A SINGLE SPACE SAFETY CONSOLE CERTIFICATION STANDARD?

PROPOSAL FOR THE INTERNATIONAL SPACE STATION PARTNERS.

Andrew Herd (ESA), Lori Childress (NASA), Kato Mitsuyasu (JAXA)

ISS, Safety and the Partners

- ***The current state of ISS operations has expanded through the addition of both Japan Aerospace Exploration Agency (JAXA) and European Space Agency (ESA) owned and operated modules (Japanese Experiment Module (JEM) and Columbus, respectively) that support science and technology experimentation.***
- ***Both the National Aeronautical and Space Administration (NASA) and Russian Federal Space Agency (FSA) continue their responsibilities for operating their respective ISS segments.***
- ***The primary responsibility of an IP team is to ensure mission success whilst maintaining safety for the ISS crew, ISS and visiting vehicles (also known as Safety of Flight (SoF))***
- ***The need to maintain a robust commonality of operational practices during this period of operational expansion becomes of paramount importance when considering Safety of Flight***

The Safety Consoles – the paper aim

- ***For safety NASA, ESA and JAXA have chosen to create a dedicated on-line, near real-time function that has the single focus on safety, and the responsibility to ensure that safety is assured.***
- ***Whilst both ESA and JAXA have taken direction and reference from the NASA Safety Console, each has developed its own set of readiness criteria for the personnel that make up the various IP safety console teams.***
- ***Aim that each IP safety console with an inter-IP common knowledge and understanding of the means by which safety is imparted on station through common training and certification. This in turn would provide all IP's with an ability to functionally support a common set of SoF principals.***

NASA Safety Console

- ***The NASA ISS MER Safety Console assures Safety of Flight (SoF) and assesses risks resulting from mission-related anomalies*, during ISS on-orbit operations.***
- ***The NASA Safety Console is also responsible to assure that any risks associated with changes to approved flight rules or crew procedures have been identified and assessed, and that hazard controls have been identified and verified.***
- ****prior to mission execution all nominal operations are certified as being safe – it is only after hardware anomalies that operational deltas arise and need further safety assessment.***

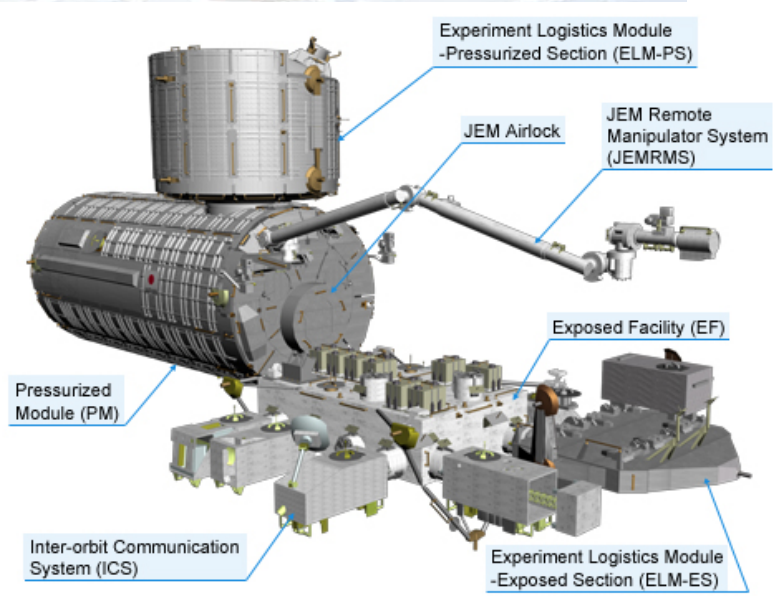
NASA Safety Console

- *The NASA Safety Console is a required participant in all unilateral and multilateral anomaly resolution teams.*

- *Interfaces include but are not limited to: ESA Safety Console, JAXA Safety Console, Subsystem MER Consoles, ISS Subsystem Safety, Payload Safety, Government Furnished Equipment (GFE) Safety, EVA Safety, ISS Safety Review Panels, Payload Operations Integration Center (POIC) Safety, Shuttle MER Safety Console, Flight Control Teams (Front Room and Back Room), ISS Management Center (IMC), Mission Operations Directorate Safety, and Kennedy Space Center (KSC) Ground Safety.*

JAXA Safety Console

- *The JAXA Human Space S&MA (JAXA S&MA) currently assures safety of JEM module, JAXA-provided payloads and JAXA crew. JAXA S&MA has a console, called "Engineering Support Room (ESR) S&MA console" in Tsukuba Space Center.*
- *confirms that JAXA h/w items are operated safely by monitoring that the operational controls are properly performed.*
- *reviews JAXA safety related changes of ODF, FR and planning. involved in JEM anomaly resolution process. participates Multilateral Anomaly Resolution Team (MART) for the ISS integrated anomalies related to JEM*



ESA Safety Console

- *ESA Safety Console is to be the primary PoC for all Columbus safety related issues and is the counterpart to the NASA Safety position located in the ISS MER (Mission Evaluation Room) and to the NASA POIC Safety position*
- *At working level*
  - *Operations Change Requests*
  - *Operations Anomalies*
  - *Safety Briefing*
  - *Yellow Tag*
  - *Real-time Flight Rule / ODF procedure approval*
  - *Corrective Maintenance Delta Safety Assessments*
  - *Next Worst Failure Analysis*

