



Oil/Gas Pipeline Technology

Science & Technology Management Department

2011



CHINA NATIONAL PETROLEUM CORPORATION

The most outstanding Chinese oil & gas pipeline team builds high-quality and efficient energy highway for you!



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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 of 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 10rd in Fortune Global 500 in

2010 and 5th among global top 50 oil companies.

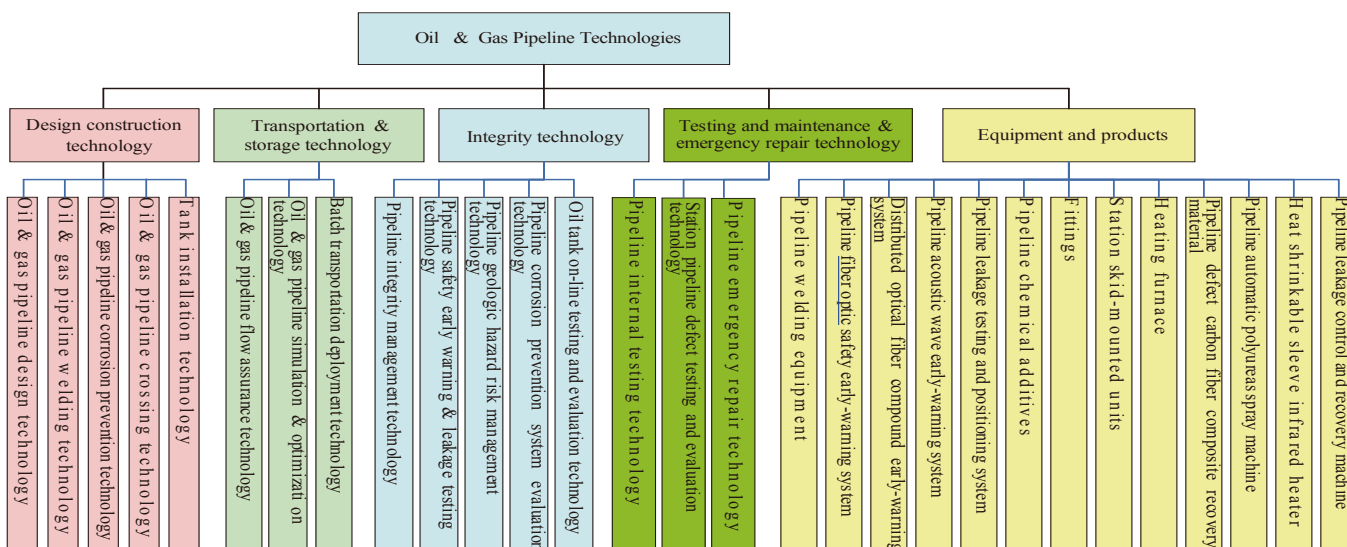
CNPC strictly follows by the combined strategies of increasing resource capacity, expanding market shares and consolidating the international role, and persists in regarding technical innovation as a key framework to advance technological progress. To develop its core businesses, focuses will be placed 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 Oil & Gas Pipeline Technology is one of the representatives for major innovations of CNPC.

1 INTRODUCTION

CNPC has a group of excellent pipeline professionals, associated research and testing facilities for oil and gas pipeline technology, and mature teams with construction, management and service experiences teams, which can provide various technologies and services for oil & gas pipeline industry.

CNPC has developed 27 unique technologies in 5 series independently, which have been successfully applied in the construction and management of the West-East Gas Pipeline, the second West-East Gas Pipeline, the Western Pipeline, the Zhongxian-Wuhan Gas Pipeline and the Lanzhou-Chengdu-Chongqing Gas Pipeline as well as the pipeline projects in Sudan, Libya, India, Russia and Central Asia.



2 UNIQUE TECHNOLOGIES

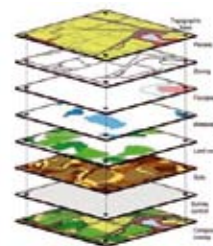
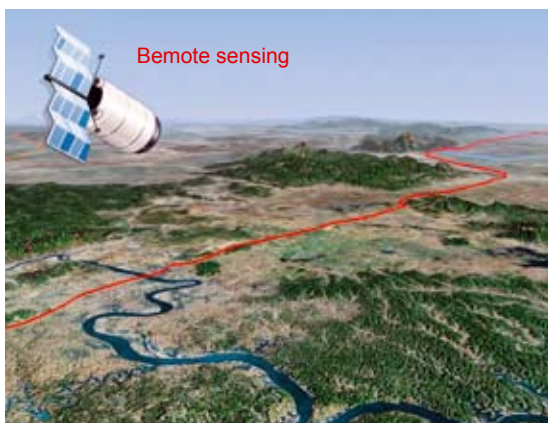
2.1 Design and Construction Technologies

CNPC not only has powerful design and construction technologies for oil and gas pipeline and tank (depot), but also possesses the national Grade A qualification of comprehensive engineering design and special grade qualification of general contract for chemical and petroleum engineering construction; as well as specialist teams composed of national survey masters, design masters and the specialists who enjoy the special government allowance. The annual design construction capacity is $20 \times 10^3 \text{ km}$ of $8 \times 10^6 \text{ m}^3$ and for oil and gas pipelines the large and medium tanks.

2.1.1 Oil and Gas Pipeline Design Technology

Based on the survey of piping route through technologies like GIS, the optimal route is selected, and various advanced software is used to conduct analysis and calculation on the transmission technology, so as to provide the construction documents and drawings related preliminary feasibility study, feasibility study, initial design, detailed design and construction drawing design to the satisfaction of the construction unit.

CNPC can provide customers with the most economical, safe, reliable and reasonable pipeline route survey design, the most advanced and applicable pipeline process and tank design, and the internationally standardized drawings.



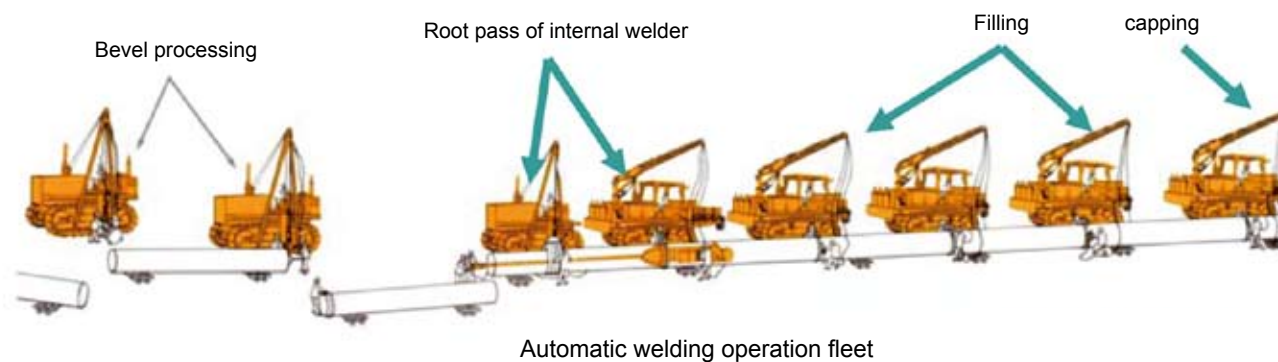
Remote sensing route of pipeline

2.1.2 Oil and gas pipeline welding technology

Oil and Gas Pipeline Welding Technology refers to the operation method of utilizing welding materials (welding rod or wire) to connect two steel pipes together under high temperature or high pressure.

Different welding methods can be used in terms of the different conditions and processes.

CNPC can provide customers with various advanced pipeline welding technologies they need.



