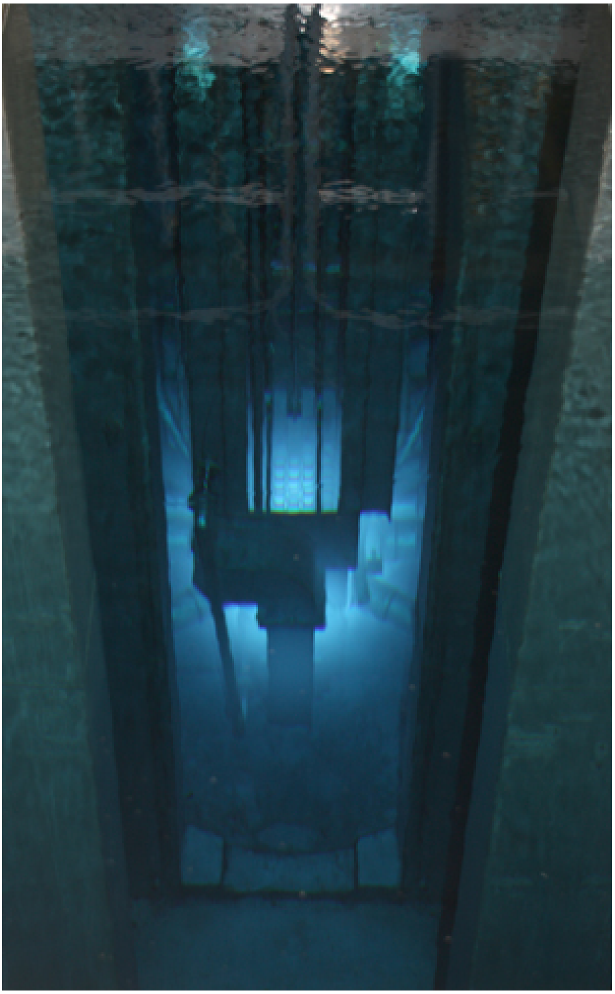
The Rhode Island Nuclear Science Center Presents:

Test, Research and Training Reactors Annual Conference

October 28 – November 1, 2018
Newport Marriott
Newport, Rhode Island



Background & Information

TRTR

The National Organization of Test, Research and Training Reactors (TRTR) represent research reactor facilities across the nation from government, major universities, national laboratories, and industry. TRTR's primary mission is education, fundamental and applied research, application of technology in areas of national concern, and improving U.S. technological competitiveness around the world. TRTR membership includes managers and directors of research reactors, educators, administrators, regulators, and research scientists and engineers.

Begun as a small technical group in the sixties, TRTR quickly grew into a national organization and adopted its current name in 1976. The organization holds an annual conference, hosted by a member institution, to discuss current technical and regulatory issues, advances in research and education, operating experience, and development of new applications in medicine, materials, health and safety, information technology, and environmental sciences among others. TRTR provides expert technical assistance to member institutions and others through peer reviews, audits and assessments.

It also publishes a quarterly newsletter, which provides the latest information in all areas of interest to the membership. This newsletter is currently undergoing upgrades and will be restarted in the near future.

2018 TRTR Meeting
Rhode Island Nuclear Science Center
16 Reactor Road
Narragansett, RI 02882
(401) 874-2600

Newport Marriott
25 America's Cup Avenue
Newport, RI 02840
(401) 849-1000

**** Program provided by sponsorship from STS Nuclear ****

Schedule

Sunday, October 28, 2018

10:00am – 12:00pm	ANS Stds. Mtg.	Enterprise
2:00pm – 5:00pm	Exec. Comm. Mtg.	Enterprise
3:00pm – 8:00pm	Registration	
6:00pm – 8:00pm	Reception	Atrium

Monday, October 29, 2018

7:00am – 5:00pm	Registration	
7:00am – 5:00pm	Exhibits	South East Foyer
7:30am – 8:30am	Breakfast Buffet	Atrium
8:30am – 9:00am	Welcome	Salons II-IV
9:00am – 10:00am	General Session	Salons II-IV
10:00am – 10:30am	Morning Break	Salons II-IV
10:30am – 12:00pm	General Session	Salons II-IV
12:00pm – 1:00pm	Lunch	Atrium
1:00pm – 2:30pm	General Session	Salons II-IV
2:30pm – 3:00pm	Afternoon Break	Salons II-IV
3:00pm – 3:30pm	General Session	Salons II-IV
3:30pm – 4:30pm	Business Meeting	Salons II-IV
4:30pm – 5:00pm	TRIGA Users Group Meeting	Salons II-IV

