

NEI, NRC raise priority for digital I&C

BY E. MICHAEL BLAKE

IN A PRESENTATION to the Nuclear Regulatory Commission on November 8, Amir Shahkarami, chairman of the Nuclear Energy Institute's (NEI) Industry Digital I&C and Human Factors Working Group, made it clear that nuclear power plants in the United States, existing and forthcoming, will ultimately have digital instrumentation and controls (I&C). The question, he said, is not if, but when.

Shahkarami noted that technical and trade schools no longer offer training with analog controls and that the equipment itself is becoming much harder to find. He said that the National Aeronautics and Space Administration, among other organizations, has started using online auction sites such as eBay to procure spares and replacements for mechanical and analog indicators and controllers that are no longer being manufactured. With electricity providers hoping for decades of operation of both existing reactors (through license renewal) and proposed new reactors, the enterprise cannot depend on entire categories of equipment that are becoming obsolete.

The briefing for the commissioners on digital I&C, held at NRC headquarters in Rockville, Md., covered not just the conversion of analog I&C systems at existing reactors to digital I&C, but new reactors that would include digital I&C from the beginning and whose design details would be predicated on the digital systems. The five commissioners heard presentations from both NEI and the agency's own staff, and commissioner Peter Lyons, among others, said that reading the advance slides from the two groups made him wonder if they were for two different meetings. He said they gave him the impression that the NRC staff considers the issue to be progressing appropriately, while NEI sees an urgent need for quicker and higher-priority action.

Both in presentations and in response to questions from the commissioners, it was frequently stated that converting from analog to digital I&C is expected to result in substantial safety benefits, as it has in other industrial sectors (such as air travel) where

Nuclear Energy Institute and Nuclear Regulatory Commission officials are facing time pressure, especially for expected license applications for new reactors.

it has been adopted. Not only is digital I&C no longer a new technology, but it was generally agreed that the nuclear power industry has been slower to adopt it than most other major industrial sectors, and nuclear power in the United States has been slower to adopt it than some other nuclear nations, such as France and Japan. Conversion to digital has been pursued at some U.S. plants only for turbine control and balance-of-plant. The changeover for I&C directly related to a nuclear steam supply system, affecting equipment such as in-core neutron monitors, not only raises questions of safety, reliability, and redundancy, but would entail physical modifications in high-radiation regions.

The view expressed by some staffers at the meeting is that there already exists a de-

terministic regulatory basis for the review and approval of license amendments for digital I&C adoption. What the industry would like, however, is a more risk-informed approach to I&C approval. The staff is carrying out more research to support a risk-informed approach, the results of which will start becoming available around mid-2007. This may create scheduling problems for potential construction/operating license (COL) applicants, who will begin submitting COL applications in late 2007 and who intend that their detailed designs will include digital I&C.

Thus far, I&C specifics have not been included in design certification applications, nor have they been required. This will have the effect of deferring the review of a new



The control panel in a current nuclear power plant

reactor's I&C until the COL application review, with the confirmation of the finished system's effectiveness to be addressed during the inspections, tests, analyses, and acceptance criteria (ITAAC) that must be carried out before a new reactor would be permitted to enter service.

guide (DG-1145) and standard review plan updates for new reactor licensing, and, as NEI puts it, is "still forming opinions on several key issues." An earlier request by Duke Energy for an analog-to-digital conversion at its three-unit Oconee plant led the NRC staff to identify potential generic issues and

consider changes to existing guidance. This stance was expressed in Branch Technical Position 19, which among other things calls attention to whether manual operator actions would be sufficient to cope with common-mode failures in the software that governs digital I&C.

requested that digital I&C be given priority attention by the commissioners and senior agency management, with meetings at the commission level held perhaps every six months, and the creation of a digital I&C/human factors steering committee, with representatives from the offices of Nuclear Reactor Regulation, New Reactors, Research, and Nuclear Security and Incident Response, to meet quarterly with the NEI working group.

Commissioner Edward McGaffigan noted that the NRC was already operating on a continuing resolution because its fiscal year 2007 budget had not yet been passed by Congress, and with Congress set to come under the control of the opposition party, it was unclear whether any budget action would take place soon. In FY 2007, the NRC has requested a substantial increase in budget authority to cover the new hiring needed to process COL applications while maintaining its other regulatory activities at appropriate levels. If there is a budget crunch, however, some tasks might have to be deferred. McGaffigan asked whether the industry could accept cutbacks in other, nonsafety-related areas to get priority treatment for I&C. Jay Thayer, NEI's vice president for operations, answered yes, adding that the industry would just have to reset its priorities.

