KEYNOTE ADDRESS

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Ladies and gentlemen, I would like to add to the welcome offered by the conference organizers to all attendees to this, the Third Spacecraft Charging Technology Conference. Many of you here, I am sure, participated in the conferences held in 1976 and 1978. These next 3 days will dramatically demonstrate the progress that has been made since the last conference with the launch and operation of SCATHA and the related ground technology.

Today, I would like to review the events that have led us to this point because this area of technology has been a showcase for NASA-Air Force coordination in general technological development. Expanding on this, I personally believe that it has been, is now, and will continue to be very important for the civilian and Air Force space programs to undertake cooperative or interdependent technology programs. As you all know, the manpower and budget resources for research and technology are always the last to be increased in good times and the first to be reduced in bad times. While we all read about the proposed buildup in the defense budget, we can anticipate that it might be some time before this buildup is felt by the technology program offices. To accomplish the many good things we need to do, we, NASA and the Air Force, simply must make the most efficient use of joint resources to solve joint problems.

I am aware, however, how difficult it really is to get beyond the philosophical presumption of such a need, through the reality of the problems involved in reaching such an objective, to a finally implemented joint program. Such a joint program can never be accomplished just because of the desires or dictates of Headquarters managers. Through the NASA-AFSC Interdependency Program, many joint activities have been initiated, but many of these have been failures, or at best, limited successes. This has not been the case with the Spacecraft Charging Program. This program has been a large success. Those of you who have had to work on day-to-day problems associated with the joint program should feel a great sense of pride in your accomplishments.

The Spacecraft Charging Program was initiated in late 1975 under joint NASA-AFSC sponsorship because of an awareness of the possible harmful effects of charged-particle interactions with geosynchronous spacecraft. The first elements of this program were designed to establish the nature of the plasma environment and the charging phenomenon. The available instrument data from the NASA Advanced Technology Satellite (ATS) program were analyzed, and the charging program funded additional studies with these same instruments. This work established a positive connection between spacecraft electrical charging events and geomagnetic substorm activity. Additional ATS and laboratory data proved that spacecraft could become charged to large negative potentials and that discharge events on insulating

surfaces could result in dangerous electromagnetic contamination. Such contamination could affect telemetry or control systems, causing pseudocommands and noise. Additionally, these studies produced the concept of differentially charged satellite surfaces, the demonstration of thermal control coating degradation, and the realization of the importance of this phenomenon in attempts to measure scientifically interesting, low-energy phenomena.

This joint NASA-AFSC program was built on these studies to expand both experimental and analytical investigations and to conduct a specially designed space test program to fully characterize the phenomena. The experimental program characterized materials and charge neutralization techniques. Additionally, materials and coatings were developed to control charge buildup. A military standard, a design standards monograph, and a charging analyzer computer program (NASCAP) were designed to predict and minimize charge buildup. Finally, the Space Test Program (STP) P78-2 spacecraft (SCATHA), incorporating a variety of engineering and scientific experiments, was designed and developed and was launched in January 1979.

During this conference you will have a chance to hear the results of all this activity, including many of the results of the SCATHA space flight. We are all, I am sure, eagerly awaiting the opportunity to discuss these findings. However, even while we have been systematically investigating these reasonably well understood phenomena, new charging phenomena have been identified and experienced.

Today, NASA's Voyager spacecraft is broadcasting live its observations of its historic encounter with Saturn. However, on an earlier encounter of the same spacecraft with Jupiter, numerous small anomalies occurred that were probably associated with charging. Luckily, our joint NASA-AFSC program had made its results known, and the spacecraft had been reworked at a late stage to minimize the potential charging effects. These experiences, as well as the latest results from SCATHA, will be used to ensure incorporation of charging control techniques into the design of the follow-on Galileo spacecraft.

Assuming continued success at the same rate as we have come to expect from this program, we will have completed our original objectives in 2 years. Only one small problem exists, and that is for the sponsoring organizations to provide sufficient funding to completely analyze the acquired data. However, beyond this the advanced systems which can be anticipated in the Shuttle era will present new challenges. These challenges will have the form of a different type of environmental interaction that could profitably use investigating in the same type of joint NASA-AFSC technology programs that have been pioneered in the Spacecraft Charging Program.

Both NASA and the Air Force are likely to require much larger spacecraft in this Shuttle era, involving larger power systems operating at significantly higher voltages. These spacecraft power systems may well have capacities 10 to 100 times higher than any operated to date and will be composed of complex structures made up of metals, insulators, and

composites. At these power levels the line voltages must be increased to hundreds of volts, resulting in perhaps a whole new set of environmental possibilities which must be evaluated and addressed.

To answer this new challenge, Col. Tom Ferguson of AFSC and I have recently approved a new interdependency investigation structured in the same way as the charging program. This program is anticipated to run for 9 years and to have a larger basis for support than its predecessor. Details of this investigative program will be provided in the last session of this conference, and, if history is an accurate predictor of the future, this program should be of enormous value to both NASA and the Air Force and should be an efficient expenditure of our valuable R&D resources.

I would like to again thank the conference organizers for inviting me to address you and to participate. I look forward to hearing the technical progress which has occurred since the last meeting.