Construction at the second West-East Gas Pipeline

2.1.3 Oil and Gas Pipeline Anticorrosion Technology

Oil and Gas Pipeline Anticorrosion Technology refers to the measures to prevent the pipeline from corrosion or deterioration under the chemical or electrochemical actions of internal and external media or due to the metabolic activity of microorganisms.



Anticorrosion operating line of steel pipe exterior

CNPC has the largest and the most complete anticorrosion processing and production line in Asia. It can provide customers with internal coating and external anticorrosion processing of various steel pipes ranging $\phi 100$ -1,400mm. The hot-bent elbow anticorrosion operating line of CNPC is the most advanced in the world that provide customers with the anticorrosion operation of elbow exteriors in different diameters, angles and anticorrosion forms.



Anticorrosion operating line of elbow exterior

2.1.4 Oil and Gas Pipeline Crossing Technology

Oil and Gas Pipeline Crossing Technology refers to the pipeline route engineering to make the pipeline cross the river, lake, railway or highway by

underwater or underground laying mode.

CNPC provides customers with the crossing construction services of long distance, large diameter and different media pipelines by horizontal directional drilling, shield and pipe jacking. The successful crossing distance is 2.6km at a maximum.

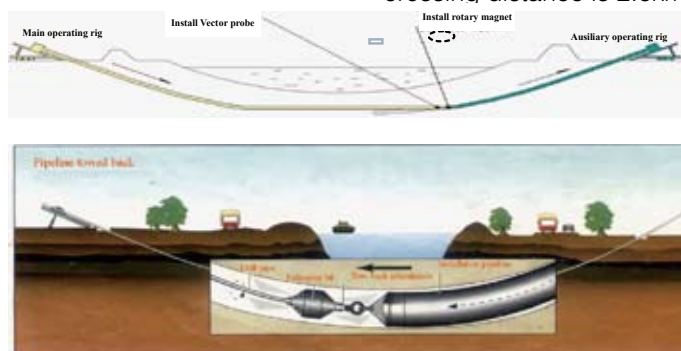
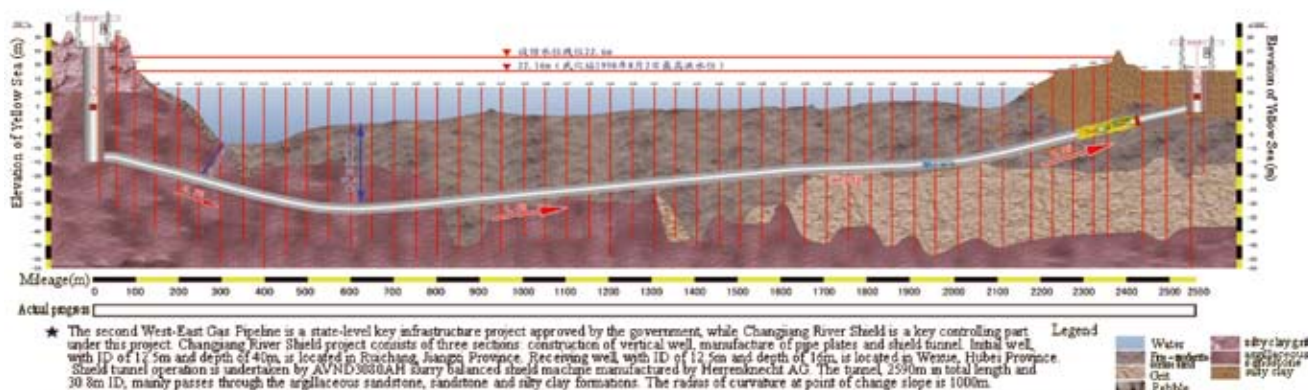


Diagram of pipeline crossing



Schedule of Changjiang River Shield Project for the second West-East Gas Pipeline

2.1.5 Tank Installation Technology

Tank Installation Technology refers to utilizing different methods to weld the stave sheets to the designated position, and the types of tanks are

mainly vault, floating roof or spherical.

CNPC provides customers with the matured, reliable, economical and efficient installations of dome-roof, floating roof or spherical tanks.



Tank farm of CNPC in China



Overseas tank farm of CNPC

2.2 Oil and Gas Transportation & Storage Technology

For oil and gas transportation and storage technology, CNPC masters the mature technologies in oil and gas pipeline flow assurance, simulation and optimization and batch transportation dispatching. It provides customers with the systematic consultation and solutions on oil and gas pipeline planning, design, commissioning, operation and maintenance.

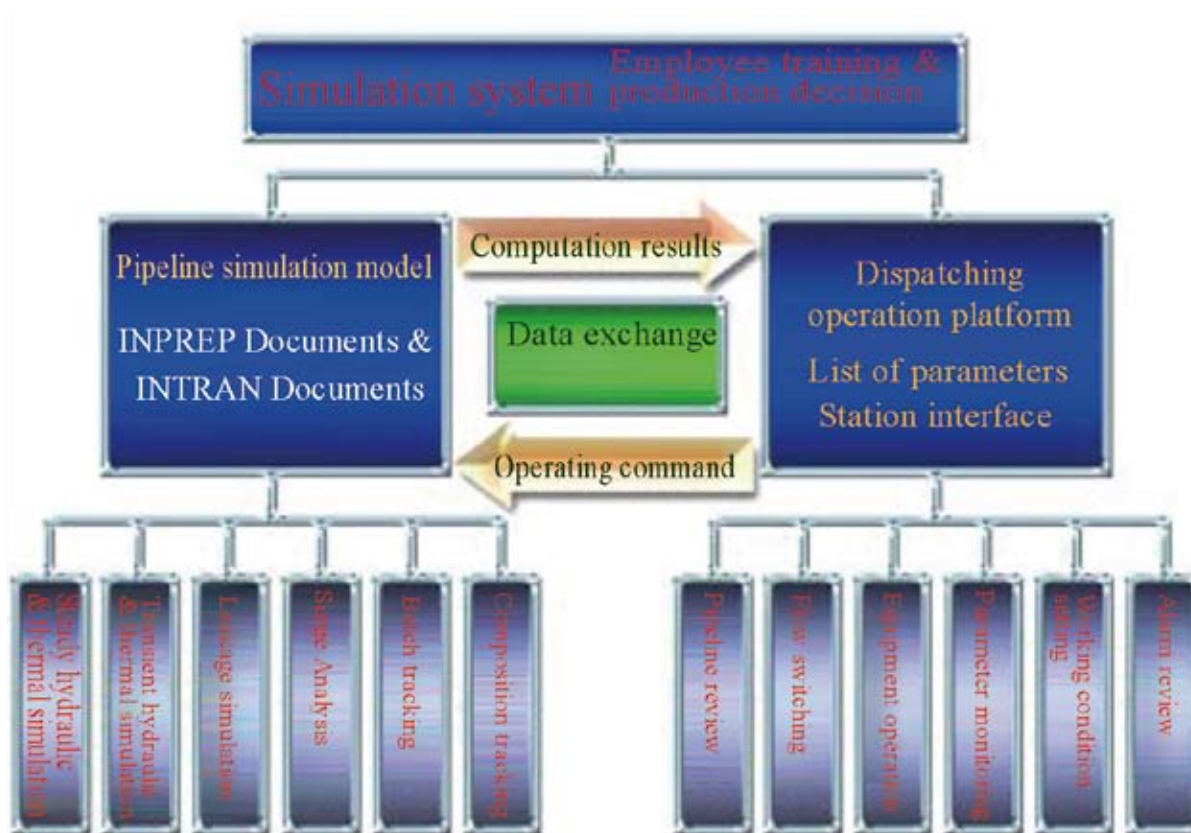
2.2.1 Oil and Gas Pipeline Flow Assurance Technology

Oil and Gas Pipeline Flow Assurance Technology puts forward flow assurance measures through predicting the flow variation of oil and gas in the pipeline and evaluating the flow safety. CNPC has distinguished expert team, advanced devices and software for prediction and simulation, which are able to provide the integrated solution of high wax and easily solidifying crude oil transportation for customers.



