely followup action. The team concluded that the speed with which urine samples could be analyzed and results reported was an IFI (70-1511/92-04-32).

The team reviewed urine sample results and determined that the analytical lower level of detection of 2 micrograms per liter (ug/l) was adequate. Results of the urine sampling program were routinely reviewed upon receipt by appropriate levels of staff. Trending analysis of quarterly urine sample results by area was routinely performed and documented in ALARA reports. Notices of high sample results were reviewed by the team and it was determined that the licensee had been responding properly to these results.

The licensee also made use of fecal sampling as followup to unusual incidents involving uranium of low transportability (Class Y and W), and as a substitute bioassay method for individuals unable to be counted in-vivo. The same contractor laboratory used for urine sample analysis had been used for fecal sample analysis. The team reviewed fecal sample results and found a low analytical sensitivity and appropriate application of this bioassay method.

The team reviewed documentation of intake estimates derived from in-vitro bioassay results. The licensee made appropriate use of NUREG CR-4884 and Draft Reg. Guide DG-8009 in the interpretation of bioassay results. The team determined that the licensee's methodology for these estimates was current and applicable. Reports of evaluations were well documented.

(4) In-vivo Bioassay

The team observed the set up and performance of in-vivo lung counting in the licensee's facility and reviewed records associated with this program to determine the adequacy of equipment, and methods, and qualifications of personnel overseeing the program. The licensee's lung counting system was located in the manufacturing area of the facility. While this was an area where no uncontained uranium was present, it would not be considered a low background area because of its location within the licensee's facility and its proximity to radiation sources. Despite these drawbacks, the licensee's counting chamber was well shielded and the in-vivo counting room was controlled to reduce the potential for contamination.

The licensee's counting system used two sodium iodide scintillation detectors with four photomultipliers each. Count collection and analysis was by a recent vintage multichannel analyzer system. The set up, source checks,

and performance of the routine 20 minute counts were proceduralized in several Regulatory Operations procedures. Technician training requirements for operation of the counting system were specified in procedure RO 04-013, "In-vivo Training Procedure." The licensee considered its staff health physics technicians to be qualified to operate the system. In December 1991, the licensee had documented and taken adequate corrective action to a self-identified violation of procedure RO 04-013 for failing to provide bi-annual training/retraining since August 1989 for personnel authorized to operate the in-vivo counting system. The procedures for scheduling, tracking, and performing the in-vivo counts were adequate. The licensee's capability to perform in-vivo counting both routinely, and in response to unusual incidents was identified as a program strength.

The team reviewed procedures, methods, and records of in-vivo counting system calibrations and performance checks. The licensee employed the services of a qualified consultant to assist in developing and verifying system operation and to perform on-site reviews approximately semi-annually. Calibrations were performed every six months using a series of lung phantoms each containing a known quantity of uranium-235 traceable to the National Institute of Standards and Technology (NIST). The quantity range of uranium content in the phantoms was appropriate. Daily source checks were performed using four radionuclide species in a fixed geometry.

A self-identified violation was documented on June 18, 1992 describing the licensee's failure to evaluate semi-annual calibrations in accordance with procedure RO 04-011. The calibration evaluation had not been performed between July 31, 1991 and June 1992. Appropriate corrective actions were documented by the licensee with respect to this self-identified violation. In addition to the example referenced above, the assessment team also noted that the in-vivo counting system's background prediction equation had been updated only twice since December 1989 (12/89 and 9/91). While no specific requirements for frequency of updating the prediction equation were found, this is an integral component of overall in-vivo count system precision and that it should be redetermined as part of the required annual full calibrations. Performing a redetermination of the background prediction equations at the same frequency as the full calibrations was identified as an area for improvement.

The assessment team reviewed records of in-vivo counting system cross-checks which had been performed. The licensee had not developed a documented cross-check program but had sent employees to other facilities for in-vivo counting for

comparison purposes. These comparisons had shown a generally close agreement in assay results. No cross-checks of sources or phantoms had been performed with other facilities. The assessment team identified the development of a documented cross-check program for the in-vivo counting system to be an area for improvement.

The assessment team reviewed frequencies for performing in-vivo counts of workers and reviewed selective results of the counts. No concerns were noted. One recent, unexpected elevated in-vivo count was still under review by the licensee at the time of the assessment to determine its causes. Notwithstanding the result still under review, in-vivo counting results indicated that the licensee employee's internal intakes of uranium of low transportability were low compared to the limits of 10 CFR Part 20.103. The elevated in-vivo count was determined to be an unresolved item (70-1151/92-04-33).

8. Effluent and Environmental Monitoring

a. Program Overview

The assessment team reviewed the license, and documents referenced in the license to determine the scope of the routine monitoring program for environmental effluents. Reports and selected data from the monitoring program were reviewed to determine whether the analytical techniques and sensitivities were adequate to demonstrate compliance with the regulations in 10 CFR Part 20, Appendix B, 40 CFR 190, 10 CFR 70.59, and conditions of the license.

Licensed program requirements for environmental monitoring are summarized in Section 2.7 of the license application. The routine program consists of monitoring environmental air, water, vegetation, fish, soil, sediment and groundwater for various chemical and radioactive constituents. In addition to the licensed environmental monitoring program, routine sampling of effluents at the point of discharge is performed in accordance with a National Pollutant Discharge Elimination System permit monitored by the South Carolina Department of Health and Environmental Control (DHEC). The licensee has also performed other non-routine monitoring programs targeted to specific effluent or environmental concerns.

b. Procedures

The NRC team reviewed procedures related to the effluent and environmental monitoring program to evaluate the adequacy of procedural guidance. Environmental program procedures were

contained in two separate manuals, namely the RA Procedures Manual, and the RO Procedures Manual.

The team reviewed the document control and the review and approval process for revisions to the RO procedures. Several problems were identified. For example, the process for preparation, revision, and control of RO procedures was not proceduralized as was the case with the RA Procedures. An indication of the consequences of this lack of control was evidenced by the assessment team's observations following the review of three sets of RO procedures in the possession of the Environmental Engineer, the Regulatory Operations Manager, and in the health physics laboratory. All three sets reviewed contained different revisions of the table of contents, and some different revisions of individual procedures between the sets. In addition the actual procedure revision in the manual often did not match the revision listed in the table of contents. Failure to establish document control of RO procedures was identified as a program weakness (70-1171/92-04-34)

c. Sample Collection and Analyses

Members of the NRC team accompanied licensee technicians during routine collection of environmental air and water, and roof vent samples to determine the adequacy of applicable procedures, and the acceptability of sample collection equipment and locations.

(1) Environmental Air Sampling

The four environmental air samplers were observed to be operating and well maintained. One sampler did not have documentation either affixed to the sampler, or in the records, to show that it had been calibrated within the past six months as specified in the procedure RO-06-003. Licensee representatives attested to this sampler having been calibrated in March 1992 with the other units. Documentation of other air sampler calibrations was complete. The documentation of calibration of environmental air samplers was identified as an area for improvement.

The technician who performed the air sample changeout failed to use forceps to minimize disturbance of the sample, and failed to record the sampler flow rate as specified in procedure RO-06-003, step 3. Closer adherence to environmental sample collection procedures was identified as an area for improvement.

