

Registry of Radioactive Sealed Sources and Devices
Safety Evaluation of Sealed Source

No.: NR-1298-D-101-S

DATE: April 10, 2008

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DEVICE TYPE:

Betavoltaic Power Cell

MODEL:

QYNCELL KRT-2000

MANUFACTURER/DISTRIBUTER:

Qynergy Corporation
3800 Osuna Rd. N.E. Ste. 2
Albuquerque, NM 87109-4401

SEALED SOURCE MODEL DESIGNATION: QYNCELL KRT-2000

ISOTOPE:

Krypton-85 (gas)

MAXIMUM ACTIVITY:

199.8 GBq (5.4 Ci)

LEAK TEST FREQUENCY:

Krypton-85

Not Required

PRINCIPLE USE:

(T) Other [Power generation]

CUSTOM SOURCE:

_____ Yes X No

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DESCRIPTION:

The model KRT-2000 QynCell is a betavoltaic power cell capable of delivering small amounts of electrical power for many years. It combines the radionuclide gas, Krypton-85 (Kr-85) with specially designed wide bandgap semiconductors to harvest the emitted beta decay and produce usable electric power. The device measures 2.00 X 1.82 X 0.46 inches. The approximate mass of the device is 100 grams.

The KRT-2000 is a single wall, welded pressure vessel constructed of 316 stainless steel. It has a hermetic ceramic to metal feedthrough for electrical connection to the converters inside the device, and a brazed and crimped copper fill tube for the introduction of Kr-85. The steel structure provides both the seal as well as limited shielding for the Kr-85.

The package is leak tested prior to the introduction of Kr-85. The package is rated to handle pressures that far exceed the Kr-85 loading pressure of 150 psi. Within the pressure vessel, epoxied to the inside walls, are two PC boards upon which are soldered the semiconductor converters that generate the electrical power. The KRT-2000 contains 5% Kr-85 gas, and 95% Argon fill the remainder of the space. The crimped fill tube and electrical feedthrough are protected by a cap that is fastened into place. Two electrical leads exit the cap and provide the electrical power output.

REVIEWER NOTE: The construction of the device acts also as containment for the krypton gas, which is added directly into the device. The device uses no separately registered source of radioactive material which is installed into the device as a separate component.

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LABELING:

The device is labeled in accordance with 10 CFR 20.1901. All labels are permanently laser etched onto the outside surface of the device package.

The device is labeled with the trefoil symbol on the large face of the device. The opposite large face of the device is labeled with the following (letter height 0.0625", no measurable depth):

QYNCELL
Caution - Radioactive Material
Krypton-85 (isotope)
Activity
Date of Loading (date of assay)
Serial Number
Part No. KRT-2000 REV A
WWW.QYNERGY.COM

DIAGRAM:

See Attachments 1-3.

CONDITIONS OF NORMAL USE:

The device may be mounted to the systems that they are intended to power.

The KRT-2000 is only designed for operation in an air environment, it is not to be used in a highly corrosive environment such as acids, sea water, or oils. This device should not be subjected to conditions that exceed ISO/99/CX3344.

The estimated working life of the device is 20 years. No regular maintenance is required.

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PROTOTYPE TESTING:

The device has been tested according to standard procedures in ISO 2919:1999 (ANSI/HPS N43.6-1997 Sealed Radioactive Sources - Classification equivalent).

Temperature:	Class X	Modified Class 3 with expanded temperature range of -60 to 200 °C
External pressure:	Class 3	25 kPa absolute to 2 MPa absolute (0 PSIA to 290 PSIA)
Impact:	Class 3	200 grams from 1 meter or equivalent imparted energy
Vibration:	Class 4	25-80 Hz at 1.5 mm amplitude for 90 minutes and up to 80-2000 Hz at 196 m/s ² (20 g _n)
Puncture:	Class 4	50 grams from one meter or equivalent imparted energy

Leak testing: Pressurized with Helium according to ISO 9978:1992 (ANSI/HPS N43.6-1997 Section A.2.2.5 equivalent). Leakage is less than 10⁻⁸ atm-cc/sec.

