POLICY ISSUE
NOTATION VOTE

March 6, 2008 SECY-08-0033

FOR: The Commissioners

FROM: Luis A. Reyes
Executive Director for Operations

SUBJECT: APPROACHES FOR AN INTEGRATED DIGITAL INSTRUMENTATION AND CONTROL AND HUMAN-MACHINE INTERFACE TEST FACILITY IN THE UNITED STATES

PURPOSE:

To provide the Commission the results of the Digital Instrumentation and Control and Human-Machine Interface (DI&C/HMI) workshops, and seek approval of staff's recommended option on how to proceed with facilities that support (DI&C/HMI) research. This paper does not address any new commitments.

SUMMARY:

The U.S. Nuclear Regulatory Commission (NRC) staff has developed three options for consideration in supporting DI&C/HMI research based on information gathered from workshops, surveys, site visits and other sources. NRC's current approach manages DI&C/HMI research by performing work in-house and by contracting with commercial organizations, U.S. Department of Energy (DOE) laboratories, academia, other government agencies, and international organizations. Although the current approach provides continuation of existing efforts without reallocation of resources, it is not as well integrated or coordinated as the options identified in this paper. The first two options improve coordination of distributed facilities through a work center ("hub and spoke" model). In option 1, the work center is NRC operated.

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The NRC operated “hub and spoke” model offers better coordination and communication of all activities but requires a slight increase in resources relative to the current approach. In option 2, the work center is contractor operated. The contractor operated “hub and spoke” model reduces project management workloads on the NRC staff but offers fewer advantages for the NRC than option 1. Option 3, building a single integrated facility, offers integration and coordination opportunities but requires extensive resources and planning to address all of the disadvantages identified in this paper.

As a result of this assessment, the staff recognizes that the current approach for conducting DI&C/HMI research could be improved. The NRC staff has commenced a review of the existing research programs and has taken steps to better coordinate their efforts by implementing option 1. Implementation of option 1 offers the opportunity for improved efficiency and effectiveness and is within the authority of the staff. Option 1 is preferred because it addresses the disadvantages of the current approach, maintains direct NRC control, provides some of the benefits of a single integrated facility. In addition, it provides opportunities to remedy workforce challenges by providing academic institutions the opportunity to serve as centers of excellence in the areas of digital I&C and HMI. The NRC staff does not recommend that the Commission re-direct the staff to pursue the contractor operated “hub and spoke” model or a single integrated facility. The contractor operated “hub and spoke” model is not recommended because it reduces opportunities for NRC staff professional development, slows the staff’s response to emerging issues, and reduces performance monitoring and control of research capabilities. The single integrated facility is not recommended because of the significant budgetary and staffing requirements to establish and maintain such a facility.

BACKGROUND:

Incorporating DI&C/HMI into nuclear power plants in the U.S. brings to light new regulatory challenges while providing potential safety benefits. The NRC staff conducts research to maintain sound technical bases for independently evaluating DI&C/HMI systems both in the near term and into the future to help ensure that current and future integration of DI&C/HMI technologies in nuclear facilities continues to be done safely and securely.

COMPBL-07-0001, “Development of a U.S. Digital Instrumentation and Control and Human-Machine Interface Test Facility,” dated March 8, 2007, stated that the current approach for NRC research in this area is to contract with a variety of national laboratories, universities, and international research facilities on a case-by-case basis. This piece-meal approach has caused the NRC’s regulatory framework to lag behind the state-of-the-art and the gap between technology and regulatory guidance in this area continues to widen. To close this gap, related research tools could be integrated into a single facility within the U.S. with an NRC-supported capability and expertise to operate and manage (or co-manage) it. This would likely create synergies and efficiencies that are not evident in the current approach.

The Staff Requirements Memorandum (SRM) for COMPBL-07-0001 dated April 5, 2007, directed the NRC staff to conduct a public workshop concerning approaches for establishing an integrated DI&C/HMI test facility in the United States and to prepare a recommendation on whether or how to proceed. The SRM stated that if possible, the workshop should seek consensus on a set of over-arching principles that should be met for the success of any of the conceptual approaches discussed.

