BASED ON EXPERIENCE

TGE GAS ENGINEERING
COMPANY PRESENTATION
TGE GAS ENGINEERING

**ORGANISATION**
- Company Profile
- History / Milestones
- Group structure
- Locations

**PRODUCT LINES AND SELECTED REFERENCES**
- Storages and Terminals for LNG
- Storages and Terminals for Petrochemical/Chemical Gases
- Small-Mid Scale Natural Gas Liquefaction Plants
- Others:
  - Package Plants for gas treatment or elements of storage production lines
  - LNG as Fuel
  - Storage Tank Design Services

**OPERATIONS**
- Product Lines
- Scope of Services
- Capacities
- Certificates
TGE Gas Engineering GmbH (TGE) is one of the world's leading contractors for projects involving the storage and handling of liquefied gases in the energy and petrochemical/chemical industries.

TGE has over 30 years of experience in this field, providing full range of services from concept/feasibility studies through to Lump Sum Turn-Key Project execution. All of which as the main partner of our customer.

Our target is to provide to customers the added value coming from our experience and Know-How in delivering "millions of m³" of Liquefied Gas Storages and Handling Facilities.

TGE is a technology focused company that is active worldwide with main operating units throughout Europe and Asia.
Since being founded in 1980 as a small, privately owned company in Bonn, Germany, TGE has considerably expanded its range of expertise alongside the changing project demands and challenges to become a major partner in the natural gas and petrochemical markets.

Today we are integrated in the CIMC Group and act worldwide as a contractor for international projects.
IMPORTANT BUSINESS MILESTONES

- **1980-1990**: Introduction of ECT technology to Taiwan and contract for design of 60 ECT storages.
- **1995**: Contract for first cryogenic LPG storage in P.R. China.
- **1996**: First ETC supply contract (6 tanks) received for Taiwan.
- **1998**: Contract for 3 × 80,000 m³ LPG storage received (world's largest LPG storage).
- **2003**: Contract for 2 × 80,000 m³ Ethylene storage received (world's largest Ethylene storage).
- **2007**: Completion of Propylene and Ethylene supply chain project (export terminal – gas carrier – import terminal).
- **2009**: TGE vaporizer system development for on- and offshore applications.
- **2011**: Acquisition of tank design company Technodyne, UK.

- **1980**
- **1985**
- **1990**
- **1995**
- **2000**
- **2005**
- **2010**
- **2015**

- **1992**: Integration of gas processing and package plant business.
- **2000**: Entrance to LNG receiving terminal business.
- **2001**: Entrance to mid-scale LNG liquefaction business.
- **2002**: Entrance to LNG export terminal business.
- **2003**: LNG import terminal with world's smallest plot area.
- **2009**: Signing of Sines LNG terminal extension and LNG storage contract in China.

COMPANY STRUCTURE

GASFIN Investment SA, Luxembourg
40 %

CIMC Group, Shenzhen/P.R.China
60 %

CIMC TGE Gas Investment SA, Luxembourg

TGE Gas Engineering GmbH, Bonn/Germany

Operation Unit Europe, Bonn/Germany

Operation Unit Technodyne, Eastleigh/UK

Operation Unit China, Shanghai/P.R.China

Branch Offices in Manchester/UK, Brussels/Belgium, New Delhi/India, Taipei/Taiwan

Project Offices in Portugal, Norway, Scotland, Sweden, Russia
CIMC – China International Marine Containers (Group)

- Founded 1980 in Shenzhen.
- Over 100 subsidiaries.
- More than 60,000 employees worldwide.
- Biggest container-manufacturing company in the world since 1996.

CIMC Enric

- Storage, transportation and dispensing products for cryogenic liquids and compressed gases.
- Process equipment's such as vaporisers, compressors, vessels, columns, reactors.
- Semi-trailer, truck-bodies and road tankers, process and storage tanks.

Gasfin

- Gasfin SA, Luxembourg is active in pursuing ‘natural gas to LNG to markets’ business activities and specialised in preparation, arranging and implementation of energy supply projects with focus to bring synergies between natural resources owners, operators and end-users.
- Offices in Strassen, Luxembourg and in Bonn/Germany.
PRODUCT LINES

Storages and Terminals for LNG

Storage and Terminals for Petrochemical/Chemical Gas

Small-Mid Scale Natural Gas Liquefaction Plants

Other

- Package Plants for gas treatment or elements of storage product lines
- LNG as Fuel
- Storage Tank Design Services
FACTS & FIGURES

STORAGES AND TERMINALS FOR LNG

- 17 Projects in Total (EPC & EP+CS)
- Import Terminals: 9
- Export Terminals: 7
- Import/Export Terminal: 1
- 72 LNG Truck/Container Loading Stations
- Total Regasification Capacity > 13 mio t/a
- Total Production Capacity
  Small-Mid Scale LNG > 3 mio t/a

Reference for all relevant International Design Codes:
Tanks: EN 14620 and API 625, API 620, ACI 376.
Facilities: NFPA 59a, EN 1473, etc.

