

## DEFENSE NUCLEAR FACILITIES SAFETY BOARD

December 16, 1993

**MEMORANDUM**  
**FOR:** G. W. Cunningham, Technical Director  
**COPIES:** Board Members  
**FROM:** Herbert W. Massie, Jr.  
**SUBJECT:** Trip Report on Configuration Management, Maintenance, and Inspection at F Canyon/FB Line of Savannah River Site

1. **Purpose:** The Defense Nuclear Facilities Safety Board (DNFSB) staff met with DOE Savannah River Office personnel and Westinghouse Savannah River Company (WSRC) personnel to assess the implementation of configuration management, maintenance, and inspection programs at the F Canyon and FB Line. This review, conducted on November 16-18, 1993, by Herbert W. Massie, Jr. and Robert F. Warther, entailed the review of adherence to pertinent DOE Orders and use of commercial nuclear industry practices. The standards used to support this review are listed in Attachment B.
2. **Summary:**
  - a. The inspection program at F Canyon/FB Line does not meet the requirements of Paragraph 11b of DOE Order 4330.4A, *Maintenance Management Program*. A recent discovery of significant corrosion in Tank 17.1 is an example of the lack of inservice inspection at F Canyon.
  - b. The configuration management program has two equipment classifications for F Canyon/FB Line systems, structures, and components. The newer classification is based on the new DOE standard, DOE-DP-STD-3005-93 (proposed) which is less conservative than the original classification.
  - c. Major upgrades have been proposed for the ventilation systems of F Canyon/FB Line, the emergency diesel generators, and fire protection. Adequate technical justification was not provided to the DNFSB staff for not completing the proposed upgrades prior to restart.
  - d. Procedures and training for performance of electrical maintenance work are inadequate.
3. **Background:** Many commercial nuclear plants have experienced equipment failures during plant startup and after being in a long-term (> 1 year) shutdown. Recent experience at K reactor also confirms this problem. The FB Line and major portions of the F Canyon have been shutdown since 1989. DOE's Order 4330.4A, *Maintenance Management Program*, provides an umbrella for effectively maintaining and

inspecting key safety and other systems so that F Canyon and FB Line can be safely operated over its current short mission ( » 22 months). A properly run configuration management program should result in having accurate drawings of key safety systems, accurate procedures and proper facility system line-ups prior to restart. Moreover, a properly-run inspection program of key safety structures and components directly protects public and worker health and safety by minimizing (if not eliminating) equipment failures. An inspection program can also be a compensatory measure for deficiencies in the design basis of an older facility.

Configuration management was discussed during the first day of the review. Also, a walkdown of the facilities was made on the first day. Maintenance, inspection, review of specific maintenance examples, and review of work packages were performed on the second and third days. A DNFSB staff member also conducted interviews of eight maintenance workers and four supervisors.

4. **Discussion:** The staff's major findings and observations for the Configuration Management program and the Maintenance and Inspection programs are as follows:
  - a. ***Configuration Management:*** Significant confusion exists in the equipment classification area. The current equipment classification has 28 Nuclear Safety Class (NS) systems defined for F Canyon/FB Line. A newer equipment classification based on the WSRC E7 "Manual for Conduct of Engineering and Technical Support" identifies only 8 NS systems. The newer system was said to be based on the new DOE Order 5480.23-related standard, DOE-DP-STD-3005-93 (proposed). This standard states that only those systems, structures, and components which are needed to prevent 25 rem at the site boundary are required as safety class items. Since the NS designated equipment under the new classification are primarily major structures, the DNFSB staff believes that the new classification reduces the defense in depth of the F Canyon and FB Line.
    1. ***Drawing Control:*** Some evidence in discussions with maintenance workers and supervisors indicated that drawings may be out-of-date. Also, not all drawings for the NS systems will be walked-down prior to restart. Reliance will be on functional testing of the safety-related system.
    2. ***Procedures:*** Electrical and Instrumentation (E&I) mechanics in the separations facilities recently initiated a safety stand-down because of an electrical incident. An E&I mechanic was performing maintenance on electronic equipment, and failed to verify a circuit de-energized prior to disconnecting the power supply. In fact, the mechanic had removed one of the power supplies to the circuit.

