

UNITED STATES NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 040-00534/94001(DRSS)

License No. SMB-00191

Priority III

Category E

Docket No. 040-00534

Licensee: General Electric Company (GE)
Lighting Business Group
Nela Park
Cleveland, OH 44112

Inspection At: (1) General Electric Institute
Nela Park Facility
1975 Noble Road
Cleveland, Ohio

(2) Chemical Products Plant
1099 Ivanhoe Road
Cleveland, Ohio

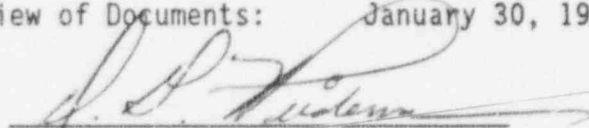
(3) Tungsten Products Plant
21800 Tungsten Road
Cleveland, Ohio

(4) Lamp Glass Engineering
24400 Highland Road
Cleveland, Ohio

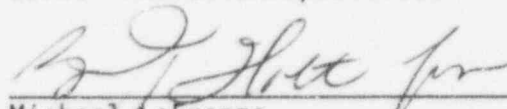
(5) Ravenna Lamp Plant
6800 N. Chestnut Street
Ravenna, Ohio

Site Inspection Conducted: November 16-17, 1994
In Office Review of Documents: January 30, 1995

Inspectors:


D. G. Wiedeman
Senior Radiation Specialist

2-1-95
Date


Michael LaFranzo
Radiation Specialist

2/3/95
Date

Approved By:


B. J. Holt, Chief
Nuclear Materials Inspection Section 1

2/3/95
Date

Inspection Summary

Inspection on November 16-17, 1994 (Report No. 040-00534/94001(DRSS))

Areas Inspected: Routine inspection to evaluate certain limited aspects of the licensee's NRC-licensed program including: (1) a license and document review of all current and former locations of use covered under the license; (2) review of information (radiation surveys) relative to assessing the current radiological status of those sites; and (3) review with the licensee recent changes in the scope of their manufacturing process as it relates to use of licensed materials. The inspectors also conducted independent radiation surveys of selected sites formerly and currently covered under the license.

Results: No violations of NRC requirements were identified. The inspectors identified residual contamination that exceeds the NRC release criteria at two of the five facilities visited.

DETAILS

1. Persons Contacted

Licensee Representatives

@*Albert Zielinski, Corporate Radiation Safety Officer
+Douglas Cole, Jr. Manager- Environmental, Health and Safety
Chemical Products Plant
+Ronald Wilson, Environmental Engineer, Tungsten Products Plant
+Michael Marusha, Plant Manager, Chemical Products Plant
+Tyron Jackson, Manager, Highland Woods Business Center
(former GE facility)

The inspectors also interviewed numerous GE employees directly involved in the manufacturing and processing of thoriated products.

*Denotes presence at site exit meeting on November 17, 1994.

+Denotes participation in the exit meeting at that facility.

@Denotes telephone exit meeting to discuss the results of smear tests on January 30, 1995.

2. Purpose and Scope of Inspection

This was a limited scope safety inspection conducted primarily to gather information and visually examine accessible areas of selected facilities to determine the extent of residual contamination within the facility. Also reviewed, in part, was the implementation of the licensee's procedures to ensure that residual contamination is not spread outside the confines of the licensee's facilities. Additionally, the inspectors reviewed the licensee's final radiological survey and conducted an independent confirmatory survey at the licensee's former facility located at 24400 Highland Road, Cleveland, Ohio. This survey indicated that the facility was decontaminated to a residual radiation level less than the NRC release criteria.

3. Background Information

The licensee has been using thoriated tungsten wire for light bulb filaments dating back to around 1917 (pre-NRC/AEC). Prior to 1962, source material was used under AEC license No. R-119. The licensee renewed their source material license with the Atomic Energy Commission (AEC) on April 30, 1962. License No. SMB-191 was issued on May 21, 1962 and authorized 1600 pounds of thorium and uranium to be used at the following locations:

- a. Nela Park, Cleveland, Ohio
- b. 21800 Tungsten Road, Cleveland, Ohio
- c. 1099 Ivanhoe Road, Cleveland, Ohio
- d. 24400 Highland Road, Cleveland, Ohio
- e. 1814 East 45th Street, Cleveland, Ohio
- f. 40 Hughes Street, Youngstown, Ohio
- g. 40 Seventeenth Avenue, Newark, New Jersey
- h. 1356 Riverside Boulevard, Memphis, Tennessee

