DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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MEMORANDUM: G. W. Cunningham, Technical Director

COPIES: Board Members

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SUBJECT: Defense Waste Processing Facility Trip Report July 6-8, 1993

1. **Purpose:** This memorandum describes the results of the DNFSB staff visit to the Defense Waste Processing Facility (DWPF) on July 6-8, 1993. The review team included William Shields, Les Ettlinger, and Ahmad Faramarzi (MITRE). The trip included a tour of all DWPF buildings other than storage areas; both levels of the main processing structure and the Low Point Pump Pit structure were walked down.

2. **Summary:** The reviewers took away a generally favorable view of the fire protection program at this facility. Numerous outside reviews have been conducted in the past several years, and measures have been taken (or are in progress) to resolve adverse findings from those reviews. When modifications are complete, the facility will meet DOE fire protection requirements (Orders 5480.7A and 6430.1) and the NFPA Codes in all respects affecting public and worker safety. We identified one potentially significant safety issue (proposed installation of water suppression in the control room) which requires near-term resolution. More detail is provided under Fire Hazards Analysis and NFPA Code Compliance in Section 4.

3. **Background:** DWPF was designed to meet DOE's older General Design Criteria in Order 6430.1 and the recently-revised fire protection order 5480.7 (now 7A). However, a number of independent reviews conducted over the past five years disclosed Life Safety Code violations. These violations centered on guaranteeing of egress paths from this windowless structure in the event of fire. To correct these deficiencies, DWPF has in progress an $18 million sprinkler upgrade project and has provided additional building exits at certain confined locations. Some of the sprinkler upgrades and other improvements to the program stem from violation of DOE property protection requirements but are have minimal impact on public and worker safety.

   Prior to commencement of radioactive operations, all projects needed to correct Life Safety Code violations are planned to be completed and some property protection work will also be finished. Depending on the start-up date for such operation, some property protection upgrades will take place after start-up.

   The DNFSB staff review encompassed eleven subject areas:

   - Final Safety Analysis Report
   - Program Organization and Qualifications of Managers
   - Pre-fire plans

- Fire Department Training and Drills
- Maintenance and Surveillance of Fire Protection Systems
- Control of Combustibles and Ignition Sources
- NFPA Code compliance
- Tracking and Resolution of Audit and Self-Assessment Findings
- Impairment Control Procedures
- Emergency Lighting and Standby Diesel Generators
- Safety Margins

4. **Discussion:**

   a. ***Final Safety Analysis Report***. DWPF is classified as a moderate hazard facility. The contractor has prepared a Final Safety Analysis Report (FSAR) for DWPF (DPSTA-200-10, Sup. 20). However, driven by new requirements in DOE Order 5480.23 and by weaknesses identified during several independent reviews, WSRC has initiated an effort to update the FSAR. Another motivating factor in the FSAR upgrade may be lack of compliance with certain requirements of DOE Order 6430.1A, specifically in the areas of fire protection and seismic qualification. The FSAR upgrade will include consideration of all hazards expected to be present at DWPF during the initial Cold Chemical Runs (CCR) and later upon commencement of radioactive operations.

   In support of CCR, which is intended to validate the DWPF design characteristics utilizing simulated waste (no radioactive material will be present), WSRC has prepared WSRC-RP-92-975, "DWPF Cold Chemical Runs Safety Envelope." This document is intended to identify and describe the hazards introduced during CCR, the safety analysis associated with those hazards, and the prevention and mitigation controls appropriate to the hazards. Since the FSAR development is underway now, the reviewers primarily examined fire protection activities that should be in place in support of CCR.

   At DWPF, fire and explosion, in combination with a seismic event, are the only mechanisms that could provide sufficient energy for dispersal of radioactive and chemical hazards into the atmosphere. The CCR accident analysis has identified several fire scenarios in the following areas of DWPF: the canyon, the pump pits, the cold feed area, and the Organic Waste Storage Tank (OWST) area. WSRC has used a combination of computer models (e.g., CFAST, FIRAC) and hand calculations to analyze the possible propagation and consequences of these fire scenarios. The most limiting and bounding fire scenario is determined to be an explosion of the OWST caused by either internal or external fires that may result in a substantial release of benzene, a highly combustible and toxic material.

   b. ***Fire Hazards Analysis (FHA)***. WSRC has prepared FHAs for all DWPF buildings. The reviewers inspected the FHA covering the Vitrification, Service, and Fan House Buildings. The FHA provides detailed information on the type of construction, nature of fire hazards, and property loss control aspects. In

addition, it identifies areas where design of fire protection systems do not comply with the requirements of NFPA codes or applicable DOE Orders and standards. Although the FHA provides general information on the available fire protection features, it does not address the secondary effects of fires as described in the NRC standards (10 CFR Part 50 Appendix R and related guidance) and in IAEA 50-SG-D2. Examples of such secondary fire effects include the consequence of water intrusion into electrical systems and deleterious effects on operating personnel from heat, smoke, fire extinguishing materials, or toxic gases.

