Chengdu Esimtech Petroleum Equipment Simulation Technology Co., Ltd.

ESIM-FGR3

Gas Production Simulation Training System

Technical Specification

1. Introduction

The gas production simulation training system is designed by Southwest Petroleum University and Chengdu Esimtech Petroleum Equipment Simulation Technology Exploitation Co, Ltd. It is an advanced and fully functional system that satisfies oilfield training.

The gas production simulation training system is a combination of petroleum engineering, computer technology, virtual reality technology, and computer simulation. It can enable students to master the inner structure of various gas production equipment and its working theories, typical stations and process. It provides various layers of training, which satisfies the training requirement of primary workers, intermediate workers, senior workers, technicians and senior technicians. The training provided by this system make the students theories of various gas production devices and usage, as well as the method of treating common accidents.

The system adopts "flow coupling" to calculate the pressure, flow rate and temperature in the pipe. Advanced mathematical model makes the training more immersive. Common accidents and device fault can be set at anytime by the instructor with the use of accident preset technology. The displaying system with large size screen presents the whole process clearly, which make the training more effective by saving time and strengthening the students' understanding.

This system consists of gas production simulation platform, graphics system and other accessory software. The consoles of this system are the same as the real equipment. The pipes are made by metal which are sturdy and durable. The panels, operations and parameter displaying are also the same as the real equipment. Hardware system is designed according to industrial standard. Data acquisition and control system adopts PLC which ensures the reliability of the system. This system has low input and maintenance input. All data acquisition is completed by sensors. There is no actual fluid within the devices, no security risks of high pressure or poisonous materials.

Figure 1 The training site

2. System Component

2.1 Major Hardware

Hardware system layout is as shown in figure 2.

Figure 1 System hardware framework

The gas production well training platform is composed of three gas wells respectively used for

flowing production, ESP drainage production, plunger drainage production. Gas gathering training platform contains the emptying manifold, antifreeze device, high pressure entrance valve group, heating furnace, production separator, metering separator, choke, pipeline pig, orifice flowmeter, water separator unit; Methanol pump rom training platform includes methanol storage tank, methanol pump. Installation and maintenance training platform contains installation and maintenance operation console, as shown in figure 3.
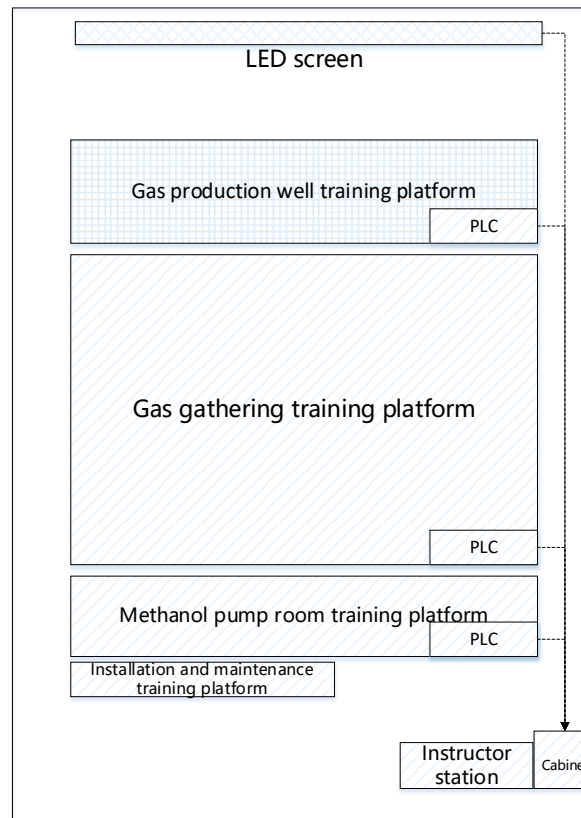

