

A Higher Degree of Production



Heaters proven by Shell's field successes



1998–2016 | Over 100 heaters (heated lengths [HL] up to 100 m) installed in eight Shell ICP field pilots in Colorado, Alberta, and Jordan.

2004–2007 | 18 heaters (HL = 200 m) installed in Shell IUP performance test conducted at Peace River, producing 200,000 barrels of light oil (>30°API oil) from 8°API heavy oil reservoir.

2012–2014 | First long-length (HL = 600 m) Shell heater installed to test deployment and high-temperature, high-voltage operation in open hole.

2017 | First installation of BoostWell™ heater (HL = 900 m) at Shell/CNRL Clifdale field in Alberta, Canada. As expected, oil production increased by a factor of five.

Target applications

- Heavy oil cold flow
- Heavy oil SAGD
- Oil wells with high wax
- Subsea applications
- Difficult hydrocarbons



Complete capabilities

Well, reservoir, and facilities consulting services

Reservoir modeling

Reservoir models which use proprietary descriptions of fluid and rock properties to deliver fit-for-purpose solutions for the subsurface needs of the customer, quantifying benefits of Salamander heaters

Production uplift and reservoir monitoring

Review of production increases and history matching of reservoir response for up-to-date production forecast and reservoir models

Integrated deepwater optimization

Review of full system value improvements enabled by Salamander heaters, including well layout, subsea manifold locations, flowline optimizations, and topside impacts to provide robust flow assurance solutions that maximize customer benefits

Heater system services

Design

Fully customized heater cables, surface equipment, and control systems to meet customer requirements

Manufacturing

Existing factory for quick turnaround or localized manufacturing for large-scale requirements

Heater assembly

Available on-site or prior to delivery

Deployment

Custom coiled tubing, assembly, deployment equipment, and on-site support

Control

Low-cost, next-generation control systems developed based on years of Salamander operating experience

Monitoring

Full-time surveillance, servicing, troubleshooting, and follow-up available



Salamander Advanced Heater Solutions works with you to increase well production, improve reservoir performance, and provide breakthroughs in deepwater developments. Our rugged heater cables are custom designed by our unparalleled team of experts.

Thanks to our ability to deliver heaters in unprecedented lengths and at higher power levels, Salamander heaters can increase production in the longest of horizontal oil wells. Our advanced heater solutions also create opportunities to simplify deepwater projects, enabling lower cost developments, extending the economic life of existing fields, and even reaching resources stranded by current technology limitations.

We bring the heat

Many heavy oil recovery technologies rely on the injection of mass—typically steam or chemicals. Since the steam does not flow where you want it to, the reservoir is poorly swept and significant oil is left behind. Using heat eliminates the impact of reservoir heterogeneity because thermal properties are much less variable than flow properties. Salamander heaters, originally developed by Shell, provide benefits in both cold flow and SAGD wells.

Salamander heaters can also provide breakthrough benefits to deepwater developments. Advancements in heater lengths enable replacement of costly and inherently unreliable flow assurance systems. Simplified field designs and well layouts, made possible by Salamander heaters, can dramatically lower initial field capital and increase ultimate oil recovery.

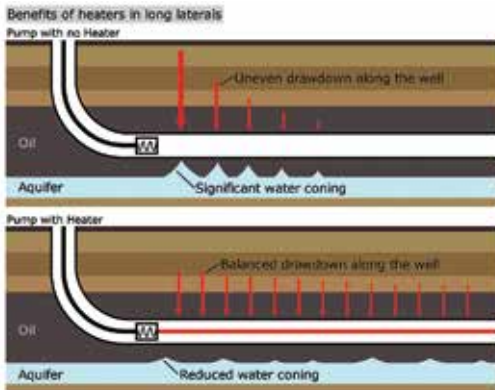
Designed for your specific needs

Salamander heater cables are the result of extensive research and development conducted over many years by Shell. All aspects of our heater cable design—core, insulant, sheath, and splices—were evaluated and validated in thousands of demanding lab tests and many field deployments in three countries. Additionally, our heater control system allows fine-tuning of temperature and power. Mechanically robust and extremely reliable, Salamander heaters are designed for greater lengths, higher power, and higher temperatures.

Complete heater solutions can be tailored to your needs, whether on-shore or in deepwater. Our in-well designs can deliver unprecedented electrical heat (up to 3 MW) in unprecedented lengths. Our deepwater application can deliver heat at lower intensities over much longer lengths (over 30 km), providing a more robust flow assurance solution to the classic challenge of operating in the lower deepwater temperature environments. These heaters also enable reaching resources stranded by current technologies.

BoostWell™ viscosity improvement

Our BoostWell™ heaters in long, horizontal segments of cold production wells optimally heat the area near the wellbore to lower oil viscosity and increase effective wellbore diameter, which results in more even drawdown along the entire length of the well.



