

January 2022

Risk Management at SNOLAB



What is SNOLAB?

SNOLAB is a world-leading deep underground fundamental science research facility, located at 2070m depth in the Vale Creighton mine

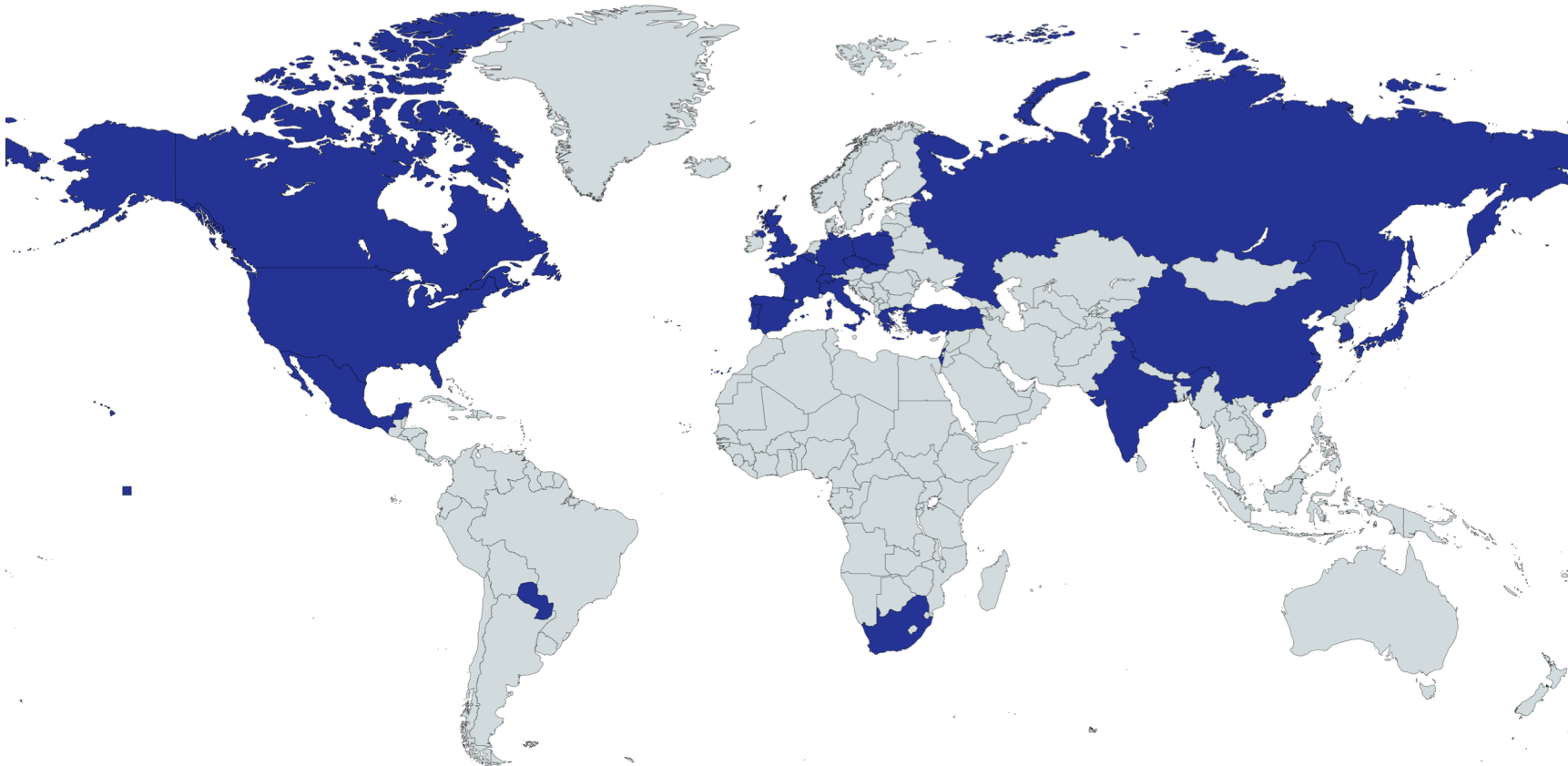
- Operates as a clean-room throughout, and shields sensitive detectors from background radiations by great depth, high purity detectors and shields

