Space Systems Company–Michoud Operations

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Mission Success Bulletin

January 29, 2009
Volume 29, Number 1

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First launch of year includes Friction Stir Welded ET-134

Launch at 3:39 a.m. Central on February 7

The STS-119 crew participates in the January 23rd Terminal Countdown Demonstration Test activities rehearsal for their upcoming launch.

Friction Stir Welding joins two barrel panels using friction and applied pressure.

When Commander **George Zamka** and his five STS-130 crew members lift off on Super Bowl Sunday, they will be sitting atop ET-134, which features both the first Liquid Hydrogen (LH2) Tank and the first Liquid Oxygen (LO2) Tank with barrel panels joined longitudinally using Friction Stir Welding. ET-132 flew last August, and two of its LH2 barrels incorporated Friction Stir Welding, but ET-134 will be the first flight of a human-rated launch vehicle with all barrels joined using the superior welding technique.

Previously, LH2 tank barrels have been fabricated using traditional fusion welding. Friction Stir Welding is different in that the materials are not melted. A rotating pin tool uses friction and applied pressure to plasticize the metal and join the LH2 longitudinal barrel panels together.

The process results in welds with increased tensile strength and fracture toughness. Weld joints are more efficient, yielding 80 percent of base material strength. Friction Stir Welding was implemented as part of the shuttle upgrades initiative in 2000 to improve robustness and productability.

Both the LH2 barrels and singular LO2 barrel are longer on the ET Friction Stir Welding tools (Tool 8 and Tool 9). Also, ET-134 is the first flight hardware to use Aluminum-Lithium 2297 thrust panels on the Intertank rather than 2219 aluminum. Thrust panels are directly adjacent to and support the Solid Rocket Booster attach points on the Intertank.

Michoud employees delivered ET-134 on October 14. In December, the tank mated with its two Solid Rocket Booster and Orbiter *Endeavour*, and then rolled to the pad January 6. *Endeavour's* STS-130 flight will be the first of five scheduled this year to close out the Space Shuttle program. Joining Commander Zamka on the 13-day mission will be pilot **Terry Virts** and mission specialists **Robert Behnken**, **Kay Hire**, **Nicholas Patrick** and **Steve Robinson**.

Endeavour and crew will deliver a third-connecting module, the Tranquility node, to the International Space Station. Tranquility will house crew racks, exercise equipment and science experiments. Other payload include the Cupola with seven windows that will be installed on the Tranquility node and serve as a control room for robotics and give astronauts much better views of the station.

STS-130 will also be the 130th shuttle mission. So far, Michoud workers have constructed 131 of the maximum 136 tanks, with three flight tanks (ET-136, ET-137 & ET-138) still to be delivered this year, along with a spare (ET-122).

ET Program Manager **Mark Bryant** says that five launches and four tank deliveries will keep employees busy. "I recognize it's unsettling with the program ending and layoffs taking place, but employees focus is key for us this year. We have plenty of work to do, and we want to do this work with the same amount of quality that we always instill. We also want to work safely with Process Excellence always in our minds. We've encountered many hurdles here at Michoud the past few years, and we've overcome each one. I'm confident we'll do that again this year. This will be our legacy for the shuttle and ET program."

Orion Manufacturing Team welcomes 2010 challenges

The *Orion* Michoud Manufacturing team begins the New Year with a full slate of program milestones and challenges. Their plan – meet them head on with continued enthusiasm and Operational Excellence.

The *Orion* Crew Module (CM) Ground Test Article (GTA) is four weeks away from taking its final shape. The team successfully completed 29 of 33 welds in ten months with first-time use of tools, weld processes and hardware. "It's been a complicated and expected learning curve," said **Mark McCloskey**, senior manager, Product Support Engineering, *Orion* Program. "What is important is this manufacturing pathfinder role is that the *Orion* Program learns and benefits from our GTA experiences."

Structural elements that comprise the CM GTA are undergoing the meticulous application of strain gauges in preparation for acceptance and development testing. A crew of Lockheed Martin test engineers from Michoud's Humanistic Technical Operations is on-site teaming with local test technicians intricately adhering sensors and wires to precise points on the structure. This activity is occurring on a non-interference basis concurrent with maturing CM-A production requirements.

