

QUALITY ASSURANCE PROGRAM FOR
TRANSPORTATION OF
RADIOISOTOPE THERMOELECTRIC GENERATORS
(RTGs)

AIR FORCE TECHNICAL APPLICATIONS CENTER
PATRICK AFB, FLORIDA

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1. Introduction.

a. Under the provisions of United States Air Force Radioactive Material (USAF RAM) Permit No. 09-30272-01AFP issued pursuant to the Air Force's Nuclear Regulatory Commission (NRC) Master Materials License No. 42-23539-01AFP, the Air Force Technical Applications Center (AFTAC) is authorized to acquire, receive, store, use, or transfer Radioisotope Thermoelectric Generators (RTGs).

b. The purpose of this document is to outline the procedures which will be followed to comply with Subpart H of Title 10, Code of Federal Regulations, Part 71 (10 CFR 71) for transportation of type B quantities of radioactive material and to insure compliance with NRC General License requirements of 10 CFR 71.12 through 71.14.

c. NRC Regulatory Guide 7.10, Establishing Quality Assurance Programs (QAPs) for Packaging Used in the Transport of Radioactive Material, Annex 2, was used as a guide in developing this plan.

d. Opening the RTGs to replace thermoelectric modules or perform other repairs is not covered under this program.

e. Packages currently used under NRC approved QAP are listed in attachment 1. Sources are special form radioactive material.

f. Activities performed relative to transportation of RTGs include:

- (1) Handling;
- (2) Shipping;
- (3) Storage;
- (4) Maintenance.

2. Quality Assurance Organization. The final responsibility for the QAP rests with the AFTAC Radiation Safety Committee (RSC). The QAP is implemented using the organization outlined in attachment 2.

3. Quality Assurance Program.

a. The RSC will implement the QAP through the organization described in paragraph 2. QAP revisions will not be made without committee approval. The QAP will insure that all transportation activities involving the RTGs are performed in accordance with applicable NRC, Department of Transportation (DOT), and Department of the Air Force Regulations, USAF RAM Permit No. 09-30272-01AFP and the specific provisions of the appropriate Certificates of Compliance (COC) and USAF NRC Master Materials License. The QAP emphasizes control of the administrative and operational matters which are critical to safety. Controls have been established to insure that transportation activities involving the RTGs are conducted in accordance with the regulations, permits, licenses and approvals mentioned above.

b. Prior to engaging in any activity important to safety, all personnel will have had indoctrination or training in that activity.

4. Design Control. This organization is not involved in the manufacturing or fabrication of packages. RTGs are designed, and manufactured/fabricated by the manufacturer under an NRC approved QAP. RTGs shall be maintained in their original design configuration as specified in the manufacturer's drawings and documents. AFTAC shall hold the COCs and maintain all existing drawings, manufacturer documents, and procedures approved in the COC.

5. Procurement Document Control. This organization is not involved in the manufacturing of packages or packaging. Procurement documents shall reflect that RTGs are authorized by a COC, USAF RAM Permit and have been manufactured under an NRC approved QAP. This is limited to hardware items for package maintenance.

6. Instructions, Procedures and Drawings.

a. Preparation of package for use prior to and after shipment:

- (1) Packages are visually inspected for damage;
- (2) Required sealed source leak tests and radiation surveys are performed;
- (3) Eye bolts are removed or inserted;
- (4) Package security on pallet and pallet security on vehicle is verified.

b. Repairs, Rework and Maintenance. Packages are supplied by the manufacturer. Maintenance of the RTGs will be limited to hardware items (nuts, bolts, slings, eye bolts and pallets) and corrosion control measures to the exterior of the package only. Opening the RTGs is not authorized.

c. Loading and Unloading Contents. This organization does not load/unload radioactive material into or out of RTGs.

d. Transportation of Package. See paragraph 14.

7. Document Control. All documents related to the RTG package (e.g., COCs, Shipping and Receiving Procedures, etc.) will be controlled and maintained by the Radiation Safety Officer (RSO). All revisions and changes will be processed through the RSO. He/she will insure that the latest versions of the documents are on file.

