PROJECT INFO

INDUSTRY - OIL & GAS PROJECTS

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April 2001

FOAMGLAS®
CELLULAR GLASS INSULATION

CERTIFICATION ISO 9002

FOAMGLAS® cellular glass

THE PREFERRED INSULATION MATERIAL OF THE OIL, GAS AND PROCEEDING INDUSTRY

FOR NOW AND FOR THE FUTURE

General Information

PITTSBURGH CORNING EUROPE

- **The Company**
- **Production**
- **Fabrication: pipeshells, pipe-segments, tank-segments, etc.**

THE COMPANY

PITTSBURGH CORNING EUROPE SA. - a 50/50 joint venture between PPG Industries and Corning Incorporated - has specialised since 1965 in the manufacture and distribution of FOAMGLAS® cellular glass insulation in Europe, Africa and the Middle East. Sales, technical assistance and distribution of FOAMGLAS® are handled by a network of sales subsidiaries, distributors and agents providing full service to the engineer and architect.

PRODUCTION

To satisfy customer requirements, Pittsburgh Corning continuously dedicates substantial investment in R & D and high-tech production processes.
The plant in Tessenderlo (Belgium) with its modern production lines, manufactures a wide range of FOAMGLAS® products for industry and building, according to ISO 9002 quality standards.

Production runs 24 hrs/day, 365 days/year in 5 shifts.
FOAMGLAS® products are made from 100% pure glass, expanded 20 times at 1000°C. R & D has made it possible to incorporate high percentages (> 50%) of high quality recycled glass (post-consumer waste) into the production of FOAMGLAS® cellular glass insulation.
We have succeeded in using less raw material and at the same time reducing energy consumption. Pittsburgh Corning embraces environmental care as one of its main priorities, therefore the FOAMGLAS® products are reinforced by an ecological quality label.

PITTSBURGH CORNING EUROPE ONLY MANUFACTURES INSULATION PRODUCTS, THEREFORE IT CAN STAY FOCUSED AND CONCENTRATE ON PRODUCING THEM BETTER.

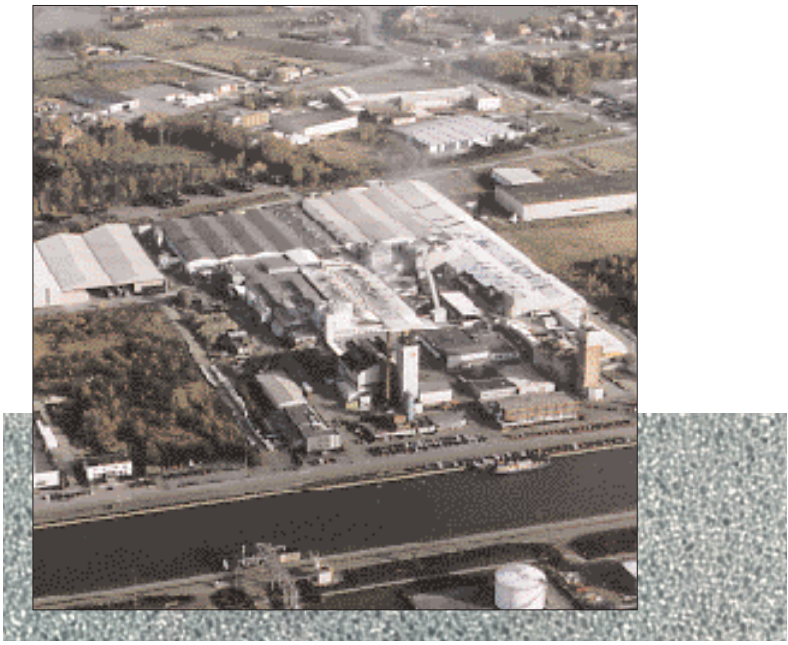
FABRICATION

The Pittsburgh Corning fab shop, in association with authorised contractors, is highly specialised in the cutting of pipeshells, pipe-segments, tank-segments etc. from FOAMGLAS® slabs.

Due to the great variety of fabrication shapes and short delivery times, frequent switching of machines is required to execute just-in-time delivery. Considerable manual manipulation and control stages are necessary, before reaching the stage of the finished product.

30 percent of all the FOAMGLAS® we produced is processed by the fabrication department. To ensure the best insulation product possible, Pittsburgh Corning technicians conduct stringent quality control tests throughout all stages of production. Moreover, external quality control is assured by the FIW, (Forschungsinstitut für Wärmeschutz) in Munich.

All accessory products for bonding, coating, anti-abrasive coating or mechanical fixing are approved by Pittsburgh Corning and aim to satisfy the highest technological standards. They have been developed and tested for their respective service temperature limits.

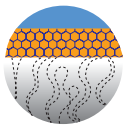


CHARACTERISTICS

Non-combustible

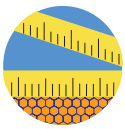
Resistant to acids and organic solvents

Waterproof



Impervious to water-vapour, μ value = ∞

High compressive strength



Dimensionally stable

Vermin- and rotproof

Easy to cut

Ecologically sound

FOAMGLAS® - for thermal efficiency and elimination of major technical and economic problems such as:

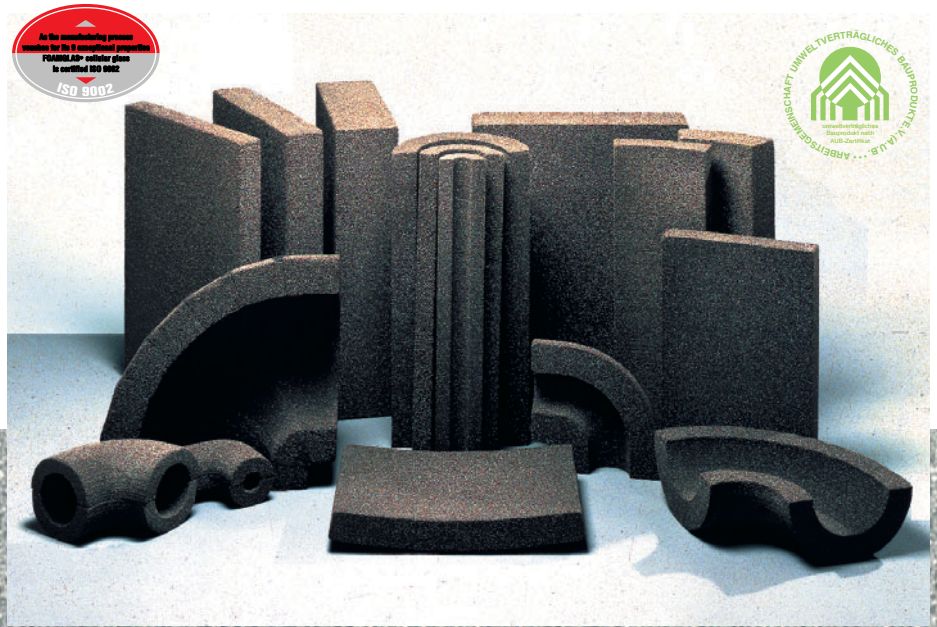
- ▼ **Increased operating costs**
- ▼ **Possible loss of process control**
- ▼ **Compromised personnel safety**
- ▼ **Mechanical damage**
- ▼ **Chemical corrosion.**

THE BENEFITS

FOAMGLAS® is classified as a non-combustible material (ISO 1182 and other tests) which is a highly competitive advantage in all risk applications.
The main criteria for fire safety are: the non-combustibility and the non absorptivity of a material. Cellular glass that is **non combustible and non absorbent** will offer the best fire protection to the insulated structure and insulants that are non-combustible but absorb combustible liquids or combustible gases will increase the combustibility of the system. FOAMGLAS® neither absorbs oils, other fluids or highly flammable hydrocarbons, as other insulants made of mineral fibres or plastic foams do.

