

Dexterous Execution of RRM on ISS

Satellite Servicing Workshop

Goddard Space Flight Center

P. Andrew Keenan

Canadian Space Agency

24May2012



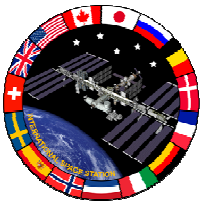
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MSS and GSFC's RRM



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Canadian Space Robotics Today

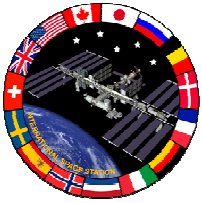


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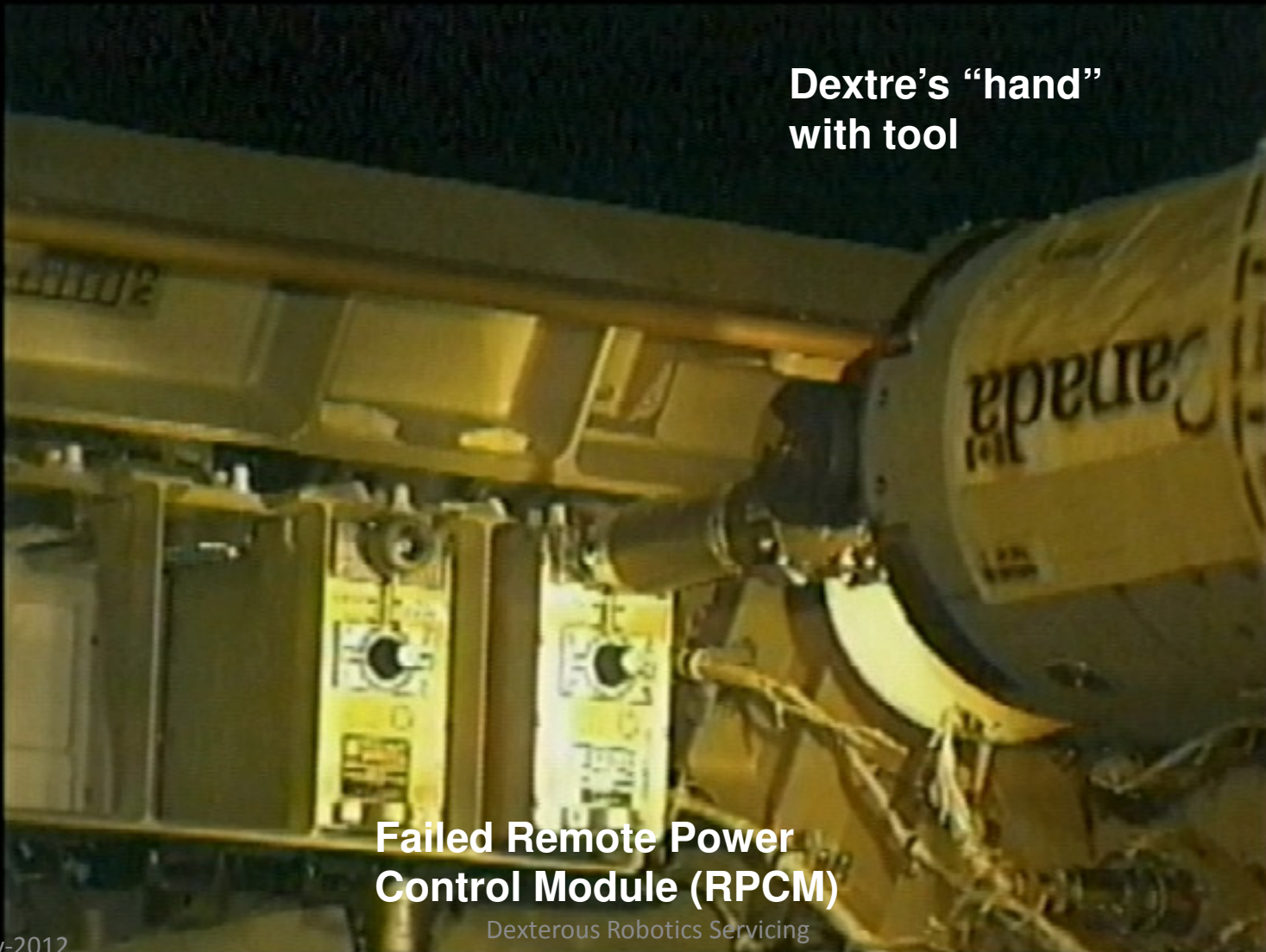
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ISS027E006921

