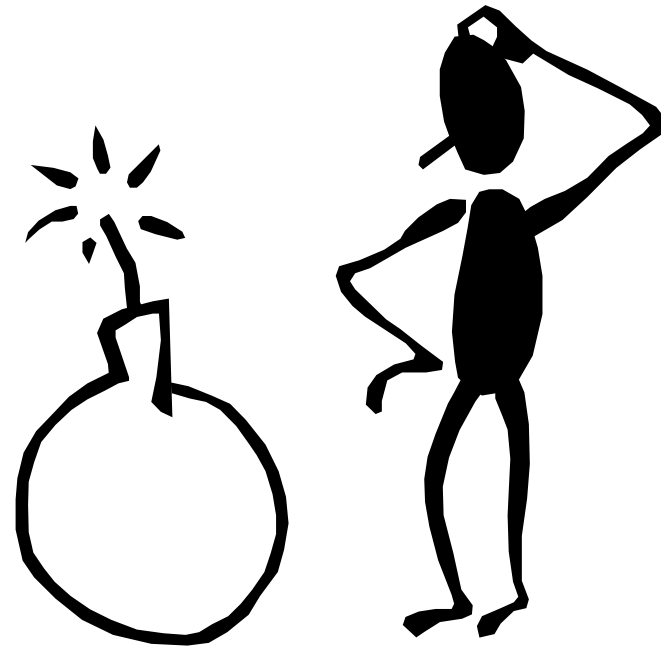


Meeting Present Day Educational Challenges with UNENE

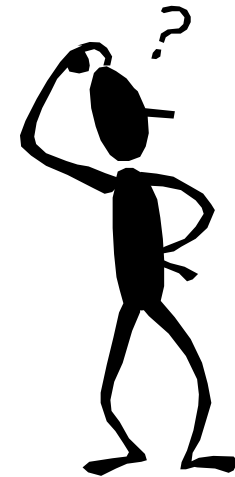


prepared by:
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prepared for presentation to the Networking Radiation Science in Health, Safety and the Environment, McIARS – COG Workshop, November 25-26, 2002, McMaster University

Overview

- Mandate and activities of UNENE
- Nuclear Engineering Background
 - The Issues and the overall vision
 - A view of the Canadian nuclear enterprise
 - Accreditation and University Standards
 - The status of Nuclear Engineering programs
- CANTEACH and UNENE progress
- Some concerns
- Steps forward
- Final message

