Summary – Queen`s Reactor Materials Testing Laboratory (RMTL)

Location: Grant Timmins Drive

Background and Summary

The Reactor Materials Testing Laboratory (RMTL) is an exciting new research endeavor for the Queen's Nuclear Materials Group in the Department of Mechanical and Materials Engineering of the Faculty of Engineering and Applied Science.

The RMTL will support the development of safe and economical nuclear power for Canada. Nuclear power is an environmentally responsible source of electricity that will be a major component of global power generation in the future. It produces electricity more cheaply, more effectively and with fewer adverse environmental effects than most alternatives. It contributes to the Canadian economy, especially in Ontario where 50% of our electricity is generated by nuclear power, supporting about 20,000 jobs. The Canadian nuclear industry as a whole currently employs more than 30,000 workers and contributes ~B$10 / year to the economy.

Materials behave quite differently in a reactor environment than in conventional applications. The differences are due to the presence of radiation fields, comprising fast particles and high energy, electro-magnetic waves. Fast particles cause displacements of the atoms in matter; this is most important in solids within the reactor. The RMTL will use accelerator technology to simulate these atomic displacements found inside a reactor. The research will help extend the life of existing nuclear power generating systems; it will lead to the design of safer, and more efficient nuclear reactors.

Accelerator technology is used for physics research at a number of universities around the country, and in many hospitals for diagnosis and treatment, including Kingston General Hospital.

The RMTL will be an internationally leading research laboratory. It will attract researchers both from Canada and internationally. Existing partners in the RMTL research program include: McMaster University, University of Western Ontario, Royal Military College, University of Toronto, the University of Ontario Institute of Technology (Canada), Imperial College and Manchester University (UK), Pennsylvania State University (USA) and the Australian Nuclear Science and Technology Organization.

The project budget is M$17.5, funded by the federal and provincial governments. Of this, M$5 will be used for construction of the new laboratory, starting in the summer of 2011 supporting the local construction industry, as well as creating two new permanent local jobs for long term operations, and a continuing population of 5-10 graduate students at Queen's University. The ~8000 square-foot laboratory will house an accelerator hall, a control room, rooms for services, laboratories for specimen preparation and characterization, and working space for researchers. The laboratory is expected to open for research in the summer of 2012.

More information: http://me.queensu.ca/research/nuclear/RMTL

See appendix for past communications and media coverage.

Licences and Approvals:

Queen's has held a license from the Canadian Nuclear Safety Commission (CNSC) for more than 40 years, which allows Queen's researchers to handle radioactive isotopes for research purposes. The CNSC is the federal agency that controls all radioactive materials and facilities to protect health, safety, security, and the environment.

The RMTL requires the approval of the CNSC because, like many facilities at hospitals and universities across the country, the research in RMTL will produce radiation (alpha, beta, gamma, neutrons) when it is operating, and relatively small amounts of short-lived radioactive materials.

Separate CNSC licences are required for construction, commissioning and operation. Once operational, the CNSC will monitor RMTL by receiving regular reports on the laboratory's operations.

The Grant Timmins site is already licensed for radioactive material storage by the CNSC; it is where Queen's keeps radioactive waste that is produced on the main campus prior to disposal.

All of the material produced at the laboratory will be handled and disposed of safely and in accordance to federal legislation and regulations. Staff will be thoroughly trained according to a CNSC approved radiation protection training.

Safe Operations:

The RMTL will be built and operated in accordance with federal legislation and regulations. Researchers and operators will be thoroughly trained in the use and handling of equipment and materials.

The operators, researchers and the public will be shielded from the radiation produced during the experiments. The small amount of short-lived radioactive materials produced will be safely handled and disposed of.

Queen's University has long history of using radioactive material safely. We have been licenced by the CNSC for more than 40 years and have a well established, comprehensive radiation safety program. The new laboratory will be operated within that existing framework.

The laboratory will be a secure facility, monitored 24 hours a day. The material has no commercial value. Specialized radioactive sources with equivalent levels of radioactivity to anything produced within the RMTL could be purchased commercially.

Radiation Produced by the Facility:

When RMTL is operating, the accelerator will produce radiation (alpha, beta, gamma, neutrons) in a secure contained environment, in a purpose-designed and constructed building. Radiation levels will be constantly monitored. The estimated exposure to employees will be of the order of the regulatory limits for the general public. The building has been designed such that radiation levels outside of the building will be negligible.

The experiments will produce relatively small amounts of short-lived radioactive materials that will still be radioactive after the accelerator is shut off. The materials involved in the experiments are in solid form. The RMTL will not produce particulate or gaseous radioactive materials. The materials will be handled safely, by thoroughly trained operators; student activities will be overseen by full time Queen`s staff.

Queen's announcement -2009-06-24

Queen's engineers receive $6.9M to build nuclear materials testing facility

Rick Holt and Mark Daymond, professors of Mechanical and Materials Engineering at Queen's University, recently received $6.9 million to support their work testing nuclear materials in a simulated reactor environment.

The funds were awarded by the Canada Foundation for Innovation (CFI) New Initiatives Fund, which supports new areas of research and technology development. The total value of the project, once provincial funds are awarded, will be $17.5 million.

"Materials exhibit fundamentally more complicated behaviour inside a nuclear reactor than when outside," says Professor Holt. "This is due to the presence of the high neutron flux which alters the way that deformation, corrosion and failure occur. This leads to a major problem for scientists working in reactor design."

While the degradation mechanisms in materials can be studied outside the reactor, the impact of radiation on these mechanisms must also be investigated. At present, this is done by carrying out a small number of targeted experiments in a nuclear test reactor, an expensive and time-consuming process. In most cases the underlying science is inferred indirectly from the data and key assumptions cannot be rigorously tested, notes Professor Holt.

"The Nuclear Materials Testing Facility is an exciting initiative to investigate these issues using an alternative approach, based on the use of accelerator technology to simulate reactor conditions rather than an actual reactor," he says. "The facility will provide a unique capability in Canada to support the development of materials for advanced reactor systems, and to improve our understanding of materials in use in existing reactors.

"We will be able to measure the dynamic effects of the reactor environment on dimensional stability, fracture and corrosion-induced degradation, as well as advancing understanding of the effects of a reactor environment by performing carefully controlled experiments," Professor Holt adds.

Profs to study nuclear reactors

QUEEN'S UNIVERSITY: Mechanical engineers receive $6.9 million

The Kingston Whig Standard

Two mechanical engineering professors at Queen's University have received $6.9 million to study nuclear materials in a simulated reactor.

Rick Holt and Matt Daymond won the award from the Canada Foundation for Innovation, which supports new research and technology development. By the time provincial money is factored in, the award will be worth about $17.5 million.

The two will use the money to study how the high energies found inside reactors causes degradation and corrosion, work that is most commonly done inside small research reactors, which is expensive, time consuming and not completely accurate, as the test reactors are much less powerful than commercial power-producing reactors.
The two say the virtual reactor will provide more accurate data and allow for more in-depth experiments that can then be applied to actual reactor design and operation.