OIL & GAS PROCESS HEATING

Vacuum-Assisted Phase-Change Indirect Electric Heater

MODEL BDRG-260

All-electric process heating for crude oil, natural gas and oil-gas-water mixed streams.

260 kW	3 classes	97%+	PLC + SCR
RATED POWER	WORKING FLUIDS	EFFICIENCY TARGET	PRECISION CONTROL

Indirect heat. Uniform transfer. Field-ready control.

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Designed around oilfield operating realities

Stable flow, controlled temperature and maintainable electric heat in one integrated package.

BDRG-260 is a sealed indirect electric heating system for crude oil, natural gas and mixed oil-gas-water streams. The electric elements heat an intermediate working fluid; phase-change circulation then spreads energy across a long process coil without placing energized elements directly in the hydrocarbon flow.

Cold climate FLOW ASSURANCE	**Mixed phase** OIL / GAS / WATER	**Zone 1 / 2** HAZARDOUS AREAS	**Local + remote** OPERATIONS

Operating problems addressed

- Cold-weather viscosity increase, wax deposition and line blockage risk.
- Local hot spots and accelerated coking in temperature-sensitive crude service.
- Heat loss, auxiliaries and operating burden associated with steam or fired systems.
- Need for automatic outlet-temperature control and SCADA-ready monitoring.

TYPICAL DUTIES Oilfield gathering stations, wellsite production, crude transfer, natural-gas heating, pressure-reduction stations and low-temperature retrofit projects.

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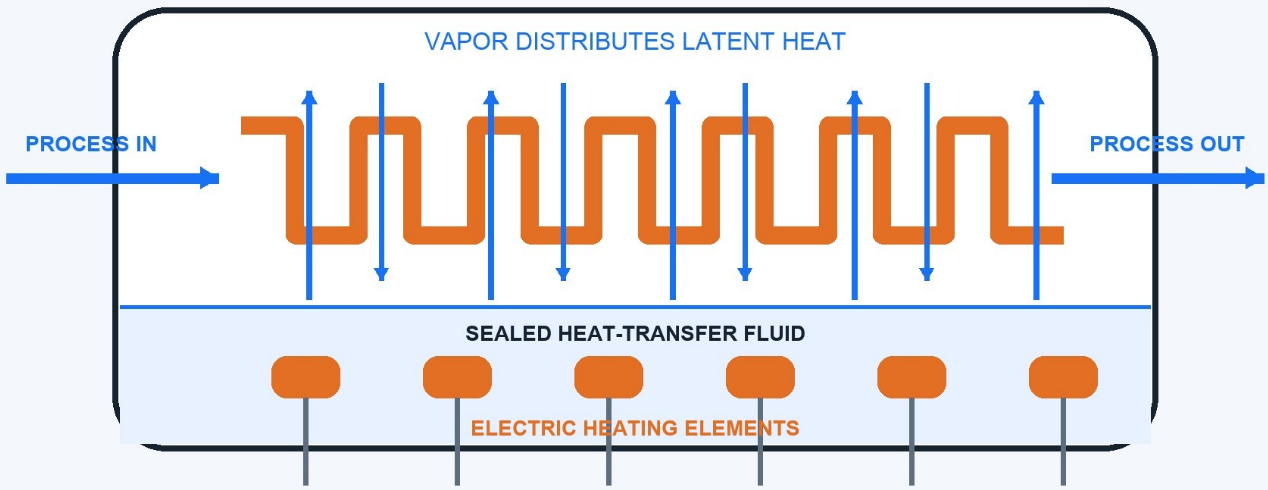
How sealed phase-change heating works

A sealed two-phase cycle moves heat to the process coil and returns condensate by gravity.



