

***Building a World-Class User Facility for  
Synchrotron Light Experiments***

***The Canadian Light Source  
Strategic Business Plan 2010-2013***

***Revisions 2011***



***Canadian Light Source*** ***Centre canadien  
de rayonnement  
synchrotron***

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## INTRODUCTION

In January 2010 *Building a World-Class User Facility for Synchrotron Light Experiments: The Canadian Light Source Strategic Business Plan 2010-2013* was approved by the Board of Directors of Canadian Light Source Inc. Developed by senior management in consultation with CLS employees, users, clients and stakeholders, *The Strategic Business Plan* is intended to cover all aspects of the development and operations of Canada's national synchrotron facility until March 31, 2013.

The plan consists of six strategic goals, with supporting objectives and deliverables:

- Goal 1: Be a global centre of excellence in synchrotron-enabled research and innovation;
- Goal 2: Make the CLS the most responsive and valuable synchrotron light facility for industry;
- Goal 3: Maximize the performance and availability of the facility;
- Goal 4: Plan for CLS' Scientific future;
- Goal 5: Ensure the long-term sustainability of the CLS as a national facility; and
- Goal 6: Make CLS one of Canada's best employers.

Over the last 12 months, CLS management has worked to implement the plan and regularly measure and report on the progress made towards achieving our strategic objectives. Progress was reported semi-annually to the CLSI Board of Directors, with an annual report of the plan's implementation during the 2009-2010 fiscal year was released to key stakeholders in October, 2010.

From its earliest inception, *The Strategic Business Plan* was envisioned as a living document that would be open to regular review and incremental revision as needed in response to lessons learned during its implementation, as well as responding to new opportunities. As well, consultation with a number of stakeholders, most notably CLS staff, has continued throughout the plan's initial implementation. These three drivers-- lessons learned, new opportunities and stakeholder feedback—have led to the revisions outlined here.

### Lessons Learned from Implementation

First steps towards implementing the plan's goals began with the assignment of an executive sponsor for each of the goals. Each executive sponsor was responsible for the assigning of leads and target dates for achieving each deliverable, reporting on progress made on a quarterly basis. It was during this process that it was observed that in some cases objectives and deliverables were duplicated or very similar among certain goals. Additional strategic objectives were also subsequently identified that were not included in the plan's initial version.

## New Opportunities

In order to remain at the forefront of scientific development, responsive to the needs of our clients and users, and relevant to the needs of Canadians, the CLS must be ready to seize opportunities of a strategic value as they become apparent. Even the most exhaustive and rigorous strategic planning process is unable to allow for all potentialities, and any realistic planning process must be ready and able to accommodate the addition of new objectives and reprioritization of targets to take advantage of these opportunities. Since the plan's approval and implementation, several notable opportunities have been identified, including:

- The announcement of the Canada Foundation for Innovation's Major Science Initiatives (MSI) program, intended to contribute operations and maintenance funding to major science facilities such as the CLS, over and above current funding sources, to the end of fiscal year 2017. Proposals are due to CFI by September, 2011.
- The Government of Canada's Non-reactor based Isotope Supply Contribution Program (NISP) to promote research into novel production methods of technetium 99-m. The CLS is leading one of the four projects being funded by NISP to March 31, 2012.
- Additional collaborative opportunities with other synchrotron facilities, academic institutions and industry, such as collaborations with the Brazilian synchrotron in the areas of control systems and remote access and the potential establishment of collaborations in advanced plant and animal imaging, and so-called green mining.

## Stakeholder Feedback

Being responsive to the constructive feedback of stakeholders is critical to the long-term success of any strategic plan, particularly when that feedback comes from one of our most important stakeholder groups – our staff. In addition to roll-out introductory sessions by management soon after the plan's adoption, opportunities for employee feedback were made available through focus groups and the annual employee survey. Combined with input gained from the Board of Directors, this feedback identified parts of the plan that are strengthened in these revisions.

## Plan Revisions

In response to the three drivers identified above, revisions have been proposed in each of the plan's goals. These include:

- Redefining the original plan's deliverables and milestones as targets;
- Refining and expansion of targets to make them more measurable; and

- The addition of new objectives and targets (identified as 'new' in the following section) to address new opportunities.

Specific revisions to each goal include:

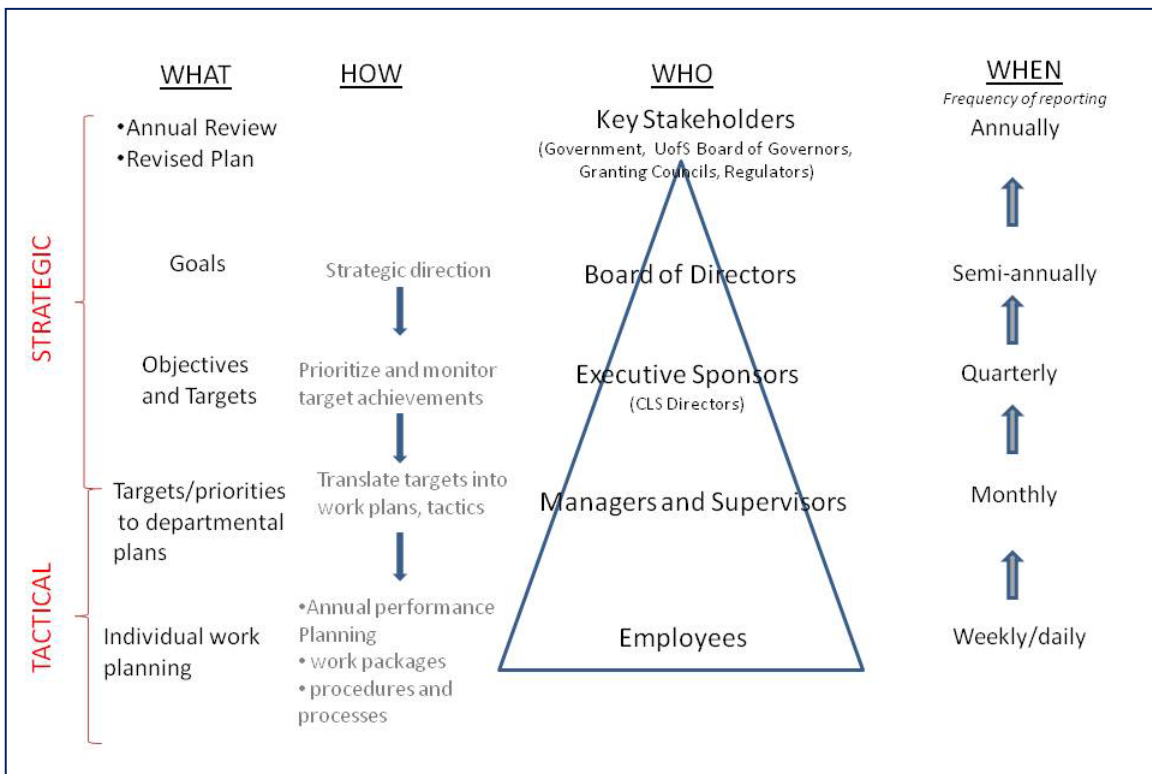
- Goal 1: Be a global centre of excellence in synchrotron-enabled research and innovation:
  - Specific targets for growth in utilization as measured by numbers of users, user visits and publications; and
  - Combining of all objectives and targets concerning growing the user base across Canada and internationally through the establishment of mentorship programs, attracting accomplished users, increased university engagement and continued efforts to lower barriers to access.
- Goal 2: Make the CLS the most responsive and valuable synchrotron light facility for industry: refining of objectives and targets to better link them to the CLS business development plan.
- Goal 3: Maximize the performance and availability of the facility: revisions in this section include an increased emphasis on the completion of beamlines currently under construction.
- Goal 4: Plan for CLS' Scientific future: revisions focus on progress achieved towards the goal's targets.
- Goal 5: Ensure the long-term sustainability of the CLS as a national facility:
  - Changes in targets and prioritization as a response to the CFI MSI program;
  - Greater emphasis on strategic communications and marketing initiatives, particularly in support of positioning the CLS as a national science facility;
  - Enhanced emphasis on supporting the economic and scientific development needs of Canadians; and
  - Ongoing efforts to ensure the utmost in demonstrating accountability.
- Goal 6: Make CLS one of Canada's best employers: revisions focus on the development of targets to better support the goal's objectives.

## Implementation: Next Steps

In addition to revisiting the plan's strategic objectives and targets plan it is important to also reflect on the plan's first full year of implementation and apply the lessons learned in order to make the process as efficient and effective as possible.

### Roles

Assigning an executive sponsor to oversee the implementation of each goal was adopted as part of the plan's initial implementation strategy. Efforts during the next year will focus on working to ensure better coordination and communication among executive sponsors and other members of the management team, as well as an increased focus on working with supervisors and individual employees to translate the plan's strategic direction into tactical processes, standard operating procedures and everyday work assignments. Fostering greater communications flow from the strategic to the everyday; from management to employee and back again, will also be a focus. A schematic of the parts played in the context of inputs and outcomes is illustrated here:



### Time Line

As a result of feedback received concerning the implementation process, an implementation and review cycle was developed to better regulate progress reporting at the executive sponsor level. This cycle promulgates due dates for key points in the

review and reporting process, culminating in the adoption of subsequent revisions to the plan.

Q1	April	<ul style="list-style-type: none"> <li>Revised plan submitted to Industry Canada</li> </ul>	
	May	<ul style="list-style-type: none"> <li>Q3/Q4 progress report submitted to Board</li> </ul>	<ul style="list-style-type: none"> <li>Deliverables and work plans part of Performance and Planning Reviews</li> </ul>
	June	<ul style="list-style-type: none"> <li>Q1 internal progress reports</li> </ul>	
Q2	July	<ul style="list-style-type: none"> <li>Annual progress review included in Annual Report</li> </ul>	
	August	<ul style="list-style-type: none"> <li>Annual report submitted to Industry Canada, U of S Board of Governors, other stakeholders</li> </ul>	<ul style="list-style-type: none"> <li>Internal feedback collection</li> </ul>
	September	<ul style="list-style-type: none"> <li>Q2 internal progress reports</li> </ul>	<ul style="list-style-type: none"> <li>Internal focus groups/feedback collection</li> </ul>
Q3	October	<ul style="list-style-type: none"> <li>Board retreat (forward planning for next SP)</li> </ul>	<ul style="list-style-type: none"> <li>Compile feedback, propose shape of revisions</li> <li>Identity new deliverables</li> </ul>
	November	<ul style="list-style-type: none"> <li>Q1/Q2 progress report submitted to Board</li> </ul>	<ul style="list-style-type: none"> <li>Incorporate new deliverables</li> <li>Begin writing revised plan</li> </ul>
	December		<ul style="list-style-type: none"> <li>Revisions/internal reviews</li> </ul>
Q4	January	<ul style="list-style-type: none"> <li>Q3 internal progress reports</li> </ul>	<ul style="list-style-type: none"> <li>Feedback sought on revisions</li> </ul>
	February	<ul style="list-style-type: none"> <li>Revised plan submitted to Board</li> </ul>	
	March	<ul style="list-style-type: none"> <li>Revised plan approved by Board</li> <li>Q4 internal progress reports</li> </ul>	<ul style="list-style-type: none"> <li>Deliverables built into work plans by managers</li> </ul>

## THE PLAN: GOALS, OBJECTIVES AND TARGETS

The strategic objectives and their supporting goals and targets follow. Care has been taken to identify objectives or targets that have either been revised or are new to the plan. Target completion dates are primarily listed by fiscal year, identifiable by the fiscal quarter, followed by the fiscal year (i.e. Q2 2011/2012). In some cases completion targets are identified by calendar year (i.e. 2011 only) as many processes at the CLS are tracked and measured based on the basis of calendar rather than fiscal years (i.e. machine operation statistics, user statistics). The majority of targets are funded within the current operating budget, however occasionally items have been identified as targets subject to either incremental funding or new sources becoming available. These targets are identified by asterisks (\*).

### 1. Be a Global Centre of Excellence in Synchrotron-Enabled Research and Innovation

The Canadian Light Source aims to support high impact, innovative science by researchers from academic, government and industrial institutions from across Canada and around the globe. We are at the leading edge of third generation medium-energy synchrotrons. All beamlines have been designed to be internationally competitive, while being optimized to the CLS machine parameters. Our goal is to have some beamlines recognized as being the best in the world in their area, as well as to have a full suite of powerful beamlines that are well suited to the needs of the Canadian synchrotron community.

