ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
UNITED STATES ATOMIC ENERGY COMMISSION
WASHINGTON 25, D.C.

January 25, 1965

Honorable Glenn T. Seaborg
Chairman
U. S. Atomic Energy Commission
Washington, D. C.

Subject: REPORT ON N.S. SAVANNAH

Dear Dr. Seaborg:

At its sixty-first meeting, January 14-16, 1965, the Advisory Committee on Reactor Safeguards reviewed the application of the Maritime Administration for an operating license for the N.S. SAVANNAH. The Committee had the benefit of discussions with the AEC-Maritime Joint Group, the Savannah Technical Staff, ship personnel, representatives of the American Export Isbrandtsen Lines, Todd Shipyards, and the AEC Staff. It also had available the documents listed below.

The N.S. SAVANNAH has now completed some 77,500 miles of sea travel. More than 1,250,000 people have visited the ship in many ports of the world. Its operating history, especially considering that it is a first-of-its-kind vessel and has been subject to the obvious pressures which came from making scheduled visits to many ports, has been good. The master of the ship and others have stated that there have been no serious malfunctions of the reactor. The leak rate of the containment has remained well below specification.

There are still features that are not up to the safety levels that the Committee deems generally advisable, but none of these items appear to be of a major nature. For example, the present control rod system continues to leak hydraulic oil, but in diminished quantities. The leaking flammable oil requires that the containment be filled with inert gas to avoid any possibility of fire. This fact, in turn, tends to inhibit entry and, hence, tends to reduce the number and thoroughness of inspections of the area. The applicant reports that the presence of small amounts of particulate matter in the hydraulic fluid has prevented proper operation of the valves in the system on several occasions and has led to the failure to scram of one, or at most two, individual rods. However, in every case the

rods have been driven in by the rod run-in mechanism. The applicant also reports some corrosion and pitting of the buffer seal shafts, but in no case has any rod ever stuck for this reason.

The present rod system has the disadvantages of a sliding shaft seal between atmospheric pressure outside and high pressure inside, the requirements of a separate and necessary hydraulic fluid system with its attendant control valves, a separate nitrogen system to provide a driving force for the oil accumulators, and an electrical control system with many relays. Each of these features can be subject to difficulties and, in consequence, this is not a wholly satisfactory system.

The alternate Marvel-Schebler drive system also have difficulties. While the drives themselves are fully contained within the pressure housing and require no shaft seal, and while they require no hydraulic fluid or nitrogen system and appear to be much more nearly fail-safe than the present drives, the applicant has stated that the accompanying electrical control circuitry is not working correctly and that installation could not be started before July 1965. The Manager of the Joint Group and a Chief Engineer of the ship have both stated that they feel that the present control rod system provides adequate safety. In view of the good scram and run-in history of these rods, and their reported continuing improvement in operating characteristics, the Committee believes that these control units could continue to be used for operation of the reactor.

At the same time, the Committee recommends that work be continued in readying a more satisfactory control rod system for shipboard use. Such rods should be fully contained within the high pressure system, should be dependent on as few auxiliary systems as possible, and should be fail-safe.

The Committee would like to review this situation in the early summer of 1965.

The Committee would like to emphasize again the importance of maintaining properly trained and competent officers, crew, and specialists such as health physicists. In particular, the Committee believes that the nuclear advisor plays an important role, at least at this early stage, and should continue to be available on board after licensing. A thorough appreciation of the hazards of nuclear operation by all crew members is particularly important.

In its letter of May 13, 1964 the Committee recommended a tug availability criterion that:

> "... adequate tugs remain in attendance at the ship until such time as there is a calculated interval of one hour between an accidental loss of coolant and the first fuel-clad melting. After th t time, the tugs should be on call so that, in the event of an accident, the tugs can arrive at the ship at least one-half hour before the calculated time when such melting is predicted to start. These time interval calculations should be based on conservative assumptions such as: total loss of electric power, loss of coolant as assumed in the MCA, and no emergency water injection. This method of operation will do much to assure the safety of the tug operators and ship crew as well as the safety of the general public in the unlikely event of an emergency".