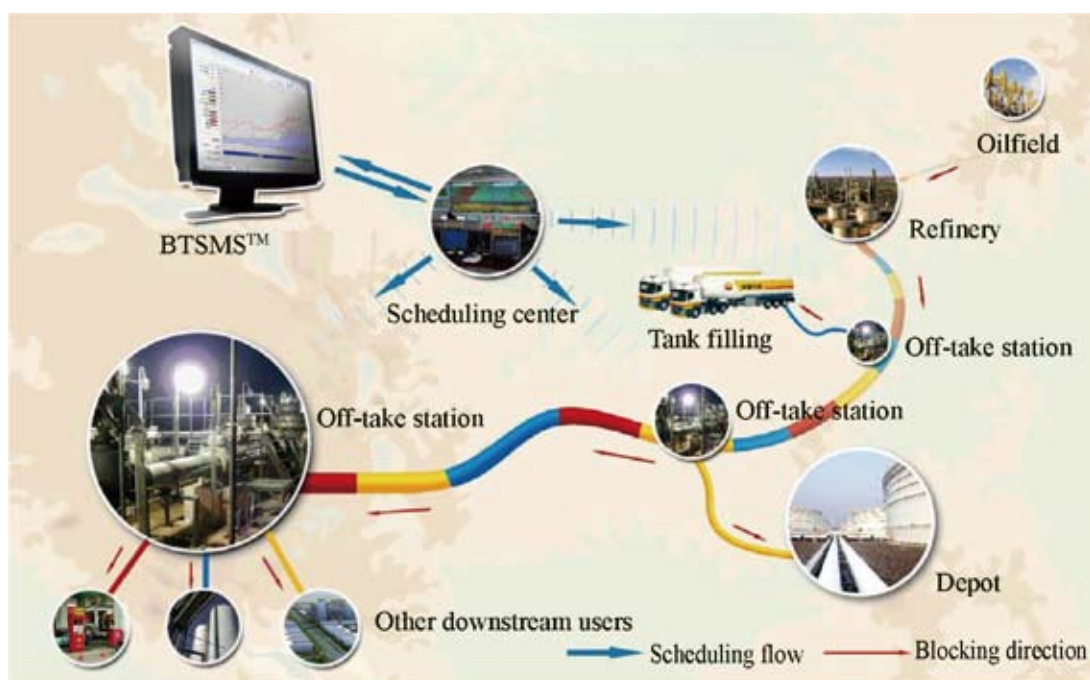
2.2.2 Oil and Gas Pipeline Simulation and Optimization Technology

Oil and Gas Pipeline Simulation and Optimization Technology is a numerical technology predicting and reproducing the running and control processes of oil and gas pipeline system. CNPC possesses the world-leading Oil and Gas Pipeline Simulation System™, which helps the customers analyze, establish and optimize the oil and gas pipeline operation plan; technological support to dispatching personnel training, with total emulation solution. The technology has been successfully used in the design and operation management for more than 20 oil and gas pipelines in China.



2.2.3 Batch Transportation Scheduling Technology

Batch Transportation Scheduling Technology is a scheduling technology by reasonably arranging the sequence and batch of oil to meet the balance of supply and demand of multiple oil sources and users. CNPC can utilize its proprietary Batch Transportation Scheduling Management System (BTSMS™) to provide solutions of the scheduling operation plan for customers, so as to increase the scheduling efficiency, minimize the volume of mixed oil and ensure the economy and safety of batch transportation.



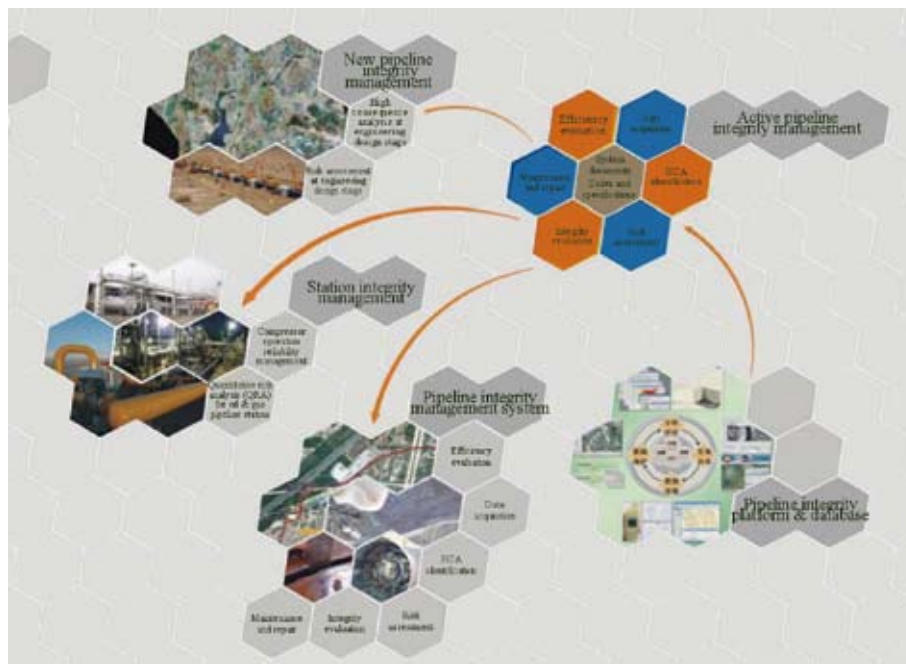
BTSMS™ can be used to quickly and accurately compile scheduling operation plan and ensure the safe and economical batch transportation.

2.3 Oil and Gas Pipeline Integrity Technology

Oil and gas pipeline integrity management is an integrated solution keeping the structures and functions of the pipeline system completely. CNPC establishes advanced and applicable pipeline integrity management mode, forms 6 proprietary technologies and provides the oil and gas pipeline integrity management and execution with various technological services and solutions.

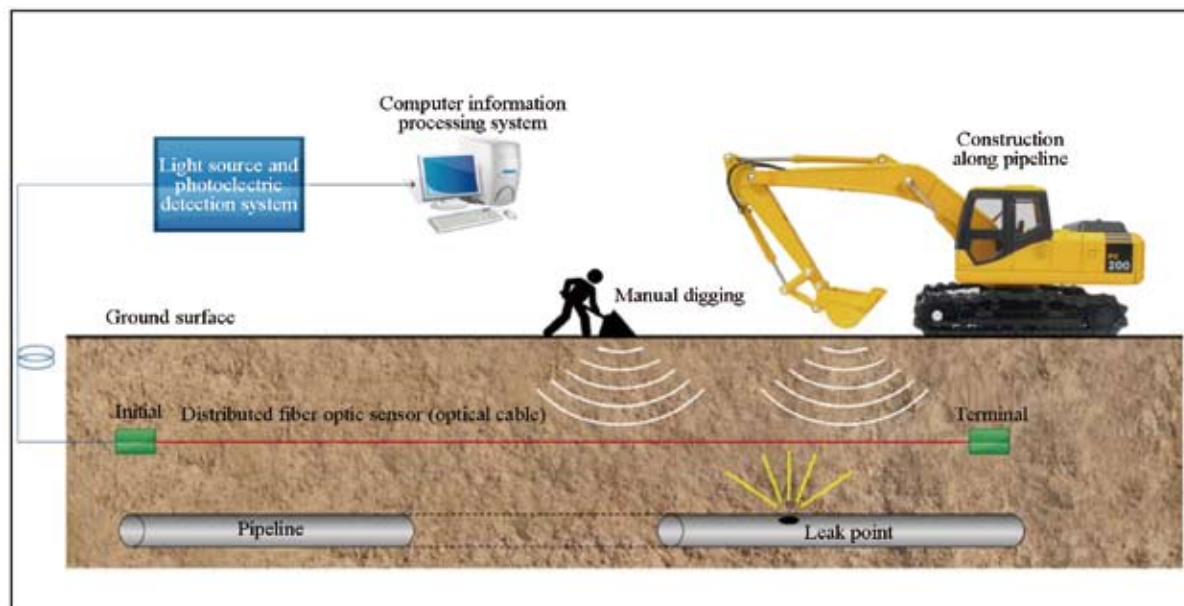
2.3.1 Pipeline integrity management system (cPIMS™)

