(NASA-TM-80014) OAST SPACE THEME WORKSHOP. VOLUME 3: WORKING GROUP SUMMARY. 7: MATERIAL (M-1). A. STATEMENT. B. TECHNOLOGY NEEDS (FORM 1). C. PRIORITY ASSESSMENT (FORM 2) (NASA) 127 p HC A07/MF G3/12

N79-15126

Unclas 42667

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

OAST SPACE THEME WORKSHOP

VOLUME III

WORKING GROUP SUMMARY

VII. MATERIAL (M-1)

A. STATEMENT

B. TECHNOLOGY NEEDS (FORM I)

C. PRIORITY ASSESSMENT (FORM II)

HELD AT THE
LANGLEY RESEARCH CENTER
APRIL 26-30, 1976

SPONSORED BY NASA-CODE RX

Foreword

The attached material represents the working papers from the OAST Space Theme Workshop held at the Langley Research Center, April 26-30, 1976, and contains a quick-look analysis of the proceedings. The material is unedited and intended for further use by the participants of the workshop and the planning elements of NASA concerned with space mission research and technology. It should be understood that the data do not represent official plans or positions but are part of the process of evolving such plans and positions.

Nearly 100 of the Agency's top technologists and scientists joined with another 35 theme specialists to produce this working document - a document that provides a technical foundation, including research and technology base candidates, for each of the six space themes.

The material in this report is considered essential to the development of Center initiatives in support of these themes. Copies of the report will be made available to the Center Management Board and the individuals at the Centers responsible for the FY'78 program planning cycle. The timing of this planning activity has caused us to distribute this document in this unedited form. Thus, it possibly contains errors, hopefully, more of a typographical rather than a technological nature. Nonetheless, the information contained is of a high professional level, reflecting the efforts of the workshop participants and will be invaluable to the planning and successful execution of the Agency's near- and far-term advanced technology program.

Stanley R. Sadin
OAST Space Theme Workshop
Chairman
NASA Headquarters
Study, Analysis, & Planning Office
Office of Aeronautics and
Space Technology

WORKING GROUP M-1 - MATERIALS AND THEMAL CONTROL

Introduction

All NASA Centers and the Jet Proplusion Laboratory were represented on the Materials and Thermal Control Working Group. The Working Group was divided into teams to provide interfaces with each of the six themes represented at the Space Theme Workshop. The entire working group complement, however, worked together to establish the technology needs and priorities. The R&T Base program was developed by the working group as an adjunct to the themes development

It should be noted that the scope of this working group includes materials, thermal control, and entry. At the 1975 OAST summer Workshop, these disciplines were represented by three separate working groups.

In reviewing the technology needs of the various themes, the working group found little commonality in the needs in materials and thermal control areas. In most cases, the materials and thermal control technologies must be closely tailored to meet widely divergent needs determined by the different operating conditions and environments of each theme. For example, the varying theme requirements introduced different emphasis to the development of composite materials and cryogenic systems. Thus, the approach of matching technology areas with various themes needs was not effective for the materials and thermal control discipline. Instead, separate technology priorities were defined for each theme.

The diversity of technologies is illustrated in the following listing of the top two priorities for each theme:

Theme 7.- Multipurpose Spare Power Platform

1. Materials for Power Generation Systems
2. Materials for Power Storage and Transmission Systems

Theme 8.- Industralization of Space

1. Spare Processing for Use on Earth
2. Fabrication Technology for Space Erectable Structure

Theme 9.- Search for Extra Terrestrial Intelligence

1. Long-Lift Cryogenic Systems for Masers

2. Stable Materials for Large Antenior Structures

Theme 10.- Exploration of the Solar System

1. Lightweight Nuclear Shielding Materials for Nuclear Electric Propulsion

2. Spacecraft Thermal Control Materials/Devices

Theme 11.- Global Services Systems

1. Long-Life Cryogenic Systems for Sensors

2. Techniques for In-Site Manufacturing in Space

Theme 12.- Advanced Transportation Systems

1. Materials for Advanced Propulsion Systems

2. Advanced Thermal Protection System/Materials

In prioritizing the entire list of technology needs, the working group emphasized the materials technology for the Advanced Transportation System (Theme 12) and Spare Power Platform (Theme 7) since these systems were considered essential building blocks in fulfilling some of the other themes. Consequently, the top for priorities evolved from these themes. These priorities should have a significant impact on future programs for the materials and thermal control technology disciplines since two of these top technologies (i.e., materials for propulsion and power systems) are not emphasized in current OAST programs. Thus, increased support in these areas by the OAST Materials Division appears warranted.

In the area of thermal control technology, the needs for several indicated the necessity for a change in the current trend in the program for this discipline. Although, the level of OAST support for thermal control technology has been declining in recent years, the high-priority theme needs for advanced thermal control systems indicates that increased support is needed. A particular important technology in this area is long-life cryogenic cooling systems for sensors, masers, and other devices (Themes 9, 10, and 11). A more concentrated and integrated OAST-supported effort in this technology appears warranted.

A few key theme needs identified potential voids in OAST's current efforts. An example of this is the need for lightweight nuclear shielding materials for Nuclear Electric Propulsion. Theme 10 Team and the working group concurred that this technology was the highest-rated materials technology for this theme. Thus, new initiatives were proposed to fill this and other current program voids.

The total impact of the theme needs on the materials and thermal control areas is illustrated by the two highest-rated technologies selected for each theme. In comparing the support of these twelve technologies with OAST's current program plans, three of these are considered to be adequately supported. Of the other nine technologies, three require

major increases in support (i.e., 50 to 70 percent greater funding levels) while the other size technologies require new initiatives.

A concern was raised by the working group on the impact of the themes concerning the fact that the Theme Teams tended to support nearer-term applied technologies rather than longer-term exploratory efforts. Thus, the more applied technologies received higher priority ratings and may receive greater support at the expense of the exploratory efforts which usually involve more risk, but often offer greater overall benefits in the long run. Thus, the working group emphasizes a continuing need for an OAST materials and thermal control program that is properly balanced between the research and more applied aspects of these disciplines.

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE POWER GENERATION SYSTEM MATERIALS/ PROCESSES

NO. 07 M-1 01
THEME / W.G. / TASK

DATE 4 / 28 / 76 (Rev. 2)

2. OBJECTIVE

~~To develop materials and processing technology to permit the development of higher efficiency, longer life space power generation~~ systems

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE Yes - FY 78 - $400K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Advanced power generation systems

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- o Lower Cost Si Solar Cell Fabrication
- o Higher Efficiency Solar Cell Materials
- o High Temperature Nuclear Reactor Materials
- o Brayton Cycle Turbine and Heat Exchanger Materials
- o Thermionic Diode Materials

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE POWER GENERATION SYSTEM MATERIALS/ PROCESSES

NO. 07 M-1 01
THEME / W.G. / TASK

DATE 4 / 28/ 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

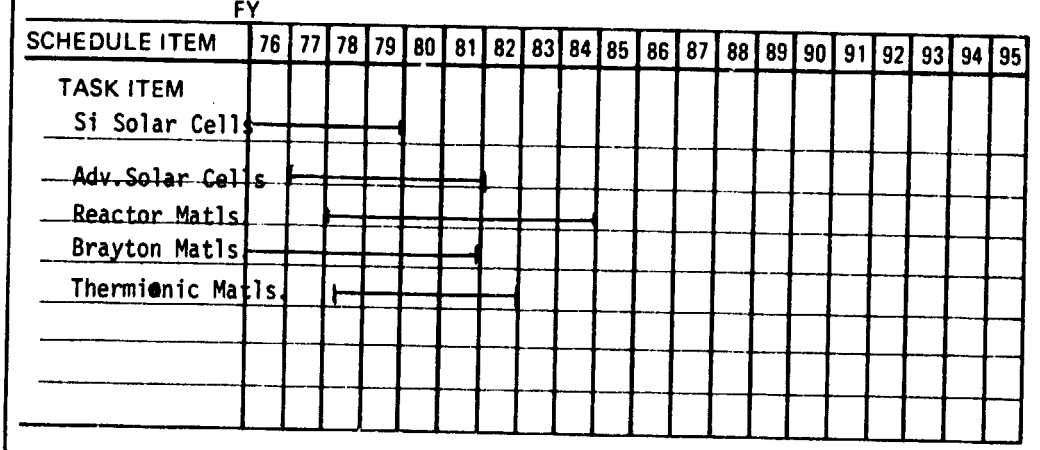
1. Laboratory development of materials/processes
2. Rig-testing under simulated operating conditions
3. Commercial scale-up
4. Incorporation in applicable system

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

Solar cells - 506-23-12; 506-23-17; 506-22-32
Thermicnics - 506-24-21

9. TECHNOLOGY SCHEDULES



MANPOWER (M-Y)																				
INHOUSE			4	4	4	4	3	1	1											
CONTRACT			5	5	5	5	4	2	1											
FUNDING (10^6 $)																				
INHOUSE			.1	.1	.1	.1	.1	.1	-											
CONTRACT			0.5	1.0	2.0	3.0	2.0	1.0	-											

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED — **FORM NO. I**

1. TITLE POWER STORAGE AND TRANSMISSION SYSTEM MATERIALS/PROCESSES

NO. 07 M-1 02
THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE

To develop materials and processing technology to permit development of high-efficiency, long-life space power storage and transmission systems

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY DATE: 1985

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR
ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE Yes - FY 78 $200K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

Advanced power storage and transmission systems

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- o High Capacity Energy Storage Materials
- o High Power Laser Transmission Materials
- o High Temperature Electrical Insulator Materials
- o High Efficiency Superconducting Materials

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE POWER STORAGE AND TRANSMISSION SYSTEM MATERIALS/PROCESSES

NO. 07 M-1 02
THEME / W.G. / TASK

DATE 4 / 27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

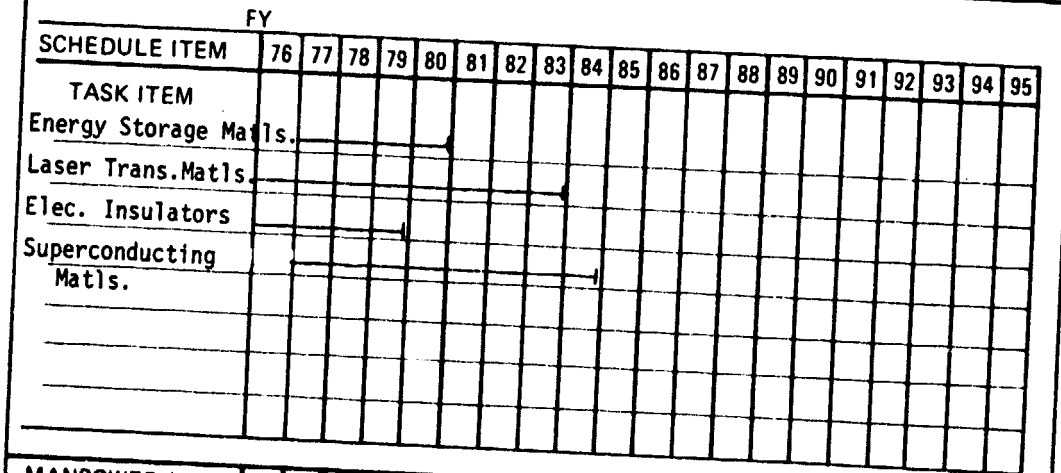
1. Laboratory development of materials/processes
2. Rig-testing under simulated operating conditions
3. Commercial scale-up
4. Incorporation in applicable system

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

Batteries - 506-23-23; 506-23-24
Fuel Cells - 506-23-24

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y) INHOUSE	2	3	4	4	3	3	2	1	1											
CONTRACT	3	3	5	5	4	4	4	4	2											
FUNDING (10^6 $) INHOUSE	.2	.2	.4	.4	.3	.2	.1	-	-											
CONTRACT	.2	.3	.5	1.0	1.0	1.5	1.5	1.0	-											

SPACE TECHNOLOGY NEED

FORM NO. I

1. TITLE THERMAL CONTROL INSULATION SYSTEMS

NO. 07 M-1 03
THEME / W.G. / TASK

DATE 4 / 28 / 76 (Rev. 3

2. OBJECTIVE To develop materials systems technologies for thermal control insulation systems for long life space power systems

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT - SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1983]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [ ] MEDIUM [X] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [ ] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE _____

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

0 Lightweight, reusable, rugged systems
0 Improved Hi and low temperature performance
0 RFI transparent

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE THERMAL CONTROL INSULATION SYSTEMS

NO. 7 M-1 03
THEME / W.G. / TASK

DATE 4 / 28/ 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

(1) Examine state-of-art of insulation systems
(2) Develop methods for improving efficiency of systems with the idea of lowering cost, extending life
(3) Implement candidate systems

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Examine S.O.A.			———																	
New Methods Dev.				———	———															
Implementation						———	———													
MANPOWER (M-Y)																				
INHOUSE		.5	.5	1.0	1.0	1.0	1.0													
CONTRACT																				
FUNDING (10^6 $)																				
INHOUSE			.5	.5	.5	.5														
CONTRACT																				

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE COMPOSITES FOR LARGE, LONG-LIFE SPACE STRUCTURES

NO. 07 M-1 04
THEME / W.G. / TASK

DATE 4 / 27 / 76 (Rev. 2

2. OBJECTIVE To develop and evaluate composites and adhesives for power system platforms

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY DATE: 1982

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE Yes - FY 78 $200K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Composites structures design

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- o Composite fabrication development - thin sections
- o Structural assembly and joining methods
- o Long-term space exposure effects
- o Fracture toughness of structural composites

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED **FORM NO. I**

TITLE COMPOSITES FOR LARGE, LONG-LIFE SPACE STRUCTURES

NO. 07 M-1 03
THEME / W.G. / TASK

DATE 4 / 27 / 76(Rev.1)

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

- o Develop fabrication methods for resin-matrix composites - emphasis on thin sections for large collectors
- o Develop assembly and adhesive bonding methods
- o Generate property data on effects of long-term exposure under expected operating temperature, vacuum, and radiation levels

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

506-17-11

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
oComposite Fab.		←	—	—	—	—														
oAssembly/Join.			←	—	—	—														
oExposure Effects				←	—	—	—													
oFracture Tough.			←	—	—	—														
MANPOWER (M-Y)																				
INHOUSE		2	2	2	1															
CONTRACT		2	2	2	1															
FUNDING (10^6 $)																				
INHOUSE		.1	.1	.1	-															
CONTRACT		.3	.3	.3	-															

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE IN-SITU MANUFACTURING OF LARGE SPACE STRUCTURES

NO. 07 M-1 05
THEME / W.G. / TASK

DATE 4 / 28 76 (Rev.2)

2. OBJECTIVE To develop methods and techniques for manufacturing large structures in space

3. NEED ANALYSIS

a) LEVEL NOW [1], WILL BE LEVEL [2] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: 1985

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [ ] MEDIUM [X] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [ ] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE Yes - FY 78 $300K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Development of special structural design concepts

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- o Develop concepts for taking high density packaged materials and developing structural members
- o Develop means for rapid automated joining of materials under orbital conditions
- o Develop advanced NDE technique for use under orbital conditions

