Personal Dosimetry at the Canadian Light Source

By

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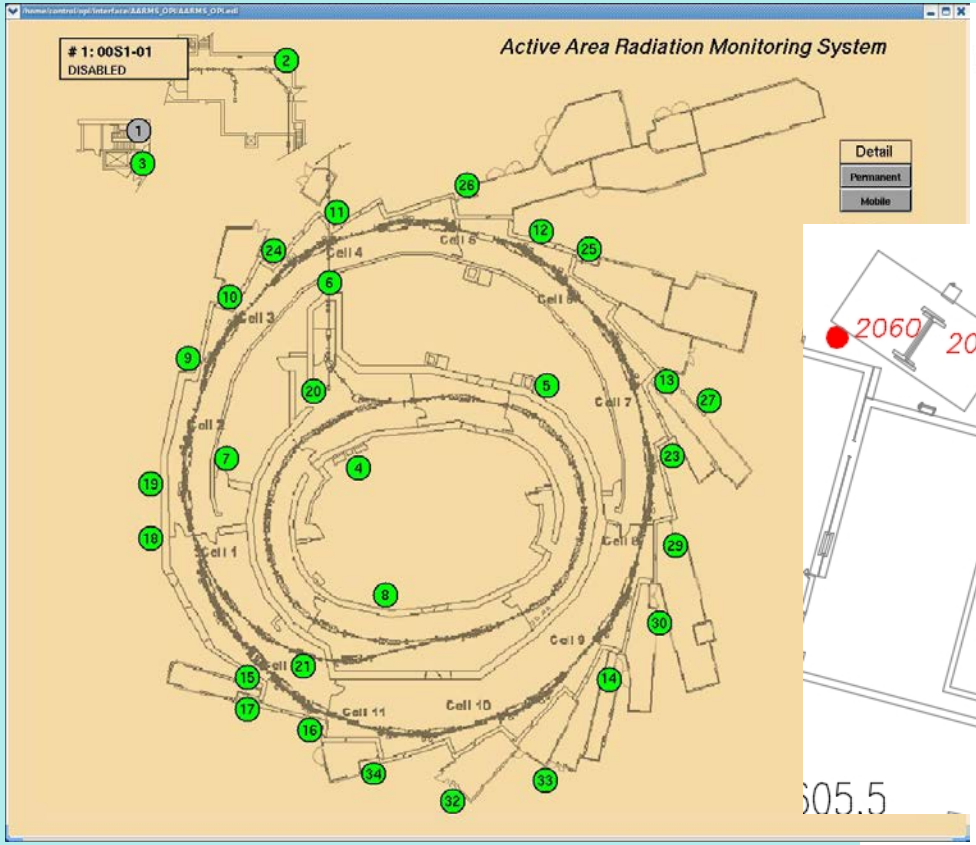
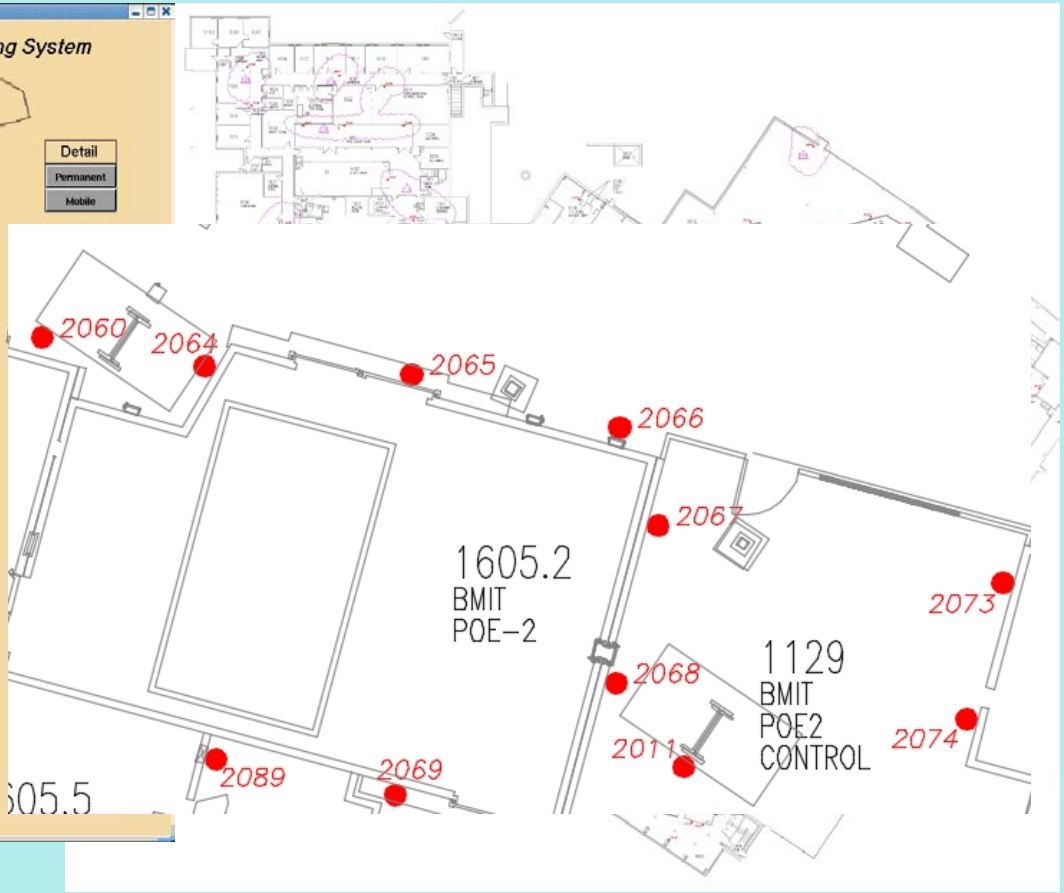
Introduction