Increases production rates (up to 5x) and improves recovery

Longer effective well length and smaller skin

Increases the life expectancy of your pump systems

Lower viscosity, stable flow rates, and precipitation control

Reduces water cut

Balanced mobility contrast results in less water coning

Easy implementation

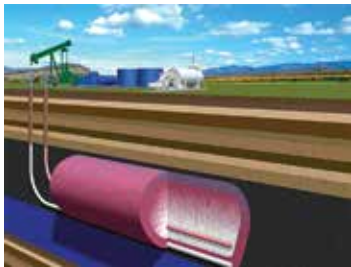
Designed for use in new or existing wells

Optimizes costs

Can pay out in less than 12 months

LinkWell™ SAGD acceleration

To improve SAGD performance, installing our LinkWell™ heaters in the injection and production wells accelerates well connection for faster oil, improved efficiency, and uniformity of steam injection.



Accelerates SAGD connection

Faster first oil in SAGD applications

Improves production and increases recovery

Better conformance and sweep profile along a longer length of the wellbore

Optimizes water usage

Can be installed before steam injection surface facilities

StreamWell™ flow assurance

Eliminates wax and hydrates

Consistently maintains temperatures above critical but below maximum operating temperatures

Improves flow

Prevents solids from compromising artificial lift

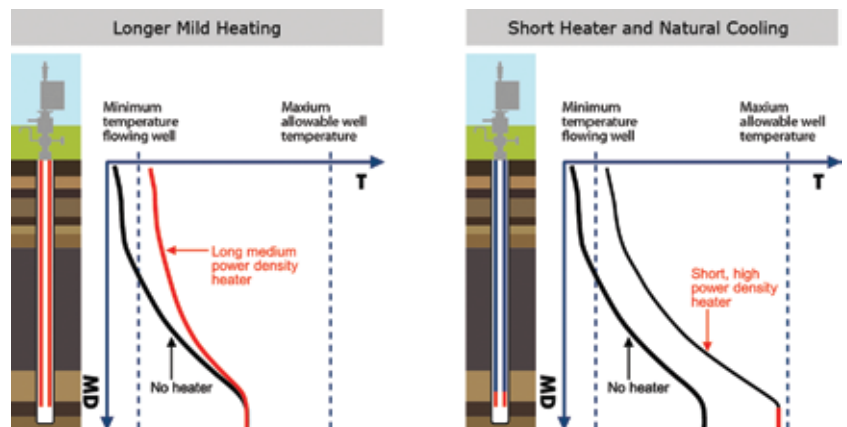
Easy implementation

Designed for new or existing wells

Optimizes costs

Can pay out in less than 12 months, and offsets the need for chemical injection and/or mechanical interventions

Our StreamWell™ heater solution installed in vertical or lateral sections of producing wells precisely controls wellbore temperatures to prevent precipitation of solids, including wax, sulfur, and hydrates.



Subsea applications

In new and existing fields, Salamander heaters add value to deepwater developments and operations. Specifically designed for the unique challenges of deepwater, these heaters prevent hydrates and wax plugging, reducing CAPEX and OPEX while increasing oil recovery.

SubseaEnable™

When installed on new flowlines, SubseaEnable™ eliminates hydrates and wax plugging and enables alternative subsea architectures (including lower cost vertical wells), giving flexibility in field planning and risk reduction. Long offset fields (beyond 30 km) are enabled, capturing stranded volumes.

SubseaExtend™

When added on existing flowlines, SubseaExtend™ eliminates hydrates and wax plugging, allows fields to operate to lower abandonment rates (capturing significant volumes), and reduces high chemical and other operating costs.

SubseaRecover™

When temporarily installed on existing flowlines that have become plugged, SubseaRecover™ can remove the plug without physical intervention in the pressure integrity system. This makes plug removal safe, cost-effective, and environmentally friendly.



Foundry™ in-situ conversion process (ICP) and in-situ upgrading process (IUP)

Our field-proven Foundry™ heater solution uses closely spaced Salamander heaters to increase temperatures throughout the entire reservoir to extract hydrocarbons from immature, kerogen-rich shales or heavy oil and bitumen; generate reservoir drive; and in some geological settings, rejuvenate production in depleted fields.

Increases recovery factors

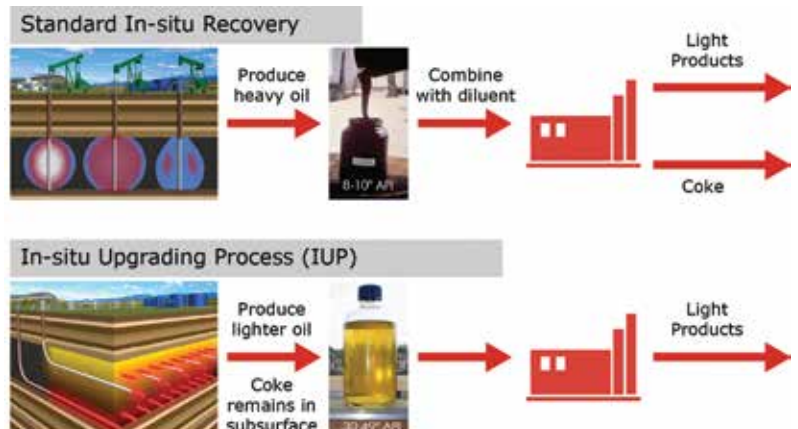
Recovery factors between 50% (ICP) and 75% (IUP) with energy ratios up to 10

Reduces diluent requirements

Allows API gravity to be tuned between 16° and 50°

Limits environmental impact

Often uses existing infrastructure, and by-products remain subsurface



For more information, visit salamandersolutions.com

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