

April 25, 1978

SECY-78-220

COMMISSIONER ACTION

~~The Commissioners~~

For:

From:

Robert B. Minogue, Director, Office of Standards Development

Thru:

Executive Director for Operations *C. J. [Signature]*

Subject:

RECOMMENDED AGENCY PLAN FOR NUCLEAR SAFETY EVALUATIONS OF FUTURE SPACE PROGRAMS

Category:

This paper covers a minor policy issue.

Issue:

How does the Commission plan to actively participate in the independent nuclear safety review of future space programs utilizing nuclear systems?

Discussion:

Origin of Review. By memorandum dated February 17, 1978, the Executive Director for Operations requested the development of an NRC plan for the safety review of nuclear systems for future space programs. This was in response to a letter from Benjamin Huberman, Office of Science and Technology Policy, to James Howard, U.S. General Accounting Office, dated January 5, 1978, which agreed with the GAO recommendation that NRC should participate in all relevant nuclear safety evaluation processes for space launches. The GAO recommendation was made in a letter to Frank Press, Director, Office of Science and Technology Policy from Richard Gutmann, Director, GAO, dated December 7, 1977.

Background

In the 1960's and early 1970's, the former Atomic Energy Commission's Director of Regulation participated in nuclear safety evaluations of space nuclear power systems. Reviews were performed on an ad hoc basis with specific direction by the Commission on specific requests from the Division of Reactor Development and Technology and the Division of Space Nuclear Systems.

In 1972, the Commission considered the need for Regulatory participation in space nuclear systems safety reviews. In the memo dated May 23, 1972, David Gabriel, Director, Division of

Contact:

R. M. Bernero

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Space Nuclear Systems (see Enclosure A), recommended that Regulatory should not participate in the safety review process since the Interagency Nuclear Safety Review Panel provided this function.

In a subsequent Commission Paper, SECY-R-522, dated August 25, 1972 (see Enclosure B), the Director of Regulation recommended that Regulatory should continue to participate in the review of space nuclear power systems. The review was to be limited to identification and analysis of radiological and nuclear risks and to exclude participation in the benefit-risk decision-making process. The Commission approved Regulatory's recommendation on August 30, 1972, but excluded the review of defense applications.

Regulatory participation ended in early 1975 when the AEC was separated into ERDA and NRC.

Future Space Nuclear Systems

Informal contact with DOE indicates that the next space nuclear system is on the Galileo mission which will be launched in January 1982. This will be a space shuttle launch of the satellite with Multi-Hundred Watt RTGs* onboard. The Safety Analysis Report schedule is: Preliminary - March 1979, Updated - March 1980, and Final - March 1981. The Safety Evaluation Report follows shortly after the Final Safety Analysis Report. In 1983, a NASA and a DOD mission is planned. The NASA Solar Polar satellite will have an RTG with a modular general purpose heat source onboard. The DOD experimental satellite will have a dynamic conversion system with a Multi-Hundred Watt plutonium-238 heat source.

Alternatives:

The alternatives considered for dealing with any forthcoming reviews are enumerated below with their pros and cons.

I. Review Position: The question of whether NRC should review, and if so, whether jointly or independently.

Alternative A. NRC review not required since Interagency Nuclear Safety Review Panel provides this function.

Pro: The Interagency Nuclear Safety Review Panel already provides a comprehensive nuclear safety evaluation of space nuclear systems.

Con: 1. An independent "third party" review is not performed.

* Radioisotope Thermoelectric Generators

2. Some members of the Interagency Nuclear Safety Review Panel have direct interests in or responsibilities in either the development or the use of space nuclear systems which may influence their evaluation.
3. Does not comply with GAO recommendation for an independent evaluation.

Alternative B. Conduct review as a member of the Interagency Nuclear Safety Review Panel.

Pro: Closest and most efficient working relationship with the other agencies involved.