Pressure-controlled phase change + gravity condensate return

STEP	FUNCTION	WHAT HAPPENS
1	Electric input	Removable electric elements heat the intermediate working fluid in the lower chamber.
2	Phase change	Under the specified operating pressure, the working fluid boils and vapor rises through the chamber.
3	Latent heat transfer	Vapor condenses on the spiral process coil and releases heat to the flowing process medium.
4	Gravity return	Condensate falls back to the heating zone and the closed-loop cycle continues.

Sealed cycle	Latent heat	Gravity	Isolated
WORKING FLUID	ENERGY TRANSFER	CONDENSATE RETURN	ELECTRIC ELEMENTS

CORE VALUE The phase-change surface distributes heat across the process coil at a controlled interface temperature, while the electric elements remain isolated from the high-pressure process stream.

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Uniform heat transfer helps manage coking risk

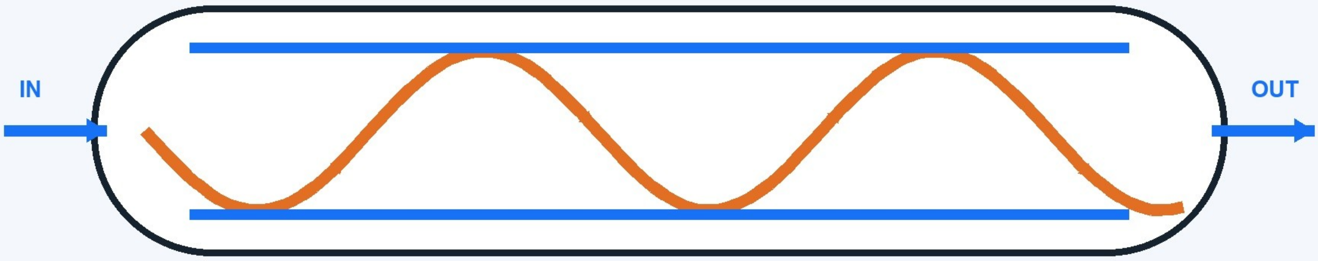
The design combines process isolation, broad-area phase-change transfer and an intensified flow path.

ANTI-COKING LOGIC Lower and more uniform heat-transfer temperature reduces localized thermal stress compared with direct, high-surface-temperature heating. Actual fouling still depends on crude composition, velocity, wall temperature and operating discipline.

LONGER EFFECTIVE PATH

HIGHER TURBULENCE

MORE UNIFORM HEATING



Swirl guidance intensifies mixing while the spiral coil provides a large heat-transfer area.

10-20×	Higher	Fewer	More uniform
TUBE/BODY LENGTH	TURBULENCE	STAGNANT ZONES	HEAT PICKUP

- Swirl guidance increases mixing around the heat-transfer surface.
- The spiral path extends residence time and available exchange area.
- A broader thermal interface helps limit concentrated heat flux.
- Process-side velocity and wall-temperature limits are checked during engineering.

DESIGN FEATURE	PROCESS EFFECT
Indirect element arrangement	No energized element is directly exposed to the hydrocarbon stream
Phase-change interface	Latent heat spreads energy across a wider and more stable surface
Spiral / swirl flow path	Promotes mixing and reduces low-velocity pockets around the coil

OPERATING DISCIPLINE Minimum flow, maximum wall temperature and shutdown permissives remain essential controls for fouling-sensitive service.

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Three working-fluid temperature classes

Water/glycol and Dowtherm-type synthetic heat-transfer fluids support low- to high-temperature indirect heating.

