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QUARTERLY LAUNCH REPORT

Special Report:

U.S. Launch Range Modernization Programs

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Special Report

U.S. LAUNCH RANGE MODERNIZATION PROGRAMS

The United States' launch ranges are experiencing considerable growth in commercial and government launch activities. The years 1997 and 1998 witnessed the greatest number of launches from the federal launch ranges yet. In 1998, the total number of commercial and FAA-licensed launches from U.S. launch sites surpassed launches for government purposes for the first time in U.S. space history. Commercial satellite services are now driving demand for launch services worldwide. Such demands have resulted in the U.S. launch industry facing greater challenges from its foreign competitors.

As a result, the national security, civil, and commercial sectors have reached consensus that the United States launch infrastructure and technologies have not kept pace with the changing launch business. Much of the equipment and systems at the ranges (such as tracking radars, telemetry systems, and fixed optical systems) were installed in the 1950s and 1960s and are still used today. It is widely acknowledged that the rapid reconfiguration of the launch ranges from one launch to the next is a much needed capability. Realizing this capability is frustrated by out-of-date technologies and an architecture not equipped to handle the continuing changes in space transportation. This capability is an important element to accommodating future commercial launch demands.

The United States space launch ranges (see Figure 1) are undertaking a series of programs to upgrade and modernize. Before 1993 Improvement and

Figure 1: The U.S. Spacelift Range System

Modernization (I&M) of the ranges was handled by the individual ranges on an ad hoc basis without the requirement to maintain commonality between ranges. In 1993, the U.S. Air Force began a new program called Range Standardization & Automation (RSA). This $1.6 billion program is anticipated to fully modernize the U.S. space launch ranges by 2006. In addition to hardware and software upgrades, the RSA program is intended to standardize range operations, hardware, and software between the ranges for common operations. A follow-on contract called Spacelift Range Systems Contract (SLRSC) will complete U.S. range modernization by transferring all responsibilities for I&M, integration, systems engineering, sustainment, and configuration management under one contract. The SLRSC contract is currently in the request for proposal (RFP) phase and is expected to be awarded in March, 2000.

THE UNITED STATES LAUNCH RANGES

The United States Air Force Space Command (USAFSPACECOM) is responsible for operating and maintaining many portions of the United States' launch range infrastructure. Although this infrastructure was created to support mostly military space missions, the USAFSPACECOM today also supports civil and commercial launches.

The U.S. launch infrastructure is physically divided into two "ranges," an Eastern Range (ER) and a Western Range (WR). The primary mission of the ranges is to support the Department of Defense spacelift operations. Secondary missions include providing support to civilian and commercial spacelift operations, ballistic missile testing, aeronautical operations, and space surveillance.[1]