- Third generation synchrotron with a 2.9GeV electron storage ring
- Electrons turned in a magnetic field and the emitted radiation is used
- The current practice is to have every employee and user issued a personal dosimeter (Ta type Luxel)
- This was not because there was an expectation of exposures being close to 1mSv per year, but due to caution and prudence while accelerators were being commissioned and the shielding design validated

AARM and PARM Location Maps

There are currently 31 permanent Active Area Radiation Monitor locations
At the end of 2016 there were 621 Passive Area Radiation Monitor locations



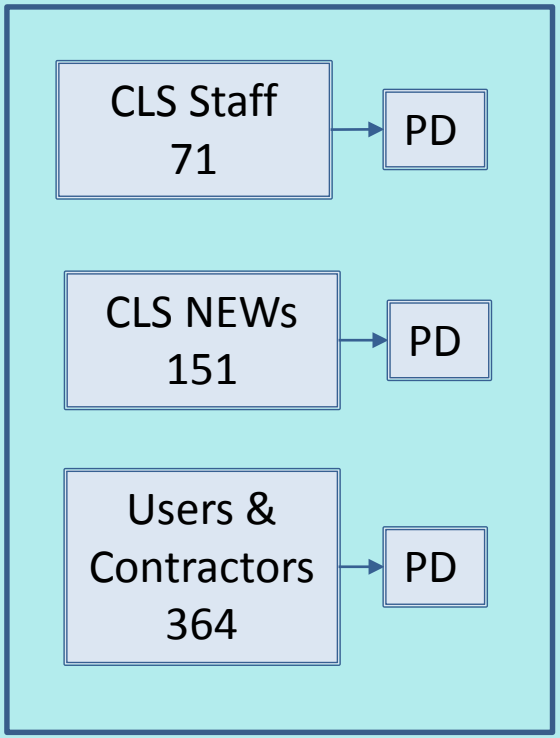


Canadian Light Source | Centre canadien de rayonnement synchrotron

Personal Radiation Monitoring Program

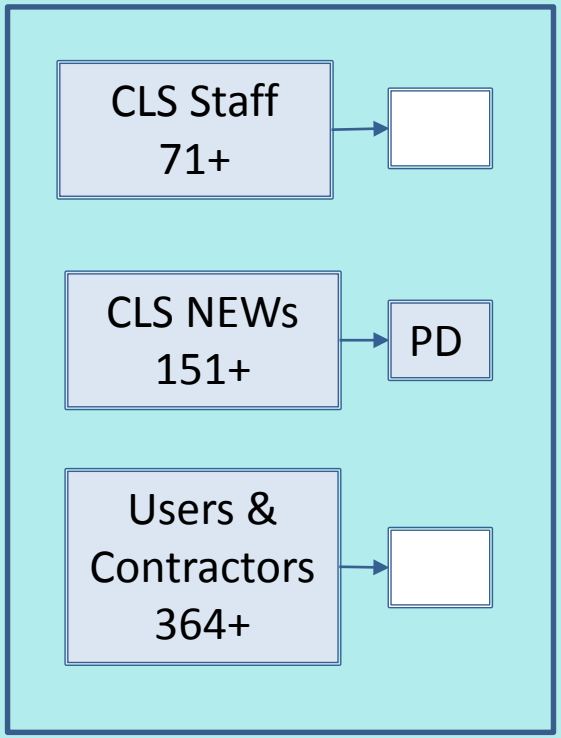
The Way It Is Now

Everyone has personal dosimetry



The Way We Propose

Only NEWs have personal dosimetry

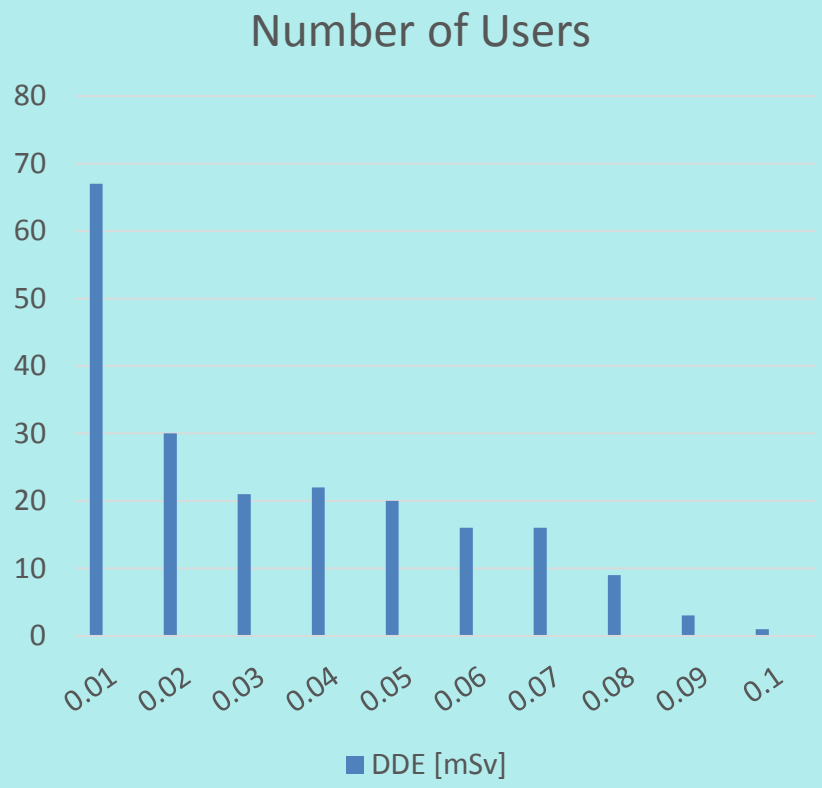


Radiation Doses to Users & Contractors (Q1, 2014 – Q4, 2016)

General Overview

- 4242 User and Contractor visits to the CLS
- None reported a deep dose greater than 0.1mSv
- 4020 deep dose reports of ‘M’, meaning below minimum measurable limit
- 17 lost or misplaced their personal dosimeter

Specifics



Radiation Doses to Users & Contractors (Q1, 2014 – Q4, 2016)

- Background radiation subtraction likely responsible for most user doses
- The background radiation difference was on average 0.1mSv between Q1, 2014 and Q4, 2016 between SAL and CLS
- Only SAL series dosimeters are meant to be stored on the SAL dosimeter rack
- To check compliance a record is made 10 – 12 times a quarter
