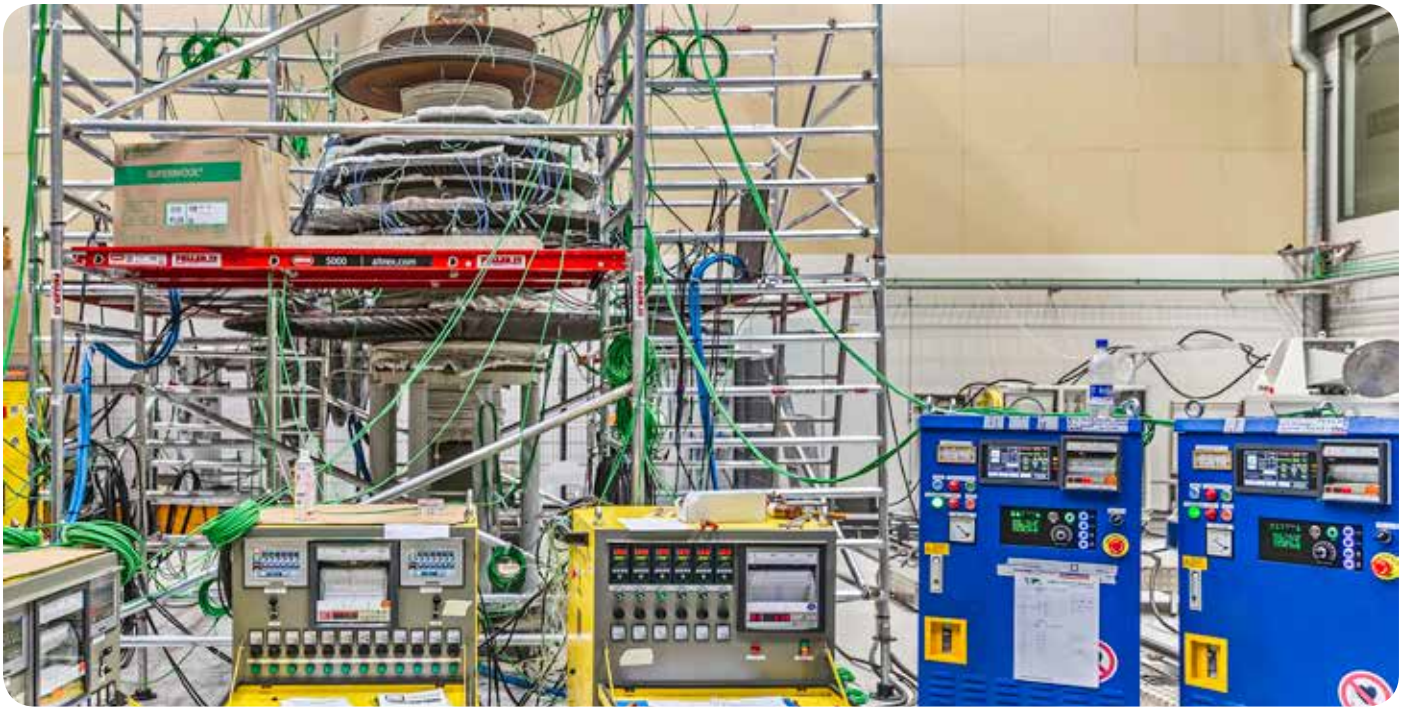
# DEILIR TECHNICAL SERVICES

## YOUR GEOTHERMAL SERVICE PARTNER

Deilir
Technical Services



## DEILIR TECHNICAL SERVICES

The Icelandic company Deilir Technical Services (DTS) specializes in services for geothermal power plants. Our experts have over thirty turbine overhaul projects under their belt, and have completed various power plant construction projects and thousands of smaller service tasks. DTS's main activities span service and repairs of geothermal power plants, focusing strongly on geothermal steam turbines.