Cellular glass can be used in the temperature range -260°C to + 430°C. The closed cell structure of FOAMGLAS® garantees that **no wick effect** will lead to spontaneous ignition. **No smoke or toxic gases** can to develop from FOAMGLAS® due to its chemical composition made from pure glass.
FOAMGLAS®, being **chemically resistant** and free from corrosive agents, protects pipes and equipment for the life-time. FOAMGLAS® resistant to salt water, acids, petrol and organic solvents.

Impervious to water and water vapour, this insulation material protects totally against corrosion, avoids ice formation and offers excellent thermal control in the long term. No vapour-barrier or gas-impermeable membrane is needed.



FOAMGLAS® insulation systems for hot and cold installations.

Fabrication types:

- **Shells for straight pipes**
  (Ø from 13.5 to 244.5 - 368 mm)
- **Segments for straight pipes**
  (Ø from 237-381 mm to 920 mm)
- **Elbows**
  (Ø from 21.3 mm to 920 mm)
- **Shells and segments for fittings**
  (Ø from 21.3 mm to 609.6 mm)
- **Vessel segments**
  (Ø from 900 mm to 8000 mm +)
- **Vessel head segments**
  (Ø from 750 mm to 5000 mm +)
- **Cone segments**
  (Ø from 450 mm to 20000 mm)

The laboratory controlled **high compressive strength** of FOAMGLAS®,ranging from 0.5 to 1.7 N/mm², can support permanent loads from tank bottoms etc., without cracking. Mechanical fixings using stainless steel straps do not compress this rigid insulation material to which metal cladding or jacketing can be easily fitted. Personnel walking on insulated pipework will not cause any damage to the insulation.

The perfect **dimensional stability** of cellular glass has proved to be advantageous under exposure to major temperature and/or moisture variations.

When pipes or reservoirs are installed underground or at ground level, it is most important, that the insulation is **both vermin- and rotproof**.

Certification

FOAMGLAS® insulation is certified to conform with the requirements of:

- Det Norske Veritas Type Approval Certificate.
- Lloyd's Register of Shipping.
- United States Coast Guard Certificate of Approval for Incombustible Materials.
- USSR Register of Shipping.
- Board of Steamship Inspection (Canada).

Classified non-combustible following:

- ISO 1182
- ASTM E 136
- IMO Resolution A 472
- BS 476 part 4
- DIN 4102 Teil 1
- NEN 6064
- Classified M0 - CECMI France
- NBN S 21-203

FOAMGLAS® cellular glass has also passed the following stress corrosion tests:

- Nuclear Regulatory Guide 1.36
- Military Specification MIL-I-24244B
- ASTM C 795 (new drip method ASTM C 692).

Tests and certificates

Pittsburgh Corning has performed and participated in several fire and explosion tests in order to identify insulation systems that not only protect the installation in case of fire and explosion, but also under normal operating conditions.

Test results and approvals - Extracts

HYDROCARBON FIRE TEST.

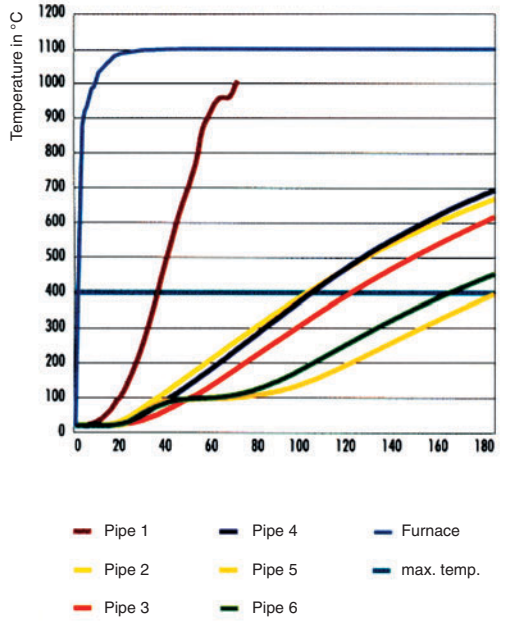
Report-n°. 250000.10\93.278

Test carried out at SINTEF, Norwegian Fire Research Laboratory, in accordance to Regulations concerning explosion and fire protection for installation in the petroleum sector, from the Norwegian Petroleum Directorate.

RESULTS

Insulation system	Average steel temperature at specified criteria
Pipe 1 50 mm FOAMGLAS® T4 0,5 mm SS 316 cladding	400 °C
	35 min
Pipe 4 50 mm FOAMGLAS® T4 38 mm Firemaster X-607 0,5 mm SS 316 cladding	400 °C
	102 min

FURNACE TEMPERATURE AND AVERAGE STEEL TEMPERATURE IN °C



JET FIRE TESTS.

Report-n°. 22N214.01

Test method/Standard:
Jet-Fire Resistance Test of Passive Fire Protection Materials OTI95634

Test performed at:
SINTEF, Norwegian Fire Research Laboratory

System 1:
Steel pipe, diameter 169 mm,
FOAMGLAS® T4 shells, thickness 39 mm,
INTERAME MAT 4, 10 mm
0.7 mm 316 stainless steel cladding

RESULTS

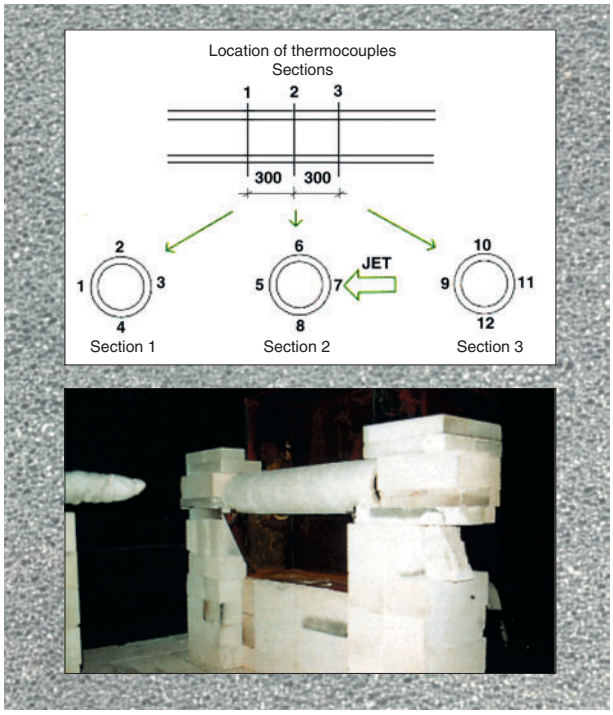
During the jet fire period:
The specimen was intact after the 60 minutes test. The average temperature rise of 20 thermocouples in the inner steel tubular was 429 °C. The time to reach 400 °C temperature rise was 56 minutes 30 seconds.

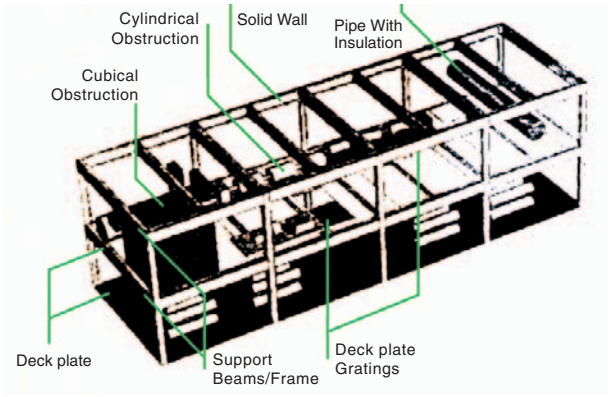
Report-n°. 22N2214.02

System 2:
Steel pipe, diameter 169 mm,
FOAMGLAS® T4 shells, thickness 39 mm,
blankets of Firemaster grade X 607, 25 mm thick
0.7 mm 316 stainless steel cladding

RESULTS

During the jet fire period:
The specimen was intact after the 60 minutes test. The average temperature rise of 20 thermocouples in the inner steel tubular was 404 °C. The time to reach 400 °C temperature rise was 59 minutes 20 seconds.