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. 1

TITLE IN-SITU MANUFACTURING OF LARGE SPACE STRUCTURES

NO. 07 M-1 05
THEME / W.G. / TASK

DATE 4 / 27/ 76

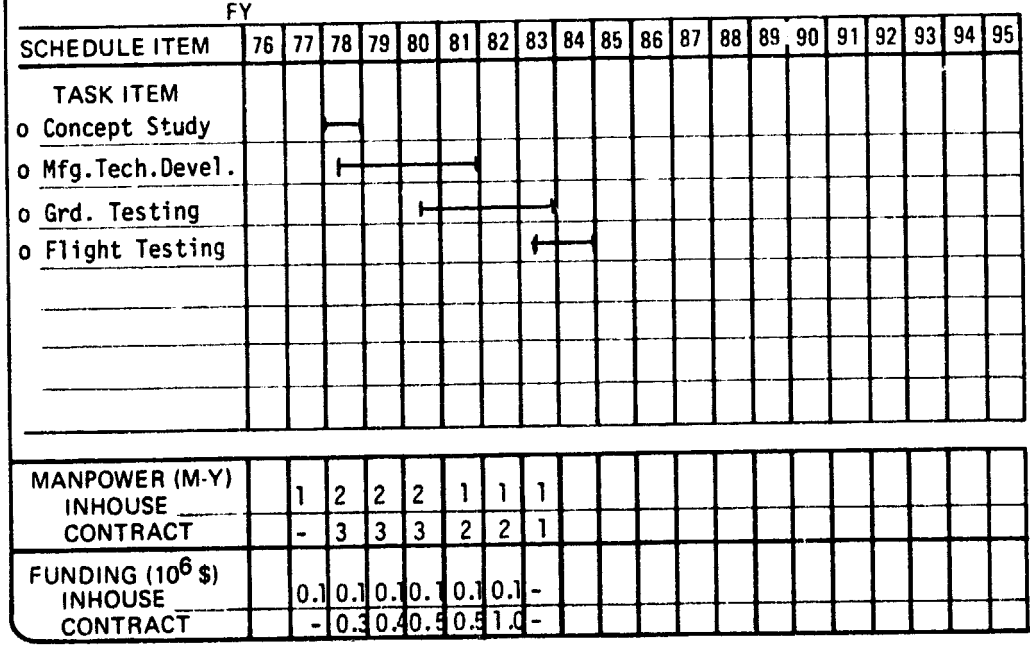
6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

1. Study available techniques applicable to large structures
2. Develop manufacturing concepts
3. Evaluate concepts by testing in large space vacuum facilities
4. Evaluate most promising concepts in orbital experiments

7. ALTERNATIVE APPROACHES/OPTIONS Manufacture structures in individual segments and transport to orbital altitudes for final assembly

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y)																				
INHOUSE		1	2	2	2	1	1	1												
CONTRACT		-	3	3	3	2	2	1												
FUNDING (10^6 $)																				
INHOUSE		0.1	0.1	0.1	0.1	0.1	0.1	-												
CONTRACT		-	0.3	0.4	0.5	0.5	1.0	-												

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
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6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED — **FORM NO. I**

1. TITLE LONG-TERM SPACE EFFECTS ON MATERIALS — NO. 7 M-1 06 (THEME / W.G. / TASK)

DATE 4 / 28 / 76(Rev. 1)

2. OBJECTIVE

To determine overall effects of vacuum, radiation, thermal cycling on properties of materials used in space platform construction

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT: HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [ ] RESEARCH [X] GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X] OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE Yes - $200K FY 78

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Considerable laboratory tests and some space flight testing has been accomplished for limited times - generally on order of 2 years - for many materials. There are still many materials that must be tested, especially materials to be used in the power generation and storage systems. Threshold exposure conditions and limitations of exposure for useful properties must be determined.

- o Vacuum evaporation effects on high-temperature alloys
- o UV effects on coatings and glasses
- o Long-time exposure effects on seals and lubricants
- o Outgassing of composite structural materials

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE LONG-TERM SPACE EFFECTS ON MATERIALS

NO. 7 M-1 06
THEME / W.G. / TASK

DATE 4 / 27/ 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Initial efforts involve evaluation of materials using simulated space environments on earth. Advanced experiments will include short term space flights, and eventual test beds on long duration flights.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

FY / SCHEDULE ITEM	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
High-temp alloys			├	─	─	─	─	─	─	┤										
Coating/glasses			├	─	─	┤														
Seals/Lubes			├	─	─	┤														
Composites			├	─	─	─	─	─	─	┤										
MANPOWER (M-Y) INHOUSE			2	2	2	3	3	2	2	2										
CONTRACT			3	3	3	3	3	3	3	3										
FUNDING (10^6 $) INHOUSE			.1	.1	.1	.1	.1	.1	-	-										
CONTRACT			.3	.3	.3	.3	.3	.2	.2	-										

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 1 OF 2

1. TITLE SPACE HABITAT MAINTENANCE & REFURBISHMENT

NO. 8 M-1 01
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE To develop methods and processes for providing on-orbit maintenance and refurbishment for space habitats

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: 1985

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [ ] MEDIUM [X] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE Yes - FY 78 requirements 300K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Contamination Control - Waste Management Methods, Non-Destructive Testing, On-Orbit Refurbishment Techniques

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Various factors associated with on-orbit maintenance of a space hatitat are included in this requirement, as stated in Item 4. Procedures and processes must be developed as well as refurbishment materials considered for routine maintenance of a space habitat. Tasks will include: 1. Determination of containmant level tolerances and control methods 2. Fluid and gas supply management 3. Internal and external inspection techniques 4. Development of repair methods or refurbishment techniques

SPACE TECHNOLOGY NEED FORM NO. I

PAGE 2 OF 2

TITLE SPACE HABITAT MAINTENANCE AND REFURBISHMENT

NO. 8 M-1 01
THEME / W.G. / TASK

DATE 4 / 27/ 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Study conceptual designs to determine potential maintenance refurbishment requirements

Construct model structures or components to demonstrate methods or techniques

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
1. (see #5)																				
2																				
3																				
4																				
MANPOWER (M-Y)																				
INHOUSE				1	4	4	4	2	2	2	2	2	2	2						
CONTRACT					4	4	4	4	4	4	4	4	4	4						
FUNDING (10^6 $)																				
INHOUSE				0	.1	.1	.1	.1	-	-	-	-	-	-						
CONTRACT					.2	.2	.2	.3	.3	.3	.3	.2	.2	.2						

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 1 OF 2

1. TITLE DEVELOPMENT OF LUNAR HABITAT CONSTRUCTION METHODS

NO. 8 M-1 02
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE To provide earth-furnished or lunar-constructed structural materials and develop construction methods for assembly of lunar shelters

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: 1990

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE Yes

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Expandable structures, foam materials, adhesives, thermal control, radiation shielding

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

To construct lunar shelter, subterranium or surface, of various materials and designs. Studies needed to determine suitability of expanded structures, inflatable liners for caves, foam blocks (IGLOOS), or modular constructions. Studies also needed to determine feasibility of using lunar materials for structural purposes

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE DEVELOPMENT OF LUNAR HABITAT CONSTRUCTION METHODS

NO. 8 M-1 02
THEME / W.G. / TASK

DATE 4 / 27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Construction of Prototype and Demonstration structures on earth

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

FY / SCHEDULE ITEM	76	77	78	73	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
General Studies			═	═	═	═	═	═	═	═	═	═	═	═	═					
MANPOWER (M-Y) INHOUSE			2	2	2	3	3	3	4	4	4	4	4	4	4					
CONTRACT			0	0	0	6	6	6	8	8	8	8	8	8	8					
FUNDING (10^6 $) INHOUSE			.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1					
CONTRACT			0	0	0	.2	.2	.3	.4	.4	.4	.4	.6	.6	.6					

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 1 OF 2

1. TITLE DEVELOPMENT OF THERMAL CONTROL TECHNIQUES TO ESTABLISH A LIVABLE ENVIRONMENT IN SPACE HABITATS

NO. 8 M-1 03
THEME / W.G. / TASK

DATE 4 /27 / 76

2. OBJECTIVE To provide suitable thermal control methods for providing livable environments in space habitats

3. NEED ANALYSIS

a) LEVEL NOW [5], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [ ] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE Yes

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Thermal Control Paints - Heat pipes - Second Surface Mirrors

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Both passive and active thermal control systems must be studied for potential candidates for the major space habitat structures or for auxillary modules - to provide improved long life systems superior in performance to currently available systems.

Specific Tasks to include:

1. Development of Thermal Control Paints and Coatings
2. Development of Heat Pipes for specific requirements
3. Development of Second Surface Mirrors
4. Development of thermoelectric thermal control systems

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE DEVELOPMENT OF THERMAL CONTROL TECHNIQUES TO ESTABLISH A LIVABLE ENVIRONMENT IN SPACE HABITATS

NO. 8 M-1 03
THEME / W.G. / TASK

DATE 4 /27 / 76

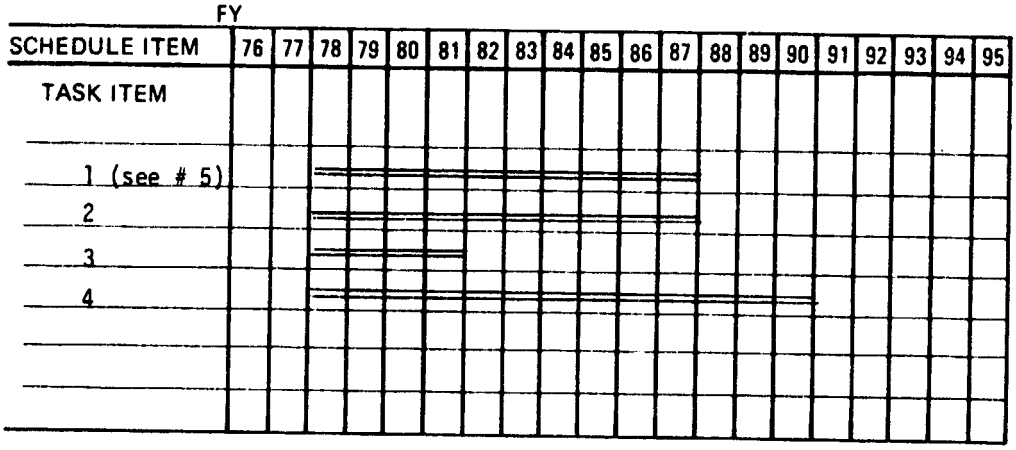
6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Based on performance characteristics of the best currently available methods, develop new improved methods

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y)																				
INHOUSE			4	4	4	4	3	3	3	3	3	3	2	2	2					
CONTRACT			8	8	8	8	6	6	6	6	6	6	4	4	4					
FUNDING (10^6 $)																				
INHOUSE			.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.1	.1	.1					
CONTRACT			.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.2	.2	.2					

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE MANUFACTURE OF COMPOSITE MATERIALS IN SPACE

NO. 8 M-1 04 (THEME / W.G. / TASK)

DATE 4 / 28 / 76

2. OBJECTIVE Development of processes and equipment to fabricate structural members in space - to provide light weight large structures

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1990]

c) RISK IN ACHIEVING ADVANCEMENT: HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: X HIGH [ ] MEDIUM [X] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X] GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X] (Check one or more)
OTHER (Specify) [ ] _____

f) R&T BASE CANDIDATE _____

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Basic materials (fiber spools, sheet, resins, prepregs) can be transported in smaller volume than an array of composite beams or trusses. Processing equipment and techniques suitable for space fabrication will be developed and evaluated on earth to demonstrate feasibility. Various form will have to be studied with respect to difficulty of span manufacture

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. 1
PAGE 2 OF 2

TITLE MANUFACTURE OF COMPOSITE MATERIALS IN SPACE

NO. 8 M-1 04
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Determine which composite systems offer promise of easy, efficient manufacture under ZERO-G conditions

Prepare earth based samples for analysis/characteristics

Prepare samples in spar type flight if possible

Prototype - small scale space flight production

Economic studies

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

FY / SCHEDULE ITEM	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
General Study			═	═	═	═	═	═	═	═										
MANPOWER (M-Y) INHOUSE			2	2	2	2	2	2	2											
CONTRACT			3	3	3	4	4	4	4											
FUNDING (10^6 $) INHOUSE			.05	.05																
CONTRACT			.1	.1	.1	.2	.2	.2	.2											

SPACE TECHNOLOGY NEED FORM NO. I

PAGE 1 OF 2

1. TITLE Development of Methods for Extraction NO. 8 M-1 05
THEME / W.G. / TASK

DATE 4 / 26 / 76

2. OBJECTIVE To make use of lunar minerals to produce structural materials and/or supplies for lunar habitat uses.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [3] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1990]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [x]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR
ENHANCING: HIGH [ ] MEDIUM [x] LOW [ ]

e) TASKS NEEDED: STUDY [x] ANALYSIS [ ] RESEARCH [ ]
GRD TEST [ ] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE Yes

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Extractive Metallurgy

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Lunar samples already available or simulated lunar samples can be used to study extractive methods and probable yields of various materials. Production of water and oxygen on the lunar surface needs to be explored.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. 1

PAGE 2 OF 2

TITLE Development of Methods for Extraction of Elemental Materials from Lunar Surface to Produce Structural Materials

NO. 8 M-1 05 (THEME / W.G. / TASK)

DATE 4 / 26 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Complete studies on available lunar samples to determine compositions and amounts of useful structural elements or compounds. Conduct limited extraction studies on lunar samples. Conduct extraction studies on simulated lunar samples. Prepare structural materials from extracted samples.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
General Studies		—	—	—	—															
MANPOWER (M-Y) INHOUSE		2	2	2	2															
CONTRACT		6	6	6	6															
FUNDING (10^6 $) INHOUSE																				
CONTRACT		.3	.3	.3	.3															

SPACE TECHNOLOGY NEED FORM NO. I

PAGE 1 OF 9

1. TITLE Space Processing for Producing Materials for Use of Man On Earth

NO. 8 M-1 06 (THEME / W.G. / TASK)

DATE 4 / 27 / 76

2. OBJECTIVE To take advantage of zero-G conditions to produce new and unique biochemical, structural, and special materials.

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1980]

c) RISK IN ACHIEVING ADVANCEMENT: HIGH [ ] MEDIUM [ ] LOW [x]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [ ] MEDIUM [x] LOW [ ]

e) TASKS NEEDED: STUDY [x] ANALYSIS [x] RESEARCH [x] GRD TEST [x] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [x] OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE Yes FY 78 Requirement 2.0M

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Considerable Basic Physics and Chemistry Research

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Based on basic experiments already accomplished on space flights, the potential benefits afforded by space processing are enormous and will require expansion of experiments and scale up of equipment to produce commercial quantities of certain biochemical or special materials. Space processing offers substantial improvements for biochemical separations and purification more powerful magnetic materials superconducting materials and new semi-conductors.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. I

TITLE Space Processing NO. 8 M-1 06 (THEME / W.G. / TASK)

DATE 4/27 /76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Use knowledge already obtained in Skylab and ASTP flights and SPAR flights to develop comprehensive program, and to select best candidate processes for providing greatest benefits.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

FY 77 RTOP includes many laboratory and SPAR experiments which could lead to selection of studies for scale-up in following years.