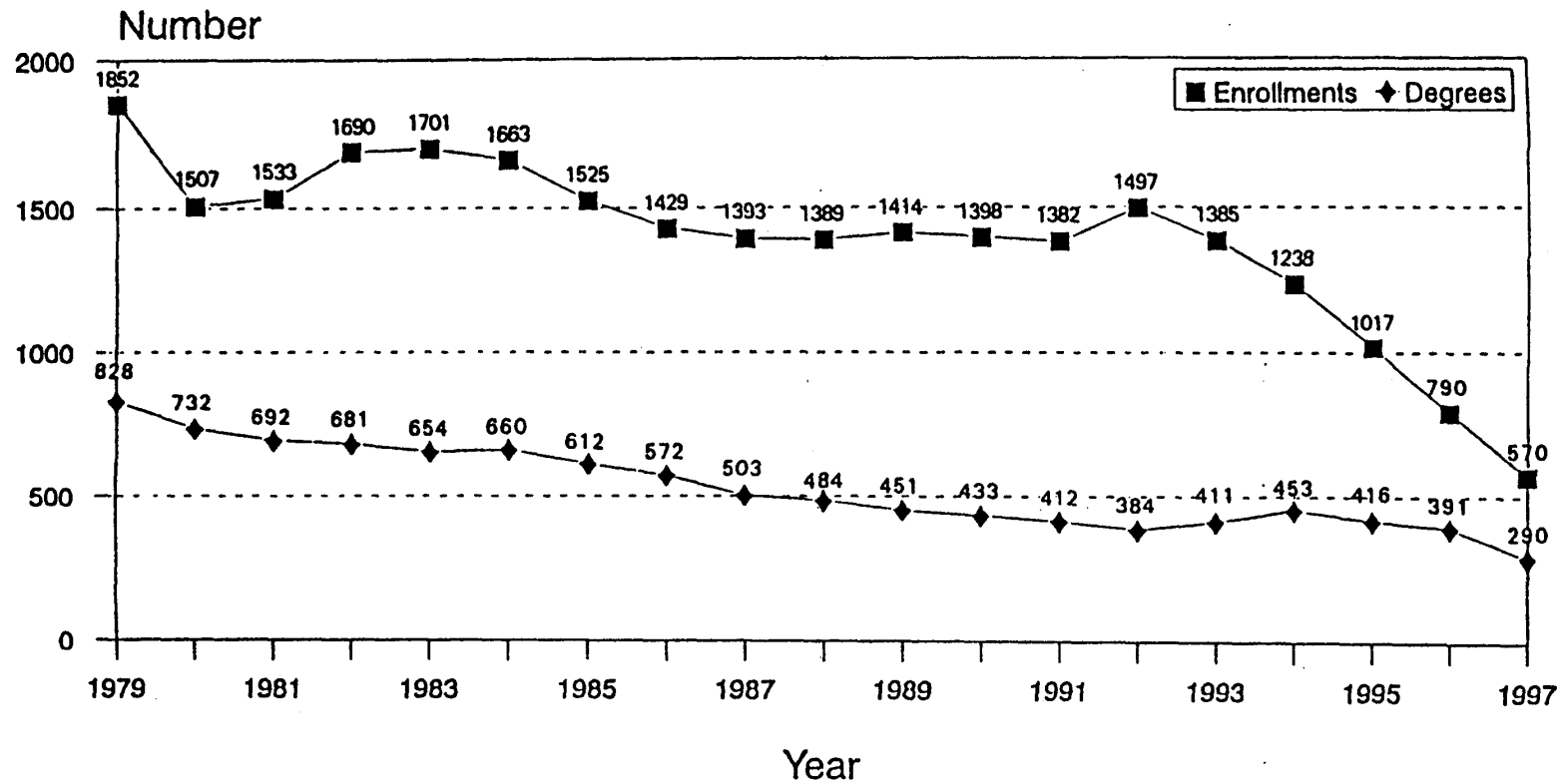


Mandate of UNENE

- Develop a Universities' Network of Excellence in Nuclear Engineering (UNENE) to create and sustain nuclear research at selected universities.
- Foster partnerships.
- Establish a sustainable supply of qualified nuclear engineers and scientists.
- Create a respected body of nuclear experts (for assessment and advising).

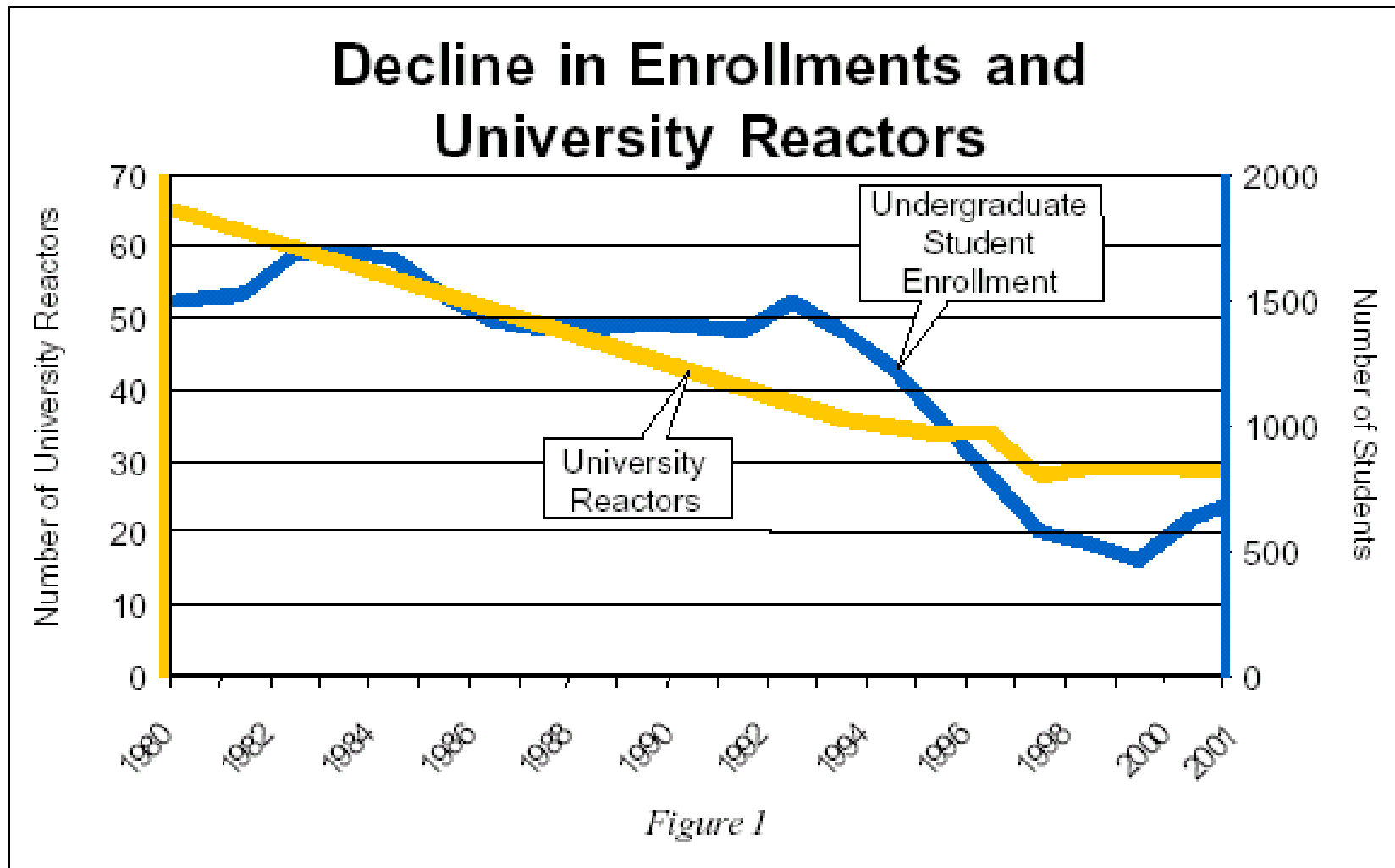
But why is it needed, what is the context and what are the issues in the road ahead?

