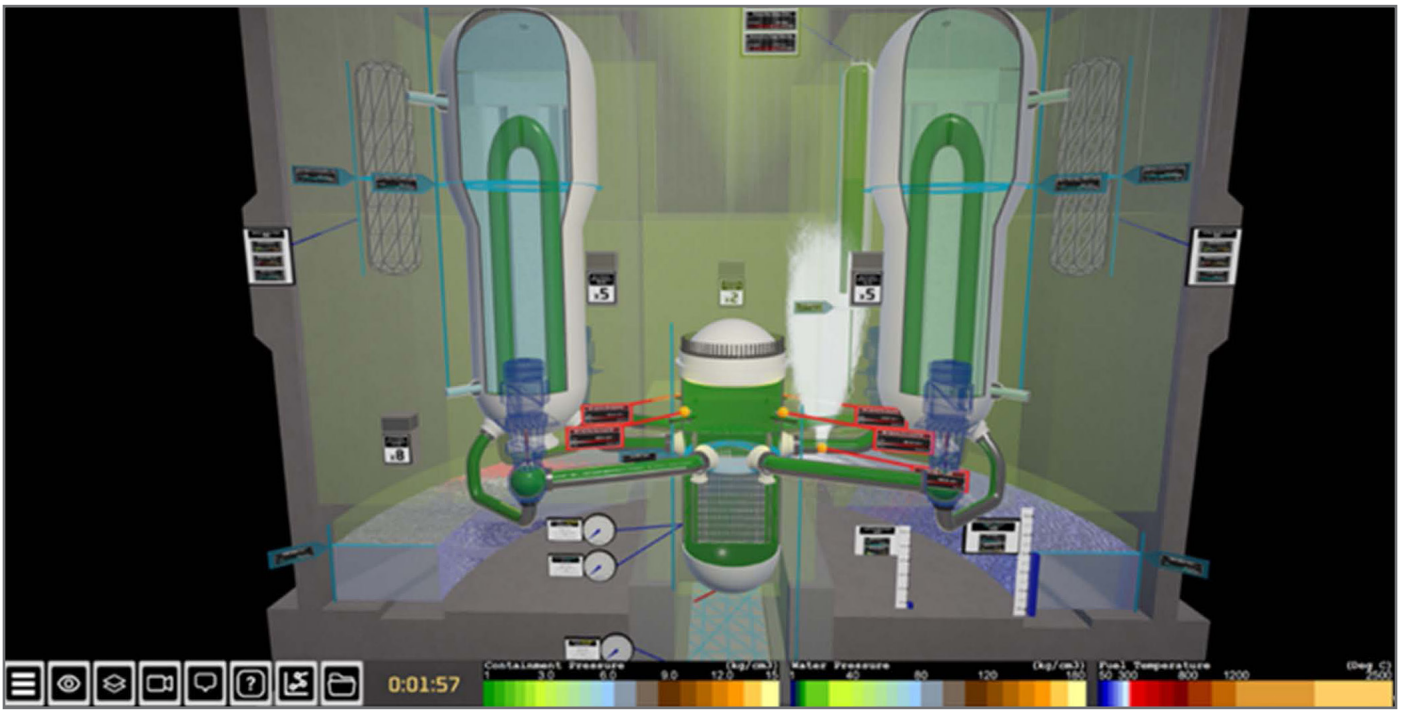
3KEYMASTER™ GlassTwin Solutions

3D Nuclear Simulator Visualization

CURTISS-WRIGHT

Nuclear Power Products and Services



GlassTwin Applications

Developed in collaboration with Blue Cloud Interactive (BCI), this ground-breaking GlassTwin technology offers realistic and interactive 3D and VR visualizations of real-time data from any simulation model (including RELAP, MELCOR, and MAAP). Our decades of expertise ensure that these tools provide real value for decision-making and understanding of complex phenomena.

A GlassTwin is a virtual copy of a real world building and systems that helps people see and understand the invisible, inaccessible internal mechanisms to learn, prepare, and practice for emergency situations. It can simulate and test scenarios or provide real-time monitoring and analysis of air, water, metal, and fuel including:

- Pressures, temperatures, void fractions
- Liquid levels, flow, velocities
- Radiation levels, gas/solute concentration
- Mass relocation, oxidation
- Damage, melting (including severe accidents)
- Pipe and vessel contents, status, rotation, motion
- Malfunctions, leaks, fire/explosions

