

REPOSITORY Oak Ridge Operations
 COLLECTION Records Holding Area
Documents 1944-94
 BOX No. A-49-6 1 of 4
75-44 Bldg. 2714-H
 FOLDER 04-60-40-01 Environmental August 12, 1970
R & D Jan-June

717285

Milton Shaw, Director, EBT, HQ

BEST COPY AVAILABLE

ENVIRONMENTAL ACTIVITIES AT ORNL

Enclosed as Attachment #1 are our comments on three new environmental 189a proposals submitted by ORNL for EBT support in their Fiscal Year 1971 Budget. These 189a's deal with Dry and Wet Cooling Towers and Beneficial Uses of Waste Heat. In addition, we are providing below a brief overall survey of the multiplicity of environmental activities at ORNL for such use as you may find appropriate.

In May, 1970, the Laboratory listed 99 separate environmental activities under six major categories (see attached Table 1) felt to be compatible with their EBT proposal. For convenience, these categories and funding totals are repeated here:

	<u>Existing \$</u>	<u>New EBT \$</u>
	(in thousands)	
I. Understanding Our Environment	2,963	170
II. Influence of the Environment on Man	3,025	625
III. Environmental Control - Waste	2,675	258
IV. Environmental Information Centers	259	260
V. Communication	0	106
VI. Technology Assessment	0	77
Totals	10,922	1,496

Eleven government organizations, in addition to the AEC, are shown as providing support for ORNL's environmental research. The \$12.5 million total includes the new EBT funds for Interdisciplinary Research Relevant to Problems of Society (IRRPOS). The AEC effort totals about \$6.5 million. Of the latter amount, we estimate that about \$2.5 million can be considered to be applicable directly or indirectly to nuclear power plants.

Six million dollars of the AEC's current effort is supported by the Division of Biology and Medicine. The remaining half million is supported by EBT as follows:

	Waste Disposal Research	\$406,000
	Nuclear Safety Information Center	\$ 90,000
OFFICE ▶		
SURNAME ▶		
DATE ▶		

In addition to the above funded activities, RDT has asked (Fall, 1969) the Laboratory's assistance in the preparation of a chapter for an OST interagency report outlining potential R&D efforts on thermal effects. The chapter for the OST report was submitted to RDT (PA) several months ago. RDT also requested (March, 1970) a Thermal Effects Program Plan. Submission of this plan, which should be a logical extension of the OST chapter, was requested by July 1, 1970, and is due to be submitted in final form very soon. We assume that the above two activities were conducted on reprogrammed RDT funds since they were not budgeted.

Finally, ORNL transmitted, in a letter to Dr. English, a LOR dated June 15, 1970, entitled "Environmental Quality Study Project" (EQSP), with Dr. J. H. Gibbons as the person in charge (see Attachment #3). One of the main purposes of this LOR is to coordinate the seven activities that are funded under 06 as well as the two currently funded activities under 04, plus the three recent LOR proposals under the 04 budget as noted above. The EQSP LOR proposes to provide a focal point for environmental activities related to nuclear power plants and to provide staff assistance to the Commission on various specified environmental matters.

In addition to all the above, we are generally aware of contacts ORNL is having with various agencies on miscellaneous environmental matters. For example, they are discussing: 1) Possible cooperative programs with TVA involving studies on the ultimate fate of radionuclides resulting from nuclear power plant operations, and 2) a recently submitted proposal to NAFCA on a study for determining if it is economically possible to remove the most harmful size of particulates (0.2 to 2 microns) from fossil fuel emissions.

Essentially all of the Laboratory's environmental work is under the direction of Dr. James L. Liverman, Associate Director for Biomedical and Environmental Sciences. Each of the two RDT tasks involves technical personnel from ORNL divisions under both Liverman and Don Trauger, Associate Director for Reactor and Engineering Sciences. It is our impression that these have been relatively loose arrangements which have suffered from a diffusion of responsibility and coordination difficulties.

The National Science Foundation (NSF) summer study is under the direction of Dr. David Rose, who reports to Dr. Hainberg for the Laboratory's Long Range Planning, but apparently reports to Dr. Liverman on the NSF work. We understand that Dr. Rose will not be directing the NSF study after September 15. The NSF study has about 30 people assigned to it for the summer period, June 15 to September 15, and the staff comes from on-going 06 and 04 programs as well as universities. We are advised that individuals loaned from RDT programs are being supported from NSF funds.

OFFICE ▶					
SURNAME ▶					
DATE ▶					

August 12, 1970

In some instances, the loan of RDT people may have been facilitated by the two-month long craft strike which delayed construction or modification of experimental equipment. The NSF reports on the summer study are scheduled to be completed September 15 and are intended to lay the groundwork for the follow-on study. Then the organization for the summer NSF study will be disbanded, and the Laboratory will assign the individuals that will comprise the permanent staff for the follow-on NSF work. This may have some implications for RDT work at ORNL; for example, we understand that Roger Carlsmith, who headed the Studies and Evaluation Task, is being assigned full time to the NSF study.

The foregoing reflects ORNL's involvement in a wide variety of environmental research activities supported by many different organizations.

