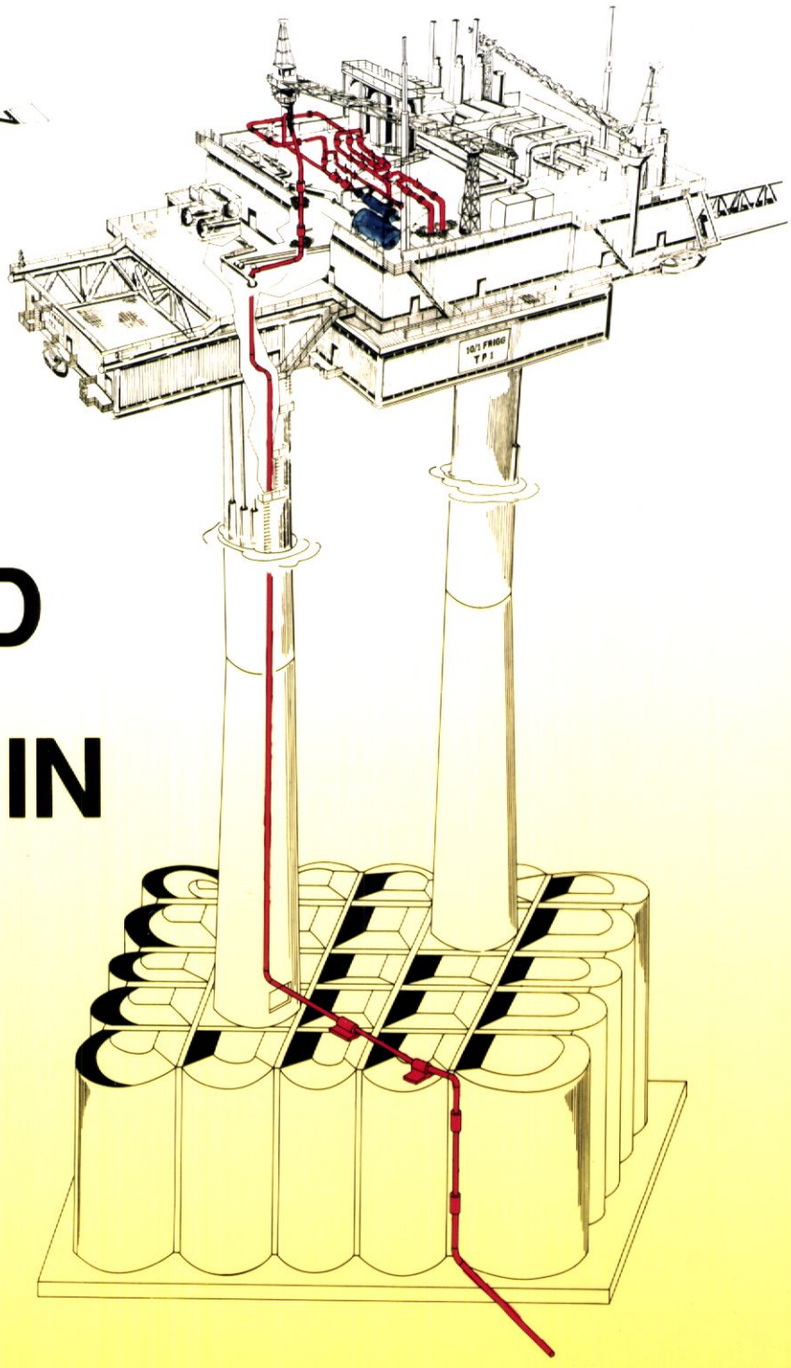
1986

FRIGG FIELD

ALWYN TIE - IN

TP1



VOLUME 1
BOOK No. 1

PROJECT DESCRIPTION AND INDEX

VOLUME 1 - PROJECT DESCRIPTION

A L W Y N T I E - I N P R O J E C T

FINAL DOCUMENTATION

C O N T E N T S

Volume 1 - Project Description and Documentation Index (This Volume)

" 2 - Engineering Data

" 3 - Construction and Commissioning

" 4 - Vendor Data

" 5 - Contract and Financial Statement

" 6 - Start up Manual (See Volume 3, book 78)

" 7 - Maintenance Manual

" 8 - R2X Riser Fabrication and Installation

VOLUME 1 - PROJECT DESCRIPTION

SECTION 1.1 DESCRIPTION OF ALWYN TIE-IN PROJECT

1.1.1 General Description of Alwyn Tie-in Project
1.1.2 General Drawings, Plot Plans, P & ID's
1.1.3 Main Engineering and Construction Contractors
1.1.4 Overall Project Schedule

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1.2.2 Alwyn Gas Data

SECTION 1.3 PRINCIPLES OF ENGINEERING DESIGN

1.3.1 Process Design
1.3.2 Structural Design
1.3.3 Mechanical Design
1.3.4 Piping Design
1.3.5 Electrical Design
1.3.6 Instrument Design
1.3.7 Safety

SECTION 1.4 DOCUMENT / DRAWING REGISTER

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1.4.2 Project Drawing/Document Register

SECTION 1.5 CONTENT OF THE JOB DATA BOOKS

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1

SECTION 1.1 DESCRIPTION OF ALWYN TIE-IN PROJECT

1.1.1 General Description of Alwyn Tie-in Project
1.1.2 General Drawings, Plot Plans, P & ID's
1.1.3 Main Engineering and Construction Contractors
1.1.4 Overall Project Schedule

SECTION 1.1.1 GENERAL DESCRIPTION OF ALWYN TIE-IN PROJECT

1.1.1.1 General Description of Alwyn Tie-In Project.

The facilities provided by Alwyn Tie-in Project are located primarily on TP1 upper level within module 01 zone, and are for routing the dry gas arriving from Alwyn NAB through Frigg to St. Fergus, Scotland, via MCP01.

The gas arriving at Frigg flows through riser R2X to the high pressure manifold and is normally routed through the transfer line to Sealine No.1. Valves have been provided also to allow the gas to be diverted either through the TP1/TCP2 interconnection line or the TP1 sales gas header,and then to St. Fergus.

The equipment includes pig receiver M28, knock out drum V47, high pressure pipework and various emergency shutdown valves. The deluge system has been extended to cover the new equipment and is initiated by fire and gas detection or manual intervention.

1.1.1.2 Purpose of Installation

The purpose of the installation is to link the North Alwyn production platform (NAB) to the TP1 platform at the Frigg Field, which will permit Alwyn gas to be landed at St. Fergus. This transportation system should provide a controlled flow of Alwyn gas into the the Frigg Field in case of:

a) Low pressure in the 24" pipeline from NAB
b) Depacking of the 24" pipeline from NAB (when the Alwyn inlet pressure on TP1 is higher than the export pressure from Frigg into the sealines to St. Fergus).

In order to achieve these various options, new installations are required.

- one pig receiver for pigging of the Alwyn-Frigg 24" pipeline
- a corrosion spool
- a leak detection system
- tie-in facilities such as interconnection pipework and valves to facilitiate the different production cases.

- low temperature relief system including a K.O. drum and vent stack. This due to the fact that the existing gas relief system on Frigg is not designed for the low temperatures in question when depressurizing equipment and piping containing Alwyn gas.

For further information see sect. 2.

1.1.1.3 Influences on Existing Systems

On the Frigg Field, the topside compression and dehydration facilities have a maximum allowable working pressure of 172 barg, whereas the sealines to Scotland are only rated at 152 barg.

It is therefore necessary to protect the sales gas headers and pipelines against overpressure, originating from the wells at the beginning of the field or from the compressors at NAB.

Over pressure protection:

The NAB topside facilties and the Alwyn-Frigg pipeline are protected against overpressure by two means:

- process control
- safety control

There are two levels of protection from the process control:

a) In case of high compressors discharge pressure, a pressure controller will limit the pressure by control of the turbine speed. This controller overrides the normal compressor control consisting of a suction pressure turbine speed control cascade.

b) A pressure transmitter at the discharge of each compressor will stop them in case of high pressure. This transmitter acts through the compressor logic system, which will check that proper actions have been taken and if otherwise activates the ESD system.

The safety control against overpressure is ensured by two barriers:

c) A pressure transmitter which in case of high or low pressure will close the pipeline isolation valve and stop the compressors.

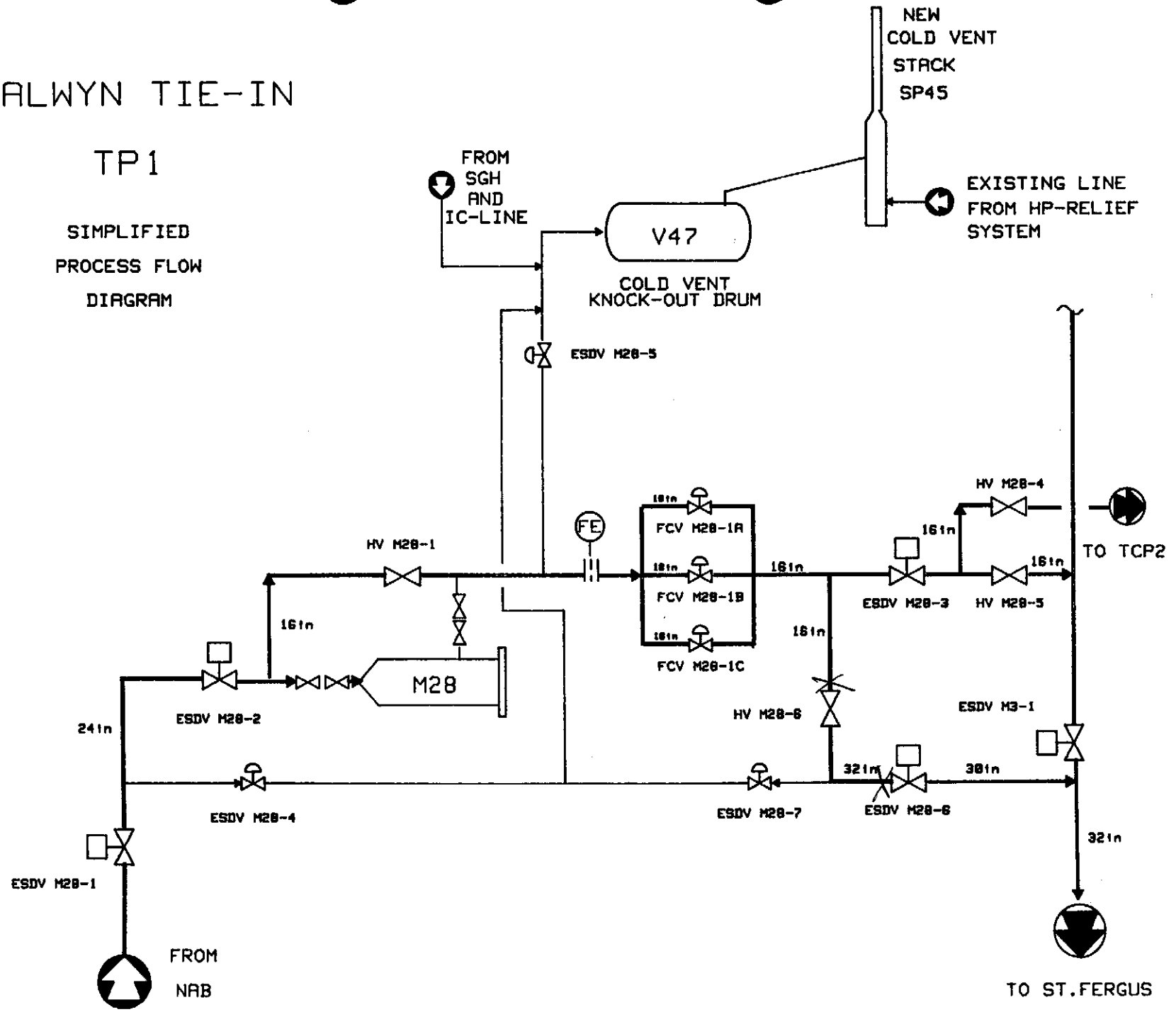
d) Full flow relief valves, located at the discharge of each compressor and set at the pipeline discharge pressure.

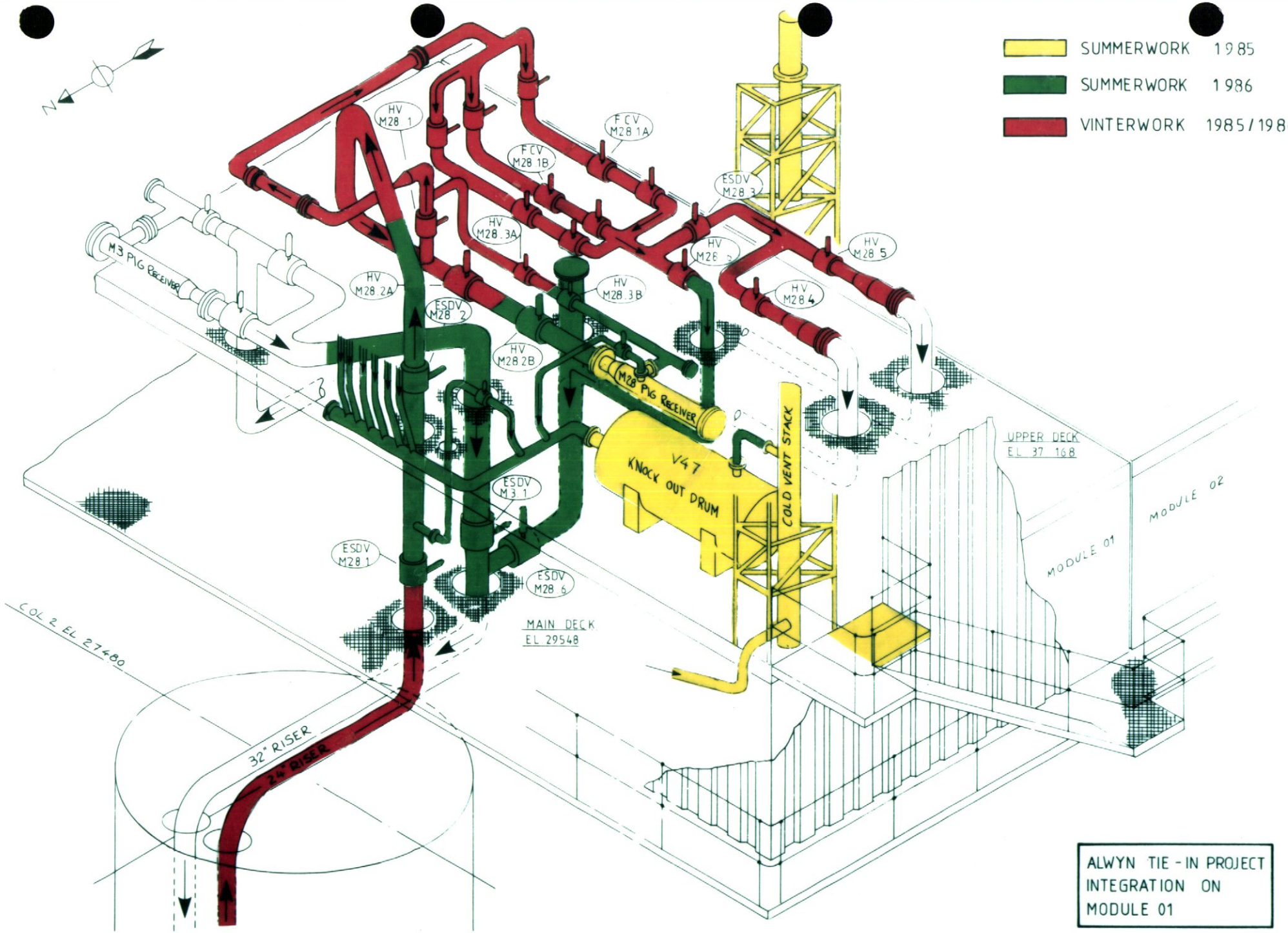
Section 1.1.2 - General Drawings, Plot Plans, P & ID's

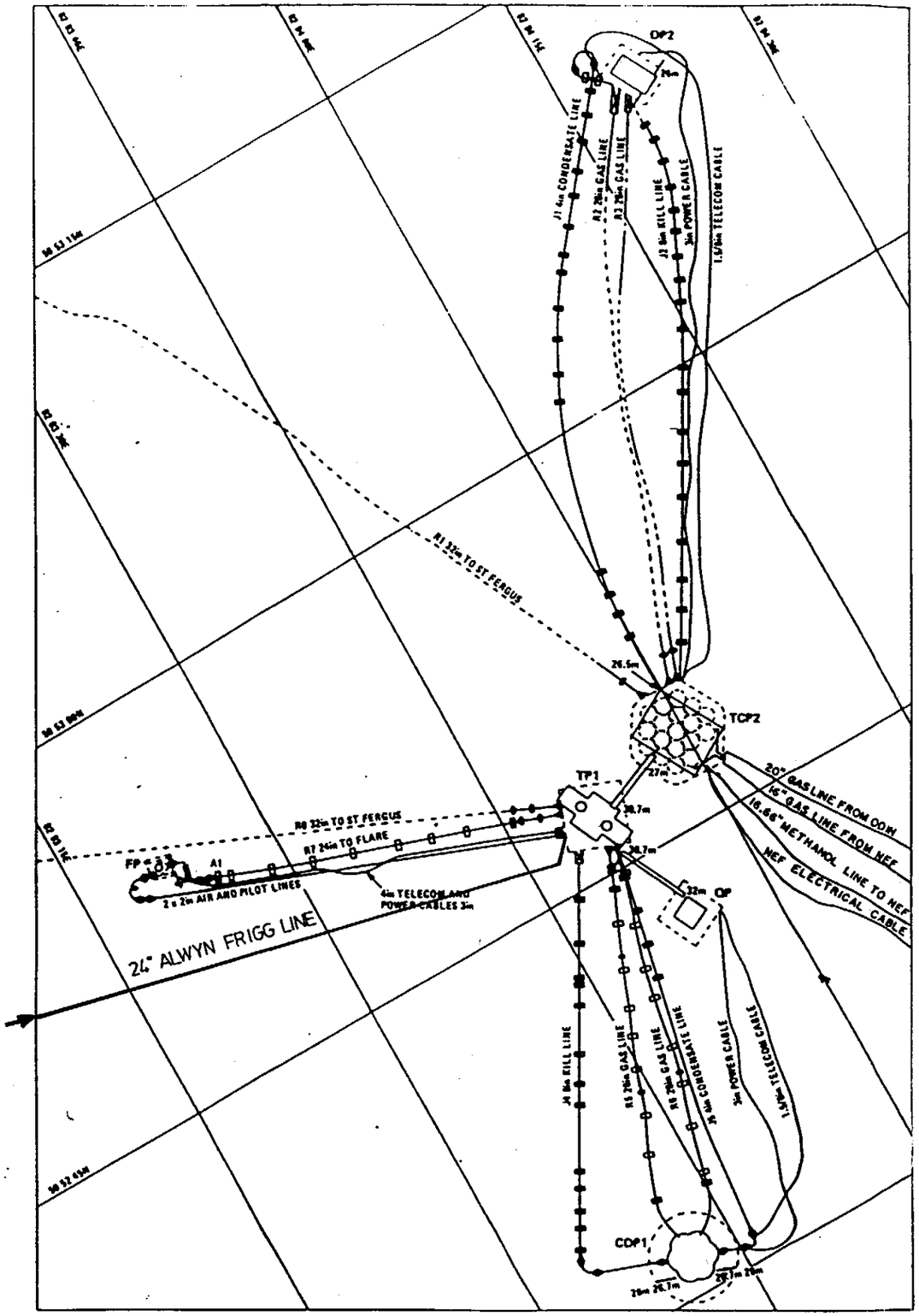
ALWYN TIE-IN

TP1

SIMPLIFIED
PROCESS FLOW
DIAGRAM

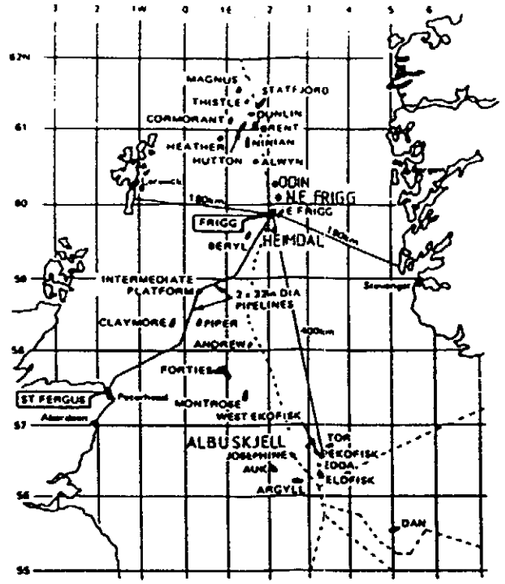



SUMMERWORK 1985
SUMMERWORK 1986
VINTERWORK 1985/1986
N
HV M28.1
FCV M28.1A
FCV M28.1B
ESDV M28.3
HV M28.3A
HV M28.2
HV M28.5
M3 PIG RECEIVER
HV M28.2A
HV M28.3B
HV M28.4
ESDV M28.2
HV M28.2B
M28 PIG RECEIVER
V47 KNOCK OUT DRUM
COLD VENT STACK
UPPER DECK EL 37.168
MODULE 02
MODULE 01
ESDV M3.1
ESDV M28.1
ESDV M28.6
MAIN DECK EL 29548
COL 2 EL 27480
32" RISER
24" RISER
ALWYN TIE-IN PROJECT
INTEGRATION ON
MODULE 01



NOTE

RIP RAP EXTENDS FROM TP1 TO CONCRETE BLOCK A1 ON R7 24in FLARE LINE



N
TRUE NORTH

PLATFORM CO-ORDINATES

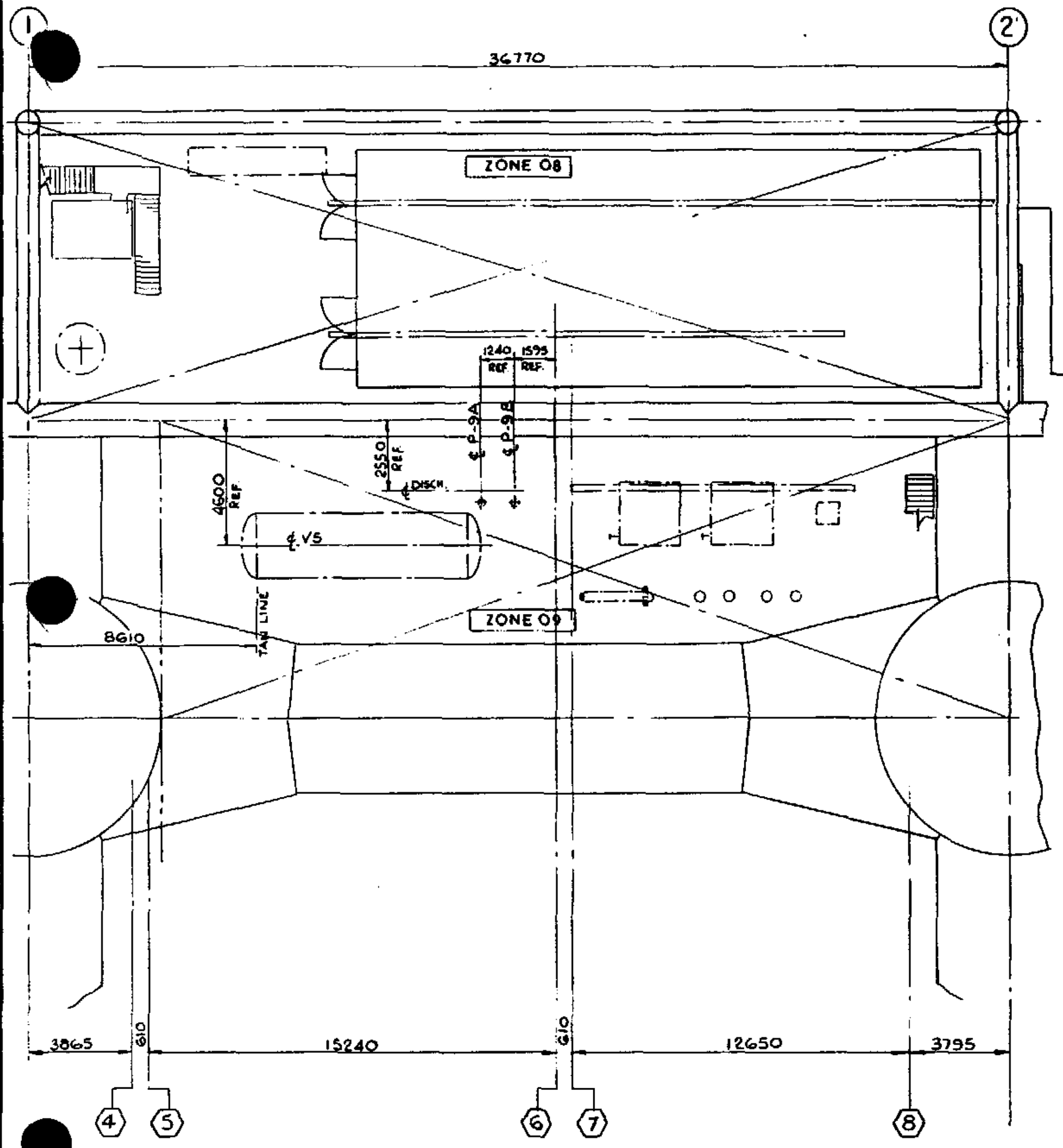
STRUCTURE	GEOGRAPHICAL CO-ORDINATES	UTM CO-ORDINATES	TRUE ORIENTATION
DP1 MAST	58° 52' 48" 718 N 02° 04' 48" 756 E	6 636 334.38 N 448 586.96 E	—
DP2	58° 53' 18" 675 N 02° 04' 26" 884 E	6 638 248 00 N 448 000 00 E	332° 52' 12"
TP1	58° 52' 47" 276 N 02° 03' 51" 306 E	6 636 548 74 N 447 616 36 E	336° 26' 28"
TCP2	58° 52' 46" 446 N 02° 03' 56" 536 E	6 636 564 14 N 447 743 92 E	331° 03' 06"
OP	58° 52' 42" 421 N 02° 03' 53" 625 E	6 636 300 00 N 447 662 56 E	334° 17' 43"
COP1	58° 52' 31" 388 N 02° 03' 41" 745 E	6 636 000 30 N 447 458 81 E	018° 37' 41"
FP	58° 52' 53" 518 N 02° 03' 21" 283 E	6 636 740 50 N 447 150 56 E	—

KEY

- UNBURIED LINE
- BURIED LINE OR LINE IN A TRENCH
- CONCRETE BLOCK (25t)
- CONCRETE BLOCK (10t)
- CONCRETE SADDLES
- GROUT BAG
- GROUT BAG NOT IN USE
- MATTRESS
- GREASE BOX
- SEAL PROTECTION
- SEAL PROTECTION WITH FLOW LIMITER
- SEAL PROTECTION WITH PERMANENT SEAL
- HYPERBARIC WELDING POSITION
- 26m CLEARANCE UNDER BRIDGE

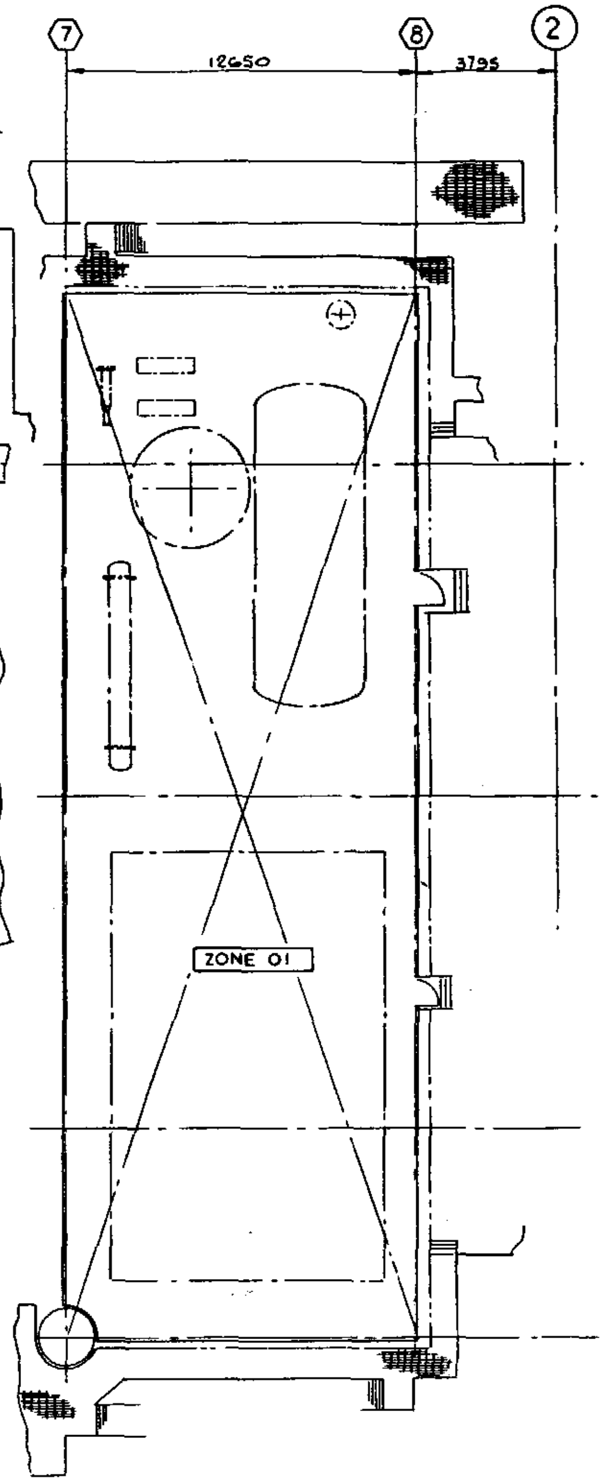
ISSUE 2 FEB. 1987

FRIGG FIELD – LOCATION | 1.1



CELLAR DECK

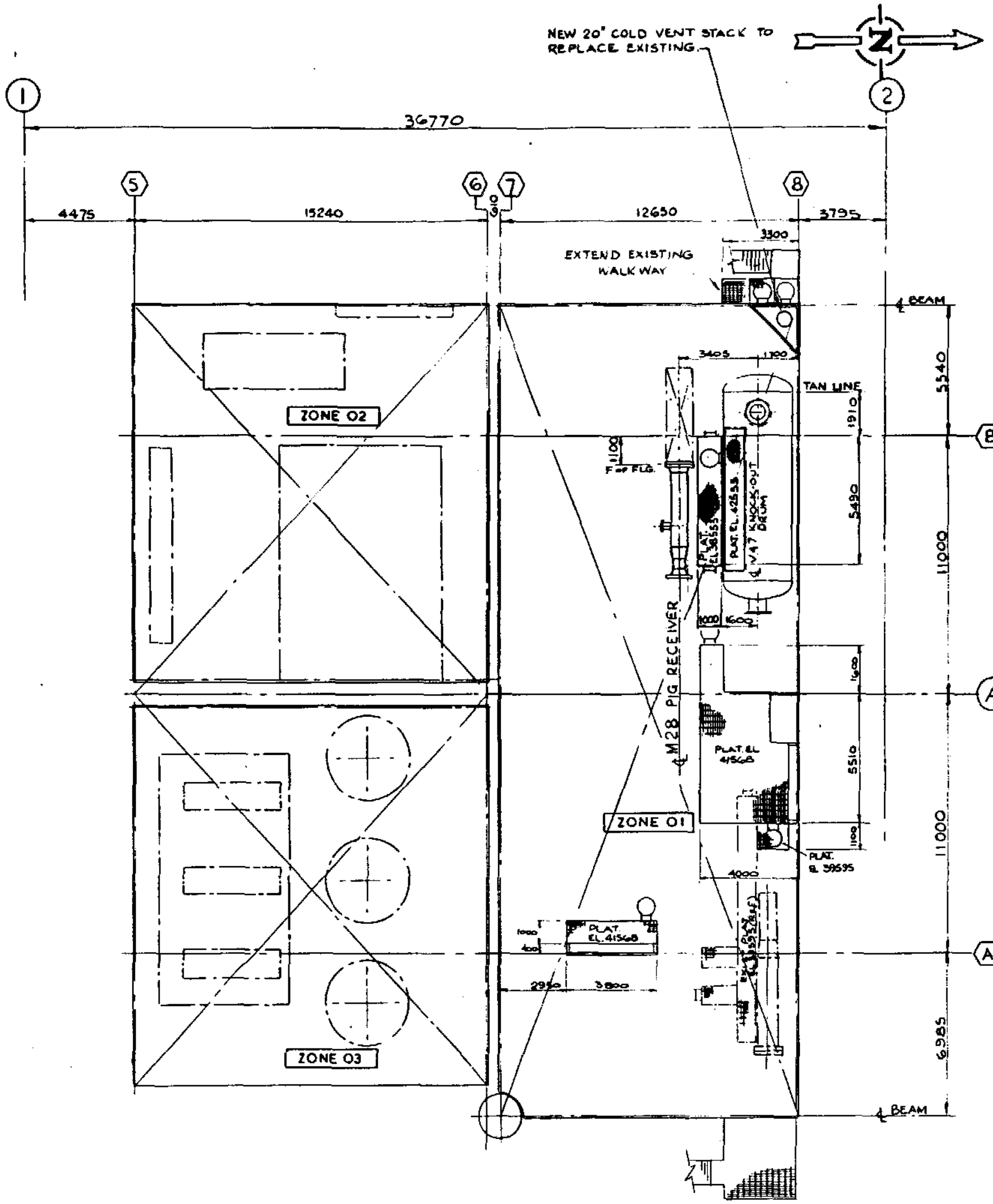
TOP OF PLATFORM EL. 23008



LOWER LEVEL

TOP OF PLATFORM EL. 29548

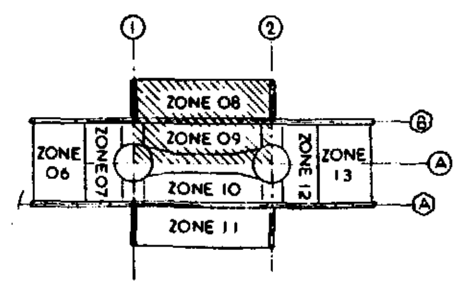
ZONE	EQUPT. No.	DESCRIPTION	℄ ELEVATION
01	M28	PIG RECEIVER	38500
01	V47	KNOCK-OUT DRUM	40853



