SOFREGAZ PRESENTATION
for
LAGUNA PROJECT
Experience in tank building and process

General Meeting - Geneva - March 4th 2011

Jérôme Sialelli

Sofregaz

GENERAL OVERVIEW

- **A fifty-year experienced Engineering and Contracting Company specialised in natural gas**
- **Activities: from Consulting to Lump Sum Turn Key projects**
- **Organisation based on 140 multidisciplinary employees**
  90% University and Technical College Graduates
- **Worldwide experience**
- **Operations fully integrated inside Maire-Tecnimont Group**
- **Main activity: Engineering services and participation in EPC projects**
  - **LNG: small liquefactions, LNG receiving terminals**
  - **Gas processing plants**
  - **Gas transmission system, compression & pumping stations**
- **Projects size & Commercial strategy:**
  - **E & EP projects within 50 M €: Stand alone**
  - **EPC projects in partnership / integration with Maire-Tecnimont group**

QSE

- **QUALITY is the core of our strategic gas and oil business. We developed a global approach of the Quality, from the consulting to the delivery of the project.**

- **SOFREGAZ considers HEALTH protection of the employees and the SAFETY aspects of the installations designed, as well as the protection of the ENVIRONMENT, an integrated part of the business objective.**

- **SOFREGAZ is certified ISO 9001, ISO 14001 and OHSAS 18001**

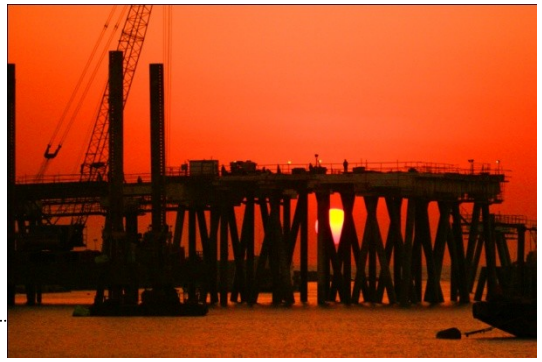
ACTIVITIES AND SERVICES

- **Feasibility studies**
- **Basic & Detailed Engineering**
- **Project Management Consulting**
- **Procurement / sourcing**
- **Construction Supervision**
- **Commissioning & start-up**

LNG RECEIVING TERMINAL BILBAO SPAIN

ALL THROUGH THE "GAS CHAIN"

- **Production, treatment**
- **LNG and LPG**
- **Transmission systems - Pumping and compression**



LNG RECEIVING TERMINAL
HAZIRA INDIA

GAS TREATMENT
WAFA LIBYA

COMPRESSION STATION
S3-S6 IRAN

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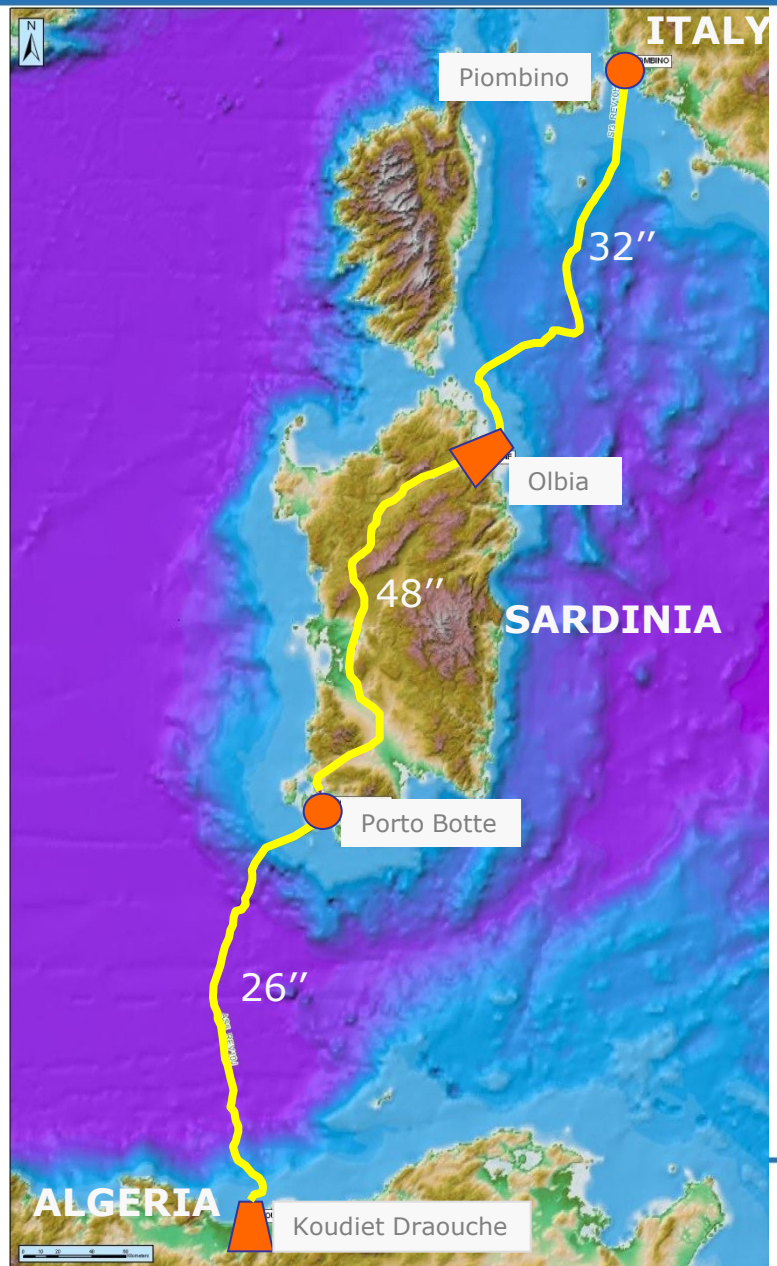
PIPELINE TRANSMISSION & COMPRESSION

- **Gas and liquid pipelines**
- **Pumping and compressor stations**
- **Telecommunication and SCADA system**

- ***Consultancy services***
- ***Engineering and supervisory services for the design and construction of pipelines***
- ***Turnkey services***
-

References:
- Beattock natural gas compressor station (United Kingdom)
- Brighouse Bay natural gas compressor station (United Kingdom)
- S3 S6 natural gas compressor stations (Iran)
- FEED Turkey - Greece natural gas pipeline
- FEED GALSI: Algeria-Sardinia-Italy natural gas pipeline stations

GAS TRANSMISSION SYSTEMS - FEED



GAS PIPELINE ALGERIA-SARDINIA-ITALY - GALSI 2006-2009

- Capacity: 8 BCM/Y
- Length: onshore 281 km; subsea: 561 km
- Pre-FEED and FEED:
  - Compression stations
  - Pressure reduction & metering stations
  - SCADA & Telecommunications

COMPRESSION STATION - EPC

S3-S6 COMPRESSION STATIONS NIGC - IRAN - 2001

- Capacity:
  S3 trains: 4 x 28 MW
  S6 trains: 3 x 28 MW
- Lump Sum Turn Key project (LSTK)

PRODUCTION AND TREATMENT (gas and oil fields)

- **Oil/gas gathering & separation**
- **Dew point adjustment**
- **Sweetening**
- **Dehydration**
- **NGL (C2+) extraction & fractionation**
- **Gas-lift**
- **Gas re-injection**

