TECHNOLOGY AND TEST

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The Technology Applications in Space Working Group was established by NASA to evaluate proposed tether applications and to formulate and make recommendations relative to the tether applications program. The initial proposals addressed by this group were the recommendations from the first Tether Workshop held in Williamsburg, Virginia, in 1983. The TAS Working Group has reviewed the tether applications program annually and published a program plan each year since its creation. This program plan summarizes the results contained in the individual project plans produced by the group's members in each of the tether applications discipline areas:

1. Electrodynamic Interactions
2. Transportation
3. Gravity Utilization
4. Constellations
5. Technology and Test
6. Science Applications

which were, and are, the basis of the workshop organization.

As a member of the TAS Working Group and representing NASA's Langley Research Center, which is a technology center, I have been responsible for the definition of the Technology and Test of Tether Applications Project Plan. This plan is specifically concerned with the definition of the technology developments and test requirements associated with the implementation of the various TAS discipline programs as well as tether applications that could provide technology-related data. The continuing recommendations contained in both the workshop report and the annual Technology and Test project plan are associated with the development of the technology relative to:

1. Tether Materials and Configurations
2. Tether System Dynamic Simulation Capability
3. Tether System Instrumentation (System performance monitoring and control)
4. TAS Program Related Science Instrumentation
5. Atmospheric/Aerothermodynamic (STARFAC) tethered system research
6. TAS Discipline Program Accomplishment, i.e. System Components

Figure 1 provides a summary of the TAS Technology Issues for each of the disciplines as well as the recommended technology mission--Atmospheric/Aerothermodynamic Technology.

As a result of the near-term implications of the electrodynamic tether (TSS-1 and Space Station potential) and atmospheric/aerothermodynamic tethered system research (TSS-2 and STARFAC), these two applications have received high priorities, and the development of the technology required to advance/implement these concepts is being strongly recommended by the TAS Working Group.

To enable these tether applications, design and development programs have been recommended and are presently underway relative to the demonstration of the hollow cathode concept which is an enabling electrodynamic tether mission technology. Additionally, studies relative to tether insulation and insulation coatings are being initiated. Finally, the realization of the electrodynamic tether concept's potential requires the development of high voltage components and high performance tether conductors as well as a tether damage detection capability and performance monitoring and control instrumentation. Such instrumentation is critical to all tether applications and is considered to be an enabling technology.

Relative to the Atmospheric/Aerothermodynamic tether application, studies have been underway to establish the feasibility and define the limitations of the Shuttle Aerothermodynamic Research Facility (STARFAC) or tethered wind-tunnel concept. These studies have established the feasibility, but not the limitations, to date. The studies have also identified a need for a high-temperature tether to extend the research capability of the concept to altitudes compatible with data required by on-going and proposed NASA flight programs. As is the case with the electrodynamic tether, the success of the STARFAC is contingent on the development of the required engineering instrumentation for system performance monitoring and control. Additionally, since STARFAC is a technology research concept, its success is dependent on the development of the required research/science instrumentation.

Finally, the TAS Working Group has recognized the need for a capability/technique with which to accomplish tether concept tests and simplfied missions which do not require the TSS. The concept of an expendable tether system is being studied to satisfy this need.

The NASA input, then to the present (1985) tether workshop, will provide a detailed review of the concepts and programs described above as follows:

1. TSS-2 Atmospheric/Aerothermodynamic Proposal/Status
2. STARFAC - Program Definition
   a) Mission Simulation Results
   b) Instrumentation Definition Study Results
3. Tether Materials Study Results
4. Expendable Tether Concept
5. Electrodynamic Tether Technology

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APPLICATION	TECHNOLOGY ISSUES
Electrodynamic Interaction	Hollow Cathode High Voltage Components High Performance Tether Conductors Tether Insulation/Insulation Coatings Tether Damage Detection
Gravity Utilization (Variable and/or Artificial Gravity)	Gravity Level Instrumentation Disturbance Damping Tether Tether Crawler Mechanism Tether Repair Tether Damage Detection
Constellations	Tether Materials/Configurations Tether Damage Detection Tether Repair
Transportation	Tether Materials/Configurations Tether Damage Detection Tether Repair
Technology & Test	Tether Materials/Configurations Tether System Dynamic Simulation/Mission Modeling Tether Monitoring and Control Instrumentation
- Technology Mission	Atmospheric/Aerothermodynamic Technology (Shuttle Tethered Aerothermodynamic Research Facility - STARFAC) o High Temperature Tether o Research Instrumentation o System Monitoring and Control Instrumentation

Fig. 1. Tether Applications in Space.

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PROGRAM STATUS

- TSS-2 ATMOSPHERIC / AEROTHERMODYNAMIC PROPOSAL
- STARFAC DEFINITION STUDY
  - MISSION SIMULATION RESULTS
  - INSTRUMENTATION STUDY RESULTS
- TETHER MATERIALS STUDY RESULTS
- EXPENDABLE TETHER CONCEPT AND MISSION STUDY RESULTS
- ELECTRODYNAMIC TETHER TECHNOLOGY DEVELOPMENT
  - HOLLOW CATHODE
  - TETHERS
  - COMPONENTS