



## **Gen IV Nuclear Materials Challenges Webinar**

**Date:** Oct 20th, 2020

**Location:** via webex

**Time:** 1:00 pm -3:00 pm EDT time (120 minutes)

**Host:** Wilson Lam, G4SR-2 Chair, Canadian Nuclear Society

**Acknowledgement:** Webinar platform supported by the Canadian Standard Association (CSA) Group

### **Webinar Focus:**

The need to develop materials capable of performing in the severe operating environments expected in Generation IV reactors represents a significant challenge in materials science. There is a range of Gen-IV small modular reactor designs currently under Canadian Nuclear Safety Commission's (CNSC) SMR Vendor Design Review process: molten salt reactor, high temperature gas cooled reactor, molten lead cooled reactor, sodium cooled reactor. Each of the Gen IV SMR design has its own unique material demands. However, to achieve improved economic performance, most designs call for significantly higher operating temperatures than the current generation of LWRs to obtain higher thermal efficiency. In some cases, the desired operating temperatures rule out the use of the structural alloys employed today, due to high temperature, high neutron flux and high corrosion operating environment. This webinar brings out some of the best material experts from US and Canada to discuss the approaches to materials development and qualification for advanced reactor technologies.

### **US Approach:**

The U.S. approach to materials development and qualification for advanced reactor technologies involves a coordinated effort between the U.S. Nuclear Regulatory Commission, industry, DOE National Laboratories, and academia. High-throughput tools are being developed to enable rapid, and innovative materials design and testing

to support accelerated materials qualifications. Adopting physics-based modeling and data-analytics to materials design and analysis will improve the predictive tools to understand both as-fabricated behaviors, and advanced reactor conditions.

Talks in this webinar will outline regulatory development plan, the NRC Gen IV workshop held in December 2019, and provide a vision for accelerated materials qualification, including a first look at the new Nuclear Materials Discovery and Qualification initiative.

### **Canadian Approach:**

The Canadian approach follows the Roadmap for SMR that outlines a collaborative approach to bring together industry, utilities, various levels of government and other stakeholders by leveraging expertise in areas such as materials engineering and design, offered by many research and development partners. This approach involves evaluating the characteristics and suitability of different SMR technologies and their alignment with Canadians' requirements and priorities.

Talks in this webinar will outline Utility's perspective on SMR Supplier/Manufacturer and Licensee Interface, leading to the discussion of nuclear material and chemistry research at the Canadian Nuclear Laboratories (CNL), followed by research activities undertaken at the Canadian universities under NSERC-UNENE Industrial Research in Nuclear Materials and NSERC-Canada Research Chairs in Mechanics and Materials, and Nuclear Fuels and Materials.

### **Webinar Co-Chairs:**



**Dr. Colin Judge, Department Manager | Nuclear Materials Department**

**Industry Programs Lead | U.S. DOE-NE Nuclear Science User Facilities**

## Idaho National Laboratory

Dr. Colin Judge is the Manager of the Idaho National Laboratory Nuclear Materials Department. He has personnel and technical oversight over the establishment of structural and physical property relationships of nuclear fuels and materials to promote a fundamental understanding in support of accelerated materials development, and meeting industry needs on behalf of the U.S. Department of Energy, Nuclear Energy. Dr. Judge has 15 years' experience in nuclear materials research, including reactor component fitness-for-service investigations, accelerated irradiation testing, and advanced material characterization. He holds a Ph.D. in Materials Science and Engineering from McMaster University in Hamilton, Ontario, Canada.



**Dr. Mohammadreza Baghbanan, P. Eng., Project Manager, Ontario Power Generation | CNS Division Chair for Materials, Chemistry and Fitness-for-service | Adjunct Professor, University of Toronto**

Dr. Baghbanan joined the Nuclear Industry in 2007 after working in the Steelmaking and Casting Industries for a few years. He is currently the OPG project manager and steering committee member for fuel channel life confirmation projects and provides technical oversight for COG fuel channel R&D, Joint Projects and Strategic R&D. Mohammad is the CNS Division Chair for Materials, Chemistry and Fitness-for-service Division and CSA N285.8 TSC – working group chair on assessment of reactor core. He holds the position of Adjunct Professor with the Materials Science and Engineering Department of the University of Toronto. Mohamad has many years of R&D experience in the areas of Nuclear Engineering, Nanocrystalline Materials, Tribology & Surface Engineering, Thermal Spray Coatings, Vibratory Surface Finishing and Metallurgical Engineering.