Figure 2 Typical device layout

1.   Gas production well training platform

    Gas production well training platform is mainly composed of plunger dewater gas production well and electrical submersible dewater gas production well. The valves on gas well are modified on the basis of real valves, with sensors inside. The operation of the valves is the same as real device. Meters are controlled by master control computer at real time. The reading of the meters is linked with students' operation.
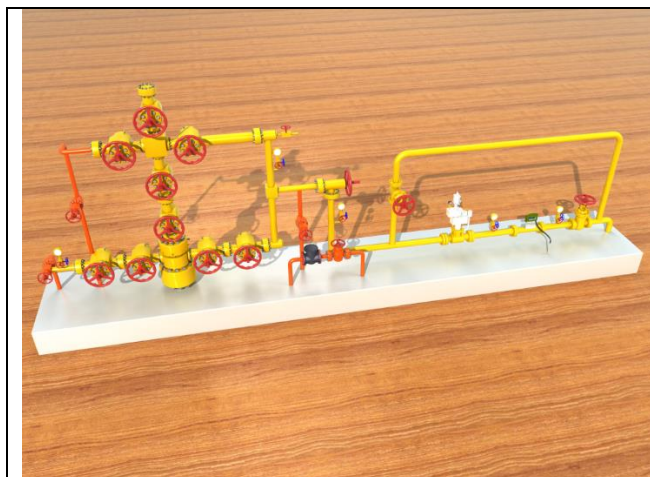
Standard flowing well

The gas well is made of mall metal. It is designed by scale according to the onsite typical structure, including the main body of the Christmas tree, 11 main valves, 1 regulating valve, 5 pressure meters, 1 sampling valve, 1 flowing meter and 4 methanol pipeline valves.
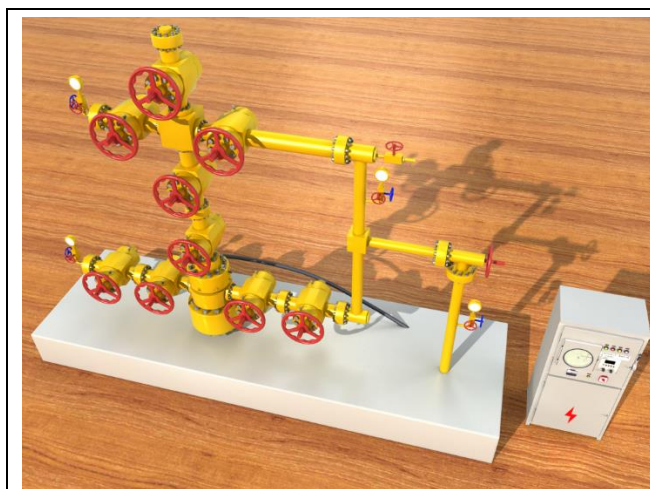
ESP drainage production well

The gas well is made of mall metal. It is designed by scale according to the onsite typical structure, including the main body of the Christmas tree, 9 main valves, 1 regulating valve, 4 pressure meters and 1 sampling valve.
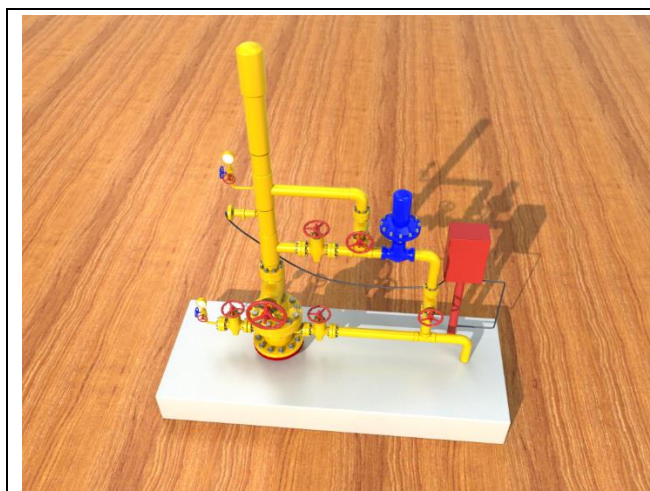

Plunger drainage production well

Made of mall metal. It is designed by scale according to the onsite typical structure, including the main body of the plunger drainage Christmas tree, 1 main valve, 5 auxiliary valves, 1 regulating valve and 2 pressure meters.

