Mutual Joint Visit Workshop on Liquefied Petroleum Gas (LPG) and Liquefied Natural Gas (LNG) Sites

The situation regarding LPG and LNG in Cyprus

by

Themistoclis Kyriacou
Senior Labour Inspection Officer

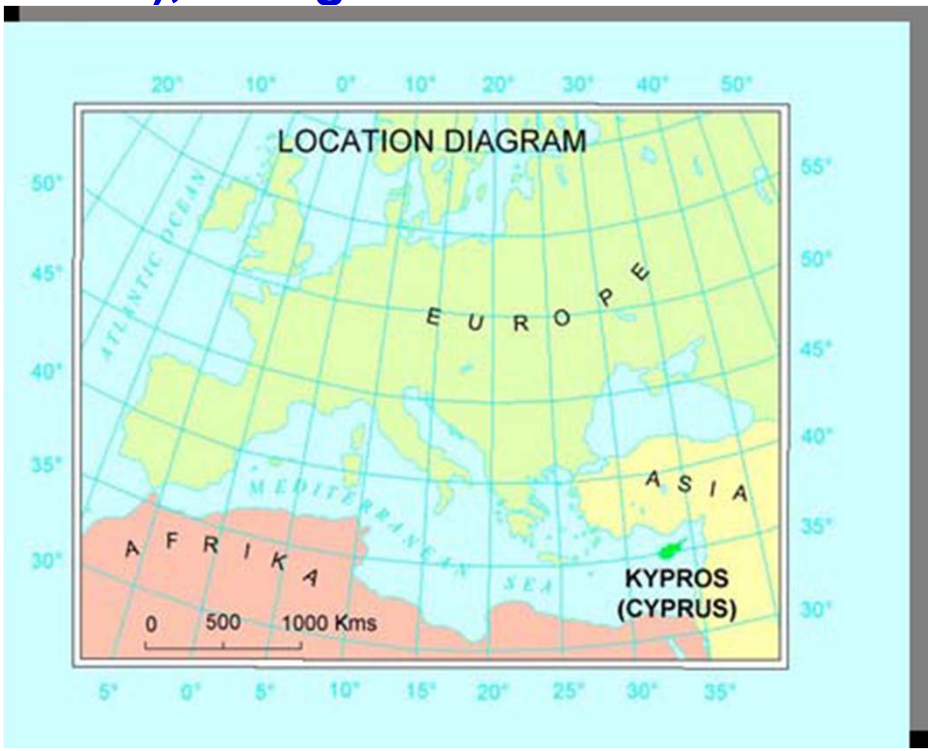
26th - 28th September 2017, Nicosia, Cyprus

Agenda

- The Department of Labour Inspection
- LPG Vs LNG
- LPG and LNG in Cyprus

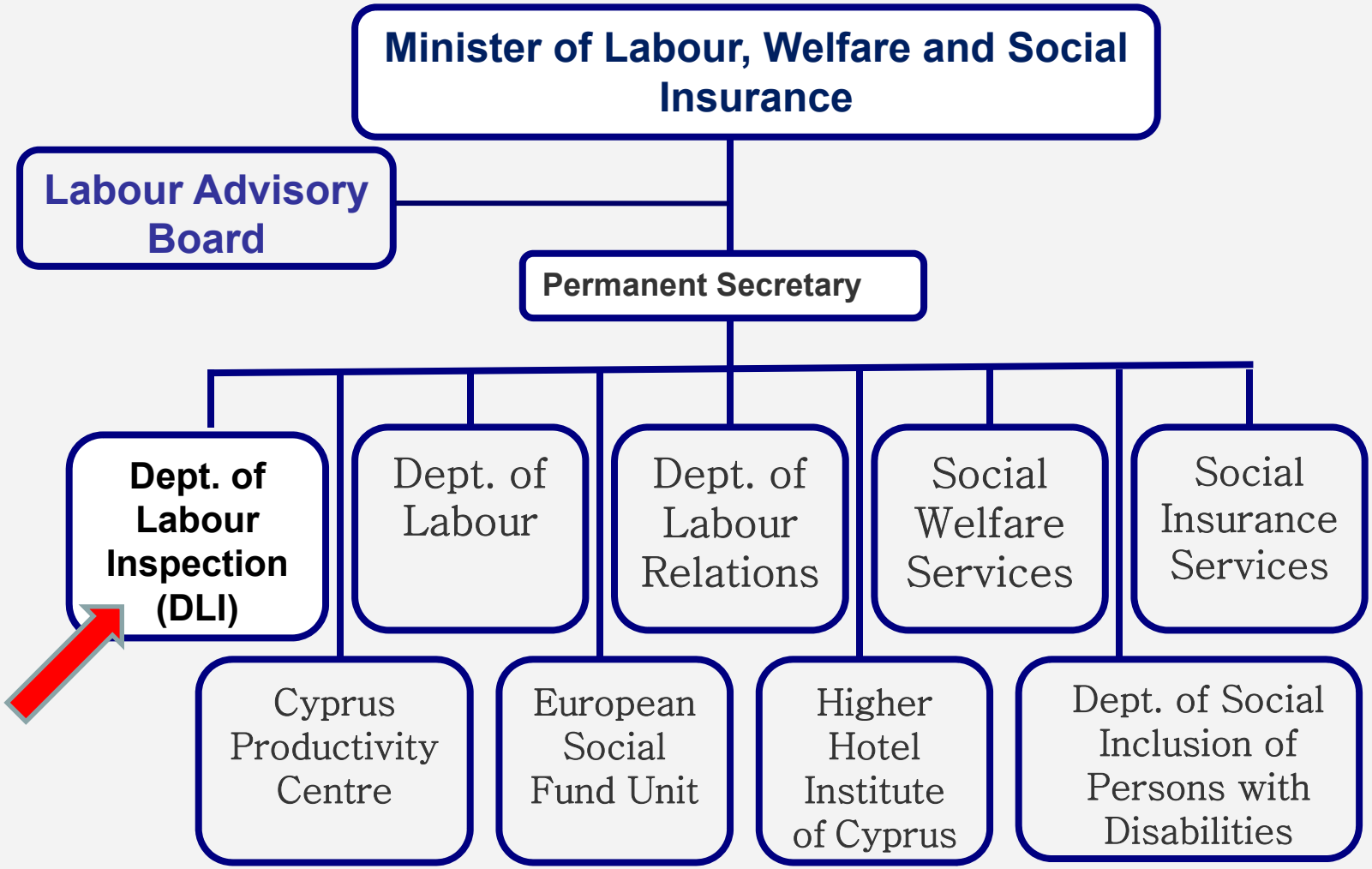
Cyprus Profile

- **Area: 9.251 km^2**
- **Population: 940.100 (Dec. 2015)**
  - **74,5% (701.000), Greek Cypriots**
  - **9,8% (90.800), Turkish Cypriots**
  - **15,7% (147.300), foreign residents and workers**

