BOEING

Backgrounder

Integrated Defense Systems
P.O. Box 516
St. Louis, MO 63166
www.boeing.com

Boeing provides expertise in Hubble payload integration, processing

Boeing engineers Steve Sperry, Chrissy Hofrichter and Glenn Glassford meet with NASA Goddard Space Flight Center team members to evaluate the outer envelope of the Flight Support System (FSS) carrier. The engineers were looking for differences between the latest engineering models and the actual hardware. Boeing Engineers ensure that Hubble components and carriers do not make hard contact with orbiter hardware in the payload bay during launch.

Surgical operating rooms, advanced microprocessor manufacturing facilities and the processing facilities for the Hubble Space Telescope all share a common characteristic – they are conducted in "ultra-clean" rooms that avoid the introduction of contaminants that could fog a camera lens or harm its delicate electronics.

Processing the Hubble Space Telescope (HST) components for launch in such an environment is just one of the many challenges Boeing engineers and technicians face as they prepare Space Shuttle Atlantis for NASA's final Hubble servicing mission in May. Boeing engineers and technicians provide the engineering analysis and support for the complex payload.

"This is probably the most challenging payload that I have worked on and it is much different than a space

station payload," said David Thompson, a Boeing payload lead engineer. He has worked with NASA on the types of power, cooling and data interfaces needed for the Hubble mission. "Hubble has had such a profound impact on the scientific community that it is neat to be a part of it."

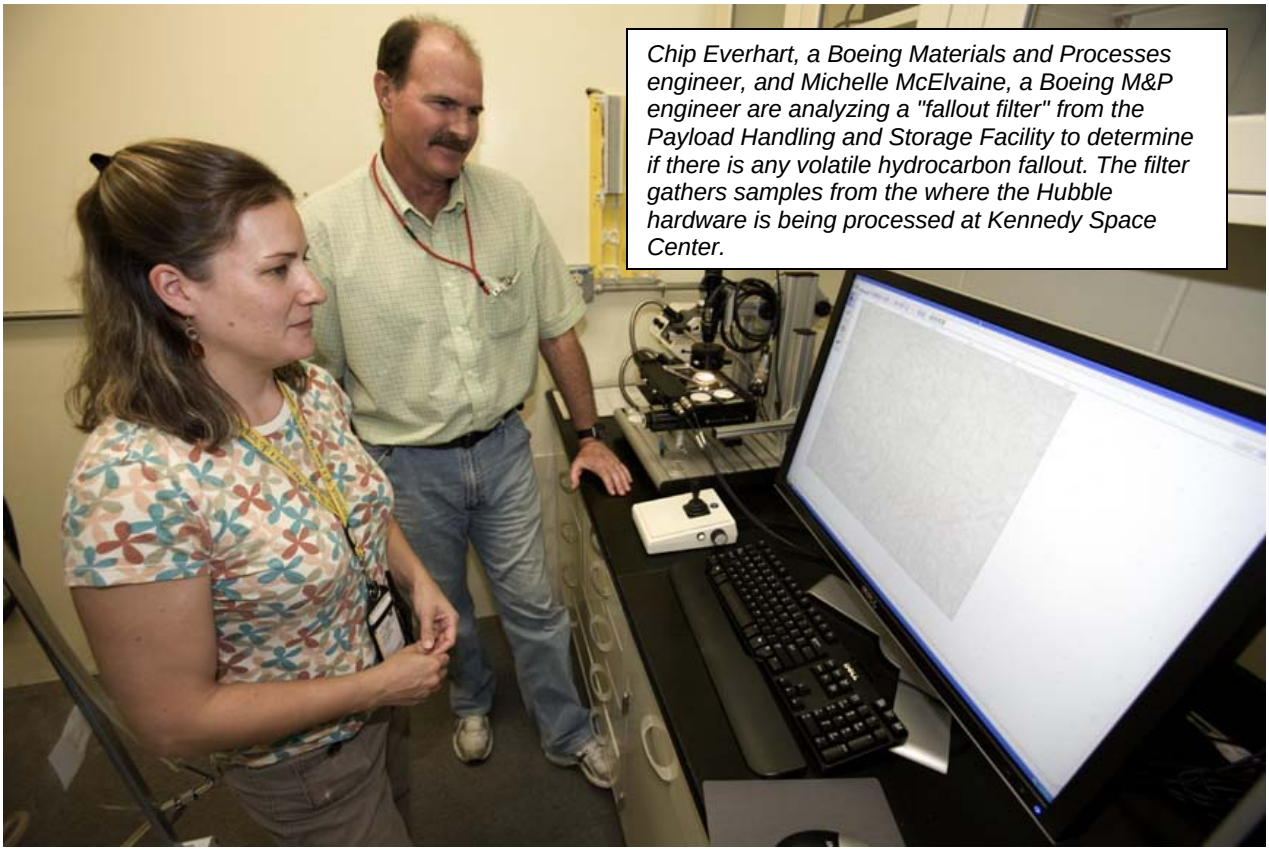
Thompson and his fellow Boeing engineers and technicians working on the Hubble servicing payload feel a real connection to one of NASA's most successful scientific missions ever. As the primary payload integrator, Boeing provides the engineering analysis and support for this complex payload.

"Before the payload even arrived, we worked closely with NASA Goddard and arranged for the requirements that they would need while they were down here, from facility cleanliness to required support stands, cranes and forklifts," said Ed Baglioni, Boeing HST flow manager.

