Form 189

U. S. ATOMIC ENERGY COMMISSION

726889

Project Proposal for Research and Development Activities

Idaho Operations Office

1. Project Title Controlled Environmental Radioiodine Tests (CERT)	2. Budget Activity 06 05 03 00	3. Date Prepared January 18, 1965
4. Contractor ID Health & Safety Division	5. Contract No. NA	6. Contractor's No. NA
7. Person in Charge Clyde A. Hawley, Jr.	8. Working Location NRTS	9. Project Term From: 1963 To: Indef.
10. Reactor Concept NA	11. Materials NA	

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12. Operating Costs

	FY 1965	FY 1966	FY 1967
A. Contract Expense			
1. Direct Labor	$ 40,000	$ 40,000	$42,500
2. Materials and Services		10,000	
3. Fuel Fabrication		1,000	
4. Misc. R&D Subcontracts	12,000	47,000	7,500
5. Irradiations (.6)		3,000	
6. Test Reactor Other (.7)			
7. Reactor Fabrication			
8. Indirect Expense			
9. NRTS Expense*			
10. Expendable Equipment			
11. Related Capital Equipment			6,000
Subtotal	$ 52,000	$ 101,000	$ 56,000
B. Non-Contract Expense			
1. Special Reactor Materials			
2. Computer Time			
3. Misc. Materials and Services	3,000	4,000	4,000
Subtotal			
Total Operating Costs	55,000	105,000	60,000

*Includes IDO NRTS

13. Direct Manpower (Man-Years)

	No. of Man-Years FY 1965	FY 1966	FY 1967
A. Scientific and Engineering	2.0	2.0	2.0
B. Other Technical	2.0	2.0	2.0
C. Other (Including Administrative)	1.0	1.0	1.0
Total	5.0	5.0	5.0
Average Salary per Man-Year	$8,000	$8,000	$8,500

14. Cost of Related Construction Projects

Construction completed FY 1964.

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COLLECTION CERT

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Controlled Environmental Radioiodine tests(CERT) 06 05 03 00 January 18, 1965

15. Purpose and Need - Environmental measurements have shown that the potential dose from radioiodines is normally the controlling hazard in effluent releases resulting from reactor excursions. The Windscale accident demonstrated that the dose from ingestion of radioiodines through the milk cycle could be orders of magnitude greater than the radioiodine inhalation dose.

Characterization of the behavior of radioiodines has been the subject of investigation in the last few years, especially in England. Differences between environmental conditions in England and the United States, the Western States in particular, reduce the confidence with which one can apply these tests results.

In the past, the ID Health and Safety Division has taken advantage of planned and accidental releases at the NRTS to investigate the behavior of radioiodine. However, because test operations dictated the release conditions, this method is time-consuming and is limited in its results. There still exist a need to verify these and other results at the NRTS and to allow extrapolation of results to any locality.

A research program quite similar to that reported by Garner[1] is currently in progress which involves a series of controlled releases. Specifically, the CERT project is designed to evaluate the relationships between (1) the concentration in air to the concentration deposited on vegetation, and (2) the amount of radioiodine on vegetation and the resultant concentration, in a cow's milk.

16. Relationship of other Projects - CERT data is useful in providing estimates of the potential biological hazards of radioiodines which could be released in the forthcoming SNAPTRAN and LOFT programs at the NRTS. Some aspects of this work are directly related to an evaluation of effect of radioiodines from weapons testing.

Ideally, the CERT project would yield data which would permit detailed examination of all the interacting parameters which determine the ultimate radioiodine content in milk. This would allow more realistic predictions of iodine hazards in safety analysis of planned releases as well as a means of evaluating the hazards and magnitude of an accidental release.

17. Accomplishments during FY 1965 - The experimental dairy farm was completed and accepted by ID-Health & Safety Division in July of 1964. This is a thirty-acre farm, complete with fences, corral, a dairy barn and irrigated by either flooding or sprinklers. Grass was planted and watered in the fall of 1963 but no stand was obtained before freezing weather occurred. The grass was replanted in the spring of 1964.

The second major test was conducted in September of 1964. This test was, essentially, an attempt to verify results obtained from the preliminary test in May 1963, the major difference being the use of irrigated pasture. The data gained during the second test is summarized as follows:

(a) 950 mCi of gaseous iodine-131 was released at ambient temperature under

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moderately unstable meteorological conditions, with an average wind speed of 9 m/sec.

(b) The average deposition velocity was 0.98 ± 0.59 cm/sec.

(c) The effective half life on grass, as measured by two different sampling techniques were 4.23 ± 0.45 and 5.50 ± 0.35 days. The technique used to obtain the former value was the same as in the preliminary test ($t_{1/2}$ 3.5 days).

(d) The ratio of contaminant in milk (pCi/liter) to that on grass (pCi/gram) was 135.

(e) The peak activity found in milk occurred two days after the release.

(f) The effective half life in milk (determined after the cows were removed from contaminated pasture) was about one day, during the first 4 or 5 days the cows were off the hot pasture, and then it increased somewhat.

A supplementary test was conducted in December 1964, with the released vapor passing over snow. The major objective of the test was to evaluate the influence of meteorological parameters on deposition velocities. The same release system (340 mCi) as before was used. Mean deposition velocity over snow was found to be 0.22 ± 0.05 cm/sec. This release took place with a mean wind speed of 6 m/sec and stable daytime conditions. A release of the same type, over dead, dry pasture grass is planned during early spring in 1965.

