ANS HFICD

SPRING 2016 NEWSLETTER http://hficd.ans.org

SPECIAL SESSION ON SOFTWARE DEPENDABILITY

HFICD is hosting a special session at the 2016 ANS Annual Meeting in New Orleans, LA. This session held on Wednesday, June 15th at 1:00 PM, focuses on the latest research in software reliability and dependability and includes the analysis and quantification methods. Speakers from the government, national labs and standards bodies will address the lessons learned in the research and next steps. Organized and moderated by Dr. Carol Smidts (The Ohio State University) and Mr. Ted Quinn (Technology Resources), papers and presentations at this special session include:

Importance Ranking of Software Dependability Attributes in the Nuclear Industry, Boyuan Li, Fuqun Huang (Ohio State), Ted L. Quinn (Technology Resources), Carol S. Smidts (Ohio State)

Development of an Automated Software Reliability Tester for Digital I&C, Brent D. Shumaker, Gregory Wayne Morton (AMS)

Software Dependability Lessons Learned, George Hughes (Schneider-Electric), invited

Software Dependability for Digital Instrumentation and Control Systems in Nuclear Power Plants—Lessons Learned from a DOE Sponsored Project, Carol S. Smidts, Fuqun Huang, Boyuan Li (Ohio State), Ted L. Quinn (Technology Resources)

Dependability Assessment of Software for Safety Instrumentation and Control Systems, Richard T. Wood (Univ of Tennessee), Robin E. Bloomfield (Adelard LLP), Nguyen Thuy (EdF R&D)

Development of Criteria for Hardware Descripted Language Programmed-Devices for Safety Systems in Nuclear Power Plants in the U.S., Steven A. Arndt, Rossnyev Alvardo, Bernard Dittman, Michael Waterman (NRC)

Automated Work Package: Initial Wireless Communication Platform Design, Development, and Evaluation, Ahmad Al Rashdan, Vivek Agarwal (INL)

Special Presentation by Dr. Arndt Lindner, 2016 Don Miller Award Winner: "Software Dependability Analysis."

If you have an idea for a session and/or would like to organize a session at a future meeting, please contact Kathy McCarthy (kathryn.mccarthy@inl.gov).

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ANS HFICD

THOUGHTS FROM THE CHAIR

—Sean Smith

Hello to the members of the division. I hope that this edition of the newsletter finds you well. I have only a few things that I would like to mention in this edition.

As usual, the terms of some executive committee members and division officers will expire at the end of the upcoming 2016 ANS Annual Meeting in New Orleans. My thanks goes out to those whose terms are expiring and I hope that you will extend your thanks to them, as well. The division cannot succeed without those who volunteer for these roles.

As current terms end, new terms of service will begin. Through the division's succession plan, the efforts of the nominating committee, the ANS voting process, and your votes, our officers will shift to new roles and the executive committee will be joined by new members.

Please consider volunteering to serve on the executive committee, one of our standing committees, or as a division officer. If you or someone you know would is willing to help the division in this capacity, please contact the division's nominations committee or any of the division officers.

My own term will expire this June. It has been a privilege to serve as your Chair and I thank you for your support. If you are able to attend the ANS meeting in New Orleans, I hope to see you there. Have a safe and pleasant summer.

Best regards,
Sean Smith, P.E.
HFICD 2015-2016 Chair

HFICD has a new website! The address hasn't changed, but the look and layout have. Please visit http://hficd.ans.org to take it for a spin. If you see something that you like (or something that you don't), let us know through the Contact Us link.

ANS HFICD

HUMAN FACTORS FOCUS: OVERCOMING "RESISTANCE" TO CHANGE

Autumn Szabo
Szabo Design and Engineering

New types of digital systems are being developed, and existing types are being upgraded with a variety of enhancements, at an unprecedented pace. Keeping up with these changes can present a problem in many industries, including a resistance by some to embracing the benefits offered by these rapid changes. Other individuals are curious as to why the resistance is so widespread and what can be done to minimize it. This article attempts to outline key strategies and observations when resistance seems overwhelming.

