

UNITED STATES GOVERNMENT

Memorandum

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TO : Ralph Elson, Director
Contract Division

FROM : Herman M. Roth, Director
Laboratory and University Division

SUBJECT: REQUEST FOR CONTRACT ACTION

OLE:JDB

DATE:

OCT 6 1967

It is requested that you take the necessary steps to process the following described contract action:

1. Nature of Action Requested:

Selection of New Contractor and/or
Negotiation of Contract
Number:
Contractor:

Modification of Contract
Number: AT-(40-1)-2789
Contractor: Virginia Institute of Marine Science
Gloucester Point, Virginia 23062

2. Nature of Services to be Covered by Contract: Research

Title: "Concentration of Suspended Radioactive Wastes Into Bottom Deposits" ✓

3. Type of Contract: Support Agreement Cost-Type Other

4. Amount of AEC Funds to be Obligated by this Contract Action: None

5. AEC Percentage of Estimated Total Cost to be Shown by this C/A: N/A

6. Description of Other Changes to be Covered by Contract Action:

Modify contract to provide for the performance of additional research to be completed during the period January 1, 1968, through June 30, 1968, without additional funds. There is no significant change in the scope of the work.

7. Authority: Form AEC-481 (Contract Authorization) from John R. Totter to S. R. Sapirie dated September 29, 1967.

Herman M. Roth
Herman M. Roth

42844

REPOSITORY *Oak Ridge Operations*
COLLECTION *Records Holding area*
BOX NO. *A-69-5 68-5 198-3 2289. 2714-H*
FOLDER *Contract AT-(40-1)-2789*
Virginia Institute of Marine Science Laboratories

COMMONWEALTH OF VIRGINIA



VIRGINIA INSTITUTE OF MARINE SCIENCE
GLOUCESTER POINT, VIRGINIA 23062

September 13, 1967

Dr. C. S. Shoup
Chief, Biological Branch
Research Development Section
U. S. Atomic Energy Commission
Oak Ridge, Tennessee

Dear Dr. Shoup:

We are replying to your letter of 5 September 1967 in which you inquire about the status of contract number AT(40-1)-2789. During 1967, we asked for a terminal year and our contract will end 31 December 1967. At the present time, we do not plan to request renewal.

We are presently closing out all aspects of the program, but several small projects require additional work. Consequently, we are asking you for a 6-month extension of the contract period without additional pay. This extension will make possible the completion of several interesting projects and will keep the present team of biologists together for the purpose of preparing approximately five manuscripts for publication. At the end of this extended period, we will, of course, submit our final report.

Sincerely,

Dexter S. Haven

Dexter S. Haven, Head
Department of Applied Science

DSH:br

CONTRACTS-2789(VH)

H 9209
SEP 15 1967

UNITED STATES GOVERNMENT

Memorandum

TO : R. G. Humphries, Director
Contract Division

FROM : Herman M. Roth, Director
Research and Development Division

SUBJECT: REQUEST FOR CONTRACT ACTION

ORS:JDB

DATE:

JAN 24 1967

It is requested that you take the necessary steps to process the following described contract action:

1. Nature of Action Requested:

Selection of New Contractor and/or
Negotiation of Contract
Number:
Contractor:

Modification of Contract
Number: AT-(40-1)-2789
Contractor: Virginia Institute of Marine Science
Gloucester Point, Virginia

2. Nature of Services to be Covered by Contract: Research

Title: "Concentration of Suspended Radioactive Wastes into Bottom Deposits"

3. Type of Contract: Lump-Sum Cost-Type Other

4. Amount to be Obligated by this Contract Action: \$21,995.00

5. Description of Other Changes to be Covered by Contract Action:

Modify contract to provide for the performance of additional research to be completed during the period January 1, 1967 through December 31, 1967. The AEC will support the project in the amount of \$21,995 in new funds. Title to equipment, if any, shall vest in the contractor under authority of the Atomic Energy Act of 1954 since the contractor's contribution is expected to equal or exceed the value of the equipment.

6. Authority:

Form AEC-481 (Contract Authorization) from C. L. Dunham to S. R. Sapirie dated January 16, 1967

Herman M. Roth
Herman M. Roth

APPENDIX "A"

For the Contract Period January 1, 1967 through December 31, 1967.

A-I RESEARCH TO BE PERFORMED BY CONTRACTOR

The Contractor will continue studies of the concentration of suspended radioactive wastes from marine organisms into bottom marine deposits to include studies of the movements of pellets from common filter feeder organisms, filtering phenomena in oysters, sediment mixing with kaolin or sand activated with Kr^{85} as tracer, concentration and mixing phenomena with studies of amphipods, ostracods, and polychatae. Sediment mixing by the invertebrates, sinking of pellets, and filtering rates will be studied by appropriate sized clays.

A-II APPROXIMATE LEVEL OF RESEARCH EFFORT

<u>(a) Contractor Personnel:</u>	<u>Approx. % of time</u>
Mr. D. S. Haven, Principal Investigator	10%
Research Associate	100%
3 Graduate Students	100%
Secretary	As Needed

(b) Premises, Facilities, and Materials to be
Furnished by the Contractor:

Laboratories and facilities necessary to conduct research on the concentration of suspended radioactive wastes into bottom deposits will be available. Equipment available includes a gamma spectrometer system with graphic recorder, proportional counting system, auxiliary scaler with detectors, survey meters, fume hood, muffle furnace, drying oven, constant temperature water bath, oyster grounds, scuba diving gear and other related instruments.

A-III ITEMS OF EQUIPMENT TO BE PURCHASED OR FABRICATED BY CONTRACTOR
COSTING \$500 OR MORE

None

U. S. ATOMIC ENERGY COMMISSION
CONTRACT AUTHORIZATION

1. DATE JAN 18 1967		2. AUTHORIZATION NO. BM-67-313
3.A. TO S. R. Sapirie, Manager Oak Ridge Operations Office		3.B. FROM <i>John R. Foster</i> C. L. Dunham, M.D., Director Division of Biology and Medicine, HQ
4.A. CONTRACTOR (Name, Address, Department, etc.) Department of Applied Science VIRGINIA INSTITUTE OF MARINE SCIENCE Gloucester Point, Virginia 23062		4.B. PRINCIPAL INVESTIGATOR(S) Dexter S. Haven
5. <input type="checkbox"/> NEW CONTRACT <input checked="" type="checkbox"/> RENEWAL <input type="checkbox"/> OTHER	6. TERM OF CONTRACT 1-1-67 thru 12-31-67	7. CONTRACT NUMBER AT(40-1)-2789
8. RECOMMENDED TYPE OF CONTRACT: <input checked="" type="checkbox"/> FIXED PRICE <input type="checkbox"/> COST REIMBURSEMENT <input type="checkbox"/>	9. PROPERTY TITLE TO VEST IN: <input type="checkbox"/> AEC <input checked="" type="checkbox"/> CONTRACTOR	10. SECURITY CLASSIFICATION: Work to be performed is under category <u>I</u> as defined by AEC Manual Appendix 3401.

11. PROJECT TITLE
"CONCENTRATION OF SUSPENDED RADIOACTIVE WASTES INTO BOTTOM DEPOSITS"

12. HEADQUARTERS TECHNICAL CONTACT
Mr. Jared J. Davis *JJD*

13. FINANCING (New AEC Funds, Not To Exceed Amounts Indicated):

A. OPERATING EXPENSES \$ 21,995
 Budget and Reporting Classification: 06 05 02 + 1,000 Unexpended Balance
 Allotment Transfer: 06-71-91 (24)

B. PLANT AND CAPITAL EQUIPMENT \$
 Budget and Reporting Classification:
 Allotment Transfer:

14. SPECIAL PROVISIONS AND INSTRUCTIONS:

The technical aspects of the proposed work have been reviewed and are approved. A need currently exists for the results of the research or other work that is to be undertaken. None of the AEC funds shall be used to confer a fellowship.
 Please keep us informed as to any problems encountered in your negotiations, as well as the date of execution of this contract and the amount of funds obligated. If the budget as negotiated differs substantially from that in the proposal, please forward a copy of the revised budget to Headquarters.
 If not already submitted, a 200-word summary of the proposed work should be forwarded by the contractor as soon as possible after negotiation of the contract.

NOTE: TERMINAL YEAR.

15. SCOPE OF WORK

Research on the uptake of radionuclides by marine organisms.

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JAN 18 1967

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FM USAEC JARED J DAVIS WASHDC

TO USAEC HERMAN M ROTH OAK RIDGE TENN

AEC

BT

UNCLAS RENEWAL HAS BEEN APPROVED FOR VIRGINIA INSTITUTE OF MARINE
SCIENCES CONTRACT AT/40-1/-2789 AND C/A BM-67-313 IN THE AMOUNT OF
\$21,995 PLUS UNEXPENDED - FOR A TERMINAL YEAR WILL BE FORWARDED TO YOU
BY MAIL WEDNESDAY, JANUARY 11, 1967. PLEASE NOTIFY VIRGINIA INSTITUTE
AS SOON AS POSSIBLE. END REF:BMES:JJD

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JAN 11 1967

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UNITED STATES GOVERNMENT

Memorandum

TO : **C. L. Dunham, Director**
Division of Biology & Medicine, HQ

DATE: **September 30, 1966**

FROM : **Herman M. Roth, Director**
Research and Development Division, OR

SUBJECT: **RENEWAL OF CONTRACT NO. AT-(40-1)-2709 WITH VIRGINIA INSTITUTE OF**
MARINE SCIENCE (DR. DEWEY S. HAVEN)

CRS:JTB

We are submitting for your review and appropriate action the following information concerning the contract which will expire on **December 31, 1966**:

1. Renewal Proposal (4)
2. Progress Report (4)
3. Financial Statement (4)
4. 200-Word Summary (3)
5. Reprint (4)

We shall appreciate your advising us of your decision so that we may proceed with the necessary contract action at the earliest possible date.


Herman M. Roth

Enclosures:
As Listed Above

BC: **C. S. Shoup, w/encls.**
D. S. Zachry, w/progress report
Alice Brown
R. L. Shannon, STIE, w/reprint,
progress report and Form ABC-427

COMMONWEALTH OF VIRGINIA



VIRGINIA INSTITUTE OF MARINE SCIENCE
GLOUCESTER POINT, VIRGINIA 23062

September 23, 1966

Dr. C. S. Shoup
Chief, Biology Branch
Research and Development Division
U. S. Atomic Energy Commission
P. O. Box E
Oak Ridge, Tennessee 37831

Dear Dr. Shoup:

Enclosed you will find six (6) copies of the following: Progress Report for 1966 for Contract No. AT-(40-1) 2789, "Concentration of Suspended Radioactive Wastes into Bottom Deposits"; a 200-word summary; our expenditure statement for 1966; a 10 per cent voucher; and a renewal proposal for Contract No. AT-(40-1) 2789 for 1967.

Sincerely,

Dexter S. Haven

Dexter S. Haven, Head
Department of Applied Science

DSH:br

Enclosures *OK MR*

cc: Dr. William J. Hargis, Jr.

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1128052

September 26, 1966

EXPENDITURE STATEMENT

Expenditures from January 1, 1966 thru September 30, 1966

<u>Classification</u>	<u>Virginia Institute of Marine Science</u>	<u>ARC</u>	
Personnel	\$ 863.00	\$11,142.60	
Materials & Supplies		2,153.75	
Indirect Costs	<u> </u>	<u>1,153.88</u>	
	863.00	14,450.23	\$15,313.23
Estimated Costs - October 1, 1966 thru December 31, 1966	<u>284.00</u>	<u>7,922.77</u>	<u>8,206.77</u>
	1,147.00	22,373.00	23,520.00

1120853

RENEWAL PROPOSAL
Concentration of Suspended Radioactive Wastes
into Bottom Deposits

by
Dexter Haven, Senior Investigator
Virginia Institute of Marine Science
Gloucester Point, Virginia

The Senior Investigator requests that the U. S. Atomic Energy Commission consider renewal of Contract No. AT-(40-1) 2789 for the period 1 January 1967 to 31 December 1967.

The Senior Investigator does not receive financial support from any other Federal agency.

The program will be under the direction of Mr. Dexter Haven, assisted by Mr. Reinaldo Morales-Alamo. Radiobiological studies will be supervised by Dr. Morris L. Brehmer, Head, Radiobiology Section. Identification of marine invertebrates will be done by Dr. Marvin L. Wass, Ecology-Pollution Department.

Proposal for 1967

This is the last year funds will be requested under Contract No. AT-(40-1) 2789. Studies have previously investigated many aspects of biodeposition. A final year is necessary, however, to complete studies now in progress and to evaluate existing data.

Studies for 1967

Two studies planned for 1967 consist of projects planned for previous years but which were not completed due to time limitations.

1) It is planned to study sinking rates of fecal pellets from several common filter feeders. The importance of this study is based on findings that fecal pellets may form a large portion of the solids retained by 44 μ sieves. That is, biodeposits and possible associated radionuclides may be transported in estuarine waters in the form of large pellets as well as in the form of fine particles in the clay-silt size range. Transport rates of these heavy pellets by currents will not be the same as the smaller suspended particles. Data on sinking rates will be useful in estimating possible rates of transport.

It is proposed to hold oysters, barnacles, and tunicates in aquaria to obtain fecal pellets. After an hour, fecal pellets will be collected. Settling rates will be determined in a Rapid Sediment Analyzer. This apparatus was developed by the Woods Hole Oceanographic Institute for measuring electronically settling velocity of sand grains. It consists of a column of water in a tube. Passage of particles past a point in the bottom of the tube is recorded electronically on a tape (Zeigler, Whitney and Hayes, 1960).

2) Studies with the Coulter Counter during 1965 and 1966 showed that oysters may filter from suspension significant quantities of inorganic particles about 1 μ in size. Results will be verified using kaolinite labeled with Kr⁸⁵. Activated clay of a size determined by a Coulter Counter will be suspended in water in a closed system. Oysters will be placed in these containers and allowed to filter

particles from suspension. Samples of the water will be removed at intervals. One sample will be filtered through a 0.2 μ millipore filter; efficiency of filtration will be based on activity retained on the filters. The second sample will be used in the Coulter Counter to determine number and size of these particles.

3) Preliminary studies in 1966 clearly demonstrate that sediment mixing may be followed using kaolinite or sand activated with Kr⁸⁵. The technique appears to be superior to our older method using clays labeled with Ce¹⁴⁴ or with fluorescent particles. In the latter studies the time required to count a single sample was often excessive; with Ce¹⁴⁴ possible reaction with substrate chemicals was always a possibility. As a consequence of the indicated utility of Kr⁸⁵ labeled materials, it is planned to continue sediment mixing studies with this technique in 1967. These studies will follow several lines:

A. During 1966, it was shown that C. filigera was capable of concentrating radionuclides from a wide area of the sediment surface into a relatively narrow zone around its burrow. This biological process appears to be a previously unreported phenomenon. More precise studies are needed to show total area "swept" by a single animal, rapidity with which sediments are concentrated, and if other groups of animals have a similar ability. Experiments are planned in which C. filigera will be placed in sediment filled aquaria to which has been added a surface film of kryptonated kaolinite. Samples of surface sediments will be taken in an exact pattern at intervals from the aquaria to determine distribution of particles in relation to animals.

B. Similar studies will be made with other invertebrates which have feeding habits similar to that of C. filigera.

C. It is proposed to study vertical mixing of sediments by several animals shown to be dominant in the area but which were not investigated during 1966. These will include two species of amphipods A. vadorum and A. macrocephala, the polychaete Nephtys incisa, and the ostracod Sarsiella zostericola. Animals will be held in sediment aquaria and kryptonated clay added to the surface sediments. Later, cores will be taken at 0.5 and 1.0 cm intervals and activity measured.

D. There appears to be a slight loss of activity with time for kryptonated kaolinite and a larger loss for kryptonated sand. These results will be checked again in 1967 so that a "correction factor" may be applied to the above studies.

Personnel

Biographical Sketch

Senior Investigator--Time allotted to project, 10%

Name--Haven, Dexter S. Title--Associate Marine Scientist

Date of birth--[REDACTED] Place of birth--[REDACTED]
Illinois

Educational Experience

Degree	[REDACTED]	Date
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]

Employment Experience

Dates	Employer	Title or Nature of Work
1948-49	U. S. Fish & Wildlife Service	Marine Biologist
1949 to date	Virginia Institute of Marine Science	Marine Biologist

Publications

- Haven, D. 1951. A quick drying ink for labeling cellulose acetate slides. *Copeia*. 1941(3):252.
- Haven, D., and J. D. Andrews. 1957. Survival and growth of Venus mercenaria, Venus campechiensis, and their hybrids in suspended trays and on natural bottoms. *Proc. Natl. Shellfish. Assoc.* 47 (1956):43-49.
- Haven, D. 1957. Distribution, growth, and availability of juvenile croaker, Micropogon undulatus, in Virginia. *Ecology* 38(1):88-97.
- Haven, D. 1959. Effects of pea crabs, Pinnotheres ostreum, on oysters, Crassostrea virginica. *Proc. Natl. Shellfish. Assoc.* 49:77-86.
- Andrews, J. D., and D. S. Haven. 1959. Fresh-water kill of oysters (Crassostrea virginica) in James River, Virginia 1958. *Proc. Natl. Shellfish. Assoc.* 49:29-49.
- Haven, D. 1959. Migration of the croaker, Micropogon undulatus. *Copeia* 1959(1):25-30.
- Haven, D. 1961. Eurasian water milfoil in the Chesapeake Bay and the Potomac River. Water management in the Potomac Estuary. Interstate Commission on the Potomac River Basin, 1961.

8. Haven, D. 1962. Seasonal cycle of condition index of oysters in the York and Rappahannock Rivers. Proc. Natl. Shellfish. Assoc. 51(1960):42-66.
9. Haven, D. 1962. Supplemental feeding of oysters with starch. Chesapeake Sci. 6:43-51.
10. Haven, D. C., and R. Morales-Alamo. 1965. Apparatus for holding individual oysters under equal water flows. Limnol. and Oceanogr. 10(4):605-606.
11. Haven, D. S., and R. Morales-Alamo. 1966. Use of fluorescent particles to trace oyster biodeposits in marine sediments. Jour. Conseil, Conseil Perm. Intern. Exploration Mer 30(2): 267-269.
12. Haven, D. S., and R. Morales-Alamo. Aspects of biodeposition by oysters and other invertebrate filter feeders. Limnol. and Oceanogr (in press).
13. Haven, D. S., and R. Morales-Alamo. Relation of biodeposition by oysters to depuration. Proceedings First National Conference on Depuration (in press).