DTS can serve both as consulting partner and hands-on service provider within power plants as regards their rotor overhauls and equipment assessmenats, including spare parts and component supply. Our team specializes in turbine rotor and part repairs and related equipment, such as vacuum and well- pumps, condensers, cooling towers and associated equipment.

We offer our outstanding services, repairs, monitoring and maintenance to geothermal power plants.

## WHAT DO WE DO FOR OUR CUSTOMERS:

- Operation and maintenance partner for geothermal power plants
- Steam turbine outage services and overhaul
- Rotor assessment and recommended scope of repairs
- Rotor repairs and components supply
- Reverse engineering, 3D scanning
- Engineering and consulting services
- Maintenance strategy for the plant to ensure better reliability
- Installation of computerized maintenance software, including assets and a maintenance program
- Organization of spare parts inventory
- Operation and maintenance training.

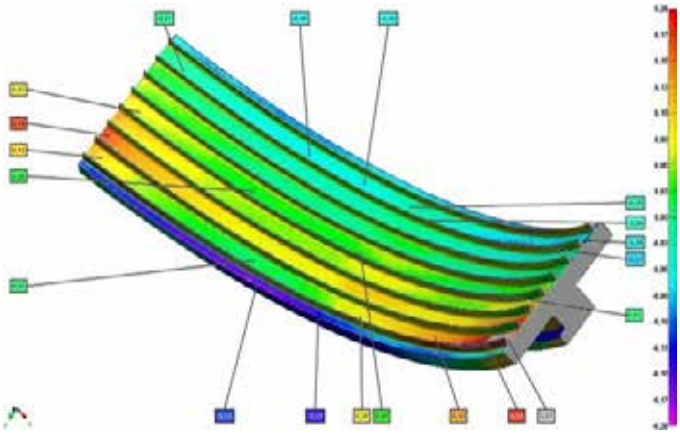
# TECHNICAL SERVICES

**Reverse Engineering**
Our engineering team provides assistance to convert design information for legacy parts and plant lay-outs to digital CAD format, and also support to analyze product design for flaws through reverse engineering.

**Part Manufacturing**
Scanned part drawings can easily be imported to milling machine for manufacturing. Faster and cheaper spare parts.

**Part-to-Part Comparison**
Two parts can be scanned, and both datasets are compared. Alignment is performed by either a best-fit method or predetermined data. Results are supplied in a color-coded model showing deviations between each part for internal and external geometry.

- 3D engineering design
- 3D reverse engineering and parts scanning
- Quality assessment
- On-site project management and project planning
- Improved equipment resistance to environment
- Diaphragm blade repairs or replacement
- Stress relief process after repair work
- Sealing face and horizontal joint overlay repairs
- Seal removal, installation and final machining



# OPERATION & MAINTENANCE SERVICE

The DTS team has good worldwide experience and our geothermal services have no limits.