- On average 55 users per quarter store their badge on the SAL rack for some of the quarter

Radiation Doses to Users & Contractors (Q1, 2014 – Q4, 2016)

- 4242 dose reports collected, but no neutron doses reported
- There were four reported beta doses
- Given this information indicating that the radiation risk is low we plan on removing users from personal dosimetry.

How Doses Will Be Determined

- Check all areas where users spend their time: beamlines, user laboratories, and areas of transit
- If they have a value ≤ 0.10mSv above background the users for that quarter will be assigned a dose of “M”
- Rationale based on each PARM being present for the entire quarter (~1800hrs of operation), whereas users are present for less than 180hrs in a quarter (equal to 22 continuous eight hour shifts)
- Also relies on dose arriving evenly over the quarter and not in a single event, which can be validated by the AARMs archive historical data

How Doses Will Be Determined

- Thus a PARM value of 0.10mSv becomes our administrative action level
- If an area has > 0.10mSv in a quarter an investigation will be conducted to determine why the radiation levels are elevated, identify what actions can be taken to remedy the issue(s) and take those necessary actions
- Users of that area(s) have their dose calculated
- Users of areas with PARMs ≤ 0.10mSv will have their dose assigned as “M” as before

How Doses Will Be Determined

- Users who occupied an area where the quarterly PARM reading was > 0.10mSv will have their dose assigned according to their occupancy of those areas as a weighted sum of the highest PARM reading

$$Quarterly\ Dose \equiv \sum_{i=1}^{n} \frac{PARM_i^{Max}}{1800hrs} \cdot \left(x_i^{shifts} \cdot 8hrs\right)$$

