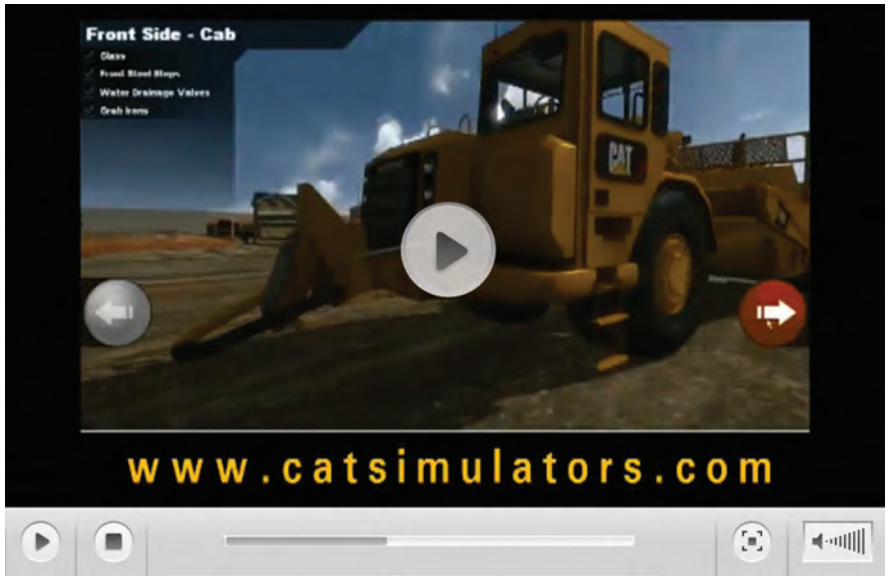
Simulators and Safety: A Training Advantage

By Annette Gentry Bailey

Heavy equipment operators working in the mining industry already face a number of safety issues inherent in the nature of the work. That makes practicing safe operating procedures all the more important. The key to a successful safety initiative is operator training. Thanks to new technology, part of this training can now come in the form of simulators.

Untrained or undertrained operators can jeopardize themselves, co-workers, machines and the job site. A case in point is given in a report by the Mine Safety & Health Administration, that a 28 year-old truck driver with 2 years experience was fatally injured on the job. While he was operating a 240-ton haul truck it left the haul road and climbed a berm, which caused it to overturn and land on the haul road. The victim, who was not wearing a seat belt, fell from the cab of the truck. In another case, a 51-year old front-end loader operator with eight weeks of experience was fatally injured at a surface clay operation. The victim parked a front-end loader on a loading ramp and was run over by the machine after he exited it.

Training operators before they ever set foot inside a machine and continuing to emphasize safety training helps to lessen the chance of an accident. While mining laws vary by country, many governments realize that laws must exist for the safety of their people and are proactive in creating those laws. For example, the U.S. Dept. of Labor created The Federal Mine Safety and Health Act of 1977.



Watch this Cat Simulators wheel tractor-scraper walk-around video.

Watch how a simulator works in this "Introduction to Simulators" video.

This Act establishes training as an important tool for preventing accidents and avoiding unsafe and unhealthy working conditions. The Mine Safety & Health Administration requires that each U.S. mine operator have an approved plan for training that includes the following:

- 40 hours of basic safety and health training for new miners who have no underground mining experience, before they begin work underground;
- 24 hours of basic safety and health training for new miners who have no surface mining experience, before they begin work at surface mining operations;
- eight hours of refresher safety and health training for all miners, each year, and
- safety-related task training for miners assigned to new jobs.

All operators must not only learn proper operating procedures, but also retain and follow the steps every time they operate a piece of heavy equipment. Not doing so could result in bodily injury, like that sustained by the operators mentioned above, or injury to other personnel.

Traditional operator training programs vary, depending on the organization conducting them. Programs might include text books, guides, eLearning

The Large Wheel Loader simulator instructs operators in the use of the lift arm and bucket controls to position the bucket and in stockpiling, truck loading and more.

(training via a computer), group discussions and, of course, training on actual machines. In addition to these tools, many instructors are discovering the merits of adding simulator training to their curriculums.

Beyond Traditional Programs

Most widely associated with flight training, realistic simulators are now available in many models for heavy equipment operator training. Some are as large as a room with a price tag to match. A more affordable type of simulator seats an individual inside a metal frame unit at a set of controls, with a screen in front of him or her. With high quality graphics and sound, plus actual working controls, an operator can gain practical knowledge and skills before training on the real machines. A computer using 3D graphics recreates a virtual setting of worksite conditions, allowing the operator to move around the environment.

Supplementing with simulator training has proven more effective than using only traditional training means in terms of the amount of knowledge retained by operators when they run actual machines. That is because the exercises can be repeated as many times as needed for the operator to learn the proper procedures, making the chances of retaining the information much higher. A simulator can also decrease the operator's anxiety level because the operator is training in a controlled environment. There is no chance of a machine mishap while he or she is becoming familiar with the controls and being exposed to training exercises for the first time.

