

# Image Captions and Descriptions for the **5DT Range of Mining Training Simulators**

5DT currently offers the following Training Simulators for the Mining Industry:

## **Surface Mining:**

- 1 Haul Truck Training Simulator
- 2 Shovel/Excavator Training Simulator
- 3 Wheeled Loader Training Simulator
- 4 Dragline Training Simulator

## **Underground Mining:**

- 5 Continuous Miner Training Simulator
- 6 Long Wall Training Simulator

Short form descriptions of the above simulators are supplied below. Image captions and image descriptions are also supplied.

## **Surface Mining**

### **1 Haul Truck Training Simulator**

#### *Introduction*

The 5DT Haul Truck Training Simulator teaches the trainee haul truck driver how to drive a large off-highway haul truck. It also teaches the trainee how to position the truck for loading (by e.g. a shovel or a wheeled loader) and how to position it for dumping, both at the ore crusher and at the waste dumping area. The trainee is also required to drive with reduced visibility (fog conditions and dust) and to drive at night.

#### *Simulator Setup*

The system consists of a mock-up cabin that is mounted on a motion base, in the midst of three large projection screens. The three screens (left, middle, right) provide the trainee with a wide field of view (approximately 180 degrees). This is the same out the window (OTW) view that a real driver would experience in a real truck. The mock-up cabin is equipped with controls and instruments that mimic real controls and instruments in a real truck. The motion base provides realistic motion cues to make the trainee feel as if he/she is driving a real truck.

#### *Interchangeability*

The mock-up cabin may easily be interchanged with mock-up cabins of other mining vehicles. The simulator hardware (computers, large projection screens and motion base) may therefore be used for several different 5DT Training Simulators.

#### *Virtual Environment*

The virtual haul truck is driven in a photo-realistic virtual environment that emulates reality very closely. The virtual surface mine emulates a real mine, with a dispatch station, service station, loading area, ore dumping area (ore crusher), waste dumping area and a road network. Realistic computer graphics (visual) models of entities like haul trucks, shovels, wheeled loaders, water cars and light delivery vehicles were also developed. These models do not only look like the real thing, but they also sound like the real thing - real sound recordings were used for this effect.

#### *Performance Measurement*

The instructor monitors the performance of the trainee. This is achieved by means of real-time graphs, reports and a record/playback module. The trainee is presented with a detailed, categorized report after each session. The record/playback module records the entire training session. The session can be played back for detail analysis and evaluation.

#### *Team Training*

The 5DT Surface Mining Training Simulators may be networked together. A Shovel Training Simulator may be networked with a Haul Truck Training Simulator so that two human operators, in two separate simulators, can work together to complete a task. The 5DT Simulators are 'Network-Ready', which means that it has been designed to function together and that it can be networked without any problems.

### *Conclusion*

The 5DT Haul Truck Training Simulator is the closest thing to reality you can get! The main advantages offered by the simulator is that one does not have to "borrow" a production-capable truck for training, that the trainee cannot damage or destroy the virtual truck and that the trainee can be exposed to life-threatening conditions and situations without putting either the trainee or the truck at risk.

### MINE\_Surface\_Truck\_001

#### **Simulator Setup: Haul Truck Training Simulator**

The mock-up cabin is situated in the midst of three high resolution, high brightness, projection screens for the left-, forward- and right view. The 3 screens provide the trainee operator with a wide field of view (180 degrees), similar to what he would have experienced in a real vehicle. The left side-view mirror can be seen on the left screen. The mock-up cabin is mounted on a high performance motion base that provides realistic motion cues to the trainee operator.

### MINE\_Surface\_Truck\_002

#### **Simulator Setup: Motion Base** (side cover skirt removed)

The mock-up cabin is mounted on a high performance motion base that provides realistic motion cues to the trainee operator. The motion base provides movement in 3 degrees of freedom (3 DOF); left-right tilt (also known as roll), forward-backward tilt (also known as pitch) and up-down movement (also known as heave). The Haul Truck Training Simulator has a realistic physics model (dynamic model) that calculates and predicts the movement of the truck. This model provides acceleration and deceleration inputs that are implemented by the motion base to subject the trainee to a very realistic driving experience.

