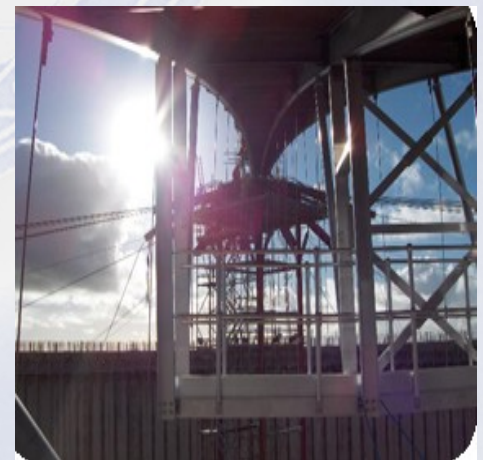




**LAGUNA-LBNO General Meeting**  
**Experience in Tank Building**

## Contents

- **Introduction to Rhyal Engineering**
- **Cryogenic Tank Construction**
- **Laguna Project Challenges**



## **Rhyal Engineering**

- **Formed in 1998 with an experienced tank construction management team and workforce**
- **One of UK's leading specialist storage tank construction**
- **Extensive fabrication and construction experience**
- **Serving all industry sectors**
- **Strong culture of team work and partnering p**





## Past Projects

### Aviation Fuel Storage Tanks – Isle of Grain Terminal, UK





## Past Projects

### Aviation Fuel Storage Tanks – Isle of Grain Terminal, UK



## Past Projects

### Aviation Fuel Storage Tanks – Isle of Grain Terminal, UK





## Past Projects

### Bio-ethanol Storage Tanks – Kingsbury Terminal, UK





## Past Projects

### Bio-ethanol Storage Tanks – Kingsbury Terminal, UK





## Past Projects

### Typical Access Restrictions – Pembroke Refinery, UK





## Past Projects

### Typical Access Restrictions – Pembroke Refinery, UK





## Past Projects

### Storage Tank and Vessels – Nitrogen Sphere



## Past Projects

### Storage Tank and Vessels – Crude Oil Tank





## Past Projects

### Storage Tank and Vessels – LNG Tanks



## **Involvement with LAGUNA**

- 
- **Experienced tank contractor**
  - **Assist with design and planning from the contractors perspective**
  - **Generate cost estimates for the tank at proposed locations**



## **Cryogenic Tank Construction**

- **LNG Tank Construction Sequence**
- **Case Study – Recent LNG Tank Build**



## **LNG Tank Construction Sequence**

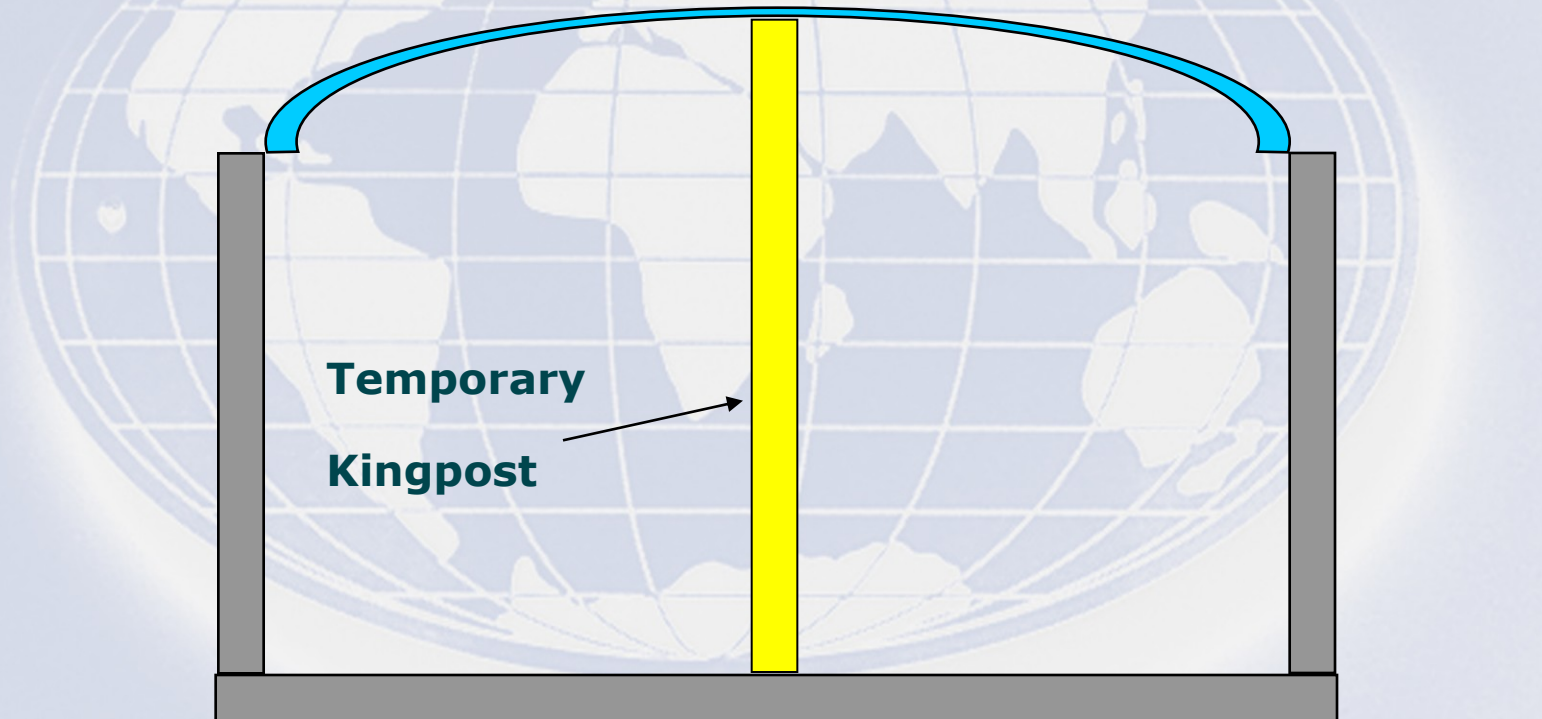
**Install foundation, slip-form cast outer concrete shell walls**





