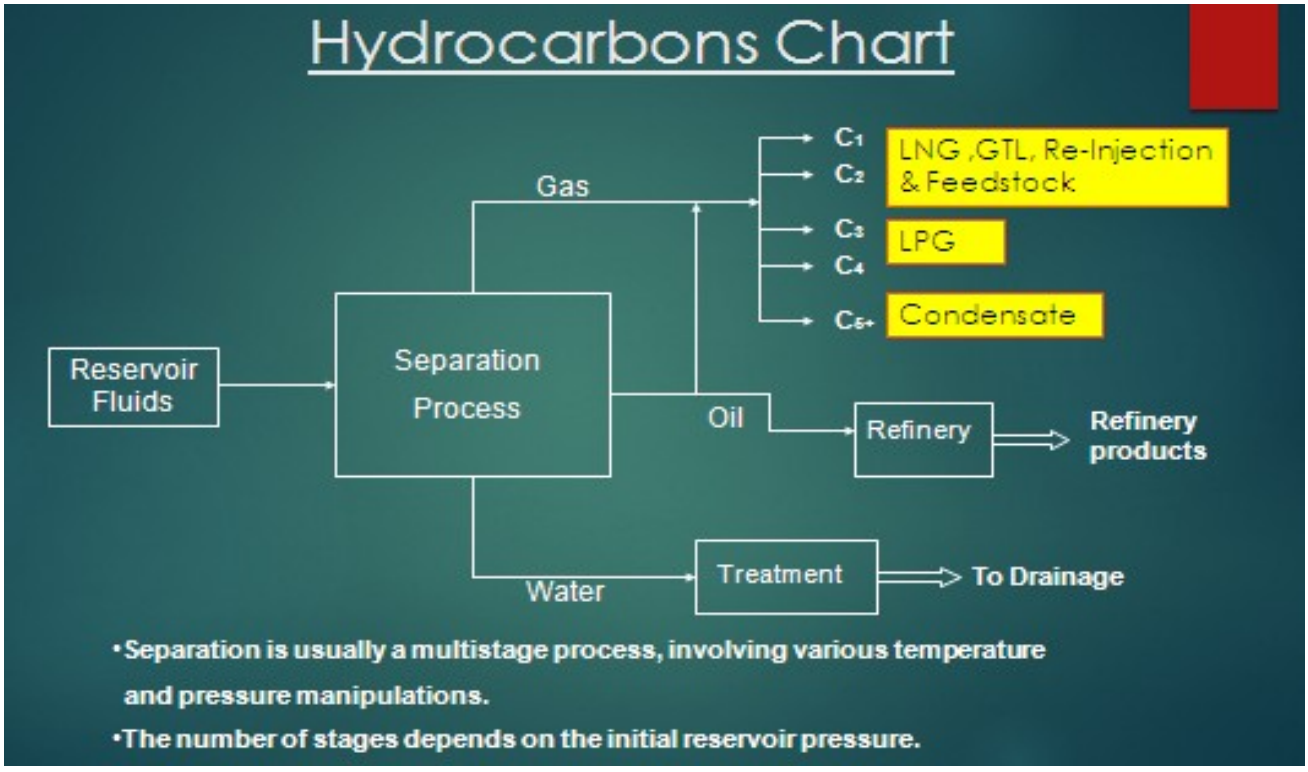
LNG INDUSTRY
PRESENT, FUTURE & SUSTAINABILITY

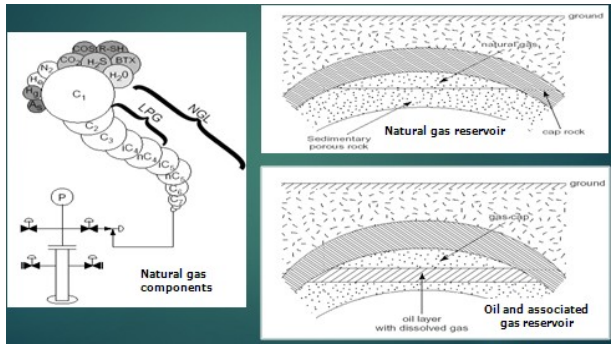
Eng. Omar Fathy El Komy

LNG INDUSTRY

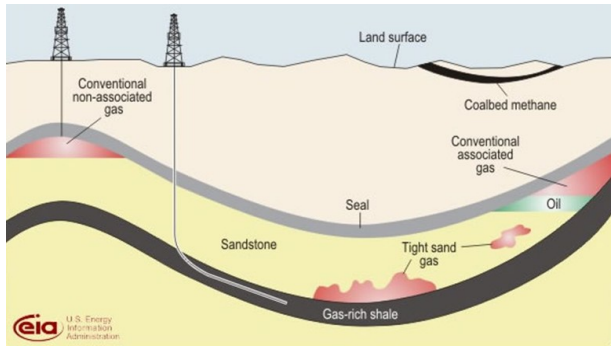
- Natural Gas Commodity
- History
- LNG as an effective tool of Natural gas monetisation
- LNG vs Pipeline
- LNG Base Load Plants
- LNG transportation
- LNG receiving Terminals
- Floating LNG plants
- FSRU (Floating Storage & Regasification Units)
- LNG Sustainability – Role of the Chemical engineers