The Office of Nuclear Regulatory Research (RES) staff conducted two workshops to discuss conceptual approaches and to develop viable options for supporting U.S. DI&C/HMI research. Representatives from various industries, academia, research and development centers, and other Federal agencies participated in this assessment. The majority of the representatives were from the nuclear industry. There was little to no interest from non-nuclear representatives in pursuing collaborative efforts. The small percentage of non-nuclear representatives who responded to invitations for participation indicated that well-established facilities and capabilities meet the needs of industries outside the nuclear community. Universities and DOE laboratories expressed interest in being research partners with the NRC. Nuclear industry representatives indicated that they may be interested in collaborative research that is focused on well-defined regulatory topics on a case-by-case basis. Workshop participants (hereafter "participants") did not express interest in collaborating as funding partners at this time. Additional information was gathered by internet research, surveys, site visits, and telephone interviews to better understand the capabilities of available DI&C/HMI facilities. The significant body of information from the workshops and other sources will be publicly available in a report expected to be issued in Spring 2008. In addition, the Commission posed nine specific questions in the April 5, 2007, SRM that were addressed by the assessment. The questions and staff responses are provided in Enclosure 1.

DISCUSSION:

The following discussion presents: (1) deployment of DI&C systems in the nuclear industry; (2) U.S. DI&C/HMI research needs to support specific nuclear regulatory applications; (3) a description of the current NRC approach for DI&C/HMI research; and (4) options for Commission consideration.

Deployment of DI&C Systems in the Nuclear Industry

Non-safety DI&C systems have been deployed in U.S. nuclear plants. Examples include digital feedwater systems, and turbine control systems. Nuclear safety DI&C systems have been deployed domestically in naval nuclear applications and overseas in locations such as the United Kingdom, France, Korea, and Japan. Participants indicated that the commercial U.S. nuclear DI&C/HMI community is a small subset of the broader DI&C/HMI community. In general, the U.S. nuclear DI&C/HMI community lags behind state-of-the-art and has little leverage over technology developments in this area. However, participants concluded that capabilities, systems, and infrastructures in the U.S. are adequate to support digital retrofits to the existing fleet of nuclear power plants and nuclear plant designs expected to be built in the 2010-2015 timeframe, but that challenges exist.

Among these challenges is a lack of knowledgeable personnel in the integration of modern DI&C/HMI technologies for commercial nuclear safety applications in both the nuclear industry and the NRC. A lack of knowledgeable personnel in the integration of DI&C/HMI technologies for nuclear applications could delay realization of the full benefit of these technologies in the United States. Participants recommended the NRC consider playing a leadership role in a workforce development activity to assess the ongoing needs of the nuclear DI&C/HMI community. Participants indicated that educational programs that focus on DI&C/HMI technologies and their nuclear applications would be advantageous. Also, personnel should be provided with research and development experience as well as practical experience including

internships and work in supervised settings, such as in current nuclear power plants. Participants concluded that any approach for addressing DI&C/HMI issues should provide opportunities to remedy workforce challenges.

Other challenges exist but participants indicated that their interests in collaborative research may be limited only to well-defined regulatory topics. Therefore, the remainder of this paper focuses on meeting DI&C/HMI regulatory research objectives for nuclear applications.

U.S. DI&C/HMI Research Needs to Support Specific Nuclear Regulatory Applications

An understanding of regulatory research needed to support DI&C/HMI nuclear applications is necessary to evaluate the adequacy of existing capabilities and formulate viable options to address any gaps. Participants identified the following areas related to DI&C/HMI technology for which enhanced regulatory guidance would be beneficial:

- retrofits to existing legacy systems in the existing nuclear power plant fleet;
- advanced light water reactors;
- advanced nuclear power concepts (e.g., Global Nuclear Energy Partnership and Next Generation Nuclear Plant research); and
- the diverse range of current once-through fuel cycle, closed fuel cycle, and long-term storage systems that will involve DI&C/HMI issues.

Research topics that address the above areas are discussed in the NRC Digital System Research Plan FY 2005 – FY 2009 (ADAMS Accession No. ML061150050) and the DOE Technology Roadmap for Instrumentation, Control, and Human-Machine Interface to Support DOE Advanced Nuclear Energy Programs issued in March 2007. No new research topics were identified by the workshops. DI&C/HMI research needs that focus on next generation nuclear plants have yet to be developed because designs are still in the early stages of development and it is uncertain what technologies will be used.