### MINE\_Surface\_Truck\_003

#### **Simulator Setup: Close-up of Truck Controls**

Real controls are used in the simulator. These include the steering wheel, retarder lever, instruments, switches, the transmission control (foreground), pedals (accelerator, service brake, emergency brake) and the hoist control lever. All the controls are active (dynamic).

### MINE\_Surface\_Truck\_004

#### **Virtual Haul Truck: Outside View: Manufacturer's Colors**

Photorealistic computer graphics models provide for a very real learning experience. The simulator also includes other vehicles like computer controlled haul trucks, a shovel, a wheeled loader, water cars and light delivery vehicles.

### MINE\_Surface\_Truck\_005

#### **Virtual Haul Truck: Outside View: Mine's Colors**

Photorealistic computer graphics models provide for a very real learning experience. The color scheme of the haul truck may be customized.

### MINE\_Surface\_Truck\_006

#### **Virtual Surface Mine**

An accurate, photorealistic virtual surface mine has been developed for the Haul Truck Training Simulator. The mine was developed using Global Positioning System (GPS) data, aerial photographs, and close-up photographs of high detail items. Custom virtual surface mines may be developed on request. Such custom virtual mines are ideal to familiarize trainees with the real mine, without them having to drive around in real vehicles.

### MINE\_Surface\_Truck\_007

#### **Virtual Dispatch Station**

The dispatch station is normally the starting point of a training session. This specific dispatch station overlooks the mine.

MINE\_Surface\_Truck\_008

### **Virtual Service Station**

A visit to the service station is necessary if the virtual haul truck runs out of fuel. It is also necessary for the trainee to know where the service station is situated.

MINE\_Surface\_Truck\_009

### **Going Down: View from the Cabin**

This view from the cabin of the virtual haul truck shows the road to the bottom of the pit. The safety wall is shown on the left. The left side-view mirror of the truck is also shown. The orientation angles of these mirrors may be adjusted. An autonomous haul truck (computer controlled haul truck) is approaching on its uphill journey out of the pit.

MINE\_Surface\_Truck\_010

### **Autonomous Trucks Queuing Up at the Loading Area**

To ensure that the training is realistic, several autonomous haul trucks (computer controlled haul trucks) share the virtual surface mine with the haul truck driven by the trainee driver. Here some of them are queuing to be loaded by the virtual shovel. The virtual shovel may be operated by a human operator, with the Haul Truck Training Simulator *networked* to the Shovel Training Simulator. There is also an autonomous (computer controlled) shovel that will continue to load trucks until the instructor decides otherwise.

MINE\_Surface\_Truck\_011

### **Action at the Loading Area**

This image shows the loading area at the bottom of the surface mine. In the foreground a shovel is loading a truck, while another truck is ready to reverse into position for loading. More trucks are approaching in the background.

MINE\_Surface\_Truck\_012

### **Haul Truck being loaded by an Autonomous Shovel (Computer Controlled Shovel)**

Here the virtual haul truck is being loaded by the virtual shovel. The virtual shovel may be operated by a human operator, with the Haul Truck Training Simulator *networked* to the Shovel Training Simulator. There is also an autonomous (computer controlled) shovel that will continue to load trucks until the instructor decides otherwise.

MINE\_Surface\_Truck\_013

### **Going Up: Outside View of Loaded Truck**

A loaded truck starts its long journey out of the pit.

MINE\_Surface\_Truck\_014

### **Dumping: Ore being dumped at the Virtual Crusher**

A virtual truck dumps its load of ore at the crusher.

MINE\_Surface\_Truck\_015

### **Dumping: Waste being dumped at the Waste Dumping Area**

A virtual truck dumps waste at one of the waste dumping areas. Note the safety wall behind the truck.

