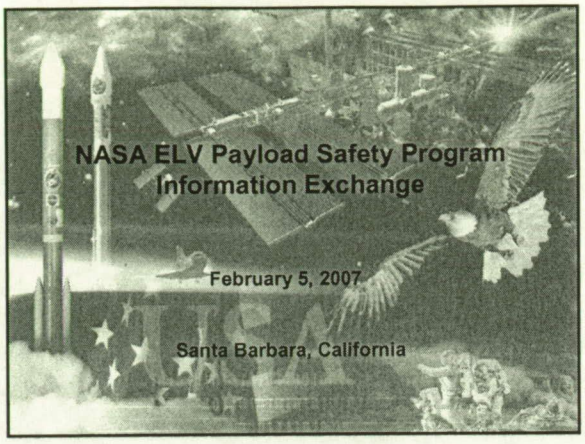


Introduction

- Welcome!
- Points of Contact:
  - Mike Dook, OSMA – Tel: (202) 358-0226; michael.dook@nasa.gov
  - Cal Staubus, NASA KSC - Tel: (321) 867-8757; calvert.a.staubus@nasa.gov
  - Tom Palo, NASA KSC – Tel: (321) 867-8726; thomas.e.palo@nasa.gov
  - Shawn Donovan, SRS Technologies – Tel: (321) 867-6240; shawn.t.donovan@nasa.gov
  - Marv Becker, SRS Technologies – Tel: (321)867-3266; marvin.l.becker@nasa.gov
  - Program Website: www.ksc.nasa.gov/elvpayloadsafety

Topics

- Background
  - Current NASA ELV Payload Safety Review Process Standard
  - Issues Needed to be Addressed by New Program
- New Program Development
  - Program Development Working Group
  - Program Development Executive Team
  - Accomplishments/Activities
  - Tasking and Funding
  - Schedule
- NPR 8715.3, Chapter 3, Payload Safety
  - NASA Payload Safety Policy
  - NASA ELV Payload Safety Program
    - Applicability
    - Roles and Responsibilities

Topics (continued)

- Proposed NPR 8715.XX, NASA ELV Payload Safety Program
  - Chapter 1, Program Overview
  - Chapter 2, Safety Review and Approval Process
    - Mission Roles & Responsibilities
    - Flow of Activities and Deliverables
    - Website
  - Chapter 3, Requirements
    - Design, Ground Operations, etc.
    - Variance
  - Training Program
- Open Discussion

Background

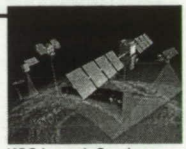
- NASA STD-8719.8, "ELV Payload Safety Review Process Standard, dtd June 1998 (scheduled for review June 2003)
  - Applies to Orbital and Deep Space ELV Missions (unmanned)
  - Focus on safety of processing at launch site, including payload processing facilities at or near launch site
  - Designed for missions involving numerous organizations and various vehicle/launch site combinations (derived from Shuttle PSRP/GSRP with appropriate differences)

Background (continued)

- NASA STD-8719.8 (continued)
  - Has been successful (with ad hoc changes) for a majority of NASA ELV payloads
  - Certain complications evolved after the Process was developed:
    - Complicated roles for projects involving multiple NASA Centers
    - Projects involving International Partners
    - Lack of approval process for use of common spacecraft bus
    - Lack of process for resolving dissenting opinions within NASA and with external organizations
    - Lack of acceptance of external approving authority and requirements

Background (continued)

Cloud-Aerosol LIDAR and Infrared Pathfinder Satellite Observation (CALIPSO) Spacecraft



Launched successfully from VAFB SLC2, April 2006

(Example) Entailed many administrative and technical complications

Highlighted weaknesses in current payload safety process

- Goddard Science Program – Langley Project – KSC Launch Services
- Co-manifested with CLOUDSAT – Led by Goddard
- NASA provided CALIPSO instrument – France provided spacecraft bus
  - "Off the shelf" hydrazine-fueled Proteus spacecraft manufactured by Alcatel Space Industries and provided by the Centre National d'Etudes Spatiales (CNES) as its "contribution" to the joint mission
  - Joint Mission Agreement – not your typical contract
- Proteus flown successfully in 2001 on the Jason-1 - led by JPL
- Goddard SMA and Engineering raised concerns with Proteus:
  - Fault tolerance for leakage of hydrazine, software safety, battery safety, others
- Resolution via Formal Variance Process:
  - Personnel safety ensured via implementation of NESC recommendations
  - Mission success risk accepted via NASA Variance

Background (continued)

- Current process requires a Payload Safety Working Group (PSWG) for each payload with representatives from all involved organizations:
  - PSWG membership by a Center/organization sometimes varies for the same mission, and from one mission to the next (even when a common, previously approved spacecraft bus is assessed)
  - Lack of communication between members within some organizations
  - Technical concerns sometimes handled differently for similar payloads (not necessarily a problem, but can be)
- Relies heavily on other agencies' requirements (e.g., Air Force)
  - Subject to other agencies' interpretation of requirements
  - Other agencies' safety focus perceived to vary when it is not their payload
  - NASA's authority is sometimes misunderstood and decisions challenged when using other agencies' requirements documents

Background (continued)

- Requires "Tailoring" of requirements for each payload
  - Subject to misunderstanding the process and benefits, and poor implementation
  - Current Process lacks the strict and consistent oversight from one project to the next needed for proper implementation
- Relies heavily on the ability of the PSWG to reach consensus
  - Current process does not identify a decision-making authority
  - No clear direction for when consensus cannot be reached
  - Resolution of contentious issues can drag-on until the "final hour"
  - No clear direction on the applicable Safety Variance Process

Background (continued)

- Summary of issues to be addressed by an Agency ELV Payload Safety Program:
  - Complicated roles and responsibilities associated with multi-partner projects
  - Working relationships and communications between all organizations involved in the payload safety process
  - Consistent interpretation and implementation of safety requirements from one project to the next
  - Consistent implementation of the Tailoring Process
  - Clearly defined NASA decision-making-authority
  - Bring Agency-wide perspective to each ELV payload project

Program Development

Program Development Working Group

- Established via Letter From Dr. Stamatelatos, March 24, 2004
- Open to all NASA Centers and other appropriate organizations

Current POCs

APL	Clay Smith	ARC	Susan Suffel
GRC	Bill Schoren	GSFC	Karen Fisher
HQ	Mike Dook, Steve Volz/SMD	JPL	Jim Lumsden
KSC	Cal Staubus, Tom Palo	JSC	Dean Moreland
LaRC	Jose' Caraballo	MSFC	Chris Cowart
WFF	Gerald Morris, Tom Moskios	30SW	Mike McCombs
45SW	Jeffrey Wethern		

- Provide technical expertise
- Provide Center's/organization's perspective
- Identify needs of future projects
- Participate in Program document development and other activities

Program Development (continued)

- Working Group Kickoff Meeting at KSC, May 22, 2004
  - Significant philosophical differences within the Group in areas such as:
    - Tailoring of requirements
    - Interpretation of requirements
    - Experiences working with Air Force and other Ranges
  - In general, members agree on need for NASA requirements and for improvements to the safety review and approval process
  - Perspectives Represented:
    - Spacecraft Design
    - Launch Operations
    - Contractor
    - Agency (appropriate project-to-project consistency)

Program Development (continued)

Executive Team (Established via letter from Bryan O'Connor, March 2006)

GSFC	Karen Fisher
KSC	Cal Staubus, Tom Palo
JPL	Jim Lumsden
HQ	Mike Dook

(Contractor support at GSFC and KSC by SRS Technologies)

- Draft Program Process/Requirements (NPD/NPR)
- Organize and facilitate Working Group activities
- Resolve Working Group comments
  - Striving to build consensus on Program Elements
  - HQ Chief, SMA has final decision
- Ensure Program is consistent with current Agency implementation of Technical Authority
- Coordinate with external organizations
  - Strive for a joint approval process with Air Force Range Safety

Program Development (continued)

Activities/Accomplishments

- Program Development Objectives and Concepts (Charter)
  - Helped to help resolve philosophical differences as a first step
- Fact Finding/Program Development Meetings During 2005 @ HQ, KSC, Patrick AFB, Vandenberg AFB, JPL, WFF, and JSC
- Briefed SMA Directors, August 11, 2005, on Objectives and the Program Concepts/Approach - Obtained OK to Proceed
- Published new Payload Safety Policy, Roles, and Responsibilities, September 2006:
  - NPR 8715.3, General Safety Program Requirements (Chapter 3)
  - Includes Agency Safety Policy applicable to all types of payloads
  - Establishes NASA ELV Payload Safety Program

Program Development (continued)

Approach

- Build on the current PSWG approach and augment as needed to address lessons learned
- New Agency Safety Program to Include:
  - Establish and maintain NASA ELV Payload Safety Policy, Roles and Responsibilities, and Associated Requirements
  - Ensure consistent interpretation of safety requirements
  - Define and oversee implementation of the safety review process
  - Provide payload projects with training, tools, and guidance
  - Identify Decision Making Authorities
    - Formal process for resolving differences within the PSWGs
    - Formal variance process
  - Enhance and formalize key partnerships (e.g., Air Force and other ranges, commercial launch service providers, etc.)

