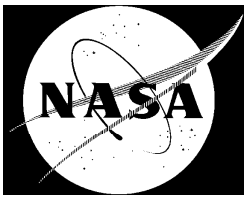
International Space Station De-crewing and Re-crewing Plan

International Space Station Program

Baseline

July 2005

National Aeronautics and Space Administration
International Space Station Program
Johnson Space Center
Houston, Texas



REVISION AND HISTORY PAGE

REV.	DESCRIPTION	PUB. DATE
-	Initial Release (Reference per SSCD XXXXXX, EFF. XX-XX-XX)	XX-XX-XX

INTERNATIONAL SPACE STATION PROGRAM

INTERNATIONAL SPACE STATION DE-CREWING AND RE-CREWING PLAN

CHANGE SHEET

Month XX, XXXX

Baseline

Space Station Control Board Directive XXXXXX/(X-X), dated XX-XX-XX. (X)

CHANGE INSTRUCTIONS

SSP 50715, International Space Station De-crewing and Re-crewing Plan, has been baselined by the authority of SSCD XXXXXX. All future updates to this document will be identified on this change sheet.

INTERNATIONAL SPACE STATION PROGRAM

INTERNATIONAL SPACE STATION DE-CREWING AND RE-CREWING PLAN

Baseline (Reference SSCD XXXXXX, dated XX-XX-XX)

LIST OF EFFECTIVE PAGES

Month XX, XXXX

The current status of all pages in this document is as shown below:

Page	Change No.	SSCD No.	Date
i - x	Baseline	XXXXXX	Month XX, XXXX
1-1 - 1-3	Baseline	XXXXXX	Month XX, XXXX
2-1 - 2-2	Baseline	XXXXXX	Month XX, XXXX
3-1 - 3-5	Baseline	XXXXXX	Month XX, XXXX
4-1	Baseline	XXXXXX	Month XX, XXXX
5-1 - 5-2	Baseline	XXXXXX	Month XX, XXXX
A-1 - A-5	Baseline	XXXXXX	Month XX, XXXX
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E-1 - E-8	Baseline	XXXXXX	Month XX, XXXX

INTERNATIONAL SPACE STATION PROGRAM

INTERNATIONAL SPACE STATION DE-CREWING AND RE-CREWING PLAN

JULY 2005

PREFACE

INTERNATIONAL SPACE STATION DE-CREWING AND RE-CREWING PLAN

The purpose of this document is to define the program process requirements, milestones and general station configuration requirements should it become necessary to de-crew the International Space Station (ISS) and later re-crew and return to normal operations.

The contents of this document are intended to be consistent with the tasks and products to be prepared by the ISS Program participants as defined in SSP 50200-01, Station Program Implementation Plan, Volume 1: Station Program Management Plan, and SSP 50200-02, Station Program Implementation Plan, Volume 2: Program and Manifesting. This document is under the control of the Space Station Control Board (SSCB).

SSCB APPROVAL NOTICE

INTERNATIONAL SPACE STATION PROGRAM

INTERNATIONAL SPACE STATION DE-CREWING AND RE-CREWING PLAN

JULY 2005

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INTERNATIONAL SPACE STATION PROGRAM

INTERNATIONAL SPACE STATION
DE-CREWING AND RE-CREWING PLAN

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INTERNATIONAL SPACE STATION DE-CREWING AND RE-CREWING PLAN

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INTERNATIONAL SPACE STATION DE-CREWING AND RE-CREWING PLAN

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INTERNATIONAL SPACE STATION DE-CREWING AND RE-CREWING PLAN

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INTERNATIONAL SPACE STATION PROGRAM

INTERNATIONAL SPACE STATION
DE-CREWING AND RE-CREWING PLAN

LIST OF CHANGES

JULY 2005

All changes to paragraphs, tables, and figures in this document are shown below:

SSCB	Entry Date	Change	Paragraph(s)
	March 2006	Baseline	All

TABLE OF CONTENTS

FIGURE

1.0 INTRODUCTION

De-crewing of the International Space Station (ISS) could occur as a result of several scenarios including; major system failure (unrecoverable or resulting in emergency condition), medical emergency or related problem, or insufficient consumables. Each of these scenarios initiates a decision making process where the de-crewing event will be classified as “planned” or “unplanned” for discussion purposes in this document. The approach to de-crewing is directly related to the scenario classification and additional definitions provided herein.

Unplanned de-crewing takes on 2 sub-classifications defined here as emergency and contingency:

A. An emergency de-crewing is defined as a scenario requiring immediate departure of the ISS crew.

   The preparation time could be as little as a few (30) minutes with little ability to configure the station systems or optimize undocking opportunities. Responses to these cases are defined by the procedures in SSP 50505-2 Basic Provisions on Crew Actions in Case of Fire on the ISS, SSP 50506-2 Basic Guidelines for Crew Activities During ISS Depressurization, All Increments/Flights and SSP 50653 Basic Provisions on Crew Actions in the Event of a Toxic Release on the ISS, All Increments/Flights, which focus on fire, cabin pressure loss, and toxic release events.

B. A contingency de-crewing is defined as a scenario allowing up to 72 hours before a crew’s departure.

   This scenario allows enough time to execute some or all of the system configurations outlined in this document but no time is available for special payload configuration needs or other system configuration “optimization” activity.

Planned de-crewing will be defined as a scenario offering greater than 72 hours before the crew needs to depart the ISS. This potentially allows for other tasks to be accomplished beyond the system configurations outlined in this document. As a result the crew can configure the station systems for optimal operation during the de-crewed phase and coordinate optimal undocking opportunities. This period includes time for crew sleep and rest.

Section 3 defines the de-crewing decision process and requirements. The decision making authorities are specifically defined since timely decisions during this process may be critical.

Section 4 outlines the baseline system configuration desired for de-crewing which also supports the ability to successfully facilitate in re-crewing. Additional steps may also be required to regain fault tolerance for ISS habitation. Deviations from the baseline may be necessary due to the ISS configuration at the time and will be appropriately analyzed for necessary changes and any required actions to be taken.

The ISS Program's top priority is to maintain ISS and crew safety and survival (reference SSP 50261-01, Generic Groundrules, Requirements, and Constraints Part 1: Strategic and Tactical Planning, Section 4.2.1A). As part of the nominal process to plan a safe and sustainable ISS configuration without a crew, the ISS and system configurations will be assessed. As time permits, depending on the scenario, a partial to full system configuration will be achieved. The risk and safety posture will be evaluated and appropriate actions taken by the ISS Program to maintain safety of the ISS and the returning crew.

