



# Top Drive Drilling System (TDDS)

Science & Technology Management Department

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CHINA NATIONAL PETROLEUM CORPORATION

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*CNPC's Top Drive Drilling System provides you with a safe and efficient drilling proposal!*



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China National Petroleum Corporation (CNPC) is a state-authorized investment agency and a state holding company. As an integrated oil company of cross-regions, cross-industries and cross-countries, it adopts modern enterprise system to realize the integration of upstream and downstream operations, internal and external trade and production and marketing. CNPC has 17 upstream companies, 33 downstream companies and 36 large-scale marketing companies. It is China's largest producer and supplier of oil and gas, and also one of the largest refined oil products and petrochemicals. In 2010 CNPC produced 105 million tons of crude oil and 72.5 billion cubic meters of natural gas, while crude processing volume reached 135 million tons. The total revenue of RMB1,720 billion with a profit of RMB172.7 billion had been achieved the same year. Its profit is among the highest of the domestic enterprises in China.

CNPC was ranked 10th in Fortune Global 500 in 2010 and 5th among global top 50 oil companies. CNPC strictly follows by the combined strategies of increasing resource capacity, expanding market shares and consolidating the international role, and persists in regarding technical innovation as a key framework to advance technological progress. To develop its core businesses, focuses will be placed on the solutions of key bottleneck technologies and key proprietary technologies. Thanks to continuously improving of the technical innovation system, optimizing the configuration of technological resources and strengthening the construction of strong talent teams, CNPC's technological creativity has been considerably upgraded. Consequently, a large number of technologies have been developed independently, with its own intellectual property.

The Top Drive Drilling System (TDDS) is one of representatives for major innovations of CNPC.

# 1 INTRODUCTION

The Top Drive Drilling System is a significant development trend of modern drilling rig technology advantageous in time saving, efficiency increase of drilling rig operation, disposal of down-hole complexity and increase of mechanization and safety, which has gradually become one of the standard drilling rig configurations. CNPC has been engaged in tracking and making R&D of Top Drive Drilling System since the late 1980s, and now there emerges a large group of excellent R&D talents as well as professional manufacturers, extensive sales network and complete after-sales service system for the supply of Top Drive Drilling System with reliable quality and stable performance as well as excellent after-sales service.

CNPC is capable of R&D and manufacture

of series products with multiple models and specifications, which encompass the advanced AC variable-frequency top drive and compact hydraulic top drive. Moreover, CNPC, which can supply auxiliary services for 2,000~12,000m drilling rigs of various models, has been granted 11 technical patents, obtained the Certificate of Type Approval issued by China Classification Society (CCS), and established an industrial standard "Top Drive Drilling System for Oil Drilling Rigs" (SY/T 6726-2008).

Top Drive Drilling System has been successfully applied in China's Sinkiang Oilfield, Sichuan Oilfield, Dagang Oilfield, Huabei Oilfield, Shengli Oilfield and Liaohe Oilfield, etc. as well as countries and regions such as the USA, Venezuela, Sudan, Saudi Arabia.