Of particular concern to safety is WSRC's intention to provide water sprinkler systems in several areas containing electrical equipment, including the main control room. Given the highly automated and computerized design of DWPF, water intrusion into electrical panels could result in electrical shorts and generation of spurious signals making it difficult to control the plant from remote control panels.

c. ***Program Organization and Qualification of Managers***. The DWPF Facility Manager has direct responsibility for the entire facility, including all fire protection SSCs located in it. Fire protection support is provided to the Facility Manager in a matrix format by three divisions. First is the Engineering and Projects Division (E&PD), which is responsible for design and construction, project management, and systems and engineering support. The second division is Environmental Health and Safety and Quality Assurance (ESH&QA), responsible for conducting audits. The third division is the Site Services Division (SSD), which provides fire protection support in areas of engineering, testing, and maintenance.

There are several departments in SSD that provide fire protection services. The Fire Department is responsible for emergency response, fire protection training, planning inspections, system impairment, acceptance and surveillance testing. Repair and maintenance of electrical problems for fire protection SSCs is performed by the Digital Control and Systems Department. The Site Fire Protection Department is responsible for establishing site-wide fire protection requirements, and providing fire protection engineering services, including performing FHAs, providing input into SAR and OSRs, review of modification packages, review of acceptance test procedures, and review of fire investigations. The responsibilities and authorities of each department appear to be well-defined.

Consistent with the requirements of DOE Order 5470.7A, "Fire Protection," WSRC requires Fire Protection Engineers (FPEs) to be either a graduate of an accredited engineering curriculum, demonstrate significant work experience (meeting requirements of Grade 11 as defined by the Office of Personnel Management), or be a registered professional engineer in fire protection. WSRC requirements follow requirements in DOE Order 5480.7A, which is applicable to all DOE nuclear and non-nuclear facilities. By comparison, NRC standards require FPEs to meet the minimum eligibility requirements as a member in the

Society of Fire Protection Engineers, which include the following: a graduate of an engineering curriculum of accepted standing, and not less than 4 years of experience, 3 of which must be in responsible charge of fire protection engineering. Hence, DOE qualification requirements for the position of FPE are less than those established by the NRC.

The FPE assigned to DWPF exceeds the minimum qualification requirements of WSRC. He possesses an engineering degree and is a member of SFPE.

d. ***Pre-Fire Plans***. The pre-fire plans are developed for different areas and zones of DWPF consistent with the requirements of Manual 2Q2-4, "Fire Control Pre-plan Format." The CAD-generated color-coded plans appear to be comprehensive, providing detailed information on fire hazards in each area, fire protection features, location of fire extinguishers, electrical switches and pull boxes that have to be manipulated to de-energize electrical hazards, ventilation system operation, and location of communication systems. The reviewer examined DPSOP 257-12T, "DWPF Pre-Plans," and reviewed pre-plans for several areas; the plans contained information adequate when measured by consensus standards in this area. The reviewer did not perform a field inspection to ensure the accuracy of information provided in pre-fire plans.

e. ***Fire Department Training and Mutual Aid Agreement***. The DWPF requirements for training Fire Department personnel meet or exceed the qualification and training requirements of NFPA-1001 and 1021, for the positions of fire fighters and fire officers. The training and qualification of fire watch personnel, as stated in SOP 200-S-4107, "200 S-Area Fire Watch Personnel", meet the requirements of NFPA 51B, "Cutting and Welding Processes." The reviewer also examined the training records for fire fighters (for 1992 and 1993), including training on the pre-fire plans (Procedure FFT-13), and the Fire Warden training records.

In summary, the Fire Department training program appears to follow the requirements and guidelines of NFPA codes. However, the training program is not a performance-based program, as required in DOE Order 5480.20. WSRC staff indicated that all fire protection related training is being consolidated under a new manual, WSRC-2Q9, "Fire Protection Description." This manual will include additional requirements that the WSRC training department is in the process of implementing in order to comply with DOE Order 5480.20, "Performance Based Training." Apparently, WSRC has begun to implement performance-based training requirements for certain functions (only mechanical and fork-lift activities appear to be complete). Other programs, such as fire protection training, will be enhanced in the future.

During interviews of Fire Department Personnel, it became apparent that there is some confusion regarding who at WSRC/DWPF would have the control of monitoring instruments subsequent to an accident. The responsibility may be delegated to the Fire Department, the Facility Manager, or the Health Physics personnel Apparently, DOE/EM is in the process developing site-wide guidance

in this area.

