

**Training Title**

**METALLURGY FOR LNG INDUSTRIES**

**Training Duration**

**5 days**

**Training Venue and Dates**

REF WC042	Metallurgy for LNG Industry	5	11-15 April 2021	\$4,250	Abu Dhabi, UAE
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**In any of the 5 star hotel. Exact venue will be informed later.**

**Training Fees**

- **4,250 US\$ per participant includes Training Materials/Handouts, Tea/Coffee breaks, Refreshments and International Buffet Lunch.**

**Training Certificate**

**Define Management Consultancy & Training Certificate of course completion will be issued to all attendees.**

**TRAINING INTRODUCTION**

**The growing trends towards usage of gas in place of oil is posing a problem relating to compatibility of existing metals and material – mostly carbon based equipment- which are exposed to a different operational condition. Carbon steel which has proved to be good for most oil field application for over fifty years, has shown a variable behaviour at lower temperatures than at the normal refining conditions. That has led to the study of stainless steel as an alternative material of choice.**

**The need for LPG and LNG for industries such as polymers and petrochemicals necessitated new ways and means of containment, and transport of these as liquids, has become a challenge. Pure gases like air is one issue and hydrocarbons contaminated with water, oil and corrodants is another issue, which involve metal/ chemicals interactions at high pressures. Corrosion is consequential and failures follow. This course lists some of these obstacles in right material selection.**

**TRAINING OBJECTIVE**

**A new insight into metal /material behavior other than normal high temperature operation which is familiar to engineers/operators**

**TRAINING METHODOLOGY:**

**A highly interactive combination of lectures and discussion sessions will be managed to maximize the amount and quality of information and knowledge transfer. The sessions will**

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start by raising the most relevant questions, and motivate everybody find the right answers. You will also be encouraged to raise your own questions and to share in the development of the right answers using your own analysis and experiences. Tests of multiple-choice type will be made available on daily basis to examine the effectiveness of delivering the course. All presentations are made in excellent colorful power point. Very useful Course Materials will be given.

- 30% Lectures
- 30% Workshops and work presentation
- 20% Group Work & Practical Exercises
- 20% Videos & General Discussions

This is a value added package

### WHO SHOULD ATTEND?

Process Engineers, Inspection Personnel, Mechanical Engineers, Material Selection Personnel, and those who handle material, and Corrosion Control Personnel

### COURSE OUTLINE

#### Carbon steel, the old veteran

Metallurgy of Carbon steel, the most widely used metal in oil and gas industry equipments- Basis for selection-physical, mechanical and metallurgical properties-Role of trace metals - effect of impurity and temperature-TTT diagram

Pre- service defects during- fabrication- storing-transport –installation and commissioning - flaws - defects and failures

In service defects- simple environmental conditions -

Understanding corrosion- under ambient conditions and in presence of water

- Why metals and materials fail?
- Why different materials show different failure patterns?
- The eight forms of material failure (corrosion)-Basic theory of corrosion
- Understanding cause of failure- from case studies and photographs
- Theory of corrosion made simple by experiments made by great people like Galvano, -Ohm's law and Niels Bohr atomic theory

#### Day 2 Gas processing environment

Types of Gas and oil resources- oil gas and water mixture and separation issues- Gas processing- phase issues and flow regimes- velocity and temperature factors in mixtures- corrosion in TOL and bottom of line-

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Types of environment in gas industry-aggressive-CO<sub>2</sub>-H<sub>2</sub>S-amine, chloride, acid, sour water, Flue gas, caustic, ammonia, polythionic acids, olefins, aromatics-how they affect carbon steel at ambient condition

Plant and machinery- pipes, storage vessels, reactors, pumps, compressors valves- heat exchangers-typical problems and failure patterns

### Day 3 Importance and principle of Cryogenics

What is cryogenics? - History of development-of liquefaction of air- the success and problems in containment transport and materials

Introduction to Natural gas separation and purification- Cryogenic separation in production and associated impurities- solvents, gases, particulates - gas liquefaction and purification

### Day 4 Cryogenics and metallurgy

How carbon steel is affected by low temperature

Introduction to Stainless steel – types and classification- how it is affected under wet gas condition-case study of failed components- stainless steel failure in production and transport of oil and gas mixture- failure under complex condition of H<sub>2</sub>S, CO<sub>2</sub>, Cl, O<sub>2</sub>, moisture in varying quantities

Stainless steel in cryogenic application

Stainless steel as cast components, lining and cladding material

What are Polymers? Their application for cryogenics

Storing and transport issues

Weldment failures

Coating issues

Cost versus reliability

Health and safety issues

### Day 5 Material testing and failure analysis

Laboratory analysis by Atomic spectra

Particulate analysis by SEM, EDX

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Acoustics for cracks and leaks  
FEA for new and old equipment

**NOTE:**

**Pre & Post Tests will be conducted**

**Case Studies, Group Exercises, Group Discussions, Last Day Review & Assessments will be carried out.**

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