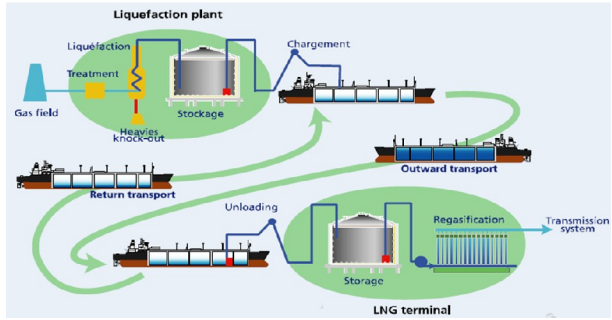
TYPES OF N.G



SHALE GAS



NATURAL GAS CHAIN



LNG

* LNG is natural gas which has been converted to liquid form for ease of storage and transport.
* LNG takes up about 1/600 of the volume of natural gas.
* LNG trading is based on its heating value.
* LNG is the most clean fossil fuel and the lowest in CO_2 emission.

LNG COMPOSITION

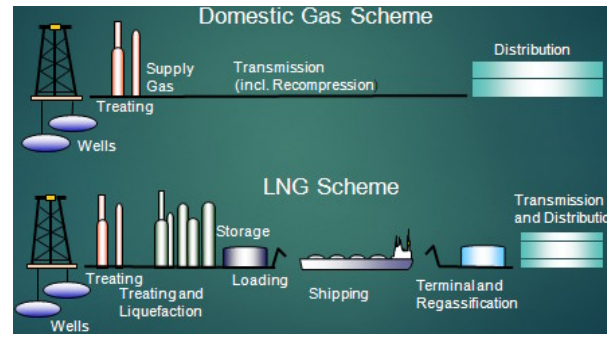
Component	Light LNH	Heavy LNG
CH4	98%	88%
C2H6	1	8
C3H8	traces	3
N2	1	1
Density Kg/m3	420	445
Heating Value BTU/SCF	1000	1130
Wobbe Index HHV / $\sqrt{SG}$	1500	1700

LIQUEFIED NATURAL GAS LNG

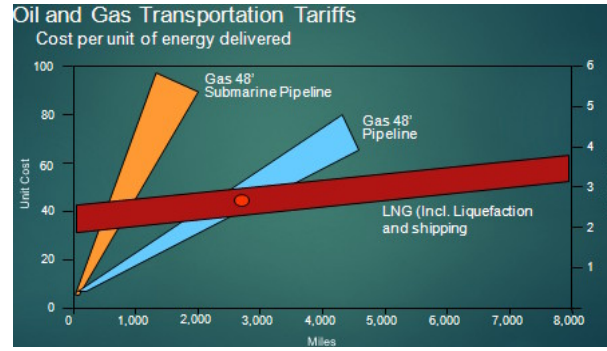
2015 KEY FIGURES

* 308 MTPA TOTAL NAMEPLATE LIQUEFACTION CAPACITY
* 19 EXPORTING COUNTRIES
* 34 IMPORTING COUNTRIES
* 777 MTPA TOTAL REGASIFICATION CAPACITY
* 245.2 MILLION TONS IMPORTED
* 72% OF GLOBAL LNG DEMAND IN ASIA

INTRODUCTION TO LNG



INTRODUCTION TO LNG



LNG

* Liquefied Natural Gas LNG is a prevailing way to monetize natural gas.

* It was first developed in the peak shaving plants in the 1940's.

* Base load LNG plants concept was developed post the Suez canal closure in November 1956.

LNG HISTORY

* Liquefied natural gas (LNG) was proven viable in 1917, when the first LNG peak shaving plant went into operation in West Virginia.

* The first commercial peak shaving liquefaction plant was built in Cleveland, Ohio in 1941. safely across the ocean.

* In January 1959, the world's first LNG tanker carried LNG cargo from Lake Charles, Louisiana to Canvey Island, United Kingdom.

* This event demonstrated that large quantities of LNG could be transported.

* In 1961, UK signed a 15-year contract to take less than 1 (mtpa) from Algeria, commencing in 1965. The first liquefaction base load plant in the world was commissioned at Arzew in Algeria to supply this contract with gas production coming from huge gas reserves found in the Sahara.

* The following year the French signed a similar deal to buy LNG from Algeria.

* Alaska's Kenai plant (which currently has a capacity of 1.3 mtpa) began LNG deliveries to Japan's Tokyo Gas and Tokyo Electric Power Company (Tepco) in 1969.

* Libya's plant at Marsa el Brega began deliveries to Spain in 1970. Italy was also supplied by Libya, marking the entry of a new producer and two new buyers into the ranks of LNG trade.

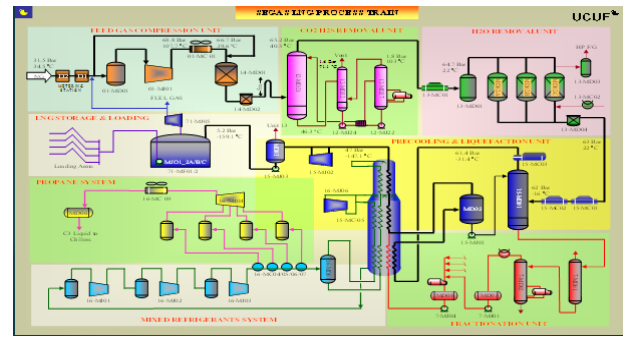
* In 1972, Brunei became Asia's first producer, bringing on stream an LNG plant at Lumut supplying Korea and Japan.