For example, there are six spectroscopy-focused beamlines that deliver intense, fully tuneable beams of photons starting from the far-infrared and extending to the upper energy limit for X-rays available from a 2.9 GeV synchrotron (Far-IR, Mid-IR, VLS-PGM, SGM, SXRMB and HXMA). The success of two early hard X-ray beamlines (CMCF and HXMA) led the way to even more advanced suites of beamlines in this range (BMIT, Bio-XAS and Brockhouse) for imaging, spectroscopy and scattering experiments. Together, the CLS beamlines support three pillars of research:

- Materials & Molecular Science,
- Earth & Environmental Science, and
- Life Science.

Having the advantage of being a relatively small facility, the CLS strives to be more than just the sum of individual beamlines, but a true user facility, with the tools, techniques, infrastructure and access processes to enable our users to deliver solutions to today's most challenging science and technology questions.

#### 1.1 Optimize Use of the Facility and Maximize Scientific Outcomes and Outputs

A key objective is to realize maximum value for the significant investment that has been made at the CLS. For this, we need to ensure the use of existing beamlines at maximum capacity. Beyond that, new beamlines and beamline upgrade projects have

been approved through the rigorous CFI process and CLS must deliver those projects efficiently.

## 1. Utilize operating beamlines to their maximum capacity

All Phase I beamlines are operational and several Phase II beamlines are open to users through the peer-review process. Many beamlines have quickly become fully utilized and some beamlines are producing a level of outputs (e.g. publications) that would be expected from a mature facility. CLS will identify and obtain additional resources for the best and most productive operational beamlines, to ensure the highest quality outputs and outcomes. At the same time, CLS will identify reasonable investments that can be made to make each beamline successful.

We have set Performance Targets for various aspects of the scientific program of the CLS. These are intended to evaluate demand for the facility (# of general user proposals), the use of the facility for doing science (# of users and user visits) and the output of the facility (# of publications in peer reviewed journals).

### Targets: (NEW)

General User Proposals: This is the number of general user proposals that are received requesting beam time for a particular year. The baseline values are 190 in 2008 and 208 in 2009

- 300 in 2010 (achieved: 306)
- 350 in 2011
- 400 in 2012
- 450 in 2013

Users and User Visits: 'Users' counts an individual only once in a calendar year. Baseline values are 393 in 2008 and 447 in 2009. When all 22 beamlines are in full operation, the target is 1000 annually. 'User visits' is the total number of visits by users in a year. Baseline values are 757 in 2008 and 904 in 2009. When all 22 beamlines are in full operation, the target is 2000 annually.

#### Users

- 550 in 2010 (achieved: 576)
- 650 in 2011
- 750 in 2012
- 850 in 2013

#### User Visits

- 1100 in 2010
- 1300 in 2011
- 1500 in 2012
- 1700 in 2013

Number of Publications. This counts only publications in peer-reviewed journals, and the articles must contain data obtained at the CLS. The baseline values are 57 in 2008 and 85 in 2009.

#### Publications

- 100 in 2010 (achieved: 128)
- 125 in 2011
- 150 in 2012
- 175 in 2013

## 2. Complete and fully commission Phase II beamlines

Continue to place a high priority on completing and commissioning all Phase II beamlines, which is the single most significant means of enhancing outputs in the 1-2 year time period.

#### Targets:

- All Phase II beamlines included in 2010 Calls for Proposals (Q3 2010/11): Achieved for REIXS, CMCF-BM, VESPERS, SXRMB and BMIT-BM. At this time we can only say with confidence that BMIT-ID is open to users through LOIs, and SyLMAND will likely open to users through LOIs in 2011.
- Phase II commissioning process completed (Q3 2010/11) *Revised:* Partial beamline commissioning has been successful to the extent that 5 beamlines are supporting peer-reviewed users. Targets for full commissioning are difficult. Formally, commissioning comes to an end no later than 6 cycles after the beamline is opened for peer-reviewed users.

## 3. Strive for continuous technical improvement of operational beamlines

In order to remain competitive internationally, the CLS cannot remain static. Improvements must be made continually within the scope of individual beamline operating budgets. More significant improvements are planned within the scope of our capital budget and are discussed in Goal 4.

#### Targets:

Beamline improvements through an allocation of \$50k/year per beamline (annually).

- Capital expenditures totalling \$2M/year for upgrades of experimental facilities (details provided in the Capital Plan).
- Improvements to the facility focused on user needs, and identified through feedback and ongoing consultation with users. Examples include user laboratory space (Life Sciences Lab) and a small animal preparation lab (refer to section 3.5).

- Improvements to beamline performance and capabilities: focused on keeping beamlines in a state of readiness that is competitive internationally. This includes fixing problems that have been identified (such as the active optics system for Far-IR) and improving performance with new technologies (new detectors for various beamlines and the on-axis visualization system for CMCF).

## 1.2 Be Responsive to the User Community

The user community created the Canadian Light Source and serving *its needs is our top priority*.

### 1. Respond to the needs of our users

Continue to support the user feedback system (recently updated) with its high rate of participation. Hold monthly meetings with the Experimental Facility Group, the Users' Advisory Committee and CLS Managers to take action on feedback, and maintain the database of actions taken and outstanding issues.

#### Targets:

- 10 End-of- Run discussions per year, with semi-annual reporting of results to the Board and the SAC
- Commit \$250k/yr to improve user amenities. The CLS is prepared to commit \$100k/yr to operate Ogle Hall as an improved user residence.

### 2. Provide a high level of staff support to users

To quote from the fall 2008 SAC Report:

*"The SAC was told that there are 140 personnel on site. However, only 2 staff members are available per beamline (an inhumane situation for full-capacity 24/7 operation), so more staff must be added (up to a total of ~200) for full support of beamlines."*

The report from the NSERC MRS Mid-Term Review echoed this recommendation:

*"It is vital that the CLS receive adequate resources in the immediate future to hire additional personnel for optimal beamline operation."*

The CLS now has the operational budget to hire up to 200 staff by 2013.

#### Targets:

- With a projected growth to 22 beamlines, aim for an average of 3 staff per beamline to provide direct user support. Some progress has already been made with the help of joint hires with the user community, selected additional positions where required, and the approval of full-time floor coordinator positions. (Included in long-term staffing plan)

- Implement a system of full-time floor coordinators to improve user support. Achieved in 2010/2011: 3 floor coordinator hired. Target in 2011/12: A 4<sup>th</sup> floor coordinator position has been approved.

### **3. Consult and support advisory committees**

The CLS relies on input and feedback from several standing advisory committees, including two advisory committees composed primarily of users – the Users' Advisory Committee (UAC) and Beamline Advisory Committee (BAC). Members of the UAC are registered users elected by our user community, and they represent the interests of the user community as a whole to the CLS. The BAC includes representatives from CLS management, the principal investigators (beam team leaders) for each beamline, and the beamline scientists. Not only does this group represent some of our most important partners and stakeholders, but they are also some of the most experienced synchrotron users at the CLS.

#### Targets:

- Assist the UAC in holding an Annual Users' Meeting (AUM).
- Hold regular meetings with the BAC and UAC

### **1.3 Grow the User Community**

The CLS currently functions primarily as a user support facility. While many facilities are already at an optimal usage level, as new facilities become operational, and to stay current with and relevant to the research aims of the larger community, systematic development of our research community, both applied and fundamental, is crucial. To achieve optimal usage of the full facility, and the best and most productive science outcomes, we aim to work towards a doubling of its user community over the next three to five years. One additional principal investigator typically increases the pool of users by three to five people. Thus, adding one principal investigator per operating beamline next year would translate to about 40 new users. As a stretch target, CLS is proposing to attempt to annually attract one new international principal investigator and two new Canadian principal investigators per operating beamline in the next three to five years. In order to grow the community appropriately, CLS is developing a formal "mentors" team consisting of senior CLS staff and high profile CLS users. One or more members of this team will visit strategically targeted institutions and individual researchers.

#### **1. Establish an international mentorship program.**

The aim of this program is to attract 14 new international users in the next year and in each subsequent year. Basing this goal on current experience, visiting seven or eight international facilities will be required.

#### Targets:

- Attract one new international principal investigator per operating beamline, per year, with focus on newly operational facilities and those that are not yet fully subscribed.

- Visit seven to eight international facilities annually. (Achieved in 2010/11: (APS, ALS, SSRL, CAMD, SOLEIL, DIAMOND, Max-Lab, SESAME, ALBA, SIAM)

## **2. Establish Canadian training, mentorship and user outreach programs.**

Consistent with the above discussion, a reasonable stretch target is to attract, on average, one new principal investigator per operating beamline per year. In this discussion, it is recognized that some facilities are already operating at close to an optimal level. The success of these facilities will develop their communities with less focused attention from the CLS; instead, attention will be concentrated on newly operational facilities and on those whose use is not yet optimal.

Getting two new Canadian users per beamline per year could be achieved by a combination of visiting Canadian universities (see section 1.5) and continuing to hold targeted workshops in Canada. A second focus of this mentorship program will be to attract “non-conventional users” from departments and disciplines that have not traditionally used synchrotron techniques

### Targets:

- Hold targeted science workshops across Canada to promote the CLS and mentorship initiatives (e.g. a one-day workshop at NRC in Ottawa in 2011)
- *NEW:* Workshops to inform the community development/mentorship process:
  - hold two targeted workshops each year for the next 2 years as community development workshops, working closely with the UAC and the user community: Achieved: Workshop in BC and Stones, Bones and Photons Workshop at the CLS, in 2010
  - one workshop for a next generation light source; and
  - two workshops to develop proposals for the last straight section.
- Hold the annual Canadian Synchrotron Summer School.
- *NEW:* Establish an Annual CLS Macromolecular Crystallography Data Collection School. (Q1 2011/12)
- Have strong presences at core Canadian academic scientific conferences (e.g. CSC and CAP).

## **3. Lower barriers to access**

Compared with travel to synchrotron light facilities in the U.S. for example, travel to Saskatoon can be extremely expensive and thus create a barrier for potential CLS users.

### Targets:

- Travel grant program for users, with priority for graduate students. (Achieved in 2010)
- *NEW:* Establish a targeted program to provide support for first users. (Q3 2011/12)

## 1.4 Develop an Active, Visible and Successful In-House Research Program

To be a great user facility, the CLS must be able to recruit and retain the best scientific staff. However, the CLS is more than just a user facility. Our partners value both our unique facilities and the expertise of our people. As a national facility, we have the opportunity to be leaders, taking on grand scientific challenges of great importance to society. For all of the above, we need a fraction of our resources to be devoted to an in-house research program.

### 1. Expand CLS funding for the trial in-house research grants started in 2009, and use this as a seed program to develop recognized areas of CLS research pre-eminence.

#### Targets:

- Second round of in-house research grants early in 2010 (Revised: see below)
- *NEW:* Provide ongoing support for in-house research in the form of post-doc positions (2 approved in 2010/11), graduate student stipends (several full and partial awards in 2010/11) and support for operating expenses (starting Q1 2011/12)

### 2. Raise the research profile of CLS scientists, and create more opportunities for funding and career growth.

#### Targets:

- Stipends for CLS-supervised graduate students (Incorporated above)
- Adjunct and joint faculty positions for CLS scientists
- *NEW:* Establish web pages for all CLS Staff Scientists (Q2 2011/12)

## 1.5 Improve and Strengthen Interaction with Universities and Research Institutions

CLS is the recipient of tremendous support from universities, as well as from national and provincial laboratories from across Canada, with the provision of 'in-kind' contributions of scientific expertise for the design of experimental facilities. The beamline teams are comprised of scientists who provide their expertise and advice to CLS on matters related to development, maintenance and enhancements to ensure that each beamline is operated as a state-of-the-art resource. Several scientists from other institutions have contributed by building and making available various critical pieces of analytical equipment at CLS. These experts work with the CLS user community to ensure the safe operation and advancement of research utilizing the equipment.

Several collaborative projects with universities funded by CANARIE (a federal agency for the development of new applications for the Canadian very high-speed fibre-optic

networks) have been undertaken to develop state-of-the-art user interfaces with experimental facilities at CLS. These projects utilize a high-speed, dedicated networking capability which allows for the operation of experiments from any location in the world.