Following the workshops, the NRC staff established sustainability and obsolescence management as a topic for further consideration as part of DI&C/HMI research. Sustainability and obsolescence management refers to the ability to maintain system functionality with technological changes occurring over the course of a nuclear facility's life cycle. This issue is being considered as part of an update to the NRC Digital System Research Plan.

A Description of the Current NRC Approach for DI&C/HMI Research

RES staff is responsible for identifying research needs in conjunction with other NRC offices and carrying out this research using both in house capabilities and contractors. When relying on contractors, the RES staff prepares solicitations, evaluates proposals, determines who is best suited to do the work, contracts with them, and provides technical oversight. To address existing and anticipated DI&C/HMI regulatory issues, the NRC staff is implementing the NRC Digital System Research Plan FY 2005 - FY 2009 that includes a series of tasks to enhance regulatory guidance for retrofits and new DI&C/HMI systems in both new and advanced reactors. Tasks identified to meet agency needs in the NRC Digital System Research Plan FY 2005 - FY 2009 are scheduled to be completed by the end of FY 2010.

The NRC also has initiated research examining the human factors and human performance aspects of new DI&C/HMI technology. HMI is an area of research within the human factors field. To develop technical bases for the establishment of new regulatory guidance, human factors research examines trends in reactor technology, human interfaces, and design and evaluation methods. This research addresses topics such as the role of personnel and automation, staffing and training, normal operations management, disturbance and emergency management, maintenance and change management, plant design and construction, and human factors engineering methods and tools. Participants indicated the lack of a dedicated domestic simulator for human factors regulatory research applications. Following the workshops, the NRC staff has gathered additional information regarding existing capabilities for human factors regulatory research and has learned that a domestic HMI simulator research facility exists at the DOE Idaho National Laboratory. The NRC staff is currently investigating the availability of this facility for NRC use.

The NRC staff and industry have also been collaborating on identifying and resolving regulatory issues. In response to SRM-M061108, "Briefing on Digital Instrumentation and Control," dated December 6, 2006, the staff formed the DI&C steering committee to provide management focus on the NRC's regulatory activities in progress across several offices, to interface with the industry on key issues, and to facilitate consistent approaches to resolving technical and regulatory challenges. The staff also formed seven task working groups that focus on key DI&C/HMI areas of concern. NRC DI&C/HMI research projects currently support some of the regulatory activities of the steering committee.

A disadvantage of the current approach is that collaborative and communication efforts with the broader DI&C/HMI community, other U.S. government agencies, and the nuclear DI&C/HMI community is not as integrated and well coordinated as is possible if one of the options presented in this paper were invoked. Therefore, the current approach is not as efficient in providing remedies to the workforce issue. The current piece-meal approach of contracting has also created communication challenges among different researchers in different DI&C/HMI areas. Delays in updating regulatory guidance to reflect technology developments may occur if the disadvantages of the current approach are not addressed.

Options

The NRC staff collaborated with workshop participants to define a set of over-arching principles on which to base and evaluate options in supporting DI&C/HMI research. These principles are that; any approach should effectively support DI&C/HMI research; provide communication opportunities with the broader DI&C/HMI community; and allow for implementation by the NRC without funding partners. The staff developed the following three options that meet the over-arching principles for Commission consideration:

(1) Coordinate the use of distributed facilities through an NRC operated work center ("hub and spoke" model);
(2) Coordinate the use of distributed facilities through a contractor operated work center ("hub and spoke" model); or
(3) Build a single integrated facility.

The advantages and disadvantages of all three options relative to the current approach are discussed below. Organizational conflict of interest issues for all options would be evaluated on a case-by-case basis using established NRC statutory and regulatory requirements.

Option 1: NRC Operated "Hub and Spoke" Model

The first option consists of a different program management model for DI&C/HMI research projects for nuclear applications. Under this model, the NRC would establish and operate a work center (the "hub"). This work center would coordinate the implementation and communication of research projects and products developed at distributed centers of excellence (the "spokes"). Enclosure 2 describes characteristics of this model, stakeholder roles, and key differences from the current approach.

