

NEW COLLABORATION TO PROTECT A SPECIES AT RISK

GRAPE: IMPROVING SEVERE ACCIDENT ANALYSIS CAPABILITIES

AECL'S INTERNATIONAL FOOTPRINT IN SAFETY, SECURITY AND NON-PROLIFERATION

VOYAGEUR

SAFETY, EXECUTION AND INNOVATION - EXCELLING TOGETHER

New AECL technology reaches private sector implementation

AECL has recently submitted a patent for its Composite Angle Profiling Tool (CAPT). This innovative tooling was developed to detect pipe wall thinning in areas in CANDU reactors with severe access limitations (feeder pipes). The technology was put to use in the Pickering A station and will soon be applied at the Bruce site. The successful deployment of this innovative AECL technology in the field is a clear example of how AECL helps to support a strong nuclear power sector in Canada.

The Composite Angle Profiling Tool is an ultrasonic testing inspection tool developed by AECL to produce wall thickness maps on feeder pipes and under welds. CAPT is based on technology first developed by AECL as part of a nuclear platform project in support of Wolsong Unit 1 Refurbishment. It was then modified and further developed by AECL for COG as part of the Feeder Integrity Joint Project. The first CAPT field trial was performed in 2009 at Pickering A by AECL as a commercial project.



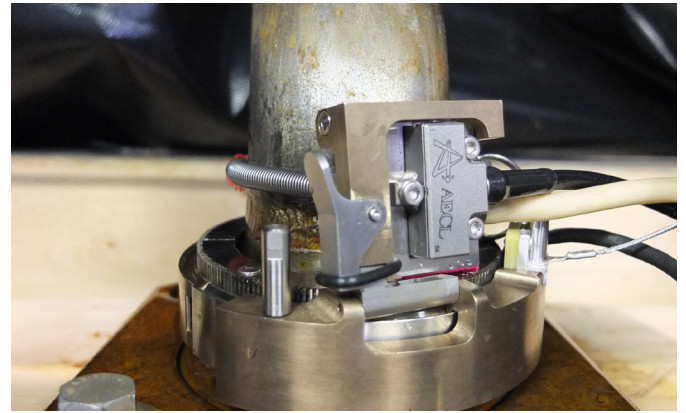
AECL's Ken Chaplin and H el ene H ebert work to refine the tool and technology in the Inspection, Monitoring and Dynamics lab in Building 456.

As part of the primary heat transport system, feeders are a crucial component in reactor safety providing coolant to the reactor core. Destructive examination of feeders had revealed highly localized thin regions (blunt flaws) immediately adjacent to Grayloc hub welds and fitting-to-fitting welds on the outlet feeders only. While blunt flaws are typically near the welds, more generalized thinning was also found at feeder bends beside or away from welds.

"The areas of the reactor that CAPT was designed to inspect are very difficult to access," explains H el ene H ebert, Research Scientist with the Inspection Monitoring and Dynamics Branch. "Our tool really excels at examining those difficult spaces – often with uneven or angled faces where the pipes bend to meet the hub. There are many obstacles, with tight tolerances and high radiation fields and contamination issues further complicating matters."

CAPT was first developed for feeder pipes in a Bruce Power A or Pickering A reactor. These reactors have as many as five welds to be inspected in as many as 480 feeders. The CAPT tool enables a more efficient job which helps to reduce worker dose and saves both time and money. The results are also far more detailed than competitor products





(Left) AECL's Composite Angle Profiling Tool (CAPT) tool mounted on a full-size mock up of a CANDU reactor's feeder piping. The tight spaces and angled surfaces provide ample technical and physical challenges.

(Right) A close-up of the CAPT tool mounted on a feeder pipe.

as CAPT uses improved data analysis software (FAATS-COG v3.0) which provides greater simplicity than competitor products, and at lower cost. CAPT also has the ability to help the analyst produce wall thickness maps through weld crowns, Grayloc hub welds and fitting-to-fitting welds. It is also compatible with the instrumentation and software already commonly used in other CANDU feeder inspections.

