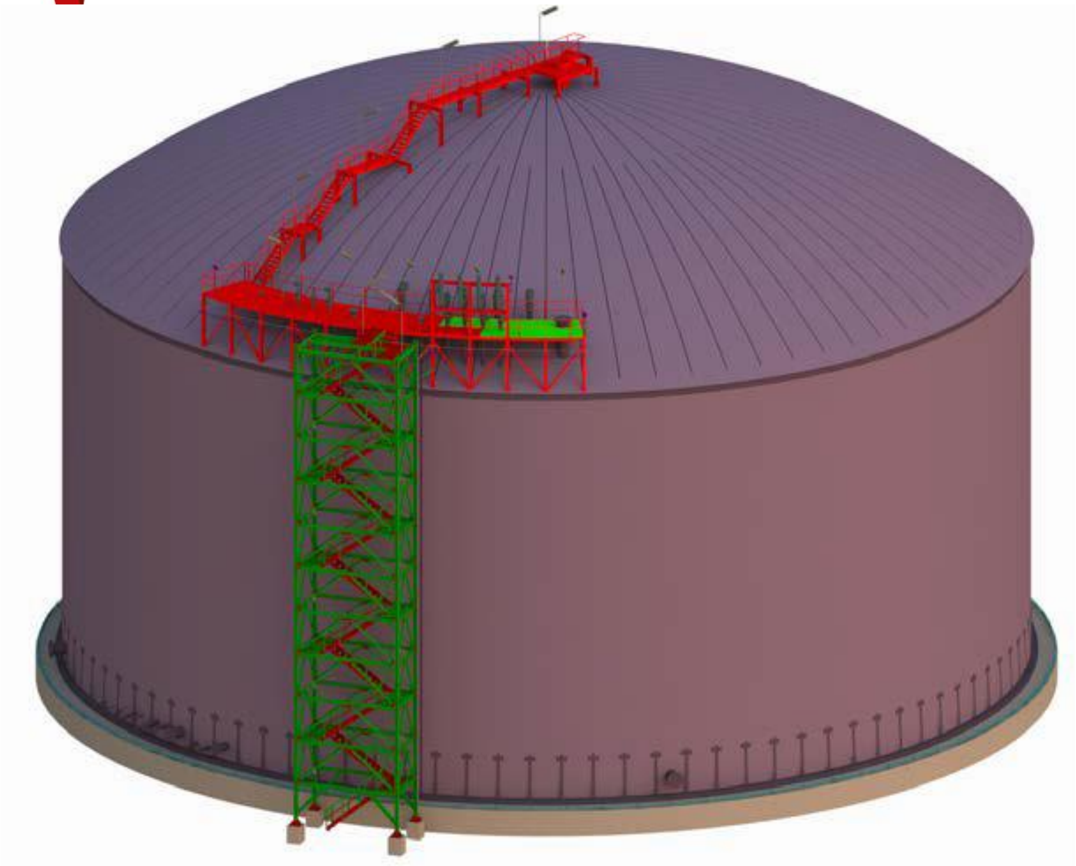
TECHNODYNE INTERNATIONAL LTD

Technodyne International Ltd



Leading Specialist in RLG Storage Tank Design

- Established in 1998
- Wholly owned by TGE Gas Engineering GmbH
- Providing Engineering Design for RLG storage tanks.
- Basic & Detail Design Packages
- Consultancy Services
- 35+ Engineers & Technicians located in Eastleigh, UK and Munich, Germany

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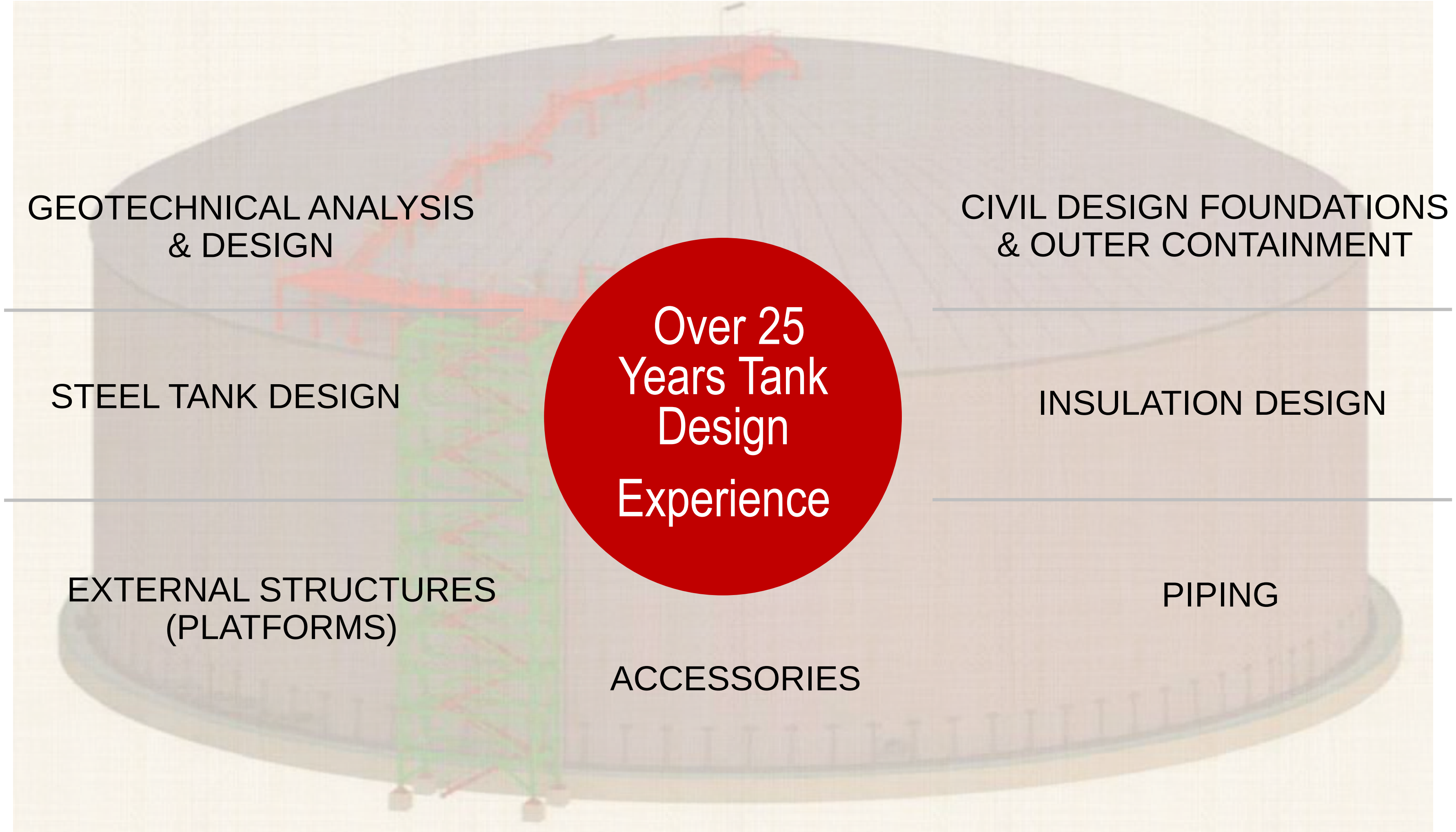


