Pipeline Test & Safety Forewarning Technology

Science & Technology Management Department

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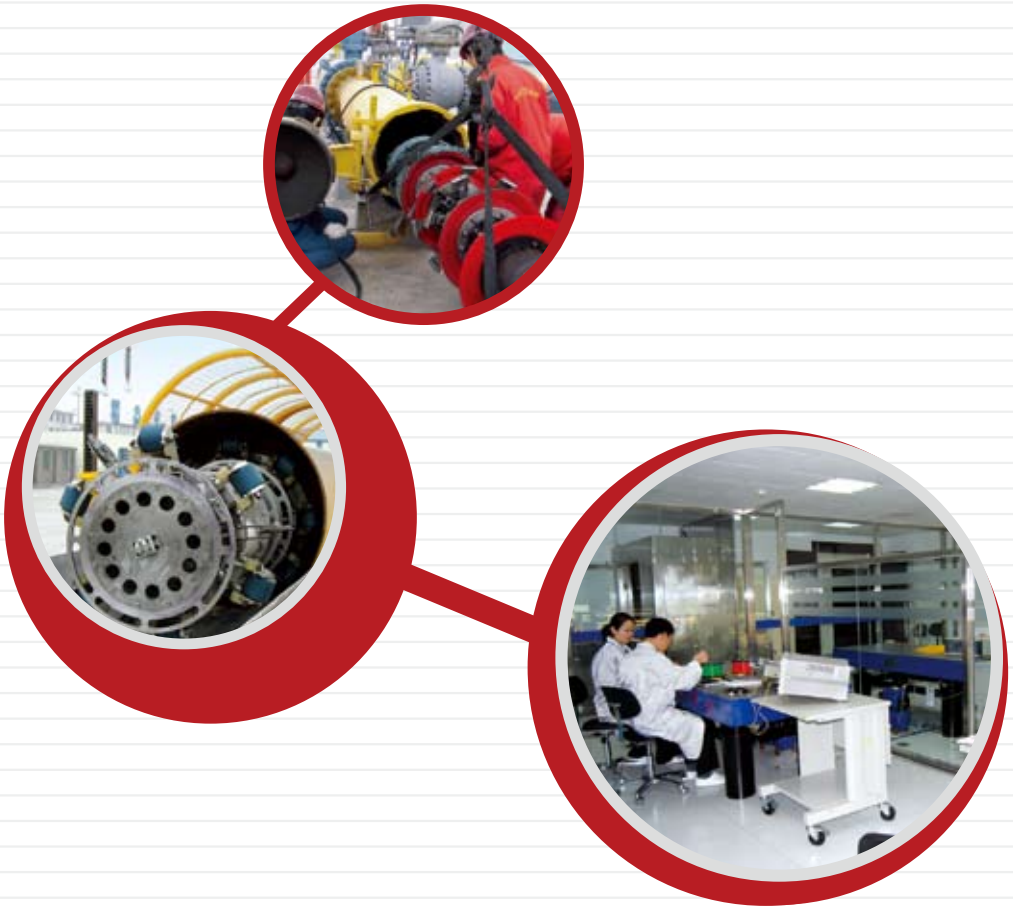

CHINA NATIONAL PETROLEUM CORPORATION

The Pipeline Test & Safety Forewarning Technology is the guardian for safe pipeline operation!

