IHRDC’s Competency-Based e-Learning Pathways for Refinery Personnel

COMPETENCY-BASED TRAINING PATHWAYS FOR REFINERY TECHNICIANS

Our highly regarded competency-based e-Learning Pathways have been designed to meet the competency development needs of petroleum technicians in the four traditional O&M specialties: Electrical, Mechanical, Instrumentation and Controls Technicians, and Operators, who work in a variety of petroleum sectors: Refining, Petrochemicals, Midstream Gas, Upstream Oil, and Upstream Gas. This guide has been prepared for the training of Refinery technicians.

The Training Pathways are divided into three progressively challenging Stages, as shown below.

Stage I: Foundation Training provides the background learning required for all new O&M personnel.

Stage II: Functional Training Pathways are divided into four paths, one for each functional area.

Stage III: Industry Sector Training Pathways provide the specific training in each industry sector; in this example, Refinery Technicians.

Sequential lists of e-Learning courses for each of the three Stages are shown on the following pages. The content of each course may be found in our online catalog, www.ihrdc.com/e-learningsolutions.
# Stage I
## Foundation Training

### OIL & GAS BUSINESS
- **All Sectors**
  - Oil and Gas Industry Overview

### HEALTH, SAFETY, & ENVIRONMENT
- **Chemical Safety**
  - Chemical Health Hazards
- **Electrical Safety**
  - Introduction to Electrical Safety
  - Advanced Electrical Safety
- **Fire Protection**
  - Fire Safety
- **Hazardous Waste Operations**
  - Hazardous Waste First Responder - Awareness
- **Health**
  - Hearing Conservation

### CORE 1: MATH, SCIENCE, & DIAGRAMS
- **Math**
  - Basics of Math
  - Basic Mathematical Operations 1
  - Basic Mathematical Operations 2
  - Formulas, Graphs, and Trends
  - Algebra
- **Chemistry**
  - Basic Principles of Chemistry 1
  - Basic Principles of Chemistry 2
  - Material Balancing
  - Reaction Rates
- **Drawings & Diagrams**
  - Basic Diagrams and Symbols 1
  - Basic Diagrams and Symbols 2
  - Flow and Electrical Diagrams

### CORE 2: FUNDAMENTALS
- **Workplace Safety**
  - Ladders and Scaffolds
- **Tools**
  - Introduction to Hand Tools
  - Precision Measurement Instruments
  - Introduction to Power Tools
- **Electrical Wiring**
  - Fasteners
- **Lubrication & Bearings**
  - Lubrication - Basics
  - Bearings - Fundamentals
- **Basic & Heavy Lifting**
  - Overview of Rigging
  - Basic Lifting
  - Heavy Lifting
- **Measurement Devices**
  - Introduction to Vibration Analysis
- **Drawings & Diagrams**
  - Industrial Process Systems
  - Blueprints
  - Electrical Diagrams
  - Piping and Instrumentation Diagrams
- **Gears, Equipment**
  - Drive Components, &
- **Shaft Alignment**
  - Shaft Alignment - Fundamentals

---

### Learning Summary: Stage I

<table>
<thead>
<tr>
<th>COURSES</th>
<th>LEARNING HOURS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OIL &amp; GAS BUSINESS</td>
<td>1 COURSE</td>
</tr>
<tr>
<td>HSE</td>
<td>12 COURSES</td>
</tr>
<tr>
<td>CORE 1: MATH, SCIENCE</td>
<td>12 COURSES</td>
</tr>
<tr>
<td>CORE 2: FUNDAMENTALS</td>
<td>16 COURSES</td>
</tr>
</tbody>
</table>
Stage II
Functional Training Pathways

### Mechanical I

- **Chemistry**
  - Gases and Flowing Liquids
  - Heat
  - Heat Transfer
  - Solids and Liquids

- **Electrical**
  - Basic Electrical Circuits
  - Basic Electrical Principles

- **Lubrication & Bearings**
  - Lubricants and Bearings
  - Lubrication - Using Lubricants

- **Materials Handling & Storage**
  - Tank Trucks

- **Physics**
  - Basic Principles of Physics
  - Fluid Systems
  - Forces and Machines

- **Pipes, Piping, & Auxiliaries**
  - Pipes and Pipe Fittings
  - Piping - Basic Components and Functions
  - Piping - System Components and Operation