## **LNG Tank Construction Sequence**

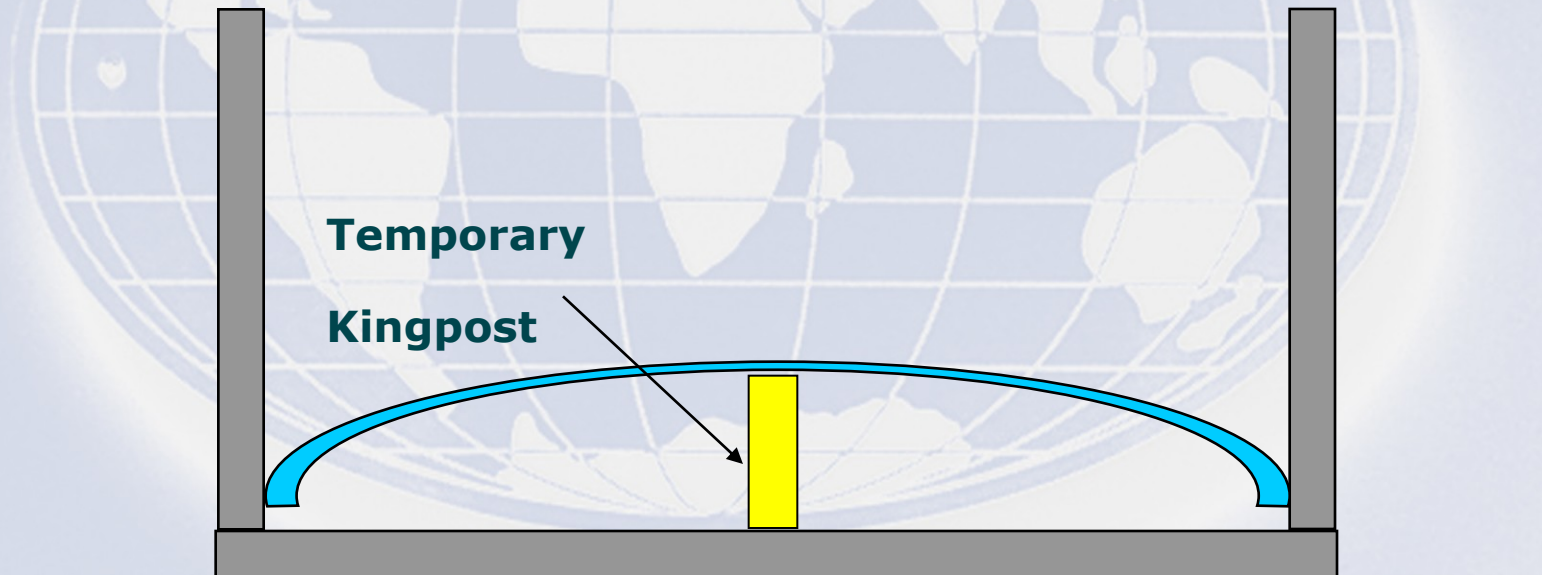
### **Roof structure & plates – kingpost method**



