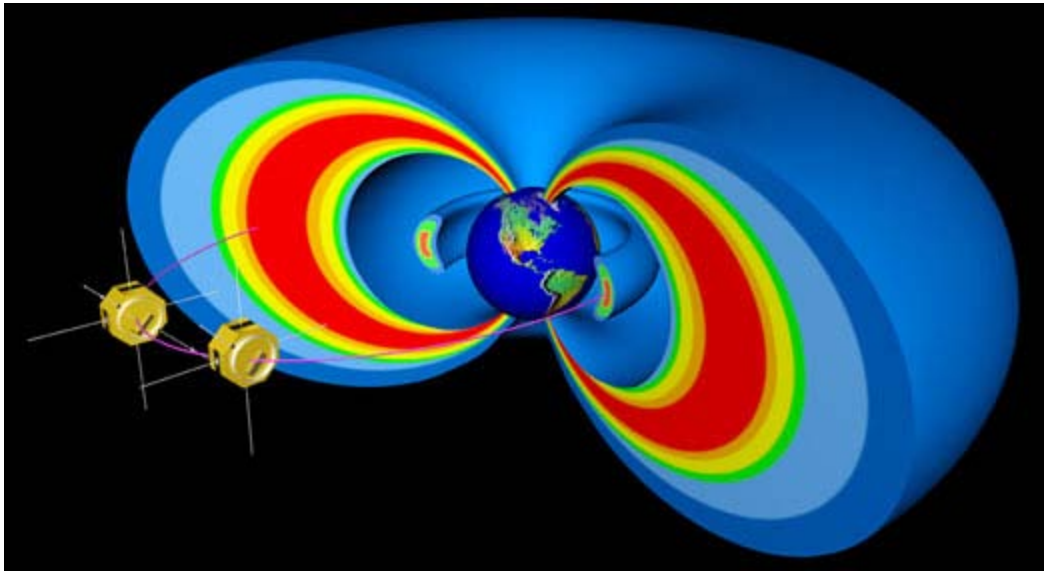


Radiation Belt Storm Probes (RBSP) Payload Safety Introduction Briefing

October 9, 2008

Astrotech Space Operations, Titusville, FL

RBSP Payload Safety Introduction Briefing - Agenda

October 9, 2008 @ ASO Conf Rm E

8:30 **Introduction**……..……..**Chuck Loftin ~ NASA/KSC**

8:45 **RBSP Program & Mission Overview**…….....**Judi VonMehlem ~ JHU APL**

9:15 **Eastern Range Safety Overview**……...**Eric Herrburger ~ 45SW/SEAL**

9:45 **Launch Services Safety Overview**……**Chuck Loftin ~ NASA/KSC**

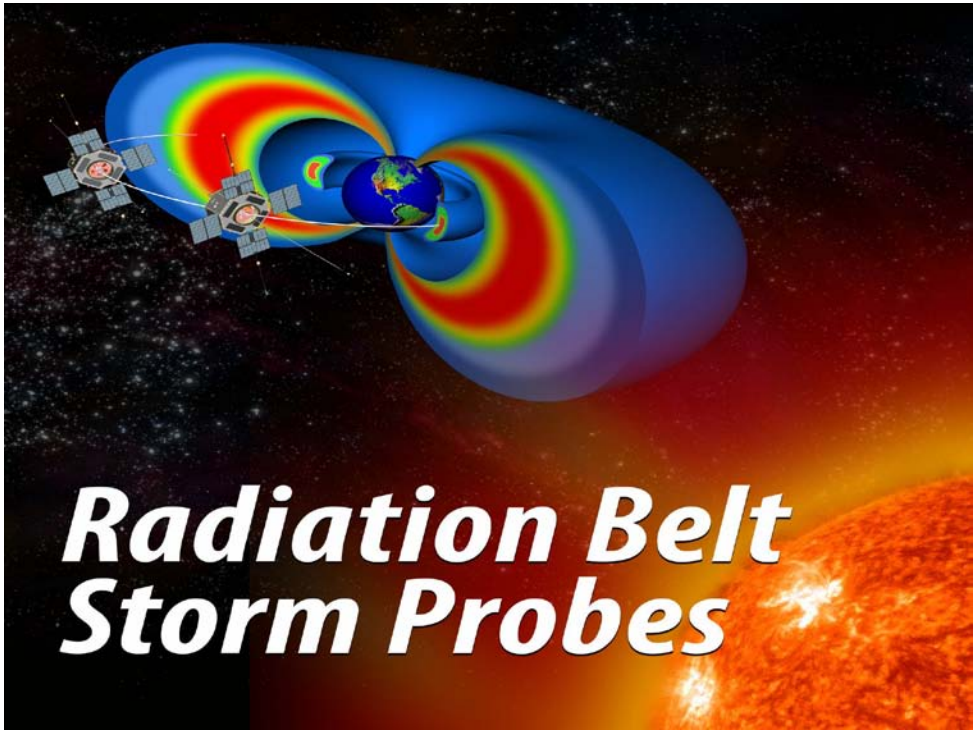
10:15 **RBSP Flight Systems Safety**……..……**Clay Smith ~ JHU APL**

- **Discussion of additional topics**

11:00 **LSSP/Deliverables Discussion**……**Dianna Lampert ~ NASA/ KSC**

11:15 **Open Discussion & Action Item Review**……..**All**

11:30 **Adjourn**

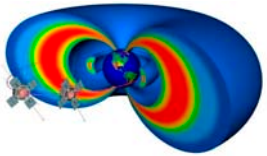


RBSP Mission Overview

Judi von Mehlem
JHU/APL
Spacecraft System Engineer/
Deputy Mission System Engineer

240-228-6419
judi.vonmehlem@jhuapl.edu

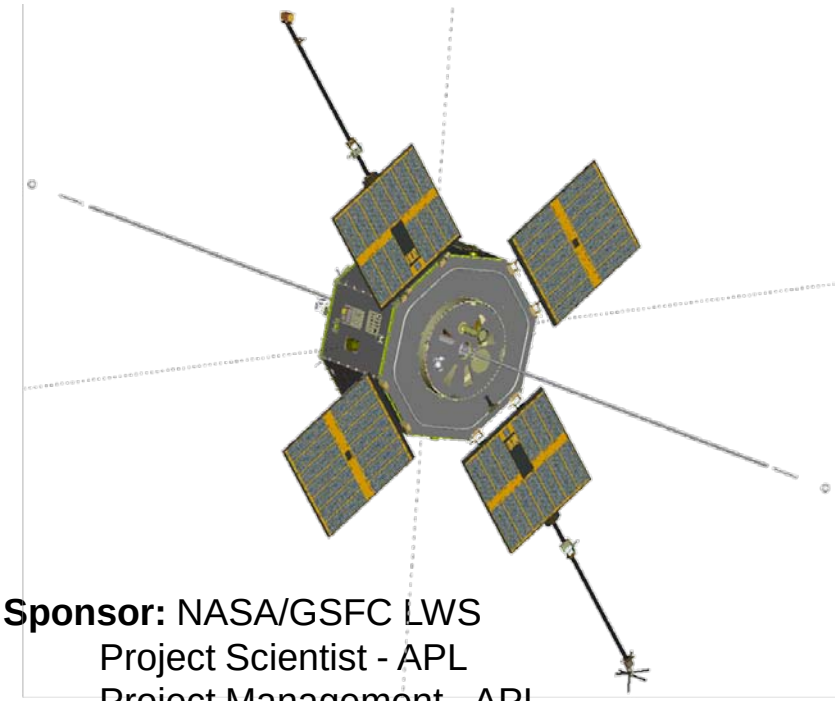
TOPICS



- Teams and Milestones
- Where will Observatories be collecting data?
- What is hoped to be learned?
- Nominal Mission Concept
- Overview of Observatories
- Contact people

Information contained in this presentation is based on the work or presentations of a number of RBSP JHU/APL scientists and engineers, including B. Mauk, N. Fox, D. Eng, J. Troll, J. Kelley, R. Conde, J. Kelley, G. Heyler, C. Herrmann

Geospace Radiation Belt Storm Probes (RBSP)



Sponsor: NASA/GSFC LWS
Project Scientist - APL
Project Management - APL
Spacecraft Development/Operations – APL
Science Investigations/Instruments:
ECT – Boston University
EFW – University of Minnesota
EMFISIS – University of Iowa
RBSPICE – New Jersey Institute Technology
PSBR - NRO

Overview

Mission:

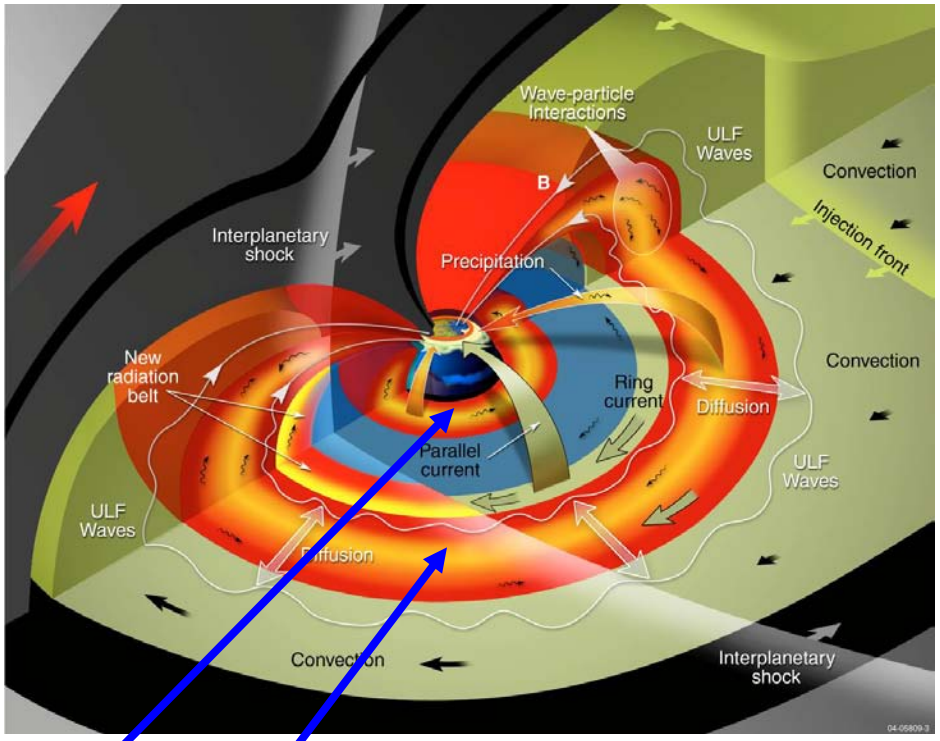
Gain scientific understanding (to the point of predictability) of how populations of relativistic electrons and ions in space form or change in response to changes in solar activity and the solar wind.

Milestones

Phase A:	6/2006 – 3/2008
Phase B:	4/2008 – 12/2008
Phase C/D:	2/2009 – 11/2011
Launch:	10/2011
Phase E:	12/2011 – 11/2014

APL

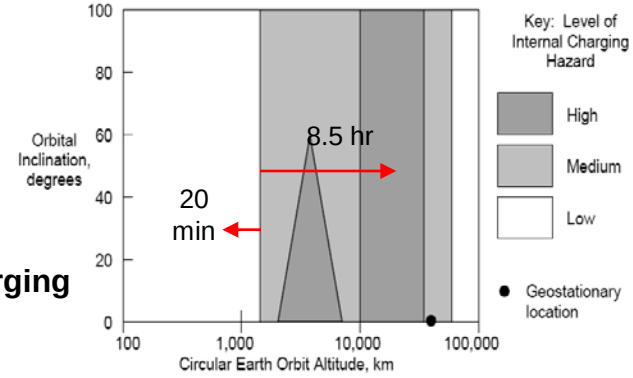
Challenge of the Van Allen Radiation Belts



Inner Belt

Outer Belt

Base on NASA-HDBK-4002

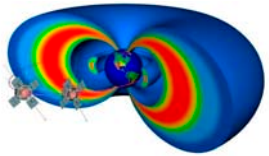


time Observatories spend at altitude

Observatory Surface Charging Effects

- **Radiation Belts:**
  - James Van Allen and his team discovered the radiation belts in 1958, from data taken on Explorer 1.
    - Radiation belts are electrons and ions trapped by the Earth's magnetic field.
  - Inner and Outer Belt
    - Inner belt (~1 to 2 RE) is stable, mostly protons, with energy ranging from 10 to 100 MeV.
    - Outer belt (~2 to 6 RE) is variable, mixture of electrons and ions, with energy ranging from 10 keV to 10 MeV.
  - Particle energies and intensities vary with magnetic disturbances, i.e. magnetic storms.
- **Radiation Processes can be Observed In Situ in the Radiation Belts**
  - Creation and variation of radiation populations result from a complicated interplay of processes.
  - A broad range of simultaneous measurements is needed to sort them out

LWS RBSP Mission Objective is important and its Impacts are broad

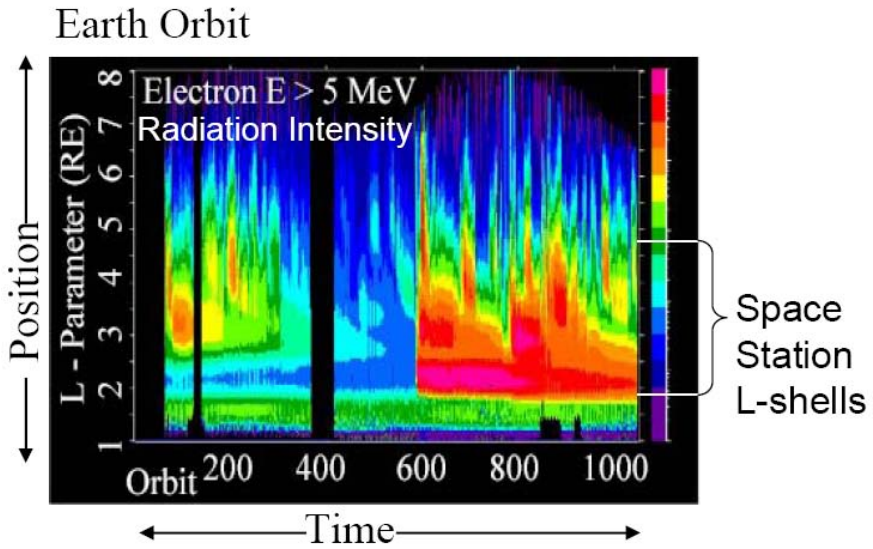


- **Objective**:

  Provide understanding, ideally to the point of predictability, of how populations of relativistic electrons and penetrating ions in space form or change in response to variable inputs of energy from the Sun.

