Amersham Corporation
40 North Avenue
Burlington, MA 01803
tel (617) 272-2000
tel (800) 225-1383

Amersham
QSA

Mr. Cass R. Chappell, Section Leader
Cask Certification Section
Storage and Transport Systems Branch
Division of Industrial and Medical Nuclear Safety
NMSS
U. S. Nuclear Regulatory Commission
Washington, DC 20555

10 May 1994

Dear Mr. Chappell:

In reference to docket number 71-9032, we are providing the additional information requested in your letter dated 17 February 1994.

The revisions are as described below and have been included as revised pages. All changes are indicated by a vertical line in the margin.

Drawings

1) Drawing 65090 sheets 1-3 have been revised to reflect that the lead and tungsten thicknesses are maximum thicknesses.

2) The initial method of attachment of the supplemental shielding is glass tape secured around the supplemental shielding and the depleted uranium shield. The tape is used to properly position the supplemental shielding before the vultafoam is poured. The container is filled with vultafoam which cures and hardens and assures that the supplemental shielding does not move during use or as a result of the hypothetical accident conditions. As the foam is already specified on the drawings we have not revised the drawing.

3) Clearer copies of the drawings are enclosed.

NTO1

General

1) The analysis in Section 3.6.2 is specifically to demonstrate compliance with the IAEA regulations in the 1985 edition, paragraph 543 under a certain set of conditions. There is no comparable requirement in the NRC regulations of 10 CFR Part 71. The thermal analysis given is Section 3.6.1 is intended to demonstrate compliance with 10 CFR 71.43 for non-exclusive use shipments.

2) The text on pages 1-1 and 2-2 has been revised to delete the reference to depleted uranium as supplemental shielding.

Additional comments

1) Miscellaneous typographical errors have been corrected on pages 5-1, 7-1 and 7-2, as identified by Carl Withee in a phone conversation on 10 Mar 94.

Please contact me, if you need any additional information. Thank you for your assistance.

Sincerely,

Cathleen Roughan

Cathleen Roughan
Regulatory Affairs Manager

1. General Information

1.1 Introduction

Amersham Corporation, Model 650 is designed for use as a source changer and shipping container for Type B quantities of radioactive material in special form. The Model 650 conforms to the criteria for Type B packaging in accordance with 10 CFR 71 and satisfies the criteria for Type B(U) packaging in accordance with IAEA Safety Series No. 6, 1985 Edition (as amended). The Model 650 will contain a maximum of 240 curies of Iridium-192.

2. Package Description

1.2.1 Packaging

The Model 650 is 13 1/4 inches (337mm) high, 10 inches (254mm) long, and 8 1/4 inches (210mm) wide in overall dimension. The gross weight of the package is 80 ± 10 lbs. (36 ± 4.5 Kg). The radioactive source assembly is housed in a titanium "U" tube. The tube is crimped in the middle of the "U" to provide a positive stop for the source assembly. The "U" tube is cast inside a depleted uranium shield assembly. The weight of the depleted uranium shield is 42 ± 2 lbs. (19 ± .91Kg).

Supplemental lead or tungsten shielding, as shown in drawing No 65002 Sheet 1 of 3, may be added to the depleted uranium shield to assure that surface dose rates are below 200 mR/hr. It is retained in position by the rigid polyurethane foam. The addition of the supplementary shielding does not affect the ability of the package to meet the Type B requirements, as shown in Section 2.10.

The shield assembly is enclosed in a steel bottom housing consisting of a rectangular shell with top and bottom cover plates of 0.135 inch (3.4mm) thick steel. The rectangular steel shell is further enclosed in a round steel tube with a wall thickness of 0.047 inch (1.2mm). The void space between the shield and the shell is filled with a castable rigid polyurethane foam. The steel-uranium interface is separated with a 0.010 inch (0.254mm) thick copper shim.

Mounted on the top cover plate is a source hold down assembly. This assembly is used to secure the radioactive source in a shielded position during transport.

An outer package lid, fabricated from 0.135 inch (3.4mm) thick steel, is bolted to the package to provide protection to the hold down assembly.

