

T73-11392

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EPS-425

CR-128851

SAFETY ASSESSMENT
FOR
EPS ELECTRON-PROTON SPECTROMETER

LEC Document Number EPS-425

(NASA-CR-128851) SAFETY ASSESSMENT FOR
EPS ELECTRON-PROTON SPECTROMETER (Lockheed
Electronics Co.) 9 p HC \$3.00 CSCL 14B

N73-20485

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Springfield, VA. 22151

G3/14

Unclas
66049

Prepared by

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Under Contract NAS 9-11373

For

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas
August 1971

SAFETY ASSESSMENT

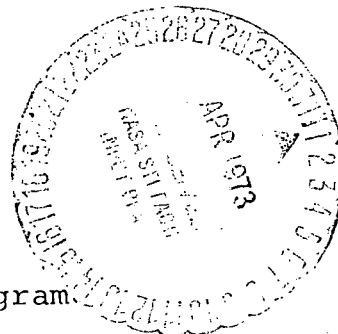
FOR

EPS ELECTRON-PROTON SPECTROMETER

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SAFETY ASSESSMENT

1. PURPOSE

The purpose of this safety analysis is to identify the efforts required to assure relatively hazard free operation of the EPS and to meet the safety requirements of the program.

Safety engineering criteria, principles, and techniques in applicable disciplines is stressed in the performance of system and subsystem studies; in test planning, and in the design, development, test, evaluation, and checkout of the equipment, and the operating procedures for the EPS program.

2. DATA

There are no formal data submittal requirements specifically associated with the EPS system safety engineering program listed in the contract. However, letter reports and safety assessment requiring the attention of NASA/MSD will be transmitted when appropriate and any accident/incident reports prepared in response to NASA/MSD direction will be submitted.

3. SYSTEM SAFETY ASSESSMENT

3.1 TOXIC FLUIDS OR MATERIALS

No toxic fluids or materials will be used during the processes of manufacturing, testing, or handling of the EPS.

3.2 FLAMMABLE FLUIDS AND MATERIALS

No flammable fluids or material will be used in the manufacturing, testing, or handling processes of the EPS, except isopropyl alcohol for cleaning the electronic subassemblies.

3.3 NUCLEAR COMPONENTS/RADIATION

The EPS instrument itself does not contain any nuclear components; however, the laboratory equipment will contain radiation sources. LEC has been licensed to use radioactive sources.

3.4 RADIOACTIVE SOURCES

<u>Radioactive Material</u>		<u>Quantity</u>
Barium-133*	Solid, Elemental	2 sources not to exceed 100 microcuries each
Cesium-137*	Solid, Elemental	4 sources, each of three not to exceed 100 microcuries, one not to exceed 1 microcurie
Bismuth-207*	Solid, Elemental	4 sources, each of three not to exceed 100 microcuries, one not to exceed 1 microcurie
Americium-241**	Solid, Elemental	1 source not to exceed 0.1 microcurie

*Evaporated onto plastic film (Typical Bionuclear Inc., Houston, Texas.)

**Electrodeposited onto platinum foil (Typical Ortec Inc.)

These radioactive sources will be used for routine checks and calibrations of lithium-drifted silicon detectors, either in air or in a vacuum chamber. Because of their solid form and low activity, it is necessary to handle the sources with only a pair of small tongs.

3.4.1 Radiation Protection Program

The sources will be stored in locked, appropriately marked cabinets when not in use, with access to authorized users only. While the sources are not in use, they will be stored in a locked cabinet such that the dose level at the surface of the cabinet is ≤ 2 mr/hr. While in use, appropriate radiation signs will be placed at the 2 mr/hr locations.

In addition, personnel using the sources on a routine basis will wear film badges available from R. S. Laudauer, Jr. and Company.

3.4.2 Waste Disposal

At the end of the EPS program, the sources will be turned over to the NASA/MSU Health Physics Group for either storage or disposal. No wastes or disposal are expected to be necessary for these sources during the duration of the EPS program.