Section 5 outlines the decision making process for re-crewing the ISS. This area is defined in general terms since the reasons for departure directly affect the decisions for return. The process does address the major elements of assuring crew safety upon return to the ISS and ability to restore system integrity. Ultimately the plans for return to ISS should mitigate the risk of de-crewing again but the processes must also recognize the potential risks associated with crew return to orbit.

1.1 PURPOSE

This document describes the processes, decision criteria, responsible organizations/boards, and timelines associated with both de-crewing and re-crewing the ISS. Preferred ISS system configurations for a de-crewing event are outlined as well.

1.2 SCOPE

This document addresses the anticipated program-level aspects of the de-crewing and re-crewing processes including the criteria and processes for decision making. The information contained herein is written at a level to allow operational team products (flight rules, procedures, etc.) to be adapted to the ISS configuration as it changes over time.

The ISS Program organization reviews potential Off Nominal Situations (ONS) to ensure that timely decisions and plans are made to preserve the ISS mission plan and mitigate any potential safety risk or impact. Programmatic planning ONS are covered in SSP 50562, ISS Program Off-Nominal Situation Plan. The increment planning ONS are in SSP 54004, Increment Definition and Requirements Document for Increment *X* Standard Blank Book, Appendix J (Increment Specific).

Real-time decision making authorities during standalone ISS operations, and while a visiting crew is present, are defined in NSTS 12820 Volume B, ISS Generic Operational Flight Rules, NSTS 12820 Volume C, Joint Shuttle-ISS Operational Flight Rules and NSTS 12820 Volume D, Soyuz/Progress ISS Joint Flight Rules. Several of these flight rules are reflected in this document in order to provide a complete understanding for how a decision to de-crew the ISS may be made. However, that document should be referenced for detailed information on real-time operations decision making authority.

Initial procedures and processes to support re-crewing planning/logistics following undocking are defined in JSC 29229, Flight Control Operations Handbook (FCOH)

Station Operations, DM-CH-06, Landing Support Officer Console Handbook, and are not restated here.

Additional actions will be invoked per SSP 50650, Program Management Operations Integration Procedures.

1.3 PRECEDENCE

In case of conflicts between this document and SSP 50200-02, Station Program Implementation Plan, Volume 2: Program Planning and Manifesting, (SPIP Vol 2), SSP 50200-02 will take precedence.

1.4 DELEGATION OF AUTHORITY

This document is approved by, and is subject to, the Space Station Control Board (SSCB) process. The ISS Program Mission Integration and Operations Office provides the book coordination for this document.

1.5 ISSUES AND OPEN WORK

Because of the complex and dynamic nature of ISS development and implementation, there can be unresolved issues concerning new or existing principles. These unresolved issues are identified by a **<TBR X-X>** in the text. Appendix C, Open Work, captures the To Be Resolved (TBR) issues associated with this operations concept. Principles associated with a TBR issue are not considered baselined until the issue is resolved and the operations concept text is updated.

Not all principles have been identified. As this document evolves, the principles will become better defined and will be incorporated into the operations concept. Open work is identified by a **<TBD X-X>** in the text. Appendix C, Open Work, captures the To Be Determined (TBD) items associated with the operations concept. Once the TBD information is defined, the correct text is inserted in place of the TBD in the document.

2.0 DOCUMENTS

2.1 APPLICABLE DOCUMENTS

The following documents include specifications, models, standards, guidelines, handbooks, and other special publications. The documents listed in this paragraph are applicable to the extent specified herein. Inclusion of applicable documents herein does not in any way supersede the order of precedence identified in Paragraph 1.3 of this document.

DOCUMENT NO.	TITLE	TYPE
SSP 50011	Concept of Operation and Utilization	Multilateral
SSP 50200-01	Station Program Implementation Plan, Volume1: Station Program Management Plan	Multilateral
SSP 50200-02	Station Program Implementation Plan, Volume 2: Program Planning and Manifesting	Multilateral
SSP 50261-01	Generic Groundrules, Requirements, and Constraints Part 1: Strategic and Tactical Planning	Multilateral
SSP 50489	ISS Mission Integration Template	Multilateral
SSP 50505-2	Basic Provisions on Crew Actions in Case of Fire on the ISS	Bilateral
SSP 50506-2	Basic Guidelines for Crew Activities During ISS Depressurization, Flights 5A.1 up to 10A	Bilateral
SSP 50562	ISS Program Off-Nominal Situation Plan	Multilateral
SSP 50650	Program Management Operations Integration Procedures	Multilateral
SSP 50653	Basic Provisions on Crew Actions in the Event of a Toxic Release on the ISS, Flights 5A.1 up to 10A	Bilateral
SSP 54004	Increment Definition and Requirements Document for Increment *X* Standard Blank Book	Multilateral

NSTS 12820 Volume B	ISS Generic Operational Flight Rules	Multilateral
NSTS 12820 Volume C	Joint Shuttle-ISS Operational Flight Rules	Multilateral
NSTS 12820 Volume D	Soyuz/Progress ISS Joint Flight Rules	Bilateral
MGT-OC-013	Replan Working Group Work Instruction	NASA Internal

2.2 REFERENCE DOCUMENTS

The following documents contain supplemental information to guide the user in the application of this document. These reference documents may or may not be specifically cited within the text of this document.

DOCUMENT NO.	TITLE	TYPE
SSP 50260	International Space Station Medical Operations Requirements Documents (ISS MORD)	Multilateral
SSP 50261-02	ISS Generic Groundrules and Constraints Part 2: Execute Planning	Multilateral
SSP 50643	Operations Interface Procedures Generic	Multilateral
JSC 29229	Flight Control Operations Handbook (FCOH) Station Operations	NASA Internal
ISS-MER-035	ISS MER Notification and Call In Requirements	NASA Internal
MGT-OA-019	On-Orbit Anomaly Resolution	NASA Internal
MGT-OC-014	Event Sequence Working Group Work Instruction	NASA Internal
DM-CH-06	Landing Support Officer Console Handbook	NASA Internal
MGT-OC-012	International Space Station Management Center Contingency Response Procedure Work Instruction	NASA Internal

3.0 DE-CREWING DECISION PROCESS

3.1 UNPLANNED DE-CREWING DECISION PROCESS

The decision process for unplanned de-crewing is initiated when an event occurs that warrants crew departure in less than 72 hours. An emergency unplanned departure is declared when the crew has to use the on-board emergency procedure book to respond to depress, fire, or toxic release conditions. A contingency unplanned departure is declared when a situation such as system failures or medical conditions dictate crew return within 72 hours or less but not immediately. Figure 3-1, Unplanned De-crewing Decision Flow, depicts the decision process for an unplanned de-crewing.

