

REPORT ON IRRADIATOR INCIDENT
AT BECTON-DICKINSON AND COMPANY
BROKEN BOW, NEBRASKA

by the
Office for Analysis and Evaluation
of Operational Data
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BACKGROUND

The Office of State Programs (SP) forwarded to the Office for Analysis and Evaluation of Operational Data (AEOD) on or about January 6, 1981 a report describing an irradiator incident which occurred at an Agreement State licensee's facility on October 24, 1980. The licensee is Becton-Dickinson Broken Bow, Nebraska (Becton-Dickinson also holds an NRC license for the use of the same type of irradiator in Connecticut).

The irradiator is an AECL model J57500 gamma sterilizer used for research and sterilization of medical products. The incident described in detail below involved a jammed source rack which resulted from damaged product carrier boxes (tote boxes) being used to pass the product to be irradiated around the source.

A review was made by AEOD of the incident to determine if the incident had generic significance. This report discusses that review and presents AEOD's recommendations concerning the matter.

DESCRIPTION OF EVENT

At 11:30 am, October 24, 1980, the licensee manually shutdown the irradiator in order to go inside to make a machine check. The audible alarm sounded indicating that the source was traveling. In a few seconds the source rack fault indicator light came on indicating that the source rack had not completed its travel in the predetermined amount of time. After several minutes with the audible alarm continuing to ring, the licensee suspected that the source rack was stuck in the raised position.

As a means of making a determination of the source position (raised position or safe storage position) the licensee checked the operation of the entry monitor (designated L-118). It would not work since the source was not completely in the safe stored position. The licensee then checked the position of the air-operated winch (checked from roof) that raises and lowers the source rack. The position of the winch indicated that the source was stuck. A survey of the source hoist building roof showed that there was a small radiation field around the source rack cable.

At approximately 1:00 pm the licensee called the designer of the irradiator, the Atomic Energy of Canada Limited (AECL) and requested assistance. AECL advised the licensee to run an auxiliary air line to the winch and repipe it so that the source rack could be manually raised to its full raised position then relieve the air pressure to let the source rack go back down. It was thought that by doing this, whatever might be holding the source rack would fall out of the way and allow the rack to return to the pool. The licensee attempted several times to free the source rack in this manner without success. The licensee again called AECL who agreed to send service personnel to assist in resolving the problem.

At approximately 9:00 pm that evening smoke was noted coming out of the maze conveyor entrance. It is assumed that the intense heat (gamma decay heat) generated by the cobalt 60 source caused the cardboard product boxes to smolder. At 10:40 pm the sprinkler system inside the irradiator activated automatically and put out the fire. Several other fires (product boxes) started and were extinguished between 10:40 pm, October 24 and 1:30 pm, October 25.

At 1:30 pm on October 25, 1980 personnel from AECL arrived at the licensee's facility. They attempted to lower the stuck source using the same procedure as previously described. On the second attempt the source rack was freed and returned to the pool.

Upon entering the irradiator cell the licensee discovered that three product tote boxes had the corners bent out and had evidently been holding up the source rack. There were fourteen boxes in which the product had burned. There did not appear to be any damage to the Co-60 source pencils. The sources were wipe tested and a water sample collected for analysis. Results of test were negative (i.e., there was no evidence of leakage of cobalt). A dummy source pencil was returned to AECL for metallurgical examination.

There was some fire damage to the source pass conveyor which precluded operation of the irradiator facility until October 28. The licensee cut six inches off the top of all product tote boxes to eliminate the split corners.

ANALYSIS AND EVALUATION

General

Description of irradiator - AECL Model J57500, - r ., IV: Cobalt 60 Source, three million curies, maximum source activity; used for research and sterilization of medical products.

Description of use - The irradiator is a controlled access irradiator in which the sealed source(s) is contained in a storage pool containing water and the sealed source(s) is fully shielded when not in use. The sealed source(s) is exposed within a mazed shielded (biological) enclosure that is maintained inaccessible during use by an entry control system. The product (contained in product boxes) to be irradiated is moved around the exposed source in tote boxes which ride on a conveyor system and are moved around the source by the product pass system. The source(s) is contained in a source rack which is moved through a central area in the product pass system from its stored position in the pool to an exposed position and back by a pneumatic hoist.

