

Reinvigorating University-Based Nuclear Education and R&D

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Presentation Objective

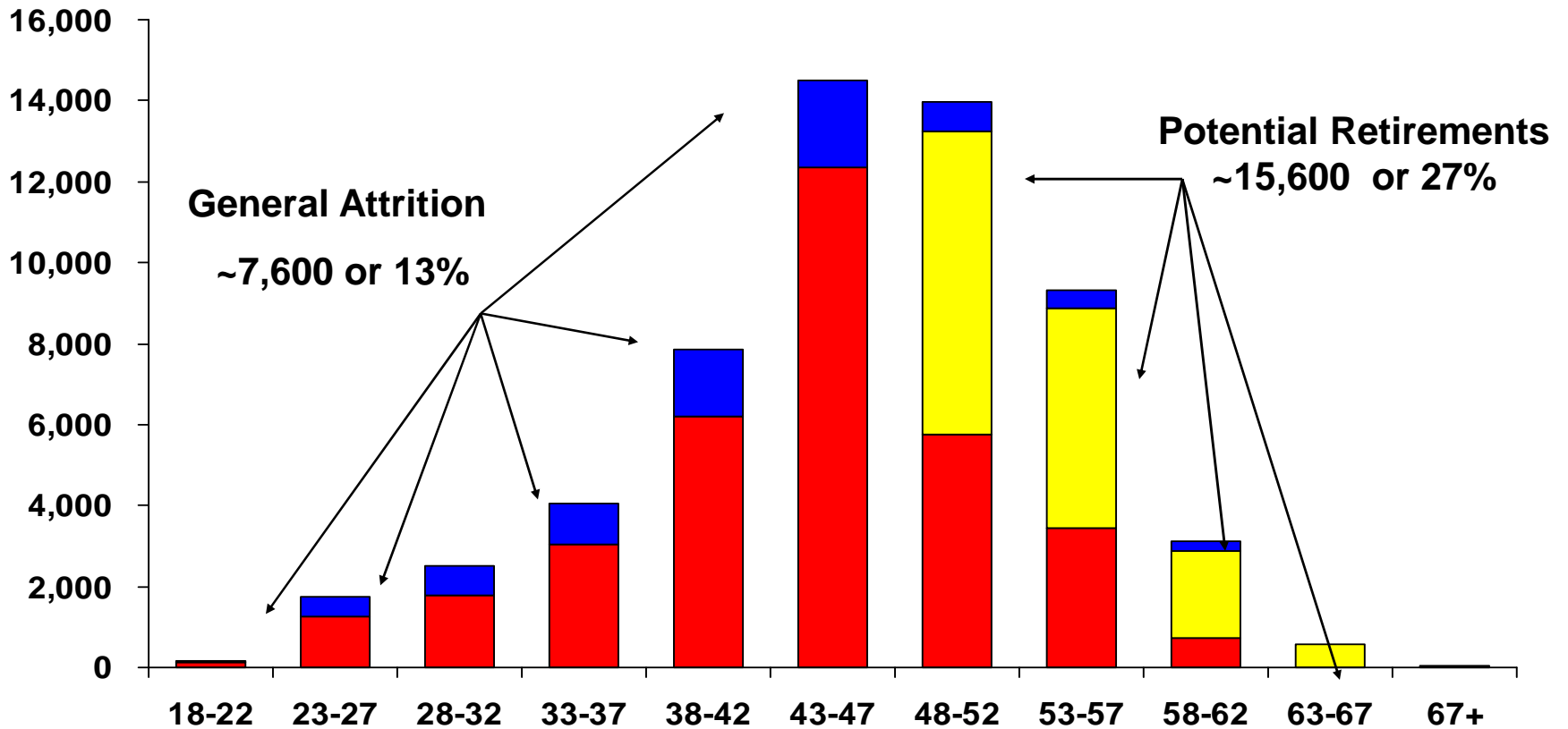
- Background: Nuclear in Canada
- Identify and explore the gaps between where we are and where we need to be.
 - Demographic
 - Institutional
 - Geographic
- Identify research and educational areas of possible collaboration

The People Side

- **Intellectual capital** is one of our main assets.
- It is in limited supply for a number of reasons (such as sector growth, demographics and competition from other industrial sectors).
- Let's look at some numbers...

