

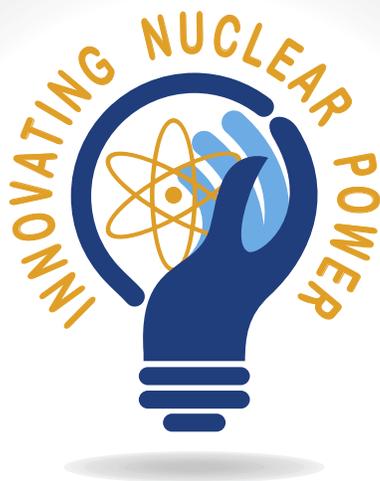


ANS Annual Meeting

2017

Official Program

June 11-15, 2017
Hyatt Regency San Francisco
San Francisco, CA





ANS

Annual 2017

Innovating Nuclear Power

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Meeting Officials

Innovating Nuclear Power

2017 Annual Meeting



GENERAL CHAIR
Jose N. Reyes, Jr.
NuScale Power



ASSISTANT GENERAL CHAIR
Daniel T. Ingersoll
NuScale Power



TECHNICAL PROGRAM CHAIR
Raymond T. Klann
Pacific Northwest National Laboratory



ASSISTANT TECHNICAL PROGRAM CHAIR
Kenneth J. Geelhood
Pacific Northwest National Laboratory



MEDIA CHAIR
Jay Z. James
Retired/Affiliated University of California, Berkeley



FINANCE CO-CHAIR
Vince Gilbert
EXCEL Services Corporation



FINANCE CO-CHAIR
Brett D. Rampal
NuScale Power, LLC



STUDENT PROGRAM CO-CHAIR
Tomi Akindede
University of California, Berkeley



STUDENT PROGRAM CO-CHAIR
Zander Mausloff
University of Florida



TECHNICAL TOUR CHAIR
Eric Harvey
Electric Power Research Institute

Daily Schedule

Saturday, June 10

7:30-8:30 am 8:00 am-5:00 pm	Workshop Registration NPIC&HMIT 2-Day Training Course (Day 1): "Helping Deliver on the Nuclear Promise: A Digital I&C Licensing and Qualification Workshop" <i>Sponsored by:</i> LOCKHEED MARTIN 	Seacliff C Seacliff C
2:00-5:00 pm	Registration	Market Street Foyer

Sunday, June 11

7:00 am-7:00 pm 8:00 am-5:00 pm	Registration NPIC&HMIT 2-Day Training Course (Day 2): "Helping Deliver on the Nuclear Promise: A Digital I&C Licensing and Qualification Workshop" <i>Sponsored by:</i> LOCKHEED MARTIN 	Market Street Foyer Seacliff C
6:00-8:00 pm 6:00-8:00 pm	NPIC&HMIT EXPO ANS President's Opening Reception	Grand and Seacliff Foyer Grand Ballroom Foyer

Monday, June 12

7:00 am-5:00 pm 7:30 am-5:00 pm 7:30-8:00 am 8:00-11:40 am 11:40 am-1:00 pm 1:00-4:00 pm	Registration NPIC&HMIT Expo Morning Coffee Service Opening Plenary: Innovating Nuclear Power Lunch on Own NPIC&HMIT Opening Plenary <i>Sponsored by:</i>  Rolls-Royce	Market Street Foyer Grand and Seacliff Foyer Grand Ballroom A/B/C Grand Ballroom A
1:00-4:15 pm 2:45-3:00 pm	ANS Technical Sessions Coffee Break <i>Sponsored by:</i>  DUKE ENERGY	Pacific Concourse Seacliff Foyer; Grand Ballroom Foyer Pacific Concourse
4:30-6:30 pm 4:30-6:40 pm	ANS President's Special Session: ANS Nuclear Grand Challenges NPIC&HMIT Technical Sessions	Grand Ballroom A Bayview B, Seacliff A/B



#ANSMeeting

Daily Schedule

Tuesday, June 13

7:00 am-5:00 pm	Registration	Market Street Foyer
7:30 am-5:00 pm	NPIC&HMIT Expo	Grand and Seacliff Foyer
7:30-8:00 am	Morning Coffee Service	
8:00-9:20 am	NPIC&HMIT Plenary	Grand Ballroom A
8:00-11:40 am	ANS Technical Sessions	Pacific Concourse
9:20-9:35 am	Coffee Break	Grand Ballroom Foyer; Seacliff Foyer; Pacific Concourse
	<i>Sponsored by:</i> 	
9:35-11:40 am	NPIC&HMIT Technical Sessions	Bayview, Seacliff, Golden Gate, Marina Rooms
11:40 am-1:00 pm	Lunch on Own	
1:00-4:15 pm	ANS Technical Sessions	Pacific Concourse
1:00-4:15 pm	NPIC&HMIT Technical Sessions	Bayview, Seacliff, Golden Gate, Marina Rooms
2:45-3:00 pm	Coffee Break	Grand Ballroom Foyer; Seacliff Foyer; Pacific Concourse
	<i>Sponsored by:</i> 	
4:30-6:30 pm	General Chair's Special Session: Innovating New Roles for Nuclear Energy	Grand Ballroom A
4:30-6:40 pm	NPIC&HMIT Technical Sessions	Bayview, Seacliff, Golden Gate, Marina Rooms
7:00-10:00 pm	NPIC&HMIT Banquet	Grand Ballroom B/C
	<i>Sponsored by:</i> 	

Wednesday, June 14

7:00 am-5:00 pm	Registration	Market Street Foyer
7:30-8:00 am	Morning Coffee Service	
8:00-9:20 am	NPIC&HMIT Plenary	Grand Ballroom A
8:00-11:40 am	ANS Technical Sessions	Pacific Concourse
9:20-9:35 am	Coffee Break	Grand Ballroom Foyer; Seacliff Foyer; Pacific Concourse
	<i>Sponsored by:</i> 	
9:35-11:40 am	NPIC&HMIT Technical Sessions	Bayview, Seacliff, Golden Gate, Marina Rooms
11:40 am-1:00 pm	Lunch on Own	
1:00-4:15 pm	ANS Technical Sessions	Pacific Concourse
1:00-4:15 pm	NPIC&HMIT Technical Sessions	Bayview, Seacliff, Golden Gate, Marina Rooms
2:45-3:00 pm	Coffee Break	Grand Ballroom Foyer; Seacliff Foyer; Pacific Concourse
4:30-6:40 pm	ANS Technical Sessions	Pacific Concourse
4:30-6:40 pm	NPIC&HMIT Technical Sessions	Bayview, Seacliff, Golden Gate, Marina Rooms

Thursday, June 15

7:00 am-12:00 pm	Registration	Market Street Foyer
7:30-8:00 am	Morning Coffee Service	
8:00 am-12:30 pm	Technical Tour: National Ignition Facility (NIF) at Lawrence & Livermore National Laboratory	
8:00-9:20 am	NPIC&HMIT Plenary	Grand Ballroom A
8:00-11:40 am	ANS Technical Sessions	Pacific Concourse
9:00 am-3:00 pm	Technical Tour: SLAC National Accelerator Lab	
9:20-9:35 am	Coffee Break	Grand Ballroom Foyer; Seacliff Foyer; Pacific Concourse
9:35-11:40 am	NPIC&HMIT Technical Sessions	Bayview, Seacliff, Golden Gate, Marina Rooms
11:40 am-1:00 pm	Lunch on Own	
1:00-4:15 pm	ANS Technical Sessions	Pacific Concourse
1:00-4:15 pm	NPIC&HMIT Technical Sessions	Bayview, Seacliff, Golden Gate, Marina Rooms
2:45-3:00 pm	Coffee Break	Grand Ballroom Foyer; Seacliff Foyer; Pacific Concourse

General Information

MEETING INFORMATION

The 2017 ANS Annual Meeting includes four days of technical programming and events, one Embedded Topical Meeting (10th International Topical Meeting on Nuclear Plant Instrumentation, Control and Human Machine Interface Technologies), and two workshops, NPIC&HMIT 2-Day: “Helping Deliver on the Nuclear Promise: A Digital I&C Licensing and Qualification Workshop” and “Preparing for the Nuclear Engineering Professional Engineering Exam.”

REGISTRATION

Location: Market Street Foyer

Name badges must be worn during all technical sessions, in the NPIC&HMIT expo and events. Certain events require a ticket, and may entail an additional cost.

REGISTRATION HOURS

Saturday, June 10	2:00 – 5:00 pm
Sunday, June 11	7:00 am – 7:00 pm
Monday, June 12	7:00 am – 5:00 pm
Tuesday, June 13	7:00 am – 5:00 pm
Wednesday, June 14	7:00 am – 5:00 pm
Thursday, June 15	7:00 am – 12:00 pm

NPIC&HMIT EXPO HOURS

Location: Grand Ballroom Foyer and Seacliff Foyer

Join us and visit with our exhibitors in the Expo! Learn about new technology, products and services that are being offered. Morning coffee service, breaks and reception will be hosted in the Expo.

For more information or to view the floorplan and exhibitors see pages 73-75.

Sunday, June 11	6:00 – 8:00 pm
Monday, June 12	7:30 am – 5:00 pm
Tuesday, June 13	7:30 am – 5:00 pm
Wednesday, June 14	7:30 am – 12:00 pm



Energy is our future, don't waste it! ©2017 AREVA Inc. All rights reserved. Photos by Warren Wright.

General Information

NOTICE TO SPEAKERS

After printing your badge, all speakers and session chairs must check in at the Speaker Desk located near the ANS Registration Desk.

ATTENDEE MEAL FUNCTIONS

Morning Coffee Service & Breaks

Morning coffee service, morning and afternoon beverages and snacks will be provided to all registered meeting attendees, Monday-Thursday.

ANS President's Opening Reception

This reception is a ticketed event. (2) Drink tickets are included with a full meeting registration. Additional tickets are available for purchase at the following cost: \$125 (Adult) / \$50 (Child, 16 and under)

ANS BUSINESS OFFICE

Sponsored by:



Regency A

Sunday-Wednesday: 8:00 am-5:00 pm

Thursday: 8:00 am-4:15 pm

ANS MEDIA CENTER

Pacific B

Monday-Tuesday: 7:45 am-5:00 pm

Wednesday: 7:45 am-4:00 pm

ANS CONFERENCE OFFICE

Regency B

Sunday-Wednesday: 8:00 am-5:00 pm

Thursday: 8:00 am-1:00 pm

ANS STUDENT OFFICE

Pacific C

Sunday-Wednesday: 8:00 am-5:00 pm

Thursday: 8:00 am-4:15 pm

EMBEDDED TOPICAL MEETING

In conjunction with the 2017 ANS Annual Meeting, the 10th International Topical Meeting on Nuclear Plant Instrumentation, Control and Human Machine Interface Technologies (NPIC&HMIT) will be taking place concurrently.

NPIC&HMIT will begin on Monday, June 12th at 1:00 pm. For additional information in regards to NPIC&HMIT, visit pages 46-68.

ANS MEETINGS APP *Sponsored by:* TerraPower™

Scan this code or type in American Nuclear Society to your app store and download the app and login to the ANS Meetings App to experience all of the app features!

- Access your personalized schedule
- Take notes
- Submit survey responses
- Join the attendees list and network
- Rate sessions
- Message fellow attendees



Scan this code with a QR reader to easily download the app.

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If you still have the email invitation sent to you by ANS Meetings:

1. Open the invitation in your inbox. Tap Verify Account.
2. Tap Open App. to complete the verification via your brand new mobile app.

If you need to retrieve your Verification Code:

1. From the event homescreen, tap the hamburger icon (three white lines) at the top left of the screen.
2. Tap Log in for more features!
3. Enter your first and last name and tap Next.
4. Tap Resend Code to have your verification code sent to your preferred email address.

General Information

OTHER THINGS TO ATTEND

Teacher's Workshop:

Saturday: 7:30 am-5:00 pm – Bayview B

Learn how ANS members conduct teacher workshops by observing one in progress. You will learn methods and hands-on activities you can incorporate into your own Local Section programs. Advance Registration is required. Please contact Janice Lindegard, ANS Education and Community Outreach Specialist at 708-579-8290 for further details. This workshop is supported by the ANS Center for Nuclear Science and Technology Information.

Professional Development Workshop:

Preparing for the Nuclear Engineering Professional Engineering Exam

Sunday: 8:00 am-5:00 pm – Pacific F

This course is designed for individuals who have passed the Fundamentals of Engineering Exam (formerly the EIT exam) and who are preparing for the Professional Engineering Exam (PE exam) in Nuclear Engineering. PLEASE NOTE: Registration for the workshop is separate from, and in addition to, the meeting registration fee.

Onsite Pricing for the workshop: \$500 for ANS members and \$600 for non-members

NPIC&HMIT 2-Day Training Course:

*Sponsored by: **LOCKHEED MARTIN***

Helping Deliver on the Nuclear Promise: A Digital I&C Licensing and Qualification Workshop

Saturday & Sunday: 8:00 am-5:00 pm – Seacliff C

This course is designed for technical and management personnel in utilities, vendors, government, national labs, and universities to learn the very basics of nuclear power plant digital I&C qualification and the licensing process. Industry operating experience will be presented throughout the course.

Onsite Pricing for the training course: \$450

First-Time Attendee Orientation

Sunday: 1:00-1:30 pm –Pacific G

The ANS Membership Committee will offer an orientation session for first-time ANS meeting attendees. Learn what goes on at national meetings, how the national organization works, and how to get involved at the national and local levels. Whether you are a member or not, student or professional, if this is your first ANS national meeting, the Membership Committee invites you to attend this session.

Student Program Q&A Meeting

Sunday: 4:00-5:00 pm – Bayview A

Attendance at the 2017 ANS Annual Meeting is an exciting professional opportunity for college and graduate students. For information on the Student Program, see the Student Program Instructions document on the Annual Meeting webpage.

Attention Runners: ANS Fun Run

Tuesday: 6:00 am – Hotel Lobby

There will be a noncompetitive run starting at 6:00 am from the lobby entrance of the hotel. We hope you can join us. Bring shoes and a big smile!

Consent To Use Photographs And Videos: All attendance of registered participants, attendees, exhibitors, sponsors and guests ("you") at American Nuclear Society ("ANS") meetings, courses, conventions, conferences, or related activities ("Events") constitutes an agreement between you and ANS regarding the use and distribution of your image, including but not limited to your name, voice and likeness ("Image"). By attending the ANS Events, you acknowledge and agree that photographs, video, and/or audio recordings may be taken of you and you grant ANS the right to use, in perpetuity, your Image in any electronic or print distribution, or by other means hereinafter created, both now and in the future, for media, art, entertainment, promotional, marketing, advertising, trade, internal use, educational purposes or any other lawful purpose. For any questions or concerns about the use of your Image, please contact the ANS Meetings & Exhibits Department at meetings@ans.org.

General Information

ABOUT ANS

Mission

ANS provides its members with opportunities for professional development. It also serves the nuclear community by creating a forum for sharing information and advancements in technology, and by engaging the public and policymakers through communication outreach.

Code of Ethics

Recognizing the profound importance of nuclear science and technology in affecting the quality of life throughout the world, members of the American Nuclear Society (ANS) are committed to the highest ethical and professional conduct.

ANS members as professionals are dedicated to improving the understanding of nuclear science and technology, appropriate applications, and potential consequences of their use.

To that end, ANS members uphold and advance the integrity and honor of their professions by using their knowledge and skill for the enhancement of human welfare and the environment; being honest and impartial; serving with fidelity the public, their employers, and their clients; and striving to continuously improve the competence and prestige of their various professions. The Code of Ethics can be found at www.ans.org/about/coe.

Statement on Diversity

The American Nuclear Society (ANS) is committed, in principle and in practice, to creating a diverse and welcoming environment for everyone interested in nuclear science and technology. Diversity means creating an environment – both in ANS and in the profession – in which all members are valued equitably for their skills and abilities and respected equally for their unique perspectives and experiences. Diverse backgrounds foster unique contributions and capabilities, and so creation of an inclusive Society ultimately leads to a more creative, effective, and technically respected Society.

ANS believes that everyone deserves opportunities for learning, networking, leadership, training, recognition, volunteering in Society activities, and all the other benefits that involvement in the Society brings, regardless of age, color, creed, disability, ethnicity, gender identity and expression, marital status, military service status, national origin, parental status, physical appearance, race, religion, sex, or sexual orientation. The selection of a member to serve in ANS's volunteer leadership structure shall be based solely on the member's ability, interest and commitment to serve. In particular, ANS encourages members at each level of the Society and in each Professional Division and Technical Group to make special efforts to recruit underrepresented minorities and women to ensure that they are adequately represented in the Society.

Respectful Behavior Policy (Abbreviated)

The open exchange of ideas, freedom of thought and expression, and productive scientific debate are central to the mission of the American Nuclear Society (ANS). These require an open and diverse environment that is built on dignity and mutual respect for all participants and ANS staff members, and is free of bias and intimidation.

ANS is dedicated to providing a safe, welcoming, and productive experience for everyone participating in Society events and other Society activities regardless of age, color, creed, disability, ethnicity, gender identity and expression, marital status, military service status, national origin, parental status, physical appearance, race, religion, sex, or sexual orientation. Creation of a safe and welcoming environment is a shared responsibility held by all participants. Therefore, ANS will not tolerate harassment of or by participants (including ANS volunteer leaders and staff members) in any form. Disciplinary action for participants found to have violated this principle may include reprimand, expulsion from an event or activity with or without a refund, temporary or permanent exclusion from all ANS events and activities, suspension or expulsion from volunteer leadership positions or groups, and/or suspension or expulsion from Society membership, as appropriate.

If you or someone else experiences harassment, regardless of how you otherwise choose to initially handle the situation, you are encouraged to report the situation to ANS. It is possible that the behavior you experienced is part of a larger pattern of repeated harassment. Please alert ANS to behavior you feel to be harassment regardless of the offender's identity or standing in the Society.

The designated contact person for reports at the 2017 Annual Meeting is ANS President Andrew C. Klein, PE during or after the event at andrew.klein@oregonstate.edu.

The complete Respectful Behavior Policy can be found at www.ans.org/about/rbp. If you have questions about the policy, please contact ANS Executive Director Robert C. Fine at 708-579-8200 or rfine@ans.org.

Plenary, Special Sessions & Events

SUNDAY, JUNE 11

ANS President's Opening Reception

Location: Grand Ballroom Foyer **Time:** 6:00 – 8:00 pm

All attendees are invited to enjoy an evening of networking. This event is included in your full meeting registration. Additional tickets are available for purchase at the following cost: \$125 (Adult) / \$50 (Child, 16 and under).

MONDAY, JUNE 12

Opening Plenary: Innovating Nuclear Power

Chair: Jose N. Reyes, Jr. (*NuScale Power*)

Location: Grand Ballroom **Time:** 8:00-11:40 am

New opportunities for nuclear energy are expanding globally. Realizing those opportunities will demand innovation throughout the nuclear lifecycle to address the needs of new customers and to ensure that nuclear power is an effective and competitive partner in our future energy mix. The session will depart from the traditional plenary format and include a single keynote talk followed by a rapid fire of brief vignettes of innovations that are occurring in many corners of the nuclear industry.

Keynote Speaker: Michael Shellenberger, President, *Environmental Progress* (A new way of thinking about nuclear's role)

Speakers:

- Jeremy Busby, ORNL (*Innovations in nuclear materials*)
- Seth Grae, Lightbridge (*Innovations in nuclear fuels*)
- Sacit Cetiner, ORNL (*Innovations in I&C*)
- Ross Snuggerud, NuScale Power (*Innovation in nuclear plant control*)
- David Gandy, EPRI (*Innovations in manufacturing*)
- Mark Peres, Fluor (*Innovation in new plant construction*)
- Craig Stover, EPRI (*Innovation in nuclear operations*)
- Donnie Davis, IBM (*Innovations in cognitive computing: Watson meets nuclear power*)
- Kristiina Soderholm, Fortum (*Innovations in global licensing*)

NPIC&HMIT Opening Plenary

Cochairs: Clayton Scott (*Schneider Electric*), Sacit M. Cetiner (*ORNL*)

Location: Grand Ballroom A **Time:** 1:00-4:00 pm

Keynote Speakers:

- Steve Kuczynski (*CEO and President of Southern Nuclear Operating Co.*)
- Jose Reyes (*CTO, NuScale*)
- David Blee (*Executive Director, U.S. NIC*)
- John E. Kelly (*Chief Technology Officer, Office of Nuclear Energy, U.S. DOE*)



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ANS President's Special Session: ANS Nuclear Grand Challenges

Location: Grand Ballroom A **Time:** 4:30-6:30 pm

Dr. Andy Klein will be joined by subject-matter experts to discuss the selected ANS Nuclear Grand Challenges in detail. Recommendations for pursuing solutions to the Challenges will be addressed, including options for ANS member and broader nuclear community engagement.

Speakers:

- Andrew Klein (*President, American Nuclear Society; Professor, Oregon State University*)
- William D. Magwood, IV (*Director-General, Nuclear Energy Agency*)
- Alan Waltar (*Past President, American Nuclear Society*)
- Julie Ezold (*Sr. Research & Development Staff, Oak Ridge National Laboratory*)
- Andrew Worrall (*Fuel Cycle R&D Technology Leader, Reactor & Nuclear Systems Division, Oak Ridge National Laboratory*)
- Paul Dickman (*Sr. Policy Fellow, Argonne National Laboratory*)
- Phil Sharpe (*Director, Nuclear Systems Design & Analysis Division, Idaho National Laboratory*)
- Todd Allen (*Professor, Engineering Physics, University of Wisconsin, Madison*)
- Ben Forget (*Professor, Nuclear Engineering, Massachusetts Institute of Technology*)
- Rita Baranwal (*Director, GAIN, Idaho National Laboratory*)
- Rachel Slaybaugh (*Assistant Professor, Nuclear Engineering, University of California, Berkeley*)

OPD Honors & Awards Dinner

Location: SENS Restaurant **Time:** 7:00 pm

Join the Operations and Power Division in celebrating the accomplishments of their colleagues and a successful year as a division. SENS Restaurant is located walking distance from the hotel just .25 Blocks.

This event is not included in your registration fee. The ticket price is \$75. Tickets may be purchased at the Registration Desk, space is limited.

TUESDAY, JUNE 13

NPIC&HMIT Tuesday Plenary

Cochairs: Clayton Scott (*Schneider Electric*), Sacit M. Cetiner (*ORNL*)

Location: Grand Ballroom A **Time:** 8:00-9:20 am

Speakers: • Nadine Sarter (*Professor, University of Michigan*) • Janos Eiler (*Director of I&C Programs, IAEA*)

Plenary, Special Sessions & Events

TUESDAY, JUNE 13 CONTINUED

General Chair's Special Session: Innovating New Roles for Nuclear Energy

Chair: Jose Reyes, Jr. (*NuScale Power*) **Location:** Grand Ballroom A **Time:** 4:30-6:30 pm

Implementing innovation into the nuclear industry has proven to be very challenging and the rapid globalization of the industry adds many new challenges. The very accomplished panel speakers will discuss several realities associated with bringing new innovations into practice, including challenges and opportunities.

Speakers and Panel:

- Pete Lyons (*Former NRC Commissioner and DOE Assistant Secretary*)
- Kent Kresa (*Former CEO of Northrop Grumman and General Motors*)
- John Kotek (*VP for Policy Development & Public Affairs, NEI*)
- Bill Magwood (*Director General of OECD Nuclear Energy Agency and former NRC Commissioner*)

NPIC&HMIT Banquet

Location: Grand Ballroom B/C **Time:** 7:00-10:00 pm

Sponsored by:  **Schneider Electric**

This event is not included in your registration fee. Tickets may be purchased at the Registration Desk for \$75 each.

Speakers Bureau Workshop

Location: Waterfront A **Time:** 6:30-8:30 pm

New members are welcome to join this dynamic group of speakers to help students and the public learn the many benefits that nuclear science and technology brings to their lives. The workshop will prepare you to participate in outreach activities in your community and review ANS messaging and outreach plans for the year. This is a great chance for potential new Bureau members to learn more before applying to join the group. Light appetizers and soft drinks will be served.

WEDNESDAY, JUNE 14

NPIC&HMIT Wednesday Plenary

Cochairs: Clayton Scott (*Schneider Electric*), Sacit M. Cetiner (*ORNL*)

Location: Grand Ballroom A **Time:** 8:00-9:20 am

Keynote Speakers

- John Lubinski (*Director of Engineering, U.S. NRC NRR*)
- Ian Nimmo (*President, User Centered Design Services Inc.*)

Focus on Communications Workshop: How Will We Save Our Nuclear Plants?

Location: Grand Ballroom A **Time:** 4:05-6:00 pm

Sponsored by:  **ANS Operations and Power Division**

Nuclear continues to face significant economic and policy turbulence both here at home and across the globe. Join ANS Washington Representative Craig Piercy and Mimi Limbach, Potomac Communications Group Managing Partner, and guests as they discuss the key challenges facing nuclear energy, science, and technology, and how the U.S. nuclear community is responding at the national, state, and local levels.

A “speed dating style” workshop follows this discussion, where attendees will have a chance to practice advocacy and communication to a variety of audiences. The workshop session will not only give attendees the topics to discuss when advocating nuclear technologies, but also the tools to succeed in communicating with a number of diverse audiences. Topics to cover include: clean energy and the environment, jobs and the positive impact on local economies, national economic impact, the science behind basic concepts, the science behind controversial topics, the necessity of nuclear in the future, and how to discuss all of these without getting combative or condescending.

Sponsored by the ANS Operations and Power Division. Beer, wine and light snacks will be served.

ANS Annual Business Meeting

Location: Garden A/B **Time:** 5:45-7:00 pm

ANS encourages all members to attend the Annual Business Meeting. During the Business Meeting, members will have the opportunity to vote for officers and directors, receive reports from the President and other Society leaders, and ask questions and make comments on Society issues. [Click here for the meeting agenda.](#)

THURSDAY, JUNE 15

NPIC&HMIT Thursday Plenary

Cochairs: Clayton Scott (*Schneider Electric*), Sacit M. Cetiner (*ORNL*)

Location: Grand Ballroom A **Time:** 8:00-9:20 am

Keynote Speakers

- Bradley Adams (*VP of Engineering, Southern Nuclear*)
- S. Jason Remer (*Director, Life Extension and New Technology Nuclear Energy Institute*)

Technical Tour: SLAC National Accelerator Laboratory

9:00 am – 3:00 pm (Lunch included)

Fee: \$60 per person

Registration for the SLAC tour closed on April 14, 2017. Board the bus for the tour at the Market Street door.

Technical Tour: National Ignition Facility (NIF) at Lawrence Livermore National Laboratory

8:00 am – 12:30 pm (Lunch is not included)

Fee: \$40 per person

Technical Sessions by Division

SPECIAL SESSIONS

Opening Plenary: Innovating Nuclear Power, Mon. am (8:00-11:40 am)
ANS President's Session, Mon. pm (4:30-6:30 pm)
General Chair's Session, Tues. pm (4:30-6:30 pm)

AEROSPACE NUCLEAR SCIENCE AND TECHNOLOGY (ANSTD)

(Hybrid Energy Systems), Mon. pm

BIOLOGY AND MEDICINE

(Isotopes and Radiation: General), Mon. pm
Biology and Medicine: General, Wed. am

DECOMMISSIONING AND ENVIRONMENTAL SCIENCES (DESD)

Korean Decommissioning and Environmental Remediation for Korean Reactors, Mon. pm
Optimal Energy Strategies Aimed at Sustainable Reduction of Greenhouse Gas Emissions—Panel—I, Tues. am
Optimal Energy Strategies Aimed at Sustainable Reduction of Greenhouse Gas Emissions—Panel—II, Tues. am
Environmental Challenges and Lessons Learned from Decommissioning Nuclear Facilities in California—Panel, Wed. am

EDUCATION, TRAINING, AND WORKFORCE DEVELOPMENT (ETWDD)

(Establishing and Advancing Nonproliferation and Nuclear Policy Education at U.S. Nuclear Science and Engineering Programs), Tues. am
(Innovations in Nuclear Education), Tues. am
Focus on Communications: Telling the Nuclear Story Through Digital and Social Media—Panel—I, Wed. pm
Focus on Communications: Building Strong Networks for Clean Energy Advocacy—Panel—II, Wed. pm

FUEL CYCLE AND WASTE MANAGEMENT (FCWMD)

Backend of the Fuel Cycle for Small Modular Reactors—Panel, Mon. pm
Recycle and Reuse of Used Nuclear Fuel Resources, Tues. am
Long-Term Once-Through Fuel Cycles—From Seawater Uranium to Breed and Burn, Tues. am
Waste Management, Ethics, and Resilience: Professor Joonhong Ahn's Legacy, Tues. am
Innovation Opportunities in Future Fuel Cycles—Panel, Tues. pm
University Research in Fuel Cycle and Waste Management—I, Wed. am
University Research in Fuel Cycle and Waste Management—II, Wed. pm
Electrochemical Separation for Used Nuclear Fuels, Wed. pm
Fuel Cycle and Waste Management: General—I, Thurs. am
Fuel Cycle and Waste Management: General—II, Thurs. pm
Integrated Used Fuel Storage Sites, Thurs. am

FUSION ENERGY (FED)

Neutronics Challenges of Fusion Facilities—I, Wed. am
Neutronics Challenges of Fusion Facilities—II, Wed. pm
Fusion Energy Applications, Wed. pm

HUMAN FACTORS, INSTRUMENTATION, AND CONTROLS (HFICD)

Human Factors, Instrumentation and Controls: General—I, Tues. am
Human Factors, Instrumentation and Controls: General—II, Wed. pm
(Cyber Security—Panel), Wed. pm

ISOTOPES AND RADIATION (IRD)

Isotopes and Radiation: General, Mon. pm

MATERIALS SCIENCE AND TECHNOLOGY (MSTD)

Nuclear Science User Facilities: Fuels Work—I, Mon. pm
Nuclear Science User Facilities: Ion Beam and NSUF Capabilities—II, Tues. pm
Nuclear Science User Facilities: Structural Materials—III, Wed. am
Accident Tolerant Fuels, Tues. am
Post Irradiation Examination and Advanced Measurement Techniques—I, Tues. pm
Post Irradiation Examination and Advanced Measurements Techniques—II, Thurs. am
Nuclear Fuels, Wed. pm
Nuclear Fuels and Materials in Fast Reactors, Thurs. am
Advanced Manufacturing, Thurs. pm

MATHEMATICS AND COMPUTATION (MCD)

Current Issues in Computational Methods—Roundtable, Mon. pm
(Current Verification and Validation Efforts of Multiphysics Packages), Tues. am
Monte Carlo Methods, Tues. pm
Computational Methods and Mathematical Modeling, Wed. am
(Neutronics Challenges of Fusion Facilities—I), Wed. am
(Neutronics Challenges of Fusion Facilities—II), Wed. pm
Uncertainty Quantification and Sensitivity Analysis—I, Wed. pm
Uncertainty Quantification and Sensitivity Analysis—II, Thurs. am
Deterministic Transport Methods, Wed. pm

NUCLEAR CRITICALITY SAFETY (NCSD)

Data, Analysis and Operations in Nuclear Criticality Safety—I, Mon. pm
Data Analysis and Operations in Nuclear Criticality Safety—II, Wed. am
Data, Analysis and Operations in Nuclear Criticality Safety—III, Wed. pm
Sharing of Good Industry Practices and/or Lessons Learned in Nuclear Criticality Safety—Panel, Tues. pm
Nuclear Criticality Safety Division Pioneer Discussion—Panel, Wed. pm
ANS-8 Standards Forum, Thurs. am

NUCLEAR INSTALLATIONS SAFETY (NISD)

Recent Trends in Probabilistic Safety/Risk Assessment for Nuclear Power Plants—Panel, Mon. pm
Nuclear Installations Safety: General, Tues. am
Nuclear Safety R&D at the Department of Energy, Tues. pm
Risk Aspects of Advanced Reactor Technologies Supported by Gain—Panel, Wed. pm
Current Topics in Probabilistic Risk Analysis, Thurs. am

NUCLEAR NONPROLIFERATION POLICY (NNPD)

Advancing Global Nuclear Energy and Strengthening National Security—Panel, Mon. pm
Establishing and Advancing Nonproliferation and Nuclear Policy Education at U.S. Nuclear Science and Engineering Programs—Panel, Tues. am
Nuclear Nonproliferation Policy: General, Wed. am

OPERATIONS AND POWER (OPD)

Hybrid Energy Systems, Mon. pm
New Nuclear Construction around the World—Panel, Tues. pm
Thermal Energy Storage Systems and their Integration with NPPS, Wed. am
Cyber Security—Panel, Wed. pm
Operations and Power: General, Thurs. am

Technical Sessions by Division

RADIATION PROTECTION AND SHIELDING (RPSD)

Radiation Protection and Shielding: General, Tues. am
Computation Tools for Radiation Protection and Shielding, Tues. pm
(Neutronics Challenges of Fusion Facilities—I), Wed. am
(Neutronics Challenges of Fusion Facilities—II), Wed. pm
Highlights of RPSD-2016/ICRS-13—I, Wed. pm
Highlights of RPSD-2016/ICRS-13—II, Wed. pm

REACTOR PHYSICS (RPD)

Reactor Physics: General—I, Mon. pm
Reactors Physics: General—II, Wed. pm
Reactor Physics: General—III, Thurs. am
Research and Test Reactors, Tues. am
Reactor Analysis Methods—I, Tues. am
Reactor Analysis Methods—II, Wed. am
Recent Advancements in Liquid and Solid Fuel Molten Salt Reactors—I, Tues. pm
Recent Advancements in Liquid and Solid Fuel Molten Salt Reactors—II, Wed. pm
Reactor Physics Design, Validation and Operational Experience, Thurs. pm

THERMAL HYDRAULICS (THD)

Two Phase Flow and Heat Transfer Fundamentals, Mon. pm
Advances in CTF and Multiphysics Coupling, Tues. am
Current Verification and Validation Efforts of Multiphysics Packages, Tues. am
(Research and Test Reactors), Tues. am

THERMAL HYDRAULICS (THD)

Experimental Thermal-Hydraulics: High Resolution Experiments—I, Tues. pm
Experimental Thermal-Hydraulics—II, Wed. am
Thermal-Hydraulics: General—I, Wed. am
Thermal-Hydraulics: General—II, Wed. pm
Computational Thermal-Hydraulics: Computational Fluid Dynamics—I, Wed. pm
Computational Thermal-Hydraulics—II, Thurs. pm
Large Eddy Simulation and Direct Numerical Simulation, Wed. pm
Thermal-Hydraulics of Advanced Reactor and Fuel Concepts, Thurs. am

YOUNG MEMBERS GROUP (YMG)

(Advancing Global Nuclear Energy and Strengthening National Security—Panel), Mon. pm
(Establishing and Advancing Nonproliferation and Nuclear Policy Education at U.S. Nuclear Science and Engineering Programs), Tues. am
Innovations in Nuclear Education—Panel, Tues. am
Workforce Transition: How to Succeed—Panel, Tues. pm
(University Research in Fuel Cycle and Waste Management—II), Wed. pm
(Thermal Energy Storage Systems and their Integration with NPPS), Wed. am
Advocacy and Communication: A Clean Energy Discussion—Panel, Wed. pm
(Operations and Power: General), Thurs. am

