Special Return-to-Flight Edition

National Aeronautics and Space Administration

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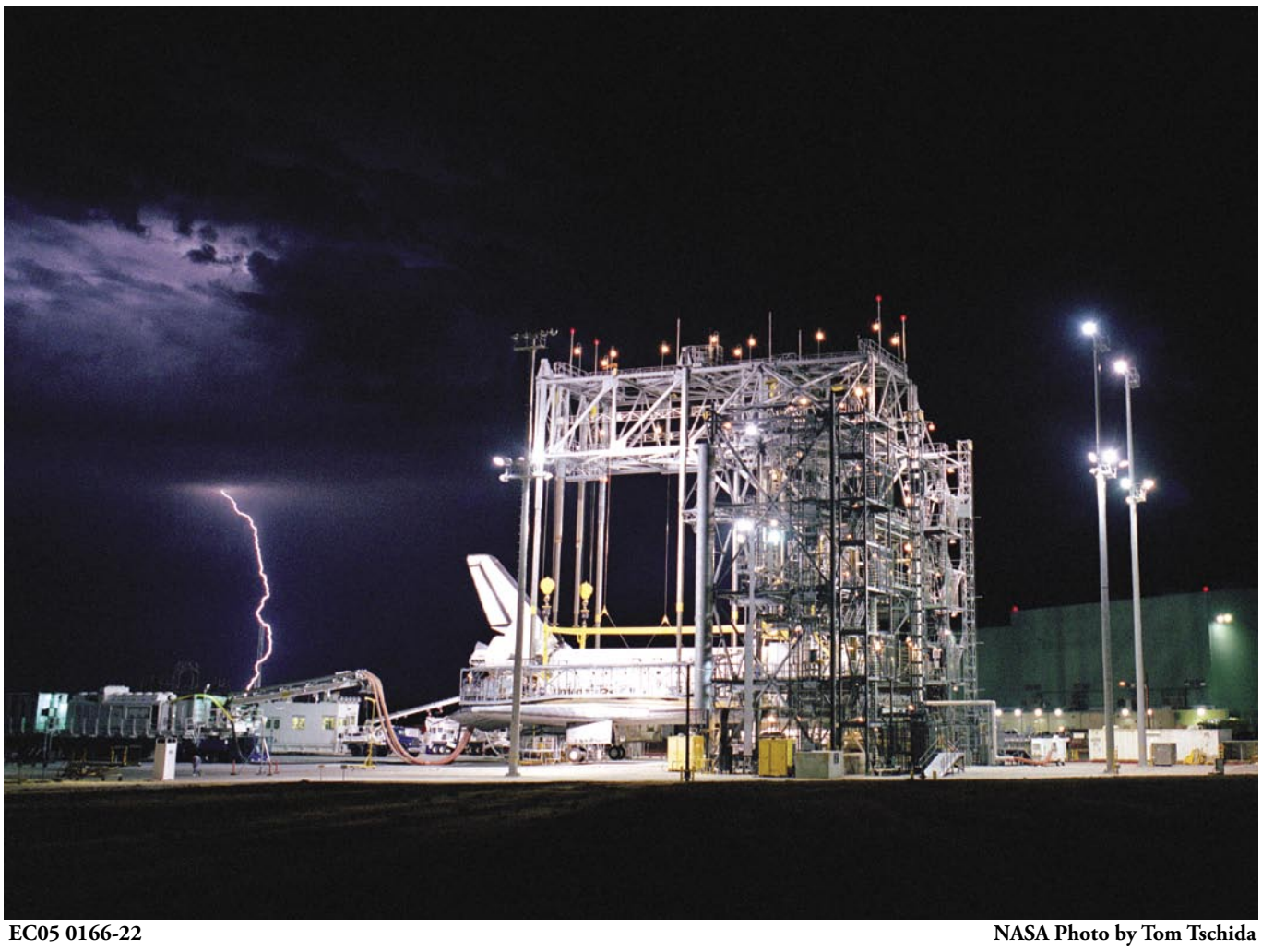
Welcome Back!



EC05 0166-22 NASA Photo by Tom Tschida

Dryden's Mate/Demate Device was used to raise Discovery and then lower it onto the NASA 747 aircraft that ferried it across the U.S. to Kennedy Space Center, Fla. A summer storm delayed operations, above, illuminating the night sky.

Arrival

Discovery lands at Dryden, prepared for Kennedy return

By Jay Levine
X-Press Editor

When Discovery landed Aug. 9, it marked a successful return to flight for the space shuttle program.

Discovery's landing also marked the 50th landing of an orbiter at Edwards Air Force Base and Dryden. It was the 112th landing of the entire shuttle program.

Prior to Discovery's arrival, Endeavour was the most recent orbiter to visit Dryden, landing here following STS-111 on June 19, 2002. Discovery has landed at Dryden 13 previous times, including its last appearance on Oct. 11, 2000. Dryden also hosted the landing of each new orbiter on its maiden flight.

For the preparation, landing and turnaround of Discovery, Johnson Space Center, Houston, had a few dozen people at Dryden to join the more than 200 from Kennedy Space Center, Fla., beefing up the standing contingent of 50 people at Dryden dedicated to shuttle work. (See related story.)

STS-114 Commander Eileen Collins, NASA's first female shuttle commander and a 1990 graduate of the Edwards Air Force Base Test Pilot School, made brief statements on the runway after landing and giving the orbiter a post-flight once-over. About six hours after touching down, five of Discovery's seven-member crew gave a press conference detailing the mission. (See related story.)

On the 14-day mission, astronauts resupplied the International Space Station and tested new safety modifications made in the wake of Columbia's loss. Crewmembers completed three space walks, including one on which they took a closer look at gap filler in the orbiter's heat shield, removing filler from between the delicate tiles.

Joe D'Agostino, manager of space shuttle support operations at Dryden, said equipment and facilities have been upgraded since Endeavour's visit. The list of improvements is headed by refurbishment of the Mate/Demate Device, or MDD, one of just two that exist for maneuvering the orbiter atop the NASA 747 Shuttle Carrier Aircraft. The other is at Kennedy Space Center.

Dryden also has a new universal coolant transporter, a key piece of equipment in the convoy of vehicles that greet the shuttle. It is used to cool internal systems on the orbiter and the flight deck. The new unit replaces

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Kennedy sends crew to prepare Discovery

By Jay Levine
X-Press Editor

Weeks before Discovery's landing, personnel from Kennedy Space Center, Fla., came to Dryden to assist with preparations in the event the orbiter landed at Edwards Air Force Base.

Dean Schaaf, Kennedy's lead NASA convoy commander, explained some of the roles played by the more than 200 people who came here to support Discovery's touchdown in California.

Schaaf and a Kennedy team of about 30 arrived at Dryden in July to prepare the equipment and facilities required for support of a potential landing. Schaaf and Casey Wood, operations manager with primary shuttle program contractor United Space Alliance, were here for about 44 days as a result of several delays of Discovery's launch, but the largest contingent of Kennedy personnel, about 170 people, arrived the day after the orbiter landed.

About 40 Kennedy employees arrived the day before the potential landing to begin making preparations at the NASA control room and Mate/Demate Device, or MDD. The MDD houses the orbiter during processing of its systems in preparation for its trek back to Kennedy and is also used to hoist the orbiter slowly, position it over the NASA 747 Shuttle Carrier Aircraft and lower it onto the SCA's back. Dryden's MDD is one of two maintained by NASA. The other is at Kennedy Space Center.

When the shuttle is in space, a daily teleconference takes place between the landing support officer at Johnson Space Center, Houston, and NASA representatives at Kennedy, White Sands Missile Range, N.M., and Dryden. During that exchange, flight officials decide which site will be best suited for a shuttle landing should the orbiter need to land that day. Dryden is normally the primary backup-landing site but White Sands sometimes offers a better opportunity. That was the case for STS-3, in 1982, when Columbia landed there with current Dryden chief pilot Gordon Fullerton piloting the mission.

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Center Director's Column

Thanks for a great landing

Center Director Kevin L. Petersen

Space Shuttle Discovery just flew a remarkable mission, and NASA is now on the path to complete construction of the International Space Station and to begin a new chapter of space exploration. On short notice, Discovery landed at an early hour Aug. 9 at Edwards and the Dryden/Edwards Air Force Base team was ready.

Being ready to receive the shuttle that day was made possible by a truly dedicated group of Dryden, Edwards and contract employees who have been preparing for such a day for many months. Dryden's shuttle operations manager, Joe D'Agostino, ensured the team was ready, as he has been doing for the past 20+ years. All the preparations paid off and the landing operations support team performed remarkably. It looked routine to the casual observer, but all of us know that it's far from routine, and that proper preparations are crucial to uneventful operations.

Many other employees sprang into action that morning, too. The Public Affairs group was here much of the night preparing for 179 media and news personnel here for the landing. The range and communications team provided crucial landing support. Security stepped it up a notch to provide full Center physical security coverage. Many other volunteers hosted visitors and guests.

In addition, thanks go to dozens of Johnson Space Center employees and the more than 200 people from Kennedy that played key roles in operations here prior to Discovery's arrival and after the landing in the preparations to transport the orbiter back to Kennedy.