## **LNG Tank Construction Sequence**

### **Roof structure & plates – blown roof method**

**Phase 1 – Construct roof at floor level**

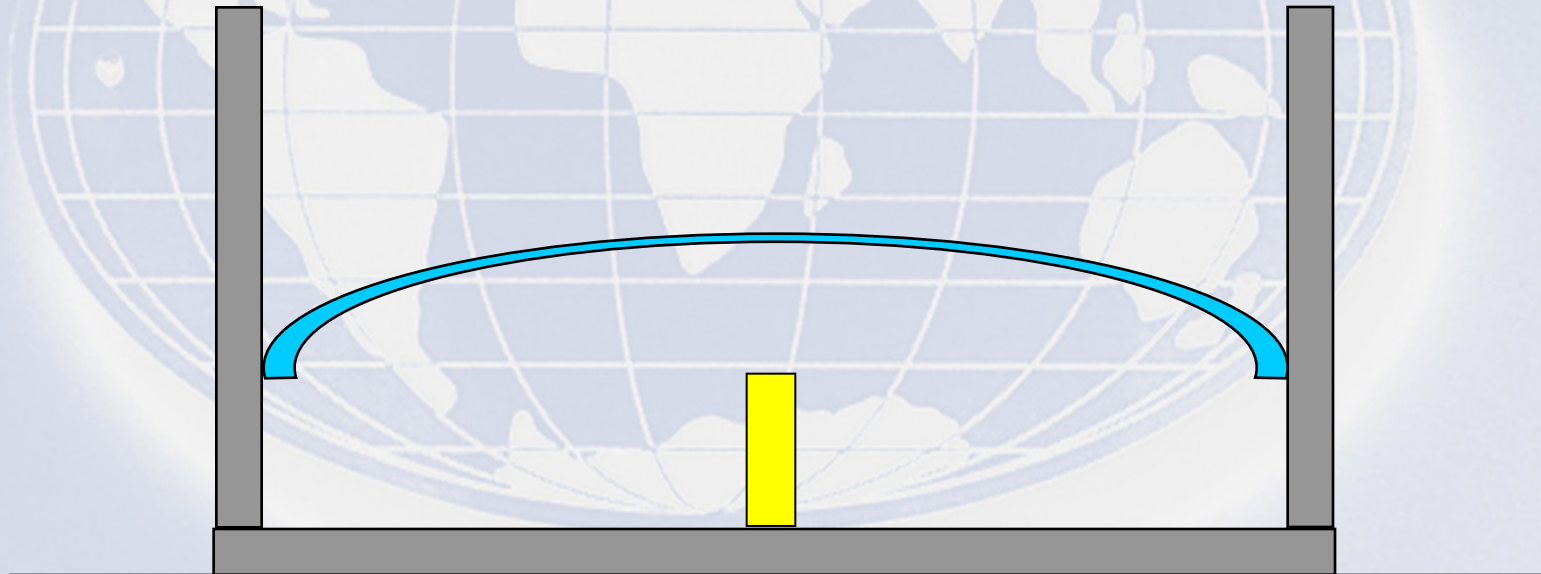




## **LNG Tank Construction Sequence**

### **Roof structure & plates – blown roof method**

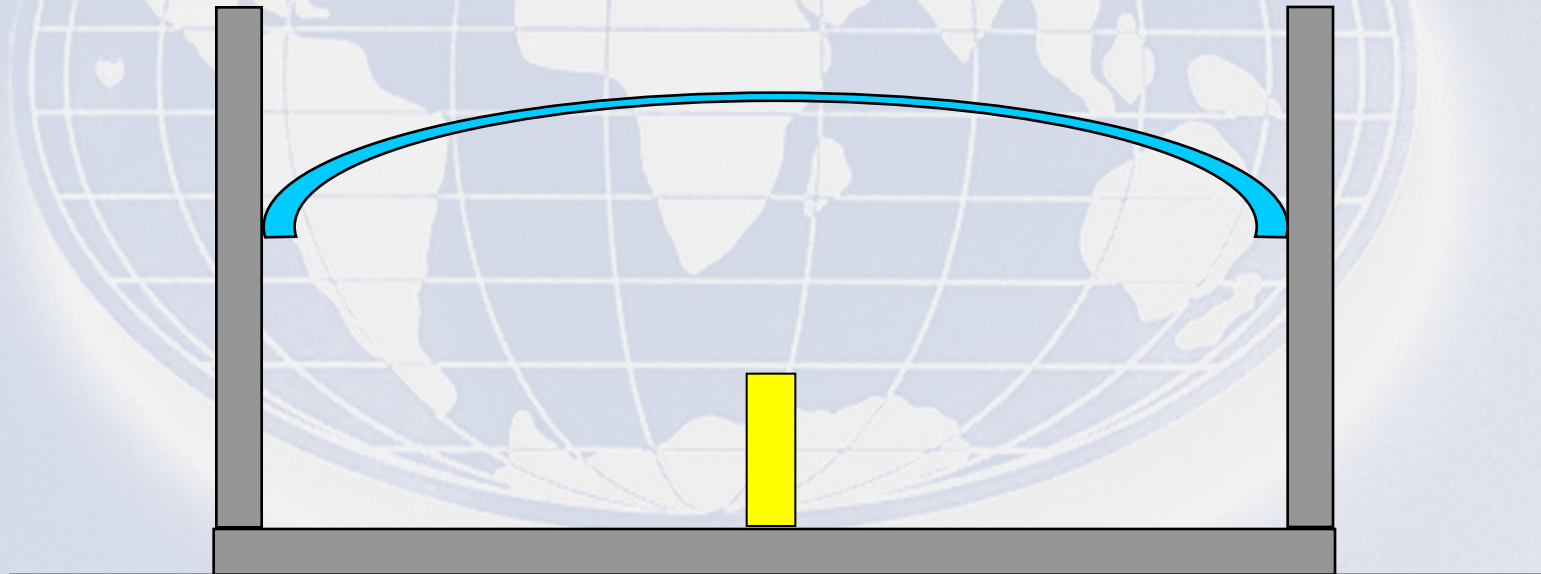
**Phase 2 – Raise roof with air cushion**



## **LNG Tank Construction Sequence**

### **Roof structure & plates – blown roof method**

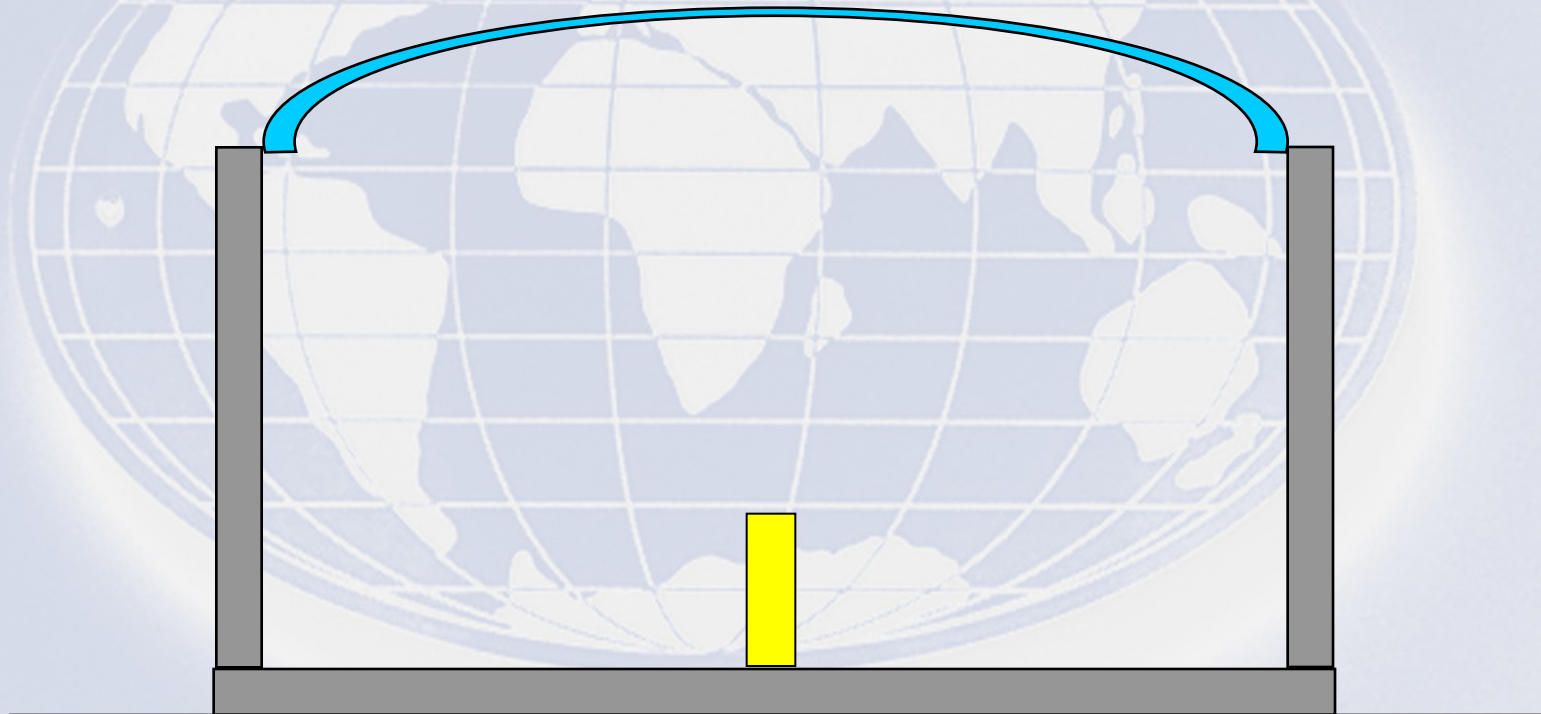
**Phase 2 – Raise roof with air cushion**





