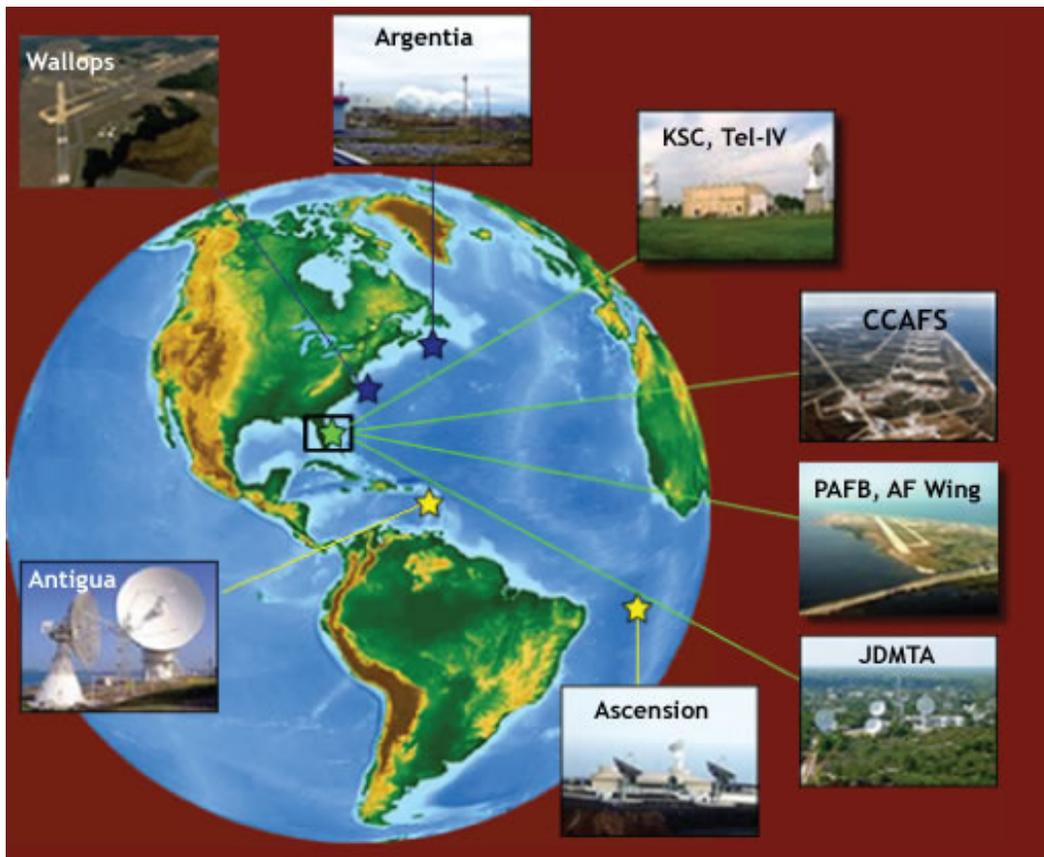


Eastern Range Instrumentation Update

The Eastern Range is the launch head at Cape Canaveral Air Force Station, which also supports Kennedy Space Center launches. Range Management activities are hosted at Patrick Air Force Base under the command of the 45th Space Wing. Downrange sites include Jonathan Dickinson Missile Tracking Annex, Wallops Flight Facility, and Antigua, Argentina, and Ascension stations. In the context of space launch operations, the Eastern Range includes all of the surrounding air, sea, and land space that is within the range of any particular launch vehicle. (See the graphic below.) The Eastern Range is not part of NASA but supports NASA activities.



Primary Objective of the Eastern Range

The primary objective of the Eastern Range is to provide for the safety of the public during launch operations. The activities and resources to ensure safety of flight include range instrumentation, infrastructure, and scheduling required to support and ensure that space and ballistic launches and other operations are appropriately supported.

The Eastern Range Range Safety Program uses instrumentation that is comprised of legacy and state-of-the-art technologies to ensure launch mission safety, launch area safety, and launch complex safety. Range instrumentation is primarily at the Florida locations of Cape Canaveral Air Force Station and Patrick Air Force Base. The Eastern Range also uses instrumentation from other Department of Defense and NASA agencies to accomplish its mission.

