



ANS HFICD

SUMMER 2018 NEWSLETTER

<http://hfcd.ans.org>

NUCLEAR TECHNOLOGY SPECIAL ISSUE

Following a very successful 10th International Topical Meeting on Nuclear Plant Instrumentation and Control and Human Machine Interface Technologies (NPIC-HMIT) embedded at the ANS Annual meeting in San Francisco, 11-15 June 2017, we are pleased to announce a special issue of *Nuclear Technology* featuring a selection of papers from the meeting.

The international NPIC&HMIT topical meetings provide a forum for scientific and engineering advancement in the parallel fields of nuclear power instrumentation and control and human factors engineering. The 2017 meeting offered an exceptional technical program of over 250 papers and presentations from all over the world. Proceedings of NPIC&HMIT topical meetings and special issues consisting of a collection of selected papers in technical journals, such as this one, continue to serve as a guidepost marking the evolution of the fields of instrumentation and control and human factors engineering with a focus on the nuclear industry.

From a large selection of high-quality papers and presentations, the *Nuclear Technology* special issue (volume 202 numbers 2-3) represents only a snapshot of the research and development work conducted by some of the world's foremost specialists in instrumentation and control and human factors engineering, all of them actively involved in various aspects of nuclear power plant safety, operational effectiveness, economic efficiency, and reliability. Their work will continue to draw the attention of industry and academia to further ongoing research,



development, and engineering activities worldwide.

The special issue, released in the May and June 2018 issues of *Nuclear Technology*, includes 19 papers across key instrumentation and control and human factors engineering topics that represent significant advances in the nuclear power area. These papers expand on the work presented at the NPIC-HMIT topical meeting with the latest and most up-to-date results.

The 11th NPIC-HMIT topical meeting will be held on February 9-14, 2019 in Orlando, Florida. See page 3 for more details and the open call for papers at the end of the newsletter. We look forward to seeing you there!

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THOUGHTS FROM THE CHAIR

—Ray Herb



Hello, HFICD Members,
I would like to introduce myself as your new HFICD Chair (2018-2019). My career started in the Navy where I graduated from the Naval Academy in 1983 and spent 7 years in the Nuclear Navy as an officer in Nuclear Submarines.

Since then I've spent 27 years in Commercial nuclear power working in various plant sites in engineering duties related to I&C: I've been involved in B&W PWRs, Westinghouse 3 loop, 4 loop and Advanced Plant reactors and GE BWRs, with a touch of Cyber Security thrown in for good luck. In addition to ANS, I serve on IEEE, IEC standards bodies, serve on NEI Digital I&C task forces and even occasionally work with DOE and IAEA when they ask.

HFICD started last year 2017-2018 with a very successful 10th NPIC-HMIT embedded topical in the Annual Meeting in San Francisco and ended with awards given out for the Don Miller Award to Dr. Jin Jiang from Western University and Dr. Belle Upadhyaya from the University of Tennessee (page 6) and the Ted Quinn Early Career Award to Chad Kiger of AMS (page 7). The nuclear industry has seen some ups and downs this past year, with bad news coming

as announcements of plant closures in California, Massachusetts, New Jersey, Ohio, and Pennsylvania and the decision to halt construction of VC Summer units 2 and 3. On a positive note TVA brought Watts Bar Unit 2 online, Vogtle 3 and 4 continue construction, and legislation in Illinois and New York may have potentially averted additional closures in those states while other states seem to be considering credits as well.

We will end the year (2018-2019) with the 11th NPIC-HMIT Topical meeting in Orlando, February 2019, and we are still accepting abstracts (see the end of this issue for a Call for Papers). These are times that beg for solutions and this is your opportunity to provide that needed spark. I look forward to seeing each of you at the Winter meeting in Orlando in November where the theme is "Joining Forces to Advance Nuclear" we will have a small preview of the NPIC-HMIT topical, and I hope that you all come to promote the use of advanced instrumentation and controls and human factors to help make nuclear more cost efficient, reliable and, as always, safer.