Biographical Sketch

Research Assistant--Time allotted to project, 100%

Name--Morales-Alamo, Reinaldo

Title--Marine Scientist A

Date of birth--[REDACTED]

Place of birth--[REDACTED]

Educational Experience

Degree

Institution Conferring

Date

[REDACTED]

[REDACTED]

[REDACTED]

Graduate Work--

[REDACTED]

Employment Experience

Dates

Employer

Title or Nature
of Work

1956-57

U. S. Fish & Wildlife Service

Shellfish Biologist

1957 to date

Virginia Institute of Marine
Science

Marine Scientist

Publications

1. Nichols, Maynard M., and R. Morales-Alamo. 1963. Productividad en sistemas marinos marginales (Productivity in marginal marine systems). Comunicaciones y Resúmenes de Trabajos, Conf. Latinoamericana Para el Estudio de las Regiones Áridas, 1963, Buenos Aires, p. 61.
2. Harrison, W., and R. Morales-Alamo. 1964. Dynamic properties of immersed sand at Virginia Beach, Virginia. Tech. Memo. No. 9, Coastal Engineering Research Center, U. S. Army Corps of Engineers. 52 p.
3. Haven, D. S., and R. Morales-Alamo. 1965. Apparatus for holding individual oysters under equal water flows. Limnol. and Oceanogr. 10(4):605-606.
4. Haven, D. S., and R. Morales-Alamo. 1966. Use of fluorescent particles to trace oyster biodeposits in marine sediments. Jour. Conseil, Conseil Perm. Intern. Exploration Mer 30(2): 267-269.
5. Haven, D. S., and R. Morales-Alamo. Aspects of biodeposition by oysters and other invertebrate filter feeders. Limnol. and Oceanogr. (in press).
6. Haven, D. S., and R. Morales-Alamo. Relation of biodeposition by oysters to depuration. Proceedings First National Conference on Depuration (in press).

II. Institution Facilities Available

The following equipment and facilities are available at the Virginia Institute of Marine Science:

1. Five Permanent Buildings
2. Radiobiology Laboratory
 - Gamma spectrometer system with graphic recorder
 - Proportional counting system
 - Auxiliary scaler with detectors
 - Survey meters
 - Fume hood
 - Muffle furnace
 - Drying oven
 - Stainless steel experiment and preparation tables
 - Metering pump
3. Chemistry Laboratory
 - Drying oven
 - Muffle furnace
 - Klett-Summerson colorimeter
 - Beckman DU Spectrophotometer with flame and UV attachment
 - Micro and Macro Kjeldahl digestion and distillation units
 - Sartorius single pan analytical balance
 - Christian Becker double pan analytical balance
 - Fume hood
 - Hot plate
 - Beckman "Model G" pH meter
 - Constant temperature culture cabinet
 - Vacuum pumps
 - LECO Carbon Analyzer
 - Glassware and chemicals
 - Coulter Counter
 - Woods Hole Rapid Sand Analyzer
4. Wet Laboratory
 - Non-metallic sea water system
 - Experiment tables
 - Holding troughs
 - Constant temperature water bath
 - 20-pen recorder
5. Field Equipment
 - 80' R/V LANGLEY
 - 55' R/V PATHFINDER
 - 26' R/V OBSERVER
 - 34' R/V W. K. BROOKS
 - 37' R/V INVESTIGATOR
 - Institute-owned oyster grounds
 - SCUBA diving gear

Budget

For Contract Period 1 January 1967 through 31 December 1967

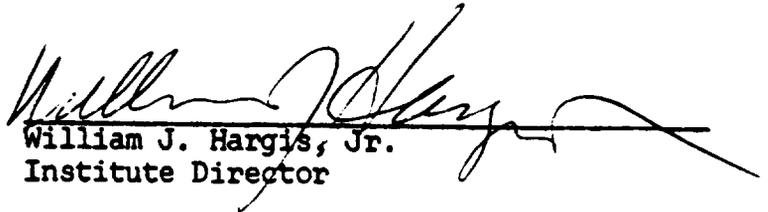
I. Approximate level of research effort.

	<u>Approx. % of</u> <u>time for</u> <u>contract work</u>	<u>Contribution</u> <u>by</u> <u>Institution</u>	<u>AEC Funds</u> <u>Requested</u>
A. <u>Personnel</u>			
Principal Investigator Dexter Haven	10%	\$ 1,313	none
Others:			
Research Associates			
Reinaldo Morales-Alamo	100%	none	\$ 8,040
3 graduate students	100%	none	8,100
Secretarial services	1.5%	none	240
Social Security, 4.2%			688
Workmans Compensation, 1.6%			262
			<u>\$17,330(A)</u>
B. <u>Materials & Supplies</u>			
Chemicals & glassware			1,000
Kryptonated sand			1,000
Nuclear instrument repair			250
Film badge service			75
Filters--cotton and millipore			250
Plastic sheet for building holding aquaria			200
Disposal of radioactive solids			500
Travel			300
			<u>\$ 3,575 (B)</u>
C. Indirect Costs (10% of A and B)			<u>2,090</u>
	Total		\$22,995

D. Unexpended funds from 1966	<u>\$ 1,000</u>
E. Total funds requested for 1967	\$21,995



Dexter S. Haven
Senior Investigator



William J. Hargis, Jr.
Institute Director

UNITED STATES GOVERNMENT

Memorandum

TO : R. G. Humphries, Director
Contract Division

FROM : Herman M. Roth, Director
Research and Development Division

SUBJECT: REQUEST FOR CONTRACT ACTION

ORS:JDB

DATE: DEC 28 1965

It is requested that you take the necessary steps to process the following described contract action:

1. Nature of Action Requested:

Selection of New Contractor and/or
Negotiation of Contract
Number:
Contractor:

Modification of Contract
Number: AT-(40-1)-2789
Contractor: Virginia Institute of Marine Science
Gloucester Point, Virginia

2. Nature of Services to be Covered by Contract: Research

Title: "Concentration of Suspended Radioactive Wastes
Into Bottom Deposits"

3. Type of Contract: Lump Sum Cost-Type Other

4. Amount to be Obligated by this Contract Action: \$18,459.00

5. Description of Other Changes to be Covered by Contract Action:
Modify contract to provide for the performance of additional research to be completed during the period January 1, 1966 through December 31, 1966. The AEC will contribute \$18,459 in new funds to the project. Title to equipment shall vest in the Contractor under authority of Atomic Energy Act of 1954.

6. Authority:

Form AEC-481 (Contract Authorization) from C. L. Dunham to S. R. Sapirie dated December 21, 1965.

Herman M. Roth
Herman M. Roth

3653

APPENDIX "A"

For the Contract Period January 1, 1966 through December 31, 1966

A-I RESEARCH TO BE PERFORMED BY CONTRACTOR

The Contractor will continue to conduct research on the concentration of radioactive waste materials into bottom deposits in the estuarine environment by filter feeding organisms such as oysters, tunicates, and barnacles. This work will include such approaches as efforts directed at (1) determination of how representative radionuclides associated with suspended silts, clays, algae, bacteria or detritus are removed from suspension by filter feeders and how firmly these same nuclides are bound to particles in the biodeposits, (2) obtaining a broad comprehension of the entire process of biodeposition in a typical estuary, and (3) determination of the concentration or dispersal of fecal pellets in estuaries.

A-II APPROXIMATE LEVEL OF RESEARCH EFFORT

	<u>Approx. % of time</u>
(a) <u>Contractor Personnel:</u>	
Mr. Dexter Haven, Principal Investigator	10%
Research Associate	100%
3 Graduate Students	100%
Secretarial Services	As Required

(b) Premises, Facilities, and Materials to be
Furnished by the Contractor:

Laboratories and facilities necessary to conduct research on the concentration of suspended radioactive wastes into bottom deposits will be available. Equipment available includes a gamma spectrometer system with graphic recorder, proportional counting system, auxiliary scaler with detectors, survey meters, fume hood, muffle furnace, drying oven, constant temperature water bath, oyster grounds, scuba diving gear and other related instruments.

A-II ITEMS OF EQUIPMENT TO BE PURCHASED OR FABRICATED
BY CONTRACTOR COSTING \$500 OR MORE

None

ASCP 9-4-81

U. S. ATOMIC ENERGY COMMISSION
CONTRACT AUTHORIZATION

1. DATE

DEC 21 1965

2. AUTHORIZATION NO.

BM-66-288

3.A. TO

S. R. Sapirie, Manager
Oak Ridge Operations Office

3.B. FROM

John R. Jolly for
C. L. Dunham, M.D., Director
Division of Biology & Medicine, HQ

4.A. CONTRACTOR (Name, Address, Department, etc.)

Department of Applied Science
VIRGINIA INSTITUTE OF MARINE SCIENCE
Gloucester Point, Virginia 23062

4.B. PRINCIPAL INVESTIGATOR(S)

Dexter S. Haven

5.

NEW CONTRACT RENEWAL OTHER

6. TERM OF CONTRACT

1-1-66 thru 12-31-66

7. CONTRACT NUMBER

AT(40-1)-2789

8. RECOMMENDED TYPE OF CONTRACT:

FIXED PRICE
 COST REIMBURSEMENT

9. PROPERTY TITLE TO VEST IN:

AEC CONTRACTOR
 CONTRACTOR UNDER AUTHORITY OF PUBLIC LAW 85-934. This has been determined to be in furtherance of the objectives of the Atomic Energy Commission.

10. SECURITY CLASSIFICATION:

Work to be performed is under category I as defined by AEC Manual Appendix 3401.

11. PROJECT TITLE

"CONCENTRATION OF SUSPENDED RADIOACTIVE WASTES INTO BOTTOM DEPOSITS"

12. HEADQUARTERS TECHNICAL CONTACT

Mr. Jared J. Davis *19*

13. FINANCING (New AEC Funds, Not To Exceed Amounts Indicated):

A. OPERATING EXPENSES	\$ 18,459
Budget and Reporting Classification: 06 05 02	+ 3,914 Unexpended Balance
Allotment Transfer: 06-61-91(24)	
B. PLANT AND CAPITAL EQUIPMENT	\$
Budget and Reporting Classification:	
Allotment Transfer:	

14. SPECIAL PROVISIONS AND INSTRUCTIONS:

The technical aspects of the proposed work have been reviewed and are approved. A need currently exists for the results of the research or other work that is to be undertaken. None of the AEC funds shall be used to confer a fellowship.
Please keep us informed as to any problems encountered in your negotiations, as well as the date of execution of this contract and the amount of funds obligated. If the budget as negotiated differs substantially from that in the proposal, please forward a copy of the revised budget to Headquarters.
If not already submitted, a 200-word summary of the proposed work should be forwarded by the contractor as soon as possible after negotiation of the contract.

15. SCOPE OF WORK

Research on the uptake of radionuclides by marine organisms.

F12571

DEC 23 1965

UNITED STATES GOVERNMENT

Memorandum

TO : C. L. Dunham, Director
Division of Biology & Medicine, HQ

DATE: September 30, 1965

FROM : Herman M. Roth, Director
Research and Development Division, OR

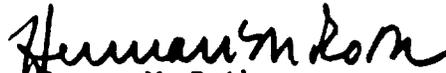
SUBJECT: RENEWAL OF CONTRACT NO. AT-(40-1)- 2709 WITH VIRGINIA INSTITUTE OF
MARINE SCIENCE (DR. DEITER S. HAVEN)

CRS:JDS

We are submitting for your review and appropriate action the following information concerning the contract which will expire on December 31, 1965:

1. Renewal Proposal (4)
2. Progress Report (4)
3. Financial Statement (4) 1 and 3 are document
4. 200-Word Summary (2)

We shall appreciate your advising us of your decision so that we may proceed with the necessary contract action at the earliest possible date.


Herman M. Roth

Enclosure:
As Listed Above

BC: C. S. Shoup, w/encls.
B. S. Zachry, w/progress report
Alice Brown ✓

RENEWAL PROPOSAL

Concentration of Suspended Radioactive Wastes
into Bottom Deposits

by

Dexter Haven, Senior Investigator
Virginia Institute of Marine Science
Gloucester Point, Virginia

The Senior Investigator requests that the U. S. Atomic Energy Commission consider renewal of Contract No. AT (40-1) 2789 for the period 1 January 1966 to 31 December 1966.

The Senior Investigator does not receive financial support from any other Federal agency.

The program will be under the direction of Mr. Dexter Haven, assisted by Mr. Reinaldo Morales-Alamo. Radiobiological studies will be supervised by Dr. Morris L. Brehmer, Head, Radiobiological Section. Identification of marine invertebrates will be done by Dr. Marvin L. Wass.

Since submission of the first progress report in 1960, research has indicated that biodeposition may be a major factor in estuarine ecology and for review purposes, a summary of the progress and the program's objectives is given prior to the presentation of this year's research proposal.

Review

Basically, biodeposition in the estuarine environment is associated with the feeding of filter feeders such as oysters, tunicates, and

barnacles. In this process detritus, clays, silts, sand grains, bacteria, algal cells and other particulate matter are filtered from suspension, ingested and later voided as fecal strings or pellets. Radioactive particles or radionuclides adsorbed or associated with any of these previously listed particles will also be removed from suspension and deposited with the fecal material. Fecal pellets or strings are compacted or aggregated with mucus and are not transported by currents at the same rates as the original components.

A second important part of biodeposition is the distribution and dispersion of fecal pellets (biodeposits) after they are voided by the various organisms. A portion will be transported from their site of deposition by currents; others will be ingested by bottom invertebrates, broken down by bacteria or incorporated into bottom deposits, creating possible concentration of radionuclides adjacent to concentrations of filter feeders.

Objectives

The overall objectives of the present program may be outlined as follows:

1. To determine how representative radionuclides associated with suspended silts, clays, algae, bacteria or detritus are removed from suspension by filter feeders and how firmly these same nuclides are bound to particles in the biodeposits.

2. To obtain a broad comprehension of the entire process of biodeposition in a typical estuary. That is, to understand the groups of animals involved, quantities of biodeposits produced and to determine the physical and chemical characteristics of biodeposits.

3. To study concentration or dispersal of fecal pellets in estuaries. This will include rate at which pellets are broken down, their sinking rates, and the quantity suspended in the water. Most important of all is a study of how biodeposits are incorporated into sediments by the action of benthic animals.

The basic reason for such a detailed knowledge of the process as outlined in 2 and 3 is that in the event nuclides are introduced into suspension, their initial and perhaps their final distribution will parallel that of particles in the biodeposits.

Proposal for 1966

In 1966 it is planned to continue studies with the Coulter Electronic Particle Counter to determine minimum size of particles which oysters might remove from suspension.

Experimental design will be the same as in 1965. Oysters and other test animals will be held in experimental troughs where they will continually receive filtered water containing particles of known size. This objective will be achieved by filtering water entering the troughs through cotton filters which remove particles larger than 1μ . To these troughs will be added particles of silts, clays or algal cells of known size. Sizes and numbers of particles entering and leaving each trough will be measured with the Coulter Counter.

The purpose of continuing these studies another year is that results in 1965 indicated that efficiency of particle removal by oysters decreased below 4μ to 5μ and that considerable volumes of particles below 1.2μ are not filtered. Many particles in sea water are in the 0.5 to 1.0μ range, and if isotopes are associated with these small

particles, many would not be removed by the oyster during feeding. That is, it is important to determine minimum size of particles removed from suspension.

Attempts to measure particle removal in the 1.0 μ range in 1965 were only partially successful. This occurred because the design of the Counter is such that it will not give accurate results when particle number (in any given size range) exceeded 20,000 particles in 0.5 microliters. It is frequently necessary to dilute samples with filtered sea water. This dilution is not a problem with larger particle sizes but in the 1.0 to 1.5 μ range, the number of natural particles is tremendous and dilution is necessary. Attempts at dilution were not successful, since sea water used for dilution was filtered through a 0.45 μ membrane filter; this filtered sea water often contained more particles in the 0.5 to 1.0 μ range than the original sample. In 1966 the same experimental design will be used, but artificial sea water containing low particle numbers will be used as a diluting media.

If time permits, the preceding study of filtration in relation to particle size will be supplemented by a similar study using isotopes in a closed system. Clays or bacteria, of a size which has been determined by the Coulter Counter, will be labelled with Ce^{144} and then fed to oysters. Quantities removed will be measured. This study was originally proposed for 1965 but our inability to determine minimum size of particles filtered prevented us from starting it.

The animal sediment study in the York River begun in February 1965 has been most useful. Monthly cores taken at 5, 10, 20 and 40 feet have defined animal communities and sediment types. Its value in the program

is that if biodeposition or sediment mixing is a factor at these depths, it must be associated with the observed populations and the existing sediment types. Consequently, realistic laboratory studies may be designed to study sediment mixing as it may occur in the estuary.

Sediments from the four depth zones will be introduced and placed in small, separate plastic aquaria. Natural populations of invertebrates present will be killed with fresh water or heat. Later, sea water will be recirculated over these sediments through a surface baffle similar to that described in the 1964 progress report. Later, representative animals found at the four plots will be placed in separate containers. Detritus-feeding annelids, like Cirriformia, representative of the 40-foot community will be placed in several containers with sediments from that depth. In sediments from 5 and 10 feet, deposit feeders, like Phoronis and Retusa, will be placed.

Sediment mixing will be followed in two ways: 1) oysters will be fed algal cells labelled with P^{32} and the resulting feces and pseudofeces containing the isotope will be placed on the surface of the sediments; 2) clays will be labelled with Ce^{144} and similarly placed in the containers. Later, cores will be taken and activity at various depths counted.

Certain animals, e.g., Clymenella, found at the 5 and 10-foot stations ingest sand. This results in burial of surface deposits or a mixing of these into the deeper layers. This will be studied by introducing a thin film of Kryptonated sands of known particle size on the surface of the sediments. Activity will be detected in samples at various depths. This material will be obtained from the Radiation Application Branch, Division of Isotopes Development.

If Kryptonated sand is not available, then glass labelled with Co⁶⁰ will be obtained from the same source. This glass will be ground to correspond with grain size of natural sediments.

In connection with the animal sediment study, the quantity of fecal material voided by the filter-feeding mollusks noted at the 5 and 10-foot stations will be studied. The animals will include Tellina, Mulinia, and Macoma. Animals will be held in troughs of running sea water and weights of biodeposit measured weekly.

The occurrence of fecal pellets in the York River will be studied again at the stations used in the animal sediment study. One station will be located at 40 feet and the second at 10 feet. During July, hourly measurements of current velocity will be made, as well as determination for total suspended solids. Water samples will be pumped from 5 feet below the surface and 2 feet above the bottom and these will be passed through a 125 μ and a 44 μ screen. Materials collected will be weighed and the percentage weight of fecal pellets in each sample calculated. Later, weight of fecal pellets will be compared to weight of total seston in the water.

