

12.0 MISSION ASSURANCE

Overview

Qualification, acceptance, quality, safety and reliability are all subject to careful and systematic scrutiny and oversight of the Sea Launch Mission Assurance organization. The Sea Launch Mission Assurance organization is the independent overseer of all Sea Launch processes and activities that effect mission success. Mission assurance is a continuous effort that starts with the acceptance of qualified hardware and continues through the mission post-flight review and the implementation of corrective actions. Through these activities, Mission Assurance ensures that the Sea Launch system, and specifically launch vehicle reliability, is maintained through a controlled set of established processes and procedures.

Mission Assurance Organization

Organization of Sea Launch Mission Assurance represents the culmination of years of effort to blend the best practices of Boeing and other U.S. companies, European companies, and companies from Russia and Ukraine. Figure 12-1 indicates the system of checks and balances in place for the review process. Each partner and contractor conducts its initial reviews according to its own established and proven processes and Sea Launch then performs an oversight supervisory evaluation of those processes. This disciplined approach of multiple independent layers of checks and verifications results in superior quality controls, which leads to higher probability of mission success.

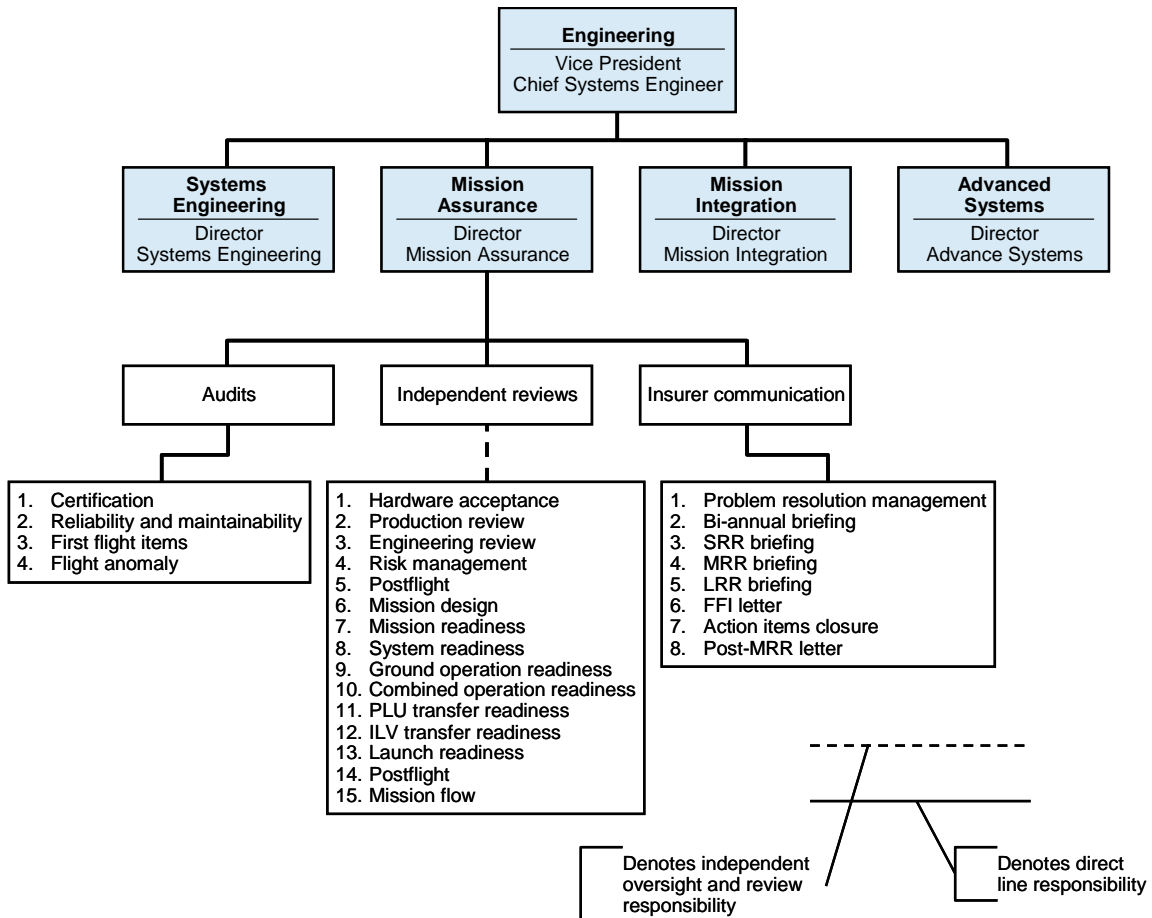


Figure 12-1. Sea Launch Mission Assurance

Customer Participation

An essential part of Sea Launch mission assurance is the involvement of the customer in the mission assurance process. The purpose is to understand all customer concerns and to assure the customer that everything reasonably possible is being done to assure mission success. Sea Launch welcomes and encourages the customer’s involvement. Sea Launch also provides formal written reports to the customer and its insurer.

Qualification Status

The Sea Launch mission assurance methodology starts with the acceptance of qualified flight-proven hardware from Sea Launch partners and suppliers. All hardware used in a mission passes qualification through analysis, similarity to other flight vehicles, and qualification through testing. During the development of the hardware and through its subsequent testing, Sea Launch assures that the integrated launch vehicle components are qualified to levels during flight with significant margins of safety. The successful flights of the Sea Launch system and its record of on-time, accurate spacecraft insertion is evidence of Sea Launch's thorough system qualification process.

Hardware Acceptance

Each set of campaign hardware is accepted in compliance with the Sea Launch acceptance plan that sets forth the verification process for acceptance of flight hardware and assurance of conformity to all Sea Launch specified requirements.

