



Lessons Learned from the Studsvik Ir-192 Transport Incident

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1) Shipment Overview

Studsvik Nuclear AB (Studsvik) produces isotopes that are used for industrial radiography. Specifically, Studsvik supplies large quantities of iridium-192 (Ir-192) in the form of thin, metallic wafers to U.S. customers. This material is used in to manufacture radiography sources used in cameras throughout the United States and the world.

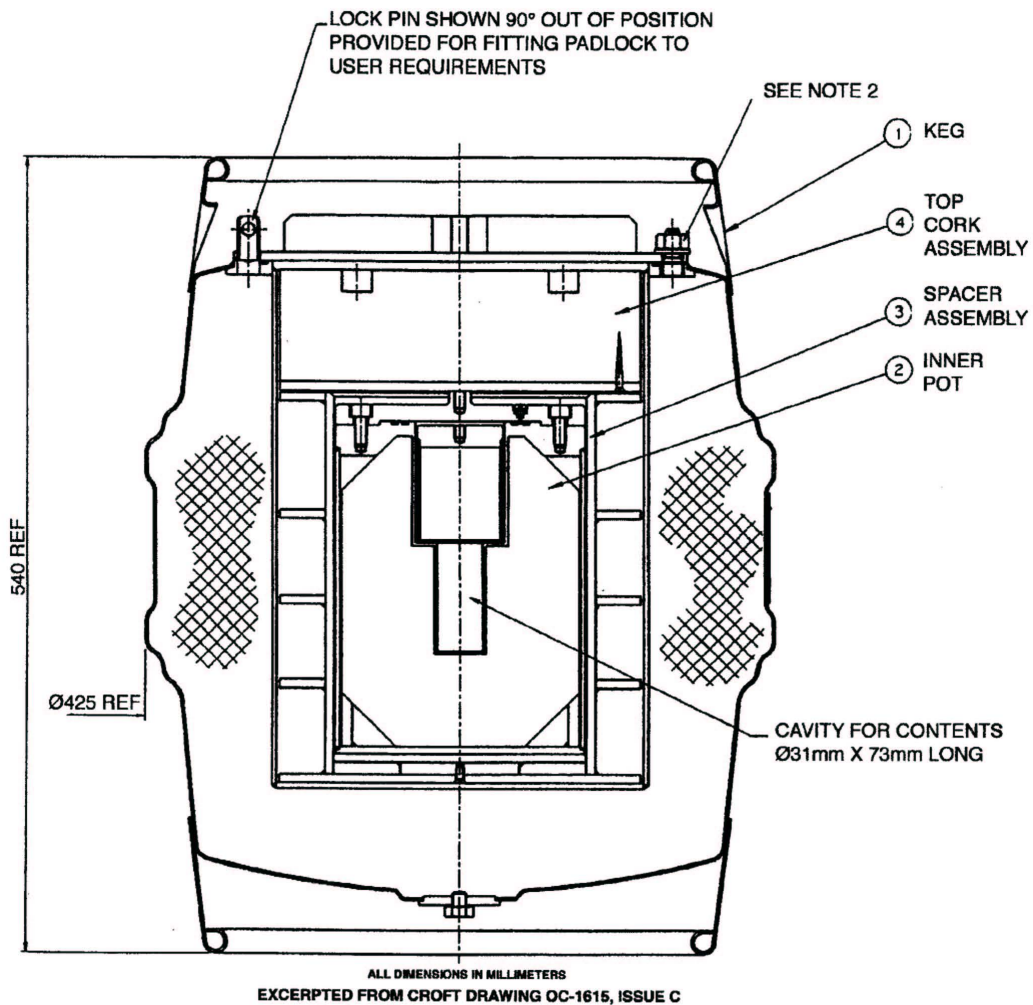
On December 27, 2001, Studsvik made a routine shipment of 366 TBq of Ir-192 from their facility in Nykoping, Sweden to Source Production and Equipment Company (SPEC) in New Orleans, LA. Studsvik made the shipment using a Type B(U) package, the Croft 2835A, which had been approved by the United Kingdom under Certificate of Competent Authority No. GB/2835A/B(U)-85 and the United States of America under Certificate of Competent Authority No. USA/0382/B(U)-85. The package was carried by motor vehicle approximately 200 kilometers from Nykoping to the Stockholm-Arlanda airport by a private carrier; flown via Paris (Roissy airport) to Memphis, Tennessee by Federal Express; and carried by tandem trailer to New Orleans, LA. The package was stored in a cargo centre at the New Orleans airport during New Year holiday and was picked up by a representative of SPEC and brought a short distance (2-3 km) in a small truck to their facility.

