



February 24 – February 28, 2013 ♦ Phoenix, Arizona

## **Teaching Radioactive Waste Management in an Undergraduate Engineering Program**

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 **UNIVERSITY  
OF ONTARIO**  
INSTITUTE OF TECHNOLOGY

# The University

The University of Ontario Institute of Technology (UOIT)  
Founding legislation passed in September 2002  
Industry Relevant



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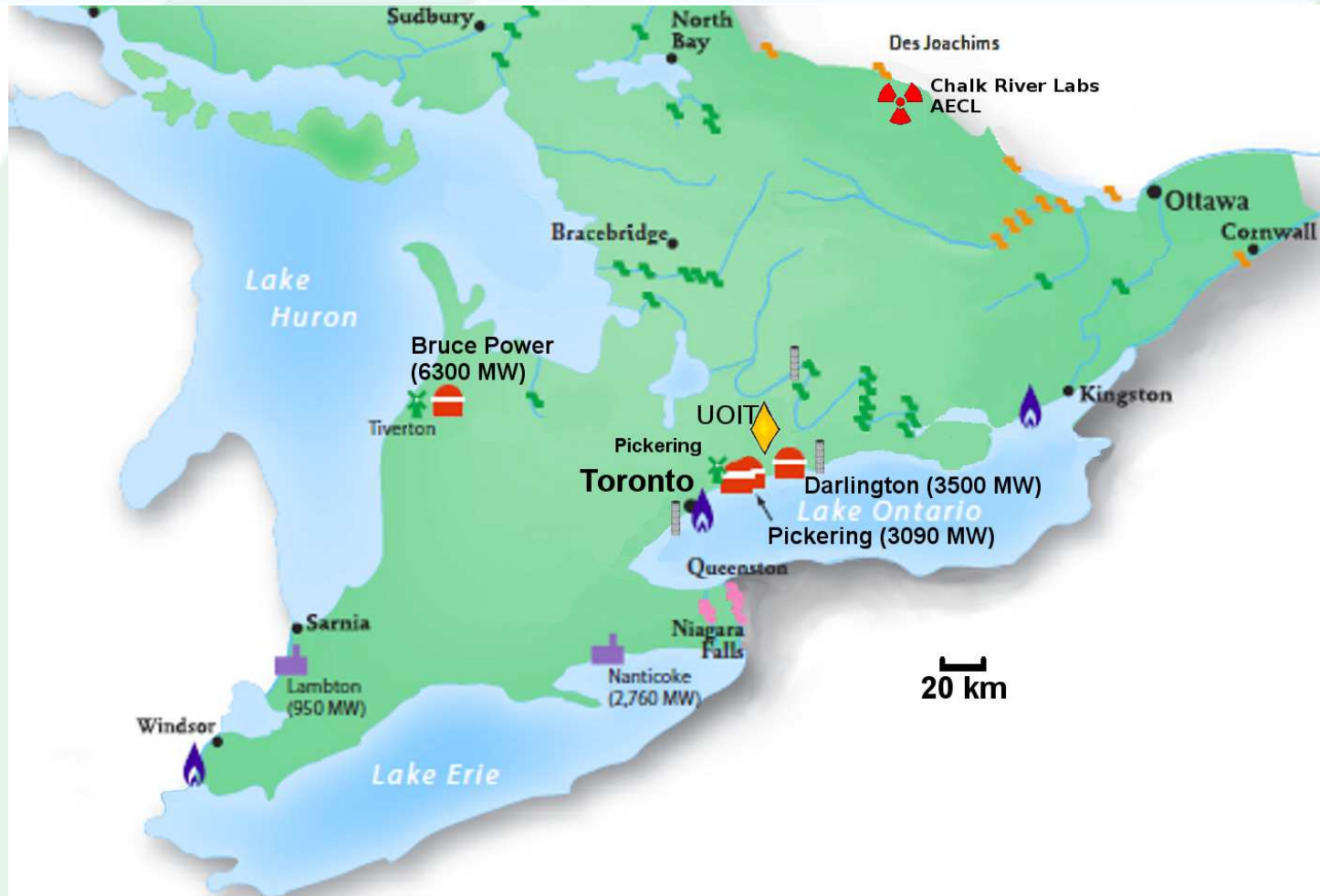
**First student intake September 2003**

**First class of Nuclear Engineering Graduated May 2007**

**4 year honors Bachelors; Masters; and Doctoral degrees, as well as diplomas (continuing ED)**

**Current enrollment >9200 students in undergraduate and graduate programs**

# Where is UOIT



# The Nuclear Program

Faculty of Energy Systems and Nuclear Science  
(FESNS)