GEOTECHNICAL ANALYSIS & DESIGN

CIVIL DESIGN FOUNDATIONS & OUTER CONTAINMENT

STEEL TANK DESIGN

Over 25 Years Tank Design Experience

INSULATION DESIGN

EXTERNAL STRUCTURES (PLATFORMS)

PIPING

ACCESSORIES

Technodyne International Ltd

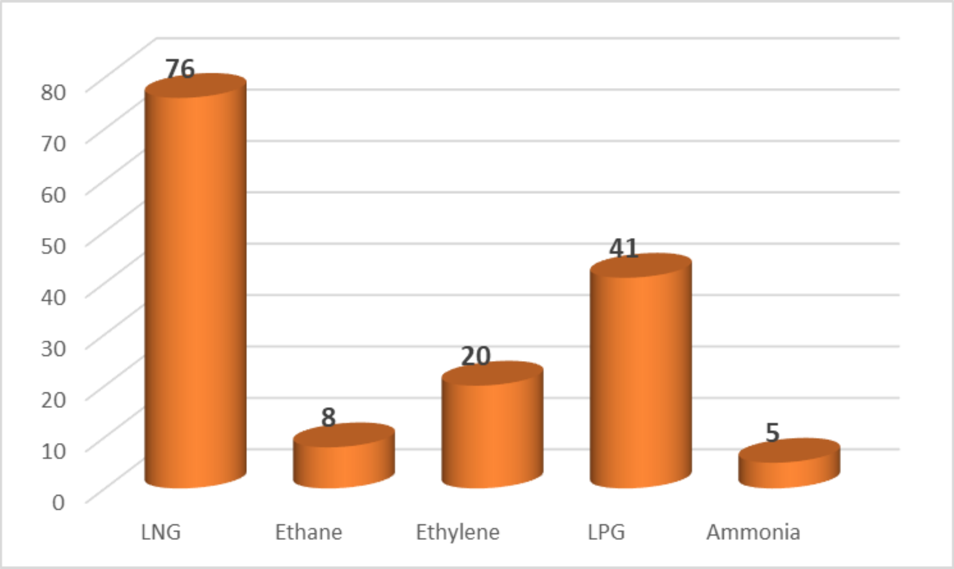
RLG TANK DESIGN - COMPETENCIES

Core Design Skills

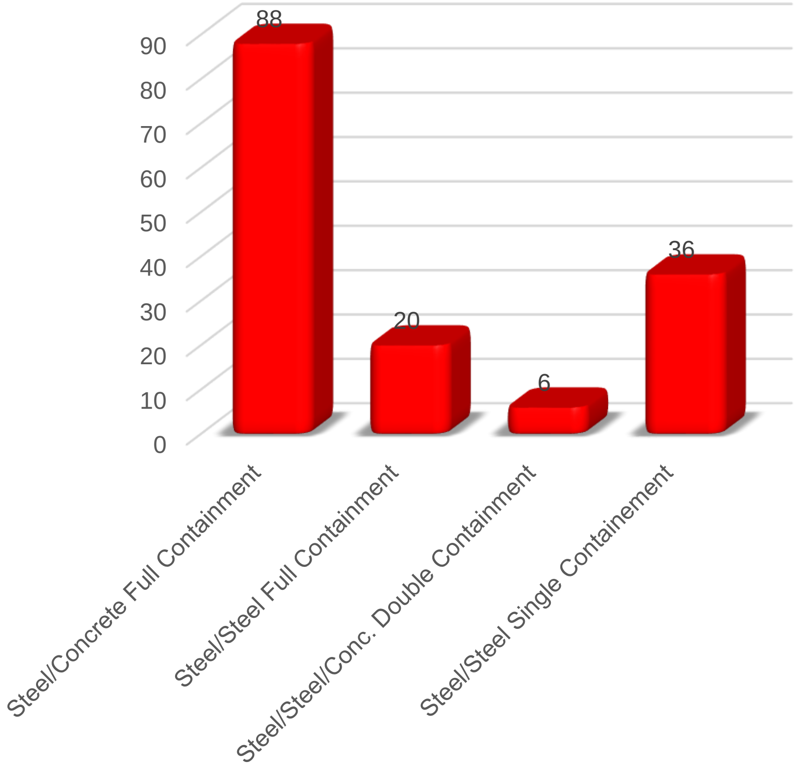
- Design of low temperature & cryogenic storage tanks
- Size range from 6,000 m³ to 260,000 m³
- Full / Double / Single containment & Membrane solutions
- Steel / Steel, Concrete / Steel, Concrete / Membrane
- Ammonia, Butane, Ethane, Ethylene, LNG, LPG, Propane Propylene
- Complete tank design & analysis capability
- Designs to International & Local Codes – API, ACI, GB & GB/T, EN and Eurocodes
- Piping & Structural design and analysis
- Construction Supervision, Technical Field Advisors

RLG TANK DESIGN - COMPETENCIES

DESIGN BY PRODUCT TYPE



DESIGN BY TANK TYPE



150
Cryogenic
tanks
designed

* All tanks designed before 2019 are constructed and have been successfully put in operation. Numbers include TGE projects

