ARC INSIGHTS

INSIGHT# 2010-06MP
FEBRUARY 4, 2010

3D Simulation Brings Immersive Dimension to Operator Training

By Tom Fiske and Dick Hill

Keywords

3D, Operator Training, OTS, Simulation, Virtual Reality (VR)

Overview

In today's business environment, companies are pushing their plants to their limits, while at the same time; both processes and control systems are becoming increasingly more complex. Staffed largely with aging workforces, with many experienced operators getting ready to retire, companies need to ensure that they can continue to operate their plants in a safe, reliable, and profitable manner. Operator training systems (OTS) provide one of the best ways to train new operators and refresh the skills of experienced ones.

> Immersive 3D VR simulation is now available for the process and energy industries. VR adds another dimension of realism to simulation by using immersive technology similar to video games, but with rigorous modeling instead of an artistic rendering.

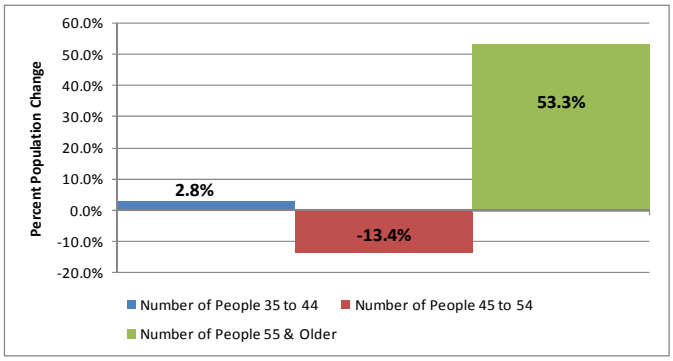
Immersive 3D virtual reality (VR) is now available for the process and energy industries. VR adds another dimension of realism to simulation. The simulation is similar to an immersive video game, but uses rigorous modeling instead of an artistic rendering. The simulator's immersive technology extends the training scope to both control room and outside operators and allows them to work as a team.

The benefits of high fidelity immersive VR simulation go beyond those of traditional simulation and include more realistic scenarios, improved communication and collaboration among work crews, off-line evaluations of procedures, and off-line training of rare abnormal situations. The Department of Energy's (DOE's) National Energy Technology Laboratory (NETL) uses a VR simulator at its state-of-the-art training center to help develop next-generation, zero-emission integrated gasification combine cycle (IGCC) power plants with carbon capture.

Need for Operator Training Systems Continues to Grow

With today's business demands, the need for well-trained operators continues to increase. Many plants now operate with raw materials and energy costs that change frequently depending on market conditions. In addition, satisfying rapidly changing demand creates constant fluxuations and potential instabilities in unit operations that challenge even the most adroit manufacturers.

The changing demographics complicate the need to improve operations. The US bureau of Labor Statistics indicates that more than 25 percent of the working population will reach retirement age this year. This could result in a shortage of almost 10 million workers. By 2030, more than 70 million people will retire, with only about 30 million people available to replace them. The loss of knowledge and shortage of workers will seriously jeopardize a company's ability to operate safely and profitably.



Changing Workforce Demographics from 2010 to 2020

Companies need to ensure that their workers can operate their facilities in a safe, reliable, and profitable manner. This is not easy, as plant automation is becoming more complex and comprehensive. Some companies tend to push plants to constraints, thus putting them at greater risk for some type of abnormal situation. Other companies tend to run their plants too conservatively, thus do not get the most from their assets. Human errors are costly, not only in terms of off-spec product and unscheduled downtime, but also in terms of equipment damage, environmental harm, and worker safety. Operator training simulators remain one of the best ways to train new operators and refresh the skills of experienced ones.

Immersive 3D VR Becomes a Reality for Operator Training

Addressing the skills gap of younger workers requires a host of techniques. These include classroom, on-the-job, and computer-based training; site visits to similar plants; and use of high fidelity training simulators. Most

young operators have never experienced a plant turnaround or a critical situation. The only way to ensure that they will take the proper action during a crisis is to prepare them for it. Most good training simulators allow for hands-on, scenario-based training to teach operators how to deal with normal and emergency situations without compromising the actual plant, worker safety, and the environment. Few other tools offer this type of training opportunity.

Simulators not only provide a great way to train the next generation of operators; they also provide a great way to keep the current workforce performing at a high level of proficiency. Preventable human errors cause approximately 40 percent of all abnormal situations. Better-trained operators make fewer mistakes; recognize process upsets earlier; and can initiate the appropriate steps and actions to mitigate any potentially harmful, wasteful, or detrimental effects.

In training, realism is very important to help ensure that operators can get the most out of it. Model fidelity must be sufficient to replicate the response of the plant so that the operators cannot tell the difference between the simulation and the real thing. The same is true for other aspects of the simulation. The more realistic it is in other aspects, the more the trainees will accept the method and retain what they've learned from their experience with the simulator.

