NASA News

National Aeronautics and
Space Administration

**Lyndon B. Johnson Space Center**
Houston, Texas 77058
AC 713 483-5111

ALSEP



Charles Redmond

For Release:
Upon Receipt

RELEASE NO: 77-47

LUNAR SCIENCE STATIONS TO CEASE FUNCTIONING SEPTEMBER 30

On September 30, against the backdrop of a waning moon, science instruments on the lunar surface will be turned off and the ALSEP (Apollo Lunar Surface Experiments Package) control center at NASA's Johnson Space Center, Houston, will be dismantled.

The Apollo lunar science stations will be shut down because of dwindling power reserves at the stations and budgetary limitations here on Earth.

Since July 20, 1969, scientists on Earth have been receiving a continuous stream of information about the Moon, from the Moon. For the past eight years much of what has been learned about the Moon has been sent by the five ALSEP's left on the Moon's surface by the Apollo explorers.

There are five operating stations, one each for Apollo missions 12, 14, 15, 16 and 17. The Apollo 11 crew placed a prototype station on the Moon in July 1969. That first station, with a design life of only 14 days, lasted 45 days and quit due to power supply failure. The remaining five Apollo stations have been nothing short of tenacious. Specifications called for a one-year operating life for the first four ALSEP's and two years for the Apollo 17 station. Apollo 12

- more -

ALSEP is now well into its eighth year and Apollo 17 ALSEP its fifth year. Over 153,000 commands have been transmitted from Earth and executed by the moon stations. More than one trillion ($10^{12}$) bits of lunar science and engineering data have been received on Earth. The total accumulated operating time for all ALSEP stations exceeds 29 years, this for equipment designed for a cumulative total of only six years. The extended life is attributed to the high reliability required for the first year's operation.

The stations were built to provide long-term lunar surface geophysical and electrical data. The surface experiments included measuring the heat produced by the Moon's interior, the kind and amount of charged particles in the Moon's tenuous ion atmosphere, measuring the magnetic environment, and most importantly of all, measuring and providing seismic data on moonquakes and meteroid impacts. Because of the extended life of the ALSEP stations, earth scientists received a real bonus from the science stations, rather than only one or two seismometers operating at any given time, all four seismometers (one each on Apollo 12, 14, 15 and 16) have been operating as a seismic network for the past five years. This network has greatly enhanced the analyses of the few large events which occur each year.

It is the seismic experiments which have intrigued scientists. For eight years seismologists have been awaiting a large meteoroid impact on the Moon's far side. With the information from such an event scientists might finally have been able to answer one of the Moon's most perplexing questions: "What is the deep interior

of the Moon like and does the Moon have a molten core?"

At the end of this fiscal year the ALSEP stations will be left on their own, all but their transmitters muted. Funding for the technical and scientific support needed to maintain the stations will cease on September 30. The timing is perhaps appropriate, for every day the small radioactive thermoelectric generators which power the stations decay a little more. When next year rolls around there are good odds that at least one of the stations will have so little power only the transmitters could function anyway.

The past eight years have been a time of tremendous increase in the knowledge and understanding about the Moon. The returned lunar samples have played an essential part in this knowledge explosion, but for some aspects of the Moon, only the ALSEP's could have helped. The ALSEP seismic information, magnetometer and heat flow experiments have contributed the principal information about the Moon's interior. It is now believed the Moon's crust is multi-layered and from 60 to 100 km thick with the secondary boundary occuring about 20 km deep. The lunar upper mantle has been determined to be fairly homogeneous and to extend to about 500 km. It is believed to consist of olivine or olivine-pyroxene matter, although other compositions also have been proposed. From 500 km deeper the seismic data indicate the Moon may be iron-enriched, although there is insufficient data to determine whether or not the Moon has a small or molten core.

Moonquakes have been discovered to show periodicity and to recur at several places in the interior. The mechanism for this has been

hypothesized as release of tidal stress in the region between 1100 and 1500km depth and may occur along possible previously existing faults or local inhomogeneities at depth. The time cycle of the deep-focus moonquakes follows the tidal cycles so closely it appears likely that tidal forces are a major factor in triggering deep-focus moonquakes.

Charged-particle, supra-thermal ion and solar wind experiments have also provided the principal data for a new understanding of the Earth's magnetosphere and the interaction of the magnetosphere with the solar wind. Ion measurements also detected a lunar surface electric potential of about +10 volts in daylight and about -100 (to periodically -250) volts in night. These experiments also provided new information concerning the electrostatic lines of force associated with the transition of the terminator across the lunar surface. The phenomenon is thought to be the result of a cloud of hot solar wind electrons near the terminator (the cloud presumably generated by the limb shock of the solar wind).Extensive lunar soil sputtering resulting from solar wind impingement was also measured by the ALSEP's and further augmented by sample analysis on Earth.

Other questions about the Moon which have not been answered by the Apollo program and the years of subsequent study include where the Moon originated and whether or not there is recoverable water on the planet.

Even though the experiments will be terminated, the transmitters will continue to serve Earth as a reference point in astronomy. The Jet Propulsion Laboratory will continue to use the signals from the

ALSEP transmitters to assist in the Lab's deep space work including geodetic and astrometric studies and spacecraft navigation. Also, the motion of the lunar orbit will be accurately monitored against a background of extra-galactic stars to test gravitational theories.

During the past eight years many of the instruments associated with each ALSEP station have experienced engineering problems. Since July, this year, engineers at JSC have been performing more than their usual maintenance and engineering functions on the ALSEP stations. In preparation for the Sept. first shutdown, the ALSEP stations have been put through a slightly different routine to extract the last ounce of engineering data possible. There are few engineering mysteries still puzzling the JSC team but each station, over the years, has developed a personality and a final understanding of that personality will assist in the design of similar stations. The Moon and Mars are the only planets now equipped with remote sensors, but it is expected that other planets will have them too and a thorough understanding of the harsh environment involved and the effects of time will enhance further the reliability of these devices.

One station in particular, the Apollo 14 ALSEP, has a rather dramatic history of engineering problems. The ALSEP 14 station started working correctly and continued this for four years, then it quit for two days in March 1975, and started up again; then it quit again; then it started up again. This "on-again, off-again" performance was repeated six times in the last two years. The problem has been diagnosed as an intermittent short circuit in one of two power conditioning units.

The short seems related to the temperature of the unit, in turn related to the position of the Sun over the lunar landscape. It is problems like this, however, that need to be fully understood to insure the proper performance of future generations of remote science stations.

Over the years the ALSEP program has cost $200 million, including the design and development of the stations themselves, the support engineering work in Houston and the science analysis work performed in dozens of university labs throughout the world. The stations have been costing about $2 million a year to operate. The program has involved hundreds of engineers and scientists and has produced a tremendous source-bank of information about the Moon, both as a planet and as an object wading through the electric and magnetic environment of the Earth and Sun.

###

September 1, 1977

Note

Bendix Aerospace, Ann Arbor, Michigan, was prime contractor for the ALSEP equipment and provided technical support for the JSC control operations.

General Electric furnished the radioisotope thermoelectric generators which provided electric power.

NASA JSC provided project management, operations control and integration; and NASA Goddard provided tracking and communications with the stations.