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UNITED STATES PROGRAM FOR TECHNICAL ASSISTANCE TO IAEA SAFEGUARDS

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DEPARTMENT OF STATE
DEPARTMENT OF ENERGY
ARMS CONTROL AND DISARMAMENT AGENCY
NUCLEAR REGULATORY COMMISSION

Final Report

Basic Visual Observation Skills Training Course

J. L. Toquam
F. A. Morris
J. R. Griggs

Project Manager:
R. Badalamente

June 1995

Prepared for
The International Atomic Energy Agency
Department of Safeguards

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1.0 INTRODUCTION

1.1 BACKGROUND

This is the third report in a series prepared to assist the International Atomic Energy Agency (IAEA or Agency) in enhancing the effectiveness of its international safeguards inspections through inspector training in Observation Skills. The first report (Phase 1) was essentially exploratory (Morris & Toquam, 1993). It defined Observation Skills[1] broadly to include all appropriate cognitive, communications, and interpersonal techniques that have the potential to help IAEA safeguards inspectors function more effectively. It identified ten specific Observation Skills components, analyzed their relevance to IAEA safeguards inspections, and reviewed a variety of inspection programs in the public and private sectors that provide training in one or more of these components. The Phase 1 report concluded that while it should be possible to draw upon these other programs in developing Observation Skills training for IAEA inspectors, the approaches utilized in these programs will likely require significant adaption to support the specific job requirements, policies, and practices that define the IAEA inspector's job.

The second report (Phase 2) provided a more specific basis for the actual design and delivery of Observation Skills training to IAEA inspectors (Toquam & Morris, 1994). It sought to convey a fuller understanding of the potential application of Observation Skills to the inspector's job, describe inspector perspectives on the relevance and importance of particular Observation Skills, identify the specific Observation Skill components that are most important and relevant to enhancing safeguards inspections, and make recommendations as to Observation Skills training for the IAEA's consideration in further developing its safeguards training program.

The present report (Phase 3) documents the design of a Basic Visual Observation Skills course and delivery of the course to safeguards inspectors at IAEA Headquarters Vienna in February and May of 1995.

1.2 RELATIONSHIP TO OTHER IAEA INITIATIVES

In light of recent experience with undeclared activities in States having a comprehensive safeguards agreement, the IAEA Director General has stressed the importance of strengthening the safeguards system by "enhancing the Agency's ability to detect and obtain access to any undeclared activities that should have been declared under safeguards agreements" (Report to the 36th Session of the general Conference, GC/XXXVI/1017). In support of this goal, the IAEA Board of Governors in 1992-93 confirmed the right of the

[1]The first report used the term "Knowledge Acquisition" skills rather than "Observational Skills." We have learned that Observational Skills is more meaningful to most readers and so use only that term in this report.

Agency to conduct special inspections and took decisions regarding the early provision and use of design information concerning facilities under construction or undergoing changes. In July 1993, the IAEA Secretariat launched an effort known as "Programme 93+2" to develop a comprehensive proposal for a strengthened and more cost-effective safeguards system. That proposal was submitted to the Board of Governors in March 1995 and at the Board's direction is continuing to move forward.

A primary focus of Programme 93+2 is reducing the costs of implementing safeguards while maintaining or improving their effectiveness and increasing the capabilities of the Agency to detect undeclared nuclear activities, especially through improved access to information and enhanced access to sites. Programme 93+2 also addresses enhanced safeguards training. The training described in this report is intended to be of sufficiently broad applicability to be generally supportive of the range measures to strengthen safeguards which the Agency has already taken, as well as measures under development as part of Programme 93+2.

1.3 PURPOSE, SCOPE, AND DESIGN OF THE COURSE

The purpose of the Basic Visual Observation Skills course is to help safeguards inspectors evaluate and improve their skills in making observations during inspections and in evaluating and interpreting this information. The course is basic in the sense that it provides training in skills which are generally applicable to inspections of all types of facilities and activities subject to safeguards. "Advanced" Observation Skills are applicable to specific facilities, activities, or proliferation pathways or indicators. These more specific, Advanced Observation Skills are not addressed in the Basic Visual Observation Skills course, which teaches how to observe rather what to observe.

The course is designed for 16 hours of classroom delivery, ideally in four 4-hour sessions over a period of four days. The first 12 hours provide training in five skill areas:

- Perception and Recognition
- Attention and Attention to Detail
- Memory
- Mental Imaging, Mapping, and Modeling Skills
- Judgment and Decision Making

Training in each of these skill areas is provided through a combination of lecture, class discussion, individual exercises, and small group activities to develop an understanding of basic cognitive principles, identify individual strengths and weaknesses, provide a menu of practical techniques for enhancing skills or compensating for weaknesses, and describe applications to safeguards inspections.

