



# THE CHINA LAKER

Vol. 9, No. 4

Newsletter of the China Lake Museum Foundation

Fall 2003

## *Concept Formulation of the Navy's FBM*

By Frank Knemeyer

*A full-scale replica of the first Fleet Ballistic Missile (FBM) stands in front of China Lake's U.S. Naval Museum of Armament and Technology. The missile represents one of the most significant tasks ever undertaken by China Lake — the concept formulation of the initial Fleet Ballistic Missile System — Polaris. This article is a brief overview of China Lake's role. (The display is the result of several years of persistent effort by Leroy Doig, III and support of the Museum Foundation Board of Directors and Navy Seabee Reserves.)*



It all started because of the "Cold War." In the early 1950s, the USSR was making unexpected advances in the development of Inter-Continental Ballistic Missiles (ICBM). These advances posed an imminent strategic nuclear threat to the United States. In February 1955, the National Security Council determined the need for a massive retaliation capability and strongly stressed the urgency for an ICBM program. Because of problems in the guidance accuracy and reentry requirements for ICBMs, the council issued a report recommending

an Intermediate Range Ballistic Missile (IRBM) program to launch missiles from sea and overseas land bases.

Two IRBM programs were initiated — the USAF THOR land-based system and the Army 1,500-mile-range Jupiter system for land-based and surface ship launch. Charles E. Wilson, then Secretary of Defense, gave these programs the highest national priority. The Army's Redstone Arsenal was assigned as the lead development agency for the Jupiter.

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# China Lake Museum Foundation

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## President's Report — September 2003

By Paul Homer, President

September and October have been busy months for the China Lake Museum Foundation, with activities supported by the foundation including the Desert Empire Fair, the Community Dinner, the United Way campaign, the Kern County AirShow, and the China Lake Alumni museum tour and happy hour. Many thanks are due to all our volunteers and staff who supported these events.

The approach of the end of another year again offers us the opportunity to reflect upon the best things that our family, friends and organizations mean to our country and us. USNMAT is one of the very best ways to let our visitors and neighbors alike know about the significant role that China Lake and the U.S. Navy play in our national defense. With the hot summer over, and the approach of the holiday season upon us, now is the time to consider the tax advantages of charitable giving. I encourage you to consider the China Lake Museum Foundation when you decide on charitable contributions. This year, after a lapse of two years, the China Lake Museum Foundation is again a participant in the United Way



Paul chats with Felice McClain of United Way at the Community Dinner

and the Combined Federal Campaign. For those of you in the Indian Wells Valley, our agency number, for both UW and CFC, is 5021. For those of you in other locations you can direct your United Way donation to us by including China Lake Museum Foundation, P.O. Box 217, Ridgecrest, CA 93556-0217 on your pledge card. Unfortunately for CFC participants in other locations, the CLMF is only qualified for the IWV CFC campaign. I strongly encourage donors to devote all or a major share of their UW/CFC contribution to the China Lake Museum Foundation. All funds to the foundation stay here and are used to further the mission of the museum.

**New Memberships For June 16, 2003 - October 10, 2003**

We would like to "Welcome and Thank" our new and renewing members!

**Business Contributor**  
**(\$100 Annually)**

Gary Charlon Insurance, Ridgecrest CA

**Benefactor Membership**  
**(\$500 Annually)**

Carlton and Virginia Hamel, Ridgecrest CA

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In the IWV United Way and CFC Campaigns

## Accomplishments of Lt. Bennett W. Hooks Remembered

by Bertha Ryan, Director

You may remember that the Museum is planning a Memorial Wall honoring the brave men and women who give their lives in accidents as part of the performance of their duties at China Lake. These plans are still in progress but, meanwhile, this newsletter will recognize some of these individuals in various issues.

The first brave China Laker we recognize is Lt. Bennett W. Hooks, who died instantly on October 5, 1956, when the Douglas A4D Skyhawk aircraft he was flying crashed five miles south of Inyokern. A local in the area at the time recalls the pilot tried to land at Inyokern due to an in-flight fire but was unable to do so. Lt. Hooks was part of the VX-5 squadron, commissioned at NAS Moffett Field in 1951 and moved to China Lake in July 1956.

