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File IV

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SANDIA SYSTEMATIC DECLASSIFICATION REVIEW
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Dear Dr. Agnew:

In a telephone conversation with you last week, Don Cotter briefly discussed a problem area in the aerospace nuclear safety work which we feel could best be answered by LASL. A more detailed discussion of the problem follows.

In 1962 Sandia Corporation was asked by the Division of Reactor Development to support that agency by providing a group capable of performing independent assessments of the hazard levels associated with the use of the various radioactive power supplies in space. The work has been primarily concerned with the re-entry destruction of these units upon return from orbit, and on the fuel response to the various environments associated with missile launch failures. The hazards are related to the possibility of inhalation, ingestion, or direct radiation from the fuels. Safety assessments have thus far been made on the SNAP-9A and SNAP-10A.

The next generator to be flown will be SNAP-19, a Pu-238 fueled 30-watt (electrical) generator. Two of the generators are to be used on the NIMBUS weather satellite to be launched in about one year. The Sandia portion of the safety assessment is now under way. However, a safety question has been raised which we feel could best be answered by LASL. This concerns the possibility of the fuel forming a critical assembly during some part of the manufacture and use sequence, or as a result of a missile abort. Each generator contains about $1\frac{1}{4}$ Kg of fuel which is about 75% Pu-238 and 25% Pu-239.

If a study shows that no problem exists with the SNAP-19 it would then be desirable to have data which could be used as a design guide for larger Pu-238 generators. Design concepts are under consideration which are to produce up to 1000 watts electrical, and use some 20 to 40 Kg of fuel. If these larger generators are not feasible because of some criticality problem, it is important for the AEC to become aware of this now.

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SANDIA SYSTEMATIC DECLASSIFICATION REVIEW
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Name: W.H. LAWRENCE
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Name: W. Layne
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Similar questions need to be answered on the other fuels which are considered to be useful in the generation of isotope power. A table is enclosed which lists these fuels. The fuels receiving the most attention are Po-210, Cm-242, and Cm-244.

I should like to request that you assess the magnitude and scope of this task and also indicate whether LASL would be willing to undertake the project. If additional background information is needed I'll have some of our people come up to give you a briefing.

Sincerely yours,

ORIGINAL SIGNED BY
GLENN A. FOWLER

VEB:9310:dh

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TABLE 1.—RADIOISOTOPIC SNAP GENERATORS

DESIGNATION	USE	POWER (WATTS ELECTRICAL)	WEIGHT (POUNDS)	ISOTOPE	DESIGN LIFE	CURRENT STATUS
	SPACE APPLICATIONS:					
SNAP-3	Demonstration device	2.5	4	Polonium-210	90 days	Program completed.
Undesignated (Modified SNAP-3).	Navy navigational satellites.	2.7	4.6	Plutonium-238	5 years	Generators launched June and November 1961. First still in operation; second failed after 8 months.
SNAP-9A	Department of Defense satellites.	25	27	Plutonium-238	5 years	Generators launched September and December 1963. Both in operation.
SNAP-11	Moon probe	21-25	30	Curium 242	90-day mission	Being tested.
SNAP-13	Thermionic demonstration device.	12	4	Curium-242	90-day mission	Being fabricated.
SNAP-17	Communications Satellite.	25	28	Strontium-90	5 years	Initiated in mid-1963.
SNAP-19	IMP Nimbus	~~25~~ 30	~~18~~ 30	Plutonium-238	5 years	Design study stage.
Undesignated	Lightweight demonstration device.	6-10	3	Plutonium-238 or Strontium-90.	Greater than 1 year.	Being tested.
	TERRESTRIAL APPLICATIONS:					
Undesignated	Axel Heiberg weather station.	5	1,680	Strontium-90	2 years minimum.	Operating since August 1961.
SNAP-7A through 7E.	Navigational buoys, lights and beacons, weather stations, etc.	6.5-60	1,000-6,000	Strontium-90	10 years	First unit in operation February 1962; four now operating.
SNAP-15A and B	Nuclear weapons	0.001	1	Plutonium-238	4 years	Under test.
SNAP-21	Ocean bottom	10	—	Strontium-90	5 years	Initiated in late 1963.

TABLE 2.—SPACE REACTOR SNAP GENERATORS

DESIGNATION	USE	POWER (KWe) DESIGN	POWER (KWe) POTENTIAL	WEIGHT[1] (POUNDS)	DESIGN LIFE	CURRENT STATUS
REACTOR PROJECTS:						
SNAP-10A	Thermoelectric demonstration system.	0.5	2	1,000	1 yr	Nearing completion.
SNAP-2	Rankine cycle demonstration system.	3	10	1,470	1 yr	Reoriented toward component improvement. See under Research and Development Programs.
SNAP-8	Communication satellites or space station.	35	—	6,000 (est.)	10,000 hrs	Power test of experimental reactor now underway.
SNAP-50	Electric propulsion and auxiliary power.	300	1,200	6,000 (est.)	10,000 hrs	Development of components continuing. Construction of reactor experiment terminated.
RESEARCH AND DEVELOPMENT PROGRAMS:						
Hydride Reactors:						
with thermoelectric power conversion			15	3,600		
with turboelectric power conversion			100	5,000		
Boiling Potassium Reactors			140-400	—		
Refractory Metals Reactor			—	—		

[1] Includes weight of a radiation shield to reduce cumulative dose over a year's operation to levels that will not damage sensitive instrumentation.

TABLE 3.—RADIOISOTOPIC MATERIALS[1]

RADIOISOTOPE	HALF-LIFE, YRS.	TYPICAL POWER DENSITY, WATTS/CC[2]	RADIATION PRESENT[3]	SHIELDING REQUIRED
Strontium-90	28.	1.4	beta and bremsstrahlung	heavy
Cesium-137	30.	0.21	beta and gamma	heavy
Cerium-144	0.78	24.5	beta and gamma	heavy
Promethium-147	2.7	1.8	beta	minor
Polonium-210	0.38	1,210.	alpha	minor
Plutonium-238	89.	3.5	alpha	minor
Curium-242	0.45	1,150.	alpha	minor
Curium-244	18.	26.4	alpha and neutron	moderate

[1] For information on radioisotope production capability, cost, and comparative economics, see Sections II and IV under Isotopic SNAP Program, "An Evaluation of Systems for Nuclear Auxiliary Power," TID-20070, a January 1965 report by the Commission staff.

[2] These power densities are here reduced below theoretical maxima in order to account for expected isotopic impurities and the diluting effect of use in a representative chemical compound form. More detailed information is contained in the above referenced report.

[3] While other forms of radiation are present, those listed are of dominant importance in heat generation and for consideration of radiation shielding.

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