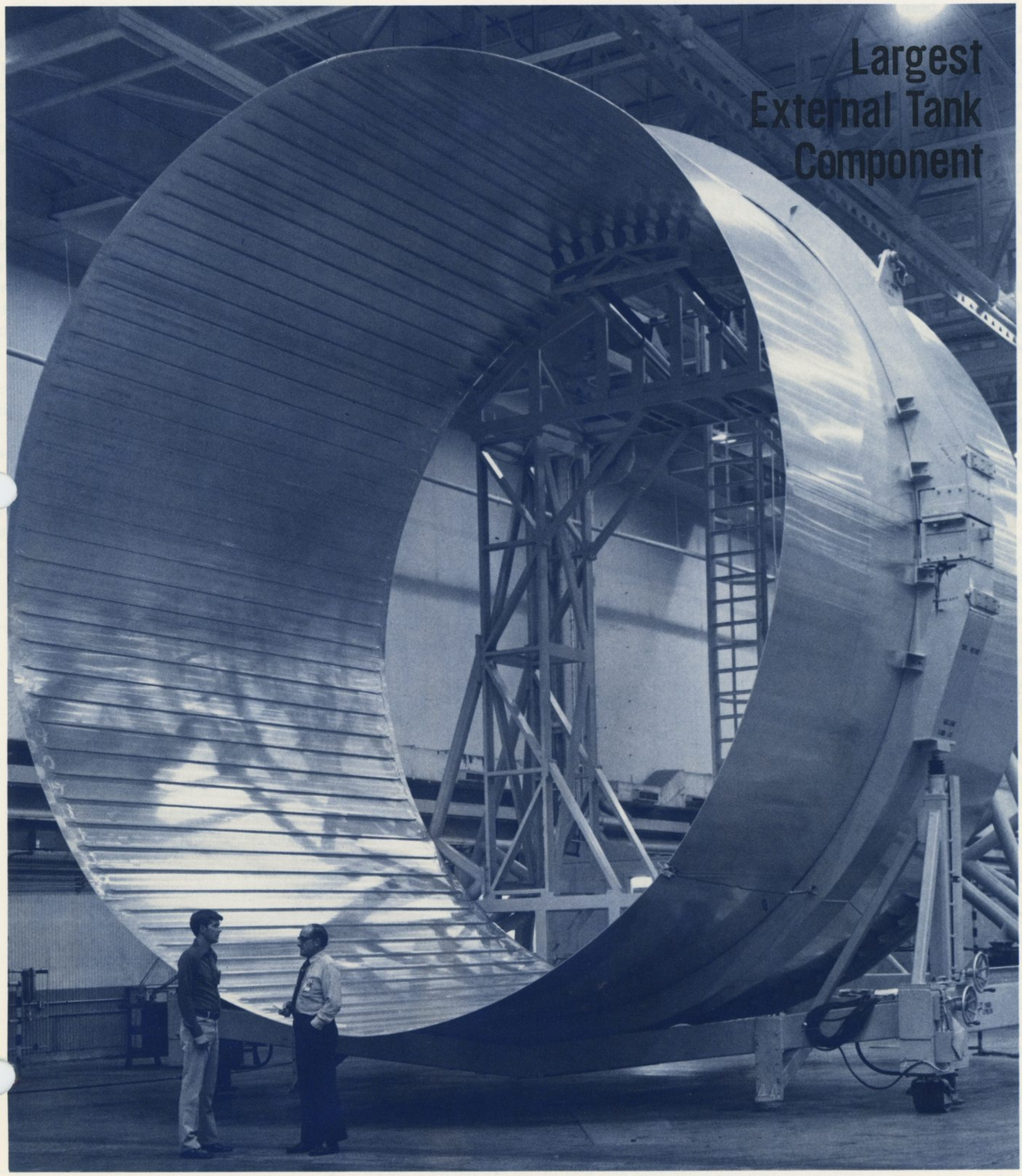
MARTIN MARIETTA
news
DENVER DIVISION

NUMBER 2/1977

Largest External Tank Component



Viking relativity measurements accurate

Almost 60 years to the day after Albert Einstein published his Theory of General Relativity, Viking scientists made crucial measurements that will test his theory as it has never been tested before. And the crucial measurements were successful.

