



EXECUTIVE PROFILE



H.M. "HASH" HASHEMIAN is 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. His technical and operational vision and leadership have enabled AMS to play a key role in ensuring the safe and cost-efficient operation of virtually every U.S. nuclear power plant, as well as many in Europe and Asia. He has accomplished these successes through the development and delivery of industry-leading instrumentation and control system testing and analysis equipment, training, and services.

A globally recognized expert in peaceful applications of nuclear energy for electricity generation and medical diagnostics and treatment, Dr. Hashemian lectures frequently around the world on nuclear power plant instrumentation and control areas. He holds three doctorate degrees in engineering including a Ph.D. in nuclear engineering, a Doctor of Engineering degree in electrical engineering, and a Ph.D. in computer engineering. He has worked for the nuclear, aerospace, and other industries, and U.S. government organizations such as the Nuclear Regulatory Commission, Department of Energy, 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 19 U.S. patents (17 awarded and 2 pending) and has written more than 300 papers and reports. This includes 70 peer-reviewed journal and magazine articles, over 200 conference papers, 9 book chapters, and numerous reports, guideline documents, and standards for the U.S. 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 Institute of Electrical and Electronics Engineers (IEEE), a Fellow of ISA, 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 and serves as an adjunct professor of nuclear engineering at the University of Tennessee.



PERSONAL DETAILS

HASHEM M. ("HASH") HASHEMIAN

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Knoxville, Tennessee 37923, USA
Citizenship: USA
Specialty: Nuclear Power Plant Instrumentation

ACADEMIC BACKGROUND

1977 ~ Present

Doctor of Philosophy (PhD), Nuclear Engineering
Chalmers University of Technology, Sweden
Doctor of Philosophy (PhD), Computer Engineering
University of Western Ontario, Canada
Doctor of Engineering (DEng), Electrical Engineering
Lamar University, USA
Master of Science, Nuclear Engineering
University of Tennessee, USA

WORK HISTORY

1985 ~ Present

President and Chief Executive Officer (CEO)
Analysis and Measurement Services Corporation
www.ams-corp.com

ABOUT AMS

Analysis and Measurement Services Corporation (AMS) is a nuclear engineering consulting firm headquartered in the United States with representatives in Austria, South Korea, Spain, Switzerland, and the United Kingdom. AMS provides equipment, training, and testing services to nearly all the nuclear power plants in the United States and many across the world. Furthermore, AMS works with a number of national and international organizations such as the U.S. Department of Energy (DOE), Electric Power Research Institute (EPRI), International Society of Automation (ISA), International Atomic Energy Agency (IAEA), and the International Electrotechnical Commission (IEC).

Headquartered in Knoxville, Tennessee, on a four-facility campus spanning more than 50,000 square feet of office and laboratory space, AMS is a leading supplier of equipment, training, and services for in-situ response time testing and on-line calibration monitoring of temperature and pressure instrumentation in nuclear power plants. AMS also provides automated equipment for performance testing of a variety of electrical and mechanical components and systems in nuclear power plants and has performed high technology research and development projects for the U.S. Department of Energy (DOE), U.S. Nuclear Regulatory Commission (NRC), U.S. Department of Defense (DOD), NASA, U.S. Navy, U.S. Airforce, utilities, manufacturers, and vendors.



INNOVATING NUCLEAR TECHNOLOGY
ANALYSIS AND MEASUREMENT SERVICES CORPORATION



PROFESSIONAL AFFILIATIONS

Fellow, American Nuclear Society (ANS)

Fellow, Institute of Electrical and Electronics Engineers (IEEE)

Fellow, International Society of Automation (ISA)

Member, European Nuclear Society (ENS)

Member, American Society of Mechanical Engineers (ASME)

Honorary Member, Tau Beta Pi Engineering Honor Society

Governor-appointed Representative, Tennessee State Energy Policy Council (2018)

Member, Honors and Awards Committee of the American Nuclear Society (2016–2017)

Member, U.S. Department of Commerce's (DOC) Civil Nuclear Trade Advisory Committee (CINTAC) (2016)

Member, East Tennessee Economic Council (ETEC) (2016–present)

