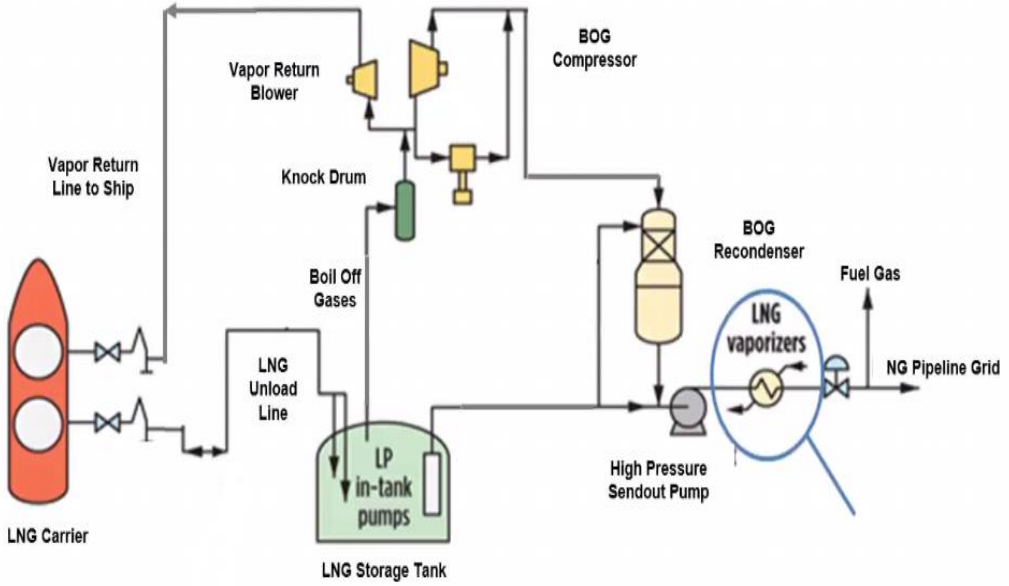
Operational & Safety Aspect of LNG/LCNG Facility

Second Knowledge Sharing Session
14th Feb, 2022

Flow of the Presentation

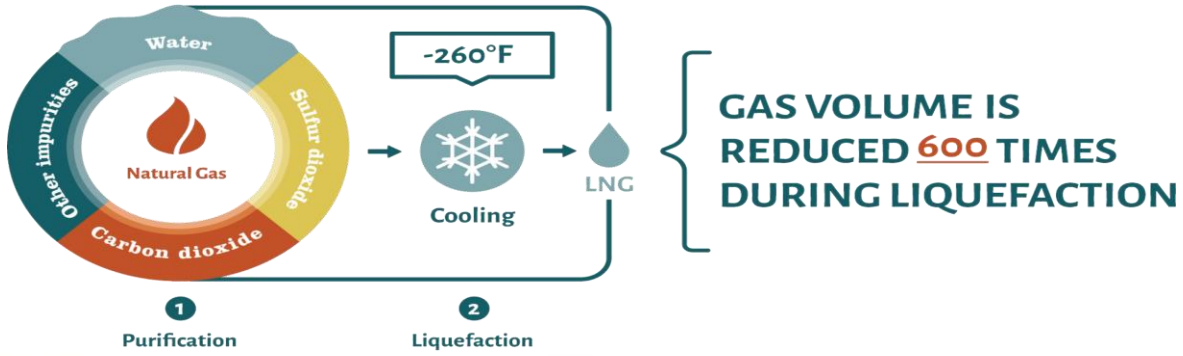
- ❑ Natural Gas
- ❑ What is LNG?
- ❑ Properties of LNG
- ❑ Typical Regasification Facility
- ❑ Risk Associated with LNG
- ❑ Occupational Hazard
- ❑ Safety Aspects of LNG Station
- ❑ Operation and Maintenance of LNG Station
- ❑ Emergency Plan and Procedure



What is LNG?