Program Development (continued)

Continuing Development/Implementation Led by KSC

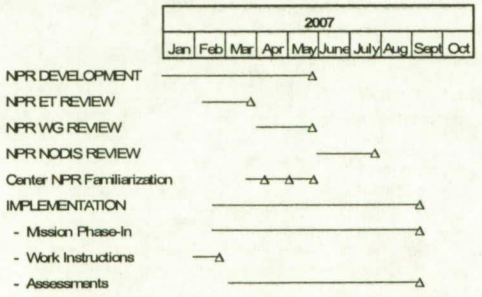
- Drafting new ELV Payload Safety Program specific NPR
  - Safety Review Process and Technical Requirements
  - Coordinate with all Center/Working Group Representatives
  - Review and Approval of NPR via NODIS
- Develop MOAs with 30th/45th SW for concurrence on NPR
- Ensure NPR written into contracts/agreements for ELV missions
- Developing Website, Tools, Training ...
- Implementation kick off activities with payload projects

Program Development (continued)

Tasking and FY06 Funding by OSMA

- KSC: ($300k) Safety Review Process Development, Overall Program Management, Executive Team Lead
  - Manager: Cal Staubus, Technical Lead: Tom Palo, Contractor: SRS
  - Developing: Tools and Training Program for project management and personnel
  - Coordinating with Range and other partners
  - Program Website: www.ksc.nasa.gov/elvpayloadsafety
    - Repository for applicable policy, requirements, standards, and guidance
    - Process schedules and checklists for use by payload projects
    - Status tracking of ELV payload projects
- GSFC: ($300k) Technical Requirements Development, Executive Team Member: Karen Fisher
- JPL: ($200k) Input to all Program Development Activities, Executive Team Member: Jim Lumsden
- GSFC: ($100k) ELV Payload Safety and Mission Success Conference

ELV Payload Safety Program Schedule



NASA Payload Safety Policy

- Published in Chapter 3 of NPR 8715.3, General Safety Program Requirements, September 2006
- Applies to all payloads controlled by NASA
- Distinguishes:
  - Manned Space Flight Payloads: Payloads that fly on, or interface with a manned space launch vehicle, spacecraft, or entry vehicle
  - Unmanned Suborbital Payloads: Payloads that fly on an unmanned suborbital vehicle (e.g., sounding rocket, balloon, or experimental aeronautical vehicle)
  - Return-to-Earth Payloads: Payloads that will return to Earth for recovery or purposes other than disposal
  - ELV Payloads: Unmanned orbital and unmanned deep space payloads
- Establishes the NASA ELV Payload Safety Program

NASA Payload Safety Policy (continued)

NPR 8715.3

3.13.4.1 Payload Safety Policy. It is NASA policy to safeguard people and resources (including flight hardware and facilities) from hazards associated with payloads controlled by NASA and hazards associated with payload-related Ground Support Equipment (GSE) by eliminating the hazards or reducing the risk associated with each hazard to an acceptable level. To accomplish this policy NASA shall:

a. Establish and maintain technical and procedural safety requirements applicable to the design, production, flight-area processing and testing, vehicle integration, flight, and planned recovery of NASA payloads.

b. Coordinate with U.S. or foreign entities that participate in NASA payload projects as needed to ensure compliance with all safety requirements that apply to each payload.

c. Incorporate all applicable safety requirements into the overall requirements for each NASA payload, the contracts for any related procurements, and any related cooperative or grant agreements.

d. Maintain an independent payload safety review and approval process designed to ensure that each NASA payload project properly implements all applicable safety requirements and to facilitate safety risk management appropriate to each payload.

NASA ELV Payload Safety Program

(As established in NPR 8715.3)

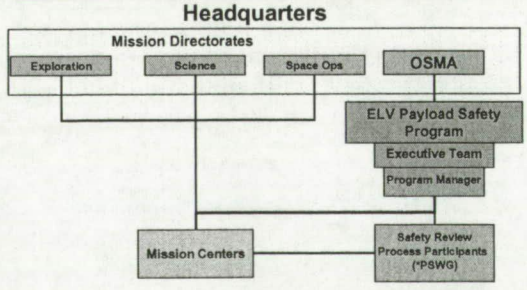
Applicability

- Applies to unmanned orbital and unmanned deep space payloads managed or launched by NASA whether developed by NASA or any contractor or independent agency in a joint venture with NASA
  - Does not apply to payloads that interface with a manned launch vehicle or spacecraft
  - Does not apply to payloads that will fly on suborbital launch vehicles
- Applies to ELV payload contracts, design, fabrication, testing, vehicle integration, launch processing, launch, and planned recovery of ELV payloads; payload provided upper stages flown on ELVs; interface hardware that is flown as part of a payload; and GSE used to support payload related operations

NASA ELV Payload Safety Program (continued)

- NPR 8715.3 defines the Program in the context of key roles and responsibilities:
  - Chief OSMA
  - ELV Payload Safety Manager
  - Executive Team - Executive Team Lead
  - Center Directors
  - Center Safety and Mission Assurance Directors
  - Payload Project Managers
  - NASA Contract, Grant, Cooperative Agreement, or Other Agreement Officers
- Program roles and responsibilities will move to Chapter 1 of new Program specific NPR currently under development

ELV Payload Safety Program Integration



NASA ELV Payload Safety Program (continued)

The Chief, Safety and Mission Assurance:

- Oversee and provide funding for administration of Program
- Approve and promulgate Agency-level Program policy and requirements
- Designate in writing and provide input to the performance evaluation of the NASA ELV Payload Safety Manager
- Designate in writing the members of the NASA ELV Payload Safety Executive Team
- Act as the technical authority when an Agency-level decision is needed regarding the interpretation or implementation of NASA ELV payload safety requirements (proposed in new NPR)

NASA ELV Payload Safety Program (continued)

NASA ELV Payload Safety Manager:

- Lead the NASA ELV Payload Safety Program and serve as the Agency focal point for all matters involving ELV payload safety...
- Develop and maintain Agency-level safety policy and requirements ...
- Develop and administer the safety review and approval process...
- Provide payload projects with guidance on implementation of policy, requirements, and processes
- Provide input and guidance ... for development of ... contracts, grants, and cooperative agreements ...
- Report to the NASA Headquarters Office of Safety and Mission Assurance ...
- Element of the HQ SMA Audits, Reviews, and Assessments program ...

NASA ELV Payload Safety Program (continued)

NASA ELV Payload Safety Manager (continued):

- Open or further enhance communication with U.S. and foreign entities ...
- Ensure that safety review activities and actions are coordinated ... as needed to resolve payload safety concerns and support approval for flight
- Establish and maintain a payload safety training program...
- Provide forum for technical interchange and lessons learned...
- Track and implement lessons learned...
- Develop/maintain a NASA ELV Payload Safety Website ... (proposed in new NPR)
- Develop, track, document, and report metrics data on the success of the Safety Program... (proposed in new NPR)
- Ensure appropriate agreements with AF Range Safety and other external organizations... (proposed in new NPR)

NASA ELV Payload Safety Program (continued)

NASA ELV Payload Safety Executive Team:

- Element of HQ Office of Safety and Mission Assurance
- Functions to provide Agency-wide perspective and insight on ELV payload safety related activities
  - Members from appropriate NASA Centers designated by OSMA
- Assess payload projects/PSWG activities to assure NPR requirements are consistently implemented throughout Agency
- Assure early identification of payload safety concerns and any applicability to other NASA payloads
- Report to the NASA HQ OSMA on ELV payload safety concerns...
- Participate in the NASA Safety and Mission Success Review (or equivalent)

NASA ELV Payload Safety Program (continued)

NASA ELV Payload Safety Executive Team (continued):

- Assure consistent interpretation of safety requirements and support each payload project as needed to assure proper implementation
- Approve alternative approaches to satisfying safety requirements ...
- Issue interim guidance ... on safety requirements, processes, and specific payload design concerns ...
- Assess and concur on any variances ...
- Ensure that Executive Team decisions are consistent with other involved organization that shares safety responsibility

NASA ELV Payload Safety Program (continued)

Executive Team Lead: (proposed in new NPR)

- Establish and document the activities and processes needed for the Executive Team to satisfy its responsibilities
- Ensure coordination with all Executive Team members on all Executive Team decisions
- Serve as the approving (signing) official for the Office of Safety and Mission Assurance for any variance to a requirement contained in the NPR

NASA ELV Payload Safety Program (continued)

Center Director: (Responsible for a Payload, Processing Facility, or Launch Site)

- Establish Center-level processes and requirements to ensure Agency policy and requirements are satisfied for each ELV payload project that uses the Center's resources
- Support safety assessments of ELV payload activities and respond to all findings and recommendations, for which the Center is responsible
- Ensure that Center personnel involved in payload projects complete training offered by ELV Payload Safety Program
- Ensure that Center support, including GSE and facilities used in processing, testing, vehicle integration, launch, and planned recovery of NASA ELV payloads comply with applicable NASA and Center technical and procedural requirements (proposed in new NPR)

NASA ELV Payload Safety Program (continued)

Center S&MA Director: (proposed in new NPR)

- Ensure implementation of Agency policy and requirements for each ELV payload project that uses the Center's resources in coordination with the NASA ELV Payload Safety Manager
- Provide each payload project with safety engineering, safety analysis, and other safety expertise needed to ensure the project successfully completes the safety review and approval process
- Ensure that processes exist and assessments are conducted to ensure compliance with this NPR and the safety of activities within the scope of their authority

NASA ELV Payload Safety Program (continued)

ELV Payload Project Manager:

- Ensure that funding and other resources are allocated for payload projects to satisfy all aspects of the NASA ELV Payload Safety Program...
- Ensure that the payload project's timeline provides for compliance with the established payload safety review and approval process
- Establish and implement any project-level processes and requirements needed to satisfy safety requirements and successfully complete the payload safety review and approval process
- Ensure all personnel ... possess the necessary certification, training, judgment and abilities (proposed in new NPR)
- Prepare and approve any variance to a safety requirement... (proposed in new NPR)

NASA ELV Payload Safety Program (continued)

NASA Contract, Grant, Cooperative Agreement, or Other Agreement Officer:

- Coordinate with the NASA ELV Payload Safety Manager and Payload Project Managers to ensure that all applicable safety and mission assurance requirements necessary for payload safety are incorporated into the contracts and agreement(s) governing each payload...