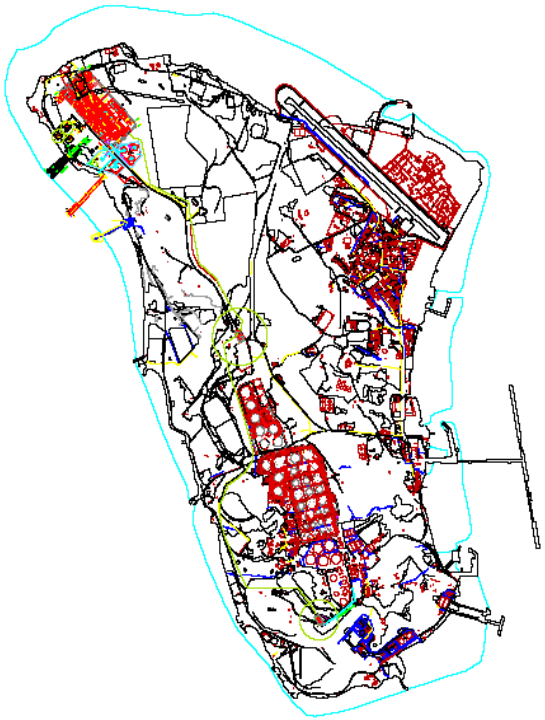
References:
- Dalan natural gas treatment plant (Iran)
- Mesdar natural gas reinjection facility (Algeria)
- R4-R5 natural gas boosting stations - phases II and III (Algeria)
- Wafa gas treatment facilities (Libya)
- FEED for the Kharg Island NGL recovery plant (Iran)

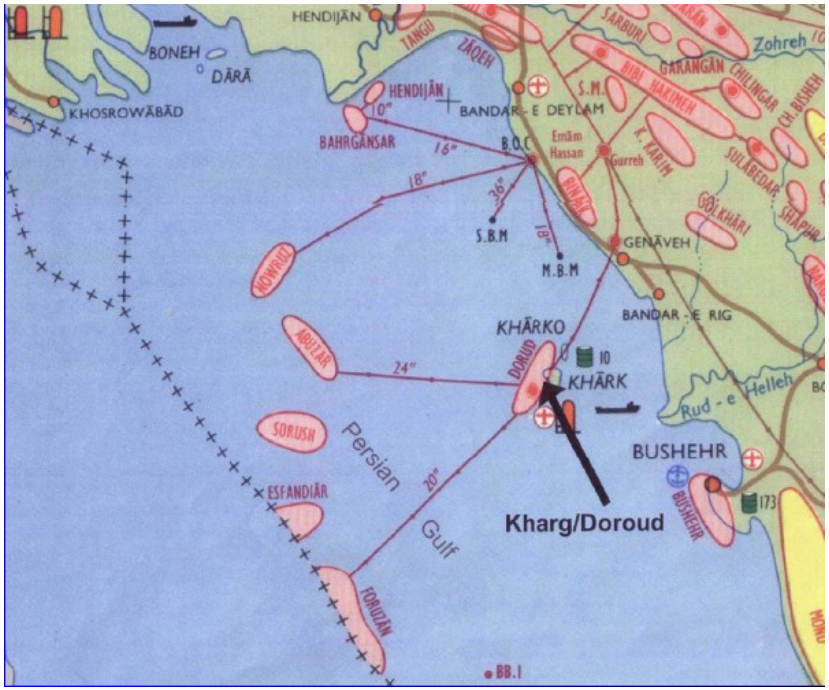
GAS TREATMENT - EPC

WAFA GAS CONDENSATE TREATMENT PLANT - AGIP GAS BV - LIBYA - 2004

- Capacity: 4.44 BSCM/year sales gas
- EPC and technical assistance, commissioning and start-up contract.

GAS TREATMENT - FEED





KHARG iSLAND GAS GATHERING AND NGL RECOVERY PLANT - IRASCO-IRITEC - IRAN – 2007-2009

FEED update

- Capacity : 550 MMSCFD
- Acid Gas Removal unit
- NGL recovery and fractionation
- Offshore pipeline hydraulic studies

LIQUEFIED NATURAL GAS (LNG)

- **Peak shaving plants**
- **Small scale liquefaction units**
- **Import ,storage and vaporization terminals**

References:
- Revithoussa LNG receiving facilities (Greece)
- Shanghai PuDong LNG peak shaving facilities (China)
- Bilbao LNG terminal (Spain)
- Guangdong LNG Terminal (China)
- Hazira LNG Terminal (India)
- Expansion of Revithoussa LNG receiving facilities (Greece)
- FEEDs for Dunkerque (France) and Panigaglia (Italy) LNG terminals

SOFREGAZ EXPERIENCE IN LNG

- **Overview of EPC experience**
  - Completed projects
  - Ongoing projects
- **Overview of engineering experience (Feasibility studies, FEEDs, PMC & technical assistance)**
  - Completed studies
  - Ongoing studies
- **Innovation**

LIQUEFIED NATURAL GAS (LNG)
TERMINALS EPC PROJECTS COMPLETED

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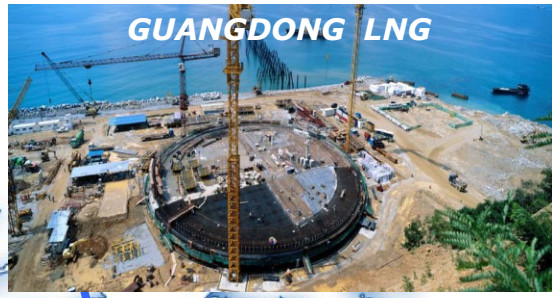

LNG TERMINALS: EPC PROJECTS ONGOING

LNG EXPERIENCE : Feasibility studies, FEEDs and BEPs for LNG facilities

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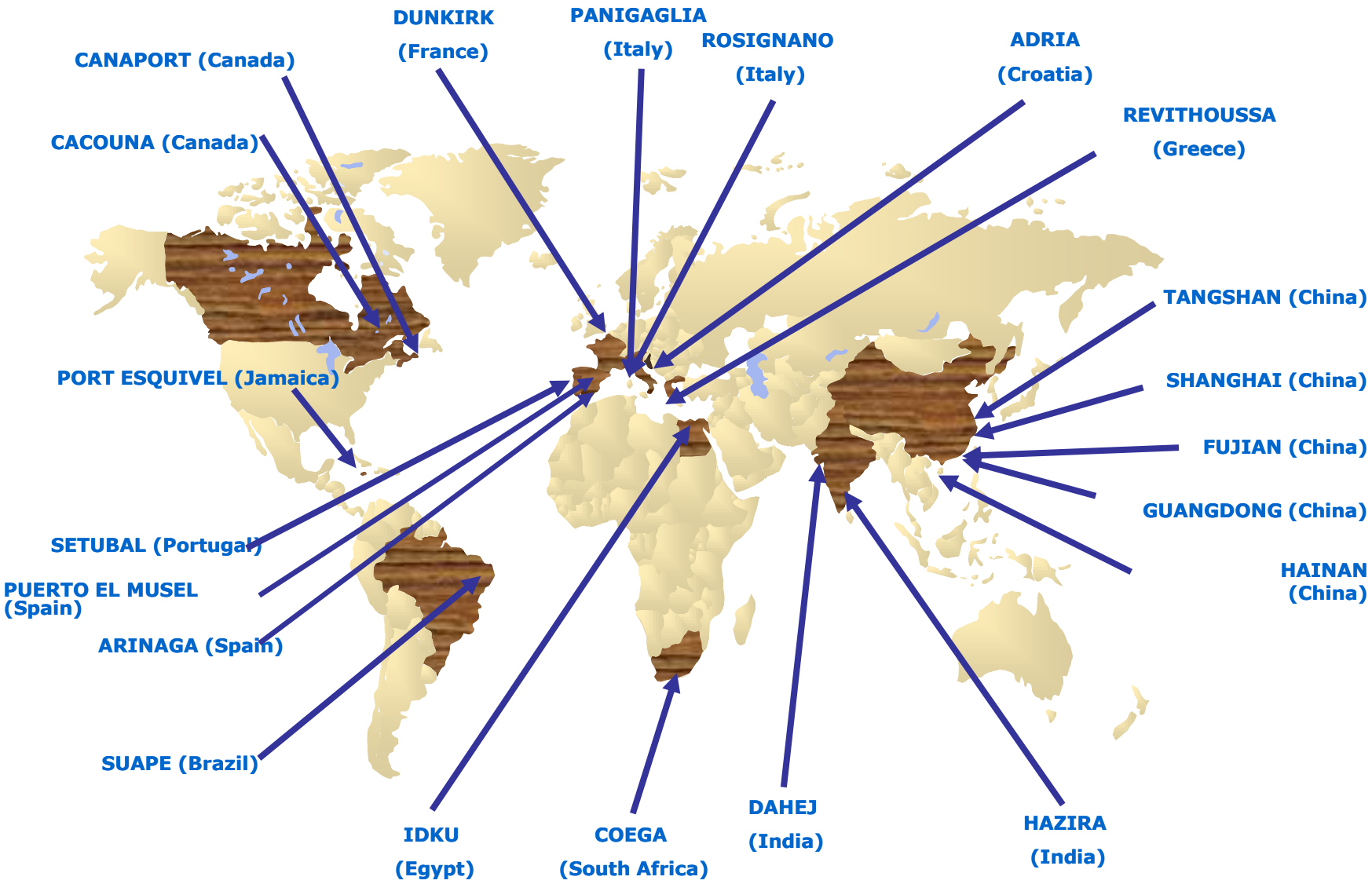

