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GUIDELINES FOR MODIFIED  
ALSEP DESIGN STUDY

ATM-839

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1.0 OBJECTIVE

The principle objective of this study program is to define modifications to the present ALSEP system in order to extend the Lunar Surface science capability of the Apollo missions. This increased capability is to be achieved through the accommodation of more experiments per mission including both existing and new designs as selected from a candidate list.

The following guidelines and constraints are defined to establish technical direction for the Modified ALSEP study effort and should be considered for a program development schedule starting with 1 January 1970 and resulting in first flight hardware delivery in 24 months.

2.0 MISSION GUIDELINES

2.1 Deployment Sites

Modified ALSEP must accommodate deployment sites in longitude range  $\pm 60^\circ$  and latitude  $\pm 50^\circ$ .

2.2 Lifetime

The Modified ALSEP system shall be designed for a 5-year operational period.

The system reliability of this design for 2-year operation shall be  $\geq$  that of the current ALSEP (1 year).

Operational complement of experiments during the three to five year period will be constrained by power source degradation.

2.3 Experiment Interchangeability

Modified ALSEP shall be designed to operate with various combinations of experiments from the candidate list based on specific science objectives for a particular mission and availability of qualified experiment hardware. Substitution, addition, or deletion of experiments shall be possible even after delivery to KSC, through the use of standardization techniques. The number of experiments will be maximized for a given array consistent with other subsystem constraints.

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3.0 SYSTEM GUIDELINES

Modified ALSEP shall be designed to be compatible with the following constraints of the interfacing system elements.

3.1 MSFN

Modified ALSEP shall operate in conjunction with the existing MSFN and under the following specific constraints.

- a. Remote site uplink and downlink frequencies and modulation/demodulation characteristics. Interrogation of MALSEP with multiple uplink signals shall not cause execution of false commands.
- b. Remote site data processing capabilities.
- c. Ground data link restrictions.
- d. MCC real time control and monitoring coverage as presently defined for ALSEP; i. e., full time coverage for 45 day period following deployment and two hours per day thereafter.
- e. Maximum bit error rates for the uplink and downlink are  $10^{-9}$  and  $10^{-4}$  respectively and are based on normal operation with a 30 foot ground station antenna. Ground stations with 85 foot antennas shall be used for high data rates and other non-routine operations.
- f. Data format selection of Modified ALSEP shall be consistent with the Apollo data format to the extent possible without sacrificing science requirements.

3.2 LM Interface

In addition to the SEQ bay, the Modified ALSEP design study shall consider location of equipment in other areas of the LM. It is assumed that a door exists in the SLA in front of the SEQ bay and that MALSEP sub-packages will be installed in LM on the on-pad stacked configuration. The maximum weight of each subpackage in the SEQ bay is 155 pounds with a total combined weight of the two packages not to exceed 266 pounds. Total



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weight of the Modified ALSEP shall not exceed (to be supplied by MSC) pounds. The telemetry interface between the Fuel Cask Assembly and LM may be redefined.

3.3 Astronaut Interface

The Modified ALSEP design shall consider Astronaut activity limitations and provide a system which minimizes traverse demands, deployment time and provides for astronaut safety. Design shall be compatible with either one or two man deployment.

4.0 MODIFIED ALSEP SYSTEM

The Modified ALSEP System shall consist of Central Station Subsystems, Experiment Subsystems and Astronaut Tools.

4.1 Central Station Guidelines

4.1.1 Power Sources

Modified ALSEP shall utilize present SNAP RTG's or simple extensions of SNAP as the power source. No new RTG development shall be undertaken for the Modified ALSEP Mission. Power source must provide minimum system power requirements for at least two years and sufficient power to operate prime long term experiments for up to five years.

The study shall consider deletion of telemetering hot and cold frame temperatures from the RTG.

4.1.2 Automatic Power Management

Modified ALSEP shall incorporate an Automatic Power Management (APM) system which provides reserve power distribution and load selection as directed by power utilization and thermal control requirements.

4.1.3 Thermal Control

The thermal swing of the Central Station components should be minimized to obtain reliable operation. The Central Station design should maintain temperatures at (to be determined).



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4.1.4 Telemetry

Positive on-off status indication should be provided for all command switchable components including all redundant elements of the Central Station.

The sampling rate for Central Station parameters shall be selected as necessary for compatibility with the measurement requirement.

4.1.5 Interconnection Scheme

The technique for interconnection of Central Station components and experiments should attempt to provide a standardized design compatible with all potential experiment arrays.

4.1.6 Test Connector

A special test connector shall be provided on the Central Station to allow monitoring of key parameters during test. The special test leads shall be protected to prevent accidental damage to Central Station components as a result of external test connection or equipment malfunction.

4.1.7 Simultaneous Operation

The design shall accommodate simultaneous operation of a total of six ALSEP's and Modified ALSEP's.

4.1.8 Experiment Compatibility

The Central Station design shall support operation of all active experiments in the candidate list. PSE is to be common to all arrays and the central electronics for this experiment shall be included within the Central Station packaging designs. Inclusion of new experiments in the Central Station will not be considered. However, location of the ASE electronics in the Central Station will be subject to trade-off considerations during the study.

Central Station electronics shall accommodate the maximum number of experiments consistent with available power, weight, volume and form factor of the Modified ALSEP System.



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4.2 Experiment Guidelines

4.2.1 All new experiments shall be designed to adapt to standardized electrical and mechanical interfaces. The experiment data formats will be controlled to be compatible with the Modified ALSEP data subsystem.

4.2.2 If required, existing ALSEP experiment designs can be changed or adapted to accommodate Modified ALSEP standardized electrical and mechanical interfaces.

4.2.3 Each experiment will have its own power converter and provide DC isolation between power, signal and chassis returns within the experiment.

4.2.4 Analog data signal interfaces with the Central Station should be avoided where possible. No analog interfaces should exist for experiments deployed at distances of 20 feet or more.

4.2.5 Each new experiment shall provide operational mode status indication within its digital data format.

4.2.6 PSE to be modified to incorporate stool as integral part of experiment.

4.3 Structural Subsystem

4.3.1 RTG (External) shall be deployed independently of Subpacks.

4.3.2 Experiment cabling between SP's while stowed in LM is permissible.

4.3.3 Carry mode fuel cask dome removal and fuel capsule transfer hardware may be stowed external to Subpacks.

4.3.4 Antenna to be stowed integral with aiming mechanism.