CONSOLIDATED ANNUAL COMPLIANCE REPORT

For the

Accelerator Facility Construction Licence – PA1CL-825.00/2004

Class 1B Particle Accelerator Operating Licence – PA1OL-02.06/2006

Covering Year 2004

Document No. 11.18.40.6 Rev. 0
Date: March 31, 2005

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REVISION HISTORY

Revision	*Date*	*Description*	*Author*
A	2005-03-21	Issued for review	M. Benmerrouche
0	2005-03-31	Issued for use	M. Benmerrouche

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1 OPERATIONAL OVERVIEW

1.1 FACILITY CONSTRUCTION AND INSTALLATION

There were no modifications or additions to the conventional building services during 2004.

The following accelerator and beamline technical system modifications and additions were performed:

- Installation of all radiation hutches for the six x-ray beamlines (five research beamlines, and one facility diagnostic beamline);
- Installation of the front-ends for all beamlines in the storage ring tunnel;
- Installation and the start of commissioning of the SGM and PGM beamlines on ID11;
- Partial installation on the experimental floor of the remaining beamlines, limited by late deliveries from suppliers; and
- Installation of two insertion devices in the storage ring for the chicaned beamlines on ID11

1.2 ACCELERATOR COMMISSIONING AND OPERATION

Commissioning continued through to 2004 June with four beam runs, followed by two runs of Routine Operation after 2004 August. The following highlights the results from each run.

1.2.1 Run 6 - January 16 to February 1

Machine physics concentrated on orbit correction and tune measurements. Some work was done with the optical diagnostic beam line. Currents up to 25 mA were achieved, but with excessively high vacuum pressure near the super-conducting cavity. HSE measurements were carried out for these 25 mA operations as well as for injection and beam abort conditions.

1.2.2 Run 7 - February 13 to February 24

More orbit correction and tune measurements were performed. Improvements to injection were done. There was still no luck going to higher currents, but there were indications that there was an obstruction in the beam pipe near the cavity that was probably the cause of the high pressure.

Following this run an obstruction in the cavity input valve was found and the valve replaced.

1.2.3 Run 8 - March 19 to April 4

The beam was now much easier to handle! More improvements to injection efficiency were done. Beams up to 88 mA were achieved. HSE made radiation measurements for the improved injection and for the higher stored beam current. Front-end conditioning began for some beamlines. Vacuum condition of the storage ring was done during overnight shifts at “high” currents.

1.2.4 Run 9 - May 14 to June 6.

Investigated position monitor accuracy and beam stability. Some development of the low level RF was done. HSE did more radiation measurements with improved shielding in place. PGM beamline commissioning began.

1.2.5 Run 10 - August 6 to August 31.

Machine physics continued with more injection optimization, orbit correction and beam position reproducibility (magnet cycling). Beam current up to 110 mA was stored. HSE measurements continued with more shielding to establish upper limit on "normal" operations. PGM commissioning continued. Vacuum conditioning continued on overnight shifts. Total integrated current for the run was 7.2 Ampere-hours.

1.2.6 Run 11 - September 17 to Oct 19.

This was the last run in 2004. Machine studies continued with more injection optimization and orbit control, as well as investigating different machine modes. Currents up to 200 mA were achieved. HSE did more radiation measurements for high current operations. Vacuum conditioning continued on overnight shifts. Total integrated current for the run was 24.6 Ampere-hours.

General observations for 2004: In 2004 all machine parameters for the storage ring were measured and the design confirmed. Beam currents up 200 mA were achieved in a safe manner. The one area that needs improvement is the beam lifetime, which is limited by the rate of vacuum conditioning. In 2004 November and December, a closer examination of the storage ring vacuum system identified several very small leaks at flanges, and several defective ion pumps. All of these problems were rectified, and clearly led to a lower operation pressure. Preliminary results in early 2005 have shown a significant improvement in the beam lifetime.

1.3 OPERATOR INTERFACE AND CONTROL ROOM

There was only one significant change to the operator interface software for the control room in 2004. This change was to implement changes to the control to support the four facility states described in the Routine Operating Conditions document that is part of the CLS license. The time the facility is in each of the states is now logged, and restrictions have been placed on the operator's ability to change the system configuration during Normal Operation mode, and inhibit operation in Shut-down or Maintenance modes. The only other changes were to the operator interface software to provide control of the additional storage ring and beamline systems that were installed and commissioned during the year. Minor changes to the operator interface software were made to incorporate operator experience feedback.

In addition to accelerator staff, technical staff have received training to operate the machine under Normal Mode of operations only, and operated the accelerator and storage ring on overnight shifts.

1.4 HSE MEETINGS AND TRAINING

The CLSI Health, Safety, and Environment (HSE) Advisory Committee met once in June 2004.

The Occupational Health and Safety Committee (provincial labour requirement for CLS Inc.) met in January, March, May, September and December. The Contractors Occupational Health and Safety Committee (required for all contractors on the CLS construction project) met as often as required, depending on the construction activities.

The minutes of the meetings are maintained and are posted on the HSE Bulletins Boards at two locations within the CLS facility. The OHSC and COHSC minutes were submitted to Saskatchewan Labour.

Various HSE courses and orientation sessions were offered and attended by CLSI personnel, contractors, emergency first responders, or facility users. The courses included Health Safety and Orientation (HSO); General Industrial Training (GIT); General Radiological Training (GRT); WHMIS; Lead Safety Training; Cryogenic Safety Training; Rigging and Crane Operations; Orientation for Emergency Services Personnel, Access Control Interlock System Training; Forklift Safety Training; Fire Extinguisher Safety Training; Laser Safety Training, IATA Transportation of Dangerous Goods Training; First Aid & CPR; Asbestos Awareness Training and Self Contained Breathing Apparatus Training.

1.5 PERSONNEL

The organization chart showing persons appointed by the licensee to be responsible for day-to-day operation of the facility is given in Figure 1.

1.6 EXECUTIVE DIRECTOR

The Executive Director of the CLSI is the full-time chief executive officer of CLSI who is responsible to the Board of Directors. He has signing authority on all CNSC licences and has the ultimate responsibility for Health, Safety and Environment at the CLS facility and is thus identified as the CLS Facility Authority.

1.7 HEALTH, SAFETY AND ENVIRONMENT MANAGER

The CLSI HSE Manager, reporting directly to the Executive Director, is responsible for developing, implementing and administering the health, safety and environmental programs, and has the authority to take any action deemed appropriate or to stop any activity deemed unsafe. The HSE Manager directs and supervises activities of all CLSI HSE personnel. The HSE Manager is the contact person on all technical issues associated with CNSC license and other licensing and regulatory authorities pertaining to health safety and environment.