8. Control of Purchased Material, Equipment and Services. Design and fabrication of RTGs are not conducted under this QAP. Procurement of replacement parts important to safety will be reviewed to ensure appropriate technical and QA requirements are included in purchase orders. Replacement parts shall be purchased from the original vendor or an equivalent qualified supplier. Replacement parts from suppliers not previously identified as qualified sources will meet requirements equal to the original criteria.

9. Identification and Control of Materials, Parts and Components. Repairs or rework of RTGs will not be conducted under this QAP. If important to safety, spare parts required for maintenance shall be purchased from the original manufacturer or qualified vendor. Spare parts will meet requirements equal to the original criteria.

10. Control of Special Processes. RTGs should require no major repairs necessitating the use of special processes. USAF RAM Permit No. 09-30272-01AFP does not authorize repair of RTGs.

11. Inspection Control. The RSO shall use a checklist to insure inspections are performed to verify that packages have been marked and labeled, and shipping papers are completed in accordance with the latest requirements. See attachment 3.

12. Test Control.

a. RTGs are not fabricated under this QAP. Packages will be visually examined to insure that they conform to the COC package description and that they are in sound condition. Any other tests prescribed by the manufacturer's operation and maintenance manuals will be completed.

b. Following any maintenance to the package and prior to offering the RTG to a carrier for transport, radiation surveys will be completed to verify shielding integrity.

13. Control of Measuring and Test Equipment. USAF RAM Permit No. 09-30272-01AFP requires that all radiation survey equipment be in calibration during use.

a. Calibration of instruments is performed by:

(1) An Air Force Precision Measurement Equipment Laboratory (PMEL) under NRC or agreement state license and/or

(2) Manufacturer according to procedures approved by the NRC.

b. All instruments are calibrated at intervals not exceeding twelve months. A calibration label is affixed to all instruments indicating the date calibrated, due date and calibrator's certification stamp. Air Force reference standards are certified as traceable to the National Institute of Standards and Technology (NIST).

14. Handling, Storage and Shipping Control. Safety procedures concerning the handling, storage and shipping of RTGs will be followed. These procedures are performed in accordance with applicable NRC, DOT and US Air Force regulations, and the manufacturer's operation and maintenance manual. Work instructions will be provided for handling, storage and shipping operations. Shipments will not be made unless all tests, certifications, acceptances and final inspections have been completed. The manufacturer's operation and maintenance manual will be used as a guide to insure that the requirements of 10 CFR 71.85 and 71.87 are met and that packages are in good condition, adequately secured on the transport vehicle, marked and labeled in accordance with DOT regulations and identified by model and package identification numbers.

15. Inspection, Test and Operating Status. Inspection, test and operating status of the RTGs will be in accordance with manufacturer's recommendations and conditions specified in USAF RAM Permit No. 09-30272-01AFP.

16. Non-Conforming Materials, Parts or Components. RTGs are used as provided by the manufacturer. Any non-conforming materials, parts or components important to QA will be identified and returned to the vendor or set aside for discard.

17. Corrective Action. The RSO or his designated representative will conduct annual evaluation visits to RTG use or storage locations authorized in accordance with USAF RAM Permit No. 09-30272-01AFP. The results of these visits will be provided in the form of a trip report to applicable headquarters, parent and subordinate units. The report will note any deviations or discrepancies, office of primary responsibility (OPR) for corrective action and abatement date, if applicable. Written response from the OPR is required to provide details of abatement. In addition, the RSO will report significant findings of staff visits to the AFTAC Radiation Safety Committee.

18. Quality Assurance Records. Records of package approvals (including references and drawings, relating to the use of the packaging) tests, audits, personnel training and qualifications, RTG shipments, and compliance inspections will be maintained. Descriptions of RTGs, manufacturer's operation and maintenance manuals, and procedures pertinent to RTG activities will also be maintained. Records will be maintained and kept in such a manner as to be identifiable and readily retrievable. Record types and retention items will be kept in accordance with 10 CFR Part 71.91(a) and (c).

19. Audits. Individuals performing the audits will have no responsibility in the activity being conducted. Audits will be conducted using prepared checklists. See attachment 4. Results of the audits will be maintained. Audit reports will be evaluated and deficient areas corrected.

