

How to ensure power plant performance and efficiency throughout the lifecycle

BUSINESS WHITE PAPER



The operating profile of a power plant is determined to serve the business needs of its owners, whose first priority is to produce energy reliably and efficiently. With well-planned operations and maintenance, the set performance targets can be met throughout the lifecycle. Customised solutions that take into account the operating profile of the power plant can maintain its productivity in every stage of the lifecycle.

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Setting priorities in energy production

— For both IPPs and utilities, it is vital in today's energy industry to ensure that the power plant performs optimally and reliably at all times.

In many markets, the power generation industry has undergone rapid changes, evolving from a stable, predictable business to one that requires flexibility and quick responses to price spikes and market changes. Fixed costs of power generation used to be relatively low and variable costs, i.e. fuel costs, were high. That ratio is changing as solar and wind power, with little to no fuel cost, increase their market share. Engine-powered plants are still needed to balance and back up the intermittent renewables, but their operating profiles may shift increasingly towards load balancing and peaking. On the other hand, baseload engine power generation is still a major contributor in the energy mix in many markets.

Priorities based on business model

The operating environment of Independent power producers, or IPPs, and utility plants is somewhat different, owing to their different business models.

IPPs sell the power they produce to utilities or end users, and therefore must ensure that the cost-to-output ratio remains on a competitive level. Their production is usually governed by power purchase agreements (PPAs), and they must meet the capacity defined in the agreements. A PPA can be made for as much as 20 years, and during that time, the output must be kept on the agreed level. This requires constant attention to the performance level of the equipment.

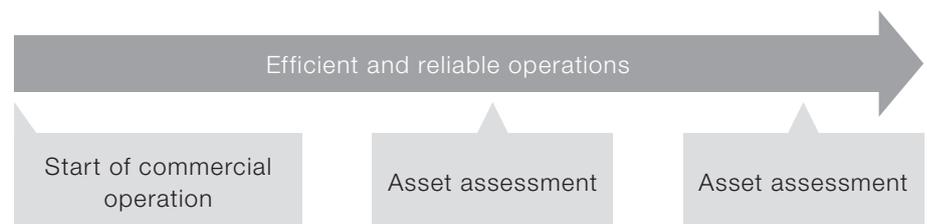
Utilities are either publicly or privately owned and produce electricity for a national or a local grid. They are required to maintain a good production level to meet the needs of the end users. At the same time, cost to serve must be kept on a reasonable level.

For both IPPs and utilities, it is vital in today's energy industry to ensure that the power plant performs optimally and reliably at all times. Lengthy maintenance outages are no longer an option; issues must be detected and prevented before they have a chance to disrupt operations. Reactive maintenance is not enough – the emphasis is now on predictive maintenance based on continuous monitoring, analysis of performance data and optimisation of maintenance activities to minimise their impact on energy production.

Ensuring efficiency and performance during the power plant lifecycle

The operation and maintenance of a power plant is always planned according to the owner's business model. What is their value proposition towards their own customers, and how can it be supported with operative and maintenance activities? It is essential to understand the entire value chain of the plant owner. The business goals and performance targets of the owners help in recognising their product and service needs.

A power plant's lifecycle has different stages, and its maintenance needs vary between these stages, which require continuous optimisation of operations and maintenance. Different solutions may be needed for different stages of the lifecycle, and when a long-term service agreement is made or renewed, it is wise to examine the alternatives offered. The scale of services may range from minimal maintenance support to full responsibility for operations and maintenance, and the choice depends on the individual needs of each plant and its owner as they move through these stages.



Source: Wärtsilä

Establishing efficient operations

At the start of commercial operations, the power plant owner has specific needs relating to an efficient beginning of operations – namely, ensuring that the business case becomes reality. Establishing skilled operating teams that match with the planned operational profile is one of the first priorities. An operating plan is created and a maintenance management system populated with the maintenance manuals of each piece of equipment in order to manage, coordinate and track on-site activities. With all equipment managed through a maintenance management system, it is easier to apply a holistic approach and match maintenance to the plant owner's operations.

Remote monitoring of the power plant equipment is initiated at an early stage to establish a continuous record of the operating parameters. The collected data is analysed by technical experts who support the on-site personnel. Up-to-date equipment condition data enables experts to keep track of the performance of the equipment and adjust maintenance schedules if necessary.

