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FINAL REPORT

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REGIONAL PROGRAM FOR ACQUISITION
OF MEDICAL EXPERIMENTS

OCTOBER 31, 1978

GENERAL ELECTRIC COMPANY
SPACE DIVISION
HOUSTON OPERATIONS

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I. SUMMARY

This is the final report on the NASA contract NAS9-15462, Regional Program for Acquisition of Medical Experiments. The General Electric Company was one of several groups selected for similar contracts covering different regions of the country. This report contains a moderately detailed description of the highlights of the GE activities along with some conclusions on their effectiveness and recommendations. In summary, the GE Regional Program effectively:

- o Informed segments of the medical community of research opportunities
- o Validated formats for regional workshops
- o Assisted potential investigators with follow-up consultations and proposal preparations
- o Identified a latent interest requiring continual dialog at the scientist/engineer interface for successful cultivation and integration.

Information which would permit direct correlation between efforts expended in connection with the Regional Program and responses of potential investigators is of interest but is presently unavailable. The task of resurveying the population of Regional Program contacts to learn who submitted proposals in response to the most recent Life Sciences Announcement of Opportunity, who will be submitting proposals in the future, and the nature of the proposed research, is outside the scope of this effort although it continues to proceed on an independent and more deliberate basis.

II. GOALS AND OBJECTIVES

The broad objective of this contract was to further NASA goals of encouraging beneficial uses of space in the Life Sciences. The immediate goals of the contract were directed to a specific geographic area and included the following:

- o Inform the science community of the unique advantages of the space environment for research, the results of previous research and experience, the flight accommodations, equipment and constraints, the flight opportunities and the procedures for participation.
- o Encourage interested scientists to participate in the program, serve as an interface with NASA life scientists, assist with engineering or science advice in order to enhance feasibility of a proposed investigation and to assist investigators in responding to a NASA Announcement of Flight Opportunity (AO).
- o Evaluate effectiveness of the various activities undertaken to accomplish the goals listed above.

III. TASK SUMMARY

The two major tasks accomplished under the contract were the coordination of workshops on Space Medicine in the Shuttle Era in both the Philadelphia and Houston areas where medical researchers from industry and medical schools participated. Detailed reports of these meetings are included in Section IV of this report.

Another important task was to assist NASA with meetings in Houston to review the Regional Programs being conducted by various groups. Two of these meetings were conducted; one in October 1977 and one in March 1978. Details are included in Section IV C.

An ongoing task that lasted for much of the contract duration was follow-up with potential investigators subsequent to regional workshops to keep them informed with supplementary up-to-date information as requested and as available. Section V contains more information on this task.

IV. SHUTTLE APPLICATIONS WORKSHOPS

A. PHILADELPHIA WORKSHOP ON SPACE MEDICINE IN THE SHUTTLE ERA

General Electric Company jointly sponsored a meeting on Space Medicine in the Shuttle Era at the Hahnemann Medical College together with Hahnemann and NASA in June 1977, as part of the nation-wide campaign designed to stimulate interest in the practical uses of space flight. A prime goal of the meeting was to acquaint people in the scientific community with the physical and biological attributes of space flight and to inform them of upcoming flight opportunities. Ideas were also solicited for scientific uses of space flight.

Results of space flight experiments in physics and space medicine were presented and discussed at the Philadelphia meeting. Also presented, from both theoretical and practical points of view, was an example of how space might be used to enhance a preparatory procedure of possible use to the pharmaceutical industry. Of particular benefit to the scientific community was the fact that previously unpublished information was presented on industrial research in space that is of considerable scientific and practical interest.

All indications are that the presentations were exceptionally well received and that the meeting's goals were achieved.

The meeting was preceded by informal workshops conducted at General Electric's Space Laboratory at King of Prussia, Pa., involving key representatives from the Philadelphia area's six medical schools. These representatives contributed ideas and suggestions and participated actively in the planning and implementation of the June meeting. A list of organizations contacted is shown in Table IV-1 illustrating the wide coverage and diversity of interests.

