Training and Development Program 2019
Active future development - your success is our goal!

The success and competitiveness of companies fundamentally depend on the expertise of their employees.

An important contribution to this is ongoing vocational learning and targeted training on demand.

Framatome offers comprehensive solutions for the development, construction and maintenance of nuclear power plants. Our offer also includes training for customers and their employees. In our courses we impart the necessary basics, as well as detailed and background knowledge for safe and efficient operation, modernization and maintenance of plants. The Framatome Training Center contributes to maintaining competence in nuclear power plants. Our long-standing international contacts with active nuclear power plant utilities and operators, authorities and institutions, provide important impulses for nuclear safety issues and solutions.

The modular training courses on technology, I&C and Framatome products are oriented toward the requirements of the various groups of users in nuclear power plants and their environment.

On request, we can provide the training sessions to your personnel at locations other than our modern Training Center in Karlstein am Main, Germany.

We can also create individual training programs tailored to the requirements of your company. For further information, please contact us; we will be happy to advise you.
Technology Courses
Training courses on power plant technology in the fields of process engineering layout and design of primary- and secondary-side systems, reactor physics and operational practice, nuclear instrumentation, operational and accident behavior, electrical engineering and process engineering requirements for safety I&C and the I&C of the turbine generator set.

I&C Courses
Training courses on safety I&C using the digital system platform TELEPERM XS covering the following topics: architectures, hardware, software, engineering, maintenance, system computer and system administration.
Training courses on hard-wired programmed I&C using the system platform ISKAMATIC.

Product Courses
Training courses focusing on Framatome products and providing detailed information on the particular product.
Program Overview

Technology Courses

Pressurized Water Reactors
- Introductory courses
- Advanced courses
- Expert courses
- Know-why courses

EPR Reactors
- Introductory courses
- Advanced courses
- Simulator courses

I&C Courses

Safety-related I&C TELEPERM XS
- Introductory courses
- Advanced courses
- Expert courses

Hard-wired programmed I&C
- Introductory courses

Product Courses

Courses relating to Framatome GmbH products
- THORC Motor Control Center
- Advanced Load Following Control (ALFC)
1

Technology Courses
Pressurized Water Reactors
Introductory, advanced, expert and know-why courses covering German and international KWU pressurized water reactors (PWR) and courses for ongoing modernization projects in OEM (KWU) plants.

Introductory Courses
Introductory courses provide a non-plant-specific overview of systems and process engineering features. An overview of the following topics is given: overview of primary- and secondary-side systems, as well as operational and safety-related I&C, nuclear physics and electrical engineering basics.

Advanced Courses
Advanced courses are plant-specific and provide detailed information on systems and on process related aspects of operational and safety-related I&C. These courses cover the following topics in detail: overview of primary- and secondary-side systems as well as operational and safety-related I&C, nuclear physics and electrical engineering basics.

Expert Courses
Expert courses are topic-based. They provide necessary understanding of available technical solutions and give background information on systems engineering design and the definition of operating modes in order to provide a deeper understanding of the construction and operational behavior of the plant.

Know-why Courses
Know-why courses are topic-based in order to impart "knowledge on why something was Developed in such a way". They therefore provide profound knowledge on current technical solutions against the background of historical technical evolution in relation to the development of codes and standards, and where relevant, incidents and accidents (such as TMI). This “know-why” also refers to the design of systems and the definition of operating modes.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>B211D</td>
<td>PWR Introductory Course (modules can booked individually)</td>
<td>08</td>
</tr>
<tr>
<td>B211D M1</td>
<td>PWR Introductory Course Module 1:</td>
<td>09</td>
</tr>
<tr>
<td></td>
<td>Overview of nuclear systems</td>
<td></td>
</tr>
<tr>
<td>B211D M2</td>
<td>PWR Introductory Course Module 2:</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Overview of secondary side, cooling water systems, operational I&amp;C</td>
<td></td>
</tr>
<tr>
<td>B211D M3</td>
<td>PWR Introductory Course Module 3:</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Electrical engineering and turbine generator I&amp;C; auxiliary and emergency power supplies</td>
<td></td>
</tr>
<tr>
<td>B211D M4</td>
<td>PWR Introductory Course Module 4:</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Physics and thermal hydraulics of the reactor core, components, radiation protection</td>
<td></td>
</tr>
<tr>
<td>B211D M5</td>
<td>PWR Introductory Course Module 5:</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Safety I&amp;C, Operational Transients and Accidents</td>
<td></td>
</tr>
<tr>
<td>B226D</td>
<td>PWR Short Introductory Course</td>
<td>14</td>
</tr>
<tr>
<td>B228D</td>
<td>PWR Safety I&amp;C from the Process Engineering Standpoint</td>
<td>15</td>
</tr>
<tr>
<td>B510</td>
<td>Basics of Nuclear Power Plant Commissioning</td>
<td>16</td>
</tr>
<tr>
<td>B880.1D</td>
<td>Nuclear Safety Basic Course</td>
<td>17</td>
</tr>
<tr>
<td>L245</td>
<td>Auxiliary and Emergency Power Supply in PWR</td>
<td>18</td>
</tr>
</tbody>
</table>
# PWR Introductory Course

**Course Number:** B211D consisting of five Modules M1 to M5

## Target Group

Engineers, technicians, master craftsmen, and administrative personnel of nuclear power plants (also specialist personnel from licensing authorities and expert organizations) who wish to obtain a general overview.

## Duration:

2 x 3 weeks

**Location:** Karlstein

**Language:** German

English on request

## Objectives

The course participants acquire an overview on the design and function of individual systems of a pressurized water reactor nuclear power plant. Furthermore, they receive insights into the operational interaction of the systems involved, and into the behavior of the plant during various transients and accidents. The documents used are based on the Philippsburg 2 ("pre-Konvoi") plant. Important differences from other PWR-plants are discussed.

Reference: Konvoi / Pre-Konvoi

## Content

- General basics, introduction and identification system
- Reactor core physics and thermal hydraulic core design
- Design, function and operating principle of the reactor coolant and pressurizer system
- Reactor auxiliary and supporting systems
- Core components, fuel rods, fuel cycle, fuel assembly fabrication
- Auxiliary power, emergency power supply
- Secondary side, main steam system, condenser and vacuum system
- Turbine generator
- Circulating water system, service water systems, component cooling systems
- Turbine electrohydraulic control, overview of the turbine generator
- Excore and incore instrumentation systems
- Nuclear operation practice and operational behavior, radiation protection
- Safety and operational I&C
- Plant behavior during operational transients and accidents

## Prerequisites

Practical experience in a power plant is desirable, but no specific knowledge of nuclear power plants is required.

## Other information:

Participants: 6 to 12 persons

Questions are set for each topic. At the end of the module, if requested, a certificate is issued to candidates who pass a test. Otherwise, a confirmation of attendance is issued.

---

**Contact**

+49 (0)9131 900 34567
training@framatome.com
www.framatome.com/EN/customer-4929/training-center.html
Target Group:
Engineers, technicians, master craftsmen, and administrative personnel of nuclear power plants who wish to acquire a general overview.

Objectives
The course participants acquire an overview of the design and function of nuclear systems in a pressurized water reactor nuclear power plant. They also obtain detailed insights into the design and function of the reactor coolant system and the primary-side auxiliary and safety systems.

Reference: Konvoi / Pre-Konvoi

Content:
- General basics and introduction to the overall plant and power plant identification system (AKZ / KKS)
- Design, function and operating principle of the reactor coolant and pressurization system
- Overview of the reactor auxiliary and supporting systems
- Volume control system
- Boric acid and demineralized water system
- Chemical system
- Coolant purification system
- Coolant degasification system
- Coolant storage and treatment system
- Residual heat removal system and fuel pool cooling system
- Component cooling water system (residual heat removal chain)
- Nuclear HVAC systems
- Gas waste processing and exhaust systems

Prerequisites
Practical experience in a power plant is desirable, but no specific knowledge of nuclear power plants is required.

Other information:
Participants: 6 to 12 persons
Questions are set for each topic.
## Target Group
Engineers, technicians, master craftsmen, and administrative personnel of nuclear power plants who wish to acquire a general overview.

## Objectives:
The participant acquire an overview of the design and function of the secondary system, the cooling water systems, I&C concept and of the operational I&C concept of a pressurized water reactor nuclear power plant.

Reference: Konvoi / Pre-Konvoi

## Content
- Overview of the secondary system:
  - Main steam system
  - Main condenser system and low-pressure feedwater heating system
  - Feedwater system and high-pressure feedwater heating system
  - Startup and shutdown system
- Circulating water system
- Service water systems
- Secured and conventional closed cooling water systems
- Overview of the I&C concept
- Overview of the operational I&C concept using the condensate system as an example

## Prerequisites
Practical experience in a power plant is desirable, but no specific knowledge of nuclear power plants is required.