The programme addresses some of the most fundamental questions in contemporary science

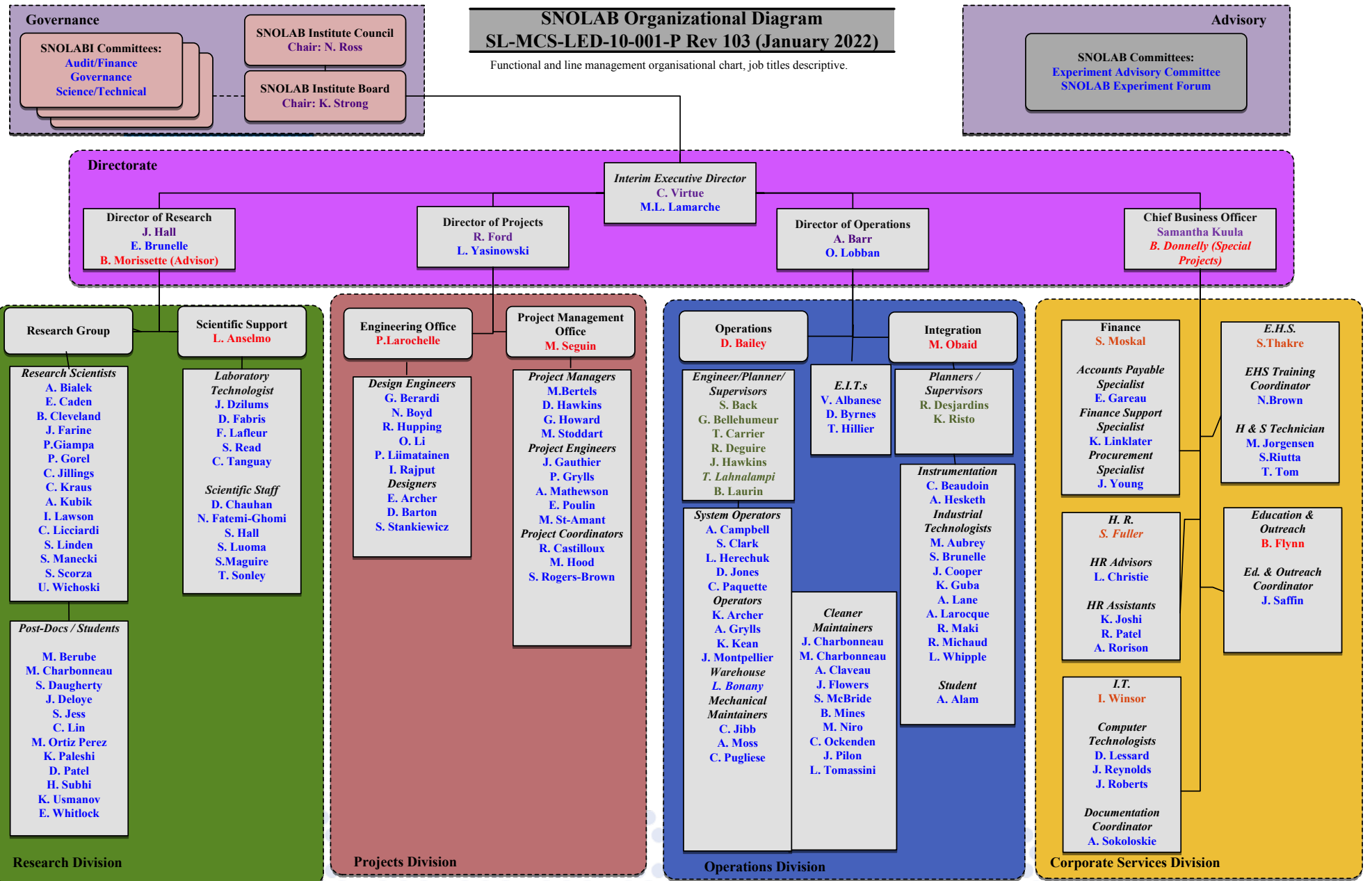
1. Why is the Universe made of matter instead of anti-matter?
2. What is dark matter?
3. Is there physics outside the Standard Model of Particle Physics?

