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**МЕЖДУНАРОДНЫЙ ЦЕНТР
ПОДГОТОВКИ ПЕРСОНАЛА**
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ADVANCED TRAINING PROGRAM
Cryogenic technique and cryogenic technologies

Duration: 40 h

Form: off-the-job

№	Topics
1	Liquefied gases of cryogenic temperature range (cryogenic liquids)
1.1	<i>Liquefied natural gas</i>
1.1.1	Basic properties of natural gas and requirements for its quality
1.1.2	Natural gas production
1.1.3	Technological cycles of natural gas liquefaction and corresponding plant layouts
1.1.4	LNG storage and transportation
1.1.5	Technologies for filling LNG into tanks and distributing LNG to consumers
1.1.6	LNG as a motor fuel
1.1.7	Industrial safety rules applied during storage and transportation of LNG
1.2	<i>Main products of low-temperature rectification of atmospheric air (oxygen, nitrogen, argon, krypton concentrate)</i>
1.2.1	Composition of standard atmosphere
1.2.2	Basic physicochemical properties of oxygen, nitrogen and argon
1.2.3	Features of binary and more complex gas mixtures
1.2.4	Low temperature rectification of atmospheric air
1.2.5	Storage and transportation of liquefied oxygen, nitrogen and argon
1.2.5.1	Stationary and transport cryogenic vessels for liquid air separation products
1.2.5.2	International standards for cryogenic vessels
1.2.5.3	Modern thermal insulation of cryogenic vessels
1.2.5.4	Technologies for filling air separation products into tanks and distributing them to the consumer
1.2.5.5	Industrial safety rules applied during storage and transportation of cryogenic air separation products
1.3	<i>Liquid hydrogen</i>
1.3.1	Methods for industrial hydrogen production
1.3.2	Technological cycles of hydrogen liquefaction and schemes of hydrogen liquefiers
1.3.3	Features of liquid hydrogen storage
1.3.3.1	Ortho-para conversion of hydrogen and measures to compensate for the associated losses of liquid hydrogen during its storage
1.3.3.2	Cryogenic vessels, pipelines, hoses and fittings used in the storage and transportation of liquid hydrogen. Taking into account the phenomenon of hydrogen embrittlement of metal structural materials
1.3.3.3	Industrial safety rules applied during storage and transportation of liquid hydrogen
1.3.4	Application of hydrogen as an energy carrier
1.3.4.1	Hydrogen as a fuel for engines for various purposes
1.3.4.2	Fuel cells
1.4	<i>Liquid helium</i>
1.4.1	Methods for industrial production of helium and requirements for its quality
1.4.2	Technological cycles of helium liquefaction and configurations of helium liquefiers
1.4.3	Features of liquid helium storage. Ways to reduce losses
1.4.4	Cryogenic vessels, pipelines, hoses and fittings used in the storage and transportation of liquid helium. Features of thermal insulation of vessels for liquid helium
1.4.5	Applications of helium
2	Liquefied hydrocarbon gases
3	Liquefied petroleum gases
Final certification	