60-90°C — **WATER / GLYCOL**
Low-temperature flow assurance

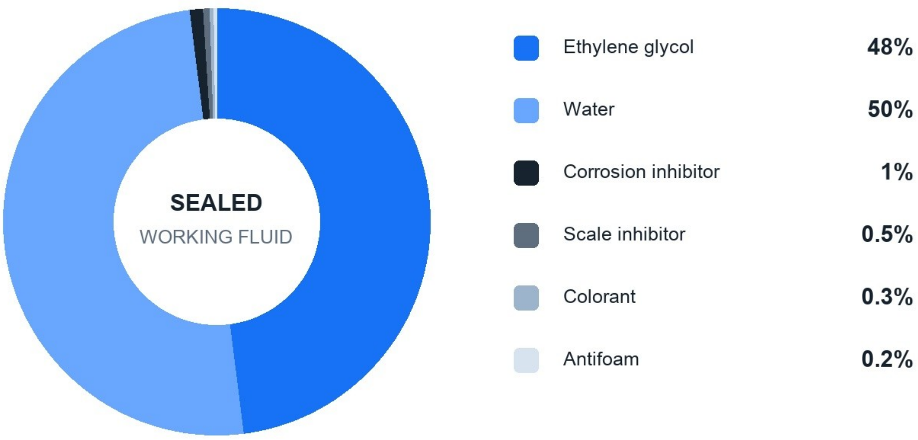
180-300°C — **DOWTHERM-BASED**
Medium-temperature process duty

260-380°C — **HIGH-TEMP DOWTHERM**
High-temperature indirect heating

Working-fluid grade, pressure, materials and protection settings are selected per project.

CLASS	PRIMARY USE	ENGINEERING FOCUS
60-90°C water / glycol	Crude flow assurance, gathering and low-temperature service	Freeze protection, vacuum/pressure setpoint and water chemistry
180-300°C Dowtherm-based	Medium-temperature process heating	Fluid grade, material compatibility, expansion and oxidation control
260-380°C high-temp Dowtherm	High-temperature indirect duty	Thermal stability, film temperature, pressure and dedicated protection settings

PROJECT-SPECIFIC SELECTION The ranges identify product classes, not one universal operating envelope. Final working fluid, setpoints, materials and heater geometry follow the approved process datasheet.



Reference composition - 60-90°C water/glycol configuration

Reference low-temperature formulation shown for configuration discussion; final mixture follows site climate and project requirements.

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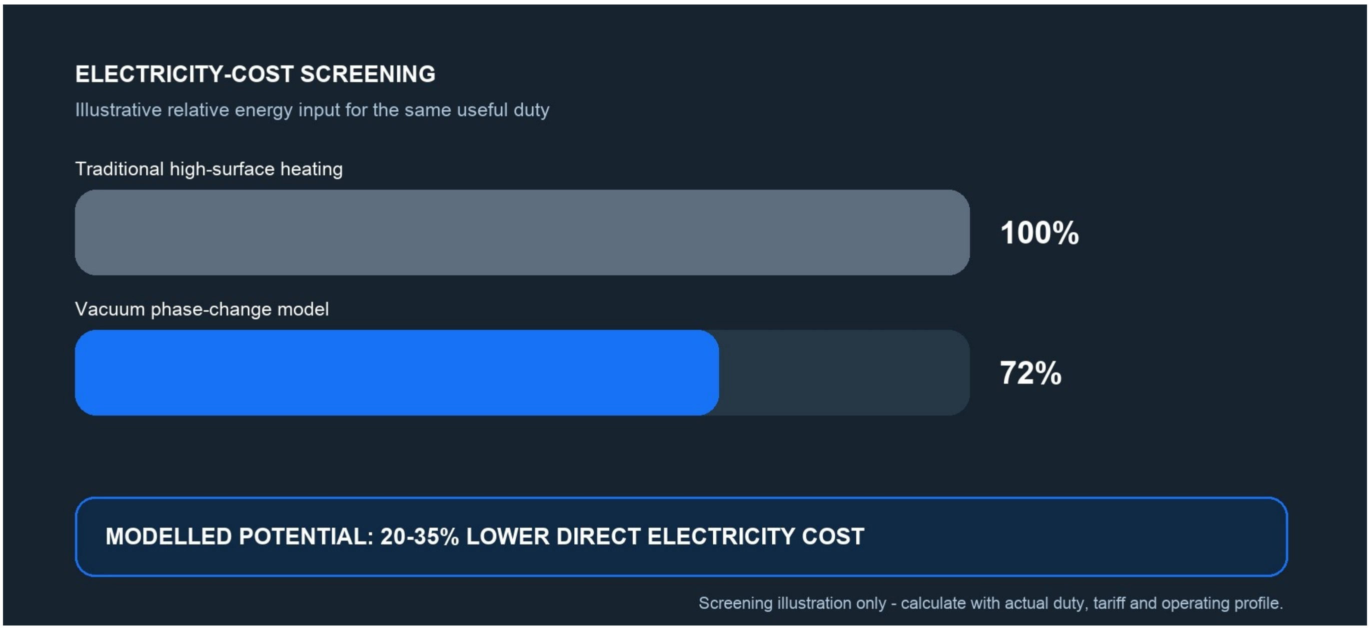
Economics: evaluate the whole heating system