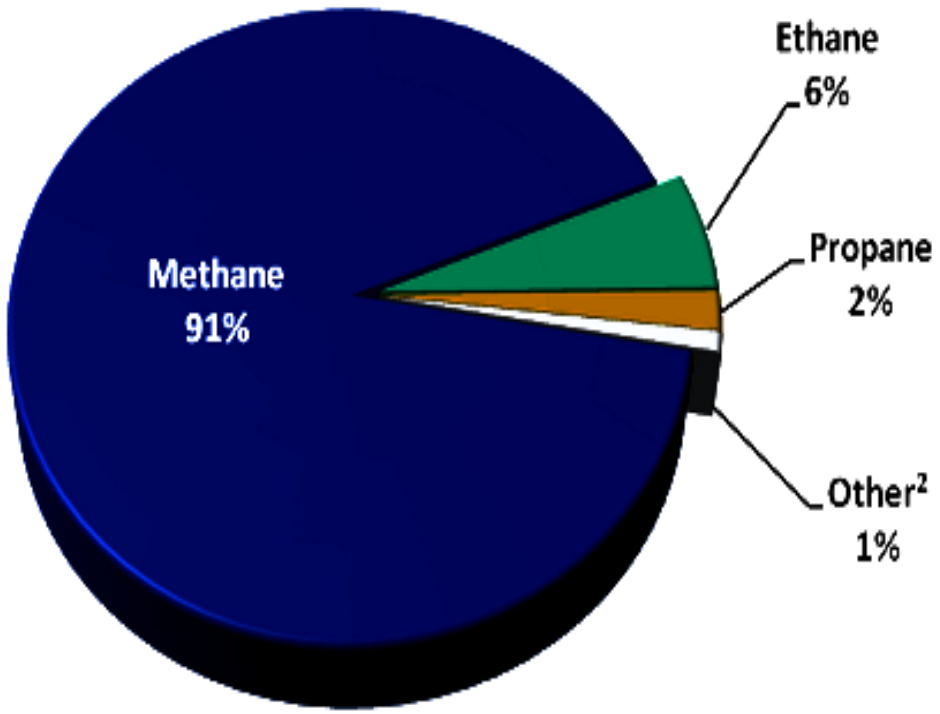
Liquefied natural gas (LNG):-

- **LNG** is natural gas (predominantly methane, CH4, with some mixture of ethane, C2H6)
- It is cooled down to liquid form up to -162 Degree Celsius
- Easy and safety of non-pressurized storage or transport
- It takes up about 1/600th the volume of natural gas in the gaseous state at standard conditions for temperature and pressure.



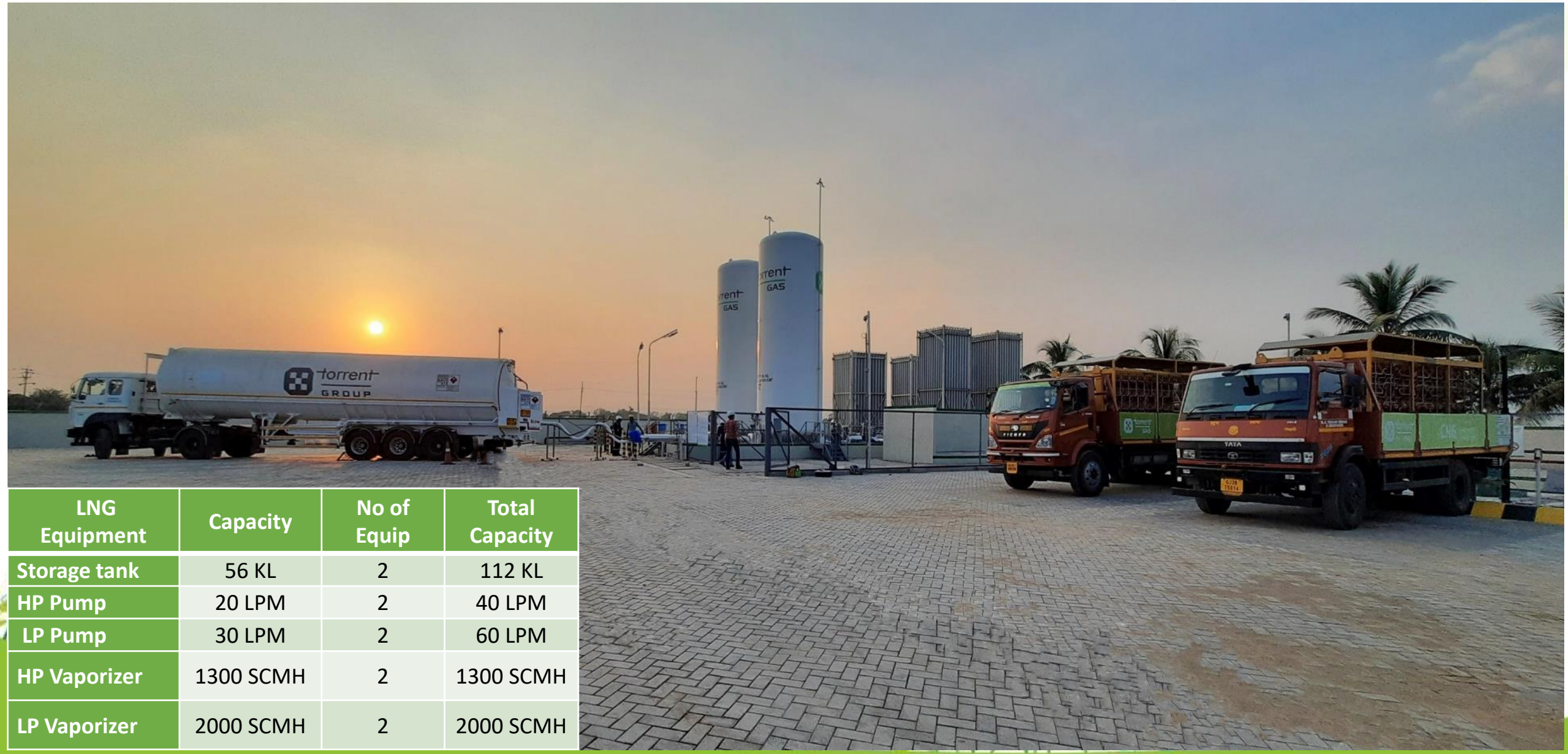
CHARACTERISTICS	
Colour	Colourless
Odour	Odourless
Freezing Point (°C):	-182.5
Boiling Point (°C):	-161.5
Flash Point (°C):	-187.8
Evaporation Rate	Rapid