The assessment team observed a licensee technician count a weekly environmental air sample after decay of radon daughter products. The counting was performed in a room in the health physics laboratory using an Eberline SAC-4 alpha counter. The background and sample counting procedure was described in RO-06-003, however the assessment team noted

that operation of the counting instrument was not proceduralized. Use of the SAC-4 had only recently been initiated for environmental air samples because of increases observed in the background counts obtained on the counters previously used. The development of an instrument operating procedure for the SAC-4 alpha counter was identified as an area for improvement.

Environmental air sample results were reviewed and it was determined that levels were well below the limits specified in 10 CFR 20, Appendix B, Table II. Site boundary doses, as reported in the semi-annual ALARA reports, were below 40 CFR 190 dose limits. The assessment team was unable to review documentation of the calculation methods used to calculate offsite doses. The assessment team noted that analytical sensitivities for measuring air particulate activities were below those specified in the license and Reg. Guide 4.16.

(2) Roof Effluent Air Sampling

NRC team members accompanied licensee technicians during the routine daily collection of roof vent samples. Prior to the accompaniment, drawings of some of the vent sampler configurations were reviewed. Single or multi-port samplers had been installed in the 39 roof vents and stacks which could potentially contain uranium in the exhausts. Efforts had been made to determine representative flow velocities for isokinetic sampling, and, in general, to design sampling configurations to meet ANSI N-13.1. The team noted that no documentation was available to demonstrate the accuracy of the isokinetic sampling systems. A report was reviewed from an NRC sponsored comparison study conducted in April 1987 of several prominent stack and room exhaust monitoring results. This report concluded that the licensee's stack monitoring was adequate. The team observed that rooftop ventilation exhaust trains were in good condition and samplers were generally operating at the intended flow rate.

Following appropriate time to decay, roof effluent samples were counted onsite using gas proportional counters. A representative number of daily sample results were reviewed and it was determined that concentrations were well below levels that would approach the limits specified in 10 CFR 20.106 and Appendix B, Table II. Daily samples rarely exceeded 1 MPC. The team concluded that the licensee's monitoring of roof exhausts was adequate to quantify uranium in gaseous effluents.

(3) Water, Soil, and Biota Sampling

The team reviewed documentation of other environmental samples routinely collected including surface water, groundwater, soil, sediment, vegetation, and fish. Collection frequency on these samples varied according to the license, and the sample analyses were performed by outside contractor laboratories. The team determined that required sample frequencies and analytical sensitivities had been met and reports and sampling data had been provided to regulatory agencies as required.

Routine groundwater sampling was conducted to measure levels of radioactivity and ammonia in monitoring wells surrounding the facility. A number of non-routine studies also had been conducted to characterize the aquifer system and groundwater mixing zone. A special study had recently been completed to evaluate water and soil samples from beneath the solvent extraction area floor. The team reviewed some of these documents for completeness and consistency with routine environmental sampling results. The evaluation of the results of non-routine studies was beyond the scope of the assessment.

Members of the NRC team accompanied a licensee technician on the routine collection of surface water samples. It was noted that procedure RO-06-006, "Collection of Routine Weekly and Monthly Environmental Samples" appropriately specifies acidification of water samples for preservation. However, the team determined that the licensee's practice was to acidify the samples just prior to shipment to its contractor laboratory. Through discussions with licensee representatives the team determined that this practice could permit samples to remain unpreserved for up to a month after collection. The team noted that EPA analytical procedures recommend acidification of water samples at the time of collection. Proper preservation of environmental water samples at the time of collection was identified as an area for improvement.

d. Analytics and Quality Assurance

The licensee implemented certain quality assurance measures on its environmental sampling program including split samples with the state DHEC, co-location of one air sampling station, and audits of contractor laboratories. The team reviewed documentation of the control measures and found them to be satisfactory. Split and co-located environmental sample results were generally in close agreement with the state's results

Environmental monitoring results were routinely reviewed by the Regulatory Affairs management, and were trended in semiannual ALARA reports. Corporate audits had been performed in the functional area of environmental monitoring and control. The team reviewed the corporate audit reports and found them to be thorough and substantive. The corporate audits of environmental, safety and industrial hygiene were identified as a program strength.

9. Emergency Preparedness

a. Scope

This area was inspected to assess the licensee's capability to respond to a potential or known emergency condition through the use of the Site Emergency Plan (SEP) and its implementing procedures, which are known as the Columbia Site Emergency Procedures (CSEPs). This assessment included review of the following elements of emergency preparedness: (1) the SEP and CSEPs, (2) facilities and equipment, (3) training, (4) drills, (5) classification and notification methodologies, (6) coordination with off-site support organizations, and (7) staffing and qualifications.

b. Site Emergency Plan and Implementing Procedures

Section 2.5 of License SNM-1107 specifies that the licensee "shall implement, maintain and execute the response measures of the Site Emergency Plan," and "shall also maintain implementing procedures for the Site Emergency Plan as necessary to implement the Plan." The version of the SEP in use at the time of the current assessment was most recently revised via page changes marked with a "Revision Submittal Date" of March 31, 1992.

In subsequent paragraphs frequent use will be made of the term "Site Area Emergency" as one of the two emergency classifications specified in NRC regulations and guidance. It should be noted that the licensee's equivalent term is "Site Emergency." An area for improvement was identified in that the licensee's terminology for emergency classification of site area emergencies did not conform to that normally employed throughout the industry and the State of South Carolina.

In 1990, the licensee revised the SEP to address the emergency planning requirements of 10 CFR 70.22, which took effect on April 7, 1990 (or in conjunction with the first license renewal thereafter). In January 1992, the NRC issued Reg. Guide 3.67, "Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities", which contains detailed guidance for use by licensees in preparing emergency plans to comply with 10 CFR 70.22(i)(3). Discussion with a licensee representative disclosed that Reg. Guide 3.67 was received by the licensee, but

no action had been taken to revise the SEP to address the more detailed informational specifications contained in Reg. Guide 3.67. The following list, although not exhaustive, includes the principal guidance elements from Reg. Guide 3.67 (section reference at end of item) which were not addressed by the SEP:

- The licensee's scheme for classifying potential emergency situations (SEP Section 3.1) lacked an appropriate degree of specificity for some events and omitted other possible events (particularly for the Site Area Emergency classification) in comparison with the examples of initiating conditions (Appendix A).

- Preplanned initial protective action recommendations (PARs) for each postulated accident having potential offsite impact should be available and provided to governmental authorities upon declaration of a Site Area Emergency (Sections 3.3 and 5.4.2).

- A summary of stack heights, typical flow rates, and efficiencies of emission-control devices should be included (Section 1.2).

- Provision should be made for an annual independent audit of the licensee's emergency preparedness program (Section 7.5).

Absence of the above-listed provisions or information in the SEP was identified as a renewal item (70-1151/92-04-35).

According to SEP Section 3.1 and CSEP-0019, "Emergency Action Procedure Guide," Rev. 1, notification of an emergency declaration is to be made to the South Carolina Department of Health and Environmental Control (South Carolina DHEC) within fifteen minutes of such declaration and to the NRC within one hour. This commitment was based on the licensee's interpretation of 10 CFR 70.22(i)(3)(viii), which specifies that the licensee shall "commit to notify the NRC operations center immediately after notification of the appropriate off-site response organizations and [emphasis added] not later than one hour after the licensee declares an emergency." The licensee was informed that the use of "and" in the cited requirement means that the one-hour criterion does not define "immediately," but rather places an upper bound on the time allowed for NRC notification of an emergency declaration. This flexibility was included in the regulation to address a situation in which the State and/or local notification process might be lengthy or significantly delayed for some reason. This matter was identified as an area for improvement.