On October 12, 1965, the license was amended to increase possession limits up to 5,100 pounds {11,245 kg} of thorium and uranium and to add a new location of use on 200 West Broadway, Dover, Ohio. In May 1968, the license was amended, adding an additional location of use at 21801 Tungsten Road, Cleveland, Ohio and the location in Memphis, Tennessee, was deleted because the State became an Agreement State. On June 19, 1981, the license was amended to delete the 21801 Tungsten Road, Cleveland, Ohio location and add two new locations of use (Winchester Lamp Plant, Winchester, Virginia and 8499 Darrow Road, Twinsburg, Ohio). On January 14, 1985, the license was amended to delete the Winchester, Virginia location and add a new location of use, Austintown Coil Plant, Youngstown, Ohio. On March 13, 1990, the license was amended to delete the location 24400 Highland Road, Cleveland, Ohio, and in September 1990, the Dover, Ohio location was deleted from the license. Currently, the license authorizes 1,653 pounds {750 kg} of thorium and 110 pounds {50 kg} of uranium at seven locations of use. During the duration of the license, the licensee was authorized to use material at fifteen individual locations.

4. Licensed Activities

Licensed activities using loose thorium powder (oxide and nitrate) were performed primarily at three locations: (1) Chemical Products Plant, Cleveland, Ohio, (2) Tungsten Products Plant, Cleveland, Ohio, and (3) Ravenna Lamp Plant, Ravenna, Ohio. Until several years ago, the Chemical Products Plant was responsible for the production of a 65% thorium slurry mix that was used at the Ravenna Lamp Plant for coating electrodes. In 1989, an event occurred at the Ravenna Plant which caused extensive low-level contamination on the floors, walls, table tops and equipment inside a room known as the "environmental room" which was used to process licensed material. This event was caused by a ventilation system failure in which the air flow reversed and pushed loose contamination trapped on the filters from the bag-house into the facility. Due to the cost of decontamination of the facility and the costs from excessive down time, the licensee decided to replace the thorium slurry with a non-radioactive chemical substitute. Consequently, this decision has significantly reduced the scope and principal activities of their NRC licensed program.

5. Current Status of Locations Inspected

a. Tungsten Products Plant

Until recently, the Tungsten Road Plant was the most active plant under the license. The principal operation was the manufacture of thoriated tungsten wire for assembly into various lamp products. In 1965, this facility manufactured 1-2% by weight thorium welding rods and thoriated electrodes for vacuum melting furnaces. The process started with mixing 30-40 kilograms of thorium nitrate powder with water into a 1-2% solution. This solution was then added to a tungsten powder and dried in a steam jacketed mixer which was a closed system. The dried oxide mix was then processed through various belt furnaces to produce a metallic tungsten-thorium mix. This mix was then sifted various times, milled, then pressed into metallic bars. These bars were then sintered and treated to form hard ingots which were then rolled into rods then drawn into wire or rods of successively smaller diameter. This process was conducted only 1-2 times per year. The manufacturing of custom made thoriated parts for furnaces and welding rods ceased approximately 7-10 years ago. This process involved hydropressing thoriated tungsten parts in a 16-inch gun barrel and applying hydraulic pressure to form a pressed part which was then fired and sintered into an alloyed piece. These pieces were then machined to their customers specifications. During the time of operations, approximately 750 pounds of thorium were used per year. The last purchase of thorium powder was in 1992 and the licensee does not plan to manufacture its own stock material in the future. The licensee plans to use the remaining stock material, then purchase pre-made thoriated tungsten wire from outside companies.

The inspectors identified residual contamination in excess of the NRC release criteria for release of facility for unrestricted use in the former thorium storage area, floor drains in several process areas, and the floor to the ingot processing area (see Independent Measurements section of report for details).

b. Chemical Products Plant, Cleveland, Ohio

In the past, the Chemical Products Plant manufactured thoriated emission mix used in the coating of certain lamp electrodes. The coating of these electrodes was done at the Ravenna Lamp Plant and in plants in Canada and Brazil. All licensed manufacturing operations at this location ceased in September 1989, when a non-radioactive substitute emission mix was developed for use at the Ravenna facility. In July 1990, the licensee hired an outside contractor to characterize and decontaminate the facility for release for unrestricted use. The NRC conducted a confirmatory

survey with its contractor, Oak Ridge Associated Universities (ORAU) on May 16, 1991, and determined that the facility did not meet the release criteria. The licensee is currently in the process of awarding a contract to another outside consulting firm to develop a characterization and remediation plan. The licensee anticipates that a contractor will be selected around January 1995.

