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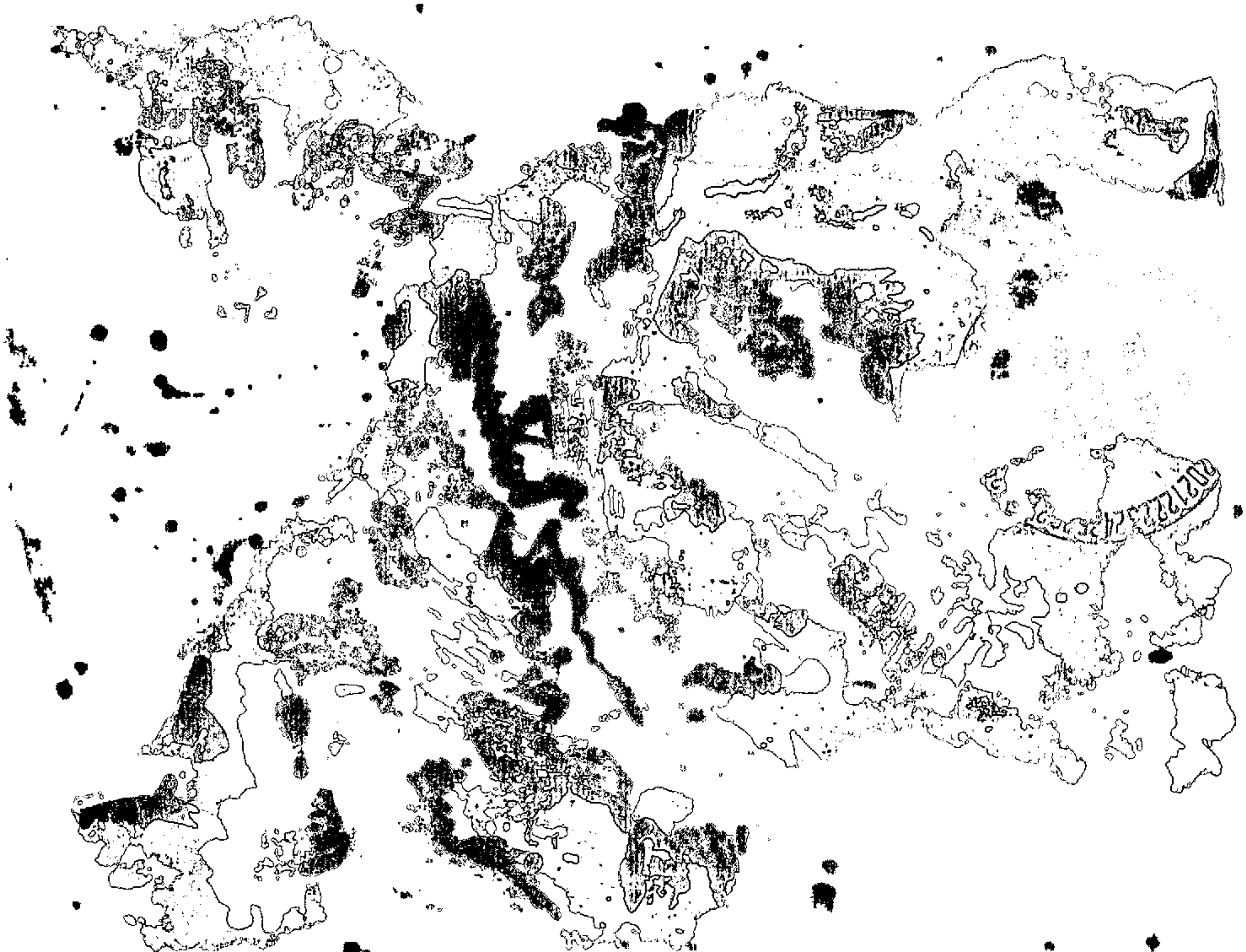
OPERATION OF SELECTED NATIONAL RESEARCH FACILITIES



A STUDY OF THE
OPERATION OF SELECTED NATIONAL RESEARCH FACILITIES

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TABLE OF CONTENTS

ABSTRACT

A study of the operation of nine selected national research facilities has been carried out. Conclusions of the study are:

--A strong resident scientific staff is required for successful facility operation. Use of the facility is shared between the staff and outside users and the sharing must be carried out in an equitable fashion. The value of the facility is diminished if it is viewed by the scientific community as being run by a pedestrian staff.

--No unique scheme of scientific management is revealed by this study except for the obvious fact that the management must be responsive to the users needs and requirements. Forming of users groups provides a convenient channel through which these needs and requirements are communicated.

INTRODUCTION

The operation and management of scientific observations using the space shuttle will present a series of interesting and novel challenges. As a partial basis for meeting these challenges it is appropriate to study the organization and operation modes of certain existing scientific laboratories which are designated as National Facilities, and which involve primarily a large research facility being used by a number of researchers "outside" the facility. It is hoped that this study will provide NASA planners with a critical overview of how a cross section of scientific enterprises responded to the problem of providing modes of operation which optimize the utility of the facility for its users. To the varying degrees that these facilities have experienced problems similar to those which may arise in the scientific and applications aspects of the shuttle program, perhaps these problems may be avoided.

When perceiving national needs requiring responses quite beyond the resources of an individual university, or existing research group, leaders in specific scientific disciplines have enlisted support from the federal government to establish national facilities, designed as centers of excellence dedicated to working on problems at the frontiers of that particular science or technology. Since each facility is a national one, it is incumbent on those who manage its operation to make it available to all qualified users whose interests may be properly served at the facility. In most instances a high quality scientific staff has been recruited for both the initial design stages and the final operational stages. This resident scientific staff is perceived to play a key role in the successful operation of the facility. It is evident that careful consideration needs to be given to the establishment of facility policies insuring optimum usage by both visitors and resident staff.

It is apparent that national laboratories whose facilities are intended to be used by scientists from a variety of institutions have different views on how best to organize the interface between the facility and its diverse potential users. In recent years, there has been an increasing demand on the part of the users of the larger facilities for a formalized arrangement giving the user a strong voice in the operation of the facility. For example, in 1946 a formally organized users organization was initiated at the Brookhaven Alternating Gradient Synchrotron, and the other accelerator laboratories since then have set up organizations which are variants of this. For a brief review of the history of Brookhaven National Laboratory, see Appendix A. The most elaborate users organization to date is probably the one at the Los Alamos Meson Physics Facility, where the delegation of responsibility to the users group has gone furthest. See Appendix B. Although several of the facilities studied did not possess formal users organizations per se, they appeared to be satisfying the users' needs and there was no apparent widespread user dissatisfaction with the absence of a formal organization. It should be noted however, that in these cases these facilities served a smaller, more homogeneous group of users.

While the construction and operation of the facilities studied here have been financed primarily through federal funding, the management of the facilities has been delegated to either a consortium of Universities or, in some cases, individual Universities. The facilities have many unique capabilities and in most instances are the only place in the country, or perhaps the world, where certain investigations can be carried out.

Without exception, the facilities employ a resident scientific staff who make use of the facility in their own research. Some of the key functions which they perform are: providing continuity for continuing projects, developing and incorporating new techniques and equipment, improving and updating facilities and instrument systems, assuring the quality of routine maintenance, assuring the optimization of operating conditions for visitors as well as themselves, serving as consultants for visitors, assisting visitors with interfacing problems, and engaging in cooperative research programs with visitors.

All of the facilities studied are available for use by qualified users in the national and international scientific community. Scientists submit proposals for use of the facility, usually in conjunction with parallel proposal for funding from some granting agency.

Although these facilities share many common features, there are also significant differences which should be noted. For example, the formality of the organization of users and the interface between users and facility is a direct function of the size of the facility. The large accelerator facilities have developed well structured users groups to provide a formal channel for interaction between the users and the managers of the facility. In contrast, those facilities which serve a rather small community of users have not felt the need for establishing formal users groups.

Some of the facilities are really a complex of facilities and are used by a diverse group of scientists in contrast with those facilities whose users encompass only a narrow range of interests. In some cases the emphasis is on the implementation of large scale research projects whose magnitudes are judged to require resources and support beyond that normally available at an individual university, and the facility serves mainly as a focal point for implementation of this task.

Without doubt, the space shuttle "facility" will be more complex than any of those studied here, nevertheless one can make many observations based on this study which should have validity in planning for the space shuttle era. A basic requirement for each scientific and technical discipline is that it attract and hold a staff of creative scientists who will devote part of their effort to optimizing the operation of the facility for their own use as well as for the use of visitors. As with all national research facilities, the access of the facility to qualified outside users should be made in as equitable a manner as possible; and the appropriate scientific community should be encouraged to contribute to the planning and operational policy of the facility.

OPERATION OF SELECTED NATIONAL RESEARCH FACILITIES

Several national research facilities of varying sizes were selected for study in this survey. The facilities selected were all engaged in some aspect of research in physical sciences but varied in size, organization and operation. There is an obvious parallel between the operation of some, but certainly not all, the facilities and the operation of the space shuttle; however the shuttle will undoubtedly be more complex than the operation of any individual facility or indeed the sum total of all the facilities studied here.

The national research facilities selected for this study were:

High Energy Accelerators:	National Accelerator Laboratory (NAL) Los Alamos Meson Physics Facility (LAMPF) Brookhaven Alternating Gradient Synchrotron (AGS)
Low Energy Accelerator:	Brookhaven Tandem Van de Graaf (TVG)
Reactor:	Brookhaven High Flux Beam Reactor (HFBR)
Observatories:	Kitt Peak National Observatory (KPNO) National Astronomy & Ionosphere Center (NAIC)
Atmospheric Research:	National Center for Atmospheric Research (NCAR)
Ocean Going Research:	Deep Sea Drilling Project (DSDP)

NATIONAL ACCELERATOR LABORATORY (NAL)
Batavia, Illinois

Purpose

The purpose of the NAL is to further the understanding of elementary particles through the use of a 200-500 billion electron volt proton accelerator--the world's largest basic scientific research instrument for high energy physics. This proton accelerator is used to explore the fundamental structure of matter. A more detailed and deeper understanding of the nature and behavior of nuclear and subnuclear particles will be made possible by the use of an accelerator in this new energy range.

The principal scientific instrument is a proton synchrotron of 200-500 BeV energy designed for intensities of up to 5 x 10^{13} protons per pulse. Three major accelerators in series are used to accelerate protons.

There are three independent experimental areas which can be in operation singly, doubly, or all together. One target station and associated experimental area is designed, in part, for use with two hydrogen bubble chambers. All three of these experimental areas (the Meson Area, Neutrino Area, and Proton Area) are presently in operation. In addition to the three experimental areas which use full energy beams extracted from the accelerator, there is an Internal Target Area. Smaller in scope and size, this area evolved through the utilization of a "hydrogen jet target" built by a Soviet group from Dubna collaborating with several U.S. institutions, including an NAL team, on physics experiments.

Administration & Operation

The NAL is operated by the Universities Research Association, Inc., of Washington D. C., a consortium of 52 major research-oriented universities, 51 in the United States and one in Canada, for the United States Atomic Energy Commission (USAEC). It is located near Batavia, Illinois about 30 miles west of Chicago. During the summer of 1973 NAL had approximately 1,100 full-time employees.

The Universities Research Association, Inc. (URA) was formed in June, 1965, by 35 major research universities after a meeting of university presidents at the National Academy of

Sciences, Washington, D. C. The corporation is governed by a Council of Presidents of the member universities. Norman Hackerman, President of Rice University, Houston, Texas, is the council's chairman.

The Council of Presidents selects members of the board of trustees. Six of the 21 trustees are appointed at large, the remaining 15 are chosen from the member universities.

The concern of an individual trustee may either be in the scientific or administrative area depending on his background. The director of the laboratory is selected by the trustees and is responsible to them.

The director of the laboratory selects 12 scientists who serve as a scientific advisory group and program committee. The users group proposes four names from which the director selects two. The committee members serve for a term of three years. This committee reviews proposals and programs and makes recommendations to the Director who makes the final decision.

There have been 72 experiment proposals approved this year. Users band together in large groups in using the machine. Several groups from several universities may collaborate in a single program. There are no individual users.

Membership in the users group is open to all interested scientists. Its purpose is to provide a formal channel for representing the interests of the non-resident users. The users group would more likely be concerned with general problems such as on-site housing facilities for visitors but does not attempt to formulate policy. Individual users who have grievances seek redress from the director, however if the problem is not resolved on that level they may request intervention by the users group.

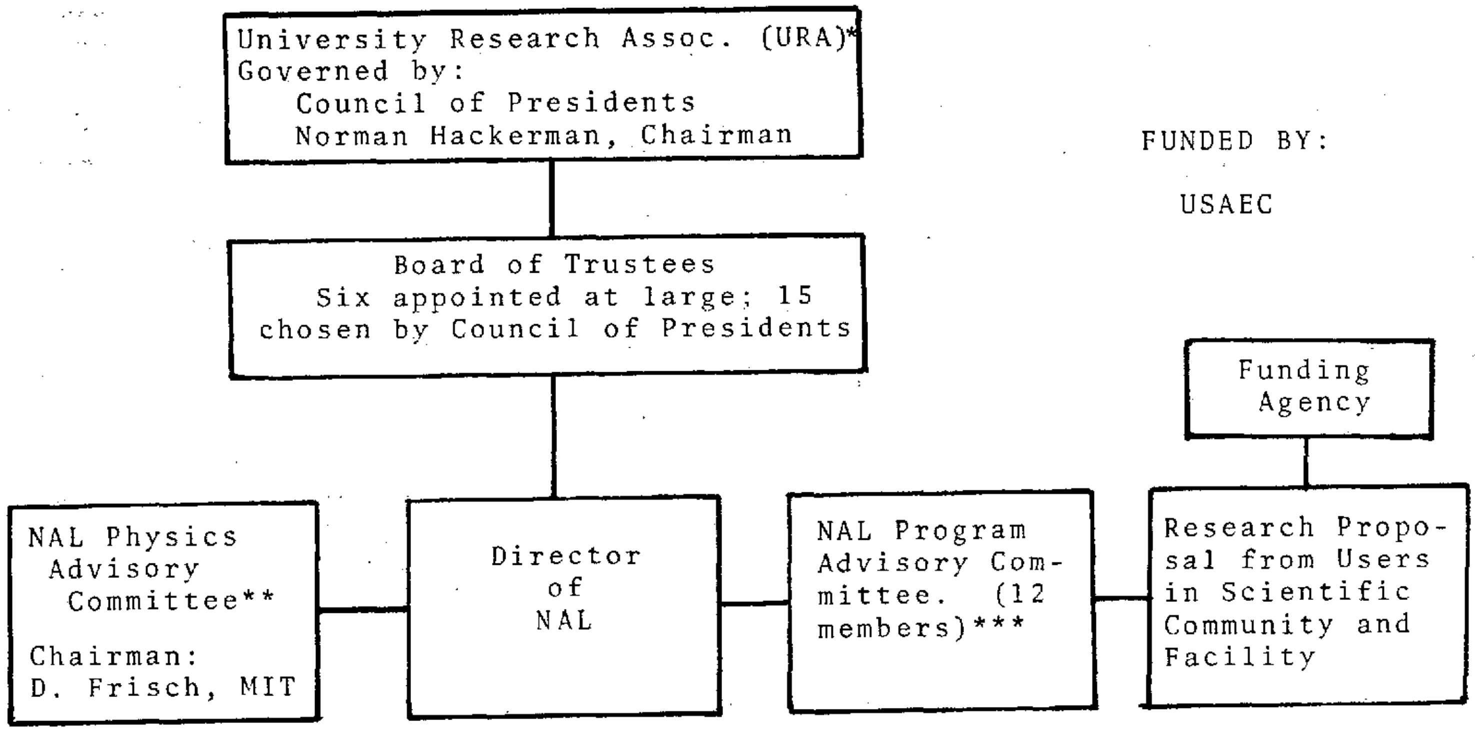
The users group is interested in questions dealing with scientific policy and the establishment of priorities. Although the important decisions in these areas are made by the trustees, the users group can exert influence.

A twelve member executive committee is elected by the users group from its membership. The committee members are primarily experimentalists. The term of an executive committeeman is two years and six members are elected each year. The executive committee of the users group meets regularly with the director. The operating funds for the users group come from URA rather than NAL. A block diagram of the administrative organization of NAL is given in Fig. 1 and a similar diagram of the structure of the users organization is given in Fig. 2.

Funding

Capital Investment		
Construction Total		$ 250,000,000
Capital Equipment		50,000,000
Annual Budget		
Operating		28,400,000
Equipment		14,500,000
NAL Scientists		
Operating	$ 1,700,000	
Equipment	300,000	
Visiting Scientists		
Operating	1,015,000	
Equipment	2,200,000	

NATIONAL ACCELERATOR LABORATORY



FUNDED BY:

USAEC

*A consortium of 52 major research-oriented universities.

**Long-range committee, appointed by Director and advises on long-range future developments of lab facilities.

***Reviews proposals and makes recommendations to Director who makes final decision. Executive Committee of Users Group proposes 4 names, director selects 2.