2. Gas gathering station training platform

Gas gathering station training platform is mainly composed of different process modules, such as high-pressure incoming area, water jacket furnace, 1st throttling area, production separator, etc. The valves on the modules are modified on the basis of real valves, with sensors inside. The operation of the valves is the same as real device. Meters are controlled by master control computer at real time. The readings of the meters are linked with students' operation.
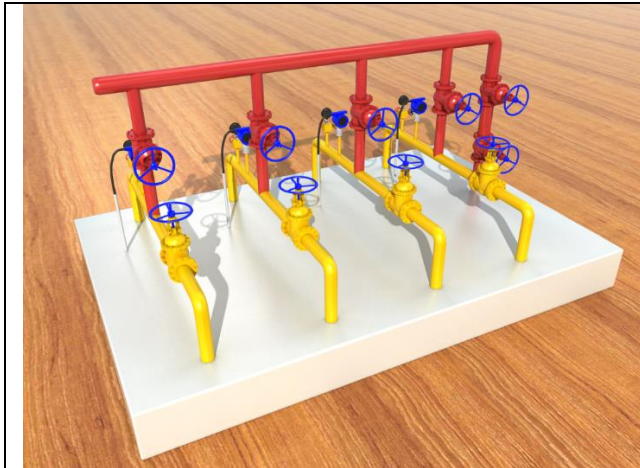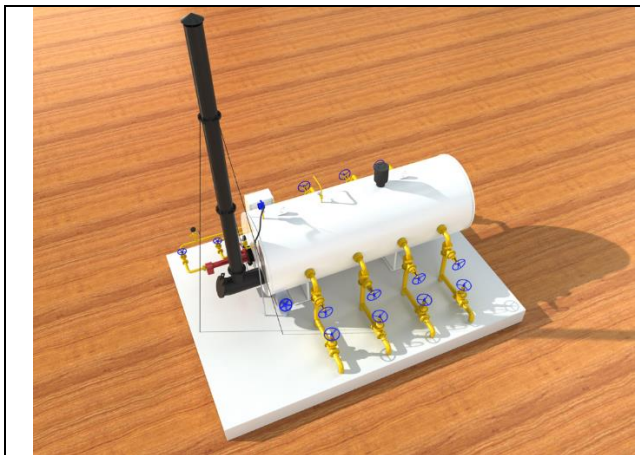
**High pressure incoming area**

All metal structure;

It is designed according to the real site device by scale, supporting four wells flowing to the station, with emptying pipeline, including pipeline, 10 valves, 4 pressure meters and 3 flow indicator.


Water jacket furnace

With four incoming and four outgoing pipes and bypass line. Made of metal, designed according to typical structure by scale on real site. The dimension of the furnace is designed and processed according to the installation environment, including water-jacket heating furnace body, pipeline, 8 valves, 4 bypass valves and an igniter valve.
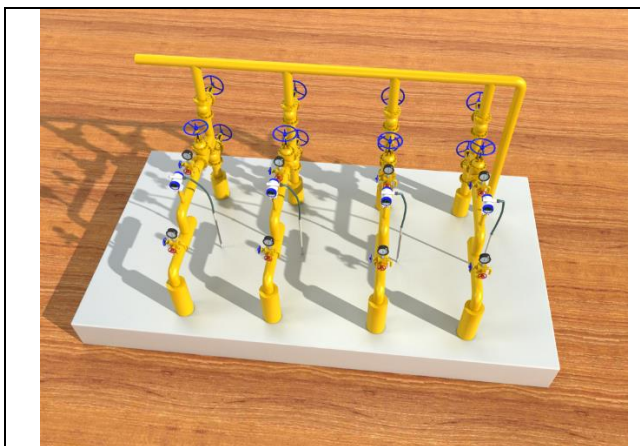
1st throttling area