Our impression is one of a complex and fluid situation in regard to staffing and organizational structure as ORNL attempts to develop a growing role in environmental matters. We therefore consider it important that NSF not approve any additional studies in these areas until ORNL has provided adequately detailed program plans (including schedules) and specific staffing and organizational arrangements for implementing these plans.

Original Signed By
Howard W. Behrman

for David F. Cope
Senior RDT-OSR, ORNL

Attachments:

1. Comments on 189a's
2. Table 1, ORNL Environmental Research Budget
3. LTR to Dr. English & NQSP 189a

CG: J. W. Crawford, w/Att. 1, 2, 3
 M. J. Whitman, w/Att. 1, 2, 3
 E. E. Kintner, w/Att. 2
 R. E. Kesiba, w/Att. 2
 E. L. Arnold, w/Att. 2
 A. J. Prosserby, w/Att. 2
 M. A. Rosen, w/Att. 2
 E. E. Sinclair, w/Att. 2

OFFICE ▶	RDT-OSR, ORNL				
SURNAME ▶	Pidkowitz ^{Behrman} / Behrman: sbj				
DATE ▶	8/12/70				

1115823

04 00 00 00 1

(189 #10260 & 10245)

Comments on Dry and Wet
Cooling Tower Proposals

These proposals which are unsolicited, as far as the Site Office can determine, represent an ORNL attempt to anticipate Commission requirements in this area. At this time, the Site Office is not in a position to judge the state-of-the-art of coolant tower technology nor how the ORNL might make a meaningful contribution by performing the scopes of work proposed. It is noted that the same individuals are listed as principal investigators on both of the 189's, and this would indicate that if the work is approved it should be on the basis of a program plan which identifies the work to be done, the schedule on which it will be performed and the key people involved.

The proposal for the wet cooling tower is endeavoring to incorporate previous work performed under the Desalination Program on the development of fluted tubes. The ORNL claims that these tubes have demonstrated an increase in heat transfer by an order of magnitude for condensing taking place on the exterior surface. This is yet to be demonstrated on an operating facility for a sustained period of time. Also, the 189 fails to mention that these types of tubes cost more when ordered in small quantities.

Available information seems to indicate that there exists a better technology base on dry cooling towers in Europe than in the United States. Item 28 of the dry cooling tower 189 indicates that the EPA Thermal Pollution Research Program is currently having a study performed which will survey present European practices and knowledge on dry towers. Using current design and operating experience the study will attempt to optimize operation of a large installation within the U.S. We understand that Headquarters staff is endeavoring to obtain copies of this document.

A dry cooling tower has been in operation at the AEC's Portsmouth Gaseous Diffusion Plant since June 1967, and the experience, though limited, compares quite favorably with water-cooled condensers.

During a recent meeting between Washington staff representatives and Westinghouse Corporation, the close coupling between the turbine and the mechanism for removing excess heat was discussed. It would appear that a cooperative effort between turbine manufacturers and cooling tower manufacturers would be one way to insure that an efficient and useful cooling tower is under development. This raises a basic question of whether the cost of cooling tower development programs should be borne by the AEC, industry, utilities or some combination of these.

The ORNL has a capability to contribute ideas, heat transfer information, and some design concepts but they lack the practical engineering experience

OFFICE ▶						
SURNAME ▶						
DATE ▶						

of relating these ideas to operating power plants. Therefore, if such a program is undertaken at the ORNL, their present capabilities should be supplemented through a cooperative project with an industrial company with experience in this area, or by hiring consultants who can supplement the ORNL staff.

OFFICE ▶						
SURNAME ▶						
DATE ▶						

1115825

The ORNL has been involved in preliminary investigations for beneficial uses of waste heat. Reflecting this interest, the Director of the Reactor Division Samuel E. Beall, Jr., made a presentation to the American Nuclear Society meeting in Los Angeles in June 1970, and the paper was entitled "How to Make a Profit on Waste Heat."

This project is primarily related to determining the feasibility of operating greenhouses utilizing the waste heat from steam electric generating stations. During FY 1971, the ORNL proposes to investigate the feasibility of maintaining a greenhouse at proper temperature and humidity utilizing condenser discharge water. They will, in parallel, determine the cost of: 1) delivering warm condenser water through pipes or open conduits, 2) maintaining the desired condenser outlet temperature during winter months when inlet water temperatures are normally low, and 3) artificial lighting with off-peak power. In addition, they will participate in the actual design of a demonstration facility which they propose should be constructed and operated by another agency, i.e., TVA or the University of Tennessee.

During FY 1972, the Laboratory proposes to study the feasibility of greenhouse-poultry house-fish culture operation, and the design of a demonstration facility. The Laboratory would participate in the procurement, installation, planning, execution, and evaluation of the program to maximize AEC benefits from this joint demonstration. Beyond 1972, the Laboratory envisions their efforts as limited to monitoring, planning, and evaluating the program as conducted by the participants.

Although thermal effects from operating electric generating stations is not exclusively a problem of reactor operations, the novel approach indicated by beneficial uses which may permit substitution of greenhouses for other cooling facilities may have possibilities worthy of consideration, though there are a number of practical problems which the ORNL has not fully taken into account and these need to be considered in developing a program plan.