However, the circuit had a second power supply which was not reflected in the maintenance procedure. This second power supply provided power to the circuit even after removal of the first power supply. The mechanic followed the maintenance procedure verbatim. However, there were two causes for this problem. First, the site electrical safety procedure, which is always in effect, was not followed. If this procedure had been followed,

the mechanic would have checked that the circuit was de-energized prior to disconnecting the power supply, and would have found the circuit to still be energized. At that point, the mechanic would have stopped work and called his supervisor. Second, the maintenance procedure was erroneous because it indicated that the circuit should have been de-energized following removal of the first power supply. This procedure had been used for over six months with no indication that it was not accurate.

The two issues that arise from this particular incident are: (1) training for E&I mechanics to check circuits de-energized prior to removing power supplies, and (2) verification of procedures. The staff noted that the CM program at SRS has not progressed substantially. SRS maintenance planning personnel stated that drawings and vendor technical manuals have not been updated, and are not accurate. The DNFSB staff did not confirm this statement. However, it would appear that accurate technical documentation was not used to prepare the maintenance procedure. If it had been used, then the procedure writer would have noted that two power supplies to the equipment existed. SRS did not address this issue.

- b. ***Maintenance and Inspection:*** No inservice inspection program exists for F Canyon/FB Line. Paragraph 1 lb of DOE Order 4330.4A requires that periodic examinations of systems, structures, and components (SSCs), particularly those important to the safe and reliable operation of a facility, shall be performed to determine whether deterioration has taken place and to develop a formal program for resolving identified issues. This periodic examination is, in effect, an inservice inspection program.

Recent experience with corrosion in the F Canyon Tank 17.1, which stores highly radioactive americium and curium in nitric acid solution, illustrates the need for an inservice inspection program. No sampling or inspections have been made on Tank 17.1 in the last 13 years. However, WSRC has in the past performed ultrasonic testing (UT) of FB-Line slab tanks to verify favorable geometry. As an example, the DNFSB staff reviewed results of a UT that had been performed about 2 years ago on a dissolver tank, D-1. Since the last inspection, (about 16 years ago), the tank corroded about 70 mils (of a 1/2 inch wall), or about 4 1/2 mils/year. The DNFSB staff found no evidence that WSRC monitored this wall thickness to establish tank integrity. For the tanks which are geometrically favorable, the staff understands that criticality concerns are more limiting than for structural integrity. Moreover, other tanks are not inspected.

1. ***Work Control:*** The work control process as specified in DOE Order 4330.4A requirements is new to F Canyon/FB Line and was implemented in February 1993. The work control program was based on an H-Area pilot program which had been initiated in 1991. Based on discussions with the WSRC maintenance managers, engineering managers, and the maintenance workers, it was stated that paperwork had substantially

increased. This may be due, in part, to the lack of familiarity of F Canyon/FB Line personnel to nuclear facility quality requirements. The staff is also concerned that confusion in the equipment classification area further impacts the work control area by making the requirements less clear. Classification of equipment is used to help set priorities on the corrective maintenance backlog. The DNFSB staff believes that because of the importance of work control to plant safety the work control process needs to be set in place prior to plant startup.

2. ***Procurement Control:*** The procurement control at F Canyon/FB Line is controlled by equipment classification which allows the use of "off the shelf" commercial-grade items on safety-related equipment. Safety-related equipment is defined as nuclear safety (NS) and critical protection (CP) items. Review of a work package KWL 83 for repair of diversion valves (which are CP equipment) confirmed that replacement of valve motor bearings used basic "off the shelf" items. Since much of the safety-related equipment is being downgraded from "NS" to "CP," nuclear-grade components for plant modifications, maintenance, and repairs will not be utilized. For NS items (using the new classifications), which are essentially safety class items (SCI) per DOE Order 6430.1A, nuclear grade replacement parts would be required. It was stated by WSRC management that many components needed to be classified as "CP" such that it will be possible to perform timely repair work. The NS components based on the new classification are: the canyon structure, emergency diesel generators, off basin and curbs, canyon exhaust tunnel and stack, canyon exhaust system, sand filters for F Canyon, and building walls for the FB Line. Except for the diesel generators, the primary NS items are major structures which are unlikely to require replacement parts.
3. ***Continuous Air Monitors (CAMs) Preventive Maintenance:*** Review of occurrence reports by the staff indicated failures of the CAMs caused by lack of timely calibration. The staff found that a predictive/preventive maintenance program which was recommended in an occurrence report had not been fully implemented. The DNFSB staff believes that this area needs increased attention for restart of the FB Line.