All employees had a chance to see the shuttle up close as it was being prepared for its return to Florida, and the NASA 747/shuttle combination is truly a spectacular sight.

To all the employees at Dryden and Edwards who participated in Discovery's successful landing operations and its preparations for return to the Kennedy Space Center, I want to express my thanks and appreciation. You rose to the occasion and enabled Dryden, once again, to do our part in NASA's return-to-flight efforts!

Astronauts recall mission

By Jay Levine
X-Press Editor

Not a day went by that the Discovery astronauts didn't think of their fallen comrades from the Columbia mission.

A picture of the Columbia crew was affixed to the commander's side of Discovery's flight deck. The small memorial wasn't a mission mandate for the Discovery crew, but for everyone on board, honoring Columbia's sacrifices was; the photo was posted out of respect for their memory and their mission.

"The Columbia crew was behind what we did," Commander Eileen Collins said at a press conference held at Dryden about six hours after landing at Edwards Air Force Base.

"The Columbia crew believed in what they did and believed in the space mission. I know if they were listening to us now they would most certainly want us to continue this mission."

Discovery's systems worked perfectly and "we felt very safe," Collins told the large media assemblage. "It was a significant accomplishment to get the shuttle flying again."

For a rapt audience, five members of Discovery's crew recalled their experiences from the nearly 14-day space mission that included re-supplying the International Space Station and a space walk to attempt a first-ever repair on the orbiter in space.

Two crewmembers were still undergoing post-flight medical exams and were not present for the press conference.

The STS-114 crew included Collins, Jim "Vegas" Kelly, who was the pilot and manned the Shuttle's robotic arms during the repair, and Mission Specialist Soichi Noguchi of Japan, who completed three space walks and was a television specialist for documentation of the mission.

Also on board was Steve Robinson, the flight engineer and systems expert who completed three space walks – including one in which gap fillers were pulled from Discovery's thermal protection system tiles. Wendy Lawrence was chief of transfer of materials to and from the orbiter and space station. Charlie Camarda transferred approximately 12,000 pounds of cargo, equipment and supplies from Discovery to the space station in his logistics role, manned the robotic arm and completed day two inspections with Andy Thomas.

Crewmembers acknowledged that while the mission was successful, much work remains. For example, a piece of foam that was shed at launch from the external tank – but which did not inflict damage on the orbiter – will be examined by STS-114 mission managers. NASA has postponed the next Shuttle launch no earlier than March 2006.

"People around the country were praying

See Astronauts, page 12

EC05 0166-10 **NASA Photo by Jim Ross**

The Discovery crew pauses for a photo after giving Discovery her post-landing once-over. From left are Stephen Robinson, Commander Eileen Collins, Andrew Thomas, Wendy Lawrence, Soichi Noguchi, Charles Camarda and Jim Kelly.

EC05 0166-08 **NASA Photo by Jim Ross**

From left, Dryden Deputy Director Steve Schmidt and Dryden Shuttle Program Manager Joe D'Agostino greet Discovery Commander Eileen Collins and the crew.

EC05 0166-12 NASA Photo by Tom Tschida

Discovery Pilot Jim Kelly, second from left, answers a question during a post-landing press conference. From left are Commander Eileen Collins, Kelly, Soichi Noguchi, Steve Robinson and Charles Camarda. Each recounted some of their mission experiences, noting especially their respect and gratitude for the work of Columbia's lost crew and their support for continued human exploration. The two remaining crewmembers, Wendy Lawrence and Andrew Thomas, did not attend the press conference because they were continuing to undergo standard medical testing given to all astronauts upon returning to Earth.

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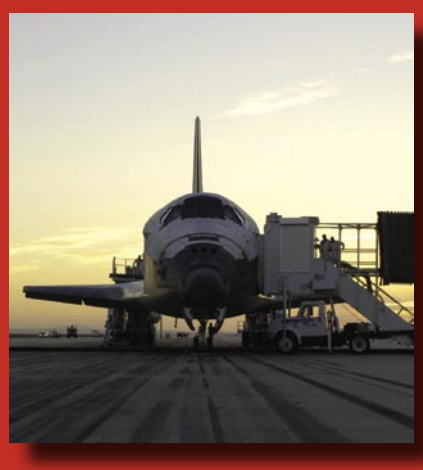

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Not to be overlooked, a few behind-the-scenes stories emerge, page 11

Cover story

Welcome Back! is a tribute to Discovery and the many people responsible for getting her back to work. While the shuttle program continues to grapple with challenges, STS-114 was a success and marked the return to flight after Columbia's loss. The cover features images, clockwise from top left, from a NASA remote camera site (liftoff); Dryden photographer Carla Thomas (landing) and Dryden videographer Lori Losey (ferry flight).

Schmidt key in return-to-flight effort

■ Dryden deputy director assisted CAIB members

By Jay Levine
X-Press Editor

Steve Schmidt watched Columbia's return from space on television Feb. 1, 2003, expecting to see a perfect landing at Kennedy Space Center, Fla. What he saw were bright streaks across the sky. The orbiter and its crew were lost.

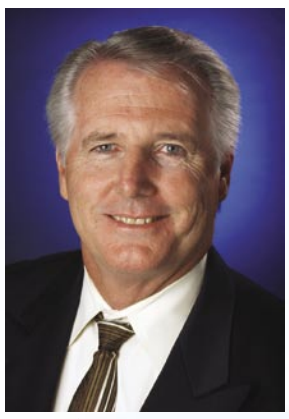
Within a few hours, NASA Administrator Sean O'Keefe called Schmidt, who then was special assistant to the administrator, and requested that he serve as the executive secretary for management of the Columbia Accident Investigation Board.

Schmidt accepted and flew that same day to Barksdale Air Force Base in Shreveport, La., to set up the infrastructure for the investigation board's formation. Once assembled, CAIB members were transported to Houston, where they would remain for the next four months.

The effort grew from two people to about 120 by the end of February. Those first two people were Schmidt – who as executive secretary for management was a key coordinator of communications, resources and people – and Dave Lengyel. Lengyel, a retired Marine working at NASA Headquarters, was asked to serve as CAIB executive secretary for administration.

Because there was no precedent for such a board, Schmidt said operational procedures had to be written from scratch and the most critical issues tackled first.

"It was like starting a corporation with $10 million and having only one month and 120 people to get it started," he said. In that context, Schmidt served as chief operating officer.



Dryden Deputy Director Steve Schmidt

"There was no building, no computers, no cell phones, no personnel, no payroll – no nothing. But in 30 days we had to have it running," he said.

To those ends, Schmidt ironed out such details as where people would work, housing, financial arrangements, procedures and guidelines for the board, its charter, and all aspects of operations so that investigators and board members could do the job they'd been tasked with. Details included what to call the investigative body.

Schmidt worked with a number of federal organizations such as the National Transportation Safety Board, the Federal Aviation Administration, the U.S. Navy and the Office of Personnel Management to keep track of appointees to the board, who were chosen by the White House.

The environment was dynamic and chaotic at times, but the singular goal was clear: complete the accident investigation and issue a report.

"It was a monumental task and everything moved very quickly," Schmidt said.

New members were added to the board daily, which meant that every day, accommodations for them had to be found. Each required tools such as computers, phones, offices, badges and security clearance verification.

The workdays lasted 14 to 18 hours, seven days a week.

"I became very familiar with the Taco Bell menu because it was open late," Schmidt said. "It was on the way out of the building, and they were open until midnight. My apartment was a mile away. For the four months we were in Houston, I didn't leave the five-mile radius where I worked and where I stayed."

In the cubicles that comprised what was referred to as "the bullpen," levity was on the agenda despite the gravity of the task. Each day at 5 p.m., Schmidt recalled, most of the board members would relieve some stress, stomping and clapping along to the Barney song.

Retired U.S. Navy Adm. Harold Gehman, CAIB chairman, wanted the group to return to the Washington, D.C., area as the investigation was wrapping up so board members could begin writing the report.

When the investigation moved from Houston to Shirlington, Va., Schmidt asked Dryden's Rob Binkley to assist with computer security issues. To assist Binkley, Roberta Sherrard also was tapped. Their goal was to make the computer move as simple as unplugging a toaster in Houston and plugging it back in to make toast in Virginia. Although Binkley and Sherrard made the transition appear effortless, the task involved transporting delicate equipment and substantial amounts of data that were invaluable to the investigation. They finished the task in less than a month – three days ahead of schedule.

Another Dryden asset, the G-3 aircraft, was used during the investigation to transport board members.

The first volume of the CAIB report was issued Aug. 26, 2003, with the final report following in October. All investigation board activities were complete on Oct. 31 – nine months after Columbia was lost.

"Gehman did an outstanding job. He was diplomatic, decisive and a good guy. He was very intelligent and a good leader," Schmidt said.

Between February and May, Schmidt had worked hours equivalent to an entire year under normal circumstances.

"It was a good cause for the right reasons and the benefits were going to be meaningful. It was easy to get immersed in the effort, but sleep was at a premium," he said.