This option would utilize capabilities of existing commercial contractors, DOE laboratories, academia, other government agencies, and international organizations, before establishing new facilities to conduct specific research activities. The staff does not envision the need for new facility construction or refurbishment to implement option 1 at this time. This option would not affect existing NRC intra-office relations regarding DI&C/HMI research activities. Advantages include better coordination and communication of activities with minimal need for additional NRC staff resources to manage the agency's several current and planned DI&C/HMI research projects. An NRC operated work center (as compared to option 2) includes greater NRC staff professional development, faster response to emerging issues, and closer performance monitoring and control of spoke capabilities. This option is also scalable to allow adding capabilities as future areas requiring research are identified. Disadvantages include additional management oversight and slight increased resources relative to the current approach to support the new management infrastructure over the next two to three years. This increase in cost may be offset by increased programmatic efficiencies over the longer term.

Participants stated that dispersed facilities can conduct DI&C research and may allow for potential synergies with training needs, but that elements of HMI research may be better accomplished if centralized. Modern networking capabilities, however, may provide opportunities for new models of conducting research with geographically spread facilities. Participants preferred a "hub and spoke" option because all challenges can be effectively addressed and it contains inherent adaptability for potential collaboration on future needs. Workforce issues may also be addressed by providing well integrated work opportunities at universities and other facilities located throughout the United States.

Option 2: Contractor Operated "Hub and Spoke" Model

The second option uses the same program management model described in option 1, but the work center would be contractor operated. In this option, the NRC staff would provide high level management oversight and direction while contracting the day to day work center operations. RES would continue identifying research needs in conjunction with other NRC offices, confirm who is best suited to do the work, and provide technical oversight to the spoke contracted by the hub. The hub contractor would support RES staff in performing programmatic activities such as preparing solicitations or facilitating communication efforts among the spokes. An advantage of this option is greater flexibility for the hub contractor to allow adding capabilities if the broader DI&C/HMI community (non-NRC) desires to enter into a contract with the hub. Disadvantages include increased cost over option 1, less direct control of the performance of the spoke

contractors, potentially reduced opportunity for the NRC staff to interact with the spoke contractors and gain expertise, and some reduction in response time for emerging issues. In addition, all of NRC's research programs coordinated by the hub could be negatively impacted if performance issues arise.

Option 3: Build a Single Integrated Facility

The third option for addressing DI&C/HMI research is to create a federally funded and operated integrated facility to serve as a national technical center of excellence that combines current and future capabilities at a single location.[1] Both new construction and refurbishment of existing facilities were considered. The facility could be reconfigurable for hardware and software research, testing hardware and software integration, and HMI research. The facility could also allow for integrating and demonstrating new technologies as they become available and for the ability to study control rooms, operations and maintenance, diagnostics, and links to field operations.

Advantages include the opportunity for researchers from diverse fields to collaborate in the same location. Disadvantages include time and a large cost to design, construct, staff, and maintain such a facility, potential duplication of capabilities at existing sites, and uncertainties that long-term workloads can be sustained at the facility. The staff has not identified interested funding partners for this option. This creates both an advantage and disadvantage for the NRC. The advantage would be sole NRC control of directing and prioritizing research. The disadvantage for the NRC would be that the significant budgetary and staffing requirements to establish and maintain such a facility may hamper the NRC's ability to fund other higher priority activities. In addition, the NRC may be obligated to support the new facility even if it encountered performance issues. Participants did not support creation of a single integrated facility because of the listed disadvantages, the potential for creating unnecessary regulatory research, and opportunities to remedy workforce issues could be limited to the site of this facility. Participants suggested that working within the larger DI&C/HMI community may provide more effective learning and collaborative opportunities.

Participants also expressed concerns about NRC's regulatory role in a new integrated research facility. Specifically, the stakeholder perception that the NRC staff could expand the scope of regulatory scrutiny beyond areas of regulatory concern and promote specific technical products through DI&C/HMI research at this facility. Other stakeholders in the nuclear DI&C/HMI may decide to build such a facility to help expedite existing nuclear plant conversions to digital I&C, to extend nuclear plant operations beyond 60 years, or to support their advanced nuclear energy programs.

RECOMMENDATION:

As directed by the Commission, the NRC staff has reviewed the viable options outlined above. As a result of the review, the staff recognized that improvements can be made in the management of DI&C/HMI research to improve efficiency and effectiveness. Option 1 (the NRC

[1] Option 3 differs from the concept of a Federally Funded Research and Development Center (FFRDC) where contractor facilities already exist. The main difference between option 3 and an FFRDC is who operates the facility. The concept of an FFRDC was considered but not supported by workshop participants because of the significant budgetary and staffing requirements to establish and maintain such a facility.

operated “hub and spoke” model) offers the opportunity for improved efficiency and effectiveness, is within the authority of the staff, and can be implemented within the existing budget.