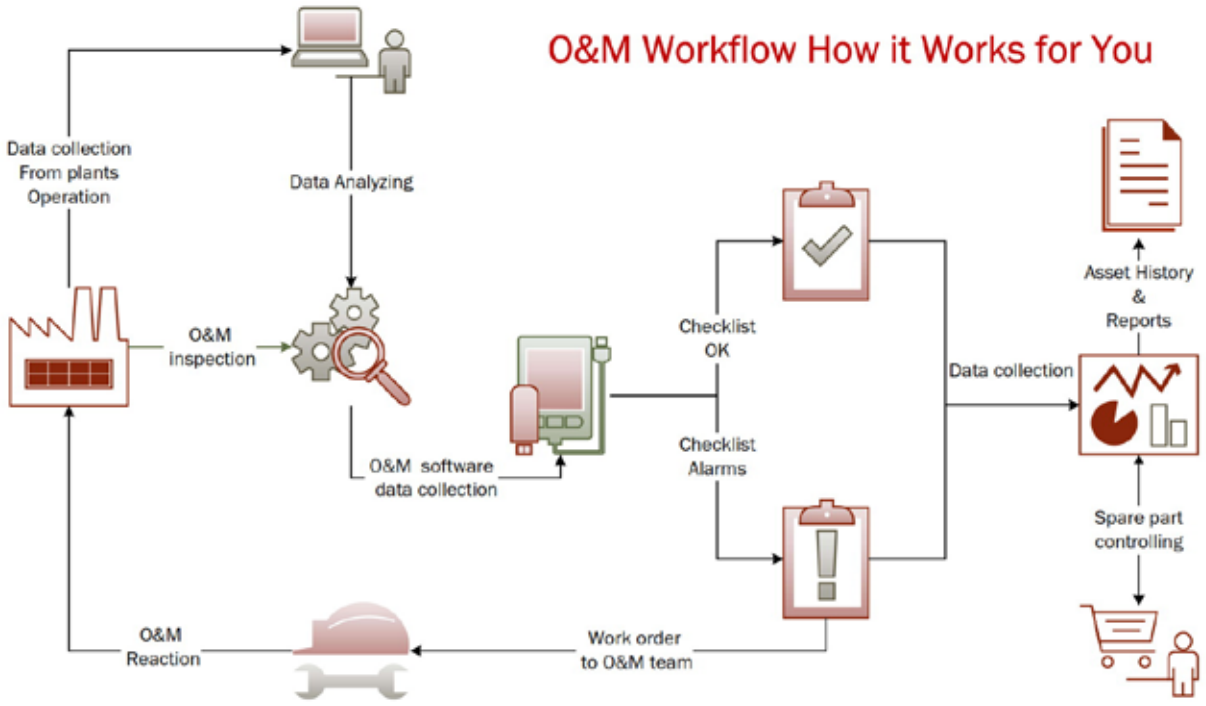
DTS offers a complete range of Operations & Maintenance (O&M) services to power plant owners. DTS has experience in setting up full scope O&M organizations to ensure safe and efficient operations, and effective management of both planned and unplanned maintenance activities.