Best Regards,

Ray Herb
Southern Nuclear
HFICD Chair, 2018-2019





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11th NPIC-HMIT Conference

February 9-14, 2019

There is probably no more exciting time to be involved in digital I&C than the present. After more than three years of work by industry experts led by NEI, NRC has finally published RIS 2002-22 Supplement 1 that will allow licensees to perform digital upgrades to safety related support systems under the 10 CFR 50.59 process utilizing a “qualitative assessment”. So, goodbye to analog control room chiller controls, analog timing relays and analog breakers. Publishing this guidance is the first step in transforming the regulatory process so that modern digital controls can be applied throughout the plant without undue regulatory barriers. Next, the industry is working with the NRC to issue updated guidance on performing 10 CFR 50.59 reviews for digital systems and a streamlined process for preparing and submitting License Amendment Requests (LAR) for complex digital upgrades for plant safety systems. Join us at the 2019 NPIC-HMIT Topical Meeting to learn more about this and other developments.

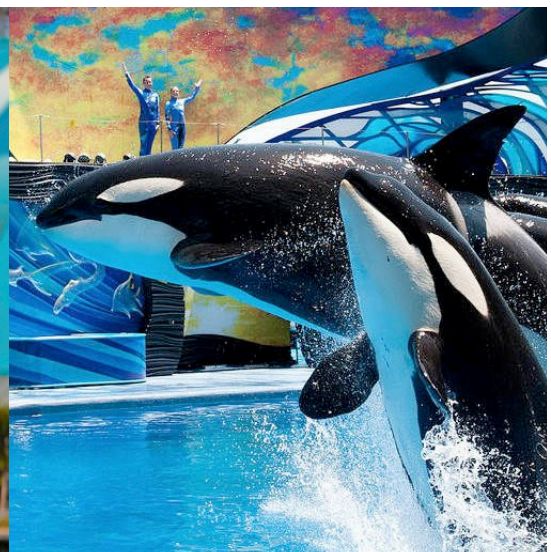


Jason Remer



Daniel Churchman

NPIC & HMIT 2019
General Co-Chairs





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2018 UHRIG FELLOW: DAN FLOYD

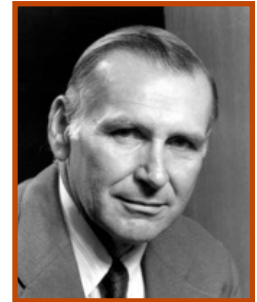


Dan Floyd, an incoming PhD student at the University of Tennessee-Knoxville, was awarded the 2018 Robert E. Uhrig Graduate Fellowship. Floyd completed his undergraduate degree at the University of Tennessee-Knoxville in Nuclear Engineering in May

2018. Dan's research interests are in the areas of advanced reactor instrumentation and autonomous control. He is currently enrolled as a PhD student at the University of Tennessee-Knoxville, working with Dr. Richard Wood in these areas.

HFICD established the Robert Uhrig Graduate Fellowship in 2014 to honor the career and

achievements of Dr. Bob Uhrig. Dr. Uhrig led a distinguished career at University of Florida, Florida Power and Light, Oak Ridge National Laboratory, and the University of Tennessee-Knoxville. Dr. Uhrig's work prior to his retirement in 2002 was primarily in the development and application of artificial intelligence in nuclear power systems. Applications for the Robert Uhrig Graduate Fellowship are due each year on February 1. Graduate students pursuing research in instrumentation and controls and/or human factors and human-machine interface are encouraged to apply.



2018 NASER SCHOLAR: ANDY RIVAS



Andy Rivas won the 2018 Joseph Naser Undergraduate Scholarship. Rivas is a rising senior in Nuclear Engineering at the University of Florida. Rivas has worked with several UF faculty as an undergraduate researcher during his undergraduate

career, primarily in plasma-facing experiments. His career goals include becoming a Nuclear Reactor Officer and working to provide clean, reliable energy worldwide.

Rivas is active in the UF student chapter of ANS and served as the logistics chair for the 2018 ANS Student Conference. In addition to his involvement with ANS,

Rivas is active in the UF Power and Energy Club.

HFICD established the Joseph Naser Undergraduate Scholarship in 2016 to honor the past chair upon his retirement after 42 years with the Electric Power Research Institute. Dr. Naser dedicated much of his career to studying human factors, behavioral sciences, and instrumentation systems for nuclear plant operations and control room design. Applications for the Joseph Naser Undergraduate Scholarship are due each year on February 1. Undergraduate students interested in instrumentation and controls and/or human factors are encouraged to apply.





