KERUI PETROLEUM TECHNOLOGY

Integrated Services for Oilfield Production, Operations and Maintenance

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Contents

Digital Reservoir Technology

By taking single well, well group and reservoir unit as objects, data fusion is carried out to form unified achievement data resource and provide service for comprehensive application of reservoir.

Existing Problems and Sources

- Historical Data Digitization and Data Governance
- Cross-disciplinary Data and Outcome Integration
- Establish Unified Data Support Services
- Improve the Quality of Newly Acquired Data
- Incorporate Unstructured Data into Management

Improved Data Availability

Break Down Data Silos

Reduce Human Error

Reduce the Risk of Data Loss

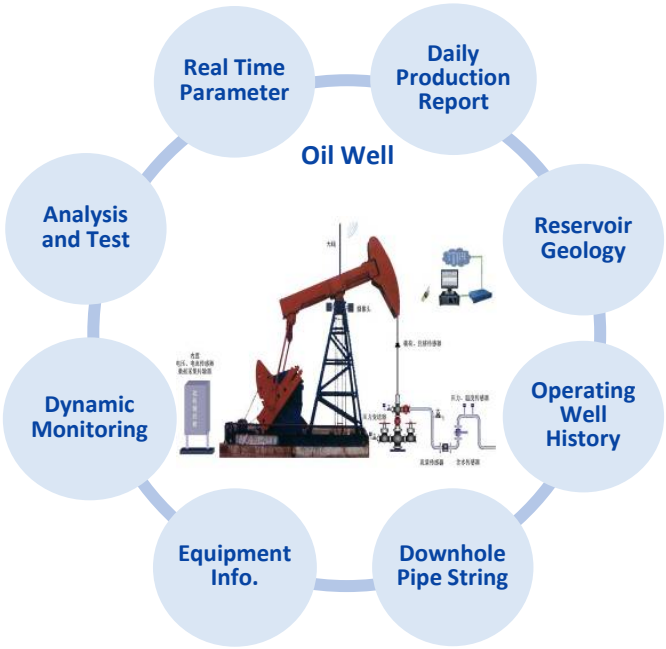
Improve Decision-making Efficiency

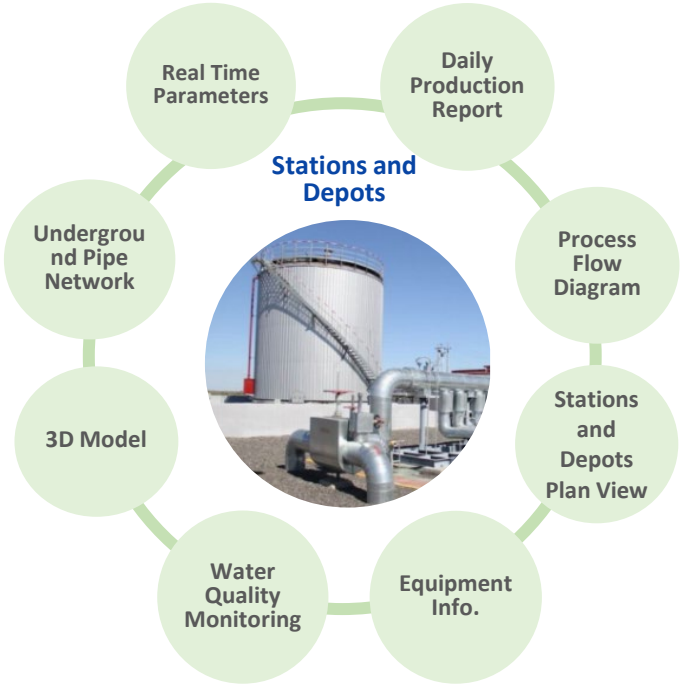
Support for Smart Applications

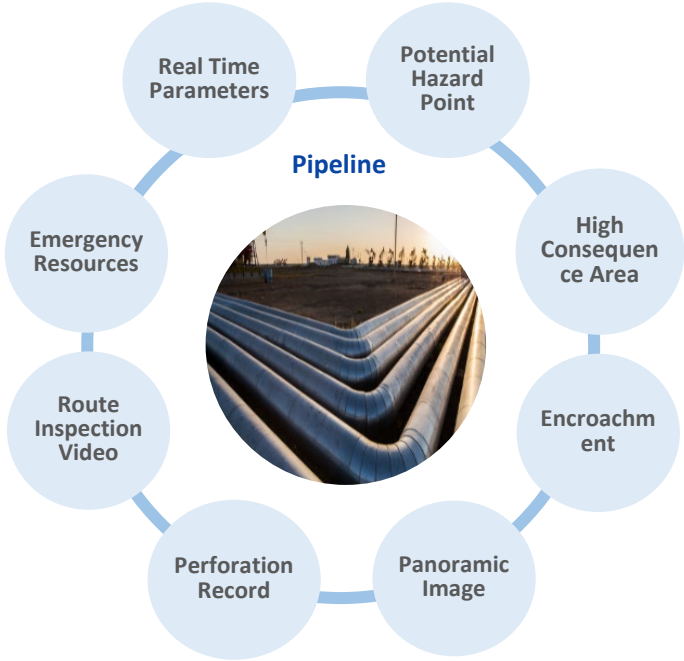
Reservoir Analysis and Management	Integrated Geological Study	Release of Original Data and Results	Professional Software Data Interface and Auxiliary Analysis		
Injection-Production Correspondence Rate Statistical System	Single-Well Comprehensive Analysis	Geological and Development Data Query and Visualization	Cyclolog	Forward	SMT
Reservoir Dynamic Analysis Software	Cycle Analysis and Basal Comparison	Integrated Research and Knowledge Output Publication	Jason	Petel	Eclipse
……	……	……	OFM	……	

Oilfield Digital Twin

Focusing on wellhead management and integrating real-time on-site data collection, the system facilitates the integraton and application of real-time operational data, static attribute data, process flow diagram data, and spatial topology information for key oilfield production nodes.







Deepoil Production Command System

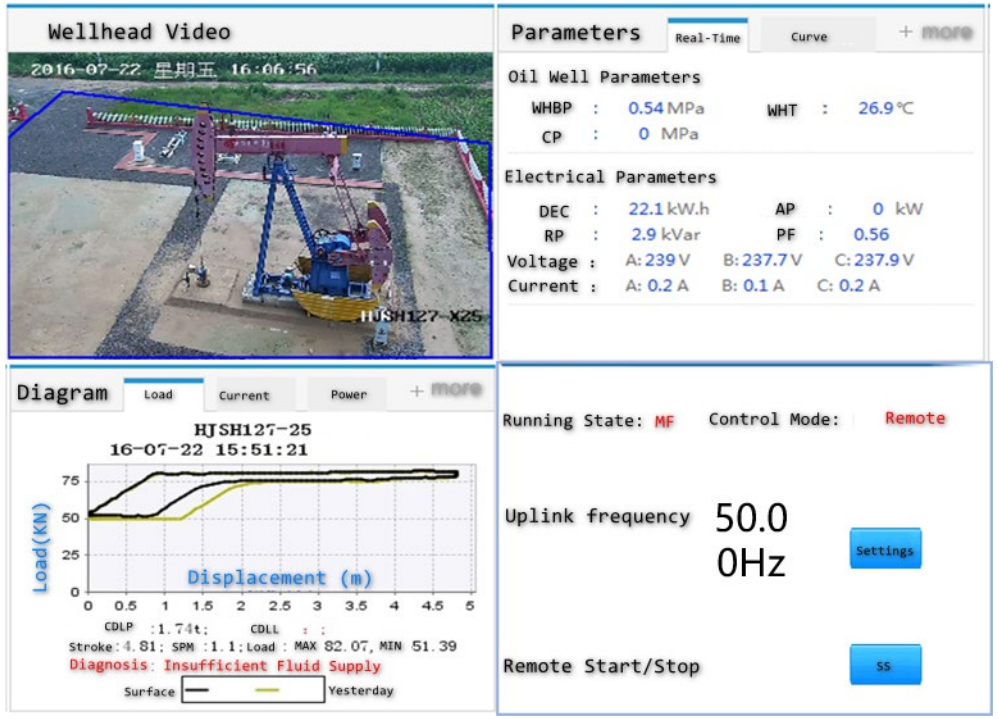
Leveraging front-end data acquisition, real-time video monitoring, SCADA-enabled automated control, and industrial Ethernet networks, the system enables end-to-end digital management of oil and gas production, covering real-time surveillance, remote operation, interdepartment collaboration, and intelligent decision-making. Applicable to onshore and offshore reservoirs as well as unconventional production sites, the command system sets a new standard for smart oilfield operations.

