U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 030-00234/91-001

License No. 20-02452-03 Priority 1 Category G3 Program Code 2300

Licensee: Worcester Memorial Hospital
(The Medical Center of Central Massachusetts/Memorial)
119 Belmont Street
Worcester, Massachusetts 01605

Facility Name: Worcester Memorial Hospital
(The Medical Center of Central Massachusetts/Memorial)

Inspection Conducted: April 8, 1991

Inspectors: Steven R. Courtemanche 5/14/91
for Mary Cahill, Health Physicist date
Nuclear Materials Safety Section A, DRSS

for Steven R. Courtemanche 5/14/91
Roy Mathew, Reactor Engineer date
Electrical Section, DRS

Approved by: M. Shanbaky 5/14/91
Mohamed M. Shanbaky, Chief date
Nuclear Materials Section, DRSS

Inspection Summary: Special Announced Inspection Report No. 030-00234/91-001

Areas Inspected: Review of the circumstances surrounding a failure of the source retraction mechanism of an Atomic Energy of Canada Limited (AECL) Theratron 780-C teletherapy unit, including: organization and scope of licensed activities, notification of the source retraction mechanism failure, events following the source retraction mechanism failure, review of source retraction mechanism malfunction, safety instruction and training, daily and monthly checks of the teletherapy unit, and incident dose assessment.

Results: No violations were identified. However, safety instructions posted at the teletherapy machine console were incomplete in that they did not contain sufficient detail on initial steps to be taken at the console in the event of a failure of the Co-60 source retraction mechanism. In addition, steps to be taken to ensure that only the patient is in the treatment room before turning the primary beam of radiation on to begin treatment or after door interlock interruption were not included in the safety instruction.

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DETAILS

1. Persons Contacted

*Mabine M. Castro, Ph.D., Medical Physicist
*Laurence E. Kelly, Vice President, Professional Services
(exit interview conducted by telephone)
Won K. Tak, M.D.
Marjorie Lany, RTT
Linda Veacera, RTT
*Charles T. Maychak, Installation Manager,
Theratronics International Limited

*denotes those in attendance at exit meeting

2. Organization and scope of Licensed Activities

Worcester Memorial Hospital is authorized by NRC License No. 20-02452-03 to perform radiation therapy treatments with an AECL Theratronics 780-C cobalt-60 (Co-60) teletherapy source. The teletherapy unit houses a 5,700 curie (Ci) Co-60 source. The last source exchange had taken place in February 1991. The Radiation Oncology Department treats approximately 45 to 50 patients per day. The Department staff consists of a radiation oncology physicist and three radiation therapy technologists. At the time of the event, one radiation therapy technologist and the physicist were present. Treatments are given to patients for a variety of malignancies.

3. Notification of Source Drawer Retraction Mechanism Failure

On April 4, 1991 at 2:00 p.m., NRC Region I received a call from the licensee's radiation oncology physicist. The physicist stated that a failure of the source retraction mechanism had occurred during the treatment of a patient. In his phone call to the Region, the physicist stated that the technologist operating the teletherapy machine noticed at 0.80 minutes into the 0.89 minute prescribed treatment time that the unit control console light indicated a source retraction mechanism failure. It was reported that the technologist attempted to reset the machine by turning the on/off key several times. When this action did not cause the source to return to the shielded position, the physicist was summoned and responded immediately. The door to the treatment room was opened, and the door interlock failed to cause the source to retract as designed. The emergency T-bar was then taken by the physicist into the treatment room and used to manually push the source into the fully shielded position. The patient was promptly removed from the treatment room.

The physicist originally reported that the actual treatment time to the patient exceeded the prescribed treatment time by approximately 30 seconds. (See Sections 5 and 8 for further details)

The licensee discontinued use of the machine following the incident and contacted Theratronics to inspect and repair the unit. (See Section 5 for details).

No apparent violations were identified.

4. Events Following Source Retraction Mechanism Malfunction

On April 5, 1991, the physicist informed Region I by telephone that efforts by Theratronics to identify the cause of the malfunction were unsuccessful. A second service representative was dispatched by Theratronics at the licensee's request and arrived at the facility on April 7, 1991.

A Confirmatory Action Letter (CAL) was issued to the licensee by Region I on April 5, 1991 which confirmed necessary actions to be taken by the licensee before patient treatment could be resumed.

5. Review of Source Retraction Mechanism Malfunction

On April 8, 1991, the inspector arrived at the licensee's facility to review circumstances surrounding the source retraction mechanism malfunction, evaluate the licensee's immediate response, and verify that actions required by the CAL were taken.

The technologist and the physicist present at the time of the event informed the inspector of the sequence of events which occurred at the time of the incident. The inspector learned that the malfunction of the source retraction mechanism occurred at 0.08 minutes into the prescribed 0.89 minute treatment time, not at 0.80 minutes as originally reported by the physicist. The error was due to misreading of the timer dial by the technologist. Further, when the console pressure loss and source drawer indicator lights came on at the console, the technologist attempted to reset the machine by pushing the timer reset and timer buttons, both designed to activate retraction of the source drawer if pushed while the source is in the unshielded position. The technologist stated that this action did not retract the source. According to the technologist, she did not attempt to push the emergency stop button or turn the on/off key at the time of the event. It was originally reported that the on/off key had been turned several times. When questioned as to why the emergency push button and on/off key were not used to attempt to retract the source, both the technologist and the physicist indicated that use of these controls would cause power to the machine to be turned off and they were concerned that power could not be restored. In this particular incident, the technologist and the physicist stated that power was necessary in order to lower the treatment table top a sufficient distance so that the patient could be moved from the treatment room. The physicist also indicated that if the orientation of the machine head had been such that the exposed source was pointing toward the ceiling, it would have not been possible for the source to be manually pushed to the shielded position. After removal of the patient, the on/off key was used to turn off the power to the unit and the treatment room door was locked. All patient treatments scheduled for the remainder of the day were cancelled.