Prior to accepting his current position as Dryden's deputy director, Schmidt also was executive director for the President's Space Commission (responsible for developing elements of President Bush's exploration initiative) as well as executive assistant for the International Space Station and Cost Evaluation Task Force.

Dryden security staff part of recovery team

By Jay Levine
X-Press Editor

Discovery landed to the cheers of people around the world and Frank Chavez, Dryden's security chief, was among those cheering.

"The first thing I said was, 'Thank God they're back safely,'" Chavez said. "Security is responsible for protecting the astronauts while they're here. We treat them like our family. We know the names of the astronauts, we know the names of their spouses and we know the names of their kids. Seeing the shuttle coming back and landing safely – it was emotional."

Taking a role in the space shuttle program's return to flight was a welcome task as the orbiter glided to a perfect landing. Chavez had endured an unenviable role assisting with the recovery effort when Columbia was lost Feb. 1, 2003. He was one of four NASA security chiefs asked early in the effort to help recover and investigate the orbiter's breakup.

"About seven minutes after it was verified that Columbia was lost, I was on the phone with the associate administrator for the Office of Safeguards and Security Protection and he was out at Kennedy with the (NASA) administrator (Sean O'Keefe). He said we should be prepared to depart – where to, I didn't know, but we were going," Chavez recalled.

Photo courtesy Frank Chavez

Frank Chavez, right, and Phil Fonseca communicate with Columbia search crews and the search command center via satellite telephones.

Dryden's security chief recalled watching Columbia television coverage because of the Center's role as an alternate landing site. In anticipation of the possibility Dryden could be called up, he had brought in special security staff from Ames Research Center, Moffett Field, Calif. So when help was needed in East Texas, Chavez said he was ready to go.

Within 48 hours Phil Fonseca, then a member of Dryden's security staff (now on military duty), Chavez and two Ames communications specialists reported to Lufkin, Texas, where NASA was setting up a command center in a convention center.

Arriving at 11:30 p.m. and bringing satellite communication equipment from

See Security, page 11

Forest Service recovery volunteers view Discovery

By Jay Levine
X-Press Editor

Space shuttles are awe-inspiring machines that have for three decades taken astronauts and materials to space and back. For one group of people, viewing Discovery after its safe landing at Dryden was particularly joyful.

Mike Dietrich was the incident commander for a group of Southern California fire fighters, Southern California Incident Management Team No. 3, who scoured East Texas to assist in the recovery of Space Shuttle Columbia after its breakup Feb. 1, 2003.

Dietrich, fire chief for the San Bernardino National Forest, came to Dryden Aug. 15 to see Discovery, bringing with him two other U.S. Forest Service colleagues who also were part of the recovery team. Jan Cawthon, a human resource specialist, and Mick McCormick, who served as deputy incident commander for the Columbia search effort, found Discovery "impressive."

For three and a half weeks in Nacogdoches, Texas, the environment was harsh as the three undertook the Columbia search and recovery mission. In all, 1,300 people took part – 45 crews, 20 people to a crew, performing the largest grid search in history. Spanning more than 2,400 square miles, search crews sought debris that would help investigators determine the cause of the loss of Columbia and her crew of seven astronauts.

Tom Marren, Space Shuttle Endeavour lead project engineer at Kennedy Space Center, Fla., worked with firefighters during the recovery effort, and was on hand at Dryden to give them a guided tour of

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NASA Photo by Carla Thomas

From left, Mike Dietrich, Jan Cawthon and Mick McCormick are pictured after a guided Discovery tour given by Kennedy Space Center's Tom Marren, right.

Where we've been

Dryden has been the site of key research in the shuttle program

By Curtis Peebles
Dryden History Office

Behind Discovery's landing on Runway 22 at Edwards Air Force Base were several decades of work dedicated to developing the world's first reusable orbital spacecraft. In some ways, building the shuttle presented greater challenges than those of the Apollo program, because a reusable space vehicle embodied technologies far beyond those existing at the shuttle program's outset. Many important elements of this effort took place at Dryden.

In 1954, three years before the launch of the Soviet satellite Sputnik 1, the National Advisory Committee for Aeronautics (NASA's predecessor) began work on the X-15 research aircraft, the first aircraft capable of reaching the edge of space. The X-15 would experience aerodynamic pressures ranging from zero to 2,000 pounds per square foot, and temperatures of some 2,000 degrees Fahrenheit. Piloting the X-15 meant controlling the vehicle under conditions of increased gravitational forces as well as during periods of weightlessness. The data acquired through the X-15 program, and the experience gained during its 199 flights at Dryden, played major roles in designing the space shuttle.

Another important source of information contributing to the shuttle's design was the lifting body program conducted at Dryden from 1963 to 1975.

Rather than deriving aerodynamic lift from wings, lifting bodies generated it from their shape. Dryden engineer R. Dale Reed was among the very first to realize the potential inherent in the lifting body concept. He also knew such an unusual concept would be a hard sell to doubting engineers and program managers.

Beginning with experiments that featured a small balsa-wood-and-tissue-paper model towed aloft by a radio-controlled mothership and then released for a glide landing, Reed was gradually able to gain support for construction of a lightweight, piloted lifting body. The first such vehicle, dubbed the M2-F1, had a plywood fuselage and an internal framework made of metal tubing, and resembled a bathtub on a tricycle. The initial tow tests were done using a souped-up 1963 Pontiac Catalina convertible. Later, the M2-F1 was towed to higher altitudes by a C-47.

This led to construction of a series of heavyweight lifting bodies – the M2-F2/F3, the HL-10 and the X-24A/X-24B. These vehicles were flown at Dryden between 1966 and 1975, and used to test a range of different vehicle configurations. They were launched from what was then the Air Force's NB-52B, reaching speeds approaching Mach 2 and altitudes of up to 90,000 feet. These tests showed that vehicles with these shapes could successfully make a controlled atmospheric re-entry.

Among the most significant contributions derived from lifting body research was the elimination of landing engines from the shuttle. Original shuttle designs called for multiple jet engines that would be started during descent to allow the shuttle to make a powered landing on a runway. This concept was put to the test with the HL-10, which was fitted with several small rocket motors and made powered landings on the dry lakebed. Ironically, these powered landings proved to be much more difficult and risky than a steep-glide approach. As

See History, page11

ECN 8923 **NASA Photo**

Space Shuttle Enterprise prototype separates from the NASA 747 on its first flight without a tailcone, which had been used in earlier flights.

Divot tests give return to flight a LIFT

By Curtis Peebles
Dryden History Office

A double sonic boom from the predawn sky announced Discovery's arrival over Edwards Air Force Base. The successful landing of the STS-114 mission came two years, seven months and eight days after Columbia was lost during re-entry. The damage that caused Columbia's destruction had been inflicted during launch, when a large piece of foam from the vehicle's external fuel tank struck a wing leading edge.

Part of the return-to-flight effort involved trying to understand the behavior of such small foam fragments, called "divots."

Divoting occurs when air pockets trapped beneath the foam expand as the shuttle ascends. The air expands because of decreasing ambient pressure (it was trapped at sea level) and heat transfer. The expanding air causes the adhesive to fail, resulting in a section of foam popping off the tank.

Engineers working to solve the foam problem sought to understand the behavior of the divots as they were caught in this airflow. Did divots break up under the dynamic pressure, did they tumble, or did they "trim" and begin to "fly" in a stable condition? Whichever of these conditions prevailed would determine the degree to which the pieces were slowed by air drag. The amount of kinetic energy of a divot, and, in turn, the amount of damage divots could inflict, is determined by their impact speed relative to that of the shuttle. Understanding divot behavior also was critical to developing computational fluid dynamics programs to assess the risk of impacts.

To provide the needed data on divot behavior, NASA's Space Shuttle Engineering and Integration Office funded the Lifting Insulating Foam Trajectory, or LIFT flight tests.

Dryden's two-seat F-15B research aircraft was selected as the testbed. Initial planning for the project began in July 2004, with ground tests continuing into late September of that year. Development work on the divot ejection system, as well as on the high-speed cameras utilized on the aircraft as part of the foam issue resolution began in late September and was completed a month later.

EC05 0028-50 **NASA Photo by Carla Thomas**

Dryden's F-15B testbed aircraft flies one of the Lifting Insulating Foam Trajectory, or LIFT, research flights.

