POICY ISSUE
(Information)

August 15, 2001 SECY-01-0155

FOR: The Commissioners

FROM: William D. Travers
Executive Director for Operations

SUBJECT: NRC RESEARCH PLAN FOR DIGITAL INSTRUMENTATION AND CONTROL

PURPOSE:

The purpose of this paper is to inform the Commission of the Research Plan (Plan) for Digital Instrumentation and Control (I&C) for fiscal years 2001-2004.

BACKGROUND:

Over the past decade, obsolescence of many of the analog I&C system components and equipment and advances in technology have led to an increasing use of digital I&C systems in U.S. nuclear power plants. Advanced reactor designs make significant use of digital I&C systems. These systems can provide many benefits in operational performance and safety to the nuclear industry. However, the introduction of digital technology into nuclear power plants also presents challenges. These include rapid technology changes, significant complexity, operational issues, and failure modes that are different from analog technology. In recognition of these issues, the staff, under the direction of the Commission, updated Chapter 7, Instrumentation and Controls, of NUREG-0800, “Standard Review Plan for Review of Safety Analysis Reports for Nuclear Power Plants,” (SRP) and issued Revision 4 of SRP Chapter 7 in June 1997.

The SRP provides guidance to the staff in performing safety reviews of applications to construct and operate nuclear facilities. It establishes criteria and guidelines for both operating plants (modifications) and proposed future advanced reactor designs, which the staff uses in evaluating whether an applicant/licensee of a nuclear power plant meets the Commission's regulations. The guidance in Chapter 7 is currently used for the review of advanced reactors, plant-specific digital retrofits and topical reports on digital equipment, and is presently considered adequate. It is also used as the basic reference review document by the regulatory agencies of several foreign countries in the review of advanced reactor I&C system designs.

CONTACT: S. Arndt, RES
(301) 415-6502

However, in view of the rapidly evolving digital technology and related standards and the need for quantitative assessment of digital I&C system reliability and risk, the staff has developed this Plan. The Plan provides a flexible guide for both short-term and long-term research activities. The results of this research will (1) enhance technical reviews, (2) provide better insights and guidance into the risks and reliability of digital systems and (3) maintain an informational database on evolving technology and new industry initiatives, including new tools, techniques, and practices relevant to the design and evaluation of future applications for nuclear power plant digital I&C systems.

In preparing the Plan, the staff has consulted the following sources:

- NUREG/CP-0136, documenting a workshop on Digital Systems Reliability and Nuclear Safety (September 1993)

- the National Academies of Science/National Research Council (NAS/NRC) study "Digital Instrumentation and Control Systems in Nuclear Power Plants: Safety and Reliability Issues" (1997)

- the Advisory Committee on Reactor Safeguards (ACRS) Report, “Review and Evaluation of the Nuclear Regulatory Commission’s Safety Research Program” (1998)

- an expert panel convened by RES to assess the state-of-the-art in digital systems research (September 1999).

The staff has also benefitted from ACRS review of the Plan. The staff has incorporated the ACRS comments on the draft Plan into the current version. The ACRS reviewed the revisions to the Plan and provided a strong endorsement of it in NUREG-1635 Vol. 4, “Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program,” (May 2001).

DISCUSSION:

The Plan addresses the need for the digital I&C research program, discusses technical issues and challenges, and establishes actions and schedules. The research has been targeted to support current regulatory activities, and potentially to support future regulatory requirements, including advanced reactor reviews and use of probabilistic risk assessment (PRA) methods in the I&C area.

The short-term research needs are focused on (i) improving efficiency of the technical review process, (ii) addressing reliability and risk considerations, (iii) reflecting evolving technology aspects, and (iv) keeping current with industry standards and practices. The long-term needs are geared toward understanding emerging I&C technologies, developing tools to evaluate their application to existing and advanced reactors, and developing appropriate methods to incorporate digital systems’ reliability information into plant PRAs. To meet the needs discussed above, the staff plans to engage in research tasks in four general areas:

(1) Systems Aspects of Digital Technology

Activities in this area will address both internal interactions and external factors that affect digital system performance, such as, electromagnetic interference and lightning. Guidance will be developed to ensure specifications are provided for environmental qualification of digital systems. Operating systems and computer diagnostics also fall into this research area.

(2) Software Quality Assurance

Software quality assurance is a planned and systematic process for controlling actions necessary to provide adequate confidence that an item, or product, conforms to established technical requirements. Existing guidance relies on subjective measures. The staff will investigate various objective criteria and software engineering techniques to identify opportunities to improve the effectiveness, efficiency and realism of staff review of digital systems.

(3) Risk Assessment of Digital I&C Systems

The NRC is increasing the use of PRA technology in regulatory matters to the extent supported by the state-of-the-art in PRA methods and data. Currently, I&C systems are not generally modeled, in detail, in plant PRAs; however, a recent Accident Sequence Precursor database study (summarized in Appendix A of the Plan) demonstrates the importance of I&C systems on plant safety. As the NRC moves toward a risk-informed regulatory environment, the staff will need the data, methods, and tools to permit accurate and effective risk assessment of digital I&C systems. The staff will analyze U.S. and foreign digital I&C failure data, investigate digital failure and reliability assessment methods, and quantify the risk importance of digital systems.