If a decision were made to have the ORNL proceed with this program, consideration should be given to making it a cooperative effort with the University of Tennessee (UT) since they operate the AEC's Agricultural Research Laboratory located only four miles from the X-10 area of the ORNL. Also, UT has agricultural expertise which the ORNL does not possess. Another possibility is to work with TVA using the condenser cooling water from their Ball Run Electric Power Plant which is about five miles from the AEC's Agricultural Research Laboratory and nine miles from the ORNL.

OFFICE ▶						
SURNAME ▶						
DATE ▶						

In summary, the Site Office judges the program to be worthy of consideration but believes that there needs to be very careful planning and coordination before it is implemented. This planning should include evaluation of utilities and agricultural and aquacultural experts on the practicality of the concept, and the coordination should insure the participation of others who have the facilities and knowledge in areas which would complement the ONNL's capabilities.

OFFICE ▶						
SURNAME ▶						
DATE ▶						

1115827

ENVIRONMENTAL RESEARCH BUDGET

Existing
Agency \$ Thousands

I. What is the Environment?

Baseline Establishment and Environmental Indices

MAN - Body Fluids Analysis Program	NIGMS	60	
MAN - GEMSAEC Fast Clinical Analyzer	NIGMS	40	
Watershed Aquatic Habitat Interactions	AEC	300	
IBP	AEC	78	
Programmatic Perception			40
National Systems Analysis (Regional Modeling)			40
Regional Modeling			<u>10</u>
		<u>478</u>	90

Analytical Methods and Standards

MAN - Body Fluids Analysis Program	NIGMS	240	
MAN - GEMSAEC Fast Clinical Analyzer	NIGMS	160	
MAN - Ultra-centrifuge Development	NCI,AEC	400	
Radionuclide Cycling in Terrestrial Ecosystems ...	AEC	135	
Systems Ecology	AEC	70	
IBP	AEC	45	
		<u>1050</u>	0

Pollutant Source Identification

Radioactive Source Identification and Monitoring	AEC	990	
Programmatic Perception			50
National Systems Analysis (Chemicals associated with cooling)			10
Regional Modeling			<u>10</u>
		<u>990</u>	70

att #2

1115828

Economic Effects

Responses of Animals to Ionizing Radiation
Responses of Higher Plants to Ionizing Radiation
Radionuclide Cycling in Terrestrial Ecosystems

AEC 160
AEC 25
AEC 65

Programmatic Perception
National Systems Analysis (uses of Waste Heat)
National Systems Analysis (Alternatives to Energy Consumption)
Regional Modeling

50
85
40
50
225

250

Societal Effects

Programmatic Perception
Regional Modeling

100
50
150

0

Subtotal

5025

III. How Could we Control our Environment?

Abatement and Control Processes

Dual Use Transport Systems
Urban Use of Waste Heat
Evaluation of Activated Charcoal Absorbers
Evaluation of Metal-Oxide-SO₂ Reactions
Waste Disposal Research-Radioactive Waste
SO₂ Sorption Studies
Water Research Program
Hyperfiltration for Sewage
Advanced Solid Waste Treatment
Hyperfiltration Membranes
Automated Analysis of Polluted Water
Corrosion Chemistry
Scale Suppression by CO₂ Addition
Effects of Steam on Scrubbing by Aerosols
Radiation Resistant Insulators
Chemical Protection Against Ionizing Radiation
MAN Subproject: Ultracentrifuge Development

OCD 40
HUD 100
West. 11
NAPCA 20
AEC 406
HEW 44
OSW 210
FWPCA 155
HUD 100
OSW 37
FWPCA 80
OSW 87
OSW 7
NAPCA 40
OCD 87
AEC 50
NCI, AEC 110

Hyperfiltration Water Treatment
Regional Modeling (Solid Waste Recovery Complex)
National Systems Analysis (Cooling Tower Technology)

200
20
18

Demonstrative Systems

Nuclear Energy Center - Urban Areas
 Desalting Feasibility and Economics Study
 Program Planning and Engineering Development
 Tunneling Technology
 Condenser Flow Model
 Administrative and Technical Services
 CO₂ Evaluation
 Heat Transfer
 Deaerators - Engineering Development
 Vertical Tube Evaporator - Pilot Plant
 Desalting Process Evaluations
 VTE Compressor, Plant Design
 Plastic Entrainment Separation
 Distillation Process Systems Analysis
 Hydrodynamics of Reverse Osmosis
 Urban De-centralization

HUD	125
OSW	3
OSW	17
HUD	100
OSW	37
OSW	62
OSW	3
OSW	174
OSW	20
OSW	319
OSW	52
OSW	4
OSW	10
OSW	25
OSW	105
HUD	35

Regional Modeling

	20
	20
	25

Subtotal

2675	258
------	-----

IV. Environmental Information Centers

Environmental Mutagenesis Information Center
 Biogeochemical Ecology Information Center
 OSW Material Information Center
 OSW Literature Survey
 Nuclear Safety Information Center (environmental activities)
 Environmental Information System
 National Systems Analysis
 Regional Modeling