Review of the SEP implementing procedures identified some minor deficiencies in CSEP-0013, "Emergency Notification of Onsite and Off-site Organizations," Rev. 1. Table II of this procedure provided telephone numbers for making emergency notifications to

off-site organizations. The listing for the NRC showed a number for Region II first, followed by primary and alternate numbers for the Headquarters Operations Center. As noted above in the discussion of 10 CFR 70.22(i)(3)(viii), notification of a declared emergency is to be made by the licensee to the NRC Headquarters Operations Center. Any notification to Region II would be unofficial and would be considered a courtesy call. Also noted in the subject procedure was that Attachment A, a two-page "Formal Notification to USNRC & South Carolina DHEC," did not include provision for approval sign-off by the Emergency Coordinator nor designated blanks serving as reminders for licensee communicators to document the names of those contacted at NRC and South Carolina DHEC along with the date and time that each notification was made. These two discrepancies in CSEP-0013 were identified as an area for improvement.

An incorrect telephone number for the National Weather Service was listed in section 1.C of CSEP-0017-B, "Establishing Meteorological Conditions and Calculating Downwind Concentrations Using Uniform Direction Wind Model," Rev. 0. The correct number (verified by calling) was included in Table II of CSEP-0013. A licensee representative agreed to correct this discrepancy.

Through discussion with members of the plant guard force assigned to the Central Alarm Station (CAS), the team determined that no gamma monitoring device had been installed at the CAS. This device would inform the guards concerning the radiation level present at the CAS during a radiation emergency affecting the plant. According to these individuals they are required to remain at the CAS during emergencies to monitor alarms and operate the site phone system. The team determined, during these discussions, that a Radiation Protection Technician conducts an initial radiation survey of the CAS as soon as possible following activation of the plant gamma alarms but no additional surveys were required. This was identified as a weakness in the plant emergency radiation protection program (70-1151/92-04-36).

c. Emergency Facilities and Equipment

This area was assessed to determine whether the licensee was maintaining adequate facilities and equipment for managing and conducting a response to an emergency.

The Plant Manager's office and adjoining conference room comprised the primary emergency operations control center for all emergencies. The inspector toured this area and noted that various emergency equipment and supply items were maintained in a case stored in the conference room closet. The primary plant telephone system (ROLM) would not operate in the event of a power failure, but 13 appropriately chosen extensions were set up to switch automatically to outside trunk lines if this occurred. A cellular telephone was maintained by Security as a further means

of insuring the availability of off-site communications capability during an emergency. Numerous portable transceivers were available for emergency communications among plant personnel. Communications equipment described here was either used routinely or tested regularly, and selective inspection disclosed no problems in this area.

The licensee's facility did not have any installed meteorological equipment to provide information on wind speed and direction that would be necessary in the event of an airborne release of hazardous material. However, a portable meteorological system was available and maintained as part of the emergency equipment inventory. The inspector requested a real-time setup of this "suitcase" system by technicians who were trained and would perform this function in an emergency. Within a period of ten minutes, two technicians obtained the equipment, completed the setup along an entrance road (adjacent to a fixed air sampler for AC power), and obtained a reading of wind velocity.

Regulatory Operations maintained two cabinets containing radiological survey instruments and supplies. Surveillance of this equipment was performed via Regulatory Operations Procedure 05-021, "Checking and Stocking Health Physics Emergency Cabinets." Records of such inventories performed between October 1991 and August 1992 were reviewed. This documentation indicated that discrepancies identified during the inventories were corrected expeditiously by licensee personnel. Inspection of one of the subject cabinets disclosed no discrepancies.

d. Emergency Response Training

The training program for the emergency response organization (ERO) was delineated in Section 7.2 of the SEP. The team reviewed these program commitments together with supporting material relative to the licensee's training/retraining methodology, and interviewed the Emergency Planning Coordinator, who had lead responsibility for training of the ERO. The training program for the Emergency Brigade was not included in this review.

The training program for primary and alternate members of the ERO involved formal classroom instruction for initial training as well as annual retraining. The team reviewed in detail the course outlines for 1992 retraining of designated Emergency Directors (5 individuals trained in July) and Emergency Coordinators (15 individuals trained in June). Topics covered in these sessions included review of 1991 exercise critique items (and corrective actions therefor), alarm activations, use of two-way radios, the new personnel accountability system, review of CSEP-0013 and CSEP-0019, a tabletop exercise, and a "class participation" quiz. The licensee did not make use of graded examinations to verify that personnel understood the subject matter. Discussion with the cognizant licensee representative

confirmed the team's determination that the retraining program for the Emergency Director and Emergency Coordinator positions was deficient in that it did not "go back to the basics," but rather focused on updating knowledge of ERO members and advising them of "lessons learned" from the last drill without reviewing the fundamentals of emergency response. Walk-through interviews with two designated Emergency Coordinators confirmed that the retraining effort as described above may not be adequate to prepare cognizant individuals to classify emergency events and direct emergency response activities (see Paragraph 9.f for details of these interviews). Inadequacies in the annual retraining for Emergency Directors and Emergency Coordinators were identified as a program weakness (70-1151/92-04-37).

In response to a Notice of Violation (issued with NRC Inspection Report No. 70-1151/91-05) for multiple examples of failure to provide training in accordance with Section 7.2 of the SEP, the licensee had implemented use of an "Emergency Training Record Tracking Form." This form contained the position title and a list of individuals to be trained during the calendar year for each ERO position or category of positions. When training was given, individuals were required to sign and date the tracking form, thus making readily identifiable any person whose ERO training was incomplete. Any individual who had not received training for his/her position as of the end of the calendar year would be disqualified from the ERO until training was completed. The team determined that this manual tracking system would be effective in correcting the subject violation if the system continued to be properly maintained. Review of selected tracking forms showed that 1992 training was complete for all designated Emergency Directors and Emergency Coordinators, but had yet to be conducted for any of the 19 individuals listed on the tracking form for Security training.

e. Drills and Exercises

The SEP required a biennial integrated emergency response exercise (Section 7.4) and limited emergency response drills on each shift during the years in which exercises are not required (Section 7.3). The last biennial exercise was conducted on October 24, 1991. Because of the extensive number of negative findings (by the NRC as well as the licensee) resulting from that exercise, the licensee planned to conduct an exercise on October 15, 1992, even though one is not required this year. The team informed the licensee that conducting an exercise during a year in which none is required will not fulfill the commitment referenced above regarding drills on each shift during "off years," except for the shift involved.

Evaluation of the 1991 exercise produced a total of 38 items for corrective action (28 were identified by the licensee, 10 by the NRC). The inspector reviewed the Commitment Tracking System (CTS)

reports on these findings. Licensee records indicated that all 38 items were corrected and closed. Documentation showed that the licensee had undertaken extensive efforts to respond to NRC findings, comments, and suggested areas for improvement. The inspector noted that the 28 licensee critique items had not been assigned CTS numbers, making the "audit trail" difficult to follow, although documentation appeared to exist regarding corrective actions for each of these items, based on a selective review. A licensee representative agreed that CTS numbers should (and will henceforth) be assigned for all exercise findings requiring corrective action.