The Theratronics service representative reviewed checks he performed of the machine in an attempt to identify the cause of the source retraction mechanism malfunction. Attempts to reproduce the malfunction were unsuccessful. Other steps included verification of proper functioning of the reset push button, timer and door interlocks, pressure regulator, low pressure indicator switch, air compressor, solenoids, cord reel and source drawer. A check of the air pressure indicator made by the service representative at the time of the inspection indicated a pressure of approximately 30 psig, an increase of 5 psig over that noted by the service representative the previous evening. The observed fluctuation in pressure was not within tolerance limits and it was speculated that a pressure regulator malfunction could have contributed to the failure of the source to retract. The service representative indicated that the solenoid valve feeding the air supply to the source drawer system had been checked and cleaned by the previous service representative on April 5. No debris had been noted on the solenoids that may have contributed to the malfunction. Voltage to the solenoids had been checked, but the service representative indicated that further monitoring of the voltage at the solenoid valve was planned. The service representative speculated that the malfunction may have been due to failure of the solenoids or regulator. These components were replaced on April 9. The inspector requested that additional trouble shooting be performed to rule out malfunction of the interlocks that operate the solenoids and source drawer unit.

No apparent violations were identified.

6. Safety Instruction and Training

At the time of the inspection, instructions were posted above the teletherapy unit control console which indicated the procedure to be followed if the operator is unable to turn the primary beam of radiation off with controls outside the treatment room. The instructions were incomplete in that they were not specific as to the steps to be followed to ensure that only the patient is in the treatment room before turning the primary beam of radiation on to begin treatment or after a door interlock interruption. The physicist stated that safety instructions would be revised to incorporate these detailed steps and that training on the revised procedures would be provided to technologists.

Records of individuals receiving safety instruction were reviewed by the inspector. Records indicated that training sessions for technologists were held annually, the most recent given by Dr. Castro in March 1991.

A technologist not involved in the incident was questioned on the procedure to be followed if the source retraction mechanism failed. The technologist indicated that she would first push one of the timer buttons and then turn the on/off key. This technologist's knowledge of the procedure differed from that of the technologist involved in the incident. This discrepancy was brought to the attention of the physicist by the inspector. The physicist stated that he would include initial steps to be taken by the operator at the control console to retract the source in the revised safety instruction. The physicist stated that reinstruction of technologists would also cover these intial steps.

The licensee submitted revised safety instructions in a letter dated April 16, 1991 in response to the CAL issued by the NRC on April 5, 1991. The submitted instructions were reviewed by the inspector and found to be incomplete. Specifically revised instructions did not include the procedure to be followed to ensure that only the patient is in the treatment room before turning the primary beam of radiation on to begin treatment or after a door interlock interruption.

No apparent violations were identified.

7. Daily and Monthly Checks of the Teletherapy Unit

Records of daily checks of the teletherapy unit performed by the technologist included checks of the treatment room door interlock, Prime Alert area radiation monitor, and emergency push button operation.

A demonstration of a daily check by the technologist at the time of the inspection appeared adequate.

Records of monthly spot checks performed by the physicist contained the required information and indicated that checks were performed at the required frequency with no notable malfunctions.

No apparent violations were identified.

8. Incident Dose Assessment

The physicist, based on the 0.08 minute treatment time to the patient before the source retraction mechanism failure, and an estimated additional 0.50 minutes before the source could be returned to the unshielded position, determined the total treatment time to the patient to be 0.58 minutes. The total treatment time was less than the prescribed treatment time of 0.89 minutes, resulting in a dose to the patient less than the total dose prescribed. The prescribed dose for the portal treated was 100 rads. The patient received 60 rads.

Following the incident, the physicist's and the technologist's whole body film badges were returned to Landauer for immediate analysis. Readings reported by Landauer were 50 millirem and 60 millirem for the physicist and the technologist, respectively.

No apparent violations were identified.

9. Exit Interview

The inspector discussed the inspection findings with licensee representatives denoted in Section 1 at the conclusion of the inspection. The scope and findings of the inspection were summarized. The inspectors emphasized actions, which are detailed in the April 5, 1991 CAL, to be taken by the licensee before patient treatments could be resumed. These included revision of safety instruction and retraining of technologists, full calibration of the teletherapy unit, and additional testing of the unit to verify proper operation prior to and after repairs by Theratronics.

10. Corrective Actions

The physicist contacted Region 1 at 2:30 p.m. on April 9 to report that all required actions, as discussed in Section 9, had been completed. Additional testing of the teletherapy unit was unsuccessful in definitively identifying the source of the malfunction. Authorization was given to resume patient treatment.

The licensee responded in writing to the CAL and inspection findings of April 16, 1991. The letter stated that all required corrective actions were taken. Revised safety instructions and a preliminary service report from Theratronics were included in the letter. The revised safety instructions were not complete in that they did not contain steps to be taken to ensure that only the patient is in the treatment room before turning the primary beam of radiation or to begin treatment or after a door interlock interruption.

Other actions taken by the licensee, according to their April 16 letter, include daily monitoring of the pressure regulator indicator and air compressor.

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