



**Plexus Scientific Corporation**

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January 6, 2020

Richard K. Struckmeyer  
Materials Safety Licensing Branch  
Division of Material Safety, State, Tribal, and Rulemaking Programs  
Office of Nuclear Material Safety and Safeguards  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

**Re: Current Lighting Solutions, LLC Responses to NRC's RAI dated November 14, 2019  
– USNRC Mail Control Number 616865**

Dear Mr. Struckmeyer,

On behalf of Current Lighting Solutions, LLC (Current), I am pleased to provide the U.S. Nuclear Regulatory Commission (NRC) the following responses to your requests for additional information (RAI) contained in your letter dated November 14, 2019. Current responses are numerically ordered consistent with the numerical sequence presented in your RAI letter.

1. *10 CFR Paragraph 32.15(b)(1) states that no person licensed under Section 32.14 shall transfer to other persons for use under Section 30.15 of this chapter or equivalent regulations of an Agreement State any part or product tested and found defective under the criteria and procedures specified in the license issued under Section 32.14, unless the defective part or product has been repaired or reworked, retested, and found by an independent inspector to meet the applicable acceptance criteria.*

*Please describe how you will prevent the transfer to other persons for use under Section 30.15 of this chapter or equivalent regulations of an Agreement State any part or product tested and found defective under the criteria and procedures specified in the license issued under Section 32.14.*

Response: All manufacturing locations for lamps that contain byproduct material and/or thorium are ISO 9001 certified. Quality control and management systems for lamp suppliers maintain appropriate design parameters. At various stages of manufacture, sampling plans are used to evaluate product performance and quality. Current does not transfer into commerce known defective arc tubes that could allow escape of radioactive materials from the lamps.

GE Quartz Metal Halide and Ceramic Metal Halide lamps containing radioactive materials and used for general purpose illumination are designed to:

- ANSI C78.43 - American National Standard for Electric Lamps—Single-Ended Metal Halide Lamps.
- ANSI C78.62035 - American National Standard for Electric Lamps—Discharge Lamps (Excluding Fluorescent Lamps)—Safety Specifications.

2. *10 CFR 32.16(a) requires each person licensed under Section 32.14 to maintain and report records of all transfers of byproduct material. Please confirm that you understand the requirement contained in this regulation.*

Response: Current understands the requirements contained in this regulation.

3. *Page 2, paragraph 4 contains the following statement: “Pursuant to 10 CFR 32.14(d)(2)(vii), Lamps are shipped in approved packaging that is designed to pass GE’s internal ETP-921 distribution ship test protocol GE2006-0519, which is similar in nature to ASTM D-5276 Standard Test Method for Drop Test of Loaded Containers by Free Fall.” Please clarify this, because 10 CFR does not contain a section 32.14(d)(2)(vii).*

Response: The sentence was corrected to read: Lamps are shipped in approved packaging that is designed to pass GE’s internal ETP-921 distribution ship test protocol GE2006-0519, which is similar in nature to ASTM D-5276 Standard Test Method for Drop Test of Loaded Containers by Free Fall.

4. *10 CFR 40.52(a) requires the applicant to satisfy the general requirements specified in Section 40.32, which requires the licensee to provide copy(ies) of possession and use license(s) for the source material. The copies of possession and use licenses that you provided specify only Krypton-85 and omit thorium.*

Response: Current’s possession licenses do not include thorium. Each lamp used for illuminating purposes contains unimportant quantities of thorium (i.e., less than 50 milligrams per lamp). Current is in process of requesting amendments to add thorium to the two possession licenses (Ohio and North Carolina) and will submit the amended licenses to the NRC upon receipt.

5. *10 CFR 40.52(b)(1) requires the applicant to submit chemical and physical form and maximum quantity of source material in each product. Please submit this information as required.*

Response: Low levels of thoriated tungsten with less than 2 weight percent of thorium oxide ThO<sub>2</sub> may exist in electrodes that are fully contained within a quartz arc tube. Some lamps may contain a thorium iodide ThI<sub>4</sub> admixture within the chemical dose that is also hermetically sealed within a quartz arc tube. Maximum quantities per lamp for GE-designed lamps that will be distributed by Current are listed in the table below. Additional details regarding Kr-85 and Th content for each product is presented in Attachment 1.

Thorium Oxide	Thorium Iodide
< 50 milligrams	< 4 milligrams

6. *10 CFR 40.52(b)(2) requires the applicant to submit details of construction and design of each product. Please resubmit this information in your revised application to take into account the inclusion of thorium. Please provide descriptive text of the construction and design of each product.*

Response: Small amounts of thorium are hermetically sealed within a quartz arc tube, and the arc tube is mechanically secured and further hermetically sealed within a second outer glass or quartz bulb. Industry proven manufacturing techniques that have been in existence for 40-50 years or longer maintain the thorium within the lamp and prevent release under normal transport and operating conditions. Attachment 2 contains an example schematic which shows the locations of the thorium inside the lamp.

7. *10 CFR 40.52(b)(3) requires the applicant submit quality control procedures to be followed in the fabrication of production lots of the product and the quality control standards the product will be required to meet. Please submit quality control procedures for manufacturing thorium lamps.*

Response: GE Quartz Metal Halide and Ceramic Metal Halide lamps used for general purpose illumination are designed to ANSI C78.43 - American National Standard for Electric Lamps—Single-Ended Metal Halide Lamps, and ANSI C78.62035 - American National Standard for Electric Lamps—Discharge Lamps (Excluding Fluorescent Lamps)—Safety Specifications. All manufacturing locations are ISO 9001 certified. Quality control and management systems for lamp suppliers maintain appropriate design parameters. At various stages of manufacture, sampling plans are used to evaluate product performance and quality.

8. *10 CFR 40.52(b)(4) requires the applicant to submit the proposed method of labeling or marking each unit, and/or its container with the identification of the manufacturer or initial transferor of the product and the source material in the product. Please provide copies of the labels that will be used on each type of product (or container where the product is too small to be labeled) that contains thorium.*

Response: Existing lamps that have ample surface area and/or possess the type of surface that can be feasibly marked and/or containers that are marked only contain “Kr-85” in the warning label as presented in our license application submittal. GE and Current are not aware that our competitors/other suppliers include “thorium” in their labels. GE will have to arrange to have “thorium” added to the marking/labeling for applicable lamps unless the NRC is willing to agree that the Kr-85 marking and product cycle instruction that is provided to general licensees (refer to Attachment 2) is acceptable and ensures adequate product safety. Product cycle instruction for lamps with Kr-85 are considered adequate for the lamp products that contain unimportant quantities of thorium. It is also noted that to retroactively change labeling for product in facility inventories will have an unacceptable, negative impact on the business.

9. *10 CFR 40.52(c) requires the applicant to assure that each product will contain no more than the quantity or the concentration of source material specified for that product in 10 CFR 40.13(c).*

Response: All lamps contain less than 50 milligrams of thorium and most lamps contain thorium amounts that are significantly below 50 milligrams. Quality control and product testing is used to ensure lamps contains the proper amount of source material and function correctly. Suppliers are audited and inspected as needed to ensure proper manufacturing in maintained. Many years of research and development went into these products. The lamp will not function correctly if design specifications are not adhered to.

10. *10 CFR 40.53(c) requires each person licensed under Section 40.52 to maintain and report records of all transfers of source material. Please confirm that you understand the requirement contained in this regulation.*

Response: Current understands the requirements contained in this regulation.

Thank you for your consideration and review of our responses as you complete your review of the subject license application. Current looks forward to a favorable review outcome and issuance of the license once Current provides the NRC copies the amended Agreement State possession licenses. Please do not hesitate to call or email Mr. Barry Hallock at (828) 702-8382 or [barryh.hallock@ge.com](mailto:barryh.hallock@ge.com) if you require further clarification to complete your review.

Sincerely,

A handwritten signature in blue ink that reads "John E. Buddenbaum".

