Safe and reliable cable solutions for the world’s nuclear industry
Recent years have seen a renaissance of nuclear power worldwide. There are some 435 nuclear power reactors in operation which account for 14% of the world’s electricity, and 30% within the European Union. New reactors are being built in China, India, Japan, the Russian Federation, South Korea, France, Finland, Slovakia, Romania and Bulgaria.

Aside from obvious economic benefits, nuclear energy can help curb global pollution and greenhouse gases, and reduce dependency on fossil fuels. However, to win wide public acceptance, nuclear power has to be perceived as being absolutely safe, under all conditions and far into the future.

As a nuclear power plant authority or operator, you not only expect new plants to achieve new levels of safety and reliability, you are currently revamping existing plants to extend operational life and reduce risk. Whether you are running a light-water reactor (Pressurized Water Reactor/PWR, French EPR/European Pressurised Reactor, Russian VVER, or Boiling Water Reactor/BWR), a heavy-water reactor (advanced CANDU type), a Gas Cooled Reactor, (GCR), a Liquid Metal Fast Reactor (LMFR), or Accelerator-Driven System (ADS), you are also looking to improve performance, while lowering construction and operating costs.

That is where custom-designed, nuclear-qualified cables play an important role by providing long-term viability, and assuring fail-safe operation indefinitely.

**What you expect from a cable producer:**

- wide range of state-of-the art cables for existing and new projects
- optimized operation, maintenance, and power plant life management (PLIM)
- proven solutions adapted to national standards and requirements
- performance and reliability over time (up to 60 years)
- protection against intrusion, attack, emergencies and natural catastrophes
- rapid response to technical requests and a long-term supply of replacement cables
- R&D knowledge and support for plant extension and upgrades
Nexans nuclear cables help assure a clean source of economical energy for coming generations.

From basic power to complex control and communications, Nexans cables are omnipresent in the nuclear industry. To satisfy the most rigorous safety standards, Nexans has designed exceptionally robust cables and developed a line of halogen-free cables that keep operating during an emergency, while protecting people and infrastructure. We draw on 35 years experience in thermal, radiation and design-based event testing.

Our close partnership with nuclear engineers has meant cables customized and fully-adapted to nuclear needs. Where radiation-protection and LOCA (Loss of Cooling Accident) procedures are required for fast automatic shutdown, Nexans manufactures highly reliable K1 (1E-LOCA) cables. Elsewhere, K3 (1E non LOCA and non-1E) cables assure flawless performance over a lifetime. Both K1 and K3 cables provide the highest levels of performance by limiting the spread of fire and emitting little smoke and toxic gases.

A complete range of cables for quality and performance

- reliability in extreme hot/cold, humidity, abrasion, vibration, etc.
- fire-performance in emergency situations: fire retardancy/fire-resistance
- low smoke and low toxicity through halogen-free materials
- technical and R&D support for total life management
- reduced construction costs due to standardized products
- quality assurance through ISO 9001/ISO 14001, approved by AFAQ and IAEA 50 C/SG-Q
- performance standards in keeping with IEC, NF, CSA, ASTM, ICEA, GOST, BS.

Specific nuclear qualifications

- RCCE: Design and Construction Rules for Electrical Equipment for Nuclear Island
- CST/BTS: Book of technical specifications: Electrical Cables for Nuclear Power Plants
- IEEE 323: for nuclear power plant equipment
- IEEE 383: for (1) thermal aging, (2) radiation, and (3) LOCA test; with (1) (2) and (3) for last day accident simulation, and (2) and (3) for first day of operation.

<table>
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<tr>
<th>Safety classification systems comparison</th>
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<tr>
<td>Safety classified</td>
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<tr>
<td>American</td>
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<tr>
<td>Russian</td>
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<tr>
<td>Korean</td>
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<td>French</td>
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Houses the nuclear core, steam generator and support systems which feed the turbine in the Conventional Island: averages 1,800 km of fire-retardant and halogen-free cables per unit.

LV/MV energy cables
These 1 kV to 10 kV cables are used to power all the pumps including the primary ones which move water between the reactor vessel and the steam generators in the containment area. Nexans produced K3 and K1 cables for operation and automatic shutdown for the EPR Taishan 1+2 project in China.

Control cables
500 V to 1,000 V control cables are used to provide control for primary pumps, safety valves, chemical and volume control, residual heat removal, containment sprinkling system (EAS), primary waste treatment, ventilation, air-conditioning, etc.
Since nuclear power plant cables must offer higher reliability than ordinary cables, insulation and design are optimized to last up to 60 years, as required for EPR Flamanville (France), and Taishan (China).