- Con:
1. NRC would lose independent "third party" review status.
 2. NRC would be involved in benefit-risk decision for flight approval.
 3. Does not comply with GAO recommendation for an independent evaluation.

Alternative C. Conduct an independent review as an observer to the Interagency Nuclear Safety Review Panel process.

- Pro:
1. NRC can remain an independent reviewer.
 2. Staff comments and advice would be submitted in a timely fashion to the Interagency Panel during the course of the review.
 3. Complies with the GAO recommendation for an independent evaluation.

Con: NRC review position would be taken subsequent to Interagency Nuclear Safety Review Panel positions causing some delay in the review process.

II. Review Scope: The question of how broad or detailed the NRC review should be.

Alternative A. Conduct a license type review of a broad and comprehensive nature which would parallel the nuclear safety evaluation performed by the Interagency Nuclear Safety Review Panel (see Enclosure C).

Pro: 1. Would provide greatest NRC and Office of Science and Technology Policy confidence in an independent "third party" review.

2. Review would be comprehensive.

Con: 1. Would require significant buildup of staff with special talents and possible contract support.

2. Would be costly and inefficient for conducting occasional reviews.

Alternative B. Conduct a moderate review covering a selected scope of principal safety related issues.

Pro: 1. Major resource buildup not required.

2. Efficient utilization of Staff for conducting occasional reviews.

3. Would provide reasonable assurance of independent "third party" advice.

Con: Review selective and not comprehensive.

III. Review Group: The question of who in NRC would conduct the review.

Alternative A: NMSS, Division of Fuel Cycle and Material Safety would conduct review.

Pro: 1. Licensing organization set up to administer case reviews.

2. Organization already exists with principal disciplines required for the review.

3. Current space nuclear systems are all isotope units using plutonium-238; special nuclear material licensed by NMSS.

Con: Organization has fewer personnel with aerospace nuclear safety experience than other NRC organizations.

Alternative B: NRR would conduct review.

Pro: 1. Licensing organization set up to administer case reviews.

2. Organization already exists with principal disciplines required for the review.

Con: Does not review materials licensing cases.

Alternative C: Other NRC organization would conduct review.

Pro: Some organizations already exist with principal disciplines required for the review.

Con: Organizations other than licensing groups are not set up to administer case reviews.

Review Position

Alternative IA is not appropriate since it is not responsive to the GAO and Office of Science and Technology Policy position of having NRC participate in the nuclear safety evaluation process for space launches.

Alternative IB would make it difficult for NRC to be an independent reviewer as a member of the Interagency Nuclear Safety Review Panel, since this panel prepares the Safety Evaluation Report and makes the risk-benefit judgment on whether the nuclear device should be launched.

Alternative IC would involve an NRC observer on the Interagency Nuclear Safety Review Panel who would be appointed by the assigned review group.

The NRC observer's function would be to attend the Interagency Panel meetings to gather information and to provide NRC questions, comments and advice during the course of the review. In this capacity NRC would be able to conduct an independent review. At the completion of the review, which includes a review of the Interagency Panel Safety Evaluation Report, the NRC staff would submit a report to the Office of Science and Technology Policy as recommended by the GAO. This report would summarize the NRC review of the individual case and the comments and advice presented to the Interagency Nuclear Safety Review Panel.

Review Scope

Alternative IIA would establish a comprehensive review which would parallel and duplicate the Interagency Nuclear Safety Review Panel review scope. This would require a significant increase in staff with specific aerospace expertise for conducting occasional reviews.

Alternative IIB would establish a moderate review, the scope of which would be limited to areas where NRC has the expertise (structural, thermal, radiological consequences, materials selection, risk analyses, etc.). The review would exclude participation in the benefit-risk decision-making process. For a mission which uses a nuclear system that had been previously approved for flight, the scope of the review may be limited to a critique of the Safety Evaluation Report. The scope of each mission review could be set by the assigned review group.