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM 1 (see p.3)		———	———	———	———	———	———	———	———	———	———	———	———	———	———					
2		———	———	———	———	———	———	———	———	———	———	———	———	———	———			———		
3					———	———	———	———	———	———	———	———	———							
MANPOWER (M-Y) INHOUSE		15	20	20	20	20	20	20	20	25	25	25	25							
CONTRACT		15	25	25	25	30	30	40	40	50	50	50	50							
FUNDING (10^6 $) INHOUSE		.3	.5	.5	.5	.5	.2	.2	.2	.2	.2	.2	.2							
CONTRACT		1.5	2.0	2.0	3.0	3.0	5.0	5.0	5.0	5.0	7.0	7.0	7.0							

SPACE TECHNOLOGY NEED FORM NO. I

PAGE 3 OF 3

1. TITLE Space Processing NO. 8 M-1 06

THEME / W.G. / TASK

DATE 4 / 27 / 76

(.5) Block No. **CONTINUATION (If Needed)**

Some specific tasks that could be included in this technology requirement are:

1. Commercial Production of Biological Materials for Medical Applications
   - Production of UROKINASE from Kidney cells to dissolve blood clots
   - Production of lymphoctes for prevention of organ transplant rejections
   - Isolation of ERYTHROPOIETIN for treatment of kidney failure
   - Separation of PHAGOCYTES for diagnosis of imunological reaction
   - Isolation of AHE for hemophilia treatment
   - Purification of Vaccines
2. Production of Electrical and Magnetic Materials
   - New magnetic materials for motors, bubble memories, tapes
   - Solar cells for Space Power Systems
   - Development of new alloys, such as directionally solidified eutectics
   - Development of silicon ribbons for integrated circuit chips
   - Space Processing of Ceramics and Glass
3. Basic R&T
   - Study of Transport Phenomena in Zero-G
   - Multiphase Flow Studies
   - Advanced Materials separation processes
   - Stability of Emulsions
   - Reaction Phenomena-transformation processes-polymerization
   - Physics and Chemistry of Organic Superconductors

SPACE TECHNOLOGY NEED

FORM NO. I

PAGE 1 OF 9

1. TITLE Development of Fabrication Techniques for Space Erectable Structures

NO. 8 M-1 07
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE

To develop fabrication techniques for constructing space structures from both composite materials and conventional materials - in space for manned and unmanned structures.

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: [1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE Yes

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Joining methods, such as welding, riveting, adhesive bonding, or unique mechanical means, will be needed to join modular sections of a large space habitat, or other space erectable structures. Procedures must be developed to accomplish these processes in space. Other fabrication processes, such as forming, molding, foaming, casting, and machining may be required in the construction of various structures; methods must be developed to accomplish these processes efficiently and economically. Automatic processes to be given maximum consideration in manned and unmanned modes.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 3

TITLE Development of Fabrication Techniques for Space Erectable Structures

NO. 8 M-1 07
THEME / W.G. / TASK

DATE 4 / 27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Review earth based processes to determine applicability to space activities. Improve processes or develop new processes where necessary. Conduct experimental tests in near earth orbit to prove principles.

7. ALTERNATIVE APPROACHES/OPTIONS

Construct modules with minimum amount of fabrication efforts required for space assembly. Emphasis on automation.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

FY / SCHEDULE ITEM	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
1 (see #5)			═══	═══	═══	═══														
2			═══	═══																
3				═══	═══	═══	═══	═══	═══	═══										

MANPOWER (M-Y)																				
INHOUSE ___		SUPPORTED BY N.I. 11 & 13																		
CONTRACT		SUPPORTED BY N.I. 14 & 30																		
FUNDING (10^6 $)																				
INHOUSE ___																				
CONTRACT																				

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 3 OF 3

1. TITLE Development of Fabrication Techniques for Space Erectable Structures

NO. 8 M-1 07
THEME / W.G. / TASK

DATE 4 / 27 / 76

(5) CONTINUATION (If Needed)

Block No.

Specific tasks required under this need are:

(1) Improved joining techniques

- Welding studies
- Riveting Methods
- Adhesive bonding

(2) Forming Processes

(3) Molding, casting, foaming in place of polymeric materials in space.

(4) Development/Implementation of automation.

SPACE TECHNOLOGY NEED

FORM NO. I

1. TITLE Long Term Space Effects on Materials for 20 Year Life Structures

NO. 8 M-1 08
THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE

To determine overall effects of vacuum, radiation, thermal cycling on properties of materials used in spacecraft construction

3. NEED ANALYSIS

a) LEVEL NOW [5], WILL BE LEVEL [7] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE:1980]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [ ] RESEARCH [X]
GRD TEST [ ] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE Yes FY78 Requirement 200K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Development of materials specifically tailored to resist total effects of space exposure.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Considerable laboratory tests and some space flight testing has been accomplished for limited times - generally on order of 2 years - for many materials. There are still many candidate materials that must be tested, especially window glasses, seals, lubricants, and surface coating materials. Threshold exposure conditions and limitations of exposure for useful material properties must be determined.

LEVEL OF STATE OF ART
1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I

TITLE Long Term Space Effects on Materials for 20 Year Life Structures

NO. 8 M-1
THEME / W.G. / TASK

DATE 4 / 28/76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Initial efforts involve evaluation of materials using simulated space environments on earth. Advanced experiments will include short term space flights, and eventual test beds on long duration flights.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
1 (see #5)			—	—	—															
2			—	—	—	—	—													
3			—	—	—															
4			—	—	—	—	—	—	—	—										
MANPOWER (M-Y) INHOUSE			3	3	4	3	3	2	2	2										
CONTRACT			8	8	8	6	6	3	3	3										
FUNDING (10^6 $) INHOUSE			.1	.1	.1	.1	.1	.1	.1	.1										
CONTRACT			.3	.3	.3	.3	.3	.2	.2	.2										

SPACE TECHNOLOGY NEED

FORM NO. 1

1. TITLE Long Term Space Effects on Materials for 20 Year Life Structures

NO. 8 M-1
THEME / W.G. / TASK

DATE 4 / 28 / 76

(5) CONTINUATION (If Needed)
Block No.

Some specific tasks required are:

1. UV effects on coatings, glasses
2. Development of optics resistant to solar radiation
3. Development of polymeric materials for long life
4. Effects of long duration space exposure on composites, seals, lubricants, coatings

SPACE TECHNOLOGY NEED — **FORM NO. I**

PAGE 1 OF 2

1. TITLE Large-Area Thin Films for RFI Protection — NO. 9/M-1/1 (THEME / W.G. / TASK)

DATE 4 / 29 / 76

2. OBJECTIVE

Develop process for fabrication of thick-metal, large-area thin-film structures for RFI shields in space applications having long-term integrity in the radiation of space.

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT: HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X] GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ] OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE FY78 $250K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Commercially available polymer films (such as kynar, mylar, etc.), having a thick metal coating (>1μ), must be evaluated for strength, fold and crease resistance, etc. Packaging and storage methods for thick-metal coated films must be devised. Joining methods such as heat sealing and adhesive bonding must be developed for fabrication of large area structures in space (>5km). Both coating and substrate must be evaluated to establish long-term resistance to degradation from the space environment.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE LARGE-AREA THIN FILMS FOR RFI PROTECTION

NO. 9 M-1 1
THEME / W.G. / TASK

DATE 4 / 27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

(1) Evaluate commercially available thick metal coated polymer films for strength, fold and crease resistance. (2) Design and prove packaging and storage techniques. (3) Establish by ground testing the long term resistance of these materials to the environment of space

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

FY / SCHEDULE ITEM	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
(1)			⊢	—	⊣															
(2)				⊢	⊣															
(3)			⊢	—	—	—	—	—	—	⊣										
MANPOWER (M-Y) INHOUSE			1	1	1	1	1	1	1											
CONTRACT			1	1	1															
FUNDING (10^6 $) INHOUSE			.1	.1	.1	.1	.1	.1	.1											
CONTRACT			.1	.1	.1															

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE Structural Materials for Large Space Antennas

NO. 9/M-1/2
THEME / W.G. / TASK

DATE 4 / 29 / 76

2. OBJECTIVE

Develop lightweight, easily fabricated structural materials having a low coefficient of thermal expansion and long-term mechanical stability in the environment of space.

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT -- SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE FY78 200K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Materials and processes must be developed to fabricate large antenna structures in space (>3000M). Candidate materials (i.e. graphite/epoxy composites) must be design for low coefficient of thermal expansion through composite fiber and lay-up development. Long-term mechanical stability to the environment of space must be demonstrated such as the influences of outgassing (particularly the loss of water), radiation, thermal fatigue and creep.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. 1

TITLE STRUCTURAL MATERIALS FOR LARGE SPACE ANTENNAS

NO. 9 M-1 02
THEME / W.G. / TASK

DATE 4 / 27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

(1) Design low coefficient of thermal expansion composite materials

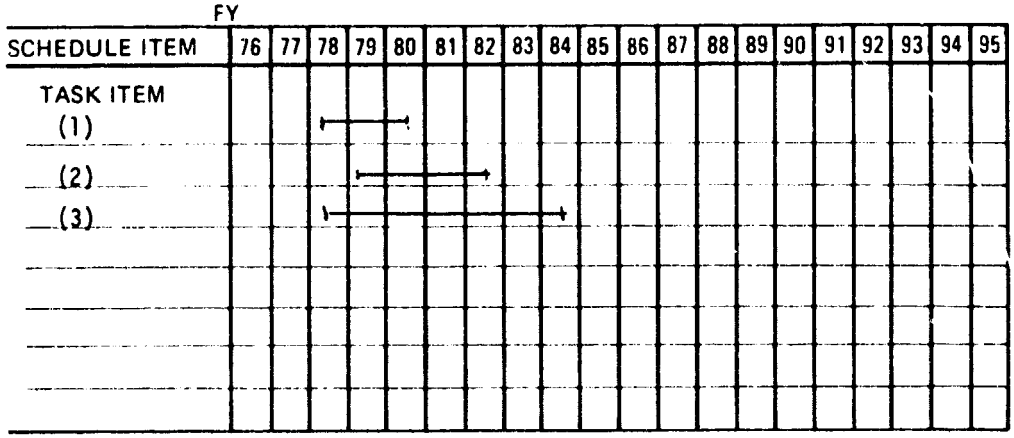
(2) Develop processes for large structure manufacturing in space

(3) Establish long term mechanical stability of large structures in the environment of space

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y)																				
INHOUSE			2	2	2	3	1	1	1											
CONTRACT			1	1	1	1	1	1	1											
FUNDING (10^6 $)																				
INHOUSE			.1	.2	.2	.3	.1	.1	.1											
CONTRACT			.1	.1	.1	.1	.1	.1	.1											

LEVEL OF STATE OF ART

1 BASIC PHENOMENA OBSERVED AND REPORTED
2 THEORY FORMULATED TO DESCRIBE PHENOMENA
3 THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4 PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5 COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6 MODEL TESTED IN AIRCRAFT ENVIRONMENT
7 MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED — **FORM NO. I**

1. TITLE Efficient and Stable Lubricants for Use in the Lunar Environment

NO. 9/M-1/3 (THEME / W.G. / TASK)

DATE 4 / 29 / 76

2. OBJECTIVE

~~Develop effective lubricants/barrier films/seals to prevent~~ loss of lubricant by creep/evaporation from massive rotating structures in the Lunar environment.

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1990]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE FY78 100K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Efficient lubricants, barrier films, and/or seals must be developed to ensure long-term adequacy in the vacuum of the lunar environment. Present lubricants are highly volatile and creep significantly and can not be relied upon for long-term space application.

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE EFFICIENT AND STABLE LUBRICANTS FOR USE IN THE LUNAR ENVIRONMENT

NO. 9 M-1 03
THEME / W.G. / TASK

DATE 4 /27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

(1) Develop efficient lubricants, barrier films, and seals to reduce lubricant creep and volitization

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

FY 76 506-16-22

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM (1)			⊢	—	⊣															
MANPOWER (M-Y) INHOUSE			.5	.5	.5															
CONTRACT																				
FUNDING (10^6 $) INHOUSE			.1	.1	.1															
CONTRACT																				

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I

1. TITLE LONG LIFE CRYOGENIC SYSTEMS FOR MASERS, ETC.

NO. 9 M-1 4
THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE To develop advanced cryogenic systems for low temperature amplifiers in the range $2^{o}K$ - $10^{o}K$

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: 1978

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR
ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X]
GRD TEST [ ] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE FY 78 $200K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Communications

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Lifetime extension of refrigerators (seals and bearings), Brayton power cycles (for refrigerators), high isolation for Dewars (MLI, supports, vacuum sealing, and Joule-Thomson valve), and radiators and developmental candidates required for above.

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE LONG LIFE CRYOGENIC SYSTEMS FOR MASERS, ETC.

NO. 9 M-1 04
THEME / W.G. / TASK

DATE 4 /28 / 76

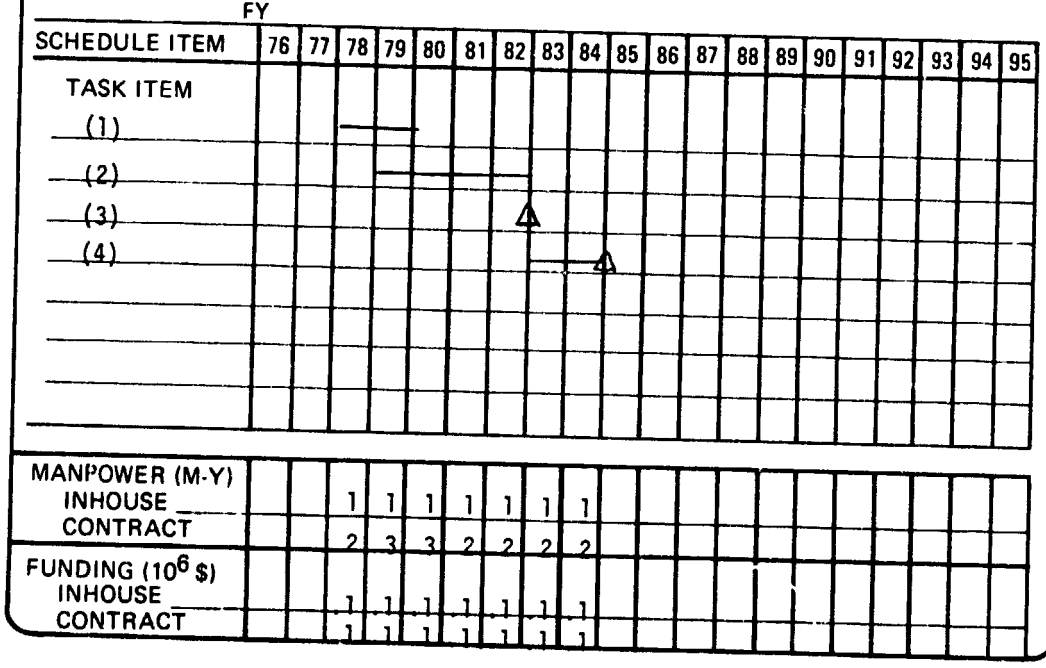
6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

(1) Current refrigerators, power sources, dewers, etc. to be evaluated for long life improvements
(2) Further development
(3) System selection
(4) Long-life readiness

7. ALTERNATIVE APPROACHES/OPTIONS Redundant units, refill dewar

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 1 OF 2

1. TITLE Radiation Stable Composites and Adhesives for Long-Term Spacecraft Structures

NO. 10 M-1 01
THEME / W.G. / TASK

DATE 4 / 27 / 76 (Rev. 2)

2. OBJECTIVE

Evaluate and develop composites and adhesives for 10-year mission spacecraft structures

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY DATE: 1985

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [ ] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE FY'78 $300K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Structures

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- Long life, radiation resistant, resin-matrix composites for spacecraft structures

SPACE TECHNOLOGY NEED FORM NO. I

TITLE Radiation Stable Composites and Adhesives for Long-Term Spacecraft Structures

NO. 10 M-1 01
THEME / W.G. / TASK

DATE 4 /28 /76 (Rev.2)

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Data will be obtained on long term radiation effects on candidate adhesives and resin matrix composites. Composite panels of epoxy and polyimide matrix materials will be exposed at appropriate radiation levels to demonstrate structural perjformance. Varying thermal cycling will also be included. Exposure duration will be of sufficient length to permit valid extrapolations to be made for 10-year exposures.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Materials Select.			—																	
Radiation Exp.			—	—	—	—														
Evaluation						—	—													
MANPOWER (M-Y)																				
INHOUSE			2	2	2	2	1													
CONTRACT																				
FUNDING (10^6 $)																				
INHOUSE			.3	.3	.3	.2	.1													
CONTRACT																				

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE MATERIALS FOR SOLAR SAILING

NO. 10 M-1 02
THEME / W.G. / TASK

DATE 4 / 27 / 76 (REV 2)

2. OBJECTIVE

Develop light-weight, tear-resistant, stable, large area polymer films and thermal control coatings for near sun and other planetary missions.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [XX]
GRD TEST [XX] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE FY'78 $250K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Large deployable support structures, attitude control

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Commercially available polymer films need to be evaluated for tear and tensile strengths, fold resistance, and long-time high temperature use. Coatings and adhesives also require high temperature integrity. Additionally, the adhesives and coating materials need protection against space radiation to prevent degradation. Fabrication techniques for production of large area films, including joining techniques, need development for sails hundreds of meters in diameter.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE Materials for Solar Sailing

NO. 10 M-1 02
THEME / W.G. / TASK

DATE 4 /27 /76 (Rev.2)

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Commercially available polymer films will be evaluated for tear and tensile strengths, fold resistance and long-time high temperature use. Coatings and adhesives required will be tested for high temperature integrity. Radiation protective coatings will be evaluated as well as fabrication and handling techniques for large area films, including joining methods, will be developed.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

FY / SCHEDULE ITEM	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Test & Eval.			———	———	———	———	———	———												
Fabrication Dev.				———	———	———	———													
Handling Dev.						———	———	———												
MANPOWER (M-Y) INHOUSE			2	4	4	4	4	1												
CONTRACT																				
FUNDING (10^6 $) INHOUSE			.25	.3	.3	.3	.3	.1												
CONTRACT																				

SPACE TECHNOLOGY NEED FORM NO. 1

PAGE 1 OF 2

1. TITLE Electronic Materials Technology Based on Electron Beam Lithography

NO. 10 M-1 03
THEME / W.G. / TASK

DATE 4 / 28 / 76 (Rev.2)

2. OBJECTIVE Develop electronic beam lithography for processing of microcircuits/devices to enhance performance of superconducting microcircuits, ultrahigh density microelectronics and integrated optics.