CPEHS	30
AEC	40
OSW	76
OSW	23
AEC	90

Subtotal

200
30
30
259
260

Existing
Agency \$ Thousands

Related New
NSF Request

V. Communication
Communication & Public Education

Subtotal 0 106 106

VI. Technology Assessment
National Systems Analysis
Regional Modeling

Subtotal 0 27 50 77

TOTAL

10922 1496

26

SUMMARY

- I. Understanding our Environment
- II. Influence of the Environment on Man
- III. Environmental Control
- IV. Environmental Information Centers
- V. Communication
- VI. Technology Assessment

2963 170
5025 625
2675 258
259 260
0 106
0 77
10922 1496

OAK RIDGE NATIONAL LABORATORY

OPERATED BY
UNION CARBIDE CORPORATION
NUCLEAR DIVISION



POST OFFICE BOX X
OAK RIDGE, TENNESSEE 37830

OFFICE OF THE DIRECTOR

June 12, 1970

xc fwd. by JHG, 7/23/70:
J. Pidkowicz

Dr. Spofford G. English
Assistant General Manager for
Research and Development
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Spof:

Studies at ORNL in Environmental Aspects of Nuclear Power Plants

As you know, we have a number of individual environmental studies (program 04 and 06) at ORNL closely related to power plant problems. Last year, commencing with a letter from Milt Shaw to F. L. Culler (6/20/69), we began developing a more centralized approach to this work and simultaneously increased our work on environmental information through an expansion of the Nuclear Safety Information Center. On October 9, 1969, we submitted to Mr. Shaw a proposal to expand this work, with emphasis on information processing and studies of thermal and radiological discharges and effects. The proposed funding level was \$400,000. Funds of \$40,000 (DBM) and \$70,000 (DRDT) were made available. On January 30, 1970, further requests for assistance to Headquarters were received from Mr. Shaw and Dr. Totter, related mostly to the development of research program plans in the areas of thermal discharges and effects and radionuclide transport and cycling models relating releases to exposure.

ORNL has made available support for this work through reprogramming of other work because we strongly concur with the urgency to meet criticisms that are so broadly evident about the environmental safety of nuclear power plants.

The attached Form 189 summarizes some of the associated activities and describes our proposed program of work for the coming year in this

1115833

Att. # 3

Dr. Spofford G. English

-2-

June 12, 1970

important area. We earnestly solicit your most vigorous efforts to help obtain full support for this work. We feel it is of very high priority in helping to ameliorate the currently broad level of low public credibility of the Commission in the environmental area.

If you have any questions on this program, please contact J. L. Liverman.

Sincerely yours,



Alvin M. Weinberg
Director

AMW:JLL:lmm

Attachment

cc: S. I. Auerbach
S. E. Beall
W. B. Cottrell
F. L. Culler
J. H. Gibbons
J. L. Liverman
R. A. McNeese (8)
K. Z. Morgan
H. M. Roth
D. B. Trauger

1115834

25. PROJECT COST AND DEVELOPMENT SCHEDULE (see also other referenced activities, in 04 and 06 areas, in environmental work associated with power plants.):

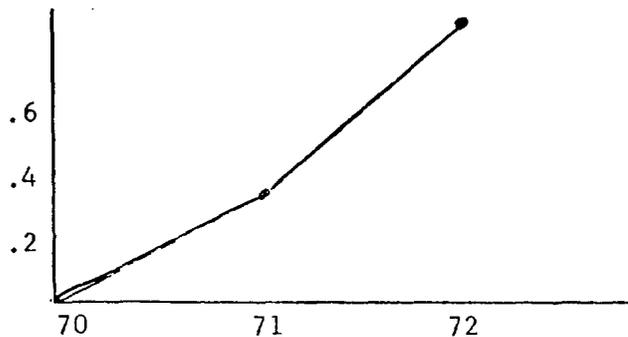
(Cost in Millions)		
Fiscal Year		
70	71	72

a. Cost Schedule

1. Research & Development (total project)	--	\$.338	\$.498
--	----	--------	--------

b. Development Schedule

cumulative
cost
(millions)



Milestones:

- | | | |
|-------|-------------|--|
| FY 71 | 1st quarter | <ul style="list-style-type: none"> (1) Draft of thermal discharges and effects program plan delivered to AEC. Commence implementation of those items AEC concurs as desirable for ORNL to undertake. (2) Finish summary and critique of current US thermal R&D. (3) Complete state-of-the-art on actinide isotopes and on Kr⁸⁵. (4) Initiate revision of thermal discharges and effects program plan following comments from AEC. |
| | 2nd quarter | <ul style="list-style-type: none"> (1) Report on cooling water inlet and out-fall design. (2) State-of-the-art report on heated water aquiculture in Japan. (3) State-of-the-art report on Sr⁹⁰ environmental release and movement. (4) Deliver draft radiological discharge program plan. (5) Deliver recommended guidelines for prelicensing thermal and hydraulic site selection studies. |
| | 3rd quarter | <ul style="list-style-type: none"> (1) First report on environmental impacts of innovative siting on thermal problems. (2) Commence work on items of radiological discharges program that AEC concurs as desirable for ORNL to undertake. |

