

## THE TALOS SHIPBOARD TEST PROGRAM

At-sea tests were necessary to determine weapon system performance and evaluate proposed system improvements. The tests were conducted from combat ships and were squeezed into the ships' schedules of operational commitments.

### INTRODUCTION

The basic objective of the shipboard test program was to evaluate the ability of the Talos missile and shipboard weapon system to provide an effective defense against aircraft attack. A major part of the effort dealt with the determination of missile and weapon system deficiencies and the evaluation of proposed improvements.

The test program was not formally chartered or planned, but evolved. The need started with the commissioning and technical evaluation of USS *Galveston* in 1958 and ended, some 27 projects later, on board USS *Chicago* in 1970, with a test involving the use of search radar data to control the midcourse phase of a missile flight.

The program was conducted under the direction of the Talos Project Office of the Bureau of Naval Weapons and with the assistance of the U.S. Naval Ship Weapon System Engineering Station. Other organizations participating were Bendix Aviation Corp., the missile contractor; Sperry Gyroscope Co., the fire control equipment contractor; Northern Ordnance and General Electric Co., the launching system contractors; the Naval Weapons Center, China Lake; the Naval Weapons Laboratory, Dahlgren; and Vitro Laboratories, the system integration contractors. APL's role was to plan the test projects, write the test procedures, and coordinate and supervise the test operations. Providing services and scheduling ships and aircraft were done by the Operational Test and Evaluation Force of the U.S. Navy. Analysis and reporting of test results were largely done at APL. Flight test analysis was conducted in collaboration with the Fleet Missile System Evaluation Group.

### PROGRAM HIGHLIGHTS

A chronological summary of the Fleet Test Program is shown in Fig. 1. All of these tests were designed, conducted, and reported by APL, with the assistance of the Talos equipment contractors.

The first Talos cruiser, *Galveston*, was commissioned May 28, 1958, at the Philadelphia Naval Shipyard. The Technical Evaluation of the Talos weapon system started in the fall of 1958 after the ship's fitting out and shakedown period. All aspects of the Talos missile system were checked out and evaluated prior to missile firings in March 1959. This was the

first use of the 50-nautical-mile Talos (XSAM-N-6b and -6bW) missiles at sea. The series of tests was followed by a Navy Operational Evaluation conducted by the Operational Test and Development Force of the Navy.

APL conducted Ship Qualification and Acceptance Trials of the 100-nautical-mile Talos system employing RIM-8C pulse homing and RIM-8D nuclear missiles on the newly commissioned USS *Little Rock* and USS *Oklahoma City* in 1960. APL also assisted the Operational Test and Development Force in a Technical Evaluation and Operational Investigation of the same system in *Galveston* in 1960 and 1961.