The staff's perspective

In the subsequent presentation, NRC staffers acknowledged that even well-maintained analog I&C systems are becoming obsolete, but a changeover to digital systems must not create new problems that may not be immediately obvious. This is why Chapter 7 of the Standard Review Plan is being revised and research is being carried out on the use of digital I&C for safety-related reactor systems to avert such problems and their unintended consequences.

Jim Dyer, director of the Office of Nuclear Reactor Regulation (NRR), said that the agency's "growing workload" for digital I&C would cover modifications to existing reactors, certification of new reactor designs (which so far have included only design acceptance criteria for I&C), and COL applications (which would include detailed designs that had not been in the certifications). Commissioner Jeffrey Merrifield asked if this was ranked in order of importance, and whether either area would compete with the others. Dyer said that he considers all three to be equally important and believes that all three can be done in parallel, but only if the NRC gets its full budget and does not have to settle for the continuing resolution, which essentially appropriates the same amount to the NRC for FY 2007 as it had in FY 2006.

The NRC staff—and also the NEI contingent—stressed that any digital I&C upgrade must demonstrate diversity and de-

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Another moving target?

The industry has been concerned for some time about the pending amendments to 10 CFR Part 52, the regulations that oversee new reactor licensing. While the final rule is expected to streamline the process, prospective COL applicants are already writing their applications, and if something unexpected ends up in the final rule—which may be issued around the beginning of 2007—some of the work that has gone into the applications may have to be done over. According to Shahkarami, NEI has similar concerns about the NRC's approach to I&C, which may be subject to changes that make work being done now by the industry useless in the approval process later.

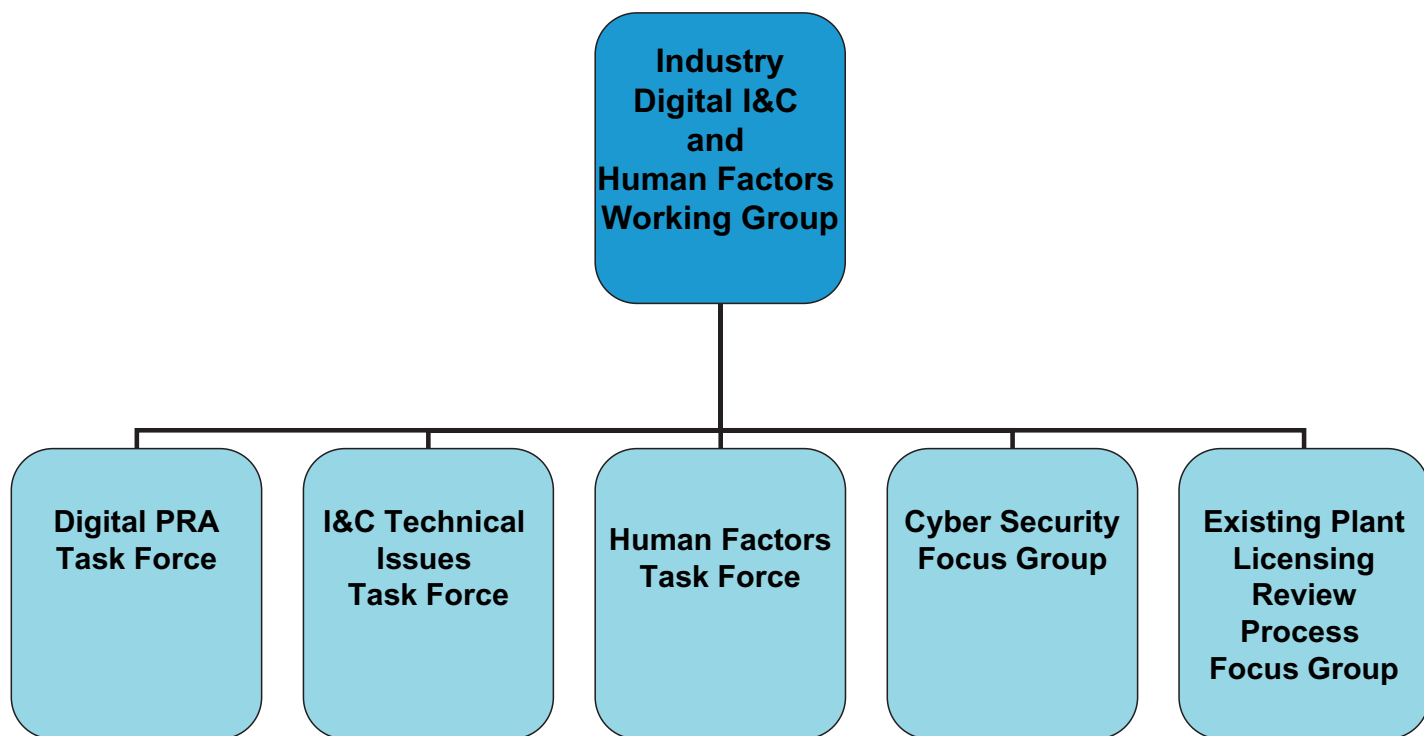
In addition to the 10CFR52 changes, the NRC staff is working on a draft regulatory

