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▶ CASE STUDIES IN SUCCESS

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THE DATA THAT ENSURES THE SAFETY AND SUCCESS OF EVERY SPACE SHUTTLE MISSION IS BACKED UP ON QUALSTAR TAPE LIBRARIES

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CASE STUDIES IN SUCCESS

BOEING®

"We researched over twenty backup solutions before selecting Qualstar with Sony AIT. In the end, nothing else came close on performance or construction."

Michael J. Laverty
Computer Engineer & Systems Administrator,
Launch Support Mission Operations,
Space Shuttle Main Engine

"Our success is dependent upon our data, and our data is dependent on Qualstar. The quality and reliability of these libraries is unparalleled, and the only system we trust."

R. Dean Patmor
Engineer / Scientist,
Launch Support Mission Operations,
Space Shuttle Main Engine

THE COMPANY

In a sprawling facility in Canoga Park, California, just north of Los Angeles, resides Boeing's Rocketdyne Propulsion & Power Division. The only hint that something special might be going on inside is the enormous rocket engine that overshadows the entrance to this high-security complex. Boeing Rocketdyne designs and builds most of America's liquid-filled rocket engines. This is also the home of the Space Shuttle Main Engine Control Room.

Boeing's Rocketdyne Propulsion & Power Division is located in Canoga Park, California, just north of Los Angeles.

Dean Patmor has a job that we all once, and maybe even now, wished we could have . . . *Rocket Scientist!* Patmor is the man in charge of Boeing's Launch Support and Mission Operations for the NASA Space Shuttle Program. His is one of the voices you hear during the final countdown for the launch of the Space Shuttle – a voice with the power to say . . . "Go or No Go" . . . to one of the most beautiful and costly flying machines in the US Space Program, with its most important cargo – the astronauts.

As you walk down the corridor to Boeing Mission Control, there are pictures of every astronaut and their Shuttle missions – one hundred and thirteen in all. Patmor has been involved in most of them, so his intensity makes sense.

On a Shuttle launch day the complex fueling process begins nine hours before liftoff when the highly volatile propellant is pumped into the tank for the engines that power the Shuttle to orbit. On TV you see the huge, orange external fuel tank on the side of the Shuttle – nose up, wings back, poised for liftoff.

In Canoga Park during those nine hours before liftoff, eight engineers sit in front of monitors looking at engine data – real time data from the Shuttle on the launch pad overlaid on previously archived data for the same engines. Another 300 Boeing engineers are on call.

The room itself is a mini-mission control with consoles and screens arrayed in an arc around the room. Engineers are monitoring the Shuttle engines as they go through self-tests and thermal conditioning – bringing the temperature of the engines down so that the frigid propellant will not destroy them on ignition. The engineers have very specific jobs and titles – Turbomachinery Engineer, Instrumentation Engineer, Software Engineer, Avionics Engineer, Performance Analysis Engineer, Principal Engineer, and Team Manager. None of them are looking at the same screen or data in the control room.

Propulsion & Power Division is the home of the Space Shuttle Main Engine Control Room. And Qualstar Tape Libraries are an integral part of the launch process where data backup, retrieval and integrity is essential.

During the fueling process, three thousand sensors report 25 times per second while every engine function is checked. The real-time feed of telemetry from the Shuttle on the pad is compared to historical data for those same engines during previous launches in a process

called trend analysis – trying to find an "out-of-family" condition that might make a Shuttle engine unsafe and require its shut down, scrubbing the mission.

So, those nine hours are critical to the mission's success. As the engineers compare the real and historical data, they can detect a problem and correct it, while analyzing the other ongoing factors such as launch pad status, vehicle readiness, or weather conditions that also affect the engines.

Michael J. Laverty, left, Computer Engineer & Systems Administrator, and R. Dean Patmor, right, Engineer / Scientist, Launch Support Mission Operations, Space Shuttle Main Engine.