## **1. Engage key universities across Canada to encourage integration of CLS into their research strategies and participation in CLS-related collaborations.**

The CLS plans to visit five universities per year, speaking with department members to learn their research needs and how we might be able to contribute to their research.

### Targets:

- Visit five universities per year. Conduct meetings with VP's of Research to ensure that CLS becomes an important part of their research strategy. This will facilitate other universities' capacity to:
  - Obtain provincial support for the CLS
  - Support CFI projects and other collaborations led by principal investigators at those universities
  - Enhance support for Research Chairs at those universities conducting synchrotron research to 'build' the user base
  - Support existing synchrotron researchers at these universities
  - Organize/participate in seminars and workshops – CLS and university researchers

## **2. Attract international collaborations to support program excellence.**

To enhance the profile of CLS and its importance to Canada as a science and technology player on the international stage, CLS actively collaborates with synchrotron facilities and universities in other countries. We have memoranda of understanding with other synchrotrons and research facilities around the world that foster collaborations and the exchange of ideas to the betterment of all parties.

An active CLS Scientific Advisory Committee (SAC) with prominent scientists from around the world provides valuable expertise to keep the technologies and scientific programs state-of-the-art. In turn, CLS staff members are members of several international advisory committees, including the National Synchrotron Light Source (NSLS) in New York, the ALBA Synchrotron Light Facility in Spain and the Shanghai Synchrotron Radiation Facility in China.

### Targets: NEW

- Proceed with collaboration with Brazil and Shanghai regarding Brockhouse project
- Proceed with collaboration with Stanford Synchrotron Radiation Lightsource regarding BioXAS project (initiated)
- Pursue partners for the development of a plant imaging centre

- Collaboration with the Brazilian Light Source (LNLS) on the use of CLS developed data acquisition and beamline control software (In FY 2010-2011: two-week site visit held at CLS, one week on-site training and coaching at LNLS)
- Collaboration with the NSLS-II project; including assisting NSLS-II in the adoption of CLS engineering methods and control software (NSLS-II staff visited CLS in December, 2010).

## **2. Make the CLS the Most Responsive and Valuable Synchrotron Light Facility for Industry**

A key component of the strategic mission of the CLS is to engage the industrial community to the highest degree possible. The CLS, as Canada's state-of-the-art synchrotron facility, provides unique capabilities to industry in a broad range of applicable technologies. The CLS is already a science and technology success story in providing an entrepreneurial advantage to Canadian industries that use synchrotron science to solve real business problems. From the earliest conceptualization of the CLS, industrial participation through collaboration and outreach has been a central consideration. In addition, CLS has chosen to focus this mandate in a group of highly qualified scientists. The CLS Industrial Group currently employs eight scientific personnel whose key focus areas are Earth and Environmental Science, Material and Molecular Science, and Life Science and Pharmaceuticals. Most synchrotrons around the world have created industrial programs, but the CLS was the first to build such programs into its core organizational structure from the outset of the project. Since then, other new facilities in Australia, France, and the UK, for example, have followed the CLS model.

The CLS has established aggressive targets for participation of industry through a cost-recovery structure. At the beginning of each six-month scheduling cycle for use of the facility, 25% of the time available on each beamline is set aside for fee-access. Unused time reverts to the broader peer-reviewed community. This easy access, coupled with a very simple and straightforward intellectual property policy, is highly attractive to industry. Industrial research and applied research of industrial relevance comprises a broad range of projects, from one-time experiments that help solve an urgent problem in a production line, to long-term projects which help companies develop new techniques or products, to measurements that satisfy regulatory requirements.

The value of all these projects for the Canadian economy goes significantly beyond the monetary value of the service that CLS provides, as in many cases the results are the basis for either creating new jobs or securing jobs that might be endangered due to changes in regulatory or environmental requirements. The industrial use of the CLS goes beyond the service that the Industrial Science Group provides for companies, as a significant number of our academic users collaborate with industrial partners.

### **2.1 Communicate, develop and deliver synchrotron science to solve business-critical industrial problems**

#### **1. Achieve industrial revenue targets**

CLS' mandate includes making up to 25% of each beamline available for industry on a cost-recovery basis. To accomplish this, the CLS has created industrial science and business development groups which operate as a single business unit with a common mission. The existing business plan projects industrial revenue to total \$2.0M by fiscal year 2012/13. For this outcome to occur, it is crucial that the CLS achieve the deliverables as outlined in the business development plan (see Appendix H).

Targets:

Fiscal year 2011/12

- Implement a revised business development plan that defines target sectors and strategy to retain and recruit clients, and achieve revenue targets and long-term projections.
- Identify, target and engage three new clients within our primary target sectors (natural resources and environment, life sciences and materials), and one new client from the secondary target sectors
- Execute a client feedback mechanism to increase our understanding of client needs and concerns, thereby improving our services and customer relations
- Create new marketing materials focusing on two industrial sector, defining the R&D needs of each sector and matching with CLS scientific and technical capabilities
- Implement a process to identify industry and sector relevant trade shows and other events in which industry is present. The process will include the criteria for attendance and a yearly analysis of outcomes
- Track beam and staff time and other resources required to complete industry projects
- Track beam and staff time and other resources required to complete industry projects

Fiscal year 2012/13

- Realize annual revenue of \$550k by fiscal year 2012/13 for fee-for-service and collaborative research as outlined in the CLS operating budget and business plan
- Develop and implement an industrial science standard operating procedure which follows several aspects of Good Lab Practice and ISO 17025.
- Develop a Laboratory Information Management System (LIMS) to accurately track time and other resources to complete projects thereby to optimize cost capture and make most efficient use of resources
  - Create new marketing materials focusing on four industrial sectors, defining the R&D needs of each sector and matching with CLS scientific and technical capabilities
- Identify, target and engage five new clients within the primary target sectors (natural resources and environment, life sciences and materials), and one new client from the secondary target sectors

## **2. Develop industry-relevant research capabilities**

Expand industry-relevant scientific capabilities and research at CLS, covering the industry value chain from discovery (fundamental) to commercial (revenue generating) science. This will increase CLS' visibility as an industrial service and solution provider.

### Targets:

Fiscal year 2011/12

- Identify, engage and conduct three demonstration projects for new clients per year, within the primary target sectors
- Create a process to encourage in-house industrial scientist projects with private sector relevance, resulting in 1-2 private sector relevant publications per year

Fiscal year 2012/13

- Identify, engage and conduct five demonstration projects for new clients per year, within the primary target sectors
- Develop and transition appropriate industry projects to industry-focused beamline (IDEAS)

## **2.2 Collaborate with academic and government users to strengthen industrial ties and improve reporting of economic impact of research**

### **1. Formulate a beam time price for academic and government users that will encourage purchase of time for industry-sponsored projects and aid in capturing accurate statistics on industrial usage.**

### Targets:

Fiscal year 2011/12

- Implement academic and government research beam time rates for industry-sponsored collaborative projects
- Develop and implement a plan to encourage the user community to purchase beam time for projects in which industry is funding some of the work
- Develop stratified fee structures to increase beamline usage

**2. Encourage collaborations between CLS staff, government laboratories, industry and academic communities in order to increase CLS expertise within various scientific areas.**

Targets:

Fiscal year 2011/12

- Create a mechanism to allow for industrial scientist to use available industrial time for personal research
- Commence three new collaborative projects per year in partnership with academia, government laboratories and/or industrial partners

Fiscal year 2012/13

- Commence five new collaborative projects per year in partnership with academia, government laboratories and/or industrial partners

**3. Establish collaborative research centres**

Act as a nucleus for multi-partner research initiatives that bring together academia, government, industry and CLS within specific research areas including mining/environmental science, novel materials and coatings and medical imaging to work on industry-relevant problems, centered on CLS scientific and technical capabilities.

Targets:

Fiscal year 2011/12

- Launch the Canadian Innovative Materials Research Centre in collaboration with Boeing and the Univ. of Saskatchewan
- Facilitate the creation of one collaborative research centre which focus on the CLS in the area of Green Mining

Fiscal year 2012/13

- Facilitate the creation of one collaborative research centre which focus on the CLS within the health sector

**4. Inform the user community of the importance of gathering information on industrial utilization and related economic impacts to support sustainable facility operations.**

Targets:

Fiscal year 2011/13

- Improve methods to track and report on the industrial program and its achievements to the user community at the Annual Users' Meeting and reinforce the importance of reporting industrial involvement of, and impact in, their research
- Make a clear statement at the Annual Users' Meeting to the user community about CLS guidelines on industrial utilization through all access mechanisms
- Collect information from users concerning potential economic impact of their work as part of end-of-run reporting

### 2.3 Create an industry-friendly environment

In order to achieve its industrial science targets, it is essential that awareness regarding the importance of responsiveness to the needs of industrial clients permeate the CLS culture. There is already an overall understanding of the significance of the industrial science mandate as part of the CLS Mission, but progress needs to be made to improve processes to facilitate industrial science, as well as to engage staff, in order for CLS to achieve its ambitious targets.

#### 1. Develop robust commercialization systems and strategies to accommodate industry usage and investment.

##### Targets:

Fiscal 2011/12

- Develop confidentiality and IP policies and procedures to accommodate industry collaboration and usage
- Develop and implement contract templates (in collaboration with Directors of Finance, Research, and Industrial Science)
- Create a process to track deliverables from research-relevant research activities
- Create agreement frameworks for CLS staff regarding confidentiality and IP
- Identify project opportunities based on market intelligence for ten companies

Fiscal year 2012/13

- Identify project opportunities based on market intelligence for twenty companies

#### 2. Engage internal staff to support industrial awareness and mandate.

##### Targets:

Fiscal 2011/12

- Hold two industry forums with industry, academia and CLS staff in order to identify sector needs and grand challenges and thereby determine industry-driven research programs
- Conduct a training course on business development of science for CLS staff

- Invite experimental facility staff to industrial science project planning meeting
- Information sessions with staff on approaches to commercialization of research discoveries

Fiscal year 2012/13

- Hold four industry forums with industry, academia and CLS staff in order to identify sector needs and grand challenges and thereby determine industry-driven research programs

### 3. Maximize the Performance and Availability of the Facility

The CLS strives to reliably deliver 6000 hours of beam time annually – 5000 to our users, industrial clients and staff researchers, and 1000 hours that are used to improve accelerator performance. This beam time is used by researchers at 14 operational and developing beamlines to conduct their research using state of the art synchrotron tools and techniques. To accomplish this requires considerable, coordinated effort to ensure that the accelerators, storage ring, support systems and conventional infrastructure operate at peak performance.

In addition to providing for the operations of the accelerator complex and current suite of beamlines, the CLS has commenced the construction of another five beamlines – three as part of the BioXAS facility, the Quantum Materials Spectroscopy Centre beamline, and the IDEAS industry and education beamline. Also, detailed design is underway for the two beamlines that will comprise the Brockhouse X-ray Diffraction Sector and CFI-funded upgrades to several endstations. Finally, the CLS is the site of feasibility study for the accelerator-based production of medical isotopes as part of the Government of Canada's Non-nuclear reactor Isotope Supply Programme. This project involves the refurbishment of one of our accelerator experimental halls and the acquisition, installation, commissioning and operation of a high power linear accelerator and isotope handling facility.

#### 3.1 Increase Accelerator Availability

##### 1. Operate the CLS 24/7 for a significant portion of the year

To remain competitive with other synchrotron light source facilities world-wide, the CLS facilities must operate 24/7 for a significant fraction of each year. This requires reliable equipment and a good maintenance process to ensure that all major equipment operates as intended when needed. CLS has set the goal of 5000 hours of user operation per year (typical of other mature facilities) with up to an additional 1000 hours of operation for developing, commissioning and improving the accelerator systems. This goal was achieved in 2008, 2009 and 2010, but it is essential to continue to meet this goal in subsequent years. This level of operation leaves approximately 12 weeks of the year for major equipment maintenance, installation of new facilities, and shut-downs.

Typically, CLS has two major maintenance outages of 4–5 weeks in April and October, and a 2 –3 week shutdown at the end of the year over Christmas and the New Year. This pattern is expected to continue for a few years, but some possible major accelerator upgrades may require a longer outage.

##### Targets:

- Annually deliver 5000 hours for user operations, 1000 hours for accelerator development, per year.