Pipeline integrity management system (cPIMS™) is a technology establishing integrity management system and guaranteeing its effective execution. The technology ensures the cyclic execution of steps like data acquisition, high consequence identification, risk assessment, integrity evaluation, repair and maintenance and efficiency evaluation by establishing applicable integrity management document system, database and management platform, and controls the risk of the pipeline within the reasonable and acceptable scope. CNPC provides customers with pipeline integrity management solutions.

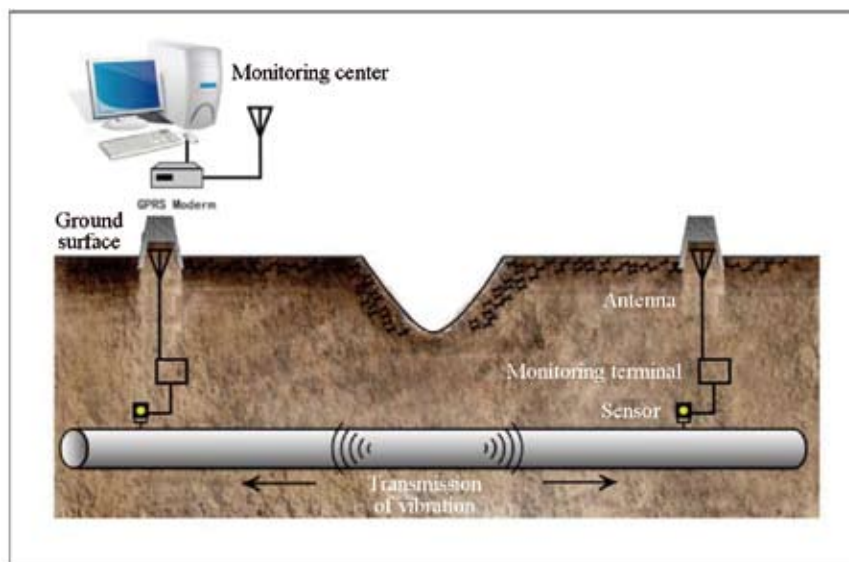


2.3.2 Early-warning and Leakage Detection Technology for Pipeline Safety

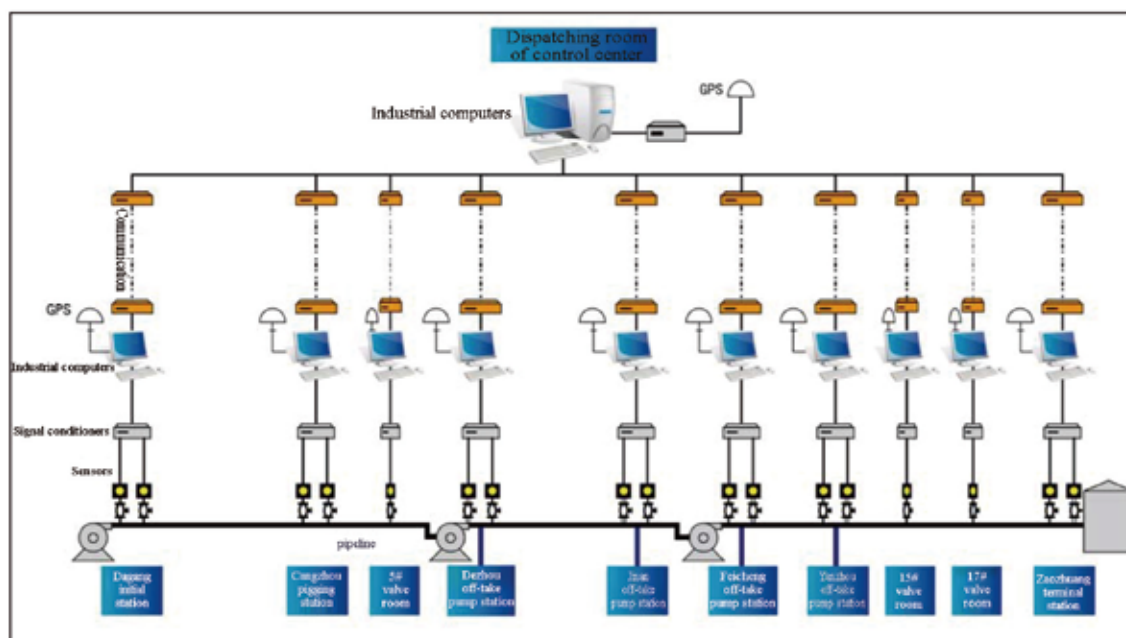
Early-warning and Leakage Detection Technology for Pipeline Safety is a technology conducting prior prevention and subsequent locating on the event of threatening pipeline security. For the incidents threatening the pipeline safety, such as the third party's destroy, corrosive cracking and geologic hazard, CNPC independently develops the distributed optical fiber compound early-warning system (cPFPS™), pipeline acoustic wave early-warning system (cPAPS™), geologic hazard early-warning system (cPGPS™) and pipeline leakage testing and positioning system (cPDLS™), which provide customers with graded systematic safety protection solutions in terms of different pipelines or different zones of the trunk lines, accident-prone zones and major protection zones of long-distance pipeline of crude, product oil and natural gas. Since it was put into practice in 2003, CNPC has used the technology to successfully make early-warning and accurately locate more than 40 times of pipeline threats and leak events.



Distributed optical fiber compound early-warning system (cPFPS™)



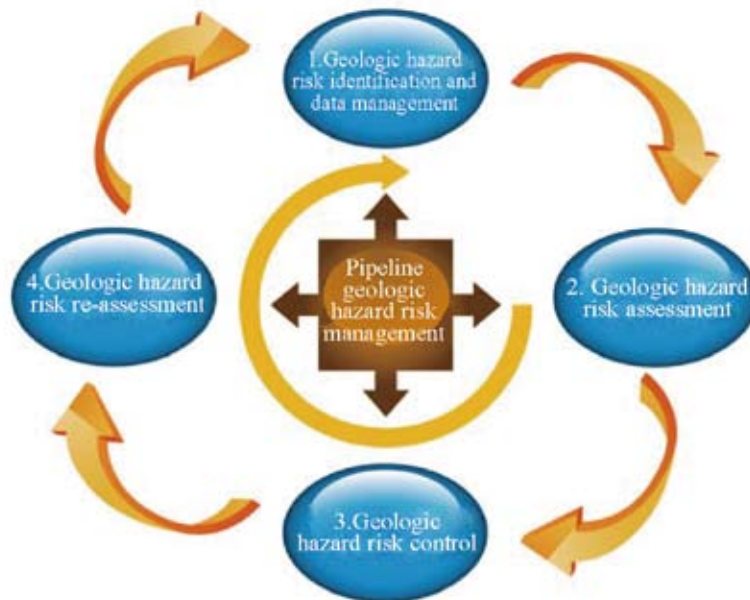
Pipeline acoustic wave early warning system (cPAPS™)



Pipeline leakage testing and positioning system (cPDLS™)

2.3.3 Pipeline geologic hazard risk management system

Pipeline geologic hazard risk management is a technology establishing geologic hazard risk management procedure and guaranteeing its effective execution. CNPC comprehensively utilizes the “3S” Technology (GIS, RS and GPS), THE Modern Risk Management and Computing Technology to develop the advanced pipeline geologic hazard risk management system (PGRM™), which can be used to realize the data management and risk assessment, rapidly identify the different geologic hazard risks in different zones along the pipeline, and provide the customers with total solution of pipeline geologic hazard risk control.



