Inspector Training for VIFM Equipment:
An Integrated Approach

Q.S. (Bob) TRUONG and R. KEEFFE
Canadian Nuclear Safety Commission, Ottawa, Canada

T. ELLACOTT
International Atomic Energy Agency, Vienna, Austria

K. DESSON
Androcom Interactive Media, Ottawa, Canada

N. HERBER
Eton Systems, Ottawa, Canada

Abstract

The VXI Integrated Fuel Monitor (VIFM) developed under the auspices of the Canadian Safeguards Support Program (CSSP) is a generic radiation monitor developed for safeguards applications. In recent years, a number of training resources – reference manuals, classroom lectures, checklists, a CD-ROM-based self-paced instructional program, and others – have been developed to ensure that IAEA Inspectors are able to use all of this sophisticated instrument's capabilities. CSSP personnel have recently developed an integrated approach to inspector training that combines all of these elements in a new way calculated to produce more effective training for the growing number of relatively inexperienced inspectors. Early evaluations from inspectors who have experienced the integrated training approach indicate that the training is more effective than traditional approaches in equipping them to perform their data acquisition and analysis tasks.

1. Introduction

The Canadian Nuclear Safety Commission (CNSC), an independent agency of the Government of Canada, regulates the use of nuclear energy and materials in Canada, and ensures that Canada's international commitments on the peaceful use of nuclear energy are respected. An important dimension of its work is support for the International Atomic Energy Agency's (IAEA's) program of international safeguards. This work is carried out through the Canadian Safeguards Support Program (CSSP).

Recognizing the urgent need for a new generation of radiation monitoring devices to replace aging spent fuel bundle counters, the CSSP sponsored the development of the VXI Integrated Fuel Monitor (VIFM) by Bot Engineering of Campbellville, Ontario, Canada [1]. The development, which began in 1995, conformed with IAEA recommendations on integrated safeguard solutions.

The VIFM, now in service at facilities in several countries, is most often used in an integrated mode, where a single cabinet can house several modules for various detectors such as bundle counters, core discharge monitors, Yes-No monitors, and other devices. It can also be used in a stand-alone, transportable mode, in which a detector can be connected to a single module linked to a laptop computer. The equipment has a virtual instrument panel and control is exercised through the use of a track ball and keyboard.

To ensure that IAEA inspectors are able to use all of this sophisticated instrument's capabilities, it was recognized early in the development process that effective training would be essential.

2. The Training Challenge

In a recent paper on training challenges facing the IAEA [2], Colin Carroll and Mike Stein of Sonalysts Inc. and Thomas Killeen of the IAEA's Section for Safeguards Training, explored the training implications of changes in the job requirements for IAEA safeguards inspectors, which are taking place at the same time the Agency is experiencing high personnel turnover among inspectors.

As part of its ongoing training methodology, the IAEA Section for Safeguards Training (TTR) continuously monitors and evaluates the training implications of changes in the job requirements for IAEA safeguards inspectors. The advent of the *Strengthened Safeguards System* and *Additional Protocol*, and the introduction of new safeguards devices and technologies, have significantly increased the amount of training that inspectors now need. Coincidentally, many of the most experienced inspectors have reached retirement age, resulting in a high turnover of personnel. Their replacements include individuals with a wide variety of work experiences and educational backgrounds, and from a broad range of nationalities representing the diversity of the IAEA's Member States.

TTR relies heavily on experienced safeguards inspectors from the Operations Divisions and on outside experts to deliver training modules, both at IAEA Headquarters in Vienna and at nuclear facilities in Member States. However, as the smaller numbers of experienced inspectors react to an increasing workload, their availability to undertake training-related assignments is proportionally reduced. As a result, the availability of qualified instructors has been decreasing at a time when the need for training of entry-level inspectors is increasing. To further complicate matters, reliance on traditional instructor-led, classroom- and laboratory-based training often makes participation in formal training courses difficult for inspectors because of their rigorous work and travel schedules. The initiative to provide self-paced multimedia training has received positive feedback but can be successful only to a limited extent. Meanwhile, internal resources have not been capable of providing sufficient effort in this area to meet all of the present requirements, particularly in situations best suited to a hands-on instructional approach.

The training challenge for coming years is to continue with the implementation of new instructional techniques and methodologies that can better meet the needs of the new generation of safeguards inspectors.

3. VIFM Training Resources

As part of the development process for the VIFM, the CSSP took on the task of developing a suite of complementary training resources designed to meet the immediate and on-going needs of facility inspectors who will have to work with the device. The decision was made to augment traditional approaches with self-paced training and refresher materials making use of current information technologies.

