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ELF AQUITAINE NORGE A/S
FRIGG FIELD INSPECTORS
INSPECTION DEP.

FRIGG FIELD

TCP2
GAS COMPRESSION
TRAINING MANUAL

VOLUME 2

mark one

1 PURPOSE

1.1 The purpose of the TCP2 Gas Compression Training Manual and its associated course is to familiarise Elf Aquitaine Norge process operators and other engineers with the theory and practice of the operation of the gas compression and power generation equipment (and associated utilities) installed on the Frigg TCP2 platform.

2 STANDARD TO BE ACHIEVED

2.1 The standard of proficiency to be achieved on completion of the course is as follows:

(a) General understanding of the principles of gas compression.

(b) General understanding of the TCP2 gas compression facilities (TCP2—C) and their functional role in the overall Frigg field process flow.

(c) General knowledge of the layout of all plant, the principles of operation and functional role of each item of major equipment.

(d) General knowledge of the instrumentation and controls associated with the gas compression facilities and their associated utilities.

(e) General knowledge of start-up and shutdown requirements and procedures for the gas compression facilities and their associated utilities.

(f) Good knowledge of key emergency procedures and safety considerations.

(g) For process operators; sufficient knowledge of all gas compression and ancillary equipment (and associated utilities) to enable safe and efficient operation, simple trouble-shooting and maintenance.

3 FORMAT OF THE MANUAL

3.1 Although this is a Training Manual, all TCP2—C system information (Parts C to F inclusive) has been presented in such a manner that it can be converted to an Operations Manual, with little change of format.

4 VALIDITY

4.1 This edition (Issue 1. October 1980) of the manual has been produced from available Piping and Instrument Diagrams (PID), Process Flow (PF) diagrams, Kvaerner-Technip design information, and vendors' information, before the completion of offshore installation.

4.2 The content of the Training Manual has not been fully validated technically and will be subject to update as a result of design changes, as-built drawings, revised control and operating methods and parameters, and alterations arising from start-up experience.

7 USE OF COLOUR

7.1 Colours have been added to system pipelines in order to assist in understanding each individual illustration. These colours are generally not related to the colour codings used on mimic diagrams or installed pipework, although wherever possible the same colours are used for particular fluids within each system or sub-system (eg Chapter). Red has been used throughout to denote ESD valve controllers.

7.2 The colour coding is generally as follows:

ESDV SYMBOLS.
FIREWATER LINES.

PROCESS GAS.
FUEL GAS.
VENTED GAS (HP & LP).
REFERENCE/BALANCE GAS (COMPRESSOR).

LUBE OIL.
HYDRAULIC OIL.
SERVICE AIR.

DIESEL OIL.
LUBE OIL SCAVENGE (GAS TURBINE).

SEA WATER.
CONDENSATE.
HP PROCESS OILY WATER.
SEAL OIL (COMPRESSOR).

LP OILY WATER.

FRESH WATER.
FRESH WATER/TEG MIXTURE.
INSTRUMENT AIR.

TEG.
METHANOL.
REFRIGERANT (AIR CONDITIONING).

FRESH WATER/TEG MIXTURE.
(WHERE DIFFERENTIATION IS NECESSARY).

VENTILATION/AIR CONDITIONING AIR.

A few departures from the above colour coding occur on some illustrations; these are identified on the colour keys which appear on all illustrations.

8 AUTHORITY VESTED IN THE TRAINING MANUAL

8.1 This is a Training Manual and as such is not intended to form a single-point reference for all platform operations; none of the procedures and associated illustrations excludes the use of revised 'as-fitted'/'as-built' drawings, operating/procedures manuals or reference material, and they are in no way intended to replace, in whole or in part, instructions which may be issued from time to time by Elf Aquitaine Norge.

5 CONTENT OF THE MANUAL

5.1 The Training Manual consists of four parts, each comprising one or more chapters, and bound in two separate volumes. The content of the parts is generally as follows:

Part C 'Gas Compression Scheme' consists of 18 chapters covering the Overall Frigg Process, Gas Compression – Description, Power Generation and all utilities. (C1 to 8 in Vol 1; C9 to 18 in Vol 2).

Part D 'Gas Compression – Operation' contains one chapter only and should be read in conjunction with Chapter C2 'Gas Compression – Description'.

Part E 'Safety' contains seven chapters covering Fire and Gas Detection Systems, fire extinguishing systems (Halon and Firewater), Personnel Safety and Chemical Hazards.

Part F 'Emergency Shutdown System' contains one chapter only, covering the safety logic of manual and automatic shutdowns.

5.2 The chapters are arranged in volumes as follows:

Vol 1 (Compression) – Chapters C1 to C8 inclusive, and D1 and F1.

Vol 2 (Utilities & Safety) – Chapters C9 to C18 inclusive, and E1 to E7 inclusive.

5.3 All chapters within each part are listed on Part Contents lists.

6 SYMBOLS AND ABBREVIATIONS

6.1 A 'Glossary of Symbols' (extracted from PID 5424W 00 0040 01 'PID Symbols and Abbreviations') appears at the beginning of both volumes of the Manual. This contains those symbols and abbreviations which have been used in producing the simplified illustrations in the Manual. In this process of simplification, much detail on the source PID and PF has been omitted in order to present only the minimum information necessary to an understanding of the purpose and operational principles of a system, sub-system or equipment. Reference material (PID and PF) has been listed at the beginning of each chapter and these drawings must be consulted for full appreciation of systems etc.

6.2 There are six different valve panel control arrangements specific to ESD and hand valves which are shown on the Glossary of Symbols. For simplicity the pertinent arrangement ('A1' or 'A2' etc) is not reproduced in detail on illustrations.

6.3 A departure from PID/PF presentation should be noted; this is the placing of 'H', 'HH', 'L' and 'LL' **outside** alarm and switch symbols on most system drawings (particularly where tag numbers are not shown). This notation has been used in order to align with the normal presentation in operations manuals and also to reduce the area taken up by these symbols.

6.4 Tag numbers of valves (other than ESDVs and associated hand valves), instruments and controllers have generally been omitted from illustrations, unless they are of particular importance in relation to Gas Compression. In addition, where lines or control arrangements are duplicated, only one (typical) has often been shown, eg a series of vessels or pumps with identical flow and control configurations.

Issue No	Dated	Amended by (Signature)	Date

RECORD OF AMENDMENTS

TCP2 GAS COMPRESSION

TRAINING MANUAL

CONTENTS

FOREWORD

RECORD OF AMENDMENTS

GLOSSARY OF SYMBOLS

PART C GAS COMPRESSION SCHEME
(Chapters C1 to C8 in Volume 1
Chapters C9 to C18 in Volume 2)

PART D GAS COMPRESSION OPERATION

PART E SAFETY (In Volume 2)

PART F EMERGENCY SHUTDOWN SYSTEM

PIPING SYMBOLS

ADJUSTABLE CHOKE VALVE


HAND CONTROL VALVE


GATE VALVE


REDUCED BORE BALL VALVE

FULL BORE BALL VALVE


GLOBE VALVE

NEEDLE VALVE

THREE-WAY VALVE

THREE-WAY BALL VALVE

ANGLE VALVE

DIAPHRAGM VALVE

MANUAL ADJUSTABLE CHOKE VALVE

BUTTERFLY VALVE

INJECTOR

CHECK VALVE

STRAINER


AIR RELEASE VALVE


AIR INLET VALVE


FUNNEL

RAPID COUPLING


HALF SYMMETRICAL COUPLING


SPECTACLE BLIND


VENT


CAP


BLIND FLANGE


PLUG

CSO CAR SEALED OPEN

CSC CAR SEALED CLOSED

TRAP OR DRAINER


AIR FILTER


FIRE HOSE REEL


FIREWATER MONITOR


GAS DETECTOR


SPRINKLER HEAD (OPEN)

DIAGRAM ABBREVIATIONS

AEG	GAS DETECTOR (ANALYSER ELEMENT GAS)
AEF	FIRE DETECTOR HEAT (ANALYSER ELEMENT FIRE)
AES	SMOKE DETECTOR (ANALYSER ELEMENT SMOKE)
AUV	ULTRA VIOLET DETECTOR
CO	CUT OFF
CWD	COOLING WATER DRAIN
DG	DIESEL GENERATOR
FC	FAIL CLOSED
FO	FAIL OPEN
HF	HYDRAULIC FLUID
IA	INSTRUMENT AIR
IG	INERT GAS
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
OD	OPEN DRAIN
PB	PUSHBUTTON
SA	SERVICE AIR
TEG	TRIETHYLENE GLYCOL

NOTE:

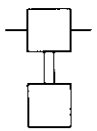
THIS GLOSSARY OF SYMBOLS CONTAINS THOSE SYMBOLS AND ABBREVIATIONS WHICH HAVE BEEN USED IN PRODUCING THE SIMPLIFIED ILLUSTRATIONS IN THIS TRAINING MANUAL.

FOR COMPLETE DETAILS, REFERENCE SHOULD BE MADE TO PID 5424W 00 0040 01; 'PID SYMBOLS AND ABBREVIATIONS'.

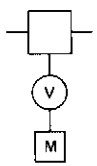
GLOSSARY OF SYMBOLS (2)

ISSUE 1. OCT 1980

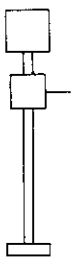
MACHINE SYMBOLS



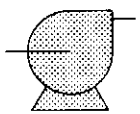
RECIPROCATING PUMP



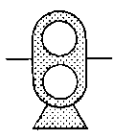
RECIPROCATING PUMP WITH MECHANICAL VARIATOR (V) MOTOR (M)



VERTICAL PUMP

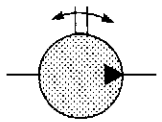


CENTRIFUGAL PUMP

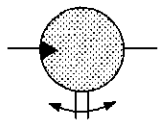


GEAR PUMP

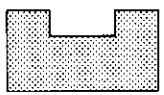
SCREW PUMP



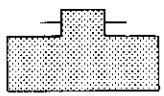
HYDRAULIC PUMP



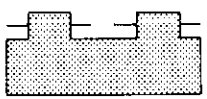
HYDRAULIC MOTOR



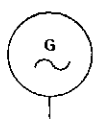
CENTRIFUGAL COMPRESSOR



SINGLE-STAGE RECIPROCATING COMPRESSOR

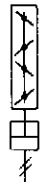


TWO-STAGE RECIPROCATING COMPRESSOR



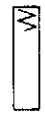
ELECTRICAL GENERATOR

HEATING AND VENTILATION SYMBOLS

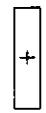


MODULATING/SHUT-OFF DAMPER WITH PNEUMATIC MOTOR

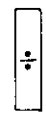
SHUT-OFF DAMPER, HAND OPERATED



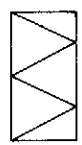
A–60 FIRE DAMPER



HEATING COIL



COOLING COIL



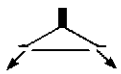
FILTER

SOUND ABSORBER

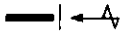
LOUVRE

HUMIDIFIER

ADJUSTMENT DAMPER

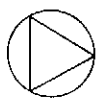


DIFFUSER



GRILLE

VENTILATION DUCT



FAN

EXHAUST AIR

THERMOSTATIC EXPANSION VALVE

GL(2)

NOTE:

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INSTRUMENTATION SYMBOLS

HYDRAULIC LINE

INSTRUMENT LINE

PNEUMATIC LINE

ELECTRIC LINE

CAPILLARY LINE

DIAPHRAGM OPERATED VALVE

OR

PRESSURE REGULATOR

DIAPHRAGM VALVE WITH HANDWHEEL

ON/OFF PILOT VALVES

PILOT VALVES

EV

PV

SOLENOID

PNEUMATIC

PISTON-OPERATED VALVE

THREE-WAY DIAPHRAGM VALVE

ANGLE DIAPHRAGM VALVE

AUTOMATIC ADJUSTABLE CHOKE VALVE

RELIEF VALVE (PSV) (= PRESSURE SAFETY VALVE)

FLAME ARRESTER (AF)

FLOW STRAIGHTENING VANE (FX)

FLOW ELEMENT, ORIFICE FLANGE OR RESTRICTION ORIFICE

RUPTURE DISC

FLOW ELEMENT (TURBINE METER)

ROTAMETER

FLOW GAUGE

INSTRUMENT LOCATION SYMBOLS

LOCALLY MOUNTED INSTRUMENT

INSTRUMENT MOUNTED IN FRONT OF CONTROL PANEL ON QP

INSTRUMENT MOUNTED INSIDE CONTROL PANEL ON QP

INSTRUMENT MOUNTED IN FRONT OF CONTROL PANEL ON TCP2–C

INSTRUMENT MOUNTED INSIDE CONTROL PANEL ON TCP2–C

INSTRUMENT MOUNTED IN FRONT OF LOCAL PANEL ON TCP2–C (NOTE: NOT CONTROL PANEL)

INSTRUMENT MOUNTED INSIDE LOCAL PANEL ON TCP2–C (NOTE: NOT CONTROL PANEL)

LOCALLY MOUNTED LIGHT

PANEL-MOUNTED LIGHT ON QP

PANEL-MOUNTED LIGHT ON TCP2–C

PANEL-MOUNTED LIGHT ON LOCAL PANEL ON TCP2–C

C

HS

C

L

FROM C OR L

HAND SWITCH { L = LOCAL; C = CONTROL ROOM

NOTE: IN SPECIAL CASES MANUAL CONTROL MAY BE FROM LOCAL PANELS, BUT THIS MUST BE AUTHORISED IN EACH CASE.

HS OR

HAND SWITCH

LG

LEVEL GLASS

LC

LEVEL CONTROLLER, EXTERNAL CHAMBER

LS

L

LEVEL SWITCH, INTERNAL MOUNTING

H

LS

LEVEL SWITCH, EXTERNAL CHAMBER

NOTE:

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IDENTIFICATION LETTERS FOR INSTRUMENTS

	VARIABLE INDICATION	PRIMARY ELEMENT	TRANSMITTER	INDICATOR	RECORDER	CONTROLLER	INDICATOR CONTROLLER	RECORDER CONTROLLER	CONTROL/ON OFF VALVE	ALARMS (5)				SIGNALISATION		SWITCH (3) & (4)	TOTALIZER/INTEGRATOR	FUNCTION RELAY/ CONVERTER	SAFETY VALVE	PNEUMATIC VALVE	THERMOWELL	PILOT VALVE	GAUGE
										HIGH	HIGH HIGH	LOW	LOW LOW	HIGH(4)	LOW(4)								
		E	T	I	R	C	IC	RC	CV	AH	AHH	AL	ALL	LH	LL	S	Q	Y	SV	PV	W	XV	G
FLOW	F	FE	FT	FI(2)	FR	FC	FIC	FRC	FCV	FAH	FAHH	FAL	FALL	FLH	FLL	FS	FQ	FY		FPV		FXV	FG
LEVEL	L	LE	LT	LI	LR	LC	LIC	LRC	LCV	LAH	LAHH	LAL	LALL	LLH	LLL	LS		LY		LPV		LXV	LG
PRESSURE	P	PE	PT	PI	PR	PC	PIC	PRC	PCV	PAH	PAHH	PAL (7)	PALL	PLH	PLL	PS(7)		PY	PSV	PPV		PXV	PG(2)
TEMPERATURE	T	TE	TT	TI	TR	TC	TIC	TRC	TCV	TAH	TAHH	TAL	TALL	TLH	TLL	TS		TY	TSV		TW		TG(2)
DIFFERENTIAL FLOW	Fd	FdE	FdT	FdI	FdR	FdC	FdIC	FdRC	FdCV	FdAH	FdAHH	FdAL	FdALL	FdLH	FdLL	FdS		FdY					
DIFFERENTIAL LEVEL	Ld	LdE	LdT	LdI	LdR	LdC	LdIC	LdRC	LdCV	LdAH	LdAHH	LdAL	LdALL	LdLH	LdLL	LdS		LdY					
DIFFERENTIAL PRESSURE	Pd	PdE	PdT	PdI	PdR	PdC	PdIC	PdRC	PdCV	PdAH	PdAHH	PdAL	PdALL	PdLH	PdLL	PdS		PdY					
DIFFERENTIAL TEMPERATURE	Td	TdE	TdT	TdI	TdR	TdC	TdIC	TdRC	TdCV	TdAH	TdAHH	TdAL	TdALL	TdLH	TdLL	TdS		TdY					
SPEED	S	SE	ST	SI	SR	SC	SIC	SRC	SCV	SAH	SAHH	SAL	SALL	SLH	SLL	SS		SY					
ANALYSER	A	AE	AT	AI	AR	AC	AIC	ARC	ACV	AAH	AAHH	AAL	AALL	ALH	ALL	AS		AY					
POSITION	Z(1)		ZT	ZI	ZR	ZC	ZIC	ZRC	ZCV	ZAH	ZAHH	ZAL	ZALL	ZLH	ZLL	ZS							
MANUAL (HAND OPERATED)	H					HC	HIC		HCV/ HV							HS						HXV	
MOISTURE (HUMIDITY)	M		MT			MC										MS							
EMERGENCY SHUTDOWN	ESD/E								ESDV (7)											EPV		EXV	
ELECTRIC CURRENT	I				IR																		
OTHERS	X	XE	XT	XI	XR	XC	XIC	XRC	XCV	XAH	XAHH	XAL	XALL	XLH (6)	XLL (6)	XS	XQ	XY		XPV		XXV	

NOTES:

1. PREFIX 'E' IS USED FOR ESD INSTRUMENTS eg 'EZ'.
2. ALSO USED TO REPRESENT A LOCAL MEASUREMENT.
3. SPECIFY HIGH OR LOW.
4. FOR VALVE POSITION SWITCHES 'H' = 'OPEN' AND 'L' = 'CLOSED'.
5. 'XA' NOT SPECIFIED ALARM(S).
6. 'XL' NOT SPECIFIED SIGNALISATION.
7. (DETAIL A1 & A2)

Detail A1	Detail A2	
11PSL001	11PSL001	11PAL001
11PSL15–1A	11PSL11–1A	11PAL11–1
11PSL25–1A	11PSL21–1A	11PAL21–1
11PSL35–1A	11PSL31–1A	11PAL31–1

NOTE:

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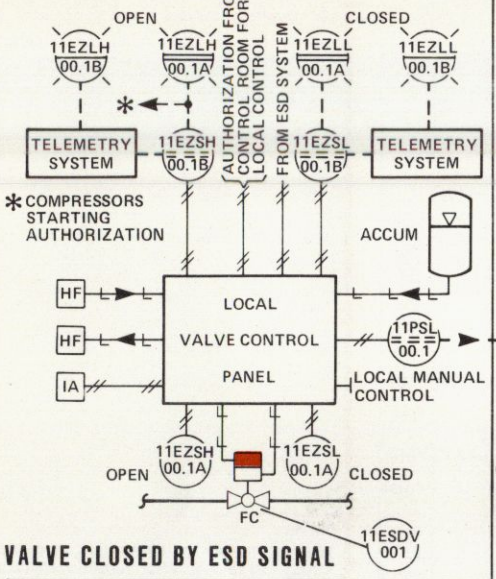
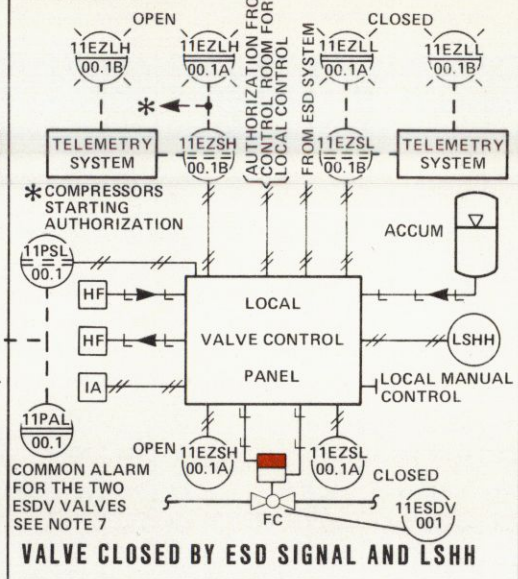
TYPICAL LOOPS

DETAIL A1



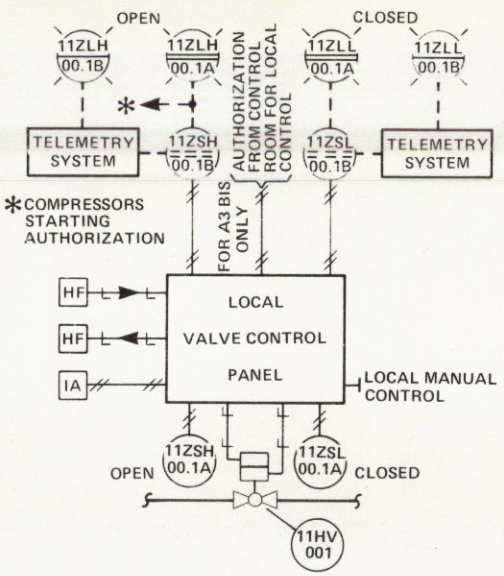
VALVE CLOSED BY ESD SIGNAL

DETAIL A2

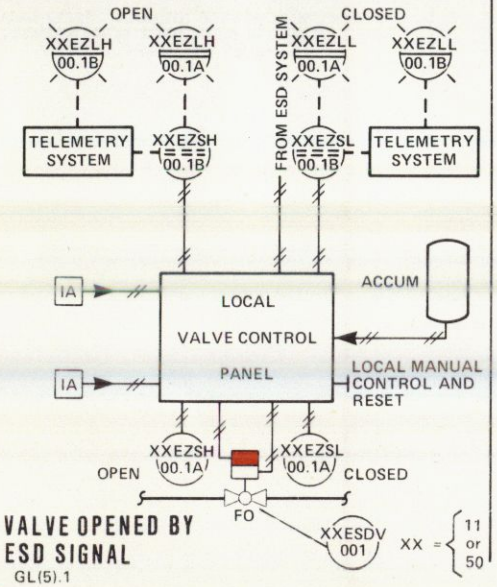


VALVE CLOSED BY ESD SIGNAL AND LSHH

DETAILS A3 AND A3 BIS



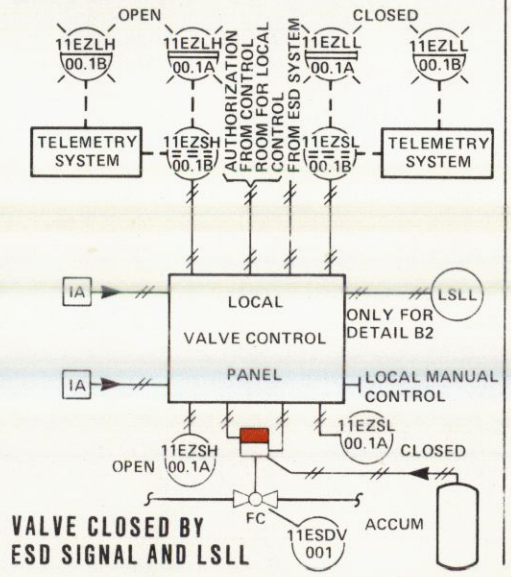
DETAIL B1



VALVE OPENED BY ESD SIGNAL

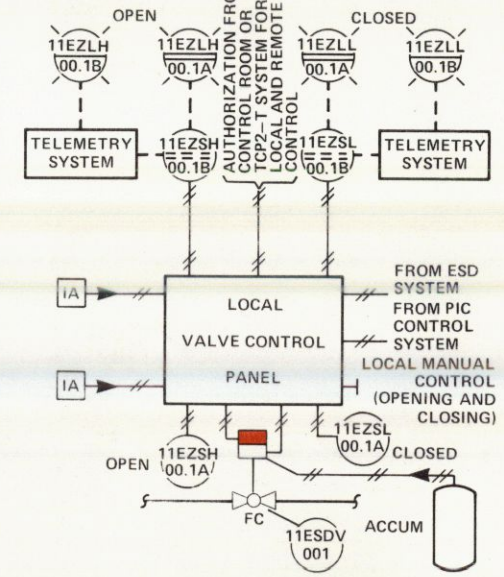
GL(5).1

DETAIL B2 AND B2 BIS



VALVE CLOSED BY ESD SIGNAL AND LSLL

DETAIL B3



NOTE:

THIS GLOSSARY OF SYMBOLS CONTAINS THOSE SYMBOLS AND ABBREVIATIONS WHICH HAVE BEEN USED IN PRODUCING THE SIMPLIFIED ILLUSTRATIONS IN THIS TRAINING MANUAL.

FOR COMPLETE DETAILS, REFERENCE SHOULD BE MADE TO PID 5424W 00 0040 01; 'PID SYMBOLS AND ABBREVIATIONS'.

GLOSSARY OF SYMBOLS (5).2 LIST OF VALVES USING 'TYPICAL LOOPS' OPPOSITE

ISSUE 1. OCT 1980

A1

11ESDV15.1
11ESDV25.1
11ESDV35.1

A2

11ESDV11.1
11ESDV21.1
11ESDV31.1

A3

11HV11.1
11HV15.1
11HV31.1
11HV35.1

A3 BIS

11HV21.1
11HV21.2
11HV25.1
11HV25.2

B1

11ESDV15.2 *
11ESDV17.1

11ESDV35.2 *
11ESDV37.1

11ESDV21.2
11ESDV25.2 *
11ESDV25.3

50ESDV11.1
50ESDV11.3

* WITH PSLL

B2

11ESDV12.2
11ESDV16.2
11ESDV22.2
11ESDV32.2
11ESDV36.2

B2 BIS

50ESDV11.5
50ESDV11.7

50ESDV11.6
50ESDV11.8

50ESDV50.5
50ESDV52.5
50ESDV54.5

B3

50ESDV16.1
50ESDV16.2
50ESDV16.3
50ESDV16.4

GL5(2)

PART C

GAS COMPRESSION SCHEME

CONTENTS

VOLUME 1:

CHAPTER C1 OVERALL FRIGG PROCESS

CHAPTER C2 GAS COMPRESSION – DESCRIPTION

CHAPTER C3 FUEL GAS SYSTEM

CHAPTER C4 HP RELIEF SYSTEM

CHAPTER C5 LP VENT SYSTEM

CHAPTER C6 OILY WATER RECOVERY SYSTEM

CHAPTER C7 CLOSED FRESH WATER/TEG DRAIN SYSTEM

CHAPTER C8 OPEN DRAINAGE SYSTEM

VOLUME 2:

CHAPTER C9 UTILITIES – GENERAL

CHAPTER C10 POWER GENERATION

CHAPTER C11 INSTRUMENT AND SERVICE AIR SYSTEM

CHAPTER C12 DIESEL OIL SYSTEM

CHAPTER C13 MAIN SEA WATER COOLING SYSTEM

CHAPTER C14 FRESH WATER COOLING SYSTEMS

CHAPTER C15 DESALINATED WATER NETWORK

CHAPTER C16 WASHDOWN SYSTEM

CHAPTER C17 HYDRAULIC SYSTEM

CHAPTER C18 AIR CONDITIONING AND VENTILATION

CHAPTER C9

UTILITIES – GENERAL

CONTENTS

SECTION 1 SUMMARY

1. Gas Compression and Utilities Matrix
2. Gas Compression Process Requirements
3. Power Generation Requirements and Utilities Interdependence
4. Interfaces with Existing TCP2–T and Frigg
5. Atmospheric Vents

ILLUSTRATIONS

C9.1 Gas Compression and Utilities Matrix
C9.2 Gas Compression Process Requirements
C9.3 Power Generation Requirements and Utilities Interdependence
C9.4 Interfaces with Existing TCP2–T and Frigg

EITHER:
ENTER LH COLUMN AND READ ACROSS FOR SUPPLIES/FUNCTIONS NECESSARY (& LOCATION IN MANUAL)

OR:
ENTER TOP COLUMN AND READ DOWN FOR SYSTEMS/FUNCTIONS NEEDING THAT UTILITY/FUNCTION (& LOCATION IN MANUAL)

CHAP & VOL	SUBJECT	C3 (1) FUEL GAS	C4 (1) HP RELIEF	C5 (1) LP VENT	C6 (1) OILY WATER RECOVERY	C7 (1) CLOSED DRAIN	C8 (1) OPEN DRAINAGE	C10 (2) POWER GENERATION	C11 (2) INSTR & SERVICE AIR	C12 (2) DIESEL OIL	C13 (2) MAIN SW COOLING	C14 (2) FRESH WATER COOLING	C15 (2) DESALINATED WATER	C16 (2) WASHDOWN	C17 (2) HYDRAULICS	C18 (2) AIR COND & VENTILATION	D1 (1) GAS COMPRESSION – OPERATION	E2 (2) FIRE DETECTION	E3 (2) GAS DETECTION	E4 (2) HALON	E5 (2) FIREWATER	F1 (1) LOGIC CONTROL
C3 (1)	FUEL GAS		x	x	x	x	x	x	x			x			x	x		x	x	x	x	x
C4 (1)	HP RELIEF						x	x	x													x
C5 (1)	LP VENT						x	x	x									x		x		x
C6 (1)	OILY WATER RECOVERY							x	x													x
C7 (1)	CLOSED DRAIN							x	x													
C8 (1)	OPEN DRAINAGE																					
C10 (2)	POWER GENERATION	x		x	x		x		x	x		x						x	x	x	x	x
C11 (2)	INSTR & SERVICE AIR						x	x	*			x						x	x	x	x	
C12 (2)	DIESEL OIL							x	x									x	x	x	x	
C13 (2)	MAIN SW COOLING					x	x	x	x			x		x								
C14 (2)	FRESH WATER COOLING					x	x	x	x		x		x									
C15 (2)	DESALINATED WATER						x	x	x		x			x								
C16 (2)	WASHDOWN						x	x	x													
C17 (2)	HYDRAULICS							x	x													x
C18 (2)	AIR COND & VENTILATION						x	x	x			x						x	x	x		x
D1 (1)	GAS COMPRESSION – OPERATION	x	x	x	x			x	x		x	x	x		x	x		x	x	x	x	x
E2 (2)	FIRE DETECTION							x														x
E3 (2)	GAS DETECTION							x														x
E4 (2)	HALON							x														x
E5 (2)	FIREWATER						x	x	x	x				x	x							x
F1 (1)	LOGIC CONTROL							x	x						x	x		x	x			

x = SUPPLIES OR FUNCTIONS REQUIRED FOR OPERATION.

* = IF TCP2–C SYSTEM NOT OPERATIONAL, INSTRUMENT AIR SUPPLY REQUIRED FROM TCP2–T

SECTION 1 – SUMMARY

1 GAS COMPRESSION AND UTILITIES MATRIX

See illustration C9.1

1.1 Illustration C9.1 lists all chapters in Parts C, D, E and F of this manual which cover the Gas Compression Process and all related systems and functions in the TCP2 Gas Compression area.

1.2 By entering the left-hand side of the Matrix with a particular subject (system or function) and reading across, it is possible to identify all the supplies or functions required for operation of that system or function and its location in the manual. For instance, the Diesel Oil System (Chapter C12, in Volume 2) requires:

(a) Power Generation (C10)

(b) Instrument and Service Air (C11)

(c) Fire Detection (E2)

(d) Gas Detection (E3)

(e) Halon (E4), and

(f) Firewater (E5)

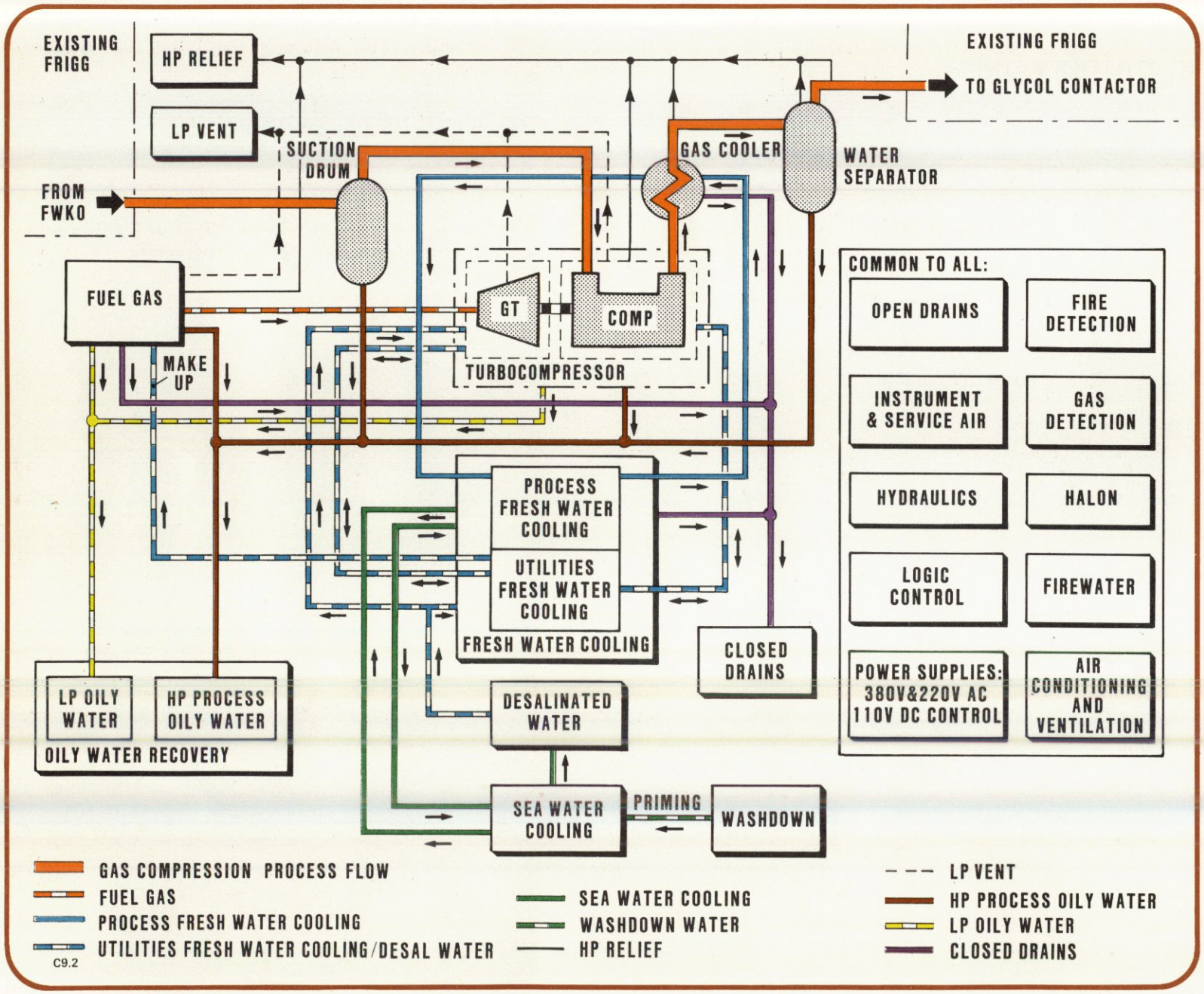
to be operational (all to be found in Volume 2).

1.3 Alternatively, by entering the top column and reading downwards, it is possible to identify all the systems or functions which require that utility or function. For instance, the Diesel Oil System (Chapter C12, in Volume 2) is used by:

(a) Power Generation (C10, Volume 2) and

(b) Firewater System (E5, Volume 2)

1.4 In addition, the Matrix may be used as a method of identifying a relevant chapter without reference to the Contents pages.