1.8 DIRECTOR OF OPERATIONS

The Director of Operations is responsible for management and administration of the technical operations of CLSI. The Director of Operations takes an active role to ensure the design and development priority for health, safety and environmental aspects of the facility design, construction and operations. He supervises the development of policies and procedures regarding access and use of facility, training and monitoring thereof, provision of required technical assistance, including those procedures, policies and protocols that provide for health, safety and environment.

1.9 QUALITY ASSURANCE MANAGER

The Quality Assurance (QA) Manager reports directly to the Executive Director and is responsible for developing, implementing and administering the quality assurance program.

1.10 CHIEF OFFICERS AND MANAGERS

Chief Officers and Managers are responsible for taking an active role to ensure:

- The protection and promotion of health and safety of all persons supervised, including adequate training regarding health, safety and environmental protection;
- The overall corporate administration, including development of frameworks for policies and procedures, approval and authorities and overall corporate protocols, provide adequate resources and priority to the issues related to health, safety and environmental protection at the CLS facility;
- The HSE requirements are known to employees of CLSI, users, contractors, and respective visitors to the CLS facility.

1.11 STAFF AND VISITORS

Everyone at the CLS is required to:

- Take an active role in promoting health and safety and protection of the environment; and
- Comply with all policies and procedures developed within the HSE management system for performing work in a safe and healthy manner, with as little impact on the environment as possible.

1.12 HEALTH SAFETY AND ENVIRONMENT ADVISORY COMMITTEE (HSEAC)

The Health Safety and Environment Advisory Committee (HSEAC) reports to the Board of Directors on matters related to health safety and environment at the Facility.

The Committee consists of the CLSI executive director, health safety and environment manager, division heads, , co-chairs of the Occupational Health and Safety Committee, synchrotron beamlines users representative, and a University of Saskatchewan representative.

The HSEAC Terms of Reference were revised in 2004 and are described in CLSI Document Number 11.13.1.1 Rev.0.

1.13 OCCUPATIONAL HEALTH AND SAFETY COMMITTEE (OHSC)

The Committee is the principal forum for the joint labour-management consultation on the development of solutions to safety and health problems at the Canadian Light Source facility.

The OHSC Terms of Reference are described in CLSI Document Number 0.13.1.1 Rev.1.

1.14 CONTRACTOR OCCUPATIONAL HEALTH & SAFETY COMMITTEE (COHSC)

The Contractor OHSC was originally formed by the general contractor, UMA, to discuss safety issues that may arise with regard to the construction of the CLS facility. A CLSI HSE representative attends every meeting. The duties of the Construction OHS Committee parallel the CLS OHS Committee duties as they apply to contractors and sub-contractors.

2 CHANGES

2.1 CHANGES IN ORGANIZATION

On November 1, 2004, Mr. Tim Ambrus joined the CLSI Department of Health Safety and Environment Department as a Health Safety and Environment Technician, reporting to the HSE Manager. Mr. Ambrus has an Occupational Health and Safety Certificate from University of Saskatchewan Extension Division and has over 10 years experience working in a chemical plant.

Additional personnel have been hired in the departments of experimental facilities, engineering, instrumentation and controls, information technology and administrative support.

2.2 CHANGES TO THE CONVENTIONAL AND TECHNICAL FACILITIES

2.2.1 Radiation Shielding

Phase II commissioning radiation measurements indicated that the bulk shielding for the linac to booster Transfer line and booster ring was for the most part effective at maintaining radiation levels within the design goals outlined in the Safety Report. However certain areas were identified as requiring additional shielding in the Phase II Commissioning Report. The local shielding was installed in 2004 at the following locations:

- Two booster roof chicane openings were covered with a 20 cm high box containing polyethylene beads.
- A lead wall was installed across from the Booster injection area against the bulk shielding wall. The wall extends +/- 30 cm of beam height and includes a 3.27 meter long section that contains 5 cm of lead and a 1.55 meter long section containing 10 cm of lead
- A lead shielding block 19 cm X 28.3 cm X 25.3 cm was added over top of the B0108-01 bending magnet to reduce the radiation produced in the event the magnet failure
- 10 cm of lead was added above the quad magnet QD1302-04 located in the booster ring
- 10 cm of lead shielding was added above the beam stop BST1305-01 located in the booster extraction area.

The following local shielding inside the storage ring was modified to accommodate installation of beamline front-ends and to ensure acceptable radiation levels at higher stored current:

- A portion of the 08ID ratchet wall concrete plug was modified to allow for easier access to the plugs after the 08ID beamline was installed.
- Lead shielding was added at the second bending magnet of each cell in the storage ring in two phases. The first phase was a block 42.5 cm wide X 30 cm thick +/- 10 cm of beam height. After radiation measurements showed this to be insufficient, and the blocks were extended to as close as possible to the storage ring.

- During installation of the XSR diagnostic beam line, the shielding block at B1402-02 was removed to make way for the beam line. Temporary lead shielding was installed near the ratchet wall. Permanent shielding will be installed in 2005.
- The storage ring waveguide shielding plug, located in the booster pit, was modified to allow installation of a component.
- The 2nd exit port of B1400-01 was fitted with a 5 cm X 10 cm X 20 cm lead brick.
- A shielding block 42.5 cm wide X 30 cm thick +/- 10 cm of beam height was added at bending magnet B1401-01 located in the storage ring.
- Openings were made through the storage ring outer wall near the roof in 2 locations to allow for installation of the MID IR and FAR IR beamlines
- The 11ID area inside the storage ring was fitted with several pieces of lead shielding including:
  - 10 cm thick fitted shielding around beam pipe near first transition piece
  - 10 cm thick fitted shielding around beam pipe between ID1 and ID2
  - 10 cm thick shielding wall around beam pipe at 2nd transition piece
  - 10 cm thick shielding wall in front of 10B2 ratchet wall

2.2.2 Access Control Interlock System (ACIS)

A revised Storage Ring Lock-up procedure (CLSI Document Number 5.7.52.1 Rev.1) was issued to accommodate the installation of an interlocked gate and a kirk key lock box for door D23.

The in-line beam-stop BST1300-02 was removed and relocated to a location along the LTB and relabeled BST0004-01. This beam stop had been installed for Phase II commissioning and is no longer required at that location.

The change of location of the in vacuum beam-stop was an integral component in the changes to the Modes of Operation that are allowed at CLS. The modes of operation and ACIS requirements are identified in the Table 5.