Inductee, University of Tennessee Nuclear Engineering Department Hall of Fame (2017)

Member Emeritus, College of Engineering Advisory Board, University of Tennessee (2014–present)

General Chairman, American Nuclear Society's 9th International Topical Meeting on Nuclear Power Plant Instrumentation, Control and Human-Machine Interface Technologies (NPIC & HMIT 2015), Charlotte, NC (February 2015)

Chairman (2013–2014) and Member (2014–2015) of Nominating Committee for the Human Factors, Instrumentation & Controls Division (HFICD) of the American Nuclear Society

Chairman, International Atomic Energy Agency (IAEA) Coordinated Research Project (CRP), "Improved Instrumentation & Control Maintenance techniques for Research Reactors" (2012–2015)

Chairman, International Atomic Energy Agency (IAEA) Coordinated Research Project (CRP), "Qualification, Condition Monitoring, and Management of Aging of Low Voltage Cables in Nuclear Power Plant Life Management" (2012–2015)

Chairman, Human Factors, Instrumentation & Controls Division (HFICD) of the American Nuclear Society (2012–2013)

Member of Technical Program Committee, American Nuclear Society's 8th International Topical Meeting on Nuclear Power Plant Instrumentation, Control and Human-Machine Interface Technologies (NPIC & HMIT 2012), San Diego, CA (July 2012)

Former Member, Industrial Advisory Board of Electrical Engineering and Computer Science (EECS) Department, University of Tennessee (2012–2015)

Technical Program Co-Chair, American Nuclear Society's 7th International Topical Meeting on Nuclear Power Plant Instrumentation, Control and Human-Machine Interface Technologies (NPIC & HMIT 2010), Las Vegas, NV (November 2010)

Member, Dean's Advisory Board for the College of Engineering, Lamar University, Texas (2010–present)

Member, U.S. National Committee of the International Electrotechnical Commission (IEC) and project leader for three IEC standards on testing the safety systems of nuclear power plants (2005–present)



**PUBLICATION REVIEW
& ACADEMIC SERVICES**

Nuclear Technology Journal of ANS
IEEE Transactions on Nuclear Science
IEEE Transactions on Instrumentation & Measurement
ISA Transactions
Annals of Nuclear Energy Journal by Elsevier
International Journal of Nuclear Energy Science and Technology by Inderscience
ASME Journal of Dynamic Systems–Measurement and Control
ASME Journal of Heat Transfer
Japan's Journal of Nuclear Science and Technology
Measurement Science and Technology Journal by IOP Publishing
Mechanical Systems and Signal Processing Journal by Elsevier
Nuclear Engineering and Design Journal by Elsevier
Nuclear Engineering and Technology Journal by Korean Nuclear Society
Nuclear Instruments and Methods in Physics Research by Elsevier
Progress in Nuclear Energy Journal by Elsevier
Recent Patents on Signal Processing Journal by Bentham Science
Water Research Journal by Elsevier

Adjunct professor of nuclear engineering at the University of Tennessee–Knoxville
Guest lecturer (2009–present) at the Electrical Engineering and Computer Science Department of the University of Tennessee–Knoxville
Distinguished Seminar Series Speaker for the University of Tennessee's Department of Mechanical, Aerospace, and Biomedical Engineering (2014)
Technical Reviewer of government proposals for research contracts or grants to universities and national laboratories (2005–present)
Member of a DOE steering committee evaluating results of large R&D grants to major U.S. companies (2004–2006)
Member of committees advising DOE on development of road maps for R&D funding for I&C research in support of U.S. nuclear facilities (2002)



