

**TELEDYNE ENERGY SYSTEMS**

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August 30, 1985

Refer to: SEN-JFV-449  
S1002.9

'85 SEP -6 A11 :50

71-5862  
PDR

**RETURN TO 396-SS**

Mr. Charles E. MacDonald  
Chief, Transportation Certification Branch  
Mail Stop 396-SS  
Nuclear Regulatory Commission  
Washington, DC 20555

Subject: Certificate of Compliance No. 5862; Docket No. 71-5862

Dear Mr. MacDonald:

This submittal is in response to your letter FCTC:CEW 71-5862 dated July 25, 1985 with an enclosure entitled "Teledyne Energy Systems, Model No. Sentinel 100F, Docket No. 71-5862 dated July 25, 1985."

In response, we are submitting revisions to the consolidated application INSD-3080, "Structural and Thermal Evaluation of Sentinel 100F," June 1985, Teledyne Energy Systems. As requested, the revisions are in the form of revised or new pages for this report. Specific instructions for modifying the report are provided below.

Item 1 of the enclosure requested a discussion of the procedures for preparation of the package for shipment specific to the requirements of 10CFR71.87. Appendix E of the revision addresses the requirements of both 71.85 and 71.87.

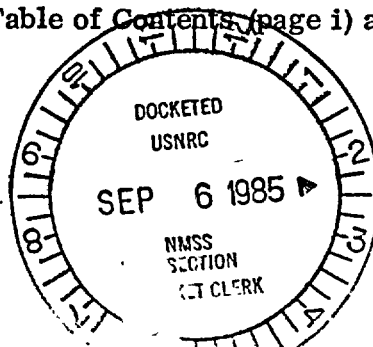
Item 2 stated that certain areas must be addressed prior to fabrication of additional packages - specifically the acceptance tests of 71.85 and drawing revisions. For purposes of the existing unit, the requirements of 71.85 have been addressed in Appendix E. With regard to new builds, we have not responded to this item since there are no plans or intentions to build additional Sentinel-100F units for reasons which have been stated in Appendix E. Owing to the non-availability of the fuel form, SrTiO<sub>2</sub>, a new unit would use a different fuel form and would be considered a new model requiring a new Certificate of Compliance application.

Item 3 requested an explanation of certain drawing revisions and a discussion of their effects on package performance. This information is provided in the revised pages as Appendix F.

Ten copies of the report page revisions are furnished. Revise INSD-3080 as follows:

1. Replace Report Title page, Table of Contents (page i) and the second page of the Preface (page ii).

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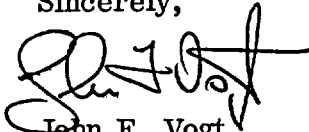
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Refer to: SEN-JFV-449  
August 30, 1985  
Page 2

2. Add Appendices E and F to the report. The last page of the current report is page 110 (Appendix D). Add pages 111 through 121 (Appendices E and F).

If you have any questions about the enclosure, please call me or Mr. Don Owings at 301-252-8220.

Sincerely,



John F. Vogt  
Project Manager

- Encls.:
- (1) Revised Title Page (10 copies)
  - (2) Revised Table of Contents (10 copies)
  - (3) Revised page ii of Preface (10 copies)
  - (4) New Appendix E (10 copies)
  - (5) New Appendix F (10 copies)

STRUCTURAL AND THERMAL  
EVALUATION  
OF SENTINEL 100F

INSD-3080

AUGUST 1985

Original Issue - August 10, 1971

Revision 1 - September 7, 1971  
(Pages 45-49 inclusive)

Revision 2 - September 24, 1971

Revision 3 - October 22, 1971

Revision 4 - June 1985

Revision 5 - August 1985

TELEDYNE ENERGY SYSTEMS  
110 West Timonium Road  
Timonium, Maryland 21093  
301-252-8220

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To reiterate, the current version of the report consists of a compilation of relevant information originally submitted over the period August 10, 1971 through January 19, 1972. Editorial remarks have been included for clarification. No new analysis is presented. The report addresses the USAEC, IAEA and DOT regulations which were in effect in the late 1971, early 1972 time period for transport of a Type B ( ) package. These conditions and requirements are summarized in the body of the report.