- **Impacts**:

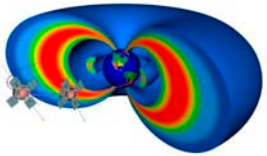
1. **Understand fundamental radiation processes operating throughout the universe.**
2. **Understand Earth's radiation belts and related regions that pose hazards to human and robotic explorers.**



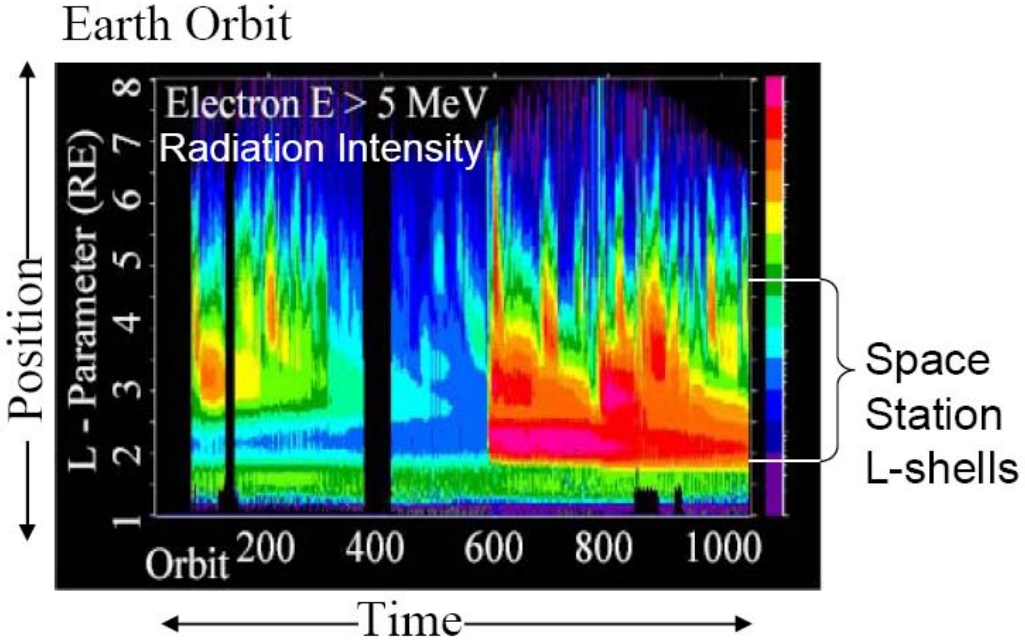
Intensities of Earth's dynamic radiation belts

APL

Radiation Processes Impact Near-Earth and Solar System Engineering Tasks



- **Earth's radiation belts are environments within which we must engineer.**
- **Any exploration program will likely have vastly expanded near-earth space infrastructure.**
- **Cost savings and risk reduction from reliable space weather forecasting models is fundamental to exploration program**



APL

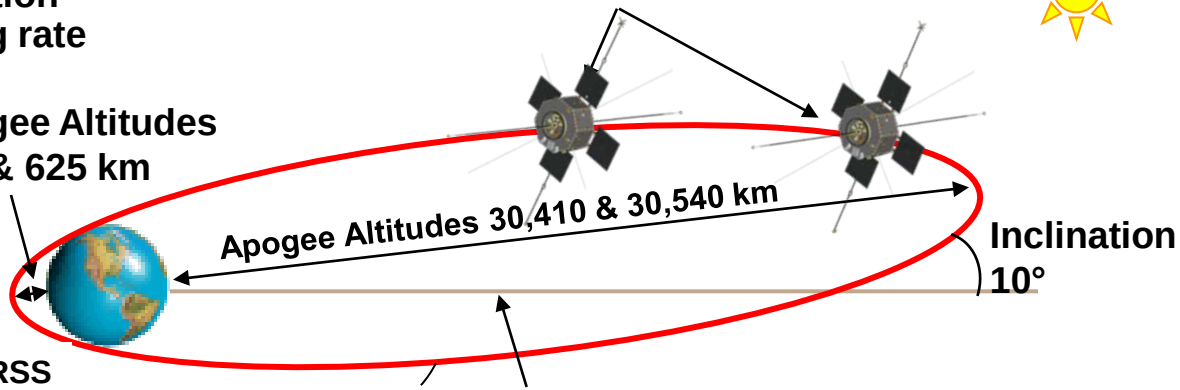
Nominal Mission Concept Summary

Launch and Orbit Insertion

- Single EELV (Observatories Stacked)
- Launch from KSC
- Each observatory independently released Sun pointed
- Spacecraft performs separation maneuver to achieve lapping rate

2 Observatories

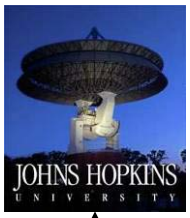
- Spin Stabilized ~5 RPM
- Spin-Axis 15°-27° off Sun
- Attitude Maneuvers Every 21 days
- Operational Design Life of 2 years



Differing apogees allow for simultaneous measurements to be taken over the full range of observatory separation distances several times over the course of the mission. This design allows one observatory to lap the other every 75 days.

APL Ground Station
- Primary

Commercial Ground Station(s)
- Data Augmentation
- Back-up



TDRSS

Critical Events at Launch

Commands & Telemetry

MOC

Instrument commands

Instrument Telemetry

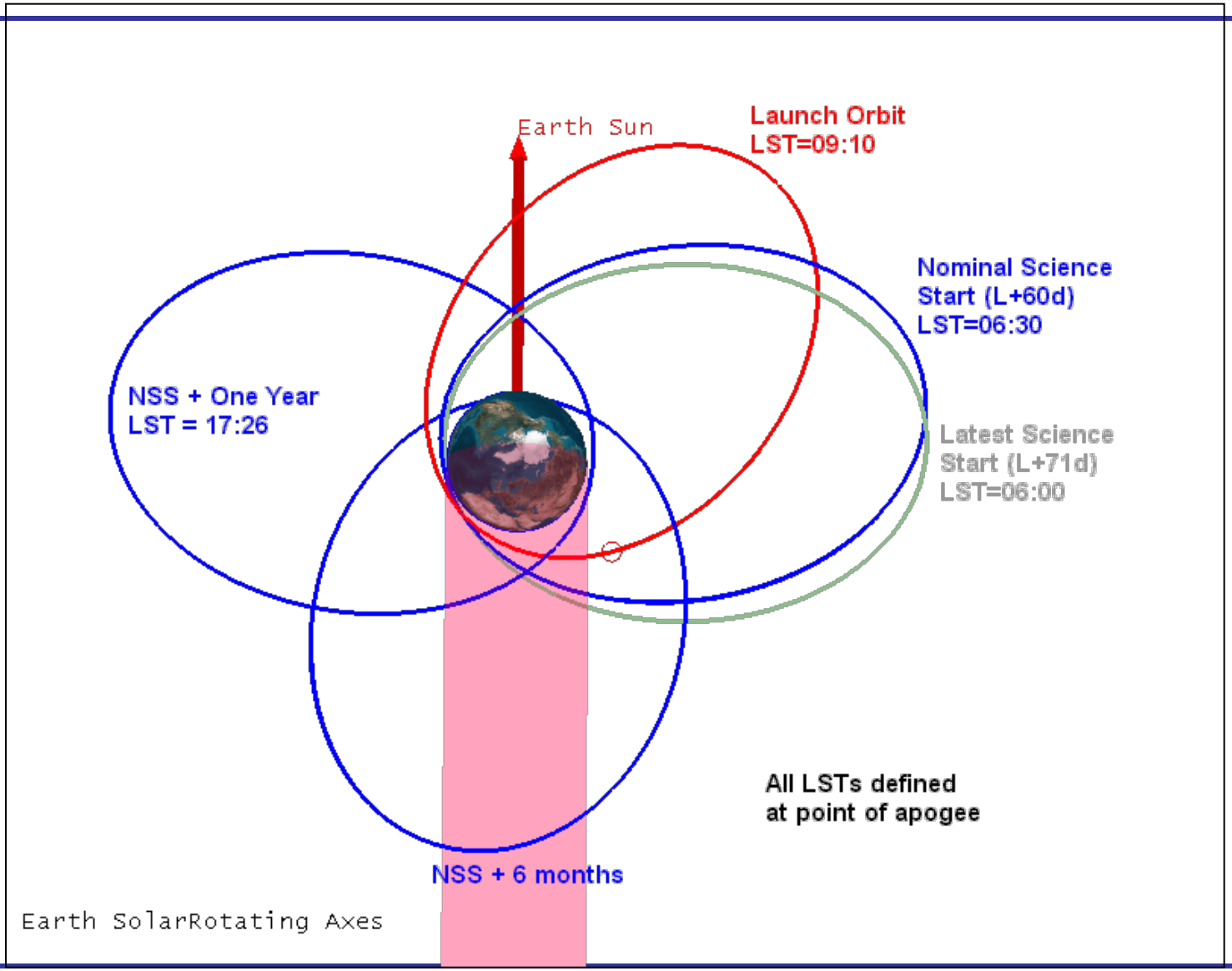
Decoupled Operations

- Basic Approach Based on TIMED, STEREO

EFW SOC | EMFISIS SOC | ECT SOC | PSBR SOC | RBSPICE SOC

APL

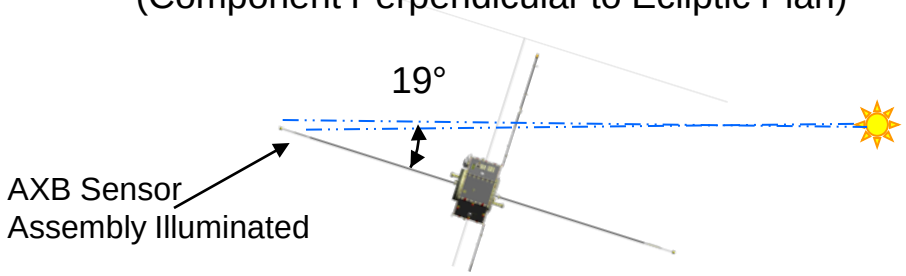
Precession of Orbit Provides Different Orientations and Positions Relative to Sun



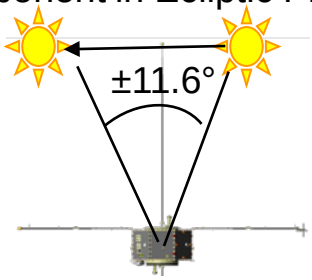
Observatory Sun Off-Pointing (Current Baseline)

	Minimum	Nominal	Maximum
N-S Angle (deg)	15.4	**19.0**	22.6
E-W Angle (deg)	8.0	11.6	15.2
Time Between Maneuvers (days)		**22**	
Total Angle off the Sun (deg)	17.3	22.1	27.0

North – South Off-Pointing
(Component Perpendicular to Ecliptic Plan)



East – West Off-pointing and drift
(Component in Ecliptic Plane)



COS (max angle) = COS (N/S)COS(E/W)

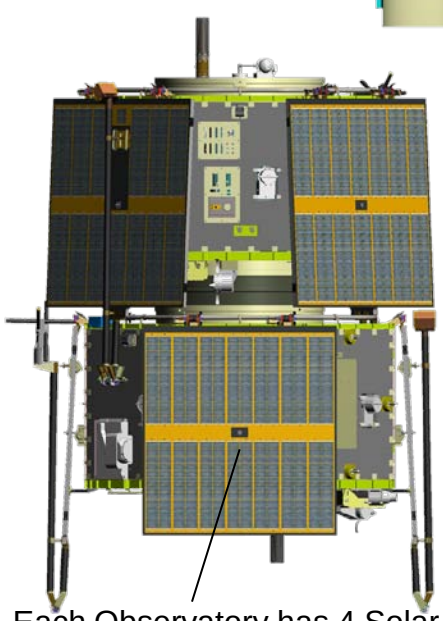
- **Operations would plan for a maneuver every 21 days**
  - Allows for 2 day missed (to provide margin in case ground contact is unavailable on a planned maneuver day)