Lt. Hooks graduated from the U.S. Naval Academy in 1946. His first assignment was to the USS *Philippine Sea* as a division officer in the gunnery depart-

ment. He served for a short time as an aide to Admiral Richard E. Byrd on an expedition to the Antarctic. Lt. Hooks earned his wings as a Naval Aviator at Pensacola in November 1949. In June 1955, he completed a course in nuclear engineering at the Post Graduate School at Monterey and came to China Lake a short time later.



He is survived by his wife and two children – a boy age eight and a girl age four months at the time.

The Skyhawk Association recently recognized Lt. Hooks with a page on its web site dedicated in his honor – go to <http://www.skyhawk.org> and click on page dedications.

The sacrifices of the men and women who give their lives during the research and development of weapons and aircraft used in the fleet save the lives of others in combat. The United States of America owes them all a debt of gratitude.

## The Birth of the Supersonic Naval Ordnance Research Track

By Elizabeth Babcock, Director

As the supersonic naval ordnance research track (SNORT) celebrates the 50<sup>th</sup> anniversary of the track's first test — a "TIM Go-Devil, 800 f.p.s." sled run on November 18, 1953 — this article provides a brief look at the events surrounding SNORT's birth.

### China Lake's First Tracks

Instrumented track tests began early at the Naval Ordnance Test Station, with its earliest track (two rails 1,500 feet in length) opening for business in 1945 on K-2 Range.

Another early NOTS track was the heavily used facility at B-4, constructed in 1946 and allowing test sleds to move down a 2.76-mile standard-gauge two-rail track at speeds of up to 605 miles an hour. Although the track was not long or precise enough to suit many NOTS range peo-

ple and their customers, it was useful for numerous early Sidewinder tests and for other simulations where a smooth ride was unnecessary.

The Station and other installations with test ranges were also scrambling to develop high-speed tracks that would allow the nation's rapidly evolving rocket and aircraft components to experience the physical phenomena associated with transonic and supersonic speeds. Although these high speeds could be simulated in wind tunnels, a choking effect frequently spoiled attempts to simulate flight conditions through the transonic range (600-800 miles per hour). Both the Air Force and the National Advisory Committee for Aeronautics (NACA, forerunner of NASA) were working on new supersonic tunnels to avoid this phenomenon, but most such facilities did not begin operation until the mid-1950s.

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## Museum Foundation Member Entertains Our Troops

by Tex Hoppus, Director

Our troops in the Middle East Theater of operation were recently visited and entertained by a member of the China Lake Museum Foundation!

Mark Hoppus, Ridgecrest-born and raised and a member of the Foundation, is also a member of the multi platinum-selling band blink-182. The band comprises singer/bassist Mark Hoppus, singer/guitarist Tom DeLonge, and drummer Travis Barker. The band recently returned from an August visit to our troops in Bahrain, aboard the *U.S.S. Memphis* (a nuclear-powered sub), in Kuwait and aboard the *U.S.S. Nimitz* (CVN-68) aircraft carrier.

While aboard the *Nimitz*, the band had lunch with *Nimitz* and Carrier Air Wing (CVW) 11 sailors and performed a concert.

According to Mark, he was excited to see what it was like to live aboard an aircraft carrier. Blink-182 completed a busy day of meeting sailors and signing autographs with a high-energy show

in typical blink-182 style. "They were really enthusiastic," said Airman Bryan Ward, Strike Fighter Squadron VFA 97. "It took a lot of dedication to come all the way out here to entertain us." Band members sang three of the songs off their upcoming album and all of the originals that they are famous for.

According to Mark, the band was honored to be aboard the *Nimitz*. For many sailors aboard *Nimitz*, the concert will be one of the most memorable moments of the Western Pacific deployment.

Band members expressed their appreciation and gratitude to the sacrifices the crew of *Nimitz* and CVW-11 make. "We are honored to have this once in a lifetime opportunity," said Mark. "We may never get another chance to play a show on an aircraft carrier. Thanks for having us on board. Go Navy!"