Revision 5, August 1985, is provided in response to an inquiry from the NRC dated July 25, 1985. This revision adds Appendices E and F.

| R5

APPENDIX E  
PREPARATION OF THE PACKAGE FOR SHIPMENT

R5  
8/85

This appendix was prepared in response to item 1 of the enclosure of an inquiry from the NRC.\* It addresses the preparation of the package for shipment used to satisfy the requirements of both 10CFR 71.85 and 71.87.

The Sentinel 100F unit is unique in that only one unit was constructed and there are no current plans to construct and transport additional units under the license supported by this application. Indeed, construction of a new unit as described herein is not possible since the fuel form peculiar to this unit,  $\text{Sr}_2\text{TiO}_4$ , is no longer available and there are no longer available and there are no plans to produce additional fuel in this form.

The procedures described herein pertaining to the RTG housing and pallet were applied during the construction phase of the unit with the intent of assuring a sealed unit with adequate structural integrity. (The RTG housing, bolted to a steel pallet assembly comprises the transportation package.) Section E.1 (below) addresses the specific requirements of 71.85.

Section E.3 addresses the specific requirements of 71.87.

E.1. Housing Seal and Structural Integrity

The RTG housing is comprised of a cylindrical shell with a 3.25" thick solid bottom plate welded in place at one end and a 2.50" thick flange welded at the open end. The weld joint configurations and inspection techniques were evaluated using weld test specimens. The specimens were subjected to tensile tests, bend tests, load/deflection tests and hardness tests to determine the effects of heat treatment. The final weld joints were inspected by an ultrasonic technique and the acceptance criteria established in TES DWG 010-800003 "ACCEPTANCE SPECIFICATION - SENTINEL

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\*Letter FCTC:CEW 71-5862, to Teledyne Energy Systems from Charles E. MacDonald, dated July 25, 1985.

100F HOUSING." This document and the test certification is included as item E.2 below.

In addition, the finished housing, with lid attached was subjected to a helium leak test with acceptance level of  $5 \times 10^{-7}$  cc/sec @ STP.

The RTG was originally designed to operate at an external hydrostatic pressure of 500 psi. Although the vessel was not actually tested, the analysis herein demonstrates considerable margins at a proof pressure of 1300 psi.

The RTG is bolted to a steel pallet assembly for shipment using the hardware shown in Figure E.1. Hardware is torqued to  $300 \pm 30$  foot pounds.

### E.2. Housing Acceptance Specification and Certification

This section provides drawing 010-800003, Acceptance Specification - Sentinel 100F housing and the associated Certification by Reliance Testing Lab., Inc. cited in section E.1.

### E.3. Preparation of Package Prior to Shipment

An operating manual\* was prepared for this and other Sentinel units. The manual includes specific instructions related to shipment including:

- a. Lifting and handling instructions for the RTG and the RTG-pallet assembly (package).
- b. Instructions for mounting the RTG to the pallet.

Prior to shipment, visual inspections are to be performed to assure the package is in unimpaired physical condition. Since the RTG was constructed as and remains a sealed unit, there are no gaskets or closure devices which require examination. The unit does not contain liquid. It is not equipped with a pressure relief device.

Prior to each shipment, standard wipe tests are performed to measure the level of non-fixed radioactive contamination on the surface of the package. The measure-

\*TES-3148, "Operation Manual for Sentinel Radioisotope Thermoelectric Generators used in AFTAC Seismic Sensor Station, Burnt Mountain, Alaska," Feb. 1985, revised June 1985, Teledyne Energy Systems.