Schedule

Tuesday, October 30, 2018		
6:00am	5k Run/Walk	Front of Hotel
7:00am – 5:00pm	Exhibits	South East Foyer
7:30am – 8:30am	Breakfast Buffet	Atrium
8:30am – 10:00am	General Session	Salons II-IV
10:00am – 10:30am	Morning Break	Salons II-IV
10:30am – 12:00pm	General Session	Salons II-IV
12:00pm – 1:00pm	Lunch	Atrium
1:00pm – 5:00pm	RINSC Tours	Meet in Lobby
7:00pm	Pub Crawl	Meet in Lobby
Wednesday, October 31, 2018		
7:00am – 5:00pm	Exhibits	South East Foyer
7:30am – 8:30am	Breakfast Buffet	Atrium
8:30am – 10:00am	NRC Session	Salons II-IV
10:00am – 10:30am	Morning Break	Salons II-IV
10:30am – 12:00pm	NRC Session	Salons II-IV
12:00pm – 1:00pm	Lunch	Atrium
1:00pm – 2:30pm	NRC Session	Salons II-IV
2:30pm – 3:00pm	Afternoon Break	Salons II-IV
3:00pm – 5:00pm	NRC Session	Salons II-IV
7:00pm – 9:00pm	Banquet	Atrium
Thursday, November 1, 2018		
7:00am – 12:00pm	Exhibits	South East Foyer
7:30am – 8:30am	Breakfast Buffet	Atrium
8:30am – 12:00pm	General Session	Salons II-IV

Monday, October 29

8:30am – 4:00pm – Session 1	
8:30am – 8:50am	Welcome
8:50am – 9:10am	2018 Status Report – Research Reactor Infrastructure Program – Doug Morrell
9:10am – 9:30am	IAEA Activities in Support of Operation and Maintenance of Research Reactors – Ram Charma
9:30am – 9:50am	In-Pile Instrumentation Initiative – Program – Brenden Heidrich
9:50am – 10:00am	Sponsor Moment
10:00am – 10:30am	Morning Break
10:30am – 10:50am	Resumption of Transient Testing of TREAT – Andy Beasley
10:50am – 11:10am	Overview and Current Status of the SHINE Medical Isotope Production Facility – Christina Barrett
11:10am – 11:30am	Lessons Learned From Helium Refrigerator Project – Michael Middleton
11:30am – 11:50am	Cybersecurity Vulnerability Assessment and Defense-in-Depth Strategy for University Research Reactors – Scott Lassell
11:50am – 12:00pm	Sponsor Moment
12:00pm – 1:00pm - Lunch	
1:00pm – 1:20pm	Development of Graphical User Interface Status Board and Control Rod Calibration Software in Python for the Oregon State TRIGA Reactor- Griffen Latimer

Monday, October 29

1:20pm – 1:40pm	NCNR Planned Outage Upgrades – Anthony Norbedo
1:40pm – 2:00pm	Implementation of a New Corrective Action Program, Reactor Run Tracking, and Sample Tracking Software Using DEVONWAY – Matthew Lund
2:00pm – 2:20pm	Recent Progress in Advanced Materials and Instrumentation Irradiation Tests at the MIT Research Reactor – Lin-wen Hu
2:20pm – 2:30pm	Sponsor Moment
2:30pm – 3:00pm	Afternoon Break
3:00pm – 3:20pm	PSU Breazeale Nuclear Reactor New Core-Moderator Assembly and Neutron Beam Port Installation – Jeffrey Geuther
3:20pm – 4:20pm	TRTR Business Meeting
4:20pm – 5:00pm	TRIGA Users Group Meeting

Tuesday, October 30

8:30am – 12:00pm – Session 2	
8:30am – 8:50am	MITR Cathodic Protection System Upgrade – Edward Lau
8:50am – 9:10am	Advanced Test Reactor Experiment Model Validation – Thomas Eiden and Rose Holtz
9:10am – 9:30am	Observed Increase in Instrumented Fuel Element Temperature Readings – Robert Schickler
9:30am – 9:50am	Neutron Radiography and X-ray Analysis of Siliceous Marine Sponges: Dragmacidon Lunaecharta – Amanda Smolinski
9:50am – 10:10am	TREAT Experiment Safety Analysis - Andy Beasley
10:10am – 10:40am	Morning Break
10:40am – 11:00am	Participation in National Level Exercise/Eagle Horizon 2018 – Amber Johnson and Beth Reed
11:00am – 12:00pm	Effective Ways to Perform Investigations of Potential Wrongdoing – Thomas Poindexter
12:00pm – 1:00pm - Lunch	
1:00pm – 5:00pm	Tours of RINSC and GSO

Wednesday, October 31

8:30am – 12:00pm – Session 3

8:30am – 10:00am	NRC Presentations
10:00am – 10:30am	Morning Break
10:30am – 12:00pm	NRC Presentations

12:00pm – 1:00pm - Lunch

1:00pm – 2:30pm	NRC Presentations
2:30pm – 3:00pm	Afternoon Break
3:00pm – 5:00pm	NRC Presentations

Thursday, November 1

8:30am – 12:00pm – Session 4	
8:30am – 8:50am	Neutron Perturbation Device Reactivity Worth Measurements in the Zero Energy Deuterium (ZED-2) Reactor – Nathan Lee
8:50am – 9:10am	Design, Fabrication, and Testing of Micro-Pocket Fission Detectors – Sarah Stevenson
9:10am – 10:10am	NRC Q&A Session

Session 1 Abstracts:
8:50am – 9:10am

2018 STATUS REPORT
RESEARCH REACTOR INFRASTRUCTURE PROGRAM

Douglas K. Morrell
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Idaho Falls, ID 83415-3890

This presentation will discuss the purpose and scope of the Department of Energy - Research Reactor Infrastructure (RRI) Program. Personnel involved in the program will be introduced and contact information will be provided for team member. Information will be provided to conference attendees as to the status of the core activities of the program. These activities include fresh fuel element fabrication and spent nuclear fuel shipment returns to the DOE. Current and future issues pertinent to the RRI program will also be presented.

