

Computer Simulation of IAEA Inspections for Strengthened Safeguards

Augmented Computer Exercise for Inspection Training (ACE-IT©)

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A computer-based simulation tool, “ACE-IT,” has been applied to IAEA Additional Protocol facility inspections.

- The tool was originally developed (1994) for “challenge inspection” training under the Chemical Weapons Convention (CWC)
- Other treaty applications followed (CTBT, FMCT, AP)
- More sophisticated technology for computer simulation has been employed in its recent development
- In this presentation, we will
 - Describe the essential features of the tool
 - Highlight its benefits and limitations

What is ACE-IT?

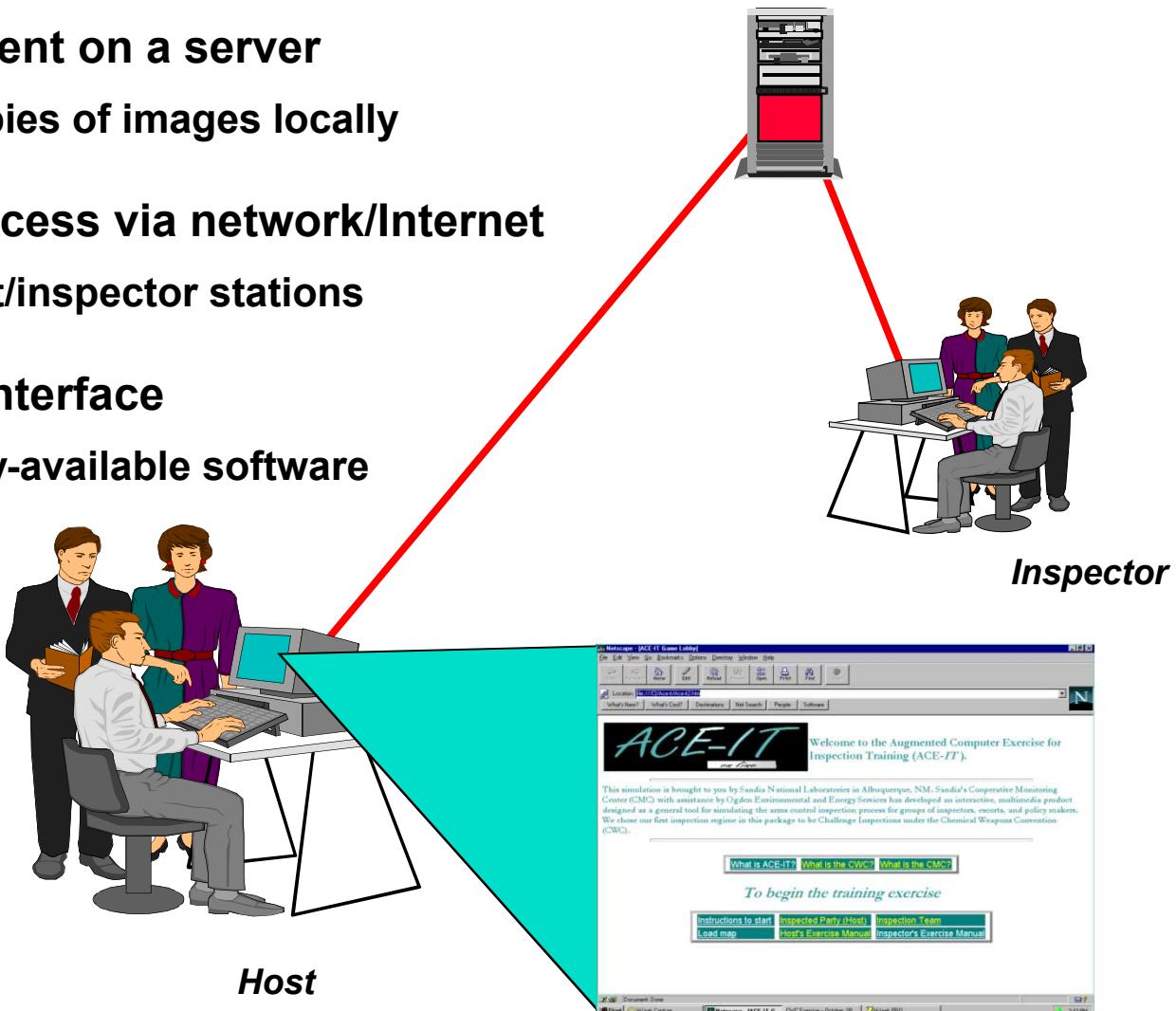
ACE-IT is a computer-based tool for simulating an on-site inspection with managed access.