By monitoring the power plant's performance throughout its lifecycle and carefully analysing the received data, the plant's lifecycle can be extended, its productivity improved and its environmental impacts reduced.

Operations stage: focus on efficiency and reliability

After operations are established, they shall remain at a stable level. During this time, the customers' primary needs are high availability and a reliable

It is important to consider the energy efficiency of the power plant, which tends to decline over the years but can be restored with upgrades and modernisations.

production level. Maintenance is carried out dynamically according to the power plant's operating profile and centred on reliability. Possible changes in the market may give rise to the need to adapt operations in order to maintain competitiveness. Upgrades to controls and automation may be carried out as needed.

Assessments help ensure continued efficiency and performance optimisation can be applied to improve it. Technological advances may be made, and these improvements to e.g. hardware, software or guidance systems can be applied to enhance the performance of the power plant from the original parameters. These improvements can range from the upgrade of a single component to a full-scale lifecycle upgrade or fuel conversion. With them, efficiency and reliability can be improved to exceed the original performance level, providing the end customers of the power plant operator with a steady supply of energy.

Technical experts continue to carry out condition monitoring and provide remote operational and technical support. They keep an eye on performance parameters, and if they detect a slow trend affecting for example the fuel efficiency of the engines, they analyse the possible causes for the change and offer recommendations.

If a long-term service agreement is made or renewed during the operating stage, it is important to consider, among other things, the energy efficiency of the power plant, which can decline over the years but can be restored with upgrades and modernisations.

The chart below demonstrates the financial impact of declining efficiency. With an asset assessment, a decline can be detected, after which efficiency and, thereby, the cost-to-output ratio can be restored and even improved with, for instance, equipment upgrades or conversions. If the upgrade or modernisation is carried out on a plant with a long term service agreement, the new performance levels reached with the activities can be guaranteed.

Examples of additional OPEX per year due to loss in efficiency

Engine type	1% eff decrease	2% eff decrease	3% eff decrease	4% eff decrease	5% eff decrease
Wärtsilä 32	720 KEUR	1,48 MEUR	2,27 MEUR	3,10 MEUR	3,97 MEUR
Wärtsilä 34SG	560 KEUR	1,15 MEUR	1,76 MEUR	2,41 MEUR	3,09 MEUR
Wärtsilä 50DF	540 KEUR	1,11 MEUR	1,70 MEUR	2,32 MEUR	2,98 MEUR

Plant size approx 100 MW HFO EUR 400.00 / t
 6,000 running hours per year GAS EUR 8.00 / MMBtu

Source: Wärtsilä

Customised solutions for every stage of the lifecycle

Solutions can be customised to suit the power plant's operating profile and answer the power plant owner's and operator's needs in the most efficient way. When making or renewing a long-term service agreement, it is wise to choose the most suitable scope, and adjust it between agreements if necessary. A change in the operating profile, market situation or business targets may require a change of agreement type towards a lighter or a more comprehensive service solution. The power plant owner's value proposition towards its end clients guides in choosing the best option and scope.

Wärtsilä's lifecycle solutions for the energy industry provide guaranteed operational reliability and efficiency, backed up by expert advice on optimising power plant operation and maintenance. Guidance on equipment performance and operations surveillance ensure the continued performance and maximised uptime of the power plant. By partnering with Wärtsilä, power plant owners can feel secure, knowing where to get help and support when needed.

Operation and Maintenance

An operation & maintenance solution with Wärtsilä means entering into a partnership, agreeing on and working towards shared productivity and profitability goals. It is an efficient business solution covering every aspect of the day-to-day operation and all related maintenance and administration tasks. It aims to maximise the productive lifetime of the installation and the return on investment. The solution is tailored to each customer's specific needs including performance and lifecycle cost guarantees.

- Wärtsilä responsible for operation & maintenance
- Lifecycle cost guarantee
- Risk management
- Optimised operation and guaranteed performance
- Maximised productive lifetime of the installation
- Maximised return on investment
- Performance improvement proposals

Guaranteed asset performance

Guaranteed asset performance is a solution where Wärtsilä guarantees the reliability or availability of a power plant. The customer can manage the operations and outsource the maintenance and its management to Wärtsilä. The onsite support engineer, online data and remote monitoring enable advanced support and immediate response from Wärtsilä's experts to ensure the safe operation of the power plant.