2) Package Overview

The 2835A package consists of a double walled exterior container which provides mechanical and thermal protection and an inner shielding vessel which provides containment and radiological protection under normal and accident conditions. The exterior container, model no. 2835, is constructed of stainless steel and has a keg shaped outer wall and cylindrical interior wall. The void space between the walls is filled with rigid, phenolic foam. The inner container or pot, model no. 2784, provides the containment boundary and is positioned within the outer keg using an aluminum spacer assembly. The pot has a depleted uranium body and shield plug that are both enclosed in stainless steel. The shield plug is held in place by the lid which is stainless steel and fixed to the vessel body by 6 cap head screws. The closure is equipped with a leak testable double fluorocarbon O-ring seals. The 2835A package is shown in Figure 1.

3) Contents of the package

The package contained 366 TBq of Ir-192 in the form of metallic wafers. The wafers measured 0.025 mm in diameter and 0.0025 mm in height and were contained within three screw top metal capsules placed within source holder within the shielded container. The capsules used in this shipment were approximately 35 mm in length and 10 mm in diameter are shown in Figure 2. The source holder, which is not listed on either Certificate of Competent Authority, is shown as Figure 3.



Outer package diameter	425 millimeters
Outer package height	540 millimeters
Shielded vessel diameter	167 millimeters
Shielded vessel height	246 millimeters
Shielded vessel cavity diameter	31 millimeters
Shielded vessel cavity height	73 millimeters
Maximum weight, including contents	127.1 kilograms

