The CLS SRF Cryogenic System Upgrade

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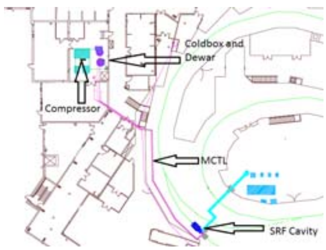
Introduction

The Canadian Light Source (CLS) is a third-generation synchrotron facility located in Saskatoon, Canada.
While system reliability has not been poor, there are issues that have come up over the 10+ years of operation of the SRF system at CLS. To further improve reliability CLS is currently working on a system upgrade that would see a spare compressor added to the system and the second CESR-B [1] unit installed in the storage ring.

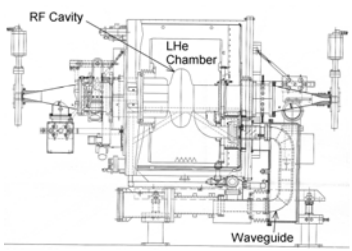
Existing System

The existing SRF system contains one CESR-B type 500 MHz installed in straight 12 of the CLS storage ring. This SRF cavity is fed with liquid helium by a Linde TCF-50 cryoplant, consisting of a 200 kW Kaeser helium compressor, an oil removal system (ORS), a gas management panel (GMP), a coldbox, and a 2000 L Cryofab dewar.

The original load specification for this plant was 284 W at 4.4 K, and the plant was tested to 313 W during commissioning.



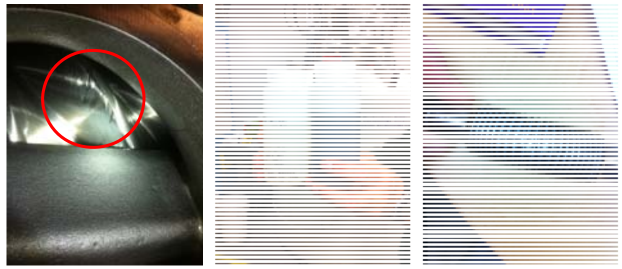
Layout of existing CLS SRF cryogenic system.



Cutaway view of the CESR-B SRF module. (Courtesy Research Instruments.)

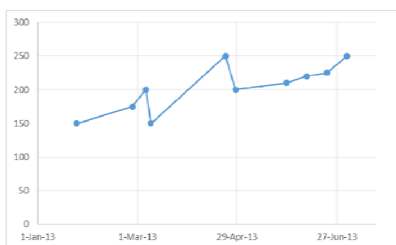
System Problems

Past failures in the CLS SRF cryogenic system include two MCTL failures, several compressor failures in close succession, and a cryomodule failure. The combined unplanned downtime for these failures has been around 14 weeks over 10 years of operation.



Left to right: Damage to compressor airend lobes, Normal oil colour (left) versus damaged airend oil colour (right), and damaged MCTL cold GHe return pipe bellows.

Left to right: Acetone pump and barrels, Acetone hoses run to coldbox, Piping and valving setup for acetone and dry N2 flush on coldbox.

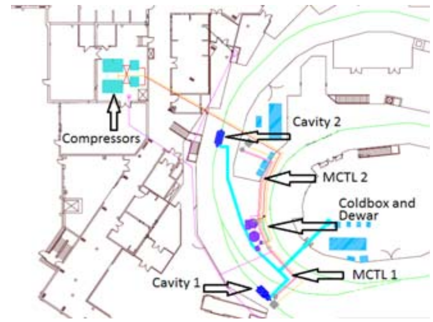


Peak beam current vs time after replacing the cryomodule with the spare cryomodule. Almost 6 months of cavity conditioning was required to reach 250 mA reliably. CLS operates in decay mode, not top-up, so this was a problem for users.

The Upgrade Project

The upgrade consists of:

- A spare helium compressor, ORS, and GMP,
- Installation of the spare cryomodule in the storage ring,
- replacement of the MCTL and valve box with 2 new MCTLs and valve boxes, and
- the move of the coldbox and dewar to the top of the storage ring radiation enclosure.



Layout of proposed CLS SRF cryogenic system.

Anticipated Benefits

While it is impossible to make the system "bulletproof", it is anticipated that the proposed changes will significantly reduce downtimes for major equipment failures, and will also reduce the risk of extended downtimes (i.e. more than a month) to a very small value.

Event	Current System	Proposed System
Compressor Failure	3 to 7 days	< 1 hour
MCTL Failure	2 to 4 weeks	7 days
Cryomodule Failure	2 to 4 weeks or more	7 days
Conditioning after Cryomodule Failure	6 months	1 month

In addition, better component design will improve performance, resulting in reduced RF tuning fluctuations and improved system control characteristics.

Reference:
[1] E. Chojnacki and J. Sears, "Superconducting RF Cavities and Cryogenics for the CESR III Upgrade," SRF 990716-09, *SRF Reports*, 1999.

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