National Aeronautics and Space Administration

Orbital Space Plane (OSP)
Level I Requirements
Program Interpretation Document

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Orbital Space Plane (OSP) Translation Document
Signature Page

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1.0 SCOPE

The purpose of this document is to provide a clear understanding and consistent interpretation of the Mission Needs Statement (MNS), Level 1 Requirements, and the Operations Concept as approved by the NASA Executive Council for the Orbital Space Plane (OSP) Program. These three documents should be considered as an integrated set of documents, which provides a basis of understanding such that the OSP Program can develop the lower level requirements and the Program Plan.

For the purposes of this document, CRV is representative of the OSP capability designed for the crew rescue mission and CTV is representative of the OSP capability designed for the crew transfer mission.

For the purposes of this document when both a minimum threshold and objective value are defined for a requirement, the intent is to find the point of diminishing return above the minimum threshold. The goal is to satisfy or exceed the defined objective.

2.0 MISSION NEEDS STATEMENT

The vehicle(s) and associated systems will support U.S. ISS requirements for crew rescue, crew transport, and cargo."Vehicle(s)" is interpreted as a desire by NASA to leave open the trade space for the CRV and CTV design. That is, the CRV and CTV vehicle(s) could be the same design, substantially different designs, or completely different designs.

"System" is interpreted as meaning the aggregate of the ground segment, flight segment, and workforce required for crew rescue and crew transport.

The word "support" is interpreted as meaning to supplement crew rescue and crew/cargo transportation provided by Soyuz and Shuttle as defined in the ISS mission model.

"U.S." is interpreted as meaning that the OSP is to provide rescue, transport, and cargo services to satisfy the allocated United States requirements. "Crew rescue" is interpreted as meaning the safe evacuation to Earth crewmembers from the ISS (note the Level I Requirements dictate no fewer than four crew members).

"Crew transport" is interpreted as meaning safe conveyance of 1 to at least 4 crewmembers from Earth to the ISS and back to Earth for crew rotation and maintenance missions. It is envisioned that the vehicle(s) must be capable of performing their missions with less than full capacity (i.e., less than 4 crew).

"Cargo" is interpreted as meaning conveyance of an undefined amount of cargo between the Earth and the ISS. It is further interpreted as meaning that cargo transport

capability is a contingency function (per the Operations Concept). The amount and type of cargo will be defined in the Level II requirements.

3.0 LEVEL 1 REQUIREMENTS

*1. The system, which may include multiple vehicles, shall provide *rescue capability for no fewer than four ISS crew as soon as practical but no later than 2010.**

**Rescue includes medical evacuation and emergency evacuation.*

"Multiple vehicles" allows the trade space to be opened for ideas such as smaller crew per vehicle but with multiple attach points on ISS or for multiple 4-person vehicles. This will be traded with the operational capability of International Space Station (ISS) and consistent with the ISS Traffic/Mission Model.

"No fewer than four" reflects potential long term changes to ISS that could result in more crew on ISS.

"Rescue capability" means safe conveyance from the ISS to the Earth. This includes evacuation for medical and/or emergency purposes.

"As soon as practical but no later than 2010" means that NASA *desires* the CRV capability prior to 2010, and that this capability is required no later than 2010.

"As soon as practical" enables response to a need for acceleration options to be pursued by the Program. The Program working with the contractor community will evaluate the practicality of earlier than 2010.

2. The system shall provide rescue capability that allows the safe return of deconditioned, ill, or injured crewmembers with ongoing treatment until arrival at definitive medical care within 24 hours. Crew should not require suits in the vehicle, but the vehicle should support crew wearing suits if the situation warrants.

"De-conditioned" is interpreted as meaning having been exposed to zero gravity for an extended period of time; "ill" is interpreted as meaning sick; "injured" is interpreted as meaning bleeding, burned, shocked, etc. These conditions dictate the kind of equipment and supplies that must be included and associated ground systems designs. The specific equipment, supplies, and crew conditions will be defined in lower level requirements.

"Ongoing treatment" assumes that the medical officer is capable of treating the patient with emergency care during all phases of the return except where the personal safety of the medical officer is concerned. For their safety, the medical officer may require restraint during critical phases of flight that could restrict movement and access to the patient.

"Definitive medical care" is interpreted as meaning the treatment of aspects of de-conditioning, illness, and/or injury of a crewmember such that the patient's condition can be improved rather than just stabilized. This excludes uncommon conditions such as exotic diseases and massive injuries where cures/fixes may not be possible anywhere. These conditions will be further defined in lower level requirements.

"Within 24 hours" is interpreted as meaning the time from the decision to return from the ISS until arrival at the appropriate medical facility.

"Crew should not require suits" means that the CRV must provide an appropriate life support system. The wearing of suits adds to the CRV volume requirement and allows for the possibility that the CRV itself could be damaged or that a crew person may enter the CRV wearing a suit for some reason.

3. The system for rescue shall provide for rapid separation from the ISS under emergency conditions followed by return to Earth.

"Rapid separation" is interpreted as meaning the CRV will have the capability to leave the ISS in a short period of time. This will be defined in further detail based on ISS emergency scenarios, docking locations, and operational considerations. Quantitative requirements for rapid separation will be developed in lower level requirements.

"Emergency conditions" is interpreted as meaning crew medical problems and the circumstances related to credible ISS failure scenarios.