AECL has been working to train a team from Babcock & Wilcox, and in mid-February they will undertake a CAPT inspection at Bruce Power Unit 7. Babcock & Wilcox modified CAPT to apply to Bruce B and this will be the first CAPT inspection not led by AECL, although AECL will have expertise on site should it be required.

"With this inspection, the knowledge transfer from AECL to the private sector will be complete," Hébert states.

Development of a Graphical Animation Interactive Software for Severe Accident Analysis Code

When a massive earthquake, followed by a devastating tsunami, struck Japan on 2011 March 11, the Canadian Nuclear Safety Commission (CNSC) activated the Emergency Operations Centre (EOC) in Ottawa and assessed the situation in Japan. During these assessments, scenarios were reviewed for Canadian nuclear power plants. Several postulated severe accident progressions were analyzed using an integrated severe accident analysis tool called MAAP-CANDU. The Technical Specialists working in the EOC found the assessment and post-processing of outputs from the analysis tool to be too onerous before the information could be interpreted and understood. As part of the Fukushima lessons learned activity for the EOC operations, the CNSC approached AECL to jointly fund a software tool to animate and display the simulation results from MAAP-CANDU.

The animation software GRaphical Animation Package Extension (GRAPE) was developed by Fauske & Associates on a contract from AECL. The software provides a user-friendly interactive interface to MAAP-CANDU and thus helps study the effect of implementing severe accident management measures in a nuclear power plant. The software is now being tested by experts at AECL. GRAPE is able to access the transient plant conditions such as pressures, temperatures, and concentrations in various plant components such as pressurizer, fuel channels, fuel bundles, and containment during a simulation and display the values on the screen to provide an overview of the accident progression and the plant response. The user can also intervene in the accident progression in an interactive mode to assess "what if" scenarios of operator actions such as opening or closing valves and starting or stopping pumps.

The intense testing of the animation package indicates that GRAPE will be able to meet the requirements of the EOC of the CNSC and provide a powerful simulation tool to graphically monitor the simulated severe accident progression during any nuclear emergencies in the future.

Economic Action Plan 2014 and AECL funding



Last week, Canada's Minister of Finance, the Honourable Jim Flaherty, tabled the Government of Canada's federal budget in Parliament. This is a good budget for AECL, and I want to provide you with my perspective as to what the budget means for us.

First, I'm pleased to advise that the budget – known as Economic Action Plan 2014 – includes a provision of \$117 million for AECL over the next two years. This is made available to AECL in support of maintaining safe and reliable operations at Chalk River Laboratories, ensuring a secure supply of medical isotopes and preparations for the expected transition of the laboratories to a Government-Owned, Contractor-Operated model.

This funding provision is in addition to other funding we receive from Government. AECL receives an annual appropriation, the principal mechanism that enables us to conduct our science and technology activities on behalf of the Government. We also receive targeted funding for programs such as the Nuclear Legacy Liabilities Program and the Port Hope Area Initiative. Collectively, this funding is entirely consistent with our new Corporate Plan, which is currently undergoing government approval. With this funding secured, we will continue to deliver on our projects and programs to Government according to plan.

One of the key purposes of the funding provided to AECL through the budget is to enable us to continue with important investments in our capital program in 2014-15. I am particularly pleased to highlight that the budget provision bodes well for major projects we are planning to undertake. I will be providing more details on the capital program in the near future.

With this budget, the Government of Canada has signaled that it will continue with its freeze on operating budgets of federal departments in order to meet its fiscal objectives. Our new Corporate Plan aligns with this policy direction. Our ongoing strategic initiative to enhance productivity helps us to meet this commitment and ensure that we live within our means. And of course, we receive revenues from our work for third-party customers. We are continuing to improve connections with private industry by focusing on customer satisfaction, on leveraging our assets and capabilities within the market, and by transferring our innovations to the private sector for commercial exploitation. Through these efforts we are able to stimulate business innovation and, ultimately, help AECL realize additional revenues.

