Laborelec Academy
Training catalogue 2017
Upgrade yourself with skills for the future
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Certificates Explained

VCA is a certified safety management system for companies conducting high risk activities in a high risk environment. This certificate demonstrates that a company structurally cares about safety, health and welfare at work for all the parties involved.

Occupational Health and Safety Assessment Series. This internationally applied British standard specifies requirements for an occupational health and safety management system to help organizations to control occupational health and safety risks.

General requirements for the competence of testing and calibration laboratories. This standard specifies the general requirements for the competence to carry out tests and/or calibrations, including sampling. It covers testing and calibration performed using standard methods, non-standard methods, and laboratory-developed methods.

This international standard, formerly known as EN473, specifies requirements for principles for the qualification and certification of personnel who perform industrial non-destructive testing (NDT).

The American Society for Nondesctructive Testing certification is an impartial validation of the competence of NDT personnel in the field.

Voluntary certification of contractors involved in the design, construction and / or maintenance of electrical installations in explosive atmospheres.

NACE International is a worldwide authority in the domain of corrosion and corrosion protection. The trainers of our introductory course about corrosion protection and paints are at least NACE CIP level 2 certified.
Power Transformers

Description
The course begins with a half-day theoretical session addressing various aspects of transformer condition assessment:

- 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.
- How to use the analysis results to create and implement a maintenance action plan.

In the afternoon, there is a visit to the ENGIE Lab Laborelec oil analysis laboratory. In addition, specific case studies are discussed to train in interpreting results and formulating recommendations.

Target audience
Maintenance staff and asset managers responsible for transformers.

Recommended number of participants 8-12
Duration (standard) 1 day
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. The following issues will be covered during the training:

- Condition monitoring of power transformers through oil analyses:
  - Best practice
  - Which analyses/how frequent
  - DGA: focus on partial discharges, sparking, stray gassing, catalytic effects / interpretation systems.
  - Interpretation of results
  - 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 on reports of the power transformer at Tihange / Doel plant.
  - 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.

Target audience
Maintenance staff, operators, asset managers, staff responsible for transformers, technical project managers.

Recommended number of participants 8-12
Duration (standard) 2 days
Introduction to condition monitoring of rotating machines through oil analysis

Description
Day 1
• 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 the afternoon, there is a visit to the ENGIE Lab Laborelec oil analysis laboratory. In addition, specific case studies are discussed to train in interpreting results and formulating recommendations.

Day 2
A workshop in collaboration with oil suppliers and filter manufacturers. Topics include lubricating oil types, filtration techniques, best practices for oil storage and refills, etc.

Recommended number of participants 8-12
Duration 2 days (when the filtration module is selected)

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

ISO 17025:2005 (002-Test/002-Cal)
OHSAS 18001:2007
ISO 9001:2008
VCA++
Introduction to generators

Description

- General introduction of generators in the plant
- The evolution of electricity principles
- The principle manufacturers, the different generator types
- The generator autopsy, meaning the virtual disassembly of each major components (stator, rotor, bearings, casing)
- How is a generator made/assembled
- The main generator failures (electrical and mechanical), with the resulting effects
- Importance of qualitative maintenance and foreign material exclusion rules

Recommended number of participants 8-12
Duration half day

Target audience
Plant operators and maintenance staff

OHSAS 18001:2007
ISO 9001:2008
VCA++
Description At the end of the training the participants should understand the working principles and assemblies of the different gas turbine components. This will allow them to perform maintenance activities and to plan maintenance activities. But it will also help to perform failure analyses, evaluate upgrades and to follow and evaluate works performed by OEM.

This training consist of:

- General mechanical background.
- Working principal of gas turbine in general
- Assembly of gas turbine component
- Working and aim of IGV’s blow off’s
- Damage phenomena
- Combustion and tuning principals
- Gas turbine materials.

The training is build up in different modules. The complete training session will be 3 days and threats the following modules:

Day 1 and 2
- Introduction
- General buildup of the unit.
- Inlet guide vanes
- Fix point, Thermal expansions and thrust in the unit
- Cooling air flow.

Day 3
- Practical Speedtronic Mark V
- General operations
- Combustion and Tuning

Recommended number of participants 8-12
Duration 3 days

Target audience
Maintenance people, mechanical engineers, project people, operators and controls engineers
Gas Turbine - GE
F Class evolution to 9 FB

Description
This training explains the differences between 9FA and 9FB. It is a short overview for people knowing the 9FA and attend to be involved in activities on 9FB units.

Content:
Hardware Differences to achieve the higher efficiency.

Recommended number of participants 8 - 12
Duration 1 day

Target audience
Maintenance people, mechanical engineers, project people, operators and controls engineers

OHSAS 18001:2007
ISO 9001:2008
VCA++

Gas Turbine - GE
DLN2.6 combustion

Description
After this training, the trainee will be able to tune the combustion system.

- DLN2.6+ philosophy
- DLN2.6+ hardware
- DLN2.6+ control loops (Full Load Auto Tune and conventional)

Recommended number of participants 8 - 12
Duration 1 day

Target audience
Maintenance people, mechanical engineers, project people, operators and controls engineers

OHSAS 18001:2007
ISO 9001:2008
VCA++
Description After this training, the trainee will be able to troubleshoot in the system.