EXPLOSION TESTS.

Report-n°. CMR-93-F25044.

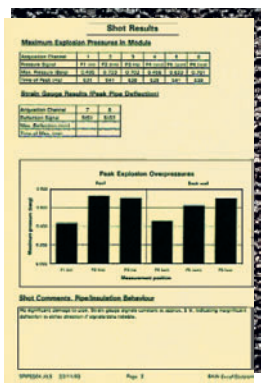
The tests were performed at CMR, (Christian Michelsen Research) Laboratory in Bergen, Norway, in a compression test module that is a copy of the M24 compressor module at Gullfaks A in 1:5 scale. The module is 8 m long, 2.5 m high and 2.5 m wide, thus having a volume of 50 m^3.

RESULTS

Test 1
Before the explosion tests using insulated pipes, a final test was conducted. It was suggested that the test was performed test with a mixture of 8.0% methane in air. The average measured pressure was 870 mbar. In the next test with insulated pipes it was decided to reduce the fuel concentration to 7.5% in order to lower the explosion pressure to 500-600 mbar.

Test 2
30 mm FOAMGLAS® T4
38 mm Firemaster X-607
0.5 mm SS 316 cladding
The average value of all six pressures was 500 mbar.
After the explosion, there was no visible damage to the pipe insulation.
The SS cladding and the Firemaster were stripped off for inspection of the FOAMGLAS®.
There were no cracks or other damage.

Test 3
50 mm FOAMGLAS® T4
0.5 mm SS 316 cladding
The average value of all six pressures was 610 mbar.
After the explosion, the pipe insulation was carefully inspected and there was no damage to the pipe insulation.


Example of shot for test 3

COMMENT
Maximum explosion overpressures exceeding the specified 500-600 mbar were obtained in all tests. Visual observations after the test showed no damage to the pipe insulation from the explosion.

New general specification for all classes covering piping, vessels and equipment

FOAMGLAS® cellular glass insulation has been used worldwide for more than 40 years and has more than proven its capability in demanding industrial applications.

FOAMGLAS® has mainly been used in cold processing insulation applications due to its exceptional characteristics relative to its resistance to water and water vapour, its low thermal expansion coefficient and its high dimensional stability.

CORROSION UNDER INSULATION:
A major problem experienced in the gas and oil industry.

In the past, high and medium temperature installations in refineries, petrochemical plants and, more especially, oil and gas platforms and onshore terminals were insulated with mineral wools and plastic foams such as PIR, PU and phenolic foams.

There have been a number of cases, both onshore and offshore, where corrosion, (even stress corrosion of stainless steel) under these types of insulation has been the major cause of operating failures.
Absorption of flammable liquids in these materials has also caused major fire disasters within the industry.

In order to find answers and solutions for these problems, Pittsburgh Corning, together with the oil and engineering companies, has developed new specifications and tested FOAMGLAS® insulation systems to meet the requirements of a new general specification for all classes covering piping, vessels and equipment insulation.

**Kårstø,
Sleipner condensate
(light oil)**

Troll Gas treatment plant at Kollsnes.

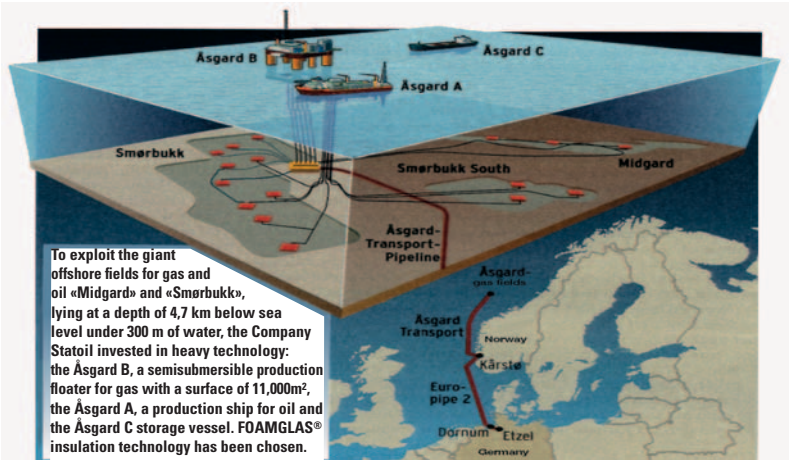
SPECIFICATION FOR PIPING, VESSELS AND EQUIPMENT

KEY DATA FOR INSULATION SYSTEMS, NORSOK INSULATION CLASSES

Insulation Class and Service	Insulation Materials	Cladding Materials	Notes
Class 1, Heat Conservation	● Cellular glass	● 316 stainless steel	Alternatively: ● Non-metallic weather-proofing membrane
Class 2, Cold Medium Conservation	● Cellular glass	● 316 stainless steel	Alternatively: ● Non-metallic weather-proofing membrane
Class 3, Personnel Protection	1) Perforated stainless steel sheet guards, or 2) As for appropriate insulation class	2) As for appropriate insulation class	1) Preferred option 2) Only when required for other purposes
Class 4, Frost Proofing	● Cellular glass	● 316 stainless steel	Alternatively: ● Non-metallic weather-proofing membrane
Class 5, Fire Proofing	● Cellular glass plus ceramic fibre blanket when necessary 3)	● 316 stainless steel + vapour barrier when fibre is used	3) For different heat loads see section 11
Class 6, Acoustic Insulation 10 dB	● Cellular glass plus ceramic or mineral wool fibre blanket	● 316 stainless steel + vapour barrier when fibre is used	Alternatively: ● Non-metallic weather-proofing membrane
Class 7, Acoustic Insulation 20 dB	● Cellular glass plus ceramic or mineral wool fibre blanket	● 316 stainless steel + vapour barrier when fibre is used	Alternatively: ● Non-metallic weather-proofing membrane
Class 8, Acoustic Insulation 30 dB	● Cellular glass plus ceramic or mineral wool fibre blanket ● Acoustic insulant plus ceramic or mineral wool fibre blanket	● 316 stainless steel + vapour barrier when fibre is used	Alternatively: ● Non-metallic weather-proofing membrane
Class 9, External Condensation and Ice Protection	● Cellular glass	● 316 stainless steel	Alternatively: ● Non-metallic weather-proofing membrane
General / Flat Large Surfaces on Tanks	● Cellular glass	● 316 stainless steel	Alternatively: ● Non-metallic weather-proofing membrane

Troll gas treatment plant at Kollsnes.
The Troll field contains 60% of Norwegian gas reserves. The Troll Gas development comprises the Troll A platform, the gas treatment plant at Kollsnes near Bergen, and pipelines linking these two installations. FOAMGLAS® insulation has been selected and specified for pipes, vessels and equipment.

Offshore field developments
Åsgard A and Åsgard B



To exploit the giant offshore fields for gas and oil «Midgard» and «Smørbukk», lying at a depth of 4,7 km below sea level under 300 m of water, the Company Statoil invested in heavy technology: the Åsgard B, a semisubmersible production floater for gas with a surface of 11,000m², the Åsgard A, a production ship for oil and the Åsgard C storage vessel. FOAMGLAS® insulation technology has been chosen.

The Åsgard Project ranks as one of Norway's and Europe's giant offshore field developments.
It is being developed with the **Åsgard A**, FPSO (Floating Production Storage and Offloading Vessel), a production ship for oil, **Åsgard B**, a semisubmersible production floater for gas and the **Åsgard C** storage vessel.

The subsea production installation in the field will be the most extensive in the world. The field lies on the Halten Bank in the Norwegian Sea, about 200 kilometers from central Norway.

The field is being developed in a chain of four interconnected projects :
- Development of Åsgard itself
- Construction of the Åsgard transport gas trunkline from the field to the Kårstø gas treatment plant.
- Kårstø KUP development project
- Europipe II gas trunkline from Kårstø to Emden in Germany.