Following the training in each of the five skill areas is an Integrating Exercise involving a simulated safeguards inspection. In this exercise, participants are provided with

a written pre-briefing that includes background and design information on the facility to be inspected. Participants then view a video tape of a facility walk-through, during which they make individual notes of their observations and questions. They next meet in one of two small groups to compare their observations and questions. Each group is then de-briefed by a facilitator. Finally, participants view the video tape a second time, during which the facilitator discusses the potential observations that they could have made. The Integrating Exercise thus gives course participants an opportunity to demonstrate their understanding by applying the skills and techniques they have learned in each of the five skill areas.

2.0 COURSE DELIVERY AND EVALUATION

The primary purpose of Phase 3 was to prepare and conduct a pilot session of the Basic Visual Observation Skills course and then to revise that course based upon input from pilot session participants. This section summarizes the activities involved in delivering the pilot session and evaluating the course content and materials. Course evaluations were then used to revise the course and deliver it to a second group of IAEA inspectors. The course revisions and course evaluations are described in this section.

2.1 PILOT COURSE DELIVERY

The pilot session of the Basic Visual Observation Skills course was delivered to twelve IAEA inspectors on February 20 to February 23, 1995 at the Agency headquarters. Because this course was a pilot session, it was conducted in a different manner than other inspector training courses held at the Agency. That is, rather than conduct this session in the traditional Agency training room, the course was held in a conference room. The primary reason for choosing a conference room rather than the training room was to encourage participants to engage in open discussion and to discuss their opinions and experiences as they relate to observational skills.

Participants in the pilot session were twelve current or former Agency inspectors. In general, the average participant had been with the Agency for 8 years. Agency tenure for participants ranged from 4 to 14 years. All participants had inspections experience; a few inspectors had moved to other sections outside of the inspections. Finally, all inspectors were specifically selected for participation in the pilot session because of their level of experience and knowledge, and their willingness to contribute to the evolution and development of this course.

On the first day of the pilot session, participants were provided a detailed description of the rationale for developing the course and procedures used to identify the course topics. In particular, Mr. Richard Hooper, Director of Concepts and Planning, provided rationale for developing and delivering the course from the Agency perspective. Mr. Hooper also explained that the course was a pilot session and that participants' input throughout the course was expected and necessary to help improve the course.

As indicated in the previous section, the course contained six topic areas and was presented in four 4-hour sessions. In the first three days, instructors covered five topic areas, including (1) Perception and Recognition; (2) Attention and Attention to Detail; (3) Memory; (4) Mental Models and Mental Imaging; and (5) Judgment and Probabilistic Reasoning. For each of theses topic areas, instructors described the basic rules and principles that guide skill development and application, provided examples and exercises to demonstrate the rules and principles, and then described application of the skills and abilities

in inspections activities. In addition, the instruction also emphasized that individuals differ in terms of skill level and provided guidance for enhancing and developing skills.

During the course presentation, participants were asked to generate examples of skill use from their own inspection experiences. Individual and group exercises were administered to provide participants with examples of the skills and with an opportunity to assess their own skill level. Finally, at the conclusion of each day, participants were asked to evaluate the course and suggest mechanisms for improving the course.

On the final day, Day 4, trainees participated in the Integrating Exercise. This exercise consisted of a simulated walk through of a facility. (This walk through was presented in a video tape.) Before conducting the walk through, however, participants were provided a short briefing that described the facility, the declared activities, and reason for conducting the walk through.

During the walk through, participants were asked to identify features, activities, events, and so on, that were relevant for evaluating the declared function of the facility. Very little other guidance was given to avoid giving participants any preconceived notions about the facility. Participants were assigned to one of two groups. Each group viewed the video tape independently. After viewing the video tape, each group participated in a debriefing session in which group members were asked to either (1) describe the activities going in the facility; or (2) describe relevant observations made during the walk through.

After the two debriefing sessions, both groups convened in the classroom to discuss the conclusions from each group and to learn about the actual use of the facility observed in the video tape.

Following the Integrating Exercise, participants were asked to provide their evaluations of the course on a structured questionnaire. These evaluations along with those obtained during the course delivery were used to revise and improve the course. Those evaluations are summarized in the next section.