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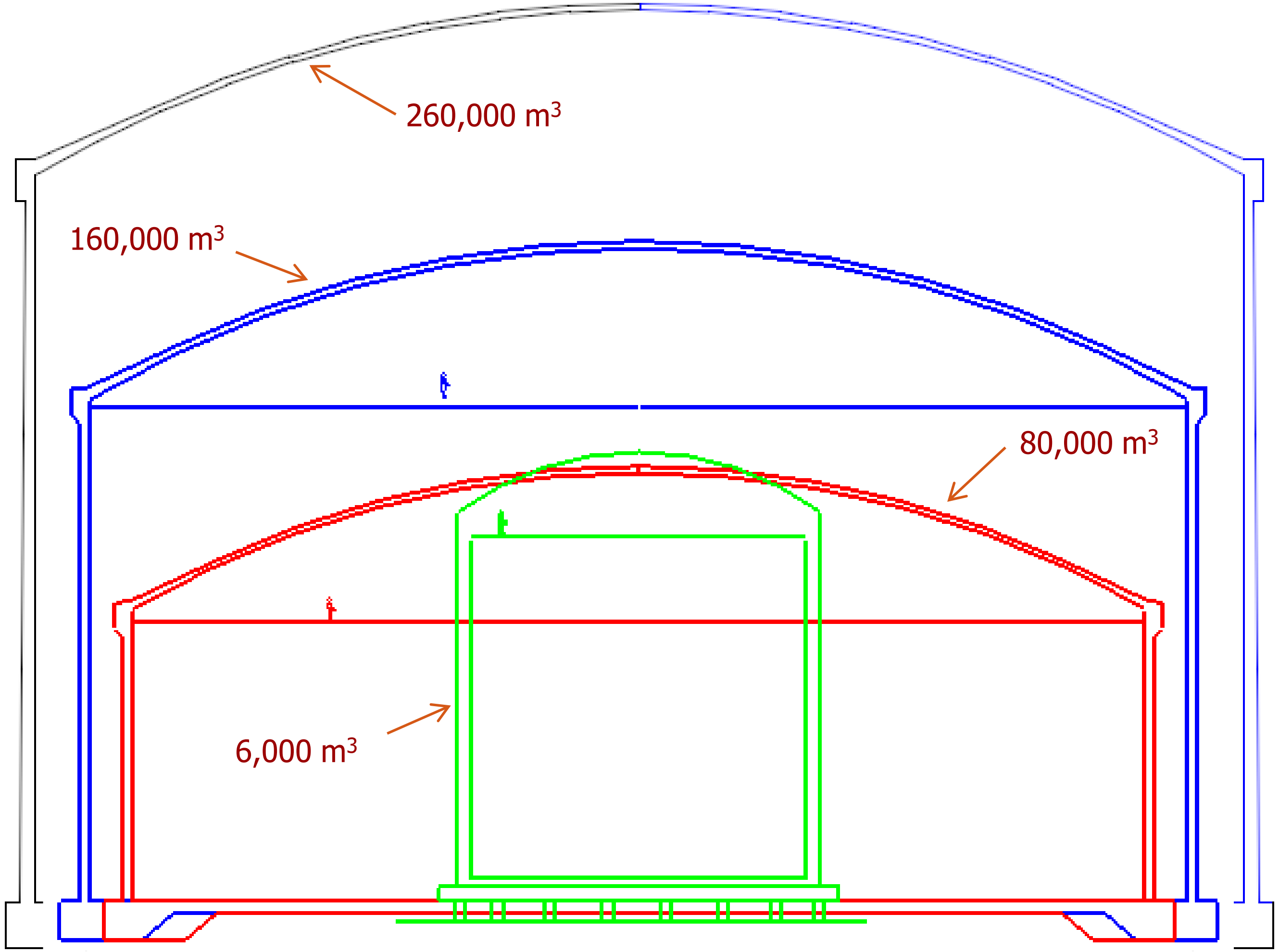
RLG TANK DESIGN - COMPETENCIES

Comparison of Storage Tank Sizes



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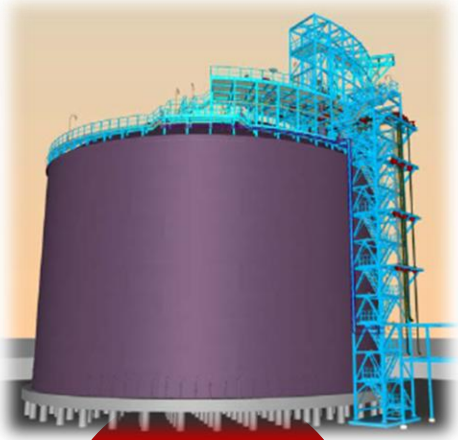
RLG TANK DESIGN - ENGINEERING SERVICES