The Åsgard A oil production ship arrived at the field in February 1999, and oil production began in May 1999. Gas production started from Åsgard B in the second half of 2000.
Growing demand for Norwegian gas from continental Europe has made this huge project possible, and Åsgard will help to meet the planned expansion in Norway's gas exports.
Gas from the field is to be piped through the Åsgard transport line to the treatment plant at Kårstø and onto European customers. Oil production from Åsgard A will be shipped from the field by shuttle tankers.

Kårstø Gas Treatment Plant

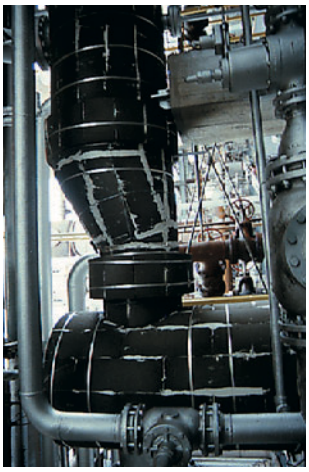
The Kårstø Gas Treatment Plant operated by Statoil at Kårstø, north of Stavanger, was established to handle rich gas being sent through the Statpipe trunkline.
After treatment, the gas is piped on to continental Europe while natural gas liquids (NGL) are shipped out in carriers.
The first gas arrived at Kårstø on 25 July 1985.

Built on a site of more than 200 hectares, the Kårstø plant treats more than 600 millions m³/day of gas coming from the Åsgard offshore field.

Kårstø - KUP Project

Kårstø also receives condensate (light oil) from the Sleipner Field for stabilisation and storage before export by ship. This part of the complex became operational on 1st October 1993. The plant ranks as Europe's largest processor and exporter of NGL and condensate.

A major development project, the Kårstø KUP (Kårstø Utbyggingsprojekt) is currently being completed at Kårstø to accept gas from the fields off mid-Norway via the Åsgard transport pipeline. The expanded facilities at Statoil's Kårstø complex also cover a plant for gas separation, storage and export of ethane. New jetties have also been completed.
The development project has doubled gas reception and treatment capacity at the plant, which is now able to handle roughly 64 million cubic metres per day.
The first gas arrived from Åsgard B platform in October 2000.
Eight million working hours have been devoted to the KUP project, turning Kårstø into the world's third largest producer of LPGs. The total cost of this project is approx. NOK 10.4 billion.
The engineering design contract was awarded to M.W. Kellogg Ltd., and the specification for piping, vessels and equipment was developed together with Statoil.



FOAMGLAS® - the ultimate industrial insulation

FOAMGLAS® T4 and the HLB grades (High Load Bearing) cover all insulation classes in the specification including the insulation of the ethane tank bases.

The main construction contract was divided into two, and awarded to UMOE (ABB) and Fabricom.

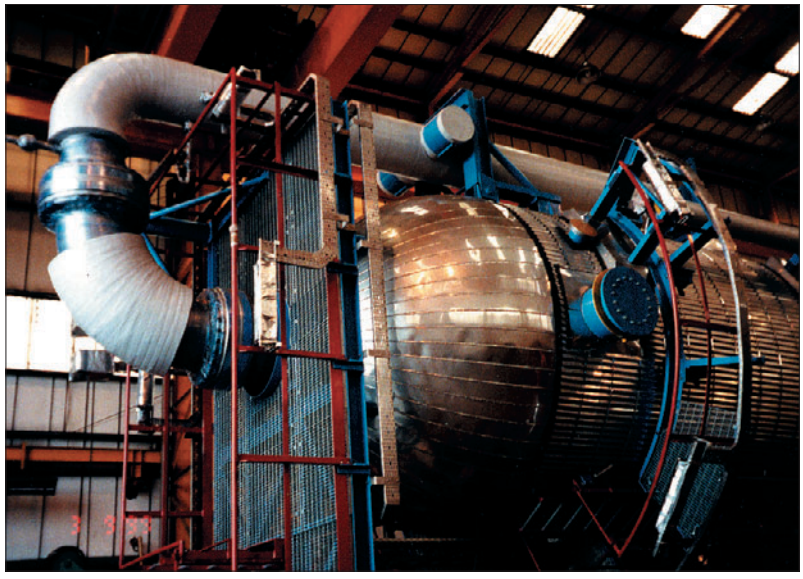
The two main insulation contracts went to Rheinhold & Mahla and Norisol.
Rheinhold & Mahla have completed the inner process area contract, starting in January 1999, running to August 2000.
100 people from R & M continuously applied FOAMGLAS® during this period, working 200,000 hours, and **20,400 Lm** of pipe shells, pipe segments and bends.

Norisol Norge AS won the ISBL and OSBL contract, and completed their work using up to 200 people, 340,000 working hours, and applying **23,600 Lm** of FOAMGLAS® T4, from January 1999 to October 2000.

The dressed vessels contract was carried out at Amec in the UK, using **3,800 m²** of pre-fabricated FOAMGLAS® vessel segments, and **500 Lm** of pipe shells.
Fabricom in Belgium, Grootint in Holland, and Precioso in France have also constructed and insulated major pipe-racks, skids and modules for this project.

The total amount of FOAMGLAS® delivered to this project is approx. 7,400 m³!
Kaefer Isoleringsteknikk AS was awarded the insulation contract by

Karstø vessels at South Humberside Fabrications. RESL installed FOAMGLAS® cellular glass insulation.



Åsgard B

Åsgard B, the semi-submersible production floater for gas is held by 16 anchors, each chain-cable being 10 m long.

Kværner Oil & Gas at the Kværner Rosenberg yard in Stavanger Norway.
Kværner Oil & Gas won the total EPCI contract from Statoil, worth NOK 6,7 billion in 1997 (850 million €)

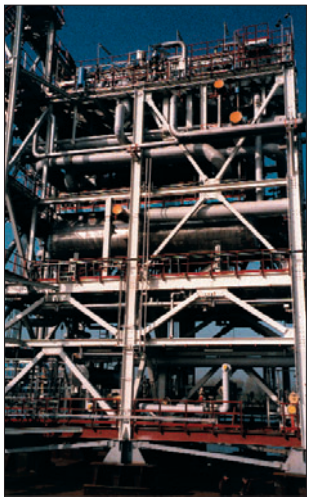
Top-side construction and installation began in June 1998 at Rosenberg, with four modules arriving from yards in Italy, UK, and Norway.
Kaefer has spent 300,000 working hours onshore at the yard and 120,000 hours offshore after it left the yard in May 2000. Offshore work was finished in December 2000. A total of 360 people worked continuously on the insulation contract during this construction period.

The total scope of work for piping insulation was 16,400 Lm, and the total scope for vessels and equipment was 4,200 m², all insulated with FOAMGLAS® T4 prefabricated pipeshells, segments, bends and vessel segments from Pittsburgh Corning Europe S.A.

