

RESUBMITTAL OF PRIOR APPLICATIONS
AND SUPPLEMENTS FOR APPROVAL TO
TRANSPORT THE SENTINEL-25F
RADIOISOTOPE THERMOELECTRIC GENERATOR
AND NEW INFORMATION TO SUPPORT THE
TYPE B () DESIGNATION

TES-3202

APRIL 19, 1985

REVISION 1

OCTOBER 1986

 **TELEDYNE ENERGY SYSTEMS**

110 West Timonium Road
Timonium, Maryland 21093

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PDR ADOCK 07104888
6 PDR

PREFACE TO REVISION 1R1
10/86

Revision 1 is in response to a NRC request* to supply component drawings for each of the Sentinel 25 series generators for the following components:

- Shield Body
- Shield Plug
- Generator Housing (Shield Vessel)
- Generator Housing Lid (Shield Vessel Lid)

There were eight Sentinel 25F generators constructed. The first five, serial numbers SN-012 through SN-016, were built circa 1970. These five units were constructed in accordance with assembly 009 of the top assembly drawing (001F10000) included with the original issue of this report. The units were fueled with the strontium titanate fuel form.

The remaining three units, SN-022 through SN-024, were built in 1976 to assembly 019 of Dwg. 001F10000. These three units were fueled with the strontium fluoride fuel form.

In response to the NRC request, a summary of the information provided follows.

* U.S. NRC Letter FCTC:CEW 71-4888, dated 23 September 1986 from Charles E. MacDonald to John W. McGrew (TES) with enclosure.

SENTINEL-25FR1
10/86

<u>UNITS</u>	<u>APPROXIMATE DATE OF CONSTRUCTION</u>	<u>FUEL FORM</u>
SN-012 through 016	1970	Sr_2TiO_3
SN-022, 023, 024	1976	SrF_2

<u>COMPONENT/ASSEMBLY</u>	<u>DRAWING NO.</u>	<u>REMARKS</u>
Top Assembly	001F10000	Included w/April '85 submittal
Shield Body	001-70009	Included w/Rev. 1 - Appropriate shield body is detail 005 of this drawing
Shield Plug	001-70060	Included w/Rev. 1 - Appropriate shield plug is detail 003 of this drawing
Shielding Specification (Tungsten Alloy)	001-80003	Included w/Rev. 1 (Appendix E)
Generator Housing	001-70070	Included w/Rev. 1 - Housing is construct- ed of 6061-T6 aluminum
Generator Housing Lid	001-40025	Included w/Rev. 1

TABLE OF CONTENTS

	<u>Page</u>
Preface	i
Preface to Revision 1	iii R1 10/86
Table of Contents	v
List of Figures	vii
I. Introduction	I-1
II. Generator Description	II-1
A. Change of Fuel Form to Strontium Fluoride (January 25, 1978)	II-4
B. Unit Maximum Internal Pressure (April 1985)	II-4
C. Security Seal Requirement (April 1985)	II-5
D. Inadvertent Opening (April 1985)	II-5
III. Fuel Capsule	III-1
A. Design Criterial	III-3
B. Material Properties	III-3
C. Stress Calculations	III-3
D. Quality Assurance	III-6
E. Information in Support of the Change to the Strontium Titanate Fuel Form (January 25, 1978)	III-7
IV. Heat Source	IV-1
Radiation Levels for Units Fueled with Strontium Fluoride (January 25, 1978)	IV-1
Structural Analysis	IV-2
A. Impact on Shield Body	IV-3
B. Impact on Shield Lid	IV-6
C. Lid Attaching Bolts	IV-7
D. Impact of Shield on Rigid Cylinder	IV-9
V. Generator Housing	V-1
A. Generator Mounting	V-1
B. Hydrostatic Pressure	V-5

TABLE OF CONTENTS (Continued)

	<u>Page</u>
VI. Shipping Pallet	VI-1
Note (April 1985)	VI-1
VII. Hypothetical Accident Fire Analysis	VII-1
A. Summary of Fire Analysis	VII-1
B. Description of Analysis	VII-2
C. Results and Conclusions	VII-7
D. Thermal Analysis for Units Fueled with Strontium Fluoride (January 25, 1978)	VII-11
References	R-1
Appendix A - Thermal Analysis Appendix to Original Report	A-1
Appendix B - Supplemental Capsule Data (April 1, 1985)	B-1
Appendix C - Modifications of Shipping Package for Sentinel (LCG) Generators to Eliminate the Protective Cage (April 1985)	C-1
Appendix D - Drawings	D-1
Appendix E - Specification for Shield Material	E-1

R1
10/86

APPENDIX D
DRAWINGS
(April 1985)

Included in this appendix are the drawings relevant to the generator configuration and current shipping package.