Dr. Irwin Shapiro of the Massachusetts Institute of Technology and a member of the Viking radio science team, discussing the experiment at a recent Viking news briefing, said, "Viking's contributions to biology, geology, meteorology, and seismology are. . .well known, but Viking is also making important contributions to fundamental physics, via (the) relativity experiment."

As Dr. Shapiro said, the Viking relativity experiment is a test of the fundamental theory of gravitation which is Einstein's theory of general relativity.

Gravitation, Dr. Shapiro pointed out, is the weakest of the four known forces in nature. "It is so weak," the Viking scientist said, "that it is 10 to the 40th (power) weaker than the electromagnetic force, the force that is responsible. . .for all of life and all of chemistry."

Why test the theory of gravitation?

"Well," Dr. Shapiro said, "we want to know whether our theory is correct because it's very important as a theoretical tool in astrophysics for understanding what makes neutron stars tick—whether black holes exist or not and what their properties are.

"We also want to know. . .the sources of the tremendous amounts of energy released in quasar outbursts seen in all parts of the electromagnetic spectrum and also to answer questions about the destiny of the universe.

"Will (the universe) continue to expand forever or will it reach a maximum size and collapse on itself like a giant black hole?"

(Editor's Note: On a black hole, the surface gravity is so great that not even light can escape, making it invisible and thus its name. It can attract and swallow matter—even a star—but it cannot radiate.)

"In addition," Dr. Shapiro said, "physicists feel that gravitation may play an important role in our understanding of elementary particles."

Healthy spacecraft

G. Calvin Broome, mission director for Viking, was brief and to the point in his opening remarks at the recent press briefing on the Viking mission. Summing up the status, he said:

"I guess the report I would make is that we have four very healthy spacecraft with relatively minor problems. We are talking to them—they are talking to us and the extended mission is well underway."

What aspects of the theory of gravitation is Viking able to test? According to Dr. Shapiro, it is able to test the behavior of light, or in this case, radio rays in the gravitational field.

The theory of general relativity predicts that the path of a light ray (or radio ray) as it passes a massive body like the Sun is deflected towards the body and also slows down as it approaches the body. The Viking relativity experiment looks for this effect and measures it by measuring the slow down, or increase, in echo delays of radio signals sent from Earth to the spacecraft and sent by the spacecraft back to Earth. The roundtrip echo delays are measured to see if the slowing down can be detected.

The result? So far, the Viking tests are in "very good agreement" with the theory of general relativity. The tests already are at least twice as effective as any previous test with a prediction that when complete they will be a ten-fold improvement over all prior tests.

"I would like to point out the incredible accuracy with which these measurements have been made," Dr. Shapiro told the press briefing. "Some of the measurements were made with an uncertainty no larger than the distance from my head to my feet. That is, only a five-foot error out of a 200 million mile path.

"That is the highest tractional accuracy of a length measurement ever made outside a laboratory in the history of man—corresponding to an error of only five-tenths parts in ten million million."

What about the theory of general relativity? "We find it to be still an accurate representation of nature at this level of test," Dr. Shapiro said.

The Economic Facts

It's your budget, too

Budgets for government spending are being debated in the Congress of the United States and in the Colorado State Legislature.

The outcome of those debates is important to you. Your taxes, the taxes of the companies whose products you buy, and the taxes of Martin Marietta will fund the budgets.

Keep that in mind as you read and hear about the state and federal budgets.

You can and should do something about your financial interest in what legislators do: Write.

The cynic's claim that lawmakers listen to no one—or only to the wealthy, the powerful, the influential—is not valid.

While the lawmaker himself may not read your letter, a member of his staff will and report your views along with the views of those who agree or disagree with you.

Letters that are brief, to the point, and clear in their views command the most attention.

If you don't write, you have no right to say your representative voted the wrong way.

Astronomer joins division's space telescope program

you are planning to build eqipment to be used by observational astronomers, you should know what an astronomer needs and how the equipment will be used.

The division does plan to build such equipment—the space telescope—and it does have someone who knows its needs and uses.

