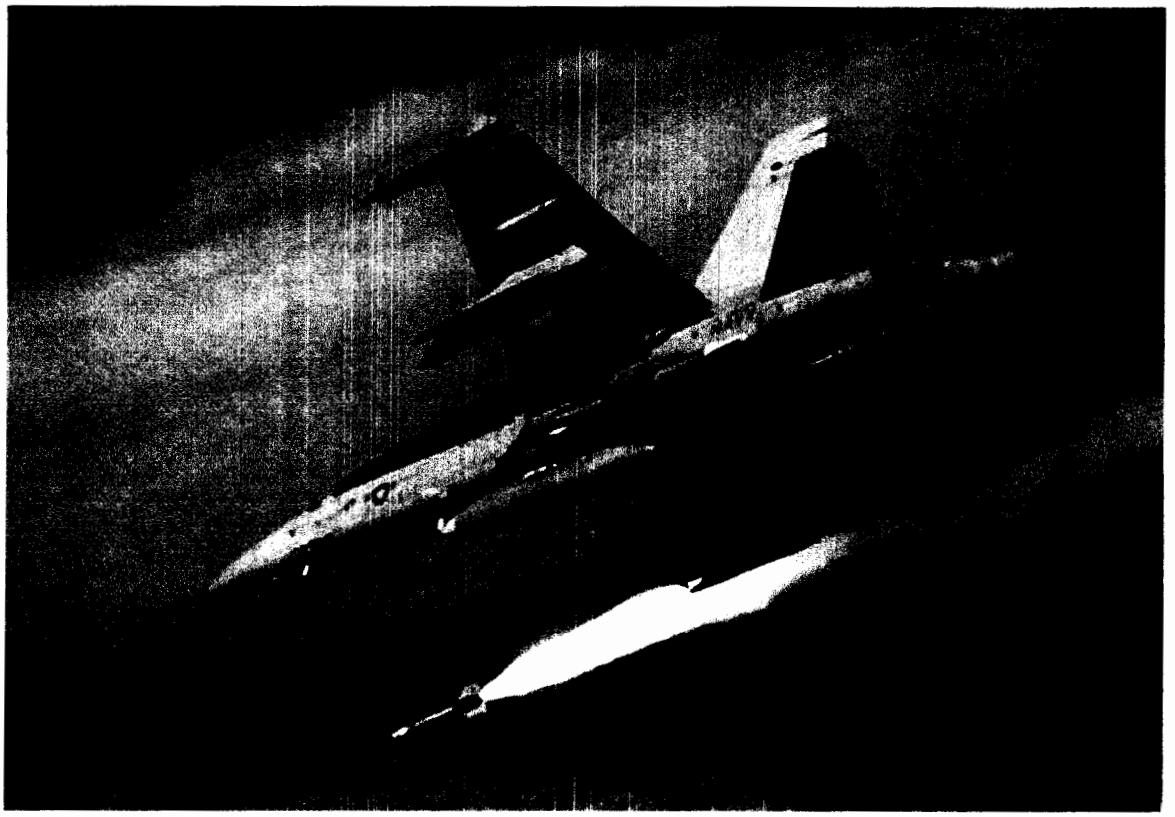
DCN 5354

# CHINA LAKE NOTEBOOK



## An Informal Collection of Information On the Base and Its Host Community

**CHINA LAKE DEFENSE ALLIANCE**
**APRIL 2005**

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Navy/MC–Naval Air Weapons Station China Lake–CA
**BRAC COMMISSION – FY 2005**
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# FOREWORD

The China Lake Defense Alliance has been gathering and compiling information on China Lake for a number of years to support the base's case for retention and growth in BRAC 2005. As the process is nearing the final stages of Defense Department and military service assessments in preparation for submittal of recommendations to the BRAC Commission, members of the Alliance thought it appropriate to publish an informal document that presents a portion of the information it has collected on China Lake, its missions, and its rightful place supporting the national and military strategies of the United States.

The China Lake RDT&E base has had a number of name changes since it was established in 1943, but its reputation for excellence built over 60+ years transcends the organizational changes the Navy and Department of Defense have undergone during this period. As the Naval Ordnance Test Station, Naval Weapons Center, and Naval Air Warfare Center Weapons Division/Naval Air Weapons Station, China Lake's extraordinary civilian-military team, first-class facilities and enormous land and air space have produced a remarkable series of products and services contributing to the military superiority of the United States.

The only way it's possible to fully appreciate China Lake's contribution to our military capability and its potential contributions in the future is to spend a considerable period of time touring the Lake, talking to its people and touching the hardware. As a poor substitute for actually coming on board, the China Lake Defense Alliance has prepared this notebook. With a minimum of editing we have tried to include a sampling of not only the scope and mission of China Lake, but also the community that supports it. We've also mentioned some of the natural resources and cultural heritage sites under the stewardship of the China Lakers. We also have included a small sample of products and services with a few pictures, and short essays on some of the special features and programs of China Lake. The source for material is the internet and short essays by China Lake retirees.

We hope this informal introduction will give at least some idea of why China Lake was, is, and in the future will continue to be a key contributor to our country's military power, We also hope this notebook might also convey an inkling of why China Lake military and civilian staff, support contractors, and retirees are avid supporters of "The Lake."

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The China Lake Defense Alliance, a component of the IWV 2000 Community and Economic Development Corporation, is a group of volunteers supporting China Lake. It is not affiliated with China Lake, United States Navy or Department of Defense.

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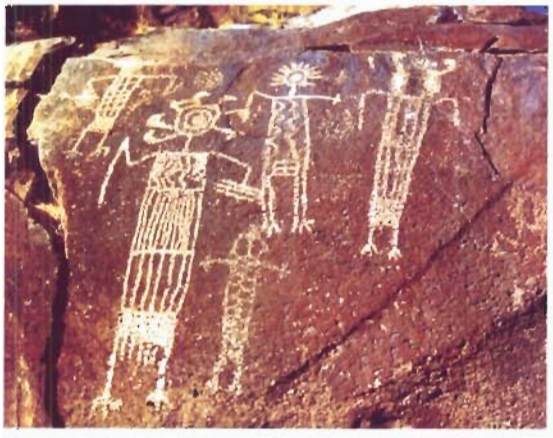
# PART 1: BASIC DATA

The Naval Air Weapons Station, China Lake, is the largest US Navy base in terms of area. Its largest tenant command, the Naval Air Warfare Center Weapons Division, is world famous for developing and testing many of the most effective and affordable weapons for the United States and its allies. It is also the home of the Navy's air operational test and evaluation unit.

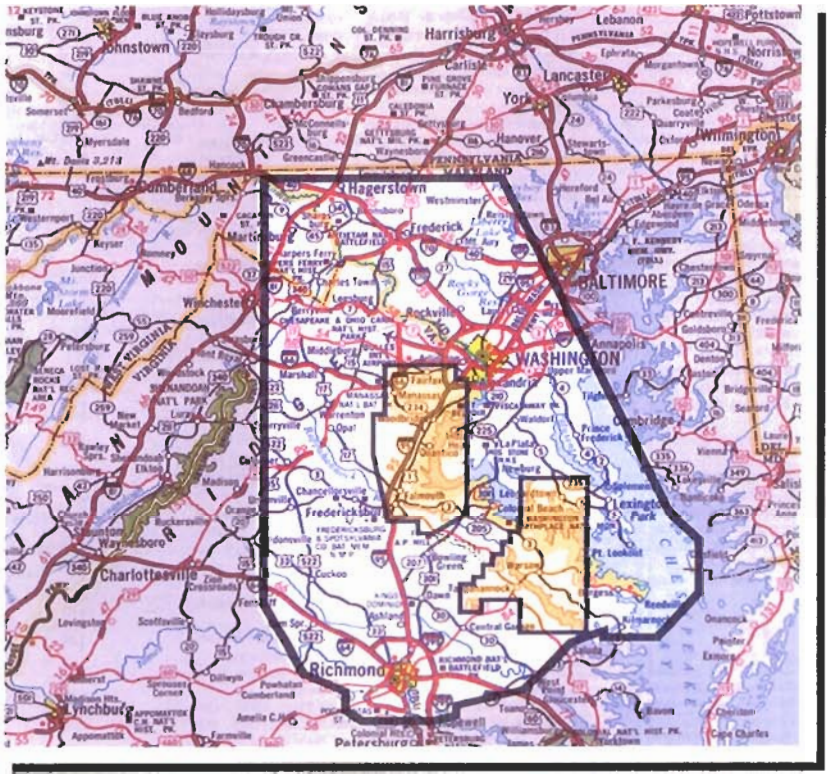


The remote site of China Lake in the Mojave Desert is the home of a great variety of desert and mountain plant and animal life and historic and cultural artifacts of American Indians and the Old West.

China Lake is located in the Mojave Desert north of Los Angeles on the east side of the Sierra Nevada Range.

Its land area is over 1.1 million acres of forested mountains and desert valleys

It is located under R-2508, the largest contiguous airspace in the United States, 18,000 sq. mi. in area.




To gain perspective on the enormous size of the land area and airspace of China Lake, this map shows the China Lake Naval Air Weapons Station and its airspace superimposed on a map of the Northern Virginia. If China Lake were located there, the airspace would extend from the Pennsylvia state line to below Richmond. The land reservation of China Lake alone would encompass a substantial part of the area between Washington DC and Richmond. China Lake is larger in area than Rhode Island.

## ELECTED REPRESENTATIVES

**U.S. Senate**
Senator Diane Feinstein
Senator Barbara Boxer

**U.S. House of Representatives**
Representative William Thomas
Representative Howard "Buck" McKeon

**California Senate**
Senator Roy Ashburn

**California Assembly**
Assemblyman Kevin McCarthy
Assemblyman William Maze

**Kern County**
Supervisor Jon McQuiston

**City of Ridgecrest**
Mayor Chip Holloway

## MAJOR CHINA LAKE COMMANDS AND THEIR MISSIONS:

In 2003 the management of the administrative aspects of all Navy bases was placed under the command of regions located around the United States. China Lake's land, public works, and basic plant management was moved to the command of the Navy's Southwest Region. The Naval Air Warfare Center Weapons Division (NAWCWPNS), Air Test and Evaluation Squadron 9 (VX-9) and other existing tenants became tenants of the Naval Air Weapons Station. In effect, the Naval Air Weapons Station became the landlord for NAWCWPNS. There has been no change to the mission of NAWCWPNS or any other tenant other than shedding plant management functions.

**The missions of the major China Lake components are listed below with the command to which they report enclosed in parentheses:**

## Naval Air Warfare Center Weapons Division (Naval Air Systems Command)

Provide our Armed Forces with effective and affordable integrated warfare systems and life-cycle support to ensure battlespace dominance.

- Perform RDT&E, logistics, and in-service support for guided missiles, free-fall weapons, targets, support equipment, crew systems, and electronic warfare.
- Integrate weapons and avionics on tactical aircraft
- Operate the Navy's western land and sea range test and evaluation complex.
- Develop and apply new technology to ensure battlespace dominance.

## Naval Operational Test Squadron 9 (Operational Test and Evaluation Force)

- Conduct independent operational testing (OT) of strike weapons systems including:
  - Strike aircraft
  - Conventional warfare equipment
  - Electronic warfare equipment
- Develop tactics and procedures for weapons systems employment.
- Support the fleet.

## Naval Air Weapons Station (Naval Southwest Region)

- Operate and maintain base facilities and base support services, including airfields, for the Naval Air Warfare Center Air Weapons Division at China Lake, assigned tenants and activities and transient units

## Work Force (Commands and Tenants) (2002):

| | |
|---|---|
| • Military: | 954 |
| • Civilians: | 3,111 |
| • Contractor: | 2,129 |
| | 6,194 |

## Annual Expenditures:

- Expended (2002): $ 1.2 Billion with its sister facility at Point Mugu
- MILCON (2003): $10.2 Million

# PART 2: CHINA LAKE PROGRAMS

## Introduction

From its inception China Lake has been a major research, development, test and evaluation center. It was established in 1943 to move the nation's tactical rocket program being conducted by the California Institute of Technology from Pasadena, California, to a region with the wide-open spaces and isolation to permit full scale testing of rocket weapons. Although it was named the Naval Ordnance Test Station or NOTS, it was intended to be a full-spectrum resource for all phases of rocket technology, system development and testing.

Over the years China Lake's mission products grew from air-launched rockets to surface rockets to fire control systems and on to guided missiles, weapon test equipment, aircraft gun systems, national test range, in-service engineering, aircraft-weapon integration, ballistic missile testing, electronic warfare, mission planning systems, crew escape systems, warfare system simulation and modeling, network centric systems, and training support. China Lake is truly a full-spectrum center providing support to all military services, federal agencies and the armed forces of our allies.

In this notebook, it would be impossible to catalog all of China Lake's products and services. The following pages offer a sampling of the center's products to give at least an indication of the range of contributions of China Lake to the arsenals of all of the services of the United States and its allies around the world.

## A FEW REASONS WHY CHINA LAKE IS IRREPLACIABLE

The Naval Air Weapons Station, China Lake is the home of the Naval Air Warfare Center Weapons Division China Lake and Air Test and Evaluation Squadron NINE:

- World's leader in RDT&E for air weapon systems proven through 60 years of unparalleled products

- Unique world-class facilities and test ranges for weapon system solutions for the warfighter

- Leading activity for experimenting and developing the next generation of warfighter technologies such as network centric warfare, uninhabited combat vehicle system integration, and hypersonic weapons

- 38% of the Navy's landholdings are at China Lake – 1.1 million acres. Area is larger than Rhode Island

- R-2508 airspace encompasses 12% of California's total airspace. Jointly managed with Edwards Air Force Base and Fort Irwin.

• Fully integrated RDT&E center for weapons development and complex system integration (aircraft and weapon).

• China Lake is famous as a developer of affordable weapons for the free world that work; for example, Sidewinder, Shrike, Harm, and as a place for finding innovative solutions to meet military needs; for example, Polaris.

• All Navy tactical aviation systems receive operational test and evaluation and initial tactics development by VX-9

• Innovator in management as well as technology; e.g. personnel demonstration program

• Plenty of room to accommodate more missions and other facilities

• Geothermal electrical energy resource sufficient to power all California bases

## MEETING FUTURE DOD NEEDS – CURRENT STRATEGIC THRUSTS:

• 21st Century Battlespace Integration
• Energetics (Explosives, Propellants, Warheads, Rocket and Ramjet Propulsion Units, and the Chemistry of Energetic Compounds)
• Hypersonic Weapons
• Uninhabited Combat Air Vehicles (UCAV)
• Directed Energy Weapons

## RESEARCH AND TECHNOLOGY PROGRAMS

The Naval Air Warfare Center Weapons Division (NAWCWD) is a full-spectrum research, development, test and evaluation (RDT&E) organization whose mission is to provide our Armed Forces with effective and affordable integrated warfare systems and life-cycle support to ensure battlespace dominance.