As I have highlighted in recent All Staffs, I expect our workforce size over the coming year of transition to be within a few tens of our current size. With this budget announcement, I want to confirm that this continues to be my planning direction. Of course, implicit in my direction is my expectation that we will deliver on our commitments to Government, to our other customers, to our regulators, to our collaborators. I am confident we can do so.

Finally, the budget also signals pending changes for health and benefit plans for public service retirees. Once the details of these changes are announced by the Government of Canada, we will make that information available to employees.

I ask for your continued support in meeting our commitments. Collectively, we must work together towards this common goal in order to establish the conditions for our future success.

Robert Walker
President & Chief Executive Officer

AECL collaboration with the University of Ottawa will advance the understanding of an important species



In our busy day-to-day lives, sometimes it's easy to overlook the fact that we work in a pretty unique location here at the Chalk River Laboratories. We get accustomed to the drive to site and the walk to our building and often forget about the beautiful lakes, rivers and forests that surround us, not to mention the diverse plants and animals that live within them.

One of these unique animals is known as the Blanding's Turtle, which is an exceptionally long-lived species that resides on site. Despite the fact that it can live in excess of 75 years – we should all be so lucky – the naturally small reproductive success and low recruitment make this species very vulnerable to extinction. Road mortality represents a serious threat to the survival of the species in addition to the loss and fragmentation of wetlands from infrastructure development.

"We're extremely interested in the Blanding's Turtle here at CRL, not only because it is listed under Federal Species at Risk Act (SARA) but also because the turtle is semi-aquatic," explains Annie Morin, an Environmental Specialist in AECL's Environmental Protection branch. "This means that the turtle does quite a bit of travel on land, whereas most of the other turtles present on-site tend to stay in the water or very close to it.

"While the listing of the Blanding's Turtle under SARA has triggered several research projects on the species, unfortunately, most of the scientific information on this species is fairly new and not specific to the CRL site," adds Morin. "So, it is difficult to understand the behaviour of the CRL population and predict its movement patterns based on the data that's currently available."

To conduct the research, AECL's Environmental Protection branch contacted a reptile Subject Matter Expert based at the University of Ottawa, Dr. Gabriel Blouin-Demers (pictured left), who has published over 90 articles in peer-reviewed journals on the ecology of reptiles. More specifically, Dr. Blouin-Demers and his graduate students have conducted studies on Blanding's Turtles in our geographic area notably Thousand Islands National Park and Gatineau Park.

"Trapping in the right location using the right equipment and the right tracking techniques is absolutely critical in getting good data for this type of study," notes Morin. "With Dr. Blouin-Demers on board, we've been able to improve all of our techniques, which will help us ensure that we get the results we are after."

The results Morin describes will not only support AECL's compliance efforts with respect to SARA, but they will also help us to implement proper mitigation measures for the conservation of the species, maintain routine operations, and increase the science knowledge on the Blanding's Turtle. And, all of this work will contribute to the generation of highly qualified people, in line with AECL's Value Proposition and helps to ensure that our nuclear sites and clean, safe environments.

"The Master student leading this project as part of Dr. Blouin-Demers team is a local student from the Ottawa Valley," concludes Morin. "It's win-win. We get to help contribute to a student's education while getting the results that we need to help protect this important species here at the Chalk River site."

The winter weather hasn't slowed things down - the work is actually already underway. The project began this past January, while the actual fieldwork is scheduled to begin in the spring. Funding was provided primarily by the Nuclear Legacy Liabilities Program and AECL's R&D group, with in-kind contributions provided by the University of Ottawa. Other partners in this project include the Ontario Ministry of Natural Resources and Environment Canada.