FIGURE 1

NAL Administrative Organization

NATIONAL ACCELERATOR LABORATORY
USERS ORGANIZATION

Approximately 800 members

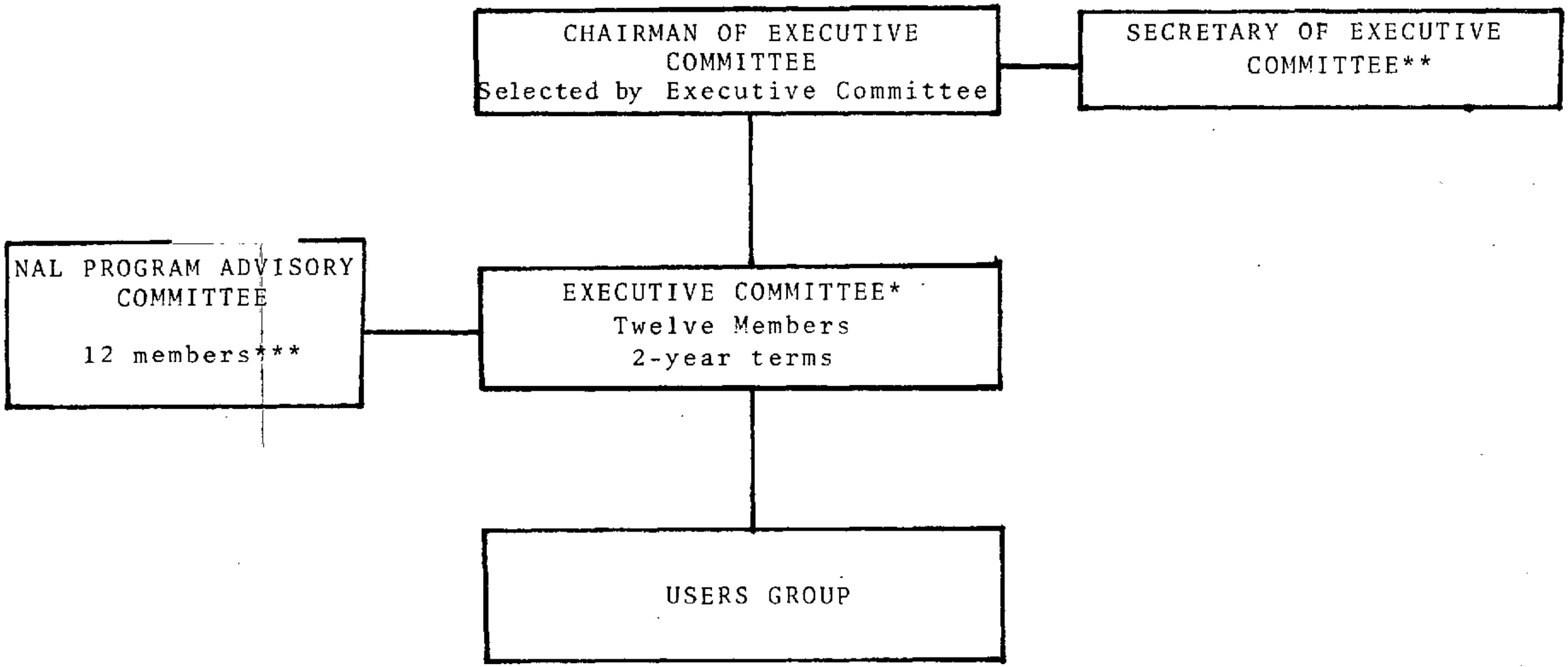


FIGURE 2
NAL Users Group

*Elected by membership. New members nominated by Executive Committee and additional nominations made by any 10 members.

**Appointed by chairman of Executive Committee

***Reviews proposals and makes recommendations to Director who makes final decision. Exec. Committee proposes 4 names, director selects 2.

LOS ALAMOS MESON PHYSICS FACILITY (LAMPF)
Los Alamos, New Mexico

Purpose

The Los Alamos Meson Physics Facility (LAMPF) is a part of the Los Alamos Scientific Laboratory. The Los Alamos Scientific Laboratory is operated by the University of California for the Atomic Energy Commission. It is the largest basic research project ever undertaken in the area of the United States bounded by the Mississippi River on the east and California on the west. The heart of the $57-million facility is a linear accelerator (also called a "linac") designed to provide a beam of protons of variable energy up to 800 MeV (million electron volts) and average intensity of 1 mA (milliampere).

The LAMPF provides a new and powerful means for carrying out an extensive program of research over a broad spectrum of scientific interest. Although mainly a tool for the atomic, nuclear, and elementary particle physicist and radiochemist, the machine also holds considerable interest for the biologist and solid-state physicist. It has important applications in medicine, isotope production, defense science, and the study of the structure of materials. This fact is of particular interest to this survey because the facility, like that of the proposed space shuttle facility, must cater efficiently to the needs of diverse groups of users, all with a variety of needs and requirements.

Administration & Operation

LAMPF is available for use by qualified members of the entire scientific community. Nearly 1,000 such members from more than 225 institutions are already members of the LAMPF Users Group.

The Users Group of LAMPF is an organization of active scientists and engineers with an interest in LAMPF and its research program. The purpose of the group is to provide a formal channel for the exchange of information between the LAMPF administration and scientists of other laboratories who will utilize LAMPF facilities in their research. It is intended to provide a means for involving scientists and engineers who are members of the Users Group in specific projects at LAMPF and additionally, to provide a channel for offering advice and counsel to the LAMPF management on operating policy and facilities.

To emphasize the significance which the LAMPF administration attaches to the user group, some of the members of the Program and Scheduling Committee are selected from candidates proposed by the Users Group.

Membership in the users group is open to practicing scientists and engineers. A four man executive committee is elected annually. The executive committee recommends the names of user scientists for consideration as members of LAMPF's Program and Scheduling Committee. Proposals for use of the facility are reviewed periodically by the fifteen member Program and Scheduling Committee. About half the members are theoreticians, half experimentalists. The committee members are predominantly from outside the Los Alamos Scientific Laboratory (LASL).

In addition to providing members to the Program and Scheduling Committee, the users group executive committee appoints a twelve member Technical Advisory Panel (TAP) from the membership of the Users Group. TAP collaborates with the staff of LAMPF in framing future plans and in devising new experimental facilities.

A LAMPF policy board composed of distinguished senior scientists is appointed by the director of the Los Alamos Laboratories to advise him on LAMPF operations.

An unusual feature of the LAMPF Users Group is the fact it has been incorporated. The incorporation is aimed at providing a legal entity which can provide services which will promote the most effective utilization of LAMPF facilities. Services contemplated are providing living accommodations for users, acquiring and disposing of property, administering trusts and the raising of required monies. A block diagram of the administrative organization of LAMPF is given in Fig. 3 and a similar diagram of the structure of the users organization is given in Fig. 4.

The LAMPF is coming into full operation at this time and it is a bit too early to evaluate the effectiveness of the users organization. The major complaints voiced by users to date appear to be related to shortage of funds which is reflected in the inadequacy of services such as the electronics pool available to the users.

The resident LAMPF scientific staff, while providing only one fourth of the principal investigators of currently

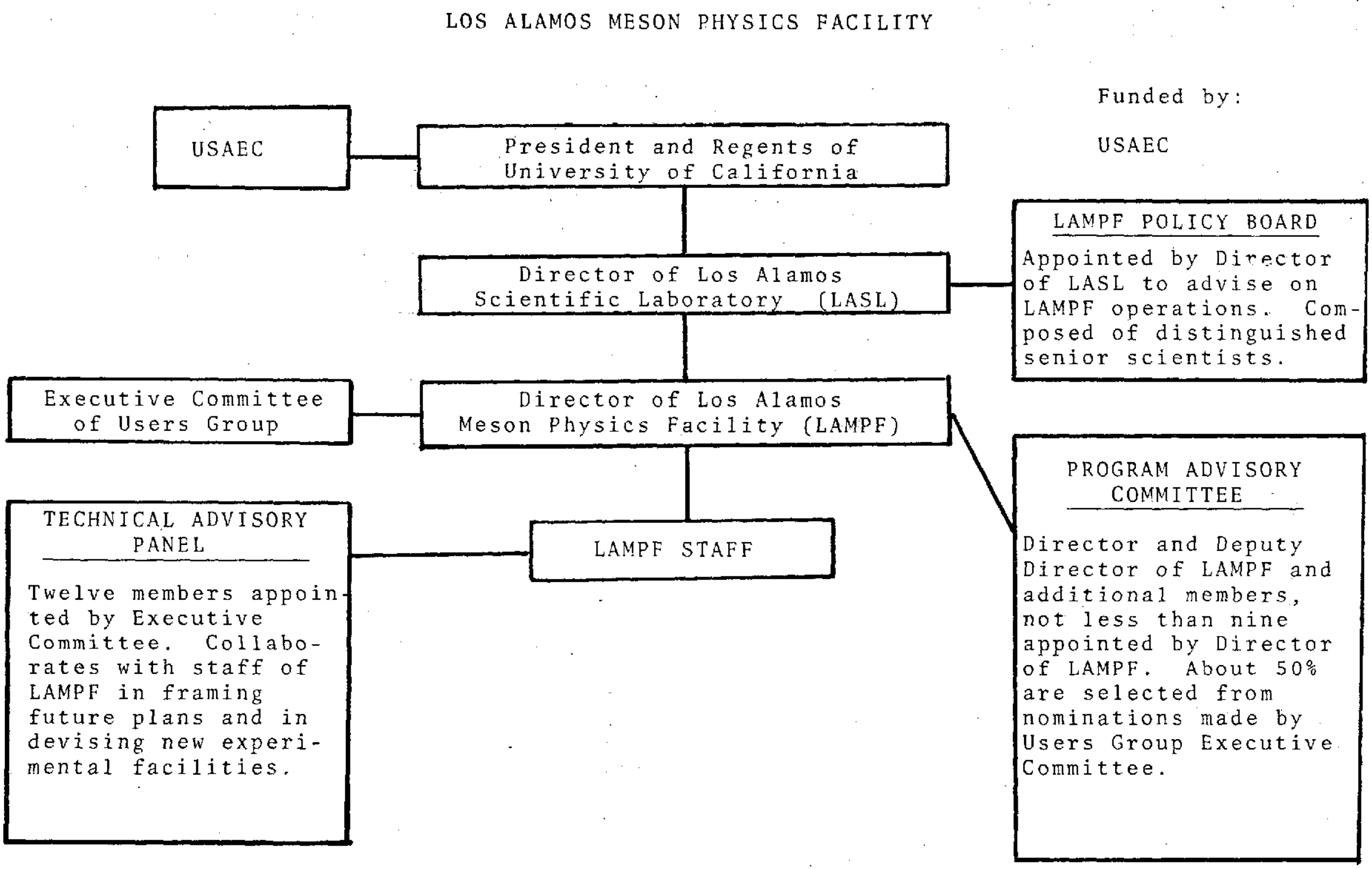


FIGURE 3
LAMPF Administrative Organization

LOS ALAMOS MESON PHYSICS FACILITY

USERS GROUP

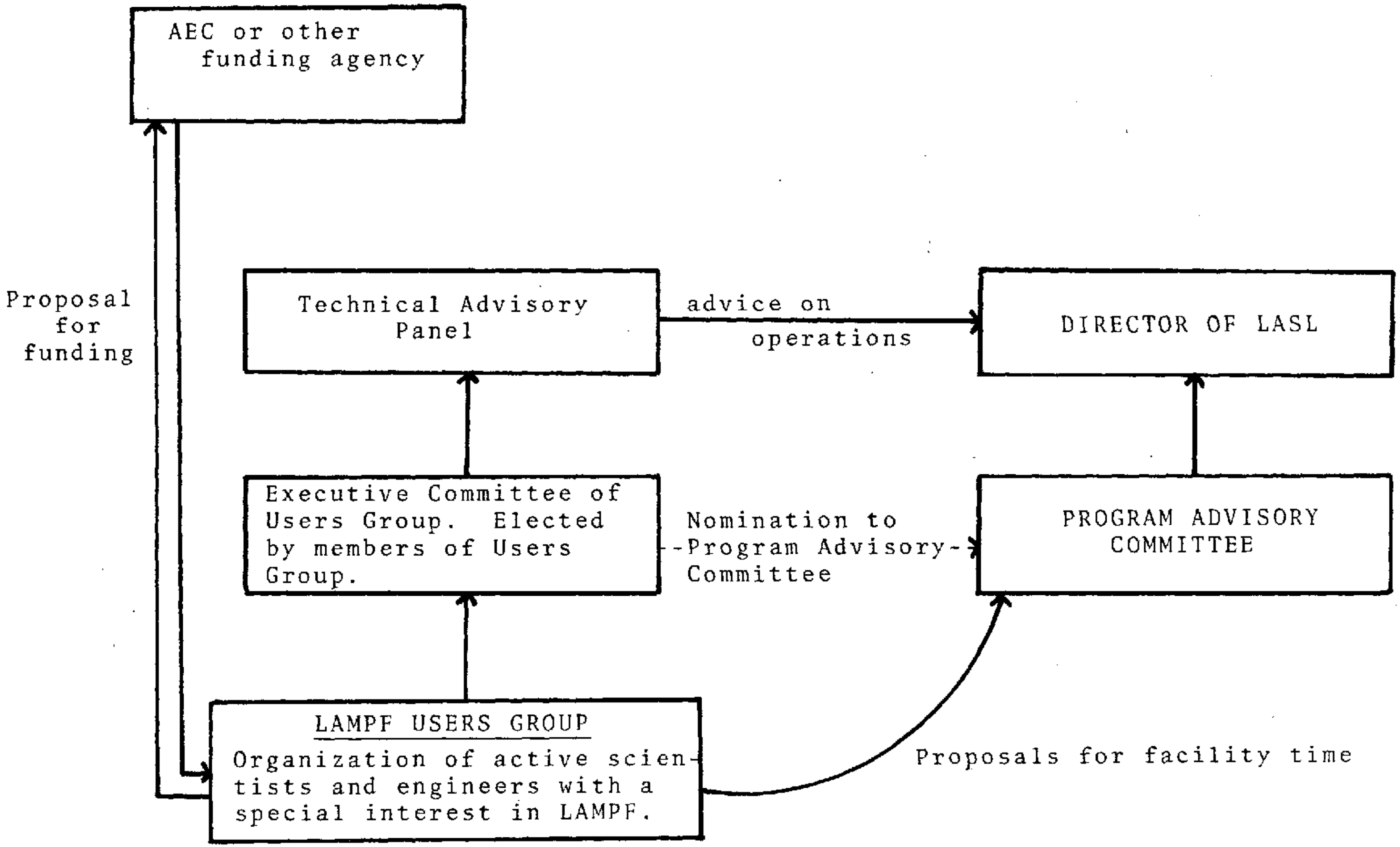


FIGURE 4

LAMPF Users Group

approved programs, is thought to be of great importance in providing scientific leadership.

Funding

Capital Investment	$ 57,000,000
Operating Costs (FY '75)	15,000,000
Visiting Scientist Support	
Expendable Equipment Fund ($5000 per experiment, 26 experiments)	130,000
Direct Support	57,000

BROOKHAVEN NATIONAL LABORATORY
Upton, New York

Three of the national facilities covered in this report are part of Brookhaven National Laboratory, which is a national center for nuclear research. A brief history of the laboratory is set forth in Appendix A. The top administrative structure, common to all these Brookhaven facilities treated in this report, is shown in Fig. 5.

