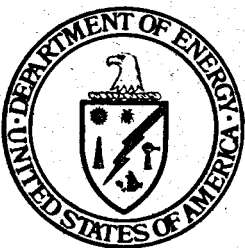


# Satellite Power System (SPS) Program Summary

Program Summary  
Published December 1978

U.S. Department of Energy  
Assistant Secretary for Energy Research  
Satellite Power System Project Office  
Washington, D.C. 20545



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## PREFACE

The Office of Energy Research was created by Public Law 95-91, Section 209, (42 U.S.C. 7239), as part of the organization plan for the Department of Energy (DOE), both of which were established concurrently on October 1, 1977. An overview of the current DOE organization is shown in Figure 1.

The Director, Office of Energy Research advises the Secretary on the physical research and energy research and development programs of the Department, utilization of multi-purpose laboratories, education and training for basic and applied research activities, and financial assistance for such research activities. The Director develops, manages and directs the physical research, basic life science, multi-disciplinary, and advance research and technology program. The Director also is chairman of the Research and Development Coordination Council which has been established by the Secretary to eliminate undesirable duplication in the conduct of these activities.

In April 1978, a Satellite Power System Project Office was established in the Office of Energy Research with a full-time Director to manage all activities in this program area. Prior to October 1, 1977, it was part of the Division of Solar Energy. The Director is responsible for the environmental, social, economic, and comparative assessment of the SPS concept and, in cooperation with NASA, is responsible for the hardware systems definition. The director manages the concept development and evaluation program, directs studies on the feasibility of the concept, and funds supporting organizations to the SPS project effort. The director focuses on SPS findings, prepares reports, and provides recommendations to DOE management, particularly with regard to major and national decisions regarding future SPS development.

As part of this latter activity, a Program Summary is issued annually. It is an overview of the ongoing research and assessment efforts of the preceding fiscal year.

# DEPARTMENT OF ENERGY

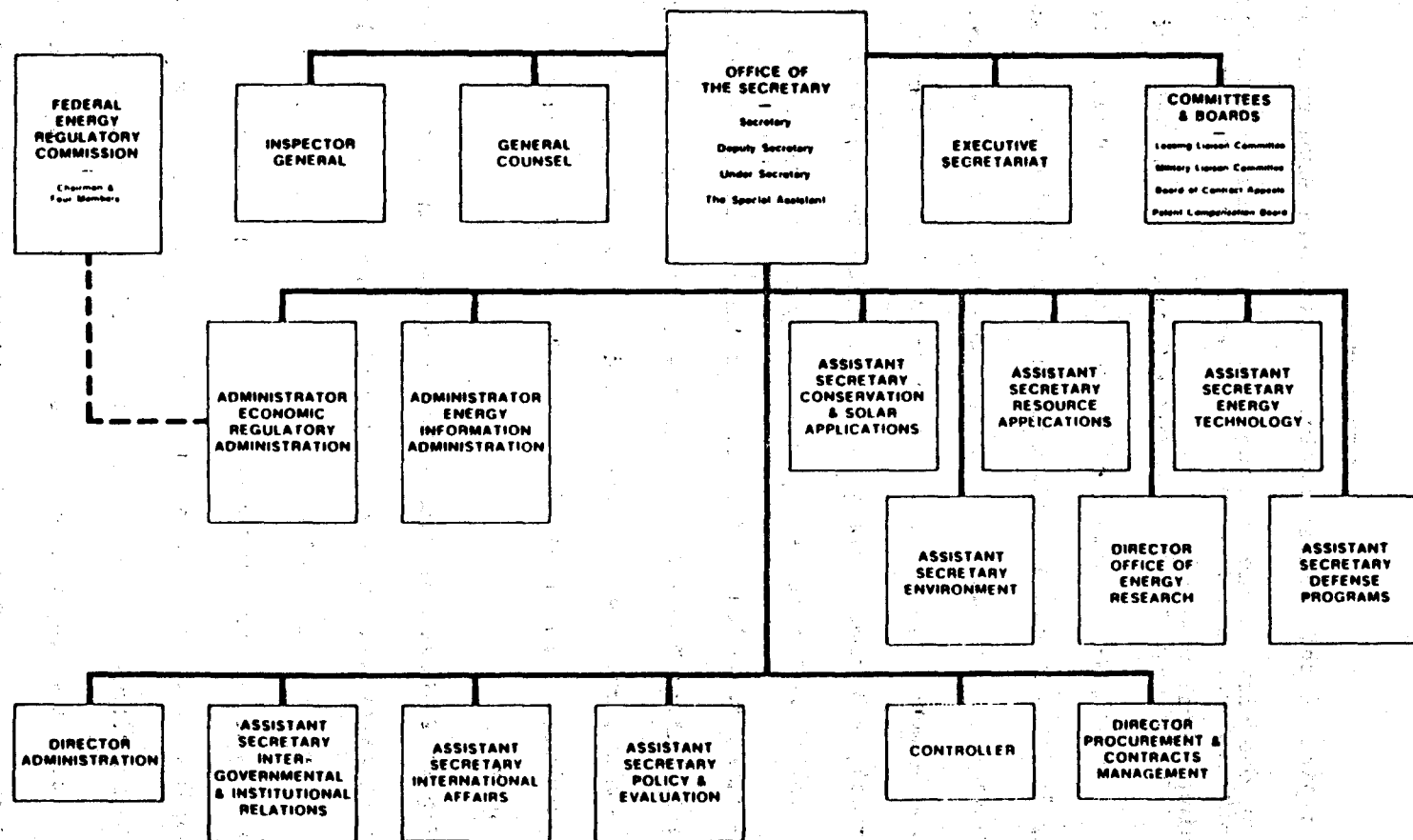


FIGURE 1. DOE Organization Overview.

## INTRODUCTION

Although the sun is, in effect, an unlimited source of energy, there are two factors that inhibit extensive development of solar electric energy-generation systems on the earth. First, the sun's energy is diffuse and second, solar energy at the earth's surface is intermittent. The sun shine reaches the earth's surface only part of each 24 hours and is often obscured by clouds. However, baseload electricity (24-hour operation) can be generated in space, where a solar energy collector is illuminated by the sun more than 99 percent of the time, regardless of weather or the day-night cycles of the earth. Such a Satellite Power System (SPS) was first suggested in 1968 by Dr. Peter Glaser, and has been under study by the National Aeronautics and Space Administration (NASA) since 1972, and by the Department of Energy since 1976.

Figure 2 shows how such a system would function. A large collector, 55 square kilometers in area, covered with photovoltaic solar cells converts solar power into electricity. The electricity is continuously converted into microwave power for transmission to large receiving, rectifying antennas (rectennas) on earth. These rectennas in turn reconvert the beamed microwave power into electricity and feed it into a utility grid. Such a satellite might weigh as much as 90 million kg., and deliver 5,000 megawatts of power continuously to its ground receiving station. A system of 60 or more of these satellites in geostationary orbit of 35,888 km. above the earth would provide a significant portion of the

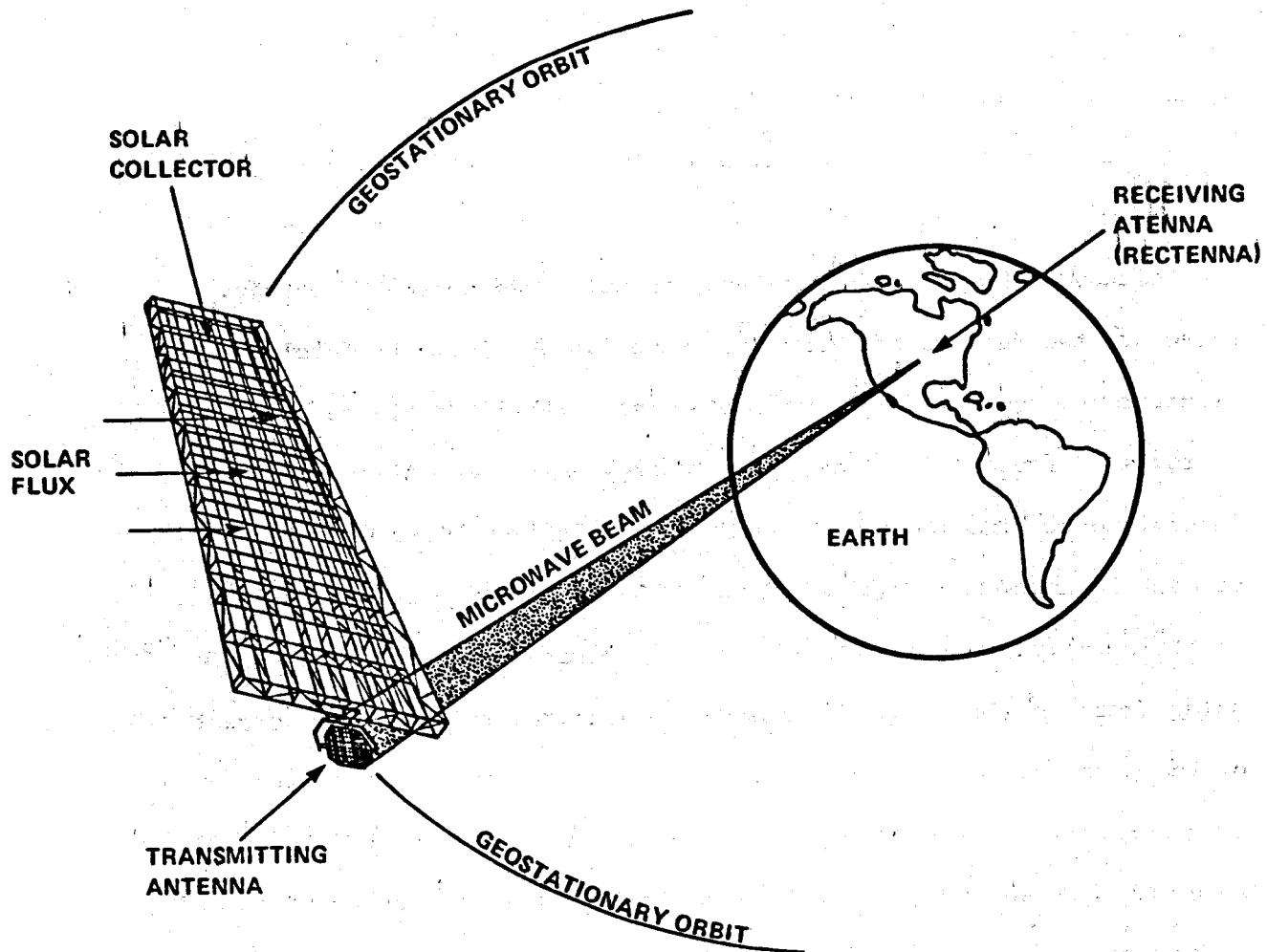


Figure 2

**MAJOR ELEMENTS OF A  
SATELLITE POWER SYSTEM (SPS)**



total U.S. electric power requirements.

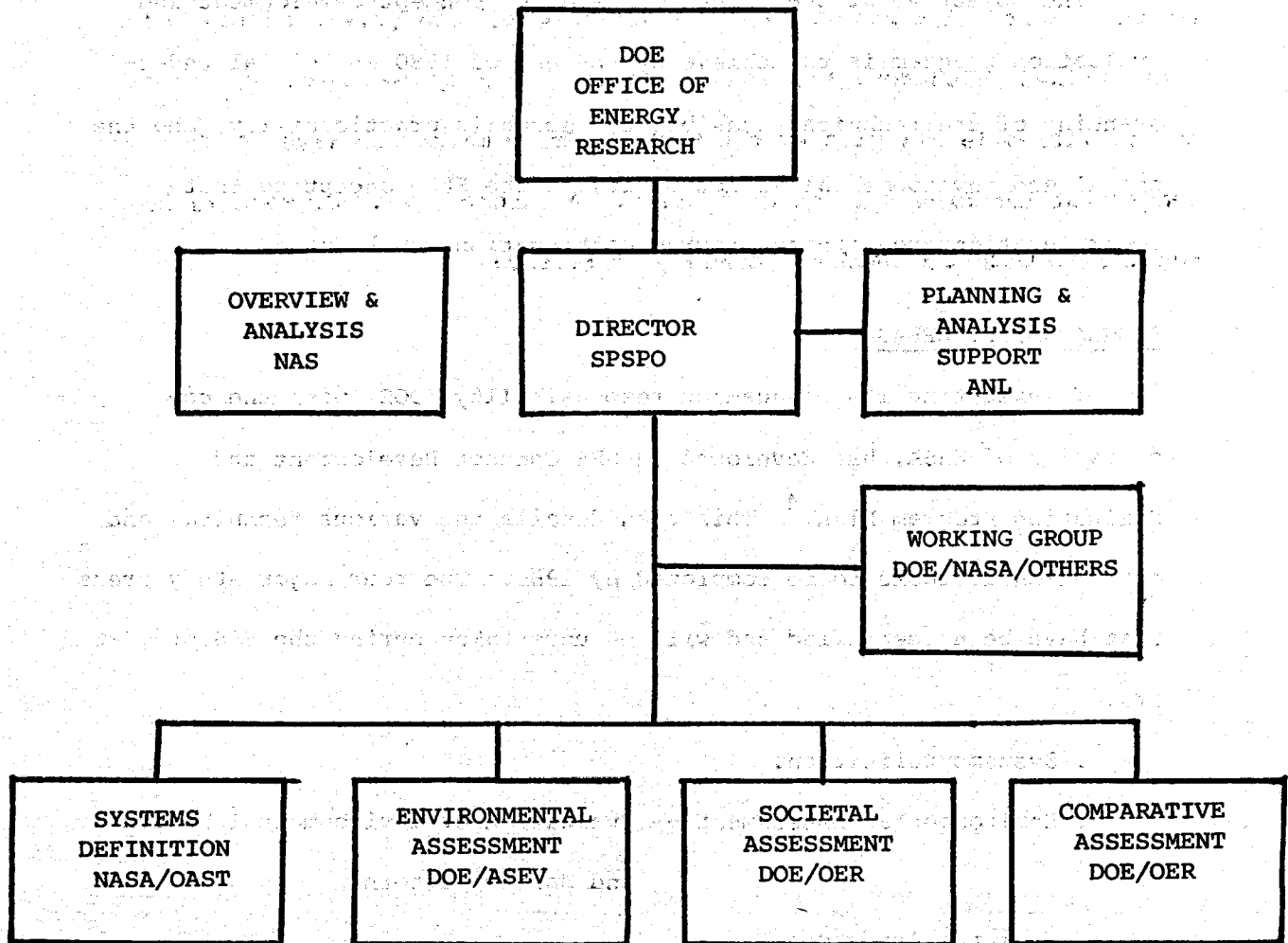
SPS technological studies, performed by NASA since 1972, have uncovered no insurmountable scientific problems, although basic questions remain relating to the feasibility and cost of the large scale engineering tasks required. For fiscal year 1977 the Office of Management and Budget (OMB) transferred the management responsibility of the SPS project from NASA to the Department of Energy (DOE). In response to the growing interest in the possibility of using space and space technology to provide significant quantities of energy for utilization on earth, the DOE (then ERDA) established a Task Group on SPS to investigate this potential energy system and to make recommendations to DOE's Administration regarding future program options. To support the Task Group's decision-making process, DOE conducted an extensive literature review on SPS and SPS-related studies. At the end of 1976, a literature survey and an SPS Environmental Assessment Plan (SEAP) were published. In the same year, the Task Group recommended a specific program of studies to determine the viability of the SPS concept and to identify any barriers to SPS implementation.