3D Functionality & Capabilities

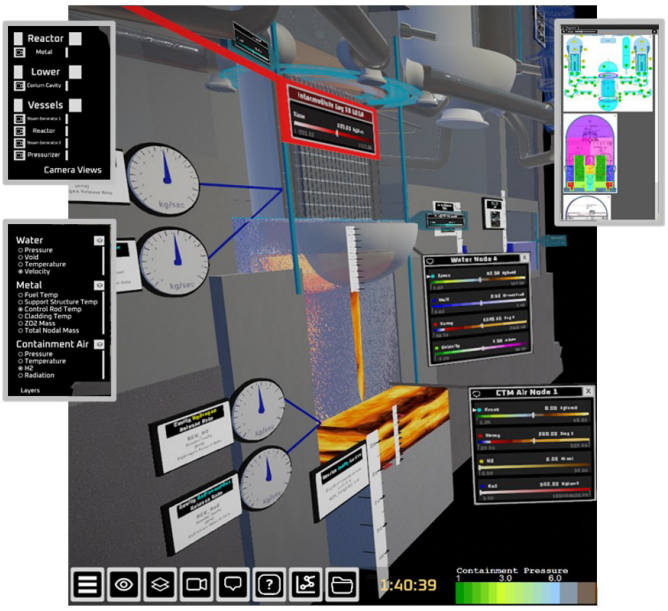
- Visualize hundreds of variables via live network connection
- Flowing, translucent liquids and gases (Adjustable opacity)
- Custom gradients for color tinting (User-editable, Live loading)
- Fly your view with keyboard/mouse or auto-framed views
- Water, corium, and concrete erosion levels
- Augmented reality (AR) measurement overlay (rulers, bars, markers)
- Accurate portrayal of pumps, hydrogen explosions, water sprays, tank levels, and other components
- Per-node Tooltips & Properties panels for customizable variables
- Built-in documentation, visibility toggles, and view presets

3KEYMASTER™ GlassTwin Solutions

3D Nuclear Simulator Visualization

Turn Data Into Knowledge & Understanding

- Understand otherwise invisible cutaways and interiors
- Change scale (site / building / pipes / reactor internals / tanks)
- Ensure a common situational understanding
- See complex relationships among many variables in one view
- Collect screenshots to enhance presentation clarity
- Access dangerous, breakable, or unavailable equipment and spaces
- Improve team problem-solving & safety
- Retain workforce (by increasing engagement)
- Reduce costs, downtime and incidents
- Validate Simulation Models



Replication of an APR1400 nuclear reactor containment building with the reactor and safety systems depicted accurately.

The Severe Accident Model

3KEYSAA is WSC's* adaptation of Severe Accident (SA) codes such as MELCOR by Sandia National Laboratory and Modular Accident Analysis Program (MAAP) by Electric Power Research Institute (EPRI), to run in the 3KEYMASTER environment. The 3KEYSAA models allow simulation of various malfunctions in abnormal/emergency situations requiring operator actions and/or observance of automatic system actions. Fuel and rod disruption, large scale melting, vessel melting, and steam and hydrogen explosions are depicted helping improve the emergency response teams involved and support research in mitigating such situations. Reference the 3KEYSAA Severe Accident Product Brochure for more information.

3D Visualization

To provide visualization of concepts and scenarios in the 3KEYMASTER severe accident projects, we integrated a powerful 3D tool with the 3KEYMASTER Environment.

This integrated platform with real-time simulator response allows 3D visualization of systems, components, and events simulated through complex engineering models executing in real-time in the 3KEYMASTER simulation environment.

The 3D visualization shows the NPP primary island from Steady State power operation condition to inserting breaks such as LOCA, which are simulated with RELAP-3D model and progression through Severe Accident conditions with automated switching to SA models such as MAAP or MELCOR.

To aid 3D visualization, WSC developed creative and intelligent schemes to map and pass physical characteristics of 3KEYMASTER Input/Output (IO) variables for each simulation node, such as temperature, Pressure, Void Fraction and Flow, to the 3D application using a customized color-coded scheme (see table with "3D Visualization of Parameters" chart).

Variables are visualized in the 3D scene in a variety of ways, including:

- Node volume colors,
- Liquid-level-matching, and
- Remaining-mass-scaling.

The real-time 3D visualization updates to depict that data as variables are calculated in the 3KEYMASTER simulation, allowing the user to obtain the parameter value at any time and location within the 3D objects, pipes, tanks etc.

3D Visualization of Parameters

Pressures	Temperatures	Void Fractions	Liquid Levels
Flows	Velocities	Radiation	Malfunctions
Leaks	Fire/Explosions	Gas Concentration	Mass
Oxidation	Damage	Melting	Pipe & Vessel Contents
Status	Rotation	Motion	

The toolbar provides controls for every visual aspect and feature of the 3D scene. This includes capabilities such as displaying and hiding of equipment, pipes and structures, zooming or resetting to a specific camera location, access to back up data and nodalization information and other pertinent and helpful user features.

*: Curtiss-Wright acquired WSC in 2024. WSC is now part of the Simulations Group.

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