



## **NON-DESTRUCTIVE TESTING FOR STEAM TURBINES**

From selecting the best NDT technique  
to monitoring inspection quality

- > Ensuring safe and efficient operation
- > Optimizing maintenance
- > Maximizing availability
- > Avoiding costly damages

# STEAM TURBINE CONDITION ASSESSMENT

## ASSISTING IN THE SELECTION AND APPLICATION OF NDT TECHNIQUES

Periodic overhauls are vital for the safe operation of steam turbines. In order to minimize downtime during such overhauls, the inspections need to be carried out quickly and efficiently. Non-destructive testing (NDT) is crucial in order to achieve this goal.

Over the years, NDT techniques have been used to assess the condition of specific components and identify defects. However, situation-specific questions still arise. Is this technique the most appropriate one in this context? Is it being applied according to the correct quality standards? Laborelec provides advice on all aspects of NDT for steam turbines, based on its extensive expertise and research experience in this domain.

### SELECTING THE MOST APPROPRIATE NDT TECHNIQUE

A large variety of NDT methods are available for the condition assessment of steam turbine components. Selecting the most appropriate one depends upon:

- > The type of component
- > The type of defect
- > The specific situation, such as the accessibility or cleanliness of the part

Laborelec can help operation and maintenance teams in this decision making process. We use simulation tools to conduct a thorough feasibility assessment and select the most important inspection parameters.

### OBJECTIVE FOLLOW-UP OF NDT INSPECTION

Laborelec can monitor the quality of NDT inspections carried out by the equipment manufacturer or contractor. We check whether the highest industrial quality standards have been followed and whether the test results have been interpreted correctly.

### EXPERT NDT EXECUTION

Our experts can also perform specific highly specialized NDT inspections themselves, using in-house tools and equipment.

### ANALYZING ROOT CAUSES AND LIFETIME EXPECTANCY

When a relevant indication is detected, our experts can perform the analyses required to identify the root cause of the problem and calculate the component's remaining lifetime.



*Laborelec assists in the selection of the most appropriate non-destructive testing technique to ensure a quick and efficient intervention on your steam turbine.*

# THE SPECIFICS OF EACH STEAM TURBINE NDT TECHNIQUE

A broad array of NDT techniques is available for the condition assessment of steam turbines. Laborelec has in-depth knowledge of all of these techniques and their advantages and limitations. This enables us to select the most appropriate technique for each particular context.

## VISUAL TESTING

### What?

Examination of component surfaces, using special equipment such as endoscopes, fiberscopes, and magnifying glasses.

### Advantages and limitations

Visual testing is a low-cost technique that can be executed while the component is in operation. It requires the eye of a seasoned expert.

### References

It is the primary method used before any other NDT inspection is executed.



## LIQUID PENETRANT TESTING

### What?

The application of a coloured or fluorescent dye to detect surface breaking defects on non-porous materials.

### Advantages and limitations

Liquid penetrant testing is a low-cost, easy-to-use technique that can be conducted on all non-porous materials, including glass, ceramics, and non-magnetic materials. It cannot be used on hot assemblies. Before this technique can be performed, the surface of the component needs to be meticulously cleaned. Otherwise, the dye cannot adequately penetrate the surface, resulting in potentially misleading indications.

### References

- > Verification of the adherence of white metal on bearings at the edges
- > Crack detection in welds
- > Inspection of stellite facing of valves
- > Crack detection in turbine blades



## MAGNETIC PARTICLE TESTING

### What?

Detection of flaws on or just underneath the surface of ferromagnetic materials, using fluorescent, black, or dry magnetic particles.

### Advantages and limitations

Magnetic particle testing is a relatively low-cost technique that allows for higher controllable sensitivity than liquid penetrant testing. It can, however, only be used on ferromagnetic materials that are perfectly clean.

