

Innovations in the Creation of 3-D Virtual Environments

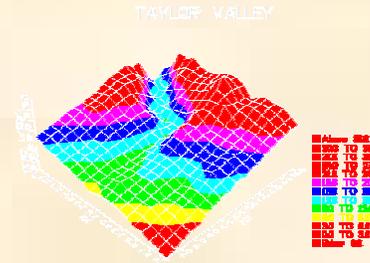
By

Robert Sanders

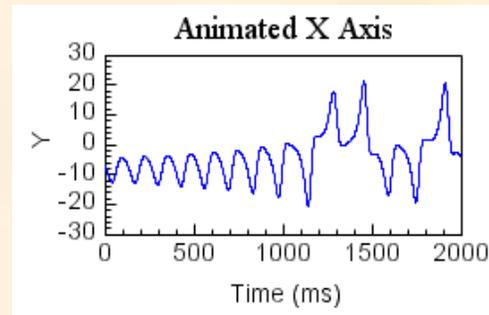
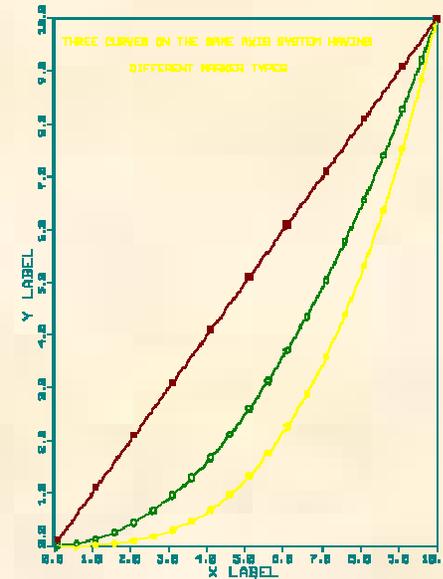
<http://VISAC.ORNL.GOV>

History of Data Presentation

- Simple Plots
 - 70's – DISSPLA, SAS
 - 80's - Lotus 1.2.3, Energraphics
- Sophisticated Plots (Animated, Trend Analysis)
 - TecPlot
 - Excel



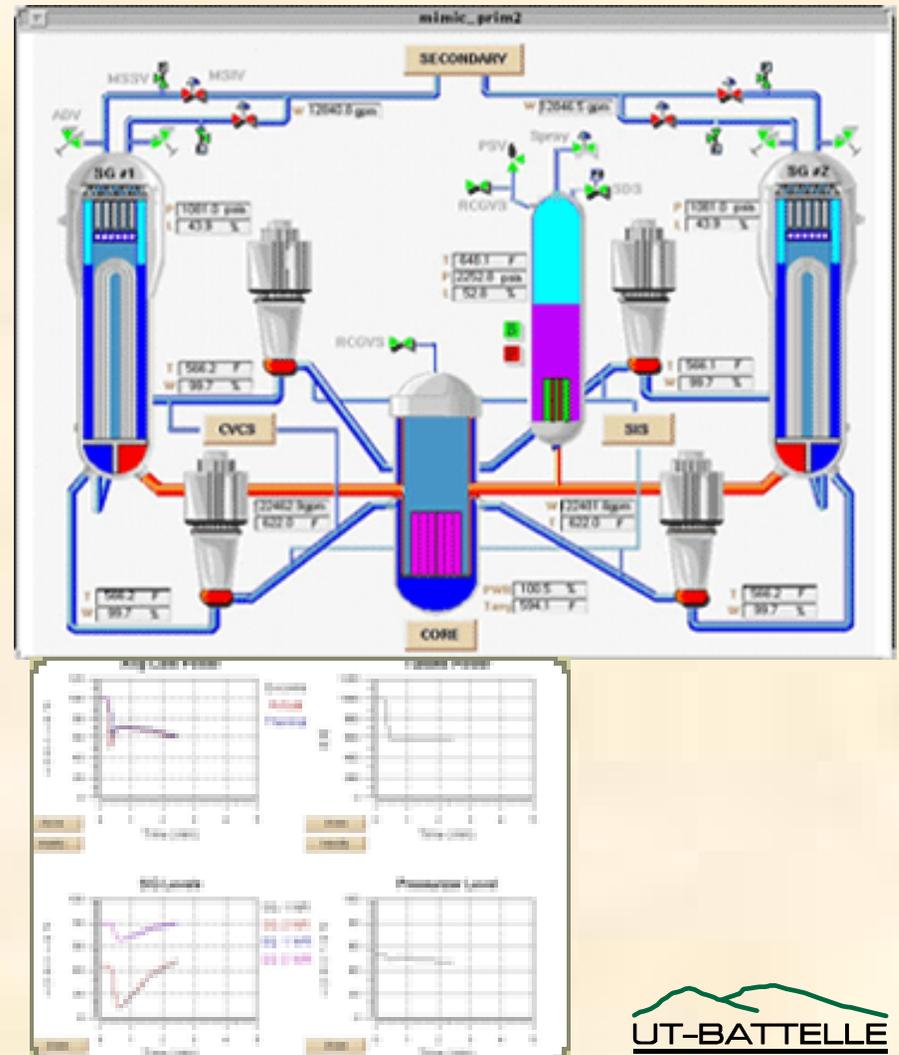
THE USE OF CURVE AND GRAPH



- These tools remain in use today

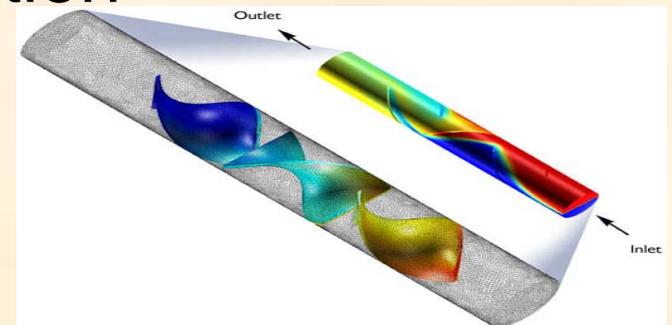
Current Presentation Technology

- High use of color and animation in data presentation
- Data is represented with system information via cartoons
 - One example is the Nuclear Plant Analyzer
- However, plots are still required for trend analysis



Data Presentation in the Future

- Data from complex three-dimensional objects can be illustrated through the use of colors
 - High stresses would be shown as red
 - A temperature scale of a tank could be used – a blue tank would be cold, a red tank would be hot
 - A similar application to pressure could be made
- In the future, an operator, instead of sitting behind a control board, could take a virtual trip around the plant examining the plant's condition



Why 3-D Graphics?

