



Oil & Gas White Paper

**Upstream, midstream, downstream...
Complete cables and cabling solutions
for complex projects**



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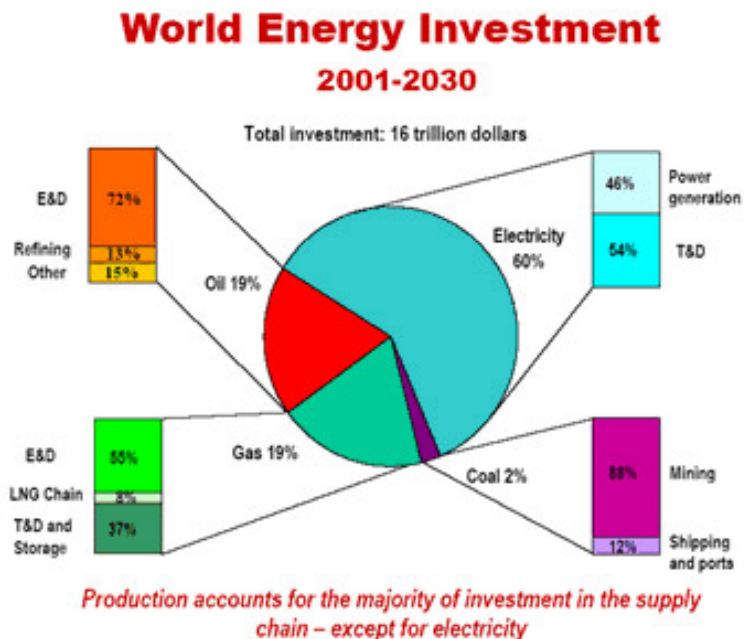
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SYNOPSIS

This report is intended to give a general overview of the global Oil & Gas market, and provide information about how Nexans is serving this market. It opens with a brief introduction explaining the long and short-term prospects of the energy market. It then lists the major Oil & Gas trends and explains how they are impacting cabling. The third section briefly explains what Oil & Gas expects from cable suppliers. This is followed by an overview of Nexans: its global expertise, local presence and technical leadership; its growing presence in Asia; and its overall product offer. The report is followed by an Appendix containing a list of recent Nexans success stories in Oil & Gas.

I. A BOOMING ENERGY MARKET: LONG AND SHORT-TERM

In its International Energy Outlook 2005, the Energy Information Administration (EIA) forecast **world energy consumption to increase 57% by 2025** (or by 2.0 percent per year on average), largely driven by emerging economies whose energy use will more than double over this period. ¹ In fact, world energy investment between 2001 and 2030 represents some 16 trillion dollars (including spending on power generation, transmission and distribution and coal). Electricity represents 60% of investment, and together, Oil & Gas 38%.



According to the April 2006 *Short-Term Energy Outlook*², continued steady world oil demand growth, combined with modest increases in world spare oil production capacity and continuing risks of geopolitical instability, are expected to keep crude oil prices high in the near future (over \$65 per barrel), and gasoline prices are likely to rise by some 10%. Furthermore, the phase-out of methyl tertiary butyl ether (MTBE) from the gasoline pool is likely to put significant pressure on ethanol and gasoline prices. And higher diesel fuel margins are expected because of the added cost of producing ultra-low-sulfur diesel fuel.

After the negative impact of two hurricanes on the US production, there is still likely to be a tight global petroleum market in 2006. Consumption growth still outpaces production. Meanwhile, geopolitical events are continuing to play a role in maintaining a level of uncertainty because of Nigeria, Iraq and the unfolding Iranian nuclear situation. Even with spare capacity growing in Saudi Arabia, the net amount is unlikely to reverse current trends.

The non-OPEC supply is expected to grow by 0.8 billion bbl/d in 2006, with new projects from Angola, the Caspian, Canada and Brazil; but these new supplies are partially offset by declines in many mature fields, such as those in the North Sea, Mexico, Indonesia and the Middle East. Overall, **world petroleum demand is forecast to increase by 2 percent in 2007** (over 1.8 percent in 2006).

¹ See Energy Plug, "International Energy Outlook 2005," available at www.eia.doe.gov/emeu/plugs/plsept05.html

² Available at www.eia.doe.gov/emeu/steo/pub/contents.html

This level of supply and demand means that **oil will remain the dominant energy fuel during the next quarter of a century**, with its share of total world energy consumption remaining at around 38%. In the developing world, oil consumption is, in fact, projected to increase for all end uses. Natural gas is the fastest growing primary energy source worldwide, maintaining growth of 2.8% annually. Gas is increasingly seen as the desired option for electric power, given the efficiency of combined-cycle gas turbines relative to coal or oil-fired generation, and the fact that it burns more cleanly than either coal or oil, making it a more attractive choice for countries interested in reducing greenhouse gas emissions.

Renewable energy sources also have a future, which has led some major oil companies like BP, ChevronTexaco, and Shell to invest heavily in solar and windpower projects. The EIA expects world consumption of renewable energy to rise by more than 50% by 2020, but its market share will change little from today's 14% (this includes traditional biomass and hydropower). Meanwhile, the European Wind Energy Association is targeting an ambitious 12% for windpower alone by 2020.

Given the hunger for energy, the worldwide Oil & Gas industry is poised to increase spending by over 14% in 2006.³ This expansion will impact four major areas of applications (where cables and cabling solutions play an important role:

- Upstream Exploration & Production (E&P)
- Midstream pipelines and LNG transport
- Downstream refining and petrochemicals
- Material handling systems

II. OIL & GAS TRENDS AND IMPACTS ON CABLING

1. UPSTREAM EXPLORATION & PRODUCTION (E&P)

1. 1 Seismic renaissance

Advancing exploration technology and sophisticated reservoir management virtually guarantee new discoveries and improved recovery of conventional Oil & Gas. A key to greater Oil & Gas exploration success and higher recovery is data – data collected by seismic cable during onshore and offshore exploration, and data gathered throughout a field's productive life.