### References

- > Inspection of turbine blades and vanes: body, fillet, and root
- > Crack detection in high/low pressure valve body and bolting threads
- > Detection of (near-)surface cracks in turbine casings
- > Inspection of rotor shaft, shaft groove, and steam inlet and outlet piping, especially areas with welds, bends, or attachment points



## METALLOGRAPHIC REPLICATION TESTING

### What?

Replication is used to evaluate microstructures and other surface features.

### Advantages and limitations

Surface replication enables the evaluation of the general microstructure as well as changes in this microstructure. It is helpful in detecting creep damage and in identifying the cause of cracking. It is a rather expensive method that requires rigorous surface preparations and safety precautions.

### References

- > Evaluation of welded areas
- > Detection of microstructure flaws: porosities, inclusions, microcracks, etc.



## ULTRASONIC TESTING

### What?

This method uses the transmission of high-frequency sound waves through a material to detect internal defects. The pulse-echo method is the most commonly used ultrasonic testing technique. Automated and advanced ultrasonic testing methods, such as phased array and time of flight diffraction, are also used.

### Advantages and limitations

Ultrasonic testing is a very accurate method for thickness and sizing measurements. It is, however, difficult to detect small volumetric indications (e.g. porosities) and to size small defects close to the surface using this technique.

Ultrasonic inspection equipment must be calibrated on a representative calibration block and system checks must be performed regularly.

### References

- > Thickness measurements and detection of erosion-corrosion
- > Crack detection and characterization
- > Verification of the adherence of white metal on bearings
- > Crack detection in bolting threads
- > Detection of tension cracks in shrouds
- > Inspection of critical areas of turbine casing, valve body, rotor shaft, and welds at the steam inlet and outlet



## EDDY CURRENT TESTING

### What?

This technique generates eddy currents up to a few millimeters below the surface of a conductive material through an induced alternating magnetic field. Material defects will disturb the flow of eddy currents and generate a traceable signal.

### Advantages and limitations

Eddy current testing is the most effective method for detecting and sizing small cracks near the surface. It is a relatively expensive technique that is mainly used on non-ferromagnetic materials. Reference standards are essential in order to guarantee accurate, replicable measurements.

### References

- Crack detection and sizing in blades, vanes, blade roots, and dovetail blade attachments of rotor wheels.



# ENSURING NDT QUALITY IN ORDER TO MAXIMIZE STEAM TURBINE AVAILABILITY



Laborelec can help ensure the safe and efficient operation of your steam turbine. Our advice will enable you to maximize the equipment's availability, avoid damages, and enhance your maintenance management.

## MAXIMIZING STEAM TURBINE AVAILABILITY

Laborelec has many years of experience in conducting and monitoring NDT inspections in the field and also in carrying out in-depth NDT research. This solid background enables us to correctly interpret the test results and recommend the optimal maintenance actions. We can help you make the best decisions for safe operation and minimal downtime of your steam turbine.

## AVOIDING COSTLY DAMAGES

In the case of a relevant indication of a defect, Laborelec is able to identify the root cause of the problem and advise on the appropriate actions to take in order to prevent costly damage. We have experts in various technical domains (NDT, materials, chemistry, etc.), which ensures that every possible cause is considered.

## REDUCING OVERHAUL TIME

Laborelec can help you minimize your steam turbine downtime during overhauls. Selecting the most appropriate NDT techniques enables efficient inspection and helps minimize the time needed for maintenance.

## OPTIMIZING MAINTENANCE PLANNING

Our experts can assist you in fine-tuning the maintenance planning and the NDT inspection program of your steam turbines. Based on our detailed lifetime expectancy calculations, we can offer you appropriate planning advice.



## Five reasons for you to choose Laborelec

- > One-stop centre for all of your energy-related needs
- > 50 years of experience
- > Increased profitability of your installations
- > Independent and confidential advice
- > Internationally recognized and certified laboratory

The Technical Competence Centre  
In energy processes and energy use  
From innovation to operational assistance

## Contact

### Non-destructive testing

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