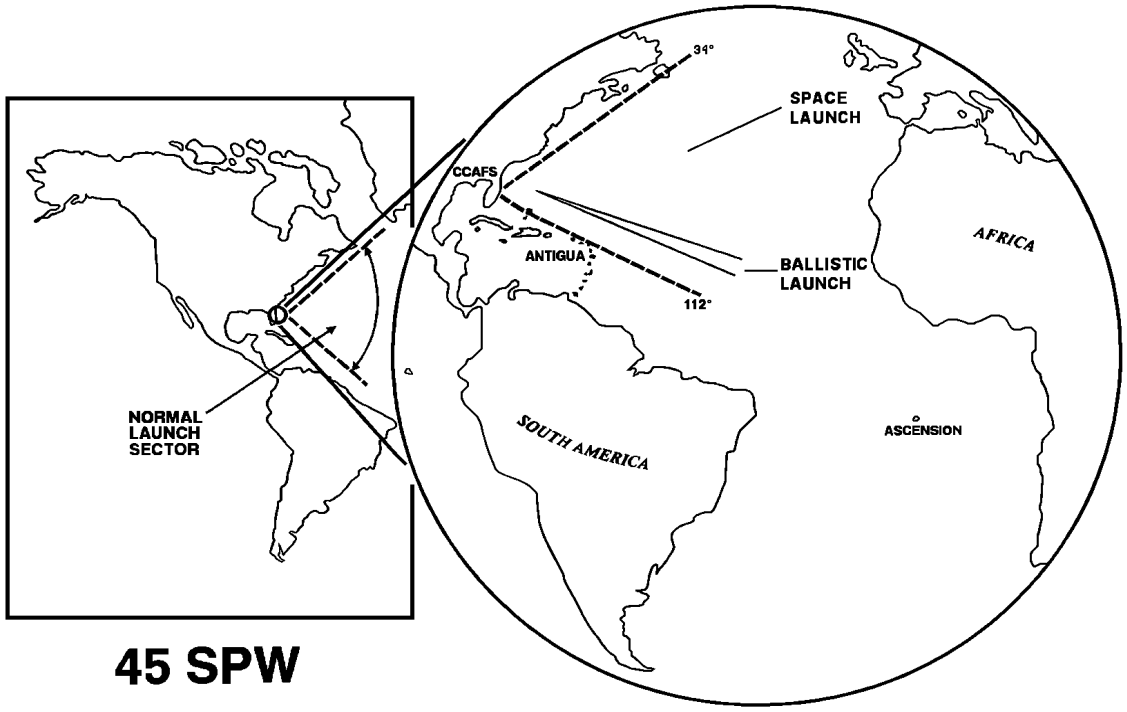

Figure 2: The U.S. Eastern Range and 45th Space Wing

[1] Source: Statement of Objectives for the Spacelift Range System Contract http://www.dwsc.stai.com/slcsacq/RFP/SOO_20_May99.htm

To accomplish these missions safely, the ranges have installed a complex system of radar and optical instrumentation, telemetry equipment, devices to monitor the weather and surrounding airspace and waterways, command and destruct capabilities, as well as facilities to process, integrate, and disseminate all the data generated by these systems.

The Eastern Range (managed by the 45th Space Wing at Patrick Air Force Base, see Figure 2) extends from Argentia in Newfoundland to Ascension Island in the South Atlantic Ocean. The Eastern Range consists of Cape Canaveral Air Station, Kennedy Space Center, and Spaceport Florida.

The Western Range (managed by the 30th Space Wing at Vandenberg Air Force Base, see Figure 3) provides uprange support by radar, telemetry, and optical sensors located at Vandenberg Air Force Base, Pillar Point Air Force Station, as well as Anderson Peak, and Santa Ynez Peak. The Western Range supports launch activities from Vandenberg Air Force Base and Edwards Air Force Base (both in California).

Both ranges also provide occasional support to launches from other U.S. launch sites such as NASA's Wallops Flight Facility and U.S. commercial launch facilities.

Collectively, the two launch ranges are referred to as the SpaceLift Range System (SLRS). The official functions of the SLRS include:[2]

- Protecting people, property and environment;
- Collecting, processing and distributing data for safety, test and evaluation, and command and control;