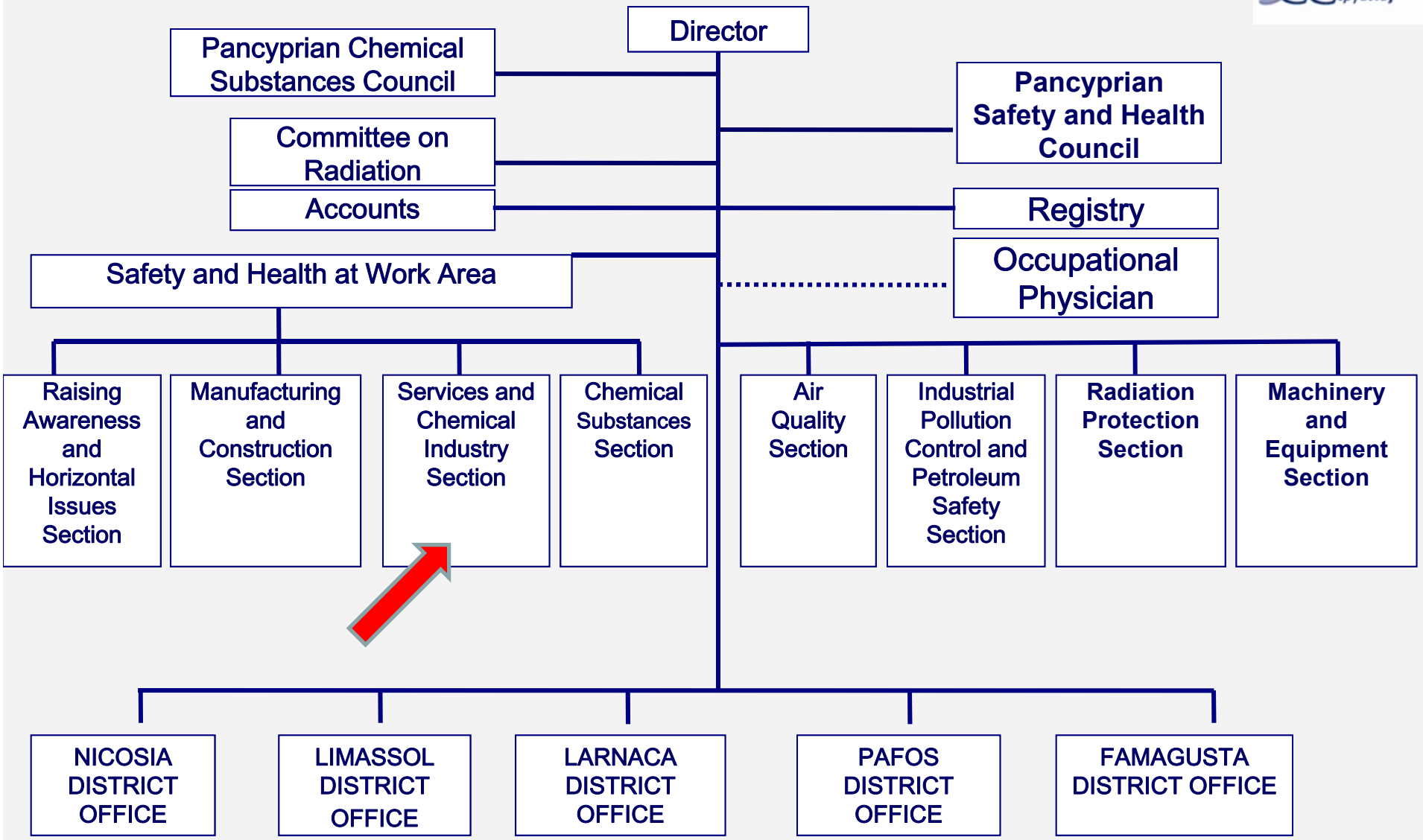


Cyprus Profile

MLWSI Organisational Structure



DLI Organisational Structure



Legislation

- The Safety and Health at Work Law
  - The Management of Safety and Health Issues at Work Regulations
  - The SEVESO Regulations
  - The Offshore Safety Regulations
  - Regulations …
- The Chemical Substances Law
- The Control of Atmospheric Pollution Law
- The Air Quality Law
- The Protection from Ionising Radiation Law

ENFORCEMENT SYSTEM

- Structured on the basis of the ILO Convention No. 81
- Specialized expertise at the Headquarters
  - University graduates
- Field operations at the District Offices
  - Higher Technical Institute graduates

Powers of Inspectors

- enter, without obstruction and without any advanced notice, any place of work
- be accompanied by a Police Officer in case needed
- be accompanied by any other person
- carry out examinations, tests, inspections and investigations
- require the presentation of any record
- require any person to give any information
- require any person in the workplace to afford him such facilities and assistance as deemed necessary
- take measurements or photographs
- take samples, articles or substances

Guidance for inspections

- Inspection Manual
- Guide on ´´Violence Towards Inspectors´´
- Criminal Prosecutions Manual
- Internal Circulars
- Department's Intranet

Actions

- Verbal recommendations and instructions, especially when no contraventions, or only minor deficiencies are found
- Letters
- Improvement Notices
- Prohibition Notices
- “Ex-parte” Court Order
- Prosecution of Offenders

Control of Major Accident Hazards

Within the DLI a specialized unit is dealing with major accident hazards

- **Implements the Health and Safety at Work (Control of Major Accident Hazards Involving Dangerous Substances) Regulations (SEVESO) (harmonizing the Cyprus legislation with the provisions of the EU Directive 2012/18/EC (SEVESO III) except of those provisions that are related to the land use and the external emergency plans for which the respective authorities are the Department of Housing and Town Planning and the Civil Defense Services)**