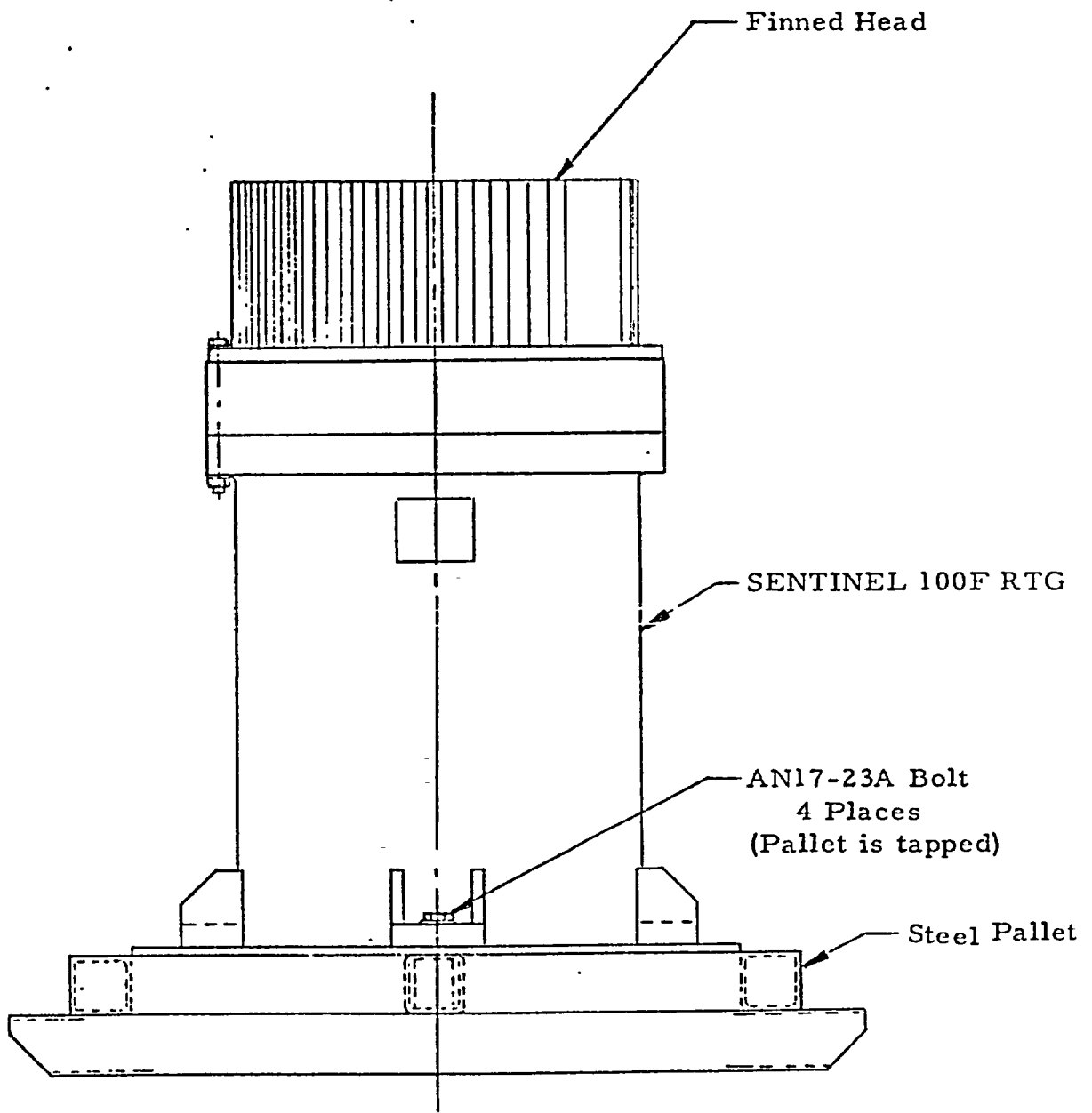



FIGURE E.1. RTG TO PALLET MOUNTING HARDWARE



SECURITY REVIEW UNCL. CONF. SECRET DI RD GP:1234 CLASSIFIER _____	REVISIONS: SEE SHEET _____					REV LEVEL			
	DWG	THIS SHEET							
010-80003									
EFFECTIVE ON	CALC WT	DASH NUMBER	NEXT ASSEMBLY	USED ON	NEXT ASSY	FINAL ASSY	TEST		
APPLICATION					QTY REQD				
CONTRACT NO. DRAWN BY <i>J. Mares</i> DATE <i>8/6/71</i> CHECKER STRESS ENGR. WT. ENGR. MATL. ENGR. RELIABILITY GR. ENGR. PROJECT ENGR. <i>E. M. [Signature]</i> <i>8/5/71</i>			 ISOTOPES NUCLEAR SYSTEMS DIVISION A TELEDYNE COMPANY <span style="float: right; font-size: small;">Beltsville Maryland</span>					<b>ACCEPTANCE SPECIFICATION - SENTINEL 100F HOUSING</b>	
			SIZE <b>A</b>	CODE IDENT NO. <b>30856</b>	010-80003				
			SCALE	SHEET 1 OF 5			018-56		

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INSD-3080 --





**I. SCOPE**

This document contains the requirements and acceptance criteria for the welded joints in the SENTINEL 100F housing.