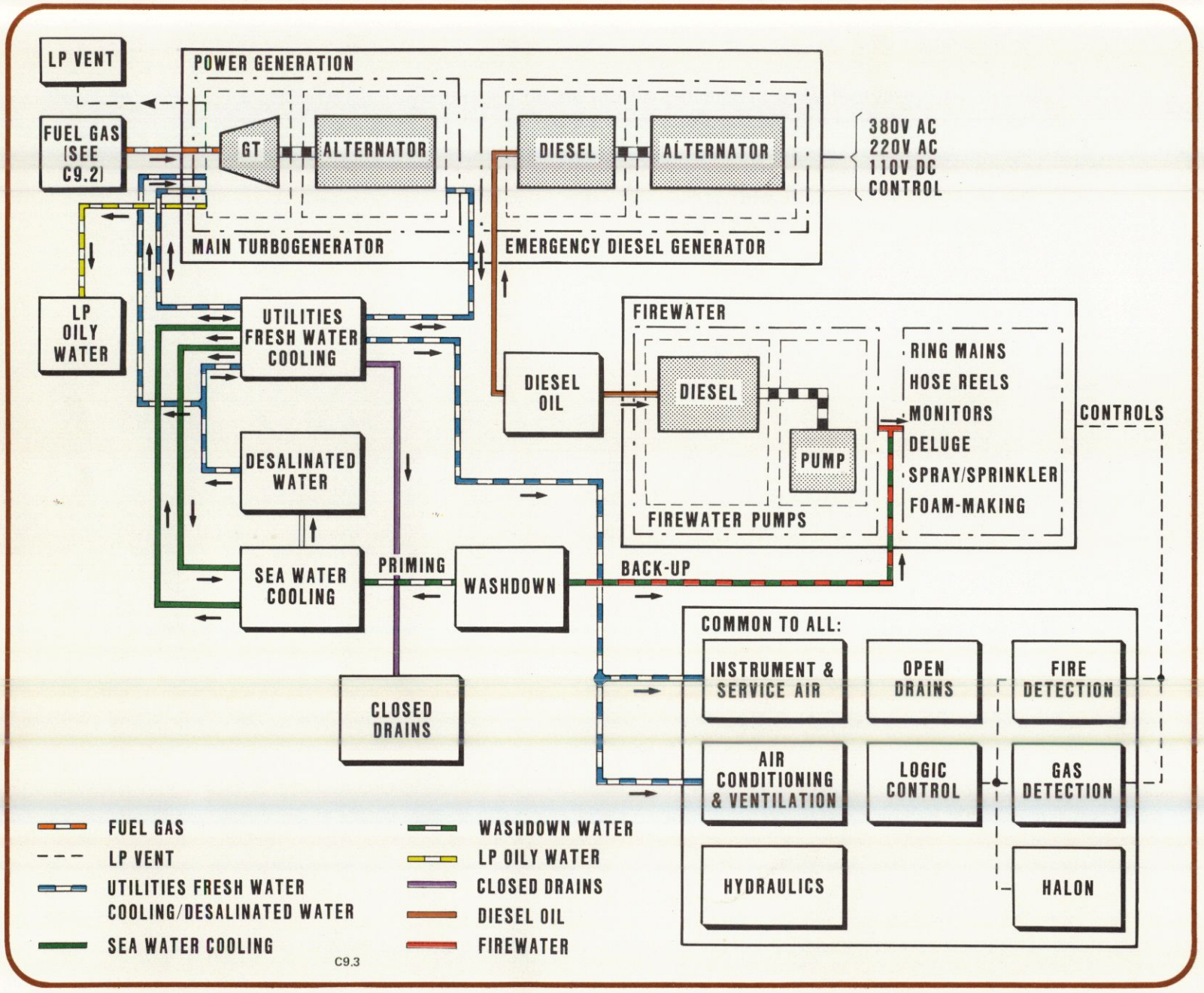

EXISTING FRIGG
HP RELIEF
LP VENT
SUCTION DRUM
FROM FWKO
FUEL GAS
MAKE UP
GT
COMP
TURBOCOMPRESSOR
GAS COOLER
WATER SEPARATOR
EXISTING FRIGG
TO GLYCOL CONTACTOR
COMMON TO ALL:
OPEN DRAINS
FIRE DETECTION
INSTRUMENT & SERVICE AIR
GAS DETECTION
HYDRAULICS
HALON
LOGIC CONTROL
FIREWATER
POWER SUPPLIES: 380V&220V AC 110V DC CONTROL
AIR CONDITIONING AND VENTILATION
PROCESS FRESH WATER COOLING
UTILITIES FRESH WATER COOLING
FRESH WATER COOLING
CLOSED DRAINS
LP OILY WATER
HP PROCESS OILY WATER
OILY WATER RECOVERY
DESALINATED WATER
SEA WATER COOLING
PRIMING
WASHDOWN
GAS COMPRESSION PROCESS FLOW
FUEL GAS
PROCESS FRESH WATER COOLING
UTILITIES FRESH WATER COOLING/DESAL WATER
SEA WATER COOLING
WASHDOWN WATER
HP RELIEF
LP VENT
HP PROCESS OILY WATER
LP OILY WATER
CLOSED DRAINS
C9.2

2 GAS COMPRESSION PROCESS REQUIREMENTS

See illustration C9.2

2.1 Shown on illustration C9.2 in schematic form are all the systems and functions necessary to the Gas Compression Process.

2.2 It must be emphasised that this is not a full piping diagram, neither does it show any interfaces with TCP2–T or other Frigg platforms; interfaces are shown on illustration C9.4.

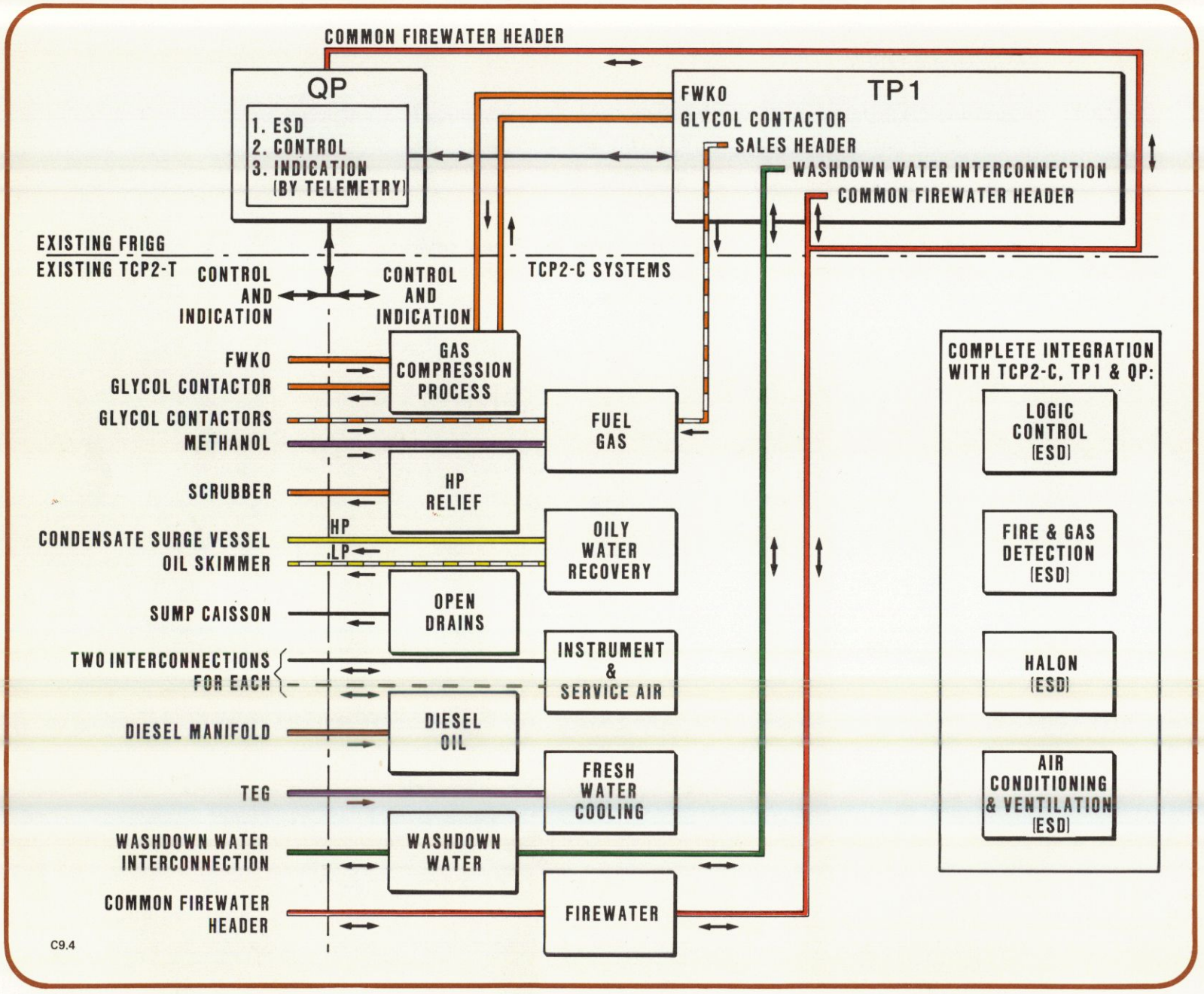

LP VENT
POWER GENERATION
FUEL GAS (SEE C9.2)
GT
ALTERNATOR
DIESEL
ALTERNATOR
380V AC
220V AC
110V DC
CONTROL
MAIN TURBOGENERATOR
EMERGENCY DIESEL GENERATOR
LP OILY WATER
UTILITIES FRESH WATER COOLING
FIREWATER
DIESEL OIL
DIESEL
RING MAINS
HOSE REELS
MONITORS
DELUGE
SPRAY/SPRINKLER
FOAM-MAKING
CONTROLS
PUMP
FIREWATER PUMPS
DESALINATED WATER
SEA WATER COOLING
PRIMING
WASHDOWN
BACK-UP
COMMON TO ALL:
INSTRUMENT & SERVICE AIR
OPEN DRAINS
FIRE DETECTION
AIR CONDITIONING & VENTILATION
LOGIC CONTROL
GAS DETECTION
HYDRAULICS
HALON
CLOSED DRAINS
FUEL GAS
LP VENT
UTILITIES FRESH WATER COOLING/DESALINATED WATER
SEA WATER COOLING
WASHDOWN WATER
LP OILY WATER
CLOSED DRAINS
DIESEL OIL
FIREWATER
C9.3

3 POWER GENERATION REQUIREMENTS AND UTILITIES INTERDEPENDENCE

See illustration C9.3

3.1 Illustration C9.3 shows, again in schematic form, the requirements of the Power Generation equipment (main and emergency) and also all other utility systems and the extent to which they are interdependent.

3.2 This illustration is again largely a functional representation. Interfaces with TCP2–T and other Frigg platforms are shown on illustration C9.4.


COMMON FIREWATER HEADER
QP
1. ESD
2. CONTROL
3. INDICATION (BY TELEMETRY)
TP1
FWKO
GLYCOL CONTACTOR
SALES HEADER
WASHDOWN WATER INTERCONNECTION
COMMON FIREWATER HEADER
EXISTING FRIGG
EXISTING TCP2-T
CONTROL AND INDICATION
CONTROL AND INDICATION
TCP2-C SYSTEMS
FWKO
GLYCOL CONTACTOR
GLYCOL CONTACTORS
METHANOL
SCRUBBER
CONDENSATE SURGE VESSEL
OIL SKIMMER
SUMP CAISSON
TWO INTERCONNECTIONS FOR EACH
DIESEL MANIFOLD
TEG
WASHDOWN WATER INTERCONNECTION
COMMON FIREWATER HEADER
HP
LP
GAS COMPRESSION PROCESS
FUEL GAS
HP RELIEF
OILY WATER RECOVERY
OPEN DRAINS
INSTRUMENT & SERVICE AIR
DIESEL OIL
FRESH WATER COOLING
WASHDOWN WATER
FIREWATER
COMPLETE INTEGRATION WITH TCP2-C, TP1 & QP:
LOGIC CONTROL (ESD)
FIRE & GAS DETECTION (ESD)
HALON (ESD)
AIR CONDITIONING & VENTILATION (ESD)
C9.4

4 INTERFACES WITH EXISTING TCP2–T AND FRIGG

See illustration C9.4

4.1 The last of the illustrations, C9.4, presents in schematic form the interfaced systems:

(a) With the existing TCP2 Treatment area and

(b) With platforms TP1 and QP.

4.2 No detail is shown, this must be obtained from the relevant chapters of this manual.

5 ATMOSPHERIC VENTS

Reference: PID 5424W 67 0040 03

5.1 Summary

5.1.1 A number of systems and tanks have provisions for venting direct to atmosphere, generally at Upper Deck level (Division II area). They are shown on individual system illustrations in the manual but are not dealt with as a separate Chapter. For convenience, the principal atmospheric vent outlets are listed below. All sizes are in inches.

5.2 Gas Turbines 11KG01A/B/C for Compressors

5.2.1 **Lube Oil System**	**Size**
Lube oil tank	2
Air/oil separator (clarifier)	2

5.2.2 **Auxiliary Fuel Gas System**	**Size**
Modulating and shut-off valves	1

5.2.3 **Water Wash System (2 off)**	1 & 1.5

5.3 Turbocompressors 11K01A/B/C; Lube and Seal Oil System

Lube and seal oil tank	6
Polluted seal oil tank (2 off)	3 & 6
Bearing chamber (2 off sized 2in, common)	3

5.4 Firewater System; Firepump Diesel Engines 68PD01A/B

Hydraulic oil tank (with flame arrester, vents outside firepump rooms)	2
Engine air intake (below floor of Pancakes 42/46)	8
Engine exhaust (to sea, below Cellar Deck. Pancakes 42/46)	10

5.5 Turbogenerators 52GG01A/B

Gas evacuation	1.5
Decompression of shut-off valve	2
Gas shut-off valve	1
Bleed valve (outside Pancake 40)	28
Gas generator (outside Pancake 40)	6
Lube oil tank	4

5.6 Emergency Diesel Generator; Diesel Engine 53GD01

Lube oil tank	3
Engine exhaust (outlet in Safe area)	16
Air compressor diesel engine exhaust (below floor of Pancake 44)	1.5

CHAPTER C10

POWER GENERATION

CONTENTS

SECTION 1 INTRODUCTION

1. Summary

SECTION 2 THE 5.5kV ELECTRICAL SYSTEM

1. Introduction
2. Normal Operation
3. Standby Operation
4. Control

SECTION 3 THE TCP2–C MAIN ELECTRICAL SYSTEM

1. Summary

SECTION 4 THE TCP2–C EMERGENCY ELECTRICAL SYSTEM

1. Summary

ILLUSTRATIONS

C10.1 5.5kV Electrical System
C10.2 TCP2–C Main Electrical System
C10.3 TCP2–C Emergency Electrical System

SECTION 1 – INTRODUCTION

Reference: PID 5424W 00 1633 00.01 & 02
EAN S892 SR87069

1 SUMMARY

1.1 The electrical power supply for the whole Frigg field is provided by an integrated system. Two principal levels of generation are provided:

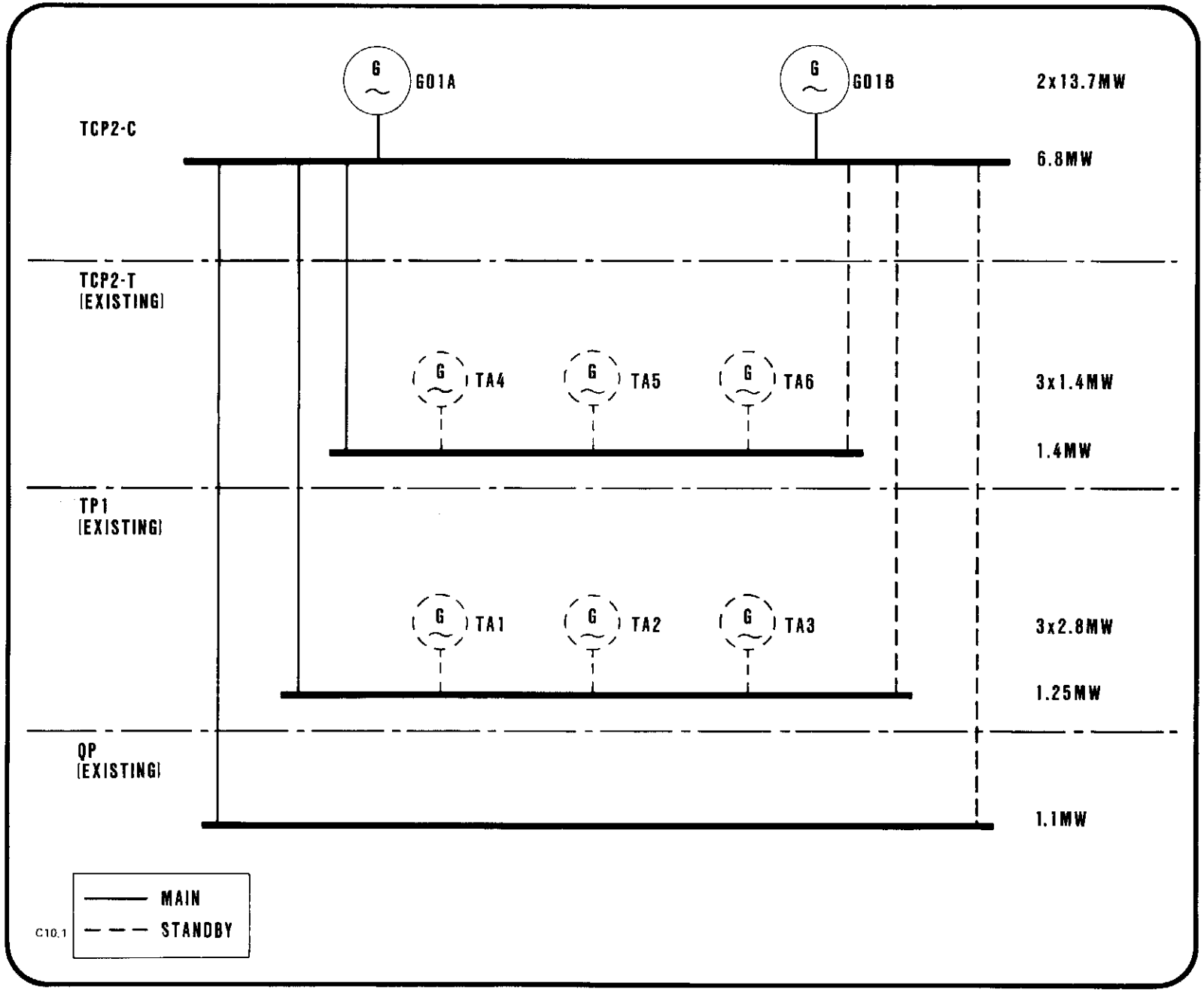
(a) Main generation in the TCP2 Gas Compression area (TCP2–C) by two 13.7MW gas turbine-driven generator sets located in Pancake 41.

(b) Standby generation by six gas turbine-driven generator sets; three sets (each rated at 1.4MW) are installed in TCP2 Treatment area (TCP2–T), and three sets (each rated at 2.8MW) in TP1.

1.2 The main and standby generator sets produce power at 5500V (5.5kV), 3-phase, 3-wire, 50Hz and this power is distributed to each of the Frigg field installations at this voltage by the 5.5kV system.

1.3 If both main and standby generation fails, a limited amount of power is supplied to TCP2–C by its own emergency diesel engine-driven generator set, having an output of 960kW at 380V, 3-phase, 3-wire, 50Hz.

1.4 If there is a total failure of all generation, supplies to essential loads are maintained by battery-supported supply units.


G
G01A
G
G01B
2x13.7MW
TCP2-C
6.8MW
TCP2-T
(EXISTING)
G
TA4
G
TA5
G
TA6
3x1.4MW
1.4MW
TP1
(EXISTING)
G
TA1
G
TA2
G
TA3
3x2.8MW
1.25MW
QP
(EXISTING)
1.1MW
MAIN
STANDBY

SECTION 2 – THE 5.5kV ELECTRICAL SYSTEM

1 INTRODUCTION

See illustration C10.1

1.1 The 5.5kV system for the whole Frigg field is shown as a single-line diagram in illustration C10.1; this gives the location of each group of generators within the Frigg field installation and shows the associated 5.5kV switchboard in each case.

1.2 On the right-hand side of the illustration, the number of generators in each group is shown together with the rating of each machine. Also shown at the right-hand side of the illustration is the normal load in MW supplied by each of the 5.5kV switchboards. (This does not include transfers of load from one switchboard to another.) The load values shown for the TCP2–T and the QP switchboards include the loads taken by DP2 and CDP1 which are fed from these switchboards respectively.

1.3 From the switchboard on TCP2–C (considered to be the main switchboard for the Frigg field) two interconnector feeders run to each of the switchboards on TCP2–T, TP1 and QP.

1.4 The equipment and circuits used for normal operation of the 5.5kV power system are shown on illustration C10.1 as solid lines. The standby equipment is represented by broken lines.

1.5 No main or standby generators are installed on QP, which must receive its 5.5kV electrical supply from elsewhere.

2 NORMAL OPERATION

2.1 Under normal conditions, all the electrical power for the Frigg field is generated by generator sets G01A and G01B on TCP2–C. Either one or both of these sets are run, depending on the total demand for power.

2.2 Power is distributed from the 5.5kV switchboard in Module 32 on TCP2–C to each of the other switchboards by one of the two interconnector feeders. The other interconnector acts as a standby, to provide an alternative circuit if the feeder in service develops a fault or is under maintenance.

2.3 Each interconnector feeder has sufficient capacity to carry the full load current required by the associated switchboard. Except during a changeover, both feeders are never in service at the same time.

2.4 The arrangement of interconnector feeders shown in illustration C10.1 as main and standby is typical only, and does not necessarily represent the actual circuits in service at any given time.

3 STANDBY OPERATION

3.1 If both the main generators G01A and G01B fail, the electrical supply to the whole Frigg field is interrupted. The emergency diesel generator sets on each platform start up automatically to restore a limited supply to their associated emergency 380V switchboards.

3.2 On the 5.5kV system, the interconnector feeders between TCP2—C and the other switchboards trip on undervoltage; all electric motors, both high voltage and low voltage, also trip.

3.3 5.5kV supplies are restored by starting up some or all of the standby generator sets TA1 to TA6. Each group of generators can first be connected to supply its associated switchboard (on TCP2—T and TP1 as the case may be) and then interconnectors are closed to restore a limited supply to the board on TCP2—C and, from there, the board on QP.

3.4 Provided that enough standby generator sets are available, full supplies can be restored to TCP2—T, TP1 and QP. The load connected to the switchboard on TCP2—C may have to be restricted to avoid overloading the standby generators. When the supply is restored, motors must be restarted at the motor control switchgear.

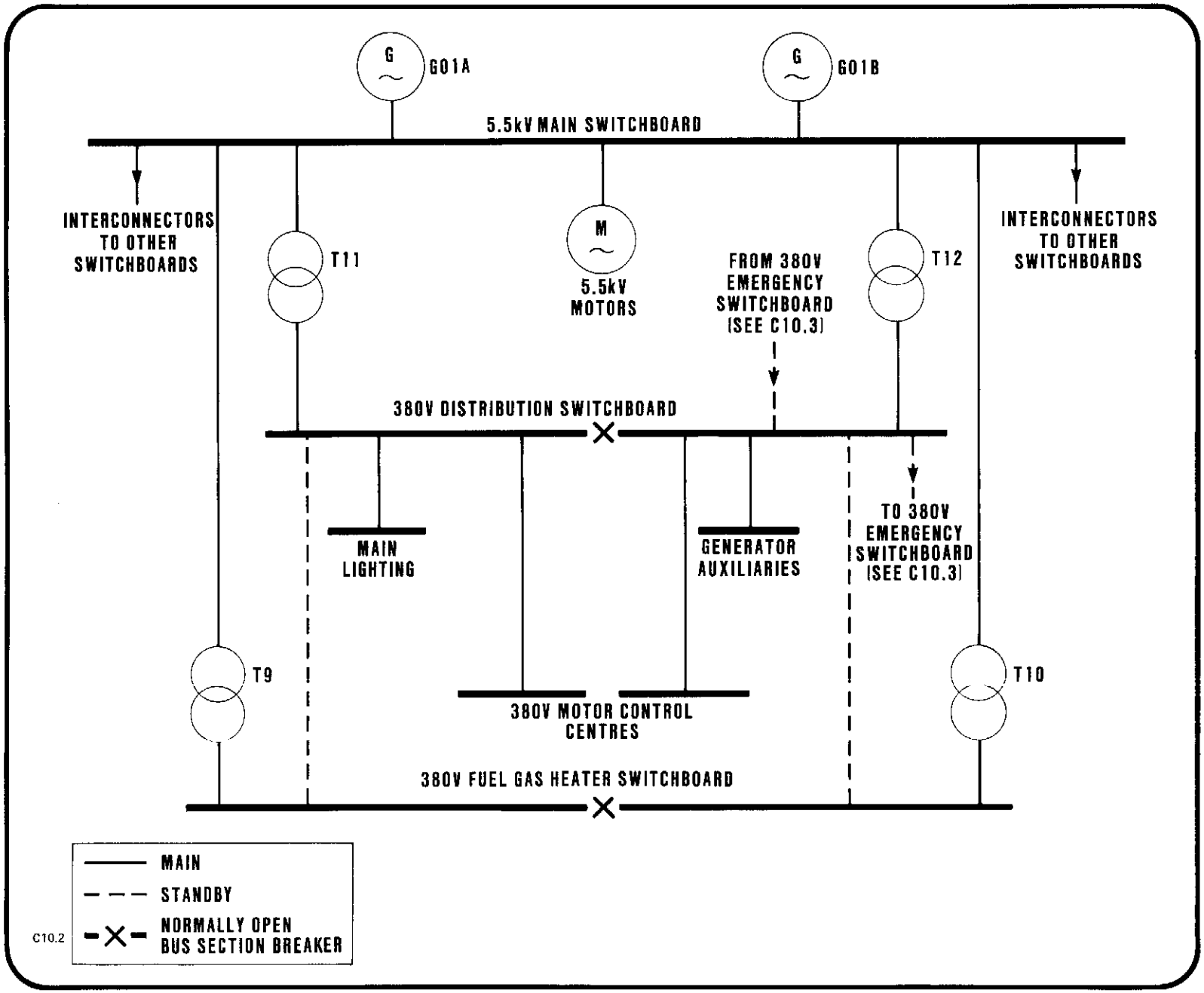
4 CONTROL

4.1 Control of the whole Frigg field electrical system is exercised from an electrical control board in the MCC room on TCP2—T.

4.2 A mimic diagram on the electrical control board represents the layout of the system and discrepancy switches, set in the mimic, control the various circuit breakers remotely.

4.3 For each of the two main and the six standby generator sets, a remote control unit is provided to start and stop the set and to provide the controls and indications necessary for its operation.

4.4 Synchronising of incoming generators is carried out either automatically, or by manual control using a synchronising trolley at the associated switchboard. Where synchronising is carried out between different parts of the network (eg interconnector feeders) manual control at the switchgear is used. The synchronising trolley is equipped with a check synchroniser unit which permits the circuit breaker to be closed only when the frequency, voltage and phase angle of the incoming supply coincides with these values for the running supply.


G
G01A
G
G01B
5.5kV MAIN SWITCHBOARD
INTERCONNECTORS TO OTHER SWITCHBOARDS
T11
M
5.5kV MOTORS
FROM 380V EMERGENCY SWITCHBOARD (SEE C10.3)
T12
INTERCONNECTORS TO OTHER SWITCHBOARDS
380V DISTRIBUTION SWITCHBOARD
MAIN LIGHTING
GENERATOR AUXILIARIES
TO 380V EMERGENCY SWITCHBOARD (SEE C10.3)
T9
T10
380V MOTOR CONTROL CENTRES
380V FUEL GAS HEATER SWITCHBOARD
MAIN
STANDBY
NORMALLY OPEN BUS SECTION BREAKER

SECTION 3 – THE TCP2–C MAIN ELECTRICAL SYSTEM

1 SUMMARY

See illustration C10.2

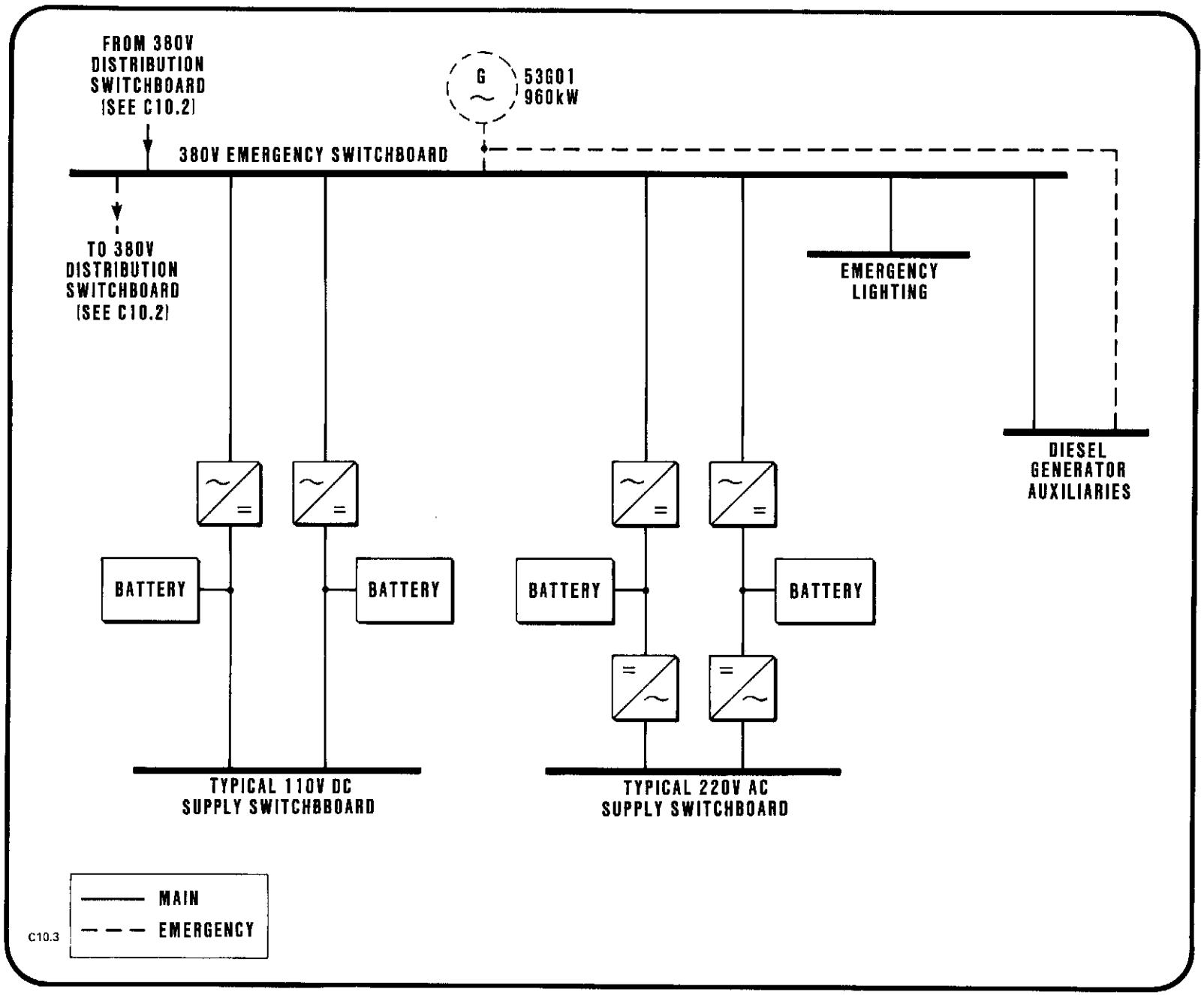
1.1 The main electrical system for TCP2–C is shown in illustration C10.2, which also indicates the principal blocks of load.

1.2 The only load connected directly at 5.5kV consists of six large pump motors for fresh and salt water cooling services. Three additional pumps and motors will be added later.

1.3 By far the greater part of the load is fed through the 380V Distribution switchboard in Module 32; transformers T11 and T12 transform the power from 5.5kV, 3-phase, 3-wire to 380–220V, 3-phase, 4-wire. Motors are supplied at 380V, 3-phase, while small loads such as lighting circuits are fed at 220V, single-phase (phase to neutral).

1.4 The main supply to the 380V Fuel Gas Heater switchboard is fed from the 5.5kV Main switchboard through transformers T9 and T10. Two circuits from the 380V Distribution switchboard provide a limited standby supply. Interlocks prevent both main and standby circuits from being used at the same time.

1.5 A feeder from the 380V Distribution switchboard provides a main supply to the 380V Emergency Distribution switchboard. A circuit from this Emergency switchboard enables a limited supply to be fed back to the Distribution switchboard during a failure of main power; this will be necessary to provide auxiliary power to start the main generator sets on an otherwise dead platform.


FROM 380V DISTRIBUTION SWITCHBOARD (SEE C10.2)
G
53G01
960kW
380V EMERGENCY SWITCHBOARD
TO 380V DISTRIBUTION SWITCHBOARD (SEE C10.2)
EMERGENCY LIGHTING
DIESEL GENERATOR AUXILIARIES
BATTERY
BATTERY
BATTERY
BATTERY
TYPICAL 110V DC SUPPLY SWITCHBBOARD
TYPICAL 220V AC SUPPLY SWITCHBOARD
MAIN
EMERGENCY
C10.3

SECTION 4 – THE TCP2–C EMERGENCY ELECTRICAL SYSTEM

1 SUMMARY

See illustration C10.3

1.1 The TCP2–C Emergency Electrical System provides power to those loads on TCP2–C that are essential to the safety of men and equipment, not only when the main electrical power supply is available but also after the main supply has failed. This emergency system is outlined as a single-line diagram in illustration C10.3.

1.2 The principal loads include:

(a) Battery-supported dc and ac systems for purposes such as process instrumentation and electrical switchgear control.

(b) Emergency lighting.

These loads are connected to the 380V Main Emergency Distribution switchboard in Pancake 44.

1.3 When power is available from the main electrical system, the Emergency switchboard is fed through a feeder from the 380V Distribution switchboard (see Section 2).

1.4 When main power fails, all loads experience an interruption of supply – except those fed from battery-supported systems. The loss of voltage at the 380V Emergency switchboard:

(a) trips the normal feeder from the 380V Distribution switchboard automatically;

(b) starts up the Emergency Diesel Generator set 53G01 automatically and, when it is running, connects it to the 380V Emergency switchboard. This generator set is located in Pancake 44.

This enables power to be restored to essential loads.

1.5 An alternative circuit is provided from the output of the diesel generator directly to the Diesel Generator Auxiliaries switchboard that enables the generator set to run independently if required for test purposes.

1.6 To provide power for the start-up of the main generator sets, a circuit is provided from the 380V Emergency switchboard to the 380V Distribution switchboard. This feeder supplies a limited amount of power for the main generator auxiliaries and can only be closed when the normal main supply feeder to the Emergency switchboard is open.

1.7 After a complete loss of ac power (both main and emergency) loads connected to the battery-supported supplies are maintained for the following times:

(a) AC supplies:

Non-essential	– 2.5 minutes
Essential	– 30 minutes

(b) DC supplies:

Non-essential	– 2.5 minutes
Essential	– 30 minutes, 2 hours or 6 hours, depending on the nature of the load

1.8 Emergency lighting is provided by twin-tube fluorescent fittings, numbering about 50 per cent of the total lighting installation. They are particularly located at exits and along escape routes. These fittings are normally fed from the main or emergency ac supply through the 380V Emergency switchboard. Each emergency lighting fitting is equipped with a self-contained rechargeable battery and inverter unit. When the ac supply fails, one tube is kept alight (powered from the battery) for a period of about 90 minutes. A built-in charger slowly recharges the battery when ac power is restored.

1.9 The electrical system is affected by manual and automatic Emergency Shutdown procedures; details are given in Chapter F1 'Safety Logic'. The Emergency Generator set is shut down automatically only by coincidence detection of high level gas in the air inlet ducts to the Emergency Substation or the Diesel Generator Room, both in Pancake 44.