LNG EXPERIENCE: Ongoing engineering studies & projects: FS / FEED / PMC / TA for LNG import terminals

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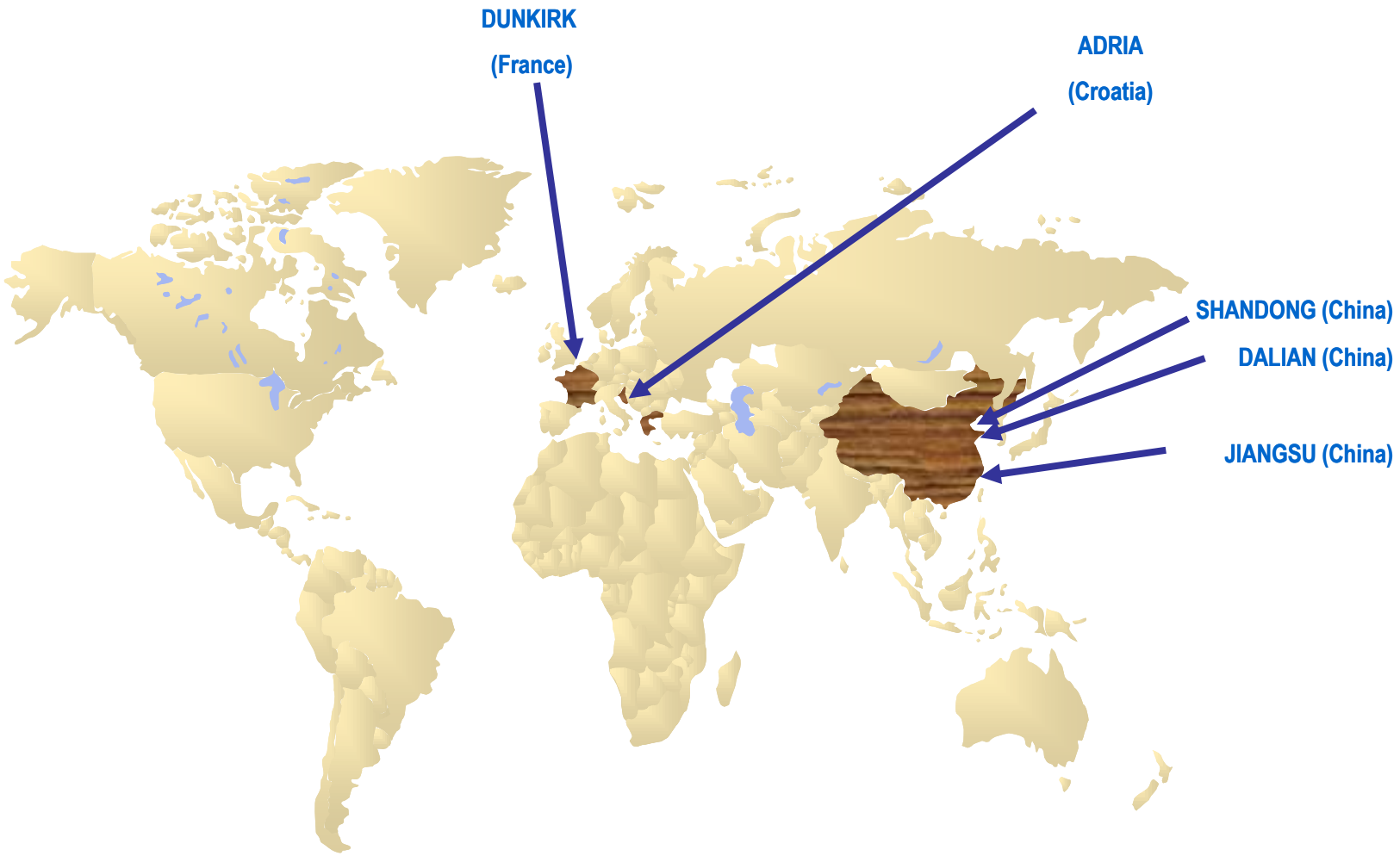


Innovation

- **RECONDENSER: vertical stainless steel vessel, used for the condensation of boil off gas (BOG).**
  This recondenser has been performed in Montoir de Bretagne and Fos Cavaou FRANCE, Dahej and Hazira INDIA, Guangdong and Shanghai CHINA, Sabine Pass USA.

- **AMBIENT AIR VAPORIZATION (AAV): concept designed to avoid problems caused by high solid content of the sea in shallow estuaries or unavailability of sea water for environmental reasons.** This technological advance has been implemented in Dahej INDIA.

SHANGHAI PEAK SHAVING

- Client: Shanghai Municipality
- Country: China
- EP+CM contract for a peak shaving
- Liquefaction capacity : 40,000 TPA
- Process: CII (Gaz De France)
- Vaporisation capacity: 0.5 BCMY
- LNG tank capacity: 20,000 m^3
- Gas pre-treatment (Carbon dioxide Removal down to 50 ppm using MEA, Gas dehydration on molecular sieves, mercury removal)
- Liquefaction using MCR technology, LNG storage + send out pumps and vaporizers.

BILBAO LNG RECEIVING TERMINAL (SPAIN)

Country:	**SPAIN**
Client:	**BBG (BP + IBERDROLA + REPSOL + EVE)**
Contractor:	**Integrated Joint Venture SAIPEM SA – SN TECHNIGAZ Leader (40%) + INITEC (33%) + SOFREGAZ (27%)**
Contract value:	**240 M EUR**
Capacity:	**2.7 Extended to 5 Mt/y**
LNG Storage:	**2 x 150,000 m^3 (full containment)**
Unloading Capacity:	**12,000 m^3/h**
LNG Carrier Size:	**135,000 m^3**
Jetty:	**Quay type**
Schedule:	**38 months**
Start-up:	**2003**

HAZIRA LNG RECEIVING TERMINAL (INDIA)

Country:	**INDIA**
Client:	**SHELL**
Contractor:	**Integrated Joint Venture SAIPEM SA – SN TECHNIGAZ + TECNIMONT + TICB + SOFREGAZ**
Contract value:	**390 M EUR**
Capacity:	**2 Mt/y**
LNG Storage:	**2 x 160,000 m^3 (full containment)**
Unloading Capacity:	**12,000 m^3/h**
LNG Carrier Size:	**145,000 m^3**
Jetty:	**1,300 m**
Schedule:	**38 months**
Start-up:	**2005**

GUANGDONG LNG RECEIVING TERMINAL (CHINA)

Country:	**CHINA**
Client:	**BP + CNOOC & ALL**
Contractor:	**Integrated Joint Venture SAIPEM Leader – SN TECHNIGAZ + TECNIMONT + SOFREGAZ**
Contract value:	**240 M EUR**
Capacity:	**3.5 (expendable to 6) Mt/y**
LNG Storage:	**2 x 160,000 m^3 (full containment)**
Unloading Capacity:	**12,000 m^3/h**
LNG Carrier Size:	**145,000 m^3**
Jetty:	**310 m**
Schedule:	**36 months**
Start-up:	**2006–2007** (3rd tank)

