elf aquitaine norge a/s

FRIGG FIELD
TCP2 COMPRESSION
FINAL REPORT

volume 1

DESIGN SYNOPSIS

STAVANGER NOVEMBER 1981

FRIGG FIELD TCP2 COMPRESSION - FINAL REPORT

INDEX - VOLUME 1 - DESIGN SYNOPSIS

1. INTRODUCTION

1. INTRODUCTION

The Frigg field Treatment and Compression Platform No. 2 (TCP2), positioned on-site in the Norwegian sector of Frigg field in 1977, is currently treating one half on the Frigg field gas production. These facilities, which process gas sent by two sealines from the 24 wells on the Drilling and Production platform No 2 (DP2) also standing in the Norwegian sector some 650 m distant, occupy somewhat less than half the available space in TCP2 and comprise free water knock out drums and glycol contactors arranged in three parallel streams. A metering station operates downstream of the glycol contactors before sending the gas into the Scottish sales gas headers for transmission to St. Fergus in Scotland by one or other of the two sealines. TCP2 is a three legged concrete platform supporting a steel truss support frame.

The space currently available on the platform will be used for receiving gas from future Frigg satellite fields and for the installation of gas compression and electric power station facilities. These two latter are the subject of the present document.

The compression facilities are divided into two phases, phase IIIA providing 100.000 hp of compression services from spring 1981 with phase IIIB adding an expected equivalent hp at a later date. They are provided to meet the needs of Elf's delivery contract with the British Gas Corporation in the face of dwindling natural pressure from the gas reservoir and will process gas from the entire Frigg field, from the UK sector via TP1 platform and from the Norwegian via TCP2 treatment.

The phase IIIA facilities comprise three sets of Alsthom-Atlantique compressors (made under licence from Nuovo Pignone), powered by Pratt and Whitney (UTI) gas turbines. In normal operation gas from each of the treatment platforms will pass through one stream with the third as a standby for either supply. These units and their accessories are each installed on self contained modules, which sit on the north east side of the support frame.

Compression takes place between the knock out separators and the glycol contactors on the treatment platforms,interconnection lines providing the choice of supply from the FWKO's to the contactors either directly or via one TCP2 compressor.

Between these modules is installed a fourth and larger module containing the main control room and electric substation, a workshop and the heating and ventilating and air conditioning room.

The field power station, installed at the same time as the compression facilities and part of the same engineering design contract, comprises two 17,15 MVA ASEA generators powered by Stal Laval gas turbines. Both units, together with ancillaries, are installed in a single turbine hall within the support frame and under the two northernmost compression modules.

The commissioning of this power station will commence the permanent stage of Frigg 5,5 kv electrical supply and the existing generators - three Ruston Units on TP1,and three Kongsberg on TCP2 treatment will henceforth be used as standby units.

All five of the new TCP2 gas turbines are fuelled with Frigg field methane and thus TCP2 Compression is equipped with metering facilities, comprising a double tube, the stand-by taking over operation during the regular calibration checks on the normal tube.

In accordance with NPD practice all emergency facilities are separated from the main production areas and are situated on the east side of the support frame and adjacent to the turbine hall. They comprise an emergency generator by NEBB powered by a SACM diesel engine, a battery and static autonomous power unit room, and an emergency sub station.

The remaining space within the support frame, on the east side between column 3 & 5, is occupied by utility functions of which the most extensive is the cooling system for the compressed gas. This installation, which guarantees the correct return temperature of compressed gas to the glycol contactors, takes sea water from column 3 and delivers it to column 5 via a set of titanium plate heat exchangers. These in turn cool fresh water, sent in a closed cycle to the three shell and tube heat exchangers for each of the main gas lines mounted on top of each compression module. Make up fresh water is provided by a water-maker unit. Access to the four seawater pumps submerged in column 3 - two normally running with two on standby - is by two 25 ton pneumatic hoists installed in the control room module.

Safety provisions include the API recommended practice of primary and secondary protection for all process facilities.

Shut down actions, which at high levels are tied in to the rest of the Frigg field, are instigated by API secondary protection, gas detection, fire detection or alarm buttons.
The shut down logic, which distinguishes various shut down levels and applies appropriate action to isolate process lines and deenergise non essential electrical supplies, is programmed into two programmable logic controllers (PLC) running in parallel. Field instrumentation is generally pneumatic or intrinsically safe electric.

Construction of the compression facilities was distributed over three Norwegian yards - Spie Batignolles Vigor at Orkanger handling the three compressor modules and the control module, and OIS dividing the rest into two yards in the south; the power generation and emergency units at Einar Øgrey in Kristiansand and the utilities at Nymo in Grimstad.

The engineering design was handled by the Kvaerner Technip consortium working under the supervision of the EAN Project engineering team.

Nomenclature:

1. Throughout the text TCP2 C means TCP2 Compression and TCP2 T TCP2 Treatment.

2. Taking the Frigg field as a whole compression phase I is described as Frigg phase IIIa and compression phase II as Frigg phase IIIb.

2. GENERAL DESIGN

2. GENERAL DESIGN

2.1 Module Pancake Concept

The TCP 2 platform consists of a steel support frame located on the three concrete legs. All equipment installed during phase IIIa is located in pancakes and modules, placed on or within the support frame.

The modules and pancakes were all built ashore and installed as complete units.

This solution was chosen for a number of reasons.

The load capability of the support frame is limited and this was given as a design criteria. Consequently the construction of modules and pancakes was based on this; to make the modules with equipment as light as possible.

To build the equipment in modules constructed ashore is also a great timesaving factor. In this case the platform is already in operation while all new equipment is built in parallel. Thus the compression packages can be installed offshore with a minimum of offshore work, and only a brief shutdown for hookup purposes.

Another factor is the flexibility that this concept offers. Only the equipment required can be installed, so there is no need for large and expensive equipment to sit idle for long periods of time. Likewise the possiblity of modifications due to different requirements in the future is vastly simplified with the module concept.

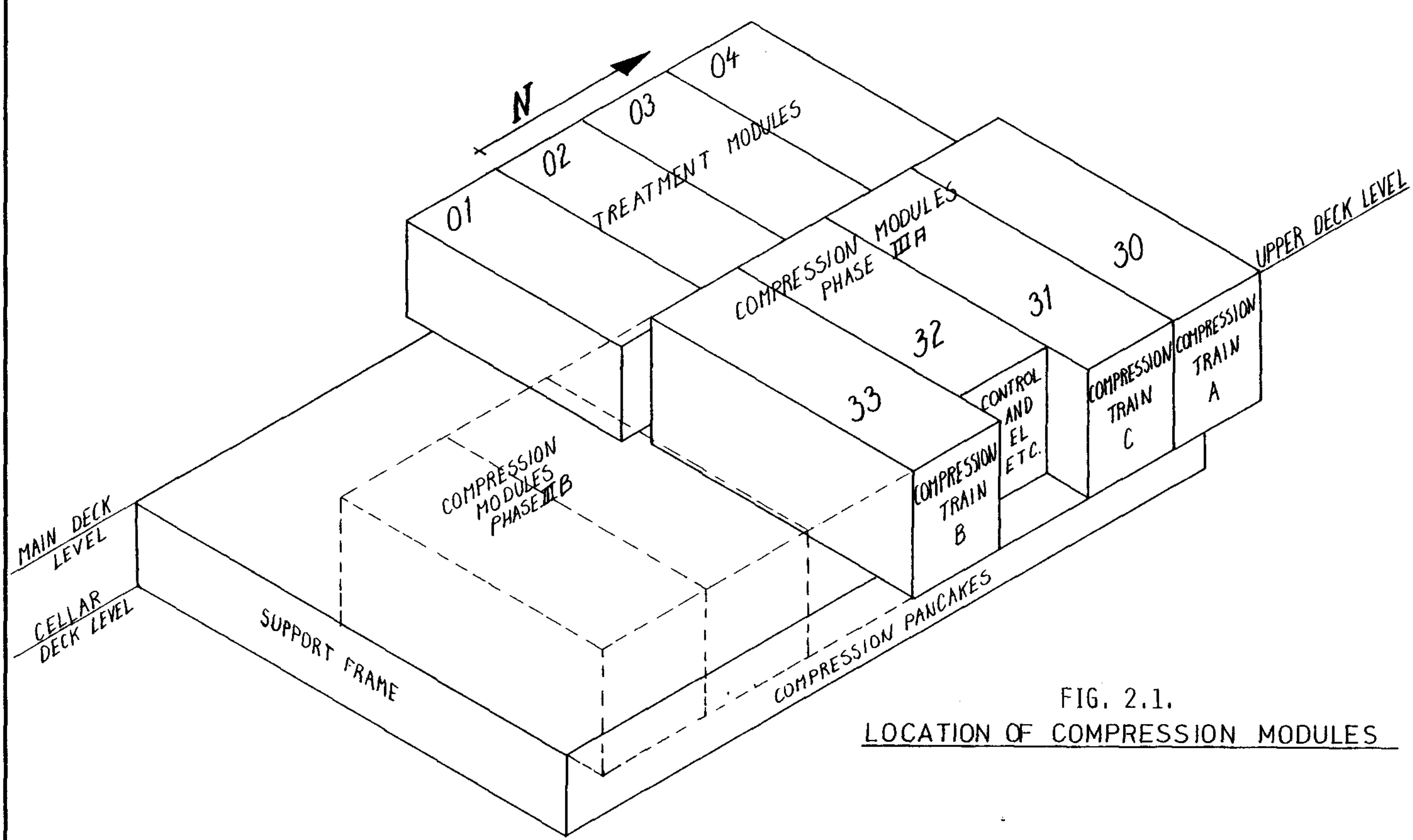


FIG. 2.1.

LOCATION OF COMPRESSION MODULES

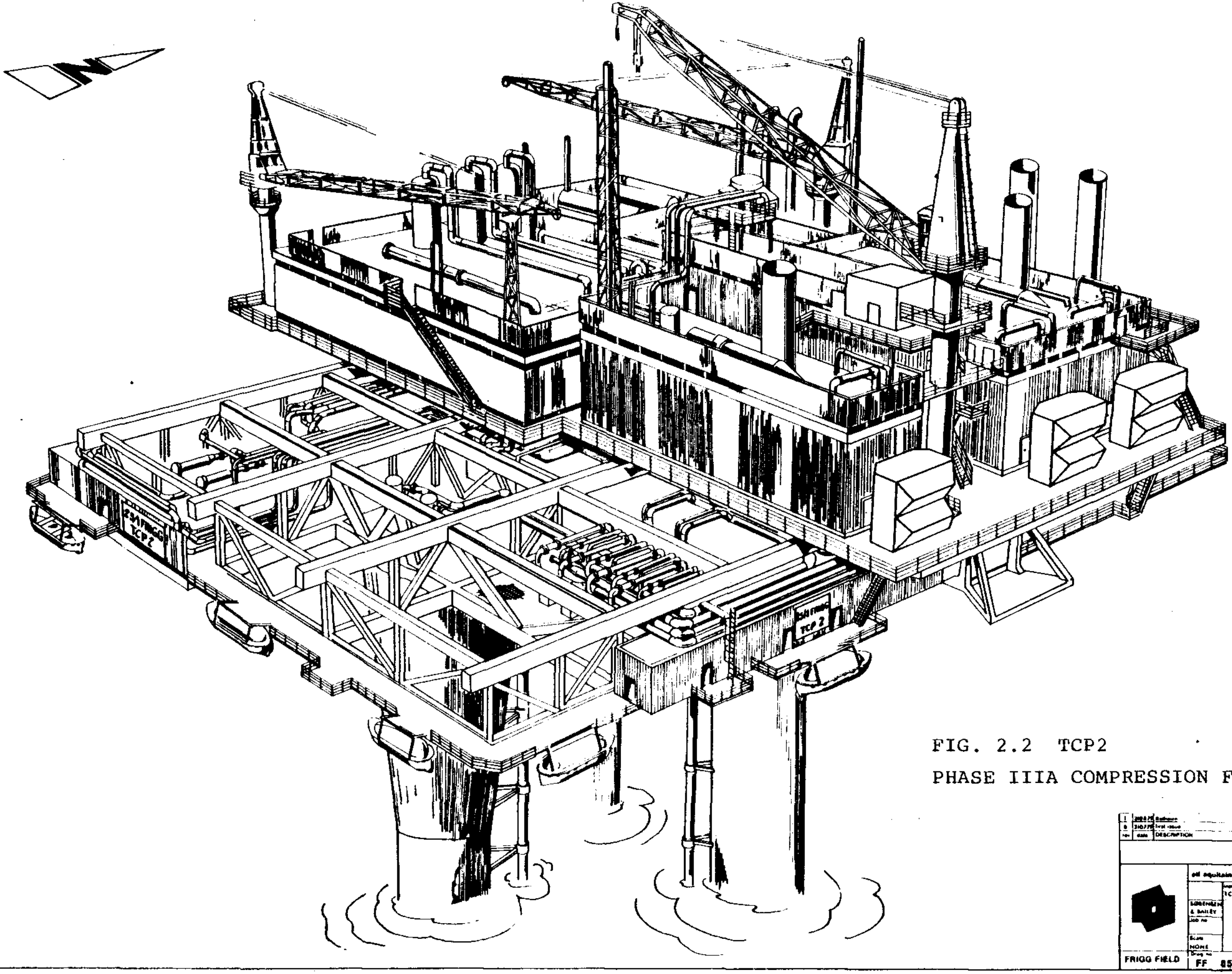


FIG. 2.2 TCP2
PHASE IIIA COMPRESSION FACILITIES

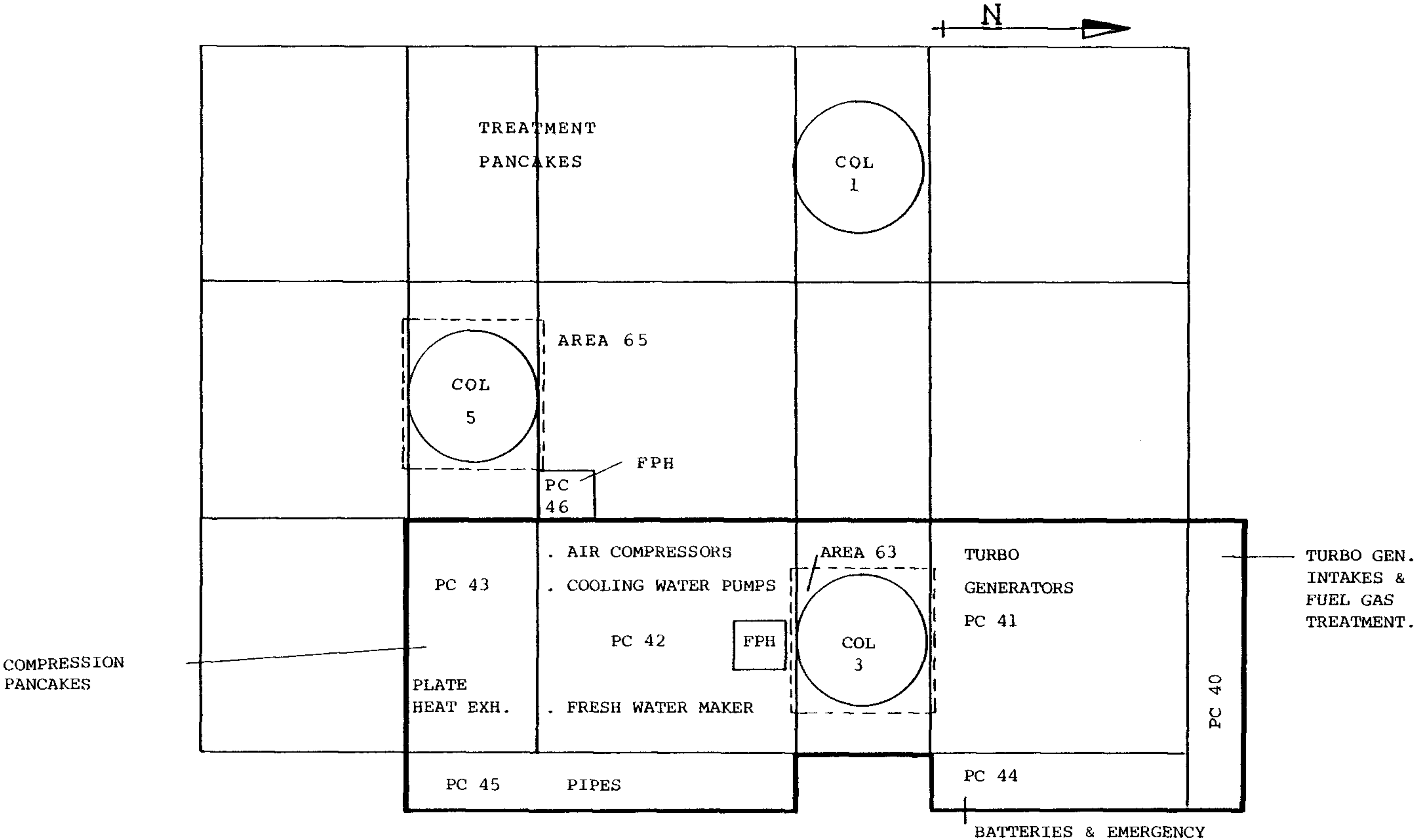


FIG. 2.3

VIEW OF TCP 2 SUPPORT FRAME CELLAR DECK LEVEL

PANCAKES ARE LOCATED WITHIN THE SUPPORT FRAME.

2.2 Structural

As mentioned in section 2.1 the requirement for lowest possible weight was a major argument for the module structural design.

While keeping the weight down the modules must also withstand the loads imposed during:

- Construction
- Sea transport
- Lifting
- Final operation.

The loads from the latter entails point and uniform loads from equipment and piping, and for the Modules 30-33 also windloads. The wind profile in relation to altitude is by derogation according to DnV 1974 and not to the 1977 regulations currently in force.

The modules and pancakes are based on a trussed frame construction, designed by plastic theory. They are enclosed by wall trusses, erected by rolled beams and built up profiles. The main longitudinal beams are built up profiles of I type with maximum web height of 1160 mm. Lower and upper deck framing have transversal main beams and longitudinal stringers of L-type. The cladding for non firewalls is corrugated stainless steel sheet mounted outside the trusses.

Padeyes for lifting are welded to the vertical wall trusses.

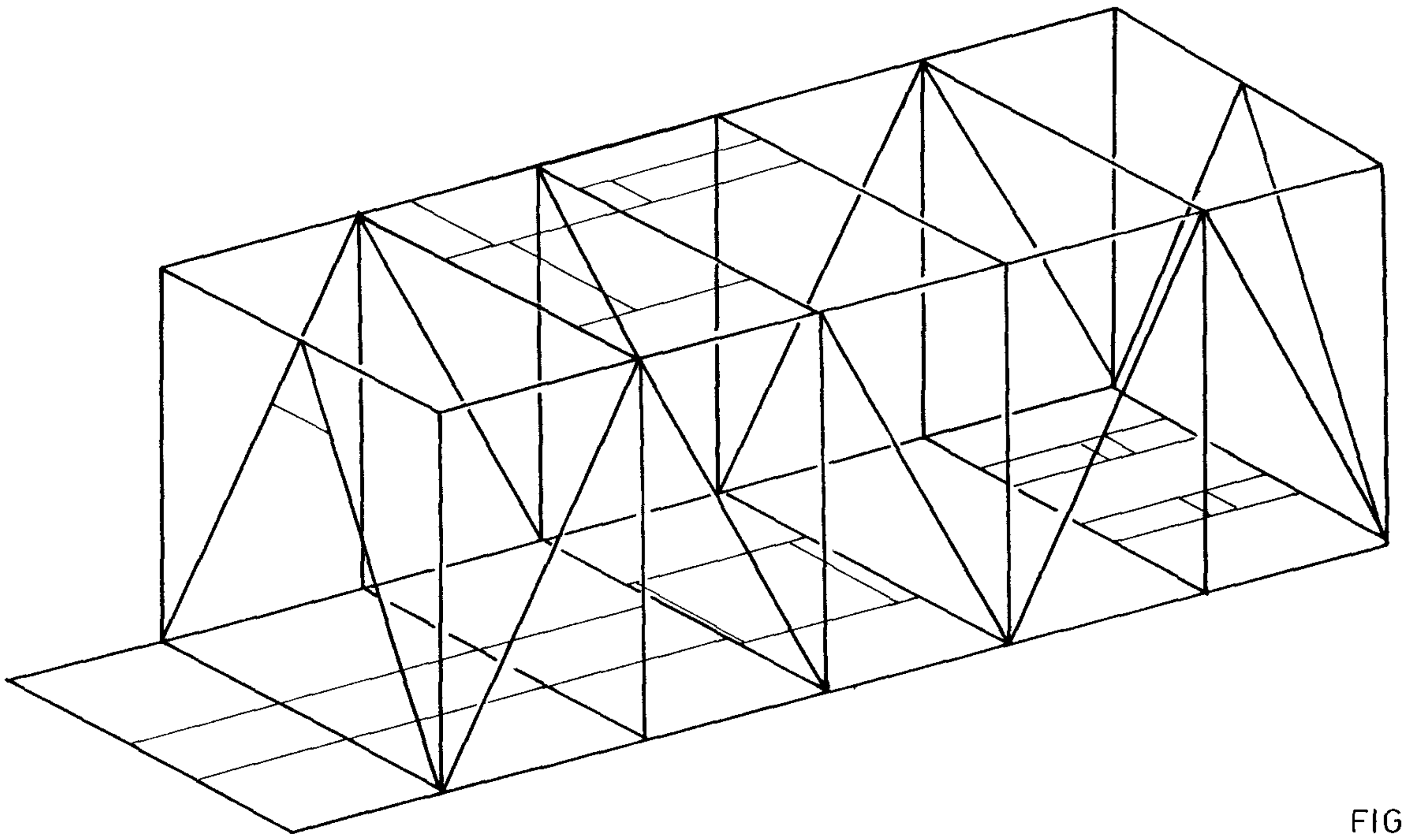


FIG. 2.4
COMPRESSION MODULES
MAIN BEAMS

2.3 Module weights

The weight of the modules and pancakes are given in the table below. The weights are in metric tonnes (MT).

LOT 1 (Orkanger)

Module 30	837 MT	
Module 31	850 MT	
Module 32	1123 MT	
Module 33	770 MT	
Total		3580 MT

LOT 2 (Kristiansand)

Pancake 40	132 MT	
Pancake 41	509 MT	
Pancake 44	153 MT	
Total		794 MT

LOT 3 (Grimstad)

Pancake 42	276 MT	
Pancake 43	152 MT	
Pancake 45	118 MT	
Total		546 MT

2.4 Material selection

A great number of material types and qualities are in use on the TCP2/C modules, the materials listed covers:

- Main structure and architectural parts
- Sea water system
- Main piping systems
- Particular material choice

2.4.1 Structural and architectural

Main support frame : ST 52-3N
Module structure : ST 52-3N (charpy tested at -20°C)
Wall plate, deck plate: MLO
Stringers : ST 37-3U
Corrugated wall plate : SS Z2 CND A/B

2.4.2 Sea water system

Pump impeller : Cuproaluminium B1489D or Inoxyda 90
Pump body : " " " " "
Discharge columns : Cuproaluminium 3P or Inoxyda 90
Bolts : Monel K500
Piping : Cu/Ni - 90/10
Rejection shafts
  Pipes and flanges : Avesta 254 stainless steel
  Bolts : Inconel 625
Plate heat exchanger : Titanium
Shell and tube heat exchanger
  Insert bush : Austenitic ductile iron,
  : 2% Ni, ASTM 571
Filters
  Filter elements : SS316L
  Shell : Carbon steel, coated with 3 mm VILASTIC
Valves : SS, A182 F316

2.4.3 Main piping systems

SYSTEM	MATERIAL	PRESS. CLASS
Process hydrocarbon gas system Oily water system (H.P.) Fuel gas system	A155 KCF70 Killed carbon steel Note 1	1500
Desalinated water system	Stainless steel, Carbon steel Note 2	150
Service air Open drains	Carbon steel	150
Firewater system Washdown system	Stainless steel, Carbon steel Note 3	150
Process hydrocarbon gas Atmospheric vent Fuel gas Methanol/Glycol/Diesel oil Cooling medium (water/glycol)	Carbon steel	150
Sea water cooling system	90/10 Cu/Ni	150
Low pressure vent Instrument air	Stainless steel	150
Oily water (process drain) Fuel gas	Killed carbon steel	300
H.P. Relief system	Killed carbon steel A333 Grade 6 Note 4.	300
Hydraulic system Diesel gen. starting air	Stainless steel	300
Hydraulic system	Stainless steel	2500
Lubricating/seal oil	Stainless steel SS 316	

NOTES:

Note 1 H.P. piping is thin walled high tensile strength pipe made by Sumitomo to API 5LX 70 modified. Postweld heat treatment is waived for wall thicknesses up to 25 mm due to the high quality. Charpy test at -30°C.

Note 2 Stainless steel for linesizes ½" to 1½" only

Note 3 Stainless steel for linesizes ½" to 2" only.

Note 4 The A333 Grade 6 steel used for the H.P. relief line has a charpy test temperature of -56°C.

2.5 Temperature, pressure and flow ratings

The initial pressure and temperature in the Frigg field reservoir is:

$T = 60^{\circ}C$
$P = 198$ bar

The gas is delivered to BGC at St. Fergus at a minimum pressure of 44 bars. The onshore process facilities have a pressure drop of 5 bars and therefore the gas arriving onshore must have a pressure of 49 bars. In addition to this requirement it is necessary to have a pipe line velocity above 4 m/s in order to avoid condensate accumulation in low spots. The delivery pressure required at outlet of compression plant must then ensure:

1) Gas arrival at St. Fergus at 49 bars
2) Gas sea line velocity of 4 m/s

When flowing well head pressure decreases below 140 bars compression becomes necessary. It is assumed that this pressure will be reached during winter 1980-81 or summer 81.

To compensate for this reduction the phase IIIA compression modules will be installed. At a further well pressure reduction the phase IIIB compression becomes necessary.

The maximum inlet pressure to compression is 140 bars.
The minimum inlet pressure for phase IIIA is 89.7 bars abs while for phase IIIB it is expected to be 52.5 bars abs.

Inlet temperature to compression plant is normally, max 50°C.
Outlet pressure is 153 bars.
The outlet temperature is 50°C with the possibility of 30°C using extra pumps.

The other sales requirements are:

Quantity sold to BGC : 80% of DGMN estimate
Total quantity (DGMN): $269 \cdot 10^9$ SCM
Recovery : 72,5-87,5%
Water dewpoint : -17°C at 41 barg
Hydrocarbon dewpoint : -12°C, P 69 barg

When leaving platform a water dew point of -5°C at 140 bars is required to avoid hydrate formation, this being obtained by glycol contactors.

The design pressure for the compression lines is 172 bar abs with a design temperature of 120°C.

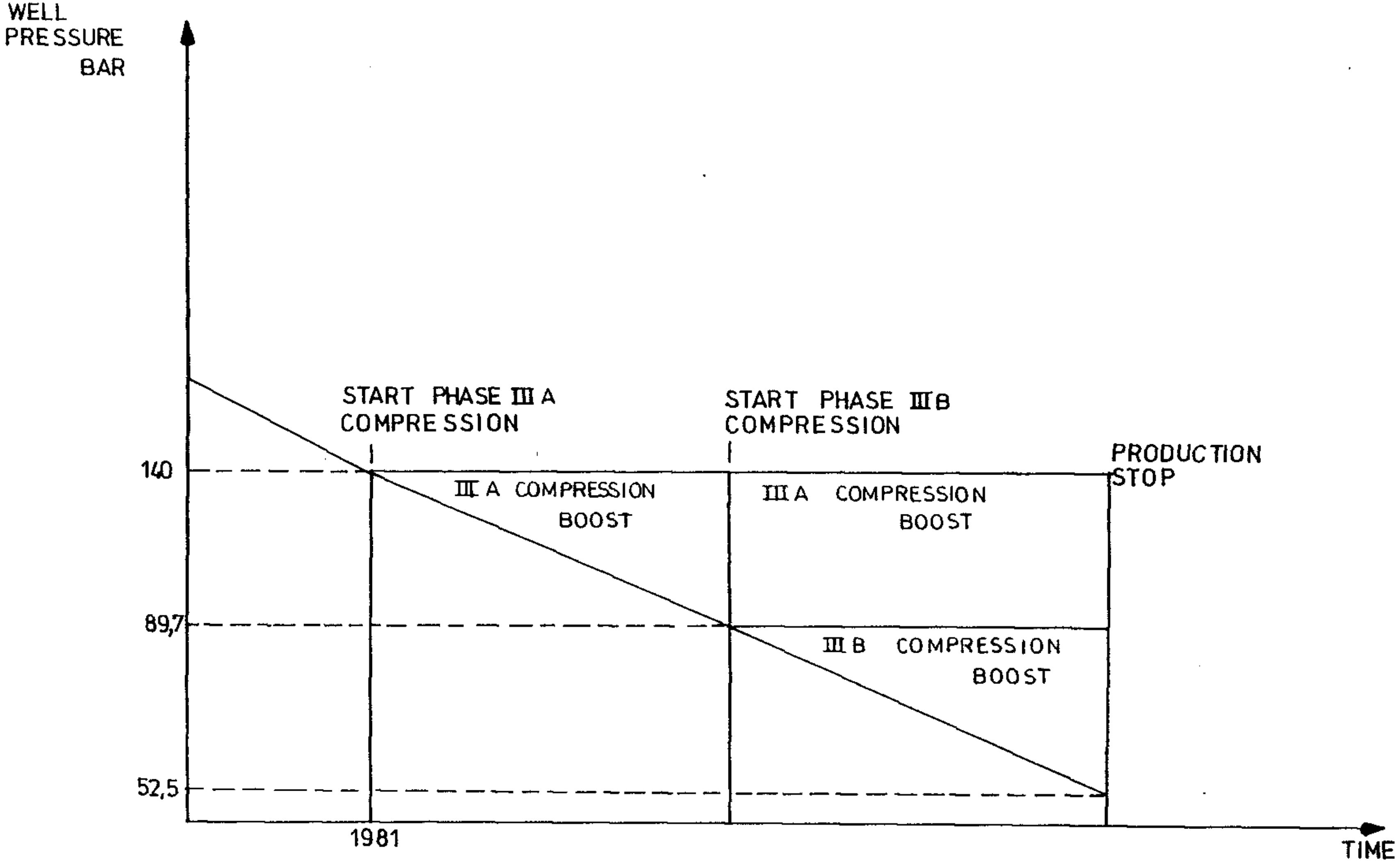


FIG. 2.5

REDUCTION IN WELL PRESSURE

2.6 Codes and Standards

The work and design of all equipment in the compression installation are performed in accordance with internationally recognized codes and standards.

A list of these is given below:

COMPRESSORS

AGMA	421.06	
DnV	P.E.R. 1.0,3.0,4.0,5.0,6.0,7.0	
NPD	Regulations for production and auxiliary systems	
ANSI	B 1.1	
ANSI	B 16.5	
ANSI	B 16.11	
ANSI	B 31.3	
API	614	1973
API	615	
API	616	
API	617	1973
ASME	Section VIII division 1	
ASME	Section IX	
ASTM	A. 193	
ASTM	A. 194	
ASTM	A. 266	
ASTM	A. 307	
ASTM	A. 320	
ASTM	A. 352	
ASTM	E. 109	
ASTM	E. 125	
ASTM	E. 138	

ELECTRICITY

Materials : IEC or equivalent
DnV requirements

Installation : Local NPD and DnV regulations

Area classification: IP code part 1
IP code part 8
DnV and NPD guidelines

FIREWATER

NFPA 13
NFPA 15
NFPA 20

NPD : Regulations for production and auxiliary system etc.

DnV : P.E.R. 1.0
" 3.0
" 5.0 and 5.0 Appendix A
" 6.0

GAS TURBINES

API 616

HEAT EXCHANGERS

BS 1515 with TEMA R

INSTRUMENTATION

General : ANSI
Flow measurement : ISO R 541
Installation : API 550, DnV, NPD regulations
Materials : ASTM, AISI
Safety valve calcs.: API 520, 521
Safety aspects : API RP 14C

PIPING

ANSI B 31.3 - Piping 1973
ANSI B 16.5 - Flanges
ANSI B 16.9
ANSI B 16.10
ANSI B 16.20 - Gaskets

API - 5LX
API - 1104

ASME section V, VIII, IX

ASTM - A.370
ASTM - E.23

PRESSURE VESSELS

BS 1515

PUMPS

API 610 1971

RELIEF AND FLARE

DnV P.E.R. 2.0

API	RP 520	Part 1	Dec. 1976
		Part 2	Jan. 1963
API	RP 521		1969
API	RP 14C		Jan. 1978

SAFETY

NPD Preliminary guidelines
"Emergency power for field installations"

NPD Preliminary guidelines
"Safety equipment, etc.. for field production installations".

NPD Regulations for
Production and auxiliary Systems on Production installations (1978).

SOLAS Conference 1974.

STRUCTURAL

"Recommended practice for planning, designing and construction fixed offshore platforms"

from API RP - 2A

"Specification for the design, fabrication and erection of structural steel for buildings and bridges"

from AISC

"Steel construction manual"

AISC

"Structural welding code" from the American Welding Society

AWS

Rules for construction and classification of fixed offshore units:

from DnV

Elf Norge's specifications for fabrication, (1052 No. 3-155 JPS/HR/hl) coating, painting, etc...

Testing and inspection of cranes for fixed offshore installations.

3. SYSTEM DESCRIPTION

3. SYSTEM DESCRIPTION

3.1 Compression lines

The TCP2 Compression Phase IIIA comprises three compression lines named A,B and C.

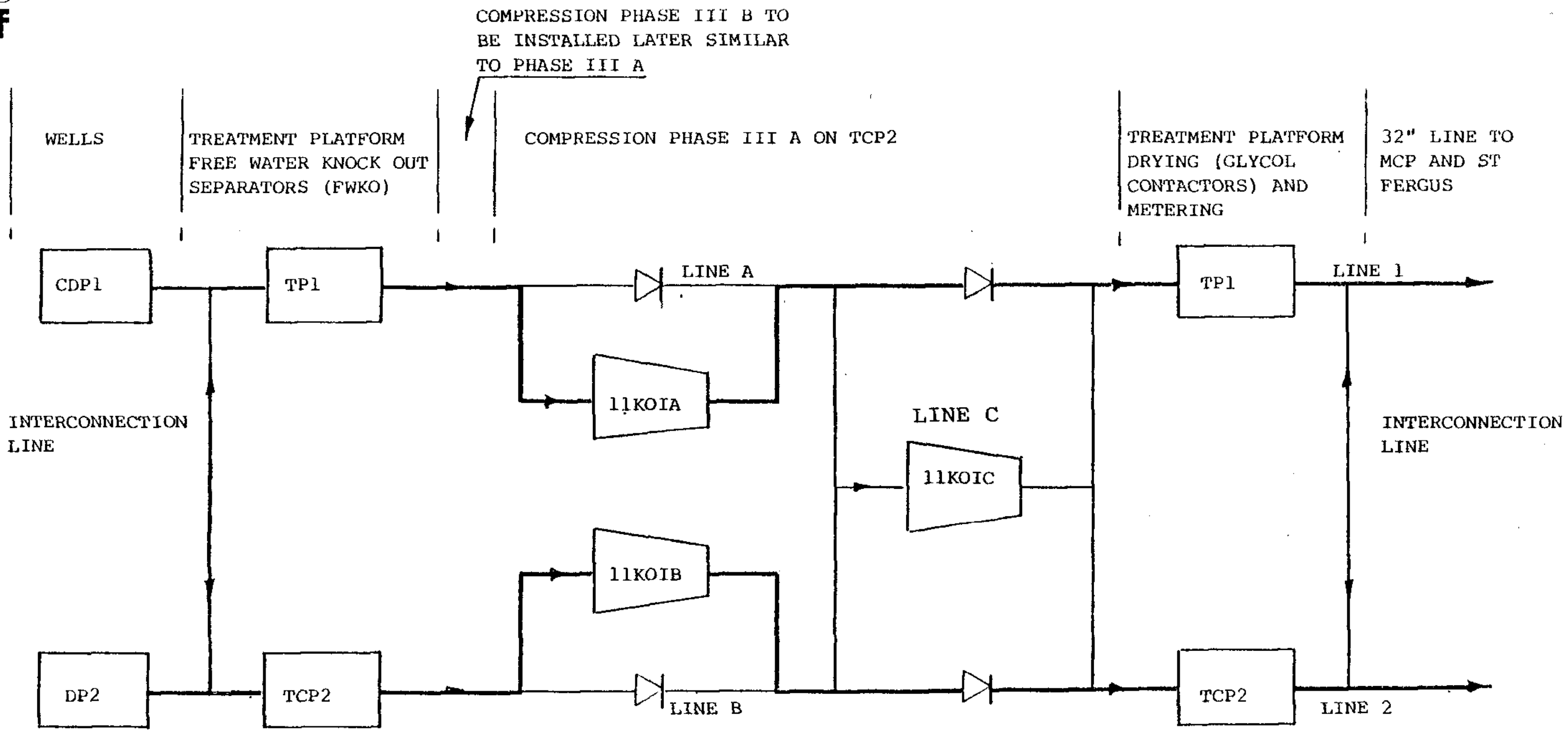
Line A compresses wet gas from the TCP2 Treatment and line B compresses wet gas from the TP1 Treatment. Line C is a common standby spare. A schematic overall field gas flow is shown on figure 3.1.

Compression lines A and B are identical and consist of suction drum, compressor, cooler and water separator. Line C comprises the same equipment exept water separator.

Any liquid in the wet gas from the Free Water Knock Out Drums in the TCP2/TP1 treatment is removed in the suction drum. The gas is then compressed to 153 bara. After compression the gas is cooled in the natural gas coolers to obtain the required operating temperature in the glycol contactors. Then any liquid formed during compression and cooling is removed in the water separator before the gas is routed to the glycol contactors in the TP1/TCP2 treatment. To avoid surge problems in the compressor during start up, shut down or if the volumetric gas flow is low it is necessary to recycle compressed gas from the natural gas cooler to the inlet of the suction drum. Each compression line is equipped with two recycle (anti-surge) lines (10" and 20") for this purpose.

Gas composition:

	Mol%
N_2	0.612
CO_2	0.320
C1	94.812
C2	4.055
C3+	0.201



FRIGG FIELD - OUTLINE FLOW SHOWING POSITION OF COMPRESSION UNITS

NOTE:
- NORMAL OPERATION IS BY 11KOI A and 11KOI B WITH 11KOI C AS STANDBY
- CUT OFF VALVE LOCKS PREVENT SIMULTANEOUS OPERATION OF 11KOI C WITH EITHER 11KOI A OR 11KOI B
- PHASE III B WILL PLACE A SIMILAR EXTRA COMPRESSOR IN SERIES ON EACH LINE WITH STANDBY IN SAME CONFIGURATION AS PHASE III A.
- EACH COMPRESSOR HAS A SUCTION DRUM UPSTREAM AND A COOLER DOWNSTREAM. A WATER SEPARATOR IS PROVIDED ON EACH OF THE TWO LINES JUST BEFORE RETURN TO THE GAS DRYERS.

Fig. 3.1

Design data: Each train:

Flow : $32 \cdot 10^6$ SCM/D

Inlet temperature : 50°C

Temperature after natural gas coolers : 50°C

Min. inlet pressure, compressors : 88.7 barg

Outlet pressure, compressors : 153 barg

Equipment

	Line A	Line B	Line C
Suction Drum	11B01A	11B01B	11B01C
Natural Gas Compressor	11K01A	11K01B	11K01C
Gas Compressor Turbine	11KG01A	11KG01B	11KG1C
Natural Gas Cooler	11E01A	11E01B	11E01C
Water Separator	11B02A	11B02B	

Each item of equipment is identical, for the three streams, but line C does not include a water separator.

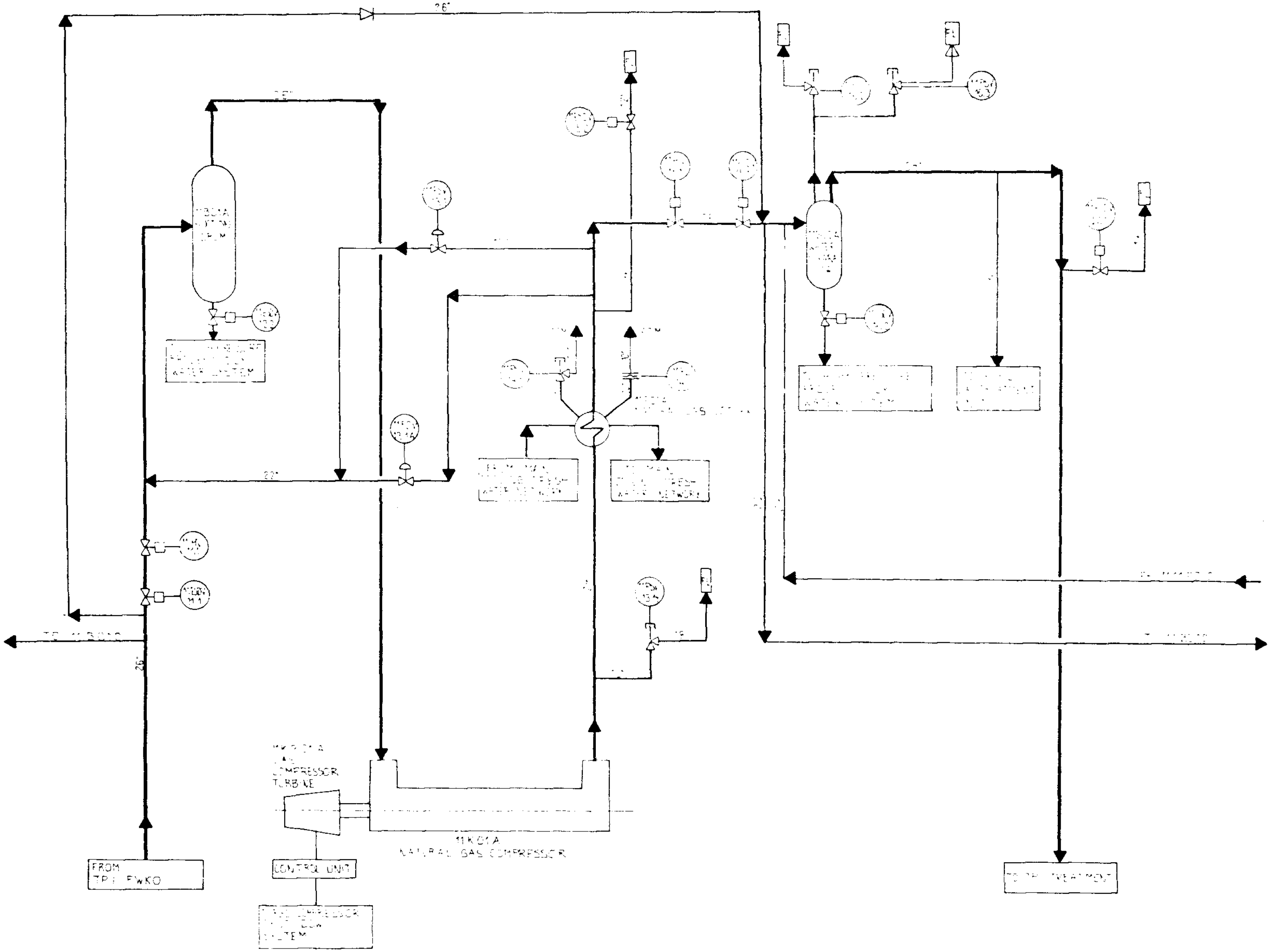


FIG. 32

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS

PHASE I - LINE A

3.2 Compressors

The gas compressors are a NOUVO PIGNONE design, made under licence by ALSTHOM ATLANTIQUE.

The compressors are seven stage centrifugal type and designed for flexible operation under a wide range of input conditions and output requirements.

3.2.1 Operating conditions

Performance at guaranteed point:

Design flow	32 MM SCM/D
Suction pressure	101 barg
Discharge pressure	153 barg
Suction temperature	50°C
Outlet temperature	91°C
Power	21.300 kW
Speed	3600 rpm
Cp/Cv	1.508

Performance at max. operating conditions

Flow	32 MM SCM/D
Suction pressure	88.7 barg
Discharge pressure	153 barg
Suction temperature	50°C
Discharge temperature	105°C
Power	28600 kW
Speed	4200 rpm

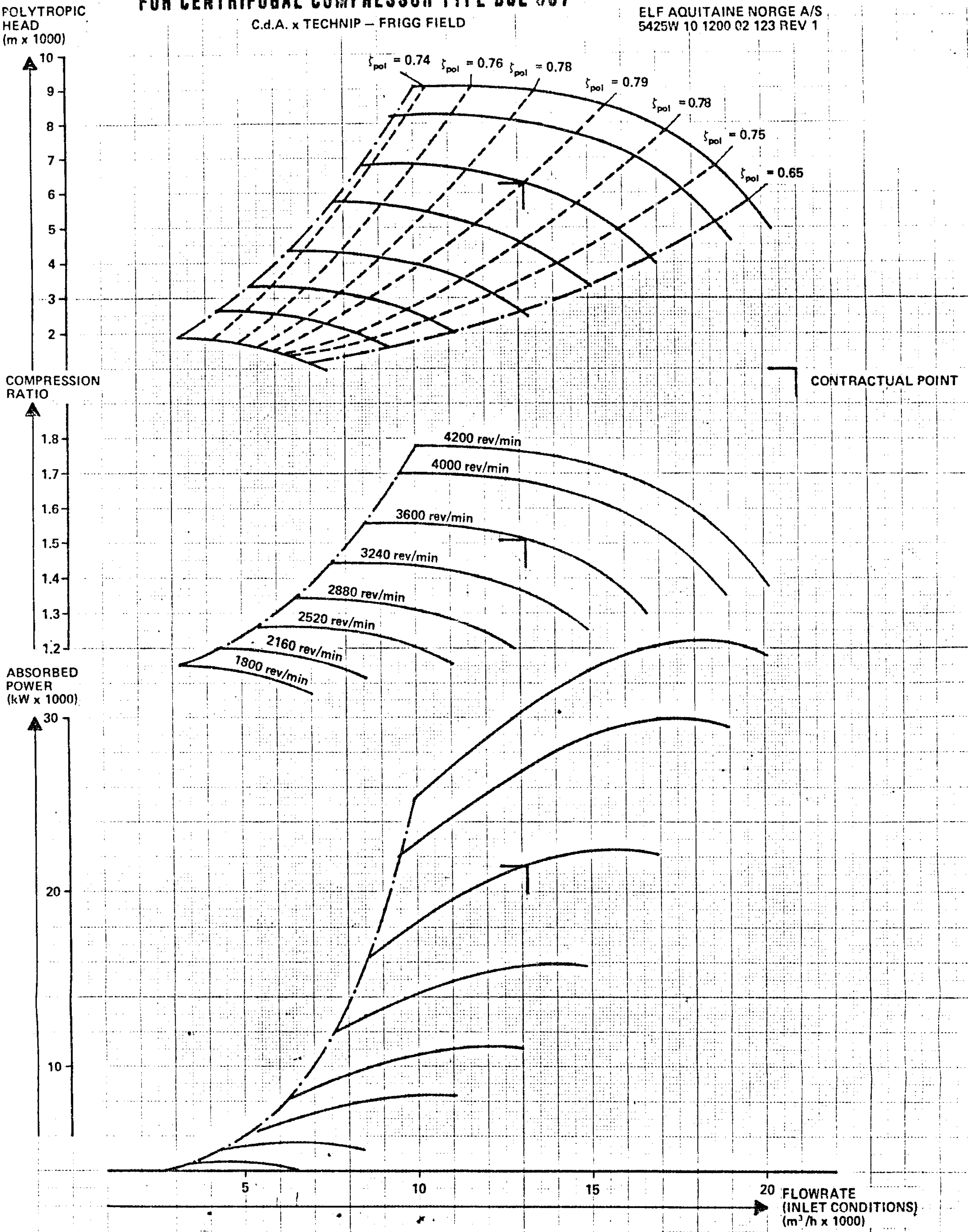
See also performance curves attached, fig. 3.3.

COMPRESSOR PERFORMANCE CURVES FOR CENTRIFUGAL COMPRESSOR TYPE BCL 607

C.d.A. x TECHNIP — FRIGG FIELD

NUOVO PIGNONE
FIRENZE
Comm.
Date 25-2-77
Dis. C.8646 /4
REVISIONI

ELF AQUITAINE NORGE A/S
5425W 10 1200 02 123 REV 1



THESE CURVES ARE VALID AT THE FOLLOWING CONDITIONS ONLY:

GAS HANDLED	:	Natural Gas	COMPRESSIBILITY	:	0.38
MOLECULAR WEIGHT	:	16.854	INLET TEMPERATURE	:	50°C
Cp/Cv		1.54	INLET PRESSURE	:	101 barg

Fig. 3.3

3.2.2 Construction

The compressors are vertically split and have the following main components:

Static unit

- casing
- heads
- diaphragms
- bearings
- seals

Moving unit

- shaft
- impellers
- balance drum

The casing is barrelshaped,closed at the ends by two vertical flanges(heads). Suction and discharge nozzles are welded to the casing. The casing is supported on four feet laid on special pillars. Two of these have provisions for longitudinal positioning.

The heads carry the housings for the rotorbearings. The heads are funnel shaped for greater pressure strength and are strongly studded to the casing.

The diaphragms separate the compression stages and have guidevanes for uniform gas distribution to the impeller suction line.

The rotor consists of a shaft on which impellers and spacers are installed. The impellers are closed backward-bladed type and are shrunk and keyed to the shaft. Before mounting each impeller is dynamically balanced.

To counteract the axial thrust towards the suction end because of the differential pressure generated on the two faces of the impeller, a balance drum is installed behind the last stage impeller.

The rotating assembly is in each end supported by a journal bearing of the tilting pad type. At the shaft end a thrust bearing of the Kingsbury type is installed.

Internal sealing between the compression stages is by labyrinth seals.

3.2.3 Lubrication and seal oil system

To prevent gas leakage, floating bushing oil seals are used. For each compressor a separate system with the following main components are provided:

11 K01 A P02 A/B	Seal oil pumps
11 K01 A B01	Seal oil overhead tank
11 K01 A Y01 A/B	Polluted seal oil tank heaters
11 K01 A T02	Polluted seal oil tank

The seals are fed at a pressure slightly higher than that of the gas inside compressor. The oil is fed from an elevated tank kept under pressure by the gas itself so that during blowdown the pressure in the seals will diminish at the same rate as that of the gas. The overhead tank will ensure continuity of oil flow to the compressor seals for 25 minutes after compressor shut down in the event of pump failure. The overhead tank is fed by two pumps taking suction from the lube oil system.

A separate lube oil system is provided for each compressor. Main components:

11 K01 A P01 A/B/C	Lube oil pumps
11 K01 A S01 A/B	Lube oil filters
11 K01 A S02 A	Lube oil filter
11 K01 A T01	Lube oil tank
11 D01 A P03	Oil clearifier

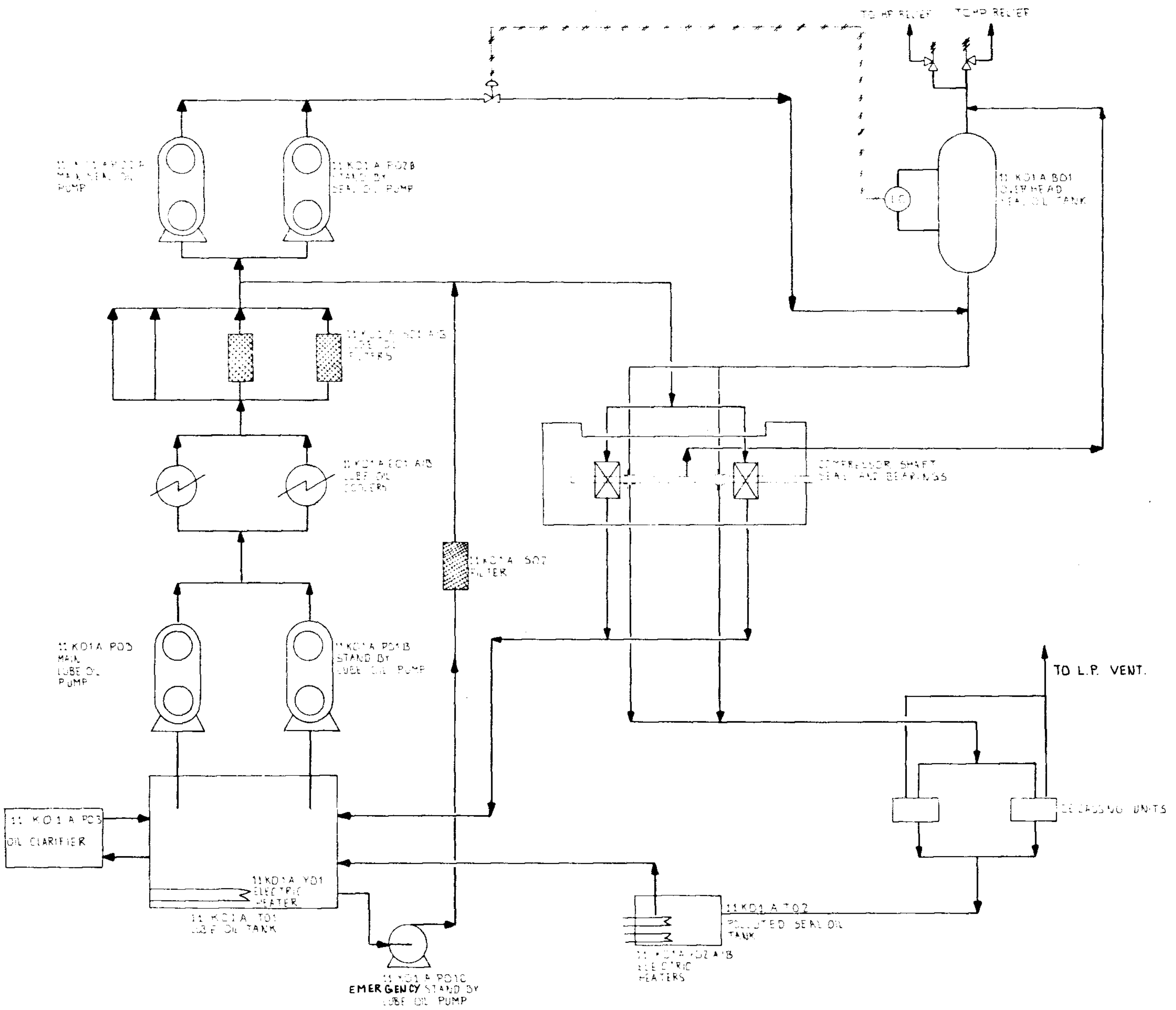


FIG 3.4

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS
LUBE AND SEAL OIL SYSTEM FOR
NATURAL GAS COMPRESSORS

3.2.4 Anti surge

The main 20" anti surge line from downstream of the heat exchanger to upstream of the suction drum incorporates an 8" flow control valve governed by the surge control unit. Under maximum flow conditions an additional 10" line incorporating an on/off 4" valve is opened.

3.2.5 Control

The compressor can be controlled by two modes.

1. Manual: Direct control of gas generator rpm.
2. Automatic: Set by discharge pressure required, monitored by a pressure controller downstream of the compressor. This acts on a stationary power controller which actuates the UTI gas turbine shut-off and modulating valve accordingly. The control system is fail safe; on loss of power the shut-off and modulating valve closes.

Duplicated speed monitors shut down the gas turbine on power turbine/compressor shaft overspeed.

3.2.6 Driver

The compressors are driven by the UTI gas turbines. See section 5.2. The gas turbine and the compressor is connected by a Bendix Coupling.

3.3 Relief system

The compression unit is provided with strategically located pressure relief valves as a secondary protection of pressure containing equipment.

This is done to protect the equipment from overpressure resulting from a fire, or a controller fault causing overpressure at compressor discharge.

The high pressure relief system is centered on the gas compression lines, the low pressure vent system provides relief for the fuel gas system and atmospheric vents originate from very low pressure sources, e.g. tank vents.

3.3.1 High pressure relief system

The high pressure relief system in the compression unit is connected to the high pressure relief scrubber CV 24 in the treatment part, from which the gas is routed to the remote flare.

The high pressure relief header system receives emergency release from pressure safety valves sized for fire protection, compressor discharge pressure relief valves and emergency shut down blow down valves.

The maximum relief rate of 13.05 MM SCMD occurs when a complete compression module is exposed to fire.

The relief pipeline in low temperature steel is designed for a maximum line velocity of 0,4 Mach and a specified operating temperature of $-54^{o}C$.

For blow down see section 3.6.

3.3.2 Low Pressure Vent System.

The TCP 2 Compression is provided with a completely self contained L.P. vent system for safe disposal of natural gas from the following sources:

Emergency releases from equipment operating at low pressure.

- fuel gas package unit
- turbine auxiliary fuel gas systems

Continuous process vents.

- Seal oil drain traps of the natural gas compressors.

Intermittent process vents.

- gas expander starter for turbines.
- main block valve
- low pressure equipment during manual blow-down.

The various releases are collected into a 16 inch vent header and led to the LP vent scrubber for removal of any liquid and disposed to the atmosphere through a vent stack located on top of module 33. The vent stack is equipped with an extinguishing package for the case of accidental ignition of the vented gas. (See detailed description in section 8.3 Fire Fighting). Calculations based on the Prof. Magnussen (University of Trondheim) turbulent flame diffusion method were used to ensure adequate protection against human exposure to the heat in locations close to the flare stack.

L.P. vent stack

height : 33 m above upper deck
diameter: 16 inch. nominal

67 BO1 L.P. vent scrubber

Size: 3.0m ID x 3.5m HT.

3.3.3 Atmospheric vents

A number of tanks and systems have provisions for venting directly to the atmosphere. The following is a list of the main atmospheric vent outlets:

Compressors/Gas Turbines 11KG01 A/B/C

Lube and seal oil system
Combined lube oil system
Fuel gas system
Water wash system

Power Generation Gas Turbines 52GG01 A/B

Gas evacuation
Decompression of shut off valve
Lube oil tank
Bleed valve
Gas generator
Gas shut off valve

Fire Pump Drivers

Diesel engine
Lube oil tank

Emergency Generator Package

Diesel engine
Diesel driven air compressor
Lube oil tank

3.4 Protection against overpressure at compressor discharge.

The protection devices listed below are designed on the following basis, and are the same for the three compression lines.

1. The compressors will not run with a suction pressure higher than 140 bar a.
2. The maximum operating discharge pressure is 154 bar a.
3. Maximum allowable pressure of the protected equipment is 172 bar a.

Pressure control devices

- The discharge pressure controller governs the speed control of the turbine.
- The two recycle valves in the antisurge system are automatically opened by the shut down signal, or by the second pressure switch (PSH2).

Pressure safety devices

A series of pressure safety devices ensure that compressor overspeed, or a blockage downstream, do not have serious consequences.

- The first pressure switch trips the turbine when the discharge pressure reaches a certain level (PSH1).
- The second pressure switch opens the recycle valves if the discharge pressure reaches a level higher than the previous one (PSH2).
- The pressure safety valve located on the compressor discharge line is set at 172 bar as a final protection.

This PSV has a specified flow rate of 10,5 MMSCMD and is not duplicated. When maintenance work is carried out a cut off valve is closed downstream, with a safety instrumentation link to the compressors, ensuring that they cannot start.

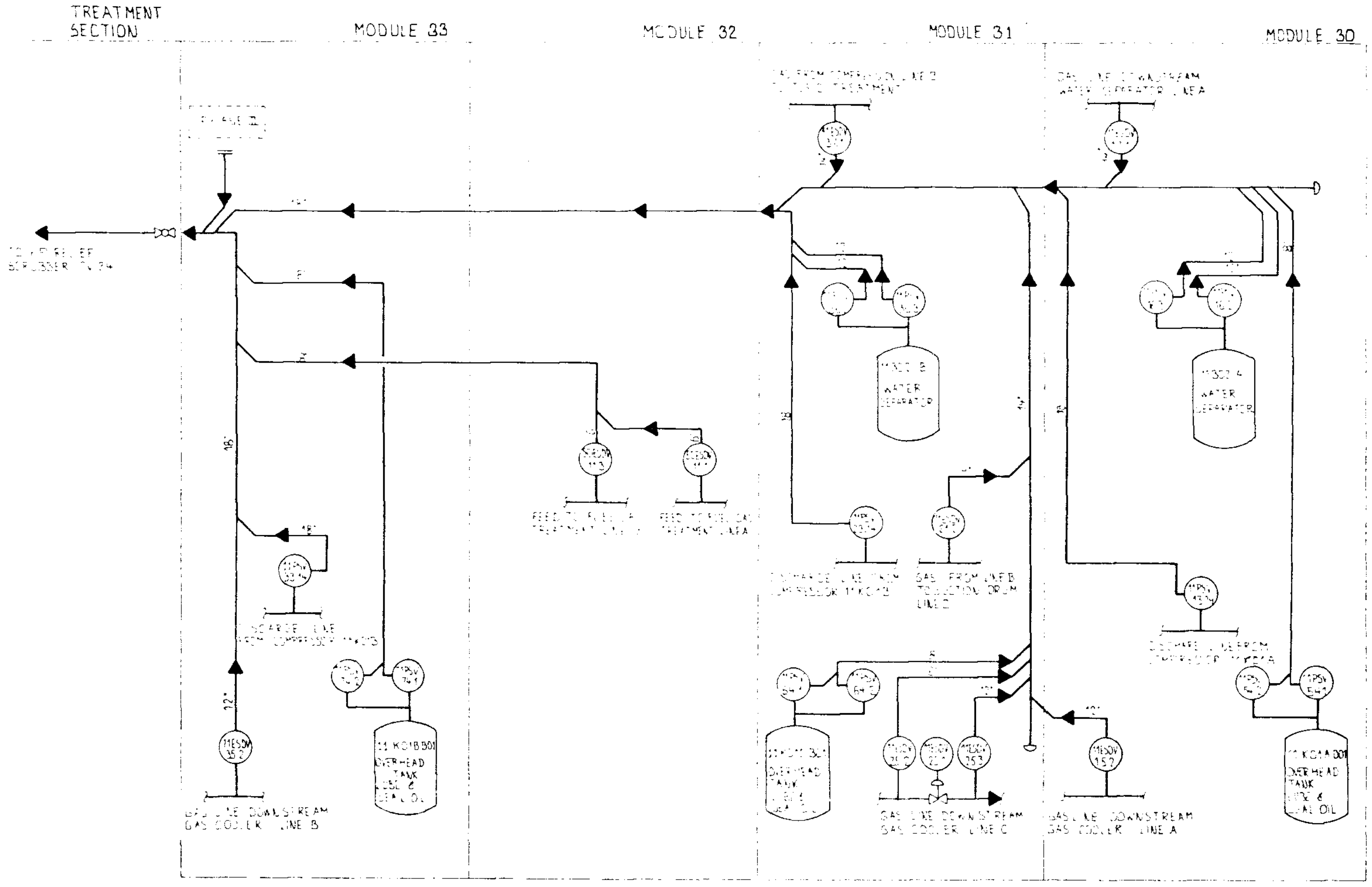


FIG 35

TCP 2 COMPRESSION SYNOPSIS
HP RELIEF SYSTEM

FRIGG FIELD

3.5 Blow Down

In the case of emergency, the processing equipment is sectionalized by means of hydraulically and pneumatically operated emergency shut down valves.

Each section is equipped with one ESD blow down valve which relieves gas from the section to the high pressure relief system.

As for the whole FRIGG FIELD, actuation of any blow down valve is a manual operation under direct supervision of QP central control room operators. The actuation may be done locally, by remote control from TCP2 compression control room or from the QP central control room. The actuation may be done section by section.

As an exeption two automatic blow down actions take place in the compression modules:

1) If a rupture in the compressor seal oil system is detected or if a low level is indicated in the seal oil tank, the module concerned is isolated and blown down immediately.

2) If 380 V power is lost to the seal oil pumps the same action takes place after a delay of 5 minutes.

During blow down the concerned compressor module will be depressurized to 5 bars abs and then isolated from the H.P. relief system using the block valves.

The compressor module blowdown valves and all other blowdown valves are sized for 25 minutes blow down time. However, the automatic blowdown of the compressors is given priority. The manual blowdown for preventing overpressure will start after compressor blowdown has been finished, the blowdown time for the manual sections is 25 minutes.

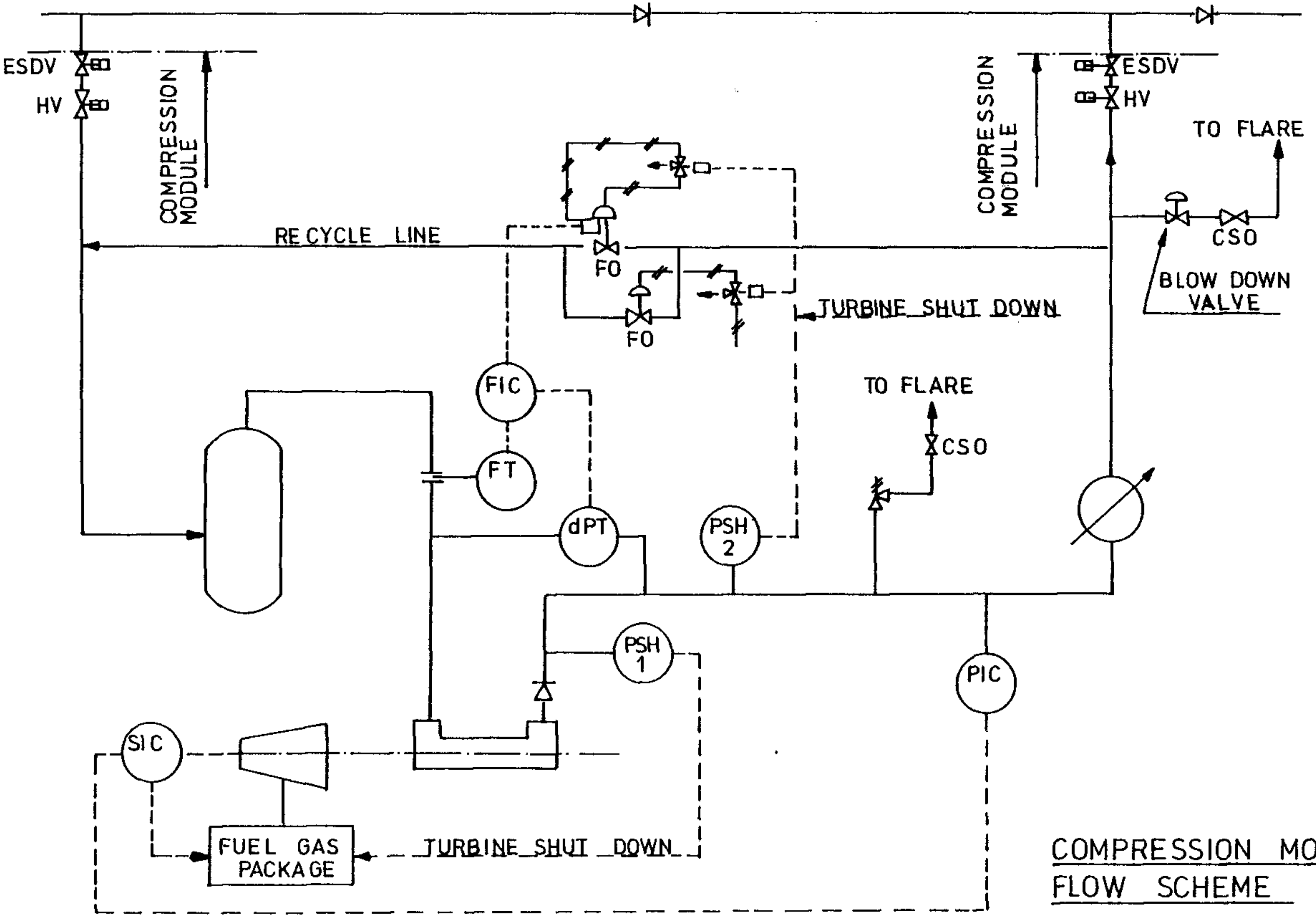
PNEUMATIC OPERATED ESD FLARE VALVES
(blow down valves relieving gas to h.p. relief system)

Valve No.	Line Type
11 ESDV 15.2	Gas line downstream gas cooler line A
11 ESDV 17.1	Gas line downstream water separator line A
11 ESDV 21.2	Gas from line B to suction drum line C
11 ESDV 25.2	Gas line downstream gas cooler line C before 11 ESDV 15.2
11 ESDV 25.3	Gas line downstream gas cooler line C after 11 ESDV 15.2
11 ESDV 37.1	Gas from compression line B to TCP 2 treatment
50 ESDV 11.1	Fuel gas system
50 ESDV 11.3	Fuel gas system
11 ESDV 35.2	Gas line downstream gas cooler line B

Each valve is equipped with a 22 l hydraulic fluid accumulator to operate the valves in case of air supply failure.

HYDRAULIC OPERATED ESD GAS VALVES
(shut down valves for sectionalizing of equipment)

11 ESDV 11.1
11 ESDV 15.1
11 ESDV 21.1
11 ESDV 25.1
11 ESDV 31.1
11 ESDV 35.1



COMPRESSION MODULE
FLOW SCHEME

Fig. 3.8

4. UTILITY SYSTEMS

4. UTILITY SYSTEMS

4.1 Cooling water network

To maintain gas returning from the compressors to the glycol contactors at the required temperature, a heat amount of 32 MM Kcal/hr must be removed from each gas stream. This is provided by a fresh water cooling system, itself cooled by sea water drawn from column 3 and discharged through column 5.

The cooling water network thus comprises two main circuits described below. The main circuits are shown on the attached schematics figure 4.1 and 4.2. The utilities cooling, fresh water make up and sea water rejection are shown on the attached figures 4.3, 4.4 and 4.5 respectively.

4.1.1 Fresh water circuit

The fresh water circuit comprises the main cooling fresh water network and the utility cooling fresh water network. The fresh water is supplied with an anti-corrosion medium from two Dosopro injection pumps. Triethylene glycol (TEG) is added to the circuit to act as an anti-freeze agent.

In the main cooling circuit fresh water is supplied by one of two horizontal centrifugal pumps at a rate of 2000 m^3/hr and 7,6 bars to the natural gas coolers. These are of the shell and tube type with gas in the tubes. The coolers are equipped with two security devices.

a) Rupture disc

b) Safety valve.

The returning fresh water is cooled in the sea water/fresh water plate exchangers made of titanum.

In the utility cooling circuit fresh water is supplied by one of two horizontal centrifugal pumps to:

- Air conditioning package refrigerant
- Compressor gas-generator lube-oil coolers
- Fuel gas heaters make up
- Turbo-generator turbine lube oil coolers
- Turbo-generator alternator & exciter coolers
- Air compressor package.