Four-channel throttling area. Made of metal, designed according to typical structure by scale on real site, including pipeline, 12 main valves, 4 pressure meters before pressure regulating, 4 pressure meters after pressure regulating, and 4 flow indicators.
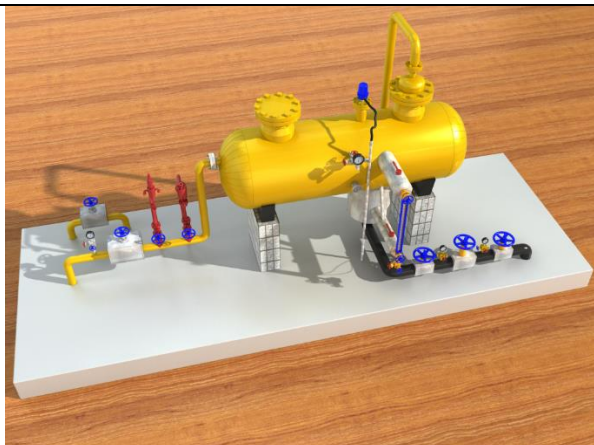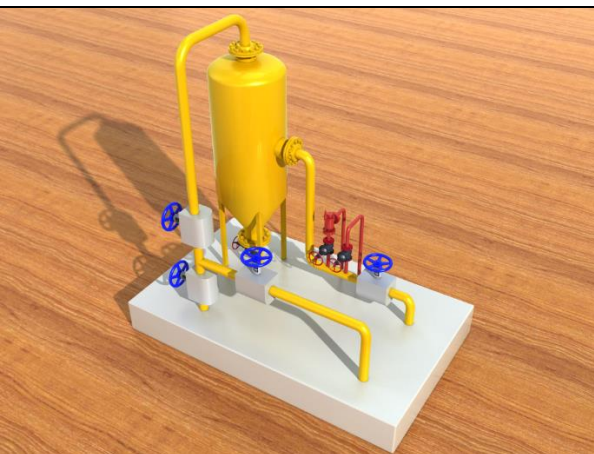
Production separator

Made of metal, designed according to typical structure by scale on real site, including the tank body, pipeline, one inlet valve, one outlet valve, two drainage valve, one drainage pressure regulating valve, 4 pressure meters, 1 level indicator and 2 high pressure emptying pipelines (manual and automatic).
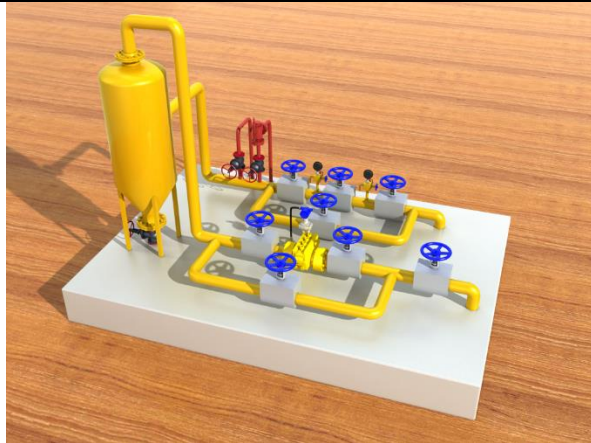