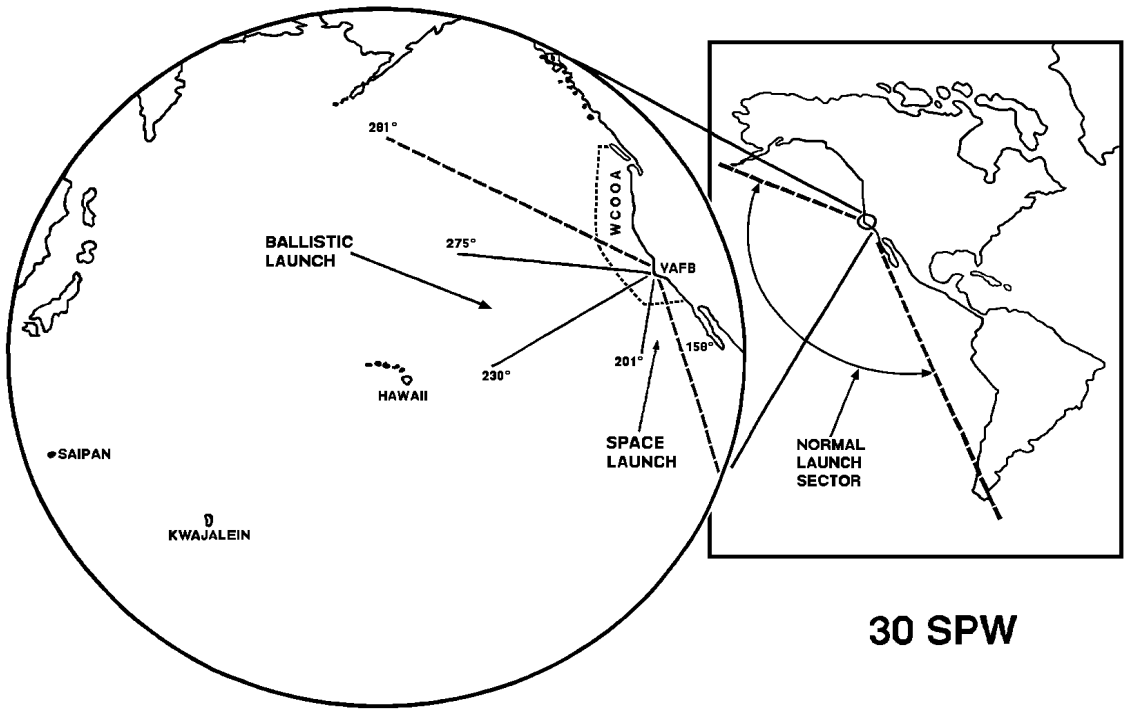

Figure 3: The U.S. Western Range and 30th Space Wing

[2] Satellite and Launch Control Systems Fact Sheet (U.S. Air Force); http://www.laafb.af.mil/SMC/PA/Fact_Sheets/cw_fs.htm

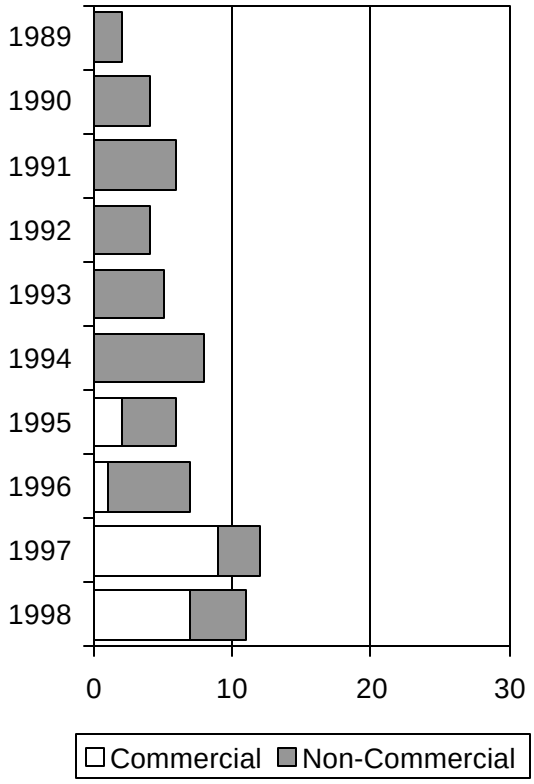

Figure 4. Launches by the Western Range sites, 1989 through 1998 (includes Vandenberg Air Force Base and Pegasus launches staged from Edwards Air Force Base); note: "Commercial" launches includes all launches licensed by FAA

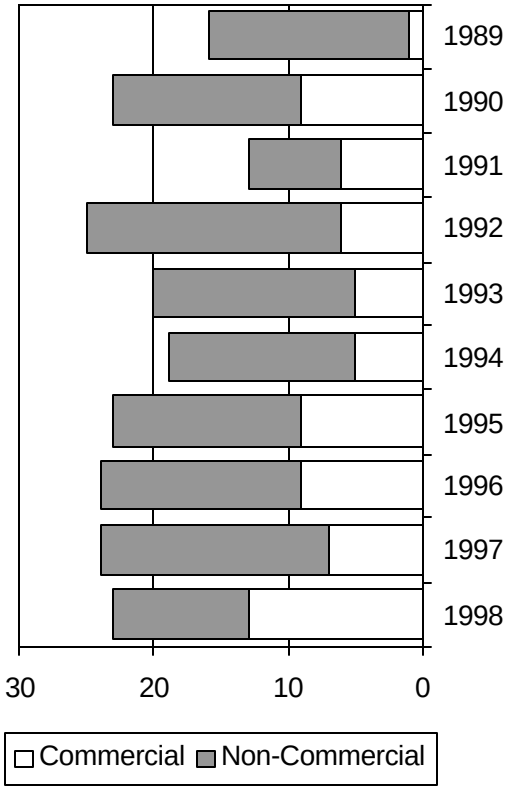

Figure 5. Launches by the Eastern Range sites, 1989 through 1998 (includes Cape Canaveral Air Station, Spaceport Florida, and Kennedy Space Center); note: "Commercial" launches includes all launches licensed by FAA

- Providing communications between instrumentation sites, control centers, and outside ranges, facilities and organizations;
- Supporting military, civilian and commercial sub-orbital, orbital and interplanetary launches;
- Testing and evaluating ballistic missiles, guided weapons and aeronautical programs; and
- Providing excess radar capacity to the space surveillance network.