BROOKHAVEN NATIONAL LABORATORY (BNL)
Upton, New York

THE ALTERNATING GRADIENT SYNCHROTRON

Purpose

The alternating gradient synchrotron (AGS) was designed and built by Brookhaven scientists to explore the relatively unknown regions of high energy physics. This protron synchrotron operates at energies up to 33 GeV. The protons are started on their journey to high energies by the Cockcroft-Walton generator, which provides an initial energy of 750,000 electron volts to the protons. They are then injected into a 450-foot-long, 200-million-electron-volt (MeV) linear accelerator, which in turn injects the protons into the circular path of the AGS. In the main accelerating section of the synchrotron, contained in an underground tunnel 18 by 18 feet in cross section and one-half mile in circumference, the particles are accelerated in a vacuum chamber that is positioned in the jaws of 240 strong-focusing magnets. These magnets serve to keep the protons in their proper orbits. Acceleration is accomplished by means of radiofrequency accelerating stations spaced around the vacuum chamber. Within one second the protons travel more than 300,000 times around the machine, reaching a speed more than 99.9% of the speed of light (about 186,000 miles per second) with an energy greater than 30 GeV. At this time a target is inserted into the proton beam inside the vacuum chamber, or the proton beam is extracted magnetically and conveyed to a target outside the accelerator tunnel. When the protons strike the nuclei of the target atoms, various high energy particles are produced. Beams of these particles are conducted into the experimental areas, where they are detected in bubble chambers, spark chambers, scintillation counters, or photographic emulsions. The results serve to

BROOKHAVEN NATIONAL LABORATORY

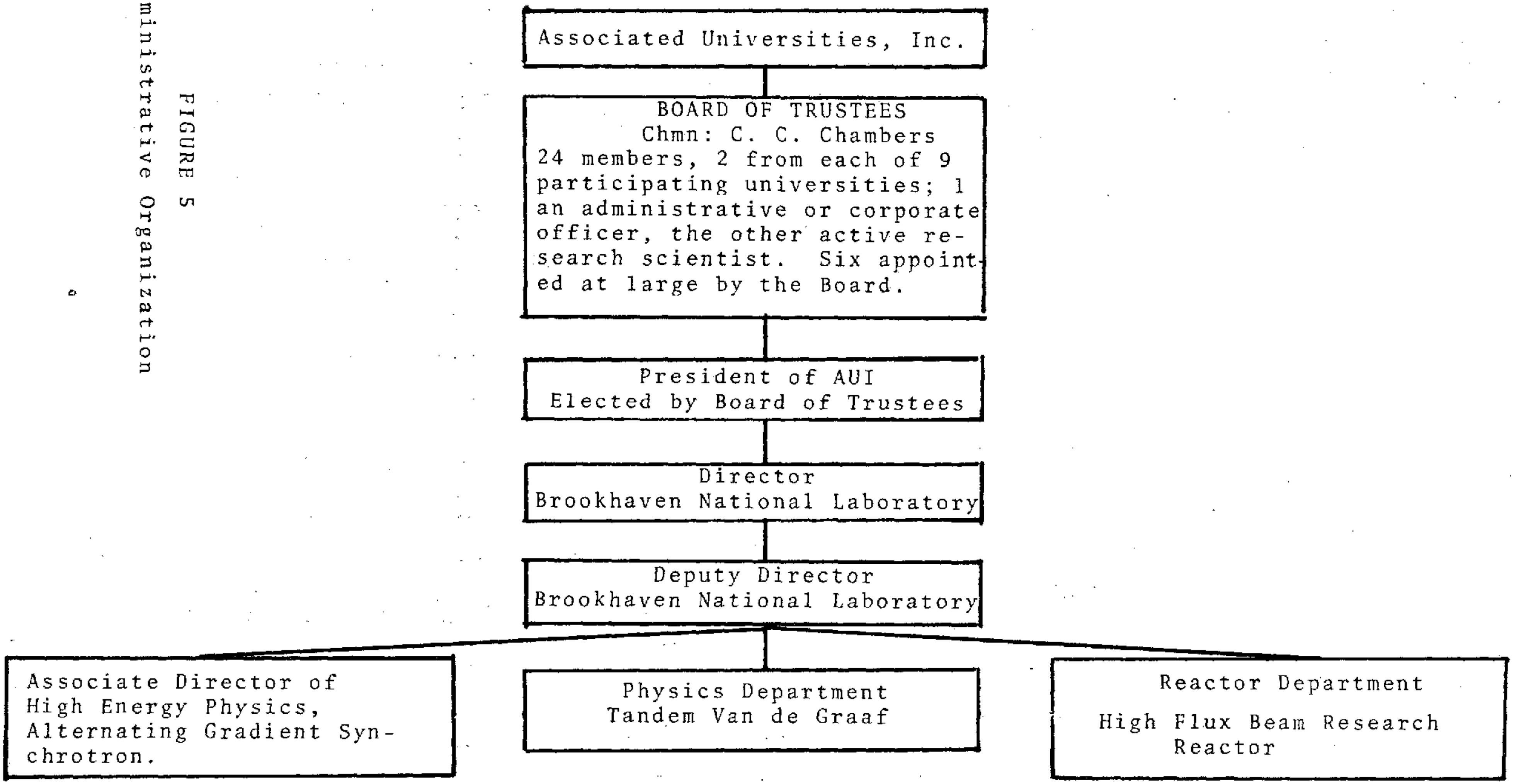


FIGURE 5

BNL Administrative Organization

increase knowledge of the complicated nature of elementary particles and sometimes produce previously unknown or unobserved particles such as the omega-minus hyperon, first observed at the AGS.

Administration & Organization

A users discussion group has been established to provide an organized channel for the interchange of information between those who utilize BNL high energy facilities for their research and the laboratory administration. The discussion group formation was in response to dissatisfaction expressed by university scientists with the degree of impact on operation and policy available to them. The purpose of the discussion group is to encourage communication between the users and the administration. The discussion group is not to consider the detailed experimental high energy program itself; this function is carried out by the BNL high energy advisory committee. The advisory committee consists of three laboratory staff scientists and six outside university members. They review proposals for experiments and make recommendations to the director, who makes the final decision. In long range planning the laboratory seeks the best possible advice on its scientific programs and the board of trustees selects a visiting committee, whose membership is drawn from senior, eminent scientists who evaluate laboratory programs.

BNL high energy scientists play a major role in planning and in the operation of the AGS machine. They assist other users in operating the facility and often are involved in cooperative programs.

A block diagram of the organization of the AGS is given in Fig. 6.

Funding

Physical Cost of Construction	$ 100,000,000
Cost of Support Facilities	8,560,000
Annual Operating Costs	6,600,000

BROOKHAVEN NATIONAL LABORATORY

Alternating Gradient Synchrotron

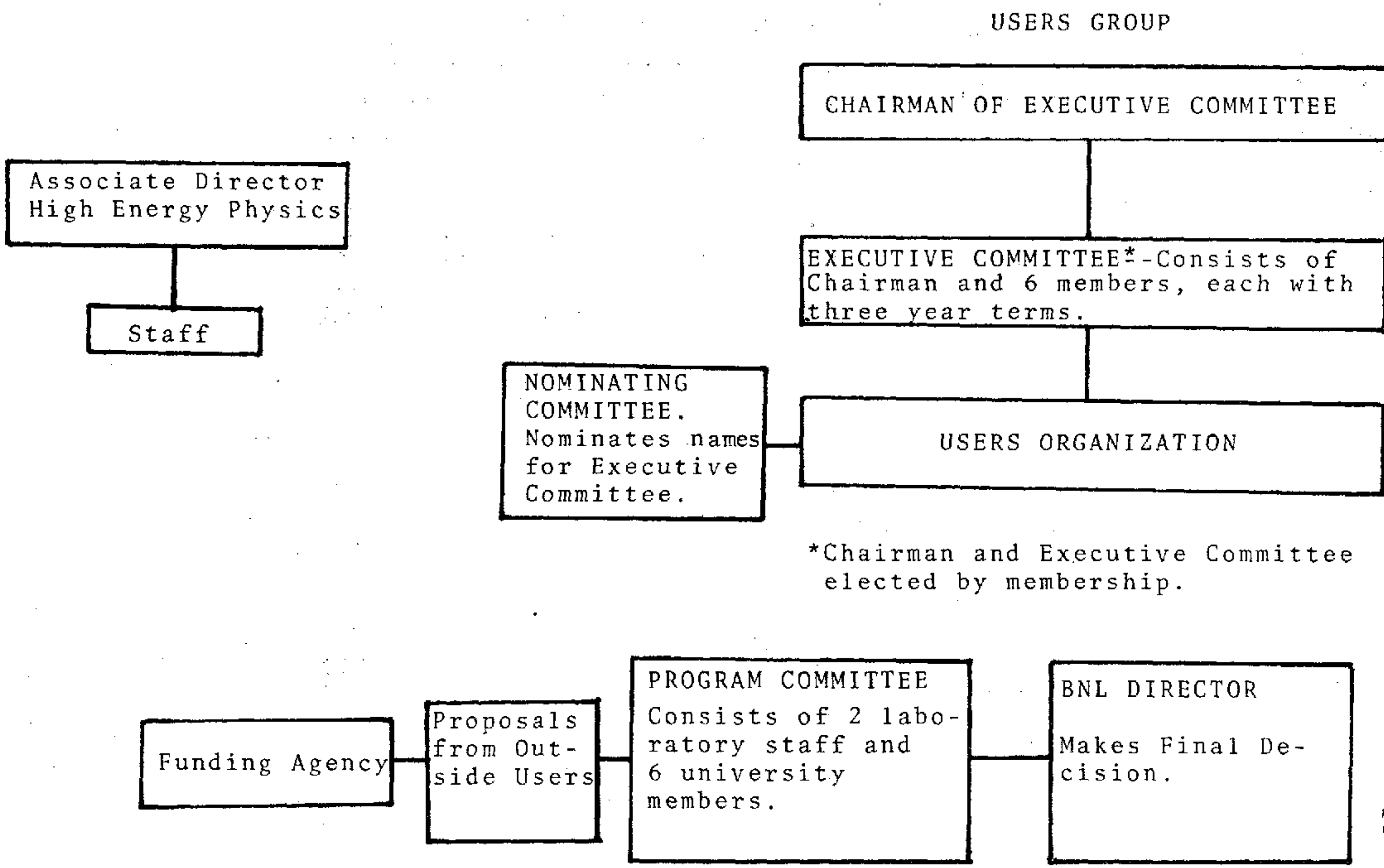


FIGURE 6

AGS Administrative Organization

BROOKHAVEN NATIONAL LABORATORY (BNL)
Upton, New York

THE TANDEM VAN de GRAAF FACILITY

Purpose

The Tandem Van de Graaf is now in routine operation for the study of all types of nuclear structure physics. Each of the two accelerators are 80 feet long and 18 feet in diameter in the central region. The unique feature of these accelerators is that they will accelerate any type of charged ion throughout the periodic table and these various types of heavy ions are being used in many new studies of nuclear level structure and various types of reaction mechanisms. Although the maximum energy capability for protons is 30 MeV many types of heavy ions like sulfur and chlorine can be accelerated to energies as high as 80-1000 MeV. The analyzed outputs of sophisticated particle detectors deployed in automated scattering chambers are fed into computers allowing data to be accumulated at an exceptionally rapid rate. Two or three days of machine time suffice for accumulating the necessary data for a typical experiment. During the past year approximately 20 projects were carried out at the Tandem facility, which involved around 38 faculty members and 15 graduate students.

Administration & Operation

The Tandem Van de Graaf is administered by the Physics Department of the Brookhaven National Laboratory and the Chairman of the Physics Department bears the prime responsibility for the operation of the facility. A resident staff of about fifteen scientists use the facility for their research. The resident staff is responsible for maintaining the proper operation of the facility and for initiating innovative improvement aimed at keeping the facility in the forefront of the field. Half of the operating time of the facility has been dedicated to the use of the resident staff. Although the research program of a resident scientist is subject to a critical evaluation by the whole resident group, it is neither formally submitted nor reviewed. Outside users are allotted the remaining half of the operating time of the facility. Until recently research proposals submitted by outside users were judged by the resident staff. Now a program committee has been constituted with a substantial non-resident membership to allow non-resident scientists a stronger voice in the allocation of that half of the facility time dedicated to their use. The program committee members are selected by the Chairman of the Physics Department and include two Brookhaven scientists and four outside users. The program committee has approved all proposals submitted to date.

A Users Group has recently been organized at the Tandem Van de Graaf Accelerator Facility. The rationale for the formation of this group reflects the major changes which have taken place in low energy nuclear physics in recent years. It has become apparent that funding for individual university laboratories was decreasing and that university users would need to engage in cooperative research carried out at facilities such as those at BNL. The Users Group is modelled after the one associated with the AGS facility at BNL. Membership in the Users Group is open to all interested scientists. Approximately two hundred scientists are kept informed of the operation but only about sixty participate in the Users Group meetings. The Users Group elects an executive committee who in turn elects a chairman. The executive committee represents the interests of the user community. Although the Users Group is dedicated to improving the communication between the users and the laboratory, the group also seems to be addressing itself to the problems of the status of low energy physics in a broad sense. A block diagram of the organization of the Tandem Van de Graaf is given in Fig. 7.

Funding

Physical Cost of Construction	$ 12,120,000
Annual Operating Cost (FY '74)	1,125,000

BROOKHAVEN NATIONAL LABORATORY

Tandem Van de Graaf

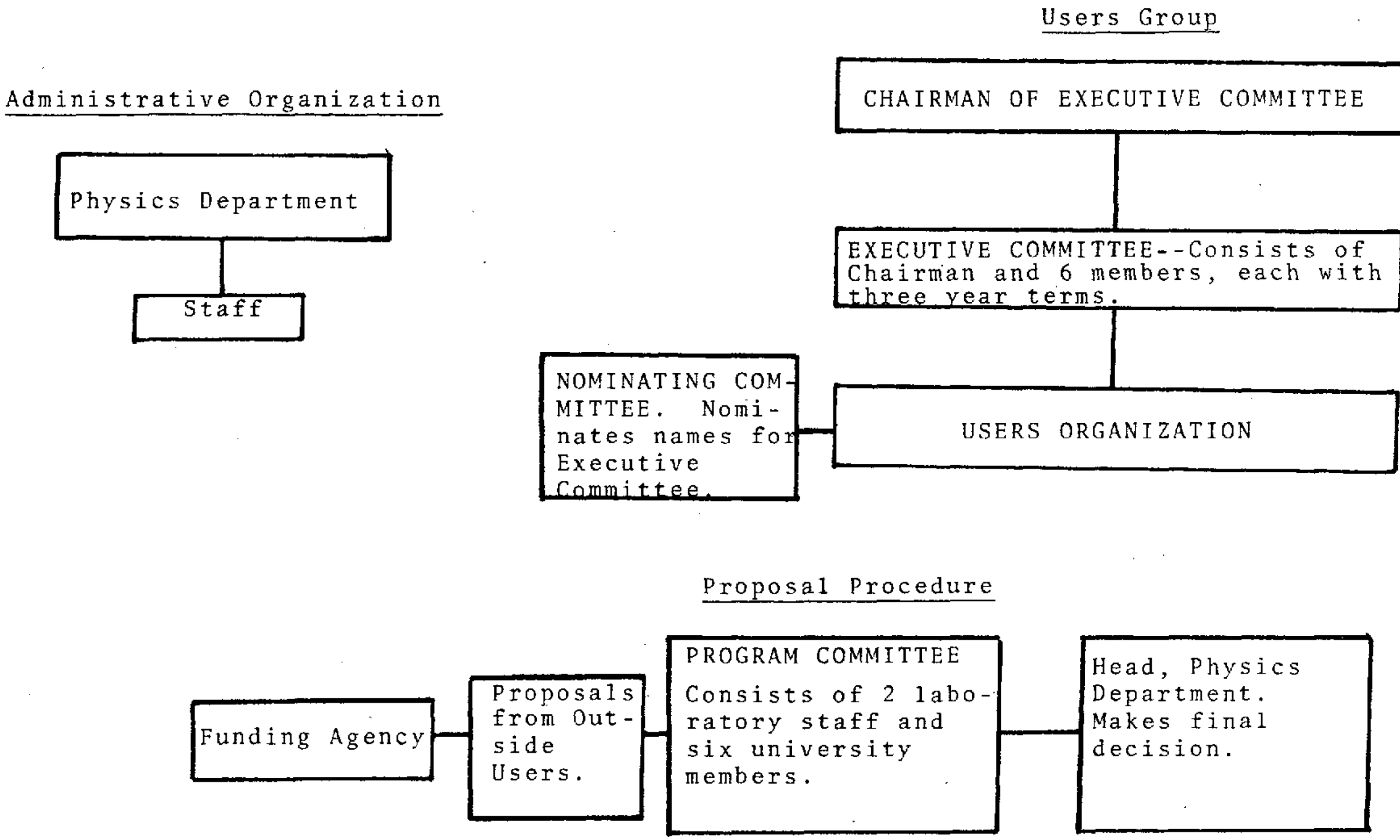


FIGURE 7

TVG Administrative Organization

BROOKHAVEN NATIONAL LABORATORY (BNL)
Upton, New York

HIGH FLUX BEAM REACTOR (HFBR)

Purpose

The high flux beam reactor is one of the newest and most advanced design research reactors in the United States. It provides intense beams of neutrons for a variety of research purposes. As experimental techniques have improved, an increasing need has arisen for higher neutron fluxes. The essential feature of the HFBR is its compact core of enriched uranium fuel elements operating at high power density in heavy water. The heavy water surrounding the core serves as coolant, moderator, and reflector. The maximum total flux is about 1.6×10^{15} neutrons per square centimeter per second. The HFBR is housed in a three-story, airtight, domed building. The bottom floor houses the operating machinery and the spent-fuel storage canal, the second or ground floor is for beam experiments and laboratories, and the top floor accommodates the control room, irradiation experiments, and fuel handling operations.

Of the sixteen experimental stations, seven are for irradiation experiments inside the reactor and nine provide beams of neutrons for experiments outside it. The external beams are brought out through the shield in beam tubes. They are used with choppers and spectrometers for resonance measurements, crystal diffraction studies, polarized neutron bombardments of magnetic materials, and fast neutron cross section measurements.

Administration & Operation

The HFBR is part of the Reactor Group of the laboratory. The head of the Reactor Department is directly responsible for the operation of the facility. Resident staff groups in areas of physics, chemistry and biology are the principal users of the facility. The in-house staff conducts their own research and are also responsible for renovation and innovation. The view was expressed that a major facility requires a responsible, and capable resident staff. Academic visitors, post-doctoral fellows and students use the facilities in collaboration with the resident staff. Arrangements for use are informal and almost always involve cooperative investigations. The fact that the community of users is small and known to each other, makes it possible to satisfy almost all demands and needs. Only one proposal for research has been turned down--primarily on the basis of the major modifications of the reactor which it would have required.

A reactor users group was formed to plan the HFBR. This group consisted of the senior reactor users on the Brookhaven staff. The group made decisions on priorities and decided on various compromises. Since it was decided that a multi-purpose reactor would not be optimum, the group needed to decide which functions should be emphasized and the decision was made to concentrate on the external beam aspect. The group worked closely with the designers to insure that their needs would be met.

A block diagram of the organization of HFBR is given in Fig. 8.

