A RISK BASED APPROACH TO IMPROVING BEAM AVAILABILITY AT AN ACCELERATOR FACILITY

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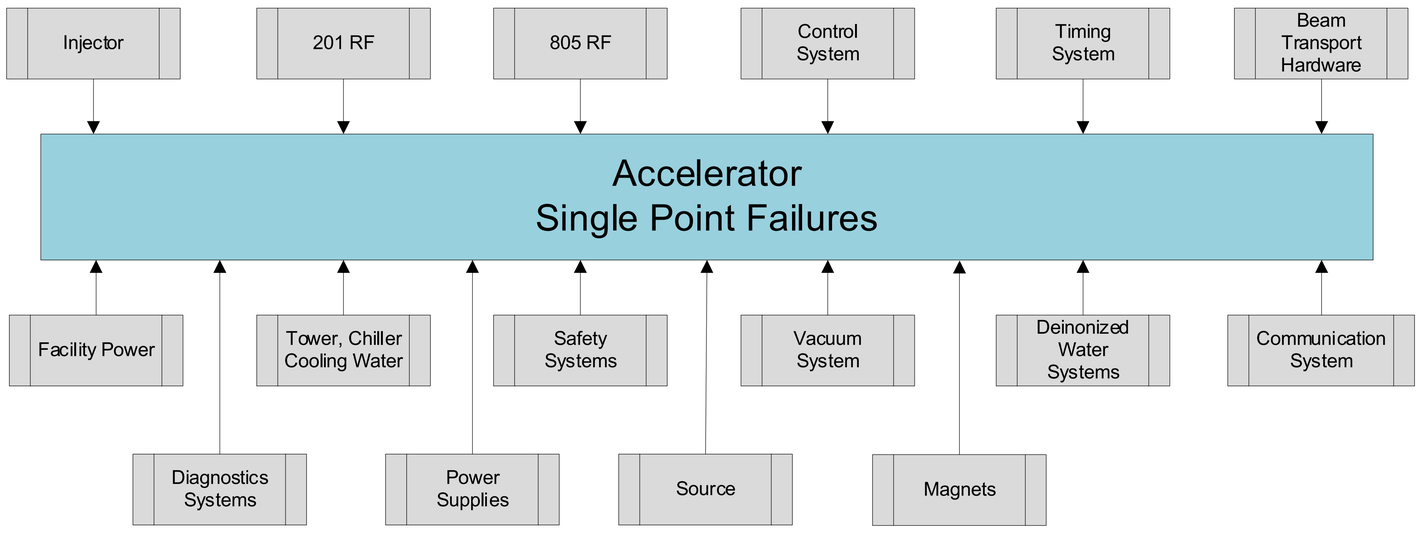
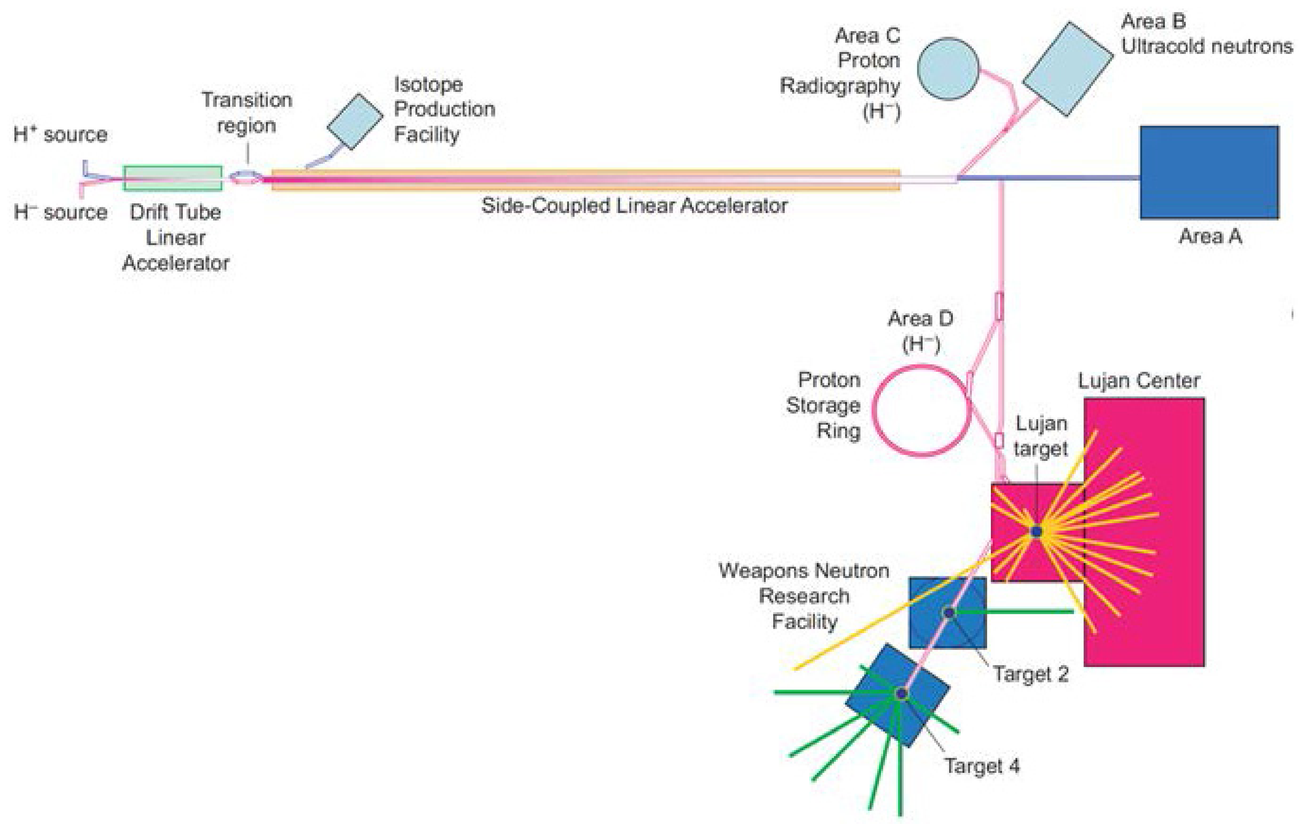
Abstract
This poster describes a risk-based approach to improving beam availability at an accelerator facility. Los Alamos Neutron Science Center (LANSCE), like many other accelerator facilities, was built many years ago and has been re-purposed when new missions were adopted. Many of the upgrades to the accelerator and beamlines allowed improvements in the general area of the upgrade but large-scale, system-wide improvements were never accomplished. Because of this, the facility operates with a mix of old and new equipment of varying condition. Limited budgets have constrained spending for spares procurement making it vital to prioritize those items predicted to have the highest impact to availability, should they fail. A systematic approach is described where equipment is inventoried, condition assessed, rated for potential failure and finally compiled into a risk-based priority list.