1115836

25. PROJECT COST AND DEVELOPMENT SCHEDULE: (continued)

- FY 71 3rd quarter (3) Report of computer studies of super oxygenation engineering characteristics for decreasing biological insults of heated water.
- (4) State-of-the-art report on I^{131} environmental release and movement.
- (5) Submit revised thermal discharge and effects program plan for consideration by AEC.
- (6) Revise radiological discharge program plan following comments from AEC on draft.
- 4th quarter (1) Second Conference on Uses of Heated Discharges.
- (2) First design of fin fish facility using heated water and designed to include significant cooling effects.
- (3) State-of-the-art report on Cs^{137} environmental release and movement.
- (4) Submit revised radiological discharge program plan.

26. DATES AND TITLES OF PUBLICATIONS:

Most of our reports are listed in the 189 on Nuclear Safety Information Center. In addition to these, the following were published or submitted for publication during FY 70:

"Radiation and Environmental Characteristics of the Actinide Isotopes," by E. D. Arnold (to be published in Proc. ANS 16th Annual Meeting, June 28 - July 2, 1970, Los Angeles, California.)

"Nuclear Energy Centers and Food Production Potential," by W. C. Yee, Proc. Joint Conference Canadian Institute of Chemists and American Chemical Society, Toronto, Canada, May 1970.

"The Loud and the Silent Crisis," by John H. Gibbons. A Chapter in The Enlightenment of Science, to be published by Charles Scribner's Sons, 1970.

Additional articles whose preparation was commenced in FY 70 but which will not appear until FY 71 are listed in Section (29). Speeches and seminars, given to a wide distribution of audiences are not listed but are available on request.

1115837

27. SCOPE:

Summary

The Project has been organized to assist the Commission in bringing its varied resources and capabilities to bear on environmental aspects of producing electric power. It's initial or planned activities include environmental information gathering, processing, and communications; research in thermal discharges and effects; studies of routine radiological releases and their environmental fate (as input to siting studies); and staff assistance to the Commission in such areas as development of a program plan in thermal effects. The Project also serves to centralize and coordinate various other ORNL activities (programs 04 and 06) in environmental studies concerned with or related to nuclear power production.

The Project brings together the several activities at ORNL in environmental factors associated with stationary power plants and related industry such as reprocessing plants. The purpose is to assist the Commission to meet the widely expressed need to be more deeply involved in environmental affairs related to atomic energy in general and nuclear power plants in particular. The following are activities of the project:

1. Information.

We are utilizing the procedures and software of an existing bibliographic information center (NSIC) to abstract, keyword index, and computer-store references useful in work associated with routine discharges from power plants (and their effects). This includes such areas as measurements and controls of releases (radiological, chemical, and thermal); release methods and abatement techniques; movement and effects of releases on the biosphere. This information is used internally to assist in the preparation of various state-of-the-art reviews and summaries on areas of interest. It is selectively distributed to interested individuals and groups based on their specific interests and requests. A keyworded abstract file ("PPIF") is also kept of projects being funded by AEC in environmental areas. Contact with the public is encouraged through correspondence and speaking engagements. The Project also attempts to aid the Commission upon request in specific areas of information such as program plan development.

2. Environmental Studies.

We are concentrating on those environmental factors related to energy conversion, waste processing, and fuel reprocessing. The most notable areas of emphasis are:

(a) Thermal. We are examining ways to move waste heat into the atmosphere at minimum cost consonant with a scientifically and socially acceptable insult to the biosphere. We are also investigating potential ways to utilize this "resource" through agricultural, aquicultural, and urban uses. Our efforts are focussed on determining the state-of-the-art in these areas, the extent of current research programs, and the identification of needed R&D. This information will contribute to the development and implementation of the program plan on thermal and discharged effects.

(b) Radiological. Our goal is to increase and correlate knowledge of low level radiological discharges, movement, and effects in the environment; to

1115838

27. SCOPE: (continued)

compare these effects with other insults associated with power production; to provide means of predicting very long-term regional consequences of radionuclides from many sources; and to develop means to monitor, control, and further abate routine radiological releases from power plants and re-processing plants. A central goal is the development, beginning with source term description, of a predictive model that will enable source, pathway, and fate description of movement for those radionuclides of significance. This will then permit regional water basin calculations for a variety of reactors and processing plants over many years that will relate source releases to resultant public exposures. These calculations, to be built on existing sub-programs at ORNL, are needed for long-term extrapolations of dose and dose commitment that are a necessary component of regional studies.

3. Siting

We propose to study the recommendations of the forthcoming OST report on power plant siting research requirements and to initiate work on those high priority requirements in which ORNL has strong competence. This will represent in part the AEC response to a recognized need on power plant siting.