Traditional training tools developed for the VIFM include:

- a conventional classroom-based course,
- demonstrations and hands-on training using a fully-equipped VIFM unit located at IAEA Headquarters for this purpose,
- a complete set of reference manuals on VIFM equipment and detectors,
- quick-reference procedures checklists.

Innovative training tools include:

- a comprehensive CD-ROM-based multimedia training package that provides inspectors with a detailed orientation to the VIFM's components, functions and operating procedures,
- a CD-ROM-based multimedia program entitled "CANDU Power Reactor Fundaments",
- a series of 11 modular video lectures, recorded on CD-ROM for computer playback, entitled "Core Discharge Monitor (CDM) Fundamentals",
- a VIFM software demonstration program, complete with sample data sets,
- the VIFM Review Program v2.2, with sample data sets, to demonstrate the analysis of Core Discharge Monitor data,
- a two-day workshop to complement the self-paced materials.

Although each of the resources identified above is useful in its own right, the real power of these materials lies in an integrated approach that makes use of each component for a specific training purpose.

4. An Integrated Training Approach

The VIFM training approach features a two-day workshop preceded by a period of CD-ROM-based self-paced study. After the workshop, inspectors are able to make use of printed and CD-ROM-based reference materials for just-in-time "refreshers".

4.1. Pre-Workshop Self-Paced Study

A VIFM CD-ROM multimedia training program is provided to inspectors well in advance of their participation in a 2-day VIFM workshop. First released in 1999, and since extensively updated and reorganized based on feedback from users and subject matter experts, the program enables inspectors to familiarize themselves with VIFM components, functions, operating procedures, computer screens, and vocabulary. In addition, the CD-ROM includes a complete set of reference manuals and a full-featured VIFM demonstration program that enables users to experience the VIFM's "look and feel" as they will encounter it during visits to nuclear generating stations.

The program operates in both "Learning" and "Reference" modes – learning mode presenting a complete training experience, which includes quizzes, tests and assignments, and reference mode serving as an easily-searched just-in-time reference source.

Comprehensive in its scope, the program provides inspectors with access to all the procedures, equipment details and screen functions they are likely to need in performing their

inspection duties (see Illustration 1). Inspectors can go through all of the material systematically, or go directly to information they need immediately to perform a task.

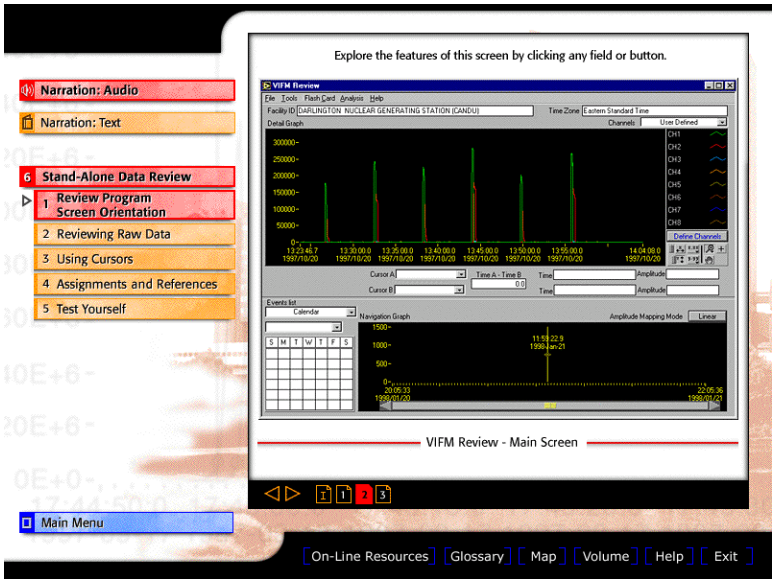

Illustration 1: The VIFM training CD enables inspectors to learn about – and practice with – all screen functions in preparation for performing their duties in the field.

Presentation screens use photographs, illustrations, animation and full-motion video to demonstrate procedures and illustrate concepts as required. In each "lesson", inspectors move through a series of teaching points represented by page icons at the bottom of the presentation screen (see Illustration 2).

Illustration 2: A video clip shows inspectors how to remove storage media from the VIFM. Numbered page icons indicate which teaching point is currently displayed.

Recognizing that for many inspectors English is a second language, all teaching points are delivered both verbally (voice-over narration) and in text format as an aid to comprehension. Inspectors choose the mode that they are most comfortable with – and can change modes as required.

Completion of the self-paced training package is a pre-requisite for workshop participation.