## 2. Ensure accelerator system operates reliably with a minimum number of trips resulting in beam loss.

The accelerator systems must not only operate, but they must operate reliably with a minimum number of trips resulting in beam loss. Although recovery from a trip is quite fast, typically 5–10 minutes, the disruption for many experiments can be much longer. When some users have only a few shifts within which to conduct their experiments, any unplanned loss of beam is significant. During the initial operation of CLS, the average time between trips was unacceptably low (less than 10 hours). Since 2007, the operations staff has increased the mean time between trips to around 30 hours, which is more acceptable to most users. However, most other facilities have a target mean time between trips of greater than 100 hours--challenging but not impossible. Achieving this target will require ongoing analysis of all trips and modifications to systems and procedures to reduce the likelihood of future trips. For now, the goal will be to increase the mean time between trips by at least 10 hours each year.

### Targets:

- Conduct ongoing analysis of all trips and modifications to systems and procedures to reduce the likelihood of future trips (Achieved – all trips analyzed as part of non-conformance management process)
- Increase the mean time between trips by at least 10 hours each year:
- Minimum Mean Time Between Trips (MTBT) in User Operation:
  - > 40 hours 2009 (not achieved – 32 h MTBT)
  - > 50 hours 2010 (not achieved – 22 h MTBT)
  - > 60 hours 2011
  - > 70 hours 2012

## 3. Minimize the recovery time between system trips

Equally important is the recovery time from trips. For simple trips, like vacuum spikes or human error, the recovery can be quite fast. However, if the trip occurs because of equipment failure then the recovery time can be more significant (hours or days). The mean time to recover can be used as a measure, but the total time lost to recovery is a more convenient measure. CLS has only recently starting monitoring the recovery time, so that past statistics are not available. Data acquired to date indicate that around 3% of the operating time is lost to unplanned trips. This would represent approximately 150 hours per year. Until more data are accumulated, a reasonable goal would be a total time lost to recovery from unplanned trips during user operation of less than 100 hours per year.

### Targets:

- Total time lost to recovery from unplanned trips during user operations < 100 hours per year
- Monitor total time lost to system trips

#### 4. Improve the reliability of accelerator system components

Experience over the first five years of operation has highlighted several areas where work needs to be done to improve the reliability of accelerator system components. Although they have not generally had a major impact on user operation, they remain a concern for reliable, consistent operation of the facility. The primary concern is old equipment from the Saskatchewan Accelerator Laboratory that was incorporated into the CLS facility. Some of this equipment is over 40 years old with no spare parts available from any source. In other cases, the performance of the equipment has been shown to be inadequate for CLS applications (e.g. insufficient stability in power supplies).

CLS technical staff has reviewed the suitability of all the old equipment, and have started a replacement program to ensure good ongoing performance and reliability from all accelerator systems. The major components that have been identified in this process are: magnet power supplies reused from SAL, three of the six linear accelerator (linac) sections, the six linac modulators, and the linac ACIS (Access Control Interlock System). The replacement program should be completed by 2012--the schedule is extended to reduce the impact on facility operations. Most of the changes are essential for moving to "top-up" operation, which requires a much more stable and reliable injector system.

##### Targets:

- Complete Linac-LTB ACIS upgrade (Q3 2009/10 - Completed)
- Complete replacement of Linac-LTB power supplies (Q4 2010/11)
- Complete modulator replacement (~~Q3-2010/2011~~; Q4 2010/2011)
- Linac section replacement and diagnostics upgrade (~~2012/13~~; Q4 2011/12)
- Complete replacement of older power supplies servicing SR1 and BTS (2010/2011 - Completed)
- Install BTS collimator/slit (~~Q3-2010/2011~~; Q3 2011/12)
- Assessment of BR1 RF system (~~Q4-2010/2011~~; Q3 2011/12)
- Upgrade of BR1 RF system (2012/13)\*
- Upgrade to cryogenics plant control software (Q4 2010/11)

#### 5. Increase availability of the main storage ring (SR1)

Several items require modification to ensure continued good availability of the main storage ring (SR1). Work over the past year on the water system has identified several deficiencies that are being addressed. Already, pH and oxygen content are monitored on the storage ring cooling system and are within design specifications. However, the water flow and particulate content are both too high. The original water system design did not account for the reduced demand as a consequence of using superconducting cavities, which need no water cooling. As a result, the high water flow is causing problems with turbulence, the effectiveness of the particulate filters, and possible erosion in certain areas. The changes to reduce the flow are complicated, as some of the magnets require the current pressure in

the water system for design operation. It is expected that it will take several semi-annual outages to make all the required changes in the SR1 cooling system.

Targets:

- Plan for SR1 and beamline water system upgrades complete (Q1 2010/11 -Completed)
- Modifications of SR1 and beamline water systems complete (Q3 2011/12)
- Establishing better filtration in LCW systems complete (~~2010/11~~; Q3 2011/12)
- RF Cavity Arc detection modifications complete (Q2 2010/11 - Completed)
- Installation of back-up PCT (Q3 2011/12)

### 3.2 Increase Accelerator Performance

There are several different aspects of accelerator performance that can or may be improved at CLS. Previous feedback from the User Advisory Committee indicated that the priority for users was increased availability and reliability (see previous sections), increased stability, top-up operation and increased current.

#### 1. Increase beam stability

Several projects are already in progress for improving beam stability. There are two main approaches: eliminate the causes of instability, and provide feedback systems to increase beam stability. The main known causes of beam instability are inadequate power supply regulation, and vibration primarily caused by water turbulence in the storage ring water cooling system. All of the power supply feedback systems are being reviewed for possible improvements to the digital feedback system algorithms and to correct some known deficiencies. Water turbulence is being addressed by the work on the storage ring water systems noted in the previous section. There are also two main beam feedback systems that are used for improving orbit stability: the global orbit feedback system and the transverse feedback system.

CLS has operated with a preliminary version of the global orbit feedback system, which is quite slow (updates are once every 0.5 seconds). This has been adequate for removing long-term drifts in the beam position, which have been reduced to below the original target stability of 10% of the beam size (horizontal and vertical). There is additional faster motion of the beam, estimated to be approximately 0.6  $\mu\text{m}$  rms horizontally and 0.5  $\mu\text{m}$  rms vertically in the frequency band between 1 Hz and 1000 Hz. While this is within the original specification, some beamlines are starting to detect this motion, and it has the potential of affecting some experiments. A faster global orbit feedback system was envisioned in the original CLS plan, and work has continued towards implementing this system with low priority. Initially it will be implemented with approximately 100 updates per second, with an evaluation of the improved performance and an analysis of the options to increase the update rate.

The transverse feedback system has been under development for the past two years, and some preliminary tests have already been carried out on the beam. It can be used to

increase the single bunch purity in the storage ring (already used in this mode for single bunch experiments), to provide a continuous monitor of the transverse tunes of the storage ring (useful for monitoring storage ring performance) and to reduce the transverse damping time for beam perturbations. This last use is important for keeping the beam size at the minimum consistent with the storage ring tunes, as well as reducing the transients on the beam position during injections, which becomes very important when CLS moves to top-up operation.

Targets:

- Implementation of the global orbit feedback system with an update rate greater than 100 per second. (Q4 2010/2011)
- Evaluate results of fast feedback system (Q3 ~~2010/2011~~; Q1 2011/12)
- Deployment of transverse feedback system for Normal operation (Q4 2009/10- Completed)
- Evaluation of transverse feedback system performance (Q2 2010/11- Completed)

**2. Increase average current through more frequent (top-up) injections and operating at higher initial current (500 mA operations).**

CLS currently operates with a maximum injected current of ~250 mA, although the storage ring (with the exception of the installed RF power) was designed for 500 mA. Over the typical 8-hour fill period, the current decays down to approximately 150 mA because of the finite lifetime of the beam. The beam lifetime is approximately 12–14 hours at 250 mA, in good agreement with the original design calculations.

There are two main strategies for achieving significantly higher average current: more frequent injections to compensate for the beam current decay, and operating at a higher initial current. In addition, some modest improvements may be possible by finding improved configurations of the storage ring beam optics and beam fill pattern.

Increasing the average current by more frequent injections (“top-up” is simply injection once every minute or two to keep the beam current constant to within 1% or less) requires the ability to inject while keeping all the beamline shutters open. This mode of operation is not permitted under the current CLS operating license, and a revision to the license with a revised safety report and safety analysis of this mode is required. Accelerator Operations staff have tested top-up injections during accelerator development shifts and can keep the current constant to within 1%. HSE staff made some preliminary radiation measurements during injections with shutters open and no significant radiation hazards were found. Nonetheless, a more detailed plan of work for revising the operating license is needed to better estimate the time and effort needed to implement top-up operation. Top-up operation can also result in significant improvements in the long-term beam stability, as thermal drifts are reduced substantially when the beam current is essentially constant.

The other strategy to increase the beam current is to increase the installed RF power in the storage ring. At present, the total RF power available to the storage ring is 300 kW. This power is sufficient to store over 300 mA in the storage ring (with the present insertion devices). At 300 mA there is overheating of the kicker ceramics that will be replaced in the

upcoming year. As well, as additional insertion devices (especially high power wigglers) are added to the ring, the total radiated power for a given beam current increases, so the maximum current for a given installed RF capacity decreases. Analysis of the current and planned insertion devices shows that 250 mA should still be possible with the presently installed 300 kW RF power. When constructing the CLS, the option of installing a second RF cavity was considered, but there was insufficient budget for the second 300 kW RF transmitter. Nonetheless, a second superconducting cavity was purchased (as a spare) and the cryoplant design allows an easy upgrade for sufficient capacity for two cavities. An upgrade for 500 mA operation is possible with the procurement of a second 300 kW RF transmitter, modification of the storage ring services in sector 2 to accommodate the second cavity, and an upgrade of the cryogenic distribution system and cryoplant to service two cavities. A conceptual layout has been developed for these modifications, but no detailed design or planning has been done. Since discussions with the User Advisory Committee indicated that users were more interested in top-up than 500 mA operation, the 500 mA upgrade work has not been allocated any resources.

There are some barriers to the implementation of either of these deliverables. During high beam current tests with no uses, over 300 mA beam current has been achieved for several minutes before the beam tripped. Originally it was assumed that the trip was related to the limitations of the RF system. However, Accelerator Operations staff has since found that the trip was caused by overheating of the injection kicker ceramic chambers, because the titanium coating for wall current bypass was too thin. All four kicker ceramic chambers need to be replaced before any normal operations above 250 mA. Replacement chambers have been ordered and will be installed at the most convenient time.

Targets:

- Dynamic Aperture studies of standard tune completed (Q1 2010/11)
- New injection kicker ceramics installed (~~Q3-2010/11~~; Q3 2011/12)
- Develop licensing amendment plan for top-up operation (~~Q1-2010/11~~; Q4 2010/11)
- Request license amendment for top-up operations (~~Q3-2010/11~~; Q2 2011/12); anticipate receipt of license amendment 2011/12
- Start of Normal Operation in Top-up (~~Q4-2011/12~~; Q4 2012/13)
- Decision on proceeding with 500 mA operation (2012/13 – prior to next CFI call for proposals)
- Procure second 300 kW RF transmitter\*
- Install second RF cavity\*
- Commission to 500 mA operations\*

### 3. Reduce beam emittance

The CLS horizontal beam emittance is substantially higher than all other recent 3 GeV light sources (~18 nm compared to 0.8 – 4 nm), primarily because of the small size of the storage ring. As a consequence, the beam size is approximately twice as large as that in other sources leading to potentially lower X-ray flux density and brightness. Some reduction

in the horizontal emittance may improve the performance of some CLS beamlines. During the original design, an alternate operating point was analysed that had significantly lower emittance (~13.5 nm), which may be a better operating point for most beamlines. Attempts to operate the storage ring at this alternate point were not successful several years ago. Since then, the likely reason for the lack of success was discovered and corrected but no further work has yet been done to examine this operating point again. Even if the storage ring can be operated at this point, additional work is needed to demonstrate the improvement (or non-deleterious effects) on each beamline. A more significant decrease in the horizontal emittance might be possible with major changes to the storage ring lattice (i.e. changes to the storage ring magnets) which will probably require major changes in design and/or magnet technology. Possible alternatives will be evaluated over the longer term, along with the potential associated improvement to the beamlines' performance.