2.2.3 Facility Access

New card readers were installed and activated at the entrances to the Main Hall first floor and the stores area. The new readers will control access to the Main Hall and the stores area. The building is divided into the Free Access Zone (FAZ), Controlled Access Zone (CAZ) and Restricted Access Zone (RAZ). Entrances to these areas are controlled and monitored with the Card Access System.

The key punch pads located at the Main Entrance and the West Entrance have been replaced with card readers.

3 RADIATION MEASUREMENTS

3.1 EQUIPMENT

The following instruments are available for use:

- Exploranium Model GR-130, MINISPEC Hand Held Gamma-Ray Spectrometer

- Exploranium Model GR-135, MINISPEC Hand Held Gamma-Ray Spectrometer
- Health Physics Instruments, Model HPI 1030, Pulse Radiation Survey Meter
- Health Physics Instruments, Model HPI 2010, Ionization chamber Monitor
- Health Physics Instruments, Model HPI 2080, Pulse Neutron Monitor
- Inovision, 451P, Ionization Chamber Survey Meter
- Ludlum Model 3030 Alpha/Beta Scintillation Counter
- Eberline Model FHT 752 Neutron Survey Meter
- Siemens Electronic Personal Dosimeters Model EPDMK2
- Canberra Electronic Personal Dosimeters Model
- ThermoEberline ESM Model FH40G-L10 Gamma Survey Meter
- ThermoEberline ESM Model FAG FH 40F5 Gamma Survey Meter
- Canberra Model ADM 606/606M with IP100, GP100 and NP100 Area Monitors.
- ScionexHolland Model 51BD51/2 Low Energy X-ray Scintillation Detector.

All instruments are calibrated annually by independent external organizations. All instruments are function tested at scheduled intervals and/or prior to use.

3.2 RADIOLOGICAL SURVEYS

3.2.1 Residual Radiological Survey

Routine residual radiological surveys are performed in the Radiological Controlled Areas where the accelerator is housed. This allows identification of any unusually high radiation exposure levels as a result of beam operation. Exposure rates are posted at all entrances to the active part of accelerator ensuring that all personnel are informed of high radiation areas and can plan their activity to keep their doses As Low As Reasonably Achievable (ALARA). The exposure rates from residual activation in various beam components are displayed in Figure 2. Drawing RAD/0054200, (Section 15.1, attached), shows the location of the survey locations.

Residual activation surveys were only completed if access to a locked up zone was required. A thorough survey was completed at the end of each commissioning run prior to allowing access to the accelerator enclosures.

Throughout 2004, radiological surveys included beamline points in the Linac, the Linac to Booster (LTB) line, the Booster Ring, the Booster Ring portion of the Booster to Storage (BTS) line, the Storage Ring portion of the BTS line, and the Storage Ring.

Figure 2 illustrates the increase in the contact dose rate at various points of the beam line. The highest contact dose rate was measured at BST1305-01 due to local shielding validation tests conducted earlier in the day. To facilitate these tests the beam was continuously dumped to this location until the validation was complete.

The contact dose rates at two points in the Linac Energy Compression System remained greater than 100 μSv/h well after commissioning was complete. CLV0002-1 routinely showed contact radiation levels ranging from 300-400 μSv/h during the year.

The contact dose at CLH0003-1 was the highest of any point on the LTB line at up to 74 μSv/h. In the booster ring, the maximum contact dose rate of 355 μSv/h recorded occurred at QF1302-04 on February 2, 2004. On the BTS line a maximum dose rate of 260 μSv/h was measured at QF1305-01 on February 24, 2004. The maximum contact dose rate of 248 μSv/h recorded in the storage ring occurred at ABS1401-02 on January 19, 2004.

Radiation levels of all components in the booster and storage rings returned to near background levels during breaks in accelerator operation.

3.2.2 Cooling Water Analyses

Water samples from the accelerator heat exchangers, cooling water systems and holding tanks were analyzed monthly for activation. By the end of 2004 there were 17 sample points requiring water analysis.

During this reporting period the highest levels measured were from four samples collected from the Storage Ring on February 23. The counts ranged from 113-147 CPM after sitting only 2 hours prior to analysis. The same samples were analyzed a second time after sitting the required six hours and were found to range from 53-54 CPM The average annual background was 52 CPM.

All samples were processed at the Department of Health Safety and Environment at the University of Saskatchewan. Figure 3 shows the results of the analyses.

3.2.3 Surface Contamination Tests

Surface contamination is monitored with random and routine monthly swipe tests. In November the monitoring program was revised to encompass 24 specific sample locations. The samples are processed at CLS using the Ludlum 3030 alpha/beta counter. All results to date have shown no activity above background levels.

3.2.4 Passive Area Radiation Monitoring (PARM) Program

A passive area monitoring program was initiated at the beginning of the second quarter of 2002, expanded during 2003 and again in 2004. TLD's sensitive to X, gamma, and beta radiation were deployed in the public access, free access, controlled access and restricted access zones. TLD's sensitive to neutrons were added at select locations throughout the facility. All TLD's were exchanged quarterly for processing.

The whole body gamma exposure for each quarter are illustrated in Figure 4. Neutron passive area radiation monitoring was expanded during 2004 and these results are shown in Figure 5. Clearly the results show that the integrated doses decreased as we moved toward routine operations.

All TLDs from the public access zone had doses less than 0.5mSv. The TLDs that recorded levels above 1.0 mSv were located in the vicinity of the injection into the storage ring. Some of the controlled and restricted access areas nearest to the Super Conducting Cavity resulted in TLD doses above 10mSv. The majority of these occurred in the first quarter of 2004. During this early stage of Phase III commissioning, beam losses were high due to poor capture efficiency and uncorrected electron orbit in the storage ring. All these areas were not occupied and access was restricted to the commissioning team members.

3.2.5 Storage Ring Super Conducting Cavity (SCC) Conditioning Tests

A full power test of the Super Conducting Cavity was completed in April. The maximum X-ray radiation level measured outside the storage ring outer wall was 10.5 µSv/h.

The Storage Ring Super Conducting Cavity was removed to allow for testing of the spare cavity in November 2004. High power testing will take place in 2005 after installation is complete.

3.2.6 Prompt Radiation Measurements

Prompt radiation measurements were taken during commissioning to monitor radiation levels both inside and outside the CLS facility. A detailed characterization of prompt radiation levels are documented in the commissioning reports.

Routine Operation of the CLS facility began on August 6. Prompt radiation measurements were carried out during each run and documented in the HSE shift reports. Machine studies (orbit correction, tune measurements, capture efficiency, etc.) continued with increasing amounts of stored electron beam current. Such activities have been carried out during Development Mode until an accelerator configuration for such higher currents is approved by the HSE Manager and the Director of Operations. An approved configuration must have been shown to keep radiation levels sufficiently low (time-averaged radiation at any location is less than 5 µS/h) to allow occupancy of the main experimental hall floor and all other normally occupied spaces within the CLS building.

