

ESIM-FTD1

Top Drive Simulation Training System

Technical Specification

1. Introduction

Top drive simulation training system is constructed according to advanced training mode and training method, focusing on the cultivation of practical operation ability.

The top drive simulation training system is developed aiming for training the operation of top drive device. It can provide training items of all top drive operation and common accident handling. It can be used for training for driller/ driller assistant, technicians, and drilling team leader. Through training with the system, trainee can master the operation method of top drive and handling skill of common accidents.

The system adopts various mathematical models to simulation the working principle of top drive, reflecting the changing rule of various parameters. Event-driven simulation technology can simulate various operation of the device which make the training closer to reality. Accidents pre-set technology simulating common accidents and device fault, enables instructor to insert the accidents or faults at any time. Trainee then can judge the phenomenon then make correct actions. This improves their skill of judging and handling accidents. Virtual reality technology constructs a perceptual environment; 3D animation synchronic with operation displays the site scene, combining with vivid sound effect. All of those makes up an immersive training environment.

Top drive simulation practice system is composed of a few top drive simulation systems. Each simulation system consists of top drive console, drawworks handle, computer and two touch screens. Top drive console is made according to the top drive produced by Beijing Petroleum Machinery Factory. The controls layout, operation method, parameter display is the same as the real product. Hardware device is constructed by industrial PLC, which ensures the reliability of the system. The system has also the advantage of low input and maintenance cost without security risks.

2. System component

2.1 Major hardware

1. Top drive console is made according to the top drive produced by Beijing Petroleum Machinery Factory. Ti can simulate various operation, co-movement relation and control logic of top drive, including IBOP, turret lock, links rotation, links tilting, clamp, operation select (drill, spin, torque), direction select (CW, stop, CCW), etc.



- Drawworks control handle
 Feature: operation method is the same as real control
 Control top drive device raising and lowering
- 2. Drawworks control is made according to the model of onsite drawworks control.

2.2 System main software

- 1. Device principle multi-media software
- 2. Top drive device control software module
- 3. Sound effect control software module
- 4. System diagnostic module
- 5. Student management and automatic scoring software module
- 6. Top drive-based 3D scene display software module

2.3 System standard configuration

SN	Name	Technical specification	Unit	Q'ty
1	Top drive console	Simulating top drive produced by Beijing Petroleum Machinery Factory	Set	5
2	Drawwoks control handle		Set	5
3	Computer	CPU: i7; memory: 16G; SSD240G; discrete graphic card	Unit	10
4	Monitor	23 inch	Unit	10
5	Displaying system	4K 80 inch LCD screen	Set	1
6	Esimtech top drive simulator master control software	Esimtech	Set	5
7	Esimtech top drive simulator graphic software	Esimtech	Set	5
8	Student table and chair	Special for education	Set	5

3. System function

3.1 Functions and features

1. The system provides conventional top drive operation, such as tripping in and out, drilling, IBOP, top drive making up, top drive breaking out, links rotation, etc. It can also provide training for

common accidents, such as top drive reaming, back reaming, etc.

2. Top drive simulation system simulates the real equipment so that trainees can operate the system without any sequence restriction. The system can reflect any operations students made, just as operating a real top drive.

3. The system has the function of displaying top drive working principle by 3D animation. So that students can understand the working principle and maintenance of top drive better. The animation provides the display of working principle of IBOP, turret, links tilt and rotation structure.

4. The system can simulate accidents and faults. Instructor can insert various top drive faults at any time during exercise. Students can judge the faults through various phenomenon (such as different states of alarms).

5. The system adopts the working mode of step by step. Though it is a non-sequence system before each student, we provide the working mode of step by step. Under this mode, instructor can give lecture of top drive operation procedure step by step to enable students to master top drive operation quickly, such as working process of making up drill stand.

6. The system can simulate various noises of well site. The noise is synchronic with students' operation, working condition and graphic display.

7. The system has automatic scoring function. It can give scores to students' operation, and gives point deduction reason, which makes training fair and just.

