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ISOTOPES DEVELOPMENT CENTER REPORT

EXAMINATION OF NINE-YEAR OLD $Cs^{137}Cl$ SOURCE CAPSULE

K. W. Haff

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Isotopes Division

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OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee
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EXAMINATION OF NINE-YEAR OLD $Cs^{137}Cl$ SOURCE CAPSULE

K. W. Haff

Abstract

A 1540-curie $Cs^{137}Cl$ source made in March 1954 and placed in service at the Oak Ridge Institute of Nuclear Studies in 1955 was opened and examined to determine the effects of aging and continuous exposure to $Cs^{137}Cl$ and gamma radiation. No evidence of corrosion or deterioration of the source capsule could be detected by metallurgical examinations.

A 1540-curie $Cs^{137}Cl$ source made in March 1954 and placed in service at the Oak Ridge Institute of Nuclear Studies was obtained for testing to determine aging effects on stainless steel radioactive source capsules over long periods of time. The source had been in continuous use in a teletherapy machine since 1955.

Historically, this source was the first $Cs^{137}Cl$ source of greater than 1000 curies to be built by Oak Ridge National Laboratory. It contained two $Cs^{137}Cl$ pellets measuring 1.250 in. in diameter and 0.531 in. and 0.504 in. high, respectively. The pellets weighed 33.07 g and 27.86 g and contained 760 and 780 curies, respectively, for a total of 1540 curies.

The source was encapsulated in two concentric stainless steel containers. The inner capsule was of type 316 stainless steel, 2.575 in. long, 1.500 in. OD, and 1.260 in. ID. The window thickness was 0.020 in. The inner capsule was plugged with a 316 stainless steel plug ~1.5 in. long and sealed with Easy-Flo silver solder. The outer capsule was of type 316 stainless steel, 3.265 in. long, 1.750 in. OD, and 1.520 in. ID. The window thickness was 0.020 in. The cap for the outer capsule was a threaded plug of 410 stainless steel and was sealed with All-State No. 430 silver bearing solder. Figure 1 is a cross sectional view of this source.

The source was removed from the teletherapy machine head and visually inspected. The capsule appeared in excellent condition, and no signs of corrosion or any sort of discoloration could be detected. The outer capsule smeared 1920 dis/min.

The source was next subjected to a vacuum leak test. The source was immersed in ethylene glycol in a glass vacuum vessel. The pressure above the source was reduced to -25 in. Hg (~5 in. Hg absolute), and the source

was observed for a stream of bubbles. No leaks were detected by this method, which has a sensitivity of approximately 5×10^{-5}cc/sec. The outer capsule was then sawed open. During the course of this operation, the saw blade cut off a corner of the inner capsule, and the inner capsule leaked in the area of the cut. No other leaks were observed by the vacuum leak test method, however.

A visual examination of the exterior of the inner capsule revealed no evidence of corrosion or deterioration of the capsule. The capsule smeared 5×10^{5} dis/min. This high smear is a result of the source's being inadvertently sawed open.

The inner capsule of the source was then opened. The source pellet surface appeared similar to that of a new pellet. The pellet had a white to gray color with a mottled brown streak near one edge. The edges of the source pellet and inner wall of the capsule at the edge of the pellet had a distinctive brown color. However, upon removal of the pellets from the capsule it was observed that the upper edge of the pellet and the adjacent area on the capsule were the only affected areas. It is suspected that the area discoloration was caused by heating during the original sealing of the capsule. The inside of the capsule and the window area of the capsule were as bright and shiny as new material. Inspection of the capsule under 80X magnification did not reveal any pitting or cracking of the inside surfaces of the capsule or window.

The capsule was decontaminated by ultrasonic cleaning in water, and a photograph of the capsule at 80X magnification was made (Fig. 2).

The capsule was then sectioned and metallurgical studies were made. Figures 3, 4, and 5 are 100X magnification photomicrographs made of the crystalline structure of the material. No evidence of change in crystalline structure or deterioration of the capsule wall or window can be seen.

