

2.3.1.6 DISCUSSION OF THE SIGNIFICANCE OF THE RESULTS FOR ALL DOSE CONTROL DATA

As reported in section "2.3.1.2 Staff Radiation Exposure" of this report, the table found in **Appendix H** of this report provides the radiological occupational annual dose data for 2011. The table provides a comparison of dosimetry results for the years 1997 to 2011. Any comparison of the dose in 2007 and 2008 to previous years is not informative or appropriate as the facility only processed tritium until January 31, 2007, and only resumed processing tritium in July of 2008.

Increases in maximum, average and collective dose in 2011 compared to 2010 are partly attributable to an increase of 10.52% in tritium processed in 2011 compared to 2010.

The increases in 2011 can also be attributed to a single customer order, which was labour intensive with an increased reject rate and produced over a 14 week period. During this 14 week period approximately 2,300 GBq's were released on average weekly as opposed to 618 GBq's on average during the other weeks of the year. Once the order was completed dose trends decreased for the rest of the year. As this type of order will no longer be pursued, dose data in the future are expected to be lower and proportional to tritium processed.

It should be noted however that dose data in 2011, show that despite an increase in tritium processed of 45.52% compared to 2009 that dose results in 2011 were slightly lower for the most part than those in 2009 which demonstrates a net improvement.

2.3.1.6.1 MAXIMUM DOSE

As expected in 2011 and as previous years, the highest dose received by any employee was to an individual working primarily in zone 3 where tritium is processed.

The maximum dose to an employee in 2011 was 1.15 mSv and is 0.27 mSv higher than the maximum dose to an employee in 2010 but 0.35 mSv lower than the maximum dose to an employee in 2009.

In 2011, the maximum dose to an employee working primarily in zone 2 was 0.44 mSv and is 0.40 mSv more than the maximum dose to an employee working primarily in zone 2 in 2010.

In 2011, the maximum dose to an employee working primarily in zone 1 was 0.05 mSv and is 0.01 mSv more than the maximum dose to an employee working primarily in zone 1 in 2010.

In 2011, the maximum dose to an employee working primarily in administration was 0.24 mSv and is 0.2 mSv more than the maximum dose to an employee working primarily in administration in 2010. This increase is not unexpected as the individual received the dose while performing repairs and maintenance in zone 3. Maximum dose of other employees working in administration was comparable between 2011 and 2010.

2.3.1.6.2 AVERAGE DOSE

The average dose for all staff in 2011 was 0.25 mSv and is 0.14 mSv higher than the average dose to all staff in 2010 but the same as the average dose to all staff in 2009.

The average dose to employees working primarily in zone 3 in 2011 was 0.87 mSv and is 0.45 mSv higher than the average dose to employees working primarily in zone 3 in 2010 but 0.19 mSv lower than the average dose to employees working primarily in zone 3 in 2009.

The average dose to employees working primarily in zone 2 in 2011 was 0.11 mSv and is 0.10 mSv higher than the average dose to employees working primarily in zone 2 in both 2010 and 2009.

The average dose to employees working primarily in zone 1 in 2011 was 0.02 mSv and is the same as average dose to employees working primarily in zone 1 in both 2010 but lower by 0.01 mSv than the average dose to employees working primarily in zone 1 in 2009.

The average dose to employees working primarily in administration in 2011 was 0.13 mSv and is 0.11 mSv higher than the average dose to employees working primarily in administration in 2010 and 0.08 mSv higher than the average dose to employees working primarily in administration in 2009. Again this increase is not unexpected as the individual received the dose while performing repairs and maintenance in zone 3. Average dose of other employees working in administration was comparable between 2011 and 2010.

2.3.1.6.3 COLLECTIVE DOSE

The collective dose for the staff in 2011 was 4.47 mSv and is 2.65 mSv higher than the collective dose to staff in 2010 but 0.10 mSv lower than the collective dose to staff in 2009 despite an increase in tritium processed of 45.52% from 2009 to 2011.

2.3.1.7 DISCUSSION ON RADIATION PROTECTION PROGRAM EFFECTIVENESS

The Radiation Protection Program has been effective in protecting the prevention of unreasonable risk to the health and safety of persons.