- **Process Control**
  - Process Dynamics and Measurement

- **Pumps and Seals**
  - Seals - Gaskets and Packing
  - Seals - Mechanical

- **Turbines & Steam Systems**
  - Steam Traps

- **Valves**
  - Safety Valves 1
  - Safety Valves 2
  - Valve Types and Operation

### Mechanical II

- **Actuator, Valve, & Motor Controllers**
  - Electric and Hydraulic Actuators
  - Introduction of Actuators
  - Motor Operators

- **Heat Exchangers**
  - Condensers and Reboilers
  - Cooling Towers
  - Introduction to Heat Exchangers
  - Operation of Shell- and Tube-Type Heat Exchangers

- **Hydraulic Systems**
  - Hydraulic Actuators
  - Hydraulic Component Inspection and Replacement
  - Hydraulic Diagrams
  - Hydraulic Fluid and Reservoirs
  - Hydraulic Principles and Circuits
  - Hydraulic Pumps
  - Hydraulic Valves 1
  - Hydraulic Valves 2
  - Routine Maintenance of Hydraulic Systems
  - Troubleshooting of Hydraulic Systems

- **Valves**
  - Basic Types and Operation of Valves 1
  - Basic Types and Operation of Valves 2
  - Safety Valves, Part I
  - Safety Valves, Part II
  - Valve Maintenance

### Mechanical III

- **Compressors**
  - Centrifugal Compressors
  - Introduction to Compressors
  - Operation of Centrifugal and Axial Compressors
  - Positive Displacement Compressors
  - Reciprocating Compressors
  - Types of Compressors - Centrifugal and Axial

- **Gears, Equipment Drive Components, & Shaft Alignment**
  - Drive Component Operations
  - Gear, Belt, and Chain Drives
  - Gears - Overhauls
  - Gears - Types and Characteristics
  - Shaft Alignment - Reverse Dial and Laser
  - Shaft Alignment - Rim and Face

- **Lubrication & Bearings**
  - Bearings - Rolling Contact
  - Bearings - Sliding Surface

- **Other Systems & Equipment**
  - Fans

- **Pumps**
  - Basic Pump Types and Operations
  - Fundamentals of Centrifugal Pumps
  - Operation of Centrifugal Pumps
  - Performance and Inspection of Pumps
  - Reciprocating Positive Displacement Pumps
  - Rotary Positive Displacement Pumps

- **Pumps & Seals**
  - Centrifugal Pump Basics and Troubleshooting
  - Centrifugal Pump Overhaul
  - Multistage Centrifugal Pumps
  - Positive Displacement Pumps

---

### Learning Summary: Stage II

| MECHANICAL I | 22 COURSES | 22 HRS |
| MECHANICAL II | 22 COURSES | 22 HRS |
| MECHANICAL III | 25 COURSES | 25 HRS |
Electrical I

- Circuits
  - Parallel Circuits
  - Series Circuits
  - Series-Parallel Circuits
  - Use of Ohm’s and Kirchhoff’s Laws in DC Circuits

- Electrical
  - AC Circuits
  - Basic Electrical Circuits
  - Basic Electrical Principles
  - Basic Electrical Test Equipment
  - Basic Electricity Review
  - Sources of Electricity
  - Voltage and Current Principles

- Electrical Generation & Storage
  - Battery Systems

- Electrical Safety
  - Electrostatic Discharge Precautions

- Electrical Theory
  - Kirchhoff’s Law
  - Magnets and Magnetic Fields
  - Ohm’s Law

- Electrical Wiring
  - Cables and Conductors
  - Conduit Installation
  - Introduction to the NEC

- Measurement Devices
  - Digital and Analog Oscilloscope

Electrical II

- Actuator, Valve, & Motor Controllers
  - Basic Functions of AC Motor Controllers
  - Troubleshooting of AC Motor Controllers
  - Motor Controllers and Operation

- Electrical Components
  - SCRs and TRIACs

- Electrical Generation & Storage
  - Power Supplies

- Electrical Wiring
  - Splices and Terminations

- Motors
  - AC and DC Motors
  - DC Motors
  - Motor Branch Circuit Protection
  - Three-Phase Motors

- Transformers, Breakers, & Switches
  - Fuses

- Variable Speed Drives
  - Applications of VSDs
  - Troubleshooting VSD Controllers
  - Introduction to VSDs
  - Programming Controllers
  - System Troubleshooting of VSDs
  - Systems and Integration of VSDs

Electrical III

- Circuits
  - Troubleshooting Electrical Circuits
  - J-K Flip-Flops
  - Troubleshooting Operational Amplifier Circuits
  - Filter Circuits