It consists of:

- Virtual model of a facility: images, maps, data
- Set of inspection roles
- Negotiated interaction between parties
- Scenario: inspection context & goals
- Set of managed access measures
- Sequence of actions
 - movement, requests for information, sampling, shroud lifts
- Integration of inspection-relevant references

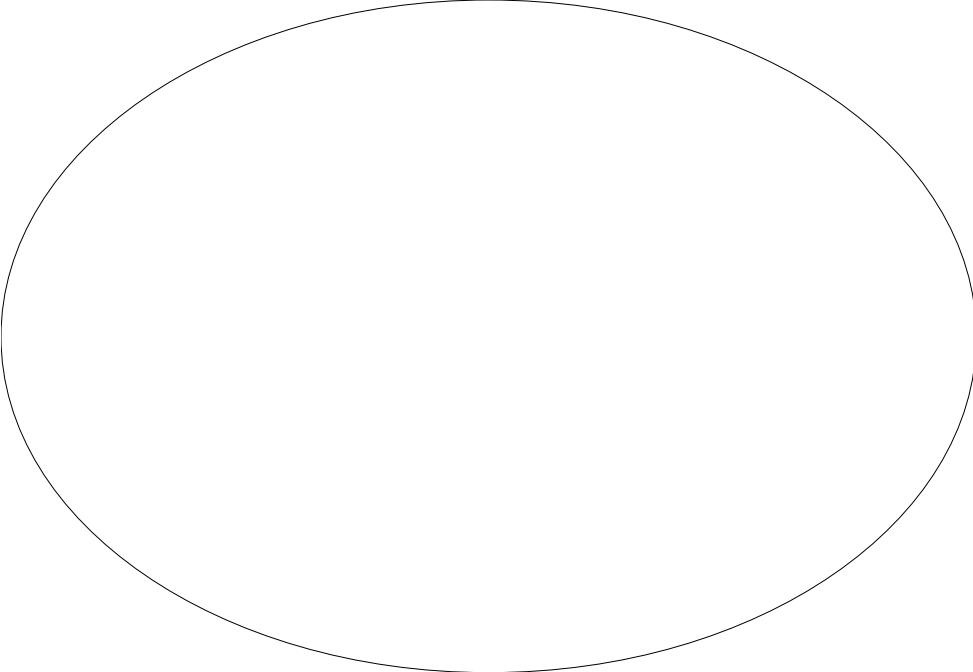
How does ACE-IT work?

- Database resident on a server
 - can store copies of images locally
- Workstation access via network/Internet
 - separate host/inspector stations
- Web-browser interface
 - Commercially-available software



How does ACE-IT model a facility?