For this reason, the staff plans to implement option 1. The RES staff and applicable NRC offices will ensure that the option is producing results that benefit the agency. As described above, it leverages existing capabilities, and provides opportunities to remedy workforce challenges by providing academic institutions the opportunity to serve as centers of excellence in the areas of digital I&C and HMI. It enhances communication with the broader DI&C/HMI community by providing well integrated work opportunities at facilities located throughout the United States. Additionally, option 1 addresses the current issues associated with the piece-meal approach to contracting by allowing better integration, communication, and control of research products. Finally, this option could support collaboration with a wide range of agencies and industries that have needs and interests in the rapidly advancing areas of instrumentation and controls, digital safety systems, and human-machine interfaces.

The NRC staff does not recommend that the Commission re-direct the staff to pursue options 2 (Contractor operated “hub and spoke” model) or 3 (a single integrated facility). Option 2 is not recommended due to the advantages of an NRC operated work center which includes greater NRC staff professional development, faster response to emerging issues, and closer performance monitoring and control of “spoke” capabilities. Additionally, option 2 is anticipated to incur greater cost than option 1. Option 3 is not recommended because of the significant budgetary and staffing requirements to establish and maintain such a facility.

RESOURCES:

The NRC staff has not formally assessed the costs of the alternatives presented but has applied its knowledge from similar models, other applications, and informal discussions with other sponsors to make informed estimates.

Adequate staffing is currently available within the FY 2008 and proposed FY 2009 RES budgets to initiate option 1. The estimated cost is 0.5 full-time equivalent staff (FTE) for 2008, and 1.0 FTE for 2009. Resources for FY 2010 and future years will be requested through the planning, budgeting, and performance management (PBPM) process. The RES staff and applicable NRC offices will ensure that the option is producing results that benefit the agency.

Estimated costs for option 2, the contractor operated "hub and spoke" model, are $400K and 0.25 FTE for FY 2008, $800K and 0.5 FTE for FY 2009, and resources for FY 2010 would be requested through the PBPM process. Funds for establishing a contract for this option are not budgeted.

Estimated costs for option 3 range from $10-$15 million for a new facility or $5-$7 million if an existing facility were available for upgrade. This estimate assumes costs for design, construction, and, equipment purchases, and depends on the scope of the research program. Funding needed to support such a facility once available is estimated to be $2.5 million a year.

This estimate assumes costs for staffing, overhead, maintenance, and support for the various research programs. Funds for establishing such a facility and for providing continued support are not currently budgeted.

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objection. The Chief Financial Officer reviewed this package and determined there is no financial impact.

/RA/

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Enclosures:
1. Answers to Nine Questions from the Staff Requirements Memorandum for COMPBL-07-0001
2. The “Hub and Spoke” Model

Answers to Nine Questions from the
Staff Requirements Memorandum for COMPBL-07-0001

The following paragraphs summarize responses to the questions contained in the Staff Requirements Memorandum for COMPBL-07-0001, "Development of a U.S. Digital Instrumentation and Control and Human-Machine Interface Test Facility," dated April 5, 2007.

QUESTION 1: What potential participants might be interested in joint participation, collaboration, and funding of such a facility, and to what extent might this include industries outside the nuclear industry?

The United States has a robust digital instrumentation and control and human-machine interface (DI&C/HMI) community with well-established capabilities and technical communities that support existing needs through professional meetings, oversight, and other forums. Because well-established facilities meet their needs, organizations outside the nuclear community expressed little interest as potential collaborators regardless of the arrangement and capabilities of any facility.

Within the nuclear community, industry representatives suggested that they may be interested in well-defined short-term topics on a case-by-case basis. Universities and U.S. Department of Energy (DOE) laboratories expressed interest in being research partners. No participant in this assessment expressed interest in becoming a funding partner.

In conclusion, at this time, there is some interest in research collaboration within the nuclear industry but no interest in providing funding to build a single integrated facility.

QUESTION 2: If the nuclear industry participated, how could conflict-of-interest issues be addressed?

The U.S. Nuclear Regulatory Commission (NRC) staff would evaluate organizational conflict-of-interest (OCOI) issues with nuclear industry collaborators on a case-by-case basis. The NRC established statutory and regulatory requirements for conducting research and avoiding OCOI issues would be used. Participants expressed a preference for third-party leadership to lessen potential conflicts in collaborations if a new facility is built. The NRC staff, however, is concerned that third-party leadership could limit the NRC's influence over directing a collaborative effort.