- Increased understanding of complex systems/data
 - Impact of events on real-world facilities
 - Rapid comprehension of simulation data
- The movie/entertainment industry has pushed for more convincing virtual realities
 - Shrek
 - Lord of the Rings
- Gaming industry has always pushed the envelope of technology



The Gaming World

- \$20 Billion annually worldwide
- (larger than movies in the U.S.)

N. America (#2 console, #2 online, #1 PC Retail)

Asia (in some ways #1 market)

Advancement in 3-D graphical engines have significantly improved as a result of the gaming industry and computer technology

- First Person Shooter (FPS) – Unreal, Doom
- Role Playing Game (RPG) – Roller Coaster Tycoon, Sims

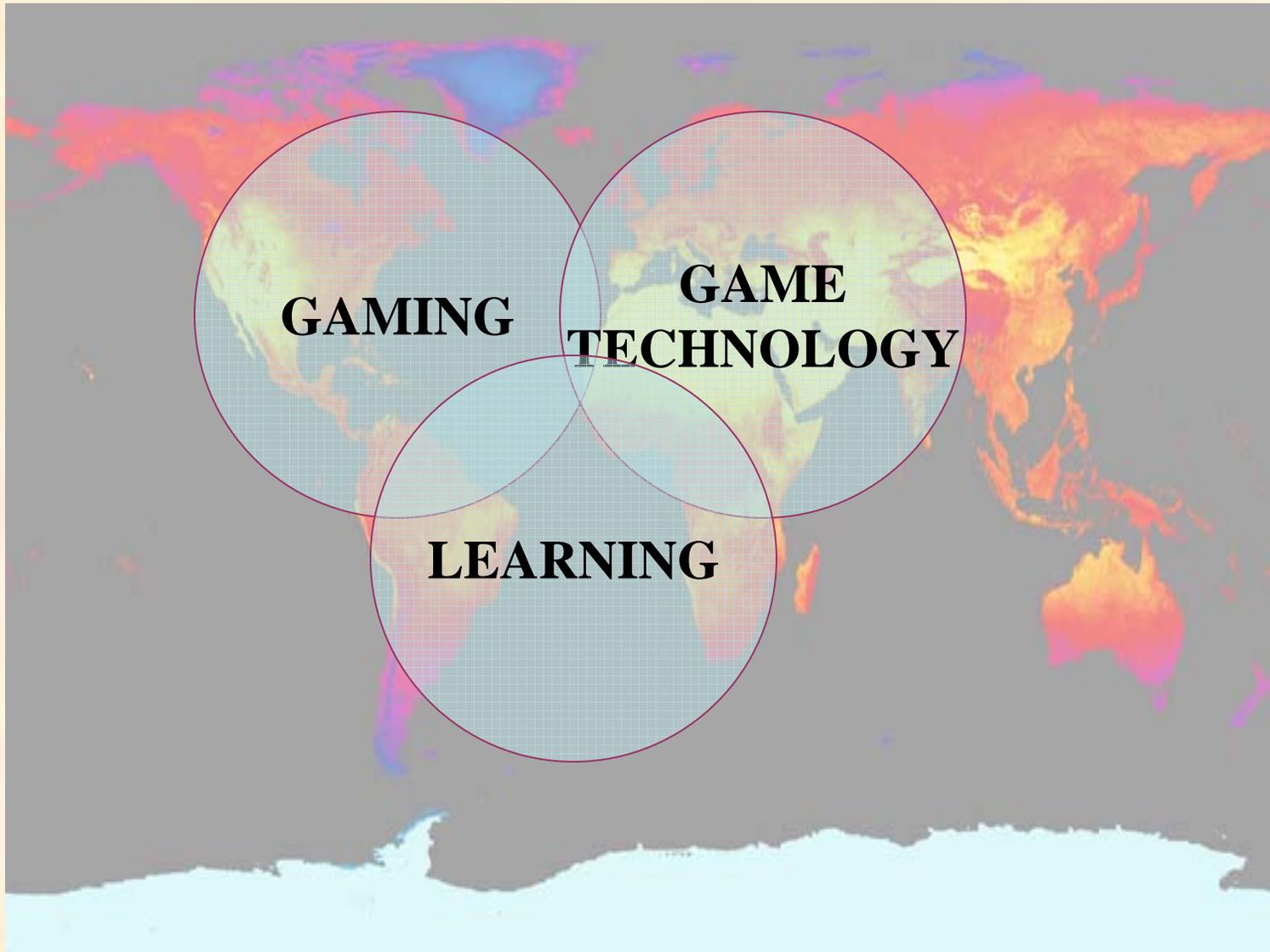
Playstation 2

Installed: 50 million+

Windows PC

Installed: 200 Million

The Important Thing is the Learning



What is Required For Creating a Virtual World?

- Runtime Engine (software)
 - Unreal Runtime Engine (Free)
 - Unreal Tournament – Runs Windows, Mac, Linux (including 64-bit version)
 - Quake/Doom
- Editors
 - UnrealED – Included with all versions of Unreal
 - GMAX – can be downloaded for use with Quake/Doom – based on Discreet's Studio MAX
 - Maya – personnel learning version included with unreal, can be downloaded
- Professional Editors – Used for TV commercials, not interactive
 - Discreet's 3D studio Max ~ \$3k - \$10k
 - Maya - \$3k

Computational Requirement is a Reasonable Modern Computer

- 2.0 GHz Processor (good application for new AMD XP processors)
- Higher end Video Card
 - NVidia – > 5600 (5700, 5950, or newest 6800)
 - ATI – 9700 or better
 - 128 Mbyte of video memory (Doom 3 requires a 512 Mbyte card for highest mode)
 - Good application for new PCI express card
- 1 Gbyte of RAM
- Typical hard drive ~ 10 to 20 GBytes of hard drive space
- A excellent game machine can be obtained for ~ \$1,500.