Review Group

A licensing office is the logical choice for being the responsible organization since it is already set up to do this type of review. In addition, since current space nuclear systems are all isotope units using plutonium-238, a special nuclear materials handling and safety problem, NMSS, Division of Fuel Cycle and Material Safety, is the proper office for the review. This division has staff expertise now in the principal disciplines of interest, viz., structural, thermal, radiological, etc. An International Programs observer should be included in the review group to assure that any international relations implications are properly addressed, including possible need for notification of safety problems under existing exchange agreements.

Review Advice

Since the nature of the review may vary from case to case, the review group would have the option to call on other NRC sources for advice. The review group may obtain advice from knowledgeable staff members with aerospace nuclear safety experience. A recent canvass of the staff indicated over eighty personnel with this experience (see Enclosure D). This advice may be obtained on an informal basis by consulting with experienced individuals or on a more formal basis by setting up an ad hoc review panel. The ad hoc panel could advise the review group on the scope of the review and could critique and advise the review group on its evaluation.

The review group could seek advice from other sources such as the ACRS. Technical support contractors with special expertise could also be engaged.

Resources

The resources needed for conducting a review of this type are greatly dependent on the system and flight chosen. If one assumes the use of the current Multi-Hundred Watt RTG in any missions of the near future, we estimate that a relatively

comprehensive NRC staff review assisted by a panel of NRC personnel with aerospace nuclear safety experience can be performed at a cost of about 20 man-month's effort. This includes about 17 man-month's effort by the NMSS review group and about 1/2 man-month by each of a panel of six advisors. (See Enclosure E for justification of resources.) The span of the review would probably run between 2 and 3 years. There are no resources in current budgets for work of this sort.

Recommendation:

The Commission direct the Executive Director for Operations to organize the staff to perform reviews of future space nuclear programs as follows:

I Review Position: Alternative C

Conduct an independent review as an observer to the Interagency Nuclear Safety Review Panel process.

II Review Scope: Alternative B

Conduct a moderate review covering a selected scope of principal safety related issues.

III Review Group: Alternative A

NMSS, Division of Fuel Cycle and Material Safety would conduct review.

Coordination:

This paper has been concurred in by the Offices of Nuclear Material Safety and Safeguards, Nuclear Reactor Regulation, Nuclear Regulatory Research, Inspection and Enforcement, and International Programs. The Office of the Executive Legal Director has no legal objection.



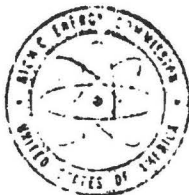
Robert B. Minogue, Director
Office of Standards Development

Enclosures: See page 8

Enclosures:

- A. Memorandum dated 5/23/72 from
David S. Gabriel, Director,
Division of Space Nuclear Systems
- B. Commission Paper SECY-R-522 dated
8/25/72, Regulatory Role in Safety
Reviews of Space Nuclear Systems
- C. Interagency Review
- D. Staff Personnel With Aerospace
Nuclear Safety Experience
- E. Estimated Review Effort

May 25, 1972



SECY-2503

CONSENT CALENDAR ITEM

REGULATORY PARTICIPATION IN SPACE NUCLEAR SYSTEMS SAFETY REVIEWS

Note by the Secretary

1. The General Manager has requested the attached memorandum of May 23, 1972 from the Director of Space Nuclear Systems be circulated as a Consent Calendar Item and has provided the following digest:

Commission decision is requested as to the need for Regulation to participate in pre-flight safety reviews of space nuclear systems and associated AEC staff actions.