The RRI program maintains fuels support contracts and provides nuclear reactor fuel at no or low cost to 24 U.S. universities operating a total of 25 reactor facilities. These facilities include:

- Twelve TRIGA facilities
- Eight plate fueled facilities
- Three AGN facilities
- One Pulstar fueled facility
- One Critical facility

The title for the fuel remains with the United States government and when the universities are finished with the fuel, the fuel is returned to the United States government for long-term storage.

Mission of the Research Reactor Infrastructure Program:
The Research Reactor Infrastructure Program is funded by the U.S. Department of Energy, Office of Nuclear Energy and is managed by the Idaho National Laboratory (INL) in Idaho Falls, Idaho. The program goals are:

- Keep all U.S. operating university reactor programs supplied with nuclear fuel.
- Provide assistance for movement of irradiated nuclear fuel from U.S. universities, after the DOE receipt facility authorizes the fuel receipt.

Session 1 Abstracts:
9:10am – 9:30am

IAEA ACTIVITES IN SUPPORT OF OPERATION AND MAINTENANCE OF RESEARCH REACTORS

Ram Charan Sharma and Christophe Xerri
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Approximately 50% of the operating research reactors (RR) in the world are more than 40 years old. Although the life of such facilities could reach 60 years and beyond, it is of paramount importance that adequate life management programmes (ageing management and refurbishment/upgradation programmes) are established well in time.

The IAEA provides support to Member States in management of all relevant activities related to operation and maintenance of operating research reactors with focus on enhancing their availability and reliability throughout the whole life cycle. This includes support for the development and implementation of plans for operation and maintenance (O&M), ageing management, human resource development, refurbishment and modernization and establishment of Integrated Management System, as well as of decommissioning plans. The specific support includes (a) capacity building through organization of training workshops and courses at national, regional, and international levels; (b) peer review services; (c) establishment of research reactors networks and coalitions, Internet Reactor Laboratory project (IRL), and International Centre based on Research Reactor (ICERR); (d) Exchange of experiences among Member States through organization of technical meetings and conferences; (e) Co-ordinated research projects of interest to research reactor community to address gaps in the existing knowledge. A peer review mission 'Integrated Safety Assessment for Research Reactors (INSARR)' service is also provided upon request by Member States.

A peer review service called Operation and Maintenance Assessment for Research Reactors (OMARR) is provided to Member States upon request. The OMARR mission provides advice and assistance to Member States in enhancing the performance of their research reactors. The service can also assist operating organizations carrying out major refurbishment or modernization of their facilities in identifying the structures, systems and components (SSCs) to be replaced. The expected results include a more efficient long-term operation, better performance, improved safety and safety culture, and optimized utilization of human and financial resources.

Session 1 Abstracts:
9:10am – 9:30am

Additional support is provided through the recently launched Research Reactor Ageing Data Base (RRADB) which compiles inputs from Member States on experience in tackling issues related to ageing degradations of SSCs. Additionally, as an outcome of a co-ordinated research program recently concluded, a Research Reactor Material Properties Data Base (RRMPDB) has been developed to provide consolidated information on properties of irradiated core structural materials.

Session 1 Abstracts:
9:30am – 9:50am

IN-PILE INSTRUMENTATION INITIATIVE – PROGRAM OVERVIEW

Brenden Heidrich, David Hurley, and Pattrick Calderoni
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The In-Pile Instrumentation Initiative (I3) is a recently established program that focuses on the in-core instrumentation needs of test reactors and advanced technology reactors. The goal is to deploy high-quality instrumentation to support irradiation experiments today and, in parallel, develop and deploy the next generation of in-pile instrumentation to support advanced reactor technologies. The program consolidates a variety of instrumentation development efforts under one umbrella. I3 grew out of a collaboration between the Idaho National Laboratory and the Boise State University that started in 2015. Partnering with universities brings new ideas and the ability to move quickly and pivot as research progresses. The national laboratory brings experience with development and deployment and integration with the other R&D programs. Currently, I3 has collaborators at several universities across the U.S. and has experiments deployed or planned for the Advanced Test Reactor, the MIT Reactor, and the BR-2 reactor at SCK in Belgium.