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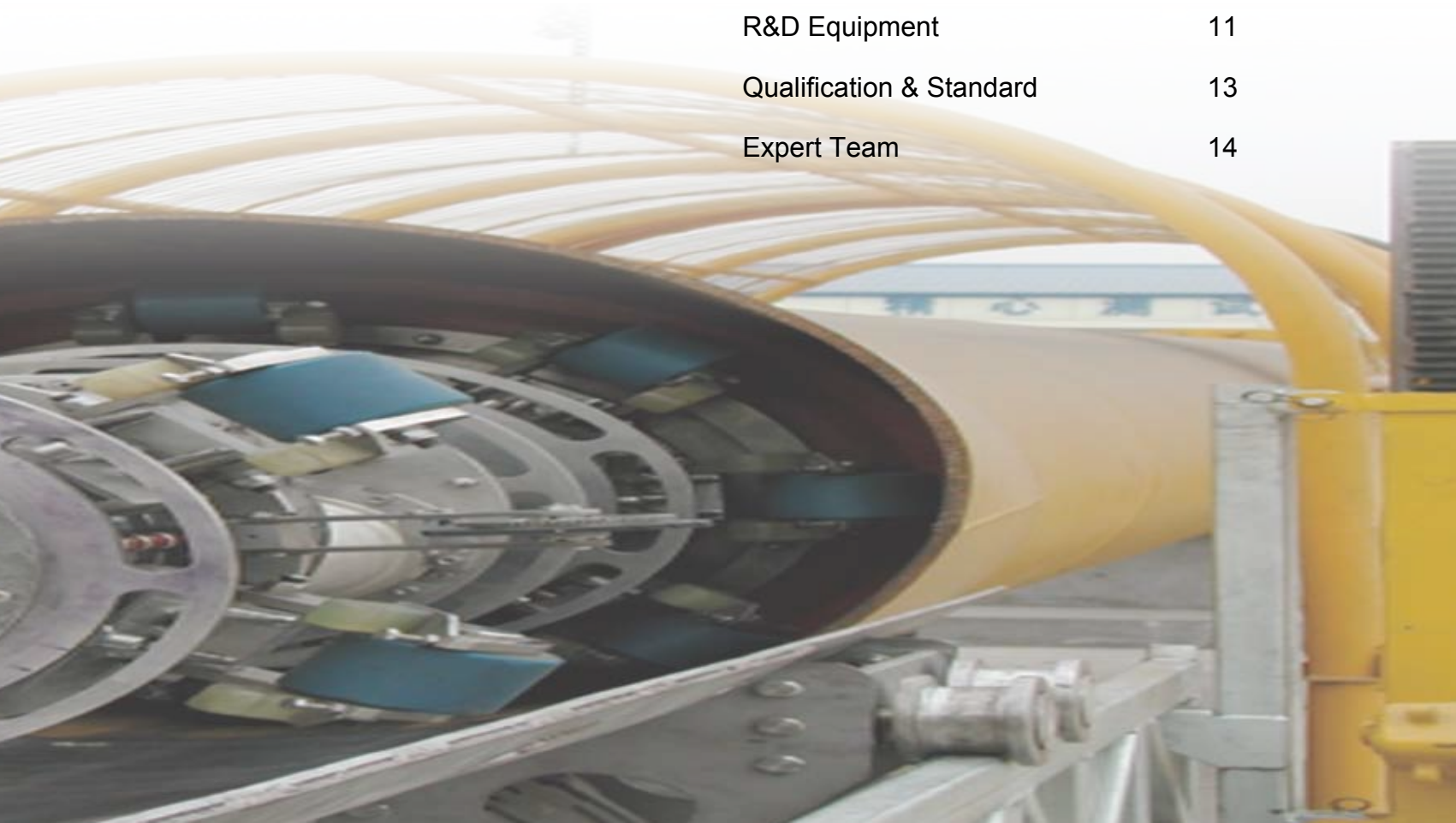


China National Petroleum Corporation (CNPC) is a state-authorized investment agency and a state holding company. As an integrated oil company of cross-regions, cross-industries and cross-countries, it adopts modern enterprise system to realize the integration of upstream and downstream operations, internal 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 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.