Funding

Physical Cost of Construction	$ 12,000,000
Modifications	300,000
Operating Costs (FY '74)	1,329,000*

*This does not include fuel costs. They are utilizing fuels paid for in previous budgets and the figure including fuel would be about $1,600,000

BROOKHAVEN NATIONAL LABORATORY

High Flux Beam Reactor

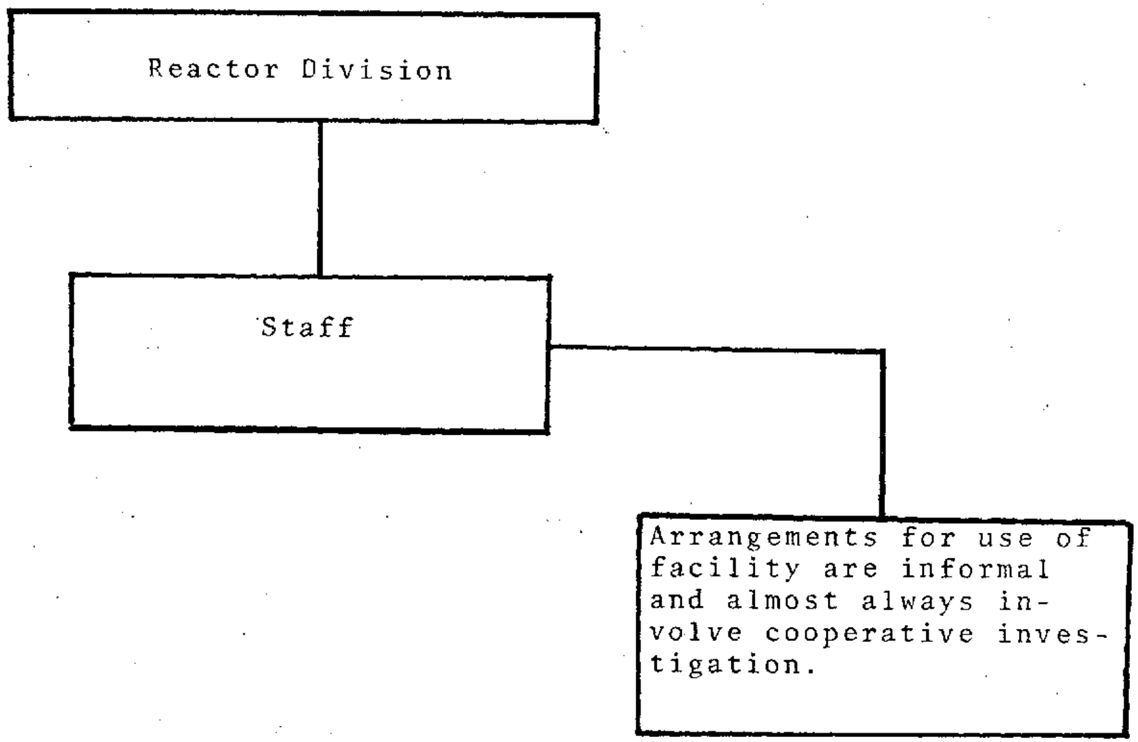


FIGURE 8

HFBR Administrative Organization

KITT PEAK NATIONAL OBSERVATORY (KPNO)
Tucson, Arizona

Purpose

Kitt Peak National Observatory (KPNO) was organized to provide high quality optical astronomy facilities in a favorable location to a wide community of observers. The KPNO observational facilities are located on Kitt Peak, in the Quinlan Mountains, about 60 miles southwest of Tucson, Arizona. Three scientific divisions are contained within the organizational structure of the Kitt Peak National Observatory. They are:

1) Stellar Division -- Performs basic research on galaxies, stars, nebulae, and the solar system (except for the sun), currently utilizing two 16-inch reflecting telescopes, two 36-inch reflecting telescopes, an 84-inch reflecting telescope, and a new 150-inch reflector.

2) Solar Division -- Performs basic research in solar astronomy utilizing the McMath solar telescope, with an 80-inch heliostat, the largest solar telescope in the world and two 36-inch heliostat solar telescopes, which use the same tower as the 80-inch but which are optically and operationally independent.

3) Planetary Sciences Division -- Conducts planetary research by means of ground-based observations and rocket-borne experiments, supplemented by laboratory and theoretical analysis and by planetary probes launched by NASA. The Division's rocket facilities are available to qualified university astronomers for astronomical research.

Administration & Operation

KPNO is operated by the Association of Universities for Research in Astronomy, Inc., (AURA) under contract with the National Science Foundation (NSF). The AURA consortium consists of twelve member universities. The AURA board, which is composed of two members from each of the twelve sponsoring universities, one scientist and one administrator, and six non-university members, is the senior administrative body. These are appointed by their universities for a period of three years, and their terms are usually renewed. The board dictates broad policy, but deals little with normal operations. There are several subcommittees to oversee operations of individual divisions, and an Executive Committee meets every three months to conduct necessary business. The full board meets just once a year. The director of the laboratory has established a small group which consults with him on various phases of the operation of the facility. This group, whose members are selected by the director, is something like an executive committee of a users group.

The facility is used by both KPNO staff members and by visitors. Observing time for visitors is 60%, while 40% is reserved for use by the KPNO in-house staff of some thirty scientists. Although the majority of the visitors are from the United States, foreign users are also welcomed, (approximately 10% of the users are foreigners). The KPNO is able to supply maintenance and travel funds for scientists while they are using the facility. The scientists base salary is presumed to be supplied by his own institution.

A comprehensive facilities manual outlining the capabilities of the KPNO is given a rather wide distribution. Periodic notices of the availability of the facilities and reports on their utilization are published in journals of the American Astronomical Society.

Use of the facility by visitors is obtained after the approval of a users proposal by the Telescope Allocating Committee. This committee, whose members are appointed by the director, consists of 9 members, three of whom are KPNO staff members. The term of appointment is two years. Proposals are reviewed by staff members whose interests are in the relevant branch of astronomy. The allocation committee may suggest merging of effort of several similar proposals.

The KPNO staff has the responsibility for developing, maintaining and improving the instruments at the facility. A typical professional staff member devotes about one-third of his time to proposal evaluation, scheduling, and other observatory duties, the rest to his personal research. Viewing time for the staff is worked in by mutual agreement.

New instrumentation for the telescopes is developed only when a KPNO staff member is personally interested, although ideas may also come from outside. Pressure from outsiders, however, appears to be almost non-existent. Much of the design of instrumentation, and even of telescopes, is done at KPNO. The McMath solar telescope was designed entirely in-house, with Dr. A. K. Pierce as Project Manager. The 150-inch telescopes have also had an astronomer, Dr. D. L. Crawford, as Project Manager, overseeing all stages of their design and construction thus insuring their utility to astronomy.

In FY '73 approximately 200 visiting astronomers utilized Kitt Peak facilities. Most of the projects involve a relatively small number of scientists and many of the projects are carried out by individuals.

A block diagram of the administrative organization of Kitt Peak National Observatory is given in Fig. 9.

Funding

Capital Investment

Telescopes and research instruments	$ 24,000,000
Land	1,900,000
Buildings	4,200,000
General Equipment	6,300,000

Annual Budget (FY '74) 7,800,000

Visitor Travel	$ 27,000
Visitor salaries	100,000

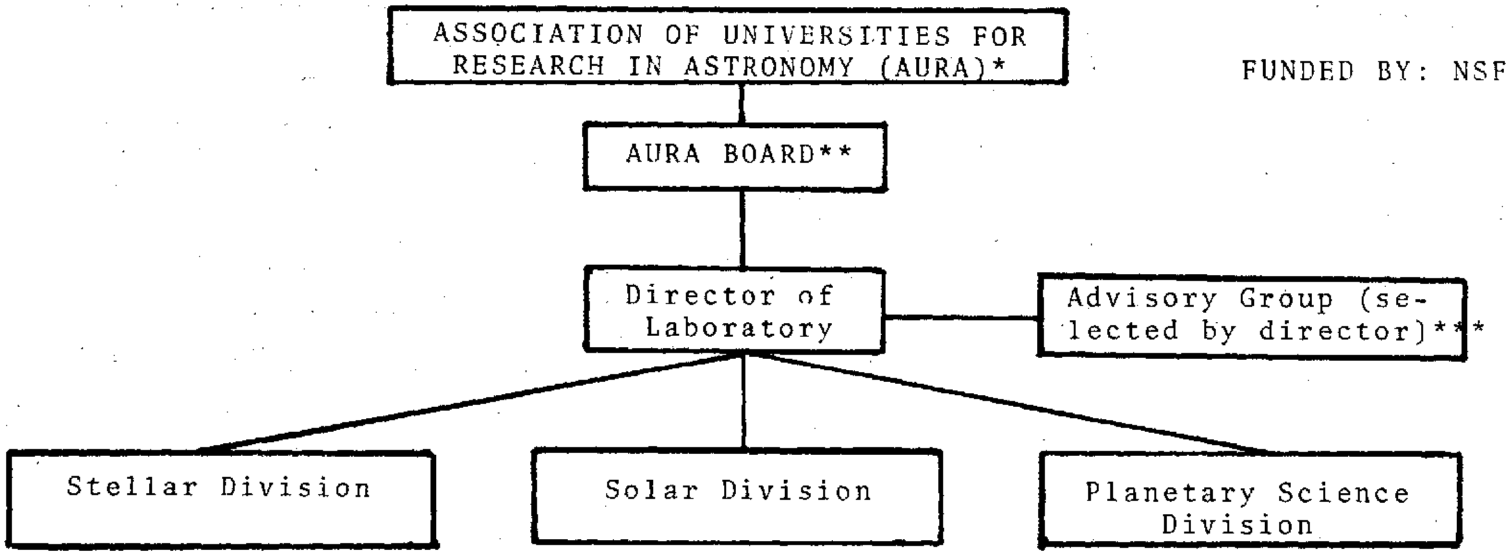
Indirect Support

CDC 6400 computer, photolab and library	500,000
Facility maintenance	1,700,000
Stellar	1,200,000
Accounting	760,000
Engineering	70,000

FIGURE 9

KPNO Administrative Organization

KITT PEAK NATIONAL OBSERVATORY

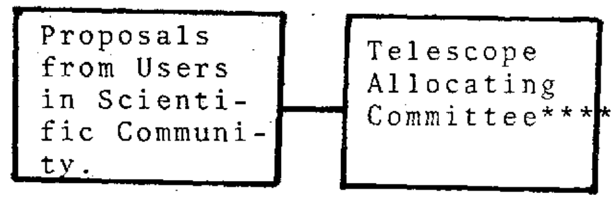


*Consortium of 12 universities

**30 members; 2 from each participating university; 6 non-university members.

***No formal users group--this group functions something like an executive committee of a users group.

****Nine members are appointed by director, 3 of whom are KPNO staff members.



NATIONAL ASTRONOMY AND IONOSPHERIC CENTER (NAIC)
Ithaca, New York

Purpose

The principal component of the NAIC is the Arecibo Observatory, located at Arecibo on the north coast of Puerto Rico. The Arecibo radio telescope was designed primarily for detailed study of the ionosphere. The design adopted consisted of a movable feed suspended over a bowl-shaped reflector, 1000 feet in diameter. The feed would permit directing a beam of radio energy on the reflector, which would reflect it anywhere within a 40-degree cone centered overhead and would receive energy collected by the reflector.

The site desired was a natural depression, in order to minimize excavation for the huge dish, and located away from populous areas and air lanes in order to reduce radio interference. It had to be in the tropics for studies of the moon and the planets, because only there do these objects pass sufficiently nearly overhead. Furthermore, a site with moderate temperature changes and low winds was desirable for the stability of the structure and to reduce swaying of the suspended feed. The 125-acre site finally chosen by aerial survey was a natural sinkhole formed by the collapse of huge limestone caves and protected by the surrounding hills.

The telescope was designed under contract with the U. S. Air Force Cambridge Research Laboratories, and was completed in 1963 at a total cost of about $9 million with funds from the Advanced Research Projects Agency of the Department of Defense. Title to the installation is held by the U. S. Government.

In astronomy, observations of radio waves are made using either radio or radar telescopes. A radio telescope receives the natural radiation emitted by the sun, planets, and other more distant celestial radio sources; but a radar telescope is used both to transmit a powerful radio signal out into space and then to receive the small amount of radio energy that is returned to it from objects in space. The energy is returned as an echo or scattered from electrons in the upper atmosphere.

The Arecibo installation functions both actively as a radar telescope and passively as a radio telescope. The capabilities of the instrument derive from its unique design which includes a large reflector, movable line feeds that correct for spherical aberration, and high-performance transmitters, receivers, and computers for taking data and analyzing them.

Scientific research at the Arecibo Observatory consists of three major programs; radio observation of celestial radio sources, radar observations of the moon and the planets, and radar studies of the earth's ionosphere.

The Arecibo Observatory makes available to astronomers and atmospheric physicists a research tool of great power and versatility. It is in operation day and night in any weather, and it is used each year by scientists from many universities. Many graduate students in ionospheric physics and radar and radio astronomy acquire research experience at Arecibo, and providing this training is an important function of the Observatory. Support at Arecibo includes a small scientific staff, electronics maintenance and development; mechanical engineering services; library darkroom and drafting services, and a computing center.

Administration & Operation

NAIC is operated by Cornell University under contract with the National Science Foundation. The President of Cornell University, in consultation with the National Science Foundation, appoints a Director of NAIC, who has primary responsibility for operation of the facility, and an advisory board made up of several eminent scientists to advise him on Arecibo matters. A Scientific Advisory Committee appointed by the Director, recommends action necessary to maintain Arecibo as a prime scientific facility. This committee has a membership of fifteen, ten of whom are not associated with Cornell. A diagram of the administrative structure and the various divisions is shown in Fig. 10.

Proposals for use of the facility are accepted from all interested scientists both U.S. and foreign. If there are no obvious technical problems the proposal is passed to three or more anonymous referees selected by the Director, in the field of the proposed research. The referees opinions guide the Director of Observatory Operations, who negotiates any required compromises and makes a decision as to acceptance and amount of observing to be assigned and scheduling. The Director of NAIC approves these decisions. From 1 February 1973 to 1 February 1974, sixty-four proposals were approved and three rejected. These proposals represented the ideas of sixty-five scientists or graduate students. The procedure for research proposals is summarized in Fig. 11.