Function Modules	Production Monitoring	Alarm and Warning	Production Dynamics	Scheduling Operation	Production Management	Emergency Response
Sub Modules	Oil Extraction Monitoring	Oil Extraction Alarm and Warning	Oil Extraction Dynamic	Dispatch Online	Oil Extraction Management	Incident handling
	Gas Extraction Monitoring	Gas Extraction Alarm and Warning	Gas Extraction Dynamic	Dispatch Meeting	Gas Extraction Management	Emergency plan
	Water Injection Monitoring	Water injection Alarm and Warning	Water Injection Dynamic	Key Work	Water Injection Management	Emergency Process
	Gathering and Transportation Monitoring	Gathering and Transportation Alarm and Warning	Gathering and Transportation Dynamic	Report Management	Gathering and Transportation Management	Emergency Specialist
	Marine Monitoring		Offshore Dynamic	Planning Management	Development Management	Emergency Team
	Patrol Monitoring		Workover Dynamic	Data Management		Emergency Supplies
			New well Dynamic	Vehicle Operation		
			Electricity dynamic			
Functions	42	31	39	20	41	15

The oil and gas production command system includes **6 major functional modules** such as production monitoring, alarm and early warning, along with **36 sub-modules and 188 business functions**, comprehensively covering the production management business of oil and gas fields.

Production Monitoring Module 01

The production monitoring module includes 7 sub-modules, such as oil production monitoring and gas production monitoring, covering 42 business functions . Relying on front-end intelligent instrument and video devices, the system enables real-time parameter monitoring, video surveillance of the production site and remote control of key equipment.

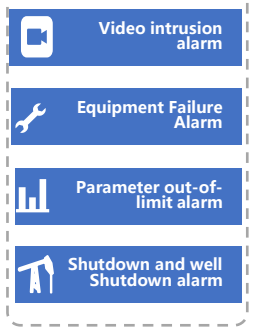


Early Warning and Alarm Module 02

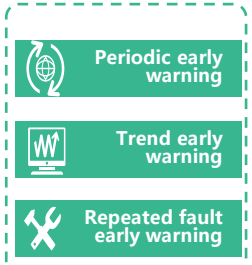
The early warning and alarm module includes 4 sub-modules and 31 business functions, including oil production and gas production early warning and alarm. By configuring parameter thresholds and building early warning mechanisams, the system enables real-time alerts and proactive warnings for abnormal conditions.

Threshold Configuration

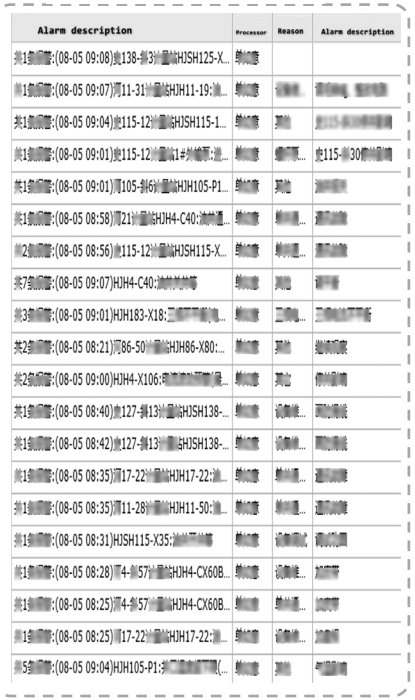
Class IV Alarms



Class III Warnings

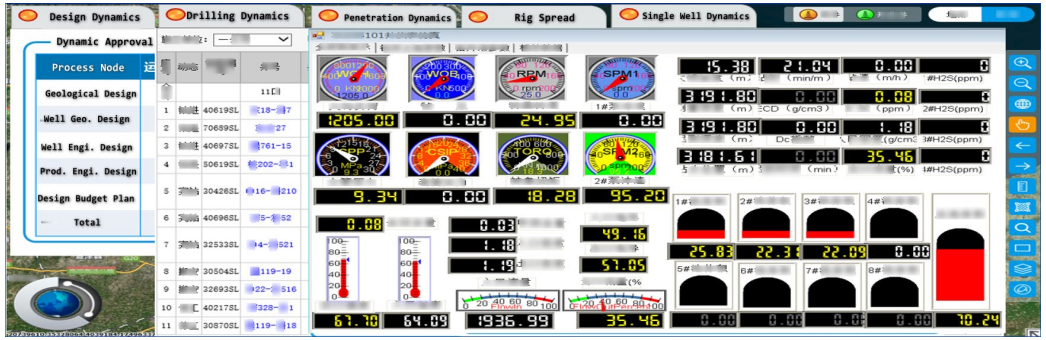


Alarm Handling



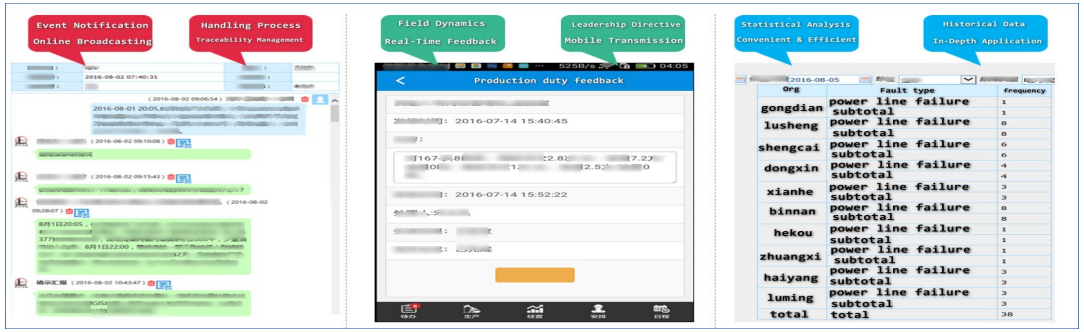
Production Dynamic Module 03

The production dynamics module includes 8 sub-modules and 39 business functions, such as oil production, oil and gas gathering and transportation, operation and construction. It enables the automatic collection of various data throughout the production process, the generation of index summaries, and the visual representation of graphs.



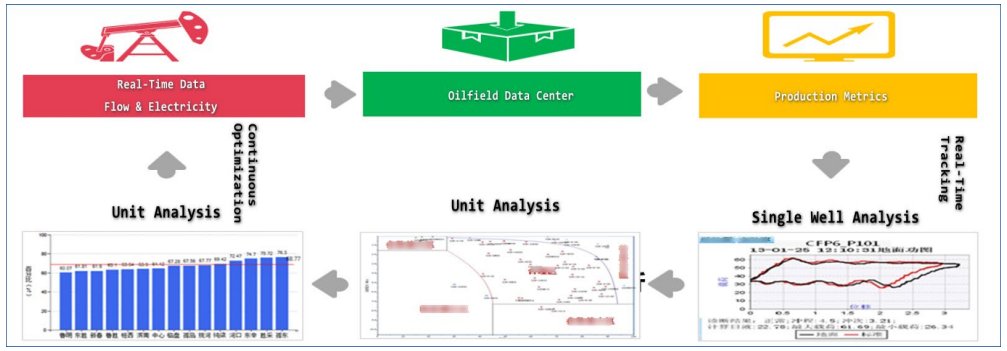
Dispatch Operation Module 04

The dispatch operation module includes 7 sub-modules and 20 business functions, such as online and production meetings. It enables the online operation of production scheduling, management and control of key workflows, automatic push of production information, real-time sharing of scheduling information, and statistical analysis of operation efficiency.



