ESIM-FLR2

Land Rig Installation Simulation Training System

Technical Specification

1. Introduction

Land rig installation simulation training system is developed by Southwest Petroleum University and Chengdu Esimtech Petroleum Equipment Simulation Technology Exploitation Co, Ltd. It is a system with advanced technology and complete functions which can satisfy the training requirements of oilfield companies.

The system is the combination of petroleum engineering technology, computer technology and virtual reality technology. It is mainly used for training new workers, drillers, assistant driller, technicians, and driller supervisor, etc. The system can provide trainings as the land rig installing whole process and notes, land rig derrick and substructure raising and lowering, rig tripping in and out, drilling operation, top drive operation, rig construction, etc.

This system is composed of 4 parts: rig installing whole process animation display module, derrick/substructure raising and lowering training module, rig virtual assembly module and rig simulation operation module. The system adopts high fidelity animation to display the whole process of land rig (exactly as the installing procedure of real land rig). The system uses hardware emulation to train students the operation of derrick and substructure raising and lowering, tripping and drilling. It adopts large quantity of mathematical models to simulation the various parameters, such as pressure, flow rate, torque, drilling rate, etc. The virtual reality technology constructs the vivid environment, combining with the 3D animation displayed through LED screen display, and vivid sound effect makes up an immersive training environment.

The whole system consists of driller console, top dive console, graphics system and other accessories. The layout of the panels, operation methods, parameter displaying is the same as the real equipment. Hardware devices are constructed by industrial PLC, which ensures the stability of the system. The system has the advantage of low input and maintenance cost, with no security risk.

2. System Component

2.1 Major Hardware

1．The controlling and parameter displaying of driller console is the same as the real equipment. It can simulate raising and lowering of drawworks and speed regulation of mud pumps. It can display parameters as WOB, top drive rotary rate, standpipe pressure, casing pressure, torque, in flow, out flow percentage, well depth, bit position, top drive height, footage, drill time, drilling rate, drill pipe speed, well bottom pressure, formation pressure, etc. This console is made of metal; simulating ZJ70D DC electric rig, with disc brake; supporting top drive operations; integrated with parameter display station.

2. Top drive console can simulate various operations, linkage and controlling of top drive, including IBOP, turret lock, links rotate, links tilt, backup tong, operation (drill, spin, torque), direction (reverse, stop, forward), etc. It simulates the top dive 70 manufactured by Beijing Petroleum Machinery Factory, all metal construction.

3. Display system

	A. Large size LED screen full color display
	◆Presenting simulated 3D animation on LED screen full color display after process by professional graphics workstation. ◆LED P2.5 screen; Resolution: 1920*1080 ◆Screen size: 5400mm(wide)*3215mm(high) (The ultimate installation size and resolution will be depended on installation environment)

2.2 System Software

2.2.1 Master Control Software

1. Rig installing whole process displaying module

2. Rig installing derrick and substructure raising and lowering training module

3. Rig virtual assembly module

4. Rig tripping/ drilling operation module

2.2.2 Graphics Software

1. Top drive-based 3D scene display software module

2. Rig installing whole process 3D animation display module

3. System Function

3.1 Functions and Features

(1) The system can display the whole process of rig installing and notes through high fidelity animation, which makes students master the installing process without going to the site.

(2) The system enables students to operate hydraulic power equipment and rig controlling system. Interactive rig model and 3D animation enables students to master the process of derrick and substructure raising and lowering.

(3) In the way of human-machine interaction, the system provides training and testing of land rig installing process.

(4) The system uses real rig as prototype. All the levers, meters and gauges, switches are the same as the real equipment. The operation and display of brake lever, clutch and weight indicator is the same as the real equipment.

(5) 3D animation simulates the real environment. The animations can display downhole conditions, equipment motions and equipment working theories. Various worker and their relationship, standing position and operation rules are presented by animation characters. The graphics software provides scene displaying toggling and split-screen display. For example, rig monkey platform scene, drilling fluid flow path and various curves and real time data.