Confer 6 degrees – BEng, BSc, BASc, MEng, MASc,  
and PhD

The only Nuclear Engineering  
program accredited in Canada

Over 400 undergraduates

Over 70 graduate students

14 Faculty



# UOIT BEng(Nuclear) Program

## Nuclear Specific courses

### 1<sup>st</sup> year

- Radiation and Nuclear Technologies

### 3<sup>rd</sup> year

- Environmental Effects of Radiation
- Nuclear Plant Operation
- Reactor Control
- Nuclear Reactor Design
- Integrated Engineering Laboratory

### 2<sup>nd</sup> year

- Introduction to Nuclear Physics
- Radiation Protection
- Nuclear Reactor Kinetics

### 4<sup>th</sup> year

- Nuclear Plant Design and Simulation
- Nuclear Plant Safety Design
- Risk Analysis
- Nuclear Fuel Cycles
- Radioactive Waste Management Design

# Nuclear Power

## Bachelor of Applied Science in Nuclear Power Plant operations staff

### Year 3

- Introduction to Nuclear Physics
- Radiation and Nuclear Technologies
- Radiation effects on Materials
- Mechanical Equipment and Systems
- Electric Power Systems
- Radiation Protection
- Nuclear Reactor Kinetics

### Year 4

- Nuclear Plant Operation
- Nuclear Plant Electric and Auxiliary Systems
- Nuclear Steam Supply Systems
- Radioactive Waste Management
- Nuclear Plant Safety
- Nuclear Plant Steam Utilization
- Reactor Control
- Nuclear Fuel Cycles

# Health Physics and Radiation Science

## 4 year Honors BSc Program

### 1<sup>st</sup> year

- Radiation and Nuclear Technol.

### 3<sup>rd</sup> Year

- Radiation Detection and Measurement
- Introduction to Nuclear Reactor Technology
- Radiation Biophysics and Dosimetry
- Radioisotopes and Radiation Machines
- Medical Imaging

### 2<sup>nd</sup> Year

- Introduction to Nuclear Physics
- Radiological and Health Physics
- Health Physics Laboratory

### 4<sup>th</sup> Year

- Risk Analysis Methods
- Industrial Applications of Radiation Techniques
- Environmental Effects of Radiation
- Therapeutic Applications of Radiation Techniques



# Radiation and Waste Management



3<sup>rd</sup> year undergraduate field laboratory

Core Courses  
Radiation Protection  
Environmental  
Effects of Radiation  
Radioactive Waste  
Management Design

# Radioactive Waste Management

Full semester course,

3 h lecture, 1 h tutorial per week

Field trips to Waste Management areas



# Radioactive Waste Management

Lectures cover:

- Definition and classification of radioactive waste
- Policy and philosophy of waste management
- Common disposal methods for different waste types
- Waste reduction
- Engineering and Design considerations for waste disposal facilities
- Pathways and environmental pathway analysis
- Computer modelling of waste release pathways

# Radioactive Waste Management

In Canada, radioactive waste management facilities are licensed by the Canadian Nuclear Regulatory Commission (CNRC)

The environmental authority is the Canadian Environmental Assessment Agency (CEAA)

Overall environmental assessment set by the CEAA, radiation aspects governed by CNRC

One challenge is to instill environmental and social awareness

# The Project

A key feature of the design course is an Environmental Assessment project

The project consists of:

- producing a conceptual design,
- analysing the design for compliance to environmental regulations,
- producing an Comprehensive Study Document, and Environmental Assessment, for the conceptual design, and
- defending the design in a public hearing situation

# The Project

Students are “randomly” placed into groups  
simulate a workplace assignment  
develop teamwork skills over the project

Phases of typical project in group setting

- concept development
- research
- work distribution
- critical evaluation
- documentation
- defend

Mandatory weekly project meetings  
sub-group interactions

# The Project

Students are introduced to the multidisciplinary nature of work and work-place

- stretch knowledgebase
- critical assess new information
- when is enough
- sharing new information
- collaborative writing
- time management

# The Review

First draft of the EA is submitted for review

Each team forms a review team

A public “hearing” is held – the review team and the proponent are present.