NATIONAL ASTRONOMY AND IONOSPHERE CENTER

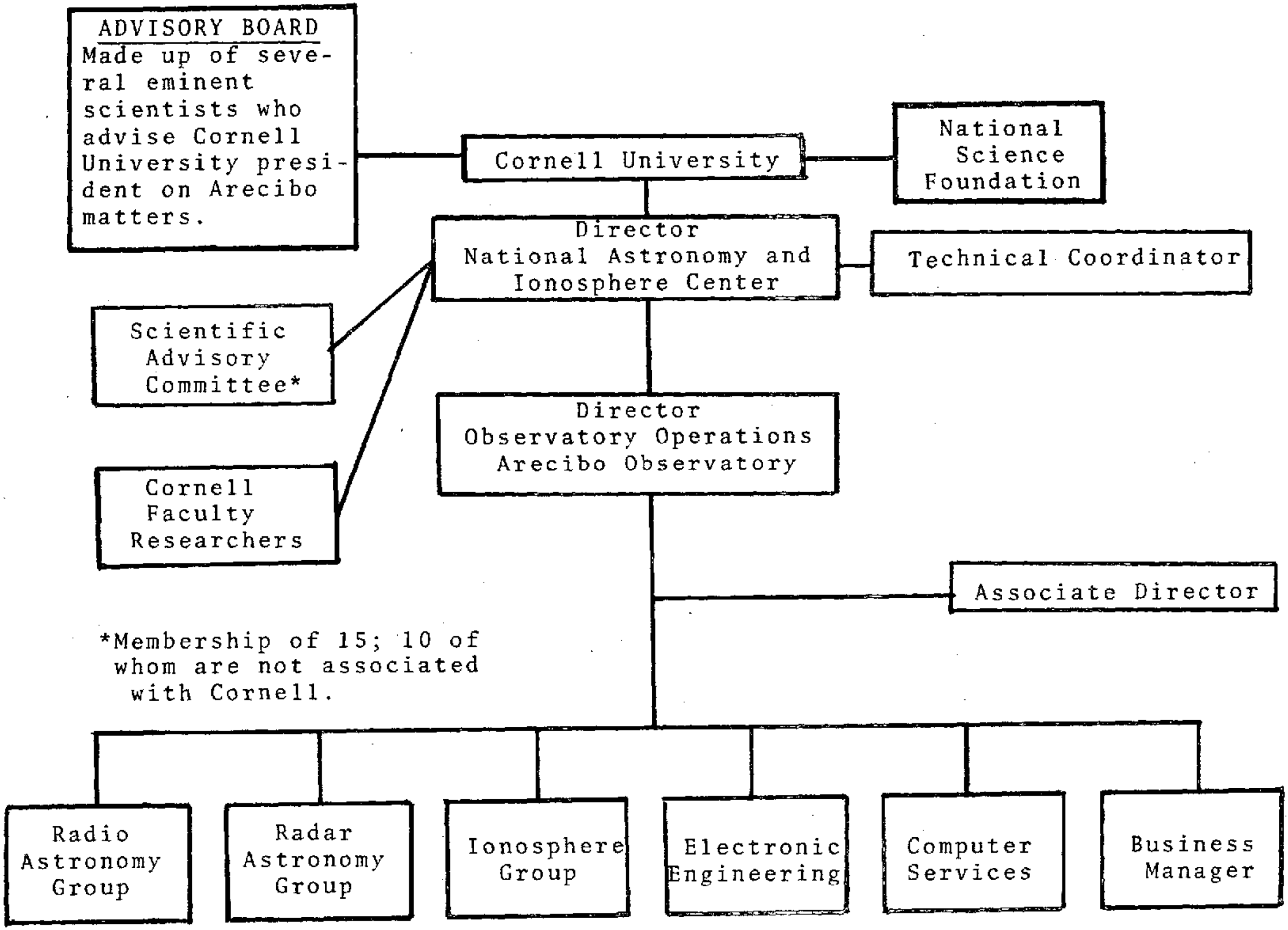


FIGURE 10

NAIC Administrative Organization

PROCEDURES WITH NAIC RESEARCH PROPOSALS

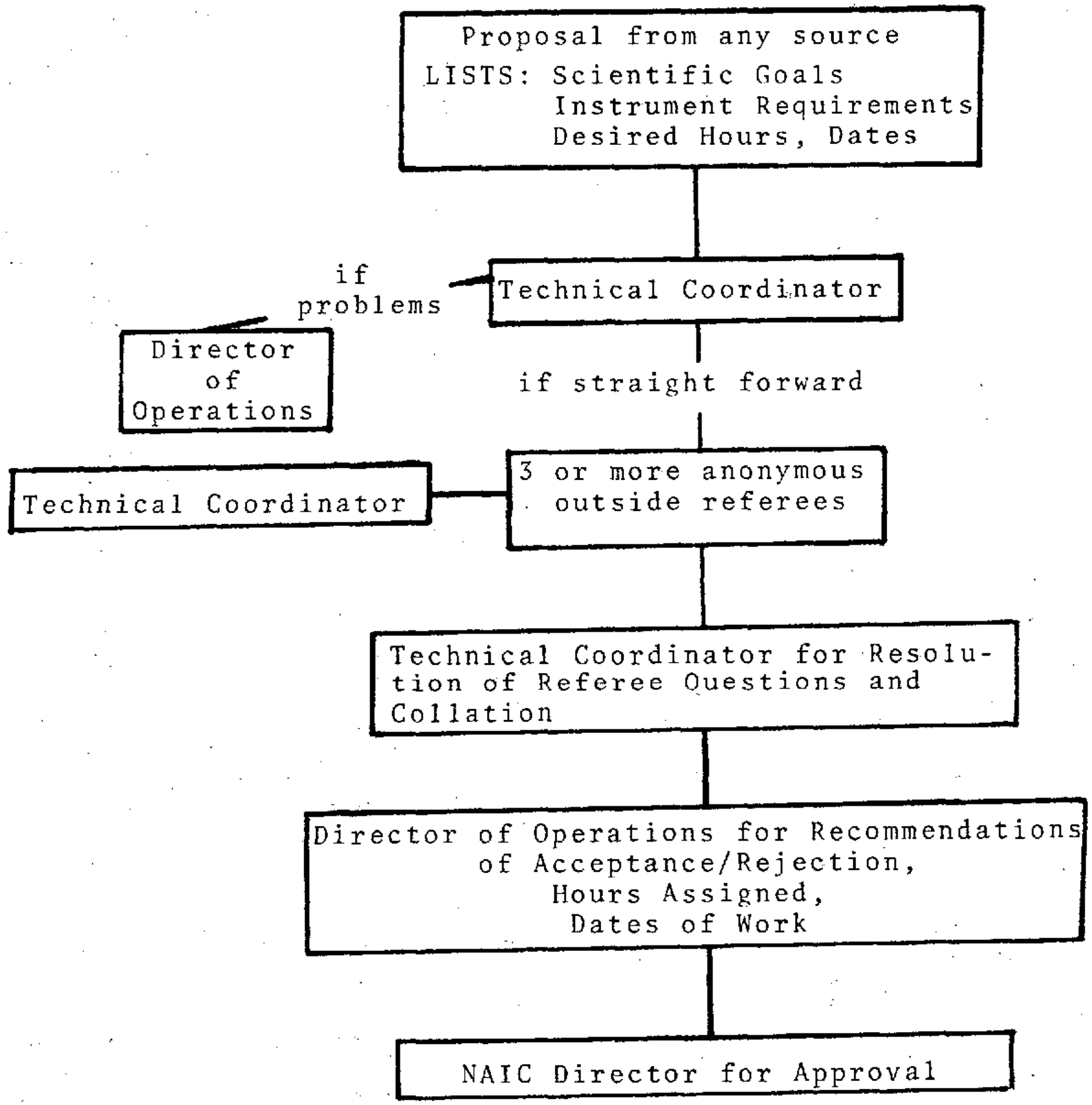


FIGURE 11
Procedure for NAIC Proposals

The NAIC staff makes use of about 30% of the observing time in doing their own research. They are responsible for maintaining and upgrading the instrumentation of the facility and help guide visiting scientists.

Depending on the availability of funds, NAIC will help scientists defray transportation and subsistence expenses at Arecibo.

The visiting scientist may, with prior approval, use non-observatory fabricated or supplied equipment but its use must be carefully coordinated with the observatory management to insure safety factors and proper interfacing. Modification of existing equipment may be undertaken by the observatory to satisfy the needs of an observer.

Funding

Capital Investment		
Equipment		$ 6,976,839
Real Property		1,158,000
Annual Budget*		
Resident scientist support	$290,000	
Visiting scientist support	25,000**	

*The amount appropriated for this fiscal year was $3,100,000; the $6,600,000 represents this fiscal year's budget plus additional monies already appropriated for two major upgradings.

**This $25,000 provides monies for some travel for visiting scientists and graduate student stipends.

FACILITIES LABORATORY OF THE NATIONAL CENTER FOR ATMOSPHERIC RESEARCH (NCAR) Boulder, Colorado

Purpose

The National Center for Atmospheric Research (NCAR) was founded in 1960 in order to provide a national institute devoted to atmospheric research. Priority is given to problems which are of interest to society. These major problems are usually suggested to NCAR by its board of trustees, which is drawn from senior, distinguished atmospheric scientists and they in turn are guided by recommendations made by National Academy of Science panels and other distinguished study groups. The National Science Foundation intends that NCAR make available large facilities, which would be beyond the resources of individual universities, to university scientists, and in addition feels that NCAR should engage in cooperative projects with university scientists. NCAR has its own resident scientific staff, whose role has been under study in recent years.

NCAR is comprised of four major divisions; Atmospheric Analysis and Prediction, Atmospheric Quality and Modification, High Altitude Observatory and the facilities laboratory. The facilities laboratory, is set up to provide research facilities for both University and NCAR users, and is comprised of a computing facility with CDC 7600 and CDC-6600 computers, a scientific ballooning facility at Palestine, Texas, and an aviation facility with a fleet of five aircraft specially instrumented for collecting meteorological data. The goals of the facility laboratory are both to develop and maintain a prime scientific facility and to provide service to outside users.

Administration & Operation

The bulk of the funding is provided by the National Science Foundation (NSF) but the NSF has handed over responsibility or managing the center to a consortium known as the University Corporation for Atmospheric Research (UCAR) which consists of delegates from the 39 universities that have atmospheric science departments. The Board of Trustees of UCAR is made up of representatives appointed by their member universities. This Board of Trustees selects the President of UCAR and in turn the Director of NCAR, who bears the direct responsibility for its operation.

Advisory panels have been set up for each operational facility. These panels are appointed by the director to review applications for use of the facility and to evaluate the operation of the facility and to recommend improvements in the facility. The members of the panels are drawn largely from university users. However, the panels have not evaluated those large projects which require firm commitments for facilities needed for carrying out long range projects. Although there is not formal users organization, UCAR is supposed to represent the needs and interests of the university scientists.

The general guideline for the development of new facilities is that they should serve an important function for Atmospheric Science research and there should be an NCAR staff scientist with an interest in using the facility. It is felt that without NCAR staff interest there exists neither a focus for improvement nor a commitment to quality. In fact, the first demonstration of the research potential of a facility should be by NCAR staffers, who establish the capability of the facility. Where the balance between providing service and doing research and development lies for the NCAR staff has been a matter of controversy and concern. It is felt strongly that there must be a strong scientific NCAR staff in each facility in order to provide communication between the technical staff and the University users. However, there may be some tendency for the staff to follow their own projects and not to be responsive to the broad concerns of NCAR, therefore a continuing evaluation of the staff is being instituted. The desired composition of the staff is a mixture consisting of 1/3 long term appointments, 1/3 renewable term appointments and 1/3 temporary visiting appointments, a mixture which appears to allow considerable flexibility in maintaining responsiveness.

New emphasis has been given to the long term planning and evaluation function of the advisory panels. It is felt that refereeing proposals can be accomplished without assembling the panels; panel meeting should deal with broader issues. A key consideration for the panels involves deciding the amount of time to be allotted to University users and to NCAR users. A subcommittee of the advisory panel has been charged with studying long term planning for the facility and means for increasing the effectiveness of the facilities use.

New emphasis has been placed on communicating with the users. A magazine regularly distributed to the users contains information on the facilities and details of programs being carried out.

A block diagram of the administrative organization of NCAR is given in Fig. 12 and a similar diagram describing the research proposals procedures is given in Fig. 13.

Funding

Capital Investment		$ 34,600,000
Land/Plant	$ 12,500,000	
Equipment	21,100,000	
*Operating Cost (FY '74)		18,900,000

*Approximately 1/4 of annual operating cost is expended for support of visiting scientists, some in the form of stipends and some in the form of subcontracts.

Recent Changes at NCAR**

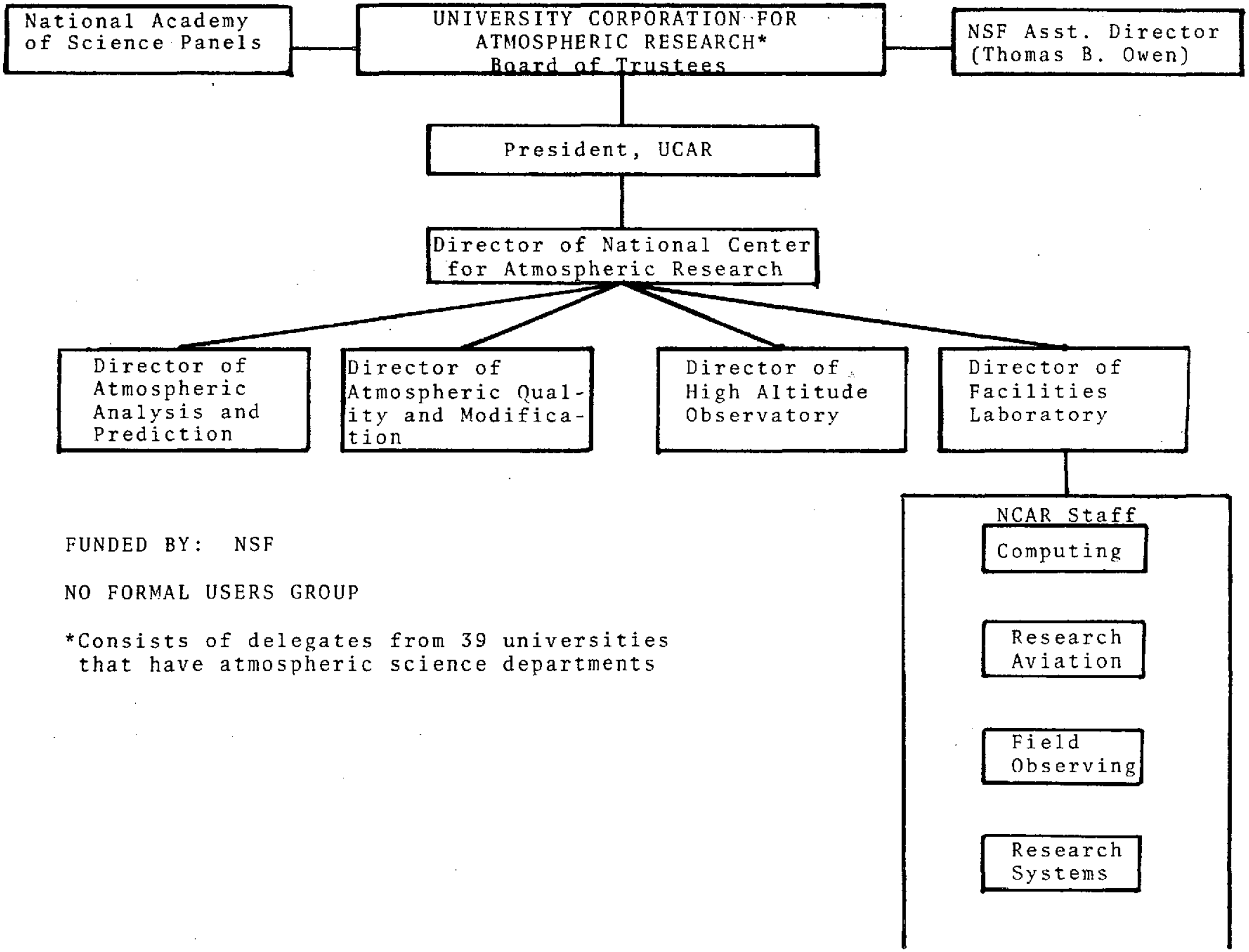
Five years ago NCAR was generally regarded as a pleasant and intellectually exciting place to work. Today, the laboratory is emerging from a shake-up which had driven morale to near bottom level and would probably have caused a mass exodus of scientists and jobs been available elsewhere. Although there are many reasons for the shakeup, probably the major ones are related to society's changing expectations of science, and the management's failure to perceive that the external pressures were building to a dangerous head.

For more than a decade the center went its own way without too much interference from either the foundation or the corporation. Last December a seven-man investigatory committee (JEC) appointed jointly by NSF and UCAR and chaired by Werner A. Baum, president of the University of Rhode Island investigated the operation of NCAR.

Although the JEC report was critical of the management and operation of NCAR, there were some in NCAR who took the attitude that it was nothing new. It was not indeed the first critical evaluation the center had received; according to the JEC report, management of the facilities had been criticized by the same UCAR subcommittee five times in nine years with little tangible effect. This time, however, there was an unusual determination on the part of UCAR that some reforms should be carried through, perhaps because the

**Science, Vol. 182, 5 Oct. 1973, p. 36.

THE NATIONAL CENTER FOR ATMOSPHERIC RESEARCH



FUNDED BY: NSF

NO FORMAL USERS GROUP

*Consists of delegates from 39 universities that have atmospheric science departments

FIGURE 12
NCAR Administrative Organization

THE NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

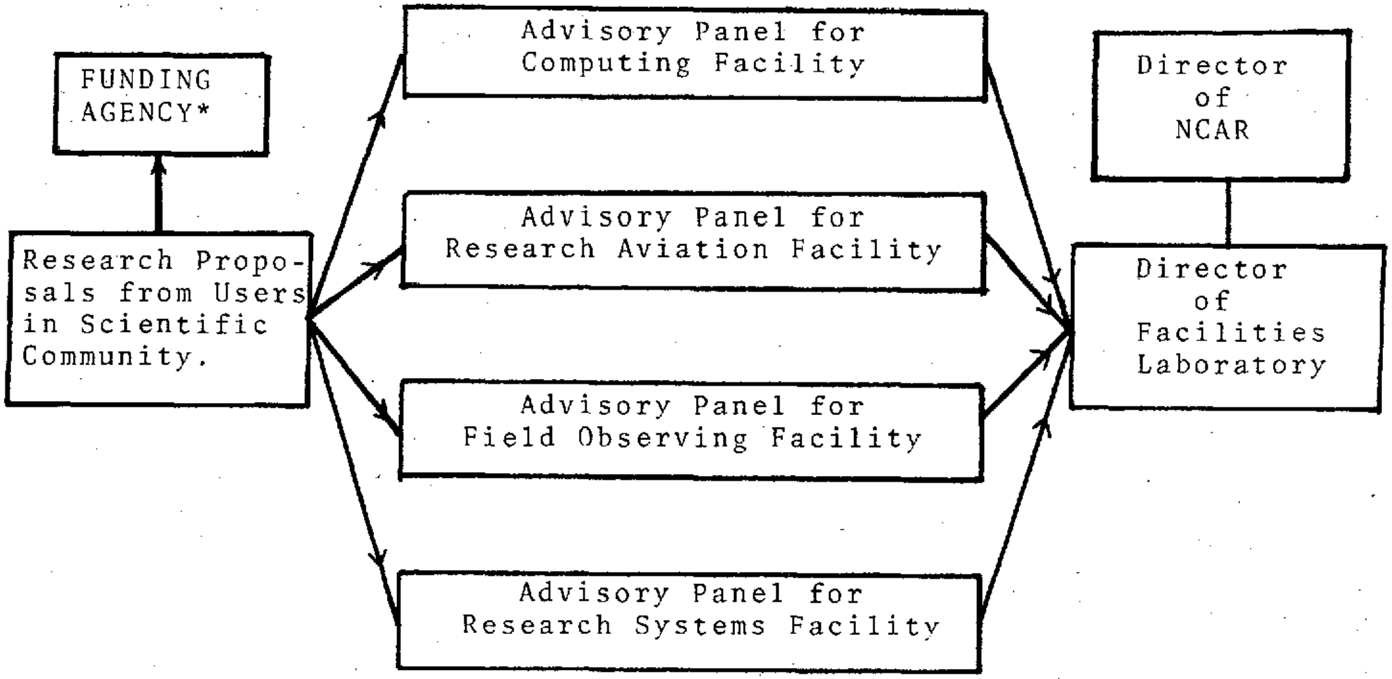


FIGURE 13
Procedure for NCAR Proposals

Advisory panels are appointed by the Director of Facilities Laboratory to review proposals. These panels are made up of University scientists.