We're lucky to live and work in a beautiful part of Ontario with wonderful animals like the Blanding's Turtle. Projects like this show the respect that AECL has for its local environment and, hopefully, can provide us with the necessary guidance to ensure the continued health and well-being of this species for many years to come.





Collaborations with the IAEA connect AECL to international opportunities

From Fukushima follow-up, to enduring issues with Iran and Syria, to nuclear power innovation and nuclear sciences, the International Atomic Energy Agency (IAEA) based in Vienna, Austria (with its 161 member countries) has a broad mandate that focuses on the safe, secure and peaceful uses of nuclear S&T.

In the area of safeguards, the IAEA verifies that countries comply with their commitments under the Non-Proliferation Treaty to ensure that nuclear material and facilities are used for peaceful purposes and not for a weapons program. In fact, the AECL-developed Cerenkov Viewing Device is the “workhorse” tool used by IAEA inspectors to confirm that nuclear fuel is not being diverted. AECL recently patented a state-of-the-art advancement of this technology which allows for automation and other improvements of this vital task.

As an independent, intergovernmental science and technology-based organization in the United Nations family, the IAEA also serves as the global focal point for nuclear cooperation and for supporting the use of nuclear science and technology for peaceful purposes, including the generation of electricity, using nuclear and isotopic techniques to promote sustainable development in areas of health, agriculture and water management, and facilitating the transfer of the technology to its developing member states.

“AECL has worked with the IAEA for many years supporting Department of Foreign Affairs Trade & Development and other federal government departments in their interactions with the IAEA. Today AECL is fully engaged with the IAEA on many levels and has interactions with every IAEA department,” says Bob Speranzini, Head of National and International Collaborations.

“Most of the work that we do is in the form of technical cooperation and support, but we also participate in meetings and provide support in areas related to policy

particularly as it pertains to non-proliferation and safeguards,” Speranzini continues.

AECL also has a good track record of chairing working groups and projects, one example being the Technical Working Group on Advanced Technologies for Heavy Water Reactors. AECL has also Chaired the INPRO Steering Committee which focuses on innovative technology, advanced fuel cycles and long term sustainability of nuclear power.

A quick roundup of AECL-IAEA initiatives best illustrates the interconnectedness of the two organizations. AECL staff participate in about 50 meetings a year with the IAEA (with IAEA reimbursement of expenses in many cases), mostly in the form of technical and expert meetings on topics ranging from operational radiation protection, environment, safety, security and safeguards to research reactors, as well as materials and chemistry of supercritical reactors, and decommissioning of nuclear facilities. In some cases, AECL staff participate as lecturers for IAEA training courses. As well, AECL supports technical visits and attachments in Canada and provides cost free experts (CFEs) to the IAEA.

Christine Butler, Manager of R&D Operations, coordinates the AECL participation and works to ensure effective communication of opportunities to engage with the IAEA.

One area of on-going AECL engagement with the IAEA relates to post-Fukushima assessment and follow-up. AECL staff actively worked with the IAEA immediately after the Fukushima accident to assess radiological consequences and now continue on working groups preparing the IAEA Comprehensive Report due in 2014. The IAEA is looking to maintain momentum in international efforts to strengthen nuclear safety and emergency preparedness since Fukushima and AECL is fully engaged in working with them including participating (as part of Canadian Government delegations) in the IAEA Fukushima Ministerial in late 2012, and the Ministerial on Nuclear Power in mid-2013.

For more information on AECL’s domestic and international collaborations and the IAEA, please contact Bob Speranzini.

AECL continuing to lead on nuclear safeguards and advancing 'Safeguards by Design' concept

On any given day, Jeremy Whitlock, AECL's Manager of Non-Proliferation & Safeguards can be found in a small office at a quiet, secluded wing of Building 600 ready and willing to put his work aside and to talk about the serious matter of nuclear safeguards.

Reminiscent of an academic setting, his office is packed with a collection of reference books and reports, some which have a noticeable vintage quality to them, and a large, map like chart that hovers over his work station and is seen periodically in the R&D ranks.