Following the end of the Cold War, the Department of Defense experienced significant downsizing, and China Lake was not exempt. Despite the downsizing, the base has maintained a vigorous program of research and development aimed at providing more effective and affordable weapon systems for the warfighter.

A description of several top-priority research and development technology projects at the NA WCWD is provided in the following summaries:

**Advanced Energetics**. Energetics is the science and technology associated with energetic materials used for explosives and rocket propellants. The objective of the Advanced Energetics thrust is to develop advanced energetic materials which (a) support weapon systems which can destroy hard, deeply buried targets, (b) provide the increased

range and speed to attack and destroy time-critical targets, (c) provide the increased range to decrease launch platform vulnerability, (d support the development of smaller, highly lethal weapons capable of internal carriage on tactical aircraft, (e) provide greater insensitivity to impacts and fire, (f) provide low signatures, and which (g) support demilitarization/green munitions.

China Lake has a variety of facilities and test sites located over 1.1 million acres of remote desert that allow for the full-spectrum of RDT &E activities necessary to support a program in energetics. Completely equipped laboratories exist for research and development of new energetic compounds, scale-up, synthesis, materials testing, and Propellant motor and warhead testing. Test facilities support testing of small amounts of energetic materials to 500,000-pound net explosive weight. Highly instrumented ranges support the testing of all-up weapons.

To meet the needs for advanced energetics for future applications, China Lake scientists are working with nano-particle metals/coatings, high nitrogen compounds, difluoramino materials, nitramine propellants, high temperature explosives, reactive metals, and micro electro-mechanical systems.

**Rocket Propulsion**. Develop integrated, high payoff rocket propulsion technology which will "double" rocket propulsion capability by 2010. This program is a Defense Department, NASA, and industry initiative which uses multiple funding sources to develop and demonstrate technologies to achieve phased performance goals. The result of this effort will provide for increased weapons kinematics, decreased weapons size, and potentially result in fewer weapons system types required in the future.

**High Speed Weapons**. Develop and demonstrate the advanced technologies needed to support the development of a long range (400-700nmi), high speed (Mach 3-6) weapon capable of being launched from air, surface, and submarine platforms to attack and destroy time-critical and hard targets.

Two programs are being planned and executed by a government/industry teams with China Lake support. Component-level developments are being conducted in propulsion and airframes, and system application studies are being performed. Large-scale integration and test of both dual-combustion ramjet and supersonic turbine engines are being planned for the near future. Flight test demonstration programs will be conducted to demonstrate and validate key subsystems for a future high speed weapon. China Lake is a key member of the government team overseeing program planning, propulsion and airframe development and testing, and the integrated system flight demonstrations.

**Advanced Initiation Devices**. Develop improved initiation device technologies applicable to a broad range of weapon systems - reduce the stressing electrical environment for munitions initiation devices, increase initiator reliability over a munition's lifetime, and develop a distributed and reliable initiator concept that will enable tailoring of unitary munition or submunition lethality.

This program is looking at low energy exploding foil initiators which require reduced voltage and energy, and can be hermetically sealed for long life, replacing the current initiator material with CL-20 to provide twice the output and one quarter of the cost of current materials, and micro electro-mechanical system design for increased reliability and for distributed initiation designs.

**Spike Urban Warfare System**. Develop and demonstrate a small cost-effective, fire and forget, precision guided missile and launcher system for Marine and special operations applications.

"Spike" is a concept for a very small, low cost, man-packable, anti-material guided missile and launcher system. It will provide a precision weapon that increases a fire team's firepower and minimizes collateral damage in urban warfare. It will provide a cost-effective weapon with which to engage lightly armored or soft urban and mechanized targets at ranges up to 3 km.

**Cruise Missile Real-Time Retargeting**. Provide cruise missiles with in-flight adaptive strike planning and battle damage indication for retargeting/mission planning.
This program is developing a laser radar (LADAR) seeker, a real-time automatic target recognition system using LADAR sensor data, and a real-time adaptive strike planning system. Successful demonstration of these systems will provide a real-time retargeting capability which can be applied to cruise missiles, advanced strike weapons and unmanned aerial vehicles.

**Precision Strike Navigator**. Develop an accurate, affordable, fiber optic gyro inertial measurement unit for precision weapons in GPS denied situations.

The goal of this program is to develop a precision strike navigator with performance equivalent to current global positioning system (GPS) navigators, a $6K average unit cost, and a volume of 14 cubic inches. Successful transition of this technology will provide a robust, low-cost navigator applicable to a variety of applications, such as cruise missiles and advanced strike weapons.

**Weapon Image Link**. Develop a direct sensor-to-weapon data Iink for in-flight retargeting, aimpoint correction, and target imagery transfer.

The goal of this program is to develop a podless data link for the F -18 aircraft, using existing antennas, that will provide for man-m-the-loop control of imaging weapons through secure transmission and reception of video and command signals, and real-time target updates.

**High Speed ARM Demonstration**. Develop and demonstrate a high-speed antiradiation missile (ARM) capable of defeating short dwell mobile intermittently emitting targets from standoff range.

The goal of this program is to demonstrate a long range, high speed, low-ejecta

propulsion/steering control system, based on an advanced integral nozzleless rocket and variable flow ducted rocket ramjet, that is compatible with the HARM AGM-88E guidance/navigation/control section in a controlled test configuration. Successful demonstration will provide for a significant improvement in standoff range, response time, and kill probability.

**Biomimetics**. Develop more efficient and compact seeker signal processing algorithms based on insect vision strategies for hyperacuity and motion detection, applied to low cost optical guidance concepts.

Scientists know that a fly eye and brain (with some 350,000 neurons) outperforms modern missile target acquisition and tracking system. The China Lake biomimetic program originally involved the Office of Naval Research, the Defense Advanced Research Project Agency (DARPA), two domestic universities, and one foreign university in Australia. The program is coordinated with similar interests in fly biomimetics in the U. S. Air Force Research Laboratory. A hyperacuity sensor and processor has been built based on fly brain circuitry, and the research is sufficiently advanced to apply to imaging weapons systems.

## WEAPON PROGRAMS

China Lake has been involved in every phase of weapon development for the Navy in its 60+ years of existence including basic and applied research; technology development; weapon design, development and test; technical management and support of contractor development, test and production monitoring; second-source development; and product improvements at the component and system level. The table on the following page is a sample of how China Lake has participated in all Navy and many Air Force and Army weapon development and test programs.

The following snippets illustrate the scope of China Lake's involvement in weapon system development and its impact on the armament of the United States and its allies:

**Fleet Ballistic Missiles.** When the decision was made in the 1950s to develop a sea based thermonuclear delivery platform to complement aircraft and land-based intercontinental missiles, attention was focused on adapting a land-based intermediate range missile, Jupiter, for launch from combat ships. Jupiter was a very large, liquid fueled missile posing major problems for shipboard carriage and launch, and the need to operate from surface vessels mitigated a major a major advantage of a sea-based leg of the nuclear triad – stealth. China Lake was commissioned to study the problem, warhead yield tradeoffs and engineering design requirements. The Polaris missile concept, launchable from stealthy, submerged submarines was the product of the China Lake study.

The later Trident missile, with increased range and multiple warheads, presented a major challenge to propulsion designers. China Lake scientists were engaged on retainer to assist in gaining the greatest possible energy from the rocket motor consistent with safety. Early static tests of the contractor design at China Lake were marred by motor detonations. China Lake scientists assisted in developing a solid motor formulation that

yielded the required thrust and energy without danger of blowing up. Today Trident motor safety is enhanced by installation of an enormous X-ray unit at China Lake, capable of radiological examination of the complete Trident motors for flaws that would be source of explosions.

**Sidewinder.** Sidewinder is probably the best-known product from China Lake for a number of reasons:

- Unprecedented success in actual combat and presence in the air-to-air inventory of almost every country in the world with fighter aircraft either through sales and co-production agreements with the United States or from Soviet Union reverse engineering of a stolen version.
- Low cost and high reliability
- Design for simplicity of manufacture and, more importantly
- Ease of use in air-to-air combat.

The original Sidewinder concept started to take shape in 1948 by Dr. William McLean, a China Lake scientist in charge of rocket and gun fire control system development, who was dissatisfied with the accuracy of unguided ordnance. Entering service in 1956, Sidewinder has undergone a series of versions until the present day with the AIM-9M in service and the AIM-9X nearing service introduction.

**Shrike**

The antiradiation weapon Shrike is another China Lake product, conceived and designed by China Lake. The producer, Texas Instrument, was a partner from the early days and participated on the design team. Shrike was employed in large numbers in Viet Nam to protect Navy and Air Force strike aircraft in missions over hostile territory. Shrike forced North Vietnamese defenders to shut down antiaircraft radars or face lethal fire from the incoming Shrike missiles.

**Unguided Weapons**

China Lake conceived and designed most of the unguided weapons used by the Navy and Marine Corps since World War II and many of those used by the Air Force and our allies. Weapons include the Mk-80 series bombs, fuzes and the bomb retarders used in low altitude attacks, Zuni, Snakeye, and chemical ordnance.

**Other Guided Weapons**

China Lake had a support role in all of the guided weapons used by the Navy and Marine Corps. In the air to air arena, China Lake developed the data package for second source procurement and provided design support and designed and developed the fuze and safety and arming package for Phoenix. China Lake assisted in solving problems encountered

## CHINA LAKE WEAPON PROGRAM INVOLVEMENT

| Program | Concept Development | Design/ Component Design | Technical Support/ Integrated Product Team | Production Oversight/ Production Mgmt Support | Test | Improved Versions | Contractor Problem Solving | 2nd Source Development | Support in Combat |
|---|---|---|---|---|---|---|---|---|---|
| WW II Rockets | X | X | X | X | X | | | X? | |
| Zuni-Mighty Mouse | X | X | | X | X | | | | |
| Fire Control | X | X | | X | X | | | | |
| Sidewinder | X | X | X | X | X | X | X | X | X |
| Polaris | X | X | | | X | | | | |
| Sparrow | | X | | X | X | X | X | X | |
| Phoenix | | X | | X | X | X | | | |
| AMRAAM | | | | | X | | | | |
| Shrike | X | X | | X | X | X | X | X | |
| HARM | X | | X | X | X | | X | | |
| Harpoon | | X | X | | X | X | X | | |
| SLAM/ER SLAM | X | X | | | X | X | X | | X |
| Tomahawk | | X | | | X | | X | | |
| Laser Guided Bombs | | | | | X | X | | | |
| Maverick | X | X | | X | X | X | | | |
| Skipper | X | X | | X | X | | | | |
| Walleye | X | X | | X | X | X | X | | |
| JSOW | | | X | | X | | | | |
| JDAM | | | | | X | | | | |
| Standard Missile | | X | | | | | | | |
| Standard ARM | | | | X | X | | X | | |
| YOV-10D NOGS | | | | X | X | | | | X |
| Navy Pave Knife | | | | X | X | | X | | X |
| ASROC | | | | | | X | | | |
| Fuel Air Explosive | X | X | | X | X | X | | | |
| Unitary & Cluster Bombs,Retarders and Fuzes | X | X | | X | X | X | X | X | |

by the contractors for Harpoon and Phoenix, designed a Tomahawk warhead and led the development of advanced versions of both Tomahawk and Phoenix.

These are only a sampling of China Lake's activity in weapon RDT&E. The accompanying chart summarizes its roles for a variety of weapons.

## Energetics

Energetics is the science and technology associated with the materials used to formulate explosives and rocket propellants. China Lake is the Navy's largest installation for the research, development, test, and evaluation of weapon systems. China Lake encompasses more than a million acres-with no encroachment by urban development. The remoteness of China Lake's fully instrumented facilities ranges, underlying approximately 20,000 square miles of joint-military restricted airspace, ensures safety and security for development and testing of new energetics technology, advanced energetics concepts, and all-up energetic systems.

Technical Capabilities Backed by 60 years of experience from cradle (idea conception) to grave (weapon-system demilitarization), China Lake is without peer in the areas of energetics, ordnance, and propulsion.

**Capabilities**. China Lake has the capability to engage in every aspect from synthesis to supporting systems in the field:

- New energetic materials synthesis, scale-up, and analysis
- Propellant and explosives formulation, characterization, scale-up, and testing –
- Ordnance and propulsion systems design, development, fabrication, and small- and large-scale testing
- Component integration (i.e., propulsion, ordnance, guidance and control, and airframe) into all-up weapon systems
- In-service engineering support

**People**. China Lake boasts an outstanding team of experienced and enthusiastic professionals. Their expertise encompasses every aspect of energetics.

**Facilities**. Scores of unique facilities and test sites support the full-spectrum of activities necessary for an effective and safe energetic systems development. State-of-the-art laboratories for research of new compounds, a complex of specialized facilities for development, scale-up, synthesis, materials testing, and propellant motor and warhead loading. China lake's test facilities and sites accommodate testing of everything from the most minute amounts of energetic materials, to all-up tactical rounds with motors and warheads, to 500,000 pounds of explosives. On land and air ranges weapons complete their development and operational testing before Fleet Introduction. China lake's unencroached, large remote areas allow open air testing of energetic materials and system components that require construction of expensive bomb-proof facilities at other bases.

**Environment.** China Lake has obtained and maintains all necessary air emission permits and operates well below the threshold allowed by its permits. Expanded operations, therefore, would not impact allowable emissions. In addition, China Lake has industrial wastewater collection systems that are in compliance with all current federal, state, and local environmental regulations. The energetic hazardous waste disposal range, which has an interim Resource Conservation and Recovery Act Part B Permit for both open burning and open detonation, enables quick, economic, and safe disposal of energetic wastes generated during the RDT&E of energetic materials, propulsion systems, and ordnance items.

**Success.** China lake's contributions to the warfighter through the RDT&E of energetics and their applications are legion. Most recently, in operations in Iraq and Afghanistan, China lake's accomplishments include the Hellfire Thermobaric Warhead, the BlU-116 Hard Target Penetrator, and the modified Rockeye leaflet dispenser.