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HFICD STUDENT BEST PAPER AWARD

2018 ANS STUDENT CONFERENCE

Machine Learning Algorithms for Detection of False Data Injection Attacks at Nuclear Power Plants

Shannon Eggers, PhD
University of Florida

IT-based intrusion detection systems that prevent cyber attacks through access controls, firewalls, and cryptography are insufficient for cyber-physical systems with interconnected computer, networking, and physical processes. In nuclear power plants (NPP), cyber security solutions also tend to either ignore or oversimplify coordinated simultaneous cyber and physical attacks. We previously modeled a hypothetical multi-faceted attack in which intruders physically damage the reactor coolant system to create a Small Break Loss of Coolant Accident (SBLOCA) while at the same time introducing a false data injection attack to mask Reactor Protection

System (RPS) and Engineered Safeguard Features (ESF) actuation system process signals [1]. The effect of this combined assault could potentially prevent or delay a reactor trip and the actuation of key protection systems such as engineered safeguards and emergency core cooling. This research analyzed two anomaly detection algorithms, principal component analysis (PCA) and independent component analysis (ICA), in their ability to detect simulated false data intrusion attacks in real process data obtained from a NPP data historian. Based upon the results of this study, PCA and ICA algorithms are promising alternatives for online intrusion detection monitoring using plant process data. As coordinated cyber and physical attacks evolve in sophistication, a suite of tools incorporating this capability will provide greater defense in depth against cyber attacks at nuclear facilities.

References

1. S. Eggers and A. Enqvist, "Modeling of coordinated cyber and physical attacks at nuclear power plants," in 2018 ANS International Congress on Advanced Nuclear Plants. ANS, 2018.



Shannon Eggers receives the HFICD Best Paper Award at the 2018 ANS Student Conference, presented by ANS President, Bob Coward.



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2018 DON MILLER AWARD WINNERS

HFICD honored two distinguished members of the human factors and instrumentation and control community with the Don Miller Award at the 2018 ANS Annual Meeting. Dr. Belle Upadhyaya was recognized for over 40 years of teaching and original research contributions including modeling nuclear plant dynamics, monitoring and diagnosis, signal processing, and reliability and maintainability engineering. Dr. Jin Jiang was recognized for his extraordinary contributions and impacts to research, development, and training in control, instrumentation, and electrical systems for nuclear power plants. Dr. Upadhyaya and Dr. Jiang will be formally recognized at the 11th NPIC-HMIT Conference in Orlando, Florida in February 2019.



Dr. Belle Upadhyaya is a Professor Emeritus in Nuclear Engineering at the University of Tennessee-Knoxville, where he has been since 1975. His activities of teaching and original research have won Dr. Upadhyaya national and international recognition in nuclear engineering and process control areas. Dr. Upadhyaya was the recipient of the 2007 American Society for Engineering Education Glenn Murphy Award for “notable professional contributions to the teaching aspects of nuclear engineering”. He is an elected fellow of the American Nuclear Society (ANS), a life fellow of the International Society of Automation (ISA), and an elected fellow of the International Society for Engineering Asset Management (ISEAM). His areas of research and technical contributions include: power plant dynamics, instrumentation and control; monitoring and diagnosis of process units; advanced signal processing for sensor and structural integrity monitoring in nuclear plants; aging and life prediction of detectors and equipment; fault detection and isolation of sensors and field devices; and reliability and maintainability engineering. His research and technical leadership in machinery monitoring and diagnosis resulted in establishing the Reliability and Maintainability Center at the University of Tennessee, which now offers undergraduate and graduate credentials and serves nearly 100 corporate members.

Dr. Jin Jiang is a Professor in Electrical and Computer Engineering at Western University in London, Ontario, where he has been since 1991. Since 2003, he has served as the NSERC/UNENE Senior Industrial Research Chair Professor in I&C for Nuclear Power Plants. Dr. Jiang is a distinguished expert, who has engaged in research on several aspects of advanced Instrumentation and Control Systems for safe and efficient operation of nuclear power plants. His solid research program is of scientific and technological importance and has contributed significantly to scientific advances in this field. He has made invaluable contributions to both fundamental and industrially applied research in I&C for nuclear power plants.



His contributions are original and significant, and have been widely accepted and recognized. As an active and productive scientist and researcher, he has an impressive record of publications with over 140 papers in leading peer-reviewed journals and over 150 papers in high-caliber conference proceedings. Of his 7 books and monographs, “Control of Nuclear Reactors” Atomic Energy Press, China, (2009), co-authored with Professor J. M. Zhang, has become a prescribed textbook on reactor control by the Chinese Ministry of Education.