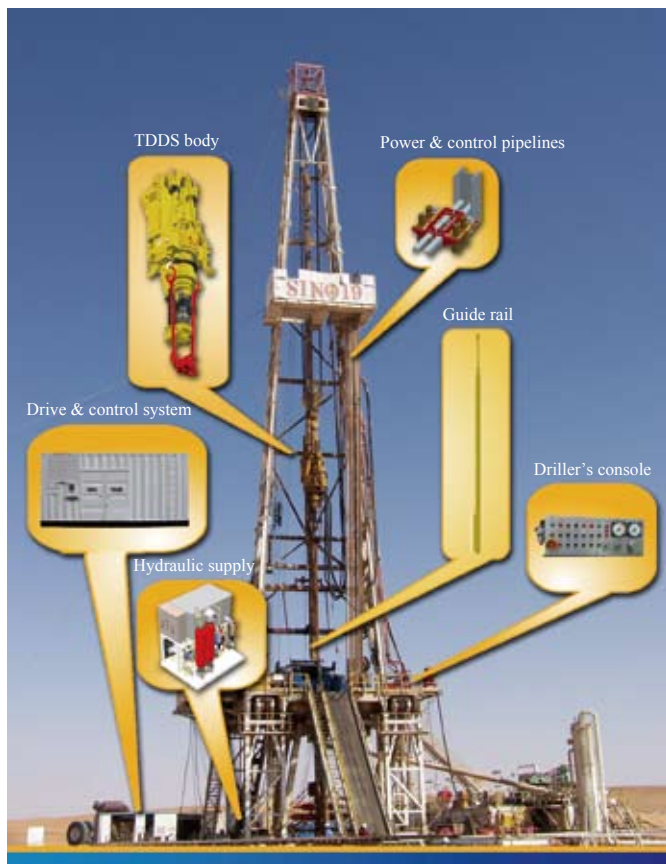


# 2

## Top Drive Drilling System (TDDS)

### 1. Top Drive Drilling System (TDDS)

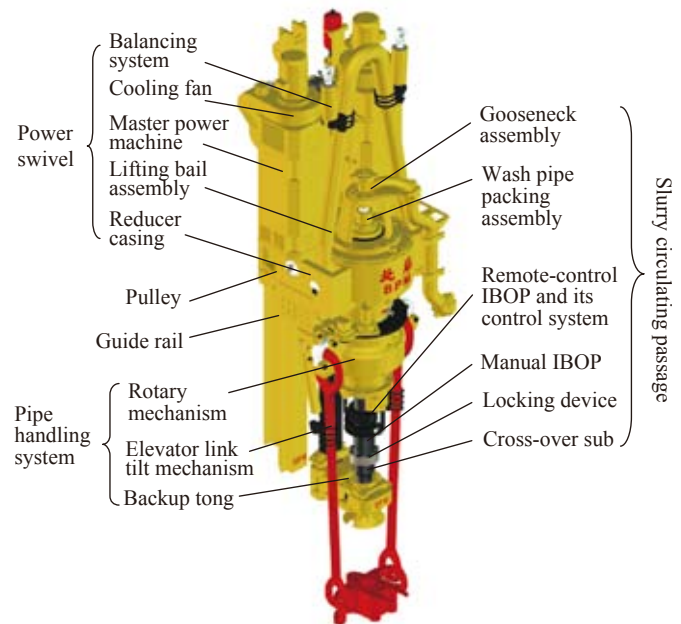
Top Drive Drilling System normally consists of body, electrical drive & control system and hydraulic drive & control system.



Structure and Composition of the Top Drive Drilling System

### (1) Main Structure of Top Drive Drilling System (TDDS)

The main structure of TDDS consists of TDDS body (incl. power swivel, pipe handling system and slurry circulating passage), guide rail and block.

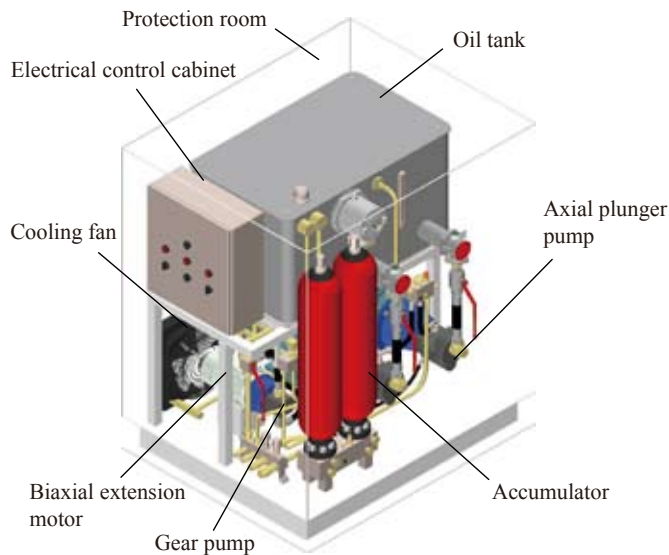


Main Structure of the Top Drive Drilling system

## (2) TDDS Hydraulic Drive & Control System

The Hydraulic Drive & Control System is an important constituent of TDDS, through which all auxiliary actions of TDDS are completed. It incorporates balancing system, backup tong system, elevator link tilt mechanism, rotary system, IBOP control system and brake system.

The hydraulic system is suitable for complicated working conditions during oil drilling (e.g. severe load variation, fire protection, anti-explosion, anti-corrosion) and is applicable in field operation environment for its good resistance to sand storm and pollution and ability to work well under a large temperature difference.