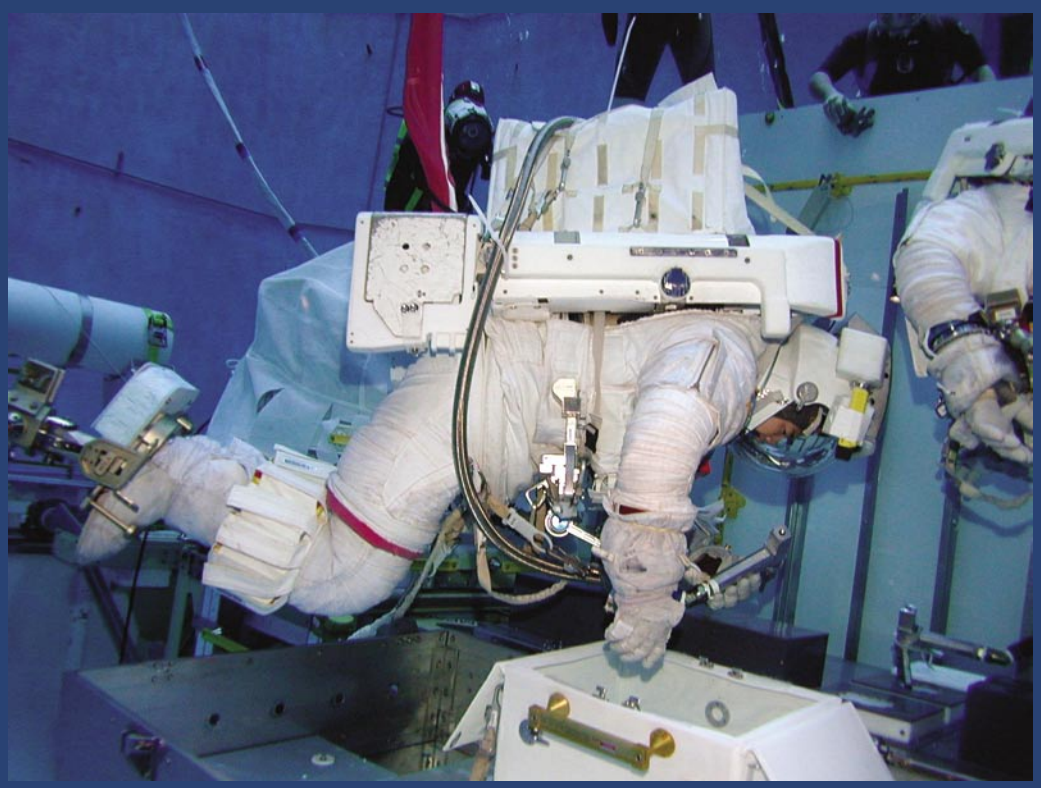
Then in November 2004, the Space Shuttle Engineering and Integration Office got the go-ahead to start preparation work for the LIFT flight-test phase.

A pylon, called the Aerodynamic Flight Test Fixture, was attached to the underside of the F-15B. Small aluminum panels covered with BX-265 tank insulation were mounted on the pylon's side. A gas pressure ejection system was used to separate the divots in flight. A high-speed digital video system was mounted under the wing. The system was capable of capturing up to 10,000 frames per second of the divots as airflow carried them away from the pylon.

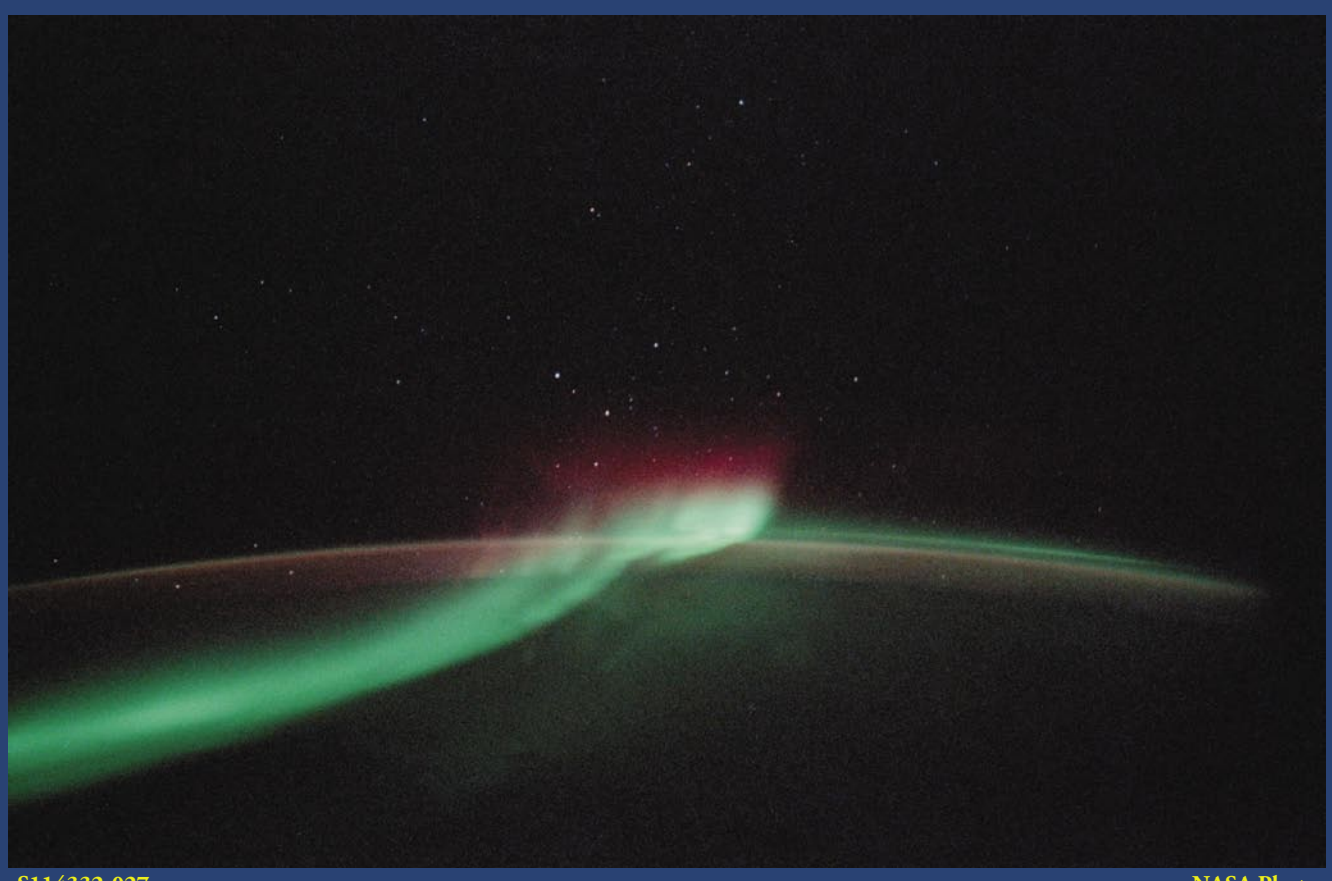
The first ground tests of the divot ejection system were successfully completed on Jan. 6, 2005. The four initial LIFT flight tests with the F-15B were made in late February. Divots were ejected at speeds up to Mach 1.4. The LIFT flights resumed in early March, with the final five in the series being made before the project was completed by month's end.

A total of 38 divots were separated at subsonic and supersonic speeds during the nine-flight test series, with test points simulating the shuttle's ascent profile. The top speed was about Mach 2, while the maximum dynamic pressure exerted was 850 pounds per square foot. All of the divot ejections and their trajectories were successfully photographed using the digital cameras. A video clip of one test showed a divot resembling a small dinner plate being ejected from the pylon, then stabilizing in the airflow with a back-and-forth wobble before being carried out of the video frame. As a check on the program's accuracy scientists from NASA Ames Research Center, Moffett Field, Calif., compared their computer predictions of the divots' trajectories with those shown in the videos.

At right, Japanese Aerospace and Exploration Agency Astronaut Soichi Noguchi, lead spacewalker for the space shuttle's return-to-flight mission, checks a potential repair technique for Discovery's heat protection tiles in the Neutral Buoyancy Laboratory at Johnson Space Center, Houston. In the image at center, STS-114 Mission Specialist Stephen K. Robinson, another of the spacewalkers on this mission, is attached to a foot restraint on the International Space Station's Canadarm2.



JSC2004-E-13024 **NASA Photo**



S114332-027 **NASA Photo**

This view of the Aurora Australis – or "southern lights" – was photographed by a crewmember aboard the Space Shuttle Discovery during the STS-114 mission.

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S114e6946 **NASA Photo**

Above, Discovery Commander Eileen Collins works out on a bicycle ergometer alongside Mission Specialist Charles Camarda in the shuttle's middeck. At right, Discovery sits piggyback on the NASA 747 as it departs Dryden for the coast-to-coast flight to Kennedy Space Center.

NASA Photo

ED05 0166-05 NASA Photo by Carla Thomas

The crew transfer vehicle, at left, is moved into position to allow the shuttle crew to disembark. The astronauts get a preliminary health check in the mobile facility before they are allowed to exit and look over the orbiter.

EC05 0166-21 NASA Photo by Tom Tschida

Above, Discovery is prepared in the Mate/Demate Device for its eventual lift onto the top of the NASA 747 Shuttle Carrier Aircraft. Once it is hoisted into position, the shuttle is fastened to the SCA for its trek back to Kennedy Space Center. The two smaller images, below right, show other views of the MDD. The tail section, top, used to improve aerodynamics during flight is moved into position. At bottom, the MDD is pictured against the backdrop of a desert sunrise.