Who do we support?

- >500 faculty researchers from 157 institutions over 24 countries
- > 800 highly qualified personnel and technical support
- ~11,000 underground person-shifts per year (~60/dayshift)

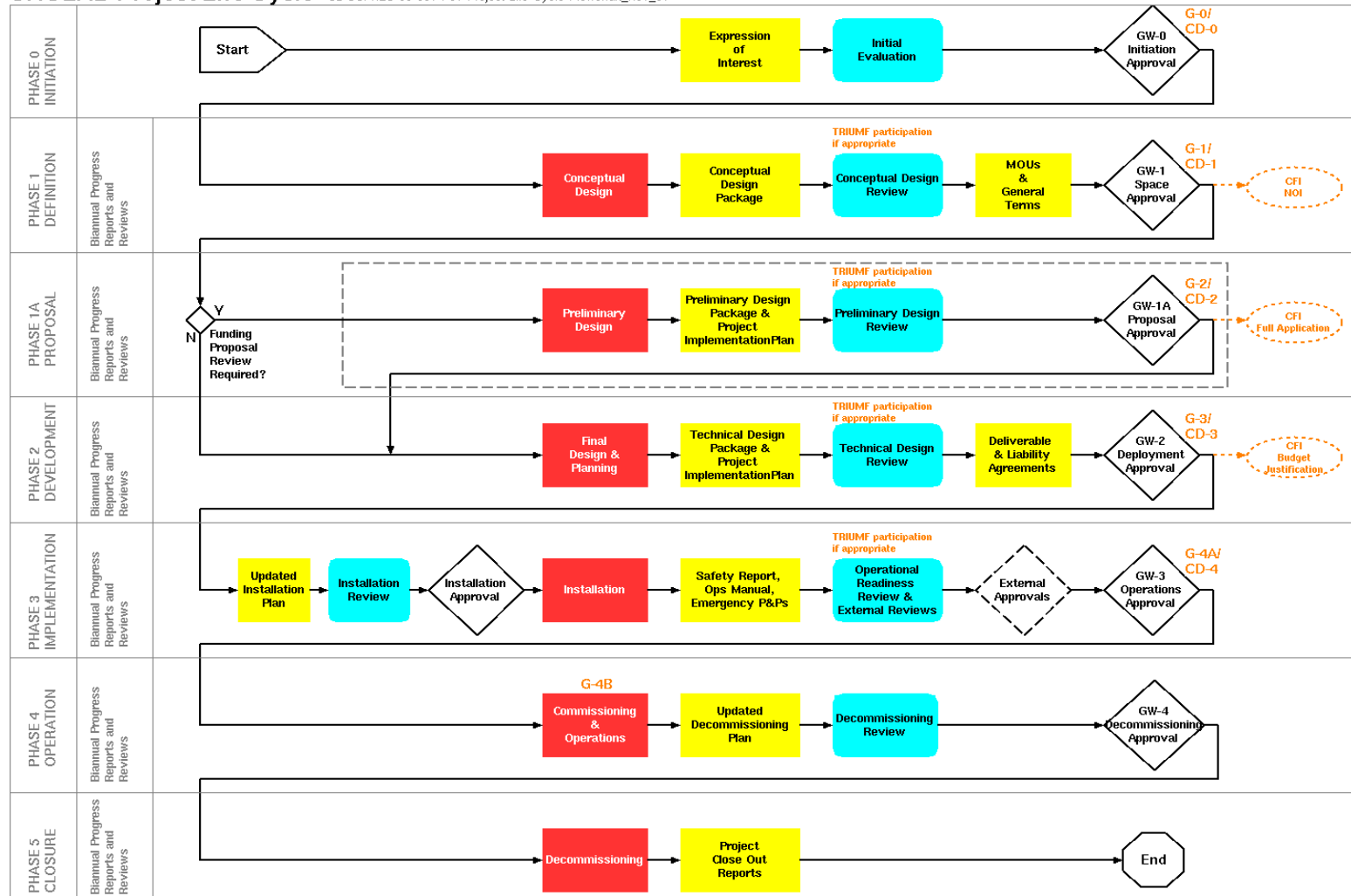


SNOLAB Structure



SNOLAB Project Life Cycle

SNOLAB Project Life Cycle SL-SCH-RES-60-001-F01-Project-Life-Cycle-Flowchart_Rev_01



Risk and Hazard Management

SNOLAB separates 'risk' and 'hazard'

- SNOLAB Terminology:

- What is a Hazard? Anything that has the capability to cause harm to people. This is scoped in terms of health and safety, environment, etc.

- What is a Risk? The likelihood and consequence of a situation arising that can affect a project. This includes internal and external quality factors.

- At the facility level, common approach adopted to monitor risk and hazard through overall facility registers

- Hazard register takes input from various hazard analyses

- Risk register takes input from Strategic Risk Group and Managers

- Registers maintained by SNOLAB Director

- All documentation available on SNOLAB DocuShare document management system

- Hazard assessments available to all staff and users

- Risk assessments available to senior staff team

Risk/Hazard Matrix Components

Risk Category: Hazards and risks are broken into general categories in each sheet. Categories of hazards and risks associated with each experiment are detailed within these generic categories, or any additionally required.

Hazard/Risk description: For each category and sub-category, specific hazards and risks are described.

