CONTRIBUTION OF THE CLS CONTROL SYSTEM TO THE CLS ACCELERATOR SYSTEM RELIABILITY

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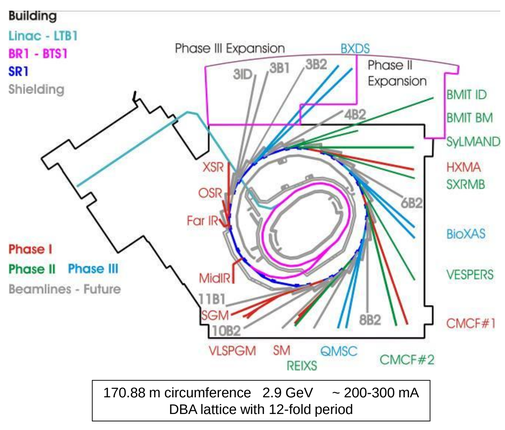
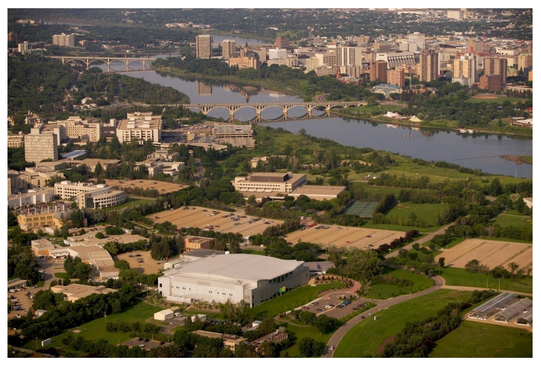
Abstract:
The control system software plays an increasingly important role in achieving overall accelerator system reliability, in this regard the CLS control system is no different. This paper reviews the two aspects of control system reliability (1) the reliability of the control system itself and it contribution to system reliability and (2) the use of the control system as a tool to aid in predicting and localizing system failure therefore providing an indirect impact on mean-time-between-failure and mean-time-to-repair. The paper provides a survey of metrics used at the CLS to evaluate system reliability, several failure modes that have been localized and removed from the system design to contribute to overall reliability. Recently CLS has deployed a new approach to alarm annunciation and fault location based on voice annunciation and nested dashboard display screens.

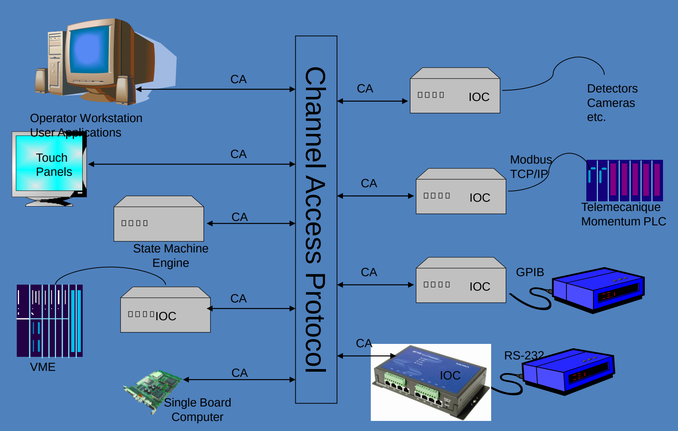
Goals:
Reliability in the context of an accelerator is the extent to which an experiment, test, or measuring procedure yields the same results on repeated trials.
Our first goal: to reliability delivery beam when scheduled for the length of time scheduled.
Our second goal: to reliably reproduce the electron beam orbit and focusing to produce x-ray beams of constant energy, position and intensity. The beam position is determined by the reproducibility of the storage ring dipole magnets and the effectiveness of the orbit correction system. Beam intensity depends on the source size which in turn relies on reproducible beam focusing from the quadrupole and sextupole magnets



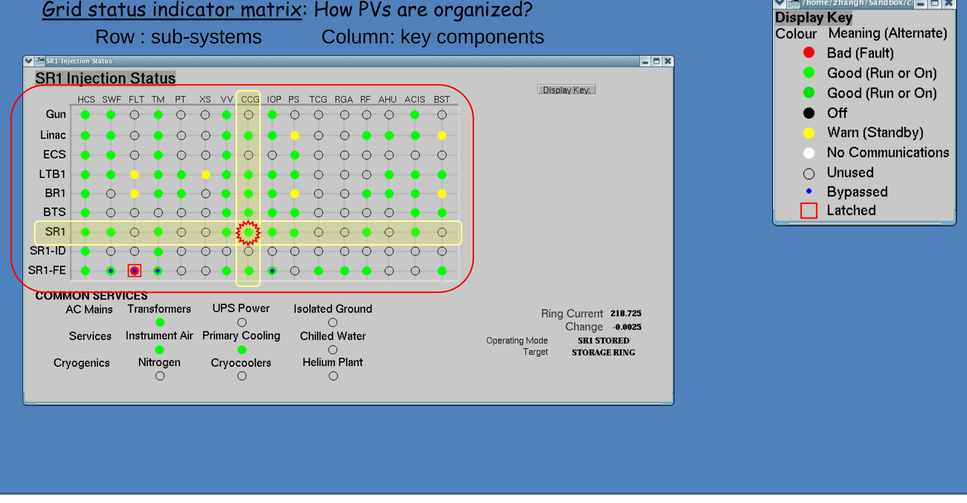
170.88 m circumference 2.9 GeV ~ 200-300 mA
DBA lattice with 12-fold period



