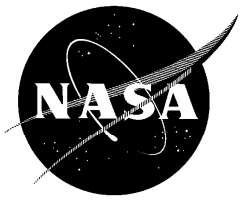
ISS End of Life Deorbit Strategy & Contingency Action Plan

International Space Station Program

Version A

July 2016

National Aeronautics and Space Administration
International Space Station Program
Johnson Space Center
Houston, Texas Contract No.: ############



Pages 2-36 are exempt in their entirety pursuant to (b)(5)

ГОСУДАРСТВЕННАЯ КОРПОРАЦИЯ
ПО КОСМИЧЕСКОЙ ДЕЯТЕЛЬНОСТИ "РОСКОСМОС"
(Госкорпорация "Роскосмос")
Щепкина ул., 42, Москва, РОССИЯ, ГСП-6, 107996. Факс (495) 688-90-63, (499) 975-44-67

STATE SPACE CORPORATION "ROSCOSMOS"
(ROSCOSMOS)
42 Schepkina st., Moscow RUSSIA, GSP-6, 107996. Fax (495) 688-90-63, (499) 975-44-67

12 July 2016 #55-6523

K. Shireman
ISS Program Manager, NASA
Fax: +1 281 483 2968

DATE REC'D: 7/12/16
VIA EMAIL FROM KSENIYA
INFO COPY TO: OA/ KAS / DWH / JRM / KOT
OC/ RP / GJL; OD/ WJR / MAM; OK/ SMF / KVP; OX/
GD / RAG / MLF /CAC;
ORIGINAL TO: INCOMING - FSA
ACTION TO: _____

RE: Upgrading FGB MDM software

Dear Mr. Shireman:

In response to your Ref. #OD-16-003 dated 04/25/2016, please be advised that (b) (4)

(b) (4)

(b) (5)

Attachment – 1 page

Sincerely,
Director, Human Space Programs Department [signature] A. A. Strelnikov

SS54152/TTI/MPS/BL/ET/07/12/16

ISS Program Managers Technical Understanding

October 2013

The International Space Station (ISS) Partnership recognizes the importance of the safety of the crew and those on the ground, and recognizes that the IGA and ISS MOUs apply to ISS operations, including a nominal or potential contingency re-entry. Therefore, all Partners share an interest in mitigating the risks associated with a potential nominal and contingency re-entry. It is important that preparation is implemented to technically ensure safe nominal and contingency re-entry scenarios. The actual dedicated means for ensuring the safe re-entry scenarios, including the execution of mutually-agreed tests to mitigate the risks, will be a shared responsibility. [redacted] (b) (5)

(b) (5) [redacted]

21/Nov 2012
Mr. Pierre Jean — Date
Director, Space Exploration Operations and Infrastructure
Program Manager, Canadian Space Station Program (CSA)

21/11/13
Mr. Bernardo Patti — Date
Head, ISS Programme and Exploration Department
European Space Agency (ESA)

11/21/2013
Mr. Masazumi Miyake — Date
Program Manager
ISS Program, Human Spaceflight Mission Directorate
Japan Aerospace Exploration Agency (JAXA)

21.11.2013
Mr. Alexey Krasnov — Date
Director of Piloted Space Programs Department
Federal Space Agency (Roscosmos)

11/21/13
Michael T. Suffredini — Date
Manager, ISS Program
Johnson Space Center, NASA

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

April 25, 2016

Reply to Attn of: OD-16-003

Mr. Alexey A. Strelnikov
Director, Department of Human Space Programs
Roscosmos State Space Corporation
42 Schepkina Street
Moscow 107996
RUSSIA

Dear Mr. Strelnikov:

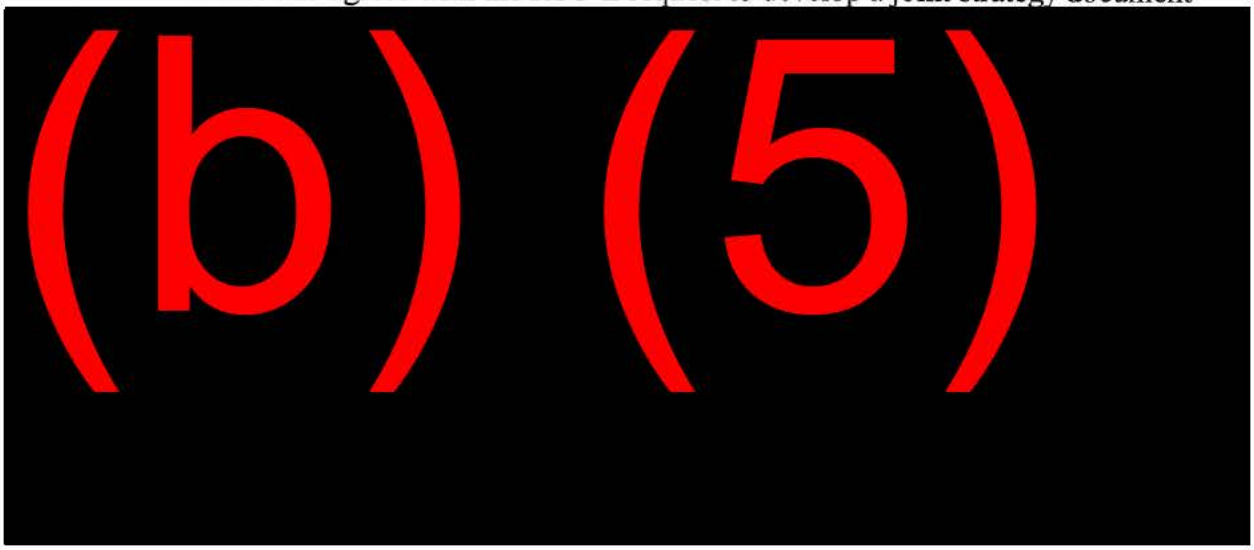
The National Aeronautics and Space Administration (NASA) and Rocket Space Corporation-Energia (RSC-E) [redacted]

[redacted]

[redacted]

[redacted] NASA and RSC-E need to work together to develop the overall ISS response and plans for a contingency depressurization as well as nominal disposal/re-entry at the end of ISS life.