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Technical Sessions by Day

MONDAY, JUNE 12

1:00-4:15 pm	Nuclear Science User Facilities: Fuels Work—I	Pacific Concourse D
	Two Phase Flow and Heat Transfer Fundamentals	Pacific Concourse E
	Backend of the Fuel Cycle for Small Modular Reactors—Panel	Pacific Concourse F
	Reactor Physics: General—I	Pacific Concourse G
	Recent Trends in Probabilistic Safety/Risk Assessment for Nuclear Power Plants—Panel	Pacific Concourse H
	Current Issues in Computational Methods—Roundtable	Pacific Concourse I
	Data, Analysis and Operations in Nuclear Criticality Safety—I	Pacific Concourse J
	Isotopes and Radiation: General	Pacific Concourse K
	Korean Decommissioning and Environmental Remediation for Korean Reactors	Pacific Concourse L
	Advancing Global Nuclear Energy and Strengthening National Security—Panel	Pacific Concourse M
	Hybrid Energy Systems	Pacific Concourse N

TUESDAY, JUNE 13

8:00-11:40 am	Accident Tolerant Fuels	Pacific Concourse D
	Advances in CTF and Multiphysics Coupling	Pacific Concourse E
	Current Verification and Validation Efforts of Multiphysics Packages	Pacific Concourse E
	Recycle and Reuse of Used Nuclear Fuel Resources	Pacific Concourse F
	Research and Test Reactors	Pacific Concourse G
	Nuclear Installations Safety: General	Pacific Concourse H
	Establishing and Advancing Nonproliferation and Nuclear Policy Education at U.S. Nuclear Science and Engineering Programs—Panel	Pacific Concourse I
	Human Factors, Instrumentation and Controls: General—I	Pacific Concourse J
	Radiation Protection and Shielding: General	Pacific Concourse K
	Long-Term Once-Through Fuel Cycles-From Seawater Uranium to Breed and Burn	Pacific Concourse L
	Reactor Analysis Methods—I	Pacific Concourse M
	Innovations in Nuclear Education—Panel	Pacific Concourse N
	Optimal Energy Strategies Aimed at Sustainable Reduction of Greenhouse Gas Emissions – Panel – I	Grand Ballroom C
Optimal Energy Strategies Aimed at Sustainable Reduction of Greenhouse Gas Emissions – Panel – II	Grand Ballroom C	
10:10 am-12:20 pm	Waste Management, Ethics, and Resilience—Professor Joonhong Ahn’s Legacy	Pacific Concourse L
1:00-4:15 pm	Nuclear Science User Facilities: Ion Beam and NSUF Capabilities —II	Pacific Concourse D
	Experimental Thermal-Hydraulics: High Resolution Experiments—I	Pacific Concourse E
	Innovation Opportunities in Future Fuel Cycles—Panel	Pacific Concourse F
	Recent Advancements in Liquid and Solid Fuel Molten Salt Reactors—I	Pacific Concourse G
	Nuclear Safety R&D at the Department of Energy	Pacific Concourse H
	Monte Carlo Methods	Pacific Concourse I
	Sharing of Good Industry Practices and/or Lessons Learned in Nuclear Criticality Safety—Panel	Pacific Concourse J
	Computation Tools for Radiation Protection and Shielding	Pacific Concourse K
	Workforce Transition: How to Succeed—Panel	Pacific Concourse L
	Post Irradiation Examination and Advanced Measurement Techniques—I	Pacific Concourse M
New Nuclear Construction around the World—Panel	Pacific Concourse N	

WEDNESDAY, JUNE 14

8:00-9:20 am	Nuclear Science User Facilities: Structural Materials—III	Pacific Concourse D
	Experimental Thermal-Hydraulics—II	Pacific Concourse E
	University Research in Fuel Cycle and Waste Management—I	Pacific Concourse F
	Reactor Analysis Methods—II	Pacific Concourse G
	Thermal-Hydraulics: General—I	Pacific Concourse H
	Computational Methods and Mathematical Modeling	Pacific Concourse I
	Data Analysis and Operations in Nuclear Criticality Safety—II	Pacific Conference J
	Nuclear Nonproliferation Policy: General	Pacific Concourse K
	Biology and Medicine: General	Pacific Concourse K
	Environmental Challenges and Lessons Learned from Decommissioning Nuclear Facilities in California—Panel	Pacific Concourse L
	Neutronics Challenges of Fusion Facilities—I	Pacific Concourse M
	Thermal Energy Storage Systems and their Integration with NPPs	Pacific Concourse N
	1:00-4:15 pm	Nuclear Fuels
Computational Thermal-Hydraulics: Computational Fluid Dynamics—I		Pacific Concourse E
University Research in Fuel Cycle and Waste Management—II		Pacific Concourse F
Recent Advancements in Liquid and Solid Fuel Molten Salt Reactors—II		Pacific Concourse G
Risk Aspects of Advanced Reactor Technologies Supported by GAIN—Panel		Pacific Concourse H
Uncertainty Quantification and Sensitivity Analysis—I		Pacific Concourse I
Nuclear Criticality Safety Division Pioneer Discussion—Panel		Pacific Concourse J
Highlights of RPSD-2016/ICRS-13—I		Pacific Concourse K
Focus on Communications: Telling the Nuclear Story Through Digital and Social Media—Panel—I		Pacific Concourse L
Neutronics Challenges of Fusion Facilities—II		Pacific Concourse M
Advocacy and Communication: A Clean Energy Discussion—Panel	Pacific Concourse N	

Technical Sessions by Day

WEDNESDAY, JUNE 14 CONTINUED

3:05-4:15 pm	Focus on Communications: Building Strong Networks for Clean Energy Advocacy—Panel—II	Pacific Concourse L
4:30-6:40 pm	Human Factors, Instrumentation and Controls: General—II	Concourse D
	Thermal-Hydraulics: General—II	Pacific Concourse E
	Electrochemical Separation for Used Nuclear Fuels	Pacific Concourse F
	Reactors Physics: General—II	Pacific Concourse G
	Large Eddy Simulation and Direct Numerical Simulation	Pacific Concourse H
	Deterministic Transport Methods	Pacific Concourse I
	Data, Analysis and Operations in Nuclear Criticality Safety—III	Pacific Concourse J
	Highlights of RPSD-2016/ICRS-13—II	Pacific Concourse K
	Fusion Energy Applications	Pacific Concourse M
	Cyber Security—Panel	Pacific Concourse N

THURSDAY, JUNE 15

8:00-9:20 am	Nuclear Fuels and Materials in Fast Reactors	Pacific Concourse D
	Thermal-Hydraulics of Advanced Reactor and Fuel Concepts	Pacific Concourse E
	Fuel Cycle and Waste Management: General—I	Pacific Concourse F
	Reactor Physics: General—III	Pacific Concourse G
	Current Topics in Probabilistic Risk Analysis	Pacific Concourse H
	Uncertainty Quantification and Sensitivity Analysis—II	Pacific Concourse I
	ANS-8 Standards Forum	Pacific Concourse J
	Post Irradiation Examination and Advanced Measurements Techniques—II	Pacific Concourse K
	Integrated Used Fuel Storage Sites	Pacific Concourse M
	Operations and Power: General	Pacific Concourse N
1:00-4:15 pm	Advanced Manufacturing	Pacific Concourse D
	Computational Thermal-Hydraulics—II	Pacific Concourse E
	Fuel Cycle and Waste Management: General—II	Pacific Concourse F
	Reactor Physics Design, Validation and Operational Experience	Pacific Concourse G

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MONDAY, JUNE 12

TECHNICAL SESSIONS – 1:00 PM

Nuclear Science User Facilities: Fuels Work—I

Sponsored by: MSTD

Session Organizer: J. Rory Kennedy (*INL*) **Chair:** Daniel Ogden (*Battelle Energy Alliance*)

Location: Pacific Concourse D **Time:** 1:00-3:50 pm

- 1:05 pm:** Microanalysis of Irradiated Metallic Hydride Nuclear fuel ($U_{0.17}ZrH_{1.6}$) Fuels, Michele Conroy, Edgar C. Buck (*PNNL*), Mehdi Balooch (*Univ. California, Berkeley*), Andrew M. Casella (*PNNL*)
- 1:30 pm:** The Characterization of Microstructure and Chemistry of Transmutation Fuels, Assel Aitkaliyeva (*INL / Univ. Florida*), Cynthia A. Papesch (*INL*)
- 1:55 pm:** Hydride Microstructure at the Metal-Oxide Interface of a Zircaloy-4 Fuel Clad from the H. B. Robinson Nuclear Reactor, M. Nedim Cinbiz, Philip D. Edmondson, Kurt Terrani (*ORNL*)
- 2:20 pm:** Fission Product and Actinide Distribution in the Sic Layer of Fissioned Triso Fuel Particles, Rachel L. Seibert (*IIT*), Tyler J. Gerczak, J. Hunn, C. Baldwin, F. Montgomery, K. Leonard, L. Terrani (*ORNL*), Jeff Terry (*IIT*)
- 3:00 pm:** Microstructure Investigations of U_3Si_2 Irradiated by Heavy Ions at LWR Temperatures, Yinbin Miao (*ANL*), Jason Harp (*INL*), Kun Mo (*ANL*), Sumit Bhattacharya (*Northwestern Univ.*), Abdellatif M. Yacout (*ANL*)
- 3:25 pm:** Microstructural Characterization of Irradiated $U_{0.17}ZrH_{1.6}$ Using Ultrasonic Techniques, Pradeep Ramuhalli, Richard Jacob, Paul J. MacFarlan, Andrew M. Casella (*PNNL*)

Two Phase Flow and Heat Transfer Fundamentals

Sponsored by: THD

Session Organizer: Seungjin Kim (*Penn State*) **Cochairs:** Seungjin Kim (*Penn State*), Dillon R. Shaver (*ANL*)

Location: Pacific Concourse E **Time:** 1:00-4:15 pm

- 1:05 pm:** A New Mechanistic Model of Nucleation Site Density, Zeyong Wang, Michael Z. Podowski (*RPI*)
- 1:30 pm:** Evaluation of the Shear Rate Effect on the Interfacial Forces Acting on a Single Bubble, Jinyong Feng, Igor A. Bolotnov (*NCSU*)
- 1:55 pm:** Verification of the Two-Fluid Model in the Spectral Element Code Nek-2P for Adiabatic Flow Conditions, Dillon R. Shaver (*ANL*), Ananias Tomboulides (*ANL & Aristotle Univ. Thessaloniki*), Aleksandr Obabko, Adrian Tentner, Prasad Vegendla, Elia Merzari (*ANL*)
- 2:20 pm:** Numerical Uncertainties vs. Model Uncertainties in Two-Phase Flow Simulations, Ling Zou, Haihua Zhao, Hongbin Zhang (*INL*)
- 3:00 pm:** Analysis of COBRA-TF Critical Heat Flux Models for Triangular Fuel Assembly Pitch, Ozlem Aktas Ozulus, Sule Ergun (*Hacettepe Univ.*)
- 3:25 pm:** CFD Simulation of Bubble Growing Under a Downward Facing Surface, Tien-Juei Chuang, Yuh-Ming Ferng, Ke-Wei Lai (*National Tsing Hua Univ.*)
- 3:50 pm:** Simulating Bubble Deformations Using the Intersection Marker (ISM) Front-Tracking Method, Mark Ho (*ANSTO*), Syed Ahsan Sharif (*ANSTO & Univ. New South Wales*), Guan Yeoh, Victoria Timchenko (*Univ. New South Wales*)

Following this session, the award ceremony for the first THD Excellence in review award will take place. Please join us to congratulate our outstanding reviewers.

Backend of the Fuel Cycle for Small Modular Reactors—Panel

Sponsored by: FCWMD

Session Organizer and Chair: Sven O. Bader (*AREVA Federal Services LLC*)

Location: Pacific Concourse F **Time:** 1:00-4:15 pm

With the current emphasis on licensing and potential deployment of SMRs, this panel will examine how the backend of the fuel cycle may look for the UNF/SNF produced by these reactors. This panel will cover the following topics: interim storage (dry and/or wet) on- or off-site; transportation; recycling of UNF with current or new recycling/reprocessing plants; and geologic repository need for SNF/HLW.

Panelists: Daniel Ingersoll (*NuScale*), Kirk Sorenson (*Flibe Energy*), John Kutsch (*Terrestrial Energy*)

Technical
Sessions:
Monday
June
12

MONDAY, JUNE 12
TECHNICAL SESSIONS – 1:00 PM

Reactor Physics: General—I

Sponsored by: RPD

Session Organizers and Cochairs: Cristian Rabiti (*INL*), Dimitrios Cokinos (*BNL*)

Location: Pacific Concourse G **Time:** 1:00-4:05 pm

1:05 pm: PARCS Analysis of the APR1400 Initial Core, Andrew Bielen, Peter J. Yarsky *ktu*

1:30 pm: Improvements to PHISICS/RELAP5-3D® Capabilities for Simulating HTGRs, Paolo Balestra (*Sapienza Univ.*), Andrea Alfonsi, Gerhard Strydom, Cristian Rabiti (*INL*), Fabio Giannetti, Gianfranco Caruso (*Sapienza Univ.*)

1:55 pm: Study on the Technology for Enhancing Element Value by Neutron Transmutation in Light Water Reactors, Hiroki Takezawa, Naoyuki Takaki (*Tokyo City Univ.*)

2:20 pm: Reactivity Worth Measurement of Control Rods of CFBR-II with Inverse Kinetics Method, Yanpeng Yin, Haojun Zhou, Meng Li (*CAEP*)

3:00 pm: The Neutron Chase: Taking Advantage of Every Neutron, Florent Heidet (*ANL*), *Early Career Physicist Award*

3:40 pm: Modeling of the SPERT Transients Using SERPENT2 with Time Dependent Capabilities, Alex Levinsky, Frederick P. Adams, Vinicius N. P. Anghel (*Canadian Nuclear Laboratories*), Ville Valtavirta (*VTT Technical Research Centre*)

Recent Trends in Probabilistic Safety/Risk Assessment for Nuclear Power Plants–Panel

Sponsored by: NISD

Session Organizer and Cochairs: Tunc Aldemir (*Ohio State*), Stefano Monti (*IAEA*)

Location: Pacific Concourse H **Time:** 1:00-4:15 pm

The objective of the panel session is to review the state-of-the-art in dynamic probabilistic safety/risk assessment (PSA/PRA) and in multi-unit site PSA/PRA research, present overviews of the plant/site level applicable tools and methods, and identify areas where further research is needed.

Panelists: Tunc Aldemir (*The Ohio State Univ*), Steven Arndt (*Univ of Tennessee*), Matthew Denman (*SNL*), Mohammad Modarres (*Univ of Maryland*), Cristian Rabiti (*INL*), Valentin Rychkov (*EdF*)

Current Issues in Computational Methods–Roundtable

Sponsored by: MCD

Session Organizer and Chair: Rachel N. Slaybaugh (*Univ of California, Berkeley*)

Location: Pacific Concourse I **Time:** 1:00-4:15 pm

But Can You Remake That Plot (and Can Anyone Else)?

Reproducible, Transparent, and Open Computation in Nuclear Engineering

How reproducible is the science involving data and computation? Is something science if it's not reproducible? Nuclear, more than many fields, has a burden to do science responsibly. This includes setting up reproducible, transparent workflows for computation. This panel of experts will discuss associated strategies, motivations, best practices, and challenges.

A challenge that is especially true for nuclear is the relationship between openness and reproducibility. Our software, data, and models often come with restrictions-making it difficult to share our work in a way that makes it verifiable by independent researchers. This panel will also investigate how to manage scientific integrity in conjunction with legal restrictions in nuclear computation.

Panelists: Morgan White (*LANL*), Fatma Deniz (*Univ of California, Berkeley*), Katy Huff (*UIUC*), Michael Frenklach (*Univ of California, Berkeley*), Seth Johnson (*ORNL*)

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BOOK SIGNING!

Meet Donald Olander and Arthur Motta, authors of the new ANS textbook **Light Water Reactor Materials**, available for signing at the ANS Annual Meeting on Tuesday 10:30 am – 12 noon on the concourse level.

MONDAY, JUNE 12

TECHNICAL SESSIONS – 1:00 PM

Data, Analysis and Operations in Nuclear Criticality Safety—I

Sponsored by: NCS D

Session Organizer: Theresa E. Cutler (*LANL*) **Chair:** Vladimir Sobes (*ORNL*)

Location: Pacific Concourse J **Time:** 1:00-4:15 pm

- 1:05 pm:** Measurement of Delayed Neutron Group Parameters Using the Fission Burst of CFBR-II, Lingli Song, Chun Zheng (*Inst. Nuclear Physics and Chemistry CAEP*)
- 1:30 pm:** Criticality Scoping Calculations for a Multi-Function Dissolver Insert, Tracy Stover, Stephen Kessler (*SRNS*)
- 1:55 pm:** Bounding the Chemistry Conditions in the HM Solvent Extraction Process Criticality Safety Analyses, Tracy Stover, Stephen Kessler, John Lint (*SRNS*)
- 2:20 pm:** Moderation Control Challenges in a Shutdown Facility, Tom Hines (*DOE*), Matthew Wilson (*Paschal Solutions Inc.*)
- 3:00 pm:** A New Look at Historic CRAC “Divergence” Experiments—Implications for a CAAS Minimum Accident of Concern, Peter L. Angelo (*Y-12 National Security Complex*)
- 3:25 pm:** Considerations for Using FGE Conversion Factors in Type A Shipping Packages at the Savannah River Site, Brittany Williamson, James Baker (*Savannah River Nuclear Solutions*)
- 3:50 pm:** The Difficulty of Defining the Terms “Credible” and “Unlikely” for Nuclear Criticality Safety Purposes, Douglas G. Bowen (*ORNL*)

Isotopes and Radiation: General

Sponsored by: IRD; **Cosponsored by:** BMD

Session Organizer: Kenan Unlu (*Penn State*) **Chair:** Manish K. Sharma (*Univ of Michigan*)

Location: Pacific Concourse K **Time:** 1:00-3:25 pm

- 1:05 pm:** Investigation of Scintillator Based Partial Defect Detector for Safeguarding Spent Fuel Assemblies, Haneol Lee, Man-Sung Yim (*KAIST*)
- 1:30 pm:** Preprocessing Analysis of the Multi Isotope Process Monitor, Nathan Gilliam, Jamie Coble (*Univ. Tenn., Knoxville*), David Meier (*PNNL*)
- 1:55 pm:** Developing a GUM Compliant Uncertainty Approach for NDA Gamma Analysis Using FRAM, Jung H. Rim, Donovan R. Porterfield (*LANL*), Michael D. Yoho (*Univ. Texas, Austin*)
- 2:20 pm:** Resonance Self-Shielding Impact on Neutron Spectrum Determination for Missouri S&T Reactor, Meshari AL Qahtani, Ayodeji B. Alajo (*Missouri Univ., Rolla*)
- 3:00 pm:** Helicon-Injected Inertial Electrostatic Confinement Neutron Source or Space Propulsion Device, George H. Miley, Drew Ahern (*Univ. Illinois, Urbana-Champaign*)

Korean Decommissioning and Environmental Remediation for Korean Reactors

Sponsored by: DESD

Session Organizer and Chair: James J. Byrne (*DESD*)

Location: Pacific Concourse L **Time:** 1:00-3:25 pm

- 1:05 pm:** Consideration for Implementing the Safety Regulation Plans on Permanent Shut-Down NPP during Transition Period in Korea, Yong Ki Chi, Kyungwoo Choi, (*KINS*)
- 1:30 pm:** Preliminary Dose Assessment during Dismantling Biological Shield of Kori Unit-1, Choong Wie Lee, Choong Wie Lee, HyungJun Kim, Donghyun Lee, Hee Reyoung Kim (*UNIST*)
- 1:55 pm:** Regulatory Consideration on Decommissioning Facilitation of Nuclear Power Plants in Korea, Kyungwoo Choi, Byung-il Kim (*KINS*)
- 2:20 pm:** A New Graphical Dismantling Process Simulation Technology for Flexible Planning of Nuclear Facility, Byung-Seon Choi, Dongjun Hyun, Ikjune Kim, Jonghwan Lee, Jeikwon Moon (*KAERI*)
- 3:00 pm:** Chemical Decontamination Performance of Radioactive Metal Surface Using HyBRID Process, Wangkyu Choi, Seonbyeong Kim, Sangyoon Park, Huijun Won, Jeikwon Moon (*KAERI*)

Technical
Sessions:
Monday
June
12

Technical Sessions:
Monday
June
12

MONDAY, JUNE 12
TECHNICAL SESSIONS – 1:00 PM

Advancing Global Nuclear Energy and Strengthening National Security–Panel

Sponsored by: NNPD; **Cosponsored by:** YMG

Session Organizer: John C. Browne (*JCB Scientific Consulting*) **Chair:** Evelyn Mullen (*LANL*)

Location: Pacific Concourse M **Time:** 1:00-4:15 pm

This panel will explore the interplay between advancing civilian nuclear energy globally while ensuring the best possible practices for safeguards against proliferation. The panel will review new directions based on past successes and failures in the nuclear energy and nonproliferation area as well as an understanding the state of the art of current safeguards technology and future research directions.

Panelists: Martin Swinhoe (*LANL*), Tomonori Iwamoto (*Japan Nuclear Fuel Limited*), Per Peterson (Univ of California, Berkeley), Thomas Isaacs (*retired LLNL*), Mike Miller (*INL*)

Hybrid Energy Systems

Sponsored by: OPD; **Cosponsored by:** ANSTD

Session Organizer: Shannon M. Bragg-Sitton (*INL*) **Chair:** Piyush Sabharwall (*INL*)

Location: Pacific Concourse N **Time:** 1:00-3:25 pm

1:05 pm: Experimental Capability for Preparation and Purification of Molten Salts to Support Advanced Reactor Concepts, Nuclear Hybrid Energy Systems and Dynamic Grid Energy Storage Concepts , James E. O'Brien, Piyush Sabharwall, SuJong Yoon (*INL*)

1:30 pm: Technology Options for Integrated Thermal Energy Storage in Nuclear Power Plants, Daniel Curtis, Natalie Shifflet, Charles Forsberg (*MIT*)

1:55 pm: Economic Assessment of Nuclear Hybrid Energy Systems: Optimization using RAVEN, Aaron S. Epiney, Andrea Alfonsi, Cristian Rabiti, Jun Chen (*INL*)

2:20 pm: Models and Simulation Environment for the Design and Optimization of Hybrid Energy Systems, Richard B. Vilim, Roberto Ponciroli (*ANL*), Thomas Harrison, Lou Qualls (*ORNL*)

3:00 pm: Using Dynamic Line Rating to Enhance Flexibility of Wind-Involved Hybrid Energy System, Wei Zhang, Katya L. Blanc, Timothy R. McJunkin, Jake P. Gentle (*INL*)

**Silicon Carbide Ceramic Technology
for Demanding Applications**

Accident Tolerant Fuel



ATF Cladding



ATF Rod Assembly

- Drop-in compatibility with existing LWRs
- Substantially higher meltdown resistance
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Advanced SiC-SiC Composites



2 cm Diameter
SiC-SiC Tubes



SiC-SiC Plate with
Complex Curvature

- Custom fabrication in multiple geometries
- Advanced joining capabilities
- Strong and stable up to 1700°C



TUESDAY, JUNE 13

TECHNICAL SESSIONS – 8:00 AM

Accident Tolerant Fuels

Sponsored by: MSTD

Session Organizer: Kenneth J. Geelhood (*PNNL*) **Chair:** Gokul Vasudevamurthy (*General Atomics*)

Location: Pacific Concourse D **Time:** 8:00-10:50 am

8:05 am: Multi-Functional Zirconium-Silicide Coatings on Zirconium-alloy for Improved Accident Tolerance, Hwasung Yeom, Hangjin Jo, Benjamin Maier, Michael Corradini, Kumar Sridharan (*Univ. Wisconsin, Madison*), Gi Cheol Lee, Hyunwoo Noh, Tong Kyun Kim, Moo Hwan Kim, Hyun Sun Park (*Pohang Univ. of Sci. and Technol.*)

8:30 am: Interdiffusion Behavior of U_3Si_2 and FeCrAl via Diffusion Couple Studies, Rita Hoggan, Jason Harp, Lingfeng He (*INL*)

8:55 am: Pressure Loading with In-Situ Permeability Measurement of SiC Ceramic Matrix Composite Tube, K. S. Shapovalov, G. M. Jacobsen, G. Vasudevamurthy, C. P. Deck (*General Atomics*)

9:35 am: Accident Tolerant Fuel Cladding Tube Irradiations in the HFIR, Christian M. Petrie, Kurt A. Terrani, Yutai Katoh (*ORNL*)

10:00 am: Improvements to Modeling Capabilities of ATF Concepts in the BISON Fuel Performance Code, Kyle A. Gamble, Danielle M. Perez, Jason D. Hales (*INL*)

10:25 am: Estimation of Core Recovery Time with TRACE, Anil Gurgen, Koroush Shirvan (*MIT*)

Advances in CTF and Multiphysics Coupling

Sponsored by: THD

Session Organizer: Maria N. Avramova (*NCSU*) **Cochairs:** Cesare Frepoli (*FPoliSolutions LLC*), Maria N. Avramova (*NCSU*)

Location: Pacific Concourse E **Time:** 8:00-9:20 am

8:05 am: Validation of CTF Droplet Entrainment and Annular/Mist Closure Models Using Riso Steam/Water Experiments, Aaron J. Wysocki, Robert Salko (*ORNL*)

8:30 am: Review of CTF's Fuel Rod Modeling Using FRAPCON-4.0's Centerline Temperature Predictions, Aysenur Toptan (*NCSU*), Robert K. Salko (*ORNL*), Maria N. Avramova (*NCSU*)

8:55 am: Implementation of a Pressure Correction Term in the CTF Subchannel Code, Marc-Olivier G. Delchini, Robert Salko (*ORNL*), Vincent Mousseau (*SNL*)

Current Verification and Validation Efforts of Multiphysics Packages

Sponsored by: THD; **Cosponsored by:** MCD

Session Organizer: Tara M. Pandya (*ORNL*) **Cochairs:** Tara M. Pandya (*ORNL*), Yassin Hassan (*Texas A&M*)

Location: Pacific Concourse E **Time:** 9:40-11:50 am

9:45 am: Proposed Semi-Analytic Benchmark for Coupled Neutronics/Thermal-Hydraulics Feedback in Multiphysics Simulations, David P. Griesheimer, David L. Aumiller, Daniel F. Gill (*BAPL*)

10:10 am: The International Experimental Thermal-Hydraulic Systems Database TIETHYS: A New NEA Validation Tool, Yeonjoo Cho (*Chung-Ang Univ.*), James Dyrda (*OECD/NEA*), Kumar Singh Rohatgi (*BNL*)

10:35 am: Calibration of COBRA-TF and STAR-CCM+ with Dakota 6.5 for CASL, Natalie C. Gordon, Lindsay N. Gilkey (*SNL*)

11:00 am: OECD/NEA EGMPEBV Activities in Multi-Physics Verification and Validation, M. Avramova (*NCSU*), M. DeHart (*INL*), J. Dyrda (*OECD NEA*), J.-P. Hudelot (*CEA Cadarache*), K. Ivanov (*NCSU*), A. Petruzzi (*Nuclear and Industrial Engineering S.r.l.*), U. Rohatgi (*BNL*), T. Valentine (*ORNL*), K. Velkov (*Gesellschaft für Anlagen- und Reaktorsicherheit*)

11:25 am: Validation of COBRA-TF and STAR-CCM+ with Dakota 6.5 for CASL, Lindsay N. Gilkey, Natalie C. Gordon (*SNL*)

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TUESDAY, JUNE 13

TECHNICAL SESSIONS – 8:00 AM

Recycle and Reuse of Used Nuclear Fuel Resources

Sponsored by: FCWMD

Session Organizer and Chair: Guillermo Daniel DelCul (ORNL)

Location: Pacific Concourse F **Time:** 8:00-11:40 am

- 8:05 am:** Engineering Scale Development/Demonstration of Zirconium Recovery from Used Fuel cladding, E. D. Collins, G. D. DelCul, J. A. Johnson, T. D. Hylton, R. D. Hunt, B. B. Spencer, E. C. Bradley (ORNL)
- 8:30 am:** Characterization of the Chlorination Products of Zirconium Alloys used for Nuclear Fuel Cladding, Rosendo Borjas Nevarez (Univ. of Nevada, Las Vegas)
- 8:55 am:** Purification of Zirconium Tetrachloride (ZrCl₄) from UNF Cladding —A Progress Report, Craig Barnes, (Univ. Tenn), Guillermo (Bill) Daniel DelCul (ORNL), David F. McLaughlin (Westinghouse), Michael Orick, Ales Styskalik (Univ. Tenn)
- 9:35 am:** Computational Studies of Gas Phase Reactions of Zirconium Tetrachloride (ZrCl₄) and Metal Chloride Impurities, Michael Orick, Ales Styskalik (Univ. Tenn.), Guillermo (Bill) Daniel DelCul (ORNL), David F. McLaughlin (Westinghouse), Craig Barnes (Univ. Tenn.)
- 10:00 am:** Adsorption of Chlorine on Zr(0001) Surface: First-Principles Predictions , Eunja Kim (Univ. Nevada, Las Vegas), Philippe F. Weck (SNL), Rosendo Borjas, Frederic Poineau (Univ. Nevada, Las Vegas)
- 10:25 am:** Removal of Tritium from the Gaseous Effluents Produced by the Recovery of Zirconium from Used Fuel Cladding, S. H. Bruffey, B. B. Spencer, G. D. DelCul (ORNL)
- 10:50 am:** Tritium Management Requirements and Approaches for UNF Reprocessing, Robert T. Jubin, Barry B. Spencer (ORNL)
- 11:15 am:** Modulation of Tetravalent Actinide Oxalate Morphology through Organic Compounds, Blaise Haidon, Benedicte Arab-Chapelet (CEA Marcoule), Pascal Roussel (UCCS-UMR), Thibaud Delahaye, Murielle Bertrand (CEA Marcoule), Stephane Grandjean (CEA), Murielle Rivenet (UCCS-UMR)

Research and Test Reactors

Sponsored by: RPD

Session Organizer and Chair: Florent Heidet (ANL)

Location: Pacific Concourse G **Time:** 8:00-10:50 am

- 8:05 am:** LOCA and LOFA Safety Margin Analysis for U-10Mo Monolithic LEU Fuel Conversion of the MURR Reactor, David Jaluvka, Earl E. Feldman (ANL), J. Charles McKibben, Leslie P. Foyto (Univ. Missouri, Columbia), John A. Stillman, Erik H. Wilson (ANL)
- 8:30 am:** Neutronics Analysis of TREAT Multi-SERTTA Calibration Test Vehicle (Multi-SERTTA CAL), Connie M. Hill, John D. Bess, Nicolas E. Woolstenhulme (INL)
- 8:55 am:** The Radiation Science and Engineering Center Utilizations and Future Developments at Penn State University, Kenan Ünlü (Penn State Univ.)
- 9:35 am:** CUDA Computation of the Feynman Distribution, A. Talamo, Y. Gohar (ANL)
- 10:00 am:** University of Wisconsin Nuclear Reactor Modeling Improvements, YoungHui Park, Alexander Swenson, Paul P. H. Wilson (Univ. Wisconsin, Madison)
- 10:25 am:** PLTEMP/ANL Verification for Assemblies Having Five-Layer Fuel Tubes, M. Kalimullah, A. P. Olson, E. E. Feldman (ANL)

TUESDAY, JUNE 13

TECHNICAL SESSIONS – 8:00 AM

Nuclear Installations Safety: General

Sponsored by: NISD

Session Organizer: Nicholas R. Brown (*Penn State*) **Chair:** Juan J. Carbajo (*ORNL*)

Location: Pacific Concourse H **Time:** 8:00-11:15 am

- 8:05 am:** Radiological Source Term Estimates of the Fukushima Daiichi Nuclear Accident, Matthew J. Krupcale, John C. Lee (*Univ. Michigan*), Theodore W. Bowyer (*PNNL*)
- 8:30 am:** Study of Control Rod Device Mechanism Missile Impact on Protection Plate, Xianhui Ye, Furui Xiong, Bin Zhen, Naibin Jiang (*Nuclear Power Inst of China*)
- 8:55 am:** LOCA Analysis for the NIST Research Reactor, Joo Seok Baek, Lap-Yan Cheng, David Diamond (*BNL*)
- 9:35 am:** Evaluation of the New Boron Model of the TRACE Code, Juan J. Carbajo (*ORNL*)
- 10:00 am:** Deterministic Selection of Design Extension Condition without Core Melt, Jong Ho Choi, Min Shin Jung and Gyu Cheon Lee (*KEPCO*)
- 10:25 am:** Power Distribution Control Strategy of the Soluble Boron Free SMR, Jinhan Bae, Jaeshik Kim, Sungju Kwon, Jinyoung Lee, Kibong Seong (*KEPCO NF*)
- 10:50 am:** Demonstration of Passive Phoretic Decontamination by Accident Simulation in a Scaled Reactor Containment, Sola Talabi (*Pittsburgh Technical*)

Establishing and Advancing Nonproliferation and Nuclear Policy Education at U.S.

Nuclear Science and Engineering Programs—Panel

Sponsored by: NNPD; **Cosponsored by:** YMG, ETWDD

Session Organizer: Charles D. Ferguson (*Federation of American Scientists*)

Chair: Gilbert J. Brown (*Univ of Massachusetts Lowell*)

Location: Pacific Concourse I **Time:** 8:00-11:40 am

Some nuclear science and engineering programs at U.S. universities have established courses and research projects on nonproliferation and nuclear policy, but many nuclear science and engineering programs have little or no formal curriculum opportunities for undergraduate and graduate students to learn about these issues. This session will feature leading practitioners in nonproliferation education and research from major universities, a national laboratory, and a think tank to discuss how they have been training the next generation in this field. This session will also assess how more nuclear science and engineering programs can develop courses and research projects in nonproliferation and nuclear policy.

