# BUILDING ON THE PAST - LOOKING TO THE FUTURE: PART 2: A FOCUS ON EXPANDING HORIZONS

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## ABSTRACT

The history of space endeavors stretches far from the first liquid-fueled rocket created by the father of modern rocketry, Robert Goddard, in 1926 and will certainly extend far beyond the construction of the International Space Station (ISS) scheduled to be complete with the addition of the Permanent Multipurpose Module on STS-133/ULF5. National Aeronautics and Space Administration (NASA) and the ISS International Partners (IPs) will be the unrelenting venue used to satisfy the curiosities of man as we seek an understanding of space through various experiments (also referred to as payloads) conducted in microgravity. The NASA Payload Safety Review Panel (PSRP) continues to serve as the lead for the review and assessment of payload hardware to assure facility and crew safety. This is the second in a series of papers and presentations that illustrate challenges and lessons learned in the areas of communication, safety requirements, and processes which have been vital to the PSRP.

## 1. BACKGROUND

For the Third International Association for the Advancement of Space Safety (IAASS) Conference in 2008, a team of contract Safety and Mission Assurance (S&MA) Payload Safety Engineers (PSEs), PSE Team and Technical Leads, and a NASA PSRP Chairman set out to review key lessons learned within Payload Safety in an effort to assess how specific and strategic planning will ensure success for future endeavors [1]. The team focused on three main areas in reviewing past experiences and planning for the future: communication, safety requirements, and processes. For the Fourth IAASS Conference, four members of the team remained the same, and a NASA PSRP Executive Officer (XO) was also added for additional perspective. The focus of the team remained on the same three main areas, communication, safety requirements, and processes, with an emphasis added to expanding horizons within these areas.

This section serves as a 'snapshot of 2010' so the readers have both a glimpse into the current state of NASA and the PSRP, as well as a look into planned future process improvements and discussions occurring with the ISS experiment safety review panels.

### 1.1 NASA 2010

NASA stands at a pivotal point in its history, with a still-evolving and presently unknown future. Decisions have been made to retire the Space Shuttle, at the conclusion of Fiscal Year (FY) 2010 (delineated as October 1, 2009-September 30, 2010). This decision was tempered, however, with provisions to complete the remaining three Shuttle flights without undue schedule pressure, allowing the retirement to be extended into FY 2011, as necessary. Additional proposals have been announced affecting the life of both the ISS and the Constellation Programs (CxP); the former of which increased the life of the ISS until 2020 and possibly longer. The future of the CxP, which was developing NASA's follow-on vehicle to the Space Shuttle, however, is still being negotiated at the highest level of the United States (U.S.) Government and is undecided at present.

Commercial Orbital Transportation Services (COTS) Vehicles are being developed for delivering cargo and crew to the ISS to augment the Russian Space Agency's (Roscosmos) Soyuz and Progress, the European Space Agency's (ESA) Automated Transfer Vehicle (ATV) and the Japan Aerospace and Exploration Agency's (JAXA) H-II Transfer Vehicle (HTV). NASA and the COTS vehicle developers are undergoing an intensive program of design and capability evaluations to assure the safety of the ISS facility and its crew. These changes result in a shift of NASA's focus to one that is centered now mostly on the ISS and have resulted in discussions and conjecture related to both how the safety panels will be utilized along with speculation over the potential merging of the various safety panels to maximize efficiencies in the challenges of a modern budget-conscious environment.

### 1.2 NASA PSRP 2010

Chartered by NASA in the 1970s, today, the PSRP supports both the Space Shuttle Program (SSP) and the ISS Program (ISSP). The PSRP Charter was updated in August 2009 to become an ISS Joint Program Directive

(JPD) replacing the previous Johnson Space Center (JSC) Policy Charter (JPC). The update included formal recognition of the PSRP authority delegation to PSRP IP Franchises and formally expanded the scope of the PSRP to review payloads planned to be operated on the ISS and transported via not only the Space Shuttle, but also on IP and/or other ISS visiting vehicles [2][3].