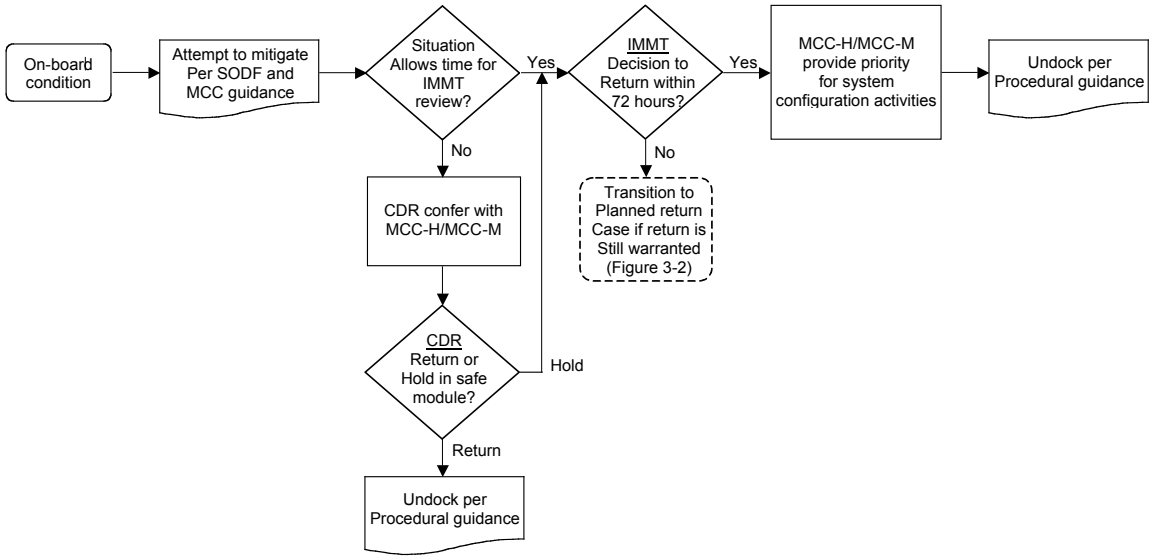

FIGURE 3-1 UNPLANNED DE-CREWING DECISION FLOW

Emergency Situations:

ISS emergency situations may result in an urgent need to de-crew the ISS. These situations are addressed in:

SSP 50506-2 Basic Guidelines for Crew Activities During ISS Depressurization for Flight 5A.1 up to 10A;

SSP 50505-2 Basic Provisions on Crew Actions in Case of Fire on the International Space Station;

SSP 50653 Basic Provisions on Crew Actions in the Event of a Toxic Release on the International Space Station for Flights 5A.1 up to 10A;

and entail:

A. Loss of ISS crew cabin pressurization

B. On-board fire or smoke condition

C. Release of toxic substance in the ISS crew cabin

For on-board emergencies the ISS commander (CDR), with support from Mission Control Center - Houston (MCC-H) and Mission Control Center - Moscow (MCC-M) will be responsible making the decisions and following the relevant procedural guidance to determine if de-crewing is necessary. It is understood that time may not allow for an ISS Mission Management Team (IMMT) to be convened in time to support the ISS CDR and Mission Control Center (MCC) team decisions to de-crew the ISS for some emergency situations. Although not depicted here, it is noted that emergency situation guidance for visiting crewmembers is provided in the appropriate flight rules and procedures. Finally, it is acknowledged that an emergency situation could have been controlled but left enough of the ISS capability unusable that de-crewing could still be required but additional time is allowed to respond to the situation. These cases can then be considered as “contingency” for the purposes of this document.

Contingency Situations:

Contingency scenarios allowing up to 72 hours prior to departure might include:

A. A crew medical condition that threatens a need to return while on-board treatment is being administered.

B. A combination of system failures that threatens the need to return while engineering teams work recovery plans.

C. An emergency that, while controlled, may result in limited ISS capability and warrant a crew return.

For contingency situations, the International Space Station Management Center (IMC) will execute MGT-OC-012, International Space Station Management Center Contingency Response Procedure Work Instruction, to ensure the appropriate program parties are notified and support personnel report to the control center. The ISS Mission Evaluations Room (MER), Houston Flight Control Team (FCT), IMC, MCC-M and other appropriate International Partners (IPs) support, as required, will conduct assessments/ analyses and provide situation specific recommendations to the IMMT for mitigating the problem or de-crewing. The IMMT will decide whether or not de-crewing is warranted. The Flight Directors from MCC-H and MCC-M have the authority to direct the crew to begin configuring systems for departure while the situation assessments are being coordinated and an IMMT decision is pending.

3.2 PLANNED DE-CREWING DECISION PROCESS

Planned de-crewing decision processes are invoked if a need to leave the ISS is greater than 72 hours away. Candidate scenarios driving this may be:

A. Consumable assessments projecting less than 45 days of on-orbit capability with no workarounds.

B. Failure of Crew Health Care System (CHeCS) Crew Medical Officer (CMO) equipment that, if not augmented/repaired, will result in a slowly degrading crew health condition, therefore, requiring crew return.

C. A slowly degrading crew health condition that results in crew return.

D. System failures that result in an unacceptable level of failure tolerance for critical functions or hazard controls.

Planned de-crewing decision processes for less than 15 days are planned to leave the ISS in such a way to minimize risk to the departing and returning crew. This also allows consideration of the following:

A. Lighted landing opportunities (approximately 7-14 days every eight weeks)

B. Adequate crew physical conditioning to support Soyuz descent and landing (if possible given the scenario)

C. Adequate time for landing logistics preparations

D. Adequate time to assess and plan for configuring the ISS vehicle for unmanned operations given operations/payloads underway at that point in time and future re-crewing.

For planned de-crewing scenarios, if time allows, the IMMT will give the final authorization to prepare for de-crewing so the final two-week on-orbit plan can be up-linked to the crew and any required phasing burns can be implemented. Prior to the actual de-crewing of the ISS, consideration is given to the timing of the next re-supply vehicle and its manifest supplies which may allow mission extension or ability to regain lost capability. Figure 3-2, Generic Process for a Planned De-crewing, depicts the generic process.

