



Safety Review Panel (SRP) Special Topic Presentation on the Iodine Compatible Water Container (ICWC)

Crew and Thermal Systems Division

3/12/2008



SRP Special Topic Agenda



- **Introduction**
 - ICWC Team
 - Purpose of presentation
 - Background/Description of ICWC System
 - Current status of ICWC Project
- **Anticipated Non-compliance/exceptions for ICWC**
 - HTV launch NCR processing
 - Tox 1 containment NCR processing
 - ISS on-orbit failure propagation and fault tolerance NCR processing
- **Comments/Discussion**



Introduction



JSC ICWC Team



- **Stephen Mcgrath – NASA OB Customer/sponsor**
- **Evan Thomas – NASA EC Technical Monitor**
- **Micah Johnson – Bioastronautics Project Manager**
- **Gerald Kuehner – Systems Engineer**
- **Emily Rabel – Project Engineer**
- **Dan Butler & Andrew Banks – Safety and Reliability Engineer**
- **Daniel Gazda – Project Scientist**
- **Dona Hooker – Softgoods Design**
- **Phil Bush – Mechanical Design and GSE**
- **Todd Upp – Quality Engineering**



Purpose of SRP Special Topic Presentation



- **Present the three (3) separate and unique non-compliances to baselined requirements anticipated for the ICWC project**
- **Present suggested impacts and rationale for approving NCRs for the ICWC project**
- **Obtain comments and direction from SRP on likelihood of receiving approved NCRs from SRP**



ICWC Background



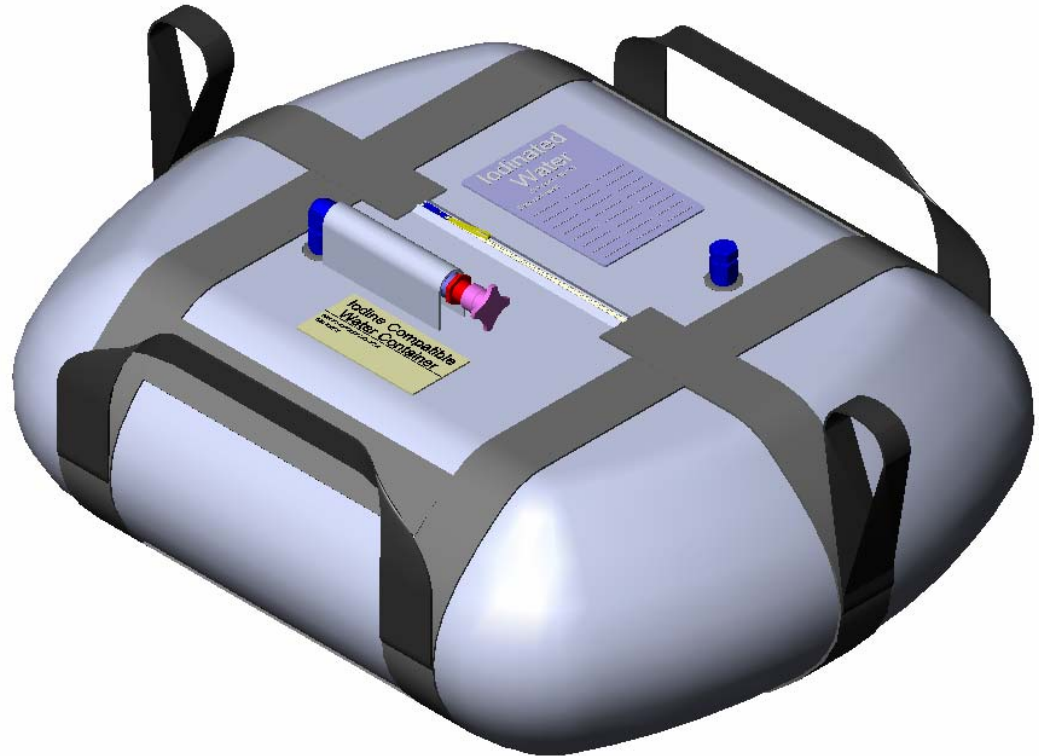
- **Iodine compatible storage containers are needed to store/supply excess iodinated water off the potable water bus. Current CWCs are not certified to stow iodinated water.**
- **Containers are needed to be “soft” and collapsible in design such that multiple ICWCs could be stowed on orbit for future use.**
- **Primary fluid interface (male 3/8” QD) was defined by station program for the ICWC project.**