The licensee recently implemented a new personnel accountability system called the Columbia Onsite Monitoring and Emergency Tracking System (COMETS). COMETS was a PC-based system which made use of the bar codes on all plant security badges, including those issued to visitors and contractors, and bar-code readers at two locations. The first full-scale tests of COMETS were conducted on August 2, 1992 in conjunction with criticality evacuation drills at 6:00 a.m. and 6:00 p.m., resulting in 10 and 12 unaccounted persons, respectively, after 30 minutes. This system, which is now considered by the licensee to be fully operational, represented an enhancement in employee safety and in the licensee's emergency response capability.

f. Emergency Classifications and Notifications

In an effort to gauge the effectiveness of the emergency response training program, the inspector conducted walk-through interviews with two manufacturing supervisors (one each on the evening shift of August 19 and the day shift of August 20). These individuals were designated for the Emergency Coordinator role and would function as Emergency Director until the Plant Manager or other Emergency Director designee arrived. The interviews focused on the efficacy of the licensee's methodologies for classifying an emergency and making notifications thereof to cognizant governmental authorities. Each interview lasted about 1.5 hours and presented two accident scenarios that required classification, notification, and consideration of protective actions for plant personnel and the public. The scenarios concerned (1) a potential criticality event, and (2) a major fire involving radioactive materials in the manufacturing area. Members of the Regulatory Engineering group assisted the team in developing and "debugging" these plant-specific scenarios. The team delineated the guidelines for each interview at the outset, including the "open book" nature of the evaluation (i.e., interviewees were urged to use applicable procedures). A licensee representative was present during both interviews to allow for confirmation and firsthand understanding of observations.

The authority and responsibility for the classification of emergency events and the initiation of emergency actions were described in CSEP-0019. Procedures, call lists, and forms for making off-site notifications were found in CSEP-0019. The general conclusion from the walk-throughs was that, while the two experienced supervisors who were interviewed seemed very knowledgeable of plant operations, both of these designated Emergency Coordinators appeared to be relatively unfamiliar and uncomfortable with their ERO role. Specific observations in support of this conclusion were as follows:

- Neither individual referred to the CSEPs. The supervisor on evening shift used CSEP-0013 call lists to obtain telephone numbers for Regulatory Engineering personnel, but never looked at the event classification criteria. The other individual inappropriately used the SEP instead of the CSEPs to derive an emergency classification.

- Of the total of four requested emergency classifications (two in each interview), only two were correct, and one was made by the Regulatory Engineering Manager during a telephone consultation.

- Neither interviewee was aware of the requirement to provide recommended protective actions to South Carolina DHEC and the NRC in conjunction with a notification of an Alert or Site Area Emergency (reference: SEP Section 4.5.1(7) and item 17 of Attachment A to CSEP-0013).

The deficiencies listed above were attributed to weaknesses in the emergency response training program (see Paragraph 9.d for further discussion of this issue).

Another matter considered during the walk-throughs was the adequacy of plant procedure RA-107, "Internal Reporting, and NRC Notification, of Unusual Occurrences," Rev. 3, effective August 17, 1992. (It should be noted that both interviewees were in possession of Rev. 2 and were not aware of the issuance of Rev. 3.) This procedure was established in response to NRC Bulletin No. 91-01, "Reporting Loss of Criticality Safety Controls," dated October 18, 1991. The team's review of this procedure identified a relatively high level of complexity including the following points:

- For unplanned nuclear criticality safety events, the user was required to determine whether "equivalent compensatory controls" have been initiated "following a significant deterioration of safety barriers." The criteria for making this determination were unclear.

- If the above determination was positive, a 1-hour notification to the NRC would be required; if negative, a 24-hour notification would be required. However, not until page 5 of RA-107 was the user informed, by a parenthetical note, that a 1-hour notification of the NRC also entailed declaration of an Alert.

The inadequacy of procedure RA-107 was confirmed during the walk-throughs with Emergency Coordinators because neither individual recognized until prompted that the scenario conditions for the potential criticality event were consistent with the RA-107 criteria for a 1-hour notification (and an Alert declaration). One of the interviewees initially stated that compensatory controls must have existed because no criticality had occurred. The problems with the procedure as written and the lack of understanding on the part of users could lead to a 24-hour report to the NRC instead of an Alert declaration, or a 1-hour report but still without an Alert declaration because RA-107 did not reference the user to the CSEPs at the point when a Alert should be declared. The inadequacy of procedure RA-107 was identified as a program weakness (70-1151/92-04-38).

g. Coordination With Offsite Support Organizations

Written agreements with offsite support groups had been updated in 1991-1992, although Appendix A of the SEP had not yet been revised to include the more recent updates. The inspector determined through review of applicable documentation and discussions with a licensee representative that the licensee was annually contacting local support agencies and South Carolina DHEC for purposes of offering training and maintaining familiarization with emergency response roles.

A telephonic interview with a representative of South Carolina DHEC and a personal interview with members of the Columbia Fire Department (CFD) disclosed that the licensee had been diligent in offering annual training and site tours to these agencies. A standing offer by the licensee to provide onsite training/orientation to new CFD personnel was typically implemented several times per year,according to CFD management. The subject interviewees all stated that their working relationship with the licensee was excellent.

h. Staffing and Personnel Qualifications

The inspector reviewed the qualification criteria for the lead roles in the ERO. The Plant Manager had chosen four of his seven staff managers as his alternates for the Emergency Director role, based upon their backgrounds. To be designated as an Emergency Coordinator, an individual had to be at a supervisory level and was required to pass the Emergency Brigade physical examination on

an annual basis; in addition, all designees passed a written qualification test in 1989 (although no annual written requalification test was given, as discussed in Paragraph 9.d, above). These criteria for ERO qualification were reasonable and appropriate.

10. Chemical Safety

The team assessed the Chemical Safety Program against the OSHA requirements and the guidance specified in the Branch Technical Positions on Management Controls/Quality Assurance, Requirements for Operation, and Chemical Safety. The following sections discuss various elements related to chemical safety that are covered by OSHA and in the BTPs. These elements include: policies and procedures, organization and responsibility, inspections and audits, design base documentation, process hazard analysis, operating procedures, training, maintenance and surveillance, chemical storage and handling, chemical release response, and hazard communication.

a. Policies and Procedures

Program procedures were contained in two separate manuals. The Regulatory Affairs Procedures Manual and the Columbia Plant Site Safety Manual contained procedures for administration of the industrial safety and hygiene program. However, the program governing chemical process safety was not as well established. Responsibilities and authorities were not specific for process hazard analysis, training, nor audits. The lack of prescriptive requirements in administrative procedures was determined to be another example of a program weakness in the area of lack of formal plant procedures (70-1151/92-04-03).

Following a review of the administrative procedures dealing with chemical safety, the team determined that the direction and guidance contained therein were general in content and broad in scope. Authorities and responsibilities of Regulatory Engineering staff and their interface with safety oversight were not clearly defined and documented. Administrative procedures were in place to ensure policies were administered but program definition was incomplete.

b. Organization and Responsibility

Procedure SY-100, "Authority and Responsibility for Safety," Rev. 3, March 1, 1988, within the Columbia Plant Site Safety Manual defined the chemical safety policy and assignment of responsibility. The Regulatory Affairs Department was given the responsibility for managing the chemical safety program and the Regulatory Engineering Section the responsibility for implementing the program using the administrative procedures prescribed in the safety manual. In addition, Regulatory Engineering was responsible for development and conduct of the program, for review

of modifications affecting chemical safety, and for independent investigations of accidents, injuries, and unusual occurrences. However, the specific activities to be performed by the Regulatory Engineering staff were not documented in the Regulatory Affairs Procedures Manual.

c. Inspections, Audits, and Appraisals

The internal management oversight program was weak for chemical safety since internal audits were conducted infrequently.

