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

TES-3212

AUGUST 1986

REVISION 1

OCTOBER 1986

TELEDYNE
ENERGY SYSTEMS

110 WEST TIMONIUM ROAD
TIMONIUM, MARYLAND 21093

PREFACE TO REVISION 1

R1
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 three Sentinel 25D units constructed circa 1968: serial numbers SN-005, SN-006 and SN-007. In response to the NRC request, a summary of the information provided for this unit follows:

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

R1
10/86

SENTINEL-25D

SN-005, 006, 007

CONSTRUCTED CIRCA 1968

COMPONENT/ASSEMBLY	DRAWING NO.	REMARKS
Top Assembly	001D10000	Included w/Aug. '86 submittal
Shield Body	001-70024	Included w/Aug. '86 submittal
Shield Plug	001-70025	Included w/Rev. 1 - the shield plug for the 25D units is Detail-001
Shield Specification (Tungsten Alloy)	001-80003	Included w/Rev. 1 (Appendix D)
Generator Housing (Shield Vessel)	001-70036 001-70033	Included w/Rev. 1 - see text below
Cast Generator Housing Specification	001-80005	Included w/Rev. 1 (Appendix D)
Generator Housing Lid (Shield Vessel Lid)	001-40015	Included w/Aug. '86 submittal

Regarding the generator housing (shield vessel), Dwg. 001-70036 provides the casting details; Spec. 001-80005 provides the material properties. After casting, the housing was then machined to final dimensions as per Dwg. 001-70033.

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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-25D

001D10000, 2 Sheets	Generator Assembly 25D	
001-70024	Shield Body	
001-40006	Finned Lid for Shipping	
001-40015	Lid 25D	
001-70025, Sheet 1	Shield Plug	R1
001-70036	Casting, Shield Vessel	10/86
001-70033	Shield Vessel, Machined	

Shipping Pallet - All Sentinel (LCG) -25 units.

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

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APPENDIX D

SPECIFICATIONS FOR SHIELD AND GENERATOR HOUSING MATERIALS

Included herein are the specifications for:

	Spec. No., Title
Tungsten Alloy, Shield Body and Shield Plug	001-80003, Shielding Specification
Forging Specification for Generator Housing	001-80004, Forging Specification

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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
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[redacted] CORPORATION
A DIVISION OF [redacted]
[redacted] INTERNATIONAL AIRPORT, [redacted]

SHIELDING SPECIFICATION

MATERIAL	SIZE	CODE IDENT NO.	001-80003
	A	30856 [redacted]	
REV E	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 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 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	11/4/68	P. Aller PFA W.A.M
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	[illegible] Added Approved Sources IN SECTION 7.0	5-12-69	J. HIMES Hordes
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	625-011 J. HIMES
D	7	Added "Powder Alloys" as approved source.	1-20-81	J. HIMES 026-006

CHG.	CODE IDENT NO.	SIZE	
E	30856 [illegible]8597	A	001-80003
	SCALE		PAGE 2

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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

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 (B) 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.

REV	SIZE	CODE IDENT NO.	
	A	30856	001-80003
	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 - 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

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DI RD GP: 1 2 3 4
CLASSIFIER Gayle Stivers 7/13/67

[redacted]

DRAWN BY / DATE	W. Miller Jr 7-7-67
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APPROVED	

MARTIN COMPANY
A DIVISION OF MARTIN MARIETTA CORPORATION
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FORGING SPECIFICATION

MATERIAL	REV	SIZE	CODE IDENT NO.	
		A	38597	001-80004
		SCALE		SHEET 1 OF 5

REVISIONS				
SYM	SHEET	DESCRIPTION	DATE	APPROVED

REV	SIZE A	CODE IDENT NO. 38597	001-80004
	SCALE		SHEET 2

FORM MM-1111 (12-65)

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	REV	SIZE A	CODE IDENT NO. 38597	001-80004
		SCALE		SHEET 3

FORM MM-1112 (12-65)

SPECIFICATIONS

1.0 SCOPE

1.1 Purpose - This specification establishes the requirements for a forging billet suitable for machining to finish dimensions for use as a pressure vessel for deep sea immersion.

20. APPLICABLE DOCUMENTS

2.1 The following documents form a part of this specification to the extent specified herein. Unless otherwise designated, referenced documents shall be to the issue in effect on July 7, 1967 except that the supplier may use later issued and/or superseding documents when such requirements would not cause degradation, non-interchangeability, re-qualification, increased cost or schedule delay.

QQA-367
6061-T6 Forging

3.0 REQUIREMENTS

3.1 General - The forging shall be in accordance with the requirements of this specification and any referenced specification and/or other documents specified herein. In case of conflict between the requirements of this specification and any referenced document, the requirements of this specification shall govern.

3.1.1 Material - The forging shall be fabricated from Aluminum Alloy of the composition 6061-T6, per QQA-367.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Inspection - The forging shall be inspected and verified per the requirements of QQA-367.

5.0 PREPARATION FOR DELIVERY

5.1 Packaging - The packaging shall conform to consolidated freight classification rules and Interstate Commerce regulations to insure safe delivery to the destination at lowest weight and smallest size.

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 forms a part.

6.1.2 Martin - Martin shall be the Martin Marietta Corporation, Nuclear Division, Baltimore, Maryland 21203.

REV	SIZE	CODE IDENT NO.	001-80004
	A	38597	
	SCALE		SHEET 5

FORM MM-1112A (12-65)