2.3.1.7.1 STAFF DOSE

The Radiation Protection Program prescribed measures to ensure that staff dose are kept to levels as low as reasonably acceptable.

The Radiation Protection Program requires that room Tritium-In-Air monitors are used to assess ambient air in zones 2 and 3 with alarm threshold that ensure that staff are evacuated from work areas with concentrations above normal in order to reduce staff dose. Action is taken accordingly to reduce or eliminate source of tritium exposure and in ensuring staff dose are kept as low as reasonably achievable.

The Radiation Protection Program requires that Portable Tritium-In-Air monitors are used by staff to identify localized sources of tritium exposure in zones 2 and 3. Action is taken accordingly to reduce or eliminate localized source of tritium exposure and in ensuring staff dose are kept as low as reasonably achievable.

The Radiation Protection Program requires that surface contamination is assessed by liquid scintillation counters at frequent enough intervals and based on results actions are taken to ensure levels are kept as low as reasonably achievable. The actions include an informal review of work practices by the Human Protection Coordinator and Department Supervisor where adjustments are made as deemed necessary. Actions contribute in ensuring staff dose are kept as low as reasonably achievable.

The Radiation Protection Program requires that staff dose is assessed by liquid scintillation counters at frequent enough intervals and based on results actions are taken to ensure levels are kept as low as reasonably achievable. The actions include an informal review of work practices by the Human Protection Coordinator and Department Supervisor where adjustments are made as deemed necessary.

The Radiation Protection Program requires that equipment used is maintained and calibrated regularly to ensure the adequacy of results.

2.3.1.7.2 PUBLIC DOSE

The Radiation Protection Program prescribed measures to ensure that public dose are kept to levels as low as reasonably acceptable.

The Radiation Protection Program requires that an Environmental Monitoring Program is in place to assess the amount of tritium released to the environment and to formally calculate the dose to the public. Results are reviewed on a quarterly basis by three members of the Health Physics Team. The actions from this review may result in changes in work practices as deemed necessary and contribute in ensuring public dose are kept as low as reasonably achievable.

The Radiation Protection Program requires that a bubbler system is in place to formally tabulate emissions from the facility. The results are verified on a weekly basis by six employee members including four members of the health physics team and production supervisors for each zone 2 and zone 3 where tritium may be released. The actions from this review may results in change in work practices as deemed necessary and contribute in ensuring public dose are kept as low as reasonably achievable.

The Radiation Protection Program requires that a real-time recording device (chart recorder) is also in place to monitor emissions from the facility as they take place. The results are verified regularly on a daily basis by the production supervisor for zone 3 where tritium is processed. The actions from this review may result in changes in work practices as deemed necessary and contribute in ensuring public dose are kept as low as reasonably achievable.

The Radiation Protection Program requires that equipment used is maintained and calibrated regularly to ensure the adequacy of results.

2.3.1.8 SUMMARY OF RADIATION PROTECTION PROGRAM PERFORMANCE

As reported in section "3.1.4 Safety Performance Objectives" of this report a number of Safety Performance Objectives have been set for the upcoming year based on historical performance in 2011 and previous years.

2.3.1.8.1 AIR EMISSION TARGET

For 2011, we set as a target to reduce emissions (HTO + HT) by 8% compared to the emissions (HTO + HT) in 2010. Unfortunately this target was not met and emissions (HTO + HT) in 2011 increased by 52.87% compared to those in 2010.

This increase is partly attributable to an increase of 10.52% in tritium processed in 2011 compared to 2010.

The increase in emissions in 2011 can also be attributed to a single customer order, which was labour intensive with an increased reject rate and produced over a 14 week period. During this 14 week period approximately 2,300 GBq's (HTO + HT) were released on average weekly as opposed to 618 GBq's (HTO + HT) on average during the other weeks of the year. Once the order was completed dose trends decreased for the rest of the year. As this type of order will no longer be pursued, dose data in the future are expected to be lower and proportional to tritium processed.

As discussed in section "3.1.4.2 Air Emission Target" of this report, despite a predicted increase in production of 12% in 2012, Senior Management has committed to observe the same air emission (HTO + HT) target that was set for 2011, 642 GBq's released weekly (HTO + HT).