PATENTS

Awarded

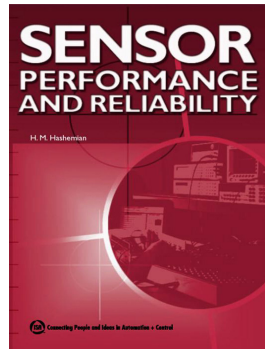
- [1] "Apparatus for Measuring the Degradation of a Sensor Time Constant." Patent No. US 4,295,128 (October 1981).
- [2] "Nuclear Reactor Rod Drop Time Testing Method." Patent No. US 6,404,835 B1 (June 2002).
- [3] "Integrated System for Verifying the Performance and Health of Instruments and Processes." Patent No. US 6,915,237 B2 (July 2005).
- [4] "Instrument and Process Performance and Reliability Verification System." Patent No. US 6,973,413 B2 (December 2005).
- [5] "Testing of Wire Systems and End Devices Installed in Industrial Processes." Patent No. US 7,254,520 B2 (August 2007).
- [6] "Cross-Calibration of Plant Instruments with Computer Data." Patent No. US 7,295,944 B2 (November 2007).
- [7] "Predictive Maintenance and Management of Aging of Installed Cables." Patent No. US 7,319,939 B2 (January 2008).
- [8] "Condition Monitoring of Electrical Cables as Installed in Industrial Processes." Patent No. US 7,478,010 B2 (January 2009).
- [9] "In-Service Calibration of Temperature Measurement Devices Using Plant Monitoring System Data." Patent No. US 7,739,067 B2 (June 2010).
- [10] "Advanced Digital Control Rod Position Indication System with Rod Drop Monitoring for Nuclear Power Plants." Patent No. US 8,351,561 B2 (January 2013).
- [11] "Diverse and Redundant Resistance Temperature Detector." Patent No. US 8,840,301 B2 (September 2014).
- [12] "Control Rod Position Indication Systems and Methods for Nuclear Power Plants." Patent No. US 8,824,617 B2 (September 2014).
- [13] "Pitot Tube Diagnostic Systems and Methods." Patent No. US 8,924,184 B2 (December 2014).
- [14] "High Resolution Digital Rod Position Indication System for Nuclear Power Plants." Patent No. US 8,903,033 B2 (December 2014).
- [15] "Systems and Methods of Monitoring Control Rods of a Nuclear Power Plant." Patent No. US 9,431,137 B2 (August 2016).
- [16] "Automated System for On-Line Monitoring and Diagnostics of Rod Position Indication Coils for Nuclear Power Plants." Patent No. US 9,697,916 (July 2017).
- [17] "Systems and Methods of Measuring Temperature in Industrial Environments." Patent No. US 9,797,787 B2 (October 2017).

Pending

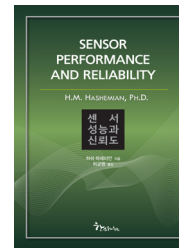
- [1] "Non-Intrusive Error Detection Techniques for Control and Shutdown Rod Position in Nuclear Reactors." Patent Application Pub. No. US 2016/0365161 A1 (December 2016).
- [2] "In-Situ Determination of Rod Control System Coil and Cable Impedances for Nuclear Power Plants." Patent Application Pub. No. US 2017/0025193 A1 (January 26, 2017).

PUBLISHED BOOKS

Sensor Performance and Reliability
International Society of Automation (ISA), 2005

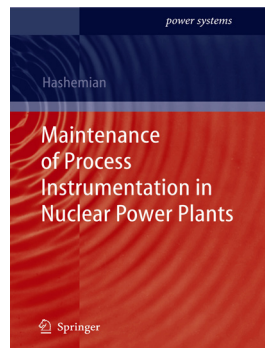


Russian Edition



Korean Edition

Maintenance of Process Instrumentation in Nuclear Power Plants
Springer-Verlag, 2006



Russian Edition

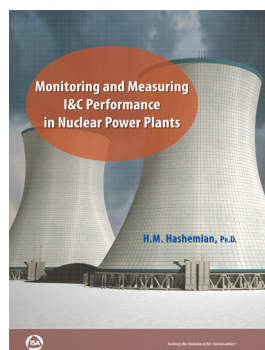


Japanese Edition



Korean Edition

Monitoring and Measuring I&C Performance in Nuclear Power Plants
International Society of Automation (ISA), 2014





**PUBLISHED
BOOK CHAPTERS**

"Electric Cables and Coatings." Chapter 6 in *Materials' Ageing and Degradation in Light Water Reactors*, edited by Dr. K. L. Murty, Cambridge, UK: Woodhead Publishing Series in Energy No. 44 (March 2013).