2. The Commissioners' approvals or comments are requested by close of business, Monday, June 5, 1972.

W. B. McCool

Secretary of the Commission

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Commissioner Larson	2	Operational Safety	1
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Exec. Asst. to GM	2	Deputy Dir. of Regulation	1
General Counsel	4	Director, Office of Admin.	3
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Information Services	1	Director of Licensing	1
Inspection	1	Dir., Off. of Tech. Advisor	1
Off. of Planning & Analysis	2		



SPACE NUCLEAR SYSTEMS

U.S. ATOMIC ENERGY COMMISSION

WASHINGTON, D.C. 20545

MAR 23 1972



Robert E. Hollingsworth, General Manager

THRU: John J. Flaherty, AGR-ED

REGULATORY PARTICIPATION IN SPACE NUCLEAR SYSTEMS SAFETY REVIEWS

At the Commission's Executive Session on "Use of Isotopic Nuclear Systems on the NASA Pioneer Spacecraft," in January, 1972, an inquiry was made by the Chairman as to the need for Regulation's participation in the pre-flight safety reviews of space nuclear systems and in associated staff actions. The purpose of this memorandum is to present information and recommendations pertaining to this subject.

We understand that in discussions pertaining to Regulation's review of AEC-owned reactors, the Deputy General Manager and the Deputy Director of Regulation agreed that Regulation should discontinue participation in review of isotopic power systems. We request that the scope of this agreement with Regulation be modified to include discontinuance of Regulation's participation in pre-flight safety reviews of all space nuclear systems and in associated AEC staff actions.

Since 1960, Regulation has been an observer in pre-flight inter-agency review panels for space nuclear systems and has participated actively in AEC staff actions, particularly in commenting upon launch approval staff papers and in Commission meetings. There have been advantages and disadvantages to this arrangement as summarized below:

Advantages

1. Regulation's review provides an independent review from a somewhat different perspective.
2. Regulation's participation facilitates a free exchange of specific safety information between both sides of the AEC organization.
3. Regulation has contributed, in the past, and could continue to provide valuable comments to the Interagency Panel Review, if timing of Regulation's comments were appropriate.

Secretariat Note: SECY-2135, approved at Policy Session 23 on January 12, 1972.

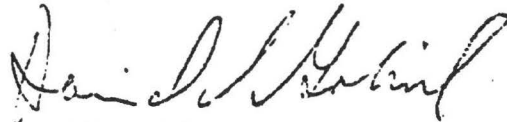
Enclosure "A"

R. E. Hollingsworth, GM

Disadvantages

1. Regulation lacks the specific aerospace expertise necessary for a complete perspective review of space nuclear systems and operations.
2. Participation could place Regulation in the position of appearing to sanction exposure levels above licensing standards in cases where low probability accident events are deemed permissible by the national security benefits of the mission.
3. Non-participation by Regulation in weapons activities makes it anomalous for Regulation to participate in SNS defense related programs.
4. The Interagency Review Panel already provides for studies and comments covered by Regulation. The Regulatory review should not be required.

The Division of Space Nuclear Systems believes it would be to the overall advantage of the interagency safety review process if Regulation did not participate in subject review activities. The pre-flight safety review process as presently constituted has generally worked out quite satisfactorily in the past. It is proposed to continue this procedure essentially as is, except for the elimination of Regulation's participation. Therefore, the overall AEC participation in the interagency reviews will continue to include the following AEC Divisions: Space Nuclear Systems, Biology and Medicine, Operational Safety and any other division and AEC field office with appropriate special expertise which may be called upon by the appointed AEC panel coordinator.*



David S. Gabriel
Director

Contact: D.S. Gabriel
Ext. 3027

* Biology and Medicine, General Counsel, Operational Safety and Regulation have concurred in this memo.



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UNITED STATES
ATOMIC ENERGY COMMISSION

WASHINGTON, D.C. 20545

September 19, 1972

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John R. Chaisson, Asst Dir of Regulation
David S. Gabriel, Director, Space Nuclear Systems

REGULATORY ROLE IN SAFETY REVIEWS OF SPACE NUCLEAR SYSTEMS
(SECY-R-522)

SECY:JD

At Regulatory Policy Session 48, August 30, 1972, the Commission:

- a. Approved Regulatory's role in the review of non-licensed space nuclear power systems excluding defense applications, (i) limiting the review to identification and analysis of radiological and nuclear risks, and (ii) excluding participation in the benefit-risk decision-making process;
- b. Discussed Regulatory's previous participation in reviewing space nuclear systems, noting that continued participation in future launches would require approximately one man-year of effort per launch over the next three years; and
- c. Requested an evaluation of Regulatory's role when adequate experience has been obtained.