At T–0, liftoff occurs and the solid fuel booster engines are lit. There is no going back now. In 8.5 minutes, the Space Shuttle goes from sea level to orbit, and once in orbit, the engines are shut down. The drama for the Boeing engineers is, in a way, over. But for the Shuttle and astronauts, for the Space Program itself, the way those engines perform means the beginning of the space adventure, over and over again, with each and every mission.

During launch, Patmor is the expert, or rather the commander of experts, on the engines built by Boeing for the Space Shuttle. Even on a relaxed day, a day without a launch of the Shuttle or one of NASA's Delta or Atlas rockets, Patmor is intense despite his casual attire. He has high standards for the way things are built, he says. He is, after all, an aeronautical engineer by training and a pilot by avocation.

THE CHALLENGE

Patmor says, with real disgust, "the single most frustrating thing about my job has been . . . finding a reliable tape backup system for trend analysis." In trend analysis, the real time telemetry is compared to historical data – backed up and archived data must be quickly located and transferred during those nine hours before launch, perhaps essential data during the 8.5 minutes from liftoff to orbit.

That's where Michael J. Laverty, a Computer Engineer and the Flight Team's Systems Administrator, comes in. He is as outgoing as Patmor is intense. He speaks rapidly, as if everyone understands everything about the computers, servers, network, backup systems and the tape libraries he manages. He designed, built and configured the systems that store the vital launch data, the history of Boeing's Space Shuttle Main Engine performance.

Two years ago, Patmor and Laverty started searching for the best backup systems, libraries and vendors they could find. "The safety and success of every launch," Patmor stressed, "depends on data. The absence of data could scrub the launch or, worse, result in a loss of life."

THE SOLUTION

As a result, they were thorough. They investigated over twenty vendors. In the end, they liked what they saw and heard from two firms in their own neighborhood – Tape Laboratories, Inc., who suggested the Sony AIT tape technology, and Qualstar Corporation, who invited them to walk through the manufacturing plant where their automated tape library would be built.

During their search, they took many libraries apart to see if any of them could meet their critical standards for design, manufacturing and operational quality. Of the twenty vendors they considered, only one met Patmor and

Laverty's criterion – and that was Qualstar's TLS-4000 Series. "Qualstar is robust – it's one solid design. Qualstar's robotics is beautiful – simple but ingenious. There is nothing that is mechanically an extra, so the robotics are smooth. This is aircraft quality hardware," said Patmor.