*In some instances NCAR funds research projects.

universities had come to regard NCAR not as a purveyor of unique facilities to their own atmospheric scientists, as NCAR was intended to be, but rather as a close competitor. Given the tighter budgets of recent years, NCAR appeared to be siphoning off NSF money for work which the Universities felt they should be doing themselves.

The main work of the center had been organized along traditional disciplinary lines of atmospheric dynamics, physics, and chemistry, with each scientist free to do very much his own thing. Now everyone has been assigned to a specific, multidisciplinary project with a clearly defined goal and there has been an almost complete turnover of scientists at the middle management level.

The management of NCAR has left itself open to question on its method of organizing its scientific leadership. From the beginning NCAR policy has been not to provide scientific direction from on top but to hire good people and let them go their own way. This is fine--and no different from university practice--provided that the quality of research remained high. But, according to some NCAR scientists, there was no great selectivity in hiring and no strict evaluation of the scientific staff.

THE DEEP SEA DRILLING PROJECT

Purpose

The Deep Sea Drilling Project (DSDP) is a scientific program with the overall objective of the exploration of the earth's crust beneath the oceans. The broad strategy is to drill holes and obtain core samples of the sediments and rocks beneath the sea bed at many locations throughout the world. This is done using the dynamically positioned drilling ship GLOMAR CHALLENGER, the only research drilling ship to successfully sample deep beneath the ocean bottom under almost four miles of water.

GLOMAR CHALLENGER has living and storage facilities that permit her to remain at sea for months at a time. She has berthing for about 70 persons, including the ship's operating crew, the drilling crew, and the scientists and technicians. Living spaces, the bridge, and laboratories dominate the upper decks aft of the drilling derrick. The ship is fitted out with some of the best laboratories ever designed for the study of geological materials at sea.

Satellite navigation permits positioning the ship accurately at any time and provides precise location of the drilling sites. The ship receives daily satellite weather photographs of cloud patterns which are used in weather forecasts to increase the safety and effectiveness of the drilling operation and schedule.

To obtain the maximum amount of information possible, panels of knowledgeable scientists from many different institutions are brought together to recommend a suitable drilling program to Scripps.

The sites suggested by the panels permit scientists to sample the oldest sediments in the ocean basin; to test hypotheses of continental drift, sea-floor spreading, and plate tectonics; and to recover nearly complete sedimentary columns extending from the present to the oldest sediments deposited on the original sea floor. On each individual cruise, the co-chief scientists on GLOMAR CHALLENGER make the final selection of drilling sites after all recommended sites have been surveyed.

Each core receives immediate study on board ship. Of prime importance is determination of its geologic age. The first analysis is by paleontologists, who report the sample's age through studies of microfossils. Geologists then study the cores by microscope to describe their composition, grain size, and general mineralogy. They describe bedding (layering), structure, and color (by comparison with standard color charts). The cores are documented photographically because many properties, including color, will change in storage. Many samples are taken for additional study on shore. Then these exceedingly valuable cores are carefully packaged and placed in cold storage aboard GLOMAR CHALLENGER until they are shipped to permanent core repositories in the United States.

When the samples of the cores reach the laboratories on shore, the scientists there perform many other studies. In a computerized and automated X-ray diffraction laboratory, the cores are analyzed for their detailed mineralogy. Preliminary chemical analyses include determination of the carbon content and composition of the interstitial solutions (those trapped within the sediments). In addition, the paleontological age determinations are refined.

When the initial analysis that is performed uniformly on all the cores is finished, the material is stored in refrigerated repositories. Samples of the core material are made available by Scripps' curators to qualified scientists who request them for individual research investigations. It is expected that DSDP samples will be used for decades to come and will compose a permanent reference for marine geology. Scientists from about two dozen countries around the world have participated in the cruises or in the study of core material.

Administration & Operation

The DSDP is supported by the National Science Foundation through a contract with the University of California. Scripps Institution of Oceanography plans and manages the Project for the University. The Project is part of the NSF's National Ocean Sediment Coring Program.

A consortium of six institutions called Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES) furnishes advice to Scripps Institution of Oceanography concerning scientific plans for Deep Sea Drilling Project. The members of JOIDES are Lamont-Doherty Geological Observatory of Columbia University, Rosenstiel School of Marine and Atmospheric Science of the University of Miami, Scripps Institution of Oceanography of the University of California at San Diego, Department of Oceanography of the University of Washington, Woods Hole Oceanographic Instutution, and the P. P. Shirshov Institute of Oceanology of the U.S.S.R. Academy of Sciences. In 1972, scientists world wide pressed vigorously for participation in the DSDP. Recognizing the truly global scope of the Project, JOIDES has invited institutions of certain other nations to become full functioning partners in JOIDES. Coupled with this plan is a proposal for a program of additional deep drilling in the oceanic floor to be called the International Program of Ocean Drilling (IPOD) in recognition of its truly international scope.

Global Marine, Inc. of Los Angeles, owner, designer, and builder of GLOMAR CHALLENGER subcontracts with the Regents of the University of California to accomplish the drilling and coring.

The Administrative organization for the DSDP is shown in Fig. 14.

Shipboard Personnel

Aboard the GLOMAR CHALLENGER there are four principal personnel: The Captain of the Ship (Global Marine), the Operations Manager (Scripps), and the Co-Chief Scientists.

The Operations Manager represents Scripps Institution of Oceanography on the vessel, and he is responsible for the technical and operational success of the program. Within this context he plans, directs and supervises the activities of Global Marine, Inc. through their designated supervisor and is charged with the responsibility of insuring that the best possible techniques, equipment and work efforts are being utilized in drilling and coring to meet the objectives established by the scientific program.

The Co-Chief Scientists are responsible for the success of the scientific mission; and they are charged with the responsibility of following, as far as possible, the drilling and coring plans recommended by the site selection panels of JOIDES as reviewed and approved by the Project Headquarters. In particular, any site changes must be consistent with recommendations made by the JOIDES Pollution Prevention and Safety Panel. The site occupation schedule or locations of sites may be changed by the chief scientists at their discretion should they feel that the results of previous drilling or the demands of the ship's schedule or weather warrant this.

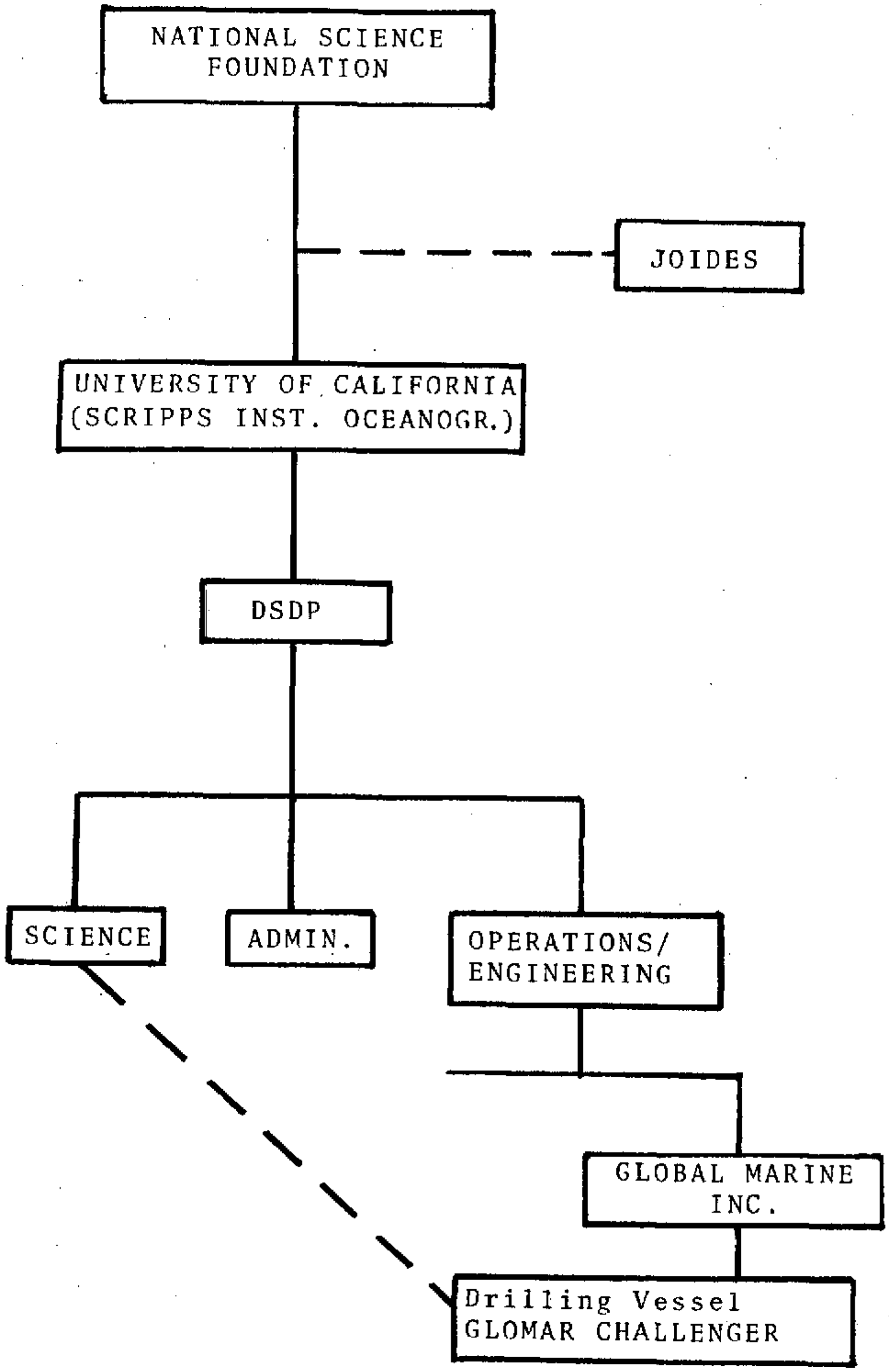


FIGURE 14

DSDP Administrative Organization

However, major changes of plan are usually made only after consultation with Headquarters

The Chief Scientists work closely with the Operations Manager and the Captain of the ship to insure maximum success of the cruise leg. They are expected to specify to the Operations Manager the drilling sites to be occupied, the depths of drilling at each site and the desired depths and extent of coring. Their authority in this matter is subject to exception only for reasons of safety of the ship, her equipment, the personnel on board or pollution hazards.

The Chief Scientists are expected to coordinate scientific work carried out aboard ship by scientific and technician staffs. The Marine Technicians are Scripps employees and work under the direction of a Laboratory Officer. Scientists work through the Laboratory Officer in matters concerning the technicians and their duties.

In addition to their responsibilities aboard ship, seagoing Chief Scientists are responsible for presenting the information gathered while at sea in the form of preliminary reports, to be completed before departing the ship, and they are expected to assume major responsibility for the preparation of that volume of the Initial Reports of the Deep Sea Drilling Project which concerns their cruise leg.

Another essential member of the shipboard team is the Science Editor. He is usually a member of the DSDP scientific staff. In addition to scientific duties, the Science Editor's familiarity with DSDP policies is of value to the scientific staff in executing all aspects of the scientific program. Because of his experience on past cruises and publications of the Initial Reports, he can provide guidance in format, reports, summaries and data presentation, plus rules of sediment nomenclature to be followed.

He has the editorial responsibility for the Initial Report Volume for that leg, and serves as the focal point of contact at DSDP for the issuance of that volume including coordinating the activities of the shore-based facilities in the preparation of data.

The scientific shipboard party is led by two co-chief scientists and consists of ten other scientists and twelve technicians. The co-chief scientists are chosen from a list of candidates who have expressed an interest or have been suggested by colleagues.

The co-chief scientists play an important role in both the scientific planning of the cruise and in the selection of the other scientific participants. The selection procedure is outlined in Fig. 15.

The shipboard science is only a small part of the overall program. Core material is made available to qualified scientists for their investigations. An important function of the DSDP is the preparation of a comprehensive initial report describing the properties of the cores and the scientific results obtained on each cruise. Fig. 16 gives a description of the distribution of the scientific materials and data.

Funding

Capital Investment		$ 12,600,000
Operating Costs (FY '74)		10,000,000
Science (Transport scientists to and from ship; limited salary support for a few visiting scientists.	$ 1,100,000	
Operation of DSDP (including technicians)	850,000	
Technical Operations	830,000	
Global Marine (Operation of ship)	7,300,000	

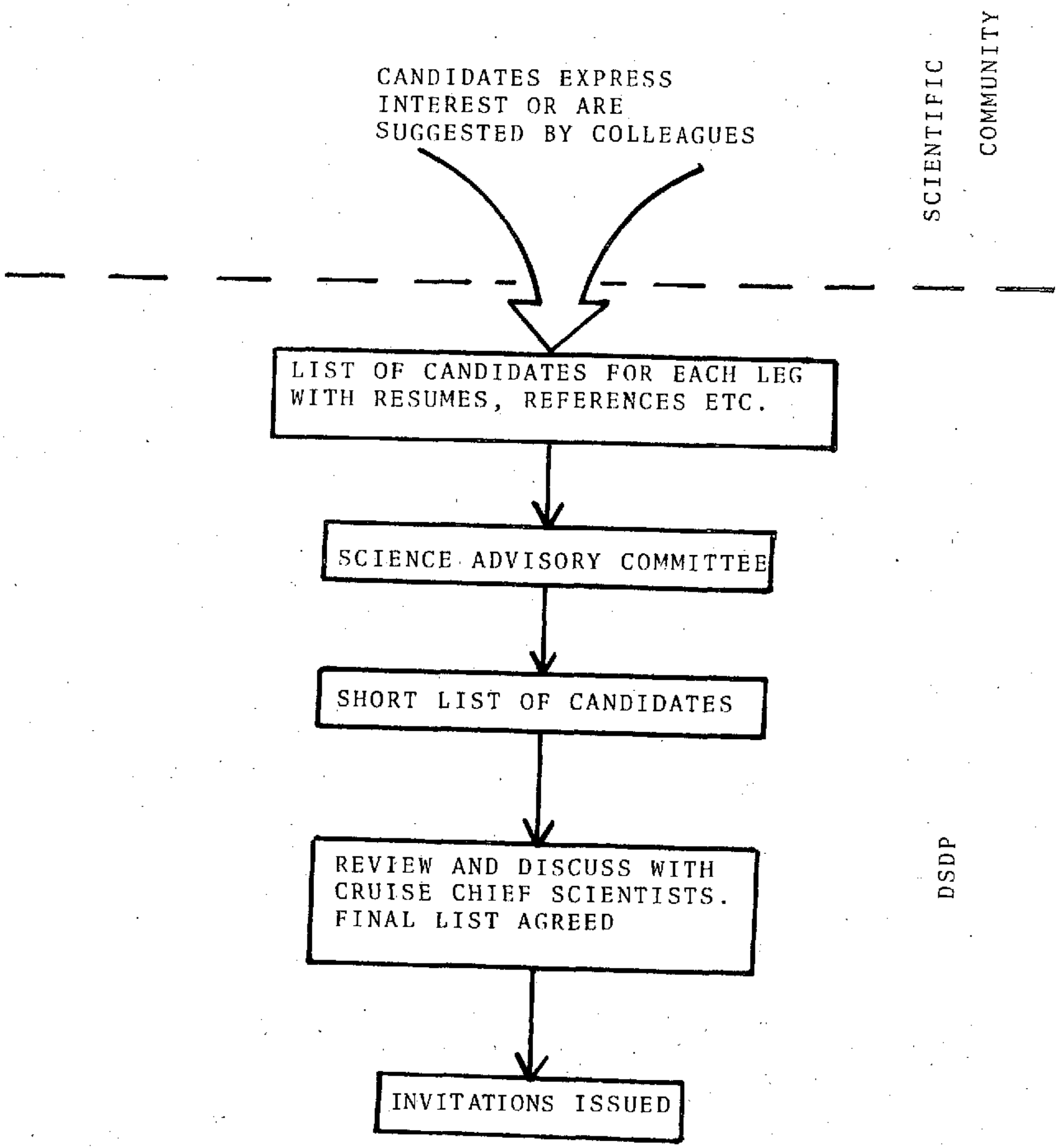
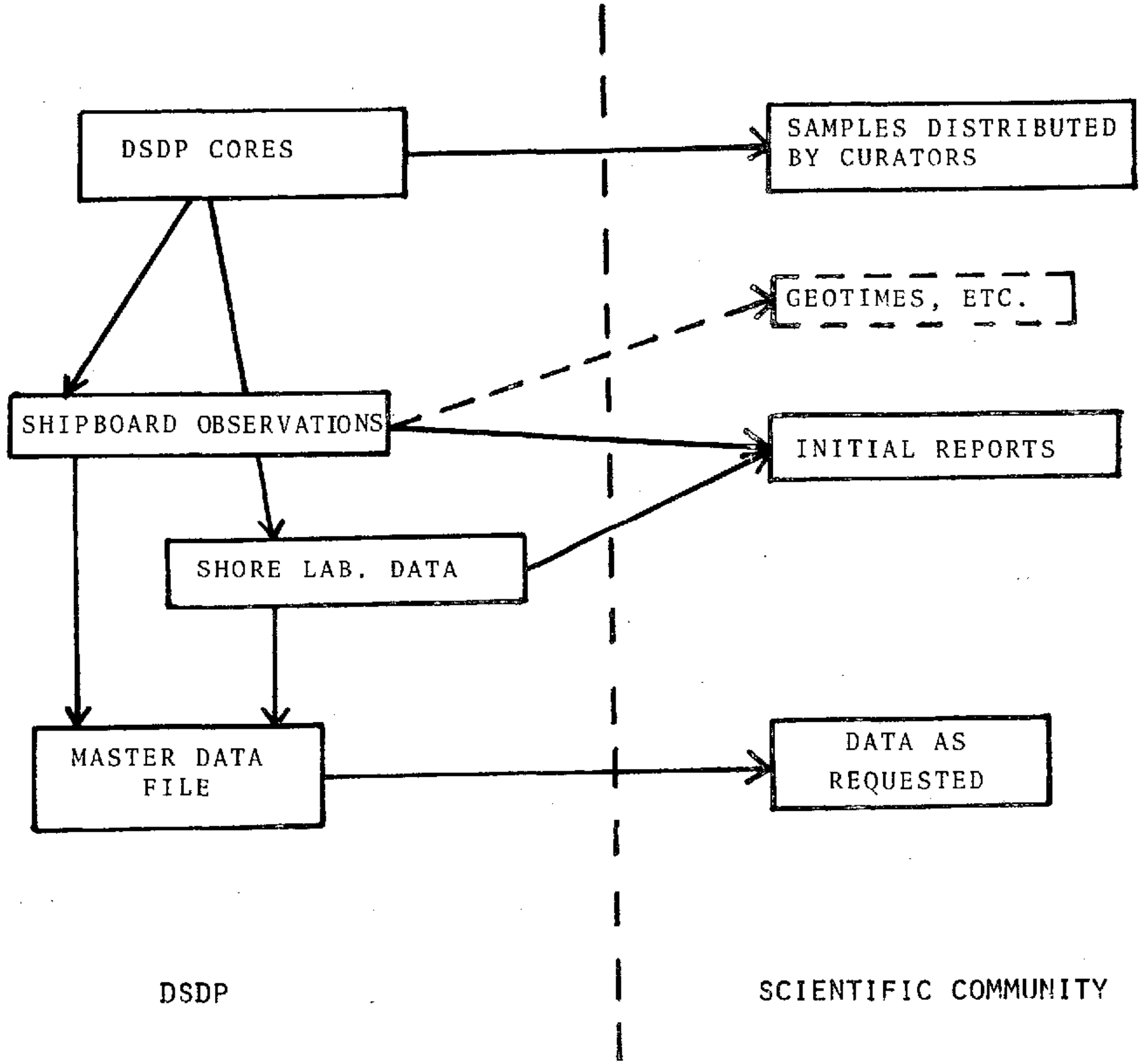