18. Proposed Program for FY 1966 - At least two more major tests are planned for FY 1966. Of primary concern will be: (1) the influence of changes in chemical form and/or chemical reactivity on the behavior of iodine-131; this will primarily involve organic iodides, and (2) the behavior of radioiodine released during a simulated fuel-element meltdown. This will involve a stainless steel clad UO_2 fuel sample, which will be irradiated in the MTR. Melting will be performed in a specially designed, shielded, induction furnace (property of General Dynamics/ Fort Worth.) It is planned that the meltdown and fission product release portion of this test will be accomplished by subcontract. This release will occur about a mile u wind of the experimental dairy farm in order to approximate a uniform distribution of activity on the pasture. If activity levels of I-131 on the pasture are too low to adequately measure, comparison and ratio technique will be used by measuring the activity of the shorter lived iodine isotopes on air samplers, vegetation and milk. The scheduling of this test for Sept/Oct. of FY 1966 is contingent upon the development of a reliable method of determining the chemical form(s) of the radioiodine.

If time permits, investigations will also be made of iodine behavior as a function of distance and under inversion conditions.

Management of the Experimental Dairy Farm, which includes irrigation, milking, farm maintenance, etc., is achieved by subcontract. This subcontract cost for FY 1966 will be about $7,000.

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The following table is an estimated schedule

Release #	Iodine Form	Location	Sampling Distance	Target Date	Remarks
4	I_2	EDF*	up to 1500m	Apr/May 65	with cows
5	Organic	EDF	up to 1500m	July/Aug 65	with cows
6	Fuel Meltdown	EDF	up to 2500m	Sept/Oct 65	with cows
7	I_2	ORCW+	up to 8000m	open	
8	I_2	ORCW	up to 8000m	open	night-time inversion
9	Organic	ORCW	up to 8000m	open	

* EDF- Experimental dairy farm
\+ ORCW - Open-range Crested Wheatgrass

The above table reflects an ambitious plan. It is improbable that all six tests can be accomplished by the end of FY 1966. Each test is representative of uncertainties still to be examined. However, the dependency of this test program on predeterminded meteorological conditions and the operational responsibilities of the ID Health & Safety Division will require that the test schedule remain flexible.

In the CERT project proposal which was submitted in January of 1964, the operating costs for FY-1966 totaled $55,000. The subject proposal calls for $105,000 for FY 1966. Two proposals are responsible for this increase.

(1) The test conducted thus far have been for ambient temperatures releases in which molecular iodine is produced by a chemical reaction and is purged into the atmosphere by nitrogen gas. Since one of the objectives of the CERT project is to delineate the range and scope of iodine behavior, high temperature releases of iodine by physical means is necessary. It is to this end that a fuel meltdown has been proposed (as described in part 18). Personnel of General Dynamics/Fort Worth (GD/FW) have had a great deal of experience in the release and measurement of fission products 2/, 3/ A preliminary estimate of the cost required for GD/FW to perform the fuel melting portion of this test was $40,000. A more detailed proposal and accurate cost estimate is now being prepared by GD/FW. Characteristic deposition and milk uptake of other isotopes, such as strontium-90 and cesium-137 will also be studied. The above mentioned $40,000 has been added to the FY 1966 proposed operating costs.

(2) Results from the three releases that have already taken place indicate that more refined studies are desirable. Field test indicate tha result of the interaction of the various parameters, general phenomena, and identify certain problems of interest.

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A series of laboratory studies have been initiated in which the various mechanisms which influence general phenomena (deposition, iodine uptake in milk) will be measured and defined. This series will employ closed chambers into which iodine-131 will be injected.

The laboratory measurements will be determined by analyses of field test data. Since a great many variables are known to exist, wind speed, humidity, grass type and density and others, it will also be necessary to establish dependency of the variables upon one and another.

The proposed operating costs of the laboratory experiments for FY 1966 are $10,000. These two items, then, account for the increase.

19. Proposed Program for FY 1967- A major change in emphasis will occur in the Cert project in FY 1967. Up to FY 1967 the isotopes being investigated will be iodine-131. Prior CERT projects proposals have indicated that the research into the behavior of radioiodine should be terminated in FY 1966. If all goes as planned, this schedule should be met.

The Experimental Dairy Farm at the NRTS was established at a cost of about $150,000, and has to date fulfilled its intended purpose. Associated as it is with a large instrumented meteorology grid, it is nearly ideal for use in examining the influence of airborne radionuclides' effect on the milk food chain.

As is stated in paragraph 18, above, a fuel-meltdown release of fission products is planned for FY 1966. We believe this to be the natural point in the progress of the research to break away from studies specifically pertaining to radioiodine and examine the needs for research into the environmental behavior of other milk-borne radionuclides, notably strontium-90 and cesium-137.

The $60,000 listed as the FY 1967 costs will include the wrap-up phase of the radioiodine tests. This includes minor releases of radioiodine which are not done in FY 1966, continuation of the laboratory studies, data compilation and the publication of a compendium of results. The costs will also include a survey of the results of the fission product release, the formulation of a detailed experimental program revolving around the environmental behavior of radiostrontium and radiocesium, and preliminary investigations of these isotopes.

References

(1) As assessment of the Quantities of Fission Products likely to be found in milk in the event of Aerial Contamination of Agricultural Land. R. L. Garner, Nature Vol. 186, 1960.
(2) Fission Product Field Release Test-1, AFSWC TR-59-44.
(3) Fission Product Field Release Test-2, AFSWC TR-60-26.

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