To implement the Task Group's recommendation, DOE developed the SPS Concept Development and Evaluation Program Plan in 1977.<sup>4</sup> Key issues were identified and several specific studies were initiated to resolve some of the key issues. Initial environmental guidelines for SPS Concept Development and Evaluation were defined in 1977,<sup>6</sup> and updated in 1978.<sup>7</sup> A storage and retrieval system was developed for DOE in-house SPS documents.

The SPS Project Office was formed in 1978. It has overall management responsibility for the joint DOE/NASA program. An organization chart is shown in Figure 3. Environmental studies are coordinated by the Assistant

Secretary for the Environment (ASEV); system studies remain the responsibility of NASA; the social and comparative assessments of the SPS are the direct responsibility of the SPS Project Office. In addition to these four major project areas a planning and analysis function has been defined to support the project office. Policy decisions and review of activities is assisted by the Working Group which consists of the leaders of the five defined activities. A special overview role is being negotiated with the National Academy of Sciences.

SPS  
CONCEPT DEVELOPMENT &  
EVALUATION PROJECT



NAS - National Academy of Sciences

ANL - Argonne National Laboratory

OAST - Office of Aeronautics and Space Technology

ASEV - Assistant Secretary for Environmental Assessment

Figure 3. SPS CONCEPT DEVELOPMENT & EVALUATION PROJECT  
ORGANIZATION OVERVIEW

## The Satellite Power System Program

### OBJECTIVE

The objective of the joint DOE/NASA SPS concept development and evaluation program is to achieve by the end of 1980 an initial understanding of the technical feasibility, economic practicability, and the social and environmental acceptability of the SPS concept so that recommendations concerning program continuation can be made.

### PROGRAM STUDY AREAS

In executing its management responsibility, DOE, with the co-operation of NASA, has developed an SPS Concept Development and Evaluation Program Plan.<sup>4</sup> This plan details the various technical and environmental tasks to be completed by 1980. The four major study areas that have been identified and will be undertaken during the SPS program are:

- . Systems Definition.
- . Environmental Assessment -- Evaluation of Environmental Health and Safety Factors.
- . Societal Assessment.
- . Comparative Assessment of Alternative Energy Systems.

The systems definition is NASA's primary responsibility, while the other areas are DOE's responsibility.

### SYSTEMS DEFINITION

NASA will identify and define the most attractive SPS concept(s)

from economic and technical considerations. The results of the systems definition effort will provide quantitative data from which environmental and societal implications of the SPS can be drawn and evaluated.

A photovoltaic energy conversion system has been selected as the reference system. Current studies are listed in Table 1. Future systems study efforts will refine the definition of the reference system.

#### ENVIRONMENTAL ASSESSMENT

An energy system has questionable value if its implementation sacrifices the health, safety, or welfare of the general public. The SPS Concept Development and Evaluation Program Plan, therefore, includes detailed study plans to determine if any of the potential environmental, health and safety effects are so adverse as to discourage development of the SPS system. Examples of these studies include the evaluation of the following factors:

- o Environmental Health and Safety (EH&S)
  - o Microwave EH&S effects.
  - o Non-microwave EH&S effects.
- o Atmospheric effects
  - o Launch flight and recovery and space operations effects.
  - o Climatological effects including microwave heating.
- o Communications effects
  - o Microwave effects on electromagnetic systems.
  - o Microwave atmospheric interaction and resulting Radio Frequency Interference and Electromagnetic Interference (RFI/EMI).
  - o Non-microwave communications effects.

Key environmental issues have been identified and DOE has initiated a number of specific studies to resolve some of these issues in FY 78, with

several studies continuing through FY 79. The studies are listed in Table 2. The results of these studies, and future efforts, will lead to a more definitive understanding of the SPS impact on public health and safety, and environmental quality, and will become inputs to the Environmental Assessment (EA) of the SPS concept.

#### SOCIETAL ASSESSMENT

In addition to its interactions with the physical environment, the SPS may have significant impacts on society, its institutions, and its resources. The DOE has therefore planned studies that will address issues of resource utilization, institutional factors, international issues and the societal effects of SPS. Study tasks (fully listed in Table 3) include evaluation of the following issues:

- o Resource Utilization
  - o Materials
  - o Land use
  - o Energy
- o Institutional Factors
  - o Federal Government involvement
  - o Regulatory Impacts (State and Local)
  - o Financing and Management
  - o Utility Integration
- o International Issues
  - o International Agreements
  - o International Organizations
  - o Military Implications

- o Societal Effects

- o Relocation - Industrial and Population
- o Centralization of Power Source
- o Public Acceptance
- o Student/Public Involvement

Studies consistent with the Program Plan, were initiated in FY 77 to deal with some aspects of the resources and institutional issues. During FY 78, the SPS Project Office implemented studies in all four areas to survey existing work as it is applicable to the SPS and to define additional efforts required for the societal assessment.

#### COMPARATIVE ASSESSMENT

Establishment of the technical, environmental and economic feasibility of an SPS energy system does not necessarily imply that it should be built. Before a commitment to SPS can be considered, DOE will complete a comparative assessment of the SPS and other advanced energy systems to determine if the implementation of the SPS would offer a distinct advantage to the American people. Other energy systems to be considered in this comparative evaluation include fossil fuel, nuclear, and solar energy systems such as terrestrial, Ocean Thermal Energy Conversion (OTEC), wind energy and biomass.

In 1976, the SPS Task Group identified comparative assessment as one of the important SPS program elements. The 1977 program Plan has placed a similar importance on this element. Work has been initiated to develop a comparative assessment methodology so that the different energy systems can be compared on a common basis. A comparative data base will be developed from which the assessments will be made. The comparative assessment effort

will consider the environmental, societal, economic and technical issues treated in the tasks above. Comparative Assessment Program Tasks started in FY 1978 are listed in Table 4.



## Fiscal Year 1978 Summary Tables

A listing of the projects sponsored by the Department of Energy are presented in Tables 1 through 4.

Table 1

FY 78 Summary Tables  
Program Element

## SYSTEMS DEFINITION TASKS

<u>Organization</u>	<u>Title</u>	<u>Projected Contribution</u>
Marshall Space Flight Center	Concept Definition	Refine and update SPS design concept, evolve viable systems and subsystems.
Marshall Space Flight Center	Cost Model Development	Provide accurate and reliable estimates of the costs of certain SPS elements.
Marshall Space Flight Center	Comparative Analysis of Metallic and Composite Materials for SPS Related Large Space Structures	Identify relative benefits and risks associated with use of composite and metallic materials for space structures.
Marshall Space Flight Center	Economic Factors Relating to the Development of the Satellite Power System	Evaluate impact of economic evaluation methodologies on SPS Concept selection.
Marshall Space Flight Center	Electrostatic Protection of the Solar Power Satellite and the Rectenna	Investigate potential hazard to SPS from "spacecraft charging" and hazard to rectenna due to lightning.
Marshall Space Flight Center	Accuracy Analysis of a Pointing Control System of the Satellite Power System	Analyze mechanisms by which SPS mechanical and electronic control subsystems affect power beam pointing accuracy and stability.
Johnson Space Center	Critique, Modify, Maintain Baseline System	Critique all parts of the baseline system, modify and integrate latest support studies into the system.
Johnson Space Center	Refine Space Construction and Maintenance Approach Construction Facilities	Analyze and refine construction, fabrication, assembly and related activities which occur in LEO and GEO orbit locations and at the rectenna site.

Table 1 continued

<u>Organization</u>	<u>Title</u>	<u>Projected Contribution</u>
Johnson Space Center	Define Industrial and Earth Transportation Complex	Define industrial and earth-based transportation requirements imposed on the U.S., identify expansion in production capability and creation of new industry to support SPS.
Johnson Space Center	Conduct Launch Site Location Analysis and Complex Definition	Define potential launch complex and funding requirements for facilities, equipment and staff for increased launch activity of a commercial scale SPS.
Johnson Space Center	Define and Analyze Operation Activity from Manufacturing Through Space Construction.	Define the flow and flow rates of raw materials, components, subassemblies and assemblies from source to launch site to the construction site, analyze system operations, and identify options.
Johnson Space Center	Analyze Integration of SPS with Ground Networks	Conduct rectenna siting analysis and create data base for construction of a rectenna in various locations.
Johnson Space Center	Prepare Technology Advancement, Development, and Facility Requirements and Plans	Develop a conceptual plan outlining technology activities including preliminary schedules and costing plans for implementation of an SPS program.
Johnson Space Center	Cost Analysis and Schedule Analysis	Perform a total-cost analysis including updating and integrating identifiable and accessible elements, cost flow requirements with time, and decision milestones.
Johnson Space Center	SPS Phase Control System Definition	Conduct simulation analysis and tradeoff/optimization studies of the baseline phase control system.
Johnson Space Center	Analysis of S-Band Solid State Transmitter for SPS	Analyze and develop design requirements of an S-Band solid state transmitter to be incorporated into the system definition study.

Table 2

FY 78 Summary Tables  
Program Element

ENVIRONMENTAL ASSESSMENT

<u>Organization</u>	<u>Title</u>	<u>Projected Contribution</u>
Argonne National Laboratory	Planning and Analysis Management Support	Performs planning and analysis functions and provides manage- ment support to the Director, SPSPO.
Argonne National Laboratory	Assessment of SPS Microwave Radiation on the Rectenna Site Ecology	Identified ecological issues of microwave reception.
Argonne National Laboratory	Assessment of SPS Rectenna Construction and Operation Impact upon the Rectenna Site Ecology	Identifies rectenna construc- tion and operation impacts to the environment and identifies research needs.
Argonne National Laboratory	Qualitative Assessment of Inadvertent Weather Effects of SPS Rocket Launches in Troposphere	Assess weather effects due to rocket launches in the tropo- sphere.
Argonne National Laboratory	Preliminary Assessment of Effects of Rocket Effluents in Stratosphere	Identifies possible strato- spheric effects of rocket exhaust emissions, and identifies further research priorities.
Argonne National Laboratory	Quality Assurance of Microwave Health and Safety Research	Develops data quality assurance for microwave Health and Safety research program.
Argonne National Laboratory	Dependency of Microwave Biological Effects on Field Intensity	Provides a methodology for correlating different micro- wave exposure conditions with biologic effects.
Argonne National Laboratory	Response of Airborne Biota to Microwave Transmission	Determines any detrimental microwave effects on avian species flying through the beam.

Table 2 continued

<u>Organization</u>	<u>Title</u>	<u>Projected Contribution</u>
Argonne National Laboratory	Teratogenetic Effects of Microwave Power Transmission	Determines teratogenetic and/or embryopathic effects of microwave radiation on mice.
Argonne National Laboratory	Effects of Microwave Power Transmission on the Nervous System	Assesses the effects of SPS microwaves on the nervous system.
Argonne National Laboratory	Immunological/ Hematological Effects of Microwave Beam Transmission.	Confirms results of existing immune effects studies.
Argonne National Laboratory	Perturbations in Behavior Resulting from the Interaction of Drugs with SPS Microwave Radiation	Determines drug-microwaves synergism used in assessing health impact of SPS and the threshold of drug-radiation interaction.
Argonne National Laboratory, Boston University	Preliminary Identification of Effects of Rocket Effluents in Upper Atmosphere, of Research Needs, and Preliminary Assessment of Impacts	Identifies current state of knowledge and assesses rocket effluent impacts on the atmosphere.
Argonne National Laboratory, South Dakota School of Mines and Technology	Preliminary Identification of Possible Issues and Impacts of Rectenna Operations	Assesses potential atmospheric effects of rectenna operations and the impacts on climate and weather.
Department of Commerce/ ITS	SPS Microwave Radiation Effects on Ionosphere, Magnetosphere, and Local Field Intensity, Program Management Distributions	Provides management support for all DOE studies on SPS Microwave Radiation effects.
Department of Commerce/ ITS	SPS Electromagnetic Compatibility Assessment, Overview Committee	Develops plan to analyze effects of SPS heating of the ionosphere and magneto- sphere in communication systems.

Table 2 continued

<u>Organization</u>	<u>Title</u>	<u>Projected Contribution</u>
Department of Commerce/ITS	SPS Microwave Radiation, Energy Storage in Vehicles and Habitable Structures	Identifies energy storage in habitable structures and vehicles, for health and safety assessment, estimates effects on electromagnetically sensitive systems.
Department of Commerce/ITS	SPS Electromagnetic Interference (EMI) Effects	Predicts SPS-microwave effects on electromagnetic systems.
Department of Commerce/ITS	SPS Radiofrequency Interference (RFI) Effects	Predicts and assesses RFI effects.
Department of Commerce/ITS, NOAA	SPS Microwave Radiation Interactive Effects on Magnetosphere and Ionosphere	Predicts synergistic effects of SPS Microwave and vehicular emissions on EM scattering properties of the magnetosphere and ionosphere.
Department of Commerce/ITS	SPS Geographic Distribution of Field Intensities	Identifies geographic power distribution and provides data to determine field strengths.
Environmental Protection Agency	Microwave Exposure Chambers for Assessment of Public Health Impacts	Develops increased capacity to study effects of exposure to microwave radiation.
Environmental Protection Agency	SPS Microwave Impacts on Public Health and Safety Overview Committee	Establishes research programs to develop understanding of microwave impact on environmental assessment.
Environmental Protection Agency	SPS Microwave Impacts on Public Health and Safety Program Coordination and Guidance	Coordinates and guides studies of microwave biological effects.
Lawrence Berkeley Laboratory	SPS Non-Microwave Impacts on Space Worker Health and Safety Program Guidance	Provides data on non-microwave impacts on space worker health and safety for preliminary environmental impact assessment.
Lawrence Berkeley Laboratory	SPS Non-Microwave Impacts on Health and Safety	Characterizes space environment and identifies probable effects on health.

Table 2 continued

<u>Organization</u>	<u>Title</u>	<u>Projected Contribution</u>
Los Alamos Scientific Laboratory	Reduction of LAGOPEDO Data	Identifies information from LAGOPEDO experiments re: effects of (multiple launch) rocket effluents in the upper atmosphere.
Los Alamos Scientific Laboratory	SPS Microwave Radiation Effects on the Ionosphere	Verifies predicted RF power density threshold for thermal runaway.
Los Alamos Scientific Laboratory	Effects of Propellant Emissions in the Upper Atmosphere	Evaluates long-range effects on the ionosphere and on climate and terrestrial communications.
Rice University Department of Commerce/ITS	SPS Magnetospheric and Ionospheric Heating Facility	Provides design of an ionospheric heating facility and experiments to assess EMC of SPS.
Science Applications Incorporated	Preliminary Assessment of Effects of Rocket Effluents in Troposphere	Assesses probable impacts of rocket launches in the troposphere.
University of California, Davis	Study of the Biological and Ecological Effects of the Satellite Power System (SPS) Microwave Power Transmission System on Behavior of Insects and other Terrestrial Invertebrates	Assesses microwave radiation effects on the honey bee, and extrapolate to other species.
Battelle Memorial Institute	SPS RFI/EMI Interference	Task coordination and guidance.