Background



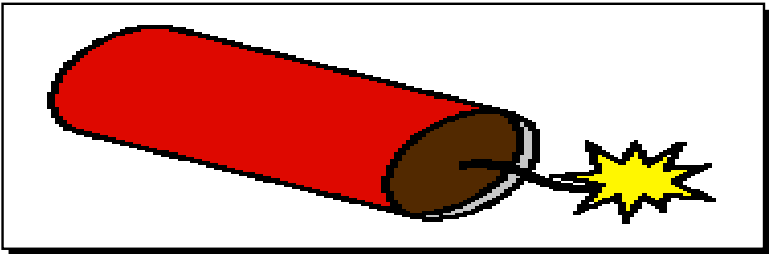
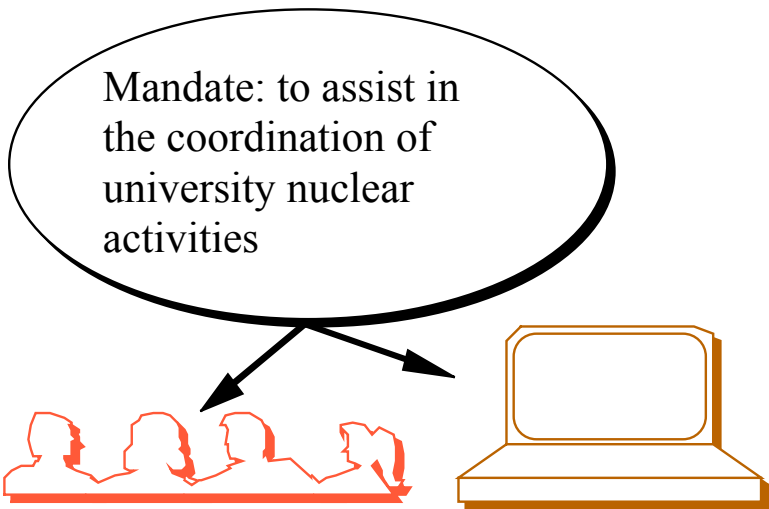
Nuclear engineering undergraduate (junior- and senior-level) enrollments and degrees, 1979–1997
(Source: U.S. Department of Energy)

Turning the corner in the US?



