NAWCWD Quick Facts
China Lake & Point Mugu, CA NAVAIR

Integrated Battlespace Arena (IBAR)

Mission. IBAR is an advanced simulation facility and the first to connect nine different Navy laboratories across the U.S. in a distributed simulation—from the subcomponent to theater levels—with a degree of fidelity, flexibility, and dependability unparalleled in the DoD. Facilities are linked worldwide with multiple fiber optic networks including SIPRNET, DREN, and range microwave telecommunication capabilities.

Unique Features. The Virtual Prototyping Facility (VPF) has the Navy's first cockpit simulation that includes communications to and from the simulated aircraft to the weapons. The uniqueness of IBAR's C2/JF integration capability lies in the union of authentic-in-the-fleet C2/JF systems with IBAR Modeling and Simulation (M&S) resources. If live assets are not available, the IBAR can simulate any aircraft, weapon, target, or terrain required. Information is networked or data linked through communications systems from any ground, air, or sea platform.

Combat Support. In the war on terror, IBAR contributed significantly to counter radio-controlled IED, electronic warfare, and unmanned systems. IBAR engineers and analysts developed a geo-referenced database to register and correlate tactical imagery terrain models based on a database maintained by the U.S. National Imaging and Mapping Agency. The database was used in theater to control raw tactical imagery from which users quickly calculated the precise location of items of interest. The database was used with great success in Kosovo, Iraq, and Afghanistan operations.

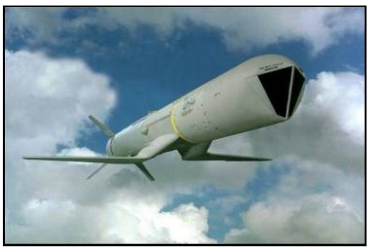
Cost / Time Savings. As a result of four months of sensor and data link simulation and testing, the IBAR saved the SLAM-ER moving target program over $2M and one to two years' worth of development time. Hardware-in-the-loop (HWIL) testing makes missile development faster and cheaper. In the 1960s, the U.S. Navy conducted 146 live-fire tests of AIM-9 en route to its final deployment at a cost of more than $1M per test. Expensive ventures prompted a search for less expensive methods. The result was HWIL testing, which reduced the number of live-fire tests for the latest version of AIM-9X to just 15! In addition, HWIL testing is faster and capabilities can perform more than 100 tests each day at a cost of < $100 per test. Live-fire is now reserved for near-final designs and to validate HWIL models.

RDT&E. IBAR is a place where warfighters exercise, rehearse, and refine concept of operations (CONOPS). With more than a decade of success in fusing virtual and real-world environments, the IBAR offers a multifaceted "system-within-systems" approach using high-performance computing, sophisticated visualization of scientific and tactical concepts, high-speed networking, mass archiving, versatile environments, and hands-on experience. The IBAR can perform warfare exercises at all security levels.

- **Subcomponent to Theater Level.** On any given day, one facility might do a simple subcomponent test for one customer; and, the next day, the same facility might be networked with several other IBAR labs and half a dozen Navy and DoD sites around the country in a complex simulation of a large-scale military operation.
- **Interconnectivity.** IBAR is interconnected by multiple fiber-optic networks. This flexibility allows simultaneous high-bandwidth transmission of different information types, such as voice, video, and data. Because the network is reconfigurable through software, virtual networks can be built up and torn down online to suit any desired purpose. Fiber-optic cable connects the IBAR to the F/A-18 Advanced Weapons Laboratory; the Range Control Center; and the Concepts, Analysis, Evaluation, and Planning Department. Through the Defense Research and Engineering Network, SIPRNET, and other networks, the IBAR can interconnect with the fleet and other armed forces deployed throughout the world.

Size / Description / Scope. Over 75,000 SF of laboratory space in Michelson Laboratory. **Annual Test Events:** 100+.
Plant Value: $500M+.

Main Facilities (in alphabetical order).