PACKAGE MODEL NUMBERS
AND
CERTIFICATE OF COMPLIANCE

MANUFACTURER AND MODEL NO.

CERTIFICATE OF COMPLIANCE NUMBER

Teledyne Energy Systems
Radioisotope Thermoelectric Generator
Sentinel Model-25 Series

4888

Teledyne Energy Systems
Radioisotope Thermoelectric Generator
Sentinel Model-100 Series

5862

AIR FORCE TECHNICAL APPLICATIONS CENTER (AFTAC)

RADIATION SAFETY COMMITTEE

The Committee is convened quarterly by the Commander, Technical Operations Division (TOD), and reviews the Radiation Safety Program to include:

- a. Adequacy of operation procedures, facilities and equipment.
- b. Procedures for control and inventory of radioactive material.
- c. Procedures for proper receipt and transfer of radioactive material.
- d. Maintaining records of training of individual users.

Records of significant actions of the committee are maintained.

The Radiation Safety Committee is comprised of the following members:

Commander, TOD, Chairman

Director of Laboratories

Director of Logistics

Director of Operations

Chief, Radiation Analysis Laboratory

Chief, Gas Analysis Laboratory

Chief, Applied Physics Laboratory

Chief, Plans and Support

Chairman, TOD Environmental Protection Committee

TOD Radiation Safety Officer (RSO)

McClellan AFB RSO

Chief, Occupational Health and Safety (Command RSO)

RADIOACTIVE MATERIAL SHIPMENT CHECKLIST

Page of Page(s)

SHIPMENT SUMMARY

SHIPPED FROM:
 Name _____
 Address _____
 City _____ State _____ Zip _____

SHIPMENT NO. _____
 SHIPMENT DATE _____
 I.R. NO. _____

LICENSE AUTHORIZATION:
 Shipper's AFR Permit No. _____
 Recipient's License: On File
 Within Expiration Date
 Authorizes R.A.M. Being Shipped
 Shipping To License No. _____
 Other Authorization (e.g. contract no.) _____

SHIPPED TO:
 Name _____
 Address _____
 City _____ State _____ Zip _____

MODE OF SHIPMENT:

Common carrier truck
 Passenger aircraft
 Federal vehicle
 U.S. Mail
 Contract carrier truck - Exclusive Use
 Cargo-only aircraft (attach special label)
 Private vehicle
 Other: _____

SHIPMENT TOTALS:

Total Number of Containers this Shipment _____ Total Curies this Shipment _____

(A SEPARATE SHIPPING RECORD FORM IS USED FOR EACH CONTAINER)

DESCRIPTION OF RADIOACTIVE MATERIAL IN CONTAINER:

(USE SEPARATE SHIPPING RECORD FORM FOR EACH CONTAINER)

NON-FISSILE MATERIAL N/A

Radionuclides	Curies	Special Form	Normal Form	Physical Form	Chemical Form
		A ₁ Limit	A ₂ Limit		
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Total _____ Sum of Fractions Rule Met Yes

FISSILE MATERIAL N/A FISSILE EXEMPT

Class I Total Grams _____ Special Form, A₁ Limit (Ci) _____ Physical Form _____
 Class II _____
 Class III Total Curies _____ Normal Form, A₂ Limit (Ci) _____ Chemical Form _____

PROPER SHIPPING NAME; UN NO.; & R.A.M. QUANTITY TYPE:

- Radioactive material, excepted package - instruments, 7, UN2910
 - Radioactive material, excepted package - articles, 7, UN2910
 - Radioactive material, excepted package - limited quantity of material, 7, UN2910, Ltd Qty
 - Radioactive material, low specific activity LSA, n.o.s., 7, UN2912
 - Radioactive material, n.o.s., 7, UN2982
 - Radioactive material, fissile, n.o.s., 7, UN2918
 - Radioactive material, special form, n.o.s., 7, UN2974
 - Other _____
- RAM Quantity Type: Ltd Qty
 Type A
 Type B
 Other: _____

RADIOACTIVE MATERIAL SHIPMENT CHECKLIST (CONT)