Panelists: Rian Bahrn (*LANL*), Charles Ferguson (*Univ of California, Berkeley*), Bethany Goldblum (*Univ of California, Berkeley*), John Mattingly (*NCSU*), Sunil Chiriyath (*NSSPI*), Sara Pozzi (*CVT*)

Human Factors, Instrumentation and Controls: General—I

Sponsored by: HFICD

Session Organizer: Kathryn Ann McCarthy (*Canadian Nuclear Laboratories*), **Chair:** Jeffrey Joel (*INL*)

Location: Pacific Concourse J **Time:** 8:00-10:25 am

- 8:05 am:** Determination of a Generic Human Error Probability Distribution, Part 1: A Dynamic Formulation of SPAR-H, Sarah M. Ewing, Kateryna Savchenko, Diego Mandelli, Ronald Boring (*INL*)
- 8:30 am:** Determination of a Generic Human Error Probability Distribution, Part 2: A Dynamic SPAR-H Example Application, Sarah M. Ewing, Ronald Boring, Diego Mandelli, Kateryna Savchenko (*INL*)
- 8:55 am:** Development of Performance Validation Tool for the NPCS for APR1400, See Chae Jeong, In Ho Song, Gyu Cheon Lee (*KEPCO E&C*), Ha Young Lim, Mun O Heo (*KHNP*)
- 9:35 am:** Nuclear Power Plant Control Room Modernization—Simulation Based Design, Bruce Hallbert, Bahram Meyssami, Sean Fuller (*INL*)
- 10:00 am:** Feasibility of Applying a Human Bio-Signals Monitoring System to Minimize Insider Threats, Young A. Suh, Man-Sung Yim (*KAIST*)

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TUESDAY, JUNE 13

TECHNICAL SESSIONS – 8:00 AM

Radiation Protection and Shielding: General

Sponsored by: RPSD

Session Organizer and Chair: Irina I. Popova (*ORNL*)

Location: Pacific Concourse K **Time:** 8:00-10:50 am

- 8:05 am:** Reconstructing Solar Particle Event Spectra from Absorbed Dose Measurements, Amir A. Bahadori, Jeremy A. Roberts (*Kansas State.*), Martin Kroupa (*Leidos*), Dan J. Fry (*NASA Johnson Space Center*)
- 8:30 am:** Initial Modeling of Urban Search Measurements, Douglas E. Peplow, Mathew W. Swinney, Gregory G. Davidson, Andrew D. Nicholson, Bruce W. Patton (*ORNL*)
- 8:55 am:** Characterization of NORM in an Urban Environment using HPGe Measurements and MCNP6 Simulations, Mathew W. Swinney, Douglas E. Peplow, Andrew D. Nicholson (*ORNL*)
- 9:35 am:** Absolute Dosimetry Model of the University of Washington Clinical Neutron Therapy System (CNTS), Gregory Moffitt (*Univ. Utah*), Robert Stewart, George Sandison (*Univ. Washington*), Tatjana Jevremovic (*Univ. Utah*)
- 10:00 am:** Validation of Methodology to Simulate Gamma Doses from Historical Weapons Tests, Thomas M. Miller, Bruce W. Patton (*ORNL*)
- 10:25 am:** Latent Effects of Radiation on Li-ion Batteries in Robots, Chuting Tan, Nicholas H. Bashian, Chase W. Hemmelgarn, Wesley J. Thio, Daniel J. Lyons, Yuan F. Zheng, Lei R. Cao, Anne C. Co (*Ohio State*)

Long-Term Once-Through Fuel Cycles-From Seawater Uranium to Breed and Burn

Sponsored by: FCWMD

Session Organizer: Kathryn D. Huff (*Univ of Illinois*) **Chair:** Charles W. Forsberg (*MIT*)

Location: Pacific Concourse L **Time:** 8:00-10:00 am

- 8:05 am:** Uranium from Seawater Cost Analysis: Recent Updates, Margaret Flicker Byers, Erich Schneider (*Univ. Texas, Austin*)
- 8:30 am:** Cost Analysis of Wind and Uranium from Seawater Acquisition symbiotic Infrastructure using Shell Enclosures, Maha N. Haji (*MIT*), Margaret E. Flicker Byers, Erich A. Schneider (*Univ. Texas, Austin*), Alexander H. Slocum (*MIT*)
- 8:55 am:** Use of NAA to Detect Uptake of Uranium and other Elements in Adsorbents, Sebastian Eder, Margaret Byers, Erich Schneider (*Univ. of Texas at Austin*)
- 9:35 am:** Assessment of Near-Breeding Heterogeneous Seed/Blanket Cores in Pressure-Tube Heavy Water Reactors with Thorium-Based Fuels, A. V. Colton, B. P. Bromley, S. Golesorkhi (*Canadian Nuclear Laboratories*)

Waste Management, Ethics, and Resilience—Professor Joonhong Ahn's Legacy

Sponsored by: FCWMD

Session Organizer and Chair: Massimiliano Fratoni (*Univ of California, Berkeley*)

Location: Pacific Concourse L **Time:** 10:10 am-12:20 pm

- 10:15 am:** Integrated Modeling and Monitoring Technologies for Environmental Resiliency in Nuclear Energy, Haruko M. Wainwright (*LBNL*), Franziska Schmidt (*Univ. California, Berkeley*), Boris Faybishenko (*LBNL*)
- 10:40 am:** Used Nuclear Fuel Management in Asia, Jor-Shan Choi (*Univ. California, Berkeley*)
- 11:05 am:** The Criticality Safety Studies of Joonhong Ahn, Alex Salazar, Milos Atz, Xudong Liu, Massimiliano Fratoni (*Univ. California, Berkeley*)
- 11:30 am:** Effect of Socio-Political Factors in Nuclear Power Development in Multi-National Framework, Viet Phuong Nguyen, Man-Sung Yim (*KAIST*)
- 11:55 am:** Preliminary Analysis of Facility Design for Pyroprocessing Safeguardability, R. A. Borrelli, Malachi Tolman, Jieun Lee (*Univ. Idaho*)

TUESDAY, JUNE 13

TECHNICAL SESSIONS – 8:00 AM

Reactor Analysis Methods—I

Sponsored by: RPD

Session Organizer: Cristian Rabiti (*INL*) **Chair:** Carlo Parisi (*INL*)

Location: Pacific Concourse M **Time:** 8:00-11:15 am

8:05 am: Improved Modelling for the Assembly Discontinuity Factors in the APEC Method, Woosong Kim, Yonghee Kim (*KAIST*)

8:30 am: Heterogeneous Neutron Leakage Model for PWR Pin-by-Pin Calculation, Bin Zhang, Hongchun Wu, Yunzhao Li, Liangzhi Cao (*Xi'an Jiaotong Univ.*)

8:55 am: Thermal Analysis of a Fuel Channel, Abdullah Weiss, Xue Yang (*Texas A&M Univ.-Kingsville*)

9:35 am: Artificial Neural Network Modeling for 2-Group Pin-Wise Group Constants, HwanYeol Yu, Haseeb ur Rehman, Yonghee Kim (*KAIST*)

10:00 am: MCNP6 and SERPENT2 Performances with Unstructured Mesh Geometry, A. Talamo, Y. Gohar (*ANL*), J. Leppanen (*VTT Technical Research Centre*)

10:25 am: Generalization of NESTLE into a Multi-Energy N-Group Formulation, William M. Kirkland, Ondrej Chvala, G. Ivan Maldonado (*Univ. Tenn., Knoxville*)

10:50 am: Verification of a Multiphysics Code with Method of Manufactured Solutions, Jipu Wang, William Martin (*Univ. Michigan*), Benjamin Collins (*ORNL*)

Innovations in Nuclear Education—Panel

Sponsored by: YMG; **Cosponsored by:** ETWDD

Session Organizer: Matthew Jeffrey Jasica (*Univ of Wisconsin, Madison*) **Chair:** Nicholas W. Thompson (*RPI*)

Location: Pacific Concourse N **Time:** 8:00-11:40 am

This session will look at what's new in education, and focus on innovative methods and ideas in both education curriculum and teaching methods. Some issues that will be discussed include incorporating coding and simulation programs into nuclear engineering curriculum, “flipped” or “blended” classrooms, and new ways to make education more interactive and effective.

Panelists: Dorin Nichita (*Univ of Ontario*), Rizwan Uddin (*Univ of Illinois*), Leigh Winfrey (*Univ of Florida*), Sama Bilbao y Leon (*Virginia Commonwealth Univ*)

Optimal Energy Strategies Aimed at Sustainable Reduction of Greenhouse Gas Emissions

– Panel – I

Sponsored by: DESD

Session Organizers: Yoon Chang (*ANL*), Daniel Meneley (*UOIT*), Jan van Erp (*Consultant*)

Cochairs: Andrew Klein (*ANS President*), Jorge Spitalnik (*WCEO*)

Location: Grand Ballroom C **Time:** 8:00-9:20 am

According to the International Panel on Climate Change (IPCC), keeping the rise of the average global temperature to less than 2 degrees Celsius will require a substantial reduction in the emission of anthropogenic greenhouse gases (AGHGs), of which carbon-dioxide and methane are the main ones. Among other critical parameters are ocean acidification and sea-level rise.

This session will address the multiple issues involved in the process of selecting energy policies most likely to achieve a substantial reduction of AGHGs, taking into account the countries' specific circumstances and their requirement not to induce a major economic down-turn with potentially serious social consequences. Experts in various areas of science and technology will share their views on this topic of great importance. The leading role that nuclear fission technology will have to play in industrial countries will be discussed.

Panelists: William D. Magwood (*OECD NEA*), Timothy Hanley (*Exelon Corp.*), Jozef Misak (*UJV-Rež*), John Kelly (*DOE*)

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TUESDAY, JUNE 13
TECHNICAL SESSIONS – 8:00 AM

Optimal Energy Strategies Aimed at Sustainable Reduction of Greenhouse Gas Emissions – Panel – II

Sponsored by: DESD

Session Organizers: Yoon Chang (ANL), Daniel Meneley (UOIT), Jan van Erp (Consultant)

Cochairs: Yoon Chang (ANL), Daniel Meneley (UOIT)

Location: Grand Ballroom C **Time:** 9:35-11:40 am

According to the International Panel on Climate Change (IPCC), keeping the rise of the average global temperature to less than 2 degrees Celsius will require a substantial reduction in the emission of anthropogenic greenhouse gases (AGHGs), of which carbon-dioxide and methane are the main ones. Among other critical parameters are ocean acidification and sea-level rise.

This session will address the multiple issues involved in the process of selecting energy policies most likely to achieve a substantial reduction of AGHGs, taking into account the countries' specific circumstances and their requirement not to induce a major economic down-turn with potentially serious social consequences. Experts in various areas of science and technology will share their views on this topic of great importance. The leading role that nuclear fission technology will have to play in industrial countries will be discussed.

Panelists: Fiona Rayment (National Nuclear Laboratory), Kazuaki Matsui (IAE), Per Peterson (Univ. of California, Berkeley), Mark Nelson (Environmental Progress)

TECHNICAL SESSIONS - 1:00 PM

Nuclear Science User Facilities: Ion Beam and NSUF Capabilities —II

Sponsored by: MSTD

Session Organizer: J. Rory Kennedy (INL) **Chair:** Daniel Ogden (Battelle Energy Alliance)

Location: Pacific Concourse D **Time:** 1:00-3:50 pm

1:05 pm: Application of NSUF Capabilities Towards Understanding the Emulation of High Dose Neutron Irradiations with Ion Beams, K. G. Field (ORNL), S. Taller (Univ. Michigan), C. J. Ulmer (Penn State.), Z. Jiao (Univ. Michigan), T. A. Saleh (LANL), A. T. Motta (Penn State.), G. S. Was (Univ. Michigan)

1:30 pm: Neutron and Ion Irradiation Studies on Advanced Steels Using the Nuclear Science User Facilities, Xiang Liu (Univ. Illinois, Urbana-Champaign), Yinbin Miao, Wei-Ying Chen (ANL), Yaqiao Wu (Boise State.), Meimei Li (ANL), James F. Stubbins (Univ. Illinois, Urbana-Champaign)

1:55 pm: Microstructural Evolution of NF709 Steel under In-situ Ion Irradiations at Room Temperature to 600 °C, Chi Xu (Univ. Florida & ANL), Meimei Li, Mark Kirk, Peter Baldo (ANL), Yong Yang (Univ. of Florida)

2:20 pm: Materials Characterization using the Center for Synchrotron Radiation Research and Instrumentation (CSRRI), a NSUF Partner Facility, Rachel Seibert, Daniel Velazquez, Zhengrong Lee, Jeff Terry (Illinois Inst. Technol.)

3:00 pm: In Situ Experimental Capabilities and Results from the X-ray Powder Diffraction Beamline, David J. Sprouster, Mohamed S. Elbakhshwan, S. K. Gill, Lynne E. Ecker (BNL)

3:25 pm: Nuclear Science User Facilities Irradiation Capabilities at Oak Ridge National Laboratory, Christian Petrie, Joel McDuffee, Nesrin Cetiner, Richard Howard, Padhraic Mulligan (ORNL)



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TUESDAY, JUNE 13

TECHNICAL SESSIONS – 1:00 PM

Experimental Thermal-Hydraulics: High Resolution Experiments—I

Sponsored by: THD

Session Organizer: Piyush Sabharwall (*INL*)

Cochairs: Bao-Wen Yang (*Xi'an Jiaotong Univ*), Rodolfo Vaghetto (*Texas A&M Univ*)

Location: Pacific Concourse E **Time:** 1:00-4:15 pm

- 1:05 pm:** Comparing Velocity Profiles Along the Rod Length of a Helical Coil Steam Generator Model, Marilyn Delgado, Saya Lee, Yassin Hassan (*Texas A&M Univ.*)
- 1:30 pm:** Processing Methodology for Double Sensor Probe in a Bubbly Flow, Chung-yen Hsu, Jiun-Ren Wang, Tien-Juei Chuang, Yuh-Ming Ferng (*National Tsing Hua Univ.*)
- 1:55 pm:** Visualization of Flow Interaction in a Channel Flow Produced by a Pair of Helically Coiled Rods, Saya Lee, Marilyn Delgado, Colin Guilbault, Yassin A. Hassan (*Texas A&M Univ.*)
- 2:20 pm:** Time-Resolved PIV/PTV Measurements on Interior Subchannels of a Wire-Wrapped 61-Pin Hexagonal Fuel Bundle, N. Goth, P. Jones, S. Lee, D. T. Nguyen, R. Vaghetto, Y. A. Hassan (*Texas A&M Univ.*)
- 3:00 pm:** High Resolution Stereoscopic PIV Measurements in a 5x5 Rod Bundle with Mixing Vane, Thien Nguyen, Mason Childs, Mateusz Marciniak, Yassin Hassan (*Texas A&M Univ.*)
- 3:25 pm:** Time Analysis on a Steam Condensation Jet, Arturo Cabral, Saya Lee, Macon Heath, Yassin A. Hassan, (*Texas A&M Univ*)
- 3:50 pm:** Thermal-Hydraulic Results for the Aboveground Configuration of a Dry Cask Simulator, S. G. Durbin, E. R. Lindgren (*SNL*), A. Zigh, J. Solis (*NRC*)

Innovation Opportunities in Future Fuel Cycles—Panel

Sponsored by: FCWMD

Session Organizer: Tim P. Tinsley (*NNL*)

Chair: Fiona Rayment (*NNL*)

Location: Pacific Concourse F **Time:** 1:00-4:15 pm

With a number of countries considering and implementing new reactor build programs, future and advanced fuel cycles are in the spotlight to deliver a range of improvements. The challenges for these future fuel cycles has never been more difficult, with the need to balance economics, wastes, security and sustainability in order to deliver the best option possible. To deliver this, new and innovative thinking is required to question all aspects of the conventional fuel cycle. This panel will seek to ask the “what if we could do...” questions and stimulate discussion on where new innovations could deliver a range of benefits.

Panelists: Fiona Rayment (*NNL*), Jack Law (*INL*), Kathy McCarthy (*Canadian Nuclear Laboratory*), Emmanuel Touron (*CEA*), Andy Worrall (*ORNL*)

Recent Advancements in Liquid and Solid Fuel Molten Salt Reactors—I

Sponsored by: RPD

Session Organizer and Chair: Massimiliano Fratoni (*Univ of California, Berkeley*)

Location: Pacific Concourse G **Time:** 1:00-4:15 pm

- 1:05 pm:** Verification of the Coupled Neutronics/Thermal-Hydraulics Code TANSY against the MSFR Benchmark, Liangzhi Cao, Tianliang Hu, Hongchun Wu (*Xi'an Jiaotong Univ.*)
- 1:30 pm:** Preliminary Results of Material Flow Controlled DMSR Depletion Calculations, Gavin Ridley, Ondrej Chvala (*Univ. Tenn, Knoxville*)
- 1:55 pm:** New Czech R&D Program on Fluoride Salt-Cooled Nuclear Reactor Systems, Jan Uhlíř, Martin Mareček (*Research Centre Rez*), Lórant Szatmáry (*UJV Rez*), Zbyšek Nový (*COMTES FHT*), Petr Toman (*MICO Ltd*), Jan Jílek (*SKODA JS*)
- 2:20 pm:** Neutronic Tests of Fluoride Salt Based MSR/FHR Coolants, Evžen Losa, Michal Košťál, Vlastimil Juříček, Jan Uhlíř (*Research Centre Řež*), Jeffrey J. Powers (*ORNL*), Nicholas R. Brown (*ORNL & Penn State.*), Donald E. Mueller, Bruce W. Patton (*ORNL*)
- 3:00 pm:** Molten Salt Reactor Simulations using MPACT-CTF, Benjamin Collins, Cole Gentry, Aaron Wysocki, Robert Salko (*ORNL*)
- 3:25 pm:** Feasibility of a Breed-and-Burn Molten Salt Reactor, Michael Martin, Manuele Aufiero, Ehud Greenspan, Massimiliano Fratoni (*Univ. California, Berkeley*)
- 3:50 pm:** Dynamic Analysis of the Next Generation Molten-Salt Breeder Reactor System, O. Chvala, M. R. Lish, V. Singh, B. R. Upadhyaya (*Univ. Tennessee, Knoxville*)

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TUESDAY, JUNE 13

TECHNICAL SESSIONS – 1:00 PM

Nuclear Safety R&D at the Department of Energy

Sponsored by: NISD

Session Organizer and Chair: Alan E. Levin (*DOE*)

Location: Pacific Concourse H **Time:** 1:00-4:15 pm

- 1:05 pm:** Dexterity and Worker Comfort in an Ergonomically Designed Glovebox Glove, Martha Chan, Cindy Lawton, Lawrence Ticknor (*LANL*)
- 1:30 pm:** Development of CFD Flow Analysis for Nuclear Facility Ventilation Systems, Philip Strons, James L. Bailey (*ANL*)
- 1:55 pm:** Fragmentation Prediction for a Brittle Ceramic: An Integrated Two-Scale Model Approach, Christopher J. O'Brien, Pierre-Alexandre Juan, John Bignell, Rémi Dingreville (*SNL*)
- 2:20 pm:** Characterizing the Benefits of Seismic Isolation of Nuclear Structures in Terms of Reduced Risk and Cost, Chandrakanth Bolisetti (*INL*), Chingching Yu (*Univ. Buffalo, SUNY*), Justin Coleman (*INL*), Ben Kosbab (*SC Solutions*), Andrew Whittaker (*Univ. Buffalo, SUNY*)
- 3:00 pm:** High Performance-Multidisciplinary Simulation for Regional Scale Earthquake Hazard and Risk Assessments, Floriana Petrone (*LBNL*), Jenna Wong (*LBNL & San Francisco State*), Mamun Miah (*LBNL*), Artie Rodgers, Anders Petersson (*LLNL*), David McCallen (*LBNL & Univ. California*)
- 3:25 pm:** Thermal Testing of Waste Packages for a Storage Environment, Victor G. Figueroa, Douglas Ammerman, Carlos Lopez, Walt Gill (*SNL*)
- 3:50 pm:** Preliminary Analysis of FFTF Loss-of-Flow Tests with SAS4A/SASSYS-1, Guanheng Zhang, Anton Moiseyev, Tyler Sumner, Thomas Fanning (*ANL*)

Monte Carlo Methods

Sponsored by: MCD

Session Organizer: Jeffery D. Densmore (*BAPL*) **Chair:** Jeffrey A. Favorite (*LANL*)

Location: Pacific Concourse I **Time:** 1:00-3:50 pm

- 1:05 pm:** Variance Estimation in Monte Carlo Eigenvalue Simulations Using Spectral Analysis Method, Jin Lei (*Texas A&M Univ., Corpus Christi*), Kaushik Banerjee, Steven P. Hamilton, Gregory G. Davidson (*ORNL*)
- 1:30 pm:** Error Convergence Characterization for Stochastic Transport Methods, Aaron Olson (*SNL*), Anil K. Prinja (*Univ. New Mexico*), Brian C. Franke (*SNL*)
- 1:55 pm:** A Comparison of the FW-CADIS and MR-CADIS Variance Reduction Methods, Douglas E. Peplow (*ORNL*)
- 2:20 pm:** Spherical Kernel Density Estimators for Monte Carlo Radiation Transport Problems, Timothy P. Burke, Brian C. Kiedrowski, William R. Martin (*Univ. Michigan*)
- 3:00 pm:** Implementation of Weighted Delta-Tracking with Scattering in the Serpent 2 Monte Carlo Code, J. S. Rehak (*Univ. California, Berkeley*), L. M. Kerby (*INL, Idaho State*), M. D. DeHart (*INL*), R. N. Slaybaugh (*Univ. California, Berkeley*), J. Leppänen (*VTT Technical Research Centre of Finland*)
- 3:25 pm:** Advancement of Functional Expansion Tallies Capabilities in Serpent 2, Brycen Wendt, Leslie Kerby (*Idaho State & INL*), Aaron Tumulak (*LANL*), Jaakko Leppänen (*VTT Technical Research Centre Finland*), Mark DeHart (*INL*)

Sharing of Good Industry Practices and/or Lessons Learned in Nuclear Criticality Safety–Panel

Sponsored by: NCSD

Session Organizer and Chair: Deborah Ann Hill (*NNL-UK*)

Location: Pacific Concourse J **Time:** 1:00-4:15 pm

Fundamental to the successful operation of any nuclear site is a first class safety culture which strives to continually improve in response to good industry practices and operating experience feedback. Speakers will provide examples of either specific good practices and/or lessons learned at their site, following which an audience discussion will be initiated on alternative good practices and experiences in these areas.

Panelists: Deborah Hill (*UK National Nuclear Laboratory*), John Miller (*SNL*), Andrew Wysong (*LANL*), Brandon O'Donnell (*BWX Technologies*), Austin McGee (*Y-12 National Security Complex*)

TUESDAY, JUNE 13

TECHNICAL SESSIONS – 1:00 PM:

Computation Tools for Radiation Protection and Shielding

Sponsored by: RPSD

Session Organizer: Irina I. Popova (ORNL) **Chair:** Michael Lorne Fensin (LANL)

Location: Pacific Concourse K **Time:** 1:00-3:50 pm

1:05 pm: Neutron & Gamma Correlations using CGM in MCNP 6.2.0, C. A. Anderson, G. W. McKinney, J. R. Tutt (LANL)

1:30 pm: New Features of TRIPOLI-4@ Version 10, The TRIPOLI-4@ Project Team : Fadhel Malouch, Emeric Brun, Cheikh Diop, François-Xavier Hugot, Cédric Jouanne, Yi-Kang Lee, Fausto Malvagi, Davide Mancusi, Alain Mazzolo, Odile Petit, Jean-Christophe Trama, Thierry Visonneau and Andrea Zoia (CEA)

1:55 pm: Testing Nesting DXTRAN Spheres for Neutron Transport in Air, M. L. Fensin, K. C. Kelley, J. S. Hendricks, B. W. Cox, J. T. Goorley, S. S. McCreedy (LANL)

2:20 pm: Speed and Memory Improvements to MCNP6 Delayed-Gamma Line Treatment, J. R. Tutt, G. W. McKinney (LANL)

3:00 pm: Using the MCNP6.2 Correlated Fission Multiplicity Models, CGMF and FREYA, Michael E. Rising, Avneet Sood (LANL)

3:25 pm: Enhanced Monte Carlo Simulation of the Voxel Phantom Lattice Submersed in a Contaminated Air Environment, Ken Veinot (Easterly Scientific & Y-12 National Security Complex), Shaheen A. Dewji, Mauritius Hiller (ORNL), Keith Eckerman, Clay Easterly (Easterly Scientific)

Workforce Transition: How to Succeed—Panel

Sponsored by: YMG

Session Organizer and Chair: Brett D. Rampal (NuScale Power, LLC)

Location: Pacific Concourse L **Time:** 1:00-4:15 pm

Hear from a group of Young Members about their experiences transitioning from undergraduate and graduate degree programs to the working world. Learn how to navigate the tricky waters of conversations with management, hear experiences about looking for a new position while currently employed, and have the opportunity to ask for advice from our “older” young member’s.

Panelists: Rian Bahran (LAWL), Harsh Desai (DOE), Jacob Dewitte (OKLO, Inc), Kathryn Huff (Univ of Illinois), Brett Rampal (NuScale), Marco Delchini (ORNL)

Technical
Sessions:
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TUESDAY, JUNE 13

TECHNICAL SESSIONS – 1:00 PM:

Post Irradiation Examination and Advanced Measurement Techniques—I

Sponsored by: MSTD

Session Organizer: Kenneth J. Geelhood (*PNNL*) **Chair:** Kallie E. Metzger (*SRNL*)

Location: Pacific Concourse M **Time:** 1:00-4:15 pm

1:05 pm: Neutron Irradiation Effects on Thermal and Mechanical Properties of NITE-SiC, Kurt Terrani, Caen Ang, Takaaki Koyanagi, Wallace Porter (*ORNL*)

1:30 pm: Precipitation of Epsilon Particles in Metal Doped Ceria Irradiated with Energetic Ions, Weilin Jiang, Michele Conroy, Ram Devanathan (*PNNL*), Caitlin Taylor, Khalid Hattar (*SNL*), Johnathan Gigax, Lin Shao (*Texas A&M*)

1:55 pm: Tungsten Foils and Composites for Fusion Applications—Mechanical Testing, Jeremy Moon (*Univ. Nevada, Reno*), Lauren Garrison (*ORNL*)

2:20 pm: The Plan for Post-Irradiation Examination of Zion Reactor Pressure Vessel Beltline Materials, Mikhail A. Sokolov, Thomas M. Rosseel, Randy K. Nanstad, Xiang Chen (*ORNL*)

3:00 pm: Preliminary Analysis of Damage to MPFDs Caused by Reactor Pulses, Mark J. Harrison, Michael A. Reichenberger, Daniel M. Nichols, Douglas S. McGregor, Jeremy A. Roberts (*Kansas State*)

3:25 pm: Post-Irradiation Examination for Conventional and Advanced Nuclear Fuel, V. V. Rondinella, T. A. G. Wiss, D. Papaioannou, S. Bremier, D. Bottomley, D. Staicu, P. Pöml, M. Marchetti, F. Cappia (*European Commission, JRC*)

3:50 pm: Comparison of Thermal Diffusivity Degradation of Irradiated Zirlo and SiC-SiC Composite, Zilong Hua (*Utah State*), Shuyan Kong, Peng Yan, Yanhong Liu (*State Power Investment Corporation Central Research Inst*), Yuefang Dong (*Utah State*), Haihong Xia (*State Power Investment Corp. Central Research Inst*), Heng Ban (*Utah State*)

New Nuclear Construction around the World—Panel

Sponsored by: OPD

Session Organizer: Edward L. Quinn (*Technology Resources*)

Cochairs: Edward L. Quinn (*Technology Resources*), Mimi Limbach (*Potomac Communications Group, Inc.*)

Location: Pacific Concourse N **Time:** 1:00-4:15 pm

This session will provide an overview of new reactor deployment activities around the world. Speakers from U.S. DOE, NRC, industry and international participants will address new construction activities and lessons learned from the perspective of a number of countries active in this area, in both LWR and non-LWR applications.

Panelists: Frank Akstulewicz (*NRC*), John Kelly (*DOE*), Kevan Weaver (*TerraPower*), Zhijian Zhang (*Chinese Nuclear Society*)

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WEDNESDAY, JUNE 14

TECHNICAL SESSIONS – 8:00 AM

Nuclear Science User Facilities: Structural Materials—III

Sponsored by: MSTD

Session Organizer: J. Rory Kennedy (*INL*) **Chair:** Daniel Ogden (*Battelle Energy Alliance*)

Location: Pacific Concourse D **Time:** 8:00-10:50 am

- 8:05 am:** Microstructure of In-Core Molten Salt Corrosion Hastelloy N® and 316 Stainless Steel, G. Zheng, D. Carpenter, M. Ames, G. Kohse, L. Hu (*MIT*)
- 8:30 am:** Post Irradiation Examination of SiC Tube Subjected to Simultaneous Irradiation and Radial High Heat Flux, Takaaki Koyanagi, Yutai Katoh, Christian M. Petrie, (*ORNL*), Christian P. Deck (*General Atomics*) Kurt A. Terrani (*ORNL*)
- 8:55 am:** Correlation Between Irradiation Defects and Transition Dimension for TEM In Situ Mechanical Testing, Kayla H. Yano (*Boise State.*), Priyam V. Patki (*Purdue Univ.*), Matthew J. Swenson (*Boise State*), Janelle P. Wharry (*Purdue Univ.*)
- 9:35 am:** Irradiation Response of the Ferrite Phase in CF3 Cast Stainless Steel, Yong Yang, Zhangbo Li (*Univ. Florida*)
- 10:00 am:** Neutron Irradiation of Nuclear Structural Materials Fabricated by Powder Metallurgy with Hot Isostatic Pressing, Donna P. Guillen (*INL*), Janelle P. Wharry (*Purdue Univ.*), David W. Gandy (*EPRI*)
- 10:25 am:** Post Irradiation Examination of Fast Neutron Irradiated 14YWT Tubes at Nuclear Science User Facilities, T. A. Saleh (*LANL*), D. L. Krumwiede (*Univ. California, Berkeley*), E. Aydogan, M. E. Quintana, T. J. Romero (*LANL*), P. Hosemann (*Univ. California, Berkeley*), S. A. Maloy (*LANL*)

Experimental Thermal-Hydraulics—II

Sponsored by: THD

Session Organizer: Stephen W. Lomperski (*ANL*) **Cochairs:** Fan-Bill Cheung (*Penn State Univ*), Marilyn Delgado (*Texas A&M Univ*)

Location: Pacific Concourse E **Time:** 8:00-11:15 am

- 8:05 am:** Orificed Flow Results for a Two-Phase Natural Circulation Loop, Casey A. Tompkins, Michael Corradini (*Univ. Wisconsin, Madison*)
- 8:30 am:** Single Rod Reflood Quenching Experiments with Simulated Decay Heat for Accident-Tolerant Fuel Claddings, Chan Lee, Kwangeun Lee, Wang Kee In, Chang Hwan Shin (*KAERI*)
- 8:55 am:** Korean Localization Program for the Performance Verification Test of APR1400's RCP, Seok Cho, Seok Kim, Byoung-Uhn Bae, Yun-Jae Cho, Yeon-Sik Kim, Woo-Jin Jeon, Young-Jung Yun (*KAERI*)
- 9:35 am:** Steady State Pool Boiling in Sea Water, Tzu Chen Huang, Chin Pan (*National Tsing Hua Univ.*)
- 10:00 am:** Observation of Downward Facing Pool Boiling on a Hemispherical Vessel under External Reactor Vessel Cooling, Xiang Zhang, Wei Lu, Teng Hu (*State Nuclear Power Technol. Research & Development*), Huajian Chang, Deqi Cheg (*Chongqing Univ.*)
- 10:25 am:** The Flow Visualization for the Separation of Air-Water Bubbly Two-Phase Flow Through a Vertical T-Junction, Jiun-Ren Wang, Chung-Yen Hsu, Yuh-Ming Ferng (*National Tsing Hua Univ.*)
- 10:50 am:** Integral Effect Test of ATLAS Facility on Multiple Failure in a Prolonged Station Blackout, Byoung-Uhn Bae, Seok Cho, Kyoung-Ho Kang, Yu-Sun Park, Jong-Rok Kim, Nam-Hyun Choi, Ki-Yong Choi (*KAERI*)

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WEDNESDAY, JUNE 14

TECHNICAL SESSIONS – 8:00 AM

University Research in Fuel Cycle and Waste Management—I

Sponsored by: FCWMD; **Cosponsored by:** YMG

Session Organizer: Jack D. Law (*INL*)

Cochairs: Jack D. Law (*INL*), Katie Mummah (*Univ of Illinois*)

Location: Pacific Concourse F **Time:** 8:00-11:15 am

- 8:05 am:** A New Group Crystallization Approach in Used Nuclear Fuel Recycling: A Look at Fission Product Behaviors, Andrew Wilcox (*Texas A&M Univ.*), Bruce Moyer (*ORNL*), Jonathan Burns (*Texas A&M Univ.*)
- 8:30 am:** Elevated Temperature Alpha Spectroscopy with Nickel-Platinum 4H-SiC Schottky Diodes, Joshua Jarrell, Eric Moore, Thomas Blue, Lei Cao (*Ohio State*)
- 8:55 am:** Chabazite Zeolite Membranes for Krypton/Xenon Separation: Control of Membrane Properties and Process Modeling, Yeon Hye Kwon, Byunghyun Min, Christine Kiang (*Georgia Inst. Tech.*), Ramesh Bhawe (*ORNL*), Sankar Nair (*Georgia Inst. Tech.*)
- 9:35 am:** Aging Processes of Silver Mordenite and Silver Functionalized Aerogel in Dry Air, Humid Air, and NO/N₂, Yue Nan, Seungrag Choi (*Syracuse Univ.*), Austin Ladshaw, Sotira Yiacomou (*Georgia Inst. Tech.*), Costas Tsouris, David DePaoli (*ORNL*), Lawrence L. Tavlarides (*Syracuse Univ.*)
- 10:00 am:** Effect of Moisture on the Adsorption of Iodine and Krypton in Multicomponent Streams on the 10 WT% C/ETS-10 Sorbent, Kai M. Coldsnow, Sachin U. Nandanwar, Austin Porter, Vivek Utgikar (*Univ. Idaho*), Piyush Sabharwall (*INL*), D. Eric Aston (*Univ. Idaho*)
- 10:25 am:** Nuclear Fuel Cycle Simulator as a Means to Model a Nuclear Hybrid Energy System, Emma K. Redfoot, R. A. Borrelli (*Univ. Idaho*)
- 10:50 am:** Energy Conversion Loop: Process Heat Applications of Hybrid Energy System, Kelley M. Verner, Lee T. Ostrom (*Univ. Idaho*), Michael G. McKellar (*INL*)

Reactor Analysis Methods—II

Sponsored by: RPD

Session Organizer: Cristian Rabiti (*INL*) **Chair:** Pavel V. Tsvetkov (*Texas A&M Univ*)

Location: Pacific Concourse G **Time:** 8:00-11:15 am

- 8:05 am:** Two-Step Analysis of Watts Bar Nuclear 1 Cycle 1 with SCALE/PARCS, Kevin Xu (*Univ. Michigan*), Matthew A. Jessee (*ORNL*), Andrew M. Ward, Thomas J. Downar (*Univ. Michigan*)
- 8:30 am:** Surrogate Models for TREAT Transient Calculations, Congjian Wang, Paul W. Talbot, Sebastian Schunert, Benjamin Baker, Yaqi Wang, Javier Ortensi, Frederick Gleicher, Mark DeHart, Cristian Rabiti (*INL*)
- 8:55 am:** RISM Industry Application #1 (ECCS/LOCA): Core Characterization Automation: Reference PWR Designs for IA#1, Aaron S. Epiney, Carlo Parisi, Andrea Alfonsi, Hongbin Zhang, Ronaldo Szilard (*INL*)
- 9:35 am:** Implementation of CMFD Acceleration Scheme in PROTEUS-MOC, Albert M Hsieh, Won Sik Yang (*Purdue Univ.*)
- 10:00 am:** Effect of Delayed Energy Release on Power Normalization in Reactor Depletion Calculations, Miriam A. Rathbun, David P. Griesheimer (*Univ. Pittsburgh*)
- 10:25 am:** Treatment of Nonuniform Temperature Distribution by Subgroup Method, Qingming He (*MIT & Xi'an Jiaotong Univ.*), Liangzhi Cao, Hongchun Wu (*Xi'an Jiaotong Univ.*), Benoit Forget, Kord Smith (*MIT*)
- 10:50 am:** Spanning the Core Design Space with Binary Perturbations—A Mathematical Investigation, Tracy Stover (*SRNS*), Stephen Kessler (*Westinghouse Electric Co.*)