## **Distinguished Panel Speakers:**



### **Mr. Wayne Moe, Idaho National Laboratory**

Mr. Wayne Moe is an environmental engineer with over 30 years of diverse industrial and nuclear facility compliance experience that includes involvement in both fossil and nuclear plant operations. He possesses multiple graduate degrees in Environmental Engineering, Waste Management, and Ecological Science from Idaho State University, the University of Idaho, and the University of North Dakota, respectively. He has also worked as a state-level air emissions researcher and environmental regulator. More recently he developed siting reactor criteria for the Next Generation Nuclear Plant (NGNP) project and participated in the national regulatory framework development team for advanced nuclear design criteria and the risk-informed, performance-based licensing modernization project.



### **Andrew Yeshnik, Materials Engineer at U.S. Nuclear Regulatory Commission**

Andrew Yeshnik is currently a materials engineer in the Advanced Reactor Technical Branch. Mr. Yeshnik is currently working on several projects within the Division of Advanced Reactors and Non-Power Production and Utilization Facilities associated with materials, chemical compatibility, and the regulatory framework for advanced reactors. He has previously reviewed materials engineering topics for the NuScale SMR and the APR1400 designs. Before joining the NRC, Andrew worked as a project engineer at Areva-Transnuclear and oversaw the construction of Dry Storage

Containers for the isolation of spent nuclear fuel. Andrew received a B.S. degree in Material Sciences and Engineering from Virginia Polytechnic Institute and State University.



**Dr. Allen Roach, Distinguished Staff Scientist at Idaho National Laboratory**

Dr. R. Allen Roach is a Distinguished Staff Scientist at Idaho National Laboratory and holds a Ph.D. in Mechanical Engineering. Allen joined INL in December 2019 after 20 years at Sandia National Labs. He is leading the Nuclear Materials Discovery and Qualification initiative (NMDQi). At Sandia he was a technical staff member and manager in a variety of roles ranging from finite element code development to component design, testing, and manufacturing. Allen has expertise and publications in multi-physics manufacturing processes including additive/advanced manufacturing, laser welds, flows in rigid and deformable porous media, corrosion, and high temperature processes including electroslag remelting and large-scale glass flows.



**Dr. Todd Allen, Professor at the University of Michigan; Senior Fellow of Third Way**

Dr. Todd Allen is Professor at the University of Michigan and a Senior Fellow at Third Way, a DC base Think Tank, supporting their Clean Energy Portfolio. He was the Deputy Director for Science and Technology at the Idaho National Laboratory from January 2013 through January 2016. Prior to INL he was a Professor in the Engineering Physics Department at the University of Wisconsin, a position held from September 2003 through December 2012 and again from January 2016-December

2018. From March 2008-December 2012, he was concurrently the Scientific Director of the Advanced Test Reactor National Scientific User Facility at INL. Prior to joining the University of Wisconsin, he was a Nuclear Engineer at Argonne National Laboratory-West in Idaho Falls. His Doctoral Degree is in Nuclear Engineering from the University of Michigan (1997) and his Bachelor's Degree in Nuclear Engineering is from Northwestern University (1984). Prior to graduate work, he was an officer in the United States Navy Nuclear Power Program.



**Dr. M. A. (Aamir) Aamir, Manager SMR Design Integration, Ontario Power Generation**

Dr. Aamir has a Masters degree in Nuclear Engineering and PhD in Computational Fluid Dynamics from the University of Manchester. He worked for AECL designing Advanced CANDU Reactors (ACR-700 and ACR-1000) and later joined Ontario Power Generation in 2005 as a Design Engineer. In 2008, he became section manager for projects design and later for new build project. In 2013, he became Design Manager for Darlington and in 2016, Design Authority for Nuclear Waste Management Division of OPG. Since July 2019, Dr. Aamir has been working as Manager for SMR Design Integration at OPG.



**Dr. Jeffrey Griffin is Vice-President of Science & Technology for Canadian Nuclear Laboratories (CNL)**

Dr. Jeffrey Griffin is Vice-President of Science & Technology for Canadian Nuclear Laboratories (CNL). In this role he manages a diverse portfolio of science and technology spanning fundamental research in physics, biology and chemistry through

nuclear energy generation, health effect, environmental impacts, nuclear medicine and high impact global security programs.