According to the European Association of Geoscientists and Engineers (Madrid, 2005), after five horrible years, exploration is in a recovery mode. Reserves replacement has been promoted to a number one priority for oil companies after years of underinvestment. R&D efforts are now being concentrated on reservoir seismic applications such as 4D, multi-component and sophisticated processing, interpretation and visualization to get more information out of existing seismic data.

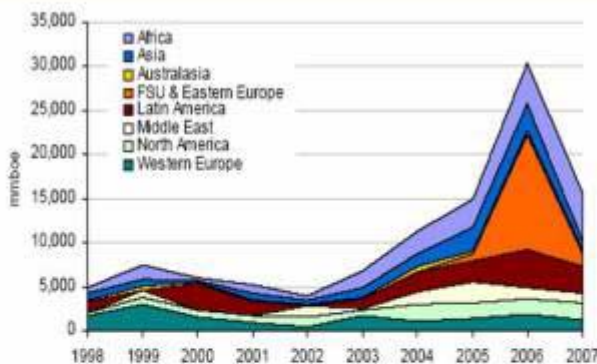
On land, terrains can be highly diverse: deserts, mountains, cities, swamps, transition zones (TZs) and shallow waters. The more precise the data acquisition cables – in terms of attenuation – the more accurate the data. Lightness, strength, resistance and watertightness are especially important for these cables. Offshore, sensor/streamers towed by lead-in cables

³ According to World Oil Magazine: February, 2006. Consult www.worldoil.com/magazine/MAGAZINE_DETAIL.asp?ART_ID=2796&MONTH_YEAR=Feb-2006

must be able to endure extreme pulling force and drag. Bottom-laid seismic cables must operate flawlessly at any depth. One recent cable development is to use a seabed-based "node" network, which requires burying by ROVs. To protect the subsea acoustic environment, instead of an air-gun umbilical, a seabed vibrator is used to provide the underwater sonic boom which would be picked up by the node sensors and transmitted to a floating buoy and possibly to a microwave receiver or satellite.

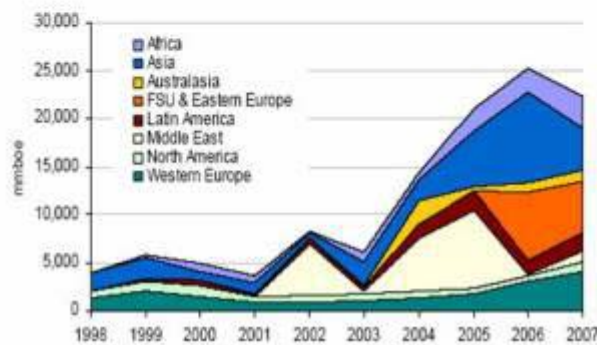
1.2 New offshore and deepwater opportunities

More & more oil & gas will come from offshore



Oil

New offshore reserve prospects being considered for bringing onstream



Gas

Source: Infield Systems

2006 will be a peak year for new offshore reserve prospects for Oil & Gas, with Africa, Asia, Australasia, the Former Soviet Union (FSU) and Eastern Europe providing new capacity to the world's markets. In fact, **offshore activity is forecast to increase a hefty 9% in 2006**, to more than 3,800 wells, with strongest growth in the Far East and South Pacific.⁴ **There are currently 27 ultra-deep projects slated to be in operation by 2008** (which is nearly double the amount of the previous five years). In deep water, the practical approach to field development is subsea wellheads and manifolds tied to surface facilities with connections that carry fluids, power and control signals. Over 80% of deepwater fields are estimated to have reserves of less than 100 million barrels of oil equivalent (boe), meaning they will likely be tied back to existing production hubs in order to be economically viable. Subsea pipelines and cables that connect subsea wells, manifolds and other facilities must be protected to avoid damage to equipment and the ocean environment.

⁴ See "Global drilling is at a 20-year high" in *World Oil Magazine*
www.worldoil.com/MAGAZINE/MAGAZINE_DETAIL.asp?ART_ID=2803&MONTH_YEAR=Feb-2006

These deepwater developments demand premium cable products and umbilicals, and innovative, service-oriented cable suppliers. Cable installation expertise is critical, as is environmental compatibility. The ability to handle combined functions can help minimize complexity and manage interfaces. And few operating conditions are more severe than those at the bottom of the ocean, making strength and durability fundamental requirements. Surface offshore platforms also require cable that often is exposed to chemicals, high temperatures and high pressures. And in many cases, it must be fire-resistant so it can continue to function in case of emergency. Ultra-deep wells (+3,000 meters) need an entire new generation of risers and umbilicals, with materials and designs which are pre-tested and simulated to withstand far higher water pressure.

1.3 Control and power from onshore

Marginal Oil & Gas fields at greater depths require power to the subsea templates and satellites, and they may need hydraulic cables to control valves for redundancy. Rather than generate electricity offshore, it is now possible to generate electricity more economically and efficiently from distant generators on land. Combined with other cables for shore-based remote control and telecommunications, this solution can reduce manpower costs on platforms and make a significant contribution to the quality-of-life. With rigs and FPSOs in short-supply, there is also a **trend towards all-subsea operations**, where everything that was once done topside is now done on the seabed, including the separation of oil and water. This means a shift towards electrical inputs and controls instead of hydraulic ones. Also, since wellheads are deeper and farther out at sea, there is a need for stronger pumps which can provide more pressure to extract and pump the oil. This in turn requires more medium-voltage energy resources over longer distances.

Both DC and AC cables are needed to transmit energy from land to offshore, often with fiber optics and hydraulic tubes in the interstices. Proven XLPE designs for underground HV power transmission and distribution must be adapted to support great depths. For topside requirements LV and MV cables must be able to handle harsh ocean conditions, and resist aggressive "mud" used for extraction. For manned and unmanned platforms and FPSOs, fire-retardant and fire-resistant cables are needed. A whole range of compensation, control and power cables are required for operational efficiency. Accessories are also important for a fully-integrated network, and software is important at every level: from network design optimization to finding the perfect "hanging" configuration, especially in tough sea conditions, subject to both currents and tides.