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2018 TED QUINN EARLY CAREER AWARD



Chad Kiger, EMC engineering manager at Analysis and Measurement Services Corporation in Knoxville, TN, was awarded the 2018 Ted Quinn Early Career Award at the 2018 ANS Annual Meeting. Mr. Kiger is recognized for his early career contributions

to the development of standards and guidelines for Electromagnetic Compatibility testing and implementation of wireless technologies for voice and data communication and equipment condition monitoring. Mr. Kiger's accomplishments will be recognized at the 11th NPIC-HMIT conference in Orlando, Florida in February 2019.

HFICD established the Ted Quinn Early Career Award in 2017 to recognize an individual for outstanding early career contribution to nuclear instrumentation and control or human machine interface technologies. It is named after Mr. Ted Quinn, President of Technology Resources, recognized leader in I&C and former ANS President. This award highlights the importance of young members in the future developments of nuclear instrumentation and controls and human factors research, development, and deployment. Nominations of deserving individuals are due each year by March 1.



HFICD EXCOMM STUDENT REPRESENTATIVE



Lee Maccarone succeeded Zach Welz as the HFICD student representative to the Executive Committee at the 2018 ANS Annual Meeting. Maccarone is a Ph.D. student at the University of Pittsburgh, working under current HFICD Secretary, Professor Daniel Cole.

Maccarone completed his B.S. degree in Mechanical Engineering in April, 2016 and immediately moved into his graduate program. His graduate research focuses on vulnerability assessment for nuclear power plant digital instrumentation and control systems. His dissertation research will develop techniques to mitigate the effects of cyber-attacks on such systems.

Maccarone won one of two HFICD best paper awards at the 2017 ANS Student Conference for his work investigating the unobservable subspace of steam generator systems for cyber-vulnerability assessment. A summary of that paper is available in the Spring 2017 HFICD newsletter.

HFICD would like to extend many thanks to Dr. Zach Welz, who served as the student representative from 2014-2016. Welz received his Ph.D. in Nuclear Engineering from the University of Tennessee in August, 2016 and transitioned to a regular member of the HFICD Executive Committee. We wish him the best in his new career at the Georgia Tech Research Institute.



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WHO IS HFICD?

The Human Factors, Instrumentation & Controls Division (HFICD) of the American Nuclear Society (ANS) is devoted to the human component of nuclear energy, along with the underlying instrumentation, control, and human-machine interface technologies. It is the leading division for advancing and promoting measurement and control technologies and the interface between operators, controls and instruments.

HFICD has been part of the ANS since 1979, when the Technical Group for Human Factors was formed. The Group became a division in 1985 and was broadened to include Instrumentation & Controls in 2008. Today, the HFICD has nearly 700 members, representing approximately 6% of ANS membership. Division members are found across all sectors of the nuclear field from utility, manufacturing, suppliers, consulting companies, national laboratories, government agencies, students, and educational institutions. HFICD includes nearly 10% student members and supports a very active student population.

The HFICD focuses on the information processing, control, and human system interaction aspects of nuclear systems. This includes the sensors that transduce physical processes into signals, monitoring, control and communications systems that process data into information and manage control and protective actions, the interfaces that display plant operational and health information, and the human cognitive capabilities that enable perception and interpretation of information.

HFICD has four primary missions:

- Provide a forum for the exchange of technical information for practitioners within the field
- Provide mechanisms for training and education for individuals entering the field or practitioners improving their skills

- Serve as an advocated for advancing HFIC technology and/or practice within the nuclear arena

- Serve as a point-of-access for external inquiries into nuclear HFIC technology and/or practices

If you have any suggestions for programs to help achieve these goals or want to volunteer to support HFICD, please contact Jamie Coble (jamie@utk.edu) to discuss new and ongoing initiatives.





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2018-2019 HFICD OFFICIALS

OFFICERS



Raymond Herb
CHAIR
Southern Company



Brent Shumaker
1st VICE CHAIR
Senior Systems Engineer
AMS Corporation



Mehdi Tadjalli
2nd VICE CHAIR
Chief Engineer and Director
Enercon Federal Services, Inc.