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Safety Console Certification Findings

- *There is no single ISS standard for safety console candidate selection, training or certification. A high degree of similarity exists between the three selected ISS IP's of the end-to-end safety console mission readiness processes, these being;*
  - *Selection (Who will be selected?)*
  - *Training (How will those who are selected be trained?)*
  - *Certification (What are the certification standards that need to be met by those selected?)*

- *<u>Selection</u> It is recognised that selection can impact the training overhead and success rate, however due to the IP-applied constraints within the selection processes used the candidates themselves does not directly impact the case for a single safety console certification standard.*

Safety Console Certification Findings

- ***Training- Similarities*** *There are three common approaches to training; self-study, taught sessions and simulations.*
  - *For self-study the ISS has a common set of safety standards and process documentation which are ideal candidates for self study.*
    - *it is highly credible that the set of ISS products that make up an ISS level portfolio of SoF resources be considered to provide for a basis of common study material for all ISS IP's for every safety console candidate.*
    - *It is also suitable to propose that this portfolio could be reformatted specifically to support effective and user-friendly self-study.*

Safety Console Certification Findings

- ***<u>Training- Similarities</u>** There are three common approaches to training; self-study, taught sessions and simulations.*
  - *For simulations, it is necessary to consider the inputs that make up a simulation; the simulation case, tool and context.*
    - *The simulation tool; the ISS AR tool instance requires anomaly reporting, (safety) assessment and response - a credible common training standard.*
    - *The simulation case; specific anomaly cases invoke relevant safety requirements and require unique operations responses. These are considered credible candidates for a common standard of simulation cases*
    - *The simulation context; the integrated aspect of a (safety) anomaly case requires a generic approach across all IP's. A credible rationale for the development of a simulation context standard.*

Safety Console Certification Findings

- ***Training- differences***
  - *For ESA alone whilst the simulations (and certification) involve review of operations products (crew procedure and flight rules), this is not part of the mission preparation role.*
  - *ESR S&MA console perform review of operation products as S&MA operation preparation (on-the-job).*
  - *Both ESA and JAXA training processes are relatively new and gone through very little iteration. NASA process on the other hand has been tried and tested over the years – however the scope and technical diversity of the NASA safety responsibilities (manifested in the recent ISS assembly) may have impacted some key aspects of the NASA training content.*
  - *Team size differences may be a significant influence on the continuous training / certification overhead, supporting an ISS collective approach, where candidates co-locate in order to complete common training*

Safety Console Certification Findings

- ***Certification – Similarities*** *Certification for all IP's revolves around assuring an acceptable standard is reached in terms of operations tools usage (console operations) and safety engineering (process) knowledge.*
  - *There is credible evidence that in both of these areas a common certification standard could be developed with common tools and safety engineering at its core.*
  - *The use of a paper test (formal assessment) is a common feature, which in itself provides scope for the adoption of a single certification approach.*
  - *IP's do use post-test interviews, however to differing degrees of formalisation. The benefit of this post test debrief may be able to enhanced through the adoption of standardisation.*

Safety Console Certification Findings

- ***Certification – differences***
  - ***Certification should always address a specific mission hardware configuration and operations scenario, and this will differ from IP to IP, and at each mission (i.e. increment stage or flight).***
  - ***IPs are also uniquely responsible for taking the lead on the safety engineering for their respective hardware and certification should also address the level of competency is these areas. For these aspects a common standard would not be suitable – however there is scope for IP cross-training within an integrated training environment that a common (training and) certification standard may bring***

Safety Console Certification Conclusion

- ***The paper presents a credible case for the development of both training data and assessment standards, which would cover significant proportion of the safety console readiness training overhead.***
- ***The similarities between the IP approaches can be considered to be affirmation of the need to undertake this task (overseen at an ISS safety level) to generate the necessary agreements and implementation documentation and (where necessary) the tools to support the training and assessment.***
- ***The differences in approach should be considered to be the 'tests" for the training and assessment proposal such that it remains valid for all applicable IPs.***

Safety Console Certification Conclusion

- ***A single ISS training and certification standard would address known issues***
  - ***the assessment of pre-defined real-time failures or unintended system reactions within a safety critical system or interface.***
  - ***safety assessment of a new task or a product (crew procedure or flight rule, for example).***
  - ***commonly agreed identification of an anomaly or issue and performance of a near real-time assessment of affected controls or impact to safety critical functions,***
  - ***Provision of a commonly understood analysis outcome (such as a safety requirement impact and resolution statement).***
  - ***development of joint training materials on common or integrated systems***
- ***A single ISS training and certification standard would draw upon***
  - ***IP's console operators fluent knowledge of IP hardware-specific hazard reports/controls, allowing a collective exchange of other IP rack, module or segment specific hazard controls***

Safety Console Certification Conclusion

- ***Presented a credible case for a single safety console training and certification standard,***
- ***Provided a justification and mechanism by which this may be carried out,***
- ***The study would conclude that each partner has presented a credible and equivalent approach the safety console certification.***
- ***This exercise has also revealed that there are benefits to be gained in an overall ISS safety context, by moving forward with the examples of IP best practice and seeking to address the recognised challenges from real-time ISS operations.***