The fresh water/TEG pipes, exchangers and pumps are drained into the cooling fresh water/TEG drain tank.

4.1.2 Sea water circuit

Sea water cooling for the plate heat exchangers is pumped directly from the sea in column 3 and is discharged to the sea through column 5. Four submerged sea water pumps made by KSB and Thune-Eureka are situated in column 3. The considerable variation between maximum and minimum sea water level was taken into account for pump head and hammer calculation. The pumps are coupled in parallel and normally two are in operation providing a flow of 4000 m^3/h at a pressure of 2,5 bar. Each has an inlet filter and a hydrostatic seal. The latter is maintained at the correct pressure by a pneumatically controlled and pressured water tank situated above on the cellar deck. A stainless steel self cleaning water strainer is situated in the circuit above column 3. The strainer is self cleaning by back flush on pressure differential.

Pipe material

Because of weight considerations and the very high corrosion allowance with carbon steel pipe a cupro-nickel alloy was selected. This pipe was specially welded by the supplier subcontractor, all work - except hook-up between modules - taking place onshore. Because of the difficulties of cold working this material, bends are composed of several welded segments. The design sea-water velocity in these pipes is 3m/s, well within the criterion of threshold sea water velocity of 3,5 m/s for erosion/corrosion problems for the material.

Water hammer

Much attention was given to the question of hammer in the sea water line just above the submerged pumps. When these pumps stop the inertia of the water could cause a partial vacuum in this part of the line. A special air inlet check valve is therefore provided at the high point downstream of the coolers to draw in air to avoid the formation of a vacuum. Another air trap valve is provided at the high point upstream of the plate heat-exchangers for releasing the air thus induced, when the system is started-up again.

Sea water rejection

The two water rejection shafts in column 5 are designed to absorb most of the kinetic energy of the circulating water before it reaches the reinforced concrete discharge chamber formed in the wall of the column and thus avoid destruction of the chamber concrete by impact of water droplets. This is done by circulating the water via four helical vanes down through the column close to the wall, the middle being open to the atmosphere. The column is flanged and assembled in sections. The outfall is just below the once per century minimum water level of 64.7 m (relative to cellar deck = 100).

The rejection shafts are made from AVESTA 254 SMO stainless steel. The water velocity in the outfall shafts is considerably above the maximum of 3,5 m/s allowed for cupronickel and can be up to 17 m/s and for this reason this specially erosion resistant high alloy stainless steel was chosen.

For full description of corrosion risks of sea water circuit see SP 5424W.1674.01.

4.1.3 Equipment

Details of main pumps

Sea water pumps - location col 3.

58 P01 B	Thune Eureka	515 KW	2000 m^3/h
58 P01 D	Thune Eureka	515 KW	2000 m^3/h
58 P01 A	KSB	500 KW	2000 m^3/h
58 P01 C	KSB	500 KW	2000 m^3/h

Main fresh water TEG pumps - situation PK 42

58 P02 A	Dresser	400 KW	2000 m^3/h
58 P02 B	Dresser	400 KW	2000 m^3/h

Utilities fresh water TEG pumps - situation PK 42

58 P04 A	Thune Eureka	100 KW	460 m^3/h
58 P04 B	Thune Eureka	100 KW	460 m^3/h

Gas/Freshwater heat exchangers

Location - top of modules 30, 31, 33

11 E01 A	Creusot Loire
11 E01 B	Creusot Loire
11 E01 C	Creusot Loire

Design pressure: shell side : 7 bars
tube side : 171 bars

Materials

Shell : A 48 FP 2
Tube bundle : A 334 Grl

Construction

- Fixed tube sheet with welded tubes

Tube area : 859 m^2

Sea water/fresh water heat exchangers

Location: pancake 43

58 E01 A1 APV
58 E01 A2 APV
58 E01 A3 APV
58 E01 A4 APV

Temperature Ranges:

Based on gas temperature out of the heat exchangers of 50°C.

Sea water	in 10°C	out 24°C
Fresh water	in 43,5°C	out 15°C

Design pressure : 6.9 bars

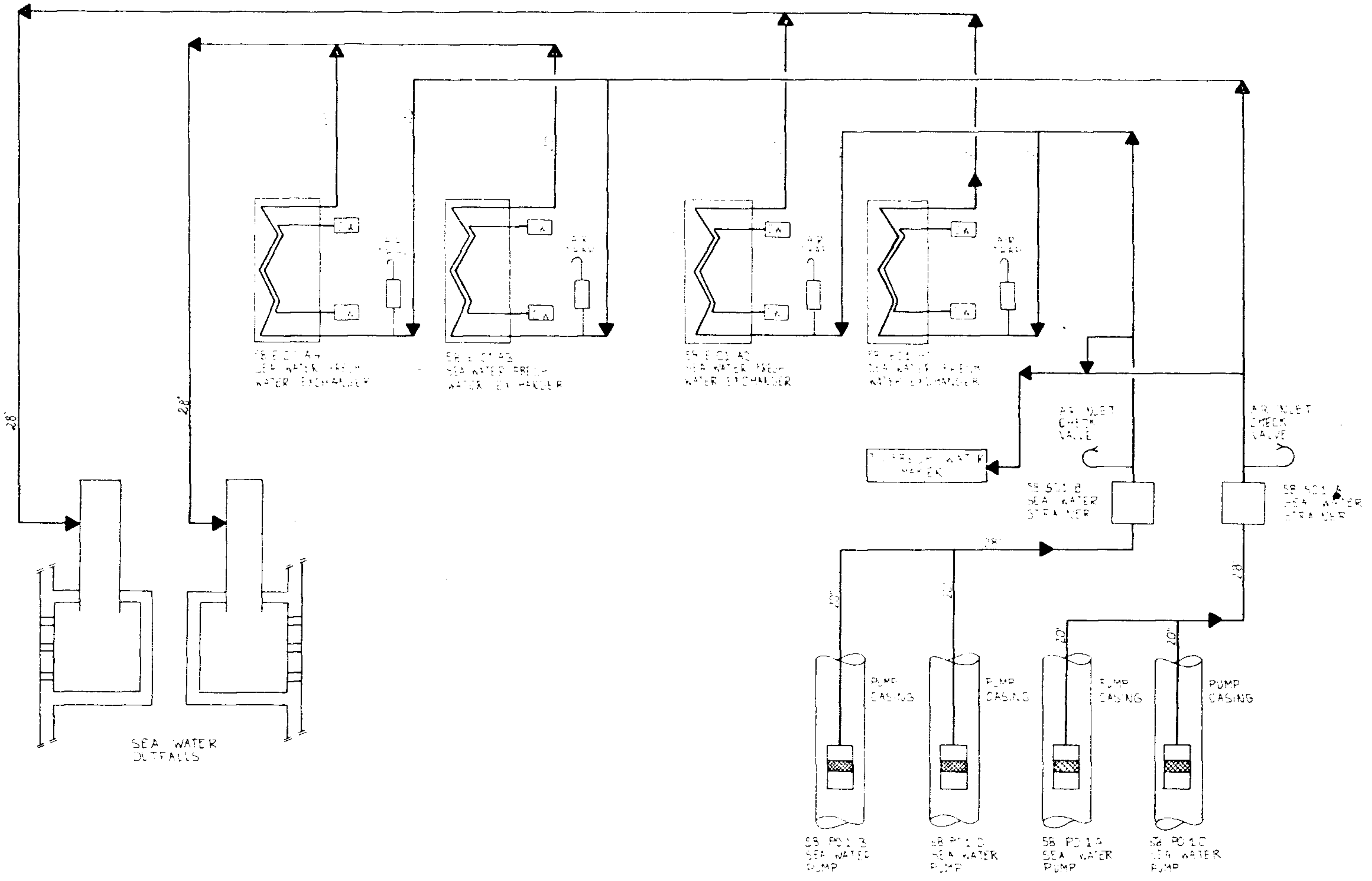


FIG 4.1

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS

MAIN SEA WATER NETWORK

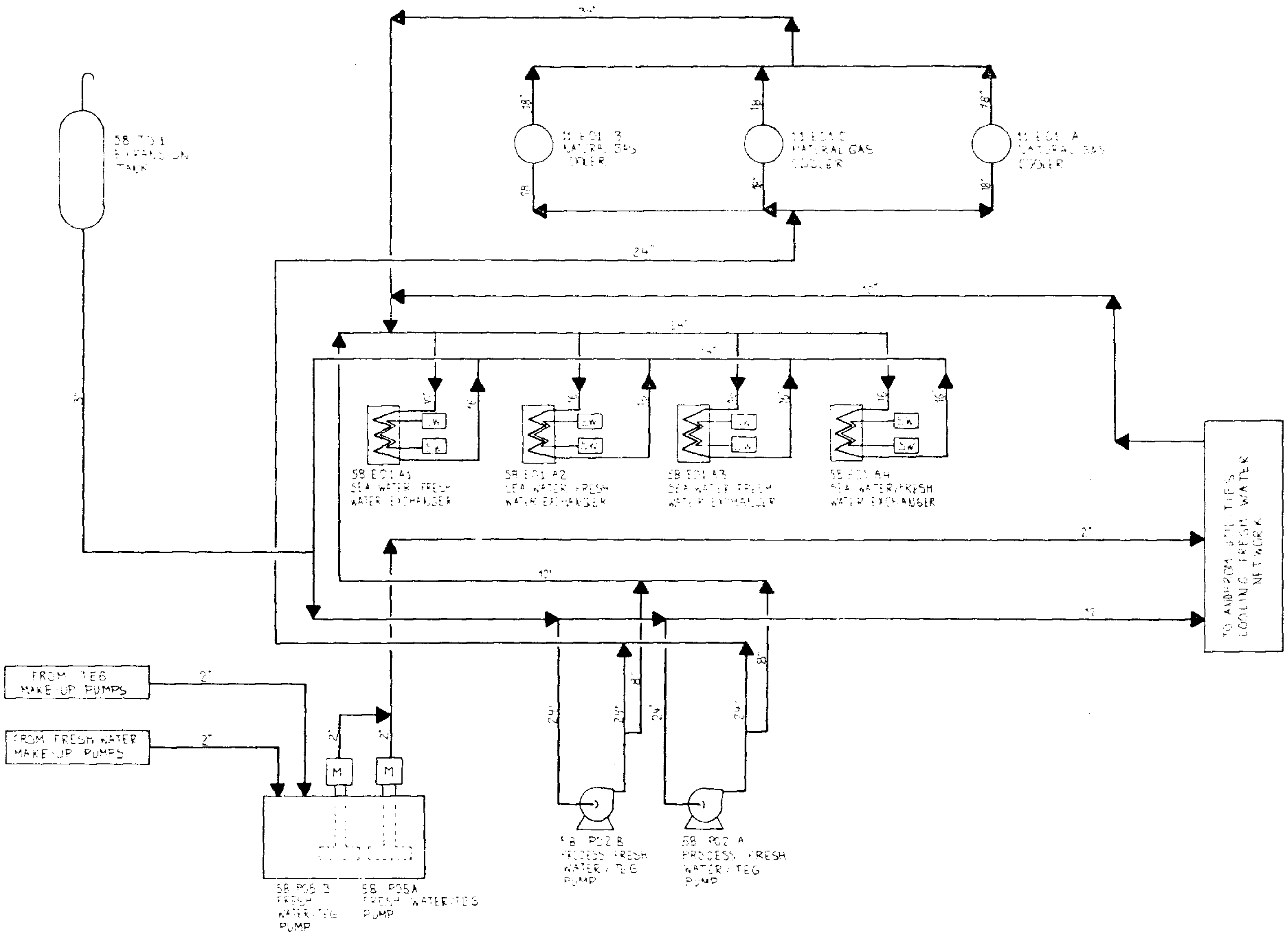


FIG 4.2

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS
MAIN FRESH WATE R
COOLING NETWORK

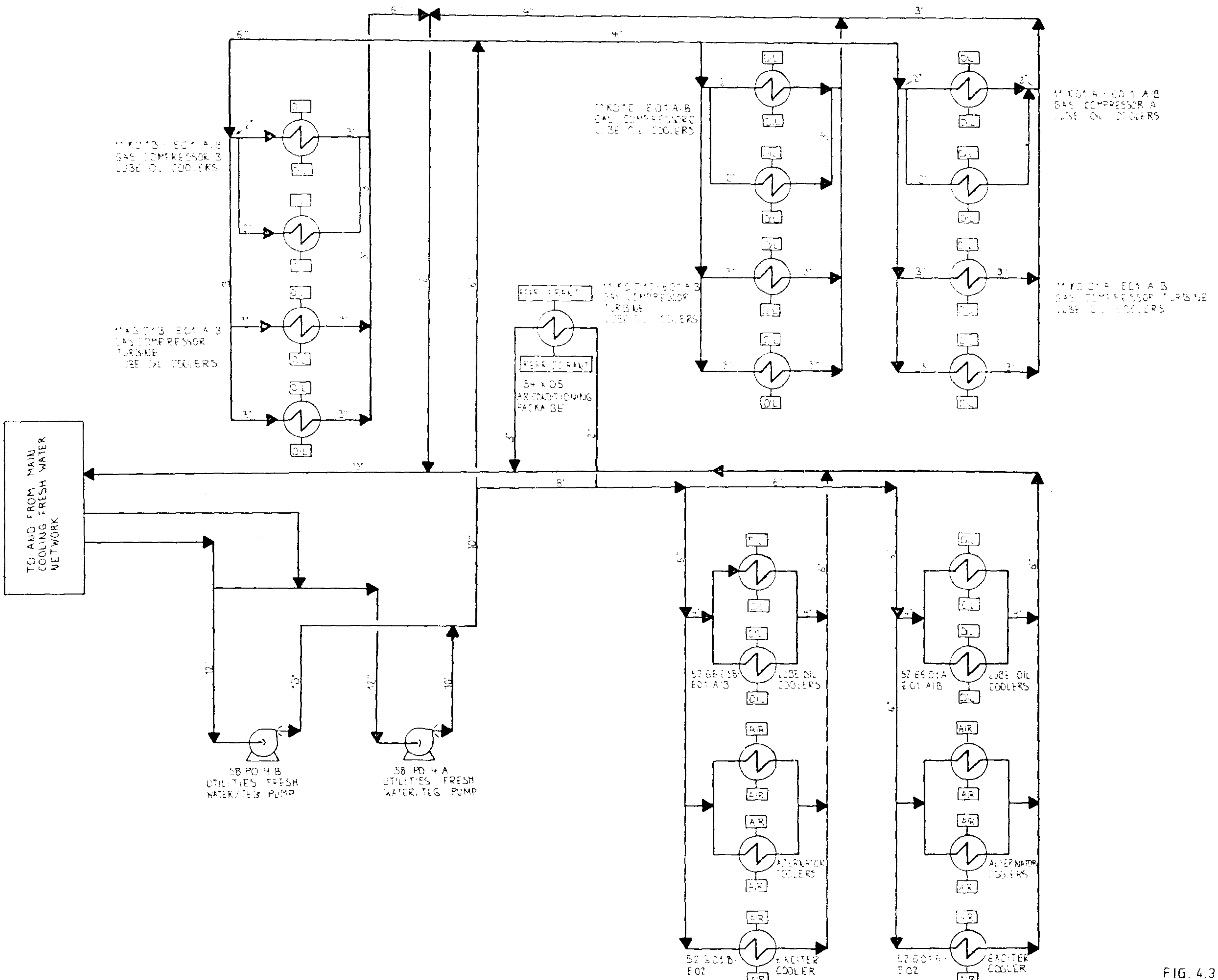


FIG. 4.3

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS
UTILITIES FRESH WATER
COOLING NETWORK

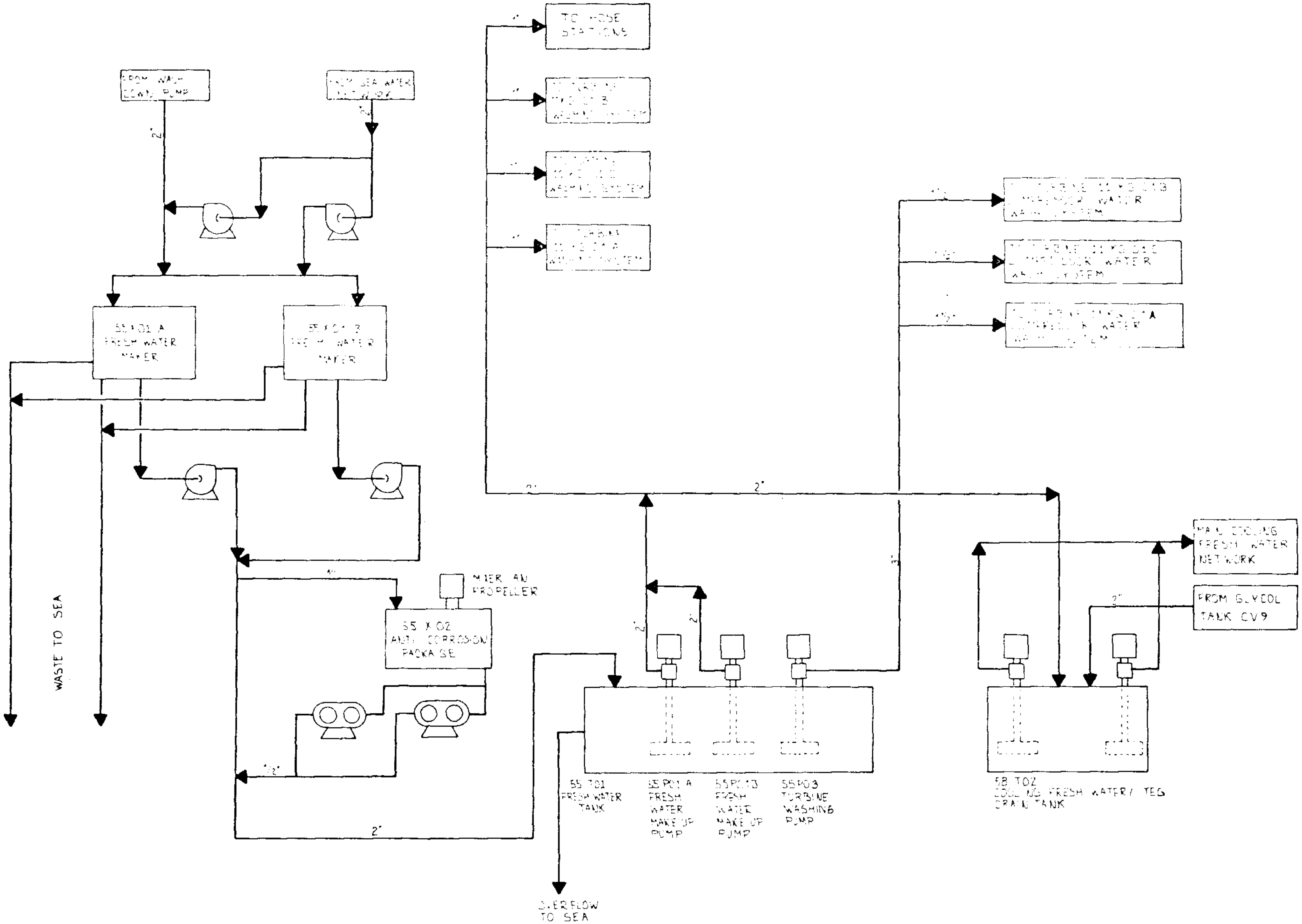


FIG. 4 4

TCP 2 COMPRESSION SYNOPSIS
FRESH WATER MAKE- UP AND
DISTRIBUTION

FRIGG FIELD

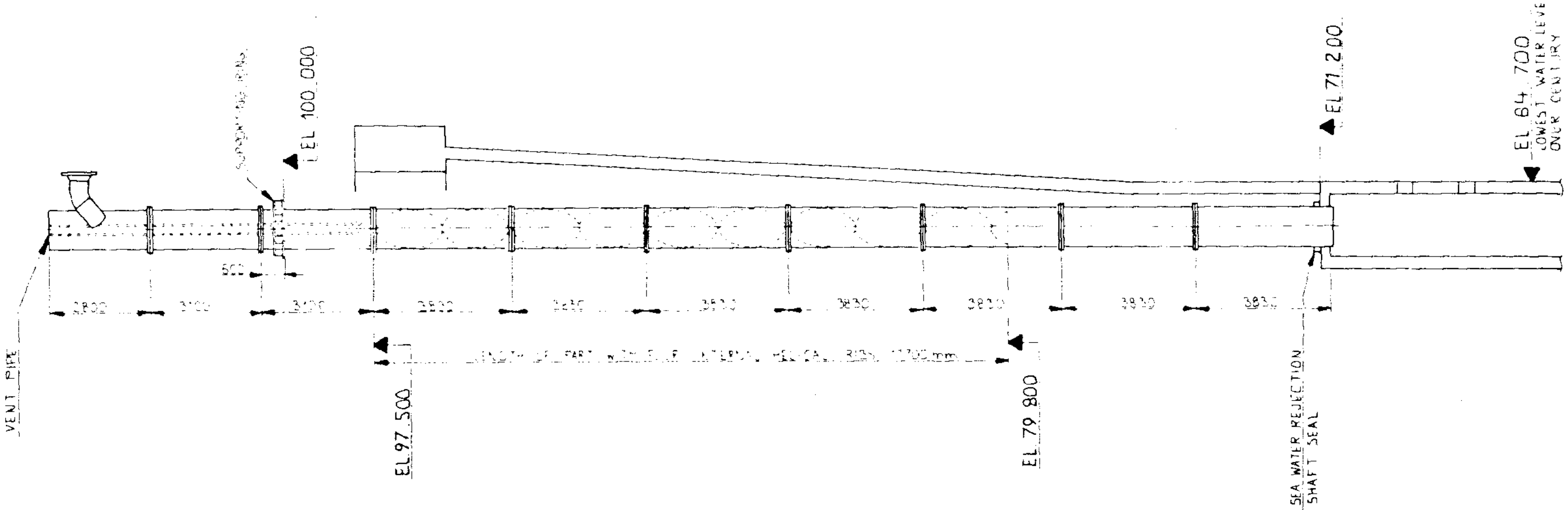


FIG 4.5

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS
SEA WATER REJECTION SHAFTS ARRANGEMENT

4.2 Instrument and service air

Instrument and service air is supplied by two air compressors located in PC 42.

The compressors are of the reciprocating type and are manufactured by Worthington.

The air is compressed in two stages with the discharge pressures of 3.94 bar and 11.54 bar after the first and second stage respectively. Between the stages and after the second stage the air is cooled by an intercooler.

The compressors are driven by electrical motors rated at 110 kW.

Capacity for the instrument air section is based on total load of all connected loads using 100% load factor.

Before the air is sent to the consumers it is cooled, filtered and dried. Filters will remove all particles larger than 5µ.

Technical data and performance:

Discharge pressure	: 11,54 bar
Discharge temperature	: +45°C
Dew point	: -30°C at 11,54 bar
Flow	: 760 Nm^3/h
Receiver capacity	: 14 m^3

From the receiver the air is distributed to the consumers:

Service air

- Compressor turbine washing system
- Gas compressors (sealing air)
- Fuel gas system

Instrument air:

- Pneumatic circuits

Main components:

57X01 K01 A/B	Air compressors
57X01 T04 A/B	Discharge bottle
57X01 T01 A/B	Interscrubber
57X01 E01 A/B	Cooler
57X01 T02 A/B	Discharge scrubber
57X01 B01 A/B	Air dryers
57X01 T01	Air receiver

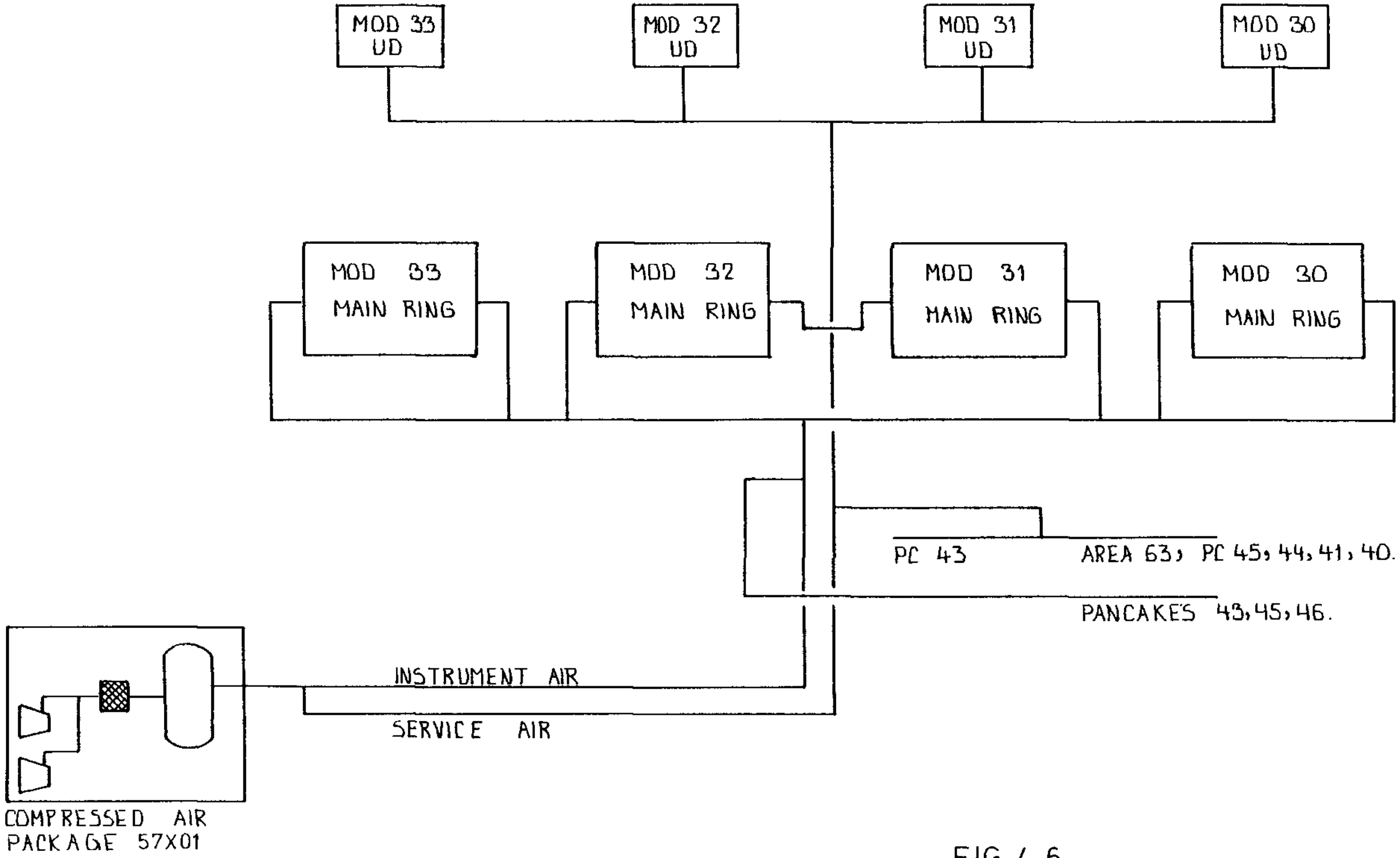


FIG. 4. 6
INSTRUMENT AND SERVICE AIR

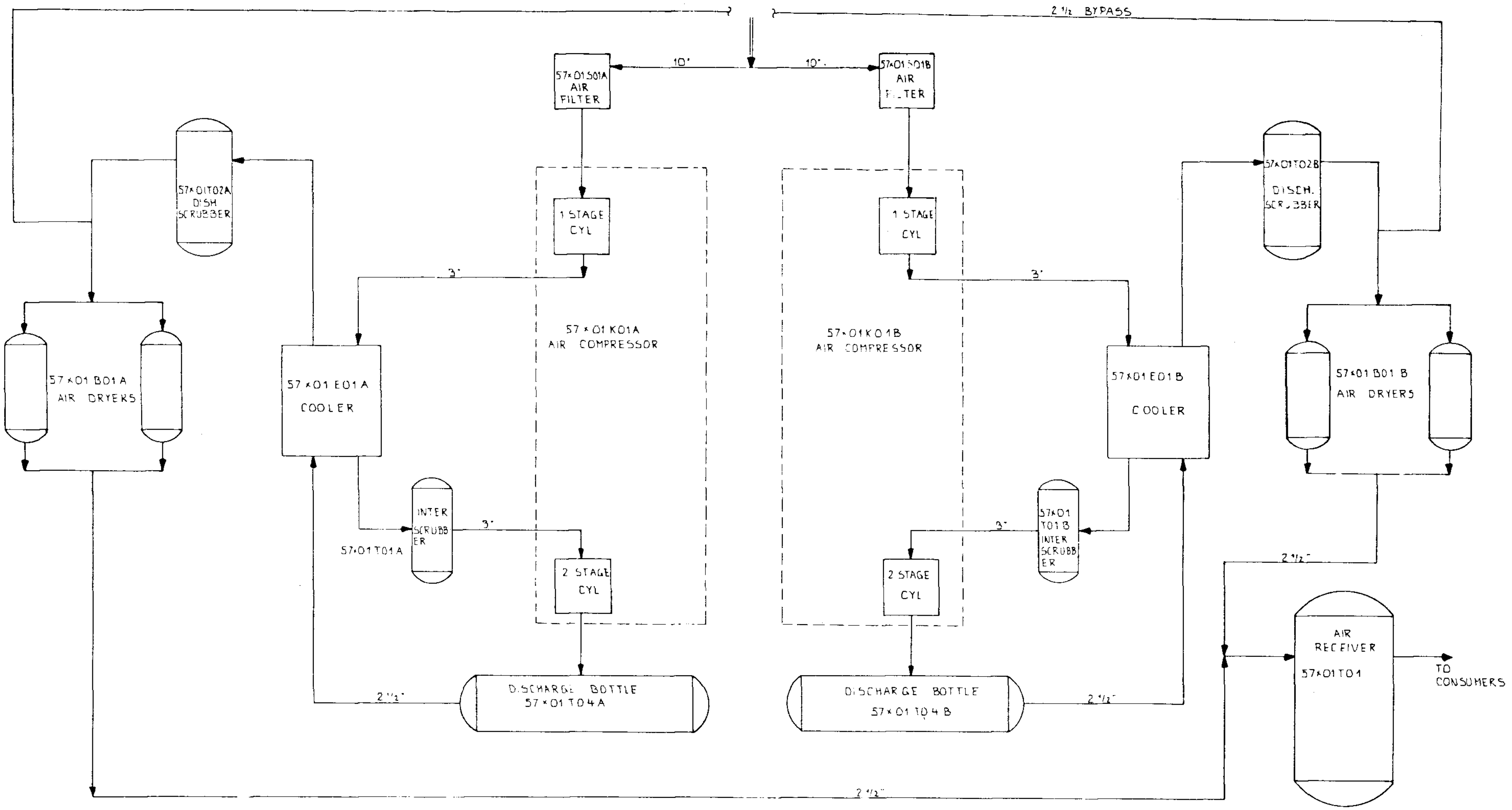


Fig 4.7

TCP 2 COMPRESSION SYNOPSIS

AIR COMPRESSORS

FRIGG FIELD

4.3 Hydraulic system

The hydraulic system feeding the main line ESDV's is a circuit pressurized at 206 bar by a central power unit comprising hydraulic oil reservoir, two pumps and accumulator. The hydraulic fluid applied has a viscosity of 77 cSt at -9°C.

The accumulator is used as damper and back up system. The two pumps work in parallel during charging of the accumulator, after which one goes on standby with automatic start if circuit pressure drops to 173 bar.

A low pressure alarm is signalled to the control room at 124 bar with a low level alarm and shut down at 103 bar.

Safety valves are set at 214 bar.

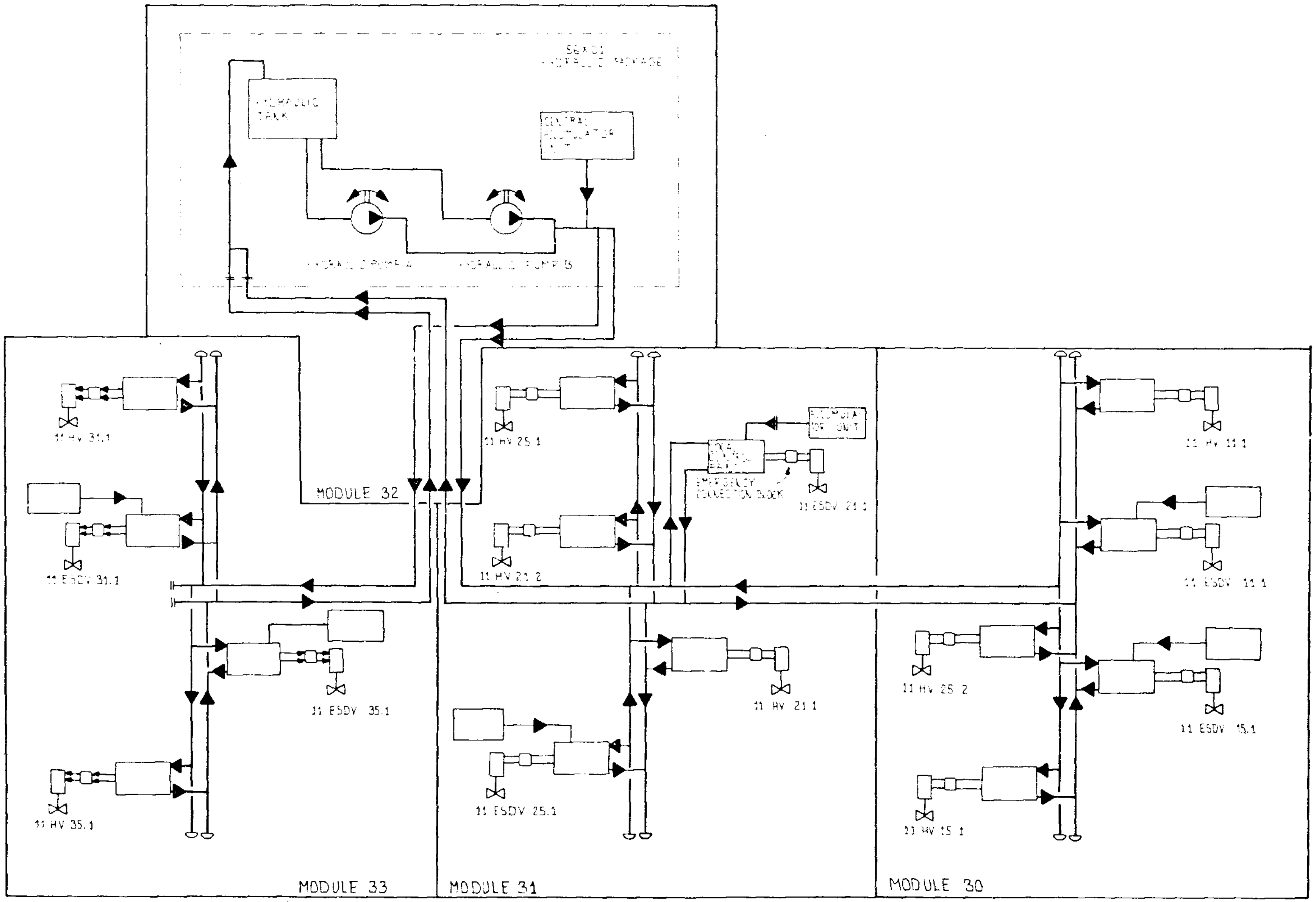


FIG 4.8

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS

HYDRAULIC SYSTEM

4.4 Wash down system

4.4.1 System description

The wash down system consist of a submerged pump feeding a ring line. This has spur lines to the firewater main, seawater network and connections to the treatment area. The pump also feeds the fresh water makers. The ring line also feeds hose stations on cellar, main- and upper deck. A dump line to sea is installed for pump testing.

4.4.2 Equipment

50 PO 2 WASH DOWN PUMP

Make : KSB

Position : Area 63

Capacity : 113,6 m^3/h

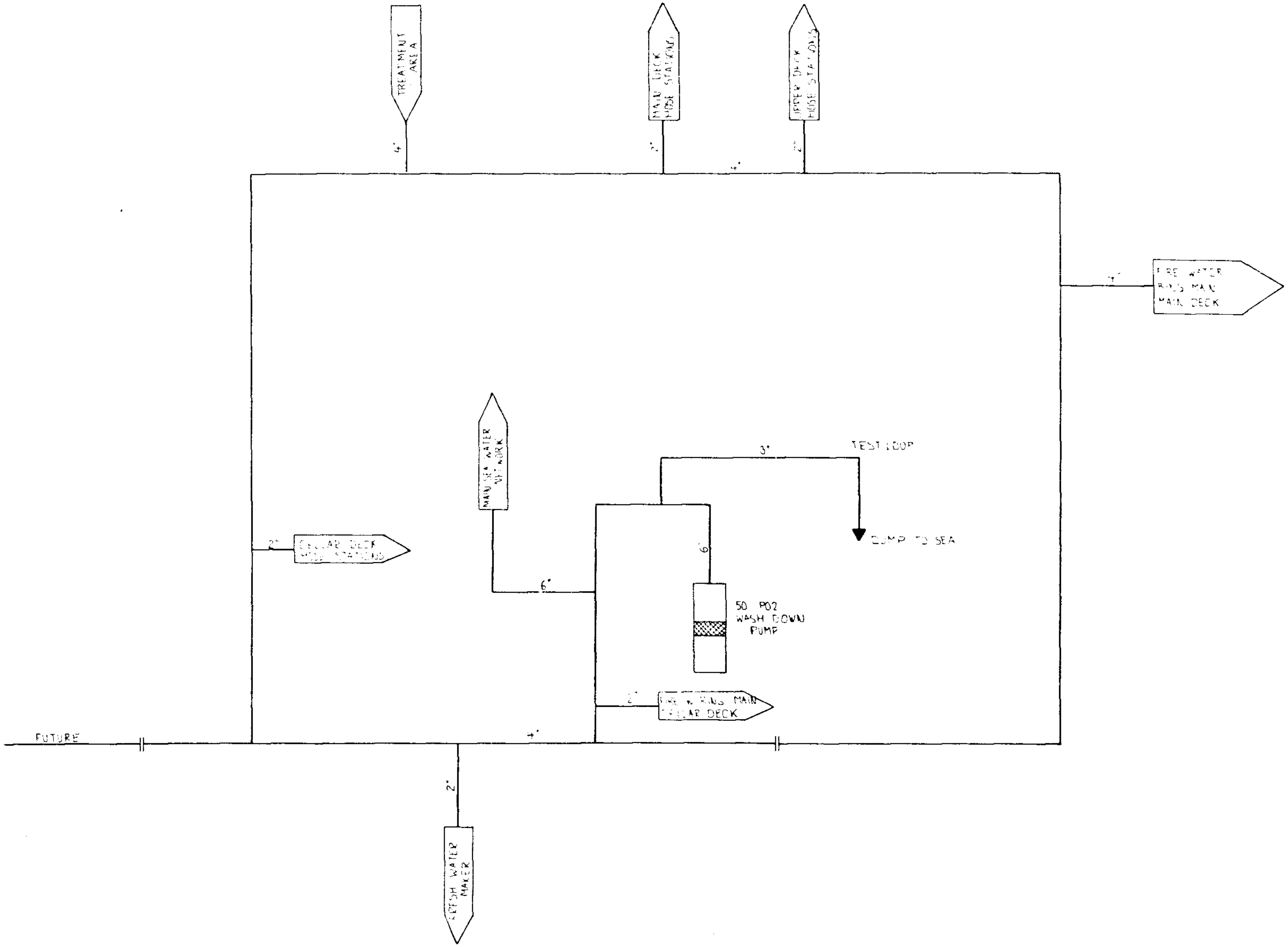


FIG 4.9

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS

WASH DOWN SYSTEM

4.5 Diesel oil system

Diesel oil is supplied to the consumers from the diesel tank in the treatment area.

Consumers:

68P01 A/B	Fire pump engines
53GD01	Emergency diesel generator engine
60X01	Pedestal crane diesel engine
53GD01K02	Air compressor for emergency generator diesel

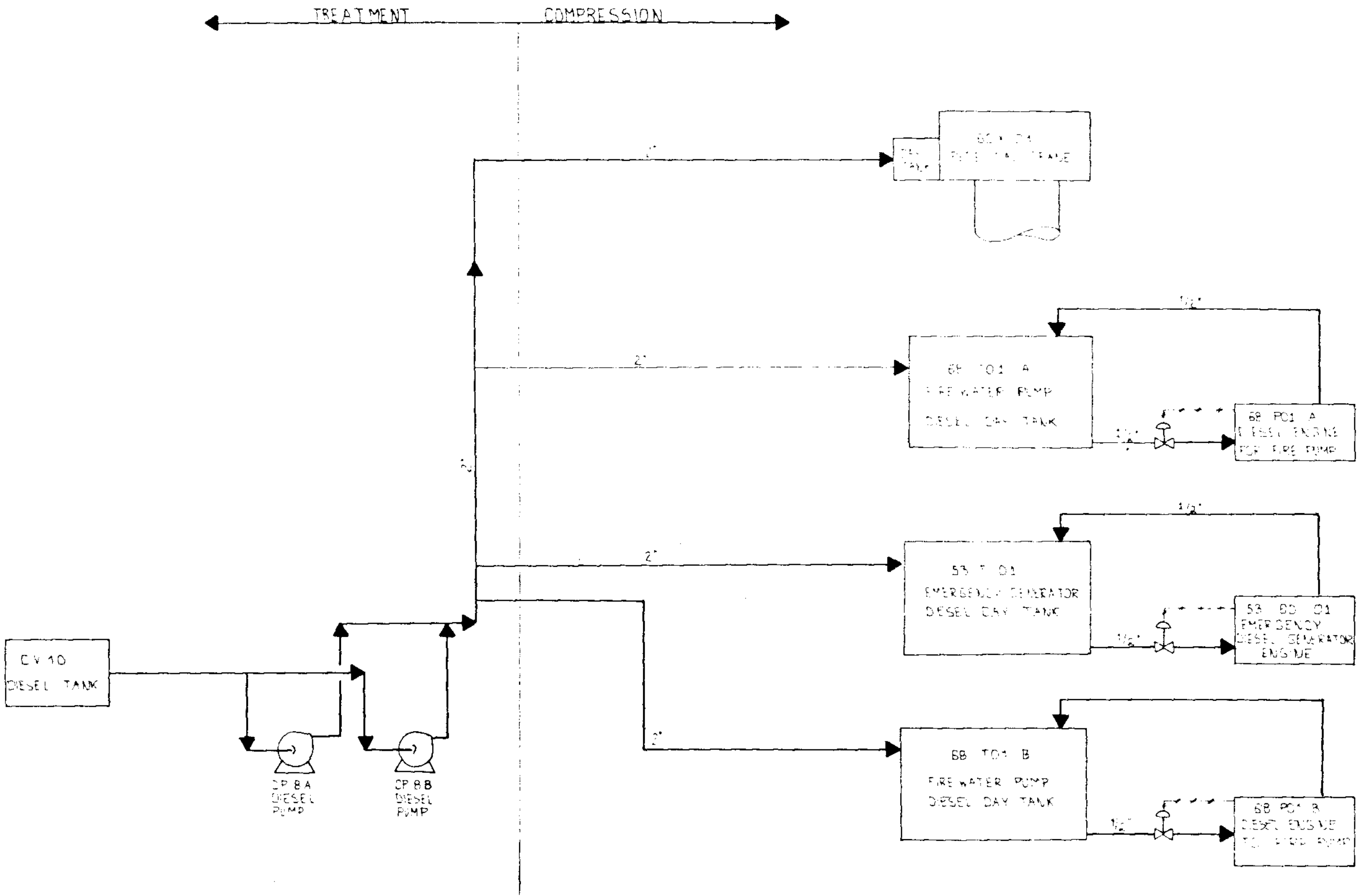


FIG 4.10

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS

DIESEL OIL SYSTEM

4.6 Fuel gas

In normal operation TCP2 Compression will use natural gas for powering the turbo compressors and turbogenerators.

4.6.1 System description

Fuel gas is taken from one of the sources:

Glycol contactors CV2 A/B/C on TCP2 Treatment
Dry gas from TP1
Discharge from 11 KO 1A

Untreated fuel gas is used for LP-vent purge. Treated fuel gas is used for turbocompressors: 11 KG 01 A/B/C and turbogenerators 52 GG 01 A/B and treated in a package supplied by ACB and situated on top of module 32. Small auxiliary fuel gas packages local to the compressor turbine and generator turbine are supplied by the respective manufacturers.

The fuel gas is treated in one of two lines to avoid inline condensation and to comply with the pressure and minimum temperature requirements by turbine vendors. The ACB package reduces the gas pressure to 19 bara with maximum liquid hydrocarbon and water recovery by cold fractionating. Max. temperature is 5°C and dew point -10°C (in L.T. separator).
The lines consists of:

ITEM NO	
50X07-EO/A/B	Fuel gas heater
50XO/A/B-EO1	Fuel gas heat exchanger
50XO/A/B-BO1	Fuel gas scrubber/L.T. separator

The fuel gas heaters have a separate heating medium, (fresh-water) electrically heated.

Methanol can be injected into the fuel gas after the fuel gas heater to avoid hydrate formation, problems that may occur during cooling and pressure reduction of untreated gas from 11K01A. Condensate is separated from the gas in the fuel gas scrubber.

Before entering the turbines the fuel gas is passed through a K.O. pot and a filter.

The gas composition is given in section 3.1 page 3.1.

4.6.2 Fuel gas metering

Parameters for fuel gas metering are derived from transmitters installed in the fuel gas line to the compression and power generation turbines, down-stream of the ACB fuel gas treatment package.

Following instrumentation is applied:

- orifice plate flow transmitter
- pressure transmitters
- temperature transmitters.

Recorders for flow rate, temperature and pressure are arranged locally close to the metering station, in the Compression Control Room, and in Quarter's Control Room; signals to the latter transmitted to Quarter's Platform via the telemetry system.

The measuring tubes are duplicated to enable in-service calibration.

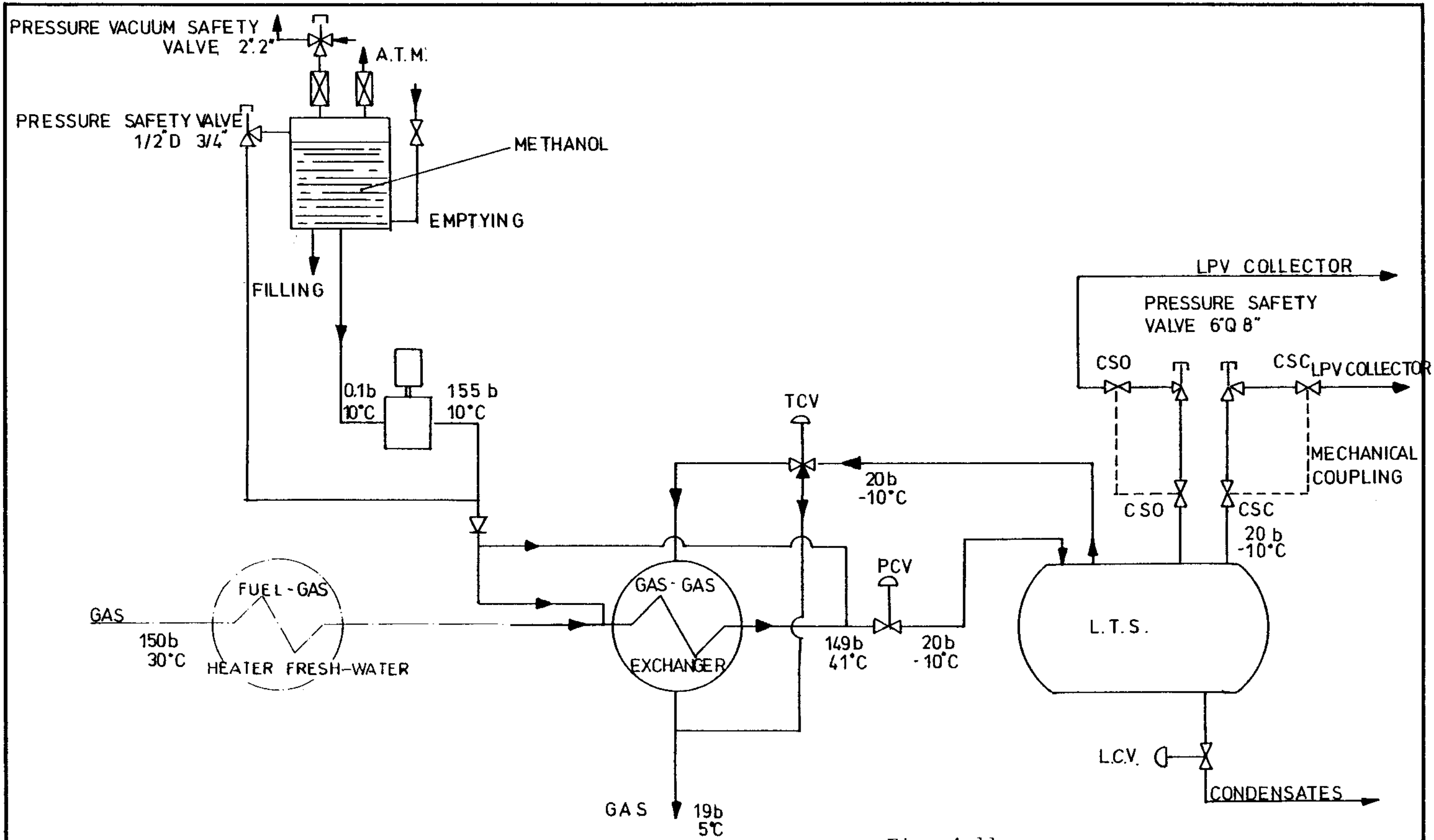
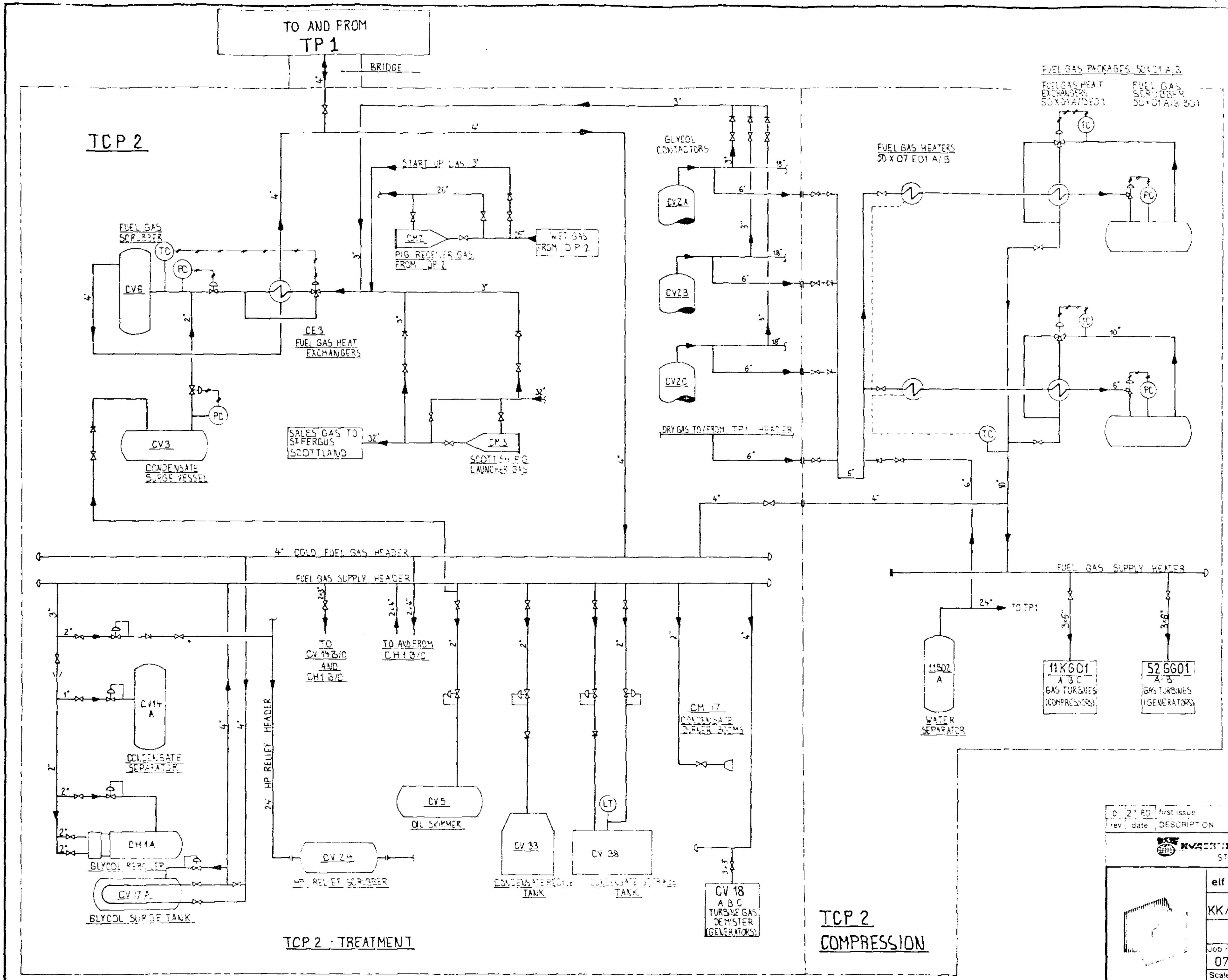


Fig. 4.11
FUEL GAS PACKAGE



REF. DRAWINGS

P/D'S
TREATMENT

ELN 2169 C 4005
ELN 2169 C 4010
ELN 2169 C 4011
ELN 2169 C 4012
ELN 2169 C 4013

ELN 2169 C 4014
ELN 2169 C 4015
ELN 2169 C 4016
ELN 2169 C 4017
ELN 2169 C 4018
ELN 2169 C 4027

COMPRESSION
ELN 2169 C 4008
ELN 2169 C 4010

5424 W 1100 3001 Sh 1
5424 W 5000 4001

FIG. 4.12

rev	date	DESCRIPTION		
0	2.1.80	first issue	SIV	KK

KVÆRNER ENGINEERING A.S
STAVANGER

elf aquitaine norge a/s

KK/SIV
Installation TCP 2
System

Job no 0732
Scale

FUEL GAS SYSTEM ON TCP 2
SCHEMATIC DIAGRAM

FRIGG FIELD
Drwg no FF 87 00 00 10 08
Rev.
Sheet

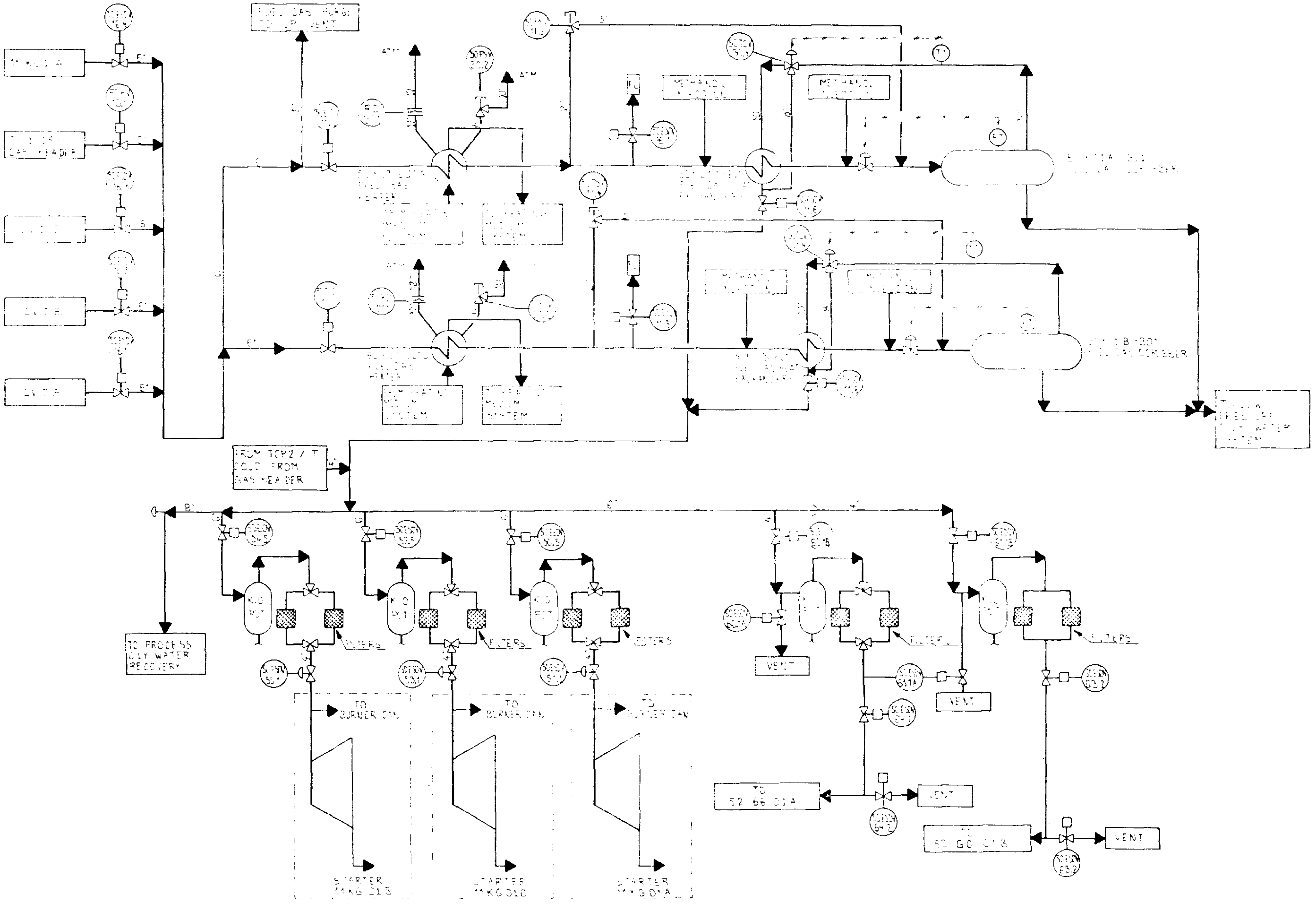


FIG. 4.13

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS

FUEL GAS SYSTEM

4.7 Drainage

4.7.1 General

The compression part of TCP 2 has five drainage systems:

- Open deck drainage from classified zones
- Open deck drainage from safe zones
- Low pressure process drainage
- Medium pressure process drainage.
- Closed fresh water/TEG drain system

The drainage is in conformity with the NPD Regulations (Clause 3.4.7) and is designed to clear the maximum load of firewater. For the basis of firewater release calculations, see section 8.3.2.

4.7.2 Deck Drainage

Open deck drainage from safe zones

The safe areas having drains drain directly to sea.

The areas are:

Fire pump room

Turbo generator room

Stal Laval H.P. air unit	- sea
Outlets from bottom of turbine to drain cleaning water (no floor drain)	- sea

Emergency generator room

Floor drain - sea

Open deck drainage from classified zones

The other zones on TCP2/C are classified. The open drains from these lead to the existing sump caisson CV13 on TCP2/T. Each gulley is equipped with a 80 mm hydraulic guard. In accordance with common refinery practice blinds are provided for isolating sections of the drainage system. The CV13 has a spare 12" inlet with syphon seal of approx 1 m. to which the new flow line is fitted together with a flow meter and an infra red pollution counter. Day tanks in safe zones are led to this system.

4.7.3 Process drainage

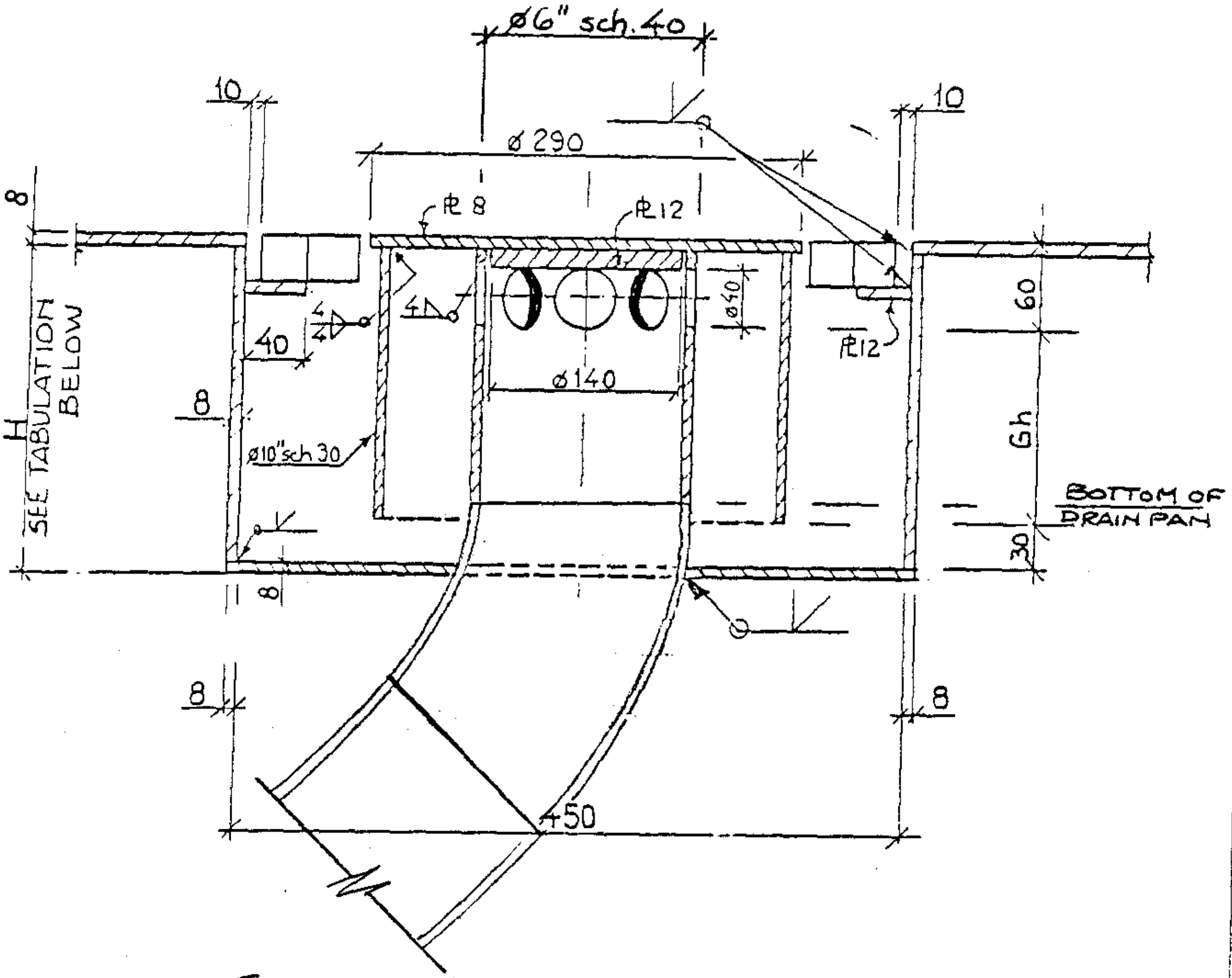
The process is drained by two closed drain systems, for low and high pressure oily water.

High pressure oily water system

The high pressure drainage leads slops from suction drums, compressors and water separators on TCP2/C to CV3 on TCP2/T. Slops are discharged from the five water separators in an intermittant operation and arrive at CV3 via a choke - to reduce pressure to 12 bar.

Low pressure oily water system

The remaining process drainage is discharged at a lower pressure (3,5 bar) from TCP2/C and leads to the oil skimmer CV5 on the TCP2/T cellar deck. A flange is already provided for this purpose (C266EA - 2"P).



SECTION A-A
1:50 (SEE REF DWG.)

ITEM	EL. BOTTOM OF DRAIN PAN.	H	Gh
D1	EL+ 99.839	191	101
D5	EL+ 99.838	192	102
D7	EL+ 99.837	193	103

FIG. 4.14

KVAERNER TECHNIP TCP 2

ELF NORGE FRIGG FIELD
TCP 2 COMPRESSION

PANCAKE 42
MODIFICATION OF DRAINBOXES

4.7.4 Fresh water drainage

The closed fresh water system can be drained to the cooling freshwater/TEG drain tank.

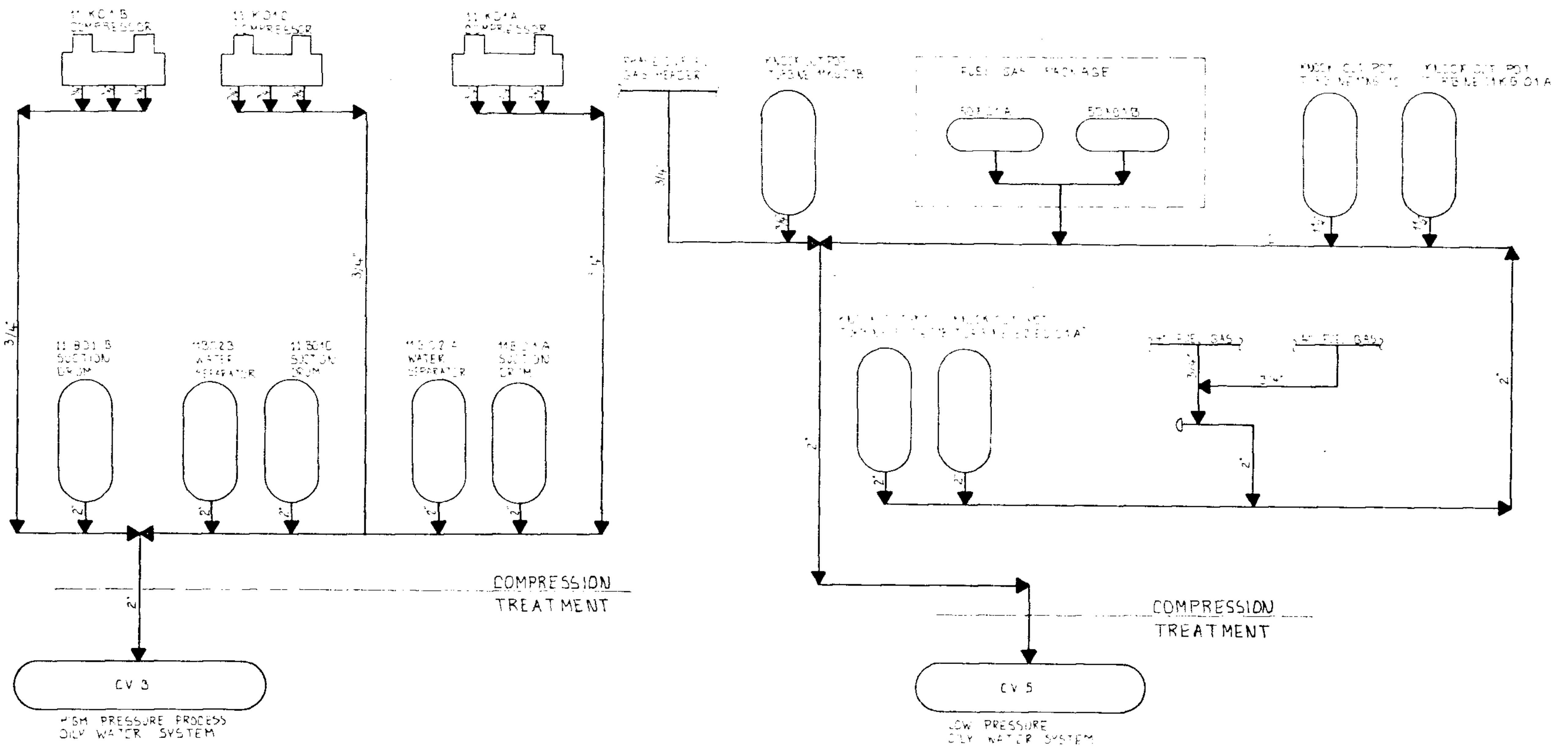


FIG 4.15

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS
LOW PRESSURE OILY WATER SYSTEM
HIGH PRESSURE PROCESS
OILY WATER SYSTEM

4.8 Crane and Hoists

To provide the necessary lifting capacity for maintenance and operation, a large capacity marine crane is mounted on a pedestal on module 32. The crane item 60x01, manufactured by Aker, has a nominal safe working load of 10 tonnes at 36 meters.

For maintenance purposes in the modules and pancakes a number of hoists have been installed. The hoists are electrically, pneumatically or manually powered.

For maintenance purposes in the modules and pancakes a number of hoists have been installed. The hoists are electrically

HOISTS FOR MAINTENANCE

EQUIPMENT NO.	LOCATION	CAPACITY (TONNES)	POWER (KW)	DRIVER
60X05A	MOD 30	8		EL (Note 1)
60X05B	MOD 33	8		EL "
60X05C	MOD 31	8		EL "
60X06A	MOD 30	12		EL
60X06B	MOD 33	12		EL
60X06C	MOD 31	12		EL
60X07	MOD 32	5		EL
60X08A	MOD 32	25		AIR DRIVEN
60X08B	MOD 32	25		AIR DRIVEN
60X09A	PC 41			MAN
60X09B	PC 44			MAN
60X010	PC 42			EL
60X11A	PC 42			EL
60X11B	PC 46			EL
60X12A	MOD 32			EL
60X14	PC 63			EL
60X15A	PC 65			EL
60X15B	PC 65			EL
60X19A/B	PC 65			MAN

All hoists with capacity above 5 tonnes are equipped with overload protection device.

All cranes in classified zones are equipped with non sparking moving metal parts.

Note 1 : Will possibly be changed for manual ones.

5. PRIME MOVERS

5. PRIME MOVERS

5.1 Turbogenerator drivers

The STAL-LAVAL power generation plant 52GG01 A/B consists of two turbogenerator sets, each of them including:

- Gas generator, STAL-LAVAL type GT35B-850
- Power turbine, STAL-LAVAL type 92-3, 3000
- Ancillary equipment, partly common for the two sets.

The gas turbines have the following data:

Turbines

- Maker	: NYLANDS VERKSTED/STAL LAVAL CONSORTIUM
- Series	: GT 35 - BO 148/149
- Rating at 15°C	: 13.5 MW
- Site rated power	: 11170 kW
- Peak power limit	: 14.650 kW
- Speed governor	: Electronic system Woodward type
- Inertia constant J (total)	: 620 kg m^2
- Governor time constant	: 0.1 s
- Turbine time constant	: 4 s
- LP rpm	: 5450
- HP rpm	: 6850

Both sets, including ancillary equipment, exhaust silencers and the common local control room are installed in a common module (pancake 41) which is a safe zone.

The air intakes each with a 4-stage filter and silencer are located on pancake 40. The exhaust stacks are also located on this pancake and connected to the exhaust ducts by flexible bellows.

The airfilters are provided with facilities for deicing, by hot air bled from the exhaust ducts.