Table 2A

FY 1977 Summary Tables  
Program Element

(Studies Continuing Through FY 78)

## ENVIRONMENTAL ASSESSMENT

<u>Organization</u>	<u>Title</u>	<u>Projected Contribution</u>
Argonne National Laboratory	SPS Preliminary Environ- mental Assessment	Completes preliminary EA against guidelines that have been pro- mulgated.
Argonne National Laboratory	SPS Management Analysis and Control	Develops quantitative control tech- niques to aid management.
Argonne National Laboratory	SPS Guidelines and Criteria	Supports review and development of guidelines for SPS concept develop- ment and evaluation.
Battelle Memorial Institute-Pacific Northwest Lab.	SPS Microwave Radiation Effects	Estimates the effects of microwave radiation on health and ecosystems.
Los Alamos Scientific Laboratory	SPS Atmospheric Effects of Microwaves	Investigates the effects of SPS microwave radiation on atmosphere (ionosphere, magnetosphere).



Table 3

**FY 78 Summary Tables**  
**Program Element**

**SOCIETAL ASSESSMENT**

<u>Organization</u>	<u>Title</u>	<u>Projected Contributions</u>
Planning Research Corporation	SPS Societal Assessment Program Coordination and Guidance	Provides management support on the SPS Societal Impact Assessment Program.
Economic Consultants	Resources	Define state of knowledge in SPS impact on national and world resources.
Rice University	Land Use	Provides preliminary assessment of SPS land use requirements and identifies potential sites based on exclusion and inclusion criteria for further analysis.
International Technical Services	Federal Involvement	Identifies the government bodies in SPS development and operation.
Economic Consultants	Impact of a Satellite Power System (SPS) on State and Local Regulations	Identifies probable state and local governmental regulation that would impact SPS development.
University of Mississippi and Carl Q. Christol	International Agreements	Determines international agreements including orbital assessment, frequency allocations, and microwave standards, that would be required for SPS implementation.
Science Applications Incorporated and Herbert E. Kierulff, Jr.	Financial Management	Assesses alternative financial management scenarios to develop and operate the SPS.
International Technical Services	International Organizations	Evaluates the advantages of developing an international organization to manage and finance the SPS.
PRC Energy Analysis Co. and Michael J. Ozeroff	Military Implications	Addresses SPS vulnerability issues and military implications.

Table 3 continued

<u>Organization</u>	<u>Title</u>	<u>Projected Contribution</u>
Argonne National Laboratory	Relocation Industrial and Population	Identify potential industrial and population relocation to the SPS power source.
Center for Policy Process	Centralization of Electric Power	Assesses historical trends and potential SPS-caused societal centralization.
Environmental Resource Group	Public Acceptance	Identifies public accept- ability determinants, and public interest groups that will play a role in SPS public acceptance.
Forum for the Advancement of Students in Science and Technology	Student Involvement in SPS	Involves the college student community in SPS project planning.

Table 4

FY 78 Summary Tables  
Program Element

COMPARATIVE ASSESSMENT

<u>Organization</u>	<u>Title</u>	<u>Projected Contribution</u>
Argonne National Laboratory	Comparative Assessment Methodology	Develops methodologies for comparing SPS to alternative energy systems.
Argonne National Laboratory	Comparative Data Base	Develops comparative data on key environmental and social issues from which assessments may be made.
Argonne National Laboratory	Terrestrial Alternatives	Develops data on alternative energy systems for use in the comparative assessments.
Argonne National Laboratory	Comparative Assessments	Provides a comparative overview on the SPS versus alternative energy supply systems, and enables DOE to make a decision regarding SPS program development at an early date.
Argonne National Laboratory	Utility Integration	Provides a review of utility systems that could employ SPS power and determines the problems of SPS integration into the utility systems

Table 4b

FY 1977 Summary Tables  
Program Element  
(Studies Continuing Through FY 1978)

COMPARATIVE ASSESSMENT

<u>Organization</u>	<u>Title</u>	<u>Projected Contribution</u>
Argonne National Laboratory Sept. 77 - May 78	SPS Comparative Assessment Methodology	Develops methodology for comparing SPS to alternative energy systems.

**SYSTEM DEFINITION STUDIES**

**FY 1978**

<b>TITLE</b>		<b>ORGANIZATION</b>
Concept Definition Studies		Marshall Space Flight Center Marshall Space Flight Center AL 35812
<b>AMOUNT</b>		<b>PRINCIPAL INVESTIGATOR</b>
FY 78 \$550,000		
FY 79 \$450,000 (Est.)		C. Guttman
FY 80 \$300,000 (Est.)		
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
Rockwell International Corp., Downey, CA	12 months - 3.1.78	NAS 8-32475

## **PROJECT SUMMARY**

### Objective

Continued definition of SPS System Concept(s), and development of viable system/subsystem design concepts.

### Approach

1. Conduct special emphasis studies in the following areas:
  - . Construction techniques for Rectenna, Satellite and SPS Support Systems.
  - . SPS transport through the Space Environment.
  - . Terrestrial and Space Operations and logistics.
  - . SPS System Concept(s) Operations Analysis.
2. Perform in depth investigation of solid state microwave power transmission.
3. Perform space transportation analyses and develop preferred concepts and data to support the SPS design concept.
4. Conduct studies to determine SPS hardware, technology components, and specific tests that could be incorporated in an SPS technology verification, and experimental demonstration program.
5. Perform systems engineering and integration analysis.
6. General cost and program data based on new technical analysis, and systems integration data.

### Benefit

Provide DOE and NASA with sufficient data and information to select a preferred viable SPS Concept(s) by FY 1980.

---

**TITLE****Cost Model Development****ORGANIZATION****Marshall Space Flight Center  
Marshall Space Flight Center, AL  
35812**

---

**AMOUNT****FY 78 \$35,000****FY 79 TBD****PRINCIPAL INVESTIGATOR****J. Hamaker**

---

**WORK LOCATION****Planning Research Corp.  
Huntsville, AL****DURATION-AWARD DATA****12 months - 2.1.78****CONTRACT NO.****NAS 8-31645**

---

**PROJECT SUMMARY****Objective****Develop cost accurate estimates of certain SPS cost elements.****Approach**

- 1. Develop Cost Estimating Relationships (CER's) for the MSFC SPS cost model. The CER's will include:**
  - . The conventional system/subsystem approach, and others.**
  - . The Red Star data base, and additional data collected from other sources.**
- 2. Analyze selected data for each program/project application to ensure that the data used are the best available predictors of the expected costs of the intended application.**
- 3. Stratify data within a CER to reflect varying degrees of hardware complexity.**

**Benefit****Provides reliable cost estimates of certain SPS cost elements.**

---

**TITLE**

Comparative Analysis of Metallic and  
Composite Materials for SPS Related  
Large Space Structures

**ORGANIZATION**

Marshall Space Flight Center  
Marshall Space Flight Center, AL  
35812

---

**AMOUNT**

FY 78 \$20,000

**PRINCIPAL INVESTIGATOR**

S. Denton

---

**WORK LOCATION**

Vought Corporation  
Dallas, TX

**DURATION-AWARD DATA**

4 months - 5/1/78

**CONTRACT NO.**

NAS 8-33062

---

**PROJECT SUMMARY****Objective:**

Perform an independent comparative analysis and evaluation of metallic and composite materials, designs, and fabrication techniques for SPS related large space structures.

**Approach:**

1. Evaluate available data from previous SPS NASA and contractor efforts to identify typical material, design and fabrication concept approaches.
2. Identify the factors and methodologies employed to assess relative benefits and potential problems.

**Benefit:**

Independent evaluating of the relative benefits and risks of composite and metallic materials for SPS large space structures.



<b>TITLE</b>		<b>ORGANIZATION</b>
Economic Factors Relating to the Development and Implementation of the Satellite Power System		Marshall Space Flight Center Marshall Space Flight Center, AL 35812
<b>AMOUNT</b>	<b>PRINCIPAL INVESTIGATOR</b>	
FY 78 \$95,000	M. Page	
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
ECON, Inc. Princeton, N.J.	8 months - 4.1.78	NAS 8-33002

#### **PROJECT SUMMARY**

##### Objective

Investigate the effects that economic factors have on SPS Concept(s) selection.

##### Approach

1. Utilize the available methodologies and computer software previously developed.
2. Investigate the consideration of economic factors in the SPS System studies that relate to the selection of the SPS satellite configuration.
3. Perform an analysis to determine the proper rate of interest to use in SPS systems definition studies.
4. Investigate the impacts of differential inflation on SPS system definition casting procedures.
5. Investigate the impact of energy system evaluation methodologies on SPS system definition studies.
6. Investigate utility interface issues that could result on SPS system design impacts.

##### Benefit

Provides an overview as to the relationship between various economic evaluation methodologies and their impacts on SPS concept selection.

<b>TITLE</b> Electrostatic Protection of the Solar Power Satellite and the Rectenna		<b>ORGANIZATION</b> Marshall Space Flight Center Marshall Space Flight Center, AL 35812
<b>AMOUNT</b> FY 78 \$50,000		<b>PRINCIPAL INVESTIGATOR</b> W. Brantley
<b>WORK LOCATION</b> Rice University Houston, Texas	<b>DURATION-AWARD DATA</b> 6 months - 6.15.78	<b>CONTRACT NO.</b> NAS 8-33023

### **PROJECT SUMMARY**

#### Objective

Investigate the potential hazard that electrostatic charging presents to the satellite and the rectenna, and determine the implications on the reference SPS design.

#### Approach

1. Investigate the rectenna lightning hazard including:
  - . The nature and distribution of natural lightning.
  - . The reference rectenna design.
  - . The effectiveness of compatible lightning protection devices.
2. Investigate satellite electrostatic space charging hazard including:
  - . Areas on the satellite likely to receive high voltages and vulnerable to resulting arcs or breakdowns.
  - . The magnitude of the hazard in each area.
  - . Specific design changes to eliminate or reduce the hazard.

#### Benefit

Reduces potential hazard from electrostatic charges to the satellite and rectenna.

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**TITLE**

Accuracy Analysis of a Pointing Control  
System of a Satellite Power System

**ORGANIZATION**

Marshall Space Flight Center  
Marshall Space Flight Center, AL  
35812

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**AMOUNT**

FY 78 \$10,000

**PRINCIPAL INVESTIGATOR**

J. Howell

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**WORK LOCATION**

University of Tennessee  
Knoxville, TN

**DURATION-AWARD DATA**

6 months - 7/1/78

**CONTRACT NO.**

NAS 8-33065

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**PROJECT SUMMARY****Objective:**

Determine overall pointing accuracy, the resolution required for  
pilot beam sensors, and define control system requirements and  
constraints.

**Approach:**

1. Analyze the microwave beam pointing control subsystem and design a  
control command scheme with the command signal generated from (1)  
a single reference subarray at the center of the antenna and from  
(2) a multiple subarray distributed throughout the antenna.
2. Investigate and determine the microwave beam pointing accuracy and  
the effects of the following on accuracy:
  - o Mechanical gimbal accuracy.
  - o Resolution and sensitivity of pilot beam sensors.
  - o Phased array pointing accuracy.
  - o Structure alignment.
  - o Dynamic structural bending and frequency.
  - o Distortions in pilot and power beams.
3. Develop a set of control subsystem requirements and design constraints.

**Benefit:**

Systems affecting SPS microwave beam pointing accuracy and stability will  
be analyzed and a pointing control system will be designed.

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**TITLE**

Critique, Modify, Maintain Baseline  
System

**ORGANIZATION**

Johnson Space Center  
Houston, TX 77058

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**AMOUNT**

FY 78 \$293,000  
FY 79 \$ 19,000 (Est.)  
FY 80 TBD

**PRINCIPAL INVESTIGATOR**

Harold E. Benson

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**WORK LOCATION**

Boeing Aerospace Company  
Seattle, Washington

**DURATION-AWARD DATA**

16 months - 6/19/78

**CONTRACT NO.**

NAS 9-15636  
Task I

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**PROJECT SUMMARY**Objective:

Critique of and further investigations of the SPS baseline system concept including rationale and prioritization, to provide sufficient data inputs for the NASA/DOE preferred concept selection in April 1979 and final concept in October 1979.

Approach:

1. Subcontractors to perform an independent critique of the preliminary baseline system concept.
2. Typical activities of further investigation include: Investigation of smaller antennas (2½ - 3 GW range), solid state microwave generators, and definition of failure modes, rates and effects analysis. Analysis of the microwave beam and phase error buildup will be conducted to the tube level, and phase control support studies integrated into the SPS design.
3. This activity will be essentially completed during first 6 months of the study (Phase I).

Benefit:

Provides a critique of the SPS baseline concept and identifies those design features requiring further analysis. Develops a rationale for any proposed effort intended to result in a major system element design change. Critically analyzes SPS system elements including the criteria of reduced cost and/or weight and the reduction of risk and technology advancement.

TITLE		ORGANIZATION
Refine Space Construction and Maintenance Approach Construction Facilities		Johnson Space Center Houston, TX 77058
AMOUNT		PRINCIPAL INVESTIGATOR
FY 78 \$150,000		Harold E. Benson
FY 79 \$ 65,000 (Est.)		
FY 80 TBD		
WORK LOCATION	DURATION-AWARD DATA	CONTRACT NO.
Boeing Aerospace Company Seattle, Washington	16 months - 6/19/78	NAS 9-15636 Task II

### **PROJECT SUMMARY**

#### Objective:

To iterate and optimize construction and maintenance approach and investigate the possibility of reducing the size and complexity of the construction base and operations with a subsequent reduction in construction costs.

#### Approach:

##### 1. Satellite Construction

- o Critique baseline concept and analyze other innovative concepts
- o Analyze alternative concepts.

##### 2. Rectenna Construction

- o Analyze construction of rectenna from three design standpoints:
  - a. Automated construction equipment and techniques.
  - b. Cost impact of innovative structural modifications.
  - c. Structural analysis for alternative electronic approaches.

#### Benefit:

Identifies an alternative construction concept. Provides the design analysis of the construction base. Develops an approach for automated construction of rectenna, the maintenance requirements for the satellite and rectenna, and the space maintenance requirements for construction and transportation systems.

TITLE		ORGANIZATION
Define Industrial and Earth Transportation Complex		Johnson Space Center Houston, TX 77058
AMOUNT		PRINCIPAL INVESTIGATOR
FY 78 \$18,000		Harold E. Benson
FY 79 \$36,000 (Est.)		
FY 80 TBD		
WORK LOCATION	DURATION-AWARD DATA	CONTRACT NO.
Boeing Aerospace Company Seattle, Washington	16 months - 6/19/78	NAS 9-15636 Task III

### PROJECT SUMMARY

#### Objective:

To define the industrial and earth-based transportation requirements imposed on the United States.