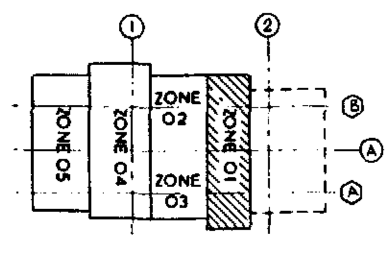
UPPER LEVEL

TOP OF PLATFORM EL. 37168

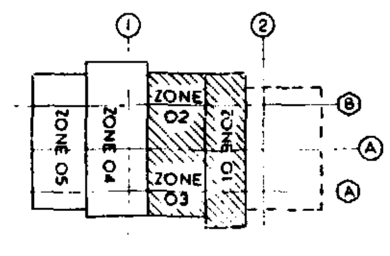
AS BUILT
UP TO :



KEY PLAN - CELLAR DECK



KEY PLAN - LOWER LEVEL



KEY PLAN - UPPER LEVEL

rev	date	DESCRIPTION	by	app
04D		'AS BUILT'		
03C	15-5-85	APPROVED FOR CONSTRUCTION		
02A	23/2/85	PRELIMINARY FOR CFT		
01A	3/12/84	REVISE V47 KNOCK OUT DRUM & COLD VENT STACK	S.S	ST
0	13/9/84	first issue PRELIMINARY	S.S	ST

ALWYN TIE-IN

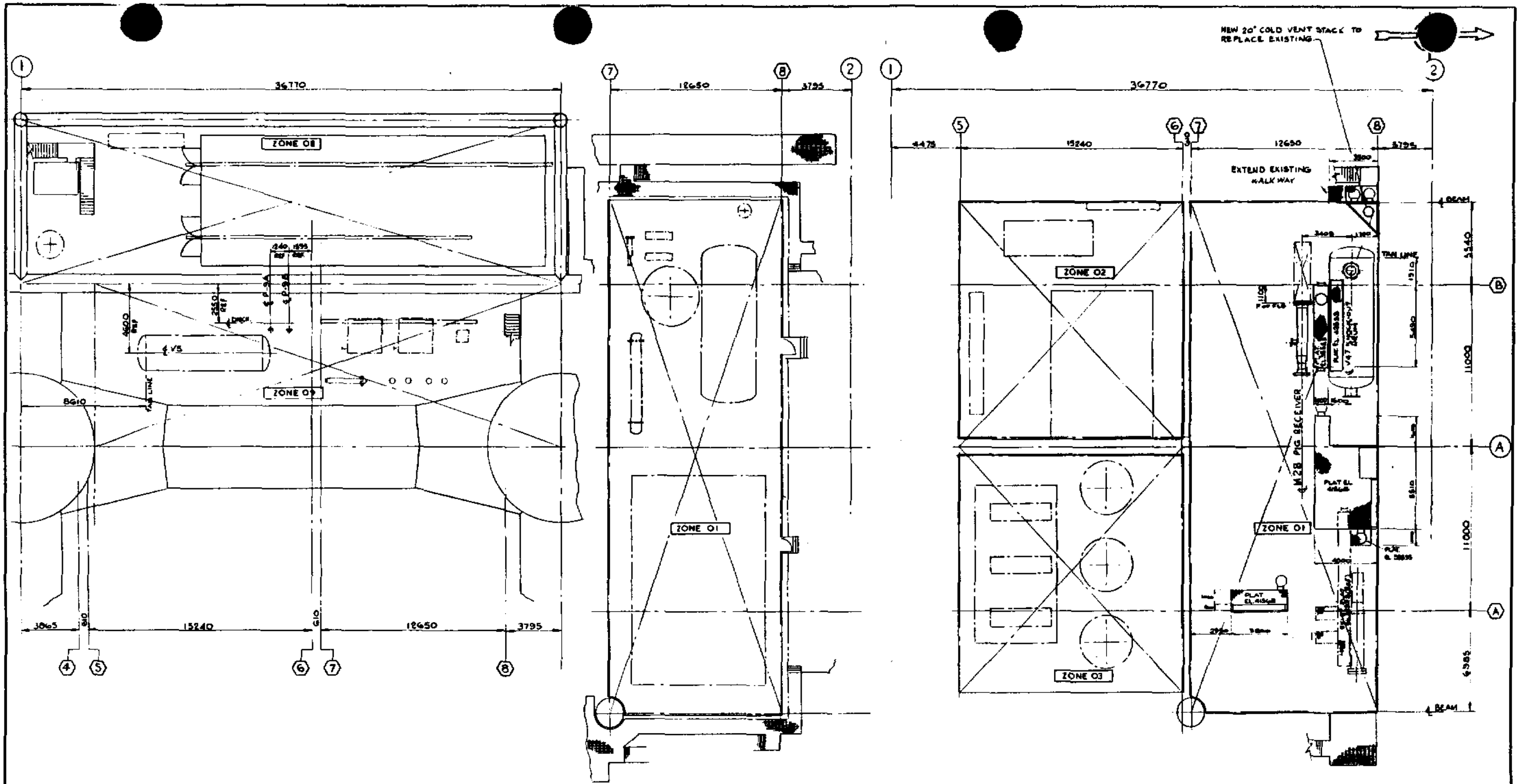
elf aquitaine norge a s

Installation: TPI System: GENERAL

PLOT PLANS - CELLAR DECK, LOWER LEVEL & UPPER LEVEL

Scale 1:125

FRIGG FIELD FF 95 20002152 C4D 1 1



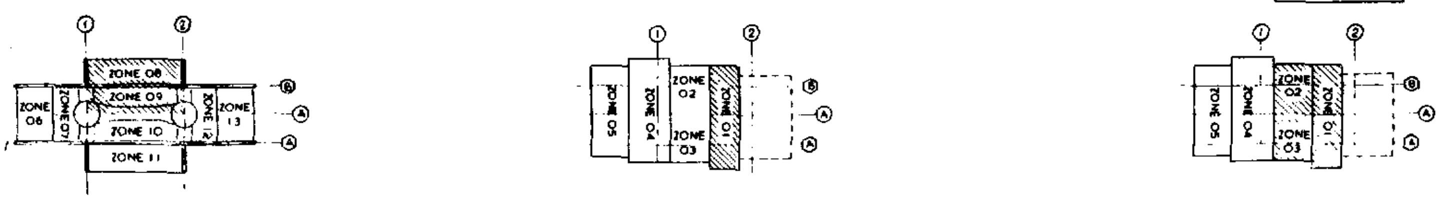
CELLAR DECK
TOP OF PLATFORM EL. 23008

LOWER LEVEL
TOP OF PLATFORM EL. 29548

ZONE	EQUIPT No.	DESCRIPTION	℄ ELEVATION
01	M 28	PIG RECEIVER	38500
01	V 47	KNOCK-OUT DRUM	40853

UPPER LEVEL
TOP OF PLATFORM EL. 37168

AS BUILT
UP TO :



KEY PLAN - CELLAR DECK
KEY PLAN - LOWER LEVEL
KEY PLAN - UPPER LEVEL

"AS BUILT"
APPROVED FOR CONSTRUCTION
PRELIMINARY FOR CFT
REVISE V47 KNOCK OUT DRUM & COLD VENT STACK
PRELIMINARY
REV DATE DESCRIPTION BY APP

ALWYN TIE-IN

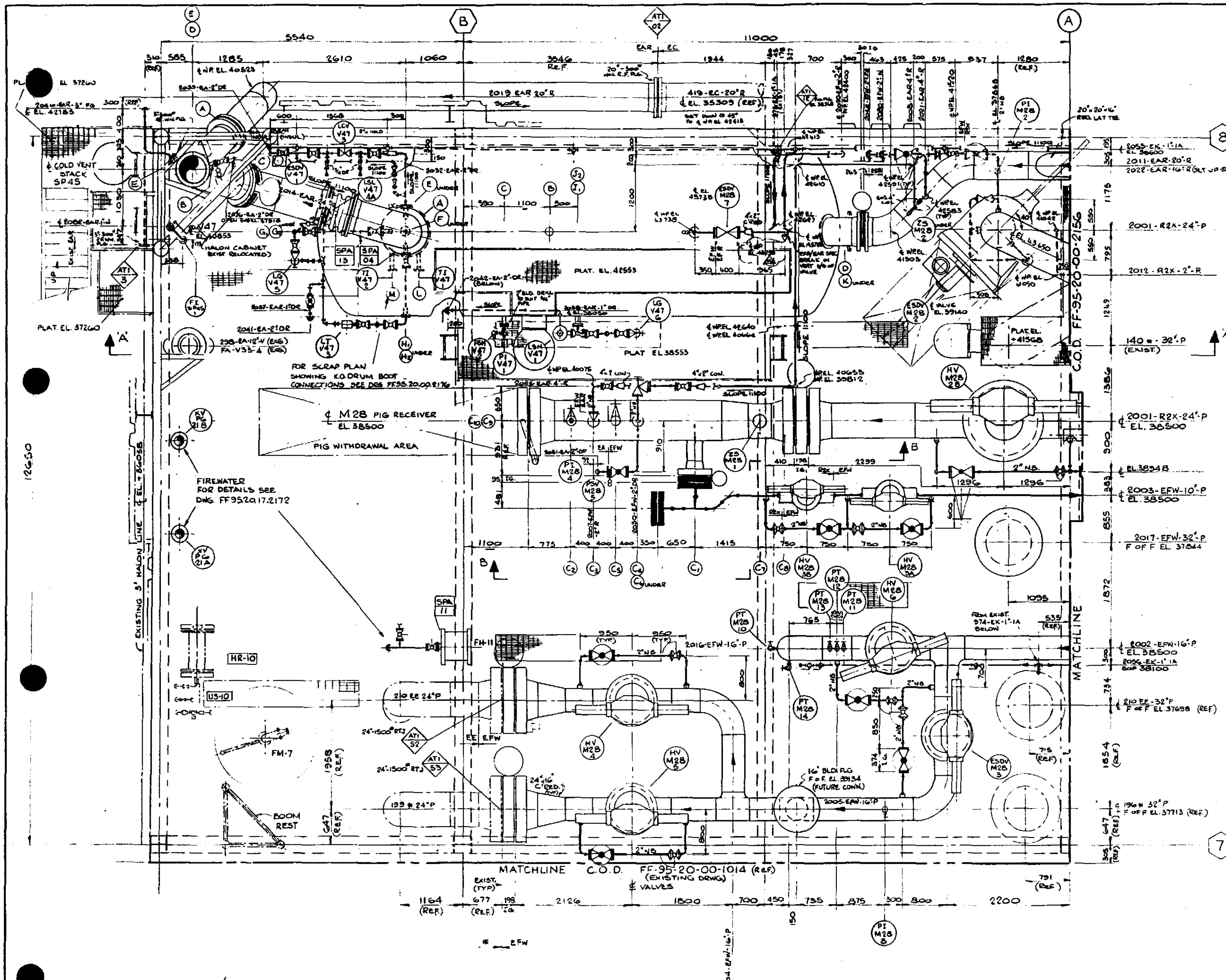
elf aquitaine norge as

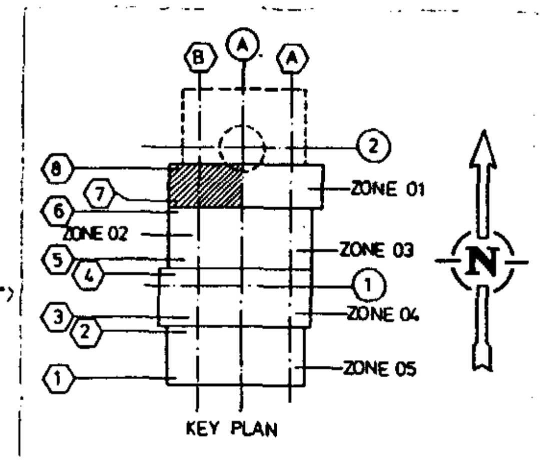
elf

TPI GENERAL
PLOT PLANS - CELLAR DECK, LOWER LEVEL & UPPER LEVEL

1:125

FRIGG FIELD
FF 95 20002152





REFERENCE DRAWINGS.

FF95.20.00.2152	PLOT PLANS
FF95.00.04.5052	P&I.D. COLD VENT K.O. DRUM
FF95.00.12.5053	" ALWYN TIE-IN/TPI GAS INLET
FF95.00.12.5054	" " " " " " LEAK DET. & FLOW CONTROL
FF95.00.12.5056	" " " " " " CONNECTIONS.
FF95.00.04.5057	" NEW COLD VENT STACK.
FF95.00.01.5063	" INSTRUMENT AIR SYSTEM.
FF95.21.25.2258	STRUCTAL-MOD.01 ACCESS PLATFORMS
FF95.20.08.2143	SCHEMATIC LAYOUT OF HYDRAULIC PIPING
FF95.20.08.2144	" " " " "
FF95.20.00.2163	SECTION
FF95.20.00.2176	"
FF95.20.00.2158	PGA. LOWER LEVEL WEST ZONE 01 EL 29548
FF95.20.04.2148	PGA COLD VENT STACK EL 49460
FF95.20.17.2172	FIREWATER DELUGE SYSTEM
FF95.20.00.2178	PIPING SUPPORT LOCATION PLAN.
FF95.20.00.2147	PART PLANS & SECTIONS ZONE 01
FF95.26.04.0002	V47 K.O. DRUM
FF95.26.15.0001	M28 PIG RECEIVER
FF95.26.04.0003	COLD VENT STACK SP.25

rev	date	DESCRIPTION	by	app
07D		AS BUILT		
06C	4-2-86	REVISED WHERE INDICATED.		
05C	12-12-85	REVISED WHERE INDICATED		
04C	26-7-85	MOD LINE 2046 & 2056, REMOVE NOTE 1		
03C	11-7-85	AFC		
02A	14-5-85	ISSUE IDC		
01A	25-2-85	first issue PRELIMINARY FOR CFT		

ALWYN TIE-IN

elf

elf aquitaine norge as P.O. Box 168 4001 Stavanger

Installation: TPI
System: GENERAL

PIPING ARRANGEMENT
UPPER LEVEL WEST
EL.37168 ZONE 01
PLANS

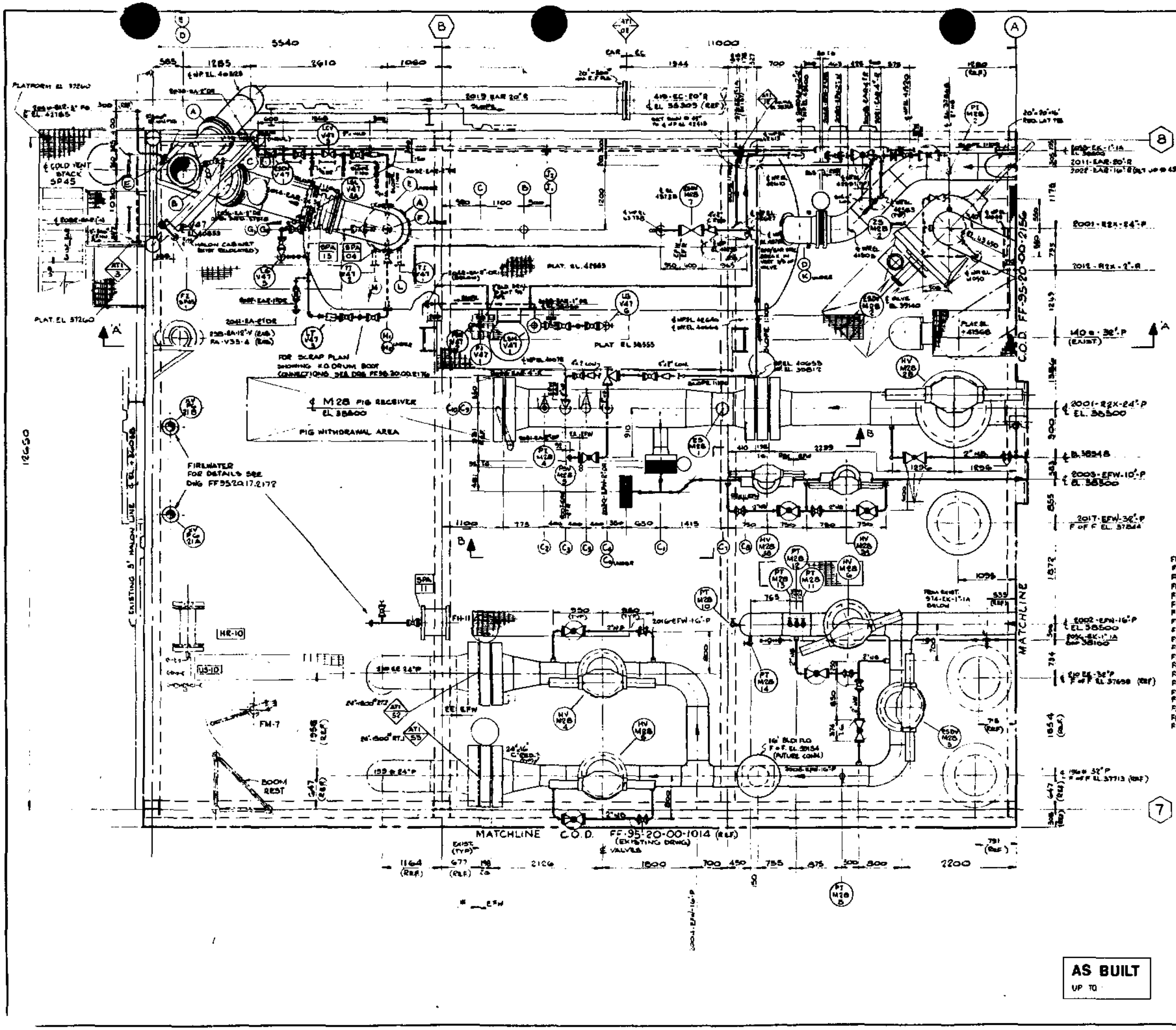
Job no:

Scale: 1:33⅓

FRIGG FIELD

Drwg no: FF 9520002155
Rev: 070

AS BUILT
UP TO :



REFERENCE DRAWINGS.

FF95.20.00.2152	PLOT PLANS
FF95.00.04.5062	P&I.D. COLD VENT K.O. DRUM
FF95.00.12.5055	" ALWYN TIE-IN/TPI CABINET
FF95.00.12.5054	" " " " " " LEAK DET & FLOW CONTROL
FF95.00.12.5056	" " " " " " CONNECTIONS
FF95.00.04.5067	" NEW COLD VENT STACK
FF95.00.01.5065	" INSTRUMENT AIR SYSTEM
FF95.21.25.2258	STRUCTAL - MOD.01 ACCESS PLATFORMS
FF95.20.08.2143	SCHEMATIC LAYOUT OF HYDRAULIC PIPING
FF95.20.08.2144	" " " " "
FF95.20.00.2163	SECTION
FF95.20.00.2176	"
FF95.20.00.2158	P&A. UPPER LEVEL WEST ZONE 01 EL 29840
FF95.20.04.2148	P&A. COLD VENT STACK EL 49460
FF95.20.17.2172	FIREWATER DELUGE SYSTEM
FF95.20.00.2178	PIPING SUPPORT LOCATION PLAN
FF95.20.00.2147	PART PLANS & SECTIONS ZONE 01
FF95.26.04.0002	V47 K.O. DRUM
FF95.26.15.0001	M28 PIG RECEIVER
FF95.26.04.0003	COLD VENT STACK SP.25

rev	date	DESCRIPTION
07D		AS BUILT
06A		REVISED WHERE INDICATED
05K		REVISED WHERE INDICATED
04K		[illegible]
03K		A.F.C.
02A		ISSUE IDC.
01A		PRELIMINARY FOR CPT

ALWYN TIE-IN

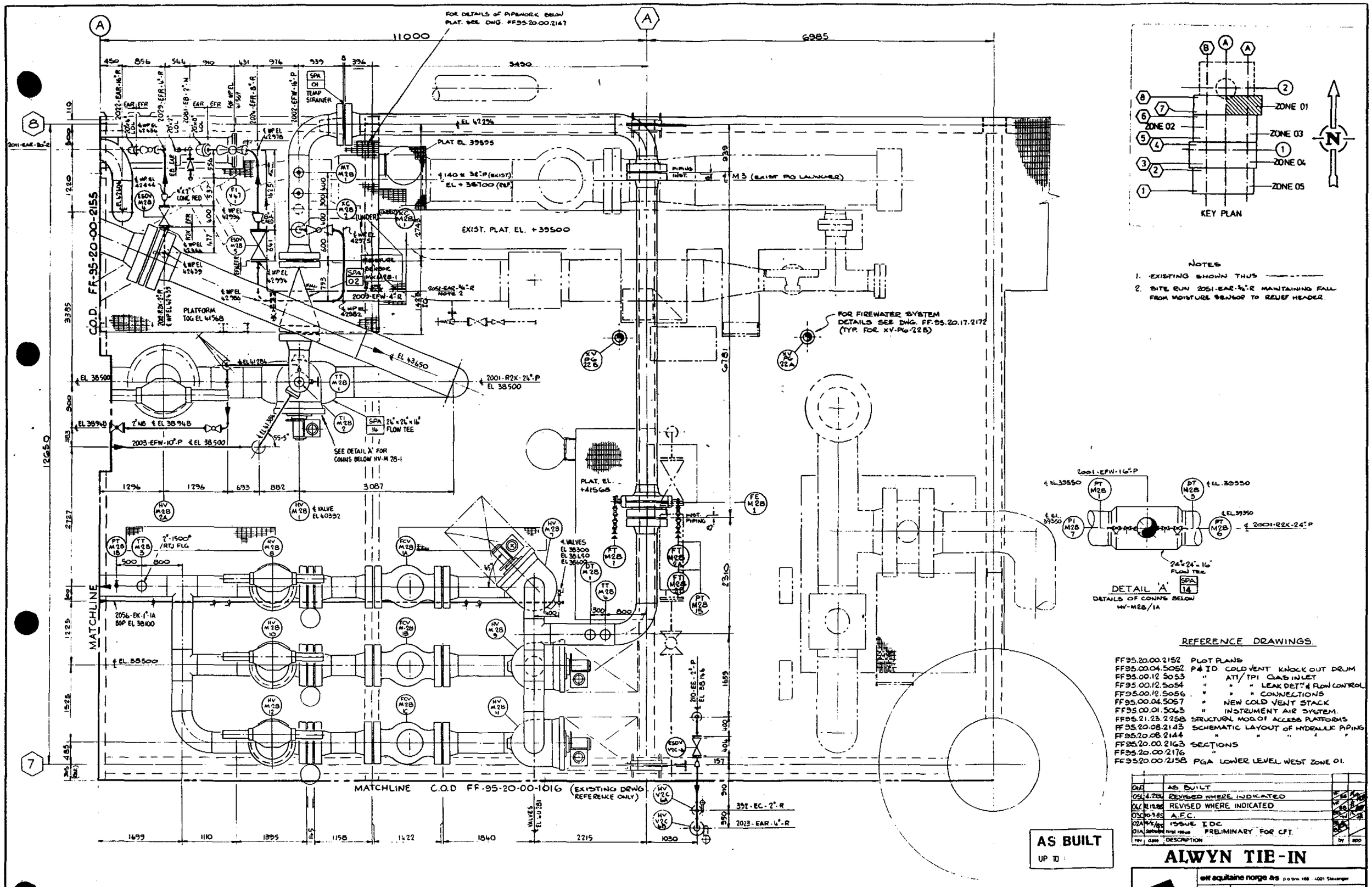
elf aquitaine norge a.s

TPI GENERAL

PIPING ARRANGEMENT UPPER LEVEL WEST EL 37169 ZONE 01 PLANS

1 : 33⅓

FRIGG FIELD FF 95 20002155



NOTES

1. EXISTING SHOWN THUS ——·——·——
2. SITE RUN 2051-EAR-¾"-R MAINTAINING FALL FROM MOISTURE SENSOR TO REUEF HEADER.

REFERENCE DRAWINGS

FF95.20.00.2152	PLOT PLANS
FF95.00.04.5052	P&ID COLD VENT KNOCK OUT DRUM
FF95.00.12.5053	" ATI/TPI GAS INLET
FF95.00.12.5054	" " " LEAK DET'N & FLOW CONTROL
FF95.00.12.5056	" " " CONNECTIONS
FF95.00.04.5057	" NEW COLD VENT STACK
FF95.00.01.5063	" INSTRUMENT AIR SYSTEM.
FF95.21.23.2258	STRUCTURAL MOD.01 ACCESS PLATFORMS
FF95.20.08.2143	SCHEMATIC LAYOUT OF HYDRAULIC PIPING
FF95.20.08.2144	" " " " "
FF95.20.00.2163	SECTIONS
FF95.20.00.2176	"
FF95.20.00.2158	PGA LOWER LEVEL WEST ZONE 01.