The two turbine units are mounted side by side in the pancake and enclosed in hoods. These hoods are ventilated to obtain safe area classification. For details on the ventilation system see section 7 and 12.

The gas turbine control equipment and the A.C. motor control cubicle are enclosed in the local control room in the mezzanine of pancake 41. The D.C. motor control cubicle and batteries are located in the emergency substation.

On pancake 40 between the air intakes, treatment facilities for the fuel gas are located. This unit consists of a liquid knock out pot where any liquids are separated and a filter. See fig. 5.1.

The lube oil system serves gas generator, power turbine and alternator bearings. The system consists of three lubrication oil pumps,two AC driven main pumps and a DC-driven spare standby pump. These are fed from an oil tank with large volume to ensure long retention time and good dearation. The oil is heated and kept above a minimum temperature.

Before the oil enters the bearings it is cooled by two water cooled heat exchangers and then goes through a filter package consisting of two filters. One cooler and one filter is normally in operation with the other as standby.

GAS GENERATOR

The gas generator GT35 is of simple cycle and twin spool type and designed for industrial applications. It consists of two multi-stage LP and HP compressors, annular combustion chamber a two stage LP turbine and single stage HP turbine.

The exhaust gas from the gas generator drives the power turbine which in turn drives the generator.

The compressor blading, the turbine blading and sealing rings and the outer and inner combustion chamber casings are coated with anticorrosion protections to meet the requirements of marine environment.

FUEL GAS

Fuel gas for the turbines is Frigg field Methane. The composition is shown in section 3.1 .

ANCILLARY SYSTEMS AND OPERATION

An autonomous compressed air system is located near the lube oil system. This provides air for starting, pneumatically operated devices and cleaning system. Two airtanks of 7 m^3 capacity at 60 bar are fed by a small electrically driven compressor. Before the air enters the tanks it goes through an intercooler and separator to remove oil or water.

A cleaning system is provided to remove salt deposits on the turbine and compressor blades. The cleaning is done by a water solution while the turbine is rotated at low speed. The solution is injected by compressed air. This procedure must be repeated frequently depending upon field experience.

The turbine is controlled by a governing system which controls the fuel gas flow to the turbine. This system is electro-hydraulic where an electric signal from a speed sensor controls a hydraulic servo which again operates the fuel control valve.

The gas generator enclosure and the gas fuel unit are equipped with halon sprinkler system for fire fighting.

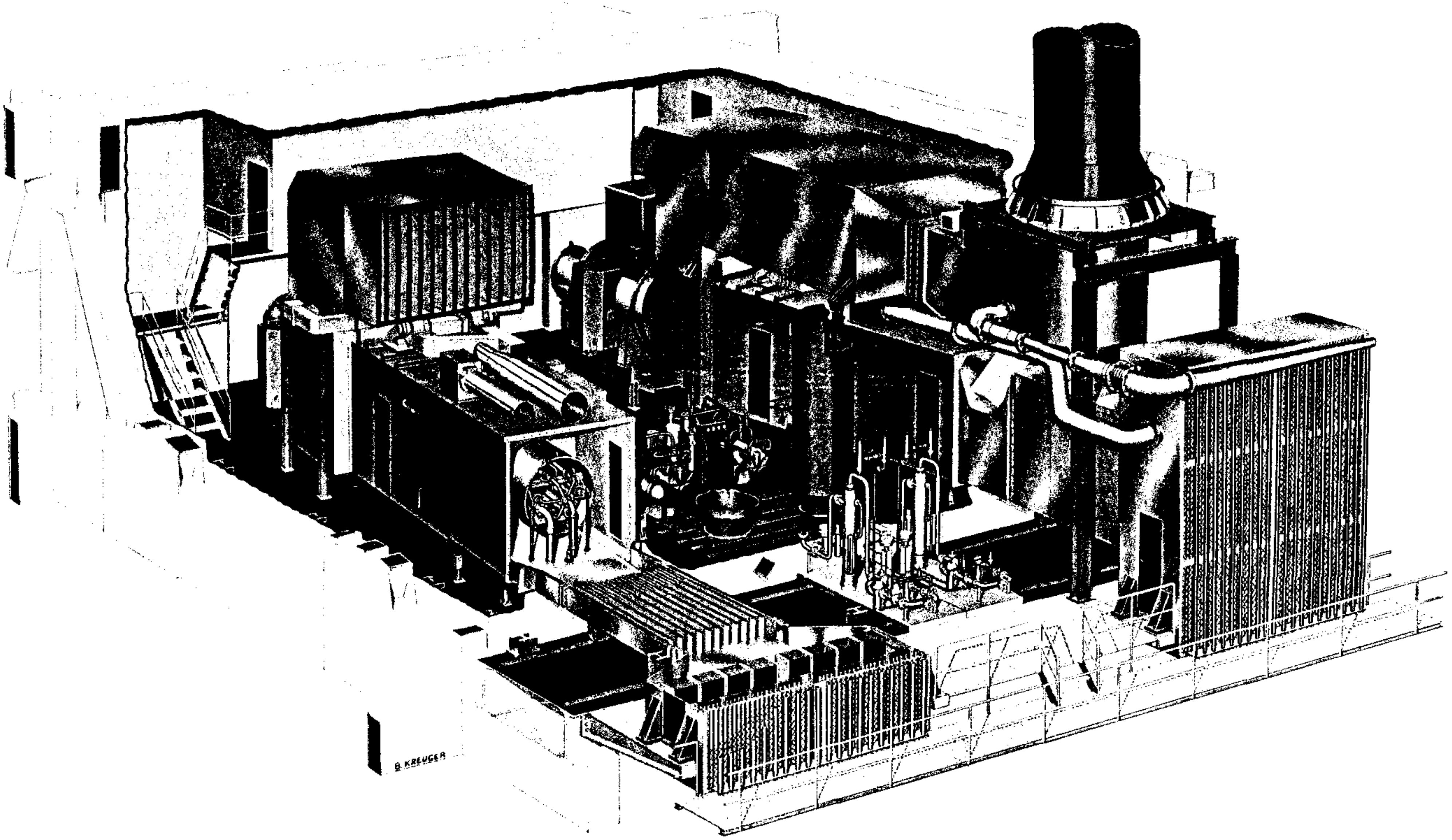
The gas generator enclosure is equipped with three halon bottles and the gas fuel unit is equipped with one halon bottle. The bottles are placed outside the enclosures. The system is released either manually by fire alarm boxes or automatically by temp switches in the gas generator enclosure or in the gas fuel unit.

The gas turbine is fitted with a sequencing system for fully automatic operation. In the event of a serious fault in the turbine, alternator or auxiliary systems, standby equipment is automatically started or an emergency stop is initiated.

The components of the sequencing system are mainly electromechanical DC relays of the plug-in type, manufactured by ASEA. They are controlled by signals from push buttons in the control room, pressure switches, level switches, temperature switches, and auxiliary contacts on the motor starters etc. The relays in turn affect motors, solenoid valves, circuit breakers etc.

The automatic sequencing system contains equipment capable of carrying out the following functions:

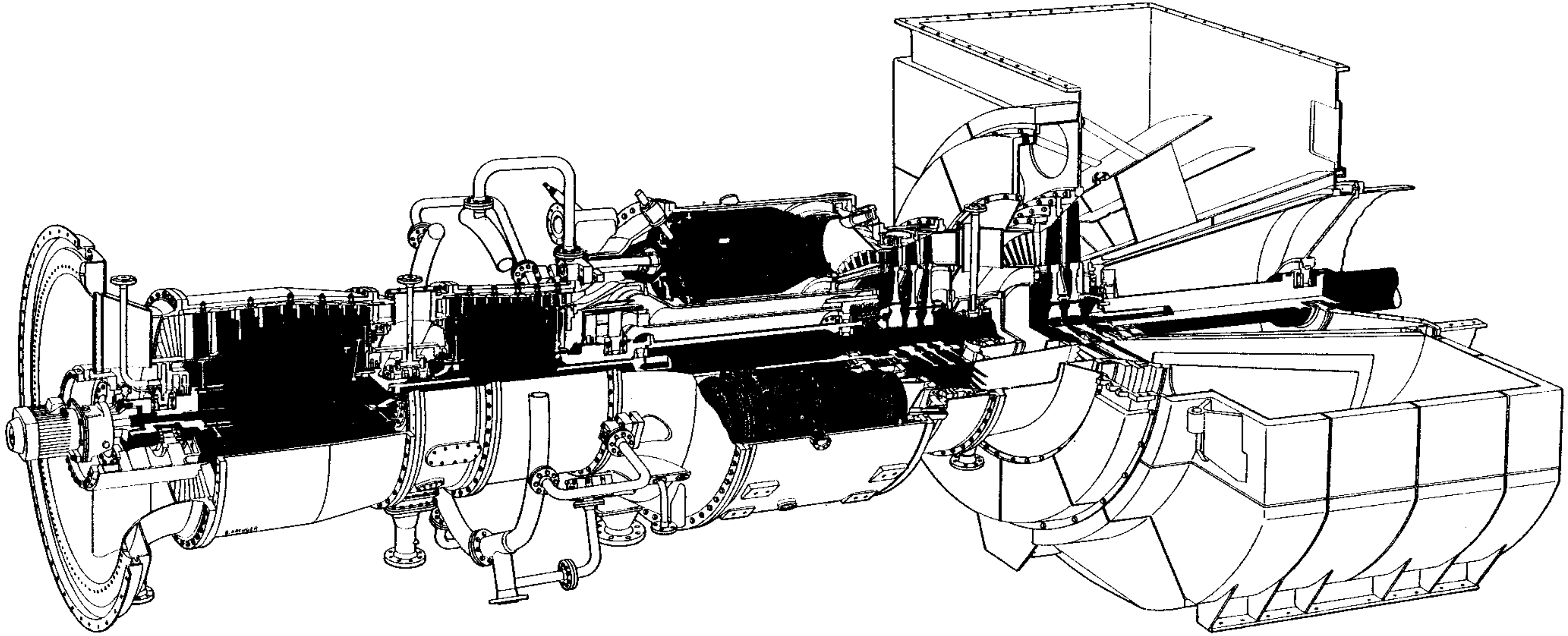
- Automatic start of turbine alternator and auxiliary system.
- Automatic synchronization of the alternator to the grid.
- Automatic loading up to a preset limit.
- Automatic stop of turbine, alternator and auxiliary system.
- Automatic cooling down.
- Automatic governing and limiting of load.
- Automatic voltage regulation.



TWO 10.5 MW GT 35 OFFSHORE GAS TURBINES

Fig. 5.1

583 E 12.78/15490-1500



GT35 GAS TURBINE

Fig. 5.2

539E 01.79/15076-2000

L-OFFSET, NORRK.

Nominal Alternator Output & Thermal Efficiency vs. Ambient Air Temperature. Rel. Humidity 60 %

Gas Generator	STAL-LAVAL GT35B-850
Free Power Turbine	STAL-LAVAL 92-3, 3000
Free Power Turbine Rotor Speed	3000 rpm
Duct Pressure Losses:	
inlet	10 mbar
stack	5 mbar
Fuel according to	BA-241-6E or AA-243-9E ed. 2

η = Thermal Efficiency %
P_{e_c} = Alternator Output at 1.013 bar Barometric Pressure, MW
p = Actual Barometric Pressure, bar
P_e = Alternator Output at Actual Barometric Pressure, MW
$P_e = P_{e_c} \times p/1.013$
Alternator Efficiency 0.975

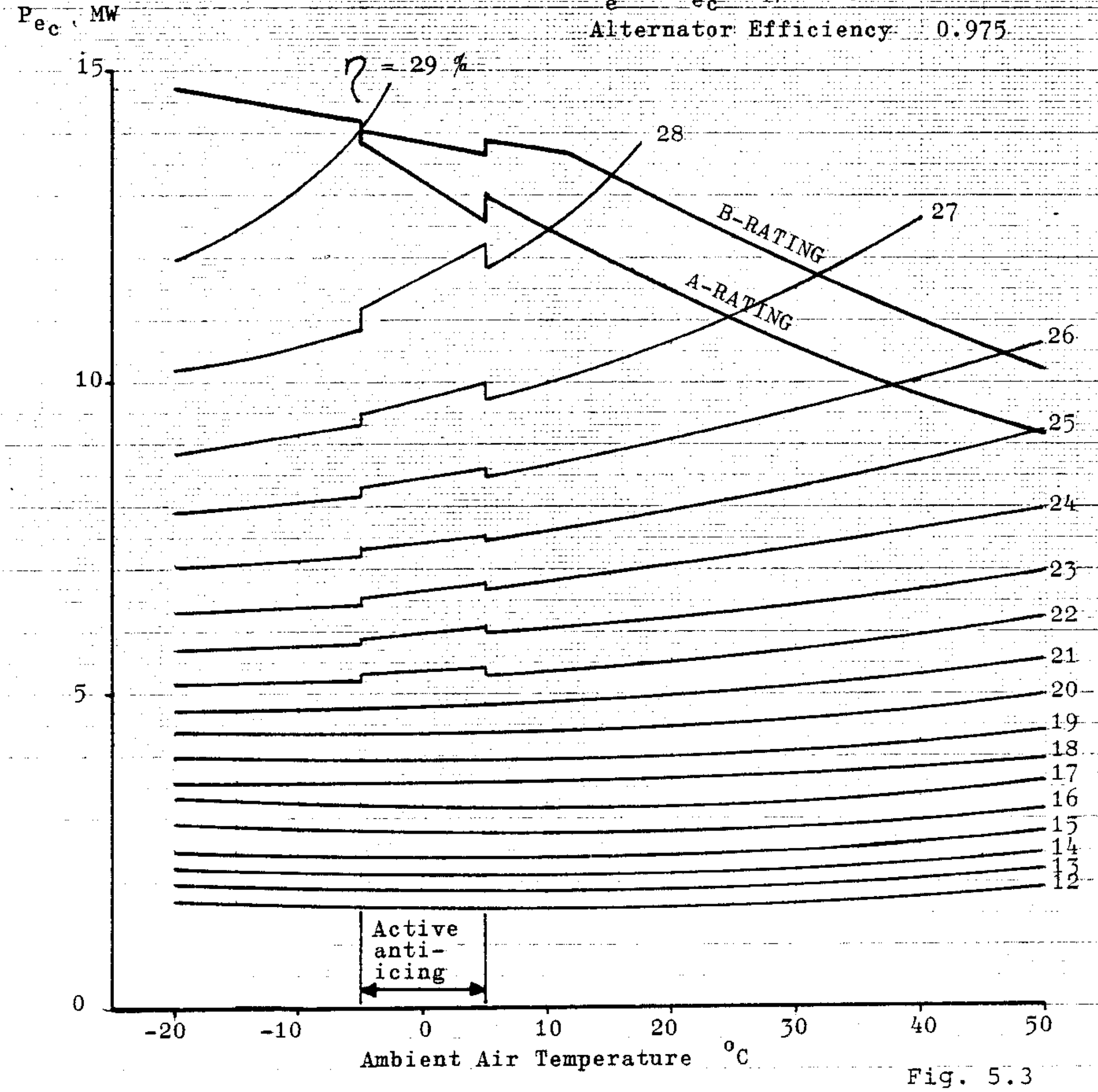


Fig. 5.3

5.2 Compressor drivers

The drivers for the compressors are gasturbines manufactured by UTI type FT4C-3F, driving via a free power turbine.

Base load : 27.260 kW at 3600 rpm
26.865 kW at 4000 rpm
Site rated power: 21.300 kW at 3600 rpm
Fuel (Frigg methane) consumption: 11.300 CM/h at 17 bar

The gasturbines 11KG01 A/B/C including auxiliary equipment are located in modules 30, 31 and 33. The turbine and compressor are mounted inside a hood sufficiently ventilated to obtain safe classification during operation. Ventilation is by eduction and two fans. Air intakes are located outside the module and the exhaust is led through the module roof to a stack above the modules. The fuel gas units are located in the open area of the modules at the west.

GAS GENERATOR

The gas generator is an axial flow twin spool gas turbine adapted from a Pratt & Whitney aircraft engine for industrial application. The major components are two compressors, a combustion chamber, and two turbines.
Air passes through the first (low pressure) compressor and the second (high pressure) compressor and enters the burner chamber where fuel is introduced through nozzles feeding eight burner cans. About 20% of the air is used for combustion. The remaining 80% is used for cooling the burner and turbine parts. Two independent spark-igniters provide ignition. Thereafter, combustion is self-sustaining. The hot gases pass through the single-stage high pressure turbine and the two-stage low pressure turbine, which extract energy to drive the two compressors, leaving the remainder of the hot gas energy to be used for driving the free turbine. The output of hot gases is regulated by controlling the flow of fuel to the combustion chamber.

FT4C DRIVER SYSTEM
IN MODULE

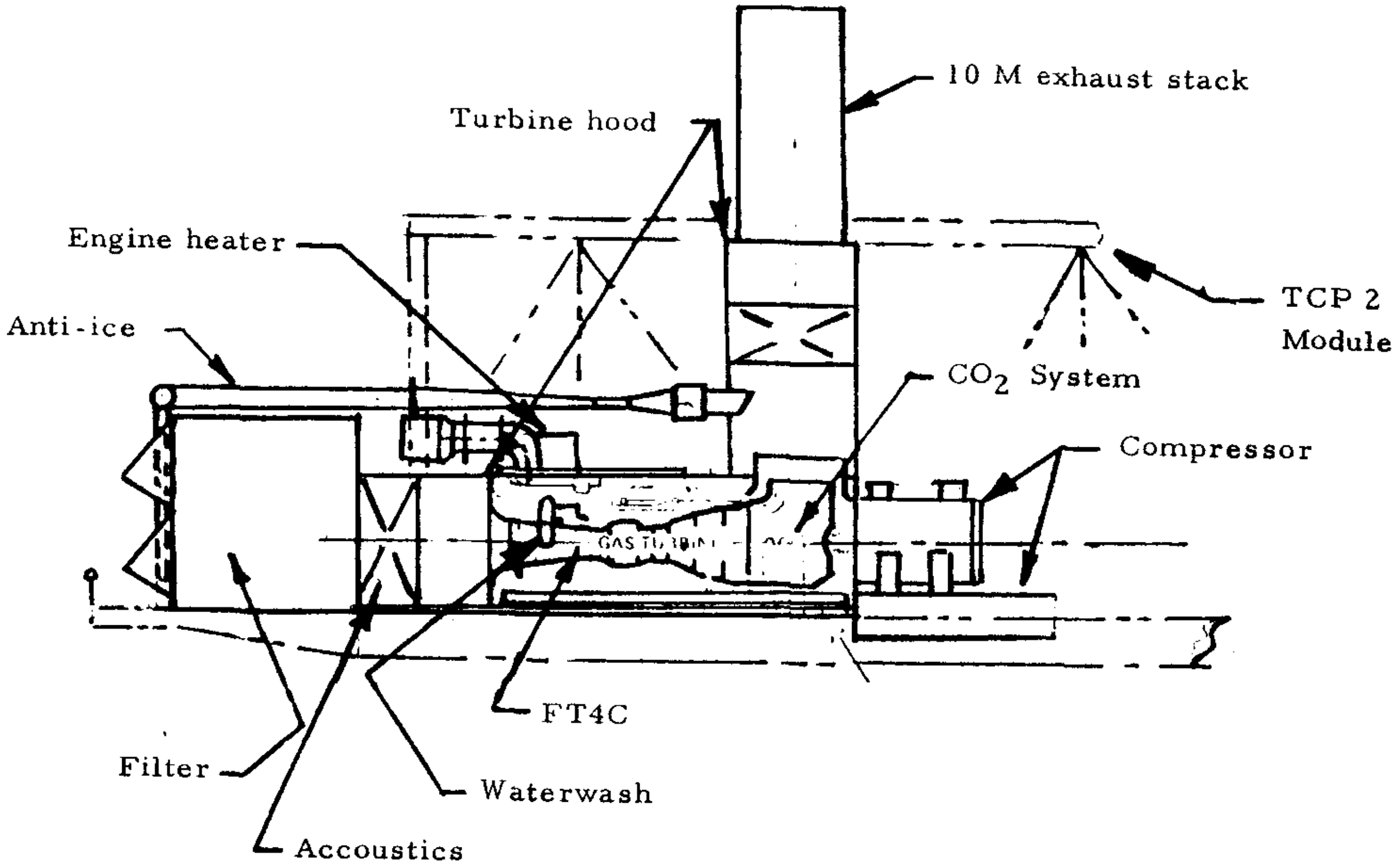
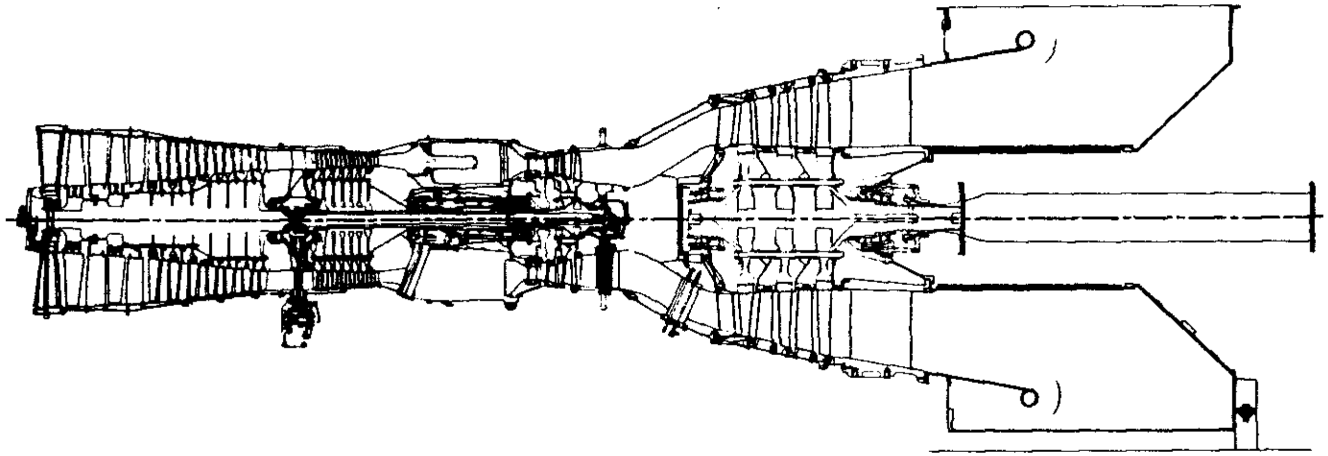


FIG. 5.4

FT4C DRIVER SYSTEM

1/7

ENGINE



FT4C-3F

FIG. 5.5

INSTRUMENTATION

Gas generator instrumentation consists of four speed transducers, one vibration pickup, six thermocouples, and four exhaust pressure sensing probes. Three of the four speed transducers are mounted on the front left of the N2 gearbox, and the fourth is mounted on the front compressor bearing cover. The vibration pickup is mounted on the inlet case. The thermocouples and pressure probes are mounted around the circumference of the turbine case and extend into the turbine discharge passage.

GAS GENERATOR SUPPORTS

The gas generator is supported at the 3 and 9 o'clock positions on the inlet case. These supports absorb vertical loading and torque produced by the engine. The rear of the gas generator is supported by the Free Turbine.

POWER TURBINE (FREE TURBINE)

The free turbine converts energy from the gas generator exhaust into a rotational energy, and transmits this energy to the compressors. The free turbine is attached to the rear flange of the gas generator exhaust case.

The inlet ducting directs the gas generator exhaust to the free turbine. This is accomplished by an annulus formed by the inner and outer ducts. The outer front duct is the only free turbine part physically attached to the gas generator. It carries the rear structural load of the gas generator to the free turbine supports.

The vanes direct the gas flow to the free turbine blades at the proper angle for maximum rotor efficiency.

The rotor assembly is a three-stage disc and blade assembly supported on each end by the free turbine main bearings.

The free turbine is supported at the three, nine and six o'clock positions of the exhaust case. The main support for the free turbine and the rear of the gas generator is provided at these points. These supports provide for vertical and horizontal adjustment of the free turbine.

All items in the turbine hood is protected by a CO_2 fire extinguishing system.

The Hood is ventilated by fans in addition to the exhaust eductor. See sections 7 and 12.

The turbines are also supplied with systems for:

- Anti-icing
- Turbine water wash system
- Fire and gas detection.

5.3 Emergency Generator Diesel Engine

The emergency generator is driven by a diesel engine, SACM type V16 BSHR Rating 1000 kW at 1500 rpm. The engine is manufactured by SACM France, and is a single acting supercharged engine with the cylinders in V configuration. The cylinders have wet type liners and individual cylinder heads are bolted to each cylinder. The pistons are oil cooled to ensure long service.

To enable the generator to operate on a syncronizing speed the engine is fitted with a governor.

Starting is by an autonomous compressed air system with two compressors (one electrically and one diesel driven) installed to charge the start air bottles.

A day tank with fuel supply for 24 hours duty is provided, with a level gauge alarm if the level drops below the emergency 24 h consumption level.

To provide an easy start of the engine it is kept at a temperature of $30^{o}C$ by a heater.

Cooling is by a closed circuit cooling system where the engine heat is dissipated in an air cooled heat exchanger placed above the generator room. The air fan for this unit is supplied from "Essential" 380 V system. The necessary air flow is provided by a fan which also ventilates the generator room.

The engine with its ancillaries is located in PC 44 as a selfcontained unit.

Operation of the emergency generator is described in § 9.3.2. The engine will start by loss of 380 V, and is intended to run during emergency situations. The following events however, will stop the engine:

- overspeed
- gas detection in ventilation inlet
- low lube oil pressure. (Second low level)

The engine with generator can be run for testing by taking the generated power out over the loadbank.

<u>Main components</u>

53GD01	Diesel engine
53GD01 K01	El. air compressor
53GD01 K02	Diesel air compressor

5.4 Black Start

In the event of the Frigg field being completely shut down, emergency generator stopped and all battery banks drained, the power generation can be restarted by equipment installed for this purpose.

This equipment is located in the emergency generator room in pancake 44.

The steps of this procedure are:

1. Start of emergency diesel driven aircompressor 53GD01 K02.

   This is a small compressor that carges the starting air bottles for the emergency generator diesel engine. The compressor engine is started by hand crank.

2. Start of emergency generator diesel engine 53GD01.

   This engine drives the emergency generator which provides enough power to start the gas production and the equipment needed for fuel gas treatment.

3. Start of main generator turbines 52GG01 A/B.

   Now enough power is available to start normal operation of the field.

6. EQUIPMENT LIST

6. EQUIPMENT LIST

MODULE 30, 31, 33

Equipment identical in all three compression lines are listed below. Equipment in lines A, B and C are located in modules 30, 33 and 31 respectively.

11B01A/B/C	SUCTION DRUM
11E01A/B/C	NATURAL GAS COOLER

Gas compressor package

11K01A/B/C	NATURAL GAS COMPRESSOR
11K01A/B/C P01A/B/C	LUBE OIL PUMPS
11K01A/B/C P02A/B	SEAL OIL PUMPS
11K01A/B/C T01	LUBE OIL TANK
11K01A/B/C P03	OIL CLARIFIER
11K01A/B/C S01A/B	LUBE OIL FILTERS
11K01A/B/C S02	LUBE OIL FILTER
11K01A/B/C T02	POLLUTED SEAL OIL TANK
11K01A/B/C B01	OVERHEAD SEAL OIL TANK
11K01A/B/C E01A/B	LUBE OIL COOLERS
11K01A/B/C Y01	LUBE OIL HEATER
11K01A/B/C Y02A/B	POLLUTED SEAL OIL TANK HEATERS

Compressor driver package

11KG01A/B/C	GAS COMPRESSOR TURBINES
11KG01A/B/C P01A/B/C	LUBE OIL PUMPS
11KG01A/B/C A2A/B	SECONDARY AIR FAN
11KG01A/B/C A3	ENGINE HEATER
11KG01A/B/C B01	K.O. POT
11KG01A/B/C S01A/B	FUEL GAS FILTERS
11KG01A/B/C T01	LUBE OIL TANK
11KG01A/B/C E01A/B	LUBE OIL COOLERS

11KG01A/B/C S02A/B	LUBE OIL FILTERS
11KG01A/B/C B01	WATER WASH TANK
11KG01A/B/C Y01	ENGINE HEATER
54X01/02/03	VENT SYSTEM MODULE 30/31/33
60X05A/B/C	MAINTENANCE HOIST 11KG01A
60X06A/B/C	MAINTENANCE HOIST 11K01A

MODULE 30

11B02A	WATER SEPARATOR
53GD01S01	EMERGENCY DIESEL SILENCER

MODULE 31

11B02B	WATER SEPARATOR

MODULE 32

58T01	EXPANSION TANK

Power distribution

S.52.32.2.14	FUEL GAS HEATER SWITCHBOARD A
S.52.32.2.15	FUEL GAS HEATER SWITCHBOARD B
S.52.32.1.1	5.5 KV DISTRIBUTION SWITCHBOARD
S.52.32.2.1	380 V MAIN DISTRIBUTION SWITCHBOARD
S.52.32.2.4	NORMAL LIGHTING SWITCHBOARD A
S.52.32.2.5	NORMAL LIGHTING SWITCHBOARD B
S.52.32.2.16	AUXILIARY DISTRIBUTION SWITCHBOARD HOIST
S.52.32.2.18	HEATING SWITCHBOARD A
S.52.32.2.19	HEATING SWITCHBOARD B
S.52.32.2.17	WELDING SOCKETS SWITCHBOARD
S.52.32.2.20	380 V WORKSHOP SWITCHBOARD
S.52.32.4.22	110 V DC NON ESSENTIAL ESD CUBICLE

S.52.32.4.23	110 V DC NON ESSENTIAL SIGNALIZATION SW.B.
T.52.32.1.9	5500/380 V TRAFO T9
T.52.32.1.10	5500/380 V TRAFO T10
T.52.32.1.11	5500/380 V TRAFO T11
T.52.32.1.12	5500/380 V TRAFO T12
RD.52.32.5.1	380/24 V DC RECTIFIER

Fuel gas package

50X01A/B	FUEL GAS PACKAGE
50X01T01	METHANOL TANK
50X01P01A/B	METHANOL INJECTION PUMP COLD FRACTION
50X07A/B	FUEL GAS HEATER PACKAGE
50X07A/BP01	WATER CIRCULATION PUMPS
50X07Y01-Y07A/B	HEATER ELEMENT EXCHANGER

Ventilation system

54X04	VENTILATION SYSTEM FAN ROOM SUBSTATION
54X05	AIRCONDITION SYSTEM CONTROL ROOM
54X07	VENTILATION SYSTEM WORKSHOP
54X16	VENTILATION SYSTEM TRANSFORMER ROOMS

Hydraulic package

56X01	HYDRAULIC PACKAGE
56X01P01A/B	HYDRAULIC PUMP

Firewater equipment

68X09	FRESH WATER MONITORS
68X10	FOAM PACKAGE

Hoists

60X01	CRANE
60X07	LIFTING IN WORKSHOP
60X08A	MAINTENANCE HOIST FOR 58P01A/B
60X08B	MAINTENANCE HOIST FOR 58P01C/D
60X12A	MAINTENANCE HOIST FOR STAINERS 58S01A/B

Switchboards

S.52.32.2.2	380 V MCC SWITCHBOARD A
S.52.32.2.3	380 V MCC SWITCHBOARD B
S.52.41.2.12	TURBINE GENERATOR A MCC SWITCHBOARD
S.52.41.2.3	TURBINE GENERATOR B MCC SWITCHBOARD

MODULE 33

Low pressure vent

	LOW PRESSURE VENT STACK
67B01	LOW PRESSURE VENT SCRUBBER
67X01	LOW PRESSURE VENT SNUFFING PACKAGE
67X02	LOW PRESSURE VENT LIGHT GAS SEAL

PANCAKE 40

Generator turbine utilities

52GG01A/B B01	GAS FUEL KNOCK OUT POT
52GG01A/B S03A/B	GAS FUEL FILTERS
52GG01A/B Y02	GOVERNING OIL TANK HEATER
52GG01A/B T02	GOVERNING OIL TANK
52GG01A/B P01	GOVERNING OIL PUMP
52GG01B TCV01	ANTI ICING VALVE

PANCAKE 41

Gas turbine package

52GG01A/B	GENERATOR TURBINE
52GG01A/B P01A/B/C	LUBE OIL PUMPS
52GG01A/B S01A/B	LUBE OIL FILTERS
52GG01A/B A01A/B	LUBE OIL COOLERS
52GG01A/B A02	LUBE OIL TANK OIL VAPOUR FAN
52GG01A/B Y01A/B	LUBE OIL HEATER
52GG01A/B T01	LUBE OIL TANK
52GG01A/B S01A/B	LUBE OIL FILTERS
52GG01A/B S02	LUBE OIL FILTER
52GG01A/B A03A/B	GAS GENERATOR HOOD FANS
52GG01A/B A01A/B	FUEL UNIT FANS
52GG01A/B Y03	TURBINE HOOD HEATER
52GG01A/B E01A/B	AC GENERATOR COOLERS
52GG01A/B E02	AC GENERATOR COOLER
52GG01A/B S04	GOVERNING OIL FILTER
52GG01A/B A04	AIR STARTER
52GG01A/B K01	START AIR COMPRESSOR
52GG01A/B B02	START AIR BOTTLE
52GG01A/B B03	START AIR COMPRESSOR LIQUID SEPARATOR
52GG01A B04	WATER WASH TANK
52GG01A TCV01	ANTI ICING VALVE

Turbine/Generator utilities

52G01A/B	HV GENERATOR
52G01A Y01/2/3	AC GENERATOR HEATERS
52G01B Y01/2/3	AC GENERATOR HEATERS
54X09	VENTILATION SYSTEM TURBINE GENERATOR ROOM
60X09A	MAINTENANCE HOIST FOR 52G01A
60X09B	MAINTENANCE HOIST FOR 52G01B
R.1.52.601A	NEUTRAL RESISTOR FOR 52G01A
B.1.52.601B	NEUTRAL RESISTOR FOR 52G01B
KA1ATOKA7A	CONTROL PANEL FOR TURBINE GENERATOR 52G01A
KA1BTOKA7B	CONTROL PANEL FOR TURBINE GENERATOR 52G01B

PANCAKE 42

55T01	FRESH WATER STORAGE TANK
58T02	COOLING FRESH WATER/TEG DRAIN TANK

Air compressor package

57X01K01A/B	AIR COMPRESSOR
57X01A01A/B	AIR COOLERS
57X01E02A/B	OIL COOLERS
57X01A01A/B	FANS FOR OIL COOLERS
57X01P01A/B	PUMPS
57X01T01	AIR RECEIVER
57X01T02A/B	DISCHARGE SCRUBBER
57X01T03A/B	INTER SCRUBBER
57X01T04A/B	DISCHARGE BOTTLES
57X01T05A/B	WATER SURGE TANKS
57X01Y01A/B	FILTER HEATERS
57X01Y02A/B	CRANKCASE HEATERS
57X01B01A/B	AIR DRYERS

Utility pumps

55P03	TURBINE WASHING PUMP
55P01A/B	FRESH WATER MAKE-UP PUMP
55P02A/B	TEG MAKE-UP PUMP
58P02A/B/C	PROCESS FRESH WATER/TEG PUMP
58P04A/B	UTILITY FRESH WATER/TEG PUMP
58P05A/B	FRESH WATER/TEG DRAIN TANK PUMP

Firepump package

62PD01A/B	DIESEL ENGINE
68P01A/B	FIRE PUMP UNITS
68PD01A/BK01A/B	AIR COMPRESSORS
68PD01A/BT01A/B	AIR BOTTLES

68PD01A/B S01	EXHAUST SILENCER
68PD01A/B S02	AIR FILTER
68PD01A/B T02	DIESEL OIL TANK
68PD01A/B T03	HYDRAULIC OIL TANK
68PD01A/B E01	HYDRAULIC OIL COOLER
68PD01A/B Y01	HYDRAULIC OIL HEATER
68PD01A/B A01	HYDRAULIC AIR FAN
68PD01A/B P01	HYDRAULIC OIL CIRCULATION PUMP
68PD01A/B Y03	ENGINE LUBE OIL HEATER
68PD01A/B Y04	ENGINE WATER HEATER
68PD01A/B Y05	CONTROL PANEL HEATER
54X10	VENTILATION SYSTEM DIESEL FIRE PUMP ROOM

Fresh water maker package

55Y01A/B/C/D	FRESH WATER STORAGE HEATER
55X01	FRESH WATER MAKER
55X01P01A/B	FEED WATER PUMPS
55X01K01A/B	COMPRESSOR
55X01P01A/B	RECIRCULATION PUMPS
55X01P02A/B	LUBE OIL PUMP
55X01P03A/B	DISTRIBUTION PUMP
55X01A/B Y01/2/3	IMMERTION HEATER
55X02	ANTI CORROSION DOSING SET
55X02P01A/B	DOSING PUMP
55X02P02	TANK AGITATOR
55X02Y01	TANK HEATER
58X02A/B	MIN. FLOW BYPASS
60X10	MAINTENANCE HOIST FOR PUMPS, MOTORS
60X11A	MAINTENANCE HOIST FOR FRESH WATER PUMP

PANCAKE 43

58E01A1/2/3/4	SEA WATER/FRESH WATER EXCHANGER

PANCAKE 44

Emergency generator package

53G01	EMERGENCY GENERATOR
53GD01	EMERGENCY DIESEL (GENERATOR)
53GD01LB01A/B	EMERGENCY DIESEL LOAD BANK
53GD01A01	AIR COOLER
53GD01K01	ELECTRICAL AIR COMPRESSOR
53GD01K02	DIESEL AIR COMPRESSOR
53GD01T01	EXPANSION TANK
53GD01T02	OIL TANK
53GD01T03A/B/C/D	AIR RECEIVER
53GD01Y01	HEATER ALTERNATOR
53GD01Y02A/B/C	PREHEATING WATER
53GD01A01	AIR FAN COOLING SYSTEM
53GD01A02	AIR FAN LOAD BANK
53GD01P01	WATER CIRCULATION PUMP
53GD01P02	OIL CIRCULATION PUMP

Emergency generator utilities

54X12	VENTILATION SYSTEM BATTERY ROOM
54X13	VENTILATION SYSTEM EMERGENCY SUBSTATION
54X15	VENTILATION SYSTEM DIESEL GENERATOR ROOM
60X09B	MAINTENANCE HOIST FOR 53GD01

Emergency power distribution

S.53.44.2.6	380 V EMERGENCY SWITCHBOARD
S.52.44.2.8	EMERGENCY LIGHTING SWITCHBOARD
S.53.44.2.7	380 V EMERGENCY DIESEL GENERATOR AUX. SW.B.
S.53.44.4.10	110 V DC INSTRUMENT SUPPLY SWITCHBOARD
S.53.44.2.21	110 V DC HEATING & VENT. TURB.COMP.DC.START
S.53.44.4.26	110 V DC TURB.GENERATOR A DC STARTERS
S.53.44.4.27	110 V DC TURB.GENERATOR B DC STARTERS
S.53.44.3.9	220 V AC INSTRUMENT SUPPLY SWITCHBOARD

S.53.44.2.24	110 V DC ESSENTIAL ESD CUBICLE
S.53.44.2.25	110 V DC ESSENTIAL SIGNALIZATION SWITCHB.
S.52.44.4.11	110 V DC ELECTRICAL SUPPLY SWITCHBOARD
RD.53.44.4.½	380/120 V DC RECTIFIER 2A/B
BAT.53.44.4.½	120 V BATTERY 70AH/5H 2A/B
RD.53.44.4.3/4	380/120 V DC RECTIFIER 3 A/B
BAT.53.44.4.3/4	120 V BATTERY 428AH/5H 3A/B
RD.53.44.3.1	380/240 V DC RECTIFIER 1A
RD.53.44.3.2	380/240 V DC RECTIFIER 1B
BAT.53.44.3.1	240 V BATTERY 1A
BAT.53.44.3.2	240 V BATTERY 1B
INV.53.44.3.1	220 V AC INVERTER 1A
INV.53.44.3.2	220 V AC INVERTER 1B
SI.53.44.3.1	220 V AC STATIC INTERRUPTOR
DGP	CONTROL PANEL FOR DIESEL GENERATOR 53G01

PANCAKE 45

60X02	LIFE BOAT
60X05	LIFE RAFT

PANCAKE 46

54X14	VENTILATION DIESEL FIRE PUMP ROOM
68X11B	MAINTENANCE OF FIRE WATER PUMP
60X12B	MAINTENANCE OF STRAINERS 58S01A/B

AREA 63

58P01B01A/C	SEA WATER PUMP FRESH WATER TANKS		
58P01B01B/D	SEA WATER PUMP FRESH WATER TANKS		
58S01A/B	SEA WATER STRAINERS		
60X14	MAINTENANCE HOIST FOR 50P02		
50P02	WASH DOWN PUMP	OUTSIDE	COLUMN 3
58P01A/C	SEA WATER PUMPS	INSIDE	" "
58P01A/D	SEA WATER PUMPS	INSIDE	" "

AREA 65

58C01	SEA WATER REJECTION SHAFT
58C02	SEA WATER REJECTION SHAFT
60X15A	MAINTENANCE HOIST FOR 58X01/2
60X15B	MAINTENANCE HOIST FOR FUTURE PUMPS 58P01E/F
60X19A/B	MAINTENANCE HOISTS FOR 58X01/2

All areas or location not decided.

68X02	MOBILE FIRE FIGHTING DEVICES	NOT DECIDED
68X06	DELUGE VALVES	ALL AREAS
68X07	HALON 1301 SYSTEM	" "
68X08	FIRE HOSE REELS	" "
68X11	SPAY NOZZLES	" "
68X12	OPEN SPRINKLER NOZZLES	" "
68X13	FUSIBLE BULB NOZZLES.	" "
S.53.44.3.10	FLASHING LIGHTS PANEL	" "
	P.A. PANEL	

7. HAZARDOUS AREA CLASSIFICATION

7. HAZARDOUS AREA CLASSIFICATION

7.1 Phase IIIa

General

As with the rest of the Frigg field the area classification system adopted is the I.P. Model Code of Safe Practice Part 1 & supplement and Part 8. Reference is also made to DnV's two Technical Notes A10/3 and A10/4. It should be noted however that in Norwegian waters, the NPD has the final jurisdiction on the matter.

The design and selection of classified electrical equipment is in conformity with BS 5345 Part I 1976. All parts of the unit come within gas group IIa except for the battery room, where equipment is to meet gas group IIc requirements. Area classification are shown on the accompagnying dwgs.

7.1.1 Enclosed rooms

Battery room (panc. 44) has negative pressure (min. 6 mm wg). On loss of ventilation battery boost charging is automatically cut. Trickle feed charging is shut down on gas detection.

Diesel emergency generator room (panc. 44) is ventilated when the diesel engine is running. The room is safe without ventilation.

Emergency substation (panc. 44) is safe without ventilation. The room is ventilated with 12 air ch/hr.

Firepump rooms are safe with 12 air ch/min. and minimum 6 mm wg. When not pressurized firepump rooms are Zone 1.

The turbo generator room (panc. 41), fan room and workshop (all mod. 32) are safe with pressurization (min. 6 mm wg) ventilation is min. 12 air ch/hr.

Generator gas turbine hoodis subpressurized to -5mm and safe with ventilation.

Control room and substation are safe without ventilation, but are normally ventilated with 12 airchanges/h at 6 mm wg overpressure.

The compressor modules (30,31,33) are normally classified as Zone 2, with a min. ventilation of 12 air ch/hr.

Compressor gas turbine hood (mod. 30,31,33) is unpressurized during operation of turbine, but is classified as safe due to the high number of air changes (910 ch/hr). During standstill compressor gas turbine hood is classified as Zone 1.

Transformer room is ventilated in order to maintain Zone 2 classification.

Diesel oil tank room is ventilated through louvres in wall facing east.

In all ventilated rooms, upon loss of ventilation duty fan and stand-by fan the emergency alarm is activated and dampers automatically close.

7.2 Outside areas

Exhaust outlets from turbo generator rooms and compressor modules (30,31,33) are classified Zone 2.

LP vent outlet is classified Zone 1.

Doors

Doors in control room, substation, emergency substation and battery room that lead to Zone 2 area open in such a manner that they can only be used for escapeways.

7.1.2 Open and naturally ventilated areas

Cellar Deck

Apart from the enclosed rooms the TCP2/C callar deck is Zone 2.

Main Deck

The interior of modules 30,31 and 33 is classified as Zone 2.

Upper Deck

The open area of the upper deck is classified as Zone 2 exept for the area around the atmospheric vent outlets which are Zone 1.

7.2 Phase IIIb

In the future the TCP2 platform will be further developed to a stage where an additional three compressor modules will be installed. This will concern the area classification of the Main and Upper decks where the Zone 2 areas will be extended.

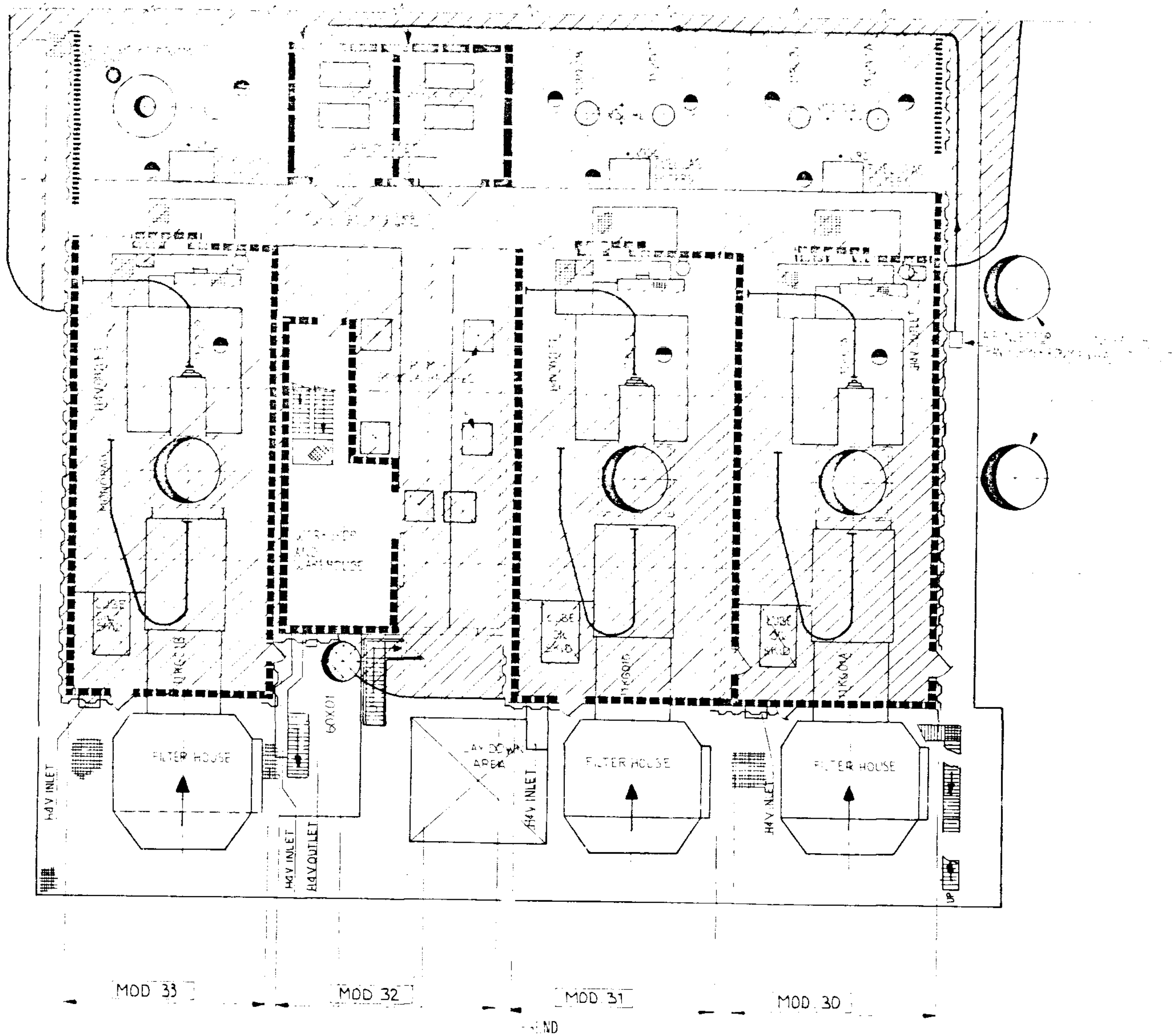
Satelite Fields Development

In the future the TCP2 platform will receive additional equipment for the treatment of gas produced from the Frigg North East and Odin gas fields.

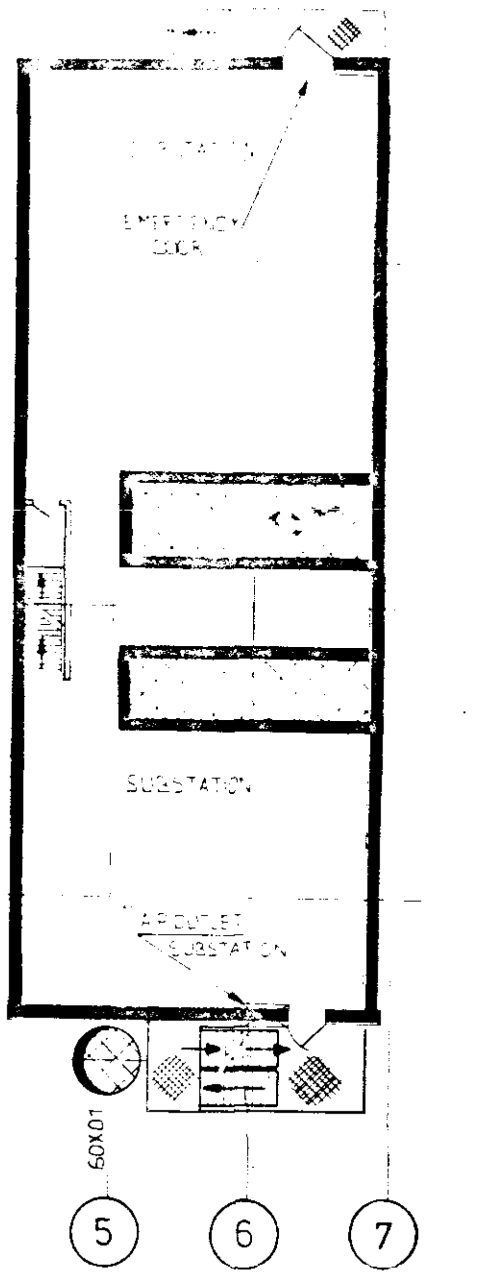
This equipment will be located on the spare areas available on the South-west part of the platform.

TCP 2/C AREA CLASSIFICATION

ROOMS	AREA CLASS FANS RUNNING	 FANS STOPPED	AIRCHANGES/H PRESSURE	SOURCE OF VENTILATION	SAFETY ACTION WHEN LOSS OF PRESSURIZATION OR GAS DETECTION
HVAC ROOM	SAFE	ZONE 1	12 AIRCH./h + 6 mm wg.	SUPPLY FAN STDBY FAN	ALARM IN CONTROL RROOM AND EL. CONTROL ROOM.
CONTROL ROOM	SAFE	SAFE	12 AIRCH/h + 6 mm wg.	SUPPLY FAN DC STDBY FAN	ALARM IN CONTROL ROOM AND EL CONTROL ROOM
WORKSHOP	SAFE	ZONE 1	12 AIRCH/h + 6 mm wg.	SUPPLY FAN STDBY FAN	ALARM IN CONTROL ROOM
TRANSFORMER ROOM	ZONE 2	ZONE 1	12 AIRCH/h NO PRESSURIZATION	SUPPLY FAN STDBY FAN	ALARM IN CONTROL ROOM AND EL. CONTROL ROOM.
SUBSTATION	SAFE	ZONE 1	12 AIRCH/h + 6 mm wg.	SUPPLY FAN STDBY FAN	ALARM IN CONTROL ROOM AND EL. CONTROL ROOM.
MODULE 30,31,33	ZONE 2	ZONE 1	12 AIRCH/h NO PRESSURIZATION	SUPPLY FAN STDBY FAN	ONLY COMPRESSION CUBICLE VENTILATED.
COMPRESSOR TURBINE HOOD	SAFE	ZONE 1	910 AIRCH/h NO PRESSURIZATION	EDUCTOR AND FANS	SHUT DOWN FOR 60% LEL.
TURBO GEN. ROOM	SAFE	ZONE 1	12 AIRCH/h + 6 mm wg.	SUPPLY FAN STDBY FAN	ALARM CONTROL ROOM AND EL. CONTROL ROOM
GENERATOR TURBINE HOOD	SAFE	ZONE 1	90 AIRCH/h - 5 mm wg.	EXTRACTION FAN STDBY FAN DC EM'CY FAN	SHUTDOWN FOR 60% LEL
GAS FUEL UNIT	ZONE 2	ZONE 1	12 AIRCH/h - 5 mm wg.	EXTRACTION FAN STDBY FAN	
FIRE PUMP ROOM	SAFE	ZONE 1	12 AIRCHANGES + 6 mm wg.	SUPPLY FAN DC STDBY FAN HYDRAULIC SUPPLY FAN	ALARM IN CONTROL ROOM AND EL. CONTROL ROOM
BATTERY ROOM	SAFE	SAFE	12 AIRCH/h - 10 mm wg.	EXTRACTION FAN STDBY FAN	ALARM IN CONTROL ROOM AND EL. CONTROL ROOM. BOOST CHARGERS CUT.
EMERGENCY SUB STATION	SAFE	SAFE	12 AIRCH/h + 6 mm wg.	SUPPLY FAN STDBY FAN	ALARM IN CONTROL ROOM AND EL. CONTROL ROOM.
DIESEL GEN ROOM	SAFE	SAFE	NO PRESSURIZATION	EXTRACTION FAN	ALARM IN CONTROL ROOM AND EL. CONTROL ROOM.



PLAN VIEW OF MAIN DECK



PART PLAN VIEW EL+114558

LEGEND

▩ ZONE 1 AREA

▨ ZONE 2 AREA

☐ SAFE AREA

OPEN CLADDING

GASTIGHT WALL

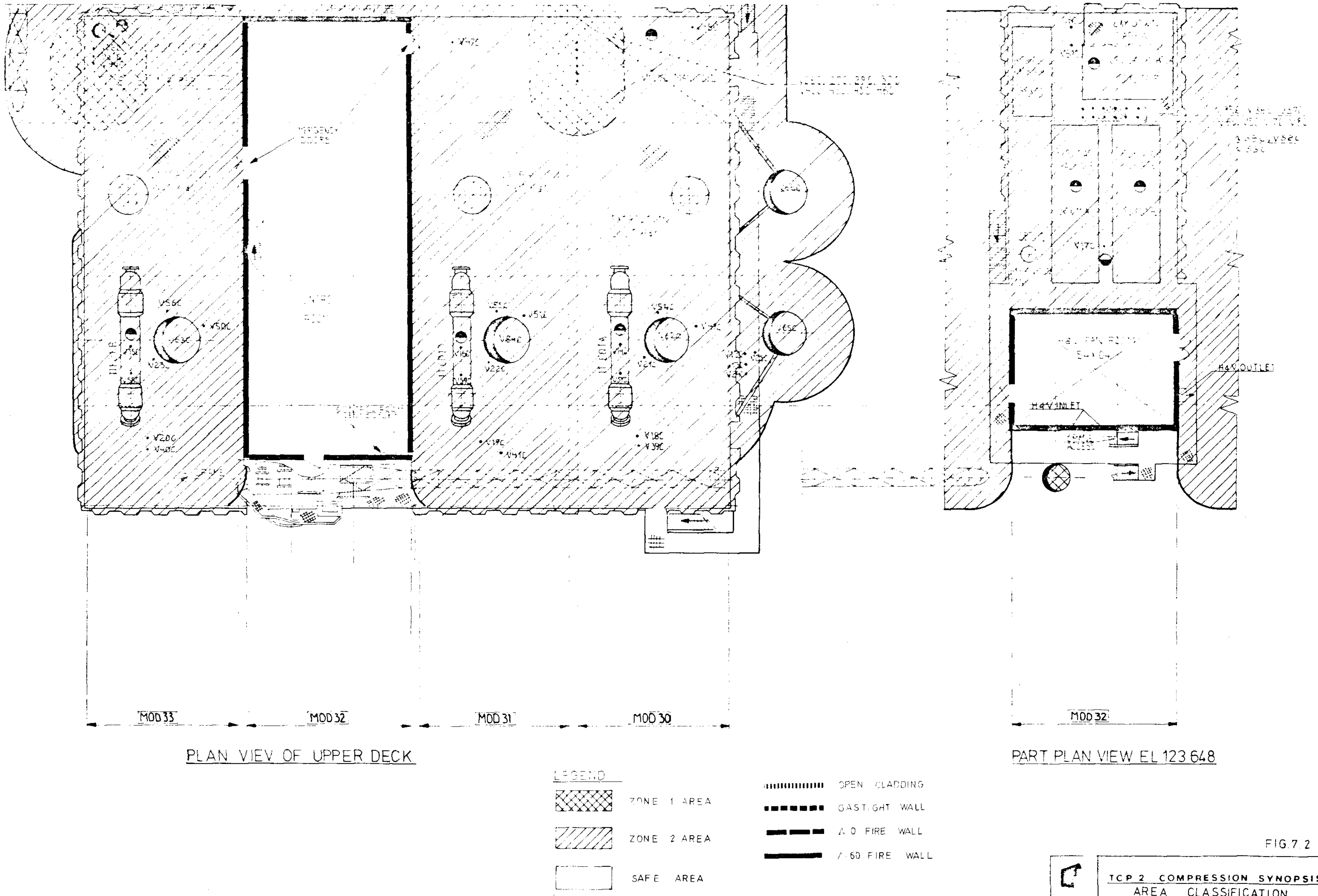
A-0 FIRE WALL

A-60 FIRE WALL

FIG. 7.1

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS
AREA CLASSIFICATION
MAIN DECK



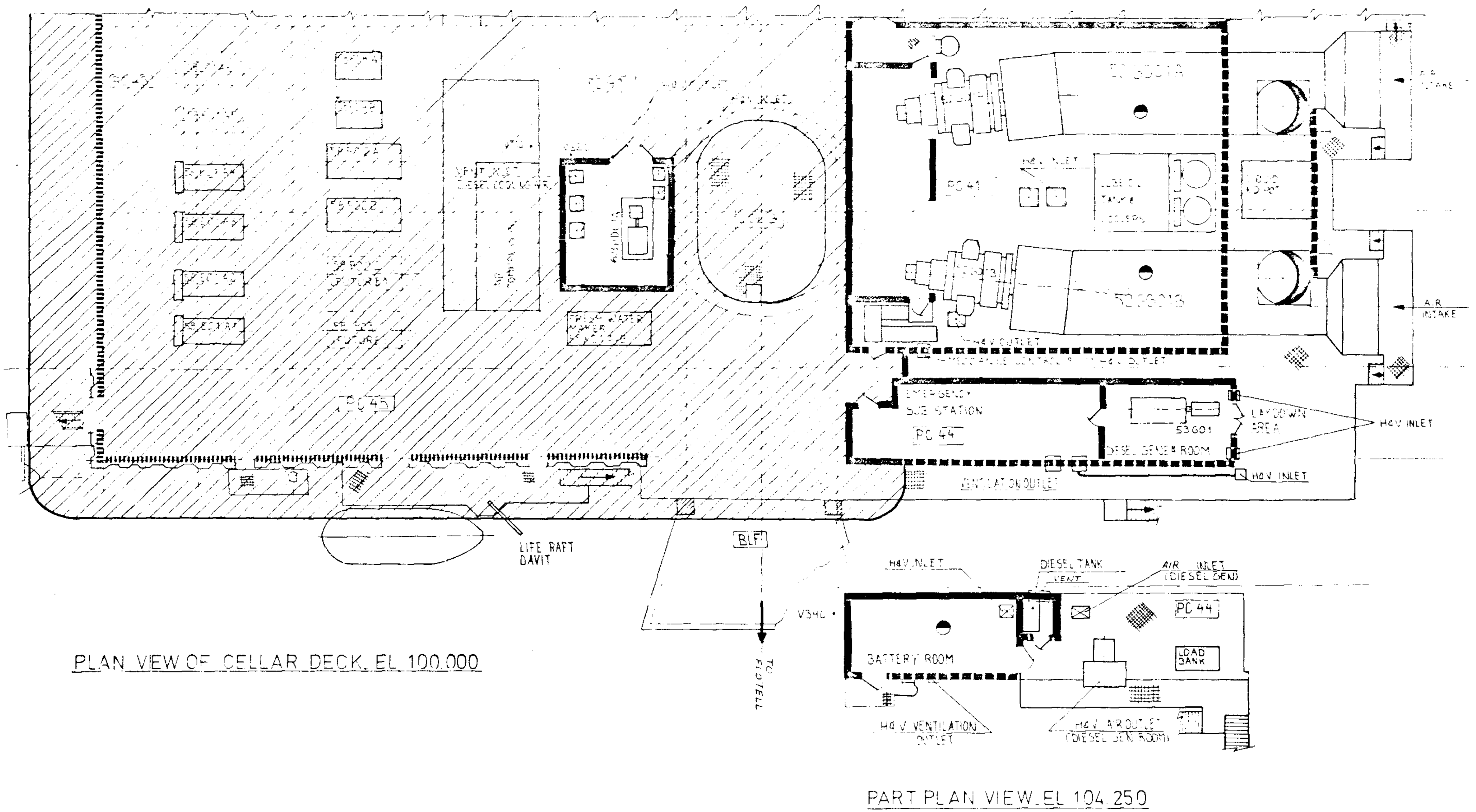
PLAN VIEW OF UPPER DECK

PART PLAN VIEW EL 123 648

FIG 7.2

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS
AREA CLASSIFICATION
UPPER DECK



PLAN VIEW OF CELLAR DECK. EL 100.000

PART PLAN VIEW. EL 104.250

LEGEND

▩	ZONE 1 AREA
▨	ZONE 2 AREA
☐	SAFE AREA

▥	OPEN CLADDING
▬ ▬ ▬	GASTIGHT WALL
▬▬ ▬▬	A 0 FIRE WALL
▬▬▬	A 60 FIRE WALL

FIG 7.3

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS
AREA CLASSIFICATION
CELLAR DECK

8. PLATFORM SAFETY

8. PLATFORM SAFETY

8.1 Escape routes and rescue stations

The basic philosophy for the safety installations is the fact that they shall as minimum conform with the safety regulations from the Norwegian Petroleum Directorate, and Maritime Directorate. The escape routes and rescue equipment are easy to maintain and operate.

8.1.1 Escape Routes

All escape routes eventually lead to either a lifeboat landing area, or to the bridge to TP 1.

Upper deck

Escapeways from the control-room and the deck above lead to the upper deck level. From this level there are four ways of reaching the lower levels:

- Stairs on the west side of the compression area.
- Via the upper deck of the treatment modules.
- Stairs on the east side of module 32.
- Stairs in the north-east corner of the compression area.

Main deck

In each module, the interior escape-routes lead through doors to the walkways outside the modules. On the north side this walkway leads to stairways going down to the cellar deck, one outside the treatment area, and one in the north-east corner of the compression area. Outside module 32 a stairway leads down to the life boat landing outside PC 45.

The walkway on the south side of the compression modules leads to the walkway outside the treatment areas.

Cellar deck

The escape routes on the western part of the compression area interconnects with those of the treatment area. In the eastern part all escape routes lead to the lifeboat landing outside PC 45.

All escape routes are provided with emergency lighting according to the regulations.

8.1.2 Lifeboat landing areas

The escape routes from the compression area lead to lifeboat landings not only in the compression area above, but to all lifeboats on the platform. Only the one belonging to the compression area is described here, for the others see Provisional status book.

During the first phase of TCP 2 production, up to May 80, 3 lifeboats were located on the north and east part of the platform. These have been removed to make room for the compression modules and pancakes.

The two lifeboats on the east side have been substituted by one lifeboat outside PC 45, and the one on the north side has been moved westwards to a new position in the treatment section.

The lifeboat station in the compression area is located on a small platform outside PC 45 and comprises a lifeboat and a liferaft with their accessories.

In emergency circumstances - with normal power cutoff - the lifeboat is lowered by gravity, though in normal operation (for routine abandon platform drill) an electric winch controls the boat's descent. Rehoisting is by the electric winch, connected to the normal power supply. The lifeboat batteries are kept under charge from the DC emergency power supply.

Nearby the lifeboat is a liferaft station with two davit launched liferafts stored in a container and a winch. A container with lifejackets is also stored on the platform. The rescue station is in addition provided with a lifebuoy and an emergency ladder which is kept in readiness near the raft container. A fire alarm button is located in PC 45 just inside of the landing area.

The landing area is lit by emergency lights and floodlights from the emergency power circuit, see sect. 9.6.5. Access is through openings in the module wall, and via the stairs from the main deck.

Lifeboat Outside PC 45

Manufacturer	:	Harding A/S type: MC
Capacity	:	50 seats

Other lifeboats on TCP2 are Watercraft.

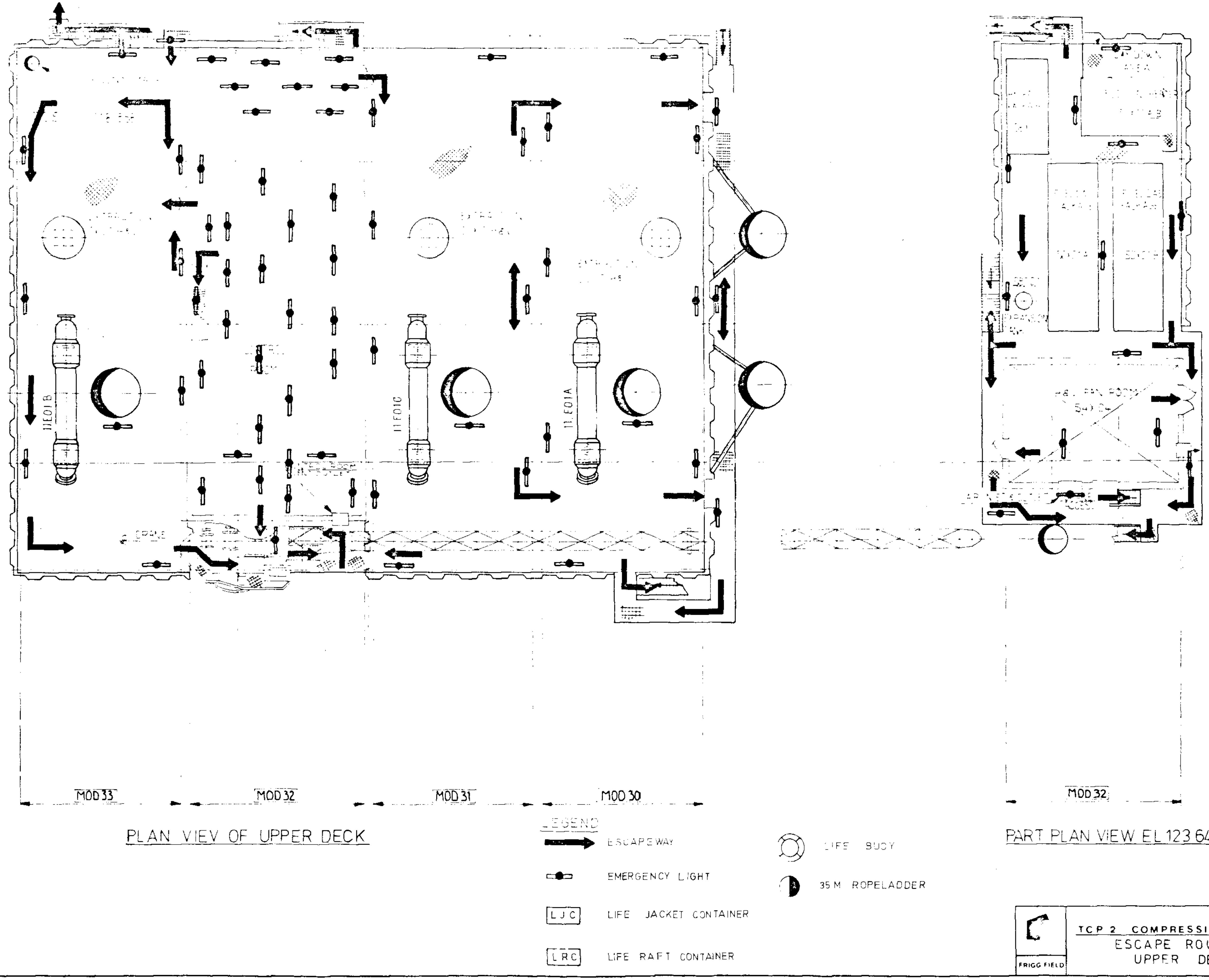
Davit: Nordavit OPD 711. Winch: Nordavit E-2135
Winch Motor: NEBB Ex(d)

Life buoy

Standard size, with self igniting buoy light and smoke signal, and rope.

References

The escapeways, lifeboat landings, and area classification drawings for the whole TCP2 are shown in the TCP2 General Basis of Design Book.