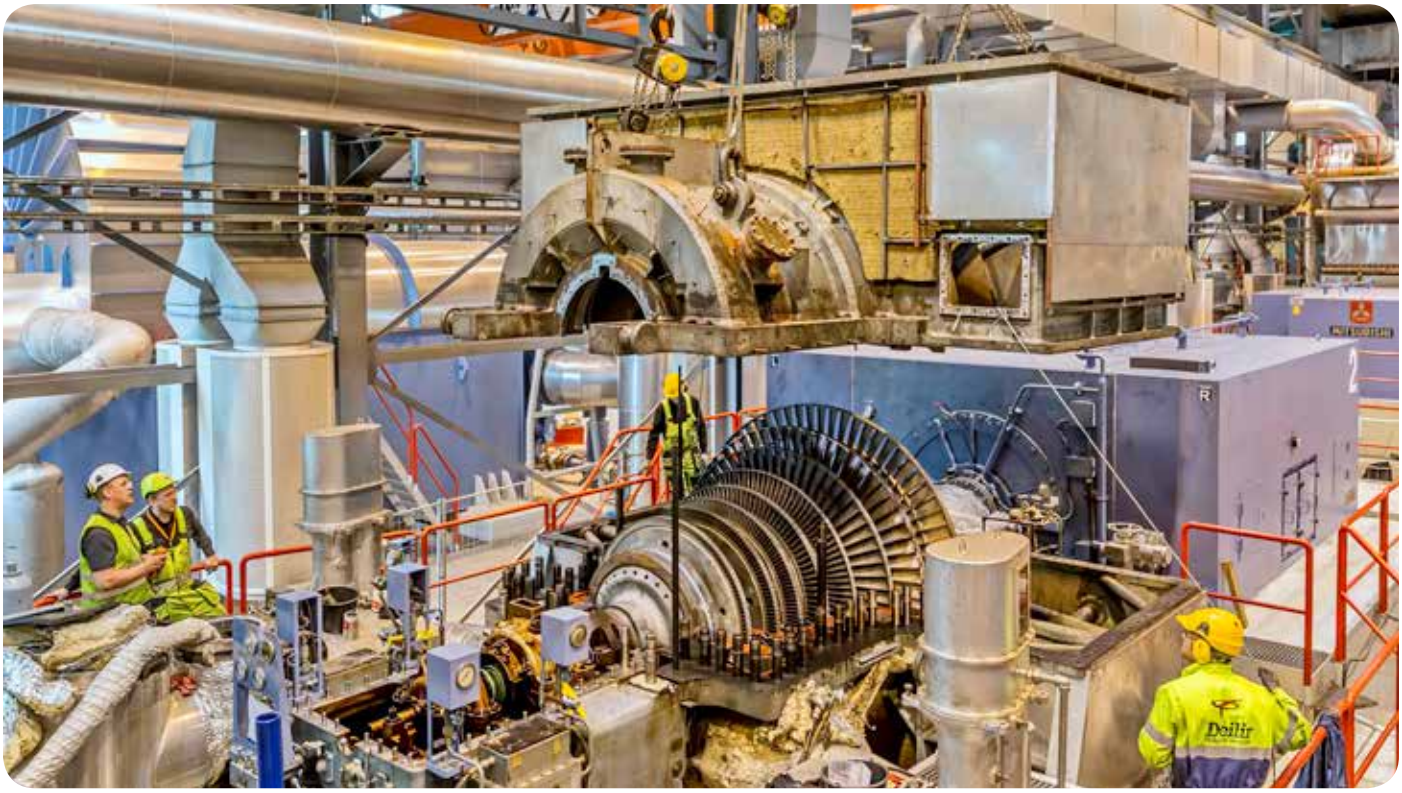
DTS provides professional service of geothermal steam turbines and surrounding equipment. Our team at DTS has experience in Fuji, Mitsubishi, Toshiba, Ormat, MAN, and Elliot turbines. Our team experience spans dozens of project planning operations, project management and hands-on work on turbine overhauls, rotor and diaphragm repairs, and affiliated equipment such as valves, pump systems and generator inspections service. Our customers can be served through different service levels depending on their needs.

| | LEVEL 1 | LEVEL 2 | LEVEL 3 |
|---|---|---|---|
| **MAINTENANCE SERVICE "PROJECT BASED"** | | | |
| Technical operation and maintenance consulting | ■ | ■ | ■ |
| Turbine overhaul service support | ■ | ■ | ■ |
| Non-destructive testing (NDT) of steam turbine rotors and diaphragms | ■ | ■ | ■ |
| Repair assessment reports | ■ | ■ | ■ |
| Periodic onsite visits | ■ | ■ | ■ |
| Material management, spare part services | ■ | ■ | ■ |
| **MAINTENANCE SERVICE "HANDS ON"** | | | |
| Turbine overhaul service | | ■ | ■ |
| Generator inspections | | ■ | ■ |
| Reverse engineering services | | ■ | ■ |
| Repairs of steam turbine rotors, diaphragms and surrounding equipment | | ■ | ■ |
| **MAINTENANCE SERVICE "KNOW HOW"** | | | |
| Full time on-site operation and maintenance service | | | ■ |
| Maintenance program set-up and database integration | | | ■ |
| Personnel leadership and maintenance training programs | | | ■ |
| Operation program set-up and training | | | ■ |
| Priority technical services | | | ■ |

# OPERATION & MAINTENANCE SERVICE

DTS offer Long Term Service Agreement to ensure maximum availability of our customer's geothermal power plants and to prevent any performance degradation throughout the power plant's entire life cycle. Our customers' peace of mind is guaranteed through Deilir Technical Services, overall operation, predictable maintenance budgets, inventory control, and proactive contract management. Our contracts are tailored to meet each customer's individual needs, to adapt to frequently changing market conditions, and to provide the best service value over the plant's life cycle.