Instrumentation/sensor cables
Individually or collectively screened multi-pair, triad or quad cables are used for constant system surveillance by measuring steam pressure, water and component temperature, liquid levels, flow rates, and vibration, etc. Nexans instrumentation/sensor cables can be bi-metallic (for thermocouples) and are designed according to K1 and K3 requirements to offer maximum reliability during normal operating conditions and in the event of incidents and accidents.

Control room cables
With over 100,000 connections throughout the power plant, these cables are its nervous system, transmitting all crucial energy and information: from low-voltage systems for lighting, ventilation and climate to measurement, control and telecommunications cables for safe operations. Nexans furnished all control and instrumentation cables for the control room of Mochovce 3+4 (Slovakia), and others.

Contains the turbine, the AC generator and the condenser, plus additional safety equipment: averages 300-500 km of cables per unit.

LV XLPE cables and connectivity
Copper (or aluminum) XLPE energy cables are used to connect the generator to the HV transformer. Nexans produces connectors, as well as cable joints and terminations. These cables are widely used around the world by conventional electrical generating systems.

ALSECURE® fire-retardant and ALSECURE® PLUS fire-resistant cables
Energy cables (up to 1 kV) prevent fire propagation and dramatically reduce smoke emission, while the latter provide LV power for alarms, smoke evacuation, lighting, sprinklers and equipment during a fire. Nexans is provided energy cables for Areva’s III-generation EPR reactor in Flamanville (France).

Control/instrumentation/sensor cables
Same as for Nuclear Island, but now they are controlling the pressure and temperature of the steam going to the high-pressure and low pressure turbine elements, and other systems, including the condenser and heaters. They can be nuclear-qualified, according to customer requirements. Nexans has provided these cables for both Ling Ao 3+4 (China), Temelin 1+2 (Czech Republic), and other projects.

Access-control cables
Secure cables that give a simple on/off signal for doors, gates, hatches, sliding panels, etc. Nexans also designs special cables for motion detectors in sensitive nuclear plant areas.
LV/MV energy cables
Public address cables
Bus/Profibus/Profinet cables
Active equipment for copper and fiber-based networks
LV XLPE cables and connectivity
Instrumentation/sensor cables
Control room cables
Control/instrumentation/sensor cables
ALSECURE® fire-retardant and ALSECURE® PLUS fire-resistant cables
Access-control cables
...for all nuclear plant infrastructures

**BALANCE OF PLANT (BOP)**

Includes offices, warehouses, workshops, emergency diesel generators, spent fuel storage, outside transformer, etc.: averages 600 km of cables per unit.

**HV and VHV XLPE cables**

For the transmission of up to 1 gigawatt of electricity to the grid network. Very robust, with low maintenance and simple accessories, these XLPE cables are usually buried in ducts or installed in galleries until reaching the grid substation.

**Active equipment for copper and fiber-based networks**

Switches and converters for cable ducts, work stations, and outside installation. Also provides power-over-Ethernet for IP cams, VoIP phones and WLAN applications.

**Bus/Profibus/Profinet cables**

ASI-bus cables provide signal transmission for building security, lighting and indoor climate control, while Profibus delivers 12 Mbits/s for complex control, and industrial Profinet cables offer 100 Mbit/s (Fast Ethernet) which fully merges control and operational functionalities.

**Outside plant can withstand tough weather conditions, including extreme heat and cold.**

**Public address cables**

High-performance loudspeaker cable for reliable public announcements and emergency instructions. These silver-copper cables deliver a full sound spectrum and continue to function during a fire.

**Advanced LANs/WANs**

Copper and/or fiber optic networks for general management and telecommunications.

As with the two Islands, a very wide range of applications can be highly centralized. Nexans has provided complete LANs in French NPPs.

**GRID INFRASTRUCTURE**

Comprises the entire grid network beyond the transformers or the gas-insulated switchgear (GIS) feeds the domestic and international grids. Nexans delivers turnkey projects, from civil engineering, cables and accessories, to connection, testing and commissioning.

**HV and VHV XLPE cables**

(60 to 500 kV)

For the transmission of up to 1 gigawatt of electricity to the grid network. Very robust, with low maintenance and simple accessories, these XLPE cables are usually buried in ducts or installed in galleries until reaching the grid substation. Nexans XLPE HV cables continue to provide safe and secure grid power handoff for France’s 59 nuclear reactors, and for the Kozloduy NPP in Bulgaria.