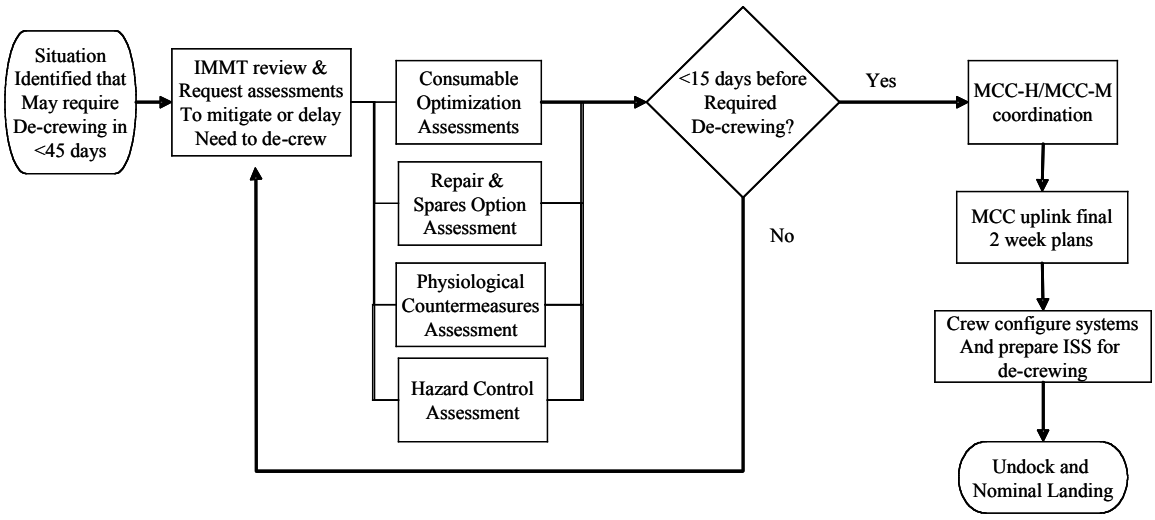

FIGURE 3-2 GENERIC PROCESS FOR A PLANNED DE-CREWING

3.2.1 CONSUMABLES CRITERIA

Consumables and expendable hardware resupplies are tracked on a weekly basis by the FCT, MER, IMC, and IMMT to monitor actual versus planned usage rate for critical items. Criteria to initiate the planned de-crewing decision process are met when it becomes evident that one or more critical consumables will reach the 45 day limit. Estimated 45 day quantities for critical consumables are listed in Appendix D for reference. Contingency conservation plans such as using Airlock (A/L) Oxygen (O_2) to save water, are evaluated and implemented to extend capability as needed.

The Increment Manager will be responsible for evaluating when this criteria has been met and requesting an IMMT to be convened to evaluate the problem, identify potential solutions, and identify follow on actions/meetings required to address the situation.

3.2.2 MEDICAL CRITERIA

Medical criteria for the planned de-crewing decision process are likely to stem from monitoring of crew medical conditions or from equipment failures that result in the inability to maintain crew physiological needs. The Integrated Medical Group (IMG) will be responsible to identify when a crew medical condition or equipment failures may require de-crewing the ISS within the next 45 days. The appropriate information is to be coordinated with the Crew Surgeon who will then submit a request for an IMMT to review the problem, identify potential solutions, and identify follow on actions/meetings required to address the situation.

It is acknowledged here that privacy requirements for certain medical situations may limit information shared with the general IMMT membership. The IMG may limit the type of information released to the mission integration and operations community at large.

3.2.3 SYSTEMS CRITERIA

Systems based criteria for the planned de-crewing decision process might result from failures that place critical functions at risk or the inability to control a potentially hazardous condition. In most cases, several equipment failures must occur to reduce system redundancy to the point which could initiate de-crewing. Nonetheless, situations could develop over time that place the crew at unnecessary risk and result in a need to de-crew the ISS.

Members of the IMMT will be responsible to identify when system failures exist that may require de-crewing the ISS. The member identifying the risk will request the IMMT to be convened to review the problem, identify potential solutions, and identify follow on actions/meetings required to address the situation.

It is acknowledged here that equipment failures for some critical ISS functions result in a loss of redundancy for the overall function, however alternate methods may be available to achieve adequate redundancy to reduce risk and maintain safety. These situations

are assessed during real-time as they occur. However, it is emphasized that increased consumable utilization must be considered as a result of those failures and what effect the accelerated depletion of reserves might have on the ability to keep the crew on-board.

4.0 SYSTEM CONFIGURATION AND ACTIVITIES FOR DE-CREWING

4.1 INTERNATIONAL SPACE STATION SYSTEMS CONFIGURATION

ISS systems will be configured beyond the emergency procedures as long as sufficient time/capability exists prior to crew departure. The configuration will be documented in a Volume B Flight Rule to minimize risk to the ISS during unmanned operations and to the returning crew. Additional detail is shown in Appendix E until final flight rule approval **<TBD 4-1>**. Deviations can be expected due to the current system status at the time that the plan is implemented based on the de-crewing scenario. The planned de-crewing configuration will also be periodically re-assessed as the ISS continues to evolve. As a part of the nominal process, each deviation will be properly assessed for acceptance.

5.0 RE-CREWING PROCESS

5.1 DECISION PROCESS

The major factors involved in the decision making process for re-crewing ISS are expected to be directly related to the original reason for de-crewing. Considerations may include:

A. Assessment of ISS habitability

B. Assessment of Cleanup requirements

C. Assessment of required repairs and spares

D. Assessment of systems readiness for re-crewing

E. Assessment of consumables

F. Launch date of a cargo vehicle which will deliver necessary reserves of consumables for ensuring crew life support as required

G. Continuation of Assembly Sequence

The current configuration will be updated as configuration changes are required.

Ultimately the plans for return to ISS should mitigate the risk of de-crewing again but the processes must also recognize the potential risks associated with crew return to orbit. Figure 5-1, International Space Station Re-crewing Decision Process, depicts the decision process.