#### Approach:

1. Select areas of production capacity issues.
2. Review and select candidate solar cell process.
3. Provide inputs for launch vehicle, structural and propellant manufacturer.
4. Update, review and analyze production flow concept.
5. Identify potential transportation problems.

#### Benefit:

Identifies new production capacity requirements, size and type of major factories, equipment, personnel and resources, potential transportation problems, facility costs and personnel, and packaging concepts.

TITLE		ORGANIZATION
Conduct Launch Site Location Analysis and Complex Definition		Johnson Space Center Houston, TX 77058
AMOUNT		PRINCIPAL INVESTIGATOR
FY 78 \$23,000		Harold E. Benson
FY 79 \$57,000 (Est.)		
FY 80 TBD		
WORK LOCATION	DURATION-AWARD DATA	CONTRACT NO.
Boeing Aerospace Company Seattle, Washington	16 months - 6/19/78	NAS 9-15636 Task IV

### PROJECT SUMMARY

#### Objective:

To define the potential launch complex for increased launch activity and the funding requirements for the facilities, equipment and staff to support the required traffic.

#### Approach:

1. Collate compatible launch vehicle and site options.
2. Conduct trade studies between space transportation rates, possible environmental impacts versus ground logistics and other impacts.
3. Analyze off-shore and on-shore launch and recovery sites for various vehicles and relative costs and problems of several approaches.

#### Benefit:

Provides parametric data of launch site options. Recommends preferred launch site latitude. Identifies emissions from a trajectory analysis. Defines the launch complex, personnel and funding requirements.

<b>TITLE</b> Define and Analyze Operational Activity from Manufacturing Through Space Construction		<b>ORGANIZATION</b> Johnson Space Center Houston, TX 77058
<b>AMOUNT</b> FY 78 \$ 16,000 FY 79 \$140,000 (Est.) FY 80 TBD		<b>PRINCIPAL INVESTIGATOR</b> Harold E. Benson
<b>WORK LOCATION</b> Boeing Aerospace Company Seattle, Washington	<b>DURATION-AWARD DATA</b> 16 months - 6/19/78	<b>CONTRACT NO.</b> NAS 9-15636 Task V

### **PROJECT SUMMARY**

#### Objective:

To define the flow and flow rates of raw materials, components, sub-assemblies and assemblies from source to launch site to the construction site.

#### Approach:

1. Develop payload packaging concepts.
2. Analyze program elements for options of system operations (i.e., control of flights from central mission control, a LEO construction, a GEO construction base, or some other alternative).
3. Define physical interfaces between program elements and manpower and computational requirements for each of the control centers.
4. Summarize all operations defined in other sections of the study.

#### Benefit:

Provides a description of the concise end-to-end operations as well as the continuity of launch and recovery site operations. Integrates the space logistics and defines the ground flow, LEO transportation and rectenna hardware.



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**TITLE**

Analyze Integration of SPS with  
Ground Networks

**ORGANIZATION**

Houston Space Center  
Houston, TX 77058

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**AMOUNT**

FY 78 \$14,000  
FY 79 \$93,000 (Est.)  
FY 80 TBD

**PRINCIPAL INVESTIGATOR**

Harold E. Benson

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**WORK LOCATION**

Boeing Aerospace Company  
Seattle, Washington

**DURATION-AWARD DATA**

16 months - 6/19/78

**CONTRACT NO.**

NAS 9-15636  
Task VI

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**PROJECT SUMMARY**Objective:

To achieve data base of requirements and considerations involved in constructing a rectenna in any location.

Approach:

1. Prepare information package and solicit utility inputs.
2. Estimate environmental (latitude) variables.
3. Define land requirements.
4. Develop site selection criteria.
5. Perform rectenna-grid interconnects and operating systems analysis.
6. Analyze SPS-grid operations.

Benefit:

Provides a data base for the requirements and alternatives before reaching a decision involved in constructing a rectenna in any location with emphasis on sensitivities associated with the total range of variables inherent in a wide range of geographical locations and classes of terrain. Develops a design criteria for various elements of the rectenna, established in order to relate to cost of construction in any location. Assesses utility grid connections and operations.

<b>TITLE</b> Prepare Technology Advancement, Development, and Facility Requirements and Plans		<b>ORGANIZATION</b>  Johnson Space Center Houston, TX 77058
<b>AMOUNT</b> FY 78 \$35,000 FY 79 \$60,000 (Est.) FY 80 TBD		<b>PRINCIPAL INVESTIGATOR</b>  Harold E. Benson
<b>WORK LOCATION</b> Boeing Aerospace Company Seattle, Washington	<b>DURATION-AWARD DATA</b>  16 months - 6/19/78	<b>CONTRACT NO.</b> NAS 9-15636 Task VII

### **PROJECT SUMMARY**

#### Objective:

To develop a conceptual plan outlining the technology activities required for implementation of an SPS program.

#### Approach:

1. Update, circulate for comments, and revise technology advancements requirements.
2. Develop initial estimate of ground-based program.
3. Develop initial estimate of shuttle flight experiments.
4. Analyze flight project and initial commercial SPS options.
5. Input technology advancement and development requirements for space construction, rectenna and avionics.
6. Develop initial overall development approach.

#### Benefit:

Advances technology and develops a schedule and cost plan for laboratory and earth-based development and testing, shuttle flight experiment and equipment, flight projects, SPS commercial development, and facility development requirements.

TITLE		ORGANIZATION
Cost Analysis and Schedule Analysis		Johnson Space Center Houston, TX 77058
AMOUNT		PRINCIPAL INVESTIGATOR
FY 78 \$ 6,000		Harold E. Benson
FY 79 \$55,000 (Est.)		
FY 80 TBD		
WORK LOCATION	DURATION-AWARD DATA	CONTRACT NO.
Boeing Aerospace Company Seattle, Washington	16 months - 6/19/78	NAS 9-15636 Task VIII

### **PROJECT SUMMARY**

#### Objective:

To provide an updated system cost estimate to reflect system changes and support the system definition document update.

#### Approach:

1. Update work breakdown structure.
2. Update costs for space construction.
3. Estimate costs for avionics.
4. Integrate and update baseline costs.
5. Update launch site costs.
6. Automate schedule analyses and development costs.

#### Benefit:

Incorporates SPS costs in WBS format. Develops an SPS program plan with options, examines the program critical path, and assesses cost/risks to provide for key decision points.

TITLE		ORGANIZATION
Support Studies: SPS Phase Control Definition		Johnson Space Center Houston, TX 77058
AMOUNT		PRINCIPAL INVESTIGATOR
FY 78 \$ 70,000		J. W. Seyl
FY 79 \$125,000 (Est.)		
FY 80 TBD		
WORK LOCATION	DURATION-AWARD DATA	CONTRACT NO.
LinCom Corporation Pasadena, CA	8 months - 3/31/78	NAS 9-15237

### **PROJECT SUMMARY**

#### Objective:

To provide further definition for the baseline phase control system design.

#### Approach:

1. Continue development of pilot signaling techniques to alleviate beam squint.
2. Define reference phase distribution system to sufficient level for investigation of:
  - o Power up algorithm and system stability.
  - o Survivability - graceful degradation.
  - o System configuration.
3. Quantify media and mechanical alignment accuracy effects.
4. Define power amplifier phase control requirements.
5. Modeling of overall SPS MW system power transmission efficiency.
6. Analysis and modeling of power transponder performance characteristics.
7. Pilot signal detailed analysis.
8. Ground-based safety (monitoring) system conceptual design.
9. Provide values of SPS transmission efficiency loss contributors.

#### Benefit:

Develops the design of the baseline system required for computer simulation. Simulates through analysis the baseline phase control system. Provides a tradeoff/optimization study of the baseline phase control system. Performs a final system sensitivity analysis.

<b>TITLE</b>		<b>ORGANIZATION</b>
Support Studies: Analysis of S-Band Solid State Transmitter		Johnson Space Center Houston, TX 77058
<b>AMOUNT</b>	<b>PRINCIPAL INVESTIGATOR</b>	
FY 78 \$30,000	L. Leopold	
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
RCA/David Sarnoff Research Center Princeton, NJ	6 months - 12/78	TBD

### **PROJECT SUMMARY**

#### Objective:

Determine the applicability of solid-state technology to the SPS microwave transmitter by conducting studies emphasizing fundamental tradeoffs and concepts and establish technical feasibility of utilizing solid-state amplifiers such as current gallium arsenide devices.

#### Approach:

1. Conduct concept and feasibility investigations, tradeoff studies.
2. Analyze a minimum of two alternative approaches or concepts for the field effect transistors (FET).
3. Perform analysis by assuming a single-stage distributed circuit FET amplifier demonstrating a minimum of 1.4 W of output RF power at 80% efficiency and a module gain of 30 dB.
4. Perform study by assuming a gallium-arsenide lumped-element amplifier with power added efficiency of 80%.

#### Benefit:

Provides a summary of tradeoff exercise parameters and conclusions. Lists the guidelines aimed at yielding designs compatible with projected space applications.

**ENVIRONMENTAL  
ASSESSMENT STUDIES  
FY 1978**

TITLE		ORGANIZATION
Planning and Analysis and Management Support		Argonne National Laboratory Washington, D.C., office
AMOUNT		PRINCIPAL INVESTIGATOR
FY 78	\$214,000	Carl A. Sandahl
FY 79	TBD	
WORK LOCATION	DURATION-AWARD DATA	CONTRACT NO.
Washington, D.C.	18 months - Sept. 1977	189-ANL49576

## PROJECT SUMMARY

### Objective

Provides management support to the Director of the SPSPO in planning and analysis functions.

### Approach

1. Provide qualified support personnel and locate office in vicinity of the SPSPO, Washington, D.C. to advise and support the SPSPO, in technical and administrative functions.
2. Utilize contractor personnel to perform specific planning and evaluation studies.
3. Utilize contractor and ANL personnel to provide a report and information storage retrieval, and distribution system.

### Benefit

1. Provides for continuing project management support in planning and analysis functions, administers fluctuating work loads, and administers specific technical functions.

<b>TITLE</b> Assessment of SPS Microwave Radiation on the Rectenna Site Ecology		<b>ORGANIZATION</b> Argonne National Laboratory 9700 South Cass Avenue Argonne, IL. 60439
<b>AMOUNT</b> \$40,000	<b>PRINCIPAL INVESTIGATOR</b> S. Ballou	
<b>WORK LOCATION</b> Argonne, IL.	<b>DURATION-AWARD DATA</b> 8 months-- April 1, 1978	<b>CONTRACT NO.</b> 189-ANL49576

### PROJECT SUMMARY

#### Objective:

Identify ecological issues for specific selected rectenna sites, evaluate impact of microwave radiation on ecological processes, and identify critical ecological research needs.

#### Approach:

1. Identify ecological issues associated with the design and concept of microwave reception.
2. Characterize estimated ecological responses.
3. Identify specific rectenna sites and characterize ecological issues associated with each site.
4. Define research requirements and establish priorities.
5. Develop research protocols.

#### Benefits:

1. Identification of critical research needs, for program implementation, and establishment of a data base for final ecological assessment.



<b>TITLE</b>		<b>ORGANIZATION</b>
Assessment of SPS Rectenna Construction and Operation Impact Upon the Rectenna Site Ecology		Argonne National Laboratory 9700 South Cass Avenue Argonne, IL. 60439
<b>AMOUNT</b>	<b>PRINCIPAL INVESTIGATOR</b>	
\$40,000	S. Ballou	
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
Argonne, IL.	8 months- April 1, 1978	189-ANL49576

### PROJECT SUMMARY

#### Objective:

Evaluate the impact of rectenna construction and operation on ecosystems, and identify critical ecological research needs.

#### Approach:

1. Identify ecological issues associated with rectenna design and construction alternatives.
2. Characterize estimated ecological responses resulting from rectenna construction and operation.
3. Identify specific rectenna sites.
4. Identify and characterize ecological issues associated with each site.
5. Identify alternative sites for minimizing ecological impacts.
6. Define research requirements and establish priorities.
7. Develop research protocols.

#### Benefit:

Identification of research needs, implementation of research program, and establishment of a data base required for final assessment.

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**TITLE**

Qualitative Assessment of Inadvertent  
Weather Effects of SPS Rocket Launches  
in Troposphere

**ORGANIZATION**

Argonne National Laboratory  
9700 Cass Avenue  
Argonne, IL 60439

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**AMOUNT**

\$10,000

**PRINCIPAL INVESTIGATOR**

J. Lee

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**WORK LOCATION**

Argonne, IL

**DURATION-AWARD DATA**

4 months - 6/78

**CONTRACT NO.**

189-ANL49576

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**PROJECT SUMMARY**Objective:

Assess potential inadvertent weather effects resulting from thermal energy and water substance release into the troposphere during single and multiple HLLV Launches.

Approach:

1. Obtain estimates of thermal energy and water release during launches from SAI.
2. Estimate potential for inadvertent weather effects using existing cloud modelling techniques and estimates of thermal energy and water release into the troposphere during rocket launches.
3. Compare water vapor flux of rocket cloud formation with the vapor fluxes into various cumuli and cumulonimbus clouds.
4. Perform a trial simulation of cloud formation and the associated precipitation using an existing one-dimension cloud model under specific meteorological conditions.
5. Review existing cloud models and select a candidate most suitable for future studies if warranted.
6. Prepare a preliminary list of issues and qualitatively assess their environmental impacts.

Benefit:

Assesses potential of ground cloud formation and the associated precipitation due to rocket launches. Data generated will provide input to rocket exhaust synergistic effects study.

<b>TITLE</b>		<b>ORGANIZATION</b>
Preliminary Assessment of Effects of Rocket Effluents in Stratosphere		Argonne National Laboratory 9700 South Cass Avenue Argonne, ILL. 60439
<b>AMOUNT</b>	<b>PRINCIPAL INVESTIGATOR</b>	
\$40,500	K. Brubaker	
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
Argonne, ILL.	6 months- April 1, 1978	189-ANL49576

### PROJECT SUMMARY

#### Objective:

Prepare a preliminary assessment of the effects of rocket propellants emitted into the stratosphere and their probable impacts.

#### Approach:

1. A review of literature and modeling approaches to predict the effects of pollutant emissions on stratospheric composition was performed.
2. The current state of knowledge regarding effects of rocket effluents in the stratosphere, including Oz (ozone) depletion, changes in high altitude cloud patterns, etc. was prepared.
3. Review currently available observational data on stratospheric composition and assess the effects of pollutant emissions, based on observable data.
4. Organize a workshop to review program and workplan, identify other issues of potential importance, and recommend additional research.
5. Prepare preliminary assessment of the effects of rocket exhaust emissions and their probable impacts, and circulate.

#### Benefits:

Provides a preliminary assessment of the possible stratospheric effects of rocket exhaust emissions. This information will be utilized in the assessment of public health and welfare impacts, climatic impacts, and will serve as an input to the formulation of guidelines for launch operations. Issues requiring further investigation and new research priorities will be identified.