CHAPTER C11

INSTRUMENT AND SERVICE AIR SYSTEMS

CONTENTS

SECTION 1 DESCRIPTION

1. Summary
2. Equipment Details
3. External Utilities and Interfaces

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2. Controls and Indicators
3. Prestart Checks
4. Start-up
5. Checks After Start-up

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2. Emergency Shutdown

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C11.1 Block Diagram
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C11.3 Air Compressor & Dryer Set – Block Diagram
C11.4 Air Compressor & Dryer Set – Schematic
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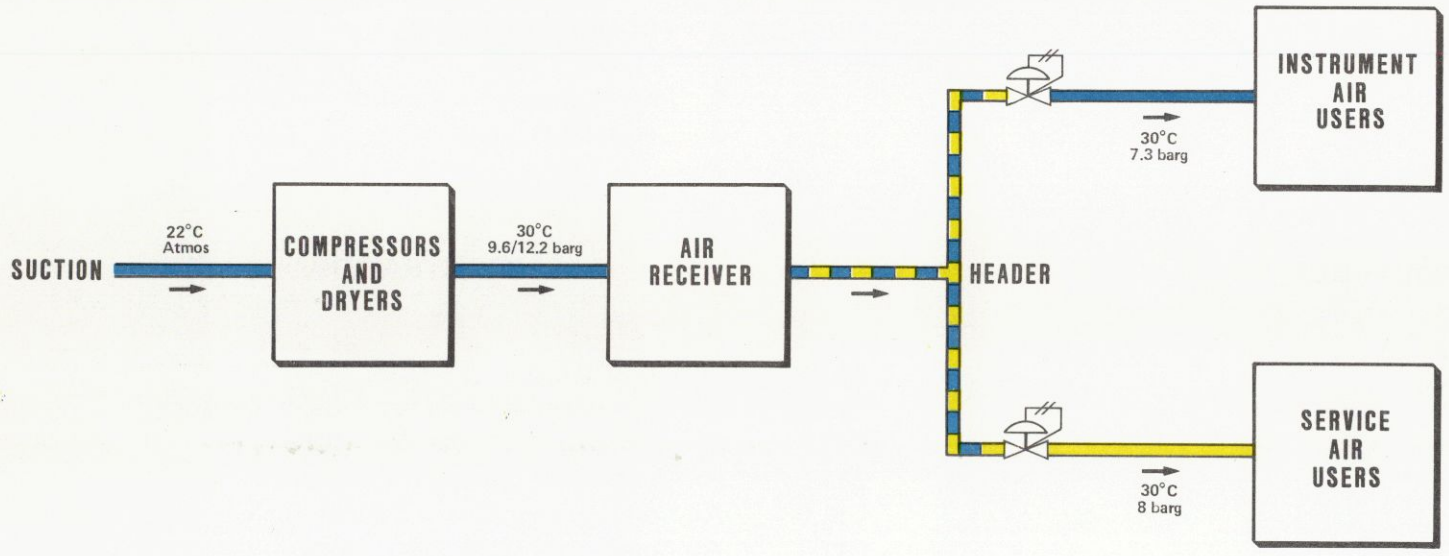
C11.6 Air Compressor Lube Oil System
C11.7 Air Compressor Dryer/Filter Unit
C11.8 System Instrumentation and Controls
C11.9 Air Compressor Set – Control Panel Layout
C11.10 Air Compressor & Dryer Set – Instrumentation and Controls


SUCTION
22°C
Atmos
COMPRESSORS AND DRYERS
30°C
9.6/12.2 barg
AIR RECEIVER
HEADER
30°C
7.3 barg
INSTRUMENT AIR USERS
30°C
8 barg
SERVICE AIR USERS
INSTRUMENT AIR
SERVICE AIR

SECTION 1 – DESCRIPTION

Reference: PID 5424W 57 0040 01
PF 5424W 57 1200 01.1

1 SUMMARY

See illustrations C11.1, C11.2, C11.3, C11.4, C11.4A, C11.5, C11.6 and C11.7

1.1 Air Systems

See illustrations C11.1 and C11.2

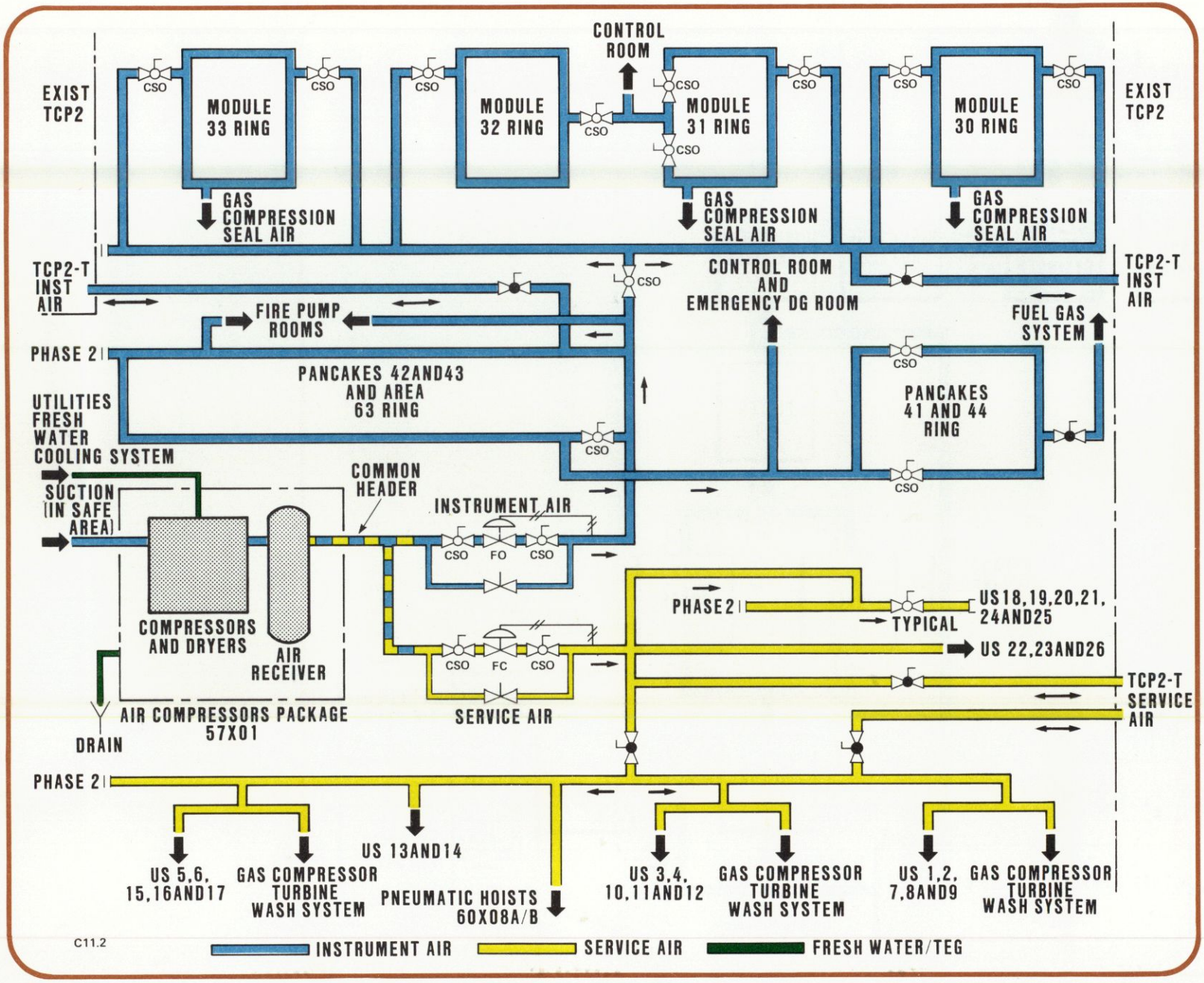
1.1.1 Dried and filtered compressed air is supplied to a common header line from a single air receiver which is part of Air Compressors Package 57X01. The package consists of two compressors, each with their own dryers and filters which ensure a supply of clean dry air for instruments and control air loops.

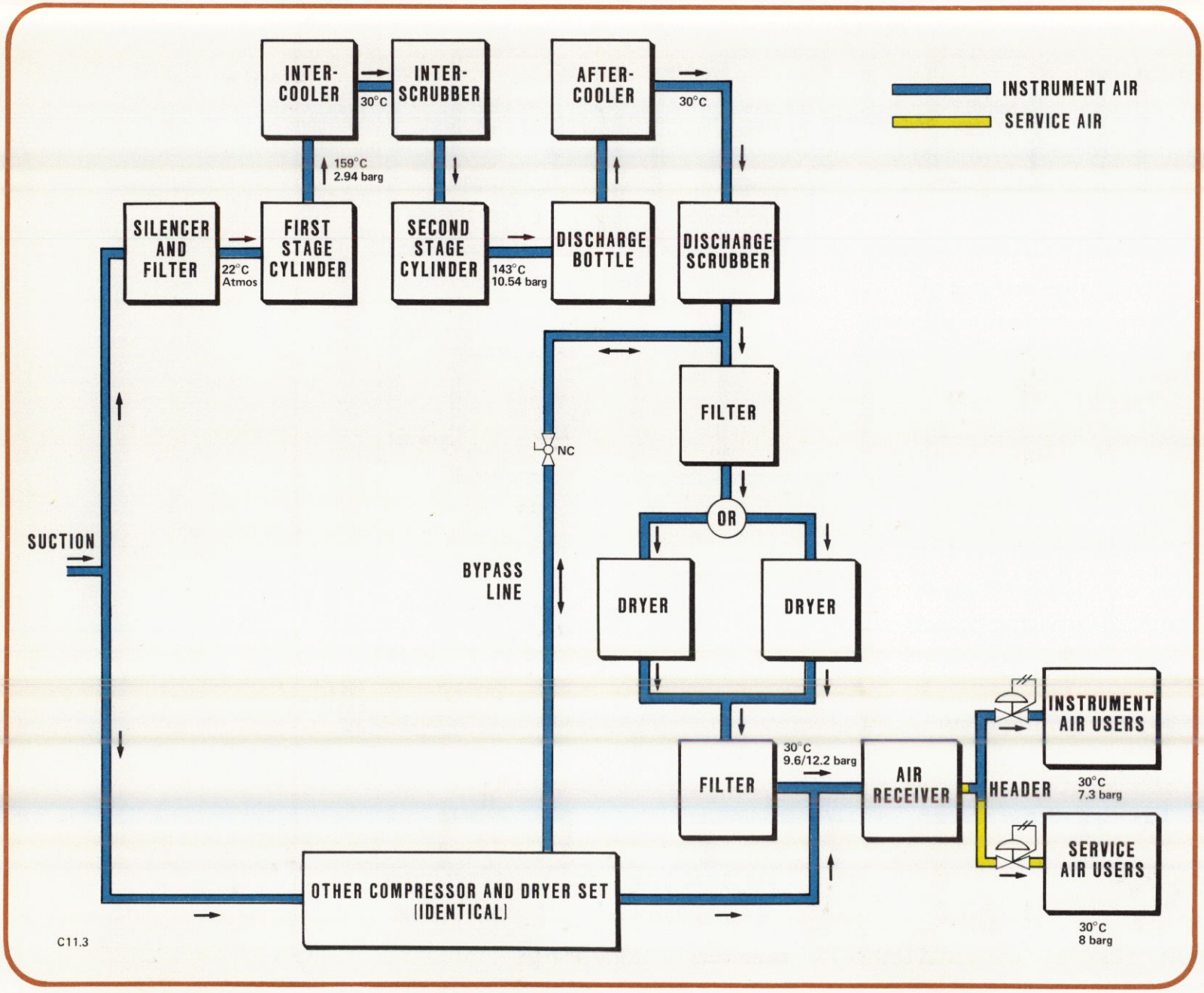
1.1.2 Two branches from the common compressed air header line supply instrument air and service air requirements, each under the control of their own pressure control valve (PCV). The standard of both instrument and service air is therefore the same, in terms of humidity and filtration, since the supply is common (only one air receiver for both compressor/dryer sets).

1.1.3 The instrument air line PCV is controlled at 7.3 barg to supply the instrument air ring mains in modules and pancakes, the gas compression package seal air systems, and other specific users.

1.1.4 The service air line PCV is controlled at 8.0 barg to supply service air to 26 of the Utility Stations in modules, pancakes and areas to the pneumatic hoists, and to the gas compression turbine washing systems. It should be noted that in the event of falling pressure in the air receiver, the service air line will be shut off preferentially in order to safeguard instrument air supplies. This modulation of the service air PCV is carried out by a pressure switch which senses pressure in the instrument air line.

1.1.5 Each of the instrument and service air circuits has two interconnections with the instrument and service air systems of the TCP2 treatment area. The instrument air systems of TCP2 compression and treatment can be interconnected at Pancake 46 and/or Module 30. The service air systems can be interconnected at Utility Station 26 (Area 46, South) and/or Module 30.


CONTROL ROOM
EXIST TCP2
MODULE 33 RING
MODULE 32 RING
MODULE 31 RING
MODULE 30 RING
EXIST TCP2
CSO
GAS COMPRESSION SEAL AIR
TCP2-T INST AIR
CONTROL ROOM AND EMERGENCY DG ROOM
TCP2-T INST AIR
FIRE PUMP ROOMS
FUEL GAS SYSTEM
PHASE 2
PANCAKES 42AND43 AND AREA 63 RING
PANCAKES 41 AND 44 RING
UTILITIES FRESH WATER COOLING SYSTEM
SUCTION (IN SAFE AREA)
COMMON HEADER
INSTRUMENT AIR
CSO FO CSO
COMPRESSORS AND DRYERS
AIR RECEIVER
PHASE 2
TYPICAL
US 18,19,20,21, 24AND25
US 22,23AND26
CSO FC CSO
TCP2-T SERVICE AIR
SERVICE AIR
AIR COMPRESSORS PACKAGE 57X01
DRAIN
PHASE 2
US 5,6, 15,16AND17
GAS COMPRESSOR TURBINE WASH SYSTEM
US 13AND14
PNEUMATIC HOISTS 60X08A/B
US 3,4, 10,11AND12
GAS COMPRESSOR TURBINE WASH SYSTEM
US 1,2, 7,8AND9
GAS COMPRESSOR TURBINE WASH SYSTEM
C11.2
INSTRUMENT AIR
SERVICE AIR
FRESH WATER/TEG


INTER-COOLER
INTER-SCRUBBER
30°C
AFTER-COOLER
30°C
INSTRUMENT AIR
SERVICE AIR
159°C
2.94 barg
SILENCER AND FILTER
22°C
Atmos
FIRST STAGE CYLINDER
SECOND STAGE CYLINDER
143°C
10.54 barg
DISCHARGE BOTTLE
DISCHARGE SCRUBBER
FILTER
NC
SUCTION
OR
BYPASS LINE
DRYER
DRYER
FILTER
30°C
9.6/12.2 barg
AIR RECEIVER
HEADER
INSTRUMENT AIR USERS
30°C
7.3 barg
SERVICE AIR USERS
30°C
8 barg
OTHER COMPRESSOR AND DRYER SET (IDENTICAL)
C11.3

1.2 Air Compressors Package 57X01

See illustration C11.3

1.2.1 The air compressors package consists of two identical sets of electrically driven 2-stage (ie 2-cylinder) reciprocating air compressors, each having their own intake/silencer assembly and dryer/filter unit. Both compressor sets discharge dried and filtered compressed air to a single air receiver at a working pressure of about 10.3 barg (PSV set at 12.9 barg). The air receiver discharges to a common header from which are piped both instrument and service air supplies. The air compressors package has its own control panel. General fault, trip and alarm annunciations are displayed in TCP2 Control Room for each compressor set. In addition, compressor status indications (RUN and STOP for each compressor set) are displayed in the Control Rooms of both TCP2 and QP.

1.2.2 Normally one compressor/dryer set is running (on duty) and will 'load' and 'unload' automatically in accordance with minor fluctuations in air receiver pressure, due to varying system demand (see paragraph 1.4). The duty compressor will start and stop automatically under control of pressure switches sensing pressure in the air receiver (set at about 9.8 and 10.5 barg respectively). The other compressor/dryer set is normally stopped but at standby, in readiness to start and stop automatically under control of two further pressure switches connected to the air receiver (set at about 9.6 and 10.5 barg respectively).

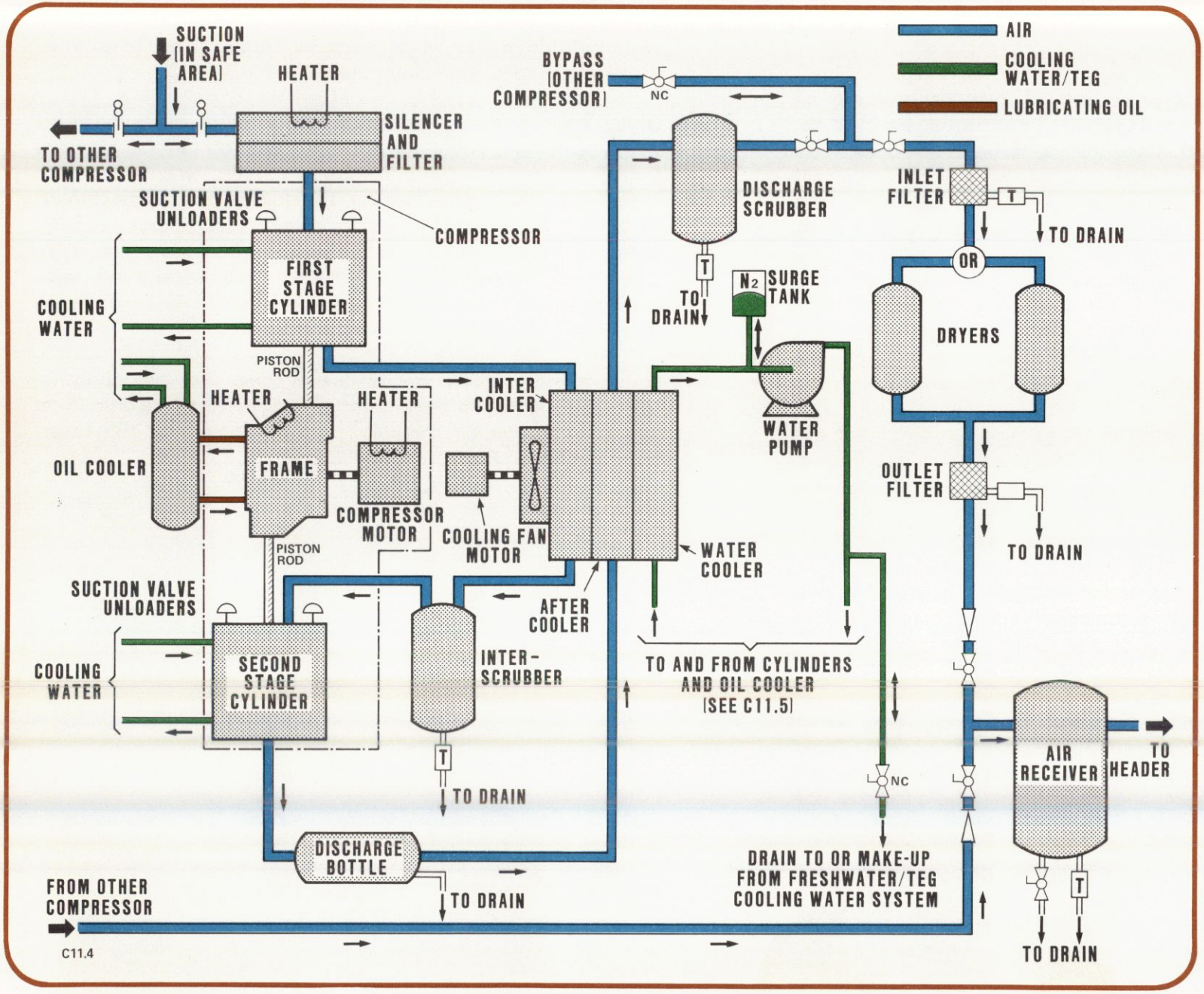
1.2.3 Each compressor/dryer set has its own closed loop fresh water cooling system which circulates a 70 per cent fresh water/30 per cent TEG mixture through the cooling jackets of the 1st and 2nd stage compression cylinders, and through the lube oil cooler (see paragraph 1.5).

1.2.4 Each set also has its own closed loop lube oil system and oil cooler, which circulates lubricant through the 'frame' containing the driving gear for the compression cylinders (see paragraph 1.6).

1.2.5 Cooling of the compressed air (after each stage of compression) and of the cooling water is effected in each compressor/dryer set by an electrically driven fan which forces air through a combined intercooler/aftercooler/water cooler assembly.

1.2.6 Drying and filtration of the compressed air from each air compressor is continuous and automatic. The 'wet' compressed air flows through an inlet filter into one of two dryers, where moisture is removed by a desiccant chemical. The dried air then passes through an outlet filter to the air receiver. The 'non-duty' dryer is simultaneously regenerated (ie moisture removed from the desiccant) by a bleed of dry air, and the dryers are automatically alternated between drying duty and regeneration. A more detailed explanation of the dryer/filter units is given in paragraph 1.7.

1.2.7 Should the dryer/filter unit of one air compressor be inoperative, the output of that air compressor can be routed to the dryer/filter unit of the other air compressor via a bypass line. This dryer/filter unit bypass line is normally shut off.


AIR
COOLING WATER/TEG
LUBRICATING OIL
SUCTION (IN SAFE AREA)
HEATER
SILENCER AND FILTER
TO OTHER COMPRESSOR
SUCTION VALVE UNLOADERS
COMPRESSOR
FIRST STAGE CYLINDER
COOLING WATER
PISTON ROD
HEATER
HEATER
FRAME
OIL COOLER
COMPRESSOR MOTOR
COOLING FAN MOTOR
PISTON ROD
SUCTION VALVE UNLOADERS
SECOND STAGE CYLINDER
COOLING WATER
INTER COOLER
AFTER COOLER
INTER-SCRUBBER
TO DRAIN
DISCHARGE BOTTLE
TO DRAIN
FROM OTHER COMPRESSOR
C11.4
BYPASS (OTHER COMPRESSOR)
NC
DISCHARGE SCRUBBER
T
TO DRAIN
N2 SURGE TANK
WATER PUMP
WATER COOLER
TO AND FROM CYLINDERS AND OIL COOLER (SEE C11.5)
NC
DRAIN TO OR MAKE-UP FROM FRESHWATER/TEG COOLING WATER SYSTEM
INLET FILTER
T
TO DRAIN
OR
DRYERS
OUTLET FILTER
TO DRAIN
AIR RECEIVER
TO HEADER
T
T
TO DRAIN

1.3 Flow of Air Through an Air Compressor

See illustration C11.4

1.3.1 Air is drawn into a combined silencer/filter assembly at atmospheric pressure and temperature from a suction head which is located in a safe area (to avoid the possible ingestion of hydrocarbon vapour by the air compressor). The silencer/filter assembly reduces the noise level and also removes coarse dirt particles. It also contains an electrical heating element which raises the temperature of the incoming air to 22°C, in order to avoid possible icing problems at the 1st stage suction valves and increase compression efficiency.

1.3.2 The air is drawn into the 1st stage cylinder (suction pressure 2.87 barg) where compression from atmospheric at 22°C to 2.94 barg at 159°C takes place (line PSV set at 4.5 barg). This 1st stage compressed air is then passed through the intercooler, where the compressed air temperature is reduced to 30°C by a motor-driven cooling fan, in order to improve subsequent moisture removal. Interstage cooling of the compressed air also achieves a reduction in compression ratio required at the next stage of compression.

1.3.3 The compressed air passes from the intercooler to the interscrubber, which removes entrained moisture. Water is removed from the interscrubber by an automatic drain trap.

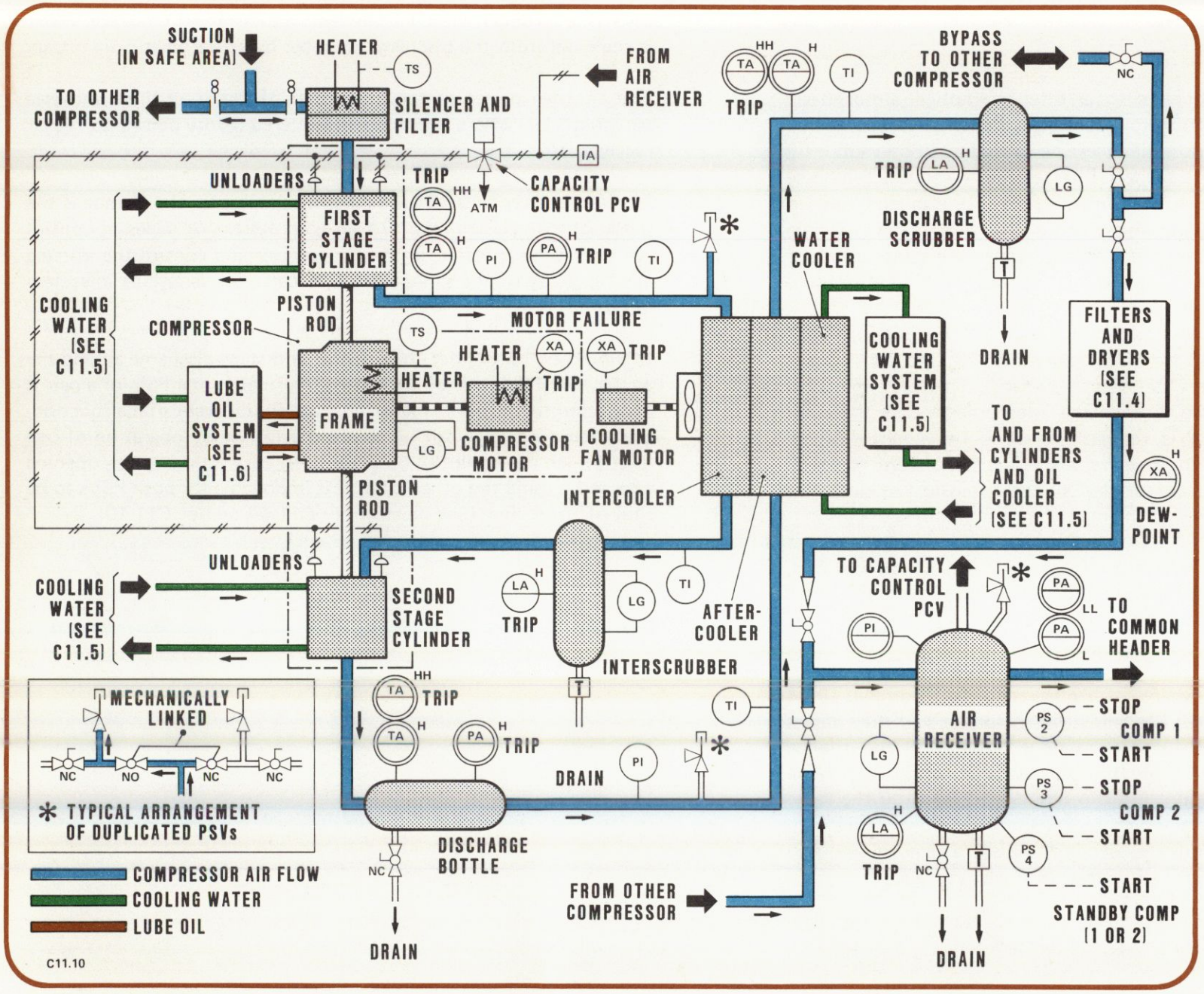
1.3.4 From the interscrubber, the 1st stage compressed air is drawn into the 2nd stage cylinder, where final compression to a nominal 10.54 barg at 143°C takes place. The 2nd stage compressed air then passes to the discharge bottle (which dampens pulsations) and thence through the aftercooler (line PSV set at 12.2 barg), where the compressed air temperature is again reduced to 30°C by the same motor-driven cooling fan which serves the intercooler. This temperature reduction improves subsequent moisture removal and also ensures adequate volumetric efficiency of the air receiver.

1.3.5 The cooled compressed air passes from the aftercooler to the discharge scrubber, which again removes entrained moisture. Water is removed from the discharge scrubber by an automatic drain trap.

1.3.6 The air then passes to the inlet filter of the dryer/filter unit (see paragraph 1.7) where it is dried and filtered before passing to the air receiver.

1.3.7 The air receiver acts as an air accumulator and also dampens the pulsations emanating from the air compressors. A series of control switches sense pressure in the air receiver and control the starting and stopping of the compressors to cater for variations in system demand.

1.3.8 It should be noted that the 1st and 2nd stage discharge air and the air receiver PSVs are all duplicated. Normally, one PSV of a pair is connected to the discharge air line but, in the event of malfunction, the alternative PSV can be connected to line by operation of one lever which mechanically operates both connection valves; opening one and closing the other. Thus it is impossible for both PSVs to be shut off from line. (See illustrations C11.4A and/or C11.10).


SUCTION (IN SAFE AREA)
HEATER
TS
TO OTHER COMPRESSOR
SILENCER AND FILTER
FROM AIR RECEIVER
IA
ATM
CAPACITY CONTROL PCV
TRIP
HH
H
TA
TI
BYPASS TO OTHER COMPRESSOR
NC
UNLOADERS
FIRST STAGE CYLINDER
PI
PA
TRIP
WATER COOLER
DISCHARGE SCRUBBER
LA
LG
T
COOLING WATER (SEE C11.5)
PISTON ROD
COMPRESSOR
MOTOR FAILURE
XA
HEATER
LUBE OIL SYSTEM (SEE C11.6)
FRAME
COMPRESSOR MOTOR
COOLING FAN MOTOR
INTERCOOLER
COOLING WATER SYSTEM (SEE C11.5)
DRAIN
FILTERS AND DRYERS (SEE C11.4)
TO AND FROM CYLINDERS AND OIL COOLER (SEE C11.5)
DEW-POINT
SECOND STAGE CYLINDER
AFTER-COOLER
INTERSCRUBBER
TO CAPACITY CONTROL PCV
LL
L
TO COMMON HEADER
AIR RECEIVER
PS 2
PS 3
PS 4
STOP COMP 1
START
STOP COMP 2
START
START STANDBY COMP (1 OR 2)
MECHANICALLY LINKED
NC
NO
* TYPICAL ARRANGEMENT OF DUPLICATED PSVs
DISCHARGE BOTTLE
FROM OTHER COMPRESSOR
COMPRESSOR AIR FLOW
COOLING WATER
LUBE OIL
C11.10

1.4 Capacity Control

See illustration C11.4A (identical to C11.10)

1.4.1 Capacity control (from 0 to 100 per cent) of the air compressors is effected by a single 3-way PCV for each compressor; the control of only one compressor is described. The suction valves of both compression cylinders are each fitted with a pneumatically operated 'unloader'. The four unloaders are interconnected by the same control air line from the PCV. The PCV is supplied with instrument air and is also connected directly to the air receiver.

1.4.2 When the compressor is at rest and with no air in the receiver the PCV is de-energised. Instrument air is therefore applied to the suction valve unloaders and all suction valves are fully opened. This ensures that when the compressor motor is started, no excessive load will be placed on it since no compression will take place.

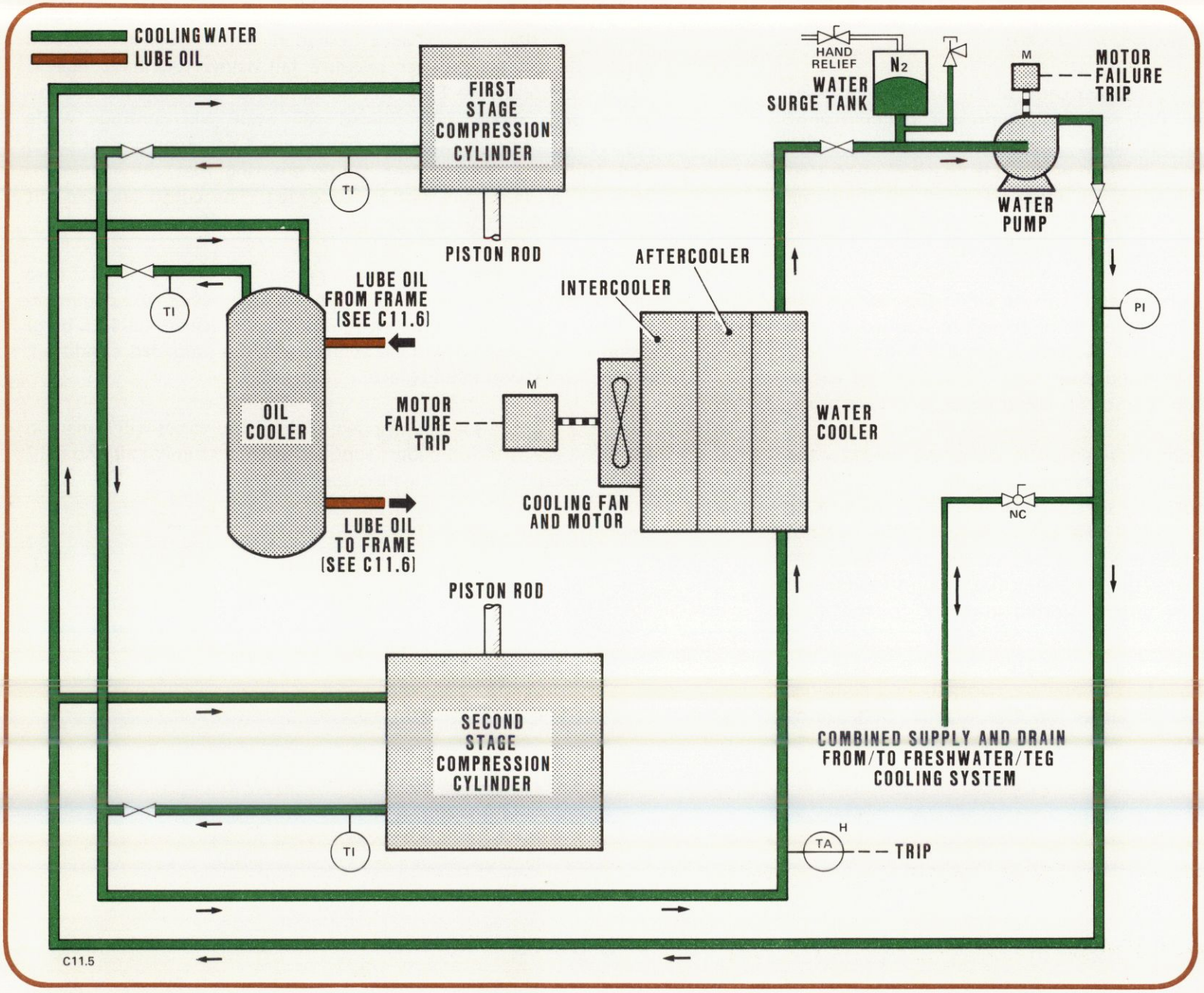
1.4.3 On start-up, the compressor is driven up to operating speed by the electric motor with all suction valves held fully open. A delay timer in the control panel is normally set for 30 seconds after the electric motor is started. At the end of this time delay, the PCV is automatically energised; this positions the 3-way valve so that instrument air is vented to atmosphere (thus releasing the suction valves) and receiver pressure is now communicated directly to the four unloaders.

1.4.4 The suction valves are now free to operate normally and compression will take place, ie the compressor will be 'loaded', pressurising the air receiver.

1.4.5 When air receiver pressure reaches 10.3 barg (the normal operating pressure) the PCV is de-energised so that instrument air is again applied to the suction valve unloaders which open the suction valves. Should air receiver pressure fall below 10.3 barg, due to system demand, the PCV will energise thus releasing the suction valves once more. This unload/load cycle will continue while receiver air pressure fluctuates between 9.8 barg (compressor start) and 10.5 barg (compressor stop), ensuring that the maximum working pressure will not be exceeded. The cut-in and cut-out settings of the PCV solenoid usually have a differential of 1 barg.

1.4.6 It will be seen that since the compressor is unloaded at 10.3 barg (all suction valves held open), when the compressor stop command is signalled by the pressure switch on the air receiver (at 10.5 barg) compressor rundown will be achieved in the unloaded condition, ie no compression taking place.

1.4.7 Once the compressor has stopped, the suction valves will remain in the open position (unloaders supplied with instrument air and PCV de-energised) ready for the next start-up.