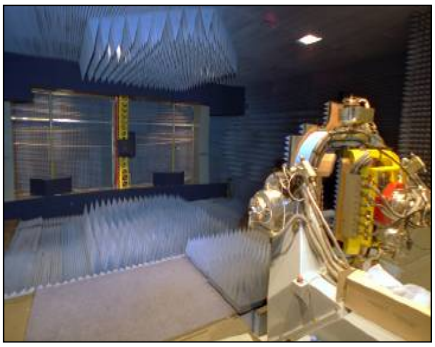


Data-Link Network Integration Facility (DLNIF). The facility supports tactical and simulated versions of data links relative to weapon, pilot, aircraft, strategic, and environmental interactions. **Data links** include Link 16, Tactical Interoperable Ground Data Link (TIGDL), AN/AWW-13 Advanced Data Link (ADL), and Tactical Targeting Network Technology (TTNT). **Sensor links** include Advanced Tactical Forward-Looking Infrared (ATFLIR), Gunsite, Shared Reconnaissance Pod (SHARP), Rover, U2, and Walleye. **Weapon links** include AARGM, Harpoon Block III, Joint Air-to-Surface Standoff Missile (JASSM), Joint Standoff Missile (JSOW), Low-cost Guided Imaging Rocket (LOGIR), SLAM, SLAM-ER, Spike, and Tomahawk. **C2 interfaces** include Joint Range Extension (JRE), Air Defense System Integrator (ADSI), and Rapid Attack Information Dissemination and Execution Relay (RAIDER).

EO/IR Systems Evaluation Laboratory. The lab excels in the reverse engineering, analysis, evaluation, and simulation of threat systems. Highly accurate and detailed threat simulations to the IBAR's VPF are provided.

HWIL Laboratory. This simulation capability includes not only mathematical modeling but also hardware testing at a system level. It uses anechoic chambers equipped with flight-motion simulators where engineers test actual hardware, subcomponents, components, and systems in an environment that accurately simulates missile flight. The RF and IR chambers are capable of sophisticated target presentation both through signal injection and scene projection. Real aircraft avionics can be incorporated and, through a fiber-optic link to the F/A-18 AWL, a pilot in an operational cockpit can further expand the simulation. The lab also features a Carco five-axis flight simulator and integrated infrared target-presentation system that have an off-boresight capability greater than 90 degrees.

- **High Off-Boresight (HOBS) Laboratory.** Features a five-axis flight motion simulator (FMS) and an off-boresight (OBS) capability up to 130 degrees.
- **Dual-Mode Laboratory.** Supports RAM that operates in both the IR and RF regions. Thus, in one place, at one time, the dual-mode seeker can fly a complete mission from launch to terminal encounter.
- **IR Scene Presentation Laboratory.** Creates HWIL and signal processor-in-the-loop (SPIL) synthetic IR environments that are used to test the Navy's most advanced seekers. The laboratory offers calibration and verification for IR projection.
- **IR-Scene Laboratory**. Features a three-axis FMS, integrated IR-scene projection capability and three separate IR-scene projection systems.

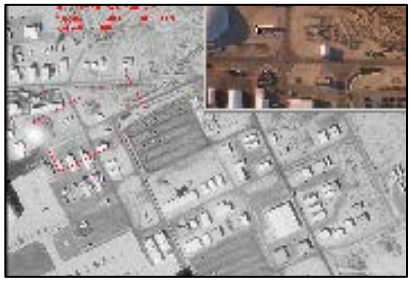


- **RF Anechoic Chamber.** Features a three-axis FMS and two-axis RF dual-target motion system. In 2010, a new 17,000-SF facility opened that includes two large RF shielded anechoic chambers, with phased-array target-presentation, and supports labs for Evolved SeaSparrow Missile (ESSM) and AMRAAM.
- **Semi-Active Laser Target-Presentation System (SALTPS) Laboratory.** Allows evaluation of laser-guided weapons and features a three-axis FMS and capability to display multiple targets across a 100-degree field of view. The SALTPS also features integrated range simulation capabilities.

Mission Planning Facility. Supports the development, testing, prototyping, and validation phases of new mission planning capabilities with a focus on "system of systems" concepts conducive to "what if" analysis.

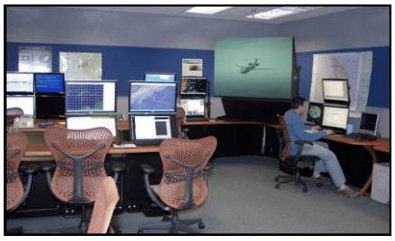
Precision Engagement Center. Conducts mission planning, reconnaissance data collection, C^2 analysis, fires integration, and weapon delivery merged with aircraft, data links, pilots, and weapons in four specialized facilities.