The PSRP processed 449 payload Safety Data Packages (SDPs) in FY 2008, resulting in approximately 150 formal (full-panel review/discussion) NASA PSRP Flight Safety Reviews (FSRs) and 280 informal (Outside-Of-Board (OOB) or partial panel review/discussion) FSRs. In FY 2009, there were 435 SDPs submitted and dispositioned, resulting in approximately 110 formal and 300 informal NASA PSRP FSRs, respectively.

The Space Shuttle and ISSP have successfully completed a total of 22 vehicle missions (21 to ISS) since the first paper in this series was written in 2008. The final servicing of the Hubble Space Telescope (HST) was among the eight Shuttle missions and was both extremely challenging and highly successful. The Russian IP also launched five Soyuz missions and seven Progress flights, including the launch and installation of a Mini-Research Module (MRM)-2, providing additional capabilities and available on-orbit volume for future ISS utilization. In addition, JAXA transported an extraordinary number of payloads (41) on their first HTV launch to ISS and demonstrated a tremendous accomplishment with their first unmanned launch vehicle to support ISS utilization and resupply.

### 1.3 PSRP Franchise Activities

NASA and ESA completed the Second Joint Formal Audit of the ESA PSRP franchise in March 2007, resulting in NASA granting full autonomy to the ESA PSRP franchise for the conduct of experiment flight safety review activities. In their third year of independent operations, the ESA PSRP continues to demonstrate compliance to the objectives and agreements as documented within the NASA/ESA PSRP franchise charter and Joint Development Plan (SSP 50695) [4][5[[6]. The Fourth NASA/ESA Joint PSRP franchise audit is scheduled for July 2010. Bi-lateral Technical Agreements for Structures/Mechanisms and Electrical Systems between the ESA and NASA Engineering Directorates are currently being finalized by the two sides' technical specialists.

NASA and JAXA agreed to charter a JAXA-based PSRP franchise on May 22, 2009 (the format being used for the franchise is the JAXA Safety Review Panel (SRP)) [7], and the Joint Development Plan (JDP) between NASA and JAXA was officially signed on November 26, 2009 [8]. An audit checklist between the NASA PSRP and JAXA SRP is being developed with the first joint audit tentatively planned for September 2010.

Following the first joint NASA/JAXA FSRs conducted in Tsukuba, Japan in November 2009, the JAXA SRP has been authorized to review experiments for the NSTS/ISS 13830 [9] classifications of "Basic" payloads thru Phase III, "Intermediate" payloads thru Phase II and "Complex" payloads thru Phase I. The NASA/JAXA "Bilateral Protocol on Cooperation in the Field of Operations Safety Support to the ISS Safety Review Process", which is an agreement which specifies the roles and responsibilities relating to operations safety participation in the safety review process, was also successfully signed and distributed in February 2010 [10]. Both Structures/Mechanisms and Fracture Control Bi-lateral Technical Agreements are at present being evaluated for approval by NASA-Johnson Space Center (JSC) and JAXA legal representatives.

NASA is facing transitions in 2010 and 2011 which bring a large measure of uncertainty. Which programs end and which continue are decisions that are outside the realm of the PSRP's influence. The purpose of the NASA and IP safety communities, however, must remain steadfast and focused towards the ever-vigilant pursuit of crew safety essential for the development of space, human exploration, and scientific study.

## 2. COMMUNICATION

The ability of two or more parties to discuss a specific topic is more than just the exchange of words. Culture and language issues between peoples of different countries can impede communication attempts. Within the U.S. space program, cultural and language differences exist from one corporation to the next and between government and industry. This will become more pronounced as the COTS process results in additional providers of launch services. A major responsibility of the ISS safety community is to assure communication differences do not hinder upon the safety of the payload.

### 2.1 Efficiencies in Communication

As changes have transpired at NASA, the PSRP has looked for and made efficiencies in the way personnel (both internal and external to NASA) communicate. The following represent only a few of the more recent advances in PSRP processes.