COOLING WATER
LUBE OIL
FIRST STAGE COMPRESSION CYLINDER
TI
PISTON ROD
HAND RELIEF
N_2
WATER SURGE TANK
M
MOTOR FAILURE TRIP
WATER PUMP
PI
AFTERCOOLER
INTERCOOLER
LUBE OIL FROM FRAME (SEE C11.6)
OIL COOLER
MOTOR FAILURE TRIP
WATER COOLER
COOLING FAN AND MOTOR
NC
LUBE OIL TO FRAME (SEE C11.6)
PISTON ROD
SECOND STAGE COMPRESSION CYLINDER
COMBINED SUPPLY AND DRAIN FROM/TO FRESHWATER/TEG COOLING SYSTEM
TA
H
TRIP
C11.5

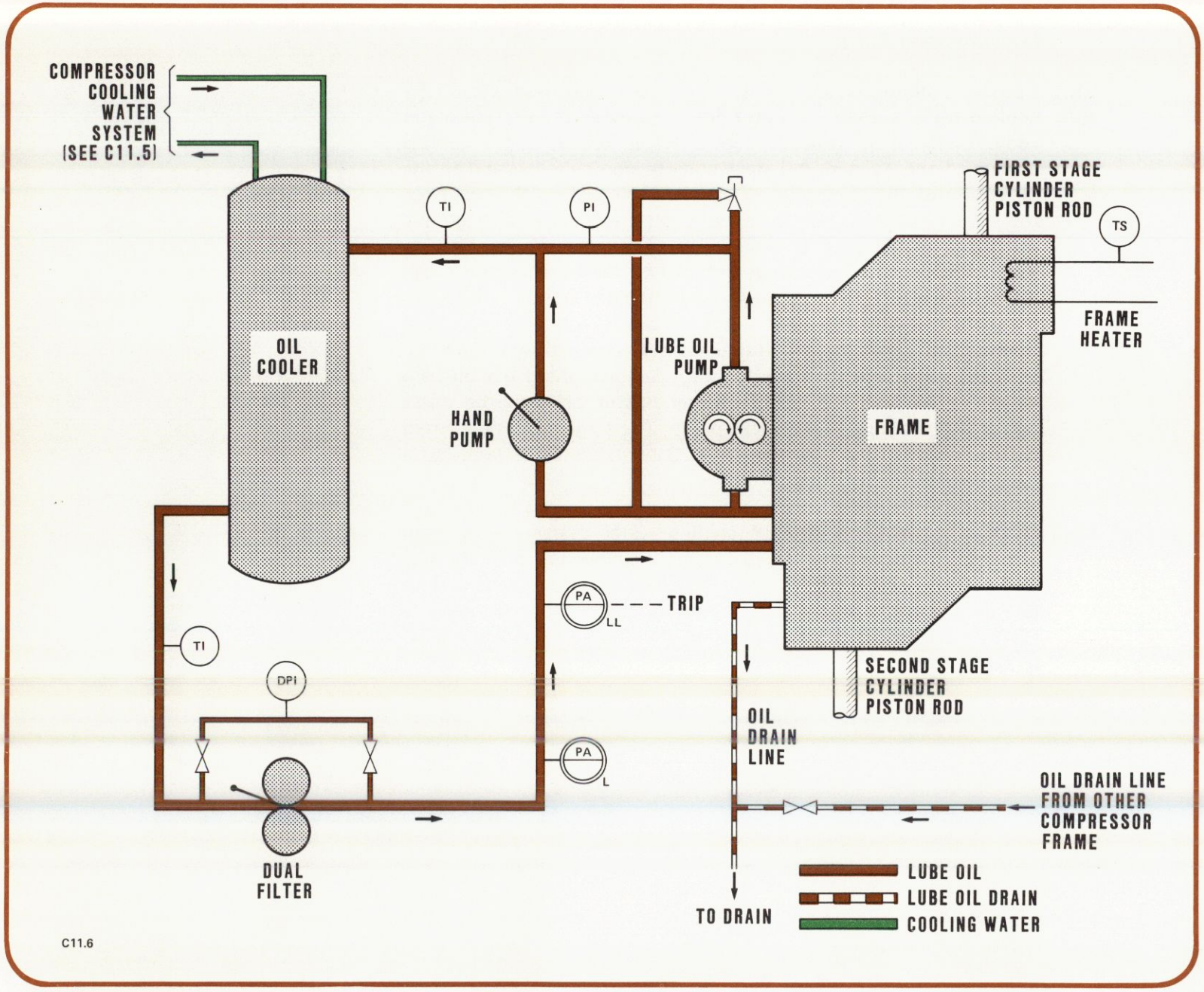
1.5 Air Compressor Cooling Water System

See illustration C11.5

1.5.1 Each air compressor set has its own closed loop fresh water/TEG cooling water system. A motor-driven centrifugal pump circulates cooled water from the fan-cooled water cooler to the cooling jackets of the 1st and 2nd stage compression cylinders and to the oil cooler of the compressor frame lube oil system. Returns from the compression cylinders and lube oil cooler pass through the water cooler and back to the suction of the water pump. Cooling water temperature is sensed at the inlet to the water cooler; a high alarm (which trips the compressor) is initiated at 50°C.

1.5.2 In order to cater for any fluctuations in cooling water flow, an enclosed surge tank (containing a nitrogen-pressurised flexible bag) is connected into the cooling water circuit between the water cooler and the inlet of the water pump. The surge tank line is fitted with a system PSV which is set at 3 barg; the surge tank has a hand-operated vent fitting.

1.5.3 Make-up of the compressor cooling water systems with fresh water/TEG mixture is allowed for by a connection with the Gas Compression area Fresh Water/TEG Utility Cooling System. This line may also be used for draining the air compressor cooling water system back to the Gas Compression area Closed Fresh Water/TEG Drain System.


COMPRESSOR COOLING WATER SYSTEM (SEE C11.5)
TI
PI
FIRST STAGE CYLINDER PISTON ROD
TS
FRAME HEATER
OIL COOLER
LUBE OIL PUMP
HAND PUMP
FRAME
PA
LL
TRIP
TI
DPI
PA
L
SECOND STAGE CYLINDER PISTON ROD
OIL DRAIN LINE
OIL DRAIN LINE FROM OTHER COMPRESSOR FRAME
DUAL FILTER
TO DRAIN
LUBE OIL
LUBE OIL DRAIN
COOLING WATER
C11.6

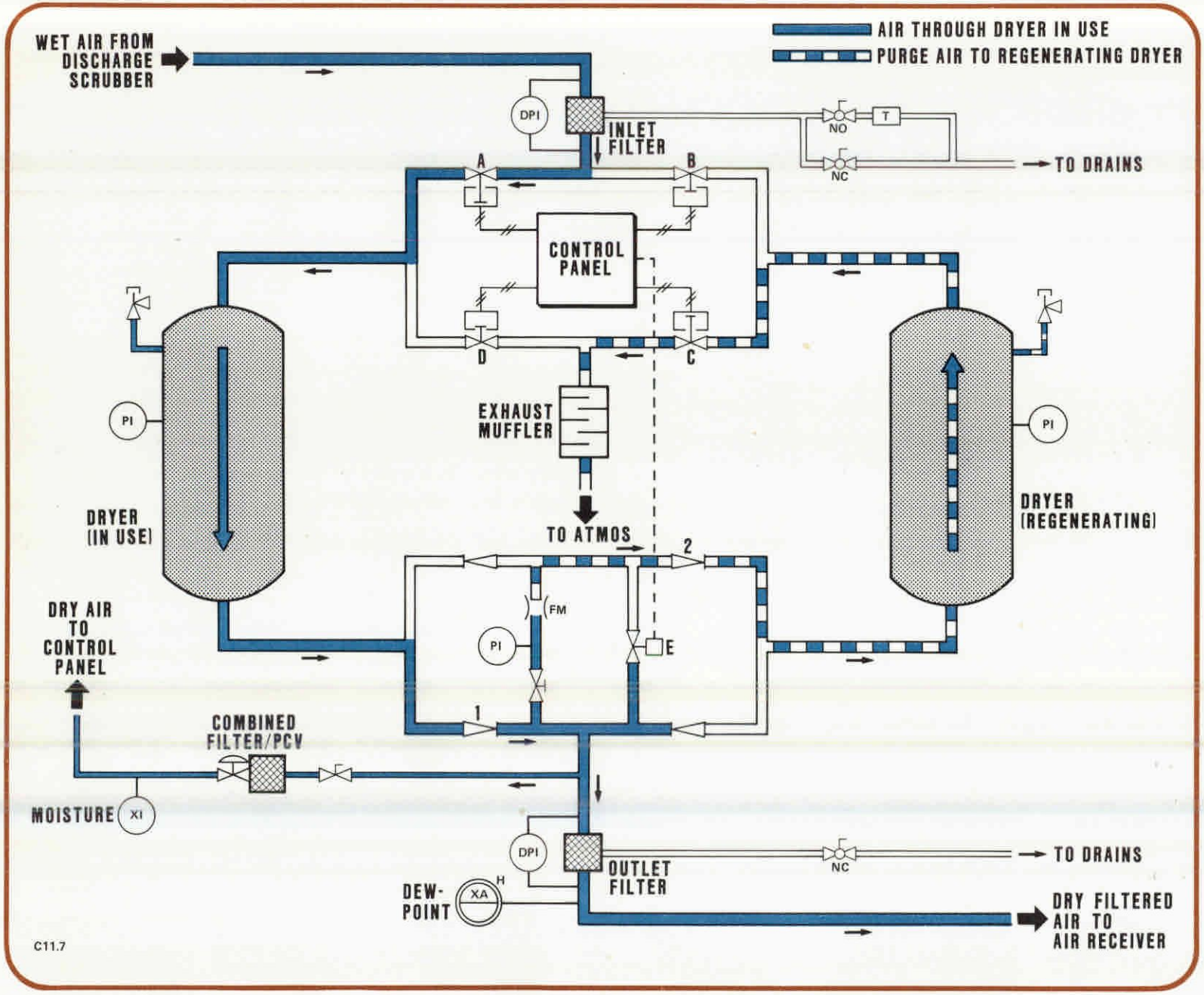
1.6 Air Compressor Lube Oil System

See illustration C11.6

1.6.1 Each air compressor set has its own closed loop lube oil system which circulates lube oil through the compressor frame. A gearwheel-type lube oil circulation pump is mounted on the frame and is driven by the air compressor electric motor. The pump circulates the lube oil from the frame, through the oil cooler (cooled by the air compressor fresh water cooling system) and filter, and back into the frame.

1.6.2 Prior to start-up, or in the event of gearwheel pump failure, lube oil can be circulated by means of a hand pump.

1.6.3 The lube oil system circuit PSV (downstream of the gearwheel pump) is set at 3 barg. Normal operating pressure should be 2 barg to 2.5 barg; a low pressure alarm is initiated at 1.5 barg and a low-low (trips compressor) at 1.02 barg.


AIR THROUGH DRYER IN USE
PURGE AIR TO REGENERATING DRYER
WET AIR FROM DISCHARGE SCRUBBER
DPI
INLET FILTER
NO
T
NC
TO DRAINS
A
B
CONTROL PANEL
D
C
EXHAUST MUFFLER
PI
PI
DRYER (IN USE)
DRYER (REGENERATING)
TO ATMOS
2
FM
PI
E
1
DRY AIR TO CONTROL PANEL
COMBINED FILTER/PCV
MOISTURE
XI
DPI
NC
TO DRAINS
OUTLET FILTER
DEW-POINT
H
XA
DRY FILTERED AIR TO AIR RECEIVER
C11.7

1.7 Air Compressor Dryer/Filter Units

See illustration C11.7

1.7.1 Each dryer/filter unit consists of an inlet filter, a pair of dryers filled with desiccant, an outlet filter and a pneumatically powered control panel. During operation, one dryer is in use while the other is being regenerated by a reverse flow of dried 'purge' air. Changeover of dryer duty is automatically effected by a cam timer in the dryer control panel. Illustration C11.7 shows air flows with the left-hand dryer in use and the right-hand dryer being re-generated.

1.7.2 'Wet' compressed air from the discharge scrubber of the compressor passes through the inlet filter, where particles below 5 microns are removed. The inlet filter is provided with a differential pressure indicator and an automatic drain trap. A manual drain valve is also fitted for use when the automatic drain trap is out of action. The filtered air then passes to the dryer lines.

1.7.3 Valves 'A' and 'B' are the wet air inlet valves to the dryers. Valves 'C' and 'D' are the regeneration purge air outlet valves from the dryers. All four valves are pneumatically operated by the cam timer in the dryer control panel. Valve 'E' is a repressurisation valve and is solenoid-operated by an electrical signal from the dryer control panel. The valving system works to the following standard pattern:

Dryer Operation	Valve Positions				
	A	D	B	C	E
Left-hand dryer Duty. Right-hand dryer Regenerating. (As illustrated)	OPEN	CLOSED	CLOSED	OPEN	CLOSED
Right-hand dryer Duty. Left-hand dryer Regenerating.	CLOSED	OPEN	OPEN	CLOSED	CLOSED

At the end of a preset time period (normally five minutes) the cam timer will initiate changeover of the valving system so that the right-hand dryer is 'duty' and the left-hand one regenerating. Thus a complete dryer cycle is 10 minutes. The dryers are continuously alternated between drying and regeneration for as long as the dryer panel pneumatic control switch is in the ON position.

1.7.4 Assuming that the dryer control panel is switched on and that the left-hand dryer is duty and the right-hand one regenerating, the wet filtered air passes via valve 'A' through the left-hand dryer, where moisture is removed by the desiccant bed. The dried air exits from the dryer and passes via check valve '1' to the outlet filter and thence to the air receiver. The outlet filter is fitted with a differential pressure indicator and a drain line. This drain line would not normally be in use since no moisture should reach the outlet filter when dryers are operating correctly.

1.7.5 Regeneration of the right-hand dryer is carried out simultaneously with the drying flow described above. When valve 'C' opens, almost instant depressurisation of the right-hand dryer chamber will take place through valve 'C' and the exhaust muffler. Purge air for regenerating the right-hand dryer is tapped from the dried air line downstream of check valve '1' through a purge pressure adjusting valve (pressure indicator fitted). The purge air then passes through a flowmeter, where it is metered and expanded to atmospheric pressure. The expansion effect super-dries the purge air which flows through check valve '2' to the right-hand dryer, picking up the moisture from the desiccant bed. The wetted purge air flows from the regenerating dryer through valve 'C' and the exhaust muffler to atmosphere.

1.7.6 When the normal 5-minute setting on the cam timer elapses (the calculated dryer regeneration time required) valve 'C' is closed, preventing any further purge air from venting to atmosphere. Valve 'E' is then opened by electrical signal, which allows dried compressed air into the purge lines and regenerated dryer. Pressure builds up until it equalises with the pressure in the left-hand dryer, which is still on drying duty.

1.7.7 The cam timer will now initiate the closing of valve 'E' and reversal of the valve 'A—C'/'B'—'D' configurations so as to place the right-hand dryer on duty and the left-hand dryer on regeneration (see paragraph 1.7.3).

1.7.8 The control air supply to the dryer control panel is led off the dry air line upstream of the outlet filter, through an isolating valve and a combined air filter/pressure reducing valve, normally set at 6 barg. It should be noted that the pneumatic cam timer in the dryer control panel will cease to operate if control air pressure to the panel falls to 4 barg.

1.7.9 A moisture indicator is fitted in the control air line to the dryer panel. Provided that the colour is dark blue, the dryers are performing satisfactorily.

1.7.10 Output of the dryers is monitored downstream of the outlet filter by an electrical moisture monitor. If the outlet air moisture content increases above a dew-point of −30°C at 10.54 barg, a high dew-point alarm will be initiated on the dryer panel.

1.7.11 The purge pressure adjusting valve is normally set at 7.5 barg which is the mandatory purge setting for a dryer working pressure of 10.54 barg. If this working pressure is not maintained, the purge pressure setting must be adjusted. However, the minimum working pressure compatible with efficient dryer performance is 9 barg, at which pressure the purge pressure adjusting valve setting must be increased to 9 barg also. It should be noted that purge pressure cannot be further adjusted for dryer working pressure below 9 barg. Although pneumatic control circuits will continue to perform satisfactorily at dryer working pressures down to a minimum of 7 barg, dryer performance may be upset if the dryers are operated continuously at pressures below 9 barg.

1.7.12 Both dryer chambers are fitted with pressure safety valves which relieve to atmosphere at 12.9 barg.

1.7.13 In the event of malfunction of a dryer/filter unit, the wet compressed air output of one compressor can be bypassed to the inlet filter of the other compressor's dryer/filter unit. This bypass line has been omitted from illustration C11.7 but is shown on C11.4.

1.8 Air Compressor Drain Lines

1.8.1 Water drain facilities are fitted to the following items of equipment in each compressor/dryer set:

(a) Interscrubber; automatic drain trap with alternative drain line.

(b) Discharge bottle.

(c) Discharge scrubber; automatic drain trap with alternative drain line.

(d) Dryer/filter unit inlet filter; automatic drain trap with alternative drain line.

(e) Dryer/filter unit outlet filter.

(f) Air receiver; automatic drain trap with alternative drain line. Also fitted with additional drain line from vessel and drain line from level gauge.

All water drains are collected into one drain line, which is common for both compressor/dryer sets. (Drain lines are shown on illustration C11.4).

1.8.2 A common oil drain line for both compressor/dryer sets collects drainage from the two compressor frames. (See illustration C11.6).

1.9 Compressor Frame and Motor Heaters

1.9.1 Each compressor frame has a space heater fitted, to minimise the effects of condensation when the compressor is shut down. The heater coil is controlled by a temperature switch.

1.9.2 Each compressor drive motor is fitted with a heater which is permanently energised when the compressor is shut down. This will minimise the effects of condensation on motor windings.

2 EQUIPMENT DETAILS

2.1 Air Compressors Package 57X01

The package consists of two identical electrically driven 2-stage (ie 2-cylinder) air compressor/dryer sets, installed in Pancake 42. Each air compressor/dryer set (designated 'A' and 'B') comprises the following:

2.1.1 Air Compressor 57X01.K01A/B

Type	–	BDCB, 2-cylinder, 16¼/8¼in (bore) x 5in (stroke) (413/210 x 127mm)
Power rating	–	93kW at 735 rev/min
Capacity (at suction conditions stated)	–	824m³/h

	1st Stage	2nd Stage
Suction pressure	Atmos	2.87 barg
Suction temperature	22°C	30°C
Discharge pressure	2.94 barg	10.54 barg
Discharge temperature	159°C	143°C
Volumetric efficiency	55.1 per cent	59.1 per cent
Outlet flowrate	680m³/h	
Comprising	Instrument air 425m³/h max continuous Service air 255m³/h max intermittent	

2.1.2 Air Compressor Motor 57X01.KM1A/B

Power supply	–	380V 3-phase 50Hz
Power rating	–	110kW at 750 rev/min

2.1.3 Intercooler/Aftercooler/Water Cooler Unit 57X01.E01A/B

Intercooler capacity	–	42 000 kcal/h
Aftercooler capacity	–	275 000 kcal/h
Water cooler capacity	–	10 010 kcal/h

2.1.4 Fan Cooler 57X01.A01A/B

Power supply	–	380V 3-phase 50Hz
Power rating	–	3.5kW at 3000 rev/min

2.1.5 Cooling Water Pump 57X01.P01A/B

Power supply	–	380V 3-phase 50Hz
Power rating	–	0.75kW

2.1.6 Electrical Heaters

	Power supply	Power rating
Inlet silencer/filter unit	380V 3-phase 50Hz	3kW
Frame oil heater	380V 3-phase 50Hz	0.5kW
Compressor motor heater	220V ac single phase	0.5kW

2.1.7 Dryer/Filter Unit 57X01.B01A/B

Heatless (desiccant) type	–	P-AR-14-80
Flowrate	–	685m³/h, compressed at 10.54 barg and 45°C max
Purge air requirement (for regeneration)	–	82m³/h
Guaranteed air dew-point	–	–20°C at 10.3 barg
Design air dew-point	–	–30°C at 10.54 barg (ie –55°C at atmospheric)

2.1.8 Miscellaneous

Inlet silencer/filter unit	–	57X01.S01A/B
Interscrubber	–	57X01.T03A/B
Discharge bottle	–	57X01.T04A/B
Discharge scrubber	–	57X01.T02A/B
Cooling water surge tank	–	57X01.T05A/B
Lube oil cooler	–	57X01.E02A/B

2.1.9 Air Receiver 57X01.T01 (one only)

Capacity	–	$14m^3$
Design pressure	–	12.9 barg at 50°C
Operating pressure	–	10.3 barg at 20°C

2.2 Utility Stations Supplied with Service Air (Hose connection)

Utility Station	Location	
	Deck	Module/Pancake/Area
US1	Upper	Module 30 (South-West)
US2	Upper	Module 30 (South-East)
US3	Upper	Module 32 (West)
US4	Upper	Module 32 (East)
US5	Upper	Module 33 (South-West)
US6	Upper	Module 33 (South-East)
US7	Main	Module 30 (South-West)
US8	Main	Module 30 (Filter Area)
US9	Main	Module 30 (South-East)
US10	Main	Module 31 (West)
US11	Main	Module 31 (Filter Area)
US12	Main	Module 31 (East)
US13	Main	Module 32 (Instr Workshop)
US14	Main	Module 32 (Mech Workshop)
US15	Main	Module 33 (South West)
US16	Main	Module 33 (South-East)(Filter Area)
US17	Main	Module 33 (South-East) (Outside)
US18	Cellar	Pancake 40 (West)
US19	Cellar	Pancake 40 (East)
US20	Cellar	Pancake 41 (North)
US21	Cellar	Area 63 (South)
US22	Cellar	Pancake 42 (West)
US23	Cellar	Pancake 42 (North)
US24	Cellar	Pancake 45 (North)
US25	Cellar	Pancake 43 (East)
US26	Cellar	Area 46 (South)

3 EXTERNAL UTILITIES AND INTERFACES

3.1 External Utilities Required

(a) Electrical supplies — 380V 3-phase 50Hz
220V ac single-phase
110V dc

(b) Fresh water/TEG mixture make-up for air compressor cooling water system.

(c) Instrument air for compressor control panel and filter unit control panels (from TCP2 treatment if first start-up).

3.2 **Interfaces**

(a) All systems using instrument air.

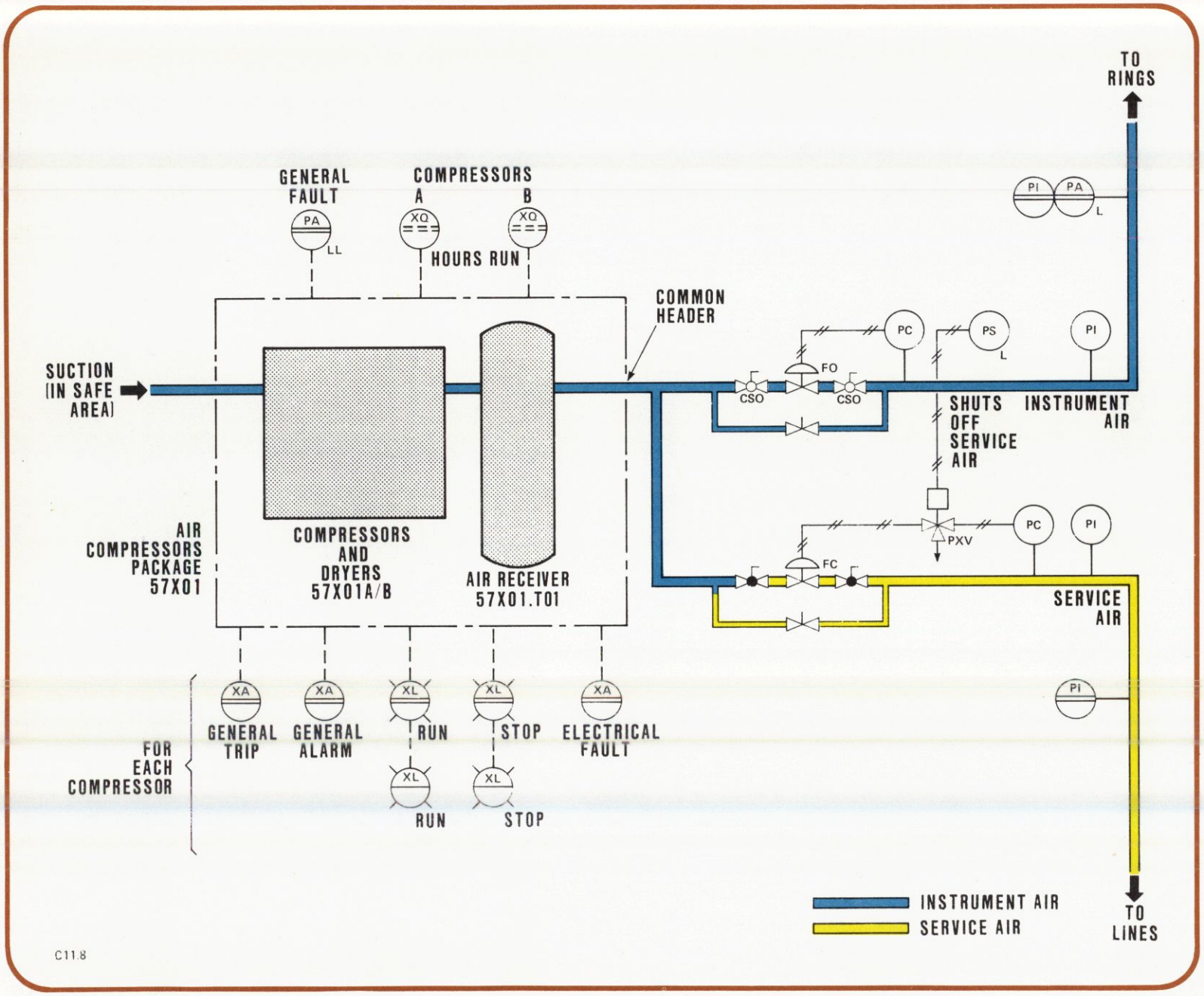
(b) Service air users.

(c) Gas compression seal air systems.

(d) Gas compressor turbine washing systems.

(e) Fresh Water/TEG Utility Cooling System (supply of fresh water/TEG).

(f) Closed Fresh Water/TEG Drain System.


TO RINGS
GENERAL FAULT
PA
LL
COMPRESSORS A
XQ
B
XQ
HOURS RUN
PI
PA
L
COMMON HEADER
PC
PS
L
PI
FO
CSO
CSO
SUCTION (IN SAFE AREA)
SHUTS OFF SERVICE AIR
INSTRUMENT AIR
AIR COMPRESSORS PACKAGE 57X01
COMPRESSORS AND DRYERS 57X01A/B
AIR RECEIVER 57X01.T01
PXV
PC
PI
FC
SERVICE AIR
PI
XA
XA
XL
XL
XA
GENERAL TRIP
GENERAL ALARM
RUN
STOP
ELECTRICAL FAULT
FOR EACH COMPRESSOR
XL
XL
RUN
STOP
INSTRUMENT AIR
SERVICE AIR
TO LINES
C11.8

SECTION 2 – OPERATION AND CONTROLS

1 OPERATING PHILOSOPHY

See illustrations C11.8, C11.9 and C11.10

1.1 One air compressor/dryer set will be selected to run as the 'duty' compressor, under automatic control, to supply the requirements of the Instrument and Service Air Systems. The other air compressor/dryer set will be selected as standby and will start and stop automatically if the duty compressor malfunctions or is unable to meet system demand.

1.2 The air compressor/dryer sets both discharge to a single air receiver, the pressure in which is sensed by three pressure switches controlling the starting and stopping of both air compressors. The duty compressor will be started at a receiver pressure of 9.8 barg and stopped at 10.5 barg. At pressures between these upper and lower limits, the duty compressor will continue running but will load and unload under control of the automatic unloading PCV (see paragraph 1.4). Should air receiver pressure fall to 9.6 barg, the standby compressor will be started (stopping at 10.5 barg).

1.3 The instrument and service air line pressures are separately controlled by their respective PCV; instrument air at 7.3 barg and service air at 8 barg. Should the pressure downstream of the instrument air PCV fall below 6.8 barg, a pneumatic control signal will cause the service air PCV to fail closed. Instrument air supplies will therefore be maintained at the expense of service air.

2 CONTROLS AND INDICATORS

2.1 Instrument Air System

2.1.1 A PCV (fails open) is modulated by a pressure controller to maintain an instrument air pressure of 7.3 barg (pressure indicator fitted downstream).

2.1.2 A pressure switch downstream of the instrument air PCV will shut off the service air PCV if instrument air pressure falls to 6.8 barg. A low pressure alarm will also be annunciated in TCP2 Control Room.

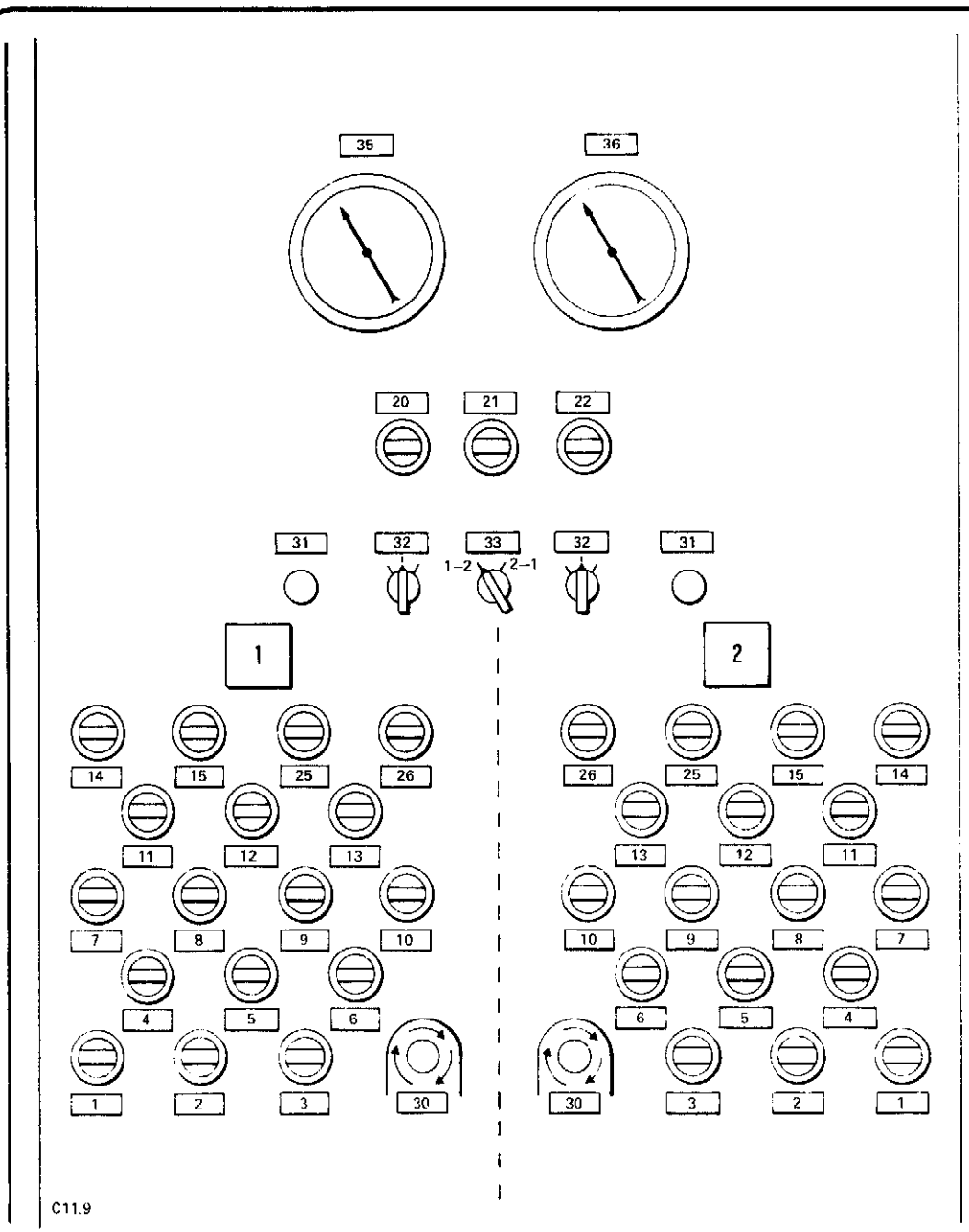
2.2 Service Air System

2.2.1 A PCV (fails closed) is modulated by a pressure controller to maintain a service air pressure of 8 barg (pressure indicator fitted downstream).

2.2.2 If instrument air pressure falls to 6.8 barg, the service air PCV will close under the control of the instrument air pressure switch mentioned in paragraph 2.1.2.

2.3 Air Compressors Package (External)

2.3.1 There are no remote control facilities. The air compressors package has its own control panel which, when set to AUTO, will control all compressor/dryer set operations.



CONTROLS AND INDICATORS

COMMON

35 CONTROL AIR PRESSURE
36 DISCHARGE PRESSURE

20 RECEIVER AIR PRESSURE LOW
21 RECEIVER AIR PRESSURE LOW–LOW
22 RECEIVER LIQUID LEVEL HIGH*

33 COMPRESSOR SELECTOR AUTO-STANDBY (1–2/2–1)

FOR EACH COMPRESSOR SET

31 RESET BUTTON
32 COMPRESSOR OPERATION; MANUAL/OFF/AUTO

14 DEW POINT HIGH
15 LUBE OIL PRESSURE LOW
25 MASTER INDICATOR
26 COMPRESSOR 'ON' INDICATOR

11 FIRST STAGE DISCHARGE TEMP HIGH
12 SECOND STAGE DISCHARGE TEMP HIGH
13 AFTERCOOLER OUTLET AIR TEMP HIGH

7 SECOND STAGE DISCHARGE PRESSURE HIGH*
8 INTERSCRUBBER LIQUID LEVEL HIGH*
9 DISCHARGE SCRUBBER LIQUID LEVEL HIGH*
10 ELECTRICAL FAILURE*

4 SECOND STAGE DISCHARGE TEMP HIGH–HIGH*
5 AFTERCOOLER OUTLET AIR TEMP HIGH–HIGH*
6 FIRST STAGE DISCHARGE PRESSURE HIGH*

1 COOLING WATER TEMP HIGH*
2 LUBE OIL PRESSURE LOW–LOW*
3 FIRST STAGE DISCHARGE TEMP HIGH–HIGH
30 EMERGENCY STOP CONTROL

*DENOTES ALARMS WHICH TRIP APPROPRIATE AIR COMPRESSOR SET.

2.3.2 Indicator lamps showing compressor utilisation (RUN and STOP) are provided for each compressor set in the Control Rooms of both TCP2 and QP.

2.3.3 Remote indications of hours run by each compressor are displayed in TCP2 Control Room.

2.3.4 TCP2 Control Room also has a number of alarms transmitted to it (for details see Section 3 ALARMS AND TRIPS). They consist of a GENERAL FAULT alarm for low-low air receiver pressure and the following for each compressor:

(a) Electrical fault.