Proposed NPR 8715.xx ELV Payload Safety Program

CHAPTER 1 Program Overview

- Payload Safety Policy (consistent with general policy in NPR 8715.3)
- Roles and Responsibilities (moved from NPR 8715.3 and updated)
- Variance Process (consistent with NPR 8715.3)

CHAPTER 2 Safety Review and Approval Process

- Payload Safety Working Group
- Roles and Responsibilities
- Flow of Activities and Deliverables
- Content of Deliverables

CHAPTER 3 Payload Design and Ground Operations Safety Requirements

- General Payload Flight Hardware and GSE Safety Design
- Safety Critical Software
- Ground Operations
- Payload Flight Hardware and GSE

Proposed NPR 8715.xx, Chapter 2 Safety Review and Approval Process

Goals

- Assure the appropriate representation and involvement of all organizations that support the mission.
- Identify and resolve any safety concerns as early as feasible during the project timeline.
- Assure that the project obtains the formal approval of all safety authorities for the mission (internal and external to the Agency).

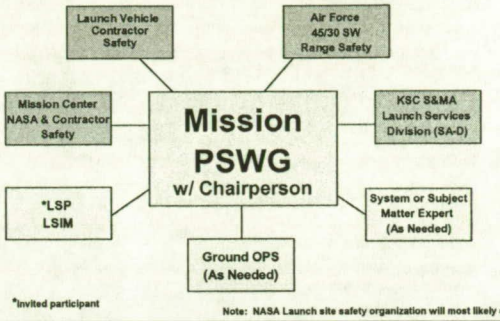
Proposed NPR 8715.xx, Chapter 2

Safety Review and Approval Roles and Responsibilities (continued)

Payload Safety Working Group (PSWG)

- NASA ELV payload missions involve various combinations of payload organizations, payload contractors, launch vehicles, payload processing sites, and launch sites
- To address this situation, a key aspect of the safety review process is the establishment of a PSWG for each payload.
- PSWG and its required activities are designed to ensure appropriate involvement of all organizations that support the associated mission and share safety responsibility for the mission (internal and external to the Agency)

Payload Safety Working Group Membership



Proposed NPR 8715.xx, Chapter 2

Safety Review and Approval Roles and Responsibilities (continued)

Payload Project Manager:

- Ensure that a Payload Organization Safety Engineer is appointed no later than the Confirmation Review or 90 days prior to the PDR
- Ensure that a PSWG is established and functions IAW the NPR
- Coordinate with the Payload Organization Safety Engineer to establish the PSWG and include the following members as applicable to the mission:
  - NASA Payload Organization Safety Engineer
  - Payload contractor safety representative
  - NASA Launch Services Division Safety Engineer
  - Launch vehicle contractor safety engineer
  - Payload processing facility safety representative
  - Range safety organization representative(s) responsible for launch
  - NASA Launch Services Program Launch Site Integration Manager (invited participant)

Proposed NPR 8715.xx, Chapter 2

Safety Review and Approval Roles and Responsibilities (continued)

Payload Project Manager (cont.):

- Ensure all project personnel involved in the review process are experienced and trained as needed
- Ensure that the payload organization plans for and fully participates in all safety review and approval process activities
- Concur on all safety review and approval process deliverables prior to submittal to the PSWG
- Ensure that all approved safety plans and procedures are implemented
- Notify the NASA ELV Payload Safety Manager of the new project and provide contact information for the appointed Payload Organization Safety Engineer
- Ensure safety status and any safety concerns are presented at mission design reviews, including the Preliminary Design Review and Critical Design Review

Proposed NPR 8715.xx, Chapter 2

Safety Review and Approval Roles and Responsibilities (continued)

Payload Project Manager (cont.):

- Obtain all safety approvals needed to accomplish each mission which shall include:
  - Approval(s) as appropriate to receive and process the payload at any NASA facility
  - Letter from the NASA ELV Payload Safety Manager indicating that the project has successful completed the payload safety process
- Provide the PSWG with a Certificate of Safety Compliance, signed by the Payload Project Manager and to be signed by all PSWG members at the Phase III Safety Review
- Brief the closure status of all items in the Safety Actions Tracking Log and any payload safety issues during the Flight Readiness Review

Proposed NPR 8715.xx, Chapter 2

Safety Review and Approval Roles and Responsibilities (continued)

Executive Team:

- For each mission, Team shall designate a member to serve as the Team's primary interface for the safety review and approval process
- Develop a mission specific assessment plan prior to the Payload Safety Introduction Meeting.
- Review all safety review submittals, participate in safety review activities as needed, and approve any alternative approaches for satisfying safety requirements
- Coordinate on guidance provided to a PSWG that has not been previously documented as an official ET position.

Proposed NPR 8715.xx, Chapter 2

Safety Review and Approval Roles and Responsibilities (continued)

Payload Organization Safety Engineer:

- Perform as the payload organization's primary member of the PSWG
- Ensure the preparation and submittal of all safety review/approval process deliverables
- Ensure the implementation of all approved safety related plans and activities
- Ensure that payload design process incorporates system safety engineering activities integral to identifying hazards, developing hazardous solutions, and ensuring compliance with this NPR
- Keep the Payload Project Manager informed of mission safety status
- Ensure that a Safety Verification Tracking Log is established and maintained for the project
- Ensure that a Safety Action Tracking Log is established and maintained for the project

Proposed NPR 8715.xx, Chapter 2

Safety Review and Approval Roles and Responsibilities (continued)

Payload Organization Safety Engineer (cont.):

- Ensure that released technical operating procedures are reviewed and approved by facility safety and other responsible organizations
- Participate in Payload Design Reviews presenting mission safety status
- Ensure that the PSWG and Executive Team are notified whenever a mishap or close call takes place involving their payload
- Mishap reporting will be conducted in accordance with contractual documentation and NPR 8621.1, *NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping*

Proposed NPR 8715.xx, Chapter 2

Safety Review and Approval Roles and Responsibilities (continued)

PSWG Members:

- Participate in the safety review/approval process
- Assist the payload project to comply with applicable safety requirements
- Within their scope of authority, assess for safety the payload design, fabrication, testing, integration, pre-launch and launch operations, planned recovery of the payload, and mission specific GSE, and interfaces with other supporting GSE, facility systems, and launch vehicle systems and GSE
- Review and comment on all payload safety review deliverables and meeting minutes
- Assess and concur with any variance to a safety requirement within their scope of authority
- Coordinate with the Executive Team and others as needed to resolve payload safety concerns

Proposed NPR 8715.xx, Chapter 2

Safety Review and Approval Roles and Responsibilities (continued)

PSWG Members (cont.):

- Coordinate with other PSWG members to identify a PSWG chairperson
  - *Note: A member of the responsible NASA launch site safety organization typically serves as the PSWG Chairperson. Depending on the mission specifics, there may be advantages to having a PSWG representative from one of the other NASA organizations involved in the mission perform this function. Example, for missions involving significant contributions from international partners, communications and coordination efforts may be more easily facilitated if the Payload Organization Safety Engineer performs as the PSWG Chairperson. A Co-Chairperson may also be appointed if deemed necessary for any mission.*

Proposed NPR 8715.xx, Chapter 2

Safety Review and Approval Roles and Responsibilities (continued)

PSWG Members (cont.):

- Ensure that payload, facility, and payload/launch vehicle integration issues are disseminated to their organization and to other PSWG members
- Participate in all PSWG meetings, mission safety reviews, design reviews, ground operations reviews, and other activities as requested by the PSWG Chairperson
- Approve plans, hazard reports, and technical operating procedures that fall under their safety responsibility
- Sign the Certificate of Safety Compliance indicating safety approval for their area(s) of responsibility and provide in writing any constraints associated with their approval to be attached as an addendum to the Certificate at the Phase III Safety Review Meeting

Proposed NPR 8715.xx, Chapter 2

Safety Review and Approval Roles and Responsibilities (continued)