Launch Configuration

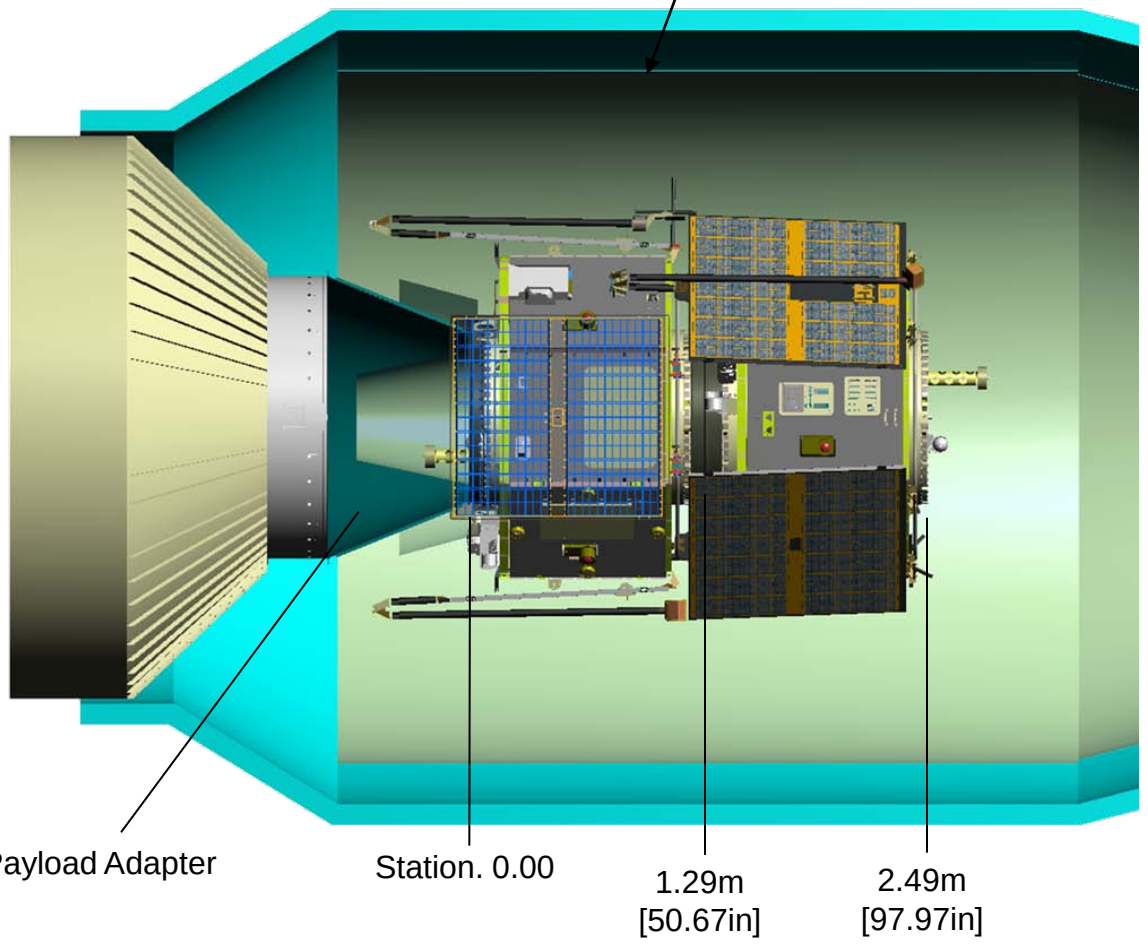
Stack Mass <1500 kg

Purge Lines:

- **RBSP-A T-0 fairing pull**
- **RBSP-B across LV/RBSP separation plane**

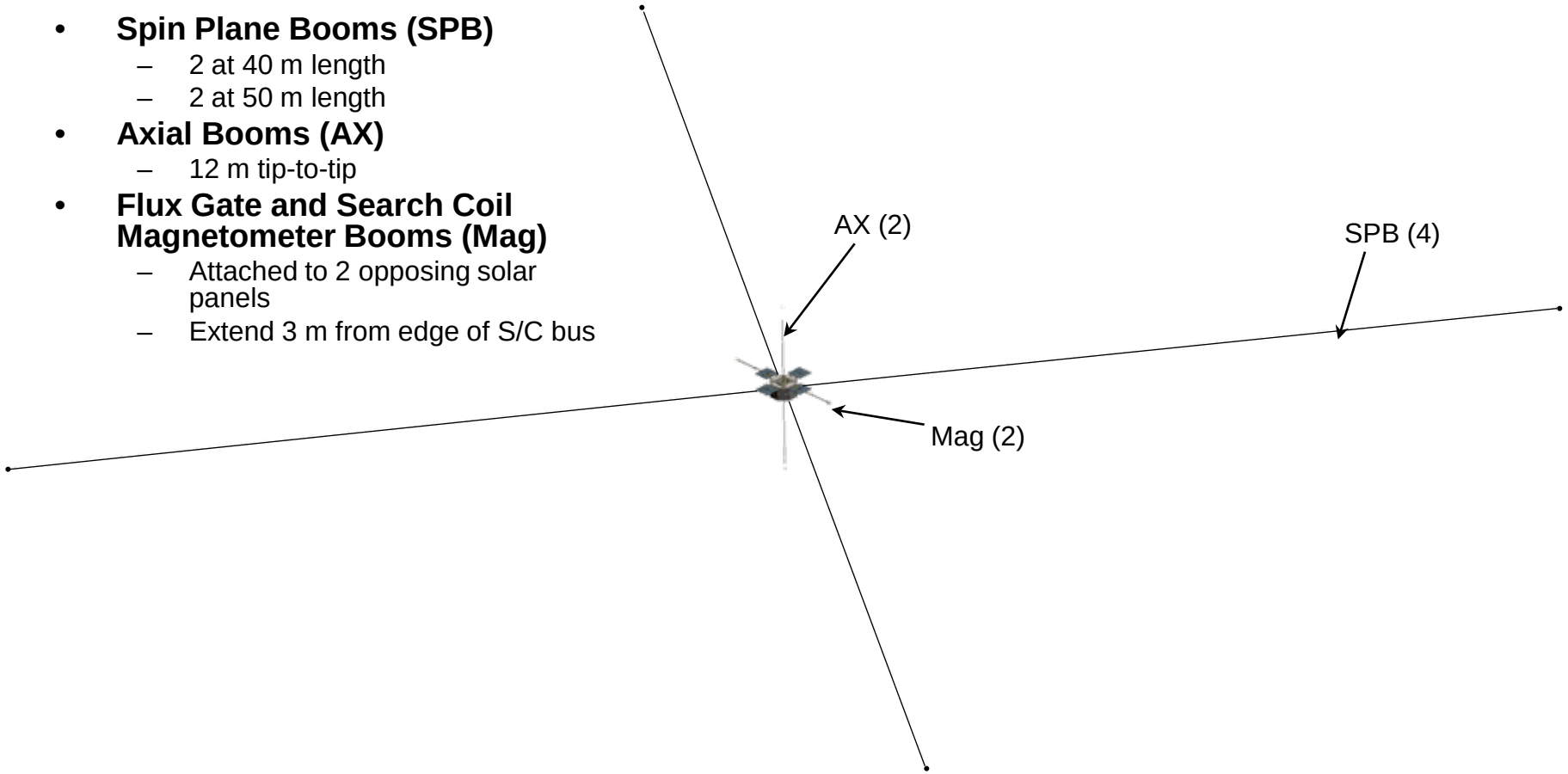


Each Observatory has 4 Solar Panels



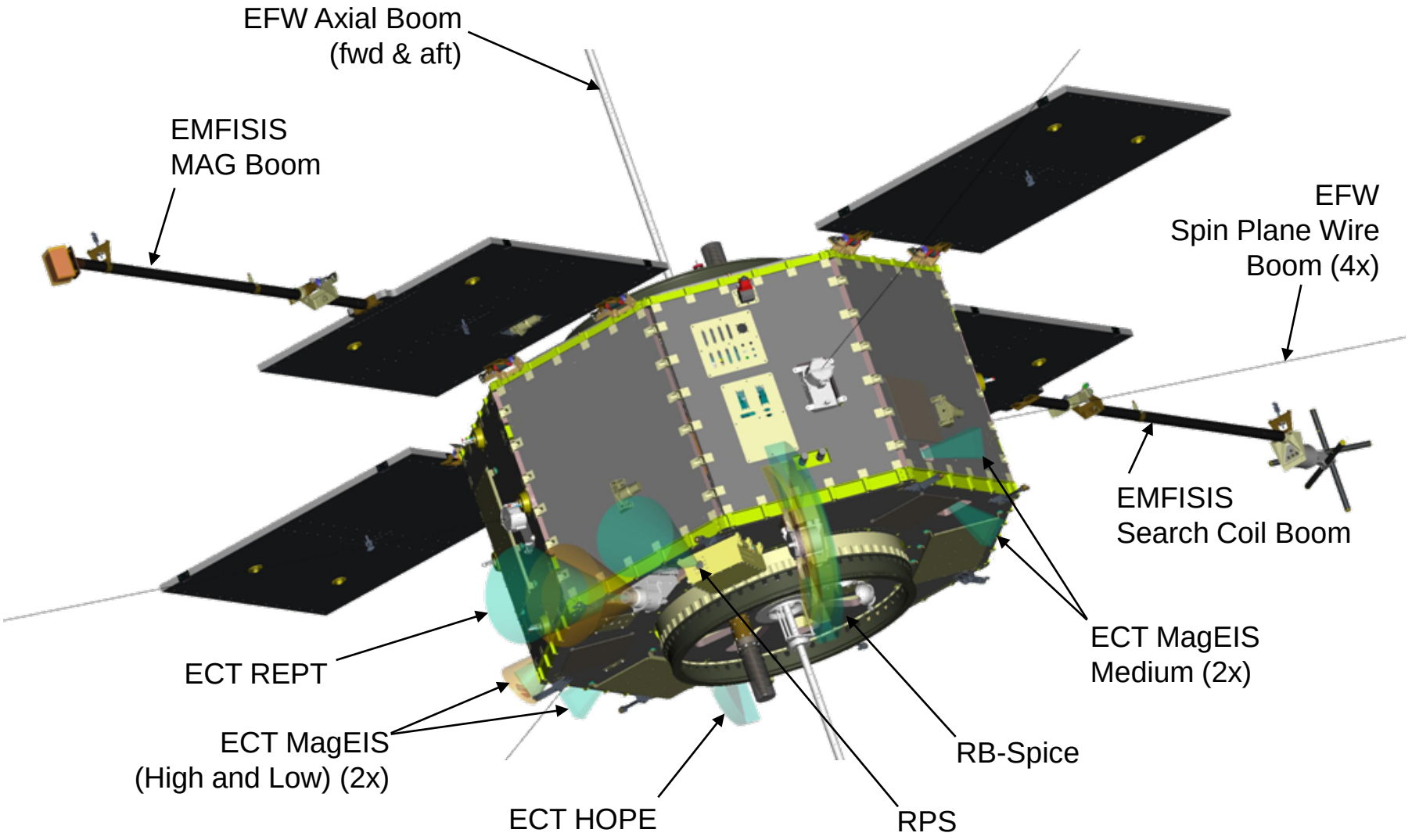
RBSP Observatory On-Orbit Configuration Illustrating Full Length of Booms

- **Spin Plane Booms (SPB)**
  - 2 at 40 m length
  - 2 at 50 m length
- **Axial Booms (AX)**
  - 12 m tip-to-tip
- **Flux Gate and Search Coil Magnetometer Booms (Mag)**
  - Attached to 2 opposing solar panels
  - Extend 3 m from edge of S/C bus