Figure 1: Section View and Selected dimensions of the 2835A

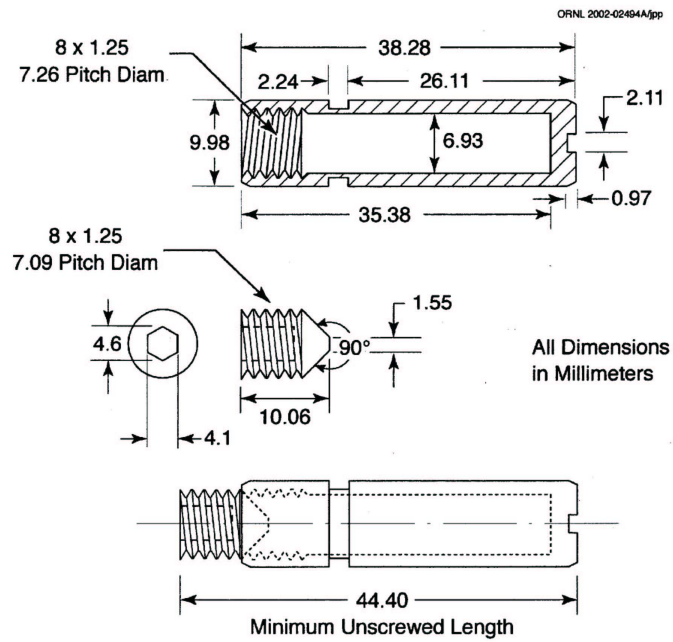


Figure 2: Ir-192 Source Capsule

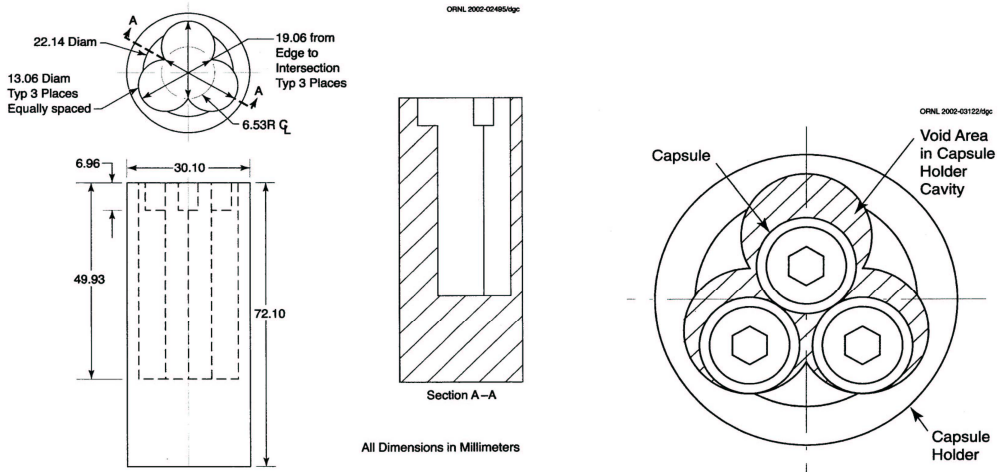


Figure 3: Ir-192 Source Capsule Holder

4) Incident Summary

On January 2, 2002 an employee of SPEC arrived at the Federal Express facility in New Orleans, LA to retrieve the shipment of Iridium-192 from Studsvik. Upon receipt of the package, the employee performed a radiation survey of the package and observed that his radiation detection survey instrument was “stuck” or “pegged” at its highest position. Believing that his survey instrument was malfunctioning, the employee accepted the package and began transport of the package to the SPEC manufacturing facility (approximately 2 – 3 kilometers). Upon arrival, the employee performed another radiation survey and observed a dose rate of 1 Rem/hour at a distance of approximately 6 meters (transport regulations authorize 10 millirem/hour at 1 meter) and observed that his pocket dosimeter read approximately 160 millirem (approximately one-third to one-half of the average background dose received by a person living in the U. S. over a one-year period). Realizing the problem was not a malfunctioning instrument, the employee contacted the company’s radiation safety officer. The RSO instructed the employee to conduct wipe tests to check for loose contamination (none was found) and to secure the package in a shielded portion of facility.

5) Initial Response

- a) Domestic Notifications: In accordance with U.S. regulations and company policy, SPEC immediately notified state and federal regulators of the incident. SPEC and the U.S. federal regulators notified the carriers of the incident to request carriers investigate the possibility that their workers may have been overexposed. As this package was part of a two package shipment, U.S. regulators began tracking the second shipment and promptly notified the consignee of the second package of potential problems (second package was received without incident by Industrial Nuclear Corporation of San Leandro, CA)
- b) International Notifications: In accordance with IAEA transport regulations, the U.S. regulators contacted the Transport Secretariat at the International Atomic Energy Agency and the Competent Authorities of Sweden, France and the United Kingdom to notify them of the incident. All agreed to conduct investigations in their respective countries and to keep each other informed by email (holiday work schedules and time difference between Europe and U.S. made email preferable to telephone). In response to this notification, the Swedish authorities provisionally assigned the event an INES Level 3 rating because of the potential exposure of individuals where acute health effects could not be ruled out.
- c) Secure Material: Although the package was no longer in transport, U.S. transport regulators continued monitoring the incident and assisted in the planning to further secure the material. Based on the SPEC’s desire to recover as much as iridium as possible and the impossibility of further transport, the material was “entombed” at SPEC using concrete blocks until plans to open the package could be developed and approved.
- d) Begin Preliminary Incident Investigation: With the material secured at SPEC, all parties began discussions on possible causes of the incident and completing analyses of individual exposures as a result of the incident.

6) Long term action

- a) Opening the package: In order to determine the cause of the incident and allow SPEC to recover the most Ir-192 as possible, a procedure to open the package was needed. After consulting with the local authorities and determining their capabilities, SPEC decided to build a large, temporary hot cell capable of handling the entire 2835A. The inner shielding pot was then transferred to an existing hot cell and opened. Upon opening the shielding pot, SPEC confirmed that the root cause of the incident was failure of the two of the three inner, screw top capsule lids. Briefly, transport vibration had caused these poor fitting, unsecured screw caps to fall off and the iridium wafers had migrated to unshielded positions.
- b) Conduct formal investigation: In addition to witnessing, videotaping and photographing the opening of the package. The U.S. Competent Authority impounded the 2835A package involved in the incident. The package was sent to independent laboratory for inspection and assessment. Since investigation is ongoing, alleged violations cannot be discussed.

7) Lessons Learned

- a) **Prompt Communication:** Given the international nature of most radioactive shipments, prompt communication can be difficult but is vital. The fact that this shipment occurred over a holiday compounded the problem. Establishing an individual point of contact at each regulatory authority and letting that individual coordinate and report response in his own country is important. Establishment of a preferred communication method is also important. Email, backed up by telephone, eliminated many problems and helped formally document the incident.
- b) **Cooperation:** Protecting the public and the environment is the major priority. Regulators, shippers, carriers and consignors must work together to evaluate the situation and determine a course of action. Once the source is secured and incident response phase is over, the investigation can begin.
- c) **Package Documentation:** Better documentation on type B(U)-96 packages needs to be available. Since these packages do not require multi-lateral review, Member States do not have any information regarding a package transported within its boundaries. Member States approving "confidential" documentation compounds this issue.
- d) **Determination of INES Level:** Member States should determine who in their country is qualified to make this determination and, given the international nature of transport, the international transport community should determine which authority is best suited to make this determination.
- e) **Leased packages:** Long term leases for packages (over one year) should include provisions for maintenance, repair and quality assurance programs for packages.
- f) **Denied Shipments:** Countries should be prepared for consignors to deny acceptance of high dose packages.
- g) **Clarification of Requirements:** Certificates should clearly describe contents, form of material and special or normal form.