Metering separator

With bypass pipes. Made of metal, designed according to typical structure by scale on real site including the tank body, pipeline, one inlet valve, one outlet valve, two drainage valve, one drainage pressure regulating valve, 4 pressure meters, 1 level indicator, 2 high pressure emptying pipelines (manual and automatic) and outflow indicator.
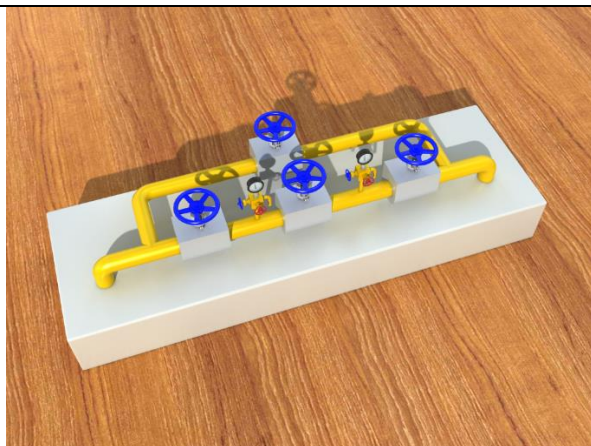

Cyclone separator

With vent pipes and bypass valve. Made of metal, designed according to typical structure by scale on real site including one inlet valve, two outlet valves, one bypass valve and 2 high pressure emptying pipelines (manual and automatic).

Water separator and gas storage unit

With metering lines and vent pipes. Made of metal, designed according to typical structure by scale on real site, including 2 inlet valves, 1 outlet regulating valve, 1 inlet bypass valve, 2 high pressure emptying pipelines (manual and automatic), out flow indicator, 3 outlet valves and 1 outlet bypass valve.
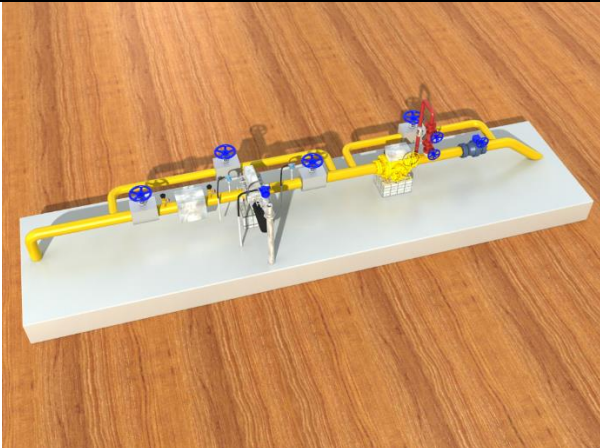

2nd throttling area

Made of metal, designed according to typical structure by scale on real site, including 1 inlet valve, 1 outlet valve, 1 pressure regulating valve, 1 bypass valve, 1 inlet pressure meter and 1 outlet pressure meter.
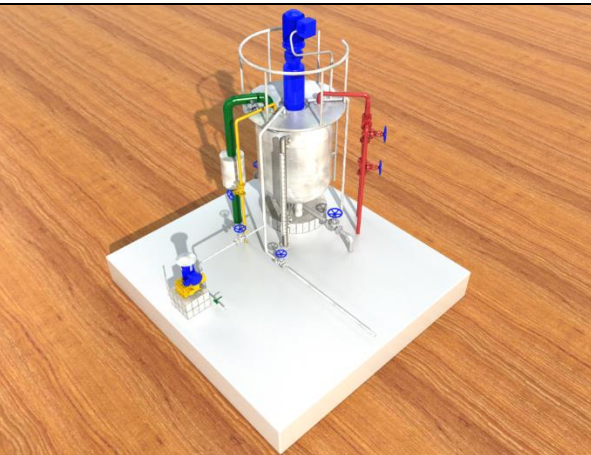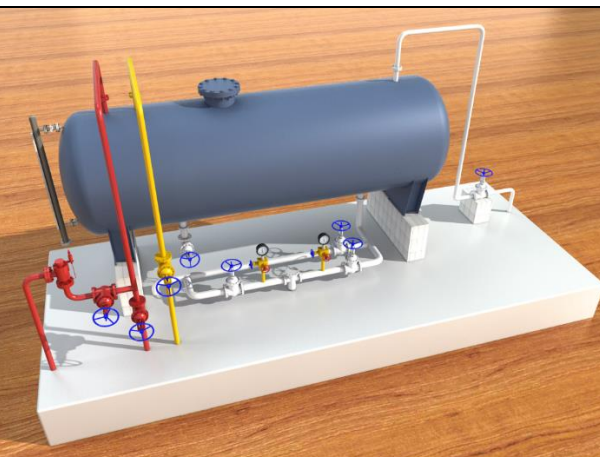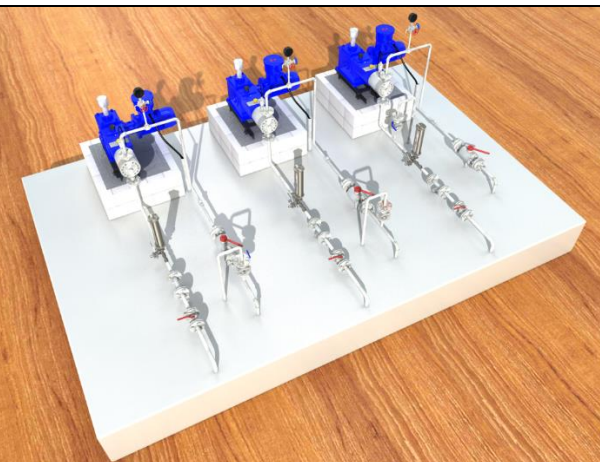