2.3.1.8.2 OCCUPATIONAL DOSE TARGET

For 2011, we set as a target to maintain the average occupational dose to all staff at 0.25 mSv, the same as 2009 despite a planned increase in production. Unfortunately this target was not met and the average occupational dose to all staff in 2011 increased 0.14 mSv compared to those in 2010.

As discussed in section "3.1.4.3 Occupational Dose Target" increases in average dose in 2011 compared to 2010 are partly attributable to an increase of 10.52% in tritium processed in 2011 compared to 2010.

The increase in 2011 can also be attributed to a single customer order, which was labour intensive with an increased reject rate and produced over a 14 week period. During this 14 week period approximately 2,300 GBq's were released on average weekly as opposed to 618 GBq's on average during the other weeks of the year. Once the order was completed dose trends decreased for the rest of the year. As this type of order will no longer be pursued, dose data in the future are expected to be lower and proportional to tritium processed.

Despite a predicted increase in production of 12% in 2012, Senior Management has committed to observe the same occupational dose target that was set for 2011, an average dose of 0.25 mSv for all staff.

2.3.1.9 SUMMARY OF CONTINUOUS IMPROVEMENTS UNDER ALARA PERFORMANCE

As prescribed in the Radiation Safety Program^[7] is a concept that is also discussed during staff, committee and management meetings.

As discussed in section "2.1.2.4 Committees" of this report in 2011 committees have been instrumental in the development and refinement of company programs and procedures and at identifying ways to reduce emissions and improve safety at the facility. Committees use meeting results as an opportunity for improvement and make recommendations accordingly. In 2011 a total of 67 minuted meetings have taken place at the company compared to 56 in 2010. The "Health Physics Committee" meetings and "Other Staff" meeting minutes both being most frequent at 18 each:

TABLE 5: BREAKDOWN OF MEETINGS HELD

COMMITTEE	NUMBER OF MEETINGS
HEALTH PHYSICS COMMITTEE	18
WORKPLACE HEALTH AND SAFETY COMMITTEE	12
EXECUTIVE COMMITTEE	1
FIRE PROTECTION COMMITTEE	5
MITIGATION COMMITTEE	6
PUBLIC INFORMATION COMMITTEE	5
WASTE MANAGEMENT COMMITTEE	2
OTHER STAFF	18
TOTAL	67

Notable improvements made by the Committees in 2011 included; the installation of a fire separation wall, the introduction of a new method that reduces waste in Zone 2, improved method of determining swipe areas in Zones 1, 2 and 3 and also an improved method of calculating dose to staff.

Committee meetings also resulted in the position of Import and Export Manager to have the added responsibility of performing activities associated with contamination control relieving the Human Protection Coordinator to identify ways to reduce exposure to staff and emissions from the facility.

2.3.1.10 SUMMARY OF RADIATION DEVICE AND INSTRUMENTATION PERFORMANCE

All instruments in 2011 continued to be maintained in a state of safe operation.

As discussed in detail in section "2.2.3 Fitness For Service" of this report the Maintenance Program^[25] has continued to remain effective in 2011. The facility and equipment associated with the facility were maintained and operated within all manufacturers' requirements and as prescribed by the Radiation Safety Program^[7] to ensure that all regulatory requirements were met.

2.3.1.11 SUMMARY OF INVENTORY CONTROL MEASURES

A number of Inventory Control Measures are in place to ensure that tritium on site does not exceed the possession limit prescribed by licence NSPFOL-13.00/2015^[1].

Procedure RSO-009 (Revision H) titled "Tritium Inventory Management" is specifically used to assess tritium inventory on site.

Tritium on site is found in:

- Bulk containers, U-beds and tritium traps
- New light sources
- New product that contain light sources
- Work in progress
- Waste
- Expired light sources taken out of product
- Product that contain expired light sources
- Non-conforming product

At the end of each month tritium inventory is analyzed by tabulating:

- Bulk containers received
- Light sources and product received
- Light sources and product shipped
- Waste shipped
- Light sources broken
- Tritium released through stack

As discussed in section “2.3.1.6 Discussion Of The Significance Of The Results” of this report, in 2011, throughout 2011 the possession limit was not exceeded. The maximum tritium activity possessed at any time during 2011 was 5,780 TBq in November. Tritium activity on site during 2011 can be found in **Appendix A** of this report.