Integrated solution of pipeline geologic hazard risk control

2.3.4 Pipeline Corrosion Prevention System Evaluation Technology

Pipeline Corrosion Prevention System Evaluation Technology is a technology ensuring the integrity of pipeline corrosion prevention system and keeping its effectiveness. CNPC owns equipments like PCM and DCVG/CIPS to provide customers with the service to evaluate the pipeline corrosion prevention system and the system maintenance solution by utilizing ECDA method.

2.3.5 Oil Tank On-line Testing and Evaluation Technology

Oil Tank On-line Testing and Evaluation Technology is a technology conducting rapid testing and evaluation on the oil tank without opening it. It provides the technologies as a guidance for scheduling oil tank repair plan. CNPC has the advanced equipment like acoustic emission test instrument, by using the integrated method of parameters analysis and waveform analysis to identify and process the detected signals, provides oil tank on-line rapid testing and evaluation service and the solution for the oil tank repair plan for customers. The technology has been successfully used in the oil tanks for many oil transfer stations of CNPC, and saved a great deal of tank-opening repair costs.



DCVG Survey along the pipeline

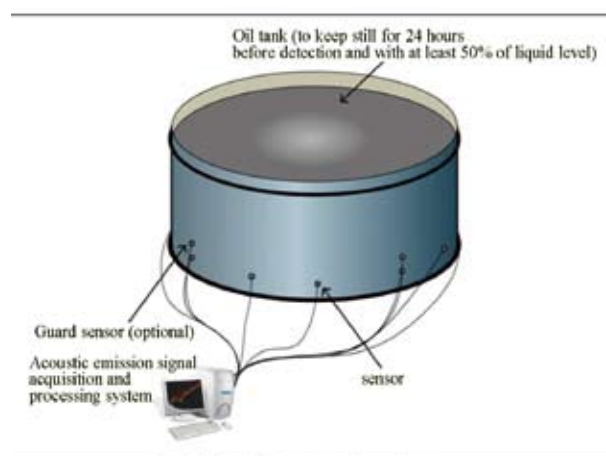


Diagram of oil tank on-line testing and evaluation

2.4 Testing and Maintenance & Emergency Repair Technology

2.4.1 Internal Pipeline Testing Technology

Internal Pipeline Testing Technology is a technology utilizing different testing equipment to obtain the relevant information of pipeline. The technology is used to detect the existing or potential hazards of the pipeline and the damages of pipeline.

CNPC provides customers with technological services and consultations, like internal testing of pipeline magnetic leakage corrosion, pipeline deformation testing, pipeline pigging, testing and evaluation of external coating of buried pipeline, and testing of buried depth of underwater pipeline. Moreover, CNPC may provide top-quality pigs and associated devices to satisfy customer's requests.



2.4.2 Station Pipeline Defect Examination and Evaluation Technology

Pipeline Defect Examination and Evaluation Technology is a technology utilizing non-destructive testing instrument and corresponding evaluation method to guarantee the integrity of pipeline structures. The testing equipments like internationally advanced ultrasonic guided wave and phased array possessed by CNPC can provide the location, qualitative and quantitative analysis of pipeline defect for customers, as well as the evaluations of the residual strength and life of defect-existed pipelines. The technology has been successfully used in defect testing of several trunk pipelines and pipelines at tens of oil and gas transmission stations in China.



Utilizing ultrasonic guided wave testing equipment to test the defect of pipelines at the station

2.4.3 Pipeline Emergency Repair Technology

Pipeline Emergency Repair Technology refers to the planned maintenance and reconstruction of oil and gas pipelines and the emergency salvage in case of incident (emergency repair under pressure), the replacement of corroded pipe sections, the adding of devices and the reconstruction of off-take stations, etc.

CNPC has the most complete hot tapping and plugging equipments in Asia, applicable for various pipe diameters. It can provide on-line pipeline maintenance and emergency repair services for customers, such as tapping, plugging, replacement and remedy. Plugging operation is applicable for DN30-1,500mm diameter, 0-15MPa media pressure and -30-+250°C media temperature.



Hot plugging operation

2.5 Equipment and Production

CNPC possesses the powerful development capability of pipeline equipment and production, and forms serial pipeline welding equipment, pipeline safety early-warning system, pipeline chemical additives, fittings, heaters used at the station, etc.

2.5.1 Pipeline welding and associated equipment

PCM-A pipeline multifunctional cutting machine is carried out in field as an apparatus specializing in cutting bevels, adaptor spools or test pipe bevels of long-distance oil and gas pipelines.



PFM pipe end shaping machine is mainly used for processing special bevels during pipeline welding, and an auxiliary apparatus of full-automatic welding in long-distance pipeline construction.



PPC pipeline pneumatic internal clamp is the special equipment for line up in the piping construction.

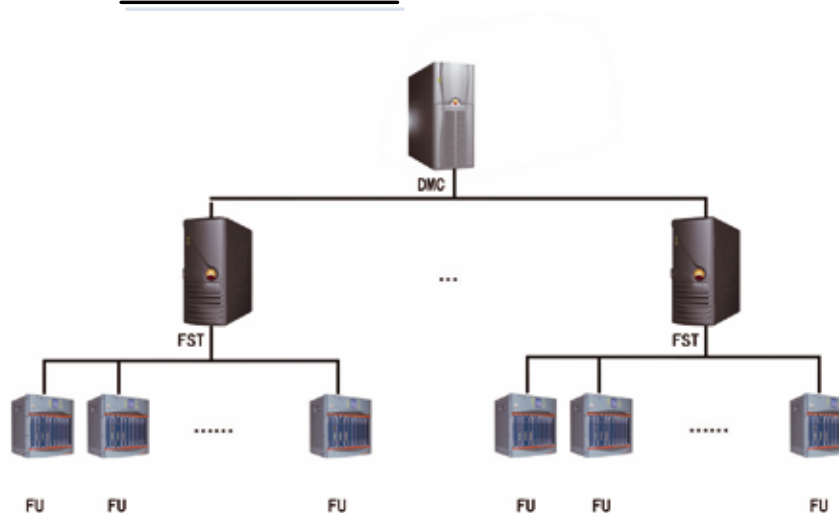
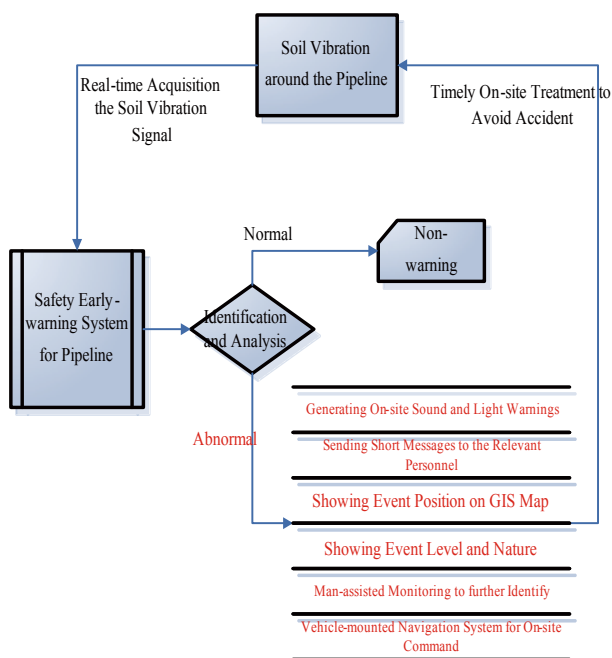


PPC-GA gap-adjustable pipeline pneumatic internal clamp is the special equipment for line up in the piping construction. It adopts brand new cylinder construction, and its tension is two to three times of the common internal clamp.