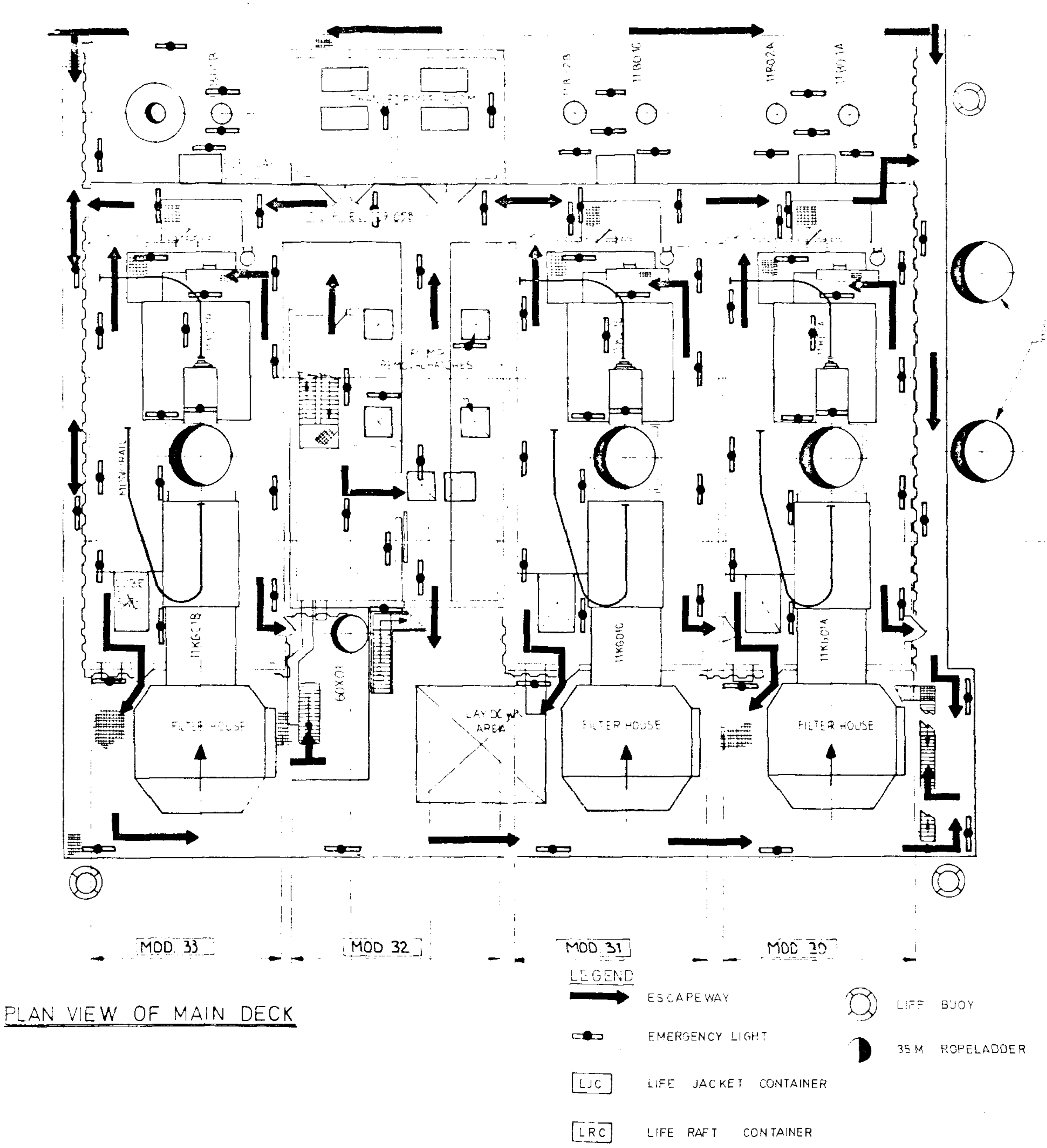
PLAN VIEV OF UPPER DECK

PART PLAN VIEW EL 123 648

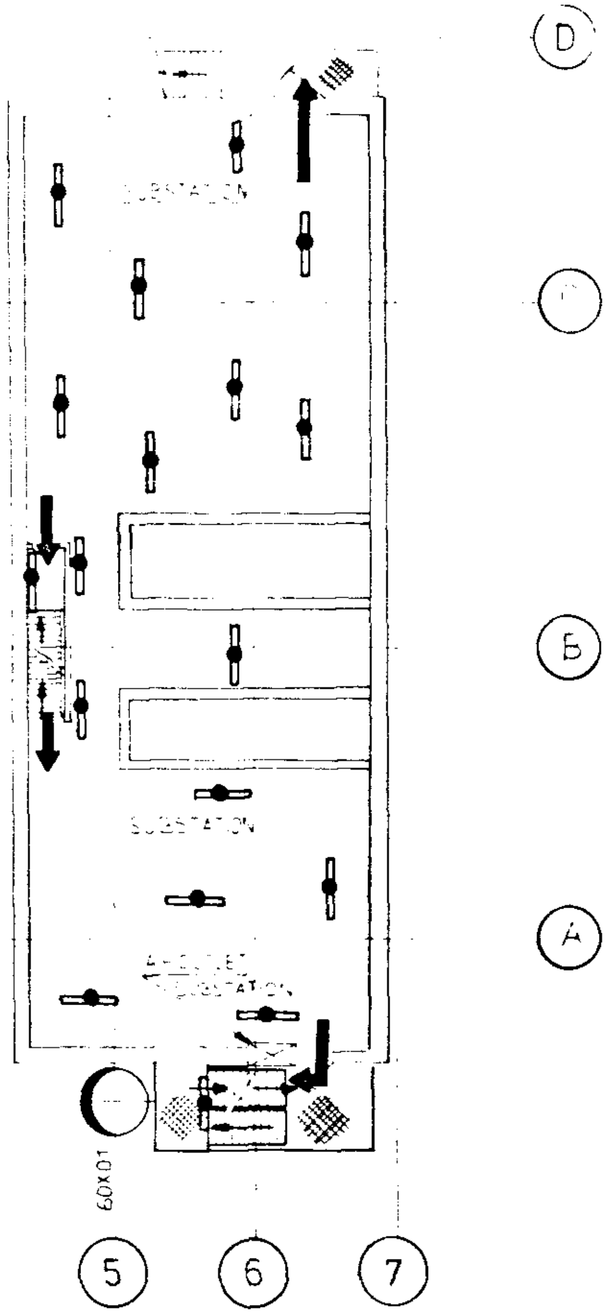
FIG 8.1

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS
ESCAPE ROUTES
UPPER DECK



PLAN VIEW OF MAIN DECK



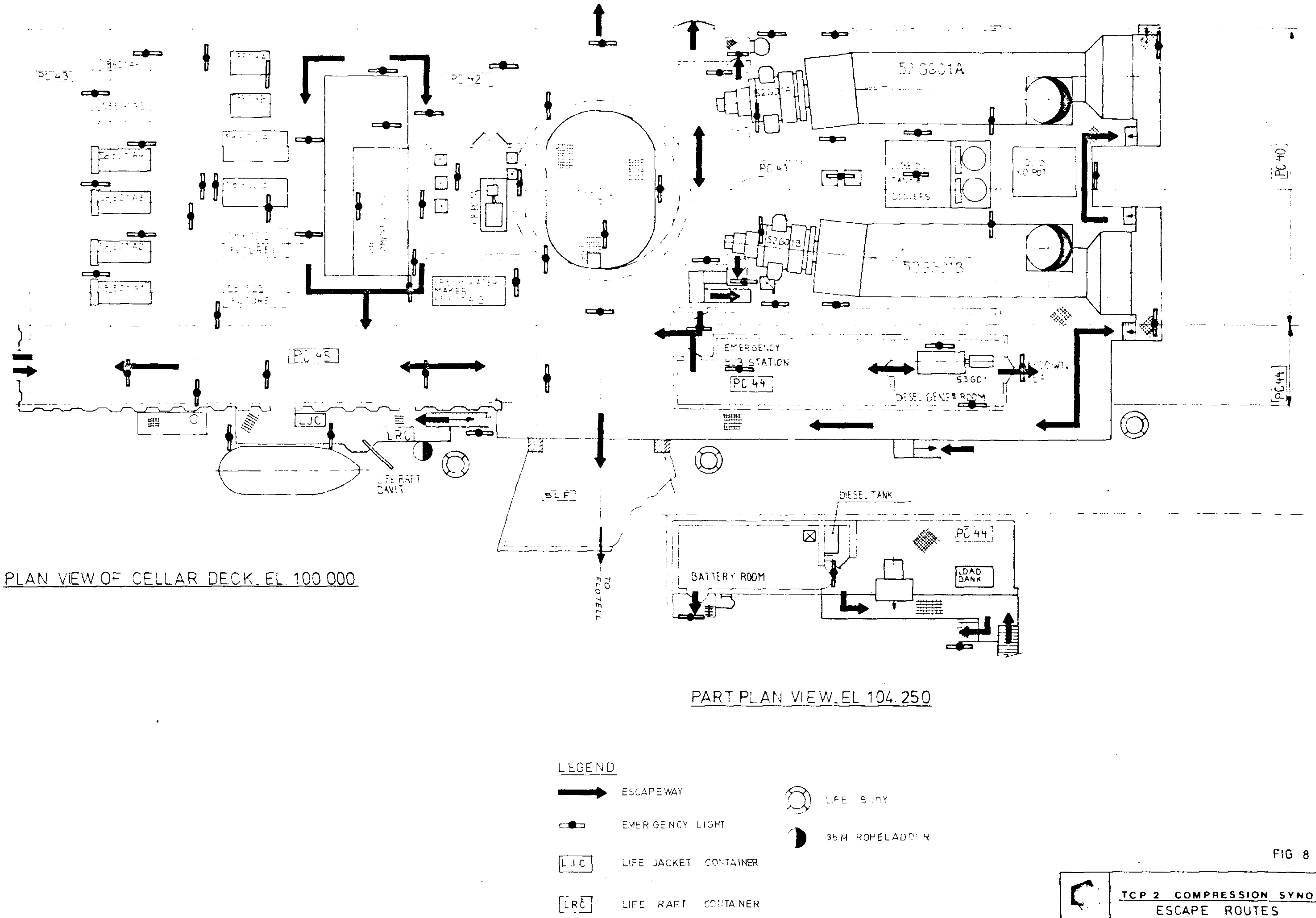
PART PLAN VIEW EL+11455

FIG 8 2

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS

ESCAPE ROUTES
MAIN DECK



PLAN VIEW OF CELLAR DECK, EL 100.000

PART PLAN VIEW, EL 104.250

FIG 8.3

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS
ESCAPE ROUTES
CELLAR DECK

8.2 Detection and P.A. Equipment

8.2.1 General

The compression facilities are provided with gas and fire detectors to obtain the required level of safety against fire and explosion risks.

Power for the detection, alarm and P.A. Circuits is supplied from the emergency distribution switchboards.

Location for all detectors are shown in the accompanying drawings.

8.2.2 Gas detection

Gas detectors serve the triple functions of:

- detecting escape of gas from process areas and imposing immediate shut down to isolate the area affected
- preventing the intake of escaped gas into enclosed and ventilated areas - 'safe' areas - by isolating the room the moment gas is detected in the ventilation intake. The normal action is to close the dampers and stop ventilation
- providing an alarm in the control room on detection of very low gas concentrations throughout the installations.

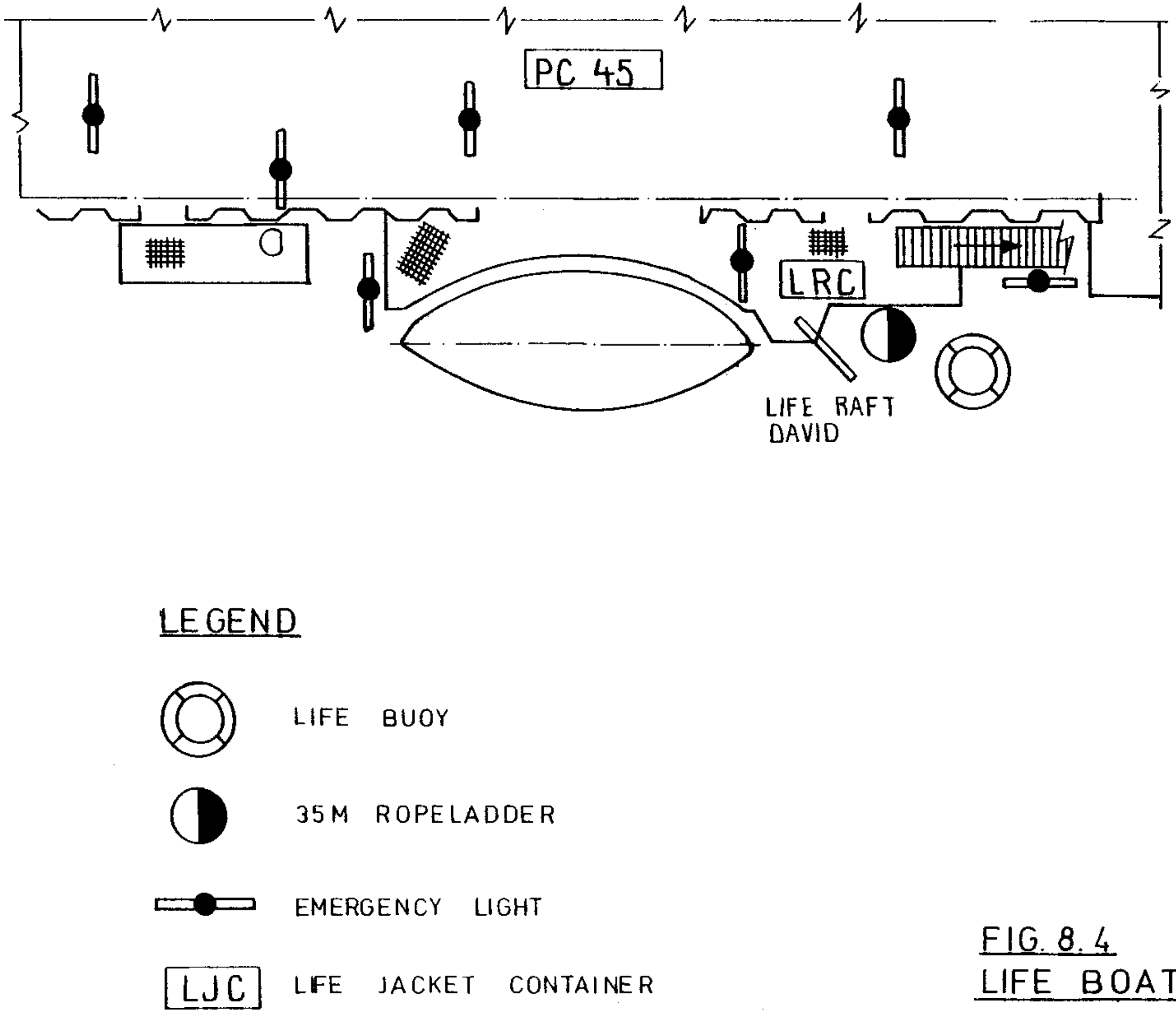


FIG. 8.4
LIFE BOAT LANDING

The main shut down philosophy is:

a) Detectors in process areas will give a 3rd level shut down to the compression (see description of 3rd level shut down in the chapter shut down system) and after a time delay 3rd level shut down on TCP2 treatment.

b) Detectors in fuel gas area package will have for result a shut down of the turbo generators and consequently a field shut down.

c) Detectors in compressor rooms and compressor room ventilation outlet will give a shut down of the compressor concerned plus action on electrical equipment of the room.

d) Detectors in ventilation air inlets will shut down ventilation fans and dampers of the concerned room with sometimes actions on electrical equipment.

Shut down actions are also described in section 8.4 and electric shut down in section 9, thus eliminating any source of ignition. The gas detectors give signals depending on the concentration of the gas present. Concentration is measured in relation to the Lower Explosive Limit (LEL).

The signals are:

1st threshold alarm level 20% LEL: alarm given in control room

2nd threshold alarm level 60% LEL: automatic shut down ESD level 3 or below

A pair of detectors functioning in coincidence is installed at each measurement point. The 20% LEL alarm is given if one detector reaches this point whereas automatic shut down only occurs if two detectors working in coincidence reach the 60% LEL threshold.

The exception to these settings is in the combustion air inlets to the gas turbines where the signal is:

1st threshold alarm level 15% LEL: in air intake of turbo generators - shut down of STAL-LAVAL gas turbines on coincidence detection

1st threshold alarm level 15% LEL: In air intake of turbo compressors - shut down of UTI gas turbines on coincidence detection

The gas detection panel in the control room permits identification of each gas detector in the event that alarm indicator lights remain lit until manual reset. Turbine hood alarms are grouped into a separate panel for each turbine.

On the gas detection panel in the compression control room the following information is given by four electro-luminescent diodes:

- power on
- fault
- alarm 1st level
- alarm 2nd level.

The last three are connected to the alarm system.

Alarm light for 1st and 2nd alarm level will stay on until manual reset.

The fault alarm will start klaxon and flashing lights in addition to the panel alarm.

If the fault disappears

- light on panel disappears
- klaxon and flashing lights remains on until manual reset.

If the fault remains:

- light on panel becomes steady
- klaxon disappears.

The system is fail-safe in the unlikely possibility of power supply failure. For power supply details see section 9.2.

LOCATION	NO. OF DETECTORS
Module 30	22
Module 31	20
Module 32	15
Module 33	20
PC 40	14
PC 41	16
PC 42	8
PC 43	1
PC 44	8
PC 46	3
Col 3	2
Total	129

The gas detectors are located where gas is likely to occur or accumulate, and where gas could enter safe areas.

- air inlets of gas turbines and diesel engines
- in gas turbine and compressor hoods
- in vicinity of fuel gas skids
- in ventilation air inlets.
- outside PC 41 turbine hall doors
- inside PC 41

Gas detection panel particulars:

Maker : ICARE
Panel arrangement: Frame rack for 19" nests
Equipment : - Detection modules
- Monitoring modules
- Power supplies
- Inhibit keys
- Rekys (ITT type GA, UNIBLOC)
- Terminals

Sensors
Make/type : A.D.F. type M and THX
Flameproof terminal housing

These detectors have a lower filament temperature than that of similar competing types, which will reduce the calibration and maintenance cost.

The Icare detectors are provided with a fault alarm indicating a negative drift of -5% off setting and have high temperature heads. Failure in detection field wiring (i.e. line rupture or earth fault) will be detected by the loop module and annunciated as "FAULT" without affecting the 20% and 60% LEL alarm outputs. Alarm outputs are fail-safe, i.e. output relays are energized in the normal condition and de-energized in the alarm condition. These outputs are connected to the Programmable Logic Controller (PLC) for activation of the varying ESD actions, and to alarm annunciators and mimic display indications. Alarm outputs can be inhibited by a key switch on each detector module and tested by depressing a test push button.

8.2.3 Fire detection

The three types of detectors are designed to handle different emergency contingencies as follows:

Smoke detectors, located in:

electrical services rooms
turbo generator modules
cooling water and utilities area
control room
HVAC room

Heat detectors, located in:

turbine hoods	
turbogenerator modules	rate compensation type
fire pump rooms	rate compensation type
emergency diesel rooms	rate compensation rype

U.V. detectors, located in:

turbo compressor modules
in fuel gas treatment units
upper deck of compressor modules.

All detectors operate on coincidence to give similar shut down actions, but coincidence operations are not necessarily confined to both of a pair of detectors; in a group, say, of eight detectors a threshold signal from just two of these would trigger shut down.

The actions from fire detectors are:

Signal from one detector - alarm in control room
Signal from two detectors in coincidence:

- Fire alarm on TCP2/C, TCP2/T, TP1, QP
- Start TCP2/C fire pumps (including signals from areas covered by halon and not sprinklers)
- 3rd level ESD in process areas
- Opening of deluge valve for area affected or release of halon in rooms
- Isolation of ventilated rooms by dampers and shut down of ventilation.

These actions, except for the control room alarm, are processed by the PLC. An exception to this procedure is the L.P. cold vent stack, where halon release is manual from the local panel and/or control room.

Fire Detectors

Fire detection is performed by the following devices, supplied by TELESYSTEMER A/S:

U.V. Detection:

Manufacturer	: Dettronic
Model	: U 7600 A
Material	: Stainless steel
Voltage	: 220 V
Enclosure	: Flame proof

Smoke Detection:

Manufacturer	: CERBERUS
Model	: F 6A EX
Material	: Thermoplastic
Voltage	: 20 V
Enclosure	: Flame proof Intrinsically safe with zener barrier type MTL 172.

Heat Detection:

Note : Both fixed temperature and rate-of-rise (differential) detectors have been applied.

Manufacturer	: Fenwal
Model	: 271-21-20
Material	: Stainless steel
Voltage	: 20 V DC
Enclosure	: Flame proof

LOCATION	TEMPERATURE		Smoke	U.V.
	Fixed	Temp. compensating		
PC 40				2
PC 41	10*	4	6	
Col. 3		2	4	
PC 42 incl. fire pump rooms		4	7	
PC 43			1	
PC 44		2	4	
Module 30	4*		4	8
Module 31	4*		4	8
Module 32			30	4
Module 33	4*		4	8
Total	22*	12	64	26

In the substation in module 32 some of the smoke detectors are located below the false floor.

*Fixed temperature detectors are located inside turbine hoods.

8.2.4 Fire alarm buttons

The electrically operated F.A.B.'s are situated as follows:

Location	No.
PC 40	2
PC 41	2
Col. 3	1
PC 42	2
PC 44	2
PC 45	1
Module 30	6
Module 31	6
Module 32	11
Module 33	7
Total	40

The pushbuttons have the same action as the fire-detectors in the same area.

Manual Fire Alarm Buttons

Manufacturer : HEYES
Model : 1026 F/A
Material : Cast iron painted red
Voltage : 220 V a.c.
Enclosure : Flame proof

The control room fire alarm panel is arranged with cabinets containing following functions:

- Nests with loop modules for

. Ultra violet detectors	(AUV)
. Smoke detectors	(AES)
. Heat detectors (fire)	(AEF)
. Manual alarm boxes	(FAB)
. Spare modules	(SM)
. Blind plates	(BP)

- Nest with modules for:
  - . display
  - . fault
  - . service
  - . alarm
  - . test
- Power supplies
- Zener barriers
- Blind alarm relays
  - . ITT Unibloc
  - . ITT GA
- Terminals

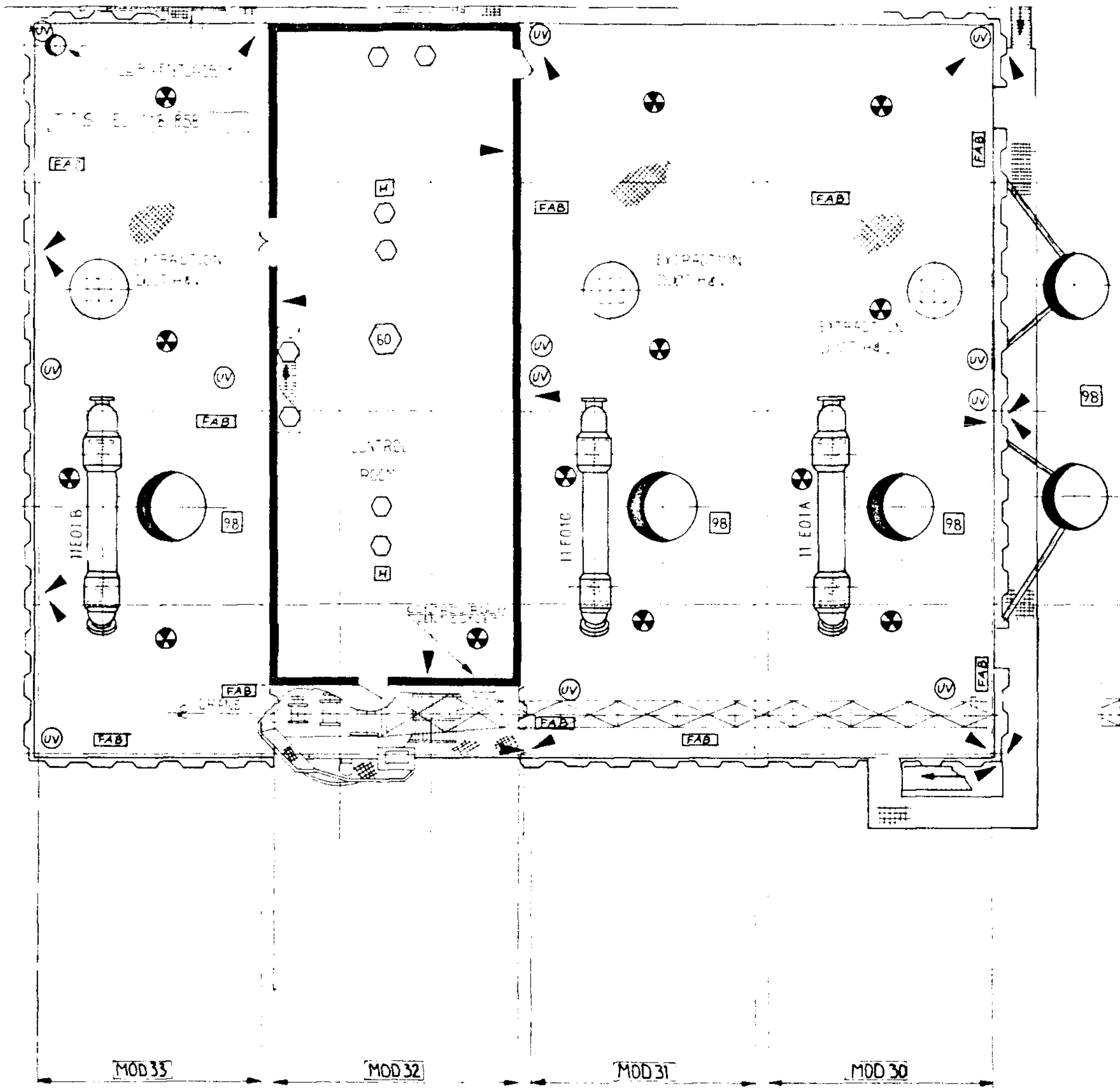
The functions to be performed by the fire alarm system are as follows:

- give a signal of any fire detector in alarm state
- permit the test of any fire detection loop without actuating the fire equipment
- detect a fault in any loop
- give by area and by deck a flashing signal for the emergency shut down mimic
- out put of detection loop connected via terminals to the programmable logic controller (PLC) for control of fire equipment and ESD.

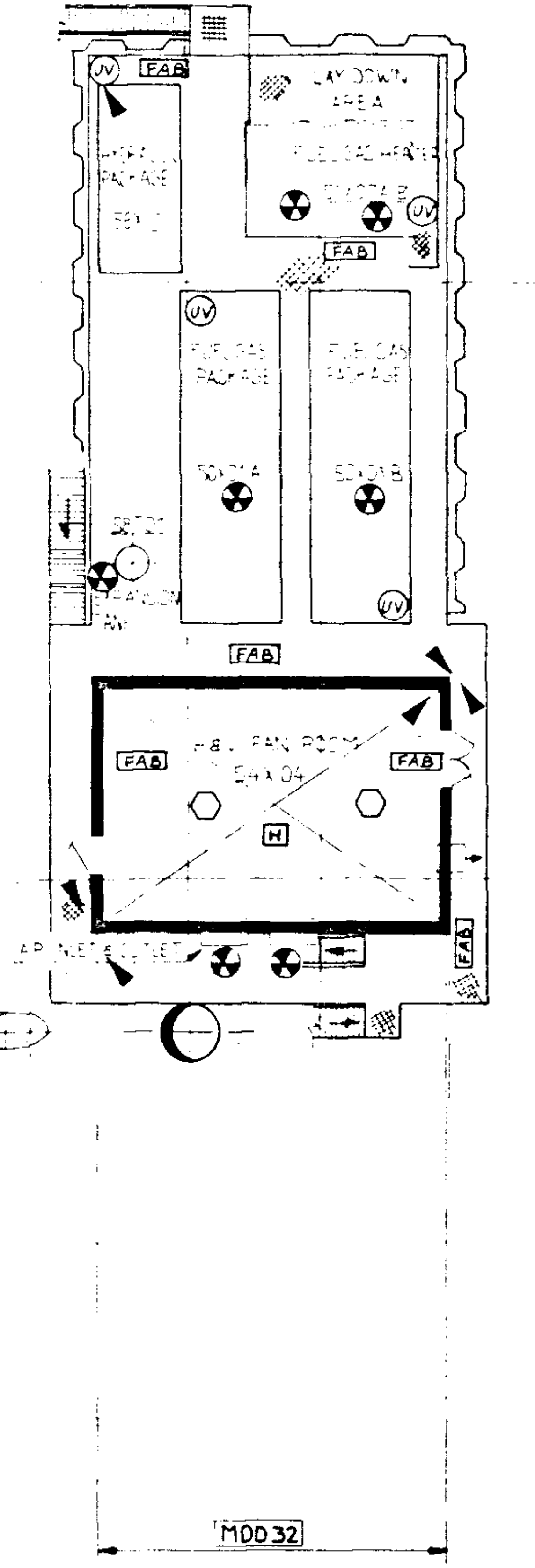
8.2.5 P.A. Equipment

Loudspeakers are installed througout the modules and pancakes, located in such a manner that no area is blanked off. The loudspeakers are used for public address and to transmit fire and muster alarms. (Zone I certified speaker, all weather type).

In noisy areas loadspeakers alarms are doubled by flashing lights.



PLAN VIEV OF UPPER DECK



PART PLAN VIEW EL 123.648

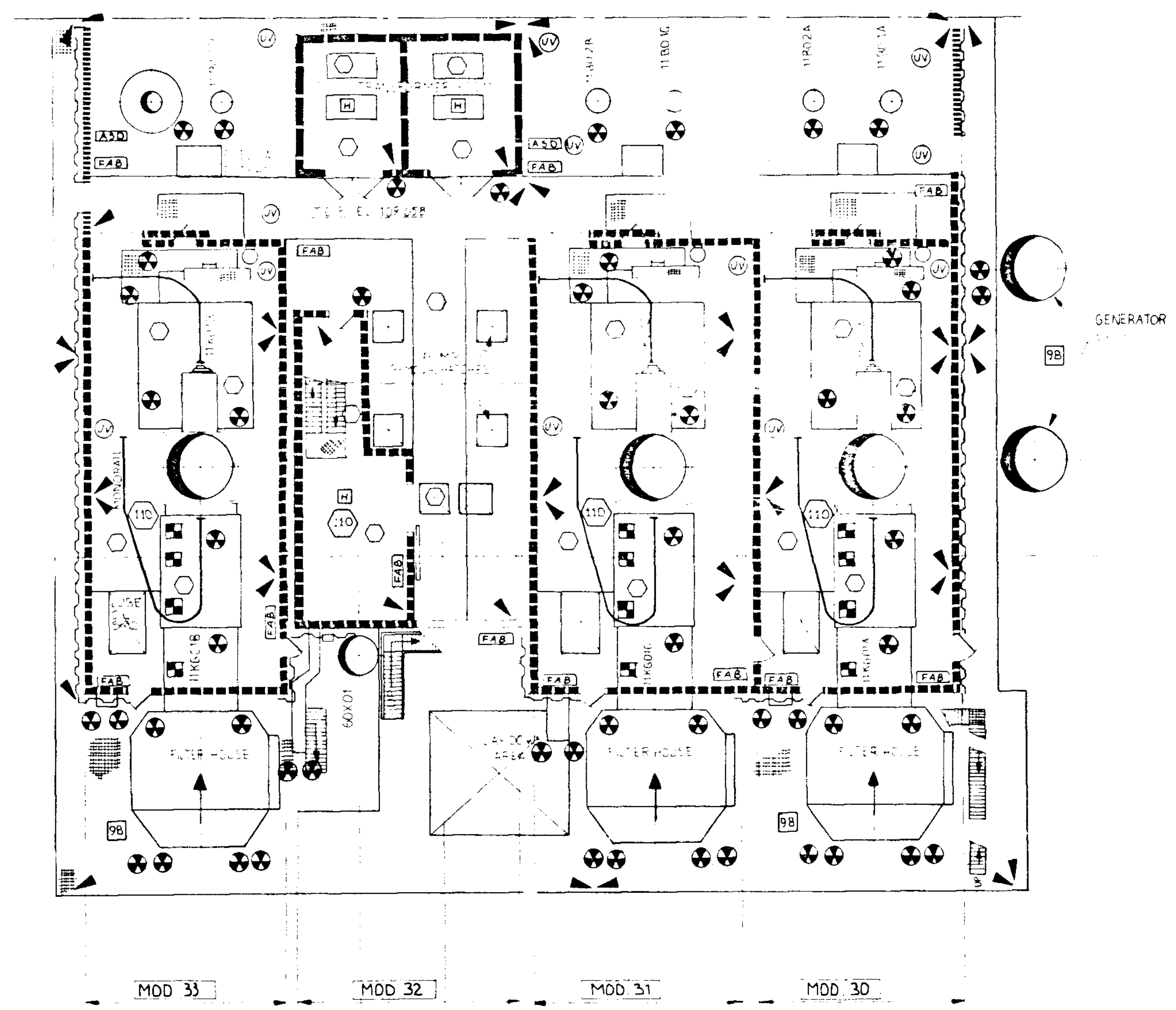
LEGEND

- FAB FIRE ALARM BUTTON
- ◀ P.A. LOUDSPEAKER
- ▚ FIXED TEMP. HEAT DETECTOR
- ⊡ RATE COMPENSATING HEAT DETECTOR
- Ⓤⓥ ULTRA VIOLET FLAME DETECTOR
- ☢ GAS DETECTOR
- ⬡ SMOKE DETECTOR
- H HALON PROTECTED AREA
- [ ] LOCAL SOUND PRESSURE DB (A)
- ⬡ REVERBERANT SOUND PRESSURE LEVEL DB (A)

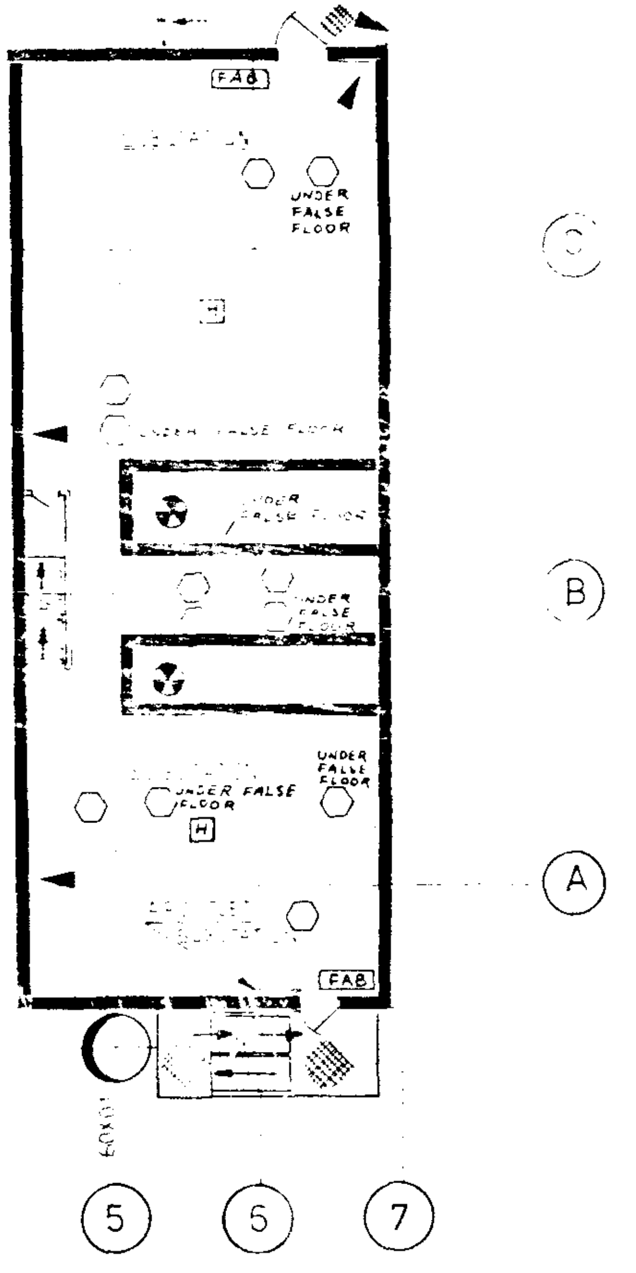
FIG. 8.5

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS
DETECTION AND P.A. EQUIPMENT
UPPER DECK



PLAN VIEW OF MAIN DECK



PART PLAN VIEW EL+114558

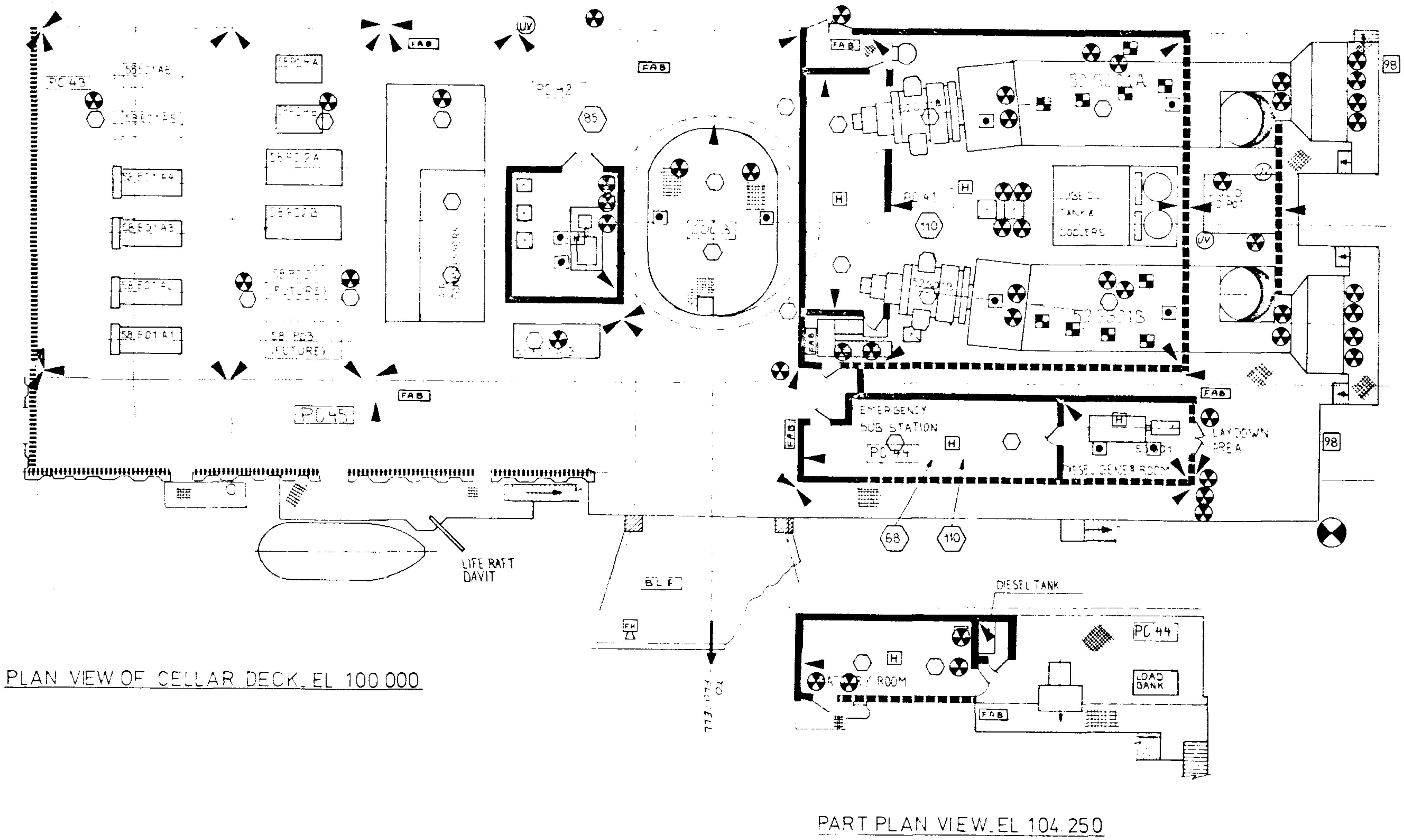
LEGEND

- FAB FIRE ALARM BUTTON
- ◀ P.A. LOUDSPEAKER
- ▚ FIXED TEMP. HEAT DETECTOR
- ⊡ RATE COMPENSATING HEAT DETECTOR
- (UV) ULTRA VIOLET FLAME DETECTOR
- ☢ GAS DETECTOR
- ⬡ SMOKE DETECTOR
- H HALON PROTECTED AREA
- ☐ LOCAL SOUND PRESSURE DB (A)
- ⬡ REVERBERANT SOUND PRESSURE LEVEL DB (A)

FIG 8.6

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS
DETECTION AND P.A EQUIPMENT
MAIN DECK



PLAN VIEW OF CELLAR DECK. EL 100 000

PART PLAN VIEW. EL 104 250

LEGEND

FAB FIRE ALARM BUTTON

◀ P.A. LOUDSPEAKER

▚ FIXED TEMP HEAT DETECTOR

⊡ RATE COMPENSATING HEAT DETECTOR

(UV) ULTRA VIOLET FLAME DETECTOR

☢ GAS DETECTOR

⬡ SMOKE DETECTOR

H HALON PROTECTED AREA

☐ LOCAL SOUND PRESSURE DB (A)

⬡ REVERBERANT SOUND PRESSURE LEVEL DB (A)

FIG 8.7

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS
DETECTION AND PA. EQUIPMENT
CELLAR DECK

8.3 Fire Fighting

8.3.1 General

TCP 2 compression has the following fire fighting equipment depending on the duty and equipment to be protected.

Firewater system

- Sprinklers
- Hose reels
- Monitors
- Foam stations

Powder extinguishers

Halon system
CO_2 system

Sprinklers automatically released on fire detection are used in process areas where fire can break out. Sprinkler nozzles are arranged to provide an anvelope of spray around the pressure vessels, piping or other process equipment affected.

Manual back-up action is provided by fire monitors aiming a concentrated jet at the area affected.

Hosereels are placed at strategic locations for manual protection from local fires or other small fires not covered by the other equipment.

Foam stations, comprising a foaming agent included by venturi flow of the discharged water, are intended particularly for fires in liquid hydrocarbon spillage and retention areas.

3.3.2 Firewater systems

The firewater headers on the four central installations on the Frigg field, i.e. QP, TP1, TCP2/T and TCP2/C are interconnected. Each header comprises a loop with an interconnection branch between each loop.

This system is kept under pressure by the QP brine pumps. Seven firepumps housed in separate firepump rooms are provided:

1 on QP
2 on TP1
2 on TCP2/T
2 on TCP2/C.

Each pump on the TCP2/C has a capacity of 7560 l/min at a delivery pressure of 8.8 bar, giving one pump system a total capacity of 15100 l/min.

NPD requires the pressure at the highest point of the system to be minimum 5 bar. Available static pressure at the highest point (elevation 29 m) is 8.8 - 2.9 = 5.9 bar.

Pressure loss in piping is 0.24 bar giving a net pressure of 5.9 - 0.25 = 5.66 bar at the highest point.

The QP brine pump maintains a pressure of 4,5 bar in all headers and interconnections, with the reserve pump starting if the pressure drops to 4,1 bars, and at 2.1 bars a firepump on TP 1 starts. When in operation the firepumps raise this pressure to 9 bars. The system throughout uses seawater pumped up directly from the sea.

The main firewater network on TCP2/C consists of two 12" loops, one for the cellar deck, and one common for the main and upper decks. Each loop has a crossover pipe and sectional valves. From the main loops branch pipes go to the various sub systems.

Deluge and sprinkler systems

These systems comprise a sprinkler system for the compressor rooms in modules 30, 31 and 33 and water spray system for exposure protection of vessels and heat exchangers. Maximum water demand is expected to occur when the systems in module 30 and 31 are in operation simultanously, giving a total flow of 15000 l/min.

Each system is controlled by a pneumatically operated delugevalve, the control signal from the shut-down system being electric.

The sprinkler and spray systems are designed in accordance with NFPA 15 where the pressure loss is calculated by the HAZEN - WILLIAMS formula.

SCHEMATIC LAYOUT FOR COMBINED RUNNING TEST --- SG xx AND PB xx

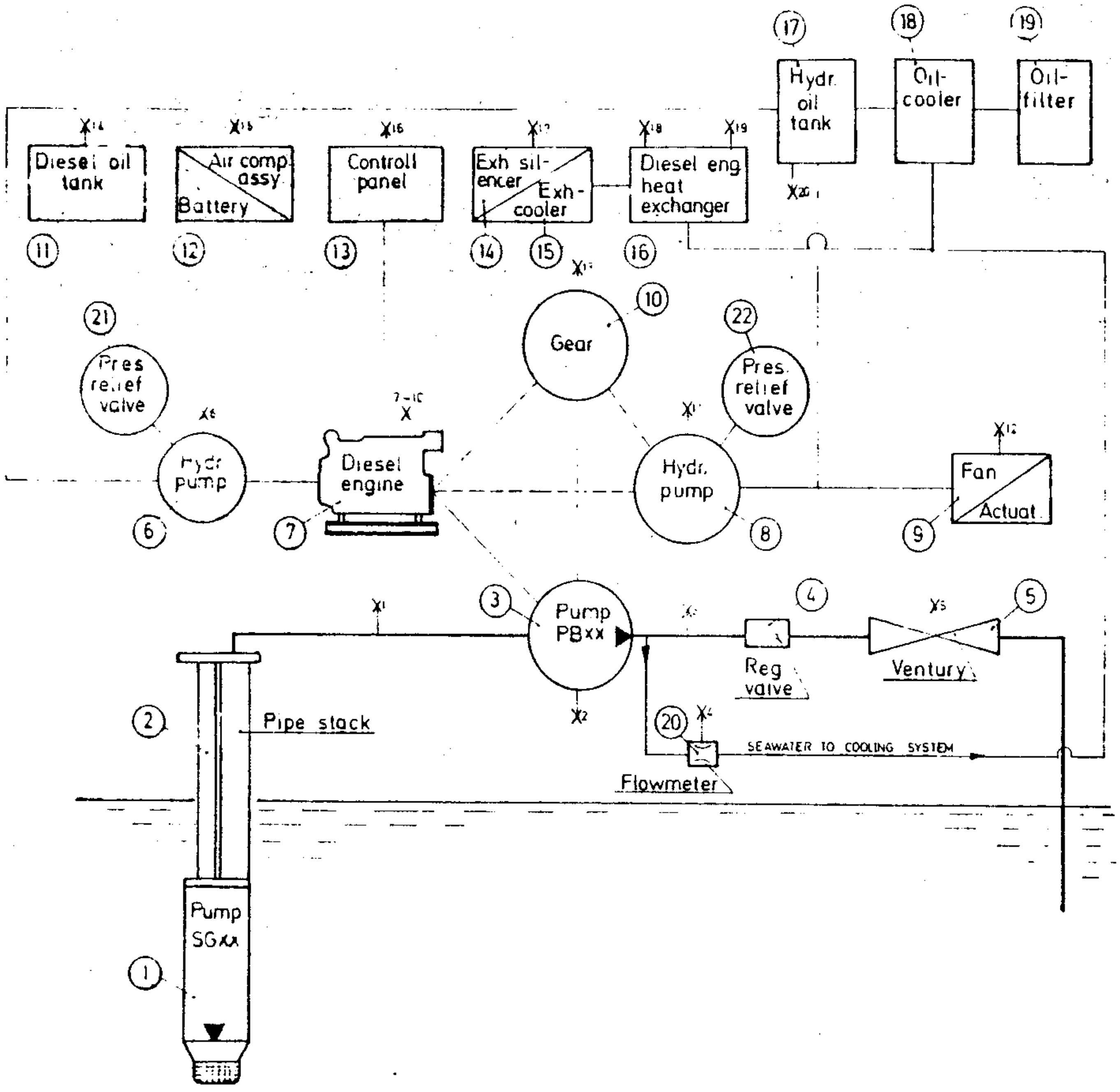


Fig. 8.8

SPECIFICATION OF EQUIPMENT

PCS	QTY	DESCRIPTION	REMARKS
1	1	PUMP SG ______	
2		PIPE STACK	
3	1	PUMP PB ______	
4	1	REGULATING VALVE	
5	1	VENTURY FLOWMETER	
6		HYDR PUMP	
7		DIESEL ENGINE	
8		HYDR PUMP	
9		FAN/ACTUATOR	
10		GEAR	
11		DIESEL OIL TANK	
12		BATTERY/AIR COMPR	
13		CONTROLL PANEL	
14		EXH SILENCER	
15		EXH COOLER	
16		DIESEL ENG. HEAT EXCH.	
17		HYDR OIL TANK	
18		OIL COOLER	
19		OIL FILTER	
20		FLOWMETER	
21		PRES. RELIEFE VALVE	
22		——	
23			
24			

MEASURING POINTS

NO	DESCRIPTION	REMARKS
1	PRESSURE	
2	TEMPERATURE	
3	PRESSURE	
4	FLOW	
5	—"—	
6	DIF. HYDR. PRESSURE	
7	COOLINGWATER TEMP	
8	ALL ENG-MOUNTED INST	
9	RPM	
10	NOISE TEST(free field)	
11	DIF HYDR PRESSURE	
12	PRESSURE/RPM	
13	TEMPERATURE	
14	FUEL CONSUMPTION	
15	PRESSURE	
16	ALL FUNCTIONS ARE TO BE TESTED	
17	TEMPERATURE	
18	TEMP SEAWATER SYSTEM	
19	TEMP FRESHWATER SYSTEM	
20	TEMPERATURE	

FRANK MOHN A/S
PUMP & GEAR WORKS

SCALE		SIGN	DATE	SCHEMATIC LAYOUT FOR COMBINED RUNNING TEST	
		OVa	4/4-79		25-2

Sprinkler systems (exposure protection) are used in:

Modules 30,31,33

Suction drum and water separator
scrubber (Mod. 33)
Natural gas cooler

Module 32

Fuel gas heaters
Fuel gas package
Hydraulic package

Deluge systems are used in:

Compressor rooms in Mod. 30,31,33.

Hose reel stations

A total of 22 firehose stations are installed. Size: 2½" connection with 1½" hose. Water demand is 385 l/min. for each hose.

Monitors

Three fire monitors are located on the upper deck, two on top of module 32 and one on a platform in the N.W. corner of module 30. Capacity of each monitor 1300 l/min.

Foam stations

Two hose stations on the upper deck of module 32 are foam stations. The foam concentrate is injected into the firehose to ensure a constant mixing ratio of foam compound and water. The type of foaming agent is the specified Angus polydol alchohol resistant foam compound.

Firewater pump

Two dieseldriven fire pumps, each capable of handling the TCP2/C design fire extinguishing load, are installed in two separate fire pump houses in conformity with the NPD regulations.

When started the fire pumps lift the static pressure of 4,5 bar in the fire water headers to an operating pressure of 8,9 bar; a discharge valve to sea regulates this pressure.

Each pump has a capacity of 7560 l/min. (454 m^3/h).

Starting of the pumps can be either automatic or manual. The automatic start is signalled by depressurizing a pneumatic circuit. Automatic start of the two pumps in the compression area will also initiate start of the two pumps in the treatment area. In case of automatic start of the 5 firepumps of the QP-TP1-TCP2/T interconnected system, the two pumps in the compression part will not start automatically. These pumps will be manually started from QP control room or locally.

The fire pump houses are safe areas installed within A60 fire walls and ventilated by electric fan with the usual ventilation security measures, see sections 3.2 and 3.3.

The riser casings are installed on the circumference of the TCP2 columns; on col 3 for pumphouse A and on col 5 for pumphouse B, the latter being situated next to one of the present TCP2/T pumphouses.

The pump package is by FRANK MOHN, and comprises:

- 252 kW diesel engine
- hydraulic power unit
- first stage submerged hydraulic pump
- booster pump
- cooling system and heat exchanger
- forced ventilation
- air starting equipment

The diesel engine drives the hydraulic power unit and the booster pump. The hydraulic unit powers the submerged first stage pump; a direct drive, with alignment and other maintenance problems is thus avoided.

The booster pump is situated next to the diesel at cellar deck level and boosts the circulation of sea water coming from the hydraulic pump 50 m below in the intake shaft. The hydraulic fluid is supplied at 250 bar and through stainless steel tubing down to the pump inside the casing.

The heat gain with the diesel running is 50 kW, and a separate room cooling system is provided , driven by the diesel and taking air from specially provided louvres which open when the engine starts. The cooling system for the diesel engine itself is an indirect fresh water circuit passing to a heat exchanger in the fire water line.

A cooler is provided to take care of the heat gain in the hydraulic oil. It is cooled by seawater and gives a temperature decrease of 5°C from 58°C to 53°C in the oil.

An entirely autonomous starting system has been adopted consisting of a duplicated air starter installation. Each providing 6 starts of 6 seconds each. Each system comprises two electric powered air compressors, storage cylinders and pneumatic starter motor. The air compressor, and other electrically driven accessories are in a state of permanent surveillance from QP & TCP2/C control room to ensure normal operation at all times.

Local instrument panel will display the status of engine functions, and also Low starting air pressure.

Failure of diesel engine start alarm is displayed in the control room.

The hydraulic first stage pump and discharge column are made of high alloy stainless steel type 2RK 65. The hydraulic oil pipes and control pipes are made of stainless steel type SS.316. The outside temperature of the exhaust gas piping has been designed to be below 80% of the auto-ignition temperature of Frigg field methane, i.e. $0,8 \times 515^{o}C = 412^{o}C$.

Minimum noise level curves have been specified by the client following NPD norms.

8.3.3 Halon

Halon 1301 stored in steel cylinders at 42 bar is used as a fire extinguisher for enclosed zones such as the electrical equipment rooms and in the hoods of the turbo generators. Halon delivers its effect by inhibiting exothermic chemical reactions between combustible products and oxygen. Rooms in which it is used are:

- H & V
- Fan room
- Transformer room
- Substation
- Control room
- Emergency generator room
- Battery room
- Emergency substation
- Turbo generator room hood
- Turbo generator control room
- Fire pump rooms.
- Workshop

The design capacity of halon for a single release is 6% of the volume of the enclosed zone concerned. Release takes place automatically for the majority of shut-down actions (see 3.3 ESD).

Each system can be shut down manually. Only control room has manual release at all times.

Controls for the halon release system are normally placed just outside the door of the room protected. Switching from automatic to manual release is a routine safety procedure if personnel are going to work in the room for any length of time and is carried out by means of a key operated switch. Manual release is from a lever within the release box. When the door of the box is opened, a signal to the PLC causes the room fan to stop, the dampers to be closed and an alarm to be sounded in the control room.

The control panel also has, near the main entrance door of each room, 3 large coloured lights, one or other of which is always on.

They indicate:

- Halon released (red)
- System on automatic control (amber)
- System on manual control (green).

Panels with repeating signalling lamps are located near other entrance doors.

8.3.4 Carbon dioxide

The turbo-compressor turbine hoods have CO_2 extinguishing equipment operating on similar principles to halon release, except that a much greater quantity is needed, CO_2 release quantity being based on 30% of the enclosed volume as against 6% for halon.

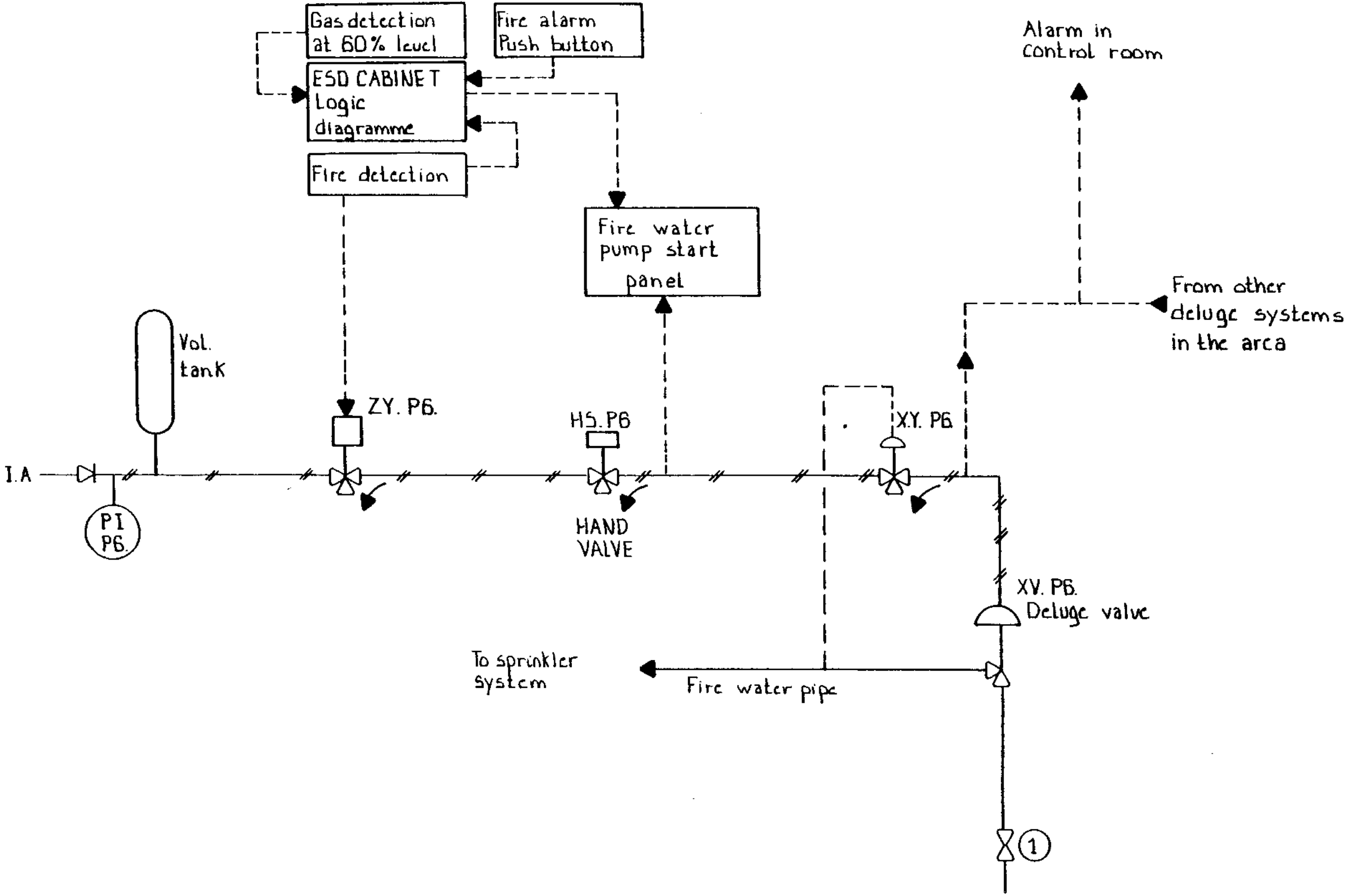


FIG. 8.9
FUNCTIONING OF DELUGE VALVES

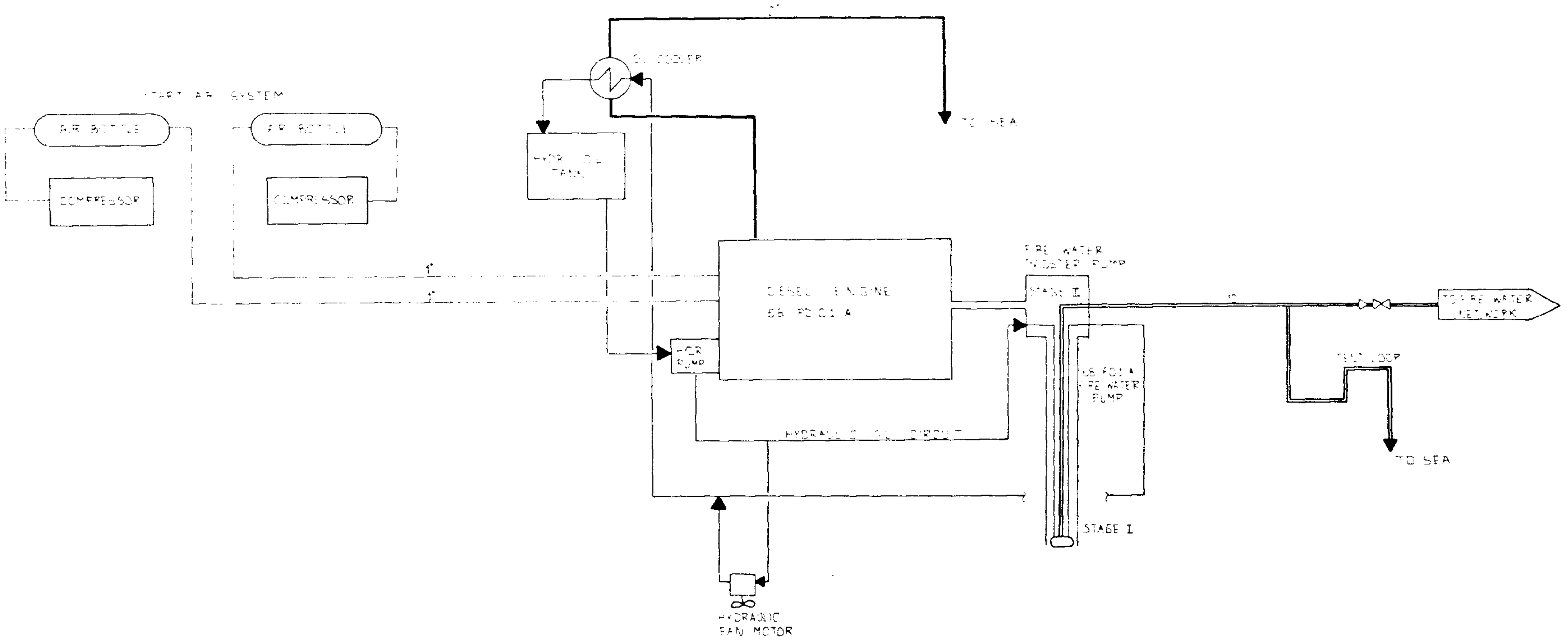


FIG.8. 10

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS

FIRE PUMPS

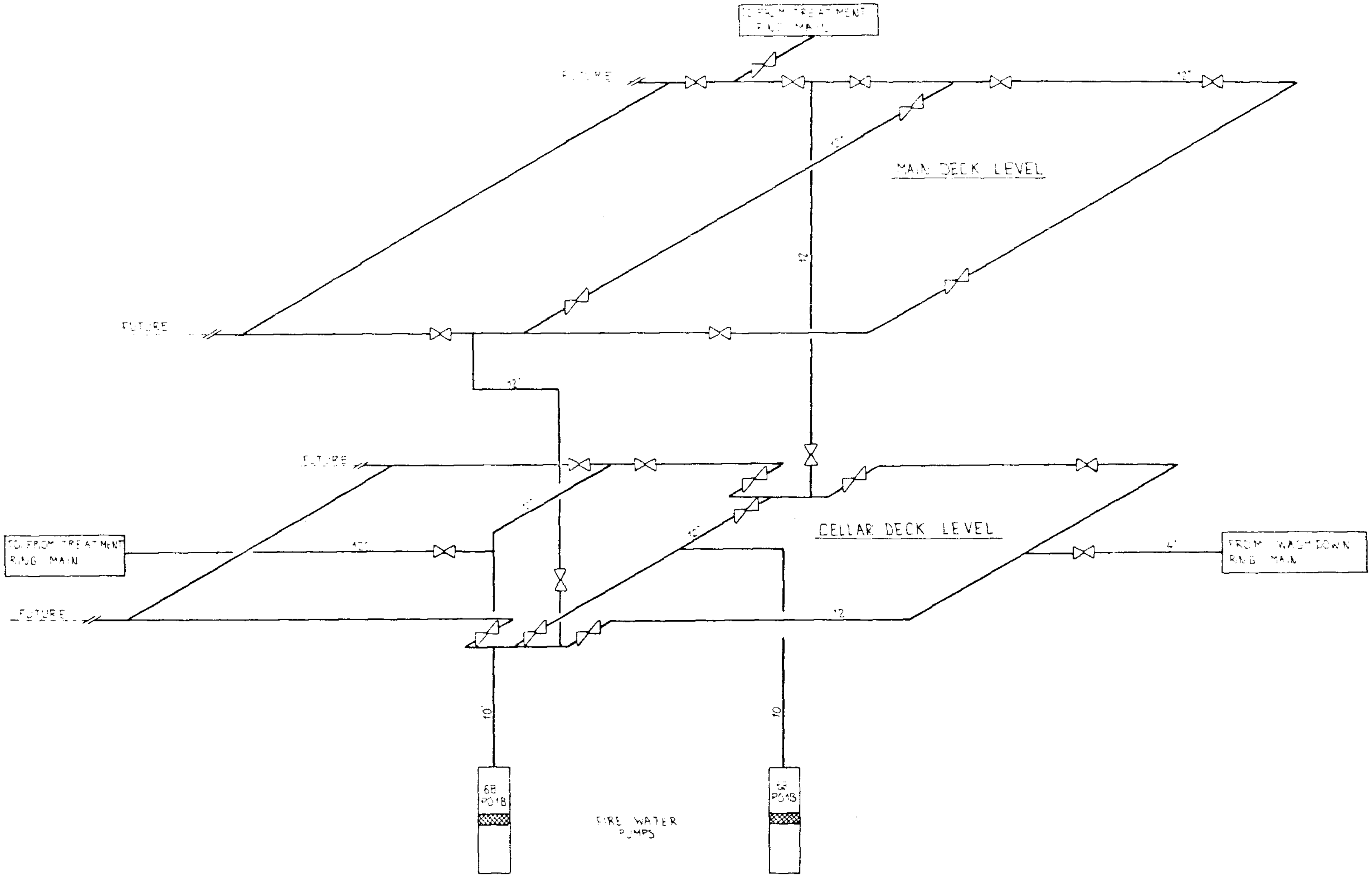


FIG 8 11

TCP 2 COMPRESSION SYNOPSIS

FRIGG FIELD

FIRE WATER
MAIN RING SYSTEM

8.3.5 L.P. VENT SNUFFING.

General.

A snuffing package is provided for the case of accidental ignition of the vented gas. Although the stack is designed to vent, the possibility of accidental ignition must be considered.

For extinguishing a possible fire of the cold vent, HALON and Dry CHEMICAL POWDER is used. HALON is injected at the bottom of the stack based on a manual action. If the fire is not extinguished, the DRY CHEMICAL POWDER can be released by manual initiation.

Design

A manual activation of snuffing system is from local panel.

The following extinguishing media are used:

- Halon 1301
- Potassium Bicarbonate for dry chemical powder.

The quantity of Halon 1301 is able to extinguish a fire under normal gas flow rate (3300 kg/hr.)

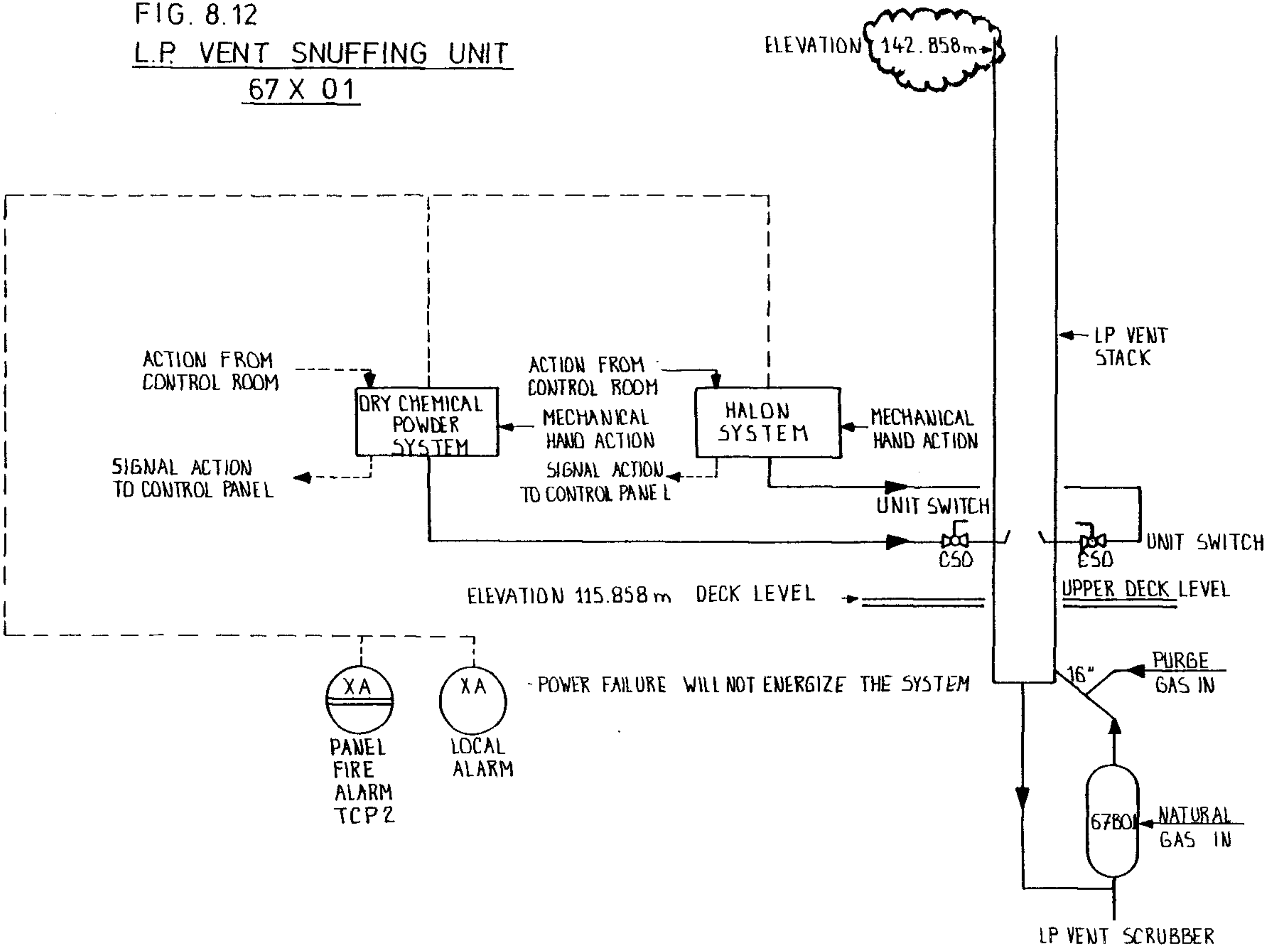
The quantity of DRY CHEMICAL POWDER is able to extinguish a fire under maximum gas flow rate (113 610 kg/hr)

The system consists of two skid mounted units containing 1 x 80 kg Halon bottle and 1 x 250 kg Dry Chemical Powder.

FIG. 8.12

L.P. VENT SNUFFING UNIT

67 X 01



8.4 ESD

General

Provision for ESD follows by and large the recommendations of API RP. 14.C, viz that any section of line threatening the safety of the platform be isolated, and under certain circumstances, blown down.

Associated with this are various actions to isolate electrically all non emergency consumers (NPD Regulation §11.1) and where appropriate to start emergency services, in the fire pump and the emergency operator.

Because of the dual function of TCP2 as a treatment platform for one series of wells and a compression unit, a distinction is made at shut down levels below and including level 3 between action on the two parts of the platform.

Further because of the functional separation of TCP2 C itself - vis three compression units and the Frigg central power generation station these two units are treated separately.

Shut down levels for the central complex of platforms are indicated on the logic diagram attached (FF 00.16.00.58.01) and shut down logic details for TCP2 C alone are shown in simplified form on Fig. 8.16.

A simplified statement of the shut down process is as follows.

Level 1: Shut down, process and electrical, of entire Frigg field (except for start of QP emergency generator). Instigation is manual, from QP control room.

Level 2: Process shut down of one or other half of Frigg field, or of TCP2, entailing blow down. This is the only level at which general blow down takes place. For the reason stated above the level 2 shut down operates separately on TCP2 C and is instigated manually from either the QP control room, or the TCP2 C control room.
The blow down operations take place after a time delay and are:

BRIDGE
COMPRESSOR MODULES
COMPRESSOR MODULE OUTLETS & INTERCONNECTING LINES
FUEL GAS PACKAGE

Immediate shut down actions include isolating the fuel gas supplies to the turbo generators.