CONSTRUCTION

OPERATION



DESIGN

COMMISSION

INSPECTION / TROUBLE SHOOT

Technodyne International Ltd

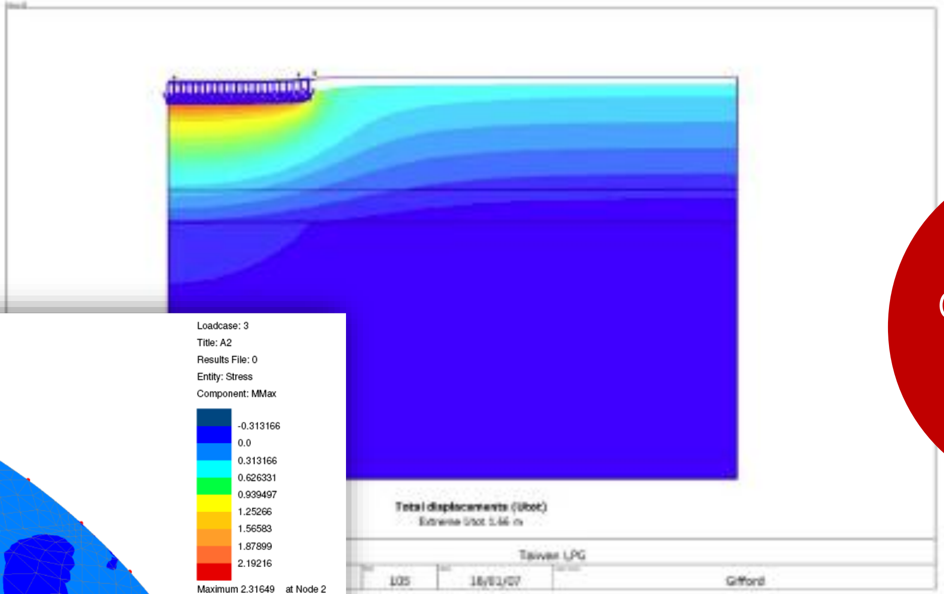
RLG TANK DESIGN - ENGINEERING SERVICES

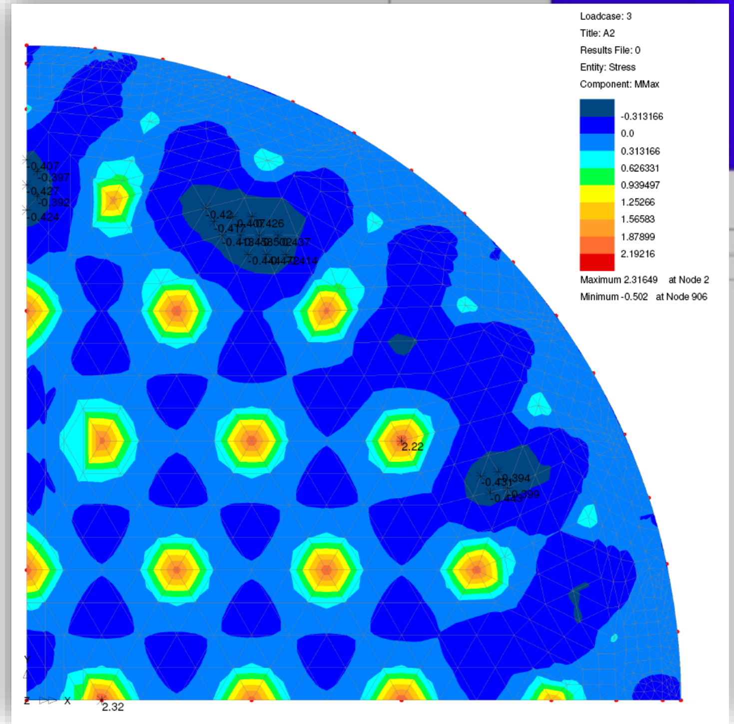
CAPABILITIES

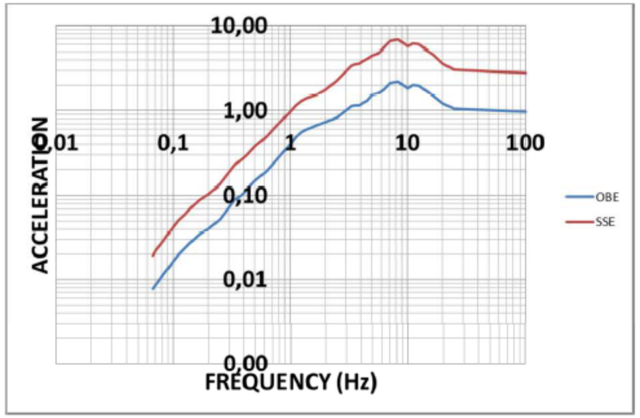
- CONCEPT & FEED STORAGE TANK DESIGN
- DETAILED STORAGE TANK DESIGN
- ENGINEERING DESIGN & ANALYSIS
- MECHANICAL, CIVIL, STRUCTURAL & PIPING DESIGN
- OWNER’S ENGINEER
- SITE SUPERVISION
- COMMISSIONING / DECOMMISSIONING ACTIVITIES
- CONSULTANCY / TROUBLE SHOOTING
- TERMINAL & TANK INSPECTIONS
- TECHNICAL SUPPORT & ADVICE FOR MAINTENANCE, REFURBISHMENTS & REVAMPS

RLG TANK DESIGN - DISCIPLINES

GEOTECHNICAL DESIGN







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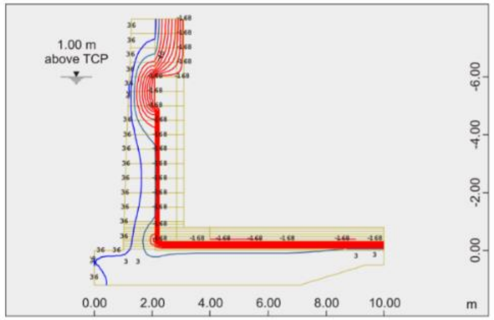
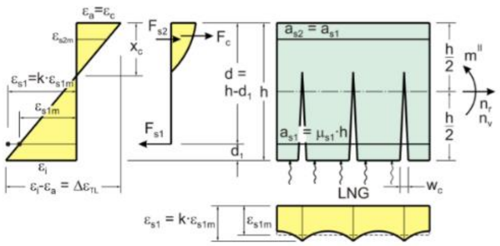
CIVIL DESIGN OUTER TANK

RLG TANK DESIGN - DISCIPLINES

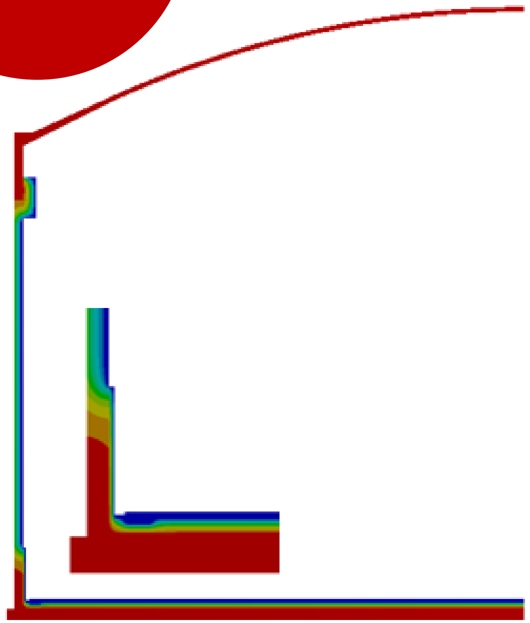
Liquid Spill Scenario
(low liquid level)



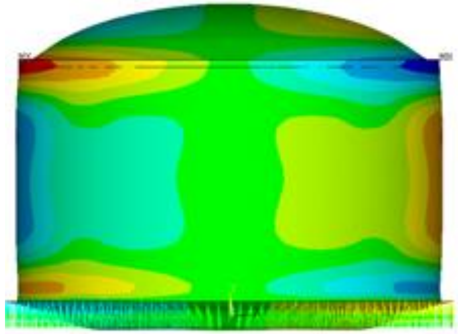
Sectional Strains/Forces



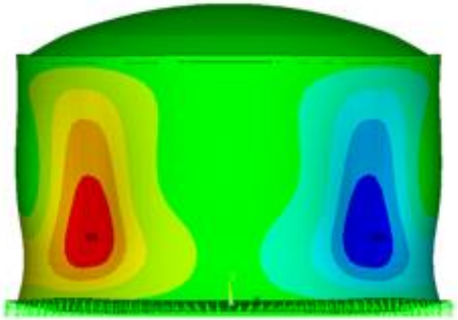
- Liquid tightness - Maintaining compression zone.
- Finite Element Analysis – Symmetric & Non Symmetric Loads



- Thermal Analysis – Inner Tank Leak (Spill)



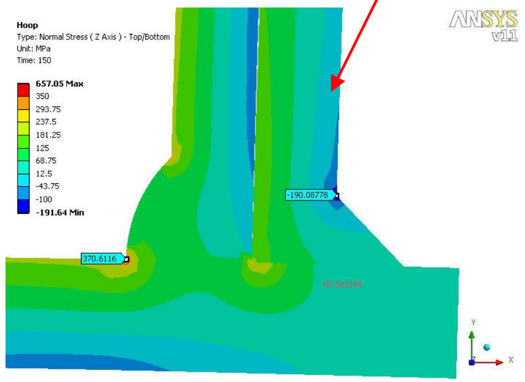
Deformation in horizontal direction due to internal pressure

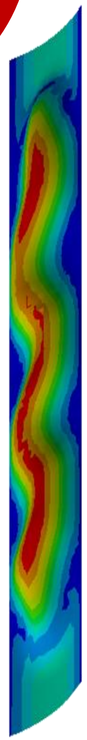


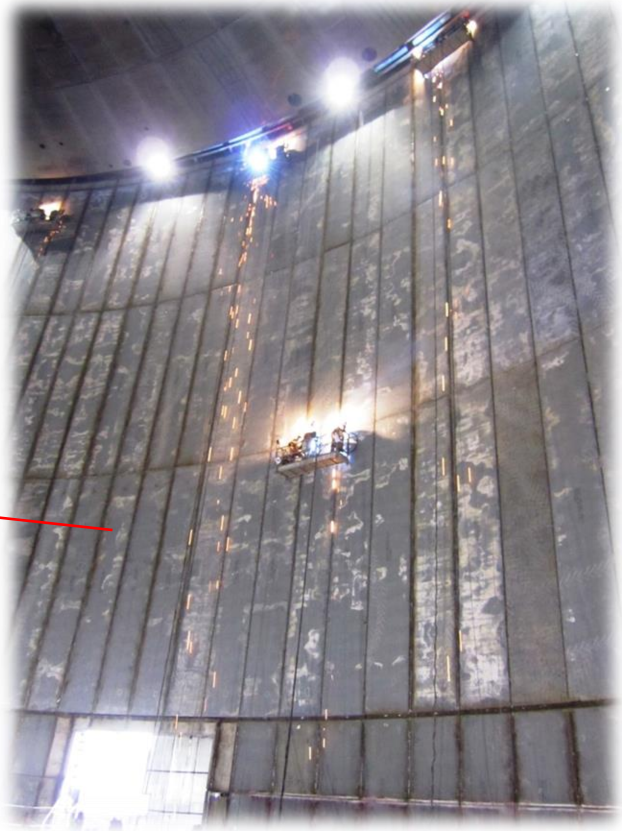
Deformation due to post-tensioning tendons on wall

