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ESIM-FCC11
Offshore drilling simulation training system

Technical Specification

I. Overview

Offshore drilling simulation training system is designed according to Chinese semi-submersible drilling platform offshore platform 981 based on IWCF training standard. Offshore platform 981 is the sixth generation of the semi-submersible drilling platform with the depth of 3000 meters, using the drilling package from Aker MH company, structured as one and half type rig tower, and four pipes as a stand.

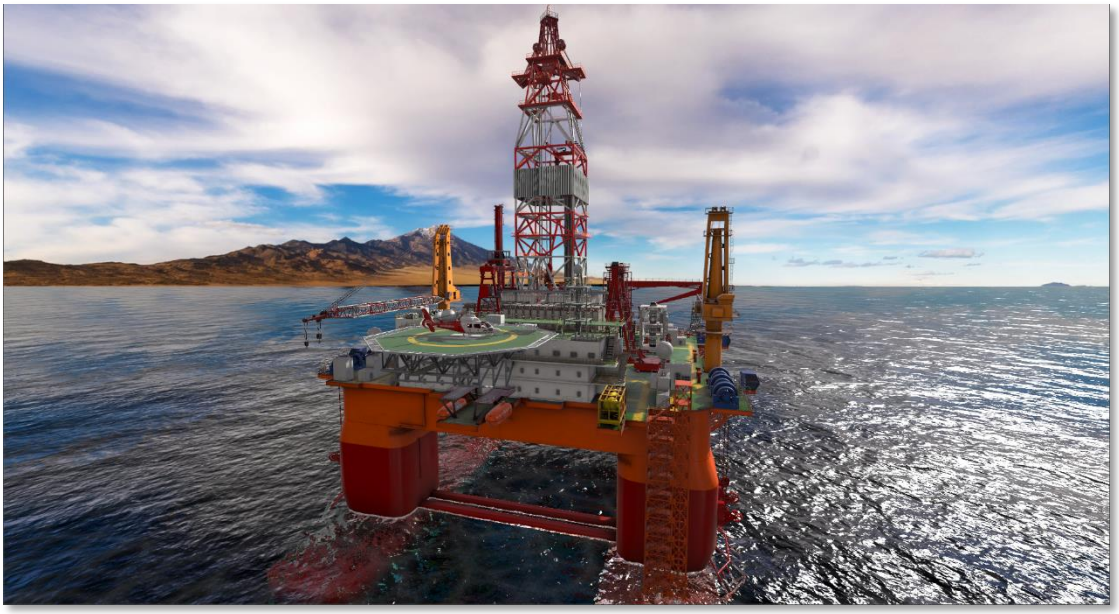

Figure 1 Offshore platform 981

Esimtech offshore drilling simulation training system using the latest downhole mathematical model and vivid 3D graphic engine, which can simulate various working condition of offshore drilling and offshore well control, including:

Drilling devices: drawworks, top drive, hydraulic tong, power slips, pipe grasper.

Circulation system: mud pump, mud pit, standpipe manifold, choke manifold, degasser.

Downhole devices: drill pipe, drill collar, check valve, drill bit, riser, casing.

Geology: formation, reservoir, low temperature gradient, well trajectory.

BOP: high pressure subsea BOP

II. Simulation training system functions

Drilling:

1. Normal tripping
2. Normal drilling

3. Kick occurs while drilling and shut-in
4. Kick occurs while tripping and shut-in
5. Shut-in in barren hole

Well control:

1. Drillers method of well killing
2. Engineers method of well killing
3. Volumetric method of well killing
4. Low choke method of well killing
5. Bullheading

III. Hardware system

Hardware system includes: offshore intelligent operation chair, offshore BOP console, Choke console, standpipe manifold, choke manifold, instructor station, computer system (Parameter computer, master control computer, graphic computer, network device, cabinet) and sound effect system. The layout of hardware devices is as shown in the following figure:

1. Offshore intelligent operation chair

The chair is the operation chair specially used for driller, imported from Norway, equipped with two 19-inch touch screens for parameter display, two 17-inch touch screen for operation, and a double five-key operation handle.