4. Other Activities

We are seeking other ways to utilize more fully the special skills and knowledge of ORNL in contributing to amelioration of environmental insults particularly those associated with power production. This includes assistance to municipal, state, and federal agency representatives, students and citizens who seek information and advice. Another activity is the identification of timely issues and subsequent organization of a working conference or symposium to concentrate on (and hopefully to clarify) the issues. This project has also furnished experts to assist the Commission in special tasks, for example, the OST study on R&D needed for power plant siting. Many specific research and development or demonstration projects are developed from this project but are presented as separate 189's in appropriate AEC activity areas.

28. RELATIONSHIP TO OTHER PROJECTS (see also the related 189 forms tabulated under Section 30):

The specialized information centers at ORNL cover a broad range of subjects and operate at many levels of sophistication. There are more than a dozen of these centers at ORNL, sharing the experience and technology of storage and retrieval techniques. Our work on environmental information associated with steam power plants and in biogeochemical data is not duplicated, per se, in any other facility or agency. We do, however, utilize information from SIE, TID (AEC), LRL (AEC), FWQA, and others. Our work on critical reviews and state-of-the-art surveys is coordinated through close communication with other potential sources of such documents (e.g., ANL) so that duplication of effort is avoided.

The accelerated concern over environmental quality has caused a rapid increase in associated research and development. In the area of stationary power plants, and particularly nuclear power plants there are a large variety of studies underway in both private and public sectors. Waste heat dispersal studies have been made

1115839

28. RELATIONSHIP TO OTHER PROJECTS: (continued)

for specific power plant sites by engineering consulting firms and university groups. In addition temperature prediction and mixing zone modelling studies for rivers and reservoirs have been actively pursued at PNL, sponsored by AEC (Production and DRDT); similar temperature studies, both theoretical and experimental, are being studied at ANL for large lakes. Similar studies for estuary systems have been sponsored by EEI.

Wet cooling tower technology is being given some attention by industry, partially under an FWQA grant, but there appears to be no concerted R&D effort by industry to improve cooling tower performance or to examine environmental effects such as those from chemical additives and plume interactions. Environmental problems associated with salt water cooling towers are significant but we are not aware of any current or planned efforts to solve them. Dry cooling towers of the capacity required for power plants are being discussed by national leaders but to our knowledge little effort on their development is currently supported by industry or government, probably because of discouraging economic prospects. Some associated heat exchanger and materials research which is applicable has been supported by OSW and AEC. Few hard data or calculations are available on the use of smaller ponds or lakes as a means for heat dump but their use is spreading, particularly in the southeast.

Several studies in beneficial uses of heated water in aquiculture, agriculture and urban uses are being proposed by ORNL to both HUD and AEC. Some work in fish production is being initiated by private industry and a demonstration/research project in agriculture is being sponsored by a public utility. However, we have found no centralized, systematic effort toward utilization of this resource. A proposal is being submitted which includes joint efforts by TVA and ORNL toward a demonstration project.

Studies of environmental aspects of routine radiological releases have centered on release controls, monitoring, movement, and systems modelling. This work has been supported in the main by AEC and PHS at Pacific Northwest Labs, ORNL, and others. Coherence is maintained through literature publication, private conferences, and communication links between professional personnel.

Numerous studies on particular aspects of power plant siting have been, or are being, made. The OST study "Considerations Affecting Steam Power Plant Selection" (1969), is notable. So too is the succeeding OST siting study (to be published, 1970) which concentrates on areas of needed R&D. Our cognizance of this is maintained through personal participation in that study by a member of our Project.

29. TECHNICAL ACCOMPLISHMENTS IN FY 1970:

Progress related to information processing is reviewed in 189-10160 (Nuclear Safety Information Center) and 189-57 (Biogeochemical Ecology Information Center). Funds were used to initiate new categories, primarily in expansion of the Nuclear Safety Information Center to include environmental aspects of power plants. As reviewed in (189a) this work is proceeding approximately on schedule. The development of key word vocabularies, a necessarily time-consuming process, is essentially complete except in areas having to do with public information. New or expanded categories include (listed by activity number) (14) Radionuclide release and movement in the environment, (15) Environmental surveys, monitoring, and radiation exposure of man, (16) Meteorological considerations, (19) Radiation dose to man from radioactivity released to the environment, (20) Effects of

29. TECHNICAL ACCOMPLISHMENTS IN FY 1970: (continued)

thermal modifications of ecological systems, and (21) Effects of radionuclides and ionizing radiation on ecological systems.

Work on several review papers has been initiated. Publication is scheduled for calendar 1970. Subjects include the following:

- Ecological and Health Physics Aspects of Tritium.
- Internal Exposure Hazards Associated with Plutonium.
- Radioactive Krypton and Its Behavior in the Environment.
- Atmospheric Effects on Cooling Towers.
- Actinide Radionuclides: Their Production, Release, and Behavior in the Environment.

Progress toward the biogeochemical literature and data center is described in 189-57 (06 Program). This work is complementary to, and builds upon, the work in the NSIC. It is more broadly addressed to ecological information and stresses data accumulation and manipulation in addition to bibliographic work.

Members of the Project have appeared before public groups, including approximately 20 university audiences, technical conferences, and civic groups (about 30) on a variety of occasions. The subject area has been the contribution of AEC programs to work in environmental quality. Audience contact has totaled several thousand college students and faculty in more than six states, over one thousand high school students and teachers, and several hundred members of civic clubs.