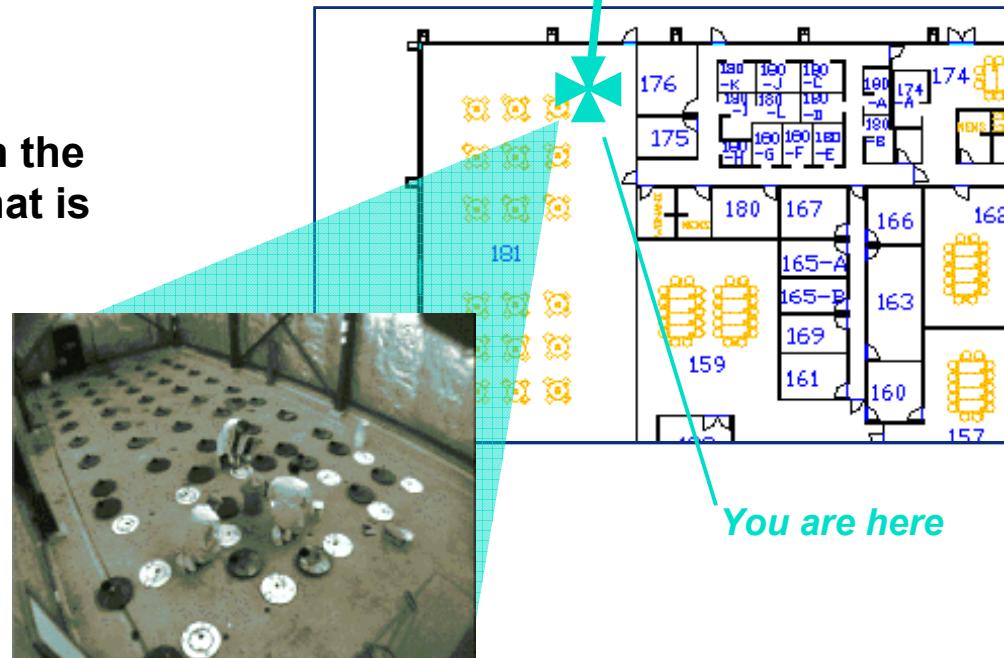
- **Virtual facility model uses immersive 360° images**
 - commercial technology (iPIX)
 - photographic images are created quickly & inexpensively
 - “hot spots” for linking and other actions
 - pan & zoom viewing
 - software shrouding
- **Participants “move” independently through the facility using images**
 - click a hot spot that links one location to another
 - Host can go anywhere
 - Inspector movement is controlled by the host



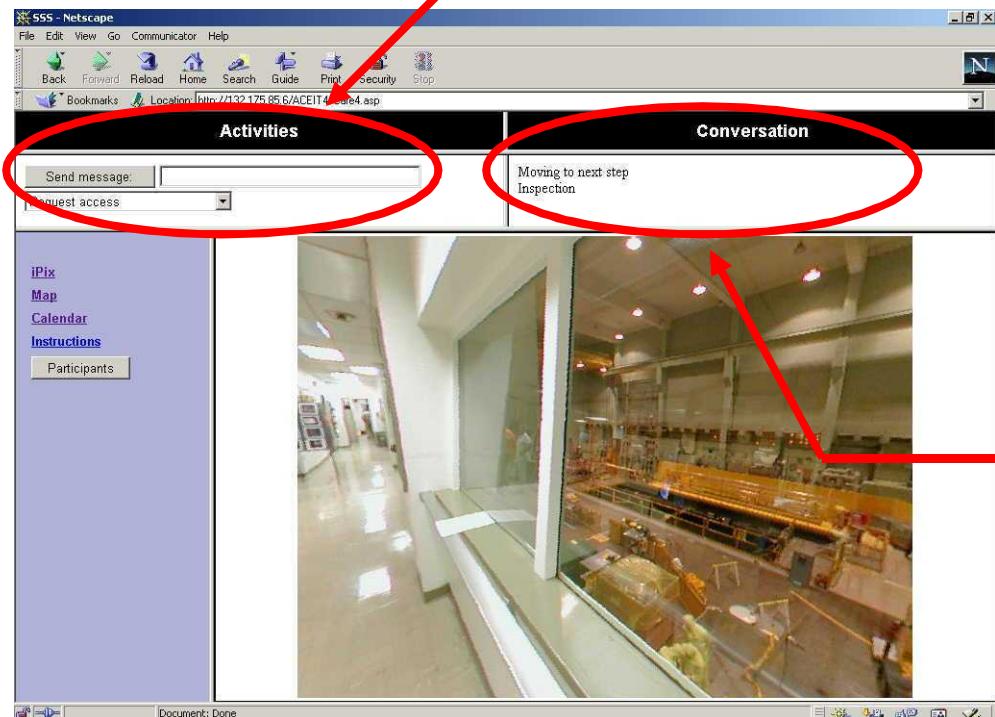
*Immersive
360° image*

How does ACE-IT model an inspection?