PSWG Chairperson:

- Schedule and conduct PSWG meetings
- Ensure that PSWG activities and decisions include the collective input and participation of all PSWG members
- Ensure PSWG participation, as required, at payload/launch vehicle integration working group meetings (e.g. Ground Operations Working Group (GOWG), Mission Integration Working Group (MIWG))
- Facilitate the signing of the Certificate of Safety Compliance by appropriate PSWG members, compile any constraints, and ensure delivery to the ELV Payload Safety Program Manager
- Ensure that all mission support and safety related documents are filed for access by the PSWG members, Executive Team and the NASA ELV Payload Safety Manager

Proposed NPR 8715.xx, Chapter 2

Safety Review and Approval Roles and Responsibilities (continued)

PSWG Chairperson (cont.):

- Establish and maintain an integrated schedule of PSWG activities
  - Provide timely notification of any change to the schedule to all parties
- Ensure all required safety review deliverables are distributed to PSWG members and all appropriate safety review officials via *The ELV Payload Safety Website*
- Ensure that the Executive Team is invited to all PSWG activities and is on distribution for all project deliverables
- Coordinate and consolidate all comments to safety review submittals
- Ensure PSWG activities are documented

Proposed NPR 8715.xx, Chapter 2
Safety Review and Approval Roles and Responsibilities (continued)

NASA Launch Services Program Manager:

- Notify the PSWG of Ground Operations Working Group and Ground Operations Review activities
- Ensure that the NASA Launch Services Division Safety Representative is notified of any payload/launch vehicle interface concerns
- Ensure launch vehicle and commercial payload processing facility contracts provide the provisions of the NPR

Proposed NPR 8715.xx, Chapter 2
Safety Review and Approval Roles and Responsibilities (continued)

NASA ELV Payload Safety Manager:

- Track the status of each payload project as it proceeds through the safety review/approval process and provide guidance on the associated activities, tools, and deliverables as needed
- Issue a letter indicating that the project has successfully completed the payload safety process

Proposed NPR 8715.xx, Chapter 2.4
Flow of Activities and Deliverables

Chapter 2.4 Overview

Identifies the required safety documentation, safety reviews, and sequence of submittal of the associated deliverables

NPR 8715.xx will define more specifically:

- Topics to be covered in required safety briefings
- Support materials for briefings
- Submittal dates for safety documentation

Proposed NPR 8715.xx, Chapter 2.4
Flow of Activities and Deliverables

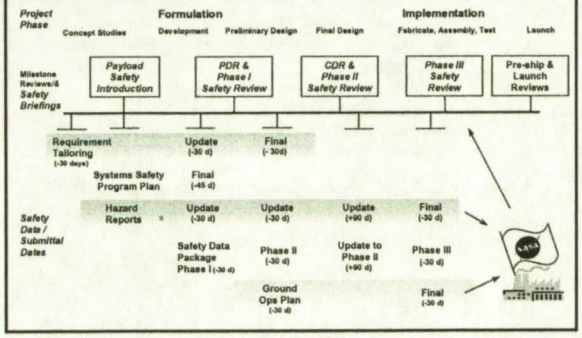
Goals

- Safety review and approval activities to continue to coincide with the project management reviews required by NPR 7120.5.
- Ensure appropriate emphasis on early safety activities
- Satisfy AF Range Safety, NASA, and others requirements
- Firm-up data delivery dates and specify in the NPR
- Maintain, but enhance NASA STD 8719.8 structure and process

Assumptions

- Payload Organization Safety Engineer is responsible for ensuring data deliverable preparation
- Activities identified in NPR 8715.xx are not all inclusive of the required project, HQ, or Center SMA documentation or reviews

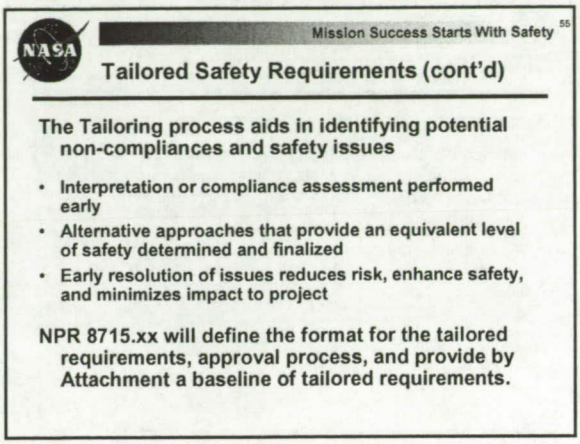
Draft NPR 8715.xx, Chapter 2.4
Flow of Activities and Deliverables

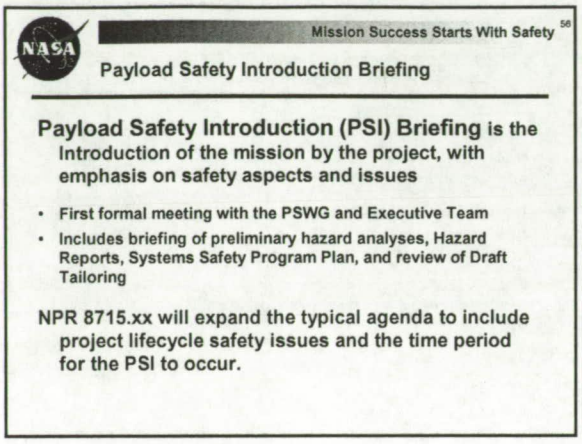


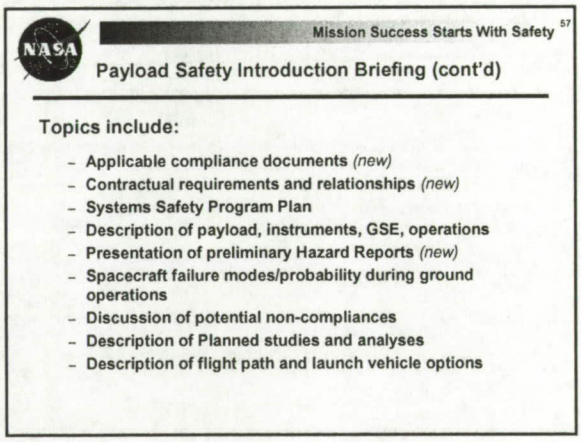
Tailored Safety Requirements

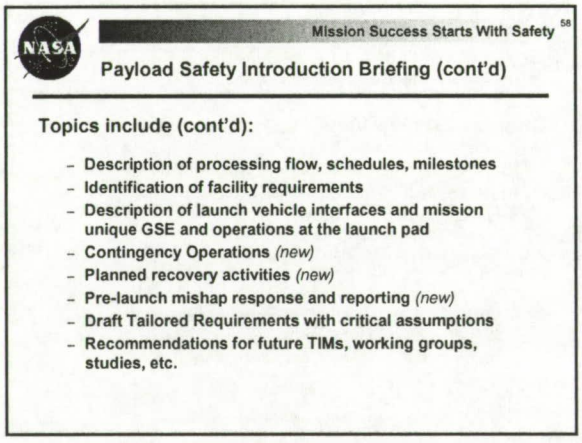
Tailored Safety Requirements result from the process of reviewing requirements to ensure applicability and compliance by the project, as written, or whether the project will achieve an equivalent level of safety through an acceptable alternative requirement.

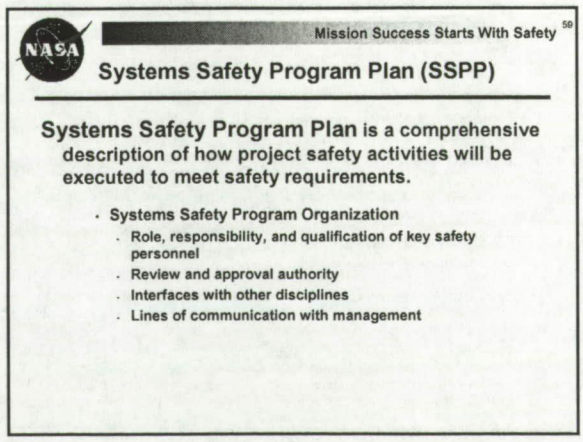
- Joint activity by all PSWG members
- Identifies applicable requirements
  - NASA, Range Safety, other Government and consensus standards
- Documents the interpretation of requirements or applicability of a requirement to a specific mission activity
- Implements lessons-learned as applicable
- Consolidates interim policy/guidance/requirements
- Documents the rationale for addition/deletion/change in requirements
- Resulting Tailored Requirements are a safety requirements for a specific mission

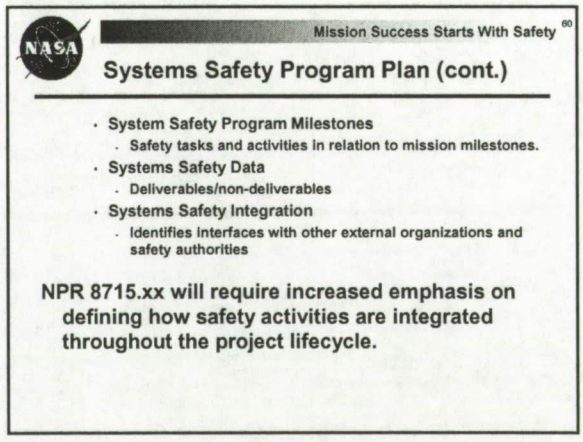

Mission Success Starts With Safety 55
Tailored Safety Requirements (cont'd)
The Tailoring process aids in identifying potential non-compliances and safety issues
• Interpretation or compliance assessment performed early
• Alternative approaches that provide an equivalent level of safety determined and finalized
• Early resolution of issues reduces risk, enhance safety, and minimizes impact to project
NPR 8715.xx will define the format for the tailored requirements, approval process, and provide by Attachment a baseline of tailored requirements.