#### Merging Calendars and Daily Teleconferences

While it is not yet clear if the NASA PSRP and the ISS SRP will indeed merge to become just one panel, at this juncture, strides have been made to promote communication and understanding between the safety panels. As part of this activity, key panel members have been engaged in cross-panel training. The practice of

sharing panel members is not a new concept as many of the individual team members that represent particular offices or directorates on the two panels are actually shared personnel between the two panels (for example: Mission Operations Directorate (MOD) Representatives, Space Life Sciences Representatives, and Crew Office Representatives). What is new is the motivation by which the cross-panel training is taking place. The panel positions involved: Panel Chairs, XOs, and Contractor Safety Engineers, allow for a more detailed view into the differences and similarities between the two panels. This has also brought about efficiencies in communications such that accidental double-booking of key personnel is eliminated.

The PSRP and SRP Coordination Offices, run by two separate Data Administrators and support staff, have worked together to develop a joint calendar. The calendar identifies the formal meetings scheduled for each panel, the Chair and XO that will reside at the review, data delivery dates, and program flight readiness meetings. This calendar is published on both the PSRP and SRP websites. Additional planning information, such as personnel availability and flight planning dates, is kept unpublished to the general public, but remains a crucial element for successful integration of the two offices and safety panel support.

The PSRP and SRP Coordination Offices have also joined to hold brief daily teleconferences with the safety teams. Formerly just a PSRP teleconference, the daily tag-ups have transformed into a joint activity to discuss upcoming meetings and schedules for the week and to accommodate as-needed coordination and concise discussions on urgent topics.

**PSRP Franchises**

In the PSRP franchise concept, NASA and the IPs have developed a practical and measurable way to promote NASA/IP relationships, further the knowledge base of safety and proven applications of Payload Safety, and decrease transoceanic travel expenses for all sides involved.

NASA maintains cognizance of the activities of the franchised panels through consistent communication via Liaison Safety Engineers who work one-on-one with the ESA and JAXA Safety Engineers. This allows for NASA to assist the development of the franchise and for NASA to obtain insight into the daily functioning of the franchised IP safety panel.

Use of routine informal NASA-franchise panel teleconferences allows opportunities for problem resolution and planning for upcoming flights. Currently, NASA PSRP XOs and PSEs hold a weekly meeting with their ESA counterparts to discuss pressing on-orbit issues, major reviews scheduled for the ESA PSRP, as well as any open work remaining for upcoming flights. A monthly teleconference is also conducted between the PSRP Chairs, XOs, and their ESA Chairs and XO counterparts. Plans for a standing weekly meeting between NASA and JAXA are being finalized; however, NASA and JAXA hold meetings at least twice a month to discuss any open payload issues, upcoming meetings, and the development and/or expansion of franchise process documents/agreements.

The monthly PSRP Internal Meeting also provides a format for more general communication between NASA and the franchised panels. The meeting agenda focuses on current policy concerns being worked by the PSRP, lessons learned, and future planning. Within the NASA PSRP, we have now realized, however, that the term "internal" may appear to signify that our IP's representatives should not attend. Certainly the intent has always been to have our IPs participating and actively involved and contributing to any adjustments to the PSRP process with which we all are tasked to comply. (Note: As a result of this feedback from one of our IP safety colleagues recently, the NASA PSRP leadership is now reviewing alternate names for the "internal meeting;" current contenders are "PSRP Special Topics" or the "Monthly PSRP Policies and Practices (MP3)").

ESA and JAXA PSRP franchise representatives are strongly encouraged and welcome to participate and to bring forward any issues, concerns, or requested clarifications and suggested policy updates. Their participation also promotes consistency amongst the NASA PSRP and franchised PSRPs for policy and/or processes and helps maintain the high standards of innovation and inclusion core to the PSRP ideals.

### 2.2 Communication Challenges in Real-time Operations

With ISS operations almost fully transitioned from assembly to utilization, the communication challenges related to experiments are becoming much more extensive. To that end, it's essential to understand the various nuances in how IP safety organizations approach real-time operations.