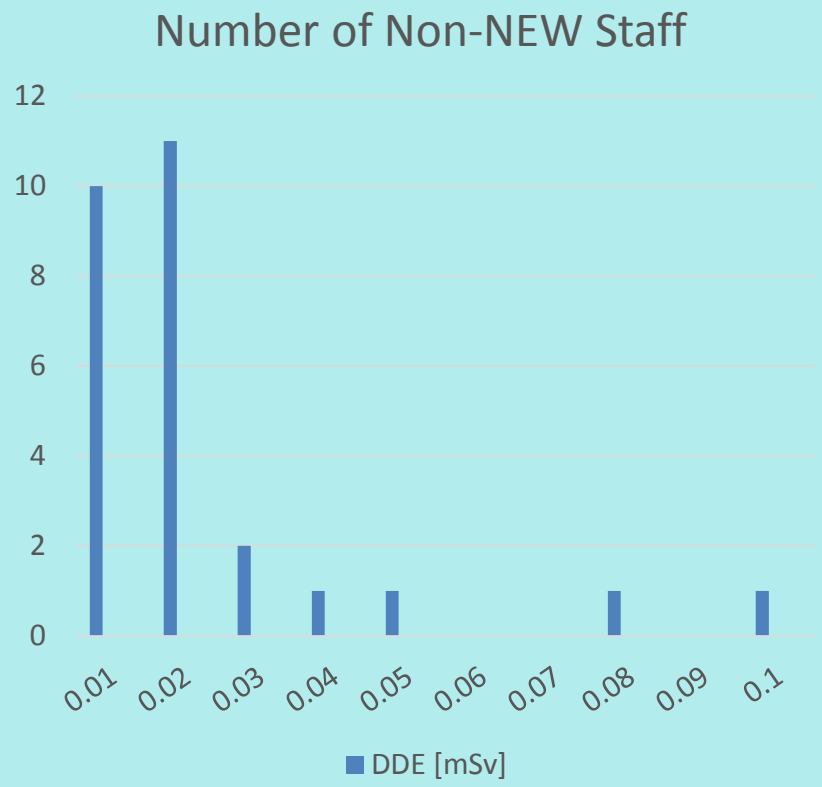
- The occupancy information is gathered from beamline experimental permits which record the number of shifts and who attended

Radiation Doses to Administration and Finance Staff (Q1, 2014 – Q4, 2016)

General Overview

- 846 CLS non-NEW personnel entries
- None of these had a Deep Dose greater than 0.1mSv
- 804 reports of “M”
- 15 lost or misplaced dosimeters in this period

Specifics



How Doses Will Be Determined

- Check the areas where non-NEW staff spend their time: office areas, mezzanine, and corridors of transit
- If they are ≤ 0.05mSv above background the administration staff for that quarter will be assigned a dose of “M”
- This is based on the PARM being present for the entire quarter (~1800hrs), whereas office staff are present for 4/18^{ths} of that time
- Again the conclusion relies on the dose measured by the PARMs arrives evenly and not in a single event, which can be verified by the AARMs data

How Doses Will Be Determined

- If there is an elevated value the dose for staff members would be calculated by taking the largest PARM reading in their work area and multiplying by the occupancy factor

$$Quarterly\ Dose \equiv \frac{PARM^{Max}}{4.5}$$

BMIT Beamline Area Case Study

MapN	Qs	DDE	FN	Placement
2057	12	M	M	POE1
2058	12	M	M	POE1
2064	12	M	M	POE2
2065	12	M	M	POE2
2066	12	M	M	POE2
2067	12	M	M	POE2
2068	12	M	M	POE2
2069	12	M	M	POE2
2074	12	M	M	POE3
2073	12	M	M	POE3
2075	12	M	M	POE3
2076	12	M	M	POE3
2081	12	M	M	SOE1
2080	12	M	M	SOE1
2205	12	M	M	SOE1
2084	12	M	M	SOE1
2084	12	0.07	M	SOE1
2086	12	M	M	SOE1
2086	12	0.11	M	SOE1
2204	12	0.06	M	SOE1
2087	12	M	M	SOE1
2088	12	M	M	POE3
2099	12	M	M	SOE1
2098	12	M	M	POE3

- BMIT Staff -

PRTN	Num	DDE	FN	
543	11	0.02	M	Employee 1
1665	12	M	M	Employee 2
123	12	M	M	Employee 3
4498	12	0.01	M	Employee 4
567	12	0.04	M	Employee 5

Conclusions

- The radiation risk to users and administration staff is small
- Future changes to accelerator operations such as doubling storage ring current and Top-Up mode of operation will have linear dose affects and will not significantly increase the risk
- Using the extensive AARM and PARM information collected each quarter the radiation exposure to users and office staff can be estimated
- This will lead to significant savings in operation cost and in dosimetry program administration time