Page of Page(s)

RADIATION SURVEY DATA:

FOR RADIOACTIVE MATERIAL BEING SHIPPED (before being placed in the shipping container):

___ Total millirem/hr @ contact _____
 ___ Total millirem/hr @ 1 foot _____
 ___ Total gamma millirem/hr @ 1 foot _____

___ PRE-PACKAGING container contamination survey completed. . . Alpha _____ dpm/100cm² <220
 . . Beta/Gamma _____ dpm/100cm² <2200

FOR FULLY LOADED AND CLOSED CONTAINER NO. _____:

___ Maximum total millirem/hr @ external surface. . . _____
 ___ Maximum total millirem/hr @ 1 meter. _____

___ Removable surface contamination: . . . Alpha _____ dpm/100cm² <220
 . . Beta/Gamma _____ dpm/100cm² <2200

___ PRE-LOADING transport vehicle contamination survey completed. . . Alpha _____ dpm/100cm² <220
 . . Beta/Gamma _____ dpm/100cm² <2200

___ POST-LOADING transport vehicle contamination survey completed. . . Alpha _____ dpm/100cm² <220
 . . Beta/Gamma _____ dpm/100cm² <2200

POST-LOADING transport vehicle radiation survey:

___ Maximum total millirem/hr @ any point on the verticle planes projected from the outer edges of the vehicle. . . _____ <200.
 ___ Maximum total millirem/hr on the upper surface of the load. _____ <200.
 ___ Maximum total millirem/hr on the lower external surface of the vehicle. _____ <200.
 ___ Maximum total millirem/hr @ any point 2 meters from the vertical planes projected by the outer edges of the vehicle _____ <10.
 ___ Maximum total millirem/hr in any normally occupied space _____ <2.

SHIPPING CONTAINER DATA: Container No. _____ DOT Specification No. _____; marked on outer container: ___ Yes ___ NA

R.A.M. LABEL APPLIED:

___ Radioactive White I
 ___ Radioactive Yellow II
 ___ Radioactive Yellow III
 ___ Empty
 ___ No label required

OTHER MARKINGS APPLIED:

___ Consignee's or consignor's name & address
 ___ Proper shipping name/UN no. in block letters

___ Container Gross Weight _____ lbs.
 ___ Other: _____

OTHER LABELS APPLIED:

___ Cargo Aircraft Only

INNER PACKAGE:

___ Marked "Radioactive"

___ Strong, tight package
 ___ Package certification on file.
 ___ Package meets standard package requirements of 49CFR173.24
 ___ Package meets general package requirements of 49CFR173.411
 ___ Each Type A package meets the design requirements of 49CFR173.412
 ___ Tamper seal number(s) applied to container: _____
 ___ Transport index for this container: _____

GENERAL CERTIFICATIONS & INFORMATION:

___ Shipment meets quality control requirements 49CFR173.474 and 173.475.
 ___ Shipment secured in order to prevent shifting during normal transportation requirements.
 ___ Vehicle placarded ___ No placarding required.
 ___ Driver(s) briefed on nature of shipment, general route, emergency response procedure, shipping papers, shipping paper accessibility requirements (49CFR177.817(e)), maintenance of exclusive use of shipment, and placarding requirements(provide spares, if required).

RADIOACTIVE MATERIAL SHIPMENT CHECKLIST (CONT)

Page of Page(s)

- Consignee notified of departure time and ETA.
- DD Form 626 completed.
- Separation distance requirement of 49CFR177.842(b) met.
- DD Form 836 completed and driver(s) briefed.
- Shipment within limits prescribed for passenger cargo-only aircraft.
- Shipment contains radioactive material intended for use in, or incident to, research, medical diagnosis or treatment.
- Shippers Declaration of Dangerous Goods completed

SHIPPING PAPERS:

Shipping Papers Contain:

- | | |
|---|---|
| <input type="checkbox"/> Proper Shipping Name | <input type="checkbox"/> Category of label applied |
| <input type="checkbox"/> Hazard Class | <input type="checkbox"/> Transport Index |
| <input type="checkbox"/> UN Number | <input type="checkbox"/> Fissile Exempt |
| <input type="checkbox"/> Total Quantity of Material | <input type="checkbox"/> Exclusive use of vehicle |
| <input type="checkbox"/> Name of each Radionuclide | <input type="checkbox"/> 24 hour emergency response number |
| <input type="checkbox"/> Physical and chemical form | <input type="checkbox"/> 49CFR172.204 Shipper's Certification |
| <input type="checkbox"/> Activity in each package | <input type="checkbox"/> 49CFR173.421-1 statement |

Following provided with shipping papers:

- Instructions for maintaining exclusive use of vehicle.
- Emergency response plan.
- Receipt letter.