MINE\_Surface\_Truck\_016

### **Continuous Day-Dusk-Night-Dawn: Sunset over the Virtual Surface Mine**

The instructor may switch the simulation to any time of the day or night. During daytime the sun position will be accurate. At night more than 2000 stars will span the sky.

MINE\_Surface\_Truck\_017

### **Driving at Night 1**

Once a trainee has mastered normal daytime driving he/she may graduate to night-time driving. Note the headlights.

MINE\_Surface\_Truck\_018

### **Driving at Night 2**

Once a trainee has mastered normal daytime driving he/she may graduate to night-time driving. Another truck is approaching. Note the stars in the background.

MINE\_Surface\_Truck\_019

### **Environmental Conditions 1: Decreased Visibility**

Visibility may be decreased by the instructor to expose the trainee to extreme driving conditions. This image shows an approaching truck that is almost obscured by fog.

MINE\_Surface\_Truck\_020

### **Environmental Conditions 2: Dust**

Special effects are used to provide for a highly realistic learning experience. Dust is kicked up by the wheels of the virtual haul truck. This will limit visibility, exactly like it would happen in reality.

MINE\_Surface\_Truck\_021

### **Emergency Situations: Engine Fire**

One of the biggest advantages of a training simulator is that one may subject trainees to life-threatening situations and conditions. Emergency situations may be programmed into a training session. The instructor may also induce emergency situations at any specific moment, e.g. a brake failure or an engine fire. The response of the trainee is evaluated. Note the highly realistic smoke of the fire.

MINE\_Surface\_Truck\_022

### **Instructor Screen: Top-Down View**

The instructor may select any viewpoint, and may also navigate around a viewpoint. This does not only enable the instructor to see top-down views, but he/she may also select side views, front views, back views, or any viewpoint that may be needed for a specific scenario. The instructor may switch to any entity in the mine. The task (training scenario) is shown in the left-top corner. Operator errors are shown just below the task. The load-mass of the selected truck is indicated in the left-bottom corner. A list of the stationary (passive) and dynamic (active) entities (e.g. other trucks) are shown on the right. The instruments and control indicators of the selected truck is shown at the bottom-center of the screen.

## **2 Shovel/Excavator Training Simulator**

### *Introduction*

The 5DT Shovel/Excavator Training Simulator teaches the trainee shovel/excavator operator how to operate a large mining shovel or excavator. It is expected of the trainee operator to load several trucks. For this purpose autonomous (computer controlled) trucks have been implemented. These trucks arrive continuously and position themselves for loading. The autonomous trucks position themselves at random positions to ensure that the trainee operator is subjected to many different loading challenges.

### *Simulator Setup*

The system consists of a mock-up cabin that is mounted on a motion base, in the midst of three large projection screens. The three screens (left, middle, right) provide the trainee with a wide field of view (approximately 180 degrees). This is the same out the window (OTW) view that a real operator would experience in a real shovel or excavator. The mock-up cabin is equipped with controls and instruments that mimic real controls and instruments in a shovel/excavator. The motion base provides realistic motion cues to make the trainee feel as if he/she is operating a real shovel/excavator.

### *Interchangeability*

The mock-up cabin may easily be interchanged with mock-up cabins of other mining vehicles. The simulator hardware (computers, large projection screens and motion base) may therefore be used for several different 5DT Training Simulators.

#### *Virtual Environment*

The virtual shovel is operated in a photo-realistic virtual environment that emulates reality very closely. The virtual surface mine emulates a real mine. Realistic computer graphics (visual) models of entities like haul trucks, wheeled loaders, water cars and light delivery vehicles were also developed. These models do not only look like the real thing, but they also sound like the real thing - real sound recordings were used for this effect.

#### *Material Interaction*

A sophisticated material interaction model has been developed for the shovel simulator. If material (e.g. ore) is removed from the mine, other material slides down to fill the empty space. This ensures realistic filling of the shovel/excavator bucket by the trainee.

#### *Performance Measurement*

The instructor monitors the performance of the trainee. This is achieved by means of real-time graphs, reports and a record/playback module. The trainee is presented with a detailed, categorized report after each session. The record/playback module records the entire training session. The session can be played back for detail analysis and evaluation.