- Electrical Components
  - Inductors, Part 1
  - Inductors, Part 2
  - Capacitors, Part 1
  - Capacitors, Part 2
  - Specialized Electronic Devices
  - Transistor Configurations

- Electrical Generation & Storage
  - AC Generator Maintenance
  - Electrical Production and Distribution

- Electrical Wiring
  - Grounding

- Transformers, Breakers, & Switches
  - High Voltage Breakers and Switchgears
  - Electromagnetic Relays
  - Ground Fault Interrupters
  - Introduction to Transformers, Breakers, and Switches
  - Maintenance of Low-Voltage Circuit Breakers
  - Relays 1
  - Relays 2
  - Transformers
## Instrumentation & Controls Technician

### Instrument I
- Actuator, Valve, & Motor Controllers
  - Pneumatic Control
  - Principles of Controllers
- Circuits
  - Parallel Circuits
  - Series Circuits
  - Series-Parallel Circuits
  - Use of Ohm’s and Kirchhoff’s Laws in DC Circuits
- Distributed Control Systems
  - Troubleshooting DCS I/Os: Practices
- Electrical
  - Voltage and Current Principles
  - Basic Electrical Test Equipment
- Electrical Components
  - Operational Amplifiers, Part 1
  - Operational Amplifiers, Part 2
  - Specialized Electronic Devices
- Electrical Safety
  - Electrostatic Discharge Precautions
- Electrical Theory
  - Kirchhoff’s Law
  - Magnets and Magnetic Fields
  - Ohm’s Law
- Human-Machine Interface & Plant Protection Systems
  - The Human-Machine Interface
- Measurement Devices
  - Digital and Analog Oscilloscopes
  - Principles of Calibration
- Networks
  - Introduction to Control and Data Systems
- Process Control
  - Introduction to Process Control
  - Principles of Process Control

### Instrument II
- Actuator, Valve, & Motor Controllers
  - Introduction to Actuators
  - Electric and Hydraulic Actuators
  - Smart Controllers
- Field Device Configuration
  - Field Devices: Analog Configuration
  - Field Devices: Configuring with a Laptop PC
- Measurement Devices
  - Field Devices: Using Field Communicators
  - Field Devices: Analyzers
  - Field Devices: Level and Flow
  - Field Devices: Pressure, Temperature, and Weight
  - Measurement of Concentration
  - Measurement of Density, Clarity, and Moisture
  - Measurement of Level and Flow
  - Measurement of Pressure and Temperature
- Process Control
  - Automatic Process Control 1
  - Automatic Process Control 2
  - Single Loop Control
  - Multiple Loop Control
  - Tuning Loops
  - Troubleshooting Loops
- Valves
  - Basic Types and Operation of Valves 1
  - Basic Types and Operation of Valves 2

### Instrument III
- Distributed Control Systems
  - Introduction to Distributed Control Systems
  - Troubleshooting DCS I/Os: Practices
  - Troubleshooting DCS I/Os: Procedures
- Field Device Configuration
  - Field Devices: Digital Configuration with a DCS
- Human-Machine Interface & Plant Protection Systems
  - Human Machine Interface and Troubleshooting
- Math
  - Binary, Octal, and Hexadecimal Numbers
- Networks
  - Introduction to Networks
  - Setting Up and Troubleshooting Networks
  - Fiber Optic Systems
- Programmable Logic Controllers
  - Installing and Maintaining PLCs
  - Architecture, Types, and Networks
  - I/O Communication
  - Troubleshooting Hardware
  - Introduction to Programming PLCs
  - Programming Common Functions
  - Program Entry, Testing, and Modification
  - Ladder Logic and Symbology
  - Troubleshooting Software and Networks

### Learning Summary: Stage II

| Instrumentation & Controls I | 23 Courses | 23 Hrs
| Instrumentation & Controls II | 21 Courses | 21 Hrs
| Instrumentation & Controls III | 18 Courses | 18 Hrs |
## Learning Summary: Stage II

<table>
<thead>
<tr>
<th>OPERATIONS</th>
<th>COURSES</th>
<th>LEARNING HOURS</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>19 COURSES</td>
<td>19 HRS</td>
</tr>
<tr>
<td>II</td>
<td>24 COURSES</td>
<td>24 HRS</td>
</tr>
<tr>
<td>III</td>
<td>17 COURSES</td>
<td>17 HRS</td>
</tr>
</tbody>
</table>