REFERENCE DRAWINGS (CONT)

FF95.20.04.2148	PGA. NITROGEN TO SP45
FF95.20.17.2172	FIREWATER DELUGE SYSTEM
FF95.20.00.2179	PIPE SUPT LOCATION PLAN
FF95.20.00.2147	PART PLANS & SECTIONS

rev	date	DESCRIPTION	by	app
06D		AS BUILT		
05C	4.7.86	REVISED WHERE INDICATED		
04C	12.12.85	REVISED WHERE INDICATED		
03C	10.9.85	A.F.C.		
02A	4/5/85	ISSUE I.D.C.		
01A	20/3/85	first issue PRELIMINARY FOR CFT		

AS BUILT UP TO :

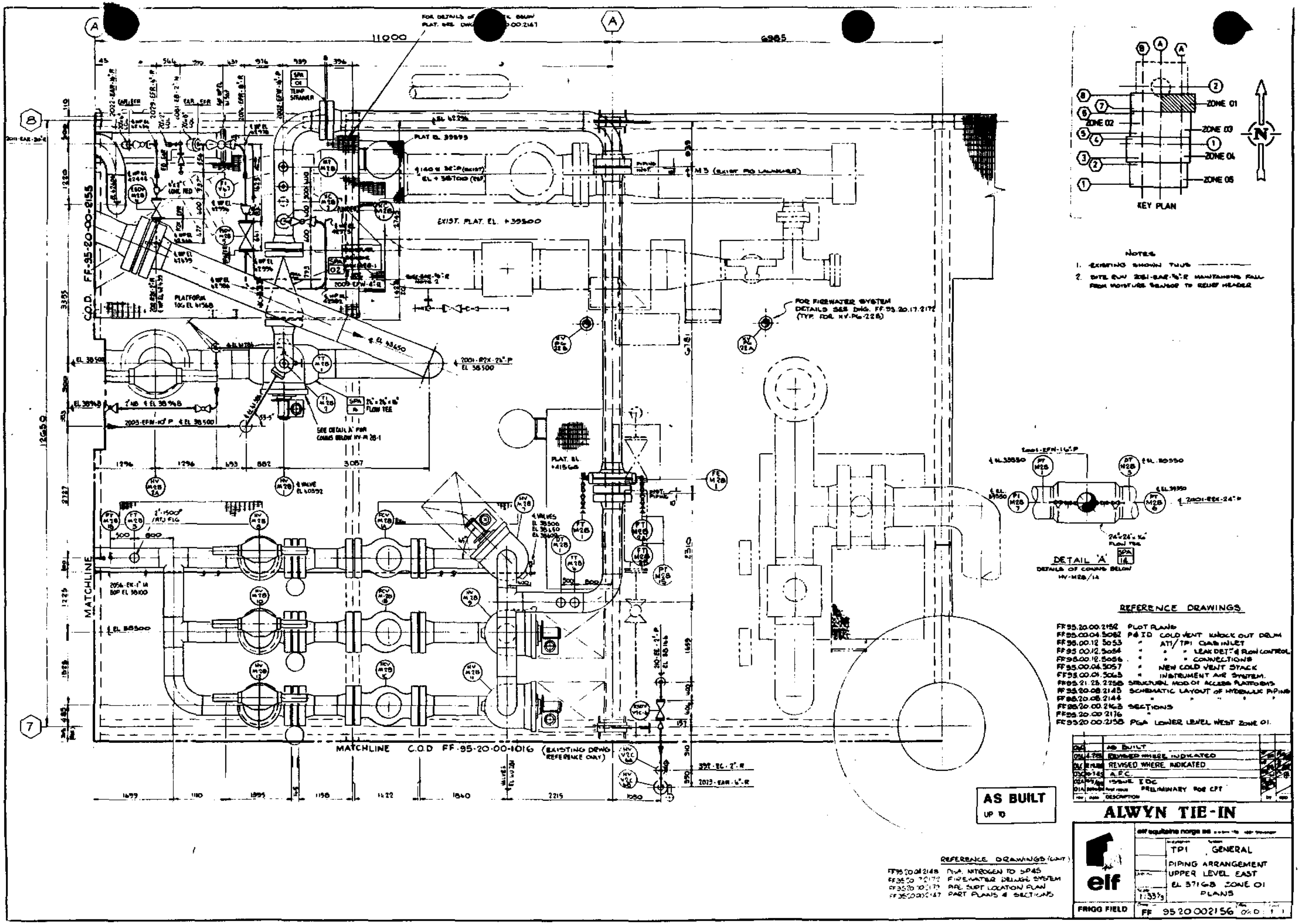
ALWYN TIE-IN

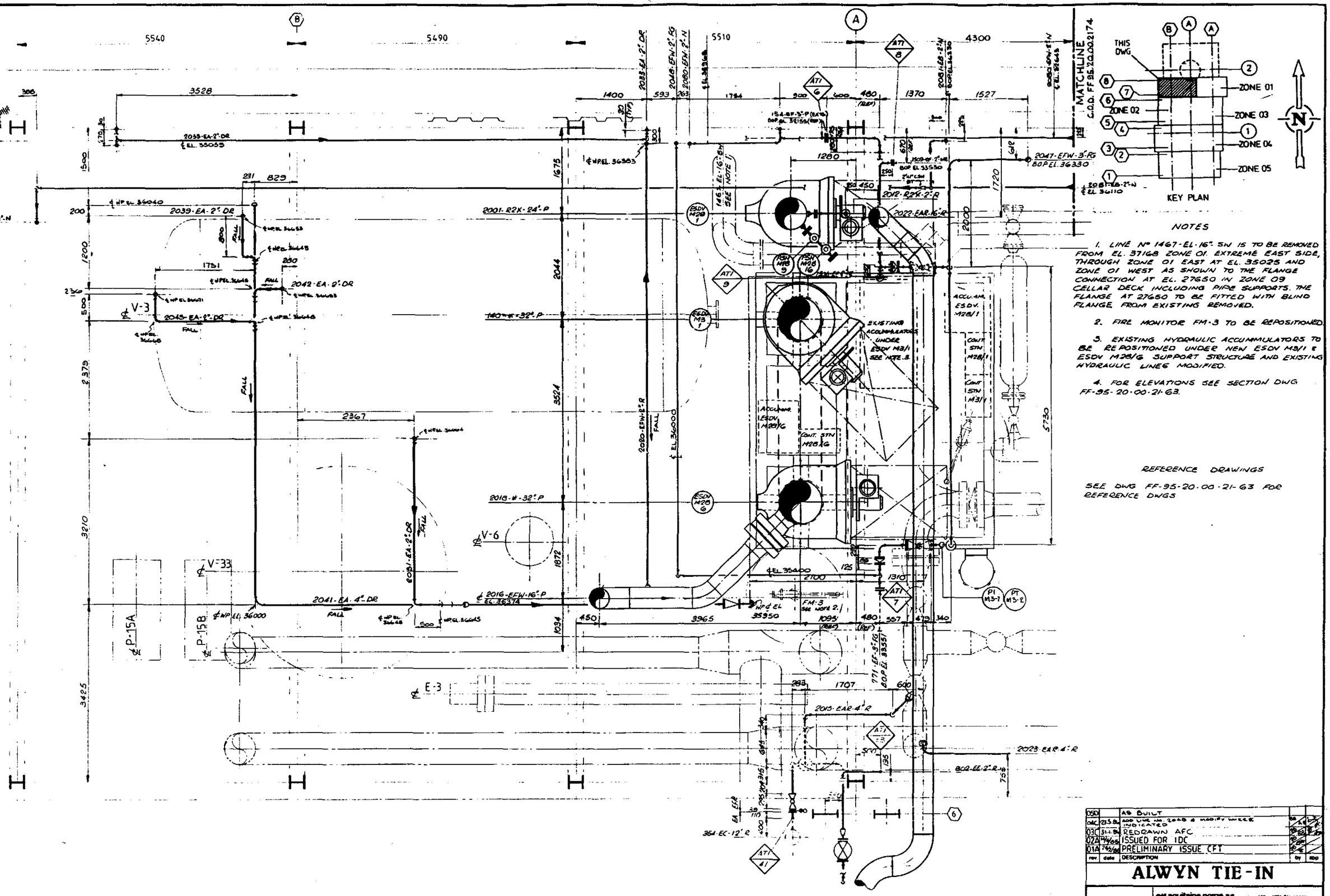
elf aquitaine norge as p.o.box 168 - 4001 Stavanger

elf

FRIGG FIELD

Installation	TPI
System	GENERAL
Job no	
Scale	1:33⅓
	PIPING ARRANGEMENT UPPER LEVEL EAST EL. 37168 ZONE 01 PLANS
Drwg no	FF 95 20 00 2156
Rev	06D
Sheet	1 1


KEY PLAN
ZONE 01
ZONE 02
ZONE 03
ZONE 04
ZONE 05
NOTES
1. EXISTING SHOWN THUS
2. SITE RUN 2051-EAE-¾"-R MAINTAINING FALL FROM MOISTURE SENSOR TO RELIEF HEADER
EXIST. PLAT. EL. +39500
MATCHLINE C.O.D FF-95-20-00-2155
MATCHLINE C.O.D FF-95-20-00-1016 (EXISTING DRWG REFERENCE ONLY)
FOR FIREWATER SYSTEM DETAILS SEE DWG. FF.95.20.17.2172
DETAIL 'A'
DETAILS OF CONNS BELOW HV-M28/1A
REFERENCE DRAWINGS
FF95.20.00.2152 PLOT PLANS
FF95.00.04.5062 P&ID COLD VENT KNOCK OUT DRUM
FF95.00.12.5053 " ATI/TP1 GAS INLET
FF95.00.12.5054 " " " LEAK DET. & FLOW CONTROL
FF95.00.12.5056 " " " CONNECTIONS
FF95.00.04.5057 " NEW COLD VENT STACK
FF95.00.01.5063 " INSTRUMENT AIR SYSTEM.
FF95.21.25.2258 STRUCTURAL MOD. OF ACCESS PLATFORMS
FF95.20.08.2145 SCHEMATIC LAYOUT OF HYDRAULIC PIPING
FF95.20.08.2144 " " " " "
FF95.20.00.2163 SECTIONS
FF95.20.00.2176 "
FF95.20.00.2158 PGA LOWER LEVEL WEST ZONE 01.
REFERENCE DRAWINGS (CONT)
FF95.20.00.2148 PGA. NITROGEN TO SP45
FF95.20.17.2172 FIREWATER DELUGE SYSTEM
FF95.20.10.2173 PIPE SUPT LOCATION PLAN
FF95.20.00.2147 PART PLANS & SECTIONS
AS BUILT
UP TO
04 AS BUILT
03 REVISED WHERE INDICATED
02 REVISED WHERE INDICATED
02 A.F.C.
02A ISSUE IDC
01A PRELIMINARY FOR CPT
rev date DESCRIPTION by app
ALWYN TIE-IN
elf
elf aquitaine norge as
TP1 GENERAL
PIPING ARRANGEMENT
UPPER LEVEL EAST
EL 37168 ZONE 01
PLANS
1:33⅓
FRIGG FIELD
FF 95 20 00 2156



NOTES

1. LINE Nº 1467-EL-16"-SW IS TO BE REMOVED FROM EL. 37168 ZONE 01. EXTREME EAST SIDE, THROUGH ZONE 01 EAST AT EL. 35025 AND ZONE 01 WEST AS SHOWN TO THE FLANGE CONNECTION AT EL. 27650 IN ZONE 09 CELLAR DECK INCLUDING PIPE SUPPORTS. THE FLANGE AT 27650 TO BE FITTED WITH BLIND FLANGE FROM EXISTING REMOVED.

2. FIRE MONITOR FM-3 TO BE REPOSITIONED.

3. EXISTING HYDRAULIC ACCUMMULATORS TO BE REPOSITIONED UNDER NEW ESDV M3/1 & ESDV M28/G SUPPORT STRUCTURE AND EXISTING HYDRAULIC LINES MODIFIED.

4. FOR ELEVATIONS SEE SECTION DWG FF-95-20-00-21-63.

REFERENCE DRAWINGS

SEE DWG FF-95-20-00-21-63 FOR REFERENCE DWGS

rev	date	DESCRIPTION	by	app
05D		AS BUILT		
04C	23.5.86	ADD LINE Nº 2048 & MODIFY WELDS INDICATED	SB	
03C	31.1.86	REDRAWN AFC	SB	
02A	24/6/85	ISSUED FOR IDC	RD	
01A	26/2/85	PRELIMINARY ISSUE CFT	RD	

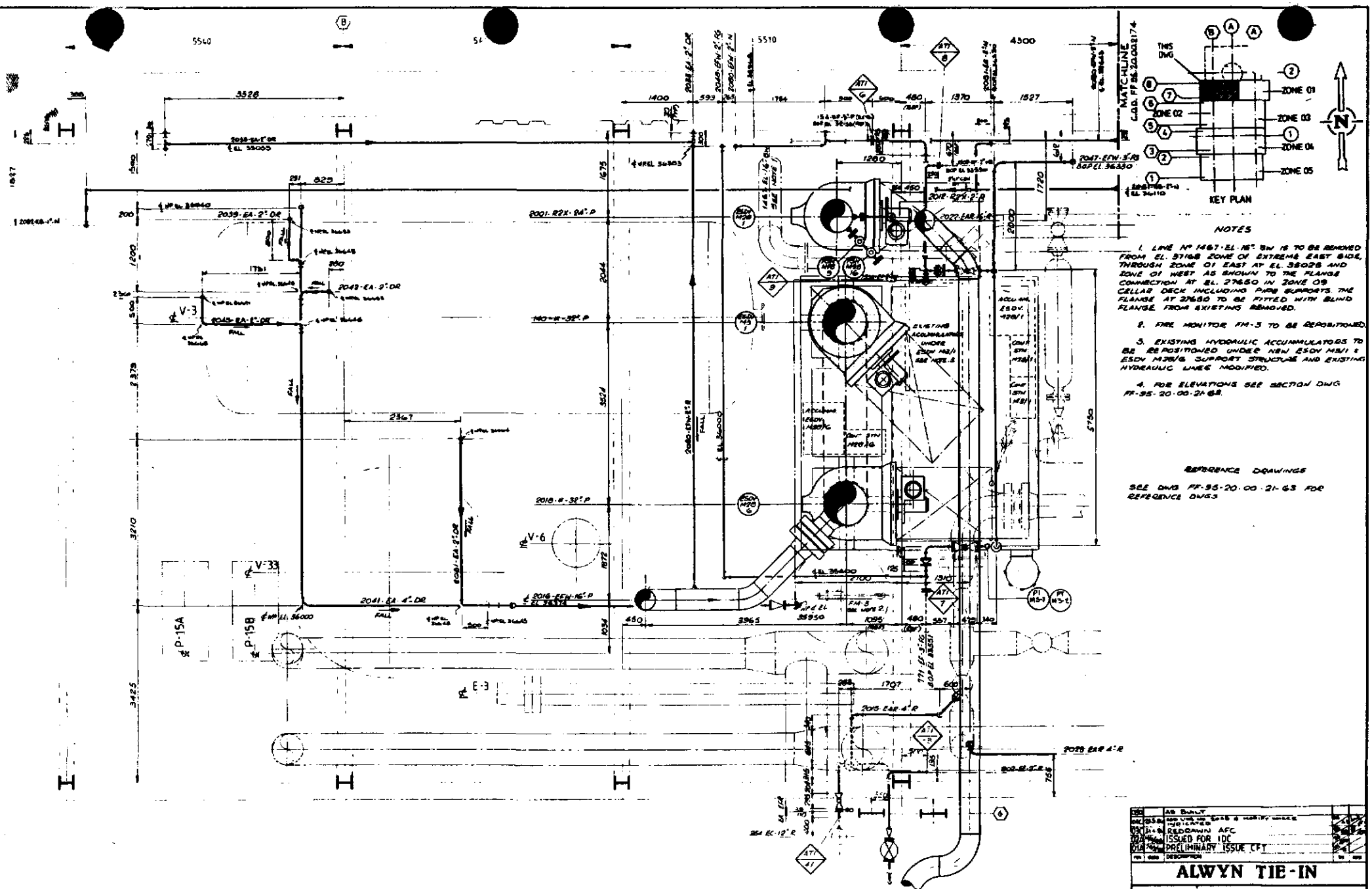
AS BUILT UP TO :

ALWYN TIE-IN

elf aquitaine norge as p.o box 168 - 4001 Stavanger

elf

Installation	TP1
System	GENERAL
	PIPING ARRANGEMENT PLAN
Job no	LOWER LEVEL WEST. EL. 29548
Scale	1:33⅓
	ZONE 01
FRIGG FIELD	Drwg no FF 95 20 00 21 58
Rev	05D
Sheet	- / -



NOTES

1. LINE Nº 1467-EL-16"-SW IS TO BE REMOVED FROM EL. 37168 ZONE 09 EXTREME EAST SIDE, THROUGH ZONE 01 EAST AT EL. 38028 AND ZONE 01 WEST AS SHOWN TO THE FLANGE CONNECTION AT EL. 27650 IN ZONE 09 CELLAR DECK INCLUDING PIPE SUPPORTS. THE FLANGE AT 27650 TO BE FITTED WITH BLIND FLANGE FROM EXISTING REMOVED.

2. FIRE MONITOR FM-3 TO BE REPOSITIONED.

3. EXISTING HYDRAULIC ACCUMMULATORS TO BE REPOSITIONED UNDER NEW ESDV M3/1 & ESDV M3/6 SUPPORT STRUCTURE AND EXISTING HYDRAULIC LINES MODIFIED.

4. FOR ELEVATIONS SEE SECTION DWG FF-95-20-00-21-68.

REFERENCE DRAWINGS

SEE DWG FF-95-20-00-21-63 FOR REFERENCE DWGS

AS BUILT UP TO

	AS BUILT	
	RE-DRAWN AFC	
	ISSUED FOR IDC	
01A	PRELIMINARY ISSUE CFT	
rev	date	description

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elf

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TP1 GENERAL

PIPING ARRANGEMENT PLAN

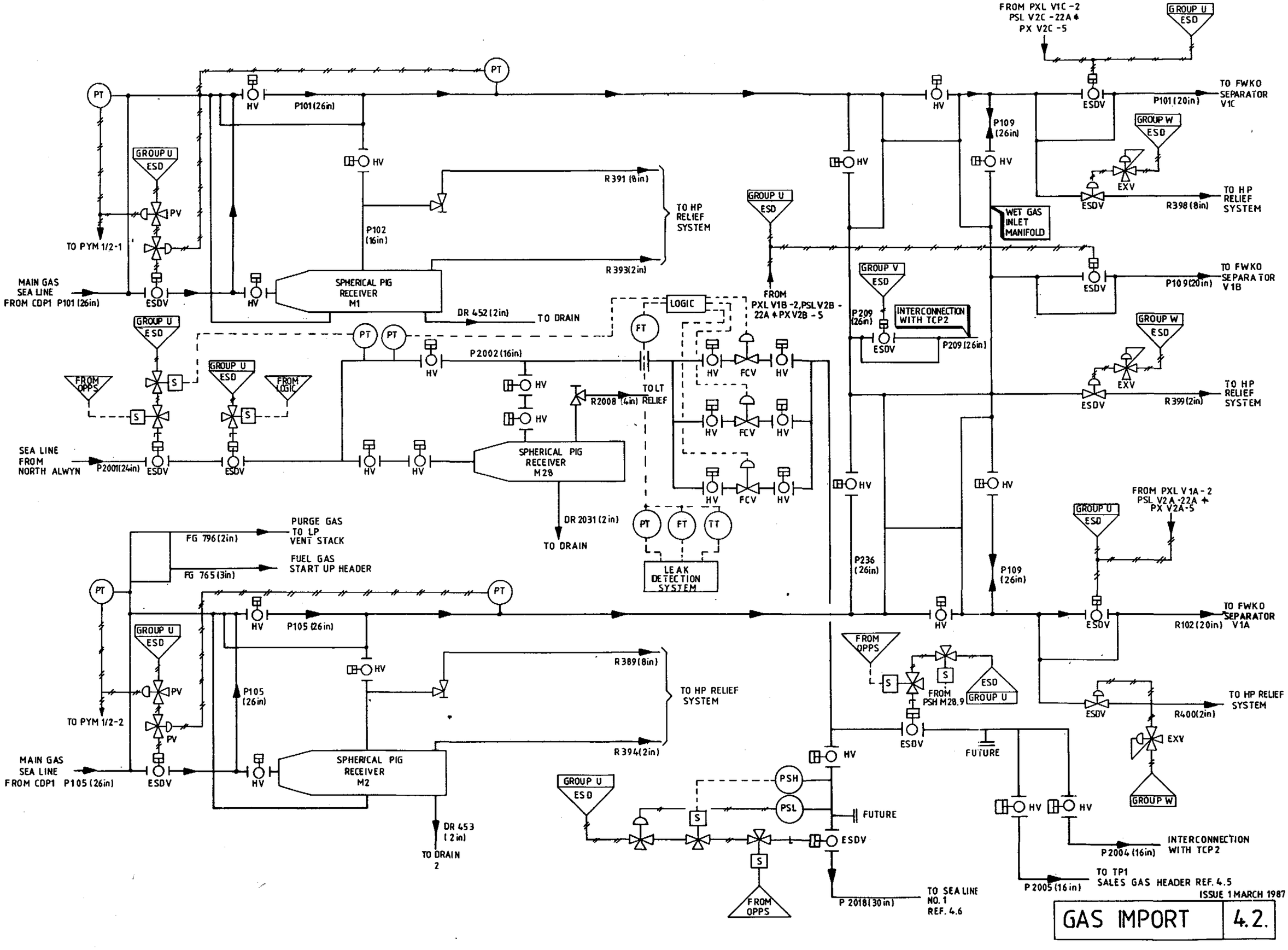
LOWER LEVEL WEST EL 29543

ZONE 01

Scale 1:35½

FRIGG FIELD

Drwg no FF 95 20 00 21 58 Rev 05 O



ISSUE 1 MARCH 1987

GAS IMPORT	4.2.

NOTES

1 EQUIPMENT ENCHANGED BY / ..O BE MODIFIED ACCORDING TO FOLLOWING OPERATING CL
- MAX / MIN OPERATING TEMPERATURE + 37 / - 92°C
- MAX OPERATING PRESSURE 153 BAR A
OTHERWISE THE EQUIPMENT IS EXISTING AS INDICATED

2 EXISTING ARRANGEMENT TYPICAL FOR V2A / B / C AND CV3A / B / C

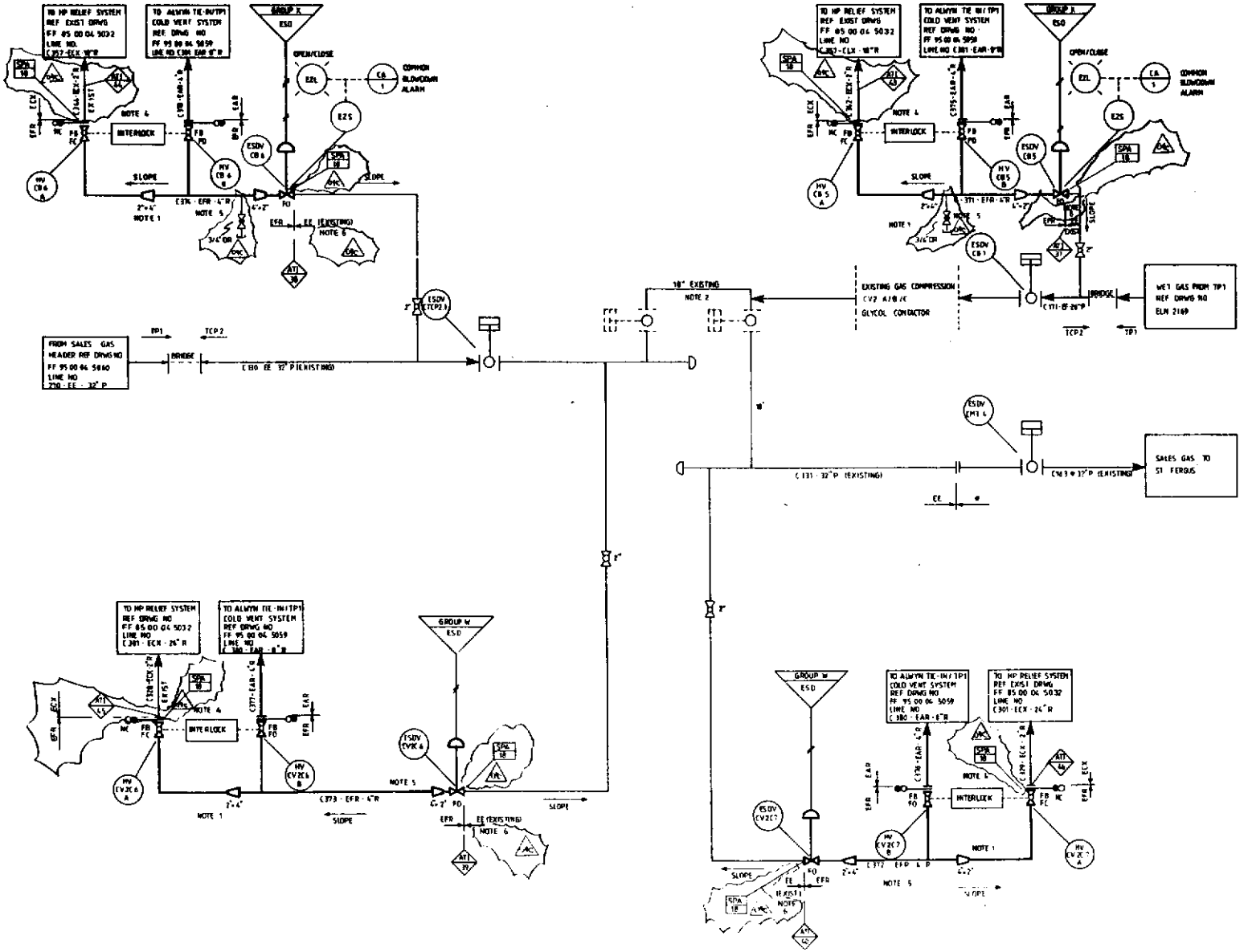
3 REF EXIST P&I.ID'S ON TP1
FF 95 00 13 5004
FF 95 00 09 5005
FF 95 00 12 5006

REF EXIST P & I.D'S ON TCP2
ELN 2169 - C 4009
C 4010
C 4011

4 INTERLOCK TO BE MANUALLY POSITIONED ON INSTRUCTIONS FROM CCR BOTH RELIEF SYSTEMS CAN NOT BE ACCESSABLE AT THE SAME TIME IN CASE OF COLD GAS IN THE SDH'S ONLY THE COLD VENT SYSTEM SHALL BE ACCESSABLE

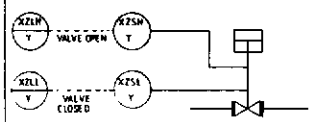
5 PIPING DOWNSTREAM ESDV TO HAVE 8 DIAM. OF STRAIGHT RUN AND TO BE OF MIN. SCH 160 FOR MIN 8 DIAM. TO REDUCE NOISE AND VIBRATION PROBLEMS

6 EXISTING LINE IS TO BE MATERIAL FOR PIPES, VALVES ETC BUT OPERATING, DESIGN & HYDROTEST PRESSURES WERE IN ACCORDANCE WITH EE SPEC



FORMAT FOR VALVE STATUS

X : E OR H
Y : TAG NO



D.C.	19.3.86	UPDATED & ISSUED FOR CONSTRUCTION	
DA	28.8.85	REMOVED PILOT VALVES	
01A	29.5.85	REV ACC TO TOC	
no.	date	DESCRIPTION	by

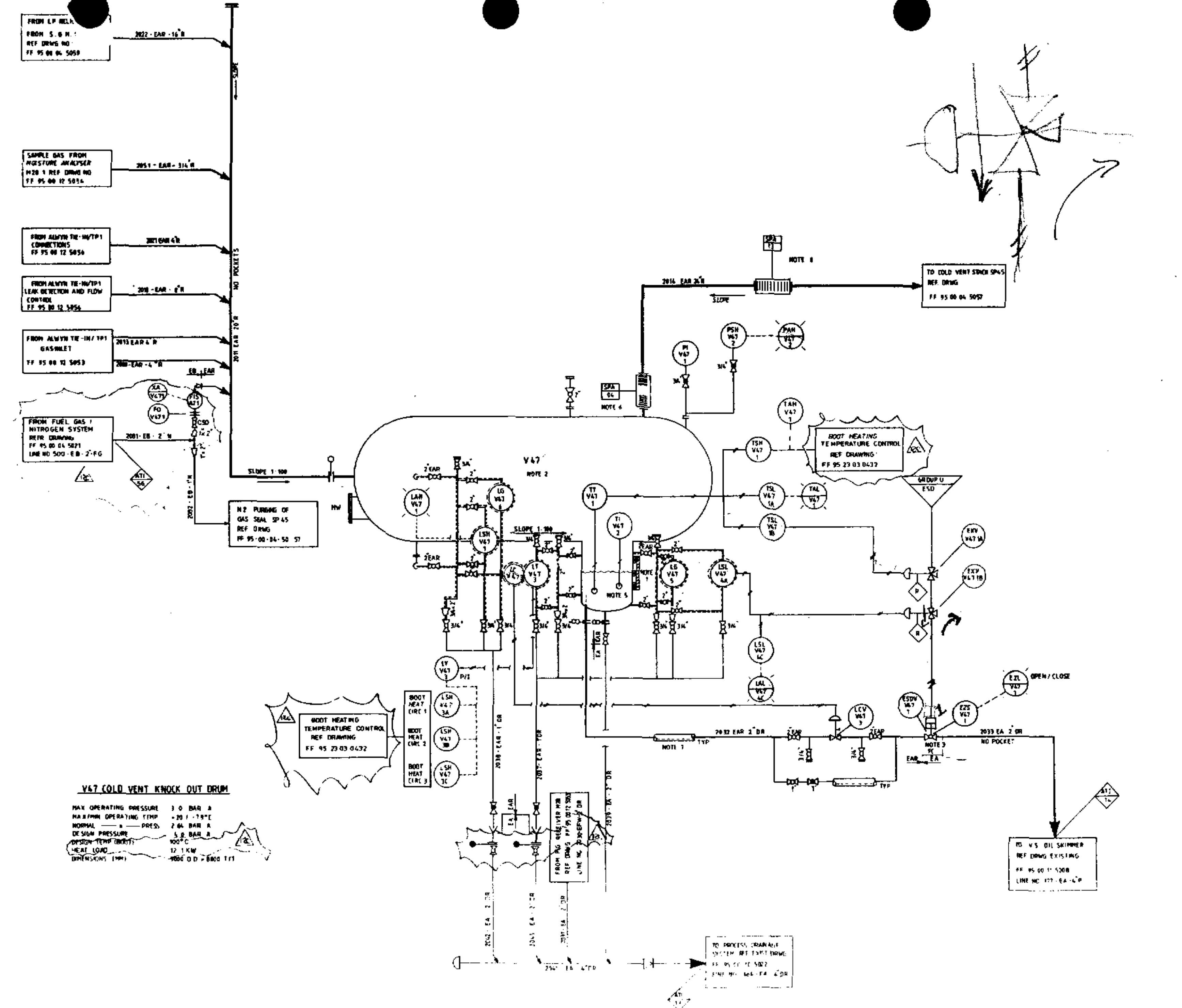
ALWYN TIE-IN

elf

elf aquitaine norge as

A1	TCP2 COLD VENT
	PIPING AND INSTRUMENT DIAGR
Dwg no	EXISTING BLOWDOWN VALVE CONNECTIONS
Scale	ON TIE-IN SALES GAS HEATERS TO ALWYN TIE-IN / TP1 COLD VENT SYSTEM

FRIGG FIELD | FF 85 00 04 5005 | 04F



NOTES

NOTE 1 . BOOT ELECTRICALLY ...ATED & INSULATED

NOTE 2 COLD VENT KNOCK OUT DRUM TO BE GUARDED FOR PERSONNEL PROTECTION AGAINST COLD TEMPERATURE

NOTE 3 : LOCATE AT MINIMUM DISTANCE FROM LCV

NOTE 4 : CONDENSATE HEATING FACILITIES TRACE HEATING

NOTE 5 : THERMOSTATIC CONTROL OF HEAT TRACING

NOTE 6 : BELLOWS REF LIST OF SPECIAL PIPE ITEMS DOC NO ALW - 20-L027

NOTE 7 LINE TO BE TRACE HEATED & INSULATED TO SPEC BREAK

V47 COLD VENT KNOCK OUT DRUM

MAX OPERATING PRESSURE	3 0 BAR A
MAX/MIN OPERATING TEMP	+20 / -79°C
NORMAL —— " —— PRESS	2 46 BAR A
DESIGN PRESSURE	5 0 BAR A
DESIGN TEMP (BOOT)	100°C
HEAT LOAD	12 1 KW
DIMENSIONS (MM)	9000 O D × 8800 T/T

11A	19 7 85	REV ACC TO IDC	/PH
10 A	26 6 85	REV ACC TO ATI / TON COMM	/PH
09B	22 3 85	REV ACC TO TON COMM	
08A	5 3 85	REV ACCORDING TO IDC MEETING	
07A	17 2 85	REV ACC TO IDC AND TON COMMENTS	
06A	25 1 85	REV ACCORDING TO IDC	
05A	16 1 85	REV ACCORDING TO IDC COMMENTS	
04A	21 12 84	REV ACCORDING TO IDC COMMENTS	
03A	12 11 84	COMMENTS FROM IDC INCORPORATED/NEW REV SYST INCORPORATED	
2	3 8 84	REV ACCORDING TO INSTR / GENERAL COMMENTS	
12C	20 3 86	UPDATED & ISSUED FOR CONSTRUCTION	PH
	3 7 86	REV ACCORDING TO TON COMMENTS	