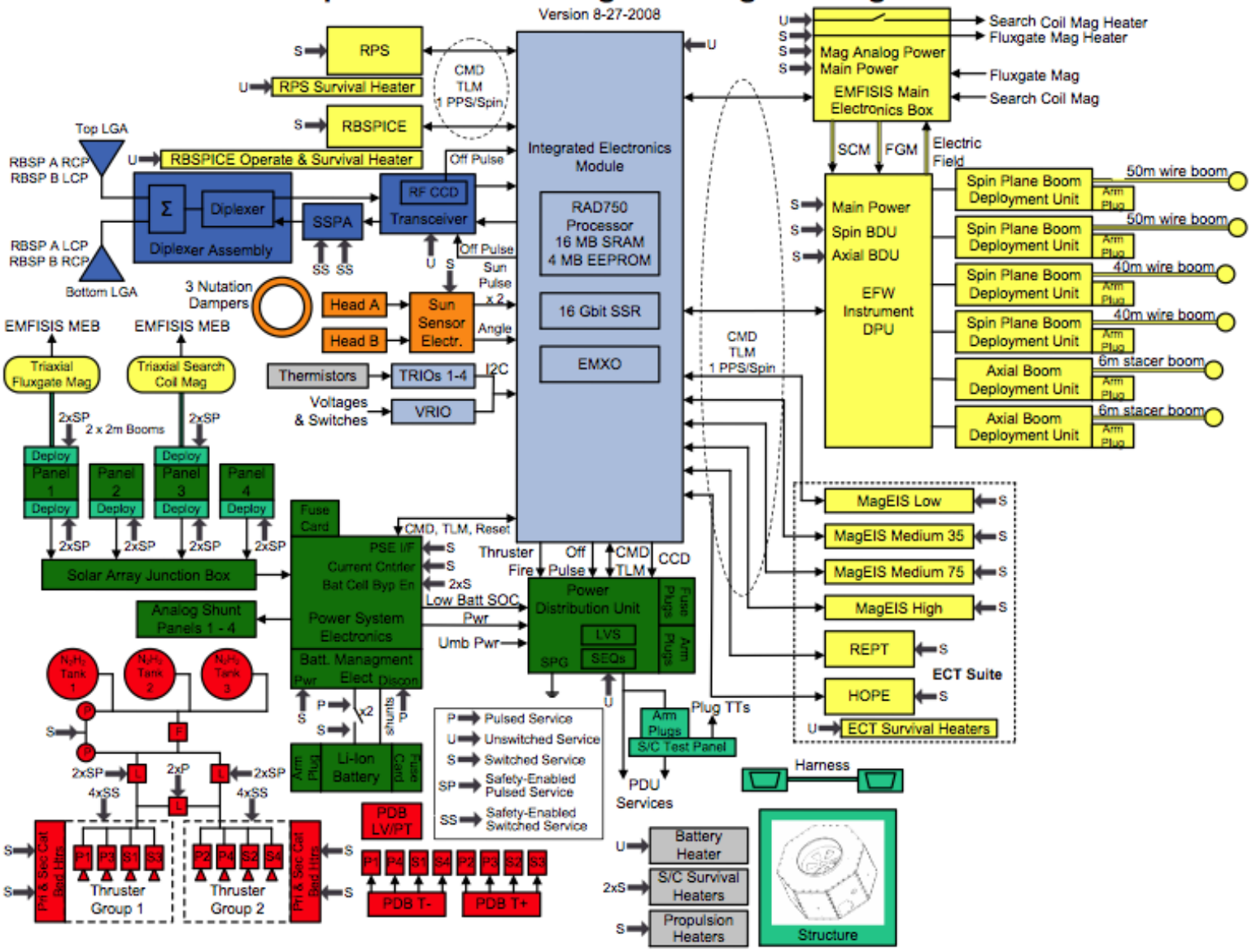


The SPBs dominate the spacecraft's dynamic response during maneuvers

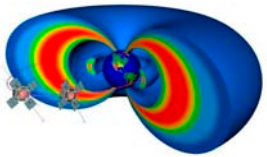
RBSP Observatory Flight Configuration



RBSP Spacecraft Block Diagram – Flight Configuration



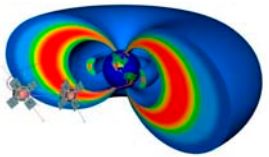
RBSP Spacecraft Bus



- **Spacecraft designed to accommodate challenges imposed by high radiation and charging environment**
  - Radiation total dose mitigation: thick electronics box walls and materials qualification
  - Charging mitigation includes: 1) no floating metal in electronic boxes 2) sufficient shielding to eliminate charging 3) design and qualification of electrical interfaces to survive discharges from the spacecraft harness insulation 4) conductive surfaces
- **Due to cost constraints, spacecraft are single string with limited redundancy**
- **There is no on-board G&C knowledge or autonomous control capability**
  - No onboard knowledge of attitude other than the spin axis-sun line angle provided by sun sensor used to reconstruct attitude knowledge on the ground.
  - Attitude adjustments and maneuvers are performed only under ground control.
  - Spacecraft cannot autonomously orient itself to a safe attitude
    - Spacecraft cannot autonomously correct for post-launch pointing and nutation errors

Rely solely on LV to position, spin up and point each observatory

Excerpt* from Mission Organization Charts to Show Contact Engineers (Bold, Italic)



RBSP Mission Manager
Betsy Park GSFC

LWS Launch Vehicle Coordinator
Tom Jones GSFC

Mission Systems Engineer
Doug Eng

Independent Technical Authority
Steve Aloezos GSFC

Mission Software Engineer
Debbie Clancy

Deputy Mission Systems Engineer
Judi von Mehlem

System Safety Engineer
Clay Smith

Data System Engineer
David Artis

Electromagnetic Environment Engineer
Carl Herrmann

Mission Design
Gene Heyler

Requirements/Verification Engineer
Rich Anderson

Radiation Engineer
Dick Maurer

Integration and Test Engineer
Elliot Rodberg

Contamination Control Engineer
Scott Lange

Fault Protection/Reliability Engineer
Kristin Fretz

G&C Systems Engineer
Robin Vaughan

Instrument Systems Engineer
Alan Reiter

Spacecraft Systems Engineer
Judi Von Mehlem
Electrical Systems Engineer
Rich Conde
Mechanical Systems Engineer
Stuart Hill
Spacecraft Comp./Parts Engineer
Shavesha Rutledge

Ground Segment Systems Engineer
Ray Harvey

Launch Services Coordinator
Stuart Hill

Structure/Dynamcis
Dave Persons

Mechanical Engineer
John Troll

Other Spacecraft Subsystem
Lead Engineers

Thermal
Bruce Williams

*Note: this organization chart is not complete

APL

45th Space Wing

This Briefing is UNCLASSIFIED

Range Safety Requirements

Eric Herrburger
45 SW/SEAL
October 2008

Overview

- Purpose
- Risk Management at the Eastern Range (ER)
- AFSPC MAN 91-710
- Safety Data Submittals
- Tailoring of Range Safety Requirements
- Summary

Purpose

- This briefing is to introduce the Range User to Range Safety Requirements. This includes
  - Range Safety Organization
  - Risk Management Requirements
  - AFSPC MANUAL 91-710 Introduction
  - Safety Data Submittals
- Questions are encouraged
  - Misinterpretation of Range Safety Requirements is common
  - It takes more than one meeting to go over all requirements

Range Safety Organization

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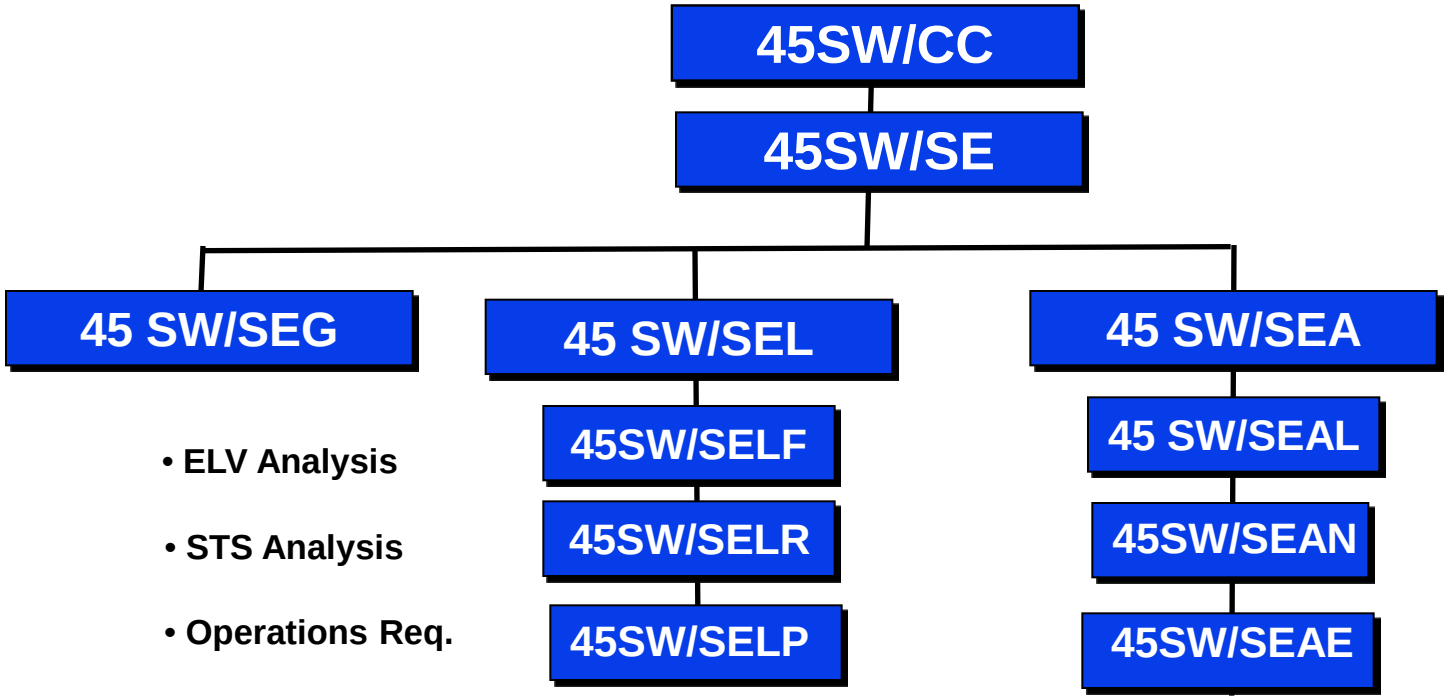


- ELV Analysis
- STS Analysis
- Operations Req.

- LV Safety
- New & Navy
- Engr Support

Risk Management

- **Public Safety**
  - **“From a Safety Standpoint they will be no more dangerous than conventional airplanes flying overhead.” (81st Congress)**
- **Launch Area Safety**
  - **Personnel located on Cape Canaveral Air Force Station (CCAFS) or elsewhere on the ER are to be protected from the hazards of Range Operations**
- **Launch Complex Safety**
  - **Minimum number of personnel shall be exposed to the minimum hazard level consistent with effective task accomplishment**

AFSPC MAN 91-710

- **Air Force Space Command Manual 91-710**
  - **Signed 1 Jul 2004**
  - **Replaces EWR 127-1**
  - **Defines the Range Safety User Requirements**
  - **Establishes a common baseline of Safety Standards**

- **All programs introduced after 1 Jul 2004 are subject to 91-710**
  - **Tailoring still allowed**
  - **Grandfathering for old programs under current versions of 127-1**

Safety Data Submittals

- **Missile System Prelaunch Safety Package (MSPSP)**
  - **Comprehensive report that provides a detailed description of flight hardware, systems, hazards, and mitigating actions. Provides the means of substantiating compliance to prelaunch safety requirements.**
  - **Refer to Attachment 1 of AFSPC MAN 91-710 Volume 3**
- **Ground Operations Plan (GOP)**
  - **Detailed description of hazardous operations and associated ground support equipment (GSE). Provides a summary of all procedures, and substantiation for classification as hazardous or non-hazardous.**
  - **This may be a program internal document containing the required information.**
  - **Refer to Attachment 1of AFPSC MAN 91-710 Volume 6**

Safety Data Submittals

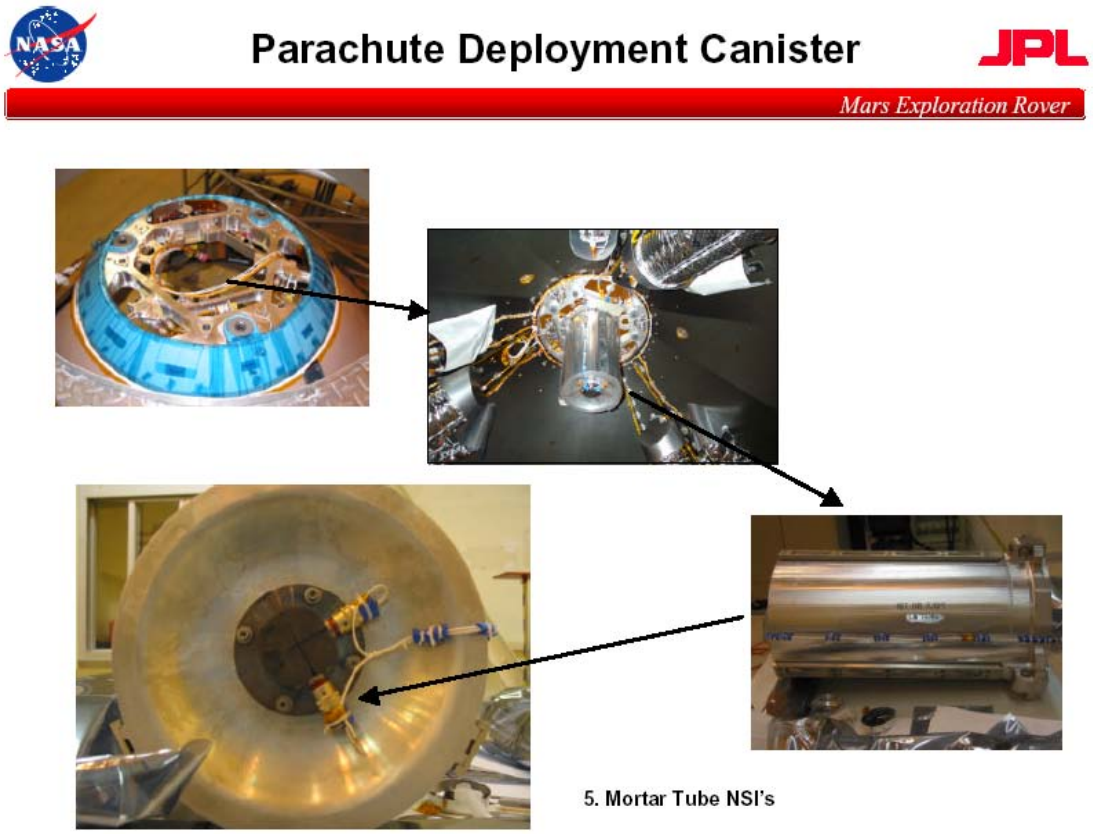
- **Procedures**
  - **Hazardous procedures performed at CCAFS shall be submitted to Range and Operations Safety for review. Procedures involving Flight Termination Systems performed anywhere shall also be submitted.**
  - **Refer to Attachment 2 of AFPSC MAN 91-710 Volume 6**
- **System Safety Program Plan**
  - **Describe in detail tasks and activities required to identify, evaluate, and eliminate and control hazards, or reduce the associated risk to a level acceptable to Range Safety throughout the mission.**
  - **This may be a program internal document containing the required information.**
  - **Refer to Attachment 2 of AFSPC MAN 91-710 Volume 1**