Mission Success Starts With Safety 56
Payload Safety Introduction Briefing
Payload Safety Introduction (PSI) Briefing is the Introduction of the mission by the project, with emphasis on safety aspects and issues
• First formal meeting with the PSWG and Executive Team
• Includes briefing of preliminary hazard analyses, Hazard Reports, Systems Safety Program Plan, and review of Draft Tailoring
NPR 8715.xx will expand the typical agenda to include project lifecycle safety issues and the time period for the PSI to occur.


Mission Success Starts With Safety 57
Payload Safety Introduction Briefing (cont'd)
Topics include:
– Applicable compliance documents (new)
– Contractual requirements and relationships (new)
– Systems Safety Program Plan
– Description of payload, instruments, GSE, operations
– Presentation of preliminary Hazard Reports (new)
– Spacecraft failure modes/probability during ground operations
– Discussion of potential non-compliances
– Description of Planned studies and analyses
– Description of flight path and launch vehicle options


Mission Success Starts With Safety 58
Payload Safety Introduction Briefing (cont'd)
Topics include (cont'd):
– Description of processing flow, schedules, milestones
– Identification of facility requirements
– Description of launch vehicle interfaces and mission unique GSE and operations at the launch pad
– Contingency Operations (new)
– Planned recovery activities (new)
– Pre-launch mishap response and reporting (new)
– Draft Tailored Requirements with critical assumptions
– Recommendations for future TIMs, working groups, studies, etc.


Mission Success Starts With Safety 59
Systems Safety Program Plan (SSPP)
Systems Safety Program Plan is a comprehensive description of how project safety activities will be executed to meet safety requirements.
• Systems Safety Program Organization
- Role, responsibility, and qualification of key safety personnel
- Review and approval authority
- Interfaces with other disciplines
- Lines of communication with management


Mission Success Starts With Safety 60
Systems Safety Program Plan (cont.)
• System Safety Program Milestones
- Safety tasks and activities in relation to mission milestones.
• Systems Safety Data
- Deliverables/non-deliverables
• Systems Safety Integration
- Identifies interfaces with other external organizations and safety authorities
NPR 8715.xx will require increased emphasis on defining how safety activities are integrated throughout the project lifecycle.

Mission Success Starts With Safety 01

Hazard Reports

Hazard Reports identify the potential hazards of a system, and define the causes, controls and verifications and assessment of risk

- Report required for each unique hazard
- Drafts required at PSI based on payload conceptual design and planned operations *(new)*
- Reports address each operational phase and/or facility *(new)*

Mission Success Starts With Safety 02

Hazard Report Format

Hazard Report

Mission:			Hazard Report No.
System: Subsystem: Category:	Design Lead: I.T. Lead System Eng:	PA Eng Safety: PM:	Rev. Date: Status: Originator
Hazard Description: Requirement(s)		Risk Initial Severity Initial Probability Final Severity Final Probability	Operational Phase NASA FAC ☐ Launch Process ☐ Transport ☐ Contractor FAC ☐ Pad ☐ Other_____ ☐

Cause	Facility	Control	Verification	Reference	Status

Mission Success Starts With Safety 03

Design Review Presentation

Safety activities and issues are presented at the CDR & PDR by the Payload Organization Safety Engineer

- Summary of safety activities and reviews, with dates and overview of upcoming safety milestones
- Summary of hazard reports and hazard resolutions
- Overview of non-compliances and potential safety issues
- Risk matrix chart (new)

Mission Success Starts With Safety 04

Safety Data Package (SDP)

Safety Data Package is a data submittal that provides a detailed description of hazardous and safety critical flight hardware equipment, systems, components and materials that comprise the payload.

- Includes hazard reports, safety assessments, inhibits, and mitigations
- Together with the *Ground Operations Plan*, it is one of the media through which prelaunch safety approval is obtained.

NPR 8715.xx clarifies the required submittals/dates for SDPs, and identifies by Attachment the required data to be submitted for each Phase.

Mission Success Starts With Safety 05

Safety Data Package (cont'd)

Safety Data Package (SDP) Phase Distinctions

- Phase I (Preliminary) SDP – provides subsystem and box level data
- Phase II (Draft) SDP – update of Phase I; provides component and piece part level data
- Updated Phase II (Draft) SDP - update of Phase II, reflecting post-CDR data, and disposition of comments to Phase I & II SDPs (new)
- Phase III (Final) SDP – a SDP that incorporates all previous comments and reflects the as-built spacecraft configuration (i.e., an on-the–shelf copy)

Mission Success Starts With Safety 06

Ground Operations Plan

Ground Operations Plan (GOP) provides a detailed description of hazardous and safety critical operations for processing a payload and its associated ground support equipment.

- Includes analysis of project-supplied GSE, description of planned operations, Operating and Support Hazard Analysis, procedure descriptions and task summaries, and contingency, training, and emergency response plans
- Together with the *Phase III Safety Data Package*, it is one of the media through which prelaunch safety approval is obtained.

Ground Operations Plan (cont.)

- If operations occur at a NASA facility, or facility where NASA personnel controls the operation, or are required to perform a task during an operation, applicable portions of the GOP and hazard reports are to be approved NLT 30 days prior to hardware arrival. (new)

NPR 8715.xx expands the scope of ground operations requirements to include all NASA processing locations; GOP is also identified as the mechanism for submitting GSE and operations data to provide for earlier (than SDP) approval requirements.

- Issue: AFSPCMan 91-710 requires GOPs to be submitted 45 days prior to design reviews; NPR 8715.xx proposes 30 days.

Phase III Payload Safety Review Presentation

Phase III Payload Safety Review is a review of safety activities and issues, and is presented by the Payload Organization Safety Engineer (new)

- Presented to PSWG and Executive Team prior to pre-ship review
- Summary of safety activities and reviews, and status of any in-process safety related work
- Overview of non-compliances and risks
- Provides a verification that all safety requirements and activities have been met, or review of plan to bring project into compliance
- Statuts of SVTL items
- Certificate of ELV Payload Safety Compliance is signed (new)

Safety Verification Tracking Log (SVTL)

Safety Verification Tracking Log identifies the required verifications from the Hazard Reports that are constraints to payload activities and operations.

- Required to be developed from hazard reports
- Updated as required if open verifications exist that are constraints to payload processing
- After payload arrival at the launch site processing facility, updated at least weekly
- Reviewed at the Phase III Final Safety Review (new)

Safety Verification Tracking Log (cont'd)

NASA ELV PAYLOAD SAFETY VERIFICATION TRACKING LOG | Page | of

PAYLOAD: | DATE:

Log No.	Hazard Report Number	Safety Verification Number	Safety Verif. Method (Identify Procedures By Number and Title)	Operation(s) Constrained	Independent Verification Required Y/n/Na	Scheduled Completion Date	Completion Date	Method of Closure (Comments)

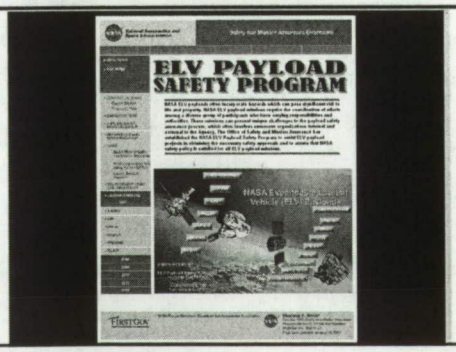
Technical Operating Procedures

Technical Operating Procedures provide a step-by-step description of the manner in which hazardous / safety critical operations will be accomplished. Procedure approval is required prior to the start of a hazardous / safety critical operation.