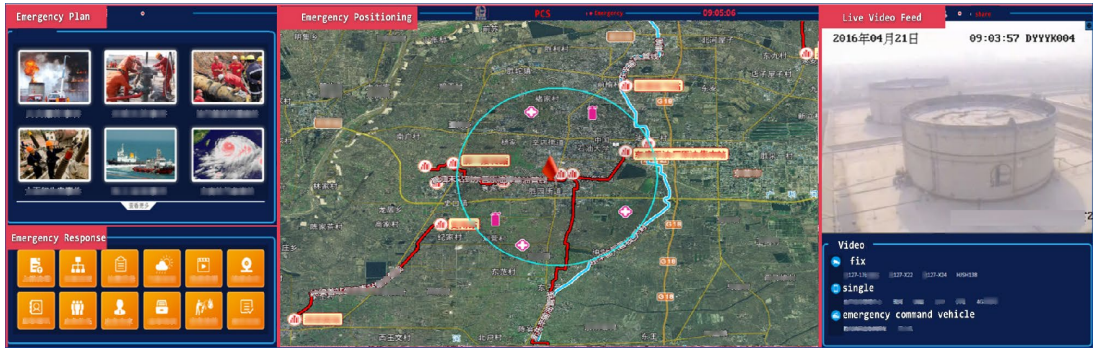
Production Management Module 05

The Production management module includes 41 business functions in 5 sub-modules, such as oil production management and development management. By real-time tracking, dynamic analysis and optimization of key production technical indicators, the analysis provides analytical tools for specialized management.



Emergency Response Module 06

The emergency response module includes 5 sub-modules, such as emergency planning and emergency experts. It quickly locates the accident site and surrounding environment, enablizing emergency scenes and standardized response procedures.



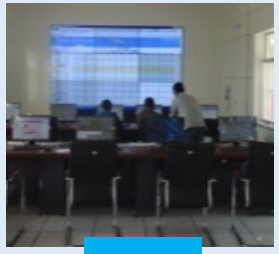
Application Outcomes and Case Studies

In major oilfield enterprises in China, the oil and gas production command system has been implemented, covering 55 oil and gas production plants and 242 management areas. Nearly 45,000 wells and over 2,200 stations and storage facilities are monitored.

Manually opening and shutdown

Before

Remote automatic well opening and shutdown



After

Manually Measurement

Before

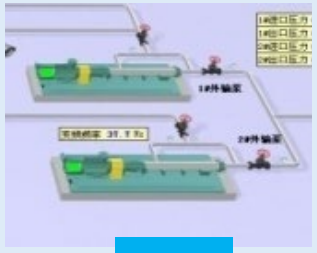
Remote Data Collection

After

Manually Adjustment

Before

Remote Control



After

Oil Content Measurement via Separator

Before

Diagram Metering Indicator

After

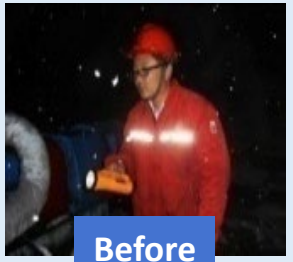
Human Patrol

Before

Electronic Monitoring

After

Manually Ignition



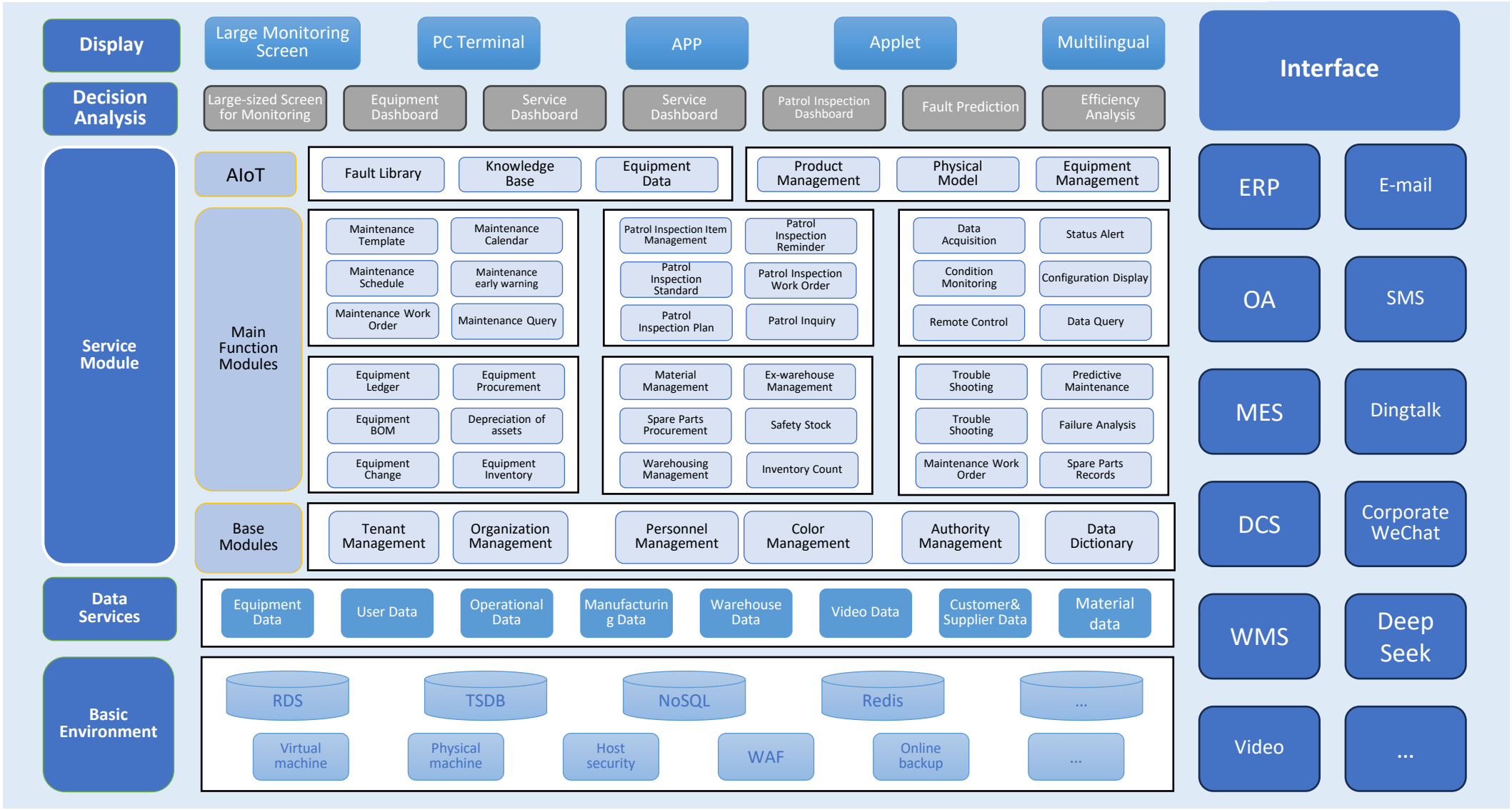
Before

Remote Ignition

After

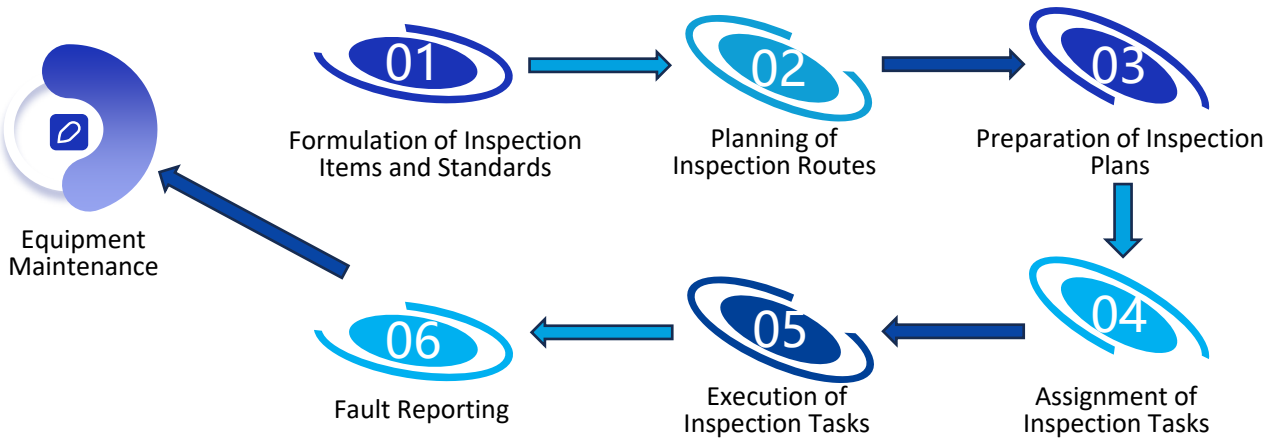
ZHY Oil Production Area: workforce reduced from 2,212 to 911, optimizing 1,301 positions. Wells managed per capita rose from 0.56 to 1.36 (↑143%), and per capita oil & gas output increased from 1,547 to 3,752 bbl (↑2,205 bbl).