Safety Data Submittals

- **Inputs to Launch Vehicle Mission Unique MSPSP or Addendum**
  - **Provide data as requested by the Launch Vehicle provider. Covers mission unique requirements and spacecraft interface to the launch vehicle. Note: RF inhibits often a concern to the LV.**
- **Launch Vehicle Integration Procedures**
  - **Provide inputs to Launch Vehicle provider for spacecraft requirements during integration.**
- **Request for Environmental Impact Analysis**
  - **AF Form 813, submitted to 45 SW Civil Engineering, as applicable**

Safety Data Submittals

- **Ordnance Photographs - Color photographs (8 x 10 or electronic) of all explosive/non-explosive ordnance, as installed**



Safety Data Submittals

- **Radiation Use Authorization Request**
  - **Provides description of ionizing and non-ionizing sources. Identifies experience and training of personnel involved with sources. The 45 SW Radiation Protection Officer is the approving authority for CCAFS.**
- **Process Safety Management Certification - OSHA 29 CFR 1910.119 requirements, as applicable**
- **Additional data requirements as defined in AFSPC MAN 91-710**

Safety Data Submittal Timeline

- **Timeline for Submittals to Range Safety:**

NASA missions may fall under NPR 8715.7 requirements

- **MSPSP: Draft(s) are submitted with design reviews**
  - **Preliminary not later than one year prior to launch**
  - **Final not later than 45 days prior to hardware is shipped to Cape**

- **Ground Operations Plan: Draft not later than one year prior to the projected date hardware will arrive at the Range.**
  - **Final not later than 45 days prior to the delivery of hardware to Cape Canaveral Air Force Station**

- **Hazardous Procedures: Drafts not later than 45 days prior to use on the Range (KSC and Astrotech 55 days prior)**
  - **Final 7 days prior to use (KSC 10 days prior to use)**

Using AFSPC MAN 91-710

- **V3, 1.2.2. Open Text**
  - **The open text contains the actual mandatory performance-based requirements.**
  - **The only tailoring expected for these requirements would be the deletion of non-applicable requirements.**
  - **Otherwise, must show Equivalent Level of Safety (ELS)**

- **V3, 1.2.3. Bordered Paragraphs**
  - **Non-mandatory, used to identify some of the potential detailed technical solutions that meet the performance requirements. In addition, the bordered paragraphs contain lessons learned.**

Tailoring of AFPSC MAN 91-710

- Tailoring process is **Optional** for new programs
- Creates a program specific safety requirements document
- Identifies potential non-compliant areas
  - Identifies Range User proposed “Equivalent Level of Safety” approaches for potential non-compliance
- Provides a method for agreeing on data submittals
- Establishes a schedule for data submittal

Tailoring of AFSPC MAN 91-710

- **Who tailors: (A1.1.4) High Performance Work Teams (HPWTs).**
  - **An HPWT shall be formed to perform tailoring during Technical Interchange Meetings.**
  - **HPWT membership shall include Range User and Range Safety personnel who have specific tailoring authority**
- **Tailoring includes (A1.1.5.1) Deletion of a Requirement.**
  - **"When a requirement is not applicable to a Range User program, the requirement shall be deleted. The original paragraph number and headings shall remain, but the non-applicable text shall be removed and replaced with the abbreviation N/A."**
- **(A1.1.5.2) Change to a Requirement**
  - **A change is allowed as long as the intent of the requirement is met and the Equivalent Level of Safety (ELS) is maintained.**
  - **All changes are highlighted in bold, using the same paragraph numbering**
  - **The HPWT can determine and approve ELS issues, but not waivers**

Tailoring of AFSPC MAN 91-710

- **(A1.1.5.3) Addition to Requirements**
  - **An addition to a requirement is allowed when there are no existing requirements addressing new technology, when unforeseen hazards are discovered, when federal or industry standards change, and for similar reasons.**
  - **Highlight changes in bold, underline new text**
- **(A1.1.5.4) Range User Information Only**
  - **Requirements such as Pad Safety responsibilities shall remain in the document.**
  - *** All "Range User Information Only" requirements shall be highlighted with an asterisk before the affected paragraph.**

Tailoring Process AFSPC MAN 91-710

- **(A1.2.1) Preparation of an Optional Draft Edition of AFSPCMAN 91-710**
  - **Eliminate all non-applicable sections**
- **(A1.2.2) Generation and Approval of Tailoring Requests**
  - **Use similar form as for EWR 127-1**
- **(A1.2.3) Publication of AFSPCMAN 91-710 [T]**
  - **The goal for final publication of an AFSPCMAN 91-710 [T] is as soon as possible, but should be no later than 30 days after the CDR. Tailoring can be an ongoing process.**
  - **Final publication will follow the format requirements of Section A1.2.3.2**

Tailoring Process AFSPC MAN 91-710

- **Final Publication includes:**
  - **Assumptions - A preface paragraph detailing the critical assumptions that were made in writing the tailored edition.**
  - **Management Summaries – Specifically identifying deletions, changes, and additions.**
  - **Tailoring Requests**

Approval Process AFSPC MAN 91-710

- **Tailoring Not impacting Public Safety (A1.2.4.3)**
  - **Signed by the appropriate Range Safety section chief or a designated representative and the appropriate Range User representative.**
  - **A1.2.4.3. Tailored volumes not affecting public safety are normally Volumes 3, 5, and 6**
- **Tailoring Impacting Public Safety (A1.2.4.2 & A1.2.4.4)**
  - **Volumes are signed by the Chief of Safety; Complete 91-710[T] is signed by the Space Wing Commander and the Range User**
  - **A1.2.4.2. Tailored volumes affecting public safety are normally Volumes 1, 2 and 4**

Summary

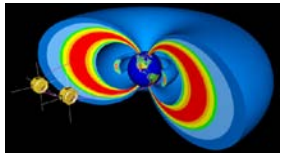
UNCLASSIFIED

- Range Safety is ready to support tailoring of AFSPC MAN 91-710
- Copies of the document are on the Internet at

http://www.e-publishing.af.mil/

Click on “Air Force Space Command” then “Safety” to access.

Eric Herrburger
45 SW/SEAL
Patrick AFB, FL
Phone: 321/494-2417
Fax: 321/494-6535
e-mail: Eric.Herrburger@patrick.af.mil

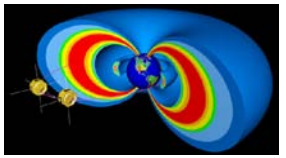


Radiation Belt Storm Probes (RBSP)

Launch Services Safety Overview

Chuck Loftin
Senior System Safety Engineer
NASA/KSC Launch Services Division
9 October 2008

Safety Roles & Responsibilities

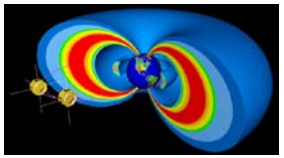


NASA/KSC Launch Services Division Safety (SA-D) services include…

- Assessing the safety of the launch vehicle
- Assessing the safety of NASA ELV spacecraft (S/C) / launch vehicle (LV) interfaces
- Assessing the safety of spacecraft processing to ensure resource protection of:
  - KSC facilities
  - KSC VAFB facilities
  - KSC controlled property
  - Other NASA assets
- NASA personnel safety
- Interfacing with payload organizations to review spacecraft for adequate safety implementation and compliance for integrated activities
- Assisting in the integration of safety activities between the payload, launch vehicle, and processing facilities

All organizations are responsible for the safety of their personnel in all facilities

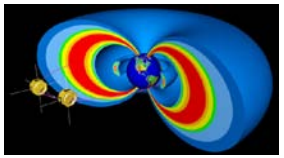
KSC Safety Activities



Safety Activities are defined by:

- NASA-STD-8709.2 – *NASA Safety and Mission Assurance Roles and Responsibilities for Expendable Launch Vehicles*
- NPD 8610.23 – *Launch Vehicle Technical Oversight Policy*
- NPR 8715.7 – *Expendable Launch Vehicle Payload Safety Program*
- NPD 8700.3 – *SMA Policy for NASA Spacecraft, Instruments, and Launch Services*
- AFSPCMAN 91-710 – *Eastern and Western Range Safety Requirements*

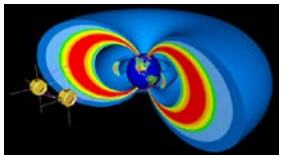
KSC Safety Activities



Activities can include:

- Safety data package review/approval for flight hardware, GSE, & processing activities
- Approval of hazardous procedures and audit of non-hazardous procedures
- Validation of customer implementation of procedural and operational controls
- Verification of facility walk-downs and training
- Chairperson of Payload Safety Working Group (PSWG)
- Support of Design Reviews, Working Groups, Technical Interchange Meetings, etc.
- Support real-time resolution of safety issues during processing
- Review/Approval of safety variances

Payload Processing at Commercial Facility



LS Division Safety roles:

- SOW Requirements
  - NASA FAR Safety Requirements
  - Safety and Health Plan
  - Mishap Reporting
- Facility/Operational Safety Requirement Tailoring
  - Incorporate applicable Range Requirements, NASA Standards, User Requirements
- Certification of Facility Readiness (CoFR)
  - Document review, Audits, Facility Walkdown
  - Facility GSE and Safety Systems
- Ground Operations Review (GOR)
- Performance Evaluation
  - User Feedback
  - Surveillance

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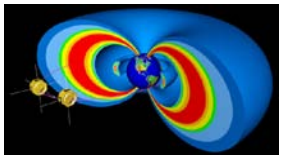
Safety Responsibilities at the PPF and Launch Site



Launch Services Division Safety

S/C Processing Facility ⟷ Launch Complex

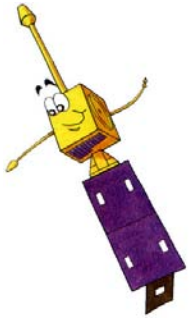
USAF Range Safety
Public Safety/Base Safety/Launch Site Safety

NASA S/C Center & Contractor Safety & Mission Assurance

Payload Processing Facility
Facility Resource Protection/Safety Control Authority

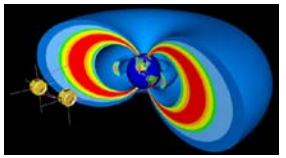
NASA KSC Safety & Mission Assurance
KSC Resource Protection; LV – S/C Integration SMA; LV SMA

LV – S/C Integration



Launch Vehicle Contractor
LV SMA; LV – S/C Integration SMA

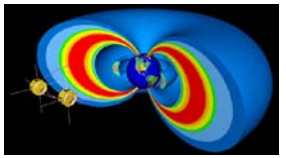
Compliance Documents



Mission, Range, and Processing Location determine applicable requirements

- NASA FAR supplement defines requirements for safety & health plan and mishap reporting
- OSHA defines personnel safety, Process Safety Management, etc.
- NPR 8715.7 defines the safety program for NASA ELV payloads
- NASA and KSC requirements and standards (i.e. NPR 8715.3) define system design and operational requirements for NASA facilities and NASA designed hardware
- KNPR 8715.3 defines operational safety requirements for processing/operations on KSC facilities (VAFB SLC-2W, KSC PHSF, etc..)
- AFSPCMAN 91-710 defines safety requirements for Eastern & Western range users
- MIL and industrial standards (e.g. ANSI, ASME, IEEE, ACGIH) may be contractually required

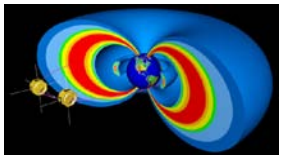
Safety Requirements and Standards



NASA Safety Documents

- NPR 8715.3*, NASA General Safety Program Requirements*
- NPR 8715.7, *Expendable Launch Vehicle Payload Safety Program*
- NASA-STD-8719.9, *Standard for Lifting Devices and Equipment*
- NASA-STD-8719.13, *Software Safety Standard*
- NPR 8621.1, *NASA Procedures and Guidelines for Mishap Reporting, Investigating, and Recordkeeping*
- NSS 1740.12, *Safety Standard For Explosives, Propellants, And Pyrotechnics* (Will soon be known as NASA-STD-8719.12)
- NASA-STD-8719.14, *Process for Limiting Orbital Debris*

Safety Requirements and Standards



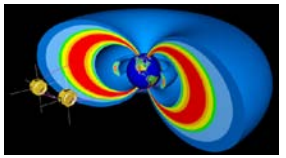
KSC Safety Documents

- KNPR 8715.3, *KSC Safety Practices – Procedural Requirements*
- KTI 5212, *Material Selection List for Plastic Films, Foams, and Adhesive Tapes*
- KNPR 1860.1, *KSC Ionizing Radiation Protection Program*
- KNPR 1860.2, *KSC Non-ionizing Radiation Protection Program*

Government

- Title 29 CFR 1910, *Occupational Safety and Health Administration*
- Title 49 CFR, Parts 171 to 178, *Transportation, Department of Transportation*
- National Fire Codes (NFPA)

NPR 8715.7 Safety Program Reviews



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Launch Services Division Safety