QUESTION 3: Do examples of similar facilities currently exist and, if so, what can be learned from their successes and challenges?

Examples of facilities with DI&C and HMI capabilities can be found within large organizations that include National Aeronautical and Space Administration, DOE laboratories, universities, several large DI&C vendors, and the Halden Reactor Project (HRP). This assessment identified various examples of government agency-industry-university partnerships in the U.S. The Industry-University Cooperative Research Centers organized by the National Science Foundation are examples of these partnerships.

The Federal Highway Administration's (FHWA) Turner-Fairbank Highway Research Center in Mclean, VA is a specific example of an integrated test bed facility to meet one industry's needs. This Federally owned and operated research facility manages and conducts research in various fields for improving highway safety. It comprises several laboratories including an advanced electronics laboratory and a human-centered systems laboratory. The facility coordinates activities with other FHWA and U.S. Department of Transportation offices, State and local government partners, academia, industry partners, military research offices, and professional organizations. The Turner-Fairbank Highway Research Center could serve as a model for an NRC-sponsored research facility.

An example of a facility established and extensively funded as a Federally Funded Research and Development Center by the NRC is the Center for Nuclear Waste Regulatory Analyses (CNWRA). The CNWRA focuses on identifying and resolving technical issues and developing tools needed to review the anticipated DOE application to evaluate the Yucca Mountain site. The facility has contractually mandated restrictions which serve to avoid any organizational conflicts of interest.

In discussing existing facilities, participants indicated the lack of a dedicated domestic simulator for human factors regulatory research applications. Following the workshops, the NRC staff has learned that efforts to design, construct, and staff such a simulator exist at the DOE Idaho National Laboratory. The staff is currently investigating the availability of this facility for NRC use.

Lessons learned from these facilities and partnerships include (1) the need for a clearly defined and focused mission for short-, mid-, and long-term timeframes, (2) strong leadership and management, and (3) the need for consistent funding to meet long-term objectives. If the NRC were to build a DI&C/HMI facility, participants recommended that the NRC capture the lessons available from the existing facilities and partnerships.

In conclusion, examples of facilities addressing DI&C/HMI issues do exist. If the NRC decides to build a research facility, the staff should contact representatives from existing facilities to gain additional insights.

QUESTION 4: What siting options are most viable (e.g., universities where integration with graduate studies might be encouraged, national laboratories, etc.), taking both cost and ease of technical information exchange into account?

Participants indicated that different siting options offered distinct advantages for certain technical areas. For example, DOE laboratories offer distinct advantages over other options in cyber security because they already have existing facilities and strong core staffs. University locations offer the potential to train the next-generation workforce as well as access to potential research subjects for basic HMI research. These siting options have lower initial costs than a new facility. However, challenges may involve sharing proprietary information, and maintaining staff continuity because of an aging workforce. The selection of a location for an NRC-sponsored facility would depend on the mission to be accomplished and long-term research objectives.

In conclusion, several siting locations with distinct benefits exist. Site selection depends heavily on the mission of the facility, and long-term research objectives that are not fully defined.

QUESTION 5: To what extent could such a facility be designed to be reconfigurable to the expected variety of plant control room and HMI designs?

The ability to reconfigure a facility is especially desirable for testing hardware and software integration, data exchange among distributed systems, and human factors research. Participants thought that a facility could be designed to be reconfigurable to meet some but not all of the NRC's research needs because of the equipment required to support the research and the variety of expected plant control room and HMI designs. To complement the reconfigurable facility, participants thought that the NRC staff could explore collaborating with vendor training facilities (simulators) for addressing issues that require plant-specific DI&C/HMI configurations.

QUESTION 6: To what extent could such a facility be designed to also be able to be used as an advanced reactor training simulator for NRC staff?

Participants discussed the potential synergies of dual-use and co-located facilities for research and training purposes. Potential benefits include shared staff, such as laboratory technicians for troubleshooting, and information that may lead both to better research and better training. Drawbacks include the loss of configuration control and operational mistakes because of personnel working on both training and research platforms. Needs for one purpose (i.e., training) may take priority and hinder progress in the other mission.