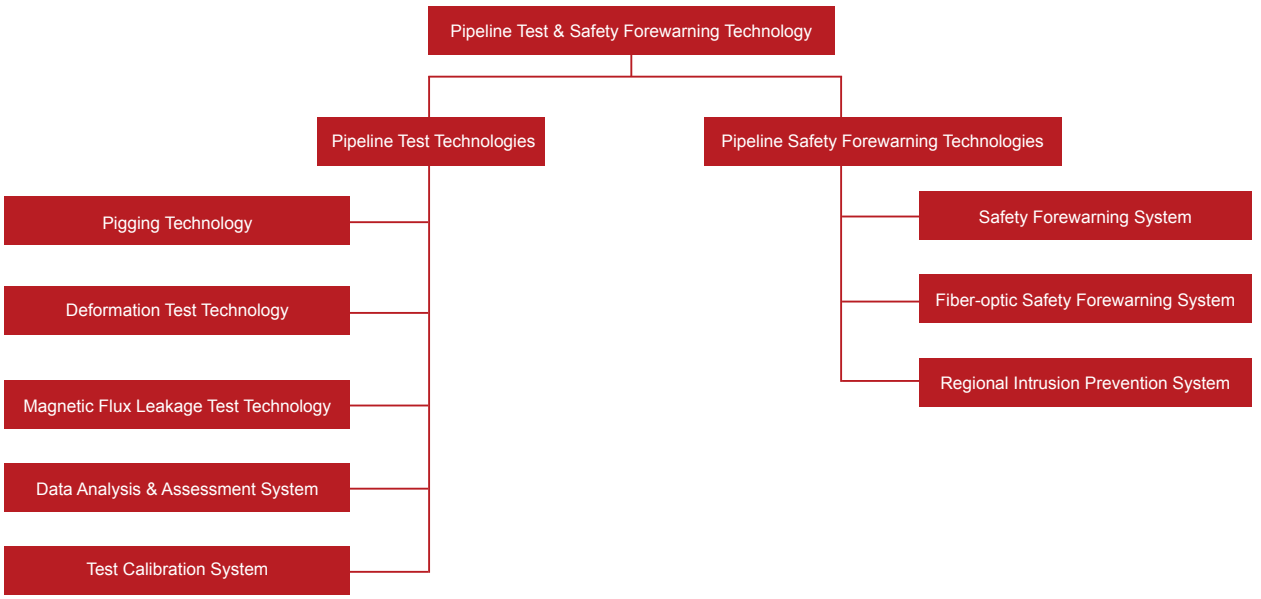
The Pipeline Test and Safety Forewarning Technology is one of representatives for major innovations of CNPC.

CLEAN ENERGY SUPPLY FOR BETTER ENVIRONMENT

1 INTRODUCTION

The Pipeline Test & Safety Forewarning Technology is an important method to ensure the safe operation of oil and gas pipelines. CNPC delivers services such as oil & gas pipeline pigging, deformation test, high-definition magnetic flux leakage test and provides the customer with a complete data analysis report. The High-definition Magnetic Flux Leakage Tester for Pipeline has been successfully researched and manufactured to fill up the gap of pipeline test technology in China.

Technologies with respect of photoelectronics, laser, fiber optic sensing and pattern recognition are first combined in The Pipeline Safety Forewarning System for safety forewarning of damage events that threaten the safety of oil and gas pipelines (a brand new forewarning technology). As an important method to ensure the safe operation of oil and gas pipelines, the Pipeline Safety Forewarning System was listed by Ministry of Science & Technology of PRC as an item of The National High Technology Research and Development Program of China ("863 Program") in 2007, also, as a national engineering laboratory item by National Development and Reform Commission and evaluated as a national key new product by Ministry of Science & Technology of PRC, Ministry of Commerce, General Administration of Quality Supervision, Inspection and Quarantine of PRC, and State Environmental Protection Administration in 2008. CNPC has professional R&D, consultation and service teams who can provide users with perfect products, services and integrated solutions.



Pipeline Test & Safety Forewarning Technology

2 UNIQUE TECHNOLOGIES

(1) Pipeline Test Technologies

Such technologies are used for acquisition of relevant pipeline information and detection of pipeline damages, hazards or potential risks with different testing devices.

Pigging Technology

The Pipeline Pigging Technology is used for removing foreign matters inside the pipeline in such a process that the delivery device, by the sending apparatus, delivers the Cleaning Pig into the pipeline, the Cleaning Pig is then pushed for operation inside the pipeline by means of the difference of pressure before and behind the Cleaning Pig. Pipeline pigging is classified into three categories: regular pigging, calliper pigging and special pigging. The Pipeline Pigging Technology is extensively applied in pipeline installation and operation.