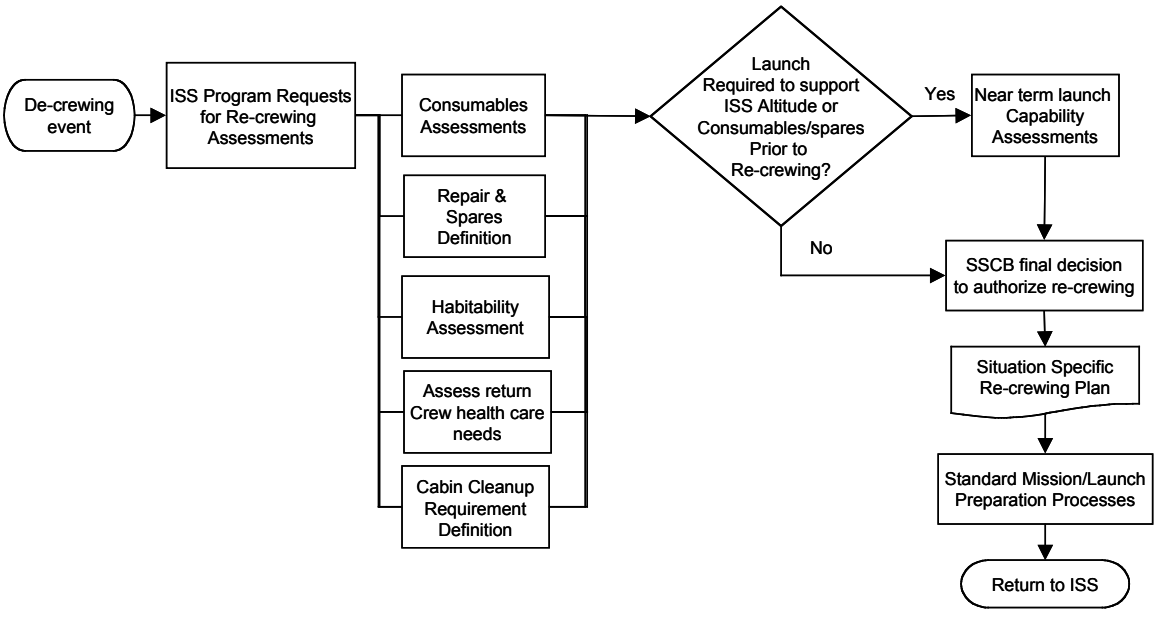

FIGURE 5-1 INTERNATIONAL SPACE STATION RE-CREWING DECISION PROCESS

It is seen here that a variety of assessments may be required in order support re-crewing decisions. The ISS Program will determine what assessments need to be conducted to fully evaluate the ability and requirements for re-crewing. Assessments may be conducted by multiple parties including the IPs, safety organizations, engineering organizations, Extravehicular Activity (EVA) organizations, training, operations teams, and the payloads community. Per Replan Working Group Work Instruction MGT-OC-013, the Replan Working Group (RWG) will ensure that assessments are properly coordinated with IPs of appropriate discipline and needs clearly identified for program management review.

Launches to the ISS may be required prior to re-crewing to boost ISS altitude while plans and equipment to support re-crewing are being prepared. Launches to station prior to re-crewing may also be necessary to pre-position or repair equipment and consumables that the returning crew will need.

The assessment findings/results will be reviewed by the appropriate program boards/panels to formulate a formal plan for re-crewing which identifies key requirements. Final approval and direction to proceed with necessary procurements and activities will be provided by SSCB.

After the re-crewing plan is baselined, the program will utilize standard flight preparation processes for the ISS and relevant launch vehicle as defined in SSP 50489, ISS Mission Integration Template.

APPENDIX A

ACRONYMS AND ABBREVIATIONS

APPENDIX A - ACRONYMS AND ABBREVIATIONS

°C	Degree Celsius
°F	Degree Fahrenheit
AAA	Avionics Air Assembly
ACO	Activation and Checkout
A/L	Airlock
ALSP	Advanced Life Support Pack
AMP	Ambulatory Medical Pack
BD-1	Russian Treadmill
CCAA	Common Cabin Air Assembly
CCPK	Crew Contamination Protection Kit
C&DH	Command and Data Handling
CDR	Commander
CDRA	Carbon Dioxide Removal System
CEVIS	Cycle Ergometer Vibration Isolation System
CHeCS	Crew Health Care System
CL	Crew Lock
CMO	Crew Medical Officer
C/O	Checkout
CO_2	Carbon Dioxide
COMM	Communications
config	configuration
CSA	Canadian Space Agency
CSA-CP	Compound Specific Analyzer - Combustion Products
CWC	Contingency Water Container
DC1	Docking Compartment 1
DCN	Document Change Notice
DCP	Display and Control Panel
DQA	Document Quality Assurance
ECLSS	Environmental Control and Life Support System
EL	Equipment Lock
ELPS	Emergency Lighting Power Supply
EMPEV	Extravehicular Manual Pressure Equalization Valve
EMU	Extravehicular Mobility Unit
EPS	Electrical Power System
ER	EXPRESS Rack
ESA	European Space Agency
ETCS	Early External Thermal Control System
EVA	Extravehicular Activity
EXPRESS	Expedite the Processing of Experiments to the Space Station

FCT	Flight Control Team
FDIR	Failure, Detection, Isolation and Recovery
FGB	Functional Cargo Block
FIT	Flight Investigation Team
GASMAP	Gas Analysis System for Metabolic Analysis of Physiology
GLA	General Luminaire Assembly
HCOR	High Rate Communication Outage Recorder
HRF	Human Research Facility
IFM	Inflight Maintenance
IMC	International Space Station Management Center
IMG	Integrated Medical Group
IMMT	ISS Mission Management Team
IMS	Inventory Management System
IMV	Inter-Module Ventilation
Int	Internal
IP	International Partner
ISO	Isolation
ISS	International Space Station
ITCS	Internal Thermal Control System
IV-CPDS	Intravehicular Charged Particle Directional Spectrometer
JAXA	Japan Aerospace Exploration Agency
kg	kilogram
Lab	Laboratory
LAN	Local Area Network
lb	pound
LEM	Life Extension Mode
LiOH	Lithium Hydroxide
LT	Low Temperature
LTL	Low Temperature Loop
LT/MT	Low Temperature and Moderate Temperature
MAMS	Microgravity Acceleration Measurement System
MBS	MRS Base System
MCA	Major Constituent Analyzer
MCC	Mission Control Center
MCC-H	Mission Control Center - Houston
MCC-M	Mission Control Center - Moscow
MCS	Maneuver Control Systems
MDM	Multiplexer/DeMultiplexer
MER	Mission Evaluations Room
MIC	Mission Integration Contract
MPEV	Manual Pressure Equalization Valves

MRS	Mobile Remote Servicer
MT	Mobile Transporter
N_2	Nitrogen
NASA	National Aeronautics and Space Administration
O_2	Oxygen
ONS	Off Nominal Situations
Ops	Operations
Ops LAN	Operations Local Area Network
PCA	Pressure Control Assembly
PCS	Portable Computer System
PDGF	Payload Data Grapple Fixture
PL	Payload
PLSS	Primary Life Support System
PMA	Pressurized Mating Adapter
POC	Point of Contact
PPA	Pump Package Assembly
Prep	Preparation
QD	Quick Disconnect
R&R	Remove and Replace
RED	Resistive Exercise Device
RFCA	Rack Flow Control Assembly
RODF	Russian On-orbit Data File
ROM	Read Only Memory
RPS	Remote Planning System
RS	Russian Segment
RSC-E	Rocket Space Corporation - Energia
RWG	Replan Working Group
RWS	Robotic Work Station
SAMS	Station Acceleration Measurement System
S-band	1550 to 5200 megahertz
SD	Smoke Detector
SFOG	Solid Fuel Oxygen Generator
SM	Service Module
SODF	Station Operations Data File
SOP	Secondary Oxygen Pack
SRCA	System on/off Remote Control Assembly
SRV-K	SM Air Conditioner System
SSCB	Space Station Control Board
SSRMS	Space Station Robotic Manipulating System
TBD	To Be Determined
TBR	To Be Resolved

