



Technical training from Laborelec Academy

For individuals as much as companies,
training means new horizons.



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For individuals as much as companies, training means new horizons.

Almost 300 experts in their respective fields put their experience and knowledge to work in an unrivalled range of innovative technical training for the energy and industrial sectors. With 55 years experience in business and technical consultancy, testing, inspections and certification, risk management, and verification, and many other areas, Laborelec Academy is ready to turn our knowledge to your competitive advantage.

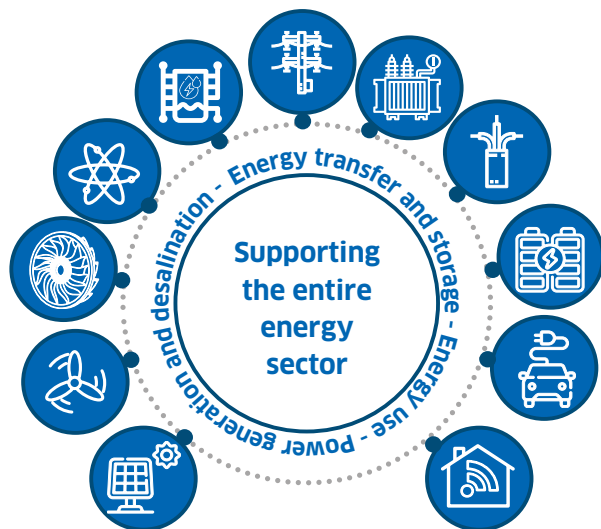
ENGIE Laborelec is a leading expertise and research center in electrical power technology, supporting customers working in electricity generation, transmission, distribution, storage and final use, with a particular focus on the energy transition and the 3 Ds - decentralisation, decarbonisation and digitalisation.

All those years at the forefront of the energy ecosystem also means more than half a century of responding to the needs of our customers and partners. We see every day what a powerful tool training is. Companies want to stay ahead of the game but, to be fully equipped to face the challenges ahead, you need reliable partners.

With a relentless focus on delivering value for our customers, we combine our expert knowledge and operational experience with state-of-the-art analysis and measurement capabilities to provide operational research and development services, specialised expertise and tailor-made global solutions. We guarantee the independence and objectivity of our solutions and recommendations.

Every type of electricity generation comes within our scope — centralised and decentralised, from fossil and nuclear to renewables. Directly or indirectly, we also work for a wide range of customers in the wider energy community, including grid operators, major industries, SMEs, and residential prosumers, as well as cities and regions.

*Expertise and research center
in electrical power technology*



*Specialising in the entire electricity value chain:
generation, transmission and distribution, RES, storage,
energy use in industry, and other end-users.*

Delivery options:

Our training can come in three different formats:

- Face-to-face classroom delivery: we can come to you, or you can come to us. We are located in Belgium, France, the Netherlands, Chile, Germany and the United Arab Emirates.
- Remote-online delivery
- Hybrid delivery (simultaneous live-classroom and remote-online delivery)

Why train with us?



Customized

The training is adapted to the needs of your company. Either existing courses are modified or new courses are specifically aligned with your organizational objectives.



Convenient

Training can be scheduled to take place at any time, and at a date and venue to suit your needs.



Flexible

We can reformat courses into shorter modules scheduled over perhaps one, two, or three days or at longer intervals. This allows participants to practice new skills before coming back for further training.



Confidentiality

Companies and participants can be assured of complete confidentiality to discuss commercially or technically sensitive company material. Laborelec and course facilitators are happy to sign confidentiality agreements.



Outcome-oriented Training

Courses are outcome-oriented. Participants can also be individually assessed against course objectives at the end of the course if required.



High calibre Trainers

Our expert course leaders are carefully selected to provide training in a style to suit your corporate culture and meet your business objectives. Our course facilitators are all leading subject matter experts.



Focus on value

With tighter travel and training budgets, in-house solutions deliver even more value for money, saving companies up to 40% when compared with publicly available training courses.



Passion

Passionate about training and skills development, we are fully committed to building capacity and confidence in everyone who takes part in our in-house training.









Customized in-house training






In addition to the standard courses, Laborelec Academy also designs in-house training courses adapted to the specific needs of your company. These can be adapted versions of existing courses or completely new, dealing for example with real cases from your company or future scenarios that you are developing.

Examples of previous customised in-house training courses

- Gamma spectrometry measurement and analysis
- Combined Cycle Gas Turbine (CCGT) simulator training
- The dangers of electricity
- Steam turbines control loops
- Operations & Maintenance for solar PV plants
- Maintenance training for Thermal Power Plants

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E-Mobility

- [EV charging infrastructure: enterprise guidelines for cost-efficient and future-proof sizing | 1-day](#) 7



EV charging infrastructure: enterprise guidelines for cost-efficient and future-proof sizing

DESCRIPTION

Hands-on training allowing the audience to make educated choices in the number and type of chargers for their present and/or future EV fleet, taking in consideration the infrastructure needs, the possible cost-cutters, the ways to anticipate fleet evolution in a sustainable approach.


PROGRAM

The basics of electricity in buildings and industrial sites: power and energy, single and three-phase, transformers and electrical cabinets:

- EV considerations: consumption, usage patterns, energy and power needs.
- Chargers: AC, DC, Vehicle-to-X. What to choose and what power levels.
- Smart charging and other cost-cutters.
- Deploying a charging infrastructure from A to Z.
- Dimensioning of the EV charging infrastructure: discussion of practical use cases.
- Work on your own case.

AUDIENCE

Companies fleet managers, companies' site managers, real estate project managers, facility manager.

 **Duration**
1 day

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 **Languages**
FR, EN, NL

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 **Delivery**
Onsite,
Remote online

Chemistry at industrial sites

• Chemistry of the water-steam cycle in thermal power plants 1-day	9
• Cooling water treatment in the industry 1-day	10
• Demineralised water preparation 1-day	11
• Introduction to water chemistry in power and desalination plants 2-days	12



Chemistry of the water-steam cycle in thermal power plants

DESCRIPTION

This course is about the chemical aspects of the water-steam cycle in a power plant. Included in the program are the different types of chemicals used in boilers, potential issues in a water-steam cycle, monitoring and specifications regarding target values and alarm levels. Actions in case of chemistry-related incident are also part of the course.

PROGRAM


The course includes the following aspects:

- detailed aspects of chemistry in a water steam cycle, such as types of chemicals used in the boiler depending on the treatment and type of boiler,
- potential issues in a water-steam cycle, such as corrosion and deposition
- monitoring and analytical programme, and knowledge of the specifications for the water steam cycle (normal values targets – alarm levels)
- chemistry aspects during transition periods: start-up, shutdown and preservation
- actions in the event of an alarm
- examples of incidents or deviations compared to normal chemistry

The last part of the course is dedicated to exercises and a quiz.

AUDIENCE

The course addresses a wide audience, including operators, power plant chemists, plant operation or maintenance engineers, consultants and technical project managers.

 **Duration**
1 day

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 **Languages**
FR, EN, NL

.....
 **Delivery**
Onsite,
Remote online



Cooling water treatment in the industry

DESCRIPTION

The course is a general introduction to cooling circuits in the industry, not only in power plants but also in other industrial sectors. Attendees get an overview about the typical designs, main components and the three main issues that may arise in cooling circuits : biofouling, scaling & corrosion.

PROGRAM

The training course includes the following topics:

Typical designs & main components

- typical designs: once-through, semi-open, with or without cooling tower
- water intake
- condenser (material, cleaning technologies, ...)
- cooling tower (if present)

Environmental aspects

- importance of site specific discharge limits such as temperature and types of chemicals

Scaling

- how to avoid scaling, how to use scale inhibitors
- main parameters to monitor the risk of scaling

Biofouling et pathogènes

- how to avoid biofouling in the cooling circuit (coating, biocide, ...)
- main parameters to be followed for a good disinfection (ORP, chemicals concentration, biology)

Corrosion

- potential corrosion issues in cooling circuits
- how to avoid corrosion in cooling circuits (inhibitors, corrosion probes, ...)

Conservation

- how to preserve cooling circuits during shutdown (cooling tower, condenser, intake, ...)

Final

- exercises & quiz

AUDIENCE

The course addresses a wide audience, including operators, power plant chemists, plant operation or maintenance engineers, consultants and technical project managers.

♥ **Duration**
1 day

♥ **Languages**
FR, EN, NL

♥ **Delivery**
Onsite,
Remote online





Demineralised water preparation

DESCRIPTION

The course aims to provide participants with a knowledge base on technologies for the preparation of demineralised water, resins or membranes. In addition to the theoretical basis, the content is greatly enriched by the field experience of our experts in industrial and power plants.

PROGRAM

Modules covered in this course:


- Characteristics of raw water
- Raw water pre-treatment plant, incl. overview of the technologies used on-site, characteristics, attention points, follow-up and monitoring aspects.
- Review of the water treatment plant
- Demineralisation by ion exchange (resins)
 - > design
 - > structure of the resin and comparison of characteristics (stability, capacity, ...)
 - > functioning of the ion exchange
 - > processes of demineralisation and regeneration
 - > monitoring aspects
 - > effluents (characteristics, quantities, permissions, attention points)
- Demineralisation by membrane technologies
 - > design
 - > calculation of scaling potential
 - > optimization of chemicals injection
 - > monitoring
 - > biocide control
 - > chemical cleaning procedure
 - > start-up and shut-down procedures
 - > preservation of membrane installation
- Exercices et quiz

AUDIENCE

The course addressed to chemists and laboratory managers.

 **Duration**
1 day

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 **Languages**
FR, EN, NL

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 **Delivery**
Onsite,
Remote online

2
DAYS



Introduction to water chemistry in power and desalination plants

DESCRIPTION

The course is a general introduction to water chemistry in power plants. Attendees get an overview on the water-steam cycle, on cooling water circuits and on demineralised water preparation.

PROGRAM

The course focuses on three main aspects:

Chemistry of the water-steam cycle

introductory concepts: types of chemicals used in a boiler, types of boilers, etc.
potential issues in a water steam cycle: corrosion, deposition, etc.

Cooling water circuits

- main components, including condenser and cooling tower

Demineralised water preparation


- characteristics of raw water
- introduction to water treatment plants

AUDIENCE

The course addresses a wide audience, including operators, power plant chemists, plant operation or maintenance engineers, consultants and technical project managers.

 **Duration**
2 days

 **Languages**
FR, EN, NL

 **Delivery**
Onsite,
Remote online



Condition assessment and monitoring

• Condition monitoring of power transformers through oil analysis – Introduction 1-day	14
• Condition assessment and monitoring of power transformers through oil analysis – Advanced 2-days	15
• Condition assessment of rotating machines through oil analysis 1-day	16
• Introduction to failure root-cause analysis (RCA) 1-day	17
• Introduction to Vibration Analysis based on Laborelec Vibration Monitoring System (LVMS) 0.5-days	18





Condition monitoring of power transformers through oil analysis – Introduction

DESCRIPTION

The course begins with a half-day theoretical session addressing various aspects of transformer condition assessment. In addition, specific case studies are discussed to train in interpreting results and formulating recommendations.

PROGRAM


The course addresses various aspects of transformer condition assessment:


- Transformer Health Index, Transformer Fleet Condition Assessment, Risk Matrix
- Why perform transformer oil analyses?
- What are the main oil and paper degradation mechanisms?
- Which analyses apply to which types of transformers?
- Why perform different kinds of analyses at different frequencies?
- What is the best frequency for conducting analyses?
- How to interpret test results: trending, comparison with international standards, etc.
- Why and when to perform electrical measurements?
- How to use the analysis results to create and implement a maintenance action plan.


In addition, specific case studies are discussed to train in interpreting results and formulating recommendations.

AUDIENCE

Maintenance staff, electrical engineers and asset managers responsible for transformers. Typical industries are powerplants, high voltage grids or large industrial sites.

 **Duration**
1 day

 **Languages**
FR, EN, NL, ES

 **Delivery**
Onsite,
Remote online


2
DAYS



Condition assessment and monitoring of power transformers through oil analysis – Advanced

DESCRIPTION

The objective is to acquire the knowledge needed to define and implement an effective oil analysis programme, to monitor the condition of transformers and to understand oil analysis reports as part of a maintenance strategy.

 **Duration**
2 days

 **Languages**
FR, EN, NL, ES

 **Delivery**
Onsite,
Remote online

PROGRAM

The following issues will be covered during the training:

Condition monitoring of power transformers through oil analyses:

- Transformer Health Index, Transformer Fleet Condition Assessment, Risk Matrix
- Best practices
- Which oil analyses/how frequent
- DGA: focus on partial discharges, sparking, stray gassing, catalytic effects / interpretation systems.
- Interpretation of results
- Why and when to perform electrical measurements?
- International standards: IEEE, IEC, Duval, ASTM, etc.
- Maintenance guidelines
- Trending and reporting
- Sampling techniques

Use of online monitoring for DGA/water: implementation and real-case advantages etc.

- New developments: importance of methanol as ageing marker, temperature correction of ageing markers, stray gassing of oils in service etc.
- REX, case studies and real-case exercises concerning power transformers within generation and high-voltage grids.
- Discussion of reports on power transformers.
- Use of unused insulating transformer oils.
- Market trends in the use of inhibited and uninhibited oils.
- Differences, advantages and drawbacks of uninhibited compared with inhibited oils.
- Importance of additives, oxidation stability tests, stray gassing, etc.

AUDIENCE

Maintenance staff, electrical engineers and asset managers responsible for transformers. Typical industries are powerplants, high voltage grids or large industrial sites.



1
DAY



Condition assessment of rotating machines through oil analysis

PROGRAM


The following topics will be covered during the training:

- Why perform lubricating oil analyses?
- What are best practices in oil sampling?
- What are the degradation mechanisms for lubricating oils?
- Which analyses apply to which types of equipment?
- What is the best frequency for conducting the analyses?
- How to interpret test results: trending, comparison with international standards, etc.
- How to use the analysis results to create and implement a maintenance action plan.

In addition, specific case studies are discussed to train in interpreting results and formulating recommendations.

AUDIENCE

Maintenance staff and asset managers responsible for turbines and other rotating equipment.

 **Duration**
1 day

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 **Languages**
FR, EN, NL

.....
 **Delivery**
Onsite,
Remote online




1
DAY



Introduction to failure root-cause analysis (RCA)

DESCRIPTION

Root cause analysis (RCA) is one of many quality improvement approaches used to identify, understand and resolve root causes of problems, incidents or accidents. It is an objective, thorough and disciplined methodology employed to determine the most probable underlying causes of problems and undesired events within an organisation with the aim of formulating and agreeing corrective actions to at least mitigate if not eliminate those causes and so produce significant long term performance improvement.

 **Duration**
1 day

 **Languages**
FR, EN, NL

 **Delivery**
Onsite,
Remote online

PROGRAM

The training course is divided in two parts:

PART 1 :

General principles of root cause analysis, implementation and identification of the necessary parameter registration.

PART 2 :

Example exercises of root cause analyses in common damage situations in power plants that must be solved interactively.

The training's approach is very "practical" and "hands-on", based on our own experience for handling cases. This course will allow you to perform/lead an RCA yourself (we will not be explaining just the basic principles), although it is as well a kind of "skill" that improves by handling different cases.

AUDIENCE

Asset managers, quality assurance managers, plant operation engineers, maintenance engineers.



0,5
DAYS



Introduction to Vibration Analysis based on Laborelec Vibration Monitoring System (LVMS)

DESCRIPTION

This basic LVMS training for operators and I&C helps them to enlarge the knowledge of the Laborelec Vibration Monitoring System (LVMS) and the vibration measurements in general. The participants will enlarge their general knowledge of vibration and the interpretation of vibrations on the condition monitoring system LVMS. The focus is on understanding the measurements, the LVMS system, and the alarms. All this to understand and get the best out of the LVMS system.

 **Duration**
0,5 days

 **Languages**
FR, EN, NL

 **Delivery**
Onsite,
Remote online

PROGRAM

This training course provides an introduction to the use and interpretation of measurements made with the LVMS. It includes a basic introduction to the theory and practice of lateral vibration analysis of large rotating machinery. Theoretical concepts are explained by means of case studies arising from extensive experience of vibration monitoring, as used in more than 100 shaft lines around the world.

Half day: introduction to the interpretation of vibrations and visualization of the vibration behavior of large rotating machines using the LVMS, including initial execution with the support of ENGIE Laborelec's vibration experts.

Important concepts covered are:

- What is a vibration?
- Which vibration sensors are used?
- How can I distinguish these different sensors?
- What are the working principles?
- How are the vibrations handled in LVMS?
- What graphics are available?
- Which information is given by these graphics?
- How to handle the LVMS screens and how to collaborate with remote LBE experts.

AUDIENCE

Power plant operation and maintenance personnel. Technically skilled personnel who would like to acquire a background in the purpose and benefits of vibration analysis on large turbomachines.



Electricity

- [Electromagnetic Compatibility \(EMC\) | 3-days](#) 20
- [Protection of Medium Voltage electrical networks | 2-days](#) 22





Electromagnetic Compatibility (EMC)

DESCRIPTION

Most electronic systems must meet electromagnetic compatibility requirements. EMC is not only considered for safety reasons but also for product compliance. Radiated and conducted interference can originate from electronic devices and can cause damage to themselves and/or other equipment.

This is why EMC is essential in an industrial environment. Indeed, it can generate a series of phenomena whose high frequency disturbances and their influence are difficult to understand and measure. This is what electrical engineering professionals must pay attention to.

PROGRAM


This training will tackle questions such as:

- What is proper grounding for modern power electronic systems?
- What are the specific problems of high voltage installations?
- What are the main causes of signal disturbances?
- Can residential equipment be used in industrial installations?

The answers to these questions and many more will be shared in our three-day hand-on technical training course on “Electromagnetic Compatibility”.

Days 1&2

- C*Signal characteristics
- Electrical impedance of conductors
- Inductive coupling
- Electrical coupling and radio waves
- Shielding
- Grounding and bonding
- Grouping and segregation of cabling
- Hot spots in industrial environments

 **Duration**
3 days

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 **Languages**
FR, NL

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 **Delivery**
Onsite

Day 3:

The program for the third day of training is specified by the participants.
The following modules are available (à la carte options according to the needs of the participants, provided upfront)

- Drives – basic (2h)
- Drives – advanced (90 min)
- Drives – bloopers (45 min)
- Lightning protection (2h)
- Surge protective devices + installations (1h)
- Cabinet organization (45 min)
- Measurement & control items (30min)
- IT-TT-TN earthing systems and EMC (90 min)
- Shielding of HV-cables (30 min)
- Casus – bloopers (20 min)
- Lightning protection of radio base stations (2h)

AUDIENCE

The training is intended for engineers and technicians responsible for the design and maintenance of electrical installations. With this they can prevent the risk of failures in modern electrical installations.


2
DAYS




Protection of Medium Voltage electrical networks

DESCRIPTION

This intermediate level course provides participants with a solid understanding regarding protection of medium voltage grids. In addition to the basic concepts of grid protection, the following topics are also covered in detail: common fault types, neutral grounding, protection of cables and lines and protection of transformers. Simplified techniques for calculating short-circuit currents are also presented. Finally, the course also focuses on the impact of decentralized electrical production on the grid, and on its behavior in case of default.

 **Duration**
2 days

.....
 **Languages**
FR, NL

.....
 **Delivery**
Onsite

PROGRAM

The following aspects will be addressed during the training:

- Defect types
- Simplified calculations of short- circuit current
- Measuring transformers
- Basic concepts (selectivity, reliability, ...)
- Neutral grounding
- Protection types and applications
- Conductor protection
- Transformer protection
- Decoupling protection
- Evolution of protection technologies.
- Introduction to IEC 61850

AUDIENCE

The training is intended for maintenance and operation technician and engineers.



Explosive atmospheres - ATEX

• ATEX Level 0: fundamentals of ATEX rules and principles 0.5-days	24
• ATEX Level 1: electrical and mechanical course 2-days	25
• ATEX Level 2: electrical and mechanical course 4-days	27





ATEX Level 0: fundamentals of ATEX rules and principles

DESCRIPTION

At an industrial site where an explosive atmosphere (ATEX) could occur, the operator is responsible for ensuring worker safety. This includes not only adapting the site's design to reduce risks, but also installing ATEX equipment and removing potential ignition sources.

Unfortunately, no matter how good the design is, inadequate installation or maintenance can alter ATEX equipment characteristics, and lack of knowledge on the part of the personnel involved can lead to hazardous conditions.

To assure safety, it is essential for everyone to respect the specific rules relating to ATEX zones and that maintenance and installation conform to ATEX standards.

To achieve this, every worker must undergo job-specific training. Our training courses are certified ISM-ATEX by INERIS and are aimed at those engaged in installation design, as well as maintenance staff, operators and supervisors.

♥ **Duration**
0,5 days

♥ **Languages**
FR, EN, NL

♥ **Delivery**
Onsite

PROGRAM

The following aspects will be addressed during the training:

- What is an explosion?
- General information about ATEX: industrial risk, legal obligations
- Setting fires and explosions: LIE, LSE, EMI, Kst, Kg, Pmax
- Ignition mechanisms: friction, static electricity, impacts, overheating
- European directives: Directive 2014/34/EU guidelines, marking equipment, related documents, zoning
- Overview of modes of protection ATEX equipment: What do I need to know?
- ATEX zone intervention rules: general rules, tools, protective clothing.

AUDIENCE

The training is intended for all workers in ATEX zones.



2
DAYS




ATEX Level 1: electrical and mechanical course

DESCRIPTION

At an industrial site where an explosive atmosphere (ATEX) could occur, the operator is responsible for ensuring worker safety. This includes not only adapting the site's design to reduce risks, but also installing ATEX equipment and removing potential ignition sources. Unfortunately, no matter how good the design is, inadequate installation or maintenance can alter ATEX equipment characteristics, and lack of knowledge on the part of the personnel involved can lead to hazardous conditions. To assure safety, it is essential for everyone to respect the specific rules relating to ATEX zones and that maintenance and installation conform to ATEX standards. To achieve this, every worker must undergo job-specific training. Our training courses are certified ISM-ATEX by Ineris and are aimed at those engaged in installation design, as well as maintenance staff, operators and supervisors.

The two-day level 1 training is particularly suitable for people who work on ATEX equipment, whether from an electrical or mechanical point of view. The trainer explains, among other things, the regulations, points to be checked and the steps to be followed for the ATEX to maintain its level of protection.

The course will be delivered in a LIVE-CLASSROOM format. At the end of the session, all participants will be tested in accordance with INERIS standard in order to be awarded with ISM-ATEX Level 1 certificate. Participants will be receiving the course presentation, Laborelec Academy issued attendance diploma and INERIS issued ISM-ATEX certificate.

 **Duration**
2 days

 **Languages**
FR, EN, NL

 **Delivery**
Onsite,
Remote online

PROGRAM

- The explosion risk and general issues concerning explosive atmospheres (legal obligations, what is an explosion, examples of explosions, etc.)
- Important parameters concerning fires and explosions: LEL, UEL, MIE, Kst, Kg, Pmax; understanding why some gases are more dangerous than others
- Ignition sources and ignition mechanisms: friction, static electricity, impacts, overheating, self-heating
- Safety of installations and workers: European directive 1999/92/EC, zoning (what are the different zones and what can I do in each zone?)
- Design of ATEX equipment: European directive 2014/34/EU, equipment marking (how to read it), documents related to the directive (explosion protection document, risk analysis, EU type certification)
- Overview of the protection modes of ATEX equipment:
- What do I need to know? What is the difference between ATEX and non-ATEX equipment? Is it all built in the same way?



- How do intrinsic safety and flameproof enclosures work?
- Installation and maintenance rules of ATEX devices according to their protection mode
- ATEX zone intervention rules: general rules, tools, adapted clothes, work permit
- Maintenance rules regarding seals, bearings, screws, cables, electrical connections, cable glands (is it sufficient to have an ATEX cable gland?), etc.
- The main goal is to ensure that ATEX devices keep all their features even after maintenance or installation
- Questionnaire at the end of the session to obtain the ISM-ATEX certificate

Level 1 training is formulated by INERIS and recognised by the EU.

AUDIENCE

All persons working with ATEX equipment, supervised by personnel trained to level 2, or for operational use.



4
DAYS




ATEX Level 2: electrical and mechanical course

DESCRIPTION

At an industrial site where an explosive atmosphere (ATEX) could occur, the operator is responsible for ensuring worker safety. This includes not only adapting the site's design to reduce risks, but also installing ATEX equipment and removing potential ignition sources. Unfortunately, no matter how good the design is, inadequate installation or maintenance can alter ATEX equipment characteristics, and lack of knowledge on the part of the personnel involved can lead to hazardous conditions. To assure safety, it is essential for everyone to respect the specific rules relating to ATEX zones and that maintenance and installation conform to ATEX standards. To achieve this, every worker must undergo job-specific training. Our training courses are certified ISM-ATEX by INERIS and are aimed at those engaged in installation design, as well as maintenance staff, operators and supervisors.

The four-day level 2 training digs into the basic concepts of mechanics and electricity and goes into more detail on, for example, zoning, equipment selection, European legislation, maintenance, inspections, and cable selection.

The course will be delivered in a LIVE-CLASSROOM format. At the end of the session, all participants will be tested in accordance with INERIS standard in order to be awarded with ISM-ATEX Level 2 certificate. Participants will be receiving the course presentation, Laborelec Academy issued attendance diploma and INERIS issued ISM-ATEX certificate.

 **Duration**
4 days

 **Languages**
FR, EN, NL

 **Delivery**
Onsite,
Remote online

PROGRAM

- The explosion risk and general issues concerning explosive atmospheres (legal obligations, what is an explosion, etc.)
- Important parameters concerning fires and explosions: LEL, UEL, MIE, Kst, Kg, Pmax; understanding why some gases are more dangerous than others
- Ignition sources and ignition mechanisms: friction, static electricity, impacts, overheating, self-heating
- European directives: Directive 2014/34/EU guidelines, equipment marking (how to read it), documents related to the directive (explosion protection document, risk analysis, EU type certification), zoning (what are the different zones and what can I do in each zone?)
- Overview of the protection modes of ATEX equipment: What do I need to know? What is the difference between *ATEX and non-ATEX equipment? Is it all built in the same way? How do intrinsic safety and flameproof enclosures work?
- Design rules for ATEX devices in protection mode



- ATEX zone intervention rules: general rules, tools, protective clothing
- Maintenance rules regarding seals, bearings, screws, cables, electrical connections, cable glands (why is it insufficient to have an ATEX cable gland?), etc.
- The main goal of ensuring that ATEX devices keep all their features even after maintenance or installation
- Questionnaire at the end of the session to obtain the ISM-ATEX certificate

Level 2 training is formulated by INERIS and recognised by the EU.

AUDIENCE

All persons directly managing workers in ATEX zones, such as senior technical maintenance staff and asset managers responsible for transformers.



Industrial cybersecurity

• Applied cybersecurity training for OT personnel 5-days	30
• Cybersecurity Risk Assessment & Management for Operators of Essential Services (OES) 2-days	33
• Implementing an ISMS for Operators of Essential Services (OES): Improving the information security posture 3-days	34
• Security 101 - Cybersecurity Awareness for all personnel 1-day	35
• Security X (Board and Executive Cybersecurity Training) 0.5-days	36



Applied cybersecurity training for OT personnel

DESCRIPTION

The global cyber threats continue to evolve at a rapid pace, with a rising number of data breaches each year. Medical services, big corporations and public entities experienced the most breaches, with malicious criminals responsible for most incidents. Some of these sectors are more appealing to cybercriminals because they collect financial and medical data, but not only all businesses that use networks can be targeted for customer data, corporate espionage, or customer attacks but also individual users can be targeting as well. At the same time, an increase in the cyber attacks within the Industrial Control Systems (ICS) has been observed. With the scale of the cyber threats to continue to rise, the need of cybersecurity awareness and cybersecurity solutions is vital.

You can follow this training in two courses: Foundations and Advanced. If desired, you can also purchase this training as a bundle.

The first part of the training (Foundations) focuses on introducing the technologies involved in modern control systems, and how they affect cybersecurity.

The second part of the training (Advanced) focuses on covering the technical aspect of the first part by providing practical labs on building Pentest skills for accessing vulnerabilities and ways to attacks.

At the end of this training, the attendees will have both theoretical and technical knowledge on how to secure a network infrastructure as well as a Industrial Control System (ICS) environment from a technological point of view.

This training course is tailored for OT or IT personnel, junior cyber security engineers, junior SOC analysts and cyber security enthusiasts.

The training sessions are developed in partnership with Thales and will take place at the Thales Cyberlab.

✔ **Duration**
5 days

✔ **Languages**
FR, EN

✔ **Delivery**
Onsite

PROGRAM

Part 1 – Foundations

Data breaches in Industrial Control Systems (ICS) are happening at an alarming rate. It's no longer a question of whether a breach will happen, it's really more a question of 'are we ready for it?'.

Within an organization there are operational technology systems and information technology systems. Both technologies and each set of systems were purpose-built, and neither was designed to work with the other. Therefore, this training course will help organization to build the bridge towards collaboration between IT and OT personnel to manage and maintain cybersafe culture. As the threat landscape from IT has merged into OT (Operation Technology) availability world due to its embedded IT concepts. Which requires to build enough technical capabilities to form a resilient workforce and implement new security policies and strategies.

The purpose of this first part foundation course is to provide people with an understanding of the technologies involved in modern control systems, and how they affect cybersecurity. The goal is not to demonstrate hacking tools, or to explain to people how to use hacking tools but to give an introduction to the technologies that are used in the systems and explain to them how to secure those systems. At the end of this training, the attendees should have a good understanding on how to secure an ICS from a technological point of view. This training also focuses to build basic knowledge in Pen-testing skills for accessing vulnerabilities and ways to attacks.

At the end of this training, user will have both theoretical and technical knowledge on Industrial protocols, OT infrastructure architecture, hardening and best practices for security solution deployment for securing control systems. Furthermore, user will also gain knowledge on the elements of IT networking model, tools to identify vulnerabilities and exercise to penetrate basic vulnerabilities.

Also, this course will help users to fulfil the requirements for attending advance course (Part 2 – Advanced).

Prerequisites: Basic knowledge of the Microsoft Windows operating environment.

Part 2 - Advanced

This part is essential to raise awareness by providing real-time demonstration of different cyberattacks and to provide close-to-reality exercise related to cybersecurity of different fields including Operation Technology (OT) and Information Technology (IT) systems, individual users and corporate networks. The main goal of this training is to prepare the cybersecurity workforce of tomorrow and to keep current cybersecurity workers up-to-date on skills and current threats.

During this training you will be able to experience a unique opportunity by visiting and having access to Thales's CyberLab. CyberLab allows the replication of network topologies to act as realistic cyberbattle fields for subject-specific trainings, and also for close-to-reality exercises. Through this virtualized environment, scenarios of attacks/defences are performed during immersive trainings on IT environments. During such events, the team in charge of defending the IT infrastructure will face various attacks using different vectors and means. Having realistic scenarios is thus a precious asset as this will help to train you in order to deal with recent attacks, executed as close to reality as possible.

At the end of this training, you will have both theoretical and technical knowledge on how the Blue Team, Red Team and Purple Team exercises are performed within an industrial environment. Furthermore, you will be able to get in contact with different types of cyberattacks before you actually face them in your own network and on the top of it you will get to know how you can secure a network infrastructure as well as an ICS environment from these kinds of attacks.

Prerequisites:

- IT knowledge (Windows, Linux)
- Moderate Network & CyberSecurity knowledge:
 - > IP (routing, switching, protocol)
 - > Network & CyberSecurity (Protection assets, mail, etc.)
- Basic scripting knowledge
- Basic knowledge in Pentesting
- Basic knowledge in CyberSecurity Protection
- OT network knowledge

AUDIENCE

Technical enthusiast personnel in ICS operations and maintenance departments, designated single point of accountability (SPoA), IT engineers and cybersecurity teams.

Cybersecurity technical enthusiasts, IT engineers, IT teams, technical enthusiast personnel in Incident Management (ITSM), operations and maintenance department, designated Single Point of Accountability (SPoA).

2
DAYS



Cybersecurity Risk Assessment & Management for Operators of Essential Services (OES)

DESCRIPTION

This course helps participants grasp the idea of real-world risk management and apply it to the cyber world. It involves identifying cyber risks & vulnerabilities, guidance to apply administrative actions, and comprehensive solutions to make sure your organization is adequately protected. This RAM course will teach you how to conduct a security risk assessment for your organization, gain the skills to develop a risk compliance assessment plan, and develop risk management to improve security posture. The course has at least 30% a hand-on approach through the use of Table Top Exercises.

✔ **Duration**
2 days

✔ **Languages**
FR, EN, NL

✔ **Delivery**
Onsite,
Remote online

PROGRAM

Les aspects suivants seront abordés lors de la formation:

- Introduction to Risk Assessments (RA)
- Threat actors and their motivations
- Threat and Risk Assessment
- Critical Controls Identification
- Maturity Assessment
- Treated Cyber Risk Profile
- Target Cyber Risk Profile and Strategy

AUDIENCE

ICS operations and maintenance department leads and manager, designated single point of accountability (SPoA), Auditors.



3
DAYS



Implementing an ISMS for Operators of Essential Services (OES): Improving the information security posture

DESCRIPTION

The high amount of information and the low-security level within critical processes, put at risk the productivity of the organizations and the security of the processed information managed by Operators of Essential Services (electricity, oil and gas, distribution system operators, industrial system operators, entities from the air and railway transportation sector, health care, drinking water suppliers). Measures to improve your security level are needed to combat threats. Organizational and technical measures need to be employed to establish a good level of security. For systems to remain secure, however, security posture must be evaluated and improved continuously. Establishing such process that will support these ongoing improvements is essential in order to maintain your security level. Experience has shown that implementing Information Security Management System (ISMS) according to internationally recognizable information security standard ISO 27001 is a very good approach to accomplish that mission. Companies obtaining the ISO/IEC 27001 certification have indirect proof that they meet the mandatory regulatory requirements imposed by the legal system under which they perform their activities. The increasing trend is for them to decide to implement an Information Security Management System (ISMS) due to industry-specific requirements or in order to build the trust of their customers.

Duration
3 days

Languages
FR, EN, NL

Delivery
Onsite,
Remote online

PROGRAM

With rich experience in the Energy and Industrial sector, we are offering our knowledge and expertise during this 3-day in-depth training, covering all clauses and controls in the ISO 27001 standard. We will be discussing:

- Securing executive support and set the objectives
- Defining the scope of the system
- Evaluating assets and analyzing the risk
- Defining the Information Security Management System
- Competencies of the ISMS Roles
- Best practices in the development and the implementation phases
- Maintaining the ISMS, monitoring and continuously improvement process
- and a lot more

AUDIENCE

Professionals who are:

- Working to implement or maintain an ISMS within an organization
- Required to audit an ISMS and are required to have a basic understanding of the standard
- Working within an organization with an ISMS, whether the organization is already certified or is considering certification to ISO/IEC 27001.

Targeted at quality managers, other executives, managers and supervisors, business process owners, program and project managers, assessors, consultants.



1
DAY



Security 101 - Cybersecurity Awareness for all personnel

DESCRIPTION

Awareness is key in understanding the possible business impact of cyber security. Gain a critical understanding of its technological needs, threats, and weaknesses. The course will offer guidance to process engineers, information technology personnel, operations managers and other plant personnel responsible for developing and maintaining the cyber security of automation systems.

✔ **Duration**
1 day

✔ **Languages**
FR, EN, NL

✔ **Delivery**
Onsite,
Remote online

PROGRAM

- Introduction
- Understanding cyber security for ICS
- ICS threat landscape
- ICS vulnerabilities
- Common cyber security threats
- ICS security myths
- Defense-in-depth cyber security plan
- Types of security attacks and prevention
- ICS security policy requirement

AUDIENCE

Managers, engineers, suppliers, integrators etc.
(everyone working within the organization)



0,5
DAYS



Security X (Board and Executive Cybersecurity Training)

DESCRIPTION

Dans le monde cyber-sécurisé d'aujourd'hui, les conseils d'administration et les dirigeants doivent réfléchir de manière critique aux cyber-problèmes importants auxquels leurs organisations sont confrontées. La cybersécurité n'est plus reléguée au département informatique, elle commence au sommet et est l'affaire de tous. Ce cours de formation prépare les membres de l'exécutif, de manière directe et non compliquée, à identifier, comprendre, évaluer et atténuer les risques liés à la cybersécurité, et à prendre des mesures pour intégrer la cybersécurité dans la stratégie, la politique et les directives.

✔ **Duration**
0,5 days

✔ **Languages**
FR, EN, NL

✔ **Delivery**
Onsite,
Remote online

PROGRAM

Immediate benefits from this course:

- Cyber security strategy strengthened with high-level buy-in and leadership
- Recognition of cyber as a business risk
- Decision-making based on subject matter familiarity
- Stronger tactical/strategic response to breaches
- Support for security mission drives investment
- Potential for new lines of business
- Budget for projects to determine exposure to threat and risk
- Set responsibility for tracking landscape evolution and cyber hygiene

AUDIENCE

CEO, CFOs CIO, CISOs, auditors, risk managers, security leaders.



Lighting technology

- [Indoor lighting: requirements, conception, technologies and energy concerns | 2-days](#)

38





Indoor lighting: requirements, conception, technologies and energy concerns

DESCRIPTION

Light is a human essential. It impacts our behaviour, wellness, social life, and our economic activity. Over time, humans have developed the technology to create artificial light, allowing social and economic activity to extend into the hours of darkness. At the same time, scientific knowledge, and the application of this knowledge, have created a world of possibilities for lighting technologies and their varying characteristics. Lighting is now a very complex business and it has to fulfil a lot of requirements. This two-day technical seminar provides enlightening answers to frequently asked questions, such as:

- What is light, and what technologies to produce it are at our disposal?
- What are the differences between lumen and lux or candela and candela / m²?
- Why are uniformity and glare important?
- What is LED technology?

PROGRAM

Lighting requirements, conception, technologies and energy concerns

- Vision and photometry fundamentals
- Light source technologies
- Light fitting and auxiliary characteristics
- LED technology
- Analysis of an existing lighting installation
- Requirements of the EN 12464 standard
- Stages of a new lighting project
- How to use simulation software
- Energy concerns in lighting

AUDIENCE

The training is intended for staff responsible for indoor lighting installations (conception and maintenance).



Duration
2 days



Languages
FR, EN, NL



Delivery
Onsite,
Remote online



Materials technology

- [Introduction to corrosion protection with paints or coatings | 1-day](#) 40
- [Material damage mechanisms in power plants: Review and Mitigation | 2-days](#) 41
- [Safety of thermal installations | 1-day](#) 42



Introduction to corrosion protection with paints or coatings

DESCRIPTION


Participants will acquire a basic knowledge of paints, including relevant requirements and quality control, such as needed for surface preparation and application of all the coating layers to achieve a functional coating system. The course will enable participants to identify which paint works require more attention than others and to ensure best practices.

PROGRAM

- Introduction to corrosion mechanisms and corrosion control
- Paint components: binder resin, solvents, and pigments
- How to select the best paint for a specific application
- How to read technical specifications and datasheets
- Application methods: spray, brush and roller
- Overview of surface preparation techniques: solvents, hand tools, power tools, blast cleaning and water jetting
- Paint failures, bad application techniques
- Standards and inspection issues
- Case studies

AUDIENCE

Project engineers, quality assurance managers, mechanical maintenance personnel and operation technicians.

 **Duration**
1 day

.....
 **Languages**
FR, EN, NL

.....
 **Delivery**
Onsite,
Remote online


2
DAYS



Material damage mechanisms in power plants: Review and Mitigation

DESCRIPTION

This training will provide an overview of the most common damage mechanisms observed in a power plant. After understanding the different mechanisms, we will go through the different techniques (NDT) to monitor them and the possibility to perform some destructive analysis in order to determine the failure mechanism. The results of those test are required and used to determine the remaining lifetime of an installation. At the end of the session, the participants are facing some practical cases that they have to investigate to determine the failure mechanism.

 **Duration**
2 days

 **Languages**
FR, EN, NL

 **Delivery**
Onsite,
Remote online

PROGRAM

- Introduction to material damage
- Integrity assessment and failure analysis: brief explanation of damage mechanisms and example
- Overview of available non-destructive and destructive testing
- Remaining life determination: application of boiler life management
- Practical cases to solve to determine the failure mechanisms

AUDIENCE

Introduction for new employee in power plant/industry or maintenance personnel.





Safety of thermal installations

DESCRIPTION

The aim is to create insight in the diverse technical safety problems related to thermal process in order to allow the students to recognize the risks and to take the necessary measures to control them. The student is expected to understand and master the technical operation of the different thermal components and their associated safety features mentioned above in order to identify and implement the prescribed regulatory safety requirements (and additional protective devices if necessary) in a concrete industrial environment.

PROGRAM


The syllabus gives an overview of different thermal installations, each with their specific safety hazards and protection measures. The following thermal equipment is discussed:

- Boiler (water-steam side)
- Boiler (firing side)

Une brève description du fonctionnement de chaque système est donnée mais le cours est particulièrement axé sur les aspects techniques des contrôles de sécurité, des équipements de sécurité et des dispositifs de protection, ainsi que sur les exigences du code réglementaire. Ces dernières sont illustrées dans le contexte national et européen. Une attention particulière est accordée à l'application de la directive sur les équipements sous pression et aux normes européennes harmonisées associées.

AUDIENCE

A brief description of the operation of each system is given but the course is particularly focused on the technical aspects of safety controls, safety fittings and protective devices, as well as the regulatory code requirements. The latter are illustrated within the national and European context. Special attention is drawn to the application of the pressure vessel directive and the associated European harmonized standards.

 **Duration**
1 day

 **Languages**
FR, EN, NL

 **Delivery**
Onsite,
Remote online

Nuclear

• Aging, qualification & obsolescence in NPPs 1.5-days	44
• Introduction to metallurgy 1-day	45
• Corrosion in PWR nuclear power plants 2-days	46
• Water chemistry of the primary circuit in nuclear power plants 1-day	47
• Water chemistry of the secondary circuit in nuclear power plants 1-day	48
• CASO process automation for Nuclear 2-days	49
• Advanced Nuclear I&C and most important regulation systems 5-days	50

1,5
DAYS



Aging, qualification & obsolescence in NPPs

DESCRIPTION

Managing ageing, qualification and obsolescence for nuclear power plants means ensuring the availability of required safety functions throughout the service life of the plant, taking into account changes that occur with time and use. This requires addressing both physical ageing of structures, systems and components (SSCs), resulting in degradation of their performance characteristics, and obsolescence of SSCs, i.e. their becoming out of date in comparison with current knowledge, standards and regulations, and technology.

 **Duration**
1,5 days

 **Languages**
FR, EN, NL

 **Delivery**
Onsite,
Remote online

PROGRAM

- Ageing management strategy and return of experience on LTO projects of nuclear power plants.
- Qualification Process: Design Input, Establishing Qualification and Preserving Qualification during the service life of the plant.
- Obsolescence Process how to identify, prioritize, and implement solutions (CGD, reverse engineering) to tackle obsolescence issues.

AUDIENCE

Personnel working on new-build power plants, lifetime extension LTO, preparing for SALTO mission, engineering and maintenance personnel.



1
DAY




Introduction to metallurgy

DESCRIPTION

The purpose of this training is to acquire general knowledge on metallic materials, necessary to understand materials behaviour under specific environments, stresses, operating conditions.

The course starts with the description of metals: what they are at the microstructural scale, how they behave at the large scale, how their properties can be modified to reach the required behaviour.

The basics will be explained afterwards for four of the most used metals in nuclear power plants: steel, stainless steel, nickel alloys and zirconium alloys. All four materials are metals, but they behave slightly differently. We'll spend most of our time on steel and stainless steel, because those metals are widely used and have many interesting behaviours.

 **Duration**
1 day

 **Languages**
FR, EN, NL

 **Delivery**
Onsite,
Remote online

PROGRAM

- Metals in general
- Steels
- Stainless steels
- Nickel alloys
- Zirconium alloys

AUDIENCE

Technicians working in PWR nuclear chemistry teams or on the maintenance of chemical circuits.



2
DAYS



Corrosion in PWR nuclear power plants

DESCRIPTION

This technical training course will allow you to better understand the corrosion issue in the PWR (Pressurized Water Reactor) Nuclear Power Plant. The focus will be set on the basic principles of corrosion and the different types of corrosion and how it is possible to prevent/minimize the corrosion phenomena in the plant. The course will be illustrated by a large set of practical examples. At the end of the session, the participants will be invited to investigate some practical cases to identify the cause(s) of the failure. After this training course, you should be able to better understand the parameters that can play a role in corrosion and the ways to minimize the phenomenon.

 **Duration**
2 days

.....
 **Languages**
FR, EN, NL

.....
 **Delivery**
Onsite,
Remote online

PROGRAM

- Main materials present in PWR nuclear power plants
- General principles of corrosion
- General principles of corrosion protection
- Different types of corrosion
- Case studies

AUDIENCE

Technicians working in PWR nuclear chemistry teams or on the maintenance of chemical circuits.



1
DAY



Water chemistry of the primary circuit in nuclear power plants

DESCRIPTION

A one-day course to get an overview of the chemical aspects of the primary circuit in a nuclear power plant. After completion of the course, participants:

- will be able to determine the chemicals to be injected into the primary water loop
- will understand the purpose of such injection
- will have understood why certain chemicals are injected during transients
- will be able to determine parameters to monitor and common KPI's, during operation and in the event of chemistry related problems


PROGRAM

Modules covered in this course are:

- Which chemicals are used in the primary loop and why
- Why certain chemicals are used in transient periods and which ones
- What are the relevant parameters to monitor and most common KPI's during normal operation
- What are the relevant parameters to monitor in case of chemistry-related problem

AUDIENCE

Chemists and laboratory managers in nuclear power plants.

 **Duration**
1 day

.....
 **Languages**
FR, EN, NL

.....
 **Delivery**
Onsite,
Remote online

1
DAY



Water chemistry of the secondary circuit in nuclear power plants

DESCRIPTION

This course is an introduction to the chemistry of the secondary circuit in nuclear power plants.


PROGRAM

After completion of the course the participant will be able to:


- Determine the chemical products to be injected into the secondary loop and why they are used
- Understand the sequestration of salts in the steam generator and its impact
- Determine the monitoring and evaluation parameters during operation and in the event of chemical-related problems

AUDIENCE

Chemists and laboratory managers in nuclear power plants.

 **Duration**
1 day

.....
 **Languages**
FR, EN, NL

.....
 **Delivery**
Onsite,
Remote online

2
DAYS




CASO process automation for Nuclear

DESCRIPTION

This training is based on our Standard CASO training, which has been tailored to suit the nuclear operators' needs/conditions, thus becoming a standard nuclear training.

Training objectives:

- Acquiring a general view of the nuclear processes and their controls
- Be able to argue in terms of nuclear process and their control structure: cascade, feedforward,...
- Be able to implement the step response en to define the parameters characteristics of the nuclear process
- Elementary view of the parameters of the PID regulator
- Operating principles and applicability nuclear domains of the measurement detectors (temperature, pressure, level, flow)

 **Duration**
2 days

 **Languages**
FR, EN, NL

 **Delivery**
Onsite,
Remote online

PROGRAM

Important notions of the training:

- Accuracy, sensitivity, measuring device, transmitter, HART protocol
- Process, control valve and regulator characteristics
- Static/dynamic behavior process
- Open/close loop (manual/auto)
- Step response – amplification process – time constant – dead time – response order
- Stable/instable process
- Parameters from the regulators

AUDIENCE

O&M and quality personnel in the nuclear generation sector.



5
DAYS



Advanced Nuclear I&C and most important regulation systems

DESCRIPTION

After following this training, the participant will have a good understanding of the nuclear process: interactions of different systems, evolution of physical parameters. The participant will acknowledge the most important control circuits of the primary and secondary loops: normal operation, controlled and commanded values, and degradation modes. The interaction between the different systems will be explained and the importance of the balance between all components will be highlighted.

PROGRAM

- Module 1 - Nuclear Processes and primary loop
- Module 2 - Steam turbine control and network
- Module 3 - SG level regulation and ΔP regulation
- Module 4 - Summary and big transients
- Module 5 - Cybersecurity

Module 1 must precede modules 2, 3 and 4. Module 4 must follow modules 1, 2 and 3. Module 5 is independent.

AUDIENCE

Technicians I&C, operations personnel in the nuclear generation sector.



Duration
5 days



Languages
FR, EN, NL



Delivery
Onsite,
Remote online



Non-destructive testing


- [Introduction to Non-Destructive Testing \(NDT\) | 1-day](#) 52
- [Non-destructive testing \(NDT\) for diagnosis and post-repair evaluation of reinforced concrete structures | 1-day](#) 53
- [Non-destructive testing \(NDT\) for metal additive-manufactured components | 3-days](#) 55




Introduction to Non-Destructive Testing (NDT)

DESCRIPTION

The course is designed to meet the needs of anyone who calls on service providers to carry out nondestructive testing (NDT) and organize and monitor associated measurement campaigns on site. At the end of the course, participants will have basic knowledge of the various NDT methods, and will be equipped to assess the most appropriate method to be deployed in a given situation, as well as the typical results each will produce.

 **Duration**
1 day

 **Languages**
FR, EN, NL

 **Delivery**
Onsite,
Remote online

PROGRAM

The course begins with what NDT is and the various elements to consider when preparing a measurement campaign, such as ASME standards and codes, and service provider certification. Every step of the process is reviewed and discussed, from preparation, preliminary studies and simulation, to reporting, including the importance of procedures, equipment calibration and site management.

The main part of the course then looks at the analysis techniques themselves, and how to guarantee that analysis is reliable. For each method, the following aspects are reviewed: choice of method in relation to the application, materials, suitability to detect certain types of defect, and limitations, using the following testing techniques and methods:

- visual examination,
- penetrant testing,
- magnetic particle testing,
- eddy current testing,
- ultrasonic testing, and
- radiographic testing.

The course ends with a comparison of the various methods, with an emphasis on their field of application. Everything is illustrated by examples drawn from real industrial settings.

Brief interactive exercises form an important and integral part of the course, designed to illustrate the theory and aid in assimilating the material. The course also includes a large number of case studies.

AUDIENCE

The course is particularly suitable for maintenance and operation staff, engineers and technicians, in power plants and other areas of industry, such as metals, petrochemicals and chemicals. The course is also aimed directly at engineers and technicians who are responsible for QA or QC.



Non-destructive testing (NDT) for diagnosis and post-repair evaluation of reinforced concrete structures

DESCRIPTION

Ageing or chemical degradation in power plants, dams, tunnels, bridges and other civil engineering infrastructure often lead to cracking or delamination affecting durability and structural integrity. Precise diagnosis is vital to assess degradation and to check the quality of repairs. Destructive testing has long been the dominant method of assessing concrete, and many operators do not have the reflex to employ nondestructive techniques despite the clear advantages.

The course covers non-destructive testing (NDT) methods for concrete in detail, how to achieve a balance between using destructive and non-destructive methods, and how to formulate reliable and cost-effective examination procedures.

 **Duration**
1 day

 **Languages**
FR, EN, NL

 **Delivery**
Onsite,
Remote online

PROGRAM

The introduction discusses where non-destructive testing is particularly appropriate for assessing concrete structures, rather than other methods, including destructive techniques. In particular, the advantages of NDT over visual inspection, core drilling and hammer-sounding surface examination will be explained, with reference to the following criteria, among others:

- depth within the structure,
- the objectivity or subjectivity of the analysis,
- resolution, and
- cost-effectiveness.

The course then takes a deep dive into non-destructive examination techniques applicable to concrete structures, and how to guarantee a reliable diagnosis, in particular making use of the following technologies:

Ultrasonic Tomography (UT) is a non-destructive method which can be used to complement or replace other destructive techniques, since it can visualize internal as well as surface conditions. Unlike hammer-sounding, it can be used to assess difficult-to-reach locations offering the possibility of inspection even when infrastructure is in operation, avoiding critical paths. Discussion of UT technique is accompanied by case studies and live demonstrations using reinforced concrete mock-ups. Detecting voids following repair is also covered.

Ultrasonic Pulse Velocity (UPV) is an alternative non-destructive means of evaluating compressive strength. Compared with core drilling, UPV has the big advantage of not requiring large quantities of material to be extracted from a range of locations. The training also focuses on UPV in European standards.

Ground Penetrating Radar (GPR) maps the reinforcement mesh at different levels and makes it possible to visualize the structure beneath the concrete's surface. It is useful for assessing conformity in new or existing structures based on engineering drawings. The risk of damaging reinforcement bars during core drilling is dramatically reduced when GPR is used. The training details GPR's advantages over conventional ferro scanning, illustrated by case studies.

Brief interactive exercises form an important and integral part of the course, designed to illustrate the theory and aid in assimilating the material.

AUDIENCE

The course is particularly suitable for engineers and technicians working in maintenance and operations, as well as design engineers and QA/QC specialists.




3
DAYS



Non-destructive testing (NDT) for metal additive-manufactured components

DESCRIPTION

Non-destructive testing is not a recent practice and has long been based on well-established procedures and standards, applying it to parts made by additive manufacturing (also known as 3D printing) presents new challenges. This course looks in detail at these challenges and how to assure reliable analysis. The course reflects the increasing trend for integrating additive-manufactured parts in industrial sectors where quality and safety criteria are particularly onerous, such as aerospace, automotive, chemical and heavy engineering, petrochemical and gas, and nuclear. Assuring quality control for these parts using reliable and standardized non-destructive techniques is essential.

 **Duration**
3 days

 **Languages**
FR, EN, NL

 **Delivery**
Onsite,
Remote online

PROGRAM

The course introduction discusses three specific approaches to metallic additive manufacturing:

- laser powder bed fusion,
- directed energy deposition, and
- binder jetting.

The course then reviews the particular characteristics of parts produced by additive manufacturing, including:

- the final material's internal characteristics, such as grain orientation, anisotropy, and crystal phases;
- the potential defects, such as different types of porosity, microcracks, and which stages of the manufacturing process could have caused these phenomena;
- the often complex shape, as well as surface condition, compared with parts made through conventional subtractive processes.

The main part of the course focuses on how to ensure reliable analysis using the following test and assessment techniques and methods:

- visual examination,
- ultrasonic testing,
- eddy current testing,
- radiographic testing,
- penetrant testing, and
- thermography.

The final part of the course focuses on standards. It reviews existing standards and those under development, as well as the work of active standards groups in organizations including ISO, ASTM, ESA, and NASA.

Brief interactive exercises form an important and integral part of the course, designed to illustrate the theory and aid in assimilating the material. The final half-day is entirely devoted to practical exercises using video of Level 2 and Level 3 certified specialists carrying out eddy current and ultrasonic inspections.

AUDIENCE

The course is particularly suitable for design engineers, maintenance staff, QA/QC engineers and mechanical maintenance and operation technicians.



Renewable energies, storage, and microgrids


- [Batteries for energy storage systems \(BESS\):
safety and performance | 2-days](#) 57
- [Improve yield and reduce costs and risks of large-scale
PV power plants | 1-day](#) 58
- [Transitioning to Hydrogen: safety of Hydrogen installations | 1-day](#) 60



Batteries for energy storage systems (BESS): safety and performance

DESCRIPTION

The two days of training will provide an overview of the different battery technologies and the main challenge of assuring good performance and, at the same time, an energy storage system that is safe. The technical and operational integration challenges of energy storage systems will be discussed, with a focus principally on lead-acid and lithium-ion batteries. The course will discuss cell chemistry and their impact on performance, cost, and safety. The potential hazards will be explained, along with installation solutions to manage this risk, ranging from cell chemistry to packaging and container integration.

 **Duration**
2 days

 **Languages**
FR, EN, NL, ES

 **Delivery**
Onsite,
Remote online

PROGRAM

Chapter 1: Introduction

Chapter 2: Energy storage

- Energy storage technologies
- Energy storage from frogs to space

Chapter 3: Battery families

- Main terminology
- Overview of battery chemistries
- Summary of technologies

Chapter 4: Potential hazards of batteries

- Main hazards
- Temperature rise reasons

Chapter 5: Design features from the cell to the installation

- Cell chemistry of Li-Ion
- Cell level design
- Module and rack level
- Container design

Chapter 6: Future of batteries

- Next generation of battery chemistries
- Resources and ethics

Chapter 7: Good practices

AUDIENCE

Anyone interested in the safety and performance aspects of Battery Energy Storage Systems.

Some of the positions of our former participants are:

- Industrial Electronics & Metrology Technician
- Project / Product Manager
- Renewables Product Manager
- Senior Project Engineer
- Technical Advisor
- Innovation Manager; Renewables
- Asset Manager; RES
- Decentralized Production Expert



Improve yield and reduce costs and risks of large-scale PV power plants

DESCRIPTION

Raise awareness on the potential of increasing revenues and reducing costs by operational excellence of solar photovoltaic power plants. Introduce the different yield degradation mechanisms, O&M cost drivers and risks and introduce tools to tackle them.

PROGRAM

Subjects that will be treated:

Yield reduction causes and the influence on the plant business case.

There are a number of different technical issues that can cause underperformance in PV plants. These are, amongst others, PID, LeTID, hot spots, soiling, tracker misalignment, etc...

Some of these causes are at module level, some are at inverter or system level. This introduction will allow you to distinguish and recognize them.

PID is one of underestimated causes for underperformance. When present, it can reduce module output by up to 80% of its initial capacity, but if detected in time, its possible to cure the module and recover the full module performance.

Soiling is another underestimated effect, that can either affects yield (if underestimated) or your operational margin (if overestimated).

- How to prioritize and what can be done?
- What is urgent and what is the right course of action?
- Can I take a wrong decision and make it worse?

Detection/quantification techniques

In this part of the course we will present the different techniques and tools that can be used to detect underperformances and to identify their root cause. Each technique is useful, but they are all complementary and need to be used as such. Depending on the issue at hand, a different approach might make sense to take the economically most optimised approach and not waste time and resources.

- IV-curve tracing
- IR inspection
- SCADA data analytics tools
- New technologies under development, eg. Day-time EL, Laser-induced EL

Duration
1 day

Languages
FR, EN, NL, ES

Delivery
Onsite,
Remote online



Possible tools

At different stages in a plant life, different tools and processes are recommended. We therefore make a difference between plants under development, where design decision can impact the CAPEX and the OPEX, and plants already in operation, where one will focus on the optimisation of the operational margin and securing that BP/investor expectations are met.

- To recover yield losses in existing plants
- To improve yield in new developments

Safety of PV plant O&M

Running a generation plant always comes with risks. In order to pro-actively manage them and reduce exposure to risk, whether for the asset or the operators, it is important to identify all possible risks.

In this section we will look at both and give an approach to how certain risks can be mitigated by design, procedures and adequate protection equipment.

- Asset safety
- Operator and technical personnel H&S

AUDIENCE

Technicians, PV Plant and Fleet Operators, O&M teams, asset managers, business developers



Transitioning to Hydrogen: safety of Hydrogen installations

DESCRIPTION

Hydrogen is an important candidate as sustainable fuel for the future. According to the Hydrogen Roadmap Europe (2019) large-scale decarbonization in transport, industry, and buildings will require the use of hydrogen. Hence blending of hydrogen into the natural gas grid as well as the use of pure hydrogen are under consideration. However, this hydrogen transition also has its particular problems. One of them is the negative effect of hydrogen on the properties of materials, known as hydrogen embrittlement.

Are you planning to invest in new equipment which will contain/transport pure hydrogen or a hydrogen mixture? The goal of the training is to give more insight to engineers and project managers working on hydrogen processes concerning the specific risks of hydrogen.




PROGRAM

Among others, following aspects will be explained: hydrogen embrittlement, explosion risk of hydrogen, high diffusivity of hydrogen, Joule-Thompson effect, etc. Practical solutions will be given about how to manage selection of material, type of connections, minimize hazardous area and other challenges for any new project.

The training course will also give some practical advice for assessing your existing infrastructure for future use of hydrogen or hydrogen mixtures. Which materials are still OK and which ones will need to be replaced? What are the main attention points? The safety properties of hydrogen will be examined and solutions will be given to handle it safely.

AUDIENCE

Engineers and project managers working on hydrogen processes concerning the specific risks of hydrogen.

-  **Duration**
1 day
.....
-  **Languages**
FR, EN, NL, ES
.....
-  **Delivery**
Onsite,
Remote online



Welding technology

- [Introduction to welding technology | 3-days](#)

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Introduction to welding technology

DESCRIPTION

The course gives an insight into the complex world of welding. It is a guidebook for all those who are assigned to tackle welding operations for new installations or for welding repair work, mainly in the power generation sector.


Participants will be able to determine priorities in relation to welding work, whether new-build or repair work, and determine whether general best practices are respected.

PROGRAM

- Basic materials knowledge and behavior applied to welding
- Typical welding processes, their scope and application
- Introduction to the major elements in welding (filler metal, gas, welding equipment, joint design)
- Relevant standards and directives
- Basics of post weld heat treatment
- Brief overview of quality assurance and non-destructive testing of welds
- Weld metallography
- Quality assurance and non-destructive testing of welds

AUDIENCE

Maintenance and quality personnel in the power generation sector.

 **Duration**
3 days

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 **Languages**
FR, EN, NL

.....
 **Delivery**
Onsite,
Remote online

Make your choice
and contact us

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