4. Safety requirements - system for crew rescue:

a. The availability (defined as "a full-up vehicle able to perform its mission") for the escape mission shall be at least:

***Objective:* 99%**

***Minimum Threshold*: 95%.**

b. The risk of loss of crew shall be, with high confidence, lower than the Soyuz for the rescue mission. "Full-up vehicle able to perform its mission" means the CRV is completely functional and every system, including redundancy, is operational 99% of the time.

"Objective of 99%" means the CRV will be able to perform crew rescue 99% of the time.

"Minimum Threshold of 95%" means the CRV will be able to perform crew rescue 95% of the time.

"The risk of loss of crew being lower than Soyuz" is interpreted as meaning the CRV must be safer than the Soyuz.

For the purposes of the OSP Program, the CRV will utilize the following PRA targets:

Objective:	1/800 with an 80% confidence
Minimum Threshold:	1/800 with an 50% confidence

A Probabilistic Risk Assessment (PRA) integrated with the ISS/STS PRA will be used to make global and integrated decisions. NASA S&MA will be the final arbitrator of verification.

5. The system shall provide transportation capability for no fewer than four crew to and from the ISS as soon as practical but no later than 2012.

"Transportation capability" means safe conveyance between the Earth and the ISS.

"No fewer than four ISS crew" means that one or more vehicles will be used to convey at least four crewmembers between the Earth and the ISS. It is envisioned that the vehicle(s) must be capable of performing their missions with less than full capacity (i.e., less than four crew).

"As soon as practical but no later than 2012" means that NASA desires the CTV capability prior to 2012, and that this capability is required no later than 2012.

"As soon as practical" indicates a need for acceleration options to be pursued by the contractors.

6. Safety requirement - system for crew transport: The risk of loss of crew shall be, with high confidence, lower than the Space Shuttle for the transport mission. "The risk of loss of crew being lower than the Space Shuttle" is interpreted as meaning the CTV must be more reliable/safe than the Space Shuttle.

For the purposes of the OSP Program the CTV will utilize the following PRA targets:

Objective:	1/400 with an 80% confidence
Minimum Threshold:	1/400 with a 50% confidence

A PRA integrated with the ISS/STS PRA will be used to make global and integrated decisions. NASA S&MA will be the final arbitrator of verification.

7. The system shall be designed for minimum life cycle costs. "Minimum life cycle costs" is interpreted as meaning the aggregate of all costs for government and contractor including design, development, test, evaluation, maintenance, and operations.

Program will use the 2020 Concept of Operations and the ISS Traffic/Mission Model as a basis for life cycle cost calculation.

8. The system shall meet all applicable ISS requirements for visiting and attached vehicles.

"Meeting the ISS requirements" means satisfying all of the appropriate ISS requirements. This will be achieved through verification of the Interface Requirements Document (IRD) between ISS and the OSP Program.

9. Compared to the Space Shuttle, the system will require less time to prepare and execute a mission and have increased launch probability.

“Less time to execute than the Space Shuttle” is interpreted as meaning that the aggregate of the actions required to plan, process the vehicle, and execute a safe flight for the CRV/CTV will take less time than has been experienced for the Space Shuttle. Quantitative requirements for mission planning and mission execution will be defined in lower level requirements documents.

“Increased launch probability” means the CRV/CTV systems will be less susceptible to launch delays caused by factors such as weather, ground, and flight system problems.

As part of the system design the OSP will look for operations improvements, widen the launch window, and decrease its sensitivity to the launch environment and weather. Quantitative requirements for launch probability will be defined in lower level requirements documents.

10. Compared to the Space Shuttle, the system will have increased on-orbit maneuverability.

“On-orbit Maneuverability” is interpreted as meaning solutions that offer increased operational capabilities or flexibility, i.e., energy margins in the baseline vehicles that could be added to increase on-orbit change in velocity.

4.0 OPERATIONS CONCEPTS

1. The vehicle(s) shall initially launch on an ELV.

"Initially" is interpreted as meaning the first number of CRVs/CTVs will be designed to be launched on a U.S. ELV. Agency policy decisions will determine if the program will consider launch on non-U.S. launch vehicles.

"Initially" is also interpreted that the CRV/CTV could eventually be launched on an RLV. Since no RLV designs exist, the OSP program will not levy requirements to be capable of flying on an RLV.

2. The system shall be operated through at least 2020. However, the system should be designed so that it could be operated for a longer time.

This is interpreted as meaning that the overall plan must consider and allow for obsolescence, spare parts manufacturing, etc. such that the System can be operated through 2020 and beyond if required.

3. NASA envisions that the systems for crew rescue and crew transport could be different versions of the same vehicle design.

This is interpreted as meaning that the CRV design could be the same design as the CTV with modifications incorporated into the CRV. This is further interpreted as not precluding two complete different designs and that the completion of the relevant trades will dictate the appropriate solution.

4. The system shall provide contingency capability for cargo delivery to or from the ISS to support a minimal level of science.

This is interpreted as meaning that cargo delivery is a contingency capability. In lieu of some or all of the passengers, the system would provide the capability to deliver a limited amount of cargo. This capability will be defined in lower level requirements.

5. The system shall support a nominal ISS crew rotation period of 4-6 months. The Program will use the ISS Traffic/Mission Model to reflect the 120 days plus contingency.