- Performance guarantees
- Maximised uptime through optimised maintenance and remote support
- Performance improvement proposals

Optional services

- Energy efficiency management

Optimised maintenance

An optimised maintenance solution is a partnership aiming to ensure that the customer's investment is secure and predictable. It ensures certainty of operations by transferring the responsibility for the maintenance of the installation to Wärtsilä. The solution covers maintenance planning and services whenever needed, with fixed prices for inspection, technical support, spare parts, training and maintenance work.

- Wärtsilä responsible for operation & maintenance
- Lifecycle cost guarantee
- Risk management
- Optimised operation and guaranteed performance
- Maximised productive lifetime of the installation
- Maximised return on investment
- Performance improvement proposals

Maintenance management and operational advisory

A Maintenance management and operational advisory services solution with Wärtsilä, enabled by remote operational advisory services, maintenance and spare parts logistics, ensures operational reliability and facility performance. The solution includes maintenance planning and coordination, condition monitoring, maintenance budgeting and operational support. This partnership ensures operational reliability and high facility performance.

- Optimal running conditions and optimised maintenance
- Financial predictability and maintenance budgeting
- Guaranteed response times
- Maximised uptime and ensured equipment safety
- Dedicated expert at your service
- Operational advisory services and frequent monitoring of equipment
- Performance improvement proposals

Wärtsilä Expertise centres around the world support customers who have a Wärtsilä lifecycle solution with advice and recommendations based on analysis of monitoring data. They are the contact point through which power plant owners and operators receive support in the day-to-day operation of their plants as well as in unforeseen situations. They also identify improvement possibilities and communicate these to the customer. Expertise centres enable a holistic view of the plant's operations and create value for customers and enable guaranteed performance.

Operations Management Experts

- Guidance and Advisory of equipment operations
- Remote troubleshooting
- Remote tuning of the equipment
- Operations surveillance to achieve agreed performance
- Remote operations

Maintenance Management Experts

- Maintenance planning
- Parts coordination and inventory management
- Maintenance resource coordination
- On-site work progress monitoring and support

Mobilisation, Quality & Safety Experts

- Mobilisation management
- Quality & Safety management
- Competence management

Case CEMEX Colombia

Renewal of long-term O&M agreement

CEMEX Colombia, a major cement company, wanted to maintain high availability of the power plant of the company's cement factory and ensure reliable power supply. Satisfied with Wärtsilä's service, CEMEX Colombia renewed the existing Asset Management agreement in summer 2014.

The five-year agreement covers daily operation of the power plant and natural gas station, preventive and predictive maintenance services, management of parts logistics and technical support services. The plant is fitted with five Wärtsilä 34SG engines with a total capacity of 25 MW.

CEMEX Colombia has had an O&M agreement with Wärtsilä since 1998. With innovative upgrades, Wärtsilä has helped improve performance and reliability of the power plant.

CEMEX Colombia and Wärtsilä aim to keep the plant in good condition through maximised lifetime, guaranteed performance and predictable lifecycle costs. The cooperation provides CEMEX Colombia with the highest possible level of risk management as well as high plant availability and reliability. Furthermore, the company benefits from the technical and business expertise of Wärtsilä's highly qualified personnel.

Summary

The first priority of power plant owners and operators is to produce energy for their customers efficiently and reliably, while creating business value and a good return for their investments. The operating profile of the power plant is determined to serve these business needs, and together with the power plant owner's value proposition, it defines the best ways to organise the operations and maintenance of the facility.

Power plants' maintenance and operational needs change during their lifecycle due to, for instance, potential changes in dispatch profile and the market environment. This should be taken into account when ensuring the continued optimal operations of the plant after the first years of operations. There are advantages with conducting assessments of the power plant's condition during its lifecycle in order to identify potential for modernisations that can improve the output level and cost-to output ratio.

A power plant owner has various options for extending the lifecycle of the power plant, including equipment upgrades, fuel conversions and changes in operating profile. By customising the solution to meet the plant owner's needs and suit the plant's operating profile, its productivity and efficiency can be enhanced and its lifecycle extended.

Wärtsilä Services in brief

Wärtsilä Services provides high-quality lifecycle services that enhance customers' business. Its broad range of services supports both shipping and power generation companies, whenever and wherever needed. Solutions range from spare parts and basic support to ensuring the maximised lifetime, increased efficiency and guaranteed performance of the customer's equipment or installation – in a safe, reliable, and environmentally sustainable way.

www.wartsila.com/services

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