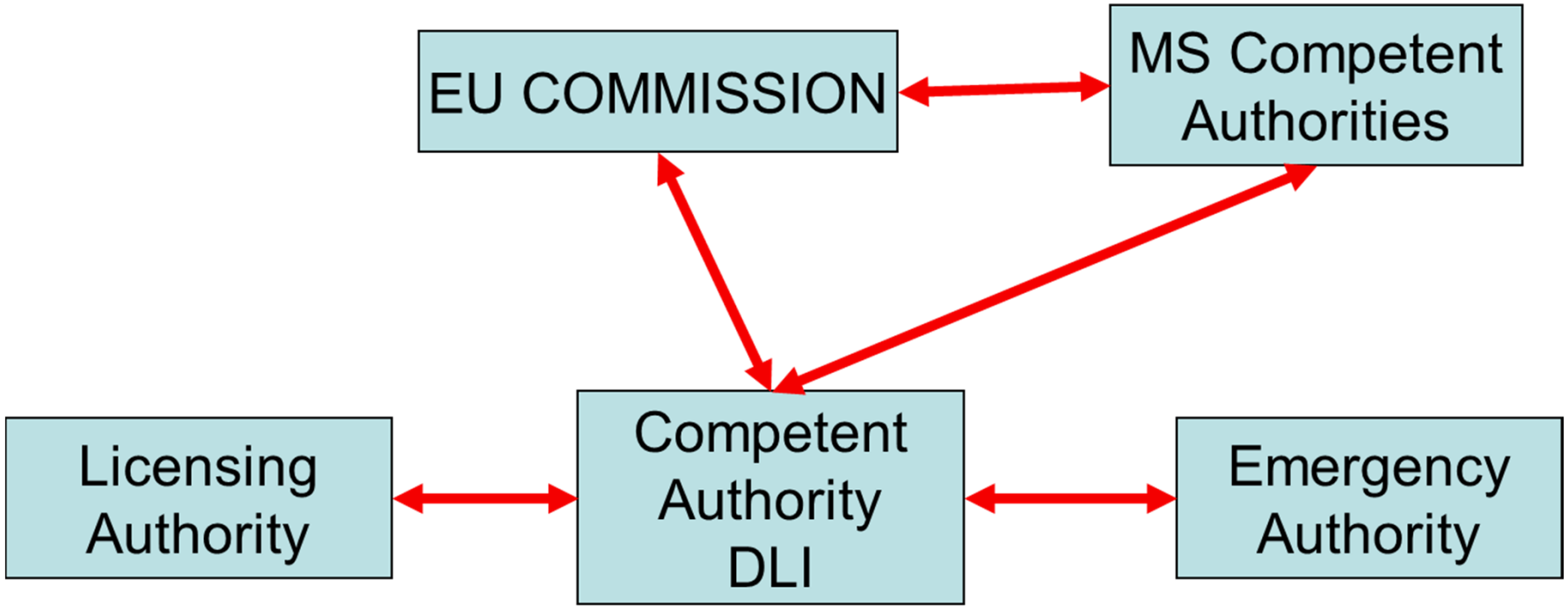
Control of Major Accident Hazards

The Regulations aim at the prevention of major accidents involving dangerous substances and at the limitation of their consequences to people and the environment

The Unit

- **Carry's out Inspections**
- **Cooperates with the Civil Defense concerning External Emergency Plans and the Department of Town Planning and Housing on issues of site planning of new establishments and on building developments in proximity to existing establishments**
- **Assesses the Safety Reports, internal emergency plan, safety management system and the safety policy of these establishments**

Control of Major Accident Hazards



Control of Offshore Operations Hazards

Within the DLI a specialized unit is dealing with offshore activities

- **Implements the Health and Safety at Work (Safety of Offshore Oil and Gas Operations) Regulations (harmonizing the Cyprus legislation with the provisions of the EU Directive 2013/30/EU (OSD) except of those provisions that are related to the licensing and the external emergency plans for which the respective authorities are the Council of Ministers and the Minister of the Environment)**

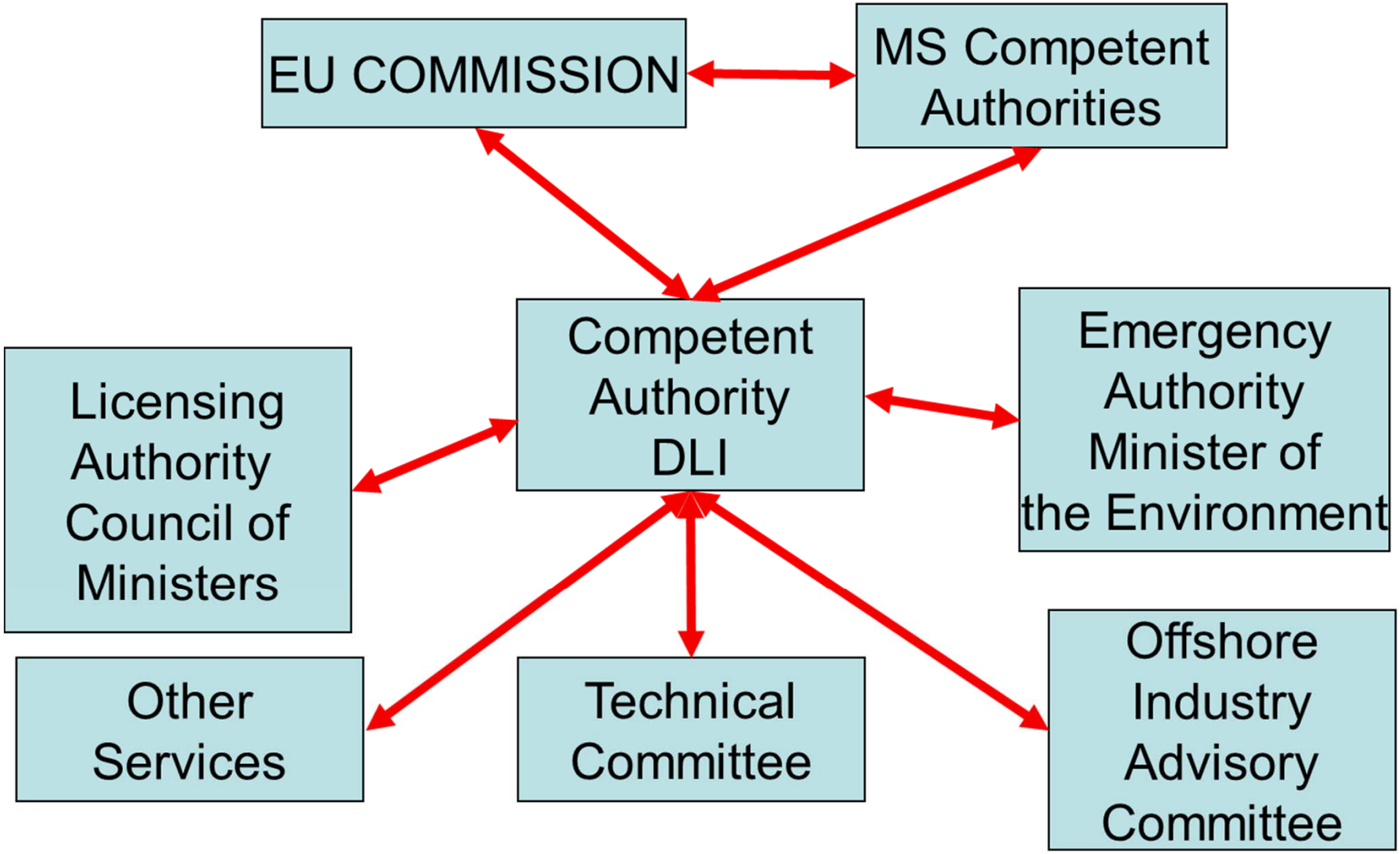
Control of Offshore Operations Hazards

The Regulations establish minimum requirements for preventing major accidents in offshore oil and gas operations and limiting the consequences of such accidents

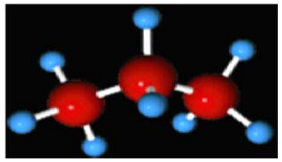
The competent authority is responsible for the following regulatory functions (art 8):

- **assessing and accepting reports on major hazards, assessing design notifications, and assessing notifications of well operations or combined operations, and other similar documents that are submitted to it**
- **overseeing compliance by operators and owners with the Regulations, including inspections, investigations and enforcement actions …….**

Control of Offshore Operations Hazards

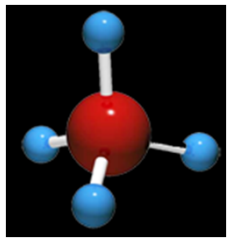


LPG Vs NG

Propane  **Butane** 

C_3H_8 **C_4H_{10}**

LPG (Propane/Butane mix)

Natural Gas (Methane) CH_4 

LNG (Liquefied Natural Gas): Methane gas is processed into LNG by cooling it to −161°C, at which point it becomes a liquid

This reduces the volume of the natural gas by a factor of more than 600 times

LPG Vs NG

What are the Key Differences Between LPG vs Natural Gas?