Tamper-proof seals are provided during shipment of these sources. Two vent holes and assembly joints which are not leak tight provide passageways for the escape of any gas generated from decomposition of the potting foam in the event the source changer is involved in a fire accident. The outer packaging is designed to avoid the collection and retention of water. The package is painted and finished to provide for easy decontamination. The radioactive material is sealed inside a stainless steel source capsule. The capsule acts as the containment vessel for the radioactive material.

2.4.2 Tamperproof feature

Refer to Section 2.4.3.

2.4.3 Positive Closure

The source assembly cannot be exposed in the Model 650 without first removing the source hold down assembly. The source hold down assembly is bolted and sealwired. Access to the source hold down assembly requires removal of the lid. The lid is bolted and padlocked, and is provided with a tamperproof sealwire. The top and bottom covers are lockwired to insure that the retaining bolts are not accidentally loosened.

2.4.4 Chemical and Galvanic Reactions

The materials used in the construction of the Model 650 source changer are depleted uranium metal, steel, titanium, and copper. Some supplementary shielding may be provided if necessary, utilizing lead or tungsten. There will be no significant chemical or galvanic action between any of these components as evidenced by the Amersham report on the use of lead.

See Model 660 Safety Analysis Report - USA/9033/B(U) Rev. 0 dated August 12, 1993 - Section 2.10 Test Report entitled "Leading of Type B Transport Devices".

The possibility of the phenomena of the formation of the eutectic alloy of iron-uranium at temperatures below the melting temperatures of the individual metals was considered. The iron-uranium eutectic alloy temperature is approximately 1337°F (725°C). However, vacuum conditions and extreme cleanliness of the surfaces are necessary to produce the alloy at this low temperature. Due to the conditions under which the shields are mounted, sufficient contact for this effect does not exist.

In support of this conclusion, the following test results are presented. A thermal test of the sample of bare depleted uranium metal was performed by Nuclear Metals, Inc., Concord, MA. The test indicated that the depleted uranium sample oxidized such that the radial dimension was reduced by 1/32 inch. A subsequent test was performed in which a sample of bare, depleted uranium metal was placed on a steel plate and subjected to the thermal test conditions. The test showed no alloying or melting characteristics in the sample, and the degree of oxidation was the same as evidenced in the first test. A copy of the test report appears in Section 2.10

Although the likelihood of the formation of an iron-uranium eutectic alloy is remote, copper separators are used at iron-uranium interfaces.

2.5 Lifting and Tiedown Standards for all Packages

2.5.1 Lifting Devices

The Model 650 is designed to be lifted by the bottom or top covers or top lid. Each is secured by four 5/16 hex bolts

5. Shielding Evaluation

5.1 Discussion and Results

The Model 650 is shielded with 42 ± 2 lbs. (19 ± .91Kg) of depleted uranium and on some models with supplemental lead. The uranium metal is cast around the titanium "U" tube which holds the source. A radiation profile of Model 650 SN 257 containing 220.5Ci of Iridium 192 (see Section 5.5) was made. An extrapolation for a 240Ci source, yielded the results which are presented in Table 5.1. From this data and from previous acceptability (NRC Certificate of Compliance No. 9032, Rev. 1 included in Section 1.3), it is concluded that the Model 650 complies with the regulatory standards in 10 CFR 71 and IAEA Safety Series No. 6, 1985 Edition (as amended).

Table 5.1
Summary of Maximum Dose Rates (mR/hr)

	At Surface			At One Meter		
	Side	Top	Bottom	Side	Top	Bottom
Gamma	173	76	43	1.0	1.0	1.0
Neutron	Not applicable			Not applicable		
Total	173	76	43	1.0	1.0	1.0

Hypothetical accident conditions will result in essentially no change in the above readings.

5.2 Source Specification

5.2.1 Gamma Source

The gamma source is Iridium 192 in the quantity of up to 240 curies.

5.2.2 Neutron Source

Not applicable

5.3 Model Specification

Not Applicable.