NASA Life Cycle Phases	FORMULATION		Approval for Implementation	IMPLEMENTATION			
	Pre-Systems Acquisitions			*Systems Acquisition*		*Operations*	*Decommissioning*
Project Life Cycle Phases	Pre-Phase A: Concept Studies	Phase A: Concept & Technology Development	Phase B: Preliminary Design & Technology Compensation	Phase C: Final Design & Fabrication	Phase D: System Assembly, Int & Test, Launch	Phase E: Operations & Sustainment	Phase F: Closeout/Recovery
Project Life Cycle Gates & Major Events	KDP A FAD Draft Project Requirements	KDP B Preliminary Project Plan	KDP C Baseline Project Plan	KDP D	KDP E Launch	KDP F End of Mission	Final Archival of Data
Mission Project Reviews	MCR	SRR MDR	PDR	CDR SIR	ORR PRE-SHIP	FRR LRR PLAR CERR	DR
ELV Payload Safety Process Major Events			**PSI SR I SR II**		**SR III**		

Acronyms

KDP – Key Decision Point
FAD – Formulation Authorization Document
MCR – Mission Concept Review
SRR – System Requirements Review
MDR – Mission Definition Review
PDR – Preliminary Design Review
CDR – Critical Design Review
SIR – System Interface Review
ORR – Operational Readiness Review
PRE-SHIP – Review prior to shipment to launch site
FRR – Flight Readiness Review
LRR – Launch Readiness Review
PLAR – Post-Launch Assessment Review
CERR – Critical Events Readiness Review
DR – Decommissioning Review

(For Description See NPR 7120.5)

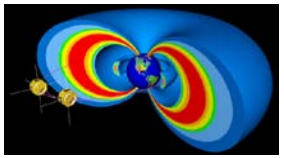
ELV Payload Safety Process Major Events

PSI – Payload Safety Introduction Briefing
SR I – Safety Review One
SR II – Safety Review Two
SR III – Safety Review Three

Summary of Safety Process Deliverables by payload project (see sect. 2.4.2)

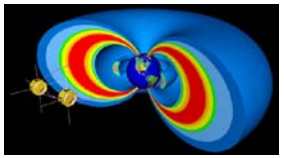
Submitted at PSI:	Due ≥ 30 days prior to SR I:	Due ≥ 30 days prior to SR II:	Due ≥ 60 days prior to SR III:
1. Applicable safety requirements docs, past approved waivers, & known tailoring issues 2. Draft Systems Safety Plan 3. Preliminary hazard list 4. Ground Operations Flow Overview	1. Final System Safety Plan 2. Tailored Payload Safety Requirmenents 3. Safety Datat Package I	1. Safety Data Package II 2. Final Tailored Safety Requirements Due at SR II: 1. Safety Actions Tracking	1. Safety Data Package III Due at SR III: 1. Safety Verifications Tracking Log 2. Safety Actions Tracking Log 3. Certificate of Safety Compliance

NPR 8715.7 Safety Review I



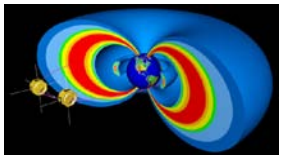
- Begins prior to PDR & completed ≤ 60 days after PDR or as necessary ensuring PSWG's timely input to Key Decision Point C
- PSWG meeting in conjunction with PDR
- Payload project submittals due ≤30 days prior to the PDR meeting:
  - Final System Safety Plan
  - Tailored Payload Safety Requirements
  - Safety Data Package I
- PSWG shall:
  - Approve the final System Safety Plan
  - Discuss comments of Safety Data package I
  - Discuss the Tailored Payload Safety Requirements
  - Assess Preliminary Hazard Analysis and any Hazard Reports
  - Address any safety issues from PDR
- The PSWG Chairperson shall provide the Payload Project Manager with:
  - Status of Safety Review I including any safety concerns following the PDR meeting
  - Assessment of the project's safety efforts and identification of any safety concerns to support the project's Key Decision Point C

NPR 8715.7 Safety Data Package I



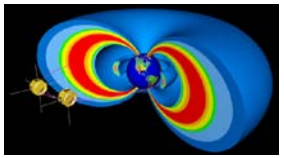
- Descriptions of hazardous and safety critical flight hardware and software, systems, components, materials, and GSE that reflects the PDR-level design and operations scenario
- A description of the payload and mission
- Initial descriptions of all payload systems including hazardous and safety critical subsystems, their operation, and interfaces
- Preliminary hazard reports and summaries of the hazard analyses
- Information identifying compliance to the Tailored Payload Safety Requirements
- For previously launched buses, identification and description of safety-related problems, mishaps, or failures that occurred during fabrication, testing, processing, or integration that could affect the safety of the flight hardware or software, GSE, personnel, or other NASA resources

NPR 8715.7 Safety Review II



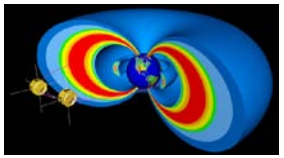
- Begins prior to CDR & completed ≤ 60 days after CDR or as necessary ensuring PSWG's timely input to Key Decision Point D
- PSWG meeting in conjunction with CDR
- Payload project submittal items due ≤30 days prior to the CDR meeting:
  - Safety Data Package II
  - Final Tailored Payload Safety Requirements
- Payload project submittal items due at CDR:
  - Safety Action Tracking Log for review and concurrence to close completed actions
- PSWG shall:
  - Discuss comments of Safety Data Package II
  - Address any safety issues from CDR
  - Review the project for any changes to the design, processing, or interfaces for new or increased hazards or safety issues
- The PSWG Chairperson provides the Payload Project Manager with:
  - Status of Safety Review II including any safety concerns following the CDR meeting
  - Assessment of the project's safety efforts and identification of any safety concerns to support the project's Key Decision Point D

NPR 8715.7 Safety Data Package II



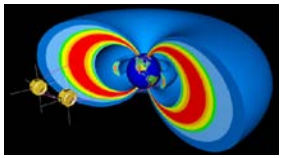
- Updated Safety Data Package I information that reflects the CDR-level design & operations
- Updated description of payload & mission
- Updated Hazard Reports
- Descriptions of hazardous and safety critical subsystems, their operation, and updated methods of compliance to the Tailored Payload Safety Requirements
- Detailed information of safety features, inhibits, monitoring systems, and their control and status during all processing phases
- Supporting plans, studies, and reports (provided or referenced), upon request
- Description of GSE, summary of hazardous, non-hazardous, and safety critical operations, list of hazard reports, and supporting hazard analyses for operations performed in NASA facilities, NASA contracted facilities, and launch site facilities (i.e., Ground Ops Plan)
- A cross-reference identifying the disposition of review comments and indicating any changes

NPR 8715.7 Safety Review III



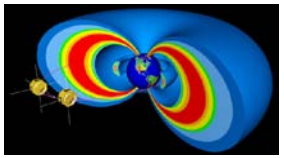
- Begins with data submittal & completed at a PSWG meeting held ≥5 business days prior to LSP's Ground Operations Review
- Payload project submittals:
  - Safety Data Package III
    - Due ≥ 60 days prior to Safety Review III
    - Finalized ≤ 30 days before hardware shipment to processing site
  - Safety Action Tracking Log
  - Safety Verification Tracking Log
  - Certificate of ELV Payload Safety Compliance
- PSWG verifies that all safety requirements have been satisfied or will be satisfied and waivers have been approved
- The PSWG Chairperson and the ELV Payload Safety Manager shall sign the Certificate of ELV Payload Safety Compliance indicating that the project has completed the safety approval process
- The ELV Payload Safety Manager shall provide the Payload Project Manager with a letter ≤ 5 days after successful completion of Safety Review III. The letter shall:
  - Indicate that the project has successfully completed the payload safety review process per this NPR
  - Include a copy of the signed Certificate of ELV Payload Safety Compliance
  - Identify any conditions or constraints applicable to the safety approvals

NPR 8715.7 Safety Data Package III



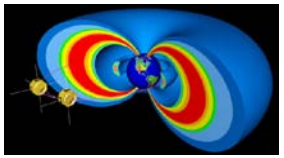
- Includes all the Safety Data Package updates with all comments addressed, incorporate all changes that reflect the as-built configuration and planned processing activities
- As-built description of payload and mission
- Final Hazard Reports
- Updated descriptions of hazardous and safety critical subsystems
- Updates to supporting plans, studies, and reports; required summaries of test results provided upon request
- Record of test failures, anomalies, mishaps involving qualification hardware, flight hardware, GSE, software (if used for hazard control), and an assessment of the resolution and safety implications of these events
- A signed copy of approved safety waivers
- A cross-reference identifying the disposition of review comments since previous submittal and indication of any changes

Safety Verification Tracking Log (SVTL)



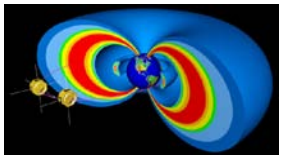
- Documentation (in a tabular format) of the status of safety verifications identified in the Hazard Reports
- Information for each safety verification:
  - tracking number
  - brief description of the verification,
  - Hazard Report number(s)
  - Any constrained operation(s)
  - If independent verification is needed
  - Scheduled and actual completion dates
  - Method of closure, status, and any comments
- “Closed” - mitigations are in place and that the safety risk is controlled as specified in the Hazard Report. Safety verifications often are best performed at a certain time in the payload processing flow.
- Submitted at Safety Review III and used to ensure the completion of safety verifications even after transportation to the launch area processing site

Safety Data Requirements/Milestones



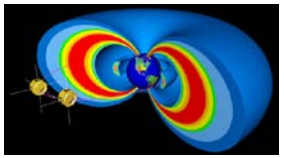
Description	Action By	Review	Requirement	Submittal Requirements
System Safety Program Plan (SSPP)	S/C	PSWG	NPR 8715.7; AFSPCMAN 91-710	- Draft due for Mission/Concept Briefing - Final due 30 days prior to PDR (part of Safety Review I)
Safety Intro/Concept Briefing	S/C	PSWG, et.al.	NPR 8715.7; AFSPCMAN 91-710	- Mission Kickoff
Requirements Tailoring	S/C	PSWG	NPR 8715.7; AFSPCMAN 91-710	- Due 30 days prior to PDR (part of Safety Review I)
S/C Safety Data Package I	S/C	PSWG	NPR 8715.7; AFSPCMAN 91-710	- Due 30 days prior to PDR (part of Safety Review I)
Preliminary Design Review (PDR)	S/C	PSWG	NPR 8715.7; AFSPCMAN 91-710	
Safety Review I	S/C	PSWG	NPR 8715.7	- Safety Data Package I due 30 days prior to PDR
Payload Safety Working Group (PSWG) meetings	S/C	PSWG	NPR 8715.7	- PDR, CDR, GOWGs, and as requested
S/C Safety Data Package II	S/C	PSWG	NPR 8715.7	- Due 30 days prior to CDR (part of Safety Review II)
Preliminary S/C Plastic Films, Foams & Adhesives (PFA) List	S/C	PSWG	KTI-5212; NPR 8715.7; AFSPCMAN 91-710	- Due 30 days prior to CDR (part of Safety Review II)

Safety Data Requirements/Milestones



Description	Action By	Review	Requirement	Submittal Requirements
Critical Design Review (CDR)	S/C	PSWG	NPR 8715.7; AFSPCMAN 91-710	
Safety Review II	S/C	PSWG	NPR 8715.7	- Safety Data Package II due 30 days prior to CDR
S/C Safety Data Package III	S/C	PSWG	NPR 8715.7 AFSPCMAN 91-710	- 90 days prior to S/C shipment (part of Safety Review III)
Final S/C Plastic Films, Foams & Adhesives (PFA) List	S/C	PSWG	KTI-5212 NPR 8715.7; AFSPCMAN 91-710	- Due 90 days prior to S/C shipment (part of Safety Review III)
Safety Verification Tracking Log (SVTL)	S/C	PSWG	NPR 8715.7	- 90 days prior to S/C shipment (part of Safety Review III)
Safety Review III	S/C	PSWG	NPR 8715.7	- Safety Data Package III due 90 days prior to S/C ship
S/C Safety Data Package III Approval	PSWG	PSWG	NPR 8715.7; AFSPCMAN 91-710	- 30 days prior to S/C shipment (end of Safety Review III)
Certificate of ELV Payload Safety Compliance	PSWG Chair, ELV Payload Safety Manager	PSWG	NPR 8715.7	- 30 days prior to S/C shipment (end of Safety Review III)

Safety Data Requirements/Milestones



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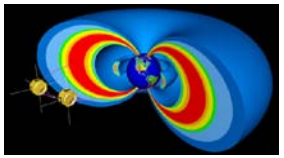
Launch Services Division Safety

Description	Action By	Review	Requirement	Submittal Requirements
S/C Hazardous Procedures	S/C	KSC, RS	KNPR 8715.3; AFSPCMAN 91-710	- 55 Days prior to use
S/C Waivers, Variances	S/C	PSWG	NPR & KNPR 8715.3; AFSPCMAN 91-710	- As needed (should be identified during the tailoring process)
LV Material Use Authorization	LV	PSWG	KNPR 8072.1; KNPR 8715.3; AFSPCMAN 91-710	
LV Mission-Unique MSPSP	LV	PSWG	AFSPCMAN 91-710	- NLT 45 days prior to H/W Shipment to Range
Radiation Use Authorization Request	S/C; LV	RPO	KNPR 1860.1; AFSPCMAN 91-710	- 4 Months prior to S/C arrival at processing site
LV Hazardous Procedures	LV	KSC, RS	EWR 127-1 or AFSPCMAN 91-710	- 55 Days prior to use
LV Waivers, Variances	LV	KSC, RS	EWR 127-1 or AFSPCMAN 91-710	
Ground Operations Review (GOR)	KSC	S/C, KSC		- 30 days prior to S/C ship
Mishap Reports	S/C; LV; PPF		KNPR 8715.3; NPR 8621.1B	- ASAP/within requirements
Safety & Mission Success Review (SMSR)	KSC & S/C	HQ Code Q	OSMA-SMARR-05-01	- L-30 days

