DEFENSE NUCLEAR FACILITIES SAFETY BOARD

October 4, 1994

MEMORANDUM FOR:	G. W. Cunningham, Technical Director
COPIES:	Board Members
FROM:	R. Arcaro, Technical Staff
SUBJECT:	Report of DNFSB Staff Review of Systems Engineering Activities at Hanford, August 30 - September 2, 1994

1. **Purpose:** This memorandum describes and provides comments on the systems engineering activities regarding the Tank Waste Remediation System (TWRS) at the Hanford Site.

2. **Summary:** Discussions and presentations from systems engineering personnel of both the Department of Energy Richland Operations Office (DOE-RL) and Westinghouse Hanford Company (WHC) indicate that improvement is being made in developing and implementing standardized systematic methods of design development. An apparent greater acceptance for the industry practices of systems engineering, hiring of experienced personnel, and an effort to proceduralize a systems engineering standard have resulted in a path forward that is reflective of a systems engineering approach.

   Improvements are still necessary, however. The pace of the current effort is slow. At least an eight month delay in construction of the Multi-function Waste Tank Facility (MWTF) is expected. Coordination between the group responsible for systems engineering and those that may benefit from it requires improvement.

3. **Background:** In a letter to DOE dated June 2, 1994, the Board accepted DOE's Implementation Plan for Recommendation 92-4 provided it be revised to address comments listed in the letter. Significant comments included the need for implementing a systems engineering approach at the project level and a need to perform an independent design review of major projects. In a letter to the Board dated August 15, 1994, the Secretary of Energy committed DOE-RL to perform an independent design review prior to start of construction of MWTF. The Secretary further committed to submit an acceptable Implementation Plan by September 30, 1994.

4. **Discussion/Observations:**

   a. Systems Engineering Improvements: Discussions with DOE-RL and WHC personnel responsible for the TWRS and MWTF program revealed improvements are underway to manage the project in a manner more consistent with the principles of systems engineering. These improvements include development of a governing directive for TWRS systems engineering, hiring of additional technical personnel at DOE-RL with experience in systems engineering, scheduling of independent design reviews, and amended planning

due to realization of uncertainties associated with the number of needed additional tanks.

1. Systems Engineering Policy Document: DOE-RL is developing an internal standard for the performance of systems engineering within TWRS. A review of a draft of this document revealed it provides a frame work consistent with best industry practice for the performance of systems engineering (as captured in MIL-STDs-499B and 1521). The document fills in many of the holes of DOE Order 4700.1, *Program Management System*, including format of design reviews and program integration activities. Currently, the document is intended to be applicable only within TWRS; however, it is the opinion of the DNFSB staff that the document may be adapted to become a DOE-wide standard. It is currently unclear if this is the intent of DOE-RL and DOE-HQ.

2. Hiring of Personnel: DOE-RL has hired three additional personnel to improve the technical competence of the organization responsible for TWRS. Two personnel are experienced in systems engineering and one is a PhD with experience in glass engineering. One of the recently hired systems engineers was a significant contributor to the development of the policy document described above. The hiring of these personnel is viewed by the DNFSB staff as a positive move toward improving the overall technical competence of the DOE-RL organization.

3. MWTF Path Forward: As DOE-RL and WHC take a more systematic approach to the design of the MWTF, several changes to the schedule and path forward have occurred. As committed to by the Secretary of Energy in her letter to the Board, an independent design review of the MWTF will occur prior to the start of construction. The design review is scheduled for the summer of 1995. This review will reportedly ensure that the "bottoms-up" design is compatible with the "top-down" systems engineering requirements. A more systematic analysis of the need for additional tanks has resulted in a decision to build two new tanks to meet operational and safety needs in the West Area. DOE-RL and WHC will delay decision on the number of new tanks in the East area until additional information on waste volume projections is available. Further consideration of the need for new tanks, beyond the six now being considered, will occur in 1997 when additional information on pretreatment is available.

b. Needed Improvements: The following comments indicate that some improvement is still required:

1. The pace at which DOE-RL is implementing systems engineering at the project level is slow. Implementing the Secretary's commitment to conduct the necessary design reviews has had an impact on the MWTF. DOE-RL currently projects that construction may be delayed eight months.

2. DOE-RL personnel responsible for operation of the tank farms are concerned that any delay in construction of new tanks in the West Tank Farm will impact the safe operation of the facility. Specifically, without adequate cross-site transfer capability and without spare tank capacity, the ability to remove waste from an identified leaking tank in the West Area is limited. DOE-RL committed to quantifying the risk associated with not building the tanks so that this uncertainty can be objectively evaluated.

3. The tank capacity requirements and uncertainty range stated by the WHC systems engineering personnel, the operations personnel, and those responsible for development of the Environmental Impact Statement, were not consistent. This discrepancy indicates a lack of effective communication between these three organizations.

4. To ensure existing project designs are compatible with requirements and architectures developed through systems engineering, WHC will perform a comparison of systems engineering products to existing project design criteria. Because project concepts-and designs are already planned, this method of "backfitting" systems engineering into the projects does not lend itself well to performing systematic evaluations of alternatives. It is the opinion of the DNFSB staff that WHC and DOE-RL will have to be diligent to ensure trade-off studies are performed without bias to ensure the most technically appropriate design alternatives are selected.

c. Status of DOE Implementation Plan for Recommendation 92-4: The DNFSB staff reviewed a draft of the DOE 92-4 Implementation Plan due to the Board by September 30, 1994. Major changes to the Implementation Plan include additional clarity on implementing systems engineering into the projects and scheduling of independent design reviews. As of September 30, the DNFSB staff learned that the Plan is in final review at DOE-HQ and is expected to be submitted to the Board the week of October 3.

5. **Future Staff Actions:** The staff intends to continue its review of the systems engineering effort at Hanford. Future efforts will concentrate on the issues described in this report as well as topics that arise from the review of other TWRS projects, particularly the Cross Site Transfer Line. The staff has planned a follow-up review of these issues the week of October 24, 1994.