Building Blocks to Training

Simulator training can be seamlessly integrated into any overall training program and represents an important building block in the process. Operators eventually need to train on an actual machine, but can begin the process of skill mastery and develop muscle memory through simulator training.

Instructors can help trainees focus on key areas of safety through virtual training. The safety focus comes to life through a simulator much more vividly than through the pages of a book. For example, the Cat Simulators Wheel Tractor-Scraper (see video) features a safety walk-around module that covers 105 different inspection points. Trainees must identify key points and answer whether they are in working order or not. The trainee learns the proper names and placement of each machine part and the software continuously pulls up the inspection points in random order so that the trainee cannot simply memorize the answers. All responses are measured and tracked so that instructors can find out what trainees have learned. These are the same inspection points that operators need to know when using an actual machine. Making sure their equipment is in good operating condition is important to their safety and to that of others on the worksite.

Another way simulators can provide safety training is by helping in the identification of fatigue issues. Fatigue (feeling mentally or physically tired) is one of the most common hazards facing operators such as haul circuit drivers. Factors from monotony and lack of sleep to working for extended hours contribute to accident potential. Operators who are fatigued have a higher rate of errors, accidents and injuries. Serious problems can occur when operators are fatigued. A simulated environment affords evaluation of operators while performing repetitive tasks and working alone. Testing for operator fatigue on a simulator can help identify:

- issues driving haul routes for extended periods of time;
- slower reflexes;
- errors and poor performance during repetitive exercises;
- lack of concentration or focus;
- ergonomic issues that lead to fatigue (slouching, twisting, leaning).

Virtual Reality, Real Results

Development of the simulator software is a detailed process. Concepts must be created along with graphic aids for the ideas. Developing the training exercises to be featured requires consultation with a subject matter expert for the particular machine to be simulated. Software developers then begin the rigorous process of designing the virtual environments and training exercises. Machine, controls, terrain, buildings, barriers and more are created for the foundation of the simulator software. Graphic designers model real-world examples into the 3D virtual

Simulator software underscores such messages as using "three points of contact" when mounting a machine.

environments. Once the virtual work sites begin to take shape, suitable textures are added to give the overall design a realistic look. Behaviors are added to the simulated environment, such as how a wheel loader interacts with rocks. Training exercise benchmarks are created by subject matter experts through another rigorous process and incorporated into the software. Realistic controls are used to ensure that operators learn properly, gain muscle memory from the movements and translate that knowledge when operating the actual machines.

Trainees learn controls familiarization through hands-on instruction and graphic imagery. Understanding how the controls work provides the foundation to operating the machine. After working through the controls familiarization module the operator can move on to specific training exercises designed for the simulated machine. Virtual training exercises are based on the same exercises that operators would perform on a real job site. Exercises are represented in different work environments, such as construction and mining, giving trainees the opportunity to practice and master component skills needed to operate actual machines. Pre-training operators as to how to drive a mining truck, for example, will expose them to exercises such as learning to drive at a mine site following specific traffic patterns in narrow corridors and avoiding berms and other common barriers. Additionally, they would learn to position the truck for loading and dumping, complete a haul cycle around the mining site and practice other specific exercises that are important in operating a mining truck. A wheel loader might feature bucket placement, stockpiling and truck spotting. New operators can practice the exercises in order to become familiar with situations that they might face on an actual job site. Simulator training also ensures that operators will not slow down production circuits or put their co-workers in danger.

To find out how trainees are progressing, instructors often use training records management software in tandem with the simulator training. Instructors can test students by putting the simulators in exam mode to find out immediately whether trainees pass or fail. Numerous metrics are taken during the exam mode (depending on the software), such as bucket slams, total dirt moved, total dirt spilled, speed, ground collisions—the list goes on. For example, the training records management software used with Cat Simulators' SimU Campus allows the option to print detailed reports for the class and individual students, and to print specific exercises and more. Instructors can determine where deficits exist in operator skills and knowledge and customize a training solution based on the operator's needs. Other records management software is available. Check the simulator owner's manual for recommendations from the manufacturer.

No matter what safety initiative your organization is focusing on, simulator training can help your organization reach its goal to have better trained and safer operators. ■

Annette Gentry Bailey writes on a variety of topics for the heavy equipment industry.

Links and References

- Compendium of Links to Intl...
- Mine Safety & Health Admin
- Mine Fatality Case Sept. 2009
- Mine Fatality Case May 2009
- Mining in Five Dimensions
- Realistic Simulation Accel...
- The Federal Mine Safety &...

Videos in This Article

- Virtual Operator Training Simul...
- Wheel Tractor-Scraper Op...

Click here for full list of links:
http://go.mining.com/mar10-a16