It is our understanding you are taking the appropriate action for the Director of Regulation and the General Manager.

Paul C. Bender
Secretary of the Commission

cc:

Chairman Schlesinger
 Commissioner Ramey
 Commissioner Larson
 Commissioner Doub
 Commissioner Ray
 General Manager
 Deputy Gen Mgr
 Exec Asst to Gen Mgr
 General Counsel
 Controller
 Director, Information Services
 Director, Inspection

Asst GC for L&R
 Dir, Reg Stds
 Dir, Reg Opers
 Dir of Licensing
 Dep Dir for F&M
 Dir, Gov't Liaiso:
 Dir, Tech Advisor
 Director, P&A
 Asst GM for Admin
 Asst GM for E&DP
 Dir, Internat'l Prog
 Asst GM for E&S
 Dir, Operational Safety
 Asst GM for Nat'l Security
 Director of Regulation
 Dep Dir of Regulation
 Dir, Admin - REG
 Spec Asst to Dir of Reg

Enclosure "A"

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August 25, 1972



SECY-R 522

POLICY SESSION ITEM

REGULATORY ROLE IN SAFETY REVIEWS OF SPACE NUCLEAR SYSTEMS

Note by the Secretary

The Director of Regulation has requested his attached report be circulated for discussion at the Policy Session on Wednesday, August 30, 1972 and has provided the following digest:

At Commission Policy Session 46 on June 1, 1972, it was decided that Regulatory should continue to participate in the review of space nuclear power systems. At that time, it was requested that Regulatory define its role in such reviews and determine whether defense space nuclear power systems should be included in the review. It is requested that the Commission approve the proposed Regulatory role in reviews of space nuclear power systems. This role will be limited to those areas where the Regulatory staff has expert technical competence; namely, defining and evaluating radiological and nuclear risks. The Regulatory staff would not participate in the risk benefit decisions concerning launches. It is also proposed that Regulatory review defense as well as nondefense systems.

W. B. McCool

Secretary of the Commission

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Commissioner Ray	2 Deputy Dir. of Regulation	4
General Manager	1 Asst. Dir. of Regulation	1
Deputy Gen. Mgr.	1 Director, Office of Admin.	3
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Controller	1 Director of Reg. Standards	3
Information Services	2 Director of Reg. Operations	1
Inspection	1 Director of Licensing	1
Off. of Planning & Analysis	2 Deputy Dir. for Fuels & Materials	3
Asst. GM for Admin.	1 Dir., Off. of Gov't. Liaison	1
Asst. GM for E&D Programs	1 Dir., Off. of Tech. Advisor	1
International Programs	1	

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ATOMIC ENERGY COMMISSION
REGULATORY ROLE IN SAFETY REVIEWS
OF SPACE NUCLEAR SYSTEMS

Report to the Commission by the Director of Regulation

THE PROBLEM

1. To define Regulatory's role and manpower requirements in reviews of non-licensed space nuclear power systems.

BACKGROUND AND DISCUSSION

2. At the Commission's Executive Session on "Use of Isotopic Nuclear Systems on the NASA Pioneer Spacecraft," in January, 1972,*an inquiry was made by the Chairman as to the need for Regulation's participation in the preflight safety reviews of space nuclear power systems and in associated staff actions. Regulatory participation in preflight safety reviews of space nuclear power systems was discussed at the Commission's Policy Session 46 on June 1, 1972,**at which time it was decided that Regulatory should continue to participate in such reviews. A staff paper which defines Regulatory's role in the review of space nuclear power systems was requested.