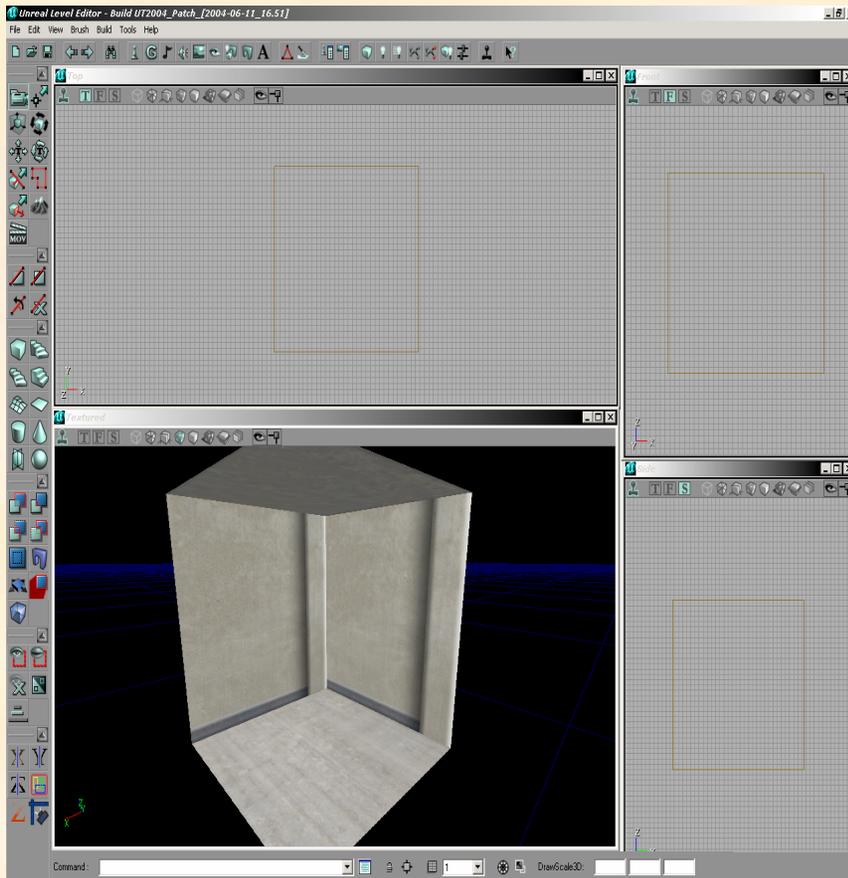
Reasons to Use Unreal

- Unreal Tournament 2004 virtual reality engine
 - Only package available that provides editing software with purchase of software
- UnrealEd 3.0
 - Comes packaged with Unreal Tournament
 - User friendly and intuitive interface
- Maya 5.0/6.0 PLE
 - Comes packaged with Unreal Tournament

Extensions of Unreal Engine

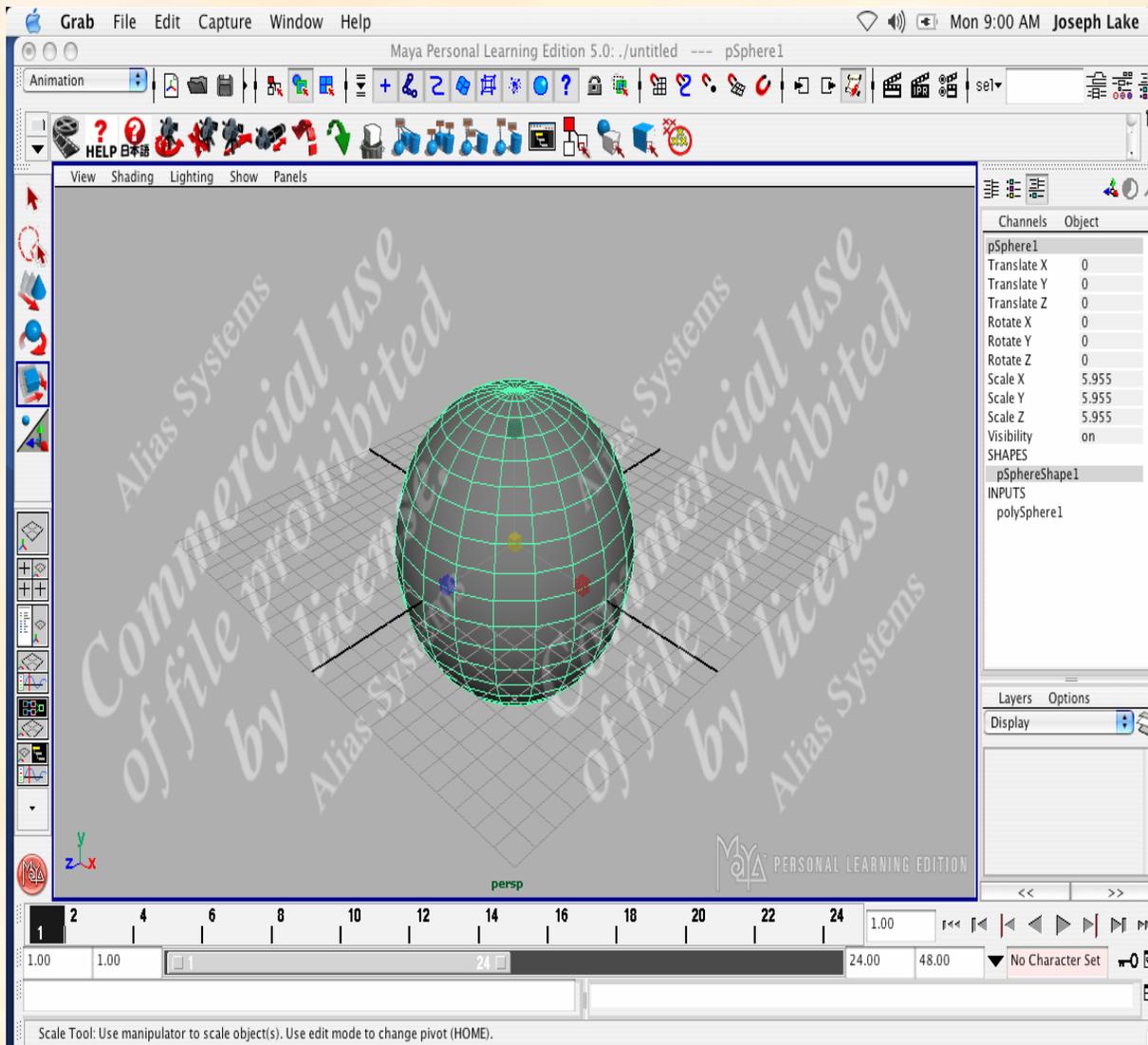
- Epic designed the Unreal engine to run under a virtual runtime engine
 - Based on object oriented programming style
 - Open architecture, easily adopted for specific applications
 - Easily ported to different platforms (Windows, Linux, Mac)
- Unreal contains several key components important to real-world simulations
 - Networking capability
 - User interaction paradigms

