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COPY NO. 8

ATOMIC ENERGY COMMISSION

SATELLITE APPLICATION OF SNAP-3

Note by the Secretary

The General Manager has requested that the attached report by the Director of Reactor Development be circulated for consideration by the Commission at an early date.

W. B. McCool

Secretary

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ATOMIC ENERGY COMMISSION

SATELLITE APPLICATION OF SNAP-3

Report to the General Manager by the  
Director, Division of Reactor Development

THE PROBLEM

1. To obtain Commission approval and to propose an approach for obtaining national approval for the use of experimental 2-watt Plutonium-238 fueled SNAP-3 generators in TRANSIT satellites to be launched in May and July 1961.

SUMMARY

2. On January 31, 1961, the AEC received a request from the Bureau of Naval Weapons to provide two experimental 2-3 watt Pu-238 fueled thermoelectric generators to be flight tested in TRANSIT 4A and 4B satellites to be launched in May and July 1961. The AEC is proceeding with a program to provide two Pu-238 fueled SNAP-3 generators for these missions.

3. This program would accomplish a useful orbital test of a radioisotope thermoelectric generator and a direct comparison of a SNAP unit with a solar power supply under actual use conditions. Telemetry data on the performance of the SNAP unit will be obtained without interfering with the primary mission of the satellite. This flight test will provide an early basis for selection of a power supply of operational TRANSIT satellites.

4. DRD review of the extensive safety analysis performed by The Martin Company concludes that the use of SNAP-3 in these

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[REDACTED]

missions is safe (Appendix "B"). This matter has been presented to the Acting Director of Regulation for review and evaluation (Appendix "C"), and his comments will be circulated to the Commission separately.

5. A proposed plan for the division of responsibilities between the AEC and the DOD has been sent to the Military Liaison Committee (Appendix "D"). This plan provides that the AEC will furnish the device; assess the safety during development, launch, orbital, and post-orbital operations; arrange for recovery of the device, in cooperation with the DOD, in the event of launch failure; and maintain custody and accountability for the device and the fuel. The JCAE was briefed on the safety aspects of the TRANSIT program on March 13, 1961.

6. It is proposed that the Chairman and the Secretary of Defense jointly present this matter to the National Aeronautics and Space Council (NASC) for approval from the standpoint of its national and international implications. AEC, DOD, NASA, and Department of State all have a direct interest in this matter and are represented in the NASC (Appendix "E"). Presidential action to the extent required can then be initiated by and through the NASC. This approach represents a direct route for obtaining Presidential approval commensurate with the short time scale of the program and presumes that an ad hoc group of the current NASC members will act on this matter in the event the full membership cannot be convened.

7. A joint public information plan will be prepared by the Office of Public Information, in close collaboration with the DOD Office of Public Affairs, and submitted for the consideration of the Commission. This plan will be designed to obtain public

[REDACTED]

acceptance of the use of this SNAP device in an early flight and to educate the public on the benefits to be derived from nuclear energy in peaceful space applications.

#### STAFF JUDGMENTS

8. The Office of Public Information concurs in the public information aspects of this report.

#### CONCLUSIONS

9. From a technical standpoint, it is entirely feasible for the AEC to provide two Pu-238 fueled SNAP-3 generators to be used in TRANSIT satellites to be launched in May and July 1961.

10. The AEC is proceeding with a program to meet this requirement. A plan has been prepared indicating proposed division of responsibilities between the AEC and the DOD in the production and use of these experimental SNAP devices.

11. A safety analysis has been conducted from which it is concluded that the proposed use of these devices will impose no undue radiation hazard upon the operating personnel and the public.

12. Approval for the use of the SNAP device on these TRANSIT missions should be obtained from the National Aeronautics and Space Council.

13. A joint AEC-DOD public information plan will be prepared and submitted to the Commission.

#### RECOMMENDATION

14. The General Manager recommends that the Atomic Energy Commission:

a. Approve the use of an experimental Pu-238 fueled SNAP-3 in TRANSIT satellites to be launched in May and July 1961 except that the safety aspects of such use will be submitted to the Commission for further consideration after receipt of comments on the safety of the device by the Acting Director of Regulation.