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External Maintenance and Dextre

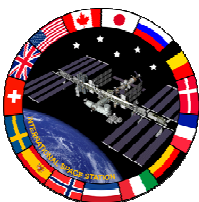


Dextre's "hand"
with tool

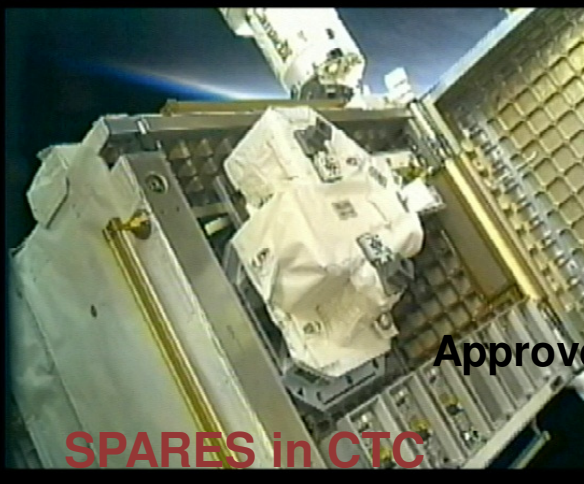
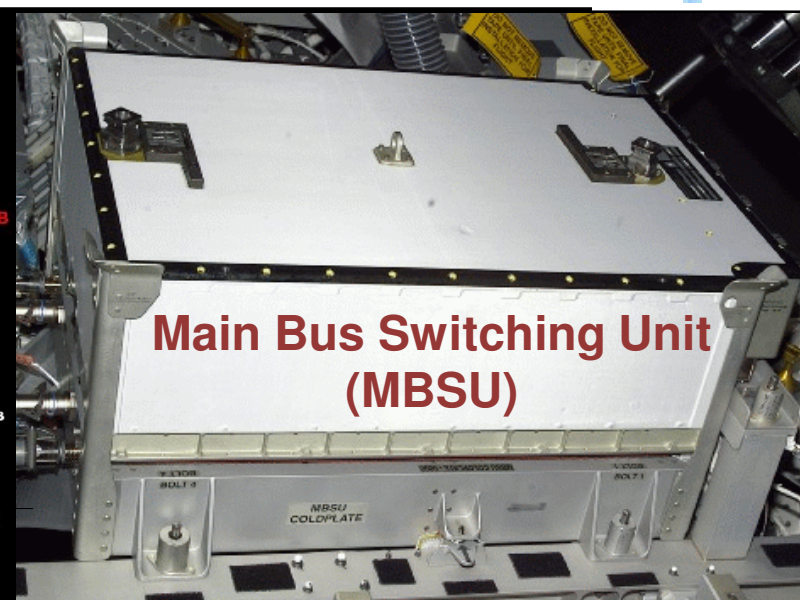
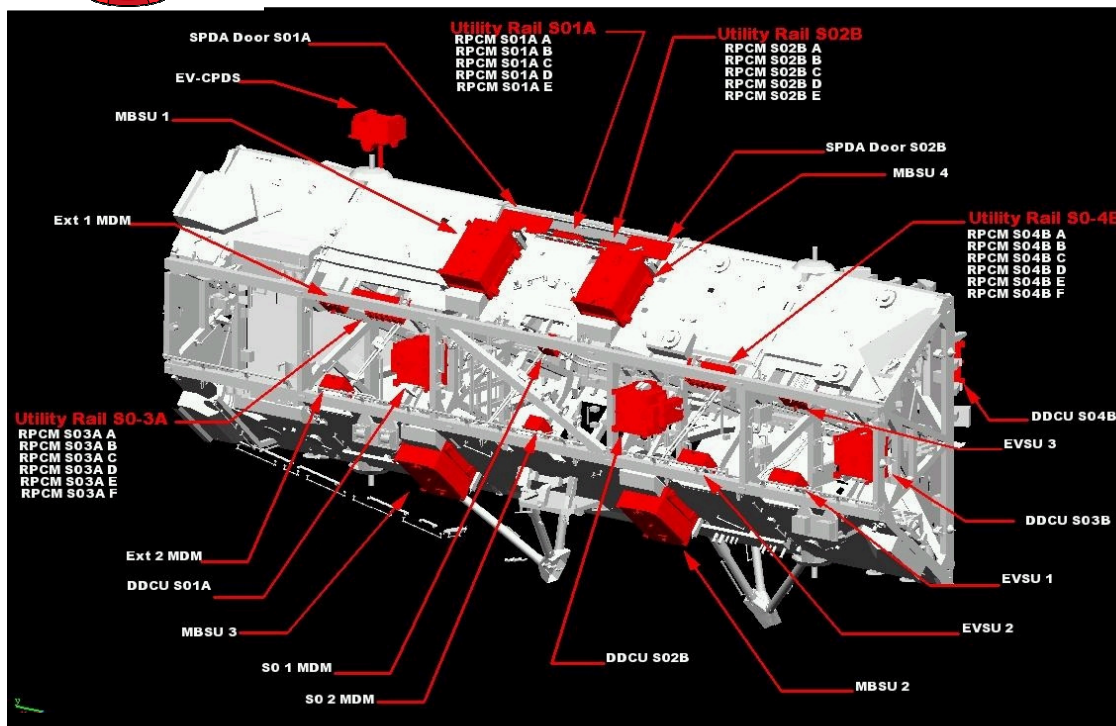
Failed Remote Power
Control Module (RPCM)