#### *Team Training*

The 5DT Surface Mining Training Simulators may be networked together. A Shovel Training Simulator may be networked with a Haul Truck Training Simulator so that two human operators, in two separate simulators, can work together to complete a task. The 5DT Simulators are 'Network-Ready', which means that it has been designed to function together and that it can be networked without any problems.

#### *Conclusion*

The 5DT Shovel Training Simulator is the closest thing to reality you can get! The main advantages offered by the simulator is that one does not have to use a production-capable shovel for training, that the trainee cannot damage or destroy the virtual shovel and that the trainee can be exposed to life-threatening conditions and situations without putting either the trainee or the shovel at risk.

#### MINE\_Surface\_Shovel\_001

##### **Simulator Setup: Close-up of Shovel Controls**

The simulator shovel controls mimic the real controls exactly. Shown here are the left- and right-hand joysticks and the three foot pedals.

The operator seat and controls are mounted on a base plate that may be mounted on the motion base with ease. One hardware setup, consisting of computers, projection screens and a motion base, may therefore be used for several different simulators. To change from one 5DT Surface Mining Simulator to another, one simply has to exchange the base plates and run the other software program.

#### MINE\_Surface\_Shovel\_002

##### **Hydraulic Shovel: Outside View**

Photorealistic computer graphics models provide for a very real learning experience. The simulator also includes other vehicles like computer controlled haul trucks, a wheeled loader, water cars and light delivery vehicles.

#### MINE\_Surface\_Shovel\_003

##### **Hydraulic Shovel: Bucket Details**

This image shows a close-up of the shovel's bucket.

#### MINE\_Surface\_Shovel\_004

##### **Hydraulic Shovel: Cabin View**

View from the cabin of a hydraulic shovel.

MINE\_Surface\_Shovel\_005

**Rope Shovel: Outside View**

Close-up view of an electric rope shovel. The shovel may propel forward or backward, or it may swing on its axis. The bucket may be lifted or lowered, as well as opened. It may also be crowded or retracted.

MINE\_Surface\_Shovel\_006

**Rope Shovel: Cabin View**

View from the cabin of an electric rope shovel while it is loading a haul truck. The shadow is important for proper orientation.

MINE\_Surface\_Shovel\_007

**Filling the Bucket: Material Interaction**

A sophisticated material interaction model has been developed for the simulator. If material is removed, other material will slide down to partly fill the empty space. This ensures realistic filling of the bucket by the trainee.

MINE\_Surface\_Shovel\_008

**Loading a Truck: Cabin View**

It is expected of the trainee shovel operator to load several trucks. For this purpose autonomous (computer controlled) trucks have been implemented. These trucks arrive continuously and position themselves for loading. The autonomous trucks position themselves at random positions to ensure that the trainee shovel operator is subjected to many different loading challenges.

MINE\_Surface\_Shovel\_009

**Instructor Screen: Top-Down View**

The instructor may select any viewpoint, and may also navigate around a viewpoint. This does not only enable the instructor to see top-down views, but he/she can also select side views, front views, back views, or any viewpoint that may be needed for a specific scenario.

### **3 Wheeled Loader Training Simulator**

#### *Introduction*

The 5DT Wheeled Loader Training Simulator teaches the trainee loader operator how to operate a wheeled loader. It is expected of the trainee operator to load several trucks. For this purpose autonomous (computer controlled) trucks have been implemented. These trucks arrive continuously and position themselves for loading. The autonomous trucks position themselves at random positions to ensure that the trainee operator is subjected to many different loading challenges.

#### *Simulator Setup*

The system consists of a mock-up cabin that is mounted on a motion base, in the midst of three large projection screens. The three screens (left, middle, right) provide the trainee with a wide field of view (approximately 180 degrees). This is the same out the window (OTW) view that a real operator would experience in a real wheeled loader. The mock-up cabin is equipped with controls and instruments that mimic real controls and instruments in a loader. The motion base provides realistic motion cues to make the trainee feel as if he/she is operating a real loader.