3. NEED ANALYSIS

a) LEVEL NOW [2]. WILL BE LEVEL [2] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY DATE: 1987

c) RISK IN ACHIEVING ADVANCEMENT: HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [ ] MEDIUM [X] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [X] GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ] OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE FY'78 $1000K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- Establish an electronic team lithography facility
- Establish minimum lateral size limitations of the order of one micron for superconducting microcircuits and silicon devices
- Processing techniques for electron beam lithography

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE Electronic Materials Technology Based on Electron Beam Lithography

NO. 10 M-1 03
THEME / W.G. / TASK

DATE 4 /28 / 76 (Rev.2)

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

An electron beam facility will be established for processing microc ircuits and devices with lateral sizes on the order of one micron. Sub-micron MOS devices will be fabricated to establish size limitations associated with materials characteristics. Wear-link structures arranged as electron switching circuits and arrays will be evaluated for reliability.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Facility			—	—																
Processing				—	—	—														
Evaluation				▲	—	—	—													
MANPOWER (M-Y)																				
INHOUSE			10	20	20	20	20													
CONTRACT																				
FUNDING (10^6 $)																				
INHOUSE			1	1	1	1	1													
CONTRACT																				

SPACE TECHNOLOGY NEED FORM NO. I

PAGE 1 OF 2

1. TITLE LONGLIFE CRYOGENIC SYSTEMS FOR MASERS

NO. 10 M-1 04
THEME / W.G. / TASK

DATE 4 / _ / 76

2. OBJECTIVE
Ten year lifetime, 2°K and 1 W for deep space communications

3. NEED ANALYSIS

a) LEVEL NOW [5], WILL BE LEVEL [6] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE FY 78, $300K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Communications

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Lifetime extension of refrigerators (seals and bearings), Brayton power cycles (for refrigerators), high isolation for Dewars (MLI, supports, vacuum sealing, and Joule-Thomson valve), and radiators and developmental candidates required for above.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. 1
PAGE 2 OF 2

TITLE Long-Life Cryogenic Systems for Masers

NO. 10/ M-1/ 04
THEME / W.G. / TASK

DATE 4 /27/ 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

- Current developments on refrigerators, power sources, dewars and J-T valve should be evaluated for long-life potential improvements
- Additional early funding to encourage rapid development
- Selection of most promising system end FY 78
- Develop for long-life readiness by FY 80

7. ALTERNATIVE APPROACHES/OPTIONS Wait and see by end FY 78, redundant units/refill dewar (remote), or paramp passive radiator (180°K) + 3X antenna diameter.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)
ADL, Hughes, Ball Bros, Garrett, Phillips & GE - GSFC, MSFC & DOD

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Evaluation		△																		
Added Funding		△																		
Selection			△																	
Readiness					△															
MANPOWER (M-Y) INHOUSE		1	2	4	4															
CONTRACT																				
FUNDING (10^6 $) INHOUSE		.05	.1	.2	.2															
CONTRACT			.2	1.0	1.0															

SPACE TECHNOLOGY NEED

FORM NO. 1

1. TITLE Materials for High-Temperature Power Conversion

NO. 10 M-1 05
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE

Develop and evaluate materials for high-temperature, high-strength, long-life components for power conversion.

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE 1987]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [ ] MEDIUM [X] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) INIT BASE CANDIDATE FY '78 $200K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Turbine and compressor design

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Development and evaluation of high-temperature, high-strength materials such as ceramics, cermets, superalloys, and refractory metals for turbine, compressor, and gas containment components will be needed.

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE Materials for High-Temperature Power Conversion

NO. 10 M-1 05
THEME / W.G. / TASK

DATE 4 /28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Candidate ceramics, cermets, superalloys and refractory metals will be evaluated in appropriate environments for high-temperature perfcrmance in turbine, compressor and gas containment applications.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

FY / SCHEDULE ITEM	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Select Candidates			—																	
Test			—	—	—	—														
Analysis				—	—	—														
MANPOWER (M-Y)																				
INHOUSE			1	2	2	2														
CONTRACT																				
FUNDING (10^6 $)																				
INHOUSE			.1	.2	.2	.2														
CONTRACT																				

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE Materials for Advanced Energy Storage

NO. 10 M-1 06
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE
Develop materials for more reliable, high-energy density primary and secondary nickel-cadmium batteries with lifetime up to 10 years.

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: 1987

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE FY '78, $300K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED
Goals for this effort will be achieved by developing lightweight materials for nickel-cadmium battery components such as cell cases, separators, electrodes and sealants which will increase efficiency and lifetime.

LEVEL OF STATE OF ART

1 BASIC PHENOMENA OBSERVED AND REPORTED
2 THEORY FORMULATED TO DESCRIBE PHENOMENA
3 THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4 PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5 COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6 MODEL TESTED IN AIRCRAFT ENVIRONMENT
7 MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE Materials for Advanced Energy Storage

NO. 10 M-1 06
THEME / W.G. / TASK

DATE 4 /28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Candidate materials for cell cases, separators, electrodes, and sealants will be selected and evaluated for performance in lightweight batteries for advanced missions, including probes.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

FY / SCHEDULE ITEM	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Select materials			—																	
Test			—	—	—	—														
Analyze Data			—	—	—	—														
MANPOWER (M-Y)																				
INHOUSE			1	2	2	1														
CONTRACT			.1	.3	.2	.2														
FUNDING (10^6 $)																				
INHOUSE																				
CONTRACT																				

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE Radiation-Resistant Solar Cells

NO. 10 M-1 07
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE
Develop high efficiency, lightweight, long-life Gallium Arsenide Solar Cells.

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT -- SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1987]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) NSF BASE CANDIDATE NOA FY'78 $500K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Development of energy storage systems and automated module fabrication methods.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Advancements in solar energy conversion and storage systems are required to satisfy future needs for large amounts of on-board power, increased array lifetime, reliability and low cost. Development of Gallium Arsenide Solar Cells offer potential to satisfy these needs.

52

5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

LEVEL OF STATE OF ART

1. BASIC PRINCIPLES OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE CONCEPT
3. THEORY TESTED BY ANALYTICAL OR EXPERIMENTAL PROOF OF CONCEPT
4. EXPERIMENTAL BREADBOARD DEVICE DEMONSTRATES FUNCTION OF CRITICAL ELEMENTS

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE Radiation-Resistant Solar Cells

NO. 10 M-1 07
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Gallium arsenide solar cells will be exposed at radiation levels encountered on advanced missions and evaluated for effects on solar conversion efficiency, filters and other cell modifications will be developed and evaluated.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM Rad. Expos.			▬	▬	▬															
Test				▬	▬	▬	▬													
MANPOWER (M-Y) INHOUSE			1	2	2	1	1													
CONTRACT																				
FUNDING (10^6 $) INHOUSE			.1	.5	.3	.1	.1													
CONTRACT																				

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED — **FORM NO. I**

1. TITLE NUCLEAR SHIELDING MATERIALS FOR SPACE EXPLORATION FACILITY

NO. 10 / M-1 / 08
THEME / W.G. / TASK

DATE 4 / 29 / 76

2. OBJECTIVE

Develop and evaluate lightweight nuclear shielding materials for NEP.

3. NEED ANALYSIS

a) LEVEL NOW [1], WILL BE LEVEL [1] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1987]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [XX] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE FY 78 - $400K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

NEP development

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- Lightweight, lightweight high-temperature materials for nuclear shielding on NEP space exploration facility.

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE NUCLEAR SHIELDING MATERIALS FOR SPACE EXPLORATION FACILITY

NO. 10 / M-1 / 08
THEME / W.G. / TASK

DATE 4 / 29 / 76

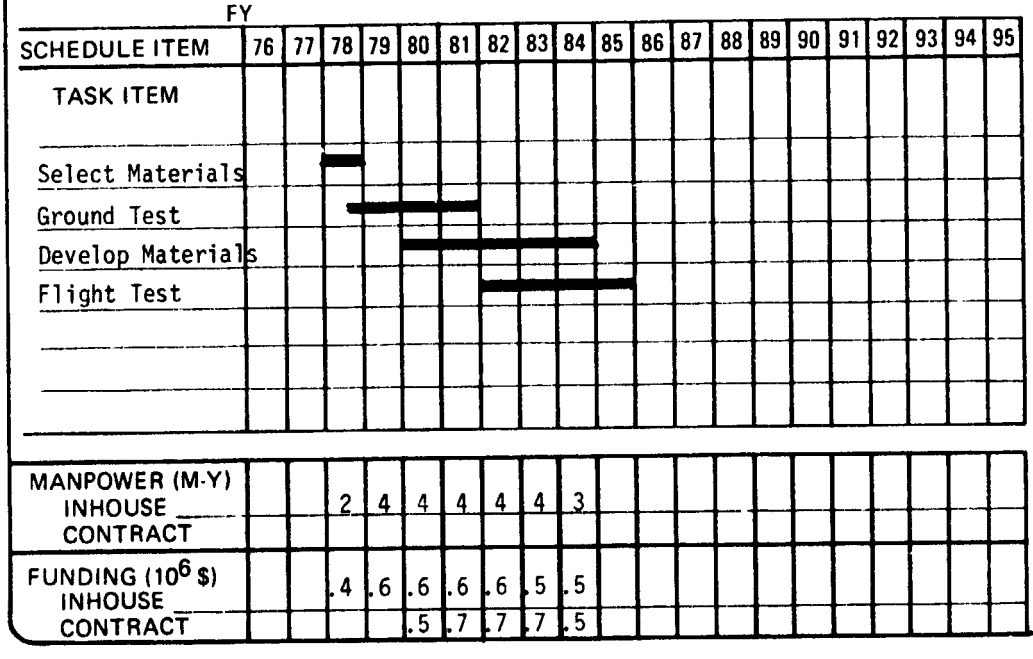
6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Selection of lightweight, high temperature materials will be made based on a literature search. As required, new materials and designs will be developed. These will be evaluated for shielding capability at radiation levels predicted for nuclear electric propulsion sources. Lithium mydride will be used as a baseline material.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y) INHOUSE			2	4	4	4	4	4	3											
CONTRACT																				
FUNDING (10^6 $) INHOUSE			.4	.6	.6	.6	.6	.5	.5											
CONTRACT					.5	.7	.7	.7	.5											

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 3

1. TITLE MATERIALS FOR PLANETARY PROBE THERMAL PROTECTION

NO. 10 M-1 09
THEME / W.G. / TASK

DATE 4 / 29 / 76

2. OBJECTIVE
Develop materials for minimum weight heat shields in order to maximize science payloads to all planets

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1982]

c) RISK IN ACHIEVING ADVANCEMENT: HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [X] GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ] (Check one or more)
OTHER (Specify) [ ]

f) R&T BASE CANDIDATE FY 78, $400K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED
Develop reflective/non-reflective head shield materials to minimize the TPS weight for each planetary probe mission. The various materials will be evaluated and verified in the Ames Research Center arc jet and laser facilities.

SPACE TECHNOLOGY NEED FORM NO. I

TITLE Materials for Planetary Probe Thermal Protection NO. 10 M-1 09
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

1. Continue to evaluate new DOD/ICBM materials
2. Develop new reflective materials
3. Develop new carbon materials as necessary
4. Determine effect of ablation on boundary layer transition using 110 MW facility
5. Confirm material performance in 165 MW facility

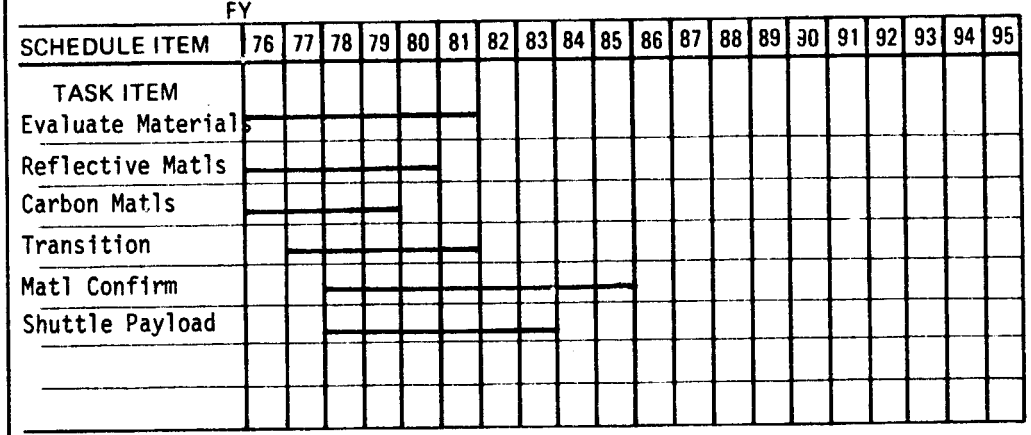
7. ALTERNATIVE APPROACHES/OPTIONS For mission requirements beyond limits of 165 Megawatt facility, utilize Laser facilities.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

RTOP 506-16-41

DOD - Ballistic Missile Heat Shield Developments

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y) INHOUSE	9	11	12	14	14	14	14													
CONTRACT	5	5	6	7	7	7	7													
FUNDING (10^6 $) INHOUSE	.7	.8	.9	.9	.9	.9	.9													
CONTRACT	.2	.2	.3	.3	.3	.3	.3													

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 3 OF 3

1. TITLE Materials for Planetary Probe Heat Shields NO. 10 M-1 09

THEME / W.G. / TASK

DATE 4 / 28 / 76

(6) CONTINUATION (If Needed)

Block No.