Source: University Currents, Spring 2002, <http://www.nuclear.gov/planning/currents.html>

Universities Committee



The Issue: low enrollment / expertise gap

- need to attract students
- need to make best use of existing expertise (university and industry)
- need to collaborate and share course material and teaching

University - industry collaborations:

- outreach to students,
- student support,
- research,
- teaching

Sharing of course material:

- distance learning
- reciprocal agreements
- sharing course material
- vision statements
- course outlines
- reference material
- diploma / degrees
- CD-ROM

The Issues

Succession planning

- education
- training
- certification
- why, not what
- the process vs. the product

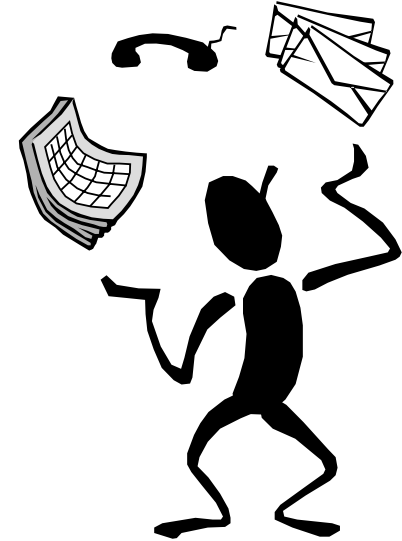
Client education and training

- material
- delivery

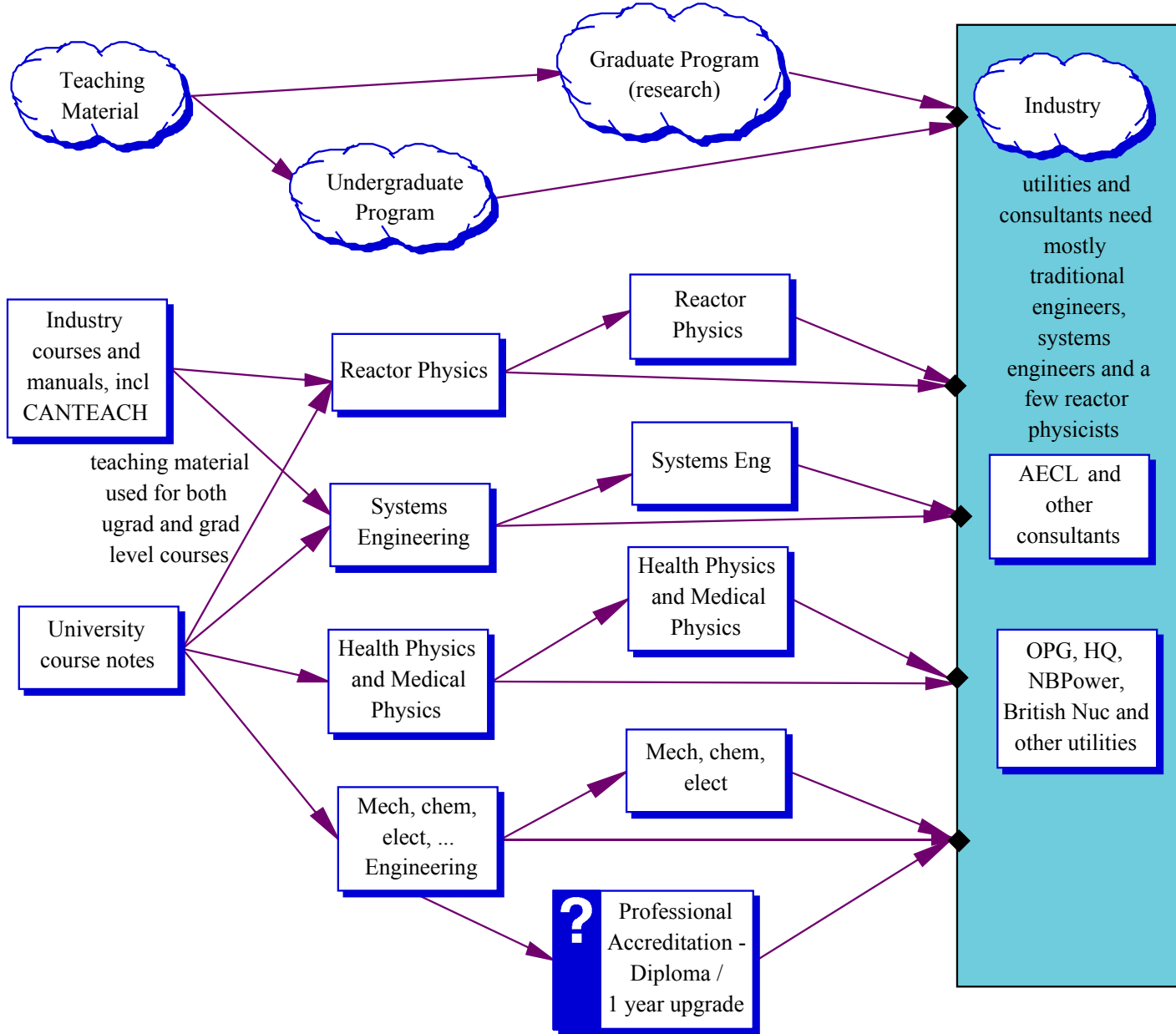
Survival of Nuclear Engineering Educational Programs