- **Each workstation is a separate “participant” in an ACE-IT exercise**
 - **Each participant takes one of two “roles”:**
 - Host team
 - Inspection team
 - **Multiple participants**
 - Up to 64 separate workstations
 - **Each participant’s “location” in the facility is given by the image that is displayed at the workstation**



An ACE-IT exercise is interactive.



ACE-IT display

- Participants select actions and send messages to each other
 - messages sent to everyone, just one's own team, or a specific individual
- Actions and messages are recorded in an exercise log

Scenario: IAEA Safeguards Additional Protocol

- Nuclear fuel cycle research and development activity (Article 2.a.(i)):
 - Advanced materials properties experiment at a research reactor, not involving nuclear material
 - Commercial fuel fabricator testing a new fuel rod design with graphite composite
- IAEA wants to inspect to:
 - Confirm declaration of the materials properties experiment
 - Invoke complementary access rights: Open source information suggests there may be other activity at the reactor related to plutonium recycling (undeclared)
- Host has unrelated information to protect
 - Proprietary information about the targets
 - Unrelated activity that is collocated with the declared activity

Why use ACE-IT? (Applications)

- Train inspectors & hosts in how to conduct an inspection with managed access
- Train hosts in how to prepare a facility, both to protect unrelated information and to demonstrate compliance
- Supplement mock inspection or tabletop exercise
 - prepare participants to make the exercise more productive
 - create additional scenarios, to leverage what can be tested
- Can create custom facilities, or even pseudo-facilities
- Explore treaty protocols, inspection provisions, and managed access measures
- Illustrate inspection issues
 - briefing tool for Congressional staff
 - demonstration tool for negotiators

Why use ACE-IT? (Benefits)

- **Time & cost savings**
- **Better availability**
 - travel unnecessary
 - no special software required
 - can reach more people
- **Easy to use and robust**
 - standard Internet browser functionality
 - intuitive navigation through virtual facility
- **Versatile choreography**
- **Greatly-reduced facility impact**
- **Low-risk: can be previewed more reliably**
- **Exercise is documented for later review & critique**

What are the limitations?

- Inspection time constraints are not modeled
- Virtual model doesn't show everything
- No single-user version
- Communication by typing is cumbersome
- Trained “drivers” are useful to facilitate exercise
- Developer must create new scenarios or facility models
- No dynamic shrouding

*Computer simulation is still not
the real thing, but it's getting
much closer!*

Conclusions

- We have developed and used a computer-based tool for simulating managed-access inspections
 - Facility modeling with photographic images provides realism
- Host preparation in advance for inspection is essential; use of computer simulation can be an important component
- Additional functionality could be developed as required
 - Various scenarios and facilities
 - Simulation capabilities: immersive video, audio communication

Summary of ACE-IT development

- Applications have expanded

- 1994 CWC
- 1997 CTBT
- 1998 FMCT
- 2000 Safeguards / Additional Protocol

- Architecture has advanced

- Local-area network → Internet (3 stations → 64 stations)
- Custom-software interface → web-browser
- Map-referenced movement → linked-image movement
- Segmented views → immersive 360° views
- Shrouding: morphed photographs → software blanking
- “Tour” mode to verify the facility model



What else could be done with ACE-IT?

- **Expand the facility model and scenario**
 - Add a variety of inspection scenarios to the same facility model
 - Create other facility models (manually)
 - Develop an automated “builder” to create new facility models rapidly
 - Incorporate artificial 3D images as well as photographic images
- **Expand the participant roles**
 - Add observers, moderators, “off-site” participants
 - Create sub-roles for hosts and inspectors, with different permissions
- **Add functionality**
 - Link to another participant to watch where they’re looking
 - Link to a host who “shepherds” the inspectors through a facility
 - Permit inspectors to navigate without automatically requesting access
 - Arbitrarily flag items on images; relay those coordinates to other participants
 - Audio communication (recorded) between participants
 - Immersive video to supplement (or replace) photographic images
- **Develop other managed-access inspection applications**

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