Nuclear Generation 5-Year Attrition (US)

Source: 2005 NEI Pipeline Survey



1. Potential Retirees are defined as employees that will be older than 53 with 25+ years of service, or older than 63 with 20 years of service, or older than 67 within the next five years.

What does this mean?

- World is experiencing a nuclear revitalization just as we are seeing a loss of people and expertise.
- Details aside, it is clear that we need to address the gap between the intellectual capital that we have in place and what we will need.
- Given the lead times involved in ramping up the knowledge sector, this is an immediate issue.

Nuclear Energy in Canada

- Canada has over 50 years of experience in nuclear power
- We have 22 reactors (built in about 20 years) using unique CANDU technology, 18 are currently in operation
- Nuclear provides 15% of Canada's electricity requirements (50% in Ontario, 30% in New Brunswick and 3% in Québec)
- Based on this, the China plan is doable.

Canada's Major Nuclear Facilities



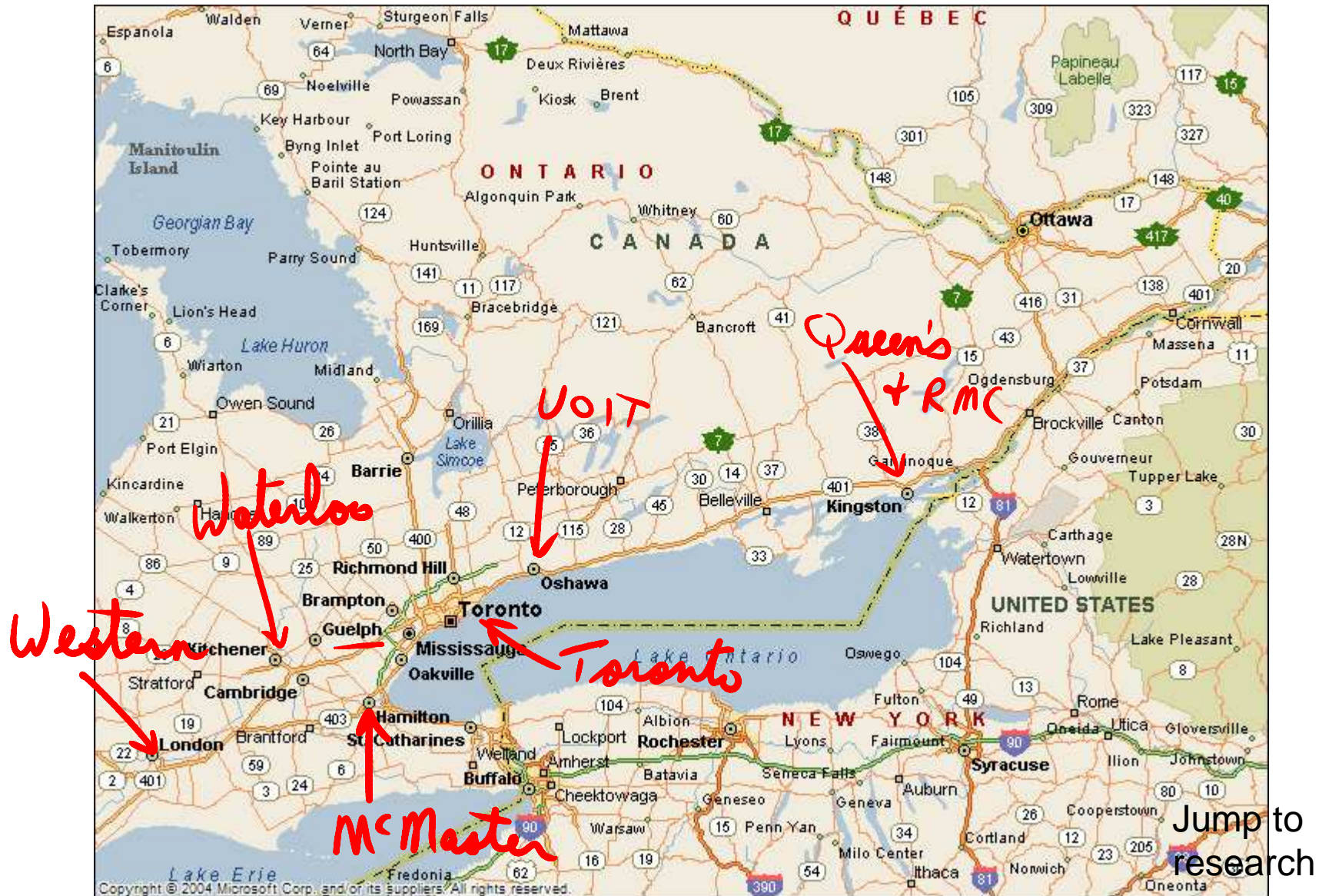
Natural Resources
Canada

Ressources naturelles
Canada

2

Canada

← 150 Km →



The Gaps

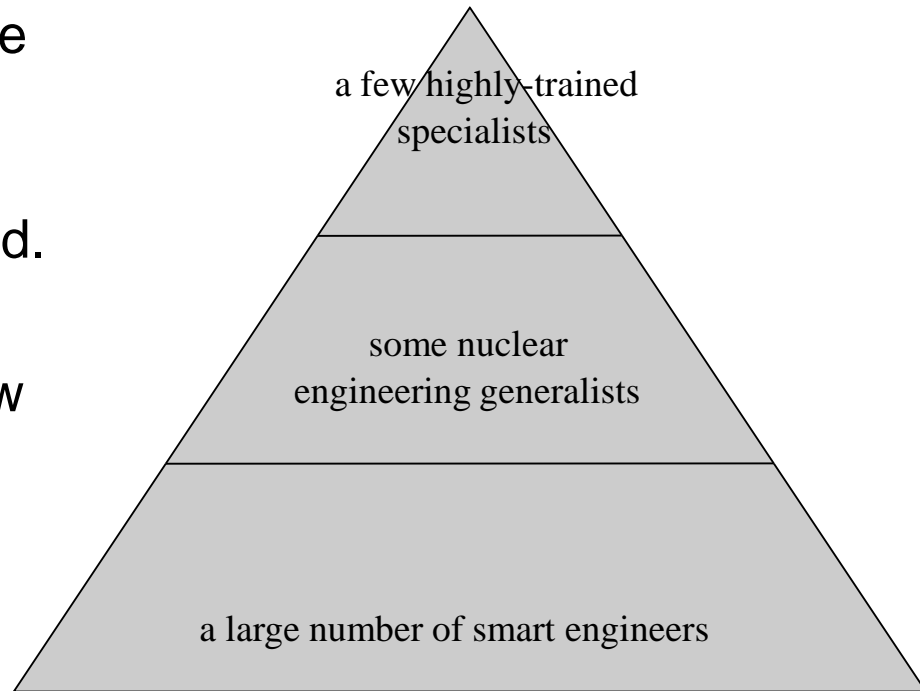
- Ad hoc gap analysis tells me there are at least 3 dimensions to the gap between where we are and where we want to be:
 - **Demographic:** there is a distance between the current age profile and a healthy age demographic for succession planning.
 - **Institutional:** there is a distance between what universities produce and what industry needs.
 - **Geographic:** there is a distance between people geographically.

The Demographic Gap

- The demographic gap spans most countries and sectors.
- Much of the intellectual capital we need is non-nuclear.
- Need to coordinate with non-nuclear sectors, else we have an unhealthy competition for this scarce resource.
- We have the institutions and mechanisms to handle skill-based training (but we need more of it).
- The universities are also doing a good job at the research level (but we need more of it). We just need to fund more exchanges between universities and industry and between countries.
- Let's get the machine going without regard for where these people will end up.

The Demographic Gap

- We need that feed stock to create nuclear welders and the bigger and better the feed stock, the easier it will be to generate the nuclear grade welders that we so sorely need. Ditto for generating that rare Ph.D. in nano-corrosion. We need good undergrads to draw from.
- As a colleague recently observed, let's make the existing pie bigger rather than try to get a bigger piece of the existing pie.