As a result of previous lessons learned with unclear or misunderstood ISS on-orbit management direction and authority, NASA PSEs are now learning to more effectively utilize the ISS Mission Evaluation Room (MER) Safety Console and ISS Operations team to its full capabilities. The same is true with IP payloads that experience issues or anomalies on-orbit. Communication with the various IP safety teams do have some distinct differences, however, and the IP safety organizations do not always mirror that of the NASA PSRP. NASA PSEs were quick to coordinate with their ESA PSRP

counterparts when an on-orbit issue arose with a recent externally-attached ESA ISS experiment. This proved to be inefficient since it was determined later that, unlike the NASA PSRP PSE function, the ESA PSRP PSEs job responsibilities and task orders do not always include support to the real-times ISS operations team (and therefore they were not in possession of the very latest on-orbit experiment status). The majority of the ESA on-orbit status and issues are worked through the ESA Operations Safety Unit via the ESA Product Assurance and Safety Officer (PASO) Console. Unlike the NASA side, generally the ESA PSRP Safety Engineers are not involved in support for on-orbit issues unless those on-orbit issues result in updates to Hazard Reports (HRs) and are thus re-boarded within the formal ESA PSRP for formal disposition.

From the NASA PSRP history, however, there have been numerous situations in ISS memory in which the operations management team has requested specific NASA PSRP opinion and responses on real-time, on-orbit situations (via requests from the Marshall Space Flight Center (MSFC) Payload Operations and Integration Center (POIC), the ISS Mission Management Team (IMMT), or MER Safety Console). The NASA PSRP continues to work with the real-time community to clearly establish our roles/responsibilities and lines of communication in order to provide support as efficiently as possible.

### 2.3 Communication Transitions for the Future

Increased communication, knowledge transfer and continuous training are fundamental for the future success of the PSRP. Given that the ISS SRP workload may decrease with the delivery of the last key ISS elements later this year, it is also imperative that NASA retains its current skilled safety workforce and also help adapt those technical specialists to support the ISS utilization phase. To help with that goal, the PSRP and SRP have been collaborating on efforts planned for the future era of ISS operations.

#### Cross Training of Chairs and Executive Officers (XOs)

NASA and its contractors have been looking into ways to optimize efficiencies within NASA's ISS SRP and PSRP. As part of this evaluation, the SRP and the PSRP have been engaged in cross-training of the key panel positions that was discussed previously. This affords an opportunity for the Chairs to support and evaluate the strengths of the panels and to find areas of synergy. Communication within each panel is decidedly different, based on the perceived knowledge of space industry safety requirements by the hardware provider and familiarity of the previously flown hardware to the panel. ISS hardware/non-experiment cargo, reviewed by SRP, has specific operational necessity and failure can result in loss of segment operability or other subsequent hazards. This contrasts with the PSRP's subject of review. Experiments are not vital for crew survival. The safety focus of the SRP, therefore, tends to emphasize reliability, maintainability and the subsequent effects of hardware failure on the ISS mission.

The following have been noted as areas where the differences in the panels are fairly profound:
- Document management practices
- Safety panel composition
- OOB approval processes
- Focus of safety impacts
- Safety backgrounds for hardware providers

The challenge in any future safety panel combination efforts will be first to understand all the differences between the two processes and then to determine how best to integrate the best of both worlds to create a sound and efficient safety review process for both types of ISS equipment (without sacrificing key details of either).

## 3. SAFETY REQUIREMENTS

The cornerstone of any safety review process lies in the quality and clarity of its imposed requirements. In truth, a safety review panel which does not or cannot periodically assess the strength and weakness of its requirements and which cannot identify and implement necessary changes is one which will be significantly weaker in the face of evolving technologies, gained knowledge/experience and scientific developments. In order for a strong safety culture to continue to live and prosper within NASA, it is therefore essential that safety requirements constantly be reviewed and updated as events dictate.

### 3.1 Efficiencies in Safety Requirements

The following efficiencies have been implemented and applied to PSRP safety requirements.