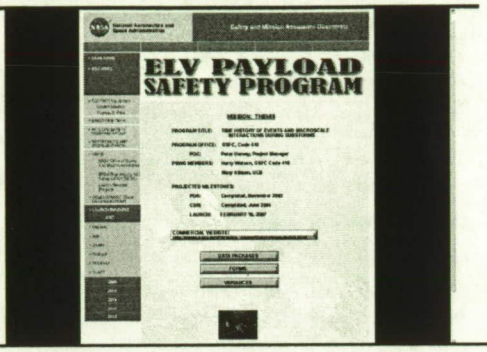
- All procedures are identified in the GOP, providing substantiation of classification, task summaries, and O&SHA
- Released hazardous procedures are to be submitted to safety approving authorities (for KSC, 55 days before use; 10 days on-the-shelf)

NPR 8715.xx will define the technical operating procedure requirements for submittal, content, format, etc. that are currently in place

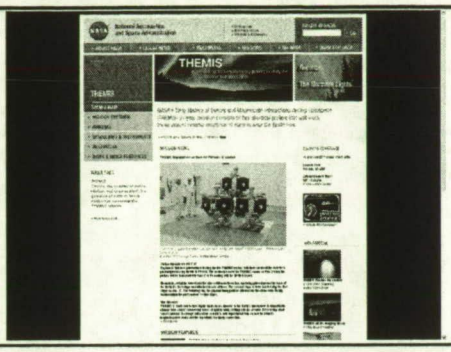
Website Demonstration



Website Demonstration



Website Demonstration



Website Discussion

- Safety Data Package Management
  - Options
    1. *Program Office* as part of normal data management/config
    2. *LSP* via their KSC website: https://elvprogram.ksc.nasa.gov
    3. *Agency ELV Payload Safety Office* via this website: http://www.ksc.nasa.gov/elvpayloadsafety
    4. *PBMA* website: http://pbma.nasa.gov
  - Issues/Concerns
    - Need to select and develop process
    - Assured access for all "partners"
    - Website support/cost – government vs contractor
    - In place or development required
    - Reliability
    - Customer Friendly

Website Discussion

	PROs	CONs
PBMA	Developed Funded by HQ Support in place Security functions	Off-site control/maintenance Unknown reliability/downtime No access when system is down
LSP	Developed Funded by LSP Support in place Tech Docs security	Access may be an issue User friendly?
EPSP	Can design in functions Tech Docs security Exec Team control/maint	Development required May need additional manpower
SV Contr	Use contr current system Less duplication of effort More current info/data	Less gov control over data Dependent on contractor Requires PO oversight? May charge for services

Website Discussion

- Agency ELV Payload Safety Office Website Will Keep:
  - Safety Data Package Archives
  - Payload ES&H Lessons Learned
  - Variances
  - Forms/templates

Proposed NPR 8715.XX, Chapter 3 Design and Ground Operations Requirements

Development:

- Consistent with the general system safety policy of NPR 8715.3
- Capture NASA and Air Force requirements as tailored for NASA ELV missions
- Obtain Air Force by-in on the use of these requirements for launches at the Eastern and Western Ranges

Proposed NPR 8715.XX, Chapter 3
Flight Hardware and GSE Safety Design

Goal: Consistent interpretation and implementation of design requirements Agency-wide

Approach:

- Provide clear requirements, associated definitions, and guidance, including examples applicable to NASA ELV payload projects
- Address:
  - Hardware Design Inhibits/Failure Tolerance
  - Design for Minimum Risk
  - Design for High Reliability

Proposed NPR 8715.XX, Chapter 3
Flight Hardware and GSE Safety Design (continued)

Hardware Design Inhibits/Failure Tolerance

- The hardware design of each payload system (including fight hardware and associated GSE) that controls a hazard shall incorporate a minimum number of design inhibits against each credible hazardous system failure (EXCEPTION: Design for High Reliability)
  - A hazardous system failure is a failure of the overall system, subsystem, or component that can result in injury to people or loss of resources, including damage to flight hardware or facilities
  - A hazardous system failure is credible if it can occur and is reasonably likely to occur. A quantitative guideline is a probability of occurrence $\geq 1 \times 10^{-3}$
  - Failures of components that meet specific Design for Minimum Risk requirements are not considered credible

Proposed NPR 8715.XX, Chapter 3
Flight Hardware and GSE Safety Design (continued)

Required Minimum Number of Design Inhibits:

- Dependent on the potential consequence(s) associated with each credible hazardous system failure
- The design of a system that controls a hazard shall incorporate no less than:
  - Three design inhibits (dual failure tolerant) against each credible system failure that can lead to loss of life
  - Two design inhibits (single failure tolerant) against each credible system failure that can lead to injury of people or loss of resources, but not loss of life

Proposed NPR 8715.XX, Chapter 3
Flight Hardware and GSE Safety Design (continued)

Determination of Credible Hazardous System Failures:

- Coordinated effort between payload organization and the PSWG
- Account for potential failure of all system components that do not meet specific Design for Minimum Risk requirements
- Without consideration of any procedural hazard controls
- If dependent on quantitative probabilistic analysis:
  - Formal written probabilistic risk assessment
  - Incorporate system and component reliability data
  - Account for uncertainty in input data and any models
  - Subjected to peer review and approval

Proposed NPR 8715.XX, Chapter 3
Flight Hardware and GSE Safety Design (continued)

Determination of Required Number of Design Inhibits for each Credible Hazardous System Failure:

- Coordinated effort between payload organization and the PSWG
- Account for both immediate and long term potential injury or illness effects associated with each hazard
- If based on an assessment that the hazard level will not exceed an injury/fatality threshold:
  - Formal written technical analysis
  - Demonstrate that the hazard level will not exceed the injury/fatality threshold
  - Subject to peer review and approval
- Design inhibits shall consist of electrical and/or mechanical hardware and be independent of any other inhibit or hazard control

Proposed NPR 8715.XX, Chapter 3
Flight Hardware and GSE Safety Design (continued)

Design Inhibits:

- Shall consist of electrical and/or mechanical hardware
  - An operator control is not considered a design inhibit
  - Implementation of operator controls may be used as justification for a variance to the requirements for design inhibits
- Each design inhibit shall be independent of any other inhibit or hazard control
- Design inhibits that protect against a specific hazardous system failure shall have design and/or implementation differences between them to protect against a common cause failure of the inhibits
- Each design inhibit shall be verifiable after installation or through a process of pre-installation testing and implementation of written procedures that ensure the inhibit's integrity during and after installation
- The system design shall allow for the system to be brought to a safe state in the event of the loss of a design inhibit.

Proposed NPR 8715.XX, Chapter 3
Flight Hardware and GSE Safety Design (continued)

Design for Minimum Risk

- Components may be eliminated from consideration as a potential source of a credible hazardous system failure by complying with requirements that have been developed specifically for each such component
  - For example: structures, pressure vessels, pressurized line and fittings, and functional pyrotechnical devices.
- Proposed NPR 8715.XX, Appendixes D and E identify specific components and provided the associated Design for Minimum Risk requirements
- Any proposed use of Design for Minimum Risk for a component not specifically addressed in Appendix D or E, requires approval by the NASA ELV Payload Safety Executive Team in coordination with any other responsible technical authority

Proposed NPR 8715.XX, Chapter 3
Flight Hardware and GSE Safety Design (continued)

Design for High Reliability: (consistent with NPR 8715.3)

- A system may be exempted from the requirements for design inhibits if the system has high reliability that is verified by a formal reliability analysis:
  - Using accepted data in which uncertainties are incorporated
  - Subject to the requirements of NPR 8705.5, Probabilistic Risk Assessment (PRA) Procedures for NASA Programs and Projects
  - Regarding ELV payload, high reliability is defined as ≥ 0.999 with 95% confidence (not specified in NPR 8715.3)
- Approach might not be acceptable to all safety authorities involved in a NASA ELV payload mission
  - Approval to use this approach must be obtained from all PSWG members as early as possible in the project timeline

Proposed NPR 8715.XX, Chapter 3
Flight Hardware and GSE Safety Design (continued)

Safety Critical Software:

- Payload systems that incorporate safety critical software that are used to support NASA missions shall have an independent verification and validation plan in accordance with NPD 8730.4, Software Independent Verification and Validation (IV&V) Policy
- NASA safety-critical software shall be developed in accordance with NPR 7150.2, NASA Software Engineering Requirements, and NASA STD 8719.13, Software Safety

Proposed NPR 8715.XX, Appendixes

- APPENDIX A. Definitions
- APPENDIX B. Acronyms
- APPENDIX C. Safety Variance Form and Instructions
- APPENDIX D. Ground Operations Safety Requirements
- APPENDIX E. Payload Flight Hardware and GSE Safety Requirements
- APPENDIX F. Safety Verification Tracking Log
- APPENDIX G. Safety Action Tracking Log
- APPENDIX H. Payload Safety Introduction Meeting Topics

Proposed NPR 8715.XX, Chapter 3
Flight Hardware and GSE Safety Design (continued)

Ground Operations:

- Safety requirements applicable to ground operations associated with flight-area processing (including testing and vehicle integration) and any planned recovery of payloads provided in NPR 8715.XX, Appendix D (in work)
- Adaptation of Air Force Space Command Manual 91-710, Range Safety User Requirements Manual, Volume 6 – Ground and Launch Personnel, Equipment, Systems, and Material Operations Safety Requirements and using various NASA S&MA and industry documents
- Requirements tailored for NASA ELV payload projects and augmented with implementation guidance NASA projects

Proposed NPR 8715.XX, Chapter 3
Flight Hardware and GSE Safety Design (continued)

- Ground Operations (Appendix D) will address:
  - Personal Safety
  - Personnel Training
  - Facility Inspection
  - Hazardous Operations
  - Hazardous Atmospheres
  - Physical/mechanical Hazards
  - Hazardous & Toxic Materials
  - Hazardous Temperatures & Cryogenics
  - Radiation (Ionizing and Nonionizing)
  - Lasers

Proposed NPR 8715.XX, Chapter 3
Flight Hardware and GSE Safety Design (continued)