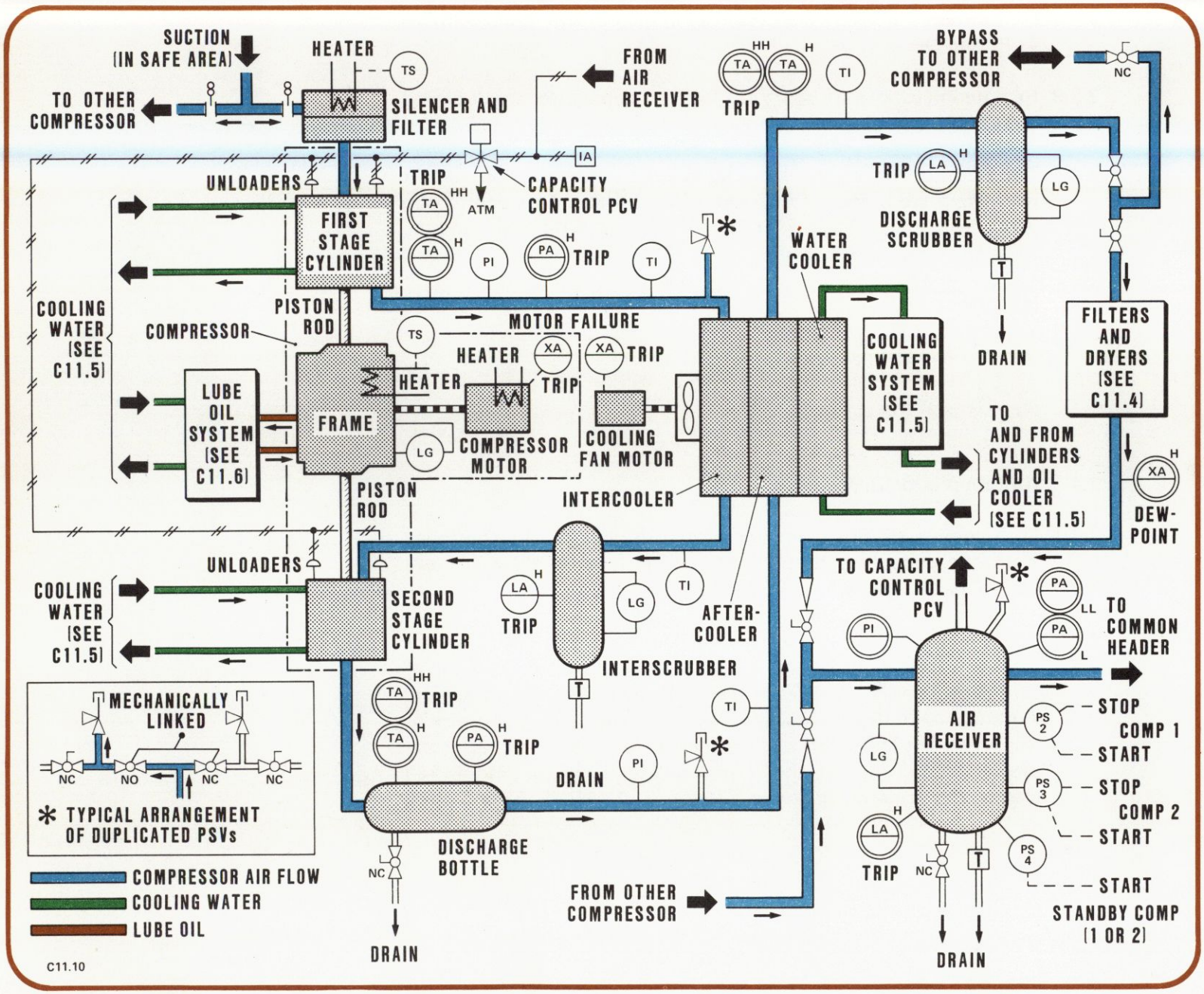
(b) General alarm.

(c) General trip.

2.4 Air Compressor/Dryer Sets

2.4.1 Both compressor/dryer sets (designated 'A' and 'B') are controlled from one panel. In addition, each dryer/filter unit has its own control panel (see Section 1 paragraph 1.7).

2.4.2 The compressor control panel is shown in illustration C11.9. The air receiver alarms (pressure and liquid level) are displayed at the top of the panel, while compressor controls (Duty/Standby selection, Auto/Manual/Off switches and Reset buttons) are in the centre of the panel. The lower part of the panel displays alarms for each compressor set and contains the Emergency Stop controls. Details of all alarms and trips are given in Section 3 ALARMS AND TRIPS.


SUCTION (IN SAFE AREA)
HEATER
TS
TO OTHER COMPRESSOR
SILENCER AND FILTER
FROM AIR RECEIVER
IA
TRIP
HH
H
TA
TI
BYPASS TO OTHER COMPRESSOR
NC
UNLOADERS
ATM
CAPACITY CONTROL PCV
FIRST STAGE CYLINDER
PI
PA
TRIP
WATER COOLER
DISCHARGE SCRUBBER
LA
LG
T
COOLING WATER (SEE C11.5)
PISTON ROD
COMPRESSOR
MOTOR FAILURE
XA
HEATER
LUBE OIL SYSTEM (SEE C11.6)
FRAME
COMPRESSOR MOTOR
COOLING FAN MOTOR
COOLING WATER SYSTEM (SEE C11.5)
DRAIN
FILTERS AND DRYERS (SEE C11.4)
TO AND FROM CYLINDERS AND OIL COOLER (SEE C11.5)
INTERCOOLER
DEW-POINT
SECOND STAGE CYLINDER
AFTER-COOLER
INTERSCRUBBER
TO CAPACITY CONTROL PCV
PA
LL
L
TO COMMON HEADER
AIR RECEIVER
PS 2
PS 3
PS 4
STOP COMP 1
START
STOP COMP 2
START
START
STANDBY COMP (1 OR 2)
MECHANICALLY LINKED
NC
NO
* TYPICAL ARRANGEMENT OF DUPLICATED PSVs
DISCHARGE BOTTLE
FROM OTHER COMPRESSOR
COMPRESSOR AIR FLOW
COOLING WATER
LUBE OIL
C11.10

3 PRESTART CHECKS

See illustration C11.10

(1) All electrical supplies are available.

(2) Instrument air supply available to compressor control panel, compressor suction valve unloaders and filter/dryer unit panel.

NOTE
If TCP2–C instrument air supply is not available, open interconnection valve from TCP2–T instrument air system.

(3) Closed lube oil systems for each compressor filled with lube oil (check frame level gauge).

(4) Make-up supply of fresh water/TEG mixture available from Fresh Water Cooling Systems.

(5) All instrument valves, block valves, PSV and PCV in correct configuration and at correct settings in accordance with the Start-up Manual, summarised as follows:

Function	Open	Closed
Compressor Sets		
Instrument valves	X	
Block valves on auto drain traps (Interscrubber, Discharge Scrubber, Filter/Dryer Set Inlet Filter, Air Receiver) and	X	
Bypass valves on the above auto drain traps		X
Spectacle blinds on compressor suction lines	X	
One PSV at each 1st stage discharge (check other PSV closed off – ganged control). Both set at 4.5 barg	X	
One PSV at each 2nd stage discharge (check other PSV closed off – ganged control). Both set at 12.2 barg	X	
Both valves at outlet of each Discharge Scrubber	X	
Bypass valve between filter/dryer units		X
All valves on closed cooling water systems	X	
PSV on cooling water systems set at 3 barg	–	–
PSV on lube oil system set at 3 barg	–	–
PSV on both dryers of each filter/dryer unit set at 12.9 barg	–	–
Bypass valves of all dryer PSVs		X
Air receiver inlet valves	X	
One PSV at air receiver (check other PSV closed off – ganged control). Both set at 12.9 barg	X	
Instrument air and air receiver air connections to unloader PCVs	X	
Instrument and Service Air Systems		
Block valves of instrument air PCV	X	
Bypass valves of instrument air PCV		X
Instrument air PCV set at 7.3 barg	–	–
Block valves of service air PCV	X	
Bypass valves of service air PCV		X
Service air PCV set to close at 6.8 barg in the instrument air line	–	–
All valves on instrument air and service air networks	X	
All Utility Station service air valves		X
Interconnection valves with TCP2–T instrument air(2) and service air(2) systems		X

NOTE

If this is the first start-up, all instrument air sub-header valves should be CLOSED and all instrument air lines upstream of all instruments should be DISCONNECTED. This is to avoid contamination of instrument air lines and instruments with moist unfiltered air.

4 START-UP

(1) Open both valves from the Fresh Water Utilities Cooling Water System to obtain make-up fresh water/TEG mixture and fill the cooling water systems of both compressors. During filling, open the vents on the surge tanks in order to vent air from the systems. When both systems are filled, close the make-up valves.

(2) Operate the hand pump on the lube oil system of each compressor to circulate oil through the system and frame. About 20 strokes of the pump should be sufficient.

(3) Set the compressor duty selector Auto-Standby switch to position 1–2 or 2–1, depending on which compressor is required to run as 'Duty' and which as 'Standby'. This decision may depend on the total running hours of each compressor to date (indicated in TCP2 Control Room).

(4) Set the compressor operation selector switches for both compressors to MANU.

(5) Both compressors will start and run up to operating speed.

(6) Check that:

(a) Intercooler/Aftercooler/Water Cooler unit cooling fans are running.

(b) Cooling water system pumps are running.

(c) Lube oil pumps are running.

(d) Unloaders keep all suction valves (1st and 2nd stage of each compressor) open for 30 seconds.

(7) Using the bypasses on the auto drain traps, manually drain the Interscrubber, Discharge Scrubber, Inlet Filter of the filter/dryer unit and Air Receiver. Manually drain the Discharge Bottle and Outlet Filter of the filter/dryer unit. Ensure that all manual drains are shut off on completion.

(8) When all moisture has cleared by operation of manual drains, check subsequent operation of all auto drain traps.

CAUTION
A COMPRESSOR SHOULD NOT RUN UNLOADED (AT 0 PER CENT CAPACITY) FOR MORE THAN 30 MINUTES. OVERHEATING OF SUCTION VALVES AND DAMAGE TO PISTONS WILL OCCUR.

(9) Start the dryer cycling operation of the filter/dryer units by setting each dryer control panel switch to ON. Check that the cam timer is operating correctly to initiate the 5-minute cycling time of the dryers, alternating between Duty and Regeneration.

(10) When air pressure in the air receiver reaches 10.3 barg:

(a) Press the Reset button for the compressor to be 'Duty' (selected at Step (3) above) and set the appropriate operation selector switch from MANU to AUTO. This compressor will now stop and start under control of the associated air receiver pressure switch (10.5 and 9.8 barg).

(b) Press the Reset button for the compressor to be 'Standby' (selected at Step (3) above) and set the appropriate operation selector switch from MANU to AUTO. This compressor will now start under control of the air receiver pressure switch (9.6 barg), stopping at 10.5 barg air receiver pressure.

(11) If this is a first start-up:

(a) Open instrument air sub-header valves one by one and blow all the lines.

(b) When air dew-point is normal, connect all the sub-headers to the instruments and open all instrument supply valves.

5 CHECKS AFTER START-UP

(1) Check cooling water pressure (about 2.5 barg, max 3 barg) and temperature (max 50°C). Cooling water temperature at the inlet to the compression cylinder jackets should be about 10°C higher than the temperature of the air at the cylinder inlets. The water outlet temperature should not be greater than 10°C more than the water inlet temperature. Make-up the cooling water system from the Fresh Water Utilities Cooling Water System if necessary.

(2) Check lube oil pressure (about 2 to 2.5 barg; max 3 barg, low alarm at 1.5 barg, low-low alarm and trip at 1.02 barg) and temperature. Check the level of oil in the frame level gauge; should indicate half full when the compressor is running.

(3) Check operation of the automatic dryer cycling programme. Adjust the settings of the control air reducing valve and purge pressure adjusting valve in the dryer control panel if necessary. (See Section 1 paragraphs 1.7.8 and 1.7.11 respectively).

(4) Check that the dryer moisture indicator is dark blue in colour.

(5) Check that the following operate correctly:

Action	Air Receiver Pressure	Instrument Air Line Pressure	Initiation By
(a) 'Duty' Comp Starts	9.8 barg	—	PS 2 or 3 on air receiver. (One switch for each compressor)
(b) 'Duty' Comp Stops	10.5 barg	—	PS 2 or 3 on air receiver. (One switch for each compressor)
(c) 'Standby' Comp Starts	9.6 barg	—	PS 4 on air receiver. (Either compressor)
(d) 'Standby' Comp Stops	10.5 barg	—	PS 2 or 3 on air receiver. (One switch for each compressor)
(e) Service Air PCV shut off	—	6.8 barg	PSL in instrument air line
(f) System Alarm in Control Room	—	6.8 barg	PSL/PAL in instrument air line

(6) Check the normal stop procedure on each compressor by switching the appropriate operation selector switch to OFF. The relevant compressor should unload and then run down to rest.

CAUTION
A COMPRESSOR SHOULD NOT BE STOPPED WHEN RUNNING ON LOAD EXCEPT IN AN EMERGENCY (SEE SECTION 3).

1 ALARMS AND TRIPS

See illustrations C11.8, C11.9 and C11.10

1.1 System Alarms and Trips

The following alarms and trips are indicated in TCP2 Control Room. They are applicable for the air compressor sets generally and for the instrument air lines. Those indicated at the air compressor at local control panel are listed separately.

Alarm	Set-point	Function/Action
General Trip	Any trip at compressor control panel	Control Room indication for each air compressor set. Check compressor set local panel. See separate listing.
General Alarm	Any alarm at compressor control panel	
Electrical Fault	Any electrical fault in air compressor sets	
General Fault	7.5 barg	Receiver air pressure low-low. Check reason at local control panel.
Instrument Air Pressure Low		System warning. Check correct functioning of instrument air PCV. Also check local control panel for fault.

1.2 Air Compressor Set Alarms and Trips

The following alarms and trips are indicated on the air compressor local control panel for each compressor set. They are listed in chronological order of air flow through a compressor set. Refer also to Section 4 TROUBLESHOOTING, paragraph 2.

Alarm	Set-point	Function/Action
Motors		
1. Compressor Motor Failure. TRIPS COMPRESSOR	–	Check electrical supply. If correct, attempt restart.
2. Intercooler/ Aftercooler/ Water Cooler Unit Fan Motor Failure. TRIPS COMPRESSOR	–	Same actions as 1.
3. Cooling Water Pump Motor Failure. TRIPS COMPRESSOR	–	Same actions as 1.
Frame Lube Oil		
4. Lube Oil Pressure Low	1.5 barg	Check if filter dP high. Change over filters. Check sump level, replenish if necessary. Check if gearwheel pump operating. Check for leaks.
5. Lube Oil Pressure Low-Low	1.02 barg	Same actions as 4.
Cooling Water		
6. Cooling Water Temp High. TRIPS COMPRESSOR	50°C (Sensed at inlet to Water Cooler)	Check water pump running correctly. Check surge tank pressurisation correct. Check for leaks. Check if 1st and 2nd stage compression air temperatures high. Check if lube oil temp high.
1st Stage Compression		
7. 1st Stage Discharge Air Temp High	170°C	Check cooling water flow in 1st stage cylinder. Check cooling water temp correct.
8. 1st Stage Discharge Air Temp High-High. TRIPS COMPRESSOR	180°C	Same checks as 7.
9. 1st Stage Discharge Air Pressure High. TRIPS COMPRESSOR	4 barg	Check discharge valves. Check unloaders.
10. Interscrubber Liquid Level High. TRIPS COMPRESSOR		Operate manual drain. Check operation of auto drain trap.

Alarm	Set-point	Function/Action
2nd Stage Compression		
11. 2nd Stage Discharge Air Temp High	155°C (Sensed at Discharge Bottle)	Check cooling fan air flow through intercooler correct. Check cooling water flow in 2nd stage cylinder. Check cooling water temp correct.
12. 2nd Stage Discharge Air Temp High-High. TRIPS COMPRESSOR	165°C (Sensed at Discharge Bottle)	Same checks as 11.
13. 2nd Stage Discharge Air Pressure High. TRIPS COMPRESSOR	11.7 barg	Check discharge valves. Check unloaders.
14. Aftercooler Outlet Air Temp High	35°C	Check cooling air fan air flow through aftercooler correct. Check cooling water flow in 2nd stage cylinder. Check cooling water temp correct.
15. Aftercooler Outlet Air Temp High-High. TRIPS COMPRESSOR	45°C	Same checks as 14.
16. Discharge scrubber Liquid Level High. TRIPS COMPRESSOR		Operate manual drain. Check operation of auto drain trap.
Dryer/Filter Unit		
17. Outlet Air Dew-point High	−30°C at 10.54 barg	Check correct operation of dryer unit: (a) Duty/Regeneration cycle. (b) Control air pressure 6 barg (minimum 4 barg). (c) Dryer working pressure 10.54 barg (minimum 9 barg). (d) Purge pressure 7.5 barg (maximum 9 barg).
Air Receiver		
18. Receiver Liquid Level High. TRIPS COMPRESSOR		Operate manual drains. Check operation of auto drain trap. Check correct operation of Filter/Dryer Unit.
19. Receiver Air Pressure Low-Low. (Indicated at TCP2 Control Room as 'General Alarm')	7.5 barg	Confirm that both compressor sets are running correctly. (Duty compressor should have started at 9.8 barg and Standby at 9.6 barg). Check that unloaders not stuck. Check for excessive system demand.

2 EMERGENCY SHUTDOWN

Operate the appropriate Emergency Stop control on the compressor control panel. Shutdown of the compressor will be carried out automatically.

1 INVESTIGATION OF ALARMS AND TRIPS

All alarms and trips are listed in Section 3, together with suggested actions.

2 GENERAL TROUBLESHOOTING

Symptom	Possible Cause	Action
1. Lack of Capacity.	(a) Compression cylinder valves incorrectly located or assembled.	Check valves.
	(b) Clogged intake filter in silencer/ filter assembly.	Clean filter.
	(c) Defective capacity control. (Unloader PCV).	Check PCV setting, actuating air supplies and unloaders.
2. Insufficient Capacity.	(a) Compression cylinder rod packing leaks.	Check packing.
	(b) Compression cylinder valves incorrectly located or assembled.	See 1(a) above.
	(c) Clogged intake filter in silencer/ filter assembly.	See 1(b) above.
	(d) Defective capacity control. (Unloader PCV).	See 1(c) above.
	(e) Speed incorrect.	Check correct compressor motor operation, supply voltage and panel speed control circuit.
	(f) Worn piston rings.	Replace rings.
	(g) Leaking head gaskets	Replace gaskets.
3. Insufficient Pressure.	(a) As for 2(a), (b), (d), (e), (f) and (g) above.	—
	(b) Excessive system leakage.	Check all joints up to common air header. Check all joints on instrument air and service air networks.
	(c) System demand exceeds capacity.	Reduce service air demand. Investigate for any unusual demand for instrument air.

Symptom	Possible Cause	Action
4. Compressor Overheats.	(a) Inadequate frame lubrication.	Check lube oil system.
	(b) Compression cylinder rod packing leaks.	Check packing.
	(c) Compression cylinder valves incorrectly located or assembled.	Check valves.
	(d) Clogged intake filter in silencer/ filter assembly.	Clean filter.
	(e) Defective capacity control. (Unloader PCV).	Check PCV setting, actuating air sup plies and unloaders.
	(f) Inadequate cooling water flow or excessive cooling water temperature.	Check cooling water system.
	(g) Excessive discharge pressure.	Check PSVs operating correctly at 1st and 2nd stage discharges, and air receiver.

Symptom	Possible Cause	Action
5. Compressor 'Knocks'.	(a) As for 4(a), (c) and (g) above.	—
	(b) Loose flywheel.	Check flywheel.
	(c) Excessive bearing clearance.	Check clearances.
	(d) Loose piston rod nut.	Check piston rods.
	(e) Crankshaft end-play excessive.	Check crankshaft.
6. Compressor Vibrates.	(a) As for 4(c) and (g) above.	—
	(b) As for 5(b) and (d) above.	—
	(c) Piping incorrectly supported.	Check all pipework supports.
	(d) Speed incorrect.	Check correct compressor motor operation, supply voltage and panel speed control circuit.

Symptom	Possible Cause	Action
7. Discharge Pressure High.	(a) Excessive system leakage.	See 3(b) above.
	(b) Defective capacity control.	See 4(e) above.
8. Discharge Temperature High.	(a) Dirty cylinder jackets.	Drain down and flush through.
	(b) Clogged intake filter in silencer/ filter assembly.	Clean filter.
	(c) Compression cylinder valves incorrectly located or assembled.	Check valves.
	(d) Excessive system leakage.	See 3(b) above.
	(e) Worn piston rings.	Replace rings.
	(f) Defective capacity control.	See 4(e) above.
	(g) Inadequate cooling water flow or excessive cooling water temperature.	See 4(f) above.
	(h) Excessive discharge pressure.	See 7 above.
9. Cooling Water Temperature High.	(a) Dirty cylinder jackets.	See 8 (a) above.
	(b) Excessive system leakage.	Check cooling water system for leaks.
	(c) Inadequate cooling water flow.	Check cooling water system.
10. Compressor Motor Fails to Start.	(a) Panel selector switch not set to either MANU or AUTO.	Set switch to appropriate position.
	(b) No electrical supply.	Check supply source and local switch.
	(c) Voltage abnormally low.	Check supply source.
	(d) Interlock circuit open.	Check control panel for trips.
	(e) Defective capacity control. (Unloader PCV).	Check PCV setting, actuating air supplies and unloaders.
11. Compressor Motor Overheats.	(a) Inadequate frame lubrication.	Check lube oil system.
	(b) Voltage incorrect or abnormally low.	Check supply source.
	(c) Speed incorrect.	Check panel speed control circuit.
	(d) Defective capacity control. (Unloader PCV).	See 10(e) above.

Symptom	Possible Cause	Action
12. Output Air Dew-point High.	(a) Inlet or outlet filters of filter/ dryer unit not clearing moisture.	Operate manual drains. Check operation of auto drain trap on inlet filter.
	(b) Dryer working pressure and purge pressure setting incorrect.	Check correct settings. Adjust purge pressure setting if working pressure low. (See Section 1 para 7).
	(c) Dryer cycle incorrect.	Check cam timer and instrument air supply to panel (6 barg minimum).
	(d) Excessive system leaks.	Check all connections in filter/dryer unit.
	(e) Filter/dryer unit check valves sticking.	Check. Free by gently knocking with a wooden mallet.

CHAPTER C12

DIESEL OIL SYSTEM

CONTENTS

SECTION 1 DESCRIPTION

1. Summary
2. Equipment Details
3. External Utilities and Interfaces

SECTION 2 OPERATION AND CONTROLS

1. Operating Philosophy
2. Prestart Checks
3. Start-up
4. Checks After Start-up
5. Normal Shutdown

SECTION 3 ALARMS AND EMERGENCY SHUTDOWN

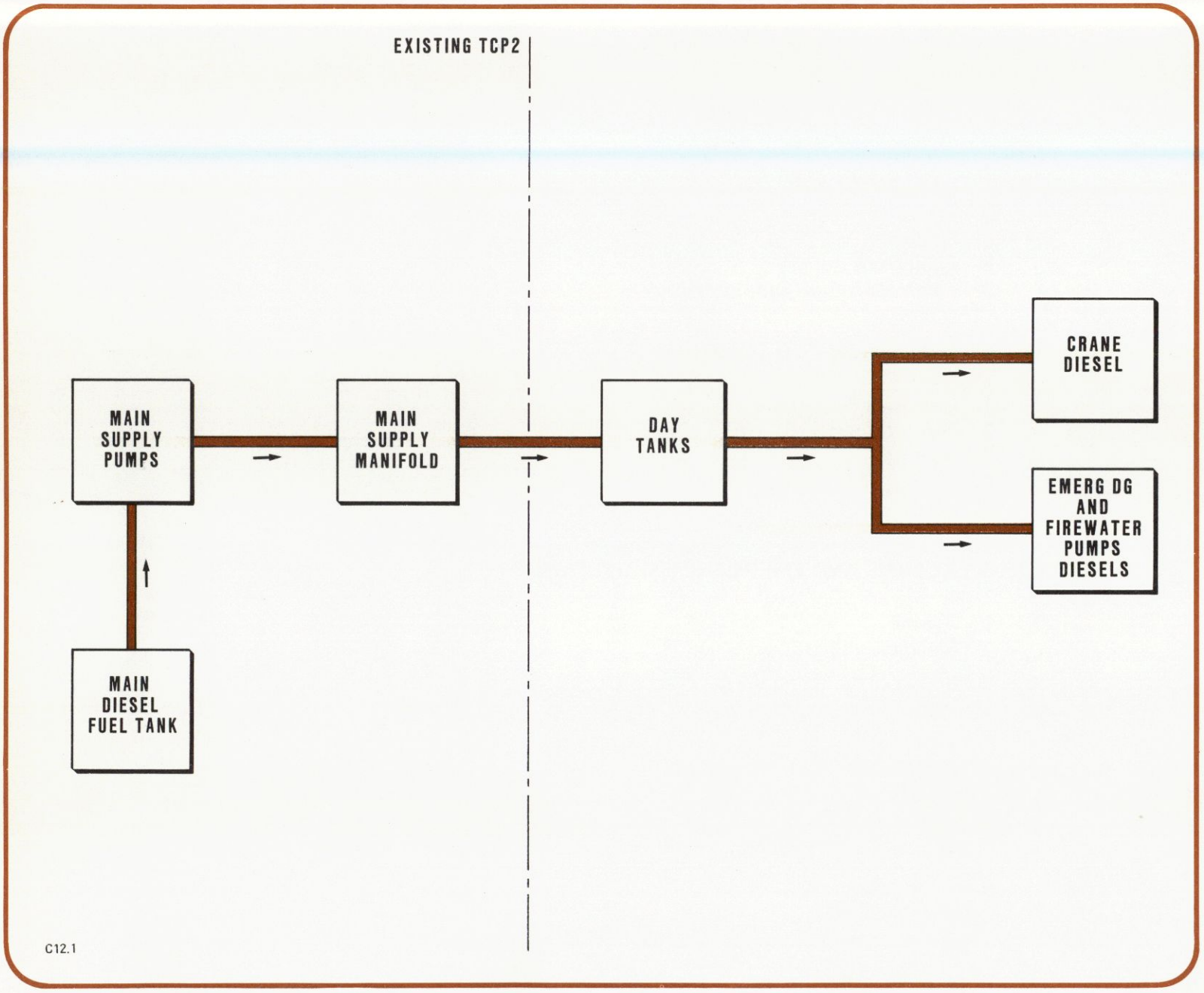
1. Alarms
2. Emergency Shutdown

SECTION 4 TROUBLESHOOTING

SECTION 5 OPERATOR MAINTENANCE

ILLUSTRATIONS

C12.1 Block Diagram
C12.2 System Schematic
C12.3 Typical Instrumentation and Controls


EXISTING TCP2
MAIN SUPPLY PUMPS
MAIN SUPPLY MANIFOLD
DAY TANKS
CRANE DIESEL
EMERG DG AND FIREWATER PUMPS DIESELS
MAIN DIESEL FUEL TANK
C12.1

SECTION 1 – DESCRIPTION

Reference: PID 5424W 50 0040 04

1 SUMMARY

See illustrations C12.1 and C12.2

1.1 The Diesel Oil System for the TCP2 Gas Compression area is supplied from the main Platform Diesel Oil System manifold, and comprises four day tanks; one each for the pedestal crane, the two firewater pump diesel engines and the emergency generator diesel engine.

1.2 Local pushbuttons at each day tank start and stop the main Diesel Oil System supply pumps which are used to replenish the day tanks.

1.3 Each diesel engine room is provided with a pushbutton outside the room, which actuates a quick-closing valve fitted in the diesel fuel supply line from the respective day tank. The quick-closing valve is fitted near the outlet of the day tank, outside the diesel engine room. These valves are all provided with manual reset facilities. The appropriate quick-closing valve must be actuated in the event of fire within the diesel engine room, in the vicinity of the day tanks, or in the immediate area of the diesel engine rooms.

2 EQUIPMENT DETAILS

(a) Day Tank for Pedestal Crane 60X01.

(b) Day Tank 68PD01A.T02 for Firewater Pump 68P01A.

(c) Day Tank 68PD01B.T02 for Firewater Pump 68P01B.

(d) Day Tank 53T01 for Emergency Generator Diesel Engine 53GD01

(e) Electrical heaters for day tanks (380V, 3-phase).

3 EXTERNAL UTILITIES AND INTERFACES

3.1 **External Utilities Required**

(a) Instrument air.

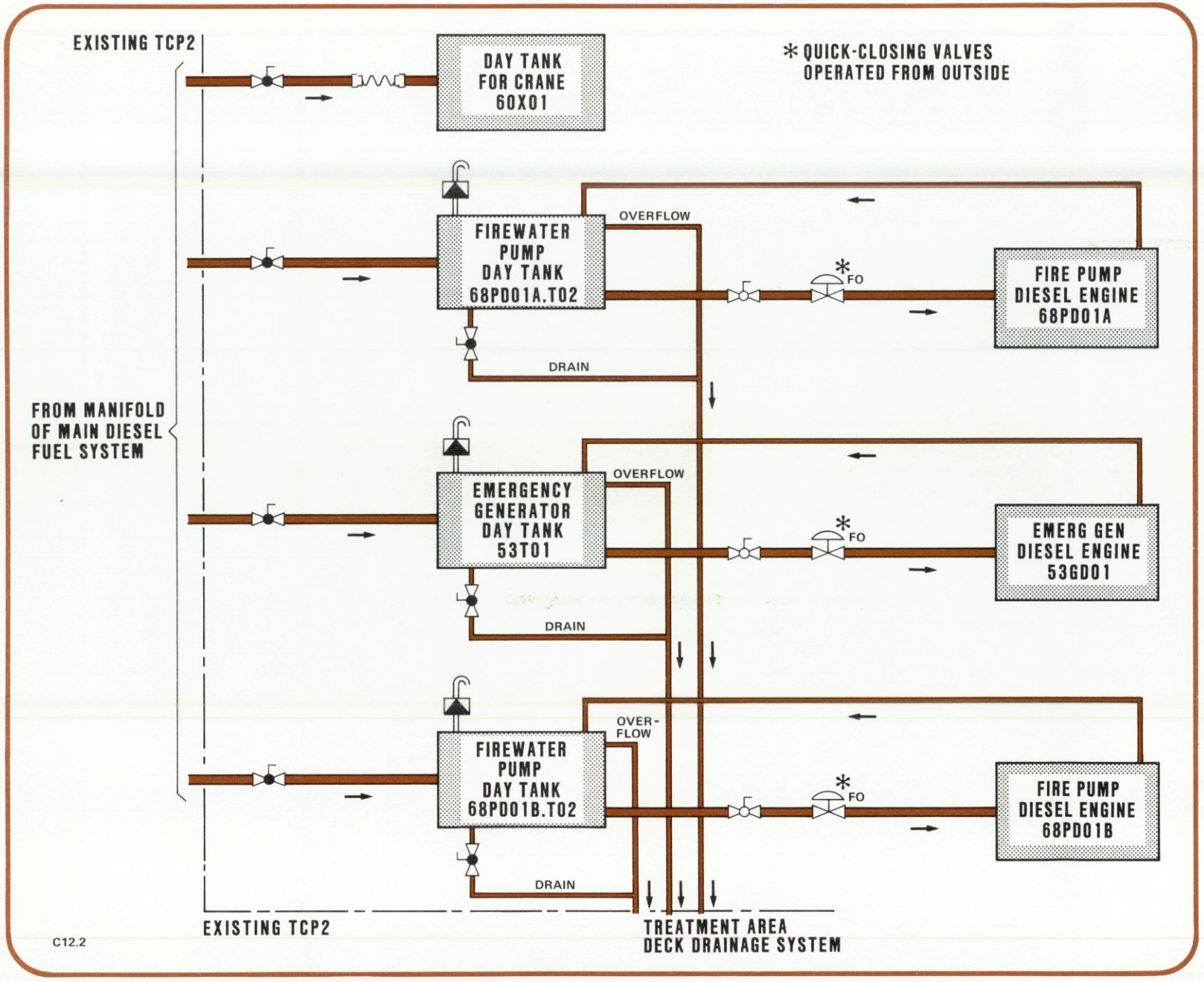
(b) Power supplies for instruments, remote pushbuttons and day tank heaters.

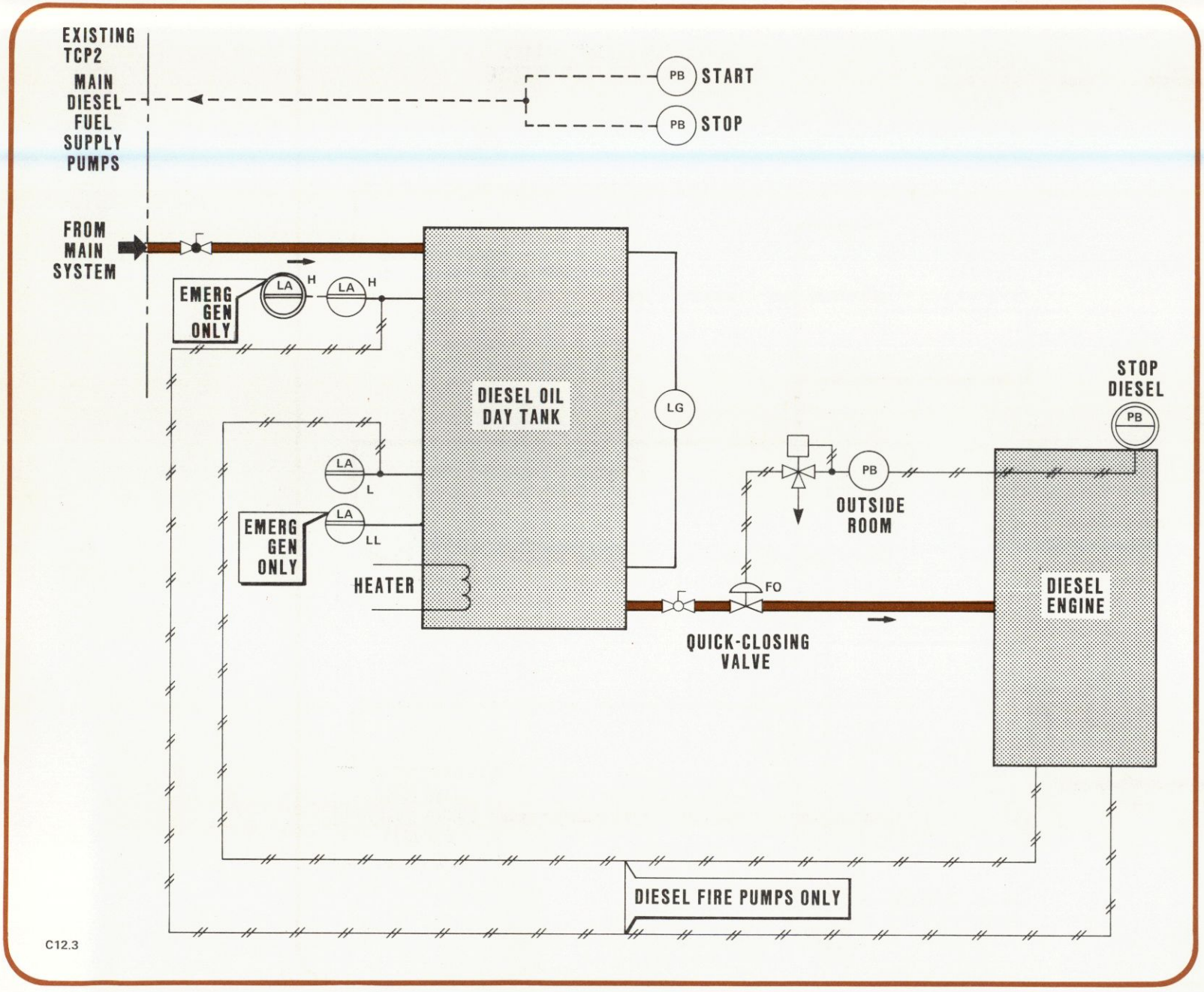
3.2 **Interfaces**

(a) Main Platform Diesel Oil System (supply).

(b) Firewater System (firewater pumps).

(c) Electrical Power Generation System (emergency generator).


EXISTING TCP2
DAY TANK FOR CRANE 60X01
* QUICK-CLOSING VALVES OPERATED FROM OUTSIDE
FIREWATER PUMP DAY TANK 68PD01A.T02
OVERFLOW
FO
FIRE PUMP DIESEL ENGINE 68PD01A
DRAIN
FROM MANIFOLD OF MAIN DIESEL FUEL SYSTEM
EMERGENCY GENERATOR DAY TANK 53T01
OVERFLOW
FO
EMERG GEN DIESEL ENGINE 53GD01
DRAIN
FIREWATER PUMP DAY TANK 68PD01B.T02
OVER-FLOW
FO
FIRE PUMP DIESEL ENGINE 68PD01B
DRAIN
EXISTING TCP2
TREATMENT AREA DECK DRAINAGE SYSTEM
C12.2


EXISTING TCP2
MAIN DIESEL FUEL SUPPLY PUMPS
PB START
PB STOP
FROM MAIN SYSTEM
EMERG GEN ONLY
LA H
LA H
DIESEL OIL DAY TANK
LG
LA L
EMERG GEN ONLY
LA LL
HEATER
STOP DIESEL
PB
PB
OUTSIDE ROOM
FO
DIESEL ENGINE
QUICK-CLOSING VALVE
DIESEL FIRE PUMPS ONLY
C12.3

SECTION 2 – OPERATION AND CONTROLS

1 OPERATING PHILOSOPHY

See illustration C12.3

1.1 Diesel fuel is supplied to the Gas Compression area from the main Diesel Fuel System (storage tank CV10). Once lines have been opened up to each day tank and user diesel engine, no operator action is necessary other than replenishment of day tanks by means of the remote pushbutton controls to the main supply pumps (CP8A/B).