FIGURE 15

Selection of Scientific Participants in DSDP

FIGURE 16

Distribution of Scientific Materials and Data



DISCUSSION

Since many of the operating characteristics of facilities are dictated primarily by their size, it is instructive to group the facilities into three size classes for the purpose of discussion.

I. The first group comprises large facilities and includes NAL, AGS, and LAMPF. In each case the facility is dominated by a single large accelerator which is central to all the activities at the installation. Each facility has resident engineering and technical staffs to assist scientists in the operation and maintenance of the machine. In each instance a users organization has been formally organized to insure non-resident users a voice in the operation of the facility. Experiments using these facilities are usually complex and are carried out by teams of investigators, rather than individuals. The teams are generally constituted from laboratory scientific staff and university staff. Regardless of whether the principal investigator is affiliated with the laboratory or with a university, proposals for use of the machine are judged by the same procedure. Most experimental programs require considerable advance planning and specialized instrumentation, which is often developed and supplied by the group carrying out the experiment. As a consequence programs usually require additional funding and resources beyond the free use of the machine and its ancillary equipment. University users must therefore seek additional support for their portion of the research program.

A strong management is an important feature of all three organizations. The director of each facility has the strong support of both the scientific community, and the federal scientific administrative and legislative community. This support has been an important component in justifying the allocation of a significant fraction of the total available funding to these enterprises. Although there have been criticism of some management decisions, it has centered more on the choice of option rather than on its scientific worthiness. The widely held view is that these facilities are being managed with good success and that they are carrying out their perceived missions in a commendable fashion.

II. The second group is comprised of the medium sized facilities and includes KPNO and NCAR. An additional common feature shared by these two facilities is that they are composed of a group of facilities rather than a single central one. Their facilities are, in the main, not unique, but they are deployed with the avowed purpose of providing high quality research facilities for outside observers and, in the case of NCAR, to provide a focus for very large research projects having a high national priority. In both instances the facilities are in competition with other existing facilities, which provide a yardstick with which the quality of the operation of the facility may be judged easily. Furthermore each facility is run by a consortium of Universities having strong departmental interest in that area of science.

In neither case has a formal users group been organized. KPNO has attempted to insure the quality of the resident staff by vesting a significant fraction of the available observing time for staff use. NCAR has emphasized staff flexibility and has established a substantial number of semi-permanent staff appointments (of several years duration) in order to improve staff vitality and responsiveness.

In both cases staff proposals are not subject to outside review while visitors proposals are reviewed, however few of these proposals are rejected. There has been substantial criticism of NCAR management and a recent reorganization has been effected in response to this criticism. Although there has been no comparable reorganization at KPNO, there does not seem to be unanimous agreement on the quality and strength of the programs.

III. The last group is comprised of the Tandem Van de Graaf, the HFBR, the NAIC and the DSDP. Like the large accelerators, there is a single instrument or facility at each of these major places, however, these facilities are used by a relatively small number of scientists usually who are initimately acquainted with each others work. There seems to be a great diversity in the style of operation of these facilities, reflecting perhaps more of the differences in the demands of the disciplines using them than the differences required by the nature of the facilities themselves.

While at NAIC all proposals are judged by outside referees and at the Tandem Van de Graaf outside users proposals are judged by a review committee, there is only an informal evaluation of proposals at HFBR and no proposals at all at the DSDP. At the HFBR the facility is used primarily by the resident staff and visitors who are working cooperatively with them. At NAIC and the Tandem Van de Graaf a certain fraction of the available time is allotted to the resident staff while the remainder is reserved for the use of visiting scientists. At the DSDP the planning of the scientific objectives of a given cruise and the shipboard implementation is carried out largely by scientists who are not permanent DSDP staff.

All of these programs appear to be well regarded by the scientific groups they are designed to serve. The management appears to be generally strong but responsive. Both the NAIC and DSDP are administered by a single university under contract with the NSF, while both the Tandem Van de Graaf and the HFBR are components of the Brookhaven National Laboratory which in turn is administered by a consortium of universities under contract with the AEC. Although it is conceivable that all these facilities could be operated under the same format, with little dimunition in the efficiency of operation, it is difficult to anticipate any improvement in scientific utility which would result.

CONCLUSIONS

In our opinion certain points can be drawn from this study which should be of some significance to planners of scientific utilization of the space shuttle.

A strong resident scientific staff is required to insure that the facility functions in an outstanding manner and that it is being continually upgraded. The division between scientific responsibility and operational responsibility at a large research facility is indeed a natural division as highlighted particularly by the DSDP and does not lead to unresolvable conflicts.

In those areas where the scientific staff bears major responsibility for the development of the instrumentation, it is reasonable to vest a certain proportion of the facility operating time exclusively for staff use as an incentive for retention of high quality staff. In those areas where development is largely shared with users, such vesting must be done with care.

High standards must be exercised in the selection of the staff and in evaluating their performance. The value of the facility will be diminished tremendously if it is viewed by the scientific community as being run largely in pursuit of programs designed and carried out by a pedestrian staff.

No unique scheme of successful scientific management is revealed by this study. A single organizational strategy for all elements of the shuttle science program would not seem desirable. Rather flexibility should be encouraged allowing different groups to structure their organizations along their usual lines. Thus, access to the facility by non-staff users should be obtained through procedures which are usually employed in evaluating scientific merit in that field.

The organization of users groups, either formal or informal, should be encouraged. Participation should be encouraged from younger scientists and those affiliated with the smaller institutions. Communication between the facility scientists and the users groups should be stimulated.

Once a research proposal has been accepted, the complete support of the facility should be available to it.

Resident staff should not retain a proprietary control over equipment which may be required by other users. Although the staff scientist must have additional incentives above those of the visiting users, these incentives should be in the area of proving the utility and worthiness of advanced equipment which they develop rather than acquiring control over many instruments. Finally, support for both staff scientist and visitors should be at a level sufficient to allow research of the highest calibre.

ACKNOWLEDGEMENTS

The helpful cooperation of both scientists affiliated with the various installations studied and scientists who have made use of these facilities as visitors is acknowledged. Although criticisms of some operations have been referred to, there has been no intention here to judge the quality of scientific work. Rather, such criticism is intended only to reflect the opinions expressed by some scientists working in that field.

APPENDIX A

The forerunner and prototype for most of the laboratories examined in this report is the Brookhaven National Laboratory and it is of interest to review its origin. By the end of World War II, it had become apparent that significant progress in fundamental research, especially in the nuclear field, would require experimental facilities of unprecedented magnitude, complexity, and cost. Wartime experience had demonstrated the practicality of close cooperation between government and the scientific community; indeed, as an outgrowth of the wartime effort under the Manhattan Engineering District (MED), federally financed, contractor-operated centers for nuclear research were already active at the Radiation Laboratory in Berkeley, California, at Los Alamos, New Mexico, at the Clinton Laboratories in Oak Ridge, Tennessee, and at the Argonne Laboratory in Chicago. Except for the Radiation Laboratory, these institutions predominantly emphasized applications rather than basic research, and no comparable research center existed in the northeast.

Informal discussion of how best to meet this deficiency began in the fall of 1945 among scientists at several northeastern universities. In January 1946, representatives or 21 major research institutions, including both universities and industrial organizations, met to consider how most effectively to cooperate in meeting the scientific needs of the northeast. This meeting resulted in a letter dated January 17, 1946, addressed to General Leslie R. Groves, then head of the MED, by Dr. George B. Pegram of Columbia University, proposing the establishment of a regional laboratory. This letter was followed by exchanges of ideas among the scientists, Dr. Pegram, and representatives of the MED, and by the middle of March 1946, it had been decided that the new laboratory should be sponsored by a group of nine universities: Columbia, Cornell, Harvard, Johns Hopkins, MIT, Pennsylvania, Princeton, Rochester, and Yale.

On March 23, representatives of these institutions met in New York and constituted themselves the "Initiatory University Group", "interested in promoting and sponsoring in the Northeast region of the country a government research laboratory for nuclear science and in cooperating with other institutions of this region in the operation of such a laboratory." Parenthetically, it should be noted that the regional emphasis for the laboratory indicated in that quotation was soon superseded by the concept of a truly national institution. As finally constituted, this group consisted of one scientist and one administrator from each university. The group (IUG), under the chairmanship first of Dr. Lee A. DuBridge (then of the University of Rochester) and later of Dr. Robert F. Bacher (then of Cornell University), moved rapidly and effectively to discharge its responsibilities. It appointed a planning committee, composed largely of scientists, and several subcommittees on such matters as site, reactors, personnel, policy, contract, etc. A committee on incorporation, composed largely of administrators designated by the nine university presidents, was also set up under the chairmanship of Dr. Pegram. The IUG, its committees and subcommittees, arrived at three basic decisions. At least partly out of deference to a strong stand taken by the MED, it was concluded that the necessary legal entity should be some form or interuniversity corporation, rather than a single existing institution, with the scientific program directed by the sponsoring institutions. After lengthy study of many possibilities, and again in conformity with the views of the MED, Camp Upton was chosen as the site of the laboratory. Finally, it was concluded that a corporation under the Education Law of the State of New York would be the most satisfactory mechanism. This last decision was implemented by the issuance, on July 18, 1946, of a charter from the Board of Regents, acting on behalf of the State Education Department. On July 3 , the incorporating Trustees, Mr. George H. Brakeley (Princeton), Dr. Pegram (Columbia), Dr. I. I. Rabi (Columbia), Dr. H. D. Smythe (Princeton), and Dr. W. W. Watson (Yale) enlarged the Board to 18 and elected an executive committee. They also elected Mr. Edward Reynolds, Administrative Vice President of Harvard, President and, under the by-laws, principal executive officer and Trustee ex officio.

On August 1, 1946, Dr. Philip M. Morse of MIT was appointed Director of the newly named Brookhaven National Laboratory. One of the many immediate tasks facing the new corporation was to negotiate a contract with the Federal Government, then represented by the MED, but after January 1, 1947, by the Atomic Energy Commission in accordance with the Atomic Energy Act of 1946 (the MacMahon Act). A letter agreement permitting the formal establishment of BNL on January 31, 1947, was made. The definitive contract (No. AT-30-2-GEN-16) was signed late in 1947; it has been extended several times, most recently to June 30, 1977. This instrument, although frequently amended, is unchanged in its essentials, and within its framework the Government and the Contractor have been able to operate with a remarkable degree of effectiveness.

APPENDIX B

CHARTER OF LAMPF USERS GROUP

USERS GROUP

LOS ALAMOS MESON PHYSICS FACILITY

CHARTER

The Los Alamos Meson Physics Facility (LAMPF) Users Group is an organization of active scientists and engineers with a special interest in LAMPF and, in particular, its research program. The purpose of this group is two-fold:

a) To provide a formal channel for the exchange of information between the LAMPF administration and scientists of other laboratories who will utilize this facility for their research.

b) To provide a means for involving scientists and engineers from user groups in specific projects at LAMPF and for offering advice and counsel to the LAMPF management on LAMPF operating policy and facilities.

Through a wide representation of scientists, the group will make known to the LAMPF administration the needs and desires of those scientists actively engaged in research projects. As an example of the relationship between the users community and the LAMPF administration, it is understood that some members of the Program and Scheduling Committee will be selected from candidates proposed by the Users Group.

1. Membership. The membership of the Users Group is open to practicing scientists and engineers. The LASL-appointed Director of LAMPF and University and National Laboratory Scientific Administrators shall be invited to be nonvoting members of the Organization. Following the drawing up of an original membership list, new members will be added by action of the Executive Committee of the Users Group upon receipt of a written request. In addition, each member will indicate in writing at the time of each general election his desire to remain on the membership list for the coming year.

2. Officers and Executive Committee. The officers of the Users Group shall consist of a Chairman, Chairman-elect, Liaison Officer, and three other elected members. The Chairman, Chairman-elect, and three elected members will constitute the Executive Committee of the LAMPF Users Group. The Liaison Officer will be an ex officio member of the Executive Committee. The Chairman-elect and the three committee members will be elected annually by mail ballot. The first slate of officers shall be elected by a plurality of the users attending the initial organization meeting held at Los Alamos on January 16, 1969, and thereafter elections shall be held as described in 2a, b, c, and d.

a. A Chairman-elect shall be elected annually by members of the Users Group by written ballot, distributed prior to October 1 to the membership as of September 1, and shall take office on January 1 of the following year. A plurality of votes cast is sufficient for election.

b. The Chairman-elect will succeed to the office of Chairman at the end of one year.

c. The term of the Chairman of the Users Group for LAMPF is for a period of one year.

d. The three other members of the Executive Committee will be elected annually.

e. A Liaison Officer of the Users Group is to be appointed by the LAMPF Director in consultation with the Chairman and Chairman-elect of the Users Group. It will be the duty of the Liaison Officer to act as secretary of the meetings and keep the minutes. He will request nominations, send and tally mail ballots, and generally serve as secretary to the Users Group. It is further the duty of the Liaison Officer to keep the Users Group informed by means of frequent newsletters of new developments at the LAMPF and other matters of interest to the users. The Liaison Officer shall serve for a period of two years and can be reappointed for an additional two. He should not serve three consecutive terms.

f. A person who has served as Chairman cannot be nominated as Chairman-elect for a period of three years.

3. Meetings. The LAMPF Users Group shall meet at least once each calendar year at a time and place designated by the Chairman, upon advice of the Executive Committee. Notice of the meeting should be sent to the members of the Users Group at least a month in advance and shall include the agenda for the meeting. The Secretary-Liaison Officer will prepare summaries of all meetings, which will be mailed to all members, arrange details of meetings and other necessary work of the Committee.

4. Procedures.

a. The Executive Committee may, on its own initiative, and shall, upon instruction of a majority of the members attending a general meeting, submit questions for consideration to the full membership. Results of the deliberations of the Users Group shall be communicated to the Director of LAMPF.

b. The Executive Committee shall recommend to the LAMPF administration names of user scientists for consideration as members of LAMPF's Program and Scheduling Committee.

c. The Executive Committee will appoint a Technical Advisory Panel (TAP) from the membership of the Users Group. The Chairman of the Executive Committee will act also as Chairman of TAP. This Committee shall consist of twelve (12) members appointed for two years in such a way that six (6) new members are added each year to take office on January 1. The duties of the TAP will be to collaborate with the staff of the LAMPF in devising new experimental facilities and evaluating future developments. The TAP will meet at least twice a year, and the Chairman-elect and the Liaison Officer are to be members ex officio.

d. The Executive Committee shall appoint a Nominating Committee consisting of five members of the Users Group, but not including any officers, who are charged with the duty of nominating a slate of candidates for the Chairman-elect and the three other elective positions of the Executive Committee. The Nominating Committee may meet in person, if it wishes, or may transact its business by mail or by telephone. The Chairman of the Nominating Committee will be designated by the Chairman of the Users Group. Direct nominations, for each of the positions, from the membership can be made by a petition from at least ten (10) members, sent to the Chairman of the Executive Committee prior to September 15.

e. In the event that a post on the Executive Committee should be vacated during the Committee's term in office, the Committee shall appoint a member of the Users Group to fill the unexpired term. If the vacated post should be that of Chairman-elect, the name of the person appointed shall appear on the ballot at the next annual election as a candidate for the office of Chairman.