With the recent advent of advanced reactor designs, including those with new fuel designs and with passive safety features, many aspects of the existing regulatory infrastructure were challenged since legacy assumptions inherent to light water reactor regulations may no longer be applicable, including those that address digital systems, staffing needs, and human performance. For example, staffing and staffing models could be challenged with new reactor applications that require significantly fewer staff to safely operate these new designs. As such, research to address potential challenges in the regulatory assumptions in staffing models was initiated. The resulting outcome of the research included processes and approaches that allowed more flexibility within the current regulatory structure for staffing assessment and methods. Human performance modeling and the use of simulation software was one such method.

The following are key strategies to overcoming "resistance:"

- Clearly define the goals and potential barriers to successful implementation of digital systems.
- Effective change occurs when all affected parties are involved.
- Recognize that culture and individuals play a key role in change management.
- When changing paradigms from analog to digital systems, a business model transformation may also be necessary.

This article explores defining goals and potential barriers more in depth than the remaining bullets. There is no one factor that impedes digital transformation. Desire, money, and tools are the top three reasons most commonly listed as impediments to driving digital technology. Some typical barriers to successful implementation of digital systems include: complacency, clarity in roles and responsibilities, lack of leadership skills, lack of vision, unclear business case, business units independently operating in "silos," culture not amenable to change, budget challenges, limitations of information technology, and regulatory concerns.

Definition of the user's need is a key to ensuring that everyone is on the same page and understands the ultimate goal of the project. Is there a key analog system that is no longer on the market? Is there whole digital system that needs to be upgraded? The clarity in vision of the digital system as well as the business case should be derived early in the planning stages. There is always the old adage "if it isn't broke, don't fix it." However, there are tremendous capabilities and benefits to modernizing certain control systems. Provide a clear understanding of what the digital upgrade will do and what it will not do. Bounding conditions on the upgrade and the digital capability should also be clearly understood and communicated.

Culture and lack of communication across groups also cause many challenges in any project. Complacency has risen as a result of too much change too quickly; this aspect of the environment can be overwhelming for those not familiar with the latest technology. Consider patience and empathy when working with those who struggle to understand the merits of digital technology. Keep affected parties informed. Communicating with regulators during the process may also reduce risks and uncertainty.

Encourage the digital system rollout at the highest levels in the organization. Provide an individual that leads the digital transformation and holds the responsibility to make clear decisions. Specify roles and responsibilities during the term of the upgrade so individuals will know

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2016 UHRIG FELLOW: PRATHAMESH BILGUNDE

Iowa State University Center for NDE

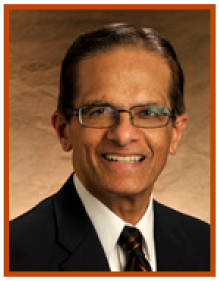
High temperature Ultrasonic Transducers for Advanced Small Modular Reactors

It is well recognized that under-coolant viewing and in-service nondestructive evaluation (NDE) are key enabling technologies required to facilitate the development of advanced small modular reactors (aSMR). Molten salt and liquid metal cooled reactors, using sodium or lead-bismuth, operate at elevated temperatures.The presence of such harsh environment poses major challenges for an effective NDE. The objective of this research is to develop ultrasonic transducers for a SMR whilst providing the modeling and experimental capabilities needed to analyze and understand the phenomena that limit performance and to enable optimization of in-service inspection capabilities.