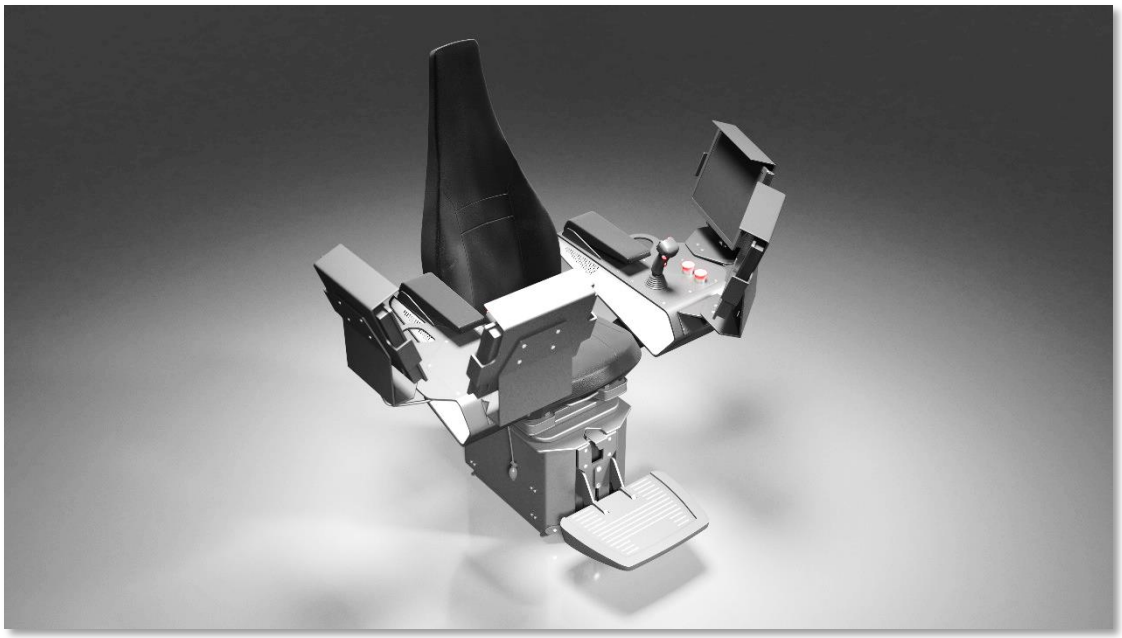

Figure 2 1 Offshore intelligent operation chair

2. Standpipe manifold

The manifold is made of all metal with no agent inside. There adopt analog sensors to collect valve state, and digital meter to display the pressure.

3. Choke manifold

The manifold is made of all metal with no agent inside. There adopt analog sensors to collect valve state, and digital meter to display the pressure.

4. Choke console

The choke console is made of all metal simulating dual hydraulic control choke valve console, including air supply switch, choke select, choke valve regulating handle, choke throttle, pump strokes reset, casing pressure meter, drill pipe pressure meter and pump strokes digital meter.

5. BOP console

The BOP console is make of all metal with aluminum panel, including upper annular preventer, lower annular preventer, shear ram preventer, upper pipe ram preventer, middle pipe ram preventer, bottom pipe ram preventer, upper and lower annular bleed-off control, upper and lower inside choke bleed-off control, upper and lower outside choke bleed-off control, upper and lower outside kill control, upper and lower inside kill control.

IV. Software system

Software system includes platform software module, instructor station software module, control software of touch screen on chair, parameter display software on the chair, rotary driven module, graphic software, tripping and drilling software, device fault handling module, problem and trouble handling module, well control software module, sound effect control software, student management software module, automatic scoring software module.

1. Platform software module

This module contains the framework of the software, the function dispatching, the data interfaces, database operation, network control, process control, hardware interaction function module. This module is the basic module of the software.

2. Instructor station software module

This module is used to calculate, display, process control of the parameters in various working conditions. This module is the core of the software system including various important mathematical models such as hook load, WOB, ROP, downhole circulation, kick, formation leakage, BOP pressure, etc. The interface is as shown in figure 7 and figure 8.