2.5.2 Pipeline optical fiber safety early-warning system

Pipeline safety early-warning system utilizes the optical communication cable which laid at the same trench of pipeline as the distributive soil vibration detection sensor to conducts long distance, continuous and real time monitoring on the soil vibration instances along the oil and gas pipeline so as to conduct early-warning and accurate location on the events that are possible to endanger the pipeline security.



2.5.3 Distributed optical fiber compound early-warning system (cPFPS™)

cPFPS™ has successfully solved the bottleneck of traditional distributed optical fiber early-warning techniques, that is, the signals cannot be processed section by section and the sensitivity of induction on vibration is low, by synthetically utilizing optical fiber early-warning technology and sound oscillation early-warning technology, realizes breakthrough on early-warning advance time and signal identification accuracy. The unidirectional protection distance of the system is 60km, and bidirectional protection distance is 120km which accomplish the zonal security protection among stations with 120km spacing; the location accuracy of the system is 80—600m and alarm accuracy rating is more than 90%. The system has been put into commercial application in many pipelines like Dagang-Jinan-Zaozhuang.



Terminal of pipeline optical fiber composite early-warning system

2.5.4 Pipeline acoustic wave early-warning system (cPAPS™)

As for cPAPS™, the alarm accuracy rating within protective zone is more than 95%, the false alarm rating is less than 1%, and it has been put into application in pipelines of Dagang-Zaozhuang, Tieling-Dalian, Qinhuangdao-Beijing and Lanzhou-Chengdu-Chongqing. cPAPS™ is suitable for the real time alarm and location of the events threatened the pipeline safety like pipeline anticorrosive coating destruction, knocking, boring and illegal excavation easily occurred in the oil stealing zones.



2.5.5 Pipeline leak testing and positioning system (cPDLS™)

Based on the sound wave and suction wave sensing technologies, cPDLS™ is able to give an alarm in time and accurately locate the tiny leak along the pipeline, and it possesses the advantages like rapid response, timely alarm and simple installation and arrangement. cPDLS™ has been successfully used in the long-distance crude and product oil transmission pipelines which are governed by CNPC.



Sensor unit at the station

2.5.6 Chemical additives of pipeline

Chemical additives of pipeline mainly indicate drag reducer and pour point depressant.

Drag reducer is a chemical additive which can effectively increase the pipe capacity and reduce the pipe pressure at specific periods and sections.

The annual output of EP serial drag reducer™ produced by CNPC can reach 5,000m³, and CNPC is one of the three largest drag reducer manufacturers in the world. The EP-A, EP-O, EP-P and EP-S serial oil product drag reducers developed independently by CNPC can increase the pipe capacity of crude by 15%-30% and that of product oil by 30%-50% at the dosage of 15-30ppm. The products are environmental protection and innoxious, and do not

influence the quality of oil product. CNPC can also provide customers with the assorted drag reducer injection and drag reducing performance evaluation services.

KS-30-01 serial drag reducers produced by CNPC are a kind of jelly composed of drag reducing polymer, dispersant and dispersive media. When the products are injected into the pipeline, the polymer is rapidly dissolved in the crude. This suppresses the turbulence of crude occurred in flow and realizes the role of drag reducing.

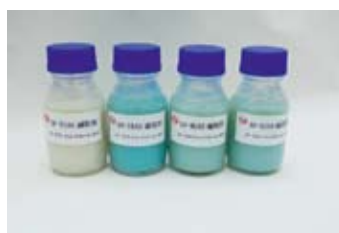
The major roles of pour point depressant are to reduce the pour point of crude and the viscosity of it at low temperature section and improve the mobility of crude.

EP serial pour point depressant is also produced by CNPC, can reduce the pour point of crude by 10-20°C, the viscosity of crude by more than 70%.

It meets customers' requirements of transmission at atmospheric temperature with low capacity.



EP-A drag reducers



EP-O drag reducers



EP-P drag reducers

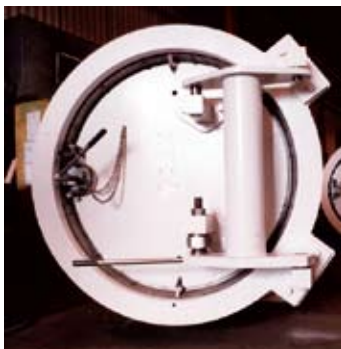


EP-S drag reducers

2.5.7 Fittings

Fittings refer to the spare parts of the piping system. It is used for direct connection, turning, branch, size change and butt, including elbow, tee joint, cross joint, reducer, pipe clamp, bushing, union, quick joint, screwed nipple, o-let, pipe plug, pipe cap, blind ram and so on (exclusive of valve, flange, fastener and gasket).

CNPC has the largest elbow and pipe fittings production line in Asia, manufacturing the elbow by using X80 steel grade with $\phi 1,620\text{mm}$, and the wall thickness below 40mm and angle below 95°, as well as pipe fittings made of various materials and used for various purposes (including dual straight slit elbow, tee joint, reducer and pipe cap).



Quick-release blind



Large pipe bender

2.5.8 Skid-mounted unit at the station

Skid-mounted unit is assembled integrately. As an integrated supply system, the skid-mounted unit is mainly composed of two parts: skid bed, equipment carrier and instrument bracket, and flowmeter, pressure regulator, valve, instrument control system and pipeline. The pressure regulating

and flow metering system is an important part of the skid-mounted unit. The skid-mounted equipment is fixed collocation, supplied as per skid, automatically collects the operational parameters and is extensively used in the construction of natural gas pipe net and trade handover.



Skid-mounted unit at the station

2.5.9 Heater

Vacuum heater of LNG pipeline natural gas concurrent heating

Vacuum heater is worked by using vacuum phase transition heat exchange mode. The condensation heat is transferred to the heated working media in the coil as the gas phase space through the vaporization heat evaporation of intermediate agent (e.g. water, organic liquid).

Water jacket heater of LNG pipeline natural gas concurrent heating

Water jacket heater is one of the fire barrel heaters. The fuel burns and produces high temperature fumes; and the high temperature fumes transfer the heat to the heated media by radiation mode through fire tube, and convection mode through flue tube.



5000kW direct heater

2.5.10 Carbon fiber composite repair materials for the pipe body defect (CERP™)

CNPC can provide customers with the carbon fiber composite repair materials for the pipe body defect (CERP™), and the pipe body reinforcing service is offered without using fire.



Tensile strength of the repaired pipe body is more than 2,500MPa

2.5.11 Pipeline automatic polyureas spray machine (PASA™)

The HL-I Pipeline automatic polyureas spray machine and the overhaul service are provided for anticorrosive coating of in active service pipeline.

