In compliance with your directive of 27 February 1956, the Evaluation Board presents a second preliminary report of the stands bomb tests held at Bikini Atoll.

Section I

Supplement to Preliminary Report on Test "FR"

In general, the observations on ship damage presented by this board in its first report were confirmed by engineering surveys. The location of the bomb burst, accurately determined from photographs, was such that no ship was within 1,000 feet of the surface point over which the bomb exploded. There were about 50 ships within half a mile of which were badly damaged, many being out of action and five sunk. It required up to 12 days to repair all of these ships hit upon sufficiently so that they could have steamed under their own power to a major base for repairs.

It is now possible to make some estimates of the radiological injuries which crews would have suffered had they been aboard Test "FR" target vessels. Measurements of radiation locally and a study of estimates made in ships show that the initial effects of principal lethal radiation, which are penetrative and invisible, would have killed almost all personnel normally stationed aboard the ships concerned around the air burst and many others at greater distances. Personnel protected by steel, water, or other dense materials would have been relatively safe in the vicinity of target vessels. The effects of radiation exposure would not have been detected at all stations immediately, even some of the most severely affected may have died of their injuries several hours. Thus it is possible that instead of the damage control work being done, the effects of damage control might have been done by personnel operating at distances beyond the work.

Section II

Observations on Test "FR"

The board divided into two groups for the observation of Test "FR". Four members, after surveying the target area from the air, witnessed the explosion from an airplane eight miles away at an altitude of 25,000 feet. Another three members inspected the target area from a small boat the day before the test and observed the burst explosion from the deck of the USS HAYDEN, 11 miles at sea to the east of the burst.
The Board reassembled on the BLYTH on 26 July, and the members were also examined photographically, data on radioactivity, and reports of other phenomena, and were inspected on the target vessels. They have since examined with members of the Task Force Technical Staff.

As scheduled, at 0200 N.T. on 25 July, a bomb was dropped from 12,000 feet, near the center of the target array. The explosion was of predicted violence and is estimated to have been at least as destructive as 20,000 tons of T.N.T.

To a degree which the Board finds remarkable, the visible, phenomena of explosion followed the predictions made by civilians and of remote-phenomenology specialists attached to TF 31. At the moment of explosion, a dense, smoke which filled the entire area, rose upward, and frothed the water surface. The blast was followed by an opaque cloud which rapidly enveloped half of the target array. The cloud vanished in about two seconds to reveal, as predicted, a column of radioactive smoke. From above the photograph it appears that the column lifted to the 25,000-ton battleship MARYLAND for a brief interval before the vessel plowed through the bottom of the lagoon. Confirmation of this occurrence was made by the analysis of radioactivity from the lagoon. No data is yet available.

The diameter of the column of water was about 200 feet, and it rose to a height of about 900 feet. Sprays may be a much greater height. The column examined roughly ten million tons of water. For several minutes after the column reached maximum height, water fell back, forming an expanding cloud of spray which enveloped about half of the target array. Rounding the base of the column was a wall of foaming water several hundred feet high.

Waves outside the water column, about 1,000 feet from the center of explosion, were 20 to 50 feet in height. These were rapidly dissipated in size as they proceeded outward. The highest waves reaching the beach of the island were about 200 feet. These did not pass over the island, and no material damage occurred there. Measurements of the underwater shock waves are not yet available. There were no seismic phenomena of significant magnitude.

The explosion produced intense radioactivity in the water of the lagoon. Radioactivity intensively after the burst is estimated to have been the equivalent of any hundred tons of radium. A few minutes exposure to this intense radiation at the peak would result in a brief interval of serious nausea and nausea with severe headaches. The effects of the radioactivity from the lagoon are not yet known.

Great quantities of radioactive water descended upon the ships from the column, and were thrown over them by waves. This highly radioactivity water consisted of such a density that after four days had elapsed, a ship would be affected by the radiation given off by the water for a distance of 1,000 feet from the center of the burst. The water from the column and the ship was rendered harmless after four days.

As to Task 14, the assembly of target ships for Task 14 took place at the same place and time as Task 14. The ships were arranged in a line, and the ships were arranged in a line, with the ships of the TF 31 in the center of the line. The ships were arranged in a line, with the ships of the TF 31 in the center of the line. The ships were arranged in a line, with the ships of the TF 31 in the center of the line.
Section III
Observations and Conclusions, Both Tests

The operation of ships that have been used to conduct the tests have set a pattern for class, effective cooperation of the Food Service and civilian scientists in the planning and execution of highly technical operations. Moreover, the tests have provided valuable training of personnel in joint operations requiring great precision and coordination of effort.

It is impossible to evaluate an air-burst in terms of conventional explosives, as to detonation and blast effects, what the largest bomb of the past was effective within a radius of a few hundred feet, the ship bomb’s effectiveness can be measured in kilometers of loss.

However, the radiological effects have no parallel in conventional weapons. It is necessary that a conventional bomb score a direct hit or a near miss of not more than a few feet to cause significant damage to a battleship. At 600 meters the second bomb, burning under water, sank a battleship immediately at a distance of nearly 500 feet. It caused an aircraft carrier 124 meters away in a few hours, while another battleship sank within five days. The first bomb, burning in air, did not harm to the superstructure of major ships within a half-mile radius, but did only minor damage to their hulls. No ship within a mile of either burst could have escaped without some damage to itself or serious injury to a large number of the crew.

Although naval results might have been more or less equivocal, the radiological phenomena accompanying the two bursts were virtually different. In the case of the air-burst bomb, it seems certain that unprepared personnel within a mile would have suffered high casualties by intense neutron and gamma radiation as well as by blast and heat. These surviving personnel effects would not have been caused by radiological penetrating effects of the burst.

In the case of the underwater explosion, the air-burst was ten times more intense and there was no hard core of significance. However, burning of the superstructure and burning of gun areas by water, the initial yield of the first ship of radiation was not high enough, but the second bomb threw large areas of highly radioactive water onto the decks and into the hulls of vessels. These contaminated ships became radioactive sources, and would have burned all living things aboard them into terrible and painful but deadly radiations.

It is too soon to attempt an analysis of all the implications of the Bikini tests. But it is not too soon to point to the necessity for further plans and financial research into several unique problems posed by the atomic bomb. The poisoning of large volumes of water presents such a problem. Early must be given to procedures for preventing not only air and water pollution, but also the potentialities of injuries against such radiological effects as were demonstrated in Bikini region.

Observations during the two tests have established the general type and range of efficiencies of air and underwater nuclear weapon bursts on water vessels, new structures, including a wide variety of passenger vessels, and personnel. From these observations and from instrumental data it will now be possible to utilize such data, not only in military and naval design and training, but also in industry and scientific study.