

ULF1.1_C2-17 CONTINGENCY SHUTTLE CREW SUPPORT (CSCS) [RI]
©[CR 6929]

CONTINGENCY SHUTTLE CREW SUPPORT (CSCS) IS A NON-CERTIFIED CAPABILITY THAT WILL BE USED TO SUSTAIN A STRANDED STS CREW ON-BOARD THE ISS IN SUPPORT OF AN STS RESCUE MISSION. ALL AVAILABLE ISS AND ORBITER RESOURCES ARE UTILIZED TO PROVIDE AN ON-ORBIT SAFE HAVEN UNTIL RESCUE MISSION ARRIVAL.

The ISS is certified to support three crewmembers based on the Soyuz return capability. The CSCS is a non-certified capability that is utilized as part of an “All out Effort” to provide the opportunity to safely return the STS crew home (up to seven crewmembers) via an STS rescue mission in the event that the orbiter has been declared “unflyable” and cannot perform a successful entry and landing.

The CSCS “Safe Haven” duration is dependent upon available orbiter and ISS consumables and resources to achieve the maximum duration possible. The orbiter is powered down to levels that maximize the docked duration while still supporting the STS crewmembers life support and hygiene needs and protecting the critical equipment required for unmanned undock and disposal. Although water, food, LiOH, etc. will be transferred over from the orbiter prior to the unmanned undocking, the duration relies on critical ISS equipment (that may not have redundancy) and waste management supplies and food that are nominally manifested and scheduled for two-crew support. For the Return to Flight (RTF) missions, it is assumed that the orbiter has not sustained damage that would prevent it from supporting the STS crew while docked or prevent water, food, O₂, etc., to be transferred over to the ISS.

Additionally, rescue mission success relies on a successful launch of the rescue STS (high probability based on launch history) and the commitment to possibly launch without resolving the failure which caused the previous orbiter to become “unflyable.”

To provide the maximum duration as possible, the ISS consumables are used to “zero” remaining. Using the ISS consumables to “zero” will result in de-manning of the ISS until a resupply is performed. For the CSCS contingency scenario, the demanning of the ISS is of a small consequence if there is any chance of returning the stranded STS crew safely home.

Reference Rule {ULF1.1_C2-18}, CONTINGENCY SHUTTLE CREW SUPPORT (CSCS) DECLARATION ACTIONS [RI], and NSTS 21519 LON Crew Rescue Mission MIP. ©[CR 7152]

ULF1.1_C2-18 CONTINGENCY SHUTTLE CREW SUPPORT (CSCS)
DECLARATION ACTIONS [RI] @CR 6930]

ONCE IT IS DETERMINED THAT THE ORBITER IS "UNFLYABLE" AND CANNOT PERFORM A SUCCESSFUL ENTRY AND LANDING, THE CONTINGENCY SHUTTLE CREW SUPPORT (CSCS) WILL BE DECLARED.

IN SUPPORT OF THE CSCS, THE FOLLOWING ACTIONS WILL BE INVOKED:

- A. ORBITER CSCS GROUP C+ POWERDOWN
- B. THE STS-300 RESCUE MISSION @DN 28] @CR 7153]
- C. TRANSFER OF MANDATORY ITEMS TO THE ISS PRIOR TO CLOSEOUT/UNDOCKING OF ORBITER AS DEFINED IN NSTS-21519, LAUNCH ON NEED CREW RESCUE FLIGHT MIP:
- D. CONSUMABLES MANAGEMENT OPTIMIZATION TO MAXIMIZE CSCS CAPABILITIES
- E. STS CREWMEMBER FOOD RATIONING AS REQUIRED
- F. TRANSFER OF ISS TRASH AND DISPOSAL ITEMS TO THE ORBITER AS THE AVAILABILITY EXISTS
- G. UNMANNED ORBITER UNDOCKING AND DISPOSAL BURN AT CSCS UNDOCKING REDLINE

All efforts will be made to repair the orbiter for a safe deorbit, entry, and landing. The CSCS scenario will only be declared when it is determined that the orbiter is "Unflyable" and cannot support a successful entry and landing. Once the CSCS is declared, multiple activities are invoked in support of the CSCS scenario.