[REDACTED]

[REDACTED]

b. Approve the proposed plan for obtaining Presidential approval of the program as set forth in paragraph 6.

c. Note that due to the very tight time schedule, pending Commission action on the safety aspects of the device, the staff will carry out briefings and other necessary preparatory actions for proceeding with obtaining Presidential approval according to the plan approved in b.

d. Note that a public information plan relating to the initial test of a SNAP-3 device in space flight and to subsequent applications of nuclear energy to space projects will be prepared by the Office of Public Information, in collaboration with the DOD Office of Public Affairs, and submitted to the Commission for approval.

e. Note that in view of the JCAE briefing on March 13, 1961, no further notification of the JCAE is deemed necessary.

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[REDACTED]

[REDACTED]

APPENDIX "A"

BACKGROUND

1. In June 1960, the Director of Defense Research and Engineering requested the Atomic Energy Commission to cooperate with the Bureau of Naval Weapons in the development of two prototype isotopic power units for evaluation in TRANSIT satellites to be launched in the spring of 1961. The AEC staff determined that Plutonium-238 is the only isotope which will meet the lifetime, weight, and radiation level requirements for the TRANSIT power supply. More detailed information concerning the TRANSIT program is contained in AEC 1000/15 dated March 22, 1961.
2. On October 24, 1960, the Military Liaison Committee was requested to determine if Pu-238 could be allocated to this program. The MLC informed the AEC on February 15, 1961, that Pu-238 is available for use in SNAP units for TRANSIT.
3. On January 31, 1961, the AEC received a request from the Bureau of Naval Weapons to provide two experimental 2-3 watt Pu-238 fueled thermoelectric generators to be flight tested in TRANSIT 4A and 4B satellites to be launched in May and July 1961.
4. It was determined that the SNAP-3 generator could be fueled with enough Pu-238 to meet this requirement. Therefore, the AEC is proceeding with a program to provide two Pu-238 fueled SNAP-3 generators for the May and July TRANSIT missions.
5. The Department of Defense and the Bureau of Naval Weapons have been informed of the actions taken by the AEC to meet this requirement.
6. Chairman Holifield of the JCAE was advised of the status of this program by the General Manager on February 25, 1961. The JCAE was given a complete briefing on the safety aspects of the TRANSIT program in the executive session on March 13, 1961.

[REDACTED]

[REDACTED]

DISCUSSION

7. An extensive safety analysis has been performed for this proposed use of a SNAP-3 device fueled with approximately 1700 curies (101 grams) of Pu-238. A summary of the conclusions derived from this analysis, as reported in Martin report MND-P-2479, dated March 1961, is contained in Appendix "B". DRD review of this analysis concludes that, the use of the SNAP-3 device fueled with a relatively small amount of Pu-238 on the required TRANSIT trajectory out of Cape Canaveral provides a safe and suitable condition for the first use of nuclear power in space. This matter has been presented to the Acting Director of Regulation for review and evaluation of the health and safety aspects of the program (Appendix "C").

8. Since these missions represent a precedent for the use of nuclear power in space, the MLC requested the AEC to furnish a plan proposing the division of responsibilities between the AEC and the DOD for this program. A proposed plan was sent to the MLC on March 27, 1961, (Appendix "D"). This plan proposes that the AEC will be responsible for furnishing a fueled device which can be used in these missions without undue hazard to the health and safety of operating personnel and the public; assessing the nuclear safety during development, launch, orbital, and post-orbital phases of this program; and arranging for necessary recovery of the device, in cooperation with the DOD, in the event of a launch failure. It is proposed that the AEC will retain custody of the device and its fuel rather than transfer it to the DOD under Section 91b of the Act. The AEC will maintain accountability records of the quantity and location of radioactive material remaining at any time. This division of responsibilities pertains only to these first two missions for flying experimental devices.

[REDACTED]

[REDACTED]

Other agreements will be made for future devices that might be used in TRANSIT or any other operational space program.