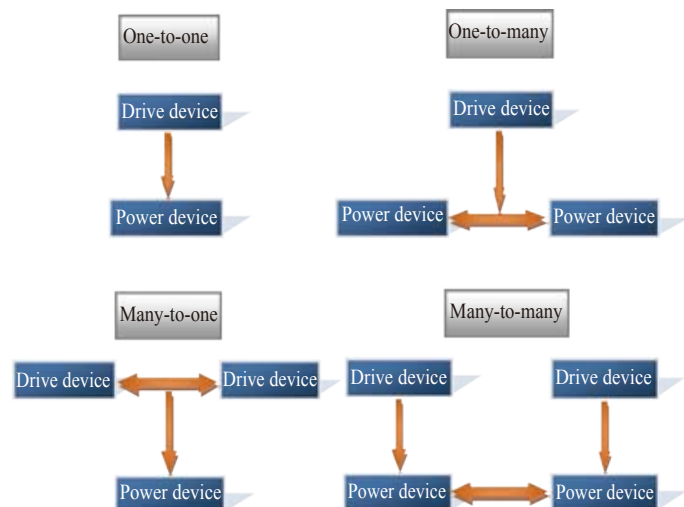
TDDS Hydraulic Drive & Control System

## (3) TDDS Electric Control System

(TDDS Electric Drive & Control System can be divided into two parts: drive and control. It can be classified into four types, i.e. one-to-one, one-to-many, many-to-one and many-to-many as per the control method of drive and power devices.

- One-to-one. A single power device is driven by a single drive set.
- One-to-many. Several power devices are driven by a single drive set and such power devices operate synchronously.
- Many-to-one. Several drive sets are connected in parallel to drive one power device.
- Many-to-many. Several drive sets are connected in parallel to drive several power devices synchronously.

The many-to-many control method is the best in terms of safety and flexibility.



#### (4) Primary Models and Technical Parameters of TDDS

TDDS model	Nominal drilling depth am	Rated load kN (US <sub>tf</sub> )	Continuous drilling torque kN·m	Uncoupling torque kN·m	Main shaft passage mm	Mud circulating pressure MPa	Clamping range of the backup tong mm	Speed range rpm	Drilling power hp
DQ120BSC	12 000	9 000 (1 000)	85	135	102	52/70c	87 ~ 250	0 ~ 200	600×2
DQ90BSD	9 000	6 750 (750)	85	135	89	52	87 ~ 220	0 ~ 200	600×2
DQ90BSC	9 000	6 750 (750)	70	110	89	52	87 ~ 220	0 ~ 200	500×2
DQ70BSD	7 000	4 500 (500)	60	90	75	35/52b	87 ~ 220	0 ~ 200	500×2
DQ70BSC	7 000	4 500 (500)	50	75	75	35/52b	87 ~ 220	0 ~ 220	400×2
DQ70BSE	7 000	4 500 (500)	50	75	75	35/52b	87 ~ 220	0 ~ 220	400×2
DQ50BC	5 000	3 150 (350)	40	60	75	35	87 ~ 220	0 ~ 180	500
DQ40BC	4 000	2 250 (250)	40	60	75	35	87 ~ 200	0 ~ 180	500
DQ40BCQ	4 000	2 250 (250)	30	45	75	35	87 ~ 200	0 ~ 200	400
DQ40Y	4 000	2 250 (250)	30	45	75	35	87 ~ 200	0 ~ 180	540
DQ30Y	3 000	1 700 (190)	22	40	64	35	87 ~ 200	0 ~ 150	400
TDET model									

Notes: "US <sub>tf</sub>" represents "short ton".  
a Nominal drilling depth is noted as per 114mm (4 1/2in) drilling stem.  
b Operating pressure in the drilling fluid circulation passage can be 52MPa.  
c The operating pressure in the drilling fluid circulating passage can be 70MPa.

#### (5) Technical Features of TDDS

- Advanced AC Variable-frequency Drive Technology featured by accurate control of torque and speed;
- Profibus Field Bus Control Technology, fiber-optic communication and Profibus cable communication, which provide good resistance to electromagnetic interference;
- Overall intelligent control of the system with PLC;
- Lifting system with dual-load passages;
- Independent hydraulic stations with redundancy

design—one is in use while the other in standby, safe, reliable and convenient for maintenance;

- Rotary head of 360-degree rotation.