The *Nimitz* Carrier Strike Group and CVW-11 are currently deployed in support of the global war on terrorism.

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## The Museum Store and Books

by Bertha Ryan, Director

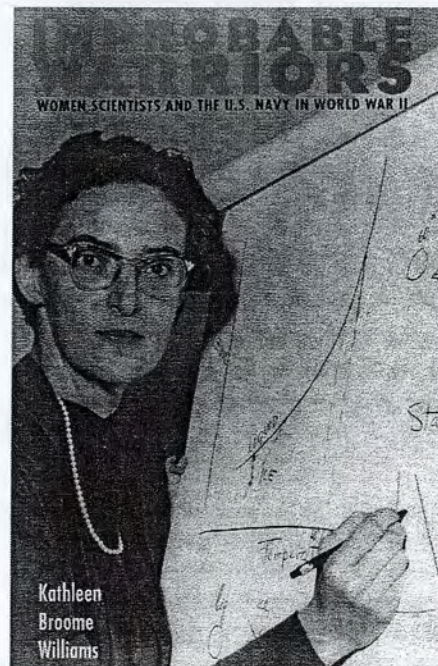
The Museum Store has many books to serve diverse interests – all at a 10% discount to you who are Museum members. One of these books is *Improbable Warriors* by Kathleen Broome Williams, the story of women scientists and the U. S. Navy in World War II.

The author describes the work of several pioneering women in the context of the development of the sciences in which they specialized (meteorology, oceanography, computer science, scientific management). This book is highly recommended to anyone interested in how these sciences existed prior to World War II and then evolved quickly during the war as results were applied to wartime necessities. The reader will recognize the roots of science and technology as we know them today. Many of the names of the people with whom these women worked are familiar.

In addition, China Lake's own WAVEes appear in the book.

Also there are amusing bits of trivia. For example, do you know how the term computer bug originated? This book will tell you.

Christmas is coming! The Museum Store has many items to please the people on your gift list. A reminder – members receive a 10% discount.



# ***Sidewinder 50th Anniversary Videos***

The long awaited VHS video tapes of the various SW50th events are now available.

## **Available Titles**

**Salute to Sidewinder**

(112 minutes)

**City Reception**

(158 minutes)

**Technical Legacy Forum**

(160 minutes)

**Shooter's Forum**

(98 minutes)

Each tape is

**\$9.95**

+ shipping & handling

***Contact Pat Brokke in the museum store***

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## *The Birth of the Supersonic Naval Ordnance Research Track* (continued from page 4)

### **The Birth of SNORT**

The birth of SNORT can be dated from November 1947, when after study of various track lengths and configurations (even one proposal for a circular track), NOTS sent the Navy's Bureau of Ordnance a plan for construction of an aptly named Long Track, described as stretching as far as 25 miles into the desert and accommodating captive testing at accelerations to speeds extending into the supersonic. In February 1948 the Bureau authorized the Station to begin a feasibility study for a more affordable high-speed three-rail track 11 miles in length.

It would take many studies and a lot of red tape before the first shovelful of dirt for SNORT construction would be turned. The Department of Defense Research and Development Board (RDB), which needed to authorize the track before it could be built, had to decide which of a dizzying variety of track proposals to endorse. An Ad Hoc Group on Track-Type Testing Facilities, chaired by John K. Northrop, president of Northrop Aircraft, Inc. and designer of two pioneering tracks for Edwards Air Force Base, began surveying existing and planned tracks.

While NOTS awaited RDB approval, local authorities went ahead with site selection and planning, settling on a flat area a mile and a half north of Inyokern Road and approximately midway between the China Lake administrative area and the village of Inyokern. Not only did the site have suitable terrain and a convenient, noninterfering location relative to the aircraft ranges, but it was also relatively free of earthquake faults, an important feature, since even a mild tremor could conceivably knock the track out of alignment.

While the Aviation Ordnance and Test Department began planning and acquiring the track's instrumentation and test carriages, design responsibility for both the track and its facilities went to the Underwater Ordnance Department (UOD) at NOTS Pasadena under the leadership of James H. Jennison, head of UOD's Development Engineering Division, who had designed NOTS' Variable-Angle Launcher at Morris Dam.