Daniel Cole
SECRETARY
Associate Professor
University of Pittsburgh



Carol Smidts
TREASURER
Professor
The Ohio State University

EXECUTIVE COMMITTEE (NEW MEMBERS)



Ronald Boring
Human Factors Scientist
Idaho National Laboratory



Eric Harvey
Senior Technical Leader
Electric Power Research
Institute



Hyun Gook Kang
Associate Professor
Rensselaer Polytechnic Institute



Pradeep Ramuhalli
Senior Scientist
Pacific Northwest National Laboratory

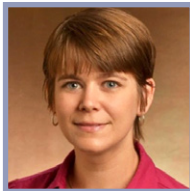


Lee Maccarone
Graduate Student Representative
Ph.D. Student
University of Pittsburgh

PAST HFICD CHAIRS



Sacit Cetiner
2017-2018 CHAIR
R&D Staff
Oak Ridge National Lab



Jamie Coble
2016-2017 CHAIR
Assistant Professor
University of Tennessee



Sean M. Smith
2015-2016 CHAIR
Embedded Software
Engineer
Lockheed Martin Corp.



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HFICD Executive Committee

2018-2019 Student Representative
Lee Maccarone, University of Pittsburgh

Term Ending in 2019
Johanna Oxstrand
(Edward) Ted Quinn
Richard Wood

Term Ending in 2020
John Hernandez
Paul Hutton
Stephen McCord
Mitch McCrory

Term Ending in 2021
Ronald Boring
Eric Harvey
Hyun Gook Kang
Pradeep Ramuhalli

Staff Liaison
Valerie Vasilievas

Board Liaison
Daniel Churchman

Ex Officio
Hans D. Gougar
Sacit Cetiner

Upcoming ANS Meetings

Utility Working Conference and Vendor Technology Expo
AUGUST 5-8, 2018

"25th Conference - Nuclear Rising to the Challenge"
Amelia Island, Florida
Omni Amelia Island Plantation

2018 ANS Winter Meeting
NOVEMBER 11-15, 2018

"Joining Forces to Advance Nuclear"
Orlando, FL
Hilton Orlando Bonnet Creek

- Division Program Committee Meeting:
Sunday November 11 from 11am - 12pm
- Division Executive Committee Meeting:
Sunday November 11 from 12pm - 2:30pm

11th Nuclear Plant Instrumentation and Control and Human-Machine Interface Technology (NPIC-HMIT) Conference

FEBRUARY 9-14, 2019
Orlando, FL
Renaissance Orlando at Seaworld



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11th Nuclear Plant Instrumentation, Control and Human-Machine Interface Technologies

February 9–14, 2019 | Orlando, FL | Renaissance Orlando at SeaWorld



CALL FOR PAPERS

EXECUTIVE CHAIRS

Honorary Chair

Bradley Adams (VP of Engineering, Southern Nuclear Operating Company)

General Co-Chairs

Daniel Churchman (Fleet Engineering Director, Southern Nuclear Operating Company)

Jason Remer (Director of Life Extension and New Technology, Nuclear Energy Institute)

Technical Co-Chairs (I&C)

Pradeep Ramuhalli (Senior Research Scientist, Pacific Northwest National Laboratory)

Technical Co-Chairs (I&C) CONTINUED

Michael Doster (Prof. of Nuclear Engineering, North Carolina State University)

James Turso (Asst. Dir. and Assoc. Res. Prof., Penn State University Radiation Science and Engineering Center)

Technical Co-Chairs (HFE)

Ron Boring (Human Factors Principal Scientist, Idaho National Laboratory)

Carol Smidts (Prof. of Nuclear Engineering, Ohio State University)

ABSTRACT DEADLINE: TUESDAY, JULY 31, 2018

JULY	→	ABSTRACTS DUE: Tuesday, July 31 (less than 1000 words)
AUGUST	→	REVIEW NOTIFICATION: Tuesday, August 14, 2018
SEPTEMBER	→	FULL PAPERS DUE: Friday, September 14, 2018
OCTOBER	→	REVIEW NOTIFICATION: Wednesday, October 31, 2018
DECEMBER	→	FINAL PAPERS DUE: Monday, December 17, 2018

ABOUT THE MEETING

This topical meeting is the eleventh in a series organized by ANS Human Factors, and Instrumentation and Controls Division (HFICD). Authors are invited to participate in the International Topical Meeting on Nuclear Plant Instrumentation, Control, and Human-Machine Interface Technologies (NPIC & HMIT).