REVIEWERS NOTE: The materials of construction are not detrimentally affected by the expected exposure to radiation from internal sources during normal operation.

EXTERNAL RADIATION LEVELS:

Qynergy Corporation states that the Radiation profiles for the KRT-2000 devices were directly measured at contact, 5 cm, 30 cm, and 100 cm from all faces of the device. Direct measurements were completed for a 5.49 Ci loading (slightly higher than the 5.4 Ci maximum). Maximum dose rates are present along the axis, passing through the large faces (Front/Back) of the KRT-2000.

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EXTERNAL RADIATION LEVELS (Cont.):

Table 1

Distance		Maximum Radiation Level			
		Front/Back		Sidewall	
(cm)	(inches)	(mSv/hr)	(mrem/hr)	(mSv/hr)	(mrem/hr)
0 contact	0 contact	32.0	3200	18.4	1840
5	1.97	11.3	1130	8.3	830
30	11.81	10.9	109	8.6	86
100	39.37		11	1.0	10
		On End			
(cm)	(inches)	(mSv/hr)	(mrem/hr)		
0 contact	0 contact	21.0	2100		
5	1.97	8.2	820		
30	11.81	9.0	90		
100	39.37	1.0	10		

QUALITY ASSURANCE AND CONTROL:

Qynergy Corporation maintains a quality assurance and control program which has been deemed acceptable for licensing purposes by the U.S. Nuclear Regulatory Commission. A copy of the program is on file with NRC.

LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE:

- Possession and use of this device requires a specific license issued by the U.S. Nuclear Regulatory Commission or an Agreement State.
- Handling, storage, use, transfer, and disposal: To be determined by the licensing authority.
- Maintenance, repair, source exchange, calibration, and training will be provided by Qynergy Corporation.
- Additional shielding may be required once the device is installed.

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

- Methods used for installation shall not alter or compromise the device, nor obscure labeling.
- The device shall not be subject to conditions that exceed its ANSI N43.6-1997 or ISO 2919:1999 classification, 99CX3344, or those specified in the above sections "Conditions of Normal Use" and "Prototype Testing."
- This registration certificate and the information contained within the references shall not be changed without the written consent of the U.S. Nuclear Regulatory Commission.

REVIWERS NOTE: Due to the elevated radiation fields associated with the device, installation and handling should be performed by experienced personnel, specifically trained in the handling of the device and radiation safety practices. The device may require the establishment of shielded storage areas and posted areas.

SAFETY ANALYSIS SUMMARY:

Based on review of the model QYNCELL KRT-2000, and the information and test data cited below, we conclude that the device is acceptable for licensing purposes.