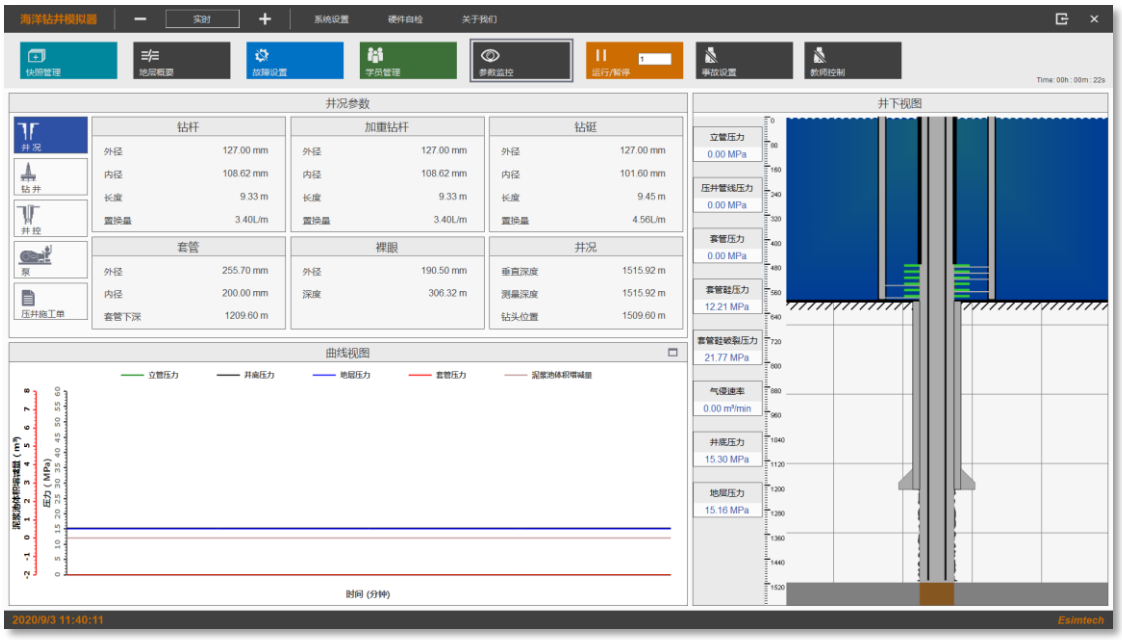

Figure 7 Instructor station software-Parameter display

Figure 8 Instructor station software-Drilling parameter setting

3. Parameter display software on the chair

Parameter display software is used to display drilling parameters on the touchscreens on the front of the chair. The interface is as shown in figure 9:

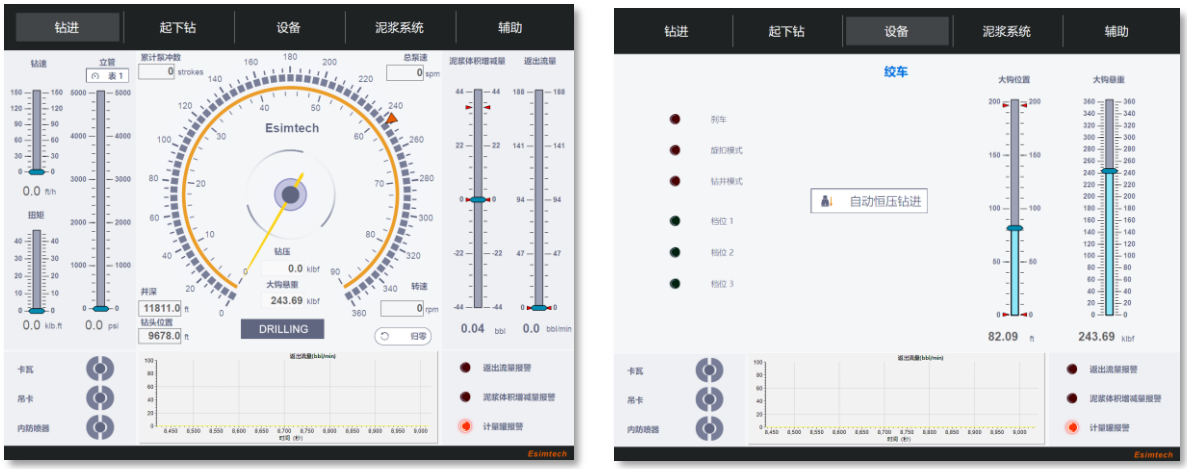

Figure 9 Parameter display interfaces on the IOC

4. Control software of touch screen on the chair

Control software of touch screen on the chair is mainly responsible for acquiring operation data of touch screen and joystick. Operation data is used to control rig system. The interface is as shown in figure 7.