3. Regulatory has been involved in safety reviews of space nuclear power systems over the past decade through the Divisions of Licensing and Regulation, Reactor Licensing, and Materials Licensing. Reviews were performed on an ad hoc basis in accordance with specific direction by the Commission or specific requests from the Division of Reactor Development and Technology and the Division of Space Nuclear Systems (SNS). In conducting these reviews, Regulatory generally has acted as a consultant by reviewing early draft proposals, participating in review board meetings and preparing a final Regulatory report on the proposal, prior to review by the National Aeronautics and Space Council. The

Secretariat Notes: ** SECY-2503, "Regulatory Participation in Space Nuclear Systems Safety Reviews".

* SECY-2236, "Policy Session 23 on January 12, 1972."

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Enclosure "3"

attachment is a list of systems which a file search indicates have been reviewed by Regulatory, although the extent of Regulatory participation in these reviews has varied considerably over the years.

4. Regulatory's principal technical competence is in the area of radiation and nuclear safety. Therefore, Regulatory proposes to limit its review of space nuclear power systems to the evaluation of those parts or subsystems which present or directly contribute to radiation or nuclear hazards and to the consequences of postulated accidents that could result in such hazards. In particular, Regulatory proposes to examine items such as the chemical and physical form of the radioactive material, the fabrication and testing of the fuel capsule and generator, the protection afforded the generator and fuel capsule by the launch vehicle, and contingency provisions which could affect the final disposition of the launch vehicle and consequently, the radioactive material in the fuel capsule. The Regulatory review would not include evaluation of accident probabilities (e.g., launch failure probabilities) or risk acceptance determinations. The purpose of Regulatory review would be to determine the adequacy and validity of the safety analysis reports presented and to identify radiation or nuclear safety issues that are not taken into account in the reports. Regulatory would submit its review and comments on radiation and nuclear safety to the AEC Coordinator on the Interagency Nuclear Safety Review Panel. If Regulatory requires additional information or outside expert assistance to complete its review, the request for such information or assistance would be made through the AEC Coordinator on the Panel.

5. If the purpose of Regulatory's participation in the review of space nuclear power systems is to provide an independent "third party" evaluation and to assist in establishing the nature of the risk so that informed judgments can be made, the value of such a review is applicable equally to defense and nondefense programs. Accordingly, defense programs should be included in the scope of Regulatory's participation. In

undertaking a review of defense programs, however, the evaluation of national security benefits that might accrue from military space nuclear power systems is clearly beyond the scope of Regulatory's competence. Regulatory proposes to identify and analyze risks with respect to radiation and nuclear safety for both defense and nondefense programs, but would not participate in the benefit-risk judgments which enter into determining whether any specific mission should be undertaken.

6. During FY 1971 and 1972, Regulatory participated in the reviews of the Transit and Pioneer space nuclear power systems. According to SNS, there are 3 launches planned over the next few years which involve new systems that have yet to be evaluated: LES 8/9 (launch in 1974); Viking (launch in 1975); and MJS (launch in 1976 or 1977). Each of these systems has 3 phases in the review process, i.e., Preliminary Safety Analysis Report, Updated Preliminary Safety Analysis Report, and Final Safety Analysis Report. Past reviews of space nuclear power systems by Regulatory have shown that manpower requirements are highly variable. As many as 3 professionals with appropriate clerical and supervisory effort may be required at peak periods of the reviews. Based on our past experience and the Regulatory role in the review process as it is defined in this paper, it is estimated that each phase of the review process for each device will require about 4 man-months. Since there are 3 launches planned within the next 3 years and each system has 3 phases in the review process, it appears that an annual effort of approximately 1 man-year will be needed over the next 3 years for Regulatory participation in the safety reviews.