## UNMANNED AERIAL VEHICLES-COMBAT AERIAL VEHICLES (UAV-UCAV)

**Operation Iraqi Freedom and Enduring Freedom-Hellfire Missiles.** In February 2001, an Air Force Predator experimental unmanned air vehicle (UAV) fired an AGM-114C against a ground target during an air combat demonstration. This groundbreaking test proved the Predator's ability to operate as a tank killer with the ability to self-designate its Hellfire missiles. During Operation Enduring Freedom, China Lake and its tenant squadron, VX-9, accelerated range testing and activities as part of a Quick Reaction Assessment. China Lake also performed weapon effectiveness analysis and made advancements using the Quick Bolt Advanced Concept Technology Demonstration to modernize Hellfire. During Operation Desert Storm, approximately 1,600 Hellfire missiles were fired against Iraqi forces.

**Putting intelligence, surveillance, and reconnaissance systems into one network.** During Millennium Challenge 2002, Defense Advanced Research Projects Agency developed unattended ground sensors at Superior Valley, relayed intelligence on tracked vehicle traffic to a Predator UAV, which transmitted the data to the Strike Warfare Command Center at China Lake. From that location, the Carrier Air Wing Commander controlled Tactical Aircraft strikes using developmental systems that synthesize intelligence feeds. This revolutionary capability provided the commander with the common operational picture, enabling real-time re-tasking of airborne assets. Throughout this exercise, NAVAIR ranges were networked with other Army, Air Force, and Marine ranges.

**Coast Guard and Homeland Defense missions.** China Lake Fleet Weapon Support Teams provide on-site technical and training assistance to operational forces worldwide. For the war on terrorism, China Lake has outfitted UAVs with specialized sensors and instrumentation required for Coast Guard and Homeland Defense missions.

**Joint Unmanned Combat Air System.** Northrop Grumman's X-47A Pegasus was

brought to China Lake for all taxi and flight tests in 2002 and 2003, and Boeing's X-45A Unmanned Combat Air Vehicle is also scheduled to conduct weapon drops on China lake ranges. Predator/Stinger tests have also been carried out on China Lake ranges. The Office of the Secretary of Defense sponsored Joint UAV Joint Test and Evaluation Program, led by the Navy at Fallon, Nevada, is developing joint tactics, techniques, and procedures in time-sensitive operations. China lake is the modeling and simulation lead for this effort. China lake's Integrated Battlespace Arena has successfully modeled numerous architectures integrating UAVs into the battlespace. Lessons learned from Operation Iraqi Freedom are being implemented through JUAV. Virtual rehearsals are conducted in simulation prior to all live exercises.

**Pegasus X-47A's first flight over Land Range**. "We made history at China Lake today," said a flight test engineer. Northrop Grumman achieved a significant milestone in autonomously controlled flight February 23, 2003, with the successful first flight of its Pegasus UAV. The flight took place at China lake and lasted 12 minutes. Most significantly, the X-47A successfully landed near a predesignated touchdown point to simulate the tailhook arrestment point on a carrier flight deck.

**Spike-UAV Integration**. Firing Spike missiles from UAVs is envisioned as a safer, more accurate alternative to rocket-propelled grenades (RPGs) and as a relatively inexpensive complement to the man-portable Javelin anti-tank missile. Compared to unguided RPGs with a range of only a few hundred yards, Spike will be guided and have a range of about two miles. A Javelin missile costs about $75,000; a Spike missile is expected to cost only about $4,000. The Javelin launcher costs about $125,000; the Spike launcher's estimated cost is $6,000. Spike, which will be light and easy to fit into a backpack, will have urban-warfare applications because the missile will be able to go through a window before exploding. Although Javelin is capable of destroying such soft targets, it makes more sense to use a lower-cost missile for this purpose and save Javelin for heavily armored targets. according to Spike program representatives, who displayed their system at a technology demonstration on Capitol Hill. Spike also could serve as a low-cost complement to the Hellfire air-to-ground, anti-tank missile, another relatively expensive weapon that has been successfully fired in combat from Predator UAVs.

## China Lake Collaboration with Industry and Other Government Agencies

China Lake is a full-spectrum research, development, test and evaluation center. It is a world leader in complex weapon system and software integration, energetic materials and subsystems, advanced weapons and guided missiles, interoperability of warfare systems, fuzing components and devices, and technology transfer. China Lake is also recognized internationally for its pioneering work in laser and optical components.

Although it's primary mission is to provide the U. S. Navy with effective, affordable, integrated, interoperable warfare systems for the warfighter, the unique capabilities of China Lake are often sought by others to solve pressing problems. This paper discusses

some recent examples of the contributions that China Lake has made in collaboration with industry and other government agencies.

**Hellfire MAC warhead development**. A new metal-augmented charge (MAC) warhead – designed, developed and built at the Weapons Center China Lake facility, with support from the Marine Corps, White Sands Missile Range, Eglin Air Force Base Open Air Range, NAVSEA Indian Head, and Redstone Technical Test Center was integrated into the AGM-114 M Hellfire missile and employed in Operation Iraqi Freedom with the US Marines. From funding to fielding, this improvement was provided in 18 months.

**ATFLIR**. Advanced Tactical Forward Looking Infrared (ATFLIR) is a real-time passive thermal imaging system for the F/A – 18. The Weapons Division, Boeing, and Raytheon worked together to provide early operational capability to the Fleet in support of the war on terrorism. As a result, ATFLIR was used in support of Operation Enduring Freedom, Southern Watch, and Iraqi Freedom.

**F-16 software problem**. China Lake collaborated with Edwards Air Force Base and nearly a score of other organizations to fix and test an F-16 Joint Direct Attack (JDAM) software glitch. Elapsed time from first call until the new software was on its way to Iraq was 30 hours.

**Next Generation Strike Warfare Architecture**. A U. S. Navy and industry team completed the successful demonstration of the Enterprise Expeditionary Strike Warfare Architecture (ESWA) at the Weapons Division Precision Engagement Center in China Lake. ESWA is an advanced targeting and strike capability that will drive the requirements for network-centric strike systems of the future. "Never before has the Navy been able to bring so many capabilities together in a horizontally integrated, open architecture," said Wendy Underwood, director of Navy command and control programs for Lockheed Martin Mission Systems.

**Pegasus X-47A Flight**. China Lake supported the successful first flight of the Northrop Grumman Pegasus experimental unmanned aerial vehicle (UAV). The autonomously controlled flight was conducted on the China Lake ranges on February 23, 2003.

**SLAM-ER Time Sensitive Strike Demonstration**. On May 6, 2003, aircraft and aircrew attached to Carrier Air Wing One (CVW-1) conducted a successful launch of the Standoff Land-Attack Missile Expanded Response (SLAM-ER) against a target on the Weapons Center Sea Test Range at Point Mugu to demonstrate the missile's capability in the time-sensitive strike role. A Tactical Dissemination Module (TDM), invented and developed at China Lake, provided the customized real-time targeting information in support of this test. This launch was the culmination of a rigorous training program for Fleet aircrew provided by the Strike Fighter Weapons School Atlantic, SCWS, Boeing, NSAWC, and the SLAM-ER Tiger Team from the Weapons Center Point Mugu facility.

**Aircraft turbine engine disk failure investigations**. NAVAIR Aircraft Center at Patuxent River and China Lake teamed with the Federal Aviation Administration, the Air

Force, and NASA Glenn to investigate engine disk failure. These failures are a leading propulsion-related safety hazard in commercial aviation. Numerous crack-detection technologies were demonstrated at the China Lake Weapons Center Weapons Survivability Laboratory.

**Quick Bolt**. Quick Bolt is a China Lake development of an affordable, integrated network-centric warfare capability for the Advanced Anti-Radiation Guided Missile (AARGM). It provides connectivity of the missile to the global information grid to incorporate off-board RF sensor information, rules of engagement, etc. Following demonstration of the concept, a Cooperative Research and Development Agreement was signed with SAT, Inc. to assist them with integration of the Quick Bolt capability on the AARGM system.

**Digital Precision Strike Suite**. China Lake has developed and fielded a system to rapidly and precisely geolocate targets for precision guided munitions. China Lake has worked with and transitioned the capability to a wide user community (over 400 end users world-wide) including the U. S. Navy, U. S. Marine Corps, the Air Force Special Operations Command, the U. S. Army Special Operations Command, the Joint Special Operations Command, and other non-DOD users.

**Ball Joint Gimbal** .The Weapons Center has developed and patented ball-joint gimbal technology, which offers lower cost, simplicity, fast response, large aperture, and applicability to multiple sensors and multiple weapons. The Weapons Center has established Cooperative R&D Agreements with Raytheon, Inc. to transition this technology to the U. S. Army's low-cost Tank Extended Range Munition program.

## DIRECTED ENERGY WEAPONS

China Lake has been involved with directed energy for the last 30 years. China Lake facilities are unique, and have been used by the Department of Defense, Department of Energy, industry, academia, and foreign customers. China Lake continues to develop for the future with interconnectivity across the directed energy community, improved test facilities, new developments in high power microwave and laser technologies and a committed goal to move directed energy into the future as an alternative resource for the warfighter. China Lake is developing and evaluating concepts for directed energy weapons, including high power microwave weapons and high-energy lasers.

**High Power Microwave.** China Lake boasts the only open-air test facility that has been fully spectrally mapped to insure there is no interference with commercial or military infrastructure. The Etcheron Valley Range is the Navy's premier high power microwave open-air test site. The range features the only open-air 100-ton turntable to slowly rotate targets. The system addresses both electrically driven and explosively driven high power microwave sources. China Lake is working with the Office of the Secretary of Defense through their Central Test and Evaluation Investment Program to continue the improvement of the Etcheron Valley Range. The Office of the Secretary of Defense is currently investing. The Navy is the first service to give the warfighter the opportunity to experience directed energy in the virtual battlefield.

**High Power Microwave Programs.** China Lake is working with industry on the directed energy Active Denial Technology Program, to perform critical open-air tests. China Lake provided the test resources at Etcheron Valley for one of the first Defense Department directed energy test programs, supporting Air Force, Army, Navy, and the Department of Energy.

**High Energy LASER Facilities.** China Lake has the most complete optical characterization facility within the Defense Department-more than 50,000 square feet. Facilities characterize optics to two meters in diameter with surface figure and roughness; measure absolute reflectivity, absorption, and scatter with a relative measurement capability of trans-mission; and facilitate rapid prototyping of specific coatings. China Lake is currently developing a laser damage test capability under the Joint Technology Office for high energy lasers along with all the required characterization analysis for both high power solid state lasers and free electron lasers. In addition, the Naval Repository for Large Optics is also located at China Lake. Included in the inventory is the backup secondary mirror for the Sealite beam director for the Mid-Infrared Advanced Chemical Laser system located in New Mexico as well as some optics and mirrors from Air Force and Army programs. An optical fabrication facility also provides the rapid prototyping of optical systems for high energy laser development, test and evaluation. China Lake's T-range is the only open-air test range for the evaluation of high energy laser sources against targets in an air stream.

**High Energy LASER Programs.** China Lake is developing and evaluating high energy laser technology for tactical aircraft via contracts for high power fiber lasers, low cost, high efficiency diode pump lasers, and LIDAR acquisition sensors. Internally executed programs include the JTO program, joint with the Air Force, and an atmospheric propagation in a maritime environment program that measures the wavefront error. Understanding this is essential in the applications of high energy lasers to the Navy.

**Interconnectivity**. China Lake is closely interconnected with the following program offices and organizations involved in high energy laser research, development and test: NAVAIR PMA–242 directed energy IPT, PMA–201, PMA–259, PEO(W), PEO(T), Directed Energy and Electric Weapons Program Office (PMS–405), Naval Research Laboratory, Office of Naval Research, Naval Postgraduate School, Office of Naval Intelligence, Naval Surface Warfare Center, Dahlgren Division, Space and Naval Warfare Systems Command, Naval Warfare Development Command, Fleet Information Warfare Center, Information Operations and Assurance Working Group, Navy Marine Corps Spectrum Center, Naval Health Research Center, Air Force Research Laboratory, National Air and Space Intelligence Center, Army Research Laboratory, Space and Missile Defense Command, National Ground Intelligence Center, OSD Live Fire Test and Evaluation Office, Defense Threat Reduction Agency, Federal Aviation Administration/Office of Spectrum Policy and Management, Los Alamos National Laboratory, Sandia National Laboratories, Texas Tech University, Texas A&M University, Boeing, General Atomics, Lockheed Martin, Northrop Grumman, and Raytheon.

# AIRCRAFT WEAPON INTEGRATION AND SOFTWARE

## Introduction

A major China Lake product area is integration of weapons, mission electronics and combat aircraft. Modern combat aircraft and weapons are programmed and control through an array of computers that must work together flawlessly in order to accomplish the system's mission. Millions of lines of code are involved in a combat aircraft's operations, and unlike your desktop or laptop, programming glitches are unacceptable.

China Lake's software development team of civil service and contractor technical personnel are in the world's top rank of computer software specialists, government or private. China Lake is responsible for the operational flight software programs for all models of the F/A-18, AV-8B, and the AH-1 aircraft, and for the software that supports the Tactical Air Range Integration Facility (TARIF) and is responsible for the Naval Air Systems Command Software Resource Center and People Process Product Resource (P3R).

The national level of achievement of China Lake's software engineering capability is measured through the Software Engineering Institute's Software Capability Maturity Model.

A Weapon System Support Activity (WSSA) provides system expertise and software engineering know-how to provide high performance, ultra-reliable, safe and secure capability for Navy and Marine tactical aircraft. Working with prime contractors for these systems, the WSSAs develop major systems as well as providing short-term responses to critical fleet needs. In order to provide this support, WSSAs employ scientists and engineers trained in weapon systems (including aircraft sensors, launch systems, and weapons) as well as sophisticated software engineering expertise. China Lake pioneered the Navy's WSSA activity with the A-7 aircraft, and since has supported the all of the Navy's fixed wing and attack aircraft, the multi-mission F/A-18 aircraft and the electronic surveillance EP-3 aircraft.

## History

The WSSA origin dates back to the early 1970s when China Lake was involved with the Navy's A-4 and A-7 systems. They built laboratories to develop software as well as sophisticated test facilities to provide realistic, real-time simulation to test the software under realistic conditions. The final test of the software was flights of the tactical system primarily on China Lake's highly instrumented ranges. Data from these test flights was synthesized in the laboratories. As defects were discovered, the software was reworked in the laboratories and tested again. This activity was repeated until the system was ready for evaluation by the Operational Evaluation and Test Force (OPTEVFOR), which certifies the system ready for fleet use. The OPTEVFOR wing responsible for these tactical systems is a tenant activity based at China Lake. This allows China Lake to quickly respond to correct any anomalies found and accelerate introduction to the fleet.