<table>
<thead>
<tr>
<th>STORAGE TANKS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Tanks installed</td>
<td>30,000 - 160,000 m³</td>
</tr>
<tr>
<td>Storage Tanks designed</td>
<td>5,000 - 260,000 m³</td>
</tr>
<tr>
<td>Storage Tanks installed in Europe</td>
<td>940,000 m³</td>
</tr>
<tr>
<td>Storage Tanks installed in Asia</td>
<td>2,068,000 m³</td>
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</table>

<table>
<thead>
<tr>
<th>INSTALLED CAPACITY</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>21 Full Containment Tanks</td>
<td>2,838,000 m³</td>
</tr>
<tr>
<td>5 Single Containment Tanks</td>
<td>170,000 m³</td>
</tr>
<tr>
<td>TOTAL INSTALLED CAPACITY</td>
<td>3,008,000 m³</td>
</tr>
</tbody>
</table>
SELECTED REFERENCES

STORAGES AND TERMINALS FOR LNG

LNG Storage Tanks for CNOCC Zhejiang Ningbo LNG

- Storage: 3 x 160,000 m³
- Design code: EN 14620
- Scope: EPC
- Location: Beilun, P.R.China
- Owner: CNOOC Zhejiang Ningbo LNG
- Completion: 2012
LNG Receiving Terminal in Sines, Portugal
1st Project for Transgas Atlantico (REN)

- Capacity: 3,9 mtpa LNG (nominal), 5,2 mtpa LNG (peak)
- Storage: 2 x 120,000 m³
- Scope: EPC
- Design code: BS 7777 and EN 1473
- Completion: 2003

2nd Project for REN – Terminal Expansion

- Capacity: 5,8 mtpa LNG (nominal), 7,8 mtpa LNG (peak)
- Storage: 1 x 150,000 m³
- Scope: EPC
- Design code: EN 14620 and EN 1473
- Completion: 2012
PRODUCT LINE

STORAGES AND TERMINALS FOR PETROCHEMICAL/CHEMICAL GASES

- Cryogenic storage for import, export buffer or distribution of LPG, Ethane, Ethylene, Propane, Propylene, Butane, Butadiene, Ammonia and other liquefied gases maintaining energy efficient overall process design with regards to energy integration.

- Earth covered tanks (ECT) for pressurised liquefied gases.

- Horizontals bullet tanks and spheres for pressurised or semi-pressurised storage of liquefied gases.

- References for all cryogenic containment types: Single – Double – Full containment.
FACTS & FIGURES

PETROCHEMICAL GAS STORAGES AND TERMINALS

- Tanks installed capacities 3,000 – 120,000 m³

### LARGEST INSTALLED CAPACITY

<table>
<thead>
<tr>
<th></th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG</td>
<td>120,000 m³ Full Containment</td>
</tr>
<tr>
<td>Ethylene</td>
<td>80,000 m³ Full Containment</td>
</tr>
<tr>
<td>Ethane</td>
<td>120,000 m³ Full Containment</td>
</tr>
<tr>
<td>Propylene</td>
<td>80,000 m³ Full Containment</td>
</tr>
<tr>
<td>Ammonia</td>
<td>30,000 m³ Double Containment</td>
</tr>
</tbody>
</table>

### INSTALLED CAPACITY

<table>
<thead>
<tr>
<th>Description</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 Full Containment Tanks with installed Capacity</td>
<td>1,205,000 m³</td>
</tr>
<tr>
<td>22 Single Containment Tanks with installed Capacity</td>
<td>560,000 m³</td>
</tr>
<tr>
<td>TOTAL INSTALLED CAPACITY</td>
<td>1,765,000 m³</td>
</tr>
</tbody>
</table>
SELECTED REFERENCES

STORAGES AND TERMINALS FOR PETROCHEMICAL/CHEMICAL GASES

Propane Terminal, Ningbo for Ningbo Hai Yue New Material Co. Ltd.
- Storage: 120,000 m³
- Design code: EN 14620
- Scope: EP + CS
- Location: Ningbo, China
- Owner: Ningbo Hai Yue New Material
- Completion: 2014

Biggest LPG Full Containment Tank in the world
STORAGES AND TERMINALS FOR PETROCHEMICAL/CHEMICAL GASES

Ethylene/Propylene Terminal for Formosa Petrochemical, Taiwan

- **Storage:** Propylene: 1 x 80,000 m³, Ethylene: 2 x 80,000 m³
- **Design code:** API 620 App. R/Q
- **Scope:** EPC
- **Location:** Mailiao, Taiwan
- **Owner:** Formosa Petrochemical Corporation
- **Completion:** 2007

Biggest Ethylene Storage in the world
**DIFFERENT STORAGE SYSTEM**

**PETROCHEMICAL/CHEMICAL GASES STORAGE**

- **Athmospheric (cryogenic refrigerated) storage condition**
- **Pressurised storage condition (at ambient temperature)**

**Special kind of storages:**
- **SEMI-Refrigerated Storages:** Spherical tanks or horizontal bullet tanks at condition between fully refrigerated and full pressurised.
- **ECT (Earth covered storages):** Horizontal bullets covered by earth mound.

