Recertification Program Helps Prevent Catastrophic Explosions

In April of 1971, part of the heavy concrete floor and ceiling and window panels in the Propulsion Systems Laboratory Equipment Building were ripped open when an exhaust header exploded. Because the blast occurred in the pre-dawn hours, only one person was injured. A mechanic walking outside the building suffered a broken arm when he was struck by a small piece of flying concrete. Had the explosion occurred later in the day, the number of injuries could have been greater.

This incident, and similar ones at Langley and Ames, emphasized the need for a well-organized, thorough, and cooperative effort to assure the safety of the many pressure vessels and pressurized systems needed to conduct NASA research. These systems supply compressed air, altitude exhaust, and various other gases and liquids essential for experimentation.

In 1976, NASA Headquarters' Office of Safety and Environmental Health issued guidelines for in-service inspection of ground-based pressure vessels and systems and the research centers were directed to develop recertification programs.

Currently, Lewis is in the fifth year of a five-year recertification program designed to identify, evaluate, document, and certify all high-priority pressurized systems and high-priority components. The program is managed at Lewis by the Facilities Engineering Division.

Why Recertify?

Recertification is defined as the procedure by which a previously certified vessel or system is determined to be qualified to operate at the designed (or rerated) pressure. Appropriate tests, inspections, examinations, and documentation are used in making such determinations.

When the first facilities at Lewis were built in the 1940's, construction proceeded quickly to meet the needs of the war effort. As a result, in some cases analyses and documentation about how the first pressure systems were designed, built, and certified are inadequate. Also, over the years, new systems have been added and the original systems have undergone extensive modifications to meet the changing needs of Lewis' programs.

Scope And Purpose

The Lewis recertification inventory currently contains 117 pressurized systems, 416 pressure vessels, 27 altitude exhaust coolers, 638 relief devices, and 360 expansion joints.

Pressurized systems include: compressed air; natural gas; gaseous hydrogen; gaseous oxygen; inert gases such as nitrogen, helium and argon; cryogenics such as liquid nitrogen, helium, argon, hydrogen and oxygen; Jet A and JP-4 fuel; and altitude exhaust (vacuum) systems.

For each pressure system and vessel, the recertification program is designed to: 1) insure its structural integrity; 2) evaluate, establish, and monitor its remaining life; and 3) assure its capability and availability for supporting research programs.

Highest priority has been given to recertifying those systems which have the largest potential for injury and damage.

Four-Step Process

The Lewis recertification program involves four major steps: identify; evaluate; document; and certify.

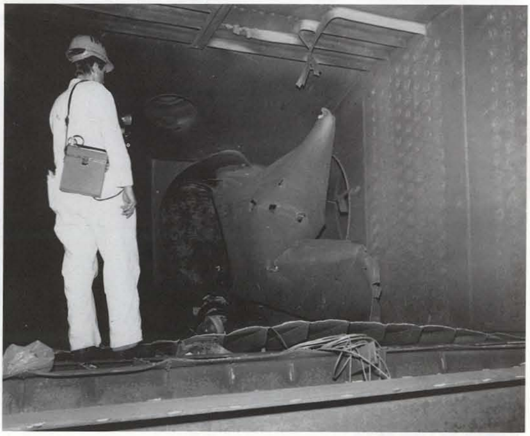
Identification includes defining each system and its components, such as pressure vessels, relief devices, coolers, and expansion joints. This step also involves gathering data such as: system components, pressure, temperature, and cyclic operation; kind of fabrication material used, such as carbon steel or stainless steel; and the type of assembly, such as welded or flanged.

Evaluation involves comparing the certification records for each system from the time of its installation with the system's current configuration. If this documentation is missing or incomplete, it is obtained from manufacturers or equivalent documentation is generated.

Documentation requires investigating piping and component suitability, determining what inspections and tests are necessary, and preparing specifications for the nondestructive testing. Additional engineering activities include conducting and documenting required stress analyses.

Certification includes visual inspection and nondestructive tests such as radiography, ultrasonic, and magnetic particle testing, or a recommended combination of such tests. All data obtained from these inspections are

In 1971, the pre-dawn explosion of an exhaust header in the Propulsion Systems Laboratory Equipment Building caused substantial damage to the heavy concrete floor and ceiling and window panels. The recertification program currently underway at Lewis is designed to prevent similar incidents in the future.