1.4 Digital Oil Field of the Future (DOFF)

Although its exact definition remains nebulous and is still evolving, **DOFF** is a data and telecommunications based strategy that began with field instrumentation and monitoring. It is a technology that links the business processes of remote field operations and back office, creating a **seamless linkage of business processes that cover the Oil & Gas asset life cycle**: real-time seismic information and drilling; reservoir management; production optimization (including downhole valve control/automation) and facility maintenance.⁵ Its proponents contend that 125 billion barrels of oil could be made available from existing fields by using its technologies. According to CERAWEEK 2006, this is how it works:

⁵ See "The Digital Oil Field of the Future : Keys to Success" in Accenture: High performance Delivered in the Supplement to the *Oil & Gas Journal*, September 2005. Available via Google via the title.

Numerous fiber optic temperature and pressure sensors are placed underground in the field and connected to the surface. Data from these sensors is sent to operations centers at the producing company's offices, where it is fed into computerized optimization models, built up from decades of geological surveys and oil production records. This combination of real time, below-ground data and sophisticated modeling allows engineers to see the equivalent of a three-dimensional movie that shows how oil is flowing through the field. This detailed view of what's happening underground enables the engineers to optimize ongoing pumping and future drilling schedules, allowing them to capture a large percent of the oil that's in the field. In addition, sensors placed on equipment can detect potential breakdowns before they occur, reducing downtime and lowering production costs.⁶

One prominent feature of digital oil production techniques is their virtualization. Information technology can reduce the need to have onsite personnel in distant or demanding locations, such as offshore rigs. Indeed, some offshore platforms are now fully automated and operated from NASA-style command centers that can be hundred of miles away on land.

Whether land-based or offshore, DOFF-type solutions require many of the cables mentioned in the previous sections (e.g. data acquisition, or seismic and oceanographic cables; instrumentation, compensation, control and power cables; topside cables, umbilicals, etc.). They also based on a Local Area Network (LAN) which can endow the process and control network with multimedia capability to consolidate onshore/offshore activities. When facilities are over 100 km away (often in deep waters) it is also important to link production units with the onshore control centers via an optical fiber backbone that can either be connected to a floating structure via a flexible riser system, or go directly to the wellhead on the sea bottom. Often this optical fiber is integrated within a long umbilical which requires accessories, joints, terminations and underwater connectors. Land-based wells also need long-distance capability and high data transmission capacity.

2. MIDSTREAM PIPELINES AND LNG TRANSPORT

2.1 Trenching and burying cables and pipelines

The increasingly "busy" and cluttered environment of the seabed, and genuine environmental concerns mean that cables, umbilicals, pipelines and flowlines must be protected from trawling equipment, anchors, heavy dropped objects and even ocean currents. The best way to safeguard seafloor infrastructure is to make a trench, bury the cable or pipeline, and then backfill it totally with seabed material, which acts both as an insulation and protection, while maintaining immobility.

An ordinary general-purpose ROV system is not enough to assure safe and efficient trenching and burying. Specialized models are needed which can adapt to the seabed (hard or soft silt) and bury cables at the proper depth. Safety, maneuverability and speed are also important factors in the laying process. ROVs require dynamic umbilicals with high tensile strength which can deliver electrical energy and data transmission at great depths.

⁶ Consult the Special Section to the *Wall Street Journal* at www.google.fr/search?hl=fr&q=%22digital+oil+field+of+the+future%22+%2B+wall+Street+Journal&btnG=Recherche+Google&meta

2.2 Flow assurance

Flow assurance is especially critical where flowlines and equipment are not easily accessible. There is always a risk of hydrate formation in gas lines and wax “plugs” in oil pipelines which can cause a costly shutdown. It is possible to pump methanol to dilute the plug, combined with a pressure bleed down, but this is time-consuming and environmentally risky. Flow assurance can be achieved by maintaining oil at a temperature high enough to ensure it will continue flowing. There are two practical options: thermal insulation or heat.

Cables can assure the continuous flow of oil or gas via several techniques. An electric current can be run from topside to the end of the pipeline, and a return current (carried by the pipeline itself) generates heat through resistance. The riser cable can also contain other elements like fluids to operate valves.

2.3 Pipeline monitoring

The ability to monitor the condition of long-distance pipelines, control pumping or compressor facilities and manage the network from remote locations helps optimize safety, environmental protection and profit. It is especially important in regions where mature pipeline systems are approaching their full life expectancy. The challenges are multiple: hydrostatic pressure at great depths, aggressive chemicals, dynamic movement due to waves and current. On land, distance and remoteness are a problem. If an incident occurs, corrective action must be taken immediately.

A host of cables and cabling solutions are used in pipeline monitoring: from complex dynamic umbilicals for subsea conditions to long optical fiber backbones, which can be separate or integrated in umbilicals. Either copper or fiber can be used for temperature monitoring, communications, and data transmission.

2.4 LNG

Gas is the fastest growing primary energy source worldwide, and delivery speed is an important factor. This means that liquefied natural gas has often to be directly transferred from a floating production ship to a shuttle tanker in ocean conditions. High flow rates are important since complete transfers must be done during daytime.

For this, cables are needed which not only maintain LNG gas in a super-cool liquefied state, but that are flexible enough to withstand violent seas. Since LNG is highly flammable, a cable design must be capable of handling a breakage or puncture to protect personnel, equipment and vessels.

3. DOWNSTREAM REFINING AND PETROCHEMICALS

In a broad sense, the key challenges facing refiners are similar to those facing producers: optimize operations, manage market risks and continue to meet higher air and water quality standards. Like energy producers, refiners depend heavily on data acquisition, computer power and sophisticated software to achieve these objectives. Like Oil & Gas producers, refiners depend on a cable nerve system to link process units, control rooms and related facilities. The presence of a variety of chemicals, high temperatures and high pressures puts special demands on cable for refinery and petrochemical plant applications. And fire-resistance is critical for cable in refineries that often must continue to function under extreme emergency conditions.