Prompt radiation measurements are performed during routine operation in areas exterior to the accelerator bulk shielding. Radiation measurements are made in both stored and injected beam modes throughout the facility with a combination of hand-held instruments and active area monitoring system. Although points throughout the facility are monitored, the emphasis is on the storage ring outer wall.

Results from these measurements are used to determine mitigation actions required to keep radiation exposures to personnel ALARA. These actions include restrictions on operations, temporary access restrictions to certain areas, additional local shielding, and relocation of alarming portable active area radiation monitors to areas where radiation levels exceed the design levels.

3.2.7 Active Area Radiation Monitoring System (AARMS)

An Active Area Radiation Monitoring System (AARMS) was deployed around the storage ring outer wall in order to monitor dose rates and hourly integrated dose radiation produced with stored beam as well as injected beam. Data from each AARM location is collected and displayed at each location. The radiation level is also displayed in the control room in a way that shows the AARM location in proximity to the accelerator areas. The data is archived for future reference. The AARM system serves as both a local warning system for staff and a remote warning system to operators of elevated radiation levels.

An additional 4 Canberra GP100SI gamma probes and 4 ADM606M Rate Meters were purchased for use during routine operation. With 22 more access locations to connect the ADMs to the CLS channel archive, the additional monitors allow AARMs to be deployed at any point on the storage ring outer wall, or at locations around the beam line optical enclosures.

4 TESTS

4.1 VALIDATION & VERIFICATION OF THE OXYGEN MONITORING SYSTEM

The verification and validation was conducted in November 2004 to ensure that the system is operating within the design specifications. The results are described in the “Oxygen Monitoring and LN_2 Distribution Validation and Verification Report” CLSI Document Number 11.5.52.3.

4.2 FIELD STRENGTH TEST OF MAGNETS

The static magnetic fields associated with most magnets used at CLS facility are confined to their interiors and hence do not present an exposure hazard. Measurements of the magnetic field strengths were undertaken to determine if any safeguards were needed. Magnetic field measurements of the Undulator for ID11 were taken on July 28, 2004. The results are shown in Table 4.

The American Conference of Governmental Industrial Hygienists has established static magnetic flux densities to which nearly all workers may be exposed day after day without adverse health effects. Continuous occupational whole body exposure during the workday (8-hour TWA) should be limited to a magnetic flux density not greater than 60 mT (600 G). Wearers of bioelectronic devices or those who have ferromagnetic surgical implants should not be exposed to magnetic flux density exceeding 0.5 mT (5 G). CLSI has adopted these ACGIH guidelines.

4.3 MICRO84 TESTS

The PLC system of old Linac ACIS (Micro84) was tested in February and August 2004. A deficiency in the program was discovered during the February check. The problem was remedied by reloading the software.

4.4 FIRE ALARM SYSTEM

The Annual Fire Alarm System Inspection was completed in March 2004 by an external company authorized by the City of Saskatoon Fire Protective Services. New smoke and heat detectors were added to the new beamline hutches as they were constructed. The new detectors were verified by an external company authorized by the Saskatoon Fire and Protective Services.

4.5 OZONE

Ozone is a colourless gas at low concentrations, which becomes blue as the concentration increases. This chemical is very toxic and is a powerful oxidizer at higher concentrations. Even very low concentrations of ozone can be harmful to the upper respiratory tract and lungs. The severity of the injury depends on both the concentration and the duration of the exposure. Severe lung damage can result from even very short-term exposure to relatively low concentrations. Exposures to extremely low concentrations of ozone initially increase the reactivity of the airways to other inhaled substances and cause an inflammatory response in the respiratory tissue.

Ozone is generated whenever the x-ray beam has a chance to interact with the air. The lower energy photons disassociate the oxygen molecules which then attach to other oxygen molecules and form O_3 radicals.

The Saskatchewan Occupational Health and Safety Regulations state that in an average 8 hour day workers should not be exposed to levels above 0.1 mg/m^3 or in a 15-minute period an average of 0.4 mg/m^3.

Ozone level measurements were taken in the SGM/PGM Hutch in March before the beampipe was connected. The synchrotron beam was allowed to travel through the air. The ozone levels reached as high as 0.65 mg/m3. The beampipe was installed, measurements were taken and no ozone was detected.

4.6 SOUND LEVEL MEASUREMENT

Excessive noise damages hearing and the damage could be permanent. The damage can occur with:

- long-term exposure to moderately high noise levels, or
- relatively short exposure to extremely high noise levels.

High noise levels have also been associated with other adverse health effects such as stress and hypertension. For occupational hygiene purposes, the sound pressure level is measured to determine noise exposures.

There are areas within CLS facility with machinery that produces noise levels in excess of the recommended 8-hour exposure limit--for instance, the mechanical room at the basement level and the cryogenic room. Periodically, construction or fabrication processes may also cause high noise levels. Such areas are posted with signs, including sound levels, and proper hearing protection devices are provided to all workers who enter those areas.

4.7 BR1/SR1 ACIS V&V TESTING

The verification and validation of the ACIS for the booster ring and storage ring was completed in 2004 September.

4.8 11ID ACIS V&V TESTING

The verification and validation of the 11ID POE was completed in May and again in November of 2004.

5 PERSONNEL EXPOSURES

Table 1 shows a summary of the distribution of annual whole body exposures recorded by Thermo-Luminescent Dosimeter (TLD) worn by CLS staff and others (visitors and contractors) during the monitoring period from January 15, 2004 to January 14, 2004. The highest gamma exposure recorded on personnel TLD was 0.2 mSv. The highest annual exposure to any worker was 0.3 mSv.

Thirty-seven extremity badges were issued to NEWs during this reporting period. Four extremity TLDs recorded exposures of 0.4 mSv, 0.4 mSv, 0.6 mSv, and 1.2 mSv.

Seventeen I1 Neutron dosimeters were issued to HSE staff during the year. These dosimeters were worn by HSE personnel during commissioning. There was no neutron dose recorded by these dosimeters.

6 UNUSUAL EVENTS

6.1 MICRO 84 FAULT - FEBRUARY 12

The Micro PLC went into fault therefore not allowing the LINAC to be locked up. The reason for the fault is not known. The failure of the system prevented the area from being locked up. The programming was reloaded and the system was verified.