ED05 0116-31 NASA Photo by Carla Thomas

EC05 0116-26 NASA Photo by Tom Tschida

EC05 0116-23 NASA Photo by Tony Landis

EC05 0166-30 NASA Photo by Carla Thomas

The Mate/Demate Device is used to lower Discovery onto the host NASA 747 Shuttle Carrier Aircraft, which carried it across the U.S. to Kennedy Space Center, Fla. The NASA 747 is one of two managed by Johnson Space Center, Houston. Pete Seidl, Dryden site manager for maintenance on NASA 747, said the pair of aircraft are based at Dryden. Major overhauls on both are performed at the Evergreen Air Center in Marana, Ariz. Regular maintenance is conducted at Dryden. Seidl and his crew of four are part of the Computer Science Corporation Applied Technology Division contract.

All about the MDD

By Jay Levine
X-Press Editor

The most extensive overhaul in the 29-year history of Dryden's Mate/Demate Device was completed in 2004, and involved replacing the mammoth structure's original coating of lead-based paint with a fresh coat of non-toxic paint.

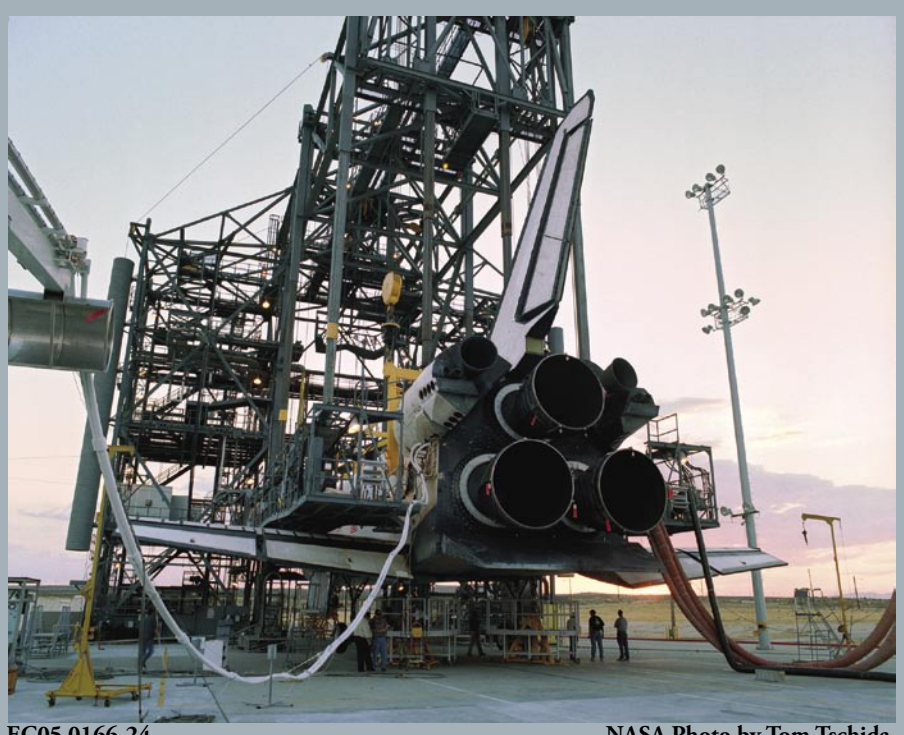
A team of contractors and NASA personnel collaborated to develop a way of disposing of the lead-based paint removed from the structure by recycling it into commercial cement. The alternative was sending it to a landfill as hazardous waste – all 240 tons of it.

The MDD had not been repainted since it was first built, although it had been retouched. The cost of the new paint job – $2 million – beat the other option: replacing the structure entirely. Replacement costs were estimated at $9 million, according to Joe D'Agostino, Dryden's manager of space shuttle operations.

In developing the contract for the MDD work, D'Agostino said he sought a team approach. Lance Dykhoff, Lockheed Martin's Dryden site manager, called on Lockheed program manager Lou Pustka to help assemble the team.

Specifications were developed and Lockheed, which holds the contract for Dryden shuttle operations, chose Anaheim, Calif.-based Techno Coatings Inc. as its partner for the project. TCI won with a team proposal that blended onsite Lockheed personnel expertise with their company's corporate knowledge and resources for the effort. The result was wholesale recycling of the MDD's old lead-based coating into cement, with the help of an additive called Blastox that mitigates lead content in paint.

The structure has served NASA well, as Dryden was the primary landing site during the early days of the space shuttle program. About a year before it would hoist Space Shuttle prototype Enterprise onto the NASA 747 Shuttle Carrier Aircraft for the first time, the gargantuan steel frame had been erected and stood ready to do the heavy lifting.



EC05 0166-24 NASA Photo by Tom Tschida

Discovery is shown inside the Mate/Demate Device. The shuttle was hoisted aloft in the MDD then positioned over the NASA 747 Shuttle Carrier Aircraft. It was then lowered slowly onto the SCA prior to its cross-country journey to Kennedy Space Center.

Dryden remains the primary backup landing site when clouds roll in at Kennedy Space Center, Fla., and the weather isn't good enough for a landing there. In all, 50 shuttle landings took place at Dryden, including those of the first nine orbiter flights minus STS-3, in which Columbia landed at White Sands, N.M. That 50-flight total also includes all of the first landings of new orbiters as each joined the fleet.

The MDD consists of two 100-foot towers with stationary platforms every twenty feet from 20 to 80 feet on each tower, and a horizontal structure mounted at the 80-foot level between the two towers. The horizontal unit cantilevers 70 feet out from the main tower units, guiding and controlling a large lift beam that attaches to the orbiters to raise and lower them.

Three large hoists are used to raise and lower the lift beam. Two of the hoists are connected to the aft portion of the lift beam and one hoist is attached to the beam's forward section. The three hoists operate simultaneously. As a unit the hoists can lift 120 tons, or 240,000 pounds, and the average space shuttle weighs in at about 231,000 pounds, D'Agostino said. D'Agostino was originally hired as a shuttle security officer and he recalled the first time the MDD was used.

"The first time we lifted (Space Shuttle prototype Enterprise) during the ALT (Approach and Landing Tests) program took a considerable amount of time, which is to be expected with a new operation," he recalled.

"We had a technical problem (mating Enterprise). The operation lasted almost 14 hours. We got it to the point where we were ready to lower Enterprise onto the 747 and we learned the orbiter didn't fit.

"To make it fit, we moved the forward strut on the 747. It was nerve-wracking."

The second time Enterprise was lifted was much more streamlined and the effort took just six to eight hours, he said. Shuttle landings later required changing work schedules in order to keep staff on site around the clock, until the orbiter was safely mated to the NASA 747 and winging its way back to Kennedy Space Center.

Dryden and Kennedy are home to NASA's two MDDs. Dryden's MDD is more complex than the one at Cape Canaveral, D'Agostino said, because the one here is used as a work site for tasks that, when they are necessary in Florida are accomplished at Kennedy's Orbiter Processing Facility. Dryden's structure is similar to its Florida twin, but the Dryden MDD has elevators and had extra equipment built into it that was required in the early days of the shuttle program. The modifications were made largely to enable the device to meet heavy-lift requirements as the shuttle program progressed.

What started out as one of the world's largest Erector sets became a permanent structure at Dryden as the needs of the space shuttle program changed and required welds, concrete and additional work platforms and heavier lift capability, D'Agostino said. Modifications since the MDD's completion in 1976 have cemented the device into Dryden history – mot just physically but metaphorically as well.

EC05 0166-28 NASA Photo by Tony Landis

Above, technicians close the orbiter's landing gear doors, a final step before Discovery can be hoisted. Below, technicians Ray Smith, left, and Raphael Rodriguez remove one of the extra-vehicular mobility units from Space Shuttle Discovery after its landing.

EC05 0166-18 NASA Photo by Jim Ross

Discovery ... from page 2

the aging cooling unit used previously and its much-less-mobile host, explained Mike Mercer. Mercer is acting site manager for United Space Alliance, NASA's contractor for day-to-day space shuttle operations.

The new unit consists of a portable purge unit and two large generators that power it, positioned on a German-made Kamag truck. The Kamag truck is as big as four mobile homes lined up end to end and has wheels capable of moving the vehicle through tough maneuvers – including driving the vehicle sideways if necessary.

Another flight crew systems vehicle, which also is called a Dobbs unit because the truck is commonly used to deliver food and services for commercial aircraft, is used to unload shuttle cargo. It resembles a bread truck at first glance, but its rear box can be elevated to bring it even with the white room/stairs lined up to the orbiter's hatch for crew use in disembarking. It replaces a system shuttle workers called "the shark cage," with a truck able to more efficiently move payload from the orbiter, Mercer said.

The white room/stairs truck also was modified to allow the flight crew transfer vehicle to hook up more quickly, allowing experiments to be unloaded after the astronauts enter the crew transfer vehicle, which also is hooked up to the stairs/white room. In the crew transfer vehicle, astronauts receive medical attention as they exit the shuttle.

Mercer said that USA workers have the enviable task of taking the astronauts' place on the orbiter after landing to complete tasks inside the vehicle until systems are no longer required to be running.

It takes a large team of diverse organizations to manage a shuttle landing, D'Agostino said. Some of these include the U.S. Department of Defense Manned Space Flight Office, Patrick Air Force Base, Fla. and Colorado Springs, Colo., and Northern Command Contingency Operations, with security assistance from the U.S. Army's Fort Irwin, near Barstow, Calif., and China Lake Naval Weapons Center, Ridgecrest, Calif. China Lake personnel assisted with helicopter services and video support, and key support was provided by Edwards Air Force Base fire and security departments, disaster preparedness and flight operations personnel and meteorologists.