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WEDNESDAY, JUNE 14

TECHNICAL SESSIONS – 8:00 AM

Thermal-Hydraulics: General—I

Sponsored by: THD

Session Organizer: Fatih Aydogan (*Univ of Idaho*)

Cochairs: Steven A. Arndt (*NRC*), Fatih Aydogan (*Univ of Idaho*)

Location: Pacific Concourse H **Time:** 8:00-11:15 am

- 8:05 am:** TRACG Benchmark Study: 2015 Fermi Thermal-Hydraulic Instability Event, Alexander Miller, Lander Ibarra, Justin Lamy, Juswald Vedovi (*GE Hitachi*), Paul Kiel (*DTE Energy*)
- 8:30 am:** Integrating Sudo-Kaminaga Correlation to the Safety Analysis Code PARET-ANL, Richard Leos (*Texas A&M Univ., Kingsville*), Zeyun Wu (*NIST & Univ. Maryland*), Robert E. Williams (*NIST*), Xue Yang (*Texas A&M Univ., Kingsville*)
- 8:55 am:** Sensitivity Studies of the Inter-Subchannel Mixing in Subchannel Analysis, Hu Mao, Bao-Wen Yang (*Xi'an Jiaotong Univ.*)
- 9:35 am:** TRACE Analysis of Loss of Flow for the APR1400, Peter Yarsky, Andrew Bielen, Ronald Harrington, William Krotiuk (*NRC*)
- 10:00 am:** TORCHE—Toolbox for Reactor Cross-Flow Heat Exchangers, J. B. Haefner, L. B. Carasik, Y. Hassan (*Texas A&M Univ.*)
- 10:25 am:** Numerical Analysis of Flow Instability in Once-through Steam Generator, Eui Kwang Kim, Jong Bum Kim, Jiyoung Jeong (*KAERI*)
- 10:50 am:** Operator Action Time Evaluation of Emergency Water Injection Strategy for Extreme SGTR Accidents, Sooyong Park, Kwang-il Ahn (*KAERI*)

Computational Methods and Mathematical Modeling

Sponsored by: MCD

Session Organizer: Jeffery D. Densmore (*BAPL*)

Chair: Timothy P. Burke (*Univ of Michigan, Ann Arbor*)

Location: Pacific Concourse I **Time:** 8:00-11:40 am

- 8:05 am:** Determining Physical Parameters of Shielded Uranium using Gamma Spectroscopy and the Differential Evolution Adaptive Metropolis (DREAM) Method, Justin R. Knowles, Keith C. Bledsoe, Jordan P. Lefebvre, Matthew A. Jessee (*ORNL*)
- 8:30 am:** Solving Inverse Transport Problems with Neutron Multiplication Measurements and Improved Differential Evolution, Keith C. Bledsoe, Jordan P. Lefebvre, Justin R. Knowles (*ORNL*)
- 8:55 am:** Addressing Over-Solving in Multiphysics Codes with Nested Solvers, Jaron P. Senecal, Wei Ji (*RPI*)
- 9:35 am:** Flux in a 1D-Reacto Cell by Response Matrix, B. D. Ganapol (*Univ. Arizona*), D. W. Nigg, D. S. Crawford (*INL*)
- 10:00 am:** Investigation of Xenon Oscillations via Point Kinetics, B. Ganapol (*Univ. Arizona*), F. Gleicher, R. Martineau (*INL*)
- 10:25 am:** Recovering Topology of Nested Volumes Represented by Single Closed Surfaces, Chelsea A. D'Angelo, Andrew Davis, Paul P. H. Wilson (*Univ. Wisconsin, Madison*)
- 10:50 am:** Analysis of the VERA Core Physics Benchmark Problems using cosRMC Code, Yao Qin, Hui Yu, Guoping Quan, Yixue Chen (*State Nuclear Power Software Development Center*)
- 11:15 am:** The Parareal Method for Solving Space-Dependent Neutron Kinetics Equations in Hexagonal-z Geometry, Yun Cai (*Tsinghua Univ. & Nuclear Power Inst of China*), Jingjing Hou (*Nuclear Power Operation Management Co.*), Xingjie Peng, Qing Li (*Nuclear Power Inst of China*), Kan Wang (*Tsinghua Univ.*)

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WEDNESDAY, JUNE 14

TECHNICAL SESSIONS – 8:00 AM

Data Analysis and Operations in Nuclear Criticality Safety—II

Sponsored by: NCSD

Session Organizer and Chair: Theresa E. Cutler (*LANL*)

Location: Pacific Conference J **Time:** 8:00-11:15 am

8:05 am: Open Source Release of NJOY2016 and NJOY21, Jeremy Lloyd Conlin, A. C. Kahler, Austin P. McCartney (*LANL*)

8:30 am: LANL-SNL Collaboration on NCS Validation, Forrest B. Brown (*LANL*), John A. Miller, Shawn J. Henderson (*SNL*), Michael E. Rising, Jennifer L. Alwin (*LANL*)

8:55 am: Study of Whisper Statistics for Criticality Safety Code Validation, Natasha Glazener, Trevor Stewart, Alan Yamanaka (*LANL*)

9:35 am: Full Law Analysis Scattering System Hub (FLASSH), Y. Zhu, A. I. Hawari (*NCSU*)

10:00 am: Semi-Analytical Benchmarks for MCNP6, Pavel Grechanuk (*Oregon State*), Michael E. Rising, Forrest B. Brown (*LANL*), Todd S. Palmer (*Oregon State*)

10:25 am: The Half Monte Carlo Method: Combining Total Monte Carlo with Nuclear Data Sensitivity Profiles, I. Hill, J. Dyrda, (*OECD Nuclear Energy Agency*)

10:50 am: Status of a New Resonance Evaluation for Cerium to Support Nuclear Criticality Safety Applications, Vladimir Sobes, Klaus Guber (*ORNL*)

Nuclear Nonproliferation Policy: General

Sponsored by: NNPD

Session Organizer: Rian M. Bahran (*LANL*) **Chair:** Kelsey Amundson (*DNFSB*)

Location: Pacific Concourse K **Time:** 8:00-8:55 am

8:05 am: Barcode Testing for the Global Identifier for UF₆ Cylinders, Jessica L. White-Horton, James R. Garner, J. Michael Whitaker (*ORNL*)

8:30 am: The Nuclear Weapons and Strategy Minor at the United States Air Force Academy, Ryan Cress, Kirk Brown (*U.S. Air Force Academy*)

Biology and Medicine: General

Sponsored by: BMD

Session Organizer: Sam Glover (*NIOSH*) **Chair:** Bryan P. Bednarz (*Univ of Wisconsin*)

Location: Pacific Concourse K **Time:** 9:40-11:00 am

9:45 am: Parametric Study of X-ray Energy Modulation for Depth Sensitive Backscatter Imaging, Lucas M. Rolison, Kelly A. Jordan, Sanjiv S. Samant (*Univ. Florida*)

10:10 am: Electron Beam Cherenkov Emission Measurements for Quality Assurance, William Chuirazzi, Richard Shawger, Ahmet S. Ayan, Jeffrey Woollard, Nilendu Gupta, Lei Caoa (*Ohio State*)

10:35 am: Demonstration of a Correlation between Tumor Absorbed Dose and Response in Several Pediatric Tumor Xenografts Treated with Radiiodinated CLR1404 Alkyl-Phospholipid Ether, Bryan Bednarz, Ian Marsh, Dana C. Baiu, Alexander E. Boruch, Ankita Shahi De, Saswati Bhattacharya, Justin Jeffery, Qianqian Zhao, Lance Hall, Jamey Weichert, Mario Otto (*Univ. Wisconsin, Madison*)

Environmental Challenges and Lessons Learned from Decommissioning Nuclear Facilities in California—Panel

Sponsored by: DESD

Session Organizer and Chair: Jay Peters (*Haley Aldrich*)

Location: Pacific Concourse L **Time:** 8:00-11:40 am

California was an early adapter of the peaceful use of nuclear energy, recognizing the clean air aspects and the perils of reliance on foreign oil, the state at its peak had 7 operating power reactors at 4 sites. The tide then turned and a new generation of nuclear activists turned their energies toward the closure of these 7 operating plants, citing the dangers of radiation and threats of nuclear Armageddon. Now 2 operating reactors remain on line, both now on a countdown to permanent closure. Three of the reactors have been decommissioned and two scheduled to start in 2017. This session will focus on the Environmental Challenges and Lessons Learned from the Decommissioning of these nuclear facilities in California.

Panelists: Loren Sharp (*PG&E*), William Halishak (*Decommissioning Consultant*), Charles Gribble (*California Department of Toxic Substances Control*), Jim Madigan (*SCE*)

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WEDNESDAY, JUNE 14

TECHNICAL SESSIONS – 8:00 AM

Neutronics Challenges of Fusion Facilities—I

Sponsored by: FED; **Cosponsored by:** RPSD, MCD

Session Organizer and Chair: Arkady Serikov (*KIT*)

Location: Pacific Concourse M **Time:** 8:00-10:25 am

- 8:05 am:** Overview of Nuclear Integration Activities for Mitigation of Radiation Loads to ITER Superconducting Magnets, Raul Pampin, Dieter Leichtle, Marco Fabbri (*Fusion for Energy*), Rafael Juarez, Aljaz Kolsek (*UNED*), Michael Loughlin, Neil Mitchell, Eduard Polunovskiy (*ITER*), Shanliang Zheng (*CCFE*)
- 8:30 am:** Investigations into Alternative Radiation Transport Codes for ITER Neutronics Analysis, Andrew Turner (*UK Atomic Energy Authority*)
- 8:55 am:** Development of the Advanced D1S for Shutdown Dose Rate Calculations in Fusion Reactors, Rosaria Villari, Davide Flammini, Fabio Moro (*ENEA*), Luigino Petrizzi (*European Commission*)
- 9:35 am:** Development of Fusion Neutronics Methodology, Software, and Testing Facility in FDS Team, Yican Wu, Jing Song, Pengcheng Long, Liqin Hu, Chao Liu, FDS Team (*Chinese Academy of Sciences*)
- 10:00 am:** Simulation of the Prompt Dose Environment in the NIF during High Yield Shots, Hesham Y. Khater, Sandra Brereton (*LLNL*)

Thermal Energy Storage Systems and their Integration with NPPs

Sponsored by: OPD; **Cosponsored by:** YMG

Session Organizer and Chair: Piyush Sabharwall (*INL*)

Location: Pacific Concourse N **Time:** 8:00-10:50 am

- 8:05 am:** Heat Storage for Peak Power with Base-Load Rankine-Cycle LWRs and Brayton-Cycle High-Temperature Reactors, Charles Forsberg (*MIT*)
- 8:30 am:** Development Strategy for Gas Turbines with Firebrick Resistance-Heated Energy Storage to Enable Nuclear-Renewable Grid Integration, Charles Forsberg (*MIT*)
- 8:55 am:** An Evaluation of Energy Storage Options for Nuclear Power, Samuel C. Johnson, Michael E. Webber (*Univ. Texas, Austin*), Justin L. Coleman (*INL*)
- 9:35 am:** Using Conductive Firebrick Resistance Heating to Enable Very High-Temperature Heat Storage in Nuclear Gas Turbine Systems, Daniel C. Stack, Charles Forsberg (*MIT*)
- 10:00 am:** Steam Accumulator Storage Integration into a Nuclear Power Plant, Seth Bisett, Alina LaPotin, Erich Schneider (*Univ. Texas, Austin*)
- 10:25 am:** Performance of Energy Storage with Nuclear and Renewable Power Systems, Benjamin Vogel (*Utah State*), Jason C. Quinn (*Colorado State*) Piyush Sabharwall (*INL*)

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WEDNESDAY, JUNE 14
TECHNICAL SESSIONS – 1:00 PM

Nuclear Fuels

Sponsored by: MSTD

Session Organizer: Kenneth J. Geelhood (*PNNL*) **Chair:** Vincenzo V. Rondinella (*EC-JRC*)

Location: Pacific Concourse D **Time:** 1:00-3:50 pm

- 1:05 pm:** A Theoretical Investigation of the Chemical Behaviour of Irradiated U-Mo/Mg Fuel, M. H. A. Piro (*Univ. Ontario Inst. Technol.*)
- 1:30 pm:** Coupling Experiments and Simulations to Understand Metallic Fuel Behavior, Assel Aitkaliyeva, Cynthia Papesch (*INL*), Michael Tonks (*Penn State Univ.*)
- 1:55 pm:** Small-Scale Mechanical Testing of UO₂, D. Frazer (*Univ. California, Berkeley*), B. Shaffer, K. Roney, H. Lim, B. Gong, P. Peralta (*Arizona State.*), P. Hosemann (*Univ. California, Berkeley*)
- 2:20 pm:** Correlation between Grain Size Distribution and Grain Boundary Character in Polycrystalline Uranium Dioxide, K. Rudman, B. Shaffer, H. Lim, R. McDonald, P. Peralta (*Arizona State.*)
- 3:00 pm:** Effect of Recrystallization on Gas Bubble Swelling in UMo Fuels, Shenyang Hu, Curt A. Lavender, Vineet Joshi (*PNNL*)
- 3:25 pm:** Neutron Generator Driven Active Nuclear Fuel Scanner, Ross Radel, Mark Thomas, Chris Seyfert, Evan Sengbusch, Eli Moll (*Phoenix Nuclear Labs*)

Computational Thermal-Hydraulics: Computational Fluid Dynamics—I

Sponsored by: THD

Session Organizer: Jun Fang (*NCSU*) **Cochairs:** W. David Pointer (*ORNL*), Jun Fang (*NCSU*)

Location: Pacific Concourse E **Time:** 1:00-4:15 pm

- 1:05 pm:** Development of a Multiphase Adjoint Capability in OpenFOAM, Robert W. Dacus, Paul J. Turinsky (*NCSU*)
- 1:30 pm:** A Non-Linear k- ϵ Turbulent Model Sensitivity Analysis for Flow Across a PWR Spacer Grid with Mixing Vanes, Giacomo Busco, Fatih S. Sarikurt, Yassin A. Hassan (*Texas A&M Univ.*)
- 1:55 pm:** Sensitivity Analysis of RANS Modeling on GEMIX CFD Benchmark Study, Fatih S. Sarikurt, Yassin A. Hassan (*Texas A&M Univ.*)
- 2:20 pm:** Validation of the Computational Fluid Dynamics Method using the Aboveground Configuration of the Dry Cask Simulator, A. Zigh, S. Gonzalez, J. Solis (*NRC*), S. G. Durbin, E. R. Lindgren (*SNL*)
- 3:00 pm:** Computation of Air Discharge into a Water Pool by Using Volume-of-Fluid Method, Ji-Su Kim, Jong Woon Park (*Dongguk Univ.*)
- 3:25 pm:** Influence of Axial Power Distributions on Rod-to-Wall Gap, Hongmei Lyu, Bao-Wen Yang, Bin Han (*Xi'an Jiaotong Univ.*)
- 3:50 pm:** Grid Pressure Drop Prediction in a Fuel Assembly, Bao-Wen Yang, Bin Han, Yudong Zha (*Xi'an Jiaotong Univ.*)

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WEDNESDAY, JUNE 14

TECHNICAL SESSIONS – 1:00 PM

University Research in Fuel Cycle and Waste Management—II

Sponsored by: FCWMD; **Cosponsored by:** YMG

Session Organizers and Cochairs: Jack D. Law (*INL*), Maggie Flicker Byers (*Univ of Texas, Austin*)

Location: Pacific Concourse F **Time:** 1:00-4:15 pm

- 1:05 pm:** Effects of $GdCl_3$ on U Electrochemical Properties in LiCl-KCl- UCl_3 - $GdCl_3$ Salt, Dalsung Yoon, Supathorn Phongikaroon (*Virginia Commonwealth Univ.*)
- 1:30 pm:** Electrochemical and Thermodynamic Properties of U in LiCl-KCl- UCl_3 Salt System, Dalsung Yoon, Supathorn Phongikaroon (*Virginia Commonwealth Univ.*)
- 1:55 pm:** Electrochemical Behavior of Lanthanum in Molten LiF-NaF-KF “Flinak” Eutectic Salt, Ryan Chesser, Shaoqiang Guo, Jinsuo Zhang (*Virginia Tech Univ.*)
- 2:20 pm:** Electrochemical Study of $BaCl_2$ and CsCl on a Liquid Bismuth Cathode in LiCl-KCl Eutectic Salt, Michael Woods, Supathorn Phongikaroon (*Virginia Commonwealth Univ.*)
- 3:00 pm:** Development of a Small Liquid Sodium Purification Loop, James Schneider, William K. Nollet (*Fort Lewis College*)
- 3:25 pm:** Ion Exchange of LiCl-KCl in H-Y Zeolite for Dechlorination of Electrorefiner Salt Waste Forms, Manish Wasnik, Krista Carlson, Michael Simpson (*Univ. Utah*)
- 3:50 pm:** Normal Pulse Voltammetry for Real Time Analysis of Electrorefiner Salt with High Concentrations of Analytes, Chao Zhang, Michael F. Simpson (*Univ. Utah*)

Recent Advancements in Liquid and Solid Fuel Molten Salt Reactors—II

Sponsored by: RPD

Session Organizer and Chair: Massimiliano Fratoni (*Univ of California, Berkeley*)

Location: Pacific Concourse G **Time:** 1:00-3:50 pm

- 1:05 pm:** Monte Carlo/CFD Coupling for Accurate Modeling of the Delayed Neutron Precursors and Compressibility Effects in Molten Salt Reactors, Manuele Aufiero (*Univ. California, Berkeley*), Pablo Rubiolo (*LPSC-IN2P3*), Massimiliano Fratoni (*Univ. California, Berkeley*)
- 1:30 pm:** Two-Dimensional Neutronic and Fuel Cycle Analysis of the LEU-Fueled Transatomic Power Molten Salt Reactor, B. R. Betzler, J. J. Powers, A. Worrall (*ORNL*), S. Robertson, L. Dewan, M. Massie (*Transatomic Power Corp.*)
- 1:55 pm:** Extension of the DIF3D Code for Molten Salt Reactor Analysis, Tongkyu Park (*Purdue Univ. and FNC Technol.*), Shengcheng Zhou (*Purdue Univ. and Xi'an Jiaotong Univ.*), Won Sik Yang (*Purdue Univ.*)
- 2:20 pm:** Comparing Sensitivity/Uncertainty Analysis Results for LR-0 Salt Experiments with Salt Reactor Models, Jeffrey J. Powers (*ORNL*), Nicholas R. Brown (*ORNL & Penn State*), Donald E. Mueller, Bruce W. Patton (*ORNL*), Evžen Losa, Michal Košťál (*Research Center Rez*)
- 3:00 pm:** Adjusted Graphite Thermal Scattering Data Applied to Fluoride-Salt-Cooled Reactors, Lance Maul (*ANSTO*)
- 3:25 pm:** Use of Spectral Shift to Greatly Improve Uranium Utilization in FHR Designs, Vedant Mehta, Dan Kotlyar (*Georgia Tech*)

Risk Aspects of Advanced Reactor Technologies Supported by GAIN—Panel

Sponsored by: NISD

Session Organizers and Cochairs: Lori Braase (*INL*), Martin B. Sattison (*INL*)

Location: Pacific Concourse H **Time:** 1:00-4:15 pm

This panel session will discuss the risk and safety research opportunities for advanced reactor technologies that are supported by DOE’s Gateway for Accelerated Innovation in Nuclear (GAIN). These technologies are high temperature gas reactors, fast reactors, and molten salt reactors. The session will consist of an overview presentation on GAIN, technical presentations on specific technology risk and safety challenges and the current R&D efforts in these areas. The session will end with a moderated, informal discussion covering the same areas. Questions from the audience are strongly encouraged and welcome.

Panelists: High Temperature Gas Reactors, Eben Mulder (*X Energy, LLC*), Hans Gougar (*INL*), Fast Reactors, Jacob DeWitte (*Oklo, Inc*), Bob Hill (*ANL*), Molten Salt Reactors, Nicholas Smith (*Southern Co.*), Lou Qualls (*ORNL*)

Technical
Sessions:
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WEDNESDAY, JUNE 14

TECHNICAL SESSIONS – 1:00 PM

Uncertainty Quantification and Sensitivity Analysis—

Sponsored by: MCD

Session Organizer: Jeffery D. Densmore (*BAPL*) **Chair:** Douglas E. Peplow (*ORNL*)

Location: Pacific Concourse I **Time:** 1:00-4:15 pm

- 1:05 pm:** Application of Polynomial Chaos Expansion in One-Dimensional Inverse Transport Problems, Justin Knowles (*ORNL*), Keith C. Bledsoe, Matthew A. Jessee, Jordan P. Lefebvre (*ORNL*)
- 1:30 pm:** Second-Order Uncertainty Analysis for Radiation Shielding Problems Using MCNP, Jeffrey A. Favorite, Tom Burr (*LANL*)
- 1:55 pm:** Adjoint-Based Constant-Mass Partial Derivatives, Jeffrey A. Favorite (*LANL*)
- 2:20 pm:** Monte Carlo Estimates of Eigenvalue Sensitivity to System Dimensions using Kernel Density Estimators, Timothy P. Burke, Brian C. Kiedrowski (*Univ. Michigan*)
- 3:00 pm:** Dakota-MCNP Coupling for Uncertainty Quantification using Polynomial Chaos Expansions, K. Combs, T. Palmer (*Oregon State.*)
- 3:25 pm:** VUSAT—A VERA-CS Uncertainty and Sensitivity Analysis Toolkit, Hongbin Zhang (*INL*), Cameron Brown (*NCSU*), Ling Zou, Haihua Zhao (*INL*)
- 3:50 pm:** Uncertainty Quantification and Sensitivity Analysis for Coupled VERA-CS and FRAPCON, Cole Blakely, Heng Ban (*Utah State.*), Hongbin Zhang (*INL*)

Nuclear Criticality Safety Division Pioneer Discussion—Panel

Sponsored by: NCS D

Session Organizer and Chair: Catherine M. Percher (*LLNL*)

Location: Pacific Concourse J **Time:** 1:00-4:15 pm

Lawrence Livermore National Laboratory Criticality Safety personnel will give a series of presentations discussing the history of criticality safety experimentation and practice at LLNL. Topics discussed will include Project Pluto (a nuclear ramjet engine fielded at the Nevada test site by LLNL), criticality experimentation including the 1963 LLNL criticality accident, and early computational criticality safety.

Panelists: David Heinrichs (*LLNL*), Chuck Barnett (*retired, LLNL*), Brian Koponen (*retired, LLNL*), Robert Ralston (*retired, LLNL*)

Highlights of RPSD-2016/ICRS-13—I

Sponsored by: RPSD

Session Organizer and Chair: Thomas M. Miller (*ORNL*), All invited

Location: Pacific Concourse K **Time:** 1:00-2:45 pm

- 1:05 pm:** Improvements in Electron-Photon-Relaxation Data for MCNP6, H. Grady Hughes and David A. Dixon (*LANL*)
- 1:30 pm:** Activation Calculation for the Dismantling and Decommissioning of a Light Water Reactor Using MCNP™ with ADVANTG and ORIGEN-S, Luc Schlömer, Sven Tittelbach, Peter-W. Phlippen, Roger Vallentin (WTI GmbH), Bernard Lukas (EnBW Kernkraft GmbH)
- 1:55 pm:** Generation of an Activation Map for Decommissioning Planning of the Berlin Experimental Reactor-II, Nicole Guilliard, Janis Lapins, Wolfgang Bernnat (*Univ. Stuttgart - IKE*)
- 2:20 pm:** Neutron-Gamma Flux and Dose Calculations in a Pressurized Water Reactor (PWR), Mariya Brovchenko, Benjamin Dechenaux (*IRSN*), Kenneth Burn, Patrizio Console Camprini (*ENEA*), Isabelle Duhamel (*IRSN*), Arthur Peron (*Contractor*)

Technical
Sessions:
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WEDNESDAY, JUNE 14

TECHNICAL SESSIONS – 1:00 PM

Focus on Communications: Building Strong Networks for Clean Energy Advocacy—Panel

Sponsored by: ETWDD

Session Organizer and Chair: Mimi Limbach (*Potomac Communications Group, Inc.*)

Location: Pacific Concourse L **Time:** 2:45-4:05 pm

Recent studies revealed technology tribalism among online communities supporting clean energy solutions. Clear divides emerge between individuals who favor nuclear energy and those who favor renewable solutions. This panel will discuss how local efforts provide issue-based activities that build stronger networks for clean energy advocacy.

Panelists: Meredith Angwin (*author of Campaigning for Clean Air*), David Blee (*Nuclear Infrastructure Council*), Amy Lientz (*INL*)

Neutronics Challenges of Fusion Facilities—II

Sponsored by: FED; **Cosponsored by:** RPSD, MCD

Session Organizer: Arkady Serikov (*KIT*) **Chair:** Rosaria Viliari (*ENEA*)

Location: Pacific Concourse M **Time:** 1:00-2:45 pm

1:05 pm: Integration of the ITER Tokamak C-Model with the Building Model, Jinan Yang, Stephen C. Wilson, Scott W. Mosher (*ORNL*)

1:30 pm: How to Reduce Shutdown Dose Rates in ITER Diagnostics Equatorial Ports, R. Juarez (*UNED*), J. Guirao (*ITER Organization*), A. Kolsek (*UNED*), M. Kochergin (*Fircroft Engineering Services Ltd.*), G. Pedroche, A. J. López-Revelles (*UNED*), V. Udintsev, L. Bertalot (*ITER Organization*), M. Ivantsky Budker (*Inst. of Nuclear Physics*), A. Zonkov, A. Alexandrov (*Project Center ITER*), J. Sanz (*UNED*), M. Walsh (*ITER Organization*)

1:55 pm: ITER Neutronic Challenges for Upper Port 14, Jonathan P. Klabacha, Brian C Linn, Russell E. Feder (*PPPL*)

2:20 pm: Neutronics Analysis for ITER Diagnostic Generic Upper Port Plug, A. Serikov (*KIT*), L. Bertalot (*ITER Organization*), U. Fischer (*KIT*), R. Juarez (*ETSII-UNED*), M. Walsh (*ITER Organization*)

Advocacy and Communication—Panel

Sponsored by: YMG/ETWDD

Session Organizer: Timothy Crook (*Transatomic Power Corporation*) Laura Hermann (*Potomac Communications Group, Inc.*)

Chair: Alyse M. Scurlock (*Duke Energy Corp*)

Location: Pacific Concourse L **Time:** 1:00-2:40 pm

Successfully advancing a pro-nuclear agenda today requires a diverse advocacy and communication tool set. Rapid change in the media industry has transformed journalism. In government, the promise of nuclear power is being decided by unique actions in each state. Join public information officers, communication professionals, media specialists, and the next generation of nuclear advocates to discuss the impact of modern nuclear advocacy. This panel will discuss the impact of the internet and social media on science reporting, explore the rise of multimedia storytelling and the diversification of outlets that filter science news, and discover successful avenues to advance support for nuclear science and technology nationwide.

Panelists: Eric Meyer (*Generation Atomic*), Nicholas Thompson (*RPI*), Kelsey Amundson (*DNFSB*), Heather Matteson (*Mothers for Nuclear*), Taylor Haby (*Mirion Technologies*)

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WEDNESDAY, JUNE 14

TECHNICAL SESSIONS – 4:30 PM

Human Factors, Instrumentation and Controls: General—II

Sponsored by: HFICD

Session Organizer: Kathryn Ann McCarthy (*Canadian Nuclear Laboratories*)

Chair: Matthew Lish (*Univ of Tennessee*)

Location: Concourse D **Time:** 4:30-6:15 pm

- 4:35 pm:** Cybersecurity Vulnerability Assessment Methodologies for Nuclear Power Plants, John Peterson, Michael Haney, R. A. Borrelli (*Univ. of Idaho*)
- 5:00 pm:** Introduction of Diverse Manual Actuation Design for APR1400, Wonwook Kim, Byung-Soo Cho, Kihyung Kim (*KEPCO E&C*)
- 5:25 pm:** Examining Two-Phase Flow with Optical Sensors, James Schneider (*Fort Lewis College*), Darius D. Lisowski (*ANL*)
- 5:50 pm:** Increasing ROI Using Your Digital Twin for Model Based Engineering, Scott Zepplin (*GSE Performance Solutions Inc.*)

Thermal-Hydraulics: General—II

Sponsored by: THD

Session Organizer: Kurshad Muftuoglu (*GE Hitachi Nuclear*)

Cochairs: Si Young Lee (*SRNL*), Wade Marcum (*Oregon State Univ*)

Location: Pacific Concourse E **Time:** 4:30-6:40 pm

- 4:35 pm:** MITR RELAP5 Model Validations at Steady States and Transients, Wenwen Zhang (*Xi'an Jiaotong Univ. & MIT*), Yu-jou Wang, (*MIT. & National Tsing Hua Univ.*) Kaichao Sun, Lin-wen Hu (*MIT*)
- 5:00 pm:** Methodology of Experiment Design for Improving Transient Critical Heat Flux Model Development, Daniel P. LaBrier, Wade R. Marcum (*Oregon State*)
- 5:25 pm:** Development of Scaling Criteria for Modeling Condensation in Horizontal Tubes Using Reduced Pressure System and Simulant Fluid, Khalid Khasawneh, Yong Hoon Jeong (*KAIST*)
- 5:50 pm:** Counterpart Test on IBLOCA of 13% Cold Leg Break in ATLAS Facility, Byoung-Uhn Bae, Kyoung-Ho Kang, Yu-Sun Park, Jong-Rok Kim, Nam-Hyun Choi, Ki-Yong Choi (*KAERI*)
- 6:15 pm:** Flow Characteristics of Intermediate Heat Exchanger with CFD Methodology on Nuclear Safety Application, Pei-Chi Tseng, Ji-Yang Yu, Xiao-Long Zhang (*Tsinghua Univ.*), Yuh-Ming Ferng, Chung-Yen Hsu, Ke-Wei Lai (*National Tsing Hua Univ*)

Electrochemical Separation for Used Nuclear Fuels

Sponsored by: FCWMD

Session Organizer: Jinsuo Zhang (*Ohio State*) **Chair:** Guo Shaqiang (*Virginia Tech*)

Location: Pacific Concourse F **Time:** 4:30-6:40 pm

- 4:35 pm:** Separation of Actinides from Lanthanides in Molten Fluorides by the Modulated-Current Electrolysis, Martin Straka, Lorant Szatmary (*UJV Rez, a.s.*)
- 5:00 pm:** Nuclear Material Monitoring in Molten Salt Systems using Cyclic Voltammetry, Vickram Singh, Dev Chidambaram (*Univ. Nevada, Reno*)
- 5:25 pm:** Electrochemical Sensor Development for Fluoride Molten Salt Redox Control, Nikolas Shay, Shaoqiang Guo, Jinsuo Zhang (*Ohio State*)
- 5:50 pm:** First-Principles-Based Computational Study on Nucleation and Growth Mechanisms of U on Mo(110) Surface Solvated in an Eutectic LiCl-KCl Molten Salt, Choah Kwon, Joonhee Kang, Byungchan Han (*Yonsei Univ.*)
- 6:15 pm:** Effect of Concentration, Temperature, and Interelectrode Gap on Voltage Drop in Electrochemical System of GdCl₃-LiCl-KCl, Hunter Andrews, Supathorn Phongikaroon (*Virginia Commonwealth Univ.*)

Technical
Sessions:
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WEDNESDAY, JUNE 14

TECHNICAL SESSIONS – 4:30 PM

Reactors Physics: General—II

Sponsored by: RPD

Session Organizer: Cristian Rabiti (*INL*) **Chair:** Amanda L. Lang (*Duke Energy*)

Location: Pacific Concourse G **Time:** 4:30-6:40 pm

- 4:35 pm:** Optimization of a Monte Carlo Model of the Transient Reactor Test Facility, Kristin Smith (*Univ. Florida*), Mark DeHart (*INL*), Sedat Goluoglu (*Univ. Florida*)
- 5:00 pm:** Development and Test of a New Verification Scheme for Transient Core Simulators, C. Demazière, V. Dykin, K. Jareteg (*Chalmers Univ. Technol.*)
- 5:25 pm:** Core Reactivity Control for a Soluble Boron Free Small Modular Reactor, Hyeong Heon Kim, Chang Kyu Chung (*KEPCO*), Mohd-Syukri Yahya, Yonghee Kim (*KAIST*)
- 5:50 pm:** Core Combination Method of Approximation (CCMA) for Neutron Fluence Calculation, Yang Wankui, Yuan Baoxin, Zhang Songbao (*INPC of CAEP*)
- 6:15 pm:** Study on Reactor Physical Module Method Used in THR Simulator, Wei Chunlin, Sui Zhe, Sun Jun (*Tsinghua Univ.*)

Large Eddy Simulation and Direct Numerical Simulation

Sponsored by: THD

Session Organizer: Elia Merzari (*ANL*)

Cochairs: Igor A. Bolotnov (*NCSU*), Lane Carasik (*Texas A&M Univ*)

Location: Pacific Concourse H **Time:** 4:30-6:40 pm

- 4:35 pm:** Heat Transfer Efficiency in Various Prandtl Number Turbulent Flows using DNS Approach, Mengnan Li, Jinyong Feng, Igor Bolotnov (*NCSU*)
- 5:00 pm:** Numerical Simulation of Twin Jets using LES with the Nek5000 Code, L. B. Carasik (*Texas A&M Univ.*), E. Merzari (*ANL*), Y. A. Hassan (*Texas A&M Univ.*)
- 5:25 pm:** Toward High Fidelity LES Simulations of 5x5 PWR Fuel Bundle with Mixing Vane, Fatih S. Sarikurt, Giacomo Busco, Yassin A. Hassan (*Texas A&M Univ.*)
- 5:50 pm:** Direct Numerical Simulation of the Turbulent Flow Through PWR Spacer Grid and Mixing Vanes, Jun Fang, Shrey Satpathy, Igor A. Bolotnov (*NCSU*)
- 6:15 pm:** Large Eddy Simulation of Turbulent Flow in Rod Bundle with Spacer Grids, Wei Zonglan, Chu Xiao, Zhang Yu, Liu Songtao (*Nuclear Power Inst of China*)

Deterministic Transport Methods

Sponsored by: MCD

Session Organizer: Jeffery D. Densmore (*BAPL*) **Chair:** Tara M. Pandya (*ORNL*)

Location: Pacific Concourse I **Time:** 4:30-6:40 pm

- 4:35 pm:** Diffusion Synthetic Acceleration for High Order S_N Transport on Meshes with Curved Surfaces, Douglas N. Woods, Todd S. Palmer (*Oregon State*)
- 5:00 pm:** Convergence Study of LR-NDA Using Fourier Analysis, Sicong Xiao, Kangyu Ren, Dean Wang (*Univ. Mass., Lowell*), Yunlin Xu, Thomas J. Downar (*Univ. Michigan*)
- 5:25 pm:** A Continuous-Discontinuous Hybrid Finite Element Method for S_N Transport, Weixiong Zheng, Ryan G. McClarren (*Texas A&M Univ.*)
- 5:50 pm:** Direct S_N Treatment of the Scattering Source with Phase Functions, Vincent Laboure, Yaqi Wang, Sebastian Schunert (*INL*)
- 6:15 pm:** Flexible Spatial Partitions in MPACT Through Module-Based Data Passing, Shane Stimpson, Benjamin Collins (*ORNL*)

Technical
Sessions:
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WEDNESDAY, JUNE 14

TECHNICAL SESSIONS – 4:30 PM

Data, Analysis and Operations in Nuclear Criticality Safety—III

Sponsored by: NCS

Session Organizer: Theresa E. Cutler (*LANL*) **Chair:** Andrew W. Prichard (*PNNL*)

Location: Pacific Concourse J **Time:** 4:30-5:25 pm

4:35 pm: Effects of Boron and Graphite Uncertainty in Fuel for TREAT Simulations, Kyle Vaughn, Zander Mausol, Esteban Gonzalez (*Univ. Florida*), Mark DeHart (*INL*), Sedat Goluoglu (*Univ. Florida*)

5:00 pm: Combining RHF and HFIR Disposition Campaigns—Analysis, Opportunity, and Lessons Learned, Tracy Stover, John Lint (*SRNS*)

Highlights of RPSD-2016/ICRS-13—II

Sponsored by: RPSD

Session Organizer and Chair: Thomas M. Miller (*ORNL*), All invited

Location: Pacific Concourse K **Time:** 4:30-6:15 pm

4:35 pm: Evaluation of RAPID for a UNF Cask Benchmark Problem, Valerio Mascolino, Alireza Haghghat (*Virginia Tech*), Nathan J. Roskoff (*Virginia Polytechnic Inst and State Univ.*)

5:00 pm: Radiological Shielding Design for the Neutron Backscattering Spectrometer EMU, Mark Ho, T. Ersez, F. Esposito, N. R. de Souza (*ANSTO*)

5:25 pm: Feasibility Study on Real-Time γ -Ray Spectrum / Dose Measurement System, Mina Kobayashi, Fuminobu Sato, Isao Murata (*Osaka Univ.*)

5:50 pm: Using the MCNP Taylor Series Perturbation Feature (Efficiently) for Shielding Problems, Jeffrey A. Favorite (*LANL*)

Fusion Energy Applications

Sponsored by: FED

Session Organizer: Arnold Lumsdaine (*ORNL*) **Chair:** Blair P. Bromley (*Canadian Nuclear Society*)

Location: Pacific Concourse M **Time:** 4:30-5:50 pm

4:35 pm: Study of Tritium Transport in Nuclear Grade Graphite and Molten Fluoride Salt Systems, Huali Wu, Ruchi Gakhar (*Univ. Wisconsin, Madison*), Cristian Contescu (*ORNL*), Raluca O. Scarlat (*Univ. Wisconsin, Madison*)

5:00 pm: Tersoff Benchmarking of Be-C-H Interatomic Potential, Aws Al-Shalash, Abdullah Weiss, Xue Yang (*Texas A&M Univ., Kingsville*)

5:25 pm: Theoretical Calculation and Simulation Studies of Balancing Forces and Axisymmetric Poloidal Halo Current in EAST, Salah Ud-Din Khan (*COMSATS*), Salah Ud-Din Khan (*King Saud Univ.*), Farooq Ahmed Shah, Kainaat Ashraf, Sehrish Bibi, Rubab Gull (*COMSATS*)

Cyber Security—Panel

Sponsored by: OPD; **Cosponsored by:** HFICD

Session Organizers and Cochairs: Virginia L. Wright (*INL*), Steven Hartenstein (*INL*)

LOCATION: Pacific Concourse N **Time:** 4:30-6:30 pm

Today's domestic nuclear reactor fleet is governed by cybersecurity regulation focused on digital computer and communications systems and networks associated with safety, security, and emergency preparedness (SEEP) functions in order to ensure that critical functions are adequately protected from cyber-attacks. The advanced nuclear fleet of tomorrow will incorporate passive safety features which will reduce or eliminate operator action needed in the case of an anomaly or accident, and which will allow, even a plant under an active cyber-attack, to return to a safe state via physics-based passive features of the reactor without operator intervention. In this future environment, through increased automation, incorporation of digital instrumentation and controls, and the reduction of need for active intervention of operators to ensure critical functions, the very nature of the cybersecurity environment will change. This panel will employ a variety of viewpoints from Industry, Government, Research, and Universities to imagine what the future state of cybersecurity for advanced reactors will be, how it builds upon the lessons learned from today, how it differs from today's environment, and challenges and pitfalls we will experience on the way.

