

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

June 28, 1996

MEMORANDUM: G. W. Cunningham

COPIES: Board Members

FROM: J. Roarty, D. K. Hayes

SUBJECT: Advanced Test Reactor Design Review

1. **Purpose:** A tour of the Advanced Test Reactor (ATR) and a brief discussion of the a) Safety Analysis Report (SAR) review and plant modifications, and b) the thermal design basis for the core were completed by the Defense Nuclear Facilities Safety Board (Board) staff R. Green, D. K. Hayes, J. Roarty, and R. Robinson on June 18, 1996.
2. **Summary:** The ATR was designed about 30 years ago and has operated successfully in support of fuel and materials development for the Naval Reactors Program. This irradiation testing program is projected to continue well into the twenty-first century.

During the past year, a comprehensive review of an upgraded ATR Safety Analysis Report was performed by the DOE (i.e., the SAR has been completed and implementation of a number safety- related system improvements identified during the SAR review are currently underway). Technical Specification Requirements were also upgraded in compliance with the Department of Energy Orders 5480.23 and 5480.22. However, an area that has not received in-depth review is the ATR design basis. Also, personnel with sufficient information to reconstruct and assess the nuclear and thermal-hydraulic design bases are limited in number. This type of effort at the Savannah River Site (K-Reactor) resulted in a major program of thermal-hydraulic testing and analysis to establish the reactor restart power limit.

3. **Discussion:**
 - a. The ATR operational performance is commendable and performance criteria were exceeded during the past three years for both operating and outage periods. A broad base of safety- related hardware upgrades are currently underway and will continue during the next 2-3 years. These include backup ventilation dampers, crane modifications, primary coolant pump motor and check valve overhauls, and firewater seismic upgrades.
 - b. The DOE SAR review was comprehensive, especially in the review of SAR Chapter 15 accident analysis. Overall, 496 comments were noted, of which 392 required corrective action before approval of the SAR by DOE.
4. **Future Action:** As a result of a review of documents provided to the Board's staff, a number of issues are listed below that require follow-up evaluation by the staff.
 - a. The thermal-hydraulic limits currently used in the ATR accident analysis are significantly above values established in ATR prototypical, out-of-pile test programs conducted by Argonne and Pacific Northwest Laboratories. ATR stated current thermal-hydraulic limits are based on information derived from

ATR start-up tests and from Savannah River test programs.

- b. The ATR design is based on no flow maldistribution among the core coolant channels, which are arranged in a serpentine pattern. This condition is obtained without a flow distribution baffle, typically used to balance flow.
- c. The validity of a 20% improvement in the ATR critical heat flux due to the use of aluminum cladding versus Inconel material, which was used in CHF tests, requires further study. A limited comparison of the material effect on CHF conducted by the Board's staff failed to show this effect. The higher thermal conductivity of aluminum could disguise an incipient burnout condition.
- d. The reactor coolant channel blockage accident requires further review and discussion.