(4) Emerging I&C Technology and Applications

Innovations in digital I&C technology have the potential to improve the safety of nuclear power plants. The staff requires knowledge of emerging technology and applications in order to make timely and accurate decisions. Research tasks in this area will provide the technical information and criteria for effective regulatory decisions. These tasks are focused on emerging technology and applications known to be pertinent to the nuclear community. Examples include predictive maintenance and online monitoring systems, advanced instrumentation, smart transmitters, wireless communication, and computer security.

As part of its development, the staff has had several discussions with the ACRS and presented the Plan in several public forums, including the 2000 Water Reactor Safety Meeting and the 3rd American Nuclear Society International Topical Meeting on Nuclear Plant Instrumentation and Control and Man-Machine Interface Technologies. These interactions with the technical community have provided insights that have been factored into the final version of the Plan. The draft Plan was used as an input to the FY 2002 and FY 2003 budget development and has guided the development and implementation of digital I&C research programs throughout FY 2001. Furthermore, the Plan is responsive to the agency's needs in developing a regulatory framework to address new reactor concepts that would allow effective implementation of new technologies.

The Emerging I&C Technology and Applications section of the Plan provides for the annual development of an emerging technology report that will be used to understand how cutting edge technologies and advancements in current technologies might affect the digital I&C program in the coming years. In this way, both changes in digital systems technologies, such as the increase in the use of wireless communications, and changes in the nuclear industry, such as the development of new I&C in support of advanced reactors will be incorporated into the Plan.

As the results of these projects become available, the staff will (1) provide products that could enhance technical reviews and (2) revise and update the research program by increasing emphasis on areas that can provide improvement to the regulatory process as appropriate. Further, an internal Technical Advisory Group composed of RES, NRR and NMSS staff, will be formed to facilitate technical information exchange among the staff in the various offices, address progress, and identify changes to the Plan as technology and needs change. Although, research in this area in support of regulation of nuclear materials has been limited in the past, it is anticipated that future updates to the research program will include NMSS program areas.

RESOURCES:

The resources for the effort outlined in the Plan were addressed in the FY 2003 budget proposal through the Planning, Budget and Performance Management process.

To achieve the stated goals, the staff will continue to explore the possibility of leveraging its resources by participating in cooperative research with other Federal Government agencies and international organizations.

COORDINATION:

The Office of Nuclear Reactor Regulation has concurred in this paper. The Office of the Chief Financial Officer has reviewed this paper for resource implications and has no objections. The Office of the General Counsel has no legal objection to this paper.

/RA/

William D. Travers
Executive Director
for Operations

Attachment: NRC Research Plan - Digital Instrumentation and Control

framework to address new reactor concepts that would allow effective implementation of new technologies.

The Emerging I&C Technology and Applications section of the Plan provides for the annual development of an emerging technology report that will be used to understand how cutting edge technologies and advancements in current technologies might affect the digital I&C program in the coming years. In this way, both changes in digital systems technologies, such as the increase in the use of wireless communications, and changes in the nuclear industry, such as the development of new I&C in support of advanced reactors will be incorporated into the Plan.

As the results of these projects become available, the staff will (1) provide products that could enhance technical reviews and (2) revise and update the research program by increasing emphasis on areas that can provide improvement to the regulatory process as appropriate. Further, an internal Technical Advisory Group composed of RES, NRR and NMSS staff, will be formed to facilitate technical information exchange among the staff in the various offices, address progress, and identify changes to the Plan as technology and needs change. Although, research in this area in support of regulation of nuclear materials has been limited in the past, it is anticipated that future updates to the research program will include NMSS program areas.

RESOURCES:

The resources for the effort outlined in the Plan were addressed in the FY 2003 budget proposal through the Planning, Budget and Performance Management process.

To achieve the stated goals, the staff will continue to explore the possibility of leveraging its resources by participating in cooperative research with other Federal Government agencies and international organizations.

COORDINATION:

The Office of Nuclear Reactor Regulation has concurred in this paper. The Office of the Chief Financial Officer has reviewed this paper for resource implications and has no objections. The Office of the General Counsel has no legal objection to this paper.

/RA/

William D. Travers
Executive Director
for Operations

Attachment: NRC Research Plan - Digital Instrumentation and Control

ADAMS ACCESSION NO.: ML012080334 (PACKAGE)
ML011990569 (SECY PAPER)
ML012080254 (ATTACHMENT)

DOCUMENT NAME: g:\Commission Paper5.wpd ***SEE PREVIOUS CONCURRENCE**
OAR in ADAMS? (Y or N) Y ADAMS ACCESSION NO.: ML012080334 TEMPLATE NO. SECY-012
Publicly Available? (Y or N) Y DATE OF RELEASE TO PUBLIC _____ SENSITIVE? N

To receive a copy of this document, indicate in the box: "**C**" = Copy without attachment/enclosure "**E**" = Copy with attachment/enclosure "**N**" = No copy

OFFICE	TechEditor		ERAB/RES		ERAB/RES		D/DET/RES		DD/RES	
NAME	PKleene*		SArndt*		DDorman*		MMayfield*		RZimmerman*	
DATE	4/18/01		7/17/01		7/18 /01		7/ 26 /01		7/ 27 /01	

OFFICE	NRR		D/RES		AC/PAB/OCFO		OGC		EDO/DEDMRS	
NAME	JZwolinski*		AThadani*		Karen Fitch* (by e-mail)		KCyr*		CPaperiello AT for	
DATE	7/26/01		7/27 /01		7/23/01		7/24/01		8/8/01	

OFFICE	EDO									
NAME	WTravers									
DATE	8/15/01									

OFFICIAL RECORD COPY