<b>TITLE</b>		<b>ORGANIZATION</b>
Quality Assurance of Microwave Health and Safety Research		Argonne National Laboratory 9700 South Cass Avenue Argonne, IL 60499
<b>AMOUNT</b>	<b>PRINCIPAL INVESTIGATOR</b>	
TBD*	S. Halverson	
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
TBD*	TBD*	189-ANL49576

# **PROJECT SUMMARY**

\* RFQ to be released no later than October 30, 1978

## Objective:

Assures that the quality of the physical research facilities and operations in a program evaluating the health and safety aspects of microwave power transmission is at the present state-of-the-art.

## Approach:

1. Visit the various research laboratories involved in various aspects of the SPS bioeffects research program.
2. Make periodic qualitative and quantitative reviews of the quality control program at each research laboratory.
3. Provide guidance as necessary to each contractor to assure optimum laboratory performance.

## Benefit:

Assures the quality of the microwave health and safety research program.

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**TITLE**

Dependence of Microwave Biological  
Effects on Field Complexity

**ORGANIZATION**

Argonne National Laboratory  
9700 South Cass Avenue  
Argonne, IL 60499

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**AMOUNT**

\*TBD

**PRINCIPAL INVESTIGATOR**

S. Halverson

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**WORK LOCATION**

\*TBD

**DURATION-AWARD DATA**

\*TBD

**CONTRACT NO.**

189-ANL49576

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**PROJECT SUMMARY**

\*RFQ to be released no later than October 30, 1978

**Objective:**

Assess the effects of the exposure system on known microwave biological effects.

**Approach:**

1. Determine thresholds for unipath and multipath irradiation systems for:
  - a. microwave-induced febrile convulsions
  - b. microwave-altered responses to physically or chemically-induced systems
  - c. microwave-induced work stoppage
  - d. sensory detection of the microwave field.
2. Experiments may be performed at power densities greater than that produced by the SPS microwave field and at frequencies which produce whole and partial body resonances.
3. Assist in interpreting existing literature.
4. Assist in the definition of exposure parameters for future experiments.

**Benefit:**

Provides a method for correlating effects obtained at low microwave intensities that use different exposure systems.

<b>TITLE</b>		<b>ORGANIZATION</b>
Response of Airborne Biota to Microwave Transmission		Argonne National Laboratory 9700 South Cass Avenue Argonne, IL 60499
<b>AMOUNT</b>	<b>PRINCIPAL INVESTIGATOR</b>	
*TBD	S. Halverson	
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
*TBD	*TBD	189-ANL49576

#### **PROJECT SUMMARY**

\*RFQ to be released no later than October 30, 1978

##### Objective:

Evaluate the effects of the SPS microwave beam on airborne biota, especially birds.

##### Approach:

1. Perform wind-tunnel experiments on small flying birds, such as passerines and larger birds such as ducks and geese to determine lethal and sublethal responses.
2. Perform navigational experiments with birds such as homing pigeons or migratory birds to determine whether microwaves interfere with navigational abilities.
3. Determine behavioral response of birds exposed to microwaves under a variety of ambient conditions.

##### Benefit:

Determines whether the added heat load of microwaves will be detrimental to birds flying through the beam under a variety of environmental conditions. Also, determines whether the microwave beam will have any effects on birds' navigation systems. Assesses effects of microwave radiation on bird behavior and determines attraction to or avoidance of the rectenna site.

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**TITLE**

Teratogenic Effects of Microwave  
Power Transmission

**ORGANIZATION**

Argonne National Laboratory  
9700 South Cass Avenue  
Argonne, IL 60499

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**AMOUNT**

\*TBD

**PRINCIPAL INVESTIGATOR**

S. Halverson

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**WORK LOCATION**

\*TBD

**DURATION-AWARD DATA**

\*TBD

**CONTRACT NO.**

189-ANL49576

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**PROJECT SUMMARY**

\*RFQ to be released no later than October 30, 1978

**Objective:**

Determine whether continuous wave 2,450 MHz microwave radiation is  
teratogenic or embryopathic in mice.

**Approach:**

1. Establish experiment that includes the following:

- a. Expose mice at 5 power densities (0.1, 0, 10 and 30)  $\text{mW/cm}^2$ .
- b. Exposure in a uniform  $\pm .5$  (dB) far-field of a plane wave.  
Whole body SAR are to be obtained on representative-sized  
animal.
- c. Animals will be exposed on the dorsal surface in an anechoic  
chamber, an environmental conditions of  $21^{\circ}$  to  $24^{\circ}\text{C}$  and 40-60%  
relative humidity.
- d. Duration of exposure is daily from 1, post breeding through  
day 18.

**Benefit:**

Determines teratogenic and/or embryopathic effects of microwave radiation  
on mice.

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**TITLE**

Effects of Microwave Power Transmission  
on the Nervous System

**ORGANIZATION**

Argonne National Laboratory  
9700 South Cass Avenue  
Argonne, IL 60499

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**AMOUNT**

\*TBD

**PRINCIPAL INVESTIGATOR**

S. Halverson

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**WORK LOCATION**

\*TBD

**DURATION-AWARD DATA**

\*TBD

**CONTRACT NO.**

189-ANL49576

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**PROJECT SUMMARY**

\*RFQ to be released no later than October 30, 1978

Objective:

Determine the effects of microwave radiation on the nervous system  
of experimental animals at microwave radiation densities below 10 mW/cm<sup>2</sup>.

Approach:

1. Investigate structural and functional changes in the nervous system  
associated with microwave radiation (for 2,450 MHz continuous wave  
radiation having power densities of 0.1 to 25 mW/cm<sup>2</sup>).
2. Explore time dependence of potential structural and functional changes.

Benefit:

Will determine qualitative and quantitative gross histochemical and  
electrophysical changes in the nervous systems of animals exposed to  
SPS-specific radiation.



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**TITLE**

Immunological/Hematological Effects  
of Microwave Beam Transmission

**ORGANIZATION**

Argonne National Laboratory  
9700 South Cass Avenue  
Argonne, IL 60499

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**AMOUNT**

\*TBD

**PRINCIPAL INVESTIGATOR**

S. Halverson

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**WORK LOCATION**

\*TBD

**DURATION-AWARD DATA**

\*TBD

**CONTRACT NO.**

189-ANL49576

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**PROJECT SUMMARY**

\*RFQ to be released no later than October 30, 1978

**Objective:**

Determine whether previous studies of microwave immunological systems effects are reproducible, and if reproducible, whether immunological competence of the animal is impaired.

**Approach:**

1. Determine the threshold of microwave immunological/hematological system effects by following the procedures of Wictor-Jedrzejczak, et al., as well as by using a free-field exposure system.
2. If appropriate, employ infectivity/disease models (i.e., bacteria, virus, tumor) to assess the effect of 2,450 MHz microwave radiation on immunocompetence of exposed animals.
3. Perform an interspecies comparison of microwave effects.

**Benefit:**

Confirms results of previous immune effects studies and determines whether immunocompetence of animals (mice) is impaired.

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**TITLE**

Perturbations in Behavior Resulting from  
the Interaction of Drugs with SPS Microwave  
Radiation

**ORGANIZATION**

Argonne National Laboratory  
9700 South Cass Avenue  
Argonne, IL 60499

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**AMOUNT**

\*TBD

**PRINCIPAL INVESTIGATOR**

S. Halverson

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**WORK LOCATION**

\*TBD

**DURATION-AWARD DATA**

\*TBD

**CONTRACT NO.**

189-ANL49576

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**PROJECT SUMMARY**

\*RFQ to be released no later than October 30, 1978

Objective:

Identify and evaluate main beam powered densities within a controlled exclusion zone at a rectenna site. Evaluate low level microwave exposure to the general public and ecology outside the controlled area from scatter from the main beam, side lobe radiation and antenna reradiation.

Approach:

1. Validate prior experiments indicating exposures as low as  $1\text{mW/cm}^2$  have resulted in behavior perturbations in rodents.
2. Evaluate acute and chronic effects of microwaves appropriate to the SPS (2,450 MHz CW) on operant behavior using small laboratory animals that have been acutely or chronically dosed with several classes of widely used drugs.
3. Assess perturbation of stable baseline operant performance during the microwave exposure regimen.
4. Establish degree of persistence of effects after termination of dosing by microwaves and drugs.

Benefit:

Will obtain results of potentially serious consequence of drug-microwaves synergism which would be useful in assessing the health impact of SPS. Will also obtain data on dose-response relationships useful for determining the threshold of drug-radiation interaction.

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**TITLE** Preliminary Identification of Effects of Rocket Effluents in Upper Atmosphere, of Research Needs and Preliminary Assessment of Impacts

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**ORGANIZATION**

Argonne National Laboratory  
9700 South Cass Avenue  
Argonne, IL 60439

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**AMOUNT**

\$115,500

**PRINCIPAL INVESTIGATOR**

M. Mendillo\*  
D. Rote

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**WORK LOCATION**

Argonne, IL  
Boston, MA

**DURATION-AWARD DATA**

6 months - 4/1/78

**CONTRACT NO.**

189-ANL49576

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**PROJECT SUMMARY**

Objective:

Summarize current state of knowledge, and identify the effects of Rocket Effluents in the upper atmosphere and assess the impacts. Identify information and analytical technique requirements and recommend research priorities.

Approach:

The following tasks are required to achieve the stated objective:

1. Present state-of-knowledge regarding upper atmospheric effects of rocket effluents (ionospheric modifications) is assessed, through a critical review of experimental and theoretical investigations.
2. Evaluate NASA space lab experiments and recommend any additional measurements that would be required.
3. Use LAGOPEDO data to simulate multiple launch effects on the upper atmosphere. Evaluate the need for a more refined model.
4. Organize workshop on possible climatic/weather modification mechanisms and impacts on rocket effluents in atmosphere.
5. Investigate possible effects of ion-engine propellants used for inter-orbit vehicles.
6. Organize in-depth workshop to identify known or predicted effects, characterize existing basis for predicting effects, and determine additional information requirements.
7. Prepare preliminary assessment of Rocket Effluents Impacts in the Upper Atmosphere.

Benefit:

Provides data base and preliminary impact analysis on upper atmosphere. Serves as basis for determination of additional research that may be required.

\*M. Mendillo of Boston University, Consultant to ANL.

<b>TITLE</b> Preliminary Identification of Possible Issues and Impacts of Rectenna Operations		<b>ORGANIZATION</b> Argonne National Laboratory 9700 South Cass Avenue Argonne, Illinois 60439
<b>AMOUNT</b> \$38,000	<b>PRINCIPAL INVESTIGATOR</b> J. Lee/T. Yamada/ H.D. Orville*	
<b>WORK LOCATION</b> Argonne, IL. Rapid City, SD	<b>DURATION-AWARD DATA</b> 6 months- April 1, 1978	<b>CONTRACT NO.</b> 189-ANL49576

#### PROJECT SUMMARY

##### Objective:

Qualitatively assess the atmospheric effects of rectenna operations and their impacts on climate and weather in order to provide inputs to the analysis of microwave propagation.

##### Approach:

This project required the following tasks:

1. Perform literature review
2. Planetary boundary layer and convective cloud modeling will be used to analyze atmospheric effects of rectenna operations.
3. Trial simulation using a 3-D model under specific rectenna configuration and atmospheric conditions will be performed.
4. Investigate the possibility of generating an organized convective flow in the vicinity of the rectenna site and the consequences, using a 2-D modeling approach.
5. Organize a workshop to identify other issues of potential importance, and recommend additional research.
6. Prepare a preliminary assessment of impacts.

##### Benefits:

Provides a preliminary assessment of the potential atmospheric effects of rectenna operations. This assessment will form the basis for rectenna design and site selection guidelines, and will serve as input to the assessment of public health and welfare impacts, and microwave propagation impacts. Issues requiring further research will be identified.

\*H. D. Orville of South Dakota School of Mines and Technology, Consultant to ANL.

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**TITLE** SPS Microwave Radiation Effects on  
Ionosphere, Magnetosphere, and Local Field  
Intensity, Program Management Distributions

**ORGANIZATION** Department of Commerce  
Institute of Telecommunication  
Sciences  
Boulder, Colorado 80302

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**AMOUNT**  
\$25,000

**PRINCIPAL INVESTIGATOR**  
C. Rush

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**WORK LOCATION**

Boulder, CO.

**DURATION-AWARD DATA**

8 months - 4/1/78

**CONTRACT NO.**

Interagency Agreement  
No. E-(49-26)-1041

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**PROJECT SUMMARY**

Objective:

Provide Program Management and Support for Studies to determine SPS Microwave radiation effects on the magnetosphere and ionosphere and on local field intensities at or near the surface of the earth.

Approach:

1. Review existing study program.
2. Provide detailed statements of work, research proposals, data and contractual documents, as required.
3. Act as liaison between DOE and research subcontractors.
4. Coordinate research program with information required by DOE, EA, SA and CA Program NASA, and NASA Systems Definition Program.

Benefit:

Provides a coordinated effort by qualified specialists on microwave effects on the atmosphere, and provides reports and data set for preliminary Environmental Impact Statement. This information will be used as an input to Societal and Comparative Assessments.

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**TITLE**  
SPS Electromagnetic Compatibility  
Assessment, Overview Committee

**ORGANIZATION** Department of Commerce  
Institute of Telecommunication  
Sciences  
Boulder, Colorado 80302

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**AMOUNT**  
\$40,000

**PRINCIPAL INVESTIGATOR**  
C. Rush  
W. F. Utlaut

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**WORK LOCATION**  
Boulder, CO

**DURATION-AWARD DATA**  
8 months - 4/1/78

**CONTRACT NO.**  
Interagency Agreement  
No. E-(49-26)-1041

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**PROJECT SUMMARY**

Objective:

Establishes research programs that will result in understanding effects of ionospheric and magnetospheric heating on communications systems.

Approach:

1. Establish overview committee to review and prioritize proposed research.
2. Develops research methodologies for ionospheric/magnetospheric heating and other experiments to identify and assess EMC of the SPS.

Benefit:

Qualified specialists coordinate EMC Research efforts with the DOE Environmental Assessment Program Plan and NASA Systems Definition Program Plan requirements.

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**TITLE**

SPS Microwave Radiation, Energy  
Storage in Vehicles and Habitable  
Structures

**ORGANIZATION**

Dept. of Commerce  
Institute of Telecommunications  
Sciences, Boulder, CO 80302

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**AMOUNT**

\$20,000

**PRINCIPAL INVESTIGATOR**

TBD

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**WORK LOCATION**

Boulder, CO

**DURATION-AWARD DATA**

8 mos. - 4.1.78

**CONTRACT NO.**

Interagency Agreement No.  
E-(49-26)-1041

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**PROJECT SUMMARY**

Identify and quantify microwave energy storage in habitable structures and vehicles. Quantify increase in local field intensity due to energy storage.

**Approach**

Utilizing analytical or experimental methods, determines any increases in local field intensities caused by energy storage in habitable structures or vehicles, for peak and average power density values from the SPS microwave beam at the rectenna site.

**Benefit**

Quantifies microwave energy storage in habitable structures and vehicles. This data will provide useful information to estimate effects on electromagnetically sensitive systems in the rectenna site vicinity, and (2) for the microwave Health and Safety Impact assessment.

