

8.0 PRE-ENVIRONMENTAL REVIEW (PER)

At the PER, the project discloses to the Integrated Independent Review Team (IIRT) the complete and comprehensive project status in order to justify readiness to proceed with environmental testing of the integrated flight system and to demonstrate that the project is on track to complete the flight and ground system development and mission operations in order to fully meet mission performance requirements within allocated cost and schedule resources.

8.1 Purpose

The purpose of the PER is to demonstrate readiness to proceed with environmental testing of the integrated flight system and to demonstrate that the project is on track to complete the flight and ground system development and mission operations in order to fully meet mission performance requirements within allocated cost and schedule resources. To that end, the project demonstrates that a requirements-compliant flight system design has been fabricated, appropriately tested at lower levels of assembly, integrated, and subjected to a successful comprehensive systems test. In addition, adequacy of planning for subsequent flight system activities, satisfactory progress on development of other system elements, and adequacy of available resources to complete remaining project activities shall be demonstrated.

8.2 Timing

The PER is held after completion of the initial successful comprehensive systems test of the fully-integrated flight system and prior to initiation of the system level environmental test sequence. When scheduling the review, the project should highlight and discuss with the review chairperson(s) any extenuating circumstances or problem areas that may deserve consideration regarding timing of the review or composition of the review team.

8.3 Objectives

The objectives of the PER are to demonstrate that: (a) all supportive flight system design analyses have been successfully completed and demonstrate adequate margin, (b) all lower level flight system verification activities have been satisfactorily completed and all discrepancies are sufficiently understood to warrant proceeding, (c) initial flight system comprehensive performance testing has established a valid performance baseline that complies with requirements, (d) planning is adequate for all remaining flight system activities, (e) development of all other flight system elements (e.g.: launch vehicle, ground system, data processing and analysis system) is satisfactory, and (f) available cost and schedule resources support completion of all necessary remaining activities with adequate margin.

The PER should present a complete and comprehensive status of the final system with emphasis on changes to requirements and to the design since CDR. It should trace all fabrication and lower level verification activities with emphasis on discrepancies and their resolution. It should detail

the composition and results of the comprehensive system test. It should detail all remaining project activities and detail status of all other mission system elements.


Programmatic considerations shall be discussed in sufficient detail to permit assessment of relevant review objectives.

Specifically, the areas listed below shall be addressed in sufficient detail to permit a judgment by the IIRT regarding accomplishment of review objectives. That judgment will be guided by attainment of the expectations delineated in the following section:

- a. Requirements / Design Update
- b. Completed Verification Activities
- c. Risk Management
- d. Safety
- e. Assurance Activities
- f. System Test Activity
- g. Launch Site Activities
- h. Launch Vehicle Interfaces
- i. Mission Operations
- j. Programmatic
- k. Project and Independent Review Activity

8.4 Criteria for Successful Completion

8.4.1 Requirements / Design Update:

- a. Requirements and design changes to hardware or software since CDR and attendant rationale are documented. As required, ICDs have been updated and approved. Resultant changes to verification matrix have been incorporated and approved.
- b. Current status of compliance with the Goddard Rules (GSFC-STD-1000) reflects adequate progress of activities to date and satisfactory plans for future activities. Any required waivers / deviations have been approved.
- c. Changes since CDR to heritage applicability or resultant verification thereof have been documented and approved.
- d. Current calculations of all critical resource margins are adequate and based on actual measured values. 

8.4.2 Completed Verification Results:

- a. Current calculations for systems performance are fully compliant with requirements.
- b. Completed analyses of current design demonstrate adequate margin for:
 - o mechanical loads, stress, and torque margin,
 - o thermal effects,
 - o radiation protection, and
 - o expected lifetime of limited life items.
- c. Results of ETU testing since CDR are documented. The design reflects the results.

- d. Life testing of limited life items is complete and the design appropriately reflects results.
- e. Results of all hardware and software verification activities below the fully integrated flight system level are successfully complete, including those associated with compatibility of units of measurement. The project verification matrix documents the results of such.
- f. All discrepancies (non-conformances, anomalies, failures, “cannot duplicate”s, etc.) are fully explained and justify proceeding to subsequent activities. All waivers are approved.
- g. A fully successful Comprehensive Performance Test of the fully integrated flight system has been completed. All discrepancies are fully explained and justify proceeding to subsequent activities.

8.4.3 Safety:

- a. Hazards and control methods have been defined and approved.
- b. Verification of controls is on-track.
- c. Required documentation is complete. Timely updates are scheduled.
- d. Appropriate interaction with test facilities, the launch range, and the launch vehicle is on track.
- e. End-of-life scenarios are fully approved.

