

# Solar Probe Plus

*A NASA Mission to Touch the Sun*



## Integrated Science Investigation of the Sun Energetic Particles

### Preliminary Design Review

05 – 06 NOV 2013

## Performance Assurance

*Joerg Gerhardus*





# Outline



- Safety, quality and reliability program being used in the development of the instrument
- Description of software quality system, and software IV&V plans
- EEE parts selection and screening plans as well as materials selection and screening plans
- Any special processes required to build the instrument
- Contamination control and ESD
- Plans for selection and qualification of special items such as detectors and mechanisms
- Any exceptions being taken to the SPP PAIP
- Preliminary FMEA, or plans for FMEA, Fault Tree Analysis
- Describe the manner in which the reliability engineer works with the design team to ensure that reliability is maximized



# Outline



- Requirements
- SMA Oversight & PAIPs
- Organization
- Design Assurance
- Hardware Quality
- Software Quality
- EEE Parts Engineering
- Safety
- Path Forward





# SPP PA Requirements and PAIPs



Tailored SMA Requirements negotiated with the SPP project:

- Solar Probe Plus (SPP) Instrument Mission Assurance Requirements Compliance Matrix
- SPP document # 7434-9096 Rev. A
- Iterative process between SPP and ISIS SMA teams utilizing best practices and combined knowledge of the diverse teams at all participating organizations

ISIS Implementation through plans (PAIP) and operating procedures:

- ISIS: SwRI document 16105-SPP-IMAR-COMPMAT-01 Rev. 0, released 10/07/13
- EPI Lo: Solar Probe Plus (SPP) Performance Assurance Implementation Plan; APL document # 7434-9001 Rev. -, released 10/14/13
- EPI-Hi: Caltech document CIT-SPP-004 Rev. -, released 10/07/2013



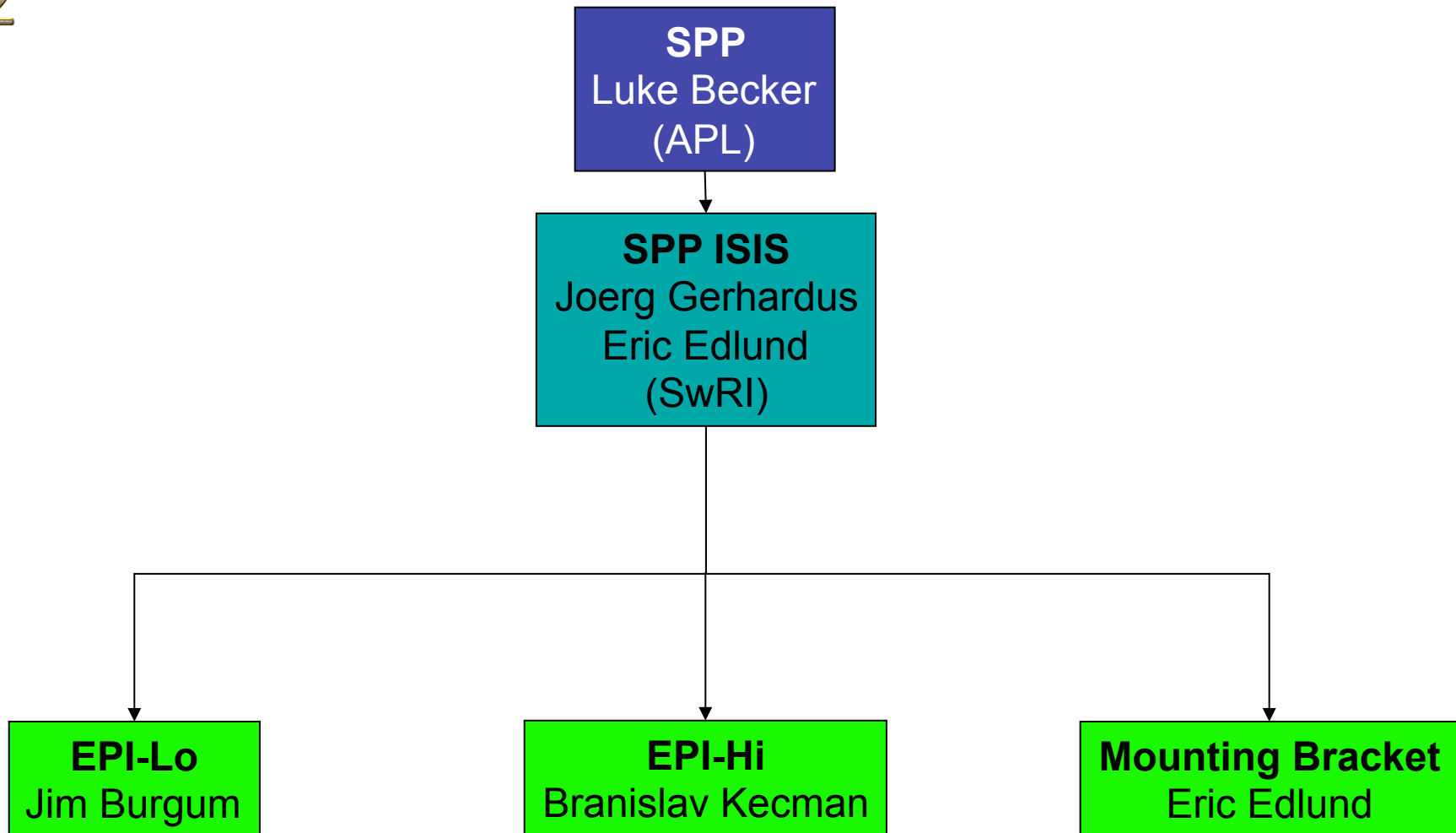
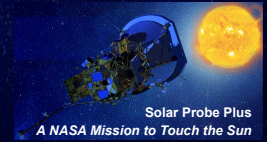
# Performance Assurance Implementation Plan