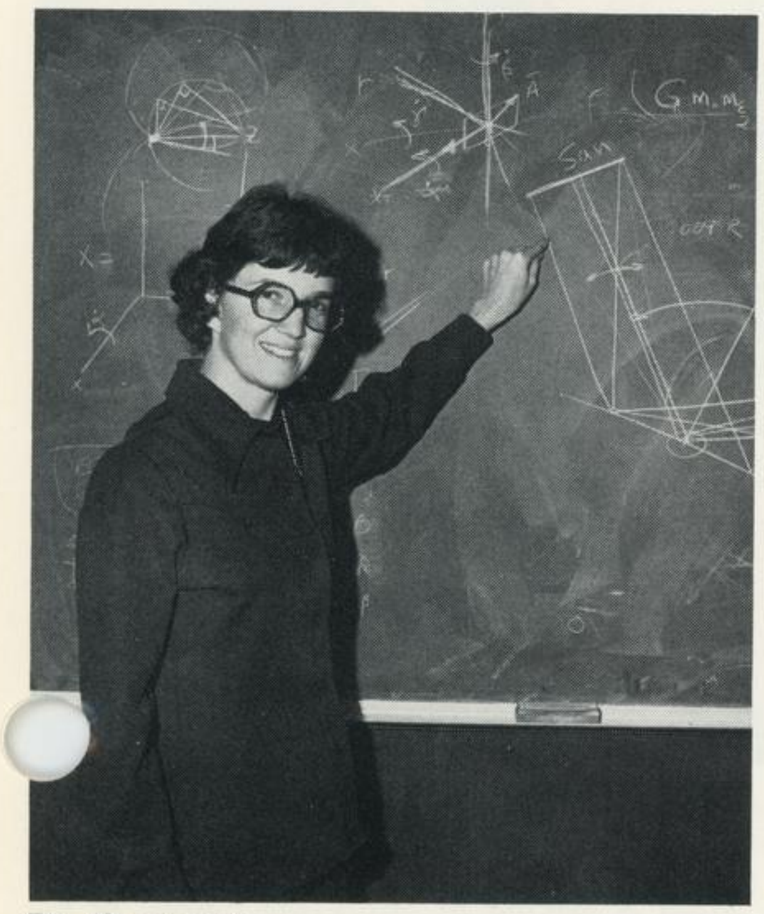
Dr. Catharine (Katy) Garmany, an observational astronomer, has joined the division's space telescope team to help engineers understand astronomical requirements of the space telescope.

"I am discussing what space telescope will see and how it will have to be used to see what it will be looking at," Dr. Garmany said. "I am also providing a link with other astronomers—astronomers prefer to talk with astronomers."

A native of New York City, Dr. Garmany moved to Denver in 1974 when her husband, Dr. George Garmany, began his residency in neurology at Colorado General Hospital. They met at the University of Virginia where each received a doctorate his in medicine and her's in astronomy.

She was a research associate at the University of Virginia for several years, working in astrometry—particularly, measurement of stellar motion—and was a parttime teacher in Atlanta before moving to Denver.

Dr. Garmany is currently associated with the University of Colorado and the Joint Institute of Laboratory Astrophysics (JILA). JILA is associated with both CU and the National Bureau of Standards.



Dr. Garmany

"Although we have made tremendous strides the past 10 to 15 years in terms of understanding astronomy," Dr. Garmany said, "we have perhaps raised more questions than we have answered. Space telescope will extend our understanding.

"We can take an enormous step forward in mapping the universe and fit together a lot of the pieces of the puzzle—pieces that are just sitting there waiting to become a part of the total picture."

Ground-based astronomical observations have been limited, Dr. Garmany explained, because the Earth's atmosphere obscures many parts of the spectrum.

"Balloons, rockets, and orbiting astronomical observatories were attempts to overcome these limitations," she said. "We have achieved some success, but these are limited instuments when compared with space telescope."

Another advantage of space telescope, as Dr. Garmany sees it, is that it will be a national laboratory open to use by all qualified astronomers. This has not been true with some of the other facilities used above the Earth's atmosphere.