UnrealEd 3.0 Interface

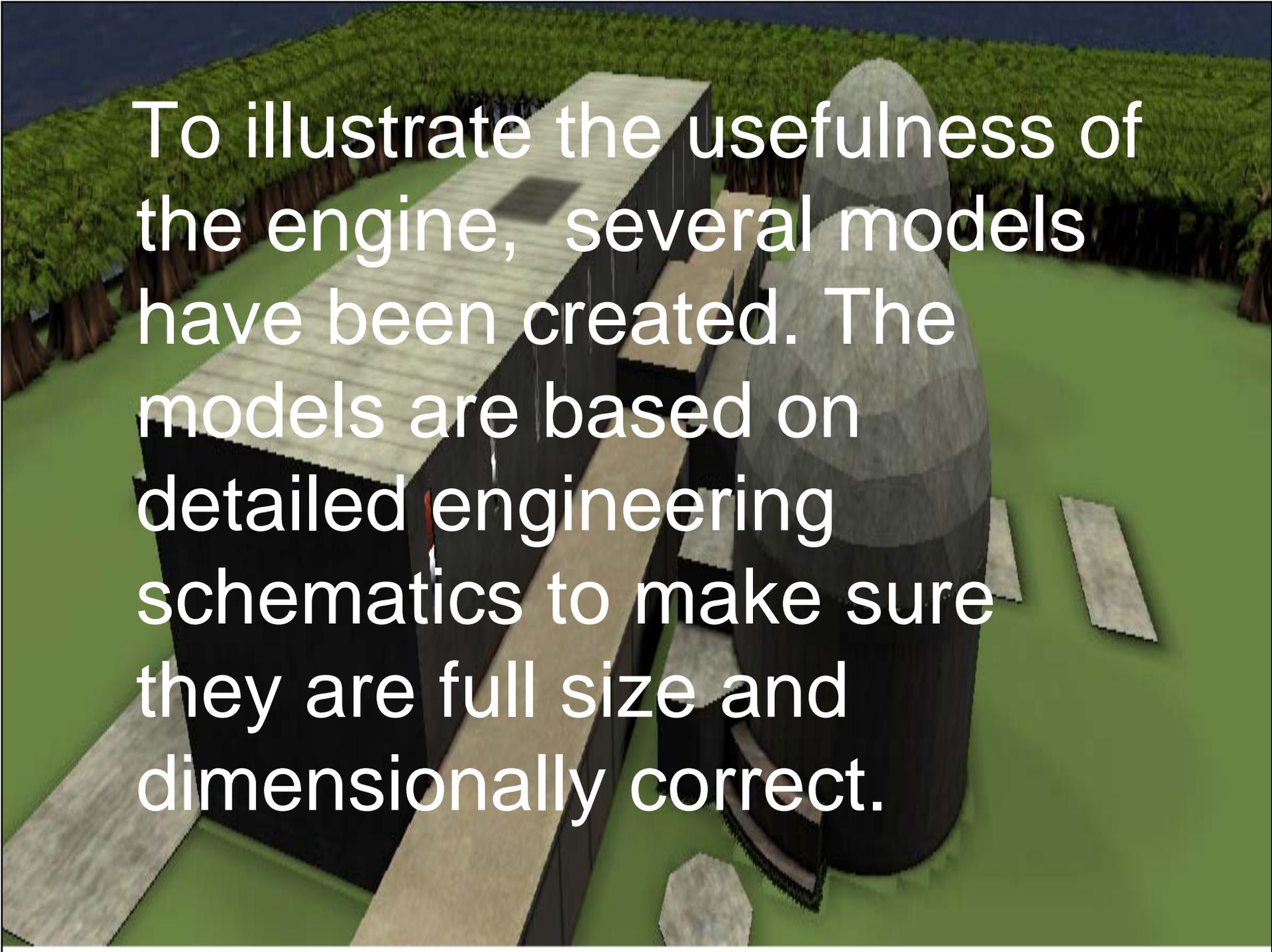


- Model geometry starts with a solid block
- Able to add and subtract out volumes
- Used to “carve out” base level
- Add specialized volumes made in Maya or 3D Studio Max for better detail