## Other information:
Participants: 6 to 12 persons
Questions are set for each topic.
## Target Group
Engineers, technicians, master craftsmen, and administrative personnel of nuclear power plants who wish to acquire a general overview.

## Objectives
The course participants acquire an overview of the electrical and hydraulic turbine and bypass control system, and of the auxiliary and emergency power supplies of a nuclear power plant.

Reference: Konvoi / Pre-Konvoi

## Content
- Turbine and bypass control systems (electric and hydraulic)
- Overview of the turbine generator set
- Auxiliary power supply
- Emergency power supply

## Prerequisites
Practical experience in a power plant is desirable, but no specific knowledge of nuclear power plants is required.

## Other information:
Participants: 6 to 12 persons
Questions are set for each topic.
**Target Group**

Engineers, technicians, master craftsmen and administrative personnel of nuclear power plants who wish to acquire a general overview.

**Objectives**

The course participants acquire an overview of thermal hydraulic and core physics processes, core instrumentation, core components, and radiation protection in a pressurized water reactor nuclear power plant.

Reference: Konvoi / Pre-Konvoi

**Content**

- Reactor core physics
- Thermal hydraulic core design
- Core components, fuel assemblies, overview of the fuel cycle, fuel fabrication
- Incore and excore instrumentation systems (neutron flux instrumentation, PDD system, aeroball system)
- Nuclear operation practice
- Radiation protection and activity flow in a nuclear power plant

**Prerequisites**

Practical experience in a power plant is desirable, but no specific knowledge of nuclear power plants is required.

**Other information:**

Participants: 6 to 12 persons
Questions are set for each topic.
## Target Group

Engineers, technicians, master craftsmen, and administrative personnel of nuclear power plants who wish to acquire a general overview.

## Duration

5 days

## Location

Karlstein

## Language

German

English on request

## Objectives

The course participants acquire an overview of safety-related I&C and plant dynamics of a pressurized water reactor nuclear power plant. Furthermore, the process- and I&C-related design bases are outlined.

Reference: Konvoi / Pre-Konvoi

## Content

- Safety-related I&C
  - Reactor power control
  - Reactor limitation system
  - Reactor protection system
- Behavior of the plant in normal operation, during operational transients and accidents
- Nuclear Safety
  - Safety concept, codes and standards, hardware design

## Prerequisites

Practical experience in a power plant is desirable, but no specific knowledge of nuclear power plants is required.

## Other information:

Participants: 6 to 12 persons
Questions are set for each topic.
## PWR Short Introductory Course

**Course Number:** B226D

### Target Group

Engineers, technicians, master craftsmen, and administrative personnel of nuclear power plants (also specialist personnel from licensing authorities and expert organizations) who wish to obtain a general overview.

### Duration: 5 days  
**Location:** Karlstein  
**Language:** German  
**English on request**

### Objectives

The course participants acquire an overview on the design and function of individual systems of a pressurized water reactor nuclear power plant. Furthermore, they receive insights into the operational interaction of the systems involved. The documents used are based on the Philippsburg 2 ("pre-Konvoi") plant.

### Content

- General basics and introduction to the overall plant
- Design, function and operating principle of the reactor coolant and pressurization system
- Overview of the reactor auxiliary and supporting systems
- Core components
- Reactor core physics
- Overview of the secondary system
- I&C concept

### Prerequisites

Practical experience in a power plant is desirable, but no specific knowledge of nuclear power plants is required.

### Other information:

Participants: 6 to 12 persons
PWR Safety I&C from the Process Engineering Standpoint
Course Number: B228D

Target Group
Engineers and technicians form the I&C or process engineering / physics fields, shift personnel and commissioning personnel (working for manufacturers, operators, authorities and expert organizations).

Objectives
The participants acquire process engineering-related knowledge on reactor control, reactor limitation functions and the reactor protection system, specifically with regard to requirements, background information and comparisons of different solutions, as well as on interaction on main operating modes and transients.

Reference: Konvoi / Pre-Konvoi

Content
• Overview of safety I&C and its hierarchy
• Operator response times, priority concept, defense in depth
• PWR power control concept, reactivity behavior, part-load diagram, control rod maneuvering concept
• Reactor power control principle, interaction and adaption to different core states
• Safety categories and hardware requirements
• Reactor power limitation functions (L-RELEB, STAFE-RELEB, Peak-RELEB, etc.)
• Control rod insertion concepts
• Preserving shutdown margin / safeguarding subcriticality (STAFAB/STEB)
• Coolant pressure and pressurizer level limitation
• Operating principle of limitation functions during power transients
• Overview of reactor protection system, relevant safety levels, safety objective concept, building concepts external events, failure concept (single failure, repair case)
• Reactor protection system and functions for the main accidents

Prerequisites
I&C basic knowledge or prior participation in the B226D compact PWR introductory course.

Other information
Participants: 6 to 12 persons
# Basics of Nuclear Power Plant Commissioning

**Course Number:** B510  
**Duration:** 1 day  
**Location:** Erlangen  
**Language:** English

## Target Group:
This training course is aimed at all supplier and sub-supplier personnel who are involved in commissioning tasks at the nuclear power plant construction site. The main objective is therefore to familiarize all course participants with the overall structure and objectives of the commissioning program and present specific examples of the ongoing project.

## Objectives:
The course participants acquire an overview of a commissioning organization and their areas of responsibility, as well as an overview of the commissioning documentation. Furthermore, they receive increased awareness of safety aspects and error prevention tools during commissioning including the correct forwarding of commissioning questions/clarification needs to responsible personnel.

## Content:
- **Basics of nuclear power plant commissioning**  
  - Nuclear physics of nuclear power plant design  
  - Fundamentals of operation of main nuclear power plant systems  
  - Commissioning phases and scopes, from initial system tests to PTO (Provisional Take Over)  
- **Introduction to nuclear safety issues during commissioning**  
  - Safety rules and regulations to be applied  
  - Duties and responsibilities during commissioning tasks  
- **Methods, instruments and tools for commissioning**  
  - Permit to work concept  
  - Commissioning management tools regarding "Materials, Tests, Permits to Work"  
- **Documentation: What is a commissioning procedure?**  
  - Applicability and significance of the commissioning documentation structure  
  - Significance of the commissioning process, procedure and reports

## Prerequisites
Basic knowledge of pressurized water reactors is advantageous.

## Other information
Participants: 6 to 12 persons.  
This course is only available in English.
### Target Group
Project managers, project engineers, and technical personnel of nuclear power plants.

### Objectives
The participants acquire an overview of the overall safety concept of a nuclear power plant.

### Content
The following topics will be covered in detail:
- Safety objectives
- Codes and standards
- Safety issues during the design phase
- PSA during design
- Safety issues during the construction phase
- Safety issues during operation of plant
- Safety improvements/assessment
- Nuclear safety: application examples

### Prerequisites
Several years of practical experience in technical work or attendance of one of the introductory courses are advantageous.

### Other information:
Participants: 6 to 12 persons
## Auxiliary and Emergency Power Supply in PWR
**Course Number:** L245

### Target Group
Utility employees who needs an overview about the auxiliary and emergency power supply in a KWU PWR nuclear power plant.

### Objectives
The participants receive an overview about auxiliary and emergency power supply in a nuclear power plant. Beside the main components generator, transformer and generator breaker the emergency diesel generator sets inclusive their auxiliary systems are known. Furthermore the requirements of auxiliary and emergency power supply according KTA are explained. The participants know the differences in design of auxiliary and emergency power supply in the German pressurized water reactors and the EPR.

### Content
The following topics will be covered in detail:
- Tasks of auxiliary and emergency power supply
  - Design criteria
  - Building concept
- General layout of auxiliary power supply
  - Requirements according KTA
  - Supply possibilities
  - Main components
  - Power transmission variants of German PWR
- General layout of emergency power supply
  - Requirements according KTA
  - Emergency power network 1 (design and supply possibilities)
  - Emergency power network 2 (design and supply possibilities)
  - Uninterruptable power supply
- General design of auxiliary and emergency power supply in the EPR

### Prerequisites
General knowledge about the design and the function of a nuclear power plant.

### Other information:
Participants: 6 to 12 persons
### B311D  PWR Plant Course

**Course Part 1:**  Primary circuit  
**Course Part 2:**  Secondary circuit: Secondary systems, power transmission and auxiliary power supply  
**Course Part 3:**  Nuclear operation, reactor I&C, operational incidents and accidents

### B850  Basics of Beyond-Design-Basis Accidents

*(Severe Accidents)*
Target Group

The course provides training for future shift personnel and prepares them for reactor operator or shift supervisor examinations on technical plant issues of PWR.

Objectives

The course participants acquire knowledge on the design of their designated nuclear power plant. In the first and second parts of the course, the key primary- and secondary side systems are presented, focusing on their design, function, I&C, operation principle and accident behavior. In the third part of the course, knowledge of the nuclear operation practices and the operation and accident behavior of the overall plant is consolidated from the following perspective: physics/thermal hydraulics, reactor safety I&C, plant dynamic analyses and the operating manual.