6.2 FIRE ALARM – MAY 18

The fire alarm was activated by an Ion Duct Detector in the Machine Shop. The area was checked and no smoke was found. Staff were allowed into the building. Twenty minutes later the detector was activated again. The area was checked and no smoke was found. It was determined that there was a fault with the smoke detector and it was replaced.

6.3 FIRE ALARM – JUNE 7

The fire alarm was activated by a Pull Station located in the Booster Pit. The pull station was not pulled. Electricians were working on the fire alarms system adding new smoke detectors to the Beamline Hutches. The pull station was missing a fastening screw.

6.4 PERSONNEL INJURY – JUNE 14

A CLS staff received a cut on his head when he struck a piece of metal bar. Stitches were required to close the cut. He was working in a congested area with little space to move. There was no time lost due to the injury.

6.5 SWITCH FAILURE - GATE 10 ZONE 4– AUGUST 13

Staff locking up Zone 4 was unable to lock up the zone. An investigation showed that the switch for Gate 10 was not working. The switch was corroded and locked in the closed position. The switch was replaced.

6.6 DOOR 32 OPENED – SEPTEMBER 28

Shielding door D32 rolled approximately 1cm therefore not allowing zone 9-1 to be locked up. The door was closed and the area was locked up. The Access Control Interlock System functioned as designed.

6.7 FIRE ALARM – NOVEMBER 4

The fire alarm was activated by an IR Beam Detector on the third floor and the building was evacuated. The detector was bumped by a contractor causing the detector to go out of alignment. This problem caused the fire alarm to be activated. The system was re-aligned.

6.8 BROKEN BERYLLIUM WINDOW – NOVEMBER 20

A broken beryllium window was found in the stores cage area. The window was received in July 2004 and placed in the stores area. Something fell on the package containing the window and broke the window. All of the pieces were collected and shipped out for proper disposal.

7 OPERATING TIME

The hours of accelerator use during commissioning and routine operations are shown in Table 2.

8 NUCLEAR SUBSTANCES

Table 3 gives the list of the sealed sources at the CLS facility.

All sealed sources except H-3 are used to function-test radiation detection instruments. The H-3 source is contained inside the Trace Gas Analyzer manufactured by Valco Instruments Company. The sealed source will not be removed from the instrument. The Trace Gas Analyzer is part of the cryogenic system and is installed in the cryogenic room.

9 RADIOACTIVE WASTE

There was no deliberate production of radioisotopes. Non-activated material was disposed of through appropriate channels. All activated material is kept in the designated Radiological Storage Areas (room 0013 and 0014) located in the facility subbasement.

10 PLANNED CHANGES

The facility Access Control Interlock System wiring and software will be upgraded in 2005 to accommodate the x-ray beamline hutches. The system will be re-verified and re-validated following the change.

CLSI will request to have its particle accelerator operating licence PA1OL-02.05/2006 amended to authorize the expansion of the north wall of the CLS building to accommodate the Bio-Medical and Imaging Therapy Beamline (BMIT).

11 EMERGENCY PROCEDURES

The Fire Alarm System connection with the U of S Heating Plant is tested on the first working Monday of each month. This test is to confirm the connection between the CLSI Fire Emergency Panel and the U of S Heating Plant Fire Emergency Panel.

The Building Evacuation Procedure was updated to include a section on actions to take if a fire is discovered.

The annual fire drill was held on September 21, 2004. The fire drill was conducted by the Department of Health, Safety and Environment from the University of Saskatchewan.

One hundred and fifty members of the Saskatoon Fire and Protective Services Department attended the "Orientation for Emergency Services Personnel" sessions November and December 2004. This training includes an Introduction to the CLS, CLS Fire protection systems, area designations, Security, hazards, signage and a tour of the facility.

Seven members of the Saskatoon Fire and Protective Services Hazmat team attended an orientation in August 2004. They received a tour of the facility, a description of the hazards present at CLS, and the area designations.

12 SIGNING AUTHORITY

I, William Thomlinson, Executive Director of the Canadian Light Source Inc., certify that the CLS facility has been operated in compliance with the Accelerator Facility Construction Licence – PA1CL-825.00/2004 and Class 1B Particle Accelerator Operating Licence PA1OL-02.06/2006, except as noted.

Signature: ______________________________

Dated: March 31, 2005

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13 TABLES

Table 1

Distribution of annual exposures to personnel at the facility during the period 2004 January 15 – 2005 January 14

	# of persons monitored	Dose (mSv)				
		0 – 0.2	0.2 - 1.0	1.0 - 5.0	5.0 - 20.0	>20.0
Nuclear Energy Workers	215	214	1	0	0	0
Others	0	0	0	0	0	0

Table 2

Accelerator Operation

(2004 Calendar Year)

Commissioning – Runs 6-9 (hours)		Routine Operation – Runs 10-11 (hours)	
Run 6 (01-16 to 02-01)	204	Run 10 (08-06 to 08-31)	
		Machine Development	75
Run 7 (02-13 to 02-24)	164	Normal Operation	220
		Total	295
Run 8 (03-19 to 04-04)	176	Run 11 (09-17 to 10-19)	
		Machine Development	280
Run 9 (05-14 to 06-06)	424	Normal Operation	327
		Total	607
TOTAL Commissioning	968	TOTAL Routine Operation	902

Table 3

Radiation device and sealed source inventory on 2004 December 31.

Sealed Source or Device Manufacturer	Isotope	Model #	Serial #	Nuclear Substance Quantity (Bq)	Reference Date (yy/mm/dd)	Location of use or Storage
Isotope Products	Ru-106	N/A	A2-310	3700000	01/09/15	Klystron Test Room
Valco Instruments Company	H-3	140	N/A	37000000000	88/03/09	Cryogenic Room
Isotope Products	Am-241	EAB-241-25U	B4-749	2086	03/12/01	Klystron Test Room
Isotope Products	Cs-137	BF-137-MF2	1017-37	1823	03/12/15	Klystron Test Room
Isotope Products	Cs-137	GF-137-D	962-78	3700000	03/08/15	Klystron Test Room
Isotope Products	Cf-252	FF-252	B2 831	92500	03/08/15	Klystron Test Room

Table 4

Estimated magnetic field flux at Undulator

45mm PPG Undulator Assembly

Location	Field Strength (mT)
Beam Height End of magnets	0.04
At end of magnets	9.61
10 cm from end of magnet	0.23
20 cm from end of magnet	0.12
60 cm from end of magnet	0.02

185mm PPG Undulator Magnet Assembly

Location	Field Strength (mT)
At beam height, undulator open	0.34
At end of magnet	37.1
10 cm from magnet	0.36
20 cm from magnet	0.02
60 cm from magnet	0.02