* In 1973 Abu Dhabi was the first in the Gulf to go for LNG instead of gas flaring at Das Island.

* Qatar, The third largest gas reserve owner after Russia and Iran has entered the LNG business as from the early 1990's. Currently they are largest LNG producer worldwide.

* Australia as from 2018 will take over the lead position.

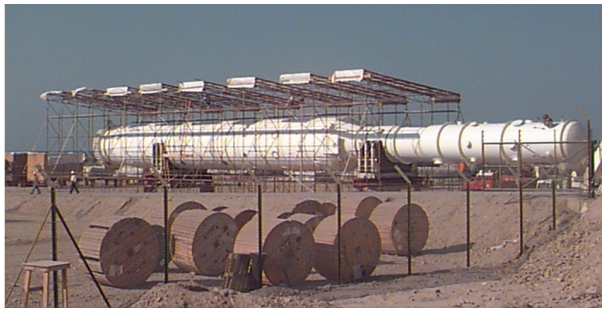
SEGAS LNG PLANT SITE AT DAMIETTA PORT

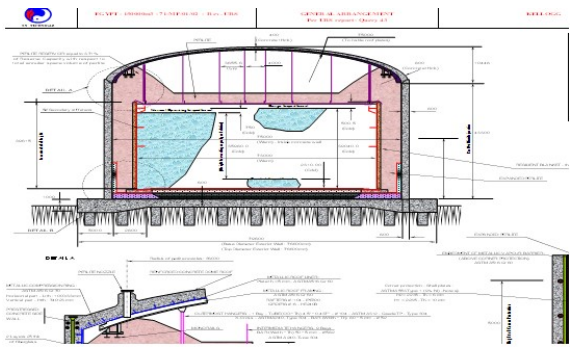


JANUARY 2002

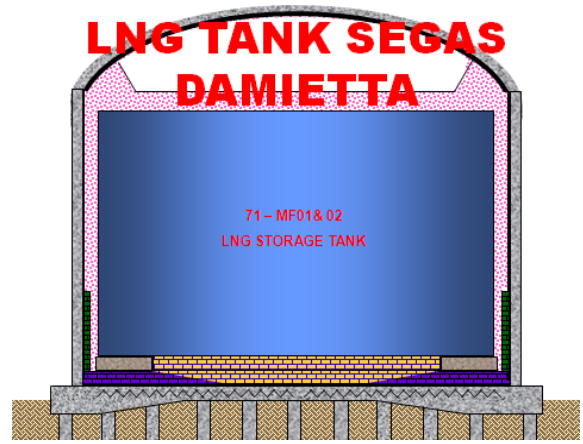
1stLNG TRAIN

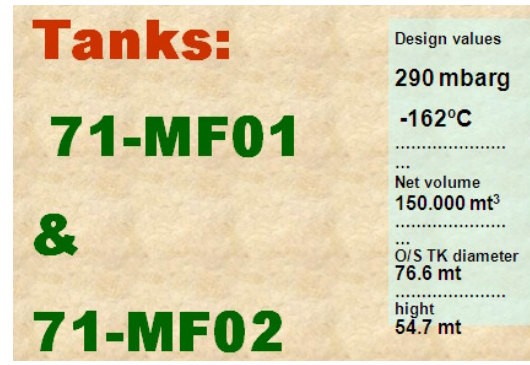
Main Cryogenic Heat Exchanger

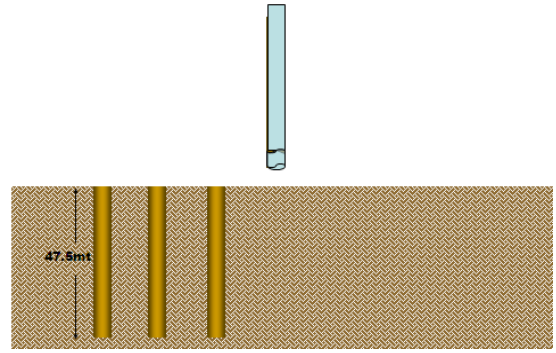




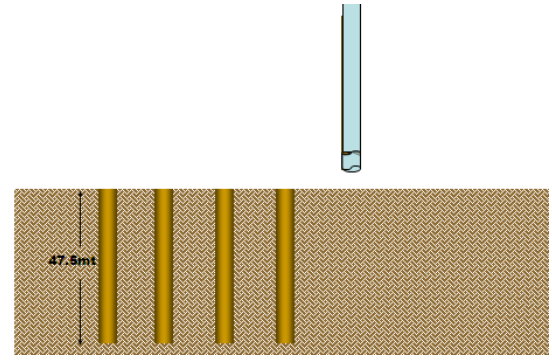
LNG STORAGE TANKS







LNG Tank Piling



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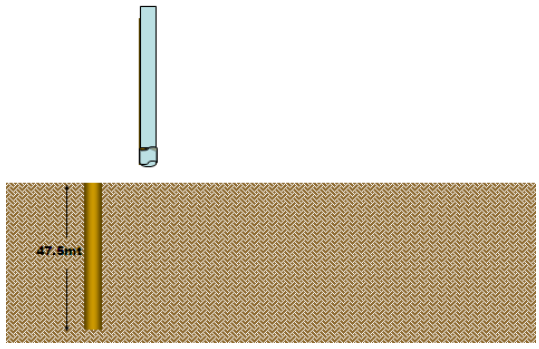