Targets:

- Successfully set up storage ring for high horizontal tune operation (Q4 2009/10)
- Assess performance effects on beamlines for new tune (Q3 2010/11)
- Determine which scientific instruments would benefit from improved emittance (2011)
- Design report on alternative storage ring upgrade designs (2011/12)

### 3.3 Build and commission new research facilities

#### 1. Build and commission beamlines currently in design

Four new beamline (Phase III) projects are under construction. Bringing these projects online quickly is the single most significant means of enhancing outputs in the 3-5 year time period.

*Targets: NEW*

- BioXAS Beamline construction complete Q1 2012/13
- BioXAS Commissioning complete Q3 2013/14
- QMSC Beamline construction complete Q4 2012/13
- QMSC Commissioning complete Q1 2014/15
- Brockhouse Building expansion Q3 2012/13
- Brockhouse Beamline design complete Q1 2012/13
- IDEAS Beamline construction complete Q2 2011/12
- IDEAS commissioning complete Q4 2011/12

#### 2. Commence major beamline upgrades

Prepare aggressive but realistic schedules for new CFI-funded beamline upgrades. Bringing these projects online quickly is the single most significant means of enhancing outputs in the 3-5 year time period.

*Targets: NEW*

- Upgrade to SGM/PGM insertion devices complete Q3 2013/14
- Upgrade to SGM/PGM beamlines complete Q1 2014/15

### 3.4 Optimize the existing infrastructure to keep the CLS in a state of readiness

#### 1. Implement an asset management system to maintain a reliable facility

The CLS facility consists of a mixture of new equipment from recent beamline projects, moderately-aged equipment from our construction, and aging equipment inherited from the Saskatchewan Accelerator Laboratory. The CLS is no longer in the favourable situation of having the bulk of the systems new and expected to operate relatively worry free. Maintaining the same level of performance requires continued effort and a balance between cost, risks and production. Establishing a balance between these competing factors requires focused data collection and monitoring to allow a meaningful evaluation of the condition of the key components and systems that leads to an informed risk assessment of those systems and sets priorities for maintaining operations.

Targets:

- Work order system operational Work request portion complete; Work management package Q3 2011/12
- Perform a risk assessment on equipment and compile an asset registry for high priority assets complete (2010/11) Q2 2011/12
- Establish Preliminary maintenance management system focusing on high priority assets complete (2010) Q2 2011/12
- Implement a fully integrated system including aligning inventory and purchasing with a maintenance plan, complete (2011/13) 2013/14

## **2. Develop and deliver laboratory and support infrastructure**

The CLS continues to expand its number of operational beamlines and increasing its user program. It must be ready to service its customers. This requires continued laboratory development within the current structural envelope, addition of new spaces and functional areas, along with revitalizing aging infrastructure. Addressing the structural concerns at the CLS will be a focus in the next 3 years.

Targets:

- Repair water infiltration in linac hall and sub-basement (Plan: Complete; Implementation: Q2 2011/12)
- Facility expansion for Brockhouse (Start construction: 2010/2011; complete 2012/13)
- Facility Vacuum Assembly Room/Cleaning Room construction complete (~~2010/2011~~; 2012/13)
- CLS bio-chem laboratory construction complete (~~2010/11~~; 2011/12)
- BMIT interior development implementation (Q2 2012/13)
- BMIT landscaping and exterior development (~~2010/11~~) – on hold pending lease negotiations with the University of Saskatchewan
- Establish new office spaces in second floor of expansion (~~2010/11~~; Q1 2011/12)

## **3. Upgrade and enhance the facility's electrical and mechanical services**

Along with structural concerns, the CLS requires upgrades and enhancements to the electrical and mechanical services within the facility. These are needed to enhance operations by improving system performance, increase reliability of system operation, and address capacity concerns for future expansion.

There are a number of HVAC upgrades required to address safety, and comfort concerns of the CLS staff, as well as to result in operational savings by allowing the reclaiming of heat from internal air before it is exhausted. The existing system in the old SAL building is 100% outdoor air and there is a need to have air returned from the office areas for energy savings and to help with the positive air control on the main hall. The welding area and chemical cleaning area is in need of a designated exhaust.

Targets:

- Improve backup power systems (Plan: 2010-Complete; install 2011/12)

- Get alternate facility electrical feed operational (2010) - complete
- Upgrade LCW capacity to service future beamlines (Research and analyze: 2010 - completed; Implementation: 2012/13)
- Machine shop/Linac HVAC upgrades (~~2010/11~~; 2012/13)
- LINAC Basement Air Handling Unit upgrades (2011/12)
- Main hall exhaust heat reclamation (~~2011/12~~; 2012/13)

#### **4. Develop advanced instrumentation, user access, control systems and data acquisition that bring new capacity to the facility (*NEW*)**

Projects in this area are focused on expanding the operational capabilities of either the accelerator or beamlines to support new science or improve quality of scientific data.

##### Targets: *NEW*

- Evaluate and prototype the potential use of X-ray BPM technology for feedback-control Q4 2011/12
- Develop and begin deploying data acquisition system based on continues scanning (improving beamline productivity and experimental data quality) Q2 2011/12
- Develop a radiometer to permit absolute flux calibration of CLS beamlines. Q3 2011/12
- Develop and deploy a photon-avalanche diode based detector system for use in STXM instruments. Q1 2011/12
- Improve fill-pattern monitoring capabilities. (This permits adding single bunch and CSR are normal modes of operation at the CLS). Completed
- Develop training management system (under the ScienceStudio project) package Completed
- Develop a remote control system (under the ScienceStudio project) Q4 2010/11
- Develop integrated grid computing capabilities in collaboration with SharcNet, IBM Research (under the ANISE Project). Q4 2011/12
- Enhance common data acquisition software Q4 2011/12

#### **5. Support the informational technology needs of the scientific program and CLS staff**

The Information Technology (IT) department is almost fully engaged in the maintenance of existing systems. The major areas this covers are serving the computer needs of the existing staff and adding services for additional staff, summer students, etc. Maintaining phone services, mail services, servers, file servers, and the computer network are all under the responsibility of the IT staff. Our Controls Instrumentation and Development division also has a major role in addressing the control data acquisition, and instrumentation/detector development requirements for the scientific program. This includes such things as data acquisition and data transfer.

Targets:

- Establish a second server room (2011/13) – on hold until building addition plans complete
- Upgrade data logging capabilities to improve equipment performance monitoring in support of a preventative maintenance program. (Q3 2011/12)
- Develop integration between CLS and WestGrid or SharcNet permitting seamless transfer of experimental data between the CLS and grid computing facilities. (Q3 2011/12)
- Develop and deploy an alarm management system, to reduce response to accelerator trips and improve machine reliability. Completed
- Begin the migration of accelerator and beamline control screen from EDM to CSS platforms to address obsolescence issues. (Q4 2011/12)

## 4. Plan for the CLS' Scientific Future

In order to remain state of the art globally, we must strive to be innovative and relevant as a national research facility. This requires that attention be paid to envisioning the capabilities that will be required of the CLS by our users and clients beyond 2013. Planning for the scientific future of the CLS involves careful consideration of a number of areas:

- existing infrastructure;
- capacity for new infrastructure;
- the user community (both existing and potentials for growth);
- the current and anticipated future direction of science;
- the vision and mission of the CLS; and
- our desire (and capability) for innovation.

Care must be taken to ensure that both human and capital requirements are identified and that a plan is in place to secure both in a timely fashion consistent with our strategic vision for the CLS. In particular, our stakeholders have shown an increased interest in new research programs in nuclear medicine and more environmentally friendly resource development (green mining). These interests have guided consideration of new facilities in several ways: a focus on nuclear medicine and related issues has reinforced our interest in exploring, for example, the potentials for fundamental nuclear physics research via a laser backscattering facility. The development of neutron beamlines would complement our photon-based material science capability, enabling the development of advanced nano-engineered drug delivery mechanisms for minimally invasive therapy and further enhancements in advanced imaging techniques. We intend to further develop capabilities specifically designed for "green mining" by holding themed workshops in this area and by recruiting personnel to lead a targeted effort in this area. Finally, in order to enable advanced pump/probe type experiments at the CLS, and to investigate a promising type of wakefield accelerator, a concerted effort in developing a CLS laser program is also being considered.

Throughout this section, items for which funding sources are yet to be identified are marked with an asterisk (\*).

### 4.1 Maximize the development of experimental facilities

After the current development projects are completed, the CLS will have one straight section and four bending magnet ports that are undeveloped. The one remaining straight section could support one proposal with two or three closely related facilities, and the four bending magnet ports could provide light to one facility each. Thus, if all possible photon

source points are fully developed, the CLS has capacity for up to 28 to 30 experimental facilities.

## **1. Develop a scientific plan for the available ports.**

Typically, in the life cycle of experimental facilities, the time from initial concept to funded proposal has been somewhere between 3 and 5 years, followed by a construction period of 2 to 3 years. Thus, some of the available expansion ports could potentially source operating experimental facilities in the 2016 timeframe. The CLS intends to continue to support and develop scientific excellence in the Canadian and international research communities by embarking on a process to identify how best to use these photon ports, with an initial focus on developing the last straight section. The target for this initial program is to have a funded proposal in 2013, with the facility operational in 2016. Developing a successful experimental facility requires the identification of a significant research opportunity, the development of a community in support of a proposal and the development of the proposal itself. Each of these actions is achieved by holding expert workshops or development meetings, and the plan for these workshops is discussed below.

The most promising target communities for the last remaining straight section include environmental and earth sciences and life sciences. Once there is some idea of the scope of the next CFI call, we will plan to hold these workshops at an appropriate time, likely in 2011 in preparation of a full proposal.

### Targets:

- Consult the national and international user community on the development of the last available straight section (2011)
- Consult the national and international user community on the development of the vacant bend magnet photon ports.
- Identify significant novel research opportunities to exploit the development of new scientific facilities
- Hold workshops to build science cases for new experimental facilities (2011)
- Submit proposals for new experimental facilities (2012)

## **2. Develop an infrastructure and upgrade plan for CLS**

As the CLS matures into an operational facility that is almost fully developed, it is clear that additional support infrastructure is necessary to optimally leverage the investment in advanced scientific instrumentation. This infrastructure includes expansion of the experimental hall to support the development of the last straight section and two of the remaining bend magnet ports, additional office space and meeting rooms for staff and visiting researchers and improved amenities for users, including:

- a building expansion to support the development of the last straight section and two of the remaining bending magnet ports \*
- upgrades to the accelerator complex to enhance the quality of all research at the CLS
- a controlled access wet laboratory to support enhanced industrial programs \*
- two new multipurpose laboratories for general users \*
- seminar rooms (one seating 200, two seating 15 and four seating 6)\*
- permanent teaching space for the outreach program, including a hands-on lab\*
- space for 10 long-term visitors (sabbaticants, consultants, etc.)\*
- space for about 50 additional employees \*
- additional warehouse space for handling remote access and on-site user samples and equipment\*
- a wellness centre, including a quiet reading room, a library, fitness equipment and a day care\*
- a guest house to accommodate 40 short- to medium-term visitors\*
- cafeteria with seating for 75\*
- connecting walkway/tunnel to VIDO (to facilitate transfer of animal models with special handling requirements – human pathogens for example) and to the Western College of Veterinary Medicine (animal storage). A connecting tunnel to VIDO may simultaneously provide the large meeting room and more efficient use of a centrally-located cafeteria\*

Some of these items, such as additional office and laboratory space, as well as meeting rooms and a lecture theatre are basic infrastructure that are crucial to address the short-term needs of CLS. They represent the basic infrastructure of any major research facility. Subsequent items strongly influence the quality of life of employees and users and are already present at other synchrotrons and similar international-calibre facilities. Thus, they must be considered in the context of any plan aimed at developing the CLS to its fullest potential.

Targets:

- Conduct stakeholder forums (staff, users) to prioritize support infrastructure needs (2010; deferred to 2011 for consistency with funding opportunities)
- Seek out capital funding sources for developing support infrastructure (2011)

### **4.3 Examine all possibilities for future machine upgrades**

The major relevant parameters to consider for upgrade are stability, reliability, current and emittance, since these parameters directly affect the efficiency and capability of the scientific program at the CLS. In addition, upgrades that affect time-dependent experiments

as well as pump probe experiments should be considered. Plans are already in place for enhancements that would deliver improved stability (top-up mode) and higher current (500 mA) (refer to Goal 3).