1.2 In the firewater pump diesel engine control circuits only, pneumatic lines from the respective day tank High and Low level alarms are connected to the Permissive-to-Start and Start-Inhibit/Stop circuits in the diesel engine control panel.

2 PRESTART CHECKS

Ensure that instrument air and electrical supplies are available.

3 START-UP

(1) Open appropriate valves at the supply manifold from main Diesel Fuel System (existing TCP2).

(2) Open appropriate day tank supply valve(s).

(3) Fill day tanks as necessary (check level gauges) by operating appropriate pump Start/Stop pushbuttons.

(4) Ensure that day tank heaters are switched on and functioning.

(5) Open appropriate day tank outlet valves to diesel engines.

(6) Ensure that quick-closing valves at day tanks and diesel engines are OPEN.

4 CHECKS AFTER START-UP

(1) Check the correct operation of all quick-closing valves by pressing the pushbutton outside each diesel engine room.

(2) Reset all quick-closing valves manually.

5 NORMAL SHUTDOWN

(1) Shut all valves in the lines to the appropriate user diesel engine.

(2) Shut manifold valves from main Diesel Oil System (existing TCP2).

SECTION 3 – ALARMS AND EMERGENCY SHUTDOWN

1 ALARMS

1.1 The day tank for the pedestal crane has no alarms.

1.2 Each day tank for the firewater pump and emergency generator diesel engines is fitted with High and Low level alarms which are displayed in TCP2 Control Room.

1.3 The day tank for the emergency generator diesel engine is fitted with an additional level alarm (Low Low) which is also displayed in TCP2 Control Room.

2 EMERGENCY SHUTDOWN

In the event of fire in a diesel engine room, in the vicinity of the day tanks or in the immediate area of the diesel engine rooms, operate the pushbutton outside the appropriate diesel engine room. This should actuate the quick-closing valve in the fuel supply line to the diesel engine (at the day tank outlet, outside the diesel engine room).

Symptom	Possible Cause	Action
1. Loss of fuel at running diesel.	(a) Day tank level low. (Alarm indication).	Check day tank level. If low, replenish by starting supply pumps (local pushbutton).
	(b) Quick-closing valve operated.	Check if operated, by whom and reason. If malfunction, re-open by manual reset.
2. Poor diesel performance.	Diesel fuel temperature too low.	Check that day tank heater operating.
3. Diesel Fire Pumps will not start.	Day tank fuel level inhibit operated – high or low. (Alarm indication).	Check day tank level. If low, replenish as in 1(a) above. If high, check overflow drain line open.
4. Fuel not delivered to day tank on demand (pump Start pushbutton pressed).	(a) Pushbutton control line malfunction.	Check power supply available.
	(b) Pump malfunction.	Report to TCP2 Control Room.
	(c) Main storage tank low.	Report to TCP2 Control Room.

SECTION 5 – OPERATOR MAINTENANCE

Periodically check the following:

(a) Day tanks' content (level gauge); replenish as necessary.

(b) Operation of all quick-closing valves (all operating positions); reset on completion.

(c) Day tank heaters operating correctly.

CHAPTER C13

MAIN SEA WATER COOLING SYSTEM

CONTENTS

SECTION 1 DESCRIPTION

1. Summary
2. Equipment Details
3. External Utilities and Interfaces

SECTION 2 OPERATION AND CONTROL

1. Operating Philosophy
2. Controls and Indicators
3. Alarms and Trips

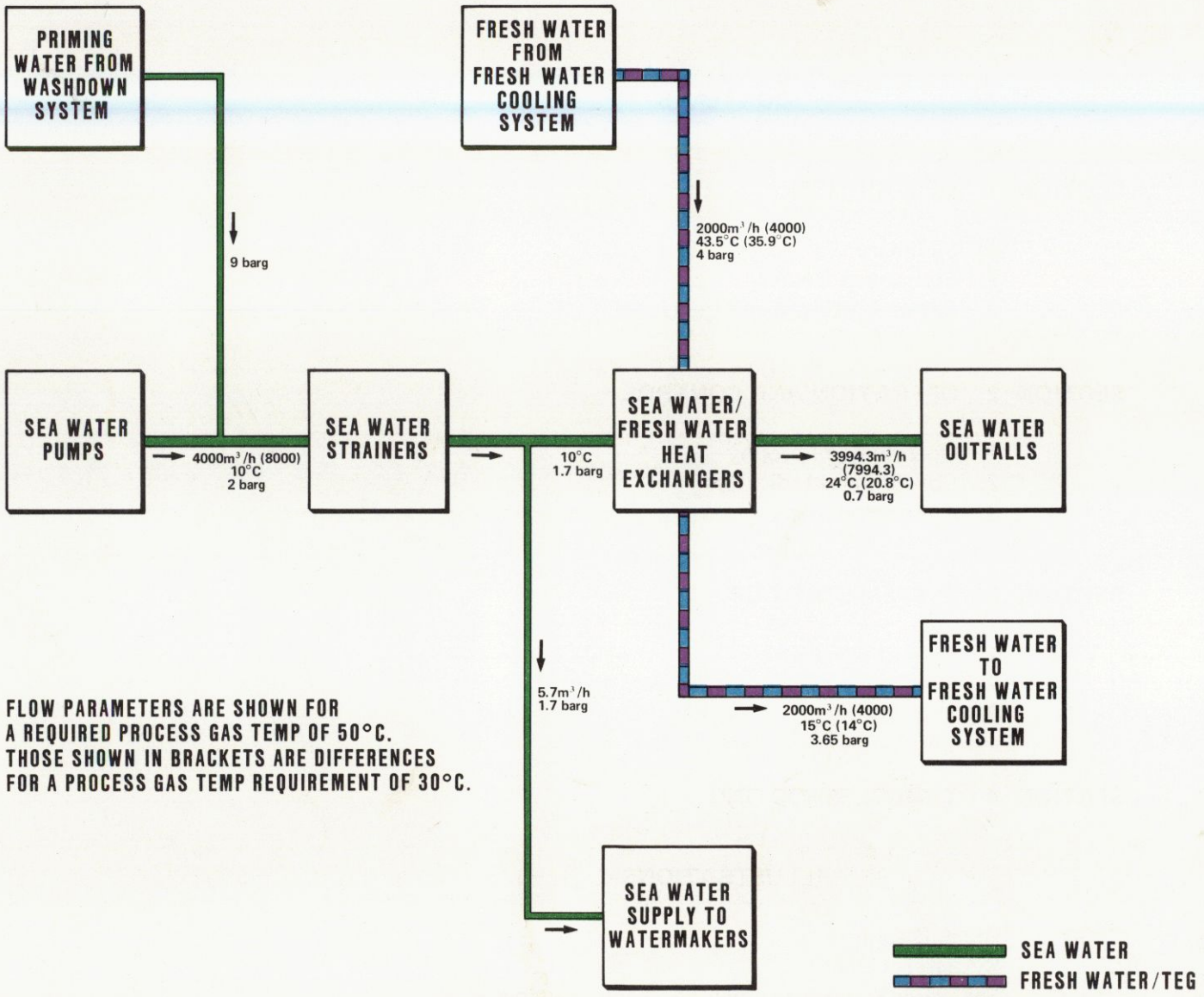
SECTION 3 SYSTEM START-UP

1. Prestart Checks
2. Start-up
3. Shutdown

SECTION 4 TROUBLESHOOTING

ILLUSTRATIONS

C13.1 Block Diagram
C13.2 System Schematic
C13.3 Sea Water Pump Instrumentation and Controls


PRIMING WATER FROM WASHDOWN SYSTEM
FRESH WATER FROM FRESH WATER COOLING SYSTEM
9 barg
2000m³/h (4000)
43.5°C (35.9°C)
4 barg
SEA WATER PUMPS
4000m³/h (8000)
10°C
2 barg
SEA WATER STRAINERS
10°C
1.7 barg
SEA WATER/ FRESH WATER HEAT EXCHANGERS
3994.3m³/h
(7994.3)
24°C (20.8°C)
0.7 barg
SEA WATER OUTFALLS
FRESH WATER TO FRESH WATER COOLING SYSTEM
2000m³/h (4000)
15°C (14°C)
3.65 barg
5.7m³/h
1.7 barg
SEA WATER SUPPLY TO WATERMAKERS
FLOW PARAMETERS ARE SHOWN FOR
A REQUIRED PROCESS GAS TEMP OF 50°C.
THOSE SHOWN IN BRACKETS ARE DIFFERENCES
FOR A PROCESS GAS TEMP REQUIREMENT OF 30°C.
SEA WATER
FRESH WATER/TEG
C13.1

SECTION 1 – DESCRIPTION

Reference: PID 5424W 58 0030 02

NOTE
Fresh water utilised as a cooling medium is a 70/30 per cent water/TEG mixture; TEG is added as an anti-freeze. For ease of description in text, it will only be referred to as 'Fresh Water'.

1 SUMMARY

See illustrations C13.1 and C13.2

1.1 The Gas Compression area Main Sea Water Cooling System supplies the following two equipments:

(a) Sea Water/Fresh Water Heat Exchangers.

(b) Watermakers.

1.2 Sea water for the system is drawn by four submerged pumps, located at the top of Column 3. Each pump motor is housed in a water-filled enclosure, in which the fresh water is maintained under pressure (by gravity) from a water tank. This prevents the ingress of sea water which would cause damage to the motor.

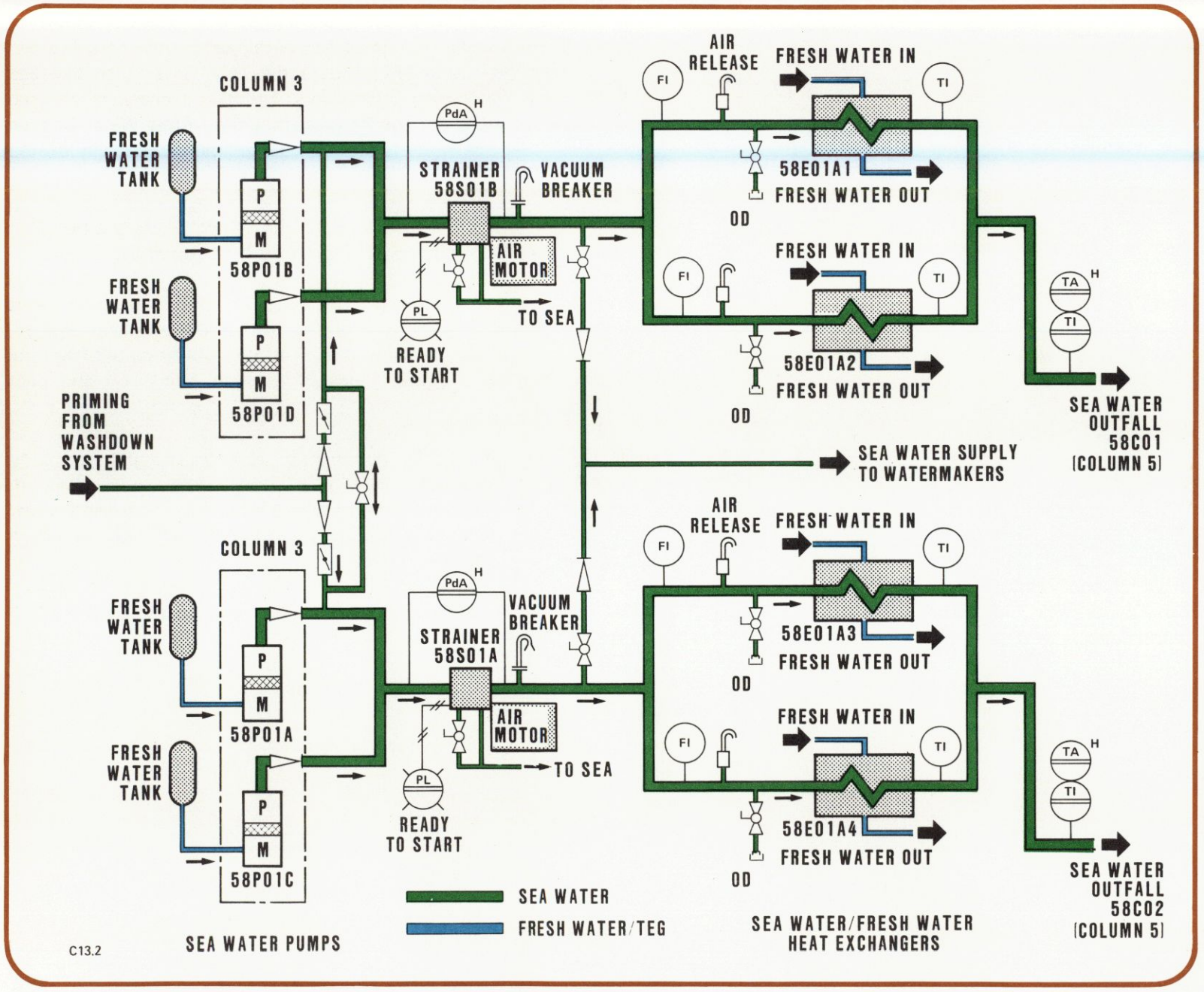
1.3 The four pump discharges are connected in two pairs so that the system can be operated with two pumps duty and two pumps at standby. Each pair of pumps supplies sea water through a strainer, which removes suspended solids above 2mm in size, to two Sea Water/Fresh Water Heat Exchangers. The heat exchangers are used to cool fresh water for the Process and Utility Fresh Water Cooling Systems. Used sea water is discharged overboard via outfalls located in Column 5.

1.4 Sea water supply for feedwater to the Watermakers can be taken from either pair of pumps, downstream of the strainers.

1.5 Prior to start-up, the system is primed to remove as much air as possible. Priming water is supplied from the Washdown System. During start-up, any remaining air is automatically vented from the system through air traps located at high points on the heat exchangers.

1.6 During pump shutdown, 'hammering', ie water hammer caused by air locks in the system, is avoided by air inlet vents ('vacuum breakers') installed downstream of the strainers. These vents allow air into the system if it is suddenly depressurised and this action cushions the hammering effect.

1.7 All remote instrumentation and alarms are located in the TCP2 Control Room.


COLUMN 3
FRESH WATER TANK
P
M
58P01B
FRESH WATER TANK
58P01D
PRIMING FROM WASHDOWN SYSTEM
PdA H
STRAINER 58S01B
VACUUM BREAKER
AIR MOTOR
PL
READY TO START
TO SEA
AIR RELEASE
FI
FRESH WATER IN
TI
58E01A1
FRESH WATER OUT
OD
FRESH WATER IN
58E01A2
FRESH WATER OUT
TA H
SEA WATER OUTFALL 58C01 (COLUMN 5)
SEA WATER SUPPLY TO WATERMAKERS
COLUMN 3
FRESH WATER TANK
58P01A
FRESH WATER TANK
58P01C
STRAINER 58S01A
VACUUM BREAKER
58E01A3
FRESH WATER OUT
58E01A4
SEA WATER OUTFALL 58C02 (COLUMN 5)
SEA WATER
FRESH WATER/TEG
SEA WATER PUMPS
SEA WATER/FRESH WATER HEAT EXCHANGERS
C13.2

2 EQUIPMENT DETAILS

2.1 Sea Water Pumps 58P01A and 58P01C

Capacity	2000m^3/h.
Discharge pressure	2 barg.
Discharge temperature	10°C.
Power supply	5.5kV 3-phase 50Hz.
Power consumption	461kW.
Speed	1500 rev/min.
BHP at shut off	350kW.

2.2 Sea Water Pumps 58P01B and 58P01D

Capacity	2000m^3/h.
Discharge pressure	2 barg.
Discharge temperature	10°C.
Power supply	5.5kV 3-phase 50Hz.
Power consumption	480kW.
Speed	1500 rev/min.
BHP at shut off	200kW.

2.3 Sea Water Strainers 58S01A and 58S01B

Flow rate	4000m^3/h
Inlet pressure	2 barg.
Maximum permissible ΔP	0.4 bar.

2.4 Sea Water/Fresh Water Heat Exchangers 58E01A1, 58E01A2, 58E01A3 and 58E01A4

	Inlet	Outlet
Sea water flow (Gas at 50°C)	4,120,000kg/h	4,120,000kg/h
Sea water flow (Gas at 30°C)	8,240,000kg/h	8,240,000kg/h
Operating temperature (Gas at 50°C)	10°C	24°C
Operating temperature (Gas at 30°C)	10°C	20.8°C
Operating pressure	1.7 barg	0.7 barg
Design temperature	35°C	
Design pressure	6.9 barg	

3 EXTERNAL UTILITIES AND INTERFACES

3.1 To operate the Main Sea Water Cooling System the following external utilities are required:

(a) Electrical power supply of 5.5kV 3-phase 50Hz for the pumps.

(b) Electrical power supply of 220V ac and/or 110V dc for instrumentation and alarms.

(c) Instrument air (including supply to air motors for sea water strainers).

(d) Washdown water at a pressure of 9 barg.

3.2 The Main Sea Water Cooling System interfaces with the following:

(a) Fresh water cooling systems for process equipment and utilities.

(b) Supply water for the Watermakers.

(c) Closed drains system as required for drainage.

SECTION 2 – OPERATION AND CONTROL

1 OPERATING PHILOSOPHY

1.1 During Phase 1 with gas delivery required at a temperature of 50°C, the equipment will operate as follows:

(a) Two pumps running – 58P01A and 58P01C.

(b) Two pumps on standby – 58P01B and 58P01D.

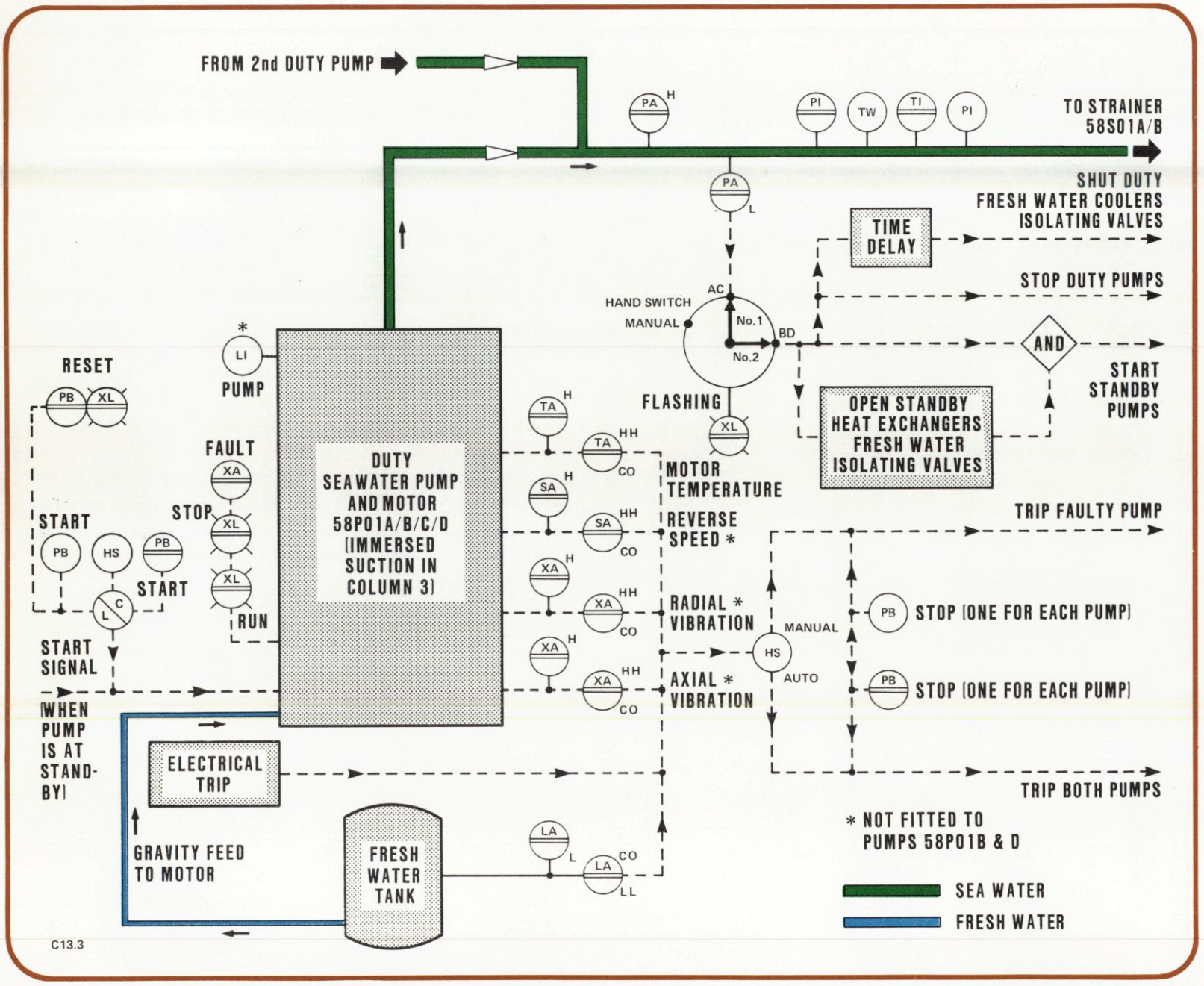
(c) One strainer on line – 58S01A.

(d) One strainer on standby – 58S01B.

(e) Two heat exchangers on line – 58E01A3 and 58E01A4.

(f) Two heat exchangers on standby – 58E01A1 and 58E01A2.

1.2 During Phase 1, but with gas delivery required at a temperature of 30°C, a greater volume of cooling water will be required to achieve this lower temperature. Therefore, all the equipment detailed in 1.1 will be required to run simultaneously. In this event, no standby equipment will be available.


FROM 2nd DUTY PUMP
PA H
PI
TW
TI
PI
TO STRAINER 58S01A/B
PA L
SHUT DUTY FRESH WATER COOLERS ISOLATING VALVES
TIME DELAY
STOP DUTY PUMPS
HAND SWITCH
MANUAL
AC
No.1
No.2
BD
AND
START STANDBY PUMPS
OPEN STANDBY HEAT EXCHANGERS FRESH WATER ISOLATING VALVES
FLASHING
XL
RESET
PB XL
LI
PUMP
FAULT
XA
STOP
XL
START
PB HS PB
START
RUN
C L
START SIGNAL
(WHEN PUMP IS AT STAND-BY)
DUTY SEAWATER PUMP AND MOTOR 58P01A/B/C/D (IMMERSED SUCTION IN COLUMN 3)
TA H
TA HH CO
MOTOR TEMPERATURE
SA H
SA HH CO
REVERSE SPEED *
XA H
XA HH CO
RADIAL * VIBRATION
XA H
XA HH CO
AXIAL * VIBRATION
TRIP FAULTY PUMP
MANUAL
HS
AUTO
PB STOP (ONE FOR EACH PUMP)
PB STOP (ONE FOR EACH PUMP)
TRIP BOTH PUMPS
ELECTRICAL TRIP
GRAVITY FEED TO MOTOR
FRESH WATER TANK
LA L
LA CO LL
* NOT FITTED TO PUMPS 58P01B & D
SEA WATER
FRESH WATER
C13.3

2 CONTROLS AND INDICATORS

See illustrations C13.2 and C13.3

2.1 Pumps

2.1.1 Each of the four pumps is fitted with the following controls and indicators:

(a) Local/Control Room. Start selector hand switch located on the TCP2 control panel.

(b) Start and Stop pushbuttons, local to the pump.

(c) Remote Start, Stop and Reset pushbuttons, located on the TCP2 control panel.

(d) Remote STOP, RUN, FAULT and RESET indicator lamps, located on the TCP2 control panel.

(e) On pumps 58P01A/C only, a level indicator, local to the pump which indicates liquid level in the pump.

2.1.2 Each pair of pumps has a two-position hand selector switch fitted inside the control panel on TCP2. The positions, marked 'Manual' and 'Auto', determine whether one or both pumps trip in the event of a pump or motor cut-out. In the 'Manual' mode, only the affected pump will trip whereas in the 'Auto' setting both pumps will trip. The position to which the switch will be set has yet to be determined.

2.1.3 Both pairs of pumps are linked electrically by a single hand switch for 'Running', 'Auto Start' or 'Manual' operation. This switch is provided with two selector arms. Prior to system start-up, both selector arms must be set to MANUAL. Incorrect positioning of this switch will cause a STANDBY PUMP SELECTION FAULT ALARM to flash on the TCP2 control panel.

2.1.4 When the duty pump pair are running satisfactorily, number one selector arm is to be set to the RUNNING position of the duty pumps whereas number two selector arm is to be set to the AUTO position of the standby pumps.

2.1.5 In the event of low discharge pressure failure of the operative pumps, the switch will allow a start-up sequence to be initiated for the standby pumps. Provision has also been made for linking in a fifth pump to this selector switch should this become necessary during future phases of operation.

2.1.6 The discharge lines from each pair of pumps are provided with the following indicators:

(a) Local pressure.

(b) Remote pressure on the TCP2 control panel.

(c) Remote temperature on the TCP2 control panel.

(d) Local thermowell fitted with a thermometer.

2.2 Strainers

2.2.1 The strainers operate independently. On receipt of an automatic or manually initiated signal they will self-clean.

2.2.2 Each strainer is fitted with the following controls and indicators:

(a) Start pushbutton, local to the strainer.

(b) Emergency Stop pushbutton, local to the strainer.

(c) Remote Stop pushbutton on the TCP2 control panel.

(d) Remote READY TO RUN indicator lamp, located on the TCP2 control panel.

(e) Differential pressure indicator, local to the strainer.

(f) Operating air pressure indicators fitted integrally with their relevant pressure control valves. Both valves are local to the strainer with associated pressure gauges which should indicate 6.8 and 5.4 barg (100 and 80 psig) respectively.

(g) Pressure indicator for the air motor timer fitted integrally in its pressure control valve local to the strainer. This pressure indicates the instrument settings for hourly or half-hourly backwash.

2.3 Heat Exchangers

Each heat exchanger has the following indicators located in the sea water pipework local to the exchanger:

(a) Flow indicator (upstream).

(b) Temperature indicator (downstream).

2.4 Sea Water Outfalls

The sea water outfall lines are each fitted with a local temperature indicator and a thermowell.

3 ALARMS AND TRIPS

3.1 Pumps

3.1.1 Each pump is fitted with the following alarms. Actions to be taken on receipt of these alarms or automatic tripping actions are shown alongside the relevant malfunction:

ALARM	ACTION
Motor fault	Investigate cause
Motor temperature high	Investigate cause
Motor temperature excessively high	Automatic trip of affected pump or pumpset
*Motor reverse speed	Stop pump and investigate cause
*Motor reverse speed excessive	Automatic trip of affected pump or pumpset
*Radial vibration high	Stop pump and investigate cause
*Radial vibration excessive	Automatic trip of affected pump or pumpset
*Axial vibration high	Stop pump and investigate cause
*Axial vibration excessive	Automatic trip of affected pump or pumpset
Electrical trip (no alarm)	Automatic trip of affected pump or pumpset
Water tank level low	Fill tank
Water tank level excessively low	Automatic trip of affected pump or pumpset

ALARMS MARKED * DO NOT APPLY TO PUMPS 58P01A and 58P01C.

3.1.2 Each pair of pumps is fitted with the following alarms in their common discharge line. Actions to be taken on receipt of these alarms or automatic tripping actions are shown alongside the relevant malfunction:

ALARM	ACTION
Discharge pressure high	Check strainer differential pressure and clean if required. Investigate failure of automatic cleaning system
Discharge pressure low	1. Automatic opening of the fresh water inlet and discharge valves on the standby heat exchangers 2. Automatic start of the standby pumpset 3. Automatic closing of the fresh water inlet and discharge valves on the duty heat exchangers 4. Automatic trip of the duty pumpset

3.1.3 During pump start-up, if the required discharge pressure of 2 barg is not attained within a preset time period, the pump will automatically trip. The timer controlling the preset period can be set within a range of 6 to 180 seconds. The correct time setting will be ascertained in the light of operating experience.

3.2 Strainers

The strainers are each fitted with a high differential pressure alarm which annunciates on the TCP2 control panel. In the event of such an alarm, the strainer must be cleaned by operating the local 'Manual' pushbutton and the failure of the automatic cleaning system should be rectified.

3.3 Heat Exchangers

Sea water flow through the heat exchangers is not monitored by any alarms. However, the discharge lines to the sea water outfalls are each fitted with a high temperature alarm which annunciates on the TCP2 control panel.

SECTION 3 – SYSTEM START-UP

NOTE
The following assumes Phase 1 operation with a gas delivery temperature of 30°C (Section 2, paragraph 1.1).

1 PRESTART CHECKS

(a) Electrical power available for equipment and alarms.

(b) Instrument air available and all required instrument root valves open.

(c) All system alarms cancelled in the TCP2 Control Room.

(d) All system drain valves closed.

(e) Fresh water tanks for pump motor pressurisation full.

(f) Washdown System pressurised.

2 START-UP

(1) Prime each side of the system, using water from the Washdown System. Isolate priming lines on completion.

NOTE
During the priming operation, care is to be taken that the Watermaker supply pressure is not affected by fluctuations in the Washdown System pressure.

(2) Open the cross-connection valve on the interconnecting priming line between both sides of the cooling system. This will allow the duty side to maintain the standby side primed and ready for automatic start.

(3) Check the strainer air pressures (paragraph 2.2.2). Ensure that the local Emergency Stop pushbutton and Control Room Stop pushbutton are pulled out and that the READY TO RUN indicator lamp is illuminated on the TCP2 control panel.

(4) Check that the pump trip selector hand switch inside the TCP2 control panel is correctly positioned (paragraph 2.1.2).

(5) Set both of the Running/Auto Start/Manual selector hand switch selector arms to MANUAL (paragraph 2.1.3).

(6) Set the Start selector hand switch to LOCAL on the duty pumps.

(7) Start both duty pumps locally and confirm that a common discharge pressure of 2 barg is attained. Check that the relevant pump RUN indicator lamps are illuminated on the TCP2 control panel.

(8) Check that the strainer differential pressure is well below 0.4 bar. Test the strainer cleaning operation by depressing the Manual Start pushbutton. During the test cleaning sequence, test the emergency stopping action by depressing the Emergency Stop pushbutton local to the strainer. Pull out the Emergency Stop pushbutton when the test is complete. This action can be repeated to test the Remote Stop pushbutton if required.

(9) Check the flow indicators on the duty heat exchangers.

(10) When correct system operation is confirmed by checking all the monitoring instruments, set the Pump Start selector hand switches on all four pumps to CONTROL ROOM.

(11) Set the Running/Auto Start/Manual selector hand switch selector arms to AC RUNNING/BD AUTO START.

(12) The Main Sea Water Cooling System is now fully operational and the Watermaker supply lines can be opened as required.

3 SHUTDOWN

(1) Set the Running/Auto Start/Manual selector hand switch selector arms to MANUAL.

(2) Stop the duty pumps from the TCP2 Control Room.

Symptom	Possible Cause	Action
Pump fails to start on manual Start command. (Fault lamp illuminated)	(a) No electrical supply.	Check supply source.
	(b) Start selector hand switch incorrectly positioned.	Select appropriate mode, ie LOCAL/CONTROL ROOM.
	(c) Running/Auto Start/Manual selector hand switch incorrectly positioned.	Position both selector arms to MANUAL.
	(d) Motor malfunction.	Check all cut-out alarms for appropriate pump. Rectify fault.
Pump fails to start on automatic Start command. (Low discharge pressure alarm)	(a) Manual/Auto selector hand switch incorrectly positioned inside TCP2 control panel.	Select correct mode.
	(b) Running/Auto Start/Manual selector hand switch incorrectly positioned.	Position selector arms to correct modes.
	(c) Fresh water isolating valves on relevant sea water/fresh water heat exchangers failed to open.	Check (b) above. If correct, investigate failure of signal to automatically open the valves.
Strainer continuously backwashes. (High dP alarm)	(a) Backwashing failing to re-establish minimum differential pressure.	Renew filter basket assembly.

Symptom	Possible Cause	Action
Strainer fails to backwash at high differential pressure. (High dP alarm)	(a) Local Emergency Stop push-button pushed in.	Pull out pushbutton.
	(b) Remote Stop pushbutton on TCP2 control panel pushed in.	Pull out pushbutton.
	(c) Air failure to filter.	Re-establish air supply.
	(d) Filter controls malfunction.	Investigate control failure.
Heat exchanger plate pack leaks.	(a) Incorrect plate arrangement. Worn or faulty gaskets.	Check plate arrangement and replace if necessary.
Heat exchanger roller assembly defective.	(a) Insufficient lubricant.	Lubricate.
High temperature at heat exchanger outlet. (High temperature alarm)	(a) Perforated plates allowing cross-leakage from fresh water system.	Replace defective plates.
	(b) Low sea water flow.	See 'Low Flow'.
Low flow through heat heat exchanger.	(a) Blocked strainer.	Initiate backwash of strainer. See 'Strainer fails to backwash at high dP'.
	(b) Incorrect system pressure.	Check pumps.
	(c) Scaling or deposition on exchanger plates.	Clean plate surfaces.
	(d) Blockage in plate pack or inlet line.	Check and clean as necessary.

For action on receipt of alarms refer to ALARMS AND TRIPS (Section 2, paragraph 3).