"That's when the world kind of came together for me," Jeremy says wistfully as he draws my attention to the Chart of Nuclides which are presented in three semi vertical groupings of tiny boxes with the name of the elements in small script arranged at a 45 degree angle. "This is the window into the invisible but real world of nuclear theory and science," he adds as he points to the line of stability, which draws, by some force of nature, all nuclides to its centre.

Nuclear safeguards is a vast and large body of technical knowledge and best practices that has evolved over time in the context of long standing international agreements and obligations overseen by both domestic and international organizations such as the Canadian Nuclear Safety Commission (CNSC) and the International Atomic Energy Agency (IAEA).

As always, one would expect all roads to ultimately lead to CANDU power reactors, and where nuclear safeguards are concerned, that is certainly no exception. This is not solely the opinion of a true believer, which Whitlock is through and through (Jeremy is a second generation Whitlock to make CRL his career); the CANDU reactor platform has an international reputation for proliferation resistance and "safeguardability," as the technical colloquialism goes.

The cornerstone of the international non-proliferation regime is the *Treaty on the Non-Proliferation of Nuclear Weapons*, or NPT. This treaty, which Canada endorsed in 1972 by being the first country to bring into force a Comprehensive Safeguards Agreement with the IAEA, provides assurance to the international community that Canada is not using nuclear material for the production of nuclear weapons or other nuclear explosive devices.

"These are serious obligations," Whitlock tells us with a grave look, "and non-cooperation and non-compliance brings with it serious repercussions," he adds.

Safeguards require accurate accounting of nuclear material and inspection activities which include various technical measures to provide assurance that sensitive material remains in place. To ensure this, the safeguards agreement gives the IAEA the right and the obligation to monitor Canada's nuclear-related activities and verify nuclear material inventories and movements within the country.

This includes the tracking of all activities involving nuclear material at CRL, although, it should be noted, this important daily operational requirement (as reported in the December 2010 issue of *Voyageur*) is not within Whitlock's purview, but the Nuclear Materials Management group. His responsibilities in non-proliferation look further afield, to Canada's support of the IAEA and the CNSC, as well as Canada's contribution to the international Generation IV advanced reactor program, and AECL's support for CANDU Energy Inc., specifically CANDU safeguards.

"CANDU technology sets the standard for effective and comprehensive safeguards, largely because of the intrinsic characteristics of the reactor design – including the fact that the CANDU fuel cycle does not require an enrichment facility," says Whitlock, "as well, plutonium concentration in spent fuel is low, particularly when compared to light water reactors."

On-power refuelling requires complex, automated, and monitored processes as standard design features he tells us, and our international collaboration with organizations like the IAEA established a transparency



framework that monitors reactor power history, individual bundle tracking at all times, both on-load fuel handling (bundles entering/leaving the core), utilizing state-of-the-art verifications technology, some of which Whitlock tells us is performed remotely.

“Yes it’s like big brother is watching, all the way from Vienna,” he says half-jokingly, “watching the bundles going in, watching them come out the other end.”

Truthfully, verification is performed by exception, not constantly, and is often triggered by discrepancies in a given inventory or an unexplained shortage which would necessitate a review of digital surveillance data. The transparency framework aims to detect diversion or theft of fuel and relies heavily on plant data. Remote monitoring provides another layer of security and proliferation resistance.

In the safeguards lexicon, continuity of knowledge is a term that is often used to describe a means to assure long term consistency in fuel reporting. A means to achieve this is state-of-the-art IAEA seals (designed by AECL) which are tamper-proof and allow containment of fuel and radioactive materials.