NASA understands and agrees with the RSC-E request to develop a joint strategy document



The point of contact for this activity is Mr. William R. Jones, and he may be reached via email at william.r.jones@nasa.gov or by phone at (281) 244-7941.

The remaining work for the contingency end of life scenario should be agreed to and captured in a joint strategy document between NASA and Roscosmos. The point of contact for this activity is Mr. Jeffrey Arend, and he may be reached via email at jeffrey.j.arend@nasa.gov or by phone at (281)-244-7038.

Sincerely,

Kirk A. Shireman
Manager, International Space Station Program

cc:
OV/Roscosmos Houston Liaison Office
RSC-E/E. A. Mikrin

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

March 3, 2016

Reply to Attn of: OM-16-007

Mr. Alexey A. Strelnikov
Deputy Director, Department of Human Space Programs
Roscosmos State Space Corporation
42 Schepkina Street
Moscow 107996
RUSSIA

Dear Mr. Strelnikov:

This letter is to request your direction to (b) (5)

(b) (5)

We believe that this work is very important to the ISS Program and we request your support in (b) (5)

Sincerely,

Kirk A. Shireman
Manager, International Space Station Program

cc:
OV/Roscosmos Houston Liaison Office
RSC-E/N. Brukhanov

estec

European Space Research
and Technology Centre
Keplerlaan 1
2201 AZ Noordwijk
The Netherlands
T +31 (0)71 565 6565
F +31 (0)71 565 6040
www.esa.int

Michael T. Suffredini, Manager ISS Programme

Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696
United States of America

Our ref. ESA-HSO-I-LE-0011

Noordwijk, 12 March 2014

Subject: Shared Responsibility of the Partners for the Contingency Re-entry of ISS

Dear Mr. Suffredini,

At the occasion of the last SSCB in held in Houston on 19 November 2013, ESA together with the other Partners, signed the ISS Program Managers Technical Understanding (TU) regarding the shared responsibility of the Partners for the contingency re-entry of ISS. As indicated by ESA during the meeting, the TU represents a broad consensus among the Partners recognising the principle of shared efforts in support of this endeavour. This represents the enabling step towards a legally binding document on the subject to be concluded in a timely fashion.(b) (5)

(b) (5)

(b) (5)

(b) (5) ESA remains fully committed to working cooperatively with NASA and the other Partner Agencies on ensuring that an ISS nominal or contingency de-orbiting and re-entry can be performed with high levels of safety for persons and assets on ground.

Sincerely,

Bernardo Patti
Head, ISS Programme and Exploration Department

International Space Station
OM/Systems Engineering and Integration Office
Fax: (281) 244-7736

NASA
Johnson Space Center
Houston, TX 77058

Fax

Ref #:	OM-13-018	**Date:**	July 2, 2013
To:	Mr. Aleksay G. Bideev	**Fax:**	N/A
CC:	OC/G. Dorth OC3/S. M. Fuller OV/Roscosmos Houston Liaison Office	**Pages:**	1
From:	Manager, Systems Engineering and Integration Office	**Phone:**	281-244-7038

Subject: Russian Ballistic Personnel Support for the International Space Station (ISS) De-Orbit Technical Interchange Meeting (TIM) #5

NASA will be conducting an ISS End of Life de-orbit TIM at the Centre National d'Études Spatiales (CNES) facility in Toulouse, France on July 15–19, 2013.

This TIM will include discussions of nominal and contingency ballistic planning for ISS de-orbit. Additionally, this TIM is focused on the integrated development of reentry test flight profiles, attitudes, decelerations, and triggering concepts for the Reentry Ballistics Recorder and I-Ball reentry recording devices planned to be used for reentry viewing experiments. These discussions will require Russian ballistics specialists familiar with Progress flight operations and the planned de-orbit flight profiles. Their expertise will be essential to the development of the I-Ball and the Reentry Ballistics Recorder flight units and the planning of each vehicle's trajectory during the experiment.

The Letter of Invitation, IH/13-135R, is written requesting support of (b) (4) (b) (4) at the ISS End of Life TIM #5. NASA understands that two of the travelers, (b) (4), will not be available to support. The Letter of Invitation will not be updated to reflect only two travelers. It is understood that the support of Russian ballistics specialist (b) (4) (b) (4) will be the only travelers to support this TIM. Their involvement and expertise will be critical to the discussions of this TIM and the success of both the planned reentry experiments and the safe de-orbit planning of the ISS.

Sincerely,

Jeffrey J. Arend

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

April 1, 2013

OM-13-006

Reply to Attn of:

Mr. Alexey Krasnov
Director of Piloted Space Programs Department
Federal Space Agency
42 Schepkina Street
Moscow 107996
RUSSIA

Dear Mr. Krasnov:

We request your assistance in accelerating certain portions of the work associated with contingency International Space Station (ISS) End of Life (EOL). We have recently become aware that the Rocket Space Corporation-Energia (RSC-E) specialists do not have Roscosmos' direction to finish some key pieces of necessary work that will put the ISS Program in a safe posture in the event of a contingency de-orbit of the ISS.

All technical solutions to the contingency EOL problem require the rendezvous and docking of two Progress vehicles during the six months between the depressurization and the de-orbit attempt, to assure enough propellant and engine life is available for the final burn sequence. It is essential that one of these fresh Progress vehicles arrive at the Service Module (SM) aft.

(b) (5)

(b) (5)

The technical experts in all contributing agencies are awaiting Roscosmos' selection of the specific departing Progress M vehicle that will be used in the simulated ISS re-entry demonstration. The partners need this confirmation in order to align manufacturing and manifest schedules for their contributed instruments to meet that flight. As soon as you are comfortable with a vehicle selection for this key demonstration, please advise your EOL Team 1 specialists. (b) (5)

(b) (5)

Finally, RSC-E has so far exported many portions of key internal EOL data packages only to the National Aeronautics and Space Administration. However, we are not authorized to re-export your technical data to the other partners who are contributing to the integrated risk discussions. For adequate multilateral review and to complete some open bilateral data requests, we are requesting that you authorize and direct RSC-E to share the exportable details of the following important technical matters:

(b) (5)

Sincerely,

Michael T. Suffredini
Manager, International Space Station Program

cc:
OV/Roscosmos Houston Liaison Office
RSC-E/V. A. Soloviev

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

January 2, 2013

Reply to Attn of: OX-12-100

Mr. Bernardo Patti
Head, ISS Programme and Exploration Department
European Space Agency, ESTEC (HSO-I)
Keplerlaan 1
2200-AG Noordwijk
THE NETHERLANDS

Dear Mr. Patti:

I want to follow up on our recent discussion of International Space Station (ISS) contingency deorbit plans and activities and confirm our understanding of next steps. At this point, I understand that (b) (5)
(b) (5)
(b) (5) In the meantime, it is critical that the ISS Partnership continue to make preparations to ensure that the ISS can be deorbited safely and properly in the case of a contingency scenario.