Jack Buddenbaum, CHP  
Senior Health Physicist

cc: Barry Hallock, EHS Leader  
Joe Cenin, General Manager  
Selmar Dorsey, Regulatory Engineer

Attachments 1 and 2

**ATTACHMENT 1**

**GE HID SKUs with Kr-85 and/or Th**

**GE Lighting and GE Current Metal Halide Lamps Containing Byproduct Materials**  
**GE Proprietary Information**

PC	Product Description	Mfr Plant	Kr-85 [Bq/Lp]	Th [g/Lp]	Th [mg/Lp]	ByProduct	Hg [mg]
10202	MPR350/VBU/PA	VLI-3449	6379.6	0.0059	5.927	Kr-85 + Th	55.0
10361	MXR50/U/MED	VLI-3449	2069.0	0.0003	0.264	Kr-85 + Th	6.5
10364	MXR50/C/U/MED	VLI-3449	2069.0	0.0003	0.264	Kr-85 + Th	6.5
10389	MVR1000U/BT37/PA	VLI-3449	8554.0	0.0098	9.848	Kr-85 + Th	151.0
11649	MPR175/C/VBU/O	VLI-3449	0.0	0.0019	1.876	Thorium	27.0
11650	MPR250/C/VBU/O	VLI-3449	0.0	0.0010	0.996	Thorium	30.0
11685	MPR360CVBUWMHO/O	BLSF-3379	0.0	0.0059	5.920	Thorium	52.0
12377	MXR70/U/MED/O	VLI-3449	4321.0	0.0006	0.585	Kr-85 + Th	11.6
12381	MXR100/U/MED/O	VLI-3449	2717.0	0.0006	0.585	Kr-85 + Th	11.0
12577	MXR70/C/U/MED/O	VLI-3449	4321.0	0.0006	0.585	Kr-85 + Th	11.6
12579	MXR100/C/U/MED/O	VLI-3449	2717.0	0.0006	0.585	Kr-85 + Th	11.0
12590	MVR70/U/MED	Times-3449	5696.0	0.0008	0.810	Kr-85 + Th	10.6
12594	MVR70/C/U/MED	VLI-3449	4199.0	0.0003	0.261	Kr-85 + Th	8.5
12598	MVR150/U/MED	VLI-3449	5521.0	0.0011	1.132	Kr-85 + Th	10.8
12604	MVR150/C/U/MED	VLI-3449	5521.0	0.0011	1.132	Kr-85 + Th	10.8
12622	MVR175/VBU/PA	BLSF-3379	0.0	0.0013	1.318	Thorium	25.7
12633	MVR175/C/VBU/PA	BLSF-3379	0.0	0.0013	1.318	Thorium	25.7
12636	MVR175/VBU/MEDPA	BLSF-3379	0.0	0.0013	1.318	Thorium	17.9
12637	MVR175/CVBUMEDPA	BLSF-3379	0.0	0.0013	1.318	Thorium	17.9
12642	MVR400/VBU/XHOPA	BLSF-3379	0.0	0.0058	5.801	Thorium	60.0
12644	MVR400/C/VBU/XHO/PA	BLSF-3379	0.0	0.0058	5.801	Thorium	60.0
12652	MVR100/U/MED	VLI-3449	2553.0	0.0004	0.395	Kr-85 + Th	9.7
12653	MVR100/C/U/MED	VLI-3449	2553.0	0.0004	0.395	Kr-85 + Th	9.7
12762	MVR250/VBU/R	VLI-3449	8690.0	0.0029	2.876	Kr-85 + Th	15.0
12769	MVR250/C/VBU/R	VLI-3449	8690.0	0.0029	2.876	Kr-85 + Th	15.0
12770	MVR400/VBU/R	VLI-3449	3908.4	0.0060	5.967	Kr-85 + Th	38.0
12772	MVR400/C/VBU/R	VLI-3449	3908.4	0.0060	5.967	Kr-85 + Th	38.0
13481	MVR150/U/WM	VLI-3449	1815.0	0.0013	1.262	Kr-85 + Th	17.5
13490	MVR150/C/U/WM	VLI-3449	1815.0	0.0013	1.262	Kr-85 + Th	17.5
13495	MVR360/U/WM/HO	BLSF-3379	0.0	0.0059	5.920	Thorium	52.0
13582	MPR400/C/VBU/HO/O	BLSF-3379	0.0	0.0059	5.860	Thorium	63.0
13923	MVR400/VBU/XHO	BLSF-3379	0.0	0.0058	5.801	Thorium	60.0
13924	MVR400/C/VBU/XHO	BLSF-3379	0.0	0.0058	5.801	Thorium	60.0
15378	CSR575/2/SE	KOTO-3449	8105.0	0	0	Kr-85	65
18101	MVR250/HOR	Times-3449	5937.0	0.0021	2.078	Kr-85 + Th	23.0
18205	MVR1000/U/BT37	VLI-3449	0.0	0.0098	9.848	Thorium	151.0
18679	MXR100/C/U/MED	VLI-3449	2717.0	0.0004	0.388	Kr-85 + Th	11.0
18680	MXR100/U/MED	VLI-3449	2717.0	0.0004	0.388	Kr-85 + Th	11.0
18708	MPR400/VBU/HO/O	BLSF-3379	0.0	0.0059	5.860	Thorium	63.0
18902	MVR175/U/MED	BLSF-3379	0.0	0.0012	1.196	Thorium	25.7
18904	MVR400/U/ED28	BLSF-3379	0.0	0.0058	5.801	Thorium	55.0
19609	MPR320/C/PA/ED28	VLI-3449	3164.5	0.0038	3.769	Kr-85 + Th	50.0
19976	MVR175/C/U/MED	BLSF-3379	0.0	0.0012	1.196	Thorium	25.7
19979	MVR400/C/U/ED28	BLSF-3379	0.0	0.0058	5.801	Thorium	63.0

# GE Lighting and GE Current Metal Halide Lamps Containing Byproduct Materials

## GE Proprietary Information

PC	Product Description	Mfr Plant	Kr-85 [Bq/Lp]	Th [g/Lp]	Th [mg/Lp]	ByProduct	Hg [mg]
20016	CMH70TU/830/G12	BLSF-3379	10.4	0	0	Kr-85	4.05
20017	CMH150TU/830/G12	BLSF-3379	39.1	0	0	Kr-85	11.6
20018	CMH150TU/942/G12	BLSF-3379	39.1	0	0	Kr-85	9
20023	CMH70TU/942/G12	BLSF-3379	10.4	0	0	Kr-85	5.7
20153	CMH39TUVU830G12	BLSF-3379	7.7	0	0	Kr-85	4.8
21853	CSR400/SE/HRUV-C	KOTO-3449	2190.0	0	0	Kr-85	16
22152	CMH70PAR30L830SP	BLSF-3379	522.8	0	0	Kr-85	8
22158	MXR70/U/MED	Times-3449	5696.0	0.0010	0.990	Kr-85 + Th	11.5
22159	CMH70PAR30L830FL	BLSF-3379	522.8	0	0	Kr-85	8
22162	MXR70/C/U/MED	VLI-3449	4199.0	0.0003	0.273	Kr-85 + Th	9.0
22495	CSR800/SE/HR/UVC	KOTO-3449	8725.0	0	0	Kr-85	56
22935	MXR150/U/MED	VLI-3449	5521.0	0.0011	1.132	Kr-85 + Th	12.5
22936	MXR150/C/U/MED	VLI-3449	5521.0	0.0011	1.132	Kr-85 + Th	12.5
23729	MVR350VBUXHOPA/E	BLSF-3379	0.0	0.0058	5.801	Thorium	54.0
23738	MVR350CVBUXHOPAE	BLSF-3379	0.0	0.0058	5.801	Thorium	54.0
25532	MVR1650/HOR	VLI-3449	0.0	0.0180	17.980	Thorium	211.5
26218	MVR400/HOR/MOG	EYE-3449	0.0	0.0144	14.400	Thorium	50.0
26317	MVR250/VBU/PA	BLSF-3379	0.0	0.0010	1.006	Thorium	37.0
26319	MVR250/C/VBU/PA	BLSF-3379	0.0	0.0010	1.006	Thorium	37.0
26851	MVR400/U/ED28/R	VLI-3449	3908.4	0.0060	5.967	Kr-85 + Th	38.0
27219	MVR750/VBU/PA	BLSF-3379	0.0	0.0106	10.592	Thorium	118.0
27501	MVR320/VBU/HO/PA	BLSF-3379	0.0	0.0030	3.021	Thorium	30.0
29485	CMH20PAR20/SP	BLSF-3379	2.3	0	0	Kr-85	2.4
29486	CMH20PAR20/FL	BLSF-3379	2.3	0	0	Kr-85	2.4
29489	CMH20PAR30/FL25	BLSF-3379	2.3	0	0	Kr-85	2.4
29696	CMH39T/U/942/G12	BLSF-3379	7.7	0	0	Kr-85	4.65
29703	CMH20T/U/830/G12	BLSF-3379	2.3	0	0	Kr-85	2.4
30942	MVR250/U/LTP	BLSF-3379	0.0	0.0010	1.006	Thorium	31.0
30951	MVR175/U/LTP	BLSF-3379	0.0	0.0012	1.196	Thorium	25.7
30953	MVR400/U/LTP	BLSF-3379	0.0	0.0058	5.801	Thorium	63.0
30968	MXR70/UO/MED/LTP	VLI-3449	4321.0	0.0006	0.585	Kr-85 + Th	11.6
40053	MVR360VBU/WM/XHO	BLSF-3379	0.0	0.0058	5.801	Thorium	48.0
40055	MVR360C/VBUWMXHO	BLSF-3379	0.0	0.0058	5.801	Thorium	48.0
40056	MPR360VBUWM/HO/O	BLSF-3379	0.0	0.0059	5.920	Thorium	52.0
40201	MVR400/HOR/BT28	EYE-3449	0.0	0.0144	14.400	Thorium	50.0
40335	MVR400/VBUED28HO	BLSF-3379	0.0	0.0059	5.860	Thorium	63.0
41433	MPR1000/VBU/HO/O	Times-3449	2958.0	0.0477	47.660	Kr-85 + Th	151.0
41826	MVR1000/U	BLSF-3379	0.0	0.0104	10.352	Thorium	150.0
41827	MVR1000/C/U	BLSF-3379	0.0	0.0104	10.352	Thorium	150.0
42066	CMH39PAR30L/SP15	BLSF-3379	6.8	0	0	Kr-85	5.05
42067	CMH39PAR30L/FL25	BLSF-3379	6.8	0	0	Kr-85	5.05
42068	CMH39UPAR20FL25	BLSF-3379	6.6	0	0	Kr-85	4.6
42069	CMH39UPAR20SP10	BLSF-3379	6.6	0	0	Kr-85	4.8
42729	MVR250/U	BLSF-3379	0.0	0.0010	1.006	Thorium	31.0
42731	MVR250/C/U	BLSF-3379	0.0	0.0010	1.006	Thorium	31.0