- LPG (propane) and natural gas (methane) have different chemical formulas: Methane is CH_4 Propane is C_3H_8
- LPG has a higher calorific value - energy content - than natural gas, with 93.2MJ/m^3 vs 38.7MJ/m^3
- For proper combustion, LPG requires an air to gas ratio of approximately 25:1 whilst natural gas requires a 10:1 ratio

LPG Vs NG

- LPG (propane) is more dense than air, at a relative density of 1.5219:1 vs natural gas (methane) at 0.5537:1, which is lighter than air
- LPG can be compressed into a liquid and stored or transported in a cylinder or larger vessel
- LNG: The natural gas is condensed into a liquid at close to atmospheric pressure by cooling it to approximately −161 °C

LPG Vs NG

Gas Properties	LPG (Propane)	Natural Gas (Methane)
Boiling Temp: ºC	-42	-161.5
Flame Temp: ºC	1967	1950
Specific Gravity	1.5219	0.5537
"Lower Explosive or Flammable Limit" (LEL/LFL) (% by volume of air)	2.1	4.4
"Upper Explosive or Flammable Limit" (UEL/UFL) (% by volume of air)	10.1	16.4

LPG and LNG in Cyprus

SEVESO ESTAPLISHMENTS

- 14 Upper Tier
  - LPG: 5
  - Petroleum products: 7
  - LPG and Petroleum products: 1
  - Various chemicals: 1
- 18 Lower Tier
  - LPG: 4
  - Petroleum products: 3
  - Various chemicals: 3
  - Explosives: 5

LPG SEVESO SITES

Establishments	Sphere	Bullet	Cylinders	Truck tanks	LPG bottling plant
3	√	√	√	√	√
1		√	√	√	√
2		√		√	
1				√	
2			√	√	
3			√		
1		√		√	

Upper tier
Lower tier

OTHER LPG SITES (not SEVESO)

Quantity (tons)	N. Of Sites
O-1	1695
1-10	242
10-50	13
Total	1950


Sign in
Λύκειο Λιβαδιών
Petraki Kyprianou
Andrea Stylianou
Ayiou Sawa
Ηγουμένων Εθνών
Andrea Stylianou
Andrea Stylianou
Jumbo
JUMBO
B3
B3
Oil & Gas Storages
Old Cyprus Petroleum
Refinery Ltd
Ammoxostou
Oil and Gas Storages
Ammoxostou
Lidl
Σούπερ Μάρκετ Λιντλ
Google
3D
Imagery ©2017 DigitalGlobe, DigitalGlobe, TerraMetrics, Map data ©2017 Google
United States
Terms
Send feedback
500 ft


B1
Vasilikos Power Station
Ηλεκτροπαραγωγικός
Σταθμός Βασιλικού
Future Energy Centre
Μελλοντικό
Ενεργειακό Κέντρο
Naval Base
utenant General...
Ναυτική Βάση
ντιστράτηγος...
Petrolina
(Holdings) Public
Vittol Fuel Farm
Google

A/A	Accident Scenario	Critical Equipment	Result
1.	Catastrophic rupture, partial rupture and LPG leakage	LPG storage tank	BLEVE, dispersion of vapor cloud, explosion of vapor cloud, pool fire
2.	Catastrophic rupture, partial rupture and LPG leakage	LPG truck tank	BLEVE, dispersion of vapor cloud, explosion of vapor cloud, pool fire
3.	Catastrophic rupture and partial rupture	LPG pipelines	Jet fire, dispersion of vapor cloud, explosion of vapor cloud
4.	Release from the safety valve of a storage tank	LPG storage tank	Jet fire, dispersion of vapor cloud, explosion of vapor cloud
5.	Release from the safety valve of LPG truck tank	LPG truck tank	Jet fire, dispersion of vapor cloud, explosion of vapor cloud
6.	Catastrophic rupture of LPG hose	LPG hose	Jet fire, dispersion of vapor cloud, explosion of vapor cloud
7.	Fire in a bunch of LPG cylinders	LPG cylinders	BLEVE, dispersion of vapor cloud, explosion of vapor cloud
8.	LPG leakage	LPG bottling plant	Dispersion of vapor cloud, explosion of vapor cloud

Question

In case of fire in a bunch of LPG cylinders for BLEVE how many cylinders you take into account

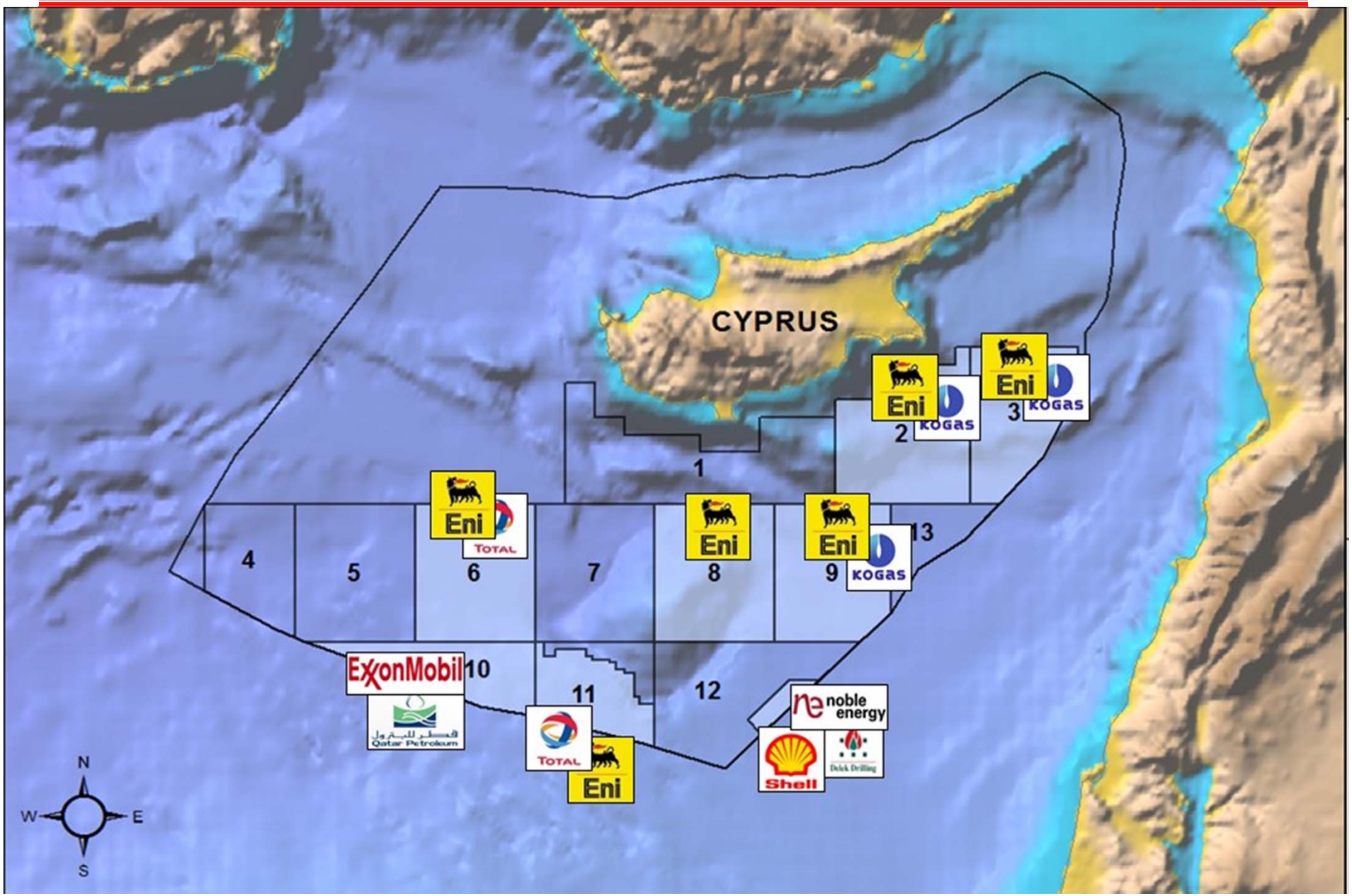
- **1 cylinder**
- **All cylinders**
- **else**