Table 5

Machine Modes of Operation

INPUTS										OUTPUTS			
	Access Control Interlock Zone									Components			
Mode	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**In Vacuum Stop BST0003-01**	**LINAC RF/GUN**	**BR RF**	**SR RF**
0	U	U	U	U	U	U	U	U	U	-	DISABLE	DISABLE	DISABLE
1A	L	L	L	L	L	U	U	U	U	Out	DISABLE	DISABLE	DISABLE
1B	L	L	L	L	L	U	U	U	U	Inline	PERMIT	DISABLE	DISABLE
2A	L	L	L	L	L	L	L	U	U	Out	DISABLE	PERMIT	DISABLE
2B	L	L	L	L	L	L	L	U	U	Inline	PERMIT	PERMIT	DISABLE
3	L	L	L	L	L	L	L	L	L	-	PERMIT	PERMIT	PERMIT
4	U	U	U	U	U	U	U	L	L	-	DISABLE	DISABLE	PERMIT
5	U	U	U	U	L	L	L	L	L	-	DISABLE	PERMIT	PERMIT
6	U	U	U	U	L	L	L	U	U	-	DISABLE	PERMIT	DISABLE
7A	L	L	L	L	L	U	U	L	L	Out	DISABLE	DISABLE	PERMIT
7B	L	L	L	L	L	U	U	L	L	Inline	PERMIT	DISABLE	PERMIT

L –
Locked
U - Unlocked
"-" (Hyphen) - denotes a "don't care" status.

14 FIGURES

Figure 1: CLSI Organizational Chart

Figure 2: Residual radiological surveys covering year 2004

Figure 3: Cooling water results covering year 2004

Figure 4: Passive area radiation monitoring results covering year 2004 – gamma exposure

Figure 5: Passive area radiation monitoring results covering year 2004 – neutron exposure

Figure 1

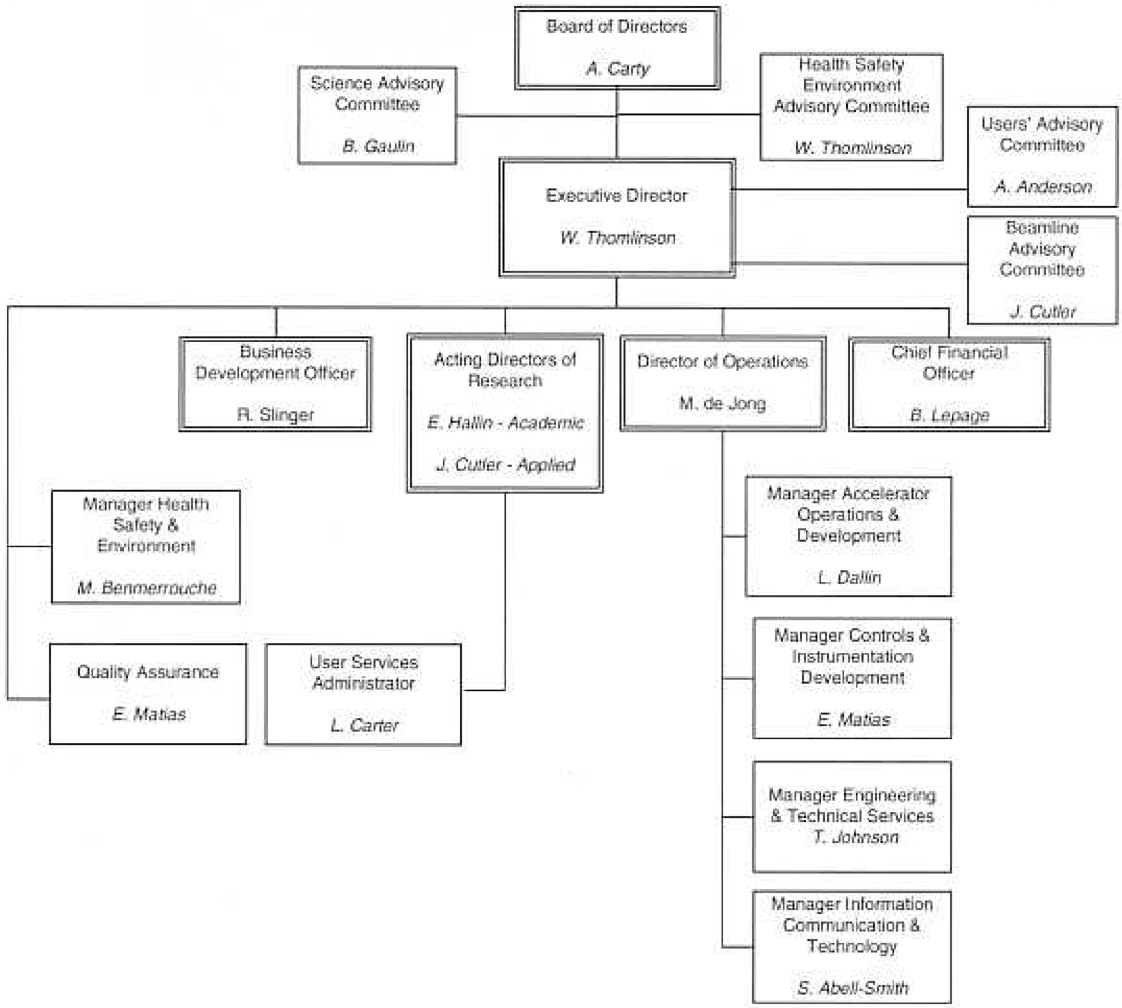

Board of Directors
A. Carty
Science Advisory Committee
B. Gaulin
Health Safety Environment Advisory Committee
W. Thomlinson
Users' Advisory Committee
A. Anderson
Executive Director
W. Thomlinson
Beamline Advisory Committee
J. Cutler
Business Development Officer
R. Slinger
Acting Directors of Research
E. Hallin - Academic
J. Cutler - Applied
Director of Operations
M. de Jong
Chief Financial Officer
B. Lepage
Manager Health Safety & Environment
M. Benmerrouche
Quality Assurance
E. Matias
User Services Administrator
L. Carter
Manager Accelerator Operations & Development
L. Dallin
Manager Controls & Instrumentation Development
E. Matias
Manager Engineering & Technical Services
T. Johnson
Manager Information Communication & Technology
S. Abell-Smith

