You have authored hundreds of journal articles, government reports and internal classified reports and given scores of presentations at national and international conferences. What has sparked the fire that is fuelling your career?

I like solving puzzles – I am a fan of cryptic crosswords, for example – and I have always been interested in understanding how things work, so a career in research came naturally. Since I know a bit about chemistry and chemical engineering from my education in the UK, corrosion seemed like a perfect career fit, because it combines fundamental physicochemical principles with a practical application.

Why are you particularly interested in the chemistry and corrosion associated with nuclear power systems?

My first venture into the area of water coolant chemistry and corrosion came during my tenure at Atomic Energy of Canada Limited, now the Canadian Nuclear Laboratory at Chalk River, Ontario. I researched the transportation of corrosion products in the primary coolant of CANDU reactors and modelled the resulting growth of radiation fields around the circuit.

We came up with one of the first mechanistic models of the rise of fields due to cobalt-60, a radioactive isotope of cobalt that is ubiquitous in water-cooled reactors. We tied the radio-activation to the corrosion of the metal in contact with the coolant, so it was natural to develop an interest in the corrosion process itself.

My enthusiasm for the subject continued after I joined the University of New Brunswick (UNB) and has expanded to include other corrosion-related subjects, such as flow-accelerated corrosion (FAC), which has a considerable impact on the operation of all steam-raising plants, not just nuclear reactors. This mode of component degradation has led to the catastrophic failure of piping systems in power plants and resulted in injuries and even deaths.

What inroads have you and your colleagues made in FAC?

Our research has improved the understanding of the problem and is developing instruments that can be used to monitor the corrosion in real time while a plant is online.

How do you aim to ensure that the work coming out of the University will have direct application for the power industry?

A large portion of the funding of UNB Nuclear comes from industry. The direct funding for the Nuclear Research Chair comes jointly from the Federal Government via its Natural Sciences and Engineering Research Council and from the CANDU Owners Group. The former promotes academic impact, and requires industrial commitment, while the latter looks for impact on the Canadian nuclear industry. We also have ongoing research contracts with industrial organisations, such as the Electric Power Research Institute in the US.

Can you talk about your relationship with the Point Lepreau nuclear power station?

New Brunswick Power, through its CANDU nuclear plant at Point Lepreau, has supported UNB Nuclear since its inception. A senior staff member from Point Lepreau sits on the Technical Advisory Committee for the Nuclear Chair, providing some oversight and advice for the research activities. Reciprocally, we are advocates for the industry and provide highly qualified personnel as potential New Brunswick Power employees.

Point Lepreau staff ask for advice from time to time in our specialist areas, such as radiation field build-up. In fact, we just participated in a project to look at how radionuclides have built up in the primary coolant since the reactor was refurbished. The plant has also installed corrosion monitors, and we shall be involved in assessing their performance.
The cost of corrosion

University of New Brunswick researchers at UNB Nuclear are internationally renowned for their work into understanding corrosion in power stations and mitigating the consequences. Their innovations make nuclear and fossil-fuelled power plants safer and more efficient.

**THE DAMAGING EFFECTS** of corrosion are a persistent problem for the power industry. Whether it is a water-cooled nuclear reactor or a fossil-fired power station, materials degradation and the build-up of corrosion products can have serious impacts on their operation, in some cases raising economic, health and environmental concerns. Thanks to a supportive, synergistic relationship between researchers at the University of New Brunswick (UNB) and the power industry in Canada and abroad, however, efforts to mitigate the consequences of corrosion are resulting in practicable solutions for power plant operation.

Derek Lister, Professor Emeritus at UNB and Research Chair in Nuclear Engineering, joined the University’s department of Chemical Engineering in 1992, bringing with him a wealth of knowledge and experience regarding water coolant chemistry and corrosion gained at his previous employment with Atomic Energy of Canada Limited. As well as playing a key role in establishing the Centre for Nuclear Energy Research (CNER) – a research institute within UNB with which Lister and his team work closely, undertaking research to complement CNER’s applications of research to industry – Lister established a research group that has garnered an international reputation for expanding the understanding of high-temperature corrosion of power plant materials.

**COSTLY AND INEFFICIENT**

Lister’s research aims to understand why corrosion occurs, how it causes radiation field build-up in nuclear reactors and how it leads to reduced heat transfer in heat-exchange equipment. In learning the mechanisms behind these issues and how to predict them, Lister and the UNB Nuclear group help power plant operators reduce costs and improve efficiency.

Corrosion is expensive; its threat to the integrity of components exacts constant vigilance with periodic inspections by plant operators, usually involving shutdowns and loss of production. Corrosion products deposit around coolant circuits, increasing pressure drops and necessitating extra pumping power while at the same time reducing thermal efficiency and increasing emissions. Cleaning by mechanical and/or chemical methods also involves shutdowns but with the extra costs of chemicals and waste disposal.

Corrosion is minimised by controlling the chemistry of the system. This entails monitoring with instruments and analysing frequently to indicate the health of the plant. The information obtained is particularly useful in conjunction with predictions of the optimal conditions for inspection and/or cleaning; since shutdowns are costly. For instance, Lister has developed one of the first mechanistic models that can predict flow-accelerated corrosion (FAC), a phenomenon that affects all steam-raising systems. Unchecked, FAC can rupture a plant’s piping and in the past has caused severe injuries and even fatalities.

Research such as Lister’s is important. It enables the design of devices capable of measuring corrosion in real time while a plant is online. “We actually have one such instrument about to be commissioned in a fossil-fuelled power station,” states Lister. With it, the plant’s operators will be kept up to date on the health of the plant’s piping, minimising the chance for catastrophic failures to occur.

**BUSINESS TIE**

Receiving the majority of its funding from the Canadian Government and the CANDU Owners Group (COG), UNB Nuclear has a relationship with the power industry that is one of commitment and reciprocation. It investigates issues and develops solutions that have real-world impacts on the power industry, while the industry in turn strongly supports UNB Nuclear and requests technical advice and assistance.

In 2004, FAC caused a feedwater line to burst at the Mihama-3 pressurised water reactor (PWR) in Japan, killing and injuring workers at the plant. Owing to UNB Nuclear’s international reputation, Lister went at the request of the Japanese to get to the bottom of the accident. The result: a fruitful collaboration lasting several years; ideas to minimise the risk of FAC-induced ruptures in the future, and innovations to be implemented in PWRs.

Enjoying a reputation far beyond the confines of the UNB campus, and with the support it receives from institutes such as CNER and groups like COG, Lister and UNB Nuclear can continue to delve into the effects of corrosion, helping to provide safer and more efficient plants for their operators and the environment.