3.2 Training Project

1. Rig installing whole process training operation
2. Rig installing virtual assembly operation
3. Raising and lowering operation
    1) Derrick raising operation
    2) Substructure raising operation
    3) Substructure lowering operation
    4) Derrick lowering operation
4. Drilling operation
    1) Normal tripping in operation
    2) Normal tripping out operation
    3) Normal drilling and making up stand operation
5. Judging and treating of downhole accidents and troubles
    1) Tripping in and slacking off
    2) Tripping out and overpull
    3) Judging and treating wall-sticking
    4) Judging and treating sand settling
    5) Judging and treating balling up
    6) Normal drilling and drilling with bouncing bit
    7) Judging and treating leaking accident
    8) Fishing tap
    9) Junk milling

4. Technical Parameters and Operational Environment

4.1 Technical Parameters

(1) Power supply: 220V/50Hz AC

(2) Power consumption: <6000W

4.2 Operational Environment

(1) Area: 10*8.5m

(2) Separate equipment power supply from light power supply

(3) Working temperature: 0℃～30℃
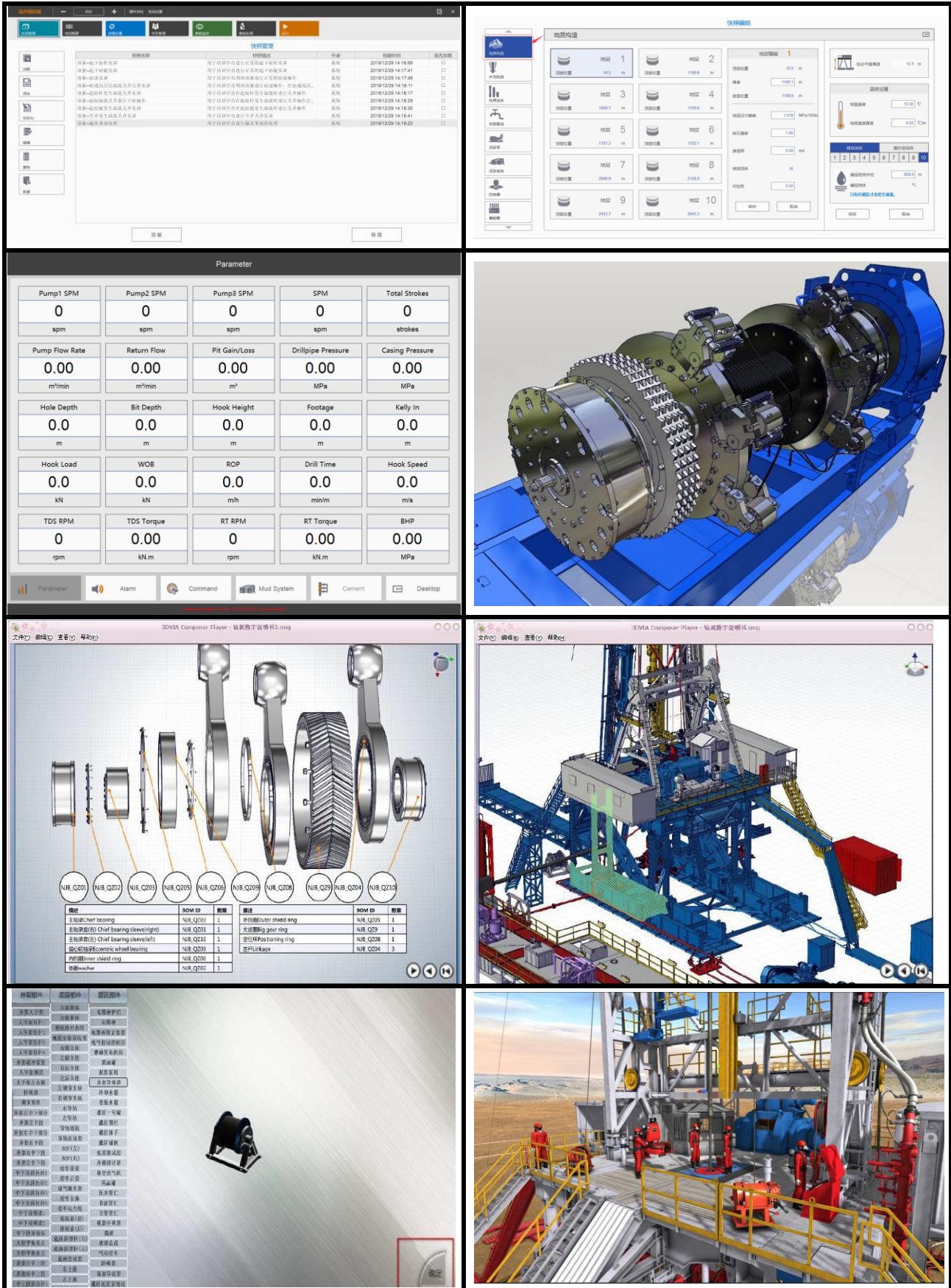
(4) Relative humidity: <90%

5. Program Running Interfaces

Figure 1 Typical program running interfaces