Once the closeout weld is made and test covers are installed on the vehicle's crew modules, hatch and other openings, the GTA will be transported to Building 404A for a combined acceptance and development test. The building has a rich historical past in testing both *Apollo* and Space Shuttle structures, but was slated for demolition after sustaining heavy damage from Hurricane Katrina. Fortunately, with NASA and U.S. Army Corps of Engineers intervention, the structure has been restored to serve another human space program.

The CM GTA is termed a "risk reduction" vehicle that is "flight-like" but not identical to the flight design. Because of its similarities, successful analysis and data from the GTA will be applied to the final design to qualify the vehicle for flight. Failure to qualify the design is the risk. The test data will ensure a first role in the *Orion* Program Critical Design Review scheduled for March 2011.

Once wired to the intricate data acquisition system, the GTA will be gradually pressurized as a team of Lockheed Martin engineers and NASA *Orion* officials look on. Captured data is critical to engineers for comparison of their predictions to the stresses and strain that the vehicle will actually experience in flight. Test data will be the basis for the final vehicle design. The GTA will undergo Non-Destructive Evaluation on the welds after testing before acceptance is complete.

"The test team's goal is to assure that when the CM GTA leaves Michoud, that it will satisfy their needs," commented **Scott Marshall**, *Orion* Michoud test lead. "We are the beginning of the build. What happens next is equally as critical. We will deliver high quality pathfinder hardware in a short time, which makes for the most fascinating concurrent engineering project I have ever experienced."

The vehicle will return to the *Orion* Main Assembly area for the Assembly, Integration and Test (A&IT) phase. There, for the next three months additional gauges, 13 simulated subsystems, backshell panels and a heat shield will be installed on the GTA using newly-installed tooling. Simulated subsystems such as the control console, environmental control & life support, avionics, etc. will be used in place of actual flight hardware for the GTA to aid in various stages of design. The subsystems will mimic the actual design properties to assure that the CM GTA maintains the same weight and center of gravity as the final capsule. On future flight vehicles, installation of these 13 subsystems will occur at Kennedy Space Center. Additional instrumentation for future acoustical, vibratory and modal testing will also be installed during this time.

When A&T milestones are completed, the GTA will be transported on the NASA Super Guppy plane to the Reverberant Acoustical Laboratory (RAL) in Waterton, Colo. for acoustic testing and then to another lab on the Denver campus for modal testing.

"Operational Excellence and process improvement have been instrumental throughout the manufacturing process thus far," explained **Perry Morton**, *Orion* manufacturing engineer. "We started with a clean slate; we designed and built for efficiency. We think and operate lean, assessing our areas and processes through LM21 Lean Six Sigma methodologies to maximum efficiency. These improvements will continue to pay off as we begin work on other *Orion* elements."

Kory Reese, test engineer, Huntsville Technical Operations, applies strain gauges to the Orion CM GTA in preparation for upcoming data acquisition testing.

The team understands the significance of the Crew Module structure as it prepares to receive component milestones and the production horizon this year. A successful Production Readiness Review Dry Run took place January 20 & 21 for the Service Module (SM) GTA and Launch Abort System Fairing Assembly. The SM houses the life support elements for the *Orion* capsule – water, oxygen, etc. Various composite parts for the SM have been in development since last year in the National Center for Advanced Manufacturing at Michoud. The Launch Abort System Fairing Assembly (LASFA) GTA will also be manufactured at Michoud and delivered later this year.

In all, the *Orion* Program requires Michoud to build seven CMs, five SMs and seven LASFAs, with the potential for many more vehicles during the Schedule B Production phase of the program.

Michoud Operations to build *Ares I* instrument unit simulator

Earlier this month, Lockheed Martin received an operations directive to begin work on a simulator that replicates the behavior of the *Ares I* instrument unit containing avionics, control, data acquisition systems, located between the Upper Stage Simulator and the *Orion* Service Module.

"We put an estimate in for the work back in August, and it went through the Lockheed Martin and NASA approval loops," according to **Jeffrey Moore**, director, Engineering & Technology Laboratories. "Much of the credit for us having this opportunity goes to the Human Space Flight Line of Business for leveraging available capacity and capabilities at Michoud."

The cylindrical instrument unit is approximately 7 feet long, 18 feet in diameter and includes a representative Upper Stage forward dome that will be sprayed with BX-265 foam. "The timeline to complete the instrument unit simulator is April 2011,"

Graphic depicting how Ares I instrument unit simulator will be used in the Service Module Ground Test Article acoustic test

Graphic depicting Ares I instrument unit simulator's cylindrical shape and Upper Stage forward dome

explains **Richard Smith**, program Point of Contact. "It consists of an aluminum cylindrical shell and a fiberglass dome, and will be assembled at Michoud."