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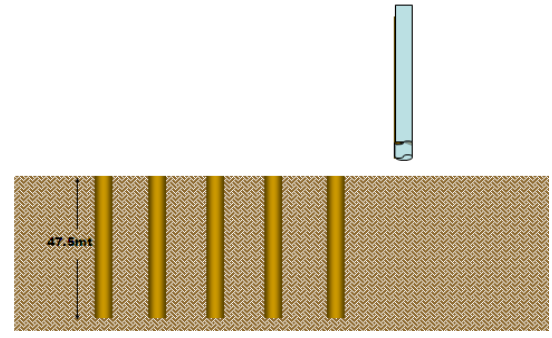

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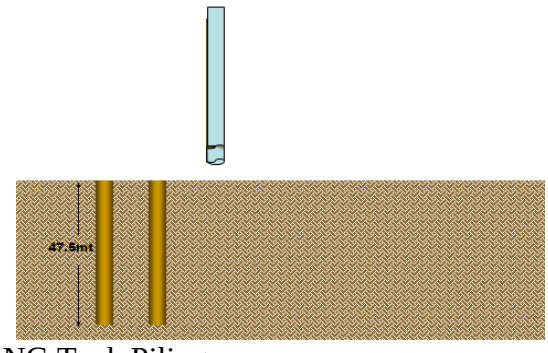

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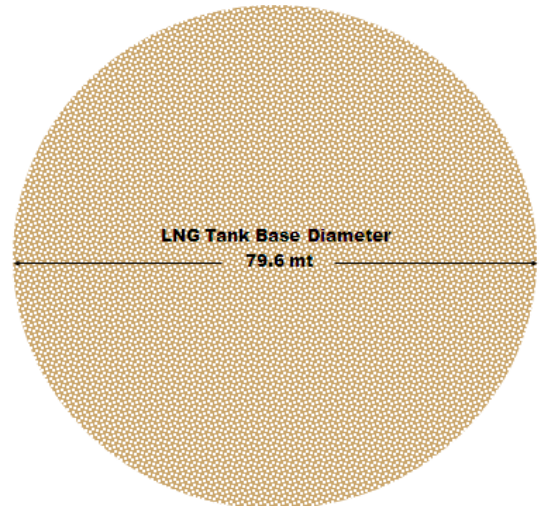

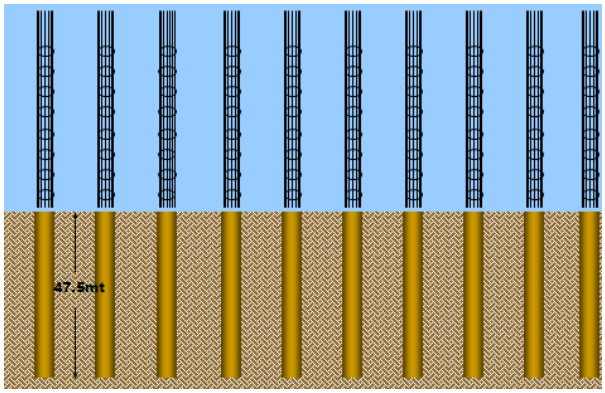

LNG Tank Piling

Dome Lifting up by air pressure

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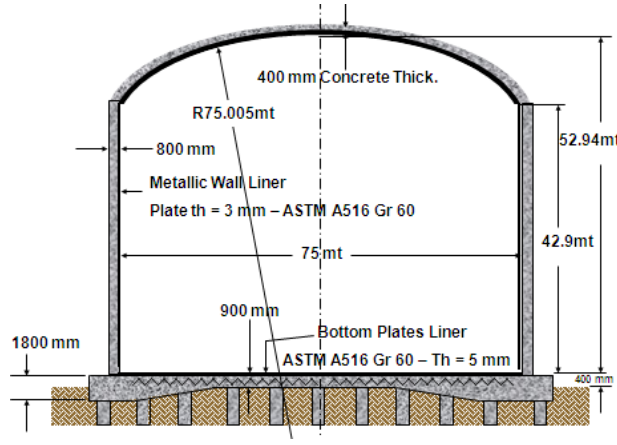
Concrete Dome roof