The Institutional Gap

- Professionals come from the universities
 - Inadequate preparation for industry
 - Research emphasis over development and teaching
 - Lack of systems approach in universities
 - Self-reinforcing myopia
 - No upgrade path for C students
 - Grades not a good measure of the person
 - System shuts out and destroys people
- University is not going to change its mandate or structure for industry
 - It is answerable to the public, not to industry

Professional Development

- 'Nuke-ify' our good engineers by a series of workshops or courses at the undergraduate level. Chem engineer -> nuclear engineer.
- Many of the courses should be of the type found in company internal training courses and in nuclear specific undergraduate level courses.
- Companies should share these courses. Again, let's not worry about where these people might end up.
- Think bigger pie.

What do we need?

- We are not going to change industry or the university mandates.
- Therefore, need
 - Access to information
 - Professional development upgrade path
 - Access to mentors and apprenticeship
 - Better measures of the person
 - Remedial programs
 - Bridging programs

The Geographic Gap

- Should decide on a common shared whiteboard / VOIP platform so that an expert in Mexico can give a course to students in Canada,
- The lives saved alone warrants the expense.
- Use of the Tablet PC and Lecture recording (via BB Flashback for instance) is cheap, works and is a good start.
- Again....bigger pie.

Canadian Initiatives

- In Canada, we have these uncoordinated nuclear elements:
 - CANTEACH – an open CANDU document repository (2001)
 - UNENE – a nuclear centre of excellence (2002)
 - NUCENG – an university based portal and repository (1998)
 - CNS – a society of nuclear individuals (conferences, bulletin, ...) (1979)
 - COG – an industrial consortium of operators and designers (1984). Sponsors CANTEACH and member of UNENE
 - .

Existing Networks

- UNENE – University Network of Excellence in Nuclear Engineering, Canada (2002)
- WNU - World Nuclear University (2003)
- ENEN - European Nuclear Education Network (2003)
- ANENT - Asian Network for Education in Nuclear Technology (2004)
- NTEC - Nuclear Technology Education Consortium (UK) (2005)
- RANSE - Russian Association of Nuclear Science and Education (2005)

Barriers?

- One barrier to bridging these gaps is the concern for security on a national and institutional level.
- Solution: limit our collective efforts to base level education, training, research and development.

Incentives

- The best solution to security issues is to build a community, ie to widen the circle of trust.
- Shared experiences and joint efforts are the stuff of understanding, respect and trust.
- The process of bridging the gaps is as important as the solutions they enable.

Conclusion

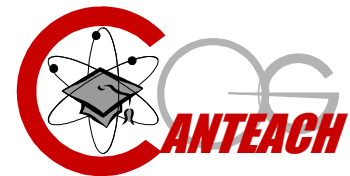
- Have demographic, institutional and geographic gaps
- The gaps can be bridged by activities like the few mentioned above
 - (CANTEACH / UNENE / NUCENG / COG / CNS / IAEA / other networks/ ...