5.4 Shielding Evaluation

The Model 650 shielding evaluation was performed on Model 650 Serial Number 257 containing 220.5 curies of Iridium 192. The radiation profile is included in Section 5.5. Extrapolation of the data to the capacity of 240 curies, (Section 5.1) clearly indicates that the Model 650 conforms to the regulatory radiation limits. As the hypothetical accident tests (Section 2.7) revealed no change in the shielding arrangement, it is concluded that shielding after the hypothetical accident is essentially unchanged. Therefore, the radiation profile indicates the package will be within acceptable limits.

5.5 Appendix

Radiation profile Model 650 Serial No. 257. see next page

7. Operating Procedure

7.1 Procedure for Loading the Package

1. Ensure that the source is locked into place in its storage position. The source assembly must be fully inserted into the source tube and the hold down block securely bolted over the source assembly. Place the hat on the 650 and secure with the four bolts. Place the padlock through the hasp, secure and remove key. Attach a tamper proof security seal with an identification mark to one of the drilled bolt heads.

2. Assure all the conditions of the Certificate of Compliance are met and the package has all the required markings.

3. If the shipping container is to be packaged in a crate or other outer packaging, the outer packaging must be strong enough to withstand the normal conditions of transport. These requirements are outlined in 10 CFR 71. The shipping container should be put in the outer package with sufficient blocking to prevent shifting during transportation.

4. Perform a radioactive contamination wipe test of the outer shipping package. This consists of rubbing filter paper or other absorbent material, using heavy finger pressure, over an area of 16 in.^{2} (100 cm^2) of the package surface. The activity on the filter paper should not exceed 0.001 uCi of removable contamination.

5. Survey the package with a survey meter at the surface and at a distance of one meter from the surface to determine the proper radioactive shipping labels to be applied to the package as required by 49 CFR 172.403. If radiation levels above 200 mR/hr at the surface or 10 mR/hr 40 inches (1m) from the surface are measured, the container must not be shipped.

6. Return the container to Amersham Corporation according to proper procedures for transporting radioactive material as established in 49 CFR 171-178.

7.2 Procedure for Unloading the Package

The consignee of a package of radioactive material must make arrangements to receive the package when it is delivered. If the package is to be picked up at the carrier's terminal, 10 CFR 20.205 requires that this be done expeditiously upon notification of its arrival.

Upon receipt, survey the exposure device with a survey meter as soon as possible, preferably at the time of pickup and no more than three hours after it was received during normal working hours. Radiation levels should not exceed 200 milliroentgens per hour at the surface of the exposure device, nor 10 milliroentgens per hour at a distance of 40 inches (1m) from the surface. Actual radiation levels should be recorded on the receiving report. If the radiation levels exceed these limits, the container should be secured in a Restricted Area, and the appropriate personnel notified in accordance with 10 CFR 20.

All components should be inspected for physical damage.

The radioisotope, activity, model number, and serial number of the source and the package model number and serial number should be recorded.

Opening and operation of the device will be performed in accordance with the operation manual supplied with the package in accordance with 10 CFR 71.89.

7.3 Preparation of an Empty Package for Transport

1. For shipment of an empty source changer first assure the changer does not ontain an unauthorized source or cropped source by performing a physical verification using the following procedure.

NOTE: Use only the gauge provided with the source changer. Do not use any other tool or a gauge for another device. If you do not have the proper gauge to perform the test, contact Amersham Corporation before conducting the test.

a. Insert the proper gauge in the empty tube(s) of the source changer. Read the gauge at the top of the outlet fitting.

b. The gauge should bottom out in the empty source tube and indicate a safe condition (the redline should be flush with the top of the source tube). Verify that each empty tube indicates a safe condition and proceed to step 2.

c. If the gauge indicates an unsafe condition (the red line is above the source tube) there may be an obstruction in the tube. Remove the gauge slowly while observing the survey meter. If the radiation levels increase as the gauge is being removed keep the gauge within the device, secure the device and contact Amersham Corporation for further instructions.

If radiation levels remain normal as the gauge is being removed, completely remove gauge and contact Amersham Corporation for shipping instructions.

2. When you have assured the container is empty, insert the hold down block securely over the empty tubes and bolt in place. Install the cover of the source changer, insert the closure bolts and padlock. Seal wire through the bolt.