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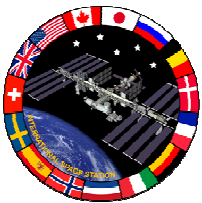
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Maintenance Task List



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Ground Control and MSS





RRM Overview



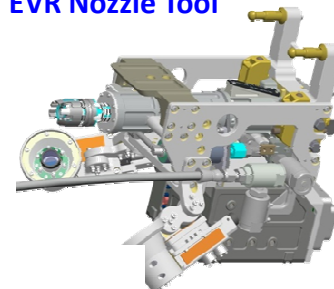
Each RRM Tool has cameras designed to maximize situation awareness for the ground operators

Dextre provides camera power and supports video transfer to ground

Safety Cap Tool

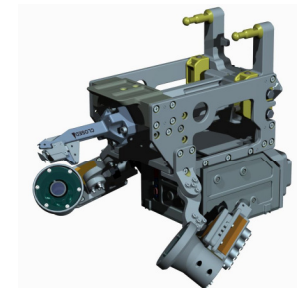


EVR Nozzle Tool

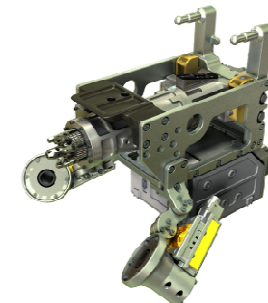


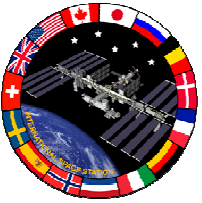
**Imagery
courtesy
NASA/GSFC**

MLI/Wire Cutter Tool



Multi-Function Tool