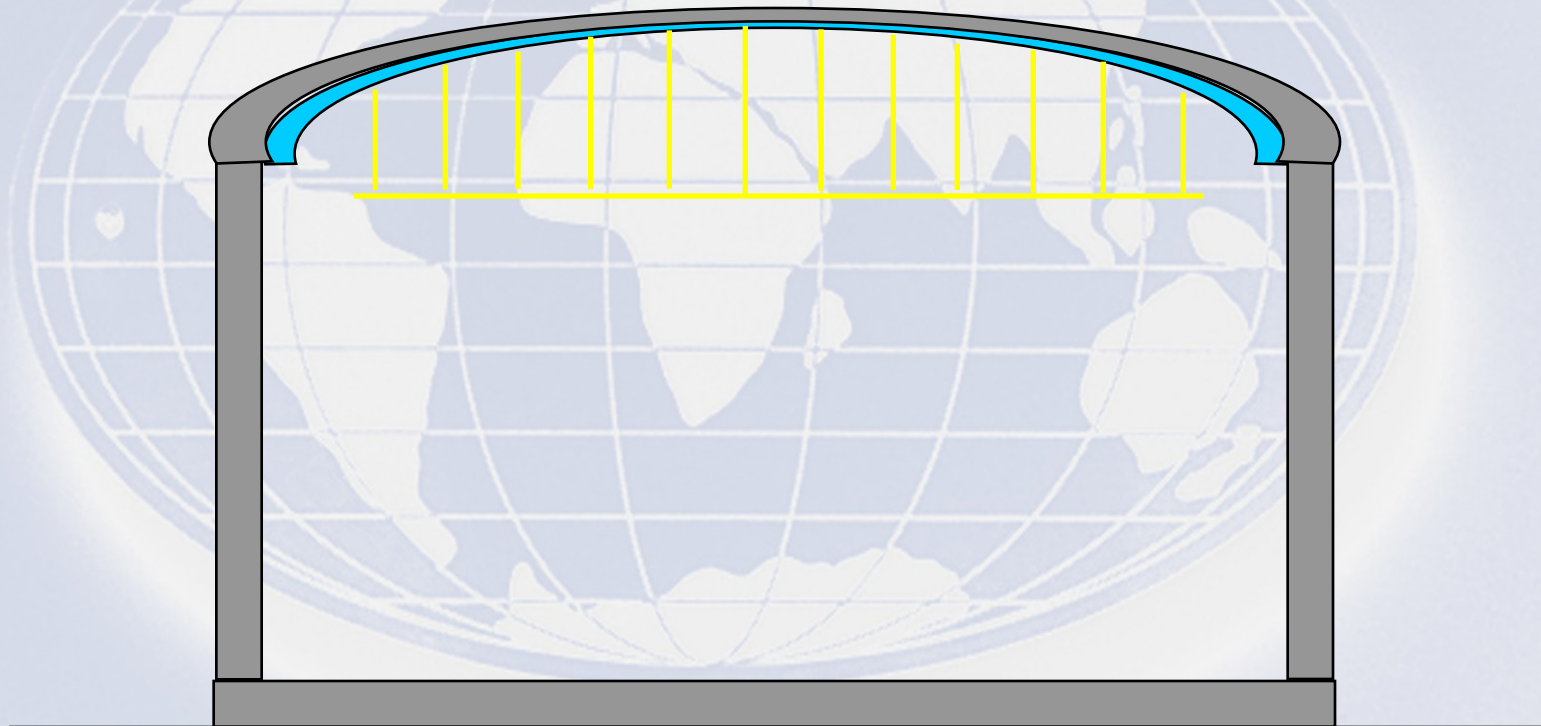
## LNG Tank Construction Sequence

### Roof structure & plates – blown roof method



## LNG Tank Construction Sequence

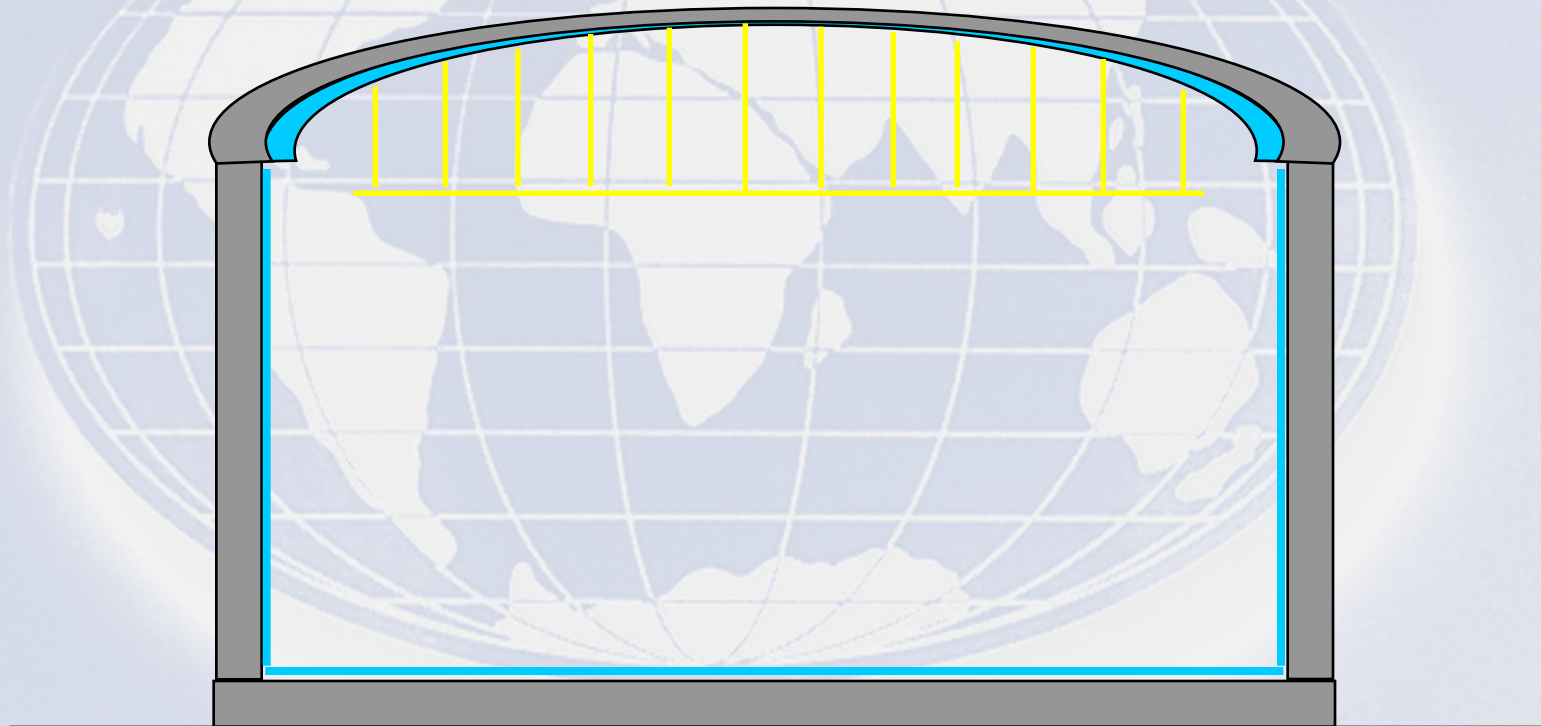
**Complete concrete surround**





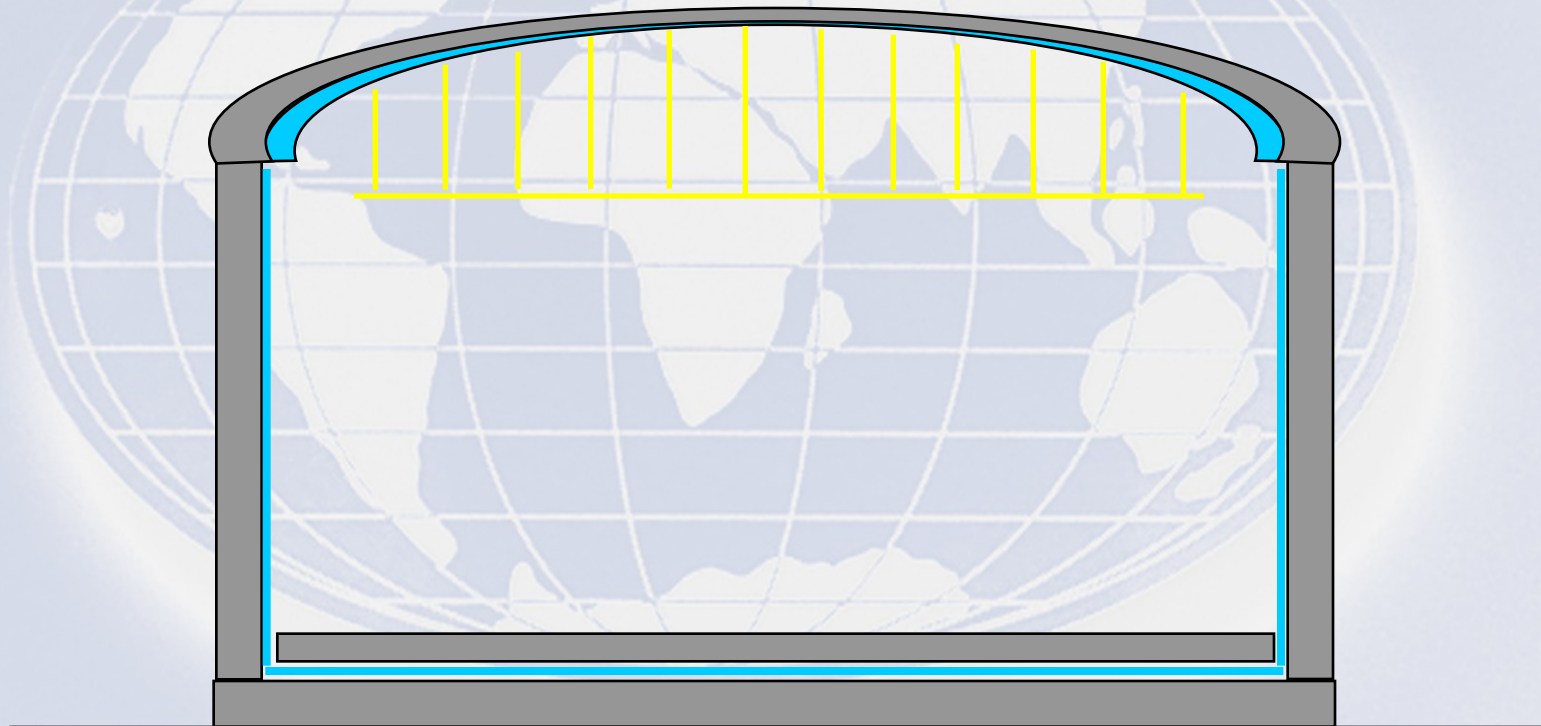
## LNG Tank Construction Sequence

**Install & weld outer tank shell & floor liner**



## LNG Tank Construction Sequence

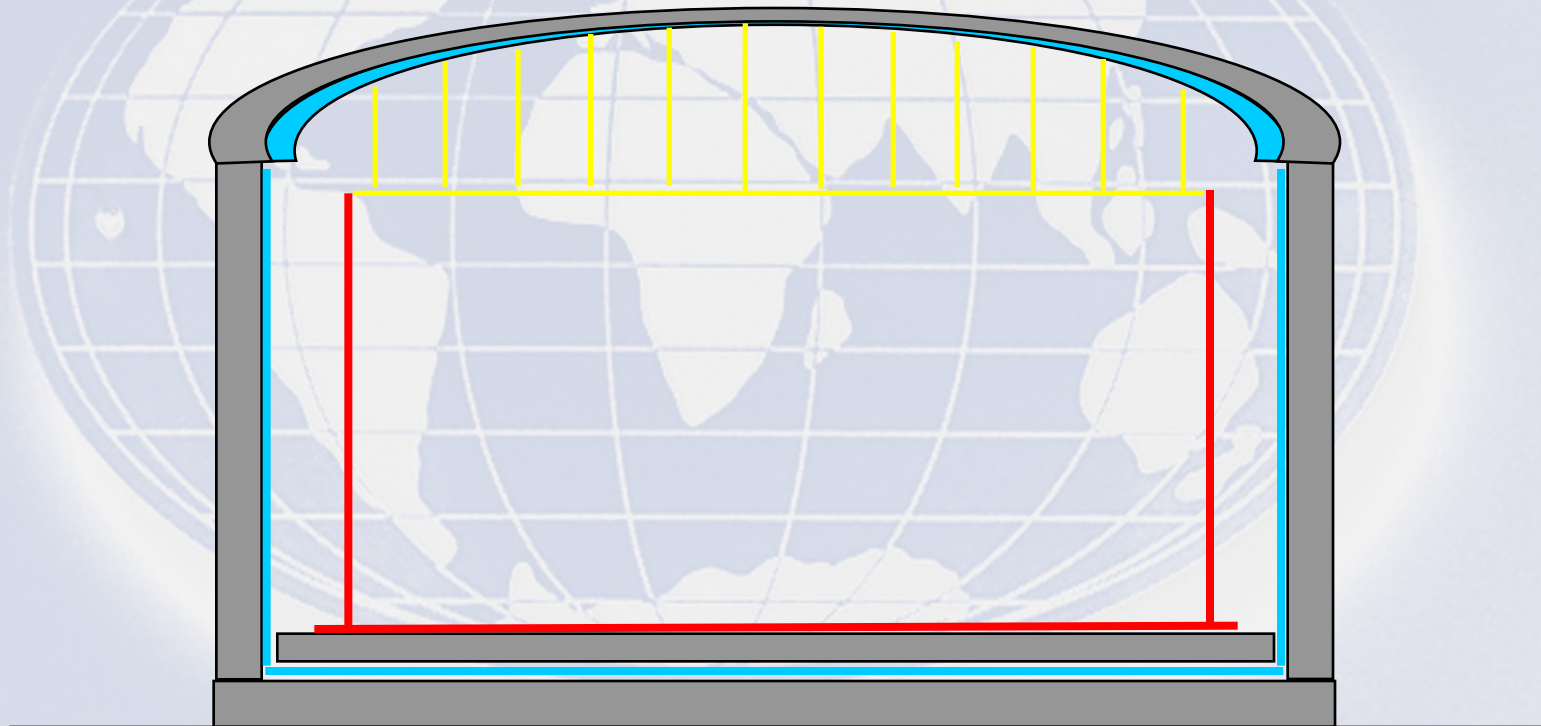