**II. APPLICABLE DOCUMENTS**

010-70001 Housing Weldment  
Navships 0900-006-3010, latest revision, "Ultrasonic Inspection Procedure and Acceptance Standards for Hull Structure Production and Repair Welds".

**III. PROCEDURE**

Ultrasonic testing is to be performed in accordance with NAVSHIPS 0900-006-3010.

**IV. ACCEPTANCE CRITERIA**

**a. Upper Weld Joint**

1. Any discontinuity whose reflection exceeds the ARL\* and has a length which exceeds 3/8" shall be rejected. Adjacent discontinuities whose reflections exceed the ARL, separated by less than 2 times the length of the longest reflection, shall be considered as a single discontinuity.

2. Indications less than the DRL\* shall be disregarded.

3. Discontinuities whose reflections equal the DRL\*, or are greater, up to and including ARL, shall be evaluated as follows:

a) If discontinuity length exceeds 3/8 inch, it shall be rejected.

b) Adjacent discontinuities separated by less than 2 times the length of the longest reflection shall be considered as a single discontinuity. The maximum distance between the outer extremities of any two such adjacent discontinuities or the sum of these lengths, whichever is greater, shall not exceed 3/8 inch.

c) If the total accumulative length of discontinuities in any 12 inches of weld length exceeds 2 inches, that weld length shall be rejected.

**b. Lower Weld Joint**

**1. Outer weld**

a) Any single discontinuity whose reflection exceeds ARL\* and has a length which exceeds 3/8 inch shall be rejected.

	SIZE	CODE IDENT NO.	
	<b>A</b>	<b>30856</b>	010-800003
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b) Indications less than DRL\* shall be disregarded.

c) Discontinuities whose reflection are equal to or greater than the DRL\*, shall be rejected if the discontinuity length exceeds 3/8 inch.

d) Adjacent discontinuities separated by less than 2 times the length of the largest discontinuity shall be considered as a single discontinuity and the maximum distance between the outer extremities of any two adjacent discontinuities shall not exceed 1/2 inch.

e) If the total accumulative length of discontinuities in any 12 inches of weld length exceeds 2-3/4 inches, that weld length shall be rejected.

f) The weld penetration shall not be less than 7/8 inch.

## 2. Fillet Weld

a) Any discontinuities less than DRL\* shall be disregarded.

b) Any discontinuity whose reflection exceeds 3/8 inch shall be rejected.

c) Adjacent discontinuities separated by less than 2 times the length of the largest reflection shall be considered as a single discontinuity.

d) Fillet weld leg shall not be less than 1/2 inch.

## IV. QUALITY ASSURANCE

Discontinuities and weld penetration are to be mapped or plotted in accordance with NAVSHIP 0900-006-3010. Five copies of all plots are to be submitted to Teledyne Isotopes, Quality Control Department, along with certification and a brief summary report of test results.

\* DRL means "Disregard Level" and ARL means "Amplitude Rejection Level" as defined in NAVSHIPS 0900-006-3010.

	SIZE	CODE IDENT NO.	
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R  
T  
L

# Reliance Testing Laboratories, Inc.

P.O. Box 85, Timonium, Maryland 21093 - (301) 252-6030

P.O. BOX 85, Timonium, Maryland 21093 - (301) 252-6030 September 4, 1971

## CERTIFICATION

REPORT NO. A-192

Metcraft Products Company  
1807 East Street  
Baltimore, Maryland 21227

Attn: A. Zelinka

REF: Purchase Order No.: 12372

Parts Name Sentinel 100F Housing Parts No.: 010-70001

Date of Inspection: August 6, 16 & 30, 1971 Method of Inspection: Ultrasonic Test

Specifications: Procedure: NAVSIPS 0900-006-3010 Ultrasonic Inspection Procedure

Evaluation: Acceptance Specification 010-800003

Technique of Inspection: A Model 715 Reflectoscope and a 5.0 MHz 1/2 inch dia. transducer was used. Instrument and inspection calibrations were made using the IIW Standard Block and the Series "B" depth/amplitude blocks having a 3/64" dia. flat bottom hole.