8. The system has complete students' information management function.

3.2 Training items

3.2.1 3D animation display of top drive working principle

- 1) Turret lock
- 2) IBOP
- 3) Top drive rotation
- 4) Links tilting
- 3.2.2 Step-by-Step working mode
 - 1) Tripping in
 - 2) Tripping out
 - 3) Top drive making up
 - 4) Top drive breaking out
 - 5) Normal drilling
- 3.2.3 Non-sequence operation mode
 - 1) Tripping in and out
 - 2) Drilling
- 3.2.4 Problem treatment
 - 1) Resistance during trip-out
 - 2) Resistance during trip-in

4. Technical parameters and working environment

4.1 Technical parameters

- 1. Power: 220V/50Hz AC
- 2. Power consumption: <3000W

3. Resolution: 1920*1080

4.2 Working environment

- 1. Area: ≥10*8.5m
- 2. Working temperature: $0^{\circ}C \sim 30^{\circ}C$
- 3. Relative humidity: <90%

5. System whole layout and program interfaces



Figure 1 Top drive simulation lab effect picture

3) reported Management	려도 강 (양 Geology Summary Failure Surting Dischert Hanagement I	Contraction Contraction			
		Snapshot Management			
19	Shapshot Name	Introduction	Author	Creation Time	Is Los
	Top Drive-BOP pressure test	Used to demonstrate the bop installation and test of	System	2019/11/21 14:48:45	
ad	Top Drive-Drilling emergency exercise			2019/11/22 9:52:28	
	Top Drive-Overflow occurs while drilling	Normal drilling, shutting in when overflow occurs durin	System	2019/9/24 14:44:57	
	Top Drive-Overflow occurs while tripping out drilpipe	Tripping out drilpipe and overflow occurs, and shuttin	System	2019/9/24 14:45:04	
NO.	Top Drive-Overflow occurs while tripping out drill collar	Tripping out drill collar and overflow occurs, and shutt	System	2019/9/24 14:45:12	
	Top Drive-Overflow occurs in bareen hole	Tripping drill collar out of well and overflows in baree	System	2019/9/24 14:45:19	
2	Top Drive-Normal drilling	Train normal drilling operation	System	2019/9/24 14:45:33	0
seAs	Top Drive-Normal trip in and out drill collar	Normal tripping in and out drill collar, making up and b	System	2019/9/24 14:45:40	0
	Top Drive-Normal trip in and out drillpipe	Normal tripping in and out drillpipe, making up and br	System	2019/9/24 14:45:49	
2	Top Drive-Leakage handling	Used to train students treatment of leakage accident.	System	2019/9/24 10:35:20	
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Figure2 Master control software interface

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					Sr	apshot Edit		
	Geology							
Centrapy						Formation Edit 1		
an a	Fi Fi	ormation 1		Formation	2		Drill Floor Height 35.0 1	
1	Тор	35.0 R	Top	3937.0		Top 35.0 ft	• 12 11	
Vielbore Geometry						Thickness 3902.0 #		_
Drilling Assembly	E Fo	ormation 3	5	Formation	4	Bottom 3937.0 tt	Temperature	
T.	Top	5577.0 R	Top	5580.0		Exemption Descente	Surface remperature 00:0	,
Surface Lines		5		Formation	6	Gradient 0.450 point	Geothermal Gradient 0.03	
~		simation ()	-	Pormation	0	Rock Strength 1.80		
Pump	Top	5582.0 11	Top	5585.0		Permeability 0.00 md	Select Reservoir Select Loss Zone	
Mad System	E FO	ormation 7	5	Formation	8	Formation Fluid Water	1 2 3 4 5 6 7 8 9	10
	Top	5600.0 R	Top	6000.0			Drainage Radius 2000.0	8
-						Abrasion Factor 0.00	Formation Fluid Gas	
BOP	E FO	ormation 9		Formation	10		Overflow only occurs in reservoir.	
Accumulator	Top	7000.0 tt	Top	9000.0		Save Cancel	Save	

Figure 3 Software running interface



Figure 4 Graphic program running interface



Figure 5 Working principle display