- reactor physics
- nuclear systems
- reactor safety
- nuclear materials
- ...

Whose problem is it, anyway? And where is the real need?

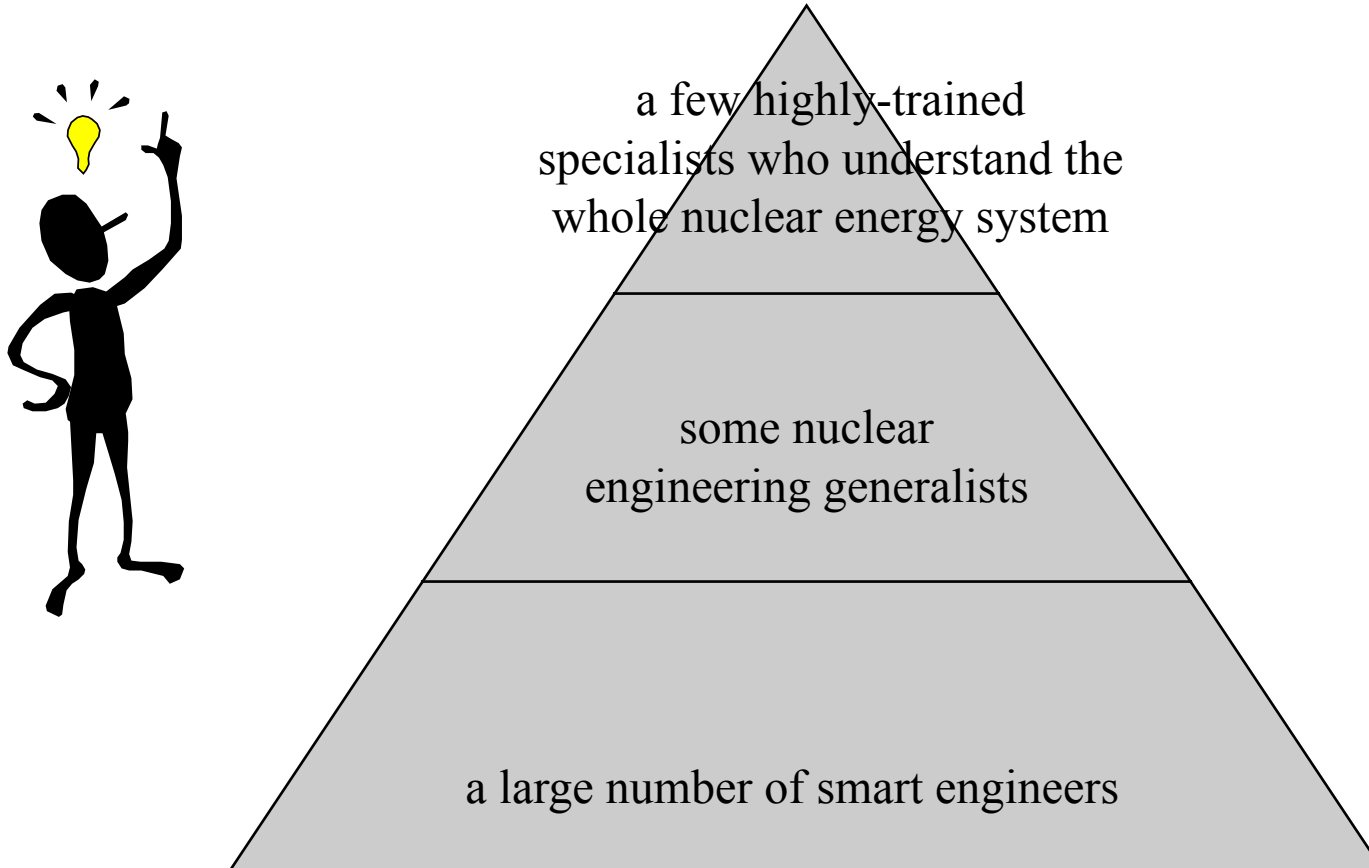


Nuclear Education Program



Succession Plan Vision

Intellectual Capital is industry's greatest asset. Thus we need to educate:



The need for design 'know how' is just as great in an operational support mode as it is in a design mode.