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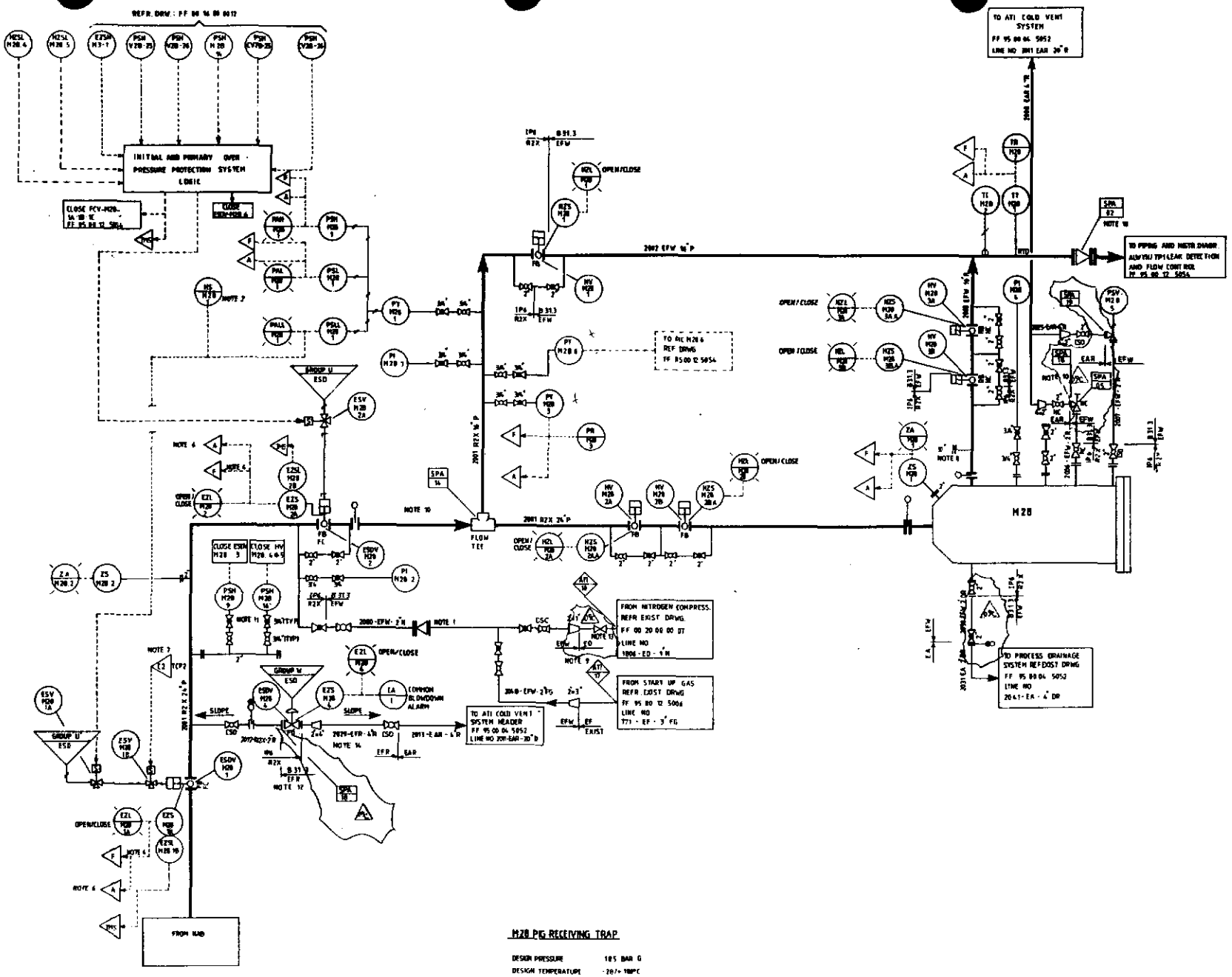
Size A1 TP1 COLD VENT

PIPING AND INSTRUMENT DIAGRAM

COLD VENT KNOCK OUT DRUM

FRIGG FIELD FF 95 00 04 50 52 12C 1 1



M28 PIG RECEIVING TRAP

DESIGN PRESSURE	185 BAR G
DESIGN TEMPERATURE	-20/+ 100°C
OPERATING PRESSURE	180.3 BAR G
OPERATING TEMPERATURE	4 °C

NOTES

NOTE 1: PRESSURIZATION OF PIPE SE... ...9-M28.1 ESDV-M28.3 BY FRIGG GAS AND N2 COMPRESSOR

NOTE 2: MAY BE OPERATED FROM QR IN THE EVENT OF ALWYN (NAD) MISINFORMATION
RTD - RESISTANCE TEMP. DETECTOR

NOTE 3: -FULL BORE OR REDUCED BORE - TO/BS
- FAIL OPENED / FAIL CLOSED - FO / FC NC - NORMALLY CLOSED
-CSO - CAP SEALED OPEN RTD RESISTANCE TEMP DETECTOR

NOTE 4: COMMON SIGNALS DENOTING ESD VALVE STATUS WILL BE SENT TO ALWYN AND ST FERGUS VIA THE TROPOSPHERIC LINK UNDER THE FOLLOWING CONDITIONS :-
A: TRANSFER LINE IN OPERATION
-A COMMON 'OR' SIGNAL WILL BE TRANSMITTED IF EITHER ESDV-M28.1 OR 2 OR 6 ARE CLOSED WHILST HV-M28.6 IS NOT CLOSED
-A1 A COMMON 'AND' SIGNAL WILL BE TRANSMITTED WHEN ESDV-M28.1 AND 2 AND 6 ARE NOT CLOSED WHILST HV-M28.6 IS NOT CLOSED.
B: TOPSIDE BACK-UP LINE IN OPERATION
-B A COMMON 'OR' SIGNAL IF EITHER ESDV-M28.1 OR 2 OR 3 ARE CLOSED WHILST EITHER HV-M28.6 OR 5 ARE NOT CLOSED
-B1 A COMMON 'AND' SIGNAL WHEN ESDV-M28.1 AND 2 AND 3 ARE NOT CLOSED WHILST HV-M28.6 OR 5 ARE NOT CLOSED.

NOTE 5: SLUGE-NO POCKETS

NOTE 6: SIGNAL SEPARATELY MULTIPLEXED TO OP CONTROL ROOM FOR TRANSMISSION TO ALWYN

NOTE 7: SHUTDOWN SIGNAL FROM SECONDARY OVERPRESSURE PROTECTION PLC'S ON TOP2

NOTE 8: PROVISION FOR PIPELINE DEWATERING

NOTE 9: THE MAXIMUM PRESSURE OF THE EXISTING N2 RESERVOIR IS NOW 180 BAR A AFTER BEING MODIFIED

NOTE 10: REF LIST OF SPECIAL PIPE ITEMS
DOC NO ALW-20-L022

NOTE 11: PSH - M28 16 CLOSES HV-M28 6 & 5 IF P= 153.1 BARG
REF DRWG NO FF 95 00 12 5056
PSH-M28 9 CLOSES ESDV-M28 3 IF P= 153.1 BARG

NOTE 12: THE MOST STRINGENT DESIGN CODE SHALL APPLY FOR THE VALVE

NOTE 13: THIS VALVE TO BE POSITIONED ADJACENT TO NITROGEN HEADER 1806-ED-1"N

NOTE 14: REMINDER TO BE POSITIONED ADJACENT TO ESDV-M28 4. PIPING DOWNSTREAM ESDV-M28 4 TO HAVE MIN 8 DIAM STRAIGHT RUN AND TO BE OF MIN SCH 160 FOR MIN 8 DIAM TO REDUCE NOISE & VIBRATION PROBLEMS

FORMAT FOR VALVE STATUS

X = E OR W
Y = TAG NUMBER

05A	27.6.95	REV ACC TO ATI/TOM COMMENTS
06A	29.7.95	REV ACCORDING TO TOM COMMENTS
06A	5.7.95	REV ACCORDING TO IDC MEETING TOM COMMENTS
06A	31.8.95	REV. ACCORDING TO TOM COMMENTS
09A	25.10.95	REV ACCORDING TO IDC COMMENTS
09C	20.12.95	UPDATED & ISSUED FOR CONSTRUCTION
08A	12.7.95	REV ACC TO IDC

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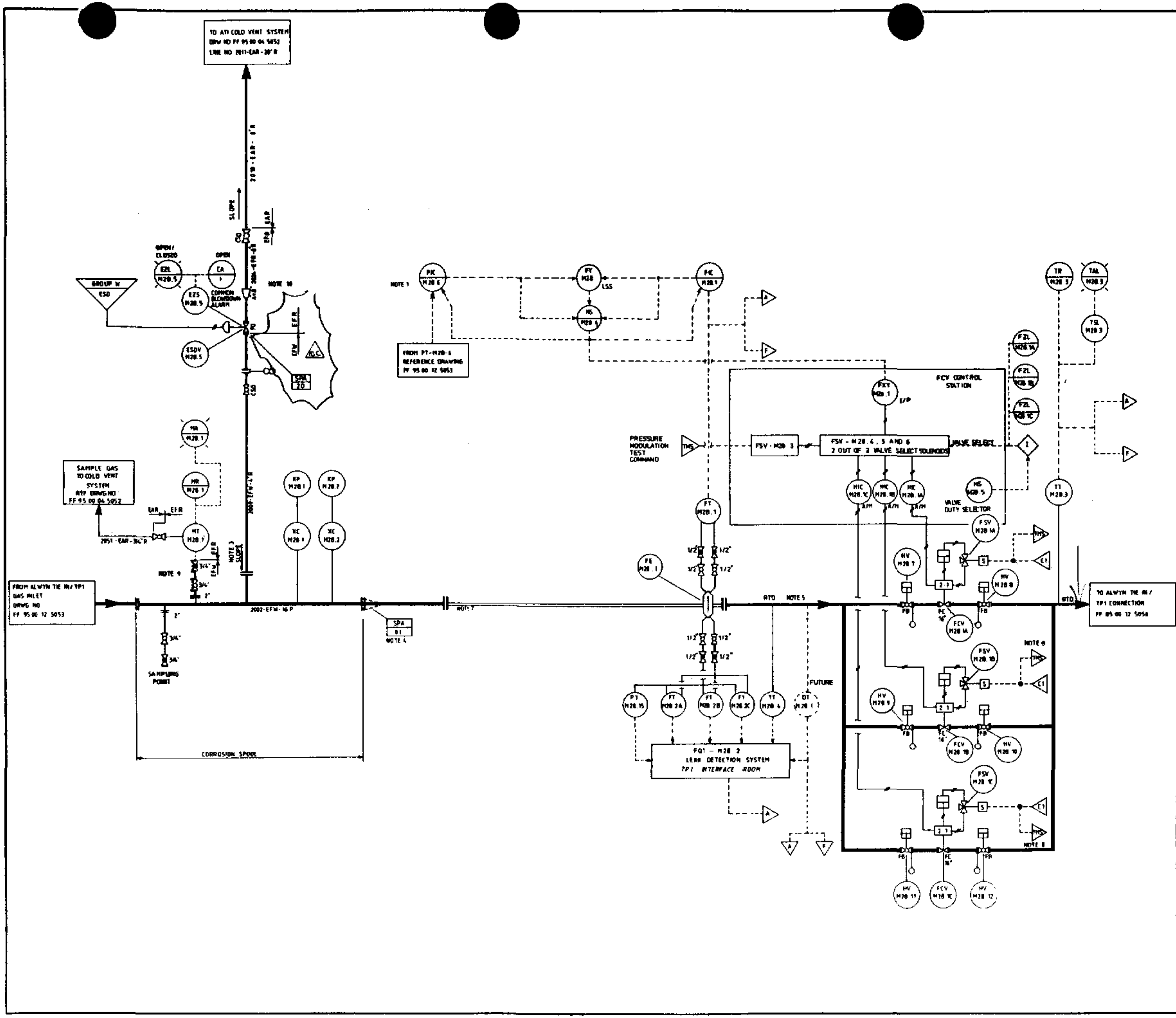
Size A1 — ATI GAS TP1 TO SALES GAS HEADERS

PIPING AND INSTRUMENT DIAGRAM

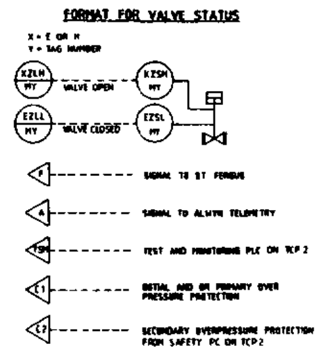
ALWYN TIE-IN / TP1
GAS INLET

FRIGG FIELD FF 95 00 12 50 53



NOTES

1. PRESSURE CONTROL ABOVE ... AND HC CONDENSATION IN ALWYN PIPE LINE UNDER CONDITIONS OF LOW DEMAND
2. - FULL BORE OR REDUCED BORE - FB/RB
   - FAIL OPEN / FAIL CLOSED - FO/FC
   - CAR SEALED OPEN - CSO
   - RTD - RESISTANCE TEMP DETECTOR
3. SLOPE - NO POCKETS
4. TEMPORARY STRAINER TO BE INSTALLED AT CORROSION SPOOL FOR INITIAL START-UP REF LIST OF SPECIAL PIPING ITEMS. DOC.NO ALW-28-L022
5. THERMOWELL ASSOCIATED WITH TT-M28.4 & PROBE OF DT-M28-1 SHALL BE LOCATED AT LEAST 3 DIAMETERS DOWNSTREAM OF FE-M28-1
6. SIGNAL SEPARATELY MULTIPLEXED TO QP CONTROL ROOM FOR TRANSMISSION TO ALWYN
7. LEAK DETECTION STRAIGHT UPSTREAM PIPE = 17 DIAMETERS
8. COMMON MONITORING BY INITIATION RELAY CONTACT
9. ELECTRICAL HEAT TRACE VALVES AND IMPULSE PIPEWORK
10. EXPANDER TO BE POSITIONED ADJACENT TO ESDV-M28.5. PIPING DOWNSTREAM ESDV-M28.5 TO HAVE MIN. 8 DIAM. STRAIGHT RUN AND TO BE OF MIN SCH 160 FOR MIN 8 DIAM. TO REDUCE NOISE & VIBRATION PROBLEMS



rev	date	DESCRIPTION	by	app
IDC	20.3.86	UPDATED & ISSUED FOR CONSTRUCTION	KB	
04A	10.1.86	FT - M28 2C ADDED	FPH	
03A	27.7.85	REV ACC TO FLOW CONTROL	FPH	
02A	27.6.85	REV ACC TO ATI/TOM COMMENTS	FPH	
06A	29.3.85	REV ACC TO TOM COMMENTS	SB	
05A	23.2.85	REDRAWN ISSUE FOR IDC TOM COMMENTS	FB	

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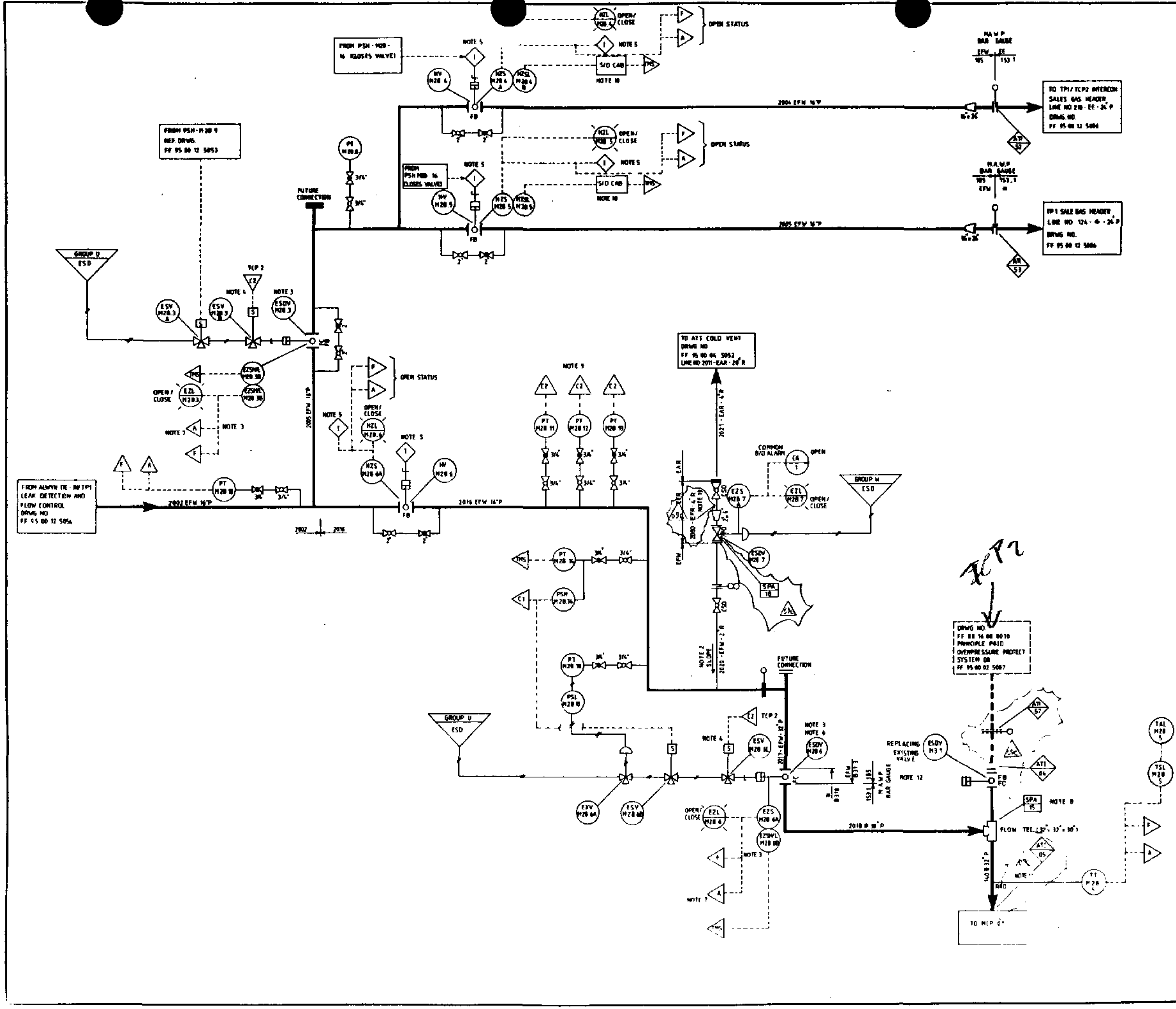
A1 | TP1 | ATI GAS TO SALES GAS HEADER

PIPING AND INSTRUMENT DIAGRAM
ALWYN TIE IN / TP1
LEAK DETECTION AND FLOW CONTROL

FRIGG FIELD | FF 95 00 12 5054 | IDC



NOTES

1. - FULL BORE OR REDUCED BORE - FB/RB
   - FAIL OPEN / CLOSE - FO / FC
2. SLOPE NO POCKETS.
3. COMMON SIGNAL 1 ESD VALVE STATUS WILL BE SENT TO ALWYN & ST FERGUS VIA THE TROPOSPHERIC LINK UNDER THE FOLLOWING CONDITIONS:

   A) TRANSFER LINE IN OPERATION
   1. A COMMON 'OR' SIGNAL WILL BE TRANSMITTED IF EITHER ESDV - M20 - 1, OR 2, OR 6 ARE CLOSED WHILST HV - M20 - 6 IS NOT CLOSED
   2. A COMMON 'AND' SIGNAL WILL BE TRANSMITTED WHEN ESDV - M20 - 1 AND 2 AND 6 ARE NOT CLOSED WHILST HV - M20 - 6 IS NOT CLOSED.

   B) TIEBACK BACK - UP LINE IN OPERATION
   1. A COMMON 'OR' SIGNAL WILL BE TRANSMITTED IF EITHER ESDV - M20 - 1 OR 2 OR 3 ARE CLOSED WHILST EITHER HV - M20 - 4, 5 ARE NOT CLOSED
   2. A COMMON 'AND' SIGNAL WILL BE TRANSMITTED WHEN ESDV - M20 - 1 AND 2 AND 3 ARE NOT CLOSED WHILST HV - M20 - 4 OR 5 ARE NOT CLOSED
4. SHUTDOWN SIGNAL FROM SECONDARY OVERPRESSURE PROTECTION PLC'S ON TCP2
5. HV - M20 - 6 MAY ONLY BE OPENED IF HV - M20 - 4 AND 5 ARE CLOSED ALSO IF HV - M20 - 6 IS NOT CLOSED NEITHER HV - M20 - 4 OR HV - M20 - 5 MAY BE OPENED.
6. ESDV M20 6 IS TO BE LOCATED AS CLOSE TO THE FLOW TEE AS IS PRACTICAL
7. SIGNAL SEPARATELY MULTIPLEXED TO QP CONTROL ROOM FOR TRANSMISSION TO ALWYN.
8. REF LIST OF SPECIAL PIPE ITEMS DOC NO ALW - 20 - 1072
9. ALWYN COMPRESSORS SHALL NOT BE TRIPPED BY THE SECONDARY OVERPRESSURE PROTECTION SYSTEM IF ALWYN GAS IS FLOWING IN THE TRANSFER LINE
10. IN THE EVENT OF EITHER HV - M20.4 OR 5 BEING NOT FULLY CLOSED WHEN THE INITIAL OVERPRESSURE PROTECTION SYSTEM ON TP1 IS ACTUATED, ESDV - M20 2 AND FCV'S M20 1A, 1B AND 1C WILL BE CLOSED REF DRWG NO FF 00 16 00 0011
11. SKIN TEMPERATURE ELEMENT SURFACE MOUNTED NOT IN LINE
12. THE MOST STRINGENT DESIGN CODE SHALL APPLY FOR THE VALVE
13. EXPANDER TO BE POSITIONED ADJACENT TO ESDV - M20. 7. PIPING DOWNSTREAM ESDV - M20 7 TO HAVE MIN. 8. DIAM STRAIGHT RUN & TO BE OF MIN. SCH 160 FOR MIN 6. DIAM TO REDUCE NOISE & VIBRATION PROBLEMS

FORMAT FOR VALVE STATUS

X = E OR H
Y = TAG NUMBER

XZLH / MY — VALVE OPEN
XZLL / MY — VALVE CLOSED

F - - - - - SIGNAL TO ST FERGUS TELEMETRY
A - - - - - SIGNAL TO ALWYN TELEMETRY
TMS - - - - - TEST AND MONITORING P.C. ON TCP2
C1 - - - - - INITIAL AND OR PRIMARY OVERPRESSURE PROTECTION
C2 - - - - - SECONDARY OVERPRESSURE PROTECTION FROM SAFETY PC ON TCP 2

rev	date	DESCRIPTION		
10A	31 3 85	DIRECT PRESSURE SENSOR ACTIVATION OF ESV M20 6A		
09A	22 7 85	REV ACC TO IDC		
08A	21 6 85	REV. ACC TO ATI/TOM COMMENTS		
05A	29 3 85	REV ACC TO TOM COMM		
04A	11 2 85	REV ACC TO TOM COMMENTS		
03A	25 1 85	REV ACC TO IDC COMMENTS		
02A	21 12 84	REV ACC TO NEW TRANSFER LINE ARRANG		
01C	20 3 86	UPDATED + ISSUED FOR CONSTRUCTION		
C	26 9 84	first issue		

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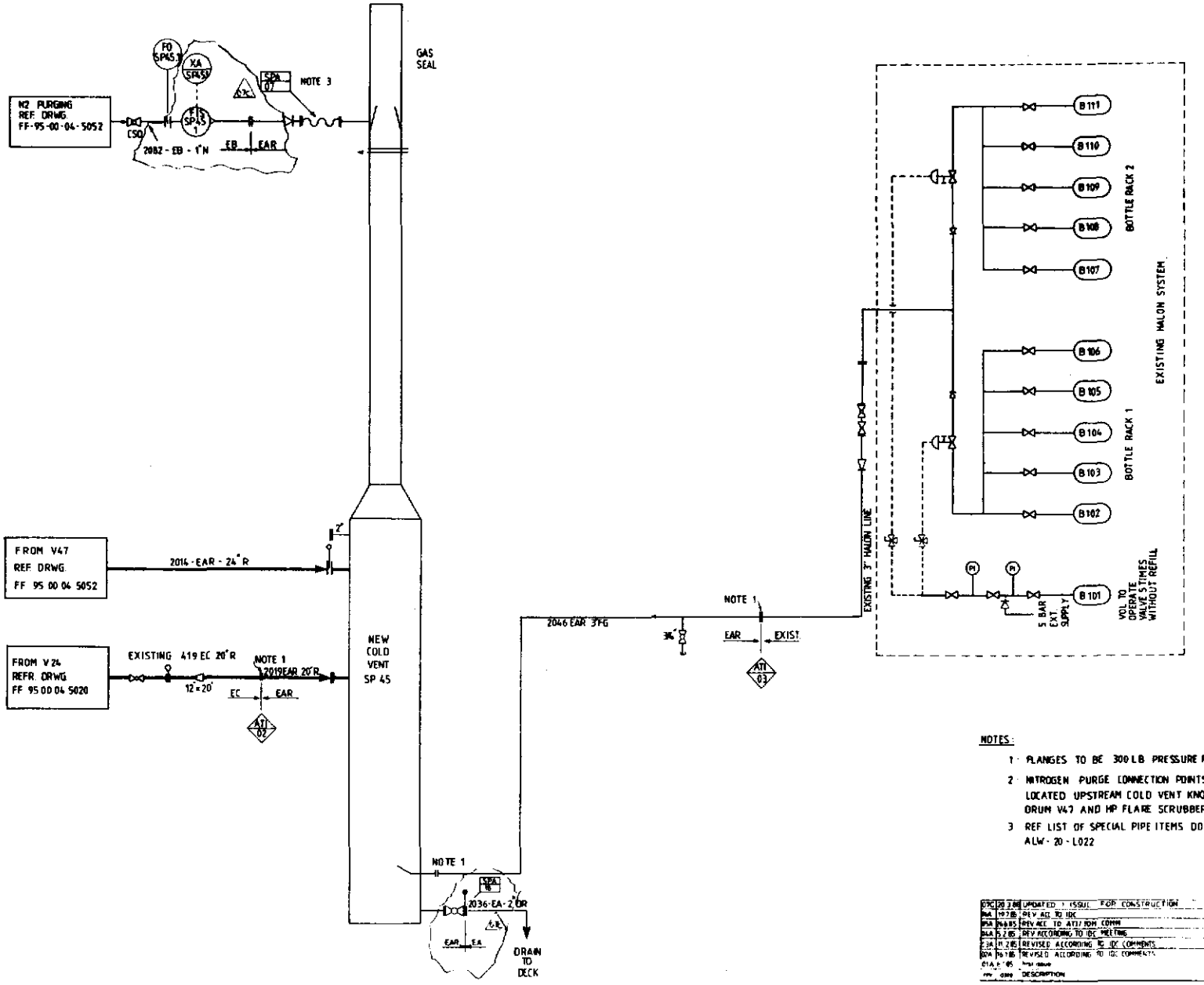
A1 TP1 ATI GAS TO SALE GAS HEADERS

PIPING AND INSTRUMENT DIAGRAM
ALWYN TIE - IN / TP1
CONNECTIONS

elf

FRIGG FIELD FF 95 00 12 50 56



NOTES:

1. FLANGES TO BE 300 LB PRESSURE RATING
2. NITROGEN PURGE CONNECTION POINTS ARE LOCATED UPSTREAM COLD VENT KNOCK OUT DRUM V47 AND HP FLARE SCRUBBER V24
3. REF LIST OF SPECIAL PIPE ITEMS DOC NO: ALW-20-L022

NEW COLD VENT SP45

DESIGN PRESSURE	¼ 2 BAR A
DESIGN TEMPERATURE	- 125°C
MAX / MIN OP TEMPERATURE	+ 20 / - 79°C

07C	20 3 96	UPDATED + ISSUE FOR CONSTRUCTION	
06A	19 7 96	REV ACC TO IDC	
05A	26 6 96	REV ACC TO ATI / KOM COMM	
04A	5 2 96	REV ACCORDING TO IDC MEETING	
03A	31 1 96	REVISED ACCORDING TO IDC COMMENTS	
02A	16 1 96	REVISED ACCORDING TO IDC COMMENTS	
01A	8 1 96	ISSUE	
REV	DATE	DESCRIPTION	

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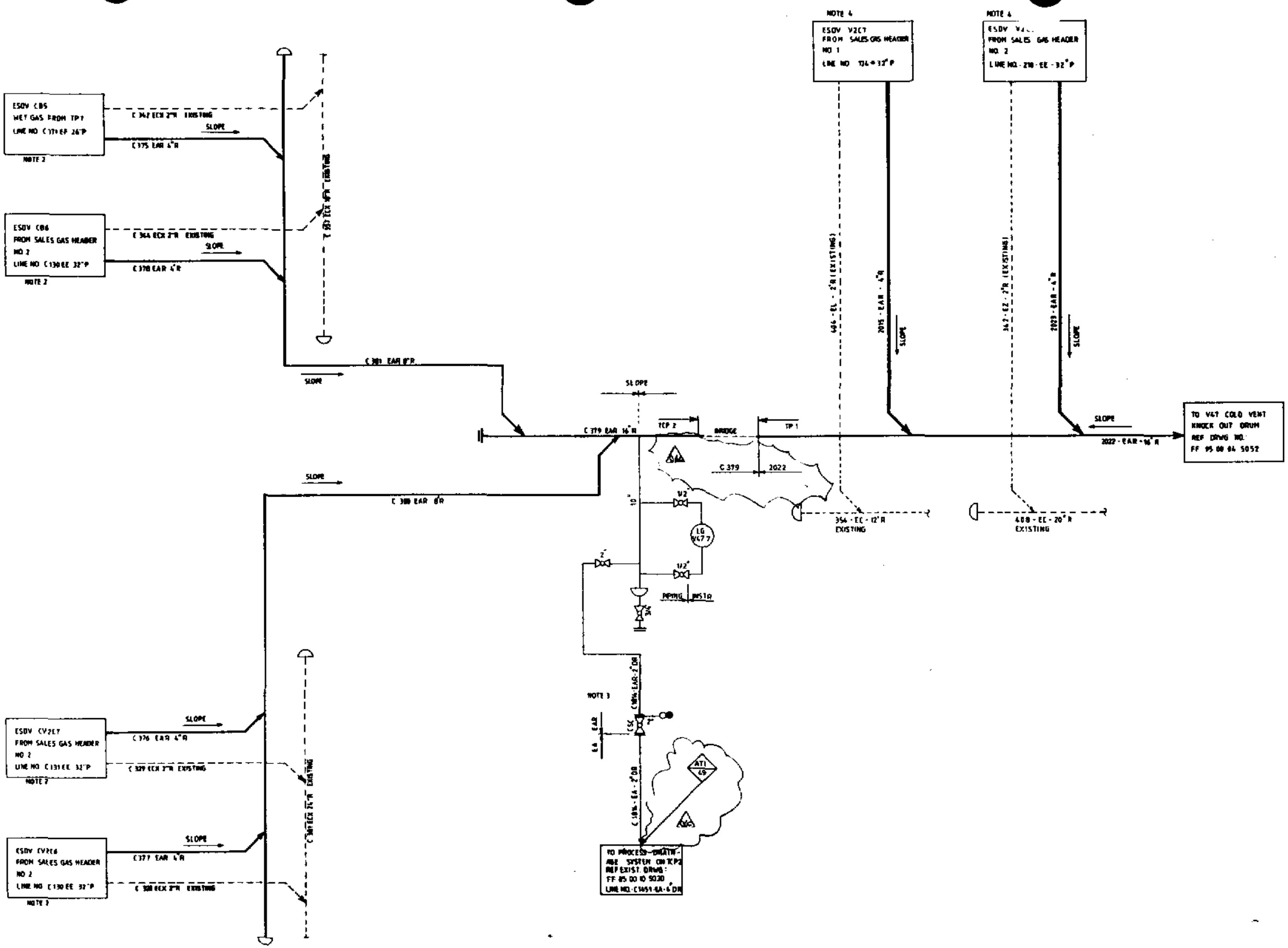
A1 TP1 ATI COLD VENT