The inspectors identified residual contamination in excess of the NRC release criteria for release of facility for unrestricted use on the floor and ceiling beams in the upper and lower pilot plant and "getter room" (see Independent Measurements section of report for details).

c. Nela Park Facility, Cleveland, Ohio

The only licensed activities conducted at this site consisted of limited use of thoriated-tungsten alloy and wire (1-2% Th) in research, development and piloting of experimental and early phase production lamps. According to the licensee, their historic experience with these components has shown that working with the thoriated-tungsten alloy wire does not generate significant releases of thorium into the working environment.

d. Ravenna Lamp Plant, Ravenna, Ohio

Operations at this facility currently include only the manufacture of wire electrodes (1-2% Th) from thoriated tungsten wire and assembly of these electrodes into lamps, which are then distributed as exempt consumer products. Previously, activities also included the coating of tungsten electrodes with a thorium mix (60% Th-oxide) manufactured at the Chemical Products Plant. The coating operations ceased in July 1989 and a management decision was made to not resume this operation. The area where the initial coating operations were performed, the "environmental room", was decontaminated at that time; however, this site is still listed on the license as an authorized location of use. The licensee plans to request that this site be released for unrestricted use at the same time the request to release the Chemical Products Plant is made, which is anticipated to be around the summer of 1995. At the time of this inspection, the inspectors found small pieces of thoriated-tungsten wire on the production floor; however, the licensee indicated that this area is periodically cleaned and the scrap material is recycled. No other loose contamination or radiation levels above natural background were identified in this facility.

e. Lamp Glass Engineering, Cleveland, Ohio

Prior to 1989, this facility was used as a quality control laboratory in which thoriated wire samples were tested for quality control/assurance and product specifications. The facility was decontaminated by GE in 1988 and a close-out survey was submitted to the NRC on February 3, 1990. The inspector's review of the survey indicates that the facility was decontaminated to a residual radiation level consistent with the NRC release criteria. The inspectors conducted a confirmatory radiation survey of the facility on November 17, 1994, and did not identify any radiation levels above natural background (see Independent Measurements section of report for details).

6. Current Status of Locations Not Inspected

a. Pitney Glass Plant/Cleveland Bulb Plant

This facility was listed on the license as an authorized location of use during the period 1963-1983. During the renewal of the license in 1983, this facility was deleted as an authorized location of use. This site is still owned and controlled by GE. At the time of this inspection, the licensee was not aware if licensed material was ever used at the facility and unaware of any records of a close-out survey. The license application dated March 26, 1962, states "This group uses only small quantities of thorium nitrate, uranium nitrate and uranium acetate (1-5 lbs.) for chemical analysis and experimental incorporation into glass."

b. Edison Park, Twinsburg, Ohio

This facility was listed on the license as an authorized location of use during the period January 1985 to January 1989. During the renewal of the license in 1989, this facility was deleted as an authorized location of use. This facility was used as an engineering facility for pilot operations and lamp assembly. This facility was sold to a GE subsidiary between the period 1985-1989 (exact date was unknown). The past operations at this facility were similar to those at the Ravenna Lamp Plant (wire pulling and installation of filaments into finished lamp products). At the time of this inspection, the licensee was unaware of any records of a close-out survey.

c. Youngstown Lamp Plant, Youngstown, Ohio

This facility was listed on the license as an authorized location of use during the period May 1962 to June 1981. During the renewal of the license in 1985, this facility was deleted as an authorized location of use. In the past, licensed activities

involved installation of wire filaments into lamps, predominately non-thoriated. Currently this facility is still owned and controlled by GE. At the time of this inspection, the licensee was unaware of any records of a close-out survey.

d. Winchester Lamp Plant, Winchester, Virginia

This facility was listed on the license as an authorized location of use during the period June 1981 to January 1985. During the renewal of the license in 1985, this facility was deleted as an authorized location of use. In the past, this facility manufactured lamps with thoriated electrodes. Currently, this facility is still owned and controlled by GE. At the time of this inspection, the licensee was unaware of any records of a close-out survey.

e. Memphis Lamp Plant, Memphis, Tennessee

This facility was listed on the license as an authorized location of use during the period May 1962 to May 1968. During the renewal of the license in 1968, this facility was deleted because the State of Tennessee became an Agreement State. This facility is currently owned and controlled by GE. In the past and currently, this facility manufactures low voltage bulbs, some models contain thoriated filaments. At the time of this inspection, the licensee was unaware of any records of a close-out survey.