Cleaning Pigs

Pipeline Deformation Test Technology

The Pipeline Deformation Test is an onsite test on the pipeline with the Deformation Tester to determine the size and location of dents, wrinkles and ovality that arise from pipeline deformation, acquire and store the pipeline deformation information and finally process and analyze the pipeline signal. It provides the basis of safe pipeline operation. The deformation test service for 8" ~ 48" steel pipelines that transport different media can be provided.

Delivery of the Deformation Tester

Magnetic Flux Leakage Test Technology for Pipeline Corrosion

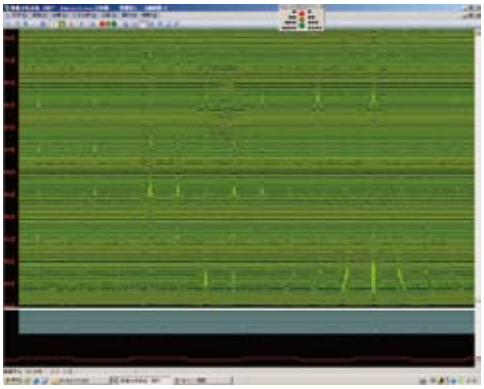
The Magnetic Flux Leakage Test Technology for Pipeline Corrosion is an onsite test carried out inside the pipeline on metallic damages (such as spot, pit and large-area corrosions) to the steel pipeline by operation of the Magnetic Flux Leakage Tester for Corrosion in the pipeline to determine the size and location of metallic damages on inside and outside pipe walls, which provides the basis of safe pipeline operation and pipeline maintenance management.

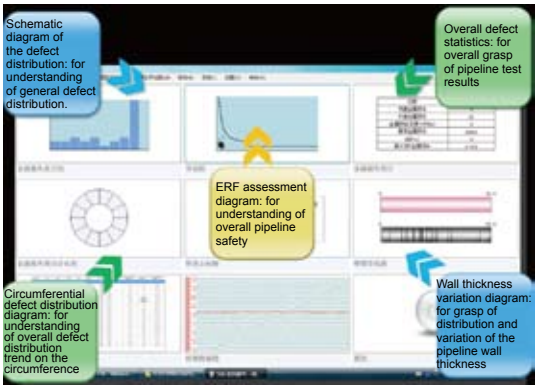
The Magnetic Flux Leakage Test Technology for Pipeline Corrosion is mainly used for corrosion test on inside and outside walls of the in-service pipeline and baseline test on the new pipeline. By this technology, the in-service oil and gas pipelines of 8" ~ 48"can be tested accompanying with the assessment and analysis report for pipeline integrity.

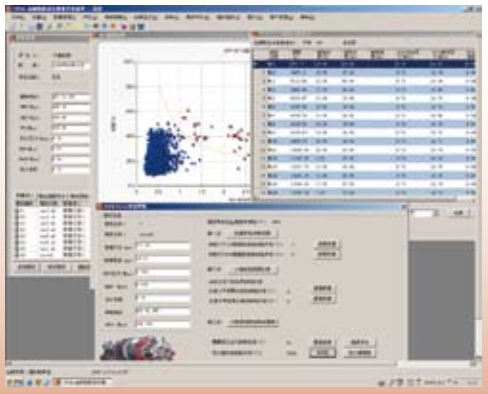
Data Analysis & Assessment System

The Data Analysis System is used to analyze and calculate the data acquired by various pipeline testers and determine the size, location and nature of the defects detected. The system consists of several modules including Graphic Data Module, Defect Identification & Measurement Module, Manual Analysis Module, Analysis Result Summarizing & Report Module, and Engineering & User Management Module.

The GIS-based Outcome Test Software can be supplied to the pipeline operators; the combination of test outcome and geographical information achieves digital pipeline management and pipeline integrity management.



