International Space Station:

Payload Processing and Services

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Acronyms

ISS	International Space Station
ISSP	International Space Station Program
SSPF	Space Station Processing Facility
OPF	Orbiter Processing Facility
NASA	National Aeronautics and Space Administration
ICD	Interface Control Document
CAD	Computer Aided Drawing
PDGF	Power Data Grappling Fixture
MBSU	Main Bus Switching Unit
SASA	S-band Antenna Support Assembly
JSC	Johnson Space Center
KSC	Kennedy Space Center
OMSRD	Operations and Maintenance Requirements and Specifications Document
LSSP	Launch Site Support Plan
LP	Launch Package
JEM-PM	Japanese Experiment Module – Pressurized Module
JEM-ELM-PS	Japanese Experiment Module – Pressurized Section

The International Space Station (ISS), the most complex international scientific endeavor in history, is an unprecedented project pushing forth support for the Vision for Space Exploration set out by President George W. Bush in 2004. The ISS has proven to provide valuable scientific research and breakthroughs. It continues to serve as a leading facility for the advancements in technology related to areas such as the development of medical practices and procedures for future long term human space travel, and new material and engineering technological solutions in support of exploration. [1]

Working as a Boeing Intern and a part of the International Space Station Program (ISSP), has proven to be a demanding task that encompasses a variety of scientific and engineering areas needed to ensure that such a great venture is completed in a safe, effective way.

Boeing serves as NASA's prime contractor responsible for the design and engineering of all United States built elements of the ISS. Upon completion, the U.S. elements in orbit on the space station will include three connecting modules, or nodes, a laboratory module, truss segments, four solar array modules, three mating adapters, a cupola viewing window module, and an upressurized logistics carrier. [2]

Boeing also processes ISS elements provide by the international partners that are making this dream a reality. International partner components to date include: a Canadian-built robotic arm and mobile servicing system used for on orbit assembly and maintenance tasks on the space station, a pressurized European laboratory called Columbus and logistics transport vehicles, a Japanese laboratory Module with an attached

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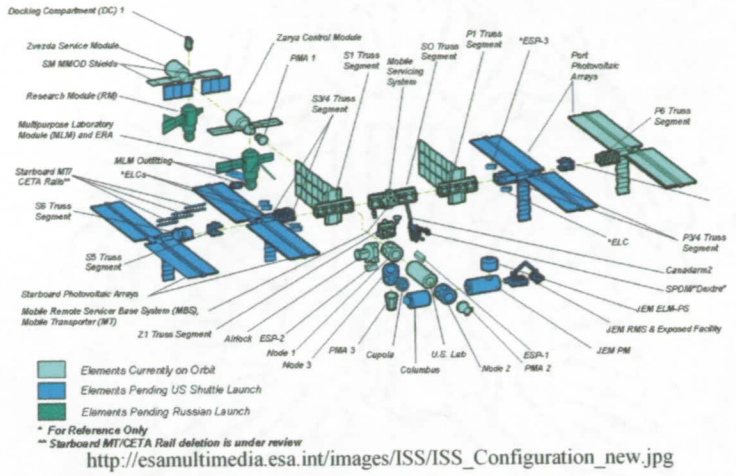
[1] Space Station Science Expedition Eleven Overview Fact Sheet. Ed. Brooke Boen. March 17, 2007. NASA/Marshall Space Center. 25 Feb. http://www.nasa.gov/centers/marshall/news/background/facts/exp11fact.html.

[2] Space Exploration: ISS Background. Ed. Ed Memi and Tanya Deason-Sharp. Nov. 2006. Boeing/Comm.Affairs. http://www.boeing.com/defense-space/space/spacestation/docs/ISS_overview.pdf

exposed exterior platform for experiments, and two Russian research modules. Other systems Boeing develops and implements include thermal control, life support, guidance, power systems. [3]

Figure 1- ISS Components



http://esamultimedia.esa.int/images/ISS/ISS_Configuration_new.jpg

Before making it to their final resting stop on orbit, all of the ISS components make their way through the Space Station Processing Facility (SSPF) at Kennedy Space Center where Boeing workers spends months on end physically integrating all experiments, flight hardware, and other payloads needed to prepare the elements for launch into orbit.

Once flight hardware has satisfied all testing requirements, Boeing transports the payload to either the Orbiter Processing Facility (OPF) or the Launch Pad in a large payload canister. This payload canister has an interior identical in size and dimensions to the Orbiter's payload bay. The payload can be installed horizontally at the OPF or vertically at the Launch pad using the pad's Rotating Service Structure.

