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Radiation Control Program
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October 20, 2003

John Jankovich
SS&D Team Leader
Division of Industrial and Medical Nuclear Safety
MS T-8F5
U.S. Nuclear Regulatory Commission
Washington, DC 20555

RE: Registration Number: MA-1059-D-118-S

Dear Mr. Jankovich:

We have completed action on a Sealed Source and Device (SSD) registration certificate for the AEA Technology QSA, Inc. Model 865 radiography exposure devices described by enclosed registration certificate No. MA-1059-D-118-S.

If you have any questions please contact me at (617) 427-2944, Extension 2015.

Sincerely,

Joshua E. Daehler
Radiation Control Officer

JED/jed

Enclosures: (1)

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF DEVICE
(AMENDED IN ITS ENTIRETY)

NO: MA-1059-D-118-S DATE: **September 17, 2003**

DEVICE TYPE: Radiography Exposure Device

MODEL: 865

MANUFACTURER/DISTRIBUTOR:

AEA Technology, QSA Inc.
40 North Ave.
Burlington, MA 01803

SEALED SOURCE MODEL DESIGNATION: AEA Technology Model 86520

ISOTOPE:	MAXIMUM ACTIVITY:
Iridium-192	240 curies (8.88 TBq)
Depleted Uranium Shielding	42 pounds (19 kilograms)

LEAK TEST FREQUENCY: 6 Months

PRINCIPAL USE: (A) Industrial Radiography

CUSTOM DEVICE: YES _____ NO __X__

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DEVICE TYPE: Radiography Exposure Device

DESCRIPTION:

The Model 865 is designed for use as a radiographic exposure device, storage container, and Type B(U) transport package. The rated capacity of the device is 240 curies (8.88 TBq) of Iridium-192. It utilizes the model 86520 source assembly (reference SS+D sheet # NR-628-S-121-S) and Model 86550 Pneumatic Control Unit. In addition to routine radiographic usage, the Model 865 exposure device is designed to be used in an underwater environment. The Model 865 device meets the ANSI N432 requirements for Class P, Type 2 device - a portable exposure device where the source moves in and out of an exposure position within the device. It meets the current requirements in 105 CMR 120.315 and 10 CFR 34.20.

The Model 865 is 13.3 centimeters (5.25 in.) in diameter and 31.1 centimeters (12.25 in.) long. The packaging incorporates a handle which extends approximately 5.4 centimeters (2.1 in.) from the cylindrical surface and **24 centimeters (9.5 in.)** long. The device also incorporates two triangularly shaped legs which extend approximately 3.5 centimeters (1.4 in.) from the cylindrical surface and are approximately 14.6 centimeters (5.75 in.) long. The total mass of the device is 27 kilograms (60 lbs).

The Model 86520 source holder assembly is housed in a brass source tube. The source tube has an outer diameter of 0.95 centimeters (3/8 in.) and a wall thickness of 1 centimeter (0.4 in.). One end of the source tube is closed by means of a plug which is soldered to the source tube. The opposite end of the source tube is soldered to the actuator mounting plate and housing.

The source tube is surrounded by depleted uranium metal for shielding. The mass of the uranium shield is 18 ± 1 kilograms (40 ± 2 lbs.). The uranium shield is encased in a 304 stainless steel housing. The shield is supported on the bottom by a 304 stainless steel base plate which is welded to the 304 stainless steel shell. The shield is supported on the top by the actuator mounting plate which is also fabricated from 304 stainless steel and is welded to the shell. The base plate and the actuator mounting plate provide support for the shield in both the horizontal and vertical directions. Brass support collars are positioned between the shield and these plates to prevent any iron-uranium interface. Mounted on the actuator mounting plate are the actuator and locking assemblies. The locking assembly is used to secure the radioactive source and source holder assembly in the shielded position.

Surrounding the actuator and locking assemblies is the actuator protective cover. This cover is fabricated from 304 stainless steel and is bolted to the package shell by means of four (4) M6 x 12 millimeter (0.5 in.) long hex head stainless steel bolts.

DEVICE TYPE: Radiography Exposure Device

DESCRIPTION (Cont'd.):

An outer package cover, also fabricated from 304 stainless steel, is installed over the actuator protective cover and is secured to the package shell by means of four (4) M6 x 12 mm (0.5 in.) long hex head stainless steel bolts. The heads of these bolts are drilled to provide a means for attaching tamper indicator seal wires during transport.