Maya Interface

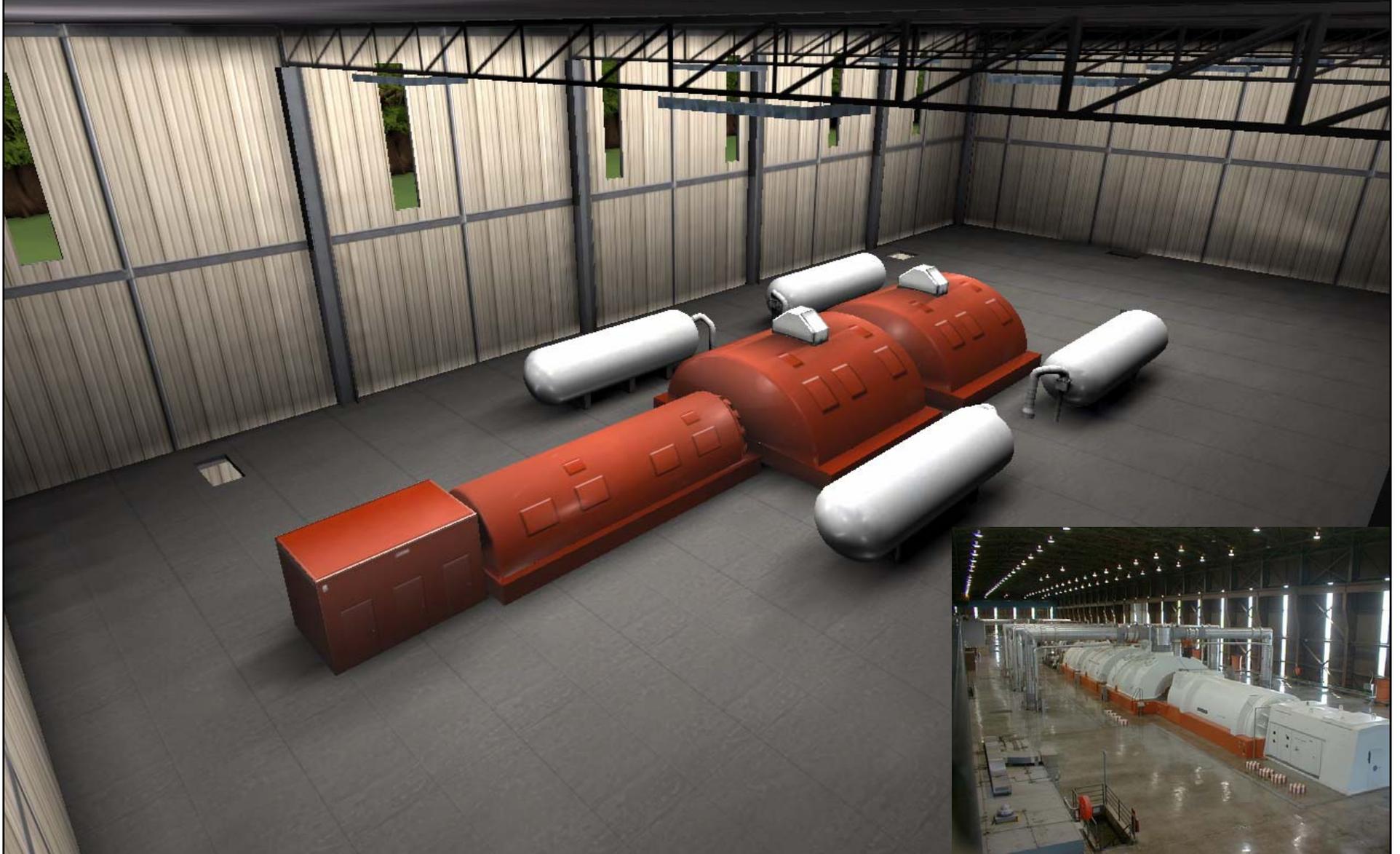


- Very powerful tool
 - Full of options for animations, rendering, and creating volumes.
- File type compatible with UnrealEd 3.0
- Interface near identical to 3D Studio Max.

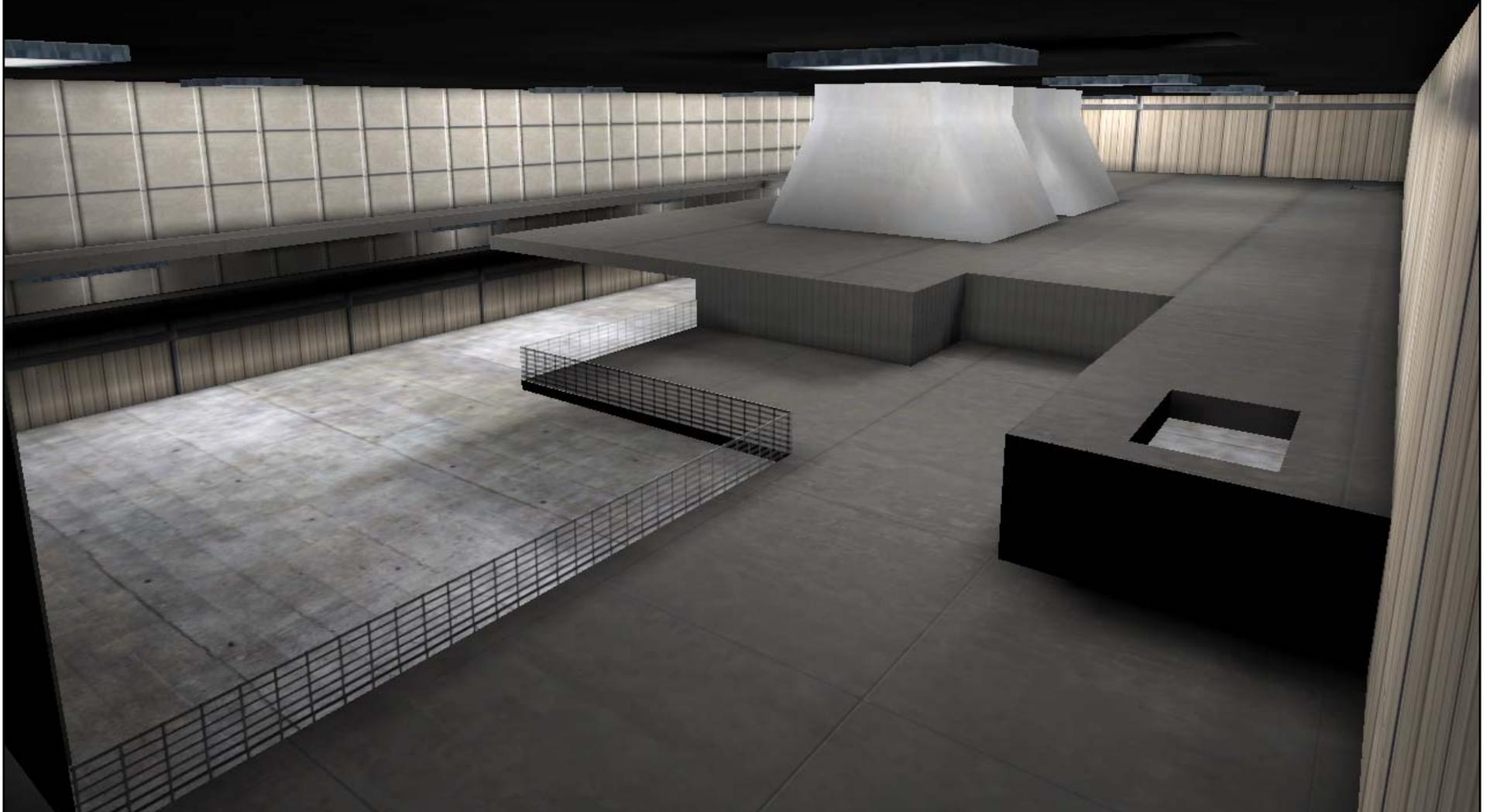
A 3D architectural rendering of a building and a dome structure in a forest. The building has a dark exterior and a light-colored, textured roof. A wooden walkway leads from the building towards a large, dark, cylindrical dome structure with a conical top. The scene is set in a lush green forest with many trees. The text is overlaid on the image in white, bold font.