Therefore, Roscosmos and NASA will begin the necessary contingency de-orbit analysis and preparatory work as soon as possible. (b) (5)

(b) (5)

This request and these activities in no way imply or indicate that NASA is changing the expectation that the ISS Partnership shares responsibility for deorbit or that NASA is accepting additional cost-sharing responsibilities or liability beyond that which would otherwise exist.

I look forward to discussing this with you further in the future.

Sincerely,

Michael T. Suffredini
Manager, International Space Station Program

cc:
OT/ESA Houston Liaison Office
Roscosmos/A. Krasnov

Identical letter to:

Mr. Masazumi Miyake
Program Manager
International Space Station Program
Human Space Systems and Utilization Mission Directorate
Japan Aerospace Exploration Agency
2-1-1 Sengen
Tsukuba, Ibaraki 305-8505
JAPAN

Mr. Pierre Jean
Director, Space Exploration Operations and Infrastructure and
Program Manager, Canadian Space Station Program
Canadian Space Agency
6767 Route de L'Aeroport
Saint-Hubert, Quebec J3Y 8Y9
CANADA

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

January 2, 2013

Reply to Attn of: OX-12-099

Mr. Alexey Krasnov
Director of Piloted Space Programs Department
Federal Space Agency
42 Schepkina Street
Moscow 107996
RUSSIA

Dear Mr. Krasnov:

I want to follow up on our recent discussion of International Space Station (ISS) contingency deorbit plans and activities and confirm our understanding of next steps. At this point, (b) (5) (b) (5) (b) (5) In the meantime, it is critical that the ISS Partnership continue to make preparations to ensure that the ISS can be deorbited safely and properly in the case of a contingency scenario.

Therefore, I request that Roscosmos and NASA work bi-laterally on the necessary contingency deorbit analyses and preparatory work immediately. (b) (5)

(b) (5)

This request and these activities in no way imply or indicate that NASA is changing the expectation that the ISS Partnership shares responsibility for deorbit or that NASA is accepting additional cost-sharing responsibilities or liability beyond that which would otherwise exist.

Please confirm your agreement with this approach. I look forward to your response.

Sincerely,

Michael T. Suffredini
Manager, International Space Station Program

cc:
OV/Roscosmos Houston Liaison Office
RSC-E/V. A. Soloviev

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

January 2, 2013

Reply to Attn of: OX-12-101

Mr. Pierre Jean
Director, Space Exploration Operations and Infrastructure and
Program Manager, Canadian Space Station Program
Canadian Space Agency
6767 Route de L'Aeroport
Saint-Hubert, Quebec J3Y 8Y9
CANADA

Dear Mr. Jean:

I want to follow up on our recent discussion of International Space Station (ISS) contingency deorbit plans and activities and confirm our understanding of next steps. At this point, (b) (5) (b) (5) (b) (5) In the meantime, it is critical that the ISS Partnership continue to make preparations to ensure that the ISS can be deorbited safely and properly in the case of a contingency scenario.

Therefore, Roscosmos and NASA will begin the necessary contingency de-orbit analysis and preparatory work as soon as possible (b) (5) (b) (5)

This request and these activities in no way imply or indicate that NASA is changing the expectation that the ISS Partnership shares responsibility for deorbit or that NASA is accepting additional cost-sharing responsibilities or liability beyond that which would otherwise exist.

I look forward to discussing this with you further in the future.

Sincerely,

Michael T. Suffredini
Manager, International Space Station Program

cc:
OR/CSA Houston Liaison Office
Roscosmos/A. Krasnov

Identical letter to:

Mr. Masazumi Miyake
Program Manager
International Space Station Program
Human Space Systems and Utilization Mission Directorate
Japan Aerospace Exploration Agency
2-1-1 Sengen
Tsukuba, Ibaraki 305-8505
JAPAN

Mr. Bernardo Patti
Head of ISS Programme Department, Directorate of Human Spaceflight
European Space Agency, ESTEC (HSF-I)
Keplerlaan 1
2200-AG Noordwijk
THE NETHERLANDS

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

January 2, 2013

Reply to Attn of: OX-12-102

Mr. Masazumi Miyake
Program Manager
International Space Station Program
Human Space Systems and Utilization Mission Directorate
Japan Aerospace Exploration Agency
2-1-1 Sengen
Tsukuba, Ibaraki 305-8505
JAPAN

Dear Mr. Miyake:

I want to follow up on our recent discussion of International Space Station (ISS) contingency deorbit plans and activities and confirm our understanding of next steps. At this point, (b) (5) (b) (5) (b) (5) In the meantime, it is critical that the ISS Partnership continue to make preparations to ensure that the ISS can be deorbited safely and properly in the case of a contingency scenario.

Therefore, Roscosmos and NASA will begin the necessary contingency de-orbit analysis and preparatory work as soon as possible. (b) (5)

(b) (5)

This request and these activities in no way imply or indicate that NASA is changing the expectation that the ISS Partnership shares responsibility for deorbit or that NASA is accepting additional cost-sharing responsibilities or liability beyond that which would otherwise exist.

I look forward to discussing this with you further in the future.

