DEFENSE NUCLEAR FACILITIES SAFETY BOARD

February 15, 1994

MEMORANDUM FOR: G.W. Cunningham, Technical Director

FROM: John Drain and Ralph West
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THROUGH: Mike Merritt and Paul Gubanc

COPIES: Board Members

SUBJECT: Report of a Trip to the Savannah River Site F-Canyon Facility, February 9-11, 1994

1. Purpose. System Planning Corporation (SPC) provides engineering technical support to the Defense Nuclear Facilities Safety Board under contract DNFSB-93-039. This memo describes and provides comment on conduct of Cold Chemical Runs of the second plutonium process at the F-Canyon Facility. The visit was conducted February 9-11 by outside experts John Drain and Ralph West. The visit was terminated early when the runs were shutdown on the evening of February 10 because of safety documentation questions concerning the process relative to the Tomsk-7 incident.

2. Summary. A cold chemical startup, simulated feed initiation, and steady state operations were observed on the afternoon of February 9 until a leak on a temporary jumper connection caused termination of operations. The next morning the second shift of operators was observed conducting a startup, steady state operations, and a shutdown. On the afternoon of February 10 the originally observed shift was monitored making a startup until operations were terminated because of safety documentation questions concerning prevention of a red-oil explosion similar to the Tomsk-7 incident in Russia in April 1993.

Observations of the runs revealed numerous problems with adherence to conduct of operations requirements.

a. Extensive oversight of operations by senior managers was anticipated but was lacking.

b. A Shift Technical Engineer was stationed to provide technical assistance to the operators and to compensate for deficiencies in the training and qualification program for the operators and supervisors. These engineers had minimal interaction with the operators and it was unclear how they provided the required compensation.

c. Lines of responsibilities among operators and supervisors were indistinct and firm

direction of operations was lacking.

d. Communications were generally informal and contributed to the lack of discipline observed during operations. Shift managers were not routinely kept apprised of problems and status changes. Operators did not question deficient operation of components, and did not routinely inform supervisors of problems.

e. On several occasions material problems were not recorded in logs or on deficiency tags. Several other errors were noted in logkeeping practices.

f. Operating procedures lacked direction in some areas, especially with regard to control of mixer-settler fluid flows and temperatures. This was also noted to be an area in which operators demonstrated a lack of knowledge of control methods and expected effects.

3. **Background.** The F-Canyon facility processes nuclear fuel targets by solvent extraction to remove highly radioactive fission products and retrieve residual uranium and plutonium for future use. The uranium is converted to oxide form at the canyon's A-Line and the plutonium is transferred to the FB-Line for processing to a metallic form. F-Canyon has not operated since March 1992 when it was shut down to resolve an Unreviewed Safety Question regarding the structural integrity of the stack liner during a seismic event. The canyon is currently making preparations to resume operations to process solutions in the facility and targets from the SRS L-Basin. As part of the startup program Cold Chemical Runs are being conducted to checkout equipment, verify procedures, accomplish required qualification actions for operators and supervisors and validate operator adherence to conduct of operation requirements. The runs consist of initiation of aqueous and organic inputs to the A and B mixer-settler banks of the second plutonium process. Following startup, a steady state is maintained for about two hours to demonstrate normal operating performance, then a shutdown is conducted. Some of the runs include initiation of simulated product feed during the cycle. Questions raised recently by DOE about the need for an Environmental Impact Statement have placed the schedule for starting operations in jeopardy.

4. **Discussion/Observations.** Lines of responsibilities within a shift were blurred and formal control of operator actions was lacking. Operator responsibilities were inconsistent between shifts. One shift had a standby operator provide significant assistance to the assigned operator despite the lack of assurance that this would be the typical assignment of personnel during operating conditions. The other shift which was observed had the first line supervisor sitting at the control panels accomplishing control actions concurrently with the operator in an uncoordinated manner. On both shifts, process control displays were changed frequently sometimes with multiple persons making changes without reference to the operator. This meant that an overview of system status was often unavailable to the operator. At one point the Facility Manager provided guidance to always have one of the consoles display a particular overview screen. This guidance was not always followed, and was inconsistently applied by the two shifts observed.

Communications between the operator and his assistant or the first line supervisor were generally informal. Operations were normally conducted following group discussions of actions to be taken and it was frequently unclear if the supervisor had agreed with or approved a suggested course of action. This was especially true during periods of stress when abnormal readings or equipment malfunctions were occurring. Part of this group decision making may have been caused by the presence of the “procedure verification” engineer.