Procedure RA-102, "Plant Inspection Program for Regulatory Compliance," Rev. 2, dated May 4, 1990, required weekly inspections by Regulatory Affairs personnel with specialty in industrial safety. This procedure required submittal of a monthly report to management summarizing the inspection findings, trends, recommended corrective actions, individuals assigned responsibility for taking corrective actions, scheduled completion dates, and status of previously identified items. The team observed no such reports for chemical safety.

Procedure RA-104, "Regulatory Affairs Review Request," Rev. 6, dated March 3, 1992, required Regulatory Affairs personnel to conduct routine audits to ensure that unauthorized changes and or operations had not occurred. However, guidance did not exist for reviews in the chemical safety area of changes to equipment and operations. In addition, Procedure RA-105, "Internal Program Audits," Rev. 2, March 11, 1992, failed to address chemical safety audits.

Management had not implemented a comprehensive internal appraisal system that provides review of chemical safety functions. No self-appraisal mechanism existed to assess accident potentials, adequacy of controls to prevent accidents, maintenance and surveillance of controls preventing accidents, and ability to mitigate effects and consequences of accidents. This has been identified as an IFI (70-1151/92-04-39).

d. Design Base Documentation

The document control system did not provide readily accessible process safety information. Responsibility for documentation was not assigned and safety documents were not readily available to safety staff. With the lack of formal documentation of the design bases, the team questioned whether the following could be adequately performed: process hazard analysis, identifying chemical risks, safety reviews, incorporation of chemical safety into processes and operating procedures, and assessing safety through internal or external audits. The immediate concern was that the absence of design base documents allowed safety reviews to be performed without a technical basis.

The Regulatory Engineering (RE) staff was developing a schedule to perform process hazard analyses in accordance with OSHA requirements. The licensee indicated that development of such analyses would provide the necessary design documents to perform the process hazard analyses. It was also noted that the RE staff responsible for chemical safety had received training in Process Hazards Analysis (PHA) techniques and had participated in the PHA of an offsite facility.

e. Process Hazard Analysis

As of the date of the assessment, a process safety hazard analysis program had not been established to ensure that safety reviews were prepared, documented, reviewed, authorized, and maintained for new and existing processes. Although a thorough analysis of the hazard potential of the chemical substances used at the plant had not been documented, suitable precautions to eliminate or reduce exposure to these hazards had been implemented. However, without documented safety analysis, continued assurance was not provided for determining that proper procedures exist and proper equipment is available for measuring the extent of, mitigating the consequences of, and dealing with a potential release of hazardous chemicals.

The licensee was in the process of initiating a process hazardous analysis (PHA) program. The licensee had developed a plan to conduct PHAs in accordance with OSHA requirements. The team noted that some Regulatory Engineering staff were receiving training in safety analysis techniques (HAZOP) and had participated in such analyses at subsidiary facilities. Development of a PHA program was determined to be an IFI (70-1151/92-04-40).

f. Operating Procedures

The operating procedures reviewed by the team adequately specified the controls and limits associated with chemical safety systems necessary for operators in the performance of their duties. In addition, procedures contained guidance for operators to cope with process abnormalities.

For example, the operating procedures governing uranium hexafluoride vaporization prescribed precautions for minimizing gaseous releases when connections broke, lines were purged prior to disconnect, and required personnel protection equipment to be worn when disconnecting process lines.

As an another example, Procedure SY-108, "Work Assignments in Confined Spaces," Rev. 3, dated November 1989, established the standards to be followed for confined space entry. This procedure specified precautionary measures to be taken for ventilation, purging and isolating vessels, electrical lockout, testing for the presence of toxic gases or explosive atmosphere, and testing for

sufficient oxygen. Form SY-108-1 listed the confined spaces in the plant and form SY-108-2 constituted a confined space work permit which provided a checklist of precautionary measures.

g. Training

Procedure CA-006, "Columbia Plant Training Policy," Rev. 4, dated January 23, 1992, established the policy and procedures for training. Operating personnel received training, both orientation and on-the-job, in industrial safety and hygiene in accordance with the requirements of OSHA's Hazard Communication Plan. However, chemical process safety training was not formalized.

Training was provided on the procedures for the safe handling and disposal of hazardous chemicals as documented in procedure SY-107, "Job Safety Analysis," Rev. 3, dated April 1988. Employees received sufficient chemical safety training for their specific job situations. Operations personnel were knowledgeable in: 1) detecting hazardous situation by smell, appearance, or monitoring equipment; 2) the physical and health hazards posed by chemicals used in their area; 3) response to an emergency; 4) work practices and protective clothing; and 5) location of MSDSs and how to read and understand them. However, excessive reliance was placed on direct line supervision. Per procedure OA-303, "Manufacturing Department Training," Rev. 2, dated June 1990, supervisors are responsible for determining the training requirements, maintaining training history, reviewing training progress, and planning annual training.

Training was provided on hazardous chemicals in the work area at the time of initial assignment and whenever a new hazard was introduced into work areas through the workplace meetings. Training included methods and observations used to detect releases, such as visual appearance and odor; physical and health hazards; protective measures to prevent exposure, such as appropriate work hazards, emergency procedures, and personal protective equipment; and the details of the hazard communication program, such as labeling and MSDSs.

Informal chemical safety training was provided through workplace meetings. Supervisors held periodic workplace meetings to discuss operational and safety issues. The Regulatory Engineering staff responsible for chemical safety used the workplace meetings to conduct chemical safety training. The training typically took place following accidents or injuries. Although this training mechanism proved efficient, it was not formalized in a program document.

h. Maintenance and Surveillance

Procedure RA-104 required Regulatory Affairs personnel to ensure that new equipment installed with safety interlocks was noted and incorporated into instrument maintenance and calibration programs. It also required a list be provided of safety interlocks and their function to the Area Manager and Manager of Maintenance. Regulatory Engineering possessed a system to identify process interlocks including those dealing with chemical safety and perform functional testing on those interlocks. A program existed to identify safety related components and systems to ensure maintenance and surveillance was performed. RA-108 listed such components and RA-109 documents the functional testing requirements. However, this procedure did not specify surveillance requirements for engineered controls other than certain interlocks. This is another example of safety related controls not being included in preventive maintenance program (70-1151/92-04-27).

Despite the documentation failure noted above, the team noted that the licensee performed surveillance activities of engineered controls other than interlocks. For example, the team determined that periodic integrity testing of storage tanks was performed. Although not formalized in a procedure, above ground tanks were subject to periodic integrity testing using such techniques as hydrostatic testing, non-destructive shell thickness testing or visual inspection as required by 40 CFR 112.7(e)(2)(vi).

The team also noted that the licensee had a procedure for safe work practices during maintenance and surveillances. For example, Safety Manual policy SY-203, "Equipment Safety Lockout and Tagging," Rev. 4, dated February 26, 1992, included the requirements of 29 CFR 1910.147 which established guidance for disabling equipment to prevent hazardous releases while maintenance is being performed. Also, procedure MAP-GE002, "Locking Out/Tagging Equipment For Maintenance," Rev. 3, dated November 1988, addresses safe maintenance practices.

i. Chemical Storage and Handling

The procedures for handling chemicals provided adequate instructions and precautions. These procedures included the unloading and loading of bulk chemicals, process operations involving chemicals, laboratory activities, and mitigation of spills and other releases.

