Rotary Sidewall Coring Tool (RSCT)

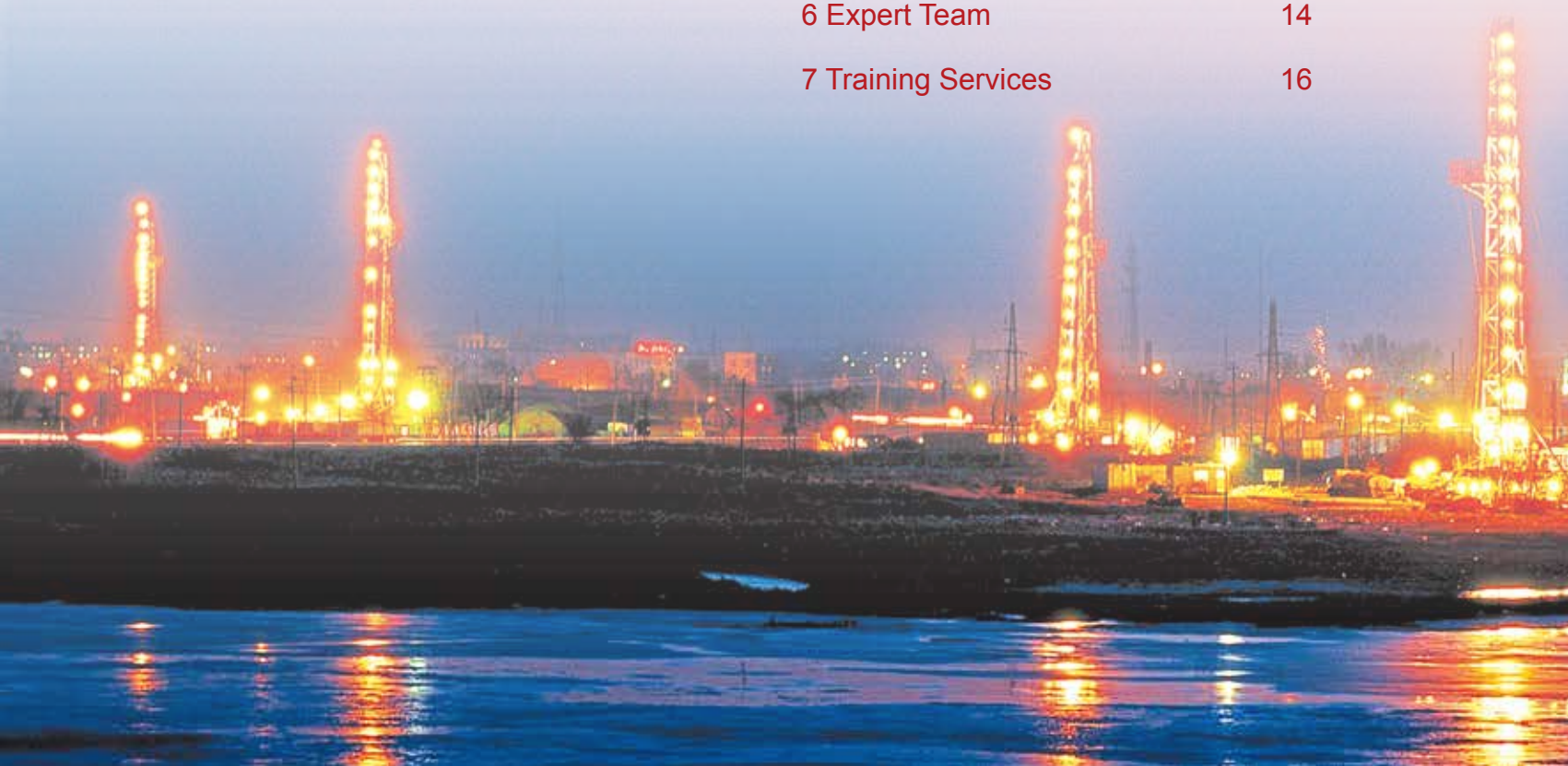
Science & Technology Management Department, CNPC

2015

CHINA NATIONAL PETROLEUM CORPORATION

Rotary sidewall coring tool lets you carry out coring at ease!