#### (6) Scope of Application

CNPC can supply Top Drive Drilling Systems required by 2,000~12,000m drilling rig of various models. They are applicable to various land drilling rigs, ocean drilling rigs, onboard drilling rigs, service rigs, etc.



## 3

## Application Cases

Top Drive Drilling System DQ120BSC was installed and tested on Well 36# in Longgang, Sichuan on May 9, 2008. It had operated continuously for 12 months from May 11 when drilling was started to May 28, 2009 when drilling was completed, and the drilling depth was 6,956m. During this period, though stuck and resisted for many times, it effectively avoided the occurrence of accidents. Particularly, when an 8.0-degree intense earthquake happened in Wenchuan, Sichuan at 14:28 on May 12, 2008, there was a strong earthquake feeling in the well site but the Top Drive Drilling System still operated well and the drilling operation ran normally.



A signing ceremony for exportation of domestic TDDS to Rowan Co. in the USA was held in the Great Hall of the People on Dec. 9, 2004.

Top Drive Drilling System, installed and tested successfully on Rig 12 in Southern America in March 2005, showed good mechanical performance.



## Application Cases



## 4

## R&amp;D Equipment

CNPC boasts excellent conditions and complete equipment for TDDS R&D. A national drilling engineering laboratory was built upon approval by National Development and Reform Commission in 2008.



National Engineering Laboratory



Manufacturing Site



Design Center



Test Control Room



Test Stand

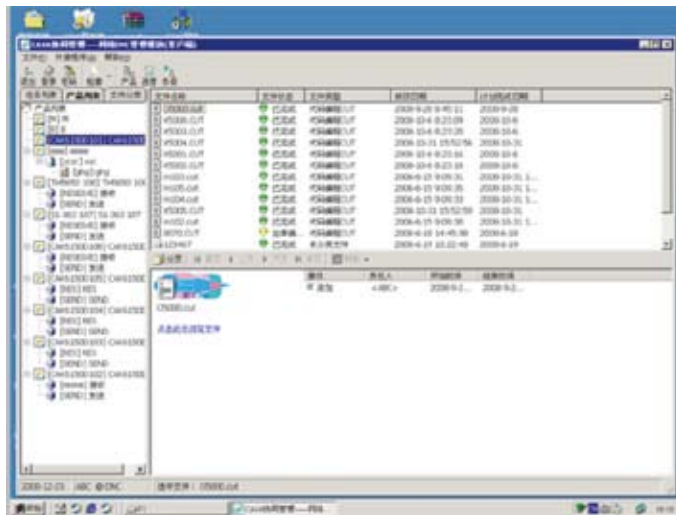




Information System Terminal



Drawing Information Management on Site



Drawing & Document Management



Video Scheduling

## 5

## Qualification and Standard

CNPC has established a series of industrial and professional specifications upon R&D for years and owns the independent intellectual property.

### (1) API Standards



API Spec 8A-1997 "Specification for Drilling and Production Hoisting Equipment"

API Spec 8C-2003 "Specification for Drilling and Production Hoisting Equipment"

API Spec 7-1 "Specification for Rotary Drill Stem Elements"

### (2) Industrial Standards

SY/T 5035-2004 "Elevator Links, Elevators and Tongs"

SY/T 5112-1999 "Specification for Drilling and Production Hoisting Equipment"

SY/T 5288-2000 "Main Connecting Dimensions of Drilling and Hoisting Equipment"

### (3) China Classification Society (CCS)

"Specification for Material and Welding"





(4) Patents

CNPC owns eleven granted patents with respect of Top Drive Drilling System, including one design patent and ten utility models.