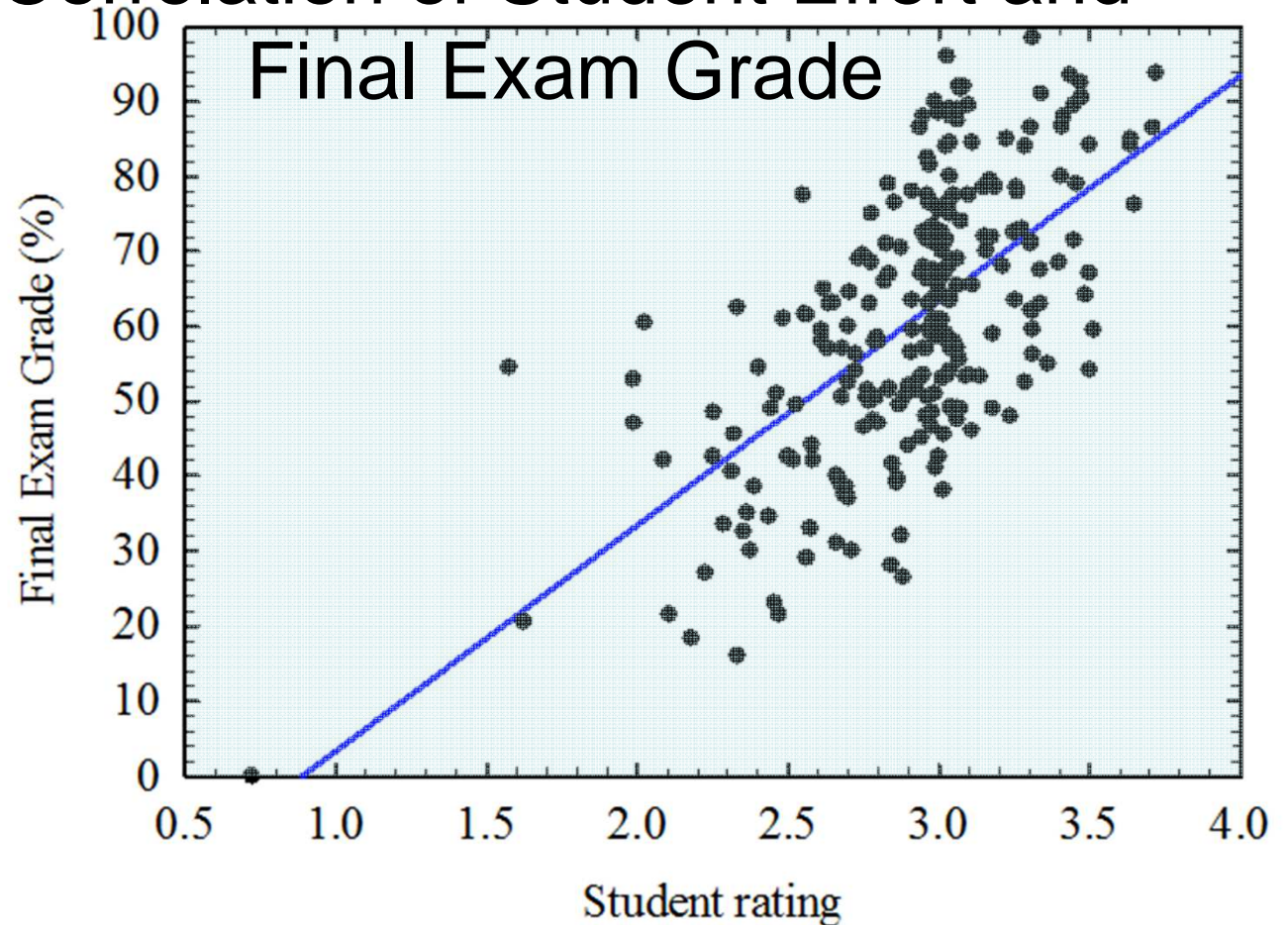
- The teams are usually subsets of the full team
- Review team is to provide a technical review
- Remaining teams to provide general public questions
- Students are in full control



# The Result

Students perform a performance rating of their teammates

## Correlation of Student Effort and Final Exam Grade



# Challenges

Balancing the work load  
Distributing the work  
Reading the guideline  
Writing

Time Management  
Skill recognition  
Plain English

# Conclusions

The Waste Management course has a major environmental assessment project which is a collaborative learning experience and provides opportunities such as:

- Gaining large project experience
- Learning the requirements of environmental assessment
- Developing social awareness





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FACULTY OF ENERGY SYSTEMS AND NUCLEAR SCIENCE

Waste Management Symposium 2013



Thank you