In the past, refineries were faced with overcapacity; but today they are extending and upgrading their process infrastructure. Indeed, the trend is towards bigger refineries, capable of handling up to 300,000 barrels per day. For petrochemicals there has been a shift from oil to gas feedstocks which means a dramatic change in suppliers, and a definite trend towards larger crackers that can handle several hundred tons of chemicals at the same time. This means a significant upgrade in both power and data transmission cables.

3.1 LANs

As with upstream Oil & Gas producers, both refineries and petrochemical plants are increasingly using data communications to improve processing. In the past, IT managers of Office Ethernet LANs were a world away from plant managers running automation control systems via programmable logic controllers (PLCs). Today, all this is changing with Ethernet rapidly becoming a common network connecting all valves, shut-offs, and equipment with the front/back office. In many ways, it parallels the DOFF concept (see page 6), where business processes are being integrated from supply, monitoring, process, maintenance and delivery.

Cables are essential to operational safety, reliability and environmental protection. Chain, control, bus and sensor cables assure the efficiency of traditional processing. However, increasingly, integrated copper/fiber LANs are providing monitoring, surveillance, data transmission, communications and crisis management. A new generation of LANs, based on Category 5, 6, and 7 copper or optical fiber can deliver Ethernet LAN capability to processing equipment. In addition, special fiber with enhanced sheathing and armoring can resist the threat of fire within buildings and hydrocarbons outside, especially when buried underground.

3.2 Power Distribution

Both refineries and petrochemical plants are often as large as mini-cities with a wide range of energy needs, including low-voltage energy cables for lighting, heating, air-conditioning and equipment, to medium-voltage cables for large processing needs.

Energy cables must meet the harsh conditions of the downstream industrial environment which include temperature extremes and, corrosive chemicals. Lead sheathing has provided excellent protection for buried power cables; but increasingly, plants are demanding lead-free sheathing to meet strict environmental guidelines. One solution is an aluminum plus poly-aramid sheathing for safer production, operations and disposal.

4. MATERIAL HANDLING SYSTEMS

Like heavy industry or the shipping industry, Oil & Gas is dependent on a wide variety of material handling systems, both offshore and on land, which operate in parallel with many of the systems mentioned above: upstream, midstream and downstream. Material handling involves everything from small and large overhead cranes in processing plants, to a whole range of outside cranes: marine self-propelled floating cranes, hydraulic deck cranes, mobile telescopic cranes and giant Ship-To-Shore Cranes (STS) in ports

Here, too, cables play an important role on ships, platforms and in ports and plants, making possible bigger loads, higher speeds, the more efficient installation of equipment, added intelligence and enhanced safety. Nexans cables offer higher tensile strength, thus ensuring a long life cycle for cranes of all types, and an added protection for materials and personnel.⁷



⁷ For further information about Nexans' contribution to Material Handling, please consult "Cabling for Material Handling White Paper" (2005), available through the Press Contacts on the title page.

III. WHAT THE INDUSTRY EXPECTS FROM CABLE SUPPLIERS

From the reservoir to the refinery it takes sophisticated technology and massive facilities to find, produce, process and transport oil and gas. Cable makes up the nerve and energy systems that connect many of the elements of this global infrastructure to gather data, power equipment, send control signals and carry fluids. Throughout the process, the economic and environmental risks are high. To minimize these risks, producers, refiners and pipeline operators need a wide range of the right products and technical expertise. They also expect much more of cable suppliers as the Oil & Gas infrastructure grows more complex.

Producers want to see high standards of safety, both for people and equipment, and an exemplary dedication to protecting the environment. They demand a high level of innovation in productions, services and processes. They expect economic value for their money and cost-effectiveness. Finally, they want a partnership approach to project execution, with a greater burden on preferred suppliers to propose, organize and manage key areas of concern (like procurement definition, cable laying, network design, and long-term maintenance and training).

These expectations have influenced the customer/supplier relationship:

- Successful companies will share the goals and values of their customers
- An integrated approach to complex projects will require a broader offering of technology, know-how and systems, i.e. global expertise
- Oil & gas producers will continue to move from the traditional “operator” role towards that of “asset manager,” shifting more responsibility to supplier and contractor, especially at the local level, sometimes half-way around the world
- Fierce competition and cost pressures will continue to drive consolidation among Oil & Gas producers and refiners, and among contractors and suppliers
- Because they have often downsized or disposed of R&D resources, oil companies are looking for suppliers who act as real partners, with suppliers working far upstream with producers to find the best possible technical solutions

IV. NEXANS: A GLOBAL CABLE LEADER FOR OIL AND GAS

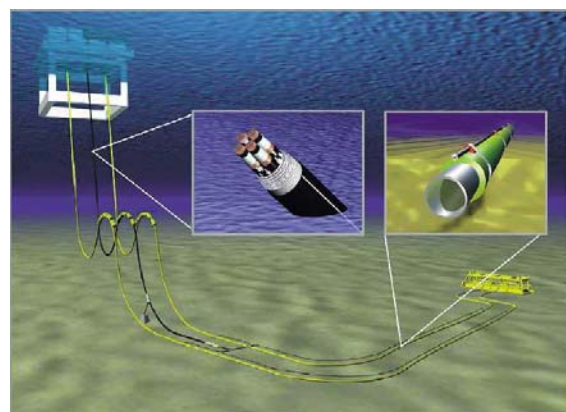
As the foregoing chapters reveal, the Oil & Gas industry is faced with massive change, and challenges on all fronts. To meet the world's insatiable hunger for energy, it has had to look both forward and backward, extending the life of old fields, while constantly looking for new ones, often far inland (e.g. Kazakhstan), or in deep waters (e.g. Gulf of Mexico, Brazil and West Africa). This often requires new methods and technology. At the same time, offshore companies have to satisfy growing issues and concerns in areas like safety, the environment and sustainable growth, while land-based refineries have to come up with ways to produce better, cheaper products with minimum pollution. The international nature of the business, and these complex challenges demand a mixture of solutions – both upstream and downstream – that only a global cable leader can provide.