The question that remains unanswered is the limited detection capability of the high temperature (HT) ultrasonic transducer. Thus, it is necessary to quantify the mechanisms that lead this sensitivity loss, to improve the signal-to-noise ratio. The causation between amplitude of the transmitted pulse and temperature dependence of the full-material matrix coefficients of a piezoelectric material is quantified in the current research to predict the performance of HT ultrasonic transducer. A physics based modeling approach is adopted to investigate the temperature dependency of ultrasonic transduction using the temperature dependent experimental data for the transducer materials. The characteristic model of HT pulse-echo NDT measurements in liquid sodium cooled fast flux nuclear reactor predicts 4 dB reduction in the amplitude of the ultrasonic signal as the temperature of PZT-5A is increased from 150 to 1950 C. However, simulated response of BSPT [[(1-x)BiScO3-xPbTiO3] piezoelectric material in the Morphotropic phase boundary composition, shows only -2dB transduction loss when the temperature is increased from room temperature to 3000C. Moreover, the amplitude of the transmitted signal shows negligible loss till 2000C which indicates that the BSPT has larger range of temperature over which transduction ability remains stable as compared to PZT-5A. It is also demonstrated that the measurement of electrical reactance of the ultrasonic transducer can be a key indicator of the material state and hence the performance of the transducer at high temperature. In addition to the piezoelectric material, temperature dependence of the backing layer, and matching layer is found to be the major source of acoustic noise. Moreover, the thermal degradation of adhesives joining the transducer components is reported to be the cause of failure of 60% HT transducers. To quantify these contributing elements, in-house capability for fabrication of HT ultrasonic transducers is being developed at Center for NDE. This fundamental work in quantifying the components that cause the sensitivity loss at high temperature can help in the development of robust high temperature transducer which is critical for the safety of the small modular reactors.

ANS HFICD

INSTRUMENTATION & CONTROLS FOCUS: DEVELOPMENT OF REFLECTION TRANSIT TIME ULTRASONIC FLOWMETER FOR COOLANT FLOW MEASUREMENT IN INTEGRAL PRESSURIZED WATER REACTORS



A recent capstone design project lead by Dr. Belle Upadhyaya at the University of Tennessee, Knoxville focused on the application of ultrasonic flow meters for flow measurement in non-circular flow channels. This design project was completed by Michael Cooper, Jason Rizk, Kendall Minor, Matthew Buttrey, and Shawn Tyler.

The objective of this senior design project was to design and build a laboratory scale flow loop to simulate the flow in the downcomer of an integral pressurized water reactor, and to perform the measurement of coolant flow rate using reflection time ultrasonic transducers. The dual ultrasonic transceivers are mounted on the outer cylindrical surface of the downcomer plenum; the acoustic signal is transmitted in upstream and downstream directions and reflected off the inner cylindrical surface. The bi-directional times of flight are measured and used to estimate the coolant flowrate and to establish the accuracy of flow velocity measurement by this technique.

Introduction

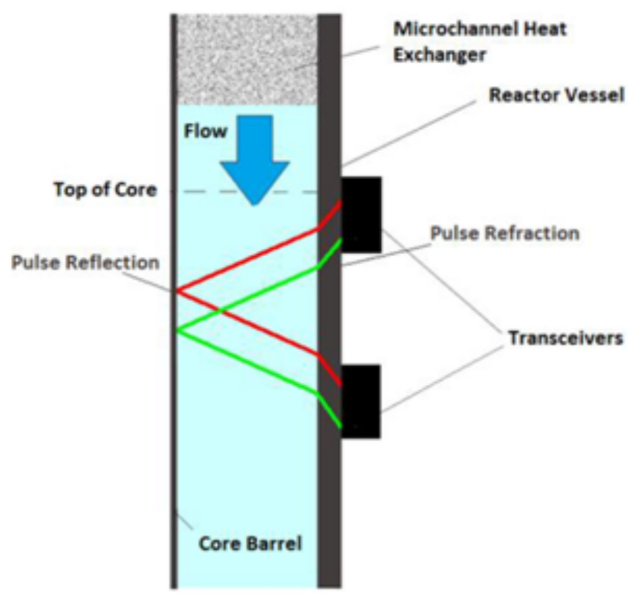
Several small modular reactor (SMR) and integral pressurized water reactor (iPWR) designs are being developed for possible deployment in the next decade. There are several challenges and technology gaps in the development of instrumentation for measuring reactor coolant flow rate. SMRs and integral reactors have limited vessel penetrations and piping, and this restricts the placement of traditional sensors, and especially flow meters such as Venturi and orifice meters. Additionally, the in-vessel space for locating sensors is limited. Even though the knowledge of actual primary coolant flow rate is not needed during normal reactor operation, the flow rate information is highly important (and is mandatory) during accident or transient reactor operation. In light of this technology gap, it is necessary to develop a non-evasive flow measurement approach.