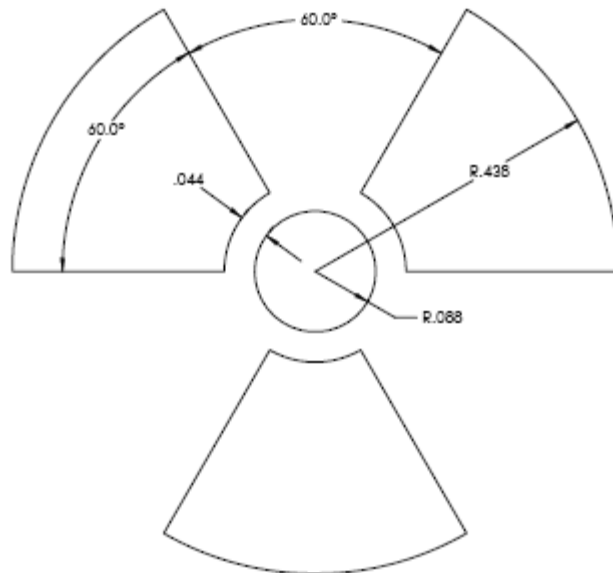
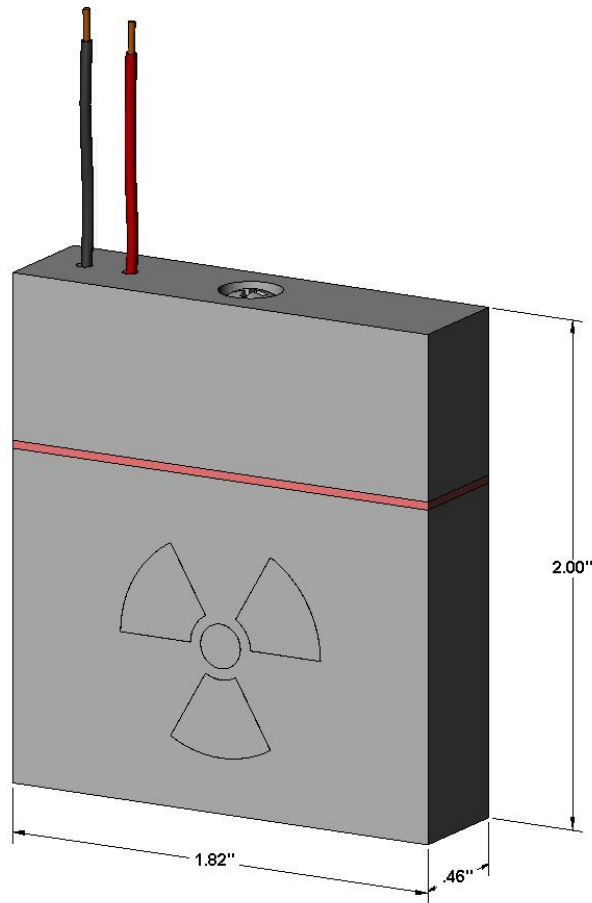
Furthermore, we conclude that these devices would be expected to maintain their integrity for normal and accidental conditions of use which might occur during the uses specified in this certificate.

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ATTACHMENT: 1

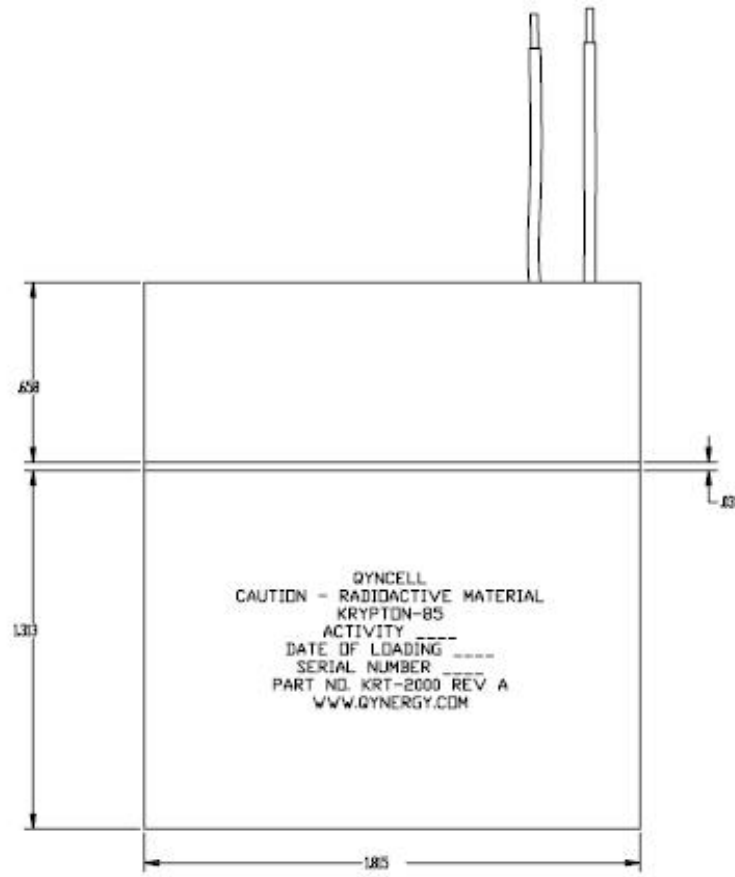


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