CHANGING LAUNCH RANGE REQUIREMENTS

The Cape Canaveral and Vandenberg launch sites conduct the majority of United States launch activities today and support both commercial and U.S. Government launches. The Western Range and Vandenberg Air Force Base conduct polar LEO launches for the U.S. government, as well as commercial launches of LEO satellites such as the Iridium system. The Eastern Range conducts all launches to GEO, typically from Cape Canaveral, in addition to a variety of LEO missions for remote sensing and commercial LEO satellites.

The increase in commercial launch rates has placed greater demands on range facilities (see Figures 4 and 5). Last year, commercial and FAA-licensed launches from the Eastern and Western ranges exceeded those of U.S. government payloads for the first time in U.S. space launch history.

The recent deployment of commercial LEO communications satellite systems is the primary driver of the relatively higher commercial launch rates. Of the 17 commercial launches conducted in 1998, for example, ten placed spacecraft in low Earth orbit and seven were to geosynchronous transfer orbit (GTO). Additionally, in the last five years, fourteen new vehicle derivatives were introduced at the launch ranges including a new vehicle family from Lockheed Martin in August 1995 (Athena).

The Eastern and Western ranges were originally built in the 1950s and early 1960s as research and development facilities for early missile programs. The architecture of the ranges and much of the equipment remain basically unchanged to this day. The majority of today's tracking radars, telemetry systems, fixed optical systems, and flight termination command sites were built or acquired in the late 1950s and early 1960s. Nearly 25 percent of the components required for the major range systems are deemed obsolete and have no source of spares.

A survey conducted in 1992 by the Air Force Space Command revealed a lack of responsiveness to changing range demands due to out-of-date technologies, an inefficient infrastructure, as well as an inability to support simultaneous operations.[3]

To accommodate increased launch activities at the U.S. launch sites, the ranges have identified a need for more efficient architectures, greater responsiveness to programmatic and weather changes, and shorter equipment reconfiguration times.

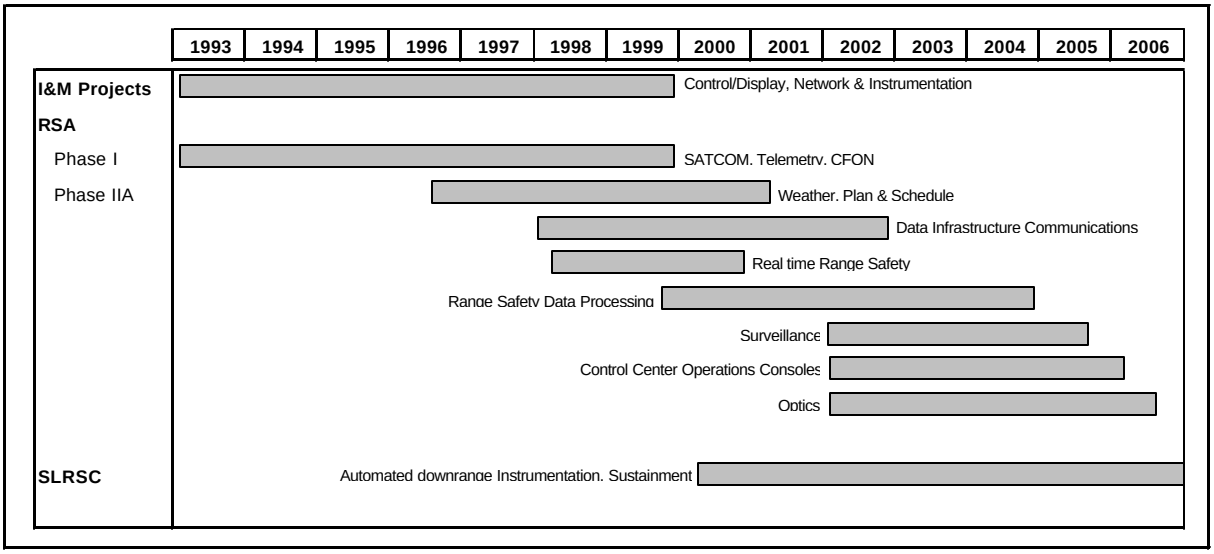

Figure 6. Integrated SpaceLift Range System Modernization Schedule

[3] Moorman, Thomas S., Air Force Space Command, *Operational Requirements Document, Range Standardization and Automation (RSA) ACAT Level II*, July 18, 1994

To bring about these improvements, the Air Force has implemented several range modernization initiatives, largely under the Range Standardization and Automation (RSA) program. The Spacelift Range System Contract (SLRSC) will continue the modernization, consolidating engineering integration and sustainment into one contract, with contract award in early to mid 2000. This contract will finish the process begun with the RSA program by both maintaining and update range assets and organizing operations for more efficient function.