Jennison, Carl H. Heilbron, and others on the design staff studied many types of track configurations in various combinations involving between two

and four rails. Eventually the designers agreed that three identical rails placed at the same level would be the most versatile configuration, since the tracks could be spaced horizontally in such a way that three different two-track widths would be possible.

### **Inhouse Funding and Outside Support**

With funding from higher sources still not forthcoming, NOTS Technical Director Dr. L.T.E. Thompson authorized Local Project 583, "Exploratory Studies for Project SNORT," thus putting the planned track in direct competition with Sidewinder and several other local projects for the discretionary funding that was ordinarily reserved for research endeavors.

In July 1949 the Northrop group recommended that SNORT be built, with the caveat that NOTS work more closely with the installations already possessing tracks. Following those findings, Rear Admiral Walter G. Schindler, BuOrd's Assistant Chief for Research, signed a November 30, 1949, charter of a new coordinating group, the Bureau of Ordnance Committee on Aeroballistics (BOCA), which was given responsibility for the assignment, coordination, and technical direction of all BuOrd aeroballistics research programs, both in-house and under contract.

By that time the Station's management team was getting discouraged about SNORT's lack of progress toward construction. In a long discussion in the January 1950 Research Board meeting, Thompson agreed with the track's critics that expensive facilities should not be built at NOTS unless an immediate need for them could be demonstrated, but he argued persuasively that SNORT was such a facility.

"The SNORT track was sold by L. T. E. Thompson to be another type of aerodynamic research tool, a sort of wind tunnel," Dr. Ivar Highberg, then head of the Ballistics Division's Exterior Ballistics Branch, later explained. "We in the Ballistics Division said it would never be used for that purpose and were trying to get a replacement for the 1,500-foot track on K Range, the terminal ballistics track." Thompson convinced Highberg to support the SNORT project.

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## *The Birth of the Supersonic Naval Ordnance Research Track* (continued from page 7)

In return, Thompson agreed to throw his weight behind the idea of constructing the proposed 3,000-foot G-4 track for terminal ballistics work.

### **More Studies and Homework**

Just as the SNORT project seemed to be gathering momentum toward construction, outside authorities once again put on the brakes. On June 15, 1950, Air Force General Joseph T. McNarney, chairman of the National Defense Management Committee, requested that all construction funds for SNORT be held up until the RDB had a chance to determine that the best available information had been used in the track's design. In an ironic coincidence, just two days later Congress authorized SNORT's eagerly awaited \$5.5-million funding.

Station managers, knowing McNarney's reputation for toughness, approached the latest holdup with trepidation, but they needn't have worried. The McNarney Committee, swayed by the advice of the Northrop group, recommended construction of the new track at NOTS, with the proviso that funds should be obligated only after China Lake showed that the design of the track incorporated "the best experience obtained from the operation of existing tracks."

Fortunately, NOTS was already learning from existing tracks. China Lake track personnel also witnessed several tests on the 2,000-foot track at Edwards Air Force Base, visited Edwards' new 10,000-ft. track to see the rail-alignment process, and got Air Force officials to agree that test runs could be made at Edwards. Visits to the Northrop Aircraft plant had allowed the China Lakers to discuss track design and witness a track vehicle under construction. The Station also learned from a just-completed 3,500-foot launching track at Holloman Air Force Base in New Mexico.

That homework paid off in October when McNarney received the stipulated RDB memorandum assuring him that "the Department of the Navy is utilizing the best experience available from the operation of existing tracks in the design of the Naval Ordnance Test Station Track." On October 26 Congress appropriated a \$950,000 first increment to cover SNORT's initial study, contracts, and contingency items. In November, as promised, McNarney released his restriction on the track's funding. The last impediment to construction seemed to have been removed.

### **Changes in Project Scope**

By mid-December Jennison and his 20-person design group in Pasadena finished the track's final schematic drawings and sent them to the Bureau. Since immediate construction of the full 11 miles of three-rail track appeared to be economically infeasible, the plan was to complete the track's first 6 miles within 2 years, with the entire 11 miles to be finished within 3 to 4 years. The track would have two rails at standard railway gauge for the full 11 miles, with a third rail extending part of the way to provide a narrower gauge.