f. Newark Lamp Plant, Newark, New Jersey

This facility was listed on the license as an authorized location of use during the period May 1962 to January 1985. During the renewal of the license in 1985, this facility was deleted as an authorized location of use. In the past, this facility manufactured decorative consumer light bulbs; however, the licensee was uncertain if licensed materials were used at this facility. The licensee closed the facility sometime in the 1980's and the licensee was unaware if this facility was still owned and controlled by GE. At the time of this inspection, the licensee was unaware of any records of a close-out survey.

g. Austintown Coil Plant, Youngstown, Ohio

This facility was first listed on the license as an authorized location of use in January 1985 and is currently listed on the license as an authorized location of use. This facility specializes in coiling wire for lamp filaments. In the past, small quantities of thoriated wire was processed at this facility. The finished product is shipped to the Euclid Lamp Plant and/or other GE facilities for final installation into the finished lamp product.

h. Euclid Lamp Plant, Cleveland, Ohio

This facility was first listed on the license as an authorized location of use in May 1962 and is currently listed on the license as an authorized location of use. This facility installs the thoriated filament into the finished lamp product and is a distribution point of the finished product.

i. Dover Wire Plant, Dover, Ohio

This facility was first listed on the license as an authorized location of use on October 16, 1965, and is currently listed on the license as an authorized location of use. This facility is predominantly involved in drawing (stretching) wire to reduce the diameter to a specified diameter. Previous licensed activities also involved polishing thoriated electrodes. The processed thoriated products are sent to other GE facilities for further processing and installation into lamp products.

j. 21801 Tungsten Road, Cleveland, Ohio

This facility was listed on the license as an authorized location of use during the period May 1968 to July 1978. During the renewal of the license in 1978, this facility was deleted as an authorized location of use. This facility was sold to another company; the exact date was unknown. At the time of this inspection, the licensee was not aware if licensed material was ever used at the facility and unaware of any records of a close-out survey.

No violations of NRC regulatory requirements were identified.

7. Independent Measurements

The NRC inspectors conducted radiological surveys in and around the former thorium operations and production areas of the Chemical Products Plant, Tungsten Products Plant, Revenna Lamp Plant, and Lamp Glass Engineering Facility. The areas surveyed included the floors, former storage areas, ceilings, walls, floor drains, and machinery used during processing of thoriated products.

Radiation surveys were performed with a Ludlum Model 3 portable survey instrument with Model 44-9 alpha-beta-gamma probes and a Victoreen Model 190 with a beta-gamma pancake probe. The instruments, NRC Nos. 042443 and 045630, were both calibrated on November 1, 1994. Prior to the surveys, the instruments were checked for accuracy and constancy with a dedicated and traceable $^{90}\text{Sr}/^{90}\text{Y}$ check source. The instruments responded as expected. The instrument results were also corrected for probe size and counting efficiency (see Attachment 1). This correction showed that for beta/gamma radiation with background included, the maximum

unrestricted release level of 3,000 disintegrations per minute/100 cm² (dpm/100 cm²) was equivalent to 240 counts/minute (cpm) on instrument No. 042443 and 200 cpm on instrument No. 045630. Background was measured and determined to be 55 cpm.

Confirmatory surveys were performed and wipe tests taken on the floors, walls, accessible ventilation ducts, drain openings, and support beams, as applicable, in randomly selected areas at each of the *affected areas* of the facilities. *Affected Areas* are defined as areas that were potentially contaminated (based on previous surveys or operating history), including areas where radioactive materials were stored or used. In addition, random surveys were conducted in *unaffected areas*, which were defined as a 10 meter buffer zone surrounding each *affected area*. Surveys included direct measurements for alpha and beta activity. Wipe tests for removable activity were taken in selected areas and analyzed for gross gamma activity.

Surveys at the Lamp Glass Engineering facility indicated that residual radioactive material was less than NRC unrestricted use criteria of 1000 dpm (17 Bq)/100 cm² average activity; 3,000 dpm (50 Bq)/100 cm² maximum activity; and 200 dpm (3 Bq)/100 cm² removable activity. These criteria are found in NRC's "Guideline for Decontamination of Facilities and Equipment prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," August 1987. Surveys at the Chemical Products Plant and Tungsten Products Plant indicated fixed residual activity in excess of the NRC release criteria in 8 out of 10 areas surveyed in the *affected areas* (see Attachment 1). These areas were identified as the Lower and Upper Pilot plant, Room E-14, Room L-4, Getter Room and Molly Doping Room, Mixer Room and Bank B Treating Room. In conclusion, the inspector's independent radiation measurements confirmed that certain areas of the Chemical Products Plant and Tungsten Products Plant exceed the NRC release criteria for release of facility for unrestricted use. However, the former facility known as the Lamp Glass Engineering facility had been adequately remediated and no radioactive material was found that exceeded the NRC guideline values for unrestricted use.