Level 3: Highest level instigated by automatic functions, on gas and fire detection.
Also instigated manually by panic buttons and by shut down button in control room.
The shut down actions are separated into:
Level 3 A: Shut down of all TCP2 C.
Level 3 B: Shut down of only the three compressor modules.
Level 3 A can be instigated manually from the QP and TCP2 C control room Level 3 B from TCP2 C control room only.

Level 4: Shut down of one stream. Can be instigated, in addition to means described for the higher levels, by automatic process actions.

Two automatic blow-down actions also take place at this level:

1) If a rupture in the compressor seal oil system is detected or if a low level is indicated in the seal oil tank the module concerned is isolated and blow down immediately.

2) If 380v power is lost to the seal oil pumps the same thing takes place after a delay of 5 minutes.

Level 5: Shut down of one piece of equipment.

More detailed responses to the various shut down levels are indicated in the following table.

For details of the electrical shut down actions consequent to the various shut down levels, and for the control secuence to and from the shut down cabinet via the PLC. See section 9 and 10 respectively.

FRIGG FIELD SHUT-DOWN LEVELS
RELATION TO TCP2 COMPRESSION
ESSENTIAL ACTIONS

SHUT DOWN LEVEL	DEFINITION	MEANS OF ACTUATION	MANUAL OR AUTOMATIC	Actions in areas Affected
1	GENERAL FIELD SHUT DOWN	BREAK-GLASS PUSH BUTTON ON QP	M	Close ESDV's Stop 5,5kv generation Start fire water pumps
2	SHUT DOWN WITH DECOMPRESSION OF: ONE OR OTHER HALF OF FIELD. AND/OR	BREAK-GLASS PUSH BUTTON ON QP PUSH-BUTTON IN TCP2/T INTERFACE ROOM	M M	Close ESDV's Blow down of treatment platforms
	COMPRESSION	BREAK-GLASS PUSH BUTTON ON QP PUSH BUTTON IN TCP2/C CONTROL ROOM	M M	Close ESDV's & fuel gas Package ESDV's Blow down (blow down of bridge and fuel gas package after time delay)
3	SHUT DOWN AT INDIVIDUAL PLATFORM LEVEL, ON TCP2 THIS IS DIVIDED INTO: TREATMENT	PUSH BUTTONS IN INTER-FACE & MCC ROOM FIRE & GAS DETECTION IN PROCESS AREA	M A	Close ESDV's on TCP2/T Close ESDV's on TCP2/C (after time delay in case of gas det.) Isolate non essential electrics.
	COMPRESSION	PUSH BUTTON IN CONTROL ROOM FIRE & GAS DETECTION	M A	Close ESDV's on TCP2/C Close ESDV's on TCP2/T (after time delay in case of gas dete Isolate non essential electrical supplies
	FUEL GAS PACKAGE	PUSH BUTTON IN CONTROL ROOM	M	Close fuel gas package ESDV's Close TCP2/C ESDV's Isolate non essential electrical supplies
4	SHUT DOWN OF SINGLE STREAM WITHIN A PLAT-FORM ON TCP2/C THIS COMPRISES: ONE OR OTHER TURBO-GENERATOR	PUSH BUTTON OUTSIDE ROOM FIRE/GAS DETECTION OPERATIONAL FAULT	M A A	Close ESDV's affected Isolation of non-essential electr. supplies in room affected on gas detection in room or ventilation extract
	ONE OF THREE TURBO-COMPRESSORS	PUSH BUTTONS OUTSIDE MODULE, ON LOCAL PANEL & IN CONTROL ROOM FIRE/GAS DETECTION OPERATIONAL FAULT	M M M A A	Fire dampers closed, halon or CO_2 release on certain fire/gas detection cases
	FUEL GAS PACKAGE	FIRE/GAS DETECTION	A	Open deluge valves in case of fire detection Close fuel package ESDV's
5	SHUT DOWN OF PART OF STREAM ON TCP2/C THIS COMPRISES: TURBO GENERATOR	FIRE/GAS DETECTION OPERATION FAULT PUSH BUTTONS ON TURBINE MEZZANINE TCP2/T MCC ROOM	A A M M M	Close fuel gas ESDV's inside module
	PART OF COMPRESSOR PROCESS	OPERATIONAL FAULTS	A	Close appropriate ESDV's
	PART OF FUEL GAS PACKAGE	OPERATIONAL FAULTS	A	Close appropriate fuel gas package ESDV's

8.4.1 Programmable Logic Controllers (PLC)

The two PLC units form the central part of the ESD system required for the control of actions initiated by:

- Fire detection system
- Gas detection system
- Manual push button
- Process shut down alarms.

The PLC units are coupled in parallel, each with a continuous fault scanner. The parallel configuration is shown on fig.8.13 where the symbols represent respectively:

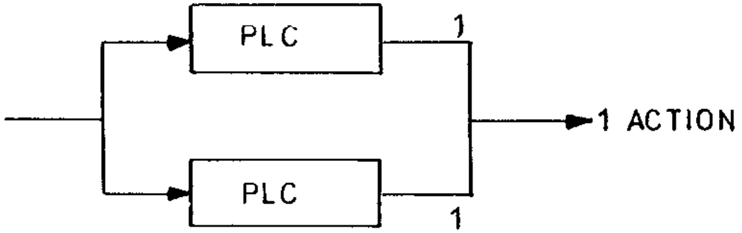
0 - unenergized
1 - energized.

Actions are only provoked if both PLC's are fed with an input giving rise to an output-1.

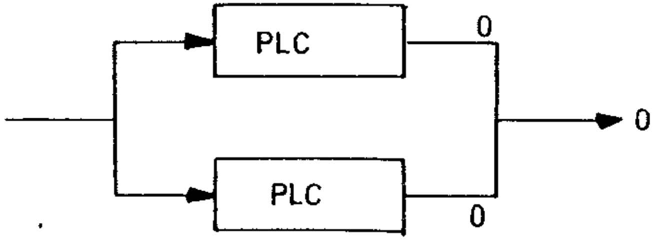
If one PLC develops a fault, that circuit switches automatically to 1, and signals the fault to the panel.

If the other PLC receives an input signal, action is thus maintained.

The two exceptions to this, are halon release and opening of deluge valves which operates on 0 output signal. This prevents an inadvertent release of halon and water from a general electrical failure, and leaves the possibility of manual release of halon.



ACTION MODE: ESD/SHUTDOWN



ACTION MODE: HALON RELEASE AND DELUGE VALVE
OPENING POSSIBLE

Fig. 8.13
PLC CONFIGURATION

FIG. 8.14
SHUT DOWN ACTION

COMPRESSOR MODULES

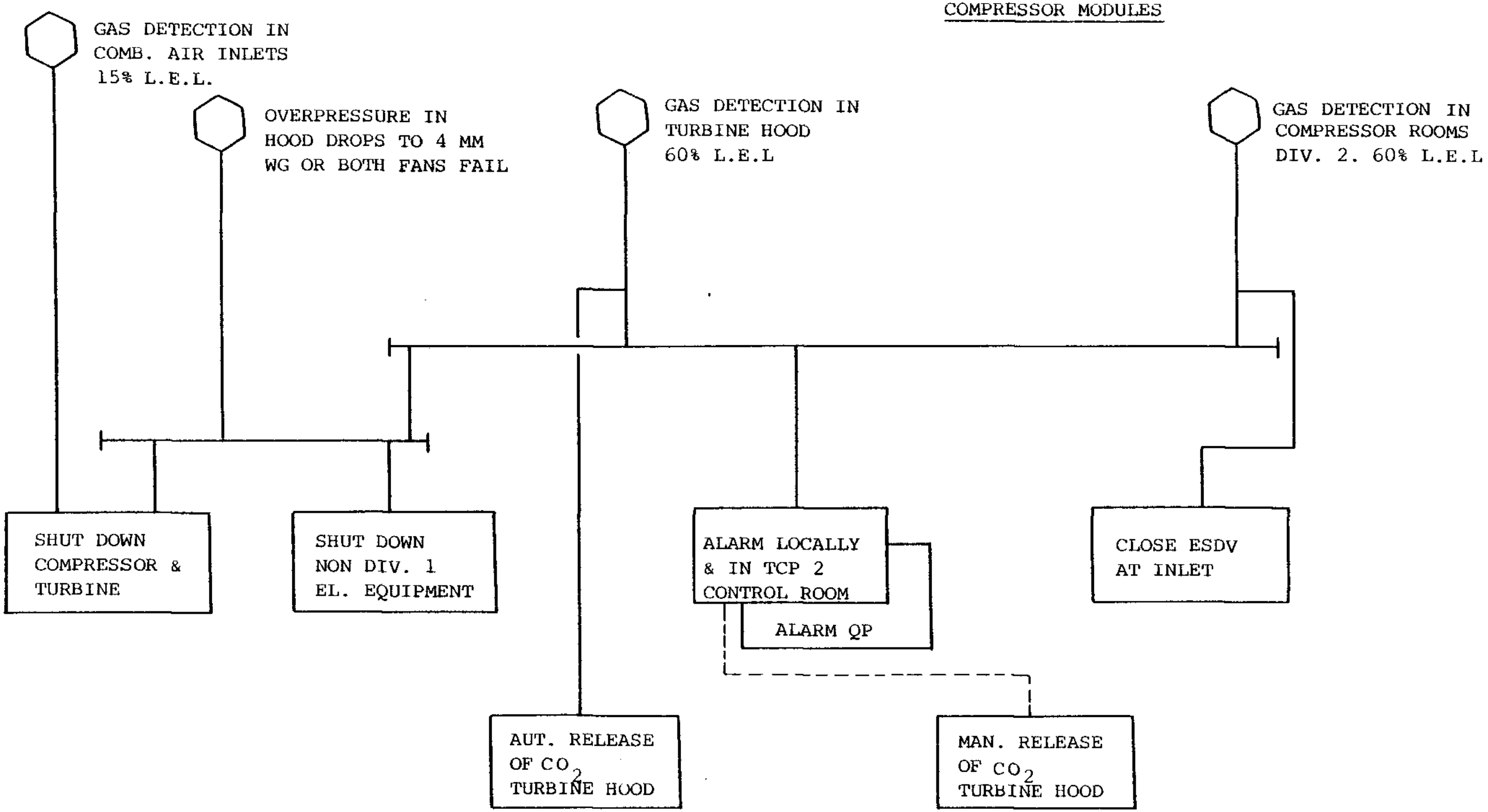
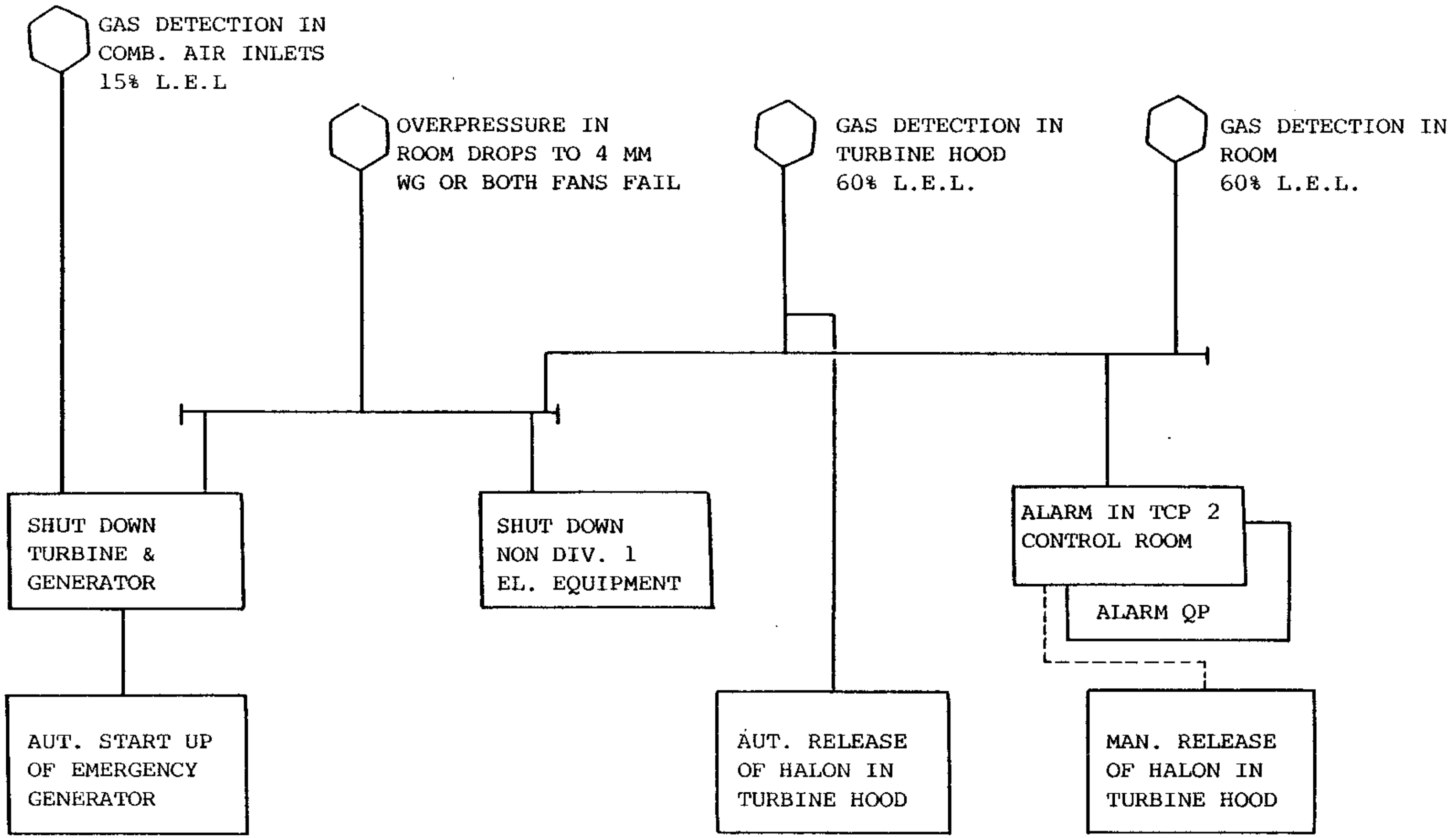
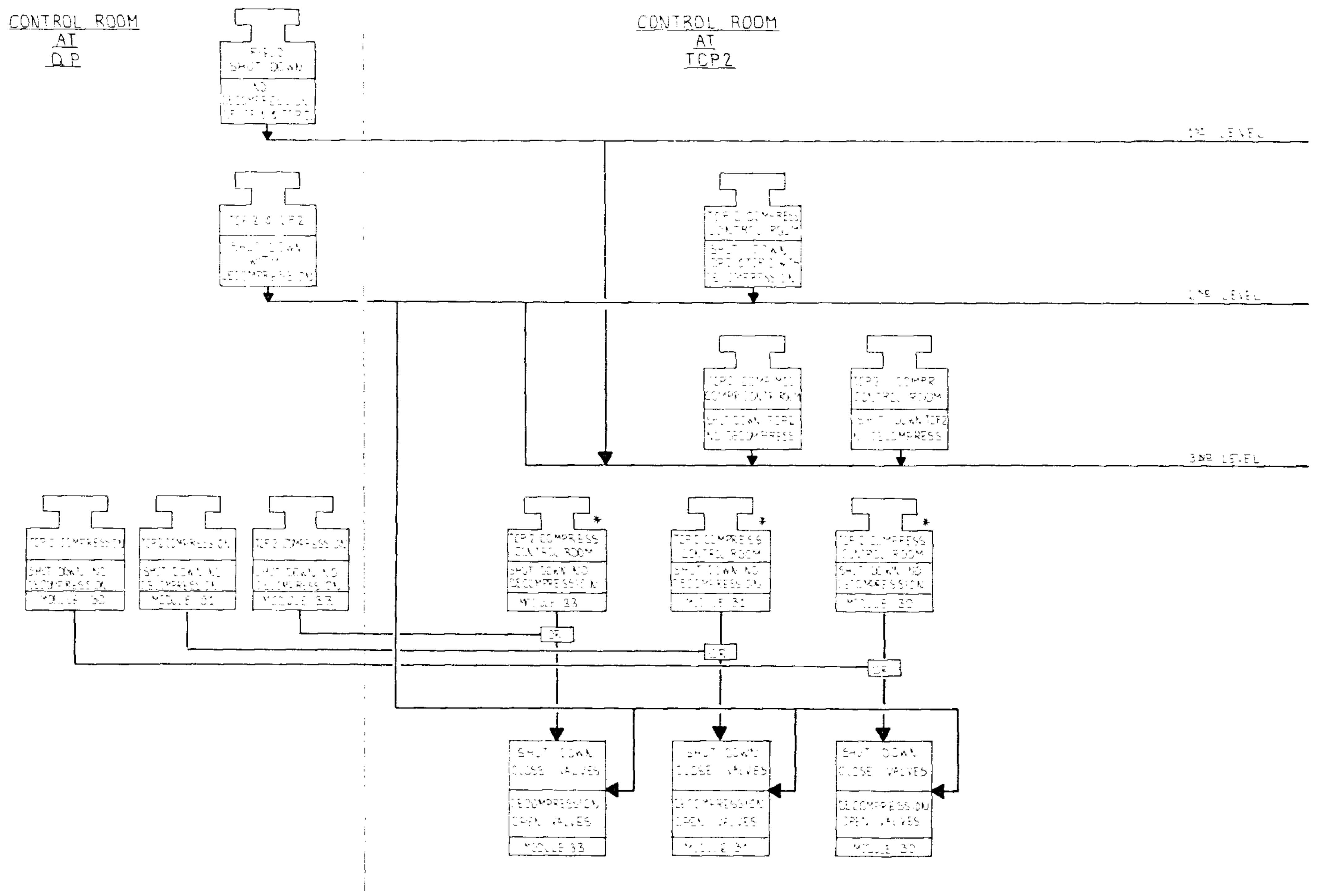


FIG. 8.15
SHUT DOWN ACTION

GENERATOR MODULE





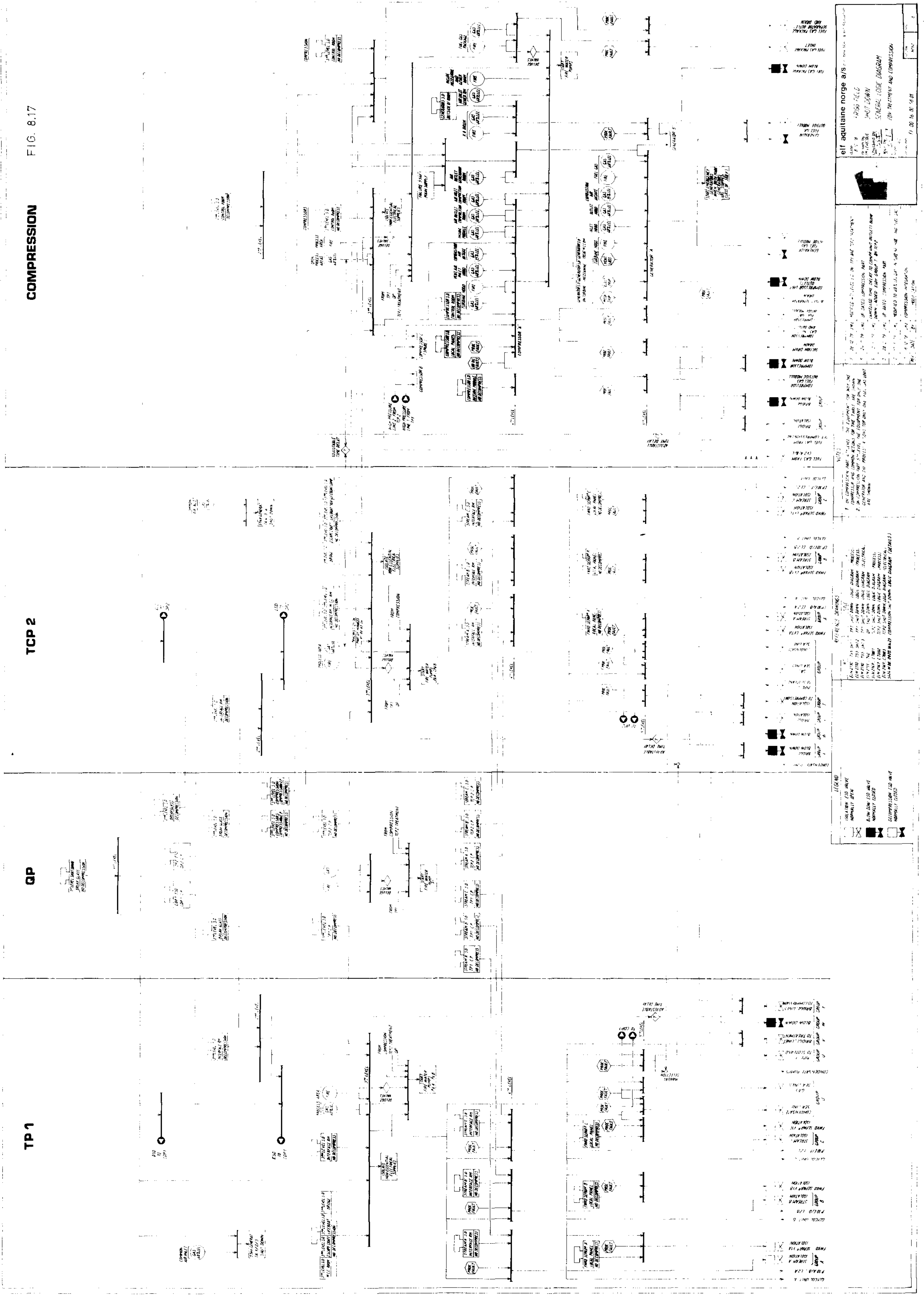
* PUSH BUTTON FOR
EACH MODULE AT
LOCAL CONTROL PANELS

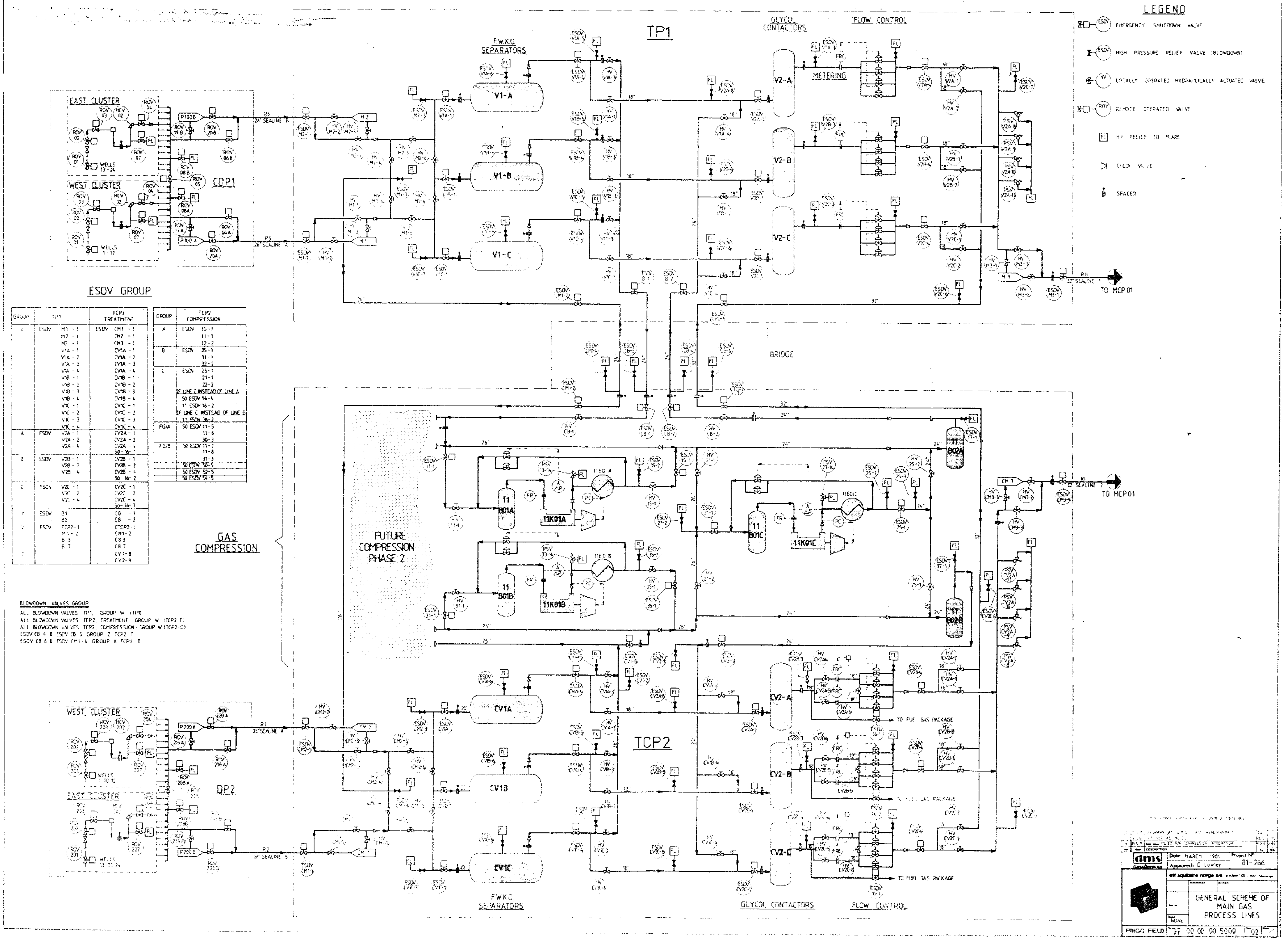
FIG 8.16

FRIGG FIELD

TCP 2 COMPRESSION SYNOPSIS
SCHEMATIC
SHUT DOWN DIAGRAM

FIG. 8.17


COMPRESSION
TCP 2
QP
TP 1
elf aquitaine norge a/s
FRIGG FIELD
SHUT DOWN
GENERAL LOGIC DIAGRAM
FOR TREATMENT AND COMPRESSION
FI 00 16 00 98 01
LEGEND
ISOLATION ESD VALVE NORMALLY OPEN
BLOW DOWN ESD VALVE NORMALLY CLOSED
DECOMPRESSION ESD VALVE NORMALLY CLOSED
COMPRESSION INTEGRATION
REV DATE BY



ESDV GROUP

GROUP	TP1	TCP2 TREATMENT
U	ESDV M1 - 1 M2 - 1 M3 - 1 V1A - 1 V1A - 2 V1A - 3 V1A - 4 V1B - 1 V1B - 2 V1B - 3 V1B - 4 V1C - 1 V1C - 2 V1C - 3 V1C - 4	ESDV CM1 - 1 CM2 - 1 CM3 - 1 CV1A - 1 CV1A - 2 CV1A - 3 CV1A - 4 CV1B - 1 CV1B - 2 CV1B - 3 CV1B - 4 CV1C - 1 CV1C - 2 CV1C - 3 CV1C - 4
A	ESDV V2A - 1 V2A - 2 V2A - 4	CV2A - 1 CV2A - 2 CV2A - 4 50 - 16 - 1
B	ESDV V2B - 1 V2B - 2 V2B - 4	CV2B - 1 CV2B - 2 CV2B - 4 50 - 16 - 2
C	ESDV V2C - 1 V2C - 2 V2C - 4	CV2C - 1 CV2C - 2 CV2C - 4 50 - 16 - 3
Y	ESDV B1 B2	CB - 1 CB - 2
V	ESDV TCP2 - 1 M1 - 2 B 3 B 7	CTCP2 - 1 CM1 - 2 CB 3 CB 7
T		CV 1 - 8 CV 2 - 9

GROUP	TCP2 COMPRESSION
A	ESDV 15 - 1 11 - 1 12 - 2
B	ESDV 35 - 1 31 - 1 32 - 2
C	ESDV 25 - 1 21 - 1 22 - 2 IF LINE C INSTEAD OF LINE A 50 ESDV 16 - 4 11 ESDV 36 - 2 IF LINE C INSTEAD OF LINE B 11 ESDV 36 - 2
FG/A	50 ESDV 11 - 5 11 - 6 30 - 3
FG/B	50 ESDV 11 - 7 11 - 8 31 - 3
	50 ESDV 50 - 5
	50 ESDV 52 - 5
	50 ESDV 54 - 5

BLOWDOWN VALVES GROUP

ALL BLOWDOWN VALVES TP1: GROUP W (TP1)
ALL BLOWDOWN VALVES TCP2, TREATMENT GROUP W (TCP2-T)
ALL BLOWDOWN VALVES TCP2, COMPRESSION: GROUP W (TCP2-C)
ESDV CB-4 & ESDV CB-5 GROUP Z TCP2-T
ESDV CB-6 & ESDV CM1-4 GROUP X TCP2-T

dms
Date MARCH - 1981
Approved: D Lawley
Project Nº 81-266
elf aquitaine norge a/s p.o.box 168 - 4001 Stavanger
GENERAL SCHEME OF
MAIN GAS
PROCESS LINES
NONE
FRIGG FIELD
00 00 00 5000
02

9. ELECTRICITY

9.1 LIST OF EQUIPMENT/ CONSUMER LIST

9.1.1 GENERATORS

TAG.NO.	DESCRIPTION	MAKE/SUPPLIER	LOCATION
52 GO1 A	Turbine Generator "A"	Nyland/Stal Laval ASEA	Module 41
52 GO1 B	Turbine Generator "B"	" "	" "
53 GO1	Emergency Diesel Generator	SACM	Module 44

9.1.2 SWITCHBOARDS
Sheet 1/2

TAG.NO.	DESCRIPTION	MAKE/SUPPLIER	LOCATION
S.52.32.1.1	5,5 kV Distribution switchboard	EGA-Oslo A/S	Main Substation, Module 32
S.52.32.2.1	380 V Main Distribution Switchboard	EGA-Bergen A/S	" " "
S.52.32.2.2	380 V Motor Control Centre Switchboard "A"	" " "	" " "
S.52.32.2.3	" " " " " " "B"	" " "	" " "
S.52.32.2.4	Normal Lighting Switchboard "A"	" " "	" " "
S.52.32.2.5	" " " "B"	" " "	" " "
S.52.41.2.12	Turbo Generator "A" MCC Switchboard	" " "	Mezzanine Control Room. Module 41
S.52.41.2.13	" " "B" " "	" " "	" " "
S.52.32.2.14	Fuel Gas Heater Distribution Switchboard "A"	" " "	Main Substation, Module 32 ,
S.52.32.2.15	" " " " " "B"	" " "	" " "
S.52.32.2.16	Auxiliary Distribution Switchboard, Hoist		" " "
S.52.32.2.17	Welding Sockets Switchboard	EGA-Bergen A/S	" " "
S.52.32.2.18	Heating Switchboard "A"		" " "
S.52.32.2.19	" " "B"		" " "

9.1.2 SWITCHBOARDS
Sheet 2/2

TAG.NO.	DESCRIPTION	MAKE/SUPPLIER	LOCATION
S.53.44.2.6	380 V Main Emergency Distribution Switchboard	EGA-Bergen A/S	Emergency Substation Pancake 44
S.53.44.2.7	380 V Emergency Diesel Generator Aux. Switchboard	" " "	" " "
S.53.44.2.8	Emergency Lighting Distribution Switchboard	" " "	" " "
S.53.44.3.9	220 V Main Instrument Supply Switchboard		" " "
S.53.44.3.10	Flashing Light and Public Address Switchboard	E.A.N.	" " "
S.53.44.4.10	110 V Main Instrument Supply Switchboard		" " "
S.53.44.4.11	110 V Electrical Supply Switchboard		" " "
S.53.44.4.21	110 V DC H&V/Turbo Compressor DC Starters	EGA-Bergen A/S	" " "
S.53.44.4.24	110 V DC Essential ESD Cubicle		" " "
S.53.44.4.25	110 V DC Essential Signalisation Switchboard		" " "
S.53.44.4.26	110 V DC Turbo Generator "A" DC Starters	ASEA	" " "
S.53.44.4.27	" " " " "B" " "	"	" " "
S.53.44.4.28	110 V DC Essential Supply Cubicle		" " "
S.52.32.4.22A	110 V DC Non Essential Electr. Contr. Sw.B. "A"		Main Substation Module 32
S.52.32.4.22B	" " " " " " " "B"		" " "
S.52.32.4.23	110 V DC Non Essential Electrical Signalisation Sw.B.		" " "

9.1.3 CONTROL PANELS AND CABINETS

TAG.NO.	DESCRIPTION	MAKE/SUPPLIER	LOCATION
KA1A to KA7A	Control Panels for Turbine Generator 52G01A	STAL LAVAL ASEA	Mezzanine Control Room. Module 41
KA1B to KA7B	" " " " " 52G01B	" "	" " "
DG P	Control Panel for Diesel Generator 53G01	SACM	Emergency Substation Module 44
KL012A	Voltage Regulator A	ASEA	Mezzanine Control Room. Module 41
KL012B	" " B	ASEA	" " "
HA.F2	Earth Cubicle		" " "
S.53.44.4.2.8	Emergency lighting panel		Module 44

9.1.4 POWER TRANSFORMERS

TAG.NO.	DESCRIPTION	MAKE/SUPPLIER	LOCATION
T.52.32.1.9	1000 kVA 5500/380 V Transformer T9	CEM	Transformer Room "A" Module 32
T.52.32.1.10	" " " " T10	"	Transformer Room "B" Module 32
T.52.32.1.11	2500 kVA 5500/380 V Transformer T11	"	Transformer Room "A" Module 32
T.52.32.1.12	" " " " T12	"	Transformer Room "B" Module 32

9.1.5 RECTIFIERS AND INVERTERS

TAG.NO.	DESCRIPTION	MAKE/SUPPLIER	LOCATION
RD.53.44.3.1	No Break System 380/240 V DC Rectifier 1A	NIFE	Emergency Substation Module 44
RD.53.44.3.2	" " " " " " 1B	"	" " "
RD.53.44.4.1	380/120 V Instrument Supply DC Rectifier 2A	"	" " "
RD.53.44.4.2	" " " " " 2B	"	" " "
RD.53.44.4.3	380/120 V Electrical Supply DC Rectifier 3A	"	" " "
RD.53.44.4.4	" " " " " 3B	"	" " "
INV.53.44.3.1	No Break System 220 V AC Inverter 1A	" (CYBEREX)	" " "
INV.53.44.3.2	" " " " " 1B	" (")	" " "
SI.53.44.3.1	No Break System Supply 220 V Static Interruptor	" (")	" " "
RD.52.32.5.1	Instrument Supply 380/24 V DC Rectifier	"	Main substation Module 32
INV.53.44.4.11	Main 110V rectifier	"	Module 44

9.1.6 BATTERY BANKS

TAG.NO.	DESCRIPTION	MAKE/SUPPLIER	LOCATION
BAT.53.44.3.1	No Break System Supply 240V119Ah/5h Battery 1A	NIFE	Battery Room Module 44
BAT.53.44.3.2	" " " " " " 1B	"	" "
BAT.53.44.4.1	Instrument Supply 120V70Ah/5h Battery 2A	"	" "
BAT.53.44.4.2	" " " " 2B	"	" "
BAT.53.44.4.3	Electrical Supply 120V428Ah/5h Battery 3A	"	" "
BAT.53.44.4.4	" " " " 3B	"	" "

CONTRACT 480 KVAERNER 5424W TECHNIP	ELF FRIGG NORGE TCP 2 COMPRESSION	PAGE	REV.	DATE
SP 5424W.00.1610.01	CONSUMER LISTING	1	4	JUIN 8

SUMMARY

Lot N°	Package N°	Designation	Page	
1	11KG01A	Natural gas compressor A	2	
	11KG01B	Natural gas compressor B	3	
	11KG01C	Natural gas compressor C	4	
		Fuel gas heater package	5/6	
		Heating and ventilation	7/8	
	56 x 01	Hydraulic package	9	
		Hoist	10/11	
2	52GG01A	Generator turbine A	12/13/14	
	52GG01B	Generator turbine B	15/16/17	
	53GD01	Emergency diesel generator	18	
		Heating and ventilation	19	
		Hoist	20	
3		Heating and ventilation	21	
	55 x 01	Fresh water maker	22	
	55 x 02	Anti corrosion dosing set	23	
	57 x 01	Instrument and service air package	24	
		HV motors	25	
	60PD01	Diesel fire pump	26	
		Hoist	27	
		Miscellaneous consumers	28	
OFF SHORE		Miscellaneous consumers	29	
	58PM01	HV motors	30	

CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP 5424W.00.1610.01	CONSUMER LISTING - LOT 1	2	4	JUIN 8

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET N°	DATA SHEET Rev	SUPPLY Panel	SUPPLY Drawer	
	NATURAL GAS COMPRESSOR A							
11K01A PM01A	Lube oil pump	M	18.5	SP 5424W 10.1600.15.3	2	S.52.32.2.2	1FG	380 V.a.c
11K01A PM01B	Lube oil pump	M	18.5	SP 5424W 10.1600.15.3	2	S.52.32.2.3	3FG	380 V.a.c
11K01A PM01C	Lube oil pump	M	3.6	SP 5424W 10.1600.15.4	2	S.53.44.4.11	a18	110 V.d.c
11K01A PM02A	Seal oil pump	M	45.0	SP 5424W 10.1600.15.2	3	S.52.32.2.2	1HIJ	380 V.a.c
11K01A PM02B	Seal oil pump	M	45.0	SP 5424W 10.1600.15.2	3	S.52.32.2.3	3HIJ	380 V.a.c
11K01A PM03	Oil clarifier	M	0.75	SP 5424W 10.1600.15.1	2	S.52.32.2.2	1A	380 V.a.c
11K01A Y01 -1	Lube oil tank heater	H	7.0	SP 5424W 10.1600.15.8	1	S.52.32.2.2	1C	380 V.a.c
11K01A Y02A	Polluted seal oil tank heater	H	3.1	SP 5424W 10.1600.15.9	1	S.52.32.2.2	1B	380 V.a.c
11K01A Y02B	Polluted seal oil tank heater	H	3.1	SP 5424W 10.1600.15.9	1	S.52.32.2.2	1B	380 V.a.c
11KG01A AM02A	Secondary air fan	M	15.0	SP 5424W 10.1600.15.6	3	S.52.32.2.2	1DE	380 V.a.c
11KG01A AM02B	Secondary air fan	M	15.0	SP 5424W 10.1600.15.6	3	S.53.44.2.7	2HI	380 V.a.c
11KG01A AM03	Engine heater fan	M	5.0	SP 5424W 10.1600.15.7	1	S.52.32.2.2	2C	380 V.a.c
11KG01A PM01A	Lube oil pump	M	5.0	SP 5424W 10.1600.15.5	3	S.52.32.2.2	2A	380 V.a.c
11KG01A PM01B	Lube oil pump	M	5.0	SP 5424W 10.1600.15.5	3	S.52.32.2.3	3A	380 V.a.c
11KG01A PM01C	Lube oil pump	M	1.5	SP 5424W 10.1600.15.11	2	S.53.44.4.11	a19	110 V.d.c
11KG01A Y01	Engine heater	H	3.0	SP 5424W 10.1600.15.10	1	S.52.32.2.2	2 B	380 V.a.c

CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING - LOT 1	3	4	JUIN 80

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET		SUPPLY		
				N°	Rev	Panel	Drawer	
	NATURAL GAS: COMPRESSOR B							
11K01B PM01A	Lube oil pump	M	18.5	SP 5424W 10,1600.15.3	2	S.52.32.2.3	1FG	380 V.a.c
11K01B PM01B	Lube oil pump	M	18.5	SP 5424W 10.1600.15.3	2	S.52.32.2.2	3FG	380 V.a.c
11K01B PM01C	Lube oil pump	M	3.6	SP 5424W 10.1600.15.4	2	S.53.44.4.11	a20	110 V.d.c
11K01B PM02A	Seal oil pump	M	45.0	SP 5424W 10.1600.15.2	3	S.52.32.2.3	1 HIJ	380 V.a.c
11K01B PM02B	Seal oil pump	M	45.0	SP 5424W 10.1600.15.2	3	S.52.32.2.2	3 HIJ	380 V.a.c
11K01B PM03	Oil clarifier	M	0.75	SP 5424W 10.1600.15.1	2	S.52.32.2.3	1C	380 V.a.c
11K01B Y01.1	Lube oil tank heater	H	7.0	SP 5424W 10.1600.15.8	1	S.52.32.2.3	1A	380 V.a.c
11K01B Y02A	Polluted seal oil tank heater	H	3.7	SP 5424W 10.1600.15.9	1	S.52.32.2.3	1B	380 V.a.c
11K01B Y02B	Polluted seal oil tank heater	H	3.7	SP 5424W 10.1600.15.9	1	S.52.32.2.3	1B	380 V.a.c
11KG01B AM02A	Secondary air fan	M	15.0	SP 5424W 10.1600.15.6	3	S.52.32.2.3	1 DE	380 V.a.c
11KG01B AM02B	Secondary air fan	M	15.0	SP 5424W 10.1600.15.6	3	S.53.44.2.7	5 CD	380 V.a.c
11KG01B AM03	Engine heater fan	M	5.0	SP 5424W 10.1600.15.7	1	S.52.32.2.3	2 C	380 V.a.c
11KG01B PM01A	Lube oil pump	M	5.0	SP 5424W 10.1600.15.5	3	S.52.32.2.3	2A	380 V.a.c
11KG01B PM01B	Lube oil pump	M	5.0	SP 5424W 10.1600.15.5	3	S.52.32.2.2	3 A	380 V.a.c
11KG01B PM01C	Lube oil pump	M	1.5	SP 5424W 10.1600.15.11	2	S.53.44.4.11	a21	110 V.d.c
11KG01B Y01	Engine heater	H	3.0	SP 5424W 10.1600.15.10	1	S.52.32.2.3	2B	380 V.a.c

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CONTRACT 480 KVAERNER
5424 W TECHNIP

SP.5424W.00.1610.01

ELF FRIGG NORGE
TCP2 COMPRESSION

CONSUMER LISTING- LOT 1

PAGE	REV.	DATE
4	4	JUIN 80

	FUNCTION	TYPE	RATED POWER	DATA SHEET N°	DATA SHEET Rev	SUPPLY Panel	SUPPLY Drawer	
	NATURAL GAS COMPRESSOR C							
11KO1C PMO1A	Lube oil pump	M	18.5	SP 5424W 10.1600.15.3	2	S.52.32.2.2	4 FG	380 V.a.c
11KO1C PMO1B	Lube oil pump	M	18.5	SP 5424W 10.1600.15.3	2	S.52.32.2.3	4 FG	380 V.a.c
11KO1C PMO1C	Lube oil pump	M	3.6	SP 5424W 10.1600.15.4	2	S.53.44.4.11	a22	110 V.d.c
11KO1C PMO2A	Seal oil pump	M	45.0	SP 5424W 10.1600.15.2	3	S.52.32.2.2	4 HIJ	380 V.a.c
11KO1C PMO2B	Seal oil pump	M	45.0	SP 5424W 10.1600.15.2	3	S.52.32.2.3	4 HIJ	380 V.a.c
11KO1C PMO3	Oil clarifier	M	0.75	SP 5424W 10.1600.15.1	2	S.52.32.2.2	4 C	380 V.a.c
11KO1C YO1-1	Lube oil tank heater	H	7.0	SP 5424W 10.1600.15.8	1	S.52.32.2.2	4 A	380 V.a.c
11KO1C YO2A	Polluted seal oil tank heater	H	3.1	SP 5424W 10.1600.15.9	1	S.52.32.2.2	4 B	380 V.a.c
11KO1C YO2B	Polluted seal oil tank heater	H	3.1	SP 5424W 10.1600.15.9	1	S.52.32.2.2	4 B	380 V.a.c
11KGO1C AMO2A	Secondary air fan	M	15.0	SP 5424W 10.1600.15.6	3	S.52.32.2.2	5 IJ	380 V.a.c
11KGO1C AMO2B	Secondary air fan	M	15.0	SP 5424W 10.1600.15.6	3	S.53.44.2.1	4 AB	380 V.a.c
11KGO1C AMO3	Engine heater fan	M	5.0	SP 5424W 10.1600.15.7	1	S.52.32.2.2	5 C	380 V.a.c
11KGO1C PMO1A	Lube oil pump	M	5.0	SP 5424W 10.1600.15.5	3	S.52.32.2.2	5 A	380 V.a.c
11KGO1C PMO1B	Lube oil pump	M	5.0	SP 5424W 10.1600.15.5	3	S.52.32.2.3	4 A	380 V.a.c
11KGO1C PMO1C	Lube oil pump	M	1.5	SP 5424W 10.1600.15.11	2	S.53.44.4.11	a23	110 V.d.c
11KGO1C YO1	Engine heater	H	3.0	SP 5424W 10.1600.15.10	1	S.52.32.2.2	5 B	380 V.a.c

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CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING- LOT 1	5	3	April 79

ITEM N°		FUNCTION	TYPE	RATED POWER	DATA SHEET		SUPPLY		
					N°	Rev	Panel	Drawer	
		FUEL GAS HEATER PACKAGES							
50 x 01	PM01A	Methanol injection pump	M	2.2	SP.5424W 50.1600.24.3	3	S.52.32.2.14	2A	380V a.c.
50 x 01	PM01B	Methanol injection pump	M	2.2	SP.5424W 50.1600.24.3	3	S.52.32.2.15	2A	380V a.c.
50 x 07	PM01A	Water circulation pump	M	15.0	SP.5424W 50.1600.24.2	3	S.52.32.2.14	1A	380V a.c.
50 x 07	PM01B	Water circulation pump	M	15.0	SP.5424W 50.1600.24.2	3	S.52.32.2.15	1A	380V a.c.
50 x 07A	Y01	Heating element of exchanger 50X07 EO5A	H	112.0	SP.5424W 50.1600.24.4	2	S.52.32.2.14	1CDEF	380V a.c.
50 x 07A	Y02	Heating element of exhanger 50X07 E05A	H	128.0	SP.5424W 50.1600.24.1	3	S.52.32.2.14	1GHIJ	380V a.c.
50 x 07A	Y03	Heating element of exchanger 50X07 E04A	H	112.0	SP.5424W 50.1600.24.4	2	S.52.32.2.14	2CDEF	380V a.c.
50 x 07A	Y04	Heating element of exchanger 50X07 E04A	H	128.0	SP.5424W 50.1600.24.1	3	S.52.32.2.14	2GHIJ	380V a.c.
50 x 07A	Y05	Heating element of exchanger 50X07 E03A	H	112.0	SP.5424W 50.1600.24.4	2	S.52.32.2.14	5CDEF	380V a.c.
50 x 07A	Y06	Heating element of exchanger 50X07 E03A	H	128.0	SP.5424W 50.1600.24.1	3	S.52.32.2.14	5GHIJ	380V a.c.
50 x 07A	Y07	Heating element of exchanger 50X07 E02A	H	240.0	SP.5424W 50.1600.24.5	2	S.52.32.2.14	6	380V a.c.
50 x 07B	Y01	Heating element of exchanger 50X07 E05B	H	112.0	SP.5424W 50.1600.24.4	2	S.52.32.2.15	1CDEF	380V a.c.
50 x 07B	Y02	Heating element of exchanger 50X07 EO5B	H	128.0	SP.5424W 50.1600.24.1	3	S.52.32.2.15	1GHIJ	380V a.c.
50 x 07B	Y03	Heating element of exchanger 50x07 E04B	H	112.0	SP.5424W 50.1600.24.4	2	S.52.32.2.15	2CDEF	380V a.c.
50 x 07B	Y04	Heating element of exchanger 50X07 E04B	H	128.0	SP.5424W 50.1600.24.1	3	S.52.32.2.15	2GHIJ	380V a.c.
50 x 07B	Y05	Heating element of exchanger 50X07 E03B	H	112.0	SP.5424W 50.1600.24.4	2	S.52.32.2.15	5CDEF	380V a.c.

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CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING- LOT 1	6	3	April 79

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET		SUPPLY		
				N°	Rev	Panel	Drawer	
50 x 07B Y06	Heating element of exchanger 50X07 EO2B	H	128.0	SP.5424W 50.1600.24.1	3	.52.32.2.15	5GHIJ	380V a.c.
50 x 07B Y07	Heating element of exchanger 50X07 EO2B	H	240.0	SP.5424W 50.1600.24.5	2	.52.32.2.15	6	380V a.c.

CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING - LOT 1	7	4	JUIN 80

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET		SUPPLY		
				N°	Rev	Panel	Drawer	
	HEATING AND VENTILATION (lot 1)							
54 x 00/001	Module 32 Pressure sensor heater	H	0.75			S.52.32.2.18	a36	
54 x 01/005	Compressor Module 30 H & V Fan motor A	M	3.7	SP 5424W 54.1600.8.1	2	S.52.32.2.2	13 A	380V.a.c
54 x 01/006	Compressor Module 30 H & V Fan motor B	M	3.7	SP.5424W 54.1600.8.1	2	S.52.32.2.3	13 A	380V.a.c
54 x 02/005	Compressor Module 31 H & V fan motor A	M	3.7	SP.5424W 54.1600.8.1	2	S.52.32.2.2	13 B	380V.a.c
54 x 02/006	Compressor Module 31 H & V fan motor B	M	3.7	SP.5424W 54.1600.8.1	2	S.52.32.2.3	13 B	380V.a.c
54 x 03/005	Compressor Module 33 H & V fan motor A	M	3.7	SP.5424W 54.1600.8.1	2	S.52.32.2.2	13 C	380V.a.c
54 x 03/006	Compressor Module 33 H & V fan motor B	M	3.7	SP.5424W 54.1600.8.1	2	S.52.32.2.3	13 C	380V.a.c
54 x 04/004	Substation and fan room H & V Heating coil	H	88.0	SP.5424W 54.1600.8.8	2	S.52.32.2.2	13HIJ	380V.a.c
54 x 04/009	Substation and fan room-H & V fan motor A	M	8.0	SP.5424W 54.1600.8.2	2	S.53.44.2.7	1C	380V.a.c
54 x 04/010	Substation and fan room H & V fan motor B	M	8.0	SP.5424W 54.1600.8.2	2	S.52.32.2.3	13E	380V.a.c
54 x 05/007	Control room H & V preheat coil	H	50.0	SP.5424W 54.1600.8.9	2	S.52.32.2.2	12IJ	380V.a.c
54 x 05/009	Control room - H & V humidifier water pump motor	M	1.0	SP.5424W 54.1600.8.4	2	S.52.32.2.2	12 B	380V.a.c
54 x 05/011	control room H & V Reheat coil	H	40.0	SP.5424W 54.1600.8.10	2	S.52.32.2.2	12FG	380V.a.c
54 x 05/014	Control room H & V fan motor A	M	6.5	SP.5424W 54.1600.8.3	2	S.53.44.2.7	1D	380V.a.c
54 x 05/015	Control room H & V Fan Motor B	M	6.	SP.5424W 54.1600.8.14	2	S.53.44.2.11	a21	110V.d.c
54 x 05/030M	Control room-H & V refrigeration unit compressor motor	M	17.0	SP.5424W 54.1600.8.5	2	S.52.32.2.2	12CD	380V.a.c

CONTRACT 480 KVAERNER
5424 W TECHNIP

SP.5424W.00.1610.01

ELF FRIGG NORGE
TCP2 COMPRESSION

CONSUMER LISTING- LOT 1

PAGE	REV.	DATE
8	3	April 79

ITEM Nº	FUNCTION	TYPE	RATED POWER	DATA SHEET Nº	DATA SHEET Rev	SUPPLY Panel	SUPPLY Drawer	
54 x 05/030Y	Control room H & V Retrogeneration unit cancase heater	H	0.10	SP.5424W 54.1600.8.11				380V.a.c
54 x 07/003	Workshop H & V Heating coil	H	40.0	SP.5424W 54.1600.8.10	2	S.52.32.2.3.	13IJ	380V.a.c
54 x 07/004	Workshop H & V Fan motor	M	1.35	SP.5424W 54.1600.8.6	2	S.52.32.2.3	13F	380V.a.c
54 x 07/005	Workshop H&V Stand by fan motor	M	1.35	SP.5424W 54.1600.8.6	2	not connected		380V.a.c
54 x 16/005	Transformer room H & V fan motor A	M	2.6	SP.5424W 54.1600.8.16	2	S.52.32.2.2	12 E	380V.a.c
54 x 16/006	Transformer room H & V fan motor B	M	2.6	SP.5424W 54.1600.8.16	2	S.52.32.2.3	13G	380V.a.c

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CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING - LOT 1	9	3	April 79

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET		SUPPLY		
				N°	Rev	Panel	Drawer	
	HYDRAULIC PACKAGE							
56 x 01A PM01	Pump motor A	M	37.0	SP5424W 56.1600.19	2	S.52.32.2.2	8 HIJ	380 Va.c
56 x 01B PM01	Pump motor B	M	37.0	SP5424W 56.1600.19	2	S.52.32.2.3	8 EFG	380Va.c

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CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING - LOT 1	10	4	Juin 80

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET N°	DATA SHEET Rev	SUPPLY Panel	SUPPLY Drawer	
	HOIST (Lot 1)							
60 x 05A M01	Module 30	M	13/3.25	SP.5424W.00. 1600.25.1	1	S.52.32.2.16	1AB	380V a.c.
60 x 05A M02	Module 30	M	0.36	SP.5424W.00. 1600.25.2	1			380V a.c.
60 x 05A M03	Module 30	M	0.36	SP.5424W.00. 1600.25.2	1			380V a.c.
60 x 05B M01	Module 33	M	13/3.25	SP.5424W.00. 1600.25.1	1		1EF	380V a.c.
60 x 05B M02	Module 33	M	0.36	SP.5424W.00. 1600.25.2	1			380V a.c.
60 x 05B M03	Module 33	M	0.36	SP.5424W.00. 1600.25.2	1			380V.a.c.
60 x 05C M01	Module 31	M	13/3.25	SP.5424W.00. 1600.25.1	1		2EF	380V.a.c.
60 x 05C M02	Module 31	M	0.36	SP.5424W.00. 1600. .25.2	1			380V.a.c.
60 x 05C M03	Module 31	M	0.36	SP.5424W.00. 1600.25.2	1			380V.a.c.
60 x 06A M01	Module 30	M	13/3.25	SP.5424W.00. 1600.25.1	1		1CD	380V.a.c.
60 x 06A M02	Module 30	M	0.36	SP.5424W.00. 1600.25.2	1			380V a.c.
60 x 06A M03	Module 30	M	0.36	SP.5424W.00. 1600.25.2	1			380V.a.c.
60 x 06B M01	Module 33	M	13/3.25	SP.5424W.00. 1600.25.1	1		1GH	380V.a.c.
60 x 06B M02	Module 33	M	0.36	SP.5424W.00. 1600.25.2	1			380V a.c.
60 x 06B M03	Module 33	M	0.36	SP.5424W.00. 1600.25.2	1			380V.a.c.
60 x 06C M01	Module 31	M	13/3.25	SP.5424W.00. 1600.25.1	1		2GH	380V.a.c.

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CONTRACT 480 KVAERNER 5424 W TECHNIP

ELF FRIGG NORGE TCP2 COMPRESSION

SP.5424W.00.1610.01

CONSUMER LISTING - LOT 1

PAGE	REV.	DATE
11	4	JUIN 80

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET N°	DATA SHEET Rev	SUPPLY Panel	SUPPLY Drawer	
60 x 06C M02	Module 31	M	0.36	SP.5424W.00. 1600.25.2	1	S 52.32.2.16		380V.a.c.
60 x 06C M03	Module 31	M	0.36	SP.5424W.00 1600.25.2	1			380V. a.c
60 x 07 M01	Module 32 - Workshop	M	13/3.25	SP.5424W.00. 1600.25.1	1		1IJ	380V.a.c
60 x 07 M02	Module 32 - Workshop	M	0.36	SP.5424W.00. 1600.25.2	1			380V.a.c
~~60 x 08A M01~~	~~Module 32~~	~~M~~	~~13/3.25~~	SP.5424W.00. ~~1600.25.1~~	~~1~~			~~380V.a.c~~
60 x 08A M02	Module 32	M	13/3.25	SP.5424W.00. 1600.25.1	1			380V.a.c
60 x 08A M03	Module 32	M	0.36	SP.5424W.00. 1600.25.2	1			380V.a.c
60 x 08A M04	Module 32	M	0.36	SP.5424W.00. 1600.25.2	1			380V.a.c
60 x 08B M01	Module 32	M	13/3.25	SP.5424W.00. 1600.25.1	1			380V.a.c
60 x 08B M02	Module 32	M	13/3.25	SP.5424W.00. 1600.25.1	1			380V.a.c
60 x 08B M03	Module 32	M	0.36	SP.5424W.00. 1600.25.2	1			380V.a.c
60 x 08B M04	Module 32	M	0.36	SP.5424W.00. 1600.25.2	1			380V.a.c

CONTRACT 480 KVAERNER
5424 W TECHNIP

SP.5424W.00.1610.01

ELF FRIGG NORGE
TCP2 COMPRESSION

CONSUMER LISTING - LOT 2

PAGE	REV.	DATE
12	4	JUIN 80

ITEM N°	FUNCTION	TYPE	RATED POWER KW	DATA SHEET N°	Rev	SUPPLY Panel	SUPPLY Drawer	
	GENERATOR TURBINE A				.			
52 GG 01A AM01A	Vent. fan fuel unit	M	0.05	SP 5424 W 52.1600.16.6	3	S 52.41.2.12	1 A	380 V.a.c
52 GG 01A AM01B	Vent. fan fuel unit	M	0.05	SP 5424 W 52.1600.16.10	2	S.53.44.4.11	a10	110V d.c
52 GG 01A AM.02	Lube oil tank vapor fan	M	0.65	SP 5424 W 52.1600.16.4	4	S.52.41.2.12	1 B	380 Va.c
52 GG 01A AM03A	Gas gen. hood Fan	M	4.0	SP 5424 W 52.1600.16.5	3	S.52.41.2.12	1 D	380V a.c
52 GG 01A AM03B	Gas gen. hood Fan	M	4.5	SP 5424 W 52 1600.16.9	2	S.53.44.4.11	a14	110V d.c
52 GG 01A K.M01	Start air compressor	M	13.0	SP 5424 W 52.1600.16.8	2	S.52.41.2.12	2 I	380V.a.c
52 GG 01A MM01	Barring motor	M	4.0	SP 5424 W 52.1600.16.1	3	S.52.412.12	3 DEF	380Va.c
52 GG ØlA PM01A	lube oil pump	M	11.0	SP.5424W 52.1600.16.3	3	S.52.41.2.12	2 D	380V.a.c
52 GG 01A PM01B	lube oil pump	M	11.0	SP.5424 W 52.1600.16.3	3	S.52.41.2.13	2 E	380V.a.c
52 GG 01A PM01C	Lube oil pump	M	4.0	SP 5424 W 52. 1600.16.11	2	S.53.44.4.11	a13	110V d.c
52 GG 01A PM02	Governor oil pump	M	3.0	SP 5424 W 52.1600.16.7	3	S.52.41.2.12	1 C	380V.a.c
52 GG 01A TCV01	Ant Icing valve	M	0.08	SP 5424 W 52.1600.16.20	2	S.52.41.2.12	3GH	380V.a.c
52 GG 01A Y01A	Lube oil heater	H	6.0	SP 5424 W 52 1600.16.12	2	S.52.41.2.12	1 H	380Va.c
52 GG 01A Y01B	Lube oil heater	H	6.0	SP 5424 W 52.1600.16.12	2	S.52.41.2.12	1H	380V.a.c
52 GG 01A Y02	Governing oil tank heater	H	1.5	SP 5424 W 52.1600.16.13	2	S.52.41.2.12	1I	380Va.c 2 phases
52 GG 01A Y03A	Turbine hood heater	H	4.4	SP 5424 W 52.1600.16.14	2	S.52.41.2.12	1 J	380V.a.c 2 phases

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CONTRACT 480 KVAERNER
5424 W TECHNIP

ELF FRIGG NORGE
TCP2 COMPRESSION

CONSUMER LISTING - LOT 2

SP.5424W.00.1610.01

PAGE 13 REV. 4 DATE JUIN 80

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET N°	DATA SHEET Rev	SUPPLY Panel	SUPPLY Drawer	
52 GG 01A Y03B	Turbine Hood heater	H	4.4	SP 5424 W 52.1600.16.14	2	S.52.41.2.12	1J	380V a.c 2 phases
52 GG 01A Y04A	"Blow in door" heater	H	0.28	SP 5424 W 52.1600.16.15	2	S.52.41.2.12	2GH	380V a.c 2 phases
52 GG 01A Y04B	"Blow in door" heater	H	0.28	SP 5424 W 52.1600.16.15	2	S.52.41.2.12	2GH	380V a.c 2 phases
52 GG 01A Y05A	Control equipment heater	H	0.9	SP 5424 W 52.1600.16.19	2	S.52.41.2.12	2 BC	380V a.c 2 phases
52 GG 01A Y05B	Control equipment heater	H	0.9	SP 5424 W 52.1600.16.19	2	S.52.41.2.12	2 BC	380 Va.c 2 phases
52 GG 01A Y05 C	Control equipment heater	H	0.9	SP 5424 W 52.1600.16.19	2	S.52.41.2.12	2 BC	380V a.c 2 phases
52 GG 01A Y05 D	Control equipment heater	H	0.9	SP.5424 W 52.1600.16.19	2	S.52.41.2.12	2 BC	380V a.c 2 phases
52 GG 01A Y05E	Control equipment heater	H	0.9	SP. 5424 W 52.1600.16.19	2	S.52.41.2.12	2 BC	380V a.c. 2 phases
52 GG 01A Y05F	Control equipment heater	H	0.9	SP 5424 W 52.1600.16.19	2	S.52.41.2.12	2 BC	380V a.c 2 phases
52 GG 01A Y05 G	Control equipment heater	H	0.9	SP 5424 W 52.1600.16.19	2	S.52.41.2.12	2 BC	380Va.c 2 phases
52 GG 01A y05H	Control equipment heater	H	0.9	SP 5424 W 52.1600.16.19	2	S.52.41.2.12	2 BC	380Va.c 2 phases
52 GG 01A Y05I	Control equipment heater	H	0.9	SP 5424 W 52.1600.16.19	2	S.52.41.2.12	2 BC	380V a.c 2 phases
52 G 01A Y01A	A.C. generator heater	H	1.0	SP 5424 W 52.1600.16.16	2	S.52.41.2.12	1E or 1F	380Va.c 2 phases
52 G 01A Y01B	A.C. generator heater	H	1.0	SP 5424 W 52.1600.16.16	2	S.52.41.2.12	1E or 1F	380Va.c 2 phases
52 G 01A Y01C	A.C. generator heater	H	1.0	SP 5424 W 52.1600.16.16	2	S.52.41.2.12	1E or 1F	380Va.c 2 pahses
52 G 01A Y01D	A.C. generator heater	H	1.0	SP 5424 W 52.1600.16.16	2	S.52.41.2.12	1E or 1F	380Va.c 2 phases
52 G 01A Y01E	A.C. generator heater	H	1.0	SP 5424 W 52.1600.16.16	2	S.52.41.2.12	1E or 1F	380Va.c 2 phases

CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING - LOT 2	14	4	JUIN 80

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET N°	DATA SHEET Rev	SUPPLY Panel	SUPPLY Drawer	
52 G 01A Y01F	A.C. generator heater	H	1.0	SP. 5424 W 52.1600.16.16	2	S.52.41.2.12	1E or 1F	380Va.c 2 phases
52 G 01A Y01G	A.C. generator heater	H	1.0	SP. 5426 W 52.1600.16.16	2	S.52.41.2.12	1E or 1F	380Va.c 2 phases
52 G 01A Y01H	A.C. genetator heater	H	1.0	SP.5424 W 52.1600.16.16	2	S.52.41.2.12	1E or 1F	380Va.c 2 phases
52.G. 01A Y02A	A.C. generator heater	H	1.0	SP. 5424 W 52.1600.16.17	2	S.52.41.2.12	1E or 1G	380Va.c 2 phases
52.G. 01A Y02B	A.C. generator heater	H	1.0	SP. 5424 W 52.1600.16.17	2	S.52.41.2.12	1E or 1G	380Va.c 2 phases
52.G. 01A Y03	A.C generator heater	H	1.0			S.52.41.2.12	1E	380V.ac 2 phases

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CONTRACT 480 KVAERNER
5424 W TECHNIP

ELF FRIGG NORGE
TCP2 COMPRESSION

PAGE	REV.	DATE
15	4	JUIN 80

SP.5424W.00.1610.61

CONSUMER LISTING - LOT 2

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET N°	DATA SHEET Rev	SUPPLY Panel	SUPPLY Drawer	
	GENERATOR TURBINE B							
52 GG 01B AM01A	Vent. fan fuel unit	M	0.05	SP 5424 W 52.1600.16.6	3	S 52.41.2.13	1A	380V.a.c
52 GG 01B AM01B	Vent fan fuel unit	M	0.05	SP 5424 W 52.1600.16.10	2	S.53.44.4.11	a17	110Vd.c
52 GG 01B AM02	Lube oil tank vapor fan	M	0.65	SP 5424 W 52.1600.16.4	4	S 52.41.2.13	1B	380V.a.c
52 GG 01B AM03A	Gas gen. hood fan	M	4.0	SP 5424 W 52.1600.16.5	3	S 52.41.2.13	1D	380Va.c
52 GG 01B AM03B	Gas gen. hood Fan	M	4.5	SP 5424 W 52.1600.16.9	2	S 53.44.4.11	a16	110V d.c
52 GG 01B K.M01	Start air compressor	M	13.0	SP 5424 W 52.1600.16.8	2	S.52.41.2.13	2I	380V.a.c
52 GG 01B MM01	Barring motor	M	4.0	SP 5424 W 52.1600.16.1	3	S.52.41.2.13	3DEF	380V.a.c
52 GG 01B PM01A	lube oil pump	M	11.0	SP.5424 W 52.1600.16.3	3	S.52.41.2.13	2D	380V.a.c
52 GG 01B PM01B	lube oil pump	M	11.0	SP 5424 W 52.1600.16.3	3	S.52.41.2.12	2E	380V.a.c
52 GG 01B PM01C	Lube oil pump	M	4.0	SP 5424 W 52.1600.16.11	2	S.53.44.4.11	a15	110V d.c
52 GG 01B PM02	Governing oil pump	M	3.0	SP 5424 W 52.1600.16.7	3	S.52.41.2.13	1C	380Va.c
52 GG 01B TCV01	Anti Icing valve	M	0.08	SP 5424 W 52.1600.16.20	2	S.52.41.2.13	3 GH	380V.a.c
52 GG 01B Y01A	Lube oil heater	H	6.0	SP 5424 W 52.1600.16.12	2	S.52.41.2.13	1H	380Va.c
52 GG 01B Y01B	Lube oil heater	H	6.0	SP 5424 W 52.1600.16.12	2	S.52.41.2.13	1H	380V.a.c
52 GG 01B Y02	Governing oil tank heater	H	1.5	SP 5424 W 52.1600.16.13	2	S.52.41.2.13	1I	380Va.c 2 phases
52 GG 01B Y03A	Turbine hood heater	H	1.4	SP 5424 W 52.1600.16.14	2	S.52.41.2.13	1J	380V a.c 2 phases

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CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING - LOT 2	16	4	JUIN 80

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET		SUPPLY		
				N°	Rev	Panel	Drawer	
52 GG 01B Y03B	Turbine hood heater	H	1.4	SP 5424 W 52.1600.16.14	2	S.52.41.2.13	1J	380Va.c 2 phases
52 GG 01B Y04A	"Blow in door" heater	H	0.28	SP 5424 W 52.1600.16.15	2	S.52.41.2.13	2 GH	380Va.c 2 phases
52 GG 01B Y04B	"Blow in door" heater	H	0.28	SP 5424 W 52.1600.16.15	2	S.52.41.2.13	2 GH	380 Va.c phases
52 GG 01B Y05A	Control equipment heater	H	0.9	SP 5424 W 52.1600.16.19	2	S.52.41.2.13	2 BC	380Va.c 2 phases
52 GG 01B Y05B	Control equipment heater	H	0.9	SP 5424 W 52.1600.16.19	2	S.52.41.2.13	2 BC	380Va.c 2 phases
52 GG 01B Y05C	Control equipment heater	H	0.9	SP 5424 W 52.1600.16.19	2	S.52.41.2.13	2 BC	380V a.c 2 phases
52 GG 01B Y05D	Control equipment heater	H	0.9	SP.5424 W 52.1600.16.19	2	S.52.41.2.13	2 BC	380 Va.c 2 phases
52 GG 01B Y05E	Control equipment heater	H	0.9	SP.5424 W 52.1600.16.19	2	S.52.41.2.13	2 BC	380Va.c 2 phases
52 GG 01B Y05F	Control equipment heater	H	0.9	SP 5624 W 52.1600.16.19	2	S.52.41.2.13	2 BC	380 Va.c 2 phases
52 GG 01B Y05G	Control equipment heater	H	0.9	SP 5424 W 52.1600.16.19	2	S.52.41.2.13	2 BC	380Va.c 2 phases
52 GG 01B Y05H	Control equipment heater	H	0.9	SP 5424 W 52.1600.16.19	2	S.52.41.2.13	2 BC	380Va.c 2 phases
52 GG 01B Y05I	Control equipment heater	H	0.9	SP 5424 W 52.1600.16.19	2	S.52.41.2.13	2 BC	380Va.c 2 phases
52 G 01B Y01A	A.C. generator heater	H	1.0	SP 5424 W 52. 1600.16.16	2	S.52.41.2.13	1E or 1F	380Va.c 2 phases
52 G 01B Y01B	A.C. generator heater	H	1.0	SP 5424 W 52. 1600.16.16	2	S.52.41.2.13	1E or 1F	380Va.c 2 phases
52 G 01B Y01C	A.C generator heater	H	1.0	SP 5424 W 52.1600.16.16	2	S.52.41.2.13	1E or 1F	380Va.c 2 phases
52 G 01B Y01D	A.C.generator heater	H	1.0	SP 5424 W 52.1600.16.16	2	S.52.41.2.13	1E or 1F	380Va.c 2 phases
52 G 01B Y01E	A.C. generator heater	H	1.0	SP 5424 W 52.1600.16.16	2	S.52.41.2.13	1E or 1F	380Va.c 2 phases

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CONTRACT 480 KVAERNER
5424 W TECHNIP