### Evaluation of Test Results:

No discontinuities exceeding the acceptance criteria of the specification were found when inspected in the annealed condition.

Inspection techniques requiring Government approval have been so approved and certificates are on file.

I HEREBY CERTIFY THE ABOVE TO BE TRULY EXTRACTED FROM ORIGINAL INSPECTION REPORTS PERTAINING TO STATED ORDER, THE ORIGINAL REPORTS ARE KEPT ON FILE AT RELIANCE TESTING LABORATORIES, INC.

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*G. H. Schaeffer*  
G. H. Schaeffer

ment technique is in accordance with the instructions of 10CFR 71.87 (i). Corrected count ratio for the 300 cm<sup>2</sup> area wipes must be less than 6600 dpm corresponding to the maximum permissible limit of 22 dpm/cm<sup>2</sup> for non-exclusive use in transport of packages containing beta-gamma emitting radionuclides.

Prior to each shipment, radiation levels are measured at the package surface and at one meter from the package surface to assure conformance with 71.43 (g). Compliance is virtually assured since the radiation survey performed on the unit determined a maximum dose rate of 80 mrem/hr on the surface of the package and a maximum dose rate at 3 feet from the surface of 5 mrem/hour. Both maximums occurred to the side of the unit. Dose rates above and below the unit are lower. At the time of these measurements (March 1972) the fuel loading (actual) was 328,400 Ci. According to the 28.8 year life for Sr-90, the current fuel loading (August 1985) would be about 238,000 curies. Dose rates are in direct proportion to the curie inventory.

This unit has no lifting rings or other devices which could inadvertently be used as tie down devices. The operating manual provides detailed instructions for attachment of tie down chains to the pallet (the intended mode of tie down).

Accessible package surface temperatures are low and within the limits prescribed by 71.43 (g).

Prior to the first shipment the package was marked with the following information:

SENTINEL-100F  
SERIAL NO. -001  
RADIOACTIVE MATERIAL  
SPECIAL FORM NOS.  
ID No. - UN-2974  
TYPE B PACKAGE  
USA/5862/B  
WEIGHT - 1235 KG (2725 LBS)

This marking was in addition to the required category "YELLOW III" radiation label with the measured transport index and a metal radiation label defining the contents of the package as Strontium-90, the number of curies and the date of measurement.

APPENDIX F  
DRAWING REVISIONS

R 5  
8/85

This appendix was prepared in response to item 3 of the enclosure of the inquiry from NRC (see letter cited in Appendix E). The inquiry noted that certain package drawings - specifically 010F10000 and 001-90039 - have had several revisions since approval of the latest supplement to this application dated Jan. 19, 1972. It noted that this consolidated application should address the drawing changes indicating what effect the changes have on package performance relative to meeting the requirements of 10CFR Part 71. This appendix provides the requested information.

The two changes to drawing 010F10000 succeeding the original submittal but prior to the latest submitted had no effects on the integrity of the package. Revision A added hardware that had been omitted from the drawing and defined the receptacle, shorting plug and test cable procured from Burton Electric Co. Revision B added a special nameplate requested by the Navy and changed quantities or part numbers which were in error. The most recent revision, REVISION C, added aluminum sheets which covered over the Navy logos and identification and showed the new Air Force nomenclature.

Drawing changes to the pallet drawing 001-90039 subsequent to Jan. 1972 merely added holes to accommodate the Sentinel 25F model. These four small tapped holes had no effect on the structural integrity of the existing pallet.



UNITED STATES  
DEPARTMENT OF JUSTICE

DOCKET NO. 71-5862  
CONTROL NO. 25724  
DATE OF DOC. 08/30/85  
DATE RCVD. 09/06/85  
FCUF \_\_\_\_\_ PDR   
FCAF \_\_\_\_\_ LPDR \_\_\_\_\_  
WM \_\_\_\_\_ I&E REF.   
WMUR \_\_\_\_\_ SAFEGUARDS \_\_\_\_\_  
FCTC  OTHER \_\_\_\_\_

DESCRIPTION:

submittal is in  
response to your  
letter dated  
07/25/85  
09/09/85 INITIAL CEC