The strongest savings case often combines energy efficiency with simpler utilities and lower operating burden.



20-35% MODELLED POTENTIAL	**97%+** EFFICIENCY TARGET	**No burner** AT PACKAGE	**Less auxiliary** SYSTEM BURDEN

VALUE DRIVER	WHERE SAVINGS MAY OCCUR
Energy transfer	Lower heat loss and broad-area transfer under the design operating point
Utility system	No local fuel-gas train, burner, flue or steam distribution at the heater package
Operations	Automatic modulation, remote monitoring and reduced routine attendance
Maintenance	Removable electric elements and fewer combustion-related components
Production continuity	Reduced fouling intervention and less disturbance when correctly selected and operated

SCREENING EXAMPLE At an electricity tariff of US$0.075/kWh, avoiding 100,000 kWh equals US$7,500/year. Replace both figures with the site's actual duty, tariff and operating hours. The 20-35% range is an illustrative model, not a guaranteed saving.

Build the business case with site data

INPUT	CALCULATION ROLE
Useful heat duty × annual hours	Defines the annual process-energy requirement
Actual heater / system efficiency	Converts useful duty into purchased energy
Electricity and fuel tariff	Converts purchased energy into direct operating cost
Maintenance + auxiliaries + attendance	Captures lifecycle costs beyond energy consumption

PAYBACK Annual benefit = avoided energy cost + avoided auxiliary and maintenance cost - new electrical operating cost. Simple payback = incremental installed cost / annual benefit.

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Field case: Xingang Oilfield heating retrofit

Xinjiang, China | Oil and gas gathering | Steam-heating replacement

260 kW	≈ RMB 6M	97%+	SCADA-ready
INSTALLED CLASS	REPORTED ANNUAL SAVING	EFFICIENCY TARGET	REMOTE OPERATION

PROJECT CHALLENGE	XGTHERMAL RESPONSE
Steam-network heat loss plus fuel, water-treatment and exhaust-system burden	All-electric indirect phase-change heater with no onsite combustion at the package
Wax deposition and low-temperature blockage risk	Automatic outlet-temperature control and broad-area heat transfer
Need to reduce staffed operation and improve visibility	Local control, interlocks and SCADA-ready remote monitoring
Retrofit required measurable operating value	Reduced fuel use, auxiliary systems, maintenance and production disturbance

CASE DISCLOSURE The approximately RMB 6 million annual saving is reported in the project material and has not been independently audited. Results are site-specific and should not be applied to another project without a duty-and-tariff model.

Project reference profile

CATEGORY	PROJECT BASIS
Application	Oil and gas gathering heating / low-temperature flow assurance
Retrofit direction	Replacement of steam-heating infrastructure
Equipment scope	Vacuum phase-change electric heating devices
Operation	Local automatic control with SCADA-ready remote interface

TRANSFERABILITY Use the case to identify value drivers—then recalculate heat duty, tariffs, hours, utilities and maintenance for the new site.

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BDRG-260 technical profile

Reference configuration normalized from the approved source documentation.