9. Since this is a precedent setting case of utmost importance to the nuclear space power program, it is necessary that the use of this device be properly reviewed and approved from the standpoint of its national and international implications. Therefore, an approach is proposed in this report for obtaining the necessary approval outside the Commission for the use of this device. The basic premise behind the proposed approach is that successful completion of this program primarily affects the space program, and therefore it should be reviewed in the same manner as other top priority space programs. The policy-making group most cognizant of space matters is the National Aeronautics and Space Council (NASC) under the Chairmanship of the President or Vice President. AEC, DOD, National Aeronautics and Space Administration, and the Department of State, which all have a direct interest in this application, are represented in the NASA (Appendix "E"). It is therefore proposed that this specific application be presented to the NASC for approval. Presidential action to the extent required can then be initiated by and through the NASC. It is presumed that an ad hoc group of the current members of the NASC will act on this matter in the event the full membership cannot be convened.

10. This proposed approach represents a direct route for obtaining national approval commensurate with the short time scale of the program. This does not mean that other agencies should not be properly informed of this program. The DRD staff will be available to brief the DOD, DOS, NASA, the Federal Radiation Council, and any other group on this matter, as requested.

[REDACTED]

[REDACTED]

11. The DRD staff will assist the Navy and DOD staffs in presenting this matter to the Secretary of Defense. It is proposed that the Chairman and the Secretary of Defense jointly should present the proposed issue to the NASC for approval as soon as practicable.

12. It is recognized that this first application of a nuclear auxiliary power source in space is likely to have a wide public impact. The public information requirements appear to fall into two categories. The first public information objective is to obtain public acceptance of the use of this particular SNAP device in an early flight. It is felt that a prerequisite to the test is to put the public on notice, in advance, that a test of a SNAP-3 auxiliary power unit is contemplated in connection with another experiment which is to be conducted at an early date. In this connection the approval of the SNAP flight test by the NASC will be of great value. A more general objective is the education of the public on the benefits to be derived from nuclear energy in peaceful space applications and the prestige that will accrue to the United States from the successful testing of the SNAP device and from further applications of nuclear energy in space activities. A joint public information plan which takes both categories of public information needs into account will be prepared by the Office of Public Information in close collaboration with the Department of Defense Office of Public Affairs and with other agencies as deemed necessary. This draft plan will be submitted at an early date for the consideration of the Commission.

[REDACTED]

[REDACTED]

APPENDIX "B"

SAFETY ANALYSIS SUMMARY\*

On the basis of this preliminary analysis, the following conclusions concerning the launching of a TRANSIT device on the prescribed trajectory can be made.

1. Launch failures do not subject the TRANSIT generator to conditions which would cause fuel capsule rupture and subsequent fuel release.

2. Complete failure of the ignition of any stage of the device does not result in a land impact of the generator.

3. South American impact would result if second stage failure occurs between T plus 218 seconds to T plus 408 seconds. The probability of this occurrence is low since the range safety officer can observe second stage performance for one minute before T plus 218 seconds occurs.

4. If South American impact should occur the fuel capsule will remain intact. Helium pressure buildup in the core is not sufficient to cause rupture at any time. The direct radiation dose levels are extremely small and do not constitute a biological hazard.

5. Partial burnup probably occurs if the injection stage fails to operate or operates unsatisfactorily. Partial burnup can occur only in an extremely remote region of the South Atlantic. No land mass would be affected.

6. If an orbit is achieved, the core on re-entry will burn up at high altitudes. Fallout produced by such a burnup introduces an insignificant quantity of radioactivity into the biosphere.

This analysis has shown that if the radioisotope generator considered is launched in the trajectory proposed for TRANSIT vehicles, it will not produce a significant radiation hazard.

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\*Extracted from the Martin Company report MND-P-2479 dated March 1961 entitled: "Safety Analysis of the TRANSIT Generator". (Confidential-DI)

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APPENDIX "C"

UNITED STATES  
ATOMIC ENERGY COMMISSION  
WASHINGTON, D. C.

March 27, 1961

MEMORANDUM

TO : Harold L. Price  
Acting Director of Regulation

FROM : Frank K. Pittman, Director  
Division of Reactor Development

SUBJECT: SAFETY REVIEW OF PROPOSED EXPERIMENTAL USE OF SNAP DEVICE  
IN TRANSIT SATELLITE

SYMBOL : RD:SNAP:GMA

As an important part of the SNAP development program, it is proposed that a Pu-238 fueled SNAP-3 device be used as a power supply in TRANSIT shots scheduled by the DOD for May and July 1961. An extensive analysis, development and testing program, including safety testing of the device under environmental conditions which would prevail during operational or abort situations, has been carried out. Reports covering this work are attached.

