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# International Workshop on the Use of Robotics and their Application at Nuclear Facilities

*February 2, 2016, 1:00 p.m. – 6:00 p.m. (EST)*

*February 3 & 4, 2016, 9:00 a.m. – 5:00 p.m. (EST)*

*National Institute of Standards and Technology  
Green Auditorium, Building 101  
100 Bureau Drive, Gaithersburg, MD, 20899*

## *Organizational Sponsors*



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## **Workshop Information**

The U.S. Nuclear Regulatory Commission's (NRC's) Office of Nuclear Regulatory Research (RES); National Institute of Standards and Technology (NIST); U.S. Department of Energy (DOE); U.S. Department of Homeland Security (DHS); United Kingdom Atomic Energy Authority (UKAEA); and the Canadian Nuclear Safety Commission (CNSC) are convening the "International Workshop on the Use of Robotics and their Application at Nuclear Facilities." This workshop addresses the use of robotics at nuclear facilities during operation, emergency response, and routine and post-accident decommissioning.

**Audience:** Designers, developers, operators, and users of robotic technologies at nuclear facilities and other challenging and hazardous environments and robotic engineers from industry, academia, research institutes, and government agencies.

## **Workshop Objectives**

The purpose of the workshop is to inform, discuss, and assess past, present, and anticipated future uses of robotics at nuclear facilities. A technical exchange of experiences and information are being sought as related to the use of mobile and stationary robots in challenging environments at nuclear and non-nuclear industrial facilities and in activities that are hazardous to humans. Examples of other challenging environments include those encountered at non-nuclear industrial facilities and during activities such as extraterrestrial exploration and deep-sea surveys. The specific objectives are:

- Facilitate the sharing of information between government agencies, industry, and academia on the present use of robotic technology for monitoring, sampling, and other surveillance functions for a range of air, water, and material conditions within critical infrastructures.
- Seek ideas and insights on possible ways to develop robotics to execute complex tasks for assessing severe nuclear accidents and reporting conditions within critical infrastructures.
- Identify strategies for using robotics to detect, examine, and recover radioactive materials such as fuel rods from damaged nuclear facilities.
- Adapt current robotic technologies used in non-nuclear applications to nuclear facility applications.
- Establish realistic plans to test both the robots and their operators for a range of nuclear facility scenarios (i.e., construction, startup, normal operations, low power and shutdown, decommissioning).
- Discuss the development of standards for evaluating the performance of robots, their implementation, and their integration with systems at nuclear facilities.
- Identify ground-breaking opportunities to facilitate the use of robotics in the nuclear industry.

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The workshop is designed to facilitate technical exchange of lessons learned from historic nuclear applications and experiences (e.g., Three-Mile Island and Fukushima Daiichi); ongoing research; and other relevant applications (e.g., NASA's Martian Exploration Rovers – Spirit, Opportunity, and Curiosity).

## **Key Outcomes Sought**

- **Knowledge:**
  - Information on the current use of robotic technologies at nuclear facilities
  - A better understanding of the state of robotics and remote systems in other challenging environments and their potential applications at nuclear facilities
  - Introduction to existing databases or compendiums of robots and remote systems for nuclear applications
  - Ideas or strategies for enhancing existing databases or compendiums with quantifiable and verifiable performance data
  
- **Development, Testing and Evaluation:**
  - Proposed approaches for using consensus standard test methods to assess performance in order to guide development, procurement, and training for nuclear applications
    - Host competitions, challenges, and technology incubators;
    - Identify best-in-class contributing technologies (e.g., sensors for non-destructive evaluation, mobility platforms, manipulators, material samplers or other tools);
    - Iterate proposed solutions through validated simulations of standard test methods and mockups;
    - Conduct comprehensive testing with standard test methods to establish reliability and gain confidence in robotic performance;
    - Deploy proposed solutions into physical mockups and test beds
  
- **Adoption and Implementation:**
  - A proposed end-user strategy for setting thresholds of capabilities (measured within standard test methods) necessary for deployment
  - A proposed regulatory approach for technical review of strategies for integrating technology, standards, training, and regulations to address implementation
  
- **Summary of the key insights drawn from presentations and panel discussions**

## **Workshop Structure**

The workshop will be divided into five sessions (afternoons and mornings). Each session will focus on a technical theme. The proposed themes and questions to be addressed are:

### **Session 1: Overview of Challenges and Opportunities for the Use of Robotic Technologies at Nuclear Facilities**

Co-Chairs: Andrew Szilagy, DOE and Adam Jacoff, NIST

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Presentations are being sought to address the following questions:

- What is the current state-of-the-practice in applying robotic technologies to challenges at nuclear facilities and other hazardous environments?
- What are the opportunities to use robotic technologies for enhanced outcomes?
- What are the possible future uses of robotics at nuclear facilities?
- What are the potential applications for using test methods from consensus standards to assess robotic performance in order to guide development, procurement, and training?
- What are some established or developing databases of robotic technologies and their application, and how have the databases been integrated into successful monitoring and remediation programs?