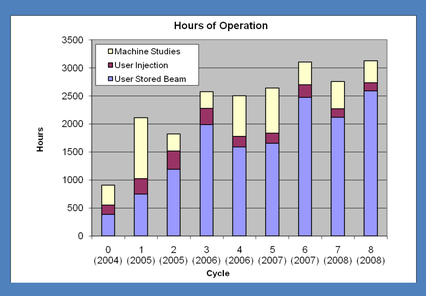
Control System



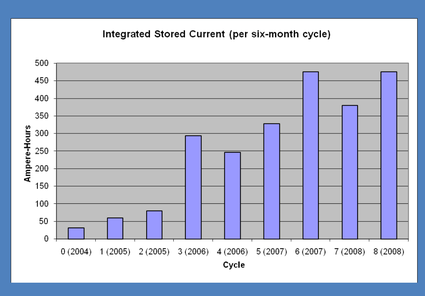
Dashboards



Operating Data



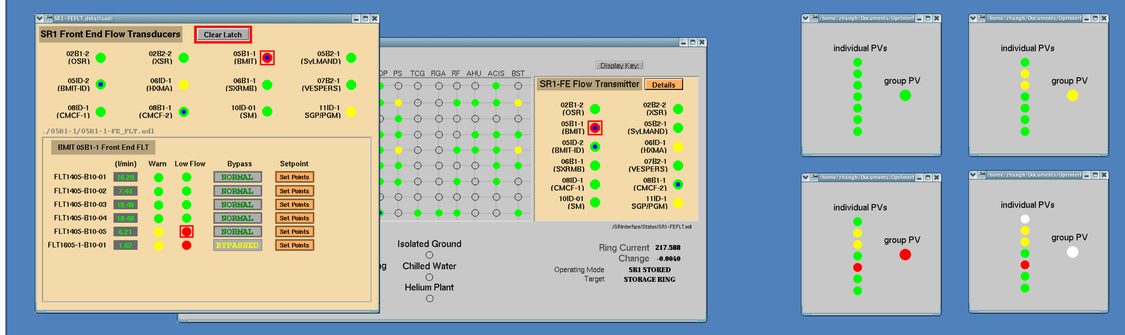
CLS as a relatively new synchrotron has progressively been increasing the number of hours of operation over the past five years. For scheduling purposes the CLS divides the calendar year into six month cycles and maintains two extended outages per year for major installation and maintenance activities.



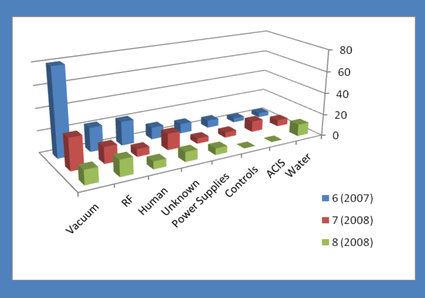
When brining a new machine online an equally important metric is the integrated stored current (amp-hours). During the early commissioning amp-hours were limited due to the need for beam-based vacuum conditioning of the storage ring and ongoing installation of beamlines and other components.

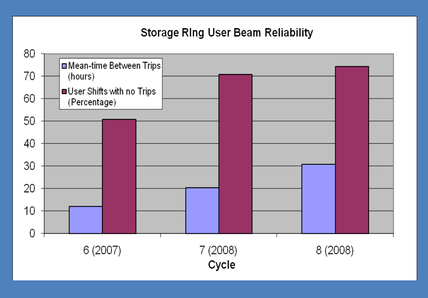
Drill Down Into EDM Screens

- ✓ Indicator matrix - a snap shot of the big picture
- ✓ Sub-screens - display components info in a sub-system
- ✓ Related displays - links to other EDM screens



Trips





One specific area that was targeted between cycle 6 and 7 was vacuum trips. This was accomplished by modifying the control system to better debounce minor vacuum transients as well as implementing a staged response to beamline front-end vacuum transients. The results in this targeted approach can be seen in the overall increase in the MTBF and the number of user shifts delivered without trip, as shown in Figure 4. In earlier cycles (not shown) target areas included improvements how flow switches are debounced as well as human factors for machine injection. This approach permits us to use metrics as a tool to focus resources on areas that provide the most benefit.

Problem/Event/Change tracking integrated into Configuration Management System