We have concluded that the proposed use can be accomplished without undue hazard to the public health and safety. The basis for this conclusion includes the following major points which are discussed in detail in the attached documentation:

a. The integrity of the fuel capsule, and therefore containment of the fuel, under conditions of launch failure or land impact.

b. The radiobiological characteristics of the fuel (101 gr., 1700 curies Pu-238) and generator, i.e., ingestion of the fuel being the mode of exposure of major biological significance.

c. Analysis of the ascent trajectory and the degree of control available to the AMR safety officer through the command destruct system.

d. Environmental conditions, including location, diffusion and transport, existing in situations where the fuel might be partially or completely dispersed.

It is requested that the office under your jurisdiction carry out whatever health and safety review and evaluation you deem pertinent and provide us with the resulting comments and conclusions.

Should you wish to inform or otherwise consider this matter with the ACRS or FRC, we would be prepared to assist.

[REDACTED]

The following are related considerations noted for your information:

1. The proposed use of a nuclear fueled SNAP generator in the TRANSIT system is classified CONFIDENTIAL.

2. Custody of the SNAP device is to be retained by the AEC for all phases of the test including ground handling, launch, orbit and recovery, if required. No transfer of nuclear material to the DOD will be involved.

3. It is proposed that the AEC and DOD, jointly, will obtain approval from the National Aeronautics and Space Council for the tests.

4. Proposed division of responsibilities between the AEC and DOD are given in Attachment 3.

In view of the tight time schedule imposed on these tests, your cooperation in expediting whatever review you may undertake, and the conclusions therefrom will be much appreciated. In this connection pertinent DRD staff are prepared to assist technically in every way possible.

[REDACTED]

[REDACTED]

APPENDIX "D"

UNITED STATES  
ATOMIC ENERGY COMMISSION  
WASHINGTON, D. C.

March 27, 1961

Dear General Loper:

As noted in your letter to Mr. Graham of February 28, 1961, there is indeed a very short time prior to the TRANSIT launch to resolve the necessary agreement of responsibilities.

As was discussed at the AEC-MLC meeting of March 23, 1961, we believe an ad hoc agreement for this particular device would be in order inasmuch as this is a test of a small prototype of a later and larger operational device, and as such is part of the development program. Under this concept, no transfer of the device is effected.

In this light, the enclosed proposal for division of responsibilities between the Atomic Energy Commission and the Department of Defense is forwarded for your review. To this end, members of my staff will be available for any assistance you may desire.

Sincerely yours,

/s/ John S. Graham  
for Glenn T. Seaborg

Chairman

The Honorable Herbert B. Loper  
Chairman  
Military Liaison Committee to the  
Atomic Energy Commission

Enclosure:  
Proposal for Agreement

PROPOSED PLAN FOR THE USE OF AN EXPERIMENTAL PU-238  
FUELED SNAP-3 IN A TRANSIT SATELLITE

I. OBJECTIVE: The objective of this plan is to delineate the responsibilities to be assumed by the AEC and the DOD and their contractors, in connection with the flight tests of experimental 2 watt Pu-238 fueled SNAP-3 power supplies to be launched in TRANSIT satellites in May 1961 and July 1961.