LNG SITES

They do not exist (for the time being)

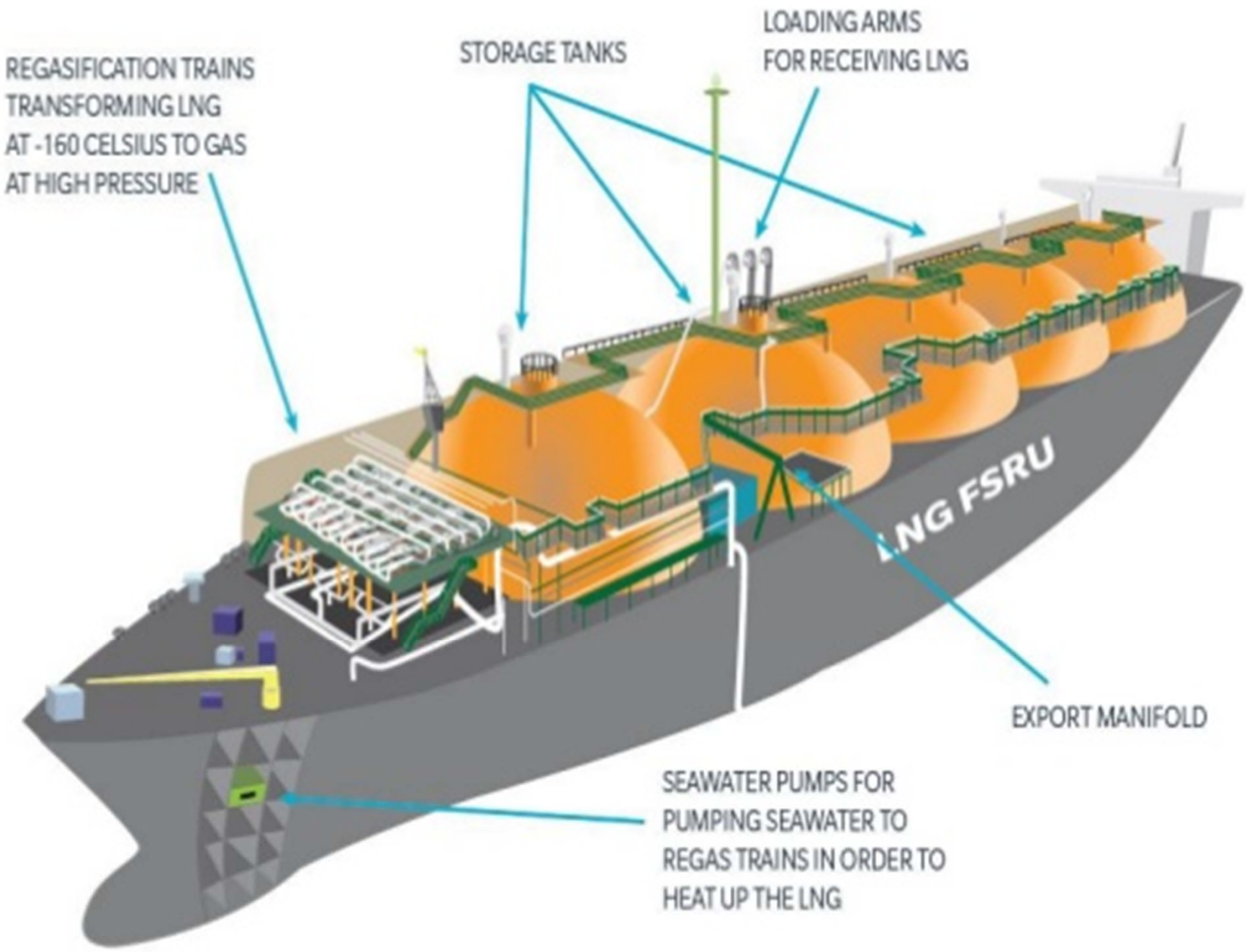
- **Exploration**
- **FSRU**
- **Liquefaction unit**