Figure 2

2004 - All Residual Surveys

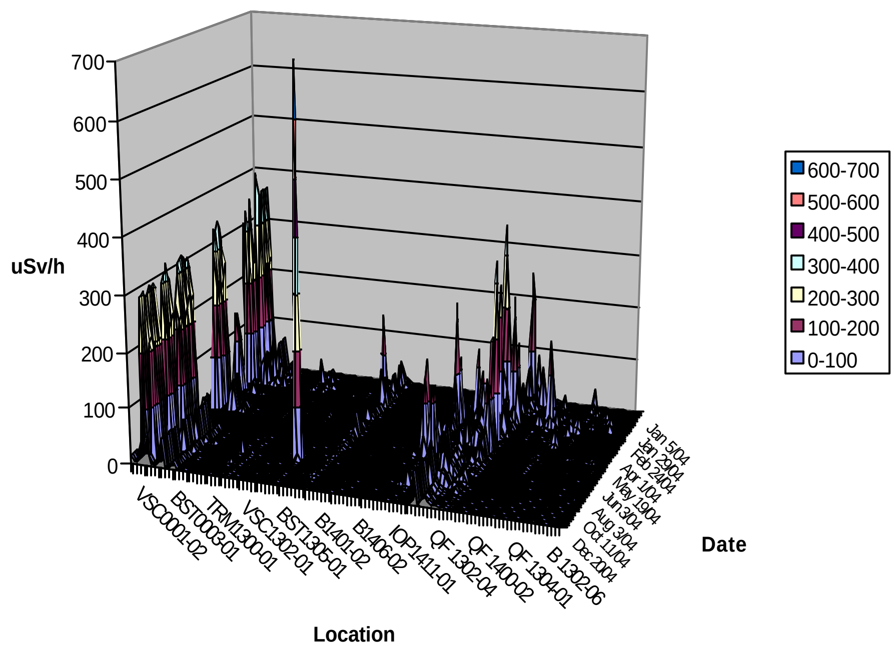


Figure 3

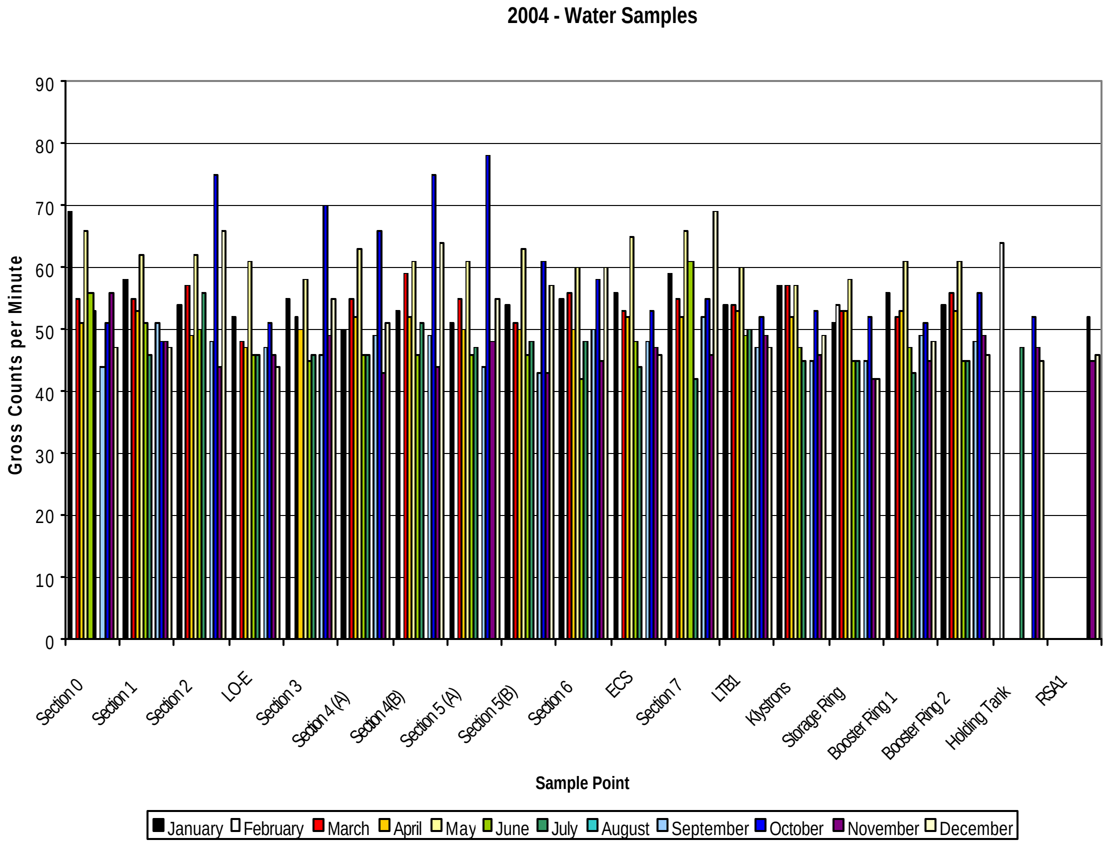

2004 - Water Samples
Gross Counts per Minute
90
80
70
60
50
40
30
20
10
0
Section 0
Section 1
Section 2
LO-E
Section 3
Section 4 (A)
Section 4(B)
Section 5 (A)
Section 5(B)
Section 6
ECS
Section 7
LTB1
Klystrons
Storage Ring
Booster Ring 1
Booster Ring 2
Holding Tank
RSA1
Sample Point
January
February
March
April
May
June
July
August
September
October
November
December