Properties of LNG



- **Flammability range:**
- Lower Explosion Limit: 5% (by volume, gas phase)
- Upper Explosion Limit: 15% (by volume, gas phase)
- **Specific Gravity:** 0.45 (water = 1)
- Auto-ignition Temperature: 537 °C (Gas Phase)
- **Liquid Density :** 426 kg/m3
- **Gas Density (25°C) :** 0.656 kg/m3

Torrent Gas Regasification Facility



LNG Equipment	Capacity	No of Equip	Total Capacity
Storage tank	56 KL	2	112 KL
HP Pump	20 LPM	2	40 LPM
LP Pump	30 LPM	2	60 LPM
HP Vaporizer	1300 SCMH	2	1300 SCMH
LP Vaporizer	2000 SCMH	2	2000 SCMH

Occupational Hazard

- Occupational health and safety issues associated with LNG facilities operations include the following:
  - Fire or Explosion
  - Roll Over
  - Contact with cold surface (Frostbite)
  - LNG Spill
  - Confined Space
  - LNG Vapor's burns

Safety Aspects of LNG Operations

- There are four safety aspects of safety in LNG Operation
- **primary containment, secondary containment, safeguard systems and separation distance**
- It is applied across the LNG value chain from production, liquefaction, and shipping to storage and re-gasification

Safety Aspects of LNG Operations

- **Primary Containment**
  - Employing suitable materials for storage tanks and other equipment
  - By appropriate engineering design throughout the value chain
- **Secondary Containment**
  - This second layer of protection ensures that if leaks or spills occur, the LNG can be contained and isolated
  - The dikes are designed to contain 100 % to 110 % of tank volume
- **Safeguard Systems**
  - In the third layer of protection, the goal is to minimize the release of LNG and mitigate the effects of a release.
  - LNG operations use systems such as gas, liquid and fire detection to rapidly identify any breach in containment and remote and automatic shut off systems to minimize leaks and spills in the case of failures
- **Separation Distance**
  - LNG facilities be sited at a safe distance from adjacent industrial, communities and other public areas
  - The safe distances or exclusion zones are based on LNG vapor dispersion data and thermal radiation contours and other considerations as specified in regulations