Dryden's Darrell Townsend and Gary Beard provided 24-hour shuttle support and Dryden's Health Unit, Life Support and Kay and Associates also were key, D'Agostino said. In addition, Dryden photo and video staff captured Discovery's landing, preparations for the return to Kennedy and departure, and Public Affairs personnel, with volunteer help, assisted 170 members of the media present for the landing and responded to community questions about the landing.

Bill Gries, Edwards Air Force Base Flight Test Center airspace manager and shuttle contingency coordinator, said the relationship between the Air Force and Dryden is exceptional.

"We have a great working relationship. Seven days prior to launch we knew who was going up and what the potential landing opportunities were. All this information is relayed to supporting personnel not only at Edwards, but China Lake, Vandenberg Air Force Base and Fort Irwin. Joe (D'Agostino) updated those and the response was great. We couldn't ask for it to be any better," said Gries, who was in Dryden's Blue Control Room for the landing.

The bulk of shuttle workers assigned to Dryden are employees of Lockheed Martin. They maintain and operate vehicles and equipment required when the shuttle lands here, said Lance Dykhoff, Lockheed Martin site manager for shuttle operations.

The 750-million-candle-power Xenon lighting that guides the shuttle to Edwards was the most visible evidence of Lockheed's work on the recent landing. In addition to a number of landing-light systems, employees also operate and maintain two Microwave Scanning Beam Landing systems, one on Runway 22 and the other on Runway 04, which are navigational aides that provide precision and final approach information to the shuttle pilot. That system provides the space shuttle with the capability to land automatically if pilots cannot see the runway due to weather.

Lockheed employees also maintain 50 generators used to power shuttle equipment, several vehicles – including a truck that refuels the convoy on the runway – and the NASA convoy command vehicle. In addition, they are responsible for maintenance of the MDD.

Often assisting the Lockheed crew is the Dryden Calibration Laboratory. Richard Elliott, AS&M, Calibration Laboratory lead, said the lab's function is to calibrate and repair test equipment to National Institute of Standards Technology specifications.

STS-114 was the first mission to fly since Feb. 1, 2003, when Columbia was lost on its return from STS-107 and its crew of seven perished. That crew included Mission Specialist David Brown, Commander Rick D. Husband, Mission Specialist Laurel Blair Salton Clark, Mission Specialist Kalpana Chawla, Mission Specialist Michael P. Anderson, pilot William C. McCool and Payload Specialist Ilan Ramon.

Kennedy ... from page 2

When it's time for a shuttle landing, Dryden is ordinarily not called up on the first day of landing opportunities because mission managers would prefer to land at the primary landing site at Kennedy. But for the second day of opportunities, Dryden is routinely called up to be ready in case weather won't permit a Kennedy landing. In some cases, White Sands personnel also are to be ready if weather is questionable at both Kennedy and Dryden.

A convoy of vehicles is required for servicing the shuttle when it comes to a stop after landing and to assist the astronauts in exiting the orbiter. The convoy is assembled at Dryden's Shuttle Area A on the day of a scheduled landing. The convoy moves along the flight line to the base Fire Department facilities, where it is joined by the U.S. Department of Defense On Scene Commander and forces and vehicles from the Edwards Air Force Base fire and medical departments.

The convoy then moves to the center taxiway, where a final briefing is held by NASA and DOD commanders. "It was at that time (on Aug. 9) that we learned the shuttle crew had completed the de-orbit burn for (a landing at) Edwards," Schaaf said.

Simultaneously, Schaaf learned the shuttle would land on the base's Runway 22, and he began to position the convoy accordingly. Once Discovery landed and came to a stop, the convoy went into action.

The first group of vehicles approached from the nose and was positioned a safe distance, 1,300 feet, from the orbiter. An assessment team checked for the possibility of any hazardous gases emanating from the orbiter, to determine if it could be safely approached and if astronauts could begin preparations to disembark.

The convoy's command vehicle, a "purge" vehicle and a mobile cool unit were other key components of the first group of vehicles (see related story, Page Two for more details). Both remain hooked up to the orbiter and are powered during preparation and transport to the shuttle processing area.

When it has been determined that the aircraft and the area surrounding it are safe, the rest of the convoy moves forward with a mobile "white room" and a staircase unit to be positioned next to the orbiter side hatch. Once the staircase is in place the crew transport vehicle is elevated to the staircase and attached; the medical team joins the astronauts inside to give them their initial post-flight checkup prior to their departure from the orbiter area. Later, the crew is taken to another medical facility to undergo more detailed evaluation prior to their flight back to Johnson Space Center.

Processing of the orbiter for "turnaround" takes about seven to ten days. During that time, information stored on the orbiter during the mission is sent to Kennedy electronically, toxic fuels are taken off the orbiter and preparations for the cross-country transport flight are made. Once the orbiter is positioned atop the SCA, the ferry flight to Kennedy is ready to begin.

It normally takes from two to several days to ferry the orbiter across the U.S. back to Florida, depending on weather. The mated SCA/orbiter must steer clear of rain showers or turbulence during the ferry flight. This is accomplished by using a "pathfinder" aircraft flying ahead of the mated pair by 20 to 30 minutes. The NASA/DOD shuttle support team, including a contingent of meteorologists, flies on this aircraft. Together, the weight of the orbiter, the heat of the day for takeoff and a normal cruising altitude of 15,000 feet mean that several refueling stops are required, as is at least one overnight stop. Ferry stops are normally made at military airfields for security and support reasons.

The STS-114 ferry mission began Aug. 12, with a refueling stop at Altus Air Force Base, Okla., and an overnight stop at Barksdale Air Force Base in Shreveport, La. Bad weather kept the two aircraft at Barksdale for two nights. The ferry mission concluded with a landing at Kennedy Space Center on Aug. 14. Preparations are under way at Kennedy for Discovery's next flight back to the space station, currently scheduled for 2006.

Home on the Range

■ WATR stays sharp with Dryden flight projects in case the shuttle comes to Edwards

Photo courtesy Mike Yettaw

By Jay Levine
X-Press Editor

When Discovery landed at Dryden Aug. 9, the Western Aeronautical Test Range staff was ready and waiting to welcome her home.

Dryden Range Control Officer Dave Jones explained the WATR's role in coordinating Center range assets and personnel with other NASA centers to support several shuttle program areas, including launch, on-orbit requirements and landing.

In fact, Dryden WATR personnel were in position at the Center four hours prior to launch and were communicating with other centers, Jones said. The WATR provides telemetry, radar, voice communication and video support for shuttle flights and the International Space Station to Johnson Space Center, Houston.

"The effort of range support put forth by WATR personnel was extraordinary – crucial for this Discovery mission," said Jan Minniear, WATR business manager.

Data telemetered from the shuttle is usually funneled directly to Johnson through the NASA Tracking and Data Relay Satellite System station located at White Sands Missile Range in New Mexico.

While TDRSS provides the orbiter's primary voice communication link, the WATR facility provides backup communication support for TDRSS should a failure occur during a shuttle mission. The WATR facility was the primary means of communication support when Discovery landed at Dryden.

Flight controllers at Johnson Space Center determined when they would require Dryden's capabilities, which on Discovery's mission was on the third orbit, Jones said. On average it takes 90 minutes for the shuttle to complete an orbit around the Earth, with the first orbit taking up to two hours depending on required maneuvering.

After a schedule of orbit times was established at Johnson, Dryden WATR personnel were given instructions for their role in the mission. During Discovery's 90-minute orbit, Dryden can "see" the orbiter for about six to 10 minutes, depending on its orbit path.

"We were very involved. We had more of a workload (on this mission), including (roles) prior to launch, on orbit and for landing. This mission had us here seven days a week (and for extended shifts)," Jones said.

Discovery's mission was marked by challenges different from those of previous shuttle journeys requiring Dryden's assistance. Deployment of the orbiter's antenna that is required for downlink of video, for example, was delayed; the new robotic arm installed to enable astronauts to examine the orbiter while in space did not permit immediate deployment. So Dryden was tapped to download video used to help mission controllers in Houston monitor the orbiter and its crew.

The WATR telemetry systems provide downlinked orbiter health and status information to Johnson and, when available, the pilot's-point-of-view video that is sent to the NASA network via satellite. When required, the telemetry systems also have the capability to provide uplinked command data to the orbiter.

"That typically is not required, but when the orbiter is in view, we have full support capability with all of our directional antennas pointed at the orbiter," Jones said.

The WATR also tracks the space station from the day prior to launch throughout the shuttle mission, to provide critical docking and undocking information. During docking, Dryden capabilities are tapped to help engineers at Johnson calibrate calculations determining the orbiter's location in relation to the ISS. As the orbiter nears the space station, Jones explained, astronauts can manually control the shuttle through the use of onboard computers, looking out windows to make a safe docking.