Contents



China National Petroleum Corporation (CNPC) is a state-authorized investment agency and a state holding company. On July 1998, with the implementation of the Institutional reform of the State Council, CNPC was reorgnized to become an integrated oil company of cross-regions, cross-industries and cross-countries, it adopts modern enterprise system to realize the integrations of upstream and downstream operations, internal and external trade, production and marketing. CNPC's business covers six main sectors: oil and gas operations, petroleum engineering service, petroleum engineering construction, petroleum equipment manufacturing, financial services and new energy development. In 2014 CNPC produced 113.67 million tons of crude oil and 95.46 billion cubic meters of natural gas, while crude processing volume reached 150.2 million tons. The total revenue of RMB 2,730 billion with a profit of RMB173.4 billion had been achieved the same year.

CNPC was ranked 3th among the world's largest 50 oil companies and 4th in Fortune Global 500 in 2014.

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 rotary sidewall coring tool (RSCT) is one of representatives for major innovations of CNPC.

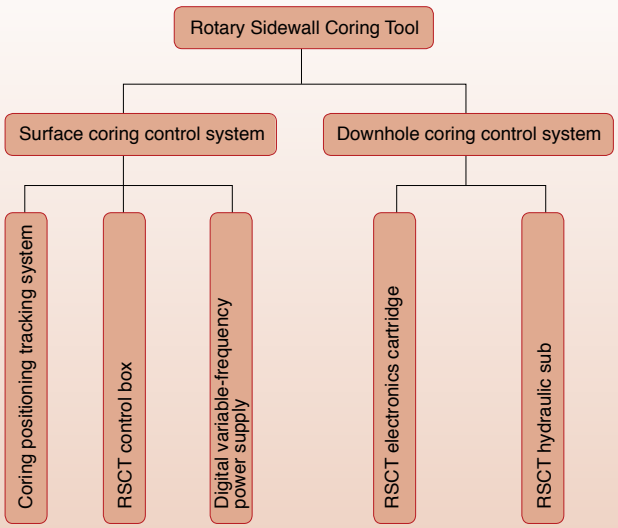
OFFERING ENERGY SOURCES, CREATING HARMONY

1 INTRODUCTION

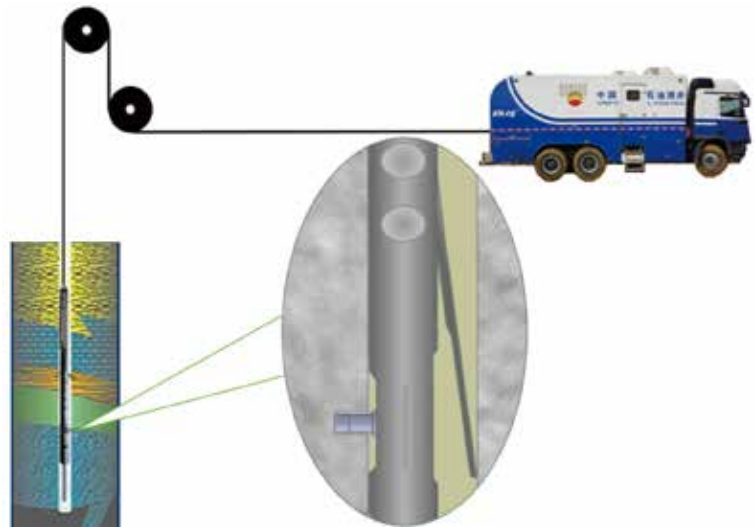
The rotary sidewall coring tool uses the hydraulic transmission technology to drive a hollow bit to vertically drill sidewall and then obtain cores; core samples are pushed into the core storage barrel as per coring horizons; core samples are taken out together with the tool and then coring is completed. The rotary sidewall coring tool is characterized by simple operation, low cost and high core recovery, regular cores, and visual observation of cores for oil-bearing property. The rotary sidewall coring tool has become one of important methods for obtaining cores.

The rotary sidewall coring tool is applicable to sidewall coring operation in the geologic exploration field involving oil, natural gas, coalfield, etc.

CNPC can study, develop and manufacture multiple models of rotary sidewall coring tool series products applicable to sidewall coring in various formations and especially hard formations in the whole interval. Rotary sidewall coring is a new coring mode which has the advantages of both drilling coring and explosion impact type sidewall coring. 2 patented technologies have been formed. The rotary sidewall coring tool was awarded with grade III science and technology achievement prize of CNPC and listed in the catalogue of 2012 self-innovative important products of CNPC in 2012.



2 CHARACTERISTIC TECHNOLOGIES



2.1 Surface coring control system

The surface coring control system consists of three parts such as coring positioning tracking system, RSCT control box, and digital variable-frequency power supply.