SP.5424W.00.1610.01

ELF FRIGG NORGE
TCP2 COMPRESSION

CONSUMER LISTING -LOT 2

PAGE	REV.	DATE
17	4	JUIN 86

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET N°	DATA SHEET Rev	SUPPLY Panel	SUPPLY Drawer	
52 G 01B Y01F	A.C. generator heater	H	1.0	SP. 5424 W 52. 1600.16.16	2	S.52.41.2.13	1E or 1F	380Va.c 2 phases
52 G 01B Y01G	A.C. generator heater	H	1.0	SP. 54 24 W 52. 1600.16.16	2	S.52.41.2.13	1E or 1F	380Va.c 2 phases
52 G 01B Y01H	A.C. generator heater	H	1.0	SP.5424 W 52 .1600.16.16	2	S.52.41.2.13	1E or 1F	380Va.c 2 phases
52 G 01B Y02A	A.C. generator heater	H	1.0	SP 5424 W 52.1600.16.17	2	S.52.41.2.13	1E or 1G	380Va.c 2 phase
52.G. 01B Y02B	A.C. generator heater	H	1.0	SP. 5424 W 52.1600.16.17	2	S.52.41.2.13	1E or 1G	380Va.c 2 phase
52.G. 01B Y03	A.C. generator heater	H	1.0			S.52.41.2.13	1E	380.Vac 2 phases

CONTRACT 480 KVAERNER
5424 W TECHNIP

ELF FRIGG NORGE
TCP2 COMPRESSION

SP.5424W.00.1610.01

CONSUMER LISTING- LOT 2

PAGE	REV.	DATE
18	4	JUIN 80

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET N°	DATA SHEET Rev	SUPPLY Panel	SUPPLY Drawer	
	EMERGENCY DIESEL GENERATOR							
53 GD 01 AM01	Air fan for cooling system	M	25.0	SP.5424W.53. 1600.23.7	4	S.53.44.2.7	4 CD	380V a.c
53 GD 01 AM02	Air fan for load bank	M	7.5	SP.5424W.53 1600.23.9	3	S.53.44.2.7	4E	380V a.c
53 GD 01 KM01	Electrical Air Compressor	M	4.0	SP.5424W.53. 1600.23.6	3	S.53.44.2.7	2E	380V a.c
53 GD 01 LB01A	Load Bank	H	200.0	SP.5424W.53 1600.23.8	2	S.53.44.2.7	4FGHI	380V a.c
53 GD 01 LB01B	Load Bank	H	200.0	SP.5424W.53 1600.23.8	2	S.53.44.2.7	5FGHI	380V a.c
53 GD 01 PM 01	Water Circulation Pump	M	0.75	SP.5424W.53 1600.23.4	3	S.53.44.2.7	2A	380V. a.c
53 GD 01 PM02	Oil Circulation Pump	M	0.55	SP.5424W.53 1600.23.5	3	S.53.44.2.7	2B	380V a.c
53 GD 01 Y01	Heater Alternator	H	0.4	SP.5424W.53 1600.23.3	2	S.53.44.2.1	2D	220V a.c
53 GD 01 Y02A	Pre-heating water	H	2.0	SP.5424W.53 1600.23.1	3	S.53.44.2.7	2C	380V.a.c
53 GD 01 Y02B	Pre-heating Water	H	2.0	SP.5424W.53 1600.23.1	3	S.53.44.2.7	2.C	380 V.a.c
53 GD 01 Y02C	Pre-Heating Water	H	2.0	SP.5424W.53 1600.23.1	3	S.53.44.2.7	2G	380V a.c
53 GD 01	220V Feeder of main control panel	H	0.4			S.52.32.2.18	a34	220v.a.c 1 phase

CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING- LOT 2	19	4	JUIN 80

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET		SUPPLY		
				N°	Rev	Panel	Drawer	
	HEATING AND VENTILLATION (LOT 2)							
54 x 09/007	Turbo Gen. room H & V fan motor A	M	6.5	SP.5424W 54.1600.8.7	2	S.52.32.2.2	13F	380V.a.c
54 x 09/008	Turbo Gen. Room H & V fan motor B	M	6.5	SP.5424W 54.1600.8.7	2	S.52.32.2.3	12F	380V.a.c
54 x 09/016	Turbo Gen. room H & V Heating Coil	H	26.0	SP.5424W 54.1600.8.12	2	S.52.32.2.3	12DE	380V.a.c
54 x 12/004	Battery Room H & V fan motor A	M	0.75	SP.5424W 54.1600.8.17	2	S.53.44.2.7	1E	380V.a.c
54 x 12/005	Battery Room H & V fan motor B	M	0.75	SP.5424W 54.1600.8.17	2	S.53.44.2.7	1F	380V.a.c
54 x 13/003	Emergency substation H & V Fan motor	M	3.0	SP.5424W 54.1600.8.19	2	S.53.44.2.7	1 G	380V.a.c
54 x 13/004	Emergency substation H & V stand by fan motor	M	1.35	SP.5424 54.1600.8.19	2	not connected		380V.a.c
54 x 13/005	Emergency substation H & V Heating coil	H	20.0	SP.5424W 54.1600.8.13	2	S.52.32.2.3	12BC	380V.a.c

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CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING -LOT 2	20	4	JUIN 80

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET		SUPPLY		
				N°	Rev	Panel	Drawer	
	Hoist (Lot 2)							
60 x 13 M01	Pancake 44	M	13/3.2	SP.5424W.00. 1600.25.1	1	S.52.32.2.16	3 AB	380V.a.c

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CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING- LOT 3	21	4	JUIN 80

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET N°	DATA SHEET Rev	SUPPLY Panel	SUPPLY Drawer	
	HEATING AND VENTILLATION (Lot 3)							
54 x 10/004	PANCAKE 42 -DIESEL FIRE PUMP ROOM -H&V FAN MOTOR A	M	1.35	SP5424W 54.1600.8.18	2	S.53.44.2.7.	1.A	380Va.c
54 x 10/005	PANCAKE 42 - DIESEL FIRE PUMP ROOM -H&V FAN MOTOR B	M	1.4	SP5424W 54.1600.8.15	2	S.53.44.4.11	a25	110Vd.c
54 x 14/004	PANCAKE 46 - DIESEL FIRE PUMP ROOM -H&V FAN MOTOR A	M	1.35	SP5424W 54.1600.8.18	2	S.53.44.2.7	1.B	380Va.c
54 x 14/005	PANCAKE 46 - DIESEL FIRE PUMP ROOM - H&V FAN MOTOR B	M	1.4	SP5424W 54.1600.8.15	2	S.53.44.4.11	a26	110Vd.c

CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING -LOT 3	22	4	JUIN 80

ITEM N°		FUNCTION	TYPE	RATED POWER	DATA SHEET		SUPPLY		
					N°	Rev	Panel	Drawer	
		FRESH WATER MAKER							
55 x 01B	PM01A	Feed water pump no 1	M	1.49	SP 5424W 55.1600.17.5	2	S52.32.2.2	11A	380Va.c
55 x 01B	PM01B	Feed water pump no 2	M	1.49	SP 5424W 55.1600.17.5	2	S52.32.2.3	11C	380Va.c
55 x o1A	KM01	Compressor	M	37.0	SP 5424W 55.1600.17.1	4	S52.32.2.2.	8DEF	380Va.c
55 x 01A	PMo1	Recirculation pump	M	3,7	SP 5424W 55.1600.17.2	3	S52.32.2.2	11D	380Va.c
55 x 01A	PM02	Lube oil pump	M	0.373	SP 5424W 55.1600.17.3	1	S52.32.2.2	11C	380Va.c
55 x 01A	PM03	Distribution pump	M	1.49	SP 5424W 55.1600.17.4	3	S52.32.2.2	11B	380Va.c
55 x 01A	Y01	Immersion heater no 1	H	12.0	SP 5424W 55.1600.17.6	2	S52.32.2.2	10D	380Va.c
55 x 01A	Y02	Immersion heater no 2	H	12.0	SP 5424W 55.1600.17.6	2	S52.32.2.2	10C	380Va.c
55 x 01A	Y03	Immersion heater no 3	H	12.0	SP 5424W 55.1600117.6	2	S52.32.2.2	10B	380Va.c
55 x 01B	KM01	Compressor	M	37.0	SP 5424W 55.1600.17.1	4	S52.32.2.3	11HIJ	380Vac.c
55 x 01B	PM01	Recirculation pump	M	3,7	SP 5424W 55.1600.17.2	3	S52.32.2.3	11E	380Va.c
55 x 01B	PM02	Lube oil Pump	M	o.373	SP 5424W 55.1600.17.3	1	S52.32.2.3	11A	380Va.c
55 x 01B	PM03	Distribution pump	M	1.49	SP 5424W 55.1600.17.4	3	S.52.32.2.3	11B	380Va.c
55 x 01B	Y01	Immersion heater no 1	H	12.0	SP 5424W 55.1600.17.6	2	S52.32.2.3	10D	380Va.c
55 x 01B	Y02	Immersion heater no 2	H	12.0	SP 5424W 55.1600.17.6	2	S52.32.2.3	10C	380Va.c
55 x 01B	Y03	Immersion heater no 3	H	12.0	SP 5424 55.1600.17.6	2	S52.32.2.3	10B	380Va.c

CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING -LOT 3	23	4	JUIN 80

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET N°	DATA SHEET Rev	SUPPLY Panel	SUPPLY Drawer	
	ANTI CORROSION DOSING SET							
55 x 02 PM01A	Dosing Pump A	M	o.75	SP.5424W 55.1600.18.1	2	S.52.32.2.3	5A	380V.a.c
55 x 02 PM01B	Dosing Pump B	M	0.75	SP.5424W 55.1600.18.1	2	S.52.32.2.2	8C	380V.a.c
55 x 02 PM02	Tank agitator	M	0.75	SP.5424W 55.1600.18.2	3	S.52.32.2.3	11D	380V.a.c
55X02 Y01	Tank heater	H	4.5	SP.5452W 55.1600.18.3	1	S.52.32.2.3	12G	380V.a.c

CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING - LOT 3	24	4	JUIN 80

ITEM Nº	FUNCTION	TYPE	RATED POWER	DATA SHEET Nº	DATA SHEET Rev	SUPPLY Panel	SUPPLY Drawer	
	INSTRUMENT AND SERVICE AIR PACKAGE							
57 x 01 AM01A	Fan for air cooler	M	3	SP5424W 57.1600.13.2	2	S.52.32.2.2	9 A	380Va.c
57 X 01 AM01B	Fan for air cooler	M	3	SP5424W 57.1600.13.2	2	S.52.32.2.3	9 A	380Va.c
57 x 01 KM01A	Compressor	M	110	SP5424W 57.1600.13.1	3	S.52.32.2.2	9 GHIJ	380Va.c
57 x 01 KM01B	Compressor	M	110	SP5424W 57.1600.13.1	3	S.52.32.2.3	9 GHIJ	380Va.c
57 x 01 PM01A	Pump for water cool circui	M	0.75	SP5424W 57.1600.13.3	2	S.52.32.2.2	9 B	380Va.c
57 x 01 PM01B	Pump for water cool circui	M	0.75	SP5424W 57.1600.13.3	2	S.52.32.2.3	9 B	380Va.c
57 x 01 Y01A	Filter heater	H	4	SP5424W 57.1600.13.4	2	S.52.32.2.2	9 C	380Va.c
57 x 01 Y01B	Filter heater	H	4	SP5424W 57.1600.13.4	2	S.52.32.2.3	10 A	380Va.c
57 x 01 Y02A	Crancase heater	H	0.5	SP5424W 57.1600.13.5	2	S.52.32.2.18	a33	220Va.c 1 phase
57 x 01 Y02B	Crancase heater	H	0.5	SP5424W 57.1600.13.5	2	S.52.32.2.19	a28	220Va.c 1 phase

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CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING - LOT 3	25	3	April 79

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET		SUPPLY		
				N°	Rev	Panel		
	HV Motors							
58 PM 02A	Process fresh water pump	M	400	SP.5424W. 58.1600.07	4	S.52.32.1.1	VC 617	5,5 KV
58 PM 02B	Process fresh water pump	M	400	SP.5424W 58.1600.07	4	S.52.32.1.1	VC 618	5,5 KV

CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING - LOT 3	26	4	JUIN.80

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET N°	DATA SHEET Rev	SUPPLY Panel	SUPPLY Drawer	
	DIESEL FIRE PUMP				-			
68PD01A KM01A	Compressor no 1	M	2	SP.5424W 68.1600.22.1	2	552.32.2.2	6FG	380Va.c
68PD01A KM01B	Compressor no 2	M	2	SP:5424W 68.1600.22.1	2	"	"	380Va.c
68 PD01A PM01	Hydraulic oil circulation pump	M	0.75	SP:5424W 68,1600.22.3	1	"	"	380Va.c
68 PD01A Y01	Hydraulic oil heater	H	3	SP.5424W 68,1600.22.2	2	"	"	220Va.c
68 PD01A Yo2	Hydraulic oil heater	H	6	SP.5424W 68.1600.22.4	0	"	"	220Va.c
68 PD01A Y03	Engine lube oil heater	H	0.15	SP.5424W 68.1600.22.5	1	552.32.2.18	a35	220Va.c
68 PD01A Y04	Engine water heater	H	2.25	SP.5424W 68.1600.22.6	0	"	"	220Va.c
68 PD01A Yo5	Control panel heater	H	0.1	SP:5424W 68.1600.22.7	0	"	"	220Va.c
68 PD01B KM01A	Compressor no 1	M	2	SP.5424W 68.1600.22.1	2	552.32.2.3	6EF	380Va.c
68PD01B KM01B	Compressor no 2	M	2	SP.5424W 68.1600.22.1	2	"	"	380Va.c
68 PD01B PM01	Hydraulic oil circulation pump	M	0.75	SP.5424W 68.1600.22.3	1	"	"	380Va.c
68 PD01B Y01	Hydraulic oil heater	H	3	SP.5424W 68.1600.22.2	2	"	"	220Va.c
68 PD01B Y02	Hydraulic oil heater	H	6	SP.5424W 68.1600.22.4	0	"	"	220Va.c
68 PD01B Y03	Engine lube oil heater	H	0.15	SP:5424W 68.1600.22.5	1	552.32.2.19	a29	220Va.c
68 PD01B Y04	Engine water heater	H	2.25	SP.5424W 68.1600.22.6	0	"	"	220Va.c
68 PD01B Y05	Control panel heater	H	0.1	SP.5424W 68.1600.22.7	0	"	"	220Va.c

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CONTRACT 480 KVAERNER
5424 W TECHNIP

ELF FRIGG NORGE
TCP2 COMPRESSION

PAGE	REV.	DATE
27	4	JUIN 80

SP.5424W.00.1610.01

CONSUMER LISTING - LOT 3

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET		SUPPLY		
				N°	Rev	Panel	Drawer	
	Hoist (Lot 3)							
60 x 11A M01	Pancake 42	M	13/3.25	SP.5424W.00. 1600.25.1	1	S 52.32.2.16	2 IJ	380V.a.c
60 x 11B M01	Pancake 46	M	13/3.25	SP.5424W.00. 1600.25.1	1	"	3 CD	380V.a.c
60 x 14 M01	Pancake 63	M	13/3.25	SP.5424W.00. 1600.25.1	1	"	3 EF	380V.a.c
60 x 15AM01	Pancake 65	M	13/3.25	SP.5424W.00. 1600.25.1	1	"	3 GH	380V.a.c
60x 15A M02	Pancake 65	M	0.36	SP.5424W.00. 1600.25.2	1	"	"	380V.a.c
60 x 15AM03	Pancake 65	M	0.36	SP.5424W.00. 1600.25.2	1	"	"	380V.a.c
60 x 15B. M01	Pancake 65	M	13/3.25	SP.5424W.00. 1600.25.1	1	S 52.32.2.16	2 CD	380V.a.c
60 x 15B - M02	" "	M	13/3.25	SP.5424 W.00. 1600.25.1	1	"	"	380V.a.c
60 x 15B - M03	" "	M	0.36	SP.5424.W.00. 1600.25.2	1	"	"	380V.a.c
60 x 15B. M04	" "	M	0.36	SP.5424.W.00 1600.25.2	1	"	"	380V.a.c

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CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING - LOT 3	28	4	JUIN 80

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET N°	DATA SHEET Rev	SUPPLY Panel	SUPPLY Drawer	
	MISCELLANEOUS CONSUMERS							
55 PM01A	Fresh water make up pump	M	3.0	SP5424W 55.1600.01	3	S.52.32.2.2	8 A	380Va.c
55 PM01B	Fresh water make up pump	M	3.0	SP5424W 55.1600.01	3	S.52.32.2.3	8 A	380Va.c
55 PM03	Turbine washing pump	M	17.0	SP5424W 55.1600.20	1	S.52.32.2.3	5 CD	380Va.c
55 Y01A	Fresh water storage tank heater	H	11.25	SP5424W 55.1600.21	3	S.52.32.2.2	6 D	380Va.c
55 Y01B	Fresh water storage tank heater	H	11.25	SP5424W 55.1600.21	3	S.52.32.2.3	8 C	380Va.c
55 Y01C	Fresh water storage tank heater	H	11.25	SP5424W 55.1600.21	3	S.52.32.2.2	6 E	380Va.c
55 Y01D	Fresh water storage tank heater	H	11.25	SP5424W 55.1600.21	3	S.52.32.2.3	8 D	380Va.c
58 PM04A	Utilities fresh water/TEG pump	M	140.0	SP5424W 58.1600.12	4	S.52.32.2.2	10GHIJ	380Va.c
58 PM04B	Utilities fresh water/TEG pump	M	140.0	SP5424W 58.1600.12	4	S.52.32.2.3	6GHIJ	380Va.c
68 PM05A	Fresh water/TEG drain tank pump	M	5.5	SP5424W 58.1600.03	5	S.52.32.2.2	6 A	380Va.c
68 PM05B	Fresh water/TEG drain tank pump	M	5.5	SP5424W 60.1600.03	5	S.52.32.2.3	5 B	380Va.c
~~60 X02~~	~~Life boat lifting motor~~ EQUIPPED SPARE	~~M~~	~~8.5~~	~~SP5424W 60.1600.11~~	~~1~~	~~S.52.32.2.3~~	~~5C~~	~~380Va.c~~

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CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
SP.5424W.00.1610.01	CONSUMER LISTING-OFF SHORE	29	3	April 79

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET N°	DATA SHEET Rev	SUPPLY Panel	SUPPLY Drawer	
	Miscellaneous consumers							
50 PM02	Wash down pump	M	62.5	SP5424W 50.1600.10	4	S.52.32.2.3	5EFG	380Va.c
55 PM02A	TEG make up pump	M	2.2	SP.5424W 55.1600.02	3	S.52.32.2.3	8B	380Va.c
55 PM02B	TEG make up pump	M	2.2	SP.5424W 55.1600.02	3	S.52.32.2.2	8B	380Va.c

MOD 5424 W · 05 · 7.78 · HIBLOT

4-00 5424 W · 08 · 7-75 · HIBLOT

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CONTRACT 480 KVAERNER 5424 W TECHNIP	ELF FRIGG NORGE TCP2 COMPRESSION	PAGE	REV.	DATE
5424W.00.1610.01	CONSUMER LISTING-OFF SHORE	30	4	Juin 80

ITEM N°	FUNCTION	TYPE	RATED POWER	DATA SHEET N°	DATA SHEET Rev	SUPPLY Panel	SUPPLY	
	HV Motors							
58 PM01A	Sea water pump	M	500	SP.5424W. 58.1600.4.1	3	S.52.32.1.1	VC615	5,5 KV
58 PM01B	Sea water pump	M	515	SP 5424W 58.1600.4.2	3	S.52.32.1.1	VC619	5,5 KV
58 PM01C	Sea water pump	M	500	SP.5424W 58.1600.4.1.	3	S.52.32.1.1	VC616	5,5 KV
58 PM01D	Sea water pump	M	515	SP.5424W 58.1600.4.2	3	S.52.32.1.1	VC620	5,5 KV
60 x 01. LCP	CRANE 220v. SUPPLY	M	5.5			S.52.32.2.19	a 21	220v. ac 1 phase

9.2 Distribution System Single Line Representation

9.2.1 Main System

9.2.1.1 5,5 kV Distribution System

High voltage power distribution on the Frigg Field is 5,5 kV 3 phase with resistor grounded neutral. The TCP 2 compression distribution is defined on the attached single line diagram.

The TCP2-C 5,5 kV distribution switchboard, located in main substation, module 32, is normally powered by the two 17,15 MVA generators installed in module 41, each running at approximately 50% load in parallel.

In its final shape, however, in case of maintenance or varying degrees of emergency, the TCP 2/C 5,5 kV distribution switchboard can be powered by gas turbine driven generators on TP 1 and TCP 2/T.

Generator incomers and feeder outgoers are connected to the 5,5 kV busbars via circuit breakers. Motor driven consumers and transformers are fed via fuses and vacuum contactors. Connected to the 5,5 kV distribution switchboard are duplicated feeders to QP, TP 1 and TCP 2/T, sea water and process fresh water pumps, two 5,5 kV/380 V fuel gas heater transformers, and two 5,5 kV/380 V transformers for feeding the main 380 V distribution switchboard.

The 5,5 kV busbar is divided into three sections by means of bus-tie breakers, in order to feed limited parts of the network if considered necessary or imperative. Interlocks are provided to prevent faulty operation of the network.

Each turbine driven generator is connected to neutral by means of a 17 ohms impedance, thus limiting the earth fault current to 187 amperes. This impedance is designed to withstand a 187 amperes earth fault current for 2 seconds and a sustained current of 12 amperes.

9.2.1.2 380 V Distribution System

The 380 V distribution switchboard is located in main substation in module 32 and is fed from the two 2500 kVA transformers T11 and T12. This switchboard consists of two busbars, "A" and "B", normally operated with a bus-tie circuit breaker in the open position. If one transformer fails, this will automatically be disconnected and the tie breaker will close.

Consumers connected to the 380 V distribution switchboard are

- General lighting & sockets
- Trace heating
- Welding sockets
- Turbine driven compressor and generator auxiliaries
- Heating and ventilation
- Fuel gas heaters

A load shedding system is provided to ensure safe operation of the distribution network and to discriminate between essential and non-essential loads.

9.2.2 380 V Emergency Distribution System

The emergency distribution system is defined on the single line diagram attached. It is located in the emergency substation, module 44, and is powered by the emergency diesel generator, rated:

1200 kVA
380 V 3 phase
50 Hz

However, the emergency distribution switchboard is during normal operation fed from the main distribution switchboard.

The TCP2-C emergency diesel generator is autonomous and not connected to the 380 V emergency system on TP1 and TCP2-T, which are supplied from QP.

Consumers connected are all systems allowing for safe evacuation of people, instrument systems necessary for safe operation of power generation, gas compressor turbines, and ESD system.

DC power supply is available via static rectifiers and autonomy is obtained by battery back-up from battery banks located in the battery room in emergency substation.

AC essential instrument supply is provided from battery banks via inverters and static interruptor.

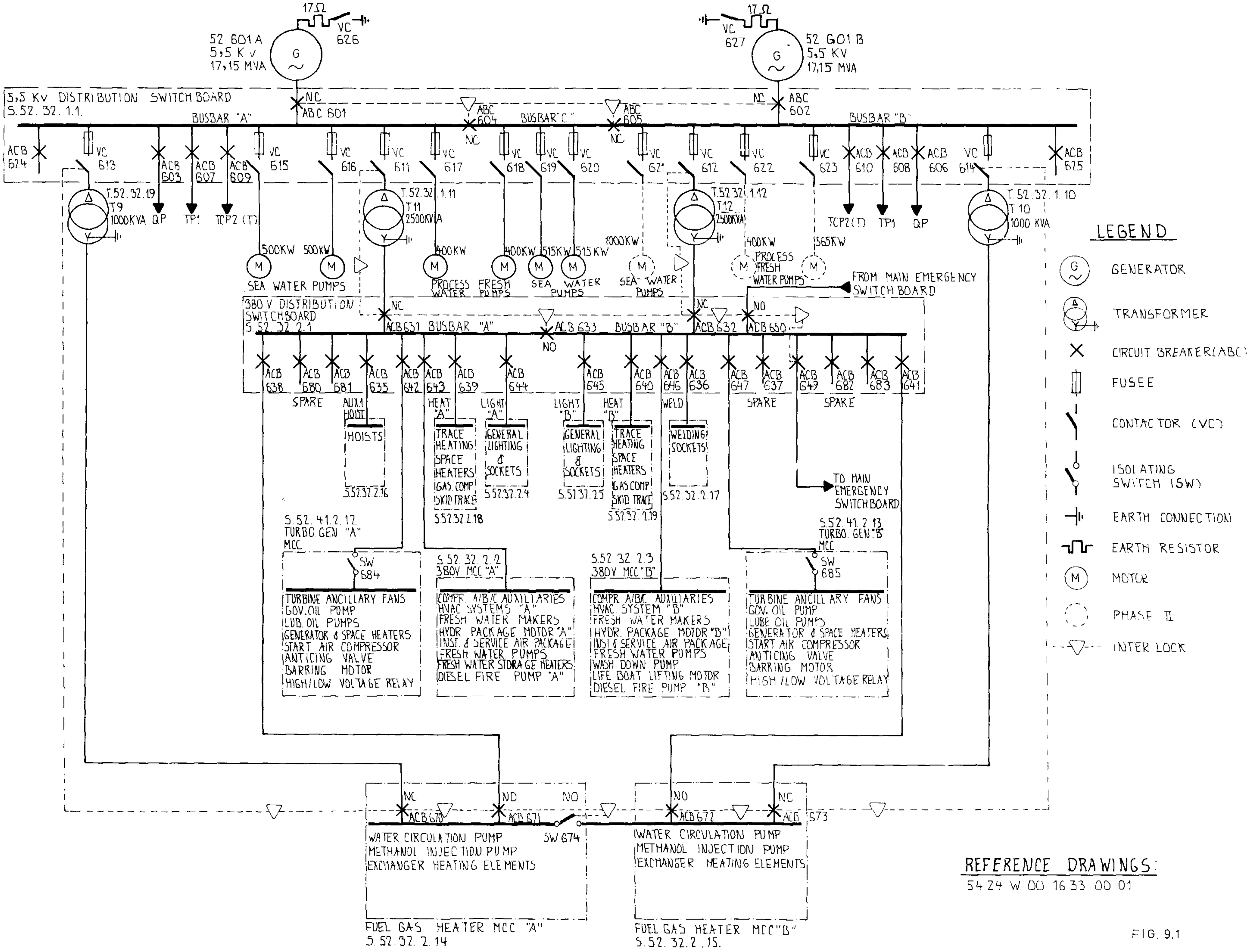
In the emergency situation the non-essential consumers are disconnected by a load shedding system. Following consumers shall then have 24 hours continuous power supply:

- Emergency lighting
- Gas detection systems
- Fire detection and fire fighting systems
- Alarm and intercommunication systems
- Emergency shut down systems
- Platform evacuation systems
- Compressor A/B/C DC lubricator oil pumps
- Turbogenerator DC vent fans and lubricator oil pump
- Other vital equipment

The emergency system complies with the NPD Regulation in that emergency consumers are fed by battery via a no break supply for 30 minutes and by emergency diesel electric generator for at least 24 hours.

9.2.3 Circuit Breaker Interlocks

See Fig. 9.1 and 9.2.



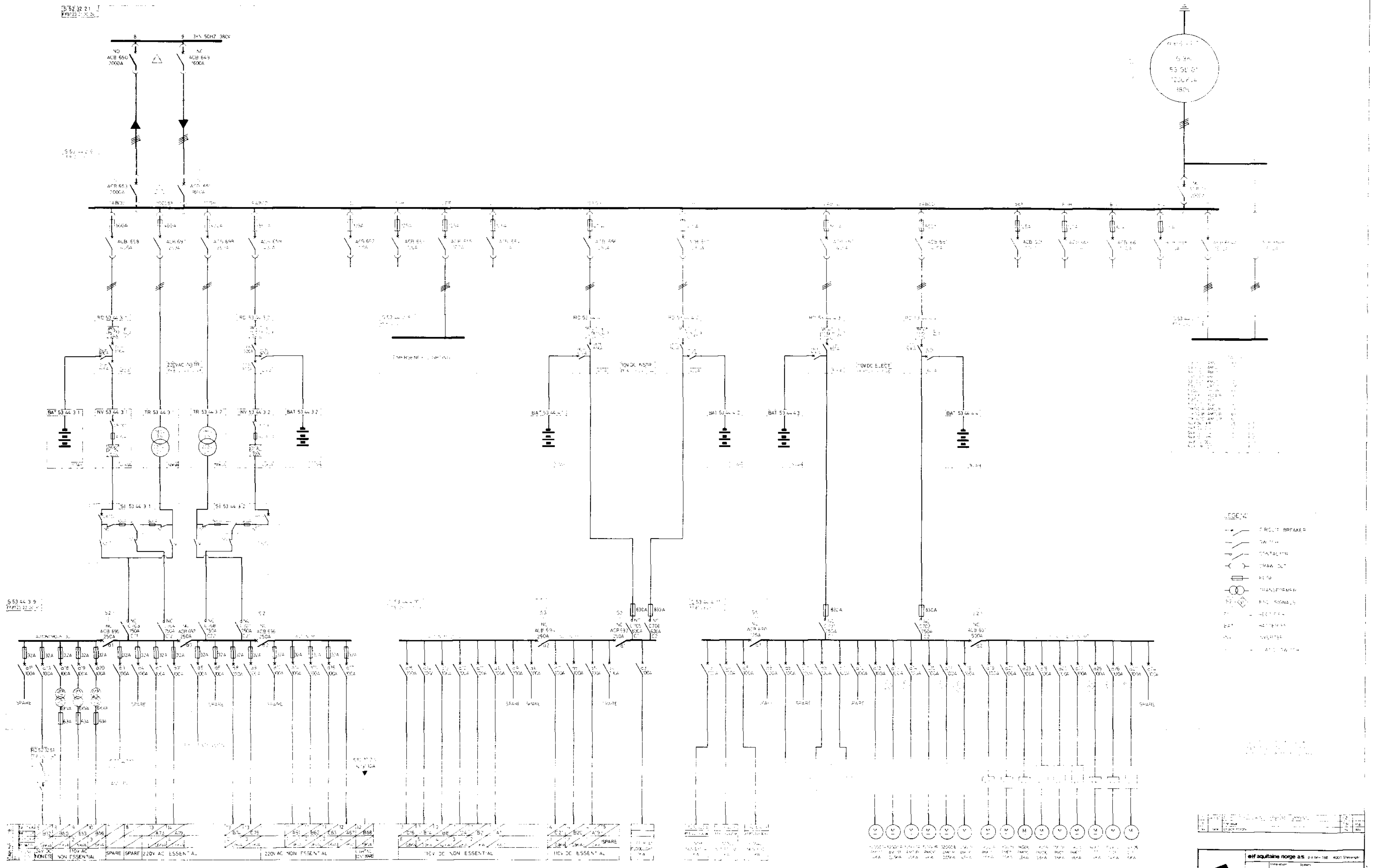
REFERENCE DRAWINGS:
54 24 W 00 16 33 00 01

FIG. 9.1

TCP 2 COMPRESSION SYNOPSIS

MAIN POWER GENERATION AND
DISTRIBUTION SINGLE LINE DIAGRAM

FRIGG FIELD



elf aquitaine norge a/s p.o.box 168 4001 Stavanger

EMERGENCY
SINGLE LINE

FRIGG FIELD

Drawing no. FF 87 23 23 0050 Rev. 1 Sheet

9.2.4 Protection and Discrimination

A full study of protection has been carried out by SOCETEC and presented to NPD, entitled:

Network Operating Notice
EAN ref.: S 892 SR 87069
SOCETEC ref.: 029 090-NRS/DJ

Below is given a summary from the sections on short circuit current calculations and protection.

The network protection system is defined with the following objectives:

- a fault on the network does not affect the stability of generators,
- to safeguard the operation of the other part of the grid not affected by the fault,
- to protect people,
- to limit the damage of the equipment subjected to fault in the power system.

So the protection system must be selective and trip the circuit breakers on each side of the faulty section.

The protection system must give an order as fast as possible.

The setting of the relays must stay independant of the operating condition (distribution arrangement) and is not required to change for the minimum load or the maximum load.

The normal variations of currents, voltage or load do not affect the protection system.

Short circuit Calculations

Calculation assumptions.

- All generators are considered as running in parallel.
  (i.e. TA1/2/3 on TP 1,
  TA4/5/6 on TCP 2-T, and
  GO1A/GO1B on TCP 2-C)

- All feeders between platforms are energized and bus-tie circuit breakers (if any) closed.

- The fault occurring on the network is a "Bolted three phase short circuit" fault.

Calculation results.

The following table of results gives all the computed evaluations of short-circuit current levels for faults occurring on the 5.5 kV network.

switch-gear	Design values (from vendors data sheets)		Max short circuit level (Evaluation)	
	Subtransient	Transient	Subtransient	Transient
TCP2-C	95 kA (peak)	38 kA r.m.s.	86.5 kA (peak)*	23.5 kA r.m.s.
TCP2-T	78 kA (peak)	30.6 kA r.m.s.	84.8 kA (peak)	23.1 kA r.m.s.
TP 1	78 kA (peak)	30.6 kA r.m.s.	80.4 kA (peak)	22.3.kA r.m.s.
Q P	78 kA (peak)	30.6 kA r.m.s.	71.0 kA (peak)	20.0 kA r.m.s.
CDP 1	25 kA ?	10.0 kA r.m.s.	19.3 kA (peak)	10.4 kA r.m.s.
DP 2	25 kA ?	10.0 kA r.m.s.	16.3 kA (peak)	8.7 kA r.m.s.

* Based on Calculations by
EFI Trondheim

Protections

H.V. Switchboard

Incomers and outgoers are protected as listed below:

Generator incomers
CB 601 - CB 602

- Neutral point overcurrent protection type RXIG 2, 50 - 150 mA setting 0.06A (12 A), 2 A time lag relay type RXKBI setting 10 sec.
- Differential protection type RADHA, 40 - 50 V setting 40 V.
- Over voltage protection type RXEG 2, 80 - 240 V setting 121 V, 2 A time lag relay 1 - 6 sec, type RXKH 2, setting 2.5 sec.
- IDMT over current, type RX1DF 2 H, setting 2.5 A, 1.8 In instantaneous =
- Under excitation protection, type RXPE 40, 1 - 4 A, setting 1.5 A, 2 A time lag relay type RXKH 2, 0.3 - 2 sec., setting 0.3 sec.
- Rotor earth fault protection, type RXNB 4.
- Negative sequence current protection, setting K = 10 sec. trip = 0.08 pu, alarm = 0.05 pu.
- Under voltage protection RXEG 2, 40 - 180 V, setting 94 V. 2 A time lag relay type RXKH 2,3 - 20 sec. setting 5 sec. 2 B time lag relay type RXKB 1, 60 - 600 ms, setting 600 ms.
- Frequency protection, type TFF 601 and TFF 603.
- Reverse power relay type RXPE 40, 30 - 120 m A, setting 72 m A, 2 A time lag relay type RXKH 2, 3 - 20 sec., setting 10 sec.
  Lock-out relay manuf. CCEE, type TAJH 7013.

Transformer outgoers

Transformer outgoers(T9-T10, T11-T12)

- Overload relay, type Tn 2M, manuf. P & B Engr. Ltd.

  . Plug setting : 92 %
  . Time setting : 20 min. fixed

- HV fuses

- Earth leakage relay, type B.P.O. Post Office Relay

  Manufacturer CCEE : type ITG 7 131
  Range:
  I = 2 - 8 In   Io = 6 - 15 A   t = 0.1 - 1 s

  Settings:
  I = 6 In   Io = 10 A   t = 0.2 s

H.V. Motor Starters

- Overload relay, type Mn 2M, manuf. P & Engrg. Ltd.

  . Plug setting: 92 - 9590
  . Time setting: 20 min. fixed

- Stalling protection relay, type B.P.O. Post Office Relay PO 3000, manuf. Kayswitch Ltd.

  . Plug setting: P.V. 400 %, DD 200 % of the motor FLC.
  . Time setting: 2.0 sec. based on the information that the starting time of the motor is 0,5 - 1 s.

- Earth leakage relay, type B.P.O. Post Office Relay

  Manuafacuturer CCEE   Type ITG 7 111   range setting 7-20 A 0.1-1 sec. setting 10 A 0.2 sec. fed by 1 ring CT type TF 80.1

- H.V. fuses : 125 A

Feeder outgoers/incomers

Feeder outgoers/incomers TCP 2/T, TP 1, QP and Future.

- Overcurrent relay, 0.7-2 I_n inverse time, type ITG 7 241
  - . Plug setting: 0.8 In
  - . Time setting: 0.3 sec.-0.5 sec.
- Earth fault relay, 10-40 A, 0.3-3 s, type ITG 7 111
  - . Plug setting: 1 p.u. 40 A
  - . Time setting: 1.5 s

  Tripping/lock-out relay type TAJH 7 013

Dynamic and Static Stability.

Electrical stability will result from equilibrium between the electrical torque developed by the alternator and the mechanical torque developed by the driving machine.

When several generators are running in parallel, there is stability when the synchronism state is maintained after a variation of one of the equilibrium parameters (e.g. sudden electrical load changes).

Static stability is related to load sharing and depends only on the set speed governor characteristics.

Dynamic stability is related to rotor speed variations with regard to the synchronism speed and the exitation performance of the machines. A bolted short-circuit will result in the synchronizing torque decreasing to zero, and the machines will accelerate according to their own kinetic characteristics. The electromotive forces will become out of phase.

After the fault clearance, the generators will be running coupled and resume synchronism if the synchronizing force is not zero. This is obtained by applying protective devices able to clear the faults before the angular divergencies reach 90°, which is the admissible limit. Studies carried out state that this limit is reached after a time of 0,25 - 0,6 seconds. If this time limit cannot be met by the protective devices, the generators should run separately on limited sections of the power supply network.

Further details are given in the SOCETEC Study, Chapter 10.

9.3 Emergency Operation.

9.3.1. Autonomous Power Supply.

9.3.1.1. Batteries.

3 duplicated groups of batteries are installed in the Battery Room in the Emergency Substation, Module 44. The Batteries are of Nickel-Cadmium alkaline type and are under constant trickle charging during normal operation. In case of loss of power the batteries have sufficient autonomy for safe operation of instrumentation and ESD system as well as the safe evacuation of the compression ares.

Operating voltage: 110V DC
240V DC.

9.3.1.2. Rectifiers and Inverters.

The rectifiers and invertors are of entirely static type, with natural convection cooling. There are two types of charging:

- Battery float charging (trickle)
- Battery boost charging.

Trickle charging is the normal operation of the rectifiers whereas the boost is intended for rapid charging of the batteries; users then disconnected and interlocked. Interlock is arranged between booster charging and ventilation, so that the boosting will be interrupted by ventilation failure and return to trickle charging.

The inverters supply 220V AC with selectible frequency governed by internal time base or by synchronizing with main system frequency.

9.3.1.3 Static Interruptor.

The static interruptor operates in conjunction with inverters 53.44.3.1 and RD 53.44.3.2. It connects the Main Instrument 220V AC supply switchboard to the preferred inverter no. -1. In case of any failure in this primary inverter (mainly output voltage drop), the static switch will connect the AC load to inverter no. -2.

The switching action is performed by two pairs of Silicon Controlled Rectifiers connected in parallel - opposing to function as contacts, the first pair connecting inverter no. -1 and the second pair connecting inverter no. -2 to the AC load. The sensing for determining and the transfer itself require a small fraction of a 50 Hz cycle (i.e. less then 20 milliseconds). The static switch will return the AC load to inverter -1 automatically when the abnormal condition has been corrected.

9.3.2 Operation of Emergency Generator.

Upon loss of the mains voltage, the emergency diesel generator is automatically started and connected to the main Emergency Switchboard within 10 seconds. The incoming circuit breaker is automatically opened.

The control panel is provided with a selector switch for the following operation modes of the emergency diesel generator:

1. "AUXILIARY."

   Enabling the emergency switchboard to be connected to the main 330 V Distribution Switchboard for feeding parts of the fuel gas heating system and other auxiliaries necessary for "Black-start", or limited operation when the main generators are out of action.

2. "TEST."

   Intended for running with the load bank connected.

3. "EMERGENCY."

   Automatic start and connection to the Main Emergency Switchboard.
   Two distinguished load shedding actions in case of

   a) Loss of normal power.
      Operation safety of platform to be ensured.

   b) Emergency shut down.
      Statutory and personal safety ensured.

When operating in the "Emergency" mode the emergency generator diesel engine is stopped, or will not start running, on the following (NPD letter OD 17291/79)

- overspeed
- low lubrication oil pressure
- gas detection in ventilation intake.

When operating in the "Auxiliary" mode the diesel is stopped in addition by high cooling water temperature. This stop function is automatically tripped out by the ESD signal when the diesel starts in the emergency mode after an ESD.

9.3.3 Electrical Shut Down and Load Shedding

9.3.3.1 Electrical ESD System

The electrical ESD system initiates shut down of voltage in areas threatened by a hazard. These voltages are:

5,5 kV	
380 V AC	
220 V AC	from heater switchboard
110 V DC	from main 110 V electrical distribution board

Electrical ESD is achieved by means of 2 cubicles:

- 1 Non-esential ESD Cubicle, located in main substation, Module 32 Cubicle includes:
  - . 380 V load shedding
  - . ESD sequence for equipment in substation 32
  - . 110 V DC distriction for MCC control
- 1 Essential and emergency ESD cubicle located in emergency substations. Cubicle includes:
  - . Batteries load shedding
  - . Black start system
  - . ESD sequence for equipment in substation 44
  - . 110 V DC distribution for MCC control

Single signals from instrument process loop control system initiate sequence inside ESD cubicle. The process initiated signals for electrical ESD are provided via the programmable logic controller (PLC).

Three ways are used to provide shut down of consumers from ESD sequence:

- lack of 110 V DC control from the electrical ESD cubicle,
- isolating of 110 V DC control in MCC,
- trip of feeder air circuit breaker.

Relays are used for sequences, contactors are used when 110 V DC reach dangerous levels.

The following essential and emergency equipment is not tripped by the automatic ESD system:

(a) Essential

Emergency Diesel Generator: Air Fan for Cooling System 380V (53GD01.AM01).

Emergency Diesel Generator: Water Circulation Pump 380V (53GD01.PM01).

Emergency Diesel Generator; Oil Circulation Pump 380V (53GD01.PM02).

Emergency Diesel Generator; Electrical Air Compressor 380V (53GD01.KM01).

Emergency Diesel Generator; Pre-heating Water 380V (53GD01.Y02A).

Emergency Diesel Generator; Pre-heating Water 380V (53GD01.Y02B).

Emergency Diesel Generator; Pre-heating Water 380V (53GD01.Y02C).

Turbo Generator 'A' Lube Oil Pump 110V DC (52GG01A.PM01C).

Turbo Generator 'A' Vent, Fan Fuel Unit 110V DC (52GG01A.AM01B).

Turbo Generator 'A' Gas Gen Hood Fan 110V DC (52GG01A.AM03B).

Turbo Generator 'B' Lube Oil Pump 110V DC (52GG01B.PM01C).

Turbo Generator 'B' Vent Fan Fuel Unit 110V DC (52GG01B.AM01B).

Turbo Generator 'B' Gas Gen Hood Fan 110V DC (52GG01B.AM03B).

Natural Gas Compressor 'A' Lube Oil Pump 110V DC (11KG01A.PM01C).

Natural Gas Compressor 'A' Lube Oil Pump 110V DC (11K01A.PM01C).

Natural Gas Compressor 'A' Secondary Air Fan 380V AC (11KG01A.AM02B).

Natural Gas Compressor 'B' Lube Oil Pump 110V DC (11KG01B.PM01C).

Natural Gas Compressor 'B' Lube Oil Pump 110V DC (11K01B.PM01C).

Natural Gas Compressor 'B' Secondary Air Fan 380V AC (11KG01B.AM02B).

Natural Gas Compressor 'C' Lube Oil Pump 110V DC (11KG01C.PM01C).

Natural Gas Compressor 'C' Lube Oil Pump 110V DC (11K01C.PM01C).

Natural Gas Compressor 'C' Secondary Air Fan 380V AC (11KG01C.AM02B).

(b) Emergency

Crane 60X01
Panel 45 Lifeboat Floodlights
Intercommunication System
Emergency Lighting Switchboard
Essential 110V DC Control Switchboard
Essential 110V DC Signal Switchboard
ESD Cubicle
Flashing Light
Public Address
Cabinet 18 Essential Instruments 220V AC and 110V DC

The following essential equipment is not tripped by first, second and third level shutdowns:

All those not tripped by the ESD System.

Pancake 42 Diesel Fire Pump Room H & V Fan Motor 'A' 380V (54X 10004)

Pancake 42 Diesel Fire Pump Room H & V Fan Motor 'B' 110V DC (54X10005)

Pancake 46 Diesel Fire Pump Room H & V Fan Motor 'A' 380V (54X14004)

Pancake 46 Diesel Fire Pump Room H & V Fan Motor 'B' 110V DC (54X14005)

Substation and Fan Room H & V Fan Motor 'A' 380V (54X04009)

Control Room H & V Fan Motor 'A' 380 V (54X05014)

Control Room H & V Fan Motor 'B' 110V DC (54X05015)

Battery Room H & V Fan Motor 'A' 380V (54X12004)

Battery Room H & V Fan Motor 'B' 380V (54X12005)

Emergency Substation H & V Fan Motor 380V (54X13003)

The following equipment is not tripped by the second level shutdown:

All essential equipment not tripped by ESD or first, second or third level shutdown.

Non-essential 110V DC control switchboards.
Non-essential 110V DC signal switchboard.
Cabinet 18 non-essential instruments 220V AC and 110V DC.

9.3.3.2 Electrical Load Shedding

General

Three cases are considered and described as

$L+L_1+L_2$: 5,5 kV power generated by Stal Laval/ ASEA generators on TCP2-C

$L+L_2$: External 5,5 kV power supply to TCP2-C

L : Emergency diesel generator only.

On sudden failure of the 5,5 kV supply due to stoppage for any reason of the Stal Laval turbines, the NIFE no break system ensures that emergency and essential auxiliary systems continue to be supplied through the main switchboards:

S53 44 4 11 Main 110V DC. Electrical Supply
S53 44 3 9 Main 220V AC. Instrument Supply
S53 44 4 10 Main 110V DC. Instrument Supply

Subsequent actions depend on two cases:

1. Normal - emergency TCP2C 380 V generator starts,
2. Exceptional - emergency generator fails to start.

In case 1 after the emergency generator starts, the main 380 V switchboard is brought back to voltage by the feeder from the 380 V emergency switchboard which is operated manually.

Load shedding of consumers from the two MCC is preselected according to power consumption within terms of the power balance and is automatically tripped depending on which of the above cases arises. The choice of consumers to be shed is up to the operators to the extent that each MCC consumer can be preprogrammed to trip on the L, L1 or L2 sequence. In the event of actual stoppage and subsequent load shedding, this prepackaged group of consumers is rapidly shed, and individual variation to consumer shedding is not possible. Function L1 involves the least power shed, function L the most. Shedding of the other 380 V switchboard departs from the main 380 V switchboard is manual.

In case 2 load shedding takes place within the three maintained switchboards mentioned above, the non essential consumers being shed after time delays of approximately 2,5 minutes. This enables some short lived but essential functions - e.g. lubrication - to be maintained without running down the batteries to an extent to jeopardise the 30 minute emergency function.

Note that in the event of loss of 5,5 kV supply the compression facilities cannot continue in operation since they depend on operation of the cooling system powered itself from the 5,5 kV switchboard.

NT 5424W 00 1600 10 ANNEX

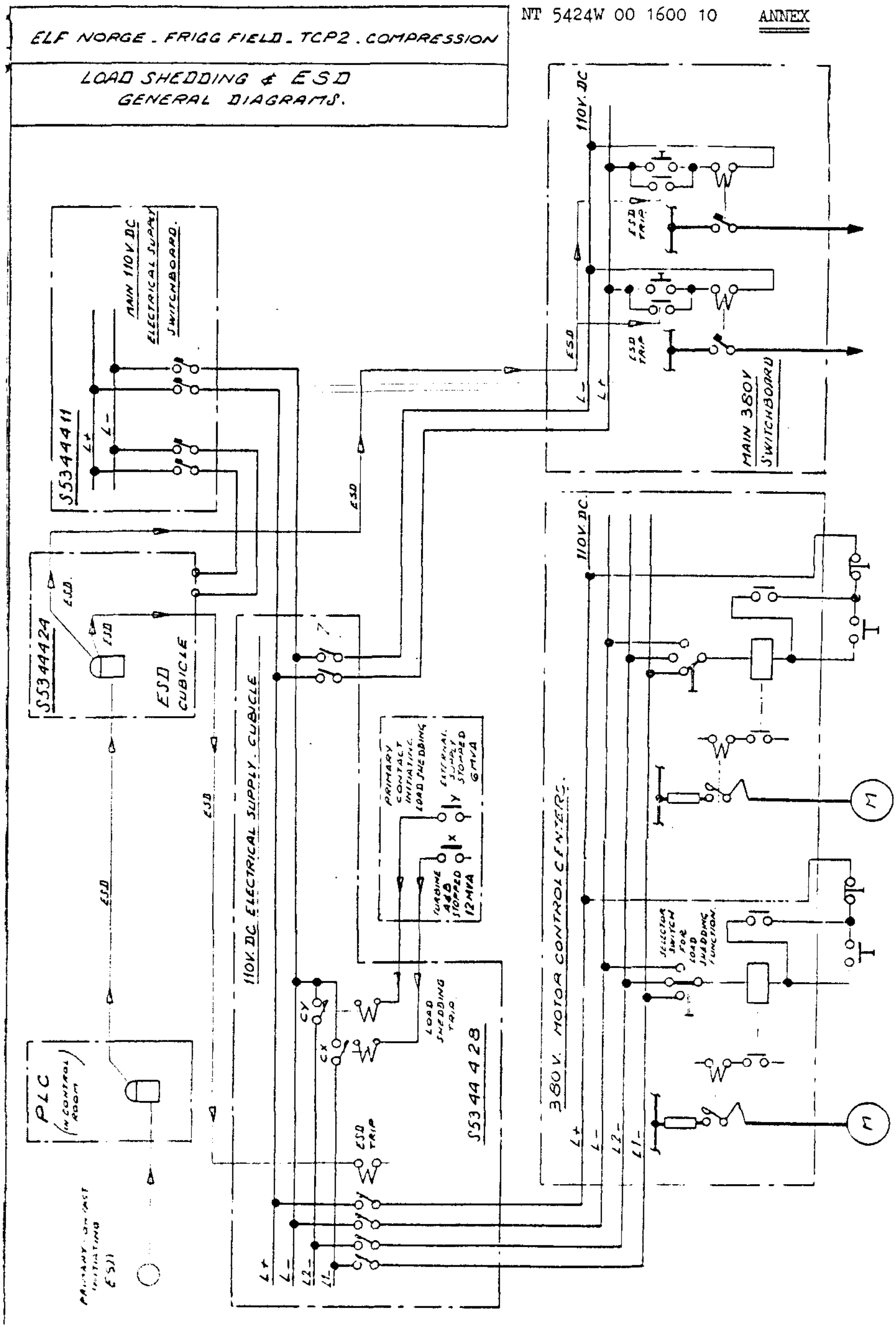


Fig. 9.3

9.4 Power Generation

9.4.1 Main Power Generation

Power generation for the Frigg Field will be performed by the two gas turbine driven generators 52G01A and 52G01B. STAL-LAVAL prime movers is described separately in Chapter 5.

Generator data:

- Make : ASEA
- Type : GTA 1125 CD, water cooled
- Serial nos : 8860.0001/0002
- Rating : 17,15 MVA
- $\cos \varphi$: 0,8
- Voltage : 5500 V ± 5%
- Frequency : 50 Hz
- RPM : 3000
- Insulation class : F
- Positive sequence
  - . Subtransient x"d : 20%
  - . Transient x'd : 25%
  - . Synchronous x d : 207%
  - x_o : 8,5%
  - x_z : 17%
- Nominal current : 1800 A
- Short circuit ratio : 0,54
- Time constant $T'd_o$: 5,3 s
- Time constant $T'd_z$: 0,58 s
- Type of voltage controller: ASEA FREA
- Exitation voltage : 42 V - 170 V

Design features of generating set:

- Gas turbine prime mover.
- Synchronous AC generator with direct connected brushless excitation equipment and controls.
- Flexible coupling between turbine & generator.
- Electric barring motor for the gas generator.
- Separated base plates for gas turbine unit & for electrical generator.
- Self-support module for the oil system.
- Self-supported module house for the governing oil & fuel system.
- Complete gas turbine enclosure with thermal acoustical insulation and ventilation system, including air ventilation filtration equipment, inlet & exhaust ducts for turbine enclosure ventilation system.
- Complete starting air system (ejector, piping & control).
- Complete oil system for gas turbine generator and its auxiliaries, including all interconnecting piping. All in stainless steel.
- Fuel gas system including twin filters and knock-out pot with manual and automatic drain; including all interconnecting piping and supported by its own skid.
- Air inlet filter house including bolts, filter frames, frame work, implosion doors with electrical tracing. All in stainless steel.
- Air inlet silencer & ducting. All in stainless steel.

- Complete marine, low velocity, high efficiency 4 stages air filtration system. All in stainless steel.
- Supporting structure for air inlet system.
- Complete stainless steel anti-icing system, in front of air filter.
- Gas exhaust ducting, including 23 meter vertical stack, silencer, and flexible joint. In stainless steel between exhaust turbine & silencer including the latter.
- Turbine heating system to prevent moisture condensation inside the turbine hood, during shut-down.
- Gas generator air compressor and gas generator turbine washing/cleaning devices.
- Thermal insulation including power turbine & exhaust casing heat insulation for person protection.
- Turbine enclosure gas detection system.
- Turbine enclosure fire protection system, including Halon bottles.
- Gas detection at turbine inlet and provisions for release of burner flame extinguishing medium upstream of turbine inlet (homogenous air water mixture).
- Fire and gas detection in turbine hood.
- All instrumentation installed and wired to junction boxes.
- Complete turbine oil & fuel governing systems, temperature control and protection system.
- Protective control and monitoring devices for AC generator.
- Shut down system.

- Ignition system.
- Grounding system.
- Panels for starting and control with assosiated relay panels.
- Axial displacement measurement devices for unit rotors.
- Electrical heaters with thermostat in the control cubicles.
- Electrical heaters with thermostat for lube oil system.
- Reactive load sharing device.
- Active load sharing device with automatic frequency adjustment.

9.4.2 Emergency Power Generation

Emergency power generation for TCP 2/C is performed by the Emergency Power Diesel Generator 53G01.

The SACM prime mover is described separately in Chapter 5.

The diesel generator set is capable of making a complete start-up and load take-over within 10 seconds upon loss of the mains voltage.

Design feature of generating set:

- Totally enclosed, externally cooled by room ventilation.
- Windings star connected with brought out neutral.
- Stand-still heater
- Roller type bearings
- Automatic voltage regulator (AVR) with manual adjustment. Static type with characteristic for reactive load sharing.
- Rotary exciter of brushless type
- Control and protection panel with necessary relaying

  Note: Safety shut-down permissible only on

  . overspeed
  . low lub. oil pressure
  . gas detection ventilation air inlet

9.5 Electrical Equipment

9.5.1 5.5 kV Distribution Switchboard

Tag no. : S.52.32.1.1
Maker : EGA-Oslo A/S
Design features:

- assembly of sheet steel cells, IP 205
- switchgear of draw-out prefabricated type
- cell types

cell types	Switchgear type:
. alternator incomer	ACB (Air Circuit Breaker)
. bus tie	ACB
. feeder outgoer/incomer	ACB
. transformer outgoer	Vacuum Contactor + Fuse
. induction motor outgoer ...	" " "
. voltage transformers	

- cell build-up
  - . fixed part with
    - + H.V. busbar compartment
    - + H.V. busbar connection compartment
    - + Housing compartment for moving part
    - + L.V. compartment
  - . mobile part with
    - + supply and load side contacts
    - + set of mobile shutters
    - + grounding devices
    - + locking system
    - + front door
- L.V. compartment
  - . protection relays
  - . auxiliary relays
  - . fuses for auxiliary circuit protection
  - . terminal block for connection of control and interlock cables

  - . meters
  - . push buttons
  - . signaling lamps
  - . selector switches
  - . branch circuit switches

- Ground busbar

Auxiliary circuits and sources are required for some of the H.V. circuits and are installed external to the H.V. Switchgear, comprising

  - . electric controls
  - . trip, in and out coils
  - . protection relaying
  - . auxiliary relaying
  - . signalling
  - . cell space heaters

Generally, services which require reliability and independence are supplied with

- 110 V DC
- 220 V AC

9.5.2 380 V Main Distribution Switchboard

Tag no : S.52.32.2.1

Maker : EGA-Bergen A/S

Design features:

- assembly of sheet steel cells, IP 205

- switchgear of draw-out prefabricated type

- cell types
  - . mains supply incomer
  - . bus tie
  - . feeder outgoer
  - . LV/LV transformer outgoer
  - . relaying
- cell build-up
  - . fixed part with
    - + guide rails for mobile part
    - + power input and output circuit contacts
    - + auxiliary circuit contacts
    - + grounding device for mobile part
    - + locking system preventing against unintended withdrawal
  - . mobile part with
    - + power stabs of connector system
    - + auxiliary circuit stabs of connector system
    - + grounding device
    - + disconnecting device
    - + H.R.C. fuses, if any
    - + Protection relays
    - + auxiliary fuses
- Ground busbar

Auxiliary circuits and sources are required for some of the circuits and are installed external to the switchgear, comprising

- . electric controls
- . trip, in and out coils
- . protection relaying
- . auxiliary relaying
- . signalling

Control voltage:

110 V DC
220 V AC

9.5.3 380 V Motor Control Centers (MCC)

Tag nos	: S.52.32.2.2 , MCC A
	S.52.32.2.3 , MCC B
Maker	: EGA-Bergen A/S

Design features:

- Same as for S.52.32.2.1, but in addition
  - . false front or door with
    - \+ control push buttons
    - \+ signalling lights
    - \+ isolation switch control
    - \+ meters
    - \+ same plate with cell item no
- Ground busbar
- External auxiliary circuits and sources comprising
  - . control circuits
  - . auxiliary relaying
  - . signalling circuits

Control voltage

110 V DC
220 V AC

9.5.4 380 V Turbo Generator MCCs

Tag nos : S.52.41.2.12 Turbogenerator A
S.52.41.2.13 Turbogenerator B
Maker : EGA-Bergen A/S
Design features:

- same as for S.52.32.2.2
S.52.32.2.3

9.5.5 380 V Fuel Gas Heater Distribution Boards

Tag nos : S.52.32.2.14
S.52.32.2.15
Maker : EGA-Bergen A/S
Design features:

- same as for S.52.32.2.2
S.52.32.2.3

The 240 kW cell also contains special equipment supplied by ACB, the supplier of the fuel gas heater package

9.5.6 Lighting and Power Distribution Boards

Tag nos : S.52.32.2.4, Lighting A
S.52.32.2.5, Lighting B
Maker : EGA-Bergen A/S
Design features:

- same as for S.52.32.2.2
  S.52.32.2.3
  however, no moving part.
- circuits, 220 V Ph+N, protected by miniature circuit breakers.

9.5.7 Power Transformers

Tag nos : T.52.32.1.9 Fuel gas heater trafo "A"
T.52.32.1.10 " " " " "B"
T.52.32.1.11 Main trafo "A"
T.52.32.1.12 " " "B"
Maker : CEM
Design features:

- Magnetic circuit grounded
- Dielectric liquid is mineral oil
- Copper windings
- Connection group Dyn 11
- Welded steel tank, ambient air cooled
- Conservator tank
- Voltage adjustment facilities by taps in steps of ∓ 2,5% of rated voltage
- Design for parallel operation

- Monitoring devices
  - . Dielectric level gauge
  - . Dial thermometer
  - . Buchholz relay; alarm and trip
  - . Thermostats; alarm and trip
- Sampling valve

Transformer Data:

Designations	T9 - T10	T11 - T12
- Maker	CEM	CEM
- Serie	ONAN	ONAN
- Dielectric	oil	oil
- Primary voltage	5 500 V	5 500 V
- Secondary voltage, on load on middle position	380 V	380 V
- Number of taps on primary side and range	5±2,5%±5%	5±2,5%±5%
- Rating	1 000 kVA	2 500 kVA
- Coupling symbol	Dyn 11	Dyn 11
- Neutral	brought out	brought out
- Short circuit voltage	5%	7%

9.5.8 380 V Main Emergency Distribution Switchboard

Tag no : S.53.44.2.6

Maker : EGA-Bergen A/S

Design features:

- Same as for S.52.32.2.1

9.5.9 380 V Emergency Diesel Auxiliary Switchboard

Tag no : S.53.44.2.7
Maker : EGA-Bergen A/S
Design features:

- Same as for S.52.32.2.1

9.5.10 Static Autonomous Power Unit

Rectifiers and Inverters

Tag nos : See page 9 .7
Makers : Both supplied by NIFE Inverter from Cyberex
Design features, rectifiers:

- Entirely static
- Convection air cooling
- Carging modes
  - . float (trickle)
  - . boost (manually)
- Static current limiter
- Ripple less than 0,1 % RMS
- Rectifiers, able to run in parallel
- Interlock with ventilation fans by interrupting of boost in case of ventilation failure

Design features, inverters:

- Entirely static
- Convection air cooling
- Thyristor inverter bridge
- Waveform smoothing devices

  - . reactance
  - . capacitor

- Distortion less than 3%
- Load power factor 0,5-1,0
- Frequency
  - . ∓ 0,5% by internal time base
  - . mains system synchronization

9.5.11 Static Interruptor

Tag no : SI.53.44.3.1

Maker : Supplied by NIFE from Cyberex

Design features: Same as item 9.5.10

9.5.12 110 V DC Electrical Supply Switchboard

Tag no : S.53.44.4.11

Maker : EGA Bergen

Design features: Same as for S.52.32.2.1

9.5.13 110 V DC Instrument Supply, Switchboard

Tag no : S.53.44.4.10

Maker : EGA Bergen

Design features: Same as for S.52.32.2.1

9.5.14 220 V DC Instrument Supply Switchboard

Tag no : S.53.44.3.9
Maker : EGA Bergen
Design features: Same as for S.52.32.2.1

9.5.15 Cubicle 18. Instrument Supply Distribution Switchboard

Tag no :
Maker :
Design features:

9.6. Consumers

9.6.1. Power Balance

The load balance for the whole network of Frigg Field is given in the following table:

Platform	Installed Load (kW)	Load in normal run (kW)	Power factor	Demand required (kVA)
TCP2-C	9580	6800	0.85	8000
TCP2-T	1700	900	0.85	1060
T P 1	1700	900	0.85	1060
Q P	1270	600	0.85	710
CDP 1	1700	350	0.85	410
D P 2	850	300	0.85	350
TOTAL	16800	9850	0,85	11590

For TP 1, TCP2-T, QP, CDP 1 and DP 2 platforms, the values of installed load correspond to the rated output of the corresponding transformers.

For all platforms, except TCP2-C, the values of "Load in normal run" given here above are the results of meter readings.

For the compression unit on TCP2-C platform, the values given here above correspond to the maximal consumption in case of:

- Phase IIIA
- Outlet gas temperature = 30^{o}C (The 50^{o}C mode requires less cooling capacity and will thus give more favourable figures.)

(NOTE: Above figures are taken from the SOCETEC Network Operation Notice and may be subject to revision according to EAN latest information.)

These values have been estimated by E.A.N. Ref. drwg. 5424W 00 1634 0001, Power Balance.

The load in normal run corresponds, for TCP2-C platform, to the following equipment:

- 4 sea water pumps (5.5 kV)
- 2 fresh water pumps (5.5 kV)
- 1 main 380 V distribution switchboard
- 2 fuel-gas heater switchboards

9.6.2 5.5. kV Pumps.

Due to the high power rating of the cooling water pumps, the motors are fed from the high voltage system.
Three pairs of pumps are normally available:

- 500 kW Sea Water Pumps
- 515 kW Sea Water Pumps
- 400 kW Fresh Water Pumps

Normally one pump of each pair is running with the number two pump in stand-by for automatic start in case of failure in the running pump.

9.6.3 Heating.

There are different kinds of heating consumers:

- Fuel gas heating
- Space heating
- Trace heating
- H & V heating.

The fuel gas heaters are connected to the fuelgas heating switchboard. The fuel gas heating is arranged in steps of 112 kW and are controlled by contactors.

Space heating are small heaters, normally less than 1 kW, connected to the heating switchboard A and B

S.52.32.2.18
S.52.32.2.19

Connection/disconnection by circuit breakers.

Trace heating (see paragraph 9.7) is also connected to the heating switchboards A and B

S 52.32.2.18
S 52.32.2.19

- Size normally 3-5 kW.
- Each circuit protected by earth fault protection device , 30m A.

Heating and ventilation heating elements are connected to local control panels, delivered by Norsk Viftefabrikk, fed from the 380V MCC A and B

S 52.32.2.2.
S 52.32.2.3

Connection/disconnection by contactor. Note that ventilation fan motors have their starter in MCC A and B.

9.6.4 Power.

Power consumers of capacity less than 132 kW are in general connected to the 380 V system. Typical consumers are

- pumps
- air compressors
- ventilation fans
- water makers

9.6.5. Lighting.

Lighting and small power convenient outlets are connected to the lighting distribution boards A and B, and Emergency Lightingswitchboard

S 52.32.2.4.
S 52.32.2.5.
S 53.44.2.8

9.6.4 Power.

Power consumers of capacity less than 132 kW are in general connected to the 380 V system. Typical consumers are

- pumps
- air compressors
- ventilation fans
- water makers

9.6.5. Lighting.

Lighting and small power convenient outlets are connected to the lighting distribution boards A and B, and Emergency Lightingswitchboard

S 52.32.2.4.
S 52.32.2.5.
S 53.44.2.8

Connection/disconnection by circuit breakers.

The lighting distribution boards are fed with 3 phase 380 V and Neutral. Each circuit is 220 V phase and Neutral.

There are two kinds of lighting distribution systems:

- Normal lighting
- Emergency lighting
  - . back up by emergency diesel generator
  - . life boat floodlights connected to 110V DC essential.

Normal lighting fixtures are fluorescent rapid start type. Some 50% of the normal outdoor lighting is equipped with 90 min. built-in battery back-up.

All emergency lighting fixtures are equipped with 90 min. built-in battery back-up. They are suitable for installation in Zone 1 areas. During normal operation of the platform <u>all</u> lighting fixtures are lit, i.e. the emergency lighting is architecturally and functionally integrated with the normal lighting system to form one complete lighting system in service.

Following lighting levels are adopted based on the IEC recommendations:

Location	Lux.
General illumination	35 - 75
walkways	35 - 75
stairways	35 - 75
control/technical rooms	550
offices/warehouses	550

9.7 Heat Tracing.

Tracing devices is designed to keep

- Fresh water distribution pipes at a temperature of 5°C.
- Oily water distribution pipe at a temperature of 5°C in valve 50 PCV 41-2.
- Instruments at a temperature of 25°C.

Power supply:

- 380/220 V AC 3-phase + neutral
- 110 V DC auxiliary source

Distribution:

- Feeders to local distribution panels from Heating Panels A and B.

  S 52.32.2.18
  S 52.32.2.19

  protected by circuit breakers with 30mA earth fault protection.

- Local distribution panels containing miniature circuit breakers with trip alarm contact for protection of local circuits.

Classification:

- Local distribution panels, Ex(d)
- Local distribution junction boxes, Ex(e)

9.8 Installation Materials.

9.8.1 Cables.

General

Specified voltages:
6.6 kV for high voltage cables
440/750 V for low voltage cables.
250 V for instrument cables.

Cross section minima:
1.5 mm^2 for multicore control cables
2,5 mm^2 for the power cables.

All cables are armoured to ensure continuous earthing. The armour consist of:

- galvanized steel wire braiding, or
- copper wire braiding, or
- phosphor bronze wire braiding or
- galvanized steel wire armour.

Fabrication Particulars.

Cable Type Al.

6000 V single wire armoured
- Conductor. Tinned copper stranded (circular)
- Conductor Screen. Semi conducting material
- Insulation. Ethylene propylene rubber EPR.
- Core screen. Semi conduction material and tinned copper.

- Bedding. PCP. Polychloroprene. Oxygen index 35%
- Armour. Copper wire braid.
- Sheath. CSP. Chlorosulphonated polyethylene. Oxygen index 35%

Cross section from 70 mm^2 to 400 mm^2

Colour of the outer sheath = black

Cable type A2

6000 V three core Armoured Non radial field type.

Conductor. Tinned copper stranded (circular).

Insulation. Ethylene propylene rubber EPR.

Filler. Hard non hydroscopic filler.

Bedding. PCP Polychloroprene. Oxygen index 35%.

Armour. Galvanized steel wire braid.

Sheath. CSP. Chlorosulphonated polyethylene. Oxygen index 35%.

Cross section

from 3 x 35 mm^2 to 3 x 185 mm^2

colour of the outer sheath = black.

Cable type B 1.

440/750 V Single Core Armoured.

- Conductor. Tinned copper stranded (circular)
- Insulation S 35 mm^2 EPR.
  S 50 mm^2 XLPE Crosslinked polyethylene.
- Bedding. PCP. Polychlorophene. Oxygen index 35%
- Armour. Copper wire braid.
- Sheath. CSP. Chlorosulphonated polyethylene. Oxygen index 35

Cross section

from 2,5 mm^2 to 400 mm^2

colour of the outer Sheath = black

Cable type B 2

440/750 V Multicore Armoured

- Conductor. Tinned copper stranded. S 35 mm^2 circular.
  S 50 " sectoral
- Insulation. $S \leq 35$ mm^2 EPR.
  $S > 50$ mm^2 XLPE.
- Filler. Hard non hydroscopic.
- Bedding. PCP Oxygen index 35%.
- Armour. Galvanized steel wire braid.
- Sheath. CSP. Oxygen index 35%

Cross section
3 x 2,5 to 3 x 240 mm^2
3 x 35 + 25 to 3 x 185 + 95 mm^2
colour of the outer sheath = black

Cable type B 3

440/750 V Multicore Armoured

- Conductor. Tinned copper stranded (circular)
- Insulation. EPR.
- Filler. Hard non hydroscopic.
- Bedding. PCP. Oxygen 35%
- Armour. Galvanized steel wire braid.
- Sheath. CSP. Oxygen index 35%

Cross section

2 x 1,5 to 37 x 1,5 mm^2
2 x 2,5 to 37 x 2,5 mm^2
4 x 4,10,16,50,150mm^2
5 x 4,10, 16 mm^2

Colour of the outer sheat = black.

Fire Resistant Cables

Instrument cables

Instrument cables are according to their application divided into different categories. The control room cables are flame retardent, whereas all field cables are fire resisting, the latter known as the BFCH "Flame-Flex" cables manufactured by Norsk Kabelfabrikk A/S.