Instrumentation development for the extreme environment inside of a test reactor core has been a slow and arduous process, with few breakthroughs of note. I3 seeks to combine expertise from a variety of fields in order to break through the barriers that have hindered the development and deployment of advanced in-core sensor technologies. Advanced manufacturing, modeling and simulation, and materials science are all leveraged to help inform the instrumentation development. The two main targets for I3 are the Advanced Test Reactor and the TREAT facility at INL. Near-term efforts include the High-Temperature Irradiation Resistant Thermocouple and the Micro-Pocket Fission Chamber.

Session 1 Abstracts:
10:30am – 10:50am

RESUMPTION OF TRANSIENT TESTING OF TREAT

Andy Beasley
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The Transient Reactor Test (TREAT) Facility, located at the Idaho National Laboratory (INL), is a versatile test facility able to subject experimental specimens to various transient nuclear conditions. TREAT was placed in standby after operating from February 1959 through April 1994, resulting in the loss of nearly all transient testing capability in the United States. Recently, the US Department of Energy (DOE) determined this capability was again needed. After DOE completed National Environmental Policy Act actions in February 2014, INL established the Resumption of Transient Testing Program (RTTP). RTTP was a multi-year effort to restart TREAT to reestablish a domestic transient testing capability. After 23 years of standby operations, the RTTP completed restart activities on August 31, 2017, 13 months ahead of schedule and nearly $20 million under budget. RTTP activities included an Environmental Assessment that resulted in a Finding of “No Significant Impact” associated with restarting TREAT, establishment of a compliant Safety Analysis Report (SAR), refurbishment and/or replacement of key reactor systems and components, key system knowledge recovery, reestablishment of configuration management, procedure updates, personnel training and qualification, and demonstration of operational readiness for reactor operations. Several key factors that contributed to successful restart are discussed. Current activities taking place at TREAT are discussed.

Session 1 Abstracts: 10:50am – 11:10am

OVERVIEW AND CURRENT STATUS OF THE SHINE MEDICAL ISOTOPE PRODUCTION FACILITY

Christina Barrett
SHINE Medical Technologies, Inc.
170 S Locust St
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SHINE Medical Technologies, Inc. (SHINE) was founded in 2010, with the goal of becoming a work leader in the safe, clean, affordable production of medical tracers and cancer treatment elements.

SHINE has developed a new method for the manufacture of medical isotopes, primarily molybdenum-99 (Mo-99). SHINE's technology involves the use of a non-reactor based, subcritical fission process. The process includes the combination of a high-output deuterium-tritium gas-target neutron source with a low enriched uranium (LEU) target in a target solution vessel (TSV). Neutrons created by accelerator-driven neutron sources induce fission in the LEU target solution, creating Mo-99 as a product. The combination of the neutron driver, subcritical assembly, and supporting systems are known as the irradiation unit (IU). Eight IUs and their supporting systems comprise the irradiation facility (IF). The SHINE facility also includes the radioisotope production facility (RPF), where the irradiated material is processed to separate medical isotopes and packaged for shipment to customers.

SHINE received a 10 CFR Part 50 Construction Permit in 2016 and is currently preparing the Operating License application. This presentation will provide an overview of SHINE technology, the licensing process, and how the SHINE production facility will fit into the global Mo-99 market.

Session 1 Abstracts:
11:10am – 11:30am

LESSONS LEARNED FROM HELIUM REFRIGERATOR PROJECT

Michael Middleton
NIST Center for Neutron Research (NCNR)
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Gaithersburg, MD 20899

The 20 MW NBSR Reactor was designed with a 55-cm diameter cryogenic beam port. The existing Liquid Hydrogen Cryogenic (Cold Source) was installed 2002. The next generation, Liquid Deuterium Cryogenic (Cold Source) will be installed in 2021 and operational in 2022. As part of this project a new larger Helium Refrigerator was required. A contact was awarded to build the new Helium Refrigerator, but before completion, the company noticed the government that they would not be able to meet the deadline and not long after filed for bankruptcy. It was decided that NCNR would complete the Refrigerator using contractors and the internal work force. The new Helium Refrigerator started operating January 2018 supplying cold helium to the existing cold source condensers. The presentation will discuss the three-year process to complete the Helium Refrigerator and the start of operation of the Helium Refrigerator and associated cold sources. There are many interesting lessons learned from this effort that can be applied to other large projects.

Session 1 Abstracts:
11:30am – 11:50am

CYBERSECURITY VULNERABILITY ASSESSMENT AND DEFENSE-IN-DEPTH STRATEGY FOR UNIVERSITY RESEARCH REACTORS

S. A. Lassell, A. I. Hawari
Nuclear Reactor Program, Dept. of Nuclear Engineering
North Carolina State University
Raleigh, NC, USA

J. S. Benjamin, K. T. Barnes, V. L. Wright
National and Homeland Security Division
Idaho National Laboratory
Idaho Falls, ID, USA