Coring positioning tracking system
Record coring data in real time and plot and track the depth correction curve

RSCT control box
Realize downhole system communication,surface acquisition data transmission,control command sending,etc.

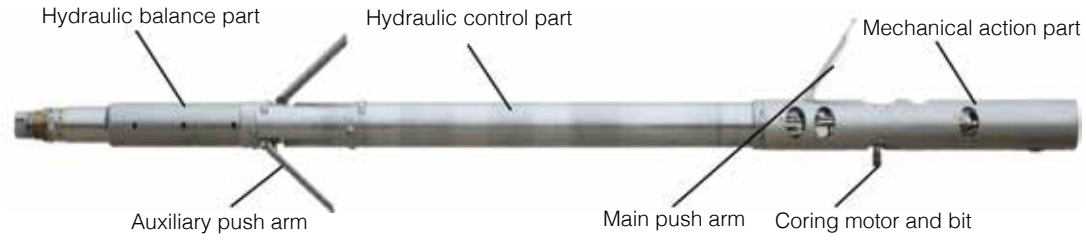
Digital variable-frequency power supply
220VAC/50Hz electric supply conversion,supplying power to downhole
RSTC hydraulic sub motor

2.2 Downhole coring control system

The downhole coring control system includes RSCT electronics cartridge and RSCT hydraulic sub.

The electronics cartridge consists of three parts such as power supply, acquisition and control and GR and realizes the functions such as GR depth correction, coring control, etc.

The hydraulic sub consists of three parts such as hydraulic pump and hydraulic balance device, hydraulic control and actuating mechanism. Controlled by a solenoid valve, the hydraulic pump provides power to the coring actions such as motor rotation, push arm opening and retracting, punch pin stretching and retracting, bit advancing and recession, core collection, etc., thus completing the coring process.



2.3 Tool Specifications and Technical Description

RSCT model	Core diameter (mm)	Core length (mm)	Number of designed cores at a time	Temperature resistance (℃)	Pressure resistance (MPa)	Applicable hole diameter (mm)	Applicable inclination (°)	Max OD of the tool (mm)
SRCT6701	25	50	26	155	140	160 ~ 390	＜18	127
SRCT6702	25	50	26 or 60	175	170	160 ~ 390	＜18	127
SRCT6703	38	65	30 or 60	175	170	190 ~ 380	⩾ 18	156

2.4 Tool Characteristics

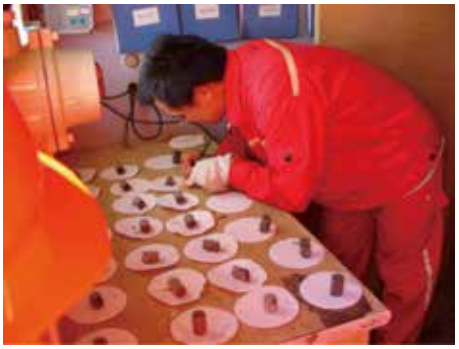
Three push arms are used in supporting and positioning and thus the tool clings to sidewall more firmly. Distance pieces are added in core collection, so that cores are identified and confirmed and depth is determined more easily. The bit advancing speed is adjusted on surface to avoid many times of tool commissioning. The working efficiency is improved. The coring tool uses the GR curve to realize accurate, convenient and reliable depth correction. The surface coring control system automatically adjusts downhole supply voltage. The coring process can be automatically controlled. The variable-frequency power supply automatically regulates motor power supply.

The cores of sandstones, limestones, granites, etc. can be drilled and collected at various depths as needed. The coring tool has wide applicable range. The rotary sidewall coring tool has high flexibility and can realize “coring as needed”. The coring time is short and the coring cost is low, thus saving a large quantity of investment in reservoir evaluation and oilfield development.

3 TYPICAL CASES

3.1 Good application effect

Some rock formations were not cored during drilling coring of well XX in Huabei oilfield. Afterwards, SRCT6701 rotary sidewall coring tool was used in coring operation and ideal cores were collected. The oil reservoir was discovered through digital core database technology analysis of the collected cores. The daily oil production of the well is up to 110t.



3.2 Good tool application performance

The rotary sidewall coring tools of other domestic manufacturers were used in drilling coring in well XX in Jidong oilfield. Due to large depth, high pressure and high temperature of the well, the coring operation failed. Afterwards, SRCT6702 rotary sidewall coring tool was used in coring operation of the well, coring succeeded with the tool at a time, and it was highly appraised by Party A.