Operation and Training

- Each LNG/ LCNG installation / dispensing station shall provide for written operating, maintenance and training procedures.
- Basic requirements
  - ➢ Have written procedures covering operation, maintenance and training
  - ➢ Keep up-to-date drawings of plant equipment
  - ➢ Have written emergency plan
  - ➢ Shall be in liaison with local authorities like Police, Fire Department, Health
    - keep them informed about emergency plans and their role in emergency situations
  - ➢ Have documents wherein safety related malfunctions are identified and analyzed for the purpose of determining their causes and preventing the possibility of reoccurrence

Operation Process

❑ LNG Unloading Process

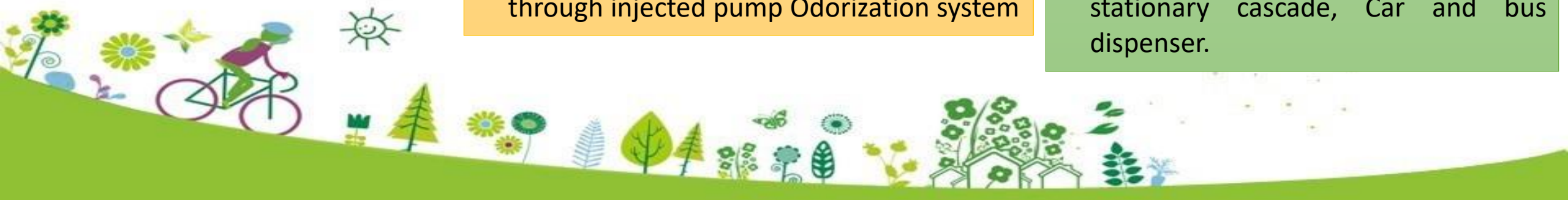
- LNG unloading from LNG tanker, LNG will be supplied to station by Mobile LNG tanker
- Unloaded by unloading pump of 350-380 LPM capacity @ 8.3 to 9.5 barg differential pressure to LNG storage tank
- Storage tank can be filled mainly by bottom filling line with provision of top filling line
- LNG will be stored vacuum-insulated pressurized tanks and 12 barg MAWP

❑ Low Pressure vaporization

- Low pressure Vaporization LNG is transferred from the storage tanks to LP vaporizers by means of 2+1 nos low pressure reciprocating pumps
- Flow of vaporization is 2000 SCMH at min. 26 barg pressure
- Flow meter is provided at discharge of vaporizer
- Temperature of 10 to 15°C, below ambient temperature at battery limit
- NG pipeline gets connected to DRS skid for further transfer to MDPE and steel network
- Low pressure PNG line gets odorized through injected pump Odorization system

❑ High Pressure vaporization

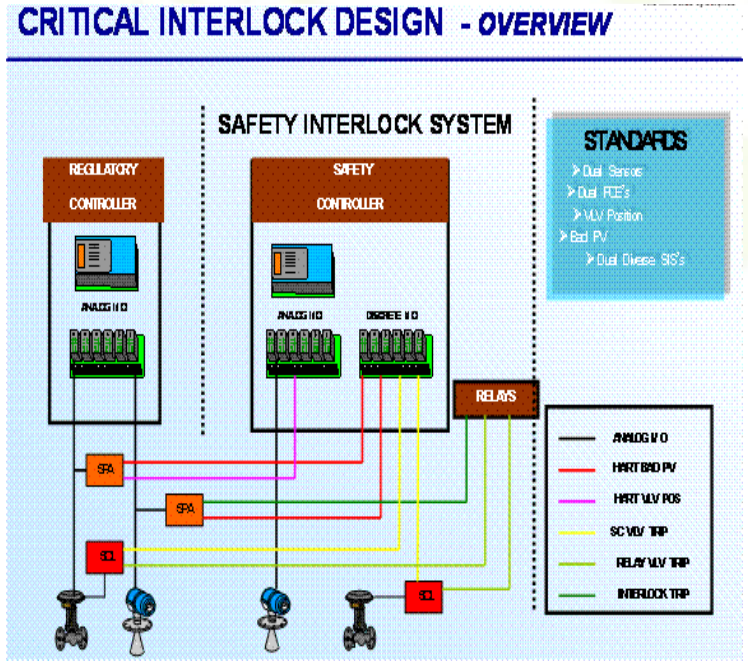
- LNG in storage tank converted to high pressure CNG using high pressure reciprocating pump of 20 LPM and high pressure vaporizer
- Flow of vaporisation is 1300 SCMH at 250 barg Pressure
- High pressure CNG will be stored in to stationary cylinder cascade after Odorization
- Cascade of 3 bank cylinder system shall be used for car dispensing
- Dispenser are connected to this cascade through priority panel which will decide sequence of operation to stationary cascade, Car and bus dispenser.