THE RANGE STANDARDIZATION AND MODERNIZATION PROGRAM

The aim of the Range Standardization and Automation (RSA) program, which began in 1993, is to fully modernize the U.S. Spacelift Range System (SLRS) by 2006 (see figure 6). The program is intended to help reduce range costs and turnaround times and to improve range flexibility and responsiveness. It is also intended to replace obsolete 1960s and 1970s vintage telemetry, tracking, command and control, weather, area surveillance, and communications systems with modern and more cost effective systems.

Overall, the RSA program is designed to standardize operations so that the Eastern and Western ranges will operate with common equipment and procedures. It will centralize and consolidate many existing facilities, effectively integrating the capabilities and facilities of the Eastern Range and Western Range into a single launch system with common systems and operations.

By the end of fiscal year 1999, the USAF expects to have spent over $500 million to bring much of the range equipment up to modern standards and will spend over $1.0 billion between fiscal years 2000 and 2006 to complete the program.[4]

The Range Standardization and Automation program is essentially divided into three phases:

- Phase I – automate the communication network at Cape Canaveral and telemetry processing for both ranges
- Phase IIA – focuses on the architecture and integration of the spacelift range system as well as standardizing and automating hardware and software
- Phase IIB - focuses on replacement and automation of the ranges' fixed instruments, i.e., instrumentation and modernization (I&M). This phase will now be completed under the SLRS contract.

One of the key RSA proposals is the change from ground-based radar to GPS-based tracking. This will provide highly accurate launch vehicle time, space, and position information. However, it will also require upgrades to both U.S. range systems and launch vehicles. Once these conversions are complete, the U.S. Air Force projects that it will be able to close 12 range radars, saving over $300M in operations and sustainment costs.[5]

Phase I Program

In 1987, the Air Force funded the first studies for range modernization and, in July 1993, awarded the RSA Phase I contract to Harris Corporation.

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[4] Lt. Gen. Roger Dekok, "Spacelift in and Beyond the Millennium," Launchspace Magazine, May/June 1999, p. 6.

[5] Speech by Lt. Gen. Lord at the Federal Aviation Administration's conference on *Commercial Space Transportation in the 21st Century: Technology and Environment, 2001-2005,* 10 February 1998, at the Key Bridge Marriott Hotel, Arlington, VA

Phase I of the RSA was designed to modernize and automate the communications network at Cape Canaveral, including satellite links for major stations at the Cape. Phase I also provides standardization and centralization of telemetry processing for both Cape Canaveral and Vandenberg Air Force Base.

The communications network segment at Cape Canaveral consists of the Eastern Range Satellite Communications Network, which includes communications hardware, processors and software, and leased capacity on Intelsat Atlantic region satellites to provide high-speed data and voice connection throughout the range. Also part of the network segment is the Cape Area Fiber Optics Network, which provides communication backbone architecture for data, voice and video services. The Network Control Subsystem monitors and displays the status of the range communication assets.

Phase IIA Program

RSA Phase IIA, initiated in 1996, is envisioned to modernize the architecture of the spacelift range system as well as integrate, standardize, and automate range hardware and software. Phase IIA is expected to be completed by 2006 (see Figure 6). It consists of seven separate efforts:

1. Weather, Plan & Schedule - involves weather instrumentation improvements and automated planning and scheduling.
2. Data Infrastructure and Communications - includes fiber optic and LAN communications, a voice and analog video communications net as well as timing services and stable reference frequencies along with a communications interface for remote sites.
3. Real Time Range Safety – involves safety and data processing improvements for standard flight operations and analysis. Network upgrades will include data format updates while the planning and scheduling systems will receive automation enhancements. These improvements will allow for real-time, near real-time and post-mission data products and will also involve an initial simulation capability for testing and training.
4. Range Safety Data Processing: new flight operations software improves range safety.
5. Surveillance - involves improved air, sea, and rail surveillance and radio frequency monitoring.
6. Control Center Operations – benefits from new control center operations consoles.
7. Optics - involving improved optics for fixed and mobile observation systems.