# FIELD SERVICE

DTS Field Services provides complete field maintenance, installation, training, and repair for geothermal power plant equipment and control systems.

Beside installation and commissioning, we offer you integrated, comprehensive solutions for inspections, on-site repairs and outage services. Our experienced service specialists have the know-how to get your equipment back online in the shortest time.

DTS also provides timely delivery of parts and components with quality and reliability.

- Installation and start-up
- Turbine overhauls
- Generator inspection
- Technical advisory
- Failure analysis
- Total power plant support
- Field consulting

# FIELD SERVICE

DTS provides comprehensive field services, including project management, labor supervision and millwright work for virtually all types of geothermal power plants – steam turbines, generators, pumps, cooling tower and other power plant equipment.

DTS O&M services will enable your power plant to run more safely, reliably, and cost-effectively. The DTS team brings a wealth of experience to our services

DTS Field Services are used to service geothermal power plant equipment in all kind of environmental with difficult conditions in rural areas, whether in northern areas such as Iceland or in Africa.

# TURBINE SERVICE WORKSHOP

The turbine workshop currently services eleven geothermal rotors in Iceland, ranging from simple to very complex repairs.

**Complexed work as have been done**

- Seal areas milled and new welded on with better materials
- Old disk removed and new welded up and milled
- Blade replenishment
- Stress relive process
- Rotor balancing

**Workshop main equipment**

- Lathe, 75 tons, for rotor repair, milling and welding
- SAW welding machine, working range 3 x 3 m
- Low speed balance machine, 32-ton load
- Rotor stress relief equipment
- Overhead crane, 32 tons
- Special purpose tooling for all manual measurement (micrometers, etc.)
- Laser measurement with hexagon arm
- Special grinding tool, small lathe, milling machine, hydraulic press, welding stand for diaphragms

# GENERAL MAINTENANCE WORKSHOP

The DTS workshop at Hellisheiði is well organized, with line management ensuring repairs flow smoothly and quickly through the workshop and minimizing the repair time for all repaired equipment.

All work orders come from maintenance software with all instructions for the repair. If such instructions are missing or require improvement, the DTS workshop will draft or amend as necessary. This enables us to keep improving all of our repair processes.

The workshop services all equipment for the power plants and Nesjavellir and Hellisheiði (total 400 MW), including thousands of valves and dozens of other pieces of equipment.

# ON POWER, HELLISHEIDI OPERATION IN ICELAND

Hellisheiði geothermal power plant is a flash steam, combined heat and power plant located in South West Iceland featuring the largest geothermal systems (high-enthalpy) in the country.

**Plant main components as DTS services**

- 6 x 45 MW MHI turbines and generators
- 1 x 33 MW Toshiba turbine and generator
- 7 x shell and tube condensers
- 14 x condenser pumps
- 48 x vacuum pumps
- 28 x cooling tower
- 6 x 160 KW fresh water pumps, 500 l/s
- 2 x 160KW brine water pumps 500 l/s
- All valves, motors, pumps, sensors, etc.
- Total water pump capacity of the plant is more than 52,800 l/s
- Steam pipeline more than 60 km

**Overview of major projects by our employees:**

- 2003-06 Installation of two 40 MW MHI turbines and generators
- 2007-08 Installation of two 40 MW MHI turbines and generators
- 2009 Overhaul of 40 MW MHI Turbine #2
- 2010 Overhaul of 40 MW MHI Turbine #1
- 2010-11 Installation of two 40 MW MHI turbines and generators
- 2011 Overhaul of 30 MW Toshiba Turbine #11
- 2012 Overhaul of 40 MW MHI Turbine #3
- 2013 Establish and operate SP Rotor repair workshop
- 2013 Overhaul of 40 MW MHI Turbines #2 & 4
- 2014 Overhaul of 40 MW MHI Turbine #1 & 5
- 2015 Major rotor repair 40 MW MHI for turbines 1-4
- 2015 Reorganizing and managing the leading maintenance workshop for ON Power
- 2015 Overhaul of 30 MW Toshiba Turbine #11
- 2016 Major rotor repair 40 MW MHI
- 2016 Overhaul of 40 MW MHI Turbine #3
- 2016 Overhaul of 40 MW MHI Turbine #6