During this initial period of operations after an extended shutdown in which significant changes in conduct of operations requirements had occurred, extensive oversight was expected to be evident to ensure adherence to the new standards. The Plan for Cold Chemical Runs for Second Plutonium Cycle (NMP-SFC-93-0429) specified that full-time coverage by a level four or higher Manager would be provided to "coach and teach facility employees in the conduct of formal and disciplined operations.." Although this coverage was provided these individuals where rarely in the control room and took little action in correcting the deficiencies noted during operations or in setting uniform practices such as maintaining an overview screen, using formal communications or investigating equipment abnormalities.

Shift Technical Engineers (STE) were stationed to provide a technical resource to identify technical, operating and quality problems and initiate recommendations or provide solutions to resolve problems. We had been briefed that they were also to provide compensation for deficiencies noted in the qualification program for the operators and supervisors. STEs sat at the uranium process control panel which was configured to monitor the plutonium process and is located about 15 feet from the second plutonium process control panel. The STEs had minimal interaction with the operators. It was unclear how the STE was expected to provide the required compensation. On several occasions the STE noted or analyzed a problem with no exchange of information with the operators. An example was a noticeable change in tank depletion rate when feed was shifted from tank llG to llH. The STE determined that the system lineup caused recirculation of the tank discharge pump to the opposite tank when using llH, but not when using llG. When questioned later the operators recognized that tank level decrease was different for the two tanks, but did not know the reason. The question was not resolved as to why the standard valve lineup isolated the recirculation paths through orifices for each tank and the only pump recirculation path provided was through a pump gland leakoff line to tank 11G. It was stated that this was the way the system had been aligned in 1989.

Additional specific deficiencies are described in the following sections.

a. **Shift Routines and Operating Practices.** DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities,* Chapter II requires that the operator responsible for the facility should be promptly notified of abnormalities or difficulties encountered in performing assigned tasks. This was not done on several occasions. During one startup evolution excessive changes in air loading to the

flow regulating valve were required to effect changes in 2AX fluid flow. A change from -13% to +20% in valve position indication (actually an indication of valve operating air pressure change) was required to open the valve. A step change to about 25 % of maximum flow occurred when the valve opened. Later a change from 38% to 54% in valve open indication was required before any increase in flow occurred, and the resultant increased flow exceeded the setpoint limits for this parameter before it could be controlled. The operators were slow to note the lack of response to the opening actions. They did not inform the shift supervisor of the difficulties in initial opening of the valve and he learned of the subsequent problems during a routine review of operational status. No firm direction was provided for continuing operations and monitoring of valve operation. Subsequently, automatic control of the valve resulted in flow rate repeatedly exceeding the setpoints set forth in the setpoint procedure (SOP 221-F-40505). Operators made no comment about this condition and made no reports. On another occasion two attempts to remotely operate the drain valve for tank 11H were unsuccessful. A third try worked and no report was made to the shift manager.

b. **Communications.**

General Comment. The arrangement of the F-Canyon control room in a long, narrow room and the age and lack of flexibility of communications systems presents a significant problem for process control using face-to-face or control room operator to remote operator communications. Consequently, establishing formal practices, policies and procedures are essential to minimizing the adverse effects of the plant's limitations.

Public Address System. DOE Order 5480.19, Chapter IV states that excessive use of the public address system for paging of personnel and unnecessary announcements should be avoided. This was not adhered to as the system was used frequently for this purpose for reasons which appeared to be not associated with process control. This indiscriminate use reduced the impact of important announcements and was distracting.

Contacting Operators. DOE Order 5480.19 states that methods should be implemented to ensure that control areas can quickly contact on-shift operators. One observed shift used portable radios for communication between the control room Process Operator and the Building Patrol Operators to accomplish valve operations. The other shift did not keep radios readily available and thus delayed operations while waiting to get radios in place.