#### *Interchangeability*

The mock-up cabin may easily be interchanged with mock-up cabins of other mining vehicles. The simulator hardware (computers, large projection screens and motion base) may therefore be used for several different 5DT Training Simulators.

#### *Virtual Environment*

The virtual loader is operated in a photo-realistic virtual environment that emulates reality very closely. The virtual surface mine emulates a real mine. Realistic computer graphics (visual) models of entities like haul trucks, water cars and light delivery vehicles were also developed. These models do not only look like the real thing, but they also sound like the real thing - real sound recordings were used for this effect.

### *Material Interaction*

A sophisticated material interaction model has been developed for the loader simulator. If material (e.g. ore) is removed from the mine, other material slides down to partly fill the empty space. This ensures realistic filling of the bucket by the trainee.

### *Performance Measurement*

The instructor monitors the performance of the trainee. This is achieved by means of real-time graphs, reports and a record/playback module. The trainee is presented with a detailed, categorized report after each session. The record/playback module records the entire training session. The session can be played back for detail analysis and evaluation.

### *Team Training*

The 5DT Surface Mining Simulators may be networked together. A Shovel Training Simulator may be networked with a Haul Truck Training Simulator so that two human operators, in two separate simulators, can work together to complete a task. The 5DT Simulators are 'Network-Ready', which means that it has been designed to function together and that it can be networked without any problems.

### *Conclusion*

The 5DT Wheeled Loader Training Simulator is the closest thing to reality you can get! The main advantages offered by the simulator is that one does not have to use a production-capable loader for training, that the trainee cannot damage or destroy the virtual loader and that the trainee can be exposed to life-threatening conditions and situations without putting either the trainee or the loader at risk.

### MINE\_Surface Loader\_001

#### **Wheeled Loader: Outside View: Manufacturer's Colors**

Photorealistic computer graphics models provide for a very real learning experience. The simulator also includes other vehicles like computer controlled haul trucks, a shovel, water cars and light delivery vehicles.

### MINE\_Surface Loader\_002

#### **Wheeled Loader: Outside View: Mine's Colors**

Photorealistic computer graphics models provide for a very real learning experience. The color scheme of the wheeled loader may be customized.

## **4 Dragline Training Simulator** {Technology Demonstrator}

### *Introduction*

The 5DT Dragline Training Simulator is a technology demonstrator of a simulator that will teach the trainee dragline operator how to operate a dragline optimally.

### *Simulator Setup*

The system will utilize an extension of the standard 5DT simulator hardware setup. The system consists of a mock-up cabin that is mounted on a motion base, in the midst of five large projection screens. The five screens provide the trainee with a wide field of view (approximately 270 degrees). This is the same out the window (OTW) view that a real operator would experience in a real dragline. The mock-up cabin is equipped with controls and instruments that mimic real controls and instruments in a dragline cabin.

### *Customized Motion Base*

The motion base provides realistic motion cues to make the trainee feel as if he/she is operating a real dragline. For this purpose a special motion base, that can *rotate* (to simulate the characteristic swing motion of a dragline), will be configured.

### *Virtual Environment*

The virtual dragline is operated in a photo-realistic virtual environment that emulates reality very closely. The virtual surface mine emulates a real mine. A realistic computer graphics (visual) model

of the dragline was developed. This model does not only look like the real thing, but it will also sound like the real thing - real sound recordings will be used for this effect.

#### *Material Interaction*

A sophisticated material interaction model has already been developed by 5DT for the shovel and loader simulators. If material (e.g. ore or overburden) is removed from the mine, other material slides down to partly fill the empty space. This ensures realistic filling of the dipper by the trainee. This model will be optimized for dragline operation.

#### *Performance Measurement*

The instructor monitors the performance of the trainee. This is achieved by means of real-time graphs, reports and a record/playback module. The trainee is presented with a detailed, categorized report after each session. The record/playback module records the entire training session. The session can be played back for detail analysis and evaluation.