The CSCS Group C+ is performed to power down the orbiter to levels that maximize the docked duration while still supporting the STS crewmembers' life support and hygiene needs and protecting the critical equipment required for unmanned undock and disposal.

The STS-300 Rescue mission is put in motion and processing is initiated. @DN 28] @CR 7153]

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ULF1.1_C2-18

CONTINGENCY SHUTTLE CREW SUPPORT (CSCS)
DECLARATION ACTIONS [RI] (CONTINUED)

Critical consumables, equipment, and crew comfort items are transferred over to the ISS to maximize CSCS duration and maintain crew health. The critical transfer items have been identified in NSTS-21519, Launch on Need Crew Rescue Flight MIP, and STS-300, Launch on Need (LON) Crew Rescue. ©[CR 7153]

Although for RTF missions, a prelaunch assessment of CSCS duration will be performed, all efforts will be made to maximize CSCS duration by optimizing real-time consumables management. Assumptions for pre-flight assessment are included in NSTS-21519, Launch on Need Crew Rescue Flight MIP. ©[DN 28]

Food rationing for the STS crew will begin as determined by available food at CSCS declaration.

As the capability exists, ISS trash and crew disposal items will be transferred over to the orbiter to aid in ISS cleanup. Exact locations of the transferred items are not required since the CG impacts will not effect the disposal burn/shuttle breakup.

The damaged orbiter will be undocked prior to violating the cryogenic redline requirements to perform an unmanned undocking and disposal burn. The redline assumptions are included in NSTS-21519, Launch on Need Crew Rescue Flight MIP. A backup opportunity for the disposal burn will be planned to be available on undock day.

Reference Rule {ULF1.1_C2-17}, CONTINGENCY SHUTTLE CREW SUPPORT (CSCS) [RI], and NSTS-21519, Launch on Need Crew Rescue Flight MIP. ©[DN 28] ©[CR 7153]

ULF1.1_C2-19 POWER DOWNS FOR SAFE HAVEN RISK

- A. A MODIFIED GROUP C POWER DOWN WILL BE MAINTAINED TO THE EXTENT PRACTICAL IF ENTRY CRITICAL TPS DAMAGE IS SUSPECTED AND BEFORE IT HAS BEEN CLEARED FOR DEORBIT. @[DN 36]

The orbiter is typically in a Group B power down while docked to ISS. A modified Group C power down will conserve more cryogenics and add margin for docked operations, end of mission, and an unmanned undocking scenario. Although this is not likely to add days of capability, it is prudent to add as much margin as possible. @[DN 36]

- B. THE CONTINGENCY SHUTTLE CREW SUPPORT (CSCS) GROUP C+ POWER DOWN WILL ONLY BE IMPLEMENTED AFTER A MANNED DEORBIT HAS BEEN GROUND RULED OUT.

The CSCS Group C+ power down protects the critical orbiter equipment and hardware required to perform unmanned undocking and disposal burn while providing maximum docked duration. The power down does not protect critical equipment/hardware required to preserve entry capability. Once the orbiter has been determined to be “Unflyable,” the CSCS scenario will be declared and the Group C+ power down actions performed to maximize CSCS capability in support of the rescue mission.

The CSCS Group C+ power down will not be used until that decision is made to avoid prematurely losing the deorbit capability.

Reference: ISS Safe Haven JOP#4, #6 for Group C+ , unmanned undocking, LON.