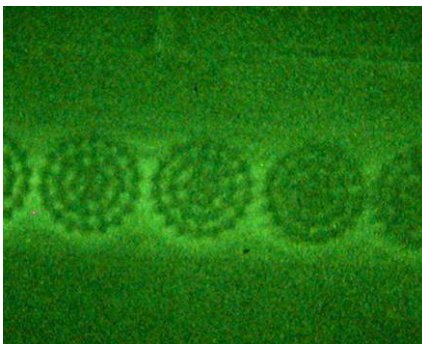
Whitlock says that as a founding member of the IAEA in 1957, Canada has been a leader in the development of a global safeguards regime and has provided the IAEA with

some their “workhorse tools,” like the AECL-developed Cerenkov Viewing Device, a portable device that allows the detection of diverted fuel in spent fuel pools.

“IAEA safeguards are developed with our input in many ways, and aim at the timely detection of significant quantities of diverted nuclear material and are based on material accountancy. This includes declared material as well as undeclared production and independent verification,” Jeremy concludes.

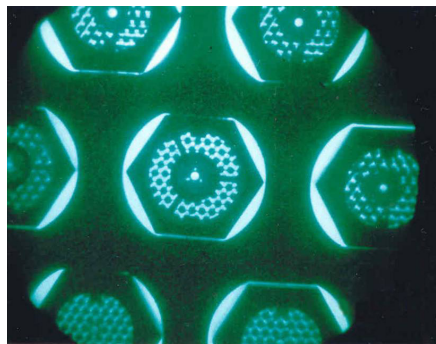
In recent years AECL has supported the IAEA’s efforts to lower the cost and increase the efficiency of safeguards, by incorporating them at an earlier stage of reactor design – a practice they labelled “Safeguards by Design”. AECL’s experience with CANDU safeguards gives us much sought-after expertise, which will be of particular help to the IAEA when it comes to new reactor concepts (such as Generation IV designs, or some “Small Modular Reactor” (SMR) concepts), for which traditional safeguards approach are either too inefficient or simply inapplicable.

“The goal is to stay ‘ahead of the game’”, explains Whitlock, “Sometimes relatively small design changes, made early enough in the process, can lead to huge cost savings or improved effectiveness, or both. We’ve seen this ourselves at AECL and have shared this best practice with the IAEA and the rest of the world.”



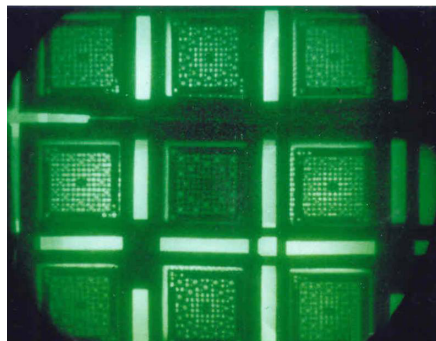
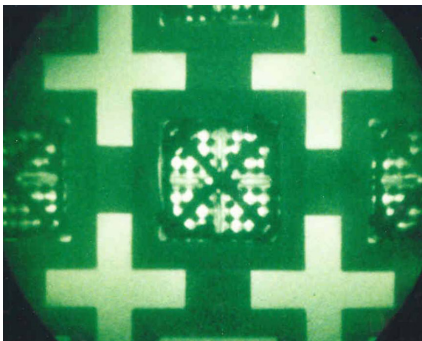
CANDU fuel bundles

BWR fuel assembly



VVER fuel assembly

PWR fuel assembly



Cerenkov Viewing Devices (CVD / QVCD)

These devices are the instrument of choice by international inspectors for routine spent fuel verification.

The Cerenkov Viewing Device (CVD) technology is used by safeguards inspection agencies to quickly verify spent nuclear fuel in spent fuel bays by amplifying the Cerenkov radiation emitted by the spent fuel under water. CVDs can use a 105 mm lens for short focal distance work (minimum 0.5 m) or a 250 mm lens for telescopic work (minimum 5 m). The CVD is designed for verification of inventories of enriched spent fuel.

The Quantitative Cerenkov Viewing Device (QCVD) technology has the added capabilities of capturing a digital image of spent fuel under water for records purposes and a quantitative assessment of burn-up and cooling time of the spent fuel through post analysis techniques. The QCVD would be capable of viewing the fainter radiation from spent CANDU fuel and could also be useful to verify the burn-up of spent fuel before its relocation to long-term storage.