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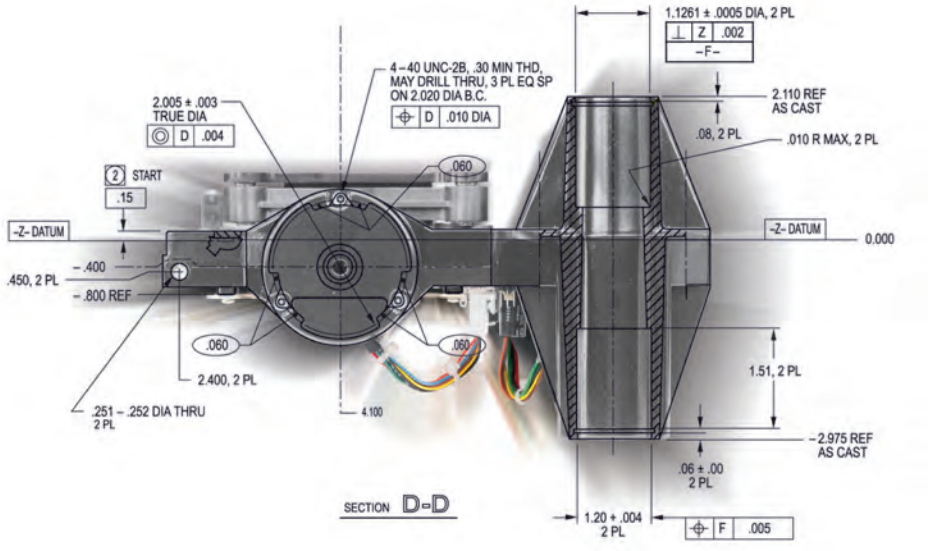
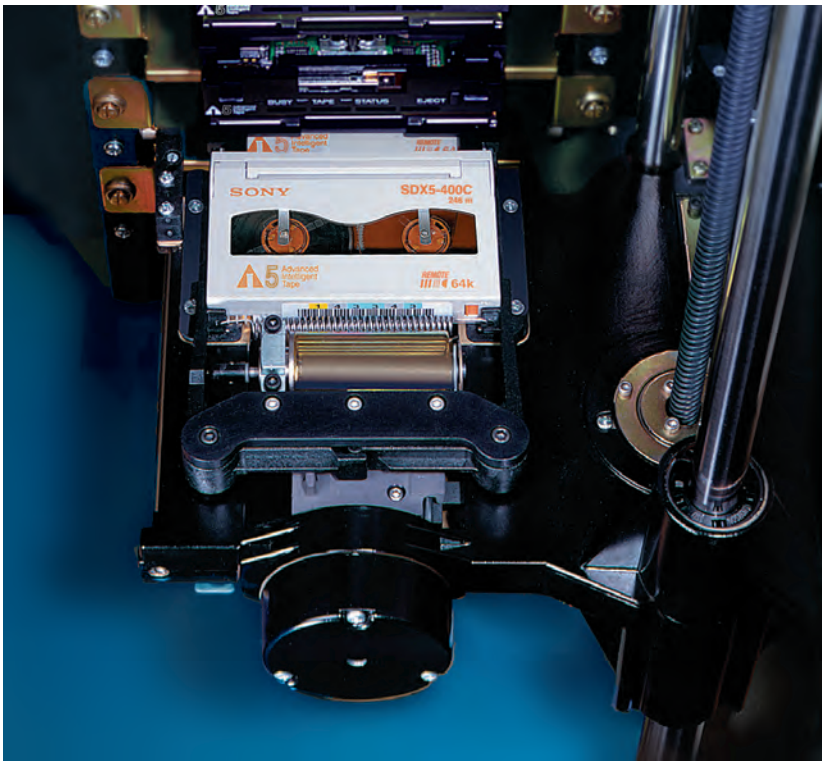


THE SOLUTION, CONTINUED



According to Laverty, one of the things that kept him up late at night before he added the Qualstar solution was the patchwork backup system he had in place.

In the past, Boeing did selective, non-full backups, hoping that the right data would be there when a restore was needed. Not only did Laverty worry that something he did not select would fail, but it was also very time intensive. "During those lengthy backups, I always had to trade-off what I wanted to protect against the time I had to get it done. It was aggravating."

"Now, we backup everything several times. I do test restores on a random basis several times a week. Every single time, the restores have been flawless and so has the Qualstar library," Laverty asserted. As good luck would have it, just three days after installing the Qualstar library, he had to restore mission-critical data – lots of it. "In twelve minutes," Laverty explains, "I restored nearly seven gigabytes across a 100Base-T network. This would have been impossible without the Qualstar library." It was at this point that Laverty and Patmor knew that they had made the right choice for Boeing, NASA, and the US Space Program.

THE FUTURE

Laverty conducts daily incremental backups and full backups every week. He backs up both onsite and offsite clients and servers. He currently has a terabyte of data, 31 servers and 85 workstations, with 150 additional clients planned within the next two years. His system's infrastructure is separate from the rest of IT, because the main engine control room must be self-contained. Laverty presently has nine Sony AIT tape drives installed in the library. The Qualstar TLS-412360 can house 360 tapes yielding 144 terabytes of native data and over 374 terabytes of data with compression.

"In twelve minutes, I restored nearly seven gigabytes across a 100Base-T network," says Laverty, left, with Patmor in the Launch Data Center.

This is the kind of reliable performance that those involved with the NASA Space Program can fully appreciate. After all, the data that ensures the safety and success of every Space Shuttle mission is backed up on Qualstar Tape Libraries.

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