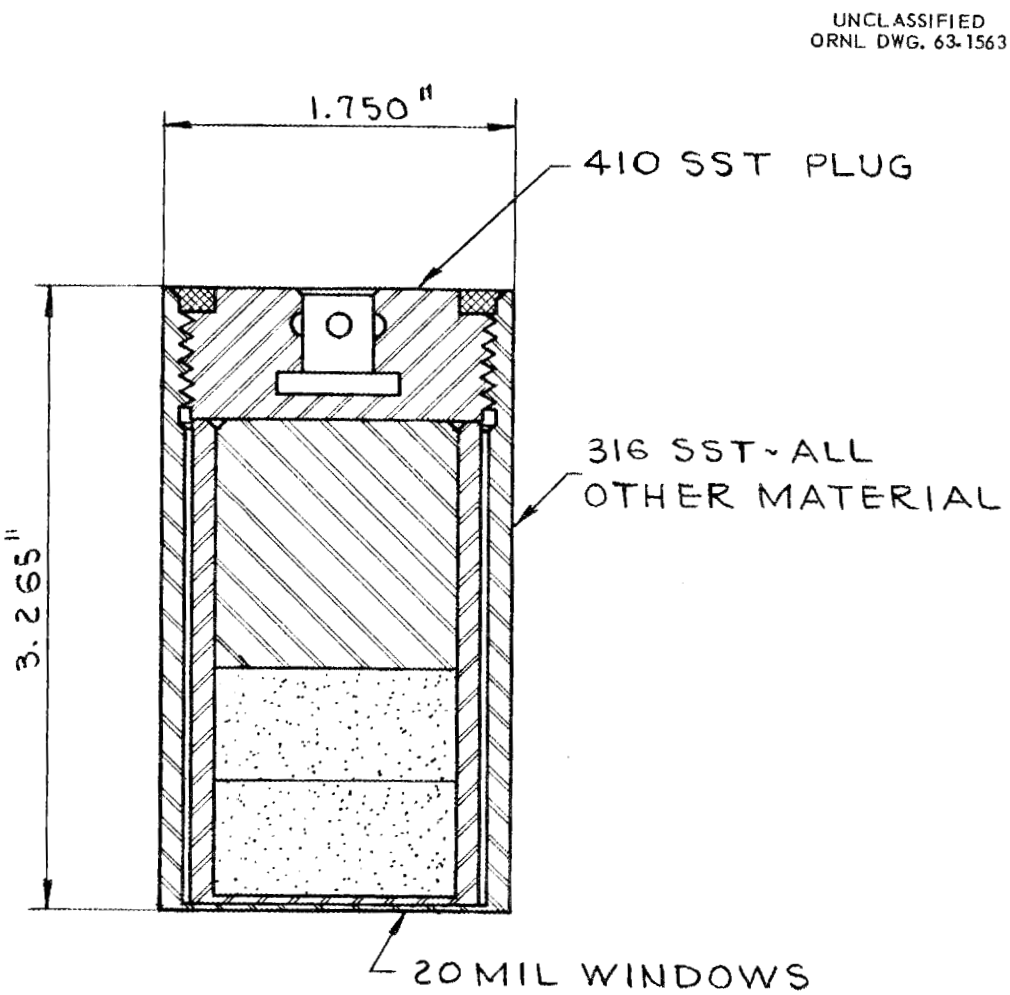

Fig. 1. 1540-curie ORINS $Cs^{137}Cl$ Source.

Fig. 2. Source Capsule Before Being Sectioned for Metallurgical Studies.

Fig. 3. Transverse Section of ORINS Source Capsule Wall, ID.

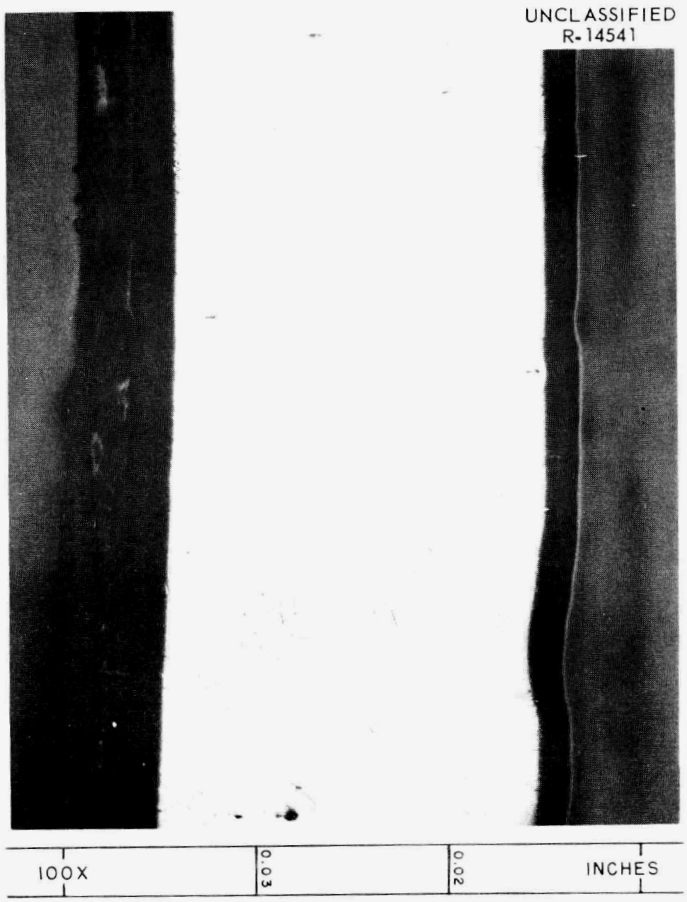

Fig. 4. Twenty-Mil Window Sections (Inside of window is to left).

Fig. 5. Longitudinal Section of Wall of ORINS Source Capsule, ID.

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