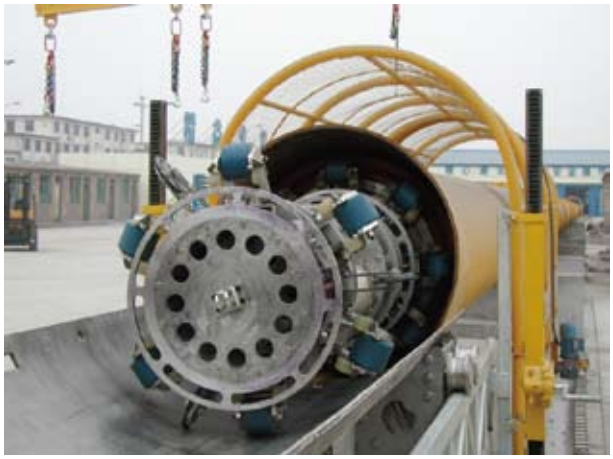




Test Calibration System

The Test Calibration System is mainly used for calibration test on the testers for 8" ~ 48" pipelines. It can verify the tester's manual test feedback result of defects with different types, shapes and sizes at different traction speeds and its performance, increase safety reliability of industrial site application and meet the test demands in different working conditions. The tests for performance, mechanical passage capability and safety reliability are covered. The unit is a hi-tech product integrated by mechanics, electrics and hydraulics and characterized by high speed, heavy duty and high power.

The optimal experimental program and technical service are available for different testing devices in the pipeline based on users' demands.



Tester Calibration Test

(2) Pipeline Safety Forewarning Technologies

Pipeline Safety Forewarning System

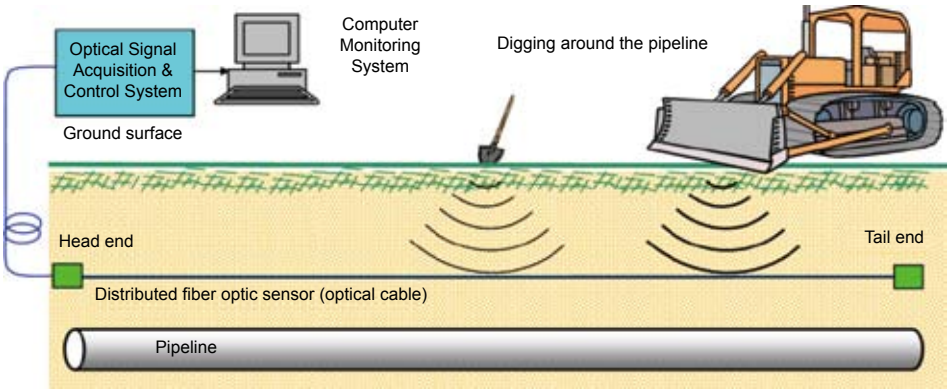
Actually, the pipeline is threatened by more and more outside damages. Most existing technologies used are for the leakage tests after pipeline damage, since the loss caused by pipeline leakage or explosion is inestimable. As an innovation, the Pipeline Safety Forewarning System uses a brand-new forewarning technology.

This system is designed for outside pipeline damages, but it can be also applied in confidential communication, forewarning of outside damages on optical cable, etc. and extended to the usage in important sites such as military base, leading government agency, chemical plant, nuclear power plant, oil depot, etc. It provides monitoring and protection to optical cables and pipelines.

The Pipeline Safety Forewarning System has the capability of forewarning and provides accurate locating and high precision. It can detect timely the accidental events that threaten the pipeline such as digging event and leakage of oil and gas pipelines, etc. to prevent the occurrence of pipeline accidents.

Pipeline Safety Forewarning Unit

Pipeline Safety Forewarning System



Schematic Diagram of System Structure

The Pipeline Safety Forewarning System can make real-time monitoring and accurate positioning of the micro-vibration signal sent by threatening events along the buried pipeline (such as illegal construction around the pipeline, man-made damage to the pipeline, natural disaster, etc.) and provide smart identification of such threatening events types and warning thereof. This system is a new pipeline safety forewarning system that can protect pipeline safety effectively with preventative measures.

The Pipeline Safety Forewarning System has the advantages such as long monitoring distance, high sensitivity, stable performance and simple operation. The following is the schematic diagram of system structure.