The machine is suitable for automatic spray of bicomponent anticorrosive paints like polyurea.



2.5.12 Thermal shrinkable sleeve infrared heater (Thermo-RSeal™)

CNPC provides customers with the Thermo-RSeal™ type Thermal shrinkable sleeve infrared heater and the repaired mouth welding service of pipelines are being laid.

The Thermo-RSeal™ type Thermal shrinkable sleeve infrared heater is suitable for sleeve heating and weld preheating of pipelines with maximum diameter of 1,219mm.



2.5.13 Pipeline leakage control and recovery machine™

CNPC can provide the customers with the device of the pipeline leakage control and recovery machine. The device possesses the characteristics of high recovery efficiency, explosion proof of complete machine and remote wireless operation, and is suitable for the salvage of high pressure pipeline leak.

The device as shown below can recover the leaked fluid with high leak pressure (leak diameter should be less than 20mm, and pipeline pressure of less than 8MPa).

2.5.14 Patented technologies

CNPC possesses 232 invention patents, 458 innovative utility patents and 110 registered software in pipeline engineering. By utilizing the most skillful, applicable, economic and effective oil and gas pipeline engineering construction technologies, CNPC will serve the global oil and gas transmission and utilize the globally advanced, assorted and applicable oil and gas pipeline transmission and storing technologies for the world oil and gas energy transmission solutions with the most safe and high efficiency.



3

TYPICAL CASES

3.1 The Second West-East Gas Pipeline Project

The total trunk line length of the Second West-East Gas Pipeline Project is 9,102km, among which the trunk line of 4,843 km with the pipe diameter of 1,219mm, the steel grade of API5L X80 and the maximum designed pressure of 12MPa. It is the most complicated gas pipeline construction project in China up to now. The geologic condition along the pipeline is complicated and diversified as it passes various landforms like desert, Gobi, salty soil, loess gulch, mountainous area, hill, plain and water net. The transportation and communication as well as construction operation conditions are tough. The pipeline crossed large rivers like the Yangtze River and the Yellow River for more than 200 times, and more than 70 mountain tunnels were constructed when crossing the Tianshan Mountain and the hills south to the Yangtze River.



3.2 Western Crude and Product Oil Pipeline Project

The total trunk line length of the Western Crude and Product Oil Pipeline Project is 1,842km, and duplex pipelines were laid in the same trench. The diameters of crude pipelines are 610mm, 711mm and 813mm; and the diameters of product oil pipelines are 559mm and 508mm. The steel grade is API5LX65, the design pressure is 8.0MPa and locally 14.0MPa. The pipelines go from Urumchi of Xinjiang Uygur Autonomous Region to Lanzhou of Gansu Province.

The project adopts numerous internationally advanced technologies and experiences in design, construction and management, as the crude and product oil pipeline project with the highest technical level in China, it adopted EPC general contract mode and took 27 months for the pipelines to be constructed and put into production.



3.3 East-West Gas Pipeline Project in India

The total trunk line length of the East-West Gas Pipeline Project in India is 1,386km, the pipe diameter is 1,219mm, the steel grade is API5LX70, the wall thickness is 17.2~25.4mm, and the design pressure is 10MPa. The pipeline goes from Kakinada of Andhra Pradesh at east coast of India to Bharuch of Gujarat at west coast.

CNPC adopted numerous new technologies of management and construction in the project construction, undertook the construction of most pipelines crossing 6 large rivers. The total length of pipeline constructed by CNPC is 1,088km. It took 10 months for CNPC to construct the pipeline and it was accomplished on schedule.



3.4 East Siberia – Pacific Ocean Pipeline Project in Russia

The total length of Aldan section of East Siberia – Pacific Ocean Pipeline Project in Russia is 170km, the pipe diameter is 1,219mm, the steel grade is API5LX70 with the wall thickness of 16-27mm. The pipeline goes from the northwest of Aldan to the Tengda region of Dastanov Mountain. The climate in the pipe laying region is extreme continental climate: it approaches -65°C in winter and 15-20°C in summer, as the largest difference in temperature in the world. The region passed by the pipeline rises and falls largely, and predominated by hill and virgin forest. As of geologic conditions, 70% is stone, 10% swamp and 20% soil aggregate and inferior soil aggregate. Most pipelines were laid in the region with seismic intensity being more than 8. The pipeline crossed 3 large rivers and 32 medium and small rivers as well as seasonal streams.

CNPC tackled numerous problems in the construction, and successfully accomplished it in 17 months.

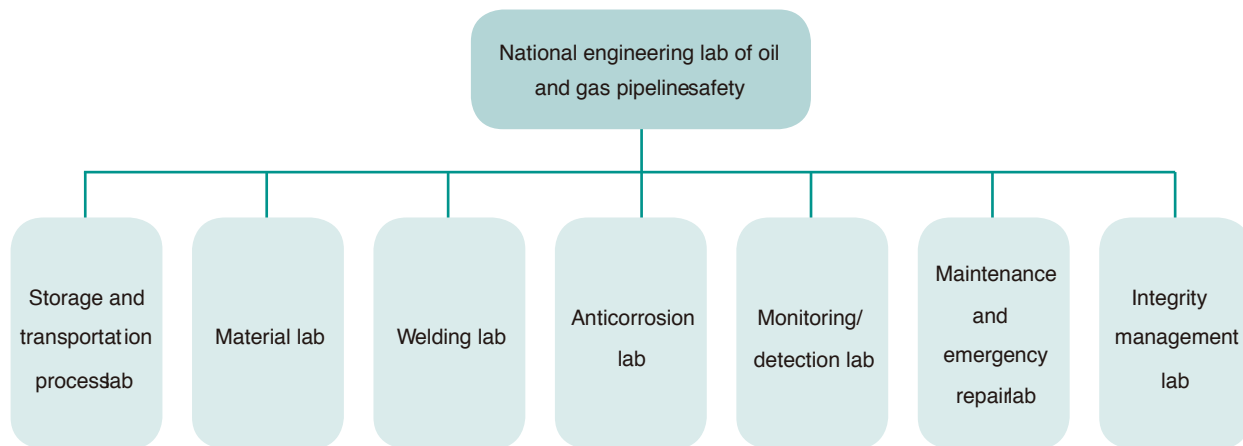


4

SCIENTIFIC RESEARCH EQUIPMENT

4.1 National Engineering Lab of Oil and Gas Pipeline Safety

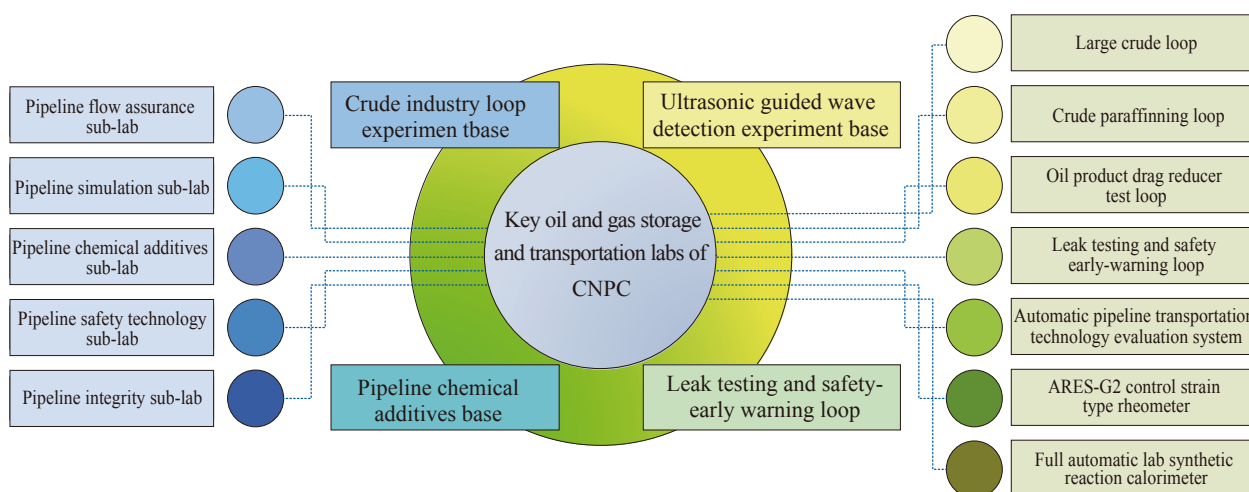
National Engineering Lab of Oil and Gas Pipeline Safety is the country-level engineering lab governed by CNPC, and it is composed of seven professional labs.