#### SSP 51700, "Payload Safety Policy and Requirements for the International Space Station"

The baselined SSP 51700 is designed to be a consolidation of the NSTS 1700.7B and NSTS 1700.7B ISS Addendum requirements documents, as they presently exist, focused on payloads operated/stowed on ISS [11][12][13]. In the current requirements architecture, Payload Organizations (POs) are required to possess an understanding of both National Space Transportation System (NSTS) documents, comparing the baseline core Shuttle payload safety document and the ISS Addendum text side by side in order to fully understand the requirements of the ISS Addendum. In addition, both of these documents currently use the Shuttle Configuration Management (CM) system. The

new SSP 51700 baseline instead places that CM responsibility into the ISSP realm.

The additional benefit of the SSP 51700 concept is that the safety requirements for payloads operating on ISS are referenced in one document; this provides a convenient venue where the POs may locate any and all applicable requirements no matter their planned ISS on-orbit location or operational scenario.

As presented at the April 20, 2010 Multilateral Safety and Mission Assurance Panel (MS&MAP), the transition of having a Shuttle-managed versus ISS-managed set of requirements also allows the PSRP to continue updating requirements well past the life of the Space Shuttle Program [14]. This provides the IPs the ability to distribute and filter any proposed technical changes or comments to requirements updates via the formal ISS CM system. The current distribution lists of the Shuttle CM do not include the IPs, and as such, the PSRP has been forced to coordinate IP comments to change requests outside of the formal Shuttle CM system via the Joint American Russian Safety Working Group (JARSWG), the MS&MAP, and other NASA PSRP dedicated discussion forums.

The current plan for the SSP 51700 document is to issue a baseline initial release in May 2010. This document introduces no new technical changes from the NSTS 1700.7B ISS Addendum; instead, it reformats the existing requirements into a common ISS requirements standard. Following that release, a technical revision will then be issued that addresses many of the necessary technical requirements updates (also known as: "Change Requests" (CRs)) presently in draft within the NASA PSRP and which are still being developed and refined.

To date, the NASA/IP community has provided 71 comments for the first revision. Transport specific requirements have been removed from SSP 51700 in lieu of pointers to the respective launch vehicle requirements and to SSP 57008, the "Unique Pressurized Payload Non-Rack Interface Control Document Template [15]".

**NSTS/ISS 13830, Section 7 "Supporting Technical Data Submittals"**

In October 2009, the PSRP successfully updated NSTS/ISS 13830, Section 7 to clarify required data expected from POs within delivered SDPs. This change was as a result of common questions and requests for additional data from the NASA PSRP technical support, including: verification plans for structural integrity and submittal of mechanical systems verification plans and reports, wiring, bonding and grounding schematics, etc. Given the history of these requests, those deliverables (amongst others) are now clearly stated in NSTS/ISS 13830 and imposed on the PO, allowing for more efficient use of review meeting time.

In addition to clarifying these existing data submittals, the NASA PSRP also included new data deliverable requirements for information regarding possible payload impacts to the ISS plasma/floating potential and the JSC Form (JF) 713 "Inflight Biohazardous Materials Approval Form" [16]. All of these updated and new requirements seek to improve the flight safety review process by clarifying the expectations of the PSRP during the preparation and conduct of the experiment safety review.

In addition, given the large number of possible launch vehicles and ISS operational scenarios, the PSRP has also begun focusing on the launch safety of experiments planned for ISS and the concept of "safe on arrival" as part of the ISS FSR process.

**Demonstration of Safety Compliance for IP Vehicles, Segments, and "Safe on Arrival" Principle**

Similar to the SSP 51700 concept, the SSP 57008 document allows the reader to easily find necessary requirements in a central location. However, unlike SSP 51700, SSP 57008 focuses on the unique environmental requirements for the various ISS modules (U.S. Operating Segment (USOS), Columbus (COL), Japanese Experiment Module (JEM)) and/or IP vehicles (Progress, Soyuz, Shuttle, ATV, HTV) [15]. It can be thought of as a "Common Interface Control Document (ICD)" for experiments on the ISS and denotes applicable unqiue temperature requirements, pressure, loads, shock, vibration limits, etc.