By the end of spring 1951, eight NOTS sled runs had occurred on the Edwards track, and 31 runs had been made on the Station's own B-4 track. By summer Jennison and his design team had worked out the major concepts of SNORT's design, and Project Engineering Inc. had completed design studies. That July Jennison accepted a challenging new job as head of the Station's Design and Production (D&P) Department. Since his responsibilities in connection with the track design also continued, the entire SNORT design staff transferred into D&P with him.

Then in October Congress appropriated \$4 million, the final installment in the \$5.5 million NOTS had estimated the track would cost. On October 24 Cdr. S. K. Wilson, NOTS Public Works Officer, began advertising contracts for the track headquarters area and the first 4.84 miles of the track. When Jennison, Heilbron, and other members of the SNORT planning group opened the bids in late November, they were shocked to discover that the lowest bid for the first two increments was for more money than was available for the entire project.

The group quickly decided that the best course would be to scale back to 4.47 miles of track, a plan that the D&P staff believed would give "the barest minimum in track facilities ... the best that can be had under the circumstances." The designers also raised the minimum zero-stress temperature for the rails to 70 degrees Fahrenheit, largely because no contractor would bid on the job at the originally stipulated 30-degree minimum. The NOTS Research Board agreed — and urged Commander Wilson "to proceed with construction of the track immediately, before prices go any higher."

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## *The Birth of the Supersonic Naval Ordnance Research Track* (continued from page 8)

### Construction Decisions

Construction of SNORT began on January 14, 1952. The grand plans for the Long Track had been scaled back considerably. The track would be only 4.1 miles long and would have just two standard-gauge rails for its entire length. But even this truncated version would still be the longest precision two-rail track in the country.

The contractor, J. A. McNeil Corporation, scraped off a long north-south gash in the desert, and workmen began pouring two hefty reinforced-concrete beams running under SNORT's entire length with a horizontal slab joining the two beams. In cross-section the joined beams and slab formed an H-shaped structure resistant to both horizontal and vertical stresses. This entire structure was buried in a compacted earthwork base.

The standard heavy crane rail selected for SNORT was laid in 50-foot lengths in order to minimize the number of joints required. To help maintain the precise track alignment necessary for controlled testing conditions, the rail ends were milled square and joined with dowel-pin connections set so that the adjoining rail ends would touch only when rail temperature reached 70 degrees.

Laying the rail was exacting work, with alignment tolerances of three to six hundredths of an inch necessary over the entire length of the track. A suitable vehicle would be able to streak down the track at a velocity of 3,500 feet per second, accelerating at rates of up to 150 g. For the track to be useful, it would need to stay in precise alignment. To develop accurate benchmarks and monuments close to the track, surveyors from the U.S. Coast and Geodetic Survey established a 12-mile-long baseline 300 feet west of the track. Surveyors could then make accurate measurements of rail alignment and horizontal, vertical, or rotational adjustments could be made to the rail.

The carriages thundering down the track would almost inevitably use most of SNORT's length, and efficient braking systems were mandatory if the test items were to be recovered. For this reason, the new track incorporated provisions for three braking systems — water brakes, sand brakes, and a third type using retro-rockets.

As track construction made rapid progress, SNORT's designers concentrated on test-sled design, which they considered fully as important as

that of the track itself. The stress caused by the force of the sled hurtling down the track needed to be balanced by corresponding elastic strains in the sled's shoes and axles. Observation of sled shoes on the B-4 track had shown that most of the wear came from heating and vaporization of a thin layer on the shoe surface. The runners of the new sleds were ingeniously designed so that at top operating speeds, shoes would run on a cushion of vapor from their own evaporation. The test-vehicle designers considered many types of propulsion, eventually selecting solid- or liquid-fuel rocket power as the only practical method for producing the high accelerations required. To minimize vibrations, the team also designed low resonant frequencies into both track and carriages.