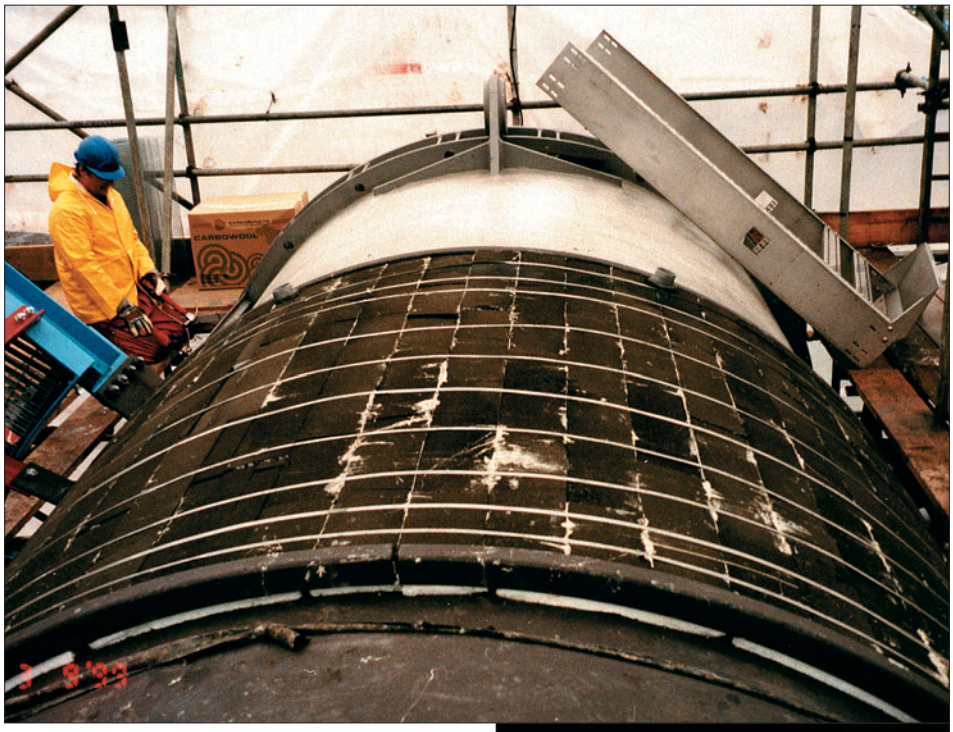
Åsgard A

The Åsgard A (FPSO) ship produces 200,000 barrels of oil daily.

FOAMGLAS® - the application, at the yard



At Fabricom in Hoboken - a subsidiary of Tractebel (Belgium) - major piperacks, skids and modules have been assembled and insulated with FOAMGLAS®.
All elements to be assembled on the modules had been delivered by the Norwegian State Company Statoil/Kellogg and then re-shipped after assembly.
Fabricom was selected as the contractor because of its highest standard in execution and control/follow-up on the jobsite, known as *Fabricom Project Management System* (FPMS).

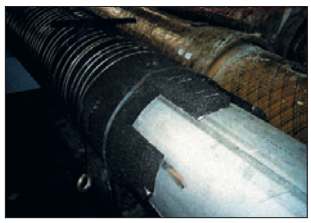


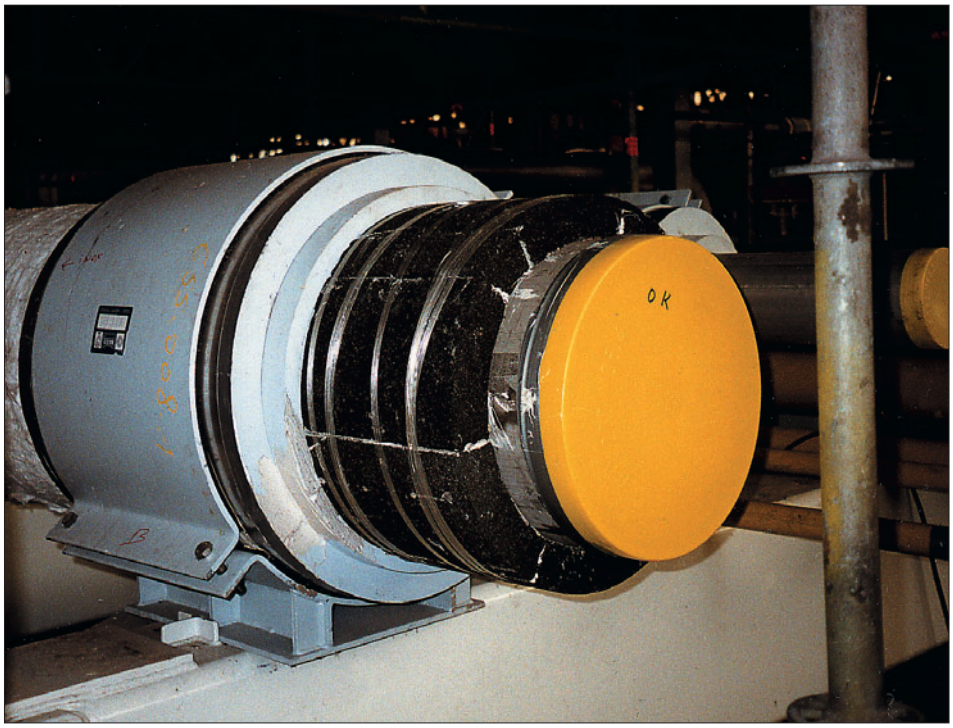
Application of FOAMGLAS® segments to a column. The segments are dry applied with Pittseal® 444 in the joints. The insulation is secured with stainless steel straps over one layer of ceramic fibre to meet the acoustic specifications.

As shown in the picture on the right, an anti-abrasive coating is sprayed onto the inner surface of the FOAMGLAS® segments. If an anti-abrasive is to be applied on-site it has to be indicated at the outset, since its application requires an increase in the interior diameter.
An anti-abrasive layer should always be applied on offshore insulation.
Two types of anti-abrasive coating are available, service temperature has to be indicated to specify the correct coating:

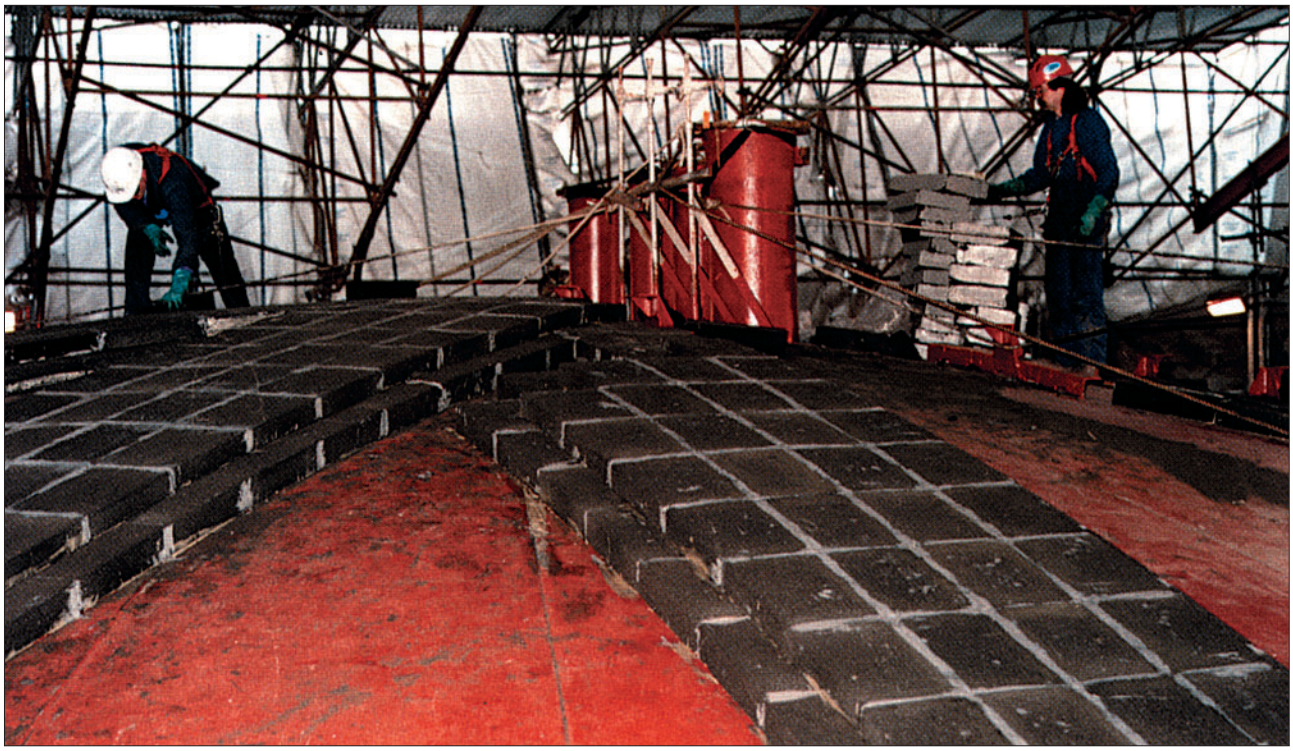
- PC® ANTI-ABRASIVE COMPOUND 2A for temperatures from -180 to + 120°C.
- PC® HIGH TEMPERATURE ANTI-ABRASIVE for high temperatures up to +350°C and temperatures lower than -180°C where inorganic materials are requested.