### **1. Prepare major beamline upgrade plans**

Some operating beamlines will prepare for the next round of the CFI Leading Edge Fund (LEF) competition. Beamlines that will likely submit upgrade proposals are SM and CMCF, with endstation enhancements a probable priority. Other eligible beamlines include HXMA, Far-IR and Mid-IR. These upgrades would not add significantly to the operating cost of the CLS. The main difficulty with these proposals will be the availability of matching funds, an inherent difficulty with all CFI proposals.

#### Targets:

- One or two CFI beamline upgrade proposals in the next CFI LEF competition (call for proposals anticipated in late 2011, for proposals due in 2012)
- Develop an upgrade plan for accelerator facilities and needed additional infrastructure

### **2. Prepare accelerator upgrade plan**

Work with the Accelerator Operations Division to advance a CFI proposal for upgrades to the accelerator complex necessary for top-up mode, increasing the operating current of the storage ring to 500 mA and reducing beam emittance.

#### Targets:

- Preparation of a proposal based on AOD upgrade plans for the next CFI LEF competition (call for proposals anticipated in late 2011, for proposals due in 2012)
- Arrange for CLS staff to spend time at other synchrotron facilities such as ALS or SSRL to learn about their upgrade and enhancement plans. (CLS staff will spend significant time at ALS in first half of 2011)

### **3. Conduct workshops to explore novel machines and next generation light sources**

Potential workshop topics include:

- Counter-propagating electrons and positrons in the same storage ring. This may be possible once top-up and more RF power are available, and has the potential benefit that one or more very sophisticated beamlines could be built in which pump/probe experiments with full control of photon energy and polarizability in both the pump and the probe would be possible.
- Producing a 'small' free electron laser test bed\*

- Modifying the dipole and multipole structure in the existing storage ring for improved natural emittance\*
- Work with the Canadian Laser community to begin research into laser based wakefield accelerators. There are about seven facilities worldwide that are making good progress in this area, and it holds enormous potential for high performance “small” synchrotron radiation beamlines complete with a dedicated source. (NEW)
- Several possibilities exist for novel machines that could be considered by an international workshop.

Targets:

- Hold a workshop to explore ways to move beyond current facility limits to remain relevant in the international context and to innovate and enable new research directions. This will likely focus on laser wakefield acceleration. (2011-2012)

#### 4.4 Develop laser capabilities to support materials science

Current directions in material science make advanced laser capability an almost indispensable tool. For example, the ability to laser align molecules within a sample to enhance polarization effects enables a range of new science capabilities and would be applicable to a number of existing experimental facilities. In addition, laser-based pump probe experiments and time slicing experiments would represent a significant enhancement to the range of science the CLS could investigate. The femtosecond laser community in Canada has already shown a real interest in developing programs at the CLS.

##### 1. Investigate the development of laser capabilities at the CLS

CLS plans to hold a targeted laser and fast timing workshop in 2010 (deferred to 2011). This workshop would identify next steps and put in place a strategy to fund and implement laser capabilities at the CLS.

Targets:

- Hold laser and fast timing workshop to identify next steps (2011)

#### 4.5 Create a Theory Group to support user and mentorship programs

Modern synchrotron light sources are increasingly recognizing the need to provide better theoretical support to their user communities, especially in light of the growth and expansion of those communities.

##### 1. Establish a Theory Group at the CLS

An innovative partnership program is proposed in which the CLS would identify one or more partner Canadian universities. To participate in this program, a partner university would

have an open tenured position for a theorist in a relevant discipline. The CLS would work with the partner university to recruit an appropriate junior level theorist and CLS would fully fund that theorist to work at CLS and with the user community for the first three years of the six-year (maximum) tenure track process. During this time, the faculty member would be resident at the CLS and travel to the partner university as required, and would engage with a user community and experimental program of interest to the theorist. During the last three years of the program, the theorist would be resident at the partner university and travel to the CLS as required. In the last three years, the CLS would fund a pro-rated portion of the salary and expenses of this individual. At the conclusion of the program, the position holder would be the responsibility of the partner university. This program has the benefit of fully integrating theorists and experimentalists and providing better theoretical support to our user community than the CLS could provide independently.

Targets:

- Develop tenure-track joint partnership programs between the CLS and Canadian universities. An MOU to establish such a position at the University of Saskatchewan is pending.

#### **4.6 Establish an X-ray instrumentation and development program**

##### **1. Develop enhanced X-ray and optical instrumentation**

To enable the ability to develop and characterize sophisticated materials, the CLS requires enhanced instrumentation in a number of specific areas, such as:

- improving optical performance and minimizing beamline downtime by allowing precise characterization of crystals using Laue diffraction;
- increasing CLS ability to develop and characterize sophisticated materials;
- developing an ability to measure the degree of polarization of synchrotron radiation photons over a wide range of photon energies;
- developing methods for more precise control of photon beams and the correction of aberration induced beam artifacts; and
- enabling a more sophisticated programme of X-ray absorption studies by developing and instrument capable of measuring relatively high energy fluorescence photons with a high precision.

Targets:

- Acquire a Laue camera and rotating anode X-ray source (has been procured by the QMSC project with delivery to UBC in March 2011; will be transferred to CLS at a future date)
- Acquire a sputtering/laser deposition system (this awaits a more general approach to obtaining laser expertise at the CLS)\*

- Develop a polarimeter and other general instrumentation to monitor the degree and direction of polarization of both very soft (10s of eV) and soft (100s of eV) photons (in progress, being developed by novel materials group using REIXS)
- Develop tools and methods to enable more precise control and dynamic aberration correction of photon beams (development of these devices awaits full capabilities of SyLMAND). Expect to test a device using the IDEAS beamline in 2012.

## 5. Ensure the long-term sustainability of the CLS as a national facility

The CLS must be responsive and accountable to a number of constituencies in order to ensure its long-term viability and sustainability.

These include:

- Industry: to encourage research using the CLS that leads to the commercialization of knowledge in support of Canada's economy;
- Government at the Federal and Provincial levels: to provide on-going funding support;
- Regulators at the Federal, provincial and local levels: ensure that the CLS meets its regulatory obligations and commitments for health, safety, environmental stewardship, research ethics and quality assurance.
- Academia: as Canada's national synchrotron research facility, CLS must foster the support of Canada's academic institutions and encourage its use by their researchers;
- The international scientific community: to demonstrate that research conducted at the CLS is world-class and state-of-the-art; and
- Public:
  - Provide a foundation for broad political support and foster a sense of ownership in Canada's synchrotron;
  - Increase awareness of the impacts of synchrotron science on the economy and everyday life;
  - Encourage youth to pursue scientific and engineering careers and contribute to the development of the next generation of highly qualified people; and
  - Foster science literacy.

### 5.1 Conduct targeted industry and government relations activities to attract investment and funding

Positive engagement with all levels of government and industrial entities, as customers as well as investors, is essential to the continued growth and successful operation of CLS. Already, three major corporations, Boehringer Ingelheim, Rockwell Collins Canada, and SaskPower have invested in CLS infrastructure. Continued successful investment outcomes by industry, government and funding agencies depends upon a long-term effort to effectively convey the valuable impact that science produced by CLS and its users has, and will continue to have, on Canadian society. In addition, developing effective processes to track the societal and economic impact of CLS research will add to the effectiveness of these communications.

CLS and the University of Saskatchewan (U of S) have continuously worked to engage various stakeholders since its starting operations in 2004, in order to obtain commitments toward some portion of the operating costs of the facility. Commitments have been made from a number of different institutions and government programs (NSERC, CIHR, NRC, CFI, WD, and the U of S).

In addition, CLS continues to aggressively pursue revenue from industry that will supplement operations.

CLS will continue to utilize various programs and agencies to obtain funding for specific aspects of operations. However, these methods do not allow for the kind of the long-term stability necessary to successfully operate a national research facility. In parallel with efforts made by the University of Saskatchewan, other universities and the Association of Universities and Colleges of Canada (AUCC), we will continue to call attention to the need to develop a framework for funding of large science facilities in Canada.

## **1. Engage federal and provincial science and technology departments and programs to leverage funding support.**

Stakeholders need to be informed of CLS successes and future plans to understand the return on their investments to date. Maintaining these relationships is critical to the future funding and support of the CLS.

### Targets:

- *NEW:* Submit application to the CFI Major Science Initiatives program (2011) outlining the planned operations and projected operating expenditures for the five years ending March 31, 2017.
- Develop a plan for renewed funding (2011/2012)
- Provide input to the Science *Technology Innovation* Committee (STIC) related to the funding of large national facilities
- Submit proposals to existing programs to provide funding for CLS programs and projects (where appropriate)
- Develop plan to target key government departments related to CLS missions
- Establish relationships and work with key federal departments including NRC, NSERC, Industry Canada, WED, CIHR and NRCan to support CLS activities
- Build strategic ties with Foreign Affairs and International Trade Canada (DFAIT), Saskatchewan Trade and Export Partnership, U of S, Innovation Place, NRC's Industrial Research Assistance Program (IRAP) and other local stakeholders

## **2. Build political momentum.**

CLS is well-positioned with respect to the federal government's overall science and technology strategy, as well as various provincial governments' innovation strategies. For example, as a multi-disciplinary national facility, CLS meets all of the government's key focus areas for research: health, environment, energy and natural resources, and information technology.

Political support is crucial to make progress on obtaining a stable platform for funding. This requires a continual and coherent approach to relations with federal and provincial members of government to increase awareness and secure support for future funding of the CLS.

Targets:

- Develop a plan and supportive briefing materials for meetings with Federal and Provincial Governments, senior officials and ministers (ongoing)
- Continue communication with local MPs and MLA's regarding CLS achievements and strategies
- Ensure that local MPs and MLAs visit CLS and understand the relevance between CLS activities and government priorities
- Increase CLS' profile with provincial governments via strengthened relations with stakeholder universities
- Work with key government officials at municipal, provincial and federal levels to broaden support for CLS
- *NEW:* Engage the user community to support funding renewal

### **3. Engage granting councils, CFI, NRC and Government departments**

Since NSERC, CIHR and NRC are presently funding partners, it is important to develop and sustain good working relations with them. CLS has worked closely with the granting councils on fiscal matters as well as scientific program development and user issues. The granting councils have a vested interest in the success of the CLS since many of their research grants are awarded to researchers doing synchrotron research. Typical grants are administered in a manner that does not contemplate major science facility operations. This has required the redefinition of eligible expenditures with reference to facility 'state of readiness' which has been critical in enabling CLS to incur the expenditures necessary for operations.

Targets:

- Invite granting councils to meetings of the Science Advisory Committee and Machine Advisory Committee to ensure that they are kept informed of facility status and plans
- Arrange regular meetings (annually) with senior program and executive members to ensure continual reporting of activities of relevance to council mandates

### **4. Seek support from industry**

Success in funding CLS operations will depend significantly on demonstration of the importance of the facility to industry and its role in commercialization and transfer of knowledge to the private sector, in addition to meeting revenue targets.

Targets:

- Increase networking opportunities with key stakeholder audiences
- Establish "SWAT Teams" (Executive Director, Research Directors, Chief Financial Officer, Business Development) to identify and pursue opportunities in target sectors and localities
- Develop a customer referral database

## 5.2 Develop strategic educational initiatives to engage the public

The science and technology sector is the fastest growing part of Canada's economy and accounts for 35% of the nation's jobs. Providing opportunities that foster the education and training of highly qualified people is one of the missions of the CLS and vital to the continued growth of Canada's knowledge economy. Developing engagement initiatives for the education community and the general public that connect them with the research conducted at the CLS creates a base for long-term support and understanding of the valuable impact that science produced by CLS and its users has, and will continue to have, on Canadian society.

### 1. Develop opportunities for the public to engage in CLS activities. *REVISED*

#### Targets: *NEW*

- Manage a sufficient team of people trained to provide tours and explanations of synchrotron science to lay audiences (annually)
- Provide tours for multiple audiences, maintaining a balance between public interest and facility activities
- Support public science education initiative opportunities such as the Engineering student event Spectrum, SK Science Centre, National Science & Technology Week, etc.

### 2. Promote involvement of educators and researchers as well as government and community agencies in support of CLS educational initiatives.