HEALTH PHYSICIST	Name Printed	Date
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ALL PURPOSE CHECKLIST		PAGE 1	OF 2	PAGES
TITLE/SUBJECT/ACTIVITY/FUNCTIONAL AREA RADIATION SAFETY PROGRAM		OPR DOL	DATE FEB 93	
NO.	ITEM <i>(Assign a paragraph number to each item. Draw a horizontal line between each major paragraph.)</i>	YES	NO	N/A
	All references are from GENR 161-1, dated Feb 89, unless otherwise specified.			
	1. Has the RPT completed a basic health physics technician course with certificate? (para 1-9a)			
	2. Are supervisors familiar with procedures to follow if one of their workers suspects that she may be pregnant? (para 1-11)			
	3. Are all female radiation workers familiar with procedures to follow when they suspect pregnancy? (1-12c)			
	4. Do all female radiation workers have a "Risk Acknowledgement" letter on file with the RSO? (para 1-9j)			
	5. Are all radiation workers briefed annually on radiation exposure including topics in para 1-9h?			
	6. Are at least 2 of each type of calibrated radiation instrument available at any time? (para 5-1a and subjective)			
	7. Are all rooms where radioisotopes are used surveyed monthly? (para 5-2)			
	8. Is the disposal of all radioactive lab waste such as glassware, containers, etc. surveyed, documented, and disposed of properly? (Chapter 10)			
	9. Is an inventory of all radioactive sources performed each quarter? (para 7-2)			
	10. Are all radioactive sources properly identified and labeled? (para 7-2)			
	11. Are all radioactive sources controlled to prevent theft, loss, damage, or unnecessary human radiation exposure? (chapter 8)			
	12. Are all receipts of radioactive material documented on Cen Form 93? (para 6-2)			
	13. Are all work areas properly posted for radiation hazards? (para 12-4)			
	14. Is the RSO immediately notified of losses or accidents involving radioisotopes? (para 11-6)			
	15. Is protective clothing (suits, gloves, booties, respirators, etc.) immediately available in case of contaminated work areas or accidents? (para 12-2j)			
	16. Are all sealed sources leak-tested as required? (para 5-3)			
	17. Do all purchase, disposal, and shipment actions of Radio Active Material receive prior approval of the RSO? (para 6-1a, 9-3, 10-2)			
	18. Does the RPT maintain procedures for each worst case accident situation? (para 11-1)			
	19. Does the RPT maintain a series 161 OI pertaining to his/her organization? (para 1-9c)			
	20. Does the RPT maintain current copies of applicable permit documents? (para 1-9f)			

NO.	ITEM <i>(Assign a paragraph number to each item. Draw a horizontal line between each major paragraph.)</i>	YES	NO	N/A
21.	Are NRC-3 forms posted for radiation workers to review? (para 1-9g)			
22.	Is the required notation attached to the NRC-3 forms? (para 1-9g)			
23.	Does the RPT provide initial orientation and annual recertification to all radiation workers? (para 1-9h)			
24.	Is radiation worker training documented on AF Form 55? (para 1-9h)			
25.	Is there an active dosimetry program? (para 4-1)			
26.	Are the dosimetry results reviewed by the RPT? (para 4-5)			
27.	Does the dosimetry program contain provisions for briefing and monitoring visitors? (para 4-1)			
28.	Are NRC-4 forms (or equivalent) on file for all assigned radiation workers? (para 4-3)			
29.	Does the RPT have procedures to investigate radiation doses above the preset "investigation level"? (para 4-5)			