- Ground Operations (Appendix D) (cont.)
  - Material Handling Operations
  - Acoustic Hazards
  - Pressurized Systems & Vacuum Systems
  - Ordnance
  - Electrical System Operations
    - Grounding
    - Bonding
    - Battery Operations
    - Energized systems
  - Launch Operations

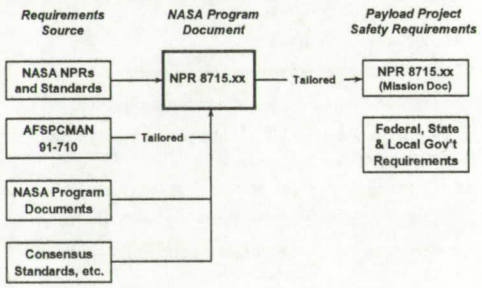
NPR 8715.xx Technical Safety Requirement – Development Approach

Goals
- Develop a NASA ELV payload safety document
  - Capture NASA requirements, interpretations, processes
    - Include NASA's role in evaluating and data approval
  - Increase commonality among NASA Centers and with Ranges
  - Ranges' acceptance of tailored requirements in lieu of AFSPCMAN 91-710

Approach
- Use AFSPCMAN 91-710 as baseline document
  - Strong heritage and comprehensive
  - Compliance required for processing and launch

Tailored AFSPCMAN 91-710 becomes Appendix E of NPR 8715.XX

Safety Requirements Flow



Tailoring Approach Details

- Maintain 91-710 chapter layout and paragraph numbering, to extent possible
- Tailoring focuses on applicable payload requirements and credible contingencies
  - Capture NASA requirements and interpretations
  - Resolve longstanding issues
- Continue to utilize 'text boxes' to propose design solutions
  - Use to identify NASA best practices
- Use applicable documents sparingly as a method to identify specific requirements
  - Maintain 'stand alone' document philosophy for ease in mission specific tailoring
  - Reference/applicable documents identified for informational purposes
- Change the unilateral Range-required approval of specific requirements to include all safety approving authorities/PSWG
- Add NASA "Requirement" identifier after each specific requirement
- Tailor Attachment 1 to provide references to data matrices

Tailoring - Example

12.1.3.3. If the ~~Range User and Range Safety~~ approving safety authorities decide that depressurizing and/or offloading the pressure systems of a mated spacecraft is prohibited at the launch pad, spacecraft ~~offload~~ demating procedures shall be approved ~~by Range Safety~~ prior to use. (Requirement)

Rationale: Clarify requirement, as an approving authority would also be the NASA Launch Services Division Safety Office. Replace 'offload' with 'demating', as offload procedures are required to be approved prior to spacecraft mating; contingency demating procedures may have to be tailored to address the circumstances of the contingency.

Tailoring - Example (cont'd)

12.1.3. Flight Hardware Pressure System Offloading.

12.1.3.1. For contingency safing operations, hazardous pressure systems shall be designed so that depressurization and drain fittings are accessible and do not create a personnel or equipment hazard for offloading ~~hazardous fluids at the launch complex~~ commodities. (Requirement)

Rationale: The commodity to be offloaded could be non-hazardous, or not a fluid; applicability at the launch complex was deleted, as capability to offload is also required at the payload processing facility.

12.1.3.2. ~~The design goal is to be able to~~ Propulsion system design shall permit the offload of ~~these~~ pressure systems at any point after pressurization or loading, including the ability to offload all systems at the launch pad without demating of the spacecraft from the launch vehicle or any other disassembly of vehicle systems. (Requirement)

Rationale: Because of the hazard potential, the ability to offload is a requirement, not a design goal.

Tailoring Example – Text Box (cont'd)

System design and contingency planning shall permit for safe movement of the payload to a payload processing facility. Planning shall address the worst-case scenario.

Accessibility through payload fairing door(s) is the desired approach. Verification/validation of the design for accessibility is best achieved through a high fidelity model, mock-up of hardware, GSE, tooling, PPE, etc., or by demonstrating similarity to accepted design and processes.

Coordination with the launch vehicle contractor is necessary for allowable payload fairing door size and placement, operational support, and ability to perform contingency support in hazardous and/or explosive environments.

Rationale: *Design solution added to ensure early coordination and planning for access to hardware in the event of a leak contingency.*

Linking Tailoring to Data Requirements

10.2.1.4. Plastic materials that may pose a hazard because of hypergolic ignition/ breakthrough shall be tested in accordance with the requirements described in KSC/MTB-175-88, *Procedure for Casual Exposure of Materials to Hypergolic Fluids, Exothermic Reaction Method* (Requirement).

10.2.2.1. ~~Range Safety~~ The PSWG may require the testing of materials whose hazardous properties are not well defined (Requirement).

10.4. Hazardous Material Data Requirements. Hazardous material data requirements ~~shall be submitted in accordance~~ with are identified in Attachment 1, A1.2.4.13.

AFSPCMAN 91-710 (T) Volume 3

AFSPCMAN 91-710 (T) Vol 3, Attach 1

A1.2.4.13. Flight Hardware Hazardous Materials Subsystems:

A1.2.4.13.2. Flight Hardware Hazardous Materials Data. At a minimum, the following hazardous materials data shall be submitted (Reference Data Matrix X-X):

A1.2.4.13.2.1. A list of all hazardous materials on the flight system and used in ground processing (Phase II (Draft) Safety Data Package) (Requirement).

A1.2.4.13.2.2. A description of how each of these materials and liquids is used and in what quantity (Phase I (Preliminary) Safety Data Package) (Requirement).

Linking Tailoring to Data Matrices

NPR 8715.xx, Appendix E (T)
Safety Requirements

10.2.1.4. Plastic materials that may pose a hazard because of hypergolic ignition/breakthrough shall be tested in accordance with the requirements described in KSC/MTB-175-88, *Procedure for Casual Exposure of Materials to Hypergolic Fluids, Exothermic Reaction Method* (Requirement).

10.2.2.1. The PSWG may require the testing of materials whose hazardous properties are not well defined (Requirement).

10.4. Hazardous Material Data Requirements. Hazardous material data requirements are identified in Attachment 1, A1.2.4.13 of this volume.

NPR 8715.xx, Attachment 1 to Appendix E, Data Requirements

A1.2.4.13. Flight Hardware Hazardous Materials Subsystems:

A1.2.4.13.2. Flight Hardware Hazardous Materials Data. At a minimum, the following hazardous materials data shall be submitted (Reference Data Matrix XX-X):

A1.2.4.13.2.1. A list of all hazardous materials on the flight system and used in ground processing (Phase II (Draft) Safety Data Package) (Requirement).

A1.2.4.13.2.2. A description of how each of these materials and liquids is used and in what quantity (Phase I (Preliminary) Safety Data Package) (Requirement).

System Data Matrix

Safety Data Matrix – EGSE Example

Electrical Ground Support Equipment		Facility / Location						Explosive Environment (√)	Facility Interface Req'ts	Design Std's (UL, NEC)	Size: HxDxW & Weight
Description / Function Manufacturer	COTS √							Hazard-proofing Method			Tip-over Analysis

Safety Data Matrix – Inhibit Status Summary

Inhibit Status Summary							
Operational Phase / Event →→							
System: Inhibit(s) Ref #		Inhibit Status: Enabled Disabled	Inhibit Status: Enabled Disabled	Inhibit Status: Enabled Disabled	Inhibit Status: Enabled Disabled	Inhibit Status: Enabled Disabled	

Safety Data Matrix – Pyro and NEI Devices

Pyrotechnic & Non-Explosive Devices			Installation Location & Connect Location	Cat. pre- & post install		Qty & NEW per device	Haz Class UN/ DOD/ DOT	Autoignition temp; ESD Sensitivity; RF Sensitivity	No Fire/ All Fire
Device Description & System Application	MFG/ Part #	Pyrotechnic Composition							

Safety Data Submittals

Impact of Late Deliverables

- Increases the potential of a safety issue requiring resolution late in safety review process
- Mission may not be able to implement an optimum solution to resolve (engineering, science and safety impact)
- Resulting risk may be unacceptable or higher than desired
- Impacts the safety review process
- Cost and schedule impacts trickle-down throughout project and support
- Noncompliance to Range Safety Requirements

Impact to Safety and Risk

- Safety requirements may not be implemented (fully) if discovered late, or after critical milestones in the design phase
- Required design changes may be constrained
  - Engineering capability or feasibility
  - Cost
  - Schedule
  - Mission goals
- Effectiveness (if instituted) of engineering solutions
  - Safety tradeoffs may result
  - Integrated hazards

Impact to Safety and Risk (cont'd)

- Additional hazard mitigations may result
  - Necessary inhibits and monitoring capability may not be optimal due to technical limitations
  - Additional cost may be incurred to implement
  - Impact to schedule; support requirements
  - New or revised of procedures may be required
  - Implementation may still result in level of risk
- Potential increase in risk
  - Compromise to spacecraft and launch vehicle safety, systems, facilities, and GSE
  - Risk to processing and pad personnel; public safety
  - Risk to mission success