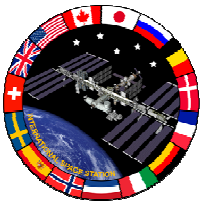


RRM Delivery to ISS on Atlantis

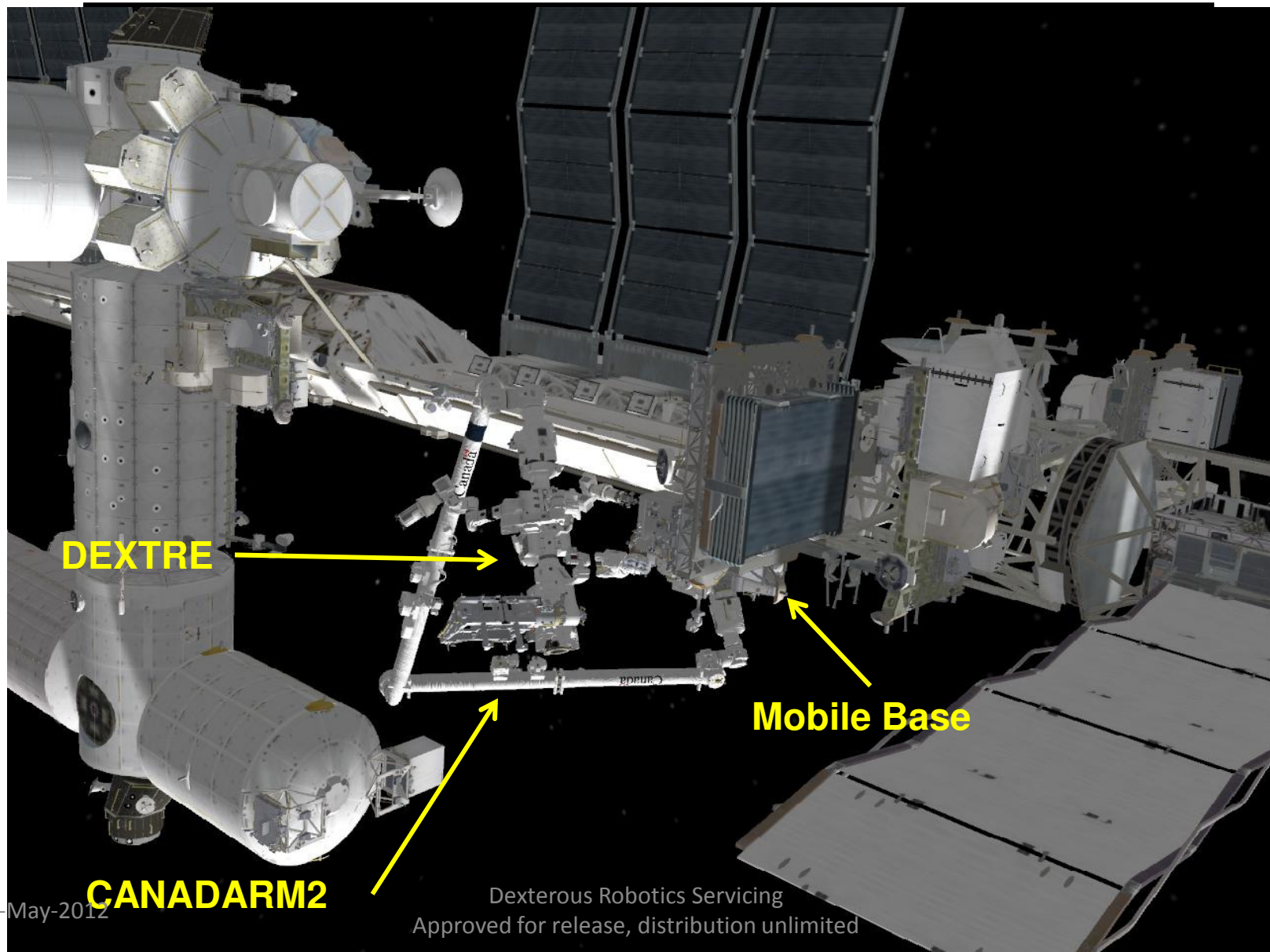


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ISS Landscape



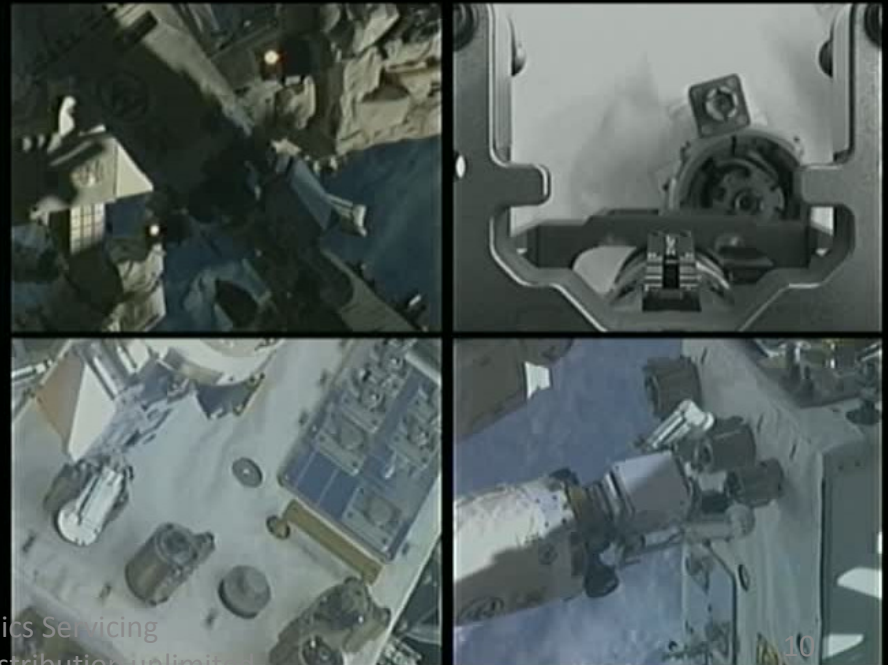
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RRM Readiness & Challenges

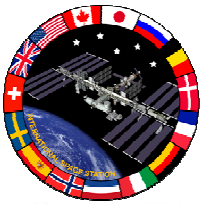


- ❑ Required positional and trajectory accuracy requirements exceed normal dexterous operational requirements
 - $\pm 6\text{mm}$ \rightarrow $\pm 2\text{mm}$ or less
 - $\pm 1\text{deg}$ \rightarrow $\pm 0.5\text{deg}$ or less
- ❑ ISS H/W is designed or “prepared” for dexterous manipulation whereas existing satellites are “unprepared”