To the relief of the test conductors, the minimum test operations that began with that first November 1953 tests showed by early February 1954 that test vehicles could operate at the hoped-for speeds and that the water brake would stop the vehicles as planned. A test series of the Falcon fuze, run during the last half of the month, was the first single-rail use of the new track. With all instrumentation operating as designed, SNORT was at last ready for its grand opening.

### Grand Opening

On the last Saturday in March 1954 nearly 1,300 community members lined up to watch the first public demonstration of SNORT, the main event in a program celebrating the fourth birthday of the Test Department.

This first public run proved so popular that SNORT demonstrations became regular features of Armed Forces Day celebrations for many years thereafter. Station management discovered that a demonstration of SNORT could be used as an impressive, reliable, and yet relatively inexpensive symbol of China Lake test activities.

More to the point for the testing community, the Navy's desert facility at last had a high-speed track that could fill the gap between static testing of wind-tunnel models and free-flight testing of full-scale rockets and missiles.

The track is still in use to this day, with SNORT's versatility accommodating runs of low or high speeds and short or long durations. Projects taking advantage of SNORT's capabilities over the years have ranged from aircrew ejection systems to live ordnance components to movie special effects.

## Concept Formulation of the Navy's FBM

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The Navy established the Special Project Office (SPO), headed by Rear Adm. William F. Raborn, to coordinate the Navy's responsibility. The primary emphasis of the Jupiter program was operational deployment by 1963-1965. This minimum deployment time led to a conservative design philosophy — off-the-shelf components incorporating an existing warhead-reentry payload and a Redstone heavy guidance package that had been successfully tested.

The resulting Jupiter missile weighed upward of 110,000 pounds with a range of 1,500 miles. It was 58 feet long and 8 feet in diameter and used a high-energy liquid propellant propulsion system. These characteristics posed serious problems for the Navy in shipboard compatibility and operations. The Navy engaged Lockheed and Aerojet to study the application of solid propellants. The ultimate aim was to have a submarine-launched system, that severely restricted the missile weight and length. The Lockheed/Aerojet design, designated Jupiter-S, was 43 feet in length, 10.5 feet in diameter, weighed 168,000 pounds and incorporated a two-stage cluster of seven solid-propellant motors. This massive size made design of a compatible submarine platform of reasonable size within the scheduled time virtually impossible.

In the spring of 1956, Capt. Levering Smith, an outstanding military officer both technically and managerially, was assigned in the SPO to lead the solid-propellant study. (Formerly a department head and Deputy Technical Director of China Lake, Capt. Smith was later promoted to rear admiral and eventually head of SPO.) He requested the Weapons Planning Group, Code 12, China Lake, to conduct analyses and study methods for improving the Jupiter-S performance. In a brief study, Don Witcher, under Dr. Frank Bothwell head of Code 12, examined the missile components and concluded there was no way the Jupiter itself could be adequately modified. The results, however, led to the possibility of a new missile concept approaching a weight of 30,000 pounds that could be achieved with the same performance and development schedule.

China Lake undertook a more intensive and detailed study to project what advanced technology in every system component would provide in the desired development time scale. Of particular importance were the nuclear warhead

yield/weight and associated reentry heat shield, inertial guidance, and solid-propellant motor with jet control. The objective was to formulate the concept of a totally new, but smaller, missile system more compatible with submarine technology that could be developed in the desired time. The China Lake team also critically reviewed the targets and related damage level that constituted massive retaliation. The basic team comprised — seven or eight members of Code 12 under Dr. Bothwell. In addition, all related resources of China Lake were involved in specific areas of technical expertise. Also available to the group were unrestricted access to the resources of the Livermore Radiation Laboratory and related highly classified documents.

The results of the technical assessment and study led to a missile concept of about 50% the size and less than 20% the weight of the Jupiter-S system proposed by Lockheed/Aerojet. The primary factor affecting the size and weight of the missile was the payload — warhead, guidance, and reentry heat shield. Code 12 achieved a critical advance in reducing the weight of the reentry payload by essentially eliminating the heavy reentry heat shield and using a smaller warhead, as discussed below.