Dosing tank

Methanol and foaming agent mixing tank. Designed according to typical structure by scale on real site, including tank body, level indicator, inlet valve, outlet valve, emptying pipeline and booster line.

Outgoing valves

With metering, pig valve, and filter. Designed according to typical structure by scale on real site, including 1 inlet valve, 1 pressure regulating valve, 1 orifice flowmeter, 2 thermometers, 2 pressure meters, 1 flowing indicator bypass valve, 1 pig sending valve, 1 outgoing valve, 1 pig sending bypass valve, 1 high pressure emptying pipeline.

3. Methanol pump section training platform

Methanol storage tank

With vent line, natural gas boosting line and liquid level gauge. Made of metal, designed according to typical structure by scale on real site. This device is designed according to the size of real equipment; it can also be customized according to different region and technology.

Methanol pump

Three groups of metering pumps. Designed according to typical structure by scale on real site. Each group contains inlet valves, outlet valves and bypass valves.

4. Installation and maintenance training platform

Installation and maintenance operation console

This console is used for the primary workers to install and maintain. The console is made of real physical devices, including gate valves, pressure valves, orifice flowmeters and safety valves.

4. Display system adopts LED screen display.

Large size LED screen full color display system
◆ The 3D animation is displayed on a LED screen after processed by professional graphic processor.
◆ LED P2.5 screen; Resolution: 1920*960
◆ 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 Gas production simulator process software

(1) Software framework module

(2) Interface controlling module

(3) Fluid calculating software module

(4) Device controlling software module

(5) Accidents and troubles software module

(6) Sound effect controlling module software

(7) System diagnostic module

2.2.2 Esimtech gas production simulator graphics software

(1) 2D flow control module

(2) 3D flow control module

(3) Equipment control module

3. System configuration

SN	Name		Unit	Q'ty
1	Gas well wellhead console	Standard flowing production well wellhead	Unit	1
2		Simple flowing production well	Unit	1
3		Plunger drainage production well wellhead	Unit	1
4		ESP production well wellhead	Unit	1
5	Gas-gathering station module	Emptying manifold	Unit	1
6		Antifreezer unit	Unit	1
7		High pressure inlet valve group	Unit	1
8		Furnace	Unit	1
9		Metering seperator	Unit	1
10		Pipe pig	Unit	1
11		Orifice flowmeter	Unit	1
12		Water separator unit	Unit	1
13		Foaming unit	Unit	1
14		1st and 2nd throttling	Set	1
15	Intallation and maintenance training platform		Set	1
16	Instructor station		Unit	1
17	Master control computer		Unit	1
18	Graphic computer		Unit	1
19	Printer		Unit	1
20	Sound effect system		Set	1
21	Computer cabinet		Set	1
22	Large size LED screen		Set	1
23	Esimtech gas production simulation training system master control software		Set	1
24	Esimtech gas production simulation training system process software		Set	1
25	Esimtech gas production simulation training system graphics software		Set	1

4. System Function

4.1 Function and Feature

(1) This system is designed according to the real equipment, that is, the appearance, the connection of the pipes and operation methods are the same as the real equipment.