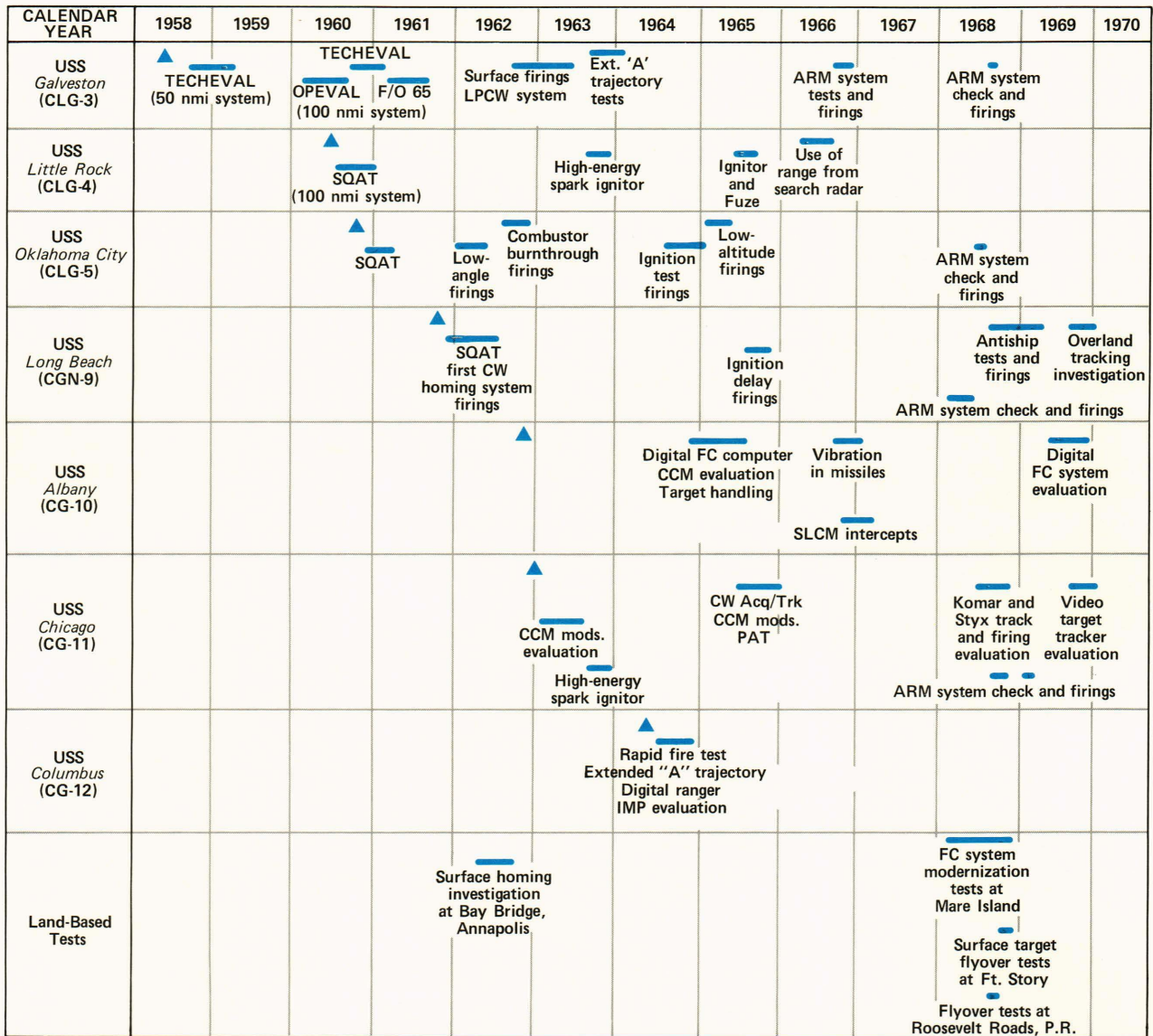
The first system to support the continuous wave homing, 100-nautical-mile-range missile was evaluated as a part of Ship Qualification and Acceptance Trials of the first nuclear-powered cruiser, USS *Long Beach*, in late 1961 and early 1962 (Fig. 2).

Development Assistance Tests for the introduction and evaluation of missile and shipboard system improvements were started in the early 1960's. That test program provided a realistic environment for the evaluation of missile, fire control, and weapon system improvements. It also provided a vehicle whereby development test work was conducted on board operational ships.

When an improvement or group of improvements was ready for evaluation, a Development Assist Project was proposed to the Navy's Talos System Manager, who would obtain Chief of Naval Operations approval and designate a project assignment. APL would prepare test plans for approval by the Navy, devise test procedures, and, with the assistance of the Operational Test and Evaluation Force, arrange for Talos ship services and any needed tracking aircraft, target aircraft, and surface and shore services. The services of missile and system contractors were provided by the U.S. Naval Missile System Engineering Station at Port Hueneme, Calif. The tests were performed under direction of an APL test conductor, with the very active participation of the Missile Engineering Station.