As a practical example, one could imagine an experiment planned for launch on an ESA ATV, transferred through the Russian Service Module (SM), stowed in the JAXA JEM, moved into the ESA Columbus (COL) module for the operation, and then either returned on a Russian Soyuz or disposed aboard a Russian Progress. Given the large number of transport and ISS environmental conditions, it is easy to see that the PO could become quickly overwhelmed with the number of unique requirements levied by the IP owners.

SSP 57008 assists the PO in documenting all those applicable requirements in one document, and is maintained by the NASA-ISS Payloads Office, working in close cooperation with the ISSP and IPs. SSP 57008 also assists the PO in the ability to clearly demonstrate the concept of "safe on arrival" for their experiment hardware after transport on the IP vehicle.

As part of the requirement to demonstrate ISS flight safety to the NASA PSRP, it must be shown (and documented in associated payload HRs) that the

equipment will arrive on ISS in a safe state after undergoing all applicable transport vehicle loading, with hazard controls fully in place, structures intact, levels of containment secure, etc. Thus, as part of the payload safety verification program for ISS, applicable transport vehicle and operational environments must be clearly known, properly assessed (via pre-flight analysis, testing, etc.) and succinctly documented within the ISS on-orbit experiment safety data.

It is with this assurance of ISS on-orbit safety, first and foremost, that provides the confidence to the IP launch/return vehicle provider that the hardware is safe for the transport phase as well. If the hardware has been designed and tested to be safe and intact upon first hatch opening and operations on the ISS, then of course, it is logical to assume that it has also been tested and designed as safe for the passive transportation phase within the IP launch vehicle.

That said, a piece of hardware may always have those unique launch vehicle integration assessments for which review authority resides completely between the payload developer and IP safety organization, and those unique launch vehicle assessments must be coordinated and completed between the IP and PO prior to final approval for delivery to and operations aboard the ISS. However, given that the bulk of the experiments reviewed today (and which will most likely be the same for the future) are simple, soft-stowed and non-structurally mounted (for launch and on-orbit), the SSP 57008 effectively serves the majority of the experiment hardware providers for understanding important launch vehicle environmental effects. It also promises to be quite beneficial for the near future in which NASA can no longer rely on the Space Shuttle to meet the ISS experiment delivery and return needs, and instead looks to our IP and commercial launch services providers. Thus, we gain efficiencies by using SSP 57008.

### 3.2 Safety Requirements Transitions for the Future

The future holds many more efficiency improvements for the PSRP. SSP 51700 is currently being evaluated for Revision A which will clarify several requirements and perhaps begin to replace NASA-specific requirements currently not as palatable to the IPs. Future revisions of SSP 51700 may also involve sufficient clarification of requirements such that the interpretation letters in NSTS/ISS 18798 may no longer be required [17].

NASA PSRP and ISS CM representatives are also developing a plan to transition both the NSTS/ISS 18798 and NSTS/ISS 13830 from a SSP lead in the CM area to the ISSP. The NASA PSRP looks forward to the future, and will continue to adapt and correct its course as needed to meet ISSP direction as it is received.

## 4. PROCESSES

PSRP Processes, the particular method of reviewing payloads for flight, generally involve a number of steps or operations from receipt of a payload SDP to approval of a payload for flight. The PSRP has adjusted to work with the ISS IP environment. As we approach the impending retirement of the Space Shuttle, and are faced with the challenge of limited resources coupled with increased demand for ISS utilization, the NASA PSRP finds itself required to develop efficiencies and innovations in the methods in which we conduct the PSRP processes.

### 4.1 Efficiencies in Processes

The following efficiencies have been implemented and applied to PSRP processes.

#### PSRP Franchises

The PSRP franchise concept is one of the key efficiencies in the area of ISS utilization. The core of the PSRP franchise is the concept of safety review panel delegation. By entrusting the review authority to the recognized/approved IP franchise safety panels, the NASA PSRP is able to focus its review attention to the U.S. payloads or those which absolutely require NASA PSRP joint review.

