Technology and Innovation

Oriented by business, the company has deepened R&D reforms and stepped up talent development in a bid to foster innovation on all fronts and create a new engine for growth.

Technological innovation is the key driver behind the company's robust growth to build an integrated international energy company. Our technological strengths and innovative capabilities were significantly improved in 2018 under an innovation-driven growth strategy. With R&D reforms continued, we have created an optimized atmosphere for innovation. As key R&D debottlenecking efforts continue as planned, innovation is playing an increasingly important role in the company's R&D. Those efforts resulted in more prestigious science and technology awards.

Construction of Technological Innovation System

The company's R&D management framework has been improved to promote construction of technological innovation system. The expert committee, as part of the R&D management platform, is responsible for evaluating R&D needs and making decisions on R&D programs. A range of procedures on R&D planning, intellectual property and confidentiality have been developed and amended to improve R&D management throughout project lifecycle. An R&D infrastructure information system is in place to encourage information sharing. Incentives are provided to facilitate transfer of new know-how and techniques and create a knowledge-based innovative atmosphere within the organization.

The company has seen new progress in the construction of R&D platforms. Continued improvements have been made in a number of national R&D facilities, including the EOR Laboratory and the Carbon Fiber Engineering & Research Center. The experimental/testing platforms for sour gas and tight oil and gas are under construction as planned. By the end of 2018, the company has 83 research institutes, 54 key laboratories and testing bases.

83

Research institutes

54

Key laboratories and testing bases

Major R&D Advances

In 2018, the company achieved major progress in know-how, core technology, equipment and model project development. A series of proprietary technologies have been developed to boost production and tap deeply buried resources and unconventional resources.

Exploration and Production

The evaluation and prediction techniques for massive conglomerate reservoirs have been developed, enabling enhanced rates of success in discovery and early production. This has supported the extension of exploration activities from the Triassic to the Permian in Mahu Sag in Xinjiang.

The theories on how gas reservoirs were formed and exploratory evaluation technologies have been developed for deep marine carbonate rocks. It paves the way for the deep marine carbonates in the northwestern part of Sichuan to become a new candidate for strategic reserve replacement in Sichuan Basin.

Significant headway has been made in continental shale oil exploration, facilitating exploration breakthroughs and production hikes in Junggar Basin, Bohai Bay Basin and Ordos Basin.

New EOR technology featuring natural gas injection and gravity-assisted miscible displacement has been developed for deep sandstone reservoirs in Tarim Basin featuring high pressure, high temperature, and high salinity, the problems that could not be resolved by chemical flooding.

Commercialization of alkali-free surfactant-polymer flooding and weak-base ASP flooding techniques has proved successful across demonstration projects in the Liaohe, Xinjiang and Daqing oilfields.

Innovative CO_2 flooding mechanisms and underground storage theories for reservoirs with ultra-low permeability have contributed to a significant increase in the average daily output per well.

Refining and Chemicals

Technological packages for 10Mt/a refining, 1Mt/a ethylene and 45/80 nitrogen fertilizer projects have been improved and applied in Guangdong Petrochemical Plant, the ethane-to-ethylene plants in Changqing and Tarim, and the nitrogen fertilizer unit of Ningxia Petrochemical Plant.

Our proprietary refining catalysts have been among the premium of its kind in the domestic market. Nation VI gasoline is commercialized and catalysts for hydrocracking are applied in industrial production. Products including specialty lubricating grease and proprietary asphalt are used in and contributing to a number of major projects.

The company produced 36 new polyolefin products under 10 categories and developed new polymerization technique, the first in Chinese market, for phosphorus-free SBR. Such new products as polyethylene with ultra high molecular weight, rubber of solution styrene butadiene and rubber of rare-earth butadiene are produced in high volumes.

Oilfield Services

Geophysical prospecting: R&D efforts have resulted in world-leading integrated seismic prospecting techniques that support simultaneous recording of 200,000 traces for both onshore and offshore blocks. DSS, a prospecting technique system based on aliasing, has been developed and applied to addressing technical and economical challenge from onshore high-density seismics.

Well logging: CIFLog2.0, a new generation of multi-well evaluation software, has been developed to support single-well and multi-well data processing, making a breakthrough in well prospecting. Formation element full-spectrum logging techniques have been applied commercially in key E&P projects in Xinjiang, Daqing and Tarim oilfields, as well as overseas blocks in Brazil, Iran and Chad, greatly improving our capabilities to evaluate complex lithostratigraphic formations and analyze residual oil in mature fields.

Drilling: High-pressure common rail EFI-based 12V175 diesel engine has been launched in Tarim Oilfield for drilling deep and ultra-deep wells. Innovative techniques for treatment and recycling of drilling wastes and fracturing fluids are widely used. Packaged products and technologies have been developed, including oil-based drilling fluids to deal with high temperature, high salinity, high density, non-planar PDC bits, and pressure-controlled drilling and completion in high-pressure saline layers. Those advances make drilling more efficient for 8000m-deep wells in the piedmont zone in Tarim basin.

Storage and Transportation

We have independently developed a suite of equipment and construction techniques for D1422 gas pipeline and applied to building the Russia-China Pipeline (Eastern Route), with a delivering capacity 40% higher than that of D1219 pipeline. Strain-based design and high-strain line pipe technologies have made headway in addressing failures of large-diameter high-pressure pipeline under certain geological conditions.

Technological Cooperation

In 2018, we continued to enhance exchange and cooperation with IOCs, NOCs, international academic bodies, industrial organizations and domestic research institutes in a bid to promote theoretical and technological innovations.

We worked closely with our international partners including Total, Petronas, Gazprom and Rosneft in R&D management, frontier technology and key technological areas in the form of working group meetings and tech workshops, etc. New achievements were made through technological cooperation with the Chinese Academy of Sciences, National Natural Science Foundation of China and China Aerospace Science & Industry Corporation. The research projects on elastic waves and deep exploration in collaboration with the Chinese Academy of Sciences delivered technological innovations, such as high-temperature, high-pressure azimuthal electromagnetic LWD prototype unit, for addressing the company's strategic technical bottlenecks; collaborative efforts with Beijing Institute of Technology and China North Industries Group Corporation around detonation driver mechanism and high explosives helped improve the performance of perforating charge products.

S&T Awards and Intellectual Property Rights

The company won two national science and technology awards in 2018. "Exploration theory & technology for conglomerates in sags and the discovery of the giant Mahu Oilfield" won the first prize of the State Science and Technology Progress Award. "Oil and gas pipeline integrity technologies and industrial application" won the second prize of the State Technological Invention Award. We led the formulation of two international standards, i.e. "Natural Gas - Upstream Area - Determination of hydrogen sulfide content by laser spectroscopy" (ISO 20676:2018) and "Rubber - Determination of Ash - Part 2: Thermo-Gravimetric Analysis (TGA)" (ISO 247-2:2018).

In 2018, the company applied for patents for 5,117 items at home and abroad, including 2,906 applications for invention patents. The company was offered 4,515 patents, including 2,120 invention patents.

5,117

Patents applied

4,515

Patents granted