Based on their success with these systems, the Navy and Marine Corps decided to host similar support for the F/A-18, A-6, and AV-8, AH-1 and later the EP-3. It was at this time that China Lake realized that tactical software not only provided integration of many on- board sensors and systems (software is often termed the "glue" that binds a system together), but also system capability (the Naval Air Systems Command, China Lake's parent activity, estimates that 80% of a system's functionality is provided by software). At the same time the growing cost to develop, test, and maintain these software intensive systems was a cause of concern to the Navy.

## The Road to Improvement

Because of this system dependence and cost concern, China Lake realized that the development and maintenance of software must be treated as an engineering discipline. As they campaigned for this enhanced approach, they teamed with groups in other services and as a result the Department of Defense established the DoD Software Engineering Institute (SEI) at Carnegie Mellon University. The SEI's core purpose is to help others make measured improvements in their software engineering capabilities and to develop the right software, delivered defect free, on time and on cost, every time. The SEI's mission was to establish best practices and advanced software engineering tools to improve the quality (meeting all performance requirements within cost and schedule) of software in DoD systems.

In order to improve the development process, China Lake, as part of the NAVAIR team, developed a strategic plan that focused not only on the software process but also higher performing organization process. China Lake was an early partner with the SEI in finding and enhancing these best practices and became one of the first to adopt them. The SEI developed the Capability Maturity Model (CMM), a rating system for evaluating the level of expertise of a software development team. Organizations are rated on the maturity of their processes from Level 1 to Level 5. As a team becomes more sophisticated, it's rating level increases. The approach enables a team to determine their level, and provides a process for improving to achieve the next and successive levels. Process improvements defined by the SEI-CMM levels can result in up to a 30% productivity increase for each level of improvement. Test costs can shift from 50% of the total costs to 30% by improving from a Level 3 to a Level 5 organization. There is up to

a 30% reduction in defects for each Level of improvement. The WSSAs also instituted the SEI developed Team Software Process and Personal Software Process along with an Earned Value Management System.

**Software Engineering Institute (SEI).** The Software Engineering Institute (SEI) at Carnegie Mellon University sets the standards for achievement in software development with nationally recognized rankings – the Software Maturity Model (SW-SMM) and the Capability Maturity Model Integration. The SEI at Carnegie Mellon University has carefully scrutinized the advanced software practices of more than 1,100 private and government agencies, including Boeing, Raytheon, and Warner Robbins AFB. In an exhaustive process involving more than 4,300 pages of documentation, more than 30 in-depth interviews and five days of on-site assessment, companies and government organizations are ranked in several areas of technical expertise, including software product engineering, quantitative control processes, software quality processes, and organizational process focus and definition.

**China Lake earns SEI Level 5 rating** (Excerpt from China Lake Defense Alliance newsletter *Newsnotes*, April 2005 edition). In mid-March, the F/A-18 Software Development Team achieved the highest rating possible on the Software Engineering Institute (SEI) Software Capability Maturity Model (SW-CMM). The Team thereby becomes only the fifth US Government organization—and the first in the Navy—to achieve that prestigious rating.

The F/A-18 Team is responsible for the software in 80% of the aircraft on a carrier flight deck. That enormous responsibility creates a great pressure for perfection.

SEI, headquartered at Carnegie Mellon University, is a federally funded, DOD sponsored research-and-development institute. Its mission is to help organizations make measured improvements in their software engineering capabilities and—in the words of SEI's vision statement—to help them "develop the right software, delivered defect free, on time and on cost, every time."

To earn the SEI Level 5 rating, the F/A-18 Team underwent a rigorous and comprehensive appraisal. Over a period of two weeks, five evaluators led by Rushby Craig of Hill AFB, examined virtually every aspect of the Team's operations.

"The appraisal is very much like an audit," commented Charles Bechtel, Chief Engineer of the F/A-18 Advanced Weapons Laboratory. "It is pretty intense."

As well as interviewing many of the F/A-18 Team's 60+ contractors and civil servants, the SEI group closely scrutinized the software development processes and products. Among the areas investigated were product engineering, quality assurance, configuration management, defect prevention, and quantitative analysis. Each was evaluated in great detail.

"They look at everything you need to do well—not just to develop world-class software, but to develop software in a world-class manner," Bechtel explained. "To receive a Level 5, you need to have a check in every box."

The SEI Level 5 rating means more than just formal recognition of the highest quality in software development. To current and prospective customers, it means they can rest assured that when the F/A-18 Team puts together a schedule and a cost estimate, the Team will meet that schedule and estimate—not a common occurrence in the complex world of software development.

The Level 5 rating also underscores the F/A-18 Team's commitment to defect prevention. Preventing software problems during initial development is far less expensive than reworking software downstream to correct the problems. "The Level 5 rating is a recognition that we are preventing defects from occurring in the first place," said Bechtel.

Who is responsible for the Team's Level 5 rating? The F/A-18 Software Development Team itself, of course. But notable for leadership in bringing the Team to this point are Sharon Juarez, the Process Lead, and Claire Velicer, the Software Development Team Lead. "Their persistence and vision kept the team moving forward to achieve this goal," said Bechtel.

**AV-8B Joint Systems/Software Support Activity (JSSA).** JSSA provides software support for the AV-8B Harrier aircraft for the United States Marine Corps and its allies, Spain and Italy. The JSSA achieved a SW-CMM Level 2 rating in record time–14 months. Much of the credit for this achievement can be attributed to JSSA's emphasis on using two process improvement intiatives–Earned Value Management and Personal Software Process/Team Software Process. In December 2001, the JSSA's Earned Value Management system was independently assessed to be fully compliant with Standard 748. In September 2002, the AV-8B JSSA achieved a SEI SW-CMM Level 4 rating. The AV-8B JSSA improved from a SW-CMM Level 1 to Level 4 in only 30 months. This is less than half the usual time for such an achievement. Through this initiative the AV-8B reduced their schedule variance by 90%. The AV-8B plans to transition process improvement to the CMMI in the next couple of years.

**The Tactical Air Range Integration Facility (TARIF).** TARIF is responsible for the engineering and development of air, land, and sea target control systems used in support of aircrew training systems at several Navy electronic warfare ranges. TARIF completed a successful appraisal that determined they were using processes that supported a SEI CMMI rating of Level 2 on June 10, 2004. This was the first formal appraisal of a product team achieving a CMMI rating at China Lake. TARIF is leading the transition from SW-CMM to CMMI. TARIF has actively pursued process improvement since 1993. They were formally appraised at a SW-CMM Level 2 in 1995 and a SW-CMM Level 3 in 2001.

**The NAVAIR Software Resource Center (SRC) and People Process Product Resource (P3R).** These organizations help NAVAIR product development teams achieve

their organizational and process improvement objectives through consultation, workshops and training seminars. P3R focuses on improving performance of intact work groups and establishing a work culture ready for change. The SRC focuses on software acquisition, development and maintenance process improvement initiatives using SEI CMMI, TSP/PSP and software measurements/metrics.

# NETWORK CENTRIC WARFARE

Under the leadership of VADM Arthur Cebrowski, USN (Ret.) the Department of Defense is engaged in a program to transform the armed forces of the United States to a more agile, responsive force attuned to the needs of national defense in the 21st century. Transformation has many aspects, but a key concept is *network centric warfare* or NCW. In NCW every element of forces – fighting and support platforms, tactical commanders, intelligence and reconnaissance resources, and even individual foot soldiers are linked together to maintain real-time knowledge and situational awareness of friend and foe and to communicate tactical information to where it is needed when it is needed.

China Lake is playing a role in network centric warfare, particular in its area of expertise in strike warfare. It is applying knowledge in strike planning, aircraft systems integration, strike mission electronic warfare and strike weaponry to the problem of real-time targeting and battle assessments.

The following examples are a sampling of China Lake's participation in the development of network centric warfare capability:

## FIRES TACTICAL DISSEMINATION MODULE

The ability to strike time critical targets continues to be a mission critical problem within the US Navy. The Navy is introducing the Naval Fires Network system as a spiral development program to transform traditional Navy strike targeting methods within the fleet. Currently there is no method providing visual images of the target area directly to the pilot of strike aircraft after he leaves his launch point. The Tactical Dissemination Module (TDM) is being developed to "push" real-time visual imagery into the cockpit of Strike aircraft. China Lake personnel brought prototype TDM equipment to Iraq during Iraqi Freedom where it was successfully employed. The China Lakers accompanied American forces from Kuwait to Baghdad in helping combat forces use the TDM.

## MILLENNIUM CHALLENGE 2002 TACTICAL COMMAND CENTER INTEGRATION

A pillar of transformation is integration of joint forces in battle. One means of developing tactical concepts for joint warfare and developing joint training capability is through large joint exercises or experiments. Millennium Challenge 2002 was a major Joint Forces Command battle experiment conducted in the summer of 2002. China Lake's ranges were used by air and ground forces in the exercise, and the Naval Strike Warfare Commander

was located at China Lake in the IBAR facility. IBAR is described in Part 5 of this notebook.

Using off-the-shelf hardware, China Lake engineers set up an integrated strike command center that gave the commander immediate access to all available intelligence information with a real-time battle picture to assist him in making timely decisions with the most accurate data available. After completion of the exercise, the Navy participants planned to adapt the IBAR setup to their shipboard centers.

## DIGITAL PRECISION STRIKE SUITE

China Lake has developed and fielded a system to rapidly and precisely geolocate targets for precision guided munitions. China Lake has worked with and transitioned the capability to a wide user community (over 400 end users world-wide) including the U. S. Navy, U. S. Marine Corps, the Air Force Special Operations Command, the U. S. Army Special Operations Command, the Joint Special Operations Command, and others.

# PART 3: MAJOR FACILITIES

China Lake's greatest asset is the people that work there – military, civil servant and contractor. In addition, it holds the most complete set of facilities for weapon-related research, technology advancement, system development, test, and training in the world. China Lake scientists, engineers and uniformed military operators are busy at work on every aspect of military technology using top-flight laboratories and ranges. China Lakers cover the gamut from exploring the microcosm of lasers and high-energy molecules to ballistic missile static testing and full-up guided missile testing with live warheads; from simulations of network-centric warfare scenarios to integration of shipboard battle management systems; from designing parachutes for Mars landing craft to designing man-portable missiles for urban warfare; from developing millions of lines of software code for every version of the F/A-18 aircraft to testing the latest uninhabited combat air vehicles; and every other aspect of modern combat weapon systems.

## ENERGETICS FACILITIES

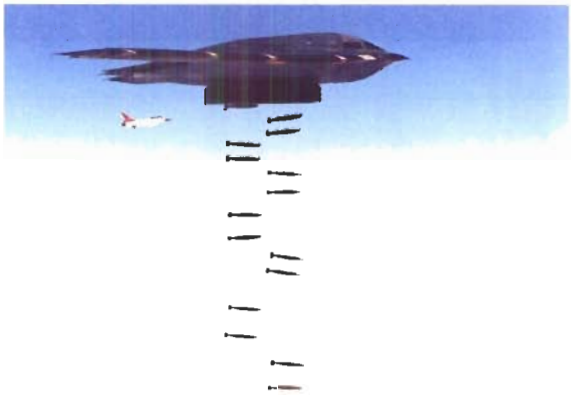
China Lake has the most complete capability in the world in the field of the chemistry of energetic materials, where high-energy molecules are designed to blend high energy yields with employment safety for missile warheads and rocket propulsion systems.

China Lake can test high-energy products from samples it produces in quantities of a few grams in its laboratories up to full scale warheads and motors. The Trident motor static test stand shown in this picture can handle solid propellant motors with up to one million pounds thrust.

## TEST RANGES

China Lake ranges cover the spectrum of every weapon test application including fully instrumented static and dynamic testing of weapon components and full-up air and surface launched weapons, aircraft and UAV-UCAV system testing, electronic warfare system testing and training including surface-to-air missile fly out simulations, safety and vulnerability testing, and more.

China Lake operates a national range with customers from every service, allied governments, other agencies and private companies. Edwards Air Force Base routinely uses China Lake ranges because of broad capability, low cost and convenience. China Lake ranges are only flight minutes from Edwards and raw test data are telemetered directly to test engineers at their Edwards home site.



The China Lake North Ranges Range Control Center can handle up to three tests simultaneously.

Warheads can be tested under static conditions for evaluation of fragmentation patterns . . .

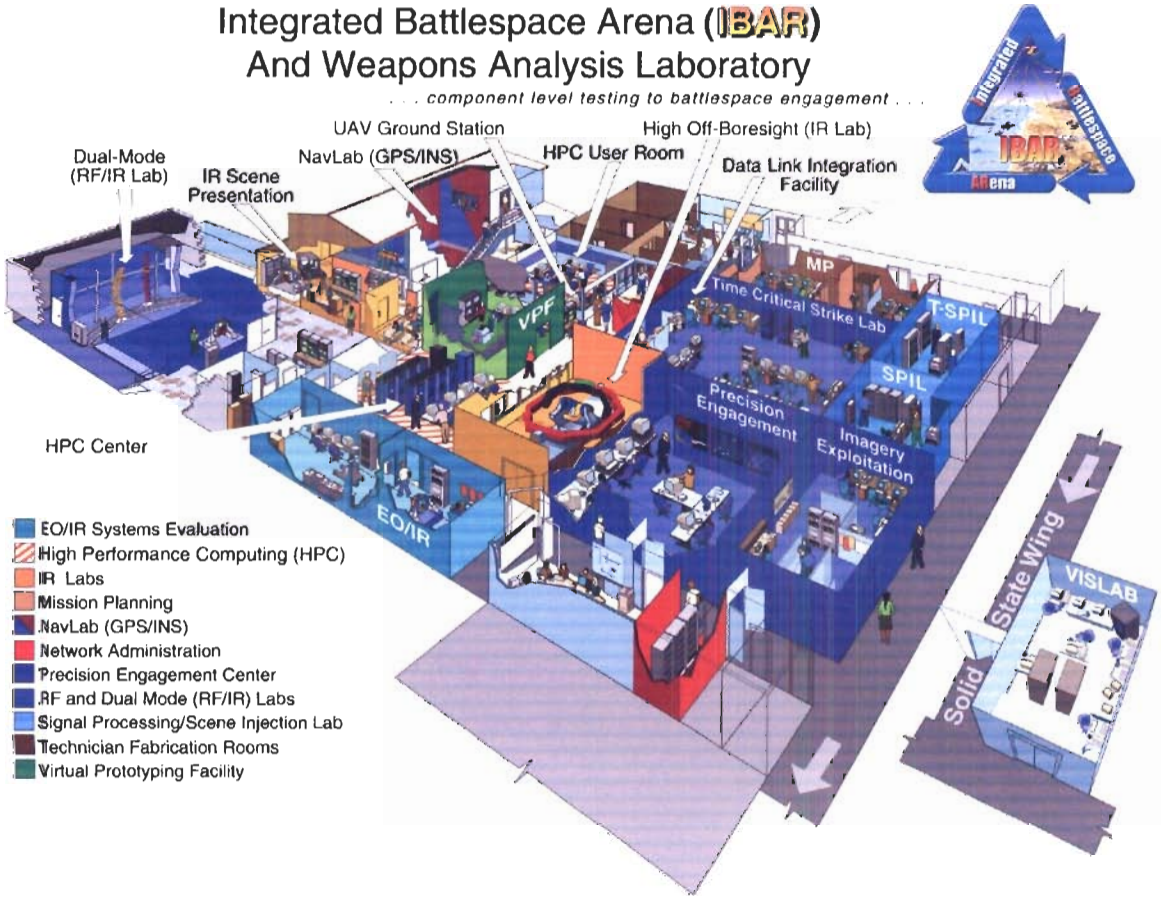
. . . or under dynamic conditions as shown in this photograph of a warhead impacting at supersonic speed from the end of the Supersonic Naval Ordnance Research Track (SNORT).