Deepoil Intelligent Platform for Equipment Operation and Maintenance



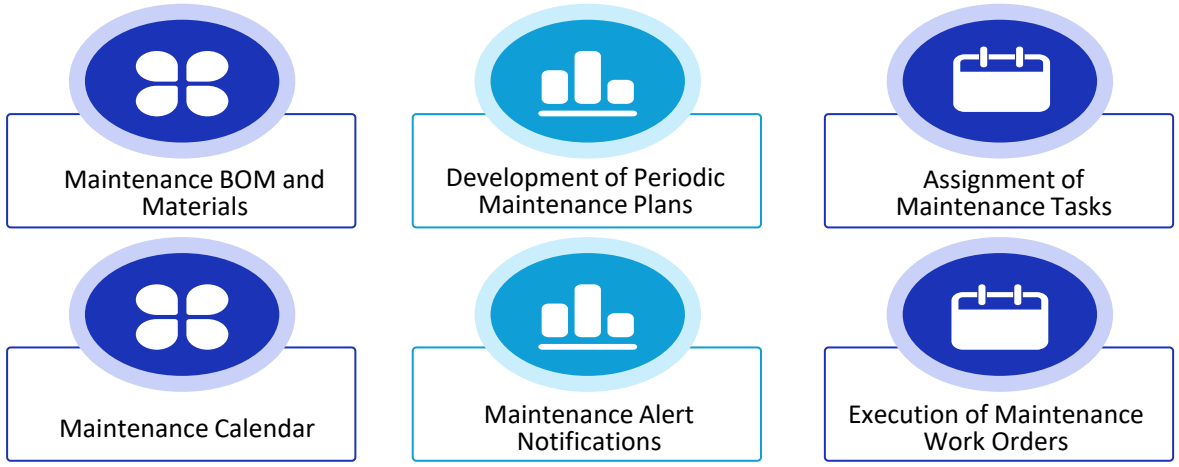
Deepoil Intelligent Platform for Equipment Operation and Maintenance

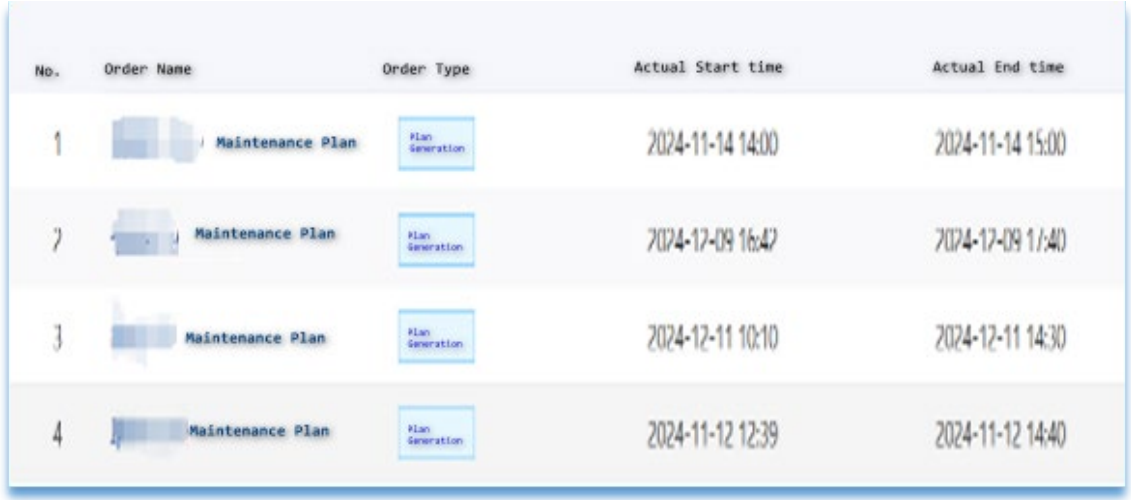
Intelligent Patrol Inspection and Maintenance Function



No	Order Name	Order Type	Order Owner	Status	Actual inspection time
1	[redacted]	Inspection	[redacted]	[redacted]	2025-03-21 07:00
2	[redacted]	Inspection	[redacted]	[redacted]	2025-03-21 08:01
3	[redacted]	Inspection	[redacted]	[redacted]	2025-03-21 07:03
4	[redacted]	Inspection	[redacted]	[redacted]	2025-03-21 07:17

Maintenance Management Function





No.	Order Name	Order Type	Actual Start time	Actual End time
1	[redacted]	Maintenance Plan	2024-11-14 14:00	2024-11-14 15:00
2	[redacted]	Maintenance Plan	2024-12-09 16:42	2024-12-09 17:40
3	[redacted]	Maintenance Plan	2024-12-11 10:10	2024-12-11 14:30
4	[redacted]	Maintenance Plan	2024-11-12 12:39	2024-11-12 14:40

Typical Case

➢ **In 2024, XX Oilfield Services Group launched the DeepOil Intelligent Equipment O&M Platform**

- Enabled full lifecycle management of equipment
- Reduced equipment failures
- Significantly reduced MTTR (Mean Time to Repair)
- Notably increased inventory turnover rate

✓ **70%** improvement in work order processing efficiency ⬆

✓ **55%** reduction in unplanned downtime ⬇

✓ **70%** improvement in MTTR ⬆

✓ **20%** improvement in OEE ⬆

✓ **30%** reduction in spare parts inventory ⬇

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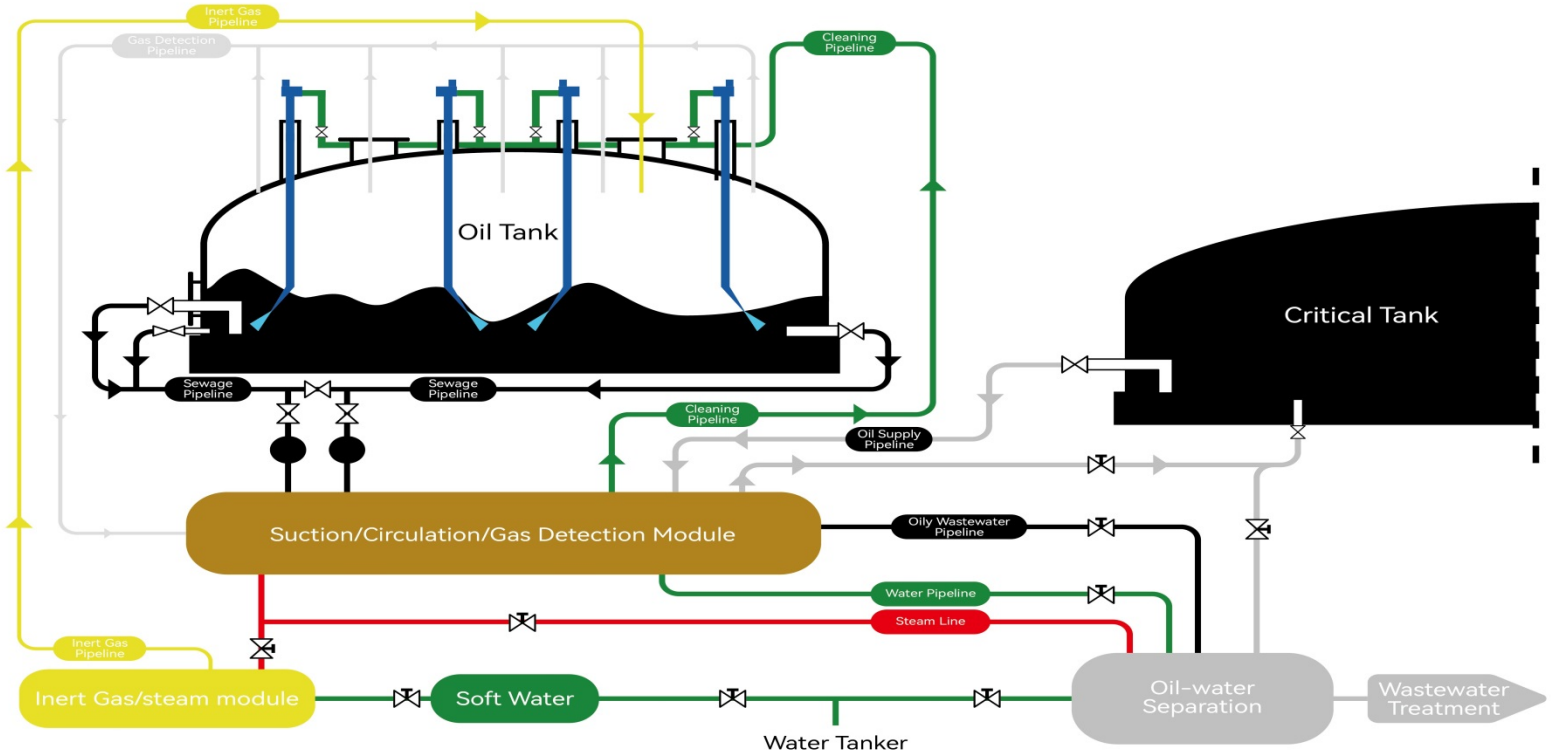
Tank Cleaning and Testing Technology