Two short-term projects were performed for Headquarters upon their request. One was a several-week evaluation and classification of thermal baseline programs associated with docketed nuclear power plants as reported in a selected set of reports. As a part of this study a guideline for minimum pre-operational and post-startup baseline studies was drafted. The second short project was an evaluation of public positions taken by certain individuals regarding environmental aspects of nuclear power plants.

Another study initiated in FY 1970 is an overall review and evaluation of (U.S.) current and projected research programs in the thermal discharge area by about 200 federal and state agencies, universities, utilities, and industries. The study is being carried out under the direction of an ecologist and an engineer. Response has been excellent, if a little overwhelming.

One member of the Project spent almost half a year serving with the Interagency OST Task Force chaired by the AEC on Needed R&D for Power Plant Siting (document in publication).

During the last four months of FY 70 a task force was organized at the request of the Commission (DRDT and DBM) to develop a program plan on thermal discharges and effects. The draft plan will be presented in early July and will represent about two man years of effort. Work was also initiated at the end of FY 70 on a program plan to determine environmental effects from releases of radioactivity. This plan will give priority attention to the development and use of radionuclide transport models in relating source releases to ultimate exposure to the public.

Members of the Project organized a working conference on "Beneficial Uses of Waste Heat." It was attended by invitation and was structured to include representation from government, electrical utilities, universities, and private

29. TECHNICAL ACCOMPLISHMENTS IN FY 1970: (continued)

industry groups, ranging from major industrial companies to small users of waste heat such as catfish growers. Approximately 85 people attended. Post-conference evaluation by the participants has indicated a nearly unanimous feeling that it was both unusual and highly successful.

Paper studies including conceptual design (patent being applied for) and cost analyses were performed for an aquiculture facility for intensive shrimp culture in heated seawater. Economic and market data collected indicate that the U. S. has remained relatively stable in fish and shrimp production and has met increasing consumption with more imports. Within a decade the extrapolated demand for shrimp will exceed current worldwide supply. This partially accounts for the intense interest in shrimp farming. A review of Japanese experience in particular indicates that large potential gains are possible through the use of heated water in shrimp production.

Preliminary studies of the use of heated water for heating and cooling of greenhouses indicate the value of cost savings to be derived from use of inexpensive low grade heat. Vegetables grown on a year-round basis could produce sufficient earnings to provide reasonable venture capital profits and could also provide a significant income and savings to the utility.

Studies of properties of actinide isotopes and their anticipated production rates were performed and it was concluded that information is needed on plant and mammalian uptake of americium and curium since extrapolation of plutonium behavior to these nuclides is subject to a large uncertainty.

30. EXPECTED RESULTS IN FY 1971:

The Project will oversee and/or coordinate the various activities at ORNL concerned with or relevant to environmental effects of nuclear power plants. This will include, but not be restricted to, the following programs:

Program 04 - Reactor Development

- a) 189a-10145 Safety Criteria for Siting and Operating Nuclear Facilities
- b) 189a-10160 Nuclear Safety Information Center
- c) 189a-10245 Dry Cooling Tower Studies
- d) 189a-10260 Wet Cooling Tower Studies
- e) 189a-10261 Beneficial Uses of Waste Heat (incooperation with TVA)

Program 06 - Biology and Medicine

- f) 189-49 Responses of Animals to Ionizing Radiation
- g) 189-50 Responses of Higher Plants & Plant Communities to Ionizing Radiation
- h) 189-51 Radionuclide Cycling in Terrestrial Ecosystems and the Use of Isotopes to Delineate and Quantify Basic Ecological Processes
- i) 189-52 Radionuclide Cycling in Aquatic Ecosystems
- j) 189-55 Thermal Enrichments Studies
- k) 189-57 Biogeochemical Ecology Information Center
- l) 189-66 Radiological and Health Physics - Internal Dose Estimation

1115842

30. EXPECTED RESULTS IN FY 1971: (continued)

In addition to these separately proposed activities we propose to undertake the following tasks:

(1) We will proceed with development of the thermal discharges and effects program plan, following guidance from the Commission. First, the program plan will be detailed to the requisite degree. Second, a state-of-the-art and summation of current and scheduled R&D programs will be prepared. Third, we will proceed to implement, to the extent possible, the highest priority items of the program plan. We anticipate that among these items will be the development of guidelines for pre-licensing surveys, post-startup studies, and systematic monitoring and reporting procedures. We will determine the limitations imposed by heat sink capacities under proposed water quality standards for various heat rejection processes in relation to the growing power demands projected.

(2) We will undertake studies in thermal effluent abatement techniques (in addition to the cooling tower studies) including detailed considerations of heated water intake and outfall design that will require a merged use of aquatic ecology and fluid dynamics. We will initiate studies of the possible desirability of offshore siting and other innovative siting ideas such as offshore salt water cooling towers that may largely obviate problems associated with thermal discharges in coastal, near-shore, or estuarine areas. We will attempt to predict the effect of varying temperature restrictions (temperature rise in receiving water) and various abatement techniques on the real cost of power.