Content

Part 1: Primary circuit
- Components in a nuclear power plant: filter, pumps, compressors, fans, auxiliary valves and heat exchangers
- Overview of the overall plant, power plant identification system, reactor coolant system and pressurizing system including the main components of the nuclear auxiliary and supporting systems (from volume control systems to component drainage and venting), as well as the residual heat removal chain
- Treatment and storage of radioactive liquid waste / activity flow in a nuclear power plant / discharge of radioactive substances into the environment/ structural radiation protection, accessibility of plant, chemical conditioning modes

Part 2: Secondary circuit: Secondary systems, power transmission and auxiliary power supply
- All secondary side systems from the main steam system to the power transmission system, auxiliary power supply / emergency power supply, DC supply

Part 3: Nuclear operation, reactor I&C, operational transients and accidents
- From reactivity behavior till to cooldown from the remote shutdown station

Prerequisites

Good power plant knowledge or prior participation in the B211D PWR introductory course.

Other information:

Participants: 6 to 12 people
Scope and Duration can be adapted to the needs of the customer
Every part of the course is concluded with a written examination.
Basics of Beyond-Design-Basis Accidents (Severe Accidents)
Course Number: B850

**Target Group**
Experts and employees from the following areas: development, commissioning and maintenance for systems used for mitigation and management of beyond-design-basis accidents in nuclear power plants.

**Objectives**
The main objective of this course it to familiarize course participants with the basics of initiating events and technological solutions for beyond-design-basis accidents including lessons learned from severe accidents Three Miles Island, Chernobyl and Fukushima.

**Content**
- From TMI-2 to Fukushima – lessons learned
- Introduction to beyond-design-basis accidents
  - International and national classification
  - Basics of beyond-design-basis accidents
- Specific design for Severe Accidents (SA)
  - Design requirements for SA systems - features of GEN III+
  - Diversity, redundancy and independence – preventive measures for SA
- Radiation protection during beyond-design-basis accidents
  - Phenomenology and radiological acceptance criteria
  - Specific measures for management or mitigation of the effects of SA
- Methods for preventing and mitigating SA
  - Scenarios and analysis methods
  - Level 1 and level 2 probabilistic safety analysis
  - Plant management during beyond-design-basis accidents

**Prerequisites**
Advanced plant knowledge, several years of relevant work experience in a PWR nuclear power plant, are advantageous.

**Other information**
Participants: 6 to 12 persons
## PWR Expert Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Course</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>B813D</td>
<td>PWR Thermal Hydraulics</td>
<td>23</td>
</tr>
<tr>
<td>B840D</td>
<td>PWR Nuclear Instrumentation</td>
<td>24</td>
</tr>
<tr>
<td>B841D</td>
<td>PWR Nuclear Operation Practice</td>
<td>25</td>
</tr>
<tr>
<td>B862D</td>
<td>PWR Design Basis Accidents</td>
<td>26</td>
</tr>
</tbody>
</table>
# PWR Thermal Hydraulics
## Course Number: B813D

<table>
<thead>
<tr>
<th>Duration: 1 day</th>
<th>Target Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: Karlstein</td>
<td>Senior shift personnel and specialists, especially for physics, I&amp;C and process engineering.</td>
</tr>
<tr>
<td>Language: German</td>
<td>Objectives</td>
</tr>
<tr>
<td>English on request</td>
<td>The training course is based on Framatome’s long-standing operational experience in operational feedback evaluation, performing design calculations, and test results obtained at the PKL facility in Erlangen and the KATHY test facility in Karlstein.</td>
</tr>
</tbody>
</table>

## Content
- Thermal and calorific state variables
- State changes of water with application examples from nuclear power plants
- Condensation processes in a PWR
- Water hammer
- Flow dynamics in nuclear power plants
- Single- and two-phase flow
- Natural circulation
- Heat transfer mechanisms
- Heat removal in forced and natural circulation
- Applications in normal operation of nuclear power plants
  - Heat transfer in reactor core, critical heat flux, film boiling
  - Secondary side heat removal, part-load diagram
  - Thermal hydraulic monitoring of the core

## Prerequisites
Several years of relevant work experience in the PWR engineering and participation in the B211D PWR introductory course are advantageous.

## Other information
Participants: 6 to 12 persons
# PWR Nuclear Instrumentation
## Course Number: B840D

### Target Group
Engineers and technicians from the I&C or process engineering / physics area, as well as commissioning experts and shift personnel.

### Duration: 3 days  
Location: Karlstein  
Language: German  
English on request

### Objectives
This course gives the participants a detailed overview of the nuclear instrumentation in a PWR plant. The following topics are discussed: principles and design of the instrumentation systems, I&C processing of the obtained neutron flux signals in limitation and reactor protection functions.

Reference: Konvoi / Pre-Konvoi

### Content
- General possibilities for neutron flux measurement
- Neutron flux excore instrumentation system
  - Mechanical design
  - Principle of neutron flux measurement
  - Source, intermediate and power range
  - Coordination of the measuring ranges, reactor protection
  - Calibration
- Physical monitoring of fuel loading
- Neutron flux incore instrumentation system
  - Mechanical design of the PDD system (PDD = Power Distribution Detector)
  - Power distribution detectors
  - Monitoring of power density distribution
  - Aeroball system
  - Nuclear process computer, POWERTRAX
  - Processing of PDD signals in limitation functions

### Prerequisites
Several years of relevant work experience in a PWR nuclear power plant. Furthermore, participation in the B211D PWR introductory course is recommended.

### Other information
Participants: 6 to 12 persons
## PWR Nuclear Operation Practice
Course Number: B841D

### Target Group
Senior shift personnel and specialist personnel especially in physics, I&C and process engineering.

### Objectives
This course provides the participants with an in-depth understanding of the operational behavior of a plant from the physics standpoint. The participants consolidate their knowledge of reactor physics and use this on concrete examples from plant operation. After completing the course, participants can independently carry out qualitative and predictive estimations.

Reference: Konvoi / Pre-Konvoi

### Content
- Neutron-physics basics
- Reactor core
- Loading of a reactor
- Neutron kinetics in subcritical and critical zero-power reactors
- Criticality monitoring during fuel loading and startup
- Reactivity coefficients and effects
  - Boron
  - Fuel temperature
  - Coolant temperature
  - Control rods
  - Xenon
- Power density distribution / xenon oscillations
- Neutron flux noise

### Prerequisites
Several years of relevant work experience in PWR engineering.

### Other information
Participants: 6 to 12 persons
# PWR Design Basis Accidents
#### Course Number: B862D

## Target Group
Persons with process and I&C engineering background from nuclear power plants, manufacturers, expert organizations or authorities.

## Duration: 5 days  
**Location:** Karlstein  
**Language:** German  
**English on request**

## Objectives
With regard to design basis accidents in PWRs, participants acquire an overview of accident-related design of the overall plant. In this context, an understanding of accident sequences is developed, characterized by thermodynamic summaries, safety I&C, safety systems and manual actions.

## Content
The following accidents (and transients) are covered with respect to the points mentioned above:

- Loss of offsite power (transient)
- Loss-of-coolant accidents (LOCA)
- Steam generator tube ruptures
- Feedwater line breaks
- Main steam line breaks
- Inadvertent operation of main steam valves
- Subcooling transients
- External events
- ATWS
- Test results of the PKL and UPTF test facilities

## Prerequisites
PWR introductory course (B211D or B226D) or "PWR Safety and Process Engineering" (B228D). Several years of relevant work experience in a PWR nuclear power plant, expert organization, authority or manufacturer are advantageous.

## Other information
Participants: 6 to 12 persons
### PWR Know-why Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>B875.25D</td>
<td>PWR Plants from the Reactor Physics Standpoint</td>
<td>28</td>
</tr>
<tr>
<td>B875.30D</td>
<td>Evaluation of Experience Feedback for Emergency Diesel and Emergency Power Supply</td>
<td>29</td>
</tr>
</tbody>
</table>

Other specific PWR/BWR know-why courses are available on request.
# PWR Plants from the Reactor Physics Standpoint

**Course Number:** B875.25D

## Duration: 2.5 days  
**Location:** Karlstein  
**Language:** German  
**English on request**

### Target Group

Physicists and engineers for reactor physics or process engineering, shift personnel.

### Objectives

Our experts share background information on basic design ("Know-Why") on important features of the conceptual design of PWR plants (German design) from the reactor physics standpoint. This reactor physics knowledge is fundamental to economic and safe operation. Furthermore, the participants receive an insight into lance fabrication (incore instrumentation) and into the operation of the Karlstein thermal hydraulic testing facility.