A methodology for identifying, assessing and mitigating the cybersecurity vulnerabilities of university research reactor (URR) industrial control systems (ICS) has been developed using the PULSTAR reactor as a test case. The PULSTAR is the latest of four research reactors built at North Carolina State University by the nation's first academic nuclear engineering program established in 1950. The 1-MW PULSTAR, which went critical in 1972, represents an active research reactor facility with a history rooted in education, scientific research and national outreach. The assessment methodology developed provides guidance for identifying and auditing critical digital assets (CDA) comprising facility Safety, Security and Emergency Preparedness (SSEP) related systems, as well as experimental apparatus and other research and educational infrastructure typical of a URR. Metrics are provided for identifying, assessing and quantifying potential cybersecurity threats and vulnerabilities for each CDA, and the consequences associated with a successful cyber-attack. These threat, vulnerability and consequence metrics may then be utilized to determine the relative risk of cyber-attack for each system, providing a ranking useful in identifying higher risk systems and establishing priorities for mitigation. A parallel assessment process for URR physical security systems (PSS) has also been developed, leveraging partnerships with campus security and IT personnel to evaluate system robustness to cyberattack. Following the implementation of the developed assessment methodology at the PULSTAR, defense-in-depth mitigation strategies were developed for application at URRs, taking into account the resources typical of university facilities. Strategies for mitigation include: 1) resolution of key common vulnerability exposures (CVE) identified for each CDA; 2) implementation of effective network security and air gapping hardware and protocols; 3) incorporating URR specific cyber security policies, procedures and training; and 4) engaging with the campus physical security

Session 1 Abstracts:
11:30am – 11:50am

System administrator to address vulnerabilities identified in the PSS. Experience with implementing the developed assessment and mitigation strategies at the PULSTAR reactor facility and an assessment of the resulting improvements in cyber security robustness will be presented.

Session 1 Abstracts:
1:00pm – 1:20pm

DEVELOPMENT OF GRAPHICAL USER INTERFACE STATUS BOARD AND CONTROL ROD CALIBRATION SOFTWARE IN PYTHON FOR THE OREGON STATE TRIGA REACTOR

Griffen Latimer
Oregon State University
Corvallis, OR 97331

As part of a series of modernization upgrades to the Oregon State TRIGA Reactor (OSTR), two software programs were developed to aid in both routine operations and annual calibration procedures. The first program is a graphical user interface (GUI) referred to as the status board, which acts as a digital book-keeping of everything inside the core, and various other sample storage related to irradiations. The second program is a control rod calibration GUI which employs the rod pull method and outputs the integral worth of each control rod.

Session 1 Abstracts:
1:20pm – 1:40pm

NCNR PLANNED OUTAGE UPGRADE

Anthony Norbedo
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In the Fall of 2017 an upgrade to the National Institute of Standards and Technology (NIST) Center for Neutron Research (NCNR) reactor systems was undertaken. The purpose was to replace old or failing system equipment and to add entirely new systems.

Various systems were affected, to name a few: Shim Arms, Effluent monitoring, Primary Pumps, Thermal Shield, new 7kW Cold Source Refrigerator, Electrical Power Panels, Re-Epoxy Floor for Research Instrumentation, Reactor Vessel inspection and Digital Storage Pool Control Console.

Information on the some of the major system upgrades and newly installed systems will be presented.

Session 1 Abstracts:
1:40pm – 2:00pm

IMPLEMENTATION OF A NEW CORRECTIVE ACTION PROGRAM, REACTOR RUN TRACKING, AND SAMPLE TRACKING SOFTWARE USING DEVONWAY

Matthew Lund
University of Utah
Salt Lake City, UT

The University of Utah Nuclear Engineering Program (UNEP) implemented a corrective action program (CAP), using DEVONWAY, in 2012 as an integral part of the UNEP Safety Culture. DEVONWAY is a quality, work, and safety management software application, used by industry including commercial power plants and INL for incident tracking. At UNEP, DEVONWAY has been used to track maintenance, reactor runs, and incidents. This year in collaboration with DEVONWAY, UNEP has implemented an update platform for CAP with brand new modules to track reactor runs and samples. The module for reactor runs tracks approvals, key reactor parameters, reactor operators, SCRAMS, samples, and power produced per run. Each key parameter is tracked over time and can be exported in various formats in reports. The system tracks reactor operator hours and reactivity manipulations for operator licensing and required reports. When a SCRAM is created in the reactor run, it initiates a corrective action item to track the failure or cause.

The samples module tracks the samples from cradle to grave allowing for recording of sample data and disposal information. The module allows for two types of samples: environmental and irradiated samples. Irradiated samples are linked with the reactor run and include information about irradiation port, power, and irradiation time. Each sample has a responsible person, who will be reminded to dispose of the sample on a future date after decay. As analysis of the samples are completed, the results are uploaded into the record as pdfs.

The updated CAP program allows for condition reports, nonconformance reports, process improvements, and recommendations, each of which will route incidents or maintenance to the responsible party. This allows tracking of problems until they are resolved and closed by administration. DEVONWAY includes an easy to use web interface and smart device apps for portable use, allowing students and staff to enter safety concerns in the lab. All these features in DEVONWAY have increased safety by verifying issues are resolved, reduced administration time required to generate reports, and simplified record keeping for staff.