3.5 VAN DE GRAAFF FACILITY

An adequate safety program is already in existence at the Van de Graaff facility, and consists of the following:

- (1) The first time the accelerator is operated in each of the three modes, (low energy proton, high energy proton, and electron mode) Health Physics will be notified to perform a radiation survey for that mode.
- (2) Prior to each accelerator startup, the operating supervisor or his alternate shall be responsible to see that the following control procedure is accomplished:
 - a. Physically check each entrance into the target area to insure that the interlock system is functioning correctly.
 - b. Inspect the target room before each accelerator startup to verify that no one is present.
 - c. Check the visual warning system to insure that all units are operating correctly.
 - d. Check the area monitoring system panel to insure that all monitors are operating.

- e. Announce over the building intercom system, two (2) minutes prior to each startup, that accelerator operations will commence immediately.
 - f. Check the roof area for occupancy restrictions when required for a particular mode of operation.
 - g. Insure that an approved operator is at the console panel during accelerator operation.
3. It shall be the responsibility of the facility supervisor to maintain an OPERATION LOG. This record will indicate modes of operation and duration of each operation, e.g., target used, current, voltage and time spent on each mode of operation.
4. Approval must be received from the Radiological Control Officer (RCO) before anyone is allowed in the target room during radiation producing operations.
5. During the period covered by Machine Use Request 000225 (April 15, 1971 to February 1, 1972), no modifications will be performed on the accelerator facilities without authorization from the RCO.
6. In the event of a RADIOLOGICAL EMERGENCY, operations will be suspended and Health Physics notified immediately.
7. The roof area will be roped off and posted "Caution Radiation Area" during electron, proton and neutron production.
8. The doors to the accelerator target room will be posted as restricted areas at all times and will be posted "Caution High Radiation Area."

3.6 ENVIRONMENTAL CHAMBERS FACILITIES

NASA/MSC Environmental Facilities will be used for Qualification Testing and other environmental testing. These facilities have their own safety program approved by NASA/MSC.

3.7 CONTROL SYSTEM TEST FACILITIES

All environmental chambers located in the Lockheed Facility test area have been checked for safety features, and personnel using these facilities are aware of the procedures and cautions.

3.8 END ITEM ASSEMBLY

Maximum efforts have been made during design to ensure that the optimum degree of inherent safety has been included in all equipment designed, procured, or leased for the EPS Program through the selection of appropriate equipment components and design features, and through the use of materials which are known to be hazard free.

Appropriate action has been taken to assure that necessary functions of the system will occur as required, and that no primary failures will cause a chain of dependent failures which would degrade system safety and create hazardous conditions.

The environmental and acceptance test procedures will be designed to reflect safety considerations in their testing operations. The safety of the operations as well as the ability of the procedures to enhance the inherent safety achieved in the subsystems and equipment is a prime consideration.

3.9 RADIO FREQUENCY (RF) RADIATION HAZARDS

The limit for equipment exposure to RF radiation has been established at 0.01 watt/square centimeter (CM^2) at any frequency. It is possible to encounter even higher power densities than this established safe maximum limit during the tests required by the Radio Frequency interference (RFI) tests; however, these high densities are localized. Susceptibility to fields and voltages from other circuits and equipment in the spacecraft was reduced to a practical minimum in the basic design of each assembly and sub-assembly. Primary consideration was given to components and circuits that are inherently free of susceptibility to magnetic fields at dc and audio frequencies. Preference was also given to circuits and components which are optimally free of susceptibility to transient voltage fluctuations and response to signals outside the intended operating frequency bands. The EPS is designed to withstand the transient supply voltage changes caused by the operation of other equipment in the spacecraft without degradation of operation. All digital logic has been designed to operate at as high a triggering voltage as feasible, definitely above the millivolt level. This design objective will provide optimum freedom from inadvertent operation due to stray pulses.