Manpower requirements to evaluate a reactor space nuclear power system would be considerably greater, but we are not aware of any reactors that are planned for space programs in the near future. Manpower requirements needed to evaluate reactor systems will be established in the future if the need arises.

STAFF JUDGMENTS

7. The Office of the General Counsel and the Divisions of Space Nuclear Systems and Operational Safety concur in the recommendations of this paper.

8. The Division of Military Application was consulted on the Regulatory role as proposed in this paper, and while it does not object to this role, DMA does not believe it is appropriate to participate in the Staff Judgments since space nuclear power systems are outside their area of responsibility.

RECOMMENDATIONS

9. The Director of Regulation recommends that the Atomic Energy Commission:

a. Approve Regulatory role in the review of non-licensed space nuclear power systems (i) to include both ~~defense and nondefense~~ ^{benefit-risk} applications, (ii) to limit the review to identification and analysis of radiological and nuclear risks, and (iii) to exclude participation in the benefit-risk decision-making process.

b. Note that this activity will involve an annual effort by the regulatory staff of approximately one man-year over the next three years.

ENCLOSURE

PAGE NO.

APPENDIX - SPACE NUCLEAR POWER SYSTEMS REVIEWED BY REGULATORY 6

APPENDIX
SPACE NUCLEAR POWER SYSTEMS
REVIEWED BY REGULATORY

Radioisotope Thermoelectric Generators

SNAP-3A
SNAP-9A
SNAP-11
SNAP-19
SNAP-27
TRANSIT
PIONEER (Modified SNAP-19)

Reactors

SNAP-2
SNAP-8
SNAP-10A
Rover
KIWI-A
KIWI-B1A
KIWI-B2A
KIWI-TNT
Nerva
NRX-A
PLUTO
Tory II-A
Tory II-C

INTERAGENCY REVIEW

The present interagency review is a comprehensive broad scope evaluation of the space nuclear system. The review is performed by the Interagency Nuclear Safety Review Panel (INSRP) composed of representatives from the Department of Energy (DOE), Department of Defense (DOD) and National Aeronautics and Space Administration (NASA).

The documents reviewed for each space nuclear system mission include the Safety Design Specification, Preliminary Safety Analysis Report, Updated Safety Analysis Report, Final Safety Analysis Report and the Safety Evaluation Report. The Safety Design Specification, the Preliminary Safety Analysis Report, the Updated Safety Analysis Report, and the Final Safety Analysis Report are prepared by a DOE contractor. The Safety Evaluation Report is prepared by INSRP. The Safety Design Specification provides the basis for designing and evaluating the performance of the radioisotope heat sources and for verifying that such heat source designs fulfill the safety requirements.

The Preliminary Safety Analysis Report is issued within 90 days after a design concept is selected. It contains a description of the design, an analytical failure mode analysis and an analytical nuclear safety analysis. This report is a three volume document with the following titles: Volume 1, Reference Design Document; Volume 2, Accident Model Document; Volume 3, Nuclear Safety Analysis Document.

The Updated Safety Analysis Report is issued within 60 days after the design freeze and is similar in format to the Preliminary Safety Analysis Report.

The Final Safety Analysis Report is issued approximately one year before the scheduled launch and is similar in format to the Updated Safety Analysis Report. This report provides final system, mission, and safety assessment data factoring in the results of the verification and qualification test programs.

The Safety Evaluation Report, prepared by the INSRP, represents a summary of the review and evaluation of the space nuclear system relative to the anticipated effect of the proposed mission on the public health and safety. The Interagency Nuclear Safety Review Panel then makes the risk-benefit judgment of whether the nuclear device should be launched and so advises the user agency. The user agency requests launch approval from the President's Office of Science and Technology Policy.