Sincerely,

Michael T. Suffredini
Manager, International Space Station Program

cc:
OS/JAXA Houston Liaison Office
Roscosmos/A. Krasnov

Identical letter to:

Mr. Bernardo Patti
Head, ISS Programme and Exploration Department
European Space Agency, ESTEC (HSO-I)
Keplerlaan 1
2200-AG Noordwijk
THE NETHERLANDS

Mr. Pierre Jean
Director, Space Exploration Operations and Infrastructure and
Program Manager, Canadian Space Station Program
Canadian Space Agency
6767 Route de L'Aeroport
Saint-Hubert, Quebec J3Y 8Y9
CANADA

DATE REC'D : **03/23/2012**
INFO COPY TO: MTS / KAS / DWH / JRM / JJA / SBR / MER
RESPONSE TO: OM-12-011
ORIGINAL TO: INCOMING – FSA

ФЕДЕРАЛЬНОЕ КОСМИЧЕСКОЕ АГЕНТСТВО
Щепкина ул. 42., Москва, РОССИЯ; ГСП-6, 107996 Факс 688-90-63, 975-44-67. Тел. 631-94-44
(РОСКОСМОС)

FEDERAL SPACE AGENCY
(ROSCOSMOS)
42 Schepkina St., Moscow, RUSSIA, GSP-6, 107996 Fax 688-90-63, 975-44-67 Phone 631-94-44

03/20/2012 No. УПП-1658-ИСХ

FAX: 281-483-2968
Michael Suffredini
Manager, International Space Station Program, NASA

Re.: 3/13/2012 No. ОМ-12-011-ИСХ

Dear Mike:

In response to your letter concerning RSC Energia's involvement in working out issues related to assessment of certain technical aspects of terminating the ISS mission using Russian nominal and modified Progress vehicles, please be advised as follows.

Roscosmos supports the need to perform such assessment and it is prepared to provide assistance to NASA in resolving the problematic issues indicated by the U.S. side.

At the same time, I would point out that NASA, as ISS program coordinator, is responsible for formulating a coordinated solution, together with all international partners, on scenarios for de-orbiting the ISS, as well as managing the partners' cooperation with regard to ensuring their specific technical implementation and providing resources.

(b) (5)

Sincerely,

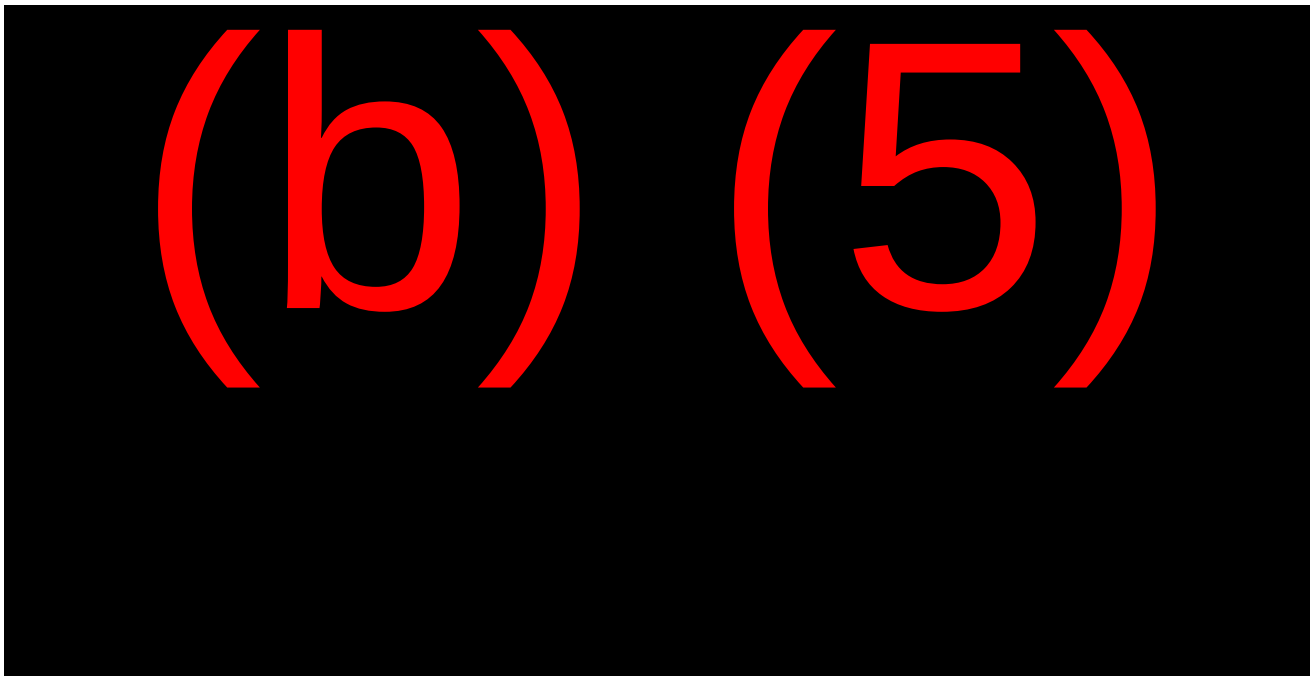
Director, Manned Flight Programs Division [signed] A.B. Krasnov

ИМ

Россия, 141070, Мос

To:	Fax:	From:	
NASA	(281) 244-8686	Name:	A. Bideev
Mr. Jeffrey J. Arend		Fax:	(205) 961-6166
Mr. Kenneth O. Todd		E-mail	
Ms. P. Moore		Ref:	F-1/102-5863 (699)
		Date:	11/17/11
		Pages:	1
		Originator:	R. Beglov

Dear Colleagues:



[signed and dated 11/17/11] A. Bideev

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

December 14, 2010

Reply to Attn of: OM-10-038

Mr. Alexey Krasnov
Director of Piloted Space Programs Department
Federal Space Agency
42 Schepkina Street
Moscow 107996
RUSSIA

Dear Mr. Krasnov:

At some point in the future, the International Space Station will be decommissioned. When that decommissioning and disposal is attempted, it will be a significant engineering and operational challenge, requiring forethought and special vehicle modifications. Because the Russian Federation is the principal integrator of the International Space Station propulsion issues, NASA wishes to discuss with you the various aspects of this operation.

As the constraints of the de-orbit operation are both unique and severe, it is important that these must be well understood and agreed by all parties before any mission proposal could be developed in detail. Therefore, we suggest (b) (5)

(b) (5)

Thank you for your support of this important study.