PIPING AND INSTRUMENT DIAGRAM

NEW COLD VENT STACK ON TP1

FRIGG FIELD FF 95 00 04 SF 57



NOTES

1. NC – NORMALLY CLOSED
2. REF. DRWG FF 95 00 04 5005
3. DRAINING OF TP1 / TCP 2 COLD GAS RELIEF HEADER TO BE PERFORMED ACCORDING TO OPERATING PROCEDURES
4. REF DRWG FF 95 00 04 5064

rev	date	DESCRIPTION	by	app
06C	10.3.06	UPDATED AND ISSUED FOR CONSTRUCTION		
05A	2.9.05	DRAIN SYSTEM MODIFIED		
04A	19.7.05	REV ACC TO IDC		
03A	28.6.05	REV ACC TO ATS / TOM COMM		
02A	9.3.05	REV. ACC TO IDC		
01A	25.2.05	first issue FOR IDC	TB	

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A1 — TP1 — COLD VENT

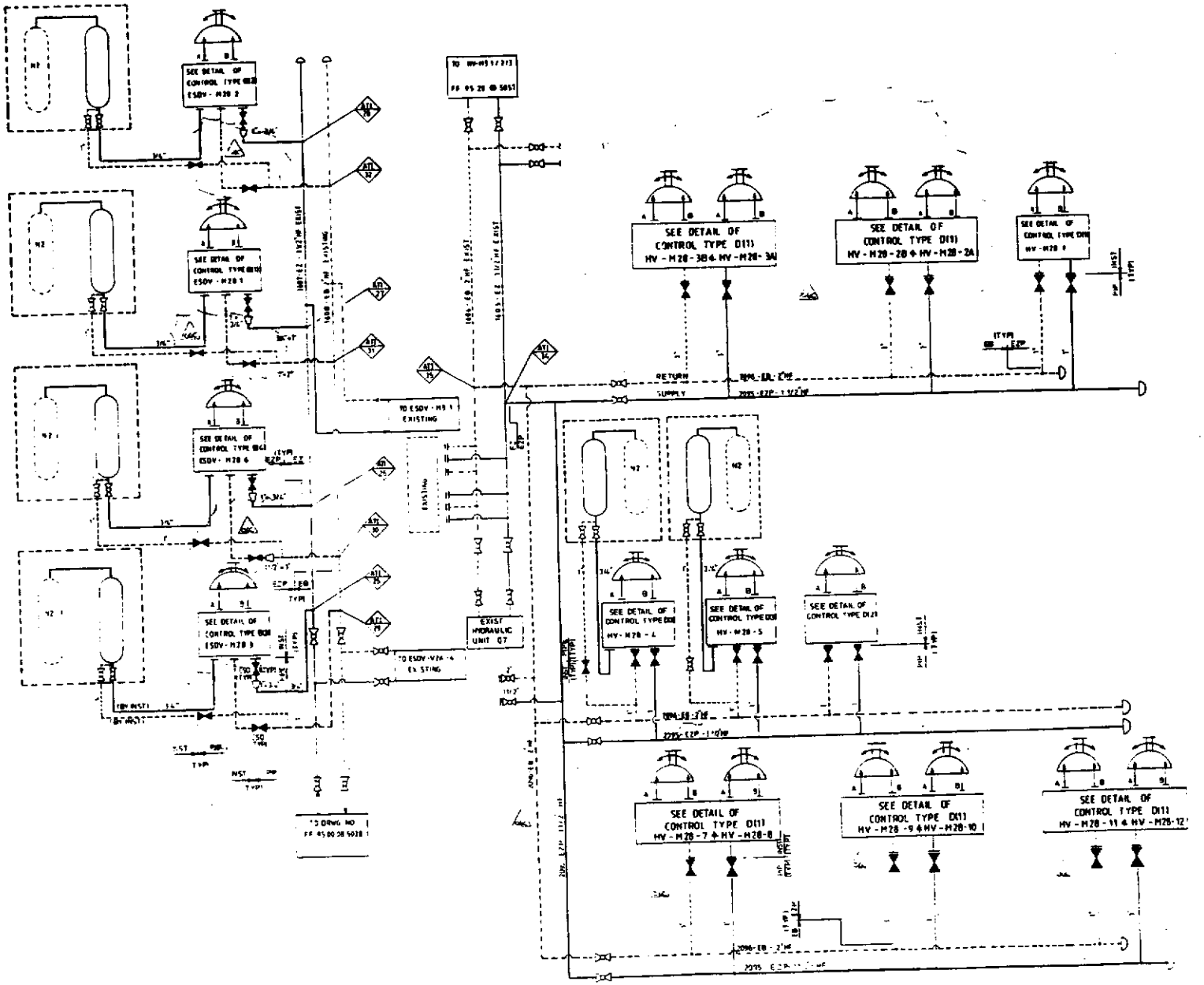
PIPING & INSTRUMENT DIAGRAM

L.T. RELIEF GAS FROM SALES GAS HEADERS NO. 1 AND 2 TO ALWYN TIE IN/TP1 COLD VENT SYST.

FRIGG FIELD — FF 95 00 04 5059 — 06C — 1 1

NOTES:

1. FOR DETAILS OF CONTROL STATIONS
   REF: DRWG
   FF 95 16 80 1434 SHT 1 TO 14



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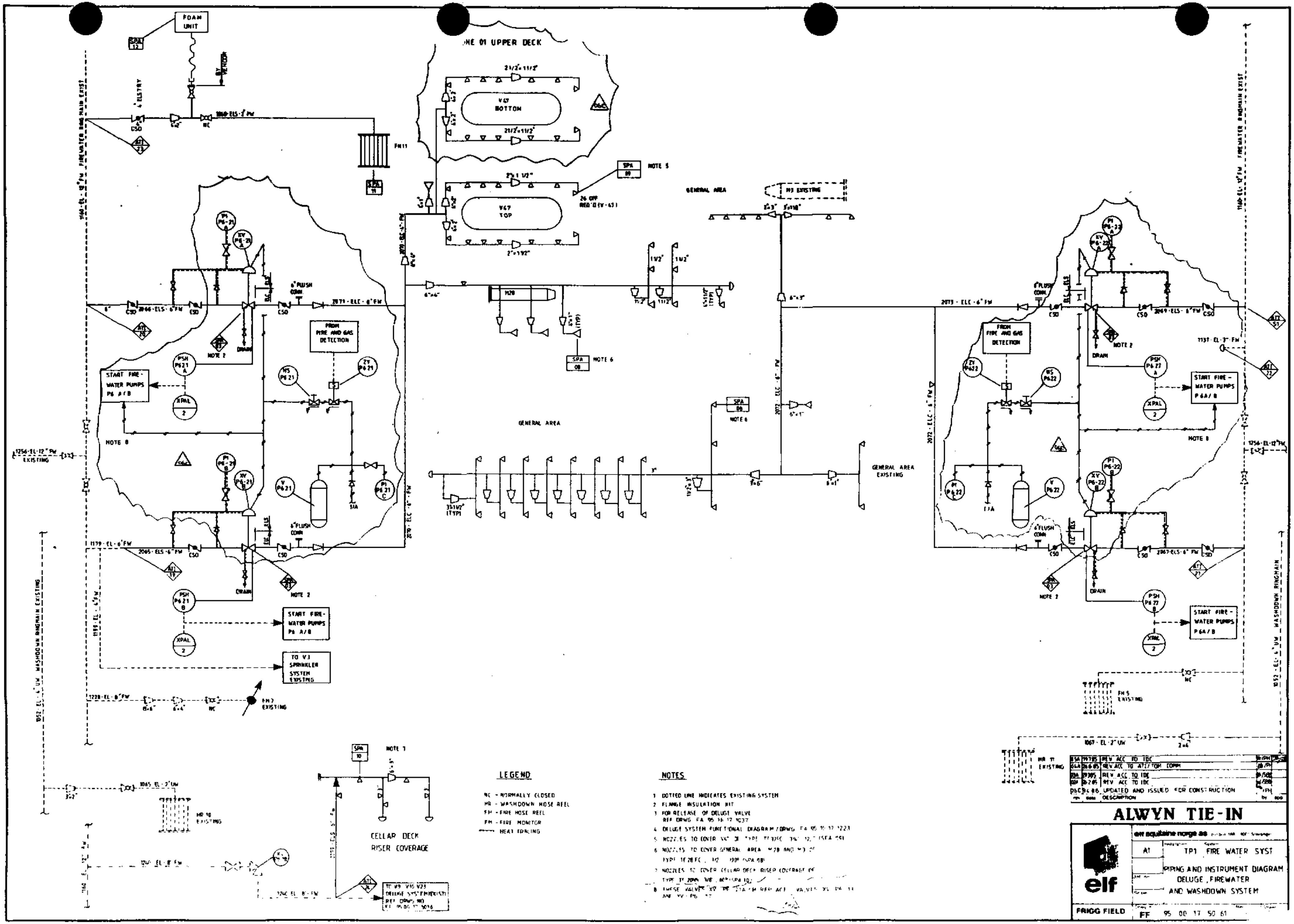
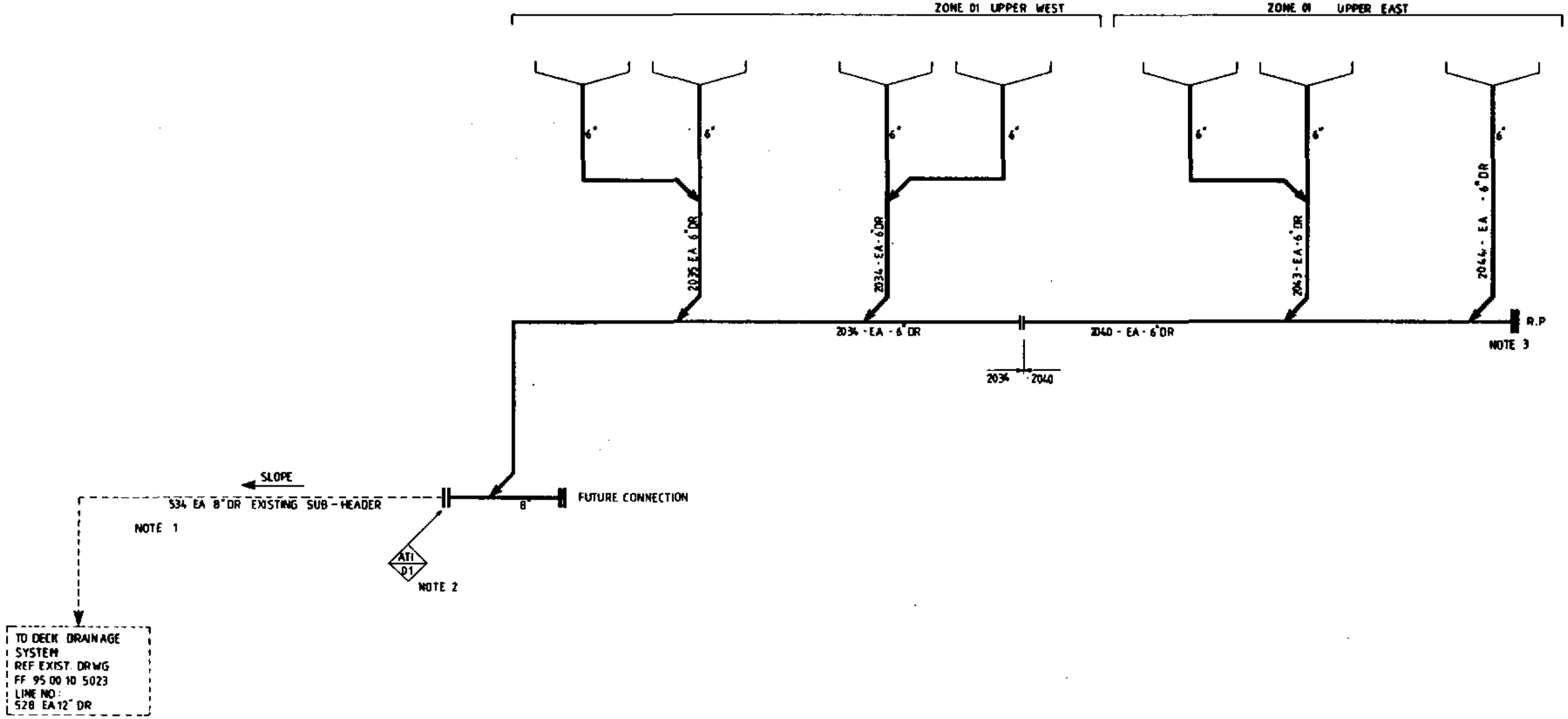
HYDRAULIC POWER SYSTEM

PIPING AND INSTRUMENT DIAGRAM HYDRAULIC POWER DISTRIBUTION

FRIGG FIELD FF 95 00 58 50 60


FOAM UNIT
FH 11
ZONE 01 UPPER DECK
V 67 BOTTOM
V67 TOP
GENERAL AREA
M3 EXISTING
M 20
NOTE 5
NOTE 6
NOTE 2
NOTE 8
NOTE 7
26 OFF REQ'D (V-67)
FROM FIRE AND GAS DETECTION
START FIRE-WATER PUMPS P6 A/B
TO V3 SPRINKLER SYSTEM EXISTING
FH 7 EXISTING
FH 5 EXISTING
HR 10 EXISTING
HR 11 EXISTING
GENERAL AREA EXISTING
CELLAR DECK RISER COVERAGE
TO V9, V16, V23 DELUGE SYSTEM (EXIST) REF DRWG NO
DRAIN
6" FLUSH CONN
2071 - ELC - 6" FW
2073 - ELC - 6" FW
2072 - ELC - 6" FW
2066 - ELS - 6" FW
2065 - ELS - 6" FW
2069 - ELS - 6" FW
2067 - ELS - 6" FW
1179 - EL - 6" FW
1256 - EL - 12" FW EXISTING
1228 - EL - 8" FW
1065 - EL - 2" UW
1067 - EL - 2" UW
1137 - EL - 3" FW
1160 - EL - 12" FW FIREWATER RINGMAIN EXIST
1052 - EL - 4" UW WASHDOWN RINGMAIN EXISTING
LEGEND
NC - NORMALLY CLOSED
HR - WASHDOWN HOSE REEL
FH - FIRE HOSE REEL
FM - FIRE MONITOR
HEAT TRACING
NOTES
1 DOTTED LINE INDICATES EXISTING SYSTEM
2 FLANGE INSULATION KIT
3 FOR RELEASE OF DELUGE VALVE REF DRWG FA 95 16 17 9037
4 DELUGE SYSTEM FUNCTIONAL DIAGRAM / DRWG FA 95 16 17 9223
5 NOZZLES TO COVER V67 OF TYPE
6 NOZZLES TO COVER GENERAL AREA M 20 AND M3 OF TYPE
7 NOZZLES TO COVER CELLAR DECK RISER COVERAGE OF TYPE
8 THESE VALVES
ALWYN TIE-IN
elf aquitaine norge as
A1
TP1 FIRE WATER SYST
PIPING AND INSTRUMENT DIAGRAM DELUGE, FIREWATER AND WASHDOWN SYSTEM
FRIGG FIELD
FF 95 00 17 50 61
UPDATED AND ISSUED FOR CONSTRUCTION
REV ACC TO IDC
REV ACC TO ATI / TOM COMM
DESCRIPTION



NOTES

NOTE 1 : DOTTE[illegible] LUSTRATES EXISTING SYSTEM

NOTE 2 : TIE - IN TO EXISTING HEADER REF LIST OF SPECIAL ITEMS DOC. NO. ALW - 20 - L022

NOTE 3. : R.P. - ROD OUT POINT

rev	date	DESCRIPTION	by	app
07C	10.3.86	ISSUED FOR CONSTRUCTION	KB/PH	[illegible]
06A	19.1.85	REV ACC TO IO:	[illegible]/PH	
05A	26.6.85	REV ACC TO ATI / TOM COMM	[illegible]/PH	
04A	29.3.85	REV ACC TO IDC	[illegible]/SBB	
03A	5.3.85	REV ACCORDING TO IDC MEETING	[illegible]/SBB	
02A	26.2.85	REVISED ACC TO NEW TRANSFER LINE	[illegible]/SBB	
01A	[illegible] 2.85	first issue FOR IDC	[illegible]/SBB	

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A1

TP 1 DRAINAGE SYSTEM

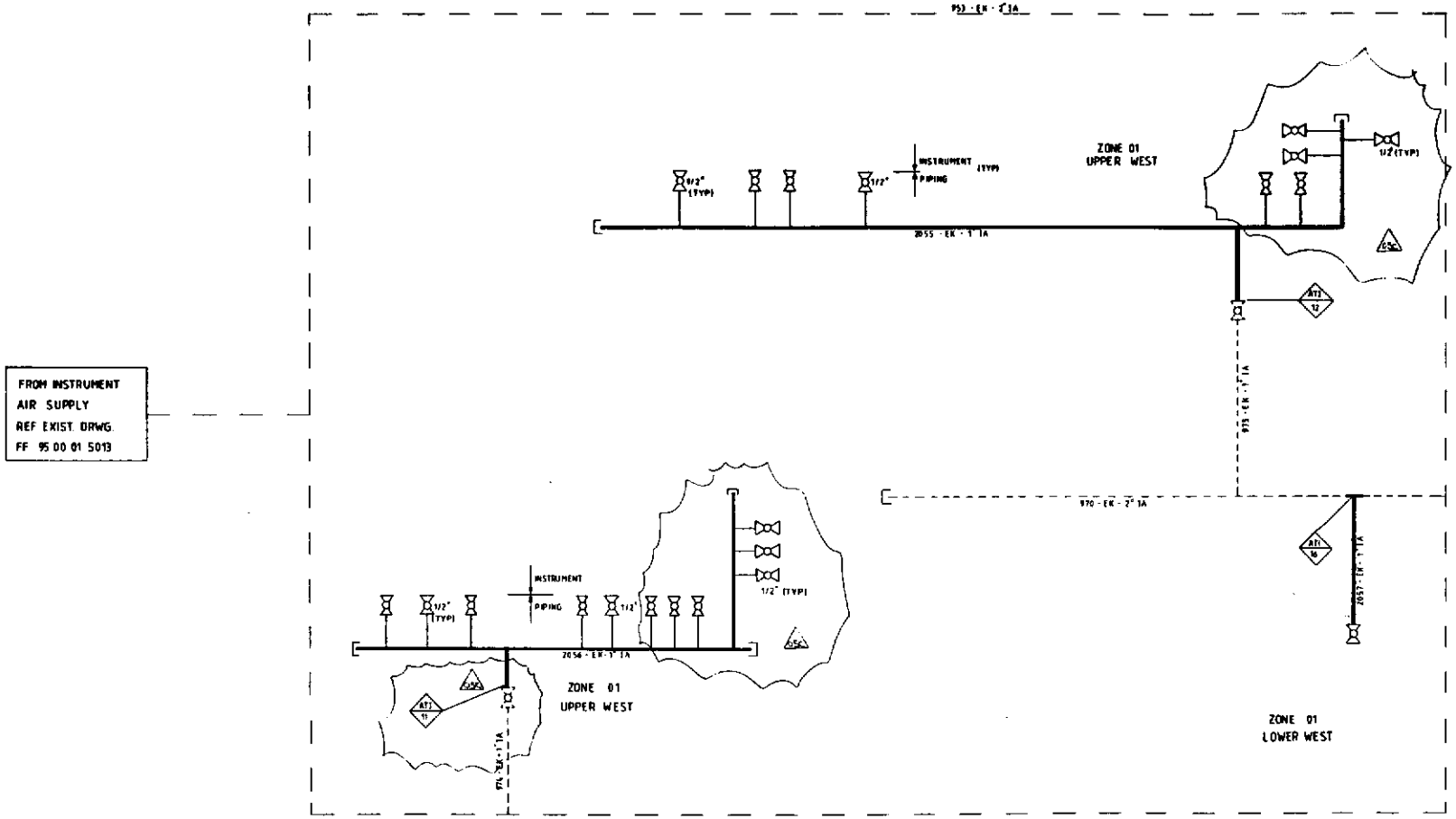
UTILITY P & ID
DECK DRAINAGE

FRIGG FIELD FF 95 00 10 50 67 07C 1 1

NOTES

1 DOTTED LINE INDICATES SYSTEM

2 REF LIST OF SPEC ITEMS DOC NO.
ALW - 20 - L022



DSC	9 4 96	UPDATED AND ISSUED FOR CONSTRUCTION	
ALW	7 1 96	REV. ACC. TO IDE	
EM	26 5 95	REV ACC TO ACT/TDM COMM	
02A	6 3 95	REV ACCORDING TO IDE MEETING	
01A	24 2 95	FOR IDE	

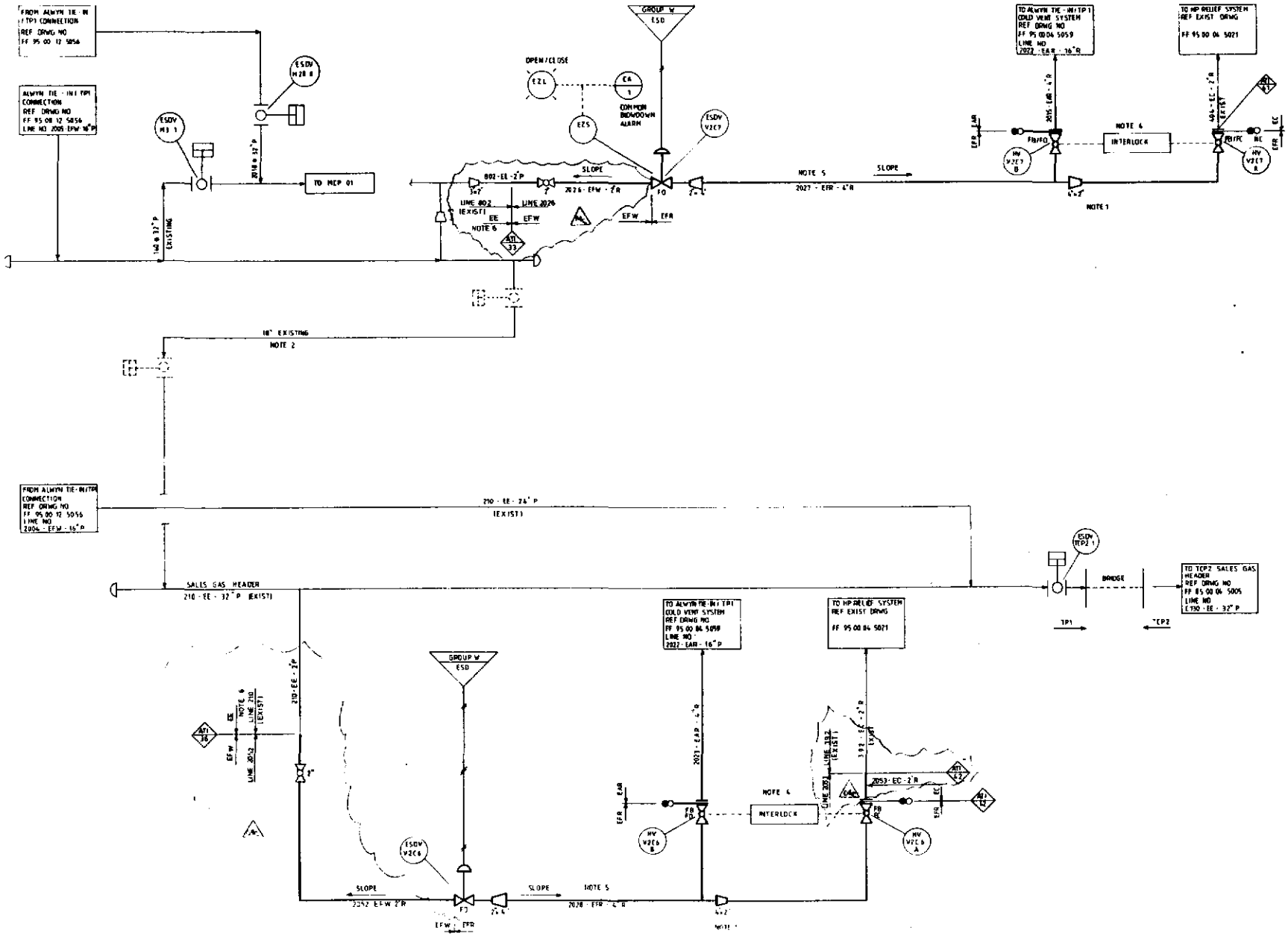
ALWYN TIE-IN

elf aquitaine norge as

A1 TP1 INSTRUMENT AIR

PIPING AND INSTRUMENT DIAGRAM
INSTRUMENT AIR
SYSTEM

FRIGG FIELD FF 95 00 01 50 63 1 1



NOTES

1. EQUIPMENT ENHANCED BY BRIDAS LINE TO [illegible] ACCORDING TO FOLLOWING OPERATING (TWP)
   - MAX/MIN OPERATING TEMPERATURE
   - MAX OPERATING PRESSURE
2. EXISTING ARRANGEMENT TYPICAL FOR V2A/B/C AND CV 2A/B/C
3. REF EXIST P&ID'S ON TP1
   FF 95 00 13 5004
   FF 95 08 09 5005
   FF 95 08 12 5006
   REF EXIST P&ID'S ON TCP2
   ELN 2168 C 4009
   C 4010
   C 4011
4. INTERLOCK TO BE MANUALLY POSITIONED ON INSTRUCTIONS FROM CCR. BOTH RELIEF SYSTEMS CAN NOT BE ACCESSABLE AT THE SAME TIME. IN CASE OF COLD GAS IN THE SGH'S ONLY THE COLD VENT SYSTEM SHALL BE ACCESSABLE.
5. PIPING DOWNSTREAM ESDV TO HAVE 8 DIAM OF STRAIGHT RUN AND TO BE OF MIN SCH 160 FOR MIN 8 DIAM TO REDUCE NOISE AND VIBRATION PROBLEMS
6. EXISTING LINE IS TO EF MATERIAL FOR PIPES, VALVES ETC BUT OPERATING DESIGN & HYDROTEST PRESSURE WERE IN ACCORDANCE WITH EE SPEC

FORMAT FOR VALVE STATUS

X = E OR N
Y = TAG NO

XZLH Y — VALVE OPEN — XZSH Y
XZLL Y — VALVE CLOSED — XZSL Y

20.3.95	UPDATED & ISSUED FOR CONSTRUCTION		
09.8.95	REMOVED PILOT VALVES		
19.7.95	REV ACC TO IDC		
26.6.95	First issue		
rev	date	DESCRIPTION	by

ALWYN TIE-IN

elf

elf aquitaine norge as

A1	TP1	COLD VENT
	PIPING AND INSTRUMENT DIAGRAM	
Job no.	EXISTING BLOWDOWN VALVE CONNECTIONS ON TP1 SALES GAS HEADER TO ALWYN TIE-IN / TP1 COLD VENT SYSTEM	
Scale		

FRIGG FIELD | Drawing no. FF 95 00 04 50 64 | Rev. ACC | Sheet T1

1.1.3 Main Engineering and Construction Contractors

1.1.3.1 Engineering Contractor

The Engineering and Construction follow up of Alwyn Tie-In Project was organized as an integrated team where Engineering Contractors personnel were located in EAN's offices as a part of the total Project Organization.

Main Contractor for suppy of personnel to the integrated team was:

Borregaard Sofresid Engineering A/S (BSE A/S) (Note 1)
P.O. box 291
1324 LYSAKER
NORWAY

Note 1: Firma changed to Borregaard Engineering A/S (BE A/S) 1. July 1986.