Phase IIB Program

A third phase, Phase IIB, of the RSA program involved complete replacement and automation of the ranges' fixed instruments such as command systems, telemetry systems, and radars. This phase will now be completed under the SLRS contract which seeks to sustain and improve the spacecraft range system.

OTHER RANGE MODERNIZATION PROGRAMS

Prior to 1993, the U.S. launch ranges conducted numerous but functionally independent life extension and technology upgrades to sustain their respective range systems. These projects were conducted under I&M contracts. Other efforts such as the replacement of the range control center at CCAS under the Range Operations Control Center (ROCC) program and the creation of a new consolidated operations center, for the Western Range (the Western Range Operations Control Center or WROCC) have also taken place. In addition to current and future programs and contracts, there are also on-going studies such

as the Air Force Space Command sponsored range integrated product team and OSD-led National Launch Capability Study Team which are examining how the U.S. launch infrastructure can better handle increased launch activities.

I&M contracts have allowed the ranges to focus on those systems with the highest need of upgrade or improvement at each range. Since 1993, the Spacelift Range Systems Contract, I&M efforts have been gradually moving towards a more coordinated system of managed modernization. The Spacelift Range Systems Contract assumes I&M responsibilities at the ranges after the 2000 contract award.

The Range Operations Control Center (ROCC) program was designed to consolidate and upgrade many of the systems at Cape Canaveral involved with range safety and range control, range scheduling, weather, electronic security, and data processing systems associated with pre-test and post-test flight analysis. The ROCC had to be developed and installed without disrupting on-going launch activity at the range. The first study contract was awarded in 1987 concluding in the operational ROCC in March 1995.

At the Western Range a new consolidated operations center, the Western Range Operations Control Center (WROCC) has been under construction since May 1998 with completion planned in February 2000. Similar to the ROCC, the WROCC will involve increased automation and centralized command as well as contributing to range standardization under the RSA.

The Air Force Space Command (AFSPC) sponsored range integrated product team (IPT) was formed to address issues raised at the AFSPC December 1997 Commercial Space Industry Leaders' Conference. The range IPT was chaired by retired Lt. General Dick Henry. Issues included range capacity and equipment reconfiguration time, modernization programs, government/commercial interfaces and the long-range plans for the ranges.

The congressionally directed National Launch Capability Study (NLCS) is an interagency working group led by the OASD (OSD C^3I). The working group is comprised of members from the Air Force Headquarters, Air Force Space Command, NASA, FAA's Associate Administrator for Commercial Space Transportation, the Department of Commerce, and the Joint Staff. The working group is examining domestic launch needs and the domestic launch capacity to meet those needs.

A major effort to rationalize United States range operations falls within the Spacelift Range System Contract (SLRSC) which will finish the process started under the RSA program by centralizing both maintenance and ongoing range improvements into a single contract for more efficient future operations.

SpaceLift Range System Contract (SLRSC)

The Spacelift Range System (SLRS) contract is the continuation of the RSA program implementation. Its program objective is to modernize instrumentation, sustain and improve the Spacelift Range System while reducing its total cost of ownership through a single systems contract for sustainment, integration, and development.

The specific SLRSC objectives are to:

1. Complete transition of depot maintenance responsibilities to the SLRSC within phase-in period without impacting operational readiness.
2. Use disciplined systems engineering approaches to sustain and improve the existing range system and integrate new SLRS components. Achieve seamless interface and activation of products delivered by this contract and any other contracts with the existing range. Improve range reliability, maintainability, and availability while reducing life cycle costs.
3. Improve range reliability, maintainability, and availability while reducing life cycle costs.
4. Establish an integrated configuration baseline system and process. Establish a single entity for SLRS integration and architecture services.
5. Modernize and integrate the Instrumentation Segment assets to include fixed and mobile optics, telemetry, command, radar, surveillance, and remaining weather systems.

The SLRSC is the vehicle by which the United States will achieve an up-to-date launch infrastructure for the next century. It is intended to improve upon the advantages initiated by the RSA program. The RFP for the SLRSC contract was issued in May 1999 with proposals due by the end of October 1999 and the contract award scheduled for March 2000. Details of the transition between RSA and SLRSC are still to be decided.