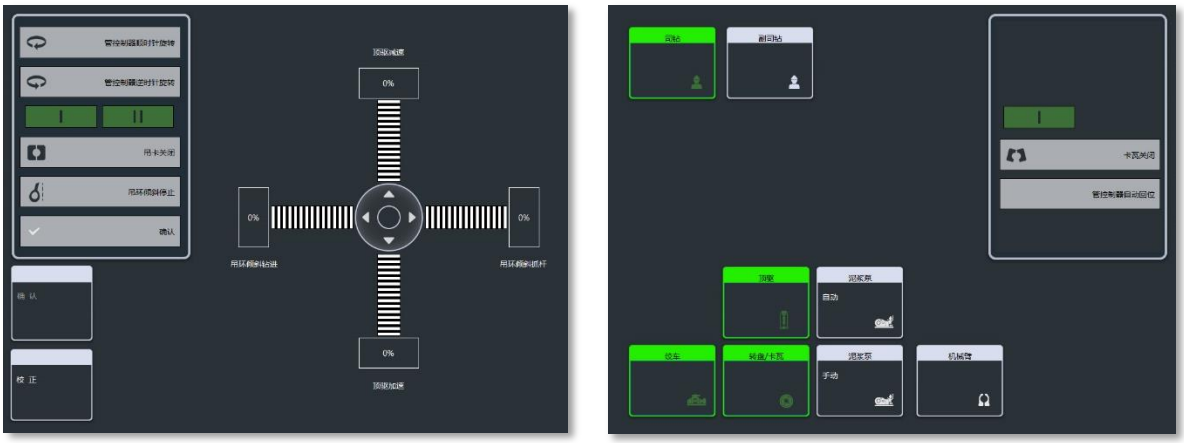

Figure 10 Control software interface of touch screen on the chair

5. Rotary driven module

The rotary driven module is used to calculate the parameters during drilling, reaming and back-reaming at real time.

6. Graphic software

3D graphic software represents the overall perspective of the whole drilling platform, and displays the working condition of devices on the drilling platform. The 3D graph of the platform is as shown in figure 11; drilling floor 3D graph is as shown in figure 12; drilling control room 3D graph is as shown in figure 13.