A view of the Canadian nuclear enterprise

Credo: The Universities are in the business of education so we can provide the baseline of training of fundamentals for the nuclear industry. The universities, really, are part of the infrastructure for industrial technology.

- We were failing to attract quality students in sufficiently large numbers as nuclear engineering is perceived as a moribund field.
- We absolutely needed to initiate a turnaround for this situation, and we didn't see how this could be done without obvious and well publicized support from the nuclear industry.
- Industry needed to make some commitments to long-term education by providing student scholarships and supporting university applied R&D. Why should a professor do applied R&D in the nuclear area? Why should students enter the field?
- The vast majority of recent young hires have had little or no exposure to nuclear training or even occasional nuclear courses. For the sake of the quality of work in the future, we need to have a workforce that understands the technology in which it is working!
- **The undergraduate level is at least as vital as the graduate level.**
- It is very important to expand our education of people in other countries in CANDU technology.
- UNENE is starting to address the above.

Accreditation and University Standards

- All Canadian university engineering programs are accredited by the Canadian Engineering Accreditation Board (CEAB). The professional associations, such as the PEO, work through this board.
- University and professional requirements dictate that standards be met and be shown to be met.
- The standards are biased towards education, not training. The focus is on basic concepts, not specific instances.
- Certification occurs through the university and college programs.
- It would be very difficult, time consuming and very expensive to duplicate this process within the industry.
- The wiser route would be to support existing programs and to be involved in the modification / enhancement of existing programs to better suit the needs of the nuclear industry.

The status of Nuclear Engineering programs in Canadian universities

- Who's who (visit the McMaster Nuclear Engineering web site at <http://nuceng.mcmaster.ca/> and go to the Who's Who page).
- AECL has prepared a brochure on the nuclear programs in Canadian universities as a beginning in setting up a network of centres of excellence.
 - this was done a few years ago
 - there has been no follow-up.
- The universities that have nuclear engineering options and conduct nuclear related research are McMaster, RMC, Ecolé Polytechnique and UNB.
- Other universities that have related expertise or otherwise can contribute include Toronto, Carleton, Manitoba, Queen's, Western and Waterloo.
- UOIT is coming online in Sept 2003 with two full undergraduate programs: (1) Nuclear Engineering and (2) Radiation Physics.
- Collectively we'd make a great nuclear department.

CANTEACH progress

- CANTEACH is intended to collect comprehensive documentation.
- Web site established at <http://canteach.candu.org> .
- Framework for the assimilation and production of material has been established
 - standard office application software (MS Word, Word Perfect, Visio, etc.)
 - delivery format is to be Adobe Acrobat pdf with a web based front end.
 - delivery mechanisms will be standard print, the web and CD-ROM.
- Focus will be initially on content preparation for ‘why’ CANDU is the way it is, rather than on more design descriptions.
- The plan is to prepare digestible, reusable ‘lectures’. Do it once, do it well, and move on. Stop reinventing the wheel.
- Current ‘workers’ are Dan Meneley (COG), Bill Garland (McMaster) and Yulia Kosarenko (COG). Hugues Bonin (RMC) prepared reactor physics and fuel management material while on leave in 2001/2002.
- Writers to come from universities and industry.

UNENE Progress

- Committed funding
 - OPG \$5M over 5 years
 - Bruce Power \$1.5M over 5 years
 - COG \$0.5M
 - CNSC \$0.15M
 - NuTech \$0.1M in kind
 - AECL considering \$1.5M or more

- The establishment of Research Chairs in Nuclear Engineers
 - McMaster – Nuclear Safety Analysis – position has been posted.
 - Queen’s – Advanced Materials and Chemistry – filled by Richard Holt.
 - Toronto – Leadership and Management in a Deregulated Electrical Energy Industry – position has been posted.
 - UOIT – Knowledge Management – in the works
 - Waterloo – Component Engineering – filled by David Shoesmith, Nuclear Waste Chemistry.
 - Western – Control, Electrical Systems and Instrumentation – status??