**HV/MV joints and terminations**

To interconnect and terminate several sections of the energy network.

Cold-shrink joints make for easy connection.
GLOBAL EXPERTISE

Nexans supplies a wide range of nuclear-compliant cables to power plants, atomic research centers, and treatment and storage facilities around the world. It also has superconductor expertise, and the project management skills required to do turnkey high-voltage installations for all grid environments.

LOCAL PRESENCE

Since 1975, Nexans has furnished the 59 nuclear plants which produce 80% of France’s electricity. Today, we supply plants in China, India, Romania, the Czech Republic, Slovakia, Bulgaria, Ukraine, Russia and South Africa, and are transferring technology to support China’s nuclear energy program.

TECHNICAL LEADERSHIP

Nexans is creating the knowledge and technology needed to satisfy the “zero-risk” expectations of the public. Our nuclear cable experts work closely with operators, manufacturers and international organizations to define technological requirements for today and tomorrow.

Examples of projects equipped with Nexans cables

<table>
<thead>
<tr>
<th>Year</th>
<th>Project</th>
<th>Country</th>
<th>Specification</th>
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<tbody>
<tr>
<td>2011</td>
<td>Fangjiashan 1 &amp; 2</td>
<td>China</td>
<td>French</td>
</tr>
<tr>
<td>2011</td>
<td>Fuqing 1 through 4</td>
<td>China</td>
<td>French</td>
</tr>
<tr>
<td>2010-11</td>
<td>Mochovce 3 &amp; 4</td>
<td>Slovakia</td>
<td>French/Russian</td>
</tr>
<tr>
<td>2010-11</td>
<td>Taishan 1 &amp; 2</td>
<td>China</td>
<td>French</td>
</tr>
<tr>
<td>2010-11</td>
<td>Fanchanggang 1 &amp; 2</td>
<td>China</td>
<td>French</td>
</tr>
<tr>
<td>2010-11</td>
<td>Ningde 3 &amp; 4</td>
<td>China</td>
<td>French</td>
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<tr>
<td>2008-10</td>
<td>EPR Hammamville</td>
<td>France</td>
<td>French</td>
</tr>
<tr>
<td>2008</td>
<td>Qinshan phase II 3+4</td>
<td>China</td>
<td>Chinese</td>
</tr>
<tr>
<td>2006</td>
<td>Kudankulam 1+2</td>
<td>India</td>
<td>Russian</td>
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<tr>
<td>2004-6</td>
<td>Lungmen 1+2</td>
<td>China</td>
<td>US-American</td>
</tr>
<tr>
<td>2003-6</td>
<td>Cernavoda 2</td>
<td>Romania</td>
<td>Canadian</td>
</tr>
<tr>
<td>2002</td>
<td>Tianwan 1+2</td>
<td>China</td>
<td>Russian</td>
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<tr>
<td>1999-2002</td>
<td>Qinshan phase III 1+2</td>
<td>China</td>
<td>Canadian</td>
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<tr>
<td>1999-2001</td>
<td>Ling Ao 1+2</td>
<td>China</td>
<td>French</td>
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<tr>
<td>1999-2003</td>
<td>Temelin 1+2</td>
<td>Czech Republic</td>
<td>Czech</td>
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<tr>
<td>1997-9</td>
<td>Chashu</td>
<td>China</td>
<td>French</td>
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<tr>
<td>1991-3</td>
<td>Daya Bay 1+2</td>
<td>China</td>
<td>French</td>
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With energy as the basis of its development, Nexans, worldwide expert in the cable industry, offers an extensive range of cables and cabling systems. The Group is a global player in the infrastructure, industry, building and Local Area Network markets. Nexans addresses a series of market segments: from energy, transport and telecom networks to shipbuilding, oil and gas, nuclear power, automotives, electronics, aeronautics, material handling and automation. Nexans is a responsible industrial company that regards sustainable development as integral to its global and operational strategy. Continuous innovation in products, solutions and services, employee development and engagement, and the introduction of safe industrial processes with limited environmental impact are among the key initiatives that place Nexans at the core of a sustainable future. With an industrial presence in 40 countries and commercial activities worldwide, Nexans employs 24,500 people and had sales in 2011 of 7 billion euros. Nexans is listed on NYSE Euronext Paris, compartment A.