- For I-Dos based as for Simplicity based HMI:
- System setup
- Reading rungs
- Understand the most important controls
- Logic forcing
- Changing constants
- Making trends

Recommended number of participants 8 - 12
Duration 1 day

Target audience
Maintenance people, mechanical engineers, project people, operators and controls engineers

Recommended number of participants 8 - 12
Duration 1 day
### Speedtronic Mark V ie

**Description** After this training, the participant will be able to troubleshoot in the system.

- System setup
- Reading rungs
- Understand the most important controls
- Logic forcing
- Changing constants
- Making trends

**Recommended number of participants** 8 - 12  
**Duration** 1 day

**Target audience**  
Maintenance people, mechanical engineers, project people, operators and controls engineers

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### Gas turbine - ALSTOM GT 26

**Description** At the end of the training the participant will have basic knowledge and understanding of the GT26

**Content:**  
The basic setup of a GT26 and all of its major components will be discussed, from Air Intake (Filter House) until the Exhaust Gas Diffuser, together with the (complicated) Cooling Air System. Also the required maintenance will briefly be discussed

**Recommended number of participants** 8 - 12  
**Duration** 1 day

**Target audience**  
Maintenance people, mechanical engineers, project people, operators and controls engineers
Gas turbine - SIEMENS V 94.2/94.3

**Description** After the course, the participants should understand the working principals and assemblies of the different gas turbine components. This will allow them to perform maintenance activities and to plan maintenance activities. But it will also help to perform failure analyses, evaluate upgrades and to follow and evaluate works performed by OEM.

This training consist of:
- General mechanical background.
- Working principal of gas turbine in general
- Assembly of gas turbine component
- Working and aim of IGV’s blow off’s
- Damage phenomena
- Combustion and tuning principals
- Gas turbine materials.

**Recommended number of participants** 8 - 12
**Duration** 2.5 days

**Target audience**
Maintenance people, mechanical engineers, project people, operators and controls engineers

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Gas turbine training – GE LM 6000 Dry Low Emissions (DLE)

**Description** After the course, the participant will be able to understand the operation of an LM6000 (regulation, staging, variable geometry, ABAL operation, acoustics and blowout, etc...), explain what mapping is as well as understand and correct any operational issue’s you might encounter during your operations.

The training consists of following modules:
- General principles of DLE combustion
- Construction of the DLE combustor and premixers
- Combustion acoustics
- Flame temperature control
- Fuel - airflow control
- Transient operability
- Control system
- Control operations
- DLE HMI screen
- OLE combustor mapping
- 11. Datalog
- 12. DLE problems

**Recommended number of participants** 6 - 8
**Duration** 3 days

**Target audience**
Production, maintenance and project people LM6000, specialist I&C
Graphical Application Programmer (GAP) on PC COG-N-LM622-B

Part 1 (2 days)
Objective Understanding controls and all the aspects of:

- The layout of the GAP’s
- The use of the software on the PC
- The reading of the logic of the GAP
- The exchange of Internal and external signals
- The way of working for searching for signals

Theoretical course on the use of the software version of the GAP with the following topics;

- The layout of the GAPs
- Practical use of the GAP
- The exchange of signals between the two GAP
- The retrieval of the origin of alarm message
- Data log
- Some practical applications by bet using of the GAP

Part 2 (1 day)
Objective Understanding and strengthen the knowledge of:

- Hardware structure and relevant alarms that can occur
- Use of GAP and GAP monitor on the HMI stations
- Understanding the structure of the core software

Hardware NetCon – Micronet - Micronet+
- CPU & redundantie
- Rack I/O
- Communication busses (LON, CAN bus,....)
- Remote IO Linknets RTC en HT
- FMV & drivers

Focus on de structure and relevant alarms /messages
- GAP 3 introduction(additional on existing GAP training)
- LM6000 Core software
- Sequence Software
- Troubleshooting Tools op HMI (Monitor GAP / Control Assistant)

The controls training is “customizable” for each specific installation on customer demand.

Recommended number of participants Max 10
Duration (Standard) 3 days (max)
Siemens SGT4000F - Custom made GT controls software & combustion system / monitoring

**Description** Custom made GT controls software & combustion system / monitoring

The controls training built on 5 bullets(hardware & software)

- Explain the controller functions in a training session to key O&M staff
- Provide instructions for C&I staff how to find all the specific control modules in the DCS system
- Provide with an explanation the risks of changing parameters, which parameters can be changed
- Presentation on experiences related to SGT4000 controls (eg. Humming experiences, Siemens outage experiences, provide with recommendations for best practices such as parameter download, basic check before, during after overhaul,...) for a bigger group of interested O&M staff
- Based on the current controller activated and implemented, provide advice on implementing Wobbe index controller

**Recommended number of participants** 8 - 12
**Duration** 2 days

Steam turbine construction, operation and maintenance

**Description** Reach especially O&M personnel an in dept understanding on all aspects related to ST maintenance and the link to operation

The training is composed out of different chapters:

- General principles of steamturbines
- Design and construction
- General assembly of turbines
- Shaftline and thermal dilatation
- Maintenance
  - Damage and degradation mechanisms
  - Inspection techniques
  - Maintenance in practice

After the training, the trainee will have gained good understanding of the general operating principles of steam turbines and advanced insights in all aspects of steam turbine maintenance

**Recommended number of participants** 8-12
**Duration** 3 days
Steam turbine hands-on training

**Description** The steam turbine hands on training is developed as on the job training for steam turbine maintenance activities.