# GE Lighting and GE Current Metal Halide Lamps Containing Byproduct Materials

## GE Proprietary Information

PC	Product Description	Mfr Plant	Kr-85 [Bq/Lp]	Th [g/Lp]	Th [mg/Lp]	ByProduct	Hg [mg]
43828	MVR400/U	BLSF-3379	0.0	0.0058	5.801	Thorium	63.0
43829	MVR400/C/U	BLSF-3379	0.0	0.0058	5.801	Thorium	63.0
44835	MVR1000/VBU/HO	BLSF-3379	0.0	0.0104	10.352	Thorium	150.0
45066	CMH39/PAR30LSP10	BLSF-3379	6.8	0	0	Kr-85	5.05
45664	MVR400/VBU/HO/PA	BLSF-3379	0.0	0.0059	5.860	Thorium	63.0
45666	MVR320VBU/XHO/PA	VLI-3449	3164.5	0.0038	3.769	Kr-85 + Th	50.0
45669	MVR320C/VBU/XHO/PA	VLI-3449	3164.5	0.0038	3.769	Kr-85 + Th	50.0
45670	MXR50/U/MED/O	VLI-3449	2069.0	0.0003	0.264	Kr-85 + Th	6.5
45671	MXR50/C/U/MED/O	VLI-3449	2069.0	0.0003	0.264	Kr-85 + Th	6.5
45683	MXR150/U/MED/O	VLI-3449	5521.0	0.0012	1.228	Kr-85 + Th	11.4
45688	MXR150/C/U/MED/O	VLI-3449	5521.0	0.0012	1.228	Kr-85 + Th	11.4
46271	MVR400/VBUED28PA	VLI-3449	6666.0	0.0053	5.317	Kr-85 + Th	40.3
46272	MVR400CVBUED28PA	VLI-3449	6666.0	0.0053	5.317	Kr-85 + Th	40.3
46273	MPR400/VBU/XHOPA	VLI-3449	6666.0	0.0053	5.317	Kr-85 + Th	40.3
46274	MPR400C/VBUXHOPA	VLI-3449	6666.0	0.0053	5.317	Kr-85 + Th	40.3
46275	MPR320/VBU/XHOPA	VLI-3449	3164.5	0.0038	3.769	Kr-85 + Th	50.0
46276	MPR320C/VBUXHOPA	VLI-3449	3164.5	0.0038	3.769	Kr-85 + Th	50.0
46632	MVR400VBD/XHO/PA	VLI-3449	6666.0	0.0053	5.317	Kr-85 + Th	40.3
47326	MVR1500/U/SPORTS	VLI-3449	0.0	0.0180	17.984	Thorium	228.0
47326	MVR1500/U/SPORTS	BLSF-3379	0.0	0.0110	11.008	Thorium	160.0
47760	MVR175/U	BLSF-3379	0.0	0.0012	1.196	Thorium	25.7
47761	MVR175/C/U	BLSF-3379	0.0	0.0012	1.196	Thorium	25.7
48824	MPR350/C/VBU/PA	VLI-3449	6379.6	0.0059	5.927	Kr-85 + Th	55.0
48825	MPR350C/VBU3K/PA	VLI-3449	6379.6	0.0060	6.030	Kr-85 + Th	55.0
49470	MPR175/VBU/O	VLI-3449	0.0	0.0019	1.876	Thorium	27.0
49471	MPR250/VBU/O	VLI-3449	0.0	0.0010	0.996	Thorium	30.0
49490	CSR1200/2/SE	KOTO-3449	9300.0	0	0	Kr-85	85
49657	MVR400/VBU/HO	BLSF-3379	0.0	0.0059	5.860	Thorium	63.0
61325	MPR175/VBU/PA/O	VLI-3449	9990.0	0.0006	0.623	Kr-85 + Th	25.3
61326	MPR250/VBU/PA/O	VLI-3449	2769.2	0.0022	2.199	Kr-85 + Th	25.8
71484	CMH39T/U930GU6.5	BLSF-3379	7.7	0	0	Kr-85	4.7
71489	CMH39MR16/930/FL	BLSF-3379	7.7	0	0	Kr-85	4.5
71490	CMH39MR16/930WFL	BLSF-3379	7.7	0	0	Kr-85	4.5
71492	CMH39MR16/942/FL	BLSF-3379	7.7	0	0	Kr-85	3.5
72882	MVR250/HOR/PA	VLI-3449	3861.6	0.0003	0.316	Kr-85 + Th	35.9
72884	MVR320HOR/ED28PA	VLI-3449	3861.6	0.0003	0.316	Kr-85 + Th	28.0
72885	MVR400HOR/ED28PA	VLI-3449	6099.2	0.0056	5.623	Kr-85 + Th	39.0
72886	MVR400HOR/PA	VLI-3449	6099.2	0.0056	5.623	Kr-85 + Th	39.0
73057	CMH70U930G8.5ULR	BLSF-3379	10.4	0	0	Kr-85	5.5
76224	CMHI23P38SP/ECO	BLSF-3379	2.3	0	0	Kr-85	2.53
76225	CMHI23P38FL/ECO	BLSF-3379	2.3	0	0	Kr-85	2.53
76226	CMHI23P38WFL/ECO	BLSF-3379	2.3	0	0	Kr-85	2.53
78665	MVR250/U/PA	BLSF-3379	0.0	0.0010	1.006	Thorium	37.0
78666	MVR400/U/PA	BLSF-3379	0.0	0.0058	5.801	Thorium	63.0
85086	CMH20T/U830GU6.5	BLSF-3379	2.3	0	0	Kr-85	2.53



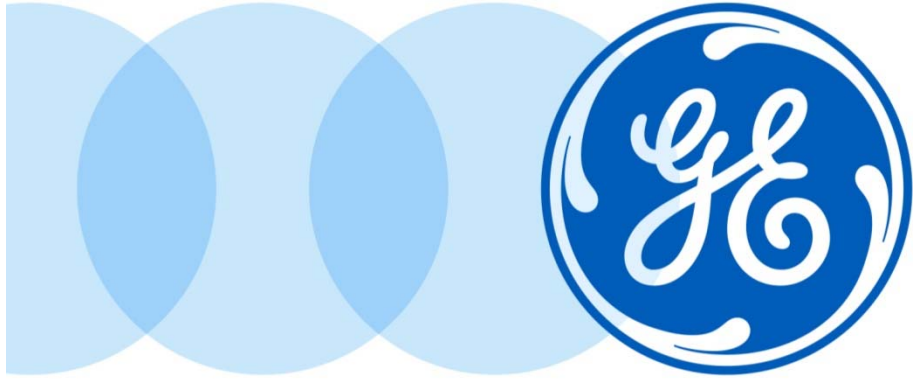
# GE Lighting and GE Current Metal Halide Lamps Containing Byproduct Materials