Parameter	BDRG-260 reference configuration
Rated power	260 kW total: 4 x 50 kW + 1 x 60 kW
Electrical supply	AC 380 V, 3-phase, 50 Hz
Installation	Horizontal, skid-mounted
Process service	Crude oil, natural gas and oil-gas-water mixed media
Heating method	Pressure-controlled phase-change indirect electric heating; vacuum-assisted where applicable
Heat-transfer range	60 to 90°C water/glycol; 180 to 300°C or 260 to 380°C synthetic-fluid options
Hazardous area	Zone 1 or Zone 2; project-specific selection
Explosion protection	Ex db IIB T4 Gb or Ex db IIC T4 Gb
Power control	Five SCR-controlled heating groups; PID temperature regulation
PLC	Siemens SIMATIC S7-200 SMART
Operation	Local / remote; manual / automatic / stop / hold modes
Communication	Modbus TCP/IP via Ethernet and Modbus RTU via RS485
Start permissive	Water/glycol reference: internal pressure at or below -0.02 MPa(g); other fluids project-specific
Thermal efficiency	97%+ target; up to approximately 98% under specified design and operating conditions

CONFIGURATION BASIS Nozzle size, process design pressure, materials, instrumentation, ambient rating and applicable codes are finalized during project engineering. Generic product-family capability is not a substitute for the final approved datasheet.

4×50 + 1×60	380 V / 50 Hz	IIB / IIC	S7-200 SMART
POWER STAGES	REFERENCE SUPPLY	EX OPTIONS	REFERENCE PLC

Engineering variables finalized before quotation

- Process design pressure, allowable pressure drop and nozzle class.
- Working-fluid grade, thermal setpoints and material compatibility.
- Hazardous-area certification, ambient conditions and enclosure requirements.
- Instrumentation brands, communication interface and documentation package.

REFERENCE MODEL BDRG-260 identifies the reference 260 kW configuration. Final equipment construction follows the signed datasheet and approved drawings.

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Technology comparison: system impact matters

BDRG-260 is positioned where electrification, clean local operation and controlled indirect heat provide project value.

COMPARISON POINT	GAS-FIRED HEATER	BDRG-260 ELECTRIC
Energy package	Burner, gas train, ignition, combustion chamber and flue	Electric elements, PLC, SCR and sealed phase-change chamber
Local emissions	Combustion products at heater	No onsite combustion at heater package
Control response	Burner turndown plus thermal inertia	Stepless electric modulation by SCR
Utilities	Fuel gas, combustion air and exhaust handling	Electrical capacity and hazardous-area electrical design
Maintenance	Burner, flame safeguard, gas train and flue	Removable elements, sensors and power/control system

Water-bath versus vacuum phase-change

COMPARISON POINT	WATER-BATH HEATER	BDRG-260 PHASE-CHANGE
Transfer mechanism	Sensible heat in a liquid bath	Latent heat by evaporation and condensation
Temperature profile	Larger bulk-fluid temperature difference	Controlled and more uniform thermal interface
Best-fit duty	General indirect heating	Crude oil, coking-sensitive and pre-separation service
Low-temperature operation	Bath heating and freeze management	Water/glycol class with project-selected freeze protection

SELECTION RULE Compare lifecycle cost, available utilities, emissions policy, area classification, maintainability and process coking sensitivity—not equipment efficiency alone.

Utilities	Emissions	Coking	Lifecycle
AVAILABLE ONSITE	PROJECT POLICY	PROCESS SENSITIVITY	COST + SERVICE

Where BDRG-260 is strongest

- Sites prioritizing electrification and zero local combustion at the heater package.
- Crude-oil duties where broad-area, lower-temperature indirect transfer is valuable.
- Facilities seeking automatic modulation, remote status and simpler routine maintenance.

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Compared with direct electromagnetic heating

The main difference is the isolated, broad-area indirect heat-transfer path.