"Nuclear Power Plant Instrumentation and Control." Chapter 3 in *Nuclear Power—Control, Reliability and Human Factors*, (Nuclear Power / Book 4), InTech European Open Access Publisher (September 2011).

Hashemian, H.M., "Nuclear Plant Instrumentation and Control System Performance Monitoring." *Instrument Engineers' Handbook: Process Software and Digital Networks*, Vol. 3, Fourth Edition/Chapter 61 (August 2011).

"Development and Application of Instrumentation and Control Components in Nuclear Power Plants." Chapter 16 in *Understanding and Mitigating Ageing in Nuclear Power Plants: Materials and Operational Aspects of Plant Life Management (PLiM)*, edited by Dr. Philip G. Tipping. Cambridge, UK: Woodhead Publishing Ltd., CRC Press (2010).

"Cross-Correlation Flow Metering." Chapter 2.5 in *Instrument Engineers' Handbook, Fourth Edition, "Process Measurement and Analysis."* CRC Press (2003).

"Response Time and Drift Testing." Chapter 1.9 in *Instrument Engineers' Handbook, Fourth Edition, "Process Measurement and Analysis."* CRC Press (2003).

"Instrument Calibration." Chapter 1.8 in *Instrument Engineers' Handbook, Fourth Edition, "Process Measurement and Analysis."* CRC Press (2003).

"Safety Instrumentation and Justification of Its Cost." Chapter 2.11 in *Instrument Engineers' Handbook, Third Edition, "Process Software and Digital Networks."* CRC Press (2002).

"Optimized Maintenance and Management of Aging of Critical Equipment in Nuclear Power Plants." Chapter 3 in *Power Plant Surveillance and Diagnostics, Applied Research with Artificial Intelligence*. Berlin, Germany: Springer-Verlag (2002).



SAMPLES OF RECENT JOURNAL ARTICLES

- "Implementation of New Cable Condition-Monitoring Technology at Oyster Creek Nuclear Generating Station", *Nuclear Technology*, Vol. 200, No. 2, (2017).
- "Nuclear Power Plant Instrumentation and Control Cable Prognostics Using Indenter Modulus Measurements", *International Journal of Prognostics and Health Management: Vol 5* (December 2014).
- "Frequency Domain Reflectometry for Remaining Useful Life Estimation of Instrumentation and Control Cables." *Journal of Risk and Reliability* (August 2014)
- "Remaining Useful Life Estimation of Electric Cables in Nuclear Power Plants." *Chemical Engineering Transactions*, Vol. 33 (September 2013).
- "Response Time Testing of Temperature Sensors Using Loop Current Step Response Method." *Int. J. Nuclear Energy Science and Technology*, Vol. 7, No. 3 (February 2013).
- "An Integrated Health Monitoring System for Fission Surface Reactors." *SciVerse ScienceDirect, Space, Propulsion & Energy Sciences International Forum—2012, Physics Procedia*, Vol. 38 (November 2012).
- "Wireless Sensor Applications in Nuclear Power Plants." *Nuclear Technology*, Vol. 173, No. 1 (January 2011).
- "State-of-the-Art Predictive Maintenance Techniques," *IEEE Transactions on Instrumentation and Measurement*, Vol. 60, No. 10 (October 2011).
- "Sensors for Next-Generation Nuclear Plants: Fiber-Optic and Wireless." *Nuclear Science and Engineering*, 169 (2011).
- "On-Line Monitoring Applications in Nuclear Power Plants." *Progress in Nuclear Energy*, Vol. 53, No. 2 (March 2011).