**Lay insulation and temp sensors**





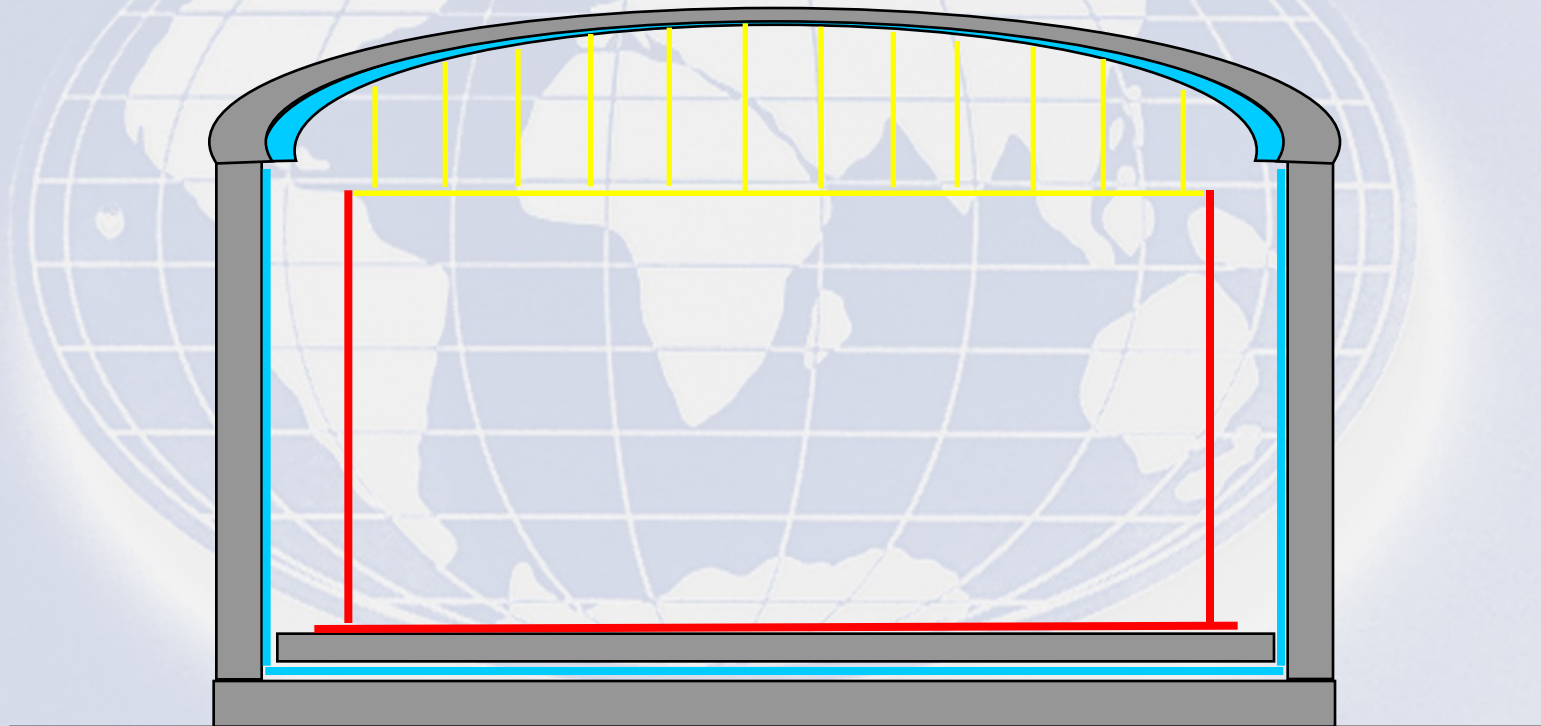
## LNG Tank Construction Sequence

**Install & weld inner tank floor & shell**



## **LNG Tank Construction Sequence**

**Install piping, hydrostatic test and insulate**







## **Case Study – LNG Tank Build, Milford Haven**

## **LNG Tank Build - Milford Haven, UK**

- **Full containment concrete-steel type tanks**