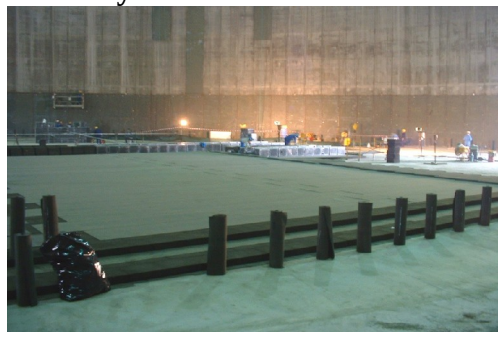
Concrete dome completed

LNG Tanks 71-MF01 & 71-MF02

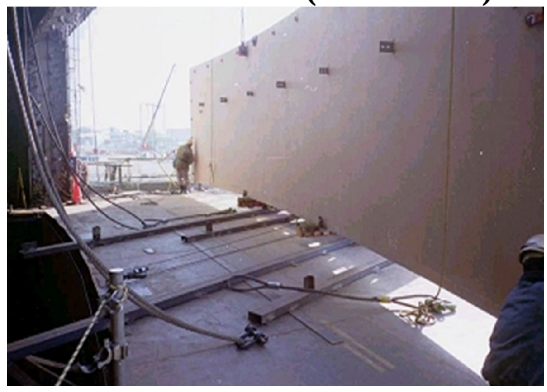


Carbon Steel Plate welding

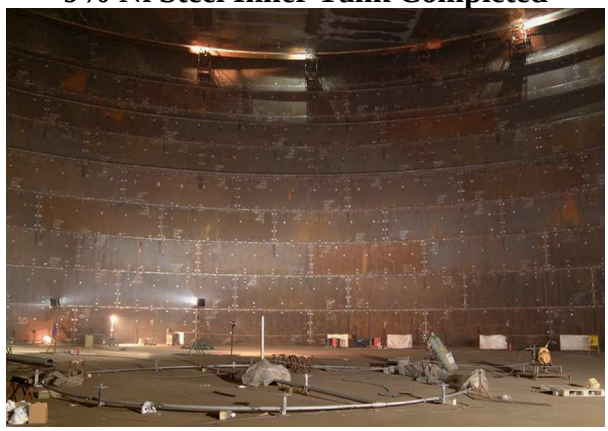
First 2 layers of foam Glass insulation



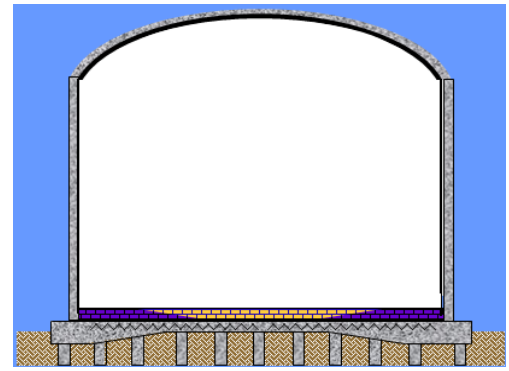
9% Ni Steel Plate (Inner Tank)



9% Ni Steel Inner Tank Completed



LNG Tanks 71-MF01 & 71-MF02



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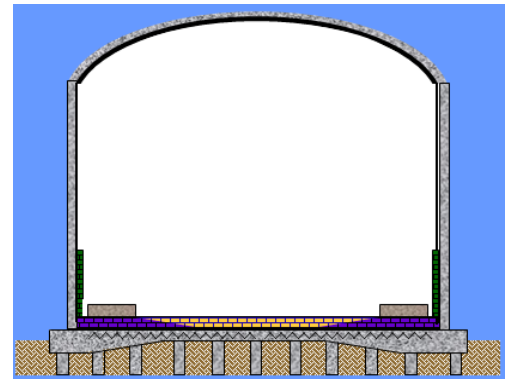

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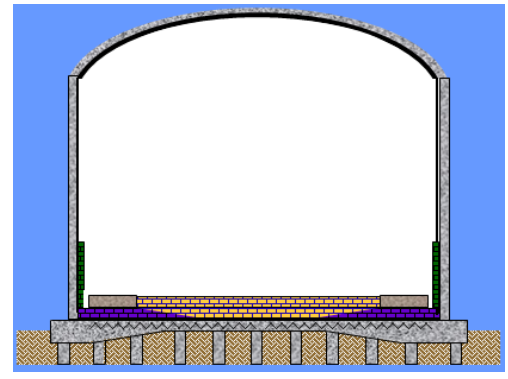

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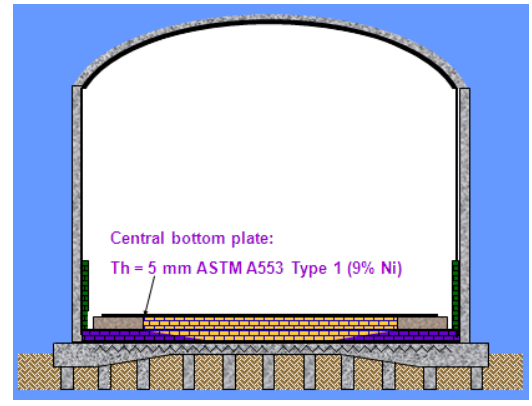

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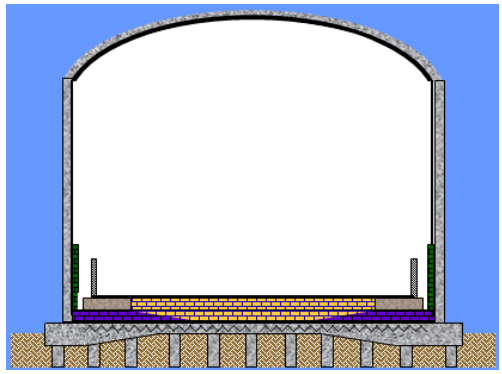