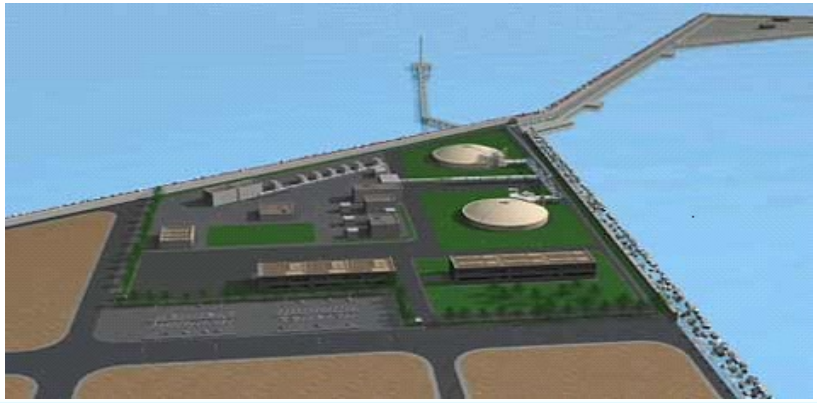
FOS II LNG RECEIVING TERMINAL (FRANCE)

Country:	**FRANCE**
Client:	**GAZ DE FRANCE**
Contractor:	**Integrated Joint Venture TECNIMONT - SOFREGAZ (50%)/ SAIPEM (50%)**
Contract value:	**~500 M EUR**
Capacity:	**6.5 Mt/year**
LNG Storage:	**3 x 110,000 m^3 (full containment)**
Unloading Capacity:	**12,000 m^3/h**
LNG Carrier Size:	**160,000 m^3**
Jetty:	**200 m existing to be upgraded**
Schedule:	**55 months**
Start-up:	**First LNG unloaded November 2009**

FOS II LNG RECEIVING TERMINAL (FRANCE)

PORTO EMPEDOCLE LNG RECEIVING TERMINAL (ITALY)

Country:	**ITALY**
Client:	**ENEL**
Contractor:	**Consortium led by Tecnimont (TECNIMONT–SOFREGAZ–TECHNITAL-GLF–BENTINI)**
Capacity:	**8 Bcm/y**
LNG Storage:	**2 x 160 000 m^3 (full containment – in pit)**
Jetty:	**Quay**
Timing:	**2010 Early works - 2011 -2015**



EXPERIENCE IN LARGE LNG STORAGE

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•In the last 10 years SOFREGAZ has successfully completed as Joint Venture member 8 EPC contracts including 11 LNG tanks with a cumulated capacity of 1,450,000 m^3.

PROJECT	Storage Qty	Unit Vol (m3)	Total Vol (m 3)	Year of completion
SHANGHAI Peak Shaving (China)	**1** (Full cont. above ground)	**20,000**	**20,000**	2000
BILBAO Rec. Ter. (Spain)	**2** (Full cont. above ground)	**150,000**	**300,000**	2004
HAZIRA Rec. Ter. (india)	**2** (Full cont. above ground)	**160,000**	**320,000**	2005
GUANGDONG Rec. Ter.(China)	**3** (Full cont. above ground)	**160,000**	**480,000**	2006/2007
FOS CAVAOU Rec. Ter. (France)	**3** (Full cont. above ground)	**110,000**	**330,000**	2009
PORTO EMPEDOCLE Rec. Ter. (Italy)	**2** (Full cont. in pit)	**165,000**	**330,000**	On going

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OVERVIEW ON PROVEN TECHNOLOGIES ON LARGHE CAPACITY CRYOGENIC STORAGE (> 60,000 m3)

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LNG large storage: Proven technology up to 240,000 m3 with international codes & regulations

TECHNOLOGY

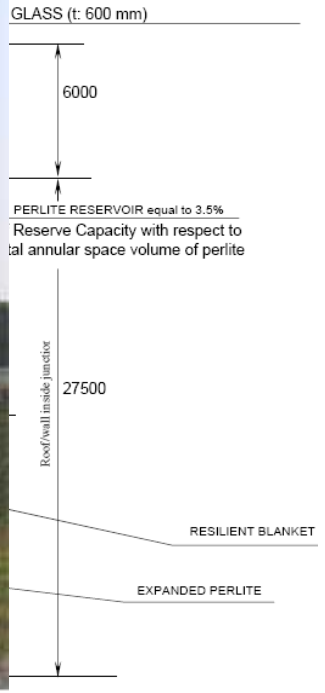
- **SELF SUPPORTING WALL**
  - Single Containment [9% Ni or SS]
  - Double Containment
  - Full Containment [inner tank 9% Ni – Outer tank: PS concrete]
- **MEMBRANES**

LOCATION

- **ABOVE GROUND**
- **IN-PIT**
- **IN-GROUND**
- **UNDERGROUND**

LNG STORAGE: SINGLE CONTAINMENT

- **Primary container designed for low temperature requirement**
- **Outer shell (if any) for insulation retention and purge gas containment but not designed for refrigerated containment**
- **Requirement of a surrounding bound for retention of the total tank inventory (plain or reinforced dykes)**



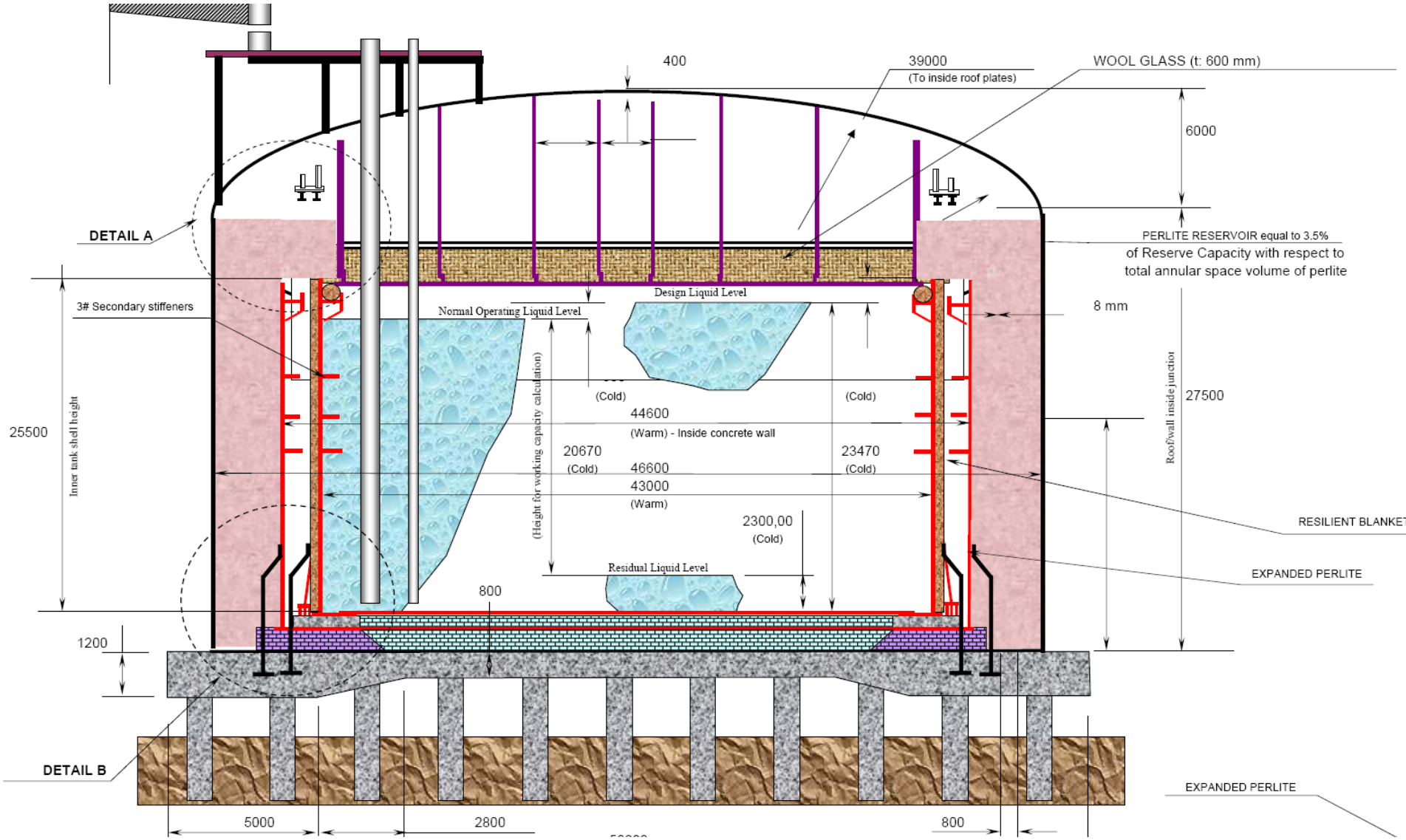
Cove Point Import Terminal, Maryland
Photo courtesy of Dominion © 2003, http://www.dom.com