TABLE IV-1

ORGANIZATIONS/COMPANIES CONTACTED

1.	CORNELL UNIV. MEDICAL COLLEGE	18.	PHILADELPHIA COLLEGE
2.	CONEMAUGH VALLEY MEMORIAL HOSPITAL	19.	RORER, WILLIAM H., INC.
3.	DEPT. OF HEALTH, EDUCATION AND WELFARE	20.	SCHEIE EYE INSTITUTE
4.	DREXEL UNIVERSITY	21.	SMITH, KLINE AND FRENCH
5.	EASTERN PA. PSYCHIATRIC INSTITUTE	22.	TEMPLE UNIVERSITY
6.	EASTERN REGIONAL RESEARCH CENTER, USDA	23.	THOMAS JEFFERSON UNIVERSITY
7.	EINSTEIN MEDICAL CENTER	24.	UNIVERSITY OF PENNSYLVANIA
8.	FRANKLIN INSTITUTE	25.	UNIVERSITY OF PITTSBURGH
9.	GENERAL ELECTRIC - CORPORATE R&D CENTER	26.	UNIVERSITY OF TORONTO
10.	HAHNEMANN HOSPITAL	27.	U. S. PUBLIC HEALTH SERVICE
11.	INSTITUTE FOR CANCER RESEARCH	28.	VETERANS ADMN. HOSPITAL (PHILA.)
12.	MCNEIL LABORATORIES, INC.	29.	E. E. VOGIN ASSOCIATES
13.	MEDICAL COLLEGE OF PENNSYLVANIA	30.	WARNER-CHILCOTT LABORATORIES
14.	MERCK, SHARP AND DOHME	31.	WARNER LAMBERT
15.	NIYOGI, SUNIL K.	32.	WISTAR INSTITUTE
16.	PENROSE LABORATORIES	33.	WYETH INTERNATIONAL, LTD.
17.	PENNSYLVANIA COLLEGE		

After the June meeting, assistance was provided in distributing questionnaires to invitees soliciting comments and indications of interest in participating further in the program. Conclusions drawn as a result of preliminary analysis of questionnaire responses indicated, for example, that a series of smaller applications workshops should be accomplished soon in the Philadelphia area to maintain the momentum and to accomplish goals for utilization of space flight.

It was found that 20 to 30 percent of the attendees were considering submittal of proposals for Shuttle experiments as a result of the workshops. Some of these researchers requested and were provided individual contact and information to assist in bringing their ideas and research to proposal and flight states.

Active interest was indicated on the part of the Philadelphia meeting attendees in the use of the space environment to pursue earth-related science in areas of physical chemistry with biological implications; space biological processing; effects of space travel and weightlessness on cardiovascular function; and effects of zero gravity on blood flow, microbiology and immunology, cancer research, biochemistry, developmental processes and pharmacodynamics.

Completed questionnaires and letters of interest received as a result of the Philadelphia meetings were screened for those interested in submitting proposals in response to the next or subsequent Space Shuttle Life Sciences Announcement of Opportunity, and the 1978 Announcement of Opportunity published by NASA Headquarters was sent to them. Those researchers who indicated a need for information and dialog concerning prior space research, proposal preparation procedures, and related subjects were personally contacted by scientific and engineering personnel knowledgeable in space flight practices and requirements.

A video tape was made of the conference and given to NASA for review and possible use at future meetings where obtaining these speakers would not be feasible. The keynote speech was transcribed

and edited and several kits of slides were prepared and used at smaller meetings where the video tapes were not appropriate.