**ULF1.1_C2-26 ORBITER SYSTEM FAILURES AND CONTINGENCY SHUTTLE
CREW SUPPORT (CSCS)/LAUNCH ON NEED (LON)**

- A. CSCS/LON WILL BE CONSIDERED IN SUPPORT OF THE FOLLOWING ORBITER FAILURE SCENARIOS: @[DN 135]
1. ORBITER SYSTEMS FAILURES THAT RESULT IN THE INABILITY OF THE ORBITER TO PERFORM A SUCCESSFUL ENTRY AND LANDING
 2. ORBITER SYSTEMS FAILURES THAT RESULT IN A LOW PROBABILITY OF A SUCCESSFUL ENTRY, LANDING, AND CREW SURVIVAL
 3. IN A FAIL CRITICAL SCENARIO AS MITIGATION TO PROVIDE TIME TO PROPERLY ASSESS AND EVALUATE THE ORBITER SYSTEMS FAILURES AND ASSOCIATED RISKS OF ENTRY AND LANDING
 4. IN SUPPORT OF A SUSPECT TPS SCENARIO UNTIL THE TPS DAMAGE AND, IF REQUIRED, TPS REPAIR HAVE BEEN CLEARED TO SUPPORT ENTRY
- B. THE CSCS/LON OPTION IS CONSIDERED AVAILABLE IF THE CAPABILITY OF THE COMBINED ORBITER AND ISS ASSETS CAN SUPPORT THE ISS CREW AND STRANDED STS CREW UNTIL ARRIVAL OF THE LON RESCUE VEHICLE.
- C. CSCS/LON CONSIDERATION CRITERIA:
1. PRE-DOCKING:

THE CSCS/LON OPTION WILL BE CONSIDERED PROVIDED THE ORBITER CAN ACHIEVE A SAFE DOCKING WITHOUT PUTTING THE ISS AT UNACCEPTABLE RISK AND DOES NOT IMPACT THE CAPABILITY OF RETURNING THE ISS CREW SAFELY TO EARTH VIA SOYUZ.
 2. DOCKED:

THE CSCS/LON OPTION WILL BE CONSIDERED PROVIDED THAT REMAINING DOCKED DOES NOT IMPACT THE CAPABILITY OF RETURNING THE ISS CREW SAFELY TO EARTH VIA SOYUZ.
@[DN 135] @[CR 7253]

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ULF1.1_C2-26 ORBITER SYSTEM FAILURES AND CONTINGENCY SHUTTLE
CREW SUPPORT (CSCS)/LAUNCH ON NEED (LON)
(CONTINUED)

3. POST-UNDOCKING: @[DN 135]

THE CSCS/LON OPTION WILL NOT BE PROTECTED AFTER A PLANNED UNDOCKING (PROPELLANT WILL NOT BE REDLINED FOR RE-RENDEZVOUS ATTEMPT). HOWEVER, IF PROPELLANT IS AVAILABLE FOR A RE-RENDEZVOUS ATTEMPT, CSCS BECOMES AN OPTION PROVIDED IT CAN MEET THE PRE-DOCKING CONSTRAINTS DEFINED ABOVE.

D. ORBITER SYSTEMS FAILURE RESPONSE CSCS/LON @[CR 7253]

1. TIME PERMITTING, THE MMT WILL HAVE THE FINAL DECISION IF CSCS/LON SHOULD BE INVOKED.
2. IF THE ORBITER SYSTEM FAILURE REQUIRES IMMEDIATE RESPONSE, THE FLIGHT CONTROL TEAM WILL EVALUATE THE ORBITER FAILURE, SYSTEMS CAPABILITIES, CURRENT MISSION ACTIVITIES, AVAILABLE LANDING OPPORTUNITIES, AND WEIGH THE ASSOCIATED RISKS TO SELECT THE PROPER COURSE OF ACTION TO SAFELY RETURN THE CREW. @[CR 7253]

With an operational ISS, additional operational flexibility and options become available. CSCS/LON is one of those options.

In the event that an orbiter failure(s) occurs that does not permit a safe reentry and landing of an orbiter, there are limited options to pursue. Although it has risks in itself, the CSCS/LON provides the opportunity and some finite time to allow a rescue mission to be attempted versus committing to an unsurvivable entry (or doing nothing at all).

For the cases where the orbiter failure(s) result in a low probability of a safe landing or crew survival, consideration will be given to invoking CSCS/LON if the rescue mission improves upon the probability of survival. The risks of returning versus the risks of invoking the CSCS/LON will need to be weighed dependent upon the extent of the orbiter failure(s), the CSCS support duration/reliability, and LON rescue mission readiness.

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**ORBITER SYSTEM FAILURES AND CONTINGENCY SHUTTLE
CREW SUPPORT (CSCS)/LAUNCH ON NEED (LON)
(CONTINUED)**

The CSCS/LON capability may also be considered as a mitigation option to provide additional time to properly assess and evaluate the orbiter systems failures and associated risks of entry and landing. For the fail-critical scenario, although the orbiter is one failure away from losing deorbit/entry capability, the prudent option would be to fully understand the failure mechanisms/causes and to evaluate the risks and probabilities of the next failure to ensure that the vehicle can support deorbit and entry.