Session 1 Abstracts:
2:00pm – 2:20pm

RECENT PROGRESS IN ADVANCED MATERIALS AND INSTRUMENTATION IRRADIATION TESTS AT THE MIT RESEARCH REACTOR

Lin-wen Hu, Gordon Kohse, and David Carpenter
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138 Albany St
Cambridge – USA

The Massachusetts Institute of Technology Reactor (MITR) is a 6 MW university research reactor that is part of the MIT Nuclear Reactor Laboratory (NRL). It is well-suited for carrying out both basic and integrated studies because of its relatively high power density (similar to that of a LWR), its capability to control chemistry and temperature to reflect prototypic conditions, its easy-access geometric configuration, its in-core space for up to three independent irradiation tests, and the proven capability of the MITR staff to design and execute proof-of-concept experiments more quickly and cost effectively than at other test reactors. The MITR has been designated as a partner facility of Department of Energy's Nuclear Science User Facilities (NSUF) since 2008 and serves a wide user base from universities, national labs and the nuclear industry. Current research programs at the NRL are centered on irradiation tests of advanced materials and sensors in support of current and next generation nuclear reactors. Building on the NRL research staff's expertise, other synergistic research projects have led to first-of-its-kind irradiation experiments such as those described here.

Four major programs are highlights of the in-core irradiation program over the last few years. A set of four fluoride salt (Flibe) irradiation experiments at 650-700 °C to study materials corrosion, tritium generation and control to support FHR development were completed with support from a DOE integrated research project and the Chinese Academy of Sciences. Accident Tolerant Fuel cladding such as SiC-SiC composites and coated Zircaloy materials have been tested at prototypic PWR chemistry and operating conditions in pressurized water loop. These ongoing campaigns are sponsored by the DOE GAIN program, NSUF, and industry sponsors (Ceramic Tubular Products, Toshiba and Westinghouse). Several instrumentation irradiation tests have been carried out at high-temperature for ultrasonic and fiber optic sensors to support radiation experiments and advanced reactor developments. These experiments are sponsored by DOE and the NSUF, with sensors provided by Idaho National Lab, the French Centre d'Energie Atomique and several universities. Steady-state and transient tests of nuclear instrumentation being

Session 1 Abstracts:
2:00pm – 2:20pm

developed for the TREAT transient test facility were performed by NRL staff both in the MITR and at TREAT.

MIT-NRL has also expanded its Post Irradiation Examination (PIE) infrastructure to enable irradiated materials handling and characterization. There are two hot cells in the reactor containment building. The larger cell is generally used for handling and disassembly of full-height in-core experiments. The smaller cell has been used to handle small, high radioactivity components and fuel from in-core experiments. This cell is accessible for installation of custom fixturing required for particular experiments. A collimated gamma scan facility can be installed in the small cell. Standard metallurgical sample preparation (epoxy mounting, sectioning, and polishing) can be carried out on activated samples in a dedicated hot laboratory. Macro-photography, optical and SEM microscopy, and optical profilometry of irradiated specimens are also completed in this space. Other equipment used with radioactive at the NRL include a xenon-flash thermal diffusivity instrument, HPGe gamma spectrometers, a liquid scintillation counter, and gaseous ^{3}H and ^{14}C collection and measurement instruments.

Session 1 Abstracts:
3:00pm – 3:20pm

PSU BREAZEALE NUCLEAR REACTOR NEW CORE-MODERATOR ASSEMBLY AND NEUTRON BEAM PORT INSTALLATION

Daniel Beck
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State College, PA 16801

The Penn State Breazeale Reactor (PSBR), which first went critical in 1955, is the nation's longest continuously operating university research reactor. The PSBR is a 1.0 MW TRIGA reactor capable of multi-axis positioning and rotation, which allows the core to be coupled to a variety of different irradiation fixtures. The reactor core is located in a 71,000 gallon pool which can be separated by a divider gate. The original reactor beam ports were designed around an MTR core, which is physically larger than a TRIGA core. As a result, only two beam ports have been usable since converting the reactor to use TRIGA fuel in 1965. During the summer of 2018, the reactor south pool was drained. The old beam ports, reactor tower, and D_2O moderator tank were decommissioned, and a new reactor tower, five new beam ports, and a hemispherical D_2O moderator assembly were installed to efficiently couple the new beam ports to the reactor core. A cold neutron source with three neutron guides will be installed in one of these beam ports.

The increase in the number of usable neutron beams from two to seven represents a significant upgrade in the capability of the reactor, and will dramatically increase the variety of research that can be conducted at the facility. The design, installation, and qualification of the new D_2O tank, reactor tower, and beam ports will be presented. Details of the demolition and construction process, including challenges encountered and lessons learned, will be shared. Finally, the procedures used to keep exposure ALARA will be discussed along with the maximum individual and total person-rem of dose recorded for the project.