Regional Intrusion Prevention System

The Regional Intrusion Prevention System is based on Fiber Optic Sensing Technology to achieve locating and warning of the intrusion event. It can be applied in oil & gas pipeline distribution stations, pump station and valve room as well as key areas and facilities such as chemical product area, ammunition depot, government agency, etc. This system solves the problems that the regular prevention technologies (such as infrared co-irradiation and laser co-irradiation, etc) are subject to outside environment and severe weather condition as well as the restriction on regular applications in leakage cable anti-explosion. The system can protect the safety of key areas and facilities effectively with its extremely high warning accuracy.

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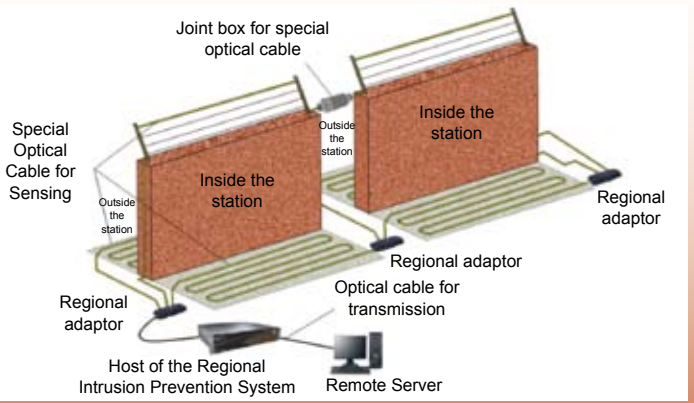


3 APPLICATION CASES

(1) Pipeline Test Work in Sudan

In 2009, CNPC finished pigging, corrosion test, digging verification for a number of offshore pipelines respectively with the diameter of 32 in. and length of 1,370km, the diameter of 20 in. and length of 76km, the diameter of 16 in. and length of 15km and the diameter of 36 in. and length of 3.5km. For these works, a great deal of data is acquired and a good result is achieved, and CNPC won voluminous praise from the owners.

Corrosion was found at 308.96m of the Stake KP537 upstream in digging verification of the main line station sections PS#3 – PS#4 in the 3/7 area. The test data were fully demonstrated and the safe pipeline operation was ensured.

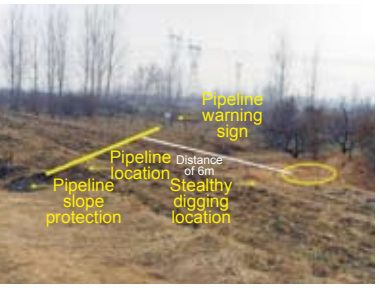
(2) Test Work on Oil Pipeline Mabianzhou Island – Guangzhou Petrochemical Plant

In 2009, the onsite pigging, deformation test and magnetic flux leakage corrosion test for the oil pipeline "Ma-Guang" were performed with pigging device, deformation testing device and high-definition magnetic flux leakage testing device used for Φ610 pipeline, and the test result of this pipeline was verified through digging. The test has proven that the magnetic flux leakage corrosion test can detect the location and size of pipeline corrosion defects timely and accurately without affecting normal pipeline operation and save the financial waste caused by blind pipeline digging and overhauling, and further play an important role in prevention of pipeline accidents, reasonable maintenance and assurance of long-distance transportation pipeline operation.

(3) Application of Safety Forewarning System in Crude Oil Transportation Pipeline Alataw Pass-Dushanzi

Six Forewarning Units (FU) and one Forewarning Supervision Terminal (FST) were used in the Pipeline Safety Forewarning System for this project to perform 24-hour monitoring of the entire pipeline. The system made successful forewarnings for 91 times among which 44 events threatening pipeline safety were found by the patrol personnel and others were ground-break events. One event of those was caused by water flushing to the extent that the water-flushed depth at lower side of the optical cable reached about 30cm and affected pipeline safety seriously. Manual and technical preventions were combined perfectly in the forewarning system to change the pipeline safety protection from passive patrol mode to positive mode and ensure pipeline safety timely and efficiently.