SAMPLES OF RECENT MAGAZINE ARTICLES

- "I&C System Sensors for Advanced Nuclear Reactor", *Nuclear Plant Journal*, July-August 2018.
- "Cable Aging Management in Nuclear Power Plants", *Nuclear Plant Journal* (February 2018).
- "Advanced Monitoring Techniques for LWR Sustainability." *Nuclear Engineering International* (April 2017).
- "Maintenance Optimization Through Data Analytics." *Nuclear Plant Journal* (April 2017).
- "New Sensors for Small Modular Reactors." *Nuclear Plant Journal* (January–February 2017).
- "In-Situ Cable Condition Monitoring In Nuclear Power Plants." *Nuclear Energy Institute Journal* (February 2017).
- "Wireless Technology." *Nuclear Plant Journal* (March–April 2015).
- "I&C Challenges." *Nuclear Plant Journal* (February 2014).
- "Methods for Testing Nuclear Power Plant Cables." *IEEE Instrumentation & Measurement Magazine* (October 2013).
- "Online Sensor Calibration Assessment in Nuclear Power Systems." *IEEE Instrumentation & Measurement Magazine* (June 2013).



HONORS & AWARDS

- 2017 **Inducted into the University of Tennessee Department of Nuclear Engineering Hall of Fame (inaugural year)**
- 2016 **Knoxville Chamber of Commerce Pinnacle Innovator Award**
- 2016 **University of Tennessee College of Engineering Nathan W. Dougherty Award** for accomplishments bringing distinction to the college through achievements and contributions to the engineering profession.
- 2016 **East Tennessee Junior Achievement Business Hall of Fame Inductee**
- 2016 U.S. Chamber of Commerce **Blue Ribbon Small Business Award**
- 2015 American Nuclear Society **Robert L. Long Training Excellence Award**
- 2015 U.S. Chamber of Commerce **Blue Ribbon Small Business Award**
- 2014 U.S. Chamber of Commerce **Blue Ribbon Small Business Award**
- 2014 Award for organization and service to "Systems: Women in Electrical Engineering and Computer Science at the University of Tennessee"
- 2013 U.S. Small Business Administration's **Small Business Person of the Year Award** for the State of Tennessee
- 2013 U.S. Chamber of Commerce **Blue Ribbon Small Business Award**
- 2012 **Inc. magazine list of the 500/5,000 fastest-growing private companies in the U.S.**
- 2012 **University of Tennessee Alumni Professional Achievement Award**
- 2012 U.S. Chamber of Commerce **Blue Ribbon Small Business Award**
- 2011 **U.S. Small Business Administration Tibbetts' Award** for unique contributions as a model of excellence for the Small Business Innovation Research (SBIR) program
- 2011 Invitee to a **White House reception in recognition of excellence in R&D work on government-funded projects**
- 2011 **Inc. magazine list of the 500/5,000 fastest-growing private companies in the U.S.**
- 2011 U.S. Chamber of Commerce **Free Enterprise Award**
- 2010 **Knoxville Chamber of Commerce Pinnacle Award** in recognition of outstanding business practices and community support
- 2009 **Business Tennessee Hot 100 Award**
- 2006 **IEC Award** for writing standards on safety of nuclear power plants
- 2001 **State of Tennessee Governor's Manufacturing Excellence Award**



NATIONAL SERVICE ACTIVITIES

"Avoiding Unnecessary Cable Replacement in Nuclear Power Plants." Submitted for publication in Proceedings of the American Nuclear Society Annual Meeting, June 2018.

"Management of Aging of Reactor Internal Components." Submitted for publication in Proceedings of the American Nuclear Society Annual Meeting, June 2018.

"Research Gap in Management of Insulation Aging of Medium Voltage Cables in Nuclear Power Plants." Submitted for publication in Proceedings of the American Nuclear Society Annual Meeting, June 2018.

"Online Monitoring of Rod Control Systems in Combustion Engineering Pressurized Water Reactors." Proceedings of the American Nuclear Society 10th International Topical Meeting on NPIC & HMIT, June 2017.

"On-Line Monitoring of I&C Transmitters and Sensors for Calibration Verification and Response Time Testing was Successfully Implemented at ATR." Proceedings of the American Nuclear Society 10th International Topical Meeting on NPIC & HMIT, June 2017.

"Emerging and Existing Sensing Technologies for Small Modular Reactors and Advanced Reactors." Proceedings of the American Nuclear Society 10th International Topical Meeting on NPIC & HMIT, June 2017.