Exploration - EEZ



Exploration- MODU

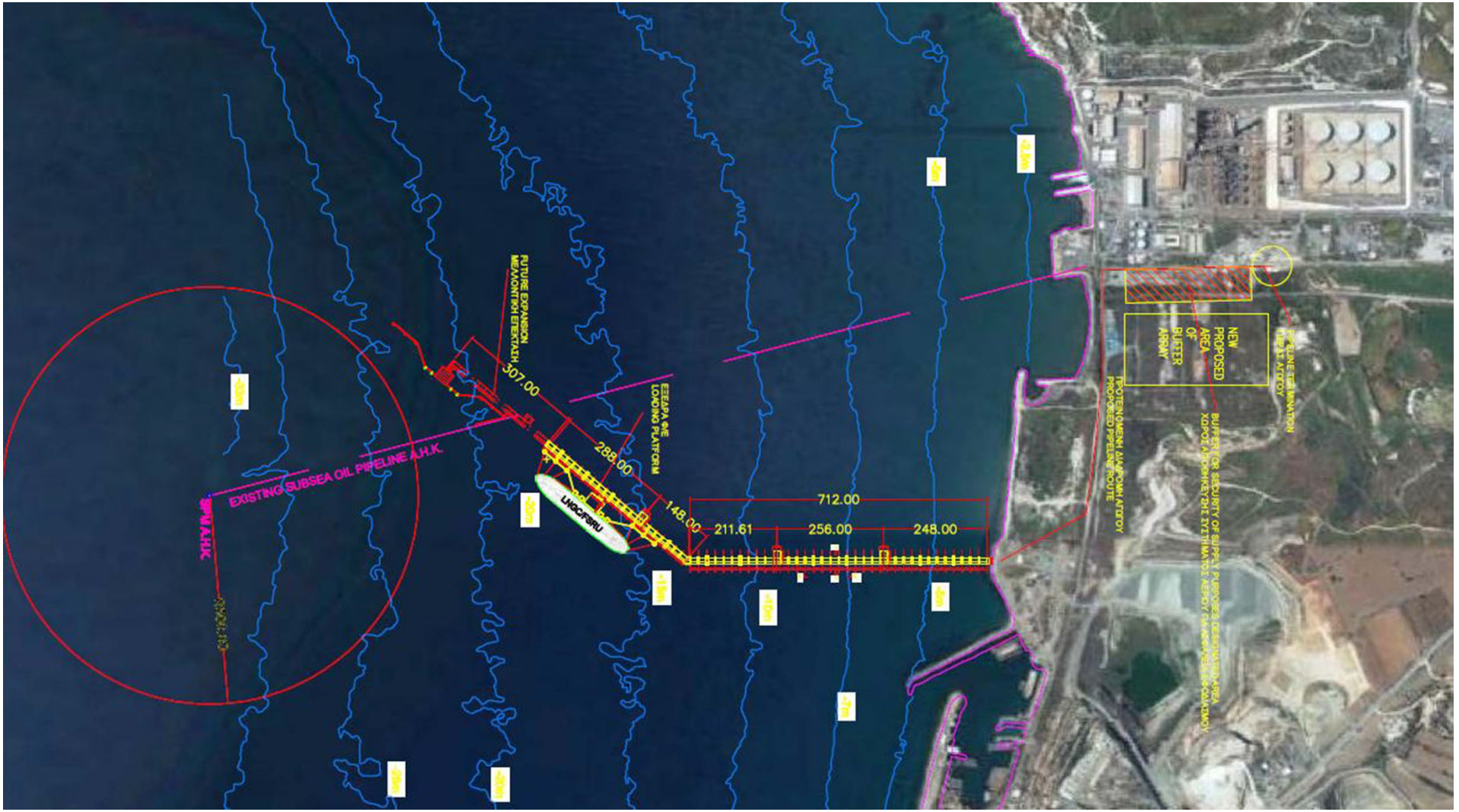
FSRU


REGASIFICATION TRAINS
TRANSFORMING LNG
AT -160 CELSIUS TO GAS
AT HIGH PRESSURE
STORAGE TANKS
LOADING ARMS
FOR RECEIVING LNG
LNG FSRU
EXPORT MANIFOLD
SEAWATER PUMPS FOR
PUMPING SEAWATER TO
REGAS TRAINS IN ORDER TO
HEAT UP THE LNG

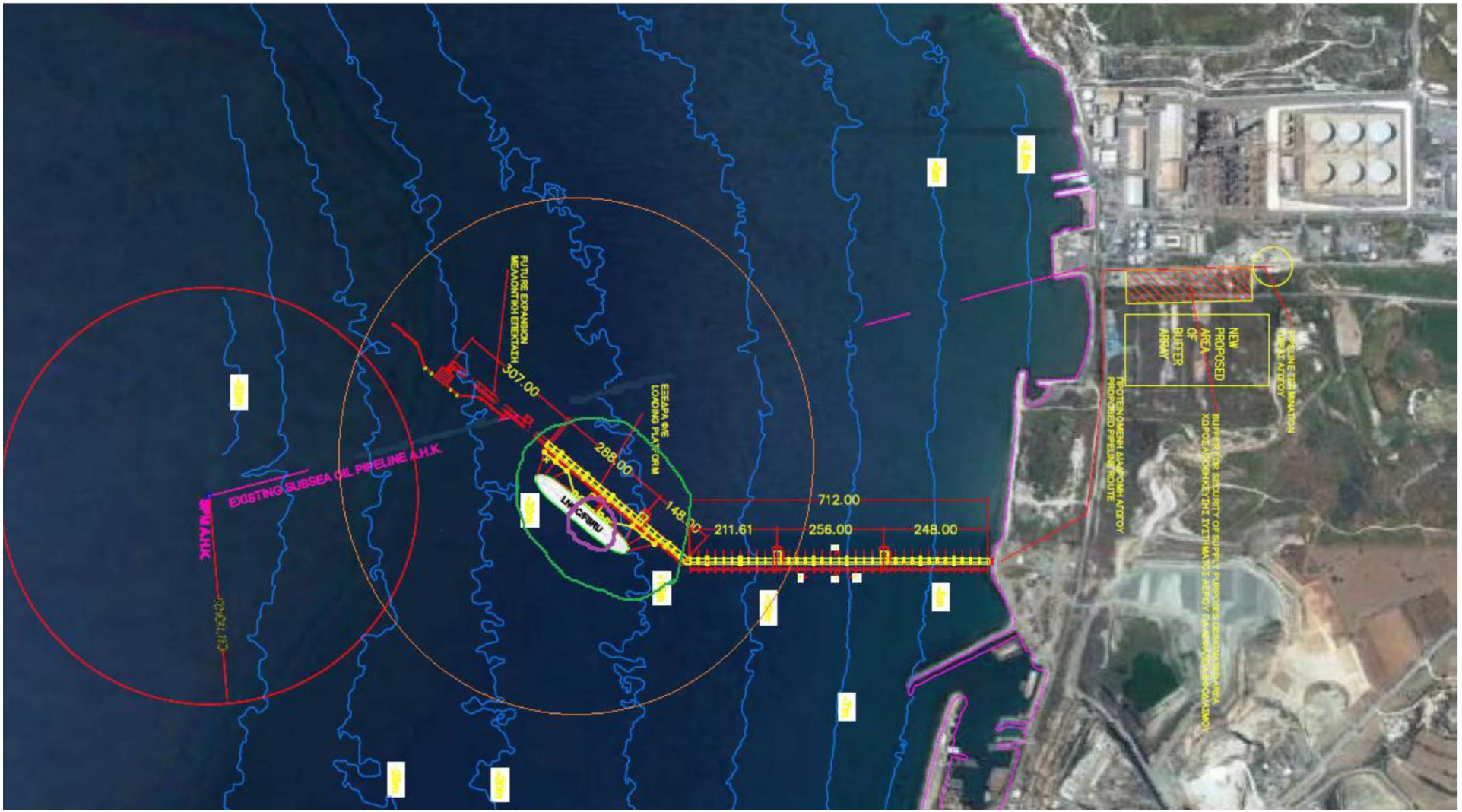
FSRU - Project

- Project aiming to develop LNG import and gas supply in Cyprus
- The project development is expected to include the following:
  - A jetty
  - A FSRU permanently moored in Vassilikos bay
  - An offshore pipeline connecting the FSRU with the receiving point onshore at Vassiliko etc

FSRU - Jetty


EXISTING SUBSEA OIL PIPELINE A.H.K.
FUTURE EXPANSION
ΜΕΛΛΟΝΤΙΚΗ ΕΠΕΚΤΑΣΗ
297.00
288.00
148.00
712.00
211.61
256.00
248.00
LNGC/FSRU
NEW PROPOSED AREA OF BUFFER ARRAY
PIPELINE TERMINATION
ΠΕΡΑΣ ΑΓΩΓΟΥ
BUFFER FOR SECURITY OF SUPPLY PURPOSES DESIGNATED AREA
ΠΡΟΤΕΙΝΟΜΕΝΗ ΔΙΑΔΡΟΜΗ ΑΓΩΓΟΥ
PROPOSED PIPELINE ROUTE