Panelists: Kevin Deyette (*NuScale*), Per Peterson (*Univ of California, Berkeley*), Mike Rowland (*IAEA*), Page Stoutland (*NTI*), Brad Yeates (*Southern Co*), Steven Hartenstein (*INL*)

Technical
Sessions:
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THURSDAY, JUNE 15

TECHNICAL SESSIONS – 8:00 AM

Nuclear Fuels and Materials in Fast Reactors

Sponsored by: MSTD

Session Organizer: Kenneth J. Geelhood (*PNNL*) **Chair:** Gokul Vasadevamurthy (*General Atomics*)

Location: Pacific Concourse D **Time:** 8:00-11:15 am

- 8:05 am:** A Phase-Field Model for the U-Pu-Zr System, Jacob Hirschhorn (*Penn. State.*), Assel Aitkaliyeva, (*Univ. Florida, INL*), Cynthia Papesch (*INL*), Michael Tonks (*Penn. State*)
- 8:30 am:** A Potential Mechanism for Lanthanide Transport in Metallic Fuels, Cetin Unal, C. Matthews (*LANL*), L. Xiang, J. Isler, J. Zhang (*Ohio State*), J. Galloway (*LANL*)
- 8:55 am:** Advanced Simulation Aided Metallic Fuel Design, C. Matthews, J. Galloway, C. Unal (*LANL*)
- 9:35 am:** Evaluation of the Thermophysical Properties and Microstructure of $UPu_{24}Zr_{15}$ Metallic Fuel, Scott Middlemas, Cynthia A. Papesch (*INL*), Assel Aitkaliyeva (*Univ. Florida*)
- 10:00 am:** Phase Verification and Thermophysical Properties Evaluation of Pu-Zr Alloys, Cynthia Papesch (*INL*), Assel Aitkaliyeva (*Univ. Florida*), Scott Middlemas (*INL*)
- 10:25 am:** Statistical Analysis in Support of Fuel Temperature Control in the Advanced Gas Reactor Experiments, Binh T. Pham, Nancy J. Lybeck, Grant L. Hawkes, Jeffrey J. Einerson (*INL*)
- 10:50 am:** Serrated Yielding in Alloy 709 at 500 °C, A. S. Alomari, N. Kumar, K.L. Murty (*NCSU*)

Thermal-Hydraulics of Advanced Reactor and Fuel Concepts

Sponsored by: THD

Session Organizer: Piyush Sabharwall (*INL*) **Cochairs:** Xiaodong Sun (*Univ. of Michigan*), Piyush Sabharwall (*INL*)

Location: Pacific Concourse E **Time:** 8:00-11:40 am

- 8:05 am:** Coupled CFD-DEM Analysis of Molten Salt-Cooled Pebble-Bed Reactor Experiment, Robert Mardus-Hall (*Univ. New South Wales*), Mark Ho (*ANSTO*), Guan Yeoh (*Univ. New South Wales & ANSTO*), Victoria Timchenko (*Univ. New South Wales*)
- 8:30 am:** Steady-State Subchannel Thermalhydraulic Assessment of Thorium-Based Fuel Concepts for Use in Pressure Tube Heavy Water Reactors, A. Nava Dominguez, Y. F. Rao, A. V. Colton B. P. Bromley (*Canadian Nuclear Laboratories*)
- 8:55 am:** Fluoride Salt Static Freezing Study, Louis J. Chapdelaine, Raluca Scarlat (*Univ. Wisconsin, Madison*)
- 9:35 am:** Performance Analysis of the Passive Residual Heat Removal System of an Integral Reactor, Joo Hyung Moon, June Woo Kee, Seok Kim, Woo Shik Kim, Young In Kim (*KAERI*)
- 10:00 am:** Scaling of Thermal Stratification in Outlet Plena of SFRS with Gallium as a Surrogate Fluid, Brendan Ward, Graham Wilson, Hitesh Bindra (*Kansas State*), Tyler Sumner (*ANL*), Rizwan-uddin (*Univ. Illinois, Urbana-Champaign*)
- 10:25 am:** Modeling the Molten Salt Reactor Experiment with the RELAP5-3D Code, Juan J. Carbajo (*ORNL*), Dane De Wet (*ORNL & Univ. California, Berkeley*), Nicholas R. Brown (*ORNL & Penn State*)
- 10:50 am:** Effects of Radiative Heat Transfer in High-Temperature Liquid-Salts, Carolyn Coyle, Emilio Baglietto, Charles Forsberg (*MIT*)
- 11:15 am:** Improved Heat Transfer and Volume Scaling through Novel Heater Design, Raleigh Lukas, James Kendrick, Per Peterson (*Univ. California, Berkeley*)

Technical
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THURSDAY, JUNE 15

TECHNICAL SESSIONS – 8:00 AM

Fuel Cycle and Waste Management: General—I

Sponsored by: FCWMD

Session Organizer and Chair: Jared A. Johnson (*ORNL*)

Location: Pacific Concourse F **Time:** 8:00-10:00 am

- 8:05 am:** Economic Module Development for the Fuel Cycle Simulation Tool CLASS, Federico Casella (*Institut Polytechnique de Grenoble & Instituto Balseiro/Centro Atómico Bariloche*), Adrien Bidaud (*Institut Polytechnique de Grenoble*), Nicolas Thiollière (*CNRS Univ.*)
- 8:30 am:** Exploring the Use of Muon Momentum for Detection of Nuclear Material Within Shielded Spent Nuclear Fuel Dry Casks, S. Chatzidakis, P. A. Hausladen, S. Croft, J. A. Chapman, J. J. Jarrell, J. M. Scaglione (*ORNL*), C. K. Choi, L. H. Tsoukalas (*Purdue Univ.*)
- 8:55 am:** On the Use of Ionic Liquids for the Recycling of the Contaminated Material, Martin Straka (*UJV Rez, a.s.*)
- 9:35 am:** Major Considerations on the Nuclear Material Accounting of PB-HTR Commercial Plants, Bing Xia, Ding She, Chunlin Wei, Jiong Guo, Jian Zhang, Fu Li, Liguang Zhang, Zaizhe Yin (*Tsinghua Univ.*)

Reactor Physics: General—III

Sponsored by: RPD

Session Organizer: Cristian Rabiti (*INL*) **Chair:** Christophe Demaziere (*Chalmers Univ of Technology*)

Location: Pacific Concourse G **Time:** 8:00-11:15 am

- 8:05 am:** Simulation of the RPI Reactor Critical Facility Core Using High-Fidelity Neutronics Code PROTEUS, C. H. Lee (*ANL*), D. J. O'Grady (*Univ. Illinois, Urbana Champaign*), Y. S. Jung, E. R. Shehemon (*ANL*)
- 8:30 am:** Verification of High-Fidelity Neutronics Code PROTEUS for C5G7 Benchmark Problems, Y. S. Jung, C. H. Lee, M. A. Smith (*ANL*)
- 8:55 am:** Preliminary Development of a Nuclide Inventory Code for HTGR, Jian Li, Jian Li, Ding She, Lei Shi (*Tsinghua Univ.*)
- 9:35 am:** Time Scale Effects on the Temperature Coefficient of Reactivity, Wenfeng Liang, Jiangmeng Wang, Qilin Xie (*Inst. Nucl. Physics and Chemistry, CAEP*)
- 10:00 am:** Analysis of Neutron Spectrum and Control Rod Worth Measurements in Several ZPPR-15 Loadings, Gerardo Aliberti, Michael A. Smith, Richard M. Lell, Chang-ho Lee (*ANL*)
- 10:25 am:** The Effects of Reflector on Core Reactivity for Conceptual Soluble Boron Free SMR, Seunghwan Jun, Jinsun Kim, Do Ik Chang, Kibong Seong (*KEPCO*)
- 10:50 am:** Heavy-Water Moderated, Molten Uranium Cooled Reactor MCNP Model, Neal L. Mann (*Neal Mann & Associates*)

Current Topics in Probabilistic Risk Analysis

Sponsored by: NISD

Session Organizer and Chair: Nicholas R. Brown (*Penn State*)

Location: Pacific Concourse H **Time:** 8:00-10:50 am

- 8:05 am:** Assembling Multiple Models within the RAVEN Framework, A. Alfonsi, C. Rabiti, D. Mandelli (*INL*)
- 8:30 am:** Uncertainty Quantification for External Events Analysis of LWRS/RISMC Project, Carlo Parisi, Andrea Alfonsi, Cristian Rabiti, Ronaldo H. Szilard (*INL*)
- 8:55 am:** Electrical Cross-Tie Option and Issues to Cope With Extended Station Blackout, Jun Su Ha, Jamila Khamis Alsuwaidi (*Khalifa Univ.*), Sung-yeop Kim (*KAERI*)
- 9:35 am:** Preliminary Study for Development of Technical Basis of Quantitative Safety Goals for NPPs Operations in UAE, Osama Ali Al Shehhi (*Federal Authority for Nuclear Regulation*), Jun Su Ha, Young-Ji Byon, Chung Suk Cho (*Khalifa Univ.*), Sung-yeop Kim (*KAERI*)
- 10:00 am:** Examining the Effect of Plume Rise on Radiological Consequences of Nuclear Accidents, Sana Ullah, Man-Sung Yim (*KAIST*)
- 10:25 am:** Sensitivity Analysis of Successful Evacuee Proportion in Hypothetical NPP Accident by Earthquake, Sung-yeop Kim, Ho-Gon Lim, (*KAERI*)

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THURSDAY, JUNE 15

TECHNICAL SESSIONS – 8:00 AM

Uncertainty Quantification and Sensitivity Analysis—II

Sponsored by: MCD

Session Organizer: Jeffery D. Densmore (*BAPL*) **Chair:** Weixiong Zheng (*Univ of California, Berkeley*)

Location: Pacific Concourse I **Time:** 8:00-10:00 am

8:05 am: Statistical Analyses of Post Irradiation Experiments of the BWR Forsmark, Volker Hannstein, Fabian Sommer (*GRS GmbH*)

8:30 am: Uncertainty and Sensitivity Analysis of TREAT Transient Test #15, Congjian Wang, Sebastian Schunert, Paul W. Talbot, Benjamin Baker, Yaqi Wang, Javier Ortensi, Frederick Gleicher, Mark DeHart, Cristian Rabiti (*INL*)

8:55 am: Kriging-Based Inverse Uncertainty Quantification of BISON Fission Gas Release Model, Xu Wu, Tomasz Kozłowski (*Univ. Illinois, Urbana-Champaign*)

9:35 am: Sensitivity Coefficients for Diffusion Coefficients and Other Reactor Physics Parameters using CE TSUNAMI-3D, Christopher Perfetti, Matthew Jessee, Bradley Rearden (*ORNL*)

Post Irradiation Examination and Advanced Measurements Techniques—II

Sponsored by: MSTD

Session Organizer: Kenneth J. Geelhood (*PNNL*) **Chair:** Kallie E. Metzger (*SRNL*)

Location: Pacific Concourse K **Time:** 8:00-10:25 am

8:05 am: Nondestructive Evaluation of Alkali-Silica Reaction in High-Strength Concrete for Aging Structures Sustainability, Alexander Heifetz, Sasan Bakhtiari, Juan Lu, (*ANL*) Anthony Bentivegna (*Construction Technology Laboratory*)

8:30 am: Evaluation of Optical Fiber Bragg Gratings in a Nuclear Reactor, Brandon A. Wilson, Tony Birri, Thomas E. Blue (*Ohio State*)

8:55 am: Optimization of Silica Optical Fiber for High Temperature, Radiation Environments, Brandon A. Wilson, Kelly M. McCary, Thomas E. Blue (*Ohio State*)

9:35 am: Helium Irradiation Tolerance of Ti_3SiC_2 MAX Phase Material, Hongliang Zhang, Ranran Su, Liqun Shi (*Fudan Univ.*), D. J. O'Connor (*Univ. Newcastle*)

10:00 am: Deposition of Ti_2AlC Thin Film, Ranran Su, Hongliang Zhang, Liqun Shi (*Fudan Univ.*)

Integrated Used Fuel Storage Sites

Sponsored by: FCWMD

Session Organizer: Jard A. Johnson (*ORNL*)

Chair: Jean-Francois Lucchini (*LANL*)

Location: Pacific Concourse M **Time:** 8:00-10:00 am

8:05 am: SNF Data Visualization on the Centralized Used Fuel Resource for Information Exchange (CURIE) Website, Robert Anthony Joseph, Aaron Myers, Joshua Jarrell, Joshua Peterson, Kaushik Banerjee (*ORNL*)

8:30 am: Estimating Public Dose Along Hypothetical Spent Nuclear Fuel Transportation Routes, Kevin J. Connolly (*ORNL*)

8:55 am: Experimental Evaluation of an Oxidizing Hazard in the Presence of Sorbents, J. F. Lucchini, B. A. Crawford, C. J. Chancellor, C. Poulos, T. Hayes (*LANL*)

9:35 am: Should WIPP Resume Unfiltered Discharge of Underground Ventilation?, P. Thakur, H. Khaing, R. Hardy (*Carlsbad Environmental Monitoring & Research Center*)

THURSDAY, JUNE 15

TECHNICAL SESSIONS – 8:00 AM

Operations and Power: General

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Sponsored by: OPD; **Cosponsored by:** YMG

Session Organizer: Piyush Sabharwall (*INL*) **Chair:** Hitesh Bindra (*Kansas State Univ*)

Location: Pacific Concourse N **Time:** 8:00-10:25 am

8:05 am: Diverting Steam from a Nuclear Power Plant to Thermal Storage to Increase Economic Efficiency of Electricity Production, Natalie Shifflet, Daniel Curtis, Charles Forsberg (*MIT*)

8:30 am: Progress in Development of Fluoride-Salt-Cooled High-Temperature Reactors (FHRs), C. W. Forsberg, L. W. Hu (*MIT*), P. F. Peterson, M. Fratoni (*Univ. California, Berkeley*), K. Sridharan (*Univ. Wisconsin, Madison*), E. Blandford (*Univ. New Mexico*)

8:55 am: An Unsteady State Gas Transport Model in Matrix Laboratory (MATLAB) for PWR Gas Management, Danial S. Soorty, Wayne M. Gibson (*ChemStaff, Inc.*)

9:35 am: Quantification of Functional Impact Classification on the Current U.S. Nuclear Fleet, Sarah M. Ewing, Nancy Johnson, Piyush Sabharwall (*INL*)

10:00 am: Measurement of Nuclear Power Plant Construction Performance Using EVMS Model, Myung S. Roh, Eun I. Lee (*KEPCO*)

ANS-8 Standards Forum

Sponsored by: NCSD

Session Organizer and Chair: Douglas G. Bowen (*ORNL*)

Location: Pacific Concourse J **Time:** 8:00-11:40 am

Speakers to be announced.

TECHNICAL SESSIONS – 1:00 PM

Advanced Manufacturing

Sponsored by: MSTD

Session Organizer and Chair: Kenneth J. Geelhood (*PNNL*)

Location: Pacific Concourse D **Time:** 1:00-2:20 pm

1:05 pm: Design and Test of Self-Lubricating Bearing for High Temperature Gas-Cooled Reactor, Qinzhao Zhang, Hong Wang (*Tsinghua Univ.*)

1:30 pm: Understanding Manufacturing Scale-Up of Plasma Sprayed Zr Barrier Coatings on U-10Mo Fuels, Dustin R. Cummins, Kendall J. Hollis, Cheng Liu, James A. Valdez, David E. Dombrowski (*LANL*)

1:55 pm: Research of Materials and Components for Molten Salt Reactors, Martina Koukolíková, Peter Sláma, Zbysek Nový (*COMTES FHT Inc.*), Pavel Svoboda, Petr Toman (*MICo Ltd.*), Martin Mareček, Jan Uhlíř (*Research Centre Rez*)

Computational Thermal-Hydraulics—II

Sponsored by: THD

Session Organizer: Randall O. Gauntt (*SNL*)

Co-chairs: John C. Luxat (*McMaster Univ*), Elia Merzari (*ANL*)

Location: Pacific Concourse E **Time:** 1:00-3:25 pm

1:05 pm: Thermal Evaluations for Hypothetically Drain-Down Spent Fuel Storage Facility at SRS, Si Y. Lee, Dennis W. Vinson (*SRNL*)

1:30 pm: Modelling of the Nuclear Propulsion Rocket, Jivan Khattry, Fatih Aydogan (*Univ. Idaho*)

1:55 pm: Modeling the Transient Reactor Test Loop in TRACE for PWR Critical Heat Flux Benchmarking, Emory Brown, Wade Marcum (*Oregon State*), Colby Jensen (*INL*)

2:20 pm: Computational Study of Droplet Dynamics in Dispersed Flow Film Boiling Regime in PWR Geometries, Shrey Satpathy, Jun Fang, Igor A. Bolotnov (*NCSU*)

3:00 pm: Improved Safety Injection Flow Map Associated with Target RCS Depressurization to Maintain Core Coolability of OPR1000, Joongoo Jeon, Wonjun Choi, Sung Joong Kim (*Hanyang Univ.*)

THURSDAY, JUNE 15

TECHNICAL SESSIONS – 1:00 PM

Fuel Cycle and Waste Management: General—II

Sponsored by: FCWMD

Session Organizer and Chair: Jared A. Johnson (*ORNL*)

Location: Pacific Concourse F **Time:** 1:00-2:45 pm

- 1:05 pm:** Conceptual Design of Decontamination System for Radioactive Contaminated Water with Microalgae, Dohyung Kim, Wooyong Kim, Unjang Lee (*ORION ENC Co. Ltd.*), Seung-Yop Lee (*Sogang Univ.*)
- 1:30 pm:** Sorption of Cobalt from Aqueous Solutions by Polystyrene-Graphene Oxide Composite Material, Zdeňka Tomášová, Mária Bubeníková (*UJV Rez, a.s.*), Petra Ecorchard (*Inst of Inorganic Chemistry of the AS CR*)
- 1:55 pm:** Initial Shipment of MNSR Reactor HEU Spent Nuclear Fuel from Ghana to China, John Dewes (*SRNL*), Kwame Aboh, Henry Odoi (*National Nuclear Research Inst.*), Igor Bolshinsky (*INL*), Sándor Tózsér (*IAEA*)
- 2:20 pm:** Chemical Consequence Analysis and Atmospheric Dispersion Coefficients under DOE-STD-3009-2014 Nuclear Safety Analysis, Roger D. Lanning (*Bechtel Inc.*)

Reactor Physics Design, Validation and Operational Experience

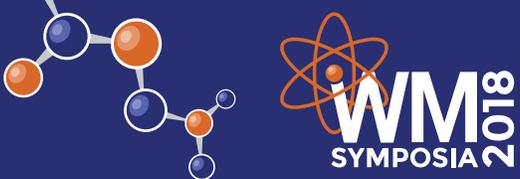
Sponsored by: RPD

Session Organizer: Cristian Rabiti (*INL*) **Chair:** Carlo Parisi (*INL*)

Location: Pacific Concourse G **Time:** 1:00-4:40 pm

- 1:05 pm:** Demonstration of Load-Follow Operations with Standalone BISON through VERA, Shane Stimpson, (*ORNL*)
- 1:30 pm:** Fast Reactor Core Analysis Using AZNHEX Neutron Diffusion Code, Juan Galicia-Aragon, Juan Luis Francois, Guillermo-Elias Bastida-Ortiz (*Univ. NacionaI Autonoma de Mexico*), Edmundo del-Valle-Gallegos (*Inst. Politecnico Nacional*), Armando Gómez-Torres (*Inst. Nacional de Investigaciones Nucleares Carretera Mexico*)
- 1:55 pm:** A Fully Passive Daily Load-Follow Operation in a Small PWR System, Ahmed Amin E. Abdelhameed, Yonghee Kim (*KAIST*)
- 2:20 pm:** AZTRAN and AZKIND Verification with a BWR Study Case, Guillermo-Elias Bastida-Ortiz, Julio-Amhed Vallejo-Quintero, Juan Galicia-Aragón, Juan-Luis François (*Univ. Nacional Autonoma de Mexico*), Andrés Rodríguez-Hernández, Armando Gómez-Torres (*Inst. Nacional de Investigaciones Nucleares Carretera Mexico*), Edmundo del Valle-Gallegos (*Inst. Politecnico Nacional*)
- 3:00 pm:** Investigation of Treat M2 and M3 Calibration Experiments for Benchmark Analysis, N. C. Sorrell, A. I. Hawari (*NCSU*), M. D. DeHart, J. D. Bess (*INL*)
- 3:25 pm:** Verification of AZTRAN v1.2 Code with a PWR-MOX Benchmark Problem, Julio-Amhed Vallejo-Quintero, Guillermo-Elias Bastida-Ortiz, Juan-Luis François (*Universidad Nacional Autónoma de México*), José-Vicente Xolocostli-Munguía, Samuel Vargas-Escamilla (*Instituto Nacional de Investigaciones Nucleares Carretera México*), Edmundo del Valle-Gallegos (*Instituto Politécnico Nacional*)
- 3:50 pm:** Improved Core Design of the Supercritical Water-Cooled Reactor CSR1000, Lianjie Wang, Di Lu, Ping Yang (*Nuclear Power Inst of China*)
- 4:15 pm:** Calculating Control Rod Differential Worth Using Adjoint-Weighted Method, Gang Wang, Ganglin Yu (*Tsinghua Univ.*)

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NPIC&HMIT: Sessions by Day

MONDAY, JUNE 12

1:00-4:00 pm	NPIC&HMIT 2017 Opening Plenary <i>Sponsored by</i>  Rolls-Royce	Grand Ballroom A
4:30-6:40 pm	Advanced Instrumentation and Monitoring Methods for Dry Storage of Spent Nuclear Fuel—Panel Automation: Effects and Applications Human Factors Engineering: Improving Nuclear Safety and Efficiency with Digital Controls—Panel	Bayview B Seacliff A Seacliff B

TUESDAY, JUNE 13

8:00-9:20 am	Tuesday Plenary	Grand Ballroom A
9:35-11:40 am	Advanced Surveillance, Diagnostics, and Prognostics—I Cyber Security in Digital I&C—I Human Machine Interface Design and Evaluation Verification and Validation of Control Room Designs and Modifications General Sessions in I&C—I Digital System Reliability—I SMR Instrumentation and Control—I	Bayview A Bayview B Seacliff A Seacliff B Seacliff C Seacliff D
1:00-4:15 pm	I&C Regulations, Standards, and Guidelines—I Electromagnetic Compatibility (EMC) and EMI/RFI Issues Cyber Security in Digital I&C—II Human Performance and Lessons-Learned in Beyond-Design-Basis and Extreme Conditions Human Reliability Applications for Improving Understanding and Performance in Plant Operations V&V Methods and Applications for Control Room Designs	Golden Gate Room Marina Room Bayview A Bayview B Seacliff A Seacliff A Seacliff B

NPIC&HMIT: Sessions by Day

TUESDAY, JUNE 13 CONTINUED

1:00-4:15 pm	Case Studies of HFE Program Implementations	Seacliff B
	The Future of I&C: Compelling Projects Lead by Young Engineers—Panel	Seacliff C
4:30-6:40 pm	Nuclear Energy R&D in I&C Areas	Seacliff D
	SMR Instrumentation and Control—II	Golden Gate Room
	Advanced Surveillance, Diagnostics, and Prognostics—II	Bayview A
	Robotics for Maintenance of Advanced Reactors—Panel	Bayview B
	Virtual Reality, Augmented Reality, and Alarms	Seacliff A
	Experience with NUREG-0711 Rev. 3—Panel	Seacliff B
	Modeling Digital I&C Systems in PRA/PSA	Seacliff C
	Light Water Reactor Sustainability (LWRS)	Seacliff D
Research Reactor I&C	Golden Gate Room	
Think Smart Think Digital: Delivering the Nuclear Promise through Digital I&C—Panel	Marina Room	

WEDNESDAY, JUNE 14

8:00-9:20 am	Wednesday Plenary	Grand Ballroom A
9:35-11:40 am	Near-Term Improvements to the Digital I&C Regulatory Infrastructure—Panel	Grand Ballroom A
	Advanced Surveillance, Diagnostics, and Prognostics—III	Bayview A
	Cyber Security in Digital I&C—III	Bayview B
	Human Factors Engineering Programs, Standards, and Guidance Initiatives	Seacliff A
	Computerized Procedure Systems	Seacliff B
	Advanced Sensors and Measurement Technologies—I	Seacliff C
	General Sessions in I&C—II	Seacliff D
	I&C for Advanced Reactors	Golden Gate Room
	Next Generation I&C Systems	Bayview A
	U.S. Department of Energy Advanced Sensors and Instrumentation Research—Panel	Bayview B
1:00-4:15 pm	Measures—I: Operator and Team Performance	Seacliff A
	Measures—II: Data Collection Methods and Challenges	Seacliff A
	Computer-Based Tools for Improving Operator and Plant Performance—I	Seacliff B
	Computer-Based Tools for Improving Operator and Plant Performance—II	Seacliff B
	I&C Research Plans and Activities by Leading Organizations—Panel	Seacliff C
	Safety Critical Software Development, Qualification, and V&V—I	Seacliff D
	Digital Control System Applications	Golden Gate Room
	I&C Modernization Experience—I	Marina Room
	I&C Lessons Learned from Fukushima	Bayview A
	Diversity and Defense in Depth (D3)—I	Bayview B
	Measures—III: Eye Tracking Applications and Methods	Seacliff A
	Experience with Control Room Modernization—I	Seacliff B
	Advanced Sensors and Measurement Technologies—II	Seacliff C
Safety Critical Software Development, Qualification, and V&V—II	Seacliff D	
On-Line Monitoring for Maintenance Optimization—I	Golden Gate Room	

THURSDAY, JUNE 15

8:00-9:20 am	Thursday Plenary	Grand Ballroom A
9:35-11:40 am	Advanced Surveillance, Diagnostics, and Prognostics—IV	Bayview A
	Cyber Security in Digital I&C—IV	Bayview B
	Supporting the Development, Practice, and Integration of Human Factors Engineering	Seacliff A
	Experience with Control Room Modernization—II	Seacliff B
	Field Programmable Gate Array (FPGA)—I	Seacliff C
	General Sessions in I&C—III	Seacliff D
	On-Line Monitoring for Maintenance Optimization—II	Golden Gate Room
	I&C Regulations, Standards, and Guidelines—II	Marina Room
	General Sessions in I&C—IV	Bayview A
	Diversity and Defense in Depth (D3)—II	Bayview B
1:00-4:15 pm	Soft Controls	Seacliff A
	Field Programmable Gate Array (FPGA)—II	Seacliff C
	Digital System Reliability—II	Seacliff D
	I&C Modernization Experience—II	Marina Room

EMBEDDED TOPICAL: NPIC&HMIT | MONDAY, JUNE 12

TECHNICAL SESSIONS - 4:30 PM

*Presentation Only

Advanced Instrumentation and Monitoring Methods for Dry Storage of Spent Nuclear Fuel—Panel

Cochairs: Stylianos Chatzidakis (*ORNL*), Shannon Chu (*EPRI*)

Location: Bayview B **Time:** 4:30-6:30 pm

The goal of this panel is to provide a forum to bring together well qualified panelists to discuss the topic of advanced instrumentation and monitoring methods for dry storage of spent nuclear fuel. This session will provide an opportunity to present new research and development on non-conventional methods to inspect and monitor the components (e.g., concrete overpack, stainless steel canister, fuel cladding) of dry storage systems during extended periods of time. This panel session topic is timely as there are currently limited options available to provide for even minimal inspections of dry storage systems. Available periodic inspections using NDE techniques have limitations on the size of crack that can be detected. In addition, these inspection techniques are limited due to inaccessibility of the canister surface as well as to a high radiation environment. Hence, advanced instrumentation and monitoring techniques, including radiation resistant sensors and power harvesting capabilities, need to be adapted and developed to overcome these limitations.

Panelists: Lei Zuo (*Virginia Tech*), Pradeep Ramuhalli (*PNNL*), Arthur Motta (*Penn State Univ*), Faranak Nekoogar (*Dirac Solutions*), Richard Vilim (*ANL*)

Automation: Effects and Applications

Session Organizer and Chair: John M. O'Hara (*BNL*)

Location: Seacliff A **Time:** 4:30-6:15 pm

4:35 pm: A Human Automation Interaction Concept for a Small Modular Reactor Control Room, Katya L. Le Blanc, Zach Spielman, Rachel Hill (*INL*), Ross Snuggerud, Brandon Pearse, John McLerran, Ryan Flamand (*NuScale Power*)

5:00 pm: Ensuring Operator Reliability in Digital Control Rooms, R. Lew (*Univ of Idaho*), R. L. Boring, T. A. Ulrich (*INL*)

5:25 pm: Effects of Adaptive Automation on Operator-System Performance, John O'Hara, James Higgins (*BNL*), DaBin Ki, Stephen Fleger (*NRC*)

5:50 pm: Multi-Layered Adaptive Human-Machine Interface to Support NPP Operators, Alexey Anokhin, Alexey Chernyaev (*JSC "Rosatom Automated Control Systems"*)

Human Factors Engineering: Improving Nuclear Safety and Efficiency with Digital Controls—Panel

Session Organizer and Chair: David Hooten (*Altran*)

Location: Seacliff B **Time:** 4:30-6:30 pm

Human factors improvements can be a big part of the potential benefits for digital upgrades. The operator experience should be considered at the conceptual phase. Digital changes that have zero impact on the existing main control room human machine interface can strand many of the potential benefits of a digital upgrade. Human factors improvements considered in the concept phase provide increased safety and efficiency with well-designed operator interfaces and displays. This panel will discuss some interesting projects underway in the industry.