# ON POWER, NESJAVELLIR OPERATION IN ICELAND

Nesjavellir power plant is located in Hengill in South West Iceland. The plant is a combined geothermal heat and power plant generating electricity and hot water for district heating.

**Plant main components as DTS services:**

- 4 x 30 MW MHI turbines and generators
- 4 x shell and tube condensers
- 8 x condenser pumps
- 13 x vacuum pumps
- 6 x 1,000 KW cold fresh water pumps 1,800 l/s
- 6 x 1,000 KW hot fresh water pumps 1,800 l/s
- All valves, motors, pumps, sensors, etc.
- Total water pump capacity of the plant is more than 26,600 l/s
- Steam pipeline more than 35 km

**Overview of major projects by our employees:**

- 2001-03 Installation of two 30 MHI turbines
- and generators
- 2002 Overhaul of 30 MW MHI Turbine #2
- 2003 Overhaul of 30 MW MHI Turbine #1
- 2004 Overhaul of 30 MW MHI Turbine #3
- 2008 Overhaul of 30 MW MHI Turbine #2
- & generator inspection
- 2010 Overhaul of 30 MW MHI Turbines #4 & 3
- 2011 Overhaul of 30 MW MHI Turbine #1
- 2012 Overhaul of 30 MW MHI Turbine #2
- 2013 Overhaul of 30 MW MHI Turbine #3
- 2014 Major rotor repair 30 MW MHI for
- Turbines 1-4
- 2015 Overhaul of 30 MW MHI Turbine #1 & 3
- & generator inspection
- 2016 Major rotor repair 30 MW MHI for
- Turbines 1-4
- 2016 Overhaul of 30 MW MHI Turbine #2

# KEY CONTACTS

**Baldur Jonasson**
CEO
Tel.: +354 864 6171
E-mail: baldur@dts.is

**Expertise**
Project management
Turbine rotors expert
Maintenance specialist
Company operation
Workshop management

**Education**
Master Craftsmanship Diploma
Marine Engineering (highest level)
Heavy Machinery Operation Certificate

**Summary**
Baldur is CO and one of the owners of DTS, and has run DTS since 2008. Baldur build up the rotor workshop and heads both the rotor workshop department and the development of rotor repair and other turbine repair at DTS for ON Power at Nesjavellir geothermal power plant (120 MWe/300 MWth), Hellisheiði geothermal power plant (303 MWe/400 MWth) and Andarkill hydro power plant (8 MWe). Before Baldur built up DTS, he operated a diesel engine workshop for eight years.
Baldur was for many years a chief marine engineer on various fishing vessels.
Baldur has long experience of operating companies, project management and control complicated repair work.
He has experience in troubleshooting and repairing geothermal turbines and auxiliary equipment, and accurately and quickly repairing breakdowns to maintain operating efficiency.

**Ingvar Magnusson**
Project Manager
Technical Department
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**Expertise**
Project management
3D scanning expert
Mechanical designer
Power plant construction
Maintenance specialist
Workshop management

**Education**
Industrial Mechanics
Master Craftsmanship Diploma
3D Scanning and Design
Inventor and Solid Work 3D design
Heavy Machinery Operation
Certificate

**Summary**
Ingvar is leading the technical department and one of the owners of DTS. Ingvar has excellent experience in power plant construction, having been involved in most geothermal power plant construction over the last sixteen years, including all major overhauls for ON Power at Nesjavellir geothermal power plant (120 MWe/300 MWth), Hellisheiði geothermal power plant (303 MWe/400 MWth) and Andarkill hydro power plant (8 MWe). Ingvar is DTS's main work planner for major projects. Ingvar heads the technical department and is DTS's main mechanical designer for 3D reverse engineering and parts scanning and design.
He has experience in troubleshooting and repairing geothermal turbines and auxiliary equipment, and accurately and quickly repairing breakdowns to maintain operating efficiency.