Prior to joining CNL, Dr. Griffin led field operations for the U.S. Department of Energy's Office of Environmental Management (DOE-EM), providing strategic direction and policy leadership for environmental remediation at DOE-EM's 16 field sites, a \$7.2 billion annual program. Dr. Griffin also served as Associate Laboratory Director at the Savannah River National Laboratory (SRNL), the U.S. DOE's premier environmental cleanup laboratory, where he managed an \$80M portfolio.

Among his career accomplishments, Dr. Griffin led the implementation of a risk reduction campaign to accelerate the closure of DOE-EM sites, resulting in multi-billion dollar cost savings; developed new business opportunities for the SRNL environmental management program to grow the program by 50%; and led U.S. national laboratory engagement with Tokyo Electric Power Company and other Japanese agencies in support of remediation efforts at the Fukushima Daiichi Power Station.

Dr. Griffin holds a Ph.D. in Nuclear Chemistry from Georgia Institute of Technology.



**Dr. Mark Daymond, Professor at the Mechanical and Materials Engineering Department of the Queen's University, Canada; NSERC-UNENE Industrial Research Chair in Nuclear Materials; Canada Research Chair in Mechanics of Materials**

Dr. Mark Daymond is a Professor at Queen's University in Kingston, Canada, where he has worked since 2004 in the Dept. of Mechanical and Materials Engineering, with a cross-appointment to the Dept. of Physics. He holds an NSERC/UNENE Industrial Research Chair in Nuclear Materials, and a Tier 1 Canada Research Chair in Mechanics of Materials. He is the Director of the Reactor Materials Testing Laboratory at Queen's ([www.rmtl.ca](http://www.rmtl.ca)) a recently commissioned accelerator facility focussed on irradiation and characterisation of materials for nuclear power applications. Prior to arriving at Queen's he worked at the Rutherford Appleton Laboratory (UK) with postdoctoral research carried out at Los Alamos National Laboratory. His Doctoral Degree is in Materials Science (1996), and his Bachelor's Degree is in Physics and Theoretical Physics (1992), both from the University of Cambridge, UK.



**Dr. Markus H.A. Piro, Ontario Tech University; Canada Research Chair in Nuclear Fuel and Materials**

Prof. Markus Piro is currently a Canada Research Chair in Nuclear Fuels and Materials at Ontario Tech University where he leads a multi-disciplinary team in support of academic and commercial projects. Previously, he was the Head of the Fuel Modelling and Fission Product Transport Section at the Canadian Nuclear Laboratories and a Post Doc at the Oak Ridge National Laboratory (ORNL). His primary research interests are in computational thermodynamics, nuclear fuel engineering, multi-scale multi-physics modelling & simulation of nuclear fuels and materials, and experimental & computational Fluid dynamics. He is the Editor of *Advances in Nuclear Fuel Chemistry* (Elsevier, 2020), the first book dedicated to nuclear fuel chemistry. He has co-chaired the 2018 Nuclear Materials conference and is a Guest Editor of the *Journal of Nuclear Materials*. Dr. Piro received BAsC and MASc degrees in Mechanical & Materials Engineering from Queens University and a PhD in Nuclear Engineering at the Royal Military College of Canada in conjunction with ORNL. He has also consulted in both nuclear and aerospace sectors for industry and government in Canada and the US.

Agenda:

US Approach		
Introductory Remarks	Colin Judge (INL)	
Review of Advanced Reactor Materials Gap Assessment	Wayne Moe (INL)	10 min
U.S. NRC Summary of Gen IV Workshop held December 2019	Andrew Yeshnik (NRC)	10 min
Nuclear Materials Discovery and Qualification initiative (NMDQi)	Allen Roach (INL)	10 min
Materials needs Beyond Current Design Concepts	Todd Allen (U of Michigan)	10 min
Q & A with the US Team	Moderated by Colin	10 min
Canadian Approach		
Introductory Remarks	Mohammadreza Baghbanan (OPG)	
SMR Supplier/Manufacturer and Licensee Interface	Aamir Aamir (OPG)	10 min
Materials Research at CNL for Advanced Reactors	Jeff Griffin (CNL)	10 min
Use of accelerator based studies to understand degradation of materials for new reactors	Mark Daymond (Queen's Univ.)	10 min
Research in Advanced Nuclear Fuels and Materials at Ontario Tech	Markus Piro (Ontario Tech Univ.)	10 min
Q & A with the Canadian Team	Moderated by Mohammad	10 min
Panel discussion	Moderated by Colin and Mohammad	20 min
Webinar Duration		120 min

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