- Deliverables
- General Quality Requirements
  - Procurement
  - QA Surveillance
  - Training and Certification
  - Design and Development Review Process
  - Configuration Management
  - Non Conformance Process and Reporting
- Hardware Quality Requirements
  - Manufacturing, Inspection, Assembly, Test, and Inspection Planning
  - Controlled Stores
  - Fabrication processes
  - Inspection
  - Acceptance Test Verification
  - Handling Packaging, Shipping
- Software Quality Requirements
  - Requirements Analysis
  - Reviews
  - Verification and Validation
- Safety
- Reliability Assurance
- EEE Parts Program



# PA Organization Chart

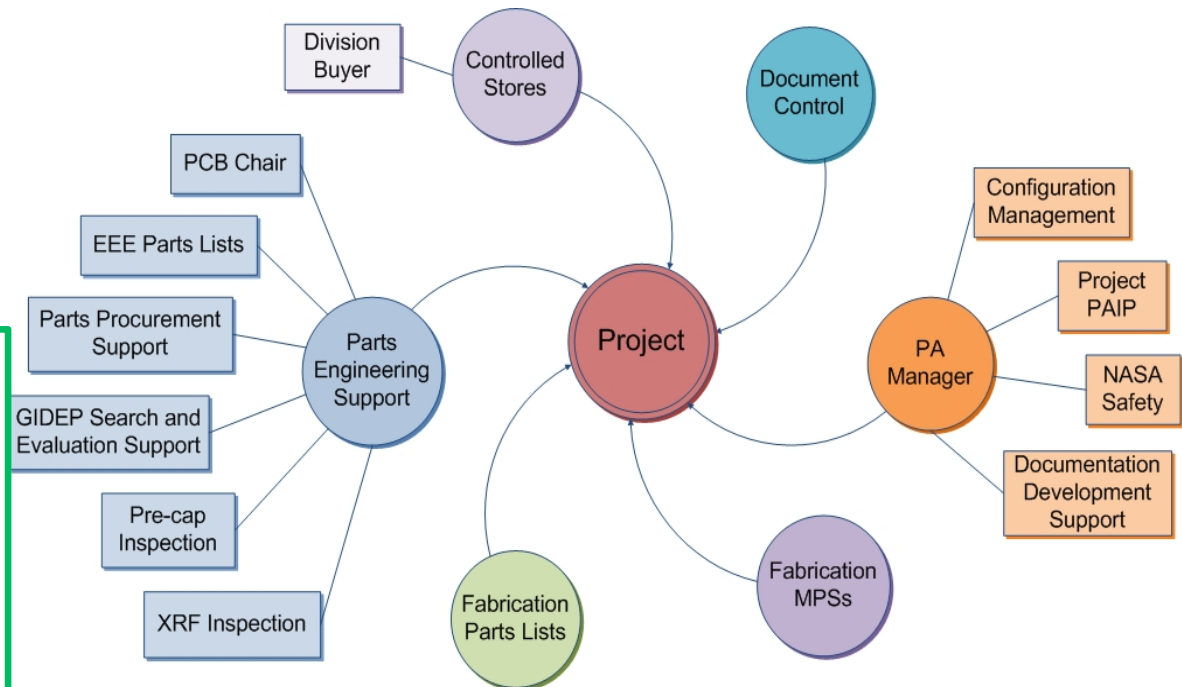




# Project Quality Assurance



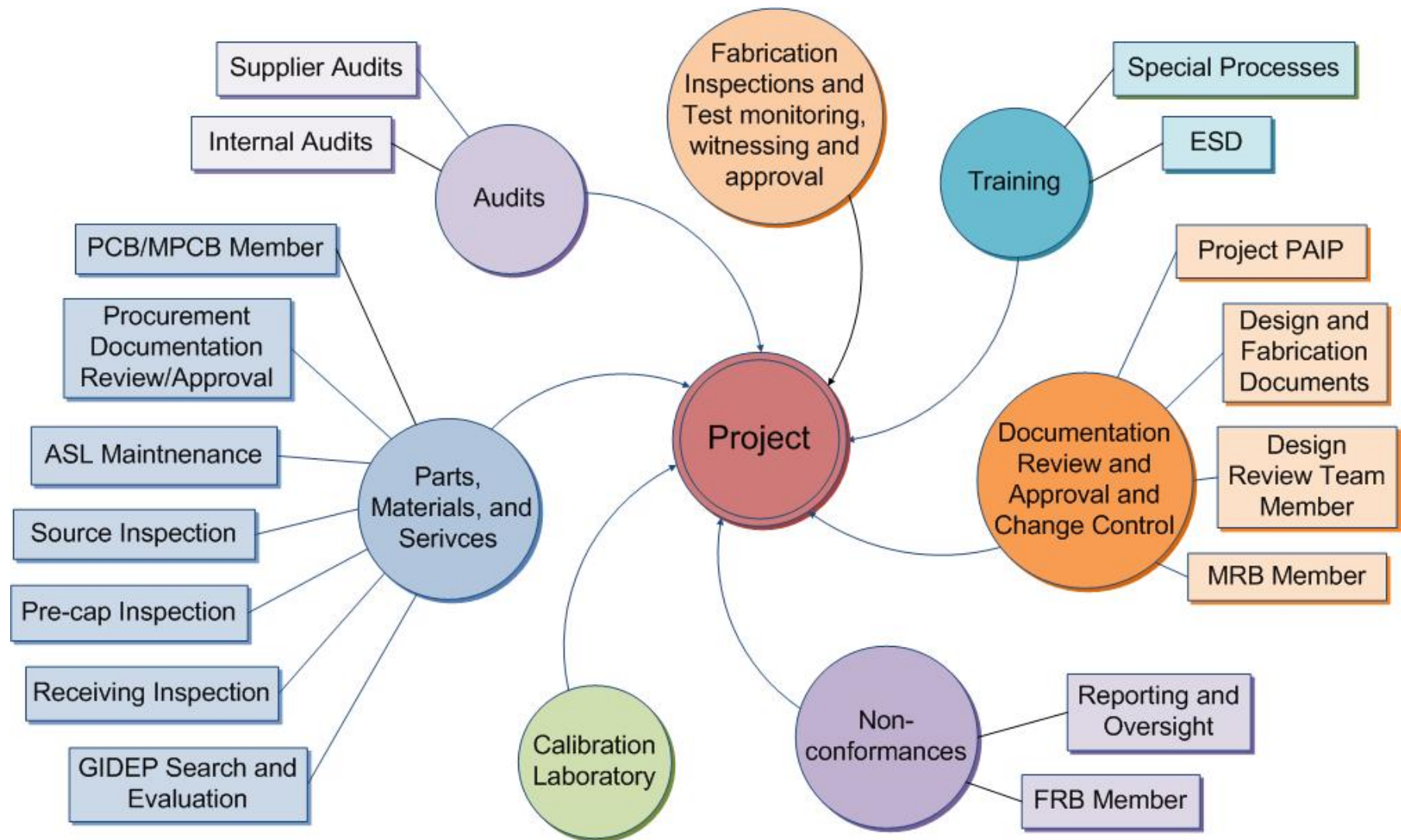
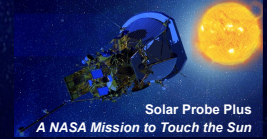
- Project Team PA
  - Reliability engineering
  - Parts acquisition oversight
- Division 15 PA Manager and Staff
  - Coordinate Div 15 Resources
- Independent Project Quality Engineer
  - Oversight & Coordination
  - QA Engineering
  - QA Inspections
- Partner QA
  - Implement local PAIP and support SwRI's SPP ISIS PA Lead