6. Perform flight test using Shuttle launched payload with velocity package to achieve radiative/convective heating rates to confirm material performance/heat shield design

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE Materials for Abort, Entry/Impact of Systems with Radioactive Materials

NO. 10 M-1 10
THEME / W.G. / TASK

DATE 4 / 29 / 76

2. OBJECTIVE

Develop advanced materials to assure survival of RTG and nuclear waste packages in the event of mission abort

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [X] MEDIUM [ ] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE FY 78, $ 50K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Develop head shield materials as required to protect each radioactive package according to the abort trajectory for each mission. The environmental requirements are different for each mission and different from those of planetary probes. The materials will be evaluated in the Ames arc jet and laser facilities as required.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. I

TITLE Materials for Abort. Entry/Impact of Systems With Radioactive Materials

NO. 10 M-1 10
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

1. Continue to evaluate new DOD/ICBM materials
2. Develop new carbon materials as necessary
3. Develop new reflective materials for Earth environment
4. Evaluate impact resistance of materials
5. Evaluate ablation performance in ARC jets
6. Perform flight verification test of nuclear waste disposal package using Shuttle

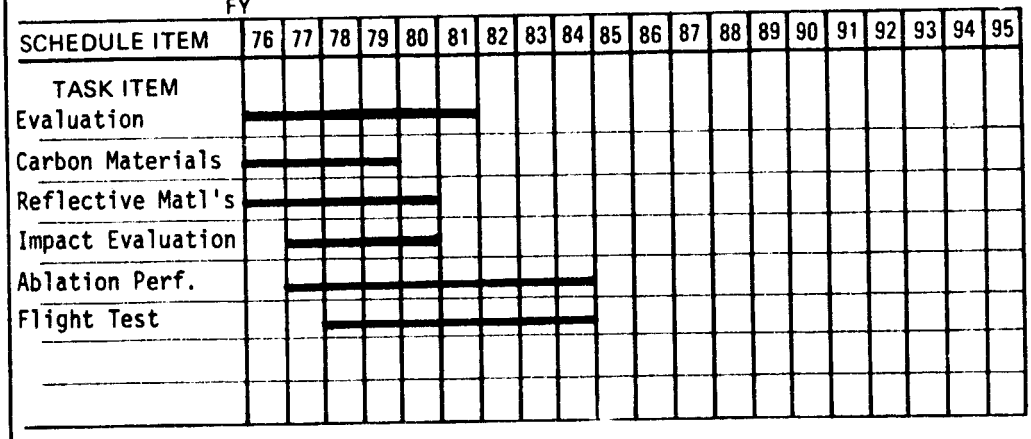
7. ALTERNATIVE APPROACHES/OPTIONS For mission requirements beyond limits of ARC jets, utilize Ames Laser Facilities to determine material performance

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

RTOP 506-16-41

DOD - Ballistic Missile Heat Shield Developments

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y) INHOUSE	1	1	2	2	3	3	3	2	1											
CONTRACT	0	0	2	3	5	20	10	4	2											
FUNDING (10^6 $) INHOUSE	.1	.1	.2	.2	.2	.2	.2	.2	.2											
CONTRACT	0	0	.1	.2	.5	2.0	1.0	.3	.1											

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE Long Life Cryogenic Systems for Science

NO. 10 / M-1 / 11
THEME / W.G. / TASK

DATE 4 / 29 / 76

2. OBJECTIVE
To develop advanced cryogenic systems for sensors or optics in the range $10^{o}K$ - $100^{o}K$ (X and gamma rays, alpha and beta particles, microwaves)

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR
ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X]
GRD TEST [ ] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE FY 78, $300K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY
DOD activities in rotary and V - M cryo engines.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED
- o Cryogenic fluid management
- o Large cooling capacity
- o Long life, durable containment
- o Cryogenic fluid transport
- o Refrigerators, cryostats, radiators

LEVEL OF STATE OF ART
1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE Long Life Cryogenic Systems for Science

NO. 10/ M-1/ 11
THEME / W.G. / TASK

DATE 4 / 29/76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

- Current developments on refrigerators, power sources, cryostats, and cryo heat pipes for radiators should be evaluated for long life
- Selection of most promising system(s)
- Develop for long life readiness by FY 80

7. ALTERNATIVE APPROACHES/OPTIONS Wait and see by end FY-78, passive radiators at 100°K, or large dewars

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

ADL, Hughes, Phillips & GE - GSFC & DOD

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Evaluation			▲																	
Selection			▲																	
Readiness					▲															
MANPOWER (M-Y) INHOUSE			2	4	4															
MANPOWER (M-Y) CONTRACT																				
FUNDING (10^6 $) INHOUSE			.1	.2	.2															
FUNDING (10^6 $) CONTRACT			.2	1	1															

LEVEL OF STATE OF ART

1 BASIC PHENOMENA OBSERVED AND REPORTED
2 THEORY FORMULATED TO DESCRIBE PHENOMENA
3 THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4 PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5 COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6 MODEL TESTED IN AIRCRAFT ENVIRONMENT
7 MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED **FORM NO. 1**

PAGE 1 OF 2

1. TITLE Sun Oriented Radiators NO. 10/M-1/12
THEME / W.G. / TASK

DATE 4 / 28 / 76 (Rev. 1)

2. OBJECTIVE
Develop radiators which can reject heat when oriented toward sun and other sources

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1988]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE FY 78 NOA $75K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Materials.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED
Various radiator configurations need to be analyzed utilizing such features as frontal shields, lateral heat rejection, and reduced heat input from planets. Promising designs should be tested and then flown. Ultimately, a system could be designed as a Mercury lander which could survive both the high solar and hot Mercury surface -- 800°F.

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE Sun Oriented Radiators

NO. 10/ M-1/ 12
THEME / W.G. / TASK

DATE 4 /27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

- Study radiator/shield configurations
- Fabricate several promising types
- Test, make improvements and retest
- Design for specific missions (Mercury orbiter, lander, sample return)
- Readiness by FY 82 for orbiter & lander

7. ALTERNATIVE APPROACHES/OPTIONS High temperature systems, short lifetime, ~~or diode heat pipes & large deployable~~ radiator development

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

Passive radiators, heat pipes

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Study			—△																	
Fab. & Test Bread				—△																
Design Orb.Rad.					—△															
Test Orb.Rad.					△															
Design Ldr.Rad					——	△														
Test Ldr.Rad.							△													
MANPOWER (M-Y) INHOUSE			1	4	4	4	4													
CONTRACT					4	8	12													
FUNDING (10^6 $) INHOUSE			.08	.2	.2	.2	.2													
CONTRACT					.2	.4	.6													

(Total $2M)

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1

1. TITLE INSULATIONS FOR SOLAR EXPLORATION VEHICLES

NO. 10 / M-1 / 13
THEME / W.G. / TASK

DATE 4 / 29 / 76

2. OBJECTIVE

- Develop high performance lightweight insulations for use in planetary atmospheres for long life times
- Develop high temperature, lightweight insulations for NEP

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [3] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1988]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE FY 78, $200K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

Structural isolation, materials

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- Various materials such as fine fibers, powders, and foams would be designed and tested for low conduction and convection heat transfer. Other important factors to be considered are: compatibility in vacuum, long lifetime, handling, moisture and other contaminants, and applicability over wide ranges of temperature and pressure.
- Current high temperature insulations for nuclear reactors are heavy. New lighter weight materials such as the use of ceramics configured to take advantage of low conductivity as well as geometric features.

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE INSULATIONS FOR SOLAR EXPLORATION VEHICLES

NO. 10 / M-1 / 13
THEME / W.G. / TASK

DATE 4 /29 /76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

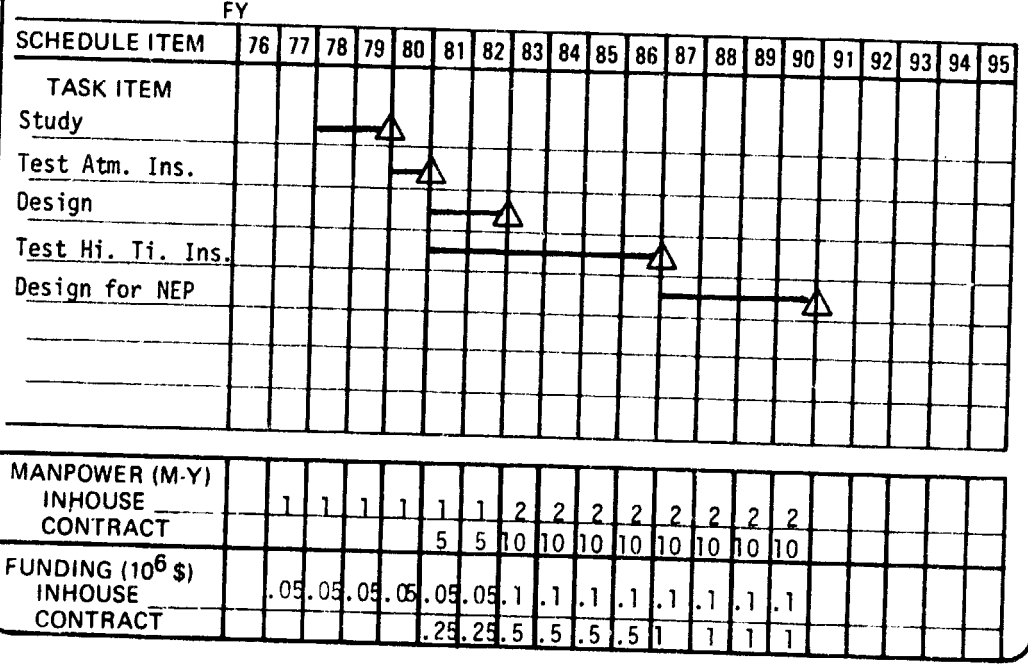
- o Study heat transfer mechanisms through various materials
- o Test various materials in different atmospheres
- o Design these for different missions (mars sample return, etc.)
- o Test and develop various porous materials at high temperatures
- o Design these for NEP application

7. ALTERNATIVE APPROACHES/OPTIONS

Heavier Dewars, Leavier refractory metals

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y)																				
INHOUSE		1	1	1	1	1	1	2	2	2	2	2	2	2	2					
CONTRACT						5	5	10	10	10	10	10	10	10	10					
FUNDING (10^6 $)																				
INHOUSE		.05	.05	.05	.05	.05	.05	.1	.1	.1	.1	.1	.1	.1	.1					
CONTRACT						.25	.25	.5	.5	.5	.5	1	1	1	1					

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE Sample Return Container Thermal Control

NO. 10/M-1/14
THEME / W.G. / TASK

DATE 4/27/76

2. OBJECTIVE
Develop thermal control for biological and physical samples containers

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1988]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR
ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE NOA, $150K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Biological Science

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

The return of physical samples cannot be subjected to temperatures higher than their ambient. Biological samples also cannot be reduced in temperature, and may require pressure control. Provision should be made for back-contamination protection.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE Sample Return Container Thermal Control

NO. 10 / M-1 / 14
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

- Determine requirements for various missions/type samples
- Design container thermal/environmental control systems for various applications
- Test containers with representative samples and in simulated environments

7. ALTERNATIVE APPROACHES/OPTIONS Sealed Dewars, Passive Containers, Larger variation in environmental control

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

NONE

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Determ. Reqts.			△																	
Design				△			△													
Test								△												
MANPOWER (M-Y)																				
INHOUSE			3	3	3	3	5	5												
CONTRACT							15	15												
FUNDING (10^6 $)																				
INHOUSE			.15	.15	.15	.15	.25	.25												
CONTRACT							.75	.75												

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE Thermal Control Materials/Devices

NO. 10 M-1 15
THEME / W.G. / TASK

DATE 4 / 29 / 76

2. OBJECTIVE
To develop materials and system technologies for thermal control of high efficiency, long life spacecraft.

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: 1985

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [ ] MEDIUM [X] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [XX]
GRD TEST [ ] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE FY 78, $300K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY None.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- o Heat Pipe Materials and Technology - High Conductance and High Flux Density
- o High Efficiency Insulation Systems

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. I

TITLE Thermal Control Materials/Devices NO. 10 / M-1 /15
THEME / W.G. / TASK

DATE 4 /29 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

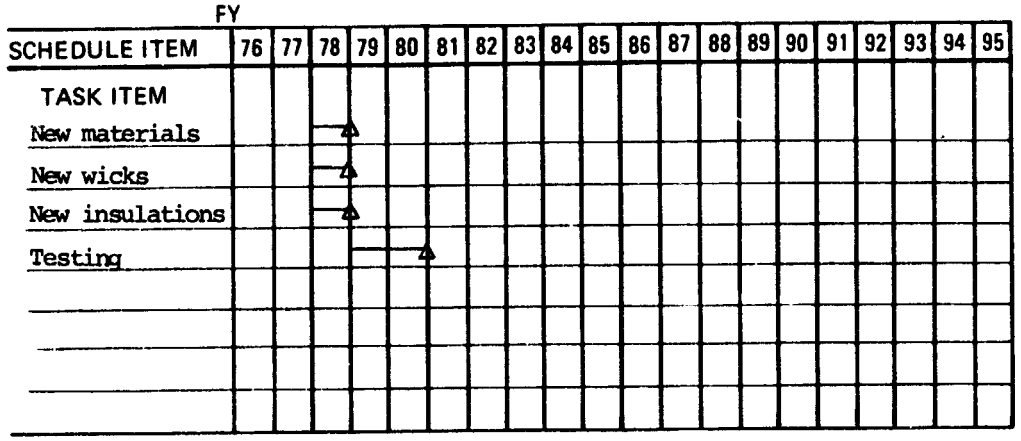
- Develop new materials compatible with heat pipe fluids which enable packaging of large radiators
- Develop new flexible wicking systems
- Investigate new insulation systems for improved efficiency and lower cost
- Test candidate materials and devices

7. ALTERNATIVE APPROACHES/OPTIONS Flexible fluid loops, moderate extension of existing insulations, dewars

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

Related work at GSFC and JFC

9. TECHNOLOGY SCHEDULES



SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE Operational Contamination

NO. 10 / M-1/16
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE
Develop methods for controlling contamination on sensitive subsystems.

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: 1980

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [ ] MEDIUM [X] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [XX] RESEARCH [ ]
GRD TEST [ ] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE NOA, '78 $200K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY None.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- o Outgassing, A/C gases deposited on optics, mirrors, radiators
- o Dust on rovers
- o Biological contamination of samples, back contam. of Earth

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE Operational Contamination

NO. 10 / M-1 / 16
THEME / W.G. / TASK

DATE 4 /28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

- Review and analytically model contamination mechanisms for various materials migrating to optics, mirrors and radiators
- Design systems to minimize dust problem on rovers
- Determine methods to reduce sample contamination
- Design provisions for eliminating back contamination

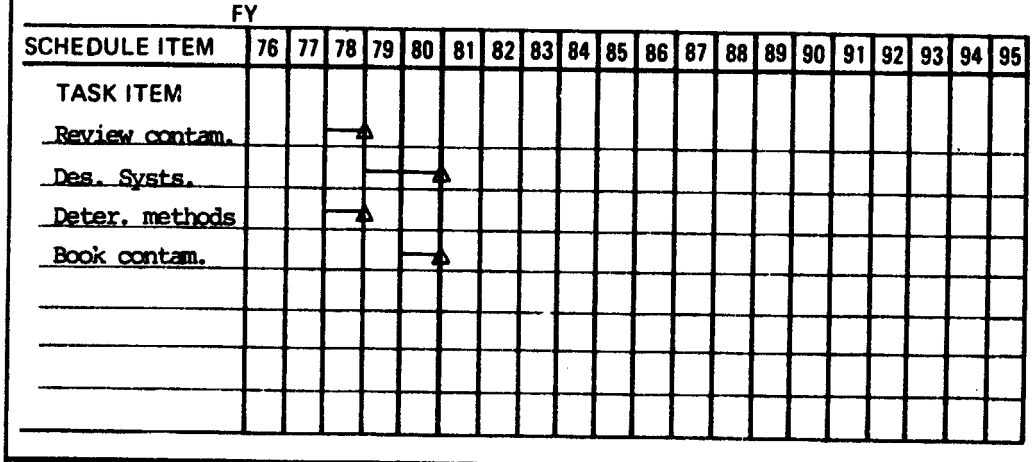
7. ALTERNATIVE APPROACHES/OPTIONS

Higher level contamination

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

MSFC activities

9. TECHNOLOGY SCHEDULES



	78	79	80
MANPOWER (M-Y) INHOUSE	2	2	2
CONTRACT	2	4	8
FUNDING (10^6 $) INHOUSE	.1	.1	.1
CONTRACT	.1	.2	.4

LEVEL OF STATE OF ART
1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED — **FORM NO. I**

1. TITLE Long-Term Space Environmental Control

NO. 10/ M-1/ 17 (THEME / W.G. / TASK)

DATE 4 / 29 / 76

2. OBJECTIVE

Develop techniques and procedures for high quality, long-life environmental control

3. NEED ANALYSIS

a) LEVEL NOW [5], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT: HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [ ] MEDIUM [X] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [X] GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X] OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE FY 78, $100K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY None

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- Thermal control and cryogenics
- Contamination - particulate and biological
- Nuclear radiation- natural and induced
- Electrostatic/EMI
- Acoustics
- Micrometeoroids

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE Long-term Space Environmental Control

NO. 10 / M-1 / 17
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

- See 5, page 1

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Evaluation							▲													
MANPOWER (M-Y) INHOUSE	2	2	2	2	2	2	2													
CONTRACT																				
FUNDING (10^6 $) INHOUSE	.1	.1	.1	.1	.1	.1	.1													
CONTRACT																				

SPACE TECHNOLOGY NEED FORM NO. 1

PAGE 1 OF 2

1. TITLE Rover Thermal Control NO. 10 / M-1 / 18
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE
Develop rover thermal control capability for application to planets.