ICWC Description



- **Iodine Compatible Water Container**
 - Bladder
 - Nomex Restraint Bag
 - Handles
 - Plumbing fixtures to interface between Bladder and Quick Disconnect
 - Labeling





Current Project Status



- **VCB Board approved CR 010675 on 10/12/2007**
 - Build Iodine Compatible Water Containers (ICWCs) in support of operations involving six crewmembers
 - Delivery for launch on ULF2 (On Dock Date presently 7/31/08)
 - Certify ICWCs for launch full on HTV.
- **ICWC IAC presented and approved at FESRRP (Oct 2007) as Crit 2NR.**
- **ICWC completed SRR December 2007**
 - Anticipated NCRs were presented including fault tolerance for catastrophic hazard and failure propagation for ISS on-orbit operations.



Current Project Status Continued



- **Following SRR OB program de-scoped HTV certification and made it a “project goal” pending ability to receive safety certification of unmodified ICWC without additional packaging controls.**
 - ICWC team will still design, analyze and test per known HTV/HRR environment requirements.
- **SRR RID added additional scope to ICWC project for stowing I2 Disinfectant (max 40ppm) which is a Tox 1 substance (TOX-RR-2008-02).**
 - OB approved change but as a “project goal” pending safety panel acceptance of the proposed ICWC design.
- **Completed PDR in January 2008 with minimal changes to ICWC design shown earlier.**
- **ICWC Phase I/II RAESR submitted to NT for review prior to going to FESRRP in March 2008.**



Anticipated Non-compliance/exceptions for ICWC



HTV Launch Non-Compliances



- **HTV Safety Requirement**

- The cargo shall meet the safety requirement specified in JSX-2001015 "HTV Cargo Safety Technical Requirement" during all phase. If the cargo complies with SSP50021 "Safety Requirements Documents" or NSTS1700.7B "Safety Policy and Requirements for Payloads Using the Space Transportation System" ISS Addendum, JSX-2001015 **need not be applied** during flight and berthing phase.

- **HTV Fluid Leak Requirement**

- The ICWC shall have at least two independent failure tolerances for fluid leak. (two fault tolerant)
- Fluid leak rate shall be within 400 liter/min (on condition of standard atmosphere) in the case of two failures. But in the case that there are at least three independent failure tolerances, fluid leak rate is not required.
- The gross weight of fluid leak shall not exceed 5 kg.



HTV Launch Hazard Classification



- **Tox 0 Fluid in contained HTV PLC considered critical hazard with low probability of occurrence.**
 - Worst Case Leakage
 - Single ICWC
 - 90-100 lbs of Tox 0 Fluid (~12 gallons)
 - Low probability of leak
 - Centrifuge load testing ICWC to verify bag can handle HTV launch environment. Max launch load for HTV is ~6g, testing conducted to 24g.
 - This is 4x the max launch load
 - Inspection of filled ICWCs prior to HTV hatch closure/launch to verify no leaks.
 - If no leaks prior to launch, with validation of 4x launch loads, likelihood of leak from launch to docking is remote.
 - Possible double bagging with pink poly
 - PWRs (P/N SEG46117689-30x) are currently launched with 22 liters (~48 pounds) of IATCS fluid on shuttle. PWRs are double bagged with pink poly and stowed in foam but are not tested for containment (GCAR# G3925)



HTV Launch Hazard Classification



- **Impacts on HTV**
 - No constraints to docking
 - JAXA assessment indicated no hazards within the PLC which would affect the flight avionics.
 - ***The mass of a leak of an entire bag would not be significant in any CoM calculations affecting trajectories.***
 - ***Likelihood of leak after launch is remote.***
- **Procedures to be developed in case of leak between HTV launch and docking to ISS**
 - High surface tension of water results in most likely scenario of “bubble” that would need to be addressed with towels and bagging of the leaky ICWC upon HTV hatch opening and ingress.
 - Details to be worked.