This steam turbine training is developed as a hands-on, on the job training for steam turbine maintenance activities. It creates a training environment where all aspects of a real outage are covered by executing all activities on a small training turbine:
- build up general knowledge of the construction of an engine and its main components
- trainees execute all main tasks encountered during disassembly, cleaning and reassembly of a steam turbine.
- use of correct tooling: measuring instruments, specific tooling, hoisting equipment, ...
- insights in basic repair and control techniques (welds, blue prints, ..)
- use of a quality system and emphasizing the importance
  - protocols
  - work methods
  - quality plan
  - planning
- organizational aspects of an outage: planning, preparation, safety, FME principles, shift co-ordination (aspects explained and covered during the mechanical activities)
- the importance of teamwork and communication between all involved parties.

**Program**
- General introduction
- History of the steam turbine used
- Steam turbine basics
- In the field training

After the course, the trainees are able to manage maintenance activities in order to lead correctly major inspections.

**Recommended number of participants** 4-6  
**Duration** 5 days
Indoor lighting: requirements, conception, technologies and energy concerns

**Description** 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

**Target audience** Staff responsible for lighting installations (conception and maintenance).

**Recommended number of participants** 6-12
**Duration** 2 days
Electromagnetic compatibility (EMC)

**Description** EMC training course “EMC and Grounding Techniques in industrial installations” is a three-day course EMC and grounding techniques for electrical engineers and electrical systems designers (technicians and engineers) to avoid interference in sprawling modern electrical installations.

On the basis of basic concepts of electrical theory and recognizable examples, demos and simple explanations, the student gets an idea of the electrical failure mechanisms and how they can be prevented or remedied.

The third day of training is one day at a map based on the following topics that will be defined by the group with the trainer according to the specific needs and covers the following topics:

- Drive (2h)
- Drives and engines (1.5 hours)
- Lightning (45 min)
- Surge protectors (45 min)
- Filters (20 min)
- ESD (electrostatic discharge) (20 min)
- EMC testing for devices (testing laboratories) (0.45 pm)
- Wiring of data / non-industrial (30 min)
- High voltage cable shielding (20 min)
- TT-TN-IT systems (earthing system) (1.5h)
- Cabinets (45 min)
- Control-measurement (30 min)

**Target audience**
Electricity technicians and installation designers.

**Recommended number of participants** 6-10

**Duration** 3 days
Description 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

Recommended number of participants 8-10
Duration 2 days

Target audience
Maintenance and Operation technician and engineers

OHSAS 18001:2007
ISO 9001:2008
VCA++
ISO 17025:2005 (002-Test/002-Cal)
**Description** Participants will acquire a basic knowledge of paints, including relevant requirements and quality control. The course will enable participants to identify which paint works require more attention than others and to ensure best practices.

- 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

**Recommended number of participants** 6-12  
**Duration** 1 day

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

- VCA++
- ISO 18001:2007
- NACE – CIP Level 2
ATEX Level 0: fundamentals of ATEX rules and principles

Description
- 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.

Target audience
All workers in ATEX zones.

Recommended number of participants 6-12
Duration half day
ATEX level 1: mechanical and electrical course

Description

- 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

Target audience

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

Recommended number of participants 6-12
Duration 1-1,5 days

Level 1 training is formulated by Ineris and recognised by the EU.
**ATEX level 2: mechanical and electrical course**

**Description** The training covers similar content to level 1 but in more detail. Additional issues are covered, such as:
- How should I zone an installation?
- When is equipment certified by a notified body?
- What can I do with equipment dating from before 2003 to make it conform to the current ATEX directive?
- How can I calculate the acceptable cable length for intrinsic safe equipment?
- How should I measure the creep distance for increased safety equipment?
- How should earthing be done?
- Particular requirements for rotating equipment
- Specific maintenance in protection mode:
  - Practical case studies are discussed during training
  - 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.

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

**Recommended number of participants** 6-12
**Duration** 3 or 4 days
Introduction to process control for operations and maintenance personnel

**Description** The goal is to gain a better understanding of the control systems of a power plant.

**Practical introduction to automation:**
- What is a control loop? A controller? How do they work?
- How to understand process dynamics?
- What are the links between process and controller?
- PID controller: basic approach
- Control structure: feedback, feedforward, cascade, ratio
- A word about bumpless transfer and anti-windup
- Application to the main control loops in a power plant
- High level overview of temperature, flow, pressure and level measurements

**Target audience**
Operations and maintenance personnel.

**Recommended number of participants** 8-10
**Duration** 2 days
Controllers and control structures: Operational aspects

**Description** The goal of the training is to understand how to set up control systems, and to gain knowledge and competencies in operational aspects of developing and modifying control structures.

- Bumpless parameter changes
- Anti-windup strategies
- “MIMO process” control with a unique controller
- Non linearity risk and handling
- Logic handling
- Measurement failure diagnostic and handling

**Recommended number of participants** 8-10  
**Duration** 2 days

**Target audience** I&C engineers and technicians.

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Process control: PID tuning

**Description** The goal of the training is to understand how to tune control systems. Participants will gain knowledge and competencies in tuning robust controllers in the context of process dynamics:

- What kind of processes?
- Process identification (1st to 4th order, dead time, integrator, etc.)
- Roles and dangers of the 3 control actions (P,I,D)
- How is it implemented in DCS?
- Process linearisation
- Tuning rules depending on process type (mainly “rules of thumb”)
- Cascade control: structure and tuning
- Practical session - identification - parameter calculation - trial and error improvement

**Recommended number of participants** 8-10  
**Duration** 3 days

**Target audience** I&C engineers and technicians

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OHSAS 18001:2007
ISO 9001:2008
VCA++
Analysis of main loops

**Description** Participants will gain a deeper understanding of the installed process: control structure, logic, and the link with operator screens (HMI).

- Process oriented description and analysis of the selected installed control loops
- Exploring the link between screens (HMI) and control structure to enhance the added-value for the operator

**Recommended number of participants** 8-10
**Duration** 4 days

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Advanced nuclear I&C and principal regulation systems

**Description** After completion of the course, the participant will have a good understanding of the nuclear process and how it is controlled, as well as the interactions of different systems and the evolution of physical parameters. The participant will understand the principal control circuits of the primary and secondary loop, its normal operation, controlled and commanded values, and degraded modes. The interactions between the different systems are explained and the importance of the balance between all components will be emphasised.

The training consists of 5 modules:

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<thead>
<tr>
<th>Module</th>
<th>Duration</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 1</td>
<td>1 day</td>
<td>Nuclear processes and the primary loop</td>
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<tr>
<td>Module 2</td>
<td>1 day</td>
<td>Steam turbine control and network</td>
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<td>Module 3</td>
<td>1 day</td>
<td>SG level regulation and ΔP regulation</td>
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<td>Module 4</td>
<td>1 day</td>
<td>Summary and big transients</td>
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<td>Module 5</td>
<td>1 day</td>
<td>Cyber-security (short module)</td>
</tr>
</tbody>
</table>

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

**Recommended number of participants** 6-12
**Duration** 5 days
Introduction to solid fuels, gaseous fuels and liquid fuels combustion

Description The course objective is to cover the basics of solid fuels, gaseous fuels and liquid fuels combustion (tailored to the needs of participants), and to further study the impact of the combustion process on boiler and burner technologies. The specific pollutant emissions to be expected and their methods of mitigation are also covered.

- Combustion and its parameters, heating value
- Solid fuels, gaseous fuels, liquid fuels, pre-treatment of fuels, fuels for start-up
- Types of coal (sub-bituminous, bituminous, lignite, etc.)
- Milling behaviour
- Combustion process: air requirements, incomplete combustion, combustion controls
- Influence of the minerals on combustion (ash analysis)
- Influence of moisture content
- Erosion and corrosion, corrosion mechanisms, chlorine corrosion, molten sulphate corrosion, dew point corrosion, CO corrosion, etc.
- Influence of heavy metals and trace elements
- Types of burners, slagging and fouling risk, air staging
- Boiler and boiler cleaning
- Impact of furnace size
- Impact of the coal on emissions
- Safety issues
- Trouble shooting examples and case studies are used throughout the course

Target audience Operators and engineers

Recommended number of participants 6-12
Duration 2 days
CFBC – Circulation fluidised bed combustion

Description Participants will gain a general understanding of CFBC, including:

- Brief description of the CFBC
- Solid fuels, fuels pre-treatment, fuels for start-up
- Combustion
- CFBC modelling
- CFBC and suppliers
- Controls
- The boiler, boiler cleaning
- Fuel efficiency and net electrical efficiency
- Trouble shooting
- Safety issues
- Erosion prevention
- Corrosion prevention
- Refractories, other materials
- Chemistry
- Bottom ash separation, bottom ash cooling, ash recycling, bed material and recycling, bottoms
- In-bed mixing
- Dosing of fuels and additives
- Prevention of sintering of the bed
- Emissions into the air, in-situ FGD, dedicated FGD, N₂O and NOₓ, CO, UBC, fly dust, fly ash, trace elements
- Cyclones and separation of solids
- Lessons learned
- Improving CFBC
- Particles (according to Geldart)
- Operations, starts, stops, low loads
- Special fuels, special materials and adaptations
- Fuel drying
- Risk management
- Literature
- EU policies: fly ash, bottom ash, gypsum, in-bed FGD, CCS, sustainable energy.

Recommended number of participants 6-12
Duration 3 days

Target audience
Engineers, managers with a technical background, project developers, operators, suppliers.
Introduction to flue gas treatment

Description
The following subjects are highlighted:

• Wet limestone-gypsum flue gas desulphurisation, production of gypsum and treatment of FGD effluent. Alternative flue gas desulphurisation technologies may also be covered.
• Dust removal, using an electrostatic precipitator (ESP) or a fabric filter (FF)
• Secondary reduction of NOx, either by selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR)

On request, the content of the course can be expanded to cover subjects such as mercury, trace elements, advanced FGD treatment, alternative flue gas desulphurisation, SO3 and the air preheater.

1-day course on theory, state-of-the-art technology and operational and maintenance aspects of:

• FGD and FGD WWTP
• SCR / SNCR
• ESP / FF
• Air preheater – brief

The course includes an open technical exchange with participants on:

• the main parameters to be followed during operation
• their interactions
• the possible actions of the operators

Recommended number of participants 8-12
Duration 1 day

Target audience
Operation and maintenance staff.

ISO 17025:2005 (002-Test/002-Cal)
OHSAS 18001:2007
ISO 9001:2008
VCA++
Introduction to water chemistry

Description A general introduction to water chemistry and its 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

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

Recommended number of participants 8-12
Duration 2 days
Chemistry of the water-steam cycle

Description
- Detailed aspects of chemistry in a water steam cycle (types of chemicals used in the boiler depending on the treatment and type of boiler, etc.)
- 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 – preservation
- Actions in the event of an alarm
- Example of incidents (deviation compared to normal chemistry)
- Exercises and quiz

Recommended number of participants 8-12
Duration 1 day

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

Cooling water treatment

Description
The training course includes the following topics:
- Design of the circuit including condenser (material, cleaning technologies, etc.) and cooling tower if present on-site
- Importance of site specific discharge limits (temperatures, chemical product, etc.)
- Scaling
  - How to avoid scaling in the cooling circuit (including using scale inhibitors)
  - Description of the main parameters to monitor the risk of scaling
- Biofouling and pathogens
  - How to avoid biofouling in the cooling circuit (coating, biocide, etc.)
  - Description of the main parameters to be followed for a good disinfection (ORP, chemical concentration, biology, etc.)
- Corrosion
  - Introduction to potential corrosion issues in cooling circuits
  - How to avoid corrosion in cooling circuit (corrosion inhibitor, corrosion probes, etc.)
- Conservation
  - How to preserve the cooling circuit during shutdown (cooling tower, condenser, intake, etc.)
- Exercises and quiz

Recommended number of participants 6-12
Duration 1 day

Target audience
Operation and maintenance personnel involved in chemistry. If chemistry experts participate, the trainer will go deeper into specific cases.
Description

The training course on demineralised water includes the following topics:

- Characteristics of raw water
- Raw water pre-treatment plant (overview of the technologies used on-site, characteristics, attention point, follow up, monitoring, etc.)
- Review of the water treatment plant. The training is adapted depending on the technologies used on-site (resins or membranes):
- Demineralisation by ion exchange (resins)
  - Design
  - Structure of the resin and the characteristics of different type of resins (stability, capacity, etc.)
  - Functioning of the ion exchange
  - Processes of demineralisation and regeneration
  - Monitoring
  - Effluent (characteristics, quantities, permissions, attention points)
- Demineralisation with membrane technologies
  - Design
  - Calculation of scaling potential
  - Optimisation of chemicals injection
  - Monitoring
  - Biocide control
  - Chemical cleaning procedure
  - Start up and shut down procedure
  - Preservation of membrane installation
- Exercises and quiz

Recommended number of participants 6-12
Duration 1 day

Target audience
Chemists and laboratory managers

OHSAS 18001:2007
ISO 9001:2008
VCA++
Water cycle chemistry of the primary circuit

**Description** After completion of the course the participant will be able to:
- Determine the chemical products to be injected into the primary water loop and why they are used
- Understand why certain chemical products are injected during transients
- Determine monitoring and evaluation parameters during operation and in the event of chemical-related problems

**Target audience**
Chemists and laboratory managers.

**Recommended number of participants** 6-12

**Duration** 1 day

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Water cycle chemistry of the secondary circuit

**Description** 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

**Target audience**
Chemists and laboratory managers.

**Recommended number of participants** 6-12

**Duration** 1 day
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.

2-day training:
- Basic materials knowledge and behaviour 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

3-day training:
- Similar to the 2-day programme but with in-depth focus on:
  - Weld metallography
  - More detailed review of the norms and standard used for welds
  - Quality assurance and non-destructive testing of welds
- Case studies, mostly from the power generation sector

Target audience
Maintenance and quality personnel in the power generation sector.

Recommended number of participants 6-12
Duration 2 or 3 days
Description Participants will gain a basic knowledge of non-destructive testing, including what tests are available and for what purposes they can be used. The focus is on applicability in the power generation field with a large number of case studies and a practical laboratory demonstration. The course includes an introduction and overview of non-destructive techniques, followed by modules with more detailed explanations and a demonstration of a specific technique:

- Penetrant testing
- Magnetic particle testing
- Ultrasonic testing
- Eddy current testing
- Radiographic testing

For a 1-day course, the participant can choose 2 modules.

Recommended number of participants 8-10

Duration 1.5 days
Introduction to root cause analysis

**Description** The training is divided into 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.

**Recommended number of participants** 8-12

**Duration** 1 day

**Target audience**
Asset managers, quality assurance managers, plant operation engineers, maintenance engineers

- OHSAS 18001:2007
- ISO 9001:2008
- VCA++
Materials technology

Materials technology for boilers, steam turbines and gas turbines

Description

• Introduction and theory
• Introduction to typical damage mechanisms in boilers
  (hydrogen embrittlement, stress corrosion cracking and creep)
• Welding defects
• Failure analyses and remaining lifetime determination
• Interactive resolution of real cases
• Exercises and quiz

Gas turbine materials

• Superalloys: composition and microstructure, properties, latest developments
• Coatings: different types, application techniques, properties
• Failure and degradation phenomena
• Reconditioning of used blades
• Methodology for remaining lifetime assessment
• Interactive resolution of real cases
• Exercises and quiz

Recommended number of participants 8-10
Duration 2 days

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

Recommended number of participants 8-10
Duration 2 days
Materials technology for gas turbine applications

Description

- Superalloys: composition and microstructure, properties, latest developments
- Coatings: different types, application techniques, properties
- Failure and degradation phenomena
- Reconditioning of used blades
- Methodology of remaining life assessment
- Practical examples
- A visit to the metallographic laboratory is included.

Recommended number of participants 8 - 10
Duration 2 days

Target audience
Engineers and mechanical maintenance and operation technicians.

OHSAS 18001:2007
ISO 9001:2008
VCA++

Materials technology in boilers and steam turbines: integrity assessment and failure analysis

Description

- Introduction
- Integrity assessment and failure analysis: brief explanation of damage mechanisms and case studies: short term overheating - long term overheating (creep) - thermal fatigue - thermal shock - welding defects - hydrogen embrittlement - fretting corrosion - high temperature corrosion - fatigue corrosion - stress corrosion cracking - cavitation - erosion - erosion-corrosion
- Remaining life determination: application of boiler life management
- Overview of available non-destructive and destructive testing

Recommended number of participants 8 - 10
Duration 1 day

Target audience
Anyone who comes into contact with boilers and steam turbines and wants to have a background in common material problems for these components.

OHSAS 18001:2007
ISO 9001:2008
VCA++
Spectral Interpretation

Description

- Introduction to interactions between irradiation and materials
- Characteristics of a spectrum (P.E. peaks, exhaust peaks, decay, foreground and background Compton effect)
- Energy calibration
- Effective calibration
- Acquisition of spectra
- Quality Control
- Examining a primary spectrum (Which isotopes are expected?)
- Examining a primary spectrum (oxygenation monitoring)
- K-40
- Origin of isotopes in a primary spectrum and possible interference (counting and recounting, oxygenation, downstream CPU, pairs “father / son”)
- Libraries used at Tihange
- Reading analysis protocols (importance of full analysis, identified peaks, unidentified peaks, MDA analysis, interference)

Recommended number of participants 6-12
Duration 2 days

Target audience
Engineers, managers with a technical background and chemists

Materials technology in nuclear power plants

Description

- Introduction to the metallurgy
- Theoretical explanation of the different failure phenomena illustrated with specific practical examples of failures
- Corrosion types for different materials (steel, stainless steel, nickel based alloys) and environment:
  - General corrosion
  - Galvanic corrosion
  - Local corrosion (pitting, crevice corrosion, etc.)
  - Fretting-corrosion
  - Intergranular corrosion or attack (IGA)
  - Stress corrosion cracking (SCC)
  - Corrosion fatigue
  - Flow accelerated corrosion (FAC)

Recommended number of participants 8-10
Duration 1 day

Target audience
Engineers and mechanical maintenance and operation technicians.
Description: This training course provides an introduction to the use and interpretation of measurements made with the Laborelec Vibration Monitoring System (LVMS). It includes an 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.

For operators:
There are two possibilities for this training course:

- **Half day**: introduction to the interpretation of vibrations and visualisation of the vibration behaviour of large rotating machines using the LVMS, including initial execution with the support of ENGIE Lab Laborelec’s vibration experts. Important concepts covered are:
  - What is a vibration?
  - Which vibration sensors are used? 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.

- **2 days**: This more advanced version allows operators to more independently interpret the LVMS data and to take relevant corrective actions or operating decisions autonomously. This module includes a full day of practice on computers in order to become fully comfortable with the LVMS behaviour, as well as practical interpretation, giving participants a more in-depth knowledge and experience with LVMS.

Target 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 turbo machines.

Recommended number of participants: 5-12

Duration:
- Operator - introduction: half day
- Operator - advanced: 2 days
**Description** This course provides an introduction to the theory and practice of lateral vibration analysis of large rotating machinery. All theoretical aspects can be demonstrated and explained through case studies based on our extensive experience of vibration monitoring with Laborelec’s Vibration Monitoring System (LVMS), as used on more than 100 shaft lines around the world:

- Basic elements of vibration analysis theory (harmonic vibrations, spectral analysis, resonance, stiffness, damping)
- Introduction to the major rotor elements, and the dynamic behaviour of a shaft line (rotor, fluid film bearings, foundation, etc.)
- Typical measurement techniques for vibration monitoring
- Relevant standards for the evaluation of vibration amplitudes (ISO 7919 and ISO 10816)
- Basics of rotor balancing
- Typical signature of vibration problems associated with turbo machines (mechanical and thermal unbalance, blade loss, rub, (mis)alignment, fluid instabilities, etc.)
- Case studies, including the use of a rotor model, will be used to illustrate important signatures:
  - Rub (Newkirk, Intermittent rub, etc.)
  - Thermal unbalance of the shaft
  - Blade loss
  - Asynchronous vibration due to instabilities in the oil film
  - Steam whirl
  - Effect of alignment on vibrations

**Target 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 of large turbo machines.

**Recommended number of participants** 8-16
**Duration** 2 days
Predictive maintenance: monitoring techniques

**Description** The role of monitoring techniques in predictive maintenance:

- Corrective and preventive maintenance
- Importance of P-F (potential-to-functional failure) interval
- An overview of the different types of techniques that may be used.
- Vibration analysis
- Oil analysis
- Thermography
- Electrical measurements

**Target audience**
Operators & technicians in the field of predictive maintenance.

**Recommended number of participants** 8-16
**Duration** 1 day
Description
Achieving improved equipment performance monitoring in order to reduce daily losses. With this performance workshop ENGIE Lab Laborelec aims to instil a perspective of continuous improvement through better understanding of equipment behaviour.

Day 1
- Introduction, expectations and scope of the training course
- Setting up the energy balance, the importance of the energy balance in determining unmeasured parameters and to reflect on equipment performance
- Steam calculations, the differences between sensible and latent heat, the use of enthalpy and steam tables to make calculations
- Performance of the boiler, thermodynamics of heat exchangers, calculation of heat transfer and the resulting important influencing factors on performance
- Workshop on unit and boiler efficiencies in different operational conditions, the impact of different coal qualities, the impact of changing ambient conditions

Day 2
- Performance of the water/steam cycle, the Carnot cycle efficiency, steam turbine efficiencies, typical losses on preheaters and bypasses
- Performance of the condenser, impact of the condenser backpressure on cycle performance, frequently encountered operational issues which impact backpressure increase
- Workshop on cycle efficiency with operational data analysis, impact of steam extraction, attemperation spray flows, increasing condenser backpressures
- Measurement errors, data compression and the impact of the data historian
- Overall power plant performance management, a pragmatic approach and tools to be used
- Typical controllable losses for operational monitoring
- Discussion on important KPIs for the power plant

Recommended number of participants 8-12
Duration 2 days
Description
This introduction course covers main aspects of cybersecurity in industrial control systems. Students will be introduced into the basics of industrial control systems cybersecurity and learn the threat landscape. Students will understand the importance of addressing cybersecurity in a technical environment, including the possible impact for business continuity.

The goal of the training is to raise the awareness of the importance of ICS cybersecurity.

This 2 hours training contents:

- A guidance on how to protect installations against Cyber Security Threats
- A strategy to mitigate technical and organizational security risks
- A correct understanding and application of security policies
- Insights into strategies and protocols to secure and monitor computer networks

Target audience
Process engineers, IT personnel, operation staff and other plant personnel responsible for developing and maintaining cyber security.

Recommended number of participants
Maximum 12

Duration
2 hours
The main goal of the training is to gain a critical understanding of the human/technological needs, threats and weaknesses regarding ICS cybersecurity.

This training will be a guide for process engineers, information technology personnel, operations staff and other plant personnel with any responsibility in developing and maintaining cybersecurity for automation systems.

The training will cover following subjects:

- The training will start by discussing the cybersecurity threats that ICS systems are facing today. This will and give an understanding of the problem and highlight the need for securing the system.

- Second, the training will focus on policies, international standards & regulations that are addressing ICS cybersecurity. Requirements coming from the internal ENGIE ICS cyber security framework will be discussed as well.

- The training will then discuss how to practically implement technical and organizational measures to mitigate ICS cyber security risks. Best Practices will be used to demonstrate how to address some vulnerabilities an efficient way. The training will also be the opportunity to show how procedures, methodologies & tools must be used together when implementing an ICS cyber security program.

A specific highlight will be put on risk assessment and vendor policies. Also, if site-specific procedures are available, those procedures will be used as starting point for practical discussion.

Recommended number of participants Maximum 10
Duration 1 day

Target audience I&C engineers, operation and maintenance managers, corporate IT team.
Description The goal of the 2-days workshop is to go from a theoretical understanding of what ICS cyber security means to a practical understanding on how to implement and enforce it.

First, participants get a full picture of the threat landscape. This includes a comparative analysis of IT and control system architecture, vulnerabilities and mitigation strategies unique to the control system domain illustrated. Then, the training explores how policies and mitigation strategies can be put in place to reduce the ICS cyber security risk. This part also highlights the importance and role of each of the people interacting with the ICS in securing the ICS. Finally, the training will explain how some of those mitigation strategies are practically put in place by exploring some of the following points (items to be selected during the intake meeting):

- General ICS cyber security policy
- ICS users management policy and best practices in the field
- ICS components management & inventory
- Password policy
- Network segmentation & network components configuration
- Patching policy
- Backup & restore policy
- Incident response plan
- Hardening your system
- Technical laptops/workstation management
- Removable devices management
- Documentation management

The intake meeting is organized in conference call at least 2 weeks before the training. A feedback meeting is organized in conference call maximum 2 weeks after the training.

Target audience
The training is developed for I&C engineers

Recommended number of participants Maximum 10
Duration 2 days
**Description** This course begins with an introduction to industrial cooling systems. Participants learn how to identify possible improvements to an existing installation and how to quantify the energy savings opportunities.

Content of the training course:

- Priorities and methodology for energy efficiency improvement: optimisation of cooling needs and cooling equipment, opportunities for heat recovery
- Types of cooling: dry cooling, evaporative cooling and compression cooling
- Description of equipment and typical energy savings measures: optimisation of cooling parameters, floating condensing pressure, intelligent defrosting systems, speed controls on cooling tower fans, etc.
- Practical examples: various case studies based on experience with energy audits
- Exercises on practical calculations concerning energy saving measures

**Recommended number of participants** 5-10

**Duration** half day

**Target audience** Technical and energy managers, process engineers.

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Energy efficiency in industrial cooling systems
Description In addition to its practical application, good lighting contributes to the wellbeing of the occupants of a building. Beginning with the basic concepts of lighting, the course presents methods for pre-dimensioning and assessing efficient lighting installations, and how to quantify possible energy savings in existing installations.

Content of the training:

- Basic introduction to lighting, photometry and colorimetry
- Sources and auxiliaries
- Light fittings: photometric distribution and electrical safety
- Criteria for equipment choice
- Standardisation, management and maintenance systems
- Relighting: what, why, how?
- Method for pre-dimensioning an installation

Recommended number of participants 5-10
Duration 1 day for the basic module + an optional half-day for the “dimensioning” module.
Energy efficiency in compressed air systems

**Description** This course begins with a basic introduction to compressed air systems. Participants learn how to identify possible improvements to an existing installation and how to quantify the energy savings opportunities.

Content of the training:

- Technical description of compressed air installations:
  - The most commonly used compressors (screw, piston, centrifugal, etc.)
  - The need for compressed air dryers and the different types
  - Individual control (load/unload, VFD) and group control (mechanical cascade control, electronic control)
  - Auxiliary equipment (air receiver, oil/water separation, distribution, filters)

- Potential energy savings in the production, distribution and consumption of compressed air:
  - Rational use of compressed air
  - Alternatives to compressed air applications
  - Reducing leakage
  - Limiting head losses
  - Reducing working pressure
  - Using a VFD compressor
  - Central control
  - Air receivers
  - Lowering the temperature of incoming air
  - Replacing filters
  - Heat recuperation

- Practical examples: various case studies are presented based on experience with energy audits

**Recommended number of participants** 5-10

**Duration** Half day

**Target audience**
Technical and energy managers, process engineers.
**Description** This training course begins with a basic introduction to energy consumption in buildings. Participants learn how to identify possible improvements to an existing building and how to quantify the energy savings opportunities.

Course content:

- Explanation of the Energy Performance of Buildings (EPB) Directive and derived local regulations
- Definition of thermal comfort and comfort parameters: PMV, PPD;
- Thermal losses and energy consumption: principles of heat loss calculation and calculation of annual consumption on the basis of the degree-days method
- Heating installations: centralised and decentralised heating systems (boilers, heat pumps, etc.)
- Ventilation and air conditioning: assessment of needs, current technologies and improvement opportunities
- Sanitary hot water: calculation of needs and energy consumption, possible improvements, including solar power
- Energy consumers in offices (vending machines, IT equipment, etc.): assessment of consumption and best practices for their efficient use
- Practical examples illustrate all aspects of the course

**Recommended number of participants** 5-10  
**Duration** 1 day

**Target audience**  
Technical and energy managers, process engineers.

- **OHSAS 18001:2007**
- **ISO 9001:2008**  
- **VCA++**
Energy efficiency in industry

Description
The course presents a methodology for the continuous improvement of energy efficiency in industry, based on practical experience gained through extensive experience of energy audits.

Course content:

- Climate policy and energy efficiency: European directives, and derived local regulations
- Methodology for continuous energy efficiency improvement in the enterprise: gathering and analysis of data, detection and quantification of improvement opportunities, performance monitoring
- HVAC in tertiary buildings: thermal comfort, thermal losses and consumption, centralised and decentralised heating, ventilation and air conditioning systems, needs, equipment and possible improvements to sanitary hot water, etc.
- Electric motors and variable speed drives: current technologies with focus on energy efficiency of motors, and on variable frequency drives and applications in flow rate adjustments, with practical examples of calculations
- Compressed air: description of current equipment with a focus on assessing energy consumption and on energy savings opportunities in production, distribution and consumption of compressed air
- Industrial cooling: description of the main cooling systems (dry, evaporative, compression) with the focus on energy efficiency by optimisation of parameters, equipment improvements and heat recovery
- Industrial heating: description of the main heating systems (hot water, steam, thermal oil) with the focus on energy efficiency by optimisation of parameters, equipment improvements and heat recovery
- Indoor lighting: basic principles, sources of light and auxiliary appliances, management systems
- Practical examples and exercises: various case studies presented based on experience with energy audits (3-day course)

Recommended number of participants 5-10
Duration 2 days or 3 days (with exercises and practical examples)

Target audience
Technical and energy managers, process engineers.

ISO

OHSAS 18001:2007

VCA++
**Description** The course begins with a basic introduction to heating systems and steam. Participants learn how to identify possible improvements to an existing installation and how to quantify the energy savings opportunities.

Course content:
- Description of the main heating systems (hot water, steam, thermal oil) with a focus on energy efficiency by optimisation of parameters, equipment improvements and heat recovery opportunities
- CHP systems with steam recovery

**Recommended number of participants** 5-10

**Duration** 1 day

**Target audience**
Technical and energy managers, process engineers.

Energy efficiency in industrial heating systems

OHSAS 18001:2007
ISO 9001:2008
VCA++
Project management

Description
The training improves your project management skills and is a process-based method for effective project management.

De training consists of following
- PMG essentials
- How to manage a Project by Project Manager and Steering Comity

After the course, Trainee is able to:
- Apply the knowledge
- To improve the controls of the projects
- Increase the project success

Recommended number of participants 8-12
Duration 3 days

Target audience
Production, Maintenance personnel and staffing

Maintenance projects (Prince 2)
Five reasons for you to choose Engie Lab

> Wide range of technical competencies in Electricity Generation, Grids, and End-Use
> Increased profitability and sustainability of your energy processes and assets
> Unique combination of contract research and operational assistance
> Independent advice based on certified laboratory and field analyses all over the world
> More than 50 years of experience
# Training Calendar @Laborelec Belgium 2017

## Upgrade yourself with skills for the future

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# Contact

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