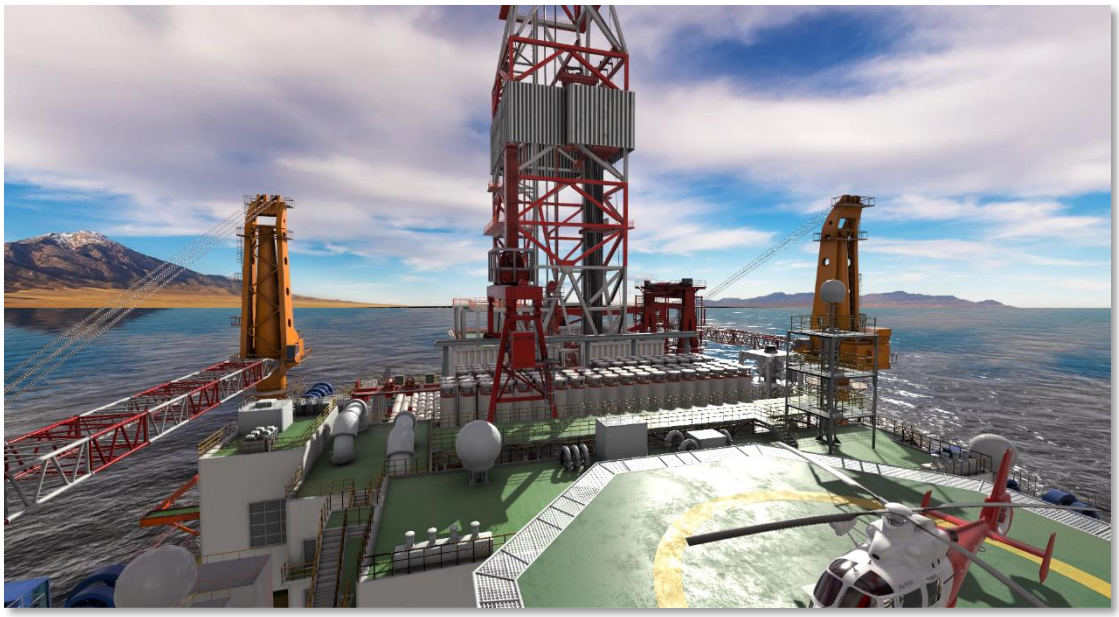

Figure 11 3D graphic software-offshore platform

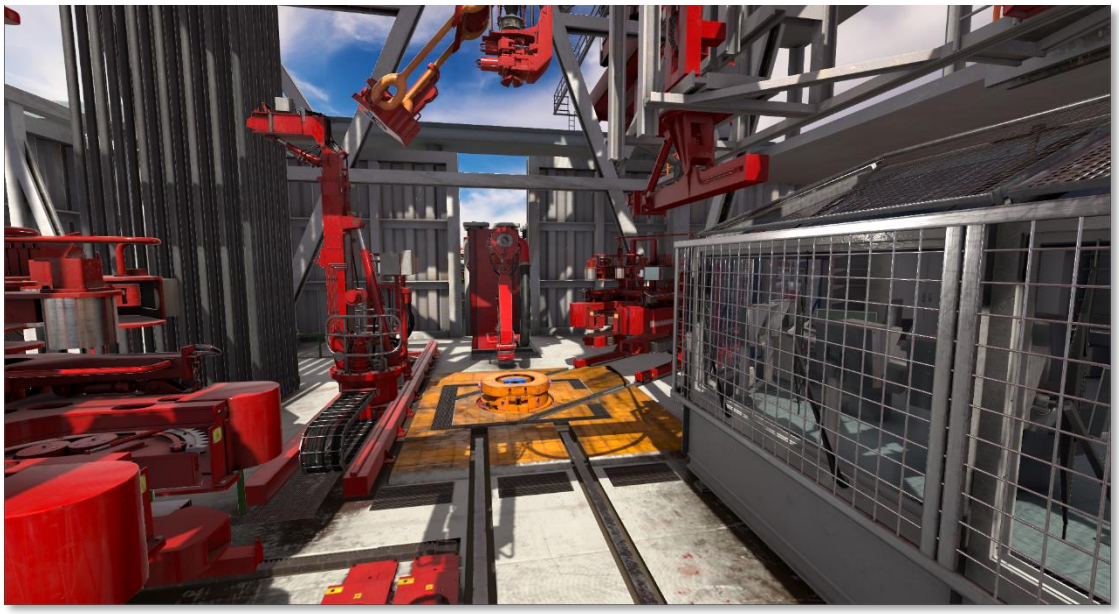

Figure 12 3D graphic software-drilling floor

Figure 13 3D graphic-drilling control room

7. Tripping and drilling software

This module is used for the device motion and parameter calculation during tripping and drilling.

8. Device fault handling module

This module is used to simulate the various device faults specified in IWCF standard. The interface is as shown in the following figure:

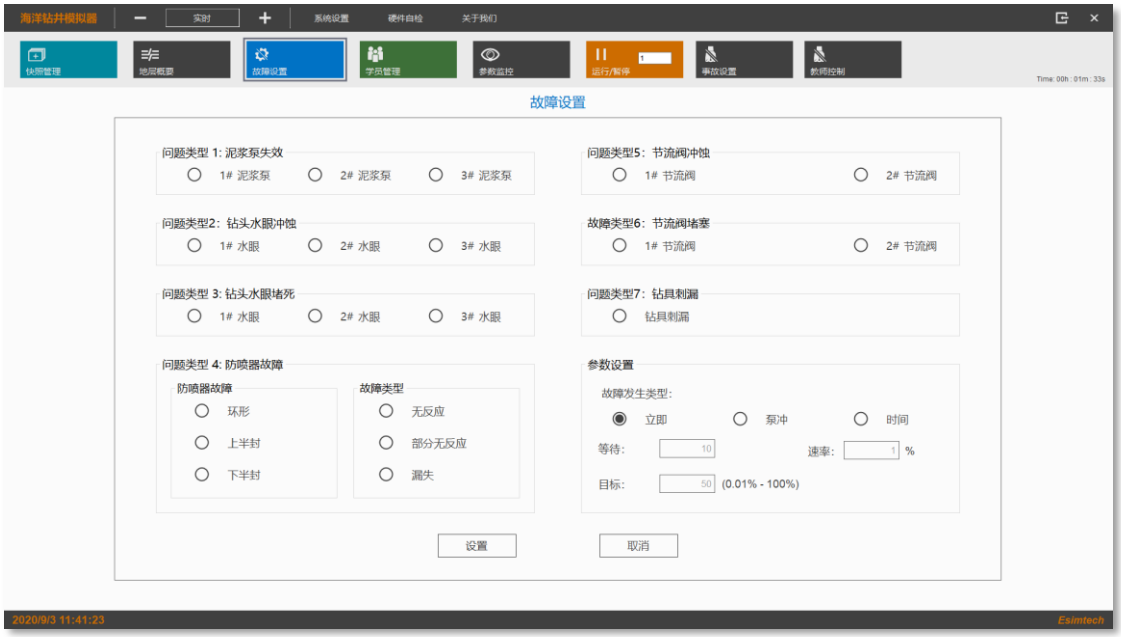

Figure 14 Fault handling software module

9. Problem and trouble handling module

This module is used to simulate the situation of pipe stuck.