Budget and Personnel for Contract No. AT (40-1) 2789 for Concentration of Suspended Radioactive Wastes into Bottom Deposits

Budget

For Contract Period 1 January 1966 through 31 December 1966

I. Approximate level of research effort.

A.	<u>Personnel</u>	Approx. % of time for contract work	Contribution by Institution	AEC Funds Requested
	Principal Investigator Dexter Haven	10%	\$1,147	None
	Others: Research Associates			
	Reinaldo Morales-Alamo	100%	None	\$7,344
	3 graduate students	100%	None	7,200
	Secretarial services	3%	None	200
	Social Security & Insurance			220
B.	<u>Materials & Supplies</u>			
	Chemicals & glassware			1,000
	Kryptonated sand			2,000
	Nuclear instrument repair			500
	Film badge service			75
	Tubes, 2000 μ for Coulter Counter			250
	New hard rubber pump for wet lab			600
	Filters--cotton and milipore			500
	Plastic sheet for building holding aquaria			250
	Travel			200
C.	Indirect costs			2,034
			Total--	\$22,373
D.	Unexpended funds on hand from 1963-65			<u>3,914</u>
E.	Total funds requested for 1966			\$18,459

1128074

*Signed
Dexter Haven
Head of Applied Science*

Personnel

Biographical Sketch

Senior Investigator - Time allotted to project, 10%

Name - Haven, Dexter S. Title - Associate Marine Scientist

Date of birth [redacted] Place of birth [redacted] Illinois

Educational Experience

Degree	Institution Conferring	Date
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

Employment Experience

Dates	Employer	Title or Nature of work
1948-49	U. S. Fish & Wildlife Service	Marine Biologist
1949 to date	Virginia Institute of Marine Science	Marine Biologist

Publications

1. Haven, D. 1951. A quick drying ink for labeling cellulose acetate slides. Copeia. 1951 (3): 252.
2. Haven, D. and J. D. Andrews. 1957. Survival and growth of Venus mercenaria, Venus campechiensis, and their hybrids in suspended trays and on natural bottoms. Proc. Natl. Shellfish. Assoc. 47 (1956): 43-49.
3. Haven, D. 1957. Distribution, growth, and availability of juvenile croaker, Micropogon undulatus, in Virginia. Ecology 38 (1): 88-97.
4. Haven, D. 1959. Effects of pea crabs, Pinnotheres ostreum, on oysters, Crassostrea virginica. Proc. Natl. Shellfish. Assoc. 49: 77-86.
5. Andrews, J. D. and D. S. Haven. 1959. Fresh-water kill of oysters (Crassostrea virginica) in James River, Virginia 1958. Proc. Natl. Shellfish. Assoc. 49: 29-49.
6. Haven, D. 1959. Migration of the croaker, Micropogon undulatus. Copeia 1959 (1): 25-30.
7. Haven, D. 1961. Eurasian water milfoil in the Chesapeake Bay and the Potomac River. Water management in the Potomac Estuary. Interstate Commission on the Potomac River Basin, 1961.

8. Haven, D. 1962. Seasonal cycle of condition index of oysters in the York and Rappahannock Rivers. Proc. Natl. Shellfish. Assoc. 51 (1960): 42-66.
9. Haven, D. 1962. Supplemental feeding of oysters with starch. Chesapeake Sci. 6: 43-51.
10. Haven, D. S. and R. Morales-Alamo. Apparatus for holding individual oysters under equal water flows. Limnol. and Oceanogr. (In press).
11. Haven, D. S. and R. Morales-Alamo. Use of fluorescent particles to trace oyster biodeposits in marine sediments. Jour. du Conseil (In press).

Biographical Sketch

Research Assistant - Time allotted to project, 100%

Name - Morales-Alamo, Reinaldo Title - Marine Scientist A

Date of birth [REDACTED] Place of birth [REDACTED]

Educational Experience

Degree	Institution Conferring	Date
[REDACTED]	[REDACTED]	[REDACTED]

Graduate Work - [REDACTED]

Employment Experience

Dates	Employer	Title or Nature of work
1956-57	U. S. Fish & Wildlife Service	Shellfish Biologist
1957 to date	Virginia Institute of Marine Science	Marine Biologist

Publications

1. Nichols, Maynard M. and R. Morales-Alamo. 1963. Productividad en sistemas marinos marginales (Productivity in marginal marine systems). Comunicaciones y Resumenes de Trabajos, Conf. Latinoamerican Para el Estudio de las Regiones Aridas, 1963, Buenos Aires, p. 61.
2. Harrison, W. and R. Morales-Alamo. 1964. Dynamic properties of immersed sand at Virginia Beach, Virginia. Tech. Memo. No. 9, Coastal Engineering Research Center, U. S. Army Corps of Engineers. 52 p.
3. Haven, D. S. and R. Morales-Alamo. Apparatus for holding individual oysters under equal water flows. Limnol. and Oceanogr. (In press).
4. Haven, D. S. and R. Morales-Alamo. Use of fluorescent particles to trace oyster biodeposits in marine sediments. Jour. du Conseil (In press).

II. Institution Facilities Available

The following equipment and facilities are available at the Virginia Institute of Marine Science:

1. Five Permanent Buildings

2. Radiobiology Laboratory

Gamma spectrometer system with graphic recorder
Proportional counting system
Auxiliary scaler with detectors
Survey meters
Fume hood
Muffle furnace
Drying oven
Stainless steel experiment and preparation tables
Metering pump

3. Chemistry Laboratory

Drying oven
Muffle furnace
Klett-Summerson colorimeter
Beckman DU Spectrophotometer with flame and UV attachment
Micro and Macro Kjeldahl digestion and distillation units
Sartorius single pan analytical balance
Christian Becker double pan analytical balance
Fume hood
Hot plate
Beckman "Model G" pH meter
Constant temperature culture cabinet
Vacuum pumps
LECO Carbon Analyzer
Glassware and chemicals
Coulter Counter

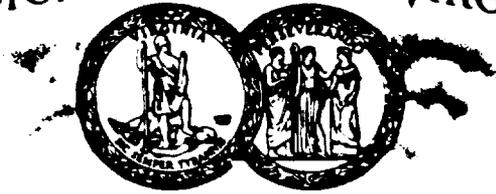
4. Wet Laboratory

Non-metallic sea water system
Experiment tables
Holding troughs
Constant temperature water bath
20-pen recorder

5. Field Equipment

80' R/V LANGLEY
55' R/V PATHFINDER
26' R/V OBSERVER
34' R/V W. K. BROOKS
37' R/V INVESTIGATOR
Institute-owned oyster grounds
SCUBA diving gear

COMMONWEALTH OF VIRGINIA



VIRGINIA INSTITUTE OF MARINE SCIENCE
GLOUCESTER POINT, VIRGINIA 23062

September 28, 1965

C

EXPENDITURE STATEMENT

Expenditures from January 1, 1965 thru September 30, 1965

O

<u>Classification</u>	<u>Virginia Institute of Marine Science</u>	<u>AEC</u>	
Personnel	\$720.00	\$ 9,445.14	
Material and Supplies		1,540.47	
Indirect Costs		<u>557.95</u>	
	\$720.00	\$11,543.56	\$12,263.56
Estimated Costs - October 1, 1965 thru December 31, 1965	240.00	5,371.44	5,611.44
	<u>\$960.00</u>	<u>\$16,915.00</u>	<u>\$17,875.00</u>

P

Y

From prior contract periods, \$3,914.00 will be available for financing the project during the contract period January 1, 1965 to December 31, 1965.

Signed

William J. Margis, Jr.
Laboratory Director

UNITED STATES GOVERNMENT

Memorandum

TO : R. G. Humphries, Director
Contract Division

FROM : Herman M. Roth, Director
Research and Development Division

SUBJECT: REQUEST FOR CONTRACT ACTION

DATE:

JAN 27 1965

ORS:JDB

It is requested that you take the necessary steps to process the following described contract action:

1. Nature of Action Requested:

Selection of New Contractor and/or
Negotiation of Contract
Number:
Contractor:

Modification of Contract
Number: AT-(40-1)-2789
Contractor: Virginia Institute of Marine Science
Gloucester Point, Virginia

2. Nature of Services to be Covered by Contract: Research

Title: "Concentration of Suspended Radioactive Wastes into
Bottom Deposits"

3. Type of Contract: Lump-Sum Cost-Type Other

4. Amount to be Obligated by this Contract Action: \$16,915.00

5. Description of Other Changes to be Covered by Contract Action:

Modify contract to provide for the performance of additional research to be completed during the period January 1, 1965 through December 31, 1965. The AEC will support the project in the amount of \$16,915 in new funds.

6. Authority:

Form AEC-481 (Contract Authorization) from C. L. Dunham to
S. R. Sapirie dated January 15, 1965

Herman M. Roth 33203
Herman M. Roth

1128880

APPENDIX "A"

For the Contract Period January 1, 1965 through December 31, 1965.

A-I RESEARCH TO BE PERFORMED BY CONTRACTOR

The Contractor will continue to conduct research on the concentration of suspended radioactive wastes into bottom sediments of rivers and estuaries by marine filter feeders such as oysters, clams, tunicates, and barnacles. This work will include such approaches as (1) measurement of the sizes of particles which oysters and other filter feeders remove from suspension, (2) study of the mixing of biodeposits labeled with Cerium-144 or Phosphorus-32 into deeper sediment layers by invertebrates by measurement of activity at various levels in cores, (3) efforts directed at determination of association between sediment types with natural invertebrate populations which might be most important in sediment mixing and biodeposition, and (4) measurement of the quantities of fecal pellets in estuarine waters.

A-II APPROXIMATE LEVEL OF RESEARCH EFFORT

<u>(a) Contractor Personnel:</u>	<u>Approx. % of time</u>
Mr. D. S. Haven, Principal Investigator	10%
Research Associate	100%
2 Graduate Students	100%
Secretary	3%
<u>(b) Premises, Facilities, and Materials to be Furnished by the Contractor:</u>	

Laboratories and facilities necessary to conduct research on the concentration of suspended radioactive wastes into bottom deposits will be available. Equipment available includes a gamma spectrometer system with graphic recorder, proportional counting system, auxiliary scaler with detectors, survey meters, fume hood, muffle furnace, drying oven, constant temperature water bath, oyster grounds, scuba diving gear and other related instruments.

A-III ITEMS OF EQUIPMENT TO BE PURCHASED OR FABRICATED BY CONTRACTOR COSTING
\$500 OR MORE

None

ABCPR 9-4.01 J. S. ATOMIC ENERGY COMMISSION CONTRACT AUTHORIZATION		1. DATE JAN 15 1965	2. AUTHORIZATION NO. EM-65-355
3.A. TO S. R. Sapirie, Manager Oak Ridge Operations Office		3.B. FROM C. L. Dunham, M. O., Director Division of Biology & Medicine	
4.A. CONTRACTOR (Name, Address, Department, etc.) VIRGINIA INSTITUTE OF MARINE SCIENCE Gloucester Point, Virginia		4.B. PRINCIPAL INVESTIGATOR(S) Dexter S. Haven	
5. <input type="checkbox"/> NEW CONTRACT <input checked="" type="checkbox"/> RENEWAL <input type="checkbox"/> OTHER		6. TERM OF CONTRACT 1-1-65 thru 12-31-65	7. CONTRACT NUMBER AT(40-1)-2789
8. RECOMMENDED TYPE OF CONTRACT: <input checked="" type="checkbox"/> FIXED PRICE <input type="checkbox"/> COST REIMBURSEMENT <input type="checkbox"/>		9. PROPERTY TITLE TO VEST IN: <input type="checkbox"/> AEC <input checked="" type="checkbox"/> CONTRACTOR <input type="checkbox"/> CONTRACTOR UNDER AUTHORITY OF PUBLIC LAW 85-934. This has been determined to be in furtherance of the objectives of the Atomic Energy Commission.	10. SECURITY CLASSIFICATION: Work to be performed is under category <u>I</u> as defined by AEC Manual Appendix 3401.
11. PROJECT TITLE "CONCENTRATION OF SUSPENDED RADIOACTIVE WASTES INTO BOTTOM DEPOSITS"			
12. HEADQUARTERS TECHNICAL CONTACT Mr. Jared J. Davis			
13. FINANCING (New AEC Funds, Not To Exceed Amounts Indicated): A. OPERATING EXPENSES \$ 16,915 Budget and Reporting Classification: 06 05 02 Allotment Transfer: 06-51-91(24) B. PLANT AND CAPITAL EQUIPMENT \$ Budget and Reporting Classification: Allotment Transfer:			
14. SPECIAL PROVISIONS AND INSTRUCTIONS: The technical aspects of the proposed work have been reviewed and are approved. A need currently exists for the results of the research or other work that is to be undertaken. None of the AEC funds shall be used to confer a fellowship. Please keep us informed as to any problems encountered in your negotiations, as well as the date of execution of this contract and the amount of funds obligated. If the budget as negotiated differs substantially from that in the proposal, please forward a copy of the revised budget to Headquarters. If not already submitted, a 200-word summary of the proposed work should be forwarded by the contractor as soon as possible after negotiation of the contract.			
15. SCOPE OF WORK Studies of the role and importance of benthic marine fauna in delivering seston, including radioactive materials or organisms, to the sediments and the redistribution of sediments by benthic organisms.			

CV

JAN 15 8 10 AM '65

RECEIVED

160

JAN 18 1965

1128882

UNITED STATES GOVERNMENT

Memorandum

TO : **C. L. Bunker, Director**
Division of Biology and Medicine, HQ

DATE: **September 23, 1946**

FROM : **Herman M. Roth, Director**
Research and Development Division, OR

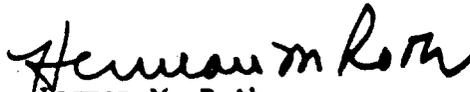
SUBJECT: **RENEWAL OF CONTRACT NO. AT-(40-1)-2700 WITH VIRGINIA INSTITUTE OF**
HEALTH SCIENCES (DR. BRUCE S. WATSON)

ENCLOSURE

We are submitting for your review and appropriate action the following information concerning the contract which will expire on **December 31, 1946**:

1. Renewal Proposal (2)
2. Progress Report (2)
3. Financial Statement (2) **Included in proposal**
4. 200-Word Summary (2)
5. Summary Report (2) **1-1-46 - 2-21-46**

We shall appreciate your advising us of your decision so that we may proceed with the necessary contract action at the earliest possible date.


Herman M. Roth

Enclosure:
As Listed Above

CC: **C. S. Shoup, w/final.**
D. S. Zuckery, w/progress report
Allen Brown ✓

RENEWAL PROPOSAL

Concentration of Suspended Radioactive Wastes
into Bottom Deposits

by

Dexter Haven, Senior Investigator
Virginia Institute of Marine Science
Gloucester Point, Virginia

The Senior Investigator requests that the U. S. Atomic Energy Commission consider renewal of Contract No. AT(40-1) 2789 for the period 1 January 1965 to 31 December 1965. The research objectives, scientific background and literature reviewed are essentially the same as in the original contract proposal, or as in the 1963 proposal.

The Senior Investigator does not receive financial support from any other Federal agency.

The program will be under the direction of Mr. Dexter Haven, assisted by Mr. Reinaldo Morales-Alamo. Radiobiological studies will be supervised by Dr. Morris L. Brehmer, Head, Radiobiological Section. Identification of marine invertebrates will be done by Dr. Marvin L. Wass.

During 1965 the proposed program will largely be a continuation of 1964 studies.

In 1964 an extensive series of studies was planned using a Coulter Counter. A delay in the arrival of this equipment and a later defect in one of its components allowed only a portion of the planned work to be completed. The instrument now appears operational and experiments completed to date seem to indicate that oysters allow many particles in the 1 to 2 μ size range to pass through its filtering system. In view of the encouraging results obtained so far in 1964, the original proposal

1126004 is still the basis for proposed work in 1965.

E 5404

It has been indicated that adsorptive capacity of various ions on clays is partly a function of particle size as shown by Harman and Fraulini (1940). Consequently, a study is planned to determine sizes of particles removed from suspension by various filter feeders. The basis of the study is that if a filter feeder removes only small particles with adsorbed radionuclides, the activity of the biodeposits might be relatively great. Removal of only large particles might result in biodeposits with lower levels of activity.

It is planned to hold oysters and other test animals in experimental troughs where they will continually receive filtered water containing particles of known size. This objective will be achieved by filtering water entering the troughs through cotton filters which remove particles larger than 1 micron. To these troughs will be added particles of silts, clays or algal cells of known size. Sizes and numbers of particles removed will be measured with the Coulter Counter.

If time permits the preceding study of filtration in relation to particle size will be supplemented by a similar study using isotopes in a closed system. Clays and bacteria, of a size which has been determined with the Coulter Counter, will be labeled with Ce^{144} or P^{32} and then fed to oysters. Quantities removed will be measured.

Studies on the occurrence of fecal pellets suspended in the York River estuary will continue since the preliminary study showed appreciable quantities being transported as part of the suspended load. Detritus and/or sediment traps will be placed at several depths in the estuary and weight of fecal pellets settling into the collectors will be measured in relation to the other components.

Studies will be made to determine what portion of the total suspended load in estuarine waters is composed of fecal pellets. This will be

done by flowing river water through a fine plankton net to collect fecal pellets, phytoplankton, zooplankton, and large particles of detritus. These will be separated into various size ranges by sieving. The weight of the particulate matter passing through the net will be estimated by comparative retention on membrane filters.

Settling rates of fecal pellets in estuarine waters will be measured as a basis for estimating rates of transport of particles in the estuary by currents.

A study is proposed on the relation between sediment type, sediment mixing, and animals living in the sediment. Studies in 1968 and 1968 indicated that certain groups of filter feeders are most effective in removing suspended sediments from the water while other groups of animals are primarily associated with the mixing of biodeposits into subsurface sediments.

Sanders (1960) has shown a definite relation between grain size of sediments and animal populations. Relation of these findings to the present work would indicate which sediments support relatively large populations of filter-feeders, and those which support only sediment "mixers". It would be useful to know if the "filterers" live in the same sediment types as the "mixers". In the event of contamination of estuarine waters with radionuclides certain sediment types, by virtue of their animal populations, might be associated with large quantities of radioactive sediments.

The proposed study will be carried out in the laboratory and in the field.

A series of York River sediments ranging from those with high silt-clay content to those composed largely of sand will be collected and placed in laboratory tanks so as to retain natural populations. A pump will be used to recirculate water to those tanks through an aerating column. Biodeposits with adsorbed P^{32} or Ce^{144} will be added. Later,

activity of sediments at various levels will be measured, and results expressed as activity per unit weight of dry sediment. Animal populations in tanks will be determined by screening representative samples obtained with a Petersen grab prior to placing them in the tanks.

Animal-sediment relationships will be studied in the field by analysis of sediment types and estimation of their animal populations. Sediment type analyses will be made using standard techniques outlined by Krumbein and Pettijohn (1938) and nomenclature designations will be based on comparative ratios between sands, silts and clays following Shepard (1954). Animal populations will be estimated on the basis of numbers per square meter as determined by Petersen grab samples. Sediments will be screened through a 0.5 mm screen and all animals collected and identified.*

Our studies for the past four years have established the magnitude of removal of suspended particulate matter from the water by oysters and other filter-feeders and the permanence of biodeposits in bottom sediments. The studies proposed for 1965 will further elucidate the close association between filter-feeders, other bottom-dwelling animals and the sediments they inhabit and the significance of such relationships in the event of radioactive contamination of estuarine waters. Therefore, continuation of these studies is considered critical for our better understanding of the processes involved.