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1988]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE NOA, F.Y. 1978 $50K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Structures, materials, power

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- Radiator (and solar panel) dust removal
- High temperature application -- inner planets
- Low temperature application -- outer planets/satellites
- High pressure -- Venus

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE Rover Thermal Control

NO. 10 / M-1 / 18
THEME / W.G. / TASK

DATE 4 /28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

- See 5, page 1

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

NONE

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Dust removal																				
Inner planets																				
Venus																				
Outer planets																				
MANPOWER (M-Y) INHOUSE			1	1	1	1	2	2	1	1	2	2	2	2	2	2	2	2	2	2
CONTRACT							4	8				4	8	8			4	8	8	8
FUNDING (10^6 $) INHOUSE			.05	.05	.05	.05	.1	.1	.05	.05	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
CONTRACT							.2	.4				.2	.4	.4			.2	.4	.4	.4

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 1 OF 2

1. TITLE Reusable Insulations

NO. 10/ M-1/ 19
THEME / W.G. / TASK

DATE 4 / 27 76

2. OBJECTIVE
Investigate types of reusable insulations for higher performance and/or less cost with multiple applications imposed by Shuttle on payloads

3. NEED ANALYSIS

a) LEVEL NOW [5], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE 1985

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [ ] MEDIUM [X] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE NOA, FY 78, $50K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Structures, materials

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- Improvement of purged multilayer systems
- Alternate load-bearing and insulations for dewars
- Attachment and penetration heat losses
- Cryo and high-temperature applications
- RF transparent insulations
- ~~Assembly, handling, non-destructive testing, access & repai~~
- Compatibility in both zero and one atmosphere
- Moisture and other containments

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE REUSABLE INSULATIONS

NO. 10/M-1/19
THEME / W.G. / TASK

DATE 4 / 28/ 76(Rev. 1)

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

See 5, Page 1

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

FY / SCHEDULE ITEM	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
MANPOWER (M-Y)																				
INHOUSE			1	2	2															
CONTRACT				4	8															
FUNDING (10^6 $)																				
INHOUSE			.05	.1	.1															
CONTRACT				.2	.4															

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED — **FORM NO. I** — PAGE 1 OF 2

1. TITLE Controllable/Multiwatt Radioactive Heater Units (RHUS) — NO. 10/ M-1/ 20 (THEME / W.G. / TASK) — DATE 4 / 27 / 76

2. OBJECTIVE

~~Evaluate approaches to modulate RHUS and assess the multi-watt RHU requirements for future missions~~

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [3] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT: HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [ ] MEDIUM [X] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [ ] GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ] OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE NOA, FY 78, $40k

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY ~~Mechanisms, materials~~

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- Thermostatic actuator - bimetallic or phase-change element
- ~~Quality multiwatt RHU~~

SPACE TECHNOLOGY NEED FORM NO. 1

TITLE Controllable/Multiwatt RHUS

NO. 10 / M-1 / 20
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Design controllers

Test controllers

Determine multiwatt mission reqts.

Estimate benefit/cost of multiwatt RHUS

7. ALTERNATIVE APPROACHES/OPTIONS

Elect. Heaters, 1 watt PHUS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Des. Control.																				
Test Control																				
MW Reqts.																				
B/C est.																				
MANPOWER (M-Y) INHOUSE			.8	1	2															
CONTRACT																				
FUNDING (10^6 $) INHOUSE			.04	.05	.1															
CONTRACT																				

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 1 OF 2

1. TITLE Solar Probe Thermal Shield

NO. 10/ M-1/ 21
THEME / W.G. / TASK

DATE 4 / 27/ 76

2. OBJECTIVE

Develop a shield system capability for protecting a spacecraft from 2500 suns (0.02 AU)

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: 1985

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [X] MEDIUM [ ] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [XX] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE NOA FY 78 $200k

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

Structures, materials, communications, high solar test facility

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- Shield materials - refractory metals, ceramics
- Subshields - graphite, Moly
- Special instrument protection

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE Solar Probe Thermal Shield

NO. 10 / M-1 / 21
THEME / W.G. / TASK

DATE 4 / 28 / 76

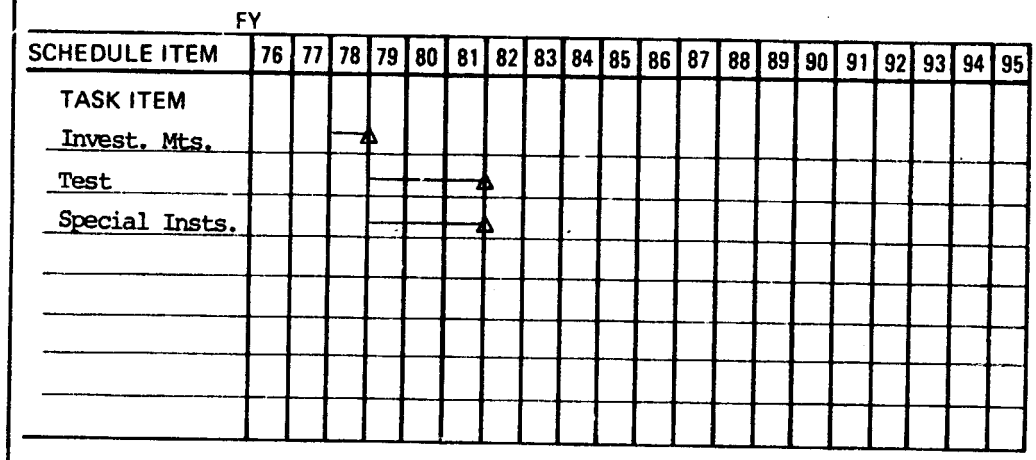
6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Investigate Materials
Test Shield System
Design Special Instr. Protection

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y)																				
INHOUSE		2	2	4	4	8														
CONTRACT		2	4	16	20	40														
FUNDING (10^6 $)																				
INHOUSE		.1	.1	.2	.2	.4														
CONTRACT		.1	.2	.8	1.0	20														

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE Min ^{o}K Cryo

NO. 10/M1/22
THEME / W.G. / TASK

DATE 4/29/76

2. OBJECTIVE

Provide Detector Cooling to < 1°K

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: 1984

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [X]
GRD TEST [ ] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE RTOP 506-25-22 $200K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

IR Detector improvement for wavelengths above 30μ.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- Liquid-vapor separation device for use in zero gravity for 0.3°K.
- Fluid mechanism required to separate He 3 from He 4 using current refrigerators for separation.

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE Min °K Cryo

NO. 10/M1/22
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

- Investigate phase separation techniques used in liquid propulsion systems for zero gravity and adopt most promising for detailed investigation. Space lab or equivalent zero gravity test required.
- He 4 exhibits superfluid behavior at low temperature and He 3 does not, therefore the thermo mechanical effect may be used to accomplish the separation.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

RTOP (506-25-22) has plans to initiate activity in FY 77.

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Investigate possible solutions		△																		
Build & test on ground			△	△																
Test in Zero Gravity					△		△													
MANPOWER (M-Y) INHOUSE		1	1	1	1	1	1													
CONTRACT		1	3	4	4	5	5													
FUNDING (10^6 $) INHOUSE																				
CONTRACT		.1	.2	.3	.3	.4	.4													

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 1 OF 2

1. TITLE Stable Thermal Control Coatings for Geosynchronous Environment

NO. 11 M-1 01 R-1
THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE

To develop stable coatings for use in geosynchronous environment for Global Service Systems

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: 1983

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR
ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE '77 - $50K; '78 - $150K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY NONE

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Stable electrically conductive coatings which are reliable, easily applied and relatively inexpensive are needed to reduce effects of space radiation on thermal control coatings.

SPACE TECHNOLOGY NEED FORM NO. I

PAGE 2 OF 2

TITLE Stable Thermal Control Coatings for Geosynchronous Environment

NO. 11 M-1 01
THEME / W.G. / TASK

DATE 4 /28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

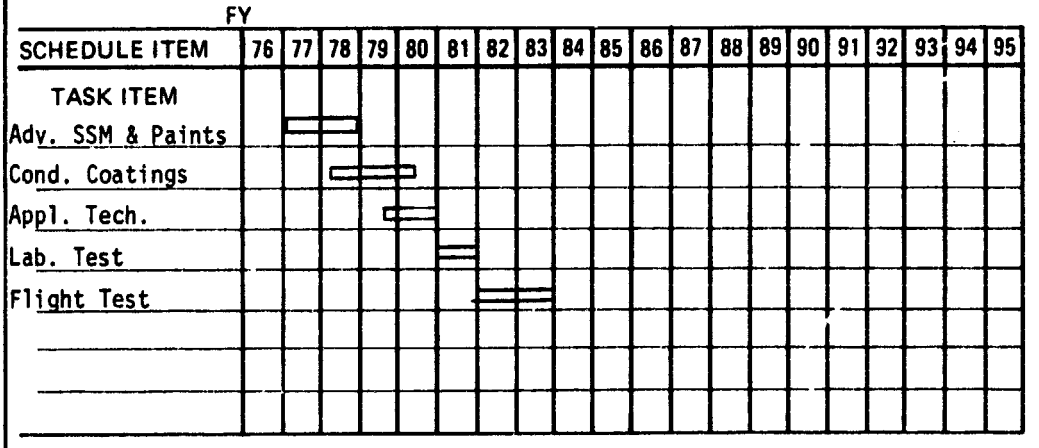
1. Advanced SSM and paint coatings completed
2. Evaluate conductive coatings for these SSM's
3. Efficient, reliable techniques for application
4. Long-life lab. tests
5. Space flight tests

7. ALTERNATIVE APPROACHES/OPTIONS NONE

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

506-16-32 SSM coatings

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y) INHOUSE		1	1	1	1	2	1													
CONTRACT		1	2	3	3	2	1													
FUNDING (10^6 $) INHOUSE		.05	.1	.1	.1	.2	.1													
CONTRACT		.1	.1	.2	.2	.2	.1													

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1

1. TITLE Techniques for In-Situ Manufacturing of Lage Space Structures

NO. 11 M-1 02
THEME / W.G. / TASK

DATE 4 / 26 / 76

2. OBJECTIVE
Develop methods and techniques for manufacturing large structures in space.

3. NEED ANALYSIS

a) LEVEL NOW [1], WILL BE LEVEL [2] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE '78 + $300K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Development of special structural design

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

0 Develop concepts for taking high density packaged materials and developing structural members.

0 Develop means for rapid automated joining of materials under orbital conditions.

0 Development of special purpose adhesives.

0 Development of NDE techniques.

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE Techniques for IN-SITU Manufacturing of Large Space Structures

NO. 11 M-1 02
THEME / W.G. / TASK

DATE 4 / 27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

1. Study available techniques which may be applicable to large space structures.
2. Develop manufacturing concepts.
3. Evaluate concepts by testing in large space vacuum facilities.
4. Evaluate more promising concept(s) in orbital experiments.

7. ALTERNATIVE APPROACHES/OPTIONS Manufacture structure individual segment and transport to orbital altitude for final assembly.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

506-17-11 Large space structures only currently funded activity.

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Concepts			SCHEDULE FOR LARGE SPACE STRUCTURES (LSS) 506-17-11																	
Joining Tech.			NI-114 AND NI-130 WILL SATISFY NEEDS FOR GLOBAL																	
Adhesive Develop.			SERVICE SYSTEMS																	
NDE Techniques																				
MANPOWER (M-Y) INHOUSE			LSS LOADING																	
CONTRACT																				
FUNDING (10^6 $) INHOUSE			LSS LOADING																	
CONTRACT																				

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED — FORM NO. 1 — PAGE 1 OF 2

1. TITLE Long Life Cryogenic Systems — NO. 11 M-1 03 R-1 (THEME / W.G. / TASK) — DATE 4 /28 / 76

2. OBJECTIVE
To develop advanced cryogenic systems for sensors

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: 1982

c) RISK IN ACHIEVING ADVANCEMENT: HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X] GRD TEST [ ] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X] OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE '78 - $200K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY DOD Activities in Rotary and V-M Cryo Engines

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

0 Cryogenic fluid management

0 Large cooling capacity

0 Long life, durable containment

0 Cryogenic fluid transport

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE Long Life Cryogenic Systems

NO. 11 M-1 03
THEME / W.G. / TASK

DATE 4 /27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

(1) Examine current State-of-Art
(2) Recommend areas not presently covered
(3) Develop new systems to meet needs
(4) Flight testing

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

JPL Science, ARC Basic Research, GSFC Cryo Heat Pipes (506-16-31), DOD

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Study & REC		X	X																	
Develop Hdwe			X	X	X		•													
Flight Test						X	X													
MANPOWER (M-Y)																				
INHOUSE		.5	1.0	2	2	1	1													
CONTRACT																				
FUNDING (10^6 $)																				
INHOUSE																				
CONTRACT		.2	.4	1.0	1.0	0.5	0.2													

SPACE TECHNOLOGY NEED FORM NO. 1

PAGE 1 OF 2

1. TITLE Contamination Control for Large Space Structures

NO. 11 M-1 04 R-1
THEME / W.G. / TASK

DATE 4 /28 / 76

2. OBJECTIVE
Develop methods for controlling contamination associated with the manufacturing or assembly of contamination sensitive large space structure.

3. NEED ANALYSIS

a) LEVEL NOW 4/3, WILL BE LEVEL [3] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: 1981

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE '77 none; '78 - $200K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Data development on contamination generation characteristics of sources (materials, overboard dumps, vents, etc.).

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

0 Develop analytical models for specific space systems involved.

0 From analytical results develop means for elimination/avoidance/ definition of contamination effects.

0 Develop techniques for cleaning optical surfaces in space.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. 1

TITLE Contamination Control for Large Space Structures

NO. 11 M-1 04
THEME / W.G. / TASK

DATE 4 /28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Develop analytical models for specific space systems involved; analytically examine induced environment and produce generalized approach to vehicle protection and/or cleaning requirements; flight testing.

7. ALTERNATIVE APPROACHES/OPTIONS NONE

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

None specifically related to large space structures or advanced vehicles; modeling tech. have been developed for shuttle under in line tasks and will be correlated using OAST package.