## GE Proprietary Information

PC	Product Description	Mfr Plant	Kr-85 [Bq/Lp]	Th [g/Lp]	Th [mg/Lp]	ByProduct	Hg [mg]
85101	CMH20MR16/830/SP	BLSF-3379	2.3	0	0	Kr-85	2.3
85110	CMH20MR16/830/FL	BLSF-3379	2.3	0	0	Kr-85	2.3
88655	ARC150/842/G12	BLSF-3379	822.5	0	0	Kr-85	29.56
90352	CMH39TCU830/G8.5	BLSF-3379	7.7	0	0	Kr-85	4.8
92585	CMH70TCU830/G8.5	BLSF-3379	10.4	0	0	Kr-85	4.6
92587	CMH70/TD/830RX7S	BLSF-3379	17.9	0	0	Kr-85	6.3
92588	CMH70/TD/942RX7S	BLSF-3379	17.9	0	0	Kr-85	6.4
92589	CMH150TD830RX7S	BLSF-3379	39.1	0	0	Kr-85	10
92590	CMH150TD942RX7S	BLSF-3379	39.1	0	0	Kr-85	8.45
92696	CMH20TC/U830G8.5	BLSF-3379	2.3	0	0	Kr-85	2.4
96526	CMH39PAR20/NSP4K	BLSF-3379	7.7	0	0	Kr-85	4.5
96527	CMH39PAR20/FL4K	BLSF-3379	7.7	0	0	Kr-85	4.5
96528	CMH39PAR30LNSP4K	BLSF-3379	7.7	0	0	Kr-85	4.5
96530	CMH39PAR30L/FL4K	BLSF-3379	7.7	0	0	Kr-85	4.5
97638	CMH20MR16/830WFL	BLSF-3379	2.3	0	0	Kr-85	2.3

**ATTACHMENT 2**

**Samples of Design, Construction and Labeling of  
GE Lighting and GE-Current Lamps Containing Kr-85 and Thorium**



# Samples of Design, Construction and Labeling of GE Lighting and GECurrent Lamps Containing Radioactive Byproducts of Kr-85 and Thorium

January 2020







imagination at work

Lamps placed into US commerce may be offered under the following names:

GE Lighting or  
GECurrent Lighting Solutions LLC  
and hereafter referred to as GE

**GE offers a combination of Metal Halide lamps that may contain:**

Kr-85	Thorium	Kr-85 + Thorium	No Radioactive Substances
			

# Fabrication & Quality Control Procedures for GE lamps

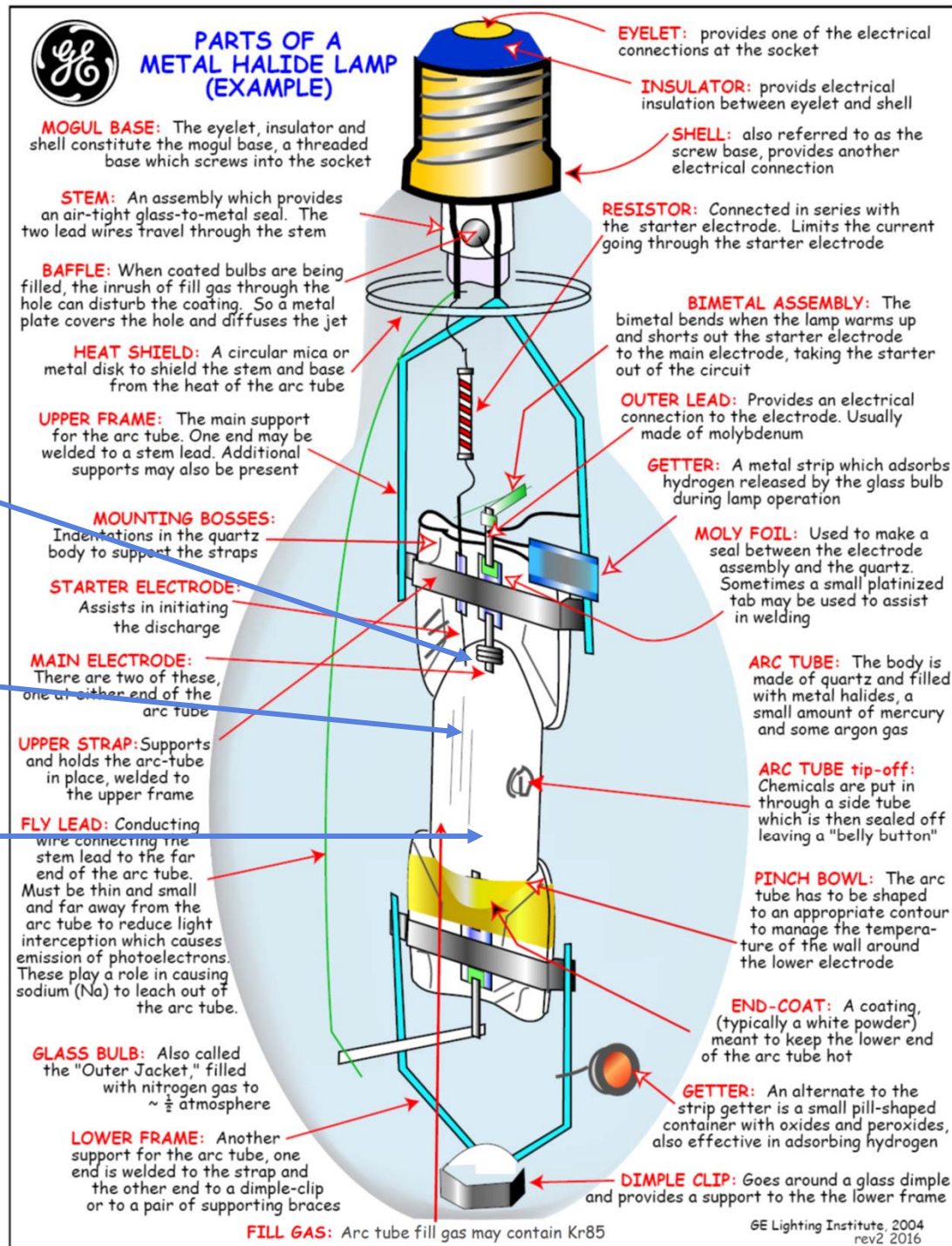
- All GE high-intensity discharge (HID) lamps are sourced from other manufacturers with two primary locations, Hungary and India. Both locations manufacture lamps containing byproduct material and are ISO 9001 certified.
- Quality control and management systems of GE's HID lamp suppliers maintain appropriate design parameters. At various stages of manufacture sampling plans are used to evaluate product performance and quality. Diagnostic tools tests arc tubes & lamps for light-up, glow checks and voltage measurements.
- GE does not transfer into commerce known defective arc tubes that could allow escape of byproduct materials from the lamp.
- GE also promotes and recommends lamp recycling for end of life product. Package labeling lists "[lamprecycle.org](http://lamprecycle.org)" as a responsible method of lamp disposal.
- GE Quartz Metal Halide and Ceramic Metal Halide lamps used for general purpose illumination are designed to:
  - ANSI C78.43 - American National Standard for Electric Lamps—Single-Ended Metal Halide Lamps
  - ANSI C78.62035 - American National Standard for Electric Lamps—Discharge Lamps (Excluding Fluorescent Lamps)—Safety Specifications

## Existence of Byproduct Materials in GE lamps

- Low levels of Kr-85 are mixed with argon and hermetically sealed within a quartz or ceramic arc tube.
- Low levels of thoriated tungsten with 2 weight percent or less of thorium oxide ThO<sub>2</sub> may exist in electrodes and are fully contained in quartz arc tube.
- Some lamps contain a thorium iodide ThI<sub>4</sub> admixture of  $\leq 4$  weight percent within the chemical dose and is hermetically sealed within a quartz arc tube.
- Industry proven manufacturing techniques that have been in existence for 40-50 years or longer maintain the byproduct material (and thorium iodide for certain lamp types) inside the arc tube and prevents leakage under normal transport and operating conditions.
- For all general purpose lighting applications arc tubes are mechanically secured within a hermetically sealed second outer glass or quartz bulb.
- A few specialty lamp products for entertainment lighting applications may have Kr-85 contained within only one thick quartz envelop.
- Introduction of Kr-85 or thorium into HID arc tube aids in lamp starting especially in low ambient temperatures, and improves lumen maintenance thus allowing for longer life and fewer intervals for replacement.

