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Roles of Information Technology in Nuclear Criticality Safety Training

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INTRODUCTION

For many years, the nuclear criticality safety (NCS) community has recognized the urgent need to develop a criticality safety workforce to meet the country's nuclear operations support requirements. While there are many causes for the current workforce shortage problem, the retirement of many experienced personnel from NCS has exacerbated the situation. The Department of Energy (DOE) Nuclear Criticality Safety Program (NCSP) has established a website (http://ncsp.llnl.gov) to assist newcomers to this field. Among other things, the DOE NCSP website offers a series of nuclear criticality safety engineer training (NCSET) modules to assist various DOE sites in training nuclear criticality safety engineers. For years, this section of the website has attracted many users worldwide, and records more than eight thousand downloads of the modules per year.

Rapid advances in information technology (IT) and communication tools have reshaped the training field and offer improving training modalities. Since the NCSET modules were originally developed in text mode, it was recognized that much of that training could be improved by utilizing these IT innovations. This paper reports a new approach to enhance the NCSET training modules and discusses the use of IT and new communication tools as effective means to help manage NCS workforce development.

DESCRIPTION OF THE ACTUAL WORK

In general, a text-based module works mostly like a textbook and, without a lecturer, effectiveness of the training can be quite limited. It addresses only one learning style. A student's learning is limited to what the text says, and lacks a lecturer to convey the importance and context of the key points in the text. Also, given the growing trend of shortening attention spans due to our "information now" world, text mode explanations can tax the student's attention span, making it more difficult to sustain student interest.

To improve training effectiveness, multi-media production technology was used in this work. This included videotaping a lecturer teaching on a subject, and the use of computer screen to display the key points of the oral presentation. Multi-media techniques such as utilization of various graphics, pictures colors, and drawings, as well as some interactions were used to maintain and engage the student. Interplay between video and audio portions of the presentation makes the teaching much more vivid and lively than the dull text mode presentation.

In using a multi-media approach, our training differs considerably from textbook training. For example, training materials for a given subject were composed into small packages. Each package consisted of a few minutes of narration, a video segment, and graphic representations that highlight a key physics topic. This presents a big challenge to the lecturer, who is a technical expert in CS field, but is not used to the "movie-making business". Repeated video tapings were required to meet the quality needed for final production. Furthermore, storyboard writing is required and is a major effort. The storyboard not only provides for the design of onscreen graphics and actions, but also contains an accompanying script to guide the onscreen lecturer, behind the scenes narrator, and multi-media developer. From a teacher's perspective, loss of the ability to interact with students makes the presentation of technical data such as mathematical calculations much more demanding and requiring far more planning than in a typical classroom setting with a "blackboard."

RESULTS

We converted the NCSET module on hand calculation methods (Part I)[1] to a multi-media module consisting of three segments covering three hand calculation methods including buckling conversion, K-infinity, and surface density evaluations. These multi-media segments are currently in a beta testing mode and will be posted on the DOE NCSP website once the review is completed. Production of the NCSET modules in multi-media format provided a great learning experience for technical experts to learn modern communication tools for teaching. We also learned that the necessary resources for this work include not only technical expertise in the NCS field but also training know-how and video production expertise

such as sound technology, lighting, and video filming artistry.

Modern innovations of virtual reality and computer technology indeed open up a new training horizon, which is not available previously. Communication venues are no longer limited to synchronous teaching methods such as teacher-student settings in classroom environments. Instead, we should take advantage of asynchronous modes of learning that allow students to effectively self-study and information share through online tools that teach and facilitate peer-to-peer and mentor interactions. In this regard, we suggest that it is time to investigate the use of modern internet and multimedia technology to explore the feasibility of utilizing retired NCS experts for video conferencing and mentoring of newcomers in the NCS field. Furthermore, it appears that the time is also ripe for utilizing this technology to develop simulators of critical and subcritical measurements. Availability of such simulators for training purposes will relieve the costly burdens of safeguarding nuclear materials, solve personnel access issues, and allow greater training opportunities to be offered in a university setting. A combination of simulators with the handling of mockup "fissile assemblies" in a training facility can produce substantial hands-on experience without all the infrastructure requirements of performing real critical and subcritical measurements.

REFERENCES

1. The DOE Nuclear Criticality Safety Program Website at http://ncsp.llnl.gov.

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