Inherent risk: The inherent risks associated with a hazard or project risk illustrate those associated risks prior to the adoption of any mitigation strategy. The purpose of identifying inherent risk is to highlight those areas of risk which are deemed of high impact, or high likelihood. The inherent risk assessment is broken into likelihood and impact with the total risk assessment being the product of the two.

Mitigation strategies: The strategies adopted to reduce the inherent risk.

Residual risk: Following the adoption of the stated mitigation strategies, the likelihood of the hazard/risk occurring is reduced to the residual likelihood. Note that the impact of the hazard or project risk remains the same as the inherent risk. Mitigation does NOT change impact.

Risk trend: To provide a mechanism to track hazard and risk assessments through the lifecycle of the project. Risks will eventually be retired when the task or element is completed.

Risk owner: Specifies responsibility for monitoring and managing the risks and hazards.

Financial Implications: Specifies in broad (logarithmic) terms the scale of the financial implications should the risk materialise

Actions: Any outstanding actions and additional comments. Completed actions bracketed to maintain visibility of tasks or actions completed.



Enumeration of Hazard and Risk

Likelihood for analyses (hazard assessment may use industry standard

frequency analyses, e.g. ODH (Fermilab)):

- 0: retired;
- 1: very unlikely to occur in project lifetime;
- 2: unlikely to occur in project lifetime;
- 3: likely to occur in project lifetime;
- 4: very likely to occur in project lifetime;

Impact for hazard analysis:

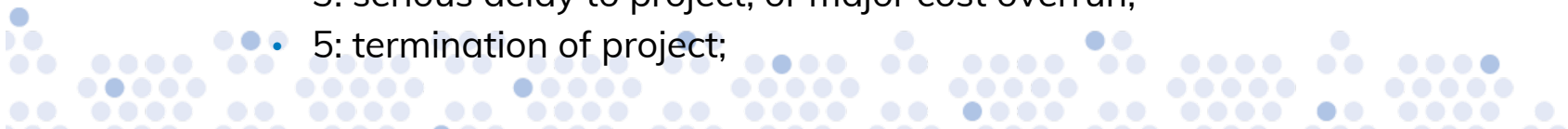
- 1: inconvenience;
- 2: minor injury;
- 3: lost time injury;
- 5: serious injuries or death;