1. AN INTEGRATED THREE-POINT APPROACH FOR THE INDUSTRY

That is why Nexans takes an integrated three-point approach to meet the extensive needs of its demanding Oil & Gas customers: **global expertise, local presence, technical leadership** – which goes far beyond the cable products, themselves, and includes a number of important behind-the-scenes services, like ongoing research, testing, standards, information-sharing and advanced delivery logistics.

For Nexans, **global expertise** means being able to manufacture a broad range of adapted cables for this specific market. The fact that cables are its core business means that it has the special and accumulated skills to supply nearly every cable and cable accessory found on surveying ships, drill rigs and vessels, or onshore in production facilities and refineries. Many of these energy and data cables must function under extremely trying conditions of heat, “mud” in the extraction process, vibration from equipment, movement from sea currents, water penetration, oil and chemical threats, etc. A sampling of Nexans cables shows the full range of products and services available:

Apart from the extent of Nexans Oil & Gas products, expertise also implies “integration” at several levels. Since the company controls the entire production chain from the molecular structure of the raw materials to final installation, every aspect of the cable is optimized to offer the highest product quality, which is essential in an industry where shutdowns can be extremely costly. Integration is also evident in Nexans ability to supply both the energy and telecom sides of Oil & Gas, often via independent systems, but also through integrated products, like multifunction umbilicals which carry energy, telecommunications, fluids and chemicals essential for extraction.



Finally, integration means the ability to combine complex functions in a unified, compatible way, often facilitating remote monitoring and control. Not just an off-the-shelf supplier of cables and components, Nexans often works closely with its customers to design, develop and install complete systems which require expertise in several different areas.

The second approach adopted by Nexans is its **local presence** in serving an industry that by its very nature operates internationally. Nexans has the broadest geographical presence in the cable industry, with plants on five continents, and representatives in over 65 countries. Not only can Oil & Gas customers fill every cable need from a single vendor, but they can count on the logistics necessary to get what they need when they need it to meet production schedules, or to rapidly carry out essential repair work, without having to tow equipment back to coastal shipyards. Through close partnerships with local shipyards, platform builders, Oil & Gas producers, refineries and installers, Nexans complements national capacities, and provides valuable input in terms of design, installation and maintenance.

Local presence also requires a mastery of international standards, and here Nexans has obtained approval certificates from the IEC and critical ISO 9001 qualifications, and also all of the main classification bodies, like Det Norske Veritas (DNV), Lloyds, etc. Moreover, as an active member on world standards committees, Nexans has pioneered many breakthroughs, including Halogen-Free, Fire-Resistant cables which are continuing to play an important safety role on land and sea.

The third approach followed by Nexans involves its **technical leadership** through constant innovation and a respect for the environment. Nexans heavily reinvests in R&D to constantly develop new products for the Oil & Gas industry. Theoretical research is done in close cooperation with universities and international research bodies in areas like polymers, plastic optical fiber, deep-sea technologies, safe and non-polluting materials, etc. Meanwhile, applied research is done in Nexans' International Research Center in Lyon, France. Once feasibility is proven, responsibility is transferred to 10 Competence Centers located in 10 countries.

For example, the Competence Center in Halden, Norway, are experts in high-voltage submarine XLPE power cables, composite cables and umbilicals for the offshore industry. In a unique high-voltage testing laboratory, it tests power cables and components in accordance with international standards for rated voltages up to 765 kV AC and 800 kV DC. Besides testing its own products, it also offers its customers facilities for testing virtually any component for power transmission systems. Other Competence Center research areas relevant to Oil & Gas are chemicals, electro-technical development, materials and extrusion, and metallurgy. Finally, onsite R&D is done in all of Nexans plants worldwide, often in close association with customers.

To free Oil & Gas companies to do what they do best, Nexans is increasingly assuming R&D responsibilities on their behalf in areas like deep-water drilling and remote "smart well" technologies. In the same vein, Nexans' market intelligence and information about new industrial trends is shared with its customers in order to facilitate major contracts. It offers customers counseling in terms of design, implementation and maintenance of Oil & Gas facilities, and assumes total responsibility for installing complete turnkey systems and networks worldwide.

2. NEXANS RESOURCES IN ASIA

One of the most dynamic areas in the world for Oil & Gas development is the Far East. Not only is this an area of the world with positive economic growth (especially China, which is currently experiencing 9.5% growth annually), it is also a part of the world which will see spectacular jumps in energy consumption of all kinds, with energy demands expected to more than double over the next quarter century.

Although both China and India can count on considerable reserves of coal (27% of world consumption for electricity production), there is increasing interest in oil & gas, not only as a source of fuel, but also as a part of heavy industry. The production of offshore plants is closely linked to the shipbuilding industry where the two frontrunners are Japan and South Korea (with approximately 31% of market share each). Meanwhile, China (with presently 7%) is aiming to expand its market share. Asian shipyards produce a full range of Oil & Gas offshore plants and vessels, including platforms, rigs, and Floating Production, Storage and Offloading (FPSO) vessels, and also survey and research ships, Liquid Natural Gas carriers, and ocean going tankers of all types.

At present, Chinese shipyards are in the process of expanding their shipbuilding market share to 15% of the world shipbuilding market, especially in commercial vessels, with the support of the Chinese Government. This has had an important impact on Korean shipbuilding. Korean shipyards are continuing to expand their product range of Oil & Gas plants to keep their shipbuilding levels high and assure constant profitability.

Compared to many other shipyards in the East, Korea's major shipyards have broad experience in the design and construction of offshore plants, and they are very competitive in this field. Both energy and telecom cables play an important role on any offshore plant in terms of operational efficiency and safety for both crew and equipment.