Flats bottom tanks, Spherical tanks, Horizontal bullets, Vertical bullets tanks, ECT (Earth covered storage)
FACTS & FIGURES

EARTH COVERED TANKS (ECT)

- Horizontal pressure vessels covered by earth mound
- Installed 400 m³ - 3,500 m³
- Transfer by either in-tank or external pump system
- Designed and manufactured to pressure-vessel codes (ASME VIII Div. 2, EN 13445, GB150, PD 5500)
- 96 Earth Covered Tanks with installed Capacity 246,000 m³ for LPG, Propylene, Butadiene, VCM, Butene, Butane, Propane, C4-LPG, C5, Raff and Light Naptha.
- 96 ECT with over 14.7 mio. operational hours.
Butadiene/Propylene ECT earth cover storage, Import Terminal for AGT, Belgium

- Storage: Propylene: 4 x 3,000 m³, Butadiene: 2 x 3,000 m³
- Scope: EPC
- Location: Kallo, Belgium
- Completion: 2005

DME – ECT earth covered storage for UK Wesseling, Germany (today Shell Rheinland)

- Storage: DME: 6 x 400 m³
- Scope: E
- Completion: 1988
PRODUCT LINE

SMALL-MID SCALE NATURAL GAS LIQUEFATION PLANTS

- Small-to-medium scale LNG production plants and LNG supply chain solutions from well head to consumer.
- Capacity range up to 500,000 tons of LNG per year.
- Gas treatment – filtering, compression (if required), purification, Removal of CO₂, Sulfur and trace impurities (mercury), Gas dehydration.
- Modular arrangement – skid mounted with high degree of prefabrication and pre-assembly.
SELECTED REFERENCES

LNG LIQUEFACTION PLANT FOR XINJIANG GUANGHUI, P. R. CHINA

- Capacity: 1.5 Mill. Nm³/d (1,100 tpd, 0.4 mtpa)
- Storage: 1 x 30,000 m³
- Process: Gas treatment, Liquefaction (Linde), Storage and Loading, Trucks for distribution
- Scope: EP + CS
- Location: Shan-Shan, Xinjiang, P.R.China
- Owner: Industry and Commerce Group Co. Ltd., Xinjiang Guanghui Co.
- Completion: 2003

TGE Entrance into Liquefaction Business First Plant in P.R.China.
PRODUCT LINE

OTHERS – GAS PROCESSING/ PACKAGE PLANTS

- Gas and oil separation, degassing, hydrocarbon and dew point control, condensate recovery and stabilization plants.
- Gas dehydration plants using glycol absorption, solid bed adsorption, refrigeration, turbo expanders, heat pumps and vortex technology.
- Gas treatment plants for sour gas removal using amine absorption and solid bed adsorption.
- Recovery and fractionation plants for hydrocarbons (LPG/NGL) and condensates.
- Nitrogen rejection plants; Compression units; Thermal oxidizers with optional waste heat recovery.
- LNG re-condenser systems; Gas dehydration units for NG underground storages.
- Glycol regeneration units; Gas re-liquefaction units; Compressor units.
- Heat exchanger units – Vaporizer.
PRODUCT LINE

OTHERS

LNG as Fuel
- “Small to medium” scale LNG distribution - a system designed for “LNG as FUEL“

Big Size Tanks
- TGE has an Cooperation agreement and is license holder for Onshore GTT Membrane system.

Technodnye Ltd. – a 100% Group company of TGE
TANK DESIGN for projects of the TGE Group and selected customers.
- Established in 1995.
- Engineering design office with full ISO 9.000 Certification.
SCOPE OF SERVICES

- Consultancy
- Technical and Commercial Feasibility Studies
- Site Selection
- Conceptual Design
- Environmental Impact Assessment (EIA) and HAZOP Studies
- Capital Cost (CAPEX) and Operating Cost (OPEX) Estimation
- Business Plan for Capital Investments and Operations
- Basic Engineering and Front End Engineering Design (FEED)

- Detailed Engineering
- Procurement/Procurement Services
- Construction/Construction Services
- Supervision Services
- Pre-Commissioning and Commissioning Services
- Start-Up/Shutdown Services
- Selection and Training of Operators
- Operation and Maintenance Services
- Life-Cycle Engineering Studies and Plant Life-Cycle Optimisation

EPC  EP & CS  CONSULTANCY
PERSONNEL & TOOLS

TGE employs more than 415 engineers and specialists worldwide of more than 25 different nationalities working together with international standard tools for design and engineering, project management – project control and administration.
TGE has always viewed Quality, as well as Health, Safety and Environmental protection as key to our success. Our Integrated Management System (IMS) forms the backbone of our management tools that we use to maintain sustainable business practices worldwide.
THANK YOU FOR YOUR ATTENTION!
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