The broad scope review of this documentation will include a nuclear safety evaluation of the space nuclear system for normal operations and potential accident conditions for the entire mission. The accident environments that the space nuclear system may be subjected will include:

- . . . shock waves and high velocity fragments from explosion of the launch vehicle on the pad or during early ascent
- . . . liquid propellant fireball and afterfire
- . . . solid propellant fire

- . aerodynamic heating and structural loading during reentry
- . high velocity earth impact
- . post impact exposure to weather and burial or long term immersion in seawater.

The response of the plutonium heat source when exposed to the accident environments is evaluated to determine whether the heat source containment will survive or fail. A failed heat source will result in the release of plutonium particles to the environment. The source term, which is not only the quantity of plutonium released but also the particle size and chemical form, is determined. The dispersion of the released plutonium and the radiological consequences to the public and the environment is evaluated. Numbers of people affected as well as the probability of being exposed are determined to indicate the risk involved.

STAFF PERSONNEL WITH AEROSPACE NUCLEAR SAFETY EXPERIENCE

<u>Organization</u>	<u>Isotopes</u>	<u>Experience Reactors</u>	<u>Non Nuclear Aerospace</u>
RES	Gary Bennett	William Farmer	
	Warren Lyon	Carl Johnson	
	Aleck Serkiz	James Richardson	
		Clyde Jupiter	
NRR	Herbert Berkow	Ralph Birkel	Leo Beltracchi
	Delbert Bunch	Leon Engle	Charles Billups
	Kazimieras Campe	Richard Froelich	James Martin
	Thomas Cox	John Gilray	
	Donald Davis	Emanuel Licitra	
	Charles Ferrell	Oliver Lynch	
	Robert Geckler	Sydney Miner	
	James Glynn	Patrick O'Reilly	
	Walter Haass	Harry Rood	
	William Regan	Richard Vollmer	
	Raymond Scholl	James Watt	
	John Spraul	Rene Audette	

Non Nuclear

Aerospace

Organization

Isotopes

Reactors

NRR

Millard Wohl

Harry Krug

SD

Fredric Anderson

Morton Fleishman

Robert Baker

Robert Bernero

Abraham Eiss

Louis Frank

James Mackin

Michael Parsont

George Rivenbark

Frank Witt

IE

Jordan Davis Reg I

Donald Burke Reg II

Leslie Gage Reg I

Peter Knapp Reg I

William Fisher Reg III

Andrew Cunningham

Reg II

Robert McClintock Reg I

Donald Miller Reg III

John Rausch Reg II

Stewart Ebnetter Reg I

Thomas Tambling Reg III

Joel Kohler Reg III

John Potter Reg II

Ronald Cook Reg III

Ross Brown Reg IV

William Grant Reg III

Duane Danielson Reg III

Ramon Hall Reg IV

Robert Everett Reg IV

Thomas Vandell Reg III

Peter Verrios Reg IV

James Konklin Reg III

Dolphus Whitesell

Reg IV

<u>Organization</u>	<u>Isotopes</u>	<u>Reactors</u>	<u>Non Nuclear Aerospace</u>
IE		Maynard Dickerson Reg IV Clifton Hale Reg IV Robert Stewart Reg IV Jessee Agee Reg IV Donald Anderson Reg IV Richard Brickley Reg IV	
IP	Joseph LaFleur		
NMSS	James Powers Sheldon Meyers		William Lake Jerry Jackson James Mayor

ESTIMATED REVIEW EFFORT

	NMSS	Panel of 6
A. Plan Review	12 mandays	4 days = 24 mandays
B. Conduct Preliminary Review		
Structural (blast, fragments and impact)	2 man months	
Thermal (pad/fireball, re-entry and post impact)	2.5 man months	
Materials	1 man month	
Consequences	3 man months	
Risk Assessment	1 man month	
C. <u>Preliminary Documentation and Comment</u>	1 man month	3 days = 18 man days
D. Conduct Final Review (1/2 of preliminary review)	5 man months	
E. <u>Final Documentation and Comment</u>	1 man month	3 days = 18 man days
Total	17 man months	3 man months
	