WSRC has established a Mutual Aid Agreement with fire departments in the counties adjacent to SRS. During an emergency, off-site personnel will report to WSRC emergency response team, should their help be requested by WSRC. Since the off-site fire fighting and emergency response personnel do not participate in fighting fires involving toxic or radioactive material, they do not receive any training to become familiar with DWPF or other SRS facilities.

f. ***Maintenance and Surveillance of Fire Protection Systems***. The fire protection and testing requirements for DWPF are included in Manual 2Q2. Procedure 2Q2-1.9 is the testing and inspection procedure for Halon systems. In general, the testing and inspection requirements appear to be consistent with NFPA codes. Specifically, the reviewer examined the procedure for testing and surveillance of Halon 1301 system. The scope and frequency of tests described in the procedure generally meet the requirements of NFPA-12A, "Standards on Halon 1301 Fire Extinguishing Systems." The adherence evidence in support of implementation of the requirements of this procedure was also reviewed for system FOS #11 for both 1992 and 1993 and considered to be satisfactory. There were no surveillance tests scheduled during the site visits so the reviewer did not witness test performance.

   In general, WSRC appears to follow the requirements of NFPA codes for surveillance and testing of fire protection SSCs, most of which are classified as production support systems. However, recognizing the importance of the CP-Class fire protection equipment, WSRC has increased the surveillance and testing frequencies for this equipment in excess of those required by NFPA. For example, as established in the Operational Safety Requirements for the facility, the Aqueous Film Forming Foam (AFFF) system is required to be inspected once a month instead of once a year. Although on the surface a more frequent inspection and test program appears to be logical, it could decrease the overall system availability. WSRC staff could not provide the basis for establishing a monthly inspection frequency for the AFFF system. In addition, they could not provide a clear basis for establishing the LCO time limits, within which remedial actions should be taken. It is not clear why the results of risk and reliability analysis, which is at the heart of SAR, are not used to establish the surveillance frequencies (and LCO time limits) needed to achieve optimum reliability and availability objectives.

g. ***Control of Combustibles and Ignition Sources***. All DWPF buildings are regularly inspected by the Fire Department for compliance with plant procedures such as SOP GEN-SZ 4495 (Rev.2), "Control of Combustibles," and SOP GEN-SZ 4494, "Control of Cutting, Welding, and Grinding." These procedures appear to comply with NFPA 51B and OSHA guidelines. The walkdown of the facility indicated that the amount of exposed combustibles (i.e., excluding closed tanks of chemicals) is very low, both fixed and transient. During plant operation there would be very little need to introduce combustibles or ignition sources into the facility. This area of fire protection has minimal safety impact on this facility so

long as the noted procedures are carefully observed and an aggressive inspection and housekeeping program is maintained.

h. ***NFPA Code Compliance***. This facility was constructed to meet DOE Order 6430.1, the earlier version of the General Design Criteria, and as such was intended to meet most applicable NFPA Codes and related commercial standards such as the UBC and UL/FM listings. Installed suppression systems, barriers, detectors, etc., generally meet the code of record and few deviations or equivalencies have been sought.

   The major area of controversy for DWPF centered on the application of NFPA 101, the Life Safety Code. Following reviews by a number of experts both within and outside of DOE (PLC, FM, Dr. Bryan of U.Md.), DOE decided on an upgrade project (Project S-620) which involves the addition of suppression and detection systems in numerous plant areas. The completion of this project will resolve Life Safety Code findings. No other significant deviations from applicable commercial criteria were noted during the review.

   One aspect of Project S-4620 gave the DNFSB staff some pause. That is the intent to remove the Halon system from the DWPF control room and replace it with water sprinklers. DWPF is a highly automated, computerized facility. Direct water impingement on control panels could result in shorts and spurious control signals making it difficult to control the plant from remote panels.

i. ***Tracking and Resolution of Audit Findings***. Meetings were held with both fire protection personnel and others assigned to track issues on a site-wide basis. Hard copy files and a computer database maintained by the fire protection organization were examined and audited by random choice of issues from previous reviews.

   It was found that the hard copy files were complete and current (except for filing delays) as to all previous findings and deficiencies. Files were kept in a single cabinet, were color-coded and labeled as to the source of the finding, and spot-check of a few files showed the contents to be a full record on the issue. The number of files was in the 300-400 range.