- **Completed 2008**
- **Storage capacity 160,000m<sup>3</sup> per tank**





## LNG Tank Build - Milford Haven, UK

**Slip forming the concrete walls**



## **LNG Tank Build - Milford Haven, UK**

### **Installing King post**





## **LNG Tank Build - Milford Haven, UK**

**Roof construction – transport petals from storage**



## LNG Tank Build - Milford Haven, UK

Roof construction – lifting petals into position





## LNG Tank Build - Milford Haven, UK

Roof construction – lifting petals into position



## **LNG Tank Build - Milford Haven, UK**

**Roof construction – erecting infill structure**





## LNG Tank Build - Milford Haven, UK

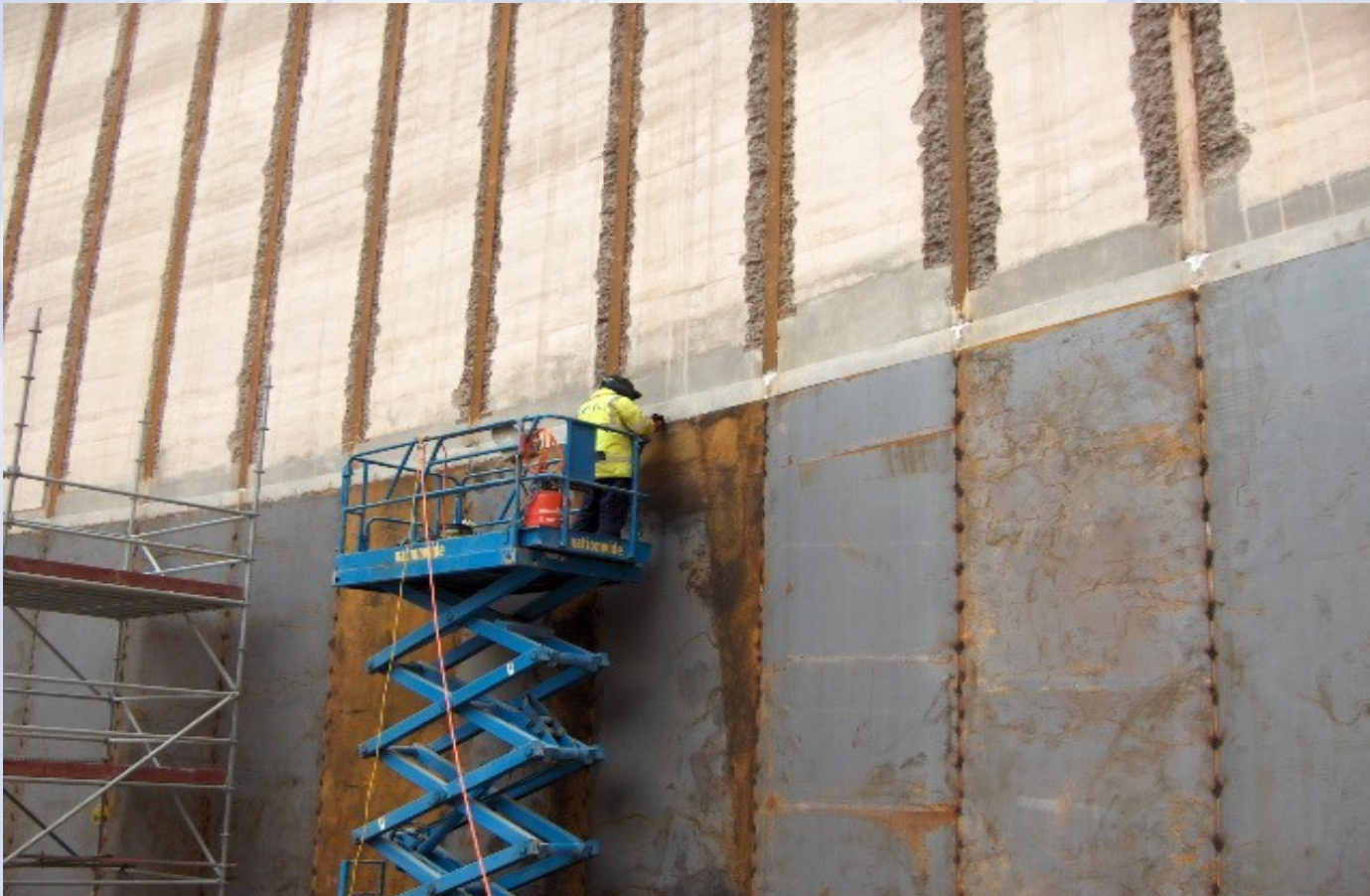
Roof construction – erecting roof plates