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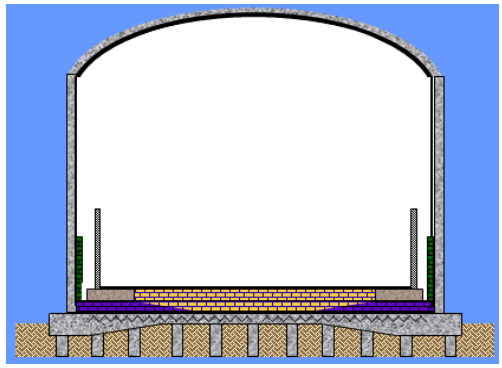

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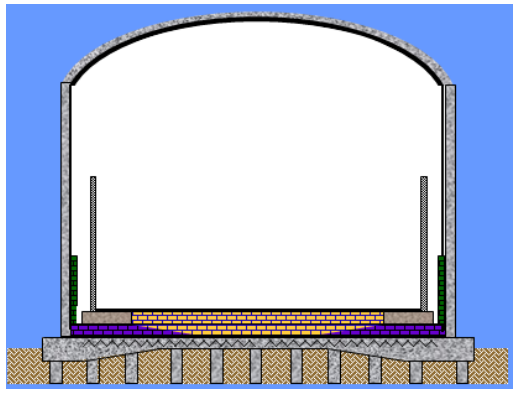

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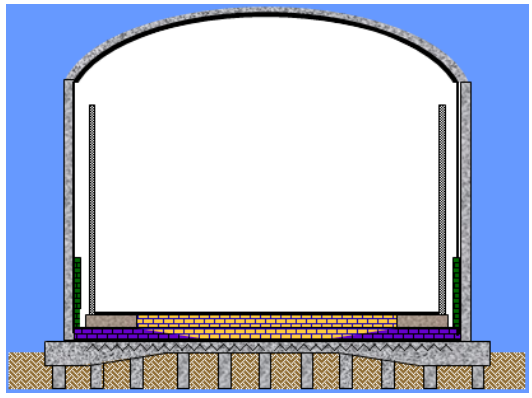

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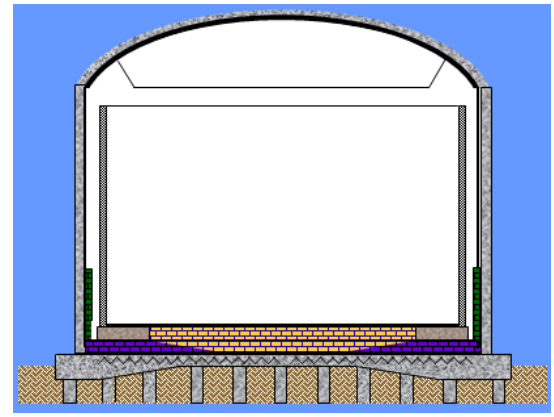

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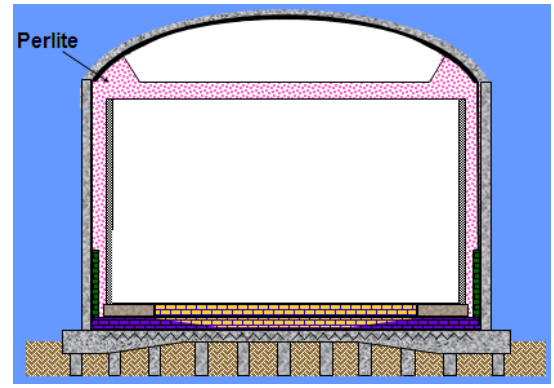

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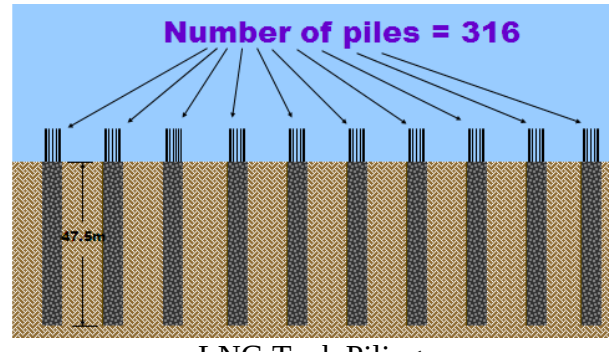

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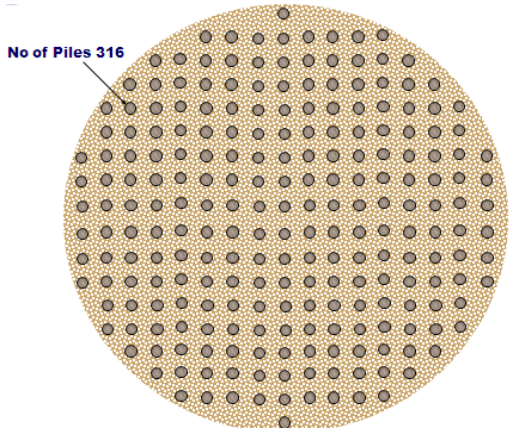

