

## E-511

### ▲ Who should attend?

Anyone interested in the whole Liquefied Natural Gas (LNG) chain: technical and managerial staff working in the LNG chain, equipment providers, personnel from engineering companies...

### ▲ Duration

5 days

### ▲ Sessions in English

Nov. 29 - Dec. 03, 2010  
Rueil-Malmaison (Paris)

**Additional sessions**  
March 29 - April 02, 2010  
Rueil-Malmaison (Paris)

September 13-17, 2010  
Rueil-Malmaison (Paris)

French sessions: F-511

### ▲ Registration

Fees: € 2,950

Contact:

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### ▲ Course Coordinator

Frank BEIJER

Ref. **PROD / LNG**

At request, this course may be organized for a single company, and tailored to its specific requirements.

# LIQUEFIED NATURAL GAS (LNG)

## OBJECTIVES

To provide technical and economical knowledge of the LNG industry.

Upon completion of the course, participants know the:

- LNG chain, as well as the location and specificities of the main LNG plants worldwide,
- main physical properties and specificities of LNG,
- hazards and HSE aspects specific to the LNG installations, as well as the main mitigation and prevention techniques,
- operating principle and conditions of the main liquefaction processes, as well as their particular constraints,
- technology of specific equipment used for LNG industry,
- main LNG contracts and the LNG markets.

## COURSE CONTENT

### THE LNG WORLD

0.50 day

The LNG Chain – Order of magnitude and trends

Location of main plants worldwide

Base load liquefaction plants – Peak shaving liquefaction plants – Small LNG plants for LNG fueled vehicles

LNG Tankers – LNG road tankers

Receiving terminals – Regasification techniques – Satellite regasification techniques

### LNG SPECIFIC PROPERTIES AND ASSOCIATED HAZARDS

0.50 day

Definition of LNG

**Physical properties:** Liquid-Vapor equilibrium, density, ratio of vapor methane / LNG, heat of vaporization, heat of combustion...

**Safety aspects:** Flash Point, Fire Point, Auto-ignition Point, Minimum Spark Energy, Flammability Limits, Deflagration, LNG Vaporization, RPT (Rapid Phase Transition), Radiation levels, Stratification / Roll-over, Sloshing, LNG clouds ignition, Asphyxiation risks, Cryogenic liquids jets, Piping behavior

### LNG HAZARD PREVENTION AND MITIGATION MEASURES

0.50 day

LNG spillage control at Design stage and in Operation

LNG clouds control in operation

LNG fires control at Design stage and in Operation

### LIQUEFACTION AND REGASIFICATION PROCESSES

0.75 day

Feed pretreatment: sweetening, dehydration, NGL extraction, mercury removal, aromatics removal...

**Different liquefaction processes:** Pure Component Refrigerants  
Pure component(s) and Mixed Refrigerant(s)  
Mixed Refrigerants

Peak Shaving simplified scheme

**Regasification process**

### LNG STORAGE, LOADING / OFFLOADING AND TRANSPORT

0.75 day

LNG tanks classification: Single Containment, Double Containment, Full Containment (self standing, membrane)

LNG storage potential hazards

Jetty head, Jetty trestle, harbor

LNG Carriers: common features, main types and differences, cargo operations, safety systems

### TECHNOLOGY OF LNG SPECIFIC EQUIPMENT

1 day

LNG cryogenic heat exchangers: Spiral Wound Heat Exchangers, Aluminum Brazed Heat Exchangers

Introduction to the technology of the Cryogenic Compressors and their drivers (Gas Turbines)

LNG Vaporizers: Open Rack Vaporizers (ORV), Submerged Combustion Vaporizers (SCV)... – Safety and Environmental aspects

Submerged LNG pumps: in-tank retractable pumps, cargo pumps, HP canned send out pumps...

Liquid cryogenic turbo-expanders, Cryogenic valves

LNG Road tankers, LNG vehicle cars, LNG Trucks

Cryogenic personnel protection items

### LNG PLANT OPERATION

0.25 day

Day to day activities in an LNG plant

Experience of some plants

### LNG TRENDS - RESEARCH AND NEW DEVELOPMENTS

0.25 day

LNG trends since the 70's

Technology development: equipment and concept development – Future...

### LNG ECONOMIC ASPECTS

0.50 day

Gas markets: natural gas reserves and production, worldwide gas demands distribution, international natural gas trade

LNG contracts: specificities of LNG contracts, pricing, shipping contracts

LNG markets trends