- The OPG sponsored course-based Master’s degree in Nuclear Engineering at McMaster University has been established. 2 students have completed the degree and 3 are in progress. Graduating students are hired by OPG.

UNENE Progress (cont'd)

- The Educational Advisory Committee (EAC) has been established and plans are in place for the delivery of courses based on the ADMI model.
 - Nuclear Power Plant Systems and Operations (G. Bereznai)
 - Reactor Physics (J. Koclas)
 - Engineering Risk Analysis (M. Pandey)
 - Reactor Chemistry and Corrosion (D. Lister)
 - Nuclear Materials (R. Holt)
 - Reactor Control and Instrumentation (J. Jiang)
 - Thermalhydraulics (N. Popov)
 - CANDU Reactor Safety (V. Snell)

- Tentative ideas for courses
 - Health Physics / Radiation Protection (McMaster?)
 - Power Plant Thermodynamics (R. Chaplin?)
 - Fuel Management (B. Lewis?)
 - Nuclear Waste Management (D. Shoesmith?)
 - Failure Modes (?)
 - Environment (?)
 - Codes, Standards and Jurisdictions (CNSC?)

Concern #1: The undergraduates are being ignored

- UNENE efforts to date are on the graduate level
 - Graduate level courses
 - Master's level scholarships
 - Research Chairs
- Admission standards prevents the bulk of the industry professionals from entering the UNENE sponsored courses.
- Undergraduate options in nuclear are receiving no support or attention. Industry apparently feels that they have no need for that.
- The more enlightened view is that:
 - Even the non-specialists working in the nuclear industry needs a solid appreciation of the nuclear aspects
 - The supply of excellent graduate students is contingent on solid undergraduate programs in nuclear

Concern #2: Will the ADMI format work for the learner?

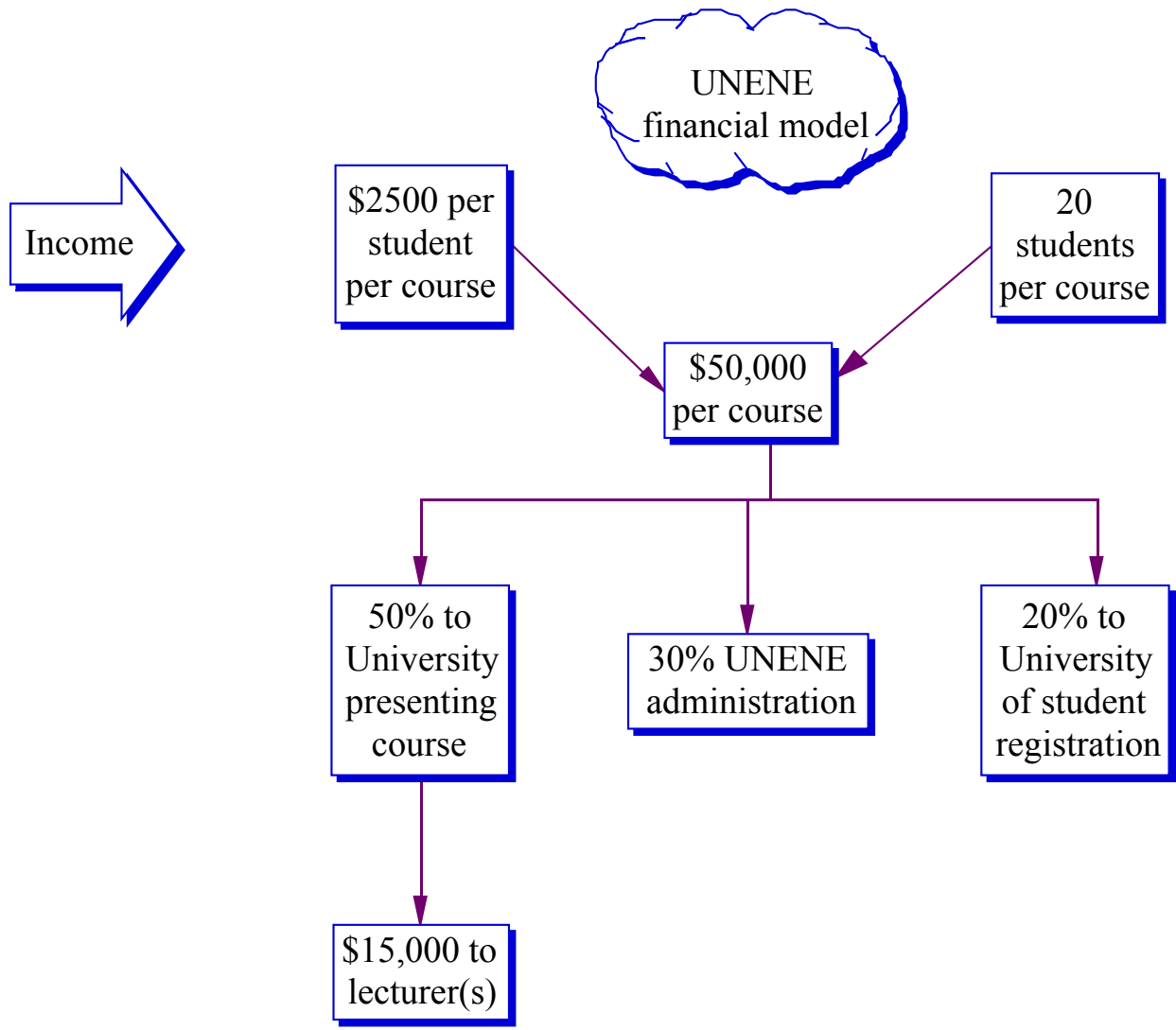
- ADMI format
 - Intensive lecturing over 3(?) long weekends
 - One month or so between weekends to do homework
 - Allows lecturer to go to students if needed
 - Allows working students the opportunity to take courses
- Can effective learning take place with such a format?
- Will anyone monitor this aspect?
- Who cares? Industry appears to be focused on the efficient delivery of material. They have NEVER spontaneously mentioned learning in conversations to date.