- **Tank cleaning is aimed to** physically separate oil, water and sand inside the tank, thus meeting the hot work requirement for tank maintenance.
- **The main process equipment for mechanical tank cleaning technology** includes cleaning machine, oil-water separator, nitrogen supply system, etc.



High Efficiency

Recovery of over 95% reusable media

Enhanced Safety

Full-process cleaning under inert gas protection

High Productivity

24/7 continuous operation with advanced automation

Optimal Results

No water or residue left after cleaning. The tank shows its original color, meeting the conditions for hot work.

Tank Cleaning and Testing Technology

Magnetic Flux Leakage (MFL) Detection for Storage Tank Bottom Plates

Floormap 3D:

Quick scanning of regular large bottom plate areas

Handscan:

Rapidly scanning of irregular bottom plate areas such as supports/heating coils

- **Suitable for Automatic Detection**

The signal is acquired by the sensor, and the software automatically analyzes to identify defects.

- **High Reliability**

A computer automatically identifies and alarms defects, reducing the influence of human factors.

- **Quantification of Defects**

The magnetic flux leakage signal has a certain correspondence with the shape and size of the defect.

- **Determine the Degree and Position of Corrosion**

Determine the extent (area and depth) of base plate corrosion and its location.

- **Output of Inspection Results**

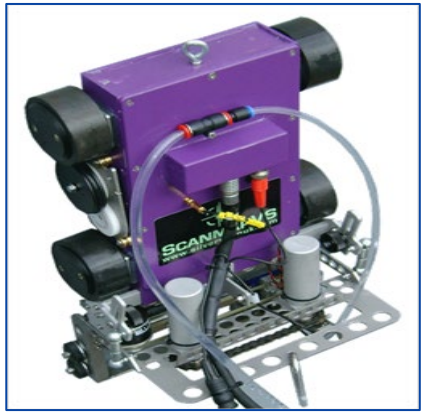
The detection result can be visually observed on a computer screen, and a detection report can also be generated.

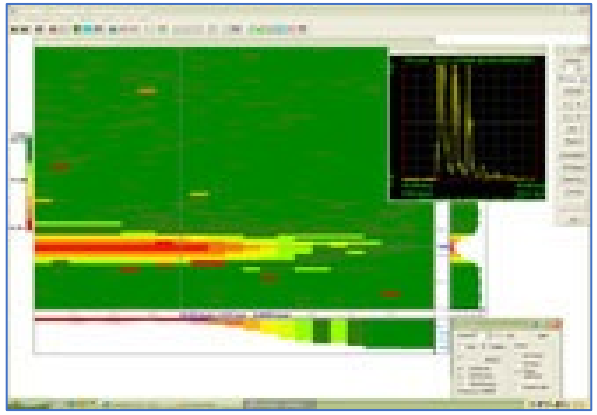
- **High Efficiency and Environmental Protection**

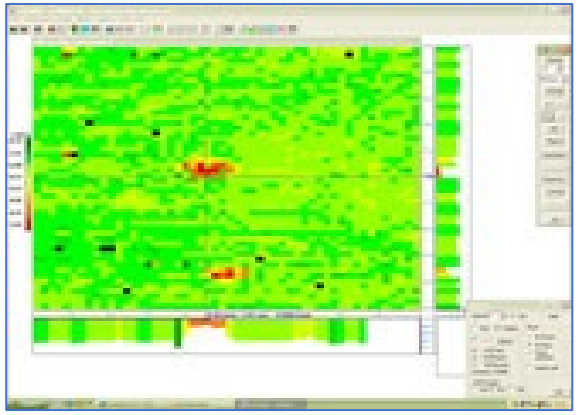
High detection speed and no pollution.