"Space telescope should also provide jobs for astronomers," she added. "Two things are happening in astronomy. One, many top-rate young astronomers are going into other fields simply because they can't find jobs in astronomy. Two, the number entering the field is declining.

"With these two occurrences, we could find ourselves where we were in the 1950s," Dr. Garmany said. "When the nation began the all-out push to put satellites into space and to begin expanded space exploration, we did not have enough qualified astronomers to do the work that needed doing.

"I believe space telescope and qualified astronomers are essential to further space exploration," she said. "The space telescope will make it possible for us to look more directly for planetary systems around other stars and open up new avenues for exploration.

"We are on the edge of another exciting period of space exploration."

Employee cited for preventing fire damage

Robert R. Gerner, electrician "A" in maintenance, has been commended for controlling a fire in the Administration building that had a high potential for causing extensive damage.

Gerner was checking lighting timers on the third floor of the Administration shortly after 9 pm Jan. 7 when he smelled smoke coming from an office area. He immediately called the division fire department, then, obtaining a fire extinguisher, he went to the scene of the fire and began fighting it.

When the plant fire department arrived at the fire, Gerner nearly had it under contol.

His initiative and alert comprehension of the danger to the building, in the opinion of fire department personnel, prevented the fire from spreading and averted a major loss.

Parking illegally? Don't do it!

If you are parked illegally, you probably have a ticket on your car right now.

And a copy of that ticket will be sent to your supervisor with instructions to take the action he believes appropriate. If you ignore what he tells you and get a second ticket, a copy of that one will be sent to the manager of your department for his action.

Parking violations have increased, and in some cases have created safety hazards. This is especially true when employees have parked in fire and emergency lanes. Cars parked on roadways and walkways also have hampered traffic.

"We are cracking down on parking violations to eliminate the hazards and to control parking lots," a plant protection spokesman said.

The best way to avoid a ticket is to park only in those areas assigned to your type parking sticker. If you don't have a parking sticker, or you aren't sure where you can park, contact plant protection.

CCMS development hardware completed, shipped to KSC in Florida

The second and last increment of development hardware for CCMS—checkout, control and monitor subsystems—has been shipped from Denver to Kennedy Space Center, Florida. It will be installed and accepted Jan. 31.

The shipment completes the complement of equipment required for the development of operational software. High production rates will now begin at the CCMS facilities on Federal Blvd.

Jack Kimpton, manager of CCMS project operations at KSC, reports the quality of the hardware is excellent and that installation and checkout of the equipment "is a piece of cake." Equipment shipped earlier is performing well and there are no significant problems with its use.

A production baseline has been established and, according to Pat Pecht, CCMS production manager, "significant progress is being made on production techniques to meet the challenge of the high-quantity production requirements during the next eight to ten month."

"We view the future with confidence," E.C. Wood, CCMS project director, said.

Employees receive invention awards

Eleven Denver division employees have been presented patent awards for their inventions by the Denver product development review board.

The inventors and their ideas:

Royzell F. Wells, electronics, "Precision Wire Stop for Plier-Type Wire Strippers." A simple, easy to use, continuously adjustable wire stop for setting wire insulation strip lengths on plier-type wire strippers. Developed for use on production hardware.

Elmer Alexus and Jack V. Babb, facilities, "Duct Sound Transmission Attenuator." The idea relates to the proper placement of sound absorbing and deflecting material to attenuate voice and sound transmission through supply and return air distribution systems. It has been used extensively in defense systems and command systems areas and has generated commercial interest.

William S. Ivers, electronics, "Line of Sight Steering Mechanism." The idea provides an adjustable line of sight for a fixed-head horizon crossing sensor, expanding its field of view for a spinning space vehicle. It is being used on SCATHA.

Theofanis G. Gavrilis and Donald J. Bottoms, electronics, "Segmented Log Periodic Antenna." The concept provides a method by which optimum performance of a log periodic antenna is obtained at selected frequencies over a multioctave frequency band. It allows flexibility of size reduction and minimizes RF loss characteristics inherent in the log periodic dipole radiators.