Panelists: Ronald Boring (*INL*), Matt Gibson (*EPRI*), Lorenzo Slay (*APS*)

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EMBEDDED TOPICAL: NPIC&HMIT | TUESDAY, JUNE 13

TECHNICAL SESSIONS - 9:35 AM

Advanced Surveillance, Diagnostics, and Prognostics —I

Chair: Todd R. Allen (*INL*)

Location: Bayview A **Time:** 9:35-11:45 am

- 9:40 am:** Determining Appropriate Data Analytics for Transformer Health Monitoring, Jose Ignacio Aizpurua, Victoria M. Catterson, Brian G. Stewart, Stephen D. J. McArthur (*Univ of Strathclyde*), Brandon Lambert, Bismark Ampofo (*Bruce Power*), Gavin Pereira, James G. Cross (*Kinectrics*)
- 10:05 am:** On-Line Monitoring Turbine Bypass System Based on Real-Time Simulation, Hang Wang, Peng Minjun, Guo Liangzhuang, Yang Xu, Li Wei (*Harbin Engineering Univ*)
- 10:30 am:** Benefits of Digitalizing and Employing Simulation to Increase Plant System Performance and Ensure Compliance with Technical Specifications, Ricardo García, Mateo Ramos (*Tecnatom*)
- 10:55 am:** 3D Advanced Gas-Cooled Nuclear Reactor Fuel Channel Reconstruction using Structure-from-Motion, Kristofer Law, Graeme West, Paul Murray (*Univ of Strathclyde*), Chris Lynch (*EDF Energy Generation*)
- 11:20 am:** Semi-Supervised Learning Approach for Crack Detection and Identification in Advanced Gas-Cooled Reactor Graphite Bricks, Craig Berry, Graeme West, Stephen McArthur (*Univ of Strathclyde*), Anna Rudge (*EDF Energy Nuclear Generation*)

Cyber Security in Digital I&C—I

Cochairs: Byungchan Han (*Yonsei Univ*), Mike Rowland (*IAEA*)

Location: Bayview B **Time:** 9:35-11:45 am

- 9:40 am:** Implications of the 2015 and 2016 Ukrainian Electric Grid Cyber Attack to Nuclear Power Plants, Joseph Weiss (*Applied Control Solutions, LLC*)
- 10:05 am:** Cyber Security Using Multi-Threaded Architecture Data Diode at the NBSR, Scott Arneson, Dağistan Şahin (*NIST*)
- 10:30 am:** Construction of a Cyber-Attack Progression Model for Nuclear Power Plants, Athi Varuttamaseni, Robert A. Bari (*BNL*), Robert Youngblood (*INL*)
- 10:55 am:** Computer Security for I&C Systems at Nuclear Facilities, Michael T. Rowland, Donald D. Dudenhoeffer, J. Scott Purvis (*IAEA*)
- 11:20 am:** Reactor Anomaly Detection Based on Extended State Observer Aided PCA, Yifei Pan, Zhe Dong, Xiaojin Huang, Yajun Zhang (*Tsinghua Univ*)*

Human Machine Interface Design and Evaluation

Session Organizer and Chair: Johanna H. Oxstrand (*INL*)

Location: Seacliff A **Time:** 9:35-11:20 am

- 9:40 am:** Operating Displays—New Concept: High Performance Displays, Luis Rejas, Isabel Parrado, Sara Fernandez, Fernando Ortega (*Tecnatom S.A.*)
- 10:05 am:** Development of Human Machine Interface (HMI) for Digital Control Rooms in Nuclear Power Plants, Antonia Nasiakou, Robert Bean, Miltiadis Alamaniotis (*Purdue Univ*)
- 10:30 am:** Development of the Delphi Display Concept for Alternative Explanations Decision Making Support, Charles Weaver, John Gwynne, Mark F. St. John (*Pacific Science & Engineering Group*)
- 10:55 am:** Integrating Human Factors Issues into Critical Portable Detection Usage, Steven M. Doettl, Patti M. Johnstone, Meredith McGhee (*Univ of Tennessee*), Franklin H. DuBoise, Jacqueline M. France (*InSolves, LLC*), Jamie B. Coble, Graham V. Walford, Laurence F. Miller (*Univ of Tennessee*)

Verification and Validation of Control Room Designs and Modifications

Session Organizer: Jari O. Laarni (*VTT Technical Research Centre of Finland*)

Chair: Paula Savioja-Kangasluoma (*STUK*)

Location: Seacliff B **Time:** 9:35-11:20 am

- 9:40 am:** Achieving Reasonable Confidence in the Validation of Control Room Designs and Modifications: A Summary of the 2015 NEA Experts' Workshop, David R. Desaulniers (*NRC*)
- 10:05 am:** Systems Usability Case in Stepwise Control Room Validation, Hanna Koskinen, Jari O. Laarni, Marja Liinasuo (*VTT Technical Research Centre of Finland*), Leena Norros (*Univ of Helsinki*), Paula Savioja (*STUK*)
- 10:30 am:** HFE in the Design of the Socio-Technical System of the Control Room of a New Generation: Issues Faced during Multi-Stage Validation, Stanislas Couix (*EdF R&D*)
- 10:55 am:** Ontology to Guide Scenario Design to Evaluate New Technologies for Control Room Modernization, Arisa Pruttianan, Nathan Lau (*Virginia Tech*), Shilo Anders, Matthew B. Weinger (*Vanderbilt Univ*)

Embedded Topical: NPIC & HMIT

EMBEDDED TOPICAL: NPIC&HMIT | TUESDAY, JUNE 13

TECHNICAL SESSIONS - 9:35 AM

General Sessions in I&C—I

Chair: Mehdi Tadjalli (*Enercon*)

Location: Seacliff C **Time:** 9:35-11:45 am

9:40 am: Preserving the Control Room Design Knowledge, Cristina Corrales, Fernando Ortega (*Tecnatom S.A.*)*

10:05 am: Development of a Utility Computer-Based Training Program on Setpoint Methodology for Nuclear Power Plants, Daniel Redden, Sr. (*Configuration Mgmt. and Eng.*), Edward L. Quinn (*Technology Resources*), Jerry Mauck (*JLM Eng and Technology Resources*), Richard Bockhorst (*Technology Resources*)

10:30 am: Development and Implementation of an In-Situ Cable Condition Monitoring Method for Nuclear Power Plants, Casey Sexton, Gary Harmon, Trevor Toll, Craig Harris (*AMS*)

10:55 am: Identification and Repair of Intermittent Cable Faults in Nuclear Power Plants, J. B. McConkey, K. M. Ryan, G. R. Harmon (*AMS*)

11:20 am: Classification and Imaging of Spent Nuclear Fuel Dry Casks Using Cosmic Ray Muons, S. Chatzidakis, P. A. Hausladen, S. Croft, J. A. Chapman, J. J. Jarrell, J. M. Scaglione (*ORNL*), C. K. Choi, L. H. Tsoukalas (*Purdue Univ*)

Digital System Reliability—I

Cochairs: Janos Eiler (*IAEA*), Carol Smidts (*Ohio State*)

Location: Seacliff D **Time:** 9:35 am-12:10 pm

9:40 am: Common Cause Failure (*CCF*): A Path to Quantitative Success, John Erinc, Steve Seaman, Jonathan Baisch (*Westinghouse*)

10:05 am: Complexity and Error Potential of Digital I&C, R. J. Heigl, A. Lindner (*TÜV Rheinland ISTec GmbH*)

10:30 am: Methodological Approach to the Sensitivity Analysis of Failure Effects in Modern Digital I&C Systems, Christian Mueller, Joerg Peschke, Evgenij Piljugin, Dagmar Sommer (*GRS*)

10:55 am: Spurious Actuations in Digital Instrumentation and Control Systems—Evaluation Framework, Ismael L. Garcia (*NRC*)

11:20 am: Analysis on Effect of Faults on Software Control Flow in a Digital System, Man Choel Kim (*Chung-Ang Univ*)*

11:45 am: Analysis and Improvement of Input Channel Selection Algorithm for Reliability of Control Systems in Nuclear Power Plants, Myunghoon Ahn, Woogoon Kim, Hyeongsoon Yim (*KEPCO E&C*)

SMR Instrumentation and Control— I

Chair: Steven A. Arndt (*NRC*)

Location: Golden Gate Room **Time:** 9:35 am-12:10 pm

9:40 am: I&C Simplification, Reliability, Diversification and the Use of FPGAs, Brian Gardes (*NuScale*), Gregg Clarkson (*Rock Creek Innovations*)*

10:05 am: Development of Thermal Transit Flow Measurement for Small Modular Reactors, E. T. Riggsbee, A. H. Hashemian, B. D. Shumaker, S. N. Tyler, P. E. Zarb (*AMS*)

10:30 am: Control System Design for a Small Pressurized Water Reactor, Peiwei Sun, Jianmin Zhang (*Xi'an Jiaotong Univ*)

10:55 am: Simulation and Control of a Passively Cooled Small Modular Reactor, Samet E. Arda, Keith E. Holbert (*Arizona State Univ*)

11:20 am: Real-Time Supervisory Control Implementation of SmAHTR Power Plant, Jacob A. Farber, Daniel G. Cole (*Univ of Pittsburgh*)

11:45 am: Model-Free Adaptive Control for MHTGR-Based Nuclear Steam Supply Systems, Zhe Dong (*Tsinghua Univ*)

Embedded Topical: NPIC & HMIT

EMBEDDED TOPICAL: NPIC&HMIT | TUESDAY, JUNE 13

TECHNICAL SESSIONS - 9:35 AM

I&C Regulations, Standards, and Guidelines—I

Chair: John Hefler (*Altran US Corp.*)

Location: Marina Room **Time:** 9:35 am-12:10 pm

9:40 am: Commercial Grade Dedication and Certification, Dinesh Taneja (*NRC*)*

10:05 am: Safety Focused Review of Instrumentation and Control Systems, Dinesh Taneja, Joseph M. Ashcraft, Luis Betancourt (*NRC*)*

10:30 am: Development of an Update to ISA S67.04 and RP 67.04 “Setpoints for Nuclear Safety-Related Instrumentation for Nuclear Power Plants, Wayne Marquino (*GEH*), Ron. Jarrett (*TVA*), Kirklyn Melson (*EXCEL*), Edward L. Quinn (*Technology Resources*), David Rahn (*NRC*)

10:55 am: Development of a New IEC Standard for HDL-Programmed Devices Performing Category B or C Functions, Alexander Wigg, Ludovic Pietre-Cambacedes, Frédéric Dumas, François Cheriaux, Rémy Delhomme (*EdF*)

11:20 am: A Qualitative Assessment of Current CCF Guidance Based on a Review of Safety System Digital Implementation Changes with Evolving Technology, Kofi Korsah, Michael Muhlheim (*ORNL*), Richard Wood (*Univ of Tennessee*)

11:45 am: IEEE Std. 1012 and NEI 96-07, Appendix D—Strange Bedfellows? David Hooten (*Altran*)

TECHNICAL SESSIONS - 1:00 PM

Electromagnetic Compatibility (EMC) and EMI/RFI Issues

Chair: Weilin Jiang (*Western Univ*)

Location: Bayview A **Time:** 1:00-2:45 pm

1:05 pm: Electromagnetic Compatibility Qualification of Power Electronics for I&C Power Applications, Zachary Crane, Chad Kiger, Jacob Woods, Bradley Headrick (*AMS*)

1:30 pm: Implementation of Wireless Technologies in Nuclear Power Plant's Electromagnetic Environment using Cognitive Radio System, Chris L. Lowe, Chad J. Kiger, David N. Jackson, David M. Young (*AMS*)

1:55 pm: Technical Basis for Revision of Regulatory Guide 1.180, “Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems”, David Dawood (*NRC*), Richard T. Wood (*Univ of Tennessee*)*

2:20 pm: Radiation Hardened RF Transceiver for In-Containment Environment Applications Using Commercial Off the Shelf Components, Shawn C. Stafford, Jorge V. Carvajal, Jonathan E. Baisch (*Westinghouse*)

Cyber Security in Digital I&C—II

Chair: Poong Hyun Seong (*KAIST*)

Location: Bayview B **Time:** 1:00-3:50 pm

1:05 pm: Security-Informed Safety: Integrating Security within the Safety Demonstration of a Smart Device, Robin Bloomfield (*Adelard/City Univ of London*), Eoin Butler, Sofia Guerra, (*Adelard LLP*), Kate Netkachova (*Adelard LLP/City Univ of London*)

1:30 pm: Development of a New IEC Standard on Cybersecurity Controls for I&C in Nuclear Power Plants—IEC 63096, Juergen Bochtler (*Siemens*), Edward L. Quinn (*Technology Resources*), Edita Bajramovic (*AREVA*)

1:55 pm: Secure Environment Establishment for FPGA-Based Safety-Critical Systems: Quality Management System Context, Vyacheslav Kharchenko, Andriy Kovalenko (*Centre for Safety Infrastructure-Oriented Research and Analysis*), Ievgen Brezhniev (*RadICS LLC*), Kostyantyn Leontiev (*Research and Production Corporation Rادی*)

2:20 pm: IEC 62859: A New International Standard on the Coordination Between Safety and Cybersecurity for Nuclear I&C Systems, Ludovic Pietre-Cambacedes (*EdF*), Edward L. Quinn (*Technology Resources*)

3:00 pm: A New International Standard on Cybersecurity for Nuclear Power Plants: IEC 62645—Cybersecurity Requirements, Edward L. Quinn (*Technology Resources*), Ludovic Pietre-Cambacedes (*EdF*), Thomas Walter (*PreussenElectra GmbH*)

3:25 pm: Dynamic Attack Surfaces in Nuclear Power Plants, Christopher C. Lamb, Lon A. Dawson (*SNL*)

EMBEDDED TOPICAL: NPIC&HMIT | TUESDAY, JUNE 13

TECHNICAL SESSIONS - 1:00 PM

Human Performance and Lessons-Learned in Beyond-Design-Basis and Extreme Conditions

Session Organizer: Alice Salway (*CNSC*)

Chair: David R. Desaulniers (*NRC*)

Location: Seacliff A **Time:** 1:00-2:45 pm

- 1:05 pm:** Analysing Lessons Learned from Experience as Part of a Project to Prepare/Train Teams to Manage Potentially Stressful Crisis Situations, Violaine Bringaud, Cecilia De La Garza, Stéphanie Pelletier (*EdF*)
- 1:30 pm:** Enhancing Workload Assessments for Validation Activities Associated with DBA and BDBA Scenarios, Aaron Derouin, Alice Salway (*Canadian Nucl Safety Comm*)
- 1:55 pm:** Supporting Resilience in Nuclear Power Plant Operation—Conceptual Frames for Human Factors Development and Validation, M. Wahlström, T. Kuula, J. Laarni (*VTT Technical Research Centre of Finland*)
- 2:20 pm:** Sharing Human and Organizational Factors Lesson-Learned from the Implementation of Post-Fukushima Actions: An NEA Initiative Supporting Enhancement of Mitigation Capabilities for Extreme Events, David R. Desaulniers (*NRC*)*

Human Reliability Applications for Improving Understanding and Performance in Plant Operations

Session Organizer and Chair: Ronald L. Boring (*INL*)

Location: Seacliff A **Time:** 3:00-4:45 pm

- 3:05 pm:** Procedure Design of F&B Operation and Its Impact on the Risk of a Nuclear Power Plant, Wondea Jung (*KAERI*)
- 3:30 pm:** Utilizing the SACADA System to Collect Simulator Training Data to Inform Human Reliability Analyses, Aaron Bly, Shawn St. Germain (*INL*), Y. James Chang (*NRC*)
- 3:55 pm:** Study on the Assessment Method for Human Error Probabilities in the Digitalized Main Control Room, Ar Ryum Kim, Ji Tae Kim (*KINS*), Young Ho Chae, PoongHyun Seong (*KAIST*), Inseok Jang (*KAERI*)
- 4:20 pm:** Design and Implementation of HuREX Analysis Supporting Interface, Seunghwan Kim, Yochan Kim, Sunyeong Choi, Jinkyun Park, Wondea Jung (*KAERI*)

V & V Methods and Applications for Control Room Designs

Session Organizer: Jari O. Laarni (*VTT Technical Research Centre of Finland*)

Chair: Hanna Koskinen (*VTT Technical Research Centre of Finland*)

Location: Seacliff B **Time:** 1:00-2:20 pm

- 1:05 pm:** The Human Factors Verification at Plant Startup for the First AP1000 Plant, Zhonghai Li, Julie I. Reed (*Westinghouse*)
- 1:30 pm:** The Overview in Safety Review of Human Factors Engineering and Control Room Design in Chinese AP1000 Nuclear Power Plant, Yan Feng (*Ministry of Environmental Protection of the People's Republic of China*)
- 1:55 pm:** A Structured Data Model Frame for Human Factors Application, Cristina Corrales, Marta Martinez, Fernando Ortega (*Tecnatom S.A.*)

Case Studies of HFE Program Implementations

Session Organizer: Dina Notte (*ERGODIN*)

Chair: Paula Savioja-Kangasluoma (*STUK*)

Location: Seacliff B **Time:** 2:25-3:20 pm

- 2:30 pm:** Human Factors Case Study: An Iterative Approach to Verifying and Validating a New Suite of Reactor Inspection and Maintenance Tooling, Charlene Gillis, Cam Ngo (*Candesco*), Emily Ferreria (*Bruce Power*)
- 2:55 pm:** Optimization of Human Factors Methods within the Design Cycle, Krista Nicholson, Jessica Phyland, Angela Vieira (*Amec Foster Wheeler Nuclear Canada*), Kristianne San Diego (*OPG*)

Embedded Topical: NPIC & HMIT

EMBEDDED TOPICAL: NPIC&HMIT | TUESDAY, JUNE 13

TECHNICAL SESSIONS - 1:00 PM

Embedded Topical: NPIC & HMIT

The Future of I&C: Compelling I&C Projects Lead by Young Engineers—Panel

Chair: Cindy Perez (*SNOP*)

Location: Seacliff C **Time:** 1:00-4:15 pm

This session will be an industry panel of young I&C engineers. This panel will have five I&C engineers to present compelling new projects in I&C at their utilities and/or laboratories. This session will be a showcase for our young engineering talent, their background in I&C projects, and what their motivation to work in I&C has been. This panel is an opportunity to provide these professionals with a valuable experience and an opportunity to meet the ANS community, while discussing captivating experiences with I&C projects in the industry. This is our future, the new faces of I&C.

Panelists: Cindy Perez (*SNOP*), Vivek Agarwal (*INL*), Lorenzo Slay (*APS*), Alexander Melin (*ORNL*), Rufino Ayala (*Rock Creek Technologies*)

Nuclear Energy R&D in I&C Areas

Chair: Craig Barnes (*Univ of Tennessee*)

Location: Seacliff D **Time:** 1:00-3:50 pm

- 1:05 pm:** Demonstrating and Arguing Safety of I&C Systems—Challenges and Recent Experiences, Janne Valkonen, Teemu Tommila, Joonas Linnosmaa (*VTT Technical Research Centre of Finland Ltd*), Peter Karpati, Vikash Katta (*OECD Halden Reactor Project*)
- 1:30 pm:** Power Control System Modification and Simulation of CPR1000, Xinyu Wei (*Xi'an Jiaotong Univ*), Li Wang (*Sun Yat-sen Univ*), Fuyu Zhao (*Xi'an Jiaotong Univ*)
- 1:55 pm:** Primary Coolant Flow Measurement for Integral Pressurized Water Reactors Using Ultrasonic Technique, Matthew R. Lish, Brooke A. McMurrer, Belle R. Upadhyaya, J. Wesley Hines (*Univ of Tennessee*)
- 2:20 pm:** Overview of Simulation and Control Tools for Extended Operability of Nuclear Reactors, R. Ponciroli, S. Passerini, R. B. Vilim (*ANL*)
- 3:00 pm:** Model-Based Verification of I&C Specifications, Maxime Neyret, Thibault Lemattre, Gaëtan Robin (*EdF*)
- 3:25 pm:** Reduced Order Methods for the Improvement of Control-Oriented Modelling of Nuclear Power Plants, Stefano Lorenzi, Antonio Cammi, Lelio Luzzi (*Politecnico di Milano*), Gianluigi Rozza (*SISSA*)

SMR Instrumentation & Control—II

Cochairs: Joe Naser (*retired, EPRI*), Charles McCarthy (*NGC*)

Location: Golden Gate Room **Time:** 1:00-4:15 pm

- 1:05 pm:** Analysis of a Nuclear Hybrid Energy System Using Absorption Chillers and Stratified Chilled-Water Storage with an mPower Reactor, Corey T. Misenheimer, Stephen Terry, J. Michael Doster (*NCSU*), Shannon Bragg-Sitton (*INL*)
- 1:30 pm:** Control Strategies for Coupling Thermal Energy Storage Systems with Small Modular Reactors, Konor Frick, J. Michael Doster (*NCSU*), Shannon M. Bragg-Sitton (*INL*)
- 1:55 pm:** The Study on Overall I&C System Scheme for Floating Nuclear Power Plant ACP100S and ACP25S, Chen Zhi, Liao Long-tao, Song Dan-rong, You Kai (*Nuclear Power Inst of China*)
- 2:20 pm:** An Intelligent Identification of the SMR's Reactor Power Control Process Based on Fuzzy Inference Model with Growing and Pruning Rules, Longtao Liao, Zhi Chen, You Kai (*Nuclear Power Inst of China*)*
- 3:00 pm:** Multi-Modular Coordination Control of HTR-PM600 Plant, Maoxuan Song, Zhe Dong, Xiaojin Huang, Zuoyi Zhang, Zongxin Wu (*Tsinghua Univ*)
- 3:25 pm:** Emerging and Existing Sensing Technologies for Small Modular Reactors and Advanced Reactors, A. H. Hashemian, T. A. Toll, H. M. Hashemian (*AMS*)
- 3:50 pm:** Power Peaking with Small Modular Reactors to Support Deep Penetration of Renewable Energy Sources, Richard Bisson, Jamie Coble, Kevin Tomsovic (*Univ of Tennessee*)

EMBEDDED TOPICAL: NPIC&HMIT | TUESDAY, JUNE 13

TECHNICAL SESSIONS - 4:30 PM

Advanced Surveillance, Diagnostics, and Prognostics—II

Chair: Jinan Yang (*ORNL*)

Location: Bayview A **Time:** 4:30-6:40 pm

- 4:35 pm:** Online Monitoring of Rod Control Systems in Combustion Engineering Pressurized Water Reactors, C. M. Fox, J. R. Gates (*APS*), S. D. Caylor, D. E. McCarter, G. W. Morton, H. M. Hashemian (*AMS*)
- 5:00 pm:** The Design of Frequency Spectrum Analysis System for Reactor Based on Nuclear Noise, Herong Zeng, Baoxin Yuan, Shilin Duan (*China Academy of Eng Physics*)*
- 5:25 pm:** Fault Diagnosis and Severity Estimation in Nuclear Power Plants, Maopu Wu, Yongkuo Liu, Zhibin Wen, Minjun Peng, Hang Wang (*Harbin Eng Univ*), Ayodeji Abiodun (*Harbin Eng. Univ/Nigeria Atomic Energy Commission*), Hong Xia, Weifeng Yu (*Harbin Eng. Univ*)
- 5:50 pm:** Virtual Sensors for Robust On-Line Monitoring (*OLM*) and Diagnostics, Ramakrishna Tipireddy, Megan Lerchen, Pradeep Ramuhalli (*PNNL*)
- 6:15 pm:** Control Systems for a Dynamic Multi-Physics Model of a Nuclear Hybrid Energy System. M. Scott Greenwood, David L. Fugate, M. Sacit Cetiner (*ORNL*)

Robotics for Maintenance of Advanced Reactors—Panel

Cochairs: Joe Kowalczyk (*Southern Co.*), Joseph Naser (*retired, EPRI*)

Location: Bayview B **Time:** 4:30-6:30 pm

This panel will bring together subject matter experts to discuss the requirements for automated maintenance activities for advanced reactors. Enabling technologies that will help achieve the objectives will be reviewed, including robotics and radiation-hardened electronics.

Panelists: Jake Dewitt (*Oklo*), Jonathan Hurst (*Agility Robotics*), Chuck Britton (*ORNL*), Masato Iehara (*MHI America*)

Virtual Reality, Augmented Reality, and Alarms

Session Organizer and Chair: Jacques V. Hugo (*INL*)

Location: Seacliff A **Time:** 4:50-6:35 pm

- 4:55 pm:** Augmented Reality System for Remote Operation, Young Soo Park, Jia Luo, Pawel Dworzanski (*ANL*), Joohee Kim (*IIT*), Byung-Seon Choi (*KAERI*)
- 5:20 pm:** A New APDS Approach—Alarm Processing Based on Alarm Prioritization, Cristina Corrales, Alberto Fuentes, Fernando Ortega (*Tecnatom SA*)
- 5:45 pm:** Unstated Assumptions in Alarm Management, David Strobhar (*Beville Eng*), invited
- 6:10 pm:** Use of Immersive 3D Virtual Reality Environments in Control Room Validations, Joakim Bergroth (*Fortum Power and Heat*), Hanna Koskinen, Jari O. Laarni (*VTT Technical Research Centre of Finland*)

Experience with NUREG-0711 Rev 3—Panel

Session Organizers: Stephen A. Flege (*NRC*), Brian D. Green (*NRC*)

Chair: Stephen A. Fleger (*NRC*)

Location: Seacliff B **Time:** 4:30-6:30 pm

NUREG-0711 is a design process assessment document that is used by the U.S. Nuclear Regulatory Commission to evaluate the human factors engineering (HFE) programs of applicants for standard nuclear power plant (NPP) design certifications. The purpose of these reviews is to verify that the HFE aspects of NPP's are developed, designed, and evaluated via a structured analysis founded on HFE principles that are acceptable to the NRC staff. Revision 3 of the NUREG has been in use now for over four years. A panel of nuclear power plant HFE experts representing vendors, government laboratories, consultants, and research institutions will discuss their lessons-learned and experiences, in utilizing the guidance found in Revision 3 of NUREG-0711.

Panelists: Ronald Boring (*INL*), Per Øivind Braarud (*Halden Reactor Project*), Bob Fuld (*Westinghouse*), Brian D. Green (*NRC*), Douglas Hill (*Hill Engineering Consultants, GmbH for Excelsior Design LLC*)

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EMBEDDED TOPICAL: NPIC&HMIT | TUESDAY, JUNE 13

TECHNICAL SESSIONS - 4:30 PM

Modeling Digital I&C Systems in PRA/PSA

Cochairs: Rob Austin (*EPRI*), Poong Hyun Seong (*KAIST*)

Location: Seacliff C **Time:** 4:30-6:40 pm

- 4:35 pm:** Probabilistic Risk Evaluation of Cyber-Attacks on a Nuclear Power Plant Safety, Jong Woo Park, Seung Jun Lee (*UNIST*)
- 5:00 pm:** Risk Assessment of Safety-Critical Data Communication in Digital Safety Feature Control System, Sang Hun Lee, Hyun Gook Kang (*RPI*), Won Dae Jung, Kwang Seop Son (*KAERI*)
- 5:25 pm:** Development of a Bayesian Belief Network Model for the Software Reliability Assessment of Nuclear Digital I&C Safety Systems, Hyun Gook Kang, Sang Hun Lee (*RPI*), Seung Jun Lee (*UNIST*), Tsong-Lun Chu, Athi Varuttamaseni, Meng Yue (*BNL*), Steve Yang (*NUV Technology LLC*), Heung Seop Eom, Jaehyun Cho (*KAERI*), Ming Li (*NRC*)
- 5:50 pm:** Application of a Bayesian Belief Network Model to Reliability Assessment of Nuclear Safety-Related Software, Seung Jun Lee (*UNIST*), Sang Hun Lee, Hyun Gook Kang (*RPI*), Tsong-Lun Chu, Athi Varuttamaseni, Meng Yue (*BNL*), Heung Seop Eom, Jaehyun Cho (*KAERI*), Ming Li (*NRC*)
- 6:10 pm:** Assessment of Dynamic PRA Techniques with Industry-Average Component Performance Data, Vaibhav Yadav, Vivek Agarwal, Andrei Gribok, Curtis L. Smith (*INL*)

Light Water Reactor Sustainability (LWRS)

Chair: John Wagner (*INL*)

Location: Seacliff D **Time:** 4:30-5:50 pm

- 4:35 pm:** Accelerated Thermal Aging of Harvested Hypalon Jacket for Remaining Useful Life Determination and Diagnosis, Robert C. Duckworth, Michelle K. Kidder, Tolga Aytug (*ORNL*), Leonard S. Fifield, William Glass III (*PNNL*), Sarah Davis (*Univ of Tennessee*)
- 5:00 pm:** Providing Plant Data Analytics Through a Seamless Digital Environment, Aaron Bly, Johanna H. Oxstrand (*INL*)
- 5:25 pm:** Concrete Structural Health Monitoring in Nuclear Power Plants, Vivek Agarwal (*INL*), Kyle D. Neal, Sankaran Mahadevan, Douglas Adams (*Vanderbilt Univ*)

Research Reactor I&C

Chair: Chad Kiger (*AMS*)

Location: Golden Gate Room **Time:** 4:30-6:10 pm

- 4:35 pm:** Managing Systematic Errors in the NBSR Thermal Power Calorimetric Measurements, Dağistan Şahin, Samuel J. MacDavid (*NIST*)
- 5:00 pm:** NBSR Reactor Control Room Upgrade, Dağistan Şahin (*NIST*)
- 5:25 pm:** Design and Implementation of Safety Channels for the Idaho State University AGN-201m Research Reactor Control Console, Maxwell J. Daniels (*Idaho State Univ*)
- 5:50 pm:** Purdue University Research Reactor (PUR-1) Reactor Protection and Control System Replacement, Robert C. Ammon (*Curtiss Wright Nuclear Group/Scientech*), Clive Herbert Townsend (*Purdue Univ*), Roy E. Ray (*Mirion Technologies*)*

Think Smart Think Digital: Delivering the Nuclear Promise through Digital I&C—Panel (Dedicated to the Memory of Jerry Voss)

Chair: Pareez Golub (*EXCEL Services, Inc.*)

Location: Marina Room **Time:** 4:30-6:30 pm

There are a lot of misconceptions, myths, and fear surrounding digital projects. With the pressures to reduce costs, there is a need to do more with less. The single largest cost driver is the cost of manpower, the second being equipment replacement. Digital components require less periodic maintenance, and are more reliable and digital controls reduce wear and tear on controlled components. The reduction in maintenance and replacement costs results in big savings and ultimately a smaller, more agile workforce. Come and see examples showcasing where digital technology has increased reliability, increased power, reduced manpower, reduced outage time, and contributed to long term reliability of large investment assets.

Panelists: Neil Archambo (*Duke*), John Connelly (*Exelon*), Ray Herb (*SNC*), Lorenzo Slay (*APS*)

EMBEDDED TOPICAL: NPIC&HMIT | WEDNESDAY, JUNE 14

TECHNICAL SESSIONS - 9:35 AM

Near-Term Improvements to the Digital I&C Regulatory Infrastructure—Panel

Chair: Michael D. Waters (*NRC*)

Location: Grand Ballroom A **Time:** 9:35-11:40 am

The NRC and industry stakeholders have identified the need to modernize the regulatory infrastructure and remove any unnecessary impediments to the use of digital technology for nuclear safety applications. In October 2016, the Commission approved the Digital I&C “Integrated Action Plan” (IAP) via SRM-SECY-16-0070 with the objective of modernizing the digital I&C regulatory infrastructure. In coordination with stakeholders, the NRC staff have identified four key topics that would have the greatest near-term impact in addressing regulatory challenges and improving timeliness, efficiency, and effectiveness. These topics include improving regulatory guidance for addressing common cause failures in digital systems, improving regulatory guidance for digital I&C modifications evaluated under 10 CFR 50.59, the process of commercial grade dedication of digital equipment, and improving guidance for digital I&C license amendment requests at operating plants.

This panel will discuss how the NRC and industry efforts will improve the regulatory infrastructure in the near term, and how these improvements will result in a state in which the nuclear power industry can obtain regulatory approval in an effective and predictable manner for different technologies and continue to maintain adequate safety. The panel will also discuss potential efficiencies from technology neutral regulatory processes to enhance regulatory certainty.