CHAPTER C14

FRESH WATER COOLING SYSTEMS

CONTENTS

SECTION 1 DESCRIPTION

1. Introduction
2. Process Fresh Water Cooling System
3. Utilities Fresh Water Cooling System
4. Priming and Make-up System

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1. Operating Philosophy
2. Controls and Indicators
3. Alarms and Trips

SECTION 3 SYSTEM START-UP

1. Prestart Checks
2. Start-up
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SECTION 4 TROUBLESHOOTING

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C14.2 System Schematic
C14.3 Process Fresh Water Cooling System
C14.4 Utilities Fresh Water Cooling System
C14.5 Priming and Make-up System
C14.6 Process Fresh Water Pumps Instrumentation and Controls
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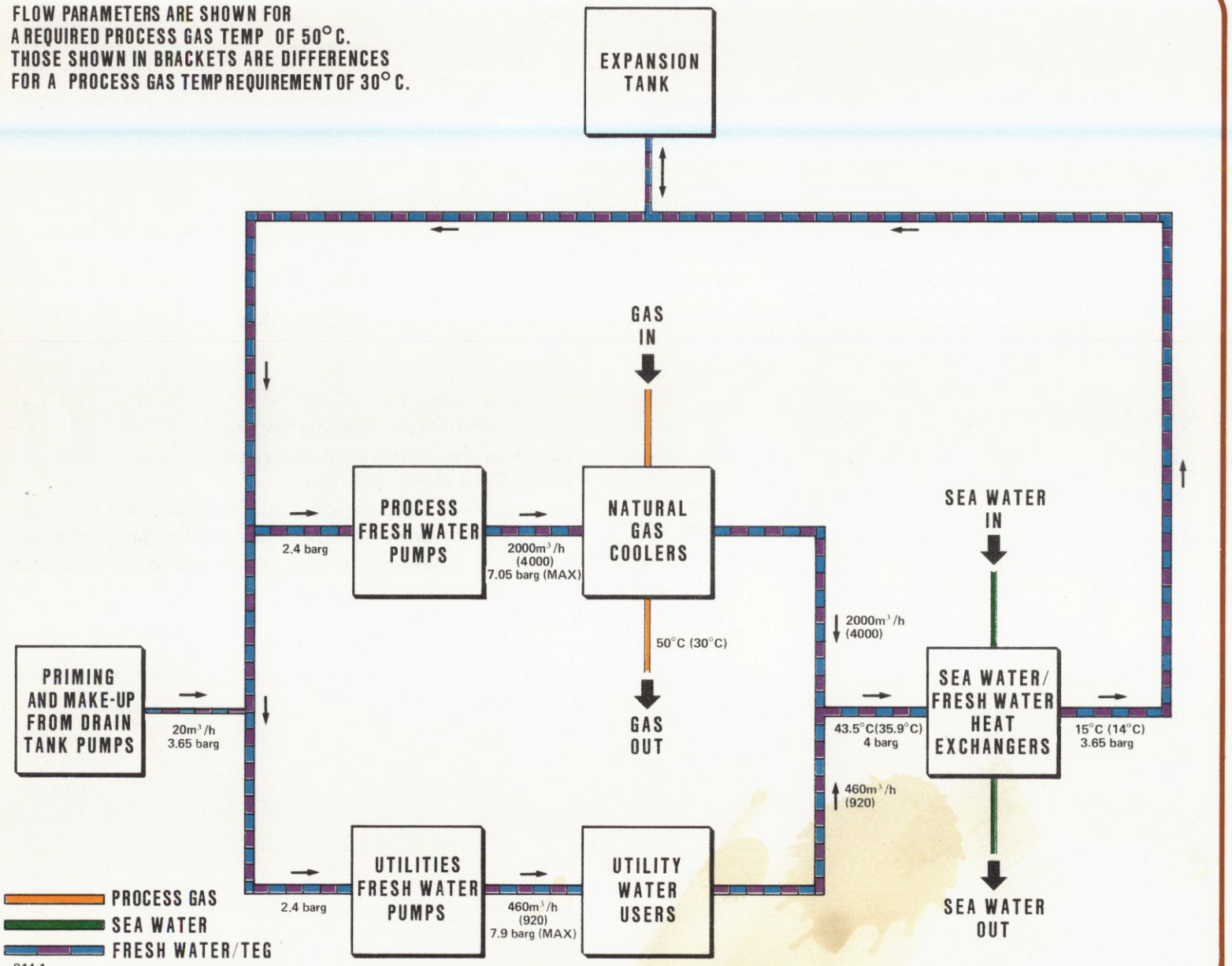
C14.8 Priming and Make-up Pumps Instrumentation and Controls

FLOW PARAMETERS ARE SHOWN FOR
A REQUIRED PROCESS GAS TEMP OF 50° C.
THOSE SHOWN IN BRACKETS ARE DIFFERENCES
FOR A PROCESS GAS TEMP REQUIREMENT OF 30° C.



C14.1

SECTION 1 – DESCRIPTION

Reference: PID 5424W 55 0040 02
PID 5424W 58 0030 01
PID 5424W 58 0040 02

NOTE
Fresh water utilised as a cooling medium is a 70/30 per cent water/TEG mixture; TEG is added as an antifreeze. For ease of description in text, it will only be referred to as 'Fresh Water'.

1 INTRODUCTION

See illustrations C14.1 and C14.2

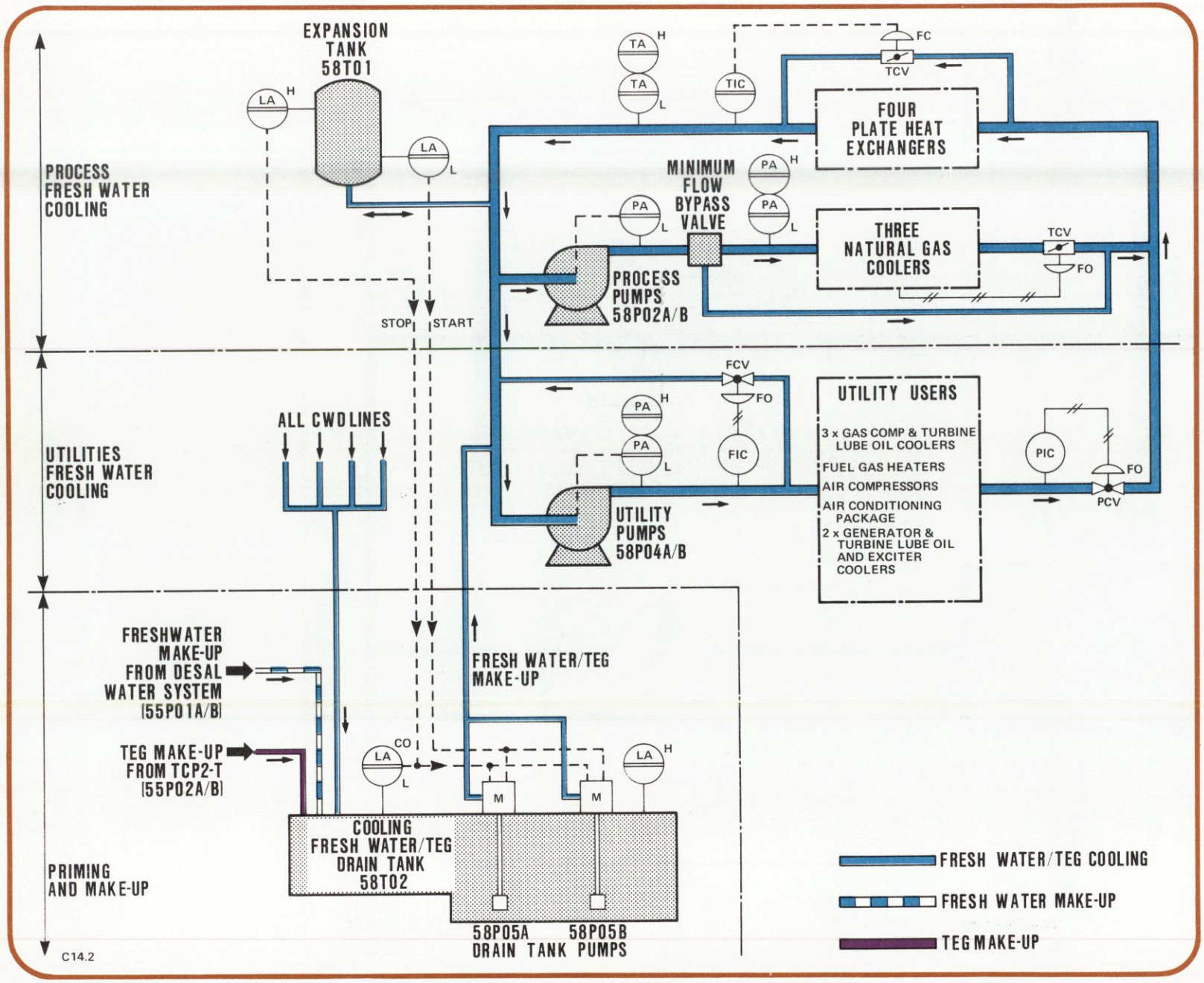
1.1 Fresh Water Cooling Systems for the Gas Compression area comprise the following:

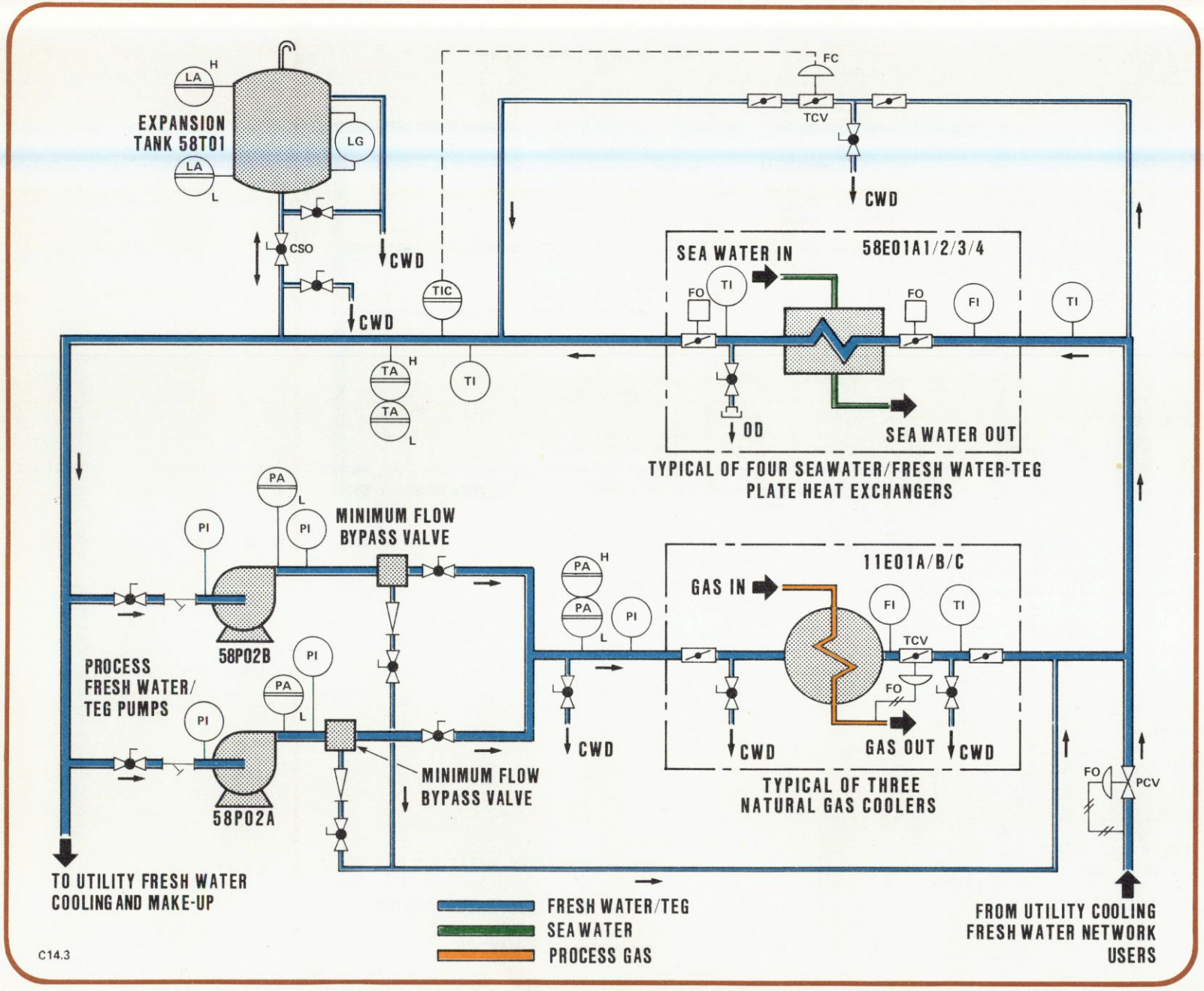
(a) Process Fresh Water Cooling System.

(b) Utilities Fresh Water Cooling System.

1.2 The systems are primed and supplied with make-up water from the Cooling Fresh Water/TEG Drain Tank.

1.3 Each system is described independently in the following text. The priming and make-up arrangements are included as an individual sub-system.


EXPANSION TANK 58T01
LA H
LA L
TA H
TA L
TIC
FC
TCV
FOUR PLATE HEAT EXCHANGERS
PROCESS FRESH WATER COOLING
MINIMUM FLOW BYPASS VALVE
PA H
PA L
PA H
PA L
THREE NATURAL GAS COOLERS
TCV
FO
PROCESS PUMPS 58P02A/B
STOP
START
FCV
FO
UTILITY USERS
3 x GAS COMP & TURBINE LUBE OIL COOLERS
FUEL GAS HEATERS
AIR COMPRESSORS
AIR CONDITIONING PACKAGE
2 x GENERATOR & TURBINE LUBE OIL AND EXCITER COOLERS
PIC
FO
PCV
ALL CWD LINES
PA H
PA L
FIC
UTILITIES FRESH WATER COOLING
UTILITY PUMPS 58P04A/B
FRESHWATER MAKE-UP FROM DESAL WATER SYSTEM (55P01A/B)
FRESH WATER/TEG MAKE-UP
TEG MAKE-UP FROM TCP2-T (55P02A/B)
LA CO L
LA H
M
M
COOLING FRESH WATER/TEG DRAIN TANK 58T02
PRIMING AND MAKE-UP
58P05A DRAIN TANK PUMPS
58P05B
C14.2
FRESH WATER/TEG COOLING
FRESH WATER MAKE-UP
TEG MAKE-UP


EXPANSION TANK 58T01
LA
H
LG
LA
L
CSO
CWD
CWD
TIC
FC
TCV
CWD
SEA WATER IN
58E01A1/2/3/4
FO
TI
FO
FI
TI
TA
H
TA
L
TI
OD
SEA WATER OUT
TYPICAL OF FOUR SEAWATER/FRESH WATER-TEG PLATE HEAT EXCHANGERS
PA
L
PI
PI
MINIMUM FLOW BYPASS VALVE
PROCESS FRESH WATER/ TEG PUMPS
58P02B
PI
PA
L
PI
58P02A
MINIMUM FLOW BYPASS VALVE
PA
H
PA
L
PI
CWD
11E01A/B/C
GAS IN
FI
TI
TCV
FO
CWD
CWD
GAS OUT
CWD
TYPICAL OF THREE NATURAL GAS COOLERS
FO
PCV
TO UTILITY FRESH WATER COOLING AND MAKE-UP
FRESH WATER/TEG
SEA WATER
PROCESS GAS
FROM UTILITY COOLING FRESH WATER NETWORK USERS

2 PROCESS FRESH WATER COOLING SYSTEM

See illustration C14.3

2.1 Summary

2.1.1 The Gas Compression area Process Fresh Water Cooling System provides the cooling medium for three Natural Gas Coolers. These coolers will normally reduce the gas delivery temperature to 50°C. Provision is also made for a gas delivery temperature requirement of 30°C. Fresh water is used because it is less corrosive than sea water.

2.1.2 Only a limited supply of fresh water is available, therefore a closed network has been provided. The fresh water is recirculated round the system by a Process Fresh Water Pump. A second pump is maintained at auto standby. Each pump is protected against low flow conditions by a bypass valve fitted downstream. This valve opens at a flow of 250m^3/h.

2.1.3 Four Sea Water/Fresh Water Heat Exchangers are connected to the system to reduce the fresh water temperature downstream of the natural gas coolers. The heat exchangers operate with two duty and two at standby.

2.1.4 An expansion tank is connected to the system downstream of the Sea Water/Fresh Water Heat Exchangers to cater for system surges caused by temperature fluctuations. The tank also provides the datum point from which system make-up is controlled.

2.1.5 A steady fresh water temperature of 15°C is required at the Natural Gas Cooler inlet to avoid fluctuations in gas delivery temperature. This is achieved by a temperature control valve fitted in the bypass line round the Sea Water/Fresh Water Heat Exchangers. The TCV will allow some water to bypass the heat exchangers if the required fresh water temperature is not being achieved.

2.1.6 Fresh water supply and return lines from the Utilities Fresh Water Cooling System are located upstream and downstream of the heat exchangers respectively.

2.2 Equipment Details

2.2.1 Process Fresh Water Pumps 58P02A/B

Capacity	2000m^3/h.
Minimum flow	250m^3/h.
Suction pressure	2.4 barg.
Discharge pressure	7.05 barg.
Power supply	5.5kV 3-phase 50Hz.
Power consumption	400kW.
Speed	1500 rev/min.

2.2.2 Expansion Tank 58T01

Capacity	6.5m^3.
Operating pressure	Atmospheric.
Design pressure	7 barg.
Operating temperature	15°C.
Design temperature	60°C.

2.2.3 Natural Gas Coolers 11E01A/B/C

Flow rate	32 million m^3/d.
Operating pressure	153 barg.
Gas inlet temperature	95°C.
Gas outlet temperature	50°C.
Calculated gas pressure drop	0.4 bar.
Water $\triangle P$	1.5 bar.

2.2.4 **Sea Water/Fresh Water Heat Exchangers 58E01A1, 58E01A2, 58E01A3 and 58E01A4**

	Inlet	Outlet
Fresh water flow (Gas at 50°C)	2,136,963kg/h	2,136,963kg/h
Fresh water flow (Gas at 30°C)	4,281,777kg/h	4,281,777kg/h
Operating temperature (Gas at 50°C)	43.5°C	15°C
Operating temperature (Gas at 30°C)	35.9°C	14°C
Operating pressure	4 barg	3.65 barg
Design temperature	60°C	
Design pressure	6.9 barg	

2.3 **External Utilities and Interfaces**

2.3.1 To operate the Process Fresh Water Cooling System, the following external utilities are required:

(a) Electrical power supply of 5.5kV 3-phase 50Hz for the process fresh water pumps.

(b) Electrical power supply of 380V 3-phase 50Hz for the drain tank pumps.

(c) Electrical power supply of 220V ac and/or 110V dc for the instrumentation and alarms.

(d) Instrument air.

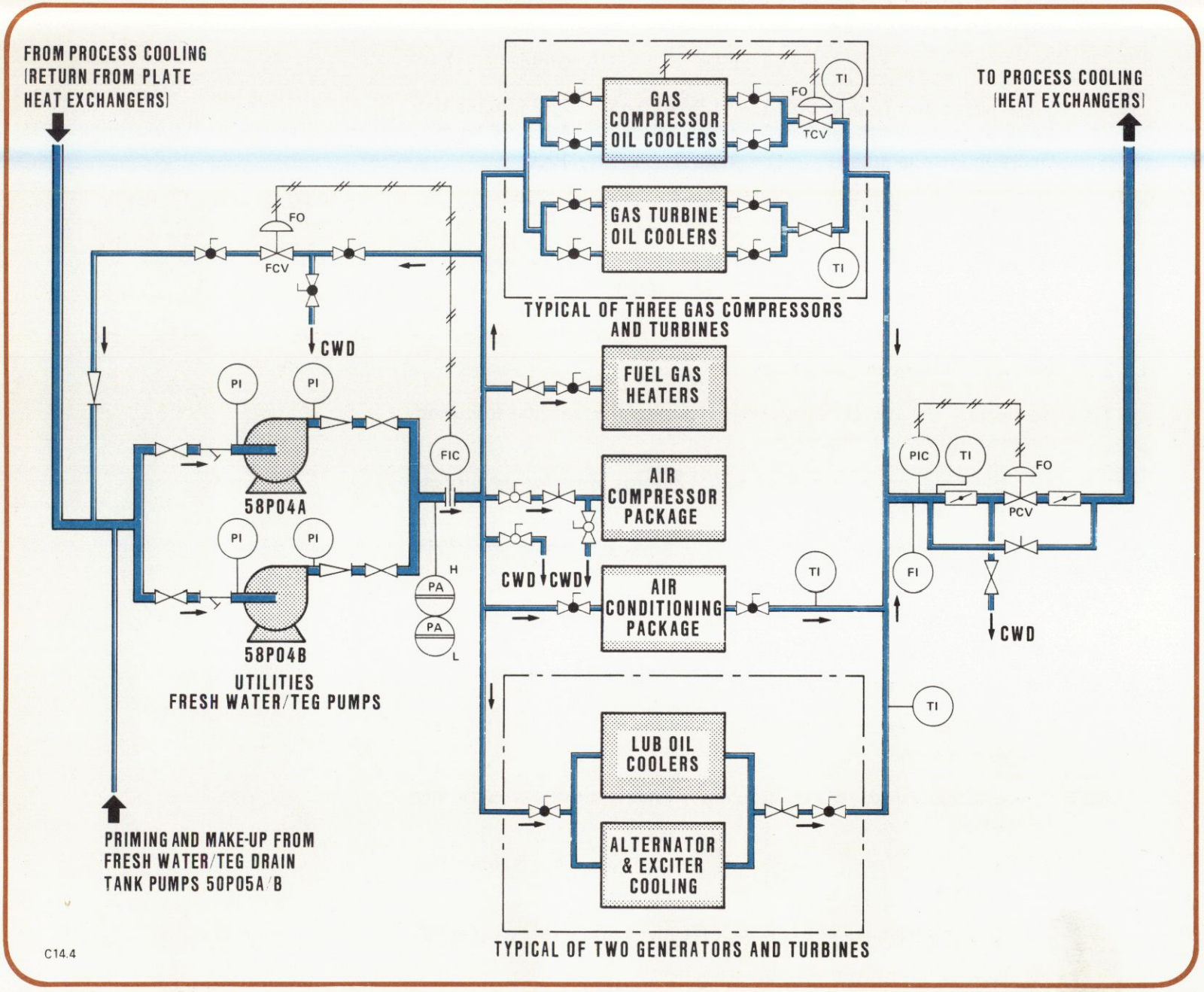
(e) Main sea water cooling at a pressure of 2 barg for the heat exchangers.

2.3.2 The Process Fresh Water Cooling System interfaces with the following:

(a) Gas compression system for gas supply to the Natural Gas Coolers.

(b) Cooling fresh water drain tank for make-up and priming water.

(c) Utilities Fresh Water Cooling System.


FROM PROCESS COOLING (RETURN FROM PLATE HEAT EXCHANGERS)
TO PROCESS COOLING (HEAT EXCHANGERS)
GAS COMPRESSOR OIL COOLERS
GAS TURBINE OIL COOLERS
TI
FO
TCV
TYPICAL OF THREE GAS COMPRESSORS AND TURBINES
FUEL GAS HEATERS
AIR COMPRESSOR PACKAGE
AIR CONDITIONING PACKAGE
FCV
CWD
PI
FIC
58P04A
58P04B
UTILITIES FRESH WATER/TEG PUMPS
PA
H
L
PIC
PCV
FI
LUB OIL COOLERS
ALTERNATOR & EXCITER COOLING
TYPICAL OF TWO GENERATORS AND TURBINES
PRIMING AND MAKE-UP FROM FRESH WATER/TEG DRAIN TANK PUMPS 50P05A/B
C14.4

3 UTILITIES FRESH WATER COOLING SYSTEM

3.1 Summary

See illustration C14.4

3.1.1 The Utilities Fresh Water Cooling System provides the cooling medium or supply water for the following equipment in the Gas Compression area:

(a) Gas compressor and turbine oil coolers.

(b) Gas generator lube oil coolers.

(c) Alternator and exciter coolers.

(d) Air compressor package for make-up water.

(e) Air conditioning package condenser.

(f) Fuel gas heaters for make-up supply.

3.1.2 System flow is maintained by two utilities fresh water pumps which operate with one duty and the other at auto standby. The pumps take a suction from the Process Fresh Water Cooling System.

3.1.3 The pumps are protected against low flow conditions by recirculation, under flow control, back to their suction at a flow of $40m^3/h$.

3.1.4 Used water from the utility coolers returns, under pressure control set at 7 barg, to the Process Fresh Water Cooling System.

3.2 Equipment Details

3.2.1 Utilities Fresh Water Pumps 58P04A/B

Capacity	$460m^3/h$.
Minimum flow	$40m^3/h$.
Suction pressure	2.4 barg.
Discharge pressure	7.9 barg.
Power supply	380V 3-phase 50Hz.
Power consumption	90kW.
Speed	1500 rev/min.

3.3 External Utilities and Interfaces

3.3.1 To operate the Utilities Fresh Water Cooling System, the following external utilities are required:

(a) Electrical power supply of 380V 3-phase 50Hz for the utilities fresh water pumps.

(b) Electrical power supply of 220V ac and/or 110V dc for instrumentation and alarms.

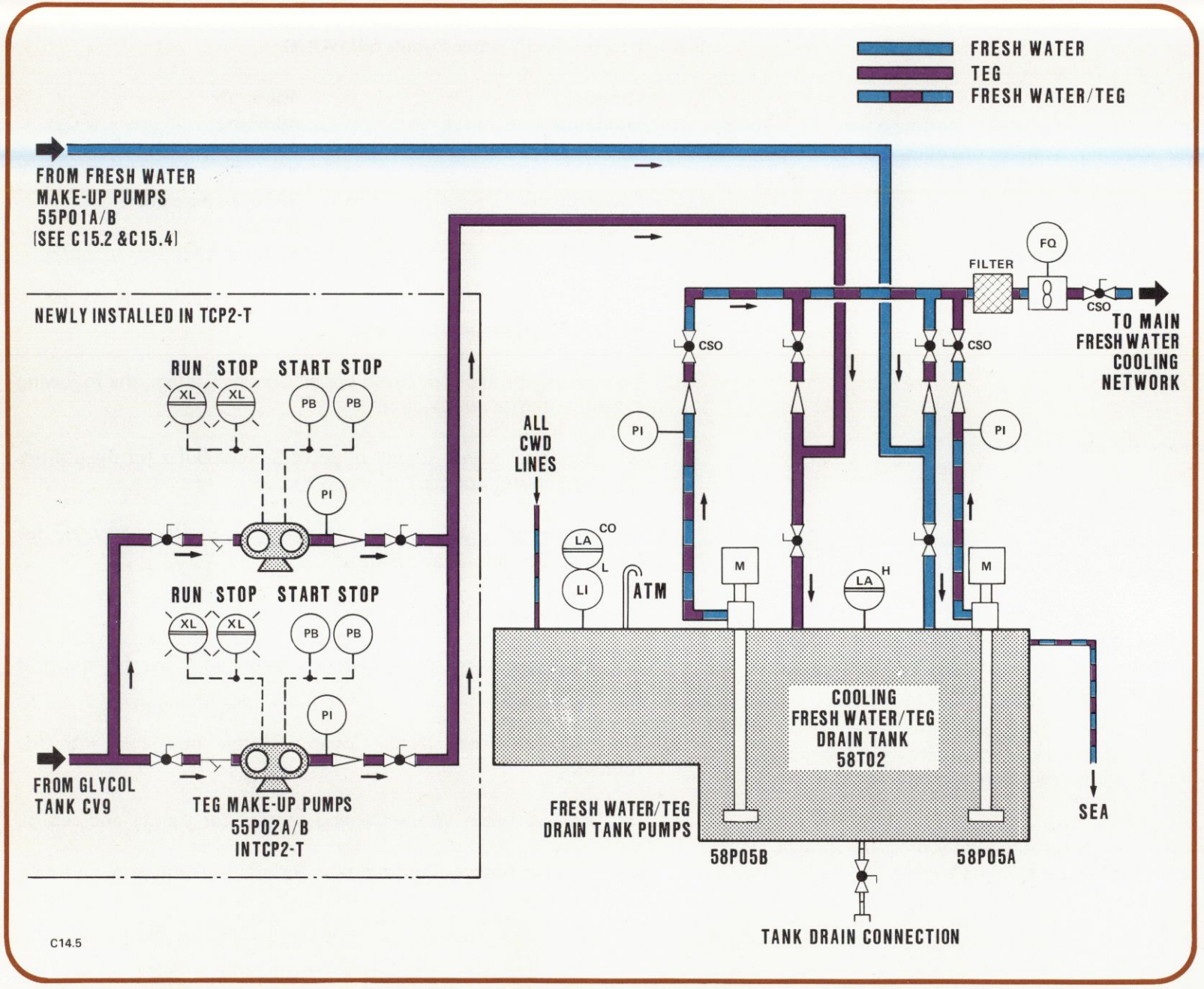
(c) Instrument air.

(d) Main sea water cooling at a pressure of 2 bar for the heat exchangers.

3.3.2 The Utilities Fresh Water Cooling System interfaces with the following:

(a) Process Fresh Water Cooling System for supply and return.

(b) Cooling fresh water drain tank for make-up and priming water.


FRESH WATER
TEG
FRESH WATER/TEG
FROM FRESH WATER MAKE-UP PUMPS 55P01A/B (SEE C15.2 &C15.4)
NEWLY INSTALLED IN TCP2-T
RUN STOP START STOP
XL
XL
PB
PB
PI
RUN STOP START STOP
XL
XL
PB
PB
PI
FROM GLYCOL TANK CV9
TEG MAKE-UP PUMPS 55P02A/B INTCP2-T
ALL CWD LINES
LA
CO
L
LI
ATM
PI
CSO
M
LA
H
CSO
PI
CSO
FILTER
FQ
CSO
TO MAIN FRESH WATER COOLING NETWORK
M
COOLING FRESH WATER/TEG DRAIN TANK 58T02
FRESH WATER/TEG DRAIN TANK PUMPS
58P05B
58P05A
SEA
TANK DRAIN CONNECTION

C14.5

4 PRIMING AND MAKE-UP SYSTEM

See illustration C14.5

4.1 Summary

4.1.1 The Process and Utility Fresh Water Cooling Systems are primed and supplied with make-up water from the Cooling Fresh Water Drain Tank. The tank is full of a 70/30 per cent mixture of fresh water/TEG.

4.1.2 Fresh water is supplied to the tank from the Desalinated Water Network as required. TEG is supplied from Glycol Tank CV9, located in TCP2 treatment area. Glycol is pumped from the tank by one of two TEG Make-up pumps (55P02A and 55P02B) located in TCP2–T.

4.1.3 Water/TEG is pumped from the Cooling Fresh Water Drain Tank (58T02) into the cooling systems by one of two Fresh Water Drain Tank pumps (58P05A and 58P05B). The pumps operate with one duty and the other at standby. The duty pump is started and stopped automatically by level switches located on the Expansion Tank (58T01).

4.2 Equipment Details

4.2.1 TEG Make-up Pumps 55P02A and 55P02B

Capacity	$5m^3/h$.
Suction pressure	0.35 barg.
Discharge pressure	5.55 barg.
Speed	1500 rev/min.
Power supply	380V 3-phase 50Hz.
Power consumption	1.5kW.

4.2.2 Fresh Water Drain Tank Pumps 58P05A and 58P05B

Capacity	$20m^3/h$.
Suction pressure	0.05 barg.
Discharge pressure	3.65 barg.
Power supply	380V 3-phase 50Hz.
Power consumption	4kW.

4.2.3 Cooling Fresh Water Drain Tank 58T02

Capacity	$80m^3$.
Operating pressure	Atmospheric.
Operating temperature	–9°C to 45°C.

4.3 External Utilities and Interfaces

4.3.1 The priming and make-up system requires the following external utilities:

(a) Electrical power supply of 380V 3-phase 50Hz for the pumps.

(b) Electrical power supply of 220V ac and/or 110V dc for the instrumentation and alarms.

(c) Instrument air.

4.3.2 The system interfaces with the following:

(a) Desalinated Water Network for filling the drain tank.

(b) Closed Fresh Water/TEG Drains System, as all of these drains flow into drain tank 58T02.

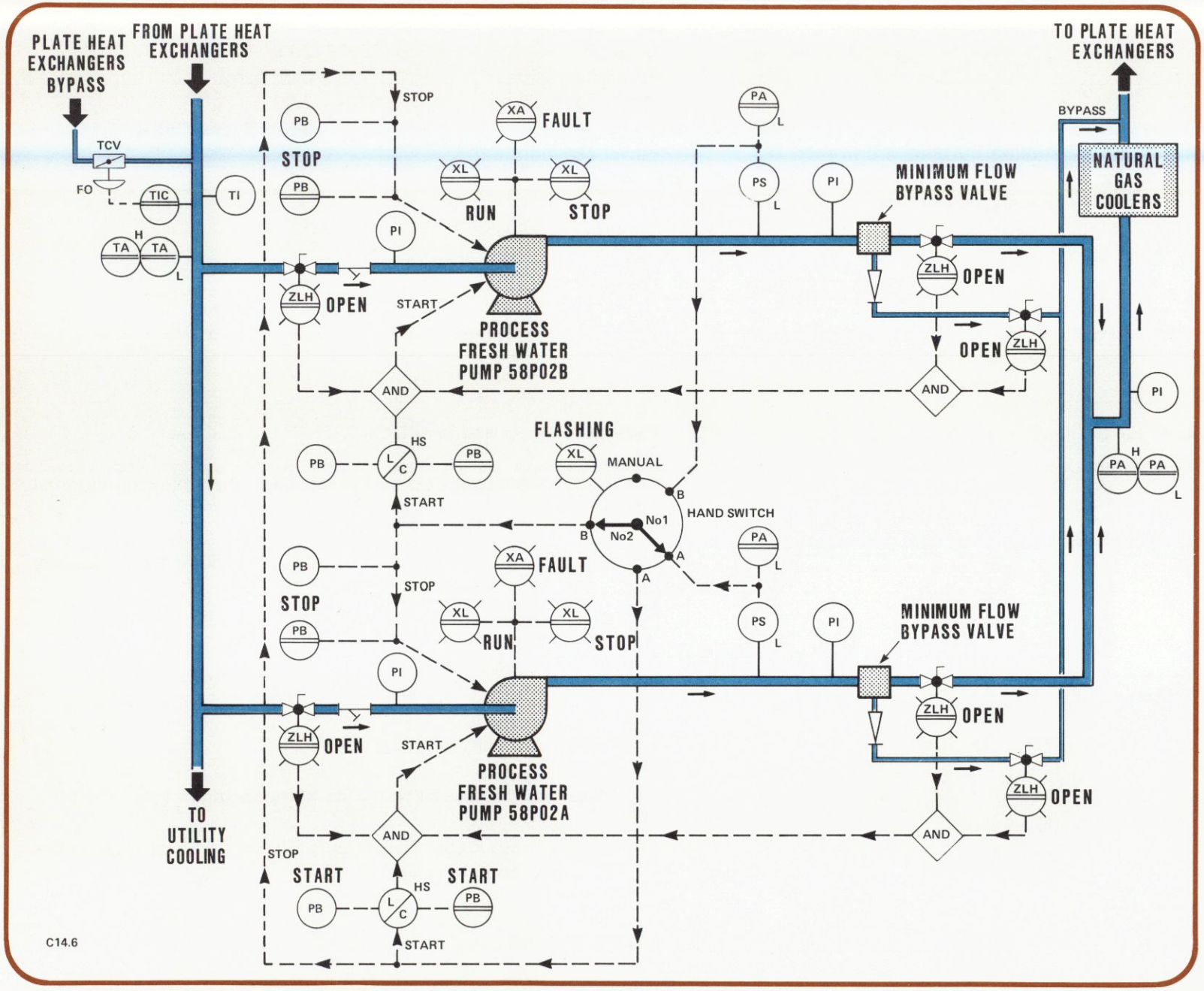


PLATE HEAT EXCHANGERS BYPASS
FROM PLATE HEAT EXCHANGERS
TO PLATE HEAT EXCHANGERS
TCV
FO
TIC
TI
TA
H
L
PB
STOP
XA
FAULT
XL
RUN
PI
PA
PS
MINIMUM FLOW BYPASS VALVE
BYPASS
NATURAL GAS COOLERS
ZLH
OPEN
START
PROCESS FRESH WATER PUMP 58P02B
AND
FLASHING
HS
L/C
MANUAL
HAND SWITCH
No1
No2
B
A
PROCESS FRESH WATER PUMP 58P02A
TO UTILITY COOLING
C14.6

SECTION 2 – OPERATION AND CONTROLS

1 OPERATING PHILOSOPHY

1.1 During Phase 1, with gas delivery required at a temperature of 50°C, the equipment will operate as follows:

(a) One Process Fresh Water pump running – 58P02A.

(b) One Process Fresh Water pump on standby – 58P02B.

(c) One Utility Fresh Water pump running – 58P04A

(d) One Utility Fresh Water pump on standby – 58P04B.

(e) Two heat exchangers on line – 58E01A3 and 58E01A4.

(f) Two heat exchangers on standby – 58E01A1 and 58E01A2.

(g) Two natural gas coolers on line – 11E01A and 11E01B.

(h) One natural gas cooler on standby – 11E01C.

(j) One Fresh Water Drain Tank pump duty – 58P05A.

(k) One Fresh Water Drain Tank pump on standby – 58P05B.

1.2 During Phase 1, but with gas delivery required at a temperature of 30°C, a greater volume of water will be required to achieve this lower temperature. Therefore all the Process and Utility fresh water pumps will run simultaneously. All four heat exchangers are also required to be on line.

2 CONTROLS AND INDICATORS

2.1 **Process Fresh Water Pumps**

See illustration C14.6

2.1.1 Each of the two pumps is fitted with the following controls and indicators:

(a) Local/Control Room. Start selector hand switch located on the TCP2 control panel.

(b) Start and Stop pushbuttons, local to the pump.

(c) Remote Start and Stop pushbuttons, located on the TCP2 control panel.