RLG TANK DESIGN - DISCIPLINES

MECHANICAL
INNER TANK







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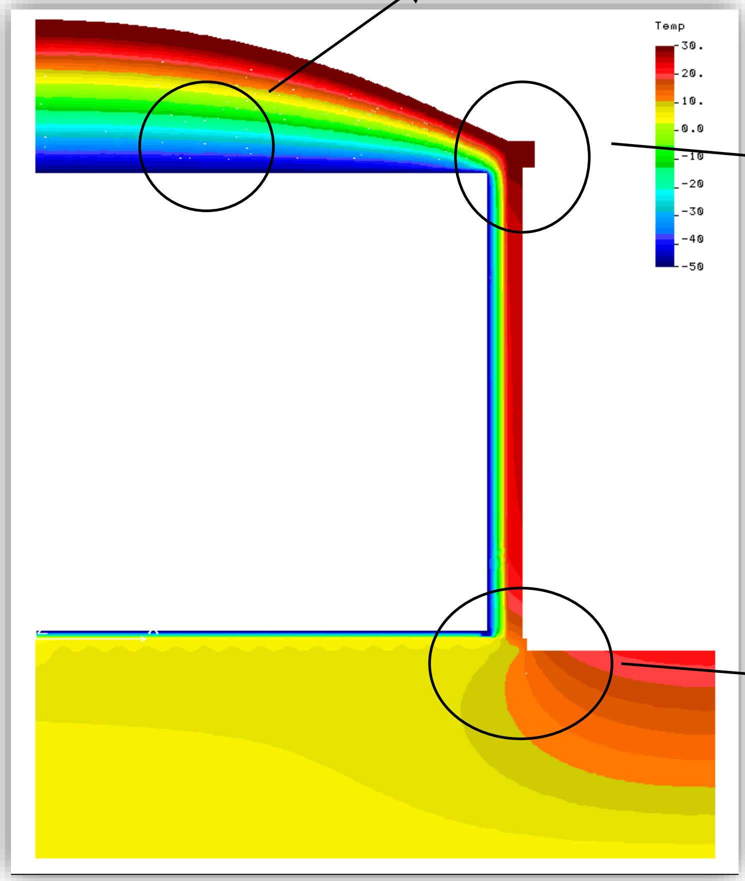
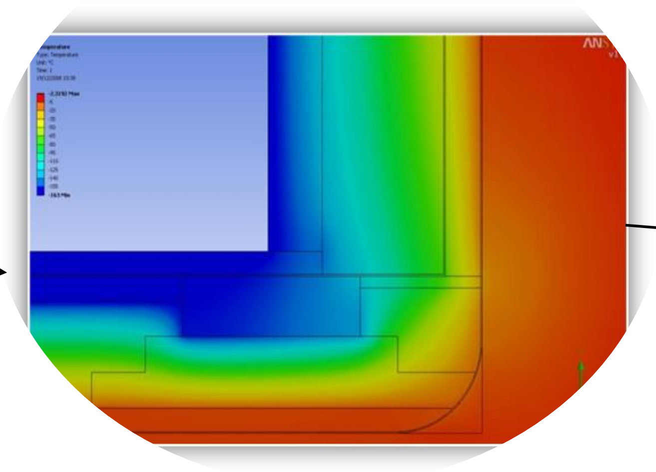
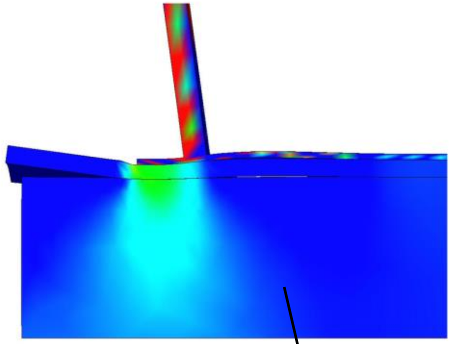
RLG TANK DESIGN - DISCIPLINES

MECHANICAL INSULATION







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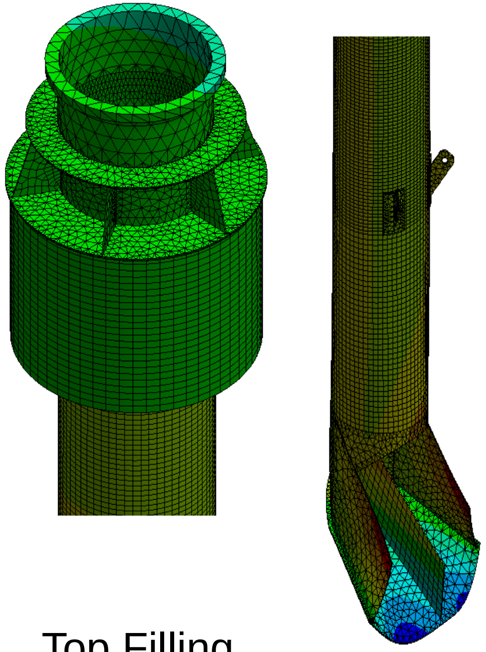
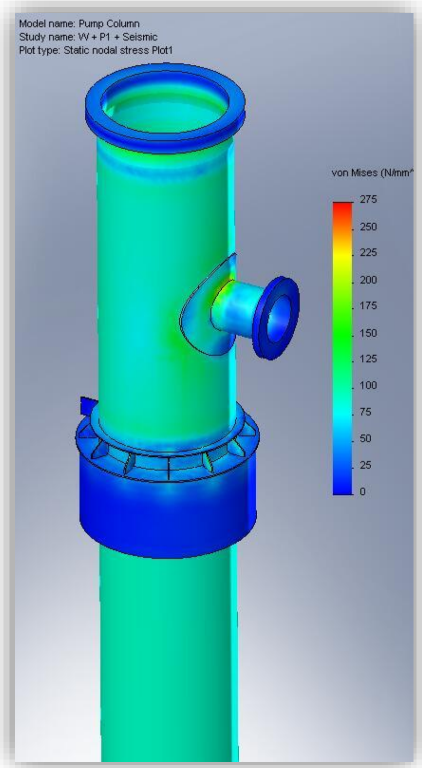
MECHANICAL NOZZLES