Jerry T. Busto and William L. Brown, manufacturing, test, and structures engineering, "Rotating Multistation Coating and Curing Fixture." The idea provides a practical and efficient means of initial curing and coating of cylindrical overwrapped parts, as demonstrated on pressure vessel production. (Emory J. Beck, a former employee, shared in the award.)

William P. Coppfer, manufacturing, test, and structures engineering, "Precision Bonding Tool for Bell Fittings." This is a design improvement that statisfied a complex production requirement on the Bell helicopter contract and resulted in cost and time savings.

William P. Coppfer and Josef Hrncir, manufacturing, test, and structures engineering, "Channel Forming and Assembly Machine for United Kingdom Program Detail Hardware." The idea represents a significant advance in the method of forming and assembling channels used in making propellant management device quadrants for United Kingdom tanks.

John A. Shepic, manufacturing, test, and structures engineering, "Biaxial Crack-Opening Displacement Gage." This is a unique device that directly measures flow in both opening and shear directions for experimental work in fracture mechanics.

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Emergency!

If it's an emergency, dial 2222!

That's the division's plant protection telephone number that will have help on the way immediately. Here are some specific instructions you should clip and keep with you or near your telephone.

FIRE: **Pull** an alarm box or **dial 2222.** Give specific location of fire to the person who answers. **Use** the proper fire extinguisher if one is available and use is practical. **Don't** endanger yourself or other employees. **Stand by** at a safe distance to direct the fire department to the fire if it is not clearly visible to firemen.

INJURY, SUDDEN ILLNESS: **Call 2222.** Give specific location of injured person, type of injury, or symptoms if it is sudden illness. **Unless** you are certified in first aid, **do not** move the person. **Do** make the person as comfortable as possible. **Stay** with person to direct those responding to the location.

SUSPICIOUS DEVICE OR OBJECT: **Do not touch.** Call 2222 and give specific location and description of object. Stand **by** at a safe distance to direct plant protection personnel to the location.

SUSPICIOUS PERSON OR ACTIVITY: Call 2222. Give specific location and describe activity. **Continue to observe,** but do not attempt to apprehend the person or stop activity.

REMEMBER: 2222 is the number to dial for all emergencies at the main facility. At Federal Boulevard, the emergency number is 224.

For all nonemergency calls, plant protection personnel may be reached at ext. 2476.

EVACUATION SIGNAL-Inside, the fire bell will ring continuously for more than one minute. Outside, the siren will be sounded steadily for one to three minutes. The fire bell ringing for less than 30 seconds is to alert fire auxiliary only.

Division exective honored by AIAA

The American Institute of Aeronautics and Astronautics (AIAA) this week presented its 1976 Space Systems Award to Walter O. Lowrie, vice president for technical operations at the division, for his work as director of the Viking program for Martin Marietta.

Presented at a banquet in Los Angeles, the award cited Lowrie "For eminent program and technical leadership in successfully designing, developing, and landing two sophisticated Viking spacecraft on the planet Mars. This outstanding achievement in spacecraft systems analysis, design, and implementation yielded the most complex spacecraft ever developed in the free world."

The award is presented annually by the AIAA to recognize outstanding achievements in the field of systems analysis, design, and implementation as applied to spacecraft and launch vehicle technology.

Reports due for former officers

Former employees of the Department of Defense, NASA, and military officers required to report defense related employment must do so by Feb. 15. The report should cover the 15-month period from July 1, 1975 to Sept. 30, 1976 to adapt to the new federal fiscal year.

Forms and information on filing them are available from R.E. Burnett, ext. 2234, Module 125 in the Engineering building at Denver and from Ray Lacombe, ext. 5-3606, column EC40 on the first floor of building 101 at Michoud.

On the cover

The forward liquid hydrogen barrel shown on the cover is one of the largest components of the external tank. Facilities engineers Jimmy Jones and Bill Smith Sr. are dwarfed by the barrel which is 27.5 feet in diameter, 20.5 feet long and weighs 4,750 pounds. Reynolds Aluminum, which supplies the aluminum sheets for the barrel, plans to feature this photo in the company's annual report.

The viking legacy

(Editor's Note: The following editorial discussing the long-range value of the Viking missions has been distributed to publications throughout the United States by the Aerospace Industries Association of America, Inc.)