Eastern Range Instrumentation Update

Information Provided by Instrumentation



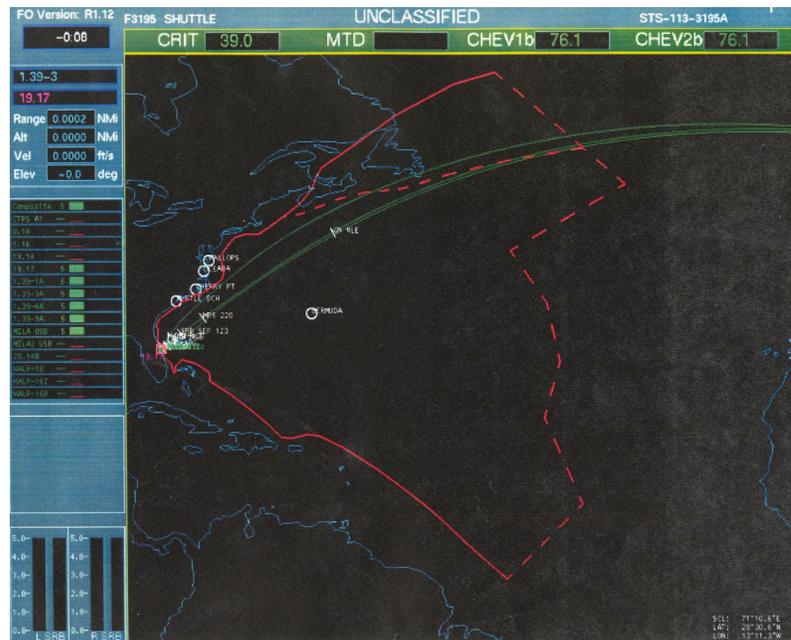
During launch operations, Eastern Range instrumentation provides vehicle positioning information from radar, vehicle telemetry, and optic tracking systems. Additionally, telemetry also provides vehicle health and status through its data stream. This range safety critical data is shipped via the range communication CORE network to the range safety display strings located in the Range Operations Control Center at Cape Canaveral Air Station. The Range Operations Control Center is shown at the left.

Range Safety Displays

The current range safety displays are designated as Flight Operations Version One (FOV1) and located at the Range Operations Control Center. The FOV1 system provides an Eastern Range range safety function and monitors launch vehicle performance. FOV1 consists of two independent systems: FOV1-A and FOV1-B. The systems acquire and process instrumentation data from the Eastern Range, NASA, and off-range sites through redundant network paths. Using the instrumentation data, these systems generate flight path and predicted impact point displays similar to the one shown below.

Using these displays, the Mission Flight Control Officer determines risk based on pre-defined mission rules and, if required, destroys any vehicle that violates those rules. The 45th Space Wing Safety Office personnel devise these mission rules to ensure public safety from any errant launch vehicle incident. This is the primary Eastern Range function.

FOV1 is constantly going through upgrade and development efforts. The fix-it-second development effort was completed in early 2007. The fix-it-third upgrades will be completed in 2008.

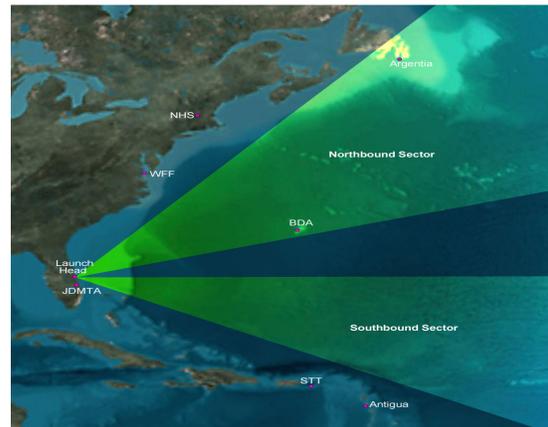


Eastern Range Instrumentation Update

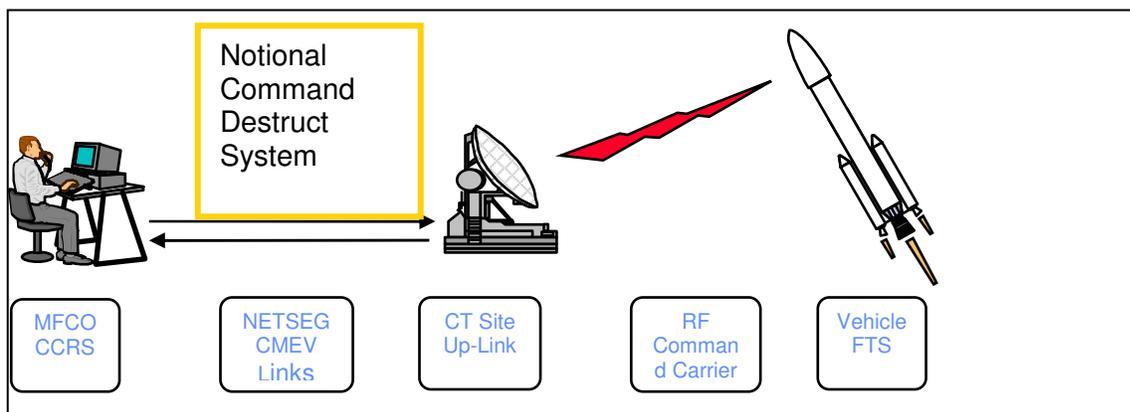
Command Destruct System

During launch operations, the 45th Space Wing is responsible for and ensures public safety through the use of a network of ground-based command destruct systems and vehicle-based flight termination systems. The two Eastern Range launch corridors are supported by downrange command transmitter sites that are geographically located along the flight path trajectory. This provides positive vehicle control throughout powered flight or orbit insertion.