FSRU - QRA


EXISTING SUBSEA OIL PIPELINE A.H.K.
A.H.K.
FUTURE EXPANSION
ΜΕΛΛΟΝΤΙΚΗ ΕΠΕΚΤΑΣΗ
307.00
288.00
148.00
EESAPA-NE
LOADING PLATFORM
LNG CARRU
712.00
211.61
256.00
248.00
NEW
PROPOSED
AREA
OF
BUFFER
ARMY
PROPOSED PIPELINE ROUTE

LNG - Scenario List

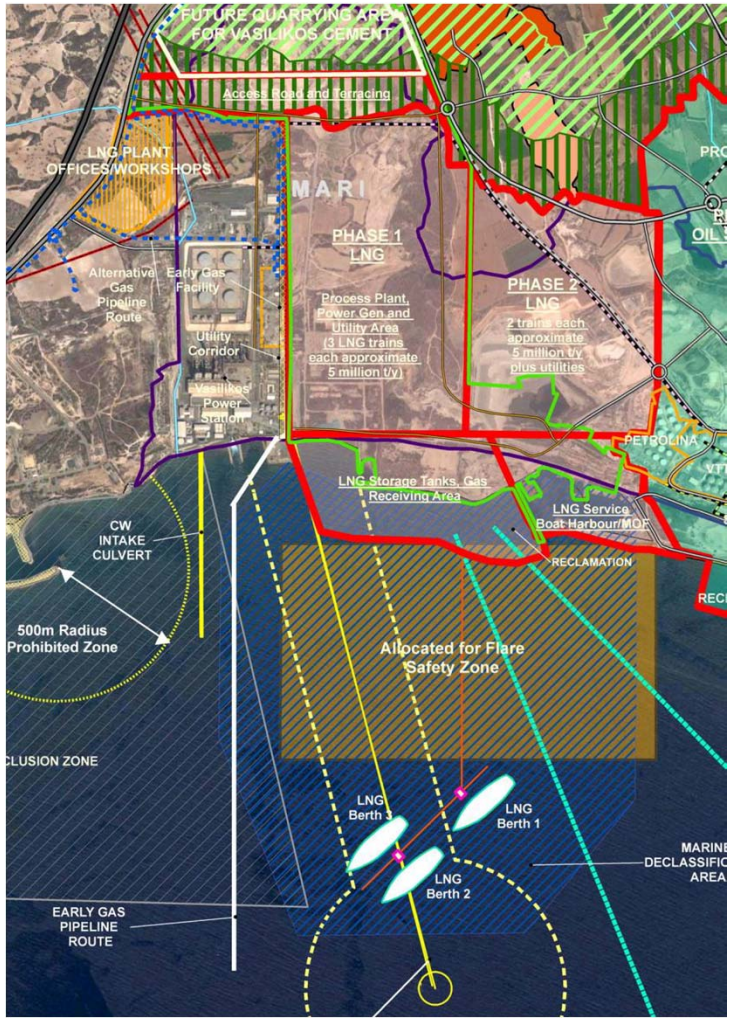
LNG release from pipework between the FSRU storage Tank 4 and Recondenser
LNG release from Recondenser to the HP Booster Pumps
LNG release from HP Booster Pumps discharge pipework up to LNG-Seawater Heat exchanger
LNG release from cargo distribution header line
NG release from the pipework between the LNG-Seawater Heat exchanger and gas export manifold ESDV
NG release from the gas export manifold
NG release from pipework between gas unloading arm and jetty ESDV
NG release from cargo vapour return line on deck
Release of LNG from the FSRU during a ship collision event by approaching LNGC
LNG release from liquid unloading hoses
NG release from vapour return hoses
LNG release from cargo distribution header between the LNGC tanks to the cargo manifold