EXPANDED PERLITE

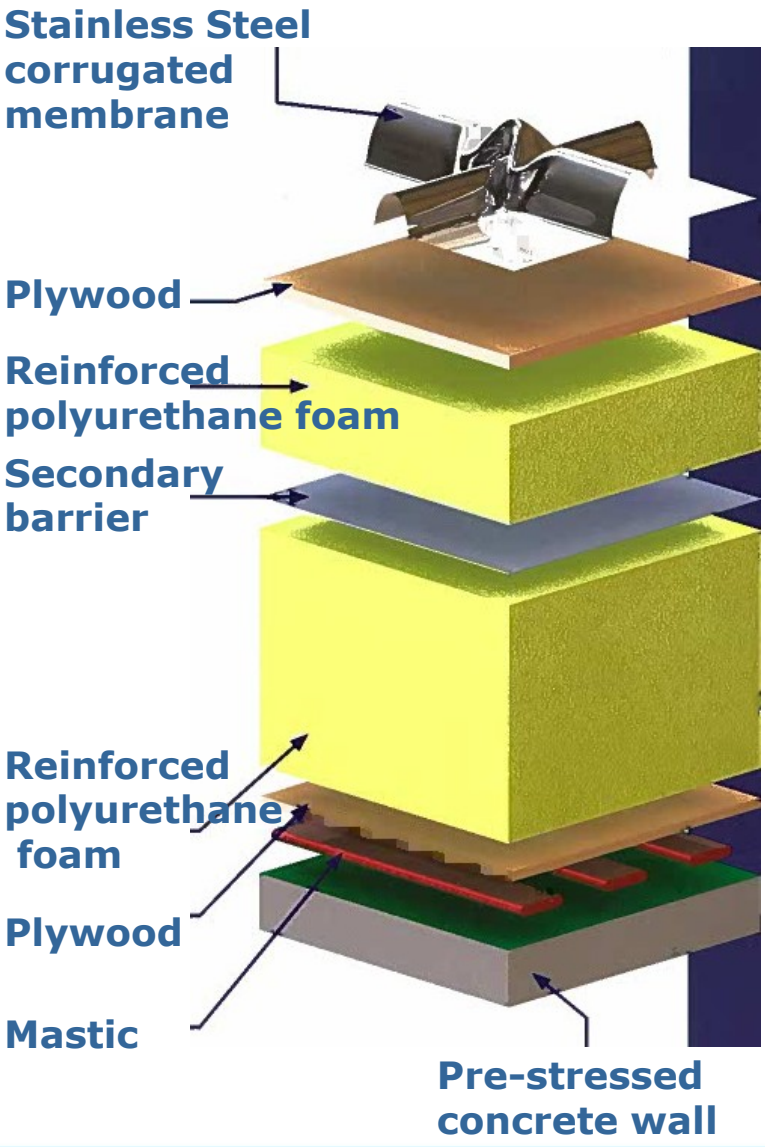
LNG STORAGE: FULL CONTAINMENT TECHNOLOGY

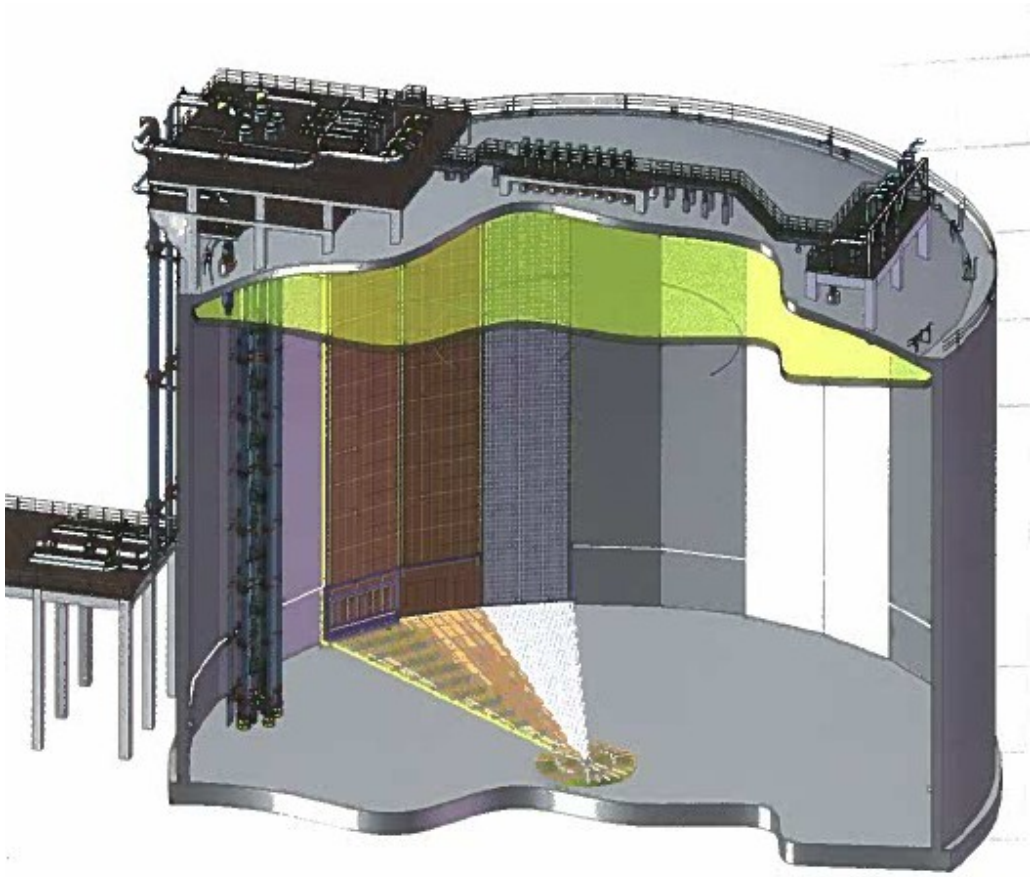
- **Both inner self supporting & second container are able of independently containing refrigerated liquid and its vapour**
- **The secondary container can be 1 to 2 m distance from the primary container**
- **The secondary container shall be able of both containing liquid and of controlling vapour resulting from product leakage**