The CVD / QCVD is considered to be less expensive, more portable, more time efficient and simpler to operate than similar technologies.



EAMS launched on Monday, February 24

Avantis.Pro, the Enterprise Asset Management Software (EAMS) project is on schedule and launched on Monday, February 24 as planned. For most users, this process will have no impact. Work requests can be submitted using the normal process and Work Management staff will enter the requests into the system.

For more information on this important new software check myAECL.

New Faces: 2014 January

Movassat, Mohammad
Horton, J
Durand, Raynald
Abidi, Seyed Aamir
Ramkissoon, Brandon
Pollit, Lori Marion
Stransky, Carlie Nancy
Peters, Kevin
Chow, Courtney
Singh, Navjot
Winchester, Dylan
Wardle, Christoher
Liu, Song Rebecca
Bhatti, Ammar
Vigneswaran, Arusanth
VandenBerg, Richard
Cole, Rodney
Mckay, Korey
Gaubie, Mariana
Huang, Sainan Gina
Pandher, Rajdeep
Duhaim, Nicholas
Essington, Autumn
Bhalla, Navneet
Chen, Billy
Border, Matthew
Desautels, Christian
McCaugherty, Kevin
Derbyshire, Vicki
Muhammad, Farrukh
McClellan, Neil
Wolfe, Benjamin
Toole, Sydney
Mistry, Jaydeep
Sharma, Abhinav
Erickson, Michael
Taylor, Sarah
Boyer, Antoine
Zia, Ahmad
Alarie, Kevin
Rodowa, Kurt
Hussick, Joliene
Mullen, Kellie
Das, Saumya
Hanlon, Sean
Sawadogo, Tegewinde
Mitchell, Crystal
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Li, Youwen
Burton, Alison
Bonter, Ronald

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WL PROJECTS
WL ENGINEERING
THERMALHYDRAULICS
APPLIED PHYSICS
FUEL DEVELOPMENT
ENVIRONMENTAL PROTECTION
ENVIRONMENTAL TECHNOLOGIES
PROCESS IMPROVEMENTS
CIVIL ENGINEERING (CRL)
MAINTENANCE ENG AND ASSESSMENT
MAINTENANCE ENG AND ASSESSMENT
MANAGEMENT SYSTEM AND SERVICE
PROTOTYPE REACTOR DECOMMISSION
D&WM PROGRAMS AND STANDARDS
WL MAINT PLNG AND WORK MGMT
IIP HARDWARE
OPERATIONS PROGS AND STANDARDS
CIVIL ENGINEERING (CRL)
CONFIGURATION MANAGEMENT
BUSINESS DEVELOPMENT
CHEMISTRY/ENVIRONMENT
ENVIRONMENTAL TECHNOLOGIES
FIRE PROTECTION PROGRAM
CIVIL ENGINEERING (CRL)
MO-99 PRODUCTION FACILITY
MAINTENANCE ENG AND ASSESSMENT
MECHANICAL EQUIPMENT DEVELOPMT
APPLICATION SERVICES
FUEL & FUEL CHANNEL SAFETY
CRL EMERGENCY PREPAREDNESS
MECHANICAL EQUIPMENT DEVELOPMT
ENVIRONMENTAL TECHNOLOGIES
INFRASTRUCTURE SERVICES
INFRASTRUCTURE SERVICES
STRATEGIC PLANNING
ENVIRONMENTAL PROTECTION
ENVIRONMENTAL PROTECTION
PROTOTYPE REACTOR DECOMMISSION
WL MAINT PLNG AND WORK MGMT
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RESOURCING AND TRAINING
PLANNING AND PROJECTS
FINANCE OPERATIONS
FINANCE OPERATIONS
WASTE MGMT AND ENVT REMEDIATION

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