Such examples could be the case for ESA or JAXA experiments operated within the Russian module, where IP-to-IP franchise agreements have not yet been established or negotiated between the two IP safety organizations.

The establishment of PSRP franchise agreements also assists NASA for the scope of review for NASA payloads on IP launch/return vehicles. Per the current bilateral franchise agreements with the ESA PSRP and JAXA SRP, U.S. payloads meeting the requirements of the ATV and HTV and which have completed their review with the NASA PSRP for safe ISS operations (and which encompass the launch requirements already for the "safe on arrival" concept) do not require extensive additional IP re-review for the planned transport on those IP vehicles. This benefit is now being fully realized with the apparent, almost complete reliance on IP launch vehicles to sustain NASA utilization requests (pending development and further exploration of the commercial launch services projects).

#### Flight Safety Certification

A noteworthy efficiency enacted in the 2007 timeframe and which is now serving quite useful in current operations is the transition from the original JF-1114A

"Certificate of NSTS/ISS Payload Safety Compliance" to the JF-906, "Flight Safety Certificate" [18][19].

This new form offers a great deal of benefits from the original. POs are able to document flight safety compliance for the U.S. Space Shuttle and operations within the USOS, show safety compliance to launch and disposal on IP vehicles (HTV, ATV, Progress, Soyuz), and document safe operations/stowage within the various ISS IP modules/segments. It is a form accepted by all IPs and is also used for non-experimental hardware within the SRP and the Flight Equipment Safety and Reliability Review Panel (FESRRP) processes.

This new multilateral safety form, in addition to the common requirements philosophy established via the PSRP franchising concept, allows for direct IP-to-IP recognition and discussions. Such a direct IP-to-IP communications philosophy is crucial for the expansion of IP relationships and processes and is the fundamental concept of the ISS program: the growth of international partnerships while expanding the horizons of space and human research.

### 4.2 Process Transitions for the Future

With respect to the numerous challenges facing the program in the upcoming years (budget, available launch vehicles, expedited manifesting requests and the need for rapid turnaround of safety reviews for urgent cargo, etc.), the NASA PSRP is considering additional process improvements for the future of the ISS.

#### Submittal Timeframe (45 Day Requirement)

The current 45 day requirement for the review of experiment SDPs is under strong consideration for review. With the varying complexities of experiment hardware launched to and operated on the ISS, it has become apparent that the 45 day review requirement may be further refined to better balance the workload of the panel support versus the difficulty of the subject's technical data.

For simple series/reflight hardware or consumables resupply, many of which are reviewed OOB with the PSRP Chair and PSE (versus a full in-board FSR with the complete PSRP present), it is often unnecessary to request a full 45 day review timeframe. In fact, the recent change request in NSTS/ISS 13830 [9], Section 9 which instituted a simplified series/reflight process for lower risk hardware fully supports this philosophy. A new characterization of the minimum acceptable timeframe is currently under discussion.

#### JSC Form 1230

An additional effort which has been in work for almost a year, and which is only now nearing completion, is a major update/rewrite of the JF-1230, "Standard Hazards" template [20]. This update corrects many of the major challenges that both Payload Developers and the PSRP community have struggled with over the years.

Commonly requested attachments (wiring schematics, required tables, listing of vented containers, etc.) have all now been added into the verbiage/instructions to ease with a PO's utilization of the form. Additionally, each section has been closely reviewed and hazard controls updated to reflect the current philosophy of the PSRP. The new form is expected to reduce the amount of required time needed in-board to discuss "standard hazards" that, at present, bog down the panel in process arguments versus true technical discussions related to the payload itself.

## 5. CONCLUSION

After the retirement of the Space Shuttle, it is anticipated by some that while there may be a reduction in the total amount of scientific hardware and experiments flying to and returning from ISS, there will be an increase in the amount of science being performed as a result of a funding shift from ISS assembly to ISS utilization.