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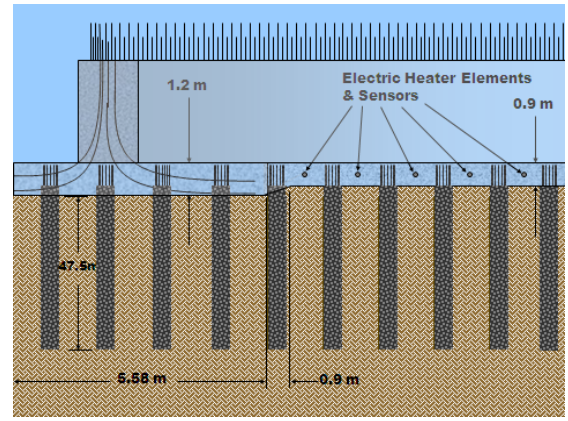
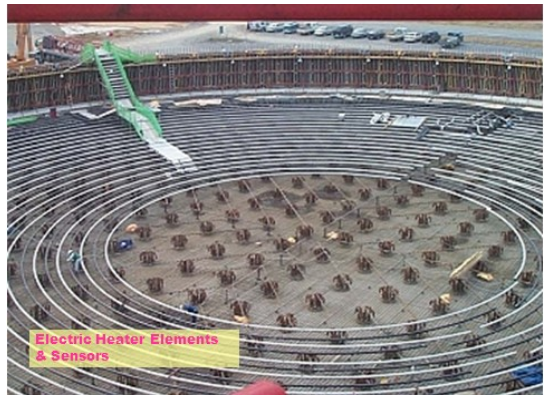
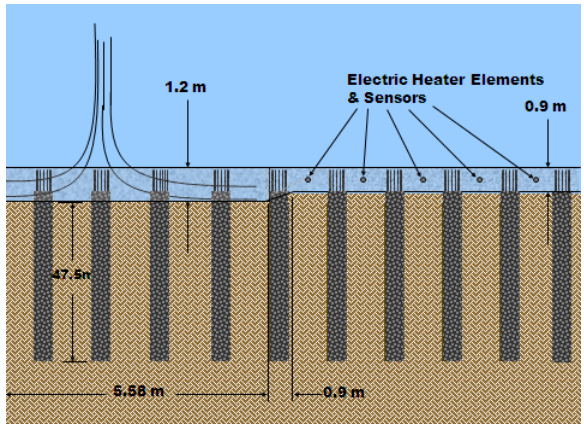
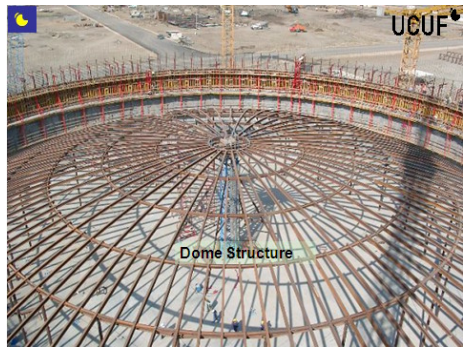
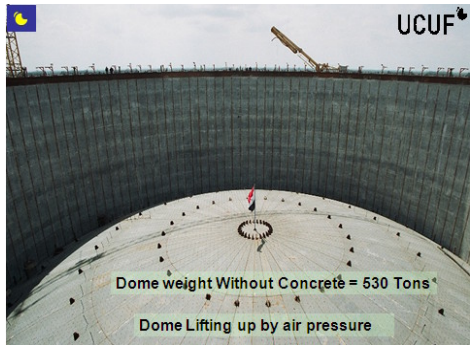
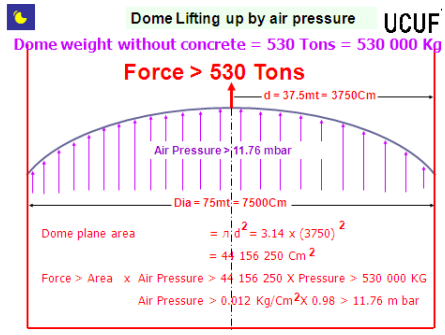


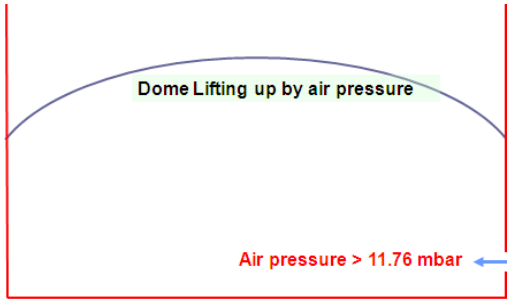


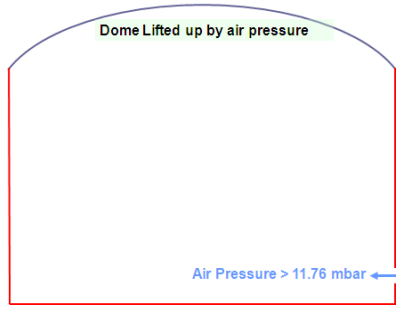












Dome Lifting up by air pressure

What is Perlite ?