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**TITLE**

SPS Electromagnetic Interference  
(EMI) Effects

**ORGANIZATION**

Department of Commerce  
Institute of Telecommunications  
Sciences, Boulder, CO 80302

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**AMOUNT**

\$65,000

**PRINCIPAL INVESTIGATOR**

W. Grant

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**WORK LOCATION**

Boulder, CO.

**DURATION-AWARD DATA**

8 mos. - 4.1.78

**CONTRACT NO.**

Interagency Agreement No.  
E-(49-26)-1041

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**PROJECT SUMMARY**Objective

Predict interference effects on electromagnetic systems and devices not intended to receive radio signals.

Approach

1. Identify critical and non-critical equipment that

predict potential effects on systems within the rectenna exclusion area;

predict effects on critical systems outside the rectenna exclusion zone.

Benefit

Provides an assessment of potential range of EMI effects, and identifies systems that could be effected.



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**TITLE**

SPS Radiofrequency Interference  
(RFI) Effects

**ORGANIZATION**

Department of Commerce  
Institute of Telecommunications  
Sciences, Boulder, CO

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**AMOUNT**

\$84,000

**PRINCIPAL INVESTIGATOR**

W. Grant

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**WORK LOCATION**

Boulder, CO

**DURATION-AWARD DATA**

8 mos. - 4.1.78

**CONTRACT NO.**

Interagency Agreement  
No. E-(49-26)-1041

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**PROJECT SUMMARY**Objective

Predicts effects on systems and devices not intended to receive SPS microwave radiofrequency signals.

Approach

1. Identify sensitive systems.
2. Quantify system performance degradation at SPS Radiofrequencies.
3. Estimate the probability of coupling prohibitive amounts of energy to the systems.

Benefit

Assesses the probability and potential of unacceptable radiofrequency interference effects caused by the SPS.

<b>TITLE</b>		<b>ORGANIZATION</b>
SPS Microwave Radiation Interactive Effects on Magnetosphere and Ionosphere		Dept. of Commerce, Institute of Telecommunications Sciences Boulder, CO 80302
<b>AMOUNT</b>	<b>PRINCIPAL INVESTIGATOR</b>	
\$30,000	C. Rush/NOAA	
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
Boulder, CO	8 mos. - 4.1.78	Interagency Agreement No. E- (49-26)-1041

## PROJECT SUMMARY

### Objective

Characterize the expected effects of SPS Microwave radiation on the EM scattering properties of the magnetosphere and ionosphere.

### Approach

1. Obtain data on realistic model from atmospheric impact assessment.
2. Using realistic models of the ionosphere and magnetosphere, predict microwave beam interactive effects.

### Benefit

Refines early predictions of SPS microwave beam interactions with the ionosphere and magnetosphere, perturbed by SPS vehicular emissions.

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**TITLE**

SPS Geographic Distribution of  
Field Intensities

**ORGANIZATION**

Department of Commerce  
Institute of Telecommunication Sciences  
Boulder, Colorado 80302

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**AMOUNT**

\$38,000

**PRINCIPAL INVESTIGATOR**

W. Grant

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**WORK LOCATION**

Boulder, Colorado

**DURATION-AWARD DATA**

8 months - 4/1/78

**CONTRACT NO.**

Interagency Agreement  
E(49-26)-1041

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**PROJECT SUMMARY**Objective:

Quantify geographic power distribution for entire SPS system.

Approach:

1. Obtain information from NASA SPS Systems Definition on MPTS radiation characteristics for a single SPS system, GEO locations for the total multi-station system and frequency-intensity spectrum.
2. Predict the field strengths expected at and near the surface of the earth from SPS microwave beam emissions.

Benefit:

Provides a determination of peak and average field strengths as a function of RF and geographic location. This information will support Health and Safety and Communication Impact assessments.

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**TITLE**

Microwave Exposure Chambers for  
Assessment of Public Health Impacts

**ORGANIZATION**

Environmental Protection Agency  
Environmental Research Center  
Research Triangle Park, NC 27711

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**AMOUNT**

\$100,000

**PRINCIPAL INVESTIGATOR**

J. S. Ali  
C. Weil

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**WORK LOCATION**

Research Triangle Park,  
NC

**DURATION-AWARD DATA**

8 months - 4/1/78

**CONTRACT NO.**

Interagency Agreement  
No. EP-78-I-01-3170

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**PROJECT SUMMARY****Objective:**

Expand EPA 2450 MHz animal exposure system facility.

**Approach:**

Expand facility, including:

1. A 1KW generator with continuous wave, pulsed, and amplitude modulated modes of operation and power level control.
2. A free-field irradiation anechoic chamber with temperature, humidity and light control.
3. Linear and circularly polarized, waveguide exposure cells.
4. Orthogonal field probes.

**Benefit:**

Increased capacity to study in-vivo exposure to 2,450 MHz radiation.

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**TITLE**

SPS Microwave Impacts on Public Health  
and Safety Overview Committee

**ORGANIZATION**

Environmental Protection Agency  
Environmental Research Center  
Research Triangle Park, NC 27711

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**AMOUNT**

\$40,000

**PRINCIPAL INVESTIGATOR**

D. Cahill

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**WORK LOCATION**

Research Triangle Park  
NC

**DURATION-AWARD DATA**

8 months - 4/1/78

**CONTRACT NO.**

EP-78-I-01-3170

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**PROJECT SUMMARY****Objective:**

To establish research programs that lead to an understanding of direct and indirect effects of SPS microwave radiation on the public and provide continuing program guidance.

**Approach:**

The following tasks were required to achieve the stated objective:

1. Establish overview committee and organize meetings to review and prioritize proposed research.
2. Develop research protocols for short-term and long-term microwave research.
3. Characterize directly and indirectly hazardous, and potentially hazardous effects on man.

**Benefit:**

Qualified specialists will coordinate the Microwave Impact study effort with the Concept Definition Plan and Environmental Impact Assessment.

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**TITLE**

SPS Microwave Impacts on Public Health  
and Safety Program Coordination and  
Guidance

**ORGANIZATION**

Environmental Protection Agency  
Environmental Research Center  
Research Triangle Park, NC 27711

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**AMOUNT**

FY 78 \$25,000

**PRINCIPAL INVESTIGATOR**

D. Cahill

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**WORK LOCATION**

Research Triangle Park  
NC

**DURATION-AWARD DATA**

8 months - 4/1/78

**CONTRACT NO.**

EP-78-I-01-3170

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**PROJECT SUMMARY**Objective:

Coordinate and guide WBS subtask efforts to determine SPS microwave radiation effects.

Approach:

1. Review DOE/ANL work breakdown structure (WBS) for task I.3.
2. Provide detailed statements of work, work breakdown structures, research proposals, data and other contractual documents required by DOE/ANL.
3. Coordinate program plans with needs and goals of DOE/ANL environmental impact assessment and NASA SPS conceptual development plan.

Benefit:

Provide reports and data for preliminary environmental impact assessment.

<b>TITLE</b> SPS Non-Microwave Impacts on Space Worker Health and Safety Program and Guidance		<b>ORGANIZATION</b> Lawrence Berkeley Lab Berkeley, CA
<b>AMOUNT</b> \$43,000	<b>PRINCIPAL INVESTIGATOR</b> M. White	
<b>WORK LOCATION</b> Berkeley, CA	<b>DURATION-AWARD DATA</b> 6 months- April 1, 1978	<b>CONTRACT NO.</b> ANL No. 31-109-38-4465

### PROJECT SUMMARY

#### Objective:

Coordinate non-microwave study efforts to determine the effects of non-microwave effects on space worker health and safety.

#### Approach:

1. Review planned DOE studies for non-microwave effects, and coordinate program plans.
2. Provide detailed statement of work, research proposals, contractual documents, and act as liaison between DOE and subcontractors, as required.

#### Benefit:

Qualified specialists will coordinate the study of non-microwave effects on space workers, and provide a Data base for preliminary impact assessment.

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**TITLE**

SPS Non-Microwave Impacts on  
Health and Safety

**ORGANIZATION**

Lawrence Berkeley Lab  
Berkeley, CA.

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**AMOUNT**

\$50,000

**PRINCIPAL INVESTIGATOR**

M. White

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**WORK LOCATION**

Berkeley, CA.

**DURATION-AWARD DATA**

8 months-April 1, 1978

**CONTRACT NO.**

ANL No. 31-109-38-4465

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**PROJECT SUMMARY****Objective:**

Characterize potential hazards of space environment to space workers and identify potential effects.

**Approach:**

1. Characterize space environment hazards.
2. Characterize SPS Construction and Operation hazards.
3. Assess worker exposure to hazards.
4. Estimate effects of worker exposure.

**Benefit:**

Provide data base to be used in the preliminary assessment of non-microwave hazards to space workers.



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**TITLE**

Reduction of LAGOPEDO Data

**ORGANIZATION**EG&G and Los Alamos Scientific Laboratory  
Los Alamos, New Mexico  
Alamos, NM

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**AMOUNT**

\$25,000

**PRINCIPAL INVESTIGATOR**J. Zinn and D. Wright

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**WORK LOCATION**

Los Alamos, N.M.

**DURATION-AWARD DATA**

6 months- April 1, 1978

**CONTRACT NO.**W7405-ENG-36  
LASL R-468

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**PROJECT SUMMARY****Objective:**

To extract information from the LAGOPEDO experiments relevant to the assessment of upper atmospheric effects of rocket effluents.

**Approach:**

Reduce and analyze and summarize relevant data from the LAGOPEDO experiments, for SPS assessment.

**Benefit:**

Provides information regarding the nature and extent of ionospheric holes caused by multiple launch rocket emissions.

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**TITLE**

SPS Microwave Radiation Effects on  
the Ionosphere

**ORGANIZATION**

Los Alamos Scientific Laboratory  
Los Alamos, New Mexico

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**AMOUNT**

\$130,000

**PRINCIPAL INVESTIGATOR**

L. Duncan

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**WORK LOCATION**

Los Alamos, N.M.

**DURATION-AWARD DATA**

9 months- April 1, 1978

**CONTRACT NO.**

W7405-ENG-36  
LASL R-467

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**PROJECT SUMMARY****Objective:**

Assesses the ability of R F ionospheric heating to produce thermal runaway.

**Approach:**

1. Heat the ionosphere using Arecibo 430 MHz incoherent backscatter radar.
2. Observe changes in electron temperature in a cross-section of heated ionosphere.
3. Establish power density threshold for thermal runaway.

**Benefit:**

Determines probability of thermal runaway from SPS microwave beam ionospheric heating, and verifies predicted power density threshold. Defines subsequent information to modify guidelines for microwave power density in the ionosphere.

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**TITLE**

Effects of Propellant Emissions  
in the Upper Atmosphere

**ORGANIZATION**

Los Alamos Scientific Laboratory  
Los Alamos, New Mexico

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**AMOUNT**

\$90,000

**PRINCIPAL INVESTIGATOR**

J. Zinn

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**WORK LOCATION**

Los Alamos, NM

**DURATION-AWARD DATA**

6 months - 4/78

**CONTRACT NO.**

LASL R-468  
W7405-ENG-36

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**PROJECT SUMMARY****Objective:**

Determine the effects of exhaust from Heavy Lift Launch Vehicles on the ionosphere.

**Approach:**

Develop and use one-dimensional and two-dimensional computer codes to investigate the chemical effects of rocket exhaust products on the ionosphere.

**Benefit:**

Evaluates long-range effects of SPS construction activities on the ionosphere and on climate and terrestrial communications.

<b>TITLE</b>		<b>ORGANIZATION</b>
SPS Magnetosphere and Ionosphere Heating Facility		Rice University Houston, Texas
<b>AMOUNT</b>	<b>PRINCIPAL INVESTIGATOR</b>	
\$58,000	W.E. Gordon/R. Dyce	
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
Houston, Texas	8 mos - 4.1.78	ANL No. 31-109-38-4465

### PROJECT SUMMARY

#### Objective:

Design and determine engineering specifications for an ionosphere heating facility.

Design physical experiments to assess the EMC of SPS.

#### Approach:

Provide detailed equipment specifications, and experimental program definition for ionosphere and magnetosphere heating tests utilizing the Arecibo, P.R. facility.

#### Benefit:

1. Provides detailed cost estimates for modification of testing facility.
2. Identifies cooperative test program for Arecibo, P.R. and Plattville, CO facilities.

TITLE		ORGANIZATION
SPS Magnetosphere and Ionosphere Heating Facility		Dept. of Commerce Inst. of Telecommunications Sciences Boulder, CO 80302
AMOUNT	PRINCIPAL INVESTIGATOR	
\$33,000	C. Rush/M.Ma	
WORK LOCATION	DURATION-AWARD DATA	CONTRACT NO.
Boulder, CO	8 mos. - 4.1.78	Interagency Agreement No. E-(49-26)-1041

#### PROJECT SUMMARY

##### Objective:

Design and determine engineering specifications for an ionosphere heating facility.

Design physical experiments to assess the EMC of SPS.

##### Approach:

Provide detailed equipment specifications, and experimental program definition for ionosphere and magnetosphere heating tests utilizing the Arecibo, P.R. facility.

##### Benefit:

1. Provides detailed cost estimates for modification of testing facility.
2. Identifies cooperative test program for Arecibo, P.R. and Plattville, CO facilities.

<b>TITLE</b>		<b>ORGANIZATION</b>
Preliminary Assessment of Effects of Rocket Effluents in Troposphere		Science Applications, Inc. Huntsville, Alabama
<b>AMOUNT</b>	<b>PRINCIPAL INVESTIGATOR</b>	
\$38,812	Arnold Goldford	
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
Huntsville, Alabama	5 mos. - 4.1.78	ANL No. 31-109-38-3764

## PROJECT SUMMARY

### Objective

Prepare a preliminary assessment of rocket propellants emitted into the troposphere, and their impacts. Estimate rocket effluents including thermal energy and water release into the troposphere.

### Approach

1. Perform a literature review on theoretical launch vehicle tropospheric interaction phenomena including hydrocarbon.
2. Collect, review, and analyze data from past launches of expendable vehicles, and correlate data to the HLLV.
3. Assess possible environmental effects of HLLV system configurations, including chemical and mechanical (acoustic) phenomena.
4. Estimate source terms to be used in inadvertent weather modification predictions.
5. Examine the feasibility and advisability of using more sophisticated simulation techniques to analyze launch vehicle ground clouds.
6. Organize a workshop on tropospheric environmental effects related to HLLV launch activity.

### Benefits

1. Provides a comprehensive overview of probable impacts of rocket propellants released into atmosphere (long and short term), and probable impacts of rocket launches in the troposphere.
2. Provides info needed to assess impacts on public health and welfare, launch site ecology, and inadvertent weather modification.
3. Prioritizes additional information and research requirements.

<b>TITLE</b>		<b>ORGANIZATION</b>
Study of Biological and Ecological Effects of the SPS MPTS on Behavior of Insects and other Terrestrial Invertebrates		University of California, Davis
<b>AMOUNT</b>	<b>PRINCIPAL INVESTIGATOR</b>	
\$42,000	N. Gary	
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
Davis, CA	6 months- July 1, 1978	ANL No. 31-109-38-4442

### PROJECT SUMMARY

#### Objective:

Study the biological and ecological effects of the SPS Microwave Power Transmission System (MPTS) radiation on insects and other invertebrates.

