



# Research and Development

*In 2004, CNPC carried out its research and development strategies in three stages such as applied basic research, technological developments and industrialization. A total of 81 major research projects, including 15 national key ones and 66 company ones, were completed. Some research projects have made remarkable progress, while others yielded important findings.*

## Exploration

### Comprehensive evaluation of oil/gas preliminary prospecting areas and research on preliminary prospecting objectives

Comprehensive evaluations of oil/gas preliminary prospecting areas and research on preliminary prospecting objectives have made considerable headways in 2004. 22 favorable oil preliminary prospecting zones and 24 gas ones have been optimized, providing direct support for geophysical prospecting deployment to make breakthroughs. Research findings on lithologic oil reservoir exploration were prominent. The research summarized 8 kinds of typical structural-sequence assemblages and their features found in 4 types of basins. In addition, sequence stratigraphy industrialization application and reservoir prediction techniques were promoted in 13 oil/gas fields. Exploration of lithologic stratigraphic reservoirs made many large discoveries, yielding 70% of the oil in place newly discovered.

### The Geo-East V1.0 integrated seismic data processing and interpretation software

The research and development of the Geo-East V1.0 integrated seismic data processing and interpretation software was completed in 2004. The software, capable of providing data-sharing and visualized interactive functions, features new application functions like migration before stack (MBS) imaging, pre-stack seismic data reservoir attributes picking up and analysis, as well as 3D visualized interpretation. It integrated functions such as united data platform, united display platform and united development platform, which can be used to conduct dynamic seismic data processing and interpretation.

In seismic prospecting of foothill belt, new technologies such like high density acquisition and pre-stack depth migration imaging were adopted, making many discoveries in the Tarim and Qaidam basins as well as in overseas complicated mountainous regions. Furthermore, progresses and technical breakthroughs were acquired in geophysical exploration and development studies such as the multiwave-multicomponent exploration techniques, time-migration seismic prospecting techniques, high-resolution exploration techniques and borehole geophysical prospecting techniques.

## Development

### Improved water flooding techniques for high water cut fields

The improved water flooding techniques for high water cut oilfields and fine reservoir description techniques were upgraded, while large cavity and fracture identification and sealing techniques were commercially applied and horizontal well drilling technologies promoted.

### Multi well combined thermal recovery techniques for heavy oil wells and steam flooding techniques for moderate-deep reservoirs

Multi well combined techniques thermal recovery of heavy oil as well as moderate-deep reservoir steam flooding techniques have been further improved and promoted. Tests of steam flooding and horizontal well gravity-weighted ultra-heavy oil flooding techniques in well Qi 40 of Liaohe oilfield saw obvious results.

### Techniques to improve the development of extremely low permeable reservoirs

The development of techniques for improving the development of extremely low permeability oil reservoirs yielded great progress in 2004. Reservoir evaluations and economic productivity study on extremely low permeability reservoirs made great progresses. Reservoir rehabilitation and advanced water flooding techniques for low pressure and extremely low permeability reservoirs were adopted in Changqing, Jilin and Tuha oilfields and yielded excellent results.



## Natural Gas Development

The development and application of natural gas exploitation techniques have made considerable headways in 2004. Super high pressure gas producing pipe strings and wellhead equipment at the Kela 2 well of Tarim oilfield, and the development of high H<sub>2</sub>S gas reservoirs and low-yielding gas reservoirs in the shallow layers in Luojiashai field, Chongqing, as well as the reservoir rehabilitation and enriched region screening of the very low permeability gas reservoir in Sulige field, made great strikes in 2004.

## Drilling

Overall process integrated mating test of under-balanced drilling technology has been made successfully in China for the first time in well Qiongxi 3, Southwest Oil & Gasfield, using independently developed under-balanced equipment and mating technology. A 457,000 m<sup>3</sup>/d high-yielding gas flow was obtained in wellhead testing, an important breakthrough in oil and gas exploration in Qiongxi structure of west Sichuan Province. Drilling equipment like rotating BOPs developed with independent intellectual property played a major role in field application in Yumen, Southwest, Changqing and Daqing oilfields.

Research of deep drilling mating technology in Xujiaweizi, Daqing oilfield acquired important achievements. Under-balanced drilling technology and "PDC bit + screw rods" complex drilling technique greatly increased the drilling speed, effectively protected the reservoirs, and shortened the completion period of a 4,300m-deep well from 180 days to 150 days. Casing drilling technology developed into a complete set of technology, performing field drilling tests in 8 wells in Jilin, Dagang and Daqing oilfields.

## Logging

High performance well logging system EILog100 with the capability of open hole well logging and perforation as well as coring operation was developed successfully, and was used to conduct 22 well-times field logging tests in 10 wells of Changqing and Huabei oilfields. Field tests indicate good instrument stability and logging data repetitiveness, which were comparative to overseas similar instruments. 3 sets of unitized logging equipment prototypes were developed and used to conduct 20 well-times field tests in 8 wells of Changqing, Shengli and Huabei oilfields, acquiring qualified logging data.

High velocity cable transmission research project made breakthrough on critical technologies like increasing TCM error correction coding and retransmission mechanism of modem system, providing new remote metering system for domestic unitized logging equipment.

Logging data processing and interpretation integrated software LEAD1.0 was developed and a complete logging technology series with independent intellectual property on aspects like downhole logging instrument, ground system and application software, was established.

## Surface engineering techniques

The key field test project - X80 large-diameter pipeline materials and tubing technique was finished successfully and procured positive effects. New products like domestic X80 pipeline steel materials,  $\varnothing 1016\text{mm} \times 15.3\text{mm}$  spiral welded pipe and  $\varnothing 1016\text{mm} \times 18.4\text{mm}$  longitudinally-welded were successfully used in the West-East Gas Pipeline and the Shaan-Jing Parallel Pipeline. New product development of X80 high strength steel pipes provided powerful technique support for the construction of large-diameter long-distance natural gas transportation trunk line in China. Deacidification technique and regeneration and utilization technique with independent intellectual properties were developed.

## Refining and chemical engineering

### Two-stage riser catalytic cracking technique

Two stage riser catalytic cracking technique developed a great variety of technologies combination, realizing catalyzer relaying, section by section reaction, short reaction time and large catalyst-oil ratio, and can effectively reduce the olefin content of gasoline, increase diesel oil yield rate and cetane content and reduce dry gas and coke yield. The technique has been used in 7 catalytic cracking units and produced obvious economic benefits.

### Ionic liquid catalyzer alkylation technique

Independently developed ionic fluid catalyzer alkylation technique was a quantum jump of traditional inorganic acid catalytic alkylation technology, and was used to realize clean production of high-octane gasoline blending components. Design, manufacture and installation of 50kt/a heavy oil suspension bed hydrocracking pilot commercial plant was also completed. Commercial test was conducted in Fushun Petrochemical with satisfying results.

### ABS production technology innovation

Achievements were obtained for the development of ABS production technology innovation in 2004. Research on synthesizing and agglomeration of small size PB latex as well as process route and practical formulation of high latex graft were performed. Experiments and commercial applied tests were conducted successfully. Progresses were made in critical technologies like PB polymerization, PB latex agglomeration and high ABS latex graft, producing qualified products with all the indices reaching the 750A super grade product standards.