Perhaps the most interesting facet of the fascinating Viking mission to Mars is the fact that the soil-scooping mechanical arm of the Viking Lander failed twice and was twice restored to operation. It is interesting because the human directors of the mission were able to examine the electronic innards of the spacecraft, diagnose the trouble and effect a solution—all from a distance of more than 200 million miles.

This ability to correct a malfunction by ultraremote control emphasizes the extraordinary technological effort the National Aeronautics and Space Administration and its industry fabrication teams put into Viking. Here is an unmanned system so marvelously developed that it was able to perform flawlessly while it chased Mars through space for 11 months and almost half a billion miles, separated itself into two spacecraft and landed one of them on the Red Planet. Then the Lander was able to photograph the mysterious neighbor planet, measure its atmosphere and analyze its soil for determination of life existence or life potential. A staggering accomplishment, even in an era when advancing technology has reduced the incredible to commonplace.

Viking will be operating well into next year, sending back to earth a treasurehouse of data. Whatever its findings, Viking already ranks as a major success because since its arrival at Mars we have learned more about the next-door planet than in all prior years of man's history.

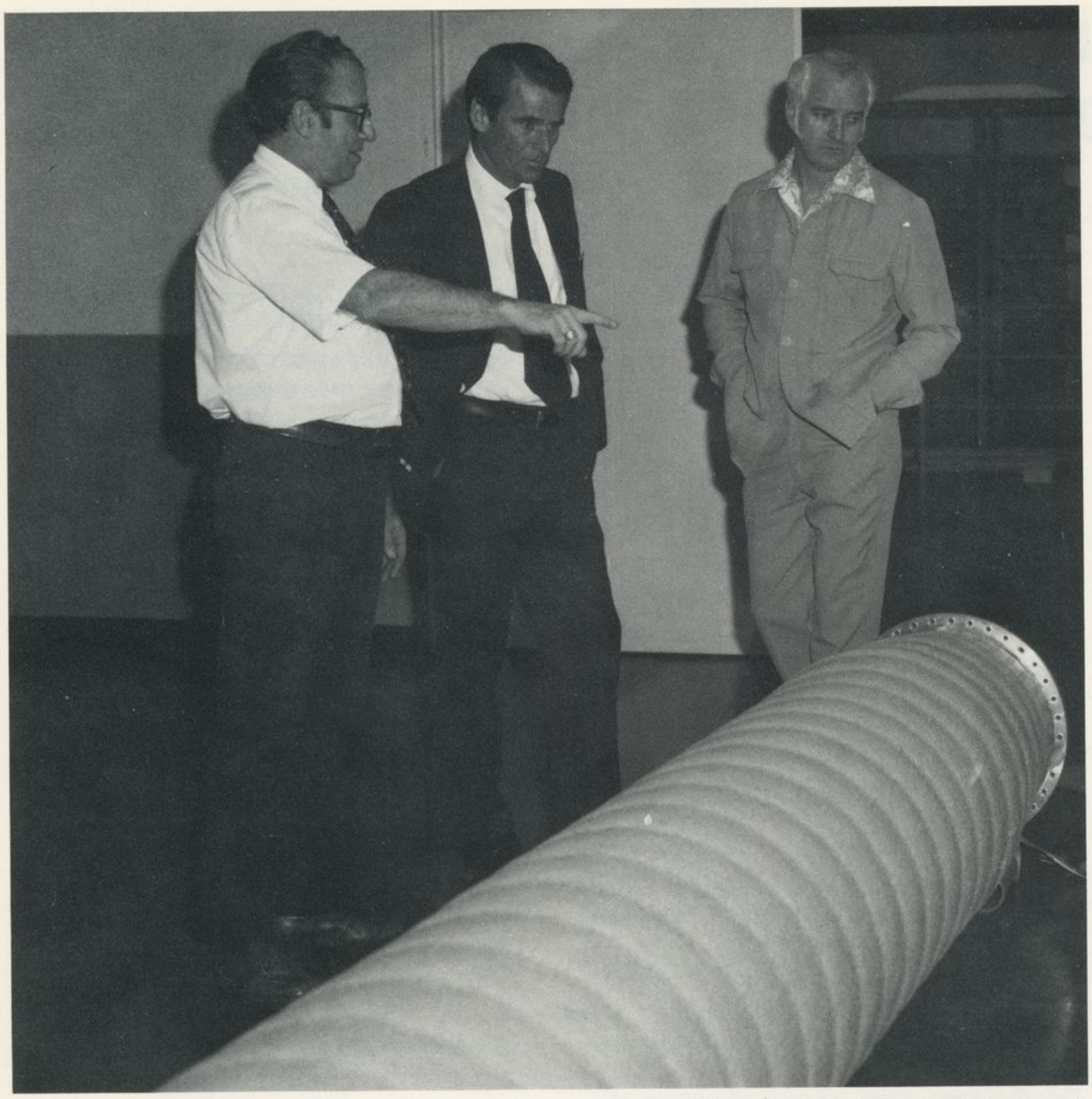
What's next? NASA has a topper in mind. If Viking has a drawback, it is immobility. But it is now possible to build an even more advanced planetary explorer, one that could roam on tractor-treads considerable distances over the Martian surface for a long period of time, sending TV pictures to earth. The possibilities of the Viking Rover make the scientific mind boggle. But it is not yet an approved program; it must be funded by the Congress.