3.3 Core examples

 Glutenite	 Limestone	 Shale
 Limy mudstone	 Sandstone	 Coal

4 SCIENTIFIC RESEARCH EQUIPMENT

4.1 Advanced design, processing and manufacturing conditions

Design center

The design center is fitted with perfect electromechanical design software and office system and meets the requirements of computer software and instrument equipment design.

Equipment manufacturing shop

Provided with advanced welding, assembling and calibration equipment.

4.2 Complete test facilities

HTHP test well

Can complete HTHP test at 175℃ and 175MPa.

Simulation test well cluster

Can complete simulation well logging test of acoustic, electrical and nuclear tools

R91 standard test well

Can complete tool logging test under actual well conditions such as 145℃ and 100MPa

Petroleum industry testing and metering station

The highest logging industry standard in the petroleum industry

4.3 Advanced and complete core test means

NMR analyzer

Can complete NMR test analysis of cores

Core imaging scanner

Can complete imaging scanning test of cores

Porosity and permeability analyzer

Can complete porosity analysis test of cores

Electrical and electrochemical measuring apparatus

Can complete electrical and electrochemical physical property measurement test of cores

5 QUALIFICATION STANDARDS

CNLC is qualified in petroleum engineering services and has passed quality management system certification and HSE management system certification.

List of technology secrets and patents

Patent: electrically controlled overflow speed regulation device for rotary sidewall coring
Patent No.: ZL 2013 2 0023243.8

Patent: three-arm push system for rotary sidewall coring
Patent No.: ZL 2013 2 0023571.8

Patent: automatic control technology for coring process
Surface regulation technology for bit advancing speed
Distance piece addition technology for core collection
Deep well coring technology

6 EXPERT TEAM

Lu Dawei Senior technical expert, professor level senior engineer. He has been engaged in logging technology work for over 40 years and has organized the preparation of mid and long-term technology development plans for China's petroleum logging industry and the introduction of significant logging technologies and equipment.

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Sun Baodian Senior technical expert, professor level senior engineer. He has successively completed the research projects such as "research on logging data optimization interpretation method", "research on logging mechanism and new logging method for remaining oil distribution in high water cut and extra-high water cut periods", "low resistivity reservoir interpretation method", "rock physical property test technology and data processing method", etc. Over 20 papers written by him have been published. He was once awarded with 4 CNPC science and technology advance prizes.

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Du Huanhong Senior technical expert, senior engineer. He has successively completed multiple key projects such as "research on digital core logging technology", "research on rock physical property and logging response mechanism", research on new logging method and processing technology for improving the development effect of difficultly produced reserves", etc. 13 papers written by him have been published. He has obtained 7 patents.

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Wang Aixin Senior technical expert, senior engineer. She has been long engaged in the study and field application of rotary sidewall coring tool and technology. She has taken charge of completing the research on multiple practical new technologies such as rotary sidewall coring in deep well, core drilling and collection in soft and hard formations, etc. She has obtained 2 patents.
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Liu Wenge Engineer. He has been long engaged in the R&D of logging tools and the study and field application of rotary sidewall coring tool and technology. He has completed the study and development of multiple practical new technologies for rotary sidewall coring.
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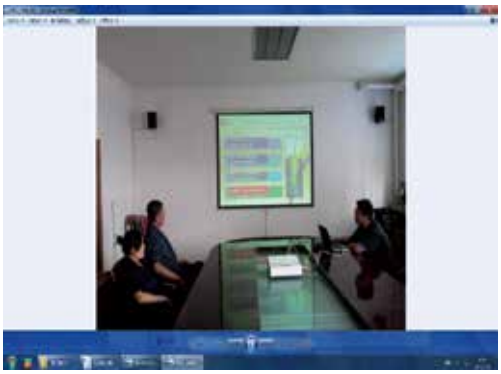
7 TRAINING SERVICES

Training

A perfect after-sales service system has been established. CNLC has professional technical personnel integrating mechanical, electrical and hydraulic knowledge. CNLC provides 24h sincerity services and remote technical support and diagnosis, solves product problems effectively in time, and provides users with personalized standard training services. Relying on video systems, work out a relevant training plan as required by users and can realize theory, simulation and field instrument operation training.