8. Laboratory Analysis (Wipe Tests)

Smear Number	Location	Direct Radiation Measurements	Smear Test Results
		disintegrations per minute *dpm/100cm ²	Removable Activity dpm/100cm ² gamma
1	Transport Cart	100	MDA
2	Room L-4, Chemical Plant, Position 1	100	MDA
3	Room L-4, Chemical Plant, Position 2	22,000	MDA
4	Next to 871 Furnace Beam, Chemical Plant	31,250	MDA

* NRC limit is 3,000 dpm/100 cm² maximum. Readings were converted from counts/minute (cpm) to disintegrations/minute (dpm) using a conversion factor of 240 cpm = \approx 3,000 dpm/100 cm².

MDA = minimum detectable activity

No violations of regulatory requirements were identified.

9. Exit Meeting

The inspectors met with the licensee's RSO at the conclusion of the site inspection on November 17 1994, and summarized the scope and findings of the inspection. On January 30, 1995, a teleconference was conducted between Mr. D. Wiedeman and Mr. Zielinski to discuss the laboratory results from the wipe tests which were collected at the time of the inspection. At the time of the phone call, Mr. Zielinski stated that GE was in the process of interviewing current and former employees of GE and reviewing historic records to determine the extent of licensed activities that were or may have been conducted at the various GE facilities. Mr. Zielinski confirmed that GE will include this information in their response to the reporting requirements under 10 CFR 40.42 when they submit their decommissioning plan for the Chemical Products Plant and Tungsten Products Plant. During the exit meeting and during the followup telephone conversations, the licensee did not indicate that any of the information reviewed during the inspection was considered proprietary.

INSTRUMENTATION WORKSHEET

Inspector: D. G. Wiedeman
Date: 11/16-17/94

Inspection Location: General Electric
Inspection Date: 11/16-17/94

Isotopes of Interest: Thorium & U-238 (2.2 mev B)

Instrument - Type: Victoreen 190	Probe: 489 (B & γ)
Serial #: 707	Serial #: 530
NRC #: 042443	NRC #: 042443
Calibration Date: 11/1/94	Size (S): 15.5 cm ²

Check Source: Isotope: SrY-90 Serial No.:
NRC Tag No.: 013251

Half Life (T_{1/2}): 27.7 years x 365 = 10,111 days

Date: 1/7/80 Activity (A₀): = 131,600 dpm

Current Date minus Source Date (t): -5,000 days

Current Check Source Activity: $A = A_0 \times \exp[-0.693t/T_{1/2}]$

= 131,600 x exp[-0.693 x 5,000 / 10,111] = 91,495 dpm = 0.41 μCi

Meter Reading with check Source (M): 36,000 cpm μCi (x 2.2x10⁶ = cpm)

Efficiency (E): $M/A = 36,000 / 91,496 = 0.393$ (x 100 = 39.3 %) ✓

Background (B): 55 cpm μCi (x 2.2x10⁶ = cpm) Date: 11/10/94
Location: lab

Maximum Release Criteria for Isotope of Interest (X): 3,000 dpm/100 cm²

Instrument Reading that Equals Maximum Release Criteria: $\{(X/100) \times S \times E\} + B$

= $\{(3,000/100) \times 15.5 \times 0.393\} + 55 = 237 \text{ cpm} = \{3,000 \text{ dpm}/100 \text{ cm}^2\}$ ✓

↓
MAX. NRC L. mit (X)

↓
Probe Size cm² (S)

↓
Efficiency (E)

↓
Background (B)



ATTACHMENT 1

No. 94-001
DOCUMENT NAME: worksheet
PAGE 1 of 1 PAGES

Tungsten Products Plant
 Survey conducted 11/16-17/1994
 *Instruments Used- Victoreen-190
 Ludlum Model 3

All survey units were converted from
 counts per minute (cpm) to
 disintegrations per minute per 100cm₂
 (dpm/100cm₂)

*See attachment No. 1 for instrument
 calibration and conversion factors.

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INCOX

18,000 dpm

8,750

450 dpm {5,600 dpm}
 500 {6,250 dpm}

16,250 dpm

300 {3,750}

225,000 dpm
 118,000

700 dpm {8,700}

1,500

5,000
 400

PROD.

18,000