LSP Portal: ELV Payload Safety Mission Documentation



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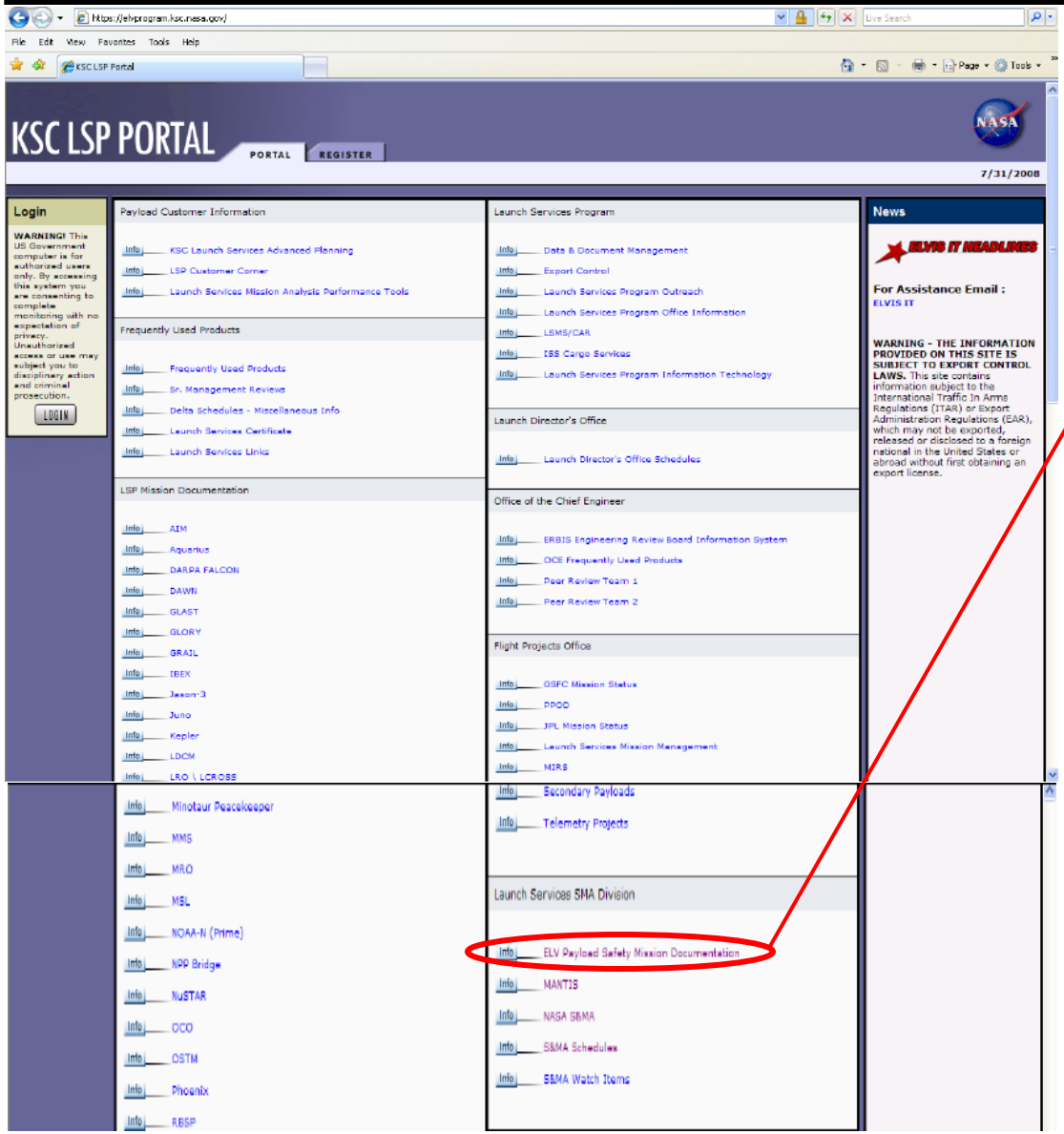
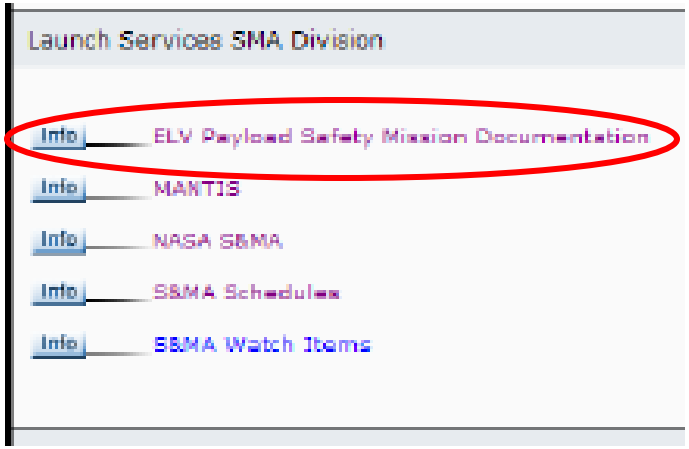
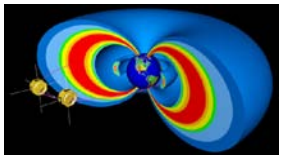
Launch Services Division Safety





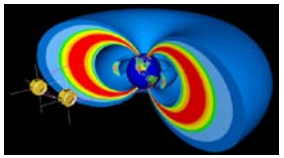
Payload Safety Working Group



The Payload Safety Working Group (as chartered by NPR 8715.7), is the "Round Table" of ELV Payload Safety

- Designed to ensure appropriate involvement and coordination of all organizations that support the associated mission and share safety responsibility for the mission
- Ensures compliance with safety requirements that apply to the payload
- Provides clear and useful guidance to the Payload Project Office
- Proactively works with the project to identify potential hazards and safety issues and advises on strategies for early abatement, mitigation, or resolution
- Provides a common and uniform ELV payload safety process
- All members have an equal say
- KSC Safety will act as PSWG Chairperson; the chair does not have an overriding veto
- Not as regimented as many safety panels
  - Informal atmosphere
  - All welcome to speak at any time about any relevant safety topic

Payload Safety Working Group

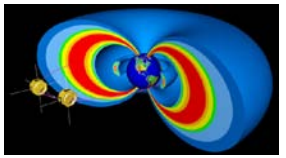


- **PSWG involvement includes:**
  - **Requirements tailoring**
  - **Approvals**
  - **Safety Plan Development**
  - **Safety Data Package Development**
  - **Safety Data Package reviews**
  - **Specialized safety working groups**
  - **General safety topics discussion**
  - **Safety action items**

- **Functions as both a panel and as a working group**

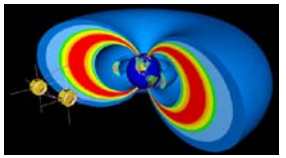
- **Working groups can be held at anytime at the request of any PSWG member by face-to-face meetings or telecons**

KSC Safety



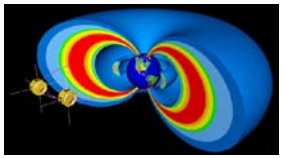
- **Things KSC Safety likes to see:**
  - **Plastic films, foams, and adhesive tapes (PFAs) to be used identified and submitted as soon as they are known**
  - **Hazard reports in Data Packages**
    - **Timely submittal of safety verification tracking log (SVTL) statuses**
  - **Safety analyses addressing KSC lessons learned**
  - **A Payload Organization safety representative at the launch site during S/C hazardous operations**
  - **Access to spacecraft propellant fill and drain valves through the payload fairing for contingency offloading**

KSC Safety



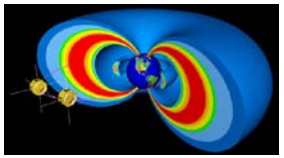
- **Things KSC Safety Does Not like to see:**
  - **Safety variances stating schedule and/or cost as the only driving factor(s)**
  - **GSE, PFAs, test plans, etc. that show up at the launch site that were not approved through the PSWG process**
  - **Launch site processing being performed before approvals**
  - **Non-safety personnel performing safety assessments**
  - ***"…but XYZ payload didn't have to…"***
  - **The use of older safety requirements because of convenience**

Contingency Planning



- **NASA Launch Services Program (LSP) Mishap Preparedness and Contingency Plan (MPCP)**
  - Developed by Launch Services Division SMA for each mission.
  - Effective from Countdown Call-To-Stations through end of Launch vehicle mission.
  - Identifies specific immediate actions that NASA Launch Team personnel take in response to a launch mishap including:
    - Establishment of an Interim Response Team (IRT)
    - Mishap notification
    - Mishap Coordination with Launch Range
    - Coordination and release of public information
    - Mishap response teleconferences
    - Data impoundment at all locations where NASA and spacecraft personnel support launch operations
    - Witness statement collection

Points of Contact

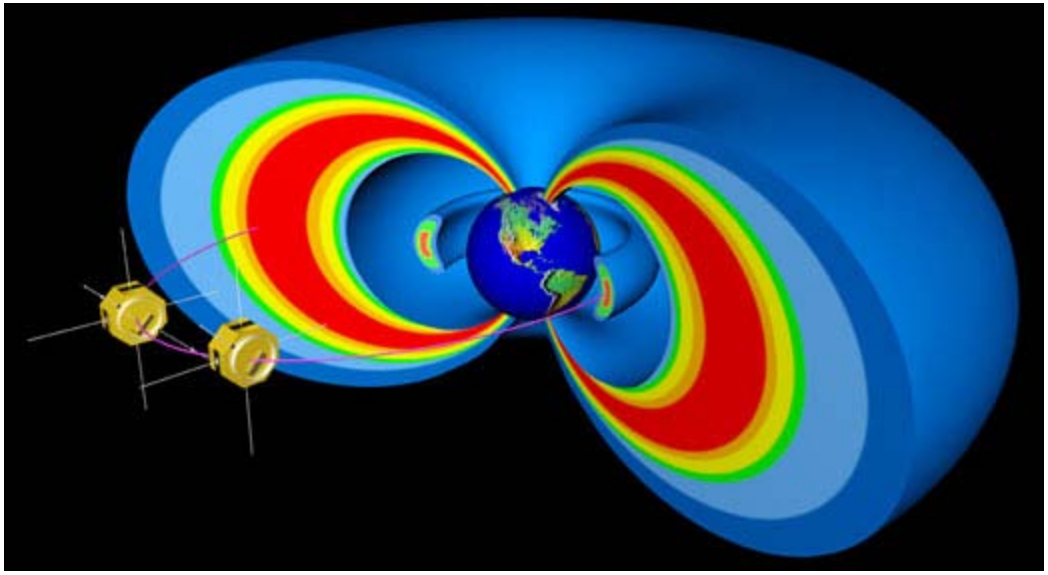


NASA/KSC Launch Services Division Safety Contacts

System Safety: Chuck Loftin
Phone: (321) 867-8797
Email: charles.e.loftin@nasa.gov

System Safety Back-up: Don Brandl
Phone: (321) 867-0830
Email: donald.e.brandl@nasa.gov

Contingency Planning: Harold Donald
Phone: (321) 867-3393
Email: harold.h.donald@nasa.gov