Details on Canadian Initiatives

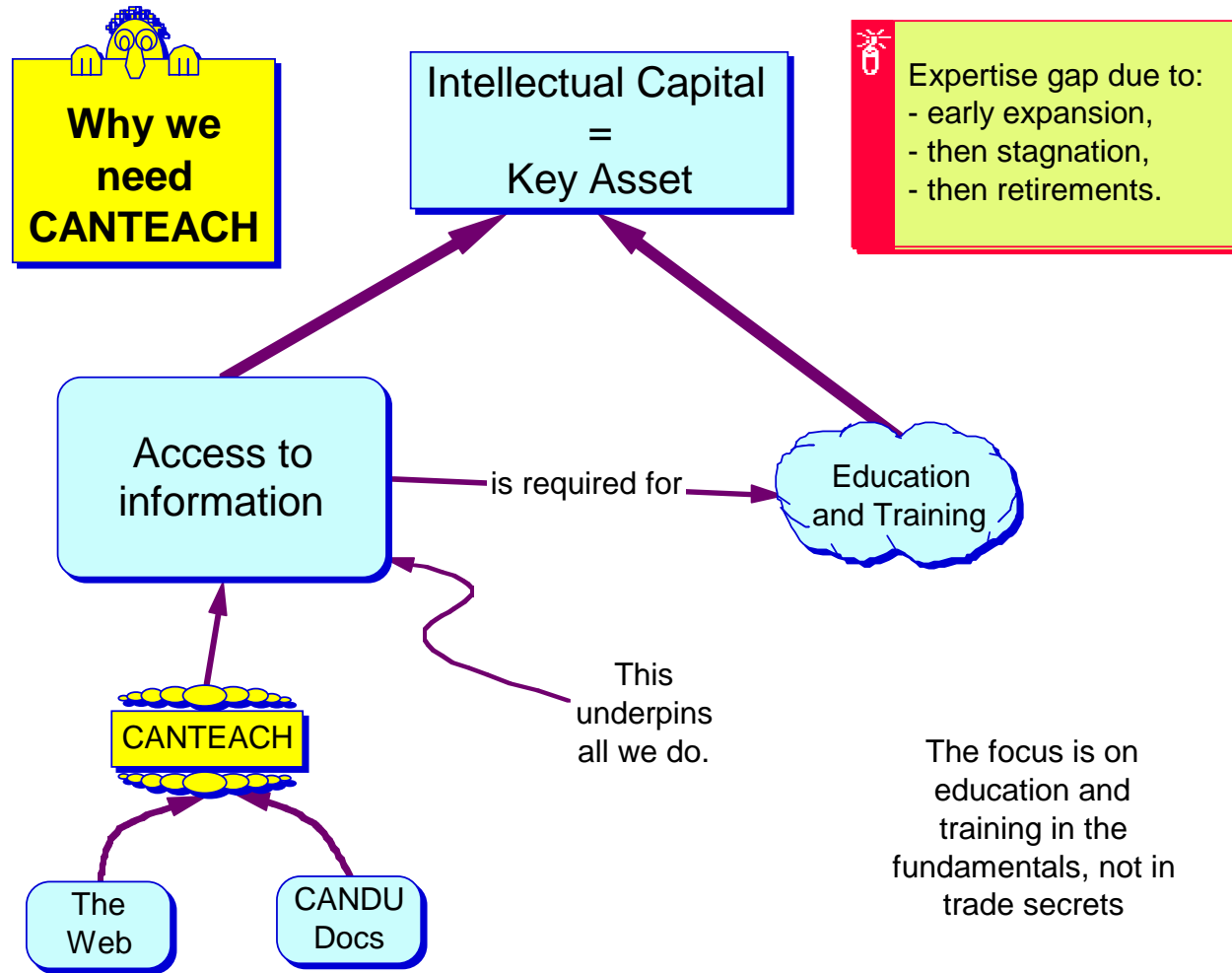
- CANTEACH
- UNENE
- NUCENG
- CNS
- COG

CANTEACH

- **Mission** To preserve technical knowledge of CANDU nuclear-electric generating system for use by present and future members of the CANDU community.
- **Mission** To provide educational and training material for Highly Qualified Personnel.
- Thus target audience is primarily at the level of the working professional.
- Aimed at capturing Know-how and Know-why.



CANTEACH Justification



Current CANTEACH Focus

- Database access
 - Scripting
 - Keywords
- Knowledge Acquisition
 - Steam Generator expert interviews
 - Nuclear Fuel expert interviews
- Document acquisition
 - Ontario Power Generation (older training courses)
 - CNSC (regulator) (new training material)
 - Chulalongkorn University courses
- Image database
 - Extraction and presentation of images in documents, etc.
- Recent paper:
 - Why it makes sense to give stuff away.

CANTEACH Web Site Tour

<http://canteach.candu.org>

The screenshot displays the CANTEACH website homepage. At the top left is the logo, which features a stylized atom symbol with a book inside, next to the word "CANTEACH" in a bold, red, sans-serif font. To the right of the logo is a search bar with a "Search" button. Below the logo and search bar is a navigation menu with the following items: Home, What's New, CANTEACH Project, Library, and Help. Underneath the navigation menu is a tagline: "The most comprehensive educational and reference library on CANDU technology".