*Identification of all benthic animals will be made by Dr. Marvin Wass,
Dept. of Ecology-Pollution.

Bibliography

- Harmon, C. G. and F. Fraulini. 1940. Properties of kaolinite as a function of its particle size. Jour. Amer. Ceram. Soc. 23: 252-258.
- Krumbein, W. C. and F. J. Pettijohn. 1938. Manual of Sedimentary Petrography. Appleton-Century-Crafts, New York, 549 p.
- Sanders, H. L. 1960. Benthic studies in Buzzards Bay. III. The structure of the soft-bottom community. Limnol. and Oceanogr. 5(2): 138-153.
- Shepard, F. P. 1954. Nomenclature based on sand-silt-clay ratios. Jour. Sed. Petrol. 24: 151-158.

Budget and Personnel for Contract No. AT (40-1) 2789 for Concentration of Suspended Radioactive Wastes into Bottom Deposits.

Budget

For Contract period 1 January 1965 through 31 December 1965.

I. Approximate level of research effort.

<u>A. Personnel</u>	Approx. % of time for contract work	Contribution by Institution	AEC Funds Requested
Principal Investigator Dexter S. Haven	10%	960	None
Others: Research Associates			
Reinaldo Morales-Alamo	100%	None	7,032
2 graduate students	100%	None	4,800
Secretarial services	3%	None	200
Social Security & Insurance			220
<u>B. Materials & Supplies</u>			
Chemicals & glassware			1000
Film badge service			75
Tubes, 2000 u and 3000 u for Coulter Counter			600
Metering pumps			500
Filters			500
Plastic sheet for building holding aquaria			250
Travel			200
<u>C. Indirect Costs</u>			<u>1538</u>
		960	\$ 16,915

Dexter S. Haven
Dexter S. Haven
Senior Investigator

PERSONNEL

Biographical Sketch

Senior Investigator - Time allotted to project 10%

Name - Haven, Dexter S. Title - Assoc. Marine Scientist

Date of birth [REDACTED] Place of birth [REDACTED] Ill.

Educational Experience

Degree	Institution Conferring	Date
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]

Employment Experience

Dates	Employer	Title or Nature of work
1948-49	U. S. Fish & Wildlife Service	Marine Biologist
1949 to date	Va. Inst. Marine Science	Marine Biologist

Publications

- Haven, D. 1951. A quick drying ink for labeling cellulose acetate slides. *Copeia*. 1951 (3):252.
- Haven, D. and J. D. Andrews. 1957. Survival and growth of Venus mercenaria, Venus campechiensis, and their hybrids in suspended trays and on natural bottoms. *Proc. Natl. Shellfish. Assoc.* 47 (1956): 43-49.
- Haven, D. 1957. Distribution, growth, and availability of juvenile croaker, Micropogon undulatus, in Virginia. *Ecology* 38 (1): 88-97.
- Haven, D. 1959. Effects of pea crabs, Pinnotheres ostreum, on oysters, Crassostrea virginica. *Proc. Natl. Shellfish. Assoc.* 49: 77-86.
- Andrews, J. D. and D. S. Haven. 1959. Fresh-water kill of oysters (Crassostrea virginica) in James River, Virginia 1958. *Proc. Natl. Shellfish. Assoc.* 49: 29-49.
- Haven, D. 1959. Migration of the croaker, Micropogon undulatus. *Copeia* 1959 (1): 25-30.
- Haven, D. 1961. Eurasian water milfoil in the Chesapeake Bay and the Potomac River. Water management in the Potomac Estuary. Interstate Commission on the Potomac River Basin, 1961.
- Haven, D. 1962. Seasonal cycle of condition index of oysters in the York and Rappahannock Rivers. *Proc. Natl. Shellfish. Assoc.* 51 (1960): 42-66.

Biographical Sketch

Research Assistant - Time allotted to project 100%

Name Morales-Alamo, Reinaldo Title Marine Scientist A

Date of birth [REDACTED] Place of birth [REDACTED]

Educational Experience

Degree	Institution Conferring	Date
[REDACTED]	[REDACTED]	[REDACTED]

Graduate Work - [REDACTED]

Employment Experience

Dates	Employer	Title or Nature of work
1956-57	U. S. Fish & Wildlife Service	Shellfish Biologist
1957 to date	Va. Inst. Mar. Science	Marine Biologist

Publications

1. Nichols, Maynard L. and R. Morales-Alamo. 1963. Productividad en sistemas marinos marginales (Productivity in marginal marine systems). Comunicaciones y Resumenes de Trabajos, Conf. Latinoamericana Para el Estudio de las Regiones Aridas, 1963, Buenos Aires, p. 61.
2. Harrison, W. and R. Morales-Alamo. In Press. Dynamic properties of immersed sand at Virginia Beach, Virginia. Tech. Memo. Coastal Engineering Research Center, U. S. Army Corps of Engineers. 37 p. + 10 figs.

II. Institution Facilities Available

The following equipment and facilities are available at the Virginia Institute of Marine Science

1. Five Permanent Buildings

2. Radiobiology Laboratory

Gamma spectrometer system with graphic recorder
Proportional counting system
Auxiliary scaler with detectors
Survey meters
Fume hood
Muffle furnace
Drying oven
Stainless steel experiment and preparation tables
Metering pump

3. Chemistry Laboratory

Drying oven
Muffle furnace
Klett-Summerson colorimeter
Beckman DU Spectrophotometer with flame and UV attachment
Micro and Macro Kjeldahl digestion and distillation units
Sartorius single pan analytical balance
Christian Becker double pan analytical balance
Fume hood
Hot plate
Beckman "Model G" pH meter
Constant temperature culture cabinet
Vacuum pumps
LECO Carbon Analyzer
Glassware and chemicals
Coulter Counter

4. Wet Laboratory

Non-metallic sea water system
Experiment tables
Holding troughs
Constant temperature water bath
20-pen recorder

5. Field Equipment

80' R/V LANGLEY
55' R/V PATHFINDER
26' R/V OBSERVER
34' R/V W. K. BROOKS
27' R/V INVESTIGATOR
Institute-owned oyster grounds
SCUBA diving gear

COMMONWEALTH OF VIRGINIA



VIRGINIA INSTITUTE OF MARINE SCIENCE

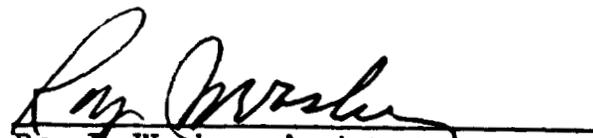
GLOUCESTER POINT, VIRGINIA 23062

September 17, 1964

EXPENDITURE STATEMENT

Expenditures from 1 January, 1964 thru 30 September, 1964

<u>Classification</u>	<u>Virginia Institute of Marine Science</u>	<u>AEC</u>	
Salaries	\$720.00	\$ 6,842.99	
Travel		388.83	
Contractual Services		93.20	
Supplies and Equipment		8,370.26	
Indirect Costs	_____	8.89	
	\$720.00	\$15,704.17	\$16,424.17
Estimated Costs - 1 October, 1963 thru 31 December, 1964	<u>240.00</u>	<u>4,295.83</u>	<u>4,535.83</u>
	\$960.00	\$20,000.00	\$20,960.00


 Roy J. Washer, Assistant
 Administrative Director

1128893

E 9401
SEP 25 1964

UNITED STATES GOVERNMENT

Memorandum

TO : R. G. Humphries, Director
Contract Division

FROM : Herman M. Roth, Director
Research and Development Division

SUBJECT: REQUEST FOR CONTRACT ACTION

DATE: JAN 20 1964

ORS:JDB

It is requested that you take the necessary steps to process the following described contract action:

1. Nature of Action Requested:

Selection of New Contractor and/or
Negotiation of Contract
Number:
Contractor:

Modification of Contract
Number: AT-(40-1)-2789
Contractor: Virginia Institute of Marine Science
Gloucester Point, Virginia

2. Nature of Services to be Covered by Contract: Research

Title: "Concentration of Suspended Radioactive Wastes into
Bottom Deposits"

3. Type of Contract: Lump-Sum Cost-Type Other

4. Amount to be Obligated by this Contract Action: \$20,000.00

5. Description of Other Changes to be Covered by Contract Action:

Modify contract to provide for the performance of additional research to be completed during the period January 1, 1964 through December 31, 1964. The AEC will support the project in the amount of \$20,000 in new funds.

6. Authority:

Form AEC-481 (Contract Authorization) from C. L. Dunham to
S. R. Sapirie dated January 2, 1964

Herman M. Roth
Herman M. Roth

23525

1128894

APPENDIX "A"

For the Contract Period January 1, 1964 through December 31, 1964.

A-I RESEARCH TO BE PERFORMED BY CONTRACTOR

The Contractor will continue to conduct research on the concentration of suspended radioactive wastes into bottom deposits by marine filter feeding organisms such as clams, mussels, tunicates, and barnacles. This research will include such approaches as (1) estimation of the initial distribution and dispersion of biodeposits in marine sediments, (2) investigation of the sizes of particles ingested by filter feeders, (3) use of radioisotopes and other techniques to estimate rates at which surface biodeposits are incorporated into deeper sediment layers by mud-dwelling marine organisms, and (4) study of the occurrence and abundance of fecal pellets in plankton.

A-II APPROXIMATE LEVEL OF RESEARCH EFFORT

<u>(a) Contractor Personnel:</u>	<u>Approx. % of time</u>
Dr. D. S. Haven - Principal Investigator	10%
Research Associate	100%
Graduate Student	100%
Secretarial Services	2%
<u>(b) Premises, Facilities, and Materials to be Furnished by the Contractor:</u>	

Laboratories and facilities necessary to conduct research on the concentration of suspended radioactive wastes into bottom deposits will be available. Equipment available includes a gamma spectrometer system with graphic recorder, proportional counting system, auxiliary scaler with detectors, survey meters, fume hood, muffle furnace, drying oven, constant temperature water bath, oyster grounds, scuba diving gear and other related instruments.

A-III ITEMS OF EQUIPMENT TO BE PURCHASED OR FABRICATED BY
CONTRACTOR COSTING \$500 OR MORE

Estimated
Cost

1. Bacteria and Cell Counter with 2 extra tubes	\$5,720.00
2. Ultraviolet Illuminator	880.00

U. S. ATOMIC ENERGY COMMISSION
CONTRACT AUTHORIZATION

DATE

JAN 2 1964

AUTHORIZATION NO.

BM-64-307

1.A. TO S. R. Sapirie, Manager
Oak Ridge Operations Office

B. FROM C. L. Dunham, M.D., Director
Division of Biology & Medicine, F

2.A. CONTRACTOR (Name, Address, Department, etc.)
Virginia Fisheries Laboratory
VIRGINIA INSTITUTE OF MARINE SCIENCE
Gloucester Point, Virginia

B. PRINCIPAL INVESTIGATOR(S)
Dexter S. Haven

3. NEW CONTRACT AMENDMENT RENEWAL

4. TERM OF CONTRACT 1-1-64 thru
12-31-64

5. CONTRACT NUMBER
(40-1)-2789

6. PROJECT AGREEMENT NO.

7. RECOMMENDED TYPE OF CONTRACT:
(Fixed-price, cost-type, at option of your office, etc.)

Fixed-price

8. PROPERTY TITLE TO VEST IN:
 AEC CONTRACTOR
 EITHER (Field Office determination)

9. SECURITY CLASSIFICATION:
Work to be performed is under category I as defined by AEC Manual Appendix 3401.

10. PROJECT TITLE
CONCENTRATION OF SUSPENDED RADIOACTIVE WASTES INTO BOTTOM DEPOSITS

11. HEADQUARTERS TECHNICAL CONTACT

Arnold B. Joseph *Arnold B Joseph*

12. BUDGET AND REPORTING CLASSIFICATION(S)
(by subactivity number)

06 05 02

13. FINANCING

BY ALLOTMENT TRANSFER -
Allotment Transfer Chargeable: 06-41-91(24)

BY FINANCIAL PLAN

MAXIMUM AMOUNT OF AEC FUNDS AUTHORIZED FOR THE PERIOD \$ _____

ESTIMATED OBLIGATION AUTHORITY AVAILABLE FROM PREVIOUS CONTRACT PERIOD \$ _____

NEW OBLIGATION AUTHORITY TO BE PROVIDED FOR IN THE CONTRACT \$ 20,000

ESTIMATED CONTRACTOR CONTRIBUTION (If applicable) \$ _____

TOTAL AMOUNT OF CONTRACT AUTHORIZED \$ _____

I. SPECIAL PROVISIONS AND INSTRUCTIONS:

The technical aspects of the proposed work have been reviewed and are approved. A need currently exists for the results of the research or other work that is to be undertaken. None of the AEC funds shall be used to confer a fellowship.

Please keep us informed as to any problems encountered in your negotiations, as well as the date of execution of this contract and the amount of funds obligated.

THE FOLLOWING ITEMS ARE APPLICABLE, IF CHECKED:

Headquarters has not made a detailed review of the following expense items, which should be investigated as part of any contract negotiation:

Overhead General and Administrative Equipment costs

It is desired that this contract be funded for its entire term.

Transfer allotment to cover the period _____ to _____ is attached.

JAN 6 - 1964

1128896

Office Memorandum • UNITED STATES GOVERNMENT

TO : **C. L. Sikes, Director**
Division of Biology and Medicine, HQ

DATE: **September 28, 1963**

FROM : **Herman M. Roth, Director**
Research and Development Division, ORO

SUBJECT: **RENEWAL OF CONTRACT NO. AT (40-1) - 2700 - VIRGINIA INSTITUTE OF**
SCIENCE (DR. H. L. HERSH AND DR. S. S. HAYES)

000.00

We are submitting for your review and appropriate action the following information concerning the contract which will expire on **October 31, 1963**.

- 1. Renewal Proposal (**330**)
- 2. Progress Report (**330**)
- 3. Financial Statement (**330**)
- 4. 200-Word Summary (**330**)

We shall appreciate your advising us of your decision so that we may proceed with the necessary contract action at the earliest possible date.

Herman M. Roth
Herman M. Roth

Enclosure:
As Listed Above

cc: **G. S. Sharp, w/final.**
D. S. Sackry, w/progress report
Alice Brown ✓

23062

September 24, 1963

Dr. C. S. Shoup
U. S. Atomic Energy Commission
Research & Development Division
Post Office Box 2
Oak Ridge, Tennessee

Dear Dr. Shoup:

We are enclosing six copies of the progress report and the expenditure statement for work completed under contract AT-(40-1)-2789 since January 1, 1963

Also enclosed are six copies of a renewal proposal for contract AT-(40-1)-2789 for the period January 1, 1964 through December 31, 1964.

Sincerely,

Dexter S. Haven

Mr. Dexter S. Haven
CO-Investigator

Morris L. Brehmer

Mr. Morris L. Brehmer
CO-Investigator

DSH/kh
Enclosures

CONTRACTS-2789(UA)

1120898

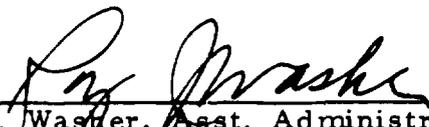
EXPENDITURE STATEMENT

Expenditures - 1 January 1963

-

30 September 1963

<u>Classification</u>	<u>Virginia Institute of Marine Science</u>	<u>AEC</u>	
Salaries	\$1314.00	\$8619.00	
Travel			
Contractual Services		48.00	
Supplies and Equipment		2655.26	
Indirect Costs		102.54	
	<u>\$1314.00</u>	<u>\$11434.80</u>	\$12,799.95
 Estimated Costs -			
 1 October 1963 thru			
31 December 1963	<u>442.00</u>	<u>8514.00</u>	<u>8,754.00</u>
	 \$1756.00	 \$20000.00	 \$31,754.00



 Roy J. Washer, Asst. Administrative
 Director

RENEWAL PROPOSAL

Concentration of Suspended Radioactive Wastes Into Bottom Deposits

by
Dexter S. Haven, Senior Investigator

Virginia Institute of Marine Science
Gloucester Point, Virginia

The Senior Investigator requests that the U. S. Atomic Energy Commission consider renewal of contract no. AT-(40-1)-2789 for the period 1 January 1964 through 31 December 1964. The research objectives, scientific background, and literature are reviewed in the original proposal. However, since several of the original objectives of the program have been achieved there will be a shift in emphasis to problems defined by the completed research.

Problems related to the field ecology and physiology will be handled by the Senior Investigator. Radiobiological studies will be conducted in the radiobiological laboratory under the supervision of Dr. Morris L. Brehmer, head, radiobiological section.

Studies will continue on rates at which biodeposits accumulate on natural bottoms in the estuary. Fluorescent minerals or fluorescent particles will be fed various filter feeders in the laboratory. Later the animals containing ingested "labeled" particles will be placed in the river. Subsequent transport or mixing of the deposits will be followed by identifying the fluorescent particles in cores under ultraviolet light.

Fluorescent grain-count data from levels in the cores will be analyzed by appropriate statistical methods, such as trend-surface analysis, multiple regression analysis, and three factor analysis. These computations will be done on electronic, digital computers.

Various authors have indicated that adsorptive capacity of various ions on some clays is a function of particle size. Consequently, a study is planned to determine sizes of particles removed from suspension by various filter feeders. In this study it is planned to hold test animals in an "open" system where they will continually receive water containing solids of known density and size. Attention will be given particles in the 1.0 to 10.0 microns size range. In this study, pre-filtered water will be introduced into troughs containing various animals. To these troughs will be added particles of silts and clays of known size, as well as bacteria and algal cells. Size ranges of particles entering and leaving the troughs will be measured with a Coulter Counter.

The preceding study of particle size and filtration will be supplemented by a similar study using isotopes in a closed system. Clays or bacteria will be labeled with C^{137} or P^{32} and then fed to oysters. Quantities removed will be plotted against particle size.

Isotopes will also be used to study rates at which surface deposits of feces and pseudofeces become incorporated into bottom deposits. In this study, clays and bacteria will be labeled with Cs^{137} and P^{32} and the mixture fed to oysters. Labeled deposits of feces will then be placed in aquaria containing typical bottom invertebrates such as annelids, crabs, and amphipods. Activity of sediments at various depths will be recorded.

Preliminary studies indicate that plankton samples collected a foot or two off the bottom in the York River estuary contain tremendous numbers of fecal pellets. This aspect of the problem will be studied in an effort to determine their origin.

Project Abstract

Oysters and other marine organisms filter large quantities of water to obtain food. During feeding undigested material is voided as fecal strings or pseudofeces, (biodeposits). Biodeposits vary in density but evidence indicates a considerable quantity is deposited on the bottom, and later resuspended by currents, while a portion is incorporated into the bottom.

Biodeposition would be of importance in the event of an accidental contamination of an estuary since the process removes algae, silts and clays along with their associated radio-nuclides.