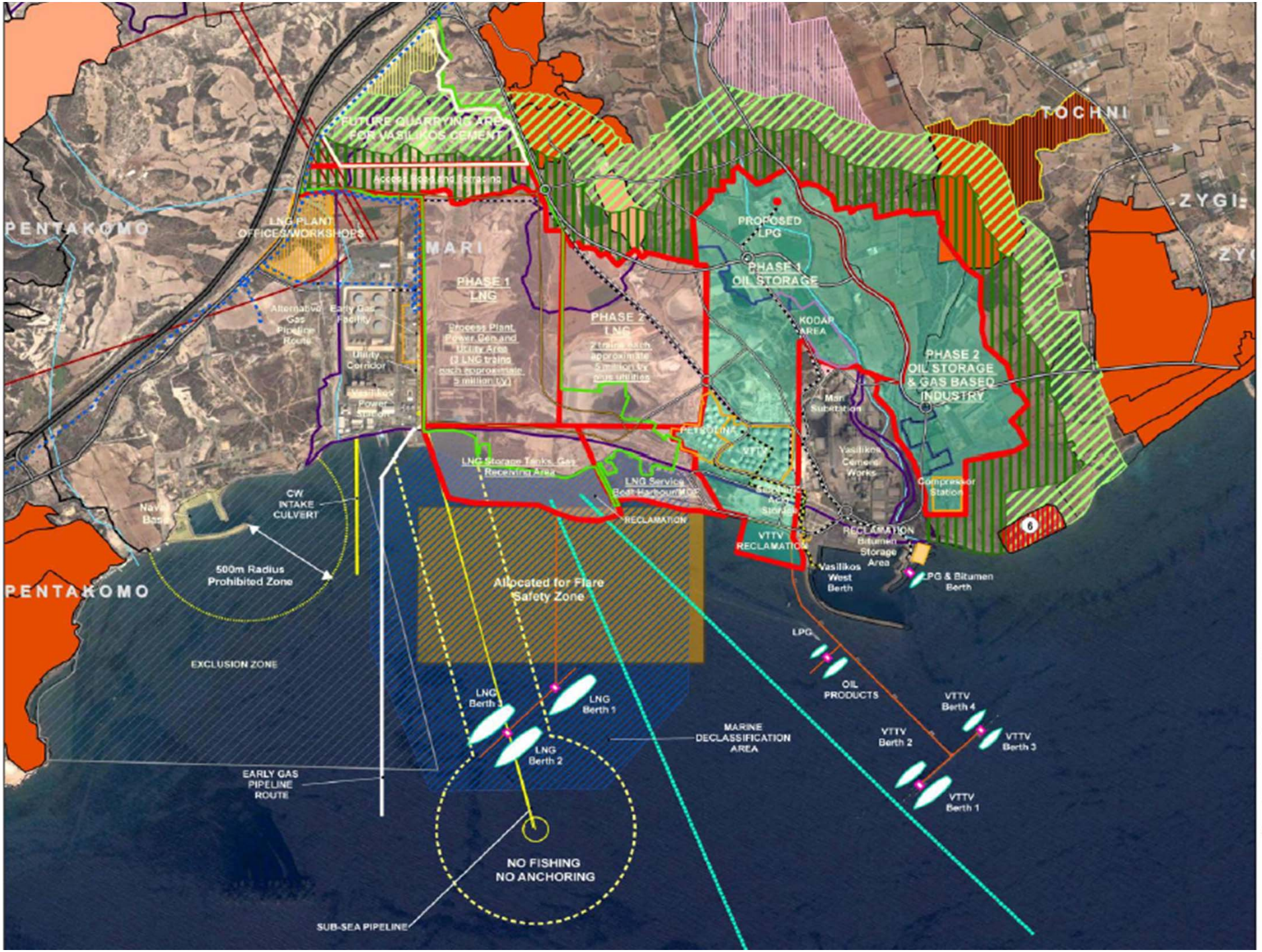
LNG - Project

- **Phase 1**

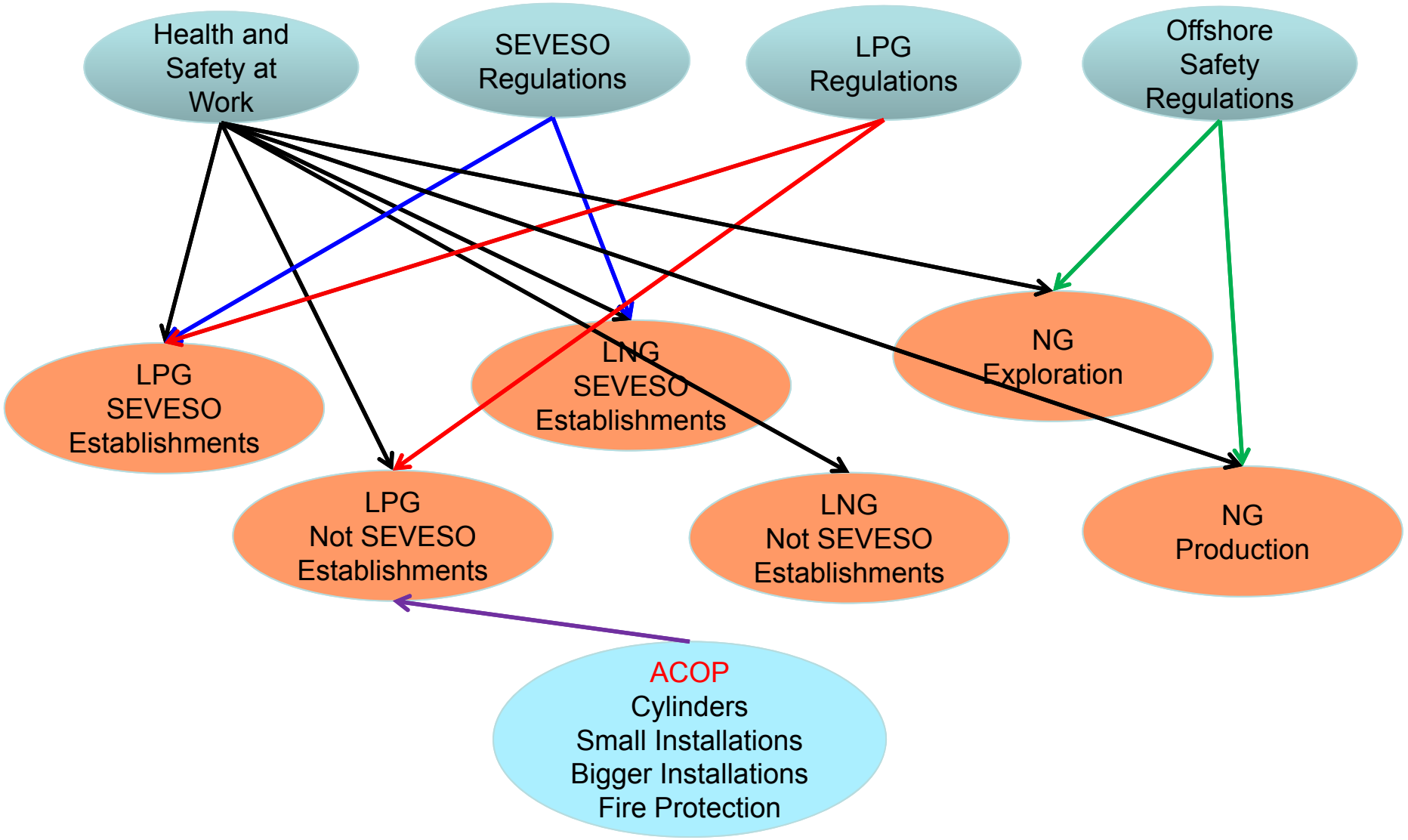
  (3 units of 5 million t/y)
- **Phase 2**

  (2 units of 5 million t/y)




FUTURE QUARRYING AREA FOR VASILIKOS CEMENT
TOCHNI
ZYGI
PENTAKOMO
LNG PLANT OFFICES/WORKSHOPS
MARI
PHASE 1 LNG
Process Plant, Power Gen and Utility Area (3 LNG trains each approximately 5 million t/y)
PHASE 2 LNG
2 trains each approximately 5 million t/y
Alternative Gas Pipeline Route
Early Gas Facility
Utility Corridor
Vasilikos Power Station
PROPOSED LPG
PHASE 1 OIL STORAGE
KODAP AREA
PHASE 2 OIL STORAGE & GAS BASED INDUSTRY
Main Substation
PETROLINA
VTTV
Vasilikos Cement Works
LNG Storage Tanks, Gas Receiving Area
LNG Service Boat Harbour/MOF
RECLAMATION
Compressor Station
Naval Base
CW INTAKE CULVERT
500m Radius Prohibited Zone
VTTV RECLAMATION
RECLAMATION
Bitumen Storage Area
Vasilikos West Berth
LPG & Bitumen Berth
Allocated for Flare Safety Zone
EXCLUSION ZONE
LPG
OIL PRODUCTS
LNG Berth 3
LNG Berth 1
LNG Berth 2
MARINE DECLASSIFICATION AREA
VTTV Berth 4
VTTV Berth 2
VTTV Berth 3
VTTV Berth 1
EARLY GAS PIPELINE ROUTE
NO FISHING NO ANCHORING
SUB-SEA PIPELINE

Legislation



Land Use Planning

- **Siting zones**
  - **"Deterministic" approach by assessing the extent of impact areas of the worst-case scenario**
  - **"Probabilistic" approach by assessing the individual risk**

- **Type of development and level of recipient sensitivity**

Land Use Planning

Zone	Impact Zone Limits		
	Thermal Radiation Limits (kW/m^2)	Blast Overpressure Limits (mbar)	Toxic Cloud (concentration limit value)
Zone I	15	350	LC50
Zone II	6	140	LC1
Zone III	3	50	IDLH

Land Use Planning

- **"Probabilistic" approach**

- **Siting Zone R1: Individual Risk >10^{-6}/year**
- **Siting Zone R2: 10^{-7}<Individual Risk< 10^{-6}/year**
- **Siting Zone R3: 10^{-8} <Individual Risk<10^{-7}/year**

Land Use Planning

- **Thank you…..**

Themistoclis Kyriacou

Τηλ.: 22405631

Fax.: 22663788

E-mail: tkyriacou@dli.mlsi.gov.cy