In the center of the page, there is a large, light-colored banner that reads "Welcome to CANTEACH Project" and "Find out what CANTEACH is". Below this banner is a grid of navigation boxes. The boxes are arranged as follows:

- Concept Map Library**: "See the bigger picture of how technical information on CANDUs is organized"
- CANDU Systems and Components**: "Information organized by BSI, components, etc."
- Site Map**: Represented by a globe icon.
- Help Desk**: Represented by a red question mark icon.
- Teacher's Lounge**: "Introduction to CANDU Bibliography Who's Who Links"
- Documents Library**: "Browse, search and download documents" (represented by a stack of books icon)
- Image Library**: "Browse, search and download images"
- New Arrivals**: Represented by a green exclamation mark icon.
- Index**: Represented by a stack of books icon.

At the bottom of the grid is a large, light-colored banner that reads "CANTEACH Library".

Oct 7-17, 2006

China / Canada Universities Initiative

25

Some issues

- Document acquisition hampered by
 - Unavailability of experts (too busy, too decayed, too retired...)
 - Unavailability of documents (lost, hidden, ...)
 - Unwillingness to release documents (IP, security, expertise self-protection, ...)
 - Unavailability of people to do knowledge acquisition (we have other full time jobs, ...)

UNENE

University Network of Excellence in Nuclear Engineering

- CANTEACH is about info. Low budget (\$150k/yr)
- UNENE is about delivery (\$3M/yr).
- UNENE generates Highly Qualified Personnel.
- Hope to make CANTEACH the repository for UNENE.

What is UNENE?

- UNENE = University Network of Excellence in Nuclear Engineering
- UNENE is an industry driven alliance of prominent Canadian universities and nuclear industry

UNENE has three distinct objectives:

- Enhance the supply of highly qualified graduates in nuclear engineering and technology.
- Reinvigorate university-based research and development in nuclear engineering and technology focusing primarily on mid to longer term research.
- Create a group of respected, university-based, nuclear experts for public and industry consultation.

Current Industry Membership

- Ontario Power Generation (OPG)
- Bruce Power (BP)
- Atomic Energy of Canada Limited (AECL)
- CANDU Owners Group (COG)
- Canadian Nuclear Safety Commission (CNSC)
- Nuclear Safety Solutions (NSS)

University Members

- McMaster University
- Queen's University
- University of Toronto
- University of Waterloo
- University of Western Ontario
- University of Ontario Institute of Technology
- Ecole Polytechnique
- University of New Brunswick
- Royal Military College
- University of Guelph

First Phase Funding

- Cash Funding (first phase)

Industry: \$ 7.8 M

Universities: \$ 0.81 M

NSERC: \$ 7.12 M (estimated)

(Not including other nuclear research chairs and programs)

- Other In-kind Support:

Industry and Universities: \$4.97M

 **Total impact ≥\$20.7M**

University Research Areas

- **McMaster:** Nuclear Safety Analyses and Thermal Hydraulics ([Dr. John Luxat](#), Associate Chair Dr. Dave Novog) [more](#)
- **Queen's:** Advanced Nuclear Materials ([Dr. Rick Holt](#), Associate Chair Dr. M. Daymond) [more](#)
- **Toronto:** Nano-Engineering of Alloys ([Dr. Roger Newman](#) + Associate Chair) [more](#)
- **Waterloo:** Risk-based Life Cycle Management ([Dr. Mahesh Pandey](#) + Associate Chair) [more](#)
- **Western:** Control, Instrumentation and Electrical Systems: ([Dr. Jin Jiang](#) + Associate Chair) [more](#)
Nuclear Chemistry ([Dr. David Shoesmith](#) [more](#) / [Clara Wren](#) [more](#))
- **UOIT:** Health Physics and Environmental Safety (Application under preparation) ([Dr. Tony Waker](#), Associate Chair Dr. Ed Waller) [more](#)
- **Ecole Polytechnique:** (Dr. Daniel Rozon, Dr. Michel Pettigrew)
- **New Brunswick:** Chemistry and Corrosion ([Dr. Derek Lister](#))
- **Royal Military College:** Nuclear Fuels ([Dr. Brent Lewis](#) under preparation) [more](#)

- [Jump to map](#)

Other Research

- About 11, 3 year projects, proposed by existing university faculty from any Canadian university will be funded at approx. \$90,000 each from UNENE and these funds will be matched by NSERC through Collaborative Research and Development grants.
 - [Dr. Marilyn Lightstone](#), McMaster University [more](#)
 - [Dr. Peter Tremain](#), Guelph University [more](#)
 - [Dr. Lynann Clapham](#), Queen's University [more](#)
- In addition to research output these projects will support Masters and Ph.D. graduate students.