Sincerely,

Michael T. Suffredini
Manager, International Space Station Program

cc:
OV/Roscosmos Houston Liaison Office
RSC-E/V. A. Solovyov

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

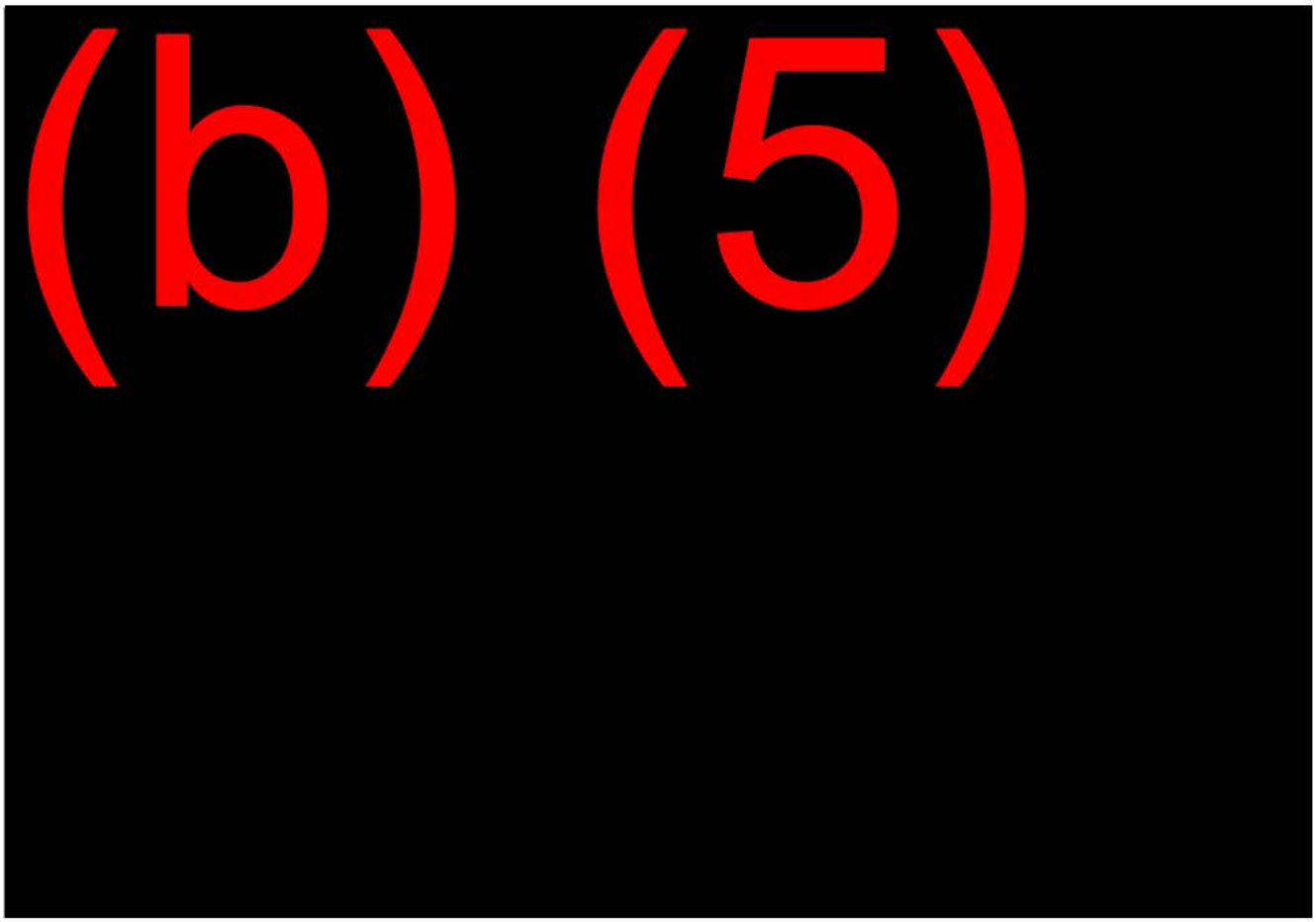
June 20, 2013

Reply to Attn of: OM-13-016

Mr. Masazumi Miyake
Program Manager
International Space Station Program
Human Spaceflight Mission Directorate
Japan Aerospace Exploration Agency
2-1-1 Sengen
Tsukuba, Ibaraki 305-8505
JAPAN

Dear Mr. Miyake:

As we have discussed, the International Space Station Exploration Working Group has not yet reached final conclusions regarding cost sharing for nominal or contingency International Space Station (ISS) de-orbit technical development activities. Because we are faced with ongoing risk to the program that must be mitigated, NASA is continuing to invest in the technical team's recommended activities. I encourage you to continue in the same spirit.



(b) (5)
(b) (5) I appreciate that both our agencies have put significant effort into this potential observation.

I hope that we will reach collective agreement on cost sharing soon. I ask you to continue to financially support in the recommended activities as we are doing within NASA, so that we do not continue at technical risk any longer than necessary.

Sincerely,

Michael T. Suffredini
Manager, International Space Station Program

cc:
OS/JAXA Houston Liaison Office

International Space Station
OM/Program Integration Office
Fax: (281) 244-7736

NASA
Johnson Space Center
Houston, TX 77058

Fax

Ref #:	OM-11-034	**Date:**	December 6, 2011
To:	Mr. Aleksay G. Bideev	**Fax:**	
CC:	OC/P. Moore OC/K. O. Todd OV/Roscosmos Houston Liaison Office	**Pages:**	1
From:	Manager, Program Integration Office	**Phone:**	281-244-7038

Subject: Controlled De-orbit of the International Space Station (ISS)

Thank you for your fax, F-1/102-5863 (699), dated November 17, 2011, regarding your suggested de-orbit scenario of using a (b) (5)

(b) (5)

We look forward to an ongoing collaboration in this challenging and difficult subject.