Two reports contained specific information applicable to the heat shield. One was a report by Julius Allen, NACA (later NASA) Ames Laboratory, on the aerodynamics of atmospheric reentry, and the other was a detailed review by the Rand Corporation on reentry heat shields and materials. A detailed study of nuclear warhead designs revealed that the case structure was composed of one of the metallurgical materials discussed in the Rand report that was quite suitable for the reentry shield. By integrating the technologies, the team was able to show how the weight of a separate heat shield could be essentially eliminated. The China Lake team discussed the concept with pertinent people at the Livermore Radiation Laboratory, who agreed that the idea was feasible. With all critical technical data in hand, the remaining problem was to determine the desired warhead yield/weight and related size and weight of the reentry payload.

The Air Force ICBMs carried multi-megaton nuclear warheads to achieve the intended damage level on enemy ICBM sites commensurate with their missile accuracy.

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## Concept Formulation of the Navy's FBM (continued from page 10)

These high yields could inflict a large area of collateral damage that in effect would victimize the surrounding population. If the enemy struck first, the probability of preventing their missile launchings was somewhat moot. To deter an adversary, you have to convince them of the devastation they would probably suffer in retaliation. Unfortunately, if they aren't convinced of the disastrous consequences you could inflict, trying to deter them would be rather questionable.

A critical part of this study was an analysis made by China Lake of major world disasters over the past many years that left countries in a state of maximum devastation/disruption. The results led to the primary choice of targeting the adversary's cities, which in effect was what resulted from the Air Force ICBMs. The mathematical model developed for determining damage level was checked against those of the Hiroshima and Nagasaki attacks. The calculations were in surprisingly close agreement. Further, these results indicated the significant value of employing low-yield warheads.

China Lake then conducted the most comprehensive analyses of nuclear attacks on USSR cities that had been made to that date. The physical characteristics of over 300 Soviet cities were examined in great detail. The damage level based on the results of the previous study for maximum disruption and urban liability related to the recovery of the 50+ largest Soviet cities was to inflict one-third fatalities, one-third injured, and one-third unscathed. This damage could be accomplished with warhead yields of only 100 to 200 kilotons at 1-2 nmi. accuracy. These results were used to determine warhead yield, target aim points and number of missiles to accomplish the intended level of damage. Next the characteristics of a feasible missile concept were established. The study indicated that a total yield of perhaps as low as 20 megatons would provide a sufficient level of devastation, as compared to the multi-megaton yield of each Air Force ICBM.

In summer 1956, the National Academy of Science Committee for Undersea Warfare convened at Woods Hole (Project Nobska) at the request of NO, Adm. Arleigh Burke. About 5% of the study

effort led by Dr. Bothwell addressed FBM concepts. Bothwell, armed with the China Lake studies, met with considerable resistance from the group in proposing an entirely different and smaller missile than the Jupiter. In August 1956 Dr. Edward Teller visited the study group. Regarding the solid-propellant Jupiter missile being considered for the FBM, he asked, "Why are you designing a 1965 weapon system with 1958 technology?" In his discussion, Teller essentially verified what Bothwell had been telling the group about advances in warhead technology – information Code 12 already had from Livermore. Bothwell and Witcher wrote Chapter 8 on the FBM study for the Nobska committee's final report. This study effort initiated the following series of events:

Sept. 4, 1956 — Dr. Teller submitted his warhead predictions to the Atomic Energy Commission for certification.

Labor Day weekend September 1956 — Bothwell and Witcher met with Capt. Smith and Dr. L. T. E. Thompson at the SPO in Washington DC. The next day they informally briefed Adm. Raborn and staff. The concept of a small missile (~30,000 pounds) was immediately adopted.

October 1956 - Nobska results were presented to Adm. Burke and staff (20,000-30,000-pound two-stage solid propellant missile system).

-November 1956 - The small missile concept was reviewed by the OSD Scientific Advisory Committee (Dr. Clark Millikan, special assistant to SecDef for guided missiles)

December 1956 – DOD approved a plan for shifting from the Army's Jupiter to the Navy's solid-propellant missile system concept called "Polaris." Hence the FBM Polaris was officially born.