Electrical Power Cables

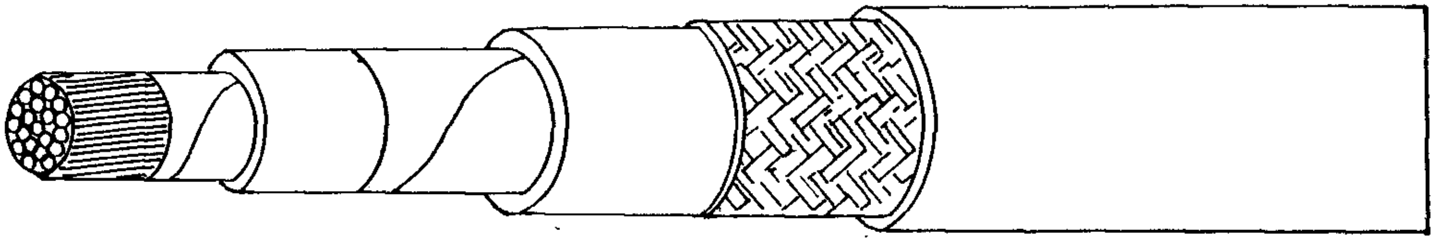
Supply to the Fire Pump Room is by "Flameflex" cables. Elsewhere routing of emergency cables is mainly through safe areas.

INSTRUMENT CABLES

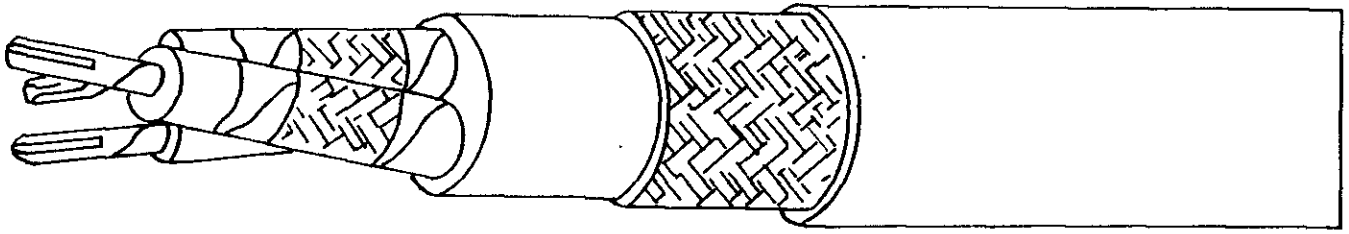
Category	Configuration	Screening	Service
2.1	Pair and multipairs	each pair screened	
2.2	triplets and multi-triplets	each triplet screened	
2.3	Quadruplets.	quadruplet screened	
2.4	Pair and multipairs	each pair screened	thermo couple extension
2.5	Multicores	overall screened	
3.1	Pair and multipairs	each pair screened	
3.2	Triplet and multitriplets	each triplet screened	
3.3	Quadruplet	guadruplet screened	
3.4	Pairs and multipairs	each pair screened	thermo couple extension
3.5	Multicores	overall screened	
4.1	Pair and multipairs	each pair screened	control room cables
4.2	triplet and multitriplets	each triplet screened	control room cables
4.3	quadruplet	quadruplet screened	control room cables
4.4	pair and multipairs	each pair screened	control room cables thermo couple extension
4.5	multicores	overall screened	
4.6	multicores	without screen	control room cables
5.1	pair and multipair	each pair screened	communication cables
5.3	quadruplet	quadruplet screened	communication cables

Categories 2.1,2.2,2.3,2.4,2.5 are flame retardant

Categories 3.1, 3.2, 3.3, 3.4, 3.5 are fire resisting



POWER CABLE 6kV SINGLE CORE (TYPE A1)



POWER CABLE 6kV MULTI CORE (TYPE A2)

Fig. 9.4

9.8.2 Cable colour, routing and segregation

Cabling can be distinguished in the following categories

- 5.5 kV cables
- Low voltage power cables
  - . Power,DC and AC
  - . Lighting
  - . DC and AC control
- Instrument cables
  - . Intrinsically safe
  - . Communication
- Emergency cables
  - . DC power
  - . Emergency lighting and power
  - . Emergency control

According to their service as listed above. Emergency and non-emergency cables are separated, and I.S. cables are separated from others by a physical barrier. The installation principles follow IEE 846-52 and NPD regulations § 11.2.3. (See Ch. 9.2.2).

In order to identify cables of different services, colour coding of all cables is applied.
The cables are coded according to the following scheme:

High voltage, power, lighting:	black
Earth cable:	green/yellow
Instrument & communication cables:	black
Intrinsically safe cables:	blue
Fire resistant cables	black/red.

The cable routing is segregated according to voltage and service on separate cable ladders and trays.
Following distances are aimed to be kept between electrical and instrument/signal/communication cables in order to minimise noise interference:

Power Wiring		Minimum Separation from Electronic or Signal Wiring.
125 V	10 amps	300 mm
250 V	50 amps	450 "
440 V	200 amps	600 "
6 KV	800 amps	1.400 "

For wiring of Intrinsically safe circuits, see § 10.2.

9.8.3 Cable ladders and trays.

Cable ladders are used for main cable routes and cable trays for secondary cables and instrument tubing. They are attached to supports welded to steel structure.
Ladders and trays are made of stainless steel.

Cables are maintained in position by clips.

Cable trays and ladders for high voltage cables are equipped with permanent warning signs.

9.8.4 Multi Cable Transits.

For all cable penetrations through bulkheads and walls multicable transits are used.

Manufacturer: AB Lyckeåborgs Bruk, Sweden.

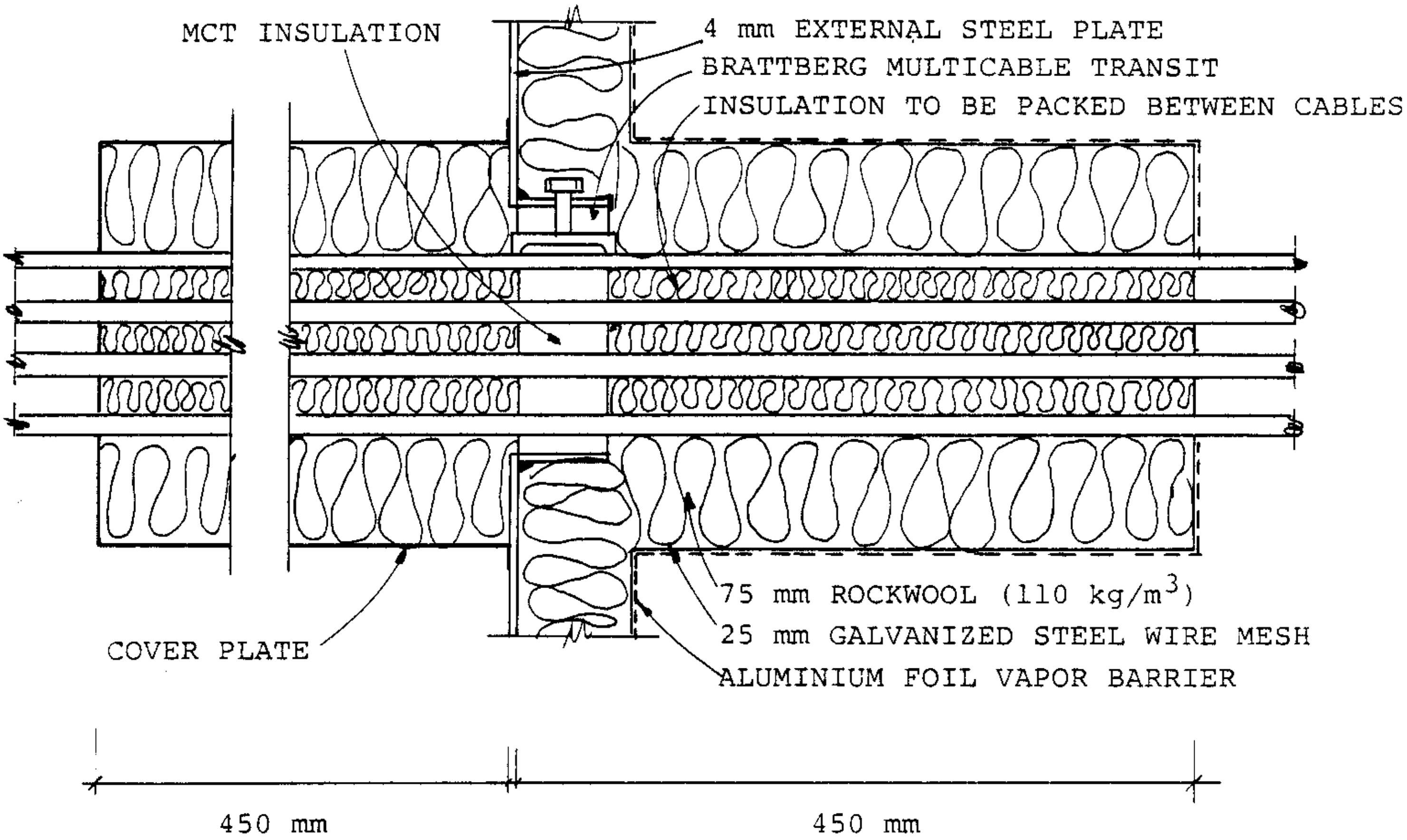
Type: RG S
RG SO

Manufacturer:	AB Lyckeåborgs Bruk, Sweden.
Type:	RG S RG SO

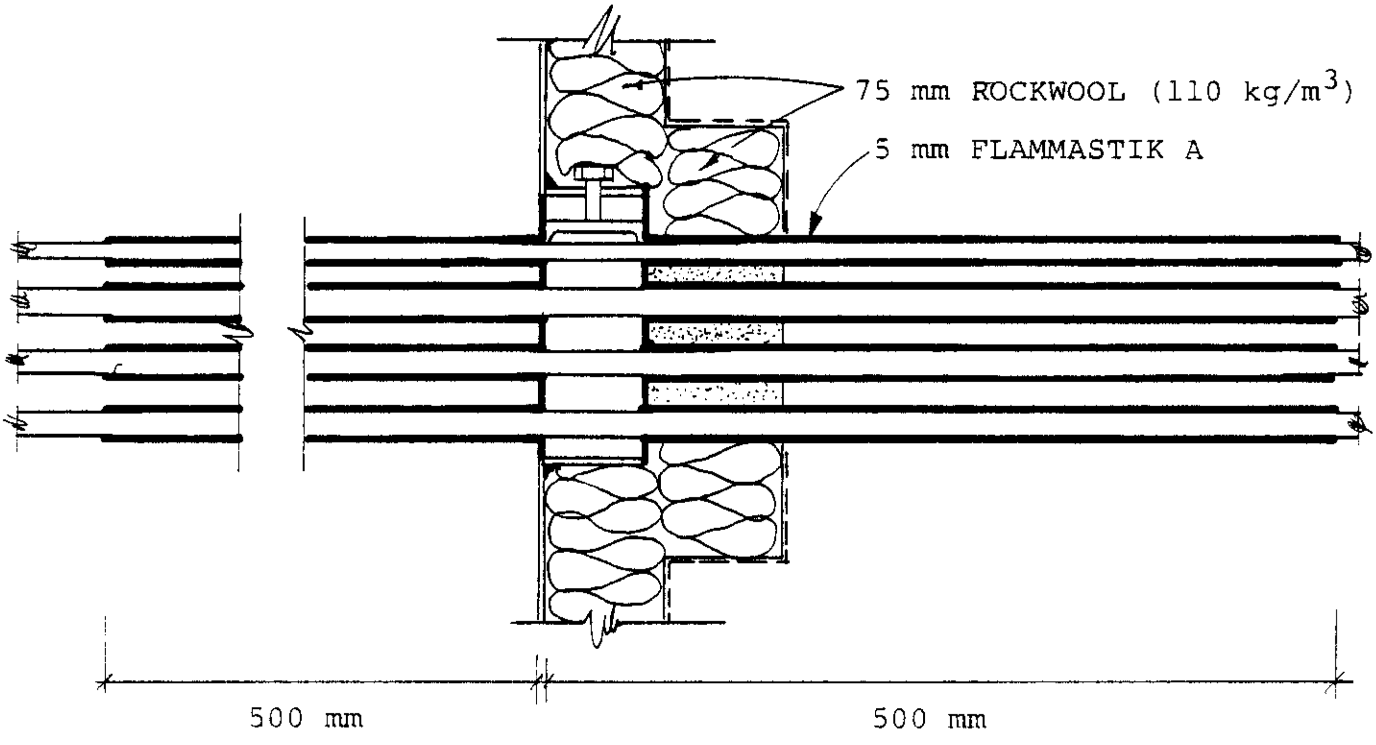
Installed and coated with Flamemastic the MCT is DnV approved for penetration in A-60 bulkheads.

Fig. 9.5

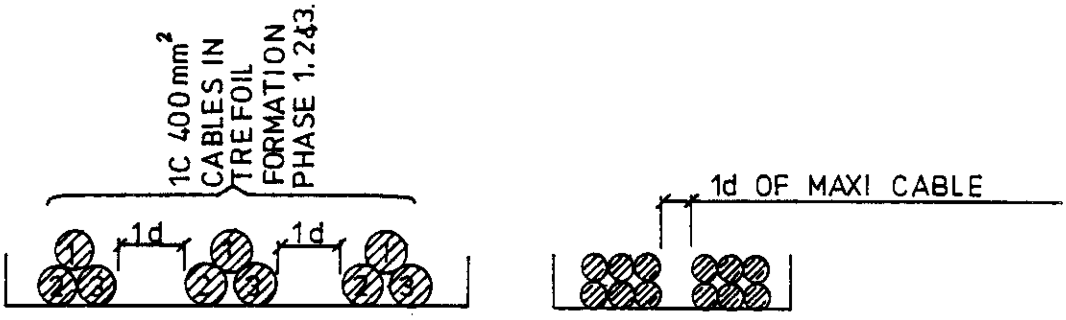
ROCKWOOL INSULATED CABLES



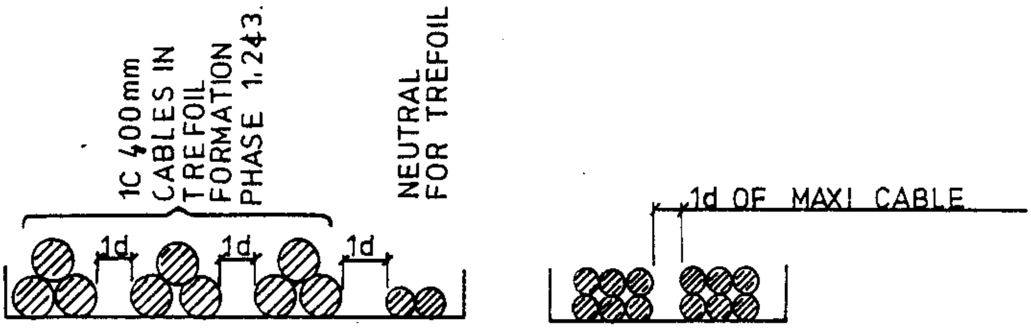
FLAMMASTIK INSULATED CABLES



5,5kV POWER CABLES



380V POWER CABLES



EMERGENCY & NON EMERGENCY POWER CABLES IN SEPARATE TRAY

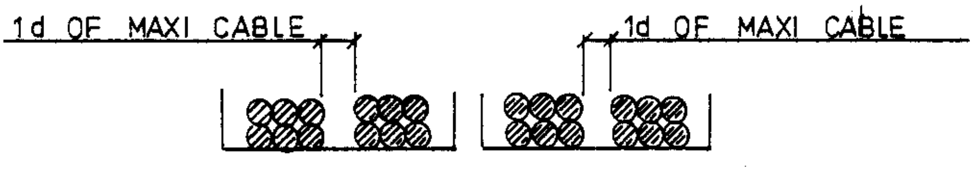


Fig. 9.6

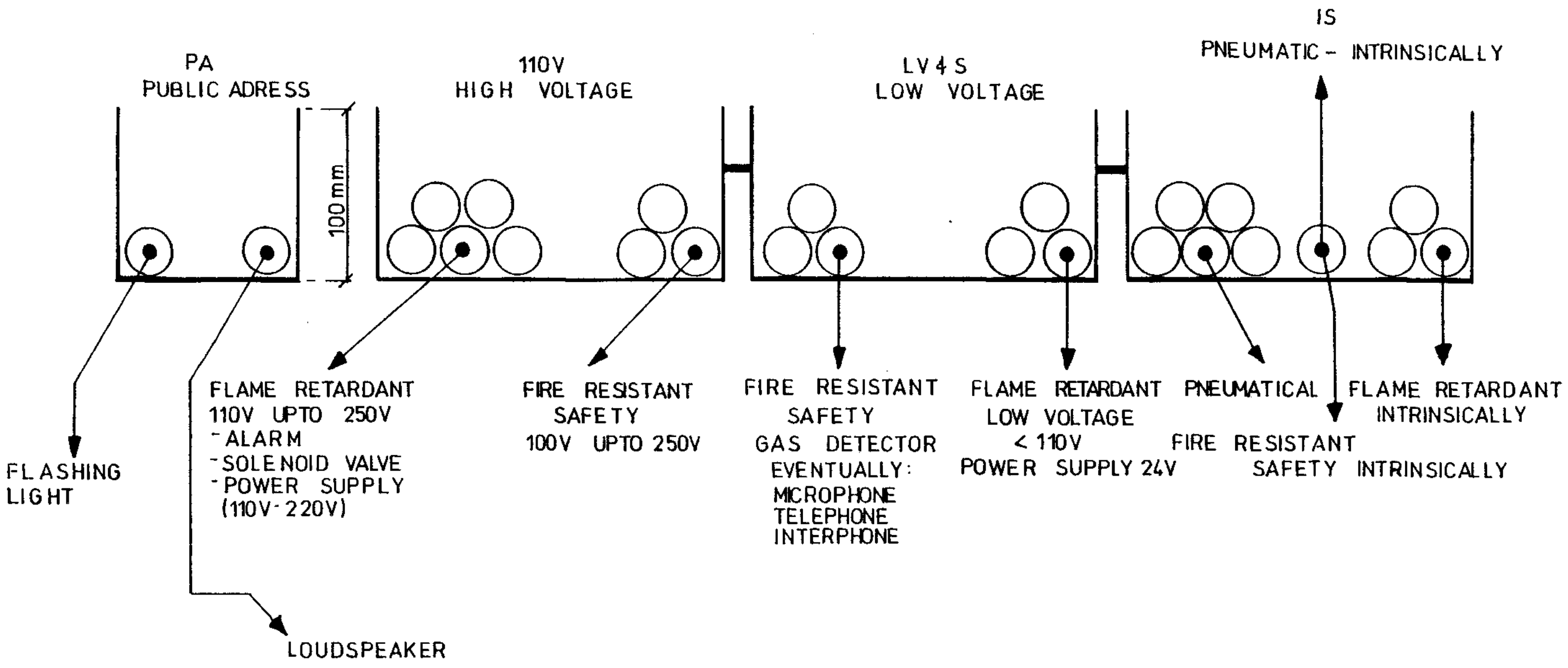

IS
PNEUMATIC - INTRINSICALLY
PA
PUBLIC ADRESS
110V
HIGH VOLTAGE
LV4S
LOW VOLTAGE
100 mm
FLASHING
LIGHT
FLAME RETARDANT
110V UPTO 250V
- ALARM
- SOLENOID VALVE
- POWER SUPPLY
(110V-220V)
LOUDSPEAKER
FIRE RESISTANT
SAFETY
100V UPTO 250V
FIRE RESISTANT
SAFETY
GAS DETECTOR
EVENTUALLY:
MICROPHONE
TELEPHONE
INTERPHONE
FLAME RETARDANT
LOW VOLTAGE
< 110V
POWER SUPPLY 24V
PNEUMATICAL
FIRE RESISTANT
SAFETY INTRINSICALLY
FLAME RETARDANT
INTRINSICALLY

Fig. 9.7

9.8.5 Junction boxes.

Junction boxes are of sturdy construction and classified for the areas in which they are installed, weatherproof IP 54, Exe.

Construction materials:

Power & Lighting : Stainless steel

Instrumentation : Stainless steel
Glass-fiber reinforced polyester.

9.8.6 Cable glands.

Most cable glands are by HAWKE

Threads are of metric type. However, some American equipment will have different cable glands.

For screened and braided cable installation practice is: (See also attached sketches).

1. Metallic junction box. Exe.
   With an industrial type gland braid is brought into the enclosure and terminated in separate terminal. Earth conductor brought out through separate gland and grounded.

2. Polyester junction box, or flameproof metallic.
   Braid is terminated in the gland with earth tag, which again is connected to the continuing cable's earth tag and grounded. (Hawke 501/453)

   In both cases the screen for each pair, triplet etc. is connected to separate earth terminals to form screen continuity from the outer end of the cabling through the junction boxes and terminated in the screen earth busbar which is connected to the main earth system at one end, but not the other, thus avoiding any current flow due to marginally different earthing potentials.

9.8.7 Tag Marking of Cores

Terminal numbers followed by terminal block numbers are marked on rings threaded onto the appropriate cable;

- on a yellow background for electric cables

- on a black background for instrument cables

Instrument cables are defined as those having voltages 48 V or less.

9.9 Earthing System

The 380 V distribution system is designed with the neutral point solidly earthed.
The neutral and the earth wire are connected in the neutral point of the secondary side of the power transformer.
Physically this connection is on the earthing busbar in the Main Distribution switchboard.

A main earthing ring made of 70 mm^2 earthing cable is fitted in each module and connected to the module earth busbar, which again are interconnected to other modules and the substation, to form a complete ring system. The earth cable is cleated to structural steelwork or run on existing cable racks.

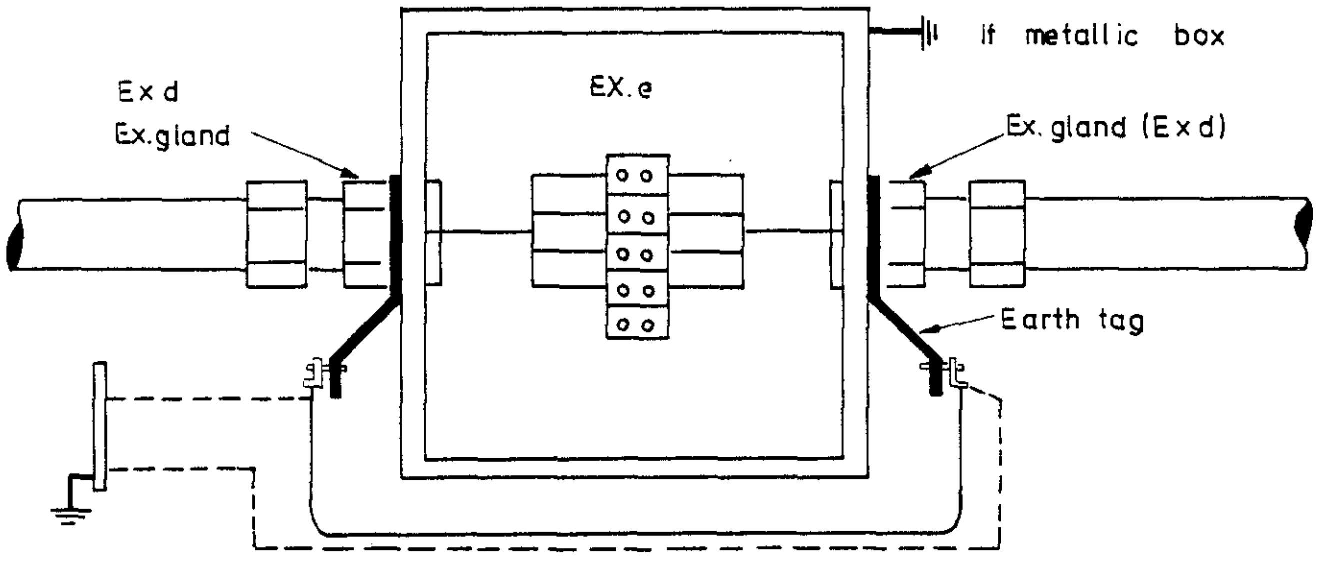
Following equipment is connected to the earthing system:

- Electrical switchboards, framework and doors (70 mm^2 in either end).
- Electrical motors and control stations (H.V. equipment by 70 mm^2).
- Power transformer frames.
- Lighting fixtures, outlets and connection boxes (by additional core).
- Electric cables, wire braid and/or screens
- Instruments located in hazardous areas.
- Cable ladders and trays.
- Pipe racks.
- Piping, with connection across flanges for continuity.
- Storage tanks and vessels.
- H & V ducting.
- Packaged or skidded equipment (2 points minimum).

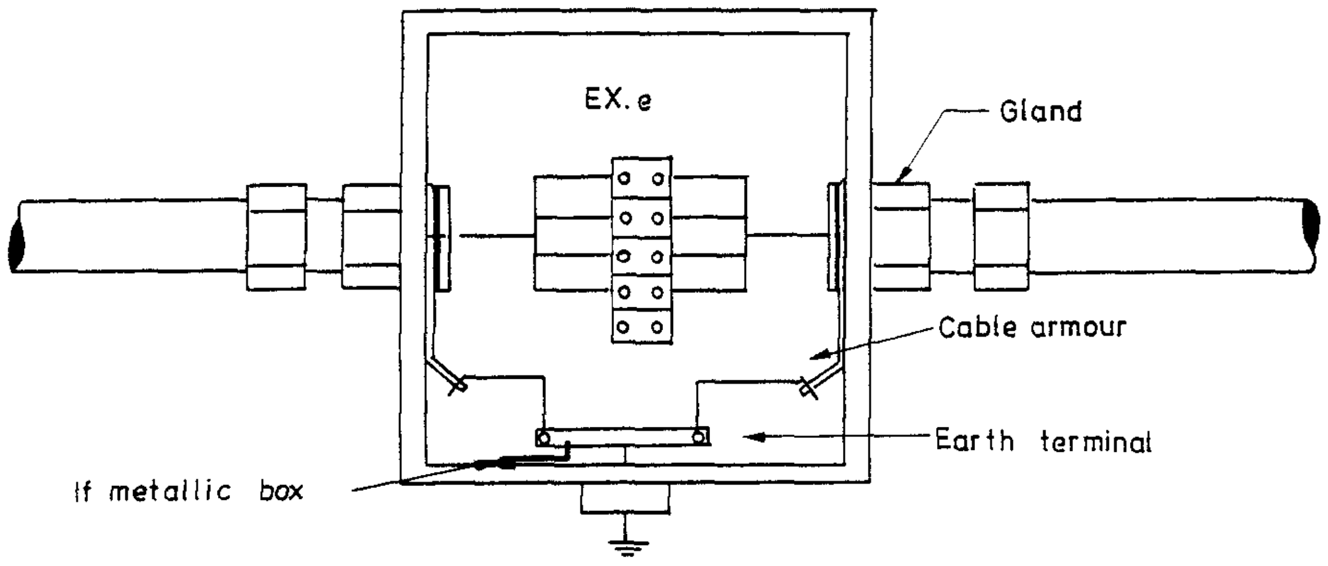
All subconnections off the main earthing ring are executed with 35 mm cable, connected with the Cadweld method to the main ring, and cable lug and bolt on the equipment side.

Special earthing cable manufactured by Norsk Kabelfabrikk is used for the earthing system.

The cable used for the earthing system is type PN-YELLOW/GREEN - PVC INSULATED manufactured by Norsk kabelfabrikk.



EXTERNAL EARTHING



INTERNAL EARTHING

Fig. 9.8

10. CONTROL

10 CONTROL

10.1 Electrical Supply

Instrument electrical supply is taken through power-distribution cabinet (item 18) in control room mod. 32 (For connection to main electrical supply, see fig. 9.2 Chapter 9).

Power distribution cabinet is supplying 220 V AC NE, 220 V AC E, 110 V AC NE, 110 V DC NE, 110 V DC E and 24 V DC NE.

10.1.2 Pneumatic Supply

Instrument air is taken from instrument and service air system (see chapter 4.2).

In control room, mod. 32, instrument air is distributed through air pressure reducer cabinet (item 48).

10.3.1 Hydraulic Supply

For description of hydraulic system see chapter 4.3.

10.2 Control Room

10.1.2 Description

The Compression Control Room, which is permanently manned, is installed in module 32. The control room is arranged with duplicated pressurization fans to provide 6 mm W.G. static overpressure, however, the control room is arranged to be safe in the event of pressure failure.

All control panels, cabinets and instrument power supply panels are installed in the control room, in addition to the operator´s control desk. Those systems upon which the safety of human life and protection of large equipment depends, is implemented by separate independant control systems. Control systems protecting vital equipment or safeguarding human life are on emergency power supply. If fail to safe action cannot be answered by e.g. spring return actuators the final control elements are equipped with back-up power from local accumulators. Controllers are generally situated in the control room, except for some turbogenerator controls in the Mezzanine room and local control loops as defined in section 10.3.6. All control functions are situated in the control room, except for some turbo generator controls in mezzanine floor and local field controls.

10.2.2 Control Room Equipment List

items 3A,B,C,D & E - Cabinets for bulkheads
item 4A - Utility panel - Heat and Vent. system, Instrument/service air system
item 4B - Utility panel - Sea/fresh water system, low press. vent. stack system
item 5A - ESD - panel
item 5B - ESD - cabinet
item 6A - Fire Detection Panel
item 6B - Gas Detection Cabinet
items 7 and 28 - Cabinets for pressure switches
item 8 - Process control panel (line A)
item 9 - Main control panel (line A)
item 10 - Process control panel (line B)
item 11 - Main control panel (line B)
item 12 - Process control panel (line C)
item 13 - Main control panel (line C)
item 14 - Mimic diagram for process
item 15 - Sequences for turbo compressor A
item 16 - Sequencer for turbo compressor B
item 17 - Sequencer for turbo compressor C
item 18 - Instrument power distribution cabinet
item 19 - Fuel gas Panel
item 20 - Cabinet for terminalblocks info Electro /Instrument
item 21 - Cabinet for converters (I/P) and power supply
item 22 - Operator control desk
item 23 and 27 - Cabinets for relays
items 24 A,B and C - Cabinets for blind instruments (Foxboro) Process part.

item 25 - Cabinet for blind instruments (Foxboro) Utility part
items 26 A and B - Cabinets for terminal blocks Utility part
item 29 - Cabinet for terminal blocks. Telemetry system
item 30 - Cabinet for blind instruments. Fuel gas system
item 31 A & B - Cabinets for terminal blocks. Process part
item 32 - Panel for seawater pump (Vibration)
item 32 A - Spare Cabinet
item 33 - Cabinet for relays - Heat and Vent. system
item 34 - Cabinet for relays and terminals - ESD and interlock system
item 35 - Cabinet for solenoid Valves
item 36 - Cabinet for solenoid Valves
item 37 - Cabinet for gas Monitor and Fire (Staal Laval)
item 38 - Cabinet for blind alarm sequencer
item 39 - Mimic diagram for fuel gas system
item 40 - Mimic diagram for fresh/sea water system
item 41 - Mimic diagram for ESD system
item 42 - Mimic diagram for Fire & Gas system
items 43 A & B - Working tables
item 44 - Blind panel for future equipments phase II
item 45 - Blind panel - Utilities
items 46 A,B,C, & D - Inclined top strip above panels
item 48 - Instruments air pressure reducers cabinet

Items for future installation

items 49 A,B & C	- Cabinets for blind instruments Process phase II
item 50	- Cabinet for blind instrument, Utility phase II
item 51	- Cabinet for Converters
items 52, 53, 54	- Cabinet for Compression phase II
item 55	- Cabinet for terminal blocks process phase II
item 56	- Cabinet for terminal blocks, Info Elect./Instr. phase II
item 57	- ESD Cabinet for phase II

10.3 Control loops

10.3.1 Principles

Following principles have been established for control loop design:

1) In hazardous areas pneumatic instrumentation is preferred, however, electronic (intrinsically safe, I.S.) or electric circuits are used in special cases. Signals requiring fast action are normally electronic or electric.

2) Instrumentation for remote control, presentation, alarm etc. in the control room is solid state.

3) ESD and blow down valves are either hydraulically or pneumatically operated via pneumatic pilot circuits.

4) Remote control instrumentation destined to initiate emergency shut down activities, and a few remote control process instrumentation signals are processed in one or other of the two P.L.C. units for appropriate shut down actions. The P.L.C. is briefly described in section 8.4.1.

The instrumentation is based on the principles described in the API RD 550.

10.3.2 Categories

Control loops for detection, control and shut down are

- pneumatic
- hydraulic
- intrinsically safe (I.S.)
- local pneumatic loops.

Following instrument categories have been adopted:

- Flow instruments
  - . Orifice plates and differential pressure transmitters
  - . Insertion turbine meters
  - . Flow recorders
  - . Flow controllers
- Pressure instruments
  - . Pressure switches
  - . Pressure controllers
  - . Pressure transmitters
  - . Pressure gauges
  - . Differential Pressure transmitters.
- Liquid level instruments
  - . Liquid level controllers
  - . Differential pressure level instruments
  - . Liquid level switches
  - . Gauge glasses.
- Temperature instruments
  - . Temperature controllers
  - . Temperature transmitters
  - . Temperature recorders
  - . Temperature indicators.

- Controllers
  - . Pneumatic controllers
  - . Electronic controllers
- Control valves and actuators
  - . Globe control valves
  - . Butterfly valves
  - . Spring opposed pneumatic diaphram or piston actuators
  - . Double acting piston actuators
  - . Direct acting positioners
  - . Pneumatic relays
  - . Pheumatic amplifiers.
  - . Relief valves.

10.3.3 Pneumatic Circuits

Pneumatic instrumentation is mainly used for local transmitters and switches for alarm-or on-off signalisation.

- smaller ESD - and blowdown valves (via local pneumatic pilot circuit)

Signal transmission to/from controlroom is via:

- pneumatic junction box and multitubing
- pneumatic signal processing, signals also derived via pressure switches for indications and alarms

or via

- pressure/voltage (or current) transmitter and multicore cables
- electronic signal processing

Pressure range: 3-15 psi
6-30 "

10.3.4 Hydraulic circuits.

Hydraulic circuits are used for actuation of ESD cut off valves (see ex. of loop).
Hydraulic pressure is maintained by the pump unit, and this pressure is maintained in the accumulators close to each ESD valve. The hydraulic actuator is governed by the pneumatic pilot. Local panels are arranged close to each ESD valve for

- pneumatic pilot
- pneumatic authorization for
- hand operating
- hydraulic control circuit

For description of hydraulic system, see Ch. 4.3.

10.3.5 Intrinsically Safe (I.S.) Circuits.

Intrinsically safe circuits are used for
- smoke detection system
- Measurement signals to indicators, recorders, controllers etc. in control room.
- See also section 10.3.1 chapter 2

A circuit is intrinsically safe when it is protected by a zener barrier. The zener barrier limits the electric energy present in the field wiring, thus avoiding sparking risk in case of cable rupture or other hazardous damage on the electrical installation.

Voltage limit: 20 V
Current limit: 24 mA

Zener barriers are installed in safe area or in flameproof terminal housings.

Where zener barriers have been applied in control circuits, the barriers are arranged and wired inside cabinets located in the compression control room, Module 32. Wiring is by braided and screened cables with blue outer sheath installed on separate cable trays. As the field wiring is I.S., flameproof terminal housings and enclosures are not required. To meet the protection requirements with regard to moist and dust, weatherproof enclosures are used in the I.S. control loop field wiring.

10.3.6 Field Circuits.

Local control loops are applied for
- level control in vessels and tanks
- closing ESD valves on excessive levels in vessels and tanks
- control of pressure in line
- control of flow in line

All field circuits are pneumatic

10.4 Telemetry.

Major process control, alarm and indication signals from TCP 2-C are routed to QP control room via the telemetry system located in the north-west corner of the TCP-2 platform. Relay marshalling cabinets and signal converters are arranged in the compression Control Room. Signals are transferred by multicore cable to the telemetry interface room and transmitted to QP via the CETT telemetry system. The connection to QP comprises a multi-channel link transmitting the information as electrical digital data on a time-shared basis, scanned by multiplexer.

Following signals are transferred between QP and TCP 2-C:

10.4.1 From QP to TCP 2-C.

- Shut down 1. level
- Shut down 2. level
- Shut down 3. level Compression
- Shut down 3. level Compressors
- Fire water pump A: Manual start
- Fire water pump B: Manual start
- High pressure at pipe from TP.1

From TCP 2-C to QP.

- Compressor A/B/C/:
  - . outlet pressure and temperature after cooler.
  - . run/stop/fault.
  - . outlet high pressure.

- Compression lines:
  - . High temperature
  - . very high temperature
  - . Hand Valves' position
  - . ESD valves' position

- Separator high level:
  - . lines A, B and C - and to TP1 & TCP2 treatment

- Fuel gas system:
  - . Temp. Press. and volume flow - on/off/faults

- Fire or gas detection fault
- Fire detection
- Gas detection
- Water discharge
- Halon discharge
- Fire water pump A/B
  - . run
  - . on demand
  - . fault
  - . power supply failure
- Air compressor A/B
  - . on
  - . off
- Shut down initiated:
  - . 2.level in compression area
  - . 3.level compression, in compression area
  - . 3. level compressors, in compression area
  - . line A
  - . line B
  - . line C

10.5 Visualisation. Mimic panels.

In order to facilitate the operators' task in supervising the compression process, mimic panels are arranged in QP and compression Control Room.

Mimic panels are provided for:

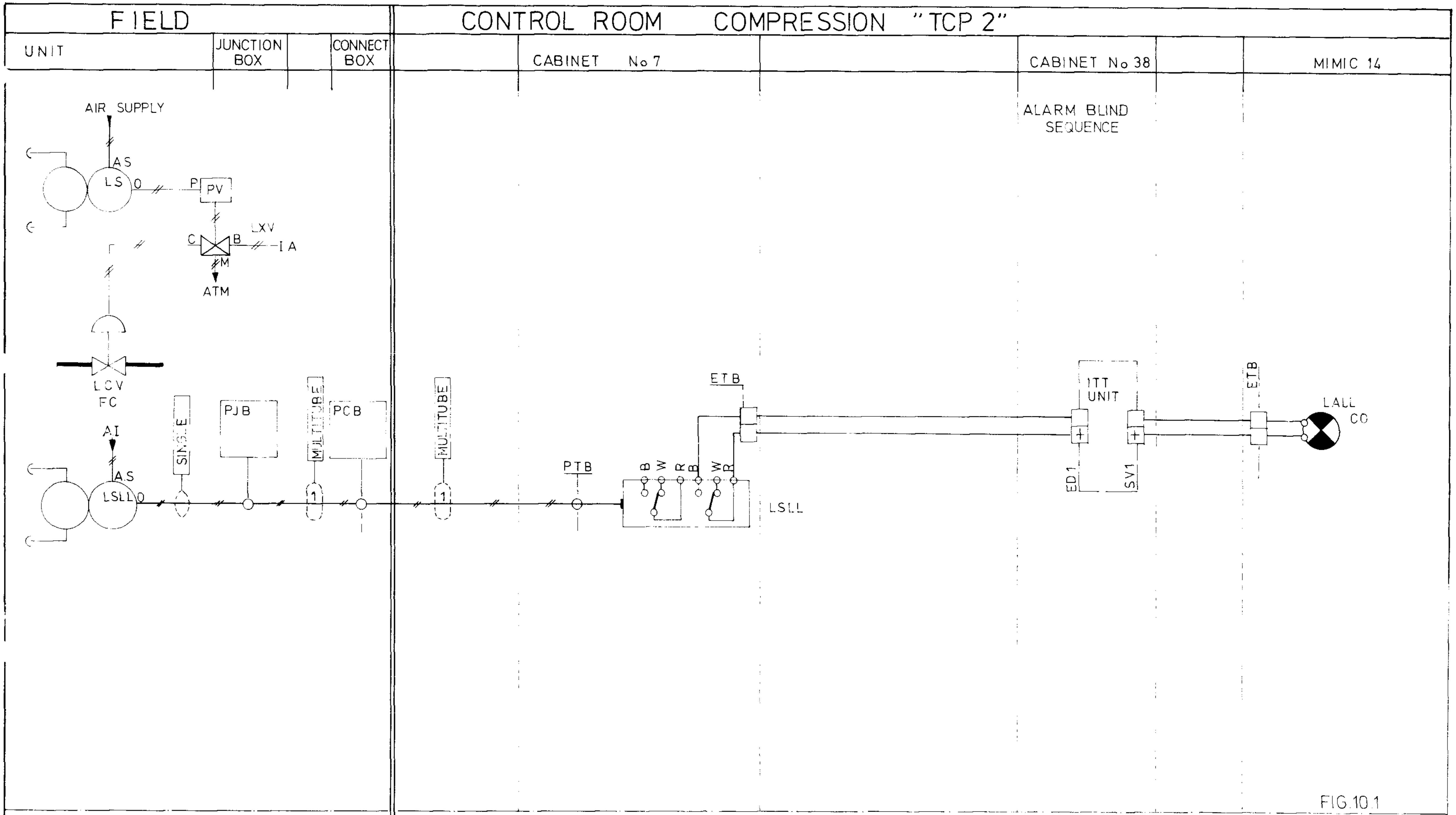
- Compression lines A/B/C
- Fuel gas system
- Fire & Gas detection
- Sea & Fresh cooling water system

Displaying:

- Main flow lines
- Temperatures
- Pressures
- Flow rates
- Valve positions
- Excessive liquid levels in tanks and vessels
- State of rotating machinery
- Areas where fire and gas has been detected.
- Initiated shut downs.

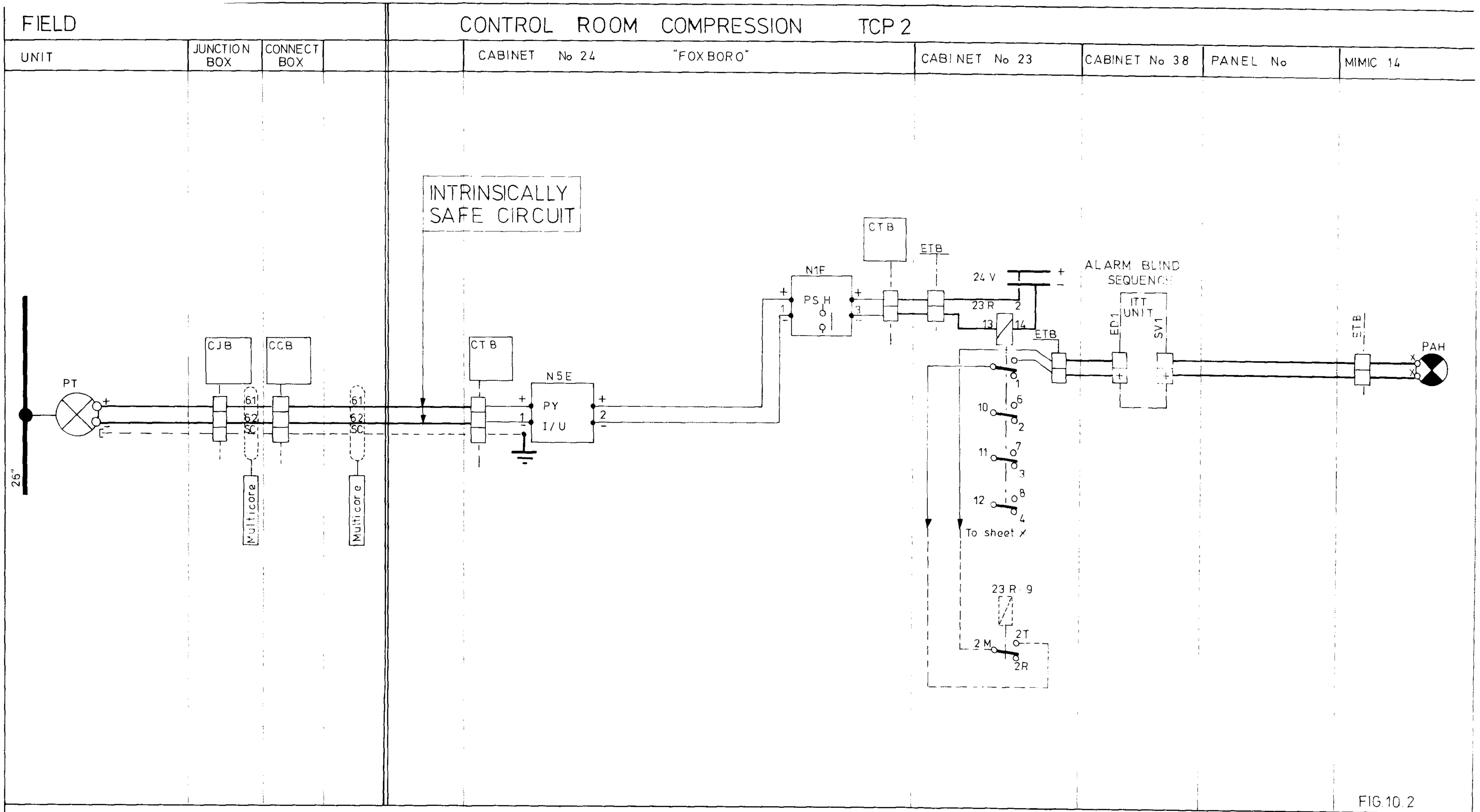
The mimic panels in Compression Control Room are located on top of the corresponding system's panels, extended up to the suspended ceiling at a 20 degree inclination.

Wiring goes through terminal block behind the mimics to the panels below. All wiring is single core cables.



CONTROL LOOP DIAGRAM

FIG.10.1



CONTROL LOOP DIAGRAM COMPRESSION

FIG. 10.2

CONTROL LOOP DIAGRAM
COMPRESSION

FIG 10.3
ESDV

ELF NORGE - FRIGG FIELD - TCP2 - COMPRESSION
KVAERNER - TECHNIP TCP2

FIG 10.3

10.6 Foxboro spec. 200 system

Foxboro spec. 200 system is used in control room module 32. It is an intrinsically safe system.

Spec. 200 system has a display area and a nest/rack area. These areas can either be in the same panel or separated in two different panels. Each displayunit is connected to a nest/rack unit by a standard 30 cores system cable. A power supply module deliver power to a number of nests. Each nest consists of one power distribution module and up to ten cards.

Spec. 200 system consists of 3 different groups of cards: input cards, function cards and output cards.

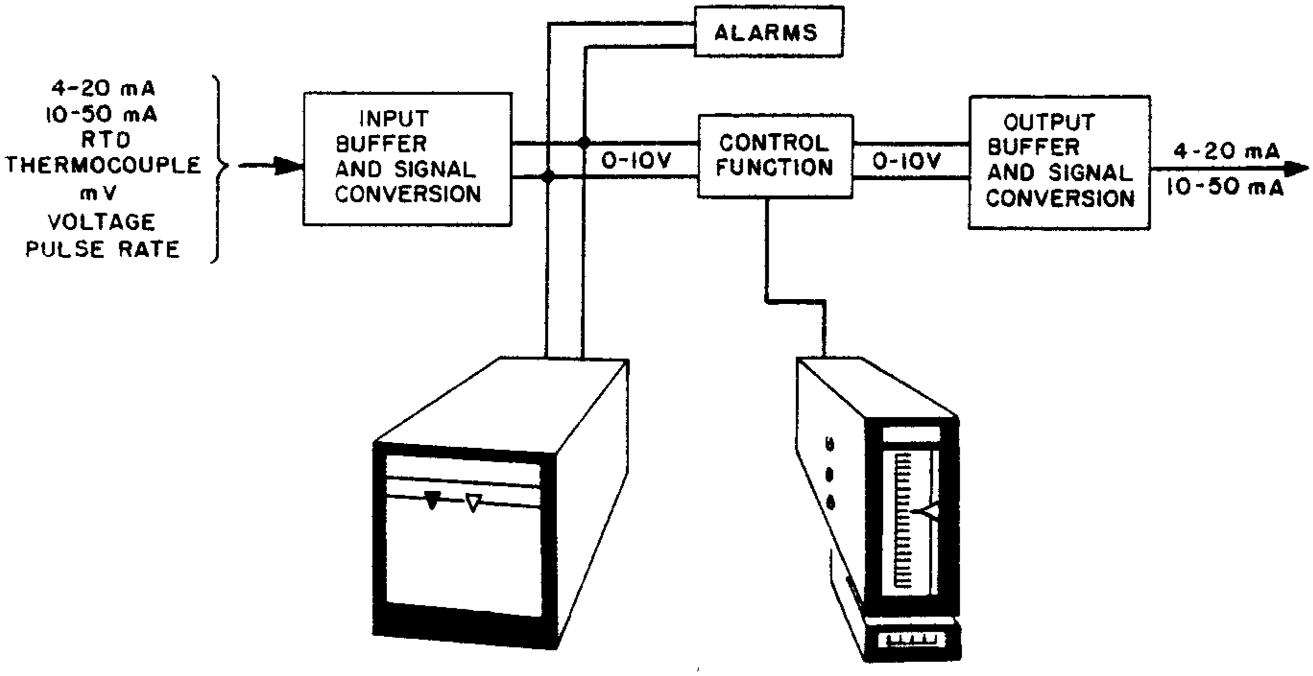


Fig. 10.4

The field circuit (from the local instrument to the input card) is intrinsically safe. Local instruments can be transmitters transducers, thermocouples, resistance bulbs etc. The input card is combined in a specially designed nest, - a PTB nest. Analog input signals from the local instruments are converted in the input cards to 0-10 VDC system signals. From the input card the signals are distributed to the function cards, which can have alarm-, control- or computing functions. From the function cards signals go to the display, alarm or to output cards. As the output signals are intrinsically safe, the output cards are mounted in PTB nests. The output signals are, in the output card, converted from 0.10 Vdc signal to mA signal.

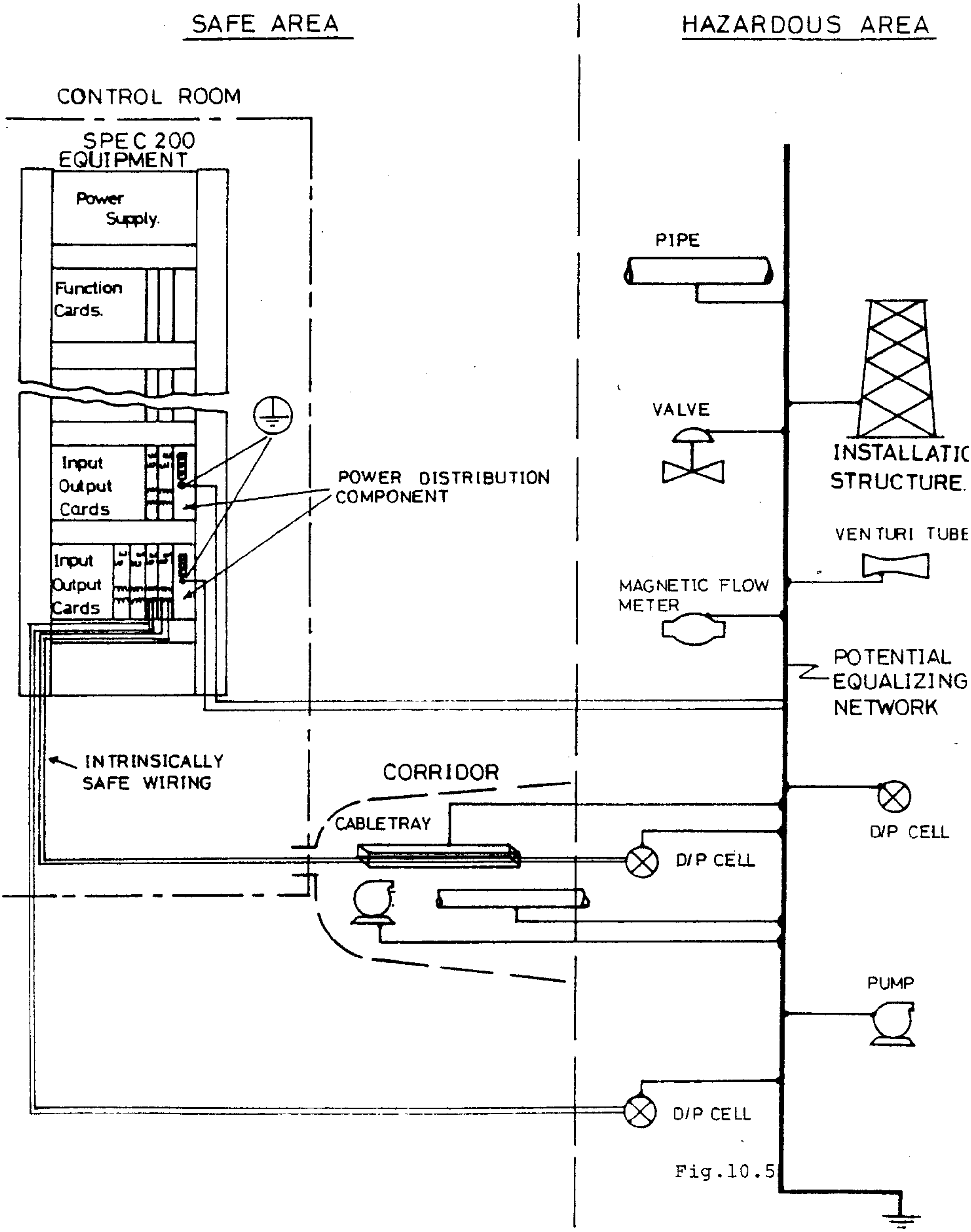

SAFE AREA
HAZARDOUS AREA
CONTROL ROOM
SPEC 200
EQUIPMENT
Power
Supply.
Function
Cards.
Input
Output
Cards
Input
Output
Cards
POWER DISTRIBUTION
COMPONENT
INTRINSICALLY
SAFE WIRING
CORRIDOR
CABLETRAY
D/P CELL
D/P CELL
PIPE
VALVE
INSTALLATI
STRUCTURE.
VENTURI TUBE
MAGNETIC FLOW
METER
POTENTIAL
EQUALIZING
NETWORK
D/P CELL
PUMP

Fig.10.5

11. PASSIVE FIRE PROTECTION

11. PASSIVE FIRE PROTECTION

In accordance with the regulations certain areas of the modules are separated by partitions in order to obtain the required classification.

The partitions are rated according to the requirements from SOLAS.

The list below indicates where the various partition types are used, these are also indicated in the area classification draw.in sec. 7.

Module 30 (Compression cubicle)	Gastight
Module 31 (Compression cubicle)	Gastight
Module 32	
HVAC room	A60
Control room	A60
Substation	A60
Transformer room	A0
Workshop	Gastight
Module 33 (Compression cubicle)	Gastight
Pancake 41	A60/Gastight
Pancake 42	
- Fire pump room	A60
Pancake 44	A60/Gastight
Pancake 45	Open cladding
Pancake 46	
- Fire pump room	A60

11.1 Exterior Walls

SOLAS A60 Walls

A 60 walls have a basic structure of minimum 4 mm steel plate stiffened at regular intervals, the external 4 mm plate skin being welded, continuous and water and gas tight.

The steel is insulated internally with 75 mm Rockwool of density 110 kg/m^3, the mats being covered by 25 mm hot-dipped galvanized wire mesh and fixed back to the steel plate by 3 mm Ø steel pins and clips. The thickness of insulation covering steel stiffening angles and channels is reduced to 25 mm. An aluminium foil vapor barrier of type 'Alu-kraft' or equal approved with taped and sealed joints is bonded to the insulation so as to provide an effective, continuous barrier against water vapor.

Internal mechanical protection of the insulation is provided by corrugated steel sheeting, type 'Robertson versacor BR 45.

SOLAS A-0 Walls

Walls classified as being SOLAS A-0 rated consist of a continuous welded steel plate skin of minimum thickness 4 mm. Where additional accoustic insulation is required, this is 25 mm Rockwool of density 45 kg/m^3 placed between steel stringers. Where thermal insulation is required, this is 50 mm Rockwool of density 45 kg/m^3 placed between and over steel stringers.

An aluminium foil vapor barrier of type Alu-kraft or equal approved sealed with tape is bonded to the insulation to give a continuous and effective barrier to the passage of water vapor.

Gastight Walls

All gastight rated outboard walls (those walls facing the sea where no SOLAS A-60 or SOLAS A-0 ratings are required) are constructed from 2 mm thick stainless steel corrugated sheeting.

The stainless steel is of quality Z2 CND 17/13, panel widths to be 980 mm with 61,5 mm corrugations and one continuous panel to cover the height specified. The cladding panels are continuously welded to each other on the sides and to stainless steel profiles on the ends which in turn are continuously welded to upper and lower truss chords.

All gastight rated inboard walls (those walls not facing the sea) are minimum 4 mm stiffened steel plate similar to that specified for SOLAS A-0 rated walls.

Non-rated cladding

Non-rated cladding is identical in all respects to the stainless steel cladding described above in section with the exception that the cladding is stopped at the top to allow a clear opening of 600 mm and at the bottom to allow a clear opening 300 mm in order to provide free ventilation.

11.2 Roof and Floor

The roofs and floors with SOLAS rating are constructed similar to the walls with identical rating.

11.3 External Doors

Doors are delivered by Hellbergs Industrier A/S, and fixed so as to comply in every respect with the manufacturer's instructions in order to satisfy the applicable SOLAS requirements.

SOLAS A-60 rated

Doors are as described above have door leafs to SOLAS A-60 certification. Door frames are continuously welded to the structural steel plate and provided with securely fixed sealing gaskets.

SOLAS A-0 rated

Doors are as described above except that the door leaf need only to have SOLAS A-0 certification.

Gastight

Doors are as described above except that the door leaf need only to have F-class certification and asbestos sealing gaskets may be substituted with neoprene.

Non-rated

Doors are as described above except that the frame in this case may be bolted or spotwelded to the structural steel plate and no sealing gasket is required.

11.4 Interior Partitions

Internal walls with a SOLAS A-rating are identical in every respect with those walls described in section 10.1 except that where the partition divides two areas which are both heated, the vapor barrier may be omitted.

Gastight

Internal gastight walls are comprised of 4 mm stiffened steel plate continuously welded along all sides.

SOLAS B-15 walls and ceilings

In the control room and wherever specified on the architectural drawings, the internal walls and the internal lining for the external walls are comprised of rigid walls elements of approximate size 900 x 3010 x 50 mm thick of type 'Isolamin 33B' as manufactured by Norrbotten Stål A/S.

B-15 rated ceilings in the control room and wherever specified on the architectural drawings, consist of 0,7 mm profiled steel sheets linked to form a continuous ceiling as manufactured by 'Daempa' type 308.

11.5 Interior Doors

SOLAS A-0 rated

Doors are identical to those described in section 10.3 but without weatherstripping except in pressurized areas.

Gastight

Doors are similar to those described in section 10.3.

Non-rated

Doors are similar to those described in section 10.3 without weatherstripping.

SOLAS B-15 rated

Doors in the 'Isolamin' internal partitions are supplied by the wall supplier and fully compatible with the panel system.

11.6.2 Piping penetrations

Where pipes penetrate SOLAS A-60 constructions, they are seal welded to the external steel plate in order to achieve gastightness. The pipes are insulated over a distance of 450 mm in from the external steel plate, and anchored on one side of the penetration to assure that no stress is placed on the welded connection.

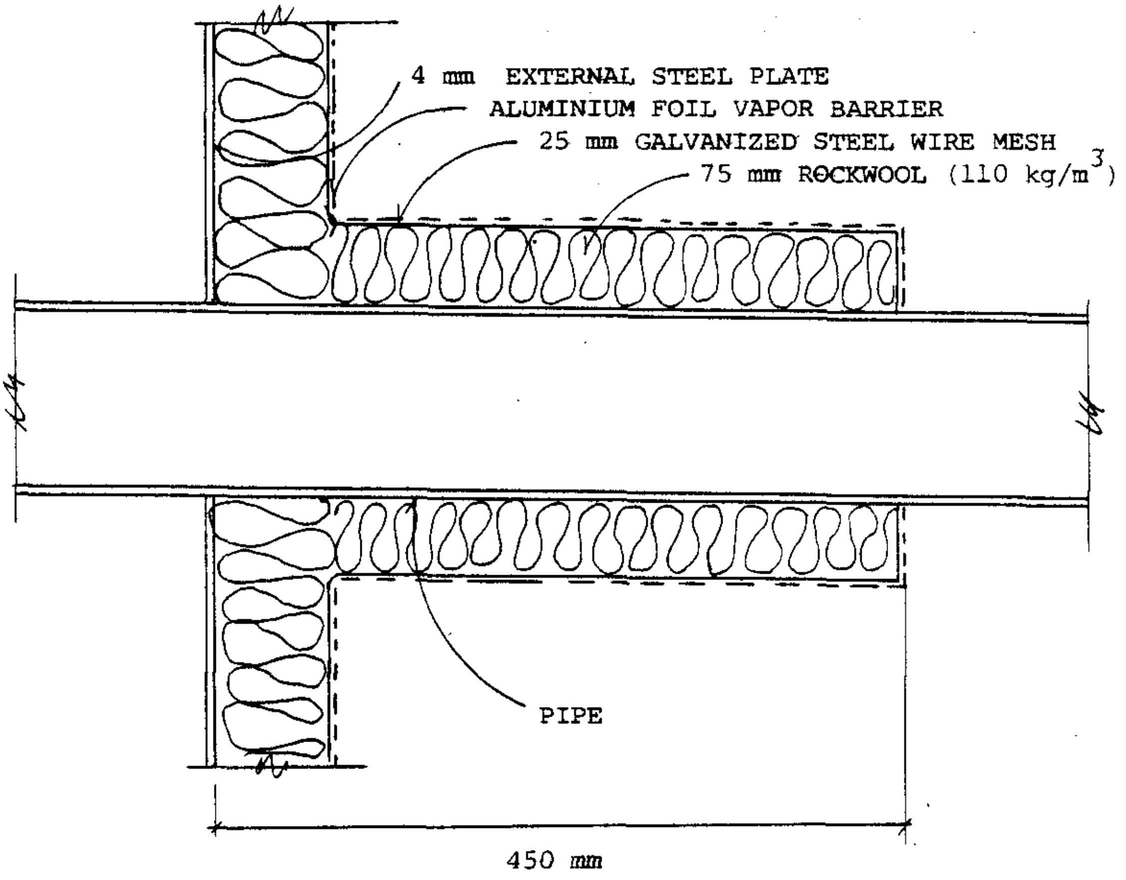


FIG. 11.2

Where movement is such that there can be no welding, the pipe is sealed externally with Bestobell Microflex fire seal.

According to DnV recommendations the securing clips (A60 side) are protected by "Flamestic 71A" sprayable (3-5mm).

For A60 penetration with Bestobell Microflex two Bestobell fire seals are installed as shown on fig. hereafter.

11.6.2 Piping penetrations (continued)

A60 penetration with Bestobell Microflex fire seal.

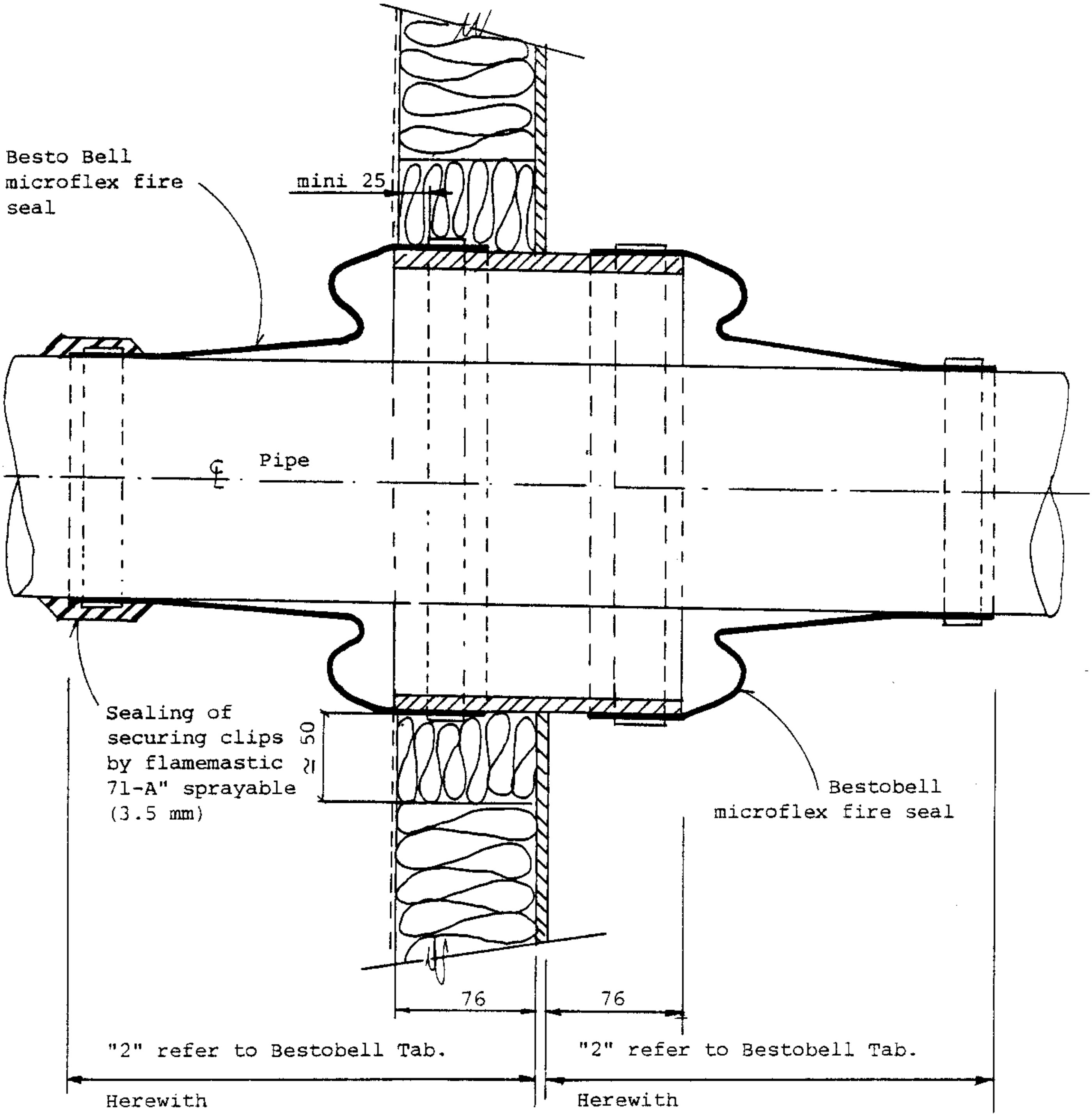


Fig. 11.3

11.6.3 Electrical penetrations

The cables go through an internal insulated Multicable Transit of type RGS which is welded to the non-hazard side of the external steel plate. 75 mm of Rockwool of density 110 kg/m^3 is applied to the MCT frame and to the penetrating cables for a distance of 450 mm on each side to the bulkhead.
Alternatively, Rockwool insulation may be substituted with Flammastik A insulation sprayed to a wet thickness of minimum 5 mm over the MCT frame and the penetrating cables for a distance of 500 mm on each side of the bulkhead, see sketches section 9.8.4.

12. VENTILATION AND PRESSURIZATION

12. VENTILATION AND PRESSURIZATION

In order to keep the interior of the modules and pancakes in accordance with the requirements of the I.P. Code for area classification as mentioned in section 7.1, the areas have to be ventilated. This means that certain areas are kept at an over- or under pressure and that a minimum of airchanges are required.

The air for all ventilation purposes is taken from the safe area outside the rooms. In all cases a main and standby A.C. fan are provided. If the ventilation should fail, or gas or fire is detected, the firedampers will close and the fans shut down. Ventilation failure is detected by flow switches. If the main fan fails the standby carries on automatically and an alarm will flash.

In some instances where it is important to maintain ventilation after failure of main power supply, emergency standby fans operating on the DC supply are installed:

- Stal-Laval gasturbine hood
- control room
- fire pump rooms

MODULE 32

HVAC room

The room is ventilated to safe classification, and Zone 1 when ventilation is shut down. Ventilation is by a unit with two fans, one running and one standby, which supplies air to the HVAC-room and substation. Each fan has a capacity of 15500 m^3/h. Of this 2500 m^3/h is routed to the HVAC room and gives min. 12 airchanges/h at 6 mm Wg. overpressure.

Transformer rooms

The two transformer rooms are ventilated from a fan unit with two fans, one running and one stand-by. Each fan has a capacity of 7000 m^3/h, 3500 m^3 to each room. Minimum 12 airchanges/h, but no pressurization is required. When ventilation is running the rooms are classified as Zone 2, and Zone 1 when ventilation is shut down.

Substation

The room is ventilated from the same system as the HVAC room with 13000 m^3 air/h. Requirements; i.e. minimum 12 airchanges/h at 6 mm Wg overpressure. The room remains 'safe' without ventilation.

Control room

The control room is fully airconditioned. Two fans in parallel, one running and one spare each 12000 m^3 air/h to give minimum 12 airchanges/h at 6 mm Wg overpressure. The spare fan is equipped with DC motor to work from the emergency supply.
The air conditioning system is designed to keep the temperature within 20 to 23°C at 45 to 55% relative humidity. The room is 'safe' without ventilation.

Workshop

Ventilated by two fans in parallel to achieve safe area classification. One fan on duty, one spare. Each fan has a capacity of 3500 m^3/h to give minimum 12 airchanges/h at 6 mm Wg overpressure. The air is heated to maximum 25°C.