HTV Launch Non-Compliances



- **Proposed ICWC NCRs**

- ICWC not designed with tested/verified double containment. Implementing design would be technically and cost prohibitive for current project.
- ICWC launched on HTV would contain more than 5 kg of liquid which if a leak occurred could be significantly more than 5kg.

- **Impact Mitigation**

- Centrifuge load testing ICWC to verify bag can handle HTV launch environment. Max launch load for HTV is ~6g, testing conducted to 24g (4X expected load).
- Inspection of filled ICWCs prior to HTV hatch closure/launch to verify no leaks.
- Possible double bagging with pink poly
 - PWRs (P/N SEG46117689-30x) are currently launched with 22 liters (~48 pounds) of IATCS fluid on shuttle. PWRs are double bagged with pink poly and stowed in foam but are not tested for containment (GCAR# G3925)



Tox 1 Containment Non-Compliances



- **Toxic or Hazardous Containment Requirements**
 - Toxic or hazardous chemicals/materials shall have failure tolerant containment appropriate with the hazard level or be contained in an approved pressure vessel as defined in SSP 30558. Source SSP 50021.
 - Any leakage of Tox 1 fluids is considered a critical hazard.
 - Critical hazards *may* be controlled via DFMR (Design For Minimum Risk).
- **Proposed ICWC NCR:**
 - ICWC not designed with tested/verified double containment. Implementing design would be technically and cost prohibitive for current project.
- **Impact Mitigation**
 - Precedent set by current CWCs used on orbit to store a Tox 2 liquid (Russian pre-treated urine) without additional levels of containment (CWC-NCR-01).



ISS Non-Compliances



- **Failure Propagation Requirement**

- A single failure of the ICWC Subsystem shall not induce any other failures external to the failed ICWC. Source: SSP 41000 Rev BH

- **Proposed ICWC NCR:**

- If ICWC experienced external leakage, other systems external to the ICWC could be damaged due to amount of possible leakage (over 10 gallons possible).
- ICWC not designed with tested/verified double containment. Implementing design would be technically and cost prohibitive for current project.

- **Impact Mitigation**

- Precedent set by CWC, PWRs and other fluid systems used on orbit that contain more than 1 gallon of fluid (CWC-NCR-01, PWR-NCR-02).
- A CR is being drafted by OE for a global exception to the failure propagation requirement in SSP41000 and all lower tier specifications.



ISS Non-Compliances Continued



- **Fault Tolerant Requirement**

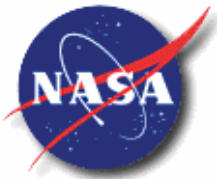
- The ICWC shall be designed such that no combination of two failures, or two operator errors or one of each can result in a disabling or fatal personnel injury, or loss of the Orbiter or ISS. Compliance with this requirement may be accomplished at the End Item level or through a combination of hazard controls at the Segment/System levels.
- Catastrophic hazards *may* be controlled via DFMR (Design For Minimum Risk), but the MDP of the ICWC does not make this a viable option.

- **Proposed ICWC NCR:**

- ICWC is not designed with multiple containment mechanisms and the ICWC will connect with systems of higher rated pressures than the current ICWC MDP. Implementing design would be technically and cost prohibitive for current project.

- **Impact Mitigation**

- Precedent set by CWC, PWRs and other fluid systems NCRS (CWC-NCR-01, PWR-NCR-02). Utilize OCADs to control hazards.



Upcoming Milestones



<i>Event/Milestone</i>	<i>Date</i>
Phase I/II Safety	March 2008
CDR	April 2008
Qualification Unit assembly	May 2008
Flight Unit assembly	June 2008
Phase III Safety	July 2008
SAR/Hardware Delivery	July 2008
Shuttle Launch – ULF2	Sept. 2008



Comments / Discussion