1.1.3.2 Construction Contractor - Onshore Prefabrication

Piping spools and structures were prefabricated onshore, mainly by:

Aker Norsco A/S
4056 TANANGER
NORWAY

1.1.3.3 Construction Contractor - Offshore Installation

1.1.3.3.1 From the start of offshore works in June 1985 until January 9th 1987, offshore installations were carried out by:

Wimpey Offshore Engineers & Constructors Ltd.
Flyover House
Great West Road
Brentford
MIDDLESEX TW8 9AR
GREAT BRITAIN

1.1.3.3.2 From January 9th 1987 until completion of offshore work March 18th 1987, the installation was performed by:

Maritime GMC A/S
Dusavikveien 37
4000 STAVANGER
NORWAY

1.1.3.4 Prefabrication and Installation Contractor - Subsea Riser

Subsea part of Alwyn riser R2X from seabed outside TP1 column 2 to Tie-In to existing riser at top of TP1 caisson was carried out by:

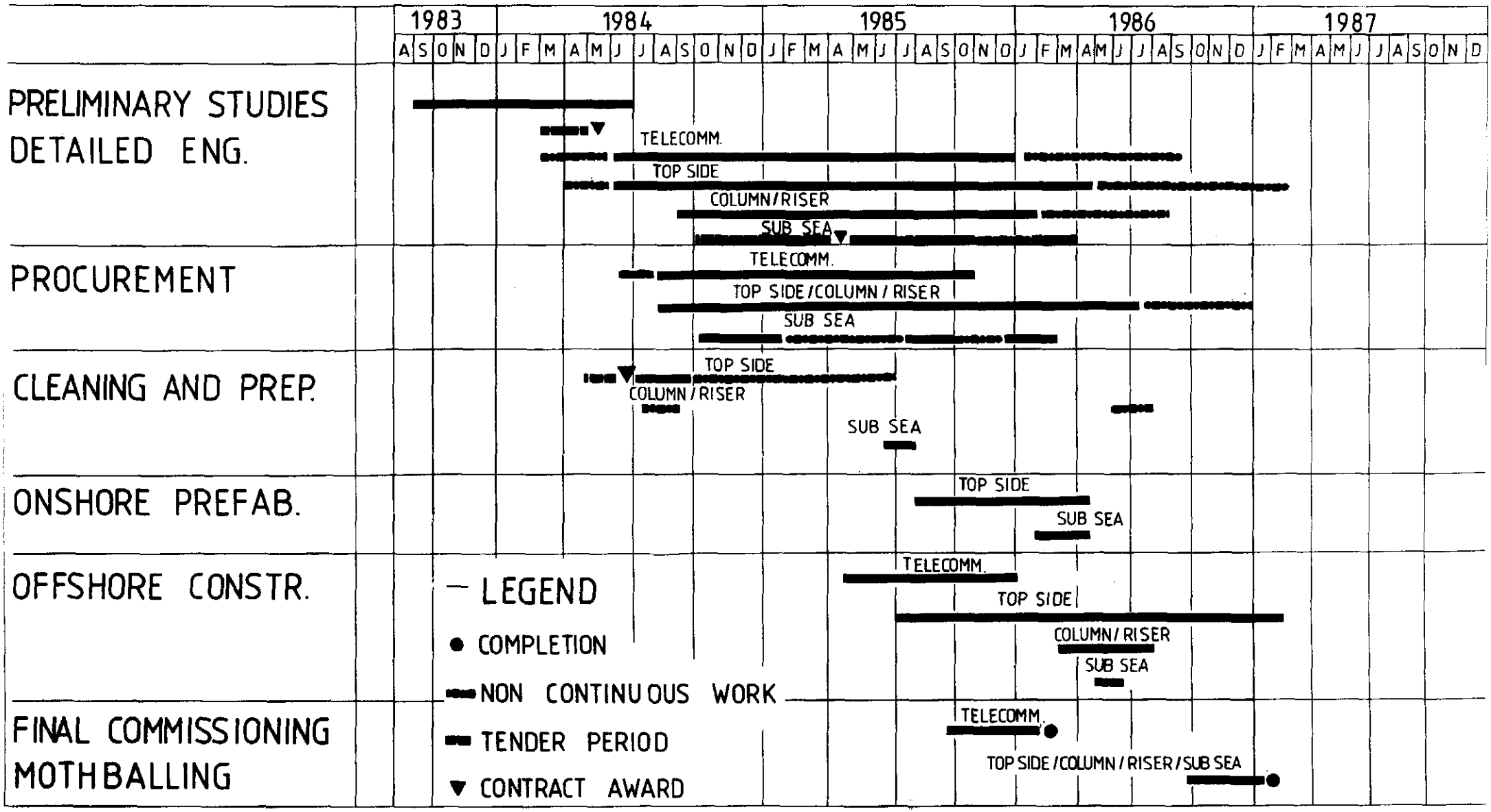
COMEX HOULDER DIVING LTD.
Bucksburn House
Howes Road
Bucksburn
ABERDEEN AB2 9RO
GREAT BRITAIN

Section 1.1.4 - Overall Project Schedule

ALWYN TIE-IN

OVERALL PROJECT SCHEDULE

REV. 07 DATE MARS 1987



2

Section 1.2 GENERAL DATA

1.2.1 Environmental Conditions

1.2.2 Alwyn Gas Data

1.2.1 GENERAL DATA ENVIRONMENTAL CONDITIONS

1.2.1.1 WIND

1.2.1.1.1 General

The wind loads has been calculated in accordance with following standards and specifications:

FF-10-21-S001 - Steel Structures for Modules and Pancakes, Basis of Design.

DnV - "Rules for Design, Construction and Inspection of Offshore Structures", Appendix "A" and"B".

BSI - "Basic Data for the Design of Buildings, Chapter V, Loading" Part 2. Wind Loads, CP 3, Chapter V, Part 2-1972.

Dynamic Factor from: NV 65-67.

1.2.1.1.2 Wind Profiles

The wind speed has been calculated as a function of hight above the mean water level and average time interval by the power law.

$$V_{tz} = \alpha \cdot V_{1hr10} \left(\frac{Z}{10}\right)^{\beta}$$

V_{tz} = the wind speed average over a time interval t as defined by α and β , 2 meters above the mean water level.

V_{1hr10}= the wind speed average over one (1) hour, 10 m above the mean water level.

α = Gust factor, referenced to V_{1hr10}.

β = Height exponent.

1.2.1.1.3 Factors in the Power Law for Wind Profiles

	AVERAGING TIME INTERVAL					
Factor	1 hr	10 min.	1 min.	15 sec.	5 sec.	3 sec.
	1.000	1.060	1.180	1.260	1.310	1.330
	0.150	0.130	0.113	0.106	0.102	0.100

1.2.1.2 REFERENCE WIND SPEED

1.2.1.2.1 TP1 and QP

The reference wind speed shall be the averaged wind speed over 1 minute, 10 meters above the mean water level, and with a 50 years return period. V_{1min}= 45 m/s.

1.2.1.2.2 TCP2

The reference wind speed shall be the averaged wind speed over 1 minute, 10 meters above the mean water level, and with a 100 years return period. V_{1min}= 50 m/s.

1.2.1.3 PREVAILING WINDS

Prevailing winds are from West South West to North West.

1.2.1.4 STORM WIND DIRECTIONS

Storm winds on Frigg Field vary in direction throughout the year according to prevailing directions stated below.

Storm Wind > 10 BEAUFORT (25 m/s)

Months	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
NW and N	44	40	35	27	19	12	28	18	51
W and SW	35	47	40	35	37	31	28	28	33
S and SE	18	13	20	34	40	57	43	54	16
E and NE	3	< 1	5	4	4	< 1	1	< 1	< 1
	100	100	100	100	100	100	100	100	100

1.2.1.5 AMBIANT AIR CONDITIONS

1.2.1.5.1 Ambient Air Temperature

The expected extreme daily average temperatures are:

Minimum - 9°C
Maximum + 22°C

1.2.1.5.2 Ambient Air Relative Humidity

Maximum 99%
Minimum 35%

and saliferous atmosphere.

1.2.1.5.3 Rainfall

Rainfall early average 990 mm
Maximum 24 hours 86 mm
Average number of rainy days 195 days/year

1.2.1.5.4 Atmospheric Pressure

Mean pressure monthly average at sea level:

753 mm/Hg (Dec.)
761 mm/Hg (June)

1.2.1.5.5 Snow and Ice Accumulation

In general no snow and ice accumulation has been considered in the overall calculation. For the cold vent stack (SP45) structural suppor tower ice thickness and ice dencities are calculated in accordance wit department of energy, offshore installations, "guidance on design and construction", section 2128, July 1977. In the flexibility analysis for the blow down headers connecting to the cold vent stack a uniform load is added to simulate the ice accumulation.

1.2.1.6 SEA WATER CHARACTERISTICS

1.2.1.6.1 Sea Water Temperature

Extreme temperatures at the sea surface:

Minimum + 4°C
Maximum + 17°C

Extreme temperatures at - 50 m LAT:

Minimum + 5°C
Maximum + 12°C

Extreme temperatures at - 100 m LAT (sea bottom):

Minimum + 4.8°C
Maximum + 9.5°C

1.2.1.6.2 Sea Water Salinity

The extreme value of the sea water salinity expressed in weight per thousand.

At the sea surface: minimum 31.27°/oo
maximum 35.40°/oo

at - 50 metres LAT: minimum 34.02°/oo
maximum 35.41°/oo

at -100 metres LAT: minimum 34.30°/oo
maximum 35.48°/oo

1.2.1.6.3 Sea Water Oxygen Content

The sea water oxygen contents based on a monthly average are:

at the sea surface : minimum 5.69 ml/l
maximum 7.16 ml/l

at - 50 metres LAT : minimum 5.51 ml/l
maximum 6.89 ml/l

at -100 metres LAT : minimum 5.56 ml/l
maximum 6.60 ml/l

1.2.1.7 WATER DEPTH - SEA LEVEL

Water depth at TP1:
- 102,835 meters from the LAT (Lower Astronomical Tide).

Water depth at QP:
- 100,335 meters from the LAT

Water depth at TCP2:
- 102,935 meters from the LAT

1.2.1.8 TIDE CONDITIONS

1.2.1.8.1 Storm Conditions

Maximum astronomical tide break, above LAT	1.70 m
Maximum wind drift surge	0.60 m

1.2.1.8.2 Operating Conditions

Maximum astronomical tide brak, above LAT	1.70 m
Maximum wind drift surge	0.30

1.2.1.9 WAVES AND CURRENT

1.2.1.9.1 Storm Conditions

Wave height	29 m
Wave period	16 s
Current velocity at surface	1,35 m/s
Current velocity at 30 metre above sea bottom	0,70 m/s
Current velocity at sea bottom	0,30 m/s

1.2.1.9.2 Operating Conditions

Wave height	17,4 m
Wave period	12 s
Current velocity at surface	1,00 m/s
Current velocity at 30 m above sea bottom	0,58 m/s
Current velocity at sea bottom	0,30 m/s

1.2.1.9.3 Prevailing Wave Direction

See 1.2.1.4 "Storm wind direction".
It has to be noted that storms from W and SW, and especially from NE and E have a short fetch which limits the wave height.

The waves which are liable to present the maximum height are from:

NW to N
SE to S

1.2.2 ALWYN GAS DATA

The Alwyn gas composition is that for the year 1989.

YEAR 1989 - OIL 110% - GAS: 7.5 MSM^3/D

(Molal percentage)

WATER	0.00
HYDROGEN SULFIDE	0.00
NITROGEN	0.44
CARBON DIOXIDE	2.11
METHANE	81.28
ETHANE	9.28
PROPANE	4.67
I. BUTANE	0.49
N BUTANE	1.19
I PENTANE	0.19
N. PENTANE	0.24
HEXANE	0.09
HEPTANE	0.02
OCTANE	0.01
NONANE	0.00
DECANE	0.00
UNDECANE PLUS	0.00

For the design composition, the gas properties are as follows:

- Molecular weight : 20.3
- Specific gravity : 0.704
- Dynamic viscosity y (10^X) : 0.020 centipoises
- Gross calorific value (MJ//SM3) : 44.21
- Wobbe Index (MJ/SM3) : 52.68
- Pseudo-critical pressure : 46 bar
- Pseudo-critical temperature : - 55°C
- Water dew point : - 5°C at 140 barg.

3

Section 1.3 PRINCIPLES OF ENGINEERING DESIGN

1.3.1 Process Design
1.3.2 Structural Design
1.3.3 Mechanical Design
1.3.4 Piping Design
1.3.5 Electrical Design
1.3.6 Instrument Design
1.3.7 Safety

1.3.1 PROCESS DESIGN

1.3.1.1 General
1.3.1.2 Gas Inlet
1.3.1.3 Corrosion Monitoring and Leak Detection/Flow Control
1.3.1.4 Operating Modes
1.3.1.5 Low Temperature Relief System
1.3.1.6 Utility Systems

1.3.2 STRUCTURAL DESIGN

1.3.2.1 General
1.3.2.2 TP1 Topside
1.3.2.3 Column 2 - TP1

1.3.3 MECHANICAL DESIGN

1.3.3.1 General
1.3.3.2 Pig Receiver M28
1.3.3.3 Cold Vent Knock Out Drum V47
1.3.3.4 Cold Vent Stack SP45

1.3.4 PIPING DESIGN

1.3.4.1 Introduction
1.3.4.2 Gas Arrival on TP1 - Riser R2X
1.3.4.3 Topside Piping System - Alwyn Gas Transfer
1.3.4.4 Blowdown System
1.3.4.5 Firewater System
1.3.4.6 Hydraulic System
1.3.4.7 Utility and Minor Services

1.3.5 ELECTRICAL DESIGN

1.3.5.1 Introduction
1.3.5.2 UPS System (QP)
1.3.5.3 HVAC (QP)
1.3.5.4 Lighting TP1
1.3.5.5 Heat tracing

1.3.6 INSTRUMENT DESIGN

1.3.6.1 Introduction
1.3.6.2 Process Control and Monitoring
1.3.6.3 Emergency Shutdown and Process Safety
1.3.6.4 Fire and Gas Detection and Protection

1.3.7 SAFETY

1.3.7.1 Introduction
1.3.7.2 Area Classification
1.3.7.3 Fire Fighting System
1.3.7.4 Alarm and Public Address System
1.3.7.5 Fire and Gas Detection System
1.3.7.6 Emergency Shut Down System

1.3.1 PROCESS DESIGN

1.3.1.1 General

The purpose of the new installations on Frigg is to receive dry and treated gas from North-Alwyn B (NAB) on Frigg and to tie-in the same gas into the existing transportation system from Frigg to St. Fergus.

Production figures are as follows:

Nominal throughput : 7,5 MSCM/D
Maximum throughput : 9.0 MSCM/D
Ultimate throughput: 21,4 MSCM/D

1.3.1.2 Gas Inlet

Gas received from NAB enters TP1 through an upgraded 24" riser in Column 2. The riser includes 2 ESD valves with one being connected to the Frigg Overpressure Protection System (OPPS).

A pig reveiver handling linalog pigs is installed downstream the ESD valves. Upstream and downstream the pig reveiver a double set of isolation valves is provided for safety reasons.

Design basis:

Design pressure	:	185 barg
Design temperature	:	- 28/100°C
Operating pressure min/max	:	110/180.3 barg
Operating temperature	:	4°C

1.3.1.3 Corrosion Monitoring and Leak Detection/Flow Control

Downstream the Gas Inlet section, the gas passes through a corrosion monitoring station. This station consists of Casasco access fittings with corrosion coupons.

Downstream the corrosion monitoring station, the gas enters the Leak Detection/Flow Control station. This station consists of a flow orifice and three flow control valves. Under normal conditions, the flow is controlled from NAB. In this case the Leak Detection/Flow Control station acts as leak detection only. A flow transmitter gives a feedback to NAB and provides data for leak monitoring.

The flow control valves act upon the following conditions:

- Low pressure in the 24" sealine from NAB (110 barg)
- Packing/Depacking of the 24" sealine from NAB.

Up to the flow control valves, the maximum operating pressur can reach 180.3 barg in case of packing of the 24" sealine from NAB. Minimum pressure is 100 barg to avoid retrograde condensation in the 24" sealine from NAB.

1.3.1.4 Operating Modes

Three different operating modes exists:

1. Production via the transfer line (HV M28.6) directly into Sealine no. 1 (32") to St. Fergus.

   This is the main operating mode.

2. In case of unavailability of the transfer line, production can be routed to sealine no. 1, via TP1 sales gas header (HV M28.5).

3. In case of unavailability of sealine no. 1, production can be routed to Sealine no. 2 via TP1/TCP2 dry gas interconnection line (HV M28.4)

1.3.1.5 Low Temperature Relief System

Due to the fact that Alwyn gas arrives at Frigg at sea temperature (4°C), which is approximately 30°C below the operating temperature on Frigg, a new relief system had to be installed in order to facilitate low temperature relief gas when blow down of the various piping sections containing Alwyn gas is performed. This relief system is stainless steel and comprises the following:

- Blow down valves on TP1 and TCP2
- Relief headers on TP1 and TCP2
- A Knock Out Drum (V47) on TP1
- A Cold Vent Stack (SP45) on TP1. This Stack includes a gas seal to minimize nitrogen sweeping consumption.

The LT Relief system is designed for a maximum throughput of 6.0 MSC/D

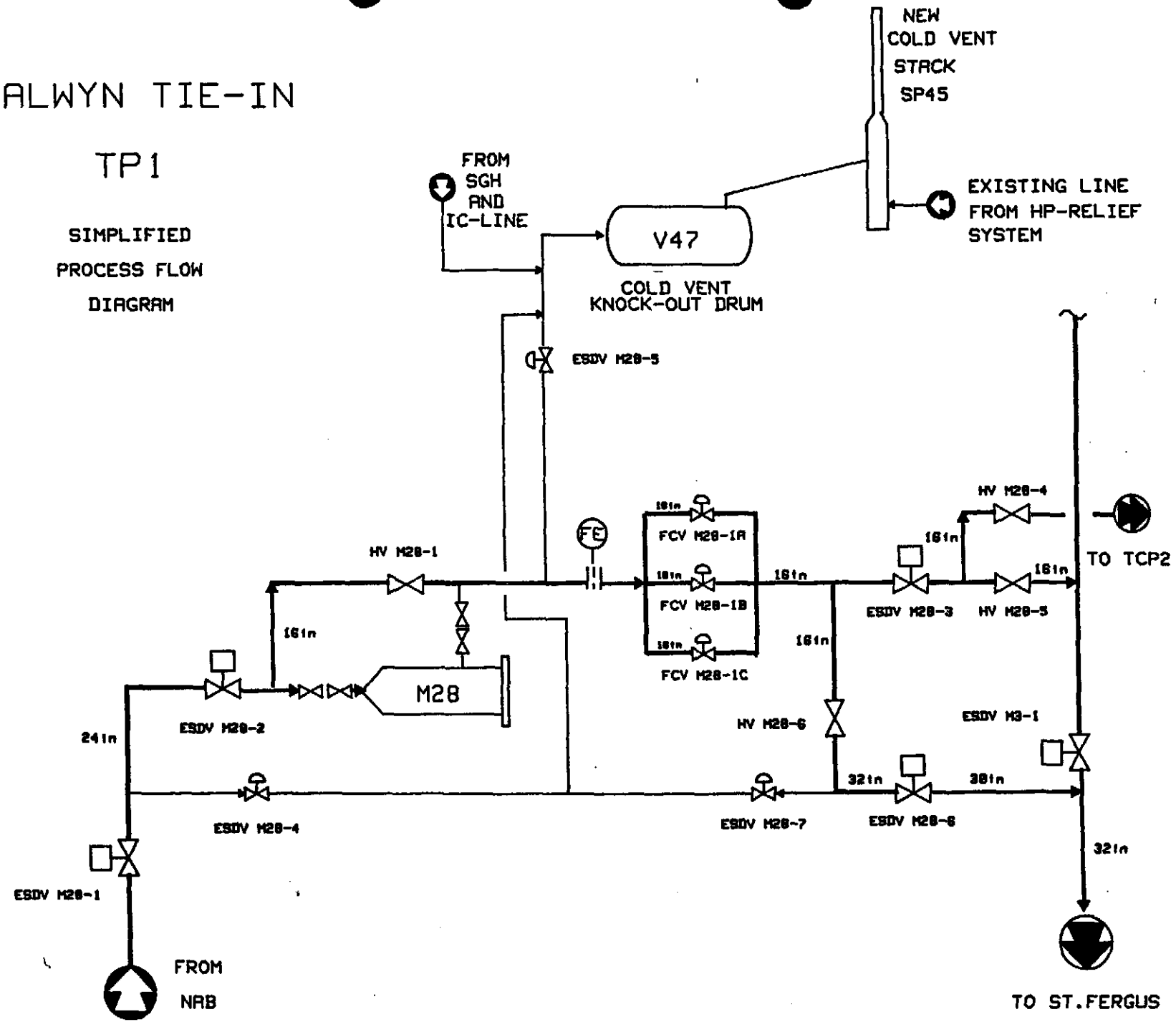
1.3.1.6 Utility Systems

Existing utility systems such as hydraulic power, instrument air, closed drain, HP fuel gas, LP fuel gas and the nitrogen system have been utilized in order to accomodate the new installations on TP1/TCP2. No modifications to these systems as such has been required.

ALWYN TIE-IN

TP1

SIMPLIFIED
PROCESS FLOW
DIAGRAM



1.3.2 STRUCTURAL DESIGN

1.3.2.1 General

All new structural installations for the Alwyn Tie-in Project is located on Platform TP1, Module 01 and Column 2.

The design has been carried out to meet the requirements of the following standards and specifications:

- NS 3472 - Norsk Standard for steel constructions
- FF.10.21.S001 - Steel structure for modules and pancakes; basis of design
- FF.10.21.S002 - materials for welded steel structures
- FF.10.21.S003 - Fabrication of steel structures
- FF.10.21.S004 - Coating of fixed marine structures
- FF.10.21.S005 - Appendices to coating spec. FF.10.21.S004

In addition several check calculation reports have been established as follws:

TP1
ALW-21-CN010 - Check strength of anchor platfrom steelwork, column 2
ALW-21-CN011 - Check strength of concrete at R2X wall penetration, column 2
ALW-21-CN012 - Check strength of anchor platfrom concrete, column 2
ALW-21-CN013 - Finite element analysis of R2X wall penetration, column 2
ALW-21-CN014 - Summary report for R2X wall penetration, column 2

QP
ALW-21-CN002 - QP, antenna frame check
ALW-21-CN003 - Revised wind load calculations for QP telecomm. tower

1.3.2.2 TP1 Topside

The topside structural steel work has been carried out on module 01 upper and lower levels and comprises of the following:

a. Removal of the old SP44 HP relief stack and support tower.

b. Design of the new SP45 cold vent stack support tower, loacted on the upper level of module 01. The detailed design is discussed in design report ALW-21-CN005.
The cold vent stack, with its support tower was manufactured by The Cromarty Firth Engineering Co. Ltd., Evanton Scotland. Full details can be found in the vendor data book against purchase order no. 552.025.0.

c. Reinforcement of module 01 main structure and local deck stiffening due to installation of Alwyn tie-in process piping and mechanical equipment. The module 01 reanalysis is discussed in design report ALW-21-CN008.

d. Design of access platforms, ladders and supports for heavy piping/mechanical equipment.

ALW-21-CN007 - Support frame for transfer line - Design report
ALW-21-CN017 - Pipe support for 24" riser
ALW-21-CN018 - Ball removal for petrovalves 32" - 30" - 24" and 16" ball valves

e. Design of temporary winch platform for pull in and installtion of 24" Alwyn subsea line and R2X riser spool.
This platform was installed on North West corner of module 08, lower level. Design details are discussed in design report ALW-21-CN009.

1.3.2.3 Column 2 - TP1

The structural design work in TP1 column 2 is limited to design of an inspection and installation access platform for R2X riser wall penetration and lower bend respectively.

The platform is installed at elevation - 58.700 (T.O.S.).

1.3.3 MECHANICAL DESIGN

1.3.3.1 General

All mechanical equipment required for the Alwyn Tie-in Project is located on TP1.

1.3.3.2 Pig Receiver M28

The pig receiving trap forms an integrated part of the R2X riser syste and therefore meets all the requirements of Institute of Petroleum Safety Code - Part 6 of the Model Code of Safe Practice in the Petroleum Industry. However, the actual design, fabrication and onshor testing of the trap has been in accordance with BS 5500: 1982, Unfired Fusion Welded Pressure Vessels.
The vessel was designed and built by Kværner Brug, Oslo, and full details can be found in the vendor data book against Purchase Order No. 652.001.0.

1.3.3.3 Cold Vent Knock Out Drum V47

A condensate knock out drum has been incorporated into the new low temperature vent system. It is located on the upper level of TP1 adjacent to the new cold vent stack SP 45.
To meet the low temperature requirement the vessel is constructed in low carbon austenitic stainless steel materials and designed in accordance with BS 5500: 1982. The vessel was manufactured by OY JA-RO AB, Finland, and full details can be found in the vendor data book against Purchase Order No. 652.002.0.

1.3.3.4 Cold Vent Stack SP45

1.3.3.4.1 General

The existing HP Relief Vent Stack SP44 was removed during the cleaning operation. In its place a new Cold Vent Stack SP45 has been installed. The new stack has a dual purpose. It can handle the gases flowing from the existing HP relief system at approximately -46°C in addition to gases from a blowdown of the Alwyn gas which can result in temperature down to -90°C.

The Cold Vent Stack, with its supporting structure was manufactured by The Cromarty Firth Engineering Co. Ltd., Evanton, Scotland. Full details can be found in the vendor data book against Purchase Order No. 552.025.0.

1.3.3.4.2 Design

The new vent stack is constructed from electric fusion welded stainless steel pipe to ASTM A312 TP 316L and is generally in accordance with class EAR of the Piping and Valve Specification.
The stack is supported to resist forces generated by environmental and operational loadings. Details of the tubular steel tower are contained in the Structural Engineering Section.

1.3.3.4.3 Stress Analysis

Although supported by a steel structure the vent stack is expected to deflect under abnormal weather conditions. A static stress analysis has therefore been carried out to determine the effect of these deflections on the vent stack and connecting 20 and 24" vent lines. A combined report ref. ALW-20-S041 details the method of determining support tower deflections and discusses the resulting stresses within the stack and its connecting pipework.

1.3.4 PIPING DESIGN

1.3.4.1 Introduction

Generally, all new piping installed for the Alwyn Tie-in Project is located on Platform TP1. The main exception being the provision of a new cold vent header, designed to accomodate the low temperatures expected to occur during a blowdown of Alwyn gas both on TP1 and TCP2.

A new specification, ALW-20-S005, has been prepared to cover requirements for pipe, valves and fittings to meet the specified design conditions for Alwyn gas arrival, process and blowdown, and for the extension of existing utility and firewater systems.

Where special items are needed with requirements outwith the scope of the above document, their requirements have been embodied in additional detailed specifications which are briefly discussed later in this section on Piping Design.

1.3.4.2 Gas Arrival on TP1 - Riser R2X

1.3.4.2.1 General

A new 24" pipeline has been laid between North Alwyn "B" Platform and Frigg TP1. The design and operation of this pipeline is the responsibility of TOTAL. At TP1 the pipeline ascends the concrete structure via the existing R2X riser system in Column 2.
However, to meet the requirements of the British Department of Energy and the operation needs of TOTAL, it has been necessary to upgrade the existing R2X riser system from class 900 lb to class 1500 lb.
Therefore, prior to the start of Alwyn Tie-in construction work, a section of the riser from EL 12500 to pig receiver M5 was removed together with a 3D bend adjacent to the wall crossing at EL-57750.
Details of all piping, valves and equipment removed can be found in the relevant cleaning package. At the start of construction, the R2X Riser System existed as two sections. Firstly a vertical section from EL+12500 to EL-59580 (approx.) fitted with temporary cover plates and secondly, a horizontal section at EL-58850 passing through the wall of col. 2 and terminating with an end cap approximately 18 m beyond the wall crossing.

The R2X riser system has been designed, fabricated, inspected, installed and tested in accordance with the requirements of the Institute of Petroleum Pipeline Safety Code - Part 6 of the Model Code of Safe Practice in the Petroleum Industry.

This section briefly discusses engineering principles adopted to achieve the required upgrading of the system above sea level. (All aspects relating to work below sea level are presented in Volume 8 book 1 through 11.

1.3.4.2.2 Valves

All main valves on the riser system and those valves isolating secondary lines are now rated at 1500 lb. While details of untagged valves are given in the Piping and Valve Specification ALW-20-S005, requirements for ESDV and HV are presented in Specification ALW-20-S003. As-built records, documentation and certification can be found in the relevant Vendor Data Books. Relevant P.O. Nos. can be located in Volume 4, books 8,9 and 10.

1.3.4.2.3 Pipe for R2X Riser

Welded carbon steel line pipe, generally in accordance with API 5L X65 has been sized and calculated to suit a design pressure of 185 bar g. Specification 10.20.S013 has been prepared to cover fabrication, inspection and testing of straight pipe sections. As-built records, documentation and certification can be found in the vendor data book against P.O. No. 544.021.0.

1.3.4.2.4 3D Bends

The on-line inspection tool to be used by TOTAL for checking the conditions of the pipeline during its operational lifetime, requires a particular geometry to be maintained at changes of direction. These requirements are given in Specification 10.20.S012 - Manufacture of Buttwelding Bends for Gas Transportation Riser. As-built records, documentation and certification can be found in the Vendor Data Book, against P.O. No. 562.049.0.

1.3.4.2.5 Flow Tee

A 16" NB connection to the leak detection and gas transfer systems requires the provision of a special tee to provide safe passage for the on line inspection tool and any cleaning used during the commissioning stage. The carrier pipe used in construction of the flow tee is the same as that used for the other parts of the R2X riser. Other details can be found in specification ALW-20-S018 for Sphere Flow Tees. As-built records, documentation and certification can be found in the Vendor Data Book against P.O. No. 552.038.0.

1.3.4.2.6 Pig Receiver

The new M28 pig receiver is considered as a mechanical item and has been discussed in Section 1.3.3

1.3.4.2.7 Stress Analysis of R2X Riser System

A comprehensive static stress analysis of the R2X riser has been carried out by:

OMNIUM TECHNIQUE DES TRANSPORTS PAR PIPELINES (OTP)
59, Rue de la Republique
Montreuil
Seine-Saint-Denis
France

The computer model for the analysis extends from the pig receiver to the seabed pipeline connection. Details of the analysis undertaken and results obtained are given in document ALW-20-CN-001.

The main requirement arising from the analysis has been for shimming of the anchor flange by 8 mm. This pre-stressing of the system is intended to give lower operating loads at the wall crossing.

1.3.4.2.8 Reference Drawings

Gas arrival via the R2X riser system is shown on the following drawing:

Drwg. no. FF-95-00-12-5053 - P & ID Alwyn Tie-In TP1 Gas Inlet

1.3.4.3 Topsides Piping System - Alwyn Gas Transfer

1.3.4.3.1 General

Gas arriving from Alwyn is dry and does not therefore require further processing before it enters the gas transportation system to St. Fergus, Scotland. However, provision has been made for the gas to pass through leak detection and flow control prior to entering the transfer piping. The pipework has been arranged to provide three possible routes for the gas downstream of the flow control valves. The main transfer line is via line 2016-EFW-16-P and valve HV28.6 to 32" Sealine no. 1. Alternatively the system allows for a back-up using either line 210-EE-24"-P which is the TP1/TCP2 interconnection sales gas header or line 124-*-24"-P - the TP1 Sales Gas Header.

1.3.4.3.2 Valves

All valves are rated at 1500 lb. Specification ALW.20.S003 details the requirements for HV and ESDV valves in the transfer system, while general untagged, minor isolating valves are covered by class EFW of the Piping and Valve Specification. Flow Control Depacking Valves are covered by Instrument Engineering. All as-built records, documentation and certification can be found in the relevant vendor data books.

1.3.4.3.3 Flow Measurement Orifice Housing

This item has been supplied in accordance with class EFW of the Piping and Valve Specification but also meets the additional requirements covered by Instrument Engineering.

1.3.4.3.4 Future Connections

Provision has been made for future connections at two locations. A 16" NB flanged connection in line 2005-EFW-16"-P will permit a future tie-in to deliver gas into any of the three transfer lines described in section 1.3.4.3.1. above.A 32" NB flanged connection upstream of ESDV M28.6 will allow delivery of gas into Sealine no.1.

1.3.4.3.5 Stress Analysis

All main topside pipework has been combined with the R2X Riser System in a comprehensive static stress analysis. This work has been carried out by:

JOHN BROWN ENGINEERS & CONSTRUCTORS LTD.
JOHN BROWN HOUSE
20 EASTBOURNE TERRACE
LONDON W2 6LE
ENGLAND

Although certain aspects of the R2X system analysis have been superseded by later work carried out by O.T.P. (see section 1.3.4.2.7), conclusions reached for the topside pipework remain valid. Full details of stress analysis are given in docoument ref. ALW-20-S042.

1.3.4.3.6 Reference Drawings

Topside Alwyn Gas Transfer piping is shown on the following P & ID's.