# Maximum concentration of byproduct materials in GE lamps

Kr-85	Thorium Oxide	Thorium Iodide
< 10,000 Bq/Lp < 0.27 $\mu$ Ci/Lp	< 0.050 g/Lp	< 200 Bq/Lp
Gas	Th232 and/or Th(nat)	Th232 and/or Th(nat)



Thorium oxide may be alloyed in the tungsten electrodes.

Thorium iodide may be present as admixture in the dose chemistry.

Arc tube fill gas may contain Kr-85

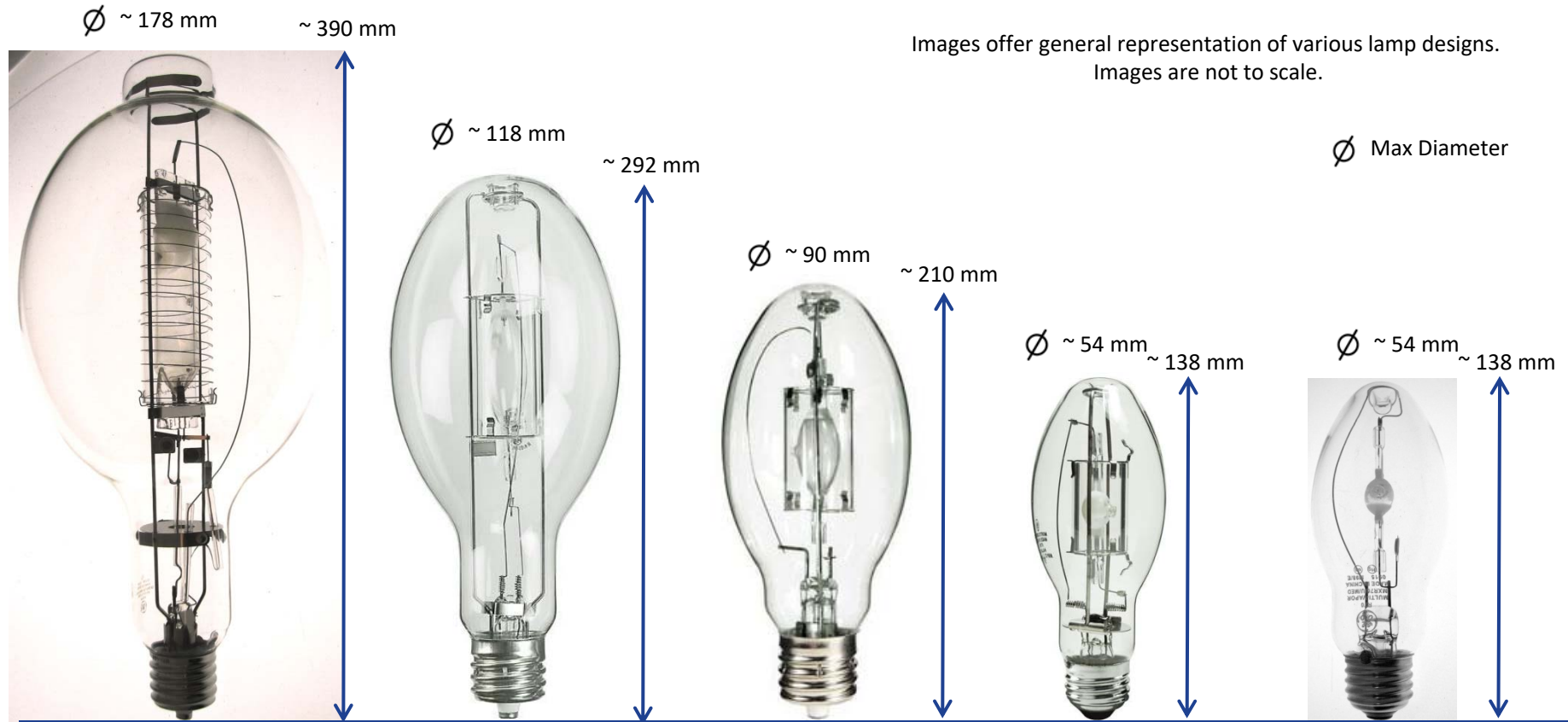
All byproduct is contained inside the hermetically sealed quartz arc tube.

GE Confidential and Proprietary Information.

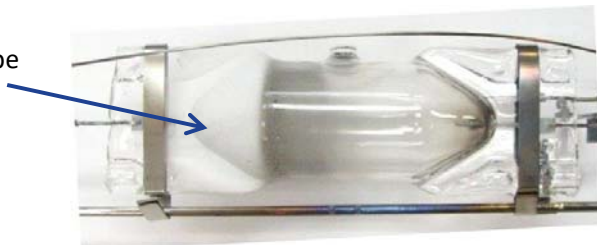
No Third Party Disclosure Without the Express Written Consent of GE



# Samples of GE Lamps Containing Kr-85 & Thorium



Quartz Arc Tube

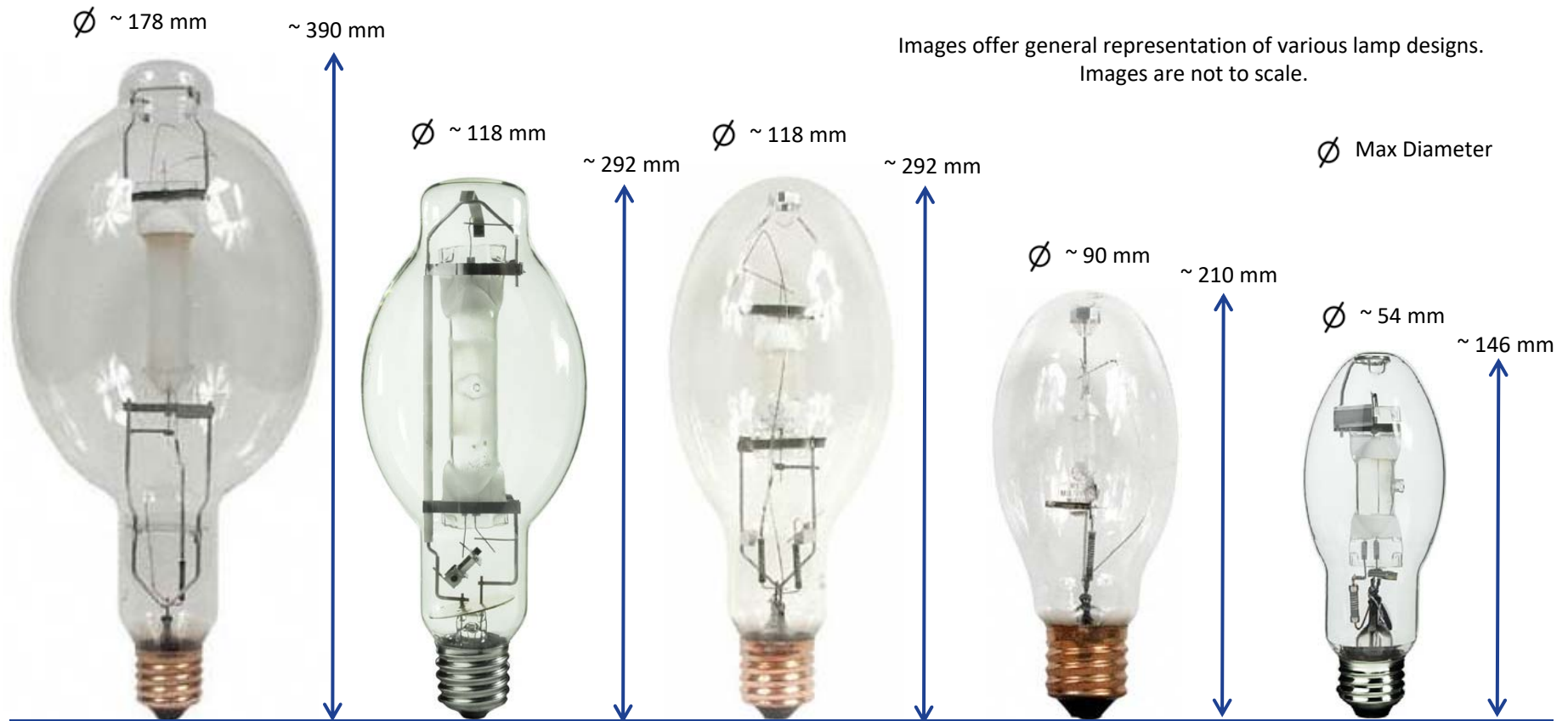


Quartz Arc Tube



Kr-85 gas and thorium alloyed with tungsten cathodes are contained within a hermetically sealed quartz arc tube.  
The arc tube is also hermetically sealed inside a glass or quartz outer bulb.