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Mission Overview

Coolant Valve Manipulation

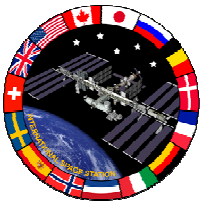


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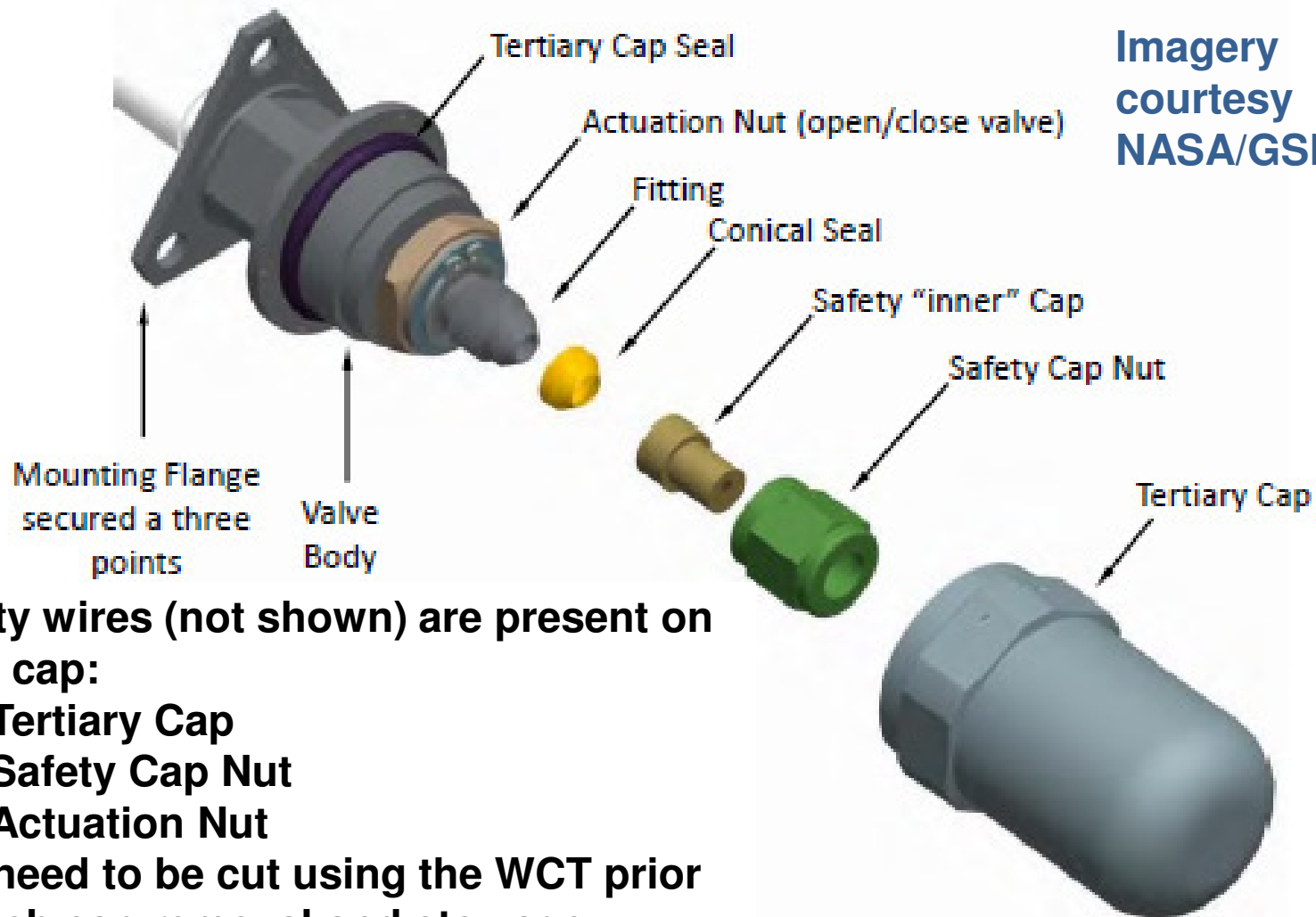


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Mission Overview

Refuelling



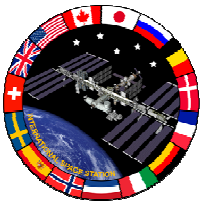
Safety wires (not shown) are present on each cap:

Tertiary Cap

Safety Cap Nut

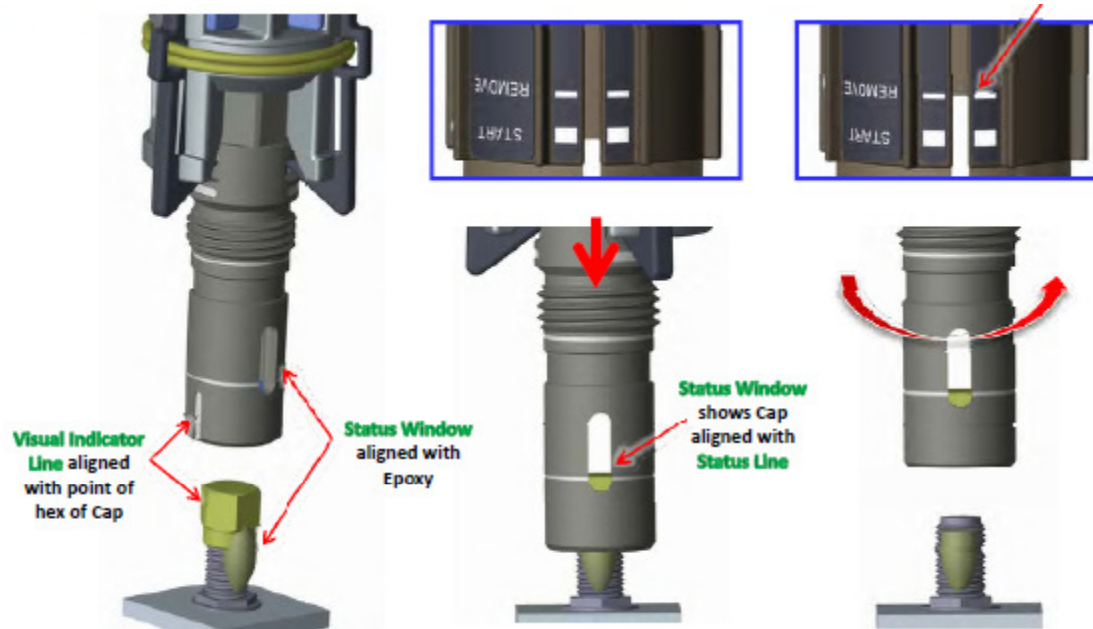
Actuation Nut

and need to be cut using the WCT prior to each cap removal and stowage



Mission Overview

Electrical Connection Access

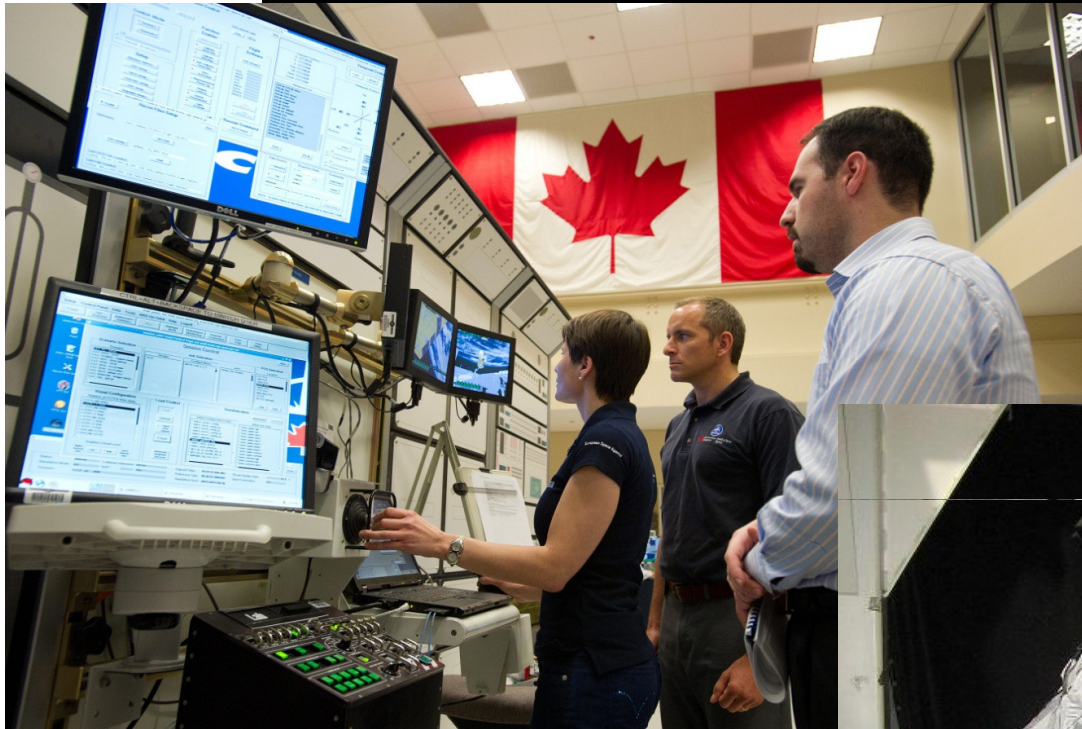


Imagery
courtesy
NASA/GSFC





CSA Involvement with RRM



Astronauts Samantha Cristoforetti (ESA) and David Saint-Jacques (CSA) with CSA robotics trainer Daniel Katzman in the MSS Operations and Training Simulator (MOTS)

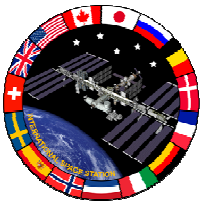
MacDonal Dettwiller & Associate's (MDA's) Ground Testbed (GT) simulator for Dextrous robotics in Brampton, Ontario – used to perform operational tests with RRM hardware