Sponsored by American Nuclear Society (ANS), NPIC & HMIT builds upon the successes of previous meetings. The meeting welcomes the submission of full-length technical papers, which will be peer reviewed and published as conference proceedings. Submitted papers must be presented. Detailed information and announcements regarding the conference will be posted on ans.org/meetings/npichmit/.

ABSTRACT GUIDELINES

Maximum of one page identifying title, authors, affiliations, and three paragraphs (total less than 1000 words) describing the key concepts of the paper. A wide range of topic areas are highlighted on the second page of this call. Authors are encouraged to submit papers on these proposed topics as well as others. Authors of accepted abstracts will be notified by **August 14, 2018**.

FULL PAPER SUBMISSION

Full papers must describe work that is new, significant, and relevant to the nuclear industry and the subject of the conference. Authors of accepted papers must agree to register and attend the conference and present their papers in person. Papers that are not presented in person at the conference will not appear in the final conference publication. Authors of accepted full papers will be notified by **October 31, 2018**.

SUBMIT AN ABSTRACT
ans.org/meetings/npichmit/

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11th Nuclear Plant Instrumentation, Control and Human-Machine Interface Technologies

February 9–14, 2019 | Orlando, FL | Renaissance Orlando at SeaWorld



SUGGESTED TOPICS

INSTRUMENTATION AND CONTROLS (I&C)

Data Analytics
Autonomous Control
Latest Trends in Digital I&C
Management of I&C Aging and Obsolescence
Electromagnetic Compatibility (EMC) and EMI/RFI Issues
Nuclear Energy R&D in I&C Area
Next Generation I&C Systems
Safety Critical Software Development, Qualification, and V&V
I&C and OLM Considerations for Life Beyond 60 Years
Wireless Technologies for Nuclear Facilities
Education and Training of I&C Professionals
Diversity and Defense in Depth (D3)
Modeling Digital I&C Systems in PRA/PSA
Advanced Surveillance, Diagnostics, and Prognostics
Field Programmable Gate Array (FPGA)
I&C Modernization Experience
SMR Instrumentation and Control
I&C for Advanced Reactors
On-line Monitoring for Maintenance Optimization
Hazard and Failure Mode Analysis for Digital Systems
I&C Regulations, Standards, and Guidelines
Digital System Reliability
Light Water Reactor Sustainability (LWRS)
On-Line Monitoring of Rod Control Systems
Cyber Security in Digital I&C
Managing and Preserving I&C Knowledge and Competence
Advanced Sensors and Measurement Technologies
Cable Aging and Cable Condition Monitoring
Research Reactor I&C
In-Pile Instrumentation
I&C Lessons Learned from Fukushima
Productivity/Efficiency Improvement
Digital Control System Applications
General Sessions in I&C

HUMAN FACTORS (HF)

Current Concepts in Advanced Control Rooms
Experience with Control Room Modernization
Lessons Learned from the Design and Operation of Generation III and III+ Reactors
Nuclear Energy R&D in HMI Areas
Applications of Technology to Enhance O&M
Design and Development of Group-View, Wall-Panel Displays
Visualization Techniques to Improve Human Decision Making
Computerized Procedure Systems
Use of Virtual Reality to Support Design and O&M
Use of Simulation for Design, Engineering, Maintenance and Verification Activities
Emerging Concepts of Operations for Advanced Reactors
Innovative Human Interface Technologies
HFE Use of PRA/PSA Insights and Results for Design and Operations
Computerized Operator Decision and Support Systems
Innovative Solutions to Alarm Overload
HFE Verification and Validation: Approaches and Methods
Designing Control Rooms for Small Modular Reactors
HFE Education and Training
Lessons Learned from Soft Controls in Plant Operations
Human Factor Lessons from Fukushima
HFE Contributions to Productivity and Efficiency
Human Factors Aspects of SMRs
HFE Standards and Guidelines Update
Workstation and Control Room Layout Design for Computer-Based Control Rooms
Use of Work-Domain and Cognitive Task Analysis for Human-System Interface Design
Human Reliability Issues in Digital Systems and Computer-Based Control Rooms
Operation of Hybrid Control Room
General Sessions in Human Factors
Advances in HFE Design and Analysis Tools
Advances in Human-Automation and Human Performance Assessment

Note: The topics listed above are not session titles; they are provided just as a guide for paper topics. The technical program committee will be happy to expand the areas and include new sessions into the program. Please contact the Technical Program Chairs for suggestions.