#### Targets:

- Attend and present at 3 to 4 educational, scientific, and government conferences and events annually
- Develop avenues for financial support for educational initiatives to supplement CLS contributions (PromoScience application September 2010 – 2013; formal partnerships with school divisions, government, community, and educational agencies as opportunities arise)
- Recruit and develop champions for CLS educational initiatives within targeted regions of Canada through connections with national associations (Canada Museum of Science & Technology, Council of Science Educators of Canada, Canada Wide Science Fair, etc)
- Participate in the development of the IDEAS (Industry/Education) beamline so that it supports education initiatives such as Students on the Beamlines, Summer School, undergraduate and graduate student training, Science on Stage Canada, and other teacher training opportunities.

### 3. Manage national programs to engage high school students across Canada

#### Targets:

- Students on the Beamlines program (5-8 student projects developed annually in collaboration with Beamline Scientists, with additional projects to be conducted in collaboration with Industry Staff on the IDEAS beamline once it is constructed and commissioned (2012)
- Curriculum-connected video conferencing program offered for education audiences (2011) and streamed via the Internet for others to observe (2012)
- Sponsor and participate in targeted student activities such as National Science Fairs
- Develop work experience programs beginning with students from the immediate area (2010) but expanding to allow national participation (2012 – requires funding)\*

### 4. Develop professional development programs for educators to solicit engagement of their students' in science produced at CLS (REVISED)

#### Targets:

- Presentations and workshops delivered to science educators, through conferences, workshops and conventions (2 or 3 annually)
- Develop educational resources to support curriculum outcomes
- Engage ministries of education, professional associations and pre-service colleges
- Maintain leading role in supporting national science education community through involvement with other initiatives such as Science on Stage Canada (CLS hosts 2010 & 2011 and will maintain a continuing connection through the organizing committee), provincial science networks, the Science & Technology Network, etc

### 5.3 Conduct integrated strategic marketing and communications activities

The effective and coordinated use of communications, public relations and marketing activities and products, in a variety of media and to a variety of audiences, is essential to generate awareness of the CLS and the value and societal impacts of synchrotron-enabled research and development. Promoting the importance of synchrotron-based research to the advancement of science, industrial innovation and the improvement to people's quality of life is vital to demonstrating the relevance of the CLS to government, users, industry, funders and the public at large. This includes celebrating the successes of Canada's synchrotron, our users, clients and staff; as well as promoting positive relationships with internal and external stakeholders, the media and the public. We do this through our own communications products and through international collaborations such as *lightsources.org*. The CLS is recognized by its peer facilities for the professional and innovative nature of its strategic marketing and communications activities.

## 1. Promote the value and societal impacts of synchrotron R&D

### Targets:

- Sponsor and participate in scientific conferences, trade shows and events targeting potential customer and user audiences
- Produce informational, promotional and educational materials and media concerning the value, impact and relevance of CLS science
- Develop informational approaches to quantify industrial-relevant research at CLS
- Promote significant, high impact results through science and research highlights and in the media.

## 2. Position the CLS as a national science facility (NEW)

In order to encourage continued support of the federal government, as well as increase our engagement with governments, universities, industry and potential users in other provinces, it is vital that we strive to enhance our profile from coast to coast.

### Targets:

- Increase media reach from markets outside of Saskatchewan
- Promote the CLS to industries, industrial organizations and governmental departments outside of Saskatchewan
- Communicate and promote the science performed by out-of-province users to their home institutions and communities through three stories or science highlights annually.
- Pitch three CLS science stories to national and extra-provincial media outlets to increase national awareness of the CLS annually

## 3. Conduct strategic communications and marketing activities

Coordinated strategic communications activities support objectives throughout this plan by reinforcing the image of the CLS and its mission with our many stakeholders and audiences. This includes coordinating messages with our stakeholders, engaging audiences and media outlets, and conducting and hosting events and announcements at the CLS.

The primary conduit for communicating the successes of the CLS and its users is through the media, with an average of 1 million people reading, watching or listening to news about the CLS and the research performed here each month (see Appendix I). Media relations involves not only talking with reporters, but also building relationships with them and working with CLS staff to cultivate their ability to effectively communicate through the media.

In addition to this, an important component of these activities include foreseeing and planning responses to issues and crises that are likely to have an impact on the operations

or reputation of the CLS. Effective crisis communications and issues management is important to maintain employee, stakeholder and public confidence in the CLS and ensure that CLS communications are prompt, accurate and fair.

Targets:

- Implement crisis communications plan (FY 2011)
- Generate detailed issue-specific communications management plans and response lines as required
- Conduct marketing and awareness building campaigns to promote the CLS to our stakeholders (REVISED)
- Conduct strategic media relations to publicize CLS successes and achievements
- Annually conduct media awareness and spokesperson training for CLS management and staff
- Explore the use of social media to publicize the CLS (Q3 2011/2012)

**4. Develop and implement a strategic branding plan**

The CLS will continue to convey a uniform brand image in support of positioning the facility as a national scientific asset.

Targets:

- Audience survey to assess branding effectiveness
- Standardized marketing materials
- Maintain and enforce visual identity guidelines
- Website development
- Explore developing bilingual promotional materials for Quebec audiences

**5. Conduct internal communications to inform and involve staff in achieving CLS objectives**

Targets:

- In the Loop staff newspaper
- Science Highlights
- Facility-wide inclusion in career-focused educational activities
- Advice on specific management-staff communications issues
- Informational sessions on commercialization of research and working with industry

## 5.4 Support the economic, social and research and development objectives of Canada

### ***NEW***

The CLS is committed to supporting Government initiatives to foster economic growth and competitiveness, address social needs, and support commercial and academic research and development. Our capabilities are directly relevant to Canada's research and economic strengths as outlined in *Advantage Canada*. The CLS is also uniquely positioned to contribute to seeking the knowledge and supporting the innovation required to address issues that directly impact the quality of life of Canadians and people around the world, such as in nuclear medicine and related biomedical research and environmental sustainability.

#### **1. Install, Commission and Evaluate Medical Isotope Facility (NEW)**

CLSI, with the NRC, NorthStar Medical Radioisotopes, U of Ottawa, and U of Toronto as collaborators, has been successful in obtaining funding for a project to construct, commission and test a high-power electron linac for the production of Mo-99 for medical applications. The funding, from NRCan and the province of Saskatchewan, runs until Q4 of 2011/2012. This facility will be installed in the old SAL Experimental Area 2 (EA2), and will include a high-power 35 MeV electron linac and a nuclear substance laboratory containing two hot-cells. Once operational, the facility will be used to determine the feasibility of this method of production of Mo-99 for Canadian hospitals.

##### Targets:

- CNSC licence amendment to release EA2 for the medical isotope facility (Q2 2011/12)
- Installation of the high-power electron linac and nuclear laboratory (Q3 2011/12)
- Production rate of Mo-99 determined, to assess commercial viability of process (Q4 2011/12)

## 5.5 Develop and implement a fundraising and stakeholder relations strategy

The future development of the CLS depends on building and maintaining effective relationships with current and prospective stakeholders. This includes fostering financial and resource support for capital projects and sustaining ongoing support for operations funding and reform by recognizing the contributions of our many partners.

#### **1. Engage current and new stakeholders with creative opportunities to solicit new funding for capital projects**

##### Targets:

- BMIT Facility goal = \$5M
- Other projects tied to strategic plan

- Improve communications mechanisms with funders

## 2. Develop stakeholder relations guidelines

Identify a process for gift acknowledgement, recognizing the funder and identification of stewardship of funders throughout the period of time after the gift/transaction so that there may be opportunity for a second solicitation for their next funding cycle.

### Targets:

- Develop and design a 'donor recognition wall' at the CLS facility (Completed Q3 FY2011)
- Develop conventions regarding naming of CLS facilities, beamlines, etc.

## 5.6 Maintain Accountability through Dissemination of Results, Risk Management and Periodic External Reviews

### *NEW*

Accountability is a core value of the CLS. The Experimental Facility Group is responsible for measuring scientific performance and for ensuring that scientific results are disseminated. The Scientific Advisory Committee regularly analyses our performance measures, and we are held accountable by the Board and primary stakeholders such as NSERC.

### 1. Maintain and enhance the detailed database of CLS utilization and publications

Publications by our users of the experimental results they obtained from the CLS are the best record of our scientific success and impact. High quality publications in respected and notable journals are an important measure by which we are measured by the international research community, current and prospective users and clients and funders.

### Targets:

- Report publications and usage statistics to SAC each May, followed by report to Board of Directors each June
- Prepare and disseminate regular science highlights, as well as 'people-focused' stories to augment statistics on HQP training.
- Prepare an annual Research Highlights Report based consisting of invited articles from users based on selected published works.

## 2. Develop strategy concerning strategic scientific direction

We regularly consult and seek input concerning the strategic scientific direction of the CLS from national and international experts on our Scientific Advisory Committee.

### Targets:

- Hold semi-annual meetings of the SAC
- Semi-annual SAC Reports
- Seek consultation and input from user and stakeholder communities

## 3. Establish an enterprise risk management system

CLS has identified a number of strategic, enterprise-level, risks within the University of Saskatchewan enterprise risk management (ERM) process and risk register. The risk management model and process utilized in the U of S ERM program is based on the AU/NZ 4360:2004 *Risk Management Guideline*, which was in turn used as a basis for the new ISO 31000 *Risk Management Guideline* (2009).

Certain elements of a comprehensive risk management system are in place as they are required for safe and reliable operation of the facility. For example, Health, Safety and Environment policies and procedures, a document control system and a quality assurance program are well developed and implemented at the CLS. Its governance and management systems are in place to ensure control over strategic and financial risks to the organization.

However, it is necessary to ensure that these risks are evaluated with reference to the overall strategic plans of the CLS. Consideration of interdependencies and mitigation strategies need to be documented to enable regular review and evaluation by management and the Board of Directors. Over the coming year, CLS will use the existing ERM process included in the U of S plan to develop a more detailed risk register for CLS. To ensure that the plan is comprehensive and well-documented, services of the University of Saskatchewan consultant will be utilized to identify the ERM framework and implementation plan.

### Targets:

- Develop and document a detailed risk register and mitigation strategies:
  - Identify key risks that could have a significant impact on the ability of CLS to achieve its objectives.
  - Define the underlying risk drivers, including financial, operational, compliance, reputational and strategic risks.
  - Assess the probability that a given event will occur and consider the impact of the potential risk.
  - Identify the risk management strategy to mitigate each potential risk:
  - Identify the points of reliance within the organization that are in place that may change that probability.
  - Identify actions required and accountabilities.

- Develop priority ratings that will enable risks to be assessed and prioritized in terms of importance to the success of the CLS to meet its strategic goals (financial and non-financial).
- Conduct ongoing reviews and evaluation of the risk management system.

## 6. Make the CLS one of Canada's Best Employers

### 6.1 Recruit and retain a highly qualified and diverse workforce

In the future, CLS will employ over 200 staff, including scientific, technical and business professionals. Continued growth in staffing is necessary to develop and maintain the increased number of experimental facilities. Many of the highly specialized positions in physical sciences, engineering, information technologies, instrumentation and design essential in a leading edge research facility require the attraction of world-class scientists from other countries. There are often only a handful of qualified, highly specialized people and CLS must ensure it is competitive with other established international synchrotrons and research facilities.

#### 1. Develop recruitment and selection processes to ensure qualified and motivated employees are hired in a timely, efficient, and cost effective manner

##### Targets:

- CLS Recruitment Policy and Guideline identifying best practices for recruiting and selecting the best candidate for a vacancy – draft for review and approval by September 2011
- Facilitating the immigration of foreign employees to ensure CLS receives a Labour Market Opinion within 12 weeks of the foreign candidate accepting the job offer – target met and subject to ongoing review of HRSDC processes
- Developing a section on the teamsite for managers with access to recruitment resources, such as guidelines, interview questions, forms, and links to external websites. – started and updated on an ongoing basis
- Training sessions for managers on the topic of employment equity compliance , interviewing techniques, etc – targeted for the fall of 2011 and offered annually thereafter or on an as-needed basis
- Create, in collaboration with CLS public relations, promotional materials for use at local, national and international level – not started, targeted for early 2012

#### 2. Develop and promote diversity programs and practices to raise CLS' profile as an outstanding equity employer.

As a facility licensed by the Canadian Nuclear Safety Commission, CLS is subject to federal jurisdiction for the purposes of labour legislation, including the *Canada Labour Code* and the federal *Employment Equity Act*. CLS' current policies and practices generally exceed the standards set out by both provincial and federal legislation. This includes a requirement to submit annual reports to Human Resources and Skills Development Canada's Labour Program that includes qualitative data on the employment equity activities and initiatives undertaken by CLS, as well as statistical reporting on the four designated groups (Women, Aboriginal Peoples, Persons with Disabilities and Visible Minorities). To meet these requirements, CLS will develop an Employment Equity Policy.