Session 2 Abstracts:
8:30am – 8:50am

MITR CATHODIC PROTECTION SYSTEM UPGRADE

Edward S. Lau
MIT Nuclear Reactor Laboratory
138 Albany Street
Cambridge, MA 02139

A steel containment shell's below-ground portion is in contact with soil and groundwater, and needs to be protected from corrosion. For this purpose, the MIT Reactor's containment building has a cathodic protection system that started many years ago with four underground electrodes. In the early 1990s it was upgraded to six electrodes. However, after 20+ years of use, its performance deteriorated severely. A comprehensive engineering evaluation was performed and identified that the system needed to be upgraded to 19 electrodes at various depths underground, in order to provide adequate protection with uniform current distribution. The new system provides a minimum of 2 milliamps per square foot for ~3600 square feet of underground containment steel and other buried metal structures that had been added over the years. This presentation describes the experience gained in the upgrade, and shares the results and outlook.

Session 2 Abstracts:
8:50am – 9:10am

ADVANCED TEST REACTOR EXPERIMENT MODEL VALIDATION

Thomas Eiden and Rose Holtz
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Idaho Falls, ID, USA

The Advanced Test Reactor (ATR) has a sister reactor, the Advanced Test Reactor-Critical (ATRC), which is used to ensure experiments can be safely tested in ATR by characterizing aspects of the experiment such as reactivity worth and its effect on axial flux profile. For example, ATR experiments are usually designed to preserve a cosign axial flux profile to ensure an even burn on the fuel, which in turn allows for the fuel to provide a regular, known, axial neutron flux so that experimenters are reasonably sure about what is happening to their experiment when it is irradiated.

Conveniently, the ATRC can also be used to validate neutronics models of the experiments or other hardware. These experiment models are used in predictive core physics analyses that ensure the fuel is protected throughout an operating cycle, and that program commitments (lobe powers, cycle length, etc) are met. Accurate experiment models ensure accurate predictions.

Recently, ATRC conducted a test run of an experiment which had an unusual configuration, with a large amount of hafnium in the top half of the test train which perturbed the axial flux profile. The experiment sponsor sent MC21 (3D) modeling results in advance, and these results were validated, with very good agreement, with an ATRC test run. These results were then used to bias the 2D HELIOS experiment model worth used in the cycle prediction model.

Session 2 Abstracts:
9:10am – 9:30am

OBSERVED INCREASE IN INSTRUMENTED FUEL ELEMENT TEMPERATURE READINGS

Robert Schickler
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A $2.20 pulse was performed on the afternoon of 5/21/2018. Upon reaching full power the next day, a sharp increase was seen in the IFE temperatures. Normally the IFE would reach a maximum temperature of 340C, but on 5/22/2018 the maximum temperature reached 385C. It stabilized there for a week but then began to slowly rise during the week of 6/11/2018. The temperature then increased on an upward trend that fit a trendline. The bottom thermocouple (the hottest) has increased faster than the middle and top thermocouples. The OSTR then went offline on 7/20/2018 for a secondary upgrade outage. At that time, the final maximum temperature was 422C, over 80 degrees higher than the original normal maximum.

Session 2 Abstracts:
9:30am – 9:50am

NEUTRON RADIOGRAPHY AND X-RAY ANALYSIS OF SILICEOUS MARINE SPONGES*: DRAGMACIDON LUNAECHARTA*

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Climate change and human activity are causing rapid changes to the world's oceans and the ecosystems contained within them. Porifera (sea sponges) have been shown to be a useful biomarker for heavy metal accumulation. This affinity for heavy metal accumulation will become more important as ocean warming increases the solubility of heavy metals. Porifera have also been shown to be notoriously difficult to identify for taxonomic purposes without genetic sampling and/or dissection of each sample. The internal architecture of a sponge and heavy metal accumulation, features seen with complementary X-ray and neutron radiography imaging techniques, could be useful as a simple means of taxonomic and biomarker identification.

Six separate specimens of Dragmacidon lunaecharta were exposed to different concentrations of cadmium chloride laced sea water, for a period of four days, as a means of exploring both the heavy metal uptake in the organisms and the capability of the different imaging techniques. Cadmium was chosen due to its high neutron cross section. The specimens were imaged using digital x-ray imaging to expose surface characteristics. Neutron imaging was performed at the NRAD reactor at Idaho National Laboratory using a prototype CMOS camera-based digital imaging system in the north beamline. Results were compared to the traditional indirect radiography performed in the east beamline. Both beamlines are radial to the core, with high gamma background. The porous structure of each specimen was visible in the x-ray images as well as both sets of neutron radiography imaging. Comparison with NAA data indicates that artifact visible in neutron radiography has a high probability of being cadmium. The study provided initial data for future studies of sea sponges and a unique test specimen for the prototype digital neutron imager.