At the end of the session, there will be demonstrations of the databases and example robotic testing exercises at the NIST Robot Test Facility (<http://www.nist.gov/el/isd/ms/roboticsbldg.cfm>).

## **Session 2: Lessons Learned Related to Robot Deployment at Fukushima Daiichi**

Co-Chairs: to be determined

Presentations are being sought to address the following questions:

- What robotic applications have been developed and deployed to survey and assess challenging conditions within the damaged reactors and auxiliary support structures (e.g., Fukushima Daiichi)?
- What lessons were learned in developing and applying these robotic technologies, and what successes were achieved?
- How were complex conditions and challenging environments negotiated by the adaptive robotic technologies?
- How were cleanup objectives, including worker safety, met by using these robotic technologies?

## **Session 3: Industry and Government Experiences in Applying Robotic Technologies to Existing Challenges**

Co-Chairs: to be determined

Presentations are being sought to address the following questions:

- What were the challenges (e.g., high-levels of radiation) encountered in identifying and applying robotic technologies?
- What insights and lessons were learned in the development and application of these robotic technologies (e.g., Three-Mile Island and Sellafield clean-ups)?
- How were complex conditions and challenging environments negotiated by adaptive robotic technology?
- What challenges (e.g., design of radiation shielding) remain for applying robotic technologies at nuclear facilities and other hazardous environments?

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## **Session 4: Ground-Breaking, Innovative Technologies, and New Developments**

Co-Chairs: to be determined

Presentations are being sought to address the following questions:

- What are the ground-breaking, innovative technologies and new developments that could enhance the functionality of robotics at nuclear facilities?
- What are the complex conditions and challenging environments that need to be negotiated by adaptive robotic technologies?
- What are the challenges for further development of new robotic strategies and tools, over the next five to ten years, to meet nuclear facility needs?

## **Session 5: Robotic Technology Testing, Operator Training and Certification, and Regulatory Standards Development**

Co-Chairs: Phil Mattson, DHS (and other to be determined)

Presentations are being sought to address the following questions:

- Where and how are robots tested?
- Where and how are robot operators trained?
- How can these testing and training programs be incorporated into a certification program recognized by industry and government?
- How do industry-developed standards (e.g., ASTM International, American Society of Mechanical Engineers, etc.) gain regulatory acceptance?
- What are the procedural and regulatory challenges that need to be addressed?

Each session will have two co-chairs. The sessions will begin with a keynote presentation followed by contributed presentations. At the end of sessions 2 through 5, there will be panel discussions moderated by the session co-chairs. Each panel will consist of the presenters and invited experts who will answer questions from the audience on lessons learned in robotic applications, identified databases, and possibilities for future nuclear applications.

The workshop organizing committee is seeking lessons learned from a wide range of international applications at nuclear facilities such as the Three-Mile Island, Chernobyl, Sellafield, and Fukushima Daiichi focusing on decontamination and decommissioning activities.

The workshop will be open to the public to encourage industry participation.

### **Workshop Registration Information and Contacts:**

#### **Workshop Registration and Logistics: NIST Conference Coordinator**

Gladys Arrisueno at 301-975-5220; [gladys.arrisueno@nist.gov](mailto:gladys.arrisueno@nist.gov)

**Web link:** NIST Events web page: <http://www.nist.gov/allevnts.cfm> will provide registration procedures; workshop agenda; and information on hotel accommodations; shuttle bus service to and from the identified hotel to NIST; shuttle bus service to and from the METRO to NIST; and the NIST map with driving instructions.

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**Registration:** All attendees must complete and submit a registration form and pay a \$71 registration fee, two weeks prior to the workshop. This form will become available in early January 2016 on the NIST Public Conference web site: <https://www-s.nist.gov/CRS/> under “International Workshop on the Use of Robotics and their Applications at Nuclear Facilities.”

**Workshop Co-Chairs:** Thomas Nicholson, NRC/RES at [Thomas.Nicholson@nrc.gov](mailto:Thomas.Nicholson@nrc.gov)  
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Adam Jacoff, NIST at [adam.jacoff@nist.gov](mailto:adam.jacoff@nist.gov)

**Organizing Committee Members:** Thomas Nicholson, Don Marksberry, Anders Gilbertson, Boby Abu-Eid, Jack Parrott, Robert Bernardo and Thomas Burton, U.S. NRC; Andrew Szilagyi, DOE-EM; Adam Jacoff and Kamel Saidi, NIST; Laurie Judd, NuVision Engineering; Takashi Hara, TEPCO; Rob Buckingham, UKAEA -RACE; Philip Mattson, DHS; and Zhao Chang Zeng, CNSC.