However, since the Korean currency, the Won, has been appreciating against the US dollar since the end of 2003, and steel prices (a major material for construction) are soaring, Korean shipyards are faced with some major challenges. These translate into high expectations of cable suppliers. They demand a competitive price for all cables; they want a high level of safety and fire-protective performance from cables; they need lighter, thinner and more flexible cables for quick and easy installation; and they expect exceptional logistics service.

To meet these challenges, Nexans has two plants in South Korea which are able to meet all requirements for high-performance, quality products online via e-procurement. The first one is **Kukdong**, a fully-owned subsidiary which (along with Nexans) currently supplies 33% of the global shipboard cable market, including offshore plants. With over 300 employees, Kukdong produces a full range of offshore and marine cables, especially rubber-insulated cables (normally used in shipbuilding) and LAN cables for networking. **Nexans Korea**, of comparable size, also produces offshore power and telecom cables, as an extension of its onshore products, mainly sold to KEPCO (the Korea Electric Power Corporation) and various telecoms. The main offshore customers for both plants are shipbuilders, who are also building offshore plants for Oil & Gas, primarily Hyundai Heavy Industry, Samsung Heavy Industry, and Daewoo Shipbuilding & Marine Engineering Co. who appreciate the fact that Nexans can supply fire-protected, fire-resistant cables for the confined and isolated offshore environment.

According to forecasts, the offshore plant market will continue to grow in Korea to follow up demands of offshore Oil & Gas drilling to meet the growing energy demands of the region.

3. A STRING OF INNOVATIONS AND RECORDS FOR OIL AND GAS

Nexans ongoing concern with Research and Development has led to a long list of innovative products for Oil & Gas, and a number of world records.

In the area of exploration, for seismic research contractors Nexans has developed copper and optical **data acquisition systems** which are not only highly sensitive with low cross-talk, but able to function in difficult conditions, both on land and in shallow water. For the oil-research contractor Sercel, Nexans designed customized lighter data-acquisition cables that could provide far greater mobility in the field.

To meet the challenges of deep-water environment, Nexans has produced a string of innovations. For **deep-water seismic acquisition**, it manufacturers towed lead-in and gun cables for 3D surveying, and developed the first full-scale, permanent 4D system laid on the sea-bottom, allowing for a reservoir to be profiled and analyzed over the long term. Nexans data acquisition cables are designed for prolonged survival in a corrosive environment. Its FOWM cable can monitor reservoir temperature and pressure up to 200°C and 1,000 bars pressure. To meet its customer's strict security demands, Nexans also manufacturers **cables for oceanography**. Originally used for defense purposes, these cables allow the monitoring of vessels coming into or leaving a drilling area.

In busy seas, anchors and trawling pose a constant threat to all undersea infrastructure, and that is why cables and pipelines often need to be trenched and buried, to avoid costly breakdowns for operators if a line is severed. A series of water-jetting **CAPJET Remote Operated Vehicles** (ROV) were developed through Norwegian expertise. An alternative to costlier burying with heavy equipment (which can cause damage to cables and pipes), the lightweight CAPJETs use water jetting for trenching and propulsion.



The system has buried more than 3,500 kilometers of cables and pipelines, often in harsh North Sea conditions. Moreover, it has been increasingly used to bury fiber-optic cables, steel and flexible flow lines and large diameter Oil & Gas pipelines at depths down to 2,000 meters.

To accommodate offshore's move away from onboard generators towards land-based energy (in compliance with the Kyoto Protocol), Nexans provides a full range of efficient and environmentally friendly **high-voltage XLPE and mass-impregnated cables** of up to 2,500 mm² for voltages up to 525 kV AC. Aside from allowing dangerous CO² emissions to be lowered, both kinds of cable are "dry" technologies: there is no danger of leakage, and they are also easily recoverable and recyclable. All materials that go into a cable are carefully tracked, so that cables can be controlled during their entire lifecycle, from conception to disposal. In addition, these cables often incorporate fiber optic cables for secure offshore telecommunications. Recently, a record-breaking 67 long 52 kV cable was installed to link land facilities with the Troll platform in the North Sea.

For conventional and next-generation “smart well” applications, Nexans produces a full range of **instrumentation, compensation, control and power cables**. These hybrid energy and data cables make it possible to monitor sensors and activate control, safety and bleed valves to regulate oil, water and gas flow. They accurately measure and control temperature, and deliver up to 36 kV for pumps, motors and relays. They are available with special shielding for the abrasive and corrosive drill rig and wellhead environment.

For platforms and floating production ships, Nexans offers a **mud-resistant, halogen-free** outer sheath for all critical cables, both energy and data, which resists the corrosive threat of “mud,” – the artificial, physico-chemical substance which is added in the oil extraction process. Meanwhile, Halogen-Free, Fire-Resistant (HFFR) and Low-Smoke, Zero-Halogen (LSOH) cables assure maximum protection for infra-structure and oil-platform workers.



These cables meet the rigorous NEK 606 standard and are approved by DNV (Det Norske Veritas). For the potentially dangerous topside environment, they are reliable, maintenance-free, and can continue operating in temperatures of up to 1,000°C for up to three hours (750°C is the norm).

In the area of **umbilicals**, there are no off-the-shelf products. All umbilicals are custom-designed to meet the specific needs of users, many of whom would like to eliminate platforms altogether, and operate facilities remotely from onshore. Because of environmental concerns, redundancy is a special concern, and a common solution is to have two backbones: one to carry only fluids and chemicals, and one to carry electricity and communications. Nexans holds several world records for offshore umbilicals.



For example, in the Nakika project in the Gulf of Mexico (Shell), it achieved a 2,300 meter depth, which beats the previous record by some 400 meters. Also, the company laid a 125 km single length umbilical in Shell’s Mensa project.

