

The 21st Century space shuttle: better than ever

By James Hartsfield

On STS-101, *Atlantis* will be the most up-to-date space shuttle ever. From a new "glass cockpit" to main engines estimated threefold safer, *Atlantis* is far different than when it first flew in 1985. Hidden beneath its familiar shape, the shuttle has undergone a metamorphosis over the years – from the inside out, thousands of advances in technology and enhanced designs have been incorporated. Today's result is a safer, more powerful and more efficient spacecraft than ever before.

"The space shuttle already is the most reliable and least risky launch system in the world," said Elric McHenry, manager of Space Shuttle Development. "We've made major improvements in safety over the past several years, and we now have several things in work to make the system even safer."



As the fleet approaches the 100th shuttle launch this year, even the most-traveled shuttles still remain young in the 100-mission lifetimes for which they were designed. NASA is preparing for the possibility of flying the space shuttle for at least another decade, McHenry said, and future shuttle improvements are geared toward a goal of doubling the launch safety of the shuttle by 2005.

"Cutting risk is our top priority," McHenry said. "Several technologies available to us may be able to do that, and we plan to vigorously pursue them. In addition to making the shuttle a safer spacecraft for astronauts, developing these safety improvements may contribute to technologies that will be used one day on whatever next-generation reusable launch vehicle may be built."

Now flying: *Atlantis*' 'glass cockpit'

A new "glass cockpit" is the most visible of more than a dozen improvements flying for the first time on *Atlantis* on STS-101. In the new cockpit, eleven full-color, flat-panel display screens replace 32 gauges and electromechanical displays and four cathode-ray tube displays. The new cockpit displays, technically labeled the Multifunction Electronic Display Subsystem (MEDS), are 75 pounds lighter and use less power than before. The color displays provide easier pilot recognition of key functions. The new cockpit will be installed in all shuttles by 2002.

MEDS replaces obsolete parts, increases safety and redundancy and sets the stage for a future "smart cockpit" upgrade that will improve the way information is presented to shuttle crews, said Andy Allen, assistant program manager, Space Shuttle Upgrades, for United Space Alliance.

"If something goes wrong and you have a red or yellow indication, it will get your eyes to the right place a whole lot quicker than trying to scan a lot of green lines to find out what happened," Allen explained.

In all, *Atlantis* had more than 100 new modifications incorporated during a 10-month period at Boeing's Palmdale, Calif., shuttle factory in 1998.

"Some modifications to *Atlantis* are as small as putting different kinds of lines and hoses inside the vehicle and some are as large and as visible as the new cockpit and an exterior airlock," Allen said. "More than a dozen of the upgrades on *Atlantis* are flying for the first time on a shuttle." Most of *Atlantis*' upgrades will be incorporated into the entire shuttle fleet in the next few years.

In addition to the new cockpit, some of *Atlantis*' major improvements include: relocating the airlock to the payload bay to prepare for International Space Station assembly flights; updating portions of the



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communications system; installing several weight reduction measures; providing additional protection to the cooling system; and strengthening the

crew cabin's floor. *Columbia* is now at the Palmdale factory receiving many of the same upgrades, including installation of the "glass cockpit."

Future shuttle upgrades: cutting risks in half by 2005

The top future shuttle enhancements that are now under development are hoped to double the shuttle's launch safety in the next five years, Elric McHenry said. They include: new sensors and computer power in the main engines that will "see" trouble coming a split second before it can do harm, allowing a safe engine shut-down; a new engine nozzle that will eliminate the need for hundreds of welds and potential leaks; electric generators for the shuttle's hydraulics that will replace the highly volatile rocket fuel that now powers the system; and a next-generation "smart cockpit" that will reduce the pilot's workload in an emergency, allowing the crew to better focus on critical tasks. Other improvements will make steering systems for the solid rockets more reliable, make the manufacturing of solid propellant safer and increase the strength of external fuel tank welds.

A "Smart Cockpit" – The new "glass cockpit" that will be initiated when *Atlantis* launches on STS-101 sets the stage for the next cockpit improvement, planned to fly by 2005: a "smart cockpit" that reduces the pilot's workload during critical periods. The enhanced displays won't fly the shuttle, but they will do much of the deductive reasoning required for a pilot to respond to a problem. By simplifying the pilot's job, this "smart cockpit" will allow astronauts to better focus on critical tasks in an emergency. The "smart cockpit" will take full advantage of the capabilities offered by the MEDS displays and will include some additional computer power to run enhanced displays.

Better Main Engines – The space shuttle's main engines operate at greater extremes of temperature and pressure than any other machine. Since 1981, three overhauls to the original design have more than tripled estimates of their safety. Now a fourth major overhaul, called the Block III engine, is planned that will make them even safer by 2005. The planned improvements include a high-tech optical and vibration sensor system and computing power in the engines that will "see" trouble coming a fraction of a second before it can do harm. Called the Advanced Health Monitoring System, the sensors will detect and track an almost microscopic flaw in an engine's performance in a split second, allowing the engine to be safely shut down before the situation can grow out of control.