The Mission Flight Control Officer monitors real time vehicle performance from the FOV Range Safety displays. (See right) If a vehicle anomaly violates mission flight rules, the Mission Flight Control Officer initiates flight termination commands to the vehicle flight termination system by activating the central command remoting system (CCRS) located in the Range Operations Control Center.



The central command remoting system generates and formats the digital command messages, then transmits the message to the applicable command transmitter (CT) site. The site then re-formats the message and uplinks the message to the vehicle. This is accomplished by the use of high power transmitters that generate a radio frequency carrier wave that is received by the vehicle flight termination system (FTS). The graphic below shows how the command destruct system works.



The command destruct ground system is constantly going through upgrade and development efforts. The 45th Space Wing Safety Office monitors all development activity to ensure this instrumentation meets or exceeds system requirements.

Eastern Range Instrumentation Update

Post-Detect Telemetry System

The premier Eastern Range launch vehicle telemetry acquisition system is the post-detect telemetry system. This system provides transport of digital post-detect telemetry data from Eastern Range telemetry sites via the Network CORE System Wide Area Network Interface Units and the microwave and commercial circuits from Jonathan Dickinson Missile Tracking Annex.



Post-detect telemetry system sites include Tel-4 at Kennedy Space Center (shown at left), Jonathan Dickinson Missile Tracking Annex, Wallops Flight Facility, Antigua, and Ascension. The post-detect telemetry data is transported to the launch customer facilities and the Range Operations Control Center (FOV1) for range safety purposes.

In 2006, the developer updated post-detect telemetry system software to Version 3.1 to provide resolution of deficiency reports generated before post-detect telemetry system initial acceptance.

INTEL SATCOM System

The INTELSAT SATCOM system now consists of two separate SATCOM strings: A Side and B Side. SATCOM A provides the transport for the post-detect telemetry system telemetry data.

This new digital communication transport service is the Eastern Range secondary telemetry and transport management system circuit transport carrier from the downrange stations of Antigua and Ascension to the Range Operations Control Center. The control center antenna is shown at right.



Wide Area Network Interface Units

The Network CORE Wide Area Network Interface Units facilitate the transport of data to Range Safety and telemetry data end users. The CORE provides the communication backbone at Cape Canaveral Air Force Station. The CORE consists of four rings, two OC-48 (2488 megabits per second) and two OC-12 (622 megabits per second). The communication link to NASA is through the Launch Operations Control Center. The primary nodes are the Range Operations Control Center, XY Facility, Southwest Terminal Building, and the East Terminal Building.

Central Telemetry Processing System

The central telemetry processing system is used for the processing, distribution, and display of

Eastern Range Instrumentation Update

Range Safety telemetry data during the powered flight portion of Eastern Range launches. Post-detect data streams into the central telemetry processing system where it undergoes frame synchronization and decommutation. The resulting telemetry parameters are used to generate 4.8 kilobits per second range safety outputs. This 4.8 kilobits per second data is forwarded to the FOV1 system for further processing and display.

Replacing the Cyber 860 Mainframe Computers

Many pre- and post-launch analysis products are produced at the Cape Central Computer Complex. For over 20 years, the Eastern Range has depended on Cyber 860 mainframe computers at the Central Computer Complex to produce launch critical and instrumentation analysis and Range Safety flight analysis. These computers and the code that resides in them are outdated in that the hardware is very costly to maintain and software problems are too difficult to fix. Two projects are in progress to replace the 860 Cyber mainframe computers.

Launch Analysis Production System. The launch analysis production system project is slated to replace Cyber 860 instrumentation analysis. The project is translating instrumentation analysis computer programs originally written in CDC Cyber FORTRAN to C++ programs that can be hosted on a standard personal computer. The project started in April 2005 and is scheduled to have the instrumentation analysis programs functioning by mid-2008. Most of the launch area production system hardware has been installed. Combined developmental and operational testing is underway.

Safety Hazards Analysis and Risk Processing. The safety hazards analysis and risk processing project is slated to replace Cyber 860 flight analysis automation. The project is re-hosting the CDC Cyber FORTRAN flight analysis programs primarily using MATLAB and C++ for computations and Java for the graphical user interface. This system will have open system architecture to allow incorporation of innovations in processor speed and storage capacity without major redevelopment. New commercial off-the-shelf software can be incorporated as "add-on" tools. The architecture will also accommodate the latest built-in analytical tools.

Safety hazards analysis and risk processing is a two-phased project. Phase 1 provides the host computer, backup storage, version control tools, and in initial suite of flight analysis modules. These Phase 1 products will eliminate 45th Space Wing reliance on the Cyber mainframes to produce flight analysis launch support products. Phase 1 software modules will enable flight analysts to process range user and weather data to produce range safety display backgrounds and range safety risk-based products for launch day support. Phase 1 development was completed on schedule in October 2007.

Phase 2 is underway and will provide contractor support for operational acceptance of Phase 1, flight analysis enhancements that were not previously possible due to Cyber 860 limitations and documentation for an organic software maintenance capability. Operational acceptance is scheduled for March 2008. Phase 2 will continue until the end of 2008.