3. Assure that the levels of removable radioactive contamination on the outside surface of the outer package do not exceed 0.001 microcurie per 16 in.^{2} (100 cm^2).

4. When you have assured the Model 650 is empty, survey the device and prepare the package for transport depending upon the radiation levels obtained, as given in 49 CFR 173.

65002

REV	DATE	DESCRIPTION
F	5/6/92	CHNGD. APPROX. THK. OF [illegible] LEAD/TUNGSTEN TO MAX. THK. PER ECO 1585
A	31 JUL 79	ADDED SHT # 3; ADDED SURVEY WARNING LABEL, ADDED MFR. TO ITEMS NOT PREVIOUSLY DESIGNATED
B	1-18-89	SEE SHEET 2
C	4-20-92	REVISED TO SHOW LEAD ECO # 942
D	6-3-92	SEE SHT 2 & 3 ECO # 903
E	1-5-93	SEE ECO 1202

A (SEE SHEET 2)

FITTING (2)
1-18 THD
(1020 STL. OR ST. STL.)

SOURCE HOLDOWN ASSY
(SEE SHT 3)

SURVEY WARNING LABEL (.020 THK STEEL)

PADIOACTIVE SOURCE ASSY

GUIDE ASSY (REF)

LID WELDMENT
(10 GA. STEEL)

WIRE ROPE

GUIDE BRACKET (10 GA. STEEL)
(REF)

SOURCE CHECK GAGE

TOP COVER
(10 GA. STEEL)

REINFORCMENT SLEEVE
(1/2 O.D. x .440 I.D. - TITANIUM)

LEAD OR TUNGSTEN - MAX. 1/8" THK. (4 SIDES IF NEEDED)

TUBING (7/16 O.D. x .035 WALL - TITANIUM)
(CAST IN SHIELD)

SHIELD, DEPLETED URANIUM
42 lbs. ± 2 lbs.

INNER SHELL (10 GA. STEEL)

RIGID POLYURETHANE FOAM

OUTER SHELL (.047 COLD ROLLED STEEL)

COPPER SHIM (.010 THK)

BOTTOM COVER
(10 GA. STEEL)

13 1/4 REF.

LEAD 1/4 THK. MAX. (IF NEEDED)

10 REF.

NOTE: LEAD SHIELDING NOT TO EXCEED ~10 LBS
TOTAL WT. NOT TO EXCEED 90 LBS

MATERIALS: NOTED

FINISH:

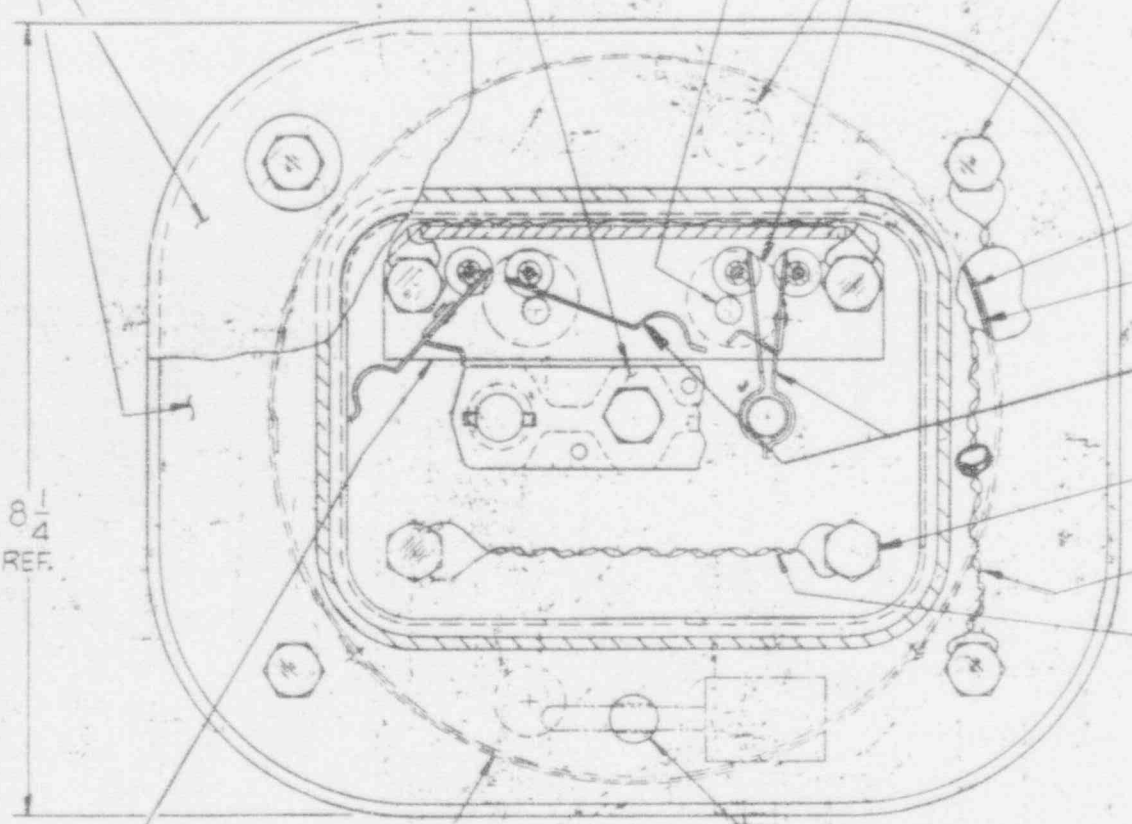
TROPICAL OPERATIONS INC.
RADIATION PRODUCTS DIVISION
[redacted]