LNG STORAGE: ALTERNATE FULL CONTAINMENT



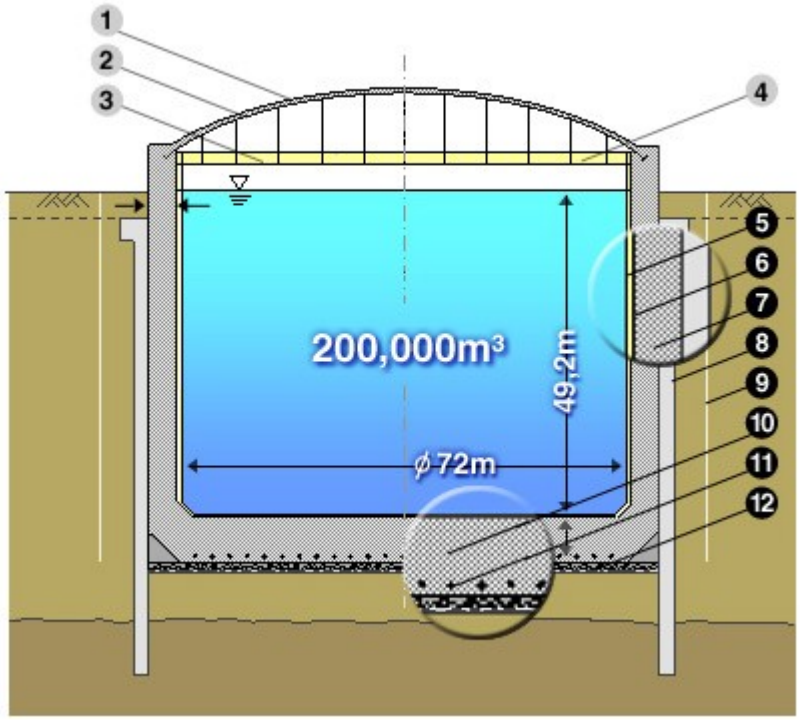
LNG STORAGE: MEMBRANE TECHNOLOGY





Typical GTS membrane (GTT license)

LNG STORAGE: IN GROUND TECHNOLOGY



LNG TANK TYPE : REFERENCES & TRENDS

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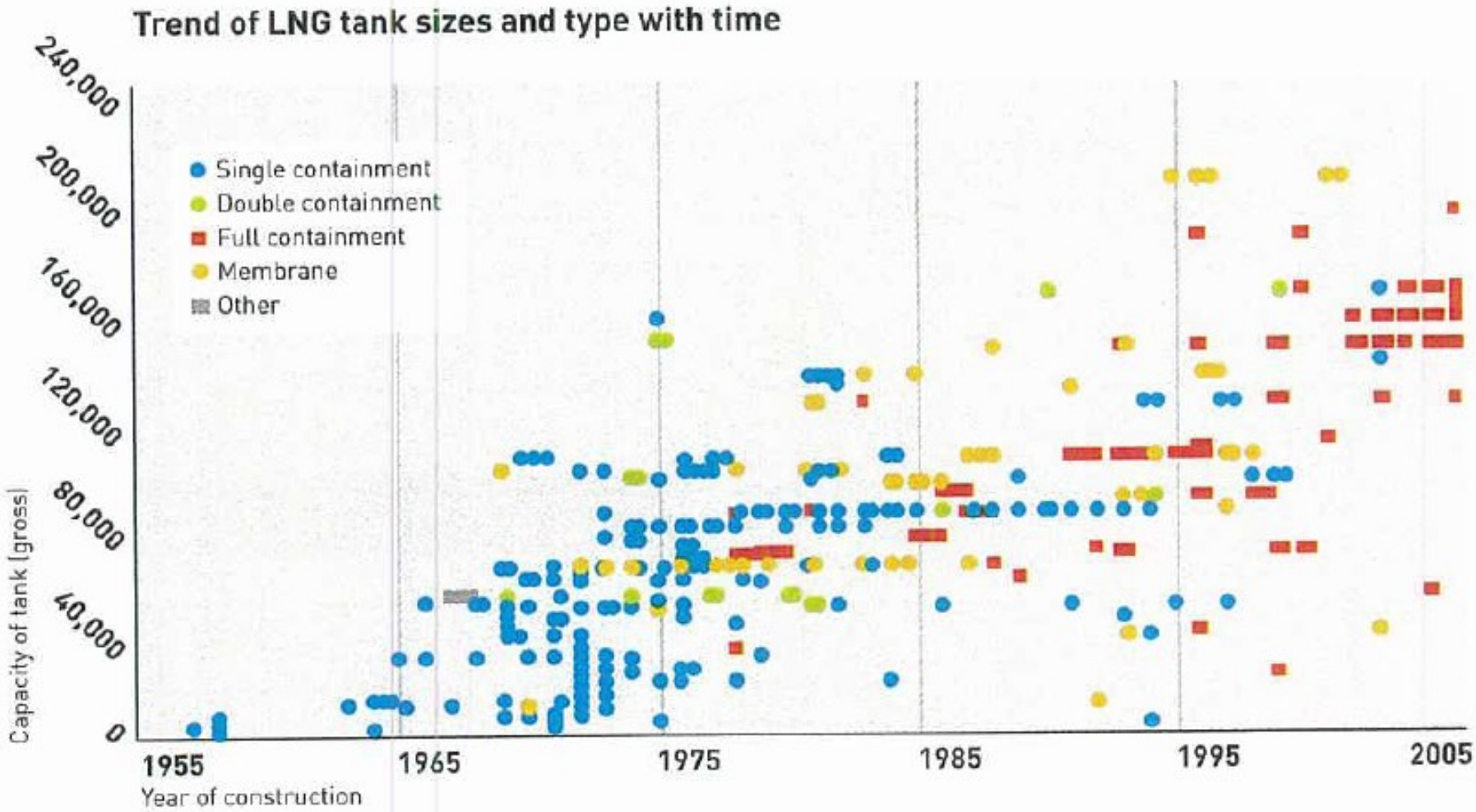

LNG STORAGE: DIRECT LNG STORAGE IN MINED CAVERN

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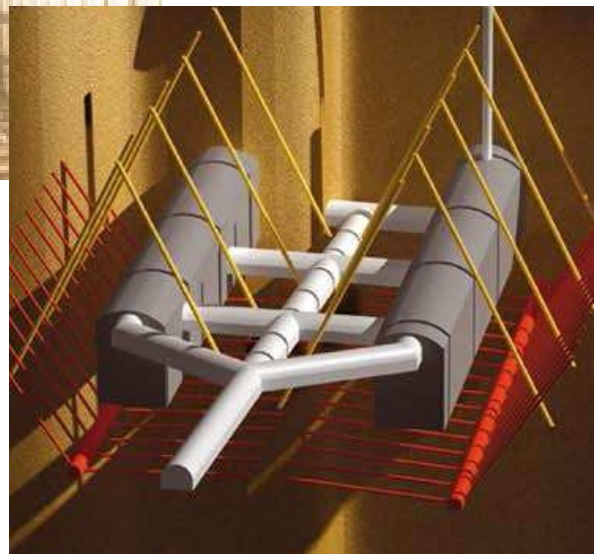
- **Technology developed by GEOSTOCK**
- **Pilot Plant in Pyongtaek in South Korea tested with liquid N2**
- **No industrial plant**



CONSTRUCTION SEQUENCE OF A CONVENTIONAL FULL CONTAINMENT LNG TANK

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TYPICAL 9% NI FULL CONTAINMENT
ABOVE GROUND LNG TANK CONSTRUCTION SEQUENCE

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SPECIFIC ASPECTS OF A LARGE LIQUID ARGON STORAGE (100 kt)

- **STORED PRODUCT: ARGON compared to LNG**

	ARGON	LNG
Boiling point at 1 atm (°C)	**minus 186**	**Around minus 160**
Liquid density (kg/m3)	**1,400**	**Around 450**
Product purity	**High purity < 1 ppb**	**Mixture of N2 (<3% vol), C1 (>90% vol), C2+, CO2 (< 50 ppm)**
Operation	**One single filling**	**Cycle of filling and emptying**
Safety	**Inert gas**	**Flamable**