(3) We will investigate the use of super-oxygenation techniques as a method for treating heated effluents. Since metabolic rates increase rapidly with water temperature and oxygen solubility correspondingly decreases, the trauma to aquatic life from heated water is related to the combined effects. New, economical techniques in transferring oxygen into water may make such treatment feasible, particularly in times of summertime peak loads. We will adapt an existing computer program to predict the oxygen retention characteristics of heated water. Results will be checked with limited laboratory experiments. Additional experiments will be planned on metabolic oxygen requirements at elevated temperatures for selected organisms and their ability to utilize supersaturated oxygen.

(4) We propose to supplement the activity (see (3) above) on beneficial uses of waste heat by a theoretical and laboratory determination of variables important for aquaculture such as metabolic oxygen requirements as a function of temperature, water flow rate, and fish packing density. The facility design developed earlier (Middle East Study Group) for shrimp studies will be applied to fin fish. The design will obviously differ in some ways since shrimp are bottom dwellers and fin fish can occupy nearly the entire water volume. Studies will include consideration of aquatic filter feeder, or possibly agricultural use of the effluent water (containing nutrients and fish waste products) as a means to improve effluent water quality and further use the nutrients. The facility design will also be studied for cooling characteristics to determine whether optimum year-round cooling is consonant with fin fish aquaculture. A review and state-of-the-art paper will be prepared on the program in heated water aquaculture being carried out in Japan.

1115843

30. EXPECTED RESULTS IN FY 1971: (continued)

(5) In addition to the state-of-the-art papers scheduled for completion as detailed in (a) above, we propose to complete state-of-knowledge reviews of nuclides I^{131} , Cs^{137} , Sr^{90} with emphasis on their release and movement in the environment. These reviews, together with other information will serve as inputs to a radiological release model that will be developed step-wise starting with source term descriptions. We will establish monitoring and reporting criteria and techniques required to gain sufficient quantification of source terms to permit long-term, multi-source river basin calculations of consequences of environmental releases, doses, and dose commitment. Source term characterizations will be obtained for reactors (by type), fuel processing plants, and waste processing plants. Fallout terms will be provided for. This work will be closely integrated with the activity described in (f) and (g) above and with the "year 2000" study of PNL. The radiological discharge program will be finished to first draft during the first quarter of FY 71. Implementation of highest priority items will be commenced as soon as possible, hopefully in advance of completion of the plan. We believe the regional, multi-source model development is urgently needed to gain credibility about the low levels of radioactivity that will be incurred with major power reactor development.

31. EXPECTED RESULTS IN FY 1972:

The thermal and radiological discharge programs should be in full operation, providing research results that will serve as input to a detailed siting plan for regions of the U. S. Sufficient information should have been developed to predict long-term regional consequences of low-level radiological releases from many sources in a river basin, lake or estuary. Firm guidelines should be established on required pre-licensing and post-startup environmental studies.

Programs in beneficial uses of waste heat should be sufficiently developed to be able to select those specific programs of definite promise and to arrange for demonstration or pilot plants in cooperation with industry.

Experimental and theoretical studies of advanced thermal effects abatement techniques and thermal effects should have progressed sufficiently to allow a much more realistic appraisal of costs and benefits. The state of knowledge should be at a point where environmental factors can be realistically integrated into regional and national power plant siting policies. We will increase our effort in coupling our studies on environmental factors in siting to regional land use planning, urban planning and decentralization (ORNL-HUD program), and the regional modelling studies (ORNL-NSF program).

32. EXPECTED RESULTS BEYOND FY 1972:

In view of the uncertainties about responsibilities in environmental matters within the various federal agencies it is difficult at this time to predict quantitatively more than two years hence. However, we believe it is in that time frame that sufficient information will be available on environmental and other considerations of making electrical power that a synthesis will be called for: to integrate a master power plant policy, including siting and effluent criteria for all types of steam electric plants. Advanced planning for land use and offshore siting will also probably be of increasing concern. Studies will contain an increasing component of systems integration and economics. Information and communication activities at all levels will be of increasing importance.

h85111

33. DESCRIPTION, JUSTIFICATION, AND COSTS OF MAJOR MATERIALS, SUBCONTRACTS, AND OTHER UNUSUAL SIGNIFICANT COST ITEMS:

<u>Description and Justification</u>	<u>Cost Estimates</u>		
	<u>FY 1970</u>	<u>FY 1971</u>	<u>FY 1972</u>
(a) Subcontracts (consultants)	--	4000	4000
(b) Equipment	--	--	10000
(c) Technical Services (computer costs)	--	1000	6000

34. DESCRIPTION AND JUSTIFICATION OF ALL EQUIPMENT ITEMS:

None

35. SPECIAL REACTOR MATERIALS REQUIREMENTS:

None

36. IRRADIATED MATERIAL REPROCESSING:

None

37. IRRADIATION SERVICE BUDGET - IRRADIATION UNITS:

None

38. PROPOSED OBLIGATIONS FOR RELATED CONSTRUCTION PROJECTS:

None

39. UTILIZATION FACILITIES AND TEST INSTALLATIONS:

None

1115845