#### Approach:

1. Design experimental facility to accommodate observation hives, incubators, experimental preparation, and anechoic chambers, and experimental controls, in an existing microwave facility.
2. Study survival, longevity, orientation of flight behavior, foraging behavior, and intra-colony behavior of the European honey bee.

#### Benefits:

Assess and evaluate microwave radiation-- behavioral effects on a economically important faunal species.

<b>TITLE</b>		<b>ORGANIZATION</b>
SPS RFI/EMI Interference		Battelle Memorial Institute Pacific Northwest Laboratory Richland, Washington
<b>AMOUNT</b>		<b>PRINCIPAL INVESTIGATOR</b>
FY 77 \$75,000		K. C. Davis
FY 78 \$38,000		
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
Richland, Washington	12 months - 8/77	EY-76-C-06-1830 D8132-81028

### **PROJECT SUMMARY**

#### Objective:

Determine terrestrial, airborne, and space-borne communications; navigation; radar; radio astronomy; and other electronic systems affected by SPS.

#### Approach:

1. List all electronic systems and equipments that might be adversely affected (RFI/EMI) by SPS operations.
2. Assess impact of SPS radiation on these systems.
3. Evaluate devices and procedures for mitigating these impacts.
4. Identify information gaps and plan and initiate research to fill these voids.

#### Benefit:

An understanding of potential SPS RFI/EMI problems and the equipment and procedures for reducing these problems.



ENVIRONMENTAL ASSESSMENT STUDIES

FY 1977

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**TITLE**

SPS Preliminary Environmental Assessment

**ORGANIZATION**Argonne National Laboratory  
9700 South Cass Avenue  
Argonne, IL 60799

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**AMOUNT**

\$140,000

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**PRINCIPAL INVESTIGATOR**

S. Halverson

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**WORK LOCATION**

Chicago, IL

**DURATION-AWARD DATA**

9 months - 9/77

**CONTRACT NO.**

189-ANL49576

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**PROJECT SUMMARY**Objective:

Complete a preliminary Environmental Impact Assessment against criteria, guidelines, and standards that have been promulgated for SPS.

Approach:

1. Develop a file of environmental and socioeconomic data and study results.
2. Complete a preliminary environmental assessment as a function of criteria and guidelines.
3. Report results.

Benefit:

1. Environmental assessment information to aid NASA in carrying out their SPS Concept Definition Work.
2. SPS environmental data for Congress, the public, environmentalists, governmental agencies, etc.

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**TITLE**

SPS Management Analysis and Control

**ORGANIZATION**Argonne National Laboratory  
9700 South Cass Avenue  
Argonne, IL 60499

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**AMOUNT**

\$25,000

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**PRINCIPAL INVESTIGATOR**

T. D. Wolsko

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**WORK LOCATION**

Chicago, IL

**DURATION-AWARD DATA**

9 months - 9/77

**CONTRACT NO.**

189-ANL49576

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**PROJECT SUMMARY**Objective:

Develop and apply control techniques to enable DOE to analyze the many program variables and their interactions for use in the Management Process.

Approach:

Complete management analysis, venture analysis, and SPS Evaluation Methodology, and produce decision trees for the SPS Concept Evaluation Program.

Benefit:

Control techniques for decision-making and for the development of recommendations.

<b>TITLE</b>		<b>ORGANIZATION</b>
SPS Guidelines and Criteria		Argonne National Laboratory 9700 South Cass Avenue Argonne, IL 60499
<b>AMOUNT</b>	<b>PRINCIPAL INVESTIGATOR</b>	
\$50,000	T. D. Wolsko	
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
Chicago, IL	12 months - 8/77	189-ANL49576

### **PROJECT SUMMARY**

#### **Objective:**

To review and support development of environmental, public health, safety, economic, and socioeconomic guidelines and criteria for SPS Concept Development and Evaluation.

#### **Approach:**

1. Review existing environmental and socioeconomic guidelines, criteria and standards.
2. Isolate existing guidelines, criteria and standards that are relevant to the development and evaluation of SPS concepts.
3. Identify areas where guidelines, standards, etc. are needed.
4. Extend guidelines, standards, etc. and develop new ones as required.

#### **Benefit:**

Guidelines and criteria to be used during SPS Concept Definition and Evaluation.

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**TITLE**

SPS Effects of Microwave Radiation

**ORGANIZATION**Battelle Memorial Institute  
Pacific Northwest Laboratory  
Richland, Washington

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**AMOUNT**

\$75,000

**PRINCIPAL INVESTIGATOR**

R. D. Phillips

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**WORK LOCATION**

Richland, Washington

**DURATION-AWARD DATA**

12 months - 9/77

**CONTRACT NO.**EY-76-C-06-1830  
D8132-81028

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**PROJECT SUMMARY**Objective:

Evaluate effects of SPS microwave radiation on public health, environment, and terrestrial ecology.

Approach:

1. Assess risks involved in exposure to microwave radiation.
2. Identify key areas of uncertainty and gaps in current knowledge.
3. Plan and undertake research to fill these voids and to improve microwave exposure effects predictive capability.
4. Up-to-date predictions as feasible.

Benefit:

Improved microwave effects data base upon which to base SPS concept definition and evaluation decisions.

<b>TITLE</b>		<b>ORGANIZATION</b>
SPS Atmospheric Effect of Microwaves		Los Alamos Scientific Laboratory Los Alamos, New Mexico
<b>AMOUNT</b>	<b>PRINCIPAL INVESTIGATOR</b>	
\$75,000	John Zinn	
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
Los Alamos, New Mexico	12 months - 9/77	W7405-ENG-36 LASL D-511

### PROJECT SUMMARY

#### Objective:

Determine indirect public health and environmental impacts from microwave beam interactions with atmosphere.

#### Approach:

1. Determine effects of beam interactions with the ionosphere and magnetosphere.
2. Determine beam climatological effects, and heat "island" effects.
3. Analyze these effects to determine impacts on public health and environment.

#### Benefit:

Will provide some of the base data needed to develop guidelines defining maximum permissible power levels within the microwave beam.

**SOCIETAL ASSESSMENT STUDIES**

**FY 1978**

<b>TITLE</b>		<b>ORGANIZATION</b>
SPS Societal Assessment Program Coordination and Guidance		PRC Systems Sciences Co. 7600 Old Springhouse Rd. McLean, VA 22102
<b>AMOUNT</b> \$37,600	<b>PRINCIPAL INVESTIGATOR</b> C. Bloomquist	
<b>WORK LOCATION</b> Los Angeles, CA	<b>DURATION-AWARD DATA</b> 5 mos. 6.1.78	<b>CONTRACT NO.</b> EG-77-C-01-4024

### **PROJECT SUMMARY**

Coordinate preparation of white papers and subsequent effects on key issues relating to the impact of the SPS on society.

#### Approach

1. Review DOE/ANL Work Breakdown Structure (WBS) for the Societal Assessment.
2. Provide detailed statements of work, WBS, research proposals, data and contract documents as required.
3. Provide liaison between DOE/PRC and subcontractors as required by DOE.
4. Coordinate program plans with needs and goals of the DOE Societal Impact assessment and the NASA SPS conceptual development plan.
5. Provide a comprehensive research needs document to serve as the basis for subsequent assessments of the SPS societal impacts.

#### Benefit

Provide direction, reports, and data for preliminary societal impact assessment.



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**TITLE**

Resources White Paper

**ORGANIZATION**Economic Consultants  
15615 Castlewoods Drive  
Sherman Oaks, CA 91405

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**AMOUNT**

\$15,090

**PRINCIPAL INVESTIGATOR**Allan Kotin

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**WORK LOCATION**

Los Angeles, CA

**DURATION-AWARD DATA**

4 mos. 6.1.78

**CONTRACT NO.**EG-77-C- 01-4024  
PRC PO#W4081

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**PROJECT SUMMARY**Objective

Survey and summarize study efforts to date which address SPS use of resources--land materials, energy and identify current needs.

Approach

1. Assemble and analyze relevant literature including tentative and anticipated results from any studies in progress.
2. Establish a list of questions in the three categories (land, materials, energy) that must be addressed in order to determine the societal impact of the SPS.
3. Determine where unanswered questions exist in each category and suggest an approach to address them.

Benefit

Provides a state of the art response to SPS - resources issues and establishes an approach to further in-depth evaluation of the problem.

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**TITLE**

Land Use White Paper

**ORGANIZATION**Space Solar Power Research Program  
Rice University  
Houston, Texas 77001

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**AMOUNT**

\$16,460

**PRINCIPAL INVESTIGATOR**James Blackburn

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**WORK LOCATION**

Houston, Texas

**DURATION-AWARD DATA**

4 mos. 6.1.78

**CONTRACT NO.**EG-77-C- 01-4024  
PRC PO# W4120

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**PROJECT SUMMARY**Objective

Identify geographic locational criteria for rectenna siting, and make preliminary determination of potential rectenna area sites in support of resource White Paper.

Approach

1. Develop a list of technical siting criteria influencing the location of rectenna sites based on the NASA Systems Definition Effort.
2. Develop a list of locational criteria for rectenna sites based on potential socio-economic and environmental impacts.
3. Combine criteria from efforts 1 and 2 above to form the basis of a spatial analysis of "eligible areas" for rectenna sites.
4. Provide a preliminary map of "eligible areas" for rectenna sites within the U.S. based on the developed eligibility criteria.

Benefit

Preliminary determination of SPS land use requirements and development of a geographic technique to select sites, and a recommended approach to further study of the problem.

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**TITLE**

Federal Involvement White Paper

**ORGANIZATION**International Technical Services, Inc.  
2001 Jefferson Davis Highway  
Arlington, VA 22202

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**AMOUNT**

\$12,200

**PRINCIPAL INVESTIGATOR**Henry G. Edler

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**WORK LOCATION**

Arlington, VA

**DURATION-AWARD DATA**

4 months 6/1/78

**CONTRACT NO.**ANL No. 31-109-38-4387

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**PROJECT SUMMARY**Objective:

Identify and characterize the role of the federal government bodies in SPS development and operation.

Approach:

1. Identify all federal government entities within whose purview the SPS would lie and be periodically reviewed.
2. Characterize the roles of these entities.
3. Develop a sequential flow chart of governmental involvement that would indicate information flow and critical paths of governmental decision-making for an SPS development program, should one be implemented.

Benefit:

Preliminary description of governmental involvement in an operational SPS.

<b>TITLE</b>		<b>ORGANIZATION</b>
Impact of a Satellite Power System (SPS) on State and Local Regulations White Paper		Economic Consultants 10960 Wilshire Boulevard Los Angeles, CA 90024
<b>AMOUNT</b>	<b>PRINCIPAL INVESTIGATOR</b>	
\$8,060	Allan Kotin	
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
Los Angeles, CA	4 months - 6/1/78	EG-77-C-01-4024 PRC PO# W4080

### **PROJECT SUMMARY**

#### Objective:

Identifies the types of regulations applying at levels that would be necessary to manage distribution of SPS electrical power.

#### Approach:

1. Characterize the current regulatory process as it applies to the provision of electrical power.
2. Evaluate utilization of this regulatory to the SPS.
3. Define problem areas and identify a means to resolve them.

#### Benefits:

Develops a preliminary assessment of the nature and extent of state and local regulations on SPS and establishes a base for further work.

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**TITLE**

International Agreements White Paper

**ORGANIZATION**Stephen Gorove  
University of Mississippi Law Center  
University, Mississippi 38677

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**AMOUNT**

\$15,400

**PRINCIPAL INVESTIGATOR**Stephen Gorove

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**WORK LOCATION**

University, Miss.

**DURATION-AWARD DATA**

4 mos. 6.1.78

**CONTRACT NO.**EG-77-C- 01-4024  
PRC PO# W4076

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**PROJECT SUMMARY**Objective

Assess problems in obtaining agreements in geostationary orbit assignment, microwave frequency allocation, and microwave exposure standards.

Approach

1. Identify the international agreements that must be obtained in the three areas, define the problems to be resolved and potential delays in the process, based on historical precedents.
2. Identify and make a preliminary evaluation of alternative strategies to facilitate obtaining the required international agreements.
3. Identify areas requiring additional study, and provide a recommended approach.

Benefit

Develops a preliminary assessment of international agreements that will be required for an SPS, and establishes a basis for further systematic study.

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**TITLE**

International Agreements White Paper

**ORGANIZATION**Carl Q. Christol  
1041 Anoka Place  
Pacific Palisades, CA 90270

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**AMOUNT**

\$16,500

**PRINCIPAL INVESTIGATOR**Carl Q. Christol

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**WORK LOCATION**

Los Angeles, CA

**DURATION-AWARD DATA**

4 mos. 6.1.78

**CONTRACT NO.**

EG-77-C-.01-4024

PRC PO# W4086

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**PROJECT SUMMARY**Objective

Assess problems in obtaining agreements on geostationary orbit assignments, microwave frequency allocations and microwave exposure standards.

Approach

1. Identify the international agreements that must be in the three areas; define problems to be resolved and potential delays in the process, based on historical precedents.
2. Identify and make a preliminary evaluation of alternative strategies to facilitate obtaining the required international agreements.
3. Identify areas requiring additional study, and provide a recommended approach.

Benefit

Develops a preliminary assessment of international agreements that will be required for an SPS, and establishes a basis for further systematic study.

<b>TITLE</b>		<b>ORGANIZATION</b>
Financial Management Scenario White Paper		Science Applications, Inc. 80 Mission Drive Pleasanton, CA 94566
<b>AMOUNT</b>	<b>PRINCIPAL INVESTIGATOR</b>	
\$13,792	J. Peter Vajk	
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
Pleasanton, CA	4 months - 6/1/78	EG-77-C-01-4024 PRC PO# W4078

### **PROJECT SUMMARY**

#### **Objective:**

Assess the potential feasibility and advantages of alternative SPS financing and management scenarios.

#### **Approach:**

1. Identify initial investment and cash flow capital requirements for SPS development and operation.
2. Determine feasible alternative policies and organizations to provide this capital, including private institutions, joint private and government, government-owned institutions, and the potential for international institutions to develop and operate the SPS.
3. Determine feasible alternative management concepts consistent with the alternative financing arrangements and considerations of public acceptance.
4. Characterize the benefits and disadvantages of each alternative and identify preferable concepts under various possible scenarios for the socioeconomic conditions prevailing during the SPS implementation time frame.
5. Identify any additional studies that are required and determine methodologies for accomplishing them.

#### **Benefit:**

Develops a preliminary approach to alternative SPS financing and management strategies, and provides a basis for further study.

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**TITLE**

Financial Management Scenarios  
White Paper #1

**ORGANIZATION**

Herbert E. Kierulff, Jr.  
776 Foxkirk Road  
Glendale, CA 91206

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**AMOUNT**

\$13,880

**PRINCIPAL INVESTIGATOR**

Herbert E. Kierulff

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**WORK LOCATION**

Los Angeles, CA

**DURATION-AWARD DATA**

4 mos. 6.1.78

**CONTRACT NO.**

EG-77-C- 01-4024  
PRC PO #W4079

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**PROJECT SUMMARY**Objective

Assess the potential feasibility and advantages of alternative SPS financing and management scenarios.