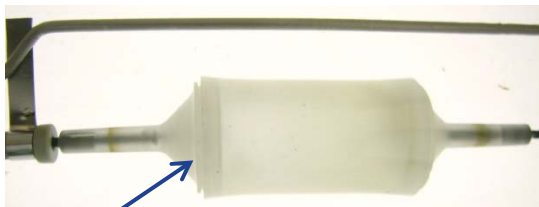
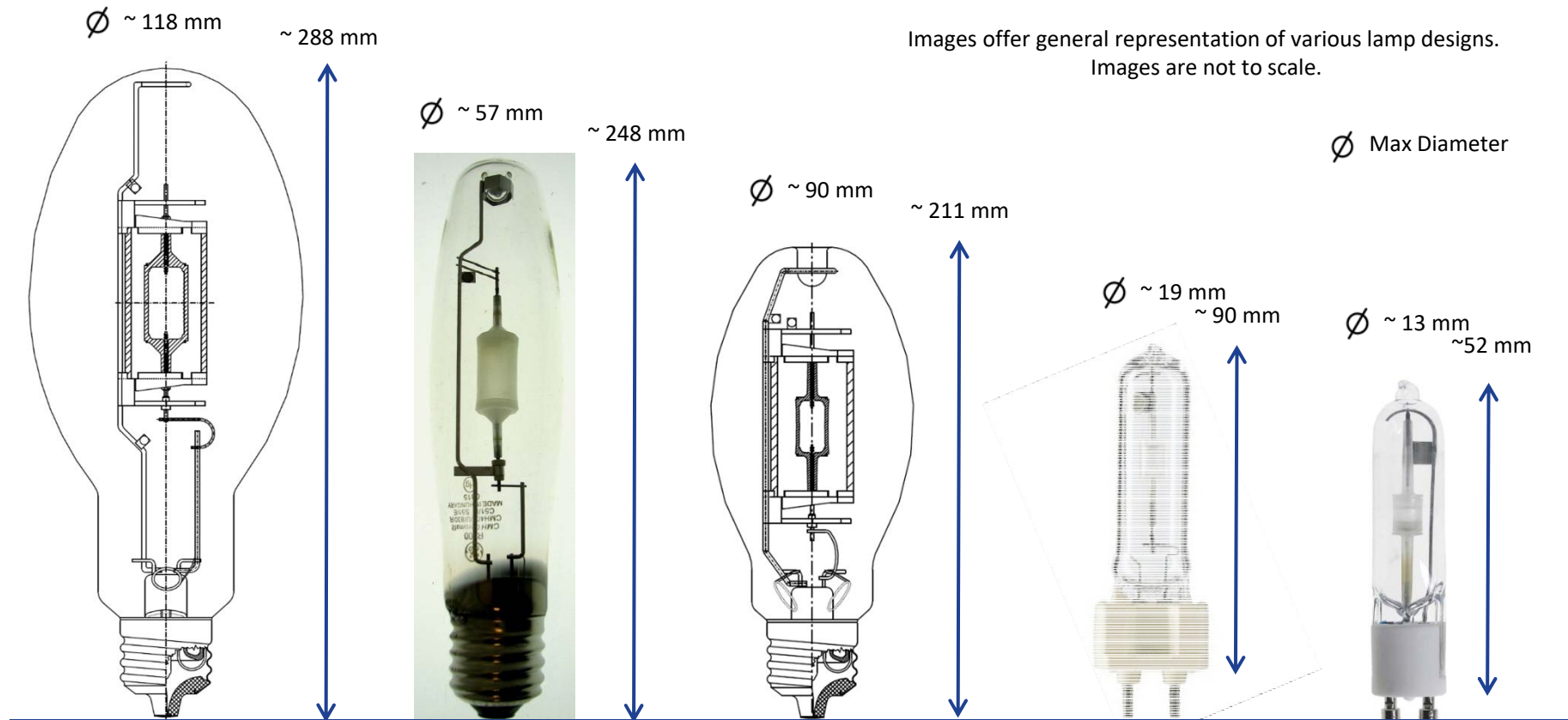
# Samples of GE Lamps Containing Thorium



Thorium oxide alloyed with tungsten electrodes are contained within a hermetically sealed quartz arc tube



# Samples of GE Lamps Containing only Kr-85



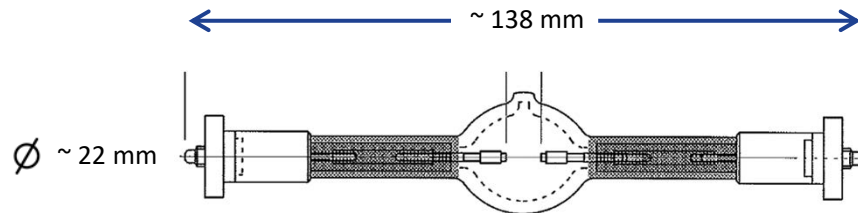
Ceramic Arc Tube

Kr-85 is contained within a hermetically sealed ceramic arc tube.  
The arc tube is also hermetically sealed inside a glass or quartz outer bulb.



Ceramic Arc Tube

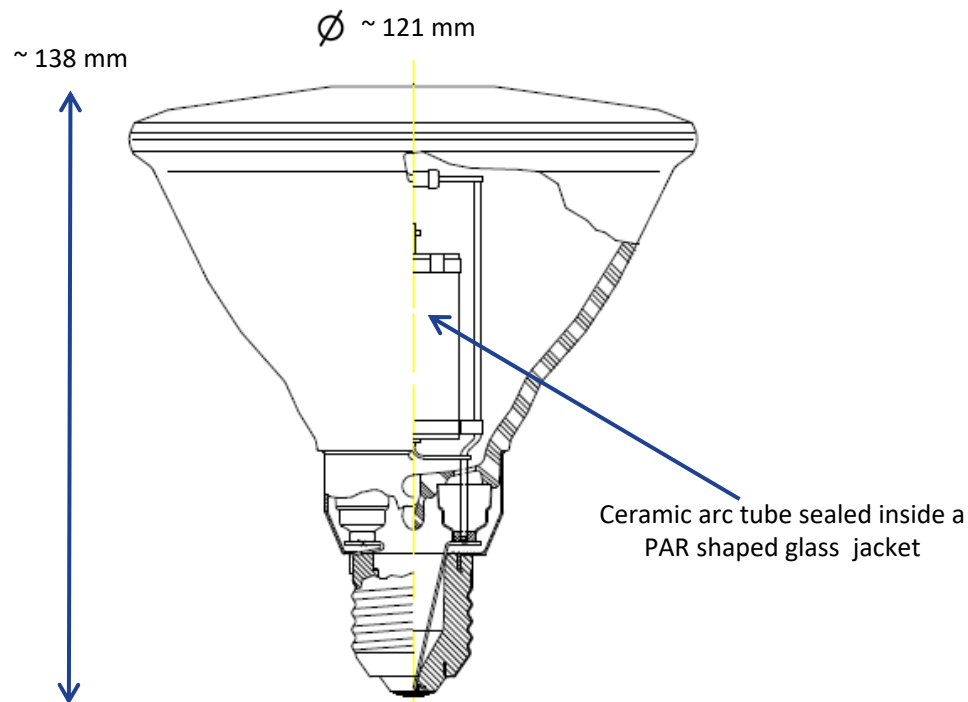
# Samples of GE Lamps Containing Kr-85



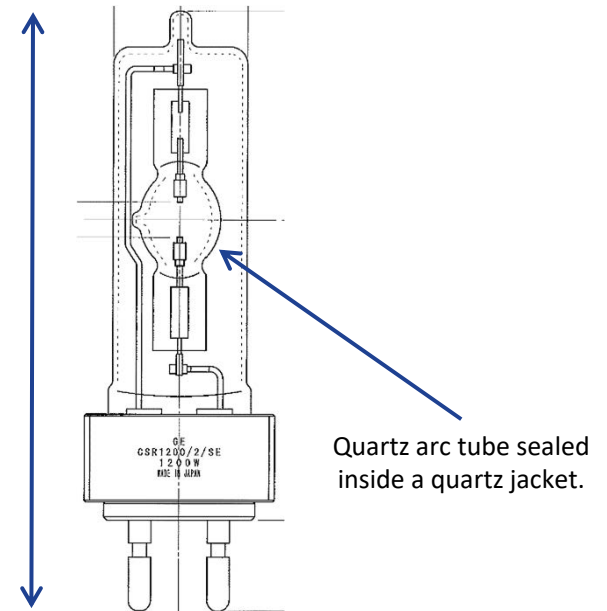
Images offer general representation of various lamp designs.  
Images are not to scale.