The prepared program will study the permanence of biodeposits in marine sediments, sizes of particles removed, and the occurrence of fecal pellets in plankton.

PERSONNEL

Biographical Sketch

Senior Investigator - Time allotted to project 10%

Name - Haven, Dexter S. Title - Assoc. Marine Scientist

Date of birth [REDACTED] Place of birth [REDACTED] Ill.

Educational Experience

Degree	Institution Conferring	Date
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]

Employment Experience

Dates	Employer	Title or Nature of work
1948-49	U. S. Fish & Wildlife Service	Marine Biologist
1949 to date	Va. Inst. Marine Science	Marine Biologist

Publications

- Haven, D. 1951. A quick drying ink for labeling cellulose acetate slides. *Copeia*. 1951 (3):252.
- Haven, D. and J. D. Andrews. 1957. Survival and growth of Venus mercenaria, Venus campechiensis, and their hybrids in suspended trays and on natural bottoms. *Proc. Natl. Shellfish. Assoc.* 47 (1956): 43-49.
- Haven, D. 1957. Distribution, growth, and availability of juvenile croaker, Micropogon undulatus, in Virginia. *Ecology* 38 (1): 88-97.
- Haven, D. 1959. Effects of pea crabs, Pinnotheres ostreum, on oysters, Crassostrea virginica. *Proc. Natl. Shellfish. Assoc.* 49: 77-86.
- Andrews, J. D. and D. S. Haven. 1959. Fresh-water kill of oysters (Crassostrea virginica) in James River, Virginia 1958. *Proc. Natl. Shellfish. Assoc.* 49: 29-49.
- Haven, D. 1959. Migration of the croaker, Micropogon undulatus. *Copeia* 1959 (1): 25-30.
- Haven, D. 1961. Eurasian water milfoil in the Chesapeake Bay and the Potomac River. Water management in the Potomac Estuary. Interstate Commission on the Potomac River Basin, 1961.
- Haven, D. 1962. Seasonal cycle of condition index of oysters in the York and Rappahannock Rivers. *Proc. Natl. Shellfish. Assoc.* 51 (1960): 42-66.

Biographical Sketch

Research Assistant - Time allotted to project 100%

Name Morales-Alamo, Reinaldo Title Marine Scientist A

Date of birth [REDACTED] Place of birth [REDACTED]

Educational Experience

Degree	Institution Conferring	Date
[REDACTED]	[REDACTED]	[REDACTED]

Graduate Work - School of Marine Science, Wm. and Mary

Employment Experience

Dates	Employer	Title or Nature of work
1956-57	U. S. Fish & Wildlife Service	Shellfish Biologist
1957 to date	Va. Inst. Mar. Science	Marine Biologist

BUDGET

For contract period 1 January 1964 through 31 December 1964.

I. Approximate level of research effort

<u>A. Personnel</u>	<u>Approx. % of time for contract work</u>	<u>Contribution by Institution</u>	<u>AEC Funds Requested</u>
<u>Principal Investigator</u>			
Dexter S. Haven	10%	960	None
<u>Others:</u>			
<u>Research Associates</u>			
Reinaldo Morales	100%	None	6145
Graduate Student	100%	None	2400
Secretarial Services	2%	None	100
 <u>B. Materials & Supplies</u>			
Chemicals & Glassware			500
Film Badge Service			75
Coulter Counter Model B with 2 extra tubes			5720
Ultraviolet illuminator			880
Metering pumps			500
Fluorescent minerals			250
Filters			500
Plastic sheets for building holding aquaria			250
Computer time			500
Travel			180
 <u>C. Indirect Costs</u>			<u>2000</u>
		<u>960</u>	<u>\$20,000</u>

II. Institution Facilities Available

The following equipment and facilities are available at the Virginia Institute of Marine Science

1. Five Permanent Buildings

2. Radiobiology Laboratory

Gamma spectrometer system with graphic recorder
Proportional counting system
Auxiliary scaler with detectors
Survey meters
Fume hood
Muffle furnace
Drying oven
Stainless steel experiment and preparation tables
Metering pump

3. Chemistry Laboratory

Drying oven
Muffle furnace
Klett-Summerson colorimeter
Beckman DU Spectrophotometer with flame and UV attachment
Micro and Macro Kjeldahl digestion and distillation units
Sartorius single pan analytical balance
Christian Becker double pan analytical balance
Fume hood
Hot plate
Beckman "Model G" pH meter
Constant temperature culture cabinet
Vacuum pumps
LECO Carbon Analyzer
Glassware and chemicals

4. Wet Laboratory

Non-metallic sea water system
Experiment tables
Holding troughs
Constant temperature water bath
20-pen recorder

5. Field Equipment

80' R/V LANGLEY
55' R/V PATHFINDER
26' R/V OBSERVER
Institute-owned oyster grounds
SCUBA diving gear

1. TO: R. G. Humphries Chairman
Contract Board. From: Res. & Dev. Div.

It is requested that the Contract Board take the necessary action to process the following described contract action in accordance with the provisions of Bulletin OR-O&M-19:

2. Nature of Action Requested

Selection of New Contractor and Negotiation of Contract.

Modification of Contract
No. AT-(40-1)-2789

Contractor: Virginia Institute of Marine Science, Gloucester Point, Virginia

Review and approval of Contract, Sub-contract or Purchase Order.

Other (Explain) _____

Number: _____
Name: _____

3. Nature of Services to be Covered by Contract

Construction Architect-Engineer Other (Explain) Research

4. Funding

Amount to be Obligated by this Contract Action : 20,000.00

Source of Funds

Approved ORO Financial Plan, _____ Quarter, Fiscal Year 19__

Project No. _____ or, Activity No. 060502

Funds to be Obligated: Allotment No. 06-31-2/63 (F.Y. 1963 Funds)

Procurement Directive No. B.M. 63-302 Dated 1-4-63

Issuing Office Dir of Res & Dev

Concurrence in Funding Statement: (signed) _____

J. E. Washington
Chief, Budget Branch

5. Project or Activity to be Covered by Contract Action:

Location of Work: _____ Construction Directive No. _____

Estimated Cost of Work to be Covered by this Contract Action \$ _____

Schedule: Date Work to Start _____ Estimated Completion Date _____

Description of Project or Activity: _____

(If more space is required use separate sheets and attach hereto)

<p>6. Contract Board Docket No. _____ (To be assigned by Board Secretary)</p>	<p>7. Request Submitted By: (signed) _____ Date: JAN 1 1963 Title: _____ G. S. SHOUP CHIEF, BIOLOGY BRANCH RESEARCH AND DEVELOPMENT DIVISION</p>
<p>8. <u>Complete Description of Services to be Furnished by Contractor:</u> Headquarters designated research contract TITLE: "Concentration of Suspended Radioactive Wastes into Bottom Deposits" (If more space is required use separate sheets and attach hereto:)</p>	
<p>9. <u>Description of other changes to be covered by Modification:</u> Modify contract to provide for the performance of additional research to be completed during the period January 1, 1963 through December 31, 1963. The AEC will support the project in the amount of \$20,000 in new funds. (If more space is required use separate sheets and attach hereto:)</p>	
<p>10. <u>Negotiated Contracts.</u> (Show why it appears desirable to negotiate new contract or to negotiate modification to existing contract) Form AEC-481 (Contract Authorization) from C. L. Dunham to S. R. Sapirie dated January 4, 1963 (If more space is required use separate sheets and attach hereto:)</p>	
<p>11. <u>Contracts, Subcontracts, or Purchase Orders Submitted for Review and Approval:</u> (Furnish brief description of action in this space and attach pertinent documents) None</p>	
<p>12. <u>Disputes:</u> Attach a statement summarizing the dispute together with pertinent documents and Background Material. None</p>	

APPENDIX "A"

For the Contract Period January 1, 1963 through December 31, 1963.

A-I RESEARCH TO BE PERFORMED BY CONTRACTOR

The Contractor will continue to conduct research on the concentration of radioactive wastes in the bottom sediment of marine environments. The work to be undertaken will consist of approaches such as (1) study of the permanence of radionuclides in the biodeposition of materials in the bottom sediments, (2) investigation of the role of filter feeders such as clams, barnacles, mussels and tunicates in removing suspended solids and associated radionuclides, (3) ecological and physiological factors influencing deposition rates in the natural environment, (4) study of the rates at which deposits accumulate on natural bottoms, and (5) laboratory studies of the influence of temperature, salinity, and turbidity on biodeposition rates by marine organisms such as oysters, clams, mussels, barnacles, and tunicates.

A-II APPROXIMATE LEVEL OF RESEARCH EFFORT

<u>(a) Contractor Personnel:</u>	<u>Approx. % of time</u>
Dr. M. L. Brehmer and Mr. D. S. Haven Co-Principal Investigators	10%
2 Research Associates	100%
1 Laboratory Aide	100%
Secretarial Assistance	25%

(b) Premises, Facilities, and Materials to be Furnished
by the Contractor:

Research laboratories and facilities necessary to conduct research on the concentration of radioactive wastes in the bottom sediment of marine environments will be available. Equipment available include a gamma spectrometer system with graphic recorder, proportional counting system, auxiliary scaler with detectors, survey meters, fume hood, muffle furnace, drying oven, constant temperature water bath, oyster grounds, scuba diving gear and other related instruments.

<u>A-III EQUIPMENT TO BE PURCHASED OR FABRICATED BY CONTRACTOR</u>	<u>Estimated Cost</u>
Metering Pumps	\$697.00

A-IV EQUIPMENT TITLE TO WHICH IS TO REMAIN WITH GOVERNMENT

None

A-V SUBSTANTIAL DEVIATIONS

Substantial deviations from the foregoing shall be discussed with and subject to the written approval of the Commission.

UNITED STATES ATOMIC ENERGY COMMISSION
CONTRACT AUTHORIZATION

2. DATE **JAN 4 1963**

3. NUMBER

NY-63-302

4. NEW CONTRACT
 RENEWAL OF

CONTRACT NO.

AT(40-1)-2789

5. RESPONSIBLE TECHNICAL REVIEWER

[Signature]
Frank F. Hooper

7. PRINCIPAL INVESTIGATOR

**Morris L. Brehmer
Dexter S. Haven**

1. TO

**S. R. Sapirie, Manager
Oak Ridge Operations Office**

FROM

**C. L. Dunham, M.D., Director
Division of Biology & Medicine**

6. CONTRACTOR

**VIRGINIA INSTITUTE OF MARINE SCIENCE
VIRGINIA FISHERIES LABORATORY**

8. DEPARTMENT

9. PROJECT TITLE

CONCENTRATION OF SUSPENDED RADIOACTIVE WASTES INTO BOTTOM DEPOSITS

10. RECOMMENDED TYPE

FIXED PRICE
 COST REIMBURSEMENT

11. TERM

1-1-63 thru 12-31-63

12. FINANCING

NEW AEC FUNDS, NOT TO EXCEED . . . \$ **20,000**
BALANCE FROM PRIOR TERM \$

ESTIMATED VOLUNTARY
CONTRACTOR CONTRIBUTION \$

TOTAL PROJECT \$

13. PROPERTY

TITLE TO VEST IN AEC

CONTRACTOR

14. ALLOTMENT TRANSFER CHARGEABLE

06-31-91 (24)

15. BUDGET AND REPORTING CLASSIFICATION

OPERATING COSTS **06 05 02**
EQUIPMENT COSTS (IF APPLICABLE)

16. SECURITY

WORK TO BE PERFORMED IS UNDER CATEGORY **I**
AS DEFINED IN AEC MANUAL SECTION 3403. "G" CLEARANCE IS
REQUESTED FOR

REMARKS:

THE TECHNICAL ASPECTS OF THE PROPOSED RESEARCH HAVE BEEN REVIEWED AND ARE APPROVED. A NEED CURRENTLY EXISTS FOR THE RESULTS OF THE RESEARCH THAT IS TO BE UNDERTAKEN. THE BUDGET INCORPORATED IN THE PROPOSAL HAS BEEN REVIEWED AND IS APPROVED EXCEPT AS INDICATED BELOW. NONE OF THE AEC FUNDS SHALL BE USED FOR CONFERRING A FELLOWSHIP. IF FUNDS ARE TO BE USED UNDER THE PROVISIONS OF AEC MANUAL 1010, THE SERVICE INVOLVED BE CONSIDERED IN THE NEGOTIATIONS.

18. ENCLOSURES

PROPOSAL DATED _____
 NOTIFICATION LETTER DATED **JAN 4 1963**
 FORM TO BE RETURNED

D 55

JAN - 7 1963

UNITED STATES GOVERNMENT

Memorandum

TO : C. L. Sargent, Director
Division of Biology and Medicine, Headquarters

DATE: October 2, 1942

FROM : Herman M. Roth, Director
Research and Development Division, Oak Ridge Operations

SUBJECT: RENEWAL OF CONTRACT NO. AT-(40-1)- 2789 - VIRGINIA INSTITUTE
OF MARINE SCIENCE (HENRIE L. HENNER AND BEATRICE S. HANCOCK)

MS:JTB

We are submitting for your review and appropriate action the following information concerning the contract which will expire on December 31, 1942:

1. Renewal Proposal (4)
2. Progress Report (4)
3. Financial Statement (4)

We shall appreciate your advising us of your decision so that we may proceed with the necessary contract action at the earliest possible date.

Herman M. Roth
Herman M. Roth

Enclosure:
As Listed Above

CC: G. S. Shoup, w/encs.
D. S. Eckery, w/progress report
Alice Brown ✓

1128911

September 27, 1962

**Research and Development Division
Oak Ridge Operations Office
U. S. Atomic Energy Commission
Post Office Box 8
Oak Ridge, Tennessee**

RE: Contract No. AT-(40-1)-2789

**ATT: Dr. C. S. Shoup, Chief
Biology Branch¹**

Dear Dr. Shoup:

Enclosed are six copies of the Progress Report and Renewal Proposal for the research contract entitled, "Concentration of Suspended Radioactive Wastes into Bottom Deposits". Three copies of the summary of the proposed research are included.

Sincerely yours,

Morris L. Kremer

**Dexter S. Laven
Co-investigators**

**MLB/jh
Enclosures**

1128912

EXPENDITURE STATEMENT

Expenditures - 1 January 1962

-

30 September 1962

<u>Classification</u>	<u>Virginia Institute of Marine Science</u>	<u>ABC</u>	
Salaries	7,088.00	8,335.00	
Equipment		3,129.89	
Research Vessel Expenses	2,500.00		
Maintenance and Operation	2,301.00	592.05	
Indirect Costs		<u>1,819.00</u>	
	<u>\$11,689.00</u>	<u>\$13,815.44</u>	\$25,704.44
 Estimated Costs - 1 October 1962 thru 31 December 1962	 4,270.00 <u>\$18,059.00</u>	 6,184.56 <u>\$20,000.00</u>	 10,354.56 <u>\$36,059.00</u>



 Roy J. Walker
 Assistant Administrative Director

000 1 1962

1120913

SUMMARY OF PROPOSED RESEARCH

Title of Project: Concentration of Suspended Radioactive Wastes into Bottom Deposits

Name and Address of Institution: Virginia Institute of Marine Science
Gloucester Point, Virginia

Previous research on this project has indicated that bio- and abioseston in the marine environment effectively concentrates radionuclides by the processes of biological assimilation or physical or chemical adsorption. The data also indicated that marine filter-feeding organisms are very efficient in removing seston from the water mass and incorporating it into bottom deposits. Theoretically, the oysters on an acre of estuarine bottom may remove more than a ton (dry weight) of material from suspension per week.

The proposed research will involve studies on the biodeposition rates of other marine filter-feeders. Clams, barnacles, mussels, and tunicates will be used in the experiments. The effects of water temperature, turbidity, salinity, and particle sizes on filtering rates will be investigated.

The rates at which bottom deposits accumulate in natural bottoms will be investigated using particles coated with a fluorescent dye. The stability of the deposits will be determined by chemical and radiochemical techniques.

The permanence of radionuclides incorporated into or adsorbed on biodepositions of oysters, clams, mussels, barnacles, and tunicates will be investigated in a flowing sea water system. Previous

Summary of Proposed Research
Page 2

experiments utilizing static systems indicate radionuclides are resistant to desorption when incorporated into biodepositions.

Harris L. Kremer

Arthur S. Egan

Signatures of Principal Investigators

RENEWAL PROPOSAL

Concentration of Suspended Radioactive Wastes Into Bottom Deposits

by

Morris L. Brehmer and Dexter S. Haven (Co-Investigators)

Virginia Institute of Marine Science, Gloucester Point, Virginia

The Co-investigators request that the U. S. Atomic Energy Commission consider renewal of Contract No. AT-(40-1)-2789 for the period 1 January 1963 through 31 December 1963. The research plans for this period are basically as outlined in the proposal submitted in application for the contract. Literature references relevant to the investigation and supplementary information were submitted in the original proposal.

Studies involving the permanence of radionuclides associated with biodeposition require additional study. The use of three radionuclides adsorbed on or incorporated into several species of biodeposition and three types of clays under various salinity conditions requires considerable time. In addition to the static permanence studies now utilized in which the water overlying the biodeposition contained in plastic tubes is withdrawn and tested for products of leaching, a flow system will be devised in which a scintillation detector is placed under a layer of biodeposited material in a trough of flowing water. A strip chart recorder will be used to monitor the decreasing level of radioactivity contained in the sediments. The flow system will prevent the establishment of an equilibrium layer between the biodeposition and water.

The role of clams, barnacles, mussels and tunicates in removing

suspended solids and associated radionuclides from the water mass will also be investigated. The permanence of radionuclides in these deposits will be studied by the methods described above.

Phosphorus-32 "tagged" bacteria will be metered into the water supply circulating over marine filter-feeders. The efficiency of the filtering systems of the various organisms will be determined by the nuclide uptake by the filter feeder as well as by the activity of the biodepositions.

The ecological and physiological investigations will be directed towards factors influencing deposition rates in the natural environment. Research on biodeposition rates on polyethylene sheets will be continued; however, stations will be relocated to include several depths. Deposits accumulating on the sheets will be measured and chemically analyzed to determine if biodepositions may be differentiated from physical depositions on the basis of chemical composition. Chemical analyses for carbon, calcium, magnesium, iron, sodium, potassium, total phosphorus, total organic nitrogen, chlorophylls and carotenoids will be run on sediments deposited on polyethylene sheets containing living oysters and on sheets containing only oyster shells.

The second aspect of the field study will be a measure of the rates at which deposits accumulate on natural bottoms. This phase will utilize natural particles coated with a fluorescent dye. The dye can be excited by ultraviolet light so the particles may be recognized by the emission. "Labeled" particles will be placed on natural areas supporting a filter-feeding animal population, and the transport, mixing, or covering of the materials by subsequent depositions will be followed by periodic sampling.

The saltwater laboratory study will be a continuation of the influence of temperature, salinity, and turbidity on biodeposition rates. Oysters, clams, mussels, barnacles, and tunicates will be utilized in these investigations.