DWG TITLE:
MOD. 650 URANIUM SHIELDED
SOURCE CHANGER
DESCRIPTIVE ASSEMBLY

CLASSIFICATION: C | DWG. NO. 65002 | REV F

SCALE 1:1 | SHEET 1 OF 3

65002



SECTION A-A

REV.	DATE	DESCRIPTION
A	31 JUL 79	SEE SHT # 1
B	1-16-89	.040 DIA SAFETY WIRE WITH .040 DIA SEAL WIRE ADDED "SEAL WIRE" CALLOUT WAS CALLED OUT AS "040 DIA SEAL WIRE" DELETED VICTORIA SEAL WIRE ON L.H. SIDE
C	4-20-92	SEE SH.-1 ECO #962
D	6-3-92	SEE ECO #963
E	1-4-93	SEE ECO #1202
F	5/6/94	SEE SHT. 1

MATERIALS: NOTED
FINISH:
DRAWN BY: J. Tenbrunsel
CHECKED BY:
APPROVED BY:
UNLESS OTHERWISE SPECIFIED TOLERANCES ARE: X ±.1, XX ±.0, XXX ±.0, ANGLES ±.0, FRACTIONS ±.0

TECHNICAL OPERATIONS INC.
RADIATION PRODUCTS DIVISION
BURLINGTON, MA 01803

DWG TITLE: MOD 650 URANIUM SHIELDED SOURCE CHANGER DESCRIPTIVE ASSEMBLY