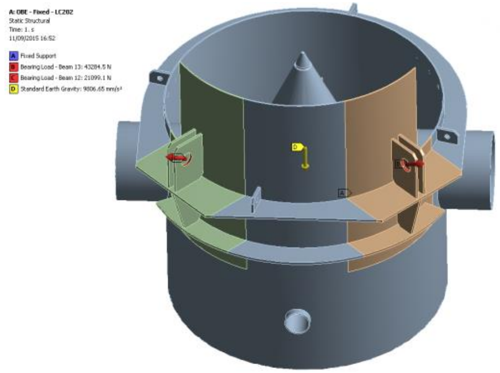
RLG TANK DESIGN - DISCIPLINES



Top Filling



Pump Column



Bottom Filling

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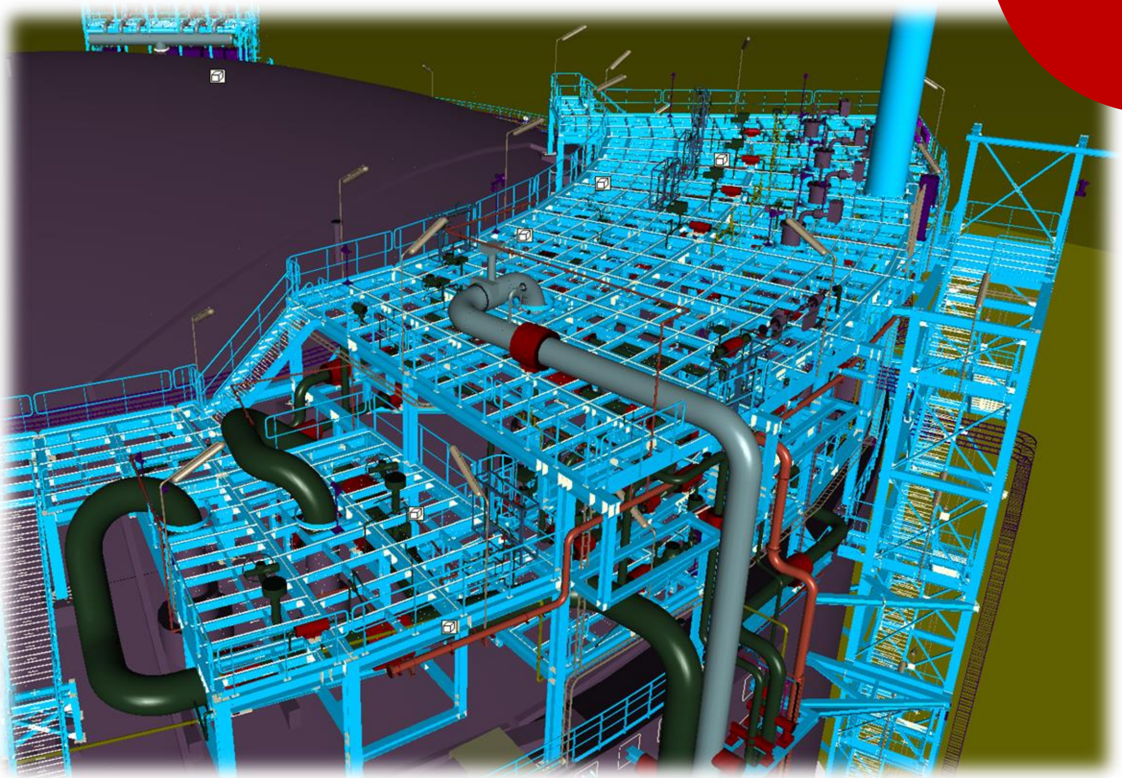
PIPING & STRUCTURAL DESIGN

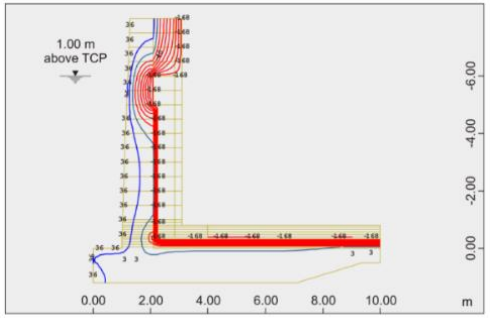
RLG TANK DESIGN - DISCIPLINES

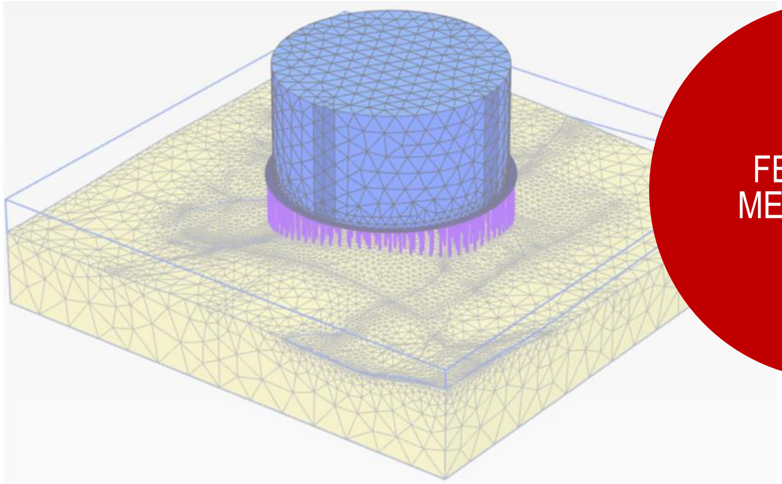


RLG TANK DESIGN - DISCIPLINES

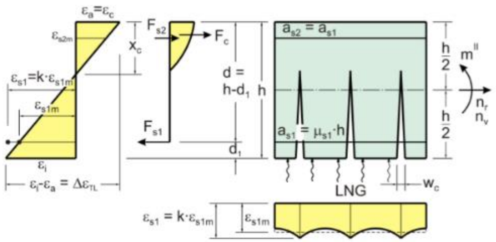
FEA CIVIL & MECHANICAL

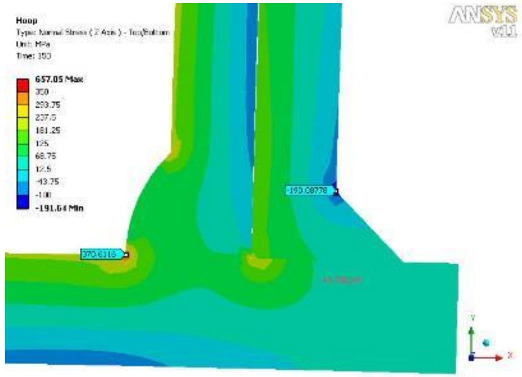
Liquid Spill Scenario
(low liquid level)