The Committee believes that the N.S. SAVANNAH should continue to use this criterion. This criterion provides substantial added assurance that mobility will be provided in the unlikely event of a serious nuclear accident at dockside. It will also provide an incentive for operation at lower powers in port areas in order to reduce the fission product burden and thus increase the time to melt in a postulated total loss of coolant accident. The Committee would like to point out that 10 CFR Part 100 might be applied to a shipboard reactor in the same way it is applied to land based reactors without taking any credit for the mobility of the ship. This is consistent with reactor safety practice in this country. However, if reliance is to be placed on mobility, it must be assured that mobility is indeed available and in time. The Committee believes that the "time-to-melt" criterion provides a substantial extra measure of this assurance. In addition, it provides considerable extra protection against a loss-of-coolant accident in which containment is very much less effective than expected.

At the same time, the engineered safeguards on the ship remain important. The "time-to-melt" criterion would not alone protect the public in the unlikely event of some other kinds of accidents, such as nuclear excursions. Furthermore, protection of the public, the passengers, and the crew must still be provided when the ship is in motion or when movement of the ship is not possible for weather reasons.

As mentioned in its letter of May 13, 1964, the Committee continues to believe that appropriate tests of the efficiency of the iodine adsorbers need to be devised. The Committee believes that such tests should be made routinely along with the particulate filter tests within one day of each port entry. Therefore, it recommends that the development of iodine tests be pursued vigorously.

In its letter of May 13, 1964, the Committee also suggested "that other monitoring and instrument systems be studied and if necessary modified to assure that, in the unlikely event of an accident, they will supply the master of the ship with sufficient information on the performance of engineered safeguards to enable him to assess the situation and take appropriate action." The Committee believes that this suggestion should also be pursued vigorously.

In summary, the Committee believes that proposed solutions to the problems regarding iodine adsorber tests and information availability for the master of the ship should be reviewed by the Staff of the Division of Reactor Licensing and implemented before the license is issued. The Committee recommends that the present "time-to-melt" criterion be retained in determining requirements for tug availability. Subject to these conditions, the Committee believes that the N.S. SAVANNAH has demonstrated that it can be operated satisfactorily as proposed by the Maritime Administration without undue hazard to the general public.

Sincerely yours,

/s/

W. D. Manly
Chairman

References Attached.

References:

1. Memorandum from U. M. Staebler, DRD, to R. E. Hollingsworth, General Manager, dated November 30, 1964, Subject: N.S. SAVANNAH - Marvel-Schebler Drive Program.

2. Memorandum from D. L. Crook, MA-AEC Joint Group to U. M. Staebler, dated November 24, 1964, 970/10857, Subject: N.S. SAVANNAH - Marvel-Schebler Drive Program.

3. Letter from John E. Bone, American Export Isbrandtsen Lines, Inc. to D. L. Crook, A.E.C./MarAd Joint Group dated November 19, 1964, Subject: N.S. SAVANNAH Control Rod Drive System.

4. Maritime Administration, U.S. Department of Commerce, N.S. SAVANNAH License Application, 970/10867, dated December 8, 1964.

5. STS-60, N.S. SAVANNAH Summary Report for Licensed Operations, dated November 1964.

6. STS-10, Port Operation of the N.S. SAVANNAH, dated November 1964.

7. STS-50, N.S. SAVANNAH Annual Operations Report, May 1963-April 1964, dated November 1964.

8. Memorandum from D. L. Crook, MA-AEC Joint Group to R. L. Doan, Division of Reactor Licensing dated November 19, 1964, 970/10819, transmitting STS-51, Quarterly Report, N.S. SAVANNAH Operations, May 1 - August 1, 1964, undated, received November 23 and December 15, 1964.

9. STS-59, An Evaluation of the Practice of Retaining Tugs on the Basis of Time to Melt, dated November 1964.