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Model Development																				
System Evaluation																				
Avoidance Protection or Cleaning Tech.																				
Flight Testing																				
MANPOWER (M-Y) INHOUSE					2	3	4	3	2	2	2									
CONTRACT																				
FUNDING (10^6 $) INHOUSE					.10	.15	.15	1.0	1.0	.15	.15									
CONTRACT																				

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE Ultra-High Conductance Heat Pipe

NO. 11 M-1 05
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE
To develop highly conductive, $\Delta T < 1^{\circ}C$ gradient over 10-100m long heat pipes.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1980]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] _____ (Check one or more)

f) NEXT BASE CANDIDATE $200K, '78 New Start

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Structural materials of low coefficient of expansion.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED
High heat transport using new artery, fluid or other techniques.

C-9

SPACE TECHNOLOGY NEED FORM NO. I

TITLE Ultra-High Conductance Heat Pipe NO. 11/M-1/05
THEME / W.G. / TASK

DATE 4 / 27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

(1) Develop concepts
(2) Fabricate candidates
(3) Test, Ground and Flight

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

RTOP 506-16-31 GSFC and ARC

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Develop concept			X	X																
Fabricate					X															
Test						X														
MANPOWER (M-Y)																				
INHOUSE			.1	.1	.2	.2														
CONTRACT			4	4	9	9														
FUNDING (10^6 $)																				
INHOUSE			-	-																
CONTRACT			.2	.2	.5	.5														

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE Geometric, Low Solar Absorptance Coating

NO. 11 M-1 06
THEME / W.G. / TASK

DATE 4 /27 / 76

2. OBJECTIVE
To develop a geometric low solar absorptance $\alpha = .01 \leq .1$ thermal control surface.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: 1980

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [ ]
GRD TEST [ ] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
(Check one or more)
OTHER (Specify) [ ]

f) R&T BASE CANDIDATE $150K, '78 New Start

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED
To design reflectors, similar to corner reflectors in lasers to reduce solar absorptance. Present technology, i.e., coatings, is limited to absorptances of .1.

95

LEVEL OF STATE OF ART
1. BASIC PRINCIPLES OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY EXPERIMENT OR ANALYTICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT IN THE LABORATORY ENVIRONMENT
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE GEOMETRIC, LOW SOLAR ABSORPTANCE COATING

NO. 11 M-1 06
THEME / W.G. / TASK

DATE 4 / 27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

(1) Study and analysis of geometric configurations
(2) Build breadboard items and test
(3) Assemble into array
(4) Test

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

RTOP 506-16-31

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Study & Analysis			X	X																
Breadboard					X	X														
Array Assy							X	X	X											
Test										X										
MANPOWER (M-Y) INHOUSE		.5	.5	.5	.5	.5	.5	.5	.5											
CONTRACT																				
FUNDING (10^6 $) INHOUSE																				
CONTRACT		.2	.2	.2	.3	.3	.3	.5	.5	.2										

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE Standardization of Thermal Systems

NO. 11 M-1 07
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE
To improve thermal analysis, thermal design, thermal hardware, and testing techniques.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1980]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [ ]
GRD TEST [ ] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

0 To standardize and improve analytical capabilities.

0 To do trade-off studies analyzing various passive and active systems for cost effectiveness.

0 To improve efficiency and lower cost of thermal control devices such as heat pipes, louvers.

0 Study test techniques to improve efficiency of or elimination of testing.

LEVEL OF STATE OF ART

1. BREADBOARD OR ANALYTICAL MODEL DEMONSTRATED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY EXPERIMENT
4. PROTOTYPE FUNCTIONAL OR CHARACTERISTICS DEMONSTRATED

5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. 1

PAGE 2 OF 2

TITLE Standardization of Thermal Systems NO. 11 M-1 07 R-1

THEME / W.G. / TASK

DATE 4 /28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

(1) To examine current analytical design hardware mfg. and test techniques

(2) Recommend areas which need improvement

(3) Implement required changes

7. ALTERNATIVE APPROACHES/OPTIONS Continue old way

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

New start NI-111

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Analysis				X																
Recommend Chg.					X															
Implement						X														
MANPOWER (M-Y) INHOUSE			1.0	1.0	1.0	1.0														
CONTRACT			5.0	6.0	6.0	6.0														
FUNDING (10^6 $) INHOUSE			-	-	-	-														
CONTRACT			.4	.4	.4	.4														

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 1 OF 2

1. TITLE Dimensionally Stable Structural Materials NO. 11 M-1 08 R1
THEME / W.G. / TASK

DATE 4 /27/ 76

2. OBJECTIVE
Provide materials with high dimensional stability for Global Service Systems.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1982]

c) RISK IN ACHIEVING ADVANCEMENT.
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [X]
GRD TEST [ ] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE '77 none; new start $200K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY NONE

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED
Prepare composite materials with minimum thermal expansion, high stiffness and minimum weight. Use laboratory and flight testing to prove acceptability and long-term environmental degradation.

LEVEL OF STATE OF ART
1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. 1
PAGE 2 OF 2

TITLE Dimensionally Stable Structural Materials NO. 11 M-1 08
THEME / W.G. / TASK

DATE 4 / 27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

1. Investigation of techniques to minimize thermal distortion in composites.
2. Construct and test in laboratory.
3. Scale-up and retest in laboratory.
4. Investigate techniques for space joining and test in lab.
5. Flight test for long-life and thermal expansion.

7. ALTERNATIVE APPROACHES/OPTIONS NONE

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)
On going activities in NASA and DOD related but needs advancement.

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Tech. for Min. Thermal Dist.		⊏⊐																		
Const. & Lab. Test			⊏⊐																	
Scale-up			⊏⊐																	
Lab. Test				⊏⊐																
Space Joining			⊏⊐																	
Lab. Test				⊏⊐																
Flight Test					⊏⊐	⊏⊐														

MANPOWER (M-Y)																				
INHOUSE		1	2	2	2	1														
CONTRACT		2	4	4	2	1														
FUNDING (10^6 $)																				
INHOUSE		.05	.1	.1	.1	.1														
CONTRACT		.15	.3	.3	.3	.1														

SPACE TECHNOLOGY NEED FORM NO. I

PAGE 1 OF 2

1. TITLE Integral Light Weight Heat Pipes for Antennaes and Radiators

NO. 11 M-1 09
THEME / W.G. / TASK

DATE 4 /28 / 76

2. OBJECTIVE
Develop light weight heat pipe system for antennaes and radiators which can be packaged in shuttle.

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE '78 New Start - $150K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Structures, materials

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED
Polymeric and composite type heat pipe materials
Flexible wicks and intergal coatings

LEVEL OF STATE OF ART
1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. 1

PAGE 1 OF 2

1. TITLE Integral Light Weight Heat Pipes for Antennaes and Radiators

NO. 11 M-1 09
THEME / W.G. / TASK

DATE 4 /28 / 76

2. OBJECTIVE
Develop light weight heat pipe system for antennaes and radiators which can be packaged in shuttle.

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE '78 New Start - $150K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Structures, materials

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED
Polymeric and composite type heat pipe materials
Flexible wicks and intergal coatings

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE Integral Light Weight Heat Pipes for Antennaes and Radiators

NO. 11 M-1 09
THEME / W.G. / TASK

DATE 4 /28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

(1) Develop new materials compatible with heat pipe fluids

(2) Develop new wicking systems

7. ALTERNATIVE APPROACHES/OPTIONS Fluid loops

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

506-16-31; JSC Activities

9. TECHNOLOGY SCHEDULES

FY / SCHEDULE ITEM	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Develop Materials			x	x	x															
Develop Wicks			x	x	x															
Integrate w/rad. & ant.						x	x													
Test (FLT)								x	x	x										
Operational															x					
MANPOWER (M-Y) INHOUSE			1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0										
CONTRACT																				
FUNDING (10^6 $) INHOUSE																				
CONTRACT			.2	.2	.2	.5	.5	.5	.5	.5					-					

SPACE TECHNOLOGY NEED

FORM NO. I

PAGE 1 OF 3

1. TITLE ADVANCED TPS/MATERIALS FOR ADVANCED VEHICLE, OT VEHICLE, HLL VEHICLE

NO. 12 M-1 01 THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE

Provide minimum weight TPS with required service life

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: 1985

c) RISK IN ACHIEVING ADVANCEMENT: HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [X] GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X] OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE FY 78 - $550K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Improved metallic and non-metallic materials with higher temperature capabilities and the required reuseability are required to provide options for application to the reentry vehicles appropriate to the environment dictated by the aerodynamic configuration and vehicle trajectory. The new materials are required to be reuseable up to temperatures of 1600° K. Some applications require higher temperatures with limited reuse. Flight tests under OEX Program are required to verify some of the developments.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. I

TITLE Advanced TPS/Materials for Advanced Vehicles
OT Vehicle, HLL Vehicle

NO. 12 M-1 01
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

1. Develop high-temperature rigid RSI materials
2. Develop high-temperature flexible RSI materials
3. Improve creep resistance of super alloy metals
4. Determine potential of non-catalytic surfaces
5. Determine effects of TPS design on boundary layer transition

7. ALTERNATIVE APPROACHES/OPTIONS Heat-pipe leading edges

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

RTOP 506-16-42, 43

OEX - New initiative #131: Five proposed tasks for flight tests. These are enumerated on page 3.

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
HI Temp HRSI	—	—	—	—	—	—	—													
HI Temp FRSI	—	—	—	—	—	—	—													
Low Creep Metals	—	—	—	—	—	—														
Low Catalytic		—	—	—	—	—	—													
Transition		—																		
OTV Direct			—	—	—	—	—	—	—											
OTV Braked			—	—	—	—	—	—	—											

MANPOWER (M·Y) INHOUSE	7	8	9	11	10	10	9													
CONTRACT	7	7	8	8	9	9	9													
FUNDING (10^6 $) INHOUSE	.6	.6	.6	.6	.7	.7	.7													
CONTRACT	.4	.4	.5	.5	.6	.6	.6													

SPACE TECHNOLOGY NEED **FORM NO. I**

1. TITLE Advanced TPS/Materials for Advanced Vehicle, OT Vehicle, HLL Vehicle

NO. 12 M-1 01
THEME / W.G. / TASK

DATE 4 / 28 / 76

(6) **CONTINUATION (If Needed)**
Block No.

6. Develop materials for direct reentry of orbital transfer vehicle
7. Develop materials for aero-braked orbital transfer vehicle

OEX PROPOSED TASKS:

1. Effects of catalytic surface on convective heating of TPS surfaces.
2. RSI repair methods evaluation.
3. Tile-to-tile gap effects on TPS performance.
4. High temperature/high density RSI applications.
5. High temperature flexible RSI (FRSI) applications.

SPACE TECHNOLOGY NEED **FORM NO. I**

PAGE 1 OF 2

1. TITLE OPTIMIZATION OF HIGH STRENGTH STRUCTURAL ALLOY AND COMPOSITE SYSTEMS NO. 12/M-1/02 THEME / W.G. / TASK

DATE 4 /28 /76

2. OBJECTIVE Develop medium to high strength structural metal matrix composites having improved fracture toughness and failure resistance.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE:]

c) RISK IN ACHIEVING ADVANCEMENT: HIGH [X] MEDIUM [ ] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X] GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ] OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE FY 78

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Develop improved fracture control through improved fracture toughness of medium to high strength alloy materials obtained through a better understanding of the micromechanical, physical and chemical processes associated with crack instability through optimization techniques such as mechanical and thermal means and alloy modification. Optimization of the failure resistance of metal matrix composites.

LEVEL OF STATE OF ART

1 BASIC PHENOMENA OBSERVED AND REPORTED
2 THEORY FORMULATED TO DESCRIBE PHENOMENA
3 THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4 PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5 COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6 MODEL TESTED IN AIRCRAFT ENVIRONMENT
7 MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE OPTIMIZATION OF HIGH STRENGTH STRUCTURAL ALLOY AND COMPOSITE SYSTEMS

NO. 12/M-1/02
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

1) Improved fracture toughness of existing alloys through optimization of thermal and mechanical treatments.

2) Improved understanding of the micromechanical processes governing crack instability to optimize fracture toughness.

3) Alloy development.

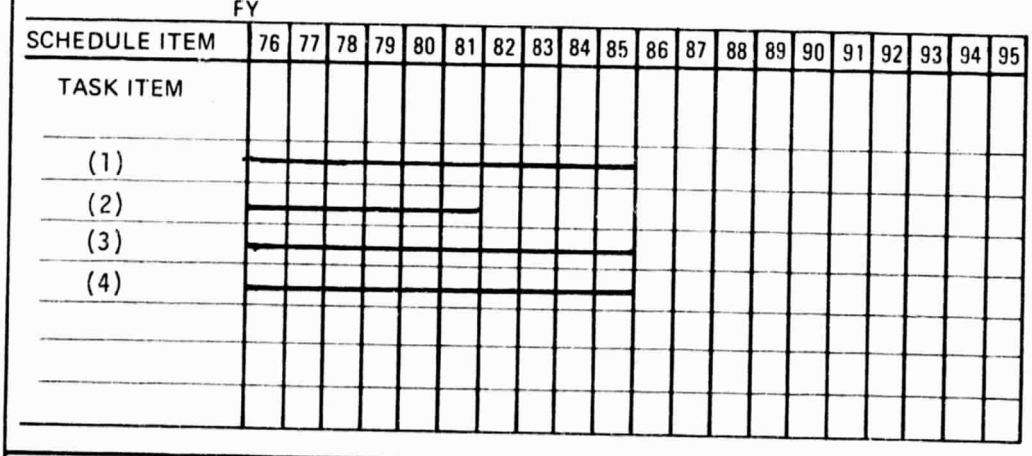
4) Improved failure resistance of metal matrix composites.