At China Lake's Survivability Range, the survivability and vulnerability of US aircraft to damage from weapons can be evaluated in helping to design aircraft. The Survivability Range simulates the high speed airflow across aircraft in flight to test the effects of weapons under dynamic conditions.

The Missile Encounter Simulation Arena (MESA) is an indoor arena where missile terminal guidance and influences fuzes can be tested against real aircraft and missile targets under any encounter geometry. It is the only facility of its kind in the world.

## INTEGRATED BATTLESPACE ARENA (IBAR)

**Integrated Battlespace Arena (IBAR).** This world-class facility comprises nine laboratories. Tests range from the subcomponent to theater levels with a degree of fidelity, flexibility, and dependability unparalleled in the DOD. Facilities are linked nationwide with fiber-optics, ethernet, and microwave telecommunication capabilities. IBAR houses the Navy's first cockpit simulation of its kind—the Virtual Prototyping Facility (VPF). The VPF cockpit simulation includes communications to and from the simulated aircraft and the weapons. Collectively, IBAR scientists have more than 72 patents to their credit and are frequent contributors of papers and journal articles that explore cutting-edge issues and techniques in modeling and simulation.




**Network Centric Warfare (NCW).** NCW uses a highly integrated and networked force structure to maximize launch platform and weapon system performance. FORCEnet—the emerging architecture of NCW—integrates sensors, networks, weapons, and decision aids into a powerful tool and places that tool in the hands of dispersed joint-service warfighters. Thus equipped, friendly forces can make rapid, accurate decisions; deliver decisive combat effects; and achieve battlefield dominance. With NCW, an intelligent, agile fighting force can slice through the fog of war and rapidly limit the adversaries' options.

Increasingly, the right decision in naval combat involves the use of precision-guided munitions. To maximize their enormous capability, these weapons (Joint Direct Attack Munition and Joint Standoff Weapon, among others) depend on specific, timely, highly precise data from a variety of sources. China Lake is an international leader in the technology and techniques necessary to transmit up-to-the-second retargeting data to weapons already inbound on the attack. Scientists and engineers are continually assessing current and future sensors, networks, and decision aids.

IBAR scientists, engineers, and analysts combine simulated and virtual assets to create advanced, computer-controlled combat scenarios. The "virtually" combined systems are analyzed to help identify additional capabilities for NCW tactics and techniques. The F/A-18 Advanced Weapons Laboratory (AWL) and the F-14 and EA-6B Weapon System Support Activities integrate their respective platforms with a profusion of computers, sensors, and systems to ensure the interoperability that is at the heart of NCW. WD provides warfighters with the network centric warfighting power to secure battlefield dominance.

China Lake NCW organizations and facilities include the IBAR, Weapons Engagement Office, and F/A-18 AWL. Among China Lake-developed NCW assets are the Tactical Dissemination Module and the Digital Precision Strike Suite.

**Joint Unmanned Combat Air System (J-UCAS).** The Office of the Secretary of Defense (OSD) sponsored Joint UAV Joint Test and Evaluation (JT&E) Program, led by the Navy at Fallon, Nevada, is developing joint tactics, techniques, and procedures in time-sensitive operations. China Lake is the modeling and simulation lead for this effort. IBAR has successfully modeled numerous architectures integrating UAVs into the battlespace. Lessons learned from Operation Iraqi Freedom are being implemented through JUAV. Virtual rehearsals are conducted in simulation prior to all live exercises.

**Joint Standoff Weapon (JSOW).** JSOW underwent testing in the GPS/INS Branch's Navigation Laboratory. Anticipating the next-generation GPS, weapon developers are using this specialized facility to assess future navigational performance. Both the current GPS signal and a simulated modernized GPS signal are fed to the JSOW simultaneously, and the output of the navigation subsystem is analyzed to determine navigation performance. The GPS modernization test regimen has already been successfully performed on the HARM missile.

**Hardware-in-the-Loop (HWIL Simulation).** Numerous weapon systems, including SPIKE and LOGIR, have used HWIL simulation in the IBAR to support live fire testing. In addition, F-22 AIM-9M Sidewinder separation studies were conducted using AIM-9M HWIL simulation.

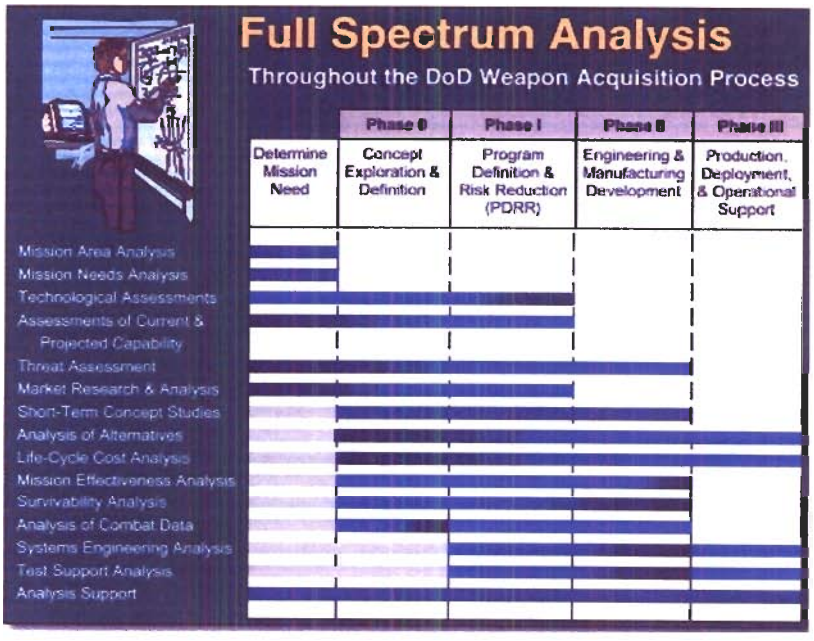
Missile guidance unit setup in the IBAR hardware-in-the-loop simulator fixture. The simulation uses realistic targets, missile aerodynamic flight simulations and is linked to other facilities at China Lake or to real aircraft in flight.

**Joint Common Missile (JCM) Program Support.** IBAR provides CONOPS refinement for Navy Missions and Targets, F/A-18 virtual prototype support to represent JCM to pilots, and missile simulation support for the U.S. Army Aviation and Missile Command JCM missile, Redstone, Alabama. IBAR provides input and feedback to JCM customers.

**SPAWAR Lightning Bolt Team Award for FORCEnet LOE 03-1.** NCW is being implemented through the FORCEnet concept. The Limited Objective Experiment (LOE) 03-1 is the first in a series of experiments to provide structured analysis of FORCEnet capabilities and themes. For example, the Air Combat Environment Test and Evaluation Facility (ACETEF), located at NAVAIR in Patuxent River, Maryland, and the IBAR located at China Lake, provided Modeling and Simulation (M&S) for the exercise. These two facilities were connected to the various SPAWAR Systems Center San Diego labs hosting the real world systems.

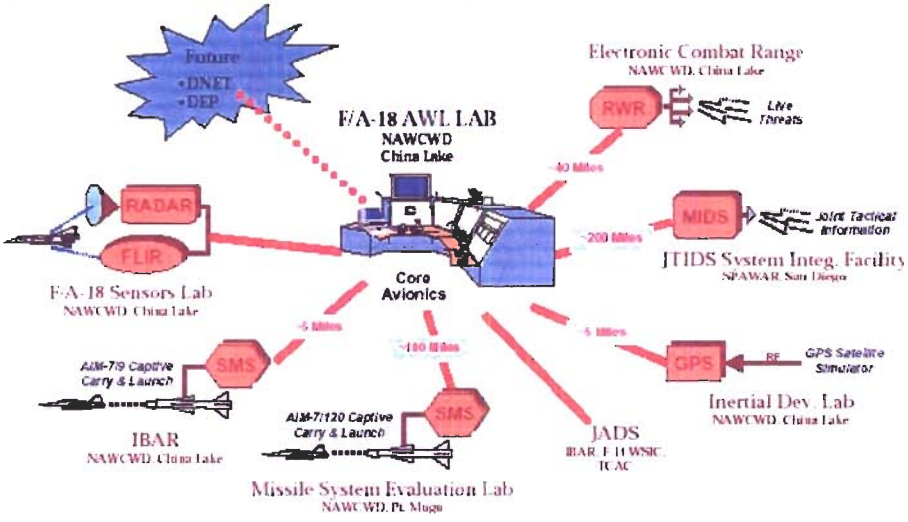
The IBAR provided M&S of a P-3 sensor system and Mission Computer; the Harpoon weapons system including fire control and weapon trajectory from aboard simulated *USS John McCain*; Brigade level Tactical Operations Center (TOC) communications along with RECON team communications; 5-inch artillery aboard simulated *USS John McCain*; and targets for all scenarios.

For their effort on the FORCEnet LOE 03-1 team, the prestigious SPAWAR Lightning Bolt Team Award was presented to China Lake IBAR employees on August 5, 2003.




IBAR is one of many simulation and analysis capabilities. China Lake analysts play a major role in every aspect of defense system acquisition.

## F/A-18 ADVANCED WEAPONS LABORATORY




Integrating weapons and mission electronics is a major portion of China Lake's mission. China Lake's in-house and contractor team is ranked in the top 6 percent of the country's software houses. China Lake is responsible for software releases on all Navy strike aircraft. The integration facility is linked in real time to facilities throughout the base.

This booklet has listed only a few of the facilities and capabilities of China Lake. Every aspect of weapons systems RDT&E in the modern network-centric United States arsenal lies within the scope of China Lake's facilities and military-civilian team capability.

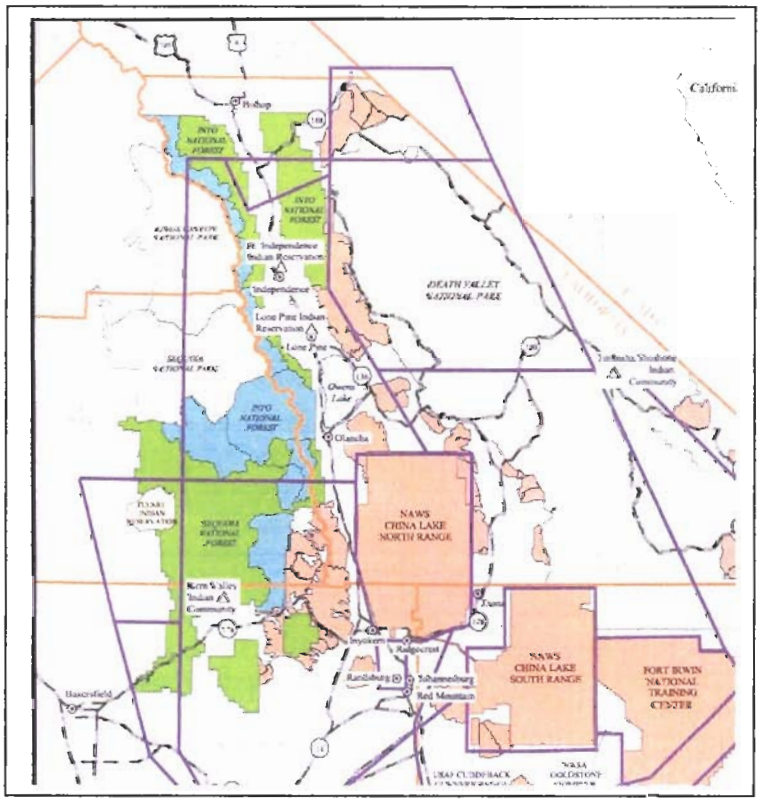
# PART 4: ENCROACHMENT CONSIDERATIONS

Encroachment is defined as anything that impacts the ability of a military activity to perform its current and future mission. Encroachment can take many forms: urban development, environmental restrictions, height obstructions, radio frequency usage, etc. Encroachment is a fact, to varying degrees, at all military installations. As the population grows, the issue naturally intensifies and many bases today are greatly affected by adjacent urban sprawl. However, of all DOD facilities, China Lake, located in a remote portion of the Mojave Desert, has the least potential to disturb the neighbors.