Radiation Belt Storm Probes (RBSP) Payload Safety Introduction Briefing

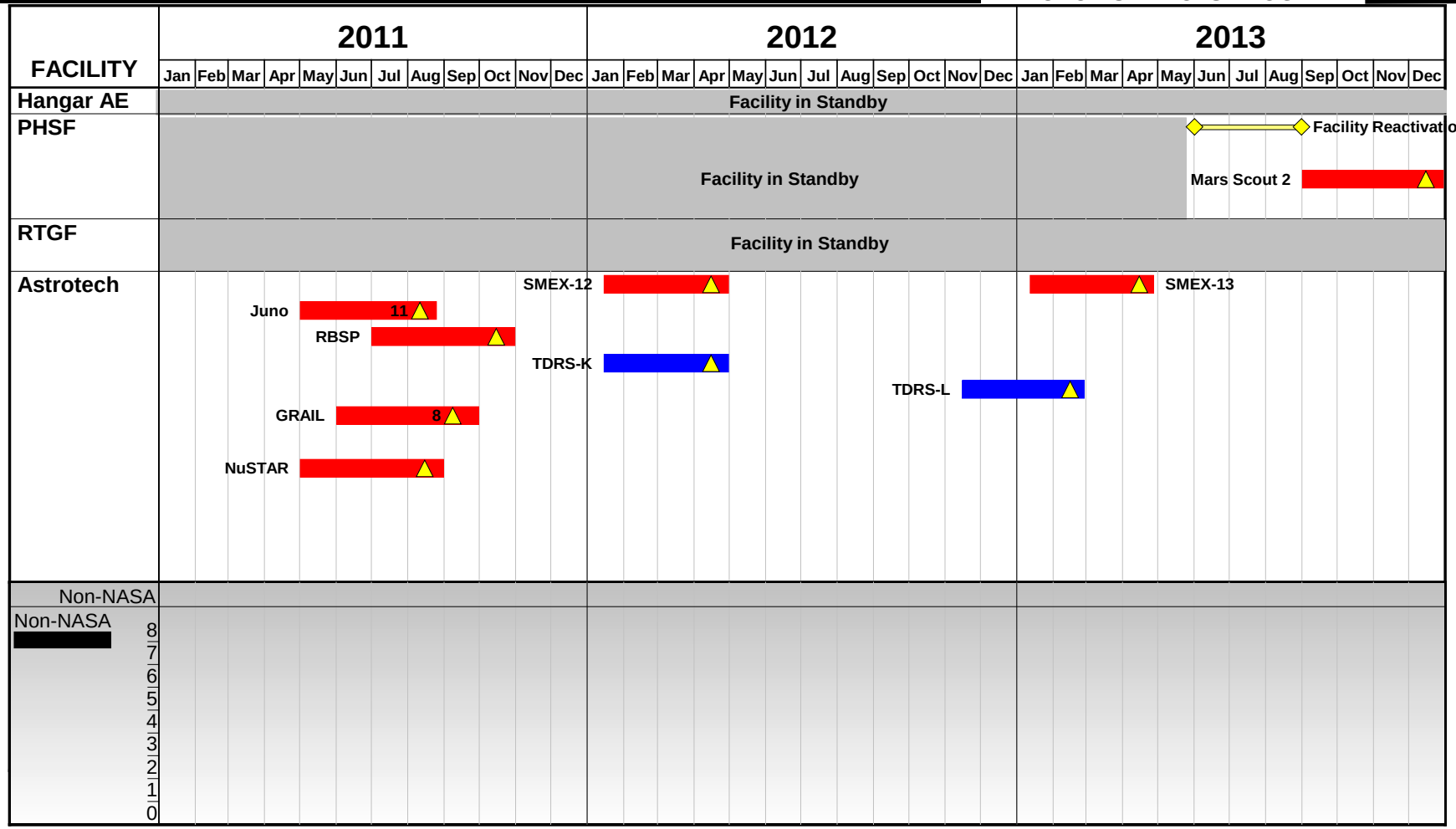
Dianna Lampert
October 9, 2008

KSC Payload Facility Utilization Plan
July 2008

Manifests:
LSP: FPB 07/01/08
Plan to Manifest: 07/09/2008

John F. Kennedy Space Center

LAUNCH SERVICES PROGRAM

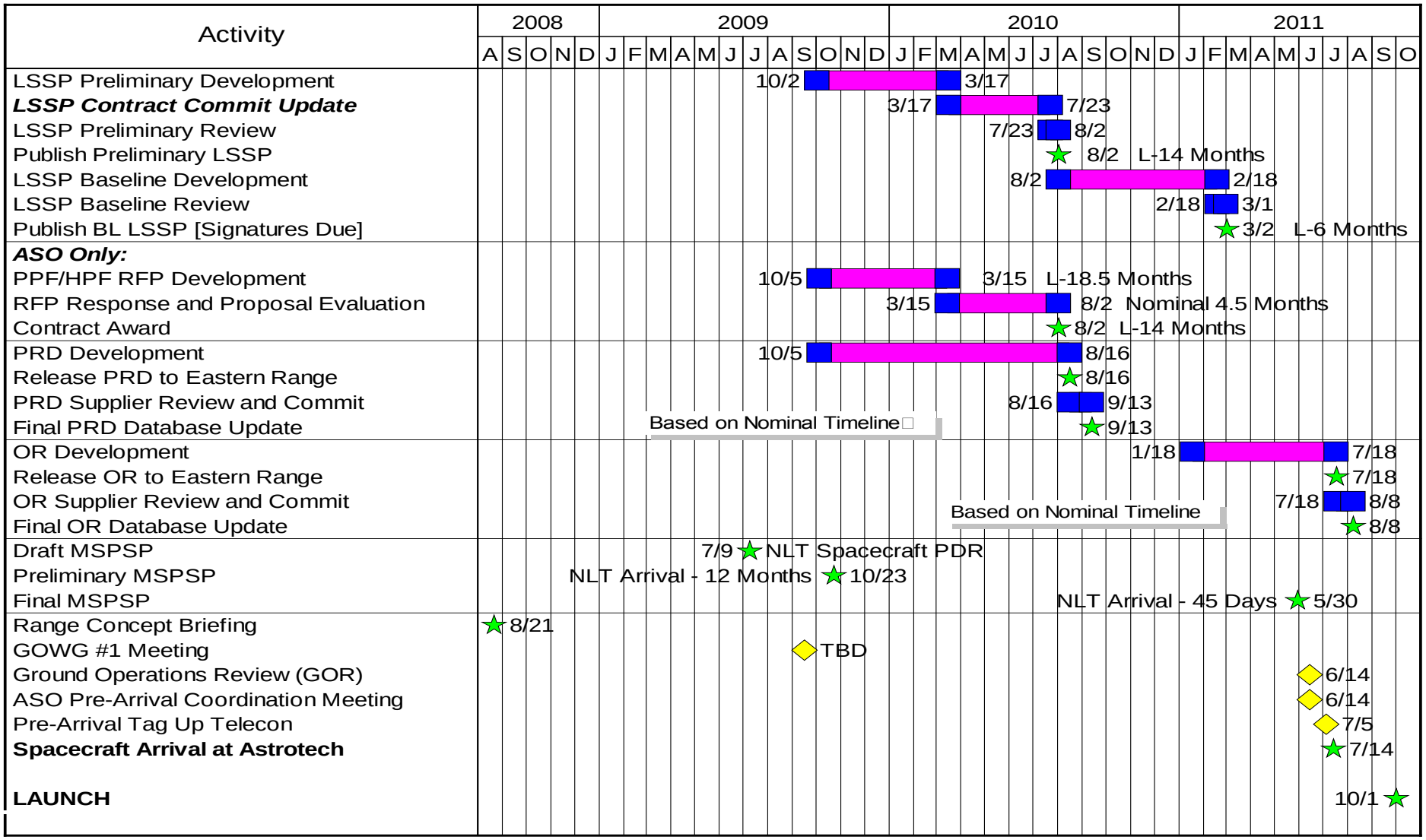


Science
Exploration Systems
Space Operations
Dept. of Defense (DOD)
ELV
Shuttle
Launch
U/R - Under Review
Conflict
Maintenance/Modifications

RBSP Launch Site Planning Schedule

John F. Kennedy Space Center

LAUNCH SERVICES PROGRAM



RBSP Deliverables List

John F. Kennedy Space Center

LAUNCH SERVICES PROGRAM

NASA Launch Services Program (LSP) Vehicle Program Deliverables
Launch Service Contractor = [**Launch Vehicle** Contractor **TBD**]
Rev. Date = 8-12-2008

First Support Date 7-14-2011
Launch Date 10-01-2011

Track #	Item	Requirement	Submittal Time	Need Date
RBSP-1	Provide Mission Concept Briefing to Range Safety, Establish Payload Safety Working Group (PSWG), & Discuss possible tailoring of Range Safety Requirements **Note 1**	AFSPCMAN 91-710 & NASA STD-8719.8	24 – 48 months prior to launch	8-21-2008
RBSP-2	Present or Submit Systems Safety Program Plan (SSPP) If NOT presented at P-1 (above) and Discuss possible tailoring of Range Safety Requirements **Note 1**	AFSPCMAN 91-710 NASA STD 8719.8	24 - 48 months prior to launch (Prefer NLT spacecraft CDR)	
RBSP-3	Submit DRAFT Missile Systems Prelaunch Safety Package (MSPSP) **Note 1**	AFSPCMAN 91-710 & NASA STD-8719.8	24 – 36 months prior to launch (Prefer NLT spacecraft CDR)	7-09-2009
RBSP-4	Provide requirements to LSIM for Preliminary LSSP **Note 2**	LSP-UG-332.01	14 - 18 months prior to launch	4-01-2010
RBSP-5	Submit Preliminary MSPSP **Note 1**	AFSPCMAN 91-710 & NASA STD-8719.8	Preferred 45 days after Spacecraft CDR (but NLT 12 months < arrival)	10-23-2009
RBSP-6	Submit Non-Standard Security Requirements (COMSEC, RTGs, etc.)	NPR 1600.1	12 - 14 months prior to launch	8-01-2010
RBSP-7	Submit Launch Site Contamination Control Plan or Special Requirements	Mission Specific	12 - 14 months prior to launch	8-01-2010
RBSP-8	Submit preliminary launch vehicle processing team computer networking requirements	Mission Specific	12 – 14 months prior to launch	8-01-2010
RBSP-9	Submit list (& test samples as required) of GSE plastics, films, & adhesives used	KTI-5212	8 – 12 months prior to launch	10-01-2010
RBSP-10	Provide input to Publish Baseline LSSP	LSP-UG-332.01	8 – 10 months prior to launch	12-01-2010
RBSP-11	Submit Personnel badging information for Launch Service Contractor personnel requiring KSC Facility Access (Unescorted TAA)	KNPR 1600.1	8 months prior to arrival	11-14-2010
RBSP-12	Provide final inputs/signature for Baseline LSSP release	LSP-UG-332.01	7 months prior to launch	3-02-2011
RBSP-13	Identify and Submit Program POC for Waste Management	LSP-UG-332.01	6 months prior to arrival	1-14-2011
RBSP-14	Submit Radio Frequency Authorization/Coordination Forms (S. Schindler)	KNPR 2570.1	4 months prior to arrival	3-14-2011
RBSP-15	Submit Use Authorization Form (ionizing & non-ionizing radiation use in KSC facility)	KNPR 1860.1 & KNPR 1860.2	4 months prior to arrival	3-14-2011
RBSP-16	Submit list of all launch vehicle PPF/HPF procedures (Hazardous & Non-Hazardous)	AFSPCMAN 91-710 & NASA STD-8719.8	90 days prior to arrival	4-14-2011
RBSP-17	Submit Process Waste Questionnaires (KSC Form 26-551) or Chemicals List for commodities brought to Commercial PPF (if list NOT included in MSPSP)	KNPR 8500.1 OR SHI-ASO-M0008	60 days prior to arrival	5-13-2011
RBSP-18	Submit Launch Vehicle Hazardous Standalone Procedures **Note 3**	KNPR 8715.3 / AFSPCMAN 91-710	55 days prior to **first use**	5-23-2011
RBSP-19	Submit Final MSPSP	AFSPCMAN 91-710	45 days prior to arrival	5-30-2011
RBSP-20	Submit Non-U.S. Persons badging information for KSC Visitor badge (Must be Escorted at all times on KSC & CCAFS.)	KNPR 1600.1	45 days prior to visit date	5-30-2011
RBSP-21	Submit Final transportation Plan & Arrival day Badging request	LSP-UG-332.01	30 days prior to arrival	6-14-2011
RBSP-22	Submit Material Safety Data Sheet (MSDS) - For ASO can be NLT 14 days < arrival	KNPD 1800.2 SHI-ASO-M0008	30 days prior to arrival	6-14-2011
RBSP-23	Submit Waste Management Training Memo – Not required for ASO	KNPR 8500.1	30 days prior to arrival	N/A
RBSP-24	Participation in Ground Operation Review (GOR)	LSP-UG-332.01	30 days prior to arrival	6-14-2011
RBSP-25	Submit Personnel Medical Certifications (Cranes, Propellant, Ordnance Handling) or Personnel Operational Training Certification/Letter (for ASO)	LSP-UG-332.01 OR SHI-ASO-M0008	30 days prior to arrival	6-14-2011

RBSP Deliverables List

John F. Kennedy Space Center

LAUNCH SERVICES PROGRAM

NASA Launch Services Program (LSP) Vehicle Program Deliverables
Launch Service Contractor = [**Launch Vehicle** Contractor **TBD**]
Rev. Date = 8-12-2008

First Support Date 7-14-2011
Launch Date 10-01-2011

Track #	Item	Requirement	Submittal Time	Need Date
RBSP-26	Submit Process Safety Management Certification (OSHA 29CFR1910.119) – if NOT included in MSPSP	AFSPCMAN 91-710	Prior to hardware shipment	7-07-2011
RBSP-27	Maintain Solvent Tracking Log - ASO Only	SHI-ASO M0008	Upon arrival	7-14-2011
RBSP-28	Submit Hurricane Plan (if at ASO, KSC, or CCAFS between June 1st and Nov 30th)	LSP-UG-332.01	Upon arrival	7-14-2011
RBSP-29	Submit Personnel Training Class Request(s) if needed to obtain TAAs for KSC Facilities	LSP-UG-332.01	30 days prior to need date	7-28-2011
RBSP-30	Provide Ordnance closeout photos and photos of hazardous components to Range Safety (If NOT already contained in Launch Vehicle MSPSP)	AFSPCMAN 91-710	30 days prior to transport to pad	8-19-2011
RBSP-31	Submit Permits for Welding/Hot Work (if needed)	KNPR 8715.3	1 week prior to need	As reqd.

General: Unique vehicle deliverables and tailored need dates may be developed by the LSIM and the LSC for each mission. Example: A highly sensitive spacecraft may require that a separate Launch Site Contamination Control Plan be submitted to the LSIM at L-TBD months.

Note:

1. The number of submittals, frequency, and submit dates are tailored for each program via the Range and NASA Safety Organizations. If Launch Service Contractor is processing flight hardware covered by an accepted MSPSP with the Range, then these items become N/A.

2. The LSSP publish and release dates are tailored for each mission. These LSSP support requirements define what KSC will provide in the payload processing facility to the Launch Service Contractor to support spacecraft processing and integration to LV mission hardware.

3. Only applies to Launch Vehicle hazardous procedures that will be conducted in the NASA provided processing facility.

Questions/Concerns/Action Items

- Any questions or concerns that need to be addressed
- Action Item Review and open issues
- Next Meeting