2.2 PILOT SESSION COURSE EVALUATIONS

Pilot session participants were provided several avenues for evaluating the course. A summary of these evaluations obtained from a structured questionnaire is provided in Table 2.1. The table provides the average or mean response (and standard deviation) from the twelve participants for nine questions. For each question, participants were asked to report their level of agreement on a five-point scale indicating 1 (Strongly Disagree), 3 (Agree), 5 (Strongly Agree).

Mean and standard deviations presented in Table 2.1 indicate that participants agreed that the course content was clear (mean 3.44). There was less agreement that the course provided a balance between theory and application (mean 2.77). In general, participants

Table 2.1. Summary of Training Evaluations for Pilot Training Session (N=12)[1]

		Mean	SD
1.	The course content was clear	3.44	.96
2.	The course content provided a balance between theory and application	2.77	1.13
3.	The course materials were of value in fully understanding the course content	3.22	1.03
4.	The class exercises and activities were useful in understanding the course content	3.66	.94
5.	Overall, the course is of value to my future job performance	3.56	1.16
6.	Instructors presented the material in a clear fashion	4.33	.67
7.	Instructors knew the material well	4.33	.67
8.	There was ample time for questions and discussion	3.55	1.07
9.	The course was scheduled appropriately (4 hrs/4 days)	3.44	.68

[1]Ratings were provided on a 5-point scale with 1=Disagree, 3=Agree to 5=Strongly Agree.

agreed that the course materials were of value in fulling understanding the course content (mean 3.22). Participants agreed more strongly that the course exercises and activities were useful in understanding the course content (mean 3.66) and the course was of value to their future job performance (mean 3.56).

In general, participants evaluates instructors positively. That is, instructors presented the material in a clear fashion (mean 4.33) and knew the material well (mean 4.33). Participants also agreed that there was ample time for questions and discussion (mean 3.55) and that the course was scheduled appropriately (mean 3.44).

In addition to the structured questions, participants responded to open-ended questions. More specific evaluative information about the course is gleaned from these comments. A summary of the most frequent comments is provided below.

- Some of the topics were presented in too basic a manner. Lecture content and exercises should be more challenging.

- In addition to a discussion of how to observe, the course should cover what to observe.

- The Integrating Exercise was the most relevant because of its direct application to the inspection job.

- The small group exercises were most relevant and useful because they allowed exchange of opinions and reflected the teamwork requirements demanded in some inspections. In contrast, another participant suggested that small group exercises tended to be dominated by a few participants.

- Individual exercises were useful because they confirmed theoretical points.

- It was sometimes unclear how the different topics were related to observational skills and how they were related to each other.

Participants also provided numerous comments related to improving and revising the course. These are summarized below.

- The course can be improved by adding more safeguard relevant examples. Some participants wanted specific examples, while others wanted only general examples to avoid generating too much discussion of the details.

- Several exercises were outside of the safeguards area and should be tied more directly to inspections activities.

- A Visual Observation Skills course should be developed for entry-level inspectors and an Advanced course for experienced inspectors.

- Other topics should be included, such as interpreting body language, interpersonal skills, decision making, and interviewing techniques.

- The course schedule - meeting for four half days - was strongly recommended. Participants also suggested extending the course to cover 5 half days.

- Refine the Integrating Exercise so that the declared activities and materials are clearly stated.

2.3 PILOT COURSE REVISION

Based on the input received from pilot session participants and from IAEA training staff, we revised the course materials and exercises. A description of the revisions is provided below.

Training Manual: The pilot session training manual developed for the pilot session included the majority of overheads presented during course delivery. Because these overheads tend to abbreviate concepts and principles, it was determined that the revised training manual should include more detailed discussion of the information presented. Thus, the training manual was redesigned to include the overheads presented during course delivery[2] and to include a detailed discussion of each of the overheads presented. (See Appendix A to review a complete revised training manual.)

Course Content: Because the topics that comprise observational skills were new to some participants, it was sometimes unclear how each contributed to observations and how each related to the other skills. To clarify these relationships, we modified the course materials so that the first session included a course map and subsequent sessions reminded participants of the relationships between the specific and general observational skills.

Many pilot session participants requested that the discussions of specific skills contain more safeguards relevant examples. To accomplish this, several features of the course content were modified. First, examples of principles and rules in using specific skills were presented in the framework of inspections activities and potential observations one could make during an inspection. These safeguard relevant examples included photos of facilities and equipment that one might encounter during an inspection.

Second, exercises were revised to more accurately reflect the types of activities inspectors perform during an inspection. For example, we revised one in-class exercise to represent a materials inspection activity that an inspector might perform. This inspection activity required participants to quickly and accurately review a list of unmatched materials identification codes to identify a particular code. (See Appendix B Session 2 for a copy of this exercise). In another example involving attention to detail, participants were given two photos of the same objects, such as exterior or interior photographs of a facility. One photograph was electronically altered to remove features and details. The task was to identify the differences between the pairs of photographs.