Primary Incident (Jammed Source Rack)

Damaged tote boxes (four to six inch splits in the corners) were being used to transport the product boxes around the exposed source. Several of the tote boxes had flaps that resulted from the split corners being peeled back. The licensee and AECL speculate that, at the time the licensee manually

attempted to shutdown the irradiator several of these tote boxes with bent out corner edges (flaps) were positioned so that the flaps extended into the space in which the source rack traveled. As the source rack moved vertically toward the pool storage position, it became jammed or stuck on the flaps of the damaged totes. The incident could have been avoided had there been procedures for the periodic inspection and removal of damaged tote boxes from the system. There is no indication in the report by the licensee nor the report by AECL that the licensee considered the use of damaged tote boxes to be related to the safe operation of the irradiator. The safety significance of the jammed source rack is evident. Several fires resulted from the product boxes and product being subjected to irradiation for an extended period (see below). More importantly, the jammed source rack rendered any emergency shutdown procedure for the irradiator useless.

From a consideration of the nature of this incident it is clear that the same or similar operating practices at other like or similar irradiator facilities could result in the same type of incident. The parts of the irradiator system of concern are the product pass system, the source rack, and the product carriers (in this case tote boxes). The operation of an irradiator facility in such a manner as to allow the product carrier or product to protrude into the travel space of the source rack could produce the same type problem as experienced at Becton-Dickinson facility.

Secondary Incident (Fires in Irradiator Enclosure)

As indicated above (Description of Event) several fires resulted from heat build up in the product and product boxes (fiberboard boxes). Excess heat buildup from gamma decay and subsequent fires can result anytime product boxes are exposed to an intense gamma flux for a prolonged period (i.e., when the product pass system is state with the source in the raised or operating position). The fire protection system for the irradiator appeared to function properly and there was no damage to the sealed sources.

General Irradiator Safety Considerations

The incident discussed in this report is an example of a general potential problem area involving the product pass system and the source rack for Category IV type irradiators [(ANSI) classification]. Although product pass systems, product totes, boxes and carriers vary considerably between irradiator installations, some common system requirements and administrative procedures could be defined. An ANSI Committee (N43-3.4)* is presently studying irradiator safety for gamma irradiators and addressing this problem. An ANSI Category IV irradiator standard, currently in draft form, is expected to be ratified and issued within the year.

*The ANSI committee discussed the incident at the Becton-Dickinson facility and concluded that, insofar, as the proposed standard was concerned, no additional design requirements to those in the unissued draft standard were necessary since certain safety services were already specified to relieve the problem. (See Attachment 1). (e.g., provision of a source guard, etc.)

PRESENT NRC LICENSING POLICY

A review of license applications of present NRC licensees using similar types of Category IV irradiators indicates that NMSS (FCML) does not explicitly consider product carrier maintenance in its review of irradiator license applications.

CONCLUSIONS

The incident was probably caused by the licensee's use of damaged tote boxes or product carriers; it could have been prevented by operating procedures requiring periodic inspection and removal of damaged tote boxes. The incident is significant relative to irradiator safety since any shutdown of the irradiator was precluded and, additionally, fires resulted from the product boxes and product being heated to combustion temperatures by prolonged exposure to the gamma source.

The fact that an ANSI Committee study and draft standard is addressing this area of irradiator safety is evidence that industry efforts are being made to correct the operating deficiencies that resulted in the incident. However, the regulatory agencies that license the use of gamma irradiator facilities should be equally active in improving this area of irradiator safety.

AEOD Recommendations

1. AEOD recommends that NMSS (FCML) amend applicable irradiator licenses to require the licensee to implement procedures to ensure that damaged product carriers are detected and removed from use.
2. AEOD recommends that NMSS (FCML) consider whether the following areas of product pass system safety are adequately addressed in the license review process for irradiator licenses: (a) the possibility of interference between the source rack and the product being moved around the source; (b) product carrier maintenance and (c) malfunctions of the product pass system that could result in prolonged irradiation of the material being irradiated.
3. AEOD recommends that IE notify all irradiator licensees that operate facilities of the type described in this report of the incident at the Becton-Dickinson facility by issuing an information notice to licensees.
4. AEOD recommends that if the Office of State Programs determines this to be an area of compatibility for Agreement State licensees that recommendations 1 and 2 be considered to apply to Agreement State licensees.