Panelists: David Rahn (*NRC*), Vic Fregonese (*NEI*), Ray Herb (*Southern Nuclear*), Hash Hashemian (*AMS*)

Advanced Surveillance, Diagnostics, and Prognostics—III

Chair: Assel Aitkaliyeva (*Areva*)

Location: Bayview A **Time:** 9:35-11:20 am

9:40 am: Implementation of New PRODIAG Algorithm and Simulation-Based Acceptance Test, Young Soo Park, Richard B. Vilim (*ANL*)

10:05 am: Data-Driven Analysis of Pressure Tubes Ultrasonic Inspection Data, P. Zacharis, G. M. West, G. Dobie, T. Lardner, A. Gachagan (*Univ of Strathclyde*)

10:30 am: An Expert-Systems Approach to Automatically Determining Flaw Depth within CANDU Pressure Tubes, T. Lardner, G. M. West, G. Dobie, A. Gachagan (*Univ of Strathclyde*)

10:55 am: Condition Monitoring and False Alarm Reducing of Sensors in NPP, Li Wei, Minjun Peng, Yonkkuo Liu, Hong Xia (*Harbin Eng Univ*)

Cyber Security in Digital I&C—III

Cochairs: Poong Hyun Seong (*KAIST*), Brian Gardes (*NuScale*)

Location: Bayview B **Time:** 9:35-11:20 am

9:40 am: Methodology on Cyber Security Evaluation in Nuclear Facilities Considering I&C Architecture, Jinsoo Shin, Gyunyoung Heo, (*Kyung Hee Univ*), Hanseong Son (*Joongbu Univ*)

10:05 am: Identification of the Accident-Related Critical Digital Assets based on Probabilistic Safety Analysis Results, Moon Kyoung Choi, Poong Hyun Seong (*KAIST*), Han Seong Son (*Joongbu Univ*)

10:30 am: Development of Cyber Security Test Scenario for Non-Safety Display System, Hee Eun Kim (*KAIST*), Han-Seong Son (*Joongbu Univ*), Jonghyun Kim (*Chosun Univ*), Hyun Gook Kang (*RPI*)

10:55 am: Computer Security Approach for Rolls-Royce SPINLINE® Safety Platform, Julien Bach, Arnaud Duthou, Pierre Monteil (*Rolls-Royce Civil Nuclear*), Mark Burzynski (*Rolls-Royce Instrumentation & Controls*)

Human Factors Engineering Programs, Standards, and Guidance Initiatives

Session Organizer: Gwendolin Holzner (*Hill Engineering Consults GmbH*),

Chair: Brian Green (*NRC*)

Location: Seacliff A **Time:** 9:35-11:20 am

9:40 am: The NEA Division of Human Aspects of Nuclear Safety, Yeonhee Hah (*OECD NEA*)*

10:05 am: Development of NUREG-0700, Rev 3, Stephen Flegler (*NRC*), John O'Hara, James Higgins (*BNL*)

10:30 am: An Overview of IEEE Human Factors Standard Development Activities—2017, Stephen Flegler, David R. Desaulniers (*NRC*)

10:55 am: EPRI Human Factors Engineering Research Update, Matt Gibson (*EPRI*), invited*

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EMBEDDED TOPICAL: NPIC&HMIT | WEDNESDAY, JUNE 14

TECHNICAL SESSIONS - 9:35 AM

Computerized Procedure Systems

Session Organizer and Chair: Johanna H. Oxstrand (*INL*)

Location: Seacliff B **Time:** 9:35-11:45 am

- 9:40 am:** Computerized Procedure Systems: Procedure Edition and Maintenance Challenges, Sara Fernandez, Andrés Vallés, Fernando Ortega (*Tecnatom S.A.*)
- 10:05 am:** Computer-Based Human-Machine Interfaces for Emergency Operation, M. H. R. Eitheim, H. Svengren, A. Fernandes (*OECD Halden Reactor Project*)
- 10:30 am:** Application of HFE to the Design and V&V of a Computerized Procedure System: Benefits and Challenges, Sara Fernandez, Cristina Corrales, Fernando Ortega (*Tecnatom S.A.*)
- 10:55 am:** The Effect of Support Functions in a Computerized Procedure System on Interface Management Tasks, Hyung Jun Kim, Seung Jun Lee (*UNIST*), Wondea Jung (*KAERI*)
- 11:20 am:** Implementing Computer-Based Procedures: Thinking Outside the Paper Margins, Aaron Bly, Johanna Oxstrand (*INL*)

Advanced Sensors and Measurement Technologies—I

Cochairs: Zander Mausolff (*Univ of Florida*), Mikhail Yastrebenetsky (*Karkov National Polytechnic Univ*)

Location: Seacliff C **Time:** 9:35-11:20 am

- 9:40 am:** Radiation Hardened Successive-Approximation ADC with Error Detection Circuits, Inyong Kwon, Chang Hwoi Kim (*KAERI*), Yongseok Lee, Jung-Yeol Yeom (*Korea Univ*)
- 10:05 am:** Test Facility for Fission Chamber Assemblies, V. A. Fedorov, E. S. Martazov, N. A. Selyaev, Yu. A. Paryshkin (*National Research Nuclear Univ "MEPhI"*), S.Yu. Obudovskii, A. V. Batyunin, V. A. Vorobyev, Yu. A. Kashchuk (*Institution "Project Center ITER"*)
- 10:30 am:** Equipment for Subcriticality Monitoring by Pulse Method, A. V. Kudryavtsev, E. S. Martazov, Yu. A. Paryshkin, V. A. Fedorov (*National Research Nuclear Univ «MEPHI»*)
- 10:55 am:** A New Probe Concept for Internal Pipework Inspection, Rahul Summan, Neha Mathur, Gordon Dobie, Graeme West, Stephen Marshall, Charles Macleod, Carmelo Mineo, Gareth Pierce (*Univ of Strathclyde*)

General Sessions in I&C—II

Chair: Pradeep Ramuhalli (*PNNL*)

Location: Seacliff D **Time:** 9:35-11:45 am

- 9:40 am:** Modelling I&C Systems with Relays for Simulation, Adapting CIM Standards, Aurélie Dehouck, Anne-Sophie Hintzy, Cécile Reboul-Salze, Rachid Hamadi (*EdF*)
- 10:05 am:** Formalization of the Functional Analysis Methodology to Improve NPP I&C System Design Process, Alexey Chernyaev, Alexey Anokhin (*JSC "Rusatom Automated Control Systems"*)
- 10:30 am:** Improving the Cross Correlation Method of Indirect Flow Measurement by Water Injection and Modeling, Xiong Gao, Alexander C. Hines, Jamie B. Coble, J. Wesley Hines, Belle R. Upadhyaya (*Univ of Tennessee*)
- 10:55 am:** Krsko Emergency Control Room Upgrade, Dennis James Milsom, Robert Michael Queenan (*Curtiss-Wright/Scientech*)*
- 11:20 am:** Qualified Display System Architecture, Glenn E. Lang, Keith Harvey, Craig Pfladderer, Patricia L. Barnes, Micah Drake, Dan Ho, Thomas Hunter (*Lockheed Martin Corp./Lockheed Martin Energy*)

EMBEDDED TOPICAL: NPIC&HMIT | WEDNESDAY, JUNE 14

TECHNICAL SESSIONS - 9:35 AM

I&C for Advanced Reactors

Chair: Fiona Rayment (*NNL*)

Location: Golden Gate Room **Time:** 9:35-11:20 am

9:40 am: A Large Scale System Approach for Stability Analysis of Multi-Unit SMR Plants, Christopher J. D'Angelo, Daniel G. Cole (*Univ of Pittsburgh*), John Collinger (*BAPL*)

10:05 am: Temperature Compensated Transfer Function for Probability of Detection (*POD*) in High Temperature Ultrasonic NDE using Low Temperature Signals, Prathamesh N. Bilgunde, Leonard J. Bond (*Iowa State Univ*)

10:30 am: Assessment of Sensor Technologies for Advanced Reactors, Kofi Korsah, R. A. Kisner, C. L. Britton, Jr. (*ORNL*), Pradeep Ramuhalli, D. W. Wootan, N. C. Anheier, Jr., A. A. Diaz, E. H. Hirt (*PNNL*), Richard B. Vilim, H. T. Chien, S. Bakhtiari, S. Sheen, S. Gopalsami, A. Heifetz, S. W. Tam, Y. Park (*ANL*), Belle R. Upadhyaya, Austin Stanford (*Univ of Tennessee*)

10:55 am: Operational Performance Risk Assessment in Support of a Supervisory Control System, A. Guler, M. Mulheim, S. Cetiner (*ORNL*), R. Denning (*Research Consultant*)

TECHNICAL SESSIONS - 1:00 PM

Next Generation I&C Systems

Chair: Joan Arimescu (*Areva*)

Location: Bayview A **Time:** 1:00-2:45 pm

1:05 pm: Real-Time Fault Detection and Transient Identification Using Extended Kalman Filters, Jason G. Pickel, Daniel G. Cole (*Univ of Pittsburgh*)

1:30 pm: Applications of Data Mining Technology to Enhance O&M: Automatic Planning of Electrical Isolation with Deep Learning, Susumu Naito, Kei Takakura, Hidehiko Kuroda, Hiroki Shiba (*Toshiba*)

1:55 pm: Task Allocation in Geo-Distributed Cyber-Physical Systems, Rachit Aggarwal, Carol Smidts (*Ohio State*)

2:20 pm: Investigation of Instrumentation Containing an Embedded Digital Device, T. Jacobi, D. Floyd, R. Wood (*Univ of Tennessee*), A. Hashemian, H. M. Hashemian, B. Shumaker (*AMS*)

U.S. Department of Energy Advanced Sensors and Instrumentation Research–Panel

Cochairs: Suibel Schuppner (*DOE*), Bruce Hallbert (*INL*)

Location: Bayview B **Time:** 1:00-4:40 pm

1:05 pm: Enhanced Micro-Pocket Fission Detector for High Temperature Reactor Evaluations, Troy Unruh (*INL*), Michael Reichenberger, Sarah Stevenson, Douglas McGregor (*Kansas State Univ*), Kevin Tsai (*Idaho State Univ*), Jean Francois Villard (*CEA*)

1:30 pm: High Spatial Resolution Distributed Fiber-Optic Sensor Networks for Reactors and Fuel Cycle Systems
Kevin P. Chen (*Univ of Pittsburgh*)*

1:55 pm: Robust Online Monitoring for Calibration Assessment of Transmitters and Instrumentation, P. Ramuhalli, R. Tipireddy, M. Lerchen (*PNNL*), B. Shumaker (*AMS*), J. Coble, A. Nair, S. Boring (*Univ of Tennessee, Knoxville*)

2:20 pm: Design and Analysis of Embedded I&C for Loop-Scale Magnetically Suspended Pump, Alexander M. Melin, Roger A. Kisner (*ORNL*), invited

3:00 pm: Nanostructured Thermoelectric Generators for Self-Powered Wireless Sensors for Nuclear Power Plant, Yanliang Zhang (*Boise State Univ*)*

3:25 pm: Computerized Operator Support System and Human Performance in the Control Room, R. Vilim, A. Grelle (*ANL*), R. Lew, T. Ulrich (*Univ of Idaho*), R. Boring, K. Thomas (*INL*)

3:50 pm: Nuclear Qualification Demonstration of a Cost Effective Common Cause Failure Mitigation in Embedded Digital Devices, Matt Gibson (*EPR1*)*

4:15 pm: Development of a Model Based Assessment Process for Qualification of Embedded Digital Devices in NPP Applications: Research Approach and Current Status, Richard Wood (*Univ of Tennessee*), H. M. Hashemian, Brent Shumaker (*AMS*), Carol Smidts (*Ohio State Univ*), Carl Elks (*Virginia Commonwealth Univ*)

Embedded Topical: NPIC & HMIT

EMBEDDED TOPICAL: NPIC&HMIT | WEDNESDAY, JUNE 14

TECHNICAL SESSIONS - 1:00 PM

Measures—I: Operator and Team Performance

Session Organizer: Nathan Ka Ching Lau (*Virginia Tech*)

Chair: P.O. Braarud (*IFE*)

Location: Seacliff A **Time:** 1:00-2:45 pm

1:05 pm: Human Performance Measures for the Evaluation of Nuclear Power Plant Control Room Interfaces: A Systematic Review, Jie Xu, Shilo Anders (*Vanderbilt Univ*), Arisa Pruttianan (*Virginia Tech*), Daniel J. France (*Vanderbilt Univ*), Nathan Lau (*Virginia Tech*), Julie A. Adams (*Oregon State Univ*), Matthew B. Weinger (*Vanderbilt Univ*)

1:30 pm: Experimental Study on Team Coordination of NPP Plant Operators based on the Simultaneous NIRS Measurements, Makoto Takahashi, Fumiyasu Shirai, Ryuta Kawashima (*Tohoku Univ*), Kazukiyo Ueda (*BWR Operator Training Center Cooperation*)

1:55 pm: Evaluating Situation Awareness in the Control Room: The Development and Initial Testing of the Process Awareness and Situation Understanding (PASU) Measure, Per Oivind Braarud (*OECD Halden Reactor Project*)

Measures—II: Data Collection Methods and Challenges

Session Organizer: Nathan Ka Ching Lau (*Virginia Tech*)

Chair: Maren Ro Eitrheim (*OECD Halden Reactor Project*)

Location: Seacliff A **Time:** 3:05-4:25 pm

3:10 pm: Technical Constraints to Conducting Operator Studies in a Reconfigurable Control Room Simulator, Brandon Rice (*INL*)

3:35 pm: A Summary Comparison of Design Evaluation Techniques, Zachary Spielman, Rachael Hill (*INL*)

4:00 pm: A Novel Tool for Improving the Data Collection Process during Control Room Modernization Human-System Interface Testing and Evaluation Activities, C. Kovesdi, J. Joe (*INL*)

Computer-Based Tools for Improving Operator and Plant Performance—I

Session Organizer: Johanna H. Oxstrand (*INL*)

Chair: Katya Le Blanc (*INL*)

Location: Seacliff B **Time:** 1:00-2:20 pm

1:05 pm: Development of Utility Generic Functional Requirements for Electronic Work Packages and Computer-Based Procedures, Johanna Oxstrand (*INL*)

1:30 pm: Supporting the Industry by Developing a Design Guidance for Computer-Based Procedures for Field Workers, Johanna Oxstrand, Katya Le Blanc (*INL*)

1:55 pm: Automated Work Package: Capabilities of the Future, Ahmad Al-Rashdan, Johanna Oxstrand, Vivek Agarwal (*INL*)

Computer-Based Tools for Improving Operator and Plant Performance—II

Session Organizer: Johanna H. Oxstrand (*INL*)

Chair: Jacques Hugo (*INL*)

Location: Seacliff B **Time:** 3:05-4:25 pm

3:10 pm: Developmental Study of Advanced HIS Design Method for Digital I&C+HMIT of PWR Plant, Hidekazu Yoshikawa (*Harbin Eng Univ*)

3:55 pm: Human Factors Principles in Information Dashboard Design, Jacques V. Hugo, Shawn St. Germain (*INL*)

4:00 pm: Design and Implementation of Wearable Devices in Machine Tools Monitoring System, Yao-Hsien Huang (*Shih Chien Univ*), Tsung-Chieh Cheng (*INER*), Yuan-Yu Tsai (*Asia Univ*)

I&C Research Plans and Activities by Leading Organizations—Panel

Chair: Ian Jung (*NRC*)

Location: Seacliff C **Time:** 1:00-4:15 pm

This panel will present a high-level, comprehensive overview of ongoing research activities and future research panels by leading research organizations (NRC, DOE, and EPRI). Panel participants will present major themes, objectives, and desired outcomes that their stakeholders wish to address. This panel will help identify areas of mutual interest for follow-up discussions or future collaborations.

Panelists: Ian Jung (*NRC*), Suibel Schuppner (*DOE*), Robert Austin III (*EPRI*)

EMBEDDED TOPICAL: NPIC&HMIT | WEDNESDAY, JUNE 14

TECHNICAL SESSIONS - 1:00 PM

Safety Critical Software Development, Qualification, and V&V—I

Chair: Edward Quinn (*Technology Resources*)

Location: Seacliff D **Time:** 1:00-3:25 pm

- 1:05 pm:** Practical Applications of Model Checking in the Finnish Nuclear Industry, Antti Pakonen (*VTT Technical Research Centre of Finland*), Topi Tahvonen (*Fennovoima Ltd*), Markus Hartikainen, Mikko Pihlanko (*Fortum Power and Heat*)
- 1:30 pm:** An Automatic Input/Output Test Experience of FPGA based Logic Controller with I/O Stimulator, Jang-Yeol Kim, Dong-Young Lee, Chang-Hwoi Kim, Kee-Choon Kwon, Jang-Soo Lee, Ji-Yeon Park (*KAERI*)
- 1:55 pm:** Safety Demonstration of a Class 1 Smart Device, Sofia Guerra, Eoin Butler, Sam George (*Adelard LLP*)
- 2:20 pm:** Test Based Reliability Assessment Method for a Safety Critical Software in Reactor Protection System, Sung Min Shin, Jaehyun Cho, Wondea Jung (*KAERI*), Seung Jun Lee (*UNIST*)
- 3:00 pm:** Safety Software Release Options to Support Plant Start-Up and Commissioning Activities, Jerry M. Stanley, Marc Kalo, Steve Leicher, Lori Richards (*Westinghouse*)

Digital Control System Applications

Chair: Hidekazu Yoshikawa (*Harbin Eng. Univ*)

Location: Golden Gate Room **Time:** 1:00-3:50 pm

- 1:05 pm:** A Novel Priority Selection System for Nuclear Power Plant, Shuo Wang, Qingwei Shi, Kelin Qi, Gang Ma, Dong Wang (*CNPE*)
- 1:30 pm:** DDK & BSF—Computerized Operator Support Implemented in Plant Computer System, Emil Ohlson (*Forsmarks NPP*)*
- 1:55 pm:** The Problem Analysis of Data Processing Performance in Nuclear Power Plant Computerized Information and Control System, Jianwei Liu, Lixue Tang, Qingyu Yang (*CNPE*)
- 2:20 pm:** Feature Selection based on PCA and the Transient Identification in Nuclear Power Plants, Shuqiao Zhou, Chao Guo, Xiaojin Huang (*Tsinghua Univ*)
- 3:00 pm:** Improving Nuclear Power Plant Safety and Operating Margins through Linear Quadratic Estimation, R. Steven Black (*AREVA Inc.*), Michael Smith (*AREVA Federal Services LLC*)
- 3:25 pm:** Integration and Assessment of Component Health Prognostics in Supervisory Control Systems, Pradeep Ramuhalli, Chris Bonebrake, Gerges Dib, Surajit Roy (*PNNL*), Sacit M. Cetiner (*ORNL*)

I&C Modernization Experience—I

Chair: Graham Walford (*Univ of Tennessee*)

Location: Marina Room **Time:** 1:00-3:25 pm

- 1:05 pm:** Comparative Requirements, Stakes and Deployment for 2 Ongoing Major I&C Modernization Projects, Arnaud Duthou, Jean-Michael Palaric (*Rolls-Royce Civil Nuclear*)
- 1:30 pm:** Identifying Requisite Changes to Support Modern Maintenance Practices, Zach Welz, Jamie Coble, J. Wesley Hines (*Univ of Tennessee*)
- 1:55 pm:** BWR Modernization Project: Installation of a New Digital Feedwater Control System, Javier Lasiera, Cristina Corrales, Mateo Ramos (*Tecnatom S. A.*)
- 2:20 pm:** Electric Actuator Modification on a Turbine Driven Feedpump at Calvert Cliffs Nuclear Power Plant, Brian T. Vilicka, Steve D. Whaley, Louis W. Gaussa, Ryan S. Blinn, Timothy J. Pasko (*Westinghouse*), Jim M. Bonner, Jonathan L. Allen (*Exelon*)
- 3:00 pm:** Integrated Emergency Control Board Including Design Extended Conditions for Krško NPP, Luis Rejas, Nicolás Moyano, Fernando Ortega, Sara Fernandez (*Tecnatom S.A*)

Embedded Topical: NPIC & HMIT

EMBEDDED TOPICAL: NPIC&HMIT | WEDNESDAY, JUNE 14

TECHNICAL SESSIONS - 4:30 PM

I&C Lessons Learned from Fukushima

Chair: Cristina Corrales (*Tecnatom S.A.*)

Location: Bayview A **Time:** 4:30-5:50 pm

- 4:35 pm:** Enhanced Electrical Penetration Components Meet the Higher Safety Standards Required for China's HTR-PM Shidaowan and Generation mPower Small Modular Reactors, Thomas Fink (Schott AG, BU Electronic Packaging), Shi Qi (*Chinergy Co, LTD*), Edward L. Quinn (*Technology Resources*), James F. Gleason (*GLSEQ, LLC*)
- 5:00 pm:** Instrumentation, Control, and Human System Interface Contributions to Historical Severe Accidents, Gary L. Johnson (*Independent Consultant*)
- 5:25 pm:** New Intrinsically Smart Severe Accident Instrumentation Saves Costs and Enhances Severe Accident Management, James Gleason, Patrick Gleason (*GLSEQ, LLC*)

Diversity and Defense in Depth (D3)—I

Chair: Michael Becker (*Northrop Grumman*)

Location: Bayview B **Time:** 4:45-6:30 pm

- 4:50 pm:** Impacts of Common Cause Failure Regulatory Requirements on Protection System Architectures, Mark Burzynski (*NewClear Day, Inc.*)
- 5:15 pm:** Graded Approach for Assessing Digital System Failure Susceptibilities, R. Torok (*EPRI*), D. Blanchard (*Applied Reliability Eng*)
- 5:40 pm:** Diversity for Safety and Security of NPP I&C: Post NUREG/CR 7007 Stage, Vyacheslav Kharchenko, Eugene Babeshko (*Center for Safety Infrastructure-Oriented Research and Analysis*), Kostyantyn Leontiiiev (*RPC Radiy*), Vyacheslav Duzhy (*National Aerospace Univ*)
- 6:05 pm:** Addressing Embedded Digital Devices in Safety-Related Systems of Nuclear Power Plants, Richard Wood (*Univ of Tennessee*), Jerry Mauck (*JLM Eng and Technology Resources*), Edward L. Quinn (*Technology Resources*)

Measures—III: Eye Tracking Applications and Methods

Session Organizer: Per Oivind Braarud (*OECD Halden Reactor Project*)

Chair: Maren Ro Eitrheim (*OECD Halden Reactor Project*)

Location: Seacliff A **Time:** 4:30-5:25 pm

- 4:35 pm:** Application of Eye Tracking for Measurement and Evaluation in Human Factors Studies in Control Room Modernization, C. Kovesdi, Z. Spielman, K. Le Blanc, B. Rice (*INL*)
- 5:00 pm:** Eye Tracking Studies based on Attentional-Resource Effectiveness, Jun Su Ha, Young-Ji Byon, Chung-Suk Cho (*Khalifa Univ. of Science, Technology and Research*), Seongkeun Kang, Poong Hyun Seong (*KAIST*)

Experience with Control Room Modernization—I

Session Organizer and Chair: Ken Thomas (*INL*)

Location: Seacliff B **Time:** 4:30-6:40 pm

- 4:35 pm:** A Review of Human-System Interface Design Issues Observed during Analog-to-Digital and Digital-to-Digital Migrations in U.S. Nuclear Power Plants, C. Kovesdi, J. Joe (*INL*)
- 5:00 pm:** Study on Main Control Room and Human-System Interface of Generation III in China, Shi Ji, Liu Qianzhong (*China Nuclear Power Plant Design Co., LTD*)
- 5:25 pm:** Optimized Application of Regulatory Human Factors Engineering Guidelines, Asriel Eisinger, Wolfgang Krause (*AREVA NP*)
- 5:50 pm:** Human Factors and Modeling Methods in the Development of Control Room Modernization Concepts, Jacques V. Hugo (*INL*), Lorenzo Slay III, John Hernandez (*APS*)
- 6:15 pm:** The Think-Aloud Protocol as a Method to Facilitate Threeway Communication in Digital Control Rooms, Ronald L. Boring (*INL*), Roger Lew (*Univ of Idaho*), Thomas A. Ulrich (*INL*)*

EMBEDDED TOPICAL: NPIC&HMIT | WEDNESDAY, JUNE 14

TECHNICAL SESSIONS - 4:30 PM

Advanced Sensors and Measurement Technologies—II

Chair: Anton Andrashov (*RadICS LLC*)

Location: Seacliff C **Time:** 4:30-5:50 pm

- 4:35 pm:** A Novel Technique Applying Spectral Estimation to Johnson Noise Thermometry, N. Dianne Bull Ezell, Charles Britton, Nance Ericson, David Holcomb (*ORNL*), M. J. Roberts, Seddik Djouadi, Richard Wood (*Univ of Tennessee*)
- 5:00 pm:** Continuous Measurement of the Boron Concentration in a Nuclear Power Plant: Why is it Essential for a Safe and Efficient Operation? Miriam Jimenez, Patrick Pirat (*Rolls-Royce*)
- 5:25 pm:** Severe Accident: Hardening of Standards and Qualification Requirements for Nuclear Pressure Transmitters, H. Fabbro, R. Desgeorge, J. C. Peres (*Rolls-Royce*)

Safety Critical Software Development, Qualification, and V&V—II

Chair: Nguyen Thy (*EdF*)

Location: Seacliff D **Time:** 4:30-6:15 pm

- 4:35 pm:** Test Case Selection Procedure for Simulation-Assisted Automation Testing, V.-M. Tikkala, A. Rantakaulio (*Fortum Power and Heat Oy*)
- 5:00 pm:** Extension of Mutation Testing for the Requirements and Design Faults, Boyuan Li, Carol Smidts (*Ohio State*)
- 5:25 pm:** An Operation Verification Strategy Against Network Attack of DCS in Nuclear Power Plant, Chao Guo, Jianghai Li, Zhe Dong, Xiaojin Huang (*Tsinghua Univ*)
- 5:50 pm:** Virtualized Hardware Environments for Supporting Digital I&C Verification, Frederick E. Derenthal IV, Carl Elks, Tim Bakker, Mohammadbagher Fotouhi (*Virginia Commonwealth Univ*)

On-line Monitoring for Maintenance Optimization—I

Chair: Stylianos Chatzidkis (*ORNL*)

Location: Golden Gate Room **Time:** 4:30-6:40 pm

- 4:35 pm:** On-Line Monitoring of I&C Transmitters and Sensors for Calibration Verification and Response Time Testing was Successfully Implemented at ATR, Phillip A. Erickson (*INL*), Ryan O'Hagan, Brent Shumaker, H. M. Hashemian (*AMS*), invited
- 5:00 pm:** On-Line Monitoring to Detect Sensor and Process Degradation under Normal Operational Transients, Samuel Boring, Jamie Coble, (*Univ of Tennessee*)
- 5:25 pm:** Bayesian Inference for High Confidence Signal Validation and Sensor Calibration Assessment, Anjali M. Nair, Jamie Coble (*Univ of Tennessee, Knoxville*)
- 5:50 pm:** On-Line Monitoring for Static and Dynamic Performance Verification of I&C Systems at Sizewell B Nuclear Power Station, P. Goffin (*EDF Energy Generation*), B. Shumaker, A. Hashemian, G. Morton (*AMS*)
- 6:15 pm:** Framework for Structural Online Health Monitoring of Aging and Degradation of Secondary Piping Systems due to Some Aspects of Erosion, Andrei V. Gribok, Vivek Agarwall (*INL*)

Embedded
Topical:
NPIC &
HMIT

EMBEDDED TOPICAL: NPIC&HMIT | THURSDAY, JUNE 15

TECHNICAL SESSIONS - 9:35 AM

Advanced Surveillance, Diagnostics, and Prognostics— IV

Chair: Mitch McCrory (SNL)

Location: Bayview A **Time:** 9:35-11:45 am

- 9:40 am:** Nuclear Power Plant Risk-Informed Surveillance Frequency Control Program Implementation at the Duke Catawba Nuclear Plant with a Focus on Instrumentation and Control Systems, Heather Szews (*Duke Energy*), James K. (Jim) Liming (*ABSG Consulting Inc.*), Edward L. (Ted) Quinn (*Technology Resources*)
- 10:05 am:** Estimation of LOCA Break Size Using Cascaded Support Vector Regression, Kwae Hwan Yoo, Man Gyun Na (*Chosun Univ*), Goen Pil Choi (*KAERI*)
- 10:30 am:** Identification of NPP Transients Using Artificial Intelligence, Young Do Koo, Ju Hyun Back, Man Gyun Na (*Chosun Univ*)
- 10:55 am:** Data Analysis for Valve Leak Detection of Nuclear Power Plant Safety Critical Components, Jung-Taek Kim, Hyeonmin Kim, Wan Man Park (*KAERI*)
- 11:20 am:** Frequency Spectrum Analysis Code for Nuclear Noise Based on Improved Wavelet Algorithm, Baoxin Yuan, Herong Zeng, Wankui Yang (*CAEP*)

Cyber Security in Digital I&C—IV

Chair: Roberto Ponciroli (ANL)

Location: Bayview B **Time:** 9:35-11:20 am

- 9:40 am:** Behavior-Based Approach to Misuse Detection of a Simulated SCADA System, Brien A. Jeffries, J. Wesley Hines (*Univ of Tennessee*), Kenny C. Gross (*Oracle Physical Sciences Research Center*)
- 10:05 am:** Nuclear Power Plant Instrumentation and Control Cyber Security Common Vector Access Leading to Relational Common Cause Failures, Phillip L. Turner, F. Mitch McCrory, Lon A. Dawson (SNL)
- 10:30 am:** Enhancing Power Plant Safety through Simulated Cyber Events, Phillip L. Turner, Susan S. Adams, Stacey M. Hendrickson (SNL)
- 10:55 am:** Risk Informed Cyber Security for Nuclear Power Plants, Phillip L. Turner, Timothy A. Wheeler (SNL), Matt Gibson (EPRI)

Supporting the Development, Practice, and Integration of Human Factors Engineering

Session Organizer: Dina Notte (ERGODIN)

Chair: Paula Savioja (STUK)

Location: Seacliff A **Time:** 9:35-10:55 am

- 9:40 am:** Training and Certification of Human Organizational Factors Designers in Nuclear Plant Engineering, Wolfgang Krause, Asriel Eisinger (*AREVA GmbH*)
- 10:05 am:** Developing a Human Factors Toolkit to Cope with Multi-Project Situation, Fei Song, Qiuyu Wang, Zhong Yuan, Shuhui Zhang (*SNERDI*)
- 10:30 am:** Early Implementation of Digital Upgrades on Simulators, Vincent Gagnon, Bernard Gagnon (*L3 MAPPS*)

Experience with Control Room Modernization—II

Session Organizer and Chair: Ken Thomas (INL)

Location: Seacliff B **Time:** 9:35-11:45 am

- 9:40 am:** Migration to a Fully-Integrated Control Room, Ken Thomas (INL), Ken Scarola (*Nuclear Automation Engineering, LLC*), John Hernandez, Tom Lambdin (APS)
- 10:05 am:** A Human Factors Engineering Meta Model for U.S. Nuclear Power Plant Control Room Modernization, Jeffrey C. Joe (INL)
- 10:30 am:** A Human Factors Engineering Process to Support Human-System Interface Design in Control Room Modernization, C. Kovesdi, J. Joe, R. Boring (INL)
- 10:55 am:** A Business Case for Nuclear Plant Control Room Modernization, Ken Thomas (INL), Sean Lawrie, Joe Niedermuller (*ScottMadden Management Consultants*), Michael Grigsby, John Hernandez, Brian Flynn (APS)
- 11:20 am:** The Graded Approach in Control Room Modernization: Selecting the Right Human Factors Evaluation Techniques, Ronald L. Boring (INL), Nathan Ka Ching Lau (*Virginia Tech*)*

EMBEDDED TOPICAL: NPIC&HMIT | THURSDAY, JUNE 15

TECHNICAL SESSIONS - 9:35 AM

Field Programmable Gate Array (FPGA)—I

Chair: Brent Shumaker (*AMS*)

Location: Seacliff C **Time:** 9:35-11:20 am

9:40 am: Development of a Systematic Approach for the Safety Analysis of PLD based Equipment of I&C Systems, Ewgenij Piljugin, Claudia Quester, Manuela Jopen (*GRS GmbH*)

10:05 am: V&V Techniques for FPGA-Based I&C Systems—How They Compare with Techniques for Microprocessors? Sam George, Sofia Guerra (*Adelard LLP*)

10:30 am: Implementing a Control Application on FPGA Platform, Jérôme Pizel, Alain Ourghanlian (*EdF*)

10:55 am: Development and Application of FPGA-Based Logic Controller, Yoonhee Lee, Sedo Sohn, Jaehee Yun (*KEPCO E&C*), Seungkweon Jeong (*Woori Technology, Inc.*)

General Sessions in I&C—III

Chair: Christian Petrie (*ORNL*)

Location: Seacliff D **Time:** 9:35-11:45 am

9:40 am: In-Pile Measurements of Fuel Rod Dimensional Changes Utilizing the Test Reactor Loop Pressure for Motion, Richard S. Skifton, Kurt L. Davis (*INL*), John C. Crepeau (*Univ of Idaho*), Steinar Solstad (*Inst for Energy Technology*)

10:05 am: Preliminary Analysis of Effect of Vanadium Self-Powered Neutron Detectors on AP1000 Reactor Core Physical Parameters, Yeshuai Sun, Xing Wang, Changhui Wang, Junhong Lv, Hui Yu, Yixue Chen (*State Power Investment Company Research Inst*)

10:30 am: Upcoming Irradiation of Ultrasonic and Fiber Optic Sensors in the MITR, Joshua Daw (*INL*), Lance Hone (*The Center for Space Nuclear Research*), Jean-François Villard, Guillaume Laffont (*CEA*), Kevin Chen (*Univ of Pittsburgh*), Jack Illare, Alfred Margaryan, Ashot Margaryan (*AFO Research, Inc.*), David Carpenter (*MIT*)

10:55 am: Improving Plant Efficiency through the Installation of TecSOLCEP Online Monitoring System, F. Javier González Mariano Martín, Iván Juan, Mateo Ramos (*Tecnatom*)

11:20 am: Industry Analytics to Optimize Time Based Maintenance for I&C Components, Curtis Good, Dan Stiffler (*Rolls-Royce*)

On-line Monitoring for Maintenance Optimization—II

Chair: Dean Crumpacker (*Sargent & Lundy*)

Location: Golden Gate Room **Time:** 9:35-10:55 am

9:40 am: Development of a Transient Signal Validation Technique via a Modified Kernel Regression Model, Ibrahim Ahmed, Gyunyoung Heo (*Kyung Hee Univ*)

10:05 am: Non-Redundant Temperature Sensor Calibration Using Autoregressive Support Vector Machine in PWR Nuclear Power Plants, Wenqing Yao, James Turso, Asok Ray, Justin Watson (*Penn State*)*

10:30 am: EPRI Modular Wireless Sensor for Equipment Condition Monitoring, Stephen Lopez (*EPRI*), Jason Gu (*Sensevere*)*

I&C Regulations, Standards, and Guidelines—II

Chair: Alan Levin (*DOE*)

Location: Marina Room **Time:** 9:35-10:55 am

9:40 am: Verification of Severe Accident Management Guideline (*SAmG*) Entry Condition for OPR1000, Young Gyu No, Poong Hyun Seong (*KAIST*)

10:05 am: Licensing of Spline Based I&C Systems: A Focus on United States, France and Finland, Julien Bach, Arnaud Duthou, Jean-Michel Palaric (*Rolls-Royce Civil Nuclear*), Mark Burzynski (*Rolls-Royce Instrumentation & Controls*)*

10:30 am: Digital I & C Near Term Regulatory Improvement, Needs and Plan for Implementation, David L. Rahn (*NRC*)*

Embedded Topical: NPIC & HMIT

EMBEDDED TOPICAL: NPIC&HMIT | THURSDAY, JUNE 15

TECHNICAL SESSIONS - 1:00 PM

General Sessions in I&C—IV

Chair: Jamie Coble (*Univ of Tennessee*)

Location: Bayview A **Time:** 1:00-2:20 pm

1:05 pm: DCIS Integration Tests for Lungmen Nuclear Power Plant, Jiin-Ming Lin, Jeen-Yee Lee (*Taiwan Power Co.*)

1:30 pm: Wide-Range Fission Chambers Signal Simulator, I. V. Alyaev, N. A. Selyaev, Yu. A. Paryshkin, V. A. Fedorov (*National Research Nuclear Univ «MEPhI»*)

1:55 pm: A Dynamic Model of Once Through Steam Generator (OTSG) for Prototypical Advanced Reactor, Fan Zhang, Jamie Coble (*Univ of Tennessee*)

Diversity and Defense in Depth (D3)—II

Chair: Thomas Hunter (*Lockheed Martin Corp./Lockheed Martin Energy*)

Location: Bayview B **Time:** 1:00-2:45 pm

1:05 pm: Advanced Licensing and Safety Engineering Method—ADLAS™, Pekka Nuutinen, Satu Sipola, Antti Rantakaulio (*Fortum Oyj*)

1:30 pm: NRC Technical Basis for Evaluation of Its Position on Protection Against Common Cause Failure in Digital Systems Used in Nuclear Power Plants, Steven A. Arndt, Rosssnyev Alvarado, Bernard Dittman, Kenneth Mott (*NRC*), Richard Wood (*Univ of Tennessee*)

1:55 pm: Development of a Diversity and Defense-In-Depth Strategy for the CNNC Fuqing, Fangjiashan and Hainan Nuclear Plants, Taha Ibrahim (*Schneider Electric*), Jerry Mauck (*JLM Eng and Technology*), Michael Howard (*Zachry Group*), Edward L. Quinn (*Technology Resources*)

2:20 pm: Development of a Diversity and Defense-In-Depth Strategy for the TerraPower TWR-P Advanced Nuclear Power Plant, Baofu Lu, Eric Williams (*TerraPower*), Jerry Mauck (*Technology Resources*), Michael Howard (*CSA Inc.*), Richard Wood (*Univ of Tennessee*), Edward L. Quinn (*Technology Resources*)

Soft Controls

Session Organizer and Chair: Lauren Reinerman-Jones (*Univ of Central Florida*)

Location: Seacliff A **Time:** 1:00-1:55 pm

1:05 pm: Workload Response to Soft Controls Presented on Two Interfaces, Lauren Reinerman-Jones, Jonathan Harris (*Univ of Central Florida*), Niav Hughes, Amy D'Agostino (*NRC*)

1:30 pm: Design Themes for Future Hybrid Nuclear Power Plant Control Rooms, Shilo Anders, Jie Xu, Dan France, Matthew B. Weinger (*Vanderbilt Univ*), Julie A. Adams (*Oregon State Univ*), Katya Le Blanc (*INL*)

EMBEDDED TOPICAL: NPIC&HMIT | THURSDAY, JUNE 15

TECHNICAL SESSIONS - 1:00 PM

Field Programmable Gate Array (FPGA)—II

Chair: Jerry Stanley (*Westinghouse*)

Location: Seacliff C **Time:** 1:00-3:25 pm

- 1:05 pm:** Development of Programmable Logic in a Rapid, Automated, and Repeatable Fashion for Safety-Related Applications, Keith A. Harvey, Dan Ho, Phil Allen, Andrew Mortellaro, Louis Yu (*Lockheed Martin Corp.*)
- 1:30 pm:** Certification of RadICS FPGA-Based Platform under U.S. NRC Requirements, Ievgenii Bakhmach, Olexandr Siora (*Research and Production Corporation Rادی*), Anton Andrashov (*RadICS LLC*), Vyacheslav Kharchenko, Andriy Kovalenko (*Centre for Safety Infrastructure-Oriented Research and Analysis*)
- 1:55 pm:** SymPLe 1131: A Novel Architectural Solution for the Realization of Verifiable Digital I&C Systems and Embedded Digital Devices, Carl Elks (*Virginia Commonwealth Univ*), Matt Gibson (*EPRI*), Tim Bakker, Richard Hite, Smitha Gautham, Vidya Venkatesh (*Virginia Commonwealth Univ*), Jason Moore (*The Mathworks*)
- 2:20 pm:** Experiences Applying Assertion Based Formal Verification to a Hardware Design of an Emergency Diesel Generator Start-up Controller, Smitha Gautham, Vidya Venkatesh, Carl Elks (*Virginia Commonwealth Univ*), Matt Gibson (*EPRI*), Tim Bakker, Richard Hite (*Virginia Commonwealth Univ*)*
- 3:00 pm:** Toward Biologically Inspired Self Healing Digital Embedded Devices: BIO-SymPLe), Shawkat Khairullah, Tim Bakker, Carl R. Elks (*Virginia Commonwealth Univ*)