First Boy: I taught my dog how to speak last month.

Second Boy: But I have never heard your dog speak.

First Boy: I never said that he learned!

Concern #3: Will the universities accept the financial model?



Concern #4: Copyright Issues

- Who owns the lecture material?
 - The author, as per usual
- Will the lecture material be open to the general public?
 - Same as a regular course
- All the courses are run under the auspices of the universities. It is the universities that are giving credit for these courses.
- The bottom line is that UNENE is just the administrative unit that is bringing industry and universities together to deliver courses.
- Just need to establish the ground rules up front.

Steps forward (general)



- Do things that latch
- Do things that have the best bang per buck
- Get industry involved in
 - promotion - students must believe that the industry will exist in the future and is an exciting career choice
 - student hires
 - scholarships support
 - support of industrial chairs (perhaps shared by several partners),
 - support of sabbatical leaves (both universities and industry)
 - teaching
 - support of the Teacher's Course
 - code centre
- Distance learning / courses for industry / on-line reference material (CANTEACH)/ on-line refreshers /professional development....
- Capitalize on AECL / Utilities / CNSC in-house material
- Functional Area Managers can play a leading role in the above.
- UNENE must dovetail with the current university environment

Costs

- Sabbaticals are typically 15% of professor's salary + expenses. Perhaps each partner could sponsor one university / industry sabbatical leave.
- Grad student scholarships are about \$15k per year or less + cost of research. In addition, foreign fee differentials are currently about \$8k. Support can be general or targeted to a project, institution, student, etc.
- Undergrad scholarships can be about \$5k per year (flexible).
- Companies can cost out the time for its own staff for teaching, supervising and writing.
- An industrial chair at a university is about \$100k-\$200K per year for 5 years, usually. But it is an efficient way to focus a university program and lever matching grants.
- Distance learning facilities would be \$50k per year, say. Prices are coming down all the time. CD based courses would be very cost effective. Web-based solution can also be very inexpensive.
- It costs almost nothing to be on an Educational Watch: Company Area Managers can facilitate the collection and review of educational material.

Final Message

- We must continue to address the key issues of
 - Succession planning
 - Client education and training
 - Survival of Nuclear Engineering Educational Programs
- UNENE is a key element in addressing these three critical issues.
- Industry involvement is absolutely vital
- Need to address the undergraduate programs.
- We need to keep an eye on ensuring that real learning takes place.

