Dr. Daniel L. Cluff

P.Phys. P.Eng. C.Eng.
B.A., Hon.B.Sc., M.Sc., M.Eng., PhD
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Chief Engineer — **CanMIND Associates** — 2008 -
Cryogenic systems design and development

- Concepts in cryogenic Energy Storage to increase the use of renewable energy for mining projects.
- Cryogenic energy storage provides a scalable source cryogenic liquids, which can be used to provide:
  - Deep mine chilling via a Cryofan©.
  - Compressed air supply via the Cryopress© and electricity production via the Cryolectrical© on demand systems for underground.
  - Motive power for fans, pumps, personnel transport and large equipment from the Dearman Engine.
  - Computational Fluid Dynamics and thermal modeling of the various cryogenic technologies.

Project Engineer — **LOWCARB - Climate change and methane mitigation.** — 2011 – 2014
European Union for Coal and Steel
Penryn, Cornwall, United Kingdom

- Designed the VamTurBurner© energy capture technology to reduce Greenhouse Gas emissions from operating coal mines in the European Union. Mechanical and thermal system design.
- Supervised staff and graduate student master's degree projects, developed work packages and budgets.
- Initiated ALGAMINE Site Rehabilitation concept and developed an international collaboration of partners to organise the proposal into work packages.
- Presented results at review meetings and at conferences:
  - Biannual Progress review meetings in Spain, Slovenia and the United Kingdom
  - World Mining Congress 2013 in Montreal, Canada,
  - The American Society of Civil Engineers ISCORD 2013 in Anchorage, Alaska
  - Renewable Energy and Sustainability Conference in London UK.
- Completed the research for PhD in Mining and Minerals Engineering by designing an energy capture system and performing advanced computational fluid dynamics and combustion dynamics computations, for ultralow CH_4 or VOC's

Mines Inspector — Ministry Northern Development and Mines, Sudbury, Ontario — 2010 – 2011

- Assessed Closure Plans of Ontario mining operations for compliance or updating to current standards.
- Inspections across Northern Ontario at operating or abandoned mines for mining act compliance of shaft cap integrity, ARD impoundments, water quality, surface vegetation, geotechnical and tailings pond stability.
- All pertinent aspects of the reports, Mining Act and EPA discussed with proponent.
- Reports provided to both proponents and Ontario Government.
- Participated in the Mining Act Revision Working Group.

Senior Researcher — MIRARCO Environmental Monitoring — 2009 – 2010
Willet Green Miller Center, Sudbury, Ontario

- Vale, #3 shaft, thermodynamics modeling for the ventilation chilling using the ice fields at Creighton
- Pele Mountain Resources, Eco Ridge, design of uranium heap leach recovery system and collection
- Remediation of mine tailings by soil amendment and research into the use of algae ponds
- Atmospheric monitoring systems upgrading
- Collaborative proposal inception, writing and revision.

Design Engineer and Project Site Manager — Site, NORCAT - Xstrata Strathcona, Onaping — 2007 – 2010
Office and Laboratory, Laurentian University, Sudbury, Ontario. — Consultant

- Supervise NORCAT contractors and research staff at Strathcona site
- Revise research program of site assessment for mix design development parameters
- Developed thermodynamics control systems to deliver Frozen Backfill to an open stope
- Design a laboratory testing program to confirm strength development as a function of thermal properties
- Continuing association as an International level consultant on Frozen Backfill concept
- Worked with patent agent and legal advisor to write patent for Laurentian University
- Interest retained in patent 25% D.L. Cluff, 25% V.N. Kazakidis and 50% to assignee Laurentian University

Professor
Physics Engineering

Cambrian College of Applied Arts and Technology
Department of Science and Engineering Technology
Sudbury, Ontario.

1986 – 2006

Lecture and course development for Mining and Civil Engineering Technology programs,
Courses taught include, Mathematics, Medical Radiation program, Physics Instrumentation, Engineering for civil and mining technology. Developed the program content for the newly instituted Bachelors of Applied Science program.

Design Engineer
Mine Automation

Laurentian University
Sudbury, Ontario.

2004 – 2006

Designed a laser diode based free space aqueous-media optical communication system for mine automation **(AMOC)**

Student Atmospheric Physics - LIDAR, University of Western Ontario, Ontario 1999 – 2000

Safety Consultant Aramco Oil, Dhahran, Kingdom of Saudi Arabia. 1997 – 1998

Design of course material for safety, delivery of material to test audiences for confirmation of concepts

Engineering Physicist
Project Manager
Collaboration Member

Site: Sudbury Neutrino Observatory, 6800L Creighton mine, Ontario. 1989 – 1995
Gamma spectroscopy and clean room station supervisor 4600 L
Office: Laurentian University, Sudbury, Ontario

- Designed and built the underground research station at the 4600 L laboratory.
- Developed safety procedures for clean room, gamma spectroscopy facility and acrylic vessel testing.
- Participated in failsafe procedure sessions to initiate safety procedures for various actions and materials such as cryogenic fluids, volatile organic compounds and isocyanate emissions from coating applications.
- Designed ventilation and dust filtration systems for clean room research station and supervised installation.
- Performed radon assessments of ambient air and worked with group to develop a new method of radon emission measurement from rock surfaces.
- Participated in geotechnical design meetings, inspected all rock-bolting and shotcrete applications for compliance to specifications
- Initiated the epoxy coatings as a cleanliness concept, initiated program made remediation recommendations.
- Commissioned the gamma spectroscopy laboratory equipment and designed operational laboratory.
- Supervised staff at the gamma spectroscopy lab operations, university laboratory and international guests.
- Wrote internal confidential reports, conference proceeding papers/presentations and journal papers.