Sincerely,

Jeffrey J. Arend

ISS Program Managers Technical Understanding

October 2013

The International Space Station (ISS) Partnership recognizes the importance of the safety of the crew and those on the ground, and recognizes that the IGA and ISS MOUs apply to ISS operations, including a nominal or potential contingency re-entry. Therefore, all Partners share an interest in mitigating the risks associated with a potential nominal and contingency re-entry. It is important that preparation is implemented to technically ensure safe nominal and contingency re-entry scenarios. The actual dedicated means for ensuring the safe re-entry scenarios, including the execution of mutually-agreed tests to mitigate the risks, will be a shared responsibility. (b) (5)

(b) (5)

21 Nov 2013

Mr. Pierre Jean — Date
Director, Space Exploration Operations and Infrastructure
Program Manager, Canadian Space Station Program (CSA)

21/11/13

Mr. Bernardo Patti — Date
Head, ISS Programme and Exploration Department
European Space Agency (ESA)

11/21/2013

Mr. Masazumi Miyake — Date
Program Manager
ISS Program, Human Spaceflight Mission Directorate
Japan Aerospace Exploration Agency (JAXA)

21.11.2013

Mr. Alexey Krasnov — Date
Director of Piloted Space Programs Department
Federal Space Agency (Roscosmos)

11/21/13

Michael T. Suffredini — Date
Manager, ISS Program
Johnson Space Center, NASA

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

June 15, 2012

Reply to Attn of: OX-12-048

Mr. Pierre Jean
Director, Operations Engineering and Program Manager
Canadian Space Station Program
Canadian Space Agency
6767 Route de L'Aeroport
Saint-Hubert, Quebec J3Y 8Y9
CANADA

Dear Mr. Jean:

I wanted to fill you in on recent discussions and planning concerning End of Life (EOL) disposition of the International Space Station (ISS). Although this event will likely not occur for many years, it is necessary to have a plan in place for how this would be handled, from policy, programmatic and technical points of view, for both nominal and contingency cases. NASA and Roscosmos will have to perform the actual EOL activities when they are necessary, and have begun exchanging ideas on de-orbit strategies. It is our intention to keep all Partners informed and involved in this process, leading up to the multilateral adoption of a technical de-orbit plan by the Program.

The ISS Intergovernmental Agreement and the Memorandum of Understanding do not specifically address responsibilities for performing EOL activities. While NASA and Roscosmos will perform most of the activities, we believe that the safe disposition of the ISS, both in orbit and on the ground, is a shared responsibility. Policy aspects will need to be addressed via agreement in the Multilateral Coordination Board (MCB). We anticipate that a directive from the MCB would contain general principles similar to the following:

Please have your designated lead for discussing the principles for the MCB directive contact Mr. Dan Jacobs of the ISS Program to begin those talks. I look forward to seeing you in Moscow and will be able to discuss this approach in more detail then.

Sincerely,

Michael T. Suffredini
Manager, International Space Station Program

cc:
OR/CSA Houston Liaison Office
Roscosmos/A. Krasnov

Identical letter to:

Mr. Tetsuro Yokoyama
Program Manager
International Space Station Program
Human Space Systems and Utilization Mission Directorate
Japan Aerospace Exploration Agency
2-1-1 Sengen
Tsukuba, Ibaraki 305-8505
JAPAN

Mr. Bernardo Patti
Head of ISS Programme Department, Directorate of Human Spaceflight
European Space Agency, ESTEC (HSF-I)
Keplerlaan 1
2200-AG Noordwijk
THE NETHERLANDS

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

June 15, 2012

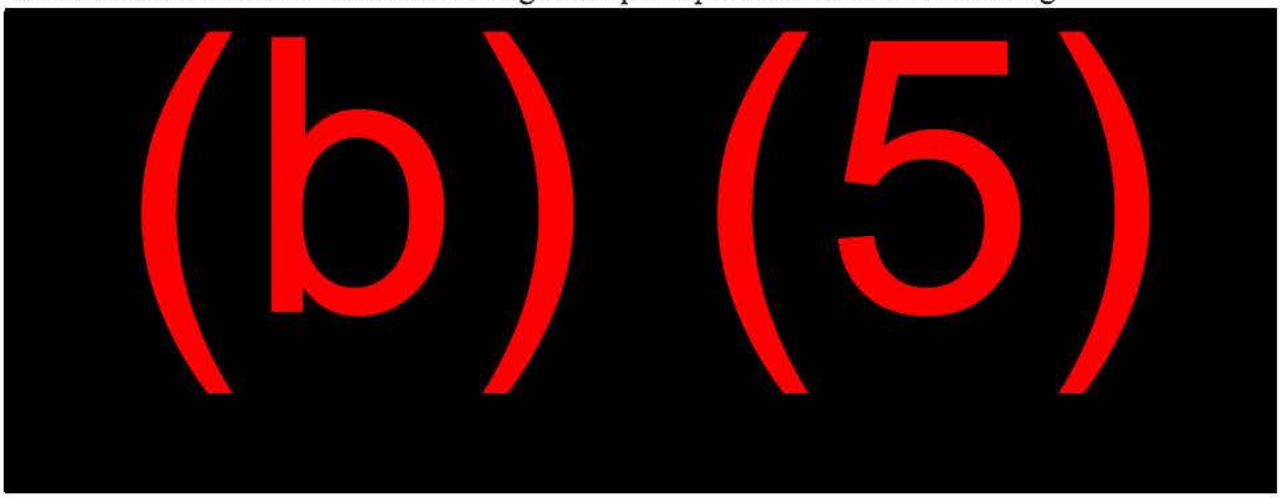
Reply to Attn of: OX-12-049

Mr. Bernardo Patti
Head, ISS Programme and Exploration Department
European Space Agency, ESTEC (HSO-I)
Keplerlaan 1
2200-AG Noordwijk
THE NETHERLANDS

Dear Mr. Patti:

I wanted to fill you in on recent discussions and planning concerning End of Life (EOL) disposition of the International Space Station (ISS). Although this event will likely not occur for many years, it is necessary to have a plan in place for how this would be handled, from policy, programmatic and technical points of view, for both nominal and contingency cases. NASA and Roscosmos will have to perform the actual EOL activities when they are necessary, and have begun exchanging ideas on de-orbit strategies. It is our intention to keep all Partners informed and involved in this process, leading up to the multilateral adoption of a technical de-orbit plan by the Program.