PERSONNEL

Biographical Sketch

Co-investigator - Time allotted to project 10%

Name - Haven, Dexter S. Title - Assoc. Marine Scientist

Date of Birth [REDACTED] Place of Birth [REDACTED], Ill.

Educational Experience

Degree	Institution Conferring	Date
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]

Employment Experience

Dates	Employer	Title or Nature of Work
1948-49	U. S. Fish & Wildlife Service	Marine Biologist
1949 to date	Va. Inst. Marine Science	Marine Biologist

Publications

- Haven, D. 1951. A quick drying ink for labelling cellulose acetate slides. Copeia. 1951 (3): 252.
- Haven, D. and J. D. Andrews. 1957. Survival and growth of Venus mercenaria, Venus campechiensis, and their hybrids in suspended trays and on natural bottoms. Proc. Natl. Shellfish. Assoc. 47 (1956): 43-49.
- Haven, D. 1957. Distribution, growth, and availability of juvenile croaker, Micropogon undulatus, in Virginia. Ecology 38 (1): 88-97.
- Haven, D. 1959. Effects of pea crabs, Pinnotheres ostreum, on oysters, Crassostrea virginica. Proc. Natl. Shellfish. Assoc. 49: 77-86.
- Andrews, J. D. and D. S. Haven. 1959. Fresh-water kill of oysters (Crassostrea virginica) in James River, Virginia 1958. Proc. Natl. Shellfish Assoc. 49: 29-49.
- Haven, D. 1959. Migration of the croaker, Micropogon undulatus. Copeia 1959 (1): 25-30.
- Haven, D. 1962. Seasonal cycle of condition index of oysters in the York and Rappahannock Rivers. Proc. Natl. Shellfish. Assoc. 51 (1960): 42-66.

Biographical Sketch

Co-investigator - Time allotted to Project 10%

Name Brehmer, Morris L Title Sr. Marine Scientist

Date of Birth [REDACTED] Place of Birth [REDACTED] Ill.

Education Experience

Degree	Institution Conferring	Date
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]

Employment Experience

Dates	Employer	Title or Nature of Work
1951-55	Ill. Dept. Conservation	Fisheries Biologist
1955	Institute of Paper Chemistry	Technical Aide
1955-58	Mich. Inst. for Fisheries Res.	Graduate Fellow
1959 to date	Va. Inst. Marine Science	Marine Biologist

Publications

1. Brehmer, Morris L. 1959. Estuarine pollution research in Virginia. Proc. Interstate Comm. Potomac River Basin, (May, 1959), pp. 27-29.
2. Grzenda, A. R. and M. L. Brehmer. 1960. A quantitative method for the collection and measurement of stream periphyton. Limn. and Oceanogr. 5 (2): 190-194.

Biographical Sketch

Research Assistant - Time allotted to project 100%

Name Morales-Alamo, Reinaldo Title Marine Scientist A

Date of Birth [REDACTED] Place of Birth [REDACTED]

Education Experience

Degree	Institution Conferring	Date
[REDACTED]	[REDACTED]	[REDACTED]

Graduate Work - [REDACTED]

Employment Experience

Dates	Employer	Title or Nature of Work
1956-57	U. S. Fish & Wildlife Service	Shellfish Biologist
1957 to date	Va. Inst. Mar. Science	Marine Biologist

Biographical Sketch

Research Assistant - Time allotted to project 100%

Name Warinner, J. E.

Title Marine Scientist B

Date of Birth [REDACTED] Place of Birth [REDACTED] Va.

Education Experience

Degree

Institution Conferring

Date

[REDACTED]
[REDACTED]

[REDACTED]
[REDACTED]

[REDACTED]
[REDACTED]

Employment Experience

Dates

Employer

Title or

1960 to date

Va. Inst. Marine Science

Nature of Work

Marine Biologist

For Contract Period 1 January 1963 through 31 December 1963.

I. Approximate Level of Research Effort

<u>A. Personnel</u>	<u>Approx. % of time for contract work</u>	<u>Contribution by Institution</u>	<u>AEC Funds Requested</u>
<u>Principal Investigators</u>			
Morris L. Brehmer	10%	\$916	None
Dexter S. Haven	10%	840	None
<u>Others:</u>			
<u>Research Associates</u>			
J. Ernest Warinner	100%	None	\$6432
Reinaldo Morales	100%	None	5880
Laboratory Aide B	100%	None	2760
Secretarial Services	25%	None	756
<u>B. Materials and Supplies</u>			
Chemicals and Glassware			1000
Film Badge Service			75
<u>C. Travel</u>			
2 Scientific Meetings			400
<u>D. Equipment to be purchased or fabricated</u>			
Metering Pumps			697
<u>F. Indirect Costs</u>			
		\$1756	2000
			\$20,000

*estimated change
See budget for letter
to CES 1/24
02/18/1963*

Morris L. Brehmer
Morris L. Brehmer, Co-investigator

Dexter S. Haven
Dexter S. Haven, Co-investigator

II. Institution Facilities Available

The following equipment and facilities are available at the Virginia Institute of Marine Science

1. Five Permanent Buildings

2. Radiobiology Laboratory

Gamma spectrometer system with graphic recorder
Proportional counting system
Auxiliary scaler with detectors
Survey meters
Fume hood
Muffle furnace
Drying oven
Stainless steel experiment and preparation tables
Metering pump

3. Chemistry Laboratory

Drying oven
Muffle furnace
Klett-Summerson colorimeter
Beckman DU Spectrophotometer with flame and UV attachment
Micro and Macro Kjeldahl digestion and distillation units
Sartorius single pan analytical balance
Christian Becker double pan analytical balance
Fume hood
Hot plate
Beckman "Model G" pH meter
Constant temperature culture cabinet
Vacuum pumps
LECO Carbon Analyzer
Glassware and chemicals

4. Wet Laboratory

Non-metallic sea water system
Experiment tables
Holding troughs
Constant temperature water bath
20-pen recorder

5. Field Equipment

80' R/V LANGLEY
55' R/V PATHFINDER
26' R/V OBSERVER
Institute-owned oyster grounds
SCUBA diving gear



VIRGINIA INSTITUTE OF MARINE SCIENCE
VIRGINIA FISHERIES LABORATORY
GLOUCESTER POINT, VIRGINIA

May 28, 1962

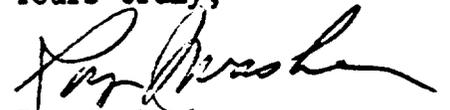
Atomic Energy Commission
P.O. Box E
Oakridge,
Tennessee

Gentlemen:

Effective July 1, 1962 our name will be changed from Virginia Fisheries Laboratory to Virginia Institute of Marine Science. This change, brought about by an act of the Virginia General Assembly of 1962, better describes the functions of our organization in the broad field of research and education in marine science and service to all segments of the maritime economy.

We extend a cordial invitation to you to visit our Institute.

Yours truly,


Roy J. Washer
Administrative Assistant
Director

RJW:ca

Full: CONTRACTS-270
Allen Brown
Joe Mc...
6-4-62
920

MAY 31 1962

1128925

1. Chairman
 TO: R. G. Humphries Contract Board. From: Res. & Dev. Div.

It is requested that the Contract Board take the necessary action to process the following described contract action in accordance with the provisions of Bulletin OR-O&M-19:

2. Nature of Action Requested

Selection of New Contractor and Negotiation of Contract.

Modification of Contract
 No. AT-(40-1)-2789

Contractor: Virginia Fisheries Laboratory
 Gloucester Point, Virginia

Review and approval of Contract, Sub-contract or Purchase Order.
 Number: _____
 Name: _____

Other (Explain) _____

3. Nature of Services to be Covered by Contract

Construction Architect-Engineer Other (Explain) Research

4. Funding

Amount to be Obligated by this Contract Action \$ 20,000.00

Source of Funds

Approved ORO Financial Plan, _____ Quarter, Fiscal Year 19____
 Project No. _____ or, Activity No. 060502
 Funds to be Obligated: Allotment No. 66-21-91(21)Y. 1962 Funds)
 Procurement Directive No. BM-62-251 Dated 12-18-61
 Issuing Office Dev. of Bus. & Med.

Concurrence in Funding Statement: (signed) R. E. Miller
 Chief, Budget Branch

5. Project or Activity to be Covered by Contract Action:

Location of Work: _____ Construction Directive No. _____
 Estimated Cost of Work to be Covered by this Contract Action \$ _____
 Schedule: Date Work to Start _____ Estimated Completion Date _____
 Description of Project or Activity: _____

(If more space is required use separate sheets and attach heretos)

<p>6. Contract Board Docket No. _____ (To be assigned by Board Secretary)</p>	<p>7. Request Submitted By: (signed) _____ Date: _____ Title: <u>C S Sharp</u> DEC 28 1961 C. S. SHARP CHIEF, BIOLOGY BRANCH RESEARCH AND DEVELOPMENT DIVISION</p>
<p>8. <u>Complete Description of Services to be Furnished by Contractor:</u> Headquarters designated research contract TITLE: "Concentration of Suspended Radioactive Wastes into Bottom Deposits" (If more space is required use separate sheets and attach hereto:)</p>	
<p>9. <u>Description of other changes to be covered by Modification:</u> Modify contract to provide for the performance of additional research to be completed not later than December 31, 1962, with new AEC funds in the amount of \$20,000. (If more space is required use separate sheets and attach hereto:)</p>	
<p>10. <u>Negotiated Contracts.</u> (Show why it appears desirable to negotiate new contract or to negotiate modification to existing contract) Form AEC-481 (Contract Authorization) from C. L. Dunham to S. R. Sapirie dated December 18, 1961 (If more space is required use separate sheets and attach hereto:)</p>	
<p>11. <u>Contracts, Subcontracts, or Purchase Orders Submitted for Review and Approval:</u> (Furnish brief descrip- tion of action in this space and attach pertinent documents) None</p>	
<p>12. <u>Disputes:</u> Attach a statement summarizing the dispute together with pertinent documents and Background Material. None</p>	

4082

1128927

APPENDIX "A"

TITLE II

This TITLE II describes the research program and cost estimates agreed upon between the Commission and the Contractor.

1. PROGRAM

a. Scope and Plan of Approach:

The Contractor will continue to conduct research on the role of fecal deposition by filter-feeding marine organisms such as the oyster as a process in concentration of suspended radioactive waste materials into bottom deposits under field and laboratory conditions. Bio-and abioseston containing radionuclides will be mixed and presented to marine filter-feeding organisms at rates commonly encountered in the marine environment, the feces and pseudofeces collected and the permanence of the radionuclides in the "biodeposition" determined. Studies will be conducted to determine the affects of turbidity and temperature upon biodeposition.

2. BUDGET

a. Outline of Cost Estimates:

(1) <u>Salaries and Wages:</u>	\$20,730.00
Dr. M. L. Brehmer and Mr. D. S. Haven (½ time each)	\$ 9,450.00
Biologists	11,280.00
(2) <u>Equipment:</u>	6,910.00
(3) <u>Research Boat Expense (10 days @ \$300/day):</u>	3,000.00
(4) <u>Maintenance and Operating Costs:</u>	3,600.00
(5) <u>Indirect Costs (10% of Direct Costs charged to Commission - \$18,190):</u>	<u>1,819.00</u>
TOTAL	\$36,059.00

- b. Items of property to be procured or manufactured by the Contractor, or to be furnished by the Government, title to which will vest or remain in the Government (see Article V): None

UNITED STATES ATOMIC ENERGY COMMISSION
CONTRACT AUTHORIZATION

2. DATE **DEC 18 1961**

3. NUMBER
BM-62-251

1. TO
**S. R. Sapiro, Manager
Oak Ridge Operations Office**

FROM **C. L. Dunham, M.D., Director
Division of Biology & Medicine**

4. NEW CONTRACT
 RENEWAL OF

CONTRACT NO.

AT(40-1)-2789

5. RESPONSIBLE TECHNICAL REVIEWER *JEW*

I. E. Wallen

6. CONTRACTOR
Virginia Fisheries Laboratory

7. PRINCIPAL INVESTIGATOR
**Morris L. Brehmer
Dexter S. Haven**

8. DEPARTMENT

9. PROJECT TITLE
CONCENTRATION OF SUSPENDED RADIOACTIVE WASTES INTO BOTTOM DEPOSITS

10. RECOMMENDED TYPE
 FIXED PRICE
 COST REIMBURSEMENT

11. TERM
1-1-62 thru 12-31-62

12. FINANCING
NEW AEC FUNDS, NOT TO EXCEED . . . \$ **20,000**
BALANCE FROM PRIOR TERM \$

ESTIMATED VOLUNTARY CONTRACTOR CONTRIBUTION \$

TOTAL PROJECT \$

13. PROPERTY
TITLE TO VEST IN AEC
 CONTRACTOR

14. ALLOTMENT TRANSFER CHARGEABLE
06-21-91(24)

15. BUDGET AND REPORTING CLASSIFICATION
OPERATING COSTS **06 05 02**
EQUIPMENT COSTS (IF APPLICABLE)

16. SECURITY
WORK TO BE PERFORMED IS UNDER CATEGORY **I**
AS DEFINED IN AEC MANUAL SECTION 3403. "Q" CLEARANCE IS REQUESTED FOR

17. REMARKS:
THE TECHNICAL ASPECTS OF THE PROPOSED RESEARCH HAVE BEEN REVIEWED AND ARE APPROVED. A NEED CURRENTLY EXISTS FOR THE RESULTS OF THE RESEARCH THAT IS TO BE UNDERTAKEN. THE BUDGET INCORPORATED IN THE PROPOSAL HAS BEEN REVIEWED AND IS APPROVED EXCEPT AS INDICATED BELOW. NONE OF THE AEC FUNDS SHALL BE USED FOR CONFERRING A FELLOWSHIP. ~~NEVER~~

18. ENCLOSURES
 PROPOSAL DATED *CRDO has copies*
 NOTIFICATION LETTER DATED *12/18/61*
 FORM TO BE RETURNED

DEC 20 1961 **RI2752**

RENEWAL PROPOSAL

The co-investigators request that the U. S. Atomic Energy Commission consider renewal of Contract No. AT-(40-1)-2789 for the period 1 January 1962 to 31 December 1962.

A part of the initial year was devoted to the acquisition of equipment, construction and modification of facilities, and the development of the experimental designs for the research work. The progress report summarizes the activities and results for the period 1 January 1961 to 31 August 1961.

The radiobiology part of Phase 2 of the project entitled "Fecal deposition by filter-feeding marine organisms as a process in concentrating suspended radioactive wastes into bottom deposits" will be a continuance of Phase 1 with modifications and extensions.

The chemistry involved in the adsorption of radionuclides on type clay particles requires additional investigation. The discrete particle sizes involved appears to determine the rate of specific adsorption. Clay particles in suspension in natural marine environments are seldom discrete particles in that some conglomeration occurs among the suspensoids. Complete dispersion in the laboratory results in atypical adsorption levels and in an atypical particle being presented to the filter-feeding marine organism. The second years abioseston-radionuclide adsorption and "biodeposition" study will involve a more intensive study of particle size-adsorption-bioremoval rates.

The bioseston-radionuclide-biodeposition studies were confined to natural climax communities during Phase 1. With the completion of new culture facilities unialgal populations will be available to the project. During Phase 2, known populations of phytoplankton organisms

will be cultured in media containing radionuclides. The cells will be rinsed to remove surface radioactivity and a suspension of the cells presented to filter-feeding organisms in the recirculating troughs designed for this purpose. The feces and pseudofeces will be collected and the activity of the "biodeposition" determined.

Bio-and abioseston containing radio nuclides will be mixed and presented to marine filter-feeding organisms at rates commonly encountered in the marine environment. The feces and pseudofeces will be collected and the permanance of the radionuclides in the "biodeposition" determined.

The oyster physiology portion of Phase 2 of the biodeposition study will also be a continuation of the original study with certain modifications.

Studies during 1961 indicated that there were wide fluctuations in quantities of materials removed from the water mass as feces and pseudofeces, and that oyster size was not as important as other factors. At present, turbidity and temperature appear to be of major importance. Consequently, it is planned to meter controlled quantities of silts and clays of known size into troughs containing oysters. During these studies, temperature will be raised from 0° to 30°C which is the range encountered by oysters under natural conditions. Temperatures will be controlled by circulating sea water through a constant temperature apparatus. Sizes of particles removed from suspension as feces and pseudofeces will be measured.

Experiments during the preceeding period indicate that oysters may deposit measurable quantities of silt and clay on bottoms immediately adjacent to the oysters. These preliminary findings must be confirmed and extended. The stability of these depositions will also be investigated. Therefore, during 1962 the study will be expanded to determine the effects of changes in environmental conditions on "biodeposition" rates of oysters.

PERSONNEL

Biographical Sketch

Co-investigator - Time allotted to project 50%

Name - Haven, Dexter S. Title - Assoc. Marine Scientist

Date of Birth [REDACTED] Place of Birth [REDACTED] Ill.

Educational Experience

Degree	Institution Conferring	Date
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]

Employment Experience

Dates	Employer	Title or Nature of work
1948-49	U. S. Fish & Wildlife Service	Marine Biologist
1949 to date	Virginia Fisheries Laboratory	Marine Biologist

Publications

- Haven, D. 1951. A quick drying ink for labelling cellulose acetate slides. Copeia. 1951 (3): 252.
- Haven, D. and J. D. Andrews. 1957. Survival and growth of Venus mercenaria, Venus campechiensis, and their hybrids in suspended trays and on natural bottoms. Proc. Natl. Shellfish. Assoc. 47 (1956): 43-49.
- Haven, D. 1957. Distribution, growth, and availability of juvenile croaker, Micropogon undulatus, in Virginia. Ecology 38 (1): 88-97.
- Haven, D. 1959. Effects of pea crabs, Finnotheres ostreum, on oysters, Crassostrea virginica. Proc. Natl. Shellfish. Assoc. 49: 77-86.
- Andrews, J. D. and D. S. Haven. 1959. Fresh-water kill of oysters (Crassostrea virginica) in James River, Virginia 1958. Proc. Natl. Shellfish. Assoc. 49: 29-49.
- Haven, D. 1959. Migration of the croaker, Micropogon undulatus. Copeia 1959 (1): 25-30.
- Haven, D. Seasonal Cycle of condition index of oysters in the York and Rappahannock Rivers, (in press).

Biographical Sketch

Co-investigator - Time allotted to Project 50%

Name Brehmer, Morris L. Title Sr. Marine Scientist

Date of Birth [REDACTED] Place of Birth [REDACTED] Ill.