VR adds another dimension of realism to simulation. VR has been used with excellent results for many years to train astronauts, pilots, and military personnel. Now, high fidelity, 3D virtual reality simulators are available for the process and energy industries. VR technology – whether 3D graphics with avatars that interact with the plant and each other or a host of other immersive technologies that use stereoscopic 3D goggles and gloves – has the potential to significantly change the way operators in the process industries train. This is especially true for addressing the skill gap of younger workers who tend to embrace the latest technology. These digital natives are constantly texting, instant messaging, gaming, and surfing the web. One of the things that makes immersive VR simulation such an effective tool for teaching younger workers, is that is so readily accepted by them.

VR adds another dimension of realism to simulation. VR technology – whether 3D graphics with avatars that interact with the plant and each other or a whole host of other immersive technologies that use stereoscopic 3D goggles and gloves – has the potential to significantly change the way operators in the process industries train.

Experienced operators and engineers should also find immersive simulators appealing because of its high-fidelity process and control simulation capability, plus its VR capability that provides a realistic and safe training environment for improving efficiency and skills.

DOE Building Training Center with 3D Immersive Tech

The National Energy Technology Laboratory (NETL), part of the US Department of Energy's (DOE) national laboratory system, supports DOE's mission to advance the national, economic, and energy security of the United States. To accomplish it mission, the NETL supports more than 1,800 research and development projects related to enabling domestic coal, natural gas, and oil to cleanly and economically supply power to the private, government and commercial sectors.

NETL's projects support the need to improve the efficiency and reduce the environmental impact of existing combustion power plants. NETL also supports projects for the design and operations of the next-generation power plants including the gasification-based plants. The integrated gasification combined cycle (IGCC) power plants are intended to facilitate carbon capture and reduce air emissions and water use.

NETL will use Invensys' SimSci-Esscor DYNSIM dynamic simulation and EYESim 3DVR technologies to help develop the next-generation IGCC zero-emission power plant. NETL will also use the high fidelity simulator to train operators. NETL will operate the immersive 3D VR simulator at both its Dynamic Simulator Research and Training Center in Morgantown, WV, and at a satellite location at the West Virginia University National Research Center for Coal and Energy.

Immersive Operator Training

The simulator is similar to an immersive 3D video game, but with the simulation based upon high fidelity process models that accurately represent the actual behavior of the plant. Trainees will don stereoscopic headsets to enter the immersive photorealistic environment and move about the facility, seeing exactly what they would see if they were in the real plant. The walkthrough provides a realistic experience be-

cause the simulator merges plant imagery with data screens from asset management or other applications that provide additional technical or procedural details.

The simulator's immersive technology extends the training scope to both control room and outside operators and allows them to coordinate activities and work as a team the way they would in a real plant. The simulator also allows them to see parts diagrams, work orders and examine the inside of vessels – which can be rigorously modeled – during training sessions. In the virtual world, trainees can perform routine tasks such as opening and closing valves and turning on pumps. It is even possible to practice extinguishing a virtual fire during a simulated emergency; a training routine that could not be attempted in a real plant. This type of experience is unlike other simulators and reinforces learning by bringing virtual reality closer to reality in the process world.

The DOE will use its new simulators for demonstration, education, and training services, including IGCC plant operation and control demonstrations, technology familiarization and hands-on computer-based training. In addition to training and plant design functions, the NETL and its research and development partners will use the simulator to showcase clean coal technology to support future clean electric power generation.

Last Word

Today's business environment creates the need for better-trained operators. Variability in raw materials, energy, and demand creates rapid swings in operating conditions. Plants are being pushed to their limits with increasing more complex control systems and processes. Companies need to ensure that their workers can operate their plants in a safe, reliable, and profitable manner. However, the aging workforce and associated loss of knowledge further complicate efforts to improve operations. OTS is one of the best ways to train new operators and refresh skills of experienced ones.

Immersive 3D VR is now available for the process and energy industries. VR adds another dimension of realism to simulation. The simulation is similar to an immersive video game, but uses rigorous modeling instead of an artistic rendering. Trainees wear stereoscopic headsets to enter the immersive VR plant. The simulator's immersive technology extends the training scope to both control room and outside operators and allows them

to work as a team. Better-trained operators are in a better position to manage the process closer to economic constraints, while minimizing the impact of any incidents, or avoiding them altogether. The DOE's NETL uses the VR simulator at its state-of-the-art training center to assist in the development of next generating zero-emission IGCC power plants with carbon capture.

Is VR ready to move beyond training and into real-time process control? Probably not just yet. While this is obviously cool technology with clear benefits for training purposes, supplier will have to build a sound business and safety case for the technology before it will be accepted in real-time operations.

For further information or to provide feedback on this Insight, please contact your account manager or the author at tfiske@arcweb.com. ARC Insights are published and copyrighted by ARC Advisory Group. The information is proprietary to ARC and no part of it may be reproduced without prior permission from ARC.