### Operations I

19 hr

- Chemistry
  - Gases and Flowing Liquids
  - Heat
  - Heat Transfer
  - Solids and Liquids

- Electrical
  - Basic Electrical Circuits
  - Basic Electrical Principles

- Materials Handling & Storage
  - Tank Trucks

- Operations Fundamentals
  - Introduction to Operation Fundamentals
  - Plant Production and Safety
  - Trends, Maintenance, and Emergencies
  - Communication in Process Operations

- Other Systems & Equipment
  - Auxiliary Vessels

### Operations II

24 hr

- Compressors
  - Introduction to Compressors
  - Types of Compressors - Centrifugal and Axial
  - Operation of Centrifugal and Axial Compressors
  - Positive Displacement Compressors

- Environmental Protection
  - Air Pollution
  - Pollution Control in Plants
  - Water Pollution and Waste Disposal

- Operations Fundamentals
  - Obtaining Samples
  - Testing Samples

- Other Systems & Equipment
  - Filtration and Screening Unit Operations
  - Fundamentals of Process Solubility

- Physics
  - Power and Energy

- Power & Steam Systems
  - Power Generation and Hydrogen Cooling

- Power Plant Operation
  - Basic Principles of Power Plant Operations

- Pumps
  - Fundamentals of Centrifugal Pumps
  - Operation of Centrifugal Pumps
  - Performance and Inspection of Pumps
  - Reciprocating Positive Displacement Pumps
  - Rotary Positive Displacement Pumps

- Refining Process Technologies
  - Typical Process Reactions, Part 1
  - Typical Process Reactions, Part 2

- Refrigeration Systems
  - Basic Concepts of Refrigeration Systems
  - Operations of Refrigeration Systems
  - Refrigeration Systems, Part 1

### Operations III

17 hr

- Actuator, Valve, & Motor Controllers
  - Introduction of Actuators
  - Electric and Hydraulic Actuators

- Boilers
  - Boilers - Basic Principles and Types
  - Boilers - Combustion, Water, and Steam

- Distillation
  - Basic Distillation System Components and Operation
  - Distillation Control Systems
  - Distillation Operating Problems

- Furnaces
  - Furnace Operating Conditions

- Operations Fundamentals
  - Process Examples

- Process Control
  - Introduction to Statistical Process Control
  - Basic Control Charts
  - Process Variations

- Valves
  - Basic Types and Operation of Valves 1
  - Basic Types and Operation of Valves 2

- Water Treatment
  - Wastewater 2
  - Water for Plant Systems 2
Stage III
Refinery Training Pathways

PLANT OPERATIONS

Boilers
Abnormal Conditions and Emergencies
Combustion and Operation
Normal Operations
Startup and Shutdown
Water and Steam
Condensate and Feedwater Systems
Condenser and Circulating Water

Furnaces
Introduction to Furnaces
Startup and Shutdown of Furnaces

Operations Fundamentals
Basic Concepts of Operations
Operator Responsibilities: Basic Operator Responsibilities
Operator Responsibilities: Advanced Operator Responsibilities

Other Systems & Equipment
Material Handling of Bulk Liquids
Portable and Emergency Equipment
Flaring, Venting, and Purging

Refrigeration System
Refrigeration Systems, Part 2

Storage Tank Operations
Above Ground Storage Tanks, Part 2
Above Ground Storage Tanks, Part 3

Turbines & Steam Systems
Boiler and Turbine Protection
Steam Systems
Bearings and Operation
Steam Flow [Steam Turbines]

REFINERY

Refinery Fundamentals
Refining Basics

Refinery Operations
Emission Controls

Refining Process Technologies
Process Reactor Fundamentals
Typical Process Reactions, Part 1
Typical Process Reactions, Part 2
Blending Operations
Azeotropic, Extractive, and Vacuum Columns
Crude Distillation Operations
Fluid Catalytic Cracking Operations
Hydrotreating and Catalytic Reforming 1
Hydrotreating and Catalytic Reforming 2
Treating and Sulfur Recovery Operations

Distillation
Basic Principles of Distillation
System Startup and Shutdown in Distillation
Towers, Reboilers, and Condensers
Basic System Components and Operation in Distillation
Control Systems in Distillation
Operating Problems in Distillation