Well, says the pragmatist, what will it cost and why should we do it? Cost: probably more than the billion spent on Viking. Why? Consider these points:

First, the money isn't spent on Mars. It means Earth jobs, thousands of them, in NASA and the principal contractors and among the hundreds of contributing companies who supply parts, materials and services.

Second, major space programs like Viking, Apollo and the Space Shuttle, provide stimulus for technology. In effect, meeting the exceptional requirements of such demanding programs pushes technology to new limits. Apollo, for example, extended our national capabilities over a broad spectrum of scientific and technological disciplines and compressed into a single decade the normal technological advance of several. Technology is a national asset; its advancement is an instrument for economic growth.

Third, there is more than intellectual curiosity involved. Exploration of Mars—and of Venus, Mercury, Jupiter, Saturn, Neptune, Uranus and Pluto—has practical potential. We are acquiring knowledge of the solar system, its origins and its evolution. In so doing, we are learning a great deal more about our own small planet. And when man learns enough—not tomorrow, but well down the pike—he may be able to change the earth to make it a better habitat, by controlling the weather, for example, or effecting medical breakthroughs by improved understanding of the life process. Knowledge is the goal. There is no greater legacy that one generation can pass to another.



The external tank thermal protection system is explained to C.B. Hurtt, center, by Bob Ballard, left. Viewing the system on a simulated liquid oxygen feed line with the two is Tom Morris, right, director of production operations at Michoud.

From Michoud

NASA awards contract for launch operations

A 42-month, $10.7 million cost plus award fee contract for Space Shuttle launch operations has been awarded the Denver division for work at Kennedy Space Center.

The contract, according to Thomas C. Wirth, who will direct external tank operations for Michoud at KSC, provides external tank test, checkout, and launch operations from now until March 31, 1980.

The external tank, being assembled at Michoud, will be transported to KSC by barge. The first tank is scheduled for delivery in late 1979.

In a related development, NASA awarded a supplemental $2.64 million cost plus award fee Space Shuttle development contract to the division for cryogeni[c] storage and liquid systems operations [at] Kennedy Space Center. Tom Farrell will head this operation.