To prepare for the Aug. 9 Discovery landing, a process called L Minus 1, which usually occurs a day before landing, is used to check all systems involved in a landing. Dryden's preliminary L Minus 1 happened on Saturday, prior to the Tuesday landing, because Dryden was not asked to be ready for a Monday landing. Kennedy Space Center, Fla., had the first two landing opportunities on Monday, both of which were scrubbed due to weather conditions.

"We check all of the data going back and forth to the orbiter to make sure every system we may have to use is operational," he said.

For Discovery's mission, final checks began at 10 p.m. Monday night.

"They called us 'green' after the two failed attempts for a Florida landing,'" Jones explained, meaning that flight controllers were calling for a landing at Edwards. "When they called us, everything was already in place."

Dryden's Tracy Ackeret, range control officer, explained the active role WATR personnel had during the Discovery mission.

"We supported 94 orbits with our radars, 132 with our telemetry antennas and at least that many with our communication systems and several orbits with our video support," Ackeret added.

Following the landing, a complex process is required to make the orbiter safe for transport to Dryden's Mate/Demate Device, where a 24-hour, seven-day-a-week umbilical connection to Kennedy via the WATR facilities is activated to allow data gathered during the mission to be transferred electronically.

Range personnel stay sharp through flight-research project support at Dryden, including a mission on the day Discovery landed, said Mike Yettaw, WATR communications lead.

"In addition to the 24-hour Discovery

See WATR, page 12

ED-0199-1 NASA Photo by Tom Tschida

Above, WATR communications group members include, seated from left, Tom Barlow, Justin Thomas and Mike Yettaw. Back row, from left, are Richard Batchelor, Doug Boston and Darren Mills. At top is the WATR "antenna farm" at sunrise.

Photo courtesy Rick Dykstra

Bob Guere operates the supporting S-band telemetry and downlinked video console, one of many shuttle-related duties for WATR employees.

Security ... from page 4

Dryden, the team spent its first 32 hours setting up secure communications among the NASA emergency operation units and initiated procedures for handling sensitive or classified information or materials.

Now part of Dryden's emergency preparedness, the communication equipment they carried was suitcase-sized satellite telephone capable of transmitting images. With the gear, field investigators could photograph something of potential significance, e-mail it and then help determine what it was they had discovered, Chavez explained.

On the third day of the recovery effort Fonseca and Chavez were dispatched to Pinehill, Texas. The work was hard, but area residents were helpful and friendly.

"It was up in the mountains, where there was a small runway run by the (U.S.) Forest Service," Chavez said. "People in a house had lent us a little side room near the airfield where we established radio communications and where some of the Blackhawk helicopters landed. We were doing searches by grid. We were responsible for coordinating communications, and anytime things were found we plotted them on a map.

"Our work was basically 18 to 20 hour workdays for 15 to 16 days straight," he recalled. "We weren't tired. We had a sense of mission and we went on adrenaline."

When they first arrived at Lufkin their cell phones weren't working and the NASA Headquarters communications officer was working with the Federal Emergency Management Agency to establish cell phone communications. Fonseca and Chavez also were fortunate to be among the last to get hotel rooms in Lufkin.

"While in the lobby, the niece of a person who worked at the local telephone company was prepared to give us phones. We never took them up on the offer, but whatever we needed, they would try to give to us. Pinehill is a community with less than 150 people. They weren't aware we were at a hotel 40 miles away. They offered their homes for us to sleep in," he said.

The community showed team members the meaning of southern hospitality.

"The first few days the only food we had was military rations," Chavez said. "Phil Fonseca said he needed to go to church. He went to church wearing security fatigues, and an hour later he returned with the biggest smile on his face. People at church welcomed him with open arms and they were preparing hot food. They would bring us so much food that when other agencies arrived, there was still plenty to go around."

Aside from hospitality, local residents offered know-how that led investigators to key discoveries. Residents advised officials that indigenous birds often searched for food at specific hours and might be used to identify potential search areas in addition to the grid search being used to cover every square inch of the debris field. The first day yielded a deceased cow, but in another discovery the birds helped uncover two deceased humans that had been buried in the area, leading to an investigation by local law enforcement authorities.

When the operations were over for Chavez and Dryden security agents, the work in East Texas remained in their thoughts.

"When I got back it took quite a while to get to sleep," Chavez remembers. "When we came back, two members of my staff, James Mooney (now retired) and Jack Vechil were tasked to fly to Barksdale (Air Force Base, La.), rent a car and provide security escorts for convoys leaving Barksdale with pieces of the shuttle."

For their work, Chavez sought out special commemorative Columbia coins and a few weeks ago Vechil was presented with one of the coins by Dryden Deputy Director Steve Schmidt (see related story, about Schmidt's role in the return-to-flight effort, elsewhere in this edition). Coins will be sent to Mooney and Fonseca.

"It was another grim part of the job transporting personal effects of the astronauts. Mooney and Vechil accepted the items and those were under their protection (during transit). To this day, it affects me.

"There are tears in my eyes right now," Chavez said.

History ... from page 5

a result, the jet engines were eliminated as a design requirement. This improved safety, simplified the vehicle, and also resulted in a major reduction in the shuttle's liftoff weight.

Dryden also played a major role in developing key technologies used in the shuttle. The F-8 Digital Fly-By-Wire research aircraft originally featured an Apollo spacecraft computer. The aircraft was then fitted with AP-101 digital computers, which also had been selected for use on the shuttle. The F-8 experience enabled shuttle engineers to find and correct the AP-101s' manufacturing and technical problems at a much earlier stage.

ED95 43234-1 **NASA Photo**

The CV-990 Landing Systems Research Aircraft engages in a space shuttle tire test.

It was at Dryden, where so many revolutionary aerospace vehicles were first flown, that Space Shuttle Enterprise first tested its wings. This took place in the summer and fall of 1977 in the Approach and Landing Test program. The prototype shuttle was carried aloft on the back of a modified 747 airliner. The pair went into a gentle dive, and the shuttle was released. The goal was to test the vehicle's aerodynamics and computer systems in subsonic flight. The first four ALT flights touched down on the lakebed, while the fifth landed on Runway 22. On this final flight, an unexpected problem cropped up. Due to the time lag between a control input by the crew and the response, the vehicle experienced a condition called pilot induced oscillation, or PIO.

To explore the problem, and determine a solution, researchers used the F-8 Digital-Fly-By-Wire aircraft. Various time delays were programmed into the plane's AP-101 computers. Test landings showed that the delay in control surface actuation could cause a pilot to over-control the aircraft, making rapid control inputs and causing a PIO. The solution was to add a software filter, which suppressed the PIO tendency – a solution that was ultimately incorporated into the shuttle's computer system.

Dryden's involvement with the shuttle program did not end with the ALT series. Overlapping the ALT and F-8 flights was the start of drop tests of the solid rocket booster parachute system. A weighted casing was taken aloft by NASA's NB-52B, and then dropped over the National Parachute Test Range, near El Centro, Calif. The first test series involved six drops in 1977 and 1978, and proved the parachute system's viability.

The shuttle was designed as a reusable spacecraft, but the amount of work involved in refurbishing a traditional ablative heat shield – which melted at a controlled rate, to carry off the intense heat of atmospheric re-entry – made this option impractical. A "hot structure" fuselage, built of exotic high-temperature metals also was considered impractical. The solution was to build the shuttle airframe from conventional aluminum, then cover it with ceramic tiles. These were both lightweight and able to sustain multiple re-entries. However, they had to be individually glued to the shuttle.

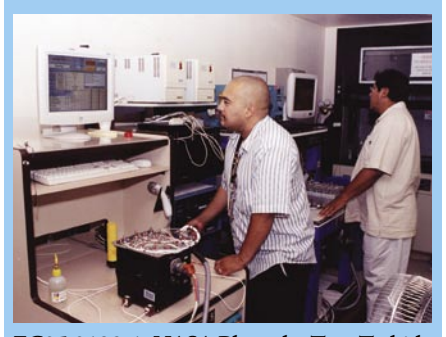
To test the tiles' ability to remain attached under the aerodynamic loads of flight, an F-104 and F-15 were used in a 1980 test series. Each aircraft was flown with a profile that produced aerodynamic pressures and airflow velocities simulating those of a shuttle flight. Because the tiles were made of materials susceptible to impact damage, there also was concern about the shuttle being launched in the rain. The positioning of the tiles on the aircraft simulated six locations on the shuttle: the forward wing area, vertical tail leading edge, window post area, aft of the wing leading edge, and the elevon trailing edge and hinge areas. The tiles were subjected to speeds of Mach 1.4 and aerodynamic pressures of 1,140 pounds per square foot during 60 flights. As a result of the flight tests, several changes were made to bonding and attachment techniques. The tests also showed that storms would have to be avoided because of the potential for damage that the raindrops would cause.

Over the nearly quarter of a century since the first shuttle was launched into space, development activities have been ongoing at Dryden.

The first of these was a second series of solid rocket booster tests made with the B-52B between 1983 and 1985 and involving eight drops. Among modifications made in the wake of Challenger's loss was the addition of a drag chute to reduce the distance needed to land. A total of eight parachute tests were made with the B-52B at speeds ranging from 160 to 230 miles per hour. These were done on both the lakebed and the concrete Edwards runway during 1990.