FOAMGLAS® shells on the stack for small diameter pipes, prepared with anti-abrasive coating, ready to be applied.





The FOAMGLAS® insulated pipe is covered with a felt and a metal jacket.
For outdoor applications, metal jackets are usually made of galvanised, pre-painted, aluminised, stainless steel or aluminium.
Felt is mainly used in high wind areas to reduce stresses by vibrations.



Domed tank covered with FOAMGLAS® insulation, applied in 2 layers (100 mm and 80 mm) with offset joints, bonded with an adhesive on polyurethane base.

Hydrocarbon Refining, Natural Gas Processing and Petrochemistry

FOAMGLAS® is used in hydrocarbon applications, offshore recovery from all types of platforms and FPSOs (Floating Production Storage and Offloading Vessels) stabilisation, separation and processing at receiving and despatch terminals.

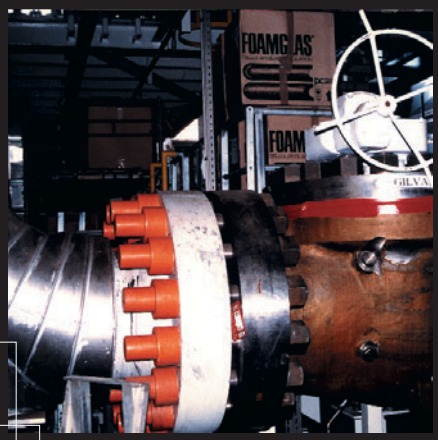
On coastal terminals, the reasons for using FOAMGLAS® are the same:

The temperature range on these terminals can be covered by FOAMGLAS®,

- from cryogenic to high temperature,
- in all types of application,
- from liquefied gases,
- cold fractionation,
- storage,
- cold process,
- dual temperature,
- fire protection,
- heat traced,
- frost protection,
- heat conservation,
- personnel protection,
- hot oils and
- volatile fluids where wicking type materials can lower the auto ignition temperatures and, of course,
- in all types of applications where corrosion under insulation or stress cracking is a risk factor.

Corrosion under insulation, or under wet insulation, is always a danger as it is not easily detected and, as all these sites are on the coast, the fire water drench systems use salt water.
High winds from the sea and the general ambient conditions also have an effect.

FOAMGLAS® is the insulation with the best documented track record - over decades - in this kind of environment.



St. Fergus Terminal, North East Scotland

The St. Fergus complex consists of a number of terminals receiving and processing gas, condensate and natural gas liquids. These hydrocarbons are recovered by various production units operating on the Offshore Oil and Gas Fields and conveyed to the terminals via pipeline systems such as Far North Liquid and Associated Gas System (FLAGS), Scottish Area Gas Evacuation (SAGE), Fulmar, Frigg etc. Operators on the terminal site include Shell, British Gas, Total Oil Marine, Mobil and Britannia Operator Limited (BOL).

From the early 80's, various engineering and design contractors have been employed to build and extend the facilities, with further on going. additions. Engineering companies such as R.M. Parsons, Foster Wheeler and Fluor Daniel have been involved and have specified FOAMGLAS® cellular glass insulation on process piping, vessels, tanks and equipment at operational temperatures ranging from –176°C to +280°C using thicknesses from 25 mm to 200 mm. These are within the operating limits of FOAMGLAS®, which remains efficient when subjected to thermal cycling and also has the benefit of being fireproof and water/watervapour resistant.

From the early 80's until the present day, Pittsburgh Corning (UK) has been supplying FOAMGLAS® cellular glass insulation for projects and maintenance. **32,000 lm** of various pipe diameters and thicknesses and **18,000m²** in the form of radiused and bevelled lagging and slabs for vessels and tanks. Applications include low temperature, cryogenic, high temperature, fire safe, acoustic and heat traced.

FOAMGLAS® is a tough, durable insulation proven world wide in the harsh conditions experienced in the offshore and coastal terminals. FOAMGLAS® provides safe and predictable results.

Flotta Terminal

Bacton Terminal Operators – BP Amoco, Shell, Phillips, BG Transco

FOAMGLAS® has been used on all four sites within the Bacton Terminal and on platforms in the gas fields within the southern North Sea.
From the original construction through to the present, FOAMGLAS® has been applied to pipes, vessels and equipment in high temperature, low temperature, above ambient, heat traced and as a non combustible insulation in fire proofed areas. The most recent application: fireproofed vessels being specified by Amec.

From 1968 to 2000, FOAMGLAS® has been used at the Bacton terminal on **9,300 lm** of piping and **5,200 m²** of vessels and storage equipment.

In the Easington and Dimlington gas terminals, where the operator is BP Amoco, FOAMGLAS® has been used on pipes, vessels, tanks and equipment for various applications and temperatures.
FOAMGLAS® was also used on the control building roofs as it is totally non-combustible.
FOAMGLAS® was also used in the associated offshore platforms and was also used on the extensions to the Dimlington terminal in 1990 and 1994.
In total, over **15,000 lm** of piping, **8,000 m²** on vessels and tanks and **4,000 m²** roofing has been supplied to the Dimlington & Easington terminals.

Oil & Gas Fields

Liverpool Bay Development

This development is a partnership between BHP Petroleum Limited, Lasmo North Sea Plc., Monument Petroleum Limited and PowerGen (North Sea) Limited. The development comprises offshore facilities and the Douglas Complex where both gas and oil production are centered. It is linked to the satellite production platforms of Hamilton, Hamilton North, Lennox and to the shore by subsea pipelines.

The onshore terminal is the Point of Ayr establishment which removes sulphur and liquids to produce 'sweet gas'. This 'sweet gas' is sent via a 27 km underground pipeline at the rate of up to 12.5 million cubic feet per hour to the combined cycle gas turbine (CCGT) power station at Connah's Quay.

BHP operates the offshore fields and the Point of Ayr terminal; PowerGen operates the power station. The oil produced by the fields is known as «Liverpool Blend», a light paraffinic crude with a low sulplus content which is sold on the world oil markets, the gas is sold to the CCGT power station and surplsu gas is sold into the British Gas Transco distribution network.

The engineering design and construction companies involved in the development were Barmac (Brown & Root and Mc Dermott Marine), for offshore R.M. Parsons and A.O.C., and UK Construction for onshore.

FOAMGLAS® cellular glass insulation was specified and installed offshore, in the terminal and in the power station for cold piping and equipment.
14,000 lm of various pipe diameters and 8,000 m^2 in slabs and vessel sets were supplied in FOAMGLAS® T4 material together with accessory materials, manufactured by Pittsburgh Corning Europe, including anti-abrasives, Pittseal® 444 joint sealant and PC® 88 adhesive. These materials were installed by Rigblast Insulation Contractors.

FOAMGLAS® was chosen by the designers for its proven in-service performance on plants and terminals. Safe, reliable, durable, corrosion free, 100% closed cell and a guarantee of less maintenance in the future.
The Liverpool Bay Development represents an investment of more than £ 1.1 billion to produce gas and oil for at least 20 years, and FOAMGLAS® cellular glass insulation manufactured by Pittsburgh Corning Europe will make a substantial contribution to yet another oil and gas project.

For hot and cold applications

FOAMGLAS® covers the temperature range offshore from -30°C to +180°C on platforms and FPSOs (Floating Production Storage and Offloading Vessels).

Cold applications limit heat gains and provide personnel protection, fire protection, acoustic, and anti-condensation. They also need to resist the sea water fire drench systems which must be tested on a regular basis. Corrosion is a problem in this environment even when using stainless and other high grade steels, so the safe chemical and neutral composition of FOAMGLAS® is the key in the offshore industry safe for people and production.