Educational Experience

Degree	Institution Conferring	Date
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]

Employment Experience

Dates	Employer	Title or Nature of Work
1951-55	Ill. Dept. Conservation	Fisheries Biologist
1955	Institute of Paper Chemistry	Technical Aide
1955-58	Mich. Inst. for Fisheries Res.	Graduate Fellow
1959 to date	Virginia Fisheries Laboratory	Marine Biologist

Publications

1. Brehmer, Morris L..1959. Estuarine pollution research in Virginia. Proc. Interstate Comm. Potomac River Basin, (May, 1959), pp. 27-29.
2. Grzenda, A. R. and M. L. Brehmer. 1960. A quantitative method for the collection and measurement of stream periphyton. Limn. and Oceanogr. 5 (2): 190-194.

Biographical Sketch

Research Assistant - Time allotted to project 100%

Name Morales-Alamo, Reinaldo Title Marine Scientist A

Date of Birth [REDACTED] Place of Birth [REDACTED]

Educational Experience

Degree	Institution Conferring	Date
[REDACTED]	[REDACTED]	[REDACTED]

Graduate Work - [REDACTED]

Employment Experience

Dates	Employer	
1956-57	U. S. Fish & Wildlife Service	Shellfish Biologist
1957 to date	Va. Fisheries Laboratory	Marine Biologist

Biographical Sketch

Research Assistant - Time allotted to project 100%

Name Warinner, J. E.

Title Marine Scientist A

Date of Birth [REDACTED] Place of Birth [REDACTED], Va.

Educational Experience

Degree
[REDACTED]

Institution Conferring
[REDACTED]

Date
[REDACTED]

Graduate Work, [REDACTED]

Employment Experience

Dates
1960 to date

Employer
Va. Fisheries Laboratory

Title or
Nature of Work
Marine Biologist

Materials, Equipment, and Facilities

The second years study of the biodeposition of inorganic suspensoids will utilize the available facilities with additions for Phase II of the contract.

The following equipment and facilities are available at the Virginia Fisheries Laboratory:

1. Radiobiology Laboratory

- Gamma spectrometer system with graphic recorder
- Proportional counting system
- Auxiliary scaler with "student grade" detectors
- Survey meters (0-20 mr. hr⁻¹)
- Fume hood
- Muffle furnace
- Drying oven
- Stainless steel experiment and preparation tables
- Metering pump

2. Chemistry Laboratory

- Drying oven
- Muffle furnace
- Klett-Summerson colorimeter
- Beckman DU Spectrophotometer with flame and UV attachment
- Micro and Macro Kjeldahl digestion and distillation units
- Sartorius single pan analytical balance
- Christian Becker double pan analytical balance
- Fume hood
- Hot plate
- Beckman "Model G" pH meter
- Constant temperature culture cabinet
- Vacuum pump
- Glassware and chemicals

3. Wet Laboratory

- Non-metallic sea water system
- Experiment tables
- Holding troughs

B.

The following additional equipment will be required for Phase II of the contract.

Radiobiology Laboratory

Detection equipment for auxiliary scaler	
1. B/A Model 810 BL Scintillation Detector	\$ 1055.
2. B/A Model 821 B flow Counter and Sample Holder	230.
3. B/A Model 800 D Low Background Shield	275.
Survey meter	
B/A Model 414 Log Survey Meter (0-3000 mr hr ⁻¹)	400.
Film Badge Service	75.
Metering Pumps	<u>450.</u>

Chemistry Laboratory

Glassware and Expendible Chemicals and Equipment	900.
Sedimentation Analyses Equipment	600.

Wet - Laboratory

Sargent (S-84895) Refrigerated Water Bath	1500.
Circulation and Metering Pumps	450.
Plexiglass for Fabrication of Experimental Troughs	500.
Thermographs	475.

\$ 6910.

C.

BUDGET

Salaries

Co-investigators ($\frac{1}{2}$ time each)	\$9450. ⁽¹⁾	
Biologist "A" (2)	<u>11280.</u>	
		\$ 20,730

Equipment, Materials, and Facilities

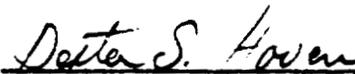
Radiobiology Laboratory Equipment	\$ 2485	
Chemistry Laboratory Equipment	1500	
Wet-Laboratory Equipment	2925 ⁽¹⁾	
Boat Time (10 days at \$300./day)	3000 ⁽¹⁾	
Laboratory Facilities		
2 offices @ 50./month	1200 ⁽¹⁾	
2 Laboratories @ \$100./month	<u>2400⁽¹⁾</u>	
		\$ 13,510

(1) Expenses borne by Virginia Fisheries Laboratory - \$ 16,050
Amount charged to contract 18,190
Administrative Expenses (10% of above) 1,810

Total Project Cost - \$ 36,050

Amount Requested from U.S.A.E.C. - \$20,000.


Morris L. Brehmer, Co-investigator


Dexter S. Haven, Co-investigator


William J. Hargis, Jr., Director


Roy J. Washer, Ass't. Adm. Director

1120938

1. Chairman
 TO: R. G. Humphries Contract Board. From: Res. & Dev. Div.

It is requested that the Contract Board take the necessary action to process the following described contract action in accordance with the provisions of Bulletin OR-O&M-19:

2. Nature of Action Requested

- Selection of New Contractor and Negotiation of Contract.
 Virginia Fisheries Laboratory
 Gloucester Point, Virginia
- Modification of Contract
 No. _____
 Contractor: _____
- Review and approval of Contract, Sub-contract or Purchase Order.
 Number: _____
 Name: _____
- Other (Explain) _____

3. Nature of Services to be Covered by Contract

Construction Architect-Engineer Other (Explain) Research

4. Funding Amount to be Obligated by this Contract Action \$ 20,000.00

Source of Funds

Approved ORO Financial Plan, _____ Quarter, Fiscal Year 19____
 Project No. _____ or, Activity No. 06 04 08 01
 Funds to be Obligated: Allotment No. 06-11-96 (F.Y. 1961 Funds)
 Procurement Directive No. BM-61-99 Dated 10-5-60
 Issuing Office New York Des. & Prod.

Concurrence in Funding Statement: (signed) A. Emille
 Chief, Budget Branch

5. Project or Activity to be Covered by Contract Action:

Location of Work: _____ Construction Directive No. _____
 Estimated Cost of Work to be Covered by this Contract Action \$ _____
 Schedule: Date Work to Start _____ Estimated Completion Date _____
 Description of Project or Activity:

(If more space is required use separate sheets and attach hereto:)

<p>6. Contract Board Docket No. _____ (To be assigned by Board Secretary)</p>	<p>7. Request Submitted By: (signed) <u>A. Schoer</u> Date: <u>OCT 2 5 1960</u> File: _____ <u>OCT 2 5 1960</u> <u>C. S. SHOUP</u> CHIEF, BIOLOGY BRANCH RESEARCH AND DEVELOPMENT DIVISION</p>
<p>8. <u>Complete Description of Services to be Furnished by Contractor:</u> Headquarters designated research contract TITLE: "Fecal Deposition by Filter-Feeding Marine Organisms as a Process in Concentrating Suspended Radioactive Wastes into Bottom Deposits" (If more space is required use separate sheets and attach hereto:)</p>	
<p>9. <u>Description of other changes to be covered by Modification:</u> New contract to provide for the performance of research to be completed not later than December 31, 1961, with AEC funds in the amount of \$20,000. Designate M. L. Brehmer and D. S. Haven as Co-Senior Investigators. Include provisions for compliance with Manual Chapter AEC-7510. (If more space is required use separate sheets and attach hereto:)</p>	
<p>10. <u>Negotiated Contracts.</u> (Show why it appears desirable to negotiate new contract or to negotiate modification to existing contract) Form AEC-481 (Contract Authorization) from C. L. Dunham to S. R. Sapirie dated October 5, 1960 (If more space is required use separate sheets and attach hereto:)</p>	
<p>11. <u>Contracts, Subcontracts, or Purchase Orders Submitted for Review and Approval:</u> (Furnish brief description of action in this space and attach pertinent documents) None</p>	
<p>12. <u>Disputes:</u> Attach a statement summarizing the dispute together with pertinent documents and Background Material. None</p>	

APPENDIX "A"

TITLE I

This TITLE I describes the research program and cost estimates agreed upon between the Commission and the Contractor.

1. PROGRAM

a. Scope and Plan of Approach:

The Contractor will investigate the role of the oyster (Crassostrea virginica) in removing inorganic suspensoids from marine waters. Field studies and laboratory studies, utilizing radioisotopes, will be made on the fecal deposition of this organism observing (1) the influences of temperature, salinity, and turbidity upon the size range, type, and quantity of material removed from marine waters and (2) the stability of "bio-depositions" with special emphasis on the leaching rate of radionuclides from these depositions.

2. BUDGET

a. Outline of Cost Estimates:

(1) <u>Salaries and Wages:</u>	\$16,620.00
Dr. M. L. Brehmer and Mr. D. S. Haven	
(½ time each)	\$6,900.00
Biologist	4,920.00
Research Assistants	4,800.00
(2) <u>Equipment, Supplies, and Materials:</u>	13,479.00
(3) <u>Maintenance and Operating Costs:</u>	3,600.00
(4) <u>Research Boat Expenses</u> (20 cruises @ \$300):	6,000.00
(5) <u>Indirect Costs</u> (10% of direct costs charged to Commission - \$18,182):	<u>1,818.00</u>
TOTAL	\$41,517.00

b. Items of property to be procured or manufactured by the Contractor, or to be furnished by the Government, title to which will vest or remain in the Government (see Article V): None

UNITED STATES ATOMIC ENERGY COMMISSION
CONTRACT AUTHORIZATION

2. DATE **OCT 5 1960**

3. NUMBER **BM - 61 - 99**

1 TO
**S. R. Sapirie, Manager
Oak Ridge Operations Office**

FROM
**C. L. Dunham, M.D., Director
DBM**

4. NEW CONTRACT
 RENEWAL OF

CONTRACT NO.

5. RESPONSIBLE TECHNICAL REVIEWER *I. E. Wallen*
I. E. Wallen

6. CONTRACTOR
**Virginia Fisheries Laboratory
(Virginia Marine Laboratory)**

7. PRINCIPAL INVESTIGATOR
**Dexter S. Haven, M.S.
Morris L. Brehmer, Ph.D.**

8. DEPARTMENT

9. PROJECT TITLE
**FECAL DEPOSITION BY FILTER-FEEDING MARINE ORGANISMS AS A PROCESS IN
CONCENTRATING SUSPENDED RADIOACTIVE WASTES INTO BOTTOM DEPOSITS**

10. RECOMMENDED TYPE
 FIXED PRICE
 COST REIMBURSEMENT
FINANCING
NEW AEC FUNDS, NOT TO EXCEED . . . \$ **20,000**
BALANCE FROM PRIOR TERM \$
ESTIMATED VOLUNTARY CONTRACTOR CONTRIBUTION \$
TOTAL PROJECT \$

11. TERM
one year from date of contract
~~5-1-60 thru 5-1-61~~

13. PROPERTY
TITLE TO VEST IN AEC
 CONTRACTOR

14. ALLOTMENT TRANSFER CHARGEABLE
06-11-91 (24)

15. BUDGET AND REPORTING CLASSIFICATION
OPERATING COSTS **06 04 08 01**
EQUIPMENT COSTS (IF APPLICABLE)

16. SECURITY
WORK TO BE PERFORMED IS UNDER CATEGORY **I**
AS DEFINED IN AEC MANUAL SECTION 3403. "Q" CLEARANCE IS REQUESTED FOR
No

17. REMARKS:
THE TECHNICAL ASPECTS OF THE PROPOSED RESEARCH HAVE BEEN REVIEWED AND ARE APPROVED. A NEED CURRENTLY EXISTS FOR THE RESULTS OF THE RESEARCH THAT IS TO BE UNDERTAKEN. THE BUDGET INCORPORATED IN THE PROPOSAL HAS BEEN REVIEWED AND IS APPROVED EXCEPT AS INDICATED BELOW. NONE OF THE AEC FUNDS SHALL BE USED FOR CONFERRING A FELLOWSHIP. IF RADIOISOTOPES ARE TO BE USED UNDER THE PROVISIONS OF AEC MANUAL 7510, THE SAVINGS SHOULD BE CONSIDERED IN THE NEGOTIATIONS.

18. ENCLOSURES
 PROPOSAL DATED _____
 NOTIFICATION LETTER DATED **OCT 5 1960**
 FORM TO BE RETURNED

~~A190087~~ **OCT 7 - 1960**



VIRGINIA FISHERIES LABORATORY

GLOUCESTER POINT, VIRGINIA

(VIRGINIA'S MARINE LABORATORY)

RE-ORS: JDB

October 18, 1960

RESEARCH

FISHERY BIOLOGY
MARINE BIOLOGY
WATER POLLUTION
HYDROGRAPHY

EDUCATION

IN THE
MARINE
SCIENCES

CONSERVATION

EDUCATION

Dr. C. S. Shoup
Chief, Biology Branch
Research and Development
U. S. Atomic Energy Commission
Oak Ridge, Tenn.

Dear Dr. Shoup:

We were pleased to learn of the approval of your research project on "Fecal Deposition by Filter-Feeding Organisms as a Process in Concentrating Suspended Particulates into Bottom Deposits." The Virginia Fisheries Laboratory is willing to meet the additional obligation which results from the approval of \$20,000 rather than the \$26,000 in the proposal.

The charges listed in the proposal were based upon Capital Outlay, Maintenance and Operation, and Salaries. The item listed as "Laboratory Facilities, etc. --\$3,600.00" was a Maintenance and Operation charge. The superscript 1 following the charge and its definition at the bottom of the page indicated that this expense was to be borne by the Virginia Fisheries Laboratory.

The modest contingency charge of \$500.00 was placed in the budget to cover necessary items of field and laboratory equipment not anticipated at the initial planning stage.

The indirect costs based on 10% of the direct charges requested from the Commission (\$2,000.00) at the revised proposal is an estimated charge to cover administrative and general costs for acquisition of equipment, biometrical computation, and typing of reports.

We would prefer that the contract become effective January 1, 1961, rather than the suggested November 1, 1960 date. The

OCT 21 1960

FACTS ARE ESSENTIAL TO WISE USE OF NATURAL RESOURCES
FACTS COME ONLY BY RESEARCH

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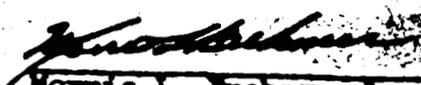
Dr. C. S. Shoup
October 18, 1960

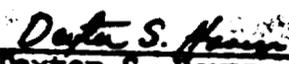
Page 2

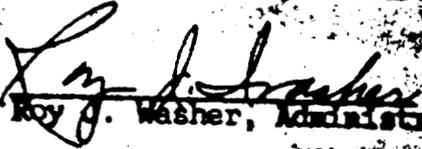
study is to be based upon the feeding activity of filter-feeding marine organisms and these organisms are virtually inactive during the winter months. The January 1, 1961 starting date would enable Mr. Haven and I to acquire the necessary equipment, run preliminary tests, and be ready to initiate the study when the oysters start feeding in February or March.

Please do not hesitate to contact us if additional information is required in preparation of the contract.

Sincerely yours,


Morris L. Ebrauer, Associate Biologist


Dexter S. Haven, Research Biologist


Roy J. Washer, Administrative Assistant

cc: Dr. Hargis
jgh

1128944

**Fecal Deposition by Filter-feeding Marine Organisms
as a Process in Concentrating Suspended Radioactive
Wastes into Bottom Deposits**

by

**Dexter S. Haven, Molluscan Physiology Unit, and
Morris L. Brehmer, Basic Ecology-Pollution Research Section**

Virginia Fisheries Laboratory

Summary

The possibility of coastal and estuarine contamination by radionuclides was emphasized by recent ship collisions within Chesapeake Bay. Other avenues of contamination are also of concern. As a result, it is important that we understand completely the processes affecting the fate of radioactive particles gaining entrance into the marine system. A thorough search of the available literature indicates the paucity of data regarding the role of biological organisms in removing ionic and particulate fission products from suspension. Preliminary investigations with oysters indicate that enormous quantities of organic and inorganic material are removed from suspension and deposited on the bottom in a compacted semi-stable form. The present project is designed to study this process of "bio-deposition."

Both field and laboratory studies are planned to investigate the role of the oyster (Crassostrea virginica) in removing inorganic suspensoids from marine waters. The influence of temperature, salinity, and turbidity upon the size range, type, and quantity of

material removed will be considered. Also, experiments have been designed which will yield information concerning the stability of "bio-depositions" with special emphasis on the leaching rate of radio-nuclides.

This study is designed as a three-year project involving two half-time co-investigators, one full-time junior biologist, and two graduate students.

We feel the information to be gained from the proposed project is especially pertinent in this "nuclear age" with the increased use of nuclear reactors in sea-going vessels and land-based installations.

Introduction

Chesapeake Bay ranks among the most productive estuaries in the world. During 1958 a total of 437 million pounds of oysters, crabs, menhaden, croakers, shad and other products were taken from Virginia waters with a value of about 25 million dollars. Of this total, oysters ranked first, with a value of 14 million dollars. Total production in the Maryland section of the Bay totaled 66 million pounds with a value of 12 million dollars. Many other human activities such as shipping, communities, agriculture and industry center on this heavily populated and rapidly growing area.

During recent years rapid advances in nuclear energy have increased the probability of accidental contamination of these waters by several routes: (1) In peace time from fallout or during war from

the use of atomic or thermonuclear weapons. (2) The accidental discharge of wastes by industrial or research groups using radioisotopes for scientific investigations. (3) From the normal operational wastes associated with the construction or operation of nuclear reactors or high-level wastes released by accident from these reactors.

Of the three, contamination from nuclear reactors appears to offer the greatest potential danger to the Bay in the absence of war conditions. This assumption is based on the increased number of nuclear-powered vessels operating in coastal waters and the extreme likelihood that before very long nuclear power reactors will be located on the Bay or its tributaries. The chances of accidents involving these reactors are remote, but a possible sinking or collision of vessels or accidental releases from power plants would increase the danger of contamination and such happenings are not unknown. Then too, normal operation of facilities of this type usually involve contamination of the environment to a certain extent.

In the event of a nuclear accident it becomes imperative to understand the processes which will disperse or concentrate radioactive materials, as all seafood from contaminated areas would probably be unfit for human consumption.

The dispersion of these radionuclides in concentrations exceeding the maximum permissible concentrations is effected by tidal action and by the volume of inflowing fresh waters. The results

of a recent government investigation in the Hampton Roads area indicate that if dispersion and dilution do not reduce the concentration to the maximum permissible level during the first few hours, then many tidal cycles will be required to reduce the concentration appreciably. During this period a combination of physical and chemical forces will produce abiotic sedimentation. The processes responsible have been described in the literature (Burbank, Lauderdale, and Eliassen, 1955; Carritt and Harley, 1957; and others). Inorganic material removed from suspension by these forces is loosely incorporated into the hydrosol layer and is easily returned to suspension by wave action or currents. Many of these physical and chemical factors which influence distribution have been partially studied, and some conception of the expected distribution by these processes is possible.

