

## Keynote Address

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### INTRODUCTORY REMARKS

The purpose **of** this meeting is **to** provide both a focus for technologists and a current assessment **to** management **of** a relatively new phenomenon that has come to be known as spacecraft charging. This Conference which was sponsored jointly by USAF and NASA is intended to become the regular **forum** for disseminating the information **gained** in the investigation **of** this phenomenon. Before proceeding **to** technical presentations, I would like to discuss the USAF/NASA interdependency program and give a brief overview of the spacecraft charging program.

### USAF/NASA INTERDEPENDENCY

By 1973 both USAF and NASA were becoming increasingly aware that they had **many** common technology problems in both aeronautics and space. The natural consequence of this realization and continually tightening budgetary constraints was the interdependency program. Existing technology programs **of** mutual interest were identified. Where one agency had more expertise **in a specific area**, it was assigned the responsibility **of** providing the technology for both agencies. In **some**

cases, an agency has cancelled its program and transferred funds to the responsible agency. Where both agencies have desired to maintain programs, the programs have been jointly managed and the technical responsibility has been clearly established. Although it has taken some time for programs to merge into an interdependent mode, the concept is now being successfully exploited and benefits are beginning to accrue. The obvious benefits of the interagency program have been to stretch the limited dollars available to both agencies, to reduce or eliminate duplication, and to provide both agencies enhanced capabilities.

### **THE SPACECRAFT CHARGING INTERDEPENDENCY PROGRAM**

The spacecraft charging USAF/NASA program is an excellent specific example of interdependency. Since spacecraft charging has influenced the performance of military, commercial and NASA satellites, it became a logical candidate for a joint program. A program plan for USAF/NASA spacecraft charging investigation was approved by Colonel Brooke and myself in November of 1975. It was planned from the beginning to reflect true interdependency. Each element of the program was assigned to either NASA or USAF with well defined accountability. The success of the total program requires that both organizations execute their portion successfully.

The objective of the spacecraft charging investigation is to provide the design criteria, materials, techniques, and test methods to insure control of the absolute and differential charging of spacecraft surfaces. This objective is being met by conducting a combined flight test and ground technology program. It is estimated that the investigation will require another 4 years to complete.

The information generated in this interdependency program will be incorporated into a design criteria handbook and test specifications which will be available to the aerospace community. The handbook will catalog the materials behavior and develop the criteria for minimizing the charge buildup. The specifications will detail the procedures for testing satellites to guarantee that they will withstand the environment without anomalies. It is planned that preliminary documents will be available by late next spring.

### **SPACECRAFT CHARGING PHENOMENON**

Spacecraft charging has come to be defined as the condition that arises when the geomagnetic substorm environment changes the potential of satellite surfaces relative to the space plasma potential. The charging phenomenon is usually

thought of in association with geosynchronous satellites, but it can also influence satellites in other orbits.

During the early 1970's, several synchronous satellites experienced spurious switching activity. Somewhat later, experimental measurements on-board ATS-5 suggested that the satellite could become charged to large negative voltages by a geomagnetic substorm. Through a detailed study of these anomalies and ground observatory data, a link was established showing that the substorm condition and the anomalies were occurring simultaneously. Laboratory tests were conducted to demonstrate that the electromagnetic pulse from an electrical discharge of an insulator could be coupled into the telemetry harness as a pseudocommand or as noise. Continued studies of the phenomenon have resulted in the concept of differential charging of satellite surfaces, in the demonstration of thermal control cabinet degradation, and in the possibility of enhanced contamination due to electrostatic forces. In addition, the uncontrolled and unwanted electric fields hinder scientific missions to measure low energy phenomena. The results of these studies will be presented in the following sessions of this Conference,

## THE CONFERENCE

In the next 3 days, you will hear discussions of what is being done to define the geomagnetic substorm environment, of the analytical tools that are being developed as guides to future spacecraft design, of the work that is underway to characterize material responses, of the material modifications that are necessary to minimize charging, and of the flight experiment aspect of the investigation, as a part of that flight program, the **USAF SCATHA** satellite will be launched in 1979 to investigate the charging phenomenon in the actual space environment. You will hear in some depth a discussion of the **SCATHA** satellite in the following talk,

By the completion of this Conference, I believe that you will have a general understanding of spacecraft charging and what is being done to handle this phenomenon. You will see that the spacecraft charging investigation is a cooperative effort between **NASA** and **USAF** to attain a goal of nationwide interest to designers, experimenters and users of future spacecraft. Successful completion of this joint program will provide us with the capability to control the adverse effects of spacecraft charging on satellite operations and scientific investigations. Such a capability is essential to the development of the sophisticated long-life satellites which will serve us all in the future,