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[3] Space Exploration: ISS Background. Ed. Ed Memi and Tanya Deason-Sharp. Nov. 2006. Boeing/Comm.Affairs. http://www.boeing.com/defense-space/space/spacestation/docs/ISS_overview.pdf

Further establishing its commitment to President Bush's Vision, NASA has vowed to complete the International Space Station and retire the Space Shuttle fleet in 2010 to allow for the development and integration of the future Constellation program that will take Man back to the Moon and on to Mars.

As a Boeing intern working under Mission Operations and Payload Services in the SSPF, it was normal for a daily work schedule to include organizing and participating in ICD walk-downs of ISS components such as the PDGF, MBSU, and SASA side wall-carriers being launched along with the Node-2 U.S. module on STS-120. ICD walk-downs entail a thorough quality inspection of flight hardware components by both JSC and KSC NASA representatives to ensure that elements conform to all engineering specifications according to ICD/CAD models prior to installation in the Orbiter.[4] The installation of the Harmony Node 2 module will increase the living and working space onboard the ISS and allow for the addition of international laboratories from Europe and Japan.

There was also a need to constantly update a database of both opened and closed processing requirements needed to be completed before an ISS component is certified for final hatch closure and departure from the SSPF. These requirements are namely derived from the Operations and Maintenance Requirements and Specifications Document (OMRSD). This document is the single authoritative source for non-drawing organizational level operations, maintenance, data and analysis requirements and

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[4] Randall, Maria. "Columbus Ground Processing TIM#5." PowerPoint presentation. Slides: 2, 4. Kennedy Space Center, Fl. 8 November 2005.

specifications that are necessary to maintain and verify hardware for flight and operational readiness. [5]

There is enormous risk involved in sending the space shuttle, the most complex machine ever built by humankind, into orbit. As a result, Boeing accounts for every single tool and item that makes its way in and out of either the Orbiter or any of the ISS components to ensure proper processing and protection from contamination or damage. Further projects completed through the duration of the internship included creating and presenting reports on any misplaced or lost items that failed to make its way out of the Orbiter or ISS component. These reports gave a detailed description of the missing item, the location where it was lost, the location it is thought to be, any investigations or searches related to the item, and any concerns NASA or Boeing think may pose a risk to payload or flight safety.

Another major project completed through the summer involved the integral relationships and agreements formed between NASA and its customers needed to successfully launch and deploy all ISS payloads. The Launch site Support Plan (LSSP), developed by JSC, serves as the primary agreement between KSC and the ISS customer for ground processing for a launch package (LP). This document outlines for KSC ground processing services for the ISS elements as submitted by the customer and details KSC's commitment to support ground processing. The LSSP addresses the launch package coordination/planning prior to hardware arrival at the SSPF, transportation on site, pre-Shuttle Integration activities as KSC beginning at hardware arrival, LP physical integration, and post landing activities for both KSC and non-KSC landings. The LSSP

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[5] "Space Shuttle: Operations and Maintenance Requirements and Specifications Document: File 1: Intro to OMRSD." 22 March, 2007. Page: 15.
http://kscgrndtsk1/rs-bin/RightSite.dll/getcontent/Tempfile?DMW_OBJECTID=090024e1826674f5&DMW_FORMAT=pdf

documents the planning and commitments for KSC to fulfill the ground processing requirements for the particular LP and mission.

A similar document, the KSC Off-Site Operation Plan, was created during the internship for the Node 2, Columbus, JEM-PM, and JEM-ELM-PS ISS elements and their respected Shuttle missions. These documents are developed to address operational requirements for payload elements to be launched on a specific mission. Requirements outlined are applicable for contingency locations within the Continental United States (CONUS) or at designated non-Continental United States (Non-CONUS) locations. The Off-Site Operation Plan serves as a source for mission-specific guidelines for support of off-site landing payload operations, planning activities and post-landing operations performed by KSC and NASA contractors. Certain requirements, for example, call for post landing purges performed to cleanse and rid the Orbiter payload bay of moisture and provide guidelines for accessing the Return Complement after landing to remove any hazardous or sensitive equipment and payloads. Special support responsibilities or services required for a mission also appear in the document for the access, preparation and transportation of any post flight Return Complement (RC) payloads from a contingency landing site to the KSC launch site via an airline ferry flight.

As the duration of the internship with Boeing came to a close, it was apparent that working within the International Space Station Program through NASA was a demanding, detailed task that required tremendous precautions to ensure the readiness and safety of all flight hardware. This is needed to make sure every Boeing processed ISS element is effectively launched on each mission.