The actuating assembly includes a source position indicator rod. When the source assembly moves out of the shielded position, the source position indicator becomes visible. The source assembly is secured in the proper storage position by means of the locking assembly. A locking rod engages an undercut in the source assembly preventing its movement. The locking rod is attached to a key operated lock and is held in place by this lock.

In the event that the lock failed, the source assembly would be contained within the device. The locking rod would prevent movement of the source assembly. Further, with the outer cover in place, an interference would exist with the source position indicator preventing movement of the source assembly.

The lock cannot be opened by any easily available substitute for the key. With the exposure device locked, the source assembly cannot be moved to an unshielded position. The lock housing is secured to the exposure device by means of welding. The outer cover prevents access to the lock assembly.

Operational Features

The Model 865 is designed as a pneumatically operated directional radiographic exposure device. The device is designed to be operated using the Model 86550 pneumatic control unit or equivalent control unit. In operation, the radioactive source assembly is moved from its shielded storage position to a position in the beam port. In the beam port position, the emergent beam is 60° wide and 30° high. The radiation intensity in all directions outside the primary beam is reduced by a factor of 10,000 by the built-in beam limiter. The radioactive source never leaves the Type 2 exposure device during operation.

Movement of the radioactive source is accomplished through the use of a pneumatic cylinder. The source assembly is attached to the piston in the pneumatic cylinder. To move the source to the exposure position in the beam port, the exposing side of the cylinder is pressurized using the control unit. When the pressure on the exposing side of the cylinder is reduced to atmospheric

DEVICE TYPE: Radiography Exposure Device

DESCRIPTION (Cont'd.):

pressure, a spring in the actuating mechanism presses against the piston and causes the source assembly to return to the shielded storage position. An additional optional air line is available to pressurize the source to its shielded storage position. This additional air line is mandatory for use of the device in underwater or underwater habitat applications.

The exposure device can only be operated when it is unlocked. When the unit is locked, the locking rod engages an undercut in the source assembly preventing its movement. Unlocking of the exposure device requires the use of a key. When the exposure device is unlocked, the source assembly is held in its shielded storage position under the positive force of the return spring. The source will remain in this position until air pressure exerts sufficient force on the actuator piston to overcome this spring force.

The air pressure is introduced into the unit through air hoses from the control unit. Separate air lines are available for pressurizing the exposing and storing sides of the actuator. Different terminal fittings are provided on these air lines to assure that the lines are not interchanged. The system is designed such that removal of the control unit (i.e., removal or disconnection of the exposing air line or severance of this line) will cause the air pressure on the exposing side of the actuator to reduce to atmospheric pressure and the spring force will then cause the source to return to the shielded storage position.

The positive source position indicator provided on this exposure device consists of a rod attached to the actuator piston. When the source is in the shielded storage position, the indicator rod is contained within the actuator assembly and is not visible. As the source moves from its storage position to the exposure position, the indicator rod emerges from the actuator assembly and becomes visible. The source position indicator also provides a secondary means of security for the source assembly. With the outer cover installed, an interference is created with the source position indicator preventing the source from moving to the exposure position.

In summary, the operational safety features are:

- The exposure device can only be operated when it is unlocked with a key and when the control unit is properly connected.
- The source assembly never leaves the exposure device.

DEVICE TYPE: Radiography Exposure Device

DESCRIPTION (Cont'd.):

- When the source assembly is in the exposure position, a built-in beam limiter reduces the size of the primary beam.
- If the control unit becomes detached from the exposure device or the air line is severed, the source automatically moves to the shielded position.
- The exposure device can be locked only when the source is in the shielded storage position.
- A positive source position indicator is provided.

LABELING:

A stainless steel plate is fastened to the device which is engraved with information necessary to satisfy the requirements of 105 CMR Section 120.241, 10 CFR Part 20, and ANSI N432, Section 4. The label contains the following minimum information:

'Type B Certificate Number'
Danger Radioactive Material
Caution - Radioactive Shielding - Depleted Uranium ('actual weight')
Total Weight ('actual weight')
Device Model Number
Device Serial Number
Isotope and capacity
Manufacturer name and address

Loaded devices also include a source identification tag attached to the device which specifies the source model number, serial number, isotope, activity and assay date. A source certificate, containing results of leak testing, is also provided with the exposure device.