4.2 Key Oil and Gas Storage and Transportation Labs

Key oil and gas storage and transportation labs take oil and gas pipeline flow assurance technology and oil and gas pipeline security technology as the main research directions, and can conduct oil and gas storage and transportation techniques study like pipeline flow assurance, pipeline chemical additives and pipeline security testing and evaluation. The capabilities of the lab like physics and chemistry detection of crude, product oil and anticorrosion and insulation materials have passed ISO17025:2005 authentication and China national lab approval qualification is mutually admitted in the world (iLac-MRA/CNAS).

The lab sets five professional sub-labs, possesses the advanced equipments include crude pipeline flow assurance experiment loop, automatic pipeline transmission technology evaluation system, full automatic lab synthetic reaction calorimeter and control strain type rheometer, and establishes the experiment bases like large crude loop, pipeline chemical additives developing, leak detection and safety early-warning loop, and ultrasonic guided wave detection.



4.2.1 Crude industry loop experiment base

Crude industry loop experiment base is the largest crude pipeline transportation industry experiment base in Asia. A large crude pipeline transportation industry experiment loop integratedly designed with the long-distance transmission pipeline is established in it, and the crude can be injected directly from the long-distance transmission pipeline to conduct crude flowage and flow behavior study as well as crude paraffinning law test study.



4.2.2 Pipeline chemical additives base

Pipeline chemical additives base is established with oil product drag reducer test loop, natural gas drag reducer test loop, physics and chemistry analyzing lab and other experiment facilities, conducts the detection, analysis and performance evaluation on raw materials of chemical additives, synthetic progress products and the finished products.



4.2.3 Leak testing and safety early-warning loop

Leak testing and safety early-warning loop is the first leak testing and safety early-warning test loop in China, with the length of 3.6km. The conveyance media realizes the transition of liquid and gas. The loop can be used to conduct pilot plant test study on the pipeline leak detection technique, the safety early-warning technique and the pipeline anticorrosion technique.



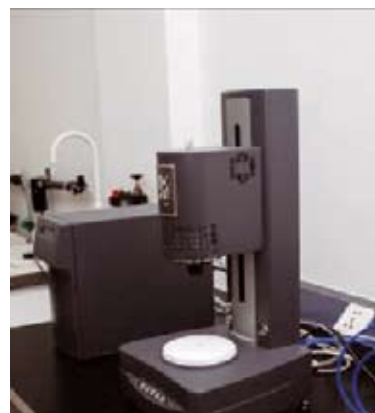
4.2.4 Ultrasonic guided wave detection experiment base (Ultrasonic guided wave international cooperation lab and training center)

Simultaneously serving as the ultrasonic guided wave international cooperation lab and training center, the base establishes cooperative relationship with many international enterprises and technological institutions like British Guided Wave Company, and jointly conduct study and extension of the ultrasonic guided wave technology in Asia. The base has been equipped with nondestructive testing equipments like ultrasonic wave, ultrasonic guided wave, phased array, TOFD and turbulence, has been established with full-scale simulation test pipeline like buried, overhead and crossing, and is able to realize the detection, diagnosis and analysis test study of various kinds of defects.



4.2.5 Testing equipments and instruments

The lab is equipped with many high-end testing equipments like differential scanning calorimeter, polarized light microscope, full automatic lab synthetic reaction calorimeter, laser particle size analyzer, Fourier infrared microscope, ARES-G2 control strain type rheometer, full automatic pour point instrument, scanning probe microscope and gas/liquid chromatograph. It is able to conduct various customized test study based on different requirements.



5 QUALIFICATIONS AND STANDARDS



In 2002, CNPC was certified by China Qualification Assessment National Approval Committee Laboratory (iLac-MRA/CNAS ISO/IEC 17025).

CNPC has worked out 35 national and industrial standards related to oil and gas pipeline, and introduces the advanced standards of America and Europe to conduct pipeline design and construction in the international pipeline project construction.



6

SPECIALISTS TEAM



Li Helin Academician of the Chinese Academy of Engineering, material scientist, and OCTG engineering specialist. He has been engaged in scientific and technological work of petroleum steel and petroleum pipe engineering for a long time, and is one of the main initiators of CNPC tubular goods research work. He put forward and established “Petroleum Pipe Engineering” subject, carried out a great deal of systematic and creative studies, and lead to develop more than 10 new materials. There are 3 study results adopted by many important petroleum pipe manufacturers abroad, 6 results accepted by API to modify the relevant standards. He had published 7 monographs and 170 papers both at home and abroad.



Chen Qingxun Professor, pipeline storage and transportation technological design specialist. He has been in charge of the important projects as a design leader both in China and abroad like the West-East Gas Pipeline Project and as a project leader in Libyan Pipeline Project. He has also organized the implementation of important projects in India, Thailand and Russia.



Wang Weiguo Professor, standing vice-president of National Engineering Lab of Pipeline Transportation Safety, pipeline storage and transportation technologist. He has organized the design and scientific research for many pipeline projects both in China and abroad, and acted as a project leader of Central Asia Pipeline Construction Project.



Liu Weimin Professor, senior oil and gas storage and transportation technologist, expert enjoying special government allowance. He has organized numerous pipeline construction projects abroad, such as Sudan and Libya.



Gao Zetao Professor, senior welding technologist, expert enjoying special government allowance. He has managed the study of key technologies for some important pipeline projects, such as the West-East Gas Pipeline Project and the second West-East Gas Pipeline Project.



Yang Zupei Professor, tutor of doctoral students, expert enjoying special government allowance, member of specialist team of China National Security Production, deputy chief and general secretary of Petroleum Storage and Transportation Professional Committee of CPS, deputy chief of China Oil, Gas and Pipeline Standards Committee, part-time professor of China Petroleum University and Southwestern Petroleum University. He has always been engaged in oil and gas storage and transportation technology research; as the first principal, he has led the special research of key scientific and technologies of the second West-East Gas Pipeline Project. More than 20 academic papers were published.



Ai MUYANG Professor, expert enjoying special government allowance, senior oil and gas storage and transportation technologist. He has always been engaged in oil and gas storage and transportation technology research; led the special research of key scientific and technologies of the second West-East Gas Pipeline Project. More than 10 academic papers were published.



Li Guoping Doctor, senior oil and gas storage and transportation technologist. He has always been engaged in pipeline chemical additives study; as the chief principal, he has undertaken the study of numerous key subjects like oil and gas pipeline security operation and storage technology, pipeline drag reducer and freeze point depressant. More than 10 academic papers were published.



Feng Qingshan Doctor, senior oil and gas storage and transportation technologist. He has always been engaged in long distance pipeline integrity management study and took part in the special research of key scientific and technologies of the second West-East Gas Pipeline Project. More than 10 academic papers were published.



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