Lifting Bail of Top Drive Drilling Rig



TDDS Design Patent



TDDS Guide Rail Patent

(5) Certificate of a National Key Product



# 6

Expert Team



**Zhong  
Shude**

Professor-level senior engineer. He has long been engaged in the R&D of petroleum equipment.  
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**Ma Jiaji**

Professor-level senior engineer. He has long been engaged in the R&D of petroleum equipment. Phone: 010-83593364



**Liu  
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Senior engineer. He is the leader of TDDS R&D and Industrialization Project and is engaged in TDDS R&D and project management all the time. Phone: 010-83597615 E-mail: ghliudri@cnpc.com.cn



**Zou  
Lianyang**

Professor-level senior engineer. He is the technical leader of TDDS R&D and Industrialization Project and is engaged in TDDS R&D and project management all the time. Phone: 010-83597490 E-mail: zoulydri@cnpc.com.cn



**Liu  
Xinli**

Engineer. He is the manufacture and sales head of TDDS R&D and Industrialization Project. He has years' experience in oil field work and is familiar with installation, operation and maintenance of drilling equipment. Phone: 010-83593447



**Jia  
Qinbin**

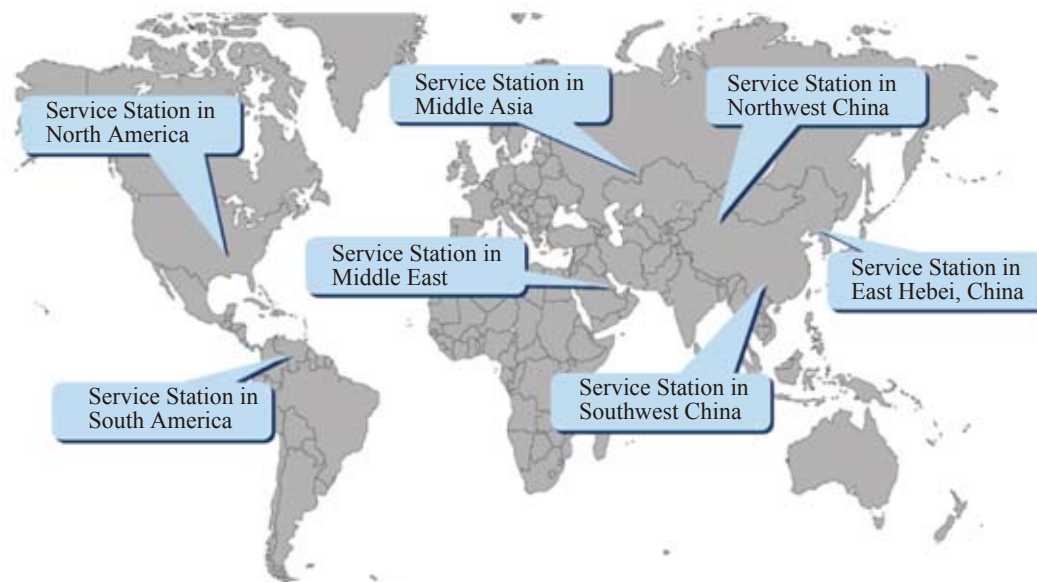
Engineer. He is the manufacture and sales head of TDDS R&D and Industrialization Project. He, who has long been engaged in mechanical processing and heat treatment, is fully experienced in the manufacture of mechanical products. Phone: 010-83593447

# 7

## Training and Service

CNPC has a professional training team who can establish corresponding training plans aimed at different user demands. CNPC can provide its customers with the integrated services of factory, simulation and site training that cover mechanical, electrical and hydraulic contents, etc. TDDS Simulation System that combines software and hardware is designed and manufactured to simulate functional actions of a top drive drilling system. Visual and simple, it can make loading, simulate actual drilling conditions and be used in the training for actual operators.

After training, professional exam will be given to accredit qualification. Multiple services such as explanation at the assembly site, demonstration at the operation site, presentation of the simulation system, etc. are provided for better understanding and memory.



CNPC has been established a complete after-sales service framework and boasts professional technicians who, equipped with mechanical, electrical and hydraulic knowledge, can stand by for 24-hour service and provide remote technical support and diagnosis to solve product problems timely and effectively. Service stations have been set up in regions (e.g. Central Hebei, Sichuan and Sinkiang in China) and countries (e.g. Dubai, Venezuela) where the use of Top Drive Drilling System is relatively centralized, and there are permanent staff at such stations to supply commonly used spare parts quickly, thus service cycle being shortened.



Internationalized-mode Services



Internationalized-mode Training



Internationalized-mode Spare Parts



Internationalized-mode Documents







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