### Content

- Core monitoring concept in PWR plants
  - Core monitoring with aeroball and the power distribution detector (PDD) system
  - Structure of the core protection system in PWR plants
- Reactor physics testing in PWR plants
  - Routine measurements = standard testing
  - Validation measurements = special testing
- Reactivity monitoring in PWR plants
  - Determining reactivity or shutdown margin
  - Requirements for shutdown margin and criteria to be met
  - Reactivity control, reactivity monitoring and associated limitations
- Neutron flux (NF) noise in PWR plants
- Visit to the Framatome lance fabrication in Karlstein
- Visit to the Framatome thermal hydraulic testing facility in Karlstein

### Prerequisites

Basic knowledge of reactor physics, relevant work experience in a PWR nuclear power plant or participation in the B226D or B211D introductory course are advantageous.

### Other information

Participants: 6 to 12 persons
**Evaluation of Experience Feedback for Emergency Diesel and Emergency Power Supply | Course Number: B875.30D**

**Target Group**
Specialist electrical and systems engineering employees (for diesel engines) and shift personnel (engineers, technicians, master craftsman, administrative personnel)

**Duration:** 1 day  
**Location:** Karlstein  
**Language:** German  
English on request

**Objectives**
Important events in auxiliary and emergency power supplies, and in diesel generator sets and their auxiliary systems which could result in partial or complete loss of power supply to the reactor system. The main objective of this course is the discussion of different significant events in the design of auxiliary and the emergency power supply systems. Employees in electrical and systems engineering (for diesel engines) receive information on the significance of various technical solutions with regard to failure modes.

**Content**
- Concepts for auxiliary and emergency power supplies and for emergency diesel (including load shedding to house load, offsite power transfer)  
- Controls, auxiliary systems, priority equipment protection  
- Biological fouling, climatic conditions (summer fuel)  
- Forsmark event (cascading failure on the electrical side)  
- Incidents in auxiliary and emergency power supplies  
- Incidents in reactor protection systems (e.g. passive failure at KKP2)  
- Incidents in emergency diesel generator sets  
- Angra 2 event: emergency power mode after blackout on the Brazilian power grid  
- Reliability in long-term operation

**Contact**
+49 (0)9131 900 34567  
training@framatome.com  
www.framatome.com/EN/customer-4929/training-center.html

**Requirements**
Relevant work experience in a PWR nuclear power plant

**Other information**
Participants: 6 to 12 people
EPR Reactors

Introductory, advanced and simulator courses for international EPR plants, ongoing project-related courses for modernization and new-build projects.

**Introductory Courses**

- Pages 31 to 32 -

Introductory courses provide a standard EPR plant overview of systems and process engineering features. An overview of the following topics is given: overview of nuclear, safety, auxiliary and secondary side systems, as well as operational and safety-related I&C, nuclear physics and electrical engineering basics.

**Advanced Courses**

- Pages 33 to 34 -

EPR advanced courses are plant- and technology-specific and provide detailed information on systems and on process related aspects of operational and safety-related I&C. These courses cover the following topics in detail: overview of nuclear, safety, auxiliary and secondary side systems including a review of basic design requirements, as well as operational and safety-related I&C, nuclear physics and electrical engineering basics.

**Simulator Courses**

- Pages 35 to 36 -

These courses make use of an EPR Training Simulator. The simulator courses offers theoretical knowledge with emphasize on practical exercises covering operational aspects from normal plant operation towards abnormal, accidents and beyond design cases.
## EPR Short Introductory Course
**Course Number:** B252EPR

### Target Group
Engineers, technicians and experts who want to become acquainted with the EPR design.

### Duration: 5 days  
**Location:** Erlangen  
**Language:** German / English

### Objectives
This course gives an overview of the design philosophy of an EPR plant and introduces its main systems. The system layout, main components and operation are discussed.

### Content
The course covers the following topics in detail:

- EPR history, design philosophy, main plant data
- EPR overview, main systems and their location
- Introduction to nuclear physics
- Overview of the primary circuits
  - Layout and main components, Instrumentation
- Overview of the auxiliary systems
  - Composition and function of the auxiliary systems
- Overview of the safety-related systems
  - Composition and function of the residual heat removal chain
- Secondary circuit – overview
  - Heat transfer and main components of the secondary circuit
- Electrical systems, I&C and reactor control
  - Main components of electrical power supply and I&C
- Overview EPR safety concept
  - Main safeguard systems and severe accident mitigation

### Prerequisites
No specific knowledge of nuclear power plants is required. knowledge required

### Other Information
Participants: 6 to 12 persons
The training materials are available in English only

### Contact
+49 (0)9131 900 34567
training@framatome.com
www.framatome.com/EN/customer-4929/training-center.html
## EPR Advanced Course
### Course Number: B257EPR

<table>
<thead>
<tr>
<th><strong>Target Group</strong></th>
<th>Engineers and technicians involved in the design, construction, commissioning or maintenance phases of new-build projects.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration:</strong></td>
<td>10 days</td>
</tr>
<tr>
<td><strong>Location:</strong></td>
<td>Erlangen</td>
</tr>
<tr>
<td><strong>Language:</strong></td>
<td>German / English</td>
</tr>
</tbody>
</table>

## Objectives
After completion of this course, the participants will be able to better recognize how the EPR systems work together based on the design principles. This course gives an overview of the EPR design, taking into account safety and design principles relevant throughout all stages of the EPR lifecycle: design, planning, construction, commissioning, periodic testing and maintenance.

## Content
The course covers the following topics in detail:
- Safety requirements, rules and regulations, and design principles of the EPR
- Reactor coolant system
  - Main components of the reactor coolant system with design principles
- Primary-to-secondary-side heat transfer, operating principle of the steam generator
- Overview of the water-steam cycle with main components
- Auxiliary power supply and emergency power concept
  - Design principles and power supply requirements
- Overview of the I&C architecture, design requirements of the operational and safety I&C
- Accident control using safety systems
  - Design of the safety injection systems for loss-of-coolant accidents (LOCA)
- Reactor auxiliary systems
  - Design and operation of the Chemical and Volume Control System (CVCS), coolant purification, coolant treatment and storage systems, and gaseous waste processing system
  - Concept of storage and handling of radioactive waste

## Prerequisites
Participation in EPR short introductory course (B252EPR) or comparable knowledge is required and 6 months of work experience.

## Other Information
Participants: 6 to 12 persons
The training materials are available in English only

---

Contact
+49 (0)9131 900 34567
training@framatome.com
www.framatome.com/EN/customer-4829/training-center.html
### EPR Simulator Courses

<table>
<thead>
<tr>
<th>B460EPR</th>
<th>Basics of Plant Operation and Transients with the EPR Training Simulator</th>
</tr>
</thead>
</table>
# Basics of Plant Operation and Transients with the EPR Training Simulator

**Course Number:** B460EPR

## Target Group
All engineering personnel involved in design, installation, commissioning, operation and maintenance of an EPR-type Pressurized Water Reactor (PWR).

## Duration: 4 days  
Location: Karlstein  
Language: English

## Objectives
The main objective of this training course is to familiarize the participants with the operation of a nuclear power plant under normal, abnormal and accident conditions using a real-life user interface HMI platform under real-time conditions. The course consists of theoretical parts (T = theory) followed by practical training and exercises on the EPR Engineering Simulator (SIM = simulator) with the OM690 MMI interface.

## Content
- **Introduction to nuclear power plant operation**
  - Overview of operational and safety targets (T module)
  - Methods and tools of operation (operating manuals, MMI system, Technical Specifications) (T/SIM module)
  - Introduction to simulator operation (SIM module)
- **Introduction to normal plant operation**
  - Systems overview and plant conditions (T module)
  - Load ramps (T/SIM module)
- **Strategies during abnormal plant operation**
  - Definitions and methods (concept of turbine trip, partial turbine trip and reactor trip (T module)
  - Examples and exercises regarding abnormal operation transients (SIM module)
- **Accident management**
  - Definitions and methods (safety systems, lines of defense, diversity) (T module)
  - Examples and exercises regarding accidents (SIM module)
  - Overview of beyond-design-basis accidents (T/SIM module)

## Prerequisites
Basics knowledge of EPR Plant Operation and Technology is required. Relevant work experience in a PWR nuclear power plant or participation in the B252EPR or B257EPR Technology courses are advantageous.

## Other Information
Participants: 4 to 8 persons  
This training course is available in English only
2
I&C Courses
Safety-related I&C TELEPERM XS

Training in all topic areas relating to design, engineering and maintenance of safety-related I&C with TELEPERM XS. For an optimal training course, we offer standard courses and customer-specific training session for all target groups. At our Training Center in Karlstein, you can deepen and consolidate the theoretical knowledge obtained in lesson through practical exercises.

**Introductory Courses**
- Pages 39 to 48 -
The introductory courses give an overview of TELEPERM XS basics in the following areas: system architecture, hardware, specific features of engineering and depending on the focus, also maintenance and V & V.

**Advanced Courses**
- Pages 49 to 54 -
These courses are topic and tool based. They provide deepened knowledge on hardware and software components in the important topic areas of TELEPERM XS engineering, test (V & V) and commissioning and operation (servicing and maintenance).