Drwg. no. FF-95-00-12-5053 - P & ID ALWYN TIE-IN
Gas Inlet
Drwg. no. FF-95-00-12-5004 - P & ID ALWYN TIE-IN
Leak Detection and Flow Control
Drwg. no. FF-95-00-12-5056 - P & ID ALWYN TIE-IN
TP1 Connection

1.3.4.4 Blowdown System

1.3.4.4.1 General

Modifications to topside piping on TP1 for the Alwyn Tie-in Project will allow the transfer of Alwyn gas to TCP2 via the 24" TP1/TCP2 interconnection header or 32" sales gas leader to St. Fergus. Therefore, in the event that Sealine 1 cannot be used, it should still be possible to transport Alwyn gas to St. Fergus via Sealine 2 from TCP2.

On arrival at Frigg, the Alwyn gas will have assumed the same temperature as the surrounding sea, i.e. in the region of 4°C. Due to the Joule Thompson effect, a blowdown of this gas would generate temperatures which are below the capasity of the existing systems on TP1 and TCP2 (-50°C).

Part of the Alwyn Tie-in Project has been the provision of a new Low Temperature H.P. Relief giving a blowdown facility for Alwyn gas on both TP1 and TCP2. The new system is based on a minimum design temperature of -125°C.

The basic system comprises a 16"NB interconnection header between TP1 and TCP2 with a K.O.Drum and Cold Vent Stack located on the upper level of Module 01 of TP1.
The existing vent stack SP44 was removed as part of the clean-up package.

With Frigg gas in the sales gas headers, both the existing HP relief system and new cold vent system are available, although interlocked valves ensures that both systems cannot be used simultaneously.
With Alwyn gas in the sales gas headers only the new cold vent system can be operated.

1.3.4.4.2 Valves

All ESD and HV's associated with the new cold vent system are rated at 1500 LB and covered by specification ALW-20-S003. Downstream of the interlocked HVs the system is rated at 150 LB and all minor isolating valves will be in accordance with class EAR of the Piping and Valve Specification. As-built records, documentation and certification can be located in the relevant vendor data books.

1.3.4.4.3 K.O. Drum & Vent Stack

The K.O. Drum V47 and Vent Stack SP45 are mechanical items and are discussed in section 1.3.3.

1.3.4.4.4 Stress Analysis

i) The new cold vent header system between TCP2 and V47 on TP1 has been sectionalised and subject to a series of integrated stress analysis. These analysis have considered both the thermal effects due to sub-zero temperatures during blowdown of Alwyn gas, and the environmental loads which bring about relative movements between TP1 and TCP2.
Details of these analysis and the reported findings and recommendations can be found in Document Ref. ALW-20-S042 and covered by section (3.0, 5.0 and 7.0).

ii) The 24" outlet from V47 to the Cold Vent Stack (line no 2014-EAR-24"-R) has been analysed to determine the effects of both sub-zero temperatures during blowdown and lateral movements of the Vent Stack which occur under certain environmental loading conditions. Chapter 2.0 of ALW-20-S042 discusses the reported findings and requirements for expansion bellows and thermal shrouds.

1.3.4.4.5 Reference Drawings

Drwg. no. FF-85-00-04-5005 - P & ID ALWYN TIE-IN
Existing Blowdown Valve Connections on TCP2 Sales Gas Headers to Alwyn Tie-in/ TP1 Cold Vent System

Drwg. no. FF-95-00-04-5059 - P & ID ALWYN TIE-IN
LT Relief Gas from Sales Gas Headers no. 1 and no. 2 to Alwyn Tie-in/TP1 Cold Vent System

Drwg. no. FF-95-00-04-5052 - P & ID ALWYN TIE-IN
Cold Vent Knock Out Drum

Drwg. no. FF-95-00-04-5057 - P & ID ALWYN TIE-IN
New Cold Vent Stack on TP1

Drwg. no. FF-95-00-04-5064 - P & ID ALWYN TIE-IN
Existing Blowdown Valve connections on TP1 Sales Gas Header to Alwyn Tie-in/ TP1 Cold Vent System

1.3.4.5 Firewater System

1.3.4.5.1 General

Due to the placing of additional new equipment on the upper level of module 01, it has been necessary to extend the cover of the existing firewater system.

Tie-ins have been made to the existing 12" NB ring main to provide a supply to two (2) new duplicate hydraulically operated differential type deluge valves. These replace the single unit removed during 'clean-up' of the area. In the cellar deck a new tie-in to line 1240-EL-8"-FW provides protection to the R2X riser. On the upper level of module 01 there is provision for a firewater hose reel and portable foam unit.

1.3.4.5.2 Valves

All pipework and valves on the firewater system are rated at 150# RF in accordance with class ELS and ELC of the Piping & Valve Specification ALW-20-S005. The deluge valves requirement are given in Specification no. ALW-20-S036. As-built records, documentation and certification can be found in the relevant vendor data book against P.O. No. 362.051.0.

1.3.4.5.3 Reference Drawings

Details of the Firewater System covered by the Alwyn Tie-in Project are given on the following drawing.

Drwg. no. FF-95-00-17-5041 - P & ID ALWYN TIE-IN
Deluge, Firewater and Washdown System

1.3.4.6 Hydraulic System

1.3.4.6.1 General

Tie-ins have been made to the existing hydraulic supply and return ring mains to provide power supply to hydraulically operated ESDV's and certain HV's. Back-up hydraulic power is obtained from independent hydraulic oil accumulators designed to give two (2) full operating cycles of the valve.

1.3.4.6.2 Hydraulic Supply and Return

The Hydraulic fluid supply ring main is constructed in stainless steel to the requirements of class EZP and rated at 2300 psi. The hydraulic fluid return ring main is constructed in carbon steel to the requirements of class EB and rated at 300 psi.

1.3.4.6.3 Reference Drawings

Piping requirements for Alwyn Tie-in Project are given on the following drawing.

Drwg. no. FF-95-00-08-5060 - P & ID ALWYN TIE-IN
Hydraulic Power Distribution

1.3.4.7 Utility and Minor Services

3.4.7.1 General

The Alwyn Tie-in Project has required extension of certain minor service lines and utility pipework to the location of new equipment and instrumentation.

1.3.4.7.2 Instrument Air

1.3.4.7.2.1 Extent of Modification

Additional instrument air manifolds have been installed in three zones of Module 01 namely:

Zone 01 upper east

Zone 01 upper west

Zone 01 lower west

Supply is taken from the existing ring main line no. 953 EK 2" 1A.

1.3.4.7.2.2 Pressure Rating

The instrument air piping is installed using galvanized carbon steel pipe in accordance with class EK of the Piping and Valve Specification, and is rated at 150# RF.

1.3.4.7.3 Nitrogen

1.3.4.7.3.1 Extent of Modification

The Cold Vent Knock Out Drum V47 and the Gas Seal on Cold Vent Stack SP45 are continuously swept by Nitrogen.

1.3.4.6.3.2 Pressure Rating

The nitrogen piping installed generally meets the requirements of class EB based on carbon steel pipe and fittings rated at 300 LB. However, where pipework ascends the vent stack support structure, this section has been manufactured from stainless steel materials to class EAR which is rated at 150 LB.

1.3.4.7.3.3 Flexible Connection

Due to contraction of the Vent Stack under operating conditions a flexible hose connection has been provided between the stainless steel supply pipe and vent stack seal connection.

1.3.4.7.4 Reference Drawings

Drwg. No. FF-95-00-04-5052 - P & ID ALWYN TIE-IN
Cold Vent Knock-out Drum V47

Drwg. No. FF-95-00-04-5057 - P & ID ALWYN TIE-IN
New Cold Vent Stack on TP1

1.3.5 ELECTRICAL DESIGN

1.3.5.1 Introduction

The electrical part of the Alwyn Tie-in installation is mainly located on QP and TP1 (Frigg Field). Some heat-tracing for ATI relief have been done on TCP2. The installation carried out on QP consists of an UPS and an HVAC system. These systems are installed in the UK communication room R1 and R2. The UPS is feeding the existing UK tropo and the new troposcatter equipment for communication between Alwyn and Frigg Field.

The TP1 installation consists mainly of a new general area lighting (normal, emergency and air craft warning lights) and heat tracing.

A lightning arrestor is installed in the vent stack.

1.3.5.2 UPS System (QP)

The existing 35 KVA rotary No Break system installed in the communication room R2 is removed together with all associated control panels, transformers, cables and batteries.

A complete new 60 KVA Siemens B32 UPS unit with rectifier, inverter, static switch distribution boards and transformers panelised into one self contained unit together with a new set Marathon ALCAD Battery package type MP 140 NiCd with 294 cells have been installed in R2 and R4.

This system is manufactured by Siemens and full details can be found in the Vendor data book. The most relevant drawings for the system are listed below:

FF.96.23.17.0322	One line diagram UK tropo room UPS system
FF.96.23.17.0329	Distr. boards DB62, 63 and 65

1.3.5.3 HVAC (QP)

To handle the additional heat emission from UK and Alwyn tropo amplifiers etc., the existing HVAC system had to go through a modification. The new HVAC installation for the UK communication rooms is still tied into the existing HVAC installation on QP. Air supply is taken from this system and exhaust are either brought back or to open air.

The new system has involved removals and modification of the existing duct system, inclusion of new ductwork, two exhaust fans, pressure control damper (fire damper), two air flow direction dampers, two shut-off dampers and HVAC control panel.

In addition, two Hitachi cooler units have been installed in R2 with associated condensers located outside R1.

These systems have been delivered by Norsk Viftefabrikk and full details can be found in the Vendor data books.

The most relevant drawings for the system are listed below:

FF.96.08.10.0909	UK Communication room. Invert, switchgear and battery room HVAC. Gen. arr. above roof.
FF.96.23.17.0330	DB 64 HVAC UK comms. room
5536-P01S-01	DB 64 logic, Bygg Automasjon
5536-P01S-02	DB 64 logic, Bygg Automasjon
5536-P01S-03	DB 64 logic, Bygg Automasjon
FF.96.23.17.0334	UK communication rooms. Equipment layout
FF.96.08.10.0908	UK comms room. Gen. arr. below roof
FF.96.08.10.0909	UK comms. room. Gen. arr. above roof.

1.3.5.4 Lighting (TP1)

The electrical lighting installtion in connection with Alwyn Tie-in consists of normal, emergency and air craft warning lighting fittings. This installtion is located on the M01 area upper level.

The normal lighting fittings are tied into the normal lighting distr. board DB2. The emergency and air craft warning lighting fittings are tied into the existing lighting circuits DB8 and DB8/7 which are fed from the emergency power supply.

These fittings are delivered by Glamox and full details can be found in the Vendor data book. The most relevant drawings are listed below:

FF.95.23.03.0401	Lighting Layout upper level
FF.95.23.03.0403	Lighting and earthing for cold vent stack

1.3.5.5 Heat Tracing

Two heat tracing panels have been installed during this project, heat tracing panel DB15 and contactor control panel DB16. Both panels are located inside the cabling room on TP1. They are fed from MCCB cubicle RA5.
The Contactor Control Panel DB16 is supplying the pyrotenax heat tracing cables, installed on the Knock Out Drum V47 boot. Three circuits are involved with associated thermistors for measuring of the surface temperature. These thermistors are connected to Zener barriers installed in DB16 sub panel. DB16 have also logic functions for temperature sensor and level controllers inside the boot.

The heat tracing panel DB15 are feeding heat tracing cables located on the M01 area.

This includes vessel trim V47 and drain, deluge, instrument housing heaters, and ATI relief. Some modification has also been done on the existing blow down system on TP1 and TCP2. On TP1 the heat tracing cables linked to this system are tied into circuits from the existing heat tracing panel, circuit no. 2 and no 6 respectively.

Regarding TCP2 circuit no 4 and no 40 in DB 316 have been used.

All panels, DB15, DB16 and DB16 sub panel, have been delivered by Vest Elektro teknikk and all details can be found in the Vendor data books. The most relevant drawings for the system are listed below:

FF.95.23.03.0430	Heat tracing distr. board DB15
FF.95.23.03.0432	Contactor control panel DB16 Knock Out Drum
FF.95.23.03.0422	Power layout Zone 1
FF.83.23.03.6001	DB16 Trace heating distribution

FF.95.23.03.6002	One line diagram sub distribution MCC "B" sheet 1 and 3.
FF.95.23.03.0426	Power layout battery and cabling room
FA.85.23.03.0110	Power layout cellar deck s.w
FA.85.23.03.0113	Power layout - main deck

1.3.6 INSTRUMENT DESIGN

1.3.6.1 Introduction

The instrumentation associated with Alwyn Tie-in is located principally on TP1, with feed-back to QP via the telemetry system, located within one of the interface rooms on TP1.

There are connections across the bridge to TCP2, these are for repeat of electrical alarms, blowdown routing valves and tie-ins to the overpressure protection system.
Process control with the exception of the depacking control valves, is local. The bulk of instrumentation is for monitoring the status of the process and/or initiating safety actions, and is displayed on the mimic or recorders located in the CCR on QP Platform. A number of process signals and the information gathered from the leak detection system are transmitted, by troposcatter equipment, to the Alwyn Platform and St. Fergus, Scotland.

The instrument design may be defined in the following categories.

1. Process control and monitoring.
2. Emergency shutdown and process safety.
3. Fire and gas detection and protection.

1.3.6.2 Process Control and Monitoring

The control and monitoring of the process is, in the main, pneumatic with local control, with pressure switches providing alarms and process shutdown signals. Valve status is provided by limit switches mounted on valves, that initiates a signal, which subsequently display's valve position on the mimic located on the main panel within the CCR on QP platform. The depacking/flow control valves may be controlled from CCR or local.

Reference drawings:

FF 95-00-12-5053	Alwyn Tie-in/TP1 gas inlet
FF 95-00-12-5054	Alwyn Tie-in/TP1 leak detection and flow control
FF 95-00-12-5056	Alwyn Tie-in/TP1 connections
FF 95-00-04-5052	Cold vent knock-out drum
FF 95-00-04-5057	New cold vent stack on TP1
FF 95-00-04-5059	LT relief gas from sales gas headers Nos. 1 & 2 to Alwyn Tie-in/TP1 cold vent. system
FF 85-00-04-5005	Existing blowdown valve connections on TCP2 sales gas headers to Alwyn Tie-in/TP1 cold vent. system
FF 95-00-04-5064	Existing blowdown valve connections on TP1 sales gas header to Alwyn Tie-in/TP1 cold vent system
FF 95-00-08-5060	Hydraulic power distribution
FA 95-16-00-1008	Loop diagrams TP1
FA 85-16-00-1008	Loop diagrams TCP2
FA 96-16-00-1175	Electrical interconnection loop diagrams
FA 96-16-00-1382	QP loop diagrams

1.3.6.3 Emergency Shutdown and Process Safety

The emergency shutdown and process safety system for Alwyn Tie-in is an extension of the existing ESD system on TP1. The levels of shutdown being the same, namely 1st, 2nd, 3rd and 4th levels. Additional gas detection and handswitches initiating (3rd) and (4th) levels respectively have been added.

The emergency shutdown valves have been connected to the group 'U' shutdown bus rail, while the blowdown valves have been connected to the group 'W' depressurization bus rail for TP1 and to group 'X' and "W" depressurization bus rail for TCP2.

Pressure transmitters, pressure switches and valve limit switches from specific items have been utilised as inputs for 4th level shutdown and to initiate either initial or secondary over pressure protection actions.

Reference drawings

FF 95-16-00-1413	Safety analysis function evaluation chart for Alwyn Tie-in
FF 95-16-00-1414	Shutdown logic diagram
FF 95-16-06-1176	Emergency shutdown system group 'U'
FF 95-16-06-1177	Emergency shutdown system group 'U'
FF 95-16-06-1179	Emergency shutdown system blowdown group 'W'
FF 95-16-06-1409	Emergency shutdown system blowdown group 'W'
FF 85 16 08 1013	Emergency shutdown pneum. blowdown group 'X'
FF 85 16 08 1104	Emergency shutdown pneum. blowdown group 'W'

1.3.6.4 Fire and Gas Detection and Protection

No new fire detection equipment has been installed for Alwyn, some items have been slightly relocated.
New gas detection sensors have been installed local to the cold vent KO-drum V47. These are connected to channels within one of the gas detection panels (located within interface room no. 2), where output initiates alarms and shutdown actions.
Fire protection for module 01 upper has been extended by the installation of duplicate deluge valves, replacing single deluge valve. Initiation of the deluge valves and the starting of fire-pumps remain unchanged. The purpose of double deluge valves is to ensure sufficient deluge water supply even with one valve mal-functioning or being out of service for maintenance.

Reference drawings

FF 95-00-17-5061	Deluge, firewater and washdown system
FF 95-16-00-1430	Instrument layout upper west
FF 95-16-00-1431	Instrument layout upper east
FA 95-16-06-1053	Console connection diagram (extention to TP1) gas detection cabinets
FA 95-16-17-1085	Fire detection panel logic circuits
FA 95-16-17-1223	Fire pump and deluge system

1.3.7 SAFETY

1.3.7.1 Introduction

The safety systems for the Alwyn Tie-in Project are largely connections to existing safety systems with little new equipment. The new installations located in module 01 upper and lower level mainly replaced existing process plants by that of a higher material specification, therefore area classification is little effected.

The previous escape routes in the area, zone 01, have been replaced by alternative routes following the same philosophy. One fire hose station, complemented with foam tank has been provided. The deluge system has been extended and expanded, the initiation is from existing fire detection, with only new pressure switches installed in the deluge system to initiate alarms and start the fire pumps.

Gas detection local to the boot of knock-out drum V47 has been added, this initiates a new alarm, and is also an input for 3rd level shutdown of TP1, and starting fire pumps.

1.3.7.2 Area Classification

Area classification of module 01 is presented on the following drawings:

Reference Drawings

FA-95-23-03-0046, Area classification lower level
FA-95-23-03-0047, Area classification upper level
FA-95-23-03-0074, Area classification looking west and east
FA-95-23-03-0075, Area classification looking nort and south

1.3.7.3 Fire Fighting System

The fire fighting system for the Alwyn Tie-in Project consists of deluge systems. Two duplex systems over the new and existing equipment in area module 01, and a small extension of an existing system in the cellar deck area over the riser at top of column no. 2.

On the upper area of module 01 a new fire hose station and foam unit has been installed.

There is no new fire detection in the area, only the relocation of a fire alarm button (FAB) and one ultra violet light detector has been necessary.

Reference Drawings

FF-95-00-17-5061, P & ID deluge, firewater and washdown system
FF-95-20-17-2157, Firewater spray coverage of 24" and 32" riser at cover plate on top of column 2
FF-95-20-17-2172, Firewater deluge system upper level zone 01 EL-37168
FF-95-16-00-1430, Instrument layout upper west EL-37168
FF-95-16-00-1431, Instrument layout upper east EL-37168

1.3.7.4 Alarm and Public Address System

For the Alwyn Tie-in Project no new public address equipment has been installed, only one PA speaker has been slightly relocated.

Reference Drawings

FF-95-16-00-1430, Instrument layout upper west EL-37168

1.3.7.5 Fire and Gas Detection System

For the Alwyn Tie-in Project no new fire detection has been installed. Only pressure switches associated with the deluge discharge have been installed.

Two gas detectors associated with the boot of knock-out drum V47 have been installed. These are used as inputs for alarm and shutdown actions.

The type of sensors are the same as previously used on TP1 and are connected to two spare channels in the gas detection panel located within interface-room no. 2.

Reference Drawings

FF-95-16-00-1430, Instrument layout upper west EL-37168
FF-95-16-00-1431, Instrument layout upper east EL-37168
FA-95-16-17-1085, Fire detection panel logic circuits
FA-95-16-17-1223, Fire pump and deluge systems
FA-95-16-06-1053, Console connection diagram extention to TP1 gas detection cabinet

1.3.7.6 Emergency Shut Down System

The Emergency shutdown system is an extension of the existing ESD system of TP1. The levels of shutdown being the same, namely 1st, 2nd, 3rd and 4th levels. The emergency shutdown valves have been connected to the group "U" bus rail, while the blowdown valves have been connected to the group "W" depressurisation bus rail for TP1, and group "W" and "X" for TCP2.

Only three new blowdown valves have been added, other blowdown valves are existing valves, which have been replaced by new ones due to change in piping class.

Reference Drawings

FF 95 16 00 1413	Safety analysis functional evaluation chart
FF 95 16 00 1414	Shutdown logic diagram
FF 95 16 06 1176	ESD system group "U"
FF 95 16 06 1177	ESD system group "U"
FF 95 16 06 1179	ESD system group "W"
FF 95 16 06 1409	ESD system group "W"
FF 95 16 08 1013	ESD system group "X"
FF 95 16 08 1104	ESD system group "W"

7

Section 1.7 - FINAL REPORT FROM CERTIFYING AUTHORITY

Report 87-3289: Final Report - Tie-In of Alwyn Field to Frigg Field. Work Carried out by Certifying Authority.

Rapport/Report

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Dato/Date	Avd./Dept.	Prosjektnr./Project No.
11.06.1987	VT-41	622101

Godkjent av/Approved by

W. Qvam

DET NORSKE VERITAS * STAVANGER *

W. Qvam

Klient, Oppdragsgiver/Client, Sponsor: Elf Aquitaine Norge A/S

Klient ref./Clients ref.:

Rapporttype/Type of Report: Additional Survey

Sammendrag/Summary

This report contains a summary of the work carried out by Veritas as Certifying Authority for the TP1 and QP platforms.

The following project phases are dealt with:
Design, fabrication and offshore hook-up and commisioning.

VERITEC Rapportnr./Report No.: 87-3289

Emnegruppe/Subject Group: P2

Rapporttittel/Title of Report:

Final report -
Tie-in of Alwyn field to Frigg field.
Work carried out be Certifying Authority.

Utført av/Work carried out by

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- installation

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FINAL REPORT

TIE-IN OF ALWYN FIELD TO THE FRIGG FIELD

WORK CARRIED OUT BY CERTIFYING AUTHORITY

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1. SUMMARY AND CONCLUSION

This report describes the certification work carried out by Det norske Veritas as Certifying Authority in connection with tie-in of the Alwyn field to the Frigg field, and the corresponding modifications at TP1 and QP Platforms.

It is concluded that the modifications are found to be in accordance with the requirements laid down in British Regulations; i.e. Statutory Instrument 289, and Department of Energy "Guidance on design and construction",1984. The platforms are therefore found to be fit for the intended operation.

2. DESCRIPTION OF CONTENT OF MODIFICATIONS ON FRIGG DUE TO ALWYN TIE-IN

2.1. General

The modifications at Frigg field are carried out in order to prepare for proper operation of the gas pipeline between Frigg and Alwyn, and injection of Alwyn gas into the Frigg-St.Fergus transportation system.

In order to achieve these tasks, the following processing equipment is installed,

- one pig receiver for pigging of the Alwyn-Frigg 24" pipeline
- a corrosion spool
- a leak detection system
- tie-in facilities such as interconnecting pipework and valves to facilitate the different production cases

In addition, the new system required utilization/modification of excisting equipment, such as

- instrument air
- plant air
- hydraulic power system
- fire fighting system
- nitrogen
- process-and deck drainage
- Frigg overpressure protection system
- relief system

2.2. Processing systems

The gas arrives at TP1 through two emergency shutdown valves and enters either the pig receiver or the reception line through hand valve M28.1.
After passing the gas inlet section, the gas is monitored in moisture analyser MT-M28.1 for dryness. The gas enters a corrosion spool for corrosion monitoring.
The flow control section consists of three flow control valves in parallell, two in operation and one stand-by.
Under normal conditions the flow is controlled from Alwyn. The flow control valves on Frigg are only used during depacking of sealine between Alwyn and TP1, and when low pressure is detected in this sealine. In order to avoid hydrocarbon condensation in the pipeline, the flow control valves will close if the upstream pressure drops below 110 barg.

In order to minimize shut-down periods on Alwyn the following three alternative production routes exist,

1. Production through the transfer line tying into sealine no.1 and thus bypassing TP1 topsides. This is the main production method.

2. Production through TP1 sales gas header leading to sealine no.1 as first alternative production route.

3. Production through TP1/TCP2 interconnection line and TCP2 sales gas header leading to sealine no.2 as second alternative production route.

2.3. Modifications of flare-and relief system

For the combination of high pressure and low temperature of the Alwyn gas, the temperature downstream the blowdown/relief valves can reach as low as -80 degrees C based on initial upstream temperature of 4 degrees C.

It was therefore required to connect the relief from Alwyn tie-in facilities to a low temperature system on TP1. The excisting vent on TP1 was thus upgraded to stainless steel in order to cope with the low temperatures of the relieved gas. Blowdown and fire safety valves on equipment containing high pressure gas have therefore been connected to the low temperature relief header at TP1.
The low temperature relief header is routed into a cold vent knock-out drum and to the vent. A gas seal is installed on top of the LT vent stack, and purging of the vent system is provided. The design rate for the vent is 6 MSCM/D.

2.4.Utility and safety systems

The new facilities are connected to the excisting utility systems for supply of
- fire water
- fuel gas (for pressurization)
- instrument air
- nitrogen
- hydraulic power
- washdown

The new systems are connected to the excisting open and closed drainage systems at TP1.

The systems have been incorporated into the existing emergency shutdown logic for TP1.

With regard to process safety system, the tie-in of Alwyn required considerable changes in the protective systems for TP1. These are further described below.

2.5. Overpressure protection system

As mentioned in para 2.3, the tie-in of Alwyn gas implies that during relief conditions, very cold gas would be released to the flare system. The excisting facilities at the Frigg field are not able to handle the large amounts that would be released from a pressure relief valve designed for process relief. An alternative overpressure protection system without relief valves has therefore been provided as secondary protection against overpressure in the Frigg topside facilities.

This system incorporates protection against high pressure originating from Frigg field compressors as well as from the Alwyn field (during a blocked outlet condition).

The overpressure protection system consists of sets of triplicated pressure transmitters connected to redundant programmable logic controllers(PLCs), initiating shutdown functions independent from functions for primary protection, when activated (2 out of 3 voting).

Extensive automatic testing of the transmitters, the logic units and signals are incorporated into the system (I.e. consistency test, dynamic test of transmitters, test of analog input card, test of digital input and output card, test of CPU and memories).

3. DESCRIPTION OF WORK CARRIED OUT BY CERTIFYING AUTHORITY

3.1. General

The scope of work for the Certifying Authority is as given in Statutory Instruments no 289, "The Offshore Installations (Construction and Survey)" and further specified in the "Offshore Installations, Guidance on design and construction" issued by Department of Energy.
Special evaluations made and are listed for each discipline.

It should be noted that the systems and equipment upstream of first shut-down valve after pig receiver are not the scope of work for the Certifying Authority.

3.2. Design review

3.2.1. System and general safety

The following aspects of the modifications have been reviewed,

a) Arrangement of new equipment relative to existing installation, including
   - layout
   - area classification
   - escape routes
   - access ways
   - personnel protection

b) Process and utility safety, including
   - process safety system
   - process shutdown systems
   - interface with existing emergengy shutdown system
   - depressuring and relief systems
   - drainage systems
   - overpressure protection system

   In particular, attention has been given to the alternative overpressure protection system, where the items related to process dynamics, shutdown logic etc have been reviewed.

c) The following aspects of fire and gas detection system,
   - signal transmission lines
   - interface with existing emergency shutdown system

d) Modification of excisting Operations manual.

Comment:

With regard to the operations manual, the following items have not been incorporated yet, and will be checked as part of the recertification of TP1,

- correct description of sales gas header overpressure protection arrangement
- correct set pressure of primary overpressure protection
- correct shut-down matrix for sales gas headers
- limitations in crane operations over processing equipment

The documents reviewed are listed in appendix I.1.

3.2.2. Computer systems

Due to the criticallity of the new overpressure protection unit, the new computer based system which shall control the overpressure protection system, have been evaluated in detail.

The following items have been reviewed,

a) Instrumentation concept
   - the reliability model applied, i.e. the methodology used in the qualitative and the quantitative assessment
   - fail safe philosophy
   - functional diversity
   - redundancy and voting

b) Operational control
   - principles of operation, test, maintenance and failure reporting
   - measures to minimize common cause failures

c) Software and hardware
   - safety related functions
   - operator interfaces
   - plant interfaces
   - physical environmental requirements
   - self-checking functions
   - component and sub-system reliability
   - construction quality control for hardware and software
   - proof testing (factory acceptance testing) programme

d) Installation
   - installation specification
   - separation

e) Testing and maintenance
   - intervals of testing and maintenance, i.e. continuous, daily and monthly
   - automatic and manual testing
   - testing procedures
   - instructions for testing and maintenance

The documents reviewed are listed in appendix I.2.

3.2.3. Electrical items

The activity included review of electrical design with emphasis on

- equipment used in hazardous areas
- segregation of main and emergency power system
- earthing and lighting systems
- cable routing
- alarms
- short circuit calculations
- personnel protection
- system protection

The documentation reviewed and design criteria specifications are listed in appendix I.3.

3.2.4. Mechanical items

The scope of work for Certifying Authority was agreed upon in meeting between EAN and DnV, ref. Minutes of Meeting dated 28/1-85.

a) Interface between a pipeline and an installation as described in "Offshore Installations, Guidance on design and construction"

b) Based on procurement schedule and Veritas Technical Note B100 the mechanical equipment were categorized as below,

Item	Class
ESD/HV valves	II(e)
Knock-out drum	I (a)
Process piping	I (e)
Piping vent stack	I (i)
Vent stack	I (i)
Drain boxes	II(a)
Drain piping	II(f)
Utility piping	I (e)
Check valve Mokveld	II(e), I(f)
Spring supports	III
Supports	III
PSV	I (f), II(e)
Deluge system	II(f)

(Class I includes equipment subject to individual design approval and survey during fabrication, while class II includes equipment to be certified by manufacturer. Normally, the general equipment specification is subject to approval. Class III includes equipment items for which neither design approval nor survey during fabrication or manufacturers documentation is required.)

Based upon this classification, the following items were reviewed,
- design specifications as detailed in appendix I.4
- design calculations, drawings and welding procedure specifications for knock-out drum v-47
- stress analysis and welding procedure spesifications for cold vent stack SP45

Comment:

Problems were experienced with cold vent stack SP45, especially as stress calculations were not available before the unit was installed onboard. This vent stack being almost a non-pressurized item, lacked proper attention with regard to design. Considering its size and location, the environmental effects should have been evaluated in time. Stress calculations carried out at a later stage in order to check its compliance with ANSI/ASME B 31.3 revealed that stresses at Y-pipe joints were beyond the permissible limit. Any modification at this stage would be a very complex operation. Therefore, other alternatives had to be considered. Y-pipe joints were then subject to finite element analysis which gave stressed well within the permissible limits. hence, the cold vent stack SP 45 was accepted without any modifications.

3.2.5. Structural

The design review is based on the received documentation regarding structural aspects. This documentation is listed in appendix I.5.