10. Well control software module

This module adopts the latest “flow coupling” method which Esimtech owns the patent right to calculate the downhole pressure. It can simulate at high precision the driller’s method of well killing, engineer’s method of well killing, volumetric method of well killing, low choking method of well killing and bull heading.

11. Sound effect control software module

This module is used to simulate the various noises such as the pump, the choke valve, the top drive, the drawworks, etc.

12. Student management software module

This module is used to manage the student’s information, record the class information, training information and score information of the students. It supports the adding, deleting and modifying of the database for the instructor to carry out training and management efficiently.

13. Automatic scoring software module

This module can give out the operation evaluation of the students according to the contents given out by the instructor, comparing the actual operation to the

standard operation, and gives out the score.

V. System features

1. Simulator function

The simulator provides training for different posts such as driller, driller assistant, drilling crew technician, drilling crew leader, drilling supervisor, etc. The simulation training can enable trainee to master the skills of soft/ hard shut-in, and conventional/unconventional well killing.

The simulator adopts mathematical models to simulate various working condition and parameters in petroleum engineering drilling operation, such as pressure, torque, ROP, flow rate, etc. and can reflect the relations between these parameters, which realizes the same effect as in real drilling operation.

The simulator enables user to set various drilling parameters, such as drilling string assembly, well structure, formation parameters, device parameters, etc. which makes the training more flexible and targeted. The software program adopts non-sequence structure, which can simulate various rig operation, and closer to reality. Virtual reality technology makes up a vivid perceptual environment, and 3D animation is synchronic with the real operation.

The simulator is made according to industrial standard, Data acquisition and control system is completed by PLC, which ensures the reliability of the system.

2. System features

1) The system complies with the training standard of IWCF and IADC.

2) The system has non-sequence structure, which has no operation sequence limit to trainees. It simulates the model and functions of real drill rig. Operator can operate the system in any way just as operating real drill rig.

3) The system has the function of provide various operations by uploading one well condition snapshot. With one appropriate well condition snapshot, student can be trained of series of operations of tripping in and out, drilling, overflow, shutting in and well killing.

4) Parameters can be set freely. Instructor can set various parameters, such as drilling string make up, formation parameters, mud parameters, devices parameters, etc. Instructor can also customize the parameters based on actual well condition and devices, so that the training is just like operating on a real well.

5) The system provides problem setting function. Instructor can set various device fault or down-hole problem during student operating. And students can judge the problems by observing the change of parameters. Instructor can set problems or

faults such as pipe leakage, nozzle plug, choke valve seizing, pump fault, BOP fault, etc.

6) The system provides speed control function. Instructor can increase and reduce the speed of the exercise when necessary.

7) The system also has alarm setting function. Trainees can set various parameter limits. When parameters exceed these limits, the system will launch an alarm. The launching and stopping of alarm comply with student's operation, working condition and graphics.

8) 3D animation simulates site visual environment. Animation can present down-hole scene, devices motion and device working theories. The animation can also display the relationship, standing position and operation rules of different working post in drilling. The scene can be displayed on the screen by shifting scenes and in split screen way, such as ranking platform, drilling fluid flow line, various curves and real time data, etc.

9) The system has lifelike scene sound effect. The system can simulate various sounds in real site. The launching and stopping of sounds comply with student's operation, working condition and graphics.

10) The system can display the changing trend of important parameters in the form of curves, so that students can judge down-hole condition and problem through the curves.

11) It has curves playback function, which can replay the parameter changes during students' operation in the form of curves for students review.

12) The system has training control function. It can freeze, save and resume exercise at any time.

13) The measurement unit can be in Metric and also English.

14) The system provides Chinese and English interfaces that can be shifted at real-time.

15) The system has automatic scoring function. It can give out score to student's operation, and also the point deduction reasons.

16) It has completed student management function.

17) The system has one-key to start function.