**Expert Courses**
- Pages 55 to 57 -
Expert courses build on the knowledge acquired in the advanced courses on system administration and maintenance.
<table>
<thead>
<tr>
<th>TXS</th>
<th>Introductory Courses</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>L231.1</td>
<td>TELEPERM XS - Fundamentals including Practicals</td>
<td>40</td>
</tr>
<tr>
<td>L231.2</td>
<td>TELEPERM XS - Fundamentals Compact</td>
<td>41</td>
</tr>
<tr>
<td>L231.3</td>
<td>TELEPERM XS - Fundamentals Overview</td>
<td>42</td>
</tr>
<tr>
<td>L531.1</td>
<td>TELEPERM XS - Maintenance HW2G/SMS (5 days)</td>
<td>43</td>
</tr>
<tr>
<td>L531.2</td>
<td>TELEPERM XS - Maintenance HW2G/DIMAS (5 days)</td>
<td>44</td>
</tr>
<tr>
<td>L531.5</td>
<td>TELEPERM XS - Maintenance HW2G/DIMAS (10 days)</td>
<td>45</td>
</tr>
<tr>
<td>L631.1</td>
<td>TELEPERM XS - Engineering Detailed Design</td>
<td>46</td>
</tr>
<tr>
<td>L631.2</td>
<td>TELEPERM XS - Engineering Detailed Design - Compact</td>
<td>47</td>
</tr>
<tr>
<td>L831.1</td>
<td>TELEPERM XS - Special BASIC/ENG/MAINT/OPERATION</td>
<td>48</td>
</tr>
</tbody>
</table>
TELEPERM XS – Fundamentals including Practicals
Course Number: L231.1

Target Group
Personnel involved in I&C project processing, including management staff and personnel in sales/marketing of I&C equipment and licensing authorities.

Objectives
Upon successful completion of this course, course participants will be able to:
• Explain the architecture and function computers of a TELEPERM XS I&C system
• State the basic functions of the hardware modules
• Explain TELEPERM XS system properties and fault detection
• State the TELEPERM XS engineering process in detail
• Design simple databases
• Work with the TELEPERM XS SPACE tools
• Interpret the diagnostic possibilities

Content
This course covers the overall concept of the safety I&C system platform TELEPERM XS (TXS). It gives an overview of TELEPERM XS products, the engineering process (including V&V and SPACE tools) and operation (handling, maintenance). The most important TELEPERM XS hardware and software components, as well as their system properties, are presented. TELEPERM XS safety architecture and maintenance/diagnostic applications are explained.

The following topics are covered in detail and their practical applications are stated:
• Basics of the TELEPERM XS system (architecture, function computers, Hardware 2nd generation and system properties)
• Engineering process including function specifications and V&V management
• Specification of a data base with HW & SW plans (detailed engineering)
• Engineering tools (SPACE)
• Introduction to diagnostics and any tools required
• Overview of the Test Bay and ERBUS
• Practical exercises, demonstrations and seminar tasks

Prerequisites
General knowledge of automation technology for safety systems in nuclear power plants. General IT skills and knowledge of Linux are required.

Other Information
This course will be the basic for the following courses:
TELEPERM XS-Maint, TXS-QDS, TXS-HW2G, TXS SIVAT, TXS-ADMIN
Participants: 6 to 8 persons
# TELEPERM XS – Fundamentals Compact

## Course Number: L231.2

<table>
<thead>
<tr>
<th><strong>Target Group</strong></th>
<th>Personnel involved in I&amp;C project processing, including management staff and personnel in sales/marketing of I&amp;C equipment and licensing authorities.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration:</strong></td>
<td>3 days</td>
</tr>
<tr>
<td><strong>Location:</strong></td>
<td>Karlstein</td>
</tr>
<tr>
<td><strong>Language:</strong></td>
<td>German / English</td>
</tr>
</tbody>
</table>

## Objectives

Upon successful completion of this course, course participants will be able to:

- Explain the architecture, function computers, TELEPERM XS hardware modules, as well as the system properties of a TXS system
- State the TELEPERM XS engineering process
- Design part of a database
- Perform some tasks with TELEPERM XS SPACE tools
- Identify and explain maintenance and diagnostic possibilities

## Content

This course essentially covers the same topics as course L231.1, but in a condensed form. Course participants receive an overview of TELEPERM XS (TXS) products, the engineering process and the process of operation and maintenance. They learn about selected hard- and software components, as well as system properties. Safety I&C architectures and maintenance/diagnostic applications are presented.

The course covers the following topics in detail:

- Basics of the TELEPERM XS system (function computer with architecture, hardware and software with system properties)
- Engineering process (incl. V&V and function specifications)
- Important function specifications as part of a database (network plan)
- SPACE tools which are a part of the engineering process
- Introduction to maintenance and the necessary tools
- Simple demonstrations and exercises are included.

## Prerequisites

General knowledge of automation technology for safety systems in nuclear power plants.

## Other Information

Participants: 6 to 8 persons
Target Group
Personnel involved in I&C project processing, including management staff and personnel in sales/marketing of I&C equipment and licensing authorities.

Objectives
Upon successful completion of this course, course participants will be able to:
- Explain the basic concepts of the TELEPERM XS system platform
- Identify the relevant hardware modules of the system platform
- State the system properties of the digital I&C system and the possibilities for fault detection
- Explain the basic principles of engineering and maintenance

Content
This course gives a condensed overview of TELEPERM XS products. The participants learn about individual components of the TELEPERM XS system. This includes hardware and software components, and an initial insight into the system properties, the engineering process and maintenance.

The course covers the following topics in detail:
- Basics of the TELEPERM XS system
- TXS function computer and system architectures
- Overview of the most important HW/SW modules and TELEPERM XS system properties
- Overview of the engineering process
- Introduction into maintenance
- Presentation of additional demonstrations

Prerequisites
General knowledge of automation technology for safety systems in nuclear power plants.

Other Information
Participants: 6 to 8 persons
TELEPERM XS – Maintenance HW2G/SMS (5days)
Course Number: L531.1

<table>
<thead>
<tr>
<th><strong>Target Group</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>I&amp;C maintenance personnel and I&amp;C testing and commissioning personnel.</td>
</tr>
</tbody>
</table>

| **Duration:** 5 days |
| **Location:** Karlstein |
| **Language:** German / English |

<table>
<thead>
<tr>
<th><strong>Objectives</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Upon successful completion of this course, course participants will be able to:</td>
</tr>
<tr>
<td>• State basics of the TELEPERM XS system (e.g. architecture, hardware and system properties)</td>
</tr>
<tr>
<td>• Explain the concept and mechanism of TELEPERM XS maintenance and its use in the context of maintenance service</td>
</tr>
<tr>
<td>• Carry out the following activities independently: system error analysis, diagnosis, troubleshooting, and recovering</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Content</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The course is based on TELEPERM XS Hardware 2nd generation and the core software version 3.3 x with SMS and GSM as diagnostic tools. After a short introduction to the basics and their plant specific application, the course focuses on the functionality, application and use of the Service Unit, which is the main tool for fault detection and diagnosis. The theoretical knowledge is consolidated in practical exercises.</td>
</tr>
<tr>
<td>The essential elements of the course are:</td>
</tr>
<tr>
<td>• System Basics (function computer and system architectures, Hardware 2nd generation and system properties)</td>
</tr>
<tr>
<td>• The basics of maintenance</td>
</tr>
<tr>
<td>• Fault analysis and diagnosis using the Service Unit and the TELEPERM XS cabinet</td>
</tr>
<tr>
<td>• Procedure and handling of module replacement</td>
</tr>
<tr>
<td>• Loading software and verify loaded software and parameter settings</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Prerequisites</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic knowledge of control and digital automation systems, basic knowledge of TELEPERM XS by preference. Previous attendance of a TELEPERM XS basics or engineering course is desirable but not essential.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Other Information</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants: 6 to 8 persons</td>
</tr>
</tbody>
</table>
# TELEPERM XS – Maintenance HW2G/DIMAS (5days)
## Course Number: L531.2

<table>
<thead>
<tr>
<th>Target Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&amp;C maintenance personnel, including I&amp;C testing and commissioning personnel.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration: 5 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: Karlstein</td>
</tr>
<tr>
<td>Language: German / English</td>
</tr>
</tbody>
</table>

## Objectives

Upon successful completion of this course, course participants will be able to:

- Explain the TELEPERM XS basics, architecture and system properties
- Explain the concept and mechanism of TELEPERM XS maintenance
- Use the different DIMAS clients on the Service Unit (SU) for TELEPERM XS diagnosis and maintenance
- Monitor the TELEPERM XS system, modify parameters and verify parameter changes
- Explain module exchange procedure and module settings

## Content

The course is based on TELEPERM XS Hardware 2nd generation and the 2nd generation of TELEPERM XS core software version \( \geq 3.6.x \) with DIMAS clients. The course starts with a short introduction to TELEPERM XS basics and their plant specific applications. The main focus is on function, application and handling of the TELEPERM XS Service Unit as a tool for diagnosis and troubleshooting in TELEPERM XS systems. Further topics are diagnosis at the cabinet and methods and handling for module replacement.