COMPARISON POINT	DIRECT ELECTROMAGNETIC	BDRG-260 PHASE-CHANGE
Heating path	Direct / localized	Intermediate fluid + phase-change transfer
Process isolation	No intermediate thermal barrier	Electric elements isolated from process stream
Reference temperature	Typically higher local surface temperature	60-90 / 180-300 / 260-380°C product classes
Internal tube length	Approx. 1-4× heater length	Approx. 10-20× heater body length
Heat distribution	More localized	Dynamic and broadly distributed
Element service	Assembly-dependent replacement	Individual elements removable
Indicative efficiency	Approx. 80% in supplied comparison	Up to approx. 98% under design conditions

Individual	5 groups	No process entry	Bypass-ready
ELEMENT REPLACEMENT	FAULT ISOLATION	ELEMENT SERVICE	MAINTENANCE PLANNING

Maintainability by design

- Removable heating elements support targeted replacement instead of complete core replacement.
- Explosion-proof terminal enclosures provide direct access to field terminations.
- Five controlled power groups simplify fault isolation and staged power management.
- A process bypass allows planned inspection, isolation and seasonal operation.
- Indirect heating keeps routine element service outside the process coil.

COMPARISON BASIS Indicative values are from the supplied BDRG-260 material. Actual performance depends on duty, flow regime, insulation, ambient conditions, control strategy and final mechanical design.

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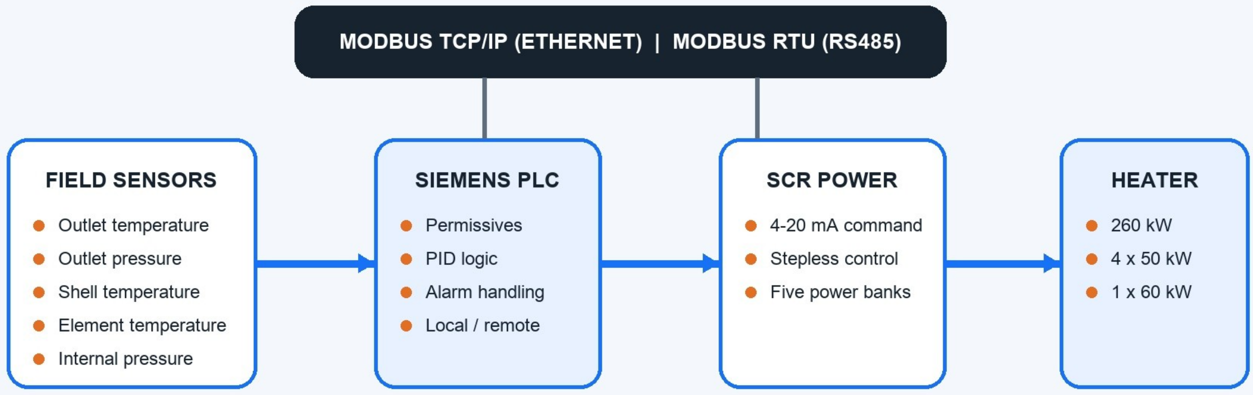
Precision control with layered protection

PLC logic coordinates measurements, permissives and stepless SCR power output.



Closed-loop control holds outlet temperature while independent protection layers remain active.

PROTECTION FUNCTION	60-90°C REFERENCE	SYSTEM RESPONSE
Shell dry-heating alarm	100°C	Heating stops; auto recovery below 95°C
Shell high-temperature trip	120°C	Alarm + main breaker trip after 5 s
Element dry-heating alarm	350°C	Heating stops; auto recovery below 340°C
Element high-temperature trip	450°C	Alarm + main breaker trip after 5 s
Outlet overpressure	Project setting	Start inhibited / heating stopped
Internal pressure high	> 0 MPa(g)	Heater start inhibited

PID	SCR	TCP/IP + RS485	Local / remote
TEMPERATURE LOOP	STEPLESS OUTPUT	COMMUNICATIONS	OPERATION

SETTING CONTROL The values above apply only to the 60-90°C water/glycol reference configuration. Synthetic-fluid classes require dedicated alarm and trip settings based on the approved fluid and safety review.