The primary categories of tests conducted as "Development Assistance Tests" were:

1. Prove-in of new capabilities such as countermeasures resistance, homing against surface



Legend:

- |  |                                     |
|--|-------------------------------------|
| TECHEVAL - Technical Evaluation            | LPCW - Long pulse-continuous wave   |
| OPEVAL - Operational Evaluation            | PAT - Passive angle tracking        |
| SQAT - Ship Qualification Acceptance Trial | IMP - Integrated Maintenance Plan   |
| F/O - Fleet Investigation                  | ARM - Antiradiation missile         |
| FC System - Fire Control System            | SLCM - Ship-launched cruise missile |
| CW - Continuous wave                       | Acq/Trk - Acquisition/Track         |
| CCM - Counter Countermeasures              | ▲ - Commissioned                    |

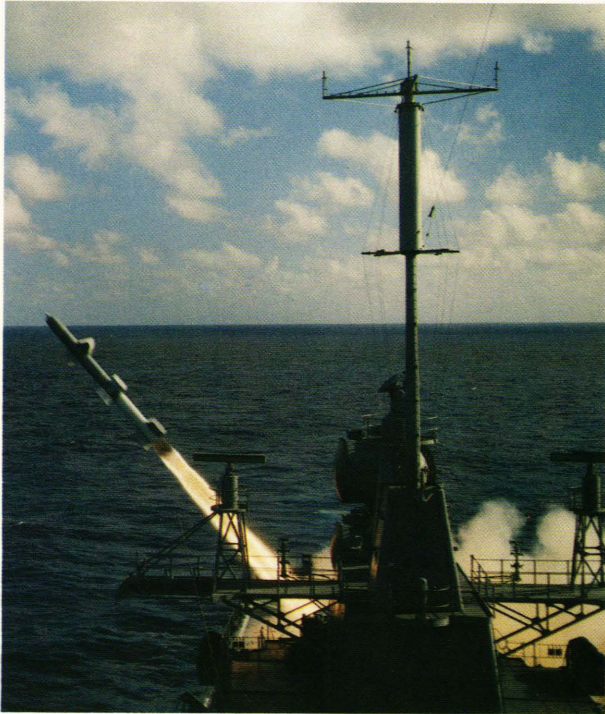
Figure 1 — Development Assistance Tests to evaluate missile and shipboard system improvements were conducted using operational ships. The types of evaluation tests and times involved are shown here.

targets, system coast provisions in case of temporary loss or fading of track, introduction of the digital fire control system, and introduction of antiradiation missile capability;

2. Demonstrations of missile capability against both low-altitude and high-altitude, high-speed targets and the ability of the system to sustain rapid-fire operations;
3. Prove-in of fire control system maintenance aids such as the Daily System Operability Test and the Integrated Maintenance Plan. Some

tests and investigations required several project operation periods to be completed successfully, and were actively pursued for a number of years before completely satisfactory results were obtained.

A typical example of a Development Assist Project requiring several years of testing was the assessment of Talos capability against surface targets. The investigation of the technical problems started in 1962 with a series of land-based tests in which a Talos con-



**Figure 2** — Talos firing from USS *Long Beach* to evaluate the 100-nautical-mile missile and continuous wave homing system. Missile and weapon system evaluations were part of the *Long Beach* Ship Qualification and Acceptance Trials.

tinuous wave illuminator, a missile front end antenna and receiver assembly, and instrumentation to identify and record signal returns were installed on a pier

of the Chesapeake Bay Bridge near Annapolis. The setup was used to gather radar reflection data on maritime traffic passing under the bridge, thus providing an evaluation of the capability of the Talos seeker to track the complex radar returns from ships. Following the Bay Bridge tests, missile firings from *Galveston* against a destroyer hulk were conducted in 1963 with considerable success, in terms of hits on the target and demonstration of extensive damage from missile impact, even though a warhead was not used. A problem revealed by these flight tests was a tendency of the missile seeker to lose track about 1 second before intercept because of the size and complexity of the target. A rapid shifting of the aimpoint along the length of the target caused considerable wing motion and erratic flight. A seeker modification in order to zero the wing control signal when this condition occurred was developed and tested aboard USS *Columbus* in 1964. Tests were also conducted with the Talos seeker mounted in the nose of a P-2V aircraft to evaluate receiver performance more extensively during antiship intercepts. The antiship test program culminated in 1968 with firings from *Long Beach* that demonstrated a Talos capability to intercept surface targets that varied in size from patrol boats to major warships.

The use of tactical ships as at-sea test sites for missile and weapon system development was very ambitious because test work had to be squeezed in between operational commitments. In spite of these heavy operational commitments, the necessary development and evaluation were accomplished and many valuable lessons were learned.