The course covers the following topics in detail:

- TELEPERM XS basics (system architecture and system properties; HW2G; SPACE function diagram editor FDE)
- Basics of TELEPERM XS maintenance with the Service Unit (DIMAS introduction, DIMAS clients, operating modes and parameterization)
- TELEPERM XS diagnostics at the cabinet (identification/repair of errors at the cabinet; replace or set modules)
- Practical exercises

## Prerequisites

General IT skills, basic I&C knowledge, as well as knowledge of digital automation systems. Basic knowledge of TXS (e.g. previous attendance of a TELEPERM XS basics or engineering course) is desirable

## Other Information

Participants: 6 to 8 persons
### Target Group
This course is intended for I&C maintenance personnel and I&C testing and commissioning personnel.

### Duration: 10 days
### Location: Karlstein
### Language: German / English

### Objectives
Upon successful completion of this course, participants will be able to:
- Explain TELEPERM XS basics, architecture and system properties
- Explain concept and mechanisms of TELEPERM XS maintenance
- Independently diagnosis and troubleshoot the TELEPERM XS system (HW faults/SW errors) with aid of the TXS Service Unit and rectify the faults/errors
- Identify hardware faults, replace faulted modules, change parameters, save changes and load software
- Document the troubleshooting

### Content
The course covers all aspects of TELEPERM XS maintenance for carrying out independent diagnosis, troubleshooting, parametrization, module replacement and commissioning of a real system. The theoretical knowledge is consolidated in practical exercises.

The course covers the following topics in detail:
- Basics of the TELEPERM XS system (system architecture, HW2G, system properties, engineering, coding concept)
- Diagnosis using the TELEPERM XS Service Unit (monitoring and annunciation concept, SU, DIMAS and DIMAS clients, introduction, operating modes and parameterization)
- Diagnosis and maintenance at the training cabinet (independent diagnostic analysis with the Service Unit and the training cabinet, module replacement, commissioning of the system in accordance to the actual TXS documentation)
- Technical documentation of faulted modules in accordance with the return procedure

### Prerequisites
Basic knowledge of I&C and experience in digital automation systems.
TELEPERM XS basic knowledge (e.g. attendance of TXS basics or engineering). Knowledge of Python is required. Generic IT skills and Linux knowledge are necessary.

### Other Information
Participants: 6 to 8 persons
### TELEPERM XS – Engineering Detailed Design
#### Course Number: L631.1

<table>
<thead>
<tr>
<th><strong>Target Group</strong></th>
<th>This course is intended for external/ internal engineers (I&amp;C, IT, QM) and training personnel</th>
</tr>
</thead>
</table>

#### Duration: 5 days  
**Location:** Karlstein  
**Language:** German / English

| **Objectives** | Upon successful completion of this course, course participants will be able to:  
• Name the basic properties of TELEPERM XS I&C systems with respect to system design, hardware and software  
• Explain the most important steps and tools of the engineering process  
• State the tools required for engineering of TELEPERM XS I&C systems  
• List the tasks and contents of I&C requirement and system specification  
• Use the engineering tools for code generation, verification & validation, testing and documentation of TELEPERM XS application software |
|---------------|--------------------------------------------------------------------------------------------|

#### Content

In addition to a short introduction to TELEPERM XS basics, the course covers the most important elements of the TXS engineering process. It gives an overview of how to generate an I&C system specification, detailed engineering of software coding, as well as the verification and validation of the individual process steps using the associated engineering tools (SPACE). The validation tool SIVAT is also examined closely. The theoretical knowledge is consolidated in practical exercises.

The course covers the following topics in detail:
• TELEPERM XS basics  
• TELEPERM XS engineering process (overview)  
• Overview of I&C requirement and system specification (levels 1-4)  
• SPACE function diagram editor FDE in detail  
• SPACE database design (identification coding concept, tips and rules)  
• Generation of an I&C system specification (hardware, software)  
• Application software coding using all SPACE tools  
• Validation of the application software using SIVAT

#### Prerequisites

Basic knowledge of I&C and experience in digital automation systems, and basic knowledge of TELEPERM XS (such as the prior attendance of a TELEPERM XS basic course). General IT skills are desirable.

#### Other Information

Participants: 6 to 8 persons
TELEPERM XS – Engineering Detailed Design – Compact
Course Number: L631.2

Target Group
I&C engineering personnel, as well as I&C test and commissioning personnel who have already take part in an engineering course.

Objectives
Upon successful completion of this course, course participants will be able to:
- Recall the basic knowledge of TELEPERM XS I&C systems with regard to system architecture, hardware and software
- Revise important steps and content of engineering processes
- Explain the tools which are necessary for engineering of TELEPERM XS I&C systems
- Use the engineering tools for creation, verification & validation and documentation of TELEPERM XS software independently

Content
This course is a refresher course for all persons who have previously participated in an engineering course. The most important features and topics of TELEPERM XS engineering are revised in a compact manner.
This course is based on the L631.1 TELEPERM XS engineering course. The participants perform practical exercises to expand and consolidate their knowledge.
The following topics are covered in detail:
- TELEPERM XS basics (function computer, system architectures and properties)
- TELEPERM XS engineering process (concept)
- SPACE function diagram editor (FDE)
- Create an I&C system specification (hardware and software)
- User software coding using all SPACE tools
- Practical exercises

Prerequisites
TELEPERM XS system knowledge with regard to architecture, hardware and software.

Other information
Participants: 6 to 8 persons.
# TELEPERM XS – SPECIAL BASIC/ENG/MAINT/OPERATION

**Course Number:** L831.1

**Duration:** 2x 5 days  
**Location:** Karlstein  
**Language:** German / English

## Target Group

Customers and staff members with an interest in acquiring comprehensive knowledge of the TELEPERM XS safety I&C system in a very short time.

## Objectives

Upon successful completion of this course, course participants will be able to:

- State the basic properties of TELEPERM XS I&C systems with respect to system design, hardware and software
- Explain the most important system architectures of the safety I&C
- Describe fundamental features of the TELEPERM XS Hardware 2nd generation and to understand the engineering process
- Work with the SPACE engineering tools, carry out system diagnostics and to know and understand the features of the Test Bay

## Content

The course provides a detailed insight into all engineering activities for the TELEPERM XS system platform. The participants consolidate their knowledge in practical exercises.

**Part 1:**
- TELEPERM XS basics (function computer, TELEPERM XS engineering process, system architecture, Hardware 2nd generation, system properties)
- Introduction to I&C function specifications (levels 1-4)
- SPACE function diagram editor FDE, design rules, and practical applications of SPACE tools
- Exercises relating to HW and SW specification and application code generation

**Part 2:**
- TELEPERM XS maintenance (monitoring concept, diagnosis at the cabinet, introduction and diagnosis using Service Unit and DIMAS, module replacement and settings, loading and verifying software, and practical exercises concerning troubleshooting)
- SIVAT introduction
- TELEPERM XS Test Bay (introduction, Test Bay structure, test program, procedure and performance)

## Prerequisites

Basic knowledge of I&C and of digital automation systems and generic IT skills are desirable.

## Other Information

This is a two part course, each part lasting 5 days.  
Participants: 6 to 8 persons
<table>
<thead>
<tr>
<th>TXS</th>
<th>Advanced Courses</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>L350.1</td>
<td>TELEPERM XS – Hardware 2nd Generation</td>
<td>50</td>
</tr>
<tr>
<td>L632.1</td>
<td>TELEPERM XS – SIVAT-V1.8 Verification and Validation</td>
<td>51</td>
</tr>
<tr>
<td>L632.2</td>
<td>TELEPERM XS – SIVAT-V3.6 Verification and Validation</td>
<td>52</td>
</tr>
<tr>
<td>L635.1</td>
<td>TELEPERM XS – QDS Applications</td>
<td>53</td>
</tr>
<tr>
<td>L720.1</td>
<td>TELEPERM XS – Test Bay and ERBUS</td>
<td>54</td>
</tr>
</tbody>
</table>
**Target Group**

This course is intended for I&C engineering personnel, technical project managers, I&C testing, commissioning and maintenance personnel.

---

**Objectives**

Upon successful completion of this course, participants will be able to:

- State the basics of TELEPERM XS Hardware 2nd generation
- Explain the connection between the mechanical structure of a cabinet and the conceptual requirements regarding the assembly of a TXS cabinet
- Explain the structure and the operating principle of cabinet modules and cabinet connection techniques
- Plan the hardware in the engineering process (e.g. cabinet arrangement diagram)

---

**Content**

The course begins with an introduction and an overview of TELEPERM XS Hardware 2nd generation. The new properties of the TELEPERM XS Hardware 2nd generation are presented, including the new range of TELEPERM XS modules. The course provides information on purpose, structure and function of the modules, including cabinet power supply, circuit breaker and monitoring. The connection between engineering specifications (identification coding, standard circuitry), cabinet structure (mechanics) and the functionality of the cabinet modules are explained in the course of creating a cabinet arrangement diagram.

