Heat trace solutions for the energy transition

Mission-critical heat trace solutions for the energy transition industries are essential as more industrial facilities convert to clean fuels and CO_2 reduction

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Every country has the responsibility to shift the world away from coal and reduce or eliminate carbon emissions to build a more sustainable world. This shift to cleaner energy brings new challenges and requires innovative heat-trace solutions in many industries to ensure reliable operation and uptime in the safest and energy-efficient way.

Liquefied natural gas (LNG) is essential in the energy transition as it plays an instrumental role in shifting away from coal and reducing carbon emissions. There is a global race to provide natural gas to the world for industry, power, and heating. Countries with excess natural gas (methane) are currently building LNG liquefaction plants to prepare LNG for export, while countries that need natural gas are building LNG regasification plants. The entire LNG supply chain – from liquefaction and gasification plants to terminals, jetties, and storage tanks – requires specific process temperature maintenance or freeze protection.

Biofuels and clean fuels are essential in the energy transition towards attaining carbon neutrality. Biofuels are derived from renewable sources such as plants, used cooking oils, algae, or biowaste. Biodiesel production, fuel terminal retrofits, renewable diesel refinery conversions, and sustainable aviation fuel (SAF) production are in progress around the world. In biofuel plants, each step of the refining process – from the handling and storage of feedstock and final products, over the pretreatment and refining processes, to the blending and transport facilities – requires specific process temperature maintenance or freeze protection.

Carbon capture and storage (CCS) is essential in the energy transition as it plays a critical role in CO_2 removal from the atmosphere. CCS technologies aim to store the CO_2 underground, and CCU technologies aim to utilise CO_2 as feedstock in other industrial processes such as enhanced oil recovery or e-fuels production. CO_2 can be captured from fuel gas (pre-combustion) or flue gas (post-combustion) in many industrial sectors (such as oil and gas, LNG, biofuels, steel, and cement) or even by direct air carbon capture (DAC) in the atmosphere. In CCS plants, the capture, utilisation or storage stages require specific process temperature maintenance or freeze protection.

Hydrogen (H_2) is essential in the energy transition towards attaining a carbon-neutral world. In traditional sectors, H_2 has been used for decades in refineries (for hydrotreatment), petrochemicals, and fertilisers (ammonia). However, new sectors are emerging fast.

- Grey H_2 generation is typically done through steam methane reforming (SMR) from natural gas, where large volumes of CO_2 are vented.
- Blue H_2 has stricter regulations to capture the CO_2 emissions with CCS technologies.
- Green H_2 uses emerging technologies based on a water electrolysis process driven by renewable electricity. This way, H_2 is generated with zero CO_2 emissions and can be used as a clean energy carrier or building block for clean transport fuels.

In H_2 plants, the generation, conversion, transport or storage stages require specific process temperature maintenance or freeze protection.