The ISS Intergovernmental Agreement and the Memorandum of Understanding do not specifically address responsibilities for performing EOL activities. While NASA and Roscosmos will perform most of the activities, we believe that the safe disposition of the ISS, both in orbit and on the ground, is a shared responsibility. Policy aspects will need to be addressed via agreement in the Multilateral Coordination Board (MCB). We anticipate that a directive from the MCB would contain general principles similar to the following:



Please have your designated lead for discussing the principles for the MCB directive contact Mr. Dan Jacobs of the ISS Program to begin those talks. I look forward to seeing you in Moscow and will be able to discuss this approach in more detail then.

Sincerely,

Michael T. Suffredini
Manager, International Space Station Program

cc:
OT/ESA Houston Liaison Office
Roscosmos/A. Krasnov

Identical letter to:

Mr. Tetsuro Yokoyama
Program Manager
International Space Station Program
Human Space Systems and Utilization Mission Directorate
Japan Aerospace Exploration Agency
2-1-1 Sengen
Tsukuba, Ibaraki 305-8505
JAPAN

Mr. Pierre Jean
Director, Operations Engineering and Program Manager
Canadian Space Station Program
Canadian Space Agency
6767 Route de L'Aeroport
Saint-Hubert, Quebec J3Y 8Y9
CANADA

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

June 15, 2012

Reply to Attn of: OX-12-050

Mr. Tetsuro Yokoyama
Program Manager
International Space Station Program
Human Space Systems and Utilization Mission Directorate
Japan Aerospace Exploration Agency
2-1-1 Sengen
Tsukuba, Ibaraki 305-8505
JAPAN

Dear Mr. Yokoyama:

I wanted to fill you in on recent discussions and planning concerning End of Life (EOL) disposition of the International Space Station (ISS). Although this event will likely not occur for many years, it is necessary to have a plan in place for how this would be handled, from policy, programmatic and technical points of view, for both nominal and contingency cases. NASA and Roscosmos will have to perform the actual EOL activities when they are necessary, and have begun exchanging ideas on de-orbit strategies. It is our intention to keep all Partners informed and involved in this process, leading up to the multilateral adoption of a technical de-orbit plan by the Program.

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Sincerely,

Michael T. Suffredini
Manager, International Space Station Program

cc:
OS/JAXA Houston Liaison Office
Roscosmos/A. Krasnov

Identical letter to:

Mr. Bernardo Patti
Head, ISS Programme and Exploration Department
European Space Agency, ESTEC (HSO-I)
Keplerlaan 1
2200-AG Noordwijk
THE NETHERLANDS

Mr. Pierre Jean
Director, Operations Engineering and Program Manager
Canadian Space Station Program
Canadian Space Agency
6767 Route de L'Aeroport
Saint-Hubert, Quebec J3Y 8Y9
CANADA

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

May 10, 2016

Reply to Attn of: OM-16-012

Mr. Alexey A. Strelnikov
Director, Department of Human Space Programs
State Space Corporation "Roscosmos"
42 Schepkina Street
Moscow 107996
RUSSIA

Dear Mr. Strelnikov:

As you know, our respective International Space Station (ISS) End of Life (EOL) planning experts conducted a Technical Interchange Meeting (TIM) in Houston, TX, from April 24-28, 2016 and developed the enclosed "ISS EOL Deorbit Strategy and Contingency Action Plan" document, which contains forward work recommendations intended to provide capability for the ISS to successfully perform de-orbit operations.

(b) (5)
(b) (5) Our joint EOL strategy requires both (1) keeping adequate propellant quantities on-board ISS to perform deorbit operations and (2) ensuring that ISS hardware configuration and software are capable of performing the planned deorbit operations.

To maintain sufficient propellant in ISS tanks, we recommend (b) (5)

(b) (5)

Sincerely,

Kirk A. Shireman
Manager, International Space Station Program

Enclosure

cc:
OV/Roscosmos Houston Liaison Office
RSC-E/E. A. Mikrin

Ref: SO-335

25 June 2014

Mr. Michael T. Suffredini
Manager
International Space Station Program
National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058
USA

Subject: Update status of i-Ball for the International Space Station (ISS) End-of-Life (EoL) study

Dear Mr. Suffredini:

Since I received your letter OX-13-037, JAXA has been working closely with your team to prepare an i-Ball for ATV-5 re-entry data acquisition. As I talked to you in ESTEC, we are waiting for the ATV-5 re-entry trajectory to be set by July 22nd in support of the i-Ball mission parameter setting to meet the cargo delivery date for SpaceX-5. (b) (5)

(b) (5)

(b) (5)

I appreciate your continuous support and look forward to a very successful campaign on ATV-5.

Sincerely,

M. Miyake

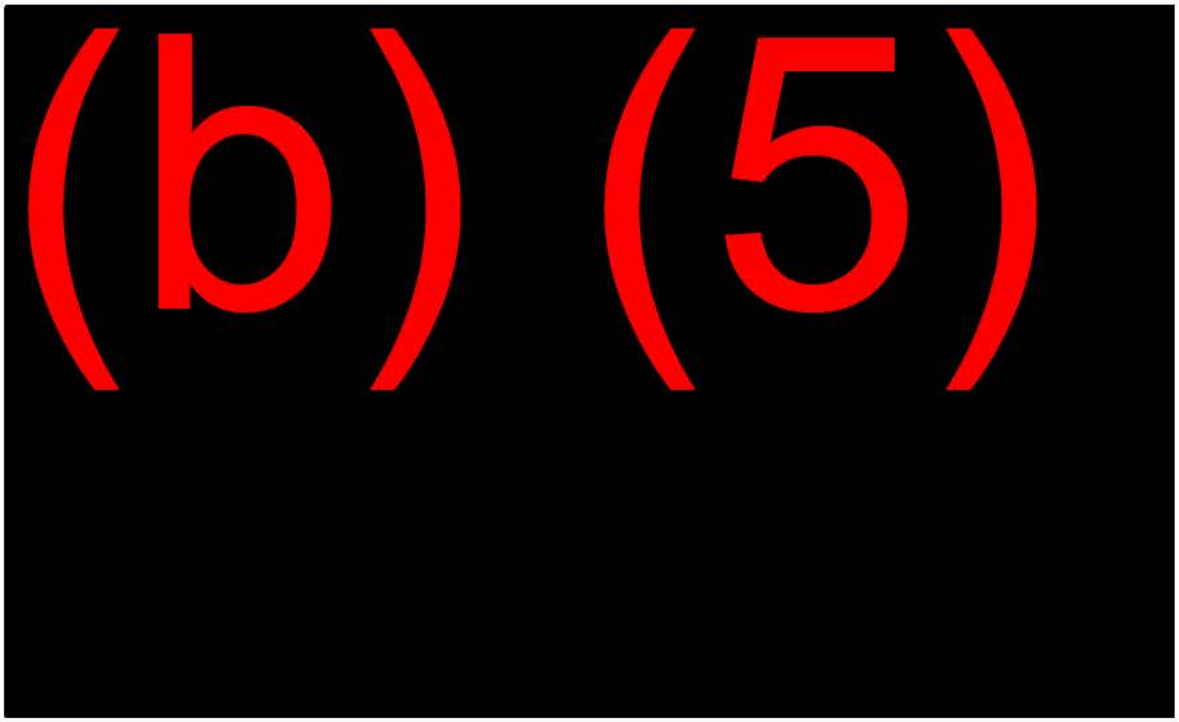
Masazumi Miyake
Manager, JAXA International Space Station Program