TCCS	Trace Contaminant Control System
TCS	Thermal Control System
TEPC	Tissue Equivalent Proportional Counter
Tri	Three
TRRJ	Thermal Radiation Rotary Joint
TVIS	Treadmill with Vibration Isolation and Stabilization
UIP	Unique Interface Panel
UOP	Utility Outlet Panel
US	United States
US Lab	United States Laboratory
USOS	United States On-orbit Segment
VAJ	Vacuum Access Jumper
VES	Vacuum Exhaust System
VOA	Volatile Organic Analyzer
VRCV	Vent and Relief Control Valve
VRS	Vacuum Resource System
VTR	Video Tape Recorder

APPENDIX B

GLOSSARY OF TERMS

APPENDIX B - GLOSSARY OF TERMS

CONTINGENCY DE-CREWING

This scenario falls within the Unplanned category. May allow up to 72 hours before de-crewing.

EMERGENCY DE-CREWING

This scenario falls within the Unplanned category. Situation requires immediate departure of the ISS crew. The preparation time could be as little as a few minutes with little ability to configure the station systems and maximize landing opportunities.

OFF NOMINAL SITUATION

An unplanned event causing a disruption of planned operations that impact the ISS and/or crew safety or the successful completion of the ISS mission.

PLANNED DE-CREWING

This scenario provides over 72 hours before de-crewing is required. The crew has time to accomplish desired system configuration and prepare ISS for de-crewing.

UNPLANNED DE-CREWING

This scenario could require departure of the ISS crew in less than 72 hours. This time includes crew sleep/rest as well. Unplanned de-crewing falls into 2 sub-categories; emergency and contingency.

APPENDIX C

OPEN WORK

APPENDIX C - OPEN WORK

Table C-1 lists the specific TBD items in the document that are not yet known. The TBD is inserted as a placeholder wherever the required data is needed and is formatted in bold type within brackets. The TBD item is numbered based on the section where the first occurrence of the item is located as the first digit and a consecutive number as the second digit (i.e., **<TBD 4-1>** is the first undetermined item assigned in Section 4 of the document). As each TBD is solved, the updated text is inserted in each place that the TBD appears in the document and the item is removed from this table. As new TBD items are assigned, they will be added to this list in accordance with the above described numbering scheme. Original TBDs will not be renumbered.

TABLE C-1 TO BE DETERMINED ITEMS

TBD	Section	Description
4-1	4.1	Development of a joint US/RS flight rule for the Appendix E content is in work.

Table C-2 lists the specific TBR issues in the document that are not yet known. The TBR is inserted as a placeholder wherever the required data is needed and is formatted in bold type within brackets. The TBR issue is numbered based on the section where the first occurrence of the issue is located as the first digit and a consecutive number as the second digit (i.e., **<TBR 4-1>** is the first unresolved issue assigned in Section 4 of the document). As each TBR is resolved, the updated text is inserted in each place that the TBR appears in the document and the issue is removed from this table. As new TBR issues are assigned, they will be added to this list in accordance with the above described numbering scheme. Original TBRs will not be renumbered.

TABLE C-2 TO BE RESOLVED ISSUES

TBR	Section	Description

APPENDIX D

45 DAY CONSUMABLE ESTIMATES

APPENDIX D - 45 DAY CONSUMABLE PLANNING ESTIMATES*

Table D-1, 45 Day Consumable Planning Estimates, provides a nominal amount of critical consumables that are required for a crew of 2 or 3 for 45 days. This data is based on approved, planned usage rates and therefore should be used as a guide only. The actual conditions and events on-orbit could affect the actual consumables required for a particular time. Critical consumables are monitored on a continuous basis and for decisions of de-crewing/re-crewing should be deferred to using the real-time data rather than the data from this table.

TABLE D-1 45 DAY CONSUMABLE PLANNING ESTIMATES

Critical Consumable	2 Crew	3 Crew
Water	180 kg	270 kg
Food	24 containers (72 rations)	36 containers (108 rations)
O_2 - assumes no Elektron capability	77 kg See Note 1	116 kg See Note 1
CO_2 removal	See Note 2 Rely on system redundancy: Vozdukh or either bed of CDRA	See Note 2 Rely on system redundancy: Vozdukh or either bed of CDRA
CHeCS	See Note 3	See Note 3

NOTES:

1) O_2 sources are provided by SFOGs, Progress tanks, and USOS A/L tanks. The priority use of these O_2 sources is determined real-time. One SFOG (_Γ_) provides O_2 for one person for one day.
2) Russian LiOH provides time to perform maintenance. Additionally, Shuttle LiOH may be also available.
3) TVIS, RED, CEVIS and the Veloergometer are each provided for different purposes. In case of nominal functionality failure, most of the equipment have alternate modes (i.e. manual, BD-1, bungees) that allow for some alternatives. The use and health of the equipment is monitored on a regular basis but decisions on de-crewing/re-crewing that are based on support of the equipment or other basic life support equipment that affect crew health needs, such as insufficient medications or poor crew health condition will be left to real-time assessment.

NOTE: *Data provided is calculated based on jointly agreed to rates as of 5/04/04 of: water - 2 liters/person/day; food - 0.27 containers (0.8 rations)/person/day [3 rations/food container] (skip cycle rate of ~2000 calories/day); O_2 - 0.86 kg/person/day; Russian LiOH - 0.33 cans/person/day and US LiOH - 0.5 cans/person/day.

Other consumables are tracked for resupply or rationing depending on capability to resupply. These items will typically not drive a de-crewing decision. For re-crewing, supplies on-board will be supplemented prior to crew arrival to ensure sufficiency to next resupply mission.