Educational Programs

- Professional Development: Joint M. Eng. Degree in Nuclear Engineering has been accredited by OCGS. Currently about 25-30 students are active. The program is delivered by faculty from UNENE universities. 10-12 graduates are expected each year.
- Full-time studies: New and continuing professors, supported by UNENE, supervise research based Masters and Doctoral students. Approx. 90 Masters, 30 Doctoral and 15 Post Doctoral people will be trained in the first phase. Currently 10 doctoral, 16 masters and 10 postdoctoral candidates are registered.

UNENE Web Site Tour

www.unene.ca



HOME

UNENE
University Network of Excellence in Nuclear Engineering ...

Excellence in Nuclear Engineering

The University Network of Excellence in Nuclear Engineering (UNENE) is an alliance of universities, nuclear power utilities, research and regulatory agencies for the support and development of nuclear education, research and development capability in Canadian universities. UNENE was established as a not-for-profit corporation by the Government of Canada with Letters Patent issued July 22, 2002.

Objectives

The main purpose of UNENE is to assure a sustainable supply of qualified nuclear engineers and scientists to meet the current and future needs of the Canadian nuclear industry through university education, university-based training and by encouraging young people to choose nuclear careers. The primary means of doing this are to establish new nuclear professorships in six Ontario universities and to enhance funding for nuclear research in selected universities in order to retain and sustain nuclear capability in the universities, now in danger of being lost. The Network will organize and deliver through its universities educational programs appropriate to students planning to enter the industry and to those already employed.

To find out more about UNENE sponsored research and educational programs...

[CLICK HERE TO ENTER THE SITE](#)


NucEng

Nuclear Engineering at McMaster University+

- CANTEACH is about info.
- UNENE is about delivery.
- NucEng (web site) is about students.
 - Courses
 - Who's Who
 - Careers
 - Links
 - Forums and List servers


NucEng Web Site Tour

www.nuceng.ca

 Nuc Eng
Home
--Help
--FAQ
--Career
--Downloads
--Univ Comm
--MNE
--CANNUC
--Humour
Announce
Nuc Ed
--Who's Who
--Nucl Ist
--Nuc Dip
--UNENE
--CANTEACH
--CNS
Research
--Interests
--Students
--Publications
--H2O Prop.
--D2O Prop.
Courses
--EP3D3
--EP4D3
--EP6D3
--EP4U4
--EP6P3
--EP712
--EP714
--EP716
--EP718
--EP704
--SNER
--Nucintro

Home
Page

Nuclear Engineering ([Bill Garland](#)), Department of [Engineering Physics](#),
[McMaster University](#)
Nuclear Engineering home url: <http://nuceng.mcmaster.ca>



This page updated on 09/17/2004 12:35:58

[FAQ](#) | [What's !\[\]\(950a62bbddad88d64435fd35607dfc42_img.jpg\)](#)
[Help](#) | [Search & Site Map](#)

Hello, hello! Wot's this, then?

This is a site for students and others interested in Nuclear Engineering as it relates to the program in the Department of Engineering Physics, McMaster University. Enjoy. Listen to a [short introduction](#) to the site (950kb swf file). (download the required [Flash player](#)).