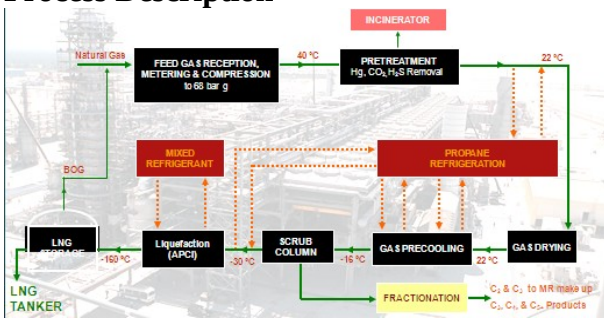
*** Perlite is siliceous volcanic rock when heated to a suitable temperature (above 870 C°) in its softening range it expands from four to twenty times its original volume.**

*** The expansion process is due to the presence of two to six percent combined water in the crude perlite it pops when heated in a manner similar to popcorn as the combined water vaporize and creates countless tiny bubbles in the softened glassy particles.**

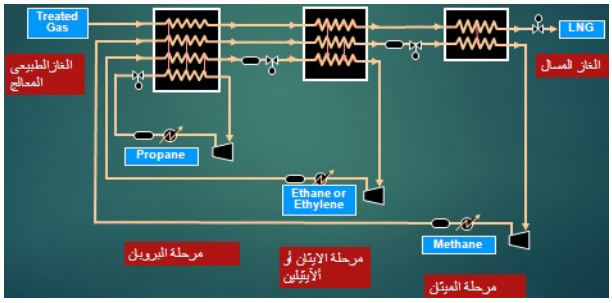
JETTY

LNG TRANSFER EQUIPMENT

Process Description



Cascade Cycle نظام الاسالة بالتبريد ذى المراحل المتتاليه



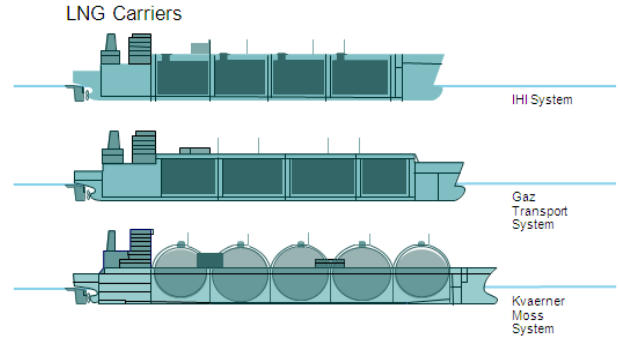
LNG-Storage and Loading

* Storage capacity determined by:
- Parcel (Ship) size.
- (Weather) delays
- Delivery pattern (location of client)
  e.g. 165,000 m^3 Ship requires +/-200,000 m^3 storage

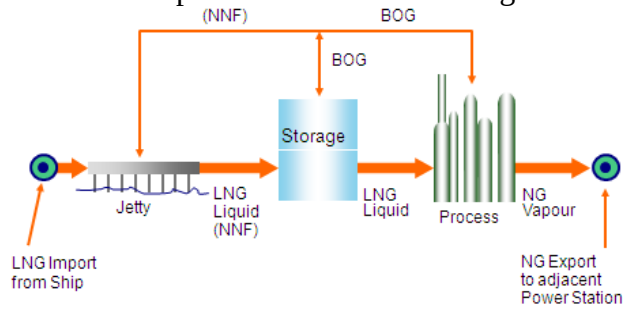
* Boil-off owing to heat inleak determined by:
- Storage capacity.
- Insulation.
- Length of Jetty.

* Boil-off gas used as fuel

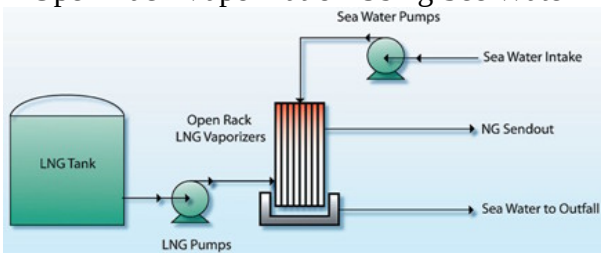
Introduction to LNG



Introduction to LNG
LNG Import Terminal - Flow Diagram



Open Rack Vaporization Using See Water



ROLE OF THE CHEMICAL ENGINEER

* Chemical Engineer is one of the master brains of the LNG industry business.
* Chemical Engineer will be involved in the LNG plants Design, R&D, Operations & Technical support, modernization and business sustainability.

Design and R&D

* In Research and Development (R&D), he develops new processes designs.
* Improve existing ones for better efficiency.
* Better protection of environments.
* Conservation of natural resources.
* More safety of people and assets.
* Life extension of equipment.

Operations support

* Plant trouble shooting and problems solving.
* Increase efficiency.
* Reduce operating costs.
* Improve plant availability.
* Improve plant reliability

Technical Support

* Plant Design for plant expansion.
* Study and design of plant modifications.
* Plant modernisation.
* Improve safety and protection levels.
* Protection of environments.
* Support of interfaces with upstream and downstream businesses.

SMART OBJECTIVES OF THE CHEMICAL ENGINEERS

*** Simple.**
* Measurable.
* Achievable.
* Realistic.
* Time labeled.