General manager visits Michoud operations

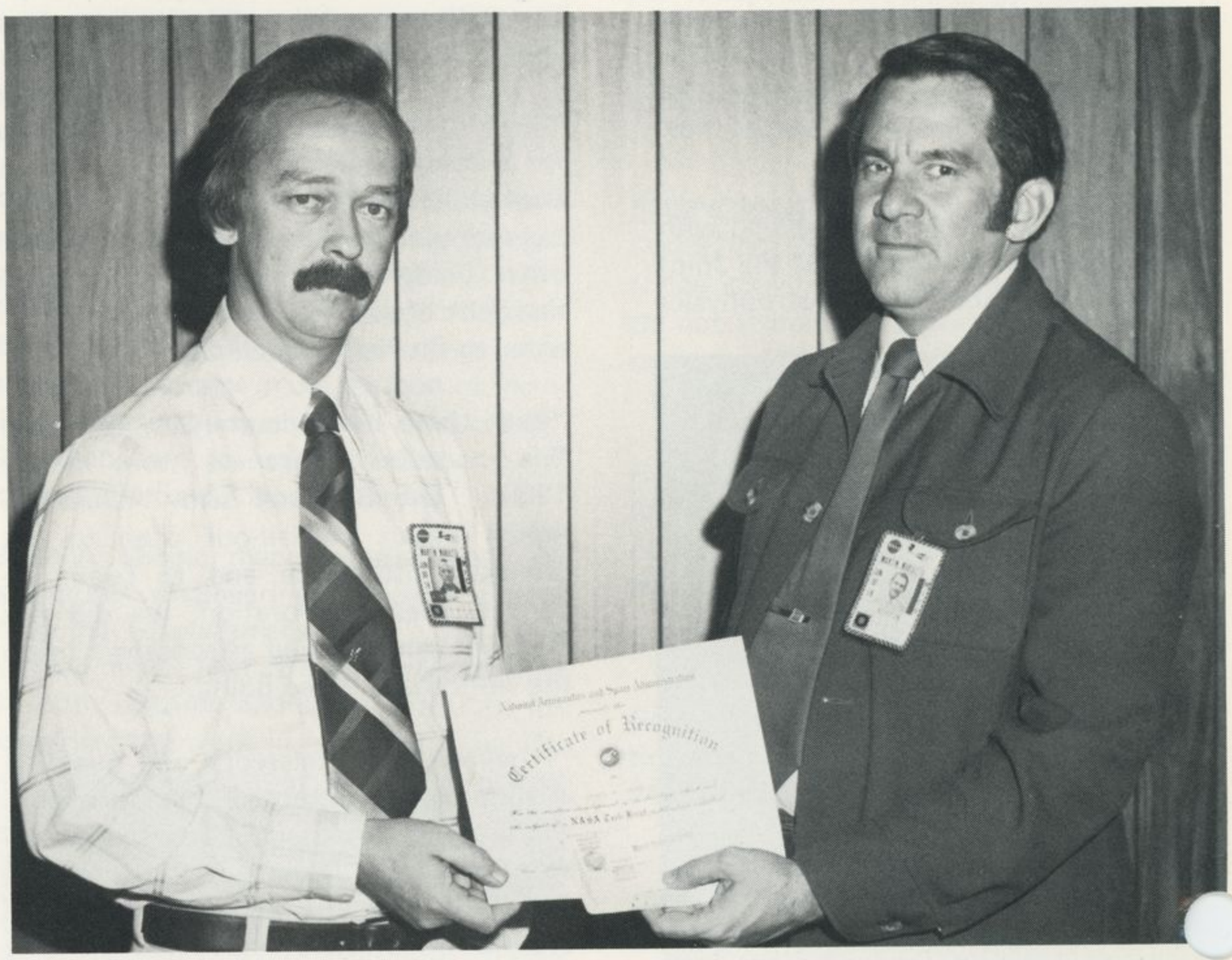
C.B. Hurtt, vice president and general manager of the Denver division, visited Michoud operations in December to present a review of the division's 1977 business opportunities to Michoud management.

He also toured the facilities to meet and talk with employees who are producing the external tank for Space Shuttle.

Meeting the milestones on the external tank program, Hurtt told Michoud personnel, helped make 1976 a successful year for the Denver division.

"The external tank contract is one factor that helped make the division NASA's number two contractor," he said. "We intended to retain that position."

Major customer focus in 1977, Hurtt said, will continue to be NASA and the Department of Defense.



James M. Dame, left, associate laboratory engineer, recently received a check and a certificate of recognition from NASA for his invention of a specialized wrench. Presenting the award is Al Norton, director of engineering at Michoud.

While congratulating Dame on his award Norton said, "I am proud of the many varied contributions the thermal protection systems group is making to insure the success of the external tank program."