7. ALTERNATIVE APPROACHES/OPTIONS Use existing medium and high strength alloys with less than optimum toughness -- weight and size penalty.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

506-16-21

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y)																				
INHOUSE	5	5	5	5	5	5	5	6	6	6										
CONTRACT	4	4	4	5	5	5	6	6	5	5										
FUNDING (10^6 $)																				
INHOUSE	.25	.25	.5	.5	.5	.5	.5	.6	.6	.6										
CONTRACT	.25	.25	.5	.5	.5	.5	.5	.6	.6	.6										

SPACE TECHNOLOGY NEED

FORM NO. I

PAGE 1 OF 2

1. TITLE More Efficient, Reliable Thermal Control Systems/Materials

NO. 12 M-1 03 R1
THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE Develop long-life capability for in-orbit thermal control of advanced space transportation system

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE FY '78, New Start, $200K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Long-life stable second-surface mirror coatings

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Long-life pumps for radiator systems, low solar absorptance/high emittance coatings for radiators and TPS materials; high efficiency heat pipes

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE More Efficient, Reliable Thermal Control Systems/Materials

NO. 12 M-1 03
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

1. Development and long-life test of pumps for high efficiency, light-weight radiators
2. Low α/ε SSM coatings for radiators
3. Conductive coatings for prevention of charge-build-up
4. Increase efficiency of structural heat pipes
5. Integrate into design of vehicle and test

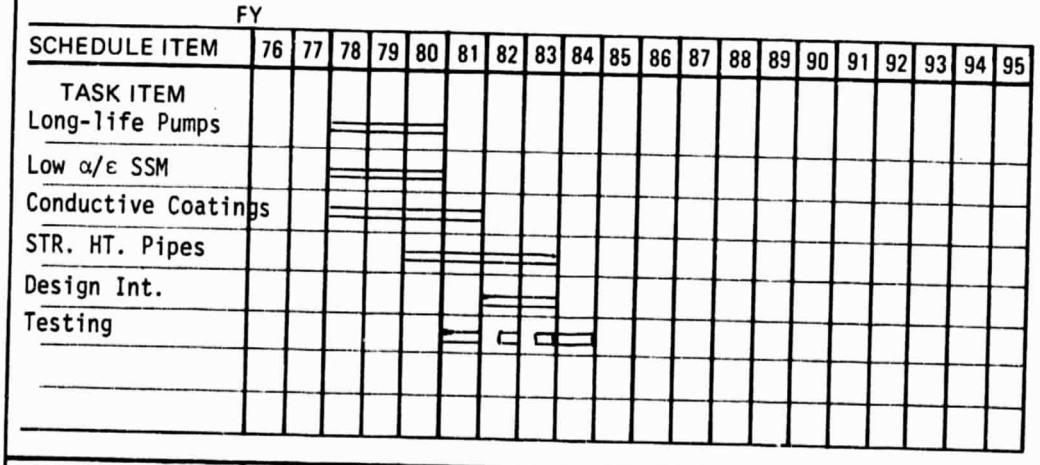
7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

506-16-32 SSM Coatings Technology

Heat Pipe Technology

9. TECHNOLOGY SCHEDULES



MANPOWER (M-Y)																				
INHOUSE		2	2	2	2	2	3	3	2											
CONTRACT		1	3	3	3	3	3	3	3											
FUNDING (10^6 $)																				
INHOUSE		.1	.1	.15	.15	.15	.15	.15	.1											
CONTRACT		.1	.3	.4	.5	.4	.4	.3	.3											

SPACE TECHNOLOGY NEED FORM NO. 1

PAGE 1 OF 2

1. TITLE IMPROVED AND/OR PREDICTED COMPATIBILITY OF METALLIC STRUCTURES EXPOSED TO CHEMICAL ENVIRONMENTS

NO. 12/M-1/04 THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE Develop an adequate understanding of the compatibility of metallic structures and chemical environments to predict and extend structural life.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [6] FOR OPERATIONAL SYSTEM USE BY [DATE: 1980]

c) RISK IN ACHIEVING ADVANCEMENT: HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X] GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ] OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE FY 78 400K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Develop an improved understanding of the chemical compatibility between space related metallic structures and chemical environments (i.e., tankage, nuclear containment vessels, etc.) in order to attain adequate quantitative models of life prediction to permit optimum selection of alloys, microstructures, etc. for space structures particularly related to reusability.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE IMPROVED AND/OR PREDICTED COMPATIBILITY OF METALLIC STRUCTURES EXPOSED TO CHEMICAL ENVIRONMENTS

NO. 12/M-1/04
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

1) Establish the kinetic and mechanistic aspects of degradation processes associated with chemical compatibility.

2) Establish the compatibility between structures and potentially degrading environments associated with ASTS.

3) Develop accurate and reliable, quantitative life prediction techniques for materials associated with the ASTS.

7. ALTERNATIVE APPROACHES/OPTIONS Use current technology for life prediction and chemical compatibility - weight increase and lack of reliability.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

506-16-31

9. TECHNOLOGY SCHEDULES

FY / SCHEDULE ITEM	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
(1)																				
(2)																				
(3)																				
MANPOWER (M-Y) INHOUSE	3	3	4	4	4	4	4	4	4											
CONTRACT	1	1	2	2	3	3	3	3	3											
FUNDING (10^6 $) INHOUSE	.2	.2	.3	.3	.3	.3	.3	.3	.3											
CONTRACT	.1	.1	.2	.2	.2	.2	.2	.2	.2											

SPACE TECHNOLOGY NEED

FORM NO. I

PAGE 1 OF 2

1. TITLE NDT/NDE TECHNIQUES PARTICULARLY RELATED TO STRUCTURAL REUSABILITY

NO. 12/M-1/05
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE

To advance the technology of nondestructive methods for the evaluation and detection of flaws in metallic structures

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1980]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE FY 78 300K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

In order to ensure structural integrity and reusability we must adequately develop accurate and reliable nondestructive testing and evaluation techniques to be more accurately applied to life prediction techniques.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE NDT/NDE TECHNIQUES PARTICULARLY RELATED TO STRUCTURAL REUSABILITY

NO. 12/M-1/05
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

1) Develop accurate and reliable nondestructive evaluation and testing techniques.

2) Apply techniques to the reusability of structures of ASTS.

7. ALTERNATIVE APPROACHES/OPTIONS Loss of reliability

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

FY / SCHEDULE ITEM	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
(1)			———	———	———	———	———	———	———	———										
(2)						———	———	———	———	———										
MANPOWER (M-Y) INHOUSE			1	1	2	3	3	3	3	3										
CONTRACT			1	1	1	2	2	2	2	2										
FUNDING (10^6 $) INHOUSE			.2	.2	.2	.3	.3	.3	.3	.2										
CONTRACT			.1	.1	.1	.1	.1	.1	.1	.1										

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE MATERIALS/PROCESSES FOR ADVANCED PROPULSION SYSTEMS

NO. 12/M-1/06 (THEME / W.G. / TASK)

DATE 4 / 28 / 76

2. OBJECTIVE Develop materials and manufacturing processes for higher performance, longer life, reusable, cost-effective propulsion systems.

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1983]

c) RISK IN ACHIEVING ADVANCEMENT: HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X] GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ] OTHER (Specify) [ ] Yes FY 78 $300K (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

Advanced chemical propulsion systems

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

- Develop alloys resistant to hydrogen embrittlement
- Determine reactivity of alloys to high-pressure oxygen
- Develop composite propellant tanks
- Develop ceramic bearings
- Develop high strength/high thermal conductivity alloys for rocket nozzles

SPACE TECHNOLOGY NEED

FORM NO. I

PAGE 2 OF 2

TITLE MATERIALS/PROCESSES FOR ADVANCED PROPULSION SYSTEMS

NO. 12/M-1/06
THEME / W.G. / TASK

DATE 4 / 28/ 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

1) Laboratory development of materials/processes
2) Rig-testing under simulated operating conditions
3) Commercial scale-up
4) Incorporation in applicable propulsion systems

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
H_2 embrittle	—	—	—	—	—	—														
O_2 effects	—	—	—	—	—	—														
Composite tanks	—	—	—	—	—	—	—	—												
Ceramic bearings			—	—	—															
Nozzle alloys			—	—	—	—	—	—												
MANPOWER (M-Y)																				
INHOUSE	1	1	2	3	3	3	2	1												
CONTRACT	-	-	1	2	2	3	2	1												
FUNDING (10^6 $)																				
INHOUSE	.1	.1	.1	.1	.1	.1	.1	-												
CONTRACT	-	-	.2	.3	.3	.5	.3	-												

THEME 07 - MULTIPURPOSE SPACE POWER PLATFORM

SPACE TECHNOLOGY NEED PRIORITY ASSESSMENT

(List in numerical order, 1 – Highest Priority)

FORM II
FORM III

WORKING GROUP M-1

DATE 4 / 29 / 76

TASK #	TECHNOLOGY NEED NO. / THEME NO.	7 SPACE POWER (*)	8 SPACE INDUST.	9 SETI	10 SOLAR SYS. EXPL.	11 GLOBAL SERVICE	12 ADV. TRANS. SYS.	NASA R&T		SUMMARY PRIORITY ASSESSMENT			
								Current	R&T Base	WG	TT	Current $K	R&T Total $K
01	POWER GENERATION MAT'LS/PROCESSES	1						X (RP)	X	3		800	1200
02	POWER STORAGE AND TRANSMISSION MAT'LS/PROC.	2						X (RP)	X	4		275	400
03	THERMAL CONTROL INSULATION SYSTEMS	5						OSF		>20*		200	200
04	COMPOSITES FOR LARGE SPACE STRUCTURES	6						X	X	17		300	500
05	IN-SITU SPACE MFG. OF LARGE STRUCTURES	3							X	>20		---	300
06	LONG-TERM SPACE EFFECTS ON MAT'LS	4							X	15		---	200
			*PRIORITY CONCURRED WITH BY WG-TT										

SPACE TECHNOLOGY NEED PRIORITY ASSESSMENT

FORM II
FORM III

(List in numerical order, 1 — Highest Priority)

WORKING GROUP M-1

DATE 4 / 29 / 76

*

TASK #	THEME NO. / TECHNOLOGY NEED NO. 08	7 SPACE POWER	8 SPACE INDUST.	9 SETI	10 SOLAR SYS. EXPL.	11 GLOBAL SERVICE	12 ADV. TRANS. SYS.	NASA R&T		SUMMARY PRIORITY ASSESSMENT			
								Current	R&T Base	WG	TT	Current $K	R&T Total$K
01	SPACE HABITAT MANUFACTURE & REPAIR		5							>20			
02	DEVELOP LUNAR HABITAT CONSTRUCTION METHODS		6							>20			
03	DEVISE THERMAL CONTROL FOR SPACE HABITAT		4					X OSF		>20			250
04	MANUFACTURE COMPOSITES IN SPACE		8							>20			
05	EXTRACTION OF STR. MAT'LS FROM LUNAR SURF. MAT'L		7						X	>20			100
06	SPACE PROCESSING FOR USE ON EARTH		1					X 04		>20			2000
07	DEV. OF FAB. TECH. FOR SPACE ERECTABLE STR.		2						X	5			500
08	EFFECT OF SPACE ENV. ON MATERIALS		3						X	16			300

* PRIORITY CONCURRED WITH BY WG-TT

THEME #9 - SETI

SPACE TECHNOLOGY NEED PRIORITY ASSESSMENT

(List in numerical order, 1 – Highest Priority)

FORM II
FORM III

WORKING GROUP M-1

DATE 4 / 29 / 76

TASK #	TECHNOLOGY NEED NO. / THEME NO.	7 SPACE POWER	8 SPACE INDUST.	9 * SETI	10 SOLAR SYS. EXPL.	11 GLOBAL SERVICE	12 ADV.TRANS. SYS.	NASA R&T Current	NASA R&T R&T Base	SUMMARY PRIORITY ASSESSMENT WG	TT	Current $K	R&T Total$K
01	LARGE-AREA THIN-FILM STRUCTURES FOR RFP PROTECTION			3					X	>20			250
02	LARGE ANTENNA STRUCTURES - STABLE			2					X	6			200
03	ADV. LUB. FOR ANTENNA STRUCT.			4**				X		>20		100	100
04	LONG-LIFE CRYOGENIC SYSTEMS FOR MASERS, ETC.			1				X (RR)	X	7		300	500

* PRIORITY CONCURRED WITH BY WG-TT

** TT QUESTIONS THE NEED FOR THIS TASK

SPACE TECHNOLOGY NEED PRIORITY ASSESSMENT

(List in numerical order, 1 — Highest Priority)

FORM II
FORM III

WORKING GROUP M-1

DATE 4 / 29 / 76

TASK #	THEME NO. / TECHNOLOGY NEED NO.	7 SPACE POWER	8 SPACE INDUST.	9 SETI	10 * SOLAR SYS. EXPL.	11 GLOBAL SERVICE	12 ADV.TRANS. SYS.	NASA R&T		SUMMARY PRIORITY ASSESSMENT			
								Current	R&T Base	WG	TT	Curr. $K	R&T Total$K
01	RAD. STABLE COMP.				9				X	11			300
02	SOLAR SAIL MTL.				7				X	>20			250
03	ELECT. MTLS. FAB.				4				X	19			1000
04	CRYO. FOR MASERS				8			X (RR)	X	8		300	500
05	MTLS. PWR. CONV.				12			X (RP)	X	>20		100	200
06	MTLS. ENERG. STOR.				6					>20			
07	HI. TEMP. SOL. CELLS				10				X	>20			500
08	NUCL. SHIELD				1				X	14			400
09	PLAN. PROBE TPS				13			X		12		400	400
10	ABORT RTG TPS				REJECT			X		>20		50	50
11	CRYO. FOR SCI.				5			X (RR)	X	9		300	500
12	SUN RADIATOR				17					>20			
13	PLAN. ATM. INSUL.				11					>20			

* PRIORITY CONCURRED WITH BY WG-TT

SPACE TECHNOLOGY NEED PRIORITY ASSESSMENT

FORM II
FORM III

(List in numerical order, 1 — Highest Priority)

WORKING GROUP M-1

DATE 4 / 29 / 76

TASK #	THEME NO. / TECHNOLOGY NEED NO.	7 SPACE POWER	8 SPACE INDUST.	9 SETI	10 * SOLAR SYS. EXPL.	11 GLOBAL SERVICE	12 ADV.TRANS. SYS.	NASA R&T		SUMMARY PRIORITY ASSESSMENT			
								Current	R&T Base	WG	TT	CURR. $K	R&T TOTAL $K
14	SAMPLE RET. E/C				3					>20			
15	T/C MTLS. DEV.				2			X		>20		300	300
16	CONTAMINATION				14				X	>20			200
17	ENVIR. CONTROL				15			X		>20		100	100
18	ROVER T/C				16					>20			
19	REUS. INSULAT.				REJECT					>20			
20	RADIOACT. HEATERS				18					>20			
21	SOLAR PROBE TPS				REJECT					>20			
22	MIN ^{0}K CRYO.				REJECT			X (RR)		10		200	200

* PRIORITY CONCURRED WITH BY WG-TT

THEME #11 – GLOBAL SERVICE

SPACE TECHNOLOGY NEED PRIORITY ASSESSMENT

(List in numerical order, 1 — Highest Priority)

FORM II
FORM III

WORKING GROUP M-1

DATE 4 / 29 / 76

TASK #	TECHNOLOGY NEED NO. / THEME NO.	7 SPACE POWER	8 SPACE INDUST.	9 SETI	10 SOLAR SYS. EXPL.	11 GLOBAL SERVICE *	12 ADV. TRANS. SYS.	NASA R&T Current	NASA R&T R&T Base	SUMMARY PRIORITY ASSESSMENT WG	TT	Curr. $K	R&T TOTAL $K
01	CONDUCTIVE THERMAL CONTROL COATINGS					4		OSS	X	13		50	200
02	MANUFACTURING IN SPACE					2			X	20		--	300
03	CRYO SYSTEMS FOR SENSORS					1			X	>20		--	200
04	CONTAMINATION					6			X	>20		--	200
05	ULTRA-HIGH COND. HEAT PIPES					3			X	18		--	200
06	LOW α COATING					7			X	>20		--	150
07	STANDARD THERMAL DESIGN					8			X	>20		--	--
08	DIMENSIONAL STABLE STRUCTURES					5			X	>20		--	200
09	INTEGRAL HEAT PIPES					9			X	>20		--	150

* PRIORITY CONCURRED WITH BY WG-TT

THEME #12 - ADVANCED SPACE TRANSPORTATION

SPACE TECHNOLOGY NEED PRIORITY ASSESSMENT

FORM II
FORM III

(List in numerical order, 1 – Highest Priority)

WORKING GROUP M-1

DATE 4/29/76

TASK #	THEME NO. / TECHNOLOGY NEED NO.	7 SPACE POWER	8 SPACE INDUST.	9 SETI	10 SOLAR SYS. EXPL.	11 GLOBAL SERVICE	12 ADV. TRANS. SYS. *	NASA R&T		SUMMARY PRIORITY ASSESSMENT			
								Current	R&T Base	WG	TT	Curr. $K	R&T TOTAL $K
01	TPS/MATERIALS						2	X		2		550	550
02	HI. STRENGTH ALLOYS AND COMPOSITES						4	X		>20		400	400
03	THERMAL CONTROL SYS. AND MAT'LS						6	OSF	X	>20		200	400
04	METALLICS AND CHEM. ENV.						3	X		>20		400	400
05	NDT/NDE FOR STRUCTURES						5		X	>20			300
06	MATL'S FOR ADVANCED PROPULSION						1		X	1			300

* PRIORITY CONCURRED WITH BY WG-TT

END

DATE

FILMED

MAR 14 1979