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Installation and package integration

Foundation, piping, bypass, power and control interfaces should be planned as one system.

Horizontal	0.3 m	≤ 4 Ω	Bypass
INSTALLATION	STRAIGHT PIPE	GROUNDING	SERVICE ACCESS

INTEGRATION PRINCIPLE Treat the heater, piping, foundation, power distribution, hazardous-area wiring and control interfaces as one coordinated package.

INSTALLATION ITEM	REFERENCE REQUIREMENT
Orientation	Horizontal installation on a firm, level foundation larger than the equipment skid.
Piping	Provide at least 0.3 m of straight pipe upstream and downstream.
Bypass	Install a bypass line for inspection, isolation and seasonal operation.
Flange alignment	Parallelism error < 1 mm; coaxial alignment error < 0.5 mm.
Grounding	Provide dedicated lightning / protective grounding; reference resistance <= 4 ohm.
Cold start	Below -10°C ambient, preheat for approximately 30 minutes before normal operation.

Typical supply scope

PACKAGE ELEMENT	TYPICAL PROJECT SCOPE
Heater assembly	Insulated horizontal vessel / chamber, internal process coil and skid support.
Electric heating system	Five removable heating-element groups and explosion-proof terminal enclosures.
Control system	PLC, HMI, SCR power control, breakers, protection devices and local controls.
Instrumentation	Temperature, pressure and internal-condition monitoring; additional flow / level instruments as required.
Documentation	GA drawing, electrical diagrams, control narrative, inspection records and operating documentation.

BOUNDARY CONFIRMATION Final supply scope, exclusions, site responsibilities and interface points are confirmed in the technical proposal and approved drawings.

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Data required for heater selection

Provide the following information for a project-specific thermal and mechanical proposal.

SELECTION ITEM	INFORMATION REQUIRED
Process	Composition, phase, density, viscosity, solids / water content and corrosive components
Flow	Normal, minimum and maximum mass or volumetric flow
Temperature	Inlet, required outlet, design temperature and ambient range
Pressure	Normal operating pressure, design pressure and allowable pressure drop
Electrical	Voltage, frequency, phase, available power and site short-circuit data
Hazardous area	Zone / division, gas group, temperature class and required certification
Mechanical	Nozzle size / class, preferred orientation, skid limits and materials
Control	Local / remote philosophy, communication protocol and station system interface
Codes	Required pressure, piping, electrical, inspection and documentation standards

Duty	Pressure	Area class	Codes
FLOW + TEMPERATURE	DESIGN + DROP	ZONE + GAS GROUP	PROJECT STANDARDS

ENGINEERING OUTPUT With complete input data, XGTHERMAL confirms heat duty, working-fluid class, coil geometry, materials, power stages, hazardous-area design, protection settings and documented supply boundary before quotation.

IMPORTANT Product-family ranges and brochure values are preliminary. Only the signed datasheet, approved drawings and contract define the delivered equipment.

Recommended inquiry package

DOCUMENT	WHY IT MATTERS
Process datasheet	Defines all normal, minimum, maximum and design cases
P&ID / line list	Confirms interfaces, bypass, instruments and shutdown philosophy
Site standard	Fixes electrical, hazardous-area, material and documentation requirements
Plot / skid limits	Controls orientation, maintenance clearance and transport envelope

From inquiry to approved proposal

- 1. Duty review — verify all operating and design cases.
- 2. Thermal selection — confirm power, working-fluid class and control range.
- 3. Mechanical definition — confirm pressure boundary, materials and interfaces.
- 4. Technical agreement — freeze scope, drawings, inspections and documentation.

XGTHERMAL
Electric Heating Solutions for O&G Industry

Thank you for your interest in XGTHERMAL.

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Project values and supply boundaries are subject to the signed technical agreement.