PLC Base Monitoring System

➢ **PLC Based Control and Monitoring System**

- PLC based monitoring and control system with the following features is provided to minimize human error in the operation of the GoLNG Delivery Module
- Real time process parameters viewing through SCADA
- Dynamic graphic viewing of the process
- Storage and tracking facility for process data in desired formats for a minimum specified period
- PLC is programmed for ensuring safe operation of system
- Safety interlocks and automatic closure of emergency shut off devices
- Flow measurement for cascade filling etc.
- Pneumatic and electrical field mounted push buttons will be provided at safe places in the installation for shutting down of the system from the field in case of any emergency



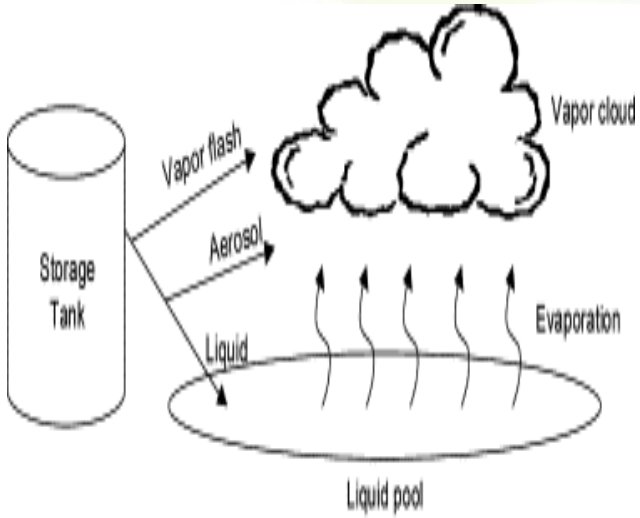
Leak, Spills & Control Measures

Leaks and accidental spills

- Several causes can lead to leaks and accidental spills, such as operational and technical failure
- The large temperature difference between the cold LNG and the ambient air
- The evaporating gas will form a vapor cloud and cools surrounding air
- Gas is lighter than air at temperatures above -110°C, it will rapidly start to rise and be mixed and diffused with air

Accidental Release Measure

- Evacuate nonessential personnel and remove or secure all ignition sources
- Stop the source of the release, if safe to do so
- Do not flush down dyke or drainage systems
- Do not touch spilled liquid (frostbite or freeze burn hazard!)
- Consider the use of water spray to disperse vapors
- Isolate the area until gas has dispersed
- Ventilate and gas test area before entering



Formation of Liquid Pool and Vapor Cloud When LNG is Spilled

Emergency Plan and Procedure

- A comprehensive **ERDMP** shall be developed in accordance to the **Petroleum and Natural Gas Regulatory Board** (Codes of Practices
- Provision of **minimum 2 points for emergency shutdown**
- Followings are the major emergency scenario could be arise during operation
  - Loss of or interruption to the gas supplies due to leaks or failure of pipeline
  - Over Odorization of the gas
  - Major failure of LCNG / LNG fittings
  - Accidents or other emergencies, which can affect the L-CNG/ LNG dispensing station
  - Civil emergencies
  - Emergency situations during transportation of LCNG through mobile cascade vehicles
  - Any other risk arising from the existence or use of the LCNG/ LNG dispensing station.
- The **emergency plan** should be tested as per PNGRB ERDMP regulations.

Challenges

Project phase Challenges	Operation phase challenges
Delay in DM NOC and various permissions as LNG was new process for Authority	Ice formation during unloading and vaporization. Same was not envisaged in design to make provision of water spray to defrost ice.
Limited vendors of LNG equipment suppliers in India	Long queuing of tankers at LNG loading point due to limited capacity which is leading to dry out of CGD network. Average turnaround time of LNG tanker is ~8 hours at Dahej Terminal.
Delay due to COVID-19	Limited provision of LNG loading facilities in India which leading to long transit distance.
	Dependency on OEM to arrest leakage in case of LNG spillage/emergency during LNG transportation
	Limited Transporters for transportation of LNG, carries risk of transporting LNG by incompetent persons.
	Deteriorated road conditions carries a risk of unforeseen accident during transportation of LNG.

Thanks