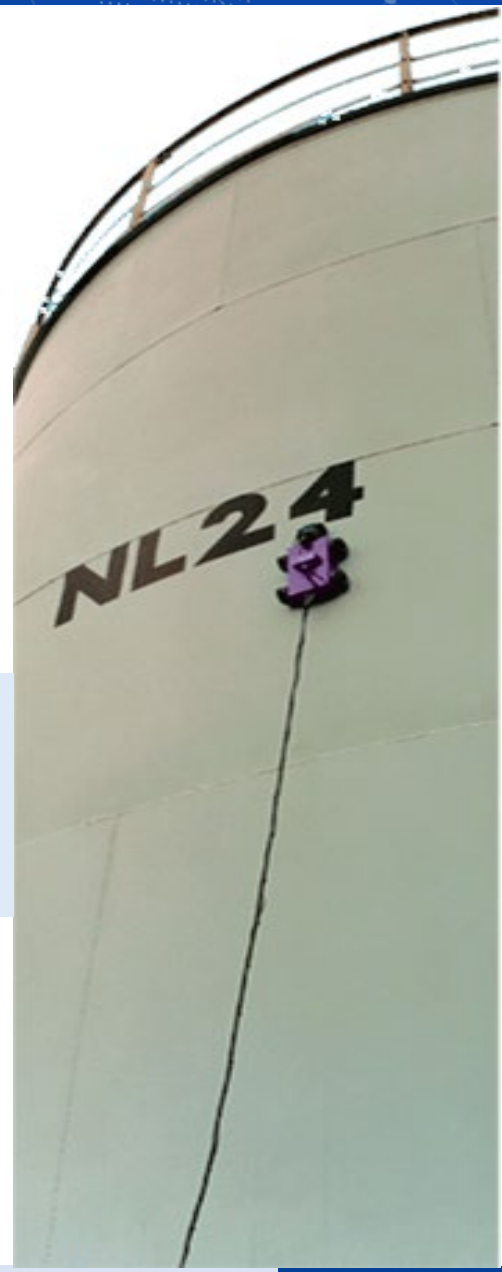
Tank Cleaning and Testing Technology

Wall-Climbing Robot Inspection-Tank Wall Inspection









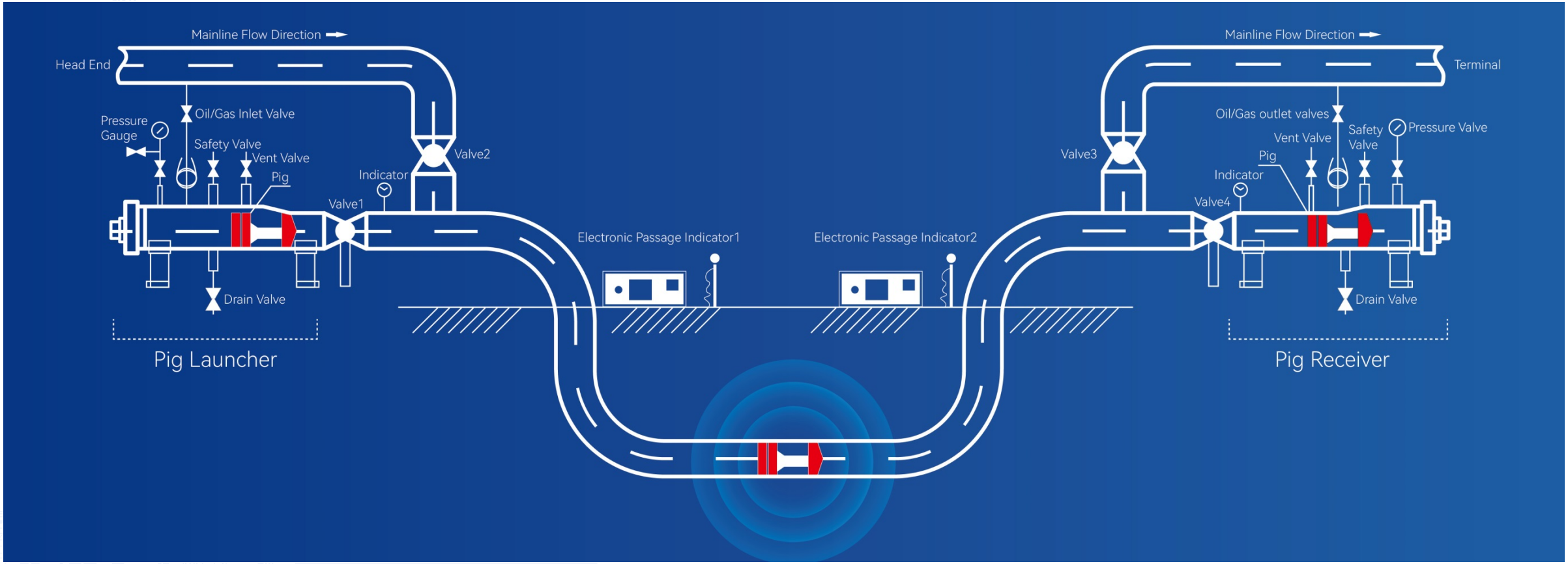
1. Ultrasonic signals are converted into waveforms to determine defect location and size.
2. Detection data is compiled into 2D images, revealing cross-sectional views of internal flaws.
3. The oscilloscope screen displays the horizontal projection of defects on the surface of the tested object.

- ✓ Uses a unique dry-coupled wheel probe, eliminating the need for traditional couplants
- ✓ Climbs vertically, horizontally, and in reverse
- ✓ Scaffolding is not required due to coaxial cable operation

Tank Cleaning and Testing Technology

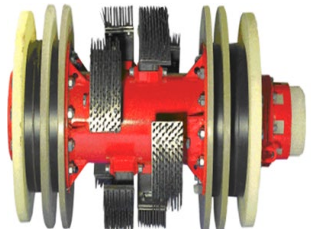
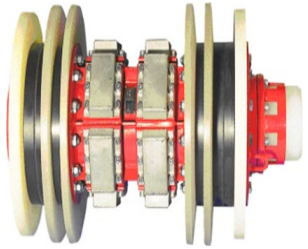
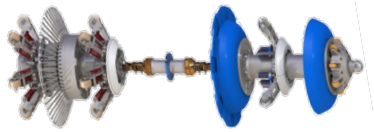
Pipeline Cleaning and Inspection Process

Site Survey → Construction Design → Pigging (Pipeline Cleaning) → Internal Inspection → Report Issuance → Excavation Verification



Tank Cleaning and Testing Technology

Pipeline Cleaning and Inspection Tools

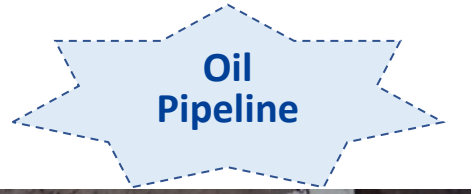
Type of Pig	Foam Pig	Gauging Disc Pig	Steel Brush Pig	Magnetic Pig	Cleaning Tools	Inspection Tools
Suitable Pipe Size	Φ168 mm-1219 mm				6”~ 48”	
Allowable Deformation	40%	25%	25%	25%	/	/
Functional Specifications	Blockage can be shattered under high pressure without interrupting pipeline operation.	The exact location of dents can be identified using the tracking device and process flow.	The steel brush runs along the inner wall, effectively removing impurities from the pipeline.	It efficiently removes most impurities and ferromagnetic materials from the pipeline.	Corrosion of internal and external walls, metal loss defects, cracks, weld anomalies, etc.	Changes in pipe diameter, such as dents and ovality; pipeline features, such as girth welds, elbows, and segment lengths.
Pictures						

Typical Case

Crude Oil Pipeline Inspection Project – Oil Production Plant A, Eastern China

Pipeline: 5 km × 8” (Station 21 to 99)

- Performed cleaning, geometric deformation inspection, and MFL detection
- 34 metal defects detected, met Owner’s requirements



Implementation Effect

- An **integrated pipeline cleaning and inspection service** was provided.
- Cleaning met acceptance standards.
- Defect locations were accurately identified, providing a reliable basis for repair.
- The service was highly recognized by the client.

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Wastewater Treatment Technology

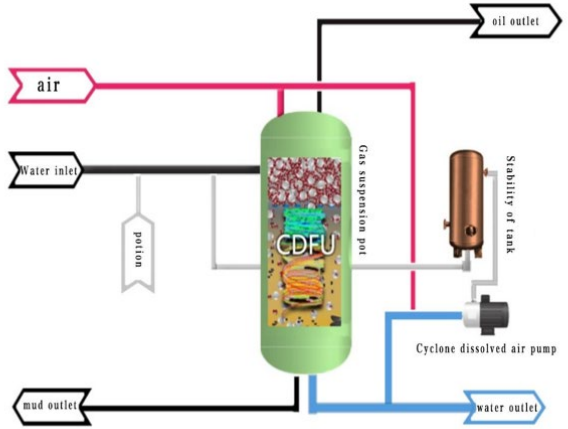
Cyclonic Dissolved Flotation Unit (CDFU)

- Effectively integrating the centrifugal separation technology and dissolved air flotation technology, it is a hybrid apparatus for efficiently separating oil and suspended solids from wastewater.

Technical Features

- The single-stage deoiling efficiency is > 90%, with the **minimum removal particle size ≤ 2 μm**.
- The skid-mounted equipment occupies a small space, with a retention time of only 1 to 5 minutes.
- High stability and efficient technical integration.
- Strong process adaptability.
- Low operation and maintenance cost.
- High level of automation, safe and reliable.