**Johann Jonasson**
Chairman
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**Expertise**
Business administration
Business development
Lean management

**Education**
Mechanical Technology & Business Administration
Master of Business & Administration
MBA from Reykjavik University

**Summary**
Johann is leading the buisness development and one of the owners of DTS. With two decades of international business experience by building innovative & technical know-how driven companies servicing two key industries exporting to more than twenty countries in four continents. Johann is Leading the Company through business development & building its network of customers & business partners worldwide.

**Lydur Skulason**
Project Manager – New Markets
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**Expertise**

Project management
Operation and maintenance
Power plant construction
O&M training
CMM management operation

**Education**

Diploma in Mechanical Technology
Master Craftsmanship Diploma
Marine Engineering (highest level)

**Summary**

Lýður has more than fifteen years' experience in geothermal power plant industry, as Project Manager – New Markets at DTS, Chief Project Manager for Green Energy Geothermal, and Power Plant Maintenance Manager for Reykjavik Energy. He is Operational Expert/Manager, Maintenance Manager, and Manager of Computerized Maintenance of Management Systems for ON Power at Nesjavellir geothermal power plant (120 MWe/300 MWth), Hellisheiði geothermal power plant (303 MWe/400 MWth) and Andarkill hydro power plant (8 MWe).
Lýður has experience in planning, supervision and project management for the construction, commissioning and operation of geothermal power plants in Africa. He was involved in the construction, commissioning and training for a 75MW project for KenGen, Kenya. He has experience in troubleshooting and repairing geothermal turbines and auxiliary equipment, and accurately and quickly repairing breakdowns to maintain operating efficiency.

**Frimann Grimsson**
Mechanical Specialist
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**Expertise**

Project management
Power plant construction
Maintenance specialist
Workshop management

**Education**

Industrial Mechanics
Master Craftsmanship Diploma
Building Plumbing
Heavy Machinery Operation Certificate

**Summary**

Frímann has excellent experience in power plant construction and maintenance, having been involved in most geothermal power plant construction for last thirty years, including all major overhauls for ON Power at Nesjavellir geothermal power plant (120 MWe/300 MWth), Hellisheiði geothermal power plant (303 MWe/400MWth), Andarkill hydro power plant (8 MWe), Svartsengi geothermal power (75 MWe/150 MWth) and Reykjanes geothermal power (100 MWe).
Frímann has been project manager for many of the power plant construction projects in Iceland.
He has experience in troubleshooting and repairing geothermal turbines and auxiliary equipment, and accurately and quickly repairing breakdowns to maintain operating efficiency

**Ingólfur Hreimsson**
Quality Manager
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**Expertise**

Project management
ISO 9001 implementing expert
3D scanning
Mechanical designer
Quality management system designer

**Education**

Mechanical and Energy Engineer B.Sc.

**Summary**

Ingólfur has implemented the ISO 9001:2015 QMS standard to DTS from start to certification and is leading continual improvements, operating the QMS and is the supervisor of LEAN in the Turbine Workshop and the Maintenance Workshop on the geothermal power plants. He has great experience supervising people and keep control of work areas. HSE trained and great at risk planning. He has good knowledge on hydro and geothermal power plants from the source to power production.
Excellent knowledge on power plants maintenance procedures and designing pumps, turbines, pipelines and mechanical parts

Deilir Technical Services is a member of:

Iceland Geothermal Cluster Initiative

ISO 9001:2015 certificated

bsi. ISO 9001:2015 Quality Management

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Deilir
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