To illustrate the usefulness of the engine, several models have been created. The models are based on detailed engineering schematics to make sure they are full size and dimensionally correct.

View of Top Floor



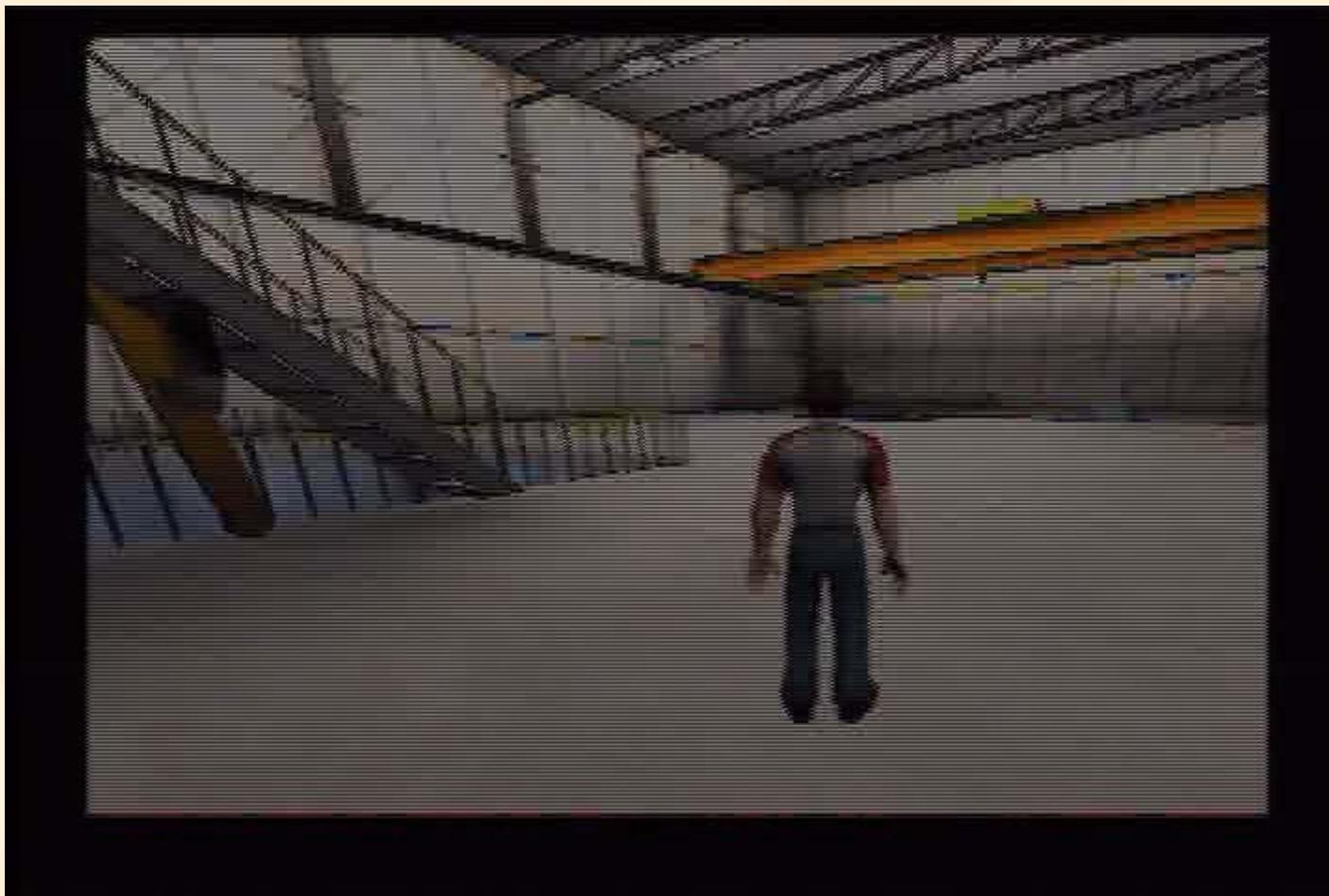
View of Second Floor



View of Bottom Floor



Walk-Through of Completed Facility - Click on Image to view movie



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Application of Model To Force-on-Force Simulation