Finally, participants from the pilot session requested more information for developing their skills. Thus, for each session, we prepared a list of techniques for developing and applying each of the skills in an inspection setting. The goal here was to help participants develop and refine these skills and to apply these skills during inspections.

Integrating Exercise: Another improvement to the pilot session involves the Integrating Exercise. Pilot session participants reported that this exercise was one of the

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[2]It is important to note that some overheads were not included in the training manual. This is because it was important to present some material only during the course to prevent participants from viewing in advance. Thus, about 5 to 10% of the overheads used in course delivery were not included in the training manual.

better features of the course. They also indicated that it should be revised so that the purpose of the walk-through was more in line with Agency inspection standards. Exercise revisions included preparing a detailed pre-briefing that describes the facility and declared activities in the facility. A new video tape was shot that much more clearly described locations and features of the facility. Finally, the debriefing was modified so that participants were provided with very clear examples of the many observational skills that could be applied when observing the walk through. In sum, the Integrating Exercise was enhanced to provide participants with more information in the pre-briefing which resulted in a more realistic exercise. (These materials are provided in Appendix B.)

Course materials prepared for the second delivery session are provided in Appendix A (Training Manual) and Appendix B (In-class Exercises, Final examination, and Training Evaluation Form.)

2.4 DELIVERY AND EVALUATION OF REVISED COURSE

The revised Basic Visual Observation Skills course was conducted at the Agency headquarters on May 15 through 18, 1995. Eleven current inspectors participated in this course. These inspectors represented a broader range of experience as compared to those attending the pilot session. Some participants were relatively new inspectors, while others were more experienced.

Procedures for conducting the revised training session were essentially the same as those for the pilot session. That is, the course was conducted in a conference room rather than the safeguards training room. The course was again delivered in four 4-hour sessions held on consecutive days. During the course, participants were encouraged to provide feedback and to engage in discussion of their own inspections experiences. On the final day after completing the Integrating Exercise, participants completed a structured questionnaire designed to elicit their evaluations of the course in general and of specific topic areas and sessions. (See Appendix B for a copy of the training evaluation questionnaire.)

Table 2.2 presents a summary of participants' evaluations of the revised Basic Visual Observation Skills course. Once again, participants responded to evaluation questions by indicating their level of agreement on a five-point scale, with 1 indicating Strong Disagreement, 3 indicating Agreement, and 5 indicating Strong Agreement.

According to the evaluation data, participants generally agreed that the course content was clear (mean 3.61), but were in somewhat less agreement that the course content provided a balance between theory and application (mean 3.31). Participants agreed that the course materials were of value in fully understanding the course content (mean 3.32), and agreed somewhat more strongly that the class exercises and activities were useful in understanding

Table 2.2. Summary of Training Evaluations for Revised Course (N=11)[1]

		Mean	SD
1.	The course content was clear	3.61	.71
2.	The course content provided a balance between theory and application	3.31	.62
3.	The course materials were of value in fully understanding the course content	3.32	.56
4.	The class exercises and activities were useful in understanding the course content	3.54	.75
5.	Overall, the course is of value to my future job performance	3.72	.80
6.	Instructors presented the material in a clear fashion	4.27	.86
7.	Instructors knew the material well	4.45	.49
8.	There was ample time for questions and discussion	3.90	.94
9.	The course was scheduled appropriately (4 hrs/4 days)	4.00	1.18

[1]Ratings were provided on a 5-point scale with 1=Disagree, 3=Agree to 5=Strongly Agree.

the course content (mean 3.54). In general, participants agreed that the course was of value to their future job performance (mean 3.72).

Participants were in stronger agreement that instructors presented the material in a clear fashion (mean 4.27) and knew the material well (mean 4.45). Finally, participants agreed that there was ample time for questions and discussion (mean 3.90) and the course was scheduled appropriately (mean 4.00).

In general, responses to the structured questions indicate that participants were in less agreement concerning course content (item 2) and course materials (item 3), relative to all other items in the questionnaire. These concerns are also represented in responses obtained from open-ended questions. A summary of the most frequent comments is provided below.

- More time is needed to adequately cover the topics. It might be useful to add another one-half day.

- Training should include facility-specific information, such as identifying nuclear equipment, detecting undeclared activities, and new enrichment and reprocessing techniques and equipment.

- Continue providing this course for both experienced and new inspectors.

- More time should be spent on the Skill Integration exercise. In fact, similar exercises should be provided for each topic area. This may include providing case studies.