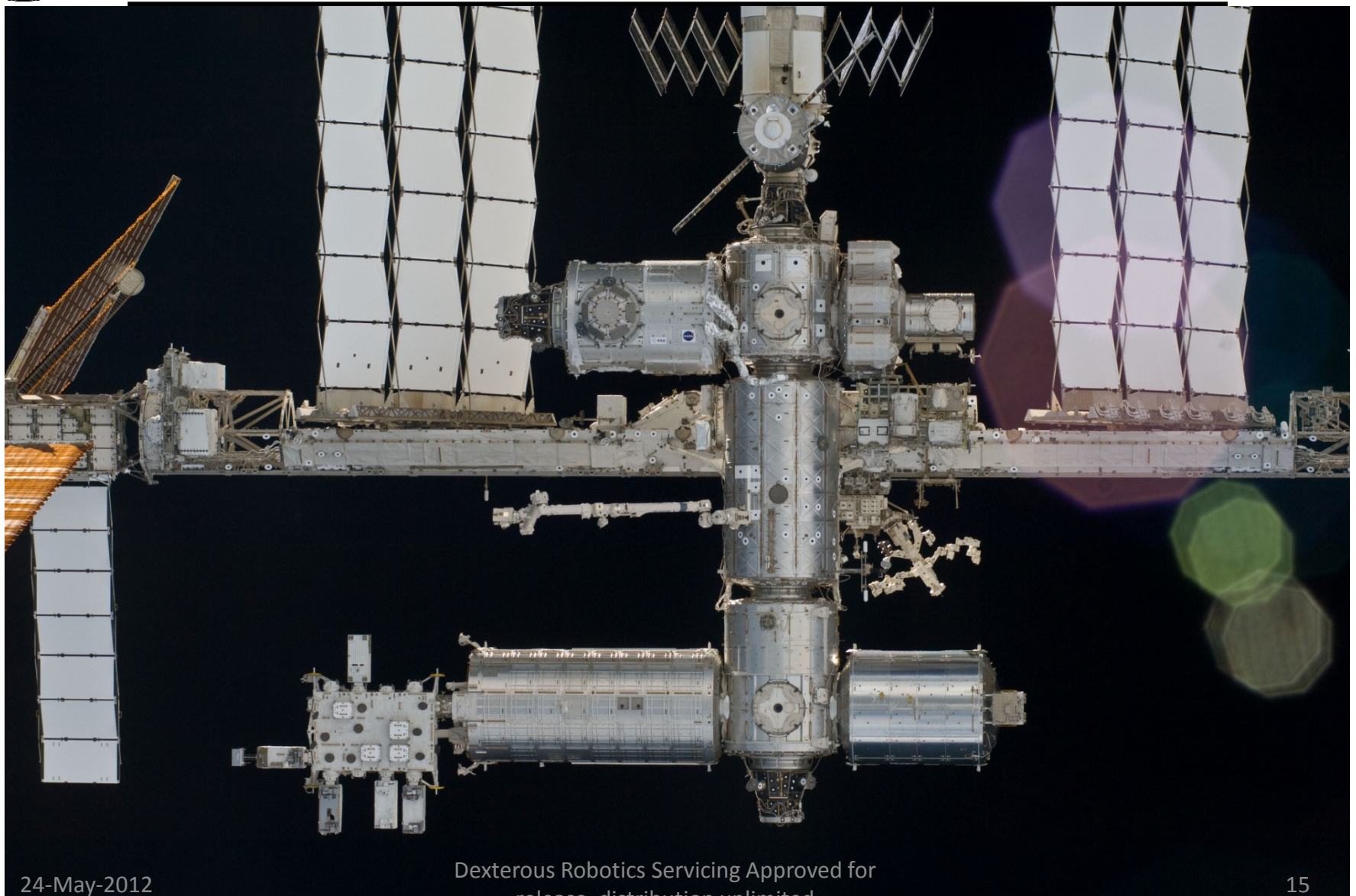
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MSS at Work



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