ABOVE: In 1985, an implosion in a cooler in the basement of the Engine Research Building was caused by the failure of several welds between a support beam and the cooler floorplate. **RIGHT:** The force of the implosion shattered windows and caused other damage to the building. The system's collapse may have been prevented if the insufficient welds had been identified and corrected earlier.

properly documented, as prescribed by approved certification guidelines.

A computer data bank has been established to store and manage this vast amount of information. For each system and its components a system data book is prepared for use as a continuing reference source.

Any system or component found to be in need of repairs is projectized through the Lewis Construction of Facilities Program or institutional funding plan.

Cooperative Effort

Because the work is so extensive and detailed, numerous NASA and contractor employees are involved.

The Facilities Engineering Division manages the recertification program. Recertification Program Manager Jim DeRaimo handles the details of program management and oversees the work of the engineering service contractor.

The contractor, O'Donnell and Associates, conducts field surveys, collects existing engineering data, updates existing drawings and schematics, prepares new system drawings if necessary, performs engineering evaluations, provides engineering/safety reports, recommends recertification requirements, prepares nondestructive testing specifications, performs nondestructive testing, and prepares final recertification documentation. The firm also provides engineering assistance for updating the recertification data bank.

The Facilities Operations and Maintenance Division is responsible for shutdown scheduling, arranging for necessary emergency repairs to be made by on-site contractors, coordinating the ongoing inspections and modifications, and arranging for follow-up inspections and recertification.

The Computer Services Division catalogues all the accumulated data and makes sure that it's programmed for convenient retrieval. The Computer Services Division has also helped developed a "tickler" file system for follow-up inspections.

Potential Hazards Identified

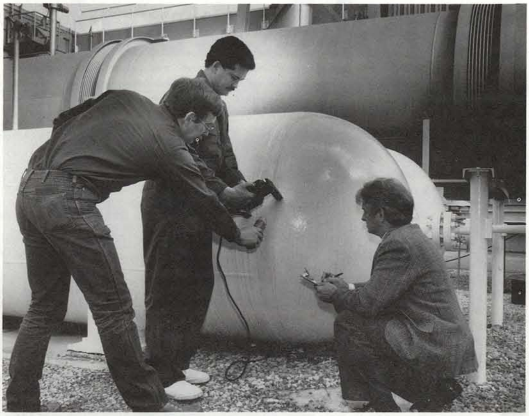
The thorough inspections of the many systems have revealed some potentially hazardous conditions. For example, in parts of certain systems, inspections found instances of: inadequate pressure capability of piping; incorrect installation of relief devices; inadequate support and protection of piping systems; poor welds and corrosion; lack of vent stacks in gaseous hydrogen systems; lack of labeling and fluid identification; and insufficient height of gaseous hydrogen vent stacks. Critical deficiencies are immediately corrected.

Continuing Protection

DeRaimo estimates that the current program is about 75 percent complete. He anticipates it will be completed as scheduled by the end of 1987 and expects a follow-on program to address less critical systems and components.

"Maintaining the safety of the newly recertified systems will depend greatly on cooperation and support from employees throughout the Center," notes DeRaimo. For example, it's essential that facilities engineers, on-site support service engineers, and contractors adhere to design codes, standards, and specifications when modifying the process systems. Operations and Maintenance personnel must provide diligent systems maintenance and repairs based on approved operating procedures. And Building Managers must make sure that unauthorized ties to process systems are strictly prohibited and that the configuration control procedures outlined in Lewis Management Instruction 8820.1 are followed. Proper modifications should be authorized only through official Process Systems Work Orders, NASA Form C-29.

"Involvement in sophisticated high-tech experimentation always presents risks," says Bill Guthrie, chief, Mechanical Engineering Branch. "The recertification program is designed to help minimize some of those risks. To ensure the highest level of safety, everyone at Lewis must help make the recertification program a success."



The current five-year recertification program is designed to insure the structural integrity and evaluate the remaining life of each of Lewis' 117 pressurized systems, 416 pressure vessels, 27 altitude exhaust coolers, 638 relief devices, and 360 expansion joints. Shown above: Recertification Program Manager Jim DeRaimo (kneeling) and O'Donnell and Associates employees Lou Hass (left) and Gary Selier conduct a magnetic particle inspection of a head-to-shell weld on a pressure vessel.

Recertification Videotape

To help build awareness of the importance of the recertification program, Guthrie has worked with the Photographic and Printing Branch to produce an informative videotape.

Entitled "Process System Recertification Program," the new 20-minute videotape fully explains the program. It is intended for all Lewis organizations that deal with process systems. Supervisors may borrow a copy of the videotape by calling Bill Guthrie (3-5480).

