RESUBMITTAL OF PRIOR APPLICATIONS AND SUPPLEMENTS FOR APPROVAL TO TRANSPORT THE SENTINEL 25E RADIOISOTOPE THERMOELECTRIC GENERATOR AS A TYPE B( ) PACKAGE

TES-3213

AUGUST 1986

REVISION 1

OCTOBER 1986

TELEDYNE
ENERGY SYSTEMS

110 WEST TIMONIUM ROAD
TIMONIUM, MARYLAND 21093

R1
10/86

PREFACE TO REVISION 1

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 a total of eight Sentinel 25E generators constructed. The first three, serial number SN-008, 009 and 010 were built circa 1968, 69. For the remaining five units. SN-017 through 021 (built in 1970-71), the design was modified as explained below. In response to the NRC request, a summary of the information provided for the 25E units follows.

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

SENTINEL 25E

R1
10/86

SN-008 THROUGH 010, BUILT 1968, 69

SN-017 THROUGH 021, BUILT 1970, 71

COMPONENT/ASSEMBLY	DRAWING NO.	REMARKS
Top Assembly	001D10000, 2 Sheets	Included w/Aug. '86 submittal - two assemblies (009 and 019) shown on this dwg. - see text below
Shield Body	001-70024	Included w/Aug. '86 submittal
Shield Plug	001-70025	Included w/Rev. 1 - two details (001 and 003) shown on dwg. - see text below
Shield Specification (Tungsten Alloy)	001-80003	Included w/Rev. 1 (Appendix D)
Generator Housing	001-70039	Included w/Rev. 1
Generator Housing Lid	001-40017, 2 Sheets	Included w/Aug. '86 submittal

Units SN-008 through 010 were constructed to assembly 009 of the top assembly drawing. The shield plug for these unis is detail 001 of Dwg. 001-70025.

Units SN-017 through 021 were constructed to assembly 019 of the top assembly drawing. The shield plug for these units is detail 003 of Dwg. 001-70025.

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APPENDIX A

DRAWING LIST

(August 1986)

The following drawings are included with and form part of this report.

Fuel Capsule - All Sentinel (LCG) - 25 units

Isotopes, Inc. Drawings:

001-20000	Fuel Capsule Assembly
001-20001	Housing
001-20002	End Cap
001-20003, Sheet 1	Liner, Capsule

Sentinel-25E

001E10000 (3 Sheets)	Generator Assembly 25E	
001-70024	Shield Body	
001-40006	Finned Lid for Shipping	
001-40017 (2 Sheets)	Lid 25E	
001-70025, Sheets 1, 2	Shield Plug	R1 10/86
001-70039	Shield Vessel Machined	

Shipping Pallet - All Sentinel (LCG) - 25 units

001-90039	Shipping Pallet: Sheets 1, 2, 3

APPENDIX D

SPECIFICATION FOR SHIELD MATERIAL

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

SECURITY REVIEW | UNCL. CONF. SECRET
DI RD GP: 1 2 3 4
CLASSIFIER George L Stevens 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. Stolb m.s.
APPROVED SHIELDING	A.M. SPAHR 7/13/67

SHIELDING SPECIFICATION

MATERIAL	SIZE	CODE IDENT NO.	
REV E	A	30856	001-80003
	SCALE		SHEET 1 OF 7

005-30 | 007-35 | 005-6 | 007-12 | 001-32 | 001-10 FORM MH-1112A (12-65)

REVISIONS

SYM	PAGE	DESCRIPTION	DATE	APPROVED
A	5	Revised Table I; WAS	11/4/68	P. Aller PFA W.A.M
		Property / Temperature 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		
		Paragraph 3.4 WAS Martin NOW Isotopes		
	6	Paragraph 4.3 WAS Martin Marietta Corporation NOW Isotopes		
	7	Paragraph 6.1.2 WAS Martin NOW Isotopes		
B	5	Elongation at Fracture in Tensile Test (%) WAS 7 NOW 5 ADDED PLATING CALLOUT & THICKNESS IN PARA 3.3	12/2/68	P. Aller PFA W.A.M
C	8	Added Approved Sources IN SECTION 7.0	3-12-69	J. HIMES
D	6	Appropriate engineering drawing was para. 3.1 in para. 4.1		625-011
		Add certification requirement in para. 4.3 3.2 was 3.1.1 in para. 4.4	2-20-71	J. HIMES
D	7	Added "Powder Alloys" as approved source.	1-20-81	J. HIMES 026-006

CHG. E

CODE IDENT NO. 30856 80597

SIZE A

001-80003

SCALE

PAGE 2

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SHEET	REV	SHEET	REV	SHEET	REV
1	A, B, D, E				
2	A, B, D, E				
3	A, B, D, E				
4					
5	A, B				
6	A, D				
7	A, C, E				

SIZE	CODE IDENT NO.	
A	30856 [redacted]	001-80003

REV D

SCALE

SHEET 3

FORM MM-1112 (12-65)

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.

TABLE I (A)

Minimum Mechanical Properties

Property	Temperature 70°F	1300°F
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.

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

(A) 3.4 Method of Assembly - 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	001-80003
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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 - CO_2, O_2, H_2, N_2.

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

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.

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

(C) 7.0 APPROVED SOURCES

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

2. Kennametal, Inc.
Latrobe, Pennsylvania 15650

(E) 3. Powder Alloys
Clifton, New Jersey 07013

REV	SIZE	CODE IDENT NO.	001-80003
E	A	30856 [redacted]	
	SCALE		SHEET 7

FORM MM-1112A (12-65)