A few specialty design ShowBiz lamps have Kr-85 hermetically sealed in only a quartz tube.

$\varnothing$  Max Diameter



$\sim 175 \text{ mm}$   $\varnothing \sim 40 \text{ mm}$



Kr-85 is contained within a hermetically sealed quartz or ceramic arc tube.  
The arc tube is also hermetically sealed inside a glass or quartz outer bulb.



# Samples of Kr-85 Lamp & Package Labeling

Multilingual caution & warning leaflet inserted inside immediate wrapping of certain metal halide lamps

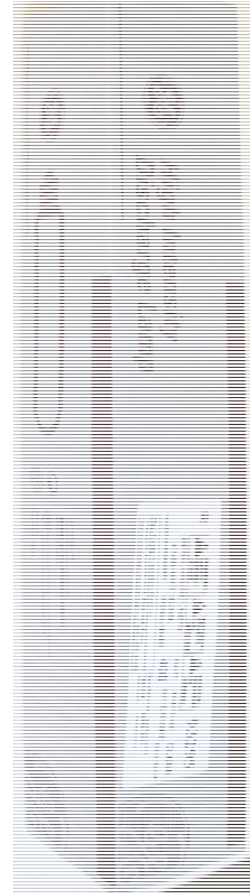
Outer Carton with Labels



Monogram

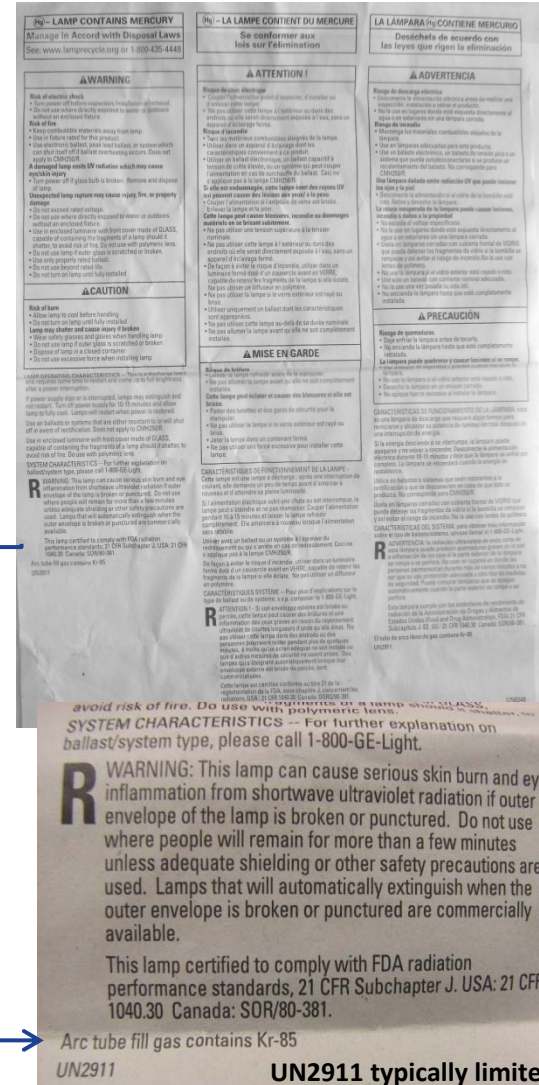


Immediate Wrapping with Label



Carton Label with UN2911

Arc tube fill gas contains Kr-85



UN2911 typically limited to outer carton not insert



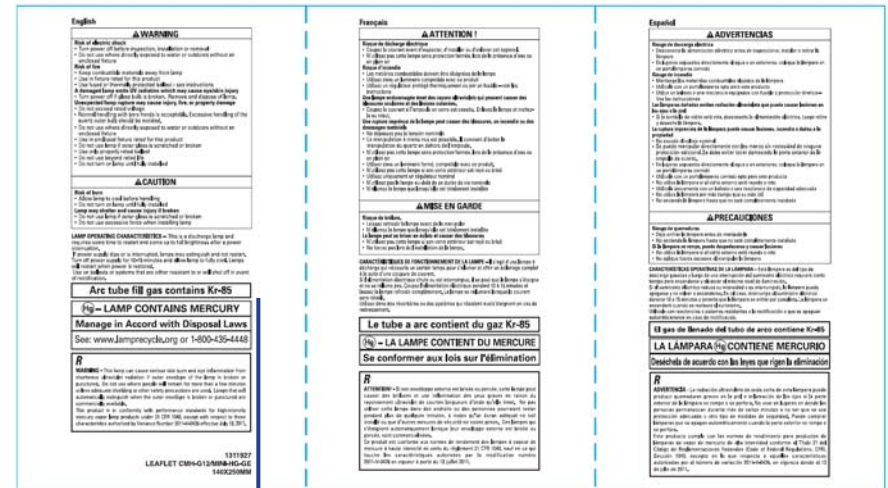
Sample packaging for Ceramic MH lamp from GE Hungary Manufacturing Plant

## Samples of Kr-85 Lamp & Package Labeling

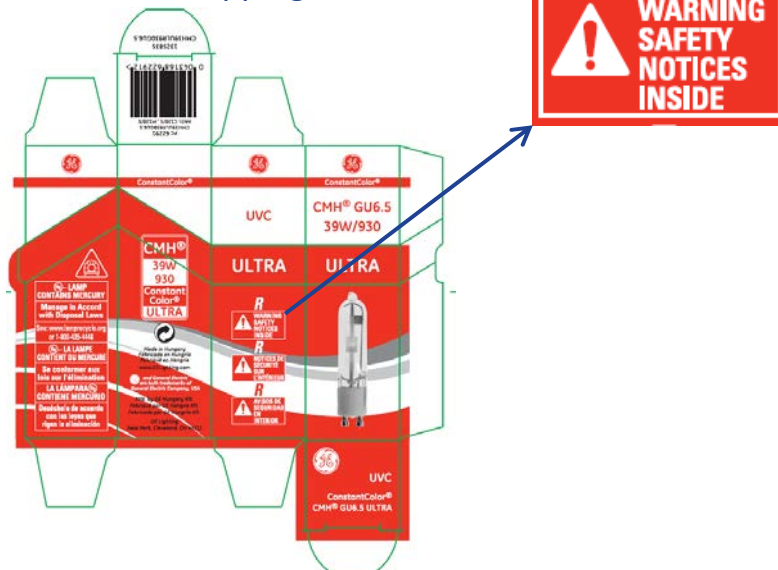
## Outer Carton Label Low Kr-85



Multilingual caution & warning leaflet inserted inside immediate wrapping of certain metal halide lamps



## Immediate Wrapping with Label



### Arc tube fill gas contains Kr-85

**(Hg) – LAMP CONTAINS MERCURY**

## Manage in Accord with Disposal Laws

See: [www.lamprecycle.org](http://www.lamprecycle.org) or 1-800-435-4448





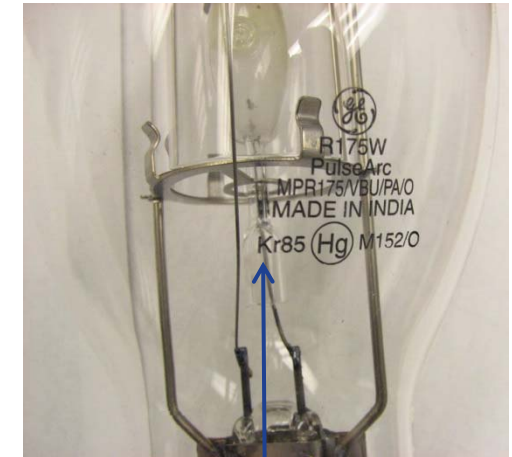
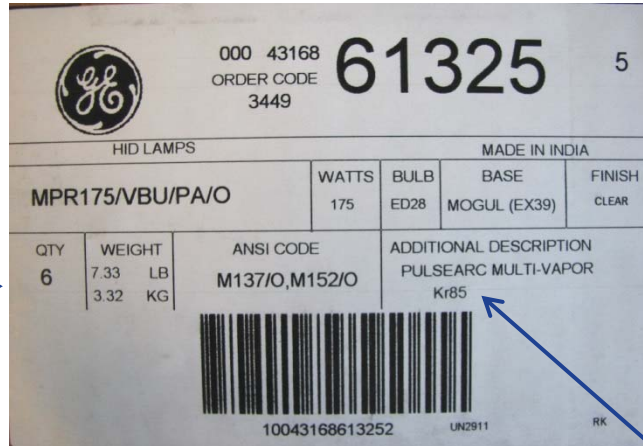
# Samples of Kr-85 Lamp & Package Labeling