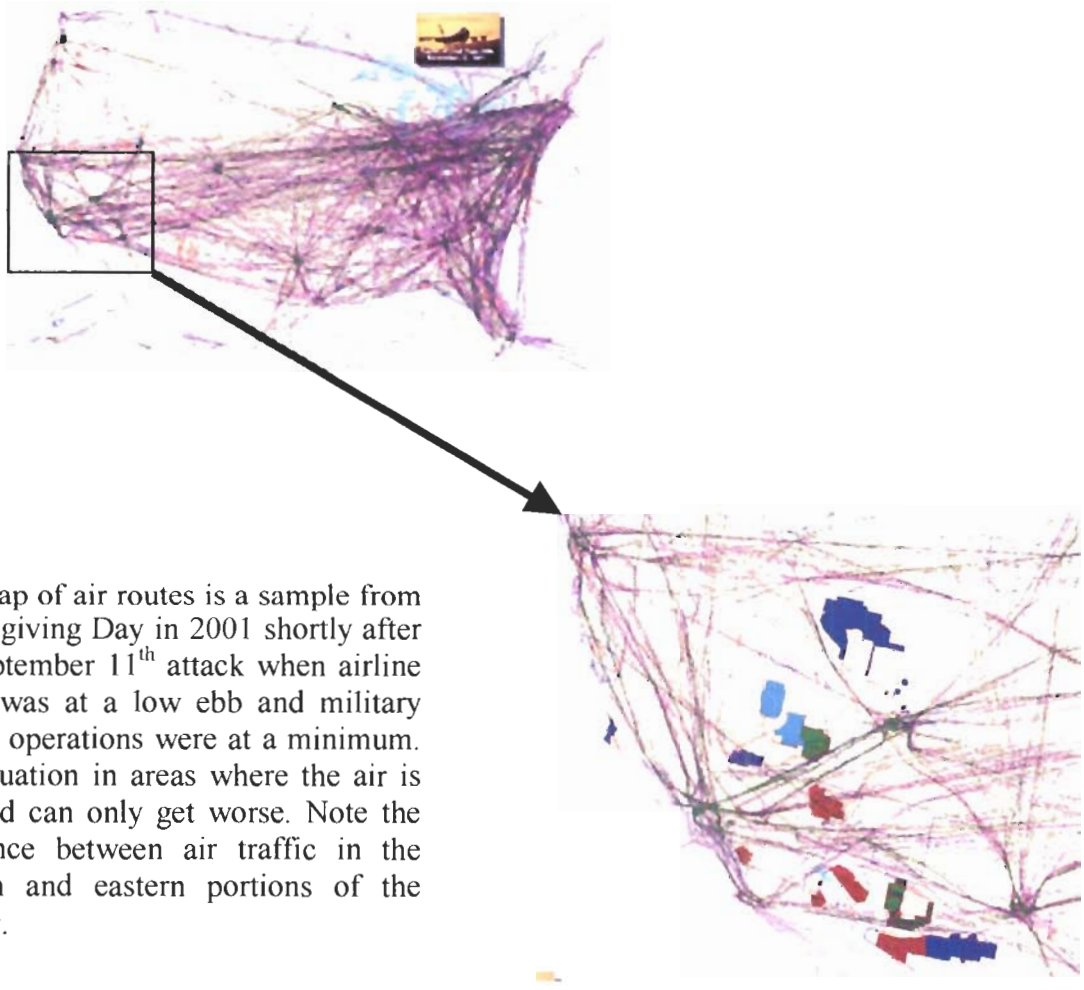
Many, if not most, of the major training and testing bases, that are located east of the Great Plains or in urban areas, face serious problems from encroachment by burgeoning residential, industrial or commercial growth. Indeed, the reason for locating bases in the West during World War II was to obtain the land, sea and air space needed to conduct military operations safely. In the years since VJ Day, the problem of encroachment in many areas has steadily worsened, and the growth of commercial air traffic has compounded the problem.

China Lake is fortunate in being immune from this type of encroachment problem. China Lake is protected by its remote location and the juxtaposition of thousands of square miles of federal land at its borders. It is safe from residential and industrial encroachment.

## R-2508 AIRSPACE




At 18,000 sq. mi. R-2508 is largest restricted airspace in United States, jointly managed by China Lake, Edwards Air Force Base and Army's Fort Irwin National Training Center in cooperation with the FAA. The air directly above China Lake is restricted from the ground up.



This map of air routes is a sample from Thanksgiving Day in 2001 shortly after the September 11th attack when airline traffic was at a low ebb and military aircraft operations were at a minimum. The situation in areas where the air is crowded can only get worse. Note the difference between air traffic in the western and eastern portions of the country.

**Encroachment Management/Sustainability**. China Lake has established a Sustainability Office that is responsible for proactive management and prevention of encroachment. In addition, a multi-disciplinary team coordinates all encroachment issues. China Lake works closely with Edwards AFB, the National Training Center at Fort Irwin, Navy Region Southwest, the Marine Corps and other military activities in the region to ensure consistency when addressing common issues. The China Lake team, including range, environmental, public affairs, planning, legal, airspace and others, has established and carefully maintains these relationships and works very closely with the surrounding cities and counties as well as the state of California.

**Wind Energy and Flight Testing, Programs Working in Harmony**. One example that demonstrates the benefits of these relationships is an agreement that allows the development of wind generating energy facilities, critical renewable energy assets, in the Tehachapi area, while protecting the military mission. The R-2508 complex, including China Lake, is critical for low-level testing and training of aircraft and weapons systems.

The Tehachapi area, in the southwest corner of the complex, is one of the richest wind resource areas in the country and there are more than 10,000 wind turbines in the area. There is significant pressure for major expansion, and technology advances require much larger turbines. Fortunately, cooperation among the military, wind industry and local jurisdictions is leading to creative and harmonious solutions.

## TELEMETRY FREQUENCY "CAPACITY"

Frequency availability and potential overlap at military test and training ranges is an emergency encroachment issue. China Lake and its neighbors, Edwards Air Force Base and the Point Mugu facility at the Naval Base Ventura County engage in flight test operations with telemetered data to ground stations, and potential frequency band problems might be a concern for these bases. This might especially be a concern if the mission of these bases were to be substantially increased.

In fact, the current TM frequency capacity can be more than doubled with the addition of recently opened up spectrum and newly developed technology.

The telemetry bands used for avionics systems testing is illustrated in the following table:

| Band | Frequency (Mhz) | Comments |
|---|---|---|
| P | 240 | Used primarily for Harm |
| L | 1435-1525 | Available for AC & Unmanned systems |
| Upper L | 1755-1850 | No longer discouraged for TM use (2003). Available for AC & Unmanned systems |
| S | 2200-2290 | Only for unmanned systems |
| S | 2360-2390 | Used for flight test. Currently somewhat congested |

Due to their proximity, China Lake and Edwards share the scheduling of TM frequencies. Because of its size and distance from Edwards and China Lake the sea range at Point Mugu may be able to reuse frequencies without unacceptable interference. The S band frequency used for flight test has had some congestion at Edwards and China Lake (i.e. not all projects received their primary choice every time they scheduled flight operations). Additional spectrum has been made available in the upper L band and is as yet under utilized

The Advanced Range Telemetry project under the Central Test and Evaluation Investment Program (CTEIP) has developed FQPSK (Feher Quadrature Phase Shift Keying) and SOQPSK (Shaped Offset Quadrature Phase Shift Keying) transmitters and demodulators that allow twice the data rate at the same amount of spectrum when compared to commonly used PCM/ FM transmitters and demodulators. The F-18 program is using this at China Lake, and the F-22 is planning on using it at Edwards. Deploying this technology to older systems represents a cost but not a technical risk to those programs. Aircraft systems are more flexible in their telemetry utilization than missiles because they have an extensive recording capability on board. The F-22 has a

telemetry bit rate of 5Mb/S while the AIM 9X has 12Mb/S. Some operations have even greater rates than AIM 9X.

A new project for FY 05 under CTEIP, the Integrated Network Enhanced Telemetry with Edwards Air Force Base lead is looking at network-enhanced telemetry as a method to even more efficiently use the telemetry spectrum.

In conclusion, there are a number of ways to increase the usability of the telemetry spectrum at China Lake and Edwards. They range from including the Point Mugu Sea Range as an option when planning China Lake-Edwards operations, using the Upper L band frequencies, upgrading existing tlemetering equipment with new technology and increased use of recording on aircraft systems. Telemetry spectrum is a cost but not a constraint in significantly increasing the tempo of operations.

# PART 5: CHINA LAKE AND NEIGHBORING BASES

China Lake is situated in close proximity to many bases of all the military services. It shares use and management of the vast R-2508 airspace, restricted to military use for test and training above 20,000 feet altitude and from the ground up above the over 2,000,000 acres of military reservation. It is a close RDT&E partner with Edwards Air Force Base and the Point Mugu facility of the Naval Air Warfare Center Weapons Division. In addition to R-2508's availability for training by Naval, Air Force and Marine Corps forces, China Lake's ranges are used for strike and electronic warfare training by Navy, Air Force and Marine Corps units from all around the western region. And China Lake's facilities and technical staff support major joint training exercises and battle experiments involving land, sea and air units in the western United States.

## JOINT AEROSPACE RDT&E CENTER

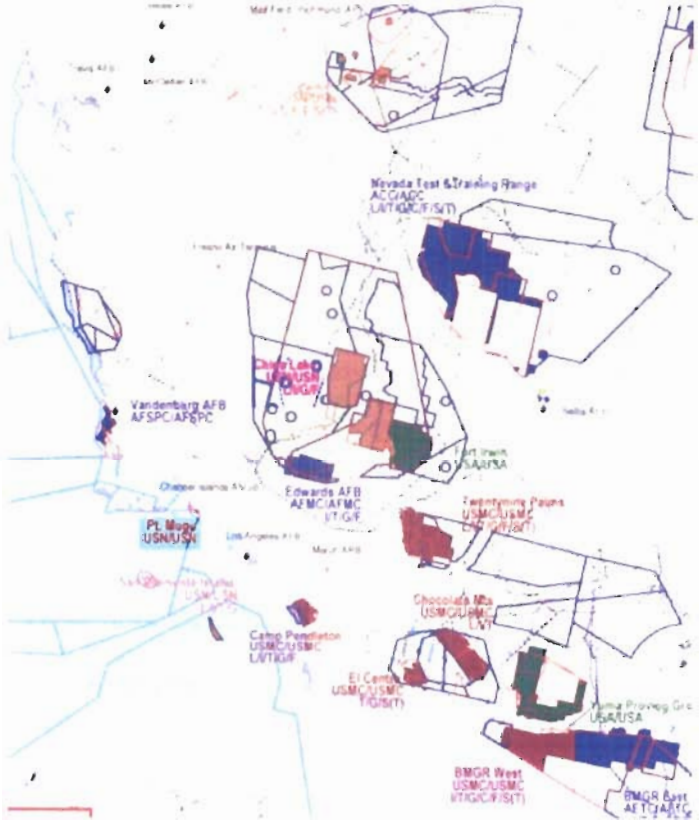
As mentioned above China Lake is a close working partner with nearby Edwards Air Force Base and its sister Naval Air Warfare Center Weapons Division facility at the Point Mugu Naval Air Station. Edwards routinely tests aircraft and uninhabited air combat vehicles (UCAVs) on China Lake ranges and its Electronic Warfare Range and on the Point Mugu Sea Range. The ranges are linked by wideband telecommunications and can function as a closely coordinated unit. With the Army's Fort Irwin National Training Center, China Lake and Edwards Air Force Base have successfully jointly managed R-2508 for many years.

The communities supporting China Lake, Edwards Air Force Base and the Point Mugu facility (Point Mugu is part of the Naval Base Ventura County), have proposed that the three bases be merged into a single Joint Aerospace RDT&E Center. Placing a significant portion of the nation's air warfare RDT&E at these three sites under joint management could yield considerable efficiencies and cost savings while carrying the Department of Defense's Military Transformation goals a significant step forward.

The proposed Joint Aerospace RDT&E Center would integrate China Lake, Edwards Air Force Base and Point Mugu along with access to the R-2508 airspace, Point Mugu Sea Range and San Nicolas Island.

## PACIFIC TEST AND TRAINING COMPLEX

China Lake is located at the centroid of a complex of Army, Navy, Air Force and Marine Corps bases essential to RDT&E and joint training of our armed forces. The air and land ranges of China Lake and its military-civilian team of experts in every facet of military weapon systems are vital assets for joint operations of these bases.




## SOUTHWEST DEFENSE COMPLEX

China Lake is a key base in a complex of military RDT&E and training base that spreads across six southwestern states – Arizona, California, Nevada, New Mexico, Texas and New Mexico. A total of 25 major bases have been identified which offer key capabilities for joint use by all of the transforming military services.

The following bases are members of the Southwest Defense Complex:

Arizona:

Army Proving Grounds, Yuma
Barry Goldwater Range
Fort Huachuca
Mesa Research Center

California:

Air Ground Combat Training Center, Twentynine Palms
Camp Pendleton
Camp Roberts-Fort Hunter Liggett Complex
Chocolate Mountain Range
Edwards Air Force Base
National Training Center, Fort Irwin
Naval Air Warfare Weapons Division, China Lake
Naval Air Warfare Weapons Division, Point Mugu
Southern California Offshore Range
Vandenberg Air Force Base

Nevada:

Naval Air Station, Fallon
Nellis Air Force Base

New Mexico

Cannon Air Force Base
Holloman Air Force Base
Albuquerque Laboratories, Kirtland Air Force Base
White Sands National Range

Texas

Corpus Christi Naval Complex
Fort Bliss
Fort Hood

Utah

Dugway Proving Grounds
Utah Test and Training Range

# PART 6: ENVIRONMENT AND CULTURAL RESOURCES

The clean air and abundant underground water reservoir are resources that support China Lake's ability to perform its mission without environmental concerns and to offer the ability to support additional missions if the services or Department of Defense choose to take advantage of its potential for expanded support to defense needs.

China Lake's 1.1 million acres lie in a desert-mountain region containing a trove of natural and cultural resources. The ability of the Navy to manage and control access to these resources has assured their preservation for future generations.

A major source of clean, renewable energy is also located on China Lake's range land which under a public-private arrangement has been operating for decades and will continue to supply energy to the grid for many years to come.

## STEWARDSHIP OF NATURAL AND CULTURAL RESOURCES

China lake has a comprehensive Environmental Impact Statement (ElS), which covers all activities, as well as accommodating a moderate increase in activity to account for future missions. The EIS protects the land, natural resources and cultural resources, and is integrated into operational planning through Comprehensive Land Use, and Integrated Natural Resources Management Plans. More than 90% of China Lake's 1.1 million acres is a safety and security buffer and remains in a mostly pristine natural state. Locations for new facilities and speclalized test events are carefully selected to minimize impact. and the staff scrutinizes virtually every mission-related activity to ensure that it complies with natural-resources laws and regulations. Activities at China Lake meet or exceed all state and federal clean air act, hazardous materials, and permitting requirements. Ongoing formal cultural-resource inventories to identify archaeological, historical, and traditional properties have been conducted on more than 11,000 acres to date.

Long-range resource planning, as well as day-to-day oversight, of scores of environmental projects, is carried out by a team of civil service professionals, ranging from archaeologists and ecologists to environmental engineers, and augmented as needed by contract specialists. Community involvement is also encouraged.
Environmental Awards. In 2003 the Governor's Award for Historic Preservation was presented to China lake for its long-standing heritage program that combines scientific, historic, recreation, and Native American values. No other military installation has been the recipient of such a prestigious award. In 2002 Weapons Division, China Lake and Point Mugu, won the Chief of Naval Operations Environmental Award. The citation read in part, "Through your resourceful Natural Resource Program, you continue to effectively balance mission support with wildlife and land management through conservation education and conscientious environmental stewardship."