Oral Instructions and Informational Communications. DOE Order 5480.19 states that, in all communications, the sender and intended receiver should be readily identifiable. The Order also directs that instructions involving the operation of equipment should be repeated by the receiver to the extent necessary for the sender to ensure the instructions are correctly understood. The identification of the

sender and intended receiver were frequently not included in communications. This was particularly true in face-to-face communications and multiple transmission exchanges after the initial transmission. Repeats of equipment operation orders also were not consistently made and again this was particularly true when orders were face-to-face. On one occasion a touch on the shoulder was used to indicate to the operator that an action should be stopped.

c. **Control of Equipment and System Status.**

Status Change Authorization and Reporting. DOE Order 5480.19 Chapter VIII states that the shift supervisor should be advised periodically of changes in status of equipment and systems so assigned. The operator and first line supervisor for the second plutonium process normally sat or stood by the process control panel. They received permission from the shift manager to start or shutdown the process and to accomplish some steps requiring specific guidance, but did not regularly report significant changes in system status. Authorization to make plant status changes such as "start process flow(s)", "raise flow stream temperatures" and "start feed/flush flow" are not being done as formally now as it is intended to be done later. Cold Chemical Runs are being conducted in a manner similar to familiarization training and not like a demonstration of actual operating practices which would be more appropriate at this stage of operational preparations.

Equipment Deficiency Identification and Documentation. DOE Order 5480.19 requires that equipment deficiencies should be noted by facility operating personnel and identified in the work control system for correction. In the cases of the malfunctioning 2AX flow control valve and tank 11H drain valve described no action was taken to enter the problems in the work control system. Also an annoying problem with bad contacts in the control panel "alarm acknowledge" push button was not identified as a problem by a deficiency tag.

d. **Operations Aspects of Facility Chemistry and Unique Processes.** DOE Order 5480.19 requires that operations personnel must have an understanding of all facility processes. Operation of the mixer-settler (2A and 2B banks) during the period of establishing the various flow streams did not seem to be well understood by operators and supervisors. Several discussions of the variations in "weight factor" and "interface level" occurred, but they had the character of personal theories rather than explanation of the phenomena being observed. There was no consensus explanation.

No guidance was provided by procedure, policy or commonly accepted practice as to the rate of increasing flows from zero to the required operating limits. No rate of increasing the temperature of a flow stream was provided. As a consequence, operators increased these parameters in irregular steps with inconsistent wait periods between adjustments. They appeared to not understand what indicated parameter(s) should be used to govern incremental increases. They were unable to

describe whether action could be taken to reduce the large number of alarms received during these operations.

e. **Operations Procedures.** An engineer was sitting next to the control operator following each procedure step as it was performed to assure procedural compliance was feasible and practiced. Where changes were needed, notations were made, and formally approved revised procedures were prepared overnight.

Several errors in the procedures used for Cold Chemical Runs were noted and corrected by the procedure compliance verifier stationed for this function. In the area of mixer-settler operation, especially during feed initiation, the procedures lacked sufficient guidance and the verifier did not initiate any changes. For example, a note in the startup procedure provides guidance for the desired range of mixer-settler solution interface level and a minimum level to try to keep the level above. The procedure provided no additional guidance concerning interface level control settings when initiating flush or feed flow, but the operator lowered the setpoint for level below the minimum stated in the procedural note. Numerous deviation alarms occurred as well as interface low level alarms, but the settings selected by the operator and supervisor were not questioned and no procedure changes were initiated.

Several steps of the shutdown procedure appeared to be accomplished under computer control. The procedure, however, was worded to indicate that the operator was to take some action rather than to verify that the action had occurred. Opportunity did not occur to confirm that rewording of this part of the procedure was done.

f. **Logkeeping.** Logkeeping during steady state conditions were noted to have several errors. A calculated value for a process parameter flow was noted as out of specification, but review determined that the calculation used a one hour vice the required two hour period of level decrease. The entry was neither annotated nor corrected. In a space provided for recording flow instrument setpoint the operator recorded present flow value. The operator recorded time in a setpoint block. This error was noted by the first line supervisor on his third review of the log containing these incorrect entries. Some chemical results which were out of specification for normal operations but considered satisfactory for this operation were not red circled as required by the contractor's operations manual. Several events such as reaching steady state were not recorded in the operator's narrative log. An unexplained 2BS low flow alarm which occurred during steady state operations was not recorded, and no explanation or corrective action was noted. Over an hour after steady state conditions were achieved, three low interface deviation alarms were received. These alarms were not recorded and no action was taken to investigate a possibly abnormal condition. An hour and 45 minutes after achieving steady stated conditions a 2AS low flow alarm occurred and again no record of the alarm or actions taken to investigate the cause was made.