# Quality Tasks







# Design Assurance



- Hardware designs governed by
  - Design process and controls
    - Requirements Definition
    - System Engineering Process
    - Design Planning
    - Peer Reviews and checklist
    - Verification and Validation
    - Control of Design Changes
- Software designs governed by
  - Structured software development process
  - Contract Reviews, Software Development Folder, Planning
  - Review of Requirements, and checklist
  - Software Design Specification, Design Peer Reviews, and checklist
  - Coding Standards, Configuration Control, and Code Walkthroughs
  - Test Plans, Test Preparations, Formal Testing, and Reporting
  - Independent QA surveillance and reporting



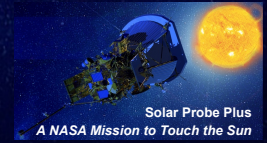
# Quality Assurance



- Procurements per released drawing and indentured parts list
- Periodic GIDEP alert verification performed on EEE parts list
- QA Receiving Inspection of EEE parts for flight hardware
- Flight PWB procurement and coupon testing at GSFC
- SwRI coordinates PCB effort for SPP ISIS with mission-level PCB



# Quality Assurance (cont'd.)



- Non-conformance control:
  - Per organization's established procedures
  - MRB and FRB established
  - All non-conformances will be processed as Anomalies or Problem/Failure reports and reported through SwRI to APL as required
- Workmanship
  - Technicians and inspectors are certified to NASA 8739 standards. Vince Ganley & Connie Ovalles are the in-house Level B certified instructors and are available to support other organizations as needed.
- ESD
  - Engineers, operators, and technicians are certified to NASA-STD-8739.7 / ANSI ESD S20.20.





# Software Quality Assurance



ISIS SQA follows the AS9100 quality program in monitoring software activities which includes review of project documents, witnessing acceptance testing, tracking action items and defects, and performing surveillances/audits.

QA has approved the ISIS Software Development Plan (SDP) which references the EPI-Hi/Lo SDPs

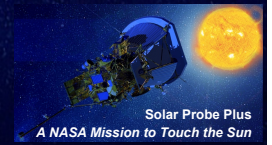
- Software Development Plan Solar Probe Plus Project ISIS Instrument Software, Document No. 16105-ISIS-SDP-01, Rev 0 Chg 0, September 2013

Regular surveillances of EPI-Hi and EPI-Lo software activity will focus on the teams compliance to their SDP and their organization's quality/procedural requirements.

- On-site surveillances by the SwRI SQA at EPI-Lo and EPI-Hi are planned.



# EEE Parts Engineering



- Primary role is to support ISIS hardware developers with meeting EEE parts requirements as called out in Solar Probe Plus Parts Control Plan, SPP document 7434-9001 Rev A
  - SwRI has significant experience working with APL & GSFC Parts Engineering Branch
  - Ensure that all parts presented to SPP Parts Control Board are compliant to the PCP
- Provide procurement support where necessary
  - Significant stock available at SwRI
    - This has already been useful to aid in prototyping and EM hardware
      - Avoid long leadtimes and expensive minimum buys
- Support coordination of common buy activities as requested
  - Allows for 1 consolidated response for the ISIS suite



# Safety



- SPP ISIS will provide Safety inputs
  - The NPR-8715.3A process circle summarizes the overall safety program risk management approach:
- Safety Hazards Analysis
- Implementation of hazard controls
- Verification





# EPI Hi/Lo Hazards and Mitigations



## ■ EPI-Lo:

### ■ High Voltage

- 200V bias voltage to the SSDs
- Fully contained inside the instrument
- Only operated in high vacuum
- Safe/arm limiting plug design

### ■ Ionizing Radiation Sources

- Planned use of the following sources (radiation datasheets have been provided to SPP):
  - Am-241 foil, 100uCi, Type A2 Capsule
  - Bi-207, 10uCi, MF-1 Disk, 25.4mm OD x 5.08mm AD, 100-200ug/cm2 Acrylic Window
  - Ba-133, 10uCi, MF-1 Disk, 25.4mm OD x 5.08mm AD, 100-200ug/cm2 Acrylic Window

## ■ EPI-Hi:

### ■ High Voltage

- 250V bias voltage to each detector within the three telescopes
- Fully contained inside the instrument

### ■ Ionizing Radiation Sources

- Planned use of the following sources:

■ Beta / gamma sources	106Ru, 207Bi: <0.1 mCi
■ Alpha sources	228Th, 241Am, 244Cm : <10 mCi
■ alpha source for producing knock-on protons	210Po : <10 mCi

## ■ General Hazard:

### ■ Nitrogen purging

- Controlled flow rates in ventilated areas
- Conducted by trained personnel
- Monitoring O<sub>2</sub> levels (where necessary)



# Summary



- SPP ISIS Performance Assurance plans and requirements are in place
- PAIPs written in response to the tailored SPP MAR Matrix
- SwRI QA independently verifies that we follow plans