- [Help](#) - Have a quick look to get oriented and to find helpful tips on using this site, including how to [contact me](#). Suggestions and comments are welcome. But before you do, check out the site [FAQ](#) page. Perhaps your question has already been answered.
- [FAQ](#) - Frequently asked questions for this site.
- [Careers](#) page - links to full-time and summer career and job information, including at our own reactor - *Jobs, jobs, jobs!!! Now contains articles relating to supply and demand.*
- [Downloads](#) Related to the Nuclear Industry.
- Canadian Nuclear Society [Universities Committee](#) - a committee devoted to assist in the coordination the activities of Canadian universities with nuclear programs, including the CNS Student conferences.
- [McMaster Nuclear Reactor](#) (tours available) - *You haven't lived until you have seen the light! [See the movie](#) - Hey Barry, you're famous!*
- [CANNUC Discussion Forum](#) - This site was started in the hope of promoting discussion regarding "all things Nuclear". Students and employees are invited to get connected via this discussion / posting board - *setup by Rob Pasuta of the McMaster Nuclear Reactor - Go Rob!*
- [Humour](#) - Take a break from work.
- Looking for general nuclear info, courses, links, technical reports, etc.? Check out the links below.

Announcements

Nuclear at McMaster University

- [Nuclear Engineering Program](http://engphys.mcmaster.ca/) <http://engphys.mcmaster.ca/>
- [Nuclear Facilities](#)
- [Radiation Safety Program](#)
- Medical Physics and Applied Radiation Sciences Program www.science.mcmaster.ca/medphys/
- McIARS www.science.mcmaster.ca/mciars/
- [Jump to UNENE research](#)

CNS

Canadian Nuclear Society

- CANTEACH is about info.
- UNENE is about delivery.
- NucEng is about students.
- **CNS is about professionals as individuals.**
 - Seminar type courses
 - Conferences
 - Fellowship and contacts
 - Forums and List servers
 - Education and Communication Committee

CNS Web Site Tour

<http://www.cns-snc.ca>

The screenshot shows the homepage of the Canadian Nuclear Society (CNS). The page has a black background with a central graphic of a stylized atom with a red maple leaf. The header features the organization's name in English and French: "CANADIAN NUCLEAR SOCIETY" and "SOCIÉTÉ NUCLÉAIRE CANADIENNE". A vertical navigation menu on the left lists various sections, including "Home", "25th Birthday!", "Branches", "Bulletin", "Conferences & Courses", "Contact us", "Council", "Education", "Event Calendar", "Honours & Awards", "Jobs", "Media", "Member C.V.s", "Membership", "News", "Nuclear History", "Nuclear Links", and "Publications". A yellow banner at the bottom left announces the "6th International Conference on Simulation Methods in Nuclear Engineering". A list of main menu items is on the right: "About the CNS", "Activities", "Publications", "CNS Membership", and "Contact Us". At the bottom, there is a notice about PDF files, a link to Adobe's Acrobat Reader, and visitor statistics.

[en français]
[Home](#)
25th Birthday!
[Branches](#)
[Bulletin](#)
[Conferences & Courses](#)
[Contact us](#)
[Council](#)
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6th International Conference on Simulation Methods in Nuclear Engineering

CANADIAN NUCLEAR SOCIETY
SOCIÉTÉ NUCLÉAIRE CANADIENNE

- **About the CNS**
- **Activities**
- **Publications**
- **CNS Membership**
- **Contact Us**

This web site links to several files in PDF format. Adobe's Acrobat Reader can be downloaded free:

This web site is maintained by the [CNS Internet Committee](#). Please forward any website-related comments to our [webmaster](#).
You are visitor number 48,804 since January 23, 2001.

COG

CANDU Owners Group

- CANTEACH is about info.
- UNENE is about delivery.
- NucEng is about students.
- CNS is about professionals as individuals.
- COG is about industrial partnerships in R&D
 - Shared R&D cost
 - Shared R&D facilities
 - Creation of and access to closed information databases

COG Web Site Tour

www.candu.org

CANDU Owners Group Inc. *La force dans la coopération* *힘은분통한상으로 이득* *Forta prin cooperare*
COG *Sóldez a través de la cooperación* *携手并进*
"Strength Through Co-operation" [Home](#) ♦ [Corporate Info](#) ♦ [Projects](#) ♦ [Resource Centre](#) ♦ [Help](#) ♦ [Contact Us](#)



[How does a CANDU Reactor work?](#)

Last updated
<January 9, 2004>

The CANDU Owners Group Inc. (COG) is a not-for-profit organization dedicated to providing programs for cooperation, mutual assistance and exchange of information for the successful support, development, operation, maintenance and economics of CANDU technology. All CANDU Operators in the world are members of COG.



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Questions?

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End