Existing control room training simulators may complement research simulators because they are being upgraded to digital systems and because there is a need for generic and plant-specific data. Further discussions with the NRC Technical Training Center (TTC) staff involved with planning for NRC new reactor simulation capabilities confirmed the potential for the Office of Nuclear Regulatory Research to use any new reactor simulation capabilities that the TTC acquires for HMI collaborative efforts.

In conclusion, participants noted that a dual research and training facility could be built but did not recommend this approach. Participants suggested that existing training facilities might be useful in providing plant-specific HMI data and should be examined further.

QUESTION 7: What impediments, if any, to information sharing among participants and to external stakeholders might exist?

Impediments to information sharing include information security, and intellectual property policies. Information security is an impediment in that diverse independent agencies can have different security standards that potentially conflict. Other concerns identified by participants include policies and practices that address intellectual property, OCOIs, and separating collaborator roles.

The sharing of data with external collaborators is not necessarily an impediment for NRC participation. The NRC has frequently participated in collaborative research programs with external organizations, and evaluates the research data independent from the other organizations.

QUESTION 8: What could be the benefits, or adverse impact, to existing and established international collaborative activities in this area?

Possible impacts to existing collaborations include increased competition for a few qualified personnel, the possibility of repeating existing research capabilities, and interruptions to short-term and long-term industry and regulatory projects. Internationally, the NRC staff has collaborated with the Halden Reactor Project (HRP) on DI&C/HMI research initiatives for many years. Current collaboration efforts with HRP include performing safety assessments on commercial-off-the-shelf equipment, ranking software engineering practices and testing digital reliability assessment methods, human reliability benchmarking, teamwork, alarm systems, and computerized procedures. Participants recommended that international collaborative efforts should not be abandoned because such efforts allow the NRC to keep pace with worldwide digital technology advances and standard practices.

QUESTION 9: What could be the NRC's legal, budgetary, and oversight role?

Participants expressed concerns about the relationship between the NRC in its regulatory role, and others in a collaborative research structure. Specifically, they cited the potential that the NRC staff could expand the scope of regulatory scrutiny beyond areas of regulatory concern and promote specific technical products through DI&C/HMI research at this facility. Instead, they suggested that the NRC's legal, budgetary, and oversight role could be that of a collaborative participant that funds projects to address nuclear-related issues in DI&C/HMI. With regard to oversight, participants expressed the preference for third-party leadership of any facility used for collaborative research to minimize OCOI and other organizational issues. However, the NRC staff noted that third-party leadership could inhibit the NRC's prioritization of research activities and that there has been extensive cooperation in the past. That is, a model for NRC participation exists.

In conclusion, participants expressed concerns with NRC involvement in a single facility and suggested that the NRC's role be that of a funding participant for projects that address nuclear-related DI&C/HMI issues.

The "Hub and Spoke" Model

Key Differences from the U.S. Nuclear Regulatory Commission (NRC) Current Approach

- Different management model
- Scalability and flexibility for steering and funding partners (option 2: contractor operated hub)
- More centralized coordination and communication of research capabilities and products
- Workshop participant consensus
- Spokes can conduct multiple research projects under a common area of expertise instead of the current one-to-one relationship between the NRC and specific research projects
- Increased logistics support from Headquarters staff if RES is the "hub"

NRC Role

- Issue final regulatory guidance.
- Provide leadership and vision.
- Provide performance oversight and the necessary checks and balances to manage the model.
- Identify and approve research projects based on NRC and stakeholder needs.
- Partition resources and project allocations among the "spokes."
- Promote stakeholder support for research initiatives.
- Seek partners for cooperative research.

"Hub" Role (NRC or contractor operated)

- Provide recommendations on the organizations most appropriate for addressing identified research topics.
- Coordinate and promote communication among "spoke" or stakeholder organizations.
- Provide centralized program management support (e.g., periodic workshops, website hosting, etc.).
- Promote digital instrumentation and control and human-machine interface (DI&C/HMI) educational programs and workforce development.

"Spoke" Roles

- Provide expert technical assistance to Headquarters staff on DI&C/HMI topics.
- Maintain experimental and computational capabilities.
- Execute agency research projects under a common area(s) of expertise on a timely basis and produce quality results (e.g., HMI spoke, Cyber Security Spoke).
- Educate, train, and maintain highly capable staff on DI&C/HMI topics.