"Comparison of Prognostic Techniques for Estimating the Remaining Useful Life of Nuclear Plant Components." Proceedings of the American Nuclear Society 10th International Topical Meeting on NPIC & HMIT, February 2015.

"Dynamic Modeling of a Small Modular Reactor for Control and Monitoring." Proceedings of the American Nuclear Society 10th International Topical Meeting on NPIC & HMIT, February 2015.

"Implementation of On-Line Monitoring to Optimize I&C Maintenance: A Case Study." Proceedings of the American Nuclear Society 10th International Topical Meeting on NPIC & HMIT, February 2015.

"Development and Application of Loose Parts and Acoustical Structural Monitoring During Plant Startup Following Steam Generator Replacement." Proceedings of the American Nuclear Society 10th International Topical Meeting on NPIC & HMIT, February 2015.

"Quantitative Methods for Reliability and Fault Tolerance of Digital Instrumentation and Control Systems." Proceedings of the American Nuclear Society 10th International Topical Meeting on NPIC & HMIT, February 2015.

"First Principles Model of a Simulation Flow Loop in Support of On-Line Monitoring Implementation in Next Generation Nuclear Power Plants." Proceedings of the American Nuclear Society 10th International Topical Meeting on NPIC & HMIT, February 2015.

"Uncertainty Quantification Methods for Robust Online Monitoring and Recalibration Interval Extension." Proceedings of the American Nuclear Society 10th International Topical Meeting on NPIC & HMIT, February 2015.



INTERNATIONAL SERVICE ACTIVITIES

Over the past 20 years, Dr. Hashemian has been invited by the International Atomic Energy Agency (IAEA) to serve as chairman of four coordinated research projects (CRPs) of the IAEA. He has also served as a member or chairman of a number of IAEA committees, writing reports and guidelines for equipment condition monitoring, aging management, and predictive maintenance for the global nuclear power industry. In addition, he has served as a project leader for three international standards prepared for the nuclear industry under the auspices of the International Electrotechnical Commission (IEC) on measurement of performance of critical components of nuclear power plants. The reports of these CRPs and related IEC standards are listed below.

“On-line Monitoring of Instrumentation in Research Reactors.” IAEA Coordinated Research Project (CRP). December 2017.

“Benchmark Analysis for Condition Monitoring Test Techniques of Aged Low Voltage Cables in Nuclear Power Plants.” IAEA Coordinated Research Project (CRP). October 2017.

“Condition Monitoring and Management of Ageing of Low Voltage Cables in Nuclear Power Plants.” IAEA Coordinated Research Project (CRP). October 2015.

“Improved Instrumentation & Control Maintenance Techniques for Research Reactors using a Plant Computer.” IAEA Coordinated Research Project (CRP). May 2015.

“Advanced Surveillance, Diagnostic and Prognostic Techniques in Monitoring Structures, Systems and Components in Nuclear Power Plants.” IAEA Nuclear Energy Series No. NP-T-3.14 (September 2013).

“Improved Instrumentation and Control Maintenance Techniques for Research Reactors.” IAEA Coordinated Research Project (CRP) (2012–2014).

“Qualification, Condition Monitoring, and Management of Aging of Low Voltage Cables in Nuclear Power Plant Life Management”. IAEA Coordinated Research Project (CRP) (2012–2014).

“On-Line Monitoring for Improving Performance of Nuclear Power Plants Parts 1 and 2: Instrumentation Channel Monitoring.” IAEA Nuclear Energy Series No. NP-T-1.1 and NP-T-1.2 (September 2008).

“On-Line Monitoring for Improving Performance of Nuclear Power Plants Part 2: Process and Component Condition Monitoring and Diagnostics.” IAEA Nuclear Energy Series No. NP-T-1.2 (September 2008).

Dr. Hashemian served as project leader and main author of the following standards of the International Electrotechnical Commission.

IEC 62385, “Methods for Assessing the Performance of Safety System Instrument Channels.” International Electrotechnical Commission (June 2007).

IEC 62342, “Management of Aging.” International Electrotechnical Commission (August 2007).

IEC 62465, “Management of Aging of Electrical Cabling Systems.” International Electrotechnical Commission (2010).