SY-206, "Safe Storage and Handling of Compressed Gas Cylinders," Rev. 3, dated April 25, 1988, provided a procedure to ensure safe handling and storage of compressed gas cylinders in accordance with Compressed Gas Association Pamphlet P-1-1965.

The overall storage and handling techniques were adequate. Incompatible materials were adequately separated. The hydrofluoric acid was stored in a separate farm than the ammonia. The nitric acid was stored in a separate dike from organics with no valving between the dikes. Acids and bases stored in containers in a common storage area were provided a sump between the storage locations, drums containing flammable/combustible chemicals were grounded, and pressure relief was provided to storage tanks.

Good practices existed except for the following situations: the sulfuric acid storage tank had no dike, the capacity of the dike for nitric acid storage tank is inadequate and the valved line to the ammonia dike was open, and there was no scrubber for the vent line from the hydrofluoric acid storage tank. The above problems were noted as an area for improvement.

j. Chemical Release Response

The licensee had implemented adequate contingency planning for emergencies. Procedures and equipment were described in the emergency plan and training was provided for employees and others designated to act under these plans. The Emergency Brigade had been trained in procedures for responding to emergencies including hazardous chemicals. Procedures were in place for notifying the EPA and state and local agencies.

The licensee had on staff a certified Red Cross instructor (first aid and CPR) and a certified EMT. These individuals were in the Regulatory Engineering section responsible for chemical safety and industrial hygiene. Also, the licensee provided medical personnel for advice and consultation. First aid supplies were readily available.

Company procedures provided cleanup measures for specific substances in the event of spills or releases of such substances and defined necessary steps to be taken in the event of a release of hazardous materials, toxic fumes, or vapors. For example, Emergency Procedure CSEP-0011, "UF_6 Releases," Rev. 0, defines actions required following an accidental release of uranium hexafluoride. Also, operating procedures COP-814301, "UF_6 Emergency Ventilation," Rev. 4, dated October 1989, MAP-EM005, "HF Release," Rev. 2, June 1989, address uranium hexafluoride and hydrogen fluoride releases.

The licensee used the Hazardous Management Emergency Response and Best Management Practices Plan to respond to hazardous chemical releases. The plan contained instructions on how to deal with spill prevention and control and contained a countermeasure program which meets the requirements of 40 CFR 112. This document was geared to the EPA regulations for offsite emergency planning,

preparedness, and response under SARA Title III, "Emergency Planning and Community Right-to-Know Act," which requires reporting for threshold levels established in the Plan.

All large aboveground fuel tanks were properly equipped with secondary containment except the sulfuric acid storage tank.

Where the eyes or body of any person could be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body were provided within the work area for immediate emergency use. Eye-wash fountains and safety showers were provided in areas where chemicals are used.

The team evaluated the actions taken by the licensee as a result of industry incidents. The licensee provided good response to outside incidents. For instance, Chemical Process Engineering identified pumps that could dead head without immediate detection. Once a list was generated, maintenance personnel installed external pump temperature switches that shut down pump and disallow restart. Safety control systems were being specifically configured for each pump application. Pump overheating was prevented by pressure switches, flow meters, logic enhancement as required to detect and prevent pumps from operating without circulation or ample supply. Operating procedures were reviewed and modified to identify mechanism used for detection of a potential dead head and to use water flush on systems when changing from ammonia to nitric acid and visa versa during cleanouts.

k. Hazard Communication

The licensee alerted employees about workplace chemicals by giving them greater access to information on the physical and health hazards of chemicals, safe handling precautions, and emergency and first aid procedures. Westinghouse had established a hazard communication program to transmit information on the hazards of chemicals to employees by means of labels on containers, material safety data sheets, and training programs.

The MSDS system was the main vehicle for communicating hazards, safe handling and emergency procedures for hazardous chemicals in the workplace. Copies of MSDSs were readily available to employees in the workplace, i.e. MSDSs were available in the control rooms. In addition, the Regulatory Engineering staff member responsible for chemical safety compiled all MSDSs in a library available for reference. MSDSs existed for each hazardous chemical used. The MSDSs reviewed by the team contained all the information required by 29 CFR 1910.1200(g)(2).

The licensee provide training for those employees who routinely encounter chemical hazards on the job. Training consisted of instructions on how to read and interpret information on labels

and MSDSs, information on the location of the written hazard communication plan, education as to the physical and health hazards of the chemicals and hazardous materials in the employee's work areas, measure employees can take to protect themselves from the hazards, and explanation of the specific procedures put into effect to provide protection, such as work practices, emergency procedures, and the use of personnel protective equipment, and information on methods and observations, such as visual appearance or smell, that workers can use to detect the presence of a hazardous chemical to which they be exposed.

In accordance with procedure SY-107, the training program focused on teaching employees what they need to know to work safely and to protect their health. Workers are observed on the job to determine if they are familiar with the hazardous properties of the chemicals they work with, and with emergency equipment and procedures. In addition, Regulatory Engineering used audiovisual materials to conduct chemical safety training.

Westinghouse Site Safety Manual Procedure SY-110, Hazard Communication (Right to Know) established the hazard communication requirements. This written hazard communication program described how the criteria for labels and other forms of warning, material safety data sheets, and employee information and training will be met.

Lists of chemicals within a particular area were posted on bulletin boards in that area. A list of hazardous chemicals known to be present used an identity that was referenced on the appropriato MSDS. The list was compiled for the workplace for individual work areas. The methods used to inform employees of the hazard of non-routine tasks, such as maintenance activities, included labeling of piping and process vessels and establishing supplemental operating instructions with the appropriate precautions.

Process vessels and containers of hazardous chemicals were labeled, tagged, or marked with the identity of the hazardous chemical and hazard warnings. The process vessels were labeled with not only chemicals normally present but chemicals that might be potential contents. Labels and hazard warning signs were prominently displayed.

The Westinghouse hazard rating was based on NFPA 704. The flammability and reactivity codes were the same. The health effects code accounted for exposures which occur during routine operation as well as during emergency conditions. The hazard warning system defined health hazards in accordance with Appendix A of 29 CFR 1900.1200. The licensee had adequately ascertained the hazards of the chemicals in accordance with the criteria set forth in Appendix B.

No significant problems existed in the hazardous material information system related to the availability of MSDSs, labeling, and appropriateness of hazard warnings. However, the training program lacked the formality to evaluate the effectiveness of its implementation. Hazardous communication training was not documented. Safety and Health training program was not explicitly defined and no training outline or manual existed to ensure proper content and application.

11. Fire Protection

The fire protection program of the facility was measured against the BTP on Fire Protection for Fuel Cycle Facilities, published in March 1989, and industry standards, notably the National Fire Protection Association codes. In performing the assessment, the team toured all the buildings and the adjacent outdoor storage, materials handling, and equipment areas which house or support licensed activities. Documents were examined for the purpose of assessing the licensee's commitment to the fire protection program and actual performance of its procedures. The assessment methods also included examination of randomly selected portable extinguishers and of installed automatic fire protection equipment, process equipment, and past inspection reports of American Nuclear Insurers (ANI). Several facility employees were interviewed.

a. Building Fire Safety

The UO2 manufacturing processes of the facility are housed in a cluster of high-bay interconnected buildings. The buildings were all constructed of noncombustible or limited combustible materials.