Heat traced applications use FOAMGLAS® for the same reasons as cold work and, of course, its compressive strength for pipe hangers and supports avoids penetration through the insulation and again penetration of pipes through decks or bulkheads can be done safely with FOAMGLAS® which cannot wick fluids or absorb gases, and cannot spread fire.

It is also a fact of life that a rigid, dimensionally stable material, which does not wrap, shrink or suffer dimensional changes due to thermal

Foinaven and Schiehallion, West of Britain Development and Production

changes or moisture ingress or, indeed, structural movement – is definately a safer background for a coating, weather barrier, vapour barrier, tape type cover, or even a metal cladding.

FOAMGLAS® is 100% closed cell construction and it is important to know that money spent on any other seal system is supported or backed up by a safe, reliable insulation system. Even fire proofing benefits from a FOAMGLAS® substrate.

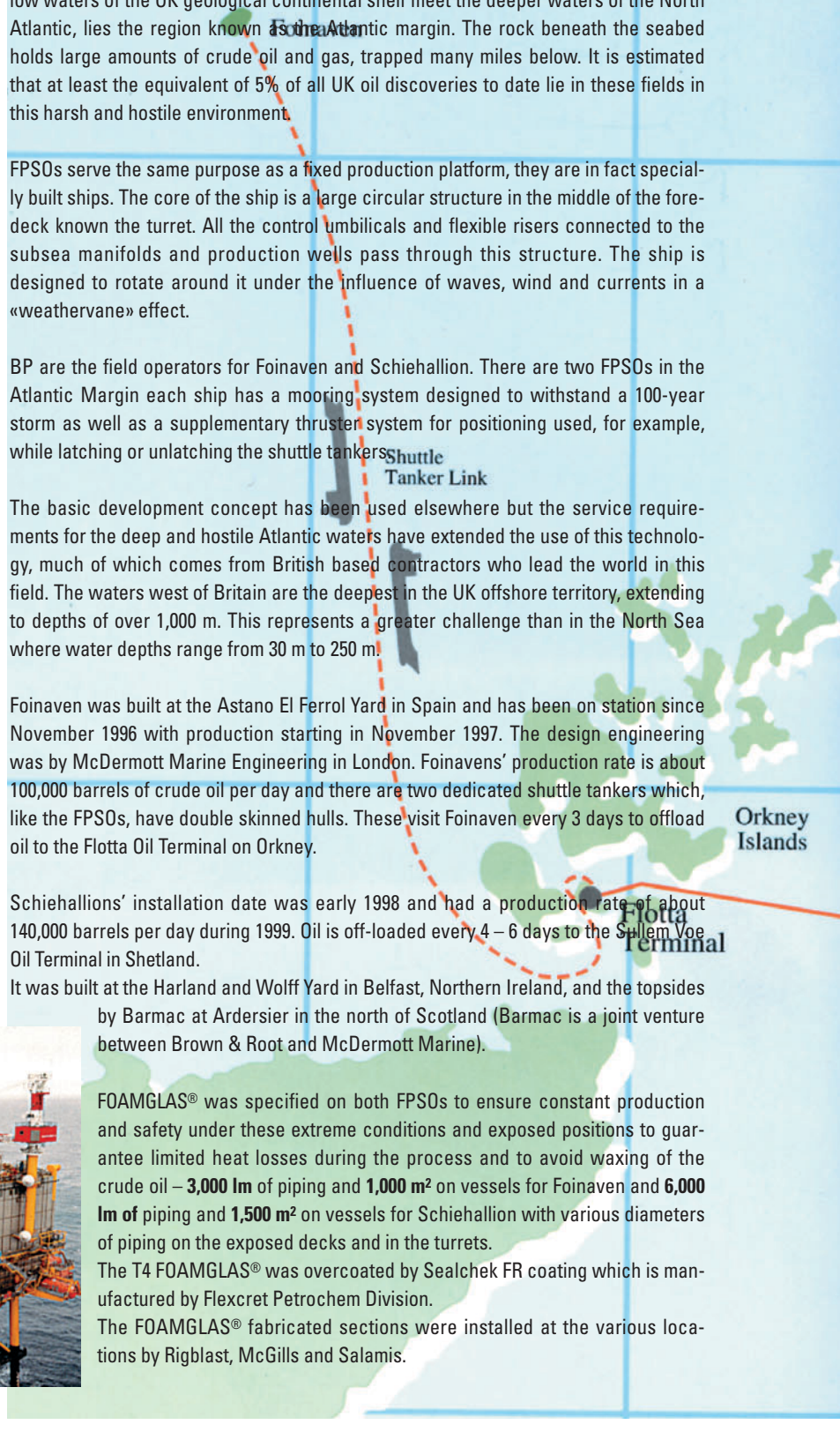
Hot works and, within the temperature range, offshore fibrous type materials, are in danger of becoming wet and lose efficiency, giving corrosion problems, problems at supports and with movement and slumping. This presents all sort of problems and high maintenance costs; time lost in production is a higher cost offshore than onshore and that is assuming materials and personnel are based at sea.

FOAMGLAS® on all UK offshore gas fields and on nearly all UK oil fields

TO THE WEST OF THE WESTERN ISLES OF ORKNEY AND SHETLAND, where the shallow waters of the UK geological continental shelf meet the deeper waters of the North Atlantic, lies the region known as the Atlantic margin. The rock beneath the seabed holds large amounts of crude oil and gas, trapped many miles below. It is estimated that at least the equivalent of 5% of all UK oil discoveries to date lie in these fields in this harsh and hostile environment.

FPSOs serve the same purpose as a fixed production platform, they are in fact specially built ships. The core of the ship is a large circular structure in the middle of the foredeck known the turret. All the control umbilicals and flexible risers connected to the subsea manifolds and production wells pass through this structure. The ship is designed to rotate around it under the influence of waves, wind and currents in a «weathervane» effect.

BP are the field operators for Foinaven and Schiehallion. There are two FPSOs in the Atlantic Margin each ship has a mooring system designed to withstand a 100-year storm as well as a supplementary thruster system for positioning used, for example, while latching or unlatching the shuttle tankers.



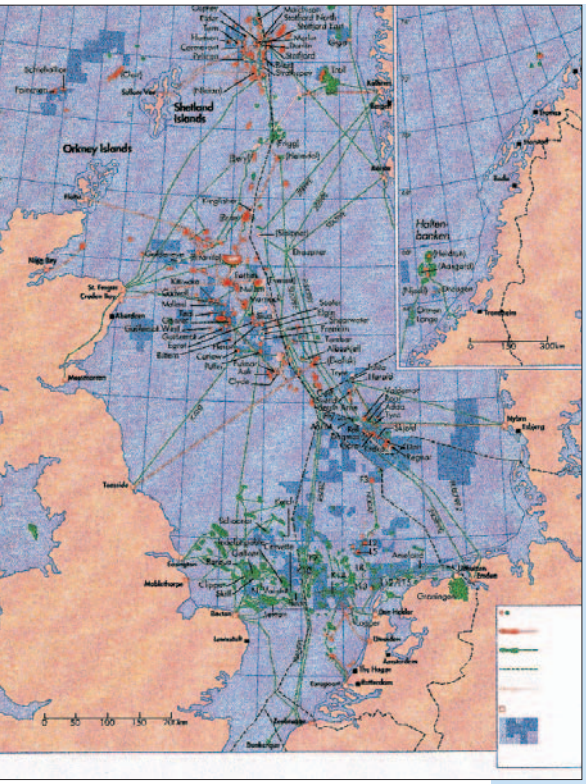
The basic development concept has been used elsewhere but the service requirements for the deep and hostile Atlantic waters have extended the use of this technology, much of which comes from British based contractors who lead the world in this field. The waters west of Britain are the deepest in the UK offshore territory, extending to depths of over 1,000 m. This represents a greater challenge than in the North Sea where water depths range from 30 m to 250 m.