The Operation and Maintenance Instruction Manual supplied with the exposure device contains general information on the components of the device, recommended safety precautions, operating instructions, and a section on maintenance of the unit.

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF DEVICE
(AMENDED IN ITS ENTIRETY)

DEVICE TYPE: Radiography Exposure Device

DIAGRAM:

Drawings of the Model 865 are found in Attachments 1 through 3.

CONDITIONS OF NORMAL USE:

The Model 865 radiographic exposure device is designed for use as an exposure device, storage container, and Type B(U) transport package for normal conditions of use encountered in industrial radiographic operations. Additionally, it is designed for use in underwater and underwater habitat applications to a maximum depth of 610 meters (2000 feet). The Model 865 accepts installation of the Model 86520 source assembly and Model 86550 Control Unit.

The expected working life of this device varies significantly depending on the operational and environmental conditions as well as the number of cycles experienced by the device. At the time of source reloading, the manufacturer inspects the device for fitness of use and function. Any device which cannot perform in a reliable or safe manner after inspection and service, will prompt removal of the device from active use.

PROTOTYPE TESTING:

The Model 865 device has been satisfactorily tested in accordance with Section 8 of the ANSI standard N432-1980, along with additional tests. The manufacturer reports the following results:

1) The portable exposure device passed all tests (shielding efficiency, horizontal shock, vertical shock, accidental drop, and endurance) as delineated in Table 5.1 of the ANSI standard.

2) The device passed additional tests (vibration resistance test per ISO 3999, reduced pressure test, external pressure test, sea water immersion pressurization test, and thermal test)

3) The source assembly passed all tests (tensile and endurance) as delineated in Table 7.1 of the ANSI standard. Reference SS+D # NR-628-S-121-S.

4) The local control unit passed the endurance test as delineated in Table 6.1 of the ANSI standard.

DEVICE TYPE: Radiography Exposure Device

PROTOTYPE TESTING (Cont'd.):

5) The portable exposure device passed all tests per IAEA Safety Series No. 6, 1985 revised edition (1990) and 10 CFR 71 for Type B(U) packaging.

The shielding efficiency test was performed with an Iridium-192 source containing 180 curies (6.7 TBq) which is less than a factor of 2 of the maximum capacity. The measured dose rates, extrapolated to the maximum capacity, were found to be below the values specified in Table 8.1 of the ANSI standard.

The horizontal shock test was conducted on the exposure device while impacting 20 times on the end of the actuator cover and 20 times on the side of the actuator cover. The vertical shock test was conducted by impacting the triangular vertical legs 100 times. After the horizontal and vertical shock tests, the exposure device's safety features remained operational and experienced no loss of structural or shielding integrity.

The accidental drop tests (30 feet) were conducted on the exposure device by impacting the rim of the outer cover, the face surface of the outer cover, and the support legs. The results indicated the outer cover was deformed by ~ ½", there was no impairment of any design or safety features, there was no structural damage to the locking assembly, and there was no loss of shielding integrity.

The endurance test was conducted per Section 8.9 of the ANSI standard. Using an automatic exposure control system the source assembly was moved from the shielded storage position to the beam port position, held in the beam port position for ~ 5 seconds, and then the spring returned the source to the shielded storage position. The exposure device was subjected to greater than 50,000 complete expose and retract cycles. The results indicated that the system remained operational and there were no observed signs of wear of the source assembly.

The exposure device was subjected to a vibration of several frequencies from 5 to 80 hertz, a reduced pressure of 1 psia for 30 minutes, an external pressure of several levels ranging from 50 to 360 psig with 100 expose and contract cycles of the source assembly at each pressure level, and a temperature exposure of up to 724° C for 30 minutes.

The device was also subjected to a seawater immersion and external pressure of 6.21 MPa (900 psig) and actuated for 303 expose and contract cycles. A second immersion and pressure test exposed the device to the same pressure for a duration of three hours. The immersion

DEVICE TYPE: Radiography Exposure Device

PROTOTYPE TESTING (Cont'd.):

and pressurization tests simulated environmental conditions equivalent to 2025 feet (617 meters) below sea level. A shielding efficiency test performed subsequent to the completion of the above tests indicated no reduction in the shielding efficiency of the exposure device. Examination following each test showed no impairment of any design features. The device operated satisfactorily both during and after each test. After the conclusion of the tests, the exposure device was disassembled and examined. There was no evidence of any ingress of water during the tests.