(2) This system can calculate the parameters according to the students' operation, such as the working condition and pipe pressure.

(3) 3D animation simulates the visual environment. The animation of the system can display the downhole condition, device motion and working theories of various devices.

(4) The system can simulate the real site noises. The sound complies with the students' operation, working condition and graphics.

(5) Accident setting can enable students to observe the causation of accident directly and master the handling of common accidents.

(6) The system has adjustable gas well parameter (pressure, temperature, flow).

(7) The system has completed expandable function.

4.2 Training Projects

(1) Flowing well startup and shutting in

(2) Plunger pump dewatering well startup and shutting in

(3) Electrical submersible pump dewatering startup and shutting in

(4) Treatment of natural gas leaking

(5) Injecting anti-freezer

(6) Natural gas venting operation

(7) Starting and shut down furnace

(8) Gas well single well metering

(9) Natural gas dehydrating operation

(10) Pig receiving and launching operation (Optional; hardware increasing is needed)

5. Technical Parameters and Operational Environment

5.1 Technical Parameters

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

(2) Power consumption: <6000W

5.2 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%

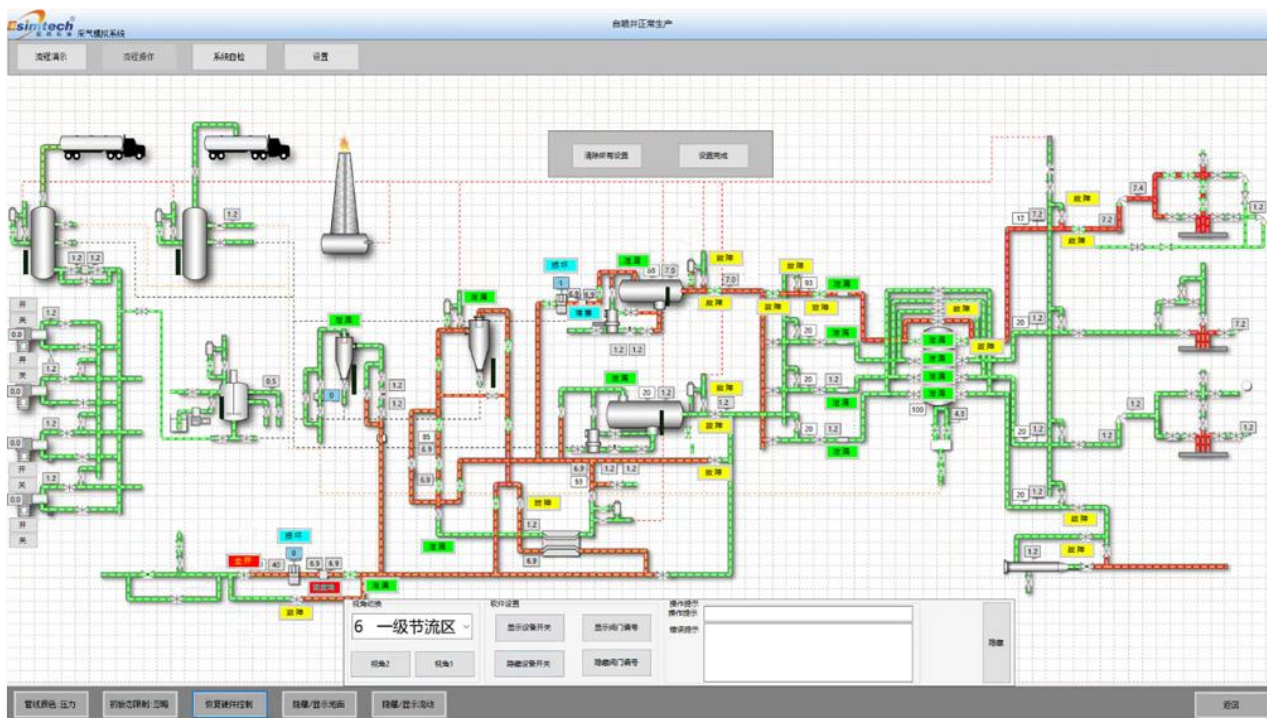# 6. System Layout and Program Interface
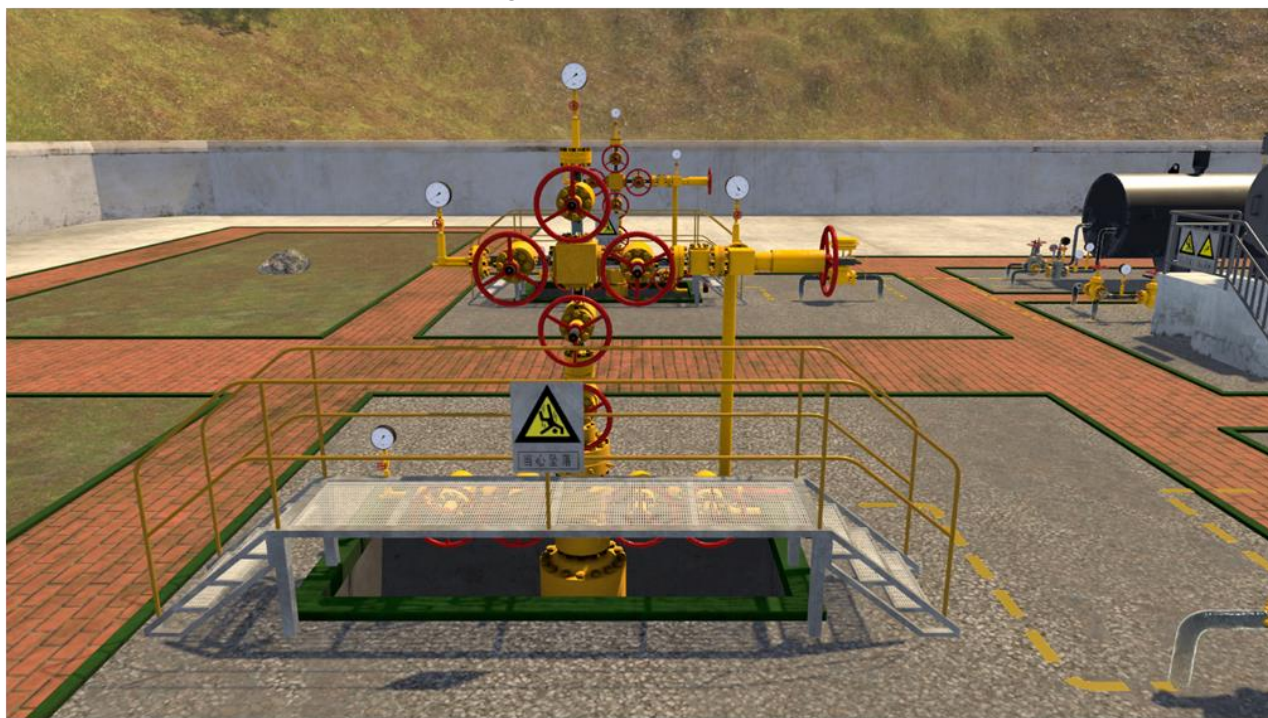

Figure 3 Master control interface

Figure 4 Graphics program running interface 1

Figure 5 Graphics program running interface 2