Additional discussion of the above issues is provided in Attachment A.

5. **Future Staff Actions:** The DNFSB staff plans the following actions for F Canyon/FB Line prior to restart:
  1. review the basis for F Canyon and FB Line not having a formal inservice inspection program,

2. review the implementation of the final equipment classification,
  3. review the implementation of the CAMs predictive/preventive maintenance program for protecting the health and safety of FB Line workers,
  4. request from DOE technical justification for not upgrading ventilation systems, emergency diesel generation and fire protection systems.
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## Attachment A

### Detailed Discussion of the F Canyon/FB Line Configuration Management, Maintenance and Inspection Reviews

November 16-18, 1993

- a. ***Configuration Management (CM)***: The scope of the CM effort at F Canyon and FB Line is focused on safety-related systems, structures, and components (SSCs) for restart. In these areas, the DNFSB staff noted significant confusion by CM organization, engineering, and maintenance representatives at the meeting. Currently, F Canyon and FB Line (FC/FBL) have two equipment classifications lists. All equipment is classified into four categories: 1) NS is nuclear safety, 2) CP is critical protection, 3) PS is production support, and 4) GS is general support: WSRC has recently reclassified its systems, structures, and components (SSCs) based on WSRC's "E7 Manual for Conduct of Engineering and Technical Support, Procedure 2.25 Functional Classifications" resulting in the second listing. This newer classification method is based on DOE Standard DOE-DP-STD-3005-93 which is based on a dose of 25 rem at the site boundary and reduces the number of NS components (i.e., safety class items per DOE Order 6430.1A) from about 28 to 8. Currently, WSRC utilizes the old equipment classification, but plans to switch over to the new classification prior to restart.

WSRC defines safety-related SSCs as those designated as NS plus CP. In reality, the site maintenance and engineering organization treats CP and NS components in a similar manner, except for procurement. Components specified as "CP" can be procured as commercial grade, off-the-shelf item; but items designated as "NS" must be procured as nuclear-grade components and meet NQA-1.

It was stated by the systems engineering (SE) manager that much of the FC/FBL equipment or replacement parts cannot be procured as "NS" because they were not designed as NS. No compensatory measure is proposed for restart.

The SE manager stated that the original M&O contractor/designer did design FC/FBL SSCs which were believed to be important (or safety-related), to a higher level of quality, but clearly not equal to today's NS standards.

1. ***Design Basis Reconstitution***: Due to the age of the plant, WSRC cannot

reconstitute the design basis (e.g., design calculations) for many of the FC/FBL systems, structures, and components. Also, not all drawings for the NS and CP systems and components will be walked down prior to startup. WSRC will rely primarily on functional testing of the safety-related systems (NS and CP) prior to restart. Based on the age of the plant, it is not clear that functional testing alone (i.e., without additional inspections) would be adequate to prevent equipment failure over a 22-month operation.

WSRC generally does not have design calculations on many of FC/FBL systems, structures, and components. However, the staff reviewed a 1985 design modification package for the FB Line breathing air system. Calculations contained in the engineering project file were basically informal with no evidence of independent checking as required by DOE Order 5700.6C (Quality Assurance) and by Appendix B of 10 CFR 50 for commercial nuclear power plants and fuel reprocessing. The DNFSB staff understands that calculations on original equipment may not exist, but that design calculation on newer designs and modifications are required; these modifications and designs were not reviewed by the DNFSB staff

2. **Configuration Control**: System engineers are key implementers of design configuration control at FB-line and F Canyon. System engineers approve all work packages and retest requirements, and then are responsible for drawing accuracy. In addition, engineering directs the predictive maintenance program because engineering is the organization that reviews the data.

Interviews with some of the maintenance workers indicated that some concerns may exist in drawing accuracy. In later discussions with WSRC system engineering management, it was stated that these could be due to the mission change of the facility. Apparently, some changes were made to drawings in anticipation of planned plant modifications. WSRC is, in fact, implementing a new system to control vendor manuals before startup.

- b. **Maintenance and Inspection**: DOE Order 4330.4A, Maintenance Management Program, was issued on October 17, 1990. This order provides a framework for safely maintaining a nuclear facility including the need to address deterioration of equipment as specified in paragraph 11b of the Order. Further guidance is found in draft DOE standard on configuration management, *Implementation Guide for Operational Configuration Management Program, Including the Adjunct Program of Design Reconstitution and Material Condition and Aging*; this document is planned for issuance by the end of November 1993 but has not been imposed as a requirement on F Canyon and FB Line.