One of the first areas that Boeing engineers take on is planning for the purge, electrical, mechanical and data interfaces between the orbiter and the Hubble payload. This connection will be the lifeblood of Hubble while astronauts switch out and upgrade necessary components of the telescope. "Those lines have to be verified for communications downlinks, software and telemetry commands because once they get on orbit and the Hubble is mated to shuttle, and then all the transmissions between the Hubble and ground are done through the orbiter," said Baglioni.

Before Hubble is ever mated to shuttle, Boeing engineers design exactly how the necessary equipment needed for the mission will go into the payload bay.

"Integration-wise, Boeing conducts the engineering reviews and once the drawings are released, United Space Alliance Ground Ops begin their work in configuring the orbiter for this mission," said Charlene Miller, Boeing STS-125 lead engineer. "We ensure



Chip Everhart, a Boeing Materials and Processes engineer, and Michelle McElvaine, a Boeing M&P engineer are analyzing a "fallout filter" from the Payload Handling and Storage Facility to determine if there is any volatile hydrocarbon fallout. The filter gathers samples from the where the Hubble hardware is being processed at Kennedy Space Center.

USA Ground Operations implements the engineering correctly and when problems arise … we help resolve them."

Imagine installing electrical wires snaking throughout your home, but leaving enough room to make sure you don't trip. The Boeing engineers integrating the Hubble servicing payload faced a similar challenge. "In the case of this unique flight, we do not use the same wiring as on a Station mission and it all had to come out. It presented a new host of problems for the technicians in getting everything routed properly," Miller said.

Roger Belew, Boeing technician, is holding an air sampling tank checking for volatile hydrocarbon levels in the Payload Handling and Storage Facility where the Hubble hardware is being processed at Kennedy Space Center.

The Hubble payload consists of four major elements. The composite Superlight Weight Interchangeable Carrier (SLIC), flying for the first time, holds the Wide Field Camera 3 instrument and two replacement battery modules. The Orbital Replacement Unit Carrier (ORCU) will carry the Cosmic Origins Spectrograph, Rate Sensor Units (RSU) and the Fine Guidance Sensor. The RSUs contain the six-replacement rate gyroscopes which, in conjunction with the FGS, help to keep Hubble pointed in the right direction. An IMAX camera, mounted on the ORCU, will give others a view of the servicing mission. The Flight Support System (FSS) will hold the Hubble telescope; the FSS Berthing and Positioning System rotates and pivots, allowing astronauts easier access while making repairs. A Soft Capture and Rendezvous System, carried on the FSS, installs at the base of Hubble to facilitate autonomous rendezvous and capture of Hubble on a future mission to dispose of the telescope at the end of its useful service life. The final element is the Multiuse Lightweight Equipment Carrier (MULE) which will bring up new thermal blankets and navigation sensors.

Boeing is responsible for the methods and steps for loading all four elements into the payload canister. The payload is then rotated from a horizontal

to vertical position before going out to the launch pad. The canister is transferred to the Payload Changeout Room (PCR) where the canister doors and payload doors are opened and an apparatus called the Payload Ground Handling Mechanism transfers the HST carriers into the orbiter.

Glen Glassford, Boeing cargo structural design engineer, ensured the Hubble carriers would have sufficient clearance and would not contact any orbiter surfaces. "We load the NASA Goddard payload models into our Orbiter payload bay model to ensure the clearance is adequate based on the requirements," Glassford said.

Once on the launch pad, Boeing engineers ensure a positive airflow balance, called a purge, is maintained that establishes a protective environment around the sensitive Hubble instruments. The airflow is away from the instruments instead of drawing it into the payload bay, similar to how a ceiling fan redirects airflow in your home.

"Our goal is to protect and maintain the integrity of the Hubble flight hardware from airborne particulate and molecular contamination," said Chip Everhart, a Boeing Materials and Processes engineer. Besides implementing strict gowning, personnel training, and monitoring requirements to enter a Hubble processing facility much like a doctor preps before entering the operating room, Everhart ensures operations around the rest of Kennedy Space Center do not create conditions that could cause problems. Restrictions on local controlled burns, insecticide and herbicide spraying, soil excavation or even cutting the lawn are imposed two weeks prior to the payload arriving at the processing facility and transfer to the launch pad. Keeping these contaminants out could mean the difference between success and failure. "Besides airborne particulates, we're most concerned with hydrocarbons and non-volatile residue comparable to the film that forms on the inside of a new car's windshield."

Another step to ensure a clean environment for the Hubble payload is installing brand new liners in space shuttle Atlantis. After cleaning the liners, an inspection using ultraviolet lights is done several times before and after rollout to the launch pad. Everhart will do the final walk down of the payload as a member of the decontamination team.

Besides keeping everything clean, engineers have kept the Hubble replacement batteries charged and conditioned. "We will give the batteries a final charge about three days before launch, which is down to the last minute before door closure," said Baglioni.

An intricate process completed by some of Boeing's finest in support of NASA and scientists around the world trying to unlock some of the mysteries of our universe.

Contacts:

Edmund G. Memi
Boeing Space Exploration
(281) 226-4029
edmund.g.memi@boeing.com

Susan Wells
Boeing Space Exploration
(321) 264-8580
susan.h.wells@boeing.com