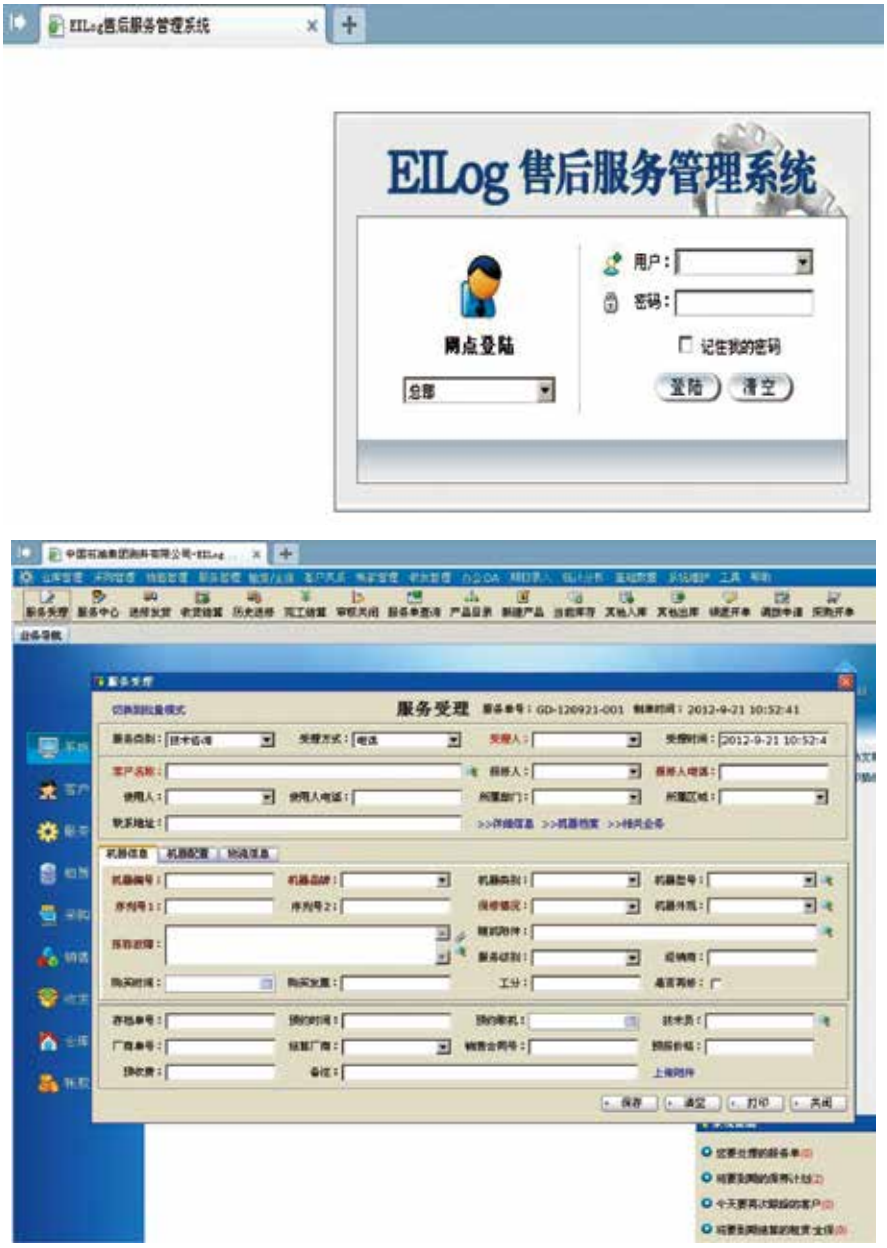
Technical support

Provide EILog logging series equipment website platform http://www.eilog.cn/ for show globally. The website has three language interfaces such as Chinese, English and Russian and includes columns such as About EILog, Product Show, Technical Support, Interchange and Communication, Sales Services, After-sales Service Management System, etc. The column “Technical Support” includes the sub-columns such as Member Login, Training Course, Maintenance Manual, Quick Index Query, Necessary Maintenance Knowledge, Revision Bulletin, Application Experience Sharing, etc., thus providing comprehensive technical support to understanding, using and maintaining EILog logging series equipment. Users can leave a message in the column “Interchange and Communication”; after seeing the message, technical support personnel reply to it in time and can serve users on line or off line.

After-sales service

The after-sales service management system tracks and records the user's after-sales service demand till meeting the user's demand.

Service hotline: 400-8876-590
Service fax: 029-88776266
Service Email: EILog@cnpc.com.cn
EILog@cpl.com.cn



FILog after-sales service management system

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