Lamp monogram includes Kr85

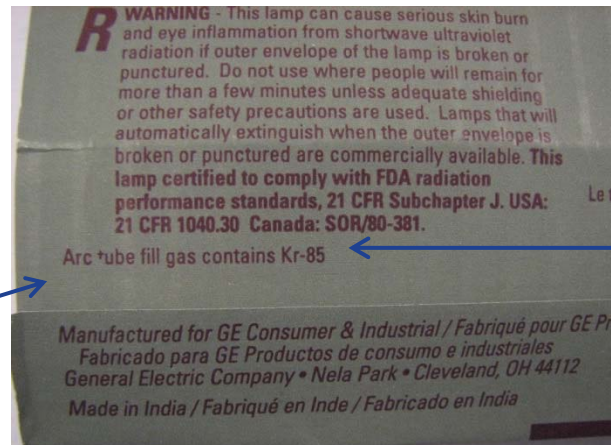
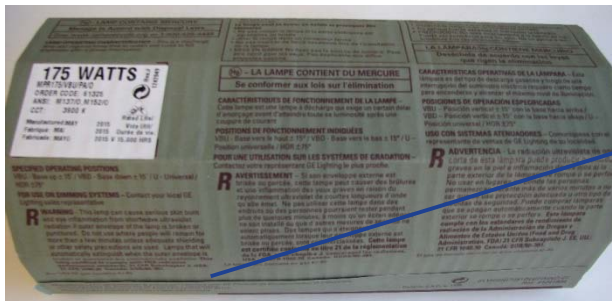
Carton Label with Kr85



Outer Carton with Labels



Immediate Wrapping with Label



Kr85



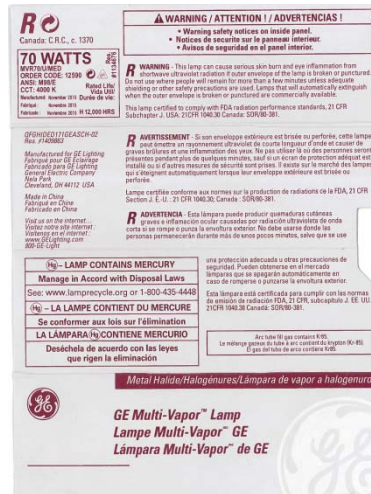
Sample packaging for Quartz MH lamp Sourced from India

# Samples of Kr-85 Lamp & Package Labeling

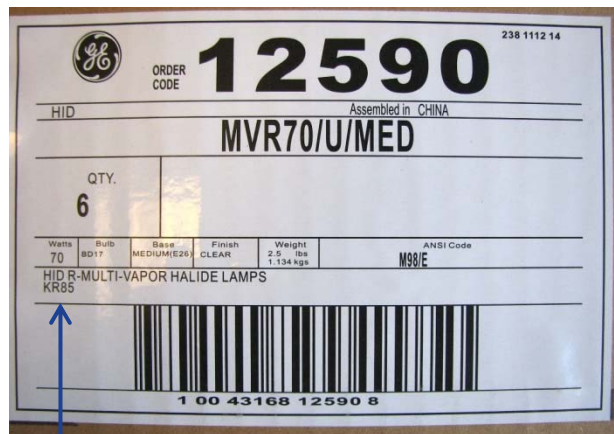
Outer Carton



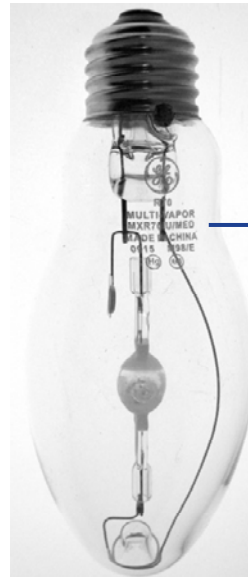
Immediate Wrapping



Arc tube fill gas contains Kr85.  
Le mélange gazeux du tube à arc contient du krypton (Kr-85).  
El gas del tubo de arco contiene Kr85.



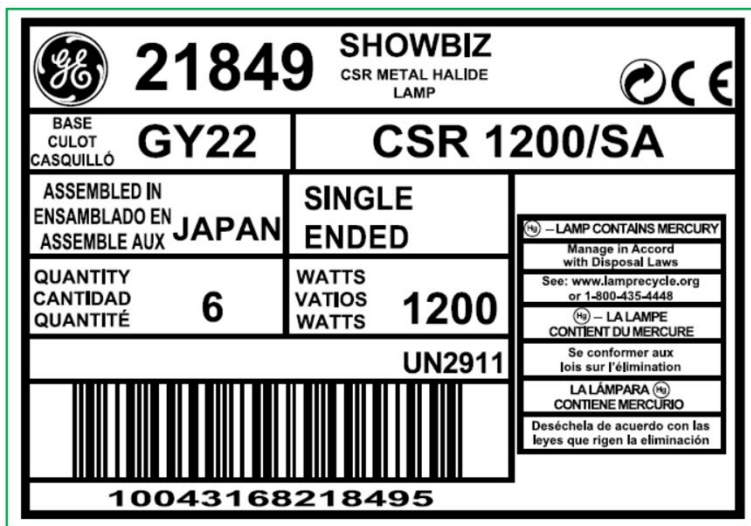
Carton Label with Kr85



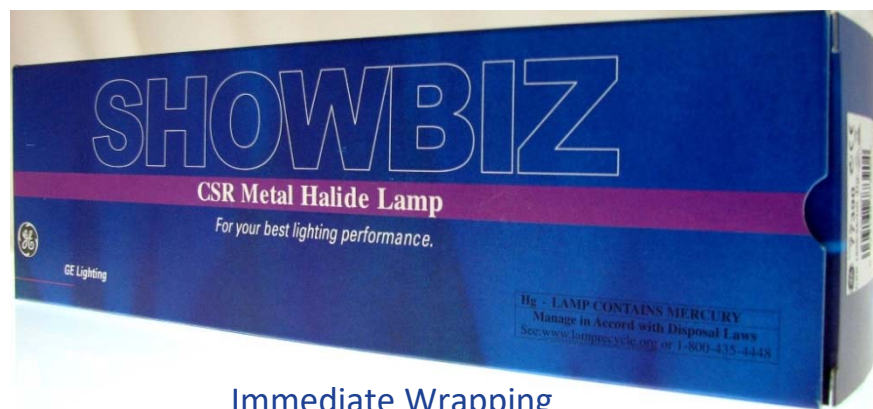
Lamp monogram includes Kr85



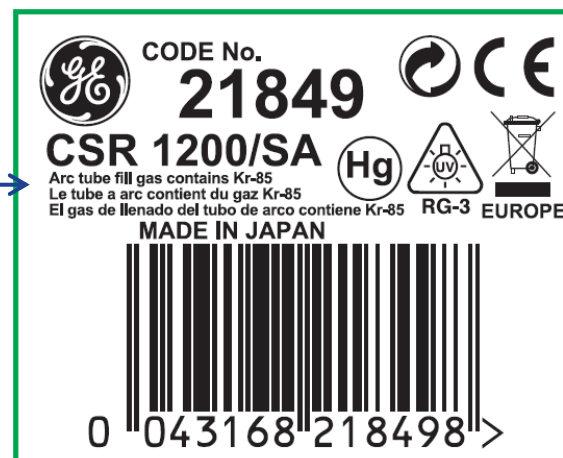
# Samples of Kr-85 Lamp & Package Labeling



Outer Carton Label



Immediate Wrapping



Immediate Wrapping or Inner Box Label with Kr85