January 1957 — SPO established a steering committee to study all aspects of the Polaris system design with a recommendation on the optimum size due 1 April 1957. Members of Code 12 were on several of the subcommittees.

At the same time, Code 12 completed an independent study and issued a report — Project Mercury — on 28 February 1957.

(continued on page 12)

Concept Formulation of the Navy's FBM (continued from page 11)

China Lake proposed a smaller missile and warhead yield, but the committee took a more conservative position and established a missile system with the following characteristics:

Payload:

Weight: 1,500 lb. (including guidance)

Warhead weight: 600 lb.

Yield: ~1 megaton (initially 700-800 kt)

Missile:

Weight: 28,600 lb.

Length: 28.5 ft.

Diameter: 54 in.

The task of designing and constructing a new missile system and submarine configuration on a short schedule was a tremendous undertak-

ing. Though initially targeted for about 1963-1965, the system was ready in 1961. The FBM under the management of the SPO was one of the finest and most successful system developments ever accomplished in DOD. To meet the national emergency, a reduced performance range (~1,200 nmi.) for the first systems and essentially an unlimited checkbook provided tremendous impetus in accelerating the schedule.

The task undertaken by China Lake was perhaps the first total system operational analysis conducted on a major weapon system in the Navy. The results served as a basis for the concept, successful development, and initial operation of the Navy's first Fleet Ballistic Missile System. This task was one of several China Lake carried out in its role supporting the FBM. Over the past decades other tasks have included supporting solid motor development and testing (Skytop) and launching development tests at San Clemente Island (Project Pop-up).



Students from the Murray School Aerospace Club tour the museum.



## Museum Happenings

by Barry Lowry, Museum Manager

Fall is upon us and activity is picking up. Although the museum is never "slow", so to speak, activity does ebb and flow with the vacation, school, holiday season cycle.

The museum staff continues to work various projects and issues around the museum. Pat Brokke, in consonance with the CLMF Museum Store Committee, is working to stock the store with gift items for the Christmas shopping season. As we have done the last two years, the museum will be open on Saturdays from day after Thanksgiving until Christmas to allow more opportunity for shopping.

We recently accepted delivery of a custom made cabinet to house the "biography kiosk" so generously donated by Sverdrup last year. This kiosk features a computer driven database of biographies and pictures of people who have contributed to China Lake's success over the years. Originally started just before the Sidewinder 50<sup>th</sup> Anniversary, the kiosk is very much a work in progress with about 15 outline and partially complete biographies installed. Now that the electronics are packaged in an attractive housing, we will work to complete the initially installed biographies. Those of you who might be interested in making your biography available on the system so museum visitors may view it are encouraged to contact the museum staff for the details of the process.

September was a busy month for the foundation and the museum staff alike. We setup and manned booths at the Desert Empire Fair, the United Way Family Fun Day and the 9<sup>th</sup> Annual Verizon Community Dinner. We also joined with the Weapons Division Public Affairs Office to add a museum information display as part of PAO's booth at the Kern County Air Show. We also toured groups from the USS Aredid Reunion, the Habitat for Humanity and a 4<sup>th</sup> grade class from Gateway school through the museum.

With an eye toward the holiday season, the museum staff and members of the board have met to discuss the annual CLMF Christmas Party. Tentatively, this will occur the afternoon of 10 December 2003 at the museum so mark your calendar.



Your museum staff hard at work at the Verizon Community Dinner

The Navy, in continuing its support of the museum, recently renovated our landscaping by removing dead bushes and trees and by planting 5 new trees around the museum front lawn. There is also a rumor afoot, as yet unconfirmed, that the building will receive a paint job in the near future!

The museum continues to increase in popularity as a tour stop for various groups and tour operators. We've already booked bus tours for February and March of '04. We have a number of Boy Scout tours on the schedule as well. We are working a tourism opportunity with one of the major hotels in Ridgecrest. We were also recently mentioned in the California 178 Corridor tour brochure published locally by IWV 2000 and RACVB.

The fun continues.....

[www.chinalakemuseum.org](http://www.chinalakemuseum.org)

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