4.2. The Workshop

The CD-ROM covers much of the information that would normally be presented in a traditional five-day classroom-based course. Consequently, there is no longer the need for so lengthy a face-to-face gathering. Having every inspector come to the workshop with a basic understanding of the VIFM enables workshop instructors to concentrate on providing value-added information such as answers to specific questions, facility-specific pointers, and news on recent development. The workshop is also used to provide expanded opportunities for hands-on training with the VIFM.

Day 1 of the workshop covers basic VIFM theory and operation. It is both a review of the self-paced learning (providing opportunities for clarifications and questions) and an opportunity to apply what has been learned through hands-on use of a fully-functional VIFM.

Day 2 covers CANDU reactor fuelling fundamentals and VIFM Core Discharge Monitor (CDM) data interpretation. A subject matter expert from Bot Engineering, manufacturer of the VIFM, participates in the second half of Day 2. This portion of the workshop gives inspectors experience in analyzing real data, comparing their interpretations with those of the subject matter expert.

Every effort is made to present a workshop that is as vividly memorable as possible, using well-produced graphics, videos, and presentation screens to support the instructor, and making physical samples of all equipment available for inspection and hands-on use by the participating inspectors.

4.3. Just-In-Time Reference Materials

A particularly important aspect of the integrated training approach is ensuring that inspectors have access to good just-in-time reference materials after their initial training is complete.

Before and during the workshop, each participating inspector is supplied with printed and CD-ROM-based quick-reference materials. These include:

- concise procedures checklists,
- searchable reference manuals in electronic form,
- the multimedia training program which offers a “Reference Mode” to facilitate access to “refreshers” on specific topics.

With these materials at hand, an inspector who may not have used the VIFM for some time can quickly refresh himself or herself, greatly reducing the chance of missteps.

5. Evaluation

To date, evaluations of the effectiveness of this integrated approach to VIFM training have been limited to end-of-workshop course evaluations, and the collection of anecdotal comments from inspectors in the field about the value of the training they have received. These preliminary sources indicate that the integrated training approach is more effective than traditional approaches in equipping inspectors to perform their data acquisition and analysis tasks.

As part of the on-going development of more effective training products, the CSSP is exploring a more systematic approach to evaluation incorporating:

- the articulation of more concise goals for the VIFM training program,
- development of " formal" measurement tools to verify that program goals are being achieved (e.g. structured course evaluations by participants; skill and knowledge tests, measurements of on-the-job performance, participation and budget records, tracking of use of on-line training materials and reference sources, etc.),
- development of less formal "appraisal" tools to capture subjective assessments of the program (e.g. attitude surveys of past graduates, access to Internet chat rooms to record comments and solicit questions, etc.).

6. Future Directions

The effectiveness of self-paced, individualized training delivered via multimedia in addressing the training needs of facility inspectors, suggests that even greater efforts should be made in this direction. This is supported by the emergence of new technologies that will make it increasingly easy to deliver interactive training remotely. Some of the opportunities that will be explored by the CSSP for VIFM and other training applications include:

- interactive training delivered on secure LANs,
- training and access to reference information at remote locations over the Internet,
- interactive training on DVD (rather than CD-ROM) that incorporates a greater proportion of dynamic information such as animation, video, and voice narrative,
- greater use of realistic simulations to give the user practical experience in using a device before it is encountered in the field.

A new generation of authoring software is also becoming available which, in addition to supporting media-rich instruction, is able to tailor instruction to individual needs. Instructional programs of this kind pre-test the inspector to determine his or her level of knowledge and experience. The inspector is then presented only with the training that he or she requires.

7. Conclusion

Inspector training is acknowledged to be a key element in the effectiveness of IAEA monitoring programs. The integrated, multi-faceted approach developed to impart knowledge and skills with respect to the VXI Integrated Fuel Monitor shows promise as a means to ensure the highest level of inspection knowledge and skills in all IAEA inspection activities. It shows promise as a way to address IAEA training challenges arising out of high personnel

turnover, changes in inspection job requirements, and changes in the character of the inspector population.

References

[1] Bot, D., Keeffe, R., Messner, R., Autonomous Data Acquisition Module for Radiation Monitoring in Integrated Systems or Stand-Alone Modes, Canadian Nuclear Safety Commission. Paper presented at the 19th ESARDA Annual Symposium on Safeguards and Nuclear Material Management, Montpellier, France, 13-15 May 1997.

[2] Carroll, C., Stein, M., Killeen, T., The Impact of the High Inspector Turnover Rate on Safeguards Training. Paper presented at the INMN 42nd Annual Meeting, Indian Wells, CA, USA, 15-19 July 2001.