- Consider providing a list of reading materials.

- More time should be spent on techniques for enhancing one's ability in a specific skill area.

Direction from the IAEA Safeguards Department Training Section also suggested that consideration be given to modifying the course in the following respects:

- Modifying the course so that it is more "performance-based" by: (1) specifying more precisely the performance which the training addresses (what the inspectors are being trained to do); (2) developing measures of performance (using indirect or proxy or indirect measures if performance is not directly measurable); (3) giving more explicit consideration to the conditions or circumstances in which performance occurs; (4) developing objective criteria for what constitutes an acceptable level of performance; and (5) incorporating these considerations to the extent feasible into the course, especially the exercises.

- Consistent with this orientation, placing somewhat less emphasis on theory in classroom instruction, more emphasis on specific techniques for improving performance relative to the criteria, and still more emphasis on in-class practice with feedback, so that participants will be able to bring their performance to acceptable levels.

- Focusing the course on the most critical skills areas. For example, consideration could be given to dropping the session on Judgment and Decision Making -- not because it is unimportant, but because there may not be time to adequately cover it along with the other topics.

- Making still greater use of "training aids," such as still photos, videos, case studies, computer-based training and so on.

- Lengthening the course if necessary to meet performance-based training objectives, while continuing to limit in-class time to four hours per day.

- To enhance the realism and practicality of the course, incorporating into the lectures and exercises some indicators of potential undeclared activities or facilities -- for illustrative and practice purposes only (the intent would not be to create a proliferation indicators or proliferation pathways course)

These and other comments provided by participants and by Agency training staff will be used to determine the next steps in further development of observational skills training for Agency inspectors.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Experience in developing and delivering the Basic Visual Observation Skills course validated many of the premises that guided course design. This same experience also suggested that further development and enhancement could make this training more useful, if it is to be continued as a basic course for all IAEA safeguards inspectors. These conclusions and recommendations are summarized below.

3.1 CONCLUSIONS

Experience in delivering the course supports retention of the following elements:

- An overall course objective of helping inspectors evaluate and improve their skills in making observations during inspections and in evaluating and interpreting this information

- A focus on basic (generic) skills with applicability to all safeguards situations and facility types: "how to look," rather than "what to look for"

- A course structure that partitions the training into discrete skill areas and then for each area includes a description of basic cognitive principles, guidance in identification of individual strengths and weaknesses, a menu of practical techniques for enhancing skills or compensating for weaknesses, and applications to safeguards inspections

- Teaching techniques that include a combination of lecture, class discussion, individual exercises, and small group activities

- An integrating exercise that gives participants an opportunity to demonstrate their understanding by applying the skills and techniques they have learned in each of the five skill areas to a realistic safeguards setting

- A course schedule that requires no more than four hours per day of in-class time

3.2 RECOMMENDATIONS

In light of the comments of participants and Agency training staff, as summarized in Section 2.4, as well as our experience in developing and delivering the pilot and revised versions of the course, we recommend that the course be further developed and enhanced for continued delivery to experienced and new inspectors. To the fullest extent possible, the course enhancements should reflect the recommendations of participants and Agency training staff. One issue that will require further discussion and assessment is the extent to which the course can incorporate the "performance-based" training model, as suggested by Agency

training staff. While we recognize the value of this approach, it applies most readily to training in skills that involve highly specific and well-defined procedures (such as operating an instrument). Because visual observational skills are more a matter of cultivating awareness and attitude than they are of applying specific procedures, at most a portion of this training can be performance-based. We recommend that this issue be addressed as part of the course development process.

Our more specific recommendations include the following:

- Focusing on fewer, critical skill areas, but in more depth
- Somewhat less emphasis on theory and somewhat more emphasis on application, including further development of both specific techniques and exercises that provide an opportunity for practice in applying those techniques
- Use of additional audiovisual materials whenever they are practical and would enhance participant interest and understanding
- Incorporation of facility-specific "observables," for purposes of illustration, into the techniques and exercises
- Additional classroom time as necessary to accommodate the above
- Inclusion of supplementary reading materials in the course manual

REFERENCES

Morris, F.A. & Toquam, J.L. (1993). *Concept Paper: Knowledge Acquisition Skills for Enhanced Safeguards Inspections.* ISPO-356, PNL-8968. Richland, Washington: Pacific Northwest Laboratory.

Toquam, J.L. & Morris, F.A. (1994). *Recommended Observational Skills Training for IAEA Safeguards Inspections.* PNL-10186. Richland, Washington: Pacific Northwest Laboratory.

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