Figure 4

Passive Area Radiation Monitoring 2004 Gamma TLD Quarterly Results

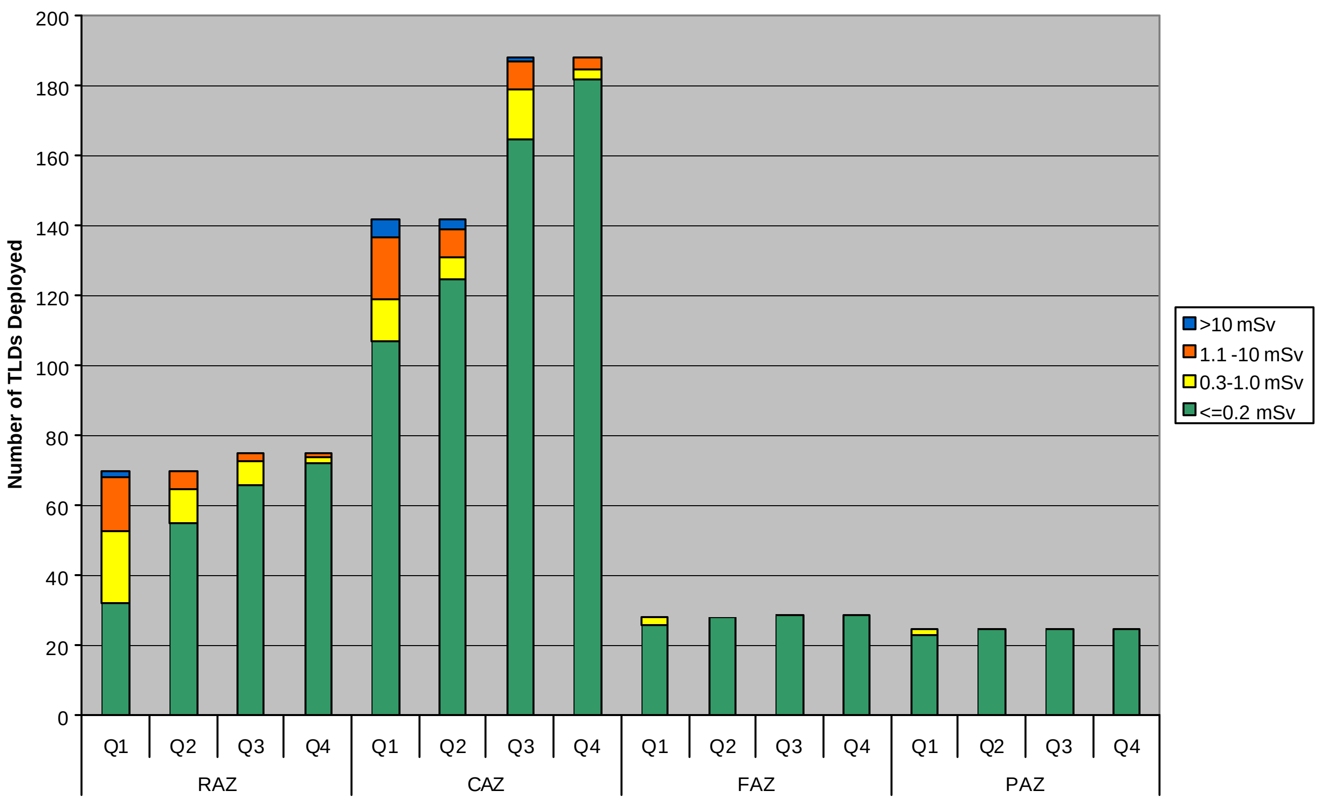
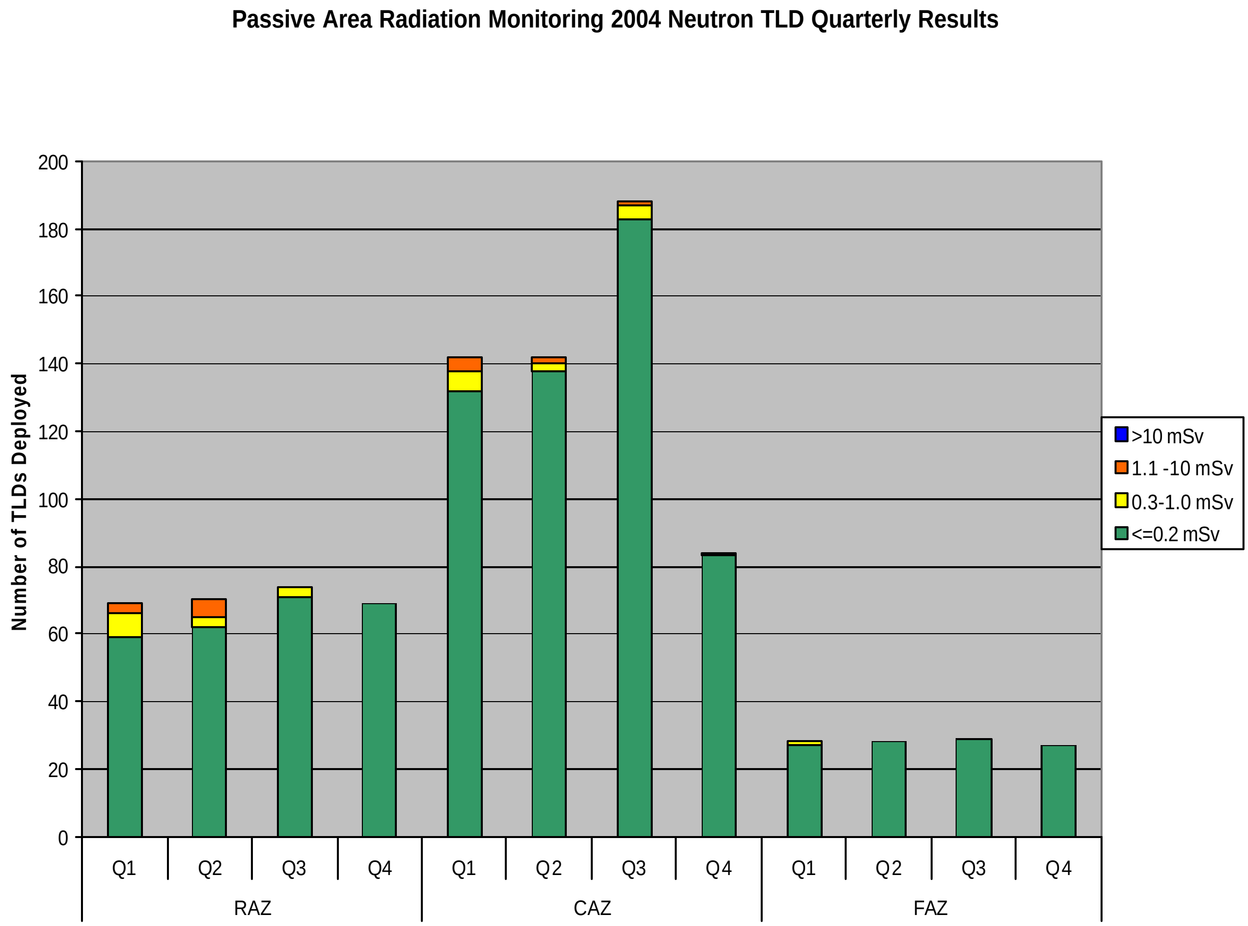


Figure 5


Passive Area Radiation Monitoring 2004 Neutron TLD Quarterly Results
Number of TLDs Deployed
0
20
40
60
80
100
120
140
160
180
200
>10 mSv
1.1 -10 mSv
0.3-1.0 mSv
<=0.2 mSv
Q1
Q2
Q3
Q4
RAZ
CAZ
FAZ

15 ATTACHMENTS

15.1 DRAWINGS

[1] RAD/0054200 Rev.1 – Residual Activation Surveys.