APPENDIX E

DETAILED SYSTEM CONFIGURATIONS

APPENDIX E - DETAILED SYSTEM CONFIGURATIONS

TABLE E-1 UNITED STATES ON-ORBIT SEGMENT PLANNED UNMANNED CONFIGURATION (PAGE 1 OF 5)

SYSTEM	UNMANNED CONFIGURATION	CREW TIME REQUIRED	COMMENTS
C&DH	- All PCS powered down	- 30 minutes* for 1 crew	- Crew (right before departure)
	- Computers in nominal config	- None	- Int 2 MDM primary desired for LTL redundancy
MCS	- No deltas	- None	
EPS	- Verify all rack power switches are in the “on” position	- 10 minutes for 1 crew	- Crew - Ground inhibit RPS monitoring
	- Verify all GLA lighting switches set to “on” Full bright and Verify SRCA on	- 5 minutes for 1 crew	- Crew
	- Dual/Tri Angle ops to reduce drag but provide adequate power	- None	- Ground
	- ELPS to remain in nominal config	- None	- Result of MER FIT 10/04
	- Update load shed and proximity ops tables for unmanned config	- None	- Ground
TCS	- ITCS loops will be configured per unmanned config procedure (1/2 US Lab avionics jumpered to LTL)	- 30 minutes* for 1 crew	- Crew using SODF ECLSS 2.815 - Ground will take care of the rest of the ITCS reconfiguration (LTL setpoints, valves, etc)
	- Perform ITCS filter and gas trap R&Rs if required	- 1 hour for 1 crew if both MT and LT are required	- De-crewing timeframe dependent
	- Consider if ITCS accumulators require top-off	- 3 hours for 2 crew	- De-crewing timeframe dependent
	- Consider Installation of Spare PPA at LTL and monitor for 24 hours time	- 1 hour 30 minutes for 2 crew	- De-crewing timeframe dependent, Present LTL has the most run time. NOTE: If spare pump does not function properly reinstallation of current pump would be required (potential time issue)

TABLE E-1 UNITED STATES ON-ORBIT SEGMENT PLANNED UNMANNED CONFIGURATION (PAGE 2 OF 5)

SYSTEM	UNMANNED CONFIGURATION	CREW TIME REQUIRED	COMMENTS
TCS (Continued)	- Non essential racks powered down and all RFCAs open to 100 lb/hour	- None	- Ground, RFCAs open to reduce risk of line growth due to flow stagnation
	- Change LT/MT setpoints to 13.9 °C (57 °F) and begin operating in dual mode as soon as possible	- None	- Ground, recommended trade-off value for optimizing loop life and dew point, and verify stable planned config before crew departure
	- TRRJs in directed position (only required if ETCS is active)	- None	- Ground
ECLSS	- Detailed hatch seal inspection	- 10 minutes per hatch for USOS* for 1 crew	- Crew - Ground should assess time since last inspection
	- All hatches closed between modules	- 1 hour for USOS* for 2 crew	- Crew (covered in SODF ECLSS 2.815) - A/L EL to CL hatch remains open
	- All MPEVs closed - All MPEVs configured per SODF ECLSS 2.815	- 30 minutes* for 2 crew	- Crew (covered in SODF ECLSS 2.815)
	- Verify Lab window closed	- 5 minutes* for 1 crew	- Crew (assess if interior cover desired)
	- Drain US Lab Condensate Tank into a CWC down to the neutral point	- 1 hour* for 1 crew	- Fill CWC early enough to use in SRV-K before departure
	- Process the CWC thru the SRV-K	- 10 minutes* for 1 crew	
	- Vent the US Lab Condensate Tank to vacuum	- None*	- Ground, Perform 3 days before crew departure (in case of icing)
	- CDRA powered down	- 15 minutes if required for 1 crew (remove jumper)*	- Crew/Ground (if required)
	- Config A/L PCA with VRCV, verify A/L EMPEV is closed	- 30 minutes for 2 crew	- Crew (IFM 4.2.317), to provide redundant positive pressure relief option. VAJ will remain installed
	- IMV open, IMV fans off	- None	- Controlled via ground/FDIR as required. Prevents pressure differential development

TABLE E-1 UNITED STATES ON-ORBIT SEGMENT PLANNED UNMANNED CONFIGURATION (PAGE 3 OF 5)

SYSTEM	UNMANNED CONFIGURATION	CREW TIME REQUIRED	COMMENTS
ECLSS (Continued)	- All CCAAs off, Node 1 Cabin Fan off, Smoke Detectors off	- None - Note: Loss of ground insight	- Controlled via ground if required (minimize potential fire sources)
	- PMA-2 connect VAJ between US Lab forward Hatch MPEV and PCA vent port	- 30 minutes for 1 crew*	- Provides ground controlled repress and depress of PMA-2
	- MCA off (consider LEM)	- None - Note: Loss of ground insight, requires crew action to restart	- Can be powered off post crew departure as required to maintain some insight while crew present - Note: LEM would drive other config changes
	- TCCS off	- None	- Can be powered off post crew departure as required to maintain some insight while crew present
	- N_2 and O_2 Supply Valves closed	- None	- Ground - ISO Valves to remain open
	- Vacuum Vent System: Disconnect all payloads from VES and VRS at UIP, capability/verify all VES and VRS QDs are capped, Deactivate system	- 10 minutes to disconnect Payloads for 1 crew	- Crew - Ground, SODF ECLSS 1.602
COMM	- Two good tapes loaded in VTRs. VTRs recently cleaned and switched to remote ops	- 10 minutes* for 1 crew	- Crew
	- Crew to config camcorders for view of Lab and Node interiors and leave powered (no tapes in camcorders)	- 20 minutes for 1 crew	- Crew/Ground. Video system powered off when not required
	- Backup S-band string powered up and ready as hot backup	- None	- Ground
	- Audio system powered off after crew departure	- None	- Ground

TABLE E-1 UNITED STATES ON-ORBIT SEGMENT PLANNED UNMANNED CONFIGURATION (PAGE 4 OF 5)

SYSTEM	UNMANNED CONFIGURATION	CREW TIME REQUIRED	COMMENTS
Robotics	- UOP bypass and DCP power cables installed on both RWSs	- 10 minutes* for 1 crew	- Crew (cables to remain installed during unmanned config)
	- MT at Worksite 4 - SSRMS based on Lab PDGF - Mate other end of SSRMS to MBS PDGF for max redundancy	- 2 hours for 2 crew	- Crew/Ground - Preferred unmanned config for redundancy, implement unless views required for undocking or future docking
EVA	- Dispose EMU batteries in Progress or Double bag - Vent EMU SOP O_2 tanks - Vent EMU PLSS O_2 tanks - Verify all bags/loose items stowed and panel switches off	- ~ 2.5 hours for 2 crew (as required)	- Crew (time is variable/ dependent on config) - Final battery disposition needs agreement - Provides protection against O_2 tank leakage, Renders EMUs No-Go for future EVA use until SOPs are replaced and PLSS tanks are refilled
	- Remove Crewlock Equipment	- 30 minutes for 1 crew	- Crew time for removing crewlock hardware as prep for emergency alternate ingress path. (Equipment lock would have to go to vacuum. with hardware in it)
Ops LAN	- All Ops LAN components powered down - LAN cables between modules unplugged - Printer cartridges removed	- 1 hour* for 1 crew	- Crew use SODF POC 2.217
Crew Health/Medical Operations	- Medical equipment config for unmanned ops: Includes hardware powerdown (exercise, defib) and reconfig (VOA, TEPC, IV-CPDS), TVIS ACO and samples and dosimeters collection	- ~ 2.5 hours for 1 crew	- Unmanned config/plan for supportable re-crewing - Soyuz manifest/RS coord