Reflection Transit Time Ultrasonic Flowmeter

Ultrasonic flowmeters are routinely used in petrochemical industry and in other applications for fluid flow rate measurement in circular pipes. The objective of the senior design project at the University of Tennessee was to implement this approach for flow measurement in the downcomer section of an integral reactor. The downcomer plenum is annulus, and a section of this resembles a truncated cone rather than a circular pipe. The goal was to develop a non-intrusive technique for flow monitoring with an emphasis on measurement accuracy and calibration of installed device(s). The cylindrical shape of the region and the ratio of circular dimensions were approximated to that of a typical iPWR design. The challenge was to demonstrate the applicability of reflection transit time measurement by mounting the dual transceivers on the same external surface of a pressure vessel. This approach would also allow for wireless transmission of the measurements.

Principle of Flow Measurement

Reflection time ultrasonic flow meter has the advantage of installing the transducers outside the reactor vessel, with the return signal being received on the same side as the transmitted signal. Ultrasonic or high-frequency acoustic waves are transmitted both in the direction of flow and opposite to the direction of flow, as shown in the figure below. The transmitted signal is then reflected off a flat surface on the core barrel or the thermal shield. There is a large decrease in the energy of the received signal due to reflection and refraction. The knowledge of the transit times of the upstream and downstream wave propagation, the distance between two ultrasonic probes, and the angle of in-



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HUMAN FACTORS FOCUS (CONT'D)

where to direct questions.

In summary, "resistance" to digital transformation is common across many industries. Involve all parties with a stake in the outcome in the decision making process. Clearly define goals and barriers with an understanding and acceptance that digital technology resistance is natural within certain organizations. Remember that culture and individuals also play a role in successful outcomes of digital technology transformation.

References and additional reading:

1. P. Hopper and C. Spetzler. (2016) "You Can't Make Good Predictions Without Embracing Uncertainty." Harvard Business Review. Brighton, MA. (cited: 2016 May) Available from: https://hbr.org/2016/05/you-cant-make-good-predictions-without-embracing-uncertainty

2. J. McConnell. (2015) "The Company Cultures That Help (Or Hinder) Digital Transformation." Harvard Business Review. Brighton, MA. (cited: 2016 May) Available from: https://hbr.org/2015/08/the-company-cultures-that-help-or-hinder-digital-transformation

3. L. Alcala. (2015) "How To Survive Digital Transformation." Harvard Business Review. Brighton, MA. (cited: 2016 May) Available from: http://www.cmswire.com/digital-experience/how-to-survive-digital-transformation/

4. Westerman, G., Bonnet, D., and McAfee, A. (2014) "The Nine Elements of Digital Transformation." Massachusetts Institute of Technology (MIT) Sloan Management Review. Cambridge, MA (cited: 2016 May) Available from: http://sloanreview.mit.edu/article/the-nine-elements-of-digital-transformation/

5. M. Fitzgerald, N. Kruschwitz, D. Bonnet, and M. Welch. (2013) "Embracing Digital Technology: A New Strategic Imperative." MIT Sloan Management Review. Cambridge, MA (cited: 2016 May) Available from: http://sloanreview.mit.edu/projects/embracing-digital-technology/

2016 HFICD STUDENT BEST PAPER AWARD WINNER

Detailed Study of the Transient Rod Pneumatic System on the Annular Core Research Reactor - Brandon Fehr, Georgia Institute of Technology

Throughout the history of the Annular Core Research Reactor (ACRR), transient rod (TR) A has experienced an increased rate of failure versus the other two TRs (B and C). Either by pneumatic force or electric motor, the transient rods remove the poison rods from the ACRR core allowing for the irradiation of experiments. In order to develop causes for why TR A is failing more often, a better understanding of the whole TR system and its components is needed. This study aims to provide a foundational understanding of how the TR pneumatic system affects the motion of the TRs and the resulting effects that the TR motion has on the neutronics of the ACRR.