CC:
Mr. Jeffrey J. Arend, Manager, JSC-OM, NASA
Mr. John Bacon, JSC-OM, NASA
Mr. Junichi Sakai, Director, JAXA Houston Office

Japan Aerospace Exploration Agency
2-1-1 Sengen, Tsukuba-shi, Ibaraki-ken, 305-8505 Japan

ISS DE-ORBIT FORWARD PLAN
NASA/ROSCOSMOS ISS PROGRAM MANAGER PROTOCOL

NASA and Roscosmos agree to jointly develop contingency ISS deorbit plan (which shall enable the development and adoption of a nominal deorbit plan) to be adopted by all partner agencies (including their commitment to support it) as soon as practically possible. The parties shall:



As new work is identified the Program Managers will amend this protocol.

Michael T. Suffredini 8/4/2014

9.04.2014

Alexei B. Krasnov

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

March 13, 2012

Reply to Attn of: OM-12-011

Mr. Alexey Krasnov
Director of Piloted Space Programs Department
Federal Space Agency
42 Schepkina Street
Moscow 107996
RUSSIA

Dear Mr. Krasnov:

We wish to ask your support of three specific technical development proposals within RSC-Energia, related to our joint International Space Station Exploration Working Group Team 1 work for the International Space Station (ISS) End-of-Life (EOL) planning.

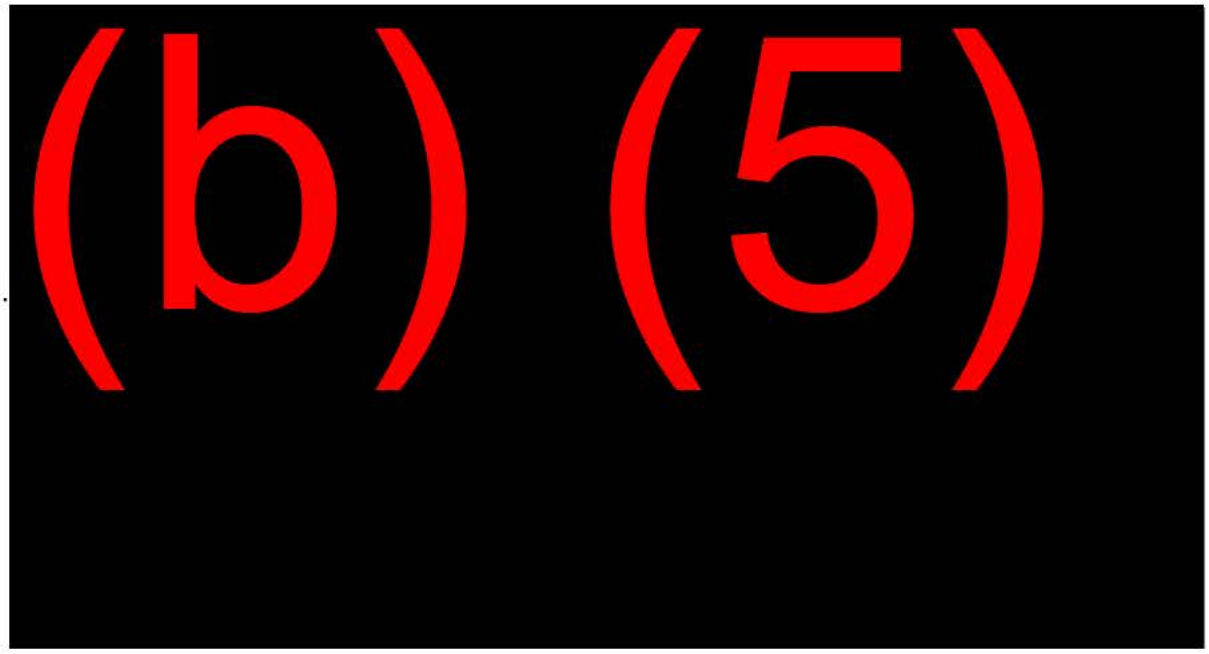
Our Team 1 technical specialists in Russia and the United States have made a joint recommendation regarding the EOL operations during their recent Technical Interchange Meeting held on February 13-17, 2012. Their recommendation to use (b) (5)

(b) (5)

To achieve the new plan, we request your authorization to RSC-Energia to conduct these three activities:

1. (b) (5)

2.

3. 

With your timely approval, the Team can still meet the two month timeframe to define the necessary SM software modifications in support of the SM 8.07 update. With that, a schedule to complete the software and SM plume analysis by December 2012 and flight tests by Summer 2013 will allow the program to immediately baseline a vastly safer and more reliable re-entry plan than we have had to date.

Sincerely,

Michael T. Suffredini
Manager, International Space Station Program

cc:
OV/Roscosmos Houston Liaison Office
RSC-E/V. A. Soloviev