The results of the Philadelphia regional workshop cannot be measured with statistical significance. Questionnaires were mailed to all invitees to the meeting and approximately 10 percent responded. About 24 of these indicated an interest in submitting an experiment proposal to NASA. General Electric knows of eight proposals actually submitted to NASA, but could not reach all attendees or associates of attendees who might have submitted proposals. Those who submitted proposals were unanimous in saying that the workshop was crucial in informing and inspiring them to propose.

B. CONFERENCE ON BIOMEDICAL/LIFE SCIENCES RESEARCH APPLICATIONS IN SPACE

Houston is the focal point for space-related life sciences research and is the site of the largest medical center of its type in the world, the Texas Medical Center.

The Texas Medical Center consists of four general hospitals and five specialized hospitals including teaching institutions. There are two medical schools, a dental school, school of Public Health, College of Pharmacy, a graduate school of biomedical sciences, two nursing schools, a cancer research institute and hospital, and several allied health programs which include degree programs located at the medical center complex. Over four thousand physicians and teachers are located at the center which serves almost 2,000,000 patients each year and has an enrollment of 6700 medical and life sciences students. It also contains the largest concentration of medical researchers in the South. This complex also has the advantage of being centrally located and has excellent adjacent facilities for meetings.

Houston was, therefore, considered a logical location for a meeting to disseminate information on the biomedical opportunities available in the Shuttle era. Preliminary meetings with Houston-area medical school presidents and deans suggested that such a meeting would be very successful.

It was decided to jointly sponsor the Houston meeting in the same fashion as was done in Philadelphia, with the University of Texas Health Science Center at Houston as co-sponsor and host, and a date of May 23-24, 1978 was established.

A detailed agenda was developed, in cooperation with the Technical Monitor and host, appropriately covering the Space Shuttle, life and physical sciences, biological processing in space, and theoretical examples of zero-g applications. The theme chosen was "Space: A Challenge for the Life Sciences."

An invitation list was developed in cooperation with the host who sent out the invitations following approval of the wording by GE and NASA. GE assured that the meeting preparations and arrangements were complete, prepared listings of invitees and attendees for future use, and assisted in taping the proceedings as directed by NASA. This tape is available for use in unedited form from the University of Texas. Also included in the tape are vignettes taken during the second day's mini-seminar at JSC.

Potential speakers were identified and contacted and arrangements were made for their transportation and expenses, following approval by the Technical Monitor. Letters of appreciation were sent to speakers and key contributors. Questionnaires were prepared and distributed to all attendees. Results have been analyzed and conclusions and recommendations communicated to the Technical Monitor, some of which are contained later in this report.

The main part of the conference was held at the Shamrock Hilton Hotel, followed by informal meetings and discussions at the University of Texas Health Science Center building. The mini-seminars held the next day at the JSC Gilruth Center comprised a unique feature of this conference where NASA researchers and experts had set up displays, gave short talks, and were available for one-on-one discussions. The opportunities to meet face-to-face, see the space equipment and/or results from previous space flights, and hold informal discussions were extremely well received by both attendees

and NASA scientists. This mini-seminar feature also provided an opportunity for a group of student users of the Get-Away Special Program to discuss types of life sciences experiments and to meet with Dr. Gilbert Moore, the chief advocate of student groups' experimenting in space.

The results of this Houston meeting are as difficult to quantify as those of the Philadelphia workshop since proposal information is considered confidential by NASA. It is known informally that at least six experiment proposals have been submitted to NASA by University of Texas personnel. Not only is there a high probability that other proposals have been submitted in response to the first AO, but indications are that proposals are in progress in anticipation of future AO's as a result of this workshop.

C. HOUSTON MEETINGS OF REGIONAL PROGRAM DIRECTORS

Johnson Space Center's Space and Life Sciences Directorate has successfully launched a national effort to extend the outreach of the space program's conventional communications channels and to add elements of personal and professional dialog which have not previously existed. Regional projects in addition to the GE effort and located in the proximity of centers of medical research have developed and utilized a variety of procedures to make the space environment more easily available for research and to ensure a fuller and more earth-oriented utilization of space by the biomedical community.