Digital System Reliability—II

Chair: Donald Chase (*Curtiss Wright*)

Location: Seacliff D **Time:** 1:00-3:50 pm

- 1:05 pm:** Analysis of, and Defense Against, Spurious Actuation and Other Incorrect Behaviors of Digital Control Systems, Nguyen Thuy (*EdF*)
- 1:30 pm:** Application of Quantitative Methods for Reliability Testing of a Nuclear Power Plant Digital Rod Position Indication Diagnostic System, G. W. Morton, B. D. Shumaker, D. E. McCarter, S. D. Caylor, J. T. Rich (*AMS*)
- 1:55 pm:** Recent Results from a Testbed for the Reliability of the Digital Instrumentation and Control Systems and Cyber-Security in Nuclear Power Plants, Yongkyu An, Calogero Sollima, Rizwan-uddin, Daniel Chen, Zbigniew Kalbarczyk (*Univ of Illinois*)
- 2:20 pm:** The Reliability Analysis of Nuclear Power Plants Safety DCS Based on Markov, Ma Quan, Luo Qi, Liu Yan-Yang, Song Xiao-Ming (*Nuclear Power Inst of China*)*
- 3:00 pm:** The Reliability Analysis of Nuclear Power Plant Safety DCS with Common Cause Failure, Zhang Qing, Ma Quan (*Nuclear Power Inst of China*)*
- 3:25 pm:** Fault Propagation and Effects Analysis for Designing an Online Monitoring System for the Secondary Loop of a Nuclear Power Plant Part of a Hybrid Energy System, Huijuan Li, Xiaoxu Diao, Xiang Li, Boyuan Li, Carol Smidts, (*Ohio State*), Shannon Bragg-Sittion (*INL*)

I&C Modernization Experience—II

Chair: Roy Ray (*Mirion Technologies*)

Location: Marina Room **Time:** 1:00-2:20 pm

- 1:05 pm:** Diablo Canyon Power Plant Digital Process Protection System Replacement Licensing Experience Using ISG-06, Kenneth J. Schrader (*PG&E*), Scott B. Patterson (*Rock Creek Innovations, LLC*), John W. Hefler (*Altran US Corp*), Edward (Ted) L. Quinn (*Technology Resources*)
- 1:30 pm:** TRICONEX PLC Digital Upgrade Projects Bruce Power Nuclear Units 1 and 2, Randy Long (*Bruce Power*)*
- 1:55 pm:** Development of Functional Requirements Specification for Digital Instrumentation and Control Systems Upgrades used at Nuclear Power Plants (*NPPs*), Roger D. Wyatt, Richard Supler (*Enercon Services*)

*Presentation Only

Embedded
Topical:
NPIC &
HMIT

Committee Meetings

NATIONAL COMMITTEES

Accreditation, Polices & Procedures

SUNDAY, 11 AM - 12 PM | WATERFRONT A

Board of Directors

Professional Division Reports

WEDNESDAY, 4 PM – 5:30 PM | GRAND BALLROOM B

ANS Board of Directors

THURSDAY, 7:30 AM – 4:30 PM | GRAND BALLROOM B

ANS Annual Business Meeting

WEDNESDAY, 5:45 PM - 7 PM | GARDEN AB

Bylaws & Rules

SUNDAY, 4 PM – 5:30 PM | WATERFRONT A

Communications

SUNDAY, 4 PM – 6 PM | GARDEN B

Finance Meeting

TUESDAY, 2 PM - 6 PM | GARDEN B

Honors & Awards

MONDAY, 4 PM - 6 PM | BOARD ROOM B

International

SUNDAY, 11:30 AM - 1:30 PM | PACIFIC H

Local Section Workshop

SUNDAY, 9 AM - 12 PM | SEACLIFF B

Membership

SUNDAY, 10 AM - 12 PM | PACIFIC G

National Program

NPC Screening & International

SUNDAY, 10 AM - 12 PM | GARDEN A

NPC National Meeting Sub Committee

WEDNESDAY, 11:30 AM - 1 PM | WATERFRONT B

NPC Program

WEDNESDAY, 4 PM – 7 PM | WATERFRONT B

NEED

SUNDAY, 7:30 PM - 9:30 PM | GOLDEN GATE

Planning Committee

SUNDAY, 2 PM – 4 PM | WATERFRONT B

President's Meeting w/ Committee Chairs

SUNDAY, 8 AM - 9 AM | BAYVIEW A

President's Meeting w/ Division Chairs

SUNDAY, 9 AM - 10 AM | BAYVIEW A

Professional Development Coordination

TUESDAY, 4 PM – 5:30 PM | WATERFRONT A

Professional Divisions

Training Workshop

SATURDAY, 5 PM - 6:30 PM | SEACLIFF B

Committee Meeting

TUESDAY, 4 PM – 5:30 PM | WATERFRONT B

NATIONAL COMMITTEES

Professional Engineering Exam

PEEC Single Reference Development

SUNDAY, 12:30 PM – 2:30 PM | SEACLIFF B

PEEC Item Writers Group

SATURDAY, 5 PM - 10 PM | SEACLIFF A

PEEC Committee Mtg

SUNDAY, 4 PM - 6 PM | PACIFIC L

Professional Women In ANS

MONDAY, 3 PM – 5 PM | GARDEN B

Public Policy

WEDNESDAY, 11:30 AM - 1:30 PM | WATERFRONT A

Publications Steering

Meetings, Proceedings & Transactions

SUNDAY, 9 AM - 10 AM | PACIFIC L

Book Publishing

SUNDAY, 11 AM - 12:30 PM | GARDEN B

Technical Journals

SUNDAY, 1 PM - 4 PM | GARDEN B

Nuclear News Editorial Advisory

SUNDAY, 2 PM – 4:00 PM | SEACLIFF B

Nuclear Technology Editorial Advisory

SUNDAY, 4:30 PM - 5:30 PM | BOARD ROOM B

Publications Steering Committee

MONDAY, 4:30 PM - 6:30 PM | BOARD ROOM A

Scholarship Policy & Coordination

MONDAY, 12 PM - 1 PM | BOARD ROOM B

Student Sections

Executive

MONDAY, 6 PM - 8 PM | PACIFIC D

SPECIAL COMMITTEES

Special Committee on the Congressional Fellow Program

TUESDAY, 3:30 PM - 4:30 PM | BOARD ROOM A

Special Committee on Nuclear in the States

SUNDAY, 2:30 PM – 4:30 PM | PACIFIC M

OTHER COMMITTEES

Christian Nuclear Fellowship

MONDAY, 7 PM – 8:30 PM | BOARD ROOM A

Christian Nuclear Fellowship Breakfast

WEDNESDAY, 7 AM – 8:00 AM | WATERFRONT B

KNS-US Chapter Meeting

MONDAY, 4:30 PM - 7 PM | WATERFRONT A

NEDHO

SUNDAY, 4 PM - 6 PM | WATERFRONT B

Committee Meetings

OTHER COMMITTEES

Nuclear Pride LGBT Organization

MONDAY, 7 AM TO 8 AM | GARDEN B

UWC Planning Committee

SUNDAY, 1 PM – 2 PM | PACIFIC D

DIVISION COMMITTEES

Accelerator Applications

Executive

MONDAY, 11:30 AM – 1:30 PM | GARDEN B

Aerospace Nuclear Science & Technology

MONDAY, 4 PM – 6 PM | WATERFRONT B

Biology and Medicine

Executive

SUNDAY, 4 PM – 5:30 PM | GOLDEN GATE

Decommissioning and Environmental Sciences

Program

SUNDAY, 3:30 PM – 4:30 PM | PACIFIC G

Executive

SUNDAY, 4:30 PM – 5:30 PM | PACIFIC G

Education, Training & Workforce Development

Program

SUNDAY, 10:30 AM – 12 PM | PACIFIC K

University/Industry/Government Relations

SUNDAY, 1:30 PM – 2 PM | PACIFIC K

Alpha Nu Sigma National Honor Society

SUNDAY, 1 PM – 2 PM | GOLDEN GATE

Executive/Membership/Honors & Awards

SUNDAY, 2 PM – 4 PM | PACIFIC K

Fuel Cycle & Waste Management

Program

SUNDAY, 12 PM – 1 PM | PACIFIC L

Executive

SUNDAY, 1 PM – 2:30 PM | PACIFIC L

Fusion Energy

Executive

TUESDAY, 6 PM – 8 PM | BOARD ROOM B

Human Factors, Instrumentation, and Controls

Program

SUNDAY, 11 AM – 12 PM | PACIFIC I

Executive

SUNDAY, 12 PM – 2:30 PM | PACIFIC I

Isotopes and Radiation

Joint Program Committee-I&R/BM

SUNDAY, 1:30 PM – 2:30 PM | GARDEN A

Executive

SUNDAY, 2:30 PM – 4:30 PM | GARDEN A

DIVISION COMMITTEES

Materials Science & Technology

Executive

MONDAY, 6 PM – 8 PM | GARDEN B

Mathematics & Computation

Program

SUNDAY, 1 PM – 2 PM | WATERFRONT A

Mathematics & Computation

Executive

SUNDAY, 2 PM – 4 PM | WATERFRONT A

Nuclear Criticality Safety

Education Meeting

SUNDAY, 1 PM – 2 PM | BAYVIEW B

Program

SUNDAY, 2 PM – 3 PM | BAYVIEW B

Executive

SUNDAY, 3 PM – 4:30 PM | BAYVIEW B

Nuclear Installations Safety

Program

SUNDAY, 4 PM – 5:30 PM | PACIFIC K

Executive

MONDAY, 6 PM – 8 PM | WATERFRONT B

Nuclear Nonproliferation Policy

Program

SUNDAY, 2:30 PM – 3:30 PM | PACIFIC J

Executive

SUNDAY, 3:30 PM – 4:30 PM | PACIFIC J

NNTG/IRD/FC&UM Integration

SUNDAY, 4:30 PM – 5 PM | PACIFIC J

Operations & Power

Program

SUNDAY, 2 PM – 3:30 PM | PACIFIC D

Executive

SUNDAY, 3:30 PM – 6 PM | PACIFIC D

Radiation Protection & Shielding

Program

SUNDAY, 10:30 AM – 11:30 AM | PACIFIC E

Standards Committee

SUNDAY, 11:30 AM – 12:30 PM | PACIFIC E

Executive

SUNDAY, 12:30 PM – 2:30 PM | PACIFIC E

Reactor Physics

Honors & Awards

SUNDAY, 10 AM – 11 AM | SEACLIFF A

Goals & Planning

SUNDAY, 1 PM - 2 PM | SEACLIFF A

Program

SUNDAY, 2 PM – 4 PM | SEACLIFF A

Committee Meetings

DIVISION COMMITTEES

Reactor Physics

Executive

SUNDAY, 4 PM – 6 PM | SEACLIFF A

Robotics & Remote Systems

Executive

SUNDAY, 12 PM – 4 PM | BOARD ROOM B

Thermal Hydraulics

Program

SUNDAY, 2:30 PM – 4:30 PM | PACIFIC I

Executive

SUNDAY, 4:30 PM – 6 PM | PACIFIC I

Young Members Group (TG)

Program

MONDAY, 10 AM – 11 AM | WATERFRONT A

Executive Committee

MONDAY, 11:30 AM – 1 PM | WATERFRONT A

STANDARDS COMMITTEES

ANS-2.6

WEDNESDAY, 1 PM – 5 PM | BOARD ROOM B

ANS-8.1

MONDAY, 3 PM – 5 PM | WATERFRONT A

STANDARDS COMMITTEES

ANS-8.19

SUNDAY, 10 AM – 12 PM | PACIFIC M

ANS-8.20

SUNDAY, 10 AM – 12 PM | BOARD ROOM A

ANS-8.22

TUESDAY, 9 AM – 11 AM | BOARD ROOM B

ANS-8.26

TUESDAY, 7 AM – 8:30 AM | BOARD ROOM B

ANS-8.28

TUESDAY, 3 PM – 5 PM | BOARD ROOM B

ANS-18.1

WEDNESDAY, 8 AM – 12 PM | BOARD ROOM B

ANS-19 Reactor Physics

MONDAY, 9 AM – 10:30 AM | BOARD ROOM B

ANS-19.3

MONDAY, 8 AM – 9 AM | BOARD ROOM B

FWDC

MONDAY, 11 AM – 1:30 PM | GARDEN A

RP3C

MONDAY, 2:30 PM – 6 PM | GARDEN A

Standards Board

TUESDAY, 8:30 AM – 5 PM | GARDEN A

Committee/Division/Other Meetings Daily

Saturday, June 10

5:00 pm – 6:30 pm	Professional Divisions Committee-Workshop	Seacliff B
5:00 pm – 10:00 pm	Professional Engineering Exam Committee- Items Writers Group	Seacliff A

Sunday, June 11

8:00 am – 9:00 am	President's Meeting w/Committee Chairs	Bayview A
9:00 am – 10:00 am	President's Meeting w/Division Chairs	Bayview A
9:00 am – 10:00 am	Publications Steering Committee-Meetings, Proceedings & Transactions	Pacific L
9:00 am – 12:00 pm	Local Section Workshop Committee	Seacliff B
10:00 am – 11:00 pm	Reactor Physics Division-Honors & Awards Committee	Seacliff A
10:00 am – 12:00 pm	Membership Committee	Pacific G
10:00 am – 12:00 pm	National Program Committee-NPC Screening	Garden A
10:00 am – 12:00 pm	ANS-8.19	Pacific M
10:00 am – 12:00 pm	ANS-8.20	Board Room A
10:30 am – 12:00 pm	Education, Training & Workforce Development Division-Program Committee	Pacific K
10:30 am – 11:30 am	Radiation Protection & Shielding Division-Program Committee	Pacific E
11:00 pm – 12:00 pm	Accreditation Policies & Procedures Committee	Waterfront A
11:00 pm – 12:00 pm	Human Factors, Instrumentation & Controls Division-Program Committee	Pacific I
11:00 pm – 12:30 pm	Publications Steering Committee-Book Publishing	Garden B
11:30 am – 1:30 pm	International Committee	Pacific H
11:30 am – 12:30 pm	Radiation Protection & Shielding Division-Standards Committee	Pacific E
12:00 pm – 1:00 pm	Fuel Cycle & Waste Management Division-Program Committee	Pacific L
12:00 pm – 2:30 pm	Human Factors, Instrumentation & Controls Division-Executive Committee	Pacific I
12:00 pm – 4:00 pm	Robotics & Remote Systems Division-Executive Committee	Board Room B
12:30 pm – 2:30 pm	Professional Engineering Exam Committee-Single Reference Development	Seacliff B
12:30 pm – 2:30 pm	Radiation Protection & Shielding Division-Executive Committee	Pacific E
1:00 pm – 2:00 pm	UWC Planning Committee	Pacific D
1:00 pm – 2:00 pm	Education, Training & Workforce Development Division-Alpha Nu Sigma National Honor Society	Golden Gate
1:00 pm – 2:00 pm	Mathematics & Computation Division-Program Committee	Waterfront A
1:00 pm – 2:00 pm	Nuclear Criticality Safety Division-Education Meeting	Bayview B
1:00 pm – 2:00 pm	Reactor Physics Division-Goals & Planning Committee	Seacliff A
1:00 pm – 2:30 pm	Fuel Cycle & Waste Management Division-Executive Committee	Pacific L
1:00 pm – 4:00 pm	Publications Steering Committee-Technical Journals	Garden B
1:30 pm – 2:00 pm	Education, Training & Workforce Development Division-University/Industry/ Government Relations Committee	Pacific K
1:30 pm – 2:30 pm	Isotopes & Radiation Division-Joint Program Committee-I&R/BM	Garden A
2:00 pm – 3:00 pm	Nuclear Criticality Safety Division-Program Committee	Bayview B
2:00 pm – 4:00 pm	Publications Steering Committee-Nuclear News Editorial Advisory	Seacliff B
2:00 pm – 3:30 pm	Operations & Power Division-Program Committee	Pacific D
2:00 pm – 4:00 pm	Planning Committee	Waterfront B
2:00 pm – 4:00 pm	Education, Training & Workforce Development Division-Executive Committee	Pacific K
2:00 pm – 4:00 pm	Mathematics & Computation Division-Executive Committee	Waterfront A
2:00 pm – 4:00 pm	Reactor Physics Division-Program Committee	Seacliff A
2:30 pm – 3:30 pm	Nuclear Nonproliferation Policy Division-Program Committee	Pacific J
2:30 pm – 4:30 pm	Special Committee on Nuclear in the States	Pacific M
2:30 pm – 4:30 pm	Isotopes & Radiation Division-Executive Committee	Garden A
2:30 pm – 4:30 pm	Thermal Hydraulics Division-Program Committee	Pacific I
3:00 pm – 4:30 pm	Nuclear Criticality Safety Division-Executive Committee	Bayview B
3:30 pm – 4:30 pm	Decommissioning and Environmental Sciences Division-Program Committee	Pacific G
3:30 pm – 4:30 pm	Nuclear Nonproliferation Policy Division-Executive Committee	Pacific J
3:30 pm – 6:00 pm	Operations & Power Division-Executive Committee	Pacific D
4:00 pm – 5:30 pm	Bylaws & Rules Committee	Waterfront A
4:00 pm – 5:30 pm	Biology & Medicine Committee	Golden Gate
4:00 pm – 5:30 pm	Nuclear Installations Safety Division-Program Committee	Pacific K

Committee/Division/Other Meetings Daily

Sunday, June 11 Continued

4:00 pm – 6:00 pm	Communications Committee	Garden B
4:00 pm – 6:00 pm	Professional Engineering Exam Committee-Committee Meeting	Pacific L
4:00 pm – 6:00 pm	NEDHO	Waterfront B
4:00 pm – 6:00 pm	Reactor Physics Division-Executive Committee	Seacliff A
4:30 pm – 5:00 pm	Nuclear Nonproliferation Policy Division-NNTG/IRD/FC&WM Integration	Pacific J
4:30 pm – 5:30 pm	Decommissioning and Environmental Sciences Division-Executive Committee	Pacific G
4:30 pm – 6:00 pm	Thermal Hydraulics Division-Executive Committee	Pacific I
4:30 pm – 5:30 pm	Publications Steering Committee-Nuclear Technology Advisory	Board Room B
7:30 pm – 9:30 pm	NEED Committee	Golden Gate

Monday, June 12

7:00 am – 8:00 am	Nuclear Pride LGBT Organization	Garden B
8:00 am – 9:00 am	ANS-19.3	Board Room B
9:00 am – 10:30 am	ANS-19 Reactor Physics	Board Room B
10:00 am – 11:00 pm	Young Members Group-Program	Waterfront A
11:00 pm – 1:30 pm	FWDC	Garden A
11:30 am – 1:00 pm	Young Members Group-Executive	Waterfront A
11:30 am – 1:30 pm	Accelerator Applications Division-Executive Committee	Garden B
12:00 pm – 1:00 pm	Scholarship Policy & Coordination Committee	Board Room B
2:30 pm – 6:00 pm	RP3C	Garden A
3:00 pm – 5:00 pm	ANS-8.1	Waterfront A
3:00 pm – 5:00 pm	Professional Women In ANS Committee	Garden B
4:00 pm – 6:00 pm	Honors & Awards Committee	Board Room B
4:00 pm – 6:00 pm	Aerospace Nuclear Science & Technology Division	Waterfront B
4:30 pm – 6:30 pm	Publications Steering Committee-Publications Steering Committee	Board Room A
4:30 pm – 7:00 pm	KNS - US Chapter Meeting	Waterfront A
6:00 pm – 8:00 pm	Student Sections Committee-Executive	Pacific D
6:00 pm – 8:00 pm	Materials Science & Technology Division-Executive Committee	Garden B
6:00 pm – 8:00 pm	Nuclear Installations Safety Division-Executive Committee	Waterfront B
7:00 pm – 8:30 pm	Christian Nuclear Fellowship	Board Room A

Tuesday, June 13

7:00 am – 8:30 am	ANS-8.26	Board Room B
8:30 am – 5:00 pm	Standards Board	Garden A
9:00 am – 11:00 am	ANS-8.22	Board Room B
2:00 pm – 6:00 pm	Finance Committee	Garden B
3:00 pm – 5:00 pm	ANS-8.28	Board Room B
3:30 pm – 4:30 pm	Special Committee on the Congressional Fellow Program	Board Room A
4:00 pm – 5:30 pm	Professional Development Coordination Committee	Waterfront A
4:00 pm – 5:30 pm	Professional Divisions Committee-Committee Meeting	Waterfront B
6:00 pm – 8:00 pm	Fusion Energy Division-Executive Committee	Board Room B

Wednesday, June 14

7:00 am – 8:30 am	Christian Nuclear Fellowship Breakfast	Waterfront B
8:00 am – 12:00 pm	ANS-18.1	Board Room B
11:30 am – 1:00 pm	National Program Committee-NPC National Meeting Subcommittee	Waterfront B
11:30 am – 1:30 pm	Public Policy Committee	Waterfront A
1:00 pm – 5:00 pm	ANS-2.6	Board Room B
4:00 pm – 5:30 pm	Board of Directors-Professional Division Reports	Grand Ballroom B
4:00 pm – 7:00 pm	National Program Committee-NPC Program	Waterfront B
5:45 pm – 7:00 pm	ANS Annual Business Meeting	Garden AB

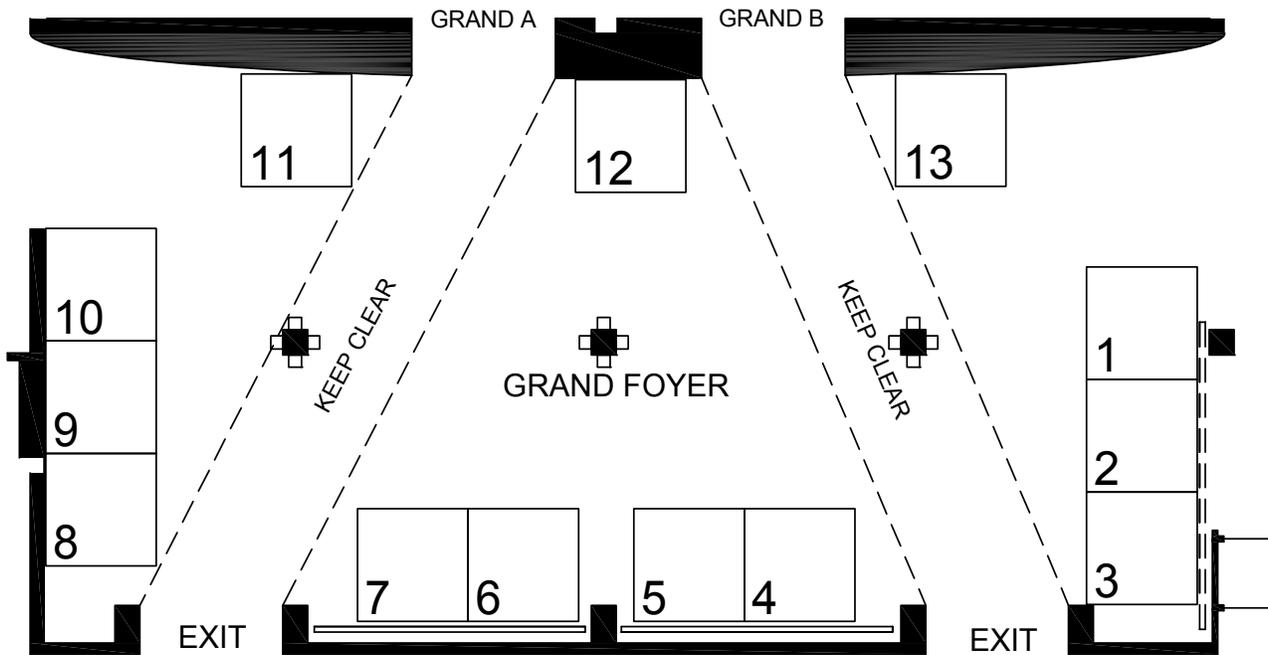
Thursday, June 15

7:30 am – 4:30 pm	ANS Board of Directors	Grand Ballroom B
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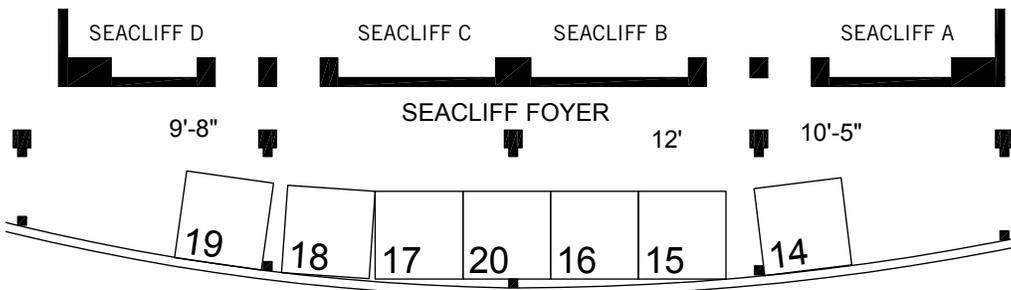
Exhibitors List

Altran	Booth 2	Northrop Grumman Corporation	Booth 17
AREVA	Booth 10	Oak Ridge National Laboratory	Booth 8
ATC Nuclear	Booth 12	Pennatronics	Booth 3
Berkeley Nuclear Engineering	Booth 19	Research and Production Corporation Radiy	Booth 16
Curtiss-Wright	Booth 11	Rolls-Royce	Booth 1
Doosan HF Controls Corp.	Booth 5	SCHOTT North America, Inc.	Booth 6
Fortum Power and Heat Oy	Booth 7	TECNATOM GROUP	Booth 13
INL - Light Water Reactor Sustainability T10	Booth 4	Thermo Fisher Scientific	Booth 18
Lockheed Martin	Booth 9	Ultra Electronics - Nuclear Control Systems	Booth 15
		Victoreen	Booth 14

Exhibits Grand Foyer



Exhibits Seacliff Foyer



Hours:

Sunday, June 11:
6:00-8:00 pm

Monday, June 12:
7:30 am-5:00 pm

Tuesday, June 13:
7:30 am-5:00 pm

Wednesday, June 14:
7:30 am-12:00 pm

Exhibitor & Expo Info

Altran

Burlington, MA (Booth 2)

Altran US Corp provides comprehensive engineering, design, and consulting services including: instrumentation and control (digital and analog), electrical, civil/structural, mechanical, material science and cybersecurity. In North America, Altran serves the Power industry out of a network of offices with more than 500 employees.

AREVA

Charlotte, NC (Booth 10)

AREVA NP is a major international player in the nuclear energy market recognized for its innovative solutions and value-added technologies for designing, building, maintaining, and advancing the global nuclear fleet. The company designs, manufactures, and installs components and fuel for nuclear power plants and offers a full range of reactor services.

With 15,000 employees worldwide, every day AREVA NP's expertise helps its customers improve the safety and performance of their nuclear plants and achieve their economic and societal goals.

AREVA NP is a subsidiary of the AREVA group.

ATC Nuclear

Oak Ridge, TN (Booth 12)

ATC Nuclear delivers value to our customers through three primary business lines consisting of Reverse Engineering, 3rd Party Dedication and Qualification, and Parts Inventory/Sourcing Management (NIMS). ATC Nuclear is the first company to offer an independent, safety-related MRO—and ATC Nuclear is the only company to offer commercial grade dedication, sourcing, warehousing, reverse engineering, and qualification under one roof.

Berkeley Nuclear Engineering

Berkeley CA (Booth 19)

Berkeley Nuclear Engineering welcomes you to the Bay Area! Please stop by exhibit table 19 to learn more about our educational commitment to fundamental nuclear science and applications, innovative nuclear power systems and fuel cycles, and nuclear security technology and policy.

Curtiss-Wright

Idaho Falls, ID (Booth 11)

Scientech, a product and service brand of Curtiss-Wright Nuclear, provides plant process computer, digital control, and annunciator systems; thermal performance software; regulatory information databases and services; nozzle dams and installation services; reactor and steam generator specialized tooling; under-vessel BWR services and equipment; inventory database services (RAPID, OIRD) and supply chain analytics; safety and probabilistic risk assessment (PRA) services; repair, refurbish and reverse engineered I&C services; security and access authorization software; and mobile technology applications.

Doosan HF Controls Corp.

Carrollton, TX (Booth 5)

Doosan HF Controls is headquartered in Carrollton Texas, USA is an I&C solutions provider that has supplied and serviced Instrumentation and Control (I&C) systems to American and International clients for over 50 years across the fossil and nuclear markets. Doosan HF Controls has become a major nuclear supplier as it expands its business portfolio. For more information: 1-866-501-9954 www.hfcontrols.com

Fortum Power and Heat Oy

Espoo, Finland (Booth 7)

Fortum is a leading clean-energy company with decades of nuclear experience. Fortum has systematically invested in digital technologies, which has further improved the world class KPIs at our NPPs. Fortum has built a solid portfolio of proven smart digital solutions, which we are now glad to offer other nuclear companies.

INL - Light Water Reactor Sustainability TIO

Idaho Falls, ID (Booth 4)

The Light Water Reactor Sustainability (LWRS) Program is an R&D program sponsored by DOE with participation by NRC and the nuclear industry. LWRS leverages the extensive capabilities of DOE's national labs to provide the technical foundation for licensing and managing the long-term safe operation of existing nuclear power plants.

Lockheed Martin

Grand Prairie, TX (Booth 9)

Headquartered in Bethesda, Maryland, Lockheed Martin is a global security and aerospace company that employs approximately 97,000 people worldwide and is principally engaged in the research, design, development, manufacture, integration and sustainment of advanced technology systems, products and services.

Exhibitor & Expo Info

Northrop Grumman Corporation

Woodland Hills, CA (Booth 17)

Northrop Grumman is a leading global security company providing innovative systems, products and solutions in autonomous systems, cyber, C4ISR, strike, and logistics and modernization to customers worldwide. Please visit news.northropgrumman.com and follow us on Twitter, @NGCNews, for more information.

Oak Ridge National Laboratory

Oak Ridge, TN (Booth 8)

Oak Ridge National Laboratory (ORNL) is a multi-program science and technology laboratory managed for the U.S. Department of Energy by UT-Battelle, LLC. Scientists and engineers at ORNL conduct basic and applied research and development to create scientific knowledge and technological solutions that strengthen the nation's leadership in key areas of science; increase the availability of clean, abundant energy; restore and protect the environment; and contribute to national security. www.ornl.gov

Pennatronics

California, PA (Booth 3)

A Premier 10CFR50 Appendix B compliant Electronics Contract Manufacturer specializing in high-mix, low & medium volume complex PCBAs and electro-mechanical assemblies. Our highly experienced team brings decades of electronics manufacturing expertise to meet your biggest challenges. The truest evaluation of our performance comes from the satisfaction and feedback of the customers we serve.

Research and Production Corporation Radiy

Kirovograd, Ukraine (Booth 16)

For over 20 years, Radiy's FPGA-based designs have provided advanced instrumentation and control (I&C) solutions for NPP modernization and new build projects in Europe and North America.

With SIL-3 certification completed and NRC licensing in progress RadICS Platform is used to address current nuclear requirements and safety operations of NPPs.

Rolls-Royce

Meylan, France (Booth 1)

Rolls-Royce is an independent nuclear instrumentation and control (I&C) supplier, providing customers with solutions designed to improve the safety, availability and reliability of their high value assets, while reducing operating costs. Our range of solutions covers digital safety I&C systems, safety critical instrumentation and long-term support services. Today, these solutions are installed on almost 50% of operating reactors worldwide.

SCHOTT North America, Inc.

Southbridge, MA (Booth 6)

SCHOTT Electronic Packaging operates worldwide as a leading manufacturer of components for the protection of sensitive electronics, including electrical feedthrough assemblies and terminal headers for nuclear power plants. Decades of maintenance-free product performance has earned SCHOTT EP a reputation around the globe as an industry leader in safety-pertinent application markets.

TECNATOM GROUP

Madrid, Spain (Booth 13)

TECNATOM is an engineering company owned by the Spanish utilities that provides products & services to the nuclear industry since 1957.

Its main technical capabilities are: Simulation & Control Rooms Supply and Modernization, NDT Inspection & Structural Integrity, Testing, Plant Operational Support, Training Centres, Development & Manufacture of NDT Equipment & Systems, Long Term Operation, New Comers, Safety Management and Emergency Response, carrying out projects in a wide range of technological areas for all type of reactors in more than 40 countries worldwide through their offices in France, Brazil, China, Emirates, Mexico and USA.

Thermo Fisher Scientific

Oakwood Village, OH (Booth 18)

Thermo Fisher Scientific is a leading provider of Class 1E Safety-Related Nuclear Plant Instrumentation and Control Systems to the global commercial nuclear power industry. The company offers reactor power monitoring systems, radiation measurement and water analysis systems, radiation hardened cameras, data management and recorders, and a full complement of services.

Ultra Electronics - Nuclear Control Systems

Dorset, UK (Booth 15)

Ultra Electronics Nuclear Control Systems specialise in the supply of radiation detection systems to the nuclear industry. Product supplied include measurement instruments for dose-rate, contamination and the measurement of radioactive concentration in air and liquids. Ultra Electronics - NCS support operating NPP's, fuel cycle facilities and decommissioning projects around the World.

Victoreen

Cleveland, OH (Booth 14)

Victoreen is a state of the art manufacturer of safety related radiation monitors, detectors, and rate meters. Victoreen is a business unit of Fluke Corporation, and has been the leader in providing solutions to detect, monitor, and characterize ionizing radiation since 1928.



ANS Organization Membership

The American Nuclear Society salutes our Organization Members as sharing in our mission to promote nuclear science and technology to benefit humanity.*

- | | | |
|--|--|---|
| AFO Research Inc. | ETRANCO, Inc. | Nutherm International, Inc. |
| Aggreko | EXCEL Services Corporation | Observed Leadership, LLC |
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| Allied Technical Resources Inc. | FirstEnergy Nuclear Operating Co. (FENOC) | Otek Corporation |
| Alphasource Inc. | Five Star Products | Pacific Gas and Electric Company |
| Ameren Missouri-Callaway Energy Center | Fluor | Phoenix Nuclear Labs, LLC |
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| BWX Technologies, Inc. | Los Alamos National Laboratory | Schafer Livermore Labs |
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| Energy Future Holdings (Luminant) | Nuclear Plant Journal | ValvTechnologies |
| Energy Northwest | Nuclear Three Inc. | Varian Security and Industrial Products |
| Energy Steel | Nuclear-21.Net | Virginia Commonwealth University |
| Engineered Solutions, Inc. | NuScale Power | Western Services Corporation |
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*Post-print roster updates at ans.org/orgmembers/memberlist.

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FLOOR PLAN
 3-D Levels



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"Hyatt is focused on caring for guests so they can be their best. It is Hyatt's practice to permit guests to use the restroom of the gender with which they identify."



ANS Annual Meeting

2017

Innovating Nuclear Power

June 11-15, 2017
Hyatt Regency San Francisco
San Francisco, CA



American Nuclear Society
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La Grange Park, IL 60526
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