Student Masters Physics, Designed and built an instrument to measure asbestos 1988 – 1990

Provincial Officer
Special Investigations

Ontario Ministry of the Environment
Special Investigations Unit,
199 Larch St, Sudbury, Ontario.

1986 – 1987

- Investigate industrial operations in Northern Ontario for compliance with environmental regulations
- Report investigation findings to ministry and proponents
- Initiate remedial actions, work with proponent to bring facilities into substantial compliance
- Issue notification offences notice to proponent
- Appear in legal proceedings as expert witness on behalf of the ministry

Employment during university Undergraduate and Graduate studies

INCO	Frood Stobie	Chute blaster
INCO	Copper Cliff Smelter	Converter isle punching, castings building labour
Ministry Environment	Northern Ontario	Sudbury Economic Environmental Survey
City of Sudbury	Coniston Corridor	Supervisor land reclamation crew
Laurentian University	The Pub Down Under	Supervisor pub security

Community Involvement

- Volunteer Science North exhibit development during inception
- Northern Lights Festival Boreal – Sound Engineer 10 years

- Science Fair Judge at local and National Science fairs, 8 years
- Fundraising for Cystic Fibrosis Research, received award from the Canadian Cystic Fibrosis Association
- Lead role of **Judas** in the Theatre Cambrian Production **Jesus Christ Superstar**
- Lead role of **Joseph** in the Theatre Cambrian Production **Joseph and the Many Colored Dream Coat**
- Lead role of **Koko** in the Sudbury Music Theater Production **The MIKADO**
- Campaign Mngr., Election day Chair, Zone Captain & Campaigner for Federal/Provincial candidates 20 yrs.

Education

Doctorate Mining and Minerals Engineering
University of Exeter, Camborne School of Mines, United Kingdom

Concepts in Coalmine Ventilation and Development of the VamTurBurner© for Extraction of Thermal Energy from Underground Ventilation Air Methane

Published in (i) WMC 2013 refereed conference, Montreal, Canada
(ii) The refereed Journal *Fuel*
(iii) The refereed Journal *Applied Thermal Engineering*

Masters Natural Resource Engineering
Laurentian University, Sudbury, Ontario

Frozen Backfill in lieu of a Cement Based Backfill for use in Permafrost Mining Conditions.
Laurentian University patent dates**,** Canada/US patent May/06/2009 World Patent November 11/2011

Published in (i) CIM 2009 refereed conference, Edmonton, Alberta, Canada
(ii) MEMO 2011 refereed conference, Sudbury, Ontario, Canada
(iii) ISCORD 2013, ASCE refereed conference, Anchorage, Alaska, USA

Masters Applied Physics
Laurentian University, Sudbury, Ontario

Instrumentation Development for the Size Characterization of Atmospherically Collected Electrostatically Aligned Asbestos Fibres Using Light Scattering Techniques.

Published in the refereed journal *Particle Characterization*

Honours Bachelors Science - Applied Physics	Laurentian University, Sudbury, Ontario
Bachelors Arts Economics/Mathematics	Laurentian University, Sudbury, Ontario
Graduate Certificate Particulate Matter	Institute of Fineparticle Science and Technology
Mining Engineering Undergraduate Equivalent (PEO)	Laurentian University, Sudbury, Ontario

Professional Associations and Memberships

CIM	Canadian Institute of Mining and Petroleum.
CAP	Canadian Association of Physicists. (# 129)
PEO	Professional Engineers Ontario (# 100127918) Canadian Land Reclamation Association.
CLRA	Cornish Institute of Engineers
CIE	The Institute of Materials Minerals and Mining (# 460056) European Commission Expert Panel (# EX2013D140980)
IMMM	
ECEP	

Licences Certifications

Waste Water Facility Collection License	(OETC)	# OT31793	Ontario Environmental Training Consortium
Waste Water Facility Treatment License	(OETC)	# OT31792	
Water Distribution and Supply Subsystem Certification	(OETC)	# OT31801	

Water Treatment Subsystem Certification	(OETC)	# OT31800
Radiation Safety Update		Laurentian University
Ontario Drivers Licence and United Kingdom Drivers Licence		Valid
U0001 and U0002 Underground Training Modules		MCTU
NORCAT Contractor Training Vale Surface/UG		ZES 001 Core
NORCAT UG TAG		662568