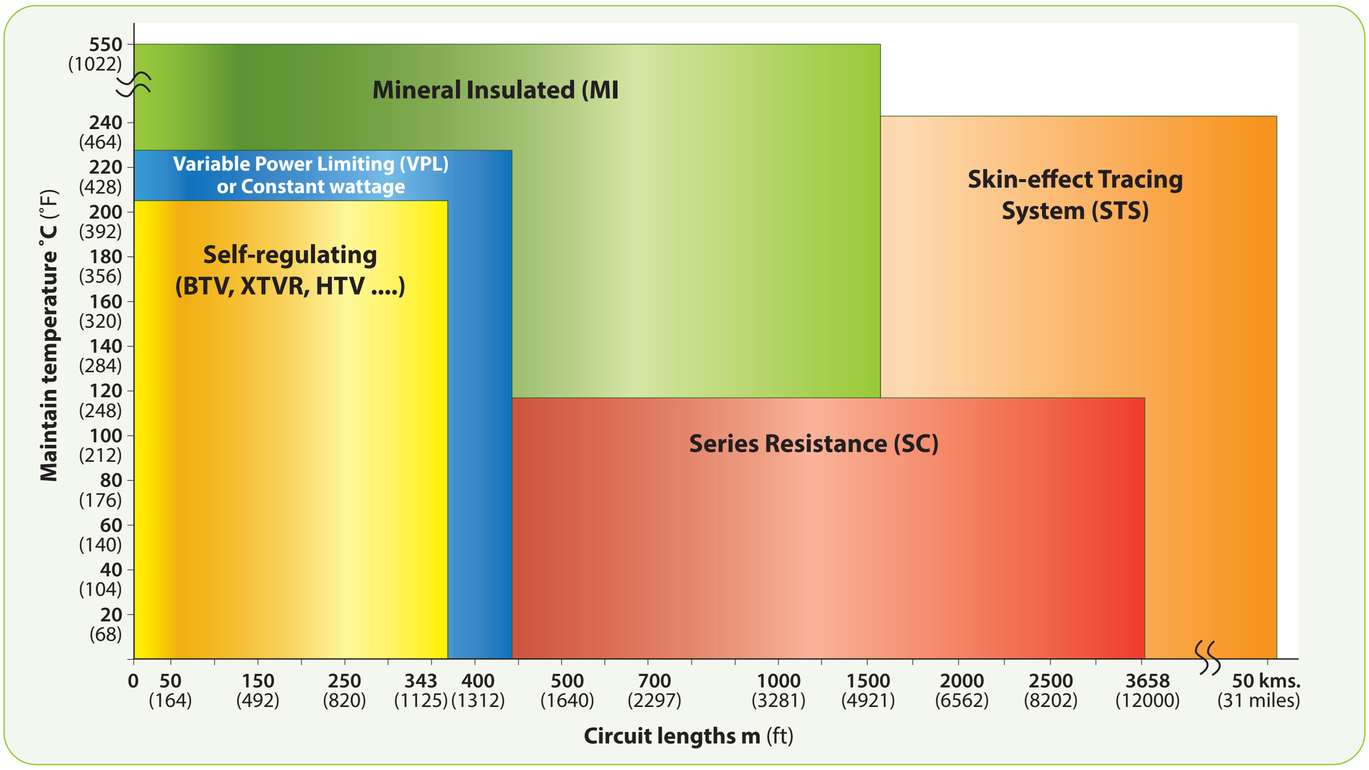

Figure 1 Cable technology portfolio: solutions that cover a wide range of temperature and circuit length requirements for any application

Managing process temperatures requires an integrated heat management system

Plants and refineries require pre-determined temperature management from pipe freeze protection to high-temperature process maintenance in piping, equipment, tanks, and instruments. Consequently, they need to rely on heat trace cables capable of meeting a broad range of precise design criteria.

nVent offers a portfolio of Raychem cable technologies that cover a wide range of temperature and circuit length requirements, as shown in **Figure 1**. Moreover, a complete heat management system must also include:

- An engineered design using proprietary TracerLynx 3D HMS software to optimise process maintenance piping, equipment, tanks, and instrument temperatures for precise design criteria and conditions.
- Power distribution system that provides the most efficient power management and electric heat tracing (EHT) designs.
- Control and monitoring system with supervisory software that confirms the system is working properly, offers useful diagnostic information to optimise maintenance and operation, manages alarms, and saves energy.
- Instrument winterisation to protect and ensure reliable operation of instruments.

The following case studies exemplify how a complete system using the right technology can solve comprehensive temperature maintenance requirements. In many cases, a combination of heating cable technologies proves most optimum.

Case study 1: Constant wattage heating cable technology in LNG industry

A major LNG facility in Corpus Christi has access to abundant natural gas and premier marine access with two loading berths large enough to receive the largest LNG carriers. The customer's mission-critical objective is operational reliability and an optimal frost heave prevention system for three 160,000 cubic metres LNG storage tanks. The project required detailed control and monitoring capabilities to minimise operational risk and maximise productivity.

nVent engineers designed a redundant frost heave prevention system using Raychem constant wattage heaters, connection kits, resistance temperature detectors (RTD), and a 277V/480V power distribution combined with a Raychem NGC-30 heat trace control and monitoring unit to save energy, minimise risk, and maximise productivity.

Case study 2: Variable power limiting heating cable technology in biofuels industry

One of the largest midstream infrastructure and logistic solution providers in the US is shifting its terminal facilities from petroleum-based to biofuels production. This conversion requires multi-million-dollar terminal retrofits to enable the aggregation, storage, blending, and distribution of biofuels, mainly biodiesel, all totalling up to 5,000 miles of pipeline and 130 liquid petroleum terminals.

Since typical terminal storage and distribution for petroleum-based products, like diesel and gasoline, do not require supplemental heat tracing, areas such as piers, jetties, tankage, blending, and interconnecting piping had limited power distribution capacity. However, biodiesel, ethanol, and SAF storage and distribution do require heat tracing to maintain the right viscosity levels. For example, biodiesel (B100) requires a process temperature maintenance of 110°F (43°C). The customer's mission-critical objectives for the heat management solution include finding the optimal yet cost-effective system design for this project that would keep critical processes running and manage the additional demands for power distribution in the terminal areas such as piers, jetties, tankage, blending and interconnecting piping.

nVent engineers designed a system using Raychem Variable Power Limiting technology (VPL-4) powered at 480V for longline heating, interconnecting piping, and vessel heating. VPL heating cables offer great features like ease of design and cut-to-length installation. However, most important to the customer was that the long circuit length capability of VPL-4 at 480V reduced the circuit count and addressed the challenge of limited power distribution in piping and vessels in areas of the terminal.

To manage the higher temperature lines that required process temperature maintenance or freeze protection, the engineers selected Raychem HTV high-temperature self-regulating heating cables with High Power Retention (HPR) technology that have a minimum of 95% power retention after 10 years and a design life of 30 years or more. The design was completed with a heat trace control and monitoring unit to save energy, minimise risk, and maximise productivity.

