

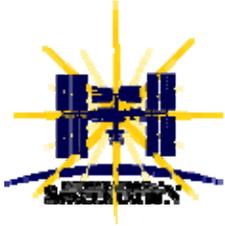
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# OZ3 Payload Engineering Integration Overview

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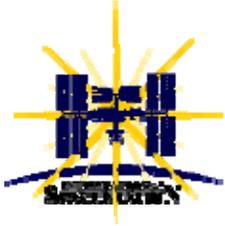


## Overall Payload Engineering Integration Process

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- An ICD Engineer is assigned to work with the PD on ICD development
- OZ3/PEI attends design reviews
- Stage Analysis is performed
- Guidelines and Constraints are identified
- Requirement Exceptions are processed
- Verification products are tracked, reviewed, approved
- Support is provided for HFIT and IPLAT
- Support is provided for Acoustics
- Cold Stowage Assets are managed by OZ3

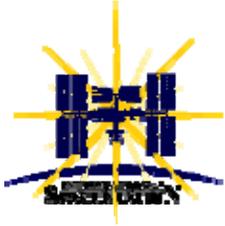


# Interface Requirements

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- An ICD Engineer is assigned to work with the PD on ICD development
  - The ICD documents the payload interfaces to ISS
  - The ICD also identifies the applicable requirements from the ISS that the payload has to meet, the verification method, due date, and verification data
    - SSP 57000 – Pressurized Payloads Interface Requirements Document
    - SSP 57001 – Pressurized Payloads ICD Template
    - SSP 57003 – Attached Payloads IRD
    - SSP 57004 – Attached Payloads ICD Template
    - SSP 57003-ELC – ELC Payloads IRD
    - SSP 57004-ELC – ELC Payloads ICD Template
    - SSP 57008 – Non Rack Payloads IRD
    - SSP 57012 – Common FRAM Payload to Launch Vehicle IRD
    - SSP 57070 – Cold Stowage IRD
    - SSP 52000-IDD-ERP – Express Interface Definition Document
    - SSP 52000-PVP-ERP – Express Payload Verification Plan
    - JPAH Vol 3 – JEM EF IRD
    - COL-RIBRE-165 – Columbus EF IRD
  - The ICD is usually at a draft state for the payload PDR and is baselined around CDR

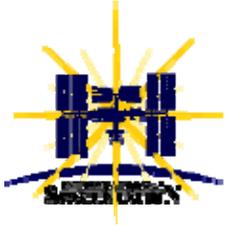


## Stage Analysis

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- Stage Analysis is performed to assess compliance with the requirements documented in SSP 57011, Payload Verification Program Plan, and to ensure that the complement of payloads meets ISS interface requirements
- The payloads are assessed at the element level as well as the ISS level
  - IVA Emergency Egress Path
  - Crew Translation Path
  - Equipment Translation Path
  - Pressurized Payload Work Volume
  - Visibility and Access to Critical Equipment and Controls
  - ECLS Clearance Zones
  - Channelized Power Analysis
  - Electrical Power System Stability
  - Pressurized Element Thermal Compatibility
  - Latent & Sensible Heat Load
  - Fluid and Atmosphere Consumables Usage
  - External Contamination/Venting
  - Element-level Thermal Compatibility of Attached Payloads
  - Payload Data Link and Software Service Assessment
  - Payload 1553B Data Bus Loading
  - Acoustic Emissions
  - Element-Level Pressurized/Attached Payloads EMI/EMC
  - Integrated Attached Payload Collision Avoidance
  - Payload Field of View
  - EVA Translation Path
  - EVA Worksites
  - Attached Payload Robotics
  - Microgravity
- Stage analysis may result in operational constraints and/or the need for complement level payload requirement exceptions

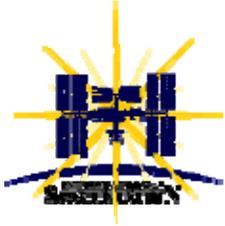


## Guidelines and Constraints

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- Guidelines and Constraints are developed as part of stage analysis and exception processing to document constraints which the Payload Operations Team will adhere to so that payloads are not operated in an unsafe or incompatible manner
  - For example, certain combinations of payloads may be too loud together and constraints are put in place to make sure that the integrated set of payload does not exceed a tolerable level
  - Another example is when there are deployed payload protrusions and one protrusion would physically interfere with another protrusion and/or the associated crew work volume
- Payload No Operations Constraints are also used in the case where a payload has not completed all of their verification products

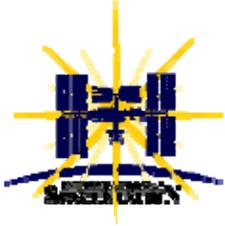


## Requirement Exceptions

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- Payload Exceptions are cases where the payload does not meet the ISS requirements but proposes that there is rationale why this might be acceptable
  - Exceptions expend additional resources and take time to evaluate
    - They typically include a section for PEI analysis.
    - If in an IP Element, then the IP must evaluate them also and provide their analysis
  - Exceptions often result in additional operational constraints
  - Some exceptions are not approved
  - Exceptions must be signed by multiple teams, including subsystem requirement owners
  - Exceptions are prepared on a PIRN/Exception form and are referenced from a table in the payload's unique ICD
- Exceptions can be at the Payload level or the Element level or even at the ISS level
  - Example at payload level: a payload exceeds the allowable mass limit
  - Example at the element level: a set of payloads in the US Lab exceed the acoustics limit
  - Example at the ISS level: a payload in the Columbus Module exceeds the microgravity limits in all modules

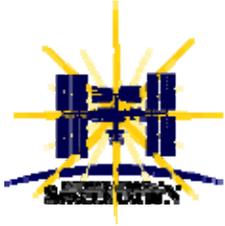


## Verification Tracking and Approval

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- Payload applicable requirements are identified in the payload unique ICD
  - Verification methods, products, due dates are identified in a table near the end of the book
- PEI loads this set of applicable requirements into a verification database and tracks the submittal and approval of all payload verification for each flight/stage
- As verification data comes in, PEI assigns discipline experts to review the data
  - Data may be approved as is
  - Additional data or clarification may be requested
  - Data may be rejected if it is not addressing the requirement
- PIRNs to the applicable requirements since the ICD was approved must also be assessed via the RCAR process
  - These PIRNs are identified on the OZ CoFR letters at ~5 months prior to flight

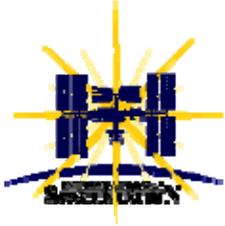


## HFIT and IPLAT Support

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- HFIT – Human Factors Integration Team provides a service to payloads that request it for verification of Human Factors requirements
  - Performed by a team of Astronaut and Crew Representatives, Boeing and NASA Human Factors experts
  - Completes all paperwork necessary to close out human factors verification
  - Saves significant time and effort for payload developers
  - Can support early development and give guidance
- IPLAT – ISS Payload Label Approval Team provides a service to payloads to review/approve payload labels and assist in the ordering of these
  - Reviews payload drawings and photos of payload hardware
  - Verifies that ISS payloads meet label requirements
  - Assists in the ordering of payload labels from the Decal Lab



## Management of Cold Storage Assets



- Coldbags and Ice Bricks +4, -26 or -32C
- MERLIN -20 to +48C
- Glacier +4 to -160C, operates in Middeck or Express
- MELFI +2, -35, -95C
- The Cold Storage Team works with PDs to plan the assets needed for ascent, on-orbit, and descent. They also provide testing support and fit check in the assets selected.



MELFI



Coldbag



MERLIN



Glacier