#### *Visualization Tools*

The record/playback module will also be adapted so that real inputs, from a real dragline, may be used as input for the module. This will enable managers to use this program as a visualization tool for a real dragline.

MINE\_Surface\_Dragline\_001

#### **Dragline: Outside View**

Outside view of a dragline.

MINE\_Surface\_Dragline\_002

#### **Dragline: Cabin View**

View from the cabin of a dragline. Note the shadow.

## **Underground Mining**

### **5 Continuous Miner Training Simulator**

This system teaches the trainee operator how to control a Continuous Miner [CM] in such a way as to increase productivity and maintain a high safety standard. The trainee controls the CM in a virtual coal or potash mine with controls that closely resemble those of a real CM. The trainee operator works through a series of training scenarios that varies in complexity from simplistic scenarios to very complex and difficult scenarios. The trainee receives a complete training report at the end of each training session. The system may be used for the training of new operators or for evaluation of experienced operators. The training is performed in a safe and controlled environment.

MINE\_Ugnd\_CM\_001

#### **Trainee Operator with Head Mounted Display and Remote Control Unit**

The trainee operator wears a Head Mounted Display [HMD]. A Remote Control Unit that accurately resembles the real unit, is used to control the virtual Continuous Miner [CM].

MINE\_Ugnd\_CM\_002

#### **The Pre-simulation Module**

The pre-simulation module teaches the trainee operator basic terminology and how to use the Remote Control Unit. A small remote control panel is superimposed on the image initially, but later it is hidden.

MINE\_Ugnd\_CM\_003

#### **The Mine Section Editor**

The mine section editor allows the instructor/administrator to create and/or edit a mine section that relates to mining conditions in their specific area. For example, rock lenses (red areas) and roof bolts (blue crosses) may be placed.

MINE\_Ugnd\_CM\_004

### **The Scenario Editor (1)**

Once a mine section has been created (refer to the image: 'The Mine Section Editor'), the Scenario Editor is used to define the starting points (and orientations) of the continuous miner, shuttle car, instructor, operator and laser guide.

MINE\_Ugnd\_CM\_005

### **The Scenario Editor (2)**

With the starting points of all the participating entities defined (refer to the image: 'The Scenario Editor (1)'), the instructor/administrator may now proceed to select time dependent events on the timeline editor.

MINE\_Ugnd\_CM\_006

### **Cutting a Split (2-D) [cross-cut]**

Some training scenarios require training in 2-D first, before progressing to full 3-D scenarios. Once the trainee understands the relevant concepts from a plan-view perspective, it is time to tackle it in fully immersed 3-D.

MINE\_Ugnd\_CM\_007

### **The Cutting Cycle**

The Cutting Cycle is the foundation of Continuous Miner [CM] operation, and is considered a critical skill. Once the trainee has mastered the basics, a Shuttle Car [SC] is added, and the trainee is required to optimally fill a SC.

MINE\_Ugnd\_CM\_008

### **Cutting into the Roof**

The trainee is taught how to use the level indication system (red and green lights) of the Continuous Miner [CM]. When these warnings are ignored, the CM will cut into the roof. Sparks and on-screen warnings will appear.

MINE\_Ugnd\_CM\_009

### **The Cable Handler**

Whenever the Continuous Miner [CM] is trammed backwards, a virtual cable handler will ensure that the power cable is kept out of harms way.

MINE\_Ugnd\_CM\_010

### **Overfilling the Shuttle Car**

Overfilling of the Shuttle Car [SC] will cause spillage of coal. The operator will see the coal spilling and hear the sound of spilling coal. A warning message will appear on the instructor screen.

MINE\_Ugnd\_CM\_011

### **Virtual Reality Continuous Miner Training Simulator**

This system teaches the trainee operator how to control a Continuous Miner [CM] in such a way as to increase productivity while maintaining a high safety standard. The trainee controls the CM in a virtual coal or potash mine with controls that closely resemble those of a real CM. The trainee operator works through a series of training scenarios that varies in complexity from simplistic scenarios to very complex and difficult scenarios. The trainee receives a complete training report at the end of each training session. The system may be used for the training of new operators or for the evaluation of experienced operators. The training is performed in a safe and controlled environment. More than 400 operators have been trained with the system to date.