Case study 3: Series resistance heating cable technology in biofuels industry

A Newfoundland refinery is undergoing a major retrofit to manufacture renewable diesel and SAF. The main feedstock will be animal fats and plant oils, which will arrive via ships from the Northeast USA. Since the previous petroleum feedstock loading dock and distribution system did not require heat tracing, the dock area had limited power distribution available. However, because animal fats and plant oil feedstocks and some finished goods become waxy and solidify at ambient temperatures, they require heat tracing to maintain temperatures in the 120°F (50°C) range to keep them in liquid form. The customer's objective was to find an efficient and budget-friendly heat management solution to sustain mission-critical processes and handle increased power needs at the dock and distribution areas.

nVent engineers designed a system using Raychem series heating (SC) cables for the longlines due to their ability to meet the process temperature maintenance needs, heat the long distribution lines, and manage the limited power distribution reliably, safely, and with the lowest installed cost. The design was completed with a heat trace control and monitoring unit to save energy, minimise risk, and maximise productivity.

Case study 4: Skin-effect tracing system technology in biofuels industry

Two major renewable producers in Port Arthur, Texas, have partnered on a challenging project to deliver chicken fat as feedstock to a rail unloading facility, then through an underground line into the refinery. The underground line would be buried at depths ranging from 6 to 100 feet. Chicken fat and used cooking oil are two of the feedstocks being utilised in the refinery to produce renewable diesel. Routing this feedstock into the refinery involves the design of a one-mile-long heated underground pipeline.

The chicken fat and oil have to be maintained at a process temperature of 120°F (50°C) to keep them in liquid form. The customer's mission-critical objectives for the heat management solution included protecting critical processes and managing the engineering and contractor challenges for construction, installation, and future reliable operation of this underground heated line.

nVent engineers designed a system using

the Raychem Skin-effect Tracing System (STS) because the bundled longline technologies would optimise the heat management system performance:

- Pre-insulated/pre-fabricated piping systems that offer superior thermal insulation reliability and underground integrity by providing a homogeneous temperature profile for the entire length of the pipeline.
- Fiber-optic Distributed Temperature Sensing (DTS) systems to measure the temperature of the underground pipeline every metre along its underground routing.
- Raychem Pipeline Supervisor (RPS) predictive analytics software for comprehensive control and to safely manage temperature-critical pipelines.
- Power distribution solution at one end of the pipeline.

Process temperature maintenance of this key feedstock line was completed using directional drilling to install a one-mile-long, pre-insulated, STS-heated, underground pipeline with the temperature being maintained at 120°F (50°C). The pipeline temperature is being monitored every metre along this pipeline using DTS-Fiber Optic. RPS ensures feedstock flow assurance by monitoring the entire pipeline and providing the data required by operations to ensure this underground line is functioning as designed.

Case study 5: Self-regulating heating cable technology in CCS industry

Ethanol plants in the Midwest USA produce significant CO_2 as a result of fermentation. With an overall goal of protecting the long-term viability of the ethanol and agricultural industry, a Midwest customer is partnering with more than 30 ethanol plants across five states on a project to reduce the carbon emissions at each location through a CCS process.

At each ethanol facility, CO_2 will be captured, dehydrated, and compressed, and then CO_2 will be gathered and transported through pipelines to the deep geological formation injection point in North Dakota. The customer's mission-critical objectives for the heat management solution include ensuring operational reliability for managing northern climate freeze protection and process temperature maintenance and optimising energy efficiency across all the plants. This CCS project is currently the largest in the world and upon completion will safely capture 18 million metric tons of CO_2 per year.

nVent engineers designed a system using Raychem XTVR high-temperature self-regulating heating cables with High Power Retention (HPR) technology for both the process temperature maintenance and freeze protection applications. The design was completed with the advanced Raychem NGC-30 heat trace control and monitoring unit to save energy, minimise risk, and maximise productivity.

Case study 6: Self-regulating heating cable technology in hydrogen industry

A leading global producer of industrial gases in Alabama is constructing a new SMR hydrogen plant to support the long-term viability of the chemical industries in the area. The facility design and construction include all the infrastructure and utilities required for an industrial project. The customer's mission-critical objectives for the heat management solution include finding the optimal system design that would keep critical process maintenance and freeze protection applications running, prevent condensation in large bore piping that transports process gases and nitrogen gas, protect/winterise instruments, and provide an energy-efficient control and monitoring solution that verifies the operational reliability of the heat management system.

nVent engineers designed a system using Raychem XTVR high-temperature self-regulating heating cables with HPR technology for both the process temperature maintenance and freeze protection applications. The design was completed with the NGC-40 heat trace control and monitoring unit to save energy, minimise risk, and maximise productivity.

Summary

Critical heat trace solutions for the energy transition industries will remain vital as more industrial facilities convert to clean fuels and CO_2 reduction. Securing reliable operation and uptime in plants and refineries, especially with the high-temperature maintain demands of new biofuel feedstocks, will require well-designed solutions to manage pipe, tank, and equipment temperatures.

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