EXTERNAL RADIATION LEVELS:

The manufacturer submitted measured dose rates for the Model 865 exposure device containing a 180 curie (6.7 TBq) Iridium-192 source (output curies). The measurements were made with a calibrated AN/PDR-27(J) survey instrument. Typical dose rates, extrapolated out to 240 curies (8.88 TBq), with the source in the shielded position are as follows:

Location	Surface Dose Rate	Dose Rate at 1 Meter
Top	1.6 mR / hr (16 μSv / hr)	0.2 mR / hr (2 μSv / hr)
Right	52 mR / hr (520 μSv / hr)	1.0 mR / hr (10 μSv / hr)
Front	70 mR / hr (700 μSv / hr)	1.1 mR / hr (11 μSv / hr)
Left	57 mR / hr (570 μSv / hr)	1.0 mR / hr (10 μSv / hr)
Rear	65 mR / hr (650 μSv / hr)	1.0 mR / hr (10 μSv / hr)
Bottom	44 mR / hr (440 μSv / hr)	0.9 mR / hr (9 μSv / hr)

The gamma dose rates for a 240 Ci (8.88 TBq) source have been derived using inverse square law and based on a gamma constant 0.48 R/hr-Ci @ 1 m (0.93 nA/kg-Bq @ 1 m). The following unshielded dose rates would be representative of those measured from the front of the device with the source in the exposed position:

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DEVICE TYPE: Radiography Exposure Device

EXTERNAL RADIATION LEVELS (Cont'd.):

Distance	Dose Rate
5 centimeters	46,080 R / hr (46.1 Sv / hr)
30 centimeters	1280 R / hr (13 Sv / hr)
100 centimeters	115 R / hr (1.2 Sv / hr)

QUALITY ASSURANCE AND CONTROL:

Devices are manufactured and distributed in accordance with the Quality Assurance program of AEA Technology, QSA Incorporated which is in compliance with the requirements of ISO 9001:1994. In addition, the Model 865 is manufactured in accordance with USNRC-approved Quality Assurance Program 71-0040. A copy of the program is on file with the Agency.

LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE:

- The exposure devices shall be distributed only to persons specifically licensed by the NRC or an Agreement State.
- The sealed sources shall be leak tested at intervals not to exceed 6 months using techniques capable of detecting 0.005 microcuries (185 Bq) of removable contamination.
- The Model 865 exposure device can be used only in conjunction with the Model 86520 source assembly, Model 86550 Control Unit, and / or other source assemblies or control units specified in a registration certificate approved by the Agency, the NRC or an Agreement State.
- Handling, storage, use, transfer and disposal are to be determined by the licensing authority.
- The Model 865 exposure device must be returned to AEA Technology for loading or unloading of a source assembly or other specific licensee authorized by the NRC or Agreement State to perform such operation. At a minimum, upon return of the device to an authorized licensee for source exchange, service, or maintenance, all seals will be inspected and replaced if necessary.

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DEVICE TYPE: Radiography Exposure Device

LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE (Cont'd):

- REVIEWER NOTE: If authorizing a licensee to perform maintenance, note that at one point in the maintenance section procedures in the user's manual, the source is held in place by only the locking mechanism. If the locking mechanism should work incorrectly or fail, the source could possibly be removed from the device. Licensee's radiation safety program should be reviewed to ensure that they have adequate training and procedures to perform this maintenance procedure.

- This registration sheet and the information contained in the references shall not be changed without the written consent of the Massachusetts Department of Public Health, Radiation Control Program.

SAFETY ANALYSIS SUMMARY:

Based on our review of the Model 865 device, and the information and test data cited below, we conclude that the radiography exposure device is acceptable for specific licensing purposes.

Furthermore, we conclude that the Model 865 radiography exposure device would be expected to maintain its containment integrity for normal conditions of use and accidental conditions which might occur during uses specified in this certificate.

REFERENCES:

The following documents for the model 865 exposure device is hereby incorporated by reference and made part of this registry document:

- AEA Technology QSA Incorporated letters dated November 21, 2001, February 19, 2002, January 7, 2003, February 4, 2003 and **August 27, 2003**, each with any enclosures thereto.