The part of the main fuel manufacturing building to the north of the five pellet lines is partially protected by a wet-pipe sprinkler system. The final fuel assembly and inspection areas are left uncovered because of nuclear criticality concern.

Other areas covered by sprinkler systems are the UF_6 bay, one part of the second level of the main manufacturing building, comprising the computer area, and part of the 1978 addition to the southwest, housing the solvent extraction system and the incinerator. The close proximity of the incinerator to the solvent extraction system presented a fire hazard. This hazard had been identified during a previous inspection in May 1990. The licensee informed the team of plans to construct a fire barrier between the solvent extraction plant and the incinerator in the near future and has already taken action to appropriate funds for the purpose. The construction of a fire barrier in this area was identified as an IFI and will be reviewed in a future inspection (70-1151/92-04-41).

The remainder of the manufacturing areas are protected by portable fire extinguishers. A system of heat-activated fire detectors covers portions of the areas, such as over the hot oil lines and the sintering furnaces.

b. Process Fire Safety

The team examined the sintering furnaces and hot oil room. The team also toured the tank farm, the boiler house, the pump houses, the equipment and buildings associated with the waste recovery system, and the now oil house. No deficiencies were found in the outside equipment and buildings.

c. Prevention of Uranium Oxide Fires

The team assessed the licensee's response to NRC Information Notice 92-14, Uranium Oxide Fires at Fuel Cycle Facilities, dated February 21, 1992. The licensee had performed an overview of the IN to a large segment of the process employees. The team also reviewed the licensee's actions in response to a uranium oxide fire that occurred on July, 30, 1992. The cause was identified as the oxidation of unstable UO_2 powder in contact with combustible material. The licensee was in the process of replacing combustible material with non-combustible material at the time of the assessment.

d. Fire Protection Equipment

The facility had a fire water system consisting of an 8-inch underground looped fire main supplied by the Columbia City water system, an adequate number of fire hydrants, two water storage tanks with capacities of 200,000 gallons and 250,000 gallons respectively, and two diesel driven fire pumps in separate pump houses.

Pull-boxes are installed at strategic locations around the facility. These, the fire detectors, the fire pumps, and the sprinkler flow alarms were connected to a central annunciator panel at the guard station.

The team requested a test of the automatic start of the pumps. Upon lowering of the fire main pressure, the fire pumps started in sequence. The team verified that the fire pump start activated the guard station alert automatically. The test was satisfactory.

Apart from the fixed fire suppression equipment mentioned above, portable extinguishers are deployed at appropriate locations throughout the facility. The type and capacity of the extinguishers were judged to be appropriate and monthly inspection

tags were initialled up to date. However, one fire extinguisher in the IFBA building was found to be discharged. The licensee took immediate action to replace the extinguisher.

Fire protection equipment maintenance records were examined for timely inspection and maintenance of the equipment. No deficiencies were found.

e. Pre-Fire Planning

The facility Pre-Fire Plan was examined. This document contains the facility's plan for responding to fire emergencies. The functions of the Emergency Director, the Emergency Coordinator, and other emergency staff members have been described in the plan. A call sequence in the event of an emergency has been established. The Emergency Brigade functions under the direction of the Emergency Coordinator. In the event of a fire, this brigade is called to action by a fire alarm, that is audible throughout the facility. When the Emergency Director (or alternate) makes a determination that offsite assistance is needed, the City of Columbia Fire Department is notified. The Fire Department may request additional help form the surrounding communities. The licensee maintained a letter detailing the agreement with the City of Columbia to provide assistance in the event of a fire. Joint fire emergency drills, of the site Emergency Brigade and the City Fire Department were performed annually. The last such drill was hold In November 1991. No deficiency was found in the prefire planning area.

f. Administrative Controls

The team examined the following documents in an effort to gauge the extent of administrative control exercised over movement of combustible substances, hazardous operations, such as welding and other hot working, housekeeping, and safety items:

(1) Safety Manual
(2) Safety Action Group Reports
(3) Weekly Safety Checklists

g. Housekeeping

The team reviewed the site to ensure that combustible materials were not accumulated in a manner so as to pose a fire hazard. In the powder storage area, the team identified many items such as, wooden pallets, and packaging materials that represented an increased fire hazard. This was identified as an area for improvement.

It also appeared to be regular practice for personnel to store cardboard boxes and drawings outside their storage cabinets, in a narrow space behind the electrical control cabinets in the ADU control room. Employees present in the control room promptly removed the objects.

The team noted several 1-gallon and one 5-gallon approved containers (some of them empty) of isopropyl alcohol stored in a cart in the IFBA production area. The material, which is flammable, was used for cleaning during certain production operations. These materials were not stored in an approved flammable storage cabinet. This was also identified as an area for improvement.

The adjoining loading dock area, where the isopropyl alcohol was dispensed into the smaller containers from a larger drum was determined to be an unsuitable place for the transfer as there were substantial quantities of various combustible materials present in the area. Also, the loading dock was not frequented by employees and there was no fire detector or sprinkler system in the area. This was an area for improvement.

h. Training

The team interviewed the Assistant Chief of Operations, City of Columbia Fire Department. The Columbia stations were expected to respond to a fire at the facility. The chief appeared to be very familiar with the facility and stated that he and his crew members make three or four tours of the facility every year.

The facility sends most of its Emergency Brigade members for fire-fighter training annually to the South Carolina Fire Academy. The team examined a list of the courses of training. The SC Fire Academy was an established fire training school. The establishment of a training program for employees at this school and the record of close cooperation with the City of Columbia Fire Department in conducting joint annual drills at the facility was considered a program strength.

12. Licensee Event Followup (92700)

During the assessment, the team also followed up on an event that had occurred at the plant in July.

On July 29, 1992, representatives from the Westinghouse Commercial Nuclear Fuel Plant (CNFP) in Columbia, SC, notified the NRC of problems that had occurred at the plant on July 8 and during the period from July 23-27. The notification was made in accordance with requirements established in NRC Bulletin 91-01.

On July 8, plant operators discovered an elevated water level in an Independent Direct Route (IDR) vaporizer used to heat UF_6 cylinders. The UF_6 cylinders are heated with 180°F hot water. They found the water level at eight inches versus the normal level of condensate which is approximately 4 inches. Nuclear criticality safety protection for the IDR vaporizers is based on two barriers: 1) preventing a sufficient mass of uranium from entering the water in the bottom of the vaporizer to form a critical concentration, and 2) preventing enough water from accumulating in the vaporizer to for a critical unreflected slab, which is approximately 9.4 inches. Upon investigating the problem, the licensee found that two of the three controls used to prevent accumulation of water in the IDR vaporizer had failed. The three controls were: 1) a gravity drain line located at the four inch level in the vaporizer, 2) a water level probe which was to alarm if the water level reached five inches, and 3) slow water feed rate, approximately 0.5 gallons per hour, during vaporization such that insufficient water would accumulate during the 55 hour vaporization process to cause a problem. The licensee found that the drain line was plugged and that the level indicator/alarm was nonfunctional. Corrective actions included unplugging the drain line and establishing a visual check (an administrative control) of the IDR vaporizers at six hour intervals during processing. The licensee also established a requirement that the operators fill out a condensate level log documenting the water level in each vaporizer. With these controls in place, the licensee deferred repair of the condensate level probe alarm until the planned annual plant shutdown for physical inventory scheduled for August 10.