8.4.4 Risk Management:

- a. All development related risks are fully retired and associated residual risk is approved.
- b. Risks associated with remaining activities are defined and credible mitigations will retire risks in a timely fashion.
- c. Lessons learned have been appropriately researched and adapted.
- d. A credible plan for utilization of limited life items and consumables (e.g.: cryogenic fluids, pyrotechnics, batteries, mechanisms) has been approved.

8.4.5 Assurance Activities:

- a. Appropriate reliability analyses have been updated.
- b. Quality Assurance planning for all subsequent activities are complete and approved.
- c. All discrepancies have been reviewed for acceptable closure. Any items requiring special attention or monitoring during subsequent activity have been identified and appropriate action planned.
- d. EEE parts and materials related qualification tests are successfully completed.
- e. Any waivers are approved.
- f. IV&V activities are successfully completed.

8.4.6 System Test Planning:

- a. Planning for Integrated Systems Test activities is complete and includes sufficient activity devoted to science validation and calibration, and operations compatibility testing.

- b. Adequate systems performance testing is planned during and between environmental exposures so as to ensure adequate functionality or uncover any deviations. Adequate testing of primary and redundant elements is planned.
- c. Sufficient operating time (including failure-free operating time) will be obtained. Critical parameters to be trended throughout the system test sequence are defined.
- d. A comprehensive environmental test sequence at appropriate exposure levels is planned that will complete all remaining required verification activities.
- e. Facility readiness reviews have been completed. Resultant actions are on track for timely completion. Handling equipment and test equipment are qualified and ready for use.
- f. Contamination control plans and required equipment are in place and compliant with requirements.



8.4.7 Launch Site Activities:

- a. Transportation plans are fully defined. Shipping containers, handling equipment, environmental control and monitoring equipment are complete and available. Qualification activities are on track.
- b. Launch site activity plan is approved and includes appropriate comprehensive system performance testing.
- c. Facilities are available for use. Support requirements, including contamination control, will be met.
- d. Ground handling and support equipment are qualified and available.

8.4.8 Launch Vehicle Interfaces:



- a. An approved up-to-date ICD is in place.
- b. First flight/mission unique items have been qualified for use.
- c. Launch vehicle related risk items are retired. Residual risks are approved.
- d. Vehicle Orbital Debris Assessment has been approved.
- e. Integrated payload/launch vehicle activity flow has been approved.
- f. Schedule of all vehicle/payload inter-related activities has been approved.
- g. An updated coupled loads analysis has been completed.

8.4.9 Mission Operations:



- a. Mission operations plans are complete for all routine and contingency scenarios.
- b. Mission operations systems are complete and available.
- c. Operations team staffing needs are fully defined. Staffing will be available to support simulations.
- d. Planning for involvement and training of launch site and of mission operations teams are defined.
- e. End-to-end operational simulations of flight and ground mission systems by actual operations team are planned and include launch and early orbit, routine science data acquisition, contingency, and end-of-life scenarios.

8.4.10 Programmatic:

- a. Organization and staffing plans delineate clear responsibilities and adequate assignment of current and future staff.
- b. Appropriate processes and metrics are in place to track and control cost, schedule, and technical activities throughout the remaining life-cycle.
- c. Appropriately detailed schedules show realistic event times as well as appropriate funded slack and are compatible with approved launch dates.
- d. Cost to complete shows adequate spending profiles and financial reserves, and is compatible with allocations.

8.4.11 Project and Independent Review Activity:

- a. Timely response to RFAs from previous IIRT reviews has occurred. Resultant actions have been implemented effectively. Schedule for completion of any outstanding RFAs is defined.
- b. An appropriate set of engineering peer reviews has been conducted and documented in compliance with GPR requirements. Resultant actions have been effectively dispositioned and executed. Appropriate additional reviews are planned.
- c. Recommendations from other project or external review activity that is applicable to the subject matter of the PER have been adequately implemented.

8.5 Results of Review

It is recognized that projects may not fully satisfy all of the above criteria at the time of the PER. Subsequent to the review, therefore, the review chairperson(s), in consultation with the review team, will assess the degree to which the above criteria have been met, the criticality of the areas where there are shortfalls, how straightforward and likely to succeed are the project's recovery plans, and other relevant factors in making a judgment as to whether the MCR has accomplished its objectives and has been successfully completed. Successful completion may be contingent on the responses to some or all of the RFAs generated at the review. In some cases a delta PER may be required.

Successful completion of the PER constitutes readiness to proceed with environmental testing of the flight system.