POLICY ISSUE
INFORMATION

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FOR: The Commissioners

FROM: Eric J. Leeds, Director
Office of Nuclear Regulatory Regulation

SUBJECT: TRAINING AND INFRASTRUCTURE NEEDS DUE TO DIGITAL MODIFICATIONS ON OPERATING REACTORS TO SUPPORT REACTOR INSPECTIONS AND OPERATOR LICENSING

PURPOSE:

This paper discusses the staff's actions to ensure that the U.S. Nuclear Regulatory Commission (NRC) operator license examiners (examiners) and inspectors maintain the necessary expertise as the existing reactors convert from analog to digital systems. The Commission requested this information paper in Staff Requirements Memorandum M080407A, "Staff Requirements—Briefing on Digital Instrumentation and Controls," dated May 1, 2008. The Commission has received similar information on training and infrastructure needs for new reactors presented in SECY-08-0096, "Training and Infrastructure Needs to Accomplish New Reactor Inspections and Operator Licensing," dated July 3, 2008. This paper does not address any new commitments or resource implications.

BACKGROUND:

At an increasing rate, the original analog electronic equipment used at nuclear plants is no longer available because of technology changes. To maintain operations, utilities are replacing obsolete analog equipment with digital components using site-specific approaches. The replacement of analog with digital equipment is not unique to nuclear power plants. The chemical processing and other industries have been replacing analog equipment at their facilities for many years. Additionally, nuclear fuel cycle facilities are in the process of installing digital systems in their existing and new facilities.

CONTACT: William B. Cartwright, NRR/DIRS
301-415-8345

To date, most analog equipment replacements at operating power plants have been non-safety related components. Digital replacements of safety related equipment have typically been equivalent component replacements with a similar appearance.

DISCUSSION:

Categories of Planned Digital Modifications at Operating Nuclear Power Plants

Digital modifications can take several approaches. The simplest and most common category of modification is the replacement of an analog device with an equivalent digital device. Many of these modifications have been made at operating reactors under licensee design controls, often as resolutions to obsolescence issues. Examples are gauge and chart recorder replacements with equivalent digital components. The NRC examiners and inspectors have been successfully dealing with these changes for a number of years. Special training or infrastructure is not needed for examiners and inspectors to support this category of change.

Functional modifications constitute the second category of digital changes. Other than changes to display appearance, they are usually transparent to the plant operators, NRC inspectors, and NRC examiners. This category can include combining the analog functions of several components into a digital architecture or reengineering the logic of the new circuits to take advantage of digital capabilities. Functional changes to safety related systems usually require NRC approval (because of license changes). The most extensive functional modification proposal submitted to the NRC to date (from Oconee) converts several safety related systems from analog to digital architecture. The digital architecture offers enhanced capabilities such as error checking, signal validation, fault-tolerance features, trending, and testing improvements. This is a first-of-a-kind project that will establish a model for the industry license amendments of this type. If the proposed Oconee changes are approved by the NRC, similar major digital modification proposals are expected from other operating nuclear power stations.

For this second category of digital modification inspectors and examiners require a basic understanding of the technology and failure modes, similar to all types of modifications. Experience indicates that additional NRC infrastructure or special training is not required to support this category of digital modifications at this time.

From the perspective of an inspector and examiner, the third and most complex category of digital modifications involves changes to the human-machine interface (HMI). New reactor applicants have proposed substantial changes over previous control room designs by replacing individual components with flat screens and computer interfaces. While some licensees of operating reactors have discussed conceptual designs for extensive flat-screen style HMI modifications, they have not yet been formally proposed.

As HMI modifications are developed, and if they are economically feasible, they may be proposed for existing reactors. For the operating reactor fleet, the timing and scope of all digital modifications are expected to vary depending on site-specific needs and resources. The staff has no indication from industry that it should anticipate major HMI modifications in the near term (several years).

Extensive digital modifications to operating reactors (that require license amendments) will require prior NRC approval. This will provide the staff with advance notification of the scope and details associated with future digital modifications at operating reactors.

Staff Actions to Date Regarding Digital Modifications

Inspection procedures for digital modifications have been available since 1995. For NRC inspectors or examiners, the process for evaluating digital modifications is the same as for other plant modifications—the inspector validates that the design requirements have been implemented properly, and the examiner ensures that license applicants have an appropriate understanding of the site-specific procedures and operator requirements.

As a result of the digital modification proposed for Oconee that is being reviewed, the staff has developed the new Inspection Procedure 52003, "Digital Instrumentation and Control Modification Inspection." This new inspection procedure provides guidance for the installation, testing, and operational phases of large digital modifications. Training on the requirements of this procedure is being conducted. Contractor support for digital modification inspections has been budgeted in 2009 and 2010 to supplement NRC inspector expertise. The staff will use the inspection feedback process to identify any lessons learned, future digital inspection improvements, and any additional inspector training needs.

The staff is also following industry initiatives on major HMI modifications for both new and existing reactors. As the industry develops the details for proposed HMI changes, the staff will recommend future NRC training needs.

To deal with obsolescence issues similar to those faced by the industry, the NRC has converted about five percent of its simulator indicators and controllers to equivalent digital components. This provides some training exposure for the NRC inspectors and examiners. In terms of formal courses, a digital instrumentation and control course for technical design reviewers has been developed and held several times. The training organization anticipates future requests for additional digital technology courses for inspectors and examiners as the industry develops specific modification proposals.

NRC inspectors and examiners are now exposed to site-specific combinations of analog and digital equipment in use for both safety and non-safety related applications (hybrid control room). Although there are site-specific differences, general digital training topics for inspectors are being defined, and external training opportunities have been identified, and are being used. Currently, NRC examiners validate the license exams at the sites before administering them. This ensures that the examiners are familiar with the site-specific systems, controls, and procedures being tested before the exam, which provides them with learning opportunities. It is important for inspectors and examiners to maintain expertise in both the analog and digital equipment at operating reactors as both are in use.

An Inspection Manual Chapter 1245 "Qualification Program for the Office of Nuclear Reactor Regulation Programs" working group has existed for several years and is used as a forum for discussing inspector and examiner qualification requirements. This working group is developing advanced electrical training qualifications that include digital instrumentation. The working group members are drawn from the training organization, each regional office, and Headquarters, making it well suited to make training recommendations for inspectors and

examiners. Part of this working group's charter is to review inspector requests for training communicated by both the inspection feedback process and a biennial internal survey. Communications between the working group and the design technical branches reviewing proposed digital changes also ensure that future inspector and examiner needs are considered based on the proposed modifications under review.

Conclusions

For digital modifications at existing reactors, the NRC inspectors and examiners are successfully meeting their responsibilities. Inspector and examiner skills will be enhanced by training developed using the existing inspection feedback processes, monitoring future proposed changes, utilizing contractor expertise, and learning from the large proposed digital modification now under review. These enhanced skills will support future site-specific digital modifications.

The staff expects the implementation of large-scale digital modifications will occur at existing reactors during the same time period that the new reactors are being built. This will result in opportunities to develop the infrastructure that meet the needs of both, resulting in cost and resource efficiencies. The Office of Nuclear Reactor Regulation, the Office of Human Resources, and the Office of New Reactors will continue close communications to coordinate their resources in this area.

COORDINATION:

The Office of the General Counsel reviewed this paper and has no legal objection.

/RA/ (James T. Wiggins acting for)

Eric J. Leeds, Director
Office of Nuclear Reactor Regulation