<u>DWG. NO.</u>	<u>DESCRIPTION</u>
001F10000	SENTINEL 25F Top Assembly Dwg.
001-70009	Shield Body
001-70060	Shield Plug
001-70070	Housing, Generator
001-40025	Lid Assembly
001-90039	Pallet Assembly (Sheets 1, 2, 3)

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APPENDIX E

SPECIFICATION FOR SHIELD MATERIAL

Included herein is specification 001-80003 for the tungsten alloy material of the shield body and shield plug.

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CLASSIFIER *George Stover 7/13/67*

This specification is to be used for material control only.



ISOTOPES
NUCLEAR SYSTEMS DIVISION
A TELEDYNE COMPANY

Baltimore, Maryland

DRAWN BY DATE

W. Miller Jr. 6-30-67

CHECKER

H. Kelly 7/13/67

APPROVED

A.J. Strob m.s.

APPROVED SHIELDING

A.M. Spamer 7/13/67

~~TELEDYNE CORPORATION~~
A DIVISION OF TELEDYNE INTERNATIONAL CORPORATION
TELEDYNE INTERNATIONAL AIRPORT, MILLS AND STATION

SHIELDING SPECIFICATION

MATERIAL

SIZE

A

CODE IDENT NO.

30856

18373

001-80003

REV

E

SCALE

SHEET

1 OF 7

005-30/1007-55/ 005-6 007-12 ↑ 001-32

001-10 FORM MM-1112A 02-65

REVISIONS

SYM	PAGE	DESCRIPTION	DATE	APPROVED																		
A	5	Revised Table I; <u>WAS</u> <u>Temperature</u> <table border="1"> <thead> <tr> <th>Property</th> <th>70°F</th> <th>1500°F</th> </tr> </thead> <tbody> <tr> <td>0.2% Tensile Yield (PSI)</td> <td>75,000</td> <td>30,000</td> </tr> <tr> <td>0.2% Compressive Yield (PSI)</td> <td>75,000</td> <td>30,000</td> </tr> <tr> <td>Ultimate Tensile Strength (PSI)</td> <td>105,000</td> <td>45,000</td> </tr> <tr> <td>Ultimate Compressive Strength (PSI)</td> <td>105,000</td> <td>45,000</td> </tr> <tr> <td>Elongation at Fracture in Tensile Test (%)</td> <td>7</td> <td>5</td> </tr> </tbody> </table> Paragraph 3.4 <u>WAS</u> Martin <u>NOW</u> Isotopes Paragraph 4.3 <u>WAS</u> Martin Marietta Corporation <u>NOW</u> Isotopes Paragraph 6.1.2 <u>WAS</u> Martin <u>NOW</u> Isotopes	Property	70°F	1500°F	0.2% Tensile Yield (PSI)	75,000	30,000	0.2% Compressive Yield (PSI)	75,000	30,000	Ultimate Tensile Strength (PSI)	105,000	45,000	Ultimate Compressive Strength (PSI)	105,000	45,000	Elongation at Fracture in Tensile Test (%)	7	5	11/4/68	P. Aller PFA W.A.M
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Ultimate Compressive Strength (PSI)	105,000	45,000																				
Elongation at Fracture in Tensile Test (%)	7	5																				
B	5	Elongation at Fracture in Tensile Test (%) <u>WAS</u> 7 <u>NOW</u> 5 ADDED PLATING CALLOUT & THICKNESS IN PARA. 3.3	12/2/68	P. Aller PFA W.A.M																		
C	8	Deleted 7.0, now 7.1 Added Approved Sources in SECTION 7.0	5-12-69	J. HINES Hines																		
D	6	Appropriate engineering drawing was para. 3.1 in para. 4.1 Add certification requirement in para. 4.3 3.2 was 3.1.1 in para. 4.4	2-20-71	025-011 J. HINES																		
D	7	Added "Powder Alloys" as approved source.	1-20-81	J. HINES 026-006																		

CODE IDENT NO.

30856
18591

SIZE

A

001-80003

CHG.

E

SCALE

PAGE

2

1.0 SCOPE

1.1 Purpose - This specification establishes the requirement for the design and manufacture of the biological shield for a radioisotope fueled thermoelectric power generator. The shielding is required to limit the radiation from the generator assembly.