Transient rod motion profiles have been generated using both experimentally-obtained pressure data and by thermodynamic theory, and input into Razorback, a SNL-developed point kinetics and thermal hydraulics code, to determine the effects that TR timing and pneumatic pressure have on reactivity addition and reactivity feedback. From this study, accurate and precise TR motion profiles have been developed, along with an increased understanding of the pulse timing sequence. With this information, a safety limit within the ACRR was verified for different TR travel lengths and pneumatic system pressures. In addition, longer reactivity addition times have been correlated to cause larger amounts of reactivity feedback. The added clarity on TR motion and timing from this study will pave the way for further study to determine the cause for the increased failure rate of TR A.

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.

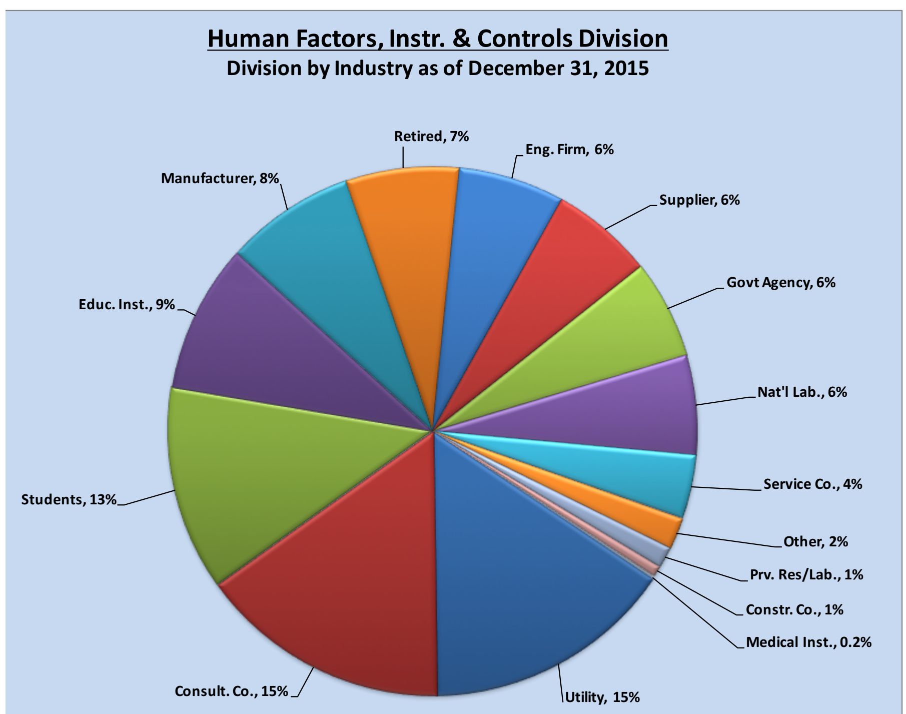
HFICD has been part of the ANS since 1979, when the Technical Group for Human Factors was formed. The Group became a division in 1985 and was broadened to include Instrumentation & Controls in 2008. Today, the HFICD has more than 800 members (166 working in utilities, 128 consultants, 99 educators, and many others).

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.

Among the HFICD's main goals are to disseminate HFICD information among its members and to promote HFICD–related activities in the nuclear power industry.

HFICD has 765 members across all professional areas of ANS. We have maintained this strong membership for the last five years, and membership continues to grow. 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. The current membership of HFICD is dominated by utilities and consulting companies, with roughly 15% of membership each. Nearly 11% of our division members are ANS Young Members, and another 13% are student members.

The Division's successful flagship Topical Meeting, the Nuclear Plant Instrumentation and Control-Human Machine Interface Technology (NPIC-HMIT), is an opportunity to present the results of one's work and to find out how others are solving problems in the HFICD's professional areas. The 10th NPIC-HMIT meeting will be held as an embedded topical at the 2017 ANS Annual Meeting in San Francisco, CA on June 11-15.



H.M. HASHEMIAN RECEIVES THE UNIVERSITY OF TENNESSEE-COLLEGE OF ENGINEERING'S PRESTIGIOUS NATHAN W. DOUGHERTY AWARD

David Goddard, University of Tennessee College of Engineering

College of Engineering Dean Wayne T. Davis (right) presents the Nathan W. Dougherty Award to H.M. Hashemian (left).