(4) Application of Safety Forewarning System in Lan-Zheng-Chang Refined Oil Product Pipeline



The Pipeline Safety Forewarning System has made warning for 717 times in total since it was formally put into service, covering 516 events threatening pipeline safety and 10 significant potential safety hazards. The system performs effective safety monitoring along the pipeline and acts as the guardian for pipeline safety. It was recorded in the forewarning report on Jan. 7, 2010 that an intentionally dug hole with length of 1m, width of 0.6m and depth about 6 – 7m was found at about 10m away from the construction site for West Line 2. Occurrence of a significant pipeline damage event had been prevented effectively with timely disposal by the operating organization.

(5) Application of Regional Intrusion Prevention System in a Prison

Accurate and timely locating warning had been achieved for nearly one month since the use of Regional Intrusion Prevention System in a prison covering 700m^2. A site inauguration ceremony for Regional Intrusion Prevention Product was held in Aug. 2009 and a simulated test for escaping of prisoners from the first and third detaining areas was made on site. The equipment could make accurate, interlinking and timely warning. The police officers' working efficiency has been greatly increased and the function of "manual and technical preventions" was presented. It has been recognized by the local public security organs.

4 R&D EQUIPMENT

CNPC possesses the National Engineering Laboratory for Oil & Gas Pipeline Transportation Safety and the largest Smart Pipeline Detector Test Center and Pipeline Safety Forewarning Test Center in Asia. It also sets up a professional pipeline monitoring/test laboratory and a production line of the Pipeline Safety Forewarning System. The series High-definition Magnetic Flux Leakage Testers and Multichannel High-precision Deformation Testers for 8"~48" pipelines at an advanced international level were successfully developed and manufactured. CNPC has research and test equipments and powerful R&D teams for the development of various pipeline test and forewarning technologies.

Debug of the Pipeline Safety Forewarning System in the National Laboratory

Test of Circuit Boards Used in the Pipeline Safety Forewarning System in the National Laboratory

5 QUALIFICATION & STANDARD

CNPC has domestic and foreign qualifications with respect to the industry and profession.

CNPC has 56 patents in the fields of test and safety forewarning technologies including 14 invention patents and 5 registered software programs. The fast growth of global oil & gas energy demand and the pipeline construction have promoted development of Pipeline Test and Safety Forewarning Technologies. We will provide the safest and most efficient guarantee proposal to our customers with our precise, applicable and cost-effective technical services.

6 EXPERT TEAM

CNPC is armed with an expert team that consists of six test & monitoring experts and professor-level senior engineers as well as more than 30 technical and academic leaders, who can provide the user with a perfect technical consultation proposal.

Li Jiuchun

Pipeline test expert and professor-level senior engineer. He once acted as the principal for the project of research and manufacture of high-definition magnetic flux leakage testing devices and organized a number of foreign pipeline work test projects in Sudan and Syria and domestic pipeline work test projects. He owns more than 20 patents and has issued more than 10 papers.

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Cao Chongzhen

Pipeline test expert and senior engineer, who acts as the general manager of CNPC Pipeline Test Technology Co., Ltd. He has been engaged in technical service businesses such as pipeline plugging, maintenance & rush repair and pipeline test for many years. He once undertook research and development based on introduced plugging and testing equipments and presided over a number of domestic and foreign pipeline service construction projects. He is fully experienced in both theory and practice.

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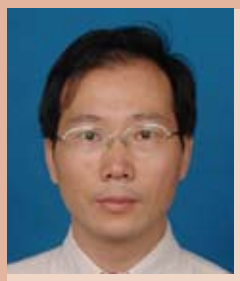

Zhang Jinquan

Pipeline photoelectronics expert and senior engineer. He is the primary inventor of the Optical-fiber Pipeline Safety Forewarning System. He applied for and now owns more than 50 patents and has issued more than 10 papers.

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Bai Shiwu

Pipeline test expert and professor-level senior engineer. He has organized and completed a number of national, provincial and ministry-level research projects in the non-destructive test field; he has been granted with 10 national patents, compiled and written 5 literatures and issued more than 30 papers.

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Jiao Shuhao

Pipeline photoelectronics expert and senior engineer. He is mainly engaged in study, organization and management of pipeline research projects. He has conducted the study of 2 national and 5 provincial and ministerial-level subjects and issued more than 10 papers.

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