2.0 APPLICABLE DOCUMENTS

None

3.0 REQUIREMENTS

The design and construction of the shield shall be in accordance with the requirements of this specification and any referenced specifications or other documents specified herein.

3.1 Material - The shield pieces shall be fabricated from a tungsten alloy consisting primarily of tungsten with small additions of copper and nickel, or other metals as binding agents. The material shall be formed by powder metallurgy techniques.

3.1.1 Density - The shield pieces shall have a density at room temperature of not less than 16.9 grams per cubic centimeters (.611 pound per cubic inch).

3.1.2 Mechanical Properties - The material in the shield shall have the mechanical properties presented in Table I as a minimum.

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	A	30856	001-80003
REV			
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TABLE I (A)

Minimum Mechanical Properties

<u>Property</u>	<u>Temperature</u>	
	<u>70°F</u>	<u>1300°F</u>
0.2% Tensile Yield (psi)	75,000	25,500
0.2% Compressive Yield (psi)	75,000	25,500
Ultimate Tensile Strength (psi)	94,000	31,000
Ultimate Compressive Strength (psi)	94,000	31,000
Elongation at Fracture in Tensile Test (%) (B)	5	4

3.2 Tolerances - Tolerances not specified herein shall be held and limited to good commercial standards.

(B) 3.3 Oxidation Retarding Coating - The surfaces of the shield pieces shall be plated with chrome plate to a thickness of 4 to 6 mils. per standard plating processes.

(A) 3.4 Method of Assembly - (A) Isotopes will provide Fe base super-alloy bolts to hold the shield plug onto the shield body and will assemble the shield in a hot cell following insertion of a radioisotope filled fuel capsule (Ni base super-alloy) into the shield body.

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	A	30856	
SCALE		SHEET 5	

3.5 Environment - The normal operating environment of the shield pieces will be as follows:

Temperature - 1200°F to 1600°F

Atmosphere - Argon - 99%

Balance - CO₂, O₂, H₂, N₂.

The shield pieces will be operated in a sealed chamber. Under emergency conditions the environment of paragraph 3.3 may be experienced.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Dimensions - The dimensions of the shield pieces will be checked for compliance with the appropriate engineering drawing.

4.2 Integrity of Oxidation Retarding Coating - The shield pieces will be inspected to determine the freedom of the oxidation resistance coating from disfiguration. Any disfiguration, and in particular nicks, scratches and blisters, discernible with unaided eye, shall be cause for rejection.

4.3 The average density of both shield pieces shall be measured by water displacement and weighing and recorded. The average density of the pieces, individually, shall be not less than 16.9 grams per cubic centimeter. If the average density of the piece is less than 16.9 grams per cubic centimeter, the part shall be rejected. Certification of density shall be transmitted with the shield pieces.

4.4 Material Strength Verification - Test data verifying the conformance of the material used in the shield pieces to the mechanical properties requirements at 70°F of paragraph 3.1.2 shall be transmitted with

	SIZE	CODE IDENT NO.	
	A	30856	00-80003
REV D	SCALE		SHEET 6

the shield pieces. Material property tests shall be run on test pieces that are fabricated from the same raw material lots and processed at the same time as the shield pieces.

4.4.1 Vendor shall submit the test procedures along with the test results.

4.5 Vendor shall submit certification of material composition with the pieces.

5.0 PREPARATION FOR DELIVERY - Preparation for delivery shall be in accordance with best commercial practices with particular care taken to insure that the oxidation retarding coating is not nicked or marred during transportation.

6.0 NOTES

6.1 Definitions

6.1.1 Manufacturer or Vendor - The manufacturer or vendor shall be the industrial organization awarded the procurement agreement of which this specification becomes a part.

④ 6.1.2 Isotopes - Isotopes shall be Teledyne Isotopes, Nuclear Systems Division, 110 W. Timonium Rd., Timonium, Md. 21093.

③ 7.0 APPROVED SOURCES

1. Sylvania Electric Products, Inc.
Chemical and Metallurgical Division
Towanda, Pennsylvania 18848

2. Kennametal, Inc.
Latrobe, Pennsylvania 15650

⑤ 3. Powder Alloys
Clifton, New Jersey 07013

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LCG-25B

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GENERATOR ASSEMBLY

LCG-25A

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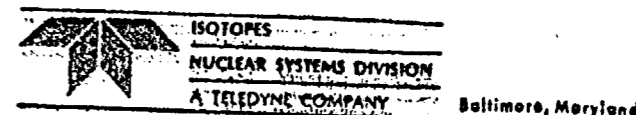
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SENTINEL 25C**

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