Session 2 Abstracts: 9:50am – 10:10am

TREAT EXPERIMENT SAFETY ANALYSIS

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The Transient Reactor Test Facility (TREAT) recently completed restart activities. In preparation for performing experiments in TREAT, a process for performing safety analysis on the planned tests to demonstrate compliance with the TREAT safety basis had to be developed and implemented. Due to the unique nature of experiment vehicles used in TREAT, the need to provide for rapid turn-around and low cost were primary concerns. In order to facilitate these requirements, the safety case is demonstrated against the experiment hardware rather than the specific experiment. This evaluation results in derived experiment requirements that require a further safety basis compliance verification based on actual test configuration and operating parameters. This presentation will provide an overview on how TREAT has successfully performed the first test vehicle commissioning and completed initial experiment operations.

Session 2 Abstracts:
10:40am – 11:00am

PARTICIPATION IN NATIONAL LEVEL EXERCISE/EAGLE HORIZON 2018

Amber Johnson
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College Park, MD

Elizabeth Reed
United States Nuclear Regulatory Commission

In May 2018 FEMA hosted the biennial national level exercise to test the emergency preparedness of all levels of government, private industry and nongovernmental organizations. Eagle Horizon 2018 simulated a large Category 4 hurricane making landfall in Virginia and then proceeding north to impact that Capital Region as a Category 2 hurricane. The exercise was designed to simulate damage to the Maryland University Training Reactor and several injects requiring licensing action were considered. The exercise allowed both participants to validate current response procedures and identify areas where normal operating procedures may need to be amended or changed. We will present on our development of the scenario, interactions with the NRC incident response staff, and lessons learned.

Session 2 Abstracts:
11:00am – 12:00pm

EFFECTIVE WAYS TO PERFORM INVESTIGATIONS OF POTENTIAL WRONGDOING

Thomas Poindexter
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Tom Poindexter, a partner at Morgan, Lewis & Bockius, with over 41 years of experience in the nuclear industry as a nuclear engineer, NRC inspector, and attorney, will discuss effective ways to perform investigations of potential wrongdoing addressed by 10 C.F.R. Sections 50.5 (Deliberate Misconduct) and 50.7 (Employee Protection). His presentation will address key steps in setting up your investigation, the differences in how to approach a self-initiated investigation versus an NRC-driven investigation (via the NRC Request for Information process), recommendations on how to determine the type of investigation you should consider (privileged or non-privileged), how to present investigation results, typical investigation personnel, and practices that can cause unintended consequences. He also will address typical ways the NRC may implement its investigative mandates and how to best ensure that you can provide the regulator with required information while protecting your legal rights.

Session 4 Abstracts: 8:30am – 8:50am

NEUTRON PERTURBATION DEVICE REACTIVITY WORTH MEASUREMENTS IN THE ZERO ENERGY DEUTERIUM (ZED-2) REACTOR

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The Zero Energy Deuterium Research Reactor (ZED-2) is a low power (200 W), heavy water moderated reactor located in Chalk River, Ontario, Canada at the Canadian Nuclear Laboratories (CNL). ZED-2 first went critical in September 1960 and is an open tank reactor with a vessel 3.3 m tall and 3.3 m in diameter. Fuel assemblies are hung vertically in the reactor in a versatile manner from movable beams that allow the fuel to be arranged in virtually any desired configuration or lattice geometry.

Historically, the ZED-2 Reactor was used for activities such as CANDU reactor development, advanced fuel cycle studies, and detector calibrations. The ZED-2 Reactor is currently undertaking a multi-year experimental program including transients, using moderator drains, various channel coolant states and online coolant changes to study reactor kinetics. Furthermore, a neutron flux perturber, capable of various input signals, frequencies, and spatial positioning in the core, has been used to probe the kinetics parameters of the core during reactor operation. The analysis of the measured transfer function of a core responding to a known perturbation reactivity worth can determine important dynamic parameters, such as prompt neutron generation time.

This presentation will discuss a brief background of the ZED-2 Reactor, an overview of recent experiments with focus on the neutron flux perturber and associated development of a new device for measuring the ZED-2 critical water level variation, an essential tool to determine the worth of the perturbation, and thus accurately measure the prompt neutron generation time.

Session 4 Abstracts:
8:50am – 9:10am

DESIGN, FABRICATION, AND TESTING OF MICRO-POCKET FISSION DETECTORSFOR IN-CORE NEUTRON FLUX MONITORING

Sarah R. Stevenson
University of California – Berkeley
Berkeley, CA

Micro-pocket fission detectors (MPFDs) have been used for in-core neutron flux monitoring at research and test reactors. The small size of these detectors allows for direct insertion into a nuclear reactor without perturbing the neutron flux. MPFDs can also be fabricated into arrays. Deploying a network of MPFD arrays will eventually allow for real-time reactor core neutron-flux mapping, a valuable tool for validating reactor simulations and computational analysis methods. The design, fabrication, and testing of prototype MPFDs has been conducted. Linear power tracking and real-time response to reactor power was observed at the KSU TRIGA Mk II Nuclear Reactor Facility and the MINERVE Nuclear Reactor at the Cadarache site of the French Atomic Energy and Alternative Energies Commission.

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