Click on image to view movie



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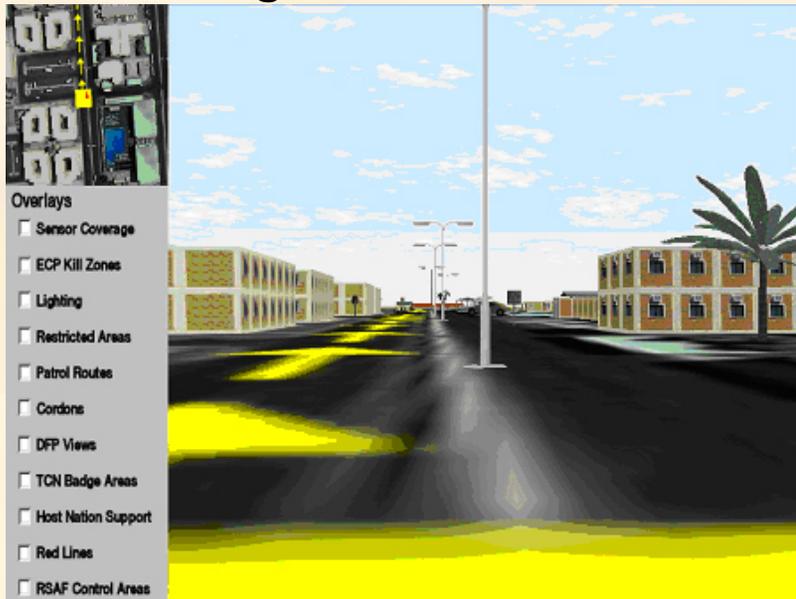

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Photo



High-end static representation
program **MPI-Vega Prime**

Game representation - **Unreal**



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Actual Photo Versus Screen Shot

Actual Photo of Industrial Facility



Unreal Representation of Industrial Facility



Screen Shot of Environment Created by ZedaSoft, Inc.

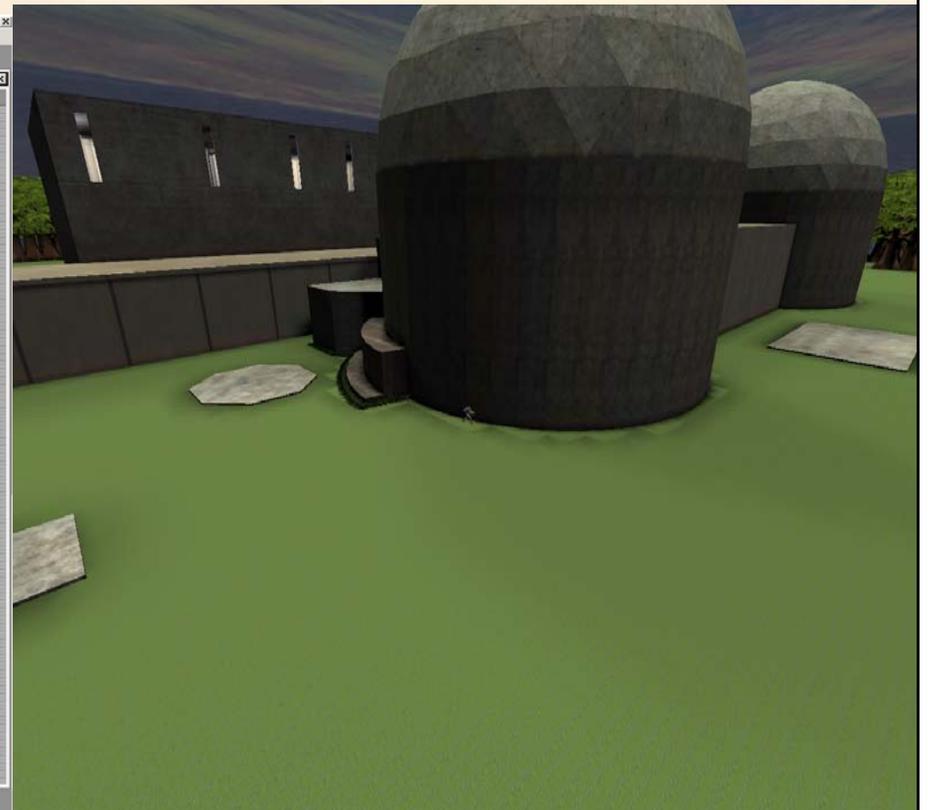
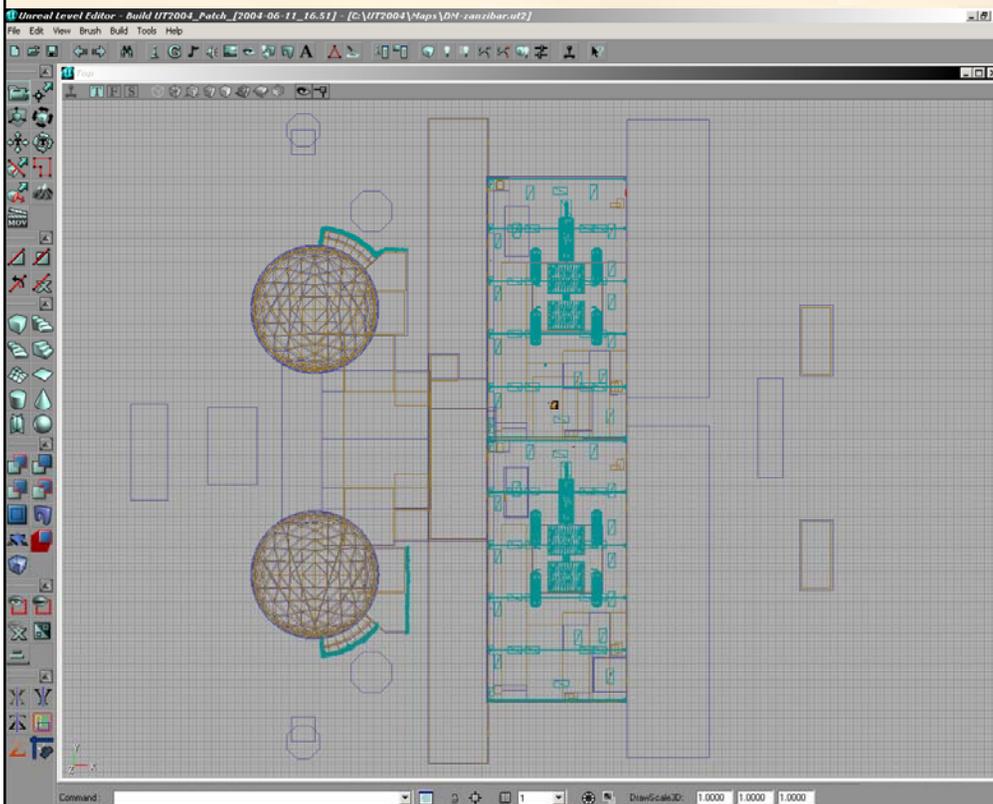


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What are the Time Requirements for Generating a Model?