H.M. Hashemian, a University of Tennessee College of Engineering alumnus and the President and Chief Executive Officer of Analysis and Measurement Services Corporation (AMS), a nuclear engineering consulting firm headquartered in Knoxville, Tennessee, and operating in the United States, Europe, and Asia, was the recipient of the college's most prestigious honor, the Nathan W. Dougherty Award.

Dr. Hashemian was recognized at the college's Faculty and Staff Awards Dinner on Thursday, April 21, 2016, held at the Knoxville Museum of Art.

Dr. Hashemian's technical and operational vision and leadership has enabled AMS to play a key role in ensuring the safe and cost-efficient operation of virtually every US nuclear power plant, as well as many in Europe and Asia, through the development and application of industry-leading instrumentation and control testing and analysis equipment and services.

A globally recognized expert who lectures frequently in nuclear power plant instrumentation and control areas, Dr. Hashemian holds a PhD in nuclear engineering, a Doctor of Engineering degree in electrical engineering, and a PhD in computer engineering. He has worked for the nuclear, aerospace, and other industries, as well as the US government, including the Nuclear Regulatory Commission, Department of Energy, Department of Defense, Air Force, Navy, and the National Aeronautics and Space Administration.

Dr. Hashemian is the author of three books: Sensor Performance and Reliability (ISA, 2005), Maintenance of Process Instrumentation in Nuclear Power Plants (Springer Verlag, 2006), and Monitoring and Measuring I&C Performance in Nuclear Power Plants (ISA, 2014). His books have been translated into Chinese, Japanese, Korean, and Russian. In addition, he is the author or co-author of twenty US patents (fourteen awarded and six pending) and has written more than three hundred papers and reports. This includes seventy peer-reviewed journal and magazine articles, over two hundred conference papers, nine book chapters, and numerous reports, guideline documents, and standards for the US Nuclear Regulatory Commission (NRC), the Electric Power Research Institute (EPRI), the International Atomic Energy Agency (IAEA), the International Electrotechnical Commission (IEC), and the International Society of Automation (ISA).

Dr. Hashemian is a Fellow of the American Nuclear Society (ANS), a Fellow of the International Society of Automation (ISA), a Fellow of the International Society of Engineering Asset Management (ISEAM), a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE), as well as a member of the European Nuclear Society (ENS). He has served as a keynote speaker, chairman, and co-chairman of numerous national and international conferences and committees.

The Nathan W. Dougherty Award was established by the College of Engineering in 1957 to pay tribute to Dr. Nathan Washington Dougherty, dean of the engineering college from 1940-56. The award honors engineers whose activities have brought acclaim to the university.

Dr. Dougherty, a 1909 UT graduate, was both an engineer and an outstanding athlete. He was president of the American Society for Engineering Education in 1954-55 and was Chairman of the UT Athletics Board from 1917 until he retired in 1956.

Previous recipients of the Nathan W. Dougherty Award include Charles "Chad" Holliday, previous CEO of DuPont and the current chairman of the board at Royal Dutch Shell; IBM Fellow Mark Dean, one of the developers of the personal computer; and Joe C. Cook, Jr., former CEO of Eli Lilly & Company Pharmaceuticals and the founder and director of Ironwood Pharmaceuticals, Inc.

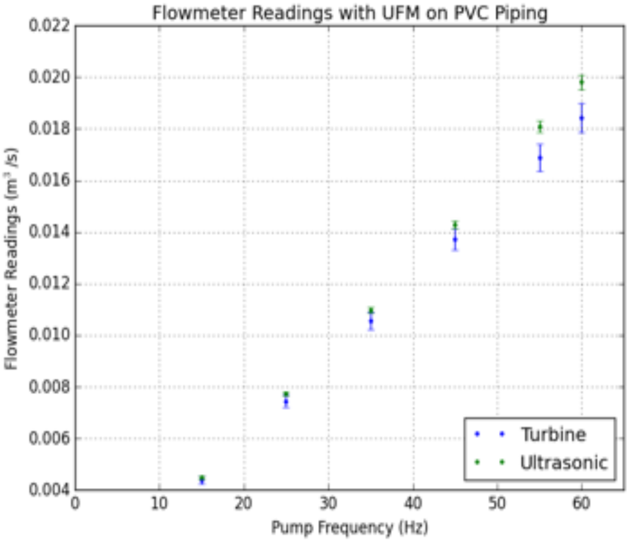
I&C FOCUS (CONT'D)

cident of the transmitted waves are then used to estimate the transit time of coolant between the two detectors. It is necessary to ensure proper installation of the ultrasonic probes, with acoustic coupling between the probe and vessel wall surface. Vessel temperature and high frequency (small amplitude) vibration would cause the measurements to have errors.