Targets:

- Adhere to annual reporting obligations in accordance with Employment Equity legislation – completed and ongoing annually
- Establish a CLS Employment Equity Committee; develop terms of reference and have first meeting by June 2011
- Develop annual employment equity targets; CLS Employment Equity Committee to consult with senior management – start September 2011
- All job postings will state CLS is an Equal Opportunity Employer – completed and ongoing
- Deliver one training program or initiative per year to CLS staff on the topic of diversity and the CLS Employment Equity policy – not yet completed
- Conduct exit interviews with departing staff as a method to identify barriers affecting the development, promotion and retention of members of the four designated groups - ongoing
- Develop, implement, and monitor recruitment practices to increase the number of applications from the targeted designated group members; deliver one program or initiative targeted at the Aboriginal population per year
- Establish processes to measure and report turnover rates for designated minority groups;

**3. Ensure that compensation programs support employee attraction and retention and are framed around the principles of internal equity, market comparability and affordability.**

An initial focus of the Human Resources Management System (HRMS) was the implementation of a comprehensive job evaluation system for the professional, scientific, and administrative employees, developed with the aid of an external consultant, in 2005 (compensation for CEP employees is governed by a collective agreement). This system provides the critical links between the position, the goals of the organization, and the performance measurement (and resulting compensation) of the individuals performing the duties. It provides the reference to the labour market to ensure that CLS is competitive in its compensation programs.

Job evaluation (JE) is a system designed to create a fair pay structure that balances the variables of internal equity (fair pay among jobs at CLS), external equity (fair pay compared to similar jobs elsewhere), gender-neutrality and affordability within a publicly funded, not-for-profit environment. The Job Evaluation process graded jobs and placed them into levels creating a job structure. Jobs are grouped together into one of three job families: Scientific & Research; Professional & Specialist; and Administration. The Job Family Matrix describes the differences between levels based on responsibility and accountability within the organization. The system requires continual review and communication to ensure it evolves with the changing work force.

Targets:

- Comprehensive review and revision of all out-of-scope job descriptions; making them available to staff on teamsite – in progress, to be completed March 2011  
Document CLS' Job Evaluation system and how it links to compensation and performance management – in progress, to be completed March 2011
- Communicate JE, Salary Administration, and Performance Management linkages to staff through employee information sessions – end of March 2011 and annually thereafter
- Monitor CLS compensation levels using reputable compensation surveys and publicly available salary scales- prior to expiry of CEP Collective Agreement and bi-annually for out of scope positions
- Develop promotional material to effectively communicate CLS' compensation and total rewards program to prospective employees – not started, targeted completion in 2012
- Deliver training session to managers on using and understanding the compensation system prior to conducting annual employee performance planning & reviews – March 2011 and annually thereafter
- Establish processes to measure and report annual turnover rates– not started

#### **4. Develop reward and recognition programs**

Develop meaningful reward and recognition programs to complement existing compensation and performance management strategies.

Targets:

- Create a long-service recognition program and deliver annually – completed FY 2011; subject to ongoing review and improvement
- Regular communication regarding staffing changes through email, newsletters and the employee newspaper - Completed
- Create a retirement program – start 2012

### **6.2 Create a healthy and positive work culture that empowers staff**

#### **1. Develop, implement and evaluate human resource policies and procedures which are meaningful to employees and support CLS' strategic goals and objectives.**

Targets:

- Document and effectively communicate HR policies, guidelines and procedures
- Develop, review and monitor policies, procedures and guidelines in relation to best HR practices
- Participate with senior management in developing staffing strategies and long-range planning
- Conduct employee opinion surveys

## **2. Effectively communicate with staff**

Comprehensive and regular internal communication plans are an important element to implement an effective employee relation program.

### Targets:

- Communicate strategic directions
- Increase awareness of current operational priorities, create shared expectations and a common vision
- Develop the team site to ensure policies and procedures are accessible to all
- Ensure effective departmental coordination
- Hold regular employee meetings
- Establish regular HR and management meetings
- Include regular HR contributions in the *In the Loop* employee newspaper and E-newsletter to stakeholders

## **3. Foster effective and positive employee relations**

Develop positive and productive relations with employees and the CEP union to maintain the effectiveness of the organization.

### Targets:

- Maintain the collective agreement and continuing positive relations with the CEP executive. Historically the union-management relationship has been quite good, and the union membership stable. The collective agreement expires every 3 years, and negotiations have generally gone very well.
- Hold regular union-management meetings
- Effective administration of the collective agreement
- Provide labour relations training for managers and supervisors to effectively manage in a unionized environment
- Develop policies and procedures to enable employees and managers to resolve issues constructively and to ensure a positive working environment for all employees.

## **4. Ensure that the CLS' benefit plan supports health and wellness initiatives.**

### Targets:

- Increase awareness of the Employee Assistance Program through effective internal communication initiatives – done and subject to ongoing review and improvement
- Research and develop best practices regarding vacation and hours of work - completed

- Increase employee awareness of benefit programs through effective internal communication – in progress
- Develop corporate policies that help staff balance work and family life – in progress
- Deliver one training program or initiative per year for CLS staff on the topic of health and wellness – targeted for spring of 2011 and annually thereafter
- Develop an employee opinion survey – completed October 2010 and to be carried out annually thereafter

### **6.3 Create an organizational structure that is responsive to corporate goals**

In any organization, consideration must be given to the resources available to determine how management will lead on a go-forward basis. This requires adjustments to deal with changing priorities and to utilize the talents of CLS staff.

A number of factors require consideration and can influence the evolution of the organization. For example, a significant capital project will be undertaken at the same time as operations commence. All synchrotron facilities must continually recreate themselves to remain at the forefront of science. The Phase III expansion and planning of future expansions requires dedicated personnel. The importance of scientific development of synchrotron research, both in the pure and the applied sciences requires a coordinated and focused approach to lead world class research, supported by an ongoing review of the CLS organizational structure.

#### **1. Develop a job/position structure that is well-defined and communicated to staff**

##### Targets:

- Organization management document conveying reporting lines and levels of accountability updated and made available to staff on teamsite - – in progress, completion expected end of March 2011
- Position descriptions that identify position mandate, authorities, duties/responsibilities, accountabilities, education and qualifications, skills – out of scope in progress with completion expected end of March 2011

#### **2. Develop effective human resource planning processes**

##### Targets:

- Implement departmental consultation process to identify short and long-term human resource planning needs – completed January 2011
- Identify required and desired professional credentials and key competencies for positions to achieve CLS' strategic goals – completed in the review and revision of job descriptions for out of scope employees
- Continuous update of a personnel plan in accordance with changing requirements of the CLS – in progress

Table 6 reflects the projected personnel plan which has been presented to the Board of Directors as part of the projected expenditure plan:

Projected # of Full-Time Employees:	2009-10	2010-11	2011-12	2012-13
Experimental Facilities (Director Research & Strategic Development, User Office(3), 1 Scientist & 1 Associate for each beamline, Optics Specialist & Associate, Radiation Physicist)	44	45	49	55
Accelerator Operations (Director, Manager, Physicists/Engineers,)	13	14	14	14
Technical User Support (Engineering, Controls & Instrumentation, IT)	81	83	83	83
Health, Safety & Environment	7	7	8	8
Industrial Science & Business Development (Director Ind Science, BD, Scientists & Associates, Marketing, PR, Communications, Outreach)	14	16	16	16
Executive, Finance & Administration (Exec Director, CFO, Contoller, Financial Assistants, HR, Purchasing/Receiving/Inventory, Admin Assts)	21	21	21	21
<b>Total number of employees</b>	<b>180</b>	<b>186</b>	<b>191</b>	<b>197</b>

Table 6: Personnel Plan

The number of employees over the projection period is relatively stable in response to the amount of committed funding available. Ideally, more staff would be hired to provide support and services for users. This staffing level will not curtail operations but will limit the ability to undertake significant design and development enhancements necessary to remain state-of-the-art. The use of outside consultants will be required to ensure that critical aspects of core operations and maintenance are addressed.

The growth in number of employees is largely to due to the addition of beamlines (Phase II and III) which require staff for operations and user support. In addition to full time employees, CLS will employ up to four graduate and 22 summer students.

### 3. Effective work planning

Effective work planning, review and coaching processes enable positive, consistent and constructive communication relative to day-to-day work responsibilities as well as contribution to the broader CLS strategic and business priorities.

*Targets:*

- Implement work planning and communication tools to enable the effective allocation of resources to meet daily (as well as short-term and long-term) needs.
- Provide coaching to managers and supervisors on an ongoing and as-needed basis.

### 4. Build strong leadership throughout the organization, particularly at the top.

*Targets:*

- Identify leadership development opportunities available externally for supervisors & managers – in progress
- Deliver workshops internally - in progress (offered through Executive Coaching professional services agreement)
- Develop leadership competencies and accountabilities – in progress (Executive Coaching)
- Performance Planning & Reviews of Supervisors/Managers/Directors through 360 Feedback – targeted for 2013

## 6.4 Foster a culture of high performance

The most critical factor to CLS success is the performance of its employees. Highly skilled and dedicated scientists, technical and business professionals are required to design, develop, maintain and operate highly technical scientific equipment. While some design efforts capitalized on the intellectual property of other facilities, CLS employees and consultants were encouraged to innovate beyond the current technology (e.g. lattice design, chicane of insertion devices, superconducting radio-frequency cavities, world leading superconducting wigglers). Some of these design efforts have resulted in the transfer of intellectual property to industry for commercialization and all have resulted in the training and retention of highly motivated scientists and professionals.

In order to provide feedback to staff regarding performance and development, a new performance support tool has been developed. The new tool includes two components: a Competency Matrix (in which the application of skills, knowledge and behaviours is assessed) and an Outcomes & Planning section (in which goals and objectives are set and measured).

These tools have been developed with the assistance of a number of employees who participated in focus groups and are continually re-evaluated.

## **1. Foster high performance through the performance management system**

Ensure that the existing performance management system continues to improve individual and team/department performance, congruent with CLS goals.

### Targets:

- Effective delivery and administration of performance planning and review programs - completed for out of scope employees and subject to ongoing review and improvement
- Pay for performance (non-union) tied to competencies and outcomes - Completed
- Implementation of a performance management system for unionized staff – in progress
- Training and coaching for supervisors on managing performance and conducting effective performance planning & reviews – Completed; offered annually

## **2. Seek stakeholder feedback on employee performance**

Obtain stakeholder performance feedback by developing systems to measure and report user satisfaction levels of a high performing synchrotron research facility.

### Targets:

- Identify and review external trend data on user satisfaction measures

## **3. Foster high performance through professional development**

Develop and implement effective training and development processes, programs and support to enable professional and career growth in a manner that contributes to CLS' strategic and business priorities.

### Targets:

- Provide staff with training and professional development opportunities in line with CLS strategic and business goals. This will require defining the different needs of employees and managers due to the large variety of experience, skills and education required for the different roles in each department.
- Individual professional development plan to monitor growth using the Performance Management system – in progress
- Professional development policies and procedures are communicated to and understood by staff – in progress
- Scientific and professional/technical cross-training opportunities (internally and in collaboration with other facilities)
- Personal effectiveness workshops tied to competencies (facilitated in-house and offered externally)

- Career progression plans for scientific staff and professionals that identify required competencies and qualifications needed to progress within the organization – in progress

**4. Establish effective introduction and orientation programs to enable successful rapid assimilation of employees into the CLS**

*Targets:*

- Conduct HR orientation for payroll & benefits with new employees within first week of employment – completed and ongoing
- Monthly orientation program facilitated by HR – completed and subject to ongoing review and revision
- Manager/Department orientation program – not started, target completion by end of 2012
- Summer Student orientation program; including first-day orientation, packages & checklist – completed and subject to ongoing review and revision annually