Flow Chart

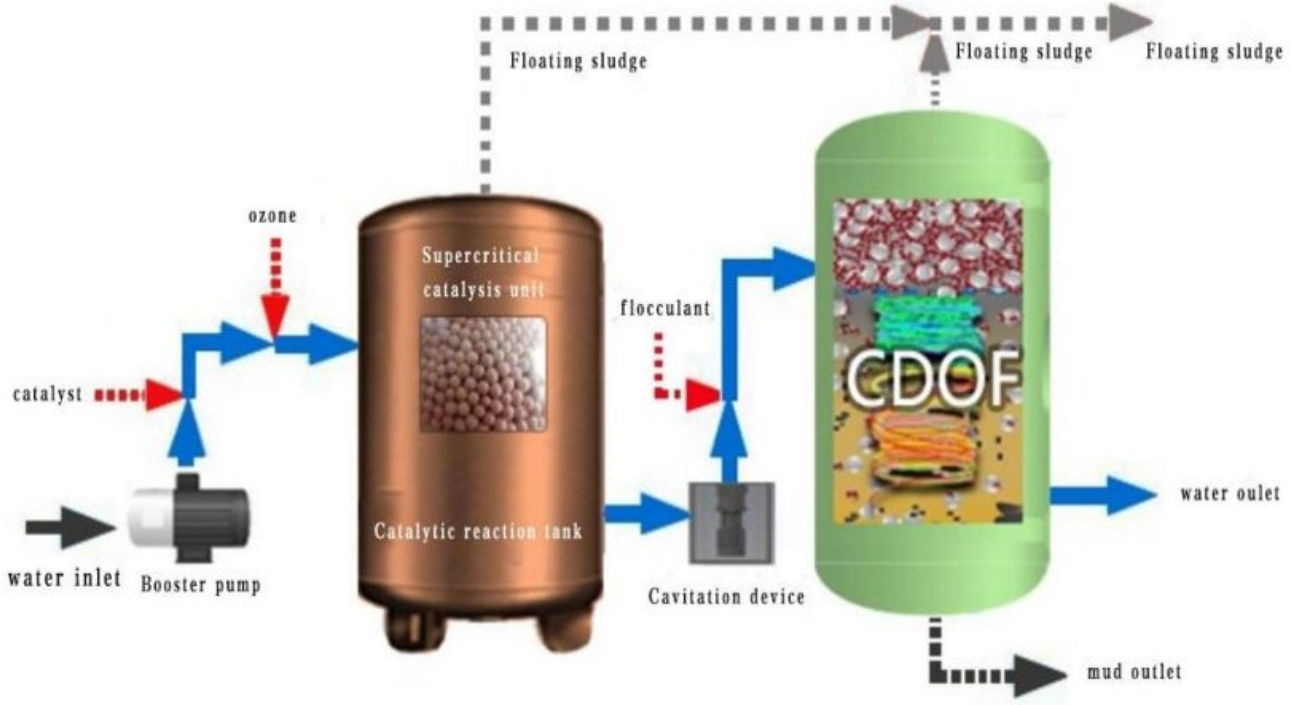


Wastewater Treatment Technology

Technical Characteristics of Cyclonic Dissolved Ozone Flotation (CDOF)

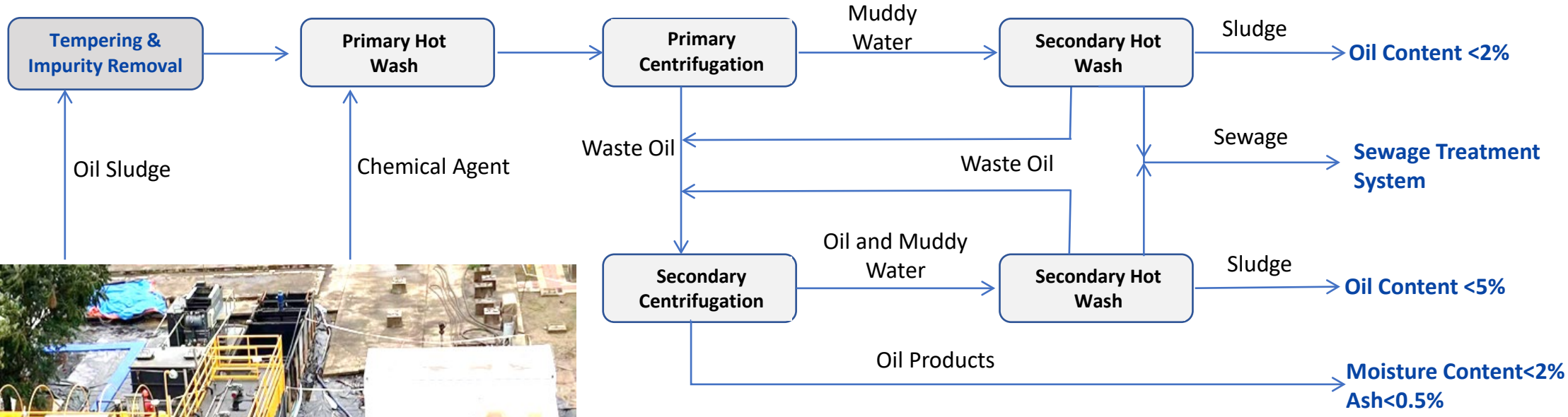
Organic combination of CDFU technology and ozone advanced (catalytic) oxidation technology mainly integrates the following technologies:

- ✓ **Cyclonic technology**
- ✓ **Flotation technology**
- ✓ **Ozone catalytic oxidation technology**
- ✓ **Supercritical catalytic technology**
- ✓ **High efficiency flocculation technology**



Waste Oil Sludge Treatment Technology

Chemical Hot Washing Technology



➢ Application Scenario

- Oily waste treatment center, oil refinery.
- Tank cleaning sludge, aged oil, and oil-based mud.
- Reduction and detoxification of oil sludge with high water content.

Advantages of Chemical Hot Washing Technology

- **Strong Universality**

  suitable for various types of oil sludge with high water content and high oil content.

- **Remarkable Effectiveness**

  oil recovery rate > 95%, oil high ash and water content < 1%; Solid moisture content < 10%, oil content < 2%.

- **High-Efficiency and Energy-Saving**

  low-pressure drive, high-efficiency centrifugal separation.

- **Proprietary Agent:** unique weakly alkaline agent compound formula.

Dross Oil Sludge Pit of Oilfield C

Residue After Chemical Hot Washing

Mud Washing Effluent Generated from Hot Washing

Treated Water for Reuse

Associated Gas Recovery Technology

It includes three technologies: casing gas (tank-top gas) recovery, wellsite power generation, and harmless combustion.

➢ **Casing Gas Recovery Technology**

The twin-screw compressor is used to recover and utilize oilfield associated gas (oil well casing gas and large tank gas).

➢ **Harmless Combustion Technology**

- The metal-fiber flat-flame burner allows the direct discharge of flue gas after combustion.
- It is mainly applied at lowgasyield well sites where free venting is prohibited.

➢ **Associated Gas Power Generation Technology**

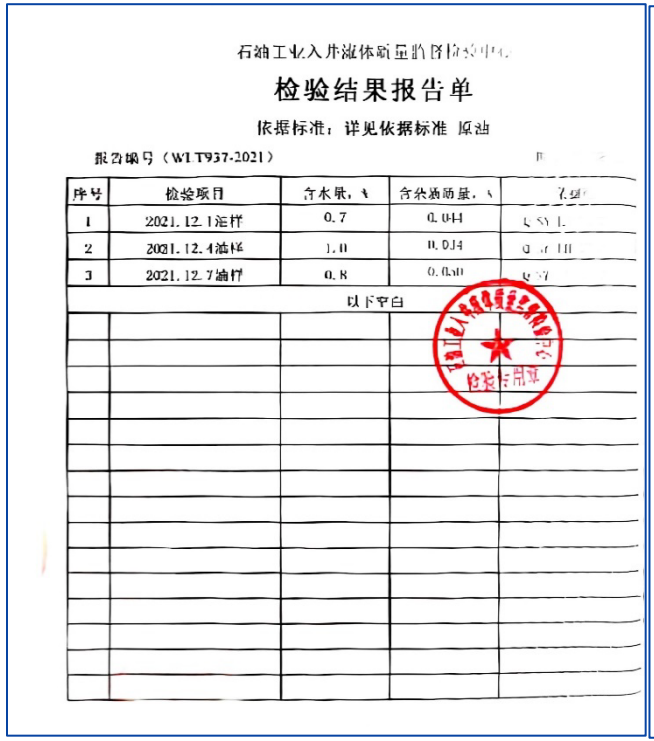
- The wellhead casing gas is used to generate 400V power for the pumping unit and the well pad.
- Waste heat from jacket water and flue gas is recovered to heat multifunctional tanks and water-jacket furnaces.