The Sea Launch hardware acceptance team conducts a thorough, independent review of flight hardware non-conformance reports and key acceptance test results, and physically inspects the hardware in the factory. Upon completion of hardware acceptance, Sea Launch certifies the hardware for its designated mission or other purpose.

The Sea Launch Chief Systems Engineer typically assigns hardware to a specific mission seven months prior to launch.

Launch Vehicle Certification

Launch vehicle certification is an essential element of mission assurance. The responsible contractors certify each launch vehicle segment prior to Sea Launch acceptance. This certification process, shown in Figure 12-2, uses a bottom-up approach wherein subsystem testing and certification are followed by system-level, stage-level and finally, the fully integrated launch vehicle testing and certification.

Configuration management is also an essential element in the acceptance process. Sea Launch partner contractors Energia and Yuzhnoye use their own traditional, established system of records called "technical passports" to track each subsystem, system and element under their authority. The technical passport is the pedigree of the processes and procedures performed at the partners' sites. The technical passport travels with its respective component during each stage of production in the factory.

Certification method	Documentation	Production
Components <ul style="list-style-type: none"> • Qualification tests • Acceptance tests • Independent quality review 	Passports	<div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 5px; width: 20%;"> <ul style="list-style-type: none"> • Biser-3 • Accelerometers • Gyroscopes • Engines • Tanks </div> <div style="border: 1px solid black; padding: 5px; width: 20%;"> <ul style="list-style-type: none"> • Biser-3 • Accelerometers • Gyroscopes • Engines • Tanks </div> <div style="border: 1px solid black; padding: 5px; width: 20%;"> <ul style="list-style-type: none"> • Batteries • Separation joint • Processors • SC adapter </div> </div>
Sea Launch/Boeing hardware acceptance review <ul style="list-style-type: none"> • Acceptance tests • Independent quality review 	Passports	
Integrated launch vehicle <ul style="list-style-type: none"> • Interface verification tests • Integrated functional checkout • Sea Launch review and acceptance 	Certification of mission readiness	

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Figure 12-2. Sea Launch Hardware Certification and Acceptance Process

**Sea Launch
Quality Assurance
Program**

It is the policy of Sea Launch to systematically integrate quality into everything we do, individually and collectively, through all mission phases, from identification of market needs to final satisfaction of customer and regulatory requirements.

The Sea Launch Quality Management System is process-based. It is a results- and improvement-oriented, customer-focused approach to building confidence in our systems while identifying and validating improvements and creating and maintaining customer satisfaction.

Objectives of the Sea Launch Quality Management System are:

- Customer expectations are clearly understood and are achieved or exceeded
- Program processes deliver safe, on time and flawlessly executed launches for every customer, every time
- Sea Launch team members have defined, documented and released procedures for all aspects of their work and scrupulously follow these procedures in the performance of the work
- Assurance that the proper level of quality oversight is applied to critical processes and operations
- Rigorous development and maintenance of documented history of all required activities
- Establishment of appropriate metrics to track achievement of these objectives, identify weaknesses, and measure progress to improve our processes and systems

Sea Launch management provides the leadership, resources, process management, training and environment necessary to ensure that each Sea Launch employee has ownership, personal responsibility and accountability for the quality of their work. This includes the capability to control and continuously improve the quality of their processes and services and a full understanding of the metrics by which their performance is evaluated.

It is the responsibility of every member of the Sea Launch team to ensure the quality and integrity of our processes and to seek innovative ways to improve our methods in order to deliver safe, on-time, cost-effective and flawlessly executed launches to every customer, every time.

**Sea Launch
Quality Oversight**

In addition to the Sea Launch Quality Assurance Program for Sea Launch hardware and operations, Sea Launch maintains oversight and insight into the quality programs of its partner companies.

- RSC Energia is ISO 9002 Registered, utilizes an internal quality group and on-site government quality inspectors, and upholds CIS Government (GOST) standards.
- BCSC is ISO 9001 Registered, utilizes an internal quality group and Boeing independent quality inspectors, and upholds Boeing Quality processes.
- SDO Yuzhnoye provides engineering oversight, while the Yuzhmash quality group oversees production. Yuzhmash utilizes on-site government quality inspectors, and upholds CIS Government (GOST) standards.

Sea Launch Mission Assurance supported by Sea Launch Quality Assurance ensures these high quality standards are upheld through hardware acceptance reviews at the factory and thorough quarterly production reviews.

Reliability

The predicted and demonstrated reliability of the Zenit-3SL is comparable with that of other heavy-lift launch vehicles. The high reliability of the Sea Launch system is the result of years of evolved problem solving, enhancements and best practices for both Zenit stages and the Block DM. The Block DM-SL upper stage and Zenit-2S each have minor modifications to adapt them for use within the Sea Launch system. Please contact your Sea Launch representative for the current reliability estimates.

**Reliability
Subsystems and
Components**

Zenit-3SL reliability is enhanced by the use of mature subsystems and components, the extensive use of redundancy for fault tolerance in mission-critical areas, ample design parameter margins (e.g., strength, stability and propulsion), manufacturing quality monitoring, and extensive testing of flight hardware.

**Anomaly
Resolution System**

The Sea Launch anomaly resolution system, based on the existing Boeing failure review, analysis and corrective action system (as used on several integrated air vehicles and avionics platforms), has been established along with a system database. The anomaly resolution system is in place to acquire and assess off-nominal history, criticality and effectiveness of changes, and to be used as a database from which recommendations can be validated. The anomaly resolution system is also used to gather data on test and flight failures, design changes, test results and repair decisions. All in-flight anomalies are dispositioned prior to launch. Details of such anomalies are typically shared with the current and subsequent launch customer.

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