For the TPS-suspect scenario, there is a concern that the TPS cannot safely support a nominal deorbit and entry of the orbiter. Until the TPS damage or repair is cleared for entry, the CSCS/LON option will be considered.

The CSCS/LON capability is considered available if the capability of the ISS and orbiter resources can support the ISS and shuttle crews until arrival of the LON rescue vehicle. ©[DN 135]

Although the orbiter may be in an unsafe entry configuration, consideration must be given to ensure that continuing to docking does not put the ISS at unacceptable risk or impact the capability of the ISS crew returning to Earth via the Soyuz. The capability to safely dock must be available. The concern is that if docking is continued, knowing that the required systems capability is unavailable, ISS crew safety could be jeopardized. This is a tough call, but all risks and consequences must be weighed. ©[DN 135]

While docked, the same considerations must be evaluated.

Re-rendezvous to the ISS post undocking is not nominally protected or redlined. Redlining this propellant would be an impact to the nominal planning of the mission. Post undocking, if propellant is available that would support a re-rendezvous, the same pre-docking constraints must be met for the second docking attempt. Since the orbiter failure requiring CSCS/LON does not permit a safe reentry and landing of the orbiter, deorbit and entry propellant can be used as part of the re-rendezvous propellant requirements since it will not be used to attempt an unsurvivable entry. Loss of the deorbit propellant would prohibit a disposal burn but would provide the opportunity to rendezvous and dock with the ISS.

It should also be noted that the CSCS/LON duration would also be impacted since a nominal docked shuttle mission was flown prior to the orbiter failure post undocking. At this point in the mission, there are minimal orbiter consumables that remain, thus providing minimal contribution to the CSCS stay. Although the rescue vehicle has had 10-11 days of processing time since the launch of the current mission, the available CSCS duration may not be sufficient to support the rescue flight. Again a tough call, but the number one goal is to use all available options to provide the opportunity to get the shuttle crew safely home (versus doing nothing).

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ULF1.1_C2-26

**ORBITER SYSTEM FAILURES AND CONTINGENCY SHUTTLE
CREW SUPPORT (CSCS)/LAUNCH ON NEED (LON)
(CONTINUED)**

The requirement to protect an unmanned undocking capability is not considered as mandatory and is not included as part of the rule. The CSCS/LON scenario is invoked because the orbiter has sustained a failure that does not permit a safe reentry and landing of the orbiter. If the orbiter can get safely docked, the opportunity exists to get the stranded crew safely home.

The optimal unmanned undocking procedure would include the disposal burn. If the orbiter failure is such that you have achieved docking (or are already docked) but does not provide a CSCS undocking/separation capability, there are other undocking options available that were reviewed at the ISS Safe Haven JOP's. For instance, a +R-Bar docking could be performed that does not require any active attitude control and Orbital Mechanics takes care of separating the vehicles. The drawback is that a disposal burn cannot be performed. For the scenario where the orbiter cannot be undocked, once the cryo consumables are depleted, the Orbiter Docking System (ODS), Pressurized Mating Adapter (PMA), and Lab hatches will be closed. ©[DN 135] ©[ED]

Time permitting, the MMT will have the final decision in invoking CSCS/LON option. If the orbiter system failure requires immediate response, the Flight Control Team will use the available data to determine the proper course of action to safely return the crew (Emergency D/O or CSCS). ©[CR 7253]

The bottom line is, all that can be done will be done to improve the probabilities and risks to provide the opportunity to get the stranded shuttle crew safely home. ©[DN 135]

*Reference Rules {A2-101}, VEHICLE SYSTEMS REDUNDANCY DEFINITIONS; {ULF1.1_C2-17}, CONTINGENCY SHUTTLE CREW SUPPORT (CSCS) [RI]; {ULF1.1_C2-18}, CONTINGENCY SHUTTLE CREW SUPPORT (CSCS) DECLARATION ACTIONS [RI]; and {ULF1.1 C2-**TBD**}, (RTF PLS). ©[DN 135]*