The DNFSB staff reviewed selected areas of the DOE Order 4330.4A as applied to FC/FBL including work control, procedures, measuring and test equipment (M&TE) calibration, use of maintenance history, maintenance backlog, and use of trending/root cause analysis. The DNFSB staff also reviewed the plant's inservice inspection

program for addressing equipment aging. Specific maintenance examples such as process vessel/tank inspections, exhaust fan maintenance, diesel generator maintenance, diverter valve maintenance, glovebox/glove maintenance and inspection program, and use of preventive and predictive maintenance were also reviewed. The staff also reviewed the maintenance organization structure and its relationship to both operations (i.e., facility management) and to engineering. The following findings and observations are noted:

1. **Management Organization:** Maintenance is performed by a matrix organization. The F Canyon and FB Line maintenance managers (MMs) report to the F Area maintenance manager, to the F Canyon facility manager and FB-Line facility manager, respectively. Facility managers provide day-to-day guidance. Support from systems engineering, procedures group, procurement, and training is all provided to the maintenance managers. The staff found this area to be satisfactory as compared to DOE Order 4330.4A requirements.
2. **Work Control/Maintenance Backlog:** The work control process as per DOE Order 4330.4A requirements is new to FC/FBL and was implemented in February 1993. The work control program was based on an H-Area pilot program which was initiated in 1991. Evidence based on discussions with the WSRC maintenance managers, engineering managers, and the maintenance workers, indicated substantially increased paperwork and concern by WSRC employees with the amount of paperwork in this area. The staff is also concerned that confusion in the equipment classification area further impacts the work control area by making the requirements less clear. The equipment classification is used to help set priorities on the corrective maintenance backlog. The maintenance organization stated that about 80 corrective maintenance packages are written each month with 50% completed. Hence, the backlog is increasing. WSRC stated that for the safety-related (NS and CP) components, fifteen packages were in the backlog.
3. **Procurement Control:** The procurement control at FC/FBL is controlled by the equipment classification. Review of a work package KWL 83 for repair of diversion valves (which are CP equipment) confirmed that replacement of valve motor bearings used basic "off the shelf" items. For NS items (using the new classifications), which are essentially safety class items (SCI) per DOE Order 6430.1A, nuclear grade replacement parts would be required. The NS components based on the new classification are: the canyon structure, emergency diesel generators, off basin and curbs, canyon exhaust tunnel and stack, canyon exhaust system, sand filters for F Canyon, and building walls for the FB Line. Except for the diesel generators, the primary NS items are major structures. All other equipment is CP, PS, or GS which allows the use of "off the shelf" commercial grade items for replacement.

At this point in time, no nuclear grade components have been utilized on FC/FBL in the past or are planned to be used in the future.

4. **Trending/Root Cause Analysis:** No systematic program has been implemented

to trend failures of NS and CP equipment and to provide input on replacement and inspection intervals to the maintenance organization. Some root cause analysis has been performed as part of occurrence reporting requirements per DOE Order 5000.3A.

5. **Inservice Inspection:** No inservice inspection program exists for F Canyon/FB Line. Paragraph 1 lb of DOE Order 4330.4A requires that periodic examinations of systems, structures, and components (SSCs), particularly those important to the safe and reliable operation of a facility, shall be performed to determine whether deterioration is taking place and to develop a formal program for resolving identified issues. This periodic examination is, in effect, an inservice inspection program.

The recent experience of corrosion in the F Canyon Tank 17.1, which stores highly radioactive americium and curium in nitric acid solution, illustrates the need of an inservice inspection program. No sampling or inspections have been made on Tank 17.1 in the last 13 years.

WSRC in its presentation to the DNFSB staff, presented several preventative maintenance examples which are inspections used at F Canyon and FB-Line. WSRC has in the past performed ultrasonic testing (UT) of FB-Line slab tanks to verify favorable geometry. As an example, the DNFSB staff reviewed results of a UT performed about 2 years ago on a dissolver tank, D-1. Since the last inspection, (about 16 years ago), the tank had corroded about 70 mils (of a 1/2 inch wall), or about 4 1/2 mils/year. This was roughly calculated by the DNFSB staff and had not been done by maintenance. No evidence of trending the wall thickness for tank integrity by WSRC was noted.