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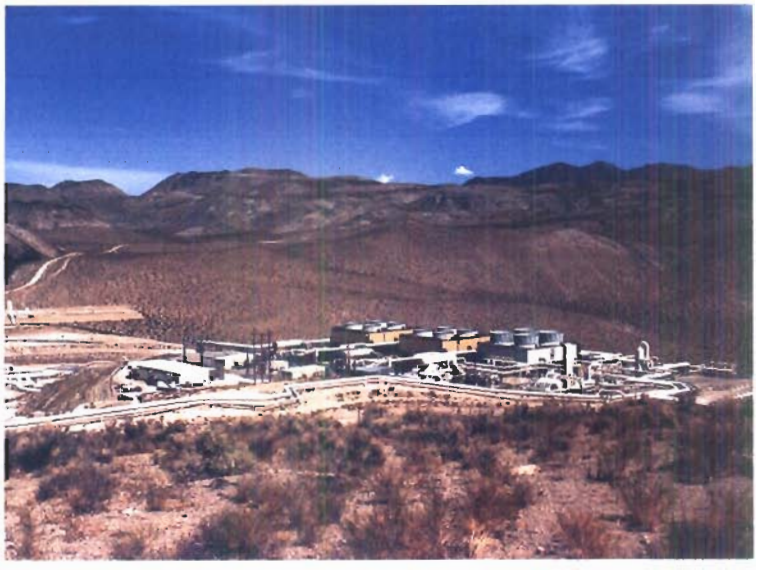
## COSO GEOTHERMAL RESOURCE

One of the largest known geothermal energy resources in the world lies under the China Lake North Range in the Coso Mountains. Special legislation in the 1970s allowed the Navy to contract with private enterprise under competition to tap into the source and build steam electric power plants. Today the Coso geothermal resource generates 270 megawatts of clean power continuously onto the Western Grid. Private investment built the station and revenue is generated for the company and local government, and the Navy's energy conservation program is funded by a portion of the revenue.



One of three Coso electric power plants, each of which operates three 33 MW turbine generators. More than 100 steam wells are managed to assure balance and long life to the field.

Wild horses roam the North Range without interference except for roundups when herd size begins to endanger the health and safety of the animals. Horses and burros captured by the wranglers are placed in adoption under a program supervised by the U.S. Department of Interior.

## PLANT AND ANIMAL LIFE

Live ordnance is tested on China Lake's ranges so one might assume that it's a dangerous place for animals. Yet, because the range area is so large, only a small portion of the land is actually used for ordnance testing. Indeed, less than 10 percent of China Lake's land is disturbed at all by humans, including roads and buildings. Over 90 percent of the land is undisturbed, allowing complete freedom for the many desert species to live out their lives in a natural environment.

Threatened and endangered species of birds, plants, and even fish are found at China Lake as well as the many mountain and desert species that abound in the West. Pictured are the Inyo Towhee, Red Fox and wild poppies that flourish after spring rains.

During the last three years, China Lake has developed aggressive management plans for preserving endangered species such as the Mojave Tui Chub, the Desert Tortoise, and the Mojave Ground Squirrel. Plans protect birds from aircraft strike hazards, and ravens from overpopulation. Wild horses and burros, potentially at risk on runways, are rounded up annually and adopted out in a formal program in coordination with the Bureau of Land Management. China lake cleared more than 100 acres of non-native vegetation that was depleting wildlife water sources and developed a Geographic Information System-based photographic database for identifying and protecting its 122 natural desert water sources.

## CULTURAL RESOURCES

The China Lake area was the home of ancient Indian tribes predating the introduction of the bow and arrow. Traditional radiological dating methods are ineffective with the relics of the ancient dwellers, and archeologists differ on the age of the most ancient examples

of art found in Little and Big Petroglyph Canyon and in sites throughout the area.

Because these treasures are located in a secure area, they are free of vandalism found in areas where the public may roam freely. The Commander of the Naval Air Weapon Station opens Little Petroglyph Canyon to conducted tours on weekends during the spring and fall.

The area's geology doesn't contain flint suitable for arrow or spear points, but the China Lake's North Range is the site of ancient volcanos yielding a plentiful supply of obsidian which can be flaked and worked. Local Indians carried on trade in obsidian with coastal and inland tribes. Obsidian points and flakes are common on the North Range and nearby sites. Federal law protects these artifacts, and if found, they must be left where they lie.

Before the Navy occupied the area, white settlers prospected in the hills and mountains, and left abandoned mines and relics of their stay around the area

# PART 7: CHINA LAKE MANAGEMENT

China Lake is known as a technical innovator in supporting the armed forces. It is also a management innovator. Over the years, China Lake has been famous for its supportive management style, giving responsibilities to its employees to help them mature. It has been able to recruit and retain top personnel because of its management style and the feedback to their alma maters by young employees to their friends and faculties. Its personnel system is a model envied by other civil servants working under the old classification system.

## WORKING CAPITAL FUND

In understanding China Lake's management, one must first understand how it does business with its customers. China Lake and other Navy laboratories and ranges operates in many ways like a private business. Its charges to customers includes a levy to cover all of its general, administrative and other overhead expenses. Unlike a private business, it makes no profit, and its overhead structure is tightly regulated at the Naval headquarters level. The one exception is for range operations. Like all national ranges, China Lake is allocated a fixed base of funds to cover capitalization costs for equipment and for certain overhead expenses.

The accounting basis for Navy RDT&E centers is the Navy Working Capital Fund.

The Navy Working Capital Fund is a revolving fund established to meet the diverse requirements of the Navy and Marine Corps operating forces. Under the revolving fund concept, an appropriation or transfer of funds finances the initial cost of goods and services. Reimbursements from a customer's appropriated account replenish the initial working capital and permit continuing operations without further appropriation by Congress. Unlike profit-oriented businesses, the goal of the revolving fund is to break even over time.

Included in the Fund are five activity groups comprised of one or more activities. These groups stabilize or fix the price of goods and services in their budget to protect customers from unforeseen fluctuations. The activity groups are: base support, supply management, transportation, depot maintenance and research and development.

## PERSONNEL DEMONSTRATION "DEMO" PROJECT

A dozen years before the term "reinventing government" was coined, Congress authorized a Navy Personnel Demonstration Project—the "Demo"—at the Naval Weapons Center, China Lake, and the Naval Ocean Systems Center, San Diego California. In the summer of 2004 the project marked its 20th anniversary. Not only is the Demo still going strong, it has become a model and a standard for other government agencies seeking effective, people-centered, performance-oriented personnel management systems.

**History.** When Congress passed the Civil Service Reform Act (CSRA) of 1978, it authorized the Office of Personnel Management to test innovative approaches to personnel management. Each CSRA project was to be limited to five years duration and cover a maximum of 5000 people.

The first such project was the Joint Personnel Demonstration Project initiated in July 1980 at the Naval Weapons Center (now the Naval Air Warfare Center Weapons Division), China Lake, and the Naval Ocean Systems Center, San Diego. Characteristically, China Lake management turned design of the Demo structure over to a cross-section of employees including mid- and lower-level supervisors. In 1984, Congress extended the Demo project to September 1990 and removed the 5,000-person limit. In 1987, the project was amended to include recruitment bonuses. In 1988 Congress again extended the Demo for five more years until 1995, and in 1994 made the project permanent. The Demo now covers approximately 10,000 federal employees.

**Distinction from GS System.** The Demo, locally developed to fit the unique needs of a research-and-development organization, differed from the General Schedule (GS) system in several important ways. At the heart of these differences was a new compensation philosophy: that performance, rather than longevity, would be the key factor in determining salaries and retention ratings. This philosophy was implemented through an integrated approach to pay performance management, and position classification.

Specifically, the Demo authorized broad pay bands—five, versus the 18 grades in the GS system. Progression between pay bands is based on the level of difficulty of an individual's work; while progression within the bands is gauged to the individual's performance. Annual performance plans, jointly developed by the employee and the immediate supervisor, were made the measuring standard for performance.

In place of the extraordinarily complex position-description of the GS system, a simple classification system was designed so that position descriptions could be quickly and easily developed and classified. The classification function was delegated to managers. A dual-career ladder was established for highly valued technical employees so that they could progress without taking supervisory positions, and greater flexibility for starting salaries was introduced. Finally, the Demo made performance (rather than tenure) the primary criterion for retention during a reduction-in-force (RIF) action.

**Through Good Times and Bad.** Federal drawdowns during 1990s led to two RIFs at the Naval Air Warfare Center Weapons Division. In the first RIF, 55 employees were actually separated from the organization. Of these, all of those in the lowest retention group were separated while only two in the highest group were separated. In the second RIF, 85 employees were separated; again all in the lowest performance group were separated while no one from the highest group was separated. Thus the post-RIF organization benefited from a greater retention of high performing employees.

**Influence on Other Federal Programs.** The Demo has served in whole or part as a model for several other personnel demonstration programs. Twelve of the sixteen Demonstration Projects that have been approved by OPM are similar to and/or a direct outgrowth of "China Lake" Demonstration Project.

Evaluating a personnel demonstration project involves many subjective elements, including employee satisfaction, perceived fairness, and management-employee relationships. To accurately assess these elements, the Weapons Division worked with the University of Southern California to devise an evaluation system based on employee-attitude surveys. These surveys have now become a standard tool for assessing the merits of personnel-management programs throughout the federal government.

**Measures of Success.** As the oldest CSRA demonstration project, the Demo has been evaluated extensively by the Office of Personnel Management resulting in sixteen management reports on all aspects of the system. As part of the evaluation the Demo system was compared to two other Navy research and development centers as "controls" for the changes introduced by the Demo.

In comparison to the baseline R&D centers, separation rates under the Demo have been lower for high performers and higher for low performers. In addition, the more flexible recruitment strategies available under the Demo have made the Weapons Division more competitive in the hiring of scientific and engineering personnel.

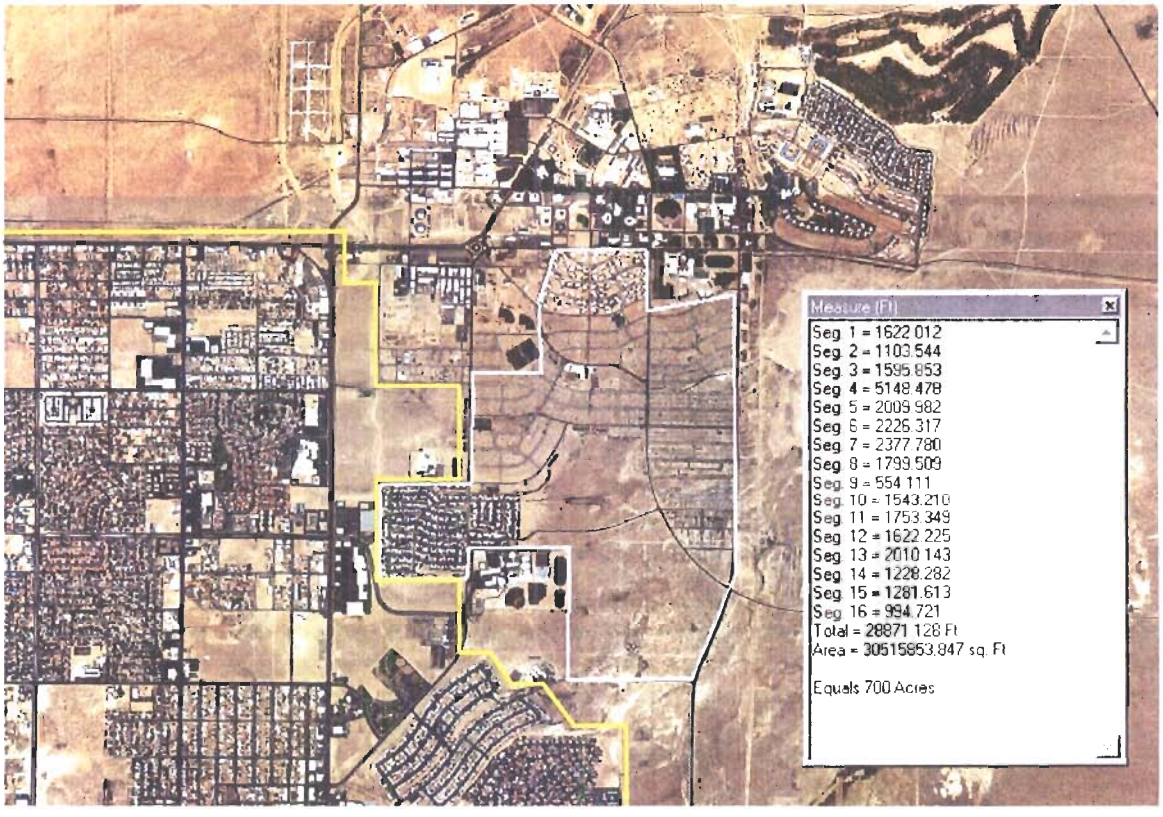
According to the Office of Personnel Management, "recruitment, retention, and reduced turnover of high performers and increased turnover of low performers have all improved. Perceived supervisory authority over classification, pay, and hiring increased, as did employee satisfaction with pay and performance management."

For 20 years the Demo has indeed demonstrated that innovative management philosophies, when diligently implemented, can help assure an organization's continued vitality in a rapidly changing world.

# PART 8: ACCOMMODATIONS FOR ADDITIONAL MISSIONS

As the Department of Defense seeks to gain efficiencies and reduce the cost of its investment in military base infrastructure, one important option is to consolidate by incorporating small bases into larger, more efficient operations. China Lake is an ideal home for receiving smaller bases, not only for its enormous size, but because it has unused infrastructure that became available after the 1990s downsizing. Many structures were torn down, but the utilities, street layout and usable space remains to be rehabbed and reoccupied.

Obviously, a military base that covers over 1700 square miles has plenty of room to accommodate almost any military mission not requiring ocean front property. During the 1990s the work population shrank from around 10,000 military, civilian and contractor personnel by nearly 50 percent, leaving plenty of room for growth in the basic headquarters area.




On of the China Lake civilian housing areas is shown outlined in white. Although the houses were demolished in the 1990s, the basic infrastructure still remains.

# PART 9: HOST COMMUNITY

## INTRODUCTION

China Lake's vast reservation is located in three counties, Kern, Inyo and San Bernardino Counties in the Mojave Desert East of the Sierra Nevada Mountain Range. Its headquarters and the home of its employees are located in the Indian Wells Valley at the northeast corner of Kern County. The principal city is Ridgecrest, an incorporated city that holds the China Lake housing and administrative areas within its borders.