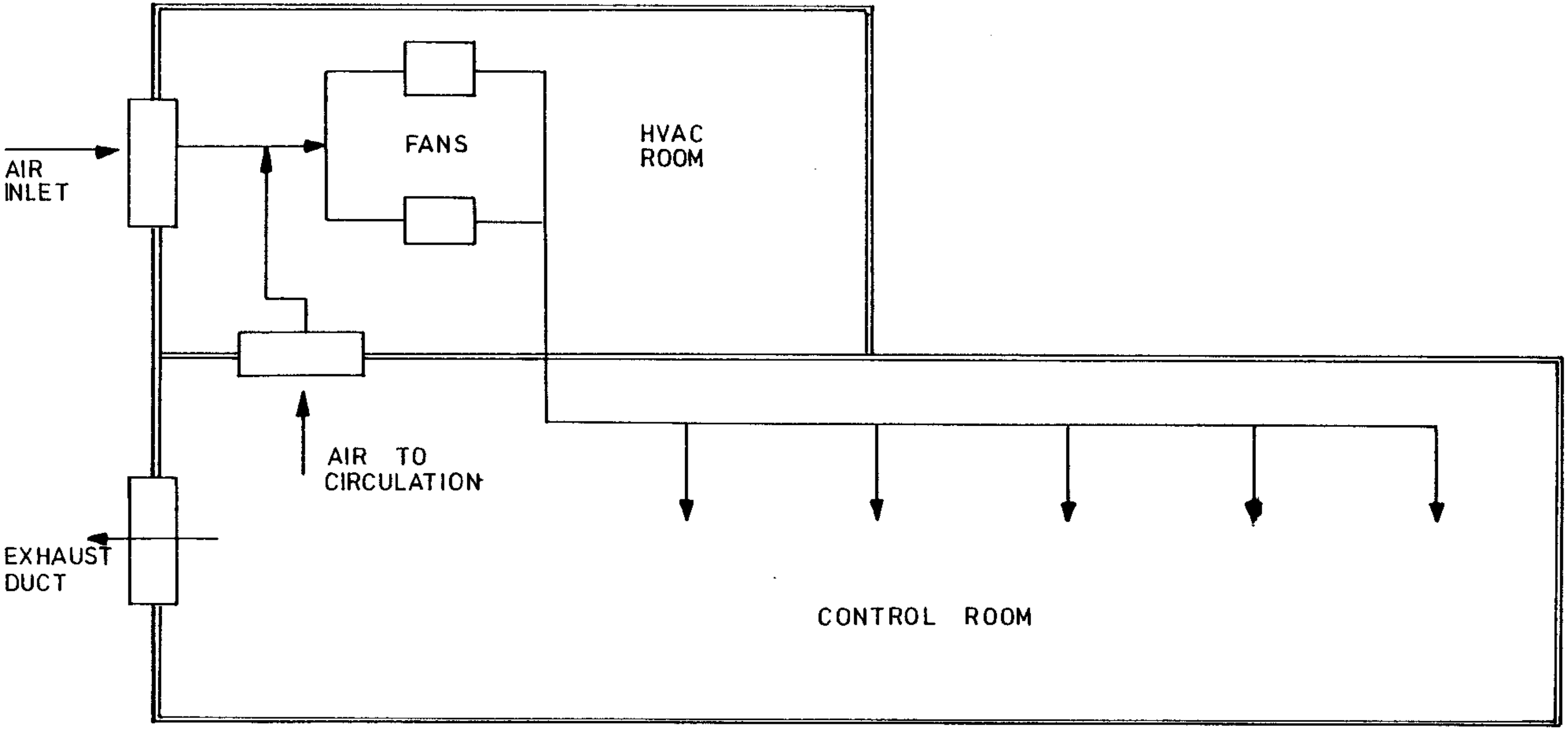


FIG. 12.1

VENTILATION OF CONTROL ROOM
MODULE 32

MODULES 30, 31, 33

Each of the three compressor modules are ventilated by separate systems. The three systems are identical.

The module is classified as Zone 2 are with ventilation, and Zone 1 when ventilation is shut down.

The ventilation system consists of two fans in parallel, one running and one stand-by, each with a capacity of 24000 m^3/h to achieve minimum 12 airchanges/h. No pressurization is required.

Compressor gas turbine hood

Ventilation in GAS TURBINE rooms and hoods is in conformity with DnV Technical Note A10/4.

The turbine hood is unpressurized during operation, but classified as safe due to the high number of airchanges maintained by fans and eductor.

	Fans only		Eductor & Fans		Eductor only		
	2 fans	1 fan	2 fans	1 fan	27 MW	20 MW	15 MW
Changes/h-hood	725	370	910	750	585	480	440
" " exhaust	500	255					
Pre-startpurge hood	60	30					
exhaust	40	20					

Airchanges during operation	910 ch/hr.
Airchanges by one fan (turbine stopped)	30 ch/hr.

When the turbine is shut down and all fans stopped, the hood is classified as Zone 1.

If fan fails, or after electrical shut down, natural convection while the turbine is cooling, provides 18 airchanges per hour. In addition, if the turbine is shut down due to detection of escaped gas, ventilation stops.
(DnV A10/4 §4.4. See also section 8.2).

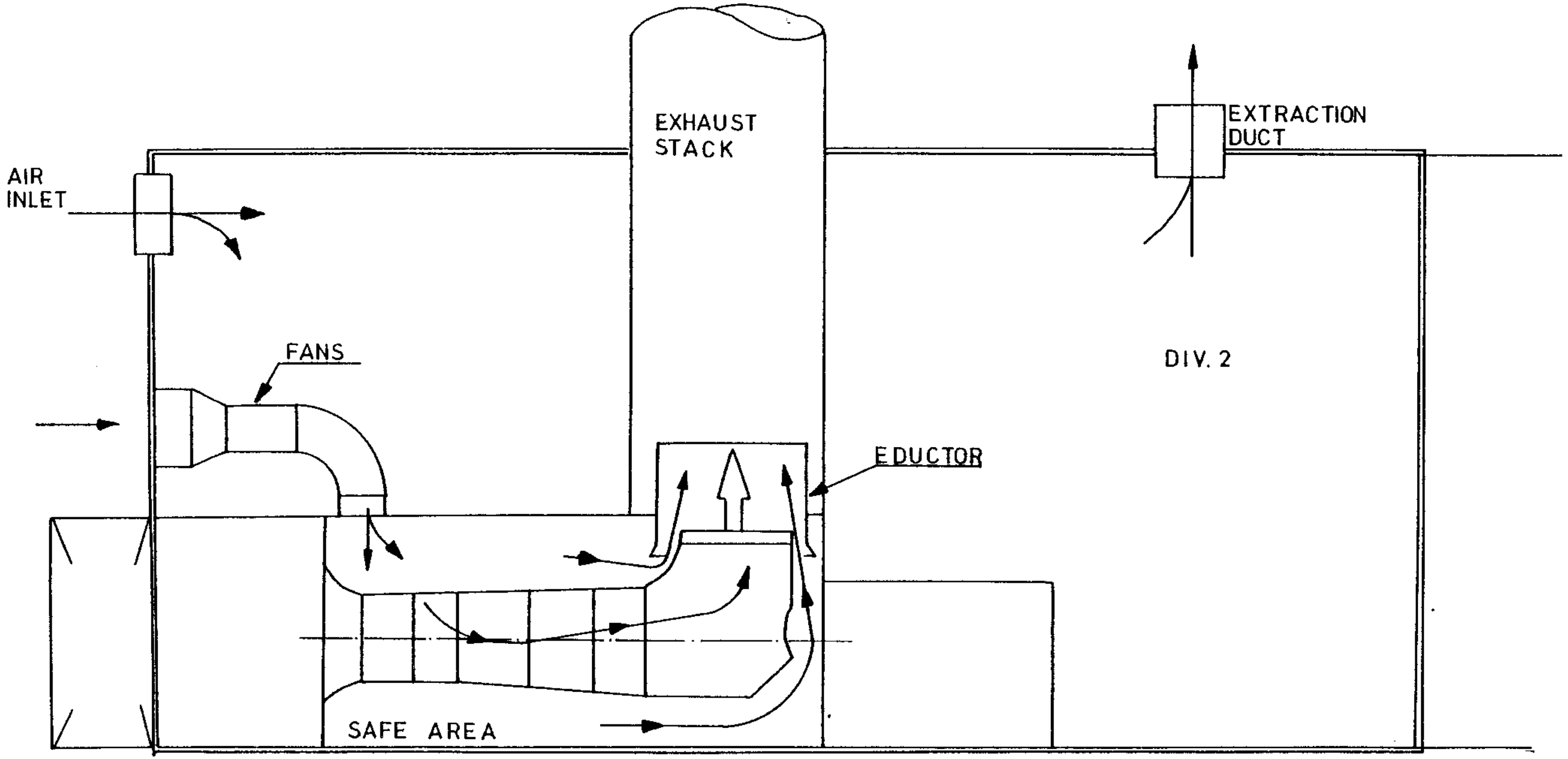


FIG. 12.2

VENTILATION OF COMPRESSION CUBICLE MODULE 30,31,33.

TURBOGENERATOR ROOM PC 41

Ventilated to maintain safe classification. When ventilation is shut down, the room is classified as Zone 1. Two fans, one running and one stand-by supplies each 27000 m^3 air/h. 24500 m^3/h to the generator room itself and 2500 to the mezzanine. Minimum 12 airchanges/h at 6 mm Wg overpressre.

Gas turbine hood

The turbine hood is ventilated by one AC fan giving 140 airchanges/hour. In addition one DC driven emergency fan. The pressure is minimum 5 mm Wg underpressure compared to the module.

TURBO GENERATOR FUEL GAS UNIT PC 40

The fuel gas unit is ventilated to maintain Zone 2 classification by AC fan in parallel giving 30-40 airchanges/hour at minimum 5 mm Wg underpressure compared to the module.

DIESEL FIREPUMP ROOMS

Each room is ventilated by separate identical systems, classified as safe with ventilation and as Zone 1 without ventilation. Two fans, one running and one DC driven as stand-by, each supplies 2100 m^3/h to give minimum 12 airchanges/h at 6 mm Wg overpressure.

In addition a hydraulic driven supply fan with a capacity of 13000 m^3/h will be in operation when the diesel is running. This fan will remove radiant heat from the engine.

PC 42,43 and 45

Classified as Zone 2 by natural ventilation.

PANCAKE 44

Battery room

Ventilated by an extraction fan unit with two fans, one running and one stand-by, each with a capacity of 1500 m^3/h, at 10 mm Wg underpressure. The room is safe with ventilation and safe without ventilation when all charging is cut.

Emergency substation

Ventilated safe by two fans in parallel, one running one spare, each with a capacity of 5200 m^3/h. The room are ventilated with 12 airchanges/h at 6 mm Wg overpressure.

Diesel generator room

Ventilated by the diesel generator remote radiator fan which draws 68500 m^3/h through the room. Together with the combustion air flow of 6000 m^3/h, the total airflow is 74500 m^3/h. No pressurization is required. The generator room and diesel tank room are classified as safe.

All ventilation systems are supplied with shut-off dampers,and where ducts penetrates a firewall firedampers are fitted. In roomswhere overpressure is required, modulating dampers are installed for control of room pressure.

See also table 7.1 in Section 7.

HVAC POWER SUPPLY/LOAD

HVAC SYSTEM	ITEM NO.	FUNCTION	S.52.32.2.2 MAIN MCC A MOD. 32 380V AC (KW)	S.52.32.2.3 MAIN MCC B MOD. 32 380V AC (KW)	S.53.44.2.7 MAIN EM. MCC PANCAKE 44 380V AC (KW)	S.53.44.4.11 EM. MCC PANCAKE 44 110V DC (KW)	PRESSURE W.G.
COMPRESSOR	54x01/005	FAN MOTOR A	3.7				
MODULE 30	54x01/006	FAN MOTOR B		3.7			VENTILATION ONLY
COMPRESSOR	54x02/005	FAN MOTOR A	3.7				
MODULE 31	54x02/006	FAN MOTOR B		3.7			" "
COMPRESSOR	54x03/005	FAN MOTOR A	3.7				
MODULE 33	54x03/006	FAN MOTOR B		3.7			" "
FAN ROOM	54x04/004	EL.HEATING COIL	88.0				
AND	54x04/009	FAN MOTOR A			8.0		6 mm
SUBSTATION	54x04/010	FAN MOTOR B		8.0			
	54x05/007	EL.PRE-HEAT COIL	50.0				
	54x05/009	FEED WATER PUMP	1.0				
CONTROL	54x05/011	EL.RE-HEAT COIL	40.0				
ROOM	54x05/014	FAN MOTOR A			6.5		6 mm
	54x05/015	FAN MOTOR B				6.0	
	54x05/030	REFRG.COMPR.MOTOR	17.0				
	54x05/030	REFRG.CRANCK.HEATER	0.1				
WORKSHOP	54x07/003	EL.HEATING COIL		40.0			
	54x07/004	FAN MOTOR		1.4			6 mm
TURBO	54x09/007	FAN MOTOR A			6.5		
GENERATOR	54x09/008	FAN MOTOR B		6.5			6 mm
ROOM	54x09/016	EL.HETATING COIL		26.0			
DIESEL FIREP.ROOM	54x10/004	FAN MOTOR A		1.35			
PANCAKE 42	54x10/005	FAN MOTOR B				1.4	6 mm
BATTERY ROOM	54x12/004	FAN MOTOR A			0.75		
	54x12/005	FAN MOTOR B			0.75		-10 mm
EMERGENCY	54x13/003	FAN MOTOR			3.0		
SUBSTATION	54x13/005	EL.HEATING COIL		20.0			6 mm
DIESEL FIREP.ROOM	54x14/004	FAN MOTOR A		1.35			
PANCAKE 46	54x14/005	FAN MOTOR B				1.4	6 mm
TRANSFORMER	54x16/005	FAN MOTOR A	2.6				
ROOMS	54x16/006	FAN MOTOR B		2.6			VENTILATION ONLY

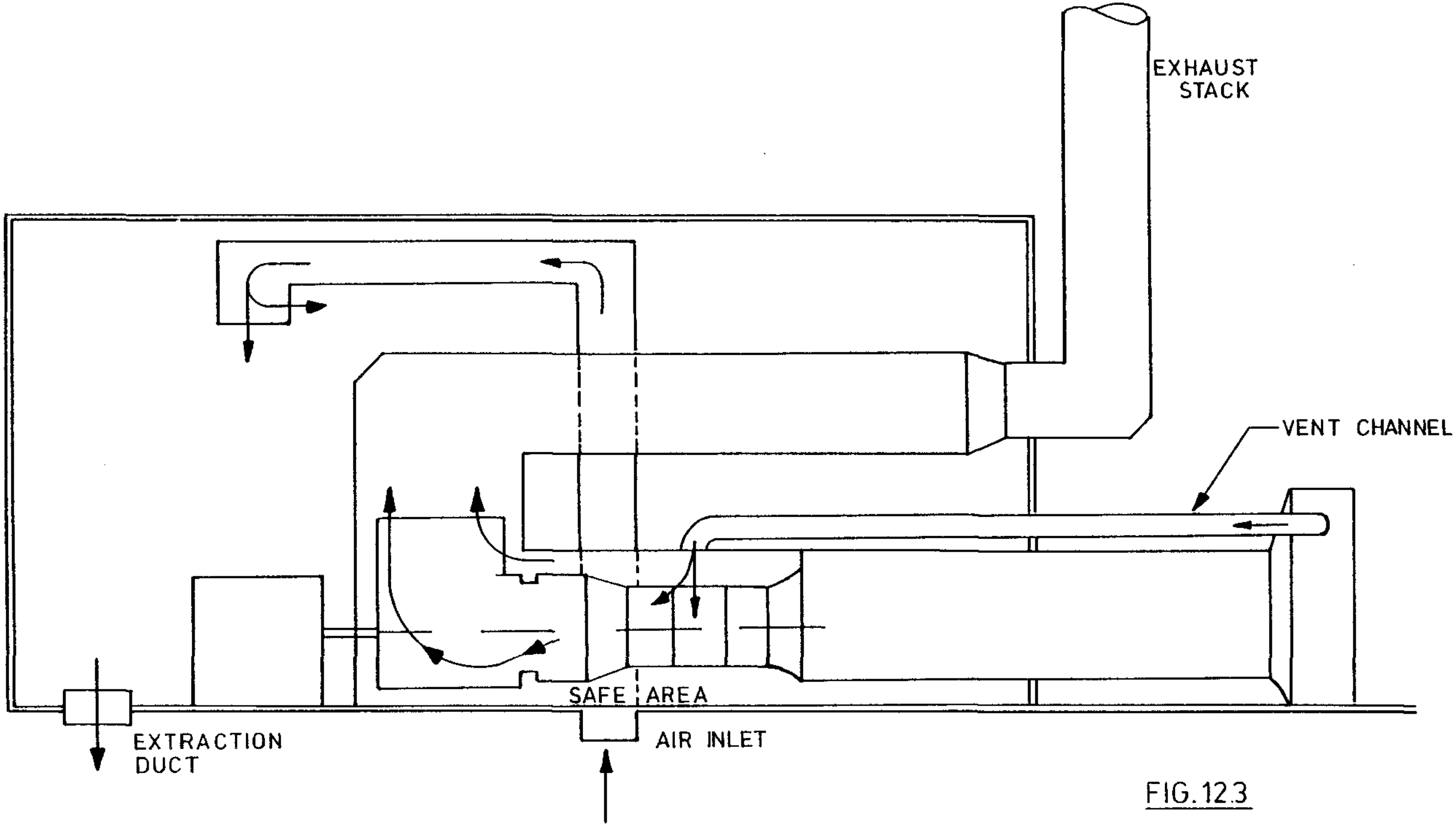


FIG. 12.3

VENTILATION OF PC 41

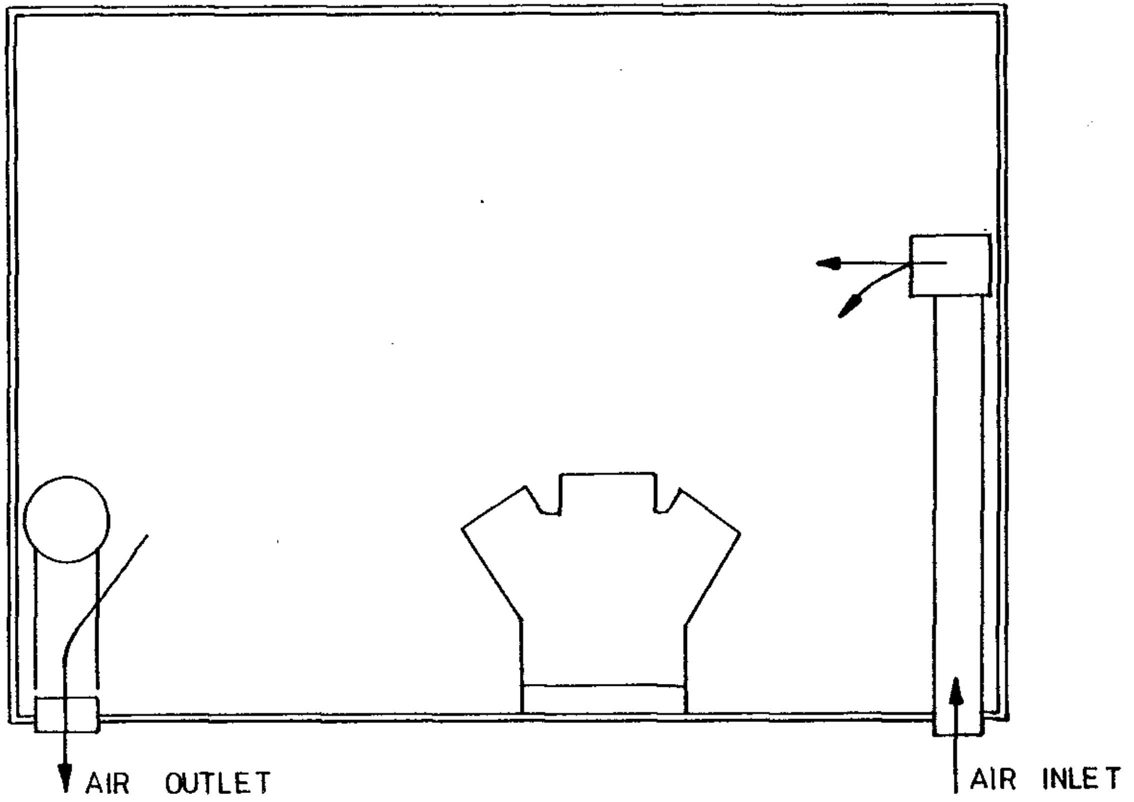


FIG. 12.4
VENTILATION OF FIRE PUMP ROOMS

13. NOISE

13 Noise

The overall basis for noise limitation is that the noise level must in no area be so high that audible alarms cannot be heard. Noise levels are shown on figures 8.6, 8.7 and 8.8 in chapter 8.2 Detection and P.A. equipment.

To ascertain this, as well as taking case of the maximum noiselevels set forth by the authorities, limitations are given to the noise emitted from the equipment. This particularly applies to the rotating machinery like pumps, compressors and drivers.

The noise limits for the various items are set forth in the specifications:

Gas Turbines 11KG01 A/B/C

Sound pressure levels measured at 1 m distance must not exceed:

Frequency	63 Hz	250 Hz	Weighted average level
Lp	100 dB	86 dB	90 dBA

ref 2×10^{-5} N/m^2

at air inlet:

88 dBA measured 1 m from air inlet filter opening.

Centrifugal Compressors 11 K01 A/B/C

The sound pressure levels measured 1 m from the compressor assembly surface must not exceed:

Frequency Hz	SPL dB
63	100
125	91
250	86
500	85
1000	85
2000	85
4000	85
8000	92

ref. 2×10^{-5} N/m^2

Diesel Fire Pump Unit

At 1 m distance the sound pressure levels must not exceed:

Requency Hz	Lp dB
63	109
125	104
250	101
500	99
1000	97
2000	96
4000	94
8000	94
A-weighted L	103

ref. 2×10^{-5} N/m^2

The noise level from the exhaust system outside the dieselgenerator room must be in accordance with ISO curve No. 6.

The construction of the walls (A60 rated) of the control room will satisfy the requirements from the NPD. Where additional accoustic insulation is required this is done by adding Rockwool mats to the walls.

The actual noise levels in the compression area will be determined by measurements during testing and start-up of the equipment.

14. VIBRATION

14. VIBRATION.

When several large pieces of machinery are in operation on or within the support frame this may cause vibration of the structure which again can cause fatigue fracture.

To analyse this problem a study has been made to establish the frequencies and amplitudes which will occur and if these values are of such significance that any action must be taken.

This study is split into three phases: where the first is to establish the behaviour of the support frame,and make an estimate of the behaviour of the modules from the information available at this stage.

The second phase is analysis of measurements made during onshore testing of the equipment, while the third phase is an evaluation of the behaviour of the platform when the equipment are installed offshore.

Although the resonance frequencies of the support frame itself are in the area of 5 Hz, the analysis was based on the machine rotation speed, which in this case is 3000 rpm. or 50 Hz.

The conclusions from the first phase are given below.

- The prediction of the dynamical effect further to the installation of modules on board of TCP 2 being presented in this document has been conducted from:
  - . an experimentation made on the platform support frame,
  - . a finite element calculation type for compression modules.

- Starting from these data, some general observations can be issued by specialists in vibratory mechanics. However, for being fully justified, they will of course have to be challenged by constraints undergone by engineering.

  . Levels presently expected should generally be <u>low</u> and should not raise any particular problem, and this all the more as the excitation forces have been considered for its highest value.

  . However the <u>gangway support</u> may be subjected to heavy vibrations and this area should be particulary controlled.

  . Besides, the equipped support frame seems particulary sensitive to <u>longitudinal effects</u> (just as the unloaded support frame). Taking into account the absence of any data on excitations likely to develop in this direction (misalignement), it may seem sensible to give further consideration to this point and at least keep a close eye on the situation in situ.

  . Starting from the unequal excitation of A and C rows, in order to reduce levels we could suggest to mount the modules "head to foot", thus alternately distributing effects on either row. In the same way, one could also suggest to avoid as far as possible the running contiguous modules.

  . Finally, it is to be noted that any casual excitation that might occour (various breaking off, shock ...) should not <u>exceed</u> by <u>10 times</u> about the norminal rating (surely assessed as maximal). Failing which, maximal stresses might reach the value of one hectobar, which would certainly require further consideration of the problem as regards fatigue.

- Connection of modules running on to this support frame has then been worked out:

  . by the SYSTEC synthesis procedure in low frequency. (though this piece of information is not absolutely useful for this problem).,

  . by direct calculation of the support frame harmonic response after identification of experimental results with a calculation model in the frequency range corresponding to machine rotation speed.

- So we have shown that in this frequency range, excitations produced by machines were largely filtered by the structure of modules (that vibrate with a 12 um amplitude, i.e. at 50 Hz a maximal acceleration of 0.12 g, and present maximal stresses close to 0.1 hb), so that forces transmitted to the support frame are reduced within a significant ratio.

- Maximum levels of vibrations and stressed have thus been estimated for the support frame, thus allowing by extrapolation the assessment of a maximum value for the case involving four compressors running out of six, together with the turbo-alternator units on the cellar deck.

  One can then estimate a maximal vibratory level on the support frame (at 3 000 t/mn).

  D_{max} 10 µm

  σmax 0.1 g

  In the same way, we can estimate a maximal stress:

  γ max 0.1 hb

  Yet it is to be noted that the gangway support can even present higher vibratory levels, that can reach 0.5 g.

To achieve this, certain limitations are set to the acceptable level of vibration from the items. As an example the requirements for the compressors are given below:

For operating compressor:

To avoid resonance on the operating compressor, the natural frequency of platform must be as follow:

FREQUENCY $<$ 20 Hz

or

FREQUENCY $>$ 85 Hz

Under a dynamic loads of 7000 kgs, the foundations vibrations cannot exceed 30µ peak to peak.
In any case the foundations vibrations cannot exceed 30 Peak to peak.

. these both conditions must be satisfied.

For stand by compressor:

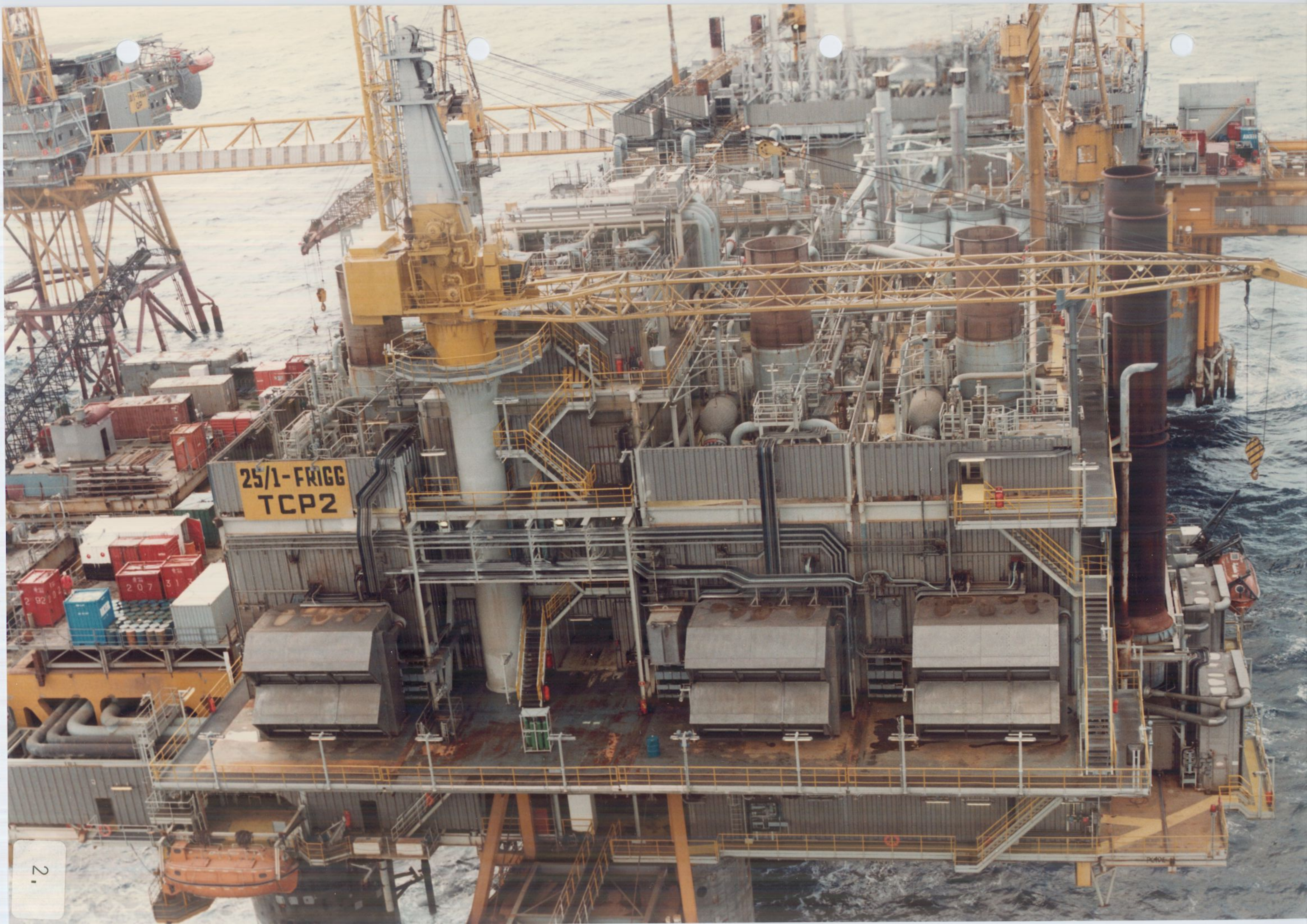
The amplitude must not exceed two time the allowance value of the running compressor. I.E. 60µ peak to peak.

In addition all rotating equipment must conform to recognized standards like API codes for pumps, compressors etc.

This chapter must be updated after start-up of the equipment, when the data from the third phase have been evaluated.

PHOTOGRAPH INDEX

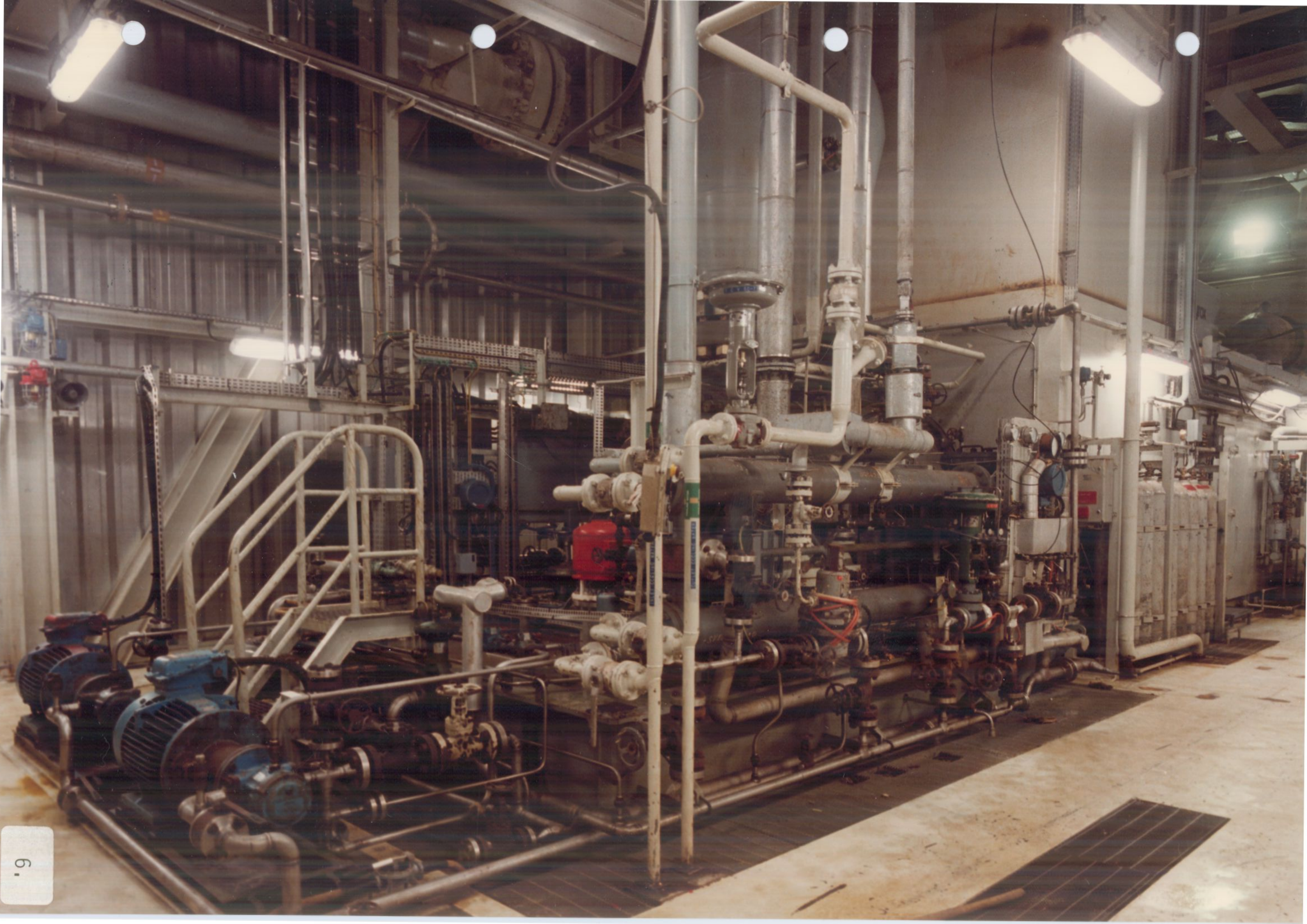
1.


25/1-FRIGG
TCP2


25/1-FRIGG
TCP2
25/1-F
TCP2

4.

5.



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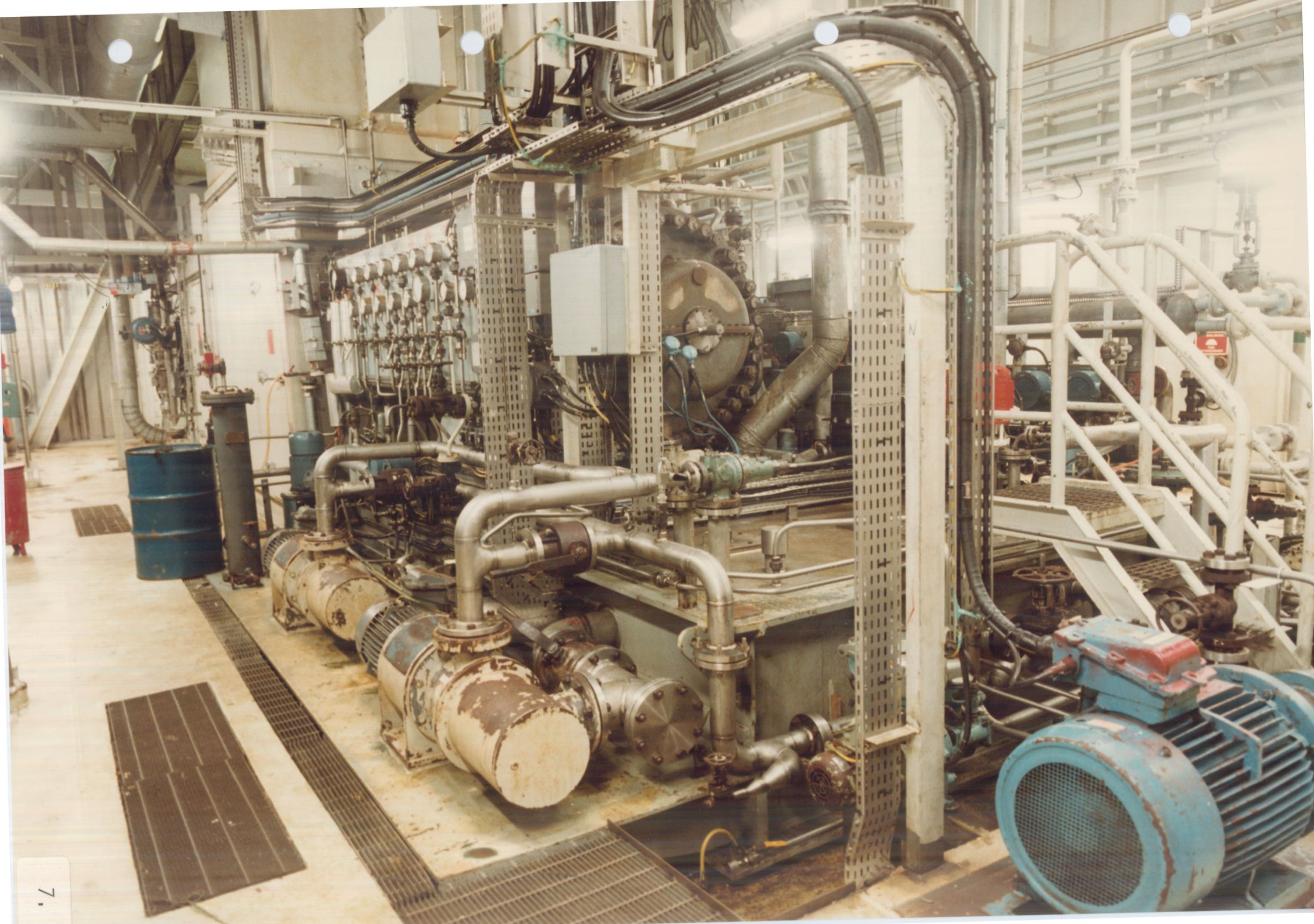

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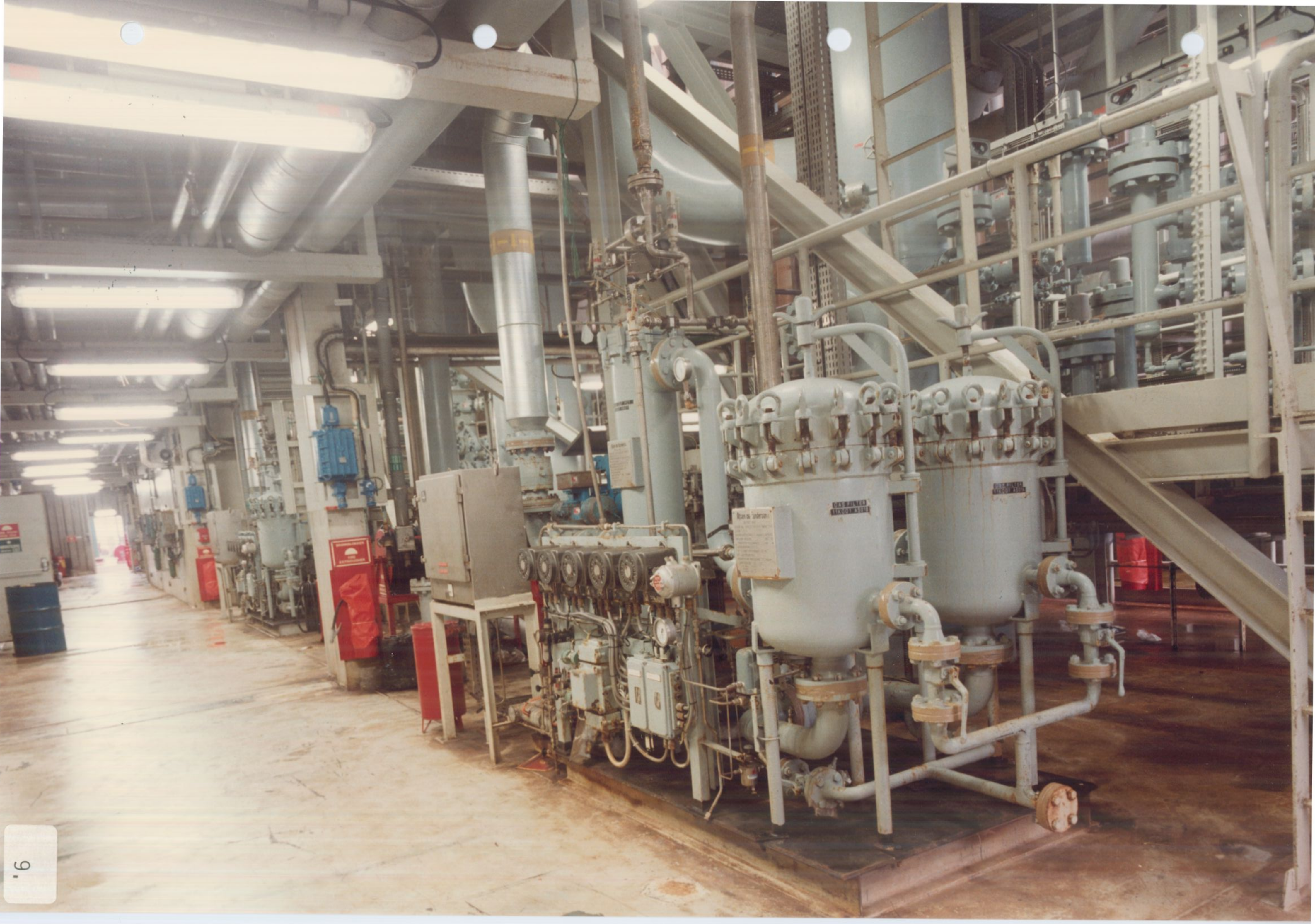


9.

10.

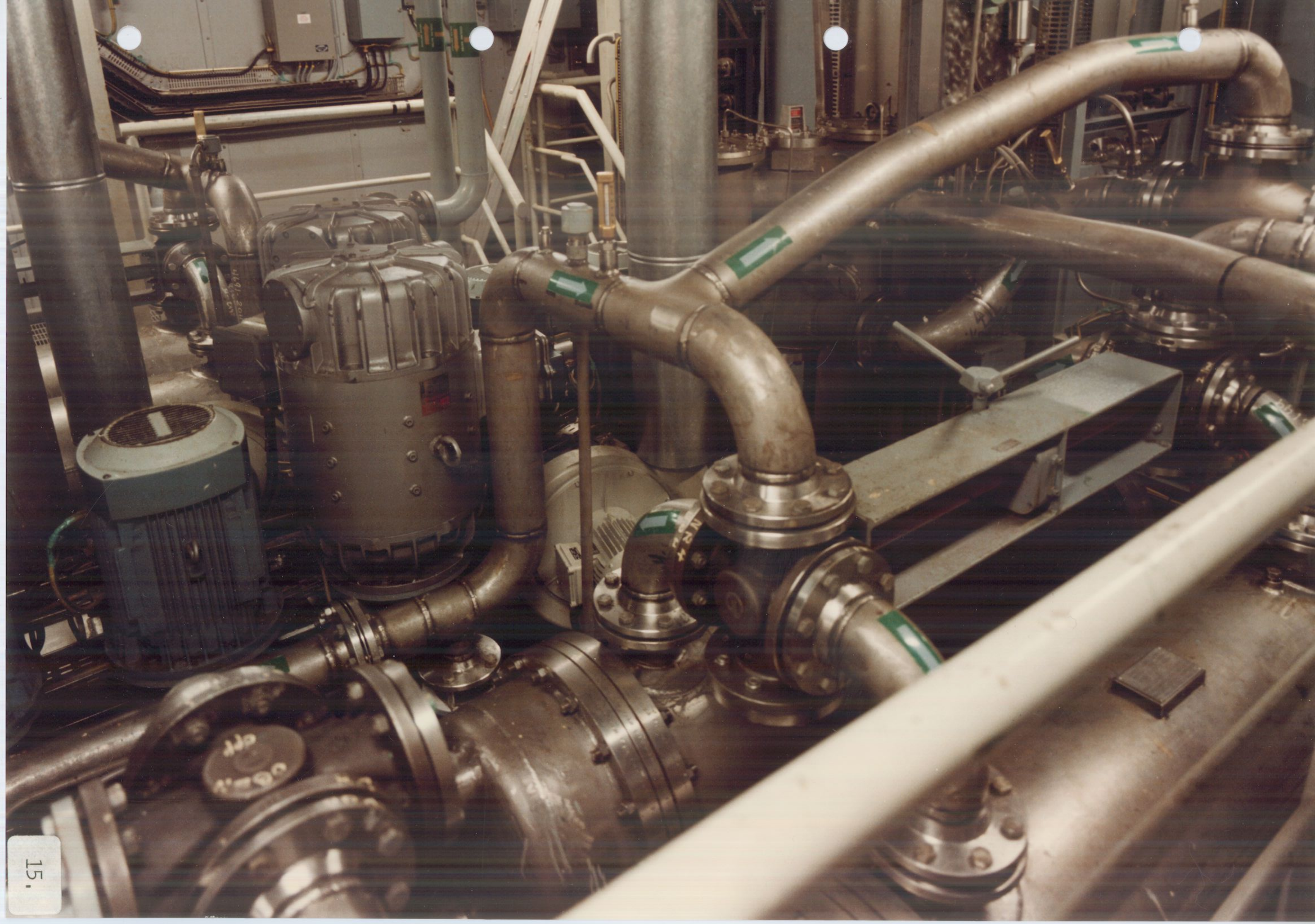
11.

12.


10/1-FRIGG
TP1
TCP2


ASEA
DANGER HIGH VOLTAGE HÖGSPÄNNING LIVSFARE
STAL-
DANGER HIGH VOLTAGE HÖGSPÄNNING LIVSFARE

14.



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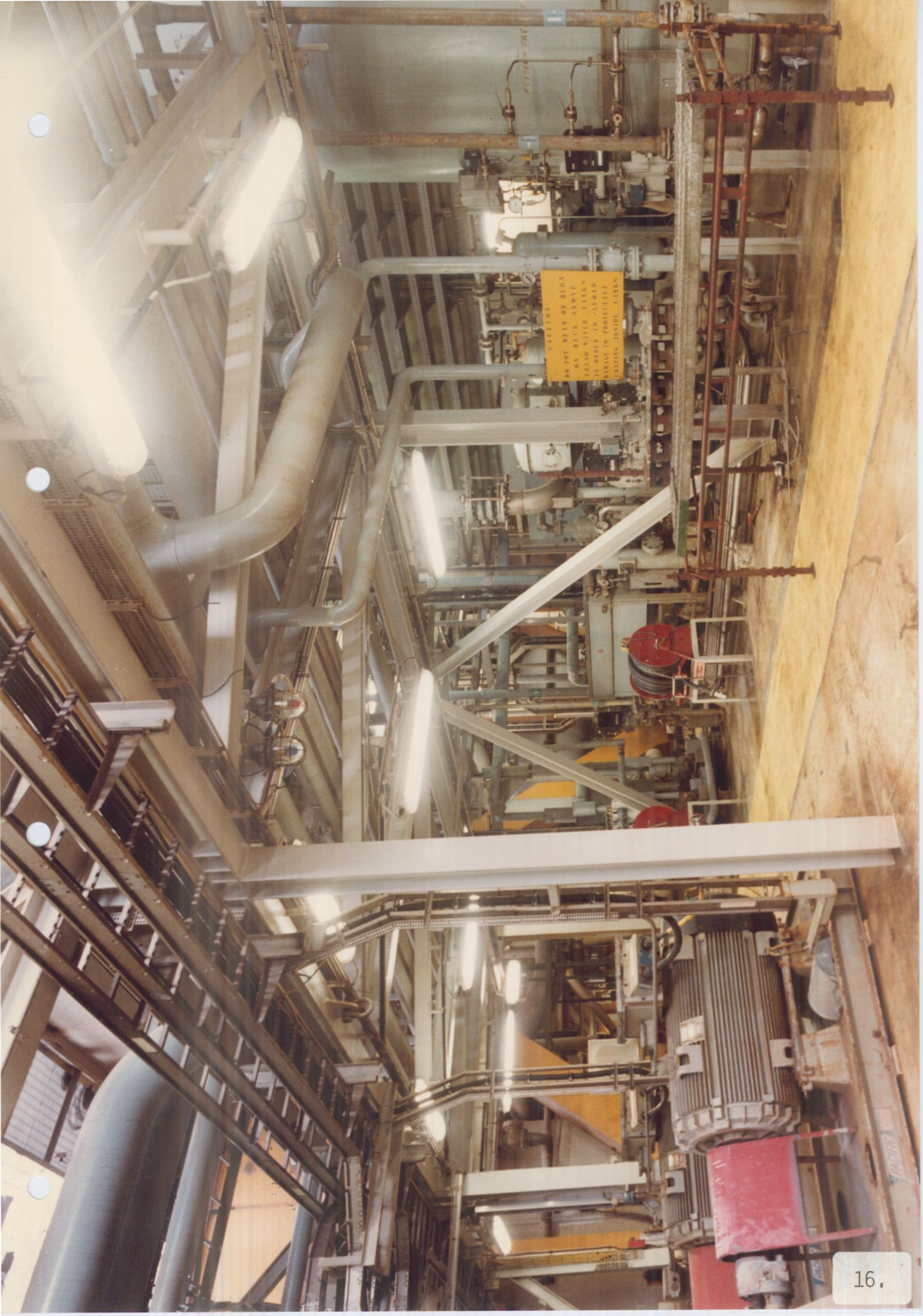
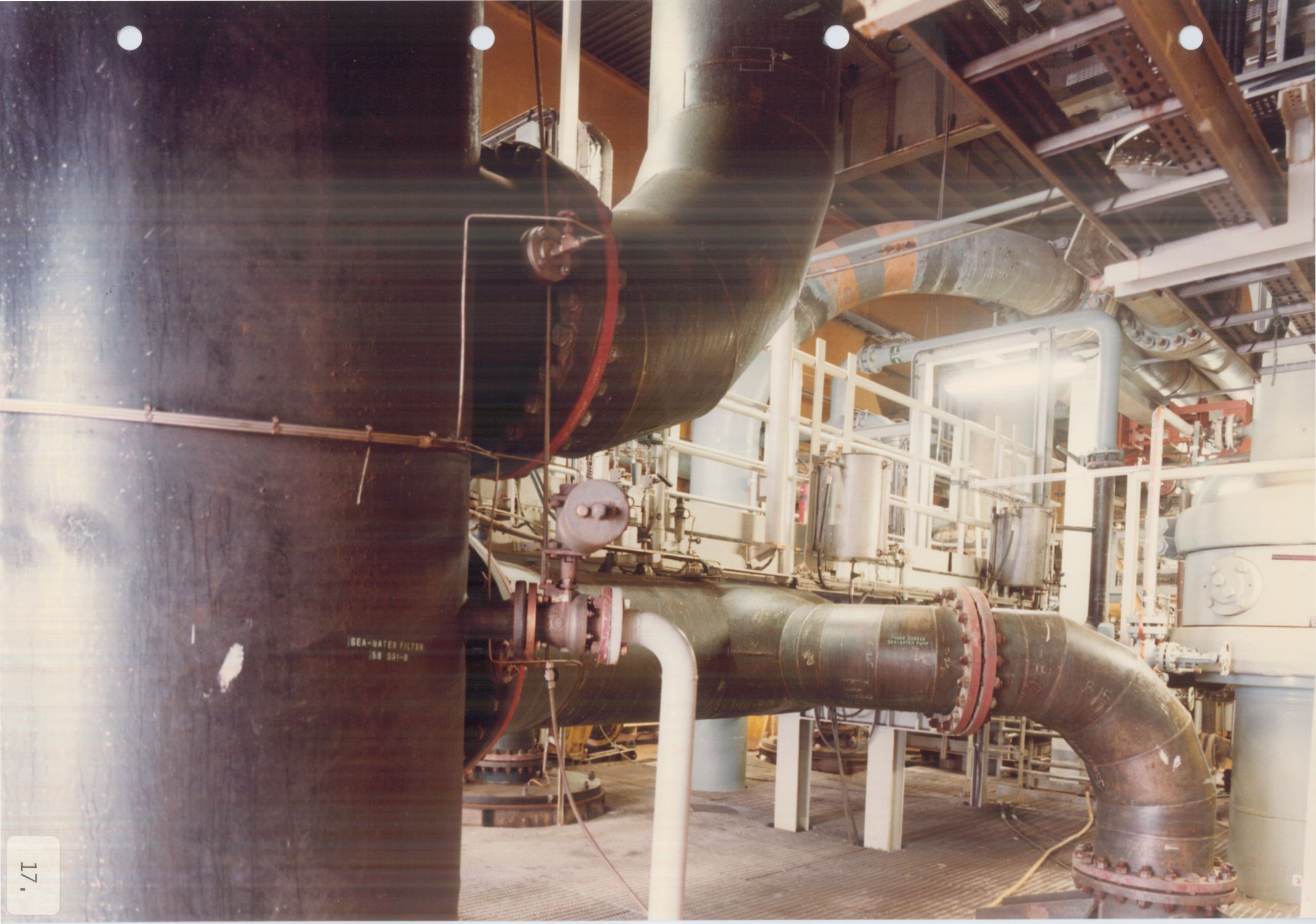
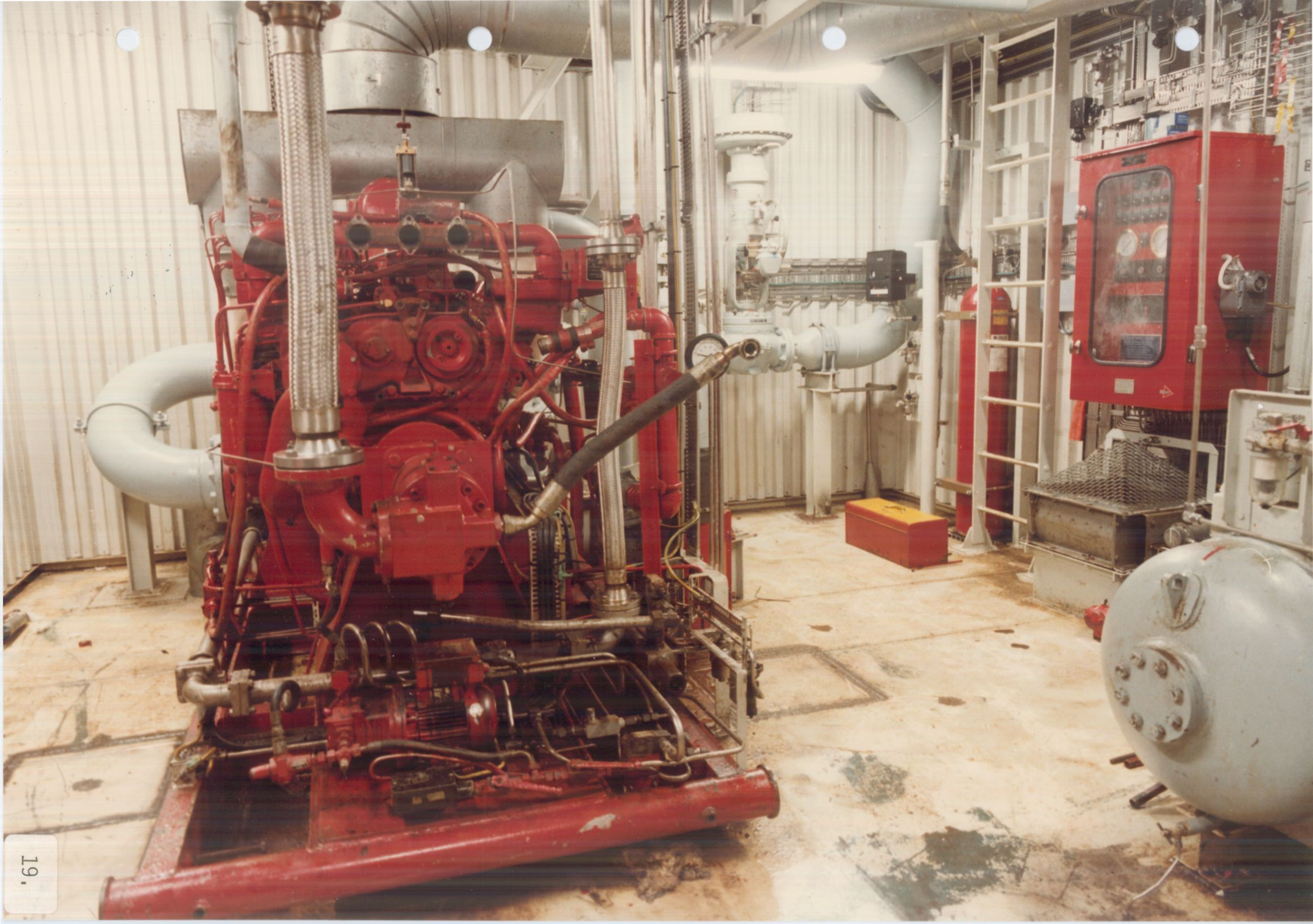

CAUTION
DO NOT WELD OR BURN
ON DECK ABOVE
FRESH WATER TANKS
IN ORDER TO AVOID
DAMAGE TO PROTECTIVE
COATING INSIDE TANKS

16.


SEA-WATER FILTER
158 001-B
THUNE EUREKA
SEA-WATER PUMP


B2
A2
A1
Elf Aquitaine NORGE A/S
TCP2 Compression
P.O. 172.253



19.


TP 1
CDP 1
QP
TCP2 C
TA 3
TA 2
TA 1
T 2
T 1
ACB 104
ACB 103
ACB 109
ACB 102
ACB 107
ACB 101
ACB 106
5,5KV
380V

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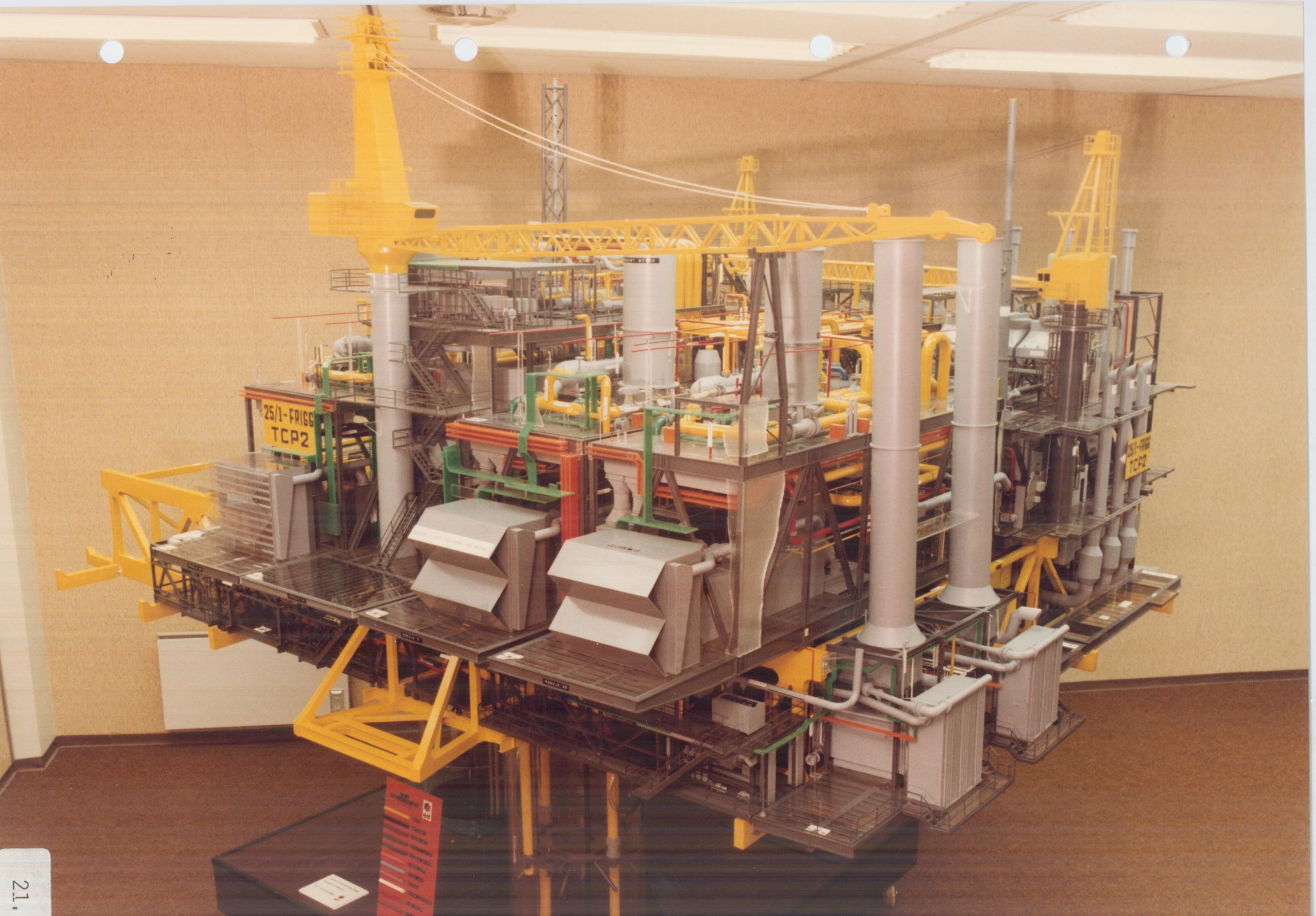
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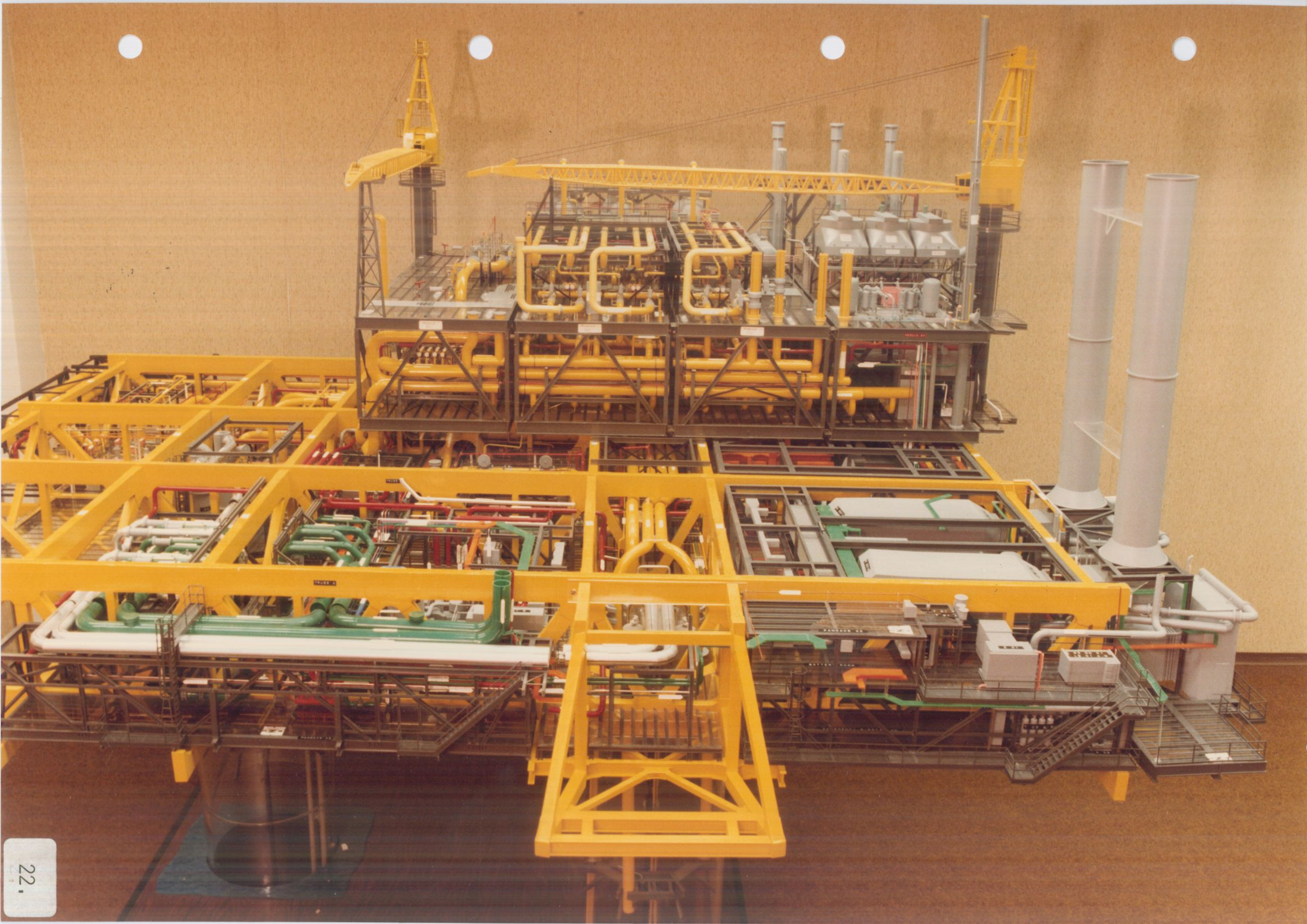
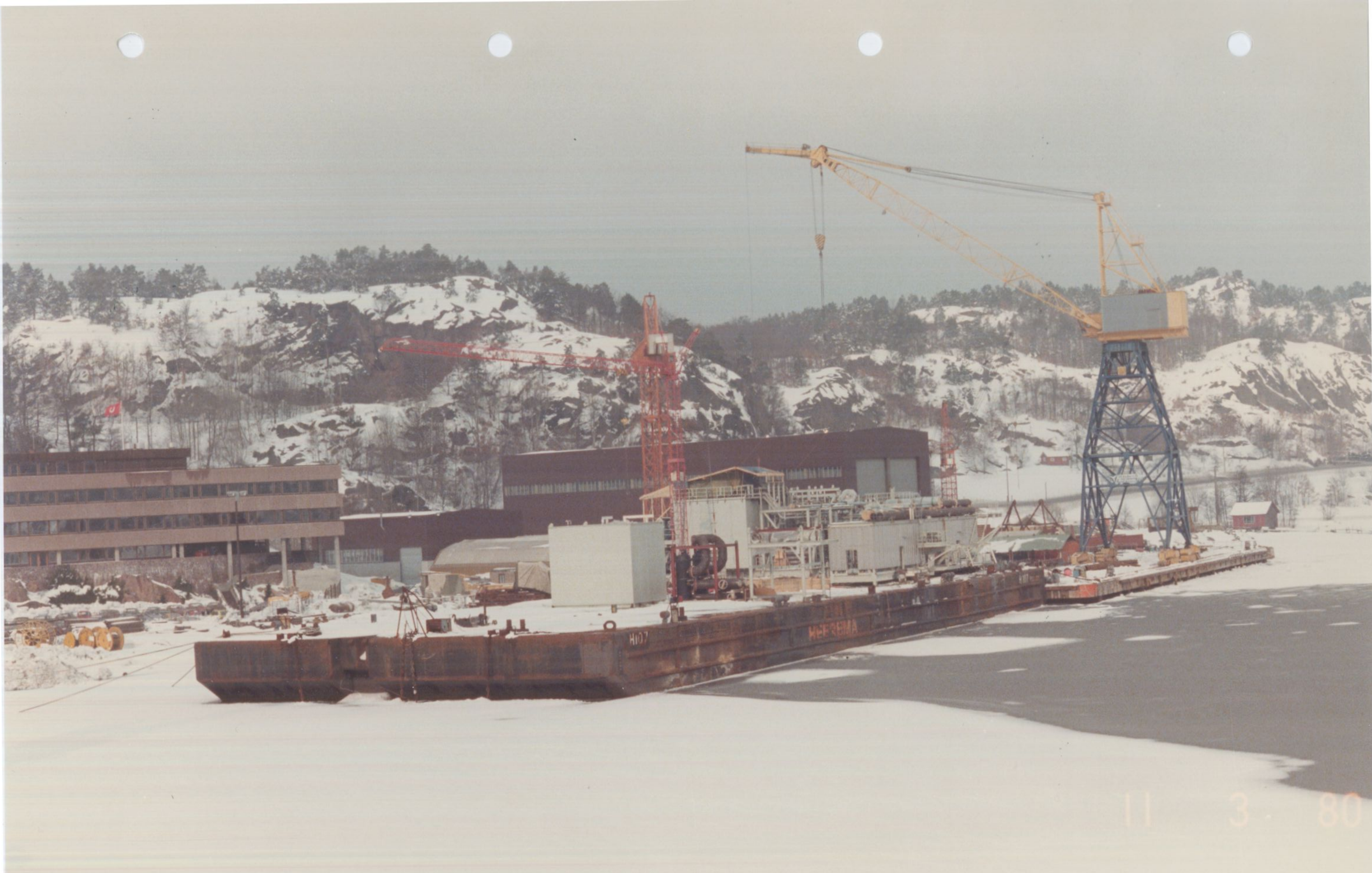
TCP2
25/1-FRIGG
TCP2





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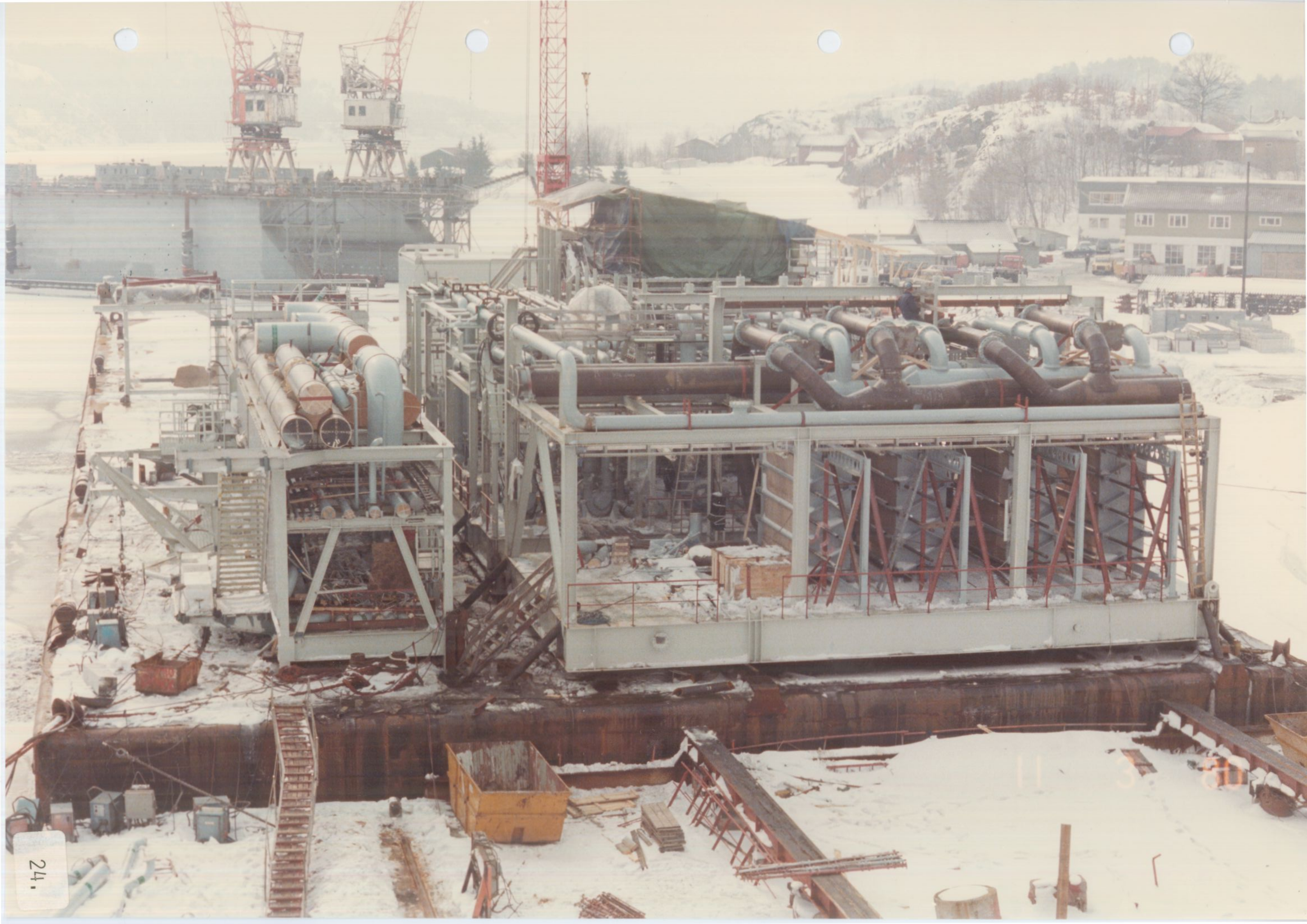

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