TABLE E-1 UNITED STATES ON-ORBIT SEGMENT PLANNED UNMANNED CONFIGURATION (PAGE 5 OF 5)

SYSTEM	UNMANNED CONFIGURATION	CREW TIME REQUIRED	COMMENTS
Crew Health/Medical Operations (Continued)	- Consider transfer of equipment to Soyuz	- 30 minutes for 1 crew	- If required. List is case and RS coord specific. Items to consider: AMP, ALSP, CSA-CP, CCPK, and Defib for crew safety
	- Environmental Sampling	- ~ 4 hours for 1 crew	- Demanning case specific - Soyuz manifest/RS coord
Housekeeping, Maintenance and Stowage	- Normal weekly cleaning (close to departure)	- 3 hours for 2 crew*	- Timing/departure dependent
	- Unpower/disconnect US food warmer	- 10 minutes* for 1 crew	
	- Remove batteries from portable equipment as appropriate	- ~ 2 hours for 1 crew	- MER provided list of hardware
	- Assess required ops for perishable items (food/trash, etc.)	- ~ 4 hours for 2 crew - Note: There is some additional stowage time allocated in RS Progress ops	- Updating IMS for locations of items and downlink an ISS interior video survey if feasible
Payloads	- Assess science impacts and departure config - Express Rack 1 and 4 active, RS-232 reboots, filters cleaned - HRF GASMAP done if not done in last 30 days - Config other rack facilities and deployed payloads for unmanned ops	- Up to 2 hours if GASMAP required, else 30 minutes for 1 crew	- All PL Laptops off - Assess other potential payload actions - ER 1 and 4 have SAMS and MAMS - requires AAA Fan, SD, and HCOR - ON if left on

NOTES:

This adds up to approximately 10* - 40 crew hours of desirable USOS ops depending on time available, of which 5* - 18 hours is parallel 2 man time (equals about 1* - 4 days of USOS prep ops).

More important/desirable activities are noted with an *.

TABLE E-2 EXPECTED RUSSIAN ORBITAL SEGMENT PLANNED UNMANNED CONFIGURATION (PAGE 1 OF 2)

SYSTEM	UNMANNED CONFIGURATION	CREW TIME REQUIRED	COMMENTS
Progress	Progress waste stowage ops	- 3 hours for 2 crew	Likely Progress config and timeframe dependent. Some amount of work is assumed if time is available Reference the RODF Progress Cargo Vehicle Transfer Operations Book
	Docking Mechanism Install Onto Hatch	- 1 hours for 2 crewmembers	
	[__-21] Matching Unit Removal	- 1 hour for 1 crewmember	
	___ and ROM Removal	- 1 hours for 1 crewmembers	
	Progress Activation	- 20 minutes for 1 crewmember	
	Docking Clamp Removal	- 20 minutes for 2 crewmembers	
	Hatch closure	- 20 minutes for 2 crewmembers	
	Kurs A System Units Removal	- 3 hours for 2 crewmembers	
____	Elektron Deactivation	- 30 minutes	____ 5.4 This activity is broken into smaller activities. Total time to deact Elektron is ~12 hours
___	__-__(PMA1) Hatch Closure	- 10 minutes for 2 crewmembers	Reference RODF Activation/Deactivation RS
[____]	__1, __2 Air Ducts Removal	- 25 minutes for 1 crewmember	Reference RODF Activation/Deactivation RS
___	___-__ Hatch Ring Removal	- 15 minutes for 1 crewmember	Reference RODF Activation/Deactivation RS
____	Vozdukh Deact	- 30 minutes for 1 crewmember	Reference RODF Activation/Deactivation RS
____	___ cartridge regen and system deactivation	- 20 minutes for 1 crewmember	____ 7.5 Total time for ___ cartridge regen and system deactivation is 36 hours
[____]	FGB Audio Subsystem [___] Deactivation	- 10 minutes	Reference RODF Activation/Deactivation RS
____	FGB Caution and Warning Panel (___) Deactivation	- 5 minutes	Reference RODF Activation/Deactivation RS
___	Food Supply System (___) Deactivation	- 15 minutes	Reference RODF Activation/Deactivation RS
[____]	Thermal Control System [____] Deactivation	- 10 minutes	Reference RODF Activation/Deactivation RS
___	Water Supply System [___] Deactivation	- 20 minutes	RS 3.4.3 Includes Rodnik and [____-2_]
___	Toilet System [___] Deactivation	- 20 minutes	Reference RODF Activation/Deactivation RS
[____]	Ventilation System [__] Deactivation	- 20 minutes	Reference RODF Activation/Deactivation RS
[____]	Air Duct Disassembly	- 20 minutes	Reference RODF Activation/Deactivation RS

TABLE E-2 EXPECTED RUSSIAN ORBITAL SEGMENT PLANNED UNMANNED CONFIGURATION (PAGE 2 OF 2)

SYSTEM	UNMANNED CONFIGURATION	CREW TIME REQUIRED	COMMENTS
_____	__-___ Hatch Ring Removal	- 15 minutes	Reference RODF Activation/Deactivation RS
[____]	SM Audio Subsystem [____] State Check	- 20 minutes	Reference RODF Activation/Deactivation RS
___	Pressure Alarm System (___) Deactivation	- 5 minutes	Reference RODF Activation/Deactivation RS
_____	Caution and Warning Panel (___) Deactivation	- 5 minutes	Reference RODF Activation/Deactivation RS
_____	Digital Clock Deactivation	- 5 minutes	Reference RODF Activation/Deactivation RS
	Consider if internal pressure covers required on any RS windows		Crew/ground coordinate based on latest window condition assessments
	DC1 Deactivation	- 15 minutes	Reference RODF Activation/Deactivation RS
	FGB De-crew	- 20 minutes for 1 crewmember	Reference RODF Activation/Deactivation RS
	SM De-crew	- 20 minutes for 1 crewmember	Reference RODF Activation/Deactivation RS
	DC1 De-crew	- 25 minutes for 1 crewmember	Reference RODF Activation/Deactivation RS

NOTES:

This adds up to approximately 20 crew hours of RS ops depending on time available, of which about 12 hours are parallel 2 man time (equals about 2 days of RS prep ops).

Soyuz prep and Soyuz ops are not included.