The simulator project requires Engineering support from the Design & Analysis, Systems Engineering, and Materials Science groups as well as from Production.

Once built, the unit will move to Denver or to the Plum Brook Facilities in Sandusky, Ohio, where it will be used to support the *Orion* Service Module Ground Test Article in tests to simulate launch acoustic behavior, as well as modal testing – shaking the test article to see what frequencies it responds to.

"This is a good, solid project for us to work on," says Mantto "It's not huge. But it will provide a handful of employees with challenging work well into 2011."

Three cited for safe work behavior

Williams winner for quarter

Reginald Williams

Joel Ascoin

George Powell

Congratulations to **Reginald Williams** for being named the overall "Doing It Safely." winner for 4th Quarter, 2009. **Joel Ascoin** and **George Powell** have also been named honorees for their safe work in the quarter.

The "Doing It Safely" program is designed to heighten safety awareness, encourage employee safety and reward employees for working safely. Lockheed Martin will continue recognizing employees for safe work this year.

Williams, a Thermal Protection Systems (TPS) equipment repairman, works in the gunroom in the Large Acreage TPS group. His co-workers say his dedication and teamwork to standing down the correct waste profile number of a chemical that was being utilized in the gunroom. Williams contacted Lockheed Martin Safety & Environmental personnel for help in identifying a waste profile number, thus allowing for the proper disposal of the chemical after it was spent.

Ascoin, the acting non-exempt group supervisor in Technology Laboratories, received the award for his research and implementation of a new Standard Test Method that will allow for the substitution of methods where no chemicals are used, thereby eliminating employee chemical exposures and hazardous waste generation.

Current lab operations mandate that technicians follow established American Society for Testing and Materials (ASTM) standards, requiring the use of acids and peroxides to digest composite materials. Ascoin conducted research into substitute ASTM methods that allow the use of a furnace for thermal degradation of the composite material. The furnace has been installed, and test trials are being conducted to confirm that the new standard can produce similar results to those of the previous methodology.

Powell, a finish painter, noticed a dent at the leak port end of the ET-138 Liquid Hydrogen Feedline during an inspection and quickly notified Quality Control and his supervisor. Because of Powell's conscientious actions, the damage has been documented on a Non-Conformance Document and investigated further.

ET Incentive Plan milestones

1.	4/25/08	Base Incentive
2.	5/31/08	STS-124 launch/land 6/14/08
3.	7/10/08	ET-127 delivery
4.	8/6/08	ET-129 delivery
5.	11/14/08	STS-126 launch/land 11/30/08
6.	11/19/08	ET-130 delivery
7.	2/14/09	ET-131 delivery
8.	3/15/09	STS-119 launch/land 3/28/09
9.	4/28/09	ET-132 delivery
10.	5/11/09	STS-125 launch/land 5/24/09
11.	7/15/09	STS-127 launch/land 7/31/09
12.	7/29/09	ET-133 delivery
13.	8/28/09	STS-128 launch/land 9/11/09
14.	10/14/09	ET-134 delivery
15.	11/16/09	STS-129 launch/land 11/27/09
16.	12/28/09	**ET-135 delivery**

Milestones

Employees celebrating anniversaries with Lockheed Martin in February 2010

35 Years
Noel DeRose
Erick Green

30 Years
Mike Campbell
Gilbert Etienne
Daniel Holcomb
Harvey Jackson
Charmaine Lemaire
Shawn Mahela
Russell Picone
Troy Smith

25 Years
Glen Dobbins
Dennis Passegear

20 Years
Perry Degelos

15 Years
Frederick Heisler
Jennifer Takeshita
Michelle Worden

5 Years
Matthew Gaiennie
Zachary Jennings

Space Shuttle schedule (final five missions)

Mission	Launch Date	Tank	Tank Delivery Date
STS-130	February 7, 2010	ET-134	October 14, 2009
STS-131	March 18, 2010	ET-135	December 20, 2009
STS-132	May 14, 2010	ET-136	February 24, 2010
STS-134	July 29, 2010	ET-137	May 5, 2010
STS-133	September 16, 2010	ET-138	June 29, 2010
		ET-122*	September 30, 2010

** Launch-on-need tank for STS-133/ET-138*

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Mission Success Bulletin is published by the Communications Department.