Foinaven was built at the Astano El Ferrol Yard in Spain and has been on station since November 1996 with production starting in November 1997. The design engineering was by McDermott Marine Engineering in London. Foinavens' production rate is about 100,000 barrels of crude oil per day and there are two dedicated shuttle tankers which, like the FPSOs, have double skinned hulls. These visit Foinaven every 3 days to offload oil to the Flotta Oil Terminal on Orkney.

Schiehallions' installation date was early 1998 and had a production rate of about 140,000 barrels per day during 1999. Oil is off-loaded every 4 – 6 days to the Sullem Voe Oil Terminal in Shetland.
It was built at the Harland and Wolff Yard in Belfast, Northern Ireland, and the topsides by Barmac at Ardersier in the north of Scotland (Barmac is a joint venture between Brown & Root and McDermott Marine).

FOAMGLAS® was specified on both FPSOs to ensure constant production and safety under these extreme conditions and exposed positions to guarantee limited heat losses during the process and to avoid waxing of the crude oil – **3,000 lm** of piping and **1,000 m²** on vessels for Foinaven and **6,000 lm of** piping and **1,500 m²** on vessels for Schiehallion with various diameters of piping on the exposed decks and in the turrets.
The T4 FOAMGLAS® was overcoated by Sealchek FR coating which is manufactured by Flexcret Petrochem Division.
The FOAMGLAS® fabricated sections were installed at the various locations by Rigblast, McGills and Salamis.

Terminals in the UK from north to south, all with FOAMGLAS® insulation



BP AMOCO	Sullom Voe, Shetland Islands.
ELF	Flotta, Orkney Islands, formerly operated by Occidental Petroleum.
BP AMOCO	Nigg, Inverness – formerly operated by Britoil.
ST. FERGUS, *ABERDEENSHIRE*	Operators on this site are British Gas, Shell, Total Oil Marine and Mobil Oil and Britannia Oil and Gas.
BP AMOCO, *CRUDDEN BAY, ABERDEENSHIRE*	This is the land fall for Forties System, BP Oil Fields, now BP Amoco.
MOSSMORRAN	Operators are Exxon and Shell, Fifeshire.
BRAEFOOT BAY	Fife is the exporting/tanker loading facility for Exxon and Shell Mossmorran.
BP AMOCO, *GRANGEMOUTH, STIRLINGSHIRE*	Comprises refinery, chemical plant, storage docks, Kinneil Tank Farm, and Hound Tooth Point Export Jetty.
PHILLIPS PETROLEUM	Seal Sands, Teesside. Eckofish Gas and other Phillips offshore units are processed on this site, it also has the largest tank farm in the UK.
BP AMOCO, *SEAL SANDS, TEESSIDE*	Central area transmission system (CATS)
BP AMOCO, *Easington, North Yorkshire*	Southern North Sea Gas fields and Loggs, i.e. Lincoln Offshore gas gathering system, including rough gas storage system.
CONOCO VIKING, *Theddlethorpe, Lincolnshire*	V Fields Gas Fields, oil to Conoco/jet refinery, Immingham, Humberside and Lindsey Oil, Stallingborough, Humberside.
BP AMOCO, *Dimlington, Humberside*	Processes BP's condensate from southern UK and oil fields in European sector.
BACTON TERMINAL, Norfolk	Shell, Phillips and BP Amoco, also UK end of intercontinental connector exporting British gas to Europe.
BP *Wytch Farm, Dorset*	Processes Wytch Farm on and off shore oil and gas.
POINT OF AYRE,	Hamilton Oil and Gas, North Wales, processes oil and gas from Liverpool Bay and Isle of Man area.
MORECAMBE BAY	British Gas, Lancashire. Processes gas and condensate from north and south Morecambe Bay, Britains biggest gas field.

Liquefied natural gas separation plant at Mossmorran, Scotland. Insulation for the bases of 4 LNG and LPG tanks, pipework and various equipment (operating temperature: -160°C to +175°C).

FOAMGLAS® References

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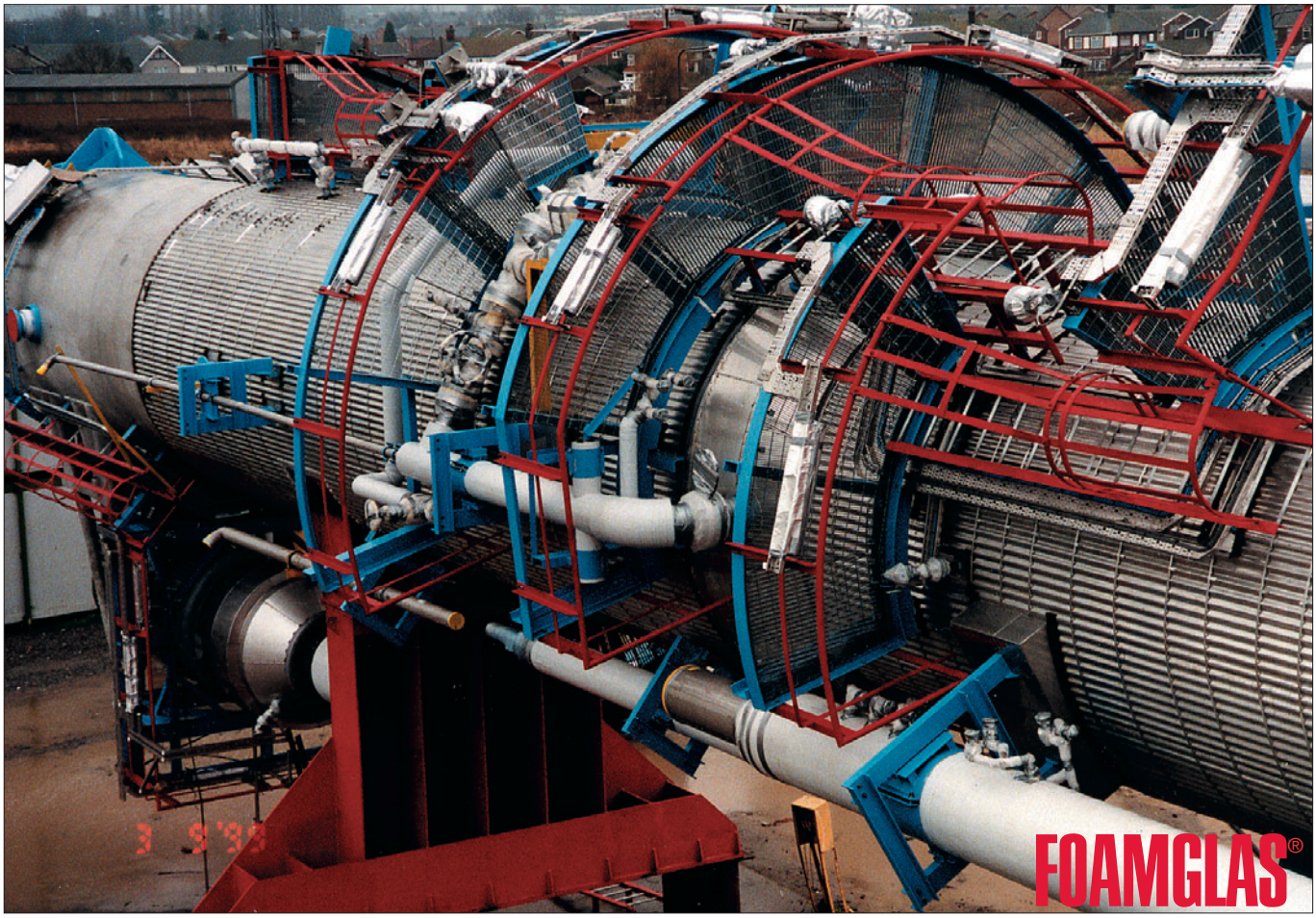

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