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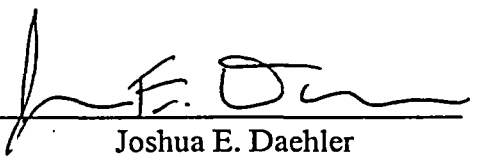
SAFETY EVALUATION OF DEVICE
(AMENDED IN ITS ENTIRETY)

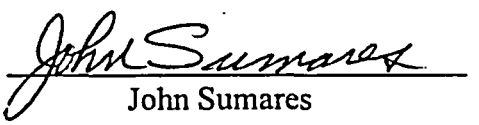
NO: MA-1059-D-118-S DATE: **September 17, 2003**

DEVICE TYPE: Radiography Exposure Device

ISSUING AGENCY:

Massachusetts Department of Public Health
Radiation Control Program

Date 09/17/03 Reviewer 
Joshua E. Daehler

Date 9/17/03 Concurrence 
John Sumares

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
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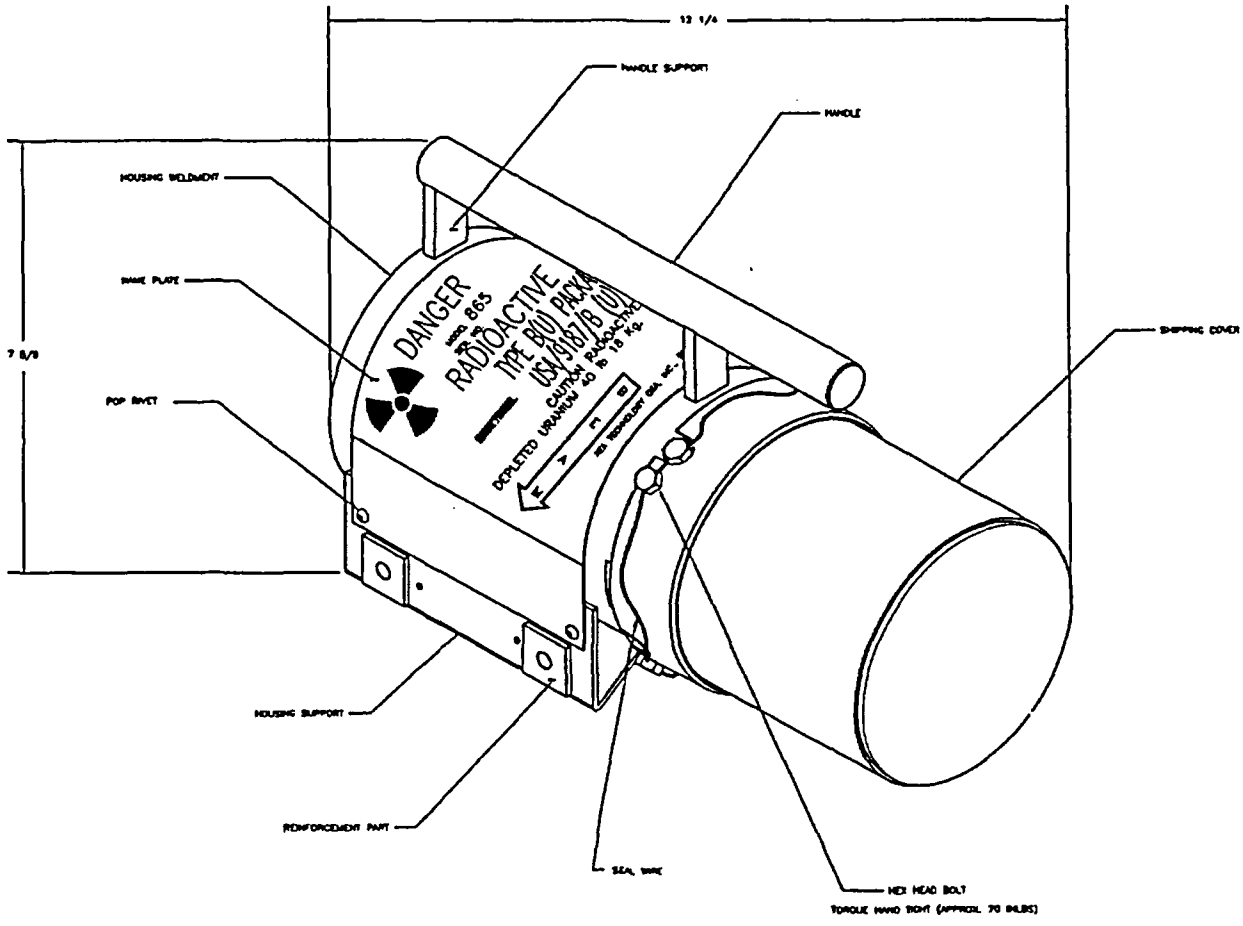