In the past, WSRC has performed vibration monitoring of selected motors and oil analysis of diesel generators as predictive techniques. In response to staff questions about performing a systematic review of all safety-related SSCs to determine if additional inspections or monitoring may be required for startup, none is planned. WSRC will rely on functional testing.

No guidance in this area has been provided by DOE Headquarters.

6. **Constant Air Monitors (CAMs) Preventive Maintenance:** An earlier review of occurrence report number SR-WSRC-FB-LINE-1992-0034 by the staff indicated concerns with failure of the count rate meters on the CAMs due to lack of timely calibration. The occurrence report recommended that the CAM systems engineer and health physics (HP) develop a predictive/preventive maintenance program for the CAMs because of their importance. The targeted completion date for this was July 12, 1993. The DNFSB staff requested evidence of the completion of this item.

On July 14, 1993 WSRC issued letter NMP-SEL-930066 which describes a predictive/preventive maintenance program for the portable CAMs. However, this program has not been fully implemented to date. The use of the CAMs are



important to warn personnel of high air activity in the FB-Line. The DNFSB staff believes that this area needs increased attention for restart.

7. **Measuring and Test Equipment (M&TE)**: The measuring and test equipment calibration program appears to be sound. However, the previous M&TE list has been broken up into two lists; M&TE and the installed process instrumentation (IPI). Previously the IPI was included in the facility M&TE list scheduled for calibration. The calibration requirements for the FC/FBL IPI were not clearly specified to the DNFSB staff. This issue needs further review prior to restart.
8. **FB Line Glovebox Maintenance**: WSRC presented a very detailed and comprehensive glovebox and glove maintenance program and procedures. The program includes mechanical line glove cartridge improvements, panel replacements, improved lighting installed, and required use of respiratory protection when working with gloveboxes. The use of respiratory protection for all glovebox work is a precautionary measure.

WSRC was aware and cognizant of the LANL TA-55 glovebox gasket issue and HB-Line glovebox occurrences. Procedures exist for glove inspection, cabinet glove port work, O-ring replacement for glove ports, HP survey of cabinet gloves, and glove replacement for several types of gloveboxes.

9. **Maintenance Procedures**: The electrical and instrumentation (E&I) mechanics in F Canyon/FB Line experienced a safety stand down recently because of a failure to follow procedures. An E&I mechanic failed to properly verify a circuit as de-energized. The circuit had a dual power supply, and the mechanic failed to ensure that the circuit had been de-energized following unplugging the first power supply. The mechanic was given a leave of absence. It should be noted that the mechanic did follow the procedure verbatim, and the procedure contained an error. The procedure had been used previously, with apparently no reported discrepancies. Two types of power supplies for the subject equipment do exist, so it is possible that the procedure was effective for other equipment.
10. **Facility Upgrades**: WSRC stated that a number of facility upgrades, including equipment replacements and repairs have been done over the life of the facility. Examples of replacements are some of the motor control centers and transformers, 221F emergency diesel generators for supplying equipment power to the building, canyon cranes -- hot and warm, FB line control room instrumentation and controls, and base supports for canyon exhaust fans.

WSRC also stated that major upgrades were needed in the ventilation systems of FC/FBL, 254-SF emergency diesel generators and fire protection. Both WSRC and DOE personnel maintained that these upgrades were necessary, but could not provide technical justification for the upgrade needed relative to restart and postrestart.

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# Attachment B

## Maintenance and Configuration Management Review Standards Referenced

1. NUREG/CR-3542, *Survey of Operating Experiences from LERs to Identify Aging Trends*, ORNL report ORNL-NSIC-216, January 1984
2. DOE Order 4330.4A *Maintenance Management Program*
3. DOE Order 5700.6C *Quality Assurance*
4. DOE-STD-5480.CM-XXX (draft) *Implementation Guide for Operation Configuration Management Program, Including the Adjunct Programs of Design Reconstitution and Material Condition and Aging*
5. DOE Order 6430.1A, *General Design Criteria*
6. DOE Standard, *DOE-DP-STD-3005-93 (Proposed), Definition and Criteria for Accident Analysis*
7. DOE Order 5000.3B, *Occurrence Reporting and Processing of Operations Information.*
8. ANSI/ASME NQA-1, *Quality Assurance Program for Nuclear Facilities*
9. Appendix B of 10 CFR 50, *Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants*