

2025 TRAINING CATALOG

This document contains all ENORISE training offers at client's site, on ENORISE premises or virtually. Some trainings are available as E-learning content on our ENORISE Learning skill up platform.

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2024 key figures:

128 participants took part in the 30 training sessions we have organized through 2024 with overall satisfaction at 85%

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MORPHEE®

Test system Automation, simulation & calibration

Based on an “all-in-one” system, numerous configurations are possible depending on the customer’s individual testing environment. As a result, it is possible to combine these three functionalities on a single platform which is installed for an engine test bench — or the three can be operated separately, using third-party tools.

For example, in a calibration configuration, the MORPHEE calibration platform usually operates with third-party automation tools.

The new 64-bit version (second part of 2016) is in line with all new operating systems and boasts outstanding performance with 5 mega samples/sec, e.g. 2500 channels at 2 kHz.

It offers the opportunity to develop new automation concepts for future test beds while taking current and upcoming emission and testing standards such as Euro 7, RDE, etc. into consideration. Furthermore, it is a powerful tool for new powertrain calibration methodologies, such as Road to Rig. Relying on its established qualities of openness and performance, MORPHEE extends its functionalities to allow the use of the same interfaces, the same models and the same tools throughout the entire development process. As a result, the new MORPHEE generation will become a unique platform for validation, combining the three functionalities of test automation, on-line calibration operations at the test bed and real-time simulation.

MORPHEE – User Training – 3 days



By focusing on practical knowledge and hands on experience, the MORPHEE User Training empowers MORPHEE bench users allowing them to be more productive. The user interfaces of MORPHEE run-time and MORPHEE Editor are explained. The training showcases typical usage scenarios like defining new measured and calculated channels, screen and method editing. Delivered in a simulated MORPHEE application environment it enables users to define new automatic test runs with automatic results storage.

Operational goals

- Know how to use the generic user interface of MORPHEE run-time (modes, monitors, components, menus)
- Understand the architecture of a MORPHEE test cell (PC, components, drivers, physical channels)
- Understand the use of measured channels, calculated channels, constants, LUTs, tables, text channels, reference channels)
- Know how to use standard instructions of MORPHEE in an automatic test run
- Know how to set up basic alarm thresholds
- Know how to use a measurement plan for results storage

MORPHEE Application

Our practical training makes use of the simulation capabilities on standard SCALE applications. The customer can choose one of the standard SCALE application environments (engine, e-motor, battery.)

Target audience

Test cell operators who are authorized to modify screens, channels, security thresholds and/or test runs. All test engineers or test facility support staff on MORPHEE 64 bits test cells.

Prerequisites

- Experience with operating test cells or test cell automation
- Being familiar with a windows PC environment

Training program

1. **Structure of MORPHEE software and hardware on a test cell**
 - MORPHEE architecture: PC, acquisition/communication cards, drivers, components, tests
 - The three modes BENCH, CAMPAIGN, TEST and the transitions between them
 - Separation between test cell specific settings and shared settings like test procedures
2. **MORPHEE standard run-time interface**
 - How to launch MORPHEE multi-modes
 - Control of standard test cell equipment from this GUI (media conditioning, engine and dyno control, I/O modules, special measurement equipment)
 - Standard MORPHEE menus and monitor windows (channels, set values, alarms ...)
 - Result data storage: instantaneous values, recorder or stabilized measurements via ALGORITHM
3. **MORPHEE Editor**
 - How to browse between the tabs: Bench Config, Campaign, Test, Components
 - Setting up the three modes in the Editor
 - How to edit standard MORPHEE channels with/without physical / internal channel / [AUTO] link
 - MORPHEE calculated channels, constants, text channels
 - MORPHEE look-up tables (LUT), tables, reference channels
 - How to edit a screen interface (graph, mono/bistable button, gauge, potentiometer, include...)
4. **General functioning of SCALE components**
 - Tree of standard SCALE components for media control, I/O, measurement devices, dyno, engine ...
 - Inheritance between father and son components
 - How to overload an inherited channel, screen or method in a son component
5. **Programming an automatic test run, e.g. a full load test**
 - Programming of test runs in cycle, CCE diagram and AMAP format
 - How to program a user dialog (yes/no question, drop down list, free input text or numbers...)
 - How to program a procedure with conditions (IF, ELSE, GOTO, ...)
 - Call of other methods
 - How to use counters and timers
 - Instructions related to the user interface (show/hide elements, messages to operator)
 - How to modify the alarm handling within the test run (activate, deactivate, modify thresholds ...)
 - How to use measurement plans for storage
 - How to store a single point or multi-point measurement, instantaneously or stabilized
 - Refuge, restart and alarm cycles, context storage management
6. **How to use the MORPHEE online help**

MORPHEE – Advanced Training – 3 days



Advanced training for Administrators about the management of a MORPHEE test cell: the participants learn how to set up the Bench Configuration page with the 3 modes as well as the various INI files. They learn to set up advanced securities and how to customize the result storage. They get deeper knowledge about MORPHEE components and about advanced capabilities of MORPHEE software.

Operational goals

- Know how to install or update MORPHEE software
- Know how to set up the functioning of the 3 modes BENCH, CAMPAIGN, TEST
- Understand the functioning of internal and physical channels in detail
- Know how to set up advanced alarm thresholds, reactions and conditions
- Know how to set up the MORPHEE.INI file and other configuration files (CFP, UEditor.config)
- Know how to take advantage of the generic functions of FEV components
- Know how to set up customized results storage (channel groups, file groups, custom storage directories)
- Know how to manage the acquisition frequencies and how to check real-time performance

MORPHEE Application

Our practical training makes use of the simulation capabilities on standard SCALE applications. The customer can choose one of the standard SCALE application environments (engine, e-motor, battery.)

Target audience

All staff in charge of the installation or administration of a test cell, or who develop MORPHEE components.

Example: test cell / test field managers, MORPHEE support team at customer site.

Prerequisites

- MORPHEE 64-bit User Training plus several months of practical experience on a MORPHEE test cell.

Training program

1. Installation or update of MORPHEE software

- Guided installation step by step: Windows components, license manager, RTX, MORPHEE...
- Architecture of a MORPHEE PC: acquisition/communication cards, drivers for field busses
- How to activate an additional driver in the INI file

2. Setting up the 3 modes BENCH, CAMPAIGN and TEST

- Which component is to be loaded in which mode, in which order?
- Discussion about advantages and drawbacks of the different solutions

3. Physical channels, MORPHEE channels, MORPHEE alarm monitoring

- Difference between physical channels and MORPHEE channels
- Automatic import of ESERIES channels into IOEDIT (physical channels)
- [AUTO] link or fixed link between MORPHEE channels and physical channels
- Detailed setup of alarm monitoring (conditional reaction, delays, hysteresis ...)

4. MORPHEE configuration files

- Customization of directories and back-up of your environment with MENV
- MORPHEE.INI file, UEditor.config file, MORPHEE.cfp file

5. Detailed functioning of SCALE components

- Screens and screen elements which are common to all SCALE components
- Management channels common to all SCALE components
- Methods for initialization, stop, alarm handling etc. which are common to all SCALE components
- Setting up the way the transitions between the 3 modes, for each component

6. How to customize results storage

- Storage frequencies and multi-frequency acquisition
- Review of how to use measurement plans for storage
- Customization of channel groups and file groups for storage
- Customization of storage directories

7. Setting up the acquisition frequencies and the real-time functioning

- Setting up the acquisition frequencies (slow, normal, fast) for each project or test
- How to check real-time performance
- How to optimize the modes initialization (RTX load)

MORPHEE – Maintenance Training – 2 days



Attendees learn how to set up all elements of a measurement chain, link them together and to a MORPHEE channel, calibrate channels and use troubleshooting tools.

Operational goals

- Understand the structure of MORPHEE hard- and software (MORPHEE PC, components, drivers, physical channels and native channels).
- Know how to link physical channels to MORPHEE channels.
- Prepare templates for units, sensors, actuators, conditioning modules and calibration steps in the database
- Create a whole measurement chain: MORPHEE channel-physical channel-conditioning module-sensor/actuator.
- Know how to perform a linear or multi-segment calibration of a channel.
- Know how to use existing troubleshooting tools for drivers or cards.

Target audience

Any staff in charge of maintaining a test cell with MORPHEE

Prerequisite

- MORPHEE Standard training or equivalent practical experience on a MORPHEE test cell.
- Practical experience of measurement chain calibration and field buses used in testbeds.

Training program

1. Structure of MORPHEE software and hardware on a testbed

- MORPHEE PC, acquisition/communication cards, drivers for field busses
- Overview of standard components for measurement devices
- Difference between physical and MORPHEE channels, link between them.

1. Create templates for units, channels, sensors in the database

- Templates for units, sensors, actuators, conditioning modules and channels
- Quantity groups and their use for calibration

2. Create a new project with Ethercat hardware and KPA studio software

- Connect some MIO modules to a PC and create a new project according to the detected modules
- Define the type of measurement (TC, voltage, current...) for each channel and save the ECAT file
- Create a complete measurement chain

3. Adding a new driver and create a link to an equipment

- Create the measurement chain from the sensor to the new physical channel
- Link the new physical channels to MORPHEE channels
- Add other physical channels from a generic driver via CFP file
- Introduction to SCALE components

4. Structure of the SCALE component tree

- Use of a maintenance screens to configure equipment
- Calibration of physical channels in MEDITOR

5. Create templates for calibration curves of measurement chain in the database

- Create a calibration session, either linear or multi-segments
- Run a calibration session or a calibration check with/without storage
- Setup of automatic calibration sessions

6. Bench backup and maintenance

- How to backup and restore a bench
- Logs and temporary files maintenance

7. Troubleshooting

- Information about software versions
- Troubleshooting of Kernel charge with DiagKernel
- Troubleshooting based on the MORPHEE logbook and post-mortem files
- Troubleshooting of drivers / acquisition boards
- Troubleshooting of Ethercat channels with KPA Studio software
- Check of the MORPHEE dongle

MORPHEE – Basic Training – E-Learning (2 Hours)



By focusing on practical knowledge and hands on experience, the MORPHEE E-learning courses empower MORPHEE bench users allowing them to be more productive. The user interfaces of MORPHEE run-time and MORPHEE Editor are explained. The training showcases typical usage scenarios like defining new measured and calculated channels, screen and method editing. Delivered in a simulated MORPHEE application environment it enables users to define new automatic test runs with automatic results storage.

Operational goals

- Know how to use the generic user interface of MORPHEE run-time (modes, monitors, components, menus)
- Understand the basic architecture of a MORPHEE test cell
- Understand the use of measured channels and calculated channels
- Know how to create a simple user interface
- Know how to right an automatic test using different available methods
- Know how to use standard instructions of MORPHEE in an automatic test run

MORPHEE Application

Our practical training makes use of the simulation capabilities on standard SCALE applications. The customer can choose one of the standard SCALE application environments (engine, e-motor, battery.)

Target audience

Test cell operators who are authorized to modify screens, channels, security thresholds and/or test runs.
All test engineers or test facility support staff on MORPHEE 64 bits test cells.

Prerequisite

- Experience with operating test cells or test cell automation
- Being familiar with a windows PC environment

Training program

1. **MORPHEE – Introduction and general presentation**
2. **MORPHEE – RUNTIME – Structure and design – 3 modes navigation**
3. **MORPHEE – EDITOR presentation and browser overview**
4. **MORPHEE – EDITOR – Calculation & measurement channels: creation and modification**
5. **MORPHEE – EDITOR – User interface – Screens creation and modification**
6. **MORPHEE – EDITOR – different types of tests – Methods creation & modification**

MORPHEE – Advanced Training French – E-Learning (12 Hours)



Advanced training for Administrators about the management of a MORPHEE test cell: the participants learn how to set up the Bench Configuration page with the 3 modes as well as the various INI files. They learn to set up advanced securities and how to customize the result storage. They get deeper knowledge about MORPHEE components and about advanced capabilities of MORPHEE software.

Operational goals

- Know how to install or update MORPHEE software
- Know how to set up the functioning of the 3 modes BENCH, CAMPAIGN, TEST
- Understand the functioning of internal and physical channels in detail
- Know how to set up advanced alarm thresholds, reactions and conditions
- Know how to set up the MORPHEE.INI file and other configuration files (CFP, UEditor.config)
- Know how to take advantage of the generic functions of SCALE components
- Know how to set up customized results storage (channel groups, file groups, custom storage directories)

Target audience

All staff in charge of the installation or administration of a test cell, or who develop MORPHEE components.

Example: test cell / test field managers, MORPHEE support team at customer site.

Prerequisite

- MORPHEE 64-bit User Training plus several months of practical experience on a MORPHEE test cell.

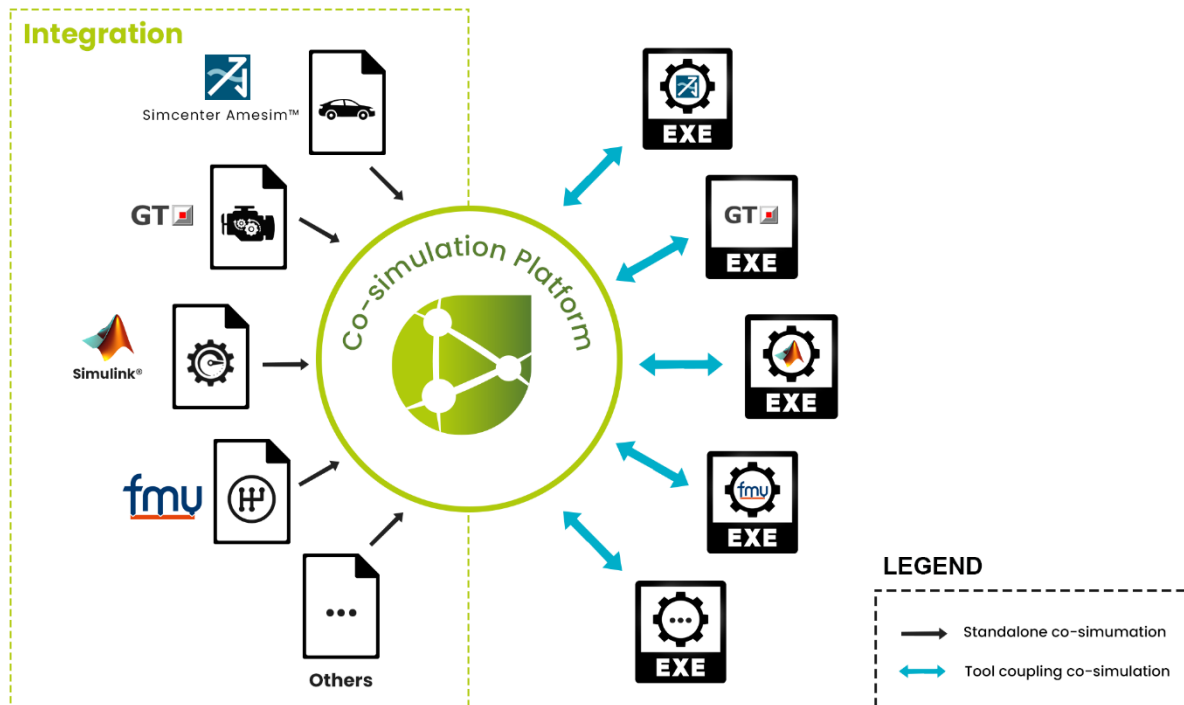
Training program

1. **Introduction, vocabulary and a reminder of MORPHEE architecture**
2. **MORPHEE Modes, Tests, Components and Test bed configuration**
3. **MORPHEE Editor and MORPHEE Executive**
4. **MORPHEE Installation and Switch tool**
5. **MEnv and Mtoolbar tools**
6. **New Test creation**
7. **Internal and physical channels, drivers, quantities, instruments and methods**
8. **ECU Configuration**
9. **Ethercat**
10. **Channels, Storage and alternative functions**

xMOD

xMOD is an application software that facilitate stand alone and tool coupling co-simulation between several simulation tools. The main idea of xMOD is to combine, within the same platform:

- **Heterogeneous model** integration environment
- Virtual **experimentation laboratory**



xMOD – Basic Training – 1 day



The concept of X-mod is to provide a platform that starts from scratch without the need of any existing models. It is empty allowing the user to import by himself his models for execution. The latter takes place within ideal performance conditions. The platform is user-friendly assuring continuity from the execution on the user's portable PC up to the execution on a test bench PC in real time (Hardware in the loop). The xMOD platform allows the exchange between the different services to happen smoothly. It also makes it possible to send simulations ready for execution for someone else without having to reconfigure.

The following training will help you understand the main use of xMOD and its basic features. It will also equip you with the practical knowledge needed to construct and run a simulation

Operational goals

- Understand xMOD-MORPHEE target and Block library
- Know the third-party tools for compiling
- Construct a simulation using xMOD basic features
- Compile and run a simulation

Target audience

- Control and simulation engineers

Prerequisite

- No prerequisites are needed

Training program

1. Introduction

- Introduction: xMOD main usage and objectives
- A skim on the workflow and concept of xMOD
- A general overview on the xMOD editor

2. Models generation

- Generating models using xMOD MORPHEE Target
- Compiling models using third party modeling tools
- xMOD-MORPHEE target Block Library

3. Constructing a simulation

- Using the generated models (compatible to xMOD) to create quantities, simulations, screens and methods.
- Learn the different basic features:
 - i. Quantities
 - ii. Dashboards
 - iii. Records
 - iv. Calibration
 - v. Methods
 - vi. Native Blocks
- Tool coupling:
 - vii. AMESim
 - viii. GT-Power
 - ix. Simulink
- FMI

4. Running a simulation

- xMOD Express

xMOD – Advanced Training – 2 days



The concept of X-mod is to provide a platform that starts from scratch without the need of any existing models. It is empty allowing the user to import by himself his models for execution. The latter takes place within ideal performance conditions. The platform is user-friendly assuring continuity from the execution on the user's portable PC up to the execution on a test bench PC in real time (Hardware in the loop). The xMOD platform allows the exchange between the different services to happen smoothly. It also makes it possible to send simulations ready for execution for someone else without having to reconfigure.

Operational goals

- Advanced compilation of several heterogeneous models (and associated debugging methodology)
- Optimize model execution, with multi-solver / multi-core methodology
- xMOD Build: Automatic compilation tool presentation
- Handling xMOD HiL solution with its specific drivers

Target audience

- Control and simulation engineers

Prerequisite

xMOD basic training

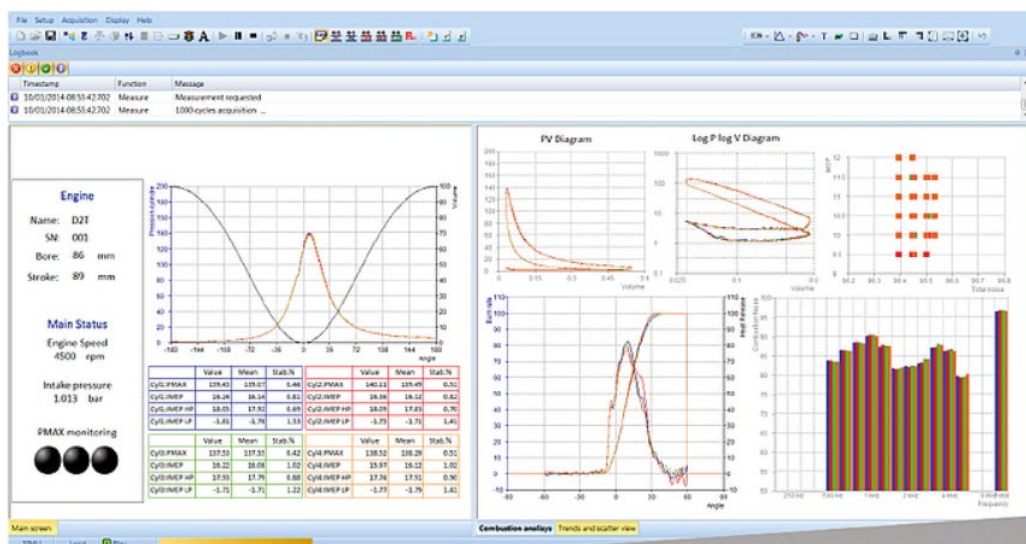
Training program

1. **xMOD setup and configuration**
2. **xMOD concept**
3. **xMOD Target**
 - Target configuration
 - Compiling a Simulink model
 - Compiling an AMESim model
 - Compiling a GT-Suite model
4. **xMOD Editor**
5. **MIPS construction**
6. **Simulation construction**
7. **Creation/Edition of xMOD quantities**
8. **Creation Edition of dashboards**
9. **xMOD Methods**
 - Cycle
 - Diagram
10. **xMOD Build**
11. **Simul Build**
12. **xMOD Express**
13. **xMOD tool coupling with Simulink**
14. **xMOD tool coupling with GT-Suite**
15. **xMOD tool coupling with AMESim**
16. **Using xMOD utilities from Matlab**
17. **Configuring RTX RTOS**
18. **Compiling models for RTX**
19. **Drivers:**
 - CAN
 - VMIC
 - Ethernet

OSIRIS

Combustion Analysis System

OSIRIS is Turnkey's fast acquisition system. Originally designed to sample data at each engine revolution crank angle, it can also work as a time-based oscilloscope. Quick to install and easy to use, it covers all the needs of engine engineers during every step of a powertrain development.



OSIRIS – User Training –1 day



OSIRIS training level 1 is about installation, configuration, TDC correction and use of OSIRIS, in acquisition mode and in simulation mode (office use).

Operational goals

- Understanding the foundations of crank angle-based acquisition
- Configuring the software for OSIRIS Evolution II or Evolution 3
- Performing a TDC correction with or without TDC sensor
- Applying the basic functions P_{MAX}, burned rate and knock level
- Displaying the data in tables and in CA-, P/V- or X/Y-graphs
- Configuring data storage and convert files into other formats
- Knowing how to access the available optional functions

Target audience

All staff working with OSIRIS, on a test bed, on board in a vehicle or at the office.

Prerequisite

- Understanding of the working principle of an internal combustion engine
- Experience with engine testing
- Basic Windows operating knowledge

Training program

1. Introduction
 - Basics of fast acquisition of pressures based on engine crank angle
 - The basic signals: CDM and TRIG
 - Overview of the whole system: OSIRIS, sensors, amplifiers, encoder, multiplier, host
 - OSIRIS rack with front and rear I/O
 - System performance depending on engine speed and angular resolution
2. Adjustment of hardware parameters and TDC + vertical signal corrections
 - Engine parameters (engine type and dimensions)
 - Coding system parameters (source of the signals ANGLES and TRIGGER)
 - Parameterization and calibration of analog channels
 - Troubleshooting on sensor and encoder connections
 - TDC correction using a TDC sensor or the thermodynamic method with corrections
 - Offset correction of analogue channels (CA offset and vertical offset)
3. Acquisition, standard calculations, display and storage
 - How to apply the standard vectorial and scalar calculations of OSIRIS basic package
 - FIR filtering (low pass, band pass and high pass)
 - Standards pressure calculations (P_{MAX}, IMEP, Max Pressure gradient)
 - Calculations of heat release and burned rate (CA₁₀, CA₅₀, CA₉₀, CA_{xy})
 - How to display measured channels and calculations as tables, CA based graph, PV graph or X/Y graph
 - Generic monitoring function in OSIRIS
 - Results storage and conversion to other file formats (I-files, text files)
4. OSIRIS options: calculations, monitoring and communication interfaces
 - P_{MAX} or KNOCK monitoring with digital output on alarm
 - Injection analysis based on a needle lift signal
 - Analysis of injection windows based on multiple pressure gradients dP/dA
 - Noise meter function (analysis of combustion noise in dB with human ear filter "A")
 - FFT analysis of rotational vibrations based on the instantaneous engine speed
 - Host interface via INDI protocol or via DCOM
5. Advanced functions of OSIRIS
 - How to customize calculations via scripts
 - Automatic file naming

OSIRIS – Advanced Training – 2 days



OSIRIS training level 2 about different available calculations: their goal, how they work and how to configure them.

Operational goals

- Know the goal of OSIRIS calculations
- Know how to check the configuration of the entire chain (synchronization, calibration, TDC, filtering)
- Understand how the OSIRIS calculations work
- Know how to parameterize OSIRIS calculations
- Know how to apply OSIRIS calculations to results data (XODF)

Target audience

Engine engineers and other users which have in their daily tasks to configure and use advanced OSIRIS calculation functions, such as heat release, combustion noise or knock, etc.

Prerequisite

- Advanced knowledge of internal combustion engine operating cycles (PV diagram...)
- Compulsory OSIRIS user training

Training program

1. Introduction and recalls
 - Recall about necessary checking of the entire configuration chain (synchronization, channels gain and offset, TDC offset setting)
 - Recall about FIR filtering functions
2. Standard pressure calculations: advanced configuration
 - Use of pressure calculations at customized crank angles
 - Pmax calculation angular range setting
 - Distribution law setting (real angles of opening and closing of valves)
 - Kappa calculation angular range setting (polytropic coefficient)
3. Heat release calculations: configuration and use
 - Calculation algorithm basic explanations
 - Configuring 3 calculation channels in one operation: heat release, fraction burnt, average gas temperature
 - Filtering and averaging prior to calculation
 - Intake pressure and temperature as input of the calculation
 - Combustion start and end detection setting
 - Considering thermal losses through the cylinder walls
 - Applying cycle results to the fraction burnt channel (CA10, CA50, ...)
4. Multiple/maxi pressure gradients: configuration and use
 - Setting maximum pressure gradient calculations (standard supply)
 - Setting multiple maximum pressure gradient calculations (optional supply)
 - Use of these results for detecting injection windows
 - Checking of results using derivation channels
5. Knock calculations: configuration and use for monitoring (alarms)
 - KNOCK calculation principles
 - MAPO calculations principles (Maximum Amplitude of Pressure Oscillations)
 - Prerequisite for an efficient knock detection
 - Setting low and high knock alarms
 - Calculation results: knock level, low knock %, high knock %
 - Activation of a digital output upon alarm detection
 - Setting the MAPO calculation (pass-band filter configuration)
 - Calculation results: MAPO and MAPO angle
 - Activation of a digital output upon alarm detection through the generic monitoring function
6. Combustion noise: configuration and use
 - Noise calculation principles (steps of the calculation)

- Low-pass filter configuration
 - Considering the human ear answer
 - Considering the engine block attenuation
 - Results: total noise, noise level, slope
7. Needle lift signal analysis: configuration and use
- Explanation of available cycle results: height, width and angle for 1 to 3 injections
 - Configuring the calculations (considering signal noise for calculation and detection)

FLEX-LAB

Manage all test cell data from a web browser

FLEX-LAB is a web-based technology solution to manage all test cell data. Easy rollout and cross-platform system, it requires only a modern web browser.

FLEX-LAB System provides a proven and an open solution for data storage and retrieval, test system utilization tracking, and live monitoring of any system through configurable data schema and dashboards, also, data from every test cell is stored in one central location.



FLEX-LAB – User Training – 2 days



During this course, the client will learn how to use FLEX-LAB system interface with conventional Engine data model. He will learn as well how to use TestManager to operate the MORPHEE modes.

Operational goals

- Define MORPHEE specific data (Norm-names, Units, Test types, Conditioning Units, Sensors/Actuators,)
- Define UUT (engine) specifications and parameters
- Define Test request and parameters
- Access to test data

On test bed PC:

- Define test bed parameters
- Test order selection and campaign mode
- Start automatic tests
- Tests sequences
- Access local measurement data

Target audience

- Test cell operators
- Test Engineers

Training program

1. Introduction
2. General synopsis
3. FLEX-LAB System
 - Users and groups
 - MORPHEE norm-names and quantities
 - Test types
 - Engine specification and parameters
 - Test orders definition
 - Testing equipment
 - Fetching Measurement Data
 - Global libraries
4. Test Manager Client
 - Basic features
 - Bench view and parameters
 - Starting campaign mode: Test order selection
 - Test descriptions
 - Starting test mode
 - Test sequence
 - Accessing measurement data
5. MORPHEE Environment Tool
 - . How to configure TestManager

FLEX-LAB – Administrator Training – 5 days

Operational goals

- Customize the FLEX-LAB data model and views
- Dashboard settings: Widget, KPI
- TMS installation and configuration (optional)
- Yield Metrics installation and configuration (optional)

Target audience

- Administrators
- Test Engineers

Prerequisite

- The participant must be familiar with MORPHEE system (basic training).
- Good IT and programming skills are required
- Familiar with modern web browser (Google Chrome, MS Internet Explorer).

Training program

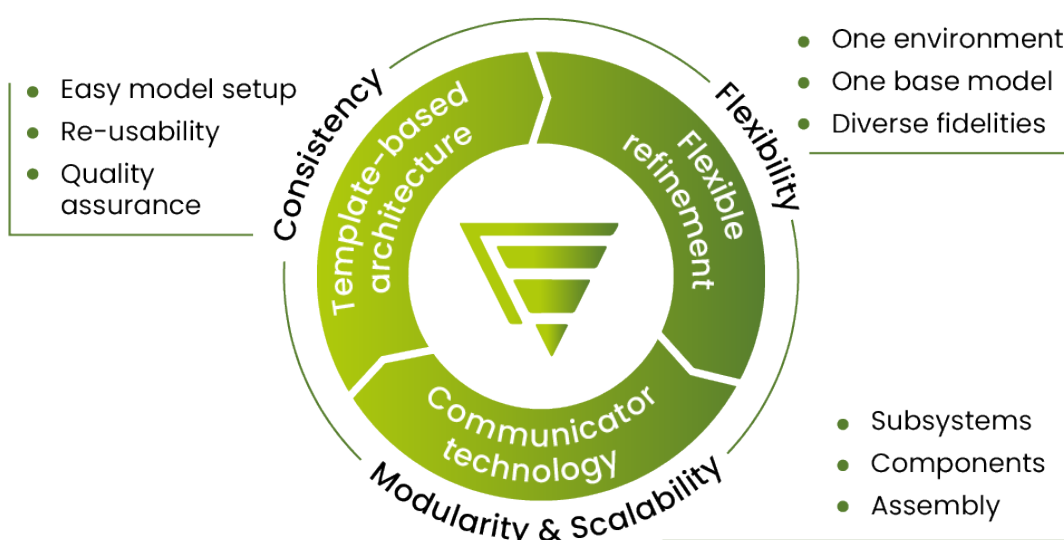
1. Introduction
2. General presentation (basic courses)
3. Global Synoptic
4. Configuration files
5. Database objects
6. Model file
7. Model compilation
8. Main configuration file
9. Modules/Plugin configuration
10. Grid configuration
11. GUI settings
12. Dashboard: Widget, KPI
13. TMS configuration (option)
14. Yield Metrics configuration (option)

Virtual Dynamics

System-level Simulation

Virtual Dynamics is an advanced simulation software for dynamic analysis of powertrain, driveline and their components. It is a suite of products composed of Virtual Engine and Virtual Gearbox together providing all building blocks needed to create dynamic models of engine, transmission, conventional and hybrid-electric drivelines. Virtual Dynamics uses the core technology of the world leading Multi-Body-Simulation Software MSC Adams as numerical integrator, pre- and post-processing features. The template-based architecture perfectly combines the advantages of single purpose software – ease of use and multi-purpose software – no limitations in extendibility.

Virtual Dynamics is a truly open system – featuring a powerful scripting language for task automation, the ability to customize the user interface, support for own solver routines and extending the modeling component library with own user-defined elements. Wizards automate and accelerate the creation of complex models like crank and drive trains. Models and corresponding data are organized in databases, strengthening data management even for global scale companies. Advanced generic 3D contacts plus fast analytical approaches for powertrain-specific contacts ensure a vast scope of application.



Virtual Dynamics Training – 2 days



Virtual Dynamics provides the tools for reliable, efficient and high-quality powertrain and driveline development. This training includes theoretical and practical knowledge about modelling and simulating the desired components or systems using Virtual Dynamics. Relevant scenarios, dedicated tools and expert tips to help the user unlock more potential from the software and increase productivity.

Operational goals

- Familiarity and comfort with the Virtual Dynamics.
- Introduction to software concepts, graphical interface and post processor.
- Understanding the modelling architecture and useful general tools.
- Theoretical and practical learning of the desired modules* and their specific capabilities.
- Apply the knowledge to manually build a working model.
- Perform some fundamental analysis and evaluate the results.
- Clarify specific customer requirements from the software.

VIRTUAL DYNAMICS Application

The available suite of products under Virtual Dynamics provide simulation capabilities of powertrain and driveline applications. This practical training introduces the different tools and methods to perform multi-body dynamic investigations. The customer may choose one or more of the standard Virtual Dynamics modules*. Basic and advanced level training for all modules are available as required. The operational goals as well the training program are flexible to be adjusted based on user request and experience.

*Crank train, *Gear train, *Valve train, *Piston and rings, *Timing and accessory drive, *Electric motor *special request.

Target audience

All engineers requiring dynamic analysis of conventional and hybrid-electric powertrain and driveline at system or component level.

Prerequisites

- Fundamental knowledge of engineering mechanics in structural and dynamic domain.
- Understanding of the working principles of the powertrain system under consideration.

Training program

1. Getting started with Virtual Dynamics

- Understanding the software concepts.
- A look at the general and special tools.
- Learn how to interact with the software.

2. Detailed introduction to the desired modules and its capabilities

- Comprehensive review of all the necessary components.
- Identifying the available fidelity levels of modelling along with their pros and cons.
- Overview of some relevant examples.

3. Practical exercise with a relevant model

- Utilizing the necessary tools to build up a model.
- Creating an example model from scratch as a team exercise.
- Learning the best use practices and general industry approaches.

4. Advanced analysis and evaluation

- Establishing the model boundary conditions and solver parameters for an optimal analysis.
- Model customization with personal requirements and preferences.
- In-depth analysis of the results using the post processor.



Advanced DoE techniques with innovative modeling algorithms

Today, it is hard to imagine powertrain development without Design of Experiments (DoE). The main challenge, though, is to make this powerful technique easily applicable for all calibration engineers which are typically not familiar with the mathematical background of this approach. At the same time, powertrain development poses challenges requiring for specific adaptations of the generic DoE methodology.

A new software tool featuring DoE based application processes have been developed at ENORISE and is available since Q1/2015. FEVcal makes the powerful DoE technique easily applicable and addresses the particular challenges of automotive development that require tailored adaptations of the generic DoE methodology. Special emphasis was placed on developing highly reliable and rapid modeling algorithms which are unique to the market. The today's state-of-the-art global modeling techniques based on Gaussian processes have been adapted to address also the specific characteristics of engine and powertrain modeling. This approach, combined with intuitive visualization and user guidance, enables the engineer to quickly investigate and optimize for example the engine's behavior



Project Trainings

End of Project Training – 1 day

This training targets the client test bench operators and engineers. It aims to guide them on how to operate the bed taking into consideration the specification of their solutions.

Operational goals

- Know the different parts of the bench and the equipment
- Understand the different Modes in MORPHEE
- Understand the different security states
- Know the different bench components and their functions
- Understand the different interaction between the components
- Understand the different test stages
- Learn how to start and operate a sample Test

Target audience

- Operators
- Test bed Engineers

Prerequisites

- Prior experience and knowledge of test bed
- Recommended to have had a Basic MORPHEE Training

Training program

1. **Structure of MORPHEE software and hardware on a test cell**
 - General presentation of the test cell
 - MORPHEE architecture: PC, acquisition/communication cards, drivers, components, tests
 - The three modes BENCH, CAMPAIGN, TEST and the transitions between them
 - Separation between test cell specific settings and shared settings like test procedures
2. **MORPHEE standard run-time interface**
 - How to launch MORPHEE multi-modes
 - Control of standard test cell equipment from this GUI (media conditioning, engine and dyno control, I/O modules, special measurement equipment)
 - Standard MORPHEE menus and monitor windows (channels, set values, alarms ...)
 - Result data storage: instantaneous values, recorder or stabilized measurements
3. **MORPHEE Editor**
 - How to browse between the tabs: Bench Config, Campaign, Test, Components
4. **General functioning of test bed components**
 - Presentation of standard/specific SCALE components for media control, I/O, measurement devices, dyno, engine...
 - Explanation of each component specific function
5. **Launching an automatic test run, e.g. a full load test**
 - Understand how an automatic test takes place
 - Explanation of each component specific function
 - How to manage results and how to retrieve stored data
 - How to perform measurement plans

To note: Customization of such training is possible to a certain level if agreed by both ENORISE and client if the foreseen training duration is not exceeded.

Customized Training – X days

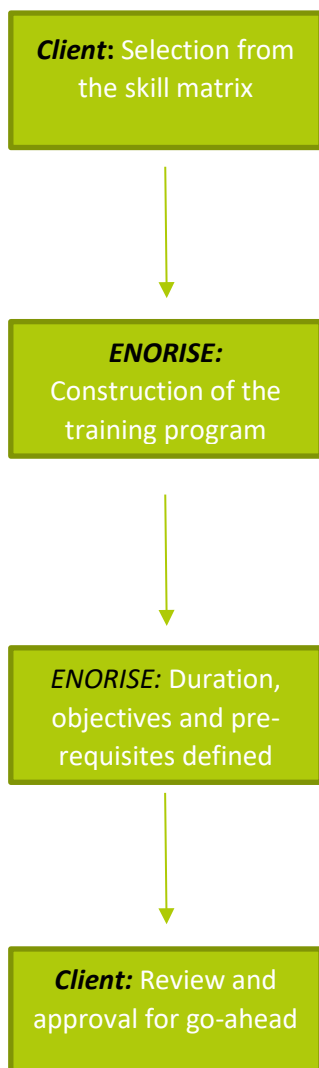
ENORISE training team have created an exhaustive product and skills matrix. The aim is to provide our customers the possibility to construct a tailored training based on their needs. This matrix could be found at the appendix section at the end of this training catalogue.

Operational goals / Prerequisites

The training goals and pre-requisites will be defined once the skills selection is done by the customer.

Training program

1. The training program will take time to be defined depends on the complexity of the skills needed.
2. The duration will be based on the clients selected skills.
3. Material documentation needs to be customized and adapted as much as possible.



Delivery types

Training on ENORISE Premises

The face to face trainings are held on preplanned sessions at ENORISE facilities. It could accommodate up to 8 participants.

- Each participant will be provided with a PC with the latest software needed
- Drink & food are provided
- Handbook (including lectures and exercises) is to be provided

Training at Customer's site

Customers could request a training at their site. Accordingly, customers need to take the following points into consideration:

- Prepare a dedicated training room for the session to take place.
- Equip the room with PCs as such to have one PC per participant
- Limit the number of participants to 6 per session

Virtual training

ENORISE is offering as well live virtual trainings. Using our online digital solutions, the clients are able:

- To save time as participants will only log-in for 2-3 hours and then get back to their jobs
- To have schedule flexibility
- To save cost with no travel and accommodation expenses needed
- To review the training content anytime afterward as such training could be documented upon request

The participants will be provided with a link to access the online training. Our sophisticated solutions will allow for the training to professionally monitor the session. Out of the available tools we list the followings:

- Ability for participants to raise hand (virtually) and write down questions
- Ability for trainer to do quick Q&A and get quick results
- Ability for trainer to manage and control microphones

The ENORISE Learning skill up platform

ENORISE's Learning Management System – skills.enoriselearning.com – is now available. It will offer upon request any training as an E-learning course. This offers the ability to:

1. Train large number of audiences
2. Have a self-paced training solution
3. Track each learner progress

ENORISE training team can take your requests to a higher level and offer a full training program. Again, based on the skill matrix, an A to Z tailored E-learning courses with a defined path can be developed.

The screenshot displays the ENORISE Learning Management System (LMS) interface. At the top, there is a navigation bar with the ENORISE logo, contact information (Call us: +33 (0)1 73 30 93 50, E-mail: contact@enorise.com), and a search bar. Below the navigation bar, the 'My courses' tab is selected, showing a grid of course cards. Each card represents a course with a title, icon, language, and completion status. The courses shown are:

- CAN** (Icon: CAN bus symbol) - english - 50% complete
- Dyno Controller Tuning** (Icon: Lightbulb) - english - 33% complete
- Introduction aux Bancs Vehicule (BAR / CD)** (Icon: Vehicle on a test bench) - french
- M4 - New features** (Icon: Steering wheel with 'M' logo) - french
- M4 for Maintenance teams** (Icon: Diagram of a MORPHEE test bench) - english
- M64 Standard pour SCALE Battery** (Icon: Battery symbol) - french

The interface also includes a 'Manage courses' button and a 'Create course' button. The background of the page features a repeating pattern of the ENORISE logo.

Appendix – Skill Matrix

No#	Subject	Work Package	Sub Work Package	Comments	Skills and training topics
1	Building	1. Information System	1.1 – Data Management		Datamodel structure and process analysis engine battery and vehicle example
2	Building	1. Information System	1.1 – Data Management		DISTRIB CENTER – Mnuget and distrib center setup and configuration
3	Building	1. Information System	1.1 – Data Management		DISTRIB CENTER – Test field management using Mnugets and version distribution
4	Building	1. Information System	1.1 – Data Management		FLEX-LAB – Administration and maintenance (users, permission, testfield creation)
5	Building	1. Information System	1.1 – Data Management		FLEX-LAB – backup and restore database
6	Building	1. Information System	1.1 – Data Management		FLEX-LAB – Battery Test demand creation and registration
7	Building	1. Information System	1.1 – Data Management		FLEX-LAB – Campaign and tests management
8	Building	1. Information System	1.1 – Data Management		FLEX-LAB – Dashboard management
9	Building	1. Information System	1.1 – Data Management		FLEX-LAB – General configuration and commissioning

10	Building	1. Information System	1.1 – Data Management	FLEX-LAB – Introduction to battery LIMS
11	Building	1. Information System	1.1 – Data Management	FLEX-LAB – Managing test fields
12	Building	1. Information System	1.1 – Data Management	FLEX-LAB – Parameters creation and modification
13	Building	1. Information System	1.1 – Data Management	FLEX-LAB – retrieve results and generate reports
14	Building	1. Information System	1.1 – Data Management	FLEX-LAB – Tables creation and modification
15	Building	1. Information System	1.1 – Data Management	FLEX-LAB – Test creation steps and details
16	Building	1. Information System	1.1 – Data Management	FLEX-LAB – Test equipments management
17	Building	1. Information System	1.1 – Data Management	FLEX-LAB – TMS – training – user and commissioning
18	Building	1. Information System	1.1 – Data Management	FLEX-LAB – YELDMETRICS – training – user and commissioning
19	Building	1. Information System	1.1 – Data Management	Generalities on server and database design
20	Building	1. Information System	1.1 – Data Management	Interface commissioning and maintenance

21	Building	1. Information System	1.1 – Data Management	SQL data base and studio setup and commissioning
22	Building	1. Information System	1.1 – Data Management	TESTMANAGER – Campaign loading
23	Building	1. Information System	1.1 – Data Management	TESTMANAGER – Link and transfer to server
24	Building	1. Information System	1.1 – Data Management	TESTMANAGER – Plugins management
25	Building	1. Information System	1.1 – Data Management	TESTMANAGER – Reference test management
26	Building	1. Information System	1.1 – Data Management	TESTMANAGER – STANDALONE Backup and restore
27	Building	1. Information System	1.1 – Data Management	TESTMANAGER – STANDALONE edition user functions
28	Building	1. Information System	1.1 – Data Management	TESTMANAGER – Test loading
29	Building	1. Information System	1.2 – Data Evaluation	Data reporting and post-processing generalities
30	Building	1. Information System	1.2 – Data Evaluation	UNILOT – Convert template to a real report
31	Building	1. Information System	1.2 – Data Evaluation	UNILOT – Export and templates

32	Building	1. Information System	1.2 - Data Evaluation		UNIPILOT – First steps into UniPlot – Diagrams
33	Building	1. Information System	1.2 - Data Evaluation		UNIPILOT - Introduction and general presentation
34	Building	1. Information System	1.2 - Data Evaluation		UNIPILOT – Post-Treatment of raw data
35	Building	1. Information System	1.2 - Data Evaluation		UNIPILOT – Sequencer
36	Building	1. Information System	1.2 - Data Evaluation	UNIPILOT, FEVALYS ...	UNIPILOT – UNISCRIP Introduction
37	Building	1. Information System	1.2 - Data Evaluation		UNIPILOT – Use templates and Data file management
38	Test Cell	2. Simulation Platform	2.1 - Calibration Software		CAMEO – Interface with MORPHEE – rules and good practices
39	Test Cell	2. Simulation Platform	2.1 - Calibration Software		ECU calibration principle and MCD3 interface
40	Test Cell	2. Simulation Platform	2.1 - Calibration Software		MCD3 - Interface to MORPHEE MCD3 (protocol, connection and component)
41	Test Cell	2. Simulation Platform	2.1 - Calibration Software		xCAL and MMBC, INCA ?

42	Test Cell	2. Simulation Platform	2.1 - Simulation Software	xMOD and application (Vehicle, E-motor, Battery simulation (EiL, BiL, EMIL, PiL ...))	xMOD- XiL-API
43	Test Cell	2. Simulation Platform	2.1 - Simulation Software		xMOD-Advanced Models generation
44	Test Cell	2. Simulation Platform	2.1 - Simulation Software		xMOD-Basic Models generation
45	Test Cell	2. Simulation Platform	2.1 - Simulation Software		xMOD-CAN driver
46	Test Cell	2. Simulation Platform	2.1 - Simulation Software		xMOD-Editor- Constructing a simulation
47	Test Cell	2. Simulation Platform	2.1 - Simulation Software		xMOD-EtherCAT driver
48	Test Cell	2. Simulation Platform	2.1 - Simulation Software		xMOD-MORPHEE Target and model compilation
49	Test Cell	2. Simulation Platform	2.1 - Simulation Software		xMOD-Running a Basic Simulation
50	Test Cell	2. Simulation Platform	2.1 - Simulation Software		xMOD-User interface
51	Test Cell	2. Simulation Platform	2.1 - Simulation Software		xMOD-XCP driver

52	Test Cell	2. Simulation Platform	2.2 - Simulation Hardware	From simulation to hardware in the loop
53	Test Cell	2. Simulation Platform	2.2 - Simulation Hardware	MIO - modules for simulation
54	Test Cell	2. Simulation Platform	2.2 - Simulation Hardware	vCAP platform for simulation
55	Test Cell	3. Calibration System	3.2 - Calibration Hardware	ECU systems and connectivity to MORPHEE generalities
56	Test Cell	3. Calibration System	3.2 - Calibration Hardware	Fast ECU access in MORPHEE - ES951 Etas box in ETHERCAT - KPA studio
57	Test Cell	3. Calibration System	3.2 - Calibration Hardware	xCAL and MMBC, ETAS box ?
58	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - 3 concepts - MODE - DESCRIPTION - COMPONENT
59	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - Acquisition - measurement plan, channels list and data logging creation
60	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - Acquisition - multi frequency - customization of storage, file format
61	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - Alarms creation and monitoring - MORPHEE monitors using
62	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - Bench-Campaign-Test mode loading Multi mode and Multi instance

63	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - Control - open and closed loop -(PID) measurement and automation basics
64	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - Convert bench application to a desktop use
65	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - Customization, configuration files and tools
66	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - Debugger and testing development
67	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - Diagnostics - logbook and postmortems
68	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - Drivers development
69	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - EDITOR - Component design and rules
70	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - EDITOR - Component tree - Component line and inheritance
71	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - EDITOR - Components group and mode switching management
72	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - EDITOR - Components parameters settings

73	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - EDITOR - declare components in MORPHEE modes
74	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - EDITOR - different type of cycles - Methods creation & modification
75	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - EDITOR - Method types ; Alarms cycle, Stop cycle, Resume cycle, refuge cycle
76	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - EDITOR - Quantities & Measurement channels creation and modification
77	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - EDITOR - Scripting - C# in MORPHEE methods and debugging scripts
78	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - EDITOR - User interface - Screens creation and modification
79	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - EDITOR Bench versionning with GIT (component-Test- Bench)
80	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - EDITOR presentation and browser overview

81	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - Installation - Update rules and startup MENV - MASTER CD
82	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - End of commissioning good practices
83	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - Introduction and general presentation
84	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - MENV - Backup and configuration management
85	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - MNUGET versioning and distribution
86	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - POWERSHELL description and commands
87	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - Protection rules - MACAOcodes - dongles - licencing
88	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - Reloading test and context management
89	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - RTX real time and Windows time, frequency and RTX optimization
90	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - RUNTIME - Structure and design - 3 modes navigation
91	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - Template - libraries definition and utilization

92	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - test development rules and good practices
93	Test Cell	4. Automation System	4.1 - Automation Software	MORPHEE - User rights management
94	Test Cell	4. Automation System	4.1 - Automation Software	SCADA - Introduction to application
95	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - Alarm and safety management in SCALE environment
96	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - Vehicle application user presentation
97	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - Battery application user presentation
98	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - Battery Test writing specificities
99	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - CORE components - Management component - Measurement, Management & Control
100	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - Customization, commissioning, preparation and utilization
101	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - Emotor Test Writing Specificities

102	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - Engine Test writing specificities
103	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - Flow chart and state machine
104	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - Installation
105	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - Introduction and general presentation
106	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - Measurement management in SCALE environment
107	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - Powertrain test writing specificities
108	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - Switching to GIT - development workflow
109	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - Test writing and coding general rules
110	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - Using the templates for components creation
111	Test Cell	4. Automation System	4.1 - Automation Software	SCALE - Vehicle Test Writing specificities
112	Test Cell	4. Automation System	4.1 - Automation Software	SCALE development rules (component, interface, channels)

113	Test Cell	4. Automation System	4.2 - Automation Hardware	AK - Commissioning and validation
114	Test Cell	4. Automation System	4.2 - Automation Hardware	AK - Connection settings and parameters
115	Test Cell	4. Automation System	4.2 - Automation Hardware	AK - Device connection and wiring
116	Test Cell	4. Automation System	4.2 - Automation Hardware	AK - Error diagnostics and maintenance
117	Test Cell	4. Automation System	4.2 - Automation Hardware	AK - MORPHEE AK feature configuration and utilization in components
118	Test Cell	4. Automation System	4.2 - Automation Hardware	AK - Protocol basics
119	Test Cell	4. Automation System	4.2 - Automation Hardware	BECKHOFF - TWINCAT and MODULE programming
120	Test Cell	4. Automation System	4.2 - Automation Hardware	CAN - CANalyser and error diagnostics
121	Test Cell	4. Automation System	4.2 - Automation Hardware	CAN - Commissioning and validation
122	Test Cell	4. Automation System	4.2 - Automation Hardware	CAN - Device connection and wiring

123	Test Cell	4. Automation System	4.2 - Automation Hardware	CAN - MORPHEE CAN feature configuration and utilization in components
124	Test Cell	4. Automation System	4.2 - Automation Hardware	CAN - Protocol basics
125	Test Cell	4. Automation System	4.2 - Automation Hardware	CAN Open - Beckhoff gateway - EL6751
126	Test Cell	4. Automation System	4.2 - Automation Hardware	CSM - Feature management in MORPHEE
127	Test Cell	4. Automation System	4.2 - Automation Hardware	Design and architecture
128	Test Cell	4. Automation System	4.2 - Automation Hardware	EtherCat Commissioning and diagnostic on failure - KPA diagnostic, status
129	Test Cell	4. Automation System	4.2 - Automation Hardware	EtherCat network Installation and Maintenance
130	Test Cell	4. Automation System	4.2 - Automation Hardware	EtherCat protocol and Hardware connection principle
131	Test Cell	4. Automation System	4.2 - Automation Hardware	HILSHER - CIFx board definition and settings
132	Test Cell	4. Automation System	4.2 - Automation Hardware	HILSHER - Gateways configuration NT100 and NT151
133	Test Cell	4. Automation System	4.2 - Automation Hardware	HILSHER - SYCON configuration software

134	Test Cell	4. Automation System	4.2 - Automation Hardware	INDICOM – protocol basics
135	Test Cell	4. Automation System	4.2 - Automation Hardware	KPA STUDIO – Calibration in KPA
136	Test Cell	4. Automation System	4.2 - Automation Hardware	KPA STUDIO – Installation of Master, license activation, Studio installation
137	Test Cell	4. Automation System	4.2 - Automation Hardware	KPA STUDIO – Slave Alias management
138	Test Cell	4. Automation System	4.2 - Automation Hardware	KPA STUDIO EtherCat board configuration
139	Test Cell	4. Automation System	4.2 - Automation Hardware	KPA STUDIO load and update device libraries
140	Test Cell	4. Automation System	4.2 - Automation Hardware	KPA STUDIO Module definition and configuration
141	Test Cell	4. Automation System	4.2 - Automation Hardware	KPA STUDIO Project handling – bus diagnostics, ECAT file generation
142	Test Cell	4. Automation System	4.2 - Automation Hardware	LIN – Protocol basics
143	Test Cell	4. Automation System	4.2 - Automation Hardware	MODBUS – Protocol basics

144	Test Cell	4. Automation System	4.2 - Automation Hardware		MORPHEE - Channel calibration rules and good practices
145	Test Cell	4. Automation System	4.2 - Automation Hardware		MORPHEE - Conditioner - Sensor - Physical channels creation
146	Test Cell	4. Automation System	4.2 - Automation Hardware		MORPHEE - Ethercat channel creation
147	Test Cell	4. Automation System	4.2 - Automation Hardware	PC + keyboard + mouse + screen + boards + cabinet etc ...	MORPHEE - hardware integration - PC integration - RTX installation and setup
148	Test Cell	4. Automation System	4.2 - Automation Hardware		MORPHEE - PC board integration and 3rd party configuration tool generalities
149	Test Cell	4. Automation System	4.2 - Automation Hardware		MORPHEE - Physical channels configuration - generalities
150	Test Cell	4. Automation System	4.2 - Automation Hardware		MORPHEE - Protocol, interface and drivers declaration
151	Test Cell	4. Automation System	4.2 - Automation Hardware		MOXA - gateway configuration
152	Test Cell	4. Automation System	4.2 - Automation Hardware		PLC and interface process logics, relays and control

153	Test Cell	4. Automation System	4.2 - Automation Hardware	PROFIBUS - Commissioning and validation
154	Test Cell	4. Automation System	4.2 - Automation Hardware	PROFIBUS - Error diagnostics and maintenance
155	Test Cell	4. Automation System	4.2 - Automation Hardware	PROFIBUS - GANTNER modules configuration (ICP and TestCommander)
156	Test Cell	4. Automation System	4.2 - Automation Hardware	PROFIBUS - MORPHEE Profibus feature configuration and utilization in components
157	Test Cell	4. Automation System	4.2 - Automation Hardware	PROFIBUS - Protocol basics
158	Test Cell	4. Automation System	4.2 - Automation Hardware	PROFIBUS - Physical channel configuration (from module to MORPHEE)
159	Test Cell	4. Automation System	4.2 - Automation Hardware	Safety rules with testing activities
160	Test Cell	4. Automation System	4.2 - Automation Hardware	Watchdog principles
161	Test Cell	4. Automation System	4.2 - Automation Hardware	WOODHEAD - Applicom - Brad Communication configuration
162	Test Cell	5. Data Acquisition	5.1 - Acquisition I/O conditioning (MIO, Beckhoff...) + boombox	Basics on signal conditioning and acquisition

163	Test Cell	5. Data Acquisition	5.1 - Acquisition	EMC and interferences
164	Test Cell	5. Data Acquisition	5.1 - Acquisition	Ethernet TCP/IP Communication support
165	Test Cell	5. Data Acquisition	5.1 - Acquisition	MIO - Diagnostic and maintenance
166	Test Cell	5. Data Acquisition	5.1 - Acquisition	MIO - Setup MIO-A
167	Test Cell	5. Data Acquisition	5.1 - Acquisition	MIO - Setup MIO-D
168	Test Cell	5. Data Acquisition	5.1 - Acquisition	MIO - Setup MIO-F01 (interface web)
169	Test Cell	5. Data Acquisition	5.1 - Acquisition	MIO - Setup MIO-R01-R02
170	Test Cell	5. Data Acquisition	5.1 - Acquisition	MIO - Setup MIO-T10-T11
171	Test Cell	5. Data Acquisition	5.1 - Acquisition	MIO Integration
172	Test Cell	5. Data Acquisition	5.1 - Acquisition	MIO modules basics
173	Test Cell	5. Data Acquisition	5.1 - Acquisition	Other IO modules other bus

174	Test Cell	5. Data Acquisition	5.1 - Acquisition		Protocols - network - fieldbus and analog connection
175	Test Cell	5. Data Acquisition	5.1 - Acquisition		Serial link RS232-RS422 RS485 Communication support
176	Test Cell	5. Data Acquisition	5.2 - Sensors		Calibration, range definition and metrologics
177	Test Cell	5. Data Acquisition	5.2 - Sensors		Diagnostic, monitoring and maintenance
178	Test Cell	5. Data Acquisition	5.2 - Sensors	Sensors (Pressure, Temp, flow etc...)	Generalities on sensors - temperature, pressure, flow - International standards - Metrologics
179	Test Cell	5. Data Acquisition	5.2 - Sensors		High speed measurements - Pressure, flow, signals and principles
180	Test Cell	5. Data Acquisition	5.2 - Sensors		IO configuration in MORPHEE
181	Test Cell	5. Data Acquisition	5.2 - Sensors		Speed and Torque - Principles of rotational measurement
182	Test Cell	5. Data Acquisition	5.3 - Measuring Devices		Air flow measurement - commissioning and maintenance- AIRRATE (Sensiflow)

183	Test Cell	5. Data Acquisition	5.3 - Measuring Devices		Blowby, Air flow, fuel flow, (EGR, Turbo) air loop measurement and structure (Temp Pres Flow QTP)
184	Test Cell	5. Data Acquisition	5.3 - Measuring Devices		Blowby measurement - commissioning and maintenance - BLOWBYRATE (AVL442)
185	Test Cell	5. Data Acquisition	5.3 - Measuring Devices		Devices and interfaces - protocol AK INDI, DCOM and functions
186	Test Cell	5. Data Acquisition	5.3 - Measuring Devices		Electrification - Measurement on power conversion - POWER METERS
187	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	HORIBA & AVL devices	Emission focus; FTIR, Raw and diluted gases, Engine or vehicle - PEMS ; CVS, dilution tunnel)
188	Test Cell	5. Data Acquisition	5.3 - Measuring Devices		Emission measurement, flow measurement Richness & lambda loop by loop around engine
189	Test Cell	5. Data Acquisition	5.3 - Measuring Devices		Emission regulation light and heavy duty - FEV Solution
190	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	AVL 415-439-472 etc	Exhaust gas measurement Smokemeter, opacimeter, particulates, emission - AVL devices
191	Test Cell	5. Data Acquisition	5.3 - Measuring Devices		Fuel consumption and conditioning- commissioning and maintenance - FUELCON- FUELRATE
192	Test Cell	5. Data Acquisition	5.3 - Measuring Devices		Measurement on battery testing - Impedance meter

193	Test Cell	5. Data Acquisition	5.3 – Measuring Devices	Measuring equipment (devices), Smokemeter, Opacimeter, particulates blowby, FTIR,Emission bench, Dilution tunnel, CVS including blower, xRate, OSIRIS (power or combustion)	Mesuring devices in engine testing
194	Test Cell	5. Data Acquisition	5.3 – Measuring Devices		OSIRIS – Acquisition Env – Angle and Time base acquisition
195	Test Cell	5. Data Acquisition	5.3 – Measuring Devices		OSIRIS – Acquisition Env – Cylinder pressure sensor
196	Test Cell	5. Data Acquisition	5.3 – Measuring Devices		OSIRIS – Acquisition Env – Encoder, CDM and trigger signal
197	Test Cell	5. Data Acquisition	5.3 – Measuring Devices		OSIRIS – Acquisition Env – Hardware configuration – system overview
198	Test Cell	5. Data Acquisition	5.3 – Measuring Devices		OSIRIS – Calculation channels – types, creation
199	Test Cell	5. Data Acquisition	5.3 – Measuring Devices		OSIRIS – Combustion analysis – Fast Data Acquisition system

200	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - Combustion noise - Engine noise measurement
201	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - Create a configuration - file, acquisition and engine definition
202	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - Data filtering
203	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - FFT analysis and rotational vibration based on engine speed
204	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - GUI management
205	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - Heat Release calculations
206	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - Installation, update, PC configuration, system connection
207	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - interface with MORPHEE
208	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - Knock calculation
209	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - Monitoring function management
210	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - Multiple/maxi pressure gradient

211	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - Needle lift and injection analysis
212	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - Physical channels - types, creation and calibration
213	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - Power meter - OSIRIS (or others Yoko?)
214	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - Script calculation and automatic file naming
215	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - Standard pressure calculations
216	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - Storage, data logging, file format and conversion
217	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - TDC tuning and configuration
218	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	OSIRIS - Troubleshooting on Sensors and encoders
219	Test Cell	5. Data Acquisition	5.3 - Measuring Devices	YOKOGAWA-interface YTMCTL in MORPHEE
220	UUT	6. UUT Control	6.1 - Controllers	DCU3K - Control from MORPHEE (EtherCat, Profibus, Analog)
221	UUT	6. UUT Control	6.1 - Controllers	DCU3K - Control modes global knowledge
222	UUT	6. UUT Control	6.1 - Controllers	DCU3K - diagnostic and maintenance

223	UUT	6. UUT Control	6.1 – Controllers		DCU3K – Double loop pid tuning (Dyno and engine)
224	UUT	6. UUT Control	6.1 – Controllers		DCU3K – Integration into testing system
225	UUT	6. UUT Control	6.1 – Controllers		DCU3K – interface, commissioning, use and maintenance
226	UUT	6. UUT Control	6.1 – Controllers		DCU3K – Settings and general parameters
227	UUT	6. UUT Control	6.1 – Controllers		DYNABOX – signal conditioning and monitoring interface
228	UUT	6. UUT Control	6.1 – Controllers		Engine Control modes PID and feedforward
229	UUT	6. UUT Control	6.1 – Controllers	DCU, TOM, SPARC, EMCON ...	Generalities on Dyno Contollers on the market interface and functions – system view
230	UUT	6. UUT Control	6.1 – Controllers		MORPHEE PID tuning
231	UUT	6. UUT Control	6.1 – Controllers		Road Load simulation – vehicle control
232	UUT	6. UUT Control	6.1 – Controllers		Robot– pilot and driver aid
233	UUT	6. UUT Control	6.1 – Controllers		TOM Embedded controler
234	UUT	6. UUT Control	6.2 – Actuators	EPS, SERVOCRAFT, AT LIN ...	Mechanical and ePedal (Servocraft, EPS3K, AT-Lin) MORPHEE embeded solution control and interface
235	UUT	6. UUT Control	6.3 – Dynamometers		AC dyno design, commissioning and maintenance
236	UUT	6. UUT Control	6.3 – Dynamometers		Dyno alignment

237	UUT	6. UUT Control	6.3 - Dynamometers	Frame + Electrical motor + Torquemeter	EC dyno commissioning, maintenance and design
238	UUT	6. UUT Control	6.3 - Dynamometers		Machine regulation
239	UUT	6. UUT Control	6.3 - Dynamometers		PM dyno design, commissioning and maintenance
240	UUT	6. UUT Control	6.4 - Inverter		ABB drive - Analog interface
241	UUT	6. UUT Control	6.4 - Inverter		ABB drive - certification
242	UUT	6. UUT Control	6.4 - Inverter		ABB drive - commissioning rules
243	UUT	6. UUT Control	6.4 - Inverter		ABB drive - configuration tools drive windows and drive composer
244	UUT	6. UUT Control	6.4 - Inverter		ABB drive - EtherCat interface
245	UUT	6. UUT Control	6.4 - Inverter		ABB drive - Maintenance and diagnostics
246	UUT	6. UUT Control	6.4 - Inverter		ABB drive - Profibus interface
247	UUT	6. UUT Control	6.4 - Inverter		ABB drive - Torque and speed measurement sensor and settings
248	UUT	6. UUT Control	6.4 - Inverter		ABB drive- Control modes and PID tuning
249	UUT	6. UUT Control	6.4 - Inverter		PWR3K commissioning and maintenance

250	UUT	6. UUT Control	6.5 - Charge / Discharge cabinet, Battery Emulator	Charge discharge cabinet (HEINZINGER, DIGATRON,	Charge/discharge cabinet generalities, dimension, performances and interface
251	UUT	6. UUT Control	6.5 - Charge / Discharge cabinet, Battery Emulator		DELTA ELEKTRONICA Battery simulator commissioning and maintenance
252	UUT	6. UUT Control	6.5 - Charge / Discharge cabinet, Battery Emulator		DIGATRON cabinet commissioning and maintenance
253	UUT	6. UUT Control	6.5 - Charge / Discharge cabinet, Battery Emulator	Battery benches	Company - battery bench generalities
254	UUT	6. UUT Control	6.5 - Charge / Discharge cabinet, Battery Emulator		HEINZINGER cabinet commissioning and maintenance
255	UUT	6. UUT Control	6.7 - Rollers	MAHA, AVL, ROTRONICS, BURKE & PORTER	Chassis dynos generalities
256	UUT	6. UUT Control	6.7 - Rollers		Emission bench or performance bench
257	UUT	6. UUT Control	6.7 - Rollers		market review and interface for each (MAHA, HORIBA, AVL,...)
258	UUT	6. UUT Control	6.8 - Description		Generalities on Electric vehicles
259	UUT	6. UUT Control	6.8 - Description		Mild Hybrid Electric Vehicle Architecture

260	UUT	7. UUT Conditioning	7.1 - Conditioning units		Conditioning devices on the market and interfaces
261	UUT	7. UUT Conditioning	7.1 - Conditioning units		Connection of process and facilities
262	UUT	7. UUT Conditioning	7.1 - Conditioning units		Cooling and safeties
263	UUT	7. UUT Conditioning	7.1 - Conditioning units		ecoolcon design, commissioning and maintenance
264	UUT	7. UUT Conditioning	7.1 - Conditioning units	xCON (Lubricant, Air,Fuel, ...), ecoolcon	Generalities on UUT conditioning air loop, lub loop, fuel loop air loop
265	UUT	7. UUT Conditioning	7.1 - Conditioning units		VULCANIC device commissioning and maintenance
266	UUT	7. UUT Conditioning	7.1 - Conditioning units		xCON interfaces, comissioning and maintenance LUBCON- COOLCON
267	UUT	7. UUT Conditioning	7.2 - Climatic chamber	BINDER, WEISS ...	Climatic chamber in battery testing - Binder WEISS safeties, control and measurement
268	UUT	7. UUT Conditioning	7.2 - Climatic chamber		Climatic function commissioning and maintenance
269	UUT	7. UUT Conditioning	7.2 - Climatic chamber		Climatic function in chassis dynos

270	UUT	7. UUT Conditioning	7.2 - Climatic chamber	Climatic function in Engine testing
271	UUT	7. UUT Conditioning	7.2 - Climatic chamber	Climatic function with eMotor and eAxle
272	UUT	7. UUT Conditioning	7.2 - Climatic chamber	Interface to Automation system
273	UUT	7. UUT Conditioning	7.3 - Vehicle fan	Blower function in Chassis dynos
274	UUT	7. UUT Conditioning	7.3 - Vehicle fan	Cooling and fan in testing environment - suppliers integration and maintenance
275	Test Cell	8. Mechanics	8.1 - Base plate	Design, structure, suspension, damping solutions, analysis, installation, transportation
276	Test Cell	8. Mechanics	8.2 - Trolleys	Standard trolleys, docking system, UUT mounting and damping, matchplate, alignment
277	Test Cell	8. Mechanics	8.3 - Shaft / Transmission	Mounting and alignment - maintenance and diagnostic
278	Test Cell	8. Mechanics	8.3 - Shaft / Transmission	Study and specification, vibration analysis torsional vibration analysis
279	Test Cell	8. Mechanics	8.3 - Shaft / Transmission	Torsional vibration tool chain (Osiris??)
280	Test Cell	8. Mechanics	8.3 - Shaft / Transmission	Vibration measurement (01dB, Hammer impact)
281	Test Cell	8. Mechanics	8.3 - Shaft / Transmission	Vibration data reporting and analysis

282	Test Cell	9. Electrical engineering	9.1 – Power cabinet		Battery test cell introduction
283	Test Cell	9. Electrical engineering	9.1 – Power cabinet	(220 VAC to xx VDC ?)	N2 homologation (France) safeties and electric work
284	Test Cell	9. Electrical engineering	9.2 – Control cabinet	FEV	Commissioning and maintenance principle
285	Test Cell	9. Electrical engineering	9.2 – Control cabinet		Wiring good practices
286	Test Cell	9. Electrical engineering	9.3 – Power connection box		Measurement/ switch boxes for E-testbeds
287	Test Cell	9. Electrical engineering	9.4 – Safeties		Other PLC architecture
288	Test Cell	9. Electrical engineering	9.4 – Safeties		Pilz safety programable relay specificities
289	Test Cell	9. Electrical engineering	9.4 – Safeties		Safeties in testing (engine, battery, vehicle) – machine EU directive – rotating machine safety

290	Test Cell	9. Electrical engineering	9.4 – Safeties		Safety concept – EMS loop configuration – PLC structure
291	Test Cell	9. Electrical engineering	9.4 – Safeties		UPS and power safety
292	Test Cell	9. Electrical engineering	9.4 – Safeties		Yellow Beckhoff modules specificities
293	Test Cell	10. Climatic	10.1 – Exhaust gas extraction		Measurements and dimension basics (flow, pressure, temp) – closed loop control – interface
294	Test Cell	10. Climatic	10.2 – Ventilation		Commissioning and maintenance principle
295	Test Cell	11. Acoustic	11.2 – Noise attenuation in ventilation		Flow and noise, ventilation noise principles
296	Test Cell	12. Fire & Gas	12.1 – Fire detection		Overall safety of the test cell – from human being to machine operation)
297	Test Cell	12. Fire & Gas	12.2 – Gas detection	HC CO/CO ₂ , H ₂ , GPL, GNV detection ...,	HC CO/CO ₂ , H ₂ , GPL, GNV detection ...,

298	Building	13. Building	13.1 – Civil works	Civil works, Dismantling, Isolation, Fuel Distribution, water piping, TGBT, Cooling tower, Chiller	General principle for civil work
299	Building	13. Building	13.4 – Fuel / Gas Distribution		Fuel safeties in testing sites
300	Building	13. Building	13.5 – Water piping		Facilities distribution and rules
301	Building	13. Building	13.5 – Water piping		process water treatment in testing sites engine or else
302	Building	13. Building	13.6 – TGBT		Electrical power distribution principles, rules, generalities earthing systems
303	Building	13. Building	13.7 – Cooling tower		Cooling the process water – principle and circuit design
304	Building	13. Building	13.8 – Chiller		Compressor installation, supplier, interface commissioning and maintenance
305	Overall	14. Services	14.1 – Project management		Maintenance project administration using Company Tool chain
306	Overall	14. Services	14.1 – Project management		Project management process in ENORISE
307	Overall	14. Services	14.2 – Packaging / transport		Shipping rules in ENORISE
308	Overall	14. Services	14.3 – Commissioning		Understand the three pillars of a project- Quality, Cost, Planning

309	Overall	14. Services	14.3 - Maintenance / Warranty	Maintenance training for ENORISE - rules and process
310	Overall	14. Services	14.4 - Training	ENORISE ACADEMY - access and practice
311	Overall	14. Services	14.4 - Training	Training a trainer for ENORISE
312	Overall	14. Services	14.6 - Final acceptance	Commissioning engineer process in ENORISE
313	Overall	14. Services	14.6 - Final acceptance	Hotline and ENORISE Support