## **LNG Tank Build - Milford Haven, UK**

**Erecting and welding outer tank shell liner**





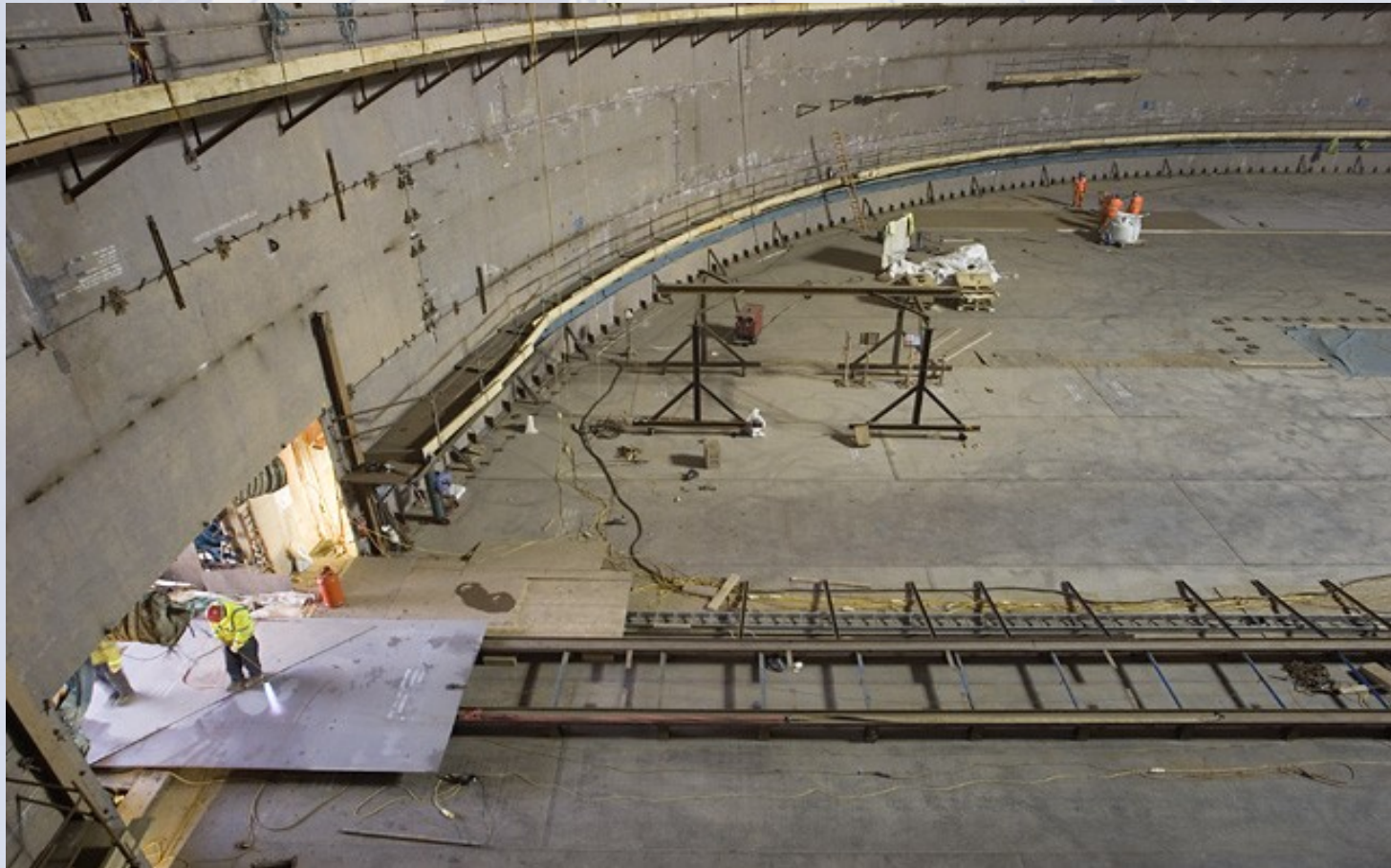
## **LNG Tank Build - Milford Haven, UK**

**Outer tank floor, insulation and inner tank floor**



## **LNG Tank Build - Milford Haven, UK**

### **Inner tank shell erection and welding**





## LNG Tank Build - Milford Haven, UK

Inner tank shell erection and welding



## **LNG Tank Build - Milford Haven, UK**

**Installing internal tank piping**





## **Dragon LNG - Milford Haven, UK**

### **Installing internal tank piping**



## LNG Tank Build - Milford Haven, UK

**Tank complete ready for hydro test**





**LAGUNA Project Challenges**




## **LAGUNA Project Challenges**

- 
- **At present we believe the three main tank construction challenges are:**
    - **Location**
    - **Construction methodology**
    - **Construction costs**



## **LAGUNA Project Challenges - Location**

- 
- **Three unique locations which are all underground, each of which present individual access restrictions**
  - **Access restrictions will impact on design, construction method, construction duration and costs**
  - **Working environment will have to be carefully considered with regard to the health and safety of the workforce**

## **LAGUNA Project Challenges - Location**


- **The size of the cavern and the access tunnels or shafts providing access to it will restrict and determine:**
  - **Transportation of the tank components to the workface**
  - **Limitation of height and work area within the cavern**
  - **Lay-down areas for materials and construction equipment**
  - **Available size and type of lifting equipment**
  - **Allowable construction sequence of other works**



## **LAGUNA Project Challenges - Methodology**

- **Proven above ground construction methods can be transferred and adapted to below ground working**
- **For each location under review we will have to consider:**
  - **Developing cavern and tank design concurrently to establish most suitable solution**
  - **Tailoring tank design to construction methodology as well as location**
  - **Best fit tank construction method**
  - **Integration of the above methodology with regard to other services required, e.g. piping, EC&I, etc**

## **LAGUNA Project Challenges - Cost**

- 
- **Construction costs will be greater than an equivalent above ground tank**
  - **Construction costs must not become prohibitive for the project**
  - **Major challenge will be to reduce these costs to an acceptable level**



## **LAGUNA Project Challenges - Cost**

- **Minimising construction costs will be possible by ensuring that:**
  - **An integrated design and construction team is developed at the earliest possible stage of the project**
  - **All operational and maintenance requirements are understood at outset of design**
  - **Current above ground storage tank construction technology is used wherever possible**
  - **Automated construction equipment is used wherever possible to reduce labour resource required**



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