N85 13852 D2

ELECTROMECHANICAL/ELECTROMAGNETICS WORKING GROUP SUMMARY

David B. Eisenhaure, Charles Stark Draper Laboratory, Chairman

INTRODUCTION

There were seven participants in the discussions conducted by this working group. The group deliberations centered on the component and system technology issues associated with the suspension and power conversion systems for the flywheel. The material which follows summarizes the recommendations and conclusions reached by this panel. At the end of this summary a list of the participants in this working group is presented in Table 1.

CONCLUSIONS AND RECOMMENDATIONS

1. Component and System Technology Issues

In view of the material presented during the paper sessions and the expertise of the panel members, it is believed (Figure 1) that adequate technology exists in both the suspension and power conversion areas to render the flywheel energy storage system concept competitive with other conventional approaches. This conclusion is partially predicated on having the Space Station control requirements, as well as the wheel stability characteristics, defined. Definition of these requirements is essential to permit appropriate component designs. For example, although magnetic suspension systems provide the storage device with several advantages, such as long life and higher efficiency, their lower stiffness, when compared with mechanical bearings, may pose a significant design problem to the control system engineer if the vehicle requirements are for high bandwidth control. Therefore, mechanical bearings cannot be ruled out at this point.

Since it is believed that the principal technology exists in these two areas, it is felt that the critical remaining issue is that of integrating the rotor, the suspension system, and the power conversion system into one operational device. To ameliorate this concern, it is recommended that the motor/generator and suspension system be developed as an integrated unit, and that the electronics and control techniques associated with that subsystem be considered an integral element of the subsystem itself.

To aid in the development of these devices, the following recommendations are made regarding efficiencies and operating voltages.

By 1987, it is believed that a storage efficiency of 80 percent should be required. This is a total storage system efficiency and includes standby losses, power conversion losses, motor/generator losses, etc., equivalent to losses normally encountered in other storage approaches such as battery systems. It is recommended, however, that a storage efficiency goal of 90 percent be set for the 1987 time frame. By 1992, it is believed that the storage efficiency requirement should be set at 85 percent with a goal of 92 percent. To insure that full advantage is being taken of the storage efficiency potential of flywheels, it is recommended that a bus voltage of 200+ volts be selected.

The other integration issue is that of combining the functions of attitude control and energy storage into one system. Although this question was not specifically addressed by this panel, it is felt that, based on the studies done by various conference participants, the technology in the power conversion and suspension systems area is adequate to support such an approach. Combining these functions into one system eliminates some problems associated with cross-coupling which must otherwise be addressed. However, the resolution of this question was left to the system studies recommended in this summary.

2. Technology Development

It was recognized that the development of this technology consisted of three major steps and encompassed a complementary mix of analytical efforts and hardware development for validation of design approaches and concept implementations. These major elements included (Figure 2)

1. Immediate studies to determine the optimal system configuration considering gimballed and non-gimballed wheel concepts and incorporating the best 1984 component technology. These studies must also address the impact of rotor configuration on other elements of the system such as motor/generators and magnetic suspension systems in order to permit the selection of the optimal configuration for the demonstration phase.

2. By 1987, focus the development program on integration and demonstration of a complete system including the rotor, suspension, and power conversion subsystems with emphasis on efficiency.

3. In parallel with the integration and demonstration effort, conduct a technology program on motor/generators, suspension systems, gimbals, and sensors to take advantage of known technological advances.

3. Flight Testing

Regarding the necessity for flight testing of this technology, the panel concluded that this was not an essential part of the development effort at this time (Figure 3). However, it is recognized that such testing may become essential in the future, depending on the final system configuration and architecture.

TABLE 1

MEMBERSHIP OF ELECTROMECHANICAL/ELECTROMAGNETICS WORKING GROUP

NAME	ORGANIZATION	PHONE
R. A. Kennedy	Sperry-Flight Systems	(703)892-0100
P. A. Studer	NASA-GSFC	(301)344-5229
L. Pursiano	Bendix-Guidance Systems	(201)393-3007
J. Downer	C. S. Draper Laboratory	(617)258-1458
D. B. Eisenhaure	C. S. Draper Laboratory	(617)258-1421
D. Litz	Westinghouse R&D Center	(412)256-2271
N. J. Groom	NASA-LaRC	(804)865-3350

1. COMPONENT AND SYSTEM TECHNOLOGY ISSUES

1.1 ADEQUATE TECHNOLOGY EXISTS IN BOTH BEARING AND POWER CONVERSION AREAS TO BE COMPETITIVE WITH ALTERNATIVE TECHNOLOGIES IF SPACE STATION CONTROL REQUIREMENTS AND WHEEL STABILITY CHARACTERISTICS ARE DEFINED.

1.2 THE PRINCIPAL CONCERN IS THE INTEGRATION OF THE ROTOR, BEARINGS, AND POWER CONVERSION.

1.3 MOTOR/GENERATOR AND BEARINGS SHOULD BE DEVELOPED AS AN INTEGRATED UNIT TOGETHER WITH THEIR ELECTRONICS AND CONTROLS.

1.4 RECOMMENDED STORAGE EFFICIENCY

1987	80% REQUIRED	90% GOAL
1992	85% REQUIRED	92% GOAL

1.5 RECOMMEND 200+ VOLTS BUS

Figure 1

2. MAJOR STEPS

2.1 IMMEDIATE STUDIES TO DETERMINE OPTIMAL OVERALL SYSTEM CONFIGURATION CONSIDERING GIMBALLED AND NON-GIMBALLED APPROACHES INCORPORATING BEST 1984 COMPONENT TECHNOLOGY.

2.2 BY 1987 DEVELOPMENT PROGRAM FOCUSING ON SYSTEM INTEGRATION AND DEMONSTRATION OF COMPLETE SYSTEM INCLUDING ROTOR, BEARING, AND POWER CONVERSION EMPHASIZING HIGH EFFICIENCY.

2.3 TECHNOLOGY PROGRAM ON MOTOR/GENERATORS, SUSPENSIONS, GIMBALS, AND SENSORS AIMED IN SUPPORT OF DEMONSTRATION PROGRAM TO TAKE ADVANTAGE OF KNOWN TECHNOLOGICAL POSSIBILITIES.

Figure 2

3. ASSESSMENT OF NEED FOR FLIGHT TESTING

NOT MANDATORY, BUT MAY BE NECESSARY, DEPENDING ON SYSTEM CONFIGURATION.

Figure 3