- **INTERNAL WALL SURFACE TREATMENT**
- **CONSTRUCTION IN A CONFINED UNDERGROUND CAVITY**
- **DRYING, FIRST COOLING AND FILLING OPERATION**
- **BOIL OFF GAS HANDLING**
- **PURITY & FILTRATION**
- **FIRST FILLING & EMPTYING IN CASE OF EMERGENCY OR MAINTENANCE**

LARGE LIQUID ARGON STORAGE: Auxiliaries

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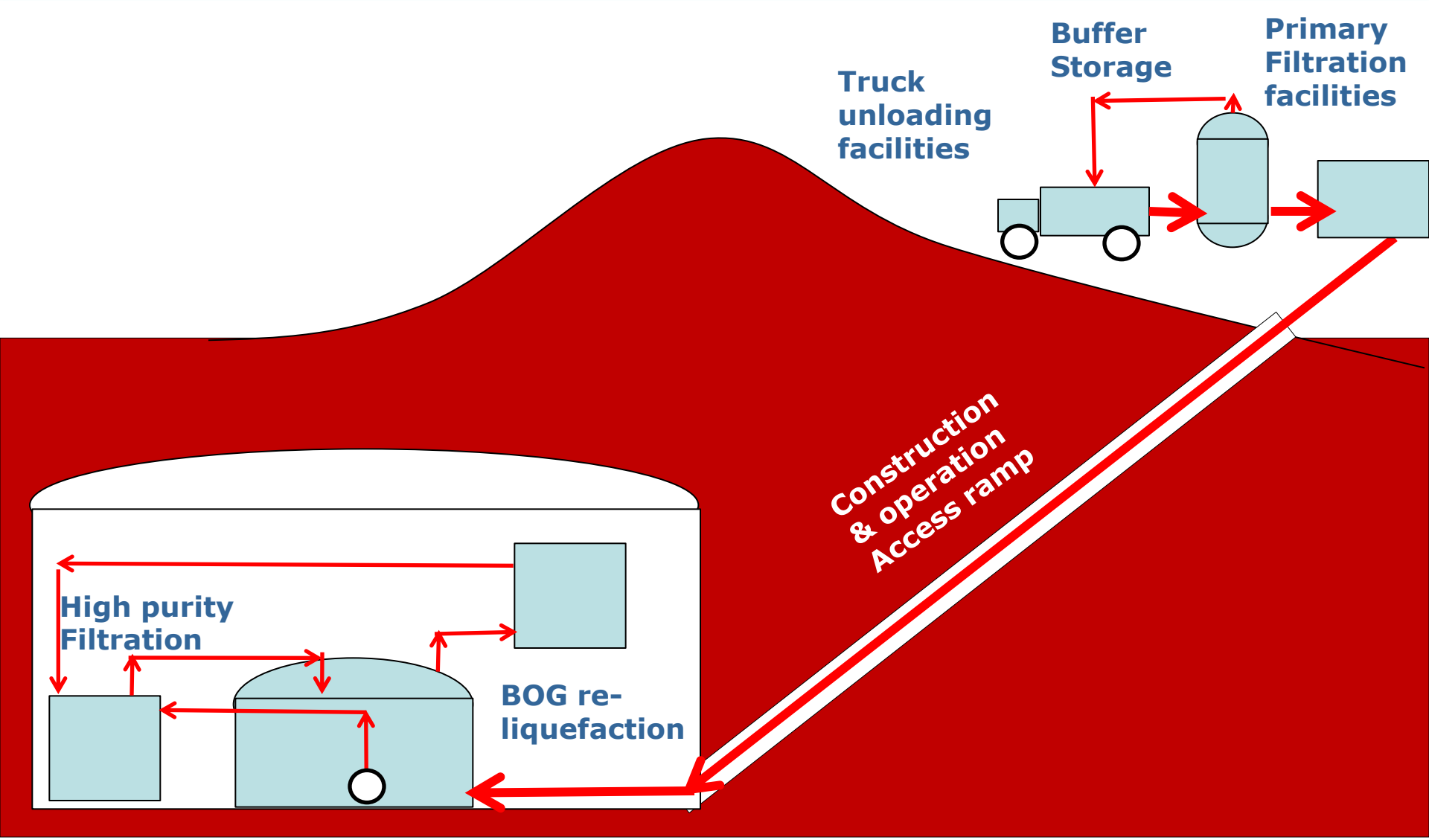
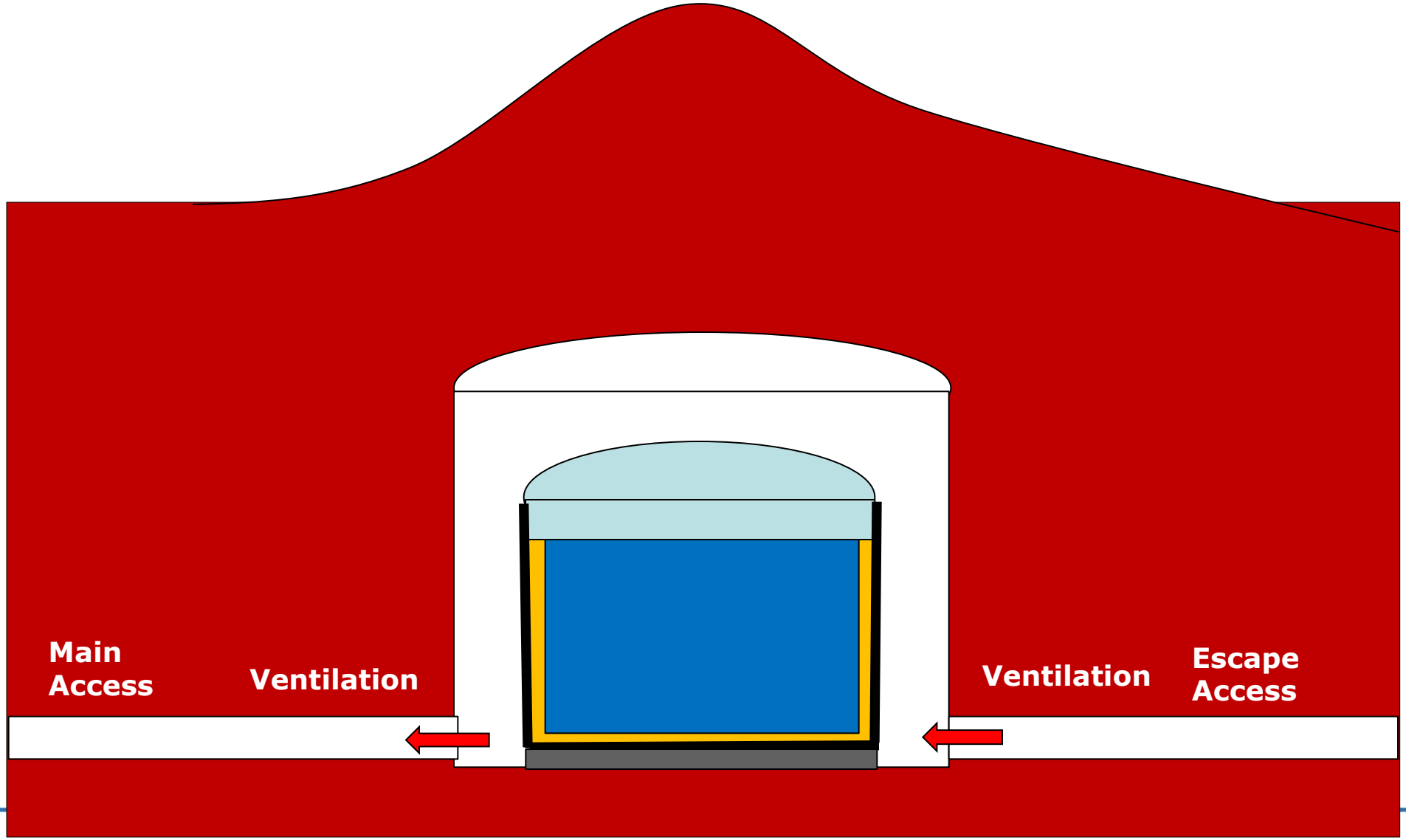
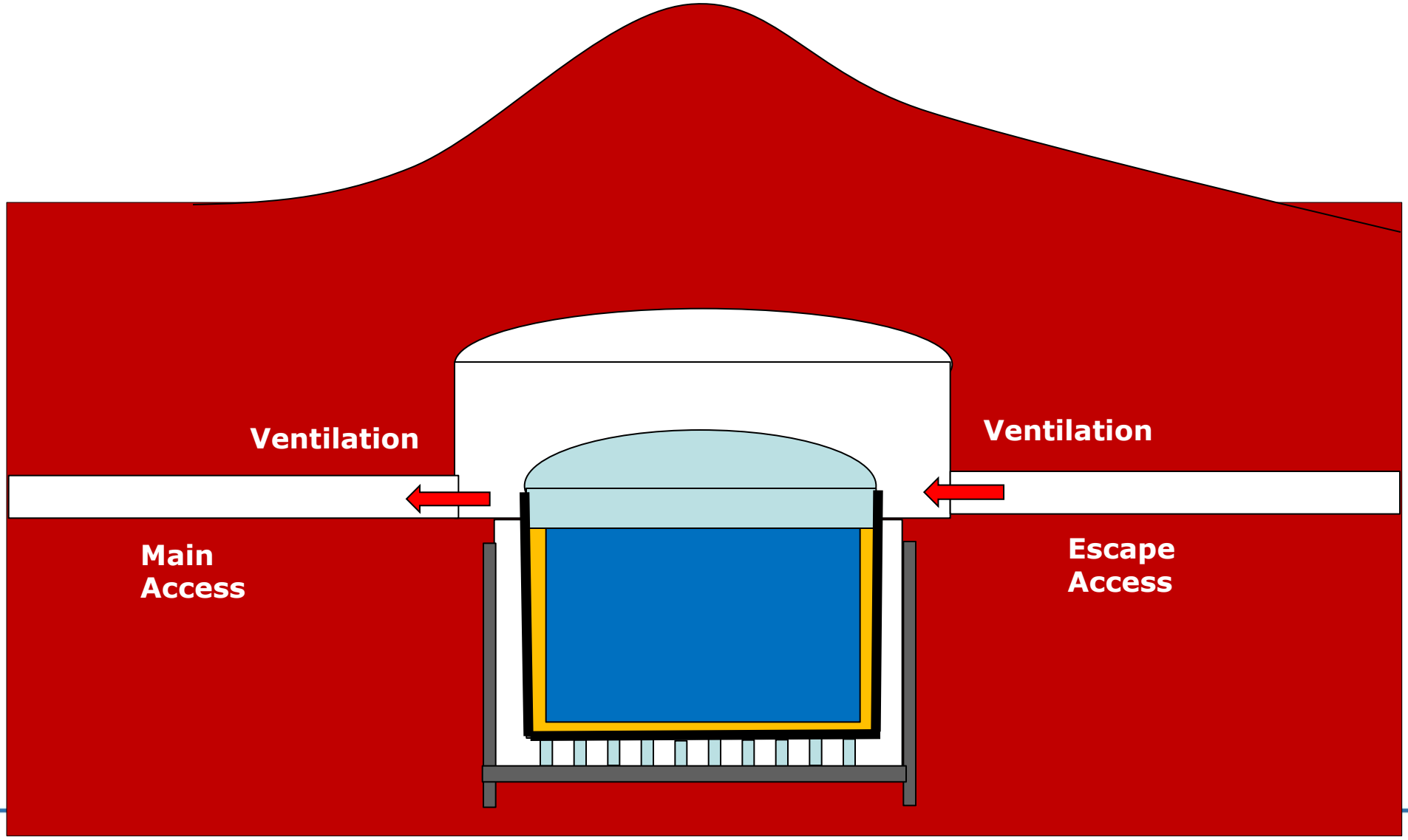