It was decided by NASA to convene a meeting of Regional Program Directors, key contributors, and medical, industrial, and academic advisors in Houston to report on their activities, critique approaches taken, review progress and problem areas, and to present plans for implementing the program in the future to assure utilization by all program segments of those procedures which have been most effective.

The first such meeting was held at JSC on October 11-12, 1977, and in addition to the status and planning discussions, included short talks on the various biomedical programs given by the JSC

scientists and also tours of the Shuttle, Spacelab, and Skylab mockups. This first meeting was of such value and importance that a second one was held on March 16-17, 1978.

In addition to assisting with planning and arrangements for out-of-town attendees, GE transcribed audio tape recordings of the meetings in draft form for NASA's use and prepared and assisted in working Action Item Lists for the Technical Monitor. GE assembled a selection of handout materials for the first meeting and following the meeting, supplied attendees with additional requested materials. Some of these were available from government or technical sources; others were reprinted. For the second meeting, GE prepared a sample newsletter for review by attendees. GE supplied material, collaborated with the JSC contractor that did the layout work, and did the printing.

V. SHUTTLE APPLICATION WORKSHOP FOLLOW-UP

The Shuttle Application Workshop follow-up activities are perhaps the most important activities for achieving successful program results. Few of the promising researchers who were contacted have previously worked with NASA on space projects and most rate their own knowledge of NASA's biomedical program as generally lacking. The workshops serve to stimulate interest and provide overviews of the Space Shuttle, previous life and physical sciences research in space, space processing applications, and some theoretical examples of other zero-g applications to relatively large groups of people. The workshop follow-up is required to develop the interested potential individual Principal Investigator (PI). As the workshops are necessarily general, they do not provide investigators all the information needed to specify and make trade-offs in equipment, protocol, power, crew training, etc. Also, the format for the proposal appears very formidable to the average researcher since many of these areas are not considerations in the ground-based research environment in which most of them work.

A large number of potential investigators were furnished information such as AO's and investigators handbooks. In addition, a few very serious investigators asked for assistance in much more depth. These requests have, in several cases, resulted in consultations or briefings between the investigator and the cognizant NASA scientists.

VI. CONCLUSIONS AND RECOMMENDATIONS

Numerous suggestions were made by various people exposed to the two regional workshops co-sponsored by GE. Many of these were in the category of continuing the program or making it stronger. Most reflect a previous lack of knowledge of the NASA program by the large majority of researchers contacted. The questionnaires returned by attendees indicated regional meetings were very beneficial, and a number of them expressed their intentions to submit a proposal. A summary sheet of attendees' evaluations of the Houston conference is included as Table VI-1. Vertical dashed lines indicate means for responses to the various questions. One recommendation emphasized by many scientists and enthusiastically endorsed by workshop attendees, as shown by the last item on the summary, was to publish a period newsletter. Periodic newsletters can be so difficult to sustain that GE recommends an alternate scheme which would require only minor printing and postage expense, i.e., to reprint selected articles and speeches which pertain to Life Sciences in space and distribute them to the science community through mailing lists obtained from the GE and other regional programs. Such material could include, for example, the five papers devoted to the subject of Space Medicine which were presented at the October 30 session of the American Astronautical Society. This would be much less costly than trying to collect, edit, and assemble a newsletter that would cover a large number of subjects. Also, it would not result in loss of detail as might well happen when trying to compress a long paper into a news item. GE also suggests publishing and disseminating reports describing design studies for the first few Space-lab experiments such as the INS-104 experiment. This should be very helpful to prospective investigators as a typical case history is much more educational than an abstract list of requirements, especially as the INS-104 utilizes off-the-shelf hardware as much as possible. The contents of such reports could include the following considerations:

- o Controls and displays
- o Mounting and vibration
- o Thermal cooling

TABLE VI-1
SPACE CONFERENCE EVALUATION RESPONSE

	<u>LOW</u>						<u>HIGH</u>
	1	2	3	4	5	6	7
Adequacy of material				7	20	14	20
Quality of presentations		2	1	7	19	19	15
Expertise of speakers				5	12	21	23
Material on Shuttle			1		11	24	24
Material on Life Sciences			1	5	13	23	17
Material on Physical Sciences			4	7	21	19	9
Material on Electrophoresis	1	1	2	7	17	18	10
Zero-g (Examples) Applications			1	4	16	20	16
Usefulness of Conference				1	18	18	23
Speaker--Participant Interchange			2	3	10	19	25
Knowledge of NASA program before conference	8	19	12	10	4	5	1
Zero-g in research		3	5	9	14	10	12
Vacuum in research	5	10	4	9	9	7	8
Inform others		1	1	6	17	20	10
OK for NASA to seek to use space for earth applications		3	1	1	5	22	22
Probability of proposal	9	6	9	9	8	4	9
Periodic Newsletter	YES		NO				
	55		1				

TOTAL OF RESPONSES = 61

NOTE: Dashed vertical lines indicate the mean of the responses for that subject.

- o Safety
- o Interconnecting cable
- o Data and microprocessors
- o Power profile and timeline constraints
- o Crew training
- o Hardware integration plans

GE has learned from one investigator in the Philadelphia area that he invested \$5000 of his institute's funds to develop pilot studies which led to the submission of his proposal in response to the NASA AO. This investigator revealed that several of his colleagues indicated a need for "seed money" to develop potential ideas before actually designing a space experiment. NASA could possibly increase new investigator interest by funding preliminary ground-based research at low levels to test new concepts for space experiments.

GE recommends that a detailed analysis be made of the major influential factors leading to the submission of a winning experiment proposal after the new PI's are chosen in June 1979. These parameters or "lessons learned" would then provide an accurate validation of both successful and unsuccessful approaches undertaken throughout the regional program efforts.

GE believes that the regional workshop program should be continued. The Philadelphia workshop proved the feasibility while the Houston workshop demonstrated some refinements in the mechanics that should be utilized in any future large regional workshops. GE has no strong recommendation as to locations for additional large workshops. Locations suggested for further consideration, however, include Maryland in the vicinity of the Johns Hopkins Medical complex and Florida near the Jacksonville and Miami medical communities. Atlanta, Georgia also has some potential as a conference site.

In addition to the large regional workshops, GE recommends the development of logical groups by disciplines of those interested

in performing space flight experiments, and the staging of a series of individual or small group meetings to provide information and assistance and to collect more details for JSC concerning experiments of interest. Such a group in a given discipline could be formed in a limited geographical region or it could be nationwide in scope. The latter arrangement would be preferable with the group very loosely organized, connected mainly by the mailing list maintained by NASA or a NASA contractor. Such groups could have their own regional meetings which would be much more specific and technical than the regional workshops held to date. A loose organization such as this would not conflict or compete with any established societies and meetings, if any, could be held in conjunction with a large society convention.

GE strongly recommends continuation of the follow-up type of activities started under this contract. This work would be similar to some of the tasks expected of the discipline specialists or the Experiment Support Scientists for experiments already approved by NASA as part of the Life Sciences Experiments Program. However, the preproposal coordination being recommended as follow-up to informative meetings should be done under a separate contract to prevent this activity from being neglected in favor of the DEO contract activities which are apt to have tight manpower and schedule constraints.

In summary, GE believes the Regional Program for Acquisition of Medical Experiments has been useful to date and should be continued if the Space Shuttle and Spacelab are to be utilized to their best advantage and to the best advantage of the nation. It has been said that NASA does not always sell its programs adequately to the public. This regional program is a valuable tool to counter this objection. GE also recommends that any future endeavors in this area should emphasize the interests of clinical medicine on earth.