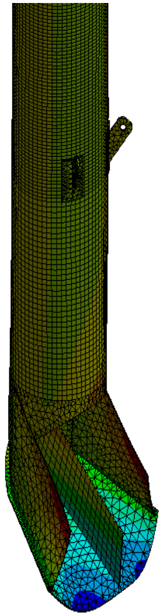


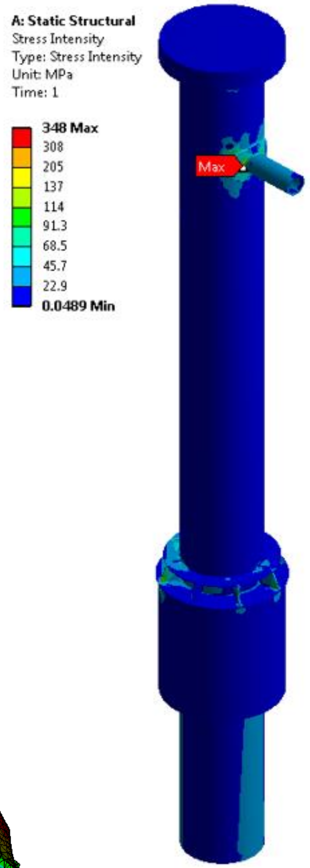


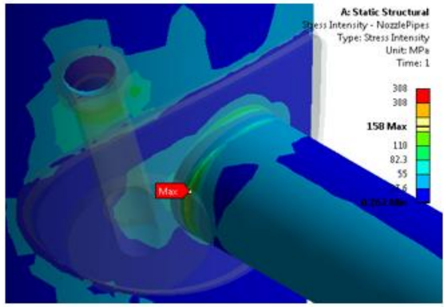
Sectional Strains/Forces

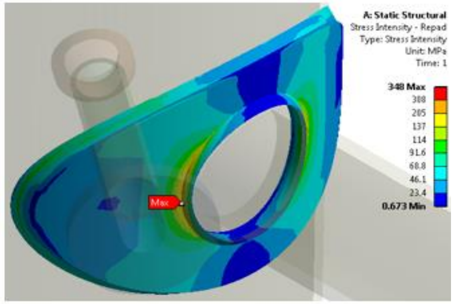


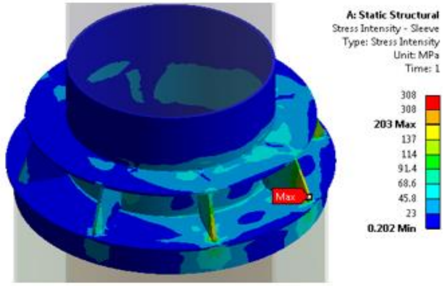












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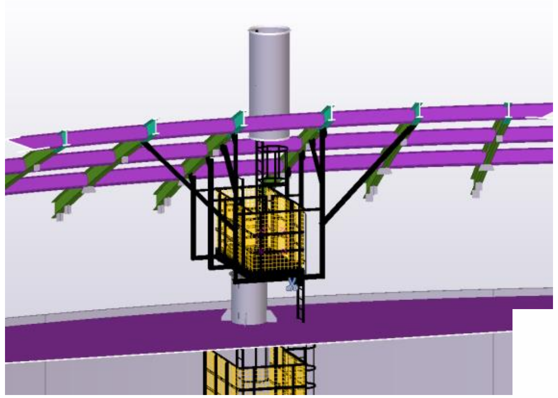
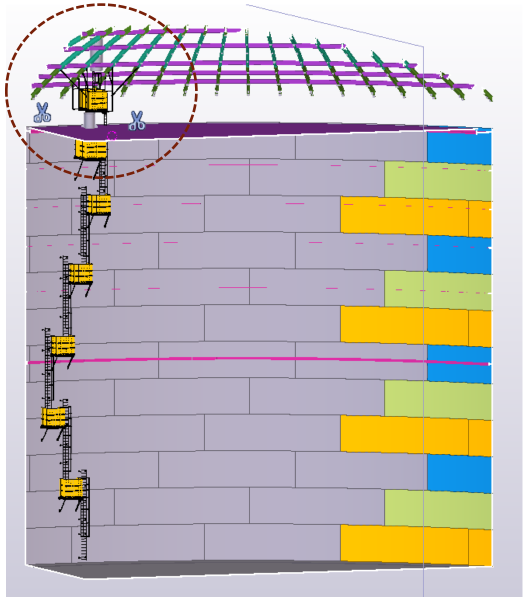
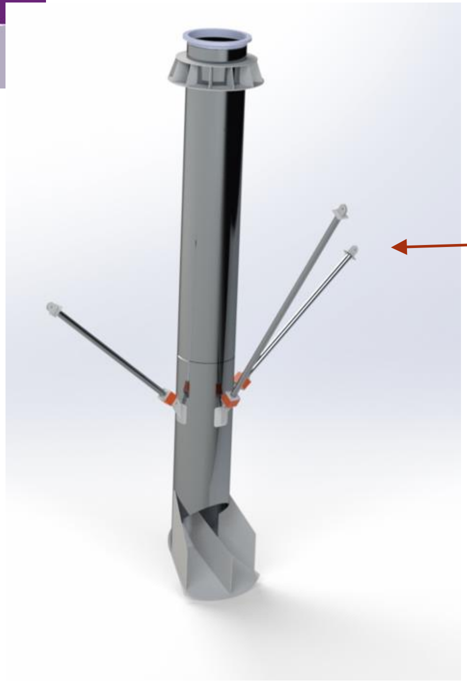
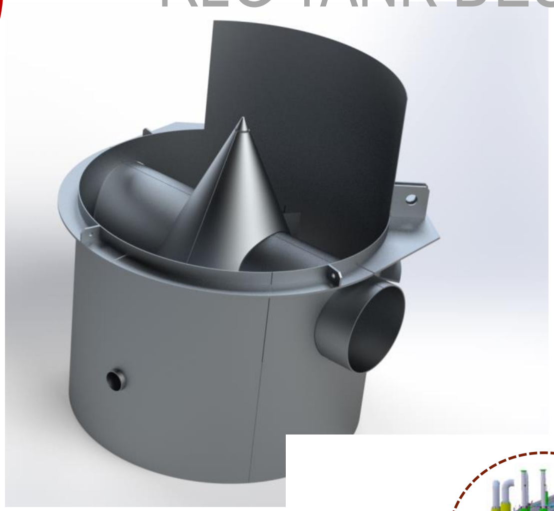
3D MODELLING