The course covers the following topics in detail:

- Basics of TELEPERM XS hardware components
- Purpose, structure and operating principle of modules
- Non code-relevant analog and binary modules
- Code-relevant modules (computer, communication, input and output modules)
- Creation of a cabinet arrangement diagram using VISIO
- Consolidation of instruction material in theoretical and practical exercises

---

**Prerequisites**

Basic knowledge of I&C and digital automation systems, basic knowledge of TELEPERM XS (introductory course). Generic IT skills (VISIO) are advantageous.

---

**Other Information**

Participants: 6 to 8 persons
# TELEPERM XS – SIVAT-V1.8 Verification and Validation

**Course Number:** L632.1  
**Duration:** 2 days  
**Location:** Karlstein  
**Language:** German / English

## Target Group
This course is intended for I&C engineering personnel and personnel who want to acquire comprehensive knowledge in this field.

## Objectives
Upon successful completion of this course, course participants will be able to:

- Explain the field of application of SIVAT in the engineering process and the concept and function of SIVAT (1.8)
- Generate a simulation code by using SIVAT (1.8)
- Create simulation scripts
- Test and validate I&C functions

## Content
This course covers the function of SIVAT (Simulation based Validation Tool V1.8) and the generation of SIVAT code. In addition, the course participants will learn how to work with SIVAT. They will learn to test and validate the engineered I&C functions in the software environment of SIVAT by using scripts.

The course covers the following topics in detail:

- The purpose, principle and requirements of the SIVAT simulation
- Generation of simulation code for an exemplary project of simulator structure
- Graphical user interface of SIVAT
- Work with simulation scripts
- Signal manipulations and simulation of malfunctions
- Practical exercises

## Prerequisites
A basic background in I&C and in electrical engineering. Experience with digital automation systems is desirable. TXS basic knowledge (such as participation in a TELEPERM XS fundamentals course) is mandatory, prior attendance of a TXS engineering course desirable.

## Other Information
Participants: 6 to 8 persons
**Target Group**

This course is intended for I&C engineering personnel and personnel who want to acquire comprehensive knowledge in this field.

**Duration:** 3 days  
**Location:** Karlstein  
**Language:** German / English

**Objectives**

Upon successful completion of this course, course participants will be able to:

- Explain the purpose, principles and requirements of a SIVAT simulation
- Use the SIVAT user interface (3.6.x)
- Explain and use the SIVAT Client API (3.6.x)
- Explain the interaction between DIMAS and SIVAT objects
- Specify and explain SIVAT test cases and their functions
- Create SIVAT test scripts using Python

**Content**

This course covers the function of SIVAT (Simulation based Validation Tool), version 3.6.x. Course participants learn about the functions of SIVAT and how it is used in the engineering process. Subsequently, the SIVAT programming interface available in Python is explained using practical examples. Based on this, the participants validate an I&C function using the SIVAT code by developing their own SIVAT/Python test script.

The course covers the following topics in detail, both theoretically and practically:

- Scope of SIVAT applications during the engineering process
- The concept and functionality of SIVAT
- Script design with help of SIVAT Client API
- Interaction between SIVAT and DIMAS
- Simulation of malfunctions
- Automation of test cases
- Integration of external models

**Prerequisites**

Knowledge of Python is mandatory. Attendance of DIMAS course L540.1 is also recommended. Basic knowledge of I&C and experience in digital automation systems are desirable. IT and Linux knowledge is necessary.

**Other Information**

Participants: 6 to 8 persons
**Target Group**
This course is intended for I&C personnel, electrical, simulator training instructors and power plant operators.

**Objectives**
Upon successful completion of this course, course participants will be able to:
- Explain the concept and mechanisms of QDS
- Use QDS, including connection to a TELEPERM XS system
- Use engineering tools such as Qt Designer, QDS_Gen, QDS_HMI and QDS_SU
- Monitor the connected TELEPERM XS system
- Modify settings
- Download application to QDS hardware

**Content**
The course provides an overview of the concept and function of the TELEPERM XS QDS (Qualified Display System). The participants learn how a QDS system is integrated into TELEPERM XS and design a QDS application using the QDS tools QDS_Gen, Qt Designer, QDS_HMI and QDS_SU. At the end of the training course, they are able to download their applications onto the QDS hardware which is connected to a TELEPERM XS training cabinet.

The course covers the following topics in detail:
- Hardware architecture
- Software architecture
- QDS in SPACE
- Engineering tools
- Designing displays
- Connection of signals and HMI
- QDS Service Unit
- Practical exercises

**Prerequisites**
Basic TELEPERM XS knowledge (e.g. previous attendance of a TELEPERM XS fundamentals course or TELEPERM XS engineering course) is desirable. IT skills and Linux knowledge are necessary.

**Other Information**
Participants: 6 to 8 persons
# TELEPERM XS – Test Bay and ERBUS

## Course Number: L720.1

### Duration: 5 days

### Location: Karlstein

### Language: English

German on request

## Target Group

This course is intended for customers and internal staff with an interest in acquiring comprehensive knowledge of the TELEPERM XS safety I&C system in the Test Bay.

## Objectives

Upon successful completion of this course, course participants will be able to:

- State the Test Bay (concept and setup, test programs and test procedures)
- Define the general concepts and setup of ERBUS (test system)
- Explain the function of the ERBUS Simulation Control Unit (SCU), the Test Machine (TM) and the Test Equipment Controller (TEC)
- Use ERBUS software tools and the ERBUS Client API
- Carry out safety I&C functional tests using Python based ERBUS scripts

## Content

The training course covers the following topics: Test Bay, platform, required resources, test plan, test procedure, test performance and conditions. This main focus of the course is the ERBUS test system (SCU with SW version 3.6.x and TM SW version 2.0.0), which is the main test system in the Test Bay. Knowledge about the ERBUS hardware and software is provided. I&C functional tests are discussed and carried out. Theoretical and practical exercises allow the participants to consolidate their knowledge.

The course covers the following topics in theory and practice:

- The concept and setup of the Test Bay
- The Test Bay equipment
- Test programs, procedures and performance
- Introduction to ERBUS, test machine and the Simulation Control Unit
- Hardware connections
- ERBUS and DIMAS in communication with the ERBUS-Shell
- Testing of signal connections and I&C functionality using Python scripts

## Prerequisites

Knowledge of Python is compulsory. Basic knowledge of I&C and experience in digital automation systems is desirable. TELEPERM XS and Linux basic knowledge is advantageous but not essential.

## Other Information

Participants: 6 to 8 persons
<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>L540.1</td>
<td>TELEPERM XS – DIMAS Fundamentals</td>
<td>56</td>
</tr>
<tr>
<td>L633.1</td>
<td>TELEPERM XS – SYSADMIN-Linux Fundamentals</td>
<td>57</td>
</tr>
</tbody>
</table>
### Target Group
This course is intended for I&C engineering, V&V, commissioning and maintenance personnel.

### Objectives
Upon successful completion of this course, participants will be able to:

- Explain the interaction between DIMAS and the online system
- Explain the basic functionalities of a Service Unit and CPU operating modes
- Perform parameter changes
- Explain DIMAS clients and their functionalities
- Develop DIMAS scripts using DIMAS Client API
- Implement graphical service interfaces with the aid of dimasQt

### Content
This course covers DIMAS functionality, version 3.6.x. The functionality and the possible applications of the Service Unit and DIMAS (including clients) are explained and consolidated on with the aid of practical exercises. The Python programming interface is explained on the basis of the DIMAS Client API with reference to practical examples. The programming skills acquired are used to perform the first steps in the development of a Graphical Service Interface.

The course covers the following topics in detail:

- Introduction to the Service Unit and DIMAS
- Principle of the TELEPERM XS service concept
- Functionality of DIMAS clients (TXSStatus, FDView, EventLog, DIMAS-Shell)
- Introduction to the DIMAS Client API (dimasUtil)
- Introduction to operating modes and parameterization
- Development of scripts and Graphical Service Interfaces
- Practical exercises

### Prerequisites
Knowledge of Python is mandatory. Basic knowledge of I&C and experience in digital automation systems, as well as basic TELEPERM XS-knowledge are advantageous but not essential. General IT skills and Linux knowledge are necessary.