Marine Local Area Networks (LANs) are another area where Nexans is making important breakthroughs to upgrade communications capability offshore to equal what is available onshore. Aside from offering a host of mixed and all-fiber solutions, the company has enhanced copper solutions, including a Category 7 cable which can deliver up to 10 Gbit/s (i.e. equal to the speed of today’s LAN fiber backbones). The latter are fully backward compatible, and avoid the necessity of expensive refitting later. For isolated and autonomous maritime facilities, there is an added safety feature. These onboard cables, which are Low-Smoke, Zero-Halogen (LSOH) are linked into a complex surveillance and fire-fighting system. Nexans cables thus not only guarantee a continuous flow of data to prevent breakdowns in the

first place, but monitor, control and resolve emergencies, while protecting vital equipment and personnel.

Co-operation with Oil & Gas companies has given rise to innovative products to improve efficiency and performance in maritime conditions. The need of positioning umbilical cables in the face of high waves, currents and platform movement resulted in a **dynamic-positioning software package** allowing cables to be dynamically connected to subsea wells under the platform/vessel in free-hanging "catenaries."

Another area of customer-driven innovation is **pipe-heating cables** which prevent hydrates or paraffin plugs from forming in deep-sea pipelines, thus reducing or even stopping the flow permanently. If shut down, a line "freezes," becoming totally unusable, an extremely costly event. The traditional solution was to add chemicals to the flow lines, but this remains a messy solution, with the ever-present danger of leakage posing an environmental threat. The Nexans answer was to either apply thermal insulation to the pipeline (using the CAPJET), or more radically, to electrically heat the pipeline by strapping a heat cable to the pipeline during the manufacturing process. This produces an induced current and a steady 27°C temperature which keeps production flowing even in freezing deep-sea conditions for lengths of up to 50 km and more. The system is now installed in Statoil's Åsgård and Huldra fields in Norway, and is being applied elsewhere in the world.

As part of its global offer to customers, Nexans also manufactures a wide range of **cable accessories** to cover all energy and telecom needs: joints and terminations, pressure systems, pumping plants, pull-in heads, terminations, buoyancy elements, branching units, amplifiers, etc.

Meanwhile, on land, given often long distances between drilling sites and refineries, Nexans provides **optical fiber backbones** based on right-of-way (ROW) technologies which allow them to either be incorporated during pipeline construction, or added later if the terrain permits. An added bonus is that fiber optic cables along pipelines provide leakage monitoring, remote control of pumping stations and network management. In addition, they allow Oil & Gas companies to generate added income by the leasing of dark fiber to telecom operators.

For shore-based refineries, Nexans supplies a host of energy and telecommunications cables, including high, medium and low-voltage cables. With its customers, Nexans shares a concern about the necessity of using lead sheathing to protect cables from water and chemical aggression, a fact which makes cables expensive to produce, heavier and less flexible. Current research is now being concentrated on finding a **thermoplastic substitute** for lead which will be safe and recyclable. To upgrade security in refineries, Nexans offers a wide mix of **shore-based LAN solutions** using copper and/or optical fiber, with the same advanced capacity mentioned above for marine applications.

Finally, Nexans has kept pace with Oil & Gas concerns for **alternative sources of energy**. Recently, Nexans has been participating in offshore wind turbine experiments requiring advanced marine cabling technology. The company was deeply involved in the offshore Danish Horns Rev project (80 turbines. Twenty-one kilometers of Nexans cables link the hubs which gather energy from the wind turbine network to the land-based power station, which feeds it into the local power grid. It has also been involved in recent wind turbine projects in Arklow (Ireland), Smøla (Norway), and the Barrow Offshore windfarm (UK).

4. CONCLUSION

Nexans sees its role in the next quarter of a century as a real partner to the dynamic and constantly evolving Oil & Gas industry. This means being able to follow producers wherever they want to go geographically, geologically, and technologically. More than ever before, Nexans believes that there is a need to constantly move “beyond cable” in order to add value to products, do innovative research, and provide a host of behind-the-scenes services – ranging from new product design to the kind of long term support that “energy” companies need to make the transition to a sustainable future possible.

V. APPENDIX

SOME RECENT NEXANS SUCCESS STORIES IN OIL & GAS

2007

24 kV power for subsea pumps

For BP, Nexans will furnish nearly 27 km of power umbilicals for the King Subsea Pump Project, providing 24 kV of power through hydraulic/electro umbilicals.

2006

“Long snake” dredged by Nexans “spider”

Two 125-km long umbilicals will be trenched and buried as part of the Ormen Lange project. This is a world first: the 420 kV XLPE submarine cable has already been type-tested.

Dolphin Energy for Qatar

Nexans is producing, transporting and installing a 90 km plus 70km umbilical for Dolphin Energy in Qatar.

March 2006

Total upstream in Nigeria

Nexans Kukdong is contracted by Hyundai Heavy Industries for an FPSO to be used on the AKPO field of Total Upstream Nigeria Limited.

January 2006

Jackup Rigs for Singapore

Nexans Kukdong is awarded five ship sets of Jackup Rigs, which are owned by Petro-Jack. They will be built by the Jurong shipyard in Singapore.

November 2005

Arthit Field in Thailand

Nexans Kukdong wins approval as a vendor for the Arthit gas field project in PTTEP, Thailand. Kukdong supplies cable products for three Arthit Wellhead platforms and produces cables for a platform in the Arthit field.

June 2005

Bohai Bay in China

Nexans Kukdong obtains the China Bohai Bay project, which consists of one FPSO and four platforms. It is being executed by ConocoPhillips (USA). Kukdong is supplying its Type P and LSE cables which have been type-approved by ABS, LR and DNV, especially for this project only.

Third deepwater rig for Jurong

Nexans is also involved with the Petrojack III project, which will be able to drill high pressure and high temperature wells at 30,000 feet while operating in 375 feet of water. It has accommodation for 120 persons.

Two ultra-deepwater rigs for Seatankers

For the Jurong Shipyard, Nexans is supplying cables for two ultra-deepwater rigs capable of operating in the challenging deep-water arena, in particular in the Gulf of Mexico, offshore Brazil and West Africa. In a dynamic positioning mode, these rigs can reach reserves at depths down to 10,000 meters.