The NEI presentation stated bluntly, "There is no clear success path for resolving long-standing technical and process issues." As a result, existing reactors are forced to delay or change plans for analog-to-digital conversion, and new reactors are faced with the potential removal of important features or the addition of unnecessary complexity. Jack Bailey, of NEI's New Plant Working Group, noted that the refurbishment of Browns Ferry-1, ongoing for four years and scheduled for completion next year, was done with the analog I&C kept intact because of regulatory uncertainty in a possible conversion to digital.

Despite this apparent anxiety, the NEI contingent noted that it was encouraged by the progress made during a meeting with NRC staffers on October 19. The NEI re-



What a new digital I&C control room for Westinghouse's API000 will look like, as shown in a presentation at the NRC briefing



NEI's Industry Digital I&C and Human Factors Working Group, along with its associated task forces and focus groups

fense-in-depth (referred to as "D3," an acronym for which Merrifield expressed dislike). Alan Howe, of NRR, who spoke next for the staff, said that in the staff's view, the industry's risk-informed approach has not included the development of a reliability model. The staff is also developing a paper for the commissioners on safety review criteria for "bidirectional channels" that convey information and control commands between safety channels and from safety to nonsafety channels. This paper is to be delivered in December.

In any system connected to computers and software, there exists a possibility for tampering, perhaps remotely by hackers, and so cyber security is a key issue in the adoption of digital I&C. The staff presentation noted that NEI is planning to submit a report to the staff on the subject. Also, as part of its ongoing effort to enlarge its staff, in part to prepare for COL submissions, the NRC is recruiting experienced as well as entry-level I&C engineers and making use of the expertise available at national laboratories.

Part of the staff's process for determining whether digital I&C can be risk-informed entails the study of analog-to-digital experience in other fields, and not all of them are vastly different from nuclear power. NRC chairman Dale Klein noted that the entire U.S. nuclear submarine fleet has been converted to digital I&C. The staff is aiming toward issuing a draft regulatory guide on risk-informed digital I&C in late 2007, and the final version in mid-2008. The digital I&C issue is also closely related, especially in new reactors, to the development of integrated control rooms,

and the staff plans to issue review criteria in August 2007.

One of the research projects is looking at a complete departure from the microprocessor-based technology of virtually all traditional digital systems. Systems based on field programmable gate array technology have been used in some other industries and may be less susceptible to common-mode failures than microprocessors. The staff is researching this and other alternatives and expects to issue review guidance in August 2007.

Commissioners' comments

After each presentation, the commissioners had the opportunity to ask questions and make comments. Some of these have already been included above; some more are listed below.

Commissioner Gregory Jaczko asked for more details on the safety benefits of digital I&C. Shahkarami cited the stable behavior of digital systems during transients and in interactions between safety and nonsafety systems. Speaking from the audience, Steve Hess, of the Electric Power Research Institute, added that the use of digital I&C thus far in feedwater and turbine control systems has led to fewer initiators that would have resulted in unnecessary reactor trips than if analog systems had been in place.

In response to a question from Lyons, staffers said that NEI's suggestion of a joint task force was something they had just heard for the first time, although they viewed it positively. Merrifield, among others, endorsed the suggestion that the commissioners continue to hold meetings

on the progress of digital I&C every six months.

In connection with the adoption of digital I&C in other industries, McGaffigan noted that the Federal Aviation Administration tolerates plane crashes, a position the NRC will never adopt toward reactor accidents. He asked whether commercial aircraft pilots are able to take over manually if the digital system fails, and whether a similar backup would exist for reactor operators. Shahkarami said that backup systems do exist in cockpits, and the NEI speakers in general said that "D3" would call for the availability of fully independent backup I&C systems for reactors.

Lyons asked whether the uncertainties in the risk-informed approach could be quantified. The staff's reply was that it is too early to tell, and that the ongoing research might provide answers later. In other exchanges on this topic, NEI and the NRC staff each said in effect that the other should not be greatly concerned by uncertainties. NEI said that the risk-informed approach would emphasize those systems and interactions that matter most, and the NRC staff said that digital I&C adoption could begin now because the research would probably not lead to a major overhaul in the proposed systems.

Merrifield asked for more detail on the staff's recruitment of I&C engineers. Dyer said that there are 13 I&C evaluators now, and the number is intended to double, with the personnel to be allotted to NRR and the New Reactors office. Merrifield suggested that the staff focus its recruiting on industries that have already gone through digital adoption, especially the nuclear Navy. ■