Also, since the Space Shuttle has had a unique capability to allow sortie operation of experiments without leaving the launch vehicle (and thus not requiring additional ISS volume for operations) this may become a lost flexibility with its retirement, directly impacting a number of current and prospective future POs that previously needed only a brief period on orbit and/or a small volume to conduct and then return their experimental research.

The ISS faces a critical time in the next several years as the ISSP balances the increased demands for ISS utilization while having to adapt to near complete reliance on foreign launch entities until such time that the commercial space industry or still To-Be-Determined (TBD) NASA next-generation spacecraft can be decided and constructed.

The PSRP process, however, whether it be conducted by NASA or one of the recognized and delegated IP franchised safety organizations, stands prepared to meet those challenges and support the needs of the ISSP, the citizens of the world, and most importantly, the crew who have dedicated and continue to risk their lives daily for the development and utilization of microgravity research and exploration. It is a task that we in the PSRP do not take lightly, and for which we dedicate our own lives to do properly and correctly each and every time.

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# Building On The Past- Looking To the Future:

## *A Focus on Expanding Horizons*

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**International Association for the Advancement of Space Safety:**
***"Making Safety Matter"***

# Presentation Outline

- Purpose of Paper
  - *Efficiencies*
  - *Operations*
  - *Transitions/Future Planning*
- Payload Safety Background
- Communication
- Safety Requirements
- Processes
- Parting Thoughts
- Contact Information

# Purpose of Paper

"State of the NASA PSRP"

- Recent PSRP efficiencies
- Communication and interactions with IPs
- Payload Safety and ISS operations
- Requirements innovations/updates
- Required transitions and future challenges

# Payload Safety Background

- Chartered by NASA in the 1970s, the NASA Payload Safety Review Panel (PSRP) began conducting reviews of payload flight hardware or Flight Safety Reviews (FSRs) in 1979 in support of the Space Shuttle Program

- Comprised of panel members and technical support representing key NASA-JSC directorates, IP Safety Communities, and other ad-hoc members, the NASA PSRP is tasked with the following:
  - *Interpretation of safety requirements and provide recommendations for implementation and/or interpretation*
  - *Evaluate modifications to hardware that either affect a safety critical subsystem or create a potential hazard to the vehicle or crew*
  - *Evaluate safety analyses, safety reports, and non-compliant conditions*
  - *Assure the resolution of safety issues*

- Provides support to both the Space Shuttle and ISS Programs, including review of experiments destined to ISS and transported on commercial launch vehicles

# Communication

- Efficiencies
  - SRP & PSRP consolidation/processes
    - *Calendar merging*
    - *Daily planning tag-ups*
  - PSRP franchises
    - *ESA PSRP & JAXA SRP*
    - *Weekly/monthly IP teleconferences*
    - *Technical agreement developments*
- Operations
  - ISS safety consoles & PSRP interactions in real-time operations
  - Coordination with IP safety representatives
- Transitions/Future Planning
  - Post-Shuttle retirement and IP interactions
  - SRP & PSRP cross-training efforts

# Safety Requirements

- Efficiencies/Operations
  - SSP 51700, “Vision 1700” status
  - Configuration Management (CM) challenges (post-shuttle)
  - NSTS/ISS 13830 updates/additions
  - Use of SSP 57008, “Common Payload ICD”
  - “Safe on Arrival” concept
- Transitions/Future Planning
  - NSTS/ISS 13830 transition to SSP “xxxxx”
  - NSTS/ISS 18798 transition

# Processes

- Efficiencies/Operations
  - IP franchises and distribution of PSRP workload
  - IP transport vehicle safety assessments
  - JF-906, “Flight Safety Certificate”
  - “IP→IP” common requirements philosophy/processes
- Transitions/Future Planning
  - Expedited reviews and minimum safety review timeframes
  - JF-1230, “Standard Hazards” Template Updates

# Parting Thoughts

- Increased ISS utilization direction and PSRP impacts
- Future challenges/required process changes
  - Commercial launch services (TBD)
  - Reliance on IP transportation vehicles
  - Resource challenges
- Expedited payloads and late manifesting
- Communication, communication, communication!

## *QUESTIONS/COMMENTS?*

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