Ridgecrest is a "Navy town" with an economy dependent on the fortunes of the base. 80 percent of the jobs are directly or indirectly dependent on the base. Ridgecrest citizens are strong boosters of the base, and the city government works closely with China Lake management to be certain that any actions it takes or plans are fully compatible with the base's operations. A resolution of the Ridgecrest City Council in the following section is indicative of the community's regard for the base.

Kern County, which also hosts the major portion of Edwards Air Force Base, is a military friendly county supporting its bases and the military establishment in every way possible.

## COMMUNITY AND ITS INFRASTRUCTURE'S ABILITY TO ACCOMMODATE A GROWING CHINA LAKE MISSION

The City of Ridgecrest maintains close touch with base management to assure that the infrastructure is available to support China Lake's present and future needs. Potential growth from expanded or new missions is a key part of the City's planning process.

As early as 1991 Ridgecrest recognized its opportunity to support sustainable growth. At that time a General Plan was adopted setting in motion plans for the next three decades. Population for 2010 was projected to be a minimum of 50,000 with a maximum of over 100,000. The Plan recognized the City's updated environment to identify and develop land use, transportation, housing, and economic development needed through 2010. Concepts were put into place for essential infrastructure to support this growth including water needs, education, land use and zoning, public safety, and sewer and waste water treatment.

According to the 2000 Census, current population is slightly less than 26,000 which means a significant, sustainable growth rate is possible. The City of Ridgecrest and the surrounding Indian Wells Valley can provide for rapid and extensive growth over a period of years without exceeding its existing infrastructure. As an example, the Wastewater Collection and Treatment facility serves both the Naval Air Warfare Center and the city of Ridgecrest with a rated capacity for over 37,000. In addition a $3 million upgrade of the plant is underway to continue to support that 37,000 plus a new plant to be developed for $30 million. Concept plans initially plan to support a population of 74,000 with phased expansions to allow for a future population of over 100,000.

Ridgecrest, Kern County and the Naval Air Weapons Station work jointly to provide housing and commercial growth opportunities with minimal environmental or encroachment issues.

Police services and public safety are operating within national standards for a population density of 34,000. Emphasis is placed on keeping up to date on equipment and policies necessary to serve current needs as well as provide for future growth. Ridgecrest is an extremely safe place to live with a very low crime rate. Ridgecrest is supported by the Kern County Sheriff's Department, California Highway Patrol, and the China Lake Police Department. It is also the home of the East Kern Municipal and Superior Court.

Ridgecrest currently contracts with the Kern County Fire Department and has the ability to expand service as growth occurs. The Indian Wells Water District has a capacity to serve over 50,000 now, without the need to use any of its allocation from the California Aqueduct project. Water is available to easily accommodate a much larger population.

Medical services are provided by Ridgecrest Regional Hospital which serves the entire Eastern Sierra area. Ridgecrest Regional Hospital is currently engaged in a major expansion of its facility. Also serving in the medical community are doctors and nurses at

Drummond Medical Group, Southern Sierra Medical Clinic and several private practices including those from Loma Linda Medical Center and USC Medical Center.

Parks and recreation facilities and quality of life are addressed through an array of programs for civilian and military families. Opportunities exceed national standards of numbers of acres per capita in parklands, sports and recreational amenities. Southern Sierra Boys and Girls Club, Indian Wells Valley Football League, Indian Wells Valley Baseball League, Indian Wells Valley Youth Softball League and recreational soccer, basketball and volleyball leagues run by the city provide youth activities. Additional recreational opportunities include hiking, mountain climbing, fishing, boating and kayaking, hunting, bird watching, off-road vehicles and mountain biking, golf, camping, and motocross.

Numerous fairs and festivals, public libraries, amateur theatrics, orchestra and musical events, antique shopping, tours of ghost towns, mining, and petroglyphs, and a variety of museums (Maturango historical, US. Naval Museum of Armament and Technology, Twenty Mule Team Museum, and Kern Valley Museum) offer additional activities to enjoy.

There are hundreds of subdivision lots available for development as housing. A housing boom has been occurring over the last several years—over 400 units of housing are in various stages of development including both single family residential and affordable apartment units give a variety of choices for housing. Ridgecrest has extremely low impact and development fees for new housing development and provides fast track planning and building support to development in the community.

Ridgecrest, Kern County, and the Naval Weapons Center at China Lake are working jointly to provide housing and commercial growth opportunities with minimal environmental or encroachment issues.

The City provides both Dial-a-Ride and fixed route transportation services. Commercial and public air support is available through Inyo Kern Airport. Major transportation corridors include California Highway 395, 14, and 178 to access major metropolitan areas such as Bakersfield, Lancaster/Palmdale, Victorville, and Los Angeles. Ridgecrest is a member of the Kern Council of Governments, which allocates street improvements, some of which are underway.

Sierra Sands Unified School District, which supports Ridgecrest and nearby communities, has received many California Distinguished School awards. Its students consistently score well academically on the achievement tests mandated by the state and follow the No Child Left Behind mandate set by the federal government. Current pupil to teacher ratio for K-12 is 21.4 to 1. As recently as 2002-03 capacity was in place for 10,000 students even though the current need is for between 5-6,000.

There are five elementary schools, two middle schools, a high school and continuation school, several private schools and a charter school. Ridgecrest is home to Cerro Coso

Community College which offers higher education classes to anyone within the community.

Other city franchises include: Southern California Edison for the city needs; alternative energy sources including wind and solar, Pacific Gas & Electric, Benz Sanitation, a County Landfill rated for a population of 50,000 over the next 20 years, and Mediacom for 500 channels of cable and high speed internet access.

The Indian Wells Valley community has 38 churches including the All Faith Chapel on the base serving a military and civilian congregation.

There are three major commercial development areas in progress. The Ridgecrest Business Park has over 56 acres and 32 individual lots for office and light industrial use. The Ridgecrest City Center Industrial Park covers 50 acres of land for office and light industrial and the Northeast Industrial Corridor is available for light industrial and manufacturing use. Several hundred acres are also available in the general area around the city of further expansion.

The environmental air quality is extremely good with over 350 days of excellent weather per year.

In summary, given all the items mentioned above Ridgecrest is in a clear position to support significant growth over the next two decades within its existing infrastructure and has plans to handle twice or even three times its current population in the future. Ridgecrest is truly the place to be for the next two decades.

## INDIAN WELLS VALLEY STATISTICS

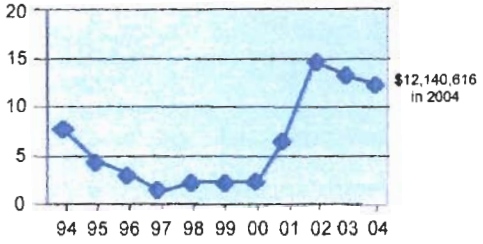
The Ridgecrest Chamber of Commerce updates statistics on the community that are helpful in describing the status of the community and its population. The following pages contain reproductions of the material provided by the Chamber.

# Indian Wells Valley Statistics

## Economic Indicators

### Ridgecrest Building Permits

Value of Building Permits
$M by Year
(per Kern County Board of Trade)

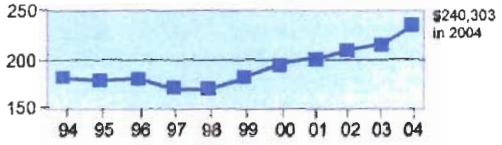



Starting in 2000 Ridgecrest saw a dramatic upward trend in building permit values; those values have stayed high since then.

According to the U.S. Census, 8 percent of Ridgecrest houses were vacant in 1990; with 13.1 percent vacant in 2000. Since that time, homes have sold or rented so well that the vacancy rate has declined to almost nothing.

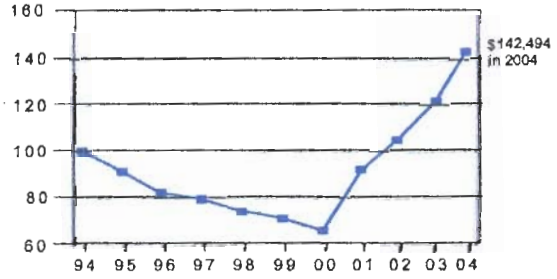
### Ridgecrest Taxable Retail Sales

$M by Year
(per California State Board of Equalization and MuniServices Co.)




### Ridgecrest Home Sales

Average Sale, $K by Year




## Valley Population

**2000 Census: 27,772**

Ridgecrest ..... 24,927
China Lake Acres ..... 1,761
Inyokern ..... 984

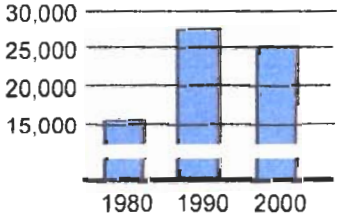
**1990 Census: 36,879**

Ridgecrest ..... 27,725

(China Lake Acres and Inyokern were not counted as separate census areas. The total for the 93555, 93556, and 93527 zip codes was given as 36,879.)

### Ridgecrest Population

*per U.S. Census*




Information compiled by **Ridgecrest Chamber of Commerce**
128 East California Avenue, Suite B, Ridgecrest, CA 93555
Phone: (760) 375-8331 • Fax: (760) 375-0365 • E-mail: *chamber@ridgenet.net* • Web: *www.ridgecrestchamber.com*

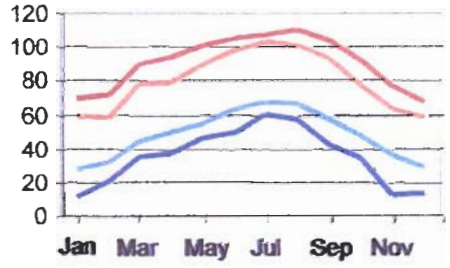
## Climate

Our climate is dry, with mild temperatures most of the year. In the summer it does get hot. Over the past 10 years, an average of 4½ inches of rain has fallen each year. The chart at right shows the high and low temperature for each month, as well as the average high and the average low per month.

Our valley has an average of 260 cloud-free days a year – better than the rest of the country, even sites in Texas, which average only about 180-200 cloud-free days a year.

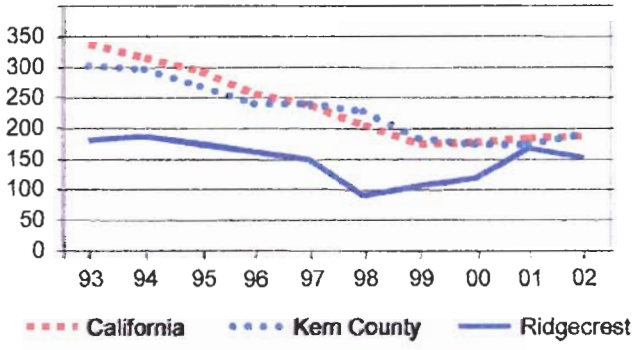
Source: Bennett Optical Research

**2004 Temperature Highs and Lows, deg. I**




Source: Geophysics Operations Secti
Naval Air Weapons Station, China La

## Crime Rate




**Crimes per 10,000 Residents**

Crimes included in the statistics charted at left are willful homicid forcible rape, robbery, aggravated assault, burglary, motor-vehicle th and larceny-theft. Not included in these statistics (the California Cri Index) are simple assaults and cas of arson. The statistics are availab online at the California Criminal Justice Statistics Center. (*http://caag.state.ca.us/cjsc/*).

For information about Ridgecrest crimes in 2003, visit the City of Ridgecrest Police Department site, *www.ci.ridgecrest.ca.us/police.asp?id=56.*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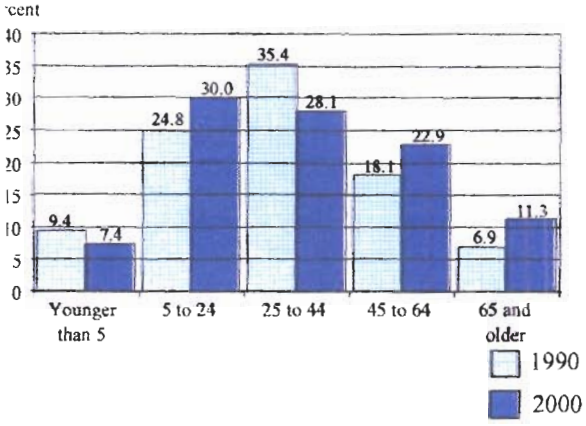
## Age Groups and Ethnicity

### *Ridgecrest Population by Age Group*

per U.S. Census




### *Ethnicity, Ridgecrest Population*

Percent per Ethnic Group, According to U.S. Census

| Ethnic Group | 1990 | 2000 |
|---|---|---|
| White | 84.2 | 76.5 |
| Hispanic/Latino | 7.9 | 12.0 |
| Asian/Pacific Islander | 3.9 | 4.0 |
| Black | 3.1 | 3.5 |
| Other | 0.2 | 2.9* |

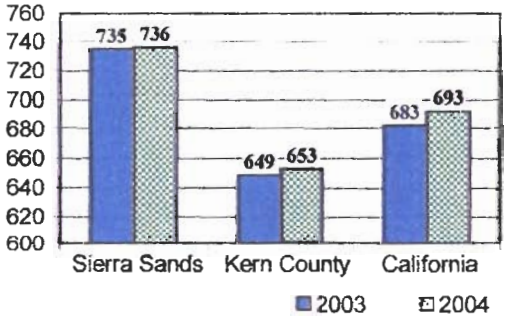
*The 2000 census allowed the choice of more than one ethnic group, a choice not available in 1990.

## Education

### *Academic Performance Index, 2003-04*

Per California Department of Education

### *Comparison of Scores for Sierra Sands, Kern County, and State of California*

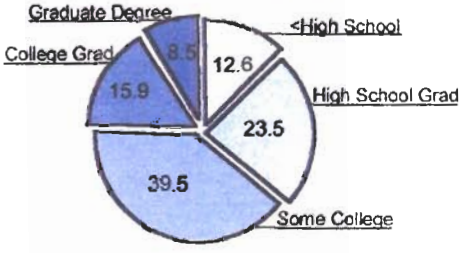



**Source: Sierra Sands** Unified School District

### *Educational Levels, 25 & Older*

per 2000 U.S. Census

Percent per category




### *SAT Scores, 2003 Burroughs High School*

| | Average verbal score | Average math score |
|---|---|---|
| Burroughs | 544 | 555 |
| California | 499 | 519 |
| U.S. | 507 | 519 |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