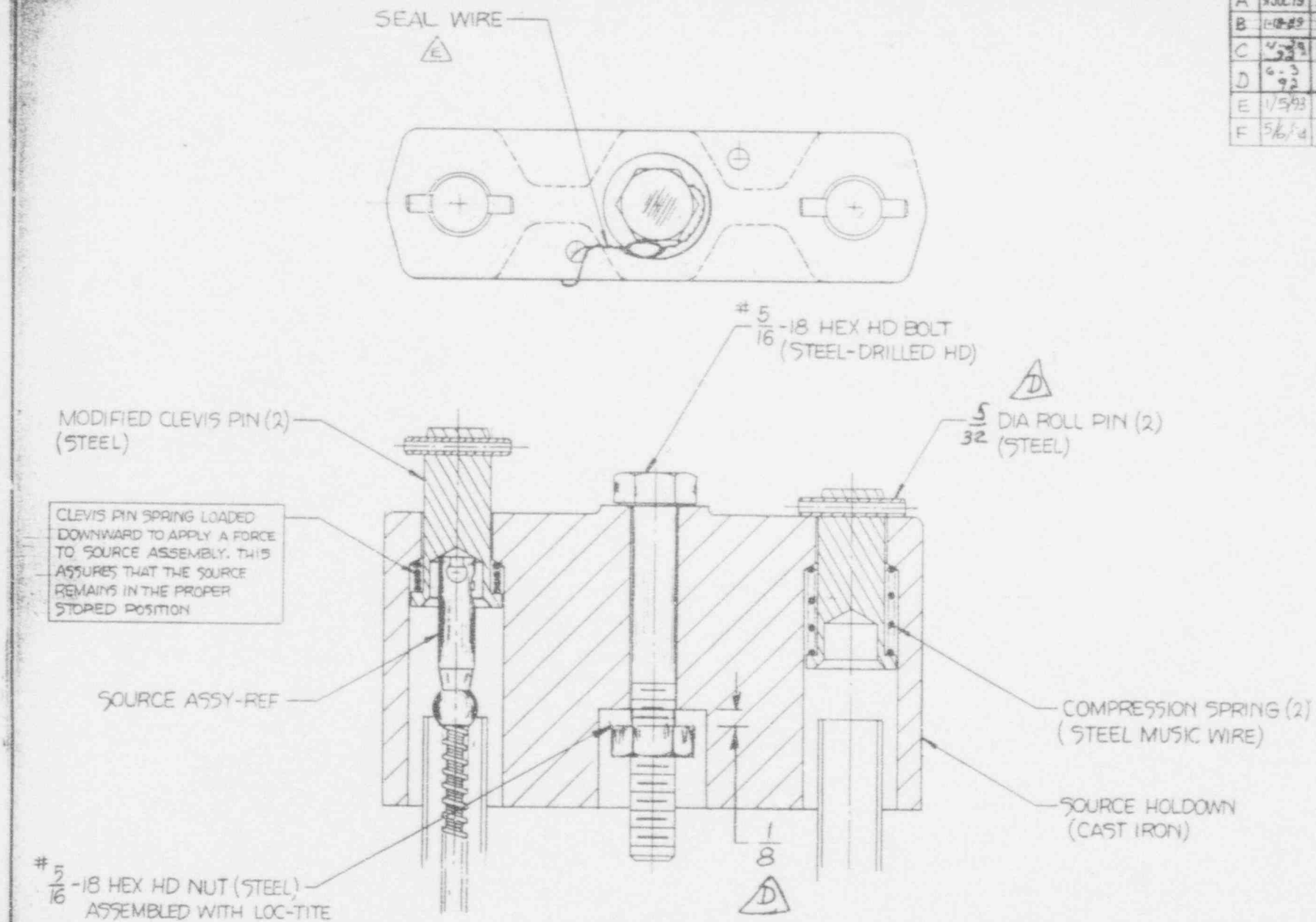
CLASSIFICATION | SIZE C | DWG NO. 65002 | REV F

SCALE 1:1 | SHEET 2 OF 3

DWG 1-7

65002

REV.	DATE	DESCRIPTION	
A	3 JUL 79	SEE SHEET # 1	
B	[illegible]	SEE SHEET # 2	
C	4-5-82	SEE SH. -1 ECO # 992	
D	6-3-92	SEE ECO # 963	GP
E	1/5/93	SEE ECO 1202	TA/GP
F	5/6/94	SEE SHT. 1	RM



SOURCE HOLDOWN ASSY

MATERIALS		TECHNICAL OPERATIONS INC. RADIATION PRODUCTS DIVISION BURLINGTON, MA. 01803
FINISH		DWG TITLE: MOD 650 URANIUM SHIELDED SOURCE CHANGER DESCRIPTIVE ASSEMBLY
DRAWN BY: [illegible] 9 Dec 79	UNLESS OTHERWISE SPECIFIED TOLERANCES ARE: .X ±	
CHECKED BY	.XX ±	
APPROVED BY	.XXX ±	
	ANGLES ±	
	FRACTIONS ±	CLASSIFICATION: C; SIZE: C; DWG. NO. 65002; REV. F
		SCALE 2:1; SHEET 3 OF 3