Impact for project risk analysis:

- 1: inconvenience to project;
- 2: delay to project, or minor cost overrun;
- 3: serious delay to project, or major cost overrun;
- 5: termination of project;

		Impact			
		1	2	3	5
Likelihood	4	4	8	12	20
	3	3	6	9	15
	2	2	4	6	10
	1	1	2	3	5
	0	0	0	0	0

In SNOLAB Assessments, mitigation strategies affect the likelihood only



Hazard Analyses

Hazard management processes have been completely rewritten to adopt an integrated process across SNOLAB

Intent is to thread hazard assessment throughout the organisation to capture and mitigate appropriate levels of hazard and threats.

Facility hazard analysis connects top-down and bottom-up hazard analyses:

- **Task Hazards:** completed for specific tasks that are deemed high risk by supervisors, managers or staff
- **Job Hazards:** what hazards are each job holder exposed to?
- **Area Hazards:** what unique hazards are people exposed to within a specific area of the facility
- **Experiment Hazards:** what hazards do the experiments introduce?
- **Facility Hazard Register:** compilation of hazards within the facility across broad categories



Hazard Analyses

103 Hazards actively tracked

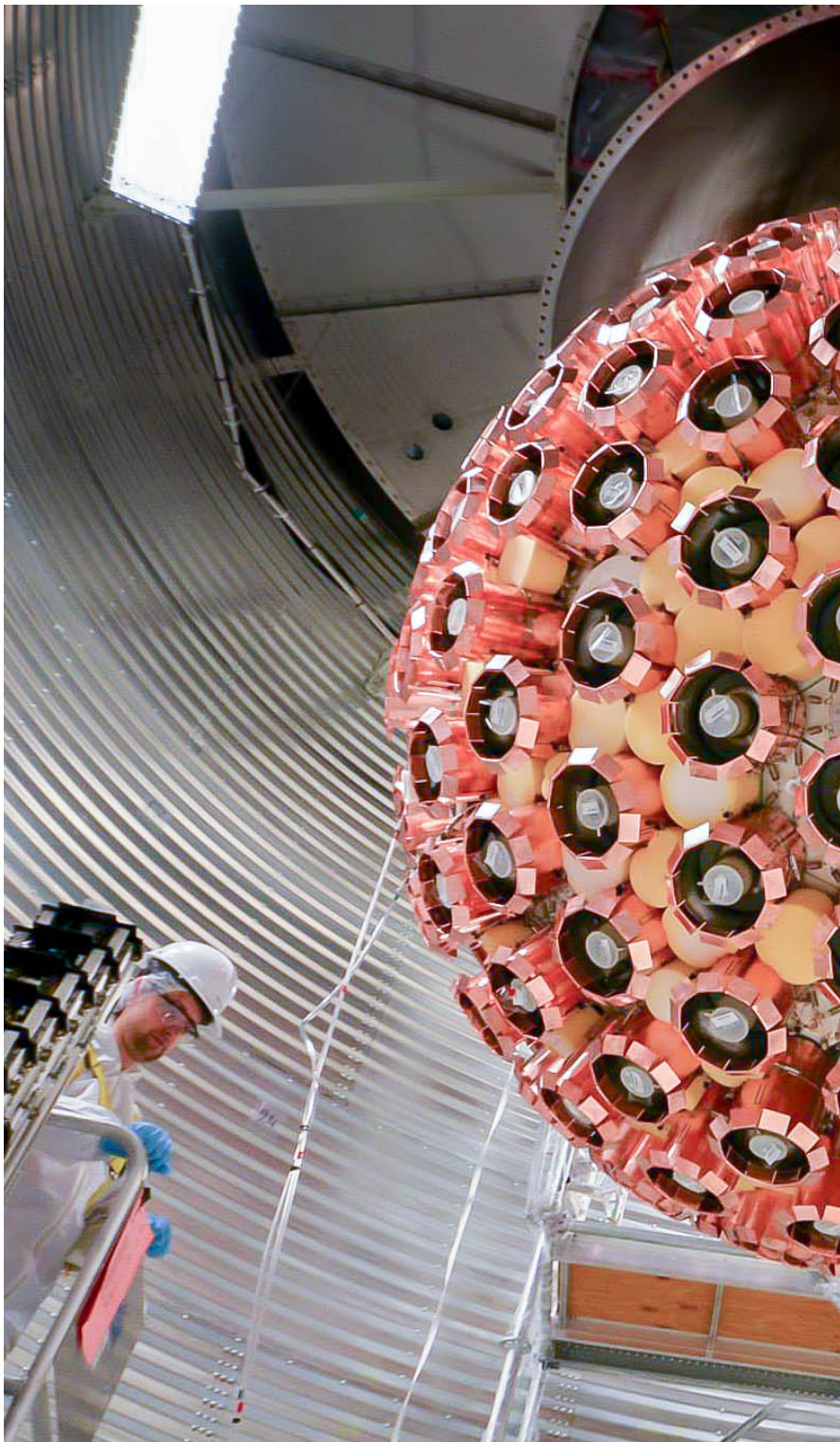
Categories of Hazards reviewed during the analysis:

- Asphyxiant/ODA
- Biological
- Chemical / Toxic
- Cryogenic/Gas
- Electrical / HV
- Fire / Explosive
- Flood / Water
- Mechanical / Physical
- Pressure / Vacuum
- Radiation / Laser / Calibration
- Vibration / Noise / Seismicity
- Physical Bodily Harm

Category		Hazard/Threat Description		Inherent Risk Assessment		
	Cause	Potential impact on personnel	Prob.	Impact	Total	
1	ASPHYXIANT/ODA	Loss of breathable air from...				9
1.1	Argon	Rapid evolution of argon liquid from target through loss of cooling - filling experimental hall	Asphyxiation, Cryogenic burn, ODA, Death	2	5	10
		Evolution of argon from storage or purification systems	Asphyxiation, ODA, Loss of consciousness	2	5	10
		Explosive combination of cryogenic fluid and water from...	Asphyxiation, Cryogenic burn, ODA, Explosive injury, ...	2	5	10

Current controls and mitigating factors	Residual Risk Assessment			Risk trend	Risk Owner	Actions Required (Completed)
	Prob.	Impact	Total			
Engineered fail-safe mechanisms on argon systems; Experiment project safety reviews (internal and external); Environment monitoring and alarm; Backup power and/or cooling	1	5	5	Risk managed	Experiment Team	DEAP/MiniCLEAN ODA/Over-pressure review completed, caveat closure underway
Engineered fail-safe mechanisms on argon systems; Experiment project safety reviews (internal and external); Environment monitoring and alarm; Procedures for process flow and operations	2	5	10	Risk enhanced	Experiment Team	Risk enhanced: DEAP argon dewar relief valves frozen, review scheduled 2015-09-09 DEAP/MiniCLEAN ODA/Over-pressure review completed, caveat closure underway
Engineered fail-safe mechanisms on argon systems; Experiment project safety reviews (internal and external); Environment monitoring	1	5	5	Risk managed	Experiment Team	DEAP/MiniCLEAN ODA/Over-pressure review completed, caveat closure underway

Colour Code for risk analysis
 Maximum score = 20
 1-4
 5-9
 10-20



Risk Management



SNOLAB has connected Strategic Plan objectives to day-day operations through Facility Business Plan

Risk management supports delivery of Strategic goals

- Defines prioritisation of tasks and time
- Maintains quality of facility and research programme

Facility risk assessment process is currently top-down

- Risks identified and monitored through discussion with Strategic Risk Group and Managers
- Organisational restructuring in progress with additional Associate Director position to provide support

Project risk register maintained by SNOLAB Director


- Monthly(ish) review and re-evaluation, updates to Board meeting quarterly

Risk Analyses

97 Risks actively tracked

Categories of Risks reviewed during the analysis:

- Facility Governance
- Facility Management
- Financial
- Staff
- Environment
- Reputational
- Opportunities

	Project Name: SNOLAB Project Director: Nigel Smith Project Managers: Nigel Smith / Karen Galpeau Project Phase: Operations Last Update: 2015-09-08 (v1.29) Project Risk Average: 5.0 SL-MCS-LED-20-005-P		Colour Code for risk analysis Maximum score = 20		
	1-4	5-9	10-20		
Category	Risk/Threat Description		Inherent Risk Assessment		
	Cause	Potential impact on SNOLAB	Prob.	Impact	Total
1	GOVERNANCE	Failure of governance due to...			10
1.1	SNOLAB Institute governance	Lack of governance structure or trust agreements / constitution	3	5	13
		Breakdown in relationship between SNOLABI trust members or SNOLABI Board of Management	2	5	10
		Lack of facility strategic planning	3	3	9

Current controls and mitigating factors	Residual Risk Assessment			Risk trend	Risk Owner	Financial Implications	Actions Required (Completed)
	Prob.	Impact	Total				
			5				
SNOLABI Governance documents and agreements - Trust agreement, constitution and terms of references for committees and Directors; Policy governance approach;	0	5	0	Risk retired	SNOLABI Director	Moderate	(Risk retired: new policy governance structures in place.)
Dialogue within SNOLABI; Definition of stakeholder desirable outcomes; Board training and effectiveness survey; Policy Governance approach;	0	5	0	Risk retired	SNOLABI Board	Extreme	(Risk retired: new policy governance structures in place)
Creation and maintenance of Strategic Plan and Facility Business Plan; SNOLAB Strategic Plan and Facility Business Plan used for planning purposes.	2	3	6	Risk open	SNOLABI Board	Moderate	Risk re-opened for Strategic Plan 2017-200: planning process to being during summer 2015



List of all risk areas tracked



- 1.1 SNOLAB Institute governance
- 1.2 SNOLAB Facility governance
- 1.3 Relationship with host
- 1.4 Relationship with funding agencies
- 1.5 Relationship with Canadian physics and science communities
- 2.1 SNOLAB Facility management
- 2.2 SNOLAB Quality management
- 2.3 SNOLAB Experiment interactions
- 2.4 Review of management practices
- 3.1 Federal funding and income
- 3.2 Provincial funding and income
- 3.3 University funding and income
- 3.4 Industrial funding and income
- 3.5 Experimental programme funding and income
- 3.6 Facility insurance
- 3.7 Facility financial management
- 4.1 SNOLAB Directorate, Management and Professional Engineers
- 4.2 SNOLAB Strategic Risk and Core Services
- 4.3 SNOLAB Supervisors
- 4.4 SNOLAB Research Team
- 4.5 SNOLAB Staff
- 4.6 Unionised staff
- 4.7 Contract staff
- 4.8 Visiting scientists and experimental teams
- 5.1 Environment, Health and Safety
- 5.2 Security
- 5.3 Access to Creighton
- 5.4 Act of God
- 6.1 Bad publicity
- 6.2 Scientific Programme
- 7.1 Positive publicity and outreach
- 7.2 Support of underground science community
- 7.3 Support of Major Infrastructures for Science, Technology and Innovation
- 7.4 Additional research programmes
- 7.5 Engagement with Vale

What's the point?

Thread EH&S and Quality throughout the organisation

- Hazard analyses are used to get staff and users to think before working.
- Review of task, job or experiment
- Identification of potential hazards
- Development of mitigation strategies before a task is undertaken, or before an experiment comes to site

Hazards analyses are essential for dialogue with stakeholders

- In an operational mine potential liability is \$3M/day if mine production is halted due to SNOLAB operations
- Development of insurance requires full hazard analyses

Risk analyses are essential for dialogue with stakeholders

- Definition of facility business plan with SNOLAB Board and funding agencies

Risk analyses guide prioritisation of work

- Connect day to day operations with high level objectives and mitigation of associated risks
- Delivery of high quality research requires attention to open risks