January 2005

Ice-resistant platform for Russia

Nexans Kukdong is awarded a contract for an ice-resistant platform, the "Prirazlomnaya" for a Russian Federal State Unitary Enterprise.

2005

Inter-platform cables in Azerbaijan

Nexans supplies 17 km of static power, communication and fiber optic cables for the Azeri project.

Direct heating for Statoil pipelines (Norway)

In 2004, 44-km of direct heating cables are installed on 6 flowlines of 6–7 km each in the Kristin Field in the North Sea, while 11 km are installed in 2005 in the Nome Field, using piggyback cables and armed feeders and risers.

Umbilicals for the Gulf of Mexico

Nexans provides BP with 117 km of hydraulic/electro umbilicals for the Gulf of Mexico's Atlantis and Thunder Horse projects at depths of approx. 2,000 meters.

Dynamic and static umbilicals for Nigeria

For the Erha project (Field OPL Block 209, Nigeria) Nexans supplies Cooper Cameron Limited with two dynamic umbilicals of 3-km length, and one static umbilical of 1 km.

2004

BP's "Plutonio" FPSOs being equipped with Nexans cables

Nexans is approved to supply British Petroleum's "Plutonio" FPSOs being built by Hyundai Heavy Industry. Kukdong is the only local manufacturer who has been approved and is supplying cables for the project.

June 2004

Indian Oil and Natural Gas Corporation chooses Nexans

Nexans (Kukdong) supplies energy, instrumentation and control, and LAN cables for a platform being built near Mumbai for the Oil and Natural Gas Corporation (ONGC) of India.

November 2003

Nexans delivers broad range of cables to Sakhalin (Shell)

Nexans (Kukdong) obtains important orders for Shell's Sakhalin island project (between Japan and Russia) from Samsung Heavy Industry and supplies halogen-free, mud-resistant, cold-resistant, rubber-insulated and sheathed cables.

March 2003

Nexans develops new sensor fiber technology for monitoring purposes

Based on developments in ROV, composite power cables and large umbilicals, Nexans new sensor fibers are used to monitor temperature, pressure, stress and overheating, so flow changes and "wax" can be predicted and controlled.

February 2003

Nexans provides umbilicals for Norwegian "Snow White" project and Gulf of Mexico deep water projects

In the new Norwegian Snøhvit ("Snow White") project off Hammerfest, a single 170 km long umbilical will transfer all wellhead functions to shore, thus eliminating costly platform facilities.

January 2003

New windpark project off the coast of Belgium

Nexans wins the design, manufacture, laying and burial of a 22-km 36kv cable in Belgium, as part of the Tractebel SEANERGY Project. Nexans is also responsible for connections to the land cable, and the windmill terminations

Nexans furnishes cables for major French refinery

Nexans supplies instrumentation and LV cables for the large Exxon Mobile PJ21 refinery at Notre-Dame-de-Gravenchon in the north of France.

Saudi Arabia project equipped with 70 km of Nexans cable

For Armaco, Nexans installs some 70 km of static power/communication cables for the Abu Safah project. Nexans is also responsible for transport and installation.

November 2002

Category 7 links in the Caspian Sea boost application sharing

In the Caspian Sea, Nexans Category 7 cables allow application sharing. Instead of having to pull three separate cables, a single cable (containing four individually screened cables) handles telephony, Internet, data and TV. This project was a cooperative effort by Nexans UK and Nexans Norway.

Nexans and Sercel successfully carry out tests for a new state-of-the-art submarine seismic system

Nexans and Sercel SA successfully carry out a first on-site testing of a new submarine seismic system called "Deep Sea Link." Both companies worked on it for several years. This trial which took place in a Norwegian fjord at a depth of 500 meters resulted in various processing exercises during a five-day period. The trials were judged to be extremely satisfactory.

Nexans provides Hyundai with 17 km of mud and fire-resistant cables

Nexans wins a contract to provide 17 km of mud and fire-resistant telecommunications cables (FRC-2) to Hyundai Heavy Industries (Ulsan, South Korea).

July 2002

17.5 million Euro contract for Norway

The contract includes provision of 75 km of umbilical cables for the Mikkell oil field exploited by Statoil in the North Sea.

20 million Euro contract to equip the world's largest wind turbine park in Denmark

Nexans delivers and installs the world's most powerful AC cable. This 150 kV, 21-kilometer-long, submarine, three-conductor cable will directly link the system with the earth-based grid of Eltra (Danish electricity company serving the Jutland peninsula). Nexans also furnishes 63 km of 30 kV XLPE cables.

June 2002

Exelon chooses Nexans as a supplier for \$20 million worth of XLPE cables

With over 5 million customers, Exelon Inc. (NXE.ECX) is one of North America's leading energy and gas utilities. The company chooses Nexans as privileged supplier of XLPE energy cables.

May 2002

Canadian White Rose project opts for Nexans instrumentation, compensation, control and power cables

Nexans supplies a full range of energy and data cables for Samsung Heavy Industry (Korea) who are building an FPSO (Floating Production Storage and Offloading Vessel) for the White Rose project off the coast of Newfoundland (CANADA). These cables are designed to support the harsh environment of the Canadian coast (-40°C).

Nexans wins a contract for deepwater umbilicals in the Gulf of Mexico

For BP, Nexans delivers umbilicals capable of operating at 2,200 meters depth in the Thunder Horse Field (delivery July 2004) and Atlantis Field (delivery Feb 2006) in the Gulf of Mexico.

March 2002

Shell awards Nexans a new contract to supply umbilical cables

Nexans wins a contract to supply additional 43.4 km of umbilical cables as part of the Nakika project in Shell's Columbia oilfield. This umbilical cable includes steel tubes for transporting hydraulic fluids to control the wellhead, plus 3 conductors for delivering power and information between the Nakika platform and the undersea wellhead.