Approach

1. Identify initial investment and cash flow capital requirements for SPS development and operation.
2. Determine feasible alternative policies and organizations to provide this capital, including private institutions joint private and government, government-owned institutions, and the potential for international institutions to develop and operate the SPS.
3. Determine feasible alternative management concepts consistent with the alternative financing arrangements and considerations of public acceptance.
4. Characterize the benefits and disadvantages of each alternative, and identify preferred concepts under various possible scenarios for the socioeconomic conditions prevailing during the SPS implementation time frame.
5. Identify any additional studies that are required and determine methodologies for accomplishing them.

Benefit

Develops a preliminary approach to alternative SPS financing and management strategies, and provides a basis for further study.



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**TITLE**

International Organizations  
White Paper

**ORGANIZATION**

International Technical Services, Inc.  
2001 Jefferson Davis Highway  
Arlington, VA 22202

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**AMOUNT**

\$12,000

**PRINCIPAL INVESTIGATOR**

Henry G. Edler

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**WORK LOCATION**

Arlington, VA

**DURATION-AWARD DATA**

2 months - 4/15/78

**CONTRACT NO.**

ANL No. 31-109-38-4387

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**PROJECT SUMMARY**Objective:

Identify (International) organizational options for SPS financial development and management.

Approach:

1. Characterize the organizational structures which have been formed for purposes similar to SPS that might serve as a model for SPS organization.
2. Survey expert opinion as to the suitability, costs and effectiveness of such organizational structures.
3. Provide a report including a critical comparison of organizational structures, and an analysis of the political, environmental and economic issues and impacts of such organizational options, including institutional factors such as international law and U.N. Resolutions,

Benefit:

Preliminary survey of SPS international organizational structures that will and will not work.

<b>TITLE</b> Military Implications White Paper		<b>ORGANIZATION</b> PRC Energy Analysis Co. 7600 Old Springhouse Road McLean, VA 22102
<b>AMOUNT</b> \$10,000	<b>PRINCIPAL INVESTIGATOR</b> Claud Bain	
<b>WORK LOCATION</b> McLean, VA	<b>DURATION-AWARD DATA</b> 4 mos. 6.1.78	<b>CONTRACT NO.</b> EG-77-C-01-4024

### PROJECT SUMMARY

#### Objective:

Determine the role, if any, that the SPS has in the U.S. Military posture, both offensively and defensively, with particular attention to SPS vulnerability.

#### Approach:

1. Investigate SPS potentialities as a weapon or other supportive element of U.S. military preparedness.
2. Determine the potential impact on international relations of SPS tactical weapons capabilities.
3. Investigate the relative vulnerability of SPS to military action, terrorist attack, or sabotage.
4. Identify questions needing further study and develop approaches that can be taken (1) without security clearance and (2) with security clearance.

#### Benefit:

Develops preliminary description of the potential military interest in SPS and system vulnerability. Identifies an approach to further study required to clarify the issues.

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**TITLE**

Military Implications  
White Paper

**ORGANIZATION**

Michael J. Ozeroff  
537 Ocampo Drive  
Pacific Palisades, CA 90272

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**AMOUNT**

\$11,980

**PRINCIPAL INVESTIGATOR**

Michael J. Ozeroff

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**WORK LOCATION**

Los Angeles, CA

**DURATION AWARD DATE**

4 mos. 6.1.78

**CONTRACT NO.**

EG-77-C- 01-4024  
PRC Po # W 4121

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**PROJECT SUMMARY****Objective:**

Characterize what role the SPS would have, if any, in the U.S. military posture, both offensively and defensively, with particular attention to SPS vulnerability.

**Approach:**

1. Investigate SPS potentialities as a weapon or other supportive element of U.S. military preparedness.
2. Determine the potential impact on international relations of tactical weapon capability.
3. Investigate the relative vulnerability of SPS to military action, terrorist attack or sabotage.
4. Identify questions needing further study and develop approaches that can be taken (1) without security clearance, and (2) with security clearance.

**Benefit:**

Develops preliminary description of the potential military interest in SPS, and system vulnerability. Identifies an approach to further study required to clarify the issues.

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**TITLE**

Relocation of Industry and Population  
White Paper

**ORGANIZATION**

Argonne National Laboratory  
9700 South Cass Avenue  
Argonne, IL 60439

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**AMOUNT**

\$10,000

**PRINCIPAL INVESTIGATOR**

Thomas Baldwin

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**WORK LOCATION**

Argonne, IL

**DURATION-AWARD DATA**

4 months - 6/1/78

**CONTRACT NO.**

189-ANL49576

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**PROJECT SUMMARY****Objective:**

Survey existing demographic work with respect to SPS and assess impacts of SPS energy availability on geographic distribution of industry and population in the U. S. and other countries receiving SPS output. Establish bases for further study.

**Approach:**

1. Perform literature review and determine the impacts of SPS large energy source on the distribution of industry and population.
2. Evaluate the potential acceptability of these impacts by appropriate interest groups.
3. Identify the approach to additional study.

**Benefit:**

Develops a preliminary demographic assessment of the SPS and provides an approach to further systematic study of the problems.

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**TITLE**

Centralization of Electrical Power  
White Paper

**ORGANIZATION**

Center for Policy Process  
1755 Massachusetts Ave. N.W.  
Washington, D.C. 20036

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**AMOUNT**

\$10,525

**PRINCIPAL INVESTIGATOR**

John Naisbitt

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**WORK LOCATION**

Washington D.C.

**DURATION-AWARD DATA**

4 mos. 6.1.78

**CONTRACT NO.**

EG-77-C- 01-4024  
PRC P.O. #W4125

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**PROJECT SUMMARY****Objective:**

Establish the relationship and influence of SPS centralized electrical power source would have on society.

**Approach:**

1. Survey recent SPS and related work.
2. Characterize the trends toward centralization (decentralization), the public reaction to these trends and estimate the anticipated public response to an SPS.
3. Determine areas requiring further study and recommend an approach to accomplishing these studies.

**Benefits:**

Develops a preliminary assessment of the SPS Centralization issue, characterizes the probable public response, and defines a basis and approach to further systematic study.

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**TITLE**

Public Acceptance

**ORGANIZATION**Environmental Resource Group  
6380 Wilshire Boulevard  
Los Angeles, Ca. 90048

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**AMOUNT**

\$11,952

**PRINCIPAL INVESTIGATOR**Arrie Bachrach

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**WORK LOCATION**

Los Angeles, Ca.

**DURATION-AWARD DATA**

4 mos. 6.1.78

**CONTRACT NO.**EG-77-C- 01-4024  
PRC P.O. # W4077

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**PROJECT SUMMARY****Objective:**

Develop a preliminary perspective of the public acceptability of the SPS Concept, and the means to monitor it.

**Approach:**

1. Identify and characterize primary SPS characteristics that would impact the "quality of life", and establish methodologies for evaluating the public (national and international) balancing of the potential benefits and disadvantages.
2. Evaluate initial views of relatively informed public interest (activist) groups, as well as studies by social scientists.
3. Identify the specific potential SPS benefits and disadvantages that are likely to be critical to public acceptance.
4. Develop a method for determining and influencing public acceptance of the SPS as a function of time. Recommend additional studies which would clarify this issue.

**Benefit:**

Develops a preliminary assessment of public acceptance, and defines an approach to further systematic study.

---

**TITLE**

Student Involvement in SPS  
White Paper

**ORGANIZATION** Forum for the

Advancement of Students in Science & Technology, Inc.  
2030 M St. NW, Suite 402  
Washington, D. C. 20036

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**AMOUNT**  
\$9,447

**PRINCIPAL INVESTIGATOR**

Leonard David

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**WORK LOCATION**

Washington, D. C.

**DURATION-AWARD DATA**

4 months - 6/1/78

**CONTRACT NO.**

EG-77-C-01-4024  
PRC PO# W4130

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**PROJECT SUMMARY****Objective:**

1. Identify a methodology to communicate information to the college community, regarding the concept and implications of SPS.
2. Investigate models and methods of conflict management which can be applied to the dissemination of SPS information.

**Approach:**

1. Survey existing mechanisms successful in disseminating information to the college community.
2. Consult with communication specialists, student program directors, students active in campus programs as to the effectiveness of various communications methods to disseminate information on the SPS concept.
3. Identify potential use of student networks and direct mail lists.
4. Determine methodologies for incorporating SPS into the educational curriculum.
5. Conduct literature search on conflict management for models which can be applied to the SPS, and identify models that have proven to be successful.

**Benefit:**

Develops a preliminary determination of models and methodologies of disseminating information on SPS to the college community, and possible conflict management models to reduce polarization of models. Acts as basis for further study.

**COMPARATIVE ASSESSMENT**

**FY 1978**



TITLE		ORGANIZATION
Comparative Assessment Methodology		Argonne National Laboratory 9700 South Cass Avenue Argonne, IL 60439
AMOUNT		PRINCIPAL INVESTIGATOR
FY 78 \$ 75,000		T. Wolsko
FY 79 \$100,000 (Est.)		
WORK LOCATION	DURATION-AWARD DATA	CONTRACT NO.
Argonne, IL	18 months 4/1/78	189-ANL 49576

### **PROJECT SUMMARY**

#### Objective:

Develop comparative methodologies that clarify decision-making regarding SPS and alternative energy generation systems.

#### Approach:

1. Review and evaluate current and historical comparative methodologies.
2. Identify methods for making comparisons within the framework of the SPS Evaluation program.
3. Develop a direct cost comparison methodology (preliminary methodology).
4. Develop a side-by-side methodology for making nominal comparisons (interim methodology).
5. Develop scenario dependent methodology (alternative futures) for making total social cost comparisons.
6. Identify the comparative impact measurements of key stockholders (interest groups, etc.) through workshops and direct solicitation.
7. Combine stockholders criteria and historical knowledge to develop SPS comparative methodology.

#### Benefit:

This study will provide methodologies for making comparative assessments that are technically based, and sensitive to the measurement criteria used by stockholders.

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**TITLE**

Comparative Data Base

**ORGANIZATION**Argonne National Laboratory  
9700 So. Cass Avenue  
Argonne, IL 60439

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**AMOUNT**FY 78 \$50,000  
FY 79 \$100,000 (Est.)  
FY 80 \$150,000 (Est.)**PRINCIPAL INVESTIGATOR**T. Wolsko

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**WORK LOCATION**

Argonne, IL

**DURATION-AWARD DATA**

24 mos. 4.1.78

**CONTRACT NO.**189-ANL49576

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**PROJECT SUMMARY**Objective

Develop comparative data on critical environmental and social issues.

Approach

1. Perform literature search on critical issue and non-critical issue areas.
2. Develop problem definition papers on critical issues.
3. Conduct colloquium in critical issue areas to gather judgements of the experts.
4. Prepare research papers on critical comparative issues.
5. Integrate critical issue data into the comparative assessments.

Benefit

Develop a data source which will be used to determine comparative assessment of the SPS on critical environmental and social issues.

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**TITLE**  
Terrestrial Alternatives

**ORGANIZATION**  
Argonne National Laboratory  
9700 So. Cass Avenue  
Argonne, IL 60439

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**AMOUNT** FY 78 \$100,000  
FY 79 \$100,000 (Est.)  
FY 80 \$ 50,000 (Est.)

**PRINCIPAL INVESTIGATOR**  
K. Hub/TBD

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**WORK LOCATION**  
Argonne, IL/TBD

**DURATION-AWARD DATA**  
22 mos. 4.1.78

**CONTRACT NO.**  
189-ANL49576

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**PROJECT SUMMARY**

**Objective**

Develop data on alternative.

**Approach**

1. Survey existing data that has been gathered by DOE, DOE contractors, and other studies on alternative energy systems.
2. Identify data gaps not covered by previous studies.
3. Develop new data to provide new information, or improve existing information as required.
4. Determine the quality of data and data sources (uncertainty).

**Benefit**

Develops data on alternative energy systems for input to comparative assessments.

TITLE Comparative Assessments		ORGANIZATION Argonne National Laboratory 9700 So. Cass Avenue Argonne, IL 60439
AMOUNT	FY 78 \$100,000 FY 79 \$200,000 (Est.) FY 80 \$200,000 (Est.)	PRINCIPAL INVESTIGATOR T. Wolsko
WORK LOCATION Argonne, IL	DURATION-AWARD DATA 26 mos. 4.1.78	CONTRACT NO. 189-ANL49576

## PROJECT SUMMARY

### Objective

Provide comparative assessments on the environmental, social, economic, and technical costs, risks, and uncertainties for SPS and alternative energy supply systems.

### Approach

1. Develop a direct cost comparison of SPS and alternative energy supply systems.
2. Develop a side-by-side analysis that makes nominal systems comparisons
3. Develop a scenario dependent analysis that assesses total social cost comparisons based on alternative futures.

### Benefit

The Comparative Assessment will provide a comparative perspective on environmental, social, economic, and technical costs, risks and uncertainties for SPS and alternative energy systems. The assessment will enable decision-makers to make an early decision as to the future direction of the SPS project.

<b>TITLE</b>		<b>ORGANIZATION</b>
SPS Utility Integration		Harza Engineering and Argonne National Laboratory Chicago, IL 9700 So. Cass Avenue Argonne, IL 60439
<b>AMOUNT</b>	<b>PRINCIPAL INVESTIGATOR</b>	
\$60,000	K. Hub	
<b>WORK LOCATION</b>	<b>DURATION-AWARD DATA</b>	<b>CONTRACT NO.</b>
Argonne, IL and Chicago, IL	6 mos. 4.1.78	189-ANL49576 ANL No. 31-109-38-4142

## PROJECT SUMMARY

### Objective

Determine the problems of SPS integration into utility systems.

### Approach

1. Characterize utility systems that might employ the SPS technology.
2. Assess SPS energy integration problems, including system reliability, system stability, reserve margin requirements, system performance, transmission and distribution.
3. Assess SPS maximum market penetration rates, based on system constraints, unit size and other parameters.

### Benefit

Develop a perspective of energy system integration problems that would accompany SPS energy technology/interaction.

**COMPARATIVE ASSESSMENT**

**FY 1977**

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**TITLE**

SPS Comparative Assessment Methodology

**ORGANIZATION**Argonne National Laboratory  
9700 South Cass Avenue  
Argonne, IL 60499

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**AMOUNT**

\$20,000

**PRINCIPAL INVESTIGATOR**

T. D. Wolsko

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**WORK LOCATION**

Chicago, IL

**DURATION-AWARD DATA**

8 months - 9/77

**CONTRACT NO.**

189-ANL49576

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**PROJECT SUMMARY**Objective:

Develop a methodology by which the total social cost of SPS may be compared to that of other energy alternatives.

Approach:

1. Develop data base for SPS, fossil, nuclear, and terrestrial solar energy systems.
2. Define a preliminary comparative assessment methodology for use in conducting the SPS Environmental Assessment.
3. Update SPS comparative assessment methodology as appropriate during the evaluation program.

Benefit:

A tool based on the latest available information and current procedures/practices that will allow a detailed and comprehensive assessment of the SPS to alternate systems.

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