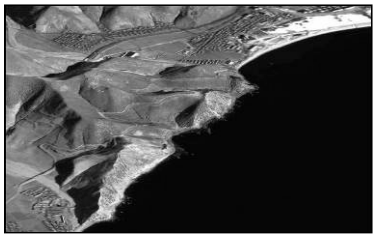
- **Precision Engagement Operations Center (PEOC).** Represents a command, control, computing, communication, and intelligence (C4I) planning-and-targeting facility using systems similar to those found onboard the aircraft carrier intelligence center (CVIC). Inside the PEOC, developers integrate new concepts into existing fleet systems to create realistic system-within-systems test environments.
- **Imagery Exploitation Laboratory (IEL).** Offers a vast online library of national and tactical imagery and intelligence products including charting resources.
- **Integration and Development Laboratory (IDL).** Integrates the latest prototypes into existing systems to support network-centric warfare.
- **Joint Networked Fires Center (JNFC).** Features 60 reconfigurable workstations and 5 overhead displays that allow customers to integrate computing assets and quickly exhibit data. The JNFC is ideal for rehearsing joint fires integration to determine adequacy of theater assets. The complex Empire Challenge exercises, with participants from England, Canada, Australia, and New Zealand, used the command center for the entire event.



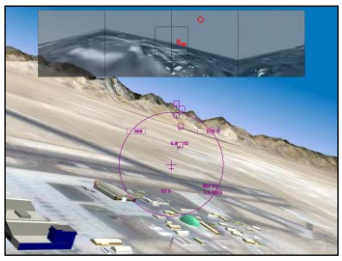
- **Man-Portable Air Defense System (MANPADS).** MANPADS is a shoulder-launched, short-range missile containing an IR seeker. A T-SPIL analysis will show exactly how a specific MANPADS responds and gathers information required to model countermeasures against the threat.

- **Unmanned Systems Facility (USF).** All aspects of unmanned aerial systems (UAS) in flight are simulated, including C2 sensor integration. The facility is an ideal test bed to rehearse combat scenarios; refine processes for collecting, recording, and handling data; evaluate sensors and data links; and identify critical events prior to live testing. All USF models are higher level architecture (HLA) and distributed interactive simulation (DIS) compliant and easily integrated with other IBAR or live assets. The backbone of the USF is the multiple unified simulation environment / Air Force synthetic environment for reconnaissance and surveillance (MUSE / AFSERS) UAS suite, which was developed under the auspices of the Joint Technology Center / Systems Integration Laboratory (JTC/SIL) at Red Arsenal and simulates flight characteristics of most military UAS. MUSE also includes a control-station surrogate featuring maps, data links, and vehicle controls.





- **Virtual Prototyping Facility (VPF).** Allows the Navy to design, test, and evaluate existing and emerging weapons without firing up a single rocket motor. It uses a collection of tightly integrated, modular simulations working in tandem with other IBAR or live assets. The facility is the brainchild of Star Trek-generation engineers. Prior to the VPF, the Navy's only option for evaluating a potential weapon design was to build and test each part separately. The only way to test the entire weapon was to fly it, a costly and time-consuming venture. Using high-speed computers and state-of-the-art virtual technology, the VPF can simulate the entire function of a missile. The VPF can model any real or conceptual military platform, weapon, or terrain based on customer requirements.



  - o ***Angel in the Cockpit Saves Lives*.** In 1999, the Crew Systems Department (CSD) at China Lake developed the Active Network Guidance in Emergency Logic (ANGEL), a virtual co-pilot to eliminate the major cause of aircraft ground collisions. During development, VPF personnel worked with the CSD to develop and exercise algorithms for ANGEL. The study compared current and future aircraft positions with those on digital terrain maps. The algorithms proved valid for every aircraft altitude and terrain slope tested.

Equipment. In addition to the data covered in the above facility descriptions, the IBAR has several mobile data link trucks and vans to enable on-site real-time data link testing, operations, and information transfer.

Interesting Facts. In the Joint Expeditionary Force Experiment (JEFX) 06, the IBAR provided simulated Global Hawk maritime demonstration sensor feeds that were realistic enough to fool JEFX participants into thinking the data were live during the test.

Recognition / Awards. Collectively, IBAR scientists and engineers 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 M&S.