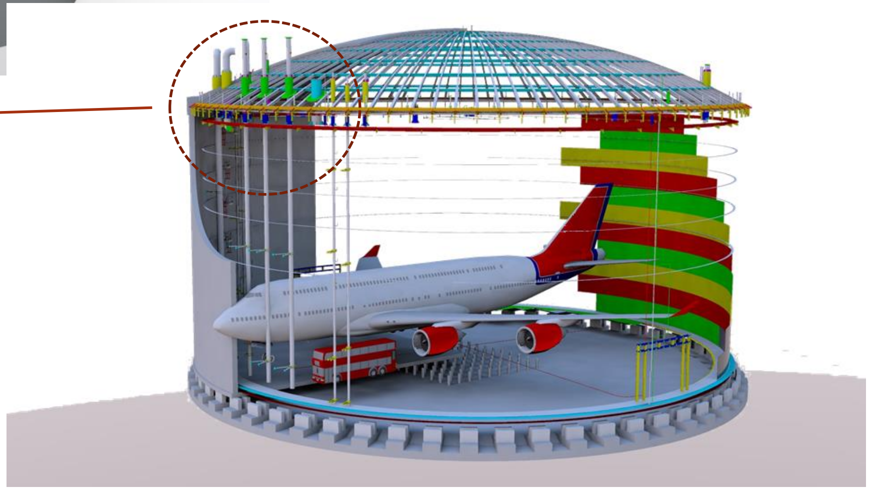
RLG TANK DESIGN - DISCIPLINES











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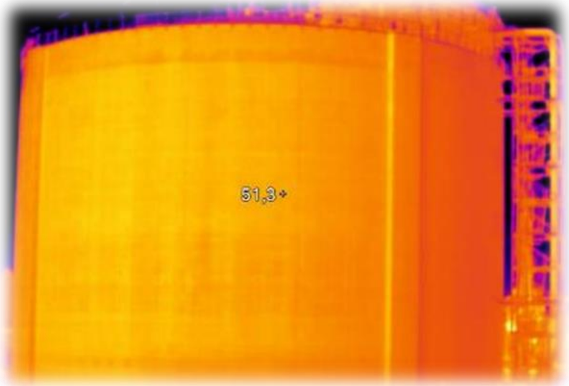
RLG TANK DESIGN - DISCIPLINES

SITE SUPPORT

INSPECTION
EEMUA 159



CONSTRUCTION

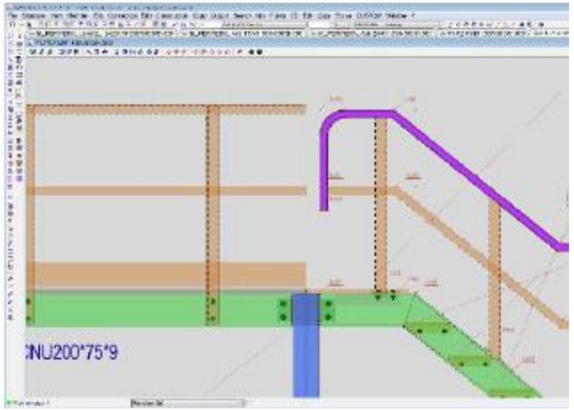
TROUBLE SHOOTING

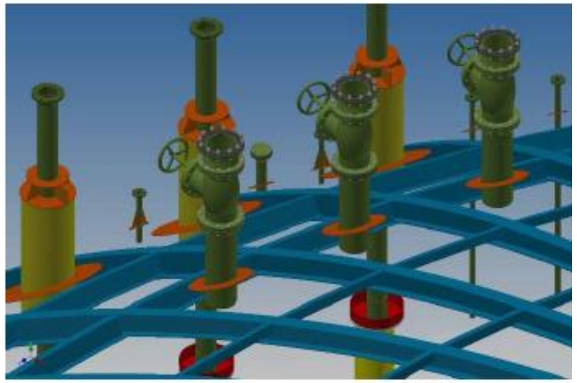
Technodyne International Ltd

RLG TANK DESIGN - TOOLS

OUR DESIGN TOOLS

- Piping – Caesar II, PDMS
- Civil Design – ANSYS, Lpile, Plaxis, SOFISTIK, Excel
- Mechanical Detailing – Autocad Microstation, Solidworks
- Civil Detailing – CADS RC, Autocad
- Structural Detailing – Tekla, BoCad
- Mechanical / Structural Design ANSYS, STAAD, Excel





Rigid impulsive pressure is obtained from

$$Pi = Ci.\rho.H.Cos(\theta).Ag$$ EN1998, A.1

$$Ci = 2\sum_{0}^{\infty}\frac{(-1)^n}{I_1'.(v_n/\gamma)v_n^2}.Cos(v_n\zeta)I_1(\frac{v_n}{\gamma}\xi)$$ EN1998, A.2

$$v_n = \frac{2n+1}{2}.\pi \qquad \gamma = H/R$$

Ring No	ζ	Ci	Pi (MPa) OBE	Pi (MPa) SSE
1	0.0176	0.7943	0.0211	0.0341
2	0.1931	0.7857	0.0209	0.0338
3	0.3686	0.7253	0.0193	0.0312
4	0.5440	0.6242	0.0166	0.0268
5	0.7195	0.4949	0.0131	0.0213
6	0.8950	0.2300	0.0061	0.0099
7	0.8950	0.2300	0.0061	0.0099
8	0.8950	0.0000	0.0000	0.0000

Impulsive base shear

Impulsive base shear $Q_i(t) = m_i A_g(t)$ mi Impulsive mass EN1998, A.3

$$m_i = m2\gamma\sum_{n=0}^{\alpha}\frac{I_1\left(\frac{v_n}{\gamma}\right)}{v_n^3 I_1'\left(\frac{v_n}{\gamma}\right)}$$ EN1998, A.4

Total contained mass of the fluid, $\rho\pi R^2 H$ = 15375256 kg

Q_i OBE = 18655 kN

Qi SSE = 30181 kN

Impulsive base moment (immediately below the tank bottom)

$$M_i'(t) = m_i h_i' A_g(t)$$ EN1998, A.5a

Fundamental Principles of Engineering Plus
An Excellent Team of Engineers and Technicians

Technodyne International Ltd

OPERATIONS - Clients

ATKINS
PARESA SpA
TGE Gas Engineering
nationalgrid
CNOOC
SINOPEC 中国石化
QChem
INDIANOIL PETRONAS
ROTARY
ROTARY ENGINEERING LIMITED
Sofregaz
dh CHEMICALS
TISSOT S.A.
Punj Lloyd
SEI 中国石化工程建设有限公司
SINOPEC ENGINEERING INCORPORATION
Tecnimont
WorleyParsons
resources & energy
WEIR
LGE PROCESS
ETIMAAD
Agip
Vopak
Enel
ENGRO
INEOS
SANMAR
DOW
REN
CHEMTEX
VTV
VIJAY TANKS & VESSELS LIMITED
BECHTEL
SAMSUNG
SAMSUNG ENGINEERING
IOOC

Technodyne International Ltd

SUMMARY

YOUR TRUSTED PARTNER

1. **Focus**
   Our teams focus on delivering on-time successful projects

2. **Reliability**
   Our products have a proven history in operation

3. **Speed**
   Flexible & fast to meet customers needs

4. **Experience**
   Over 20 years as an industry leader across different products & tank types

5. **Service**
   Highly responsive to customers requests