On July 28, as Regulatory Engineering personnel were conducting a check of the vaporizer condensate level log for the period from July 23-27, it was noted that a drain line in a different vaporizer had apparently become plugged during a period when no UF_6 cylinder was being processed. Regulatory Engineering also found that vaporizer levels had not been recorded in the log on three separate occasions while a cylinder was being processed. During an investigation of this problem, the licensee determined that, again, two of three controls to prevent water accumulation in the vaporizer had been lost: 1) water level alarm probes were nonfunctional and the replacement administrative control of documenting vaporizer levels in the log had failed, and 2) drain lines had been assessed not to be reliable due to the plugging problem. However, the slow water feed rate of 0.5 gallons per hour still remained intact.

On July 29, the licensee became aware that the actual feed rate of water to the IDR vaporizers during processing is approximately 14 gallons per hour during the five hour startup period, and six gallons per hour during the remaining fifty hours of processing for each UF_6 cylinder. Therefore, this new data invalidated the remaining control to prevent accumulation of water in the vaporizer and the licensee realized that no

controls associated with that barrier had been in place on July 8 and during t[illegible]eriod from July 23-27. Due to this determination, the licensee notified NRC Headquarters an[illegible]Region II of the problem.

As a result of this problem, the licensee placed the IDR vaporizer syst[illegible] in a safe shutdown condition with no SNM present. In a letter to Regio[illegible] II dated July 30, 1992, the licensee indicated that teams were established to review both incidents, identify root causes, and establish corrective actions. The licensee committed to Region II that the IDR vaporizers would not be restarted until the above items were completed and a presentation was made to the region detailing the findings and corrective actions. Although no uranium was eve[illegible] introduced into or detected in the water in the vaporizers and that barrier remained in place, the problem was of concern. The second event w[illegible]d not have occurred if the licensee had performed an adequate review of the first event and taken the appropriate corrective actions

In a letter issued August 7, 1992, to Region II, the licensee [illegible]ated that the root cause of the problem had been determined to be fa[illegible]e to provide effective engineered controls for assuring that vaporize[illegible] levels did not exceed conditions specified in the criticality safety analyses. The letter also stipulated that the licensee would take the following actions to correct the problems noted and prevent recurrence:

- Inspect all piping ass[illegible]d wit[illegible]e MAP IDR vaporizers drain system to verify that no [illegible]ockages or restrictions remained.

- Periodic inspection would be scheduled and performed to verify the continued functionality of the drain system.

- Piping modifications would be implemented to establish passive engineered control to maintain the appropriate liqu[illegible] level in the vaporizers.

- Liquid level probes would be installed and functionally verified on each MAP IDR vaporizer to alarm at the six inch level and would be interlocked to shut off team and emergency cooling water to the vaporizers.

- Routine functional testing would be conducted to verify operability of the probes.

Following discussions concerning the adequacy of the corrective actions that had been planned, the licensee issued another letter to Region II dated August 26, 1992. The letter included an Executive Summary of the findings of the team which had investigated the MAP IDR vaporizer event and further detailed the corrective actions that the licensee would take. The licensee's team determined that, in addition to failure to provide effective engineered controls, the high condensate level in the vaporizers had been caused by debris that had lodged in a check valve in

the gravity drain line. Therefore, in addition to the actions mentioned above, the licensee agreed to do the following prior to resuming operations of the MAP IDR vaporizers:

- Train the operators on the consequences of allowing trash to fall into the vaporizers and provide trash receptacles for such items.
- Establish preventive maintenance on vaporizer condensate drain lines to be conducted every eight weeks.
- Functionally check the level probe as part of each cylinder installation and perform an initial check of the probe interlock and perform a functional check annually thereafter.
- Update and validate the procedures affected by the changes that had been made.
- Increase management surveillance to insure procedural compliance.
- Train the operators on the vaporizer criticality safety interlocks, walk down the systems with the operators, and train the operators on the procedural changes that had been made.

An assessment team member reviewed the corrective actions that the licensee had taken on August 28 and 29. The NRC team member verified that the physical changes had been made to the vapor zone, i.e. that the level probe had been installed and that the 3-inch passive, non-routine drain was in place. The team member observed the functional test of the level probe and the functional test of the level probe interlocks during the evening of August 28. Through interviews with selected MAP team members and review of the training material provided, the NRC team member determined that the training provided to the operators appeared to be adequate. Although the procedures had been revised and were being revised further on August 29, the major changes appeared to be adequate to provide for safe operation of the vaporizers. After further in-office review of the finalized procedures and plan for increased management surveillance on August 31, the NRC issued the licensee a letter dated September 1, 1992, which indicated that Region II concurred with the resumption of the MAP IDR vaporization operations.

13. Exit Meeting

During the meeting, the items described in this report as program weaknesses, program strengths, and areas for improvement were presented to the licensee personnel indicated in Paragraph 1. Particular emphasis was placed upon those issues related to lack of control of non-favorable geometry containers. The licensee provided comments on various findings presented by the team but voiced no opposition to the team findings. The exit meeting was also attended by the Director, DRSS for Region II and the Chief, Fuel Cycle Safety Branch for the Office of Nuclear Materials Safety and Safeguards. Following the exit meeting, a meeting was held with the Director, DRSS, the Chief, Fuel Cycle Safety Branch for NMSS and key members of the licensee management for the purpose of

reaching agreement on the course of action the licensee would take with regards to the team findings in the area of criticality safety. At this meeting, the licensee agreed to meet with Regional management and present a performance improvement program (PIP) addressing the area of criticality safety.

14. Abbrevations and Acronyms

ADU	Ammonium Diuranate
ALARA	As Low As Reasonably Achievable
ANI	American Nuclear Insurers
ANS	American Nuclear Society
ANSI	American National Standards Institute
ART	Airborne Reduction Team
BTP	Branch Technical Position
CAD	Computer Aided Drafting
CAS	Central Alarm Station
CFD	Columbia Fire Department
CNFP	Commercial Nuclear Fuel Plant
COMETS	Columbia Onsite Monitoring and Emergency Tracking System
CPR	Cardio-pulmonary resuscitation
CSA	Criticality Safety Assessment
CSEP	Columbia Site Emergency Procedures
CTS	Commitment Tracking System
DHEC	Department of Health and Environmental Control
DOE	Department of Energy
DP	Data Packs
dpm	Disintegrations per minute
DRSS	Division of Radiation Safety and Safeguards
EMT	Emergency Medical Technician
EPA	Environmental Protection Agency
EPS	Electronic Procedure System
ERO	Emergency Response Organization
GE	General Electric
HAZOP	Hazard and Operability (analysis)
HEPA	High Efficiency Particulate Air (filter)
HP	Health Physics
IAEA	International Atomic Energy Agency
IDR	Indirect Dry Route
IFBA	Integrated Fuel Burnable Assembly
IFI	Inspector Followup Item
IMOB	Operations Branch of NMSS
IMSB	Fuel Cycle Safety Branch of NMSS
kg	Kilogram(s)
LLWB	Low-Level Waste Management Branch of NMSS
MAP	Manufacturing Automation Project
MAPCON	Maintenance Planning and Control
MPC	Maximum Permissible Concentration
mR/h	Millirem per hour
MSDS	Material Safety Data Sheet
NCS	Nuclear Criticality Safety
NCSE	Nuclear Criticality Safety Evaluation