

# Solar Probe Plus

*A NASA Mission to Touch the Sun*



## Integrated Science Investigation of the Sun Energetic Particles

### Preliminary Design Review

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## Verification

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# Verification - Outline



- Documentation
- Verification Process Definition
  - Verification Program Concept
  - Verification Program Planning
  - Verification Methods
  - Requirements Verification Matrix
  - Verification Process
- Performance Requirements
- Environmental Requirements
- Interface Requirements
- Assurance Requirements



# Documentation



SPP System Verification and Validation Plan, 7434-9099  
ISIS Verification and Validation Plan, 16105-ISIS\_VVP-01

- These documents define the Verification Process:
  - Verification Program Concept
  - Verification Program Planning
  - Verification Methods
  - Requirement Verification Matrix
  - Verification Process





# Verification Process Definition



## Verification Program Concept:

- ISIS instrument requirements verification is part of the overall SPP verification campaign.
- EPI-Lo requirements will be verified by APL.
- EPI-Hi requirements will be verified by Caltech.
- Tracking of all ISIS requirements verification will be performed by the ISIS Systems Engineer, reporting to the SPP Requirements & Verification Engineer.



# Verification Process Definition



## Verification Program Planning:

- Verification and Validation Plans produced before PDR.
- Test and Calibration Plans, inputs for I&T before CDR.
- Test, Verification and Calibration reports generated throughout all pre-launch phases.



# Verification Process Definition



## Verification Methods:

- Test

Most requirements should be verified by test or supported by quantitative test data.

- Analysis

Some requirements cannot be verified by test (e.g. due to cost or physical limitations) or may not be fully verifiable by testing alone.

- Demonstration

Applied to some qualitative requirements that cannot be easily tested or requirements that cannot be tested over a full range of relevant scenarios.

- Inspection

Used to verify a design characteristic or method or where a requirement may be satisfied solely by the review of documentation.

Every requirement must be verified by one or more of the above methods.



# Verification Process Definition

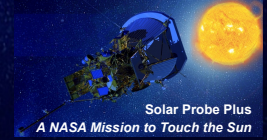


## Requirement Verification Matrix:

- Tracking of verification by means of matrices containing:
  - Requirement reference number
  - Requirement Description
  - Verification Method: one or more of Test, Analysis, Demonstration and Inspection
  - Verification Activity
  - Closure Status: closed, open, waived, deferred, etc.;
  - Closure Date
  - Responsible Organization
  - Comments



# Verification Process Definition



## Verification Process:

- Development of Verification Procedures
  - Procedures approved by the design engineer, the systems engineer, the project manager, and QA and released prior to execution.
  - Will comply with the format requirements and configuration control authority of the originating agency (APL, Caltech, or SwRI).
- Performance of Test Readiness Reviews
  - Required before installing flight hardware into a test environment.
- Test Execution
  - Test engineer assigned
  - QA participation
  - Equipment calibrated before test
  - Test procedures under document control





# Verification Process Definition



## Verification Process continued:

- Post-test Reviews

- Test results are reviewed and approved by the ISIS SE to ensure adequate verification of requirements.
- All hardware non-conformances or failures shall be documented.
- Any corrective actions identified shall be processed by the cognizant engineer and elevated as appropriate.
- For any test failure, the reason must be identified.
- Hardware under test / test setup must not be disturbed in any way that prohibits duplication of a test failure.
- The post-test review will result in a “pass” or “fail”.

- Completion of the Verification Matrix

- Verification is tracked by entering data into the Verification Matrix.



# Verification Process Definition

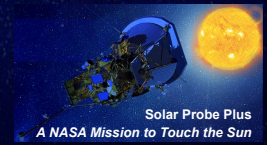


## Verification Process continued:

- Requirement Closure
  - A requirement will be declared “closed” when all verification activities planned for and associated with the requirement have been completed satisfactorily.
- Waivers and Deviations
  - In cases where it may be acceptable that a requirement is not met, a waiver or deviation will be filed with the JHU/APL SPP Project Office, and NASA Goddard Program Office, as appropriate.
  - The SPP waivers and deviations process is documented in the SPP Configuration Management Plan, 7434-9006.
  - All hardware non-conformances or failures shall be documented.



# Performance Requirements



Performance requirements are defined in:

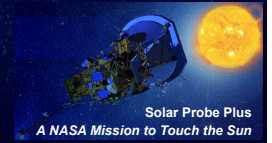
- Level 1 Requirements for the Solar Probe Plus Mission
- SPP Mission Requirements Document (Level 2), 7434-9047
- SPP Level 3 Payload Requirements Document (Level 3), 7434-9051
- ISIS Instrument Requirements Document (Level 4), 16105-ISIS-IRD-01

Level 2 - 4 documents:

- Each document contains a Requirement Verification Matrix.
- Level 2 and 3 verification typically inspection of documentation verifying lower level requirements found in the ISIS IRD.
- ISIS Systems Engineer will flow verification data up to the appropriate document owners.
- Performance requirements are formally managed by the SPP Requirements & Verification Engineer and are tracked in the SPP System Requirements Database, DOORS.



# Environmental Requirements



Environmental requirements are defined in:

- SPP Contamination Control Plan, 7434-9011
- SPP Environmental Design and Test Requirements Document, 7434-9039
- SPP Electromagnetic Environment Control Plan, 7434-9040

Environmental requirements documents:

- Each document contains a Requirement Verification Matrix.
- ISIS Systems Engineer will flow verification data up to the appropriate document owners.
- Environmental requirements are not maintained in the SPP System Requirements Database, DOORS.
- The SPP System Assurance Manager is responsible for verification of Assurance requirements.





# Interface Requirements



Interface requirements are defined in:

- SPP to ISIS ICD, 7434-9058
- SPP General Instrument to Spacecraft ICD, 7434-9066
- MOC to SOC ICD 7434-9078

Interface requirements documents:

- Each document contains a Requirement Verification Matrix.
- ISIS Systems Engineer will flow verification data up to the appropriate document owners.
- Interface requirements are not maintained in the SPP System Requirements Database, DOORS.



# Assurance Requirements



Assurance requirements are defined in:

- SPP Product Assurance Implementation Plan (PAIP), 7434-9003
- EPI-Lo Product Assurance Implementation Plan (PAIP), 7464-9001
- EPI-Hi Product Assurance Implementation Plan (PAIP), CIT-SPP-004

Assurance requirements documents:

- Each document contains a Compliance Matrix
  - Comply
  - Do not Comply
  - Comply with Caveats
  - N/A
- Assurance requirements are not maintained in the SPP System Requirements Database, DOORS.