Learning Summary: Stage III

<table>
<thead>
<tr>
<th>PLANT OPERATIONS</th>
<th>COURSES</th>
<th>LEARNING HOURS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boilers</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Furnaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operations Fundamentals</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Other Systems &amp; Equipment</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Refrigeration System</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Storage Tank Operations</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Turbines &amp; Steam Systems</td>
<td>22</td>
<td>22</td>
</tr>
</tbody>
</table>

REFINERY

Refinery Fundamentals
Refining Basics

Refinery Operations
Emission Controls

Refining Process Technologies
Process Reactor Fundamentals
Typical Process Reactions, Part 1
Typical Process Reactions, Part 2
Blending Operations
Azeotropic, Extractive, and Vacuum Columns
Crude Distillation Operations
Fluid Catalytic Cracking Operations
Hydrotreating and Catalytic Reforming 1
Hydrotreating and Catalytic Reforming 2
Treating and Sulfur Recovery Operations

Distillation
Basic Principles of Distillation
System Startup and Shutdown in Distillation
Towers, Reboilers, and Condensers
Basic System Components and Operation in Distillation
Control Systems in Distillation
Operating Problems in Distillation

LICENSING BY STAGES

Clients may license these e-Learning Pathways on a Stage basis or as a complete three Stage package. The courses may be installed on a client’s server or hosted on IHRDC’s LMS.

IHRDC can aggregate our e-Learning courses to meet your training needs: entry level or advanced.

ESTIMATED TIME FOR COMPLETION

The time that it takes to complete the Refinery Training Pathway depends on the learner’s pace and the amount of time devoted to training each day or week.

The complete Refinery e-Learning Pathway includes 158-167 courses, that consist of approximately 167 hours of learning.
Be sure to contact us today to discuss this outstanding e-Learning resource, view several typical courses, or obtain a quotation. Please visit www.ihrdc.com or contact a Sales Representative in your area (see below) by telephone or e-mail. We welcome the opportunity to share this innovative e-Learning system with you.

IHRDC

WORLDWIDE LOCATIONS

IHRDC/CORPORATE HEADQUARTERS
535 Boylston Street, 12th Floor Boston, MA 02116 USA
Tel: +1.617.536.0202 Fax: +1.617.536.4396
Email: corporate@ihrdc.com

IHRDC/NORTH AMERICA
HOUSTON
Tel: +1.281.340.8535
Email: houston@ihrdc.com

IHRDC/EUROPE
LONDON
Tel: +44.01420.543427
Email: london@ihrdc.com

AMSTERDAM
Tel: +31.299.373480
Email: amsterdam@ihrdc.com

IHRDC/MIDDLE EAST
ABU DHABI
Tel: +971.2.676.2662
Email: abudhabi@ihrdc.com

IHRDC/AFRICA
LAGOS
Tel: +234.803.301.4101
Email: lagos@ihrdc.com

IHRDC/ASIA
KUALA LUMPUR
Tel: +60.3.4065.0800
Email: kualalumpur@ihrdc.com

JAKARTA
Email: jakarta@ihrdc.com

IHRDC has Representatives in:
BRAZIL, INDIA, KUWAIT, MEXICO, PAKISTAN, QATAR, VENEZUELA, AND VIETNAM.

COMPLETE DETAILS AVAILABLE ONLINE:
WWW.IHRDC.COM

CONNECT WITH IHRDC
blog.IHRDC.com
IHRDC
@IHRDCTraining

IHRDC/CORPORATE HEADQUARTERS
535 Boylston Street, 12th Floor Boston, MA 02116 USA
Tel: +1.617.536.0202 Fax: +1.617.536.4396
Email: corporate@ihrdc.com

IHRDC/NORTH AMERICA
HOUSTON
Tel: +1.281.340.8535
Email: houston@ihrdc.com

IHRDC/EUROPE
LONDON
Tel: +44.01420.543427
Email: london@ihrdc.com

AMSTERDAM
Tel: +31.299.373480
Email: amsterdam@ihrdc.com

IHRDC/MIDDLE EAST
ABU DHABI
Tel: +971.2.676.2662
Email: abudhabi@ihrdc.com

IHRDC/AFRICA
LAGOS
Tel: +234.803.301.4101
Email: lagos@ihrdc.com

IHRDC/ASIA
KUALA LUMPUR
Tel: +60.3.4065.0800
Email: kualalumpur@ihrdc.com

JAKARTA
Email: jakarta@ihrdc.com

IHRDC has Representatives in:
BRAZIL, INDIA, KUWAIT, MEXICO, PAKISTAN, QATAR, VENEZUELA, AND VIETNAM.