The received design documentation reviewed contained the following main aspects,

- -specifications
- -structural modifications of module M01 due to changed weights
- -structural calculations and drawings of the lattice cold vent stack tower located on module M01
- -connection of riser R24 penetration through platform TP1 column C2
- -anchor platforms, working platforms and winch platform
- -documentation of sheave block and anchor plates on TP1

It should be noted that as the riser R24 itself is outside Veritas' scope of work, only the attachments of riser R24 to platform TP1 is considered relevant for Veritas' structural design review as Certifying Authority for TP1.

Comment:

The design review of listed design documentation in Appendix I.5. reveal that the documented modifications satisfy design requirements with respect to structural strength.

It should, however, be noted that the structural modifications were accepted based on the condition that M01, upper level, shall not be used as lie-down area for live load (ref. DnV telex IOD-76/Gje/Nyboe/Land dated 14/5-1985).

3.3. Review of piping and equipment fabrication, and documentation check

The review carried out during the fabrication phase related to
- survey of fabrication of class I equipment
- witnessing of factory tests
- inspection of selected electrical items
- check of fabrication and installation documentation

in order to ensure that the fabricated items were in accordance with design documentation, approved specifications and applicable codes and standards.

It should be noted that design documentation like calculations and design reports from manufacturers of class I equipment and some structural members are covered by design review carried out by the relevant disciplines (this includes specific master files as well). This documentation is therefore listed as part of design review.

The following inspection and survey reports describe the work carried out,

- Inspection reports from DnV-Helsingfors dated 16/5, 17/7 and 18/7 1985
  Inspection of knock-out drum V-47

- Survey report from DnV-Aberdeen dated 15/8-1985
  Survey of cold vent stack

- STG FRI-AW 09/86 of 01.07.1986
  Fabrication survey of process line no 2017 EFW 32"P

- Survey report dated 29/5-1985
  Inspection of HVAC Distribution panel board, Stavanger

- Survey report dated 30/5-1985
  Vendor inspection of electrical HVAC Equipment, Norsk Viftefabrikk

- Survey report dated 15/7-1987
  Vendor inspection of UPS system, Siemens

- Witnessing parts of factory acceptance test of overpressure protection computer system, 14/11-1985, ASEA, Oslo

Spot check of the following documentation was carried out,

- 20 W21-115 Fabrication 2017-EFW-32"-P
- 20 W24-154 Installation 2027-EFR- 2"-R
- 20 W24-190 " 2053-EC - 2"-R
- 20 W28-408 Flush & Hydrotest 2009-EFW- 4"-R
- 20 W42-179 Modified line 1509-EF - 2"-ME

3.4. Offshore hook-up and commisioning

The work carried out by Certifying Authority during this phase related to

- witnessing of pressure test of selected process lines
- visual inspection of the new installation
- testing of electrical systems and safety systems
- inspection of strengthening of module M01
- spot check of documentation, in particular test documentation

The following survey reports describe the work carried out by Certifying Authority,

- STG-FRI-AW-11/85 of 01.04. 1985
  Strengthening of module M01

- STG-FRI-AW-44/85 of 03.10.85
  Annual survey, primary and secondary structure steel, items with regard to new cold vent stack and strengthening of module M01

- Inspection report dated 12.06.1986
  Survey of electrical installations and test of UPS system
  - test of loss of main power
  - " rectifier
  - " inverter
  - test of automatic change-over sequence
  - test of all alarm and indication functions

- STG FRI-AW 18/86 of 13.08.1986
  Witnessing of pressure test of process lines no. 2017 and 2018

- STG FRI-AW 31/86 of 22.12.1986
  Witnessing of pressure test of process line no. 2002 EFW 16"P

- STG FRI-AW 32/86 of 21.12.1986
  Witnessing of pressure test of process lines no. 2001, 2002 and 2003

- STG FRI-AW 33/86 of 17.12.1986
  Witnessing of pressure test of process lines no. 2081 and 2082

- STG-FRI-AW-01/87 of 04.03.1987
  Survey of electrical installations

- STG-FRI-AW-02/87 of 04.03.1987
  Survey of items with regard to system and general safety testing of fire and gas detection systenms and selected process safety systems

- STG-FRI-AW-03/87 of 22.05.1987
  Testing of overpressure protection system and emergency shutdown system
  Check of outstanding items from survey described in survey report STG-FRI-AW-02/87 of 04.03.87

Comment:

Survey report STG-FRI-AW-03/87 lists marking and painting of new escape routes in connection with modified layout as outstanding items, as this work would form part of normal maintenance work for the entire installation.
Check of escape routes will be carried out during annual survey.

4.CONCLUSION

Based on thr review described above , it is concluded that the new equipment and modifications carried out to excisting equipment on TP1 and QP fulfill the requirements laid down in British Regulations, and the codes and Standards referred to therein. The installations are therefore found to be fit for the intended operation.

Appendix I.

DESIGN DOCUMENTATION REVIEWED

Appendix I.1.
Documentation- items related to system and general safety

P&IDs

FF 0016 00 0010,sh1,2	rev 2	Principle P&ID, secondary protection system
FF 8500 04 5005	rev 03A	Excisting blowdown valve connections on TCP2 sales gas header to TP1 cold vent
FF 9500 01 5063	rev 03A	Instrument air system
FF 9500 04 5052	rev 10A	Cold vent knock-out drum
FF 9500 04 5057	rev 05A	new cold vent stack
FF 9500 04 5059	rev 05A	Relief gas from sales gas headers no 1 and 2 to Alwyn tie-in/TP1 headers
FF 9500 04 5064	rev 03A	Excisting blow-down valve connections on TP1 sales gas headers to TP1 cold vent
FF 9500 08 5060	rev 03A	Hydraulic power distribution
FF 9500 10 5062	rev 05A	Deck drainage
FF 9500 12 5053	rev 07A	Alwyn tie-in/TP1 Gas inlet
FF 9500 12 5054	rev 09A	Alwyn tie-in/TP1 Leak detection and flow control
FF 9500 12 5056	rev 08A	Alwyn tie-in/TP1 Connections
FF 9500 17 5061	rev 04A	Deluge, firewater and washdown

Other drawings/documentation related to process safety

FF 8716 00 1064, sh10	rev 0	Sales gas headers, cause and effect diagram
FF 9516 00 1413	rev 02C	Safety analysis function evaluation chart
FF 9516 00 1414	rev 02C	Shutdown logic diagram
FF 9516 00 1451	rev 01C	Modified layout of excisting transits at TP1 interface room
FF 9516 06 1179	rev 06C	ESD system blowdown group W
FF 9516 06 1409	rev 01C	ESD system blowdown group W
ALW 00 R001	rev 02A	Process description
ALW 00 R002	rev 02A	Description of fire fighting
ALW 00 R004	rev 03A	HP Relief and overpressure protection implementation
ALW 00 R005	rev 02A	Hydraulic power distribution
TPG 5961 E 22 1,	03.84	Dynamic analysis of sales gas headers
311E-PM 86/A39/TEH	09.86	Addendum report to dynamic analysis of sales gas headers
	05.83	"Alternative proposal for anti-overpressure protection system"
311E-P 83/780/YP/TG	09.83	"Frigg field -overpressure protection of sales gas headers and pipes to Scotland"
311E-PM 84/80/YP	03.84	Supplementary documentation to sales gas headers overpressure protection system, "alternative" system

Div. documentation

MR 96112	rev 02	Installation of Alwyn telecom equipment
FF 1021 00 1002	rev 4	Safety ladder
FF 1021 00 1007	rev 2	Fixed handrails
FF 9520 00 2142	rev 01A	Principal layout for Alwyn tie-in, module 01
FF 9520 00 2152	rev 04D	Plot plans-cellar deck, upper level and lower level
FF 9520 00 2154	rev 04D	Plan of escape routes
FF 9523 03 0046	rev 10	Area classification-lower level
FF 9523 03 0047	rev 12	" upper level
FF 9523 03 0048	rev 9	" cellar deck
FF 9523 03 0074	rev 12	" looking west and east
FF 9523 03 0075	rev 11	Area classification- looking north and south

Revised operations manual

Documentation related to instrumentation systems

FF 9516 00 1399	rev 02C	Process hook-up level gauge
FF 9516 00 1400	rev 02C	Pneumatic hook-up
FF 9516 00 1415	rev 03C	Field wiring block diagram
FF 9516 00 1416	rev 03C	Interconnection diagram J.box 01-ISo-1
FF 9516 00 1417	rev 03C	Interconnection diagram J.box IJB-01-ISO2
FF 9516 00 1418	rev 03C	Interconnection diagram J.box IJB-01-ISO3
FF 9516 00 1419	rev 03C	Interconnection diagram J.box IJB 01-FP01
FF 9516 00 1421	rev 05C	Barrier Panel no2. Analogue signal wiring
FF 9516 00 1437	rev 01C	Interconnection diagram J.box IJB 01-FP02
FF 9516 00 1451	rev 01C	Modified layout of existing transits at TP1 interface room
FA 9516 01 1010	rev 02C	Interface cabinet wiring diagram
FF 9616 11 1553	rev 05C	Block diagram showing signal routing to the St. Fergus and Alwyn links in the U.K. radio room
FF 9616 11 1557	rev 03C	Spectra-tek multiplex equipment installation details
FF 9616 14 0083	rev 01C	Terminal cabinet wiring diagram
FA 9616 14 1128	rev 03C	Control panel TP1 front view
FA 9616 14 1533	rev 03G	TP1 mimic panel (original)
FA 9616 14 1533	rev 03C	Proposed layout of mimic diagram for Alwyn tie-in
FF 9616 14 1560	rev 03C	Back of panel arrangement for existing section of QP control panel

FF 9616 14 1561	rev 03C	Modification to TP1 control panel in QP control room
FF 9616 14 1575	rev 03C	Alarm relay common bus wiring
FF 9661 21 1568	rev 03C	UK communications room termination and wiring diagram
ALW-16-S-001	rev 0	Pig arrival switch spec.
ALW-16-S-003	rev 03B	Hydraulic and pneumatic control stations spec.
ALW-16-S-004	rev 04C	Instrument cables spec.
ALW-16-S-007	rev 04C	DC Current repeaters and trip amplifiers
ALW-16-S-012	rev 02B	Electrical pressure switches spec.
ALW-16-S-013	rev 02B	Pneumatic pressure switches spec.
ALW-16-S-016	rev 02C	Instrument testing, calibration and precommisioning procedure
ALW-16-S-020	rev 02B	Cable gland spec.
ALW-16-S-030	rev 03C	Junction boxes spec.
ALW-16-S-033	rev 02B	Electronic controllers spec.
ALW-16-S-035	rev 02B	Electronic pressure and flow transmitters spec.
ALW-16-S-036	rev 02B	Pneumatic pressure transmitters spec.

APPENDIX I.2. DESIGN DOCUMENTATION - COMPUTER SYSTEMS

The following documents have been reviewed:

ELF Documents

Document Number	Issue	Title
-	Feb. 1983	Reliability study
-	Aug. 1986	Reliability study
Specification:		
90092-16S-001	27.09.84	General description
90092-16S-002	May 85	Technical specification
90092-16S-004	20.01.85	Master file summary
90092-16S-005	13.02.85	Cable specification
90092-16S-006	14.02.85	Spec. control valve actuator
90092-16S-007	06.02.85	Spec 4" ball valve actuator
90092-16S-008	07.02.85	Spec. for solenoid valve
90092-16S-009	08.02.85	Spec. for press. transmiter
90092-16S-010	08.02.85	Spec. for solenoid valve
90092-16S-011	17.04.85	Spec. for press. switch
90092-16S-012	14.02.85	Autom. ratio station...
90092-16S-013	13.02.85	Spec. solenoid valve
90092-16S-014	15.02.85	Spec. limit switch
90092-16S-015	May 85	Spec. Prog. Logical Cont
90092-16S-016	28.02.85	Spec. galv. isol v./c. ..
90092-16S-017	27.02.85	Spec. press. tran. encl.
90092-16S-018	07.03.85	Test procedure
90092-16S-019	05.03.85	Spec. cab. intr. safe barr.
90092-16S-020	07.03.85	Spec. adj. reset restr.
90092-16S-021	18.03.85	Spec. valve limit switches
90092-16S-022	16.04.85	Spec. remote ann. panel
90092-16S-023	17.04.85	Spec. junc. boxes
90092-16S-024	26.03.85	Spec. term. cab. and ..
90092-16S-026	27.03.85	Spec. airset
90092-16S-027	13.04.85	Spec. manometer gauges
90092-16S-029	07.05.85	Off. innstall. spec. instr.
90092-23S-001	Rev. 0/ER	Off. in. sp. no-break supply
90092-23S-002	Rev. 0/ER	Off. in. sp. trace heating

FF 00 16 00 0010	Rev. 2	Prin. pip. and inst. dia second prot. system
FF 00 16 00 0011	Rev. 0	Principle block diagram Preliminary
FF 00 16 00 0012	Rev. 0	Cause and effect dia. Preliminary
FF 00 16 00 1005	Rev. 0	OPS Instrument flow diagram
FF 85 16 00 0072	Rev. 3	Interace cabinets Shts. 03a,31,52,66,68,70-75
FF 85 16 00 0072	Rev. 0-2	Loop diagrams Shts. 2/10,2/39,2/45,2/55, 2/70,3/10,3/39,3/45,3/55, 3/70,4/10,4/39,4/45,4/55, 4/70,6/18-6/20,6/32-6/34, 7/70,0/95
FF 85 20 00 5072	Rev. 0	P. a. clm 3- elevation ..
FF 85 20 00 5073	Rev. 9	P. a. column 3- plan ..
FF 85 20 12 2745	Rev. 0	Iso. main gas TCP2
FF 85 23 00 0356	Rev. 0	PS heaters in PT boxes
FF 87 16 00 0018	Rev. 0-3	Compressor modification shts 4/42,9/19-9/21,26/3, 30/5,30/13,31/4,14/29, 14/30,14/35,30/15,30/11,152
FF 87 16 00 0018	Rev. 1-3	Annunciator installation shts 2-4,10
FF 87 16 00 0018	Rev. 1-3	Compressor modification shts 2/8,2/15,2/45,2/47, 2/48,2/60,2/77-2/79,2/110, 2/111,2/122,2/243, 2/246,2/249, 2/702,3/8,3/15,3/45,3/47, 3/48,3/60,3/77-3/79,3/110, 3/111,3/122,4/8,4/15,4/45, 4/47,4/48,4/60,4/77-4/79, 4/110,4/111,4/122
FF 87 16 00 0018	Rev. 1-2	Loop diagrams shts 19/1-19/5
FF 87 20 00 1078	Rev. 1	P.a. module 30-main ..
FF 87 20 00 1082	Rev. 1	P.a. module 31-main ..
FF 87 20 00 1085	Rev. 1	P.a. module 33-main ..
FF 87 23 00 0122	Rev. 0	No break supply OPS
FF 87 20 13 2041	Rev. 0	Iso. fuel gas to turb. ..

FF 95 16 00 0085	Rev. 0-3	Interface cabinets shts 03A,33A,34A,37-48
FF 95 16 00 0085	Rev. 1-2	Loop diagrams shts 2/08,2/39,2/46,2/55, 3/08,3/39,3/46,3/55,4/08, 4/39,4746,4/55,6/18,6/19, 6/24,6/25,6/32-6/34,0/60
FF 95 16 00 1420	Rev. 03C	ATI barrier panel no. 1 ..
FF 95 16 00 1421	Rev. 03C	ATI barrier panel no. 2 .. sheets 1,2
FF 95 20 00 1011	Rev. 0	P. a. p. lower west zone 01
FF 95 20 00 1012	Rev. 0	P. a. p. lower east zone 01
FF 95 20 00 1017	Rev. 0	P. a. p. lower east zone 03
FF 95 20 00 2155	Rev. 01A	P. a. up. level west zone 01 For information
FF 95 20 00 2156	Rev. 01A	P. a. up. level east zone 01 For information
FF 95 20 00 2158	Rev. 01A	P. a. p. lw. west zne 01 For information
FF 95 20 00 2163	Rev. 01A	P. a. sec. zone 01 For information
FF 95 20 00 2176	Rev. 01A	P. a. sections For information
FF 95 20 12 3341	Rev. 1	Isom main gas tr. mod. TP1
FF 95 23 00 0431	Rev. 0	PS heaters in PT boxes
FF 96 16 00 0081	Rev. 0	Annunciator installation Preliminary
FF 96 16 00 1535	Rev. 04C	Ctrl room, ATI wiring dia.
FF 96 16 11 1539	Rev. 05C	UK com.room eq. & cbl. ..
FF 96 16 11 1552	Rev. 03C	Junc. box interc. dia. sheets 1,2,3.
FF 96 16 11 1553	Rev. 05C	Block dia. signal routing.. sheet 1
FF 96 16 11 1553	Rev. 04C	Signal list sheets 2-5
FF 96 16 11 1558	Rev. 02C	Spectratek multiplex eq. .. sheet 1-7
FF 96 16 11 1559	Rev. 02C	Junction box, ex. TJB-4, ...
FF 96 16 14 082	Rev. 02C	Term cabinets wiring diagram sheets 2-4,55,21,49,50,53, 85,98,137,142,145,146, 148,150,151,154,171,172,193
FF 96 16 14 1546	Rev. 02C	Main disribution frame
FF 96 16 14 1561	Rev. 03C	Mod. to TP1 ctrl. panel...
FF 96 16 14 1562	Rev. 03C	Cable rtn, cble ladder...
FF 96 16 21 1573	Rev. 03C	UK comms room electr. sheet 1/2.

FA 85 16 00 1008	Rev. 01C/03	Treat. pl. TCP2 loop dia. Sheet 6/20
FA 95 16 00 1008	Rev. 03C/02C	Treat. pl TP1, loop dia. sht. 6/70-6/96,6/98-6/105, 6/107-6/140,9/61,9/55, 9/56,6/24
FA 95 16 01 1011	Rev. 02C	TP1 Telementry singal list Shts. 1/16-1/19,1/23-1/25, 1/33,1/36,1/37,1/4,1/39, 1/54,1/59-1/61,1/64,1/75, 1/75,2/11-2/14,2/18-2/20, 2/28,2/31-2/34,2/38,2/45, 2/50-2/52,2/55,2/66
FA 96 16 00 1175	Rev. 03C	Electr. intercon. loop .. sheets 1,2,1/21B,1/21A
FA 96 16 00 1382	Rev. 02C	Qua. plat. loop dia. Sheets 1,2,1/34,1/35,1/39, 1/50,1/51,1/52
FA 96 16 11 1549	Rev. 02C	Liaison UK jnc box A shet 1,2,6,9,18,20
FA 96 16 11 1550	Rev. 03C/02C	Liaiso UK jnc. box .... sheet 1,2,6,9,18,20
FA 96 16 11 1551	Rev. 02C	Liais UK mash. box (tjb 9) sheets 1,2,6,9,18,20
FA 96 16 14 1130	Rev. 02C	TP1 control panel, w. dia. sheets 1-3,5,9-14,18,19
FA 96 16 14 1131	Rev. 02C	Alarm cbnt, connect. dia. sheet no. 1,2,61
FA 96 16 14 1134	Rev. 02C	Telecom., junc. box (tjb 9) sheets 1,2,4,6
FA 96 16 14 1372	Rev. 02C	Annunciator layout LC1 sheets 7-9
FA 96 16 14 1373	Rev. 03C/02C	Interpsng, relay cab. no. 11 shts. 1-4,12,19-21,23,24 31-33,35-42
FA 96 16 14 1448	Rev. 02C	TP1 mimic panel sht. 1,2,10,15-27,31,34-36

ELN 2169	As built July 82	Treatment/Compression platform No. 2
Sheet C 5034		P. a. module 02, upper decl
C 5036		P. a. module 03, upper deck
C 5053		Section A2-A2, module 02 ..
C 5054		Sec. B2-B2 and C2-C2, ...
C 5060		Sec. A5-A5 Pancake 05 ....
C 5857		Pancake 05

A sea Per Kure documents
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A sea software and hardware documentation.

APPENDIX I.3. DESIGN DOCUMENTATION - ELECTRICAL

Drawings_UPS_system

Drawing number:	Sheet no.:	Title:
FA 95 16 06 1053	1	Console Conn. Diagr.
FF 95 16 00 1415	1/1	Field wiring block diagram
FF 95 16 00 1420	1/1	ATI Barrier panel No. 1 Signal wiring
FF 95 16 00 1423	1 & 2	ATI Barrier Panel 1 & 2
FF 95 16 00 1425	1/1	Interconn. diagr. for moisture sensor
FF 95 16 00 1436	1 & 2	Relay panel TP1
FF 95 16 00 1438	1-20	ATI Relay Panel terminal wiring diagram
FF 95 16 00 1449	1/1	ATI Relay Panel arr.
FF 95 16 00 1450	1/1	ATI Interface room cable routing & layout
FF 95 16 00 1455	1-5	TPI interface room power distr. and load lists
FF 95 16 06 1456	1/1	ATI fire & gas cable routing between interf. room No.1 and 2 (Zone 06)
FF 96 23 17 0322		One line diagram UK tropo room UPS system
FF 96 23 17 0329	2 & 3	DB 63 & 65 UK tropo
FF 96 23 17 0332	1-2	Cable list.
FF 96 23 17 0335	1	UK Comm. rooms power layout
FF 96 23 17 0344	1	Power layout roof
FF 96 23 17 0350	1	DB schedule for DA 01 emergency supply
FF 96 16 00 1175	1	Loop diagram UK UPS fault
FF 96 16 11 1553	1/5	Block diagram showing signal routing to the St. Fergus & Alwyn links in the UK radio room
FF 96 16 14 1576	1/1	Back of panel power distr. 24 v DC

Drawings_HVAC

FF 96 23 17 0330	1/1	DB 64 HVAC-UK Comm. room
FF 96-08-10-0002	1/1	UK Comm. room inter-switch gear-battery room HVAC gen. arr. prior to ATI
FF 96-08-10-0003	1/1	Do. below roof
FF 96-08-10-0004	1/1	Do. above roof
FF 96-08-10-0909	1/1	Do. above roof

Specifications:

311E-TID/85/S 23426/PF		Uninteruptible power supply
311E-S23-638/KAP/s1		Cable ladder
311E-S-497/PF/ha		Power transformer
311E-S20-664/KAP/s1		Lighting
311E-S23-646/KAP/s1		Electrical junction boxes
311E-TID/S20-628/KAP/en		Electrical cable
311E-S23-S04/PF/en		Distribution panel board
311E-S23-653/LJE/s1		HVAC
NO-GR-ELE-001	Rev. 2	Regulations and Standards
NO-GR-ELE-002	Rev. 2	Design and protection of Electrical Cables
NO-GR-ELE-008		Electrical Cables
NO-GR-ELE-010		Earthing and Lightning Protection
NO-GR-ELE-016		Lightning and socket outlet installation

Certificates for Zener barriers

- PTB No.: Ex-782007X

APPENDIX I.4. DESIGN DOCUMENTATION - MECHANICAL ITEMS

Specifications

Document Number:	Rev.:	Title:
ALW-20-S003	02B	"Specification for Emergency Shut Down Valves (ESDV) and Hydraulic Valves (HV)"
ALW-16-S-002	02B	"Hydraulic and Pneumatic Actuarots"
ALW-16-S-005	02B	"Hydraulic and Pneumatic Actuarots"
ALW-10-26-S002	03B	"Pressure Vessels"
ALW-16-S-001	0	"Pig Arrival Switch"
ALW-20-S005	02B	Piping and Valve Material Specification
10-20-S003	04C	Piping Fabrication and Installation
10-20-S004	02B	Piping Pressure Test Procedure
10-20-S005	02B	Piping Flushing Specification
10-20-S007	02B	Piping Support Systems
10-20-S008	02B	Piping Fire Fighting Items
10-20-S009	02B	Piping Special Items
10-20-S010	02B	Piping Marking of Spools
10-20-S011	02B	Piping Weight Determination
ALW-16-S-023	Rev. 02B	Compresion fittings spec.
ALW-16-S-025	Rev. 03C	Tubing-stainless steel.
ALW-16-S-027	Rev. 3C	Shut-off valves
ALW-16-S-008	Rev. 04B	Control valve spec.
ALW-16-S-038	Rev. 02B	Blowdown & control valve spec.
ALW-20-S-021	Rev. 02B	Spec. for non-slam check valves
ALW-20-S-018	Rev. 02B	Spec. for sphere flow tees

Drawings

Piping drawings:

Drawing no.:	Sht.no.:	Rev.:
FF 9520 12 2191	1	03C
FF 9520 10 2224	1,2 + 3	04C
FF 9520 10 2225	1 + 2	04C
FF 9520 10 2230	1	03C
FF 9520 10 2233	1 + 2	03C
FF 9520 10 2234	1	03C
FF 9520 10 2165	1	04C
FF 9520 12 2111	1	03C
FF 9520 00 2165	1	01A
FF 9520 00 2180	1	01A
FF 9520 00 2154	1	03C
FF 9520 00 2153	1	03C
FF 9520 00 2164	1	04C
FF 9520 04 2148	1	02C
FF 9520 00 2152	1	03C

Design documentation:

Knockout drum V47:

Drawing no.:	Rev.:	Title:
FF 9526 04 00 02	03C	Arrangement and datasheet for V-47
LHJ 2250 42 13	B	Stress calculations
LHJ 2250 11 13		Drawing
LHJ 2250 14		Drawing
LHJ 2250 28		Drawing
EAN ref. LAC/038		Welding procedure specifications.

Cold Vent stack SP 45.

EAN ref. LAC/052		Welding procedure specifications
EAN ref. LAC/096		Design Calculations Cold Vent/Blow down
EAN ref. ALW-20-S041		Re-analysis of cold vent stack SP 45
EAN ref. ALW-20-S041 (LAC/110)	Rev. 02A	Stress analysis of cold vent stack SP 45.

General:

MR 90103;	Master filew on utility system
EAN ref. LAC/099	Hydrotest of pipe 2018.

APPENDIX I.5. DESIGN DOCUMENTATION - STRUCTURAL

General documents:

Document no.:	Rev.:	Title:
AE 5446 001	10.05.84	Aker Eng. Report QP antenna frames check.
FF 10-21-S003	2	Specification - fabrication of steel structures of modules and pancakes
FF 10-21-S004	0	Specification - cooling of fixed marine structures
FF 10-21-S005	1	Specification - Appendix to coating spec. FF 10-21-S004

Module_MO1_documents:

Document no.:	Rev.:	Title:
ALW-21-CN-001	02A	Reanalysis of MO1, TP1.
B-796	31.08.85	Elf Technical Report: NDT of 10 joints of MO1
ALW-21-CN-008	01A	New deck beams, Upper deck - MO1
FF-95-21-23-2203	02C	TP1 Module Mo1 Strengthening GA_s Details
FF-95-21-23-2263	02C	TP1 Module MO1 Strengthening - Details
851/012/ST2682	0	Under deck stiffening and temp. cut outs - MO1 (Wimpey drwg.)
851/012/ST2683	0	Under deck stiffening details (Wimpey drwg.)

Cold vent tower on MO1 documents:

Document no.:	Rev.:	Title:
ALW-21-CW-005	01A	Module MO1 Cold vent tower
ALW-21-CW-005	01A	Module MO1 Cold vent tower Addendum I (10.04.85)
MR 90103 B	-	Master File (Structural part of Master File)
851/012	July -85	Wimpey Calc. Note: Vent Stack - wind loading
05-05-1425	Aug. -85	Design calcs. for A-frame structure of sparrows twin boom lifting crane to be used for cold vent stack erection on Frigg TP1. (Sparrows Offshore Services LTD)
FF 95 21 23 2250	Rev. 03C	Cold vent stack tower sections
FF 95 21 23 2251	Rev. 04C	Cold vent stack tower elevations
FF 95 21 23 2252	Rev. 04C	Cold vent stck tower sections & details
FF 95 21 23 2255	Rev. 03C	Cold vent stack tower bracing & base stiffening
FF 95 21 23 2256	Rev. 03C	Removal of cold vent stack pedistal, cladding, etc.
FF 95 21 23 2257	Rev. 04C	Mods to top deck new cold vent stack
FF 95 21 23 2258	Rev. 04C	G.a. access to platforms upper deck
FF 95 21 23 2259	Rev. 03C	Access platforms upper deck sections
FF 95 21 23 2260	Rev. 03C	Access platforms upper deck sections & details
FF 95 21 23 2261	Rev. 03C	Access platforms upper deck sections & details
FF 95 21 23 2264	Rev. 02C	Modifications to cladding
FF 95 21 23 2265	Rev. 03C	Access platfaorm for removal of corrosion tools

24" riser R2X/anchor platform/winch platform etc. documents:

Document no.:	Rev.:	Title:
ALW-21-CN-010	01A	Check strength of anchor platform steelwork
ALW-21-CN-012	01A	Check strength of anchor platform concrete.
ALW-21-CN-011	01A	Check strength of concrete at wall penetration.
ALW-21-CN-013	1	Finite element analyses of Frigg field R2X riser penetration
MR 95178	3	Installation of 24" bend and inspection platform for riser R2X in column 2.
-	22/11-84	R2X riser penetration calculation of spring stiffness Bergen Engineering
ALW-20-CN-001	03A	Riser R2X stress analysis (info. except sec. 2.12)
ALW-20-CN-009	02A	Temporary winch platform Design Report.
ALW-21-CN-015	02A	Rigging and Padeye & Design.
ALW-21-CN-CN-014	01A	Summary Report for Riser R24 Penetration
FF-10-077-0	19.08.85	Elf calculations: padeye SWl 51.7 kn (Pages 13-17)
ALW-21-CN-007	01A	Support frame for transfer line.
FF-95-21-28-1140	3	Frigg Field TP1 Column 2 Section Platform Et + 5000
FF-95-21-23-1239	03C	TP1 Column C2 Platform at el-58700 General arrangement
FF-95-21-23-1240	03C	TP1 Column C2 Platform at el-58700 steelwork details.

Document no.:	Rev.:	Title:
FF-95-21-23-2271	04C	Winch Platform for R24 riser installation General Arrangement
FF-95-21-23-2272	03C	Winch Platform for R24 riser installation Section and details
FF-95-21-23-2273	01C	Winch Plaform for R24 riser installation Section and details.
851/012/FM/207/01	A	New deck openings (Wimpey)
851/012/F/M/208/01	A	Details of temp. steelwork (Wimpey)
851/012/F/M/216/01	A	General arrangement (Wimpey)
851/012/F/M/224/01	A	Detail of Padeye P10 (Wimpey)
FF-10-21-00-0012	1	Standard Padeyes SWL 20 kn - SWL 100 kn
FF-95-21-2276	03C	Support steelwork for transfer line GA and sections
FF-95-21-2277	03C	Support steelwork for transfer line sections and details
FF-95-21-2278	03C	Support steelwork for transfer line details

Sheave_block/anchor_plates_documentation:

Document no.:	Rev.:	Title:
DE. 693	-	Verification of sheave block. Doris/Sernbebom Report
-	Aug. -84	ELF Calc. Note: Check at anchor plate used for pull-in of Alwyn sealine
WUE-84/09/5	27/09. 84	WUE Inspection Report TP1 Sheave Block and Anchor Plates.