   The DWPF Fire Protection Data Base is a dBase file which is intended to be used in parallel with the hard copy files. The use of dBase, of course, allows sorting of records and printing of specialized reports, thus easing the tracking of a large number of items. Spot-check of the data base proved that it was effective and accurate. However, WSRC fire protection personnel noted that the data base was not complete (some FHA findings were not yet entered) and that resources to keep it up had been recently drawn onto other projects. Since new issues continue to arise and other issues are closed, there is a danger that this very useful tracking tool will be rendered ineffective.

j. ***Impairment Control Procedures***. Procedure GEN-SZ-701, "Fire System Impairment Control/Fire Watch," dated 2 March 1993, establishes the

requirements for control of impairments to fire protection systems. Specifically, the procedure requires that roving or stationary fire watches be established for systems that are declared inoperable. A fire protection impairment form (tag) is placed on the component providing information as to the nature of impairment, time and date, and associated compensatory actions.

The reviewer examined related administrative and adherence evidence and found them adequate. However, during the physical inspection of the facility on 7 July 1993, the reviewer found at least one fire door that was rendered inoperable by having the door latch taped to prevent it from closing and there was no impairment tag attached to the door. The inspection record on the door indicated that the door was inspected and considered acceptable three days earlier, on 4 July 1993. It is not clear how long the door had been impaired. In addition, during the walkdown, several other fire doors were left in open position defeating their intended safety function to prevent propagation of fires. Although the WSRC staff could not provide any clear explanation for this weakness, they cited numerous testing and maintenance activities and lack of diligence of the maintenance staff possible explanations.

k. ***Fire Protection Review of Modification Packages***. WSRC Manual SW4-V5 includes Procedure CT-10.02, "Design Authority Technical Review Procedure," dated 25 June 1993. This procedure establishes requirements for technical review of all permanent and temporary modifications. The procedure includes several attachments, each providing a set of general questions to be considered in reviewing modifications. Section B of Attachment D1 includes 14 review questions specific to fire protection. If any of these questions is answered positively, then the work package is forwarded to the FPE for a detailed review. To accomplish this, the FPE utilizes the information available in the Functional Design Criteria, which include the design basis for DWPF. This design review system, although perhaps slightly less rigorous than that used in the commercial nuclear power industry, is adequate to ensure that the design basis for the facility is maintained.

l. ***Emergency Lighting and Standby Diesel Generators***. The DWPF emergency lighting system is powered by the standby diesel generators and the off-site power grid. However, the standby diesel generators were not purchased to meet the requirements of NFPA 110, "Emergency and Standby Power System," for a Class B installation. In addition, the off-site power lines may not be available subsequent to design basis events (e.g., seismic, tornado). Consequently, WSRC has provided self-contained emergency lights throughout the facility. During the facility inspection, a number of these battery packs were observed to be in an operational condition.

The illumination level of emergency lighting does not meet the one footcandle criteria of NFPA 101, "Life Safety Code," (as a point of reference the normal illumination level in a typical office building is around 100-200 footcandle, or approximately 2 Watts per square foot of floor area). In fact, WSRC has determined that the existing illumination levels are generally around 0.1

footcandle; one order of magnitude lower than the acceptance criterion. Recognizing this deficiency, WSRC is considering two possible solutions. The first option is to increase the number of self-contained battery packs. The second option, which relies on the standby diesel generators, requires upgrading the generators to allow the minimum testing and surveillance requirements for the Class-B diesel generators specified in NFPA 110. An example of such an upgrade is addition of a test switch to simulate loss of off-site power.

m. ***Safety Margins***. The CCR Safety Envelope has been used to develop an Operational Safety Requirement (OSR) for the CCR. The reviewers inspected the set point for actuation of the AFFF system to mitigate potential explosion of OWST. Specifically, the reviewers focused on the adequacy of safety margin (the margin between safety and operating envelopes). Consensus standards, such as NFPA-69, "Explosion Prevention Systems", require that for prevention/mitigation of explosion of combustible liquid, the set point for manual actuation of a preventative or mitigation system should be 25% below the Lower Explosive Limit (LEL) of the combustible of concern. In addition, NRC's Regulatory Guide 3.6 and ANSI standards require the safety margin to be sufficient for mitigating actions to be taken, and to account for any possible instrument drift and calibration uncertainties.

   For the instrument activating the AFFF system, the reviewer determined that the OSRs establish the NFPA-recommended safety margin between the Limiting Control Setting (LCS) and the LEL for the analyzer detecting presence of Benzene in the non-inerted outer tank. In addition, Procedure SOP-CT-8.04 (Rev. 2), Instrument Scaling and Set Point Control Procedure, requires instrument set points to include adequate margin for any errors in the instrument loop (i.e., square root of sum of squared errors for different components in the loop). Other DWPF procedures require that an additional 2% safety margin be incorporated into the calibration to account for any uncertainties in the accuracy of Calibration and Test Equipment. Although the reviewer inspected administrative evidence, adherence evidence such the calibration records for the outer tank vapor analyzer were not reviewed.