5. This Charter shall be adopted, if approved, by two-thirds of the prospective members attending the initial meetings.

6. This Charter may be amended by a written vote of the members. A proposed amendment shall be introduced at a general meeting. A two-thirds majority of the members voting is required for passage of the amendment. The vote must be taken within a month of the time the amendment was introduced.

Adopted at
Second LAMPF Users Meeting
Los Alamos, New Mexico
January 16, 1969

Amended December 31, 1970

LOS ALAMOS MESON PHYSICS FACILITY USERS GROUP, INC.

BY-LAWS

Article I - MEETINGS

Section 1. Place of Meeting

Meetings of the members and of the board of directors of this group may be held at a place designated by the board of directors or by a majority vote of a quorum of the membership with notice given as provided in these by-laws.

Section 2. Annual Meeting of Members

An annual meeting of the members shall be held in each calendar year between October 15 and November 30. The election of members to the open positions on the board of directors, one of which shall be designated chairman-elect, will be conducted prior to the annual meeting as provided in these by-laws.

The first board of directors shall be the current executive committee of the LAMPF Users Group chartered on January 16, 1969 at Los Alamos, New Mexico with the addition of the past-chairman of said group and the liaison officer of the said group also serving. The term of the first board shall be from the adoption of these by-laws until December 31, 1972.

For the first elected board of directors the terms of office shall be one year for the past-chairman, two years for the chairman, three years for the chairman-elect, two years for two members, and one year for two members. The chairman-elect will succeed to the office of chairman and the chairman will succeed to the position of past-chairman at the end of one year.

Section 3. Notice of Annual Meeting of Members

At least ten (10) and not more than thirty (30) days prior to the date fixed by Section 2. of this Article for the holding of annual meeting of members, notice of the time and place of such meeting shall be mailed as hereinafter provided to each member entitled to vote at such meeting. Notice of the meeting shall state the matters to come before the membership so far as known.

Section 4. Delayed Annual Meeting

If for any reason the annual meeting of the members shall not be held on the day hereinbefore designated, such meeting shall be called on the earliest convenient date thereafter provided that the notice for such meeting shall be the same as herein required for the annual meeting originally scheduled, namely not less than ten (10) nor more than thirty (30) days notice.

Section 5. Order of Business at Annual or Delayed Annual Meeting

a) Reading notice and proof of mailing notice or of publication.

b) Approval of minutes of the last preceding meeting.

c) Report of Chairman.

d) Report of Chairmen of Committees.

e) Report of Secretary/Treasurer.

f) Announcement of results of the election of directors.

g) Transaction of other business mentioned in the notice or from the floor.

Provided that, in the absence of any objection, the presiding officer may vary the order of business at his discretion.

Section 6. Special Meeting of Members

A special meeting of the members may be called at any time by the chairman, or by a majority of the board of directors or by fifty (50) members of the membership. The method by which such meeting may be called is as follows: Upon receipt of a specification in writing setting forth date and objects of the

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proposed special meeting signed by the chairman, or by majority of the board of directors, or by fifty (50) members of the membership as the case may be, the secretary or an assistant secretary shall mail the notices or otherwise communicate the same requisite to such meeting.

Section 7. Notice of Special Meetings of Members

At least ten (10) and not more than thirty (30) days prior to the date fixed for the holding of any special meeting of members, notice of the time and place and purposes of such meeting shall be communicated as hereinafter provided, to each member entitled to vote at such meeting. No business not mentioned in the notice shall be transacted at such meeting.

Section 8. Organization Meeting of the Board of Directors

At the place of holding the annual meeting of members and immediately following the same, the board of directors as constituted upon final adjournment of such annual meeting shall convene for its annual meeting for the purpose of appointing officers and transacting any other business properly brought before it.

Section 9. Regular Meetings of the Board

Regular meetings of the board of directors shall be held not less frequently than annually at such place as the board shall from time to time determine. No notice of regular meetings of the board shall be required.

Section 10. Special Meetings of the Board

Special meetings of the board of directors may be called by the chairman or a majority of the board of directors at any other time by means of any convenient communication of the time, place, and purpose thereof directed to each director at his usual or otherwise known address, and action taken at such meeting shall not be invalidated for want of notice if such notice shall be waived as hereinafter provided.

Section 11. Notice and Mailing

All notices required to be given by any provision of these by-laws shall state the authority pursuant to which they are issued (as, "by the chairman" or "by order of the board of directors" or "by order of the membership", as the case may be).

Section 12. Waiver of Notice

Notice of the time, place, and purpose of any meeting of the members or of the board of directors, may be waived by any communication indicating assent by the respective member or director or by failure to object at the meeting.

Article II - QUORUM

Section 1. Quorum of Members

Present in person or by proxy of members representing at least ten (10) percent of the membership of this association shall constitute a quorum of the members.

Section 2. Quorum of Directors

At least fifty (50) percent of the directors shall constitute a quorum.

Article III - VOTING, ELECTIONS, AND PROXIES

Section 1. Who is Entitled to Vote

Each member or member organization is entitled to one vote as herein provided.

Section 2. Proxies

No proxy shall be deemed effective unless signed by the member and filed with the group. The proxy may specify over the signature of the member the duration (not to exceed two (2) years) for which it shall remain in effect. A proxy shall extend to all meetings of the members occurring within the specified duration unless sooner withdrawn in writing by the member.

Section 3. Election by Mail

The board of directors may choose to conduct voting and election by mail. Ballots must be sent to the members no later than five (5) weeks before the next annual or special meeting of the members. In order for a ballot to be counted its envelope must be signed by the member and received at the business address of the LAMPF Users Group not less than one (1) week before the next annual or special meeting.

Article IV - BOARD OF DIRECTORS

Section 1. Number and Term of Directors

The business, property, and affairs of this group shall be managed by a board of seven (7) directors provided that the membership shall have the power to increase the number not to exceed twelve (12). Each director shall hold office for the term for which he was elected and until his successor is elected and qualified. The term of the director designated as chairman-elect, who will succeed to the office of chairman at the end of one year, shall be three (3) years. All other directors shall be elected for a term of two (2) years, provided that nothing herein shall be construed to prevent the election of a director to succeed himself. All terms of office begin January 1 of the year following election.

Section 2. Power to Make By-Laws

The membership shall have power to make or alter any by-law or by-laws including the fixing and altering of the number of directors.

Section 3. Power to Appoint Officers and Agents

a) The board of directors shall have power to appoint officers and agents as the board may deem necessary for transaction of the business of the group. Such appointed officers and agents may be removed by the board of directors whenever, in the judgment of the board, the best interests of the group will be served thereby.

b) The board of directors at its first meeting of the year will appoint a Liaison Officer from the staff of LAMPF with the concurrence of the LAMPF Director. It will be the duty of the Liaison Officer to act as secretary/treasurer of the group.

c) The board of directors shall submit to the LAMPF administration names of members for consideration as members of LAMPF's Program Advisory Committee (PAC) whenever there are positions open because of reason of membership rotation.

Section 4. Power to Fill Vacancies

The board shall have power to fill any vacancy in any office. In the event that a post on the board of directors should be vacated during the board's term in office, the board shall appoint a member of the LAMPF Users Group to fill the unexpired term. If the vacated post should be that of chairman-elect, the name of the person appointed shall appear on the ballot at the next annual election as a candidate for the office of chairman.

Section 5. Delegation of Powers

For any reason deemed sufficient by the board of directors, whether occasioned by absence or otherwise, the board may delegate all or any powers and duties of any officer to any other officer, director, or member, but no officer or director shall execute, acknowledge, or verify any instrument in more than one capacity.

Section 6. Power to Appoint Committees

a) The board of directors shall appoint committees, standing or special, from time to time, from the membership including the board members and confer powers on such committees and revoke such powers and terminate the existence of such committees at pleasure. It may also terminate at will the term of individual members of such committees.

b) The board of directors will appoint each year a nominating committee consisting of five (5) members of the LAMPF Users Group, but not including any members of the board of directors, who are charged with the duty of nominating a slate of candidates for the chairman-elect and the other elective positions on the board of directors. The nominating committee may meet in person, if it wishes, or may transact its business by mail or by telephone. The chairman of the nominating committee will be designated by the chairman of the board of directors. Direct nominations, for each of the positions, from the membership can be made by a petition from at least ten (10) members sent to the chairman of the board of directors prior to two (2) months in advance of annual meeting.

c) The board of directors will appoint a Technical Advisory Panel (TAP) from the membership. The chairman of the board of directors will act also as chairman of the TAP. This committee shall consist of

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twelve (12) members appointed for two years in such a way that six (6) new members are added each year to take office on January 1. The duties of the TAP will be to collaborate with the staff of the LAMPF in devising new experimental facilities and evaluating future developments. The TAP will meet at least twice a year, and members of the board of directors and the liaison officer are to be members ex-officio.

Section 7. Power to Require Bonds

The board of directors may require any officer or agent to file with the group a satisfactory bond conditioned for faithful performance of his duties.

Section 8. Compensation

The directors, officers, and committee members shall serve without pay. The compensation of agents, employees or consultants may be fixed by the board.

Article V - OFFICERS

Section 1. Officers

The officers of the group shall consist of a chairman, chairman-elect, and secretary/treasurer.

Section 2. Duties of Officers

a) Chairman--The chairman shall preside at all meetings of the membership of the group and the meetings of the board of directors. He shall enforce due observance of the constitution and by-laws. He shall perform duties as directed by the group or board of directors or as his office may require. He will be an ex-officio member of all committees in which he is not an appointed or elected member. He shall succeed to the position of past-chairman at the end of one year.

b) Chairman-Elect--In the absence of the chairman, the chairman-elect shall perform the duties of chairman. Otherwise he will provide assistance in conducting the affairs of the group as requested by the chairman. He shall succeed to the office of chairman at the end of one year.

c) Secretary/Treasurer--The secretary/treasurer shall keep a complete and accurate record of the proceedings of the meetings of the group and of the meetings of the board of directors. He shall, unless other committees are appointed to fill any of the following functions, maintain a file of correspondence of the group, and keep an accurate record of all members of the group, showing the name and address of each. He will request nominations, send and tally mail ballots, and keep the membership informed by means of newsletters of new developments at the facility. He shall receive all money belonging to the group and shall keep an accurate record of all receipts and expenditures. He shall report verbally the state of the treasury at each meeting of the board of directors, and to the membership at least once a year by a written report. He shall make no payments except as authorized in the budget or in the minutes of meetings of the board of directors. He shall submit his books for verification or audit to a bookkeeper or accountant specified by the board if so requested by the board.

Article VI - EXECUTION OF INSTRUMENTS

Section 1. Checks, etc.

All checks, drafts and orders for payment of money shall be signed in the name of the group and shall be signed by the chairman or secretary/treasurer or such other officers or agents as the board of directors shall from time to time designate for that purpose.

Article VII - MEMBERSHIP

Section 1. Membership

The membership is open to practicing scientists and engineers and organizations of scientists and engineers. The qualifications for membership and their voting or nonvoting status shall be determined by the board of directors with concurrence of the membership. Following the drawing up of an original membership list, new members will be added by action of the board of directors upon receipt of a written request. In addition, each member will indicate in writing at the time of each general election his desire to remain on the membership list for the coming year.

Article VIII - AMENDMENT OF BY-LAWS

Section 1. Amendments. How Effected.

These by-laws may be amended, altered, added to, or repealed by a written vote of the members. A proposed amendment shall be introduced at a general meeting. A two-thirds majority of the members voting is required for passage of the amendment. The vote must be taken within a month of the time the amendment was introduced.

Certificate

I certify that I am the duly appointed, qualified, and acting secretary of the Los Alamos Meson Physics Facility Users Group, Inc., a nonprofit corporation, and that by a special mail ballot the membership decided by a two-thirds majority of those voting that the above and foregoing by-laws are adopted.

____

Secretary

ARTICLES OF INCORPORATION

OF THE

LOS ALAMOS MESON PHYSICS FACILITY USERS GROUP, INC.

Article I - NAME

The name of the corporation is the Los Alamos Meson Physics Facility Users Group which may be abbreviated to "LAMPF Users Group".

Article II - PURPOSES

The purpose of the corporation is to promote the advancement of science as follows:

a) To provide a channel for the exchange of information among scientists interested in working at LAMPF and between scientists and the LAMPF administration.

b) To provide a means for facilitating involvement of scientists and engineers in specific projects at LAMPF.

c) To provide an entity responsive to the representations of its members for offering advice and counsel to the LAMPF management on operating policy and facilities.

d) To provide a legal entity responsible to its members for providing services which will promote the most effective utilization of the LAMPF for the common good and general welfare of human society.

e) To provide a legal entity which will have the flexibility and adaptability to do anything necessary to aid scientists, particularly those from institutions other than LASL, to use the facility.

f) To represent, when feasible and desirable, the membership in contracts with other parties.

g) To make, perform, and carry out contracts of every kind, as the purposes of the corporation shall require, with any person, firm, association, corporation, government or governmental agency or instrumentality.

h) To acquire property, real or personal, by gift, purchase, devise or bequest, and to hold and dispose of such property as the purposes of the corporation shall require.

i) To act as trustee under any trusts incidental to the principle objects of the corporation, and to receive, hold, administer, and expend funds and property subject to said trusts.

j) To borrow, assess fees, or otherwise raise money as needed for accomplishing its purposes.

k) To erect, lease, reserve, or buy living accommodations as found to be needed or desirable to facilitate access of its members to the research facility or to organized meetings concerning the same.

l) To have all the capacity to act possessed by natural persons as are necessary and proper to accomplish its purposes.

Article III - NONPROFIT AND NONPOLITICAL CHARACTER

a) This corporation is organized under the provisions of Chapter 15, Article 14 of the laws of the State of New Mexico pertaining to nonprofit corporations. It will not afford pecuniary gain, incidentally or otherwise, to its members. No part of net funds acquired by the corporation from any source will be used for the benefit of private interests such as designated individuals, or persons controlled directly or indirectly by such private interests, except that reasonable compensation may be paid for services rendered to or for the corporation affecting one or more of its purposes.

b) This corporation will have no capital stock and will pay no dividends or other pecuniary remuneration directly or indirectly to its members as such.

c) This corporation, its incorporators, directors, and officers will not discriminate, in the admission of its membership, administration of its affairs or dealings with others, on the basis of race, color, religion, sex, or national origin.

d) This corporation is nonpolitical and will not directly or indirectly participate or intervene in political campaigns on behalf of, or in opposition to, any candidate for public office.

Article IV - DURATION

The period of duration of this corporation shall be one hundred (100) years unless sooner terminated or extended as provided by law.

Article V - REGISTERED OFFICE

The registered office of this corporation in the State of New Mexico will be located at Los Alamos, New Mexico 87544. The name of the registered agent in charge thereof is ________________.

Article VI - INCORPORATORS

________________ address ________________

________________ address ________________

________________ address ________________

________________ address ________________

________________ address ________________

________________ address ________________

________________ address ________________

Article VII - DIRECTORS

The first board of directors will be constituted by seven (7) members whose names and addresses and tenures are as follows:

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Article VIII - OFFICERS

a) The officers of the group shall be a Chairman, Chairman-Elect, and Secretary/Treasurer.

b) Each officer will perform such duties as usually are incident to the office to which he has been elected or appointed and such other duties as may be imposed upon him by the board of directors of the membership of the group.

c) Vacancy in any office shall be filled for the balance of the term thereof by a person appointed by the board of directors.

Article IX - COMMITTEES

The board of directors, or the group, by resolution of its members shall determine from time to time the number and identity of committees.

Article X - BY-LAWS

The group shall adopt such by-laws as are necessary for its government, and may amend or repeal the same as provided for therein.

Article XI - TERMINATION

If, upon termination of this corporation, there shall be assets (except for special designated funds held in escrow) such assets shall be delivered as a contribution to another organization which shall be exempt from taxation under provisions of Section 501(c) of the Internal Revenue Code (or as it may hereafter be amended).

IN WITNESS WHEREOF, we the incorporators hereunto set our hands and seals this ________day of

______________________, 1972.

Signed ______________________________

______________________________ ______________________________

______________________________ ______________________________

______________________________ ______________________________

STATE OF NEW MEXICO)
) ss
COUNTY OF LOS ALAMOS)

I, ________________________________, a notary public in and for the state and county aforesaid, do hereby certify that on this _____ day of _______________, 197__, before me personally appeared

____

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____

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to me personally known, and known to me to be the same persons described in and who executed the foregoing instrument and severally acknowledged to me that they executed the same as their free act and deed.

Witness my hand and official seal at said county the day and year last above written.

______________________________(SEAL)
Notary Public

My Commission Expires

____