Accelerator Single Point Failures

Introduction
The LANSCE facility operates a proton accelerator originally built in the late 60s and early 70s to deliver beam to five experimental areas. The facility has done very well over the years delivering beam at an overall 80-85% availability even as the original mission has changed and expanded by several other Experimental Areas (EAs). Accelerator availability is a measure of uptime divided by total time so the Mean-Time-To-Repair (MTTR) metric lowers available beam time to each of the EAs. The Availability metric is calculated weekly during production runs to each EA and then combined into an overall total for the accelerator.
It is the objective of Accelerator Operations and Technology (AOT) Division management, the organization operating and maintaining LANSCE, to improve the availability metric to 90% or greater using a risk-based approach for identifying and purchasing adequate operational spares to lower the unscheduled down time (MTTR). To achieve this goal, risks of failure shall be identified and prioritized from the top level down, from systems to structures to components (SSCs). Downtime (MTTR) data for the past history of failures along with the trends associated with particular equipment has already been captured for the availability metric. By mining this data, performing equipment assessments and assigning risk by subject matter experts, the most appropriate spares procurement list can be created.



Graphical Representation of the LANSCE Accelerator

Equipment Assessment

	Safety	Environment	Security	Reliability	Availability	Maintainability	System Physical Condition	Aging Degradation	Equipment Obsolescence	Spares	Mission Opportunity
3	Imminent Safety Issue	Severe environmental risk	Compromise of security	Greater than 20 failures during a ~5000 h Run Cycle; incl. machine turn on & beam tune	Overall downtime of more than 1 week in a run cycle	Greater than 1 days of Mean Time To Repair	System provides frequent evidence of not performing to its design requirements	System shows significant evidence of ageing	System is past End-Of-Life. Spare Parts are Unavailable for purchase	No spares in stock	Strong business case for upgrade
2	Code issue, Engineered Controls Issues, Potential for Adverse Safety from Failure Modes	Minor environmental risk, of compliance issues	Security incident	Greater than 5 but less than 20 failures during a ~5000 h Run Cycle, incl. machine turn on & beam tune	Overall downtime of less than 1 week but more than 1 day in a run cycle	More than 2 hour but less than 1 days of Mean Time To Repair	System provides occasional evidence of not performing to its design requirements	System shows evidence of ageing that will increasingly affect performance	System is approaching end of life and it is difficult to obtain Spare Parts	Limited spares in stock	Moderate business case for upgrade
1	No Safety Issue	Negligible environmental impact	Inconsequential impact to security	Less than 5 failures during a ~5000 h Run Cycle, incl. machine turn on & beam tune	Overall downtime of less than 1 day in a run cycle	Less than 2 hours of Mean Time To Repair	System provides no evidence of performance degradation	System shows no evidence of ageing	System is available for purchase - No End-Of-Life date	No spares issue	No business case for upgrade

Risk Register
As explained earlier, AOT Management's goal is to reduce the risks leading to unscheduled downtime and to optimize risk mitigation strategies to lower the highest risks. Starting with the equipment assessment, the Top 10-15 for the four disciplines compiled into a list of ~50 which became the basis for the risk register.
As was originally proposed, the risk register is a list of risks that lead to exceptional unscheduled downtime should they occur, thereby substantially affecting the availability metric. Each risk is evaluated for probability and consequence with availability (or schedule) as one of the major factors in the risk consequence.

Risk Analysis
Modern and well tested methods of risk-based analysis and planning are regularly applied to complex systems in industry to ensure maximized performance within imposed constraints. Such methodologies, strategic maintenance planning, can also be applied to a large and complex expert-based scientific infrastructure such as the LANSCE proton accelerator system. AOT SMEs assign probability and consequence to the SSCs on the risk register, prioritize the results, and then optimize the overall list. The resulting list would then allow AOT division to strategically fine tune its operational, maintenance, and improvement priorities based on the risks and the available resources. The goal of this endeavor has been to generate a pilot program that can be carried forward, refined, and fully-implemented in future years.