Typical Case I

➢ **Process Route: Chemical hot washing + agent-assisted cryogenic separation**

Petroleum Industry Well Inflow Fluid Quality Inspection Center

Inspection Results Report



检验结果报告单

依据标准：详见依据标准 原油

报告编号（WLT937-2021）

序号	检验项目	含水量，%	含杂质质量，%	备注
1	2021.12.1油样	0.7	0.014	
2	2021.12.4油样	1.0	0.014	
3	2021.12.7油样	0.8	0.030	
以下空白				

Petroleum Industry Well Inflow Fluid Quality Inspection Center

Inspection Results Report

检验结果报告单

依据标准：SY/T 5329-2012 碎屑岩油藏注水水质指标及分析方法

报告编号（WLT938-2021）

序号	检验项目	标准规定指标	检验结果	单项判定	执行标准
12.01	含油量，mg/L	/	150.61	实测值	SY/T 5329-20
	悬浮固体含量，mg/L	/	2387.60	实测值	SY/T 5329-20
12.04	含油量，mg/L	/	46.13	实测值	SY/T 5329-20
	悬浮固体含量，mg/L	/	2495.07	实测值	SY/T 5329-20
12.07	含油量，mg/L	/	379.14	实测值	SY/T 5329-20
	悬浮固体含量，mg/L	/	9382.82	实测值	SY/T 5329-20
以下空白					

- **Treatment Objects:** Dross oil sludge, tank-cleaning sludge, and aged oil
- **Treatment Highlights:** Residue oil content on a dry basis < 2%, recovered oil ash content < 1%
- **Equipment Scope:** Skid-mounted 4 x 40ft standard containers, 20,000 t/y chemical hot-washing system

Typical Case II

Sewage Treatment Project of an Oilfield in Western China

- **Year:** 2018
- **Inlet Sewage Oil Content:** ≤1,000 ppm, ss≤500 ppm

Effect Under Normal Working Condition

Inlet Water | Primary Effluent | Secondary Effluent

Effect Under Impact Conditions

Inlet Water | Effluent

Treatment Capacity: 2,400m³/day

Processing Equipment: Two-Stage CDFU

Treated Water: ≤ 10 ppm, ss ≤ 10 ppm

KERUI PETROLEUM TECHNOLOGY

Contents

Oil and Gas Well Site Separation Technology

➢ Main Application Scenarios:

1) Exploration wells without surface gathering and transmission facilities during oil and gas testing;
2) Oil and gas wells with incomplete surface pipe networks;
3) Remote wells and scattered wells without plans for surface pipeline construction.

Multifunctional Oil Collector

Provides gas storage, gas-liquid separation, direct metering, self-heating, pressure-driven automatic loading and other functions.

Quantitative Loading Control System

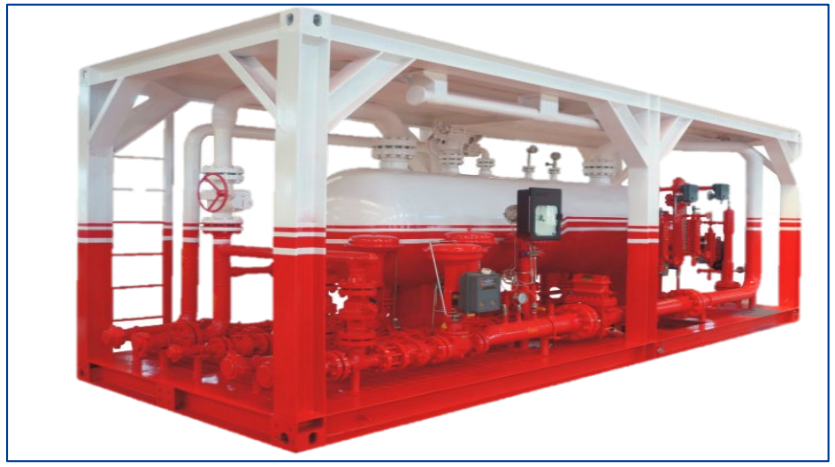
Enables automatic crude oil metering, anti-static and spill prevention, quantitative loading, and safety interlock.

Oil and Gas Well Site Separation Technology

➢ Three-phase Separator

Skid-mounted device with highly automated and independent operation.

Capalbe of separating and metering oil, gas and water phases.



Shell Diameter	800 mm	**Shell Length**	3200mm
Working Pressure	2175 psi	**Liquid Handling Capacity**	Liquid volume 200 m^3/day
Gas Processing Capacity	Gas volume: 300, 000 m^3/day	**Applicable Environment**	Standard or H2S-containing oil, gas and water

➢ Cyclone Desander

Installed upstream or downstream of the wellhead manifold.

Removes sand from wellhead fluid, reducing damage to downstream equipment.

Diameter	3-1/16"	**Operation Temperature**	-29°C ambient minimum temperature 121°C maximum fluid temperature
Gas Handling Capacity	0-150×10^4 m^3/d	**Applicable Environment**	Standard or H2S-containing oil and gas water
Working Pressure	10,000 psi	**Connection Port**	3"FIG1502

Note: The equipment is designed for specific conditions. We offer customized solutions based on the client's oil and gas well conditions.

Oil and Gas Mixed Transportation Technology

Application Scenario:

Oil and gas wells with mature gathering and transmission pipeline networks, addressing issues of mixed oil and gas transportation and pressurized drainage.

For Gas-Bearing Oil Wells:

Reduces wellhead backpressure, increases oil and gas production, and minimizes wear on downhole rod pumps.

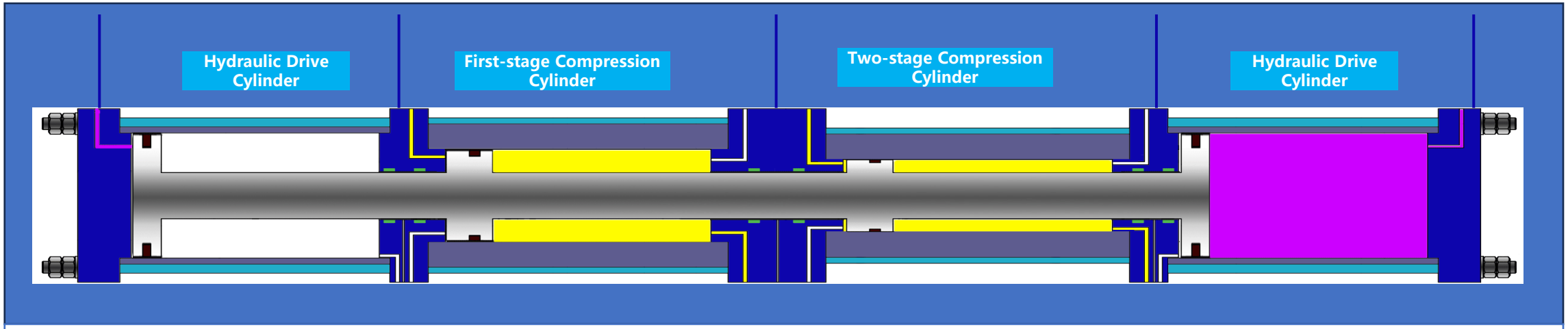
For Gas Wells:

Solves issues such as well shut-in, flooding, and gas lock.

Oil and Gas Mixed Transportation Technology

Working Principle:

- The hydraulic oil provided by the hydraulic pump enters the hydraulic cylinder to push the piston to reciprocate.
- The gas-liquid mixture produced by the oil and gas well is pressurized step by step after entering the hydraulic cylinder and output.



Technical Advantages:

- Unlike conventional liquid injection pumps and gas boosters, the liquid-driven compressor is suitable for gas-liquid mixed transport and pressurization, significantly improving delivery efficiency.
- Compared with conventional plunger pumps, it is capable of handling higher pressure operating conditions.
- The compressor features high cost performance, low maintenance cost, energy and power saving and highly automated.

Typical Case: Shanxi XX Natural Gas Mixed Transmission Project

Compressor	CMP-3.5(0.5-2)-115+115-GL/L
Power	230KW Electric Motor
Inlet Pressure	0.5 - 2 MPa
Discharge Pressure	3.5 MPa
Design Capacity	50000 Nm³/d
Compressor Stages	First-stage/Two-stage Compression
Skid Dimensions (Excluding Trailer)	8500 x 2400 x 2300mm
Weight	8.5 t
Applicable Site	Shanxi

➢ Implementation Effect

- ✓ Compared with the conventional compressor equipment, the failure rate **decreased by 10%**
- ✓ Energy-saving and power-saving with higher efficiency, boosting **overall benefits by about 20%.**

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ACHIEVING, CREATING AND SHARING TOGETHER

Shandong Kerui Petroleum Technology Co., Ltd.