NASA News Briefs

Space Technology Brings New Findings On Ancient Maya

Satellite images of Mexico's Yucatan Penisula, Central Guatemala, and Belize have led to new discoveries about ancient Maya settlement patterns, environmental setting, and natural resource use. NASA scientists have found evidence of an ancient river plain, sea level changes, and tectonic fault lines, which may have been important geographic elements in shaping the ancient Maya civilization. The satellite imagery is also being used to detect Maya water sources, such as a natural wells and ponds, and compare their locations to those of ancient Maya ruins.

Noted for its elaborate temples, advanced mathematics and astronomy, and large-scale architecture, the Maya civilization spread across Central America from 2000 BC until the Spanish conquest in the 16th century. Investigators believe the remote sensing project will help explain how the Maya built a sophisticated civilization in a relatively resource-poor environment. They also hope to understand the mysterious cycles of expansion and decline that characterized the Maya civilization. Many scholars believe that environmental problems, including the misuse of resources, may have led to the periods of decline.

While remote sensing has been widely used to search for archaeological sites, the Ames project is the first to use space technology to attempt to understand an ancient civilization by studying its environment.

The Ames archaeology-remote sensing project stems from NASA's interest in demonstrating the applications of space technology to a wide variety of disciplines. The project also reflects NASA's growing emphasis on applying space technology to studying the Earth's ecosystem and the problems involved in maintaining a stable, life-sustaining environment on Earth.

International Space Research Program Underway In Greenland

An international space science research program, named the 1987 Greenland-II Cooperative Observations of Polar Electrodynamics (COPE), plans to launch ten suborbital rockets from So/ndre Stro/mfjord, Greenland. The launch operations began last month and will continue until early April.

The program is being conducted by NASA in cooperation with the Air Force Geophysics Laboratory (AFGL), the Danish Meterological Institute (DMI), and the National Science Foundation.

The program objective is to better understand the Sun's outer atmosphere and how it affects the near-space environment of Earth, as well as the Earth's atmosphere. Scientists expect to gather new knowledge about Sun-Earth relationships and fundamental plasma processes in Earth's space environment. The program will employ ten sub-orbital rockets and airborne and ground-based measurement systems.

Five rocket-borne experiments will release chemicals creating artificial vapor clouds above 155 miles altitude visible over a 500-mile radius from the launch site.

Greenland is considered unique for these scientific investigations because of its access to the auroral oval, polar cap, and polar cusp; its existing rocket range; support from an extensive array of scientific ground observing stations in Greenland, Scandinavia, and North America; and a broad choice of launch azimuths.

Last summer, personnel from Goddard-Wallops Flight Facility installed additional launchers and related ground support equipment, radar, telemetry and communications systems. Vehicle and payload assembly structures were erected and the Danish launch facility at So/ndre Stro/mfjord was expanded and improved.

Payload experimenters represent NASA, AFGL, DMI, Cornell University, Danish Space Research Institute, Utah State University, University of Alaska, University of Alabama-Huntsville, Clemson University, Naval Research Laboratory, Southwest Research Institute, and Franklin Research Center. Ground-based scientists represent Stanford Research Institute International, Boston University, Cornell University, Lockheed Corp., the University of Michigan, and Technology International Corp.

NASA COSPAS/SARSAT Managers Honored By USSR

Two NASA search and rescue mission managers, Robert Lovell and Fred Flatow, were recently awarded the Yuri Gagarin medal by a space delegation from the Soviet Union. Named after the Soviet cosmonaut who was the first man in space, the Yuri Gagarin medal is awarded for outstanding achievement in astronautics.

The medal was bestowed on Lovell and Flatow in recognition of their contribution to COSPAS/SARSAT, an international search and rescue program which uses satellites to rescue people in distress. Since its inception in 1979, COSPAS/SARSAT has helped save nearly 750 lives.

Lovell has worked for NASA for 25 years. Since 1980, he has served as director, Communications Division, at Headquarters. He manages advanced communications satellite technology research and development.

Flatow joined COSPAS/SARSAT in 1982 as deputy for search and rescue missions at Goddard. He became search and rescue mission manager in 1984.

The United States, Canada, France, and the Soviet Union are the principal partners in the search and rescue program. In the United States, COSPAS/SARSAT is jointly operated by NASA, the National Oceanic and Atmospheric Administration, the Coast Guard, and the Air Force. The research and development effort for the U.S. participation in COSPAS/SARSAT is conducted at Goddard.