### Other Information
Participants: 6 to 8 persons
# TELEPERM XS – SYSADMIN-Linux Fundamentals

**Course Number:** L633.1  
**Duration:** 2 days  
**Location:** Karlstein  
**Language:** German / English

## Target Group
This course is intended for technicians responsible for the administration of a TELEPERM XS system.

## Objectives
Upon successful completion of this course, participants will be able to:

- State the basic functions of the TELEPERM XS Service Unit (SU)
- Configure TELEPERM XS hardware and software for a SU
- Install and test TELEPERM XS Core Software
- Perform basic administrative tasks on a TELEPERM XS Service Unit

## Content
The course is based on the Linux operating system and TXS software version, higher than 3.3. Using the TELEPERM XS Service Unit. The participants learn how to set up and administrate users, groups and printers. Furthermore, they learn how to install TELEPERM XS software packages. YaST system administration is also dealt with. Handling of the KDE desktop environment be consolidated. The participants consolidate the acquired knowledge in practical exercises.

The course covers the following topics in detail:

- Overview of TELEPERM XS and Linux
- Installation of SUSE Linux Enterprise Server
- KDE and Linux concepts
- Creation of TELEPERM XS users and groups
- Installation of TELEPERM XS software packages
- Configuration and administration of TELEPERM XS
- YaST Control Center
- Practical exercises, including testing of the installation

## Prerequisites
Basic knowledge of I&C and computer technology, and of the Linux operating system are mandatory. Experience with digital automation systems is desirable. Basic knowledge of TELEPERM XS is mandatory.

## Other Information
Participants: 6 to 8 persons

---

**Contact**

+49 (0)9131 900 34567  
training@framatome.com  
www.framatome.com/EN/customer-4829/training-center.html
Hard-Wired Programmed I&C

Training in all topic areas relating to design, function, engineering operation- and monitoring of hard-wired programmed I&C systems used in KWU power plants.

Introductory Courses
The introductory courses give an overview of I&C concepts, open-loop control systems, closed-loop control systems, equipment protection systems and operation- and monitoring concepts.
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>L223</td>
<td>Process Control System ISKAMATIC B</td>
<td>60</td>
</tr>
<tr>
<td>L244</td>
<td>I&amp;C Concept Operational I&amp;C</td>
<td>61</td>
</tr>
</tbody>
</table>
# Process Control System ISKAMATIC B
## Course Number: L223

<table>
<thead>
<tr>
<th>Duration: 5 Days</th>
<th>Location: Karlstein</th>
<th>Language: German</th>
<th>English on request</th>
</tr>
</thead>
</table>

## Target Group
Utility employees from engineering, operation and maintenance departments, and employees of licensing authorities.

## Objective
The participants are familiarized with the ISKAMATIC B control system and its applications. After the course, the participants will be able to:
- Perform engineering
- Operate ISKAMATIC B
- Interpret signal patterns
- Detect malfunctions
- Work with the documentation.

## Content
- Overview of the ISKAMATIC B process control system
- System data and design
- Logic symbols
- Design of the standard cabinet (ISKAMATIC E)
- Documentation (function diagrams and circuit diagrams)
- Alarm annunciation concept
- Binary signal conditioning and limit signal generation
- Control interface
- Undervoltage monitoring
- Fault isolation and priority control
- Sub-loop control
- Subgroup control
- Group control
- Protective logics
- Practical exercises on modules

## Prerequisites
General basic knowledge of signal conditioning, control technology and logic functions.

## Other Information
Participants: 6 to 8 persons
| I&C Concept Operational I&C  
Course Number: L244 |
|------------------------|

**Target Group**
Utility employees who concentrate with the use of operational I&C in a KWU nuclear power plant.

| Duration: 2 Days  
Location: Karlstein  
Language: German  
English on request |
|-------------------|

**Objective**
The participants are familiarized with the use of conventional I&C in a nuclear power plant. After the course, the participants will be able to:
- Illustrate the basics usage of the I&C systems ISKAMATIC and TELEPERM C inside the power plant
- Explain the operation and monitoring concept of ISKAMATIC and TELEPERM C

**Content**
The course covers the following topics in detail:
- I&C concept
- Overview main condensate system
- Measured value acquisition an conditioning
- Binary signal conditioning
- Analog signal conditioning
- Open-loop control on the example of the main condensate system
  - Group control
  - Subgroup control
  - Sub-loop control
  - Individual drive control
  - Priority control
- Equipment protection on the example of the main condensate system
- Closed-loop control on the example of the main condensate system
- Alarm concept.

**Prerequisites**
General knowledge about automation technology in nuclear power plants

**Other Information**
Participants: 6 to 8 persons
3

Product Courses
Product Courses

Electrical Engineering
THORC Motor Control Center - Pages 64 to 65 -

Retrofitting and Modernization
Advanced Load Following Control (ALFC) - Pages 66 to 67 -
### Target Group

Fitters, technicians and engineers from power utilities involved in engineering, design, operation and maintenance activities, and regulatory authorities.

### Objectives

The participants are familiarized with the software-free thyristor-controlled motor control center THORC and its possible applications. At the end of the course, the participants will be able to use THORC, that is, to perform engineering, installation, commissioning, to interpret the documentation, identify and rectify system faults, and also to perform periodic testing.

### Content

- Comparison between thyristor and contactor technology
- Codes and standards, requirements and qualification
- Engineering & design
- Module installation
- Tests and commissioning
- Operating modes, faults and handling
- Functional tests
- Troubleshooting
- Commissioning
- Periodic testing

### Prerequisites

General knowledge of electrical and plant engineering.

### Other information

Participants: limited to 6 persons
Retrofitting and Modernization

B855_ALV  Advanced Load Following Control (ALFC)
**Advanced Load Following Control (ALFC)**  
**Course Number:** B855D_ALV

<table>
<thead>
<tr>
<th>Target Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWR physics, I&amp;C, systems engineering, failure analysis and production specialists, personnel from expert organizations, power grid operators and FRAMATOME employees. In particular, the course focuses on decision makers responsible for I&amp;C upgrades in PWR plants, will be addressed.</td>
</tr>
</tbody>
</table>

| Duration: 2 days |
| Location: Karlstein |
| Language: German / English |

<table>
<thead>
<tr>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>The participants acquire in-depth process engineering knowledge in relation to reactor control. On this basis, the optimization potential of the I&amp;C with regard to optimized full-load operation (economizing on fuel and/or power uprating) and load cycling (up to the remote controlled, fully automated operation by the load dispatcher with new economic possibilities) is explained with reference to examples of upgrades.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Process: control assembly maneuvering concept, instrumentation, part-load diagram…</td>
</tr>
<tr>
<td>• I&amp;C concept and objectives for upgrades</td>
</tr>
<tr>
<td>• Grid requirements (volatile renewable energy)</td>
</tr>
<tr>
<td>• Digital control algorithms used</td>
</tr>
<tr>
<td>• Coolant temperature control (optimized setpoint control)</td>
</tr>
<tr>
<td>• Power distribution control (2-point xenon model, adaptive algorithms and controlling stochastic cycling operation)</td>
</tr>
<tr>
<td>• Bank position control (adaption to reactivity coefficients, predictive reactivity management)</td>
</tr>
<tr>
<td>• Primary side leakage makeup (PRILE)</td>
</tr>
<tr>
<td>• Consideration of condition limitation functions and PCI</td>
</tr>
<tr>
<td>• Visualization on the process computer</td>
</tr>
<tr>
<td>• Commissioning trials and operational experience (in total &gt; 13 years)</td>
</tr>
<tr>
<td>• Initiating new international projects</td>
</tr>
<tr>
<td>• Providing control energy and marketing opportunities</td>
</tr>
<tr>
<td>• Visiting the core instrumentation fabrication facility</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevant work experience in a PWR nuclear power plant or corresponding introductory courses.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants: 6 to 12 persons</td>
</tr>
</tbody>
</table>
Organization and Information

Do you have specific requirements for a training course?
We can put together a tailor-made course. Please contact us and we will be happy to advise you.

Course Options
Progress checks can be arranged on completion of almost all courses. Terms are available on request.

TELEPERM® XS is a registered trademark of Framatome or its affiliates, in the United States or other countries.

Our website offers tips on how to plan your trip and find accommodation nearby.

Online offer / booking
Find out more about our current course catalog with dates and prices under:


To apply, please use our online booking form or contact us by email.

Framatome GmbH
Training Center
Seligenstädter Straße 100
63791 Karlstein
Germany

E-Mail: training@framatome.com
Tel.: +49 (0) 9131900 34567
Fax: +49 (0) 9131900 31868
Framatome is a major international player in the nuclear energy market recognized for its innovative solutions and value-added technologies for designing, building, maintaining, and advancing the global nuclear fleet. The company designs, manufactures, and installs component, and fuel and instrumentation and control systems for nuclear power plants and offers a full range of reactor services.

With 14,000 employees worldwide, every day Framatome’s expertise helps its customers improve the safety and performance of their nuclear plants and achieve their economic and societal goals.

Framatome is owned by the EDF Group (75,5%), Mitsubishi Heavy Industries (MHI – 19,5%) and Assystem (5%).