II. PROPOSED DIVISION OF RESPONSIBILITIES BETWEEN AEC AND DOD

A. The AEC will assume full responsibility for:

1. Retaining custody of the SNAP generator and insuring that the device is handled in accordance with previously approved procedures during all phases of its development and use.
2. Design, fabrication and acceptance testing of the SNAP generators and associated electrical converters prior to delivery to Johns Hopkins University Applied Physics Laboratory (APL).
3. Shipment and storage of the device prior to installation on the satellite at APL.
4. Technical observation of: (a) installation of the SNAP unit on the satellite; (b) acceptance tests of the entire satellite system; and (c) removal of the unit from the satellite after testing by DOD personnel at APL.
5. Shipment of the SNAP generator from APL to the Cape Canaveral launch site and storage of the device at the launch site prior to installation on the satellite.
6. Technical observation of the installation and check-out of the SNAP generator on the satellite by APL personnel at Cape Canaveral.
7. Technical observation during remainder of launch pad and missile firing operations conducted by the DOD.
8. Arranging for recovery of the SNAP device in the event of missile abort.
9. Assuring that the Pu-238 fueled SNAP-3 device can be used in these specific TRANSIT missions with no undue hazard to the operating personnel and the public.
10. Providing technical assistance to the DOD concerning details on the design of the SNAP unit and health and safety aspects of its use.  
(Examples: a. The AEC will brief Atlantic Missile Range safety and range operations personnel, and will brief any other DOD personnel on technical aspects of the program as required.  
b. The AEC would recommend to the Air Force range safety personnel the necessary health safety procedures to be used at the launch site during normal operations.)
11. Providing an inter-agency coordinated public information plan designed to prepare the public prior to the orbital tests of these nuclear devices and to properly inform the world after the units are launched in the event of either a mission success or failure.
12. Maintaining a record of the type, location, and quantity of radioactive material remaining from this shot at any time based on tracking information furnished by the DOD and/or NASA.
13. Review and approval of DOD plans for installation of the SNAP generator and operating procedures pertinent to the health and safety aspects of its use.
14. Preparation of an operating manual covering detailed handling procedures and safety precautions to be followed during shipment, storage, use, and recovery (after abort) of the nuclear system.

[REDACTED]

B. The DOD will assume full responsibility for:

1. Providing to the AEC detailed technical data concerning the integration of the SNAP unit with the satellite, missile performance and trajectory details, and operational procedures to be followed prior to, during and after launch of the TRANSIT satellite, including command destruct procedures.
2. Providing the payload equipment to be powered by the SNAP unit as well as mounting provisions for installing the unit on the satellite.
3. Installing the SNAP unit on the satellite, conducting acceptance tests of the unit and removing the unit from the satellite at APL all in the presence of a technical representative of the AEC.
4. Installing the SNAP unit on the satellite and conducting final check-out of the system at the launch site in the presence of the AEC representative.
5. Providing to the AEC data obtained during pre-launch tests of the SNAP unit and telemetry data describing the performance of the SNAP unit in space.
6. Providing a back-up power supply for these missions in the event that national approval for use of the SNAP device cannot be obtained, or the SNAP unit fails to check-out at the launch site, or if for some other reason the mission would have to be carried out without the SNAP unit.
7. Installing the satellite on the missile and firing the missile in accordance with previously established procedures.
8. Providing range, ground, and nuclear safety support in accordance with previously established procedures.  
(Example: The range safety officer will adhere to the command destruct procedures for this mission which will have been provided to the AEC and will have been used in assessing the safety of this launch trajectory.)
9. Providing trajectory and impact information and recovery support in the event of an aborted mission.
10. Furnishing tracking information to the AEC concerning the location of the radioactive material.
11. Coordinating with the AEC a public information plan compatible with the TRANSIT and SNAP space programs.
12. Submitting to the AEC for review and approval DOD plans for installation of the SNAP generator and operating procedures pertinent to the health and safety aspects of its use.

C. Joint Responsibility

1. Obtaining national approval (such as National Aeronautics and Space Council) of the use of experimental Pu-238 fueled SNAP-3 generators in these TRANSIT missions.
2. Coordinating flight test plans with the Department of State.

APPENDIX "E"

Purpose and Membership of the National Aeronautics  
and Space Council \*

Creation and Authority. - The National Aeronautics and Space Council was established by the National Aeronautics and Space Act of 1958 (Public Law 85-568, 72 Stat. 426).

Purpose. - The functions of the Council are to advise the President of the United States regarding policies, plans, programs, and accomplishments of the United States agencies engaged in aeronautical and space activities, and the development of a comprehensive program of such activities.

Organization. - The nine-member National Aeronautics and Space Council is composed of the President, the Secretary of State, the Secretary of Defense, the Administrator of the National Aeronautics and Space Administration, the Chairman of the Atomic Energy Commission, one additional member appointed by the President from Federal agencies, and three other members appointed by the President from among individuals in private life who are eminent in science, engineering, technology, education, administration, or public affairs.

Officials

Chairman - President or Vice President of the United States

Members:

Secretary of State  
Secretary of Defense  
Administrator, National Aeronautics and Space Administration  
Chairman, Atomic Energy Commission  
Director, National Science Foundation  
President, National Academy of Sciences  
Vacant  
Vacant

Secretary -

\* Extracted from U. S. Government Organization Manual 1960-1961