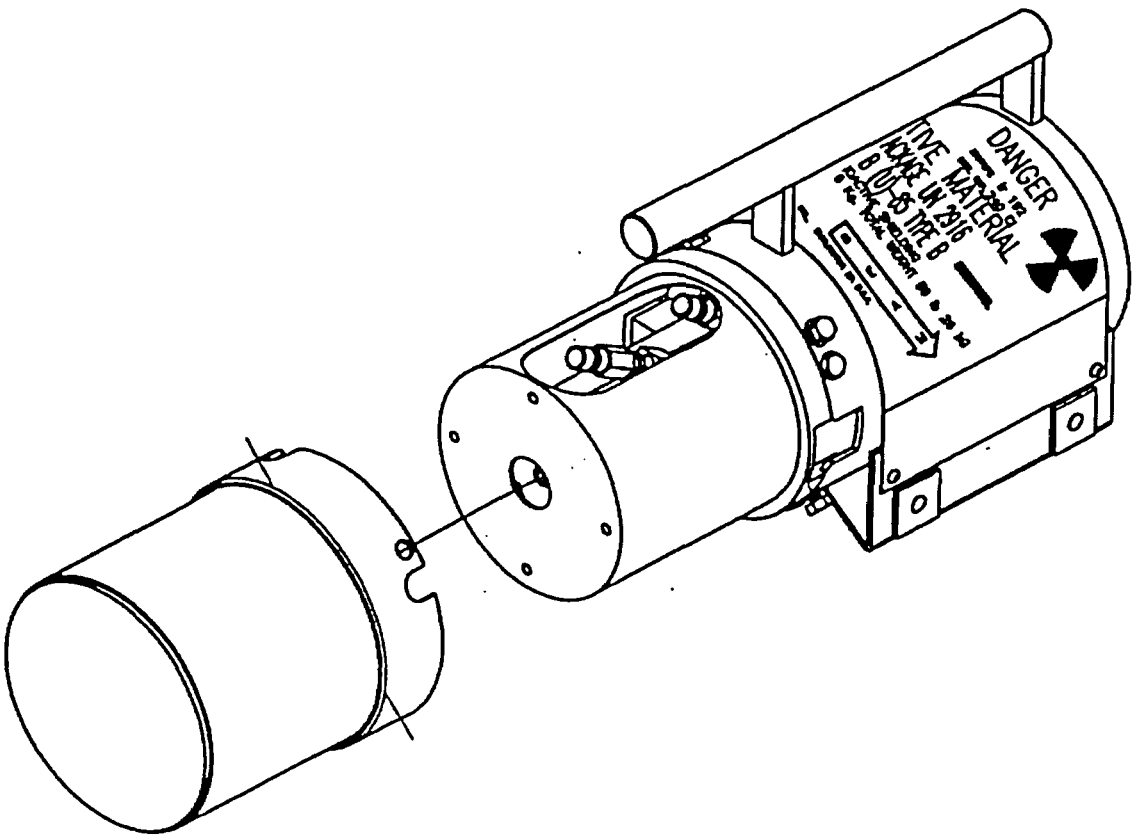
MODEL 865 PROJECTOR ASSEMBLY
(Dimensions are in inches.)



REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF DEVICE
(AMENDED IN ITS ENTIRETY)

NO: MA-1059-D-118-S DATE: **September 17, 2003** Attachment 2 of 3

MODEL 865 PROJECTOR ASSEMBLY



REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF DEVICE
(AMENDED IN ITS ENTIRETY)

NO: MA-1059-D-118-S DATE: **September 17, 2003** Attachment 3 of 3

MODEL 865 PROJECTOR ASSEMBLY
(Dimensions are in inches.)