Impact to Safety Review Process

- Late submittal reduces allocated safety review time
  - Increases the potential of omission/oversight
  - Cause further delays if additional data/clarification is needed
- Systems, safety and mitigation changes add to the review process
  - Additional analysis/test/reports required
  - Ensure adequate mitigation
  - Demonstrate an equivalent level of safety

Impact to Safety Review Process

- Disrupts the planned work schedule of reviewers
  - May infringe on data review required for other missions
- Potentially could result in submittal of a Mission Risk, with associated briefings, documentation, and tracking
- Affects the release of other mission documents (e.g., Interface Control Document, Launch Site Support Plan)
  - Safety inputs are required
  - Impacts the OPR's schedule for document development

Impact to Safety Requirements

- Noncompliance to NPR
  - NASA policy requires a variance to be submitted
    - Missed delivery milestone
    - Potential for an additional non-compliance to a technical requirement
  - Impact to payload project (associated cost and schedule) for variance preparation, briefings, coordination
  - Cost and time for variance review/approval by OSMA, ELV Payload Safety Program, Center Director(s), PSWG, Range, etc.
  - Terms of acceptance may include additional mitigations, process/procedural changes, or non-concur
- Noncompliance to other requirements (e.g., Range, OSHA)

Impact to Launch Vehicle Contractor

- Spacecraft safety data package is needed for preparation of the launch vehicle mission-specific safety data package
  - Contract deliverable requirement
- May require unanticipated support requirements, or modifications to vehicle / pad activities
  - Mission-specific GSE requirements
  - Procedural changes for pad operations
- Changes to established procedures/processes or need for out-of-sequence work increases risk
  - Schedule changes
  - Support availability

Corrective Action - Goals

- Ensure that safety and ELV Payload Safety Program objectives are achieved
  - Safety is adequately performed in a timely and efficient manner consistent for all missions
  - Mission objectives are met
- Minimize cost and schedule impacts
- Ensure requirements and associated corrective actions are defined and implemented consistently
- Required actions are value-added
  - Provide an equivalent means to ensure safety is appropriately in-step with mission activities, not a paperwork exercise

Corrective Action - Options

- Potential options to achieve safety confidence and manage risk increase in severity:
  - 'Get-well' schedules from Project Management for milestones / deliverables
  - Risk process / watch item used to monitor status and resolution
  - Variance (Level I)
  - Formal project assumption of risk / cost / schedule impact due to potential 'safety-driven' changes
  - 'Delta' safety reviews
  - System Engineering briefings to provide data
  - Additional interim safety data submittals
  - Variance (Level II)
  - Audits of Engineering Data
  - Project Milestone Reviews (PDR, CDR, FRR, LRR, etc.) are kept 'OPEN' to completion
- Goal is to prevent a delay in payload shipping, processing, transportation to the pad, or launch

Implementation Methods

- Project action required is documented in the ELV Payload Safety Program NPR
  - Assessment of factors would determine required action(s)
    - Example #1: Late submittal of Safety Data Package
      - Considerations:
        - Extent of delinquency; frequency
        - Project phase or milestone (e.g., PDR vs. CDR)
        - Criticality and probability of late safety findings impacting project milestones
      - Remedial steps required: Safety Assurance through 'back up' means; Project awareness/assumption of risk; Safety Program monitoring

Implementation Methods

- Example #2: Late submittal of hazardous technical operating procedure.
  - Considerations:
    - Extent of delinquency; frequency
    - Impact to processing if safety approval is delayed
    - Criticality and probability of potential safety risk
  - Remedial action required: Compliance (delay performing operation), or Variance (level 1) required; Project awareness/assumption of risk; Occurrence tracked by Payload Safety Program

Process Improvements

- Data Requirements and Development
  - Prioritization of safety data requirements to a specific submittal phase
  - Develop data matrices
    - Consistent format and content defines the standard for assessment and expedites compilation of required data
- Document Submittal
  - Electronic transmittal will eliminate delay in data transfer
- Variance Approval Process
  - Potential for approval of certain variances to be delegated to the SMA Director
    - Approval process for Project and ELV Payload Safety Program would not change
- Propose Change to Range Safety Requirements
  - Reduce required delivery date of safety data packages from 45 days prior to design review, to 30 days.

Summary

- Late submittals can have a wide range of impacts
  - Technical, cost, and schedule impacts to Project and Safety activities
  - Impacts can flow to other organizations and other missions
- Design and safety activities have to be synchronized
  - Mission engineering milestones are established by project
  - Safety involvement and input need to be timely
  - Safety-related requirements/changes imposed late have a higher likelihood of major impact
- Process changes can provide some improvement
  - Resolutions (data preparation and submittal, variance approval, etc.) will require a change to current way of doing business
  - Other factors...Training? Communication? Staffing? Safety culture?
- Alternative (back-up) data sources need to be identified in advance, and be utilized when primary sources can not deliver as required.
  - Risks must be acknowledged by Project Management

Proposed NPR 8715.XX, Chapter 1 Variance Process

Consistent with NASA safety variance requirements in NPR 8715.3:

- A variance consists of documented and approved permission for relief from an established SMA requirement
  - Exception authorizes permanent relief from a specific requirement and may be requested at any time during the project life cycle
  - Deviation authorizes temporary relief in advance from a specific requirement and is requested during the formulation/planning/design stages
  - Waiver authorizes temporary relief after the fact from a specific requirement and is requested during the implementation of a project or operation to address situations that were unforeseen during design or planning
- Each variance type may involve approval of alternative means that provide an equivalent or lower level of risk or formal acceptance of increased risk (inconsistent with AF Range policy)
- Approval authorities vary based on the type/level of requirement (design/technical, administrative/milestone, HQ/local) and on whether approval includes acceptance of increased risk

"New" Waiver Process

- Non-conformance – the state or situation of not fulfilling a requirement
- Waiver - a written authorization allowing relief from a requirement (Note: The relief can be temporary)
- Exception - A written authorization granting permanent relief from a specific, non-applicable requirement
- Variance - This term has specific significance in the administration of OSHA requirements and will only be used in relation to OSHA regulations and requirements
- Deviation - encompassed by the terms exception and waiver

Proposed NPR 8715.XX, Chapter 1 Variance Process (continued)

Each Payload Project Manager:

- Coordinate with their mission PSWG and the Executive Team as soon as the Project identifies a potential noncompliance with a safety requirement
  - To identify all options for resolving any issues and determining if a variance is required
- Document any safety variance request using the format provided in NPR 8715.XX, Appendix C
- Submit any draft variance request to their mission PSWG and to the Executive Team for review and input
- Ensure request is coordinated with all concurring and approving officials as agreed to by the PSWG and Executive Team and the appropriate signatures are obtained

Proposed NPR 8715.XX, Chapter 1 Variance Process (continued)

The PSWG and the Executive Team:

- Ensure request and accompanying data are correct and complete
- Ensure any residual risk is properly characterized (quantitatively or qualitatively and any increase in risk is properly identified
- Assess effects on requirements or other ELV payload projects and initiate any actions needed to address such effects
- Ensure request identifies all needed signatures for approval, concurrence, and any risk acceptance
  - NASA and external approval authorities
  - Technical authority (or equivalent) responsible for the requirement
  - Center Directors or other NASA officials responsible for people or property exposed to any risk associated with the variance
- The Chief of OSMA may delegate his approval authority for HQ level NPR safety variances

Training Program

2 Courses to be developed and offered:

- ELV Payload Safety Process
  - 1 - Day process and requirements course for program managers and center S&MA managers
- ELV Payload Safety Analysis
  - A detailed 3 - Day process and analysis course with panel and working group exercises for PSWG members

Training Program (continued)

ELV Payload Safety Process – 1 day course

- System Safety Requirements Overview
- Management Roles & Responsibilities
  - Safety Requirements in Contracts
  - Resources (Budget/Manpower)
  - Reviews & Approvals
  - Mission Assurance & Personnel Safety
- ELV Payload Safety Review and Approval Process
  - NPR Chapter 2 Requirements
  - Additional Roles and Responsibilities (PSWG & others)
  - Deliverables & Schedule
  - NPR Chapter 3 Payload Design and Ground Operations Safety Requirements Summary
  - Requirements
  - Format
  - Examples

Training Program (continued)

ELV Payload Safety Analysis – 3 Day course

- Payload Mission Life Cycle
- Roles & Responsibilities
- Payload System Safety Unique Requirements
- Compliance Documents
- Process Requirements
  - Phase reviews
  - Variances
  - Approval/certification
- Payload Design Requirements
- Payload Ground Processing Requirements
- Requirements Verification

Training Program (continued)

ELV Payload Safety Analysis – 3 Day course (cont.)

- Technical Operating Procedures
- Deliverables
  - Schedule
  - Content
  - Forms
- Presentations
  - Phase I, II, III Safety Reviews
  - SARR/SMARR
- Launch Site "Protocol"
  - Communications/coordination
  - Anomaly & mishap reporting
- Communication Interfaces
- Issue Resolution
- Lessons Learned

- **Questions or Comments?**
- **Action Items**

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This Presentation details the Expendable Launch Vehicle Payload Safety Program in its development and plan for implementation. It is an overview of the Program's policies, processes, and requirements.

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