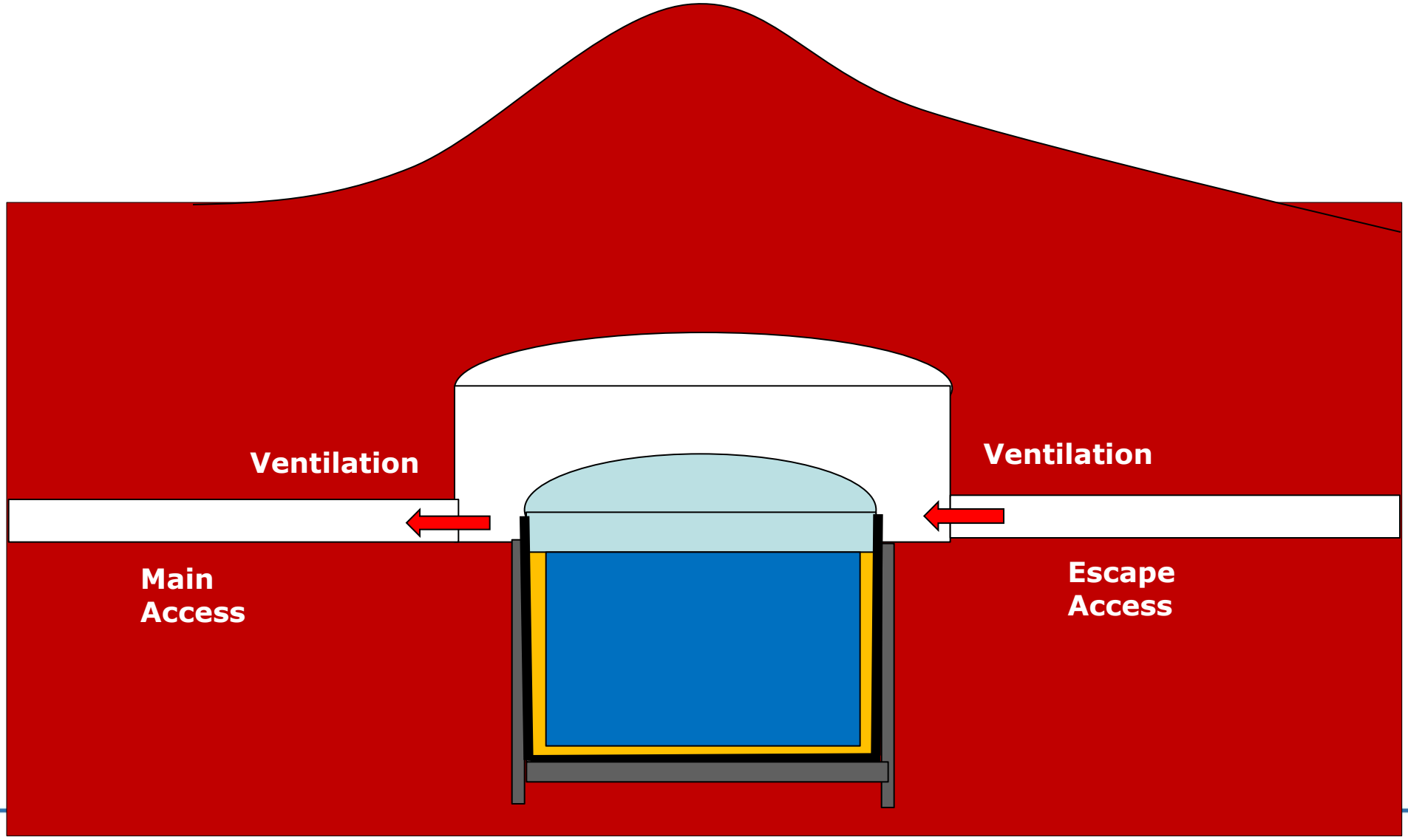
LARGE LIQUID ARGON STORAGE: Conventional



LARGE LIQUID ARGON STORAGE: In pit



LARGE LIQUID ARGON STORAGE: Inground



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THANK YOU FOR YOUR ATTENTION