## **6 Long Wall Training Simulator**

This system teaches the trainee operator how to control a Long Wall (LW) in such a way as to increase productivity and maintain a high safety standard.

The trainee controls the LW in a virtual coal mine with controls that closely resemble those of a real LW. The trainee wears a head mounted display (HMD) that is fitted with a head tracker. A real Shearer Remote Control Device is interfaced to the simulator computer.

The system may be used for the training of new operators or for evaluation of experienced operators. The training is performed in a safe and controlled environment.

MINE\_Ugnd\_LW\_001

### **Configuration Screen**

The *virtual* Long Wall may be configured to mimic a specific *real* Long Wall. The instructor may configure the position of the main gate and the tail gate. Attachments to the auxiliary (secondary) booms may also be configured, e.g. attaching a lump breaker or a water boom (boom fitted with water sprayers). The instructor may also configure the rotation (clockwise or counter-clockwise) of the left- and right drum.

MINE\_Ugnd\_LW\_002

### **Controls**

Before a trainee can control the virtual Long Wall, he/she needs to master the different controls. The Shearer Information Screen is situated at the bottom-left. This screen provides feedback as to the status of the shearer. The shearer is started with the Shearer Control Panel (bottom-center). This virtual panel is operated via mouse-clicks. Once the shearer has been started, it may be controlled with the Shearer Remote Control (top-right). The Shearer Remote Control may be operated via mouse-clicks as well. A real Shearer Remote Control, interfaced to the simulator computer, is normally used. Once a trainee has mastered the controls (pre-simulation mode) he/she may graduate to the main simulator.

MINE\_Ugnd\_LW\_003

### **Simulator Setup**

The trainee views the virtual Long Wall and its surroundings with a Head Mounted Display (HMD). The HMD is fitted with a Head Tracker. The Head Tracker tracks the orientation of the trainee's head and relays this information to the host simulation computer. This computer then calculates the image that the trainee would see in the virtual Long Wall, and the image is rendered to the HMD. The trainee controls the virtual Long Wall with a real Shearer Remote Control that is interfaced with the host simulation computer.

MINE\_Ugnd\_LW\_004

### **Trainee View**

The trainee views the virtual Long Wall and its surroundings with a Head Mounted Display (HMD). The trainee may 'walk' under the roof supports by means of a special simulation joystick. The Hydraulic cylinders are shown on the left. The shearer is shown to the right. In the distance the floor pans curve ('snake') to the right.

MINE\_Ugnd\_LW\_005

### **Fire Suppression System**

This image shows the fire suppression system at work. Water spray is directed backwards. The left cutter drum is shown in the foreground (left). The cutter drum cowl has been released and it hangs down. The lump breaker can be seen just below the center of the screen, below the boom of the left cutter drum. The lump breaker breaks large lumps of coal on the conveyor belt (track).

MINE\_Ugnd\_LW\_006

### **Water Sprayers**

This image shows an outside view of the Long Wall. The instructor may navigate a virtual camera to any specific viewpoint. Such viewpoints are normally used to point out specific characteristics to the trainee. The water sprayers have been switched on for dust suppression.

MINE\_Ugnd\_LW\_007

### **Positioning the Ranging Arms**

The ranging arms have been positioned for cutting. The leading drum has been raised to the roof and the trailing drum has been lowered to the ground. Note the cowl of the trailing drum being dragged along on ground level.

MINE\_Ugnd\_LW\_008

### **Roof Supports and Snaking Floor Pans**

This image shows the Long Wall in its totality, with roof supports and the floor pans curving ('snaking') on the ground. The Shearer is shown in the distance (left-top).

MINE\_Ugnd\_LW\_009

### **Advancing Roof Supports**

The roof supports systematically advance once the shearer has passed. The shearer is moving from right to left in this image. Roof support movement may be accelerated for demonstration and instruction purposes.

P. Olckers

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