Experimental Loop and Results of Flow Measurement

An experimental flow loop was designed and built to demonstrate the applicability of this approach for flow measurement in non-circular metal sections. The loop consists of a cast steel rectangular test section (84-inchx12-inchx3-inch), a centrifugal pump driven by a 7.5 hp variable speed induction motor and a variable frequency drive. About 60-ft of piping was installed to enable any gas in the water to be reabsorbed by the circulating water. Two ultrasonic probes were installed on the 3-inch surface of the test section with interface to a General Electric AT600 ultrasonic module that transmits to and receives the high frequency data from the transducers. The maximum water flow rate is 300 gpm, at a pump speed of $\approx$ 3600 RPM. The pump speed was varied from 900 RPM to 3600 RPM for testing and data acquisition at variable flow conditions. A turbine flowmeter was installed for verification of the flow rate measured by the ultrasonic device.

The plot below shows the comparison of the flow rates (m^3/sec) as measured by the ultrasonic device and the turbine flowmeter. The ultrasonic meter was within 5% of the measurements given by the turbine flowmeter. The results demonstrate the feasibility of using ultrasonic reflection transit time approach for flow rate measurement in a non-evasive manner.



Remarks

In order to provide an average value of the flow rate measurement in practice, it is necessary to have these probes installed around the vessel circumference, and use these multiple measurements to estimate an average flow velocity. Design challenges for application to integral reactors include overcoming high-temperature and radiation environment, and installation of the devices at appropriate locations around the reactor vessel.

Acknowledgments

This design project was funded in part by a grant from the Electric Power Research Institute.

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Upcoming ANS Meetings

2016 ANS Annual Meeting
JUNE 12-16, 2016
"Nuclear Power: Leading the Supply of Clean, Carbon Free Energy"
New Orleans, Louisiana
Hyatt Regency New Orleans

- Division Program Committee Meeting:
  Sunday June 12 from 11am - 12pm
  Meetin room TBD
- Division Executive Committee Meeting:
  Sunday June 12 from 12pm - 2:30pm
  Meeting room TBD

Utility Working Conference and Vendor Technology Expo
AUGUST 14-17, 2016
Amelia Island, Florida
Omni Amelia Island Plantation

2016 ANS Winter Meeting and Nuclear Technology Expo
NOVEMBER 6-10, 2016
"Nuclear Science & Technology: Imperatives for a Sustainable World"
Las Vegas, Nevada
Caesar's Palace

10th International Embedded Topical Meeting on Nuclear Plant Instrumentation, Control & Human-Machine Interface Technologies (NPIC & HMIT 2017)

June 11–15, 2017 • San Francisco, CA, USA • Hyatt Regency San Francisco

CALL FOR PAPERS

Abstract Submission Deadline: Friday, September 30, 2016

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

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Johanna Oxstrand – HFE Tracks
Human Factors Scientist • Idaho National Laboratory

About the Meeting

This embedded topical is the tenth 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).

NPIC & HMIT is the de facto forum for nuclear instrumentation and control (I&C) and human factors engineering (HFE) professionals to meet with leaders in industry and academia, discover the state of the technology, exchange information, and discuss future directions.

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.

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 October 15, 2016.

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 April 10, 2017.

Page Charges

All full papers are limited to ten pages. Any paper exceeding the ten-page limit will be charged a $100.00 per page.

Submission Website

http://npic-hmit.ans.org/

Detailed information and announcements regarding the conference will be posted on the website.

Proceedings Coordinator

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Key Dates

Abstracts Due
September 30, 2016

Notification of Acceptance
October 15, 2016

Full Papers Due
February 28, 2017

Notification of Full Paper Acceptance
April 10, 2017