Enhancing Nuclear Newcomer Training with 3-D Visualization Learning Tools

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About L-3 MAPPS

- L-3 Communications
- Headquarters
  - New York City
- Traded on NYSE
  - LLL
- Approximately 38,000 employees
- 2015 Revenues
  - US$10.5 billion
- Ranked #252 by Fortune in 2015

- L-3 MAPPS
- Headquarters
  - Montreal, Canada
- Three business areas...
  - Marine Systems and Simulation
  - Power Systems and Simulation
  - Space Systems and Simulation
- Common technology basis for all three businesses
- Committed to Quality
  - ISO9001:2008
Our Global Presence

World’s leading supplier of Full Scope Operator Training Simulators for Nuclear Power Plants

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Topics

• Today’s Nuclear Training Programs
• Understanding the Profile of Today’s Learners
• Understanding the Limitations of the Traditional Classroom Environment
• What is L-3 MAPPS doing to Enhance Nuclear Candidates Learning?
• Conclusions
Today’s Nuclear Training Programs
Typical Training Timeline

Generic Fundamentals

- Understanding basic plant design
- Exposure to basic plant components such as valves, pumps, heat exchangers, etc.
- Understanding how components are built and how they work

Systems Training

- Understanding the various systems in the power plant
- Understanding purpose and behavior of systems
- Understanding physical phenomena in systems

Operations Training

- Exposure to control room environment and operating procedures
- Understanding operations
- Practicing operating procedures

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Challenges to Overcome

✓ The teaching materials used today were developed in the 1970s and 1980s
✓ The profile of today’s learners has changed dramatically
✓ Using “traditional” teaching materials and methods on today’s learners can result in poor knowledge transfer and retention
✓ There are limitations to the classroom environment that need to be overcome
Understanding the Profile of Today’s Learners
New Generation – New Needs

- “Digital Natives”
- Highly Visual Learners
  - Prefer processing pictures, sound and video rather than text
- Experiential Learners
  - Learn by discovery rather than “being told”
  - Like to interact with content to explore
  - Simulation, games and role playing allow them to learn by “being there”
- Do best when you give them a sense of purpose and control
- Two very important principles
  - Seeing is understanding
  - Interacting helps remember
Seeing is Understanding

- Imagination is subjective and varies with each person
- Take imagination out of the equation by showing
- Applies to all generations

Facts
- Human brain processes visual information **60,000X Faster** than text
- 90% of information that comes to the brain is visual
- Visual aids in the classroom improve learning by **up to 400%**
Interacting Helps Remember

- Listening is passive
- Passive learning efficiency varies greatly from person to person
- Engaged learning (interactive learning) has higher efficiency
- Engaging students helps them create links between the subject being taught and an actual experience
- Applies to all generations

The Learning Pyramid: National Training Laboratories (Bethel, Maine)
Understanding the Limitations of the Traditional Classroom Environment
Classroom Limitations

Time
• Limited time to present and explain complex concepts
• Limited (if any) one-on-one instructor-to-student face time

Student Attention & Focus
• Often, student’s focus is on taking notes rather than understanding
• Attention and focus depend on many factors like class duration, student’s personal conditions and state of mind, interest in subject, etc.

Every Student is Different
• Classroom teaching is usually designed as a “one size fits all” course
• Different students understand concepts at different speeds
• Different students have different learning styles
What is L-3 MAPPS Doing to Enhance Nuclear Candidates Learning?

Learning About the Basic Building Blocks
Learning Modules
Understanding the Basic Building Blocks

• Introduction to components, reactor theory and thermodynamics

• The components segment focuses on the basic building blocks of the nuclear power plant
  – Exposure to valves, pumps, heat exchangers, etc.
  – Understanding how components are built and how they work

• L-3 MAPPS introduces Learning Modules
  – Designed to complement, not replace, existing curriculum
  – Runs within web browsers
  – Can be launched via link in existing instructional material (PowerPoint, Word, PDF, etc.)

• Fully interactive Learning Modules show users
  – How the equipment works (Principles of Operation)
  – How the equipment is built (Major Components)
Learning Modules
Quick Demonstration
How complex can these things be?
What is L-3 MAPPS Doing to Enhance Nuclear Candidates Learning?

Learning About Basic Plant Systems
System Knowledge Modules
Understanding Plant Systems

• After learning about the basic building blocks (generic fundamentals), the blocks are put together to form systems
  – Understanding the various systems in the power plant
  – Understanding purpose and behavior of systems
  – Understanding physical phenomena in systems
• L-3 MAPPS introduces System Knowledge Modules
  – Focus on basic systems or common control loops
  – Avoid overwhelming students with too much information
  – Avoid getting into operational procedures too early
    ▪ Understanding what the system does and how it works comes before learning how to operate it
What is L-3 MAPPS Doing to Enhance Nuclear Candidates Learning?

Learning Simulators: Making Complex Systems Easier to Understand
Learning Simulators
Understanding the Most Complex Phenomena in NPPs

• Designed to assist teaching and learning of major plant transients and the associated systems and behavior
  – Goal is to increase/accelerate understanding while increasing retention
• Couples 2-D & 3-D interactive graphic visualization with high-fidelity simulation
  – Provides a visually rich graphical representation of complex plant events
  – Interactive environment provides engaging student experience
• Primarily focused on the Nuclear Steam Supply System (NSSS)
  – All plant systems can be represented in 3-D but the Learning Simulator focuses on the most complex parts of the plant
• Versatile tool that can be used in
  – Instructor-led sessions
  – Individual (personal) sessions with built-in, automatic instructional feedback (captions)
Learning Simulators
Quick Demonstration
Learning Simulators

3-D visualization provides an overall view of system properties at a particular point in time.

Analysis screen provides 2-D system overview, access to key variables and associated trends.

Plots provide a historical view of the system behavior.
Learning Simulators – Training Delivery

- Can be instructor-led
- Blend of 2-D and 3-D visualizations
- Objective is learning “how something works” vs. “knowing what switch to turn when”

- Can be individually used by students
- Allows students to learn at their own pace and to focus on what they have trouble with
- Designed to guide students in the learning process

- Can be integrated into virtual or full scope simulator control room
- Allows students to understand the consequences of their actions
- Reinforces comprehensive learning instead of procedure learning
Conclusions

• Existing curriculum and teaching techniques should be enhanced to
  – Be more interactive and engaging
  – Provide a richer visual learning environment

• Learning should continue outside the classroom
  – Encourage outside-the-classroom learning by providing easy-to-use tools

• Interactive, visual environments are now affordable and offer an effective means to enhance worker knowledge
  – Enhance generic fundamentals with the Learning Modules
  – Enhance basic system learning with the System Knowledge Modules
  – Enhance complex system learning with the Learning Simulators

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Thank you

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