A simple model was created in 2 months. This included training on the various software packages and time to study engineering drawings.



Application of Models to Real-World Problems

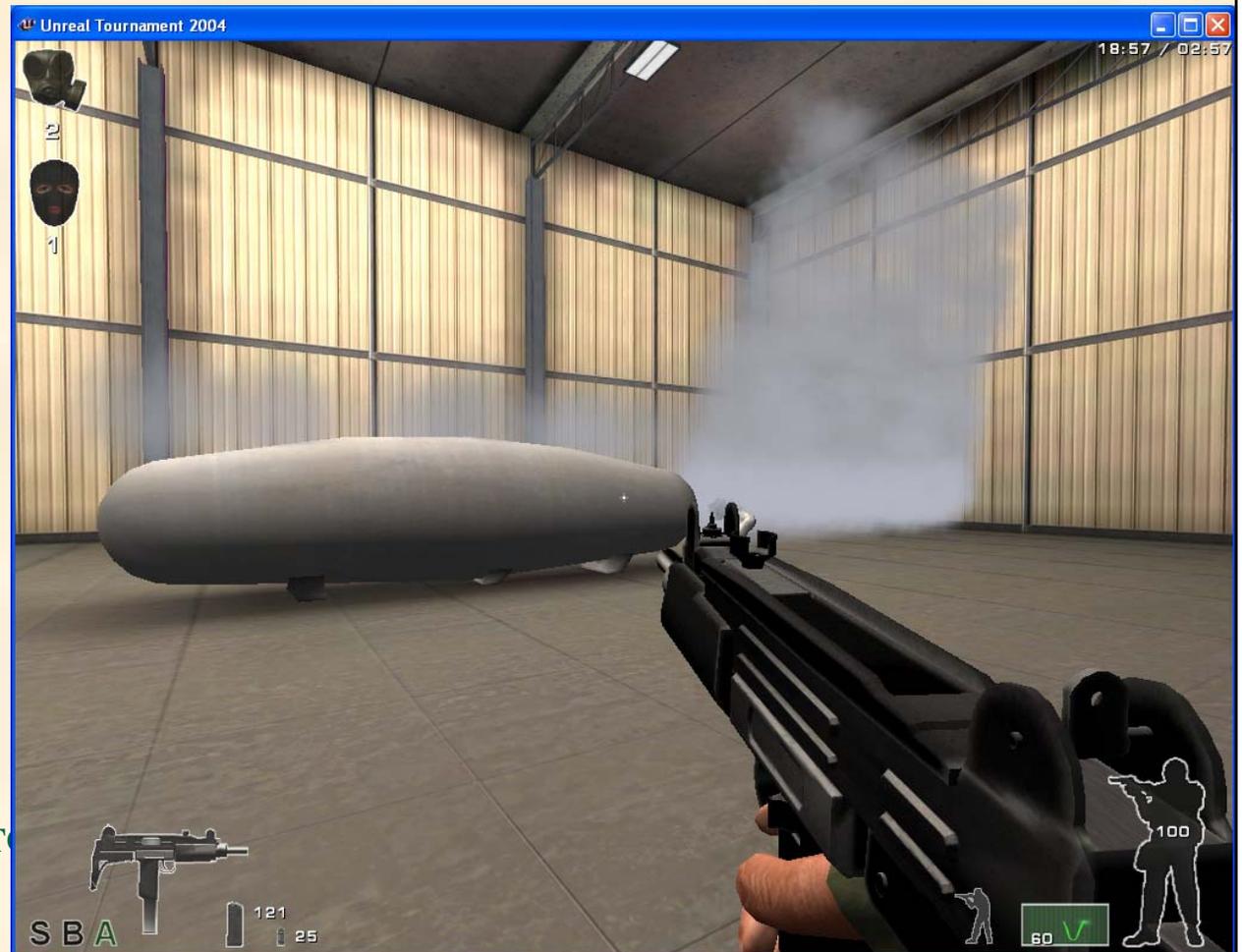


- Display plant conditions on control consoles
- Show physical consequences

Various Events can be Simulated

- An over-pressurization event can be illustrated with either a break at a junction or a tank rupture
- Hazardous environments can be shown in several ways
 - Radiation fields can be demonstrated via a simulated Geiger counter
 - Effects of chemical agents simulated on “players” health

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Conclusions

- Engineers in the future will still require simple plots for specific problem solutions, but for demonstration purposes a virtual reality has important advantages in visualization
 - Failed components
 - Interaction of events
 - Environment
- In the serious games world, adapting major games like Half-Life 2, Doom 3, Unreal and Command & Conquer provides an incredible opportunity to use off-the-shelf games and technologies to build high-impact 3D visualization at low cost

Conclusions (continued)

- 3-D representation can also be used in initial plant design and layout
 - Functionality of layout
 - can large equipment be serviced
 - ALARA consideration
 - Construction planning
 - potential pipe interfaces are hard to visualize
 - Sharing of information

Questions & Demo

Useful Links:

<http://udn.epicgames.com> – Epic's home page

<http://udn.epicgames.com/Two/UnrealEngine2Runtime22262001> - Free version of runtime

http://www.alias.com/eng/index_flash.shtml - Maya's home page

<http://www.unrealtournament.com/ut2004/> - Unreal 2004's home page

<http://www.sas.jolt.co.uk/> - Interesting Mod to Unreal

<http://www.nvidia.com/page/home> - Nvidia's home page

<http://www.ati.com/> - ATI's home page

<http://www.amd.com/us-en/> - AMD's home page

<http://www.intel.com/> - Intel's home page

<http://www.alienware.com/> - High end PCs

<http://www.gamespot.com/alienware/> - review of Alienware

<http://www.evga.com/> - EVGA's home page (Video Cards)

<http://usa.asus.com/index.htm> - Asus's home page (Motherboards)

<http://www.abit-usa.com/> - Abit's home page (Motherboards)

<http://www.seriousgamessummit.com/>



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Presentation Information

A copy of the slides are posted at:

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