In contrast, a search of the literature indicates a paucity of research regarding the role of marine organisms in the stabilization of suspended radionuclides. Many of the nuclides in the water mass will be ingested and assimilated as food or absorbed or adsorbed by living plants and animals. Consequently, the final distribution of radioactive matter may not depend solely on physical and chemical conditions, but may be profoundly modified by the activity of living organisms.

A review of all factors which cause deposition is beyond the scope of this discussion. However, one important biological aspect

of the problem has received very little study and may be a major factor in initiating deposition of suspended radioactive materials in bottom deposits. This process involves the deposition of fecal materials on the bottom by filter-feeding marine invertebrates.

General Review of Deposition of Fecal Materials by
Filter-feeding Animals

Many marine invertebrates living on the bottom or in the upper layers as plankton, filter large quantities of water to obtain food. During feeding, undigested material is voided in the form of fecal pellets or strings. Fecal matter varies in density, but evidence indicates that in shallow coastal water it settles to the bottom.

Data from the literature indicate that fecal material has a high degree of stability. The volume of water filtered by a natural population is enormous. Therefore, it may be assumed that the quantity of radionuclides removed from suspension by biological action may exceed that deposited by a combination of physical-chemical forces. The "biodeposition" would also have a higher degree of stability due to redigestion and compaction by additional bottom-dwelling organisms.

Various authors (Moore, 1931, 1931a; Edge, 1934; Loosanoff and Engle, 1947; Yonge, 1949; Moore and Kruse, 1956; and Lund, 1957 1957a) have commented on fecal materials of marine organisms.

These authors show that oysters, crabs, scallops, copepods, barnacles, tunicates, and other invertebrates void fecal material in compacted pellets or strings of characteristic shape varying in length from less than a millimeter to over eight millimeters.

Pseudofeces may also be formed by lamellibranchs, as observed by Fox, Sverdrup and Cunningham (1937), Yonge (1949), Loosanoff and Engle (1947), Ballentine and Morton (1956), and Lund (1957).

Pseudofeces consist of suspended plankton materials rejected by the mollusk's food-sorting mechanism. Unlike feces, such matter does not pass through the animal's intestinal tract and is only loosely aggregated into clumps and strings by mucus. Observation shows that pseudofeces from Crassostrea virginica settle to the bottom after being ejected from the shell as do the feces.

Occurrence of Fecal Deposits in Marine Sediments

Moore (1933) and Moore and Kruse (1956) commented on the presence of rod-shaped and ovoid pellets which are found in many oceanic regions of the world in depths ranging up to 4,000 meters. On occasions "pellets" were extremely abundant, and the authors suggest they were truly fecal in origin. However, they were unable to associate pellets with definite organisms.

More precise information exists on fecal matter deposited by animals living in coastal area. Moore (1931a, 1933) states that in the Clyde Sea area, fecal pellets from Calanus and euphausiids are deposited

at a rate approaching 33.4 mg. per square cm. per week during the spring. He also states that in extreme cases the whole mud can consist of pellets with no admixture of fine materials, and that it is normal for pellets to form 40 per cent of the total sample. However, in regard to this last statement he implied that most pellets originated secondarily from organisms such as maldanid worms ingesting bottom "mud."

Fox, Sverdrup and Cunningham (1937) cite Dumas who says that one thousand Cardium sp. individuals may produce fecal matter to a depth of 0.45 meters per square meter per year, or 1,250,000 cubic meters of mud per year in 250 hectares.

Fecal Deposits Produced by Oysters

A review of the literature indicates that oysters may deposit large amounts of fecal matter. Ito and Imai (1955) state that in Japanese waters a single raft of oysters, occupying 60 square meters, will deposit 0.6 to 1.0 ton of fecal material (dry weight) every year. This is equivalent to six or ten tons per year wet weight.

Lund (1957) working at Aransas Pass in the Gulf of Mexico in 1947 devised a quantitative method for measuring quantities of wastes voided by the oyster, Crassostrea virginica. Utilizing aquaria and specially designed troughs, he was able to collect all feces and pseudo-feces produced by groups of oysters for varying periods of time. He estimated that if a single layer of oysters was crowded so as to cover

all the area in one acre, then the volume of "oyster silt" deposited would equal 35.9 cubic yards in eleven days. The equivalent dry weight of this quantity was calculated as 8.36 tons in the same eleven-day period.

Research on quantities of fecal material deposited by oysters began at the Virginia Fisheries Laboratory in the summer of 1959 and utilized techniques developed by Lund (1957).

During a seven-week period in September and October 1959, twenty-four oysters produced an average of 91 grams dry weight of feces and pseudofeces each week, or 3.8 grams per week per oyster.

Total quantities of fecal matter produced by oysters growing under natural conditions are best approximated by calculating the density of oysters in commercial plantings. In Chesapeake Bay, commercial growers often harvest 1,000 bushels of market oysters per acre. Calculations utilizing data previously presented show that an acre of oysters would produce about 2,500 pounds dry weight of feces and pseudofeces each week. The maximum value would be 5,500 pounds per acre per week.

Rates at which fecal matter may accumulate on natural oyster beds is probably less than the calculated amounts, but the problem has never been studied.

A series of tests made in Texas (Lund, 1957) showed that dried oyster feces contain about 73 per cent inorganic matter while

similar tests at the Virginia Fisheries Laboratory indicated that inorganic content of feces and pseudofeces may range up to 80 per cent. The low organic content of the deposition is significant because, even if all organic matter were decomposed by bacterial action, there would still remain a large quantity of mineral matter unaffected by the process.

The oyster is only one of the many Pelycypoda in the Chesapeake Bay areas, and is outnumbered in many places by Venus mercenaria, Mya aranaria, and approximately 43 other species. Each of these organisms will add its fecal load to the bottom and total quantities will certainly exceed that deposited by the oyster. Added to this total will be fecal materials from tunicates, barnacles and copepods, which are present in tremendous numbers. Data are lacking on quantity of fecal wastes voided by these animals, and we may only surmise that the total quantity is large.

Type and Size of Particles Removed from Suspension by Oysters

The quantity of fecal material deposited by oysters leads to a consideration of the original state of these particles in the water mass, and the factors which regulate their rate of removal.

Studies reviewed by Korringa (1949) and Lund (1957) showed that oysters may remove a wide variety of organisms from suspension including yeast cells, chloroplasts, diatoms, bacteria, and protozoa as well as non-living materials such as detritus, soluble starch,

milk, carbon black, and kaolin. These particles from strained from the water with a mucous net which cover the gill ostia (MacGinitie, 1941; MacGinitie and MacGinitie, 1949). Particles trapped in the mucus are transported to the oyster's palpa, where sorting may occur during which certain particles are ingested while others are rejected as pseudofeces. Ingestion, however, does not always imply digestion, for frequently the feces will contain quantities of living organisms in addition to inorganic matter (Yonge, 1926; Loosanoff and Engle, 1947; Korringa, 1949; and others). Pseudofeces will also vary in composition and may consist of living cells of various types and quantities or organic and inorganic detritus loosely aggregated by mucus.

Particles removed from suspension by oysters range in size up to large sand grains, while minimum size is about two micra and perhaps smaller (Jørgensen and Goldberg, 1953; Korringa, 1949).

Rates at which particles are removed from suspension vary with ecological conditions. Turbidity, water temperature, cell concentration or type, presence or absence of a mucous net and many other factors influence filtration rates (Loosanoff and Tommers, 1948; Korringa, 1952; Jørgensen and Goldberg, 1953; Lund, 1957; Loosanoff, 1958).

Previous work on particle filtration is extensive, but the workers have omitted one interesting aspect of the problem pertinent to fecal deposition. They have not differentiated quantitatively between

particles removed as feces and those removed as pseudofeces. This is an important distinction because the ultimate disposition of the two substances in bottom deposits may be completely different. Particles ingested and voided as feces are compacted, have been acted on by enzymes, and may be greatly altered from their original composition, Yonge (1926, 1935). Conversely, pseudofeces are simply rejected materials loosely consolidated into strings or clumps by mucus.

Stability of Fecal Wastes in Bottom Deposits

In considering stabilization of radioactive materials by the process of fecal deposition, it is recognized that deposits will initially contain many nuclides which were originally suspended in the water mass. However, the permanence of these fecal deposits and their associated inorganic ions has never been determined.

Observations by Lund (1957) suggest that: "The self-silt deposit by the oyster is flocculated or somewhat coherent and resists displacement by flow traction much more than the silt compounds precipitated by gravity; therefore, the cleaning of an oyster bed by traction would demand a faster flow of water than that required for movement of the same particle by gravity. Furthermore, even if the oyster bed is cleaned by tidal currents or wind action, the material of the self-silt deposit does not readily return (deflocculate) to its original finely divided state..."

Many bottom-living invertebrates such as species of echinoderms, annelids, crustaceans, and mollusks are of biological importance in restricting further transport of bottom materials. Many of these mud-dwelling organisms ingest bottom muds and form firm pellets which may last for a hundred years and probably much longer (Moore, 1931).

Bacterial decomposition or chemical action will release inorganic ions and associated radioactive nuclides from fecal deposits and many will be returned to the water mass. However, rates of solution or leaching from deposits are matters of speculation and must be determined.

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Proposed Research for a Three-year Period

I. Production of fecal materials of oysters and other organisms will be measured quantitatively. Representative organisms will be held in troughs designed to retain feces and pseudofeces. Fecal production will be measured under environmental conditions encountered at Gloucester Point, Virginia. The following points will be studied:

- *A. Influence of temperature, salinity, and turbidity on rates of fecal deposition by the oyster.
- *B. Size range, type, and quantity of particles removed from suspension as feces and pseudofeces, in relation to those originally present in the water mass.
- C. Fecal deposition by other marine invertebrates.

II. The second phase of the study will investigate the ultimate disposition of feces and pseudofeces deposited on the bottom.

- A. Permanence of fecal deposits will be studied in aquaria and in large outdoor tanks. Oysters will be allowed to build up fecal deposits to a depth of several inches, and then be removed. The subsequent physical and chemical changes in these deposits will be followed.
- *B. Deposits associated with natural oyster beds will be investigated. Rate of deposition of materials on the bottom will be related to various environmental conditions such as current velocity, salinity, etc.

*will be done during first year of study.

These natural bottom deposits will be examined for particle size, microscopic appearance and chemical composition.

III. The third phase of the study will be conducted in the Laboratory and will utilize radiobiological techniques. Experiments will be based on data obtained in I and II.

- *A. Radioactive plankton, clay and silt suspensions with adsorbed radioactive ions and particles, will be fed to oysters in standing water aquaria. Rates at which these substances are removed from suspension will be determined.
- B. Fecal deposits obtained during this phase will be held in standing water aquaria to determine how permanently radioactive ions are associated with fecal deposits. Rates of solution or leaching of the various components will be followed using standard radiobiological assay methods.
- C. A special phase of this study will investigate the possible "stripping" of radioactive ions adsorbed on particles in the oyster's gastro-intestinal tract.

It is proposed that all phases of the problem will be the joint effort of Mr. Haven and Dr. Brehmer. Mr. Haven will be concerned with problems in oyster physiology while Dr. Brehmer will supervise radiobiological and chemical work.

*will be done during first year of study.

Scientific Personnel

Dexter S. Haven, M.S., Associate Biologist, Oyster Physiologist (half-time)

Scientific experience:

Employed at Virginia Fisheries Laboratory from 1949 to present. From 1949 through 1954 did research on croaker and juvenile fish in Chesapeake Bay. From 1954 to present has been primarily concerned with oyster ecology.

Publications:

1. Haven, D. 1951. A quick drying ink for labelling cellulose acetate slides. Copeia, 1951(3): 252.
2. Haven, D. and J. D. Andrews. 1957. Survival and growth of Venus mercenaria, Venus campechiensis, and their hybrids in suspended trays and on natural bottoms. Proc. Natl. Shellfish. Assoc. 47(1956): 43-49.
3. Haven, D. 1957. Distribution, growth, and availability of juvenile croaker, Micropogon undulatus, in Virginia. Ecology 38(1): 88-97.
4. Haven, D. 1959. Effects of pea crabs, Pinnotherea ostreum, on oysters, Crassostrea virginica. Proc. Natl. Shellfish. Assoc. 49: 77-86.
5. Andrews, J. D. and D. S. Haven. 1959. Fresh-water kill of oysters (Crassostrea virginica) in James River, Virginia 1958. Proc. Natl. Shellfish. Assoc. 49: 29-49.
6. Haven, D. 1959. Migration of the croaker, Micropogon undulatus. Copeia 1959 (1): 25-30.

Morris L. Brehmer, Ph.D., Associate Biologist, Ecologist (half-time)

Scientific experience:

Technical Aide--Illinois Natural History Survey (1951)

Fisheries Biologist--Illinois Department of Conservation
(1951-1955)

Technical Aide--Institute of Paper Chemistry (1955)

Graduate Fellow--Michigan Institute for Fisheries
Research (1955-1958)

Associate Biologist--Virginia Fisheries Laboratory
(1959 -)

Publications:

Grzenda, A. R. and M. L. Brehmer. A quantitative
method for the collection and measurement of
periphyton. Limn. and Oceanogr. (in Press).

Other Personnel: (full working time)

1. Biologist "A"
2. Graduate Assistants (2)

MATERIALS, EQUIPMENT, AND FACILITIES

The proposed study of the deposition of inorganic suspensoids by oysters will require facilities and instrumentation for complete physical, chemical, and radiological analyses.

The following equipment and facilities are available at the Virginia Fisheries Laboratory:

1. Chemistry laboratory with the following equipment:

- Drying oven
- Muffle furnace
- Klett-Summerson calorimeter
- Beckman DU Spectrophotometer with flame attachment
- Micro and Macro Kjeldahl digestion and distillation units
- Sartorius single pan analytical balance
- Christian Becker double pan analytical balance
- Fume hood
- Hot plate
- Beckman "Model G" pH meter
- Constant temperature culture cabinet
- Vacuum pump
- Glassware and chemicals

2. Room designated for radiobiology but not equipped
Equipment needed: (Prices quoted from Nuclear-Chicago Catalog)

1-Model 186 Imperial Scaler with variable low input sensitivity to one millivolt for doing alpha and proportional counting	\$1,300
1-Model DS5-5 Scintillation Detector, Well Counter with sodium iodide crystal for efficient measurement of low level gamma emitting samples	1,067
1-Model 1810 gamma-ray spectrometer for reducing background and scatter radiation for low level counting	857

Laboratory Furniture

1-Airflow fume hood - 6 feet wide	\$1,490
1-Muffle furnace	295
1-Drying oven	170
1-Hot plate	95
1-Sink Unit	365
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	\$2,415

Chemicals and Glassware

Chemicals and Glassware for Radiobiology Laboratory	\$1,000
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3. Field Equipment available at Virginia Fisheries Laboratory

Fifty-five foot Oceanic Research Vessel "Pathfinder"
Boats and motors
Aquaria and sea-water system
Outdoor sea tanks
Current meter

Additional Field Equipment required:

1-SCUBA mask type self-contained underwater breathing apparatus with accessories	\$ 500
1-"Standby" sea water pump with motor	500
1-Core sampler for collecting bottom deposits	100
1-Benthos sampler for collecting bottom sediments	150
1-set standard sieves for screening bottom deposits	150
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	\$1,400

4. Additional laboratory equipment required:

**1-Research microscope for identification of
organic constituents of feces and pseudofeces
and for particle size determination**

\$1,500

BUDGET

First Year

Salaries

Co-investigators (half-time each)	\$6,900 ¹	
Biologist "A"	4,920	
Graduate Students (two)	<u>4,800</u>	\$16,620

Equipment, Materials, and Facilities

Isotope detection and measurement equipment, Health Physics equipment	5,664	
Laboratory Furniture	2,415	
Chemicals and Glassware	2,000 ²	
Field Equipment	1,400	
Optical Equipment	1,500	
"Pathfinder" expenses (20 cruises @ \$300)	6,000 ³	
Laboratory Facilities (2 offices @ \$50/month) (2 laboratories @ \$100/month)	3,600 ¹	
Contingencies	<u>500</u>	23,079

Indirect costs (10% of amount requested from U. S. Atomic Energy Commission)	<u>2,419</u>	\$42,118
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- ¹Expense borne by Virginia Fisheries Laboratory
- ²One-half expense borne by Virginia Fisheries Laboratory
- ³Two-thirds expense borne by Virginia Fisheries Laboratory

Summary

Costs borne by Virginia Fisheries Laboratory	\$15,500
Amount requested from U. S. Atomic Energy Commission	<u>26,618</u>
	\$42,118

Second Year

Salaries

Co-investigators (half-time each)	\$7,050 ¹	
Biologist "A"	5,160	
Graduate Students (two)	<u>4,800</u>	\$17,010

Equipment, Materials, and Facilities

Chemicals and Glassware	1,000	
"Pathfinder" expense (20 cruises @ \$300)	6,000 ³	
Laboratory Facilities (2 offices @ \$50/month) (2 laboratories @ \$100/month)	3,600 ¹	
Contingencies	<u>500</u>	11,100

Indirect costs (10% of amount requested from U. S. Atomic Energy Commission)	<u>1,346</u>	\$29,456
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¹ Expenses borne by Virginia Fisheries Laboratory

³ Two-thirds expense borne by Virginia Fisheries Laboratory

Summary

Costs borne by Virginia Fisheries Laboratory	\$14,650
Amount requested from U. S. Atomic Energy Commission	<u>14,806</u>
	\$29,456

Third Year

Salaries

Co-investigators (half-time each)	\$7,200 ¹	
Biologist "A"	5,280	
Graduate Students (two)	<u>4,800</u>	\$17,280

Equipment, Materials, and Facilities

Chemicals and Glassware	1,000	
"Pathfinder" expense (20 cruises @ \$300)	6,000 ³	
Laboratory Facilities (2 offices @ \$50/month) (2 laboratories @ \$100/month)	3,600 ¹	
Contingencies	<u>500</u>	11,100

Indirect costs (10% of amount requested from U. S. Atomic Energy Commission)	<u>1,358</u>	\$29,738
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¹Expense borne by Virginia Fisheries Laboratory

³Two-thirds expense borne by Virginia Fisheries Laboratory

Summary

Costs borne by Virginia Fisheries Laboratory	\$14,800
Amount requested from U. S. Atomic Energy Commission	<u>14,938</u>
	\$29,738

Summary of the Budget

	Amount borne by V. F. L.	Amount requested from A. E. C.	Total
FIRST YEAR	\$15,500	\$26,618	\$ 42,118
SECOND YEAR	14,650	14,806	29,456
THIRD YEAR	14,800	14,938	29,738
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BUDGET TOTALS	\$44,950	\$56,362	\$101,312

Signed Dexter S. Haven
Dexter S. Haven, Associate Biologist

Morris L. Brehmer
Morris L. Brehmer, Associate Biologist

Roy J. Washer
Roy J. Washer, Administrative Assistant

William J. Hargis, Jr.
William J. Hargis, Jr., Laboratory Director
and Chairman, Department of Marine Science