Landings at the Kennedy Space Center also revealed problems with tire wear. To address the problem, a CV-990 airliner was modified with shuttle landing gear and a tire in the center fuselage. A hydraulic mounting put stress on the landing gear to simulate the weight of the shuttle and the effects of crosswinds during landing. Crosswind landings impose lateral stress on tires and landing gear beyond the stress caused by forward momentum. A total of 155 landing tests were made between April 1993 and August 1995. As a result of the CV-990 tests, the shuttle tire design was improved, permitting the vehicle to land safely on the Kennedy runway in higher crosswinds.

Dryden's most recent contribution to shuttle development came during the F-15B Lifting Insulating Foam Trajectory, or LIFT flight tests. (See related article.)



EC05 0192-1 NASA Photo by Tom Tschida

Battery lab

Dryden's Aeronautical Electrical Systems Facility, more commonly known as the battery lab, charged up to six batteries for Discovery's payload bay. Electronics technicians Roberto Arellano Jr., left, and Juan Santos service a battery for the ER-2.

Photo courtesy Kimberly Vaughn

Making tracks

Once the shuttle lands and the wheels come to a stop, a team of Dryden employees is dispatched to the runway to measure skid marks.

It might sound like an unusual job, but Dave McAllister, a lead operations engineer, said the skids have a story to tell.

It's called post-flight reconstruction; the shuttle pilot wants to be aware of the results to know how well he or she did at landing the orbiter.

"We're usually waiting near the runway as the shuttle touches down and lands. We measure each location where the orbiter touches down, from the top of the runway," McAllister said.

In addition, the team will look at where the orbiter comes to a stop for information that can be used to determine tire and brake wear. It takes about four hours to take the measurements.

EC05 0168-4 NASA Photo by Tom Tschida

Media town

More than 170 members of the national and international press came to Dryden to see Discovery's return from space. Above is the "media farm" that cropped up in the Dryden Public Affairs Office parking lot.

Photo courtesy Gwen Young

Look at this!

Dryden staffers Kristie Carlson, left, and Patti Daws exhibit the sort of enthusiasm created everywhere by Discovery's landing at Edwards Air Force Base.

Astronauts ... from page 3

for us and their prayers were answered. We'll find out exactly what happened (to cause the foam divot to be shed) and find a way to fix it," Collins said.

On the whole, the astronauts said they were impressed with the orbiter's condition after looking it over out on the Edwards runway.

"I was amazed how clean it was – it was the cleanest I have ever seen it (after a mission)," Camarda observed. "Damage to the shuttle was minimal. Foam came off and we have to look at that. I knew the probability and risk (of a shuttle mission) and I accepted the risk. We'll clean up the external tank so that it doesn't 'liberate' foam."

Camarda was optimistic that future missions will have greater flexibility for performing in-space repairs.

"We touched on repair techniques for tiles, and we'll be able to fix reinforced carbon-carbon tile. We may be able to repair something as difficult as the (wings') leading edge in orbit," he said.

Robinson shared Camarda's optimism about the prospect of additional repairs being possible in space, which will benefit future long-duration missions.

"Things are going to fail. Things are going to fail during the violence of launch, or maybe on the way there (to a destination in space) and they need to be repaired. We're good at repairing things on the inside. What we haven't done much of, is replacing or repairing things that aren't really designed to be repaired," he said.

"We took the first baby steps in that direction on this mission. We got right up close to the vehicle. The operation itself was simple, but you have to be very careful. There were two delicate things in very close contact – the underside of the orbiter, and in this case, me. You have to realize that Wendy Lawrence was flying this arm; Jim Kelly was helping out with camera views. She had no windows. She was inside the space station and it's like flying a jet by watching TV. This was a very delicate operation she performed," he explained.

During the mission, crewmembers said they were not concerned about damage sustained by the thermal protection shield blanket on the orbiter's front left exterior.

EC05 0166-57 NASA Photo by Jim Ross

Astronaut Steve Robinson, at right, looks at where, during a space walk, he removed gap fillers from the thermal protection system tiles on the orbiter's belly. Also inspecting the orbiter are astronauts Jim "Vegas" Kelly, left, and Japan's Soichi Noguchi.

"I wasn't concerned about that blanket damage at all. There was consideration of a fourth space walk (to further examine the area); it was a good decision not to do that," Collins said.

For the most part, the astronauts said that during STS-114, their time was largely spent just staying focused on work.

"When you're flying, you have tasks and you're busy, focused on the mission." Collins said.

During re-entry preparations the astronauts were busy with related tasks, but not so busy that the Columbia crew was far from their thoughts.

"There was a moment of trepidation right before Eileen hit the 'execute' on the de-orbit burn, because once you do that you're coming home," Kelly said. "There was a moment of reflection on the Columbia crew."

Several crewmembers also described their pride in participating in the mission and the excitement of flying in a space shuttle.

"It was a great honor participating in this mission," Noguchi said. "It was a great opportunity for an international astronaut to join a great American crew and do the tasks on space shuttle. Hopefully other foreign nationals will have such an opportunity. Columbia is in our minds during mission, but I concentrated on what I should do."

For Kelly, there was no doubt about what constituted his favorite part of the mission.

"I enjoyed watching the world go by, and I enjoyed the challenges," he said. "There are a lot of game-day challenges. I thrive on those, and what we did was a success."

Collins said the view of Earth from space was her fondest memory.

"This experience that we had was just absolutely wonderful – breathtaking, and a challenge. It was a huge achievement," she said. "The human side of being in space is something I wish I could share with all of you. I wish I could have taken all of you up there with us.

"We saw some of the most beautiful parts of the Earth. During the day we flew over North American, Europe, Africa, Asia, the Pacific Ocean and Australia. At night we saw the Southern Lights. In fact, we flew through the Aurora Borealis and beautiful, moving lights with colors. We saw many sunrises and sunsets."

Concerning future shuttle missions, Collins said obstacles remain but that NASA will be ready.

"The shuttles will not fly forever; we do see signs of aging," she said. "Airplanes' age is just like people age. We're going to continue to fly the shuttle until we finish our commitment to the International Space Station. I think that the work that's been done on the shuttle program has been fantastic.

"I accepted the risks to fly this flight. I was right in there with the controversies and issues on what should be fixed and shouldn't be fixed. We did all the right things. We fixed what needed to be fixed. We realize more work will have to be done. Eventually the shuttle will make its last flight and that will be a sad day, because I believe the space shuttle program has been very successful."

And, she said, the mission of space exploration must continue.

"This mission was a very important step toward exploring space and making life better for everyone. We all believe in space exploration. Space exploration is a fantastic part of the human experience and people must continue to support it."

Visitors ... from page 4

Discovery while she was being prepped for her cross-country return flight to Florida. In a letter Marren wrote to Gene Zimmerman, Forest Supervisor for the San Bernardino National Forest, he reflected on the search effort.

"I sincerely believe that without the firefighters' systematic gridding of the entire 4-mile-by-200-mile corridor, NASA would have never been able to bring the investigation to a conclusion. Thanks to people like (these fire fighters), the space shuttle will fly again," Marren wrote.

Staff from the U.S. Environmental Protection Agency, Federal Emergency Management Agency and other federal agencies joined volunteers collecting the debris, which was then turned over to NASA and sent to Barksdale Air Force Base, La., to be used in reconstructing Columbia. The recovered debris was later sent to Kennedy Space Center.

Crews worked 12-hour shifts slogging through murky water, thick woods and thorns in an inhospitable environment that subjected searchers to drastic temperature changes, sickness and snakes. In one incident, a search team member was bitten in the shoulder by a deadly Cottonmouth water moccasin.

For McCormick, a veteran of earthquake emergency operations, the work was grim and harsh, but he said that the orbiters "bond the nation together, and the recovery effort was an example of that bond people everywhere feel for the space program."

"It was one of the most rewarding experiences of my career. It was being a part of history and it helped NASA to get back on track," he said.

Native Americans who assisted with the search impressed Cawthon.

"It seemed like a transcendent effort when I saw a Native American dream catcher with a space shuttle in the middle," she recalled.

WATR ... from page 10

operations, we continued to support all Dryden missions, including the successful, final dual Unmanned Combat Air Vehicle flight," he said.

"Dryden uses the same long-range radio communications systems for both the shuttle and local Dryden flight research mission support. This provides WATR communications (staff) an advantage, in that the local flight support allows us to maintain a high degree of proficiency operating the systems required to support space shuttle operations, including launch, on orbit and landing."

Additional WATR support provided during the landing at Dryden included long-range optical and infrared cameras, video vans for runway video coverage as well as the Mission Control Center that offer key support personnel a location in which to coordinate and monitor landing activities.

Should Dryden experience a commercial power failure during shuttle activities, all crucial WATR areas feature uninterrupted power systems as well as backup generator services. In addition, onsite contractor maintenance personnel monitor the backup systems and provide any emergency services required during critical shuttle operations.

The X-Press is published for civil servants, contractors, retirees and others interested in the work of the Dryden Flight Research Center.

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