(d) Remote STOP and RUN indicator lamps, located on the TCP2 control panel.

(e) Local suction and discharge pressure indicators.

(f) Remote inlet, discharge and bypass isolating valve position indicator lamps, located on the TCP2 control panel.

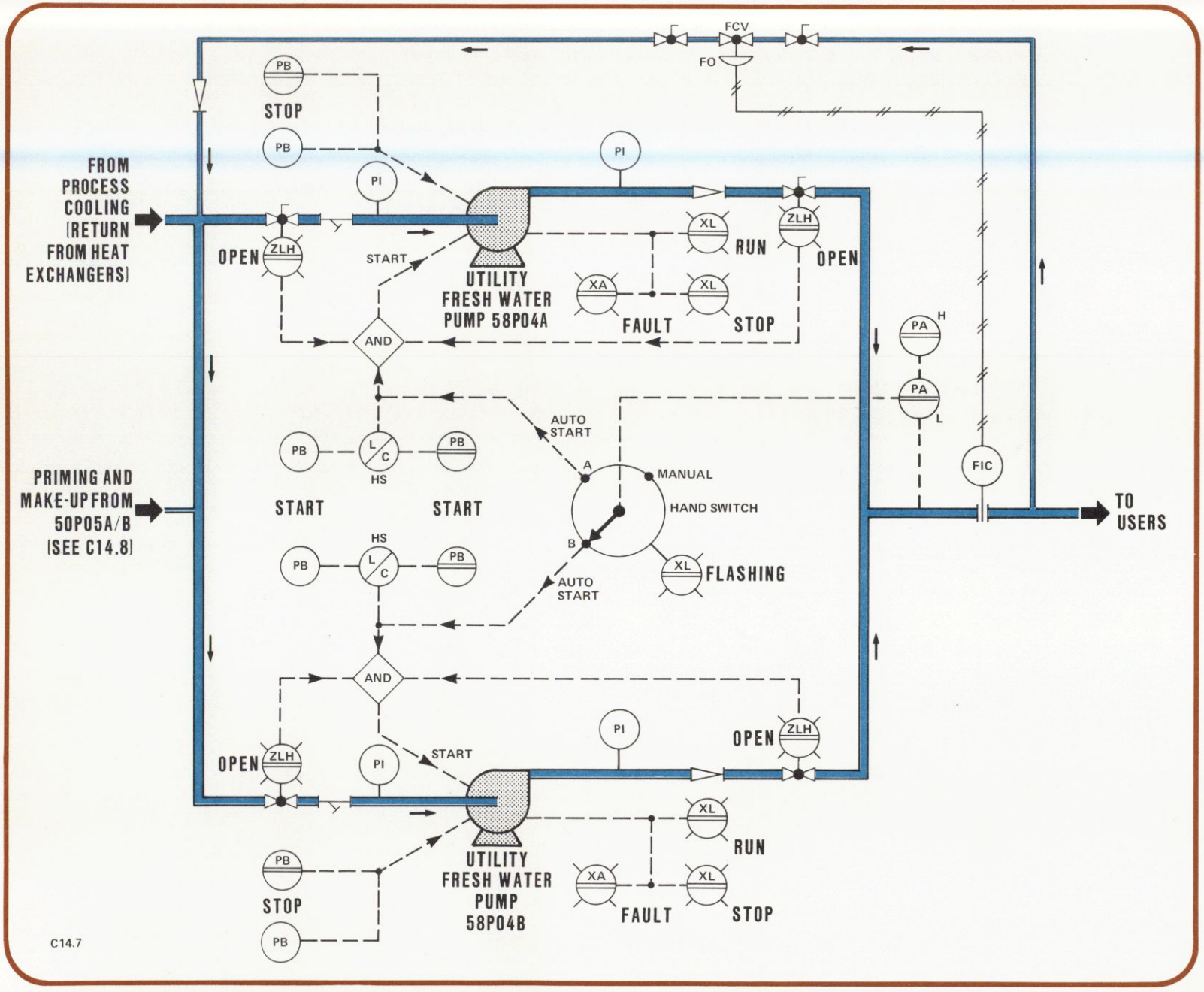
2.1.2 Both pumps are linked electrically by a single hand switch for 'Running', 'Auto Start' or 'Manual' operation. This switch is provided with two selector arms. Prior to system start-up, both selector arms must be set to MANUAL. Incorrect positioning of this switch will cause a STANDBY PUMP SELECTION FAULT lamp to flash on the TCP2 control panel.

2.1.3 When the duty pump is running satisfactorily, number one selector arm is to be set to the RUNNING position of the duty pump, whereas number two selector arm is to be set to the AUTO position of the standby pump.

2.1.4 In the event of low discharge pressure failure of the operative pump, the switch will allow a start-up sequence to be initiated for the standby pump. Provision has also been made for linking in a third and fourth pump to this selector switch should this become necessary during future phases of operation.

2.1.5 The pump discharge line in Module 33 is fitted with a local pressure indicator.

NOTE
The pumps will NOT start unless their suction, discharge and bypass isolating valves are OPEN.


FCV
FO
PB
STOP
PB
PI
PI
FROM PROCESS COOLING (RETURN FROM HEAT EXCHANGERS)
OPEN
ZLH
START
UTILITY FRESH WATER PUMP 58P04A
XA
XL
RUN
ZLH
OPEN
FAULT
XL
STOP
AND
PA
H
PA
L
FIC
AUTO START
PB
L
C
PB
HS
A
MANUAL
HAND SWITCH
PRIMING AND MAKE-UP FROM 50P05A/B (SEE C14.8)
START
START
B
HS
PB
L
C
PB
XL
FLASHING
AUTO START
TO USERS
AND
PI
OPEN
ZLH
OPEN
ZLH
PI
START
XL
RUN
PB
STOP
PB
UTILITY FRESH WATER PUMP 58P04B
XA
FAULT
XL
STOP
C14.7

2.2 Utilities Fresh Water Pumps

See illustration C14.7

2.2.1 Each of the two pumps is fitted with the following controls and indicators:

(a) Local/Control Room. Start selector hand switch located on the TCP2 control panel.

(b) Start and Stop pushbuttons, local to the pump.

(c) Remote Start and Stop pushbuttons, located on the TCP2 control panel.

(d) Remote STOP and RUN indicator lamps, located on the TCP2 control panel.

(e) Local suction and discharge pressure indicators.

(f) Remote inlet and discharge isolating valve position indicator lamps, located on the TCP2 control panel.

2.2.2 Both pumps are linked electrically by a single standby selector switch marked STANDBY A/STANDBY B/MANUAL. The switch is located on the TCP2 control panel and is provided to select which pump is to automatically start in the event of low system pressure. Prior to system start-up, this selector switch is to be positioned at MANUAL. Incorrect positioning of the switch will cause a STANDBY PUMP SELECTION FAULT lamp to flash on the TCP2 control panel.

2.2.3 A recirculation line, from the pumps discharge back to their suction, is fitted with a flow control valve. The valve is modulated in response to a flow controller located downstream of the pumps. The valve opens to recirculate water through the pumps should a low flow condition of 250m^3/h occur.

NOTE
The pumps will NOT start unless their suction and discharge valves are OPEN.

2.3 Fresh Water/Sea Water Heat Exchangers

2.3.1 The heat exchangers are each fitted with the following controls and indicators:

(a) Remote inlet and discharge isolating valve position indicator lamps, located on the TCP2 control panel.

(b) Each isolating valve has an Open pushbutton and a Close pushbutton, local to the valve.

(c) Each isolating valve has a remote Open pushbutton and a Close pushbutton, located on the TCP2 control panel.

(d) Each heat exchanger fresh water discharge line has a local temperature indicator.

2.3.2 A temperature control valve is fitted in the heat exchangers' fresh water bypass line. The valve is modulated in response to a temperature controller located downstream of the heat exchangers. This valve allows water to bypass the heat exchangers, if necessary, to maintain a constant fresh water temperature of 15°C, as required for the efficient operation of the Natural Gas Coolers. The valve fails CLOSED.

2.3.3 A local temperature indicator is fitted in the heat exchangers' common fresh water discharge line located in Pancake 45.

2.4 Natural Gas Coolers

2.4.1 Each Natural Gas Cooler is fitted with the following controls and indicators:

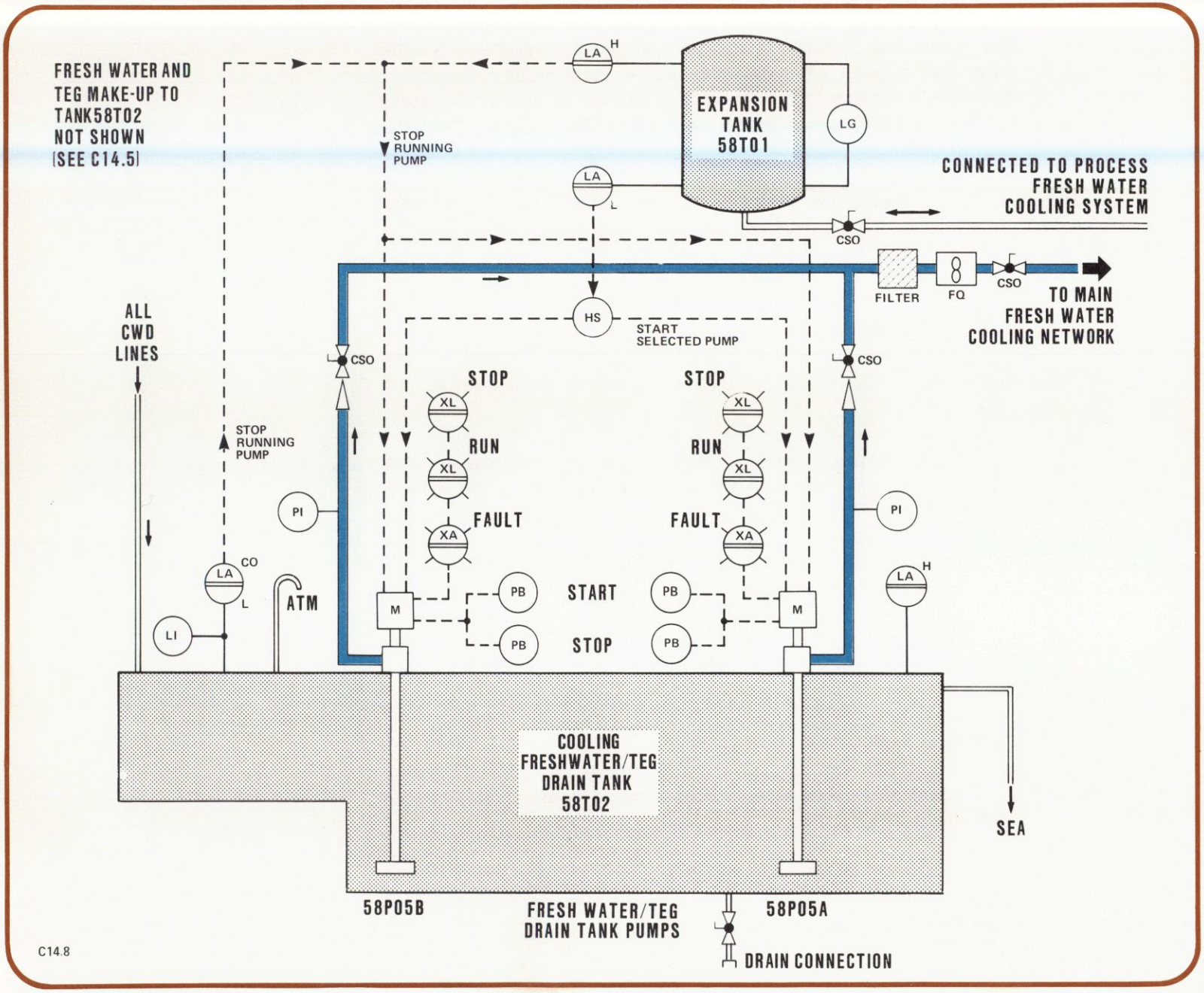
(a) A temperature control valve located in the downstream fresh water line, which is modulated in response to a temperature controller fitted in the gas delivery line. This valve allows the required flow of water through the cooler to maintain the optimum gas delivery temperature of 50°C during Phase 1 operation. The valve fails OPEN.

(b) Temperature and flow indicators are fitted in the downstream fresh water line, local to each cooler.

2.5 Expansion Tank

2.5.1 The expansion tank is fitted with a level gauge which should read approximately 50 per cent.

2.5.2 A low level alarm on the expansion tank initiates start of the selected duty fresh water drain tank pump; a high level alarm stops the drain tank pump.


FRESH WATER AND TEG MAKE-UP TO TANK58T02 NOT SHOWN (SEE C14.5)
LA H
EXPANSION TANK 58T01
LG
LA L
STOP RUNNING PUMP
CONNECTED TO PROCESS FRESH WATER COOLING SYSTEM
CSO
FILTER
FQ
CSO
TO MAIN FRESH WATER COOLING NETWORK
HS
START SELECTED PUMP
ALL CWD LINES
CSO
CSO
STOP
XL
RUN
XL
FAULT
XA
STOP
XL
RUN
XL
FAULT
XA
STOP RUNNING PUMP
PI
PI
LA CO L
ATM
LI
M
PB
START
PB
STOP
PB
PB
M
LA H
COOLING FRESHWATER/TEG DRAIN TANK 58T02
SEA
58P05B
FRESH WATER/TEG DRAIN TANK PUMPS
58P05A
DRAIN CONNECTION

C14.8

2.6 Fresh Water Drain Tank Pumps

See illustration C14.8

2.6.1 Each of the pumps is fitted with the following controls and indicators:

(a) Start and Stop pushbuttons local to the pumps.

(b) Remote STOP and RUN indicator lamps, located on the TCP2 control panel.

(c) Local discharge pressure indicators.

2.6.2 Both pumps are linked electrically by a Duty/Standby hand selector switch. The pumps discharge into a common line which is fitted with a flow totaliser (integrator).

2.7 TEG Make-up Pumps

Each pump is fitted with the following controls and indicators:

(a) Start and Stop pushbuttons local to the pumps.

(b) Remote STOP and RUN indicator lamps, located on the TCP2 control panel.

(c) Local discharge pressure indicators.

2.8 Cooling Fresh Water Drain Tank

The tank is fitted with a local level indicator and a high level alarm.

3 ALARMS AND TRIPS

The systems and system equipment are fitted with the following alarms and trips. Action to be taken on receipt of these alarms, or automatic tripping actions, are shown alongside the relevant malfunction.

Equipment/System	Alarm	Action
Process fresh water pumps.	Motor fault.	Investigate cause.
	Low discharge pressure.	Automatic start of standby pump. Automatic stop of duty pump.
Process system upstream of Natural Gas Coolers.	High pressure.	Check position of duty heat exchanger isolating valves. Check position of Natural Gas Cooler fresh water isolating valves and TCVs. Check flow indicators on Natural Gas Coolers. Check flow indicators on duty heat exchangers.
	Low pressure.	Check pumps. Check expansion tank level. Check for system leaks.
Process system downstream of Heat Exchangers.	High temperature.	Check position of TCV on the heat exchanger bypass line. Check for system low flow. Check Main Sea Water Cooling System.
	Low temperature.	Check position of TCV in the heat exchanger bypass line.

Equipment/System	Alarm	Action
Expansion tank.	High level.	Check that Fresh Water Drain Tank Pump is stopped.
	Low level.	Check that Fresh Water Drain Tank Pump has started. Check system for leaks. Check Utility System users.
Cooling Fresh Water Drain Tank.	High level.	Check that TEG and/or fresh water make-up pumps are not discharging into tank. Check source lines for all drains into tank.
	Low level.	Fill tank to required level. Check reason for excessive demand for water in the Process or Utility Cooling Systems.
Fresh Water Drain Tank Pumps.	Motor fault.	Investigate cause.
Utilities Fresh Water Pumps.	Motor fault.	Investigate cause.
	Low discharge pressure.	Automatic start of standby pump. Investigate failure of duty pump (if stopped). Investigate excessive demand on the system if both pumps are running. Check position of low flow recycle FCV.
	High discharge pressure.	Check position of PCV in discharge line to process system.

SECTION 3 – SYSTEM START-UP

1 PRESTART CHECKS

(a) Electrical power available for equipment and alarms.

(b) Instrument air available and all required instrument root valves open.

(c) All system alarms cancelled on the TCP2 control panel.

(d) All system drain valves closed.

(e) All system valves in their prestart configuration.

(f) Cooling Fresh Water Drain Tank 58T02 full of fresh water/ TEG.

2 START-UP

(1) Select Fresh Water Drain Tank pump 58P05A as duty.

(2) Set the start selector hand switches for the Utilities Fresh Water pumps 58P04A and 58P04B to LOCAL.

(3) Position the standby selector hand switch for the Utilities Fresh Water pumps to MANUAL.

(4) Set the start selector hand switches for the Process Fresh Water pumps 58P02A and 58P02B to LOCAL.

(5) Set both the Running/Auto Start/Manual selector hand switch selector arms for the Process Fresh Water pumps to MANUAL.

(6) Start Fresh Water Drain Tank pump 58P05A locally. Check that a discharge pressure of 3.65 barg is attained and that the relevant RUN lamp is illuminated on the TCP2 control panel. This pump will prime the Process and Utility Cooling Systems.

(7) When a water level is indicated in Expansion Tank 58T01, start Utilities Fresh Water pump 58P04A locally. Check that a discharge pressure of 7.9 barg is attained and that the relevant RUN lamp is illuminated on the TCP2 control panel. When 58P04A is running satisfactorily, set the standby selector hand switch to 58P04B STANDBY.

(8) When the water level in the Expansion Tank 58T01 is indicating 40 per cent, start Process Fresh Water pump 58P02A. Check that a discharge pressure of 7.05 barg is attained and that the relevant RUN lamp is illuminated on the TCP2 control panel. When the pump is running satisfactorily, set number one selector arm on the Running/Auto Start/Manual selector hand switch to A, RUNNING and number two selector arm to B, AUTO START.

(9) Drain Tank Pump 58P05A will continue running until a 'high' level is reached in Expansion Tank 58T01. At this point, the pump will stop automatically and remain at auto standby, starting and stopping in response to the 'High' and 'Low' limit switches on the expansion tank.

(10) When correct system operation is confirmed by checking all the monitoring instruments, set the Process and Utility pumps start selector hand switches to CONTROL ROOM.

(11) The Process and Utilities Fresh Water Cooling Systems are now fully operational. Cooling Fresh Water Drain Tank 58T02 should be refilled to its working level with a 70/30 per cent fresh water/TEG mixture.

3 CHECKS AFTER START-UP

(a) Make routine system checks.

(b) Take a sample of the fresh water/TEG in the system and send it to the laboratory.

(c) Monitor the cooling water temperature.

4 SHUTDOWN

(1) Set both the Running/Auto Start/Manual selector hand switch selector arms for the Process Fresh Water pumps to MANUAL. Stop the duty pump from the TCP2 control room.

(2) Stop the Fresh Water Drain Tank pump locally.

(3) Set the 'Standby' selector hand switch for the Utilities Fresh Water pumps to MANUAL. Stop the duty pump from the TCP2 control panel.

Symptom	Possible Cause	Action
Process Fresh Water pump fails to start on manual Start command. (Fault Lamp)	(a) No electrical supply.	Check supply source.
	(b) Start selector hand switch incorrectly positioned.	Select correct mode, ie LOCAL/ CONTROL ROOM.
	(c) Running/Auto Start/Manual selector switch incorrectly positioned.	Position both selector arms to MANUAL.
	(d) Suction valve, discharge valve or bypass valve closed.	Open valves.
	(e) Motor malfunction.	Investigate fault.
Process Fresh Water pump fails to start on automatic Start command. (Low discharge pressure alarm)	(a) Running/Auto Start/Manual selector switch incorrectly positioned.	Select correct positions for selector arms.
	(b) Suction valve, discharge valve or bypass valve closed.	Open valves.
	(c) Motor malfunction.	Investigate fault.
Utilities Fresh Water pump fails to start on manual Start command. (Fault Lamp)	(a) No electrical supply.	Check supply source.
	(b) Start selector hand switch incorrectly positioned.	Select correct mode, ie LOCAL/ CONTROL ROOM.
	(c) Standby pump selector incorrectly positioned.	Select MANUAL.
	(d) Suction or discharge valve closed.	Open valves.
	(e) Motor malfunction.	Investigate fault.

Symptom	Possible Cause	Action
Utilities Fresh Water pump fails to start on automatic Start command. (Low discharge pressure alarm)	(a) Standby pump selector hand switch incorrectly positioned.	Select relevant standby pump.
	(b) Suction or discharge valve closed.	Open valves.
	(c) Motor malfunction	Investigate fault.
Fresh Water Drain Tank pump fails to start on manual or automatic Start command.	(a) Low level in drain tank.	Fill tank.
	(b) No electrical supply	Check supply source.
	(c) Motor malfunction.	Select standby pump and investigate fault on duty pump.

For action on receipt of alarms refer to ALARMS AND TRIPS (Section 3).

CHAPTER C15

DESALINATED WATER NETWORK

CONTENTS

SECTION 1 DESCRIPTION

1. Summary
2. Equipment Details
3. External Utilities and Interfaces

SECTION 2 OPERATION AND CONTROLS

1. Operating Philosophy
2. Controls and Indicators
3. Prestart Checks
4. Start-up
5. Checks After Start-up
6. Shutdown

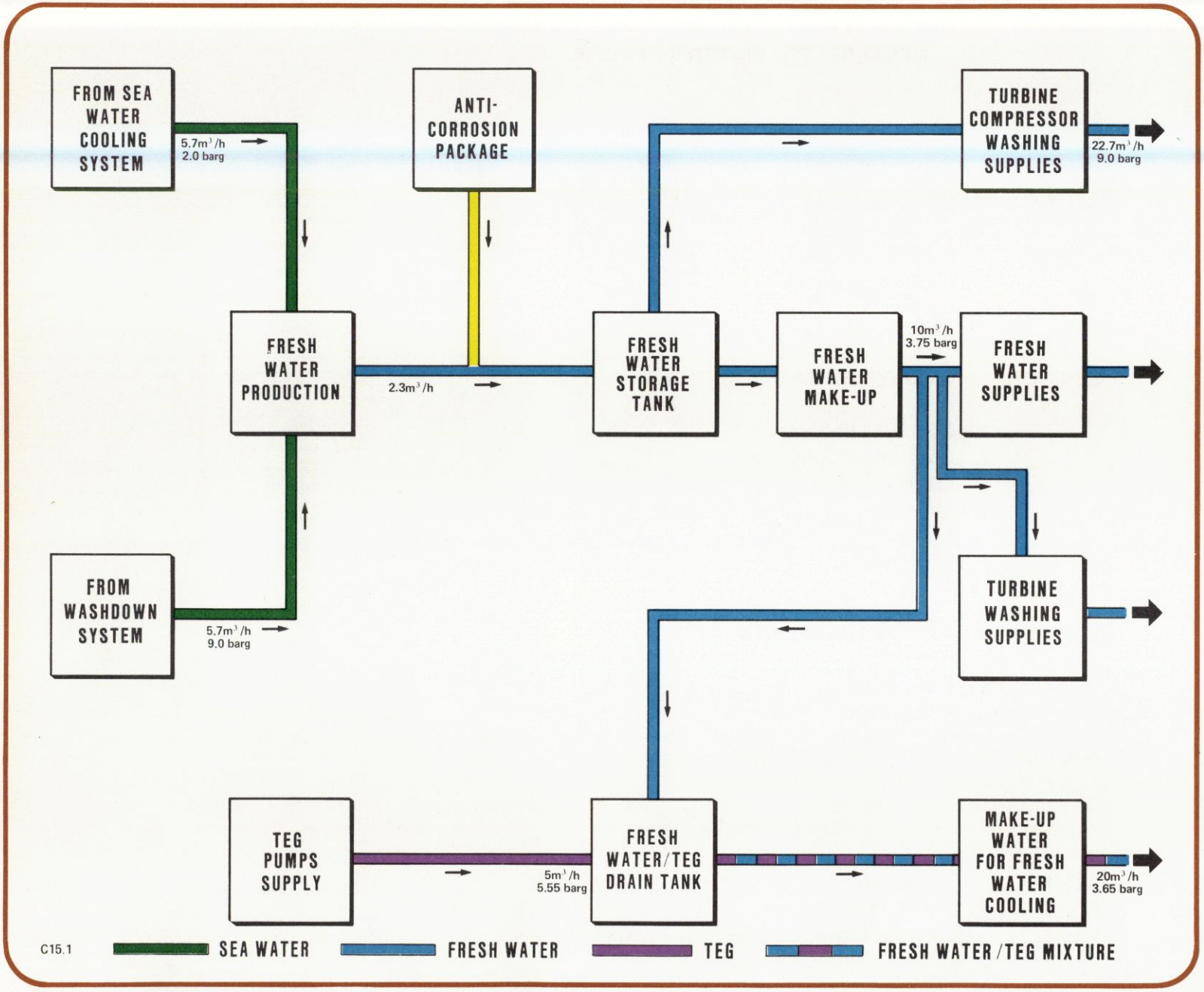
SECTION 3 ALARMS AND TRIPS

1. General

SECTION 4 TROUBLESHOOTING

ILLUSTRATIONS

C15.1 Block Diagram
C15.2 System Schematic
C15.3 Watermaker/Dosing Package Instrumentation
C15.4 Pump and Tank Instrumentation


FROM SEA WATER COOLING SYSTEM
5.7m³/h
2.0 barg
ANTI-CORROSION PACKAGE
TURBINE COMPRESSOR WASHING SUPPLIES
22.7m³/h
9.0 barg
FRESH WATER PRODUCTION
2.3m³/h
FRESH WATER STORAGE TANK
FRESH WATER MAKE-UP
10m³/h
3.75 barg
FRESH WATER SUPPLIES
FROM WASHDOWN SYSTEM
5.7m³/h
9.0 barg
TURBINE WASHING SUPPLIES
TEG PUMPS SUPPLY
5m³/h
5.55 barg
FRESH WATER/TEG DRAIN TANK
MAKE-UP WATER FOR FRESH WATER COOLING
20m³/h
3.65 barg
C15.1
SEA WATER
FRESH WATER
TEG
FRESH WATER/TEG MIXTURE

SECTION 1 – DESCRIPTION

Reference: PID 5424W 55 0040 02

1 SUMMARY

See illustrations C15.1 and C15.2

1.1 The Desalinated Water Network produces and distributes fresh water to the following users in the Gas Compression area, in order that they may be assured of an adequate supply:

(a) Fresh Water Cooling Systems.

(b) Turbine Compressor Wash Water Systems.

(c) Turbine Washing Systems.

(d) Fresh water supplies on Upper and Main Decks and various Pancakes.

1.2 Fresh water is produced from sea water by two identical vapour compression Watermakers. The source of feed water for the units is either:

(a) Main Sea Water Cooling System, or

(b) Washdown System.

1.3 The Watermakers require a specific pressure of approximately 3 barg for efficient operation and the source water pressures may differ from this. Booster pumps are therefore installed upstream of the Watermaker inlet to increase pressure from the Main Sea Water Cooling System source, and a PCV is installed on the Washdown System source to give the required pressure in the Watermakers.

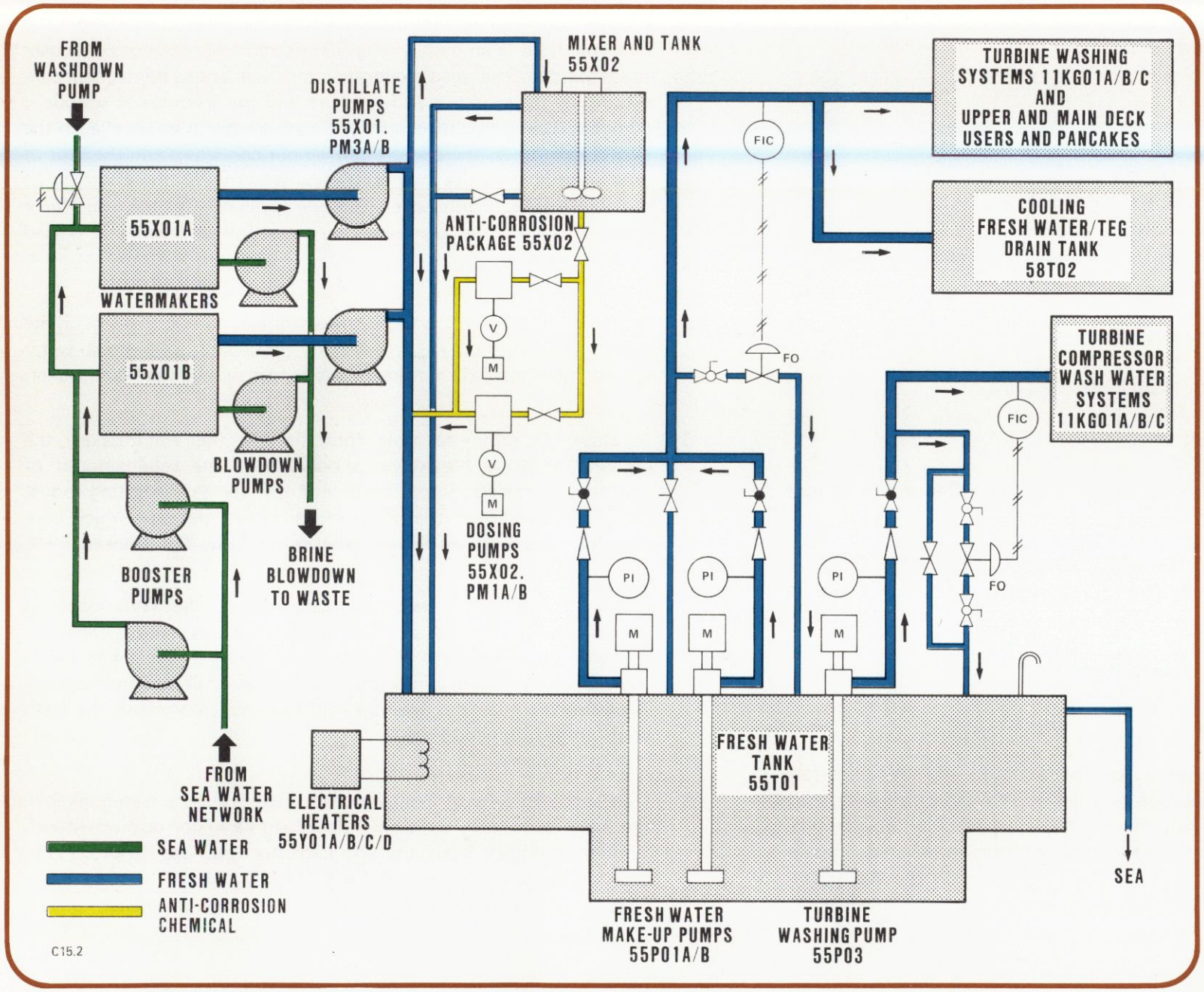
1.4 The Watermakers can operate separately or in parallel. They are of the horizontal spray film design, feed water being sprayed from the inlet manifold in an overlapping film pattern over the hot condenser tube bundle. The feed water is vaporised under controlled conditions of temperature and pressure and the fresh water vapour is compressed and introduced into the evaporator tube bundle. In the evaporator tubes, the compressed vapour condenses and the heat of condensation provides the necessary energy for continued boiling of the feed water. Fresh water distillate condensed in the evaporator tubes flows to the distillate pump suction and brine is passed to blowdown.

1.5 Brine is dumped to waste by blowdown pumps. The distillate pumps (55X01.PM3A/B) transfer the fresh water to the fresh water storage tank (55T01) via a heat exchanger within the Watermaker.

1.6 In order to minimise scale formation in the Watermaker, the amount of brine blowdown should equal the total amount of distillate produced. Since this is not the normal operating mode, the Watermaker has its own chemical dosing package which continually doses an anti-scale solution to the Watermaker inlet.

1.7 The purity of fresh water distillate leaving the Watermaker is continually monitored at the discharge by a salinity analyser measuring conductivity. If the distillate purity exceeds 4 to 5mg/l total dissolved solids (expressed as sodium chloride by the conductivity method) the analyser will automatically cause the fresh water to be dumped to waste.

1.8 During the transfer of fresh water distillate from the Watermaker to the fresh water tank, the flow is dosed with anti-corrosion chemical. This is supplied from the anti-corrosion package (55X02). An anti-corrosion dosing pump (55X02.PM1A/B) will automatically start as soon as the distillate pump starts in the Watermaker.


FROM WASHDOWN PUMP
DISTILLATE PUMPS 55X01. PM3A/B
MIXER AND TANK 55X02
TURBINE WASHING SYSTEMS 11KG01A/B/C AND UPPER AND MAIN DECK USERS AND PANCAKES
COOLING FRESH WATER/TEG DRAIN TANK 58T02
55X01A
WATERMAKERS
55X01B
ANTI-CORROSION PACKAGE 55X02
FIC
FO
TURBINE COMPRESSOR WASH WATER SYSTEMS 11KG01A/B/C
BLOWDOWN PUMPS
BRINE BLOWDOWN TO WASTE
BOOSTER PUMPS
DOSING PUMPS 55X02. PM1A/B
PI
M
V
FRESH WATER TANK 55T01
FROM SEA WATER NETWORK
ELECTRICAL HEATERS 55Y01A/B/C/D
SEA WATER
FRESH WATER
ANTI-CORROSION CHEMICAL
FRESH WATER MAKE-UP PUMPS 55P01A/B
TURBINE WASHING PUMP 55P03
SEA
C15.2

1.9 The fresh water tank is provided with four electrical heaters (55Y01A/B/C/D) to prevent freezing in winter.

1.10 Two fresh water make-up pumps (55P01A/B), mounted in the fresh water tank, supply all the users in the Compression Package except the Turbine Compressor washwater system. This system has its own turbine washing pump (55P03).

1.11 In the event of low fresh water demand by users, running pumps are protected by flow control valves in their discharge lines, which will divert flow back to the fresh water tank.

2 EQUIPMENT DETAILS

2.1 Watermaker Booster Pumps

Power supply	380V 3-phase 50Hz.
Speed	3000 rev/min.
Flow rate	11.4m^3/h.

2.2 Fresh Watermakers 55X01A/B

Distillate output per unit	2.27m^3/h (54.48 tonnes/day).
Feed rate per unit	5.7m^3/h.
Brine production per unit	3.43m^3/h.
Residual salinity (MAX)	4mg/l TDS (as NaCl).

2.3 Anti-corrosion Package 55X02

Tank capacity	1.1m^3 complete with mixer.
Tank construction	Carbon steel with internal epoxy lining.
Dosing pumps	Capacity = 0 to 100 l/h. Discharge pressure = 2 barg.

2.4 Fresh Water Tank 55T01

Capacity	50m^3.
Operating pressure	Atmospheric.
Operating temperature	11°C to 19°C.

Tank is provided with:

(a) Four electrical heaters (ON/OFF) – 55Y01A/B/C/D.

(b) One level indicator.

(c) One atmospheric vent.

(d) One overflow line to sea.

2.5 Fresh Water Make-up Pumps 55P01A/B

Capacity	10m^3/h.
Suction pressure	0.05 barg.
Discharge pressure	3.75 barg.
Power supply	380V 3-phase 50Hz.
Power consumption	2.1kW.
Speed	2840 rev/min.

2.6 Turbine Washing Pump 55P03

Capacity	22.7m^3/h.
Suction pressure	0.05 barg.
Discharge pressure	9.05 barg.
Power supply	380V 3-phase 50Hz.

3 EXTERNAL UTILITIES AND INTERFACES

3.1 The Desalinated Water Network requires the following utilities during start-up and normal operation:

(a) Sea water source.

(b) Instrument air for valve operation.

(c) Chemical products for the Watermaker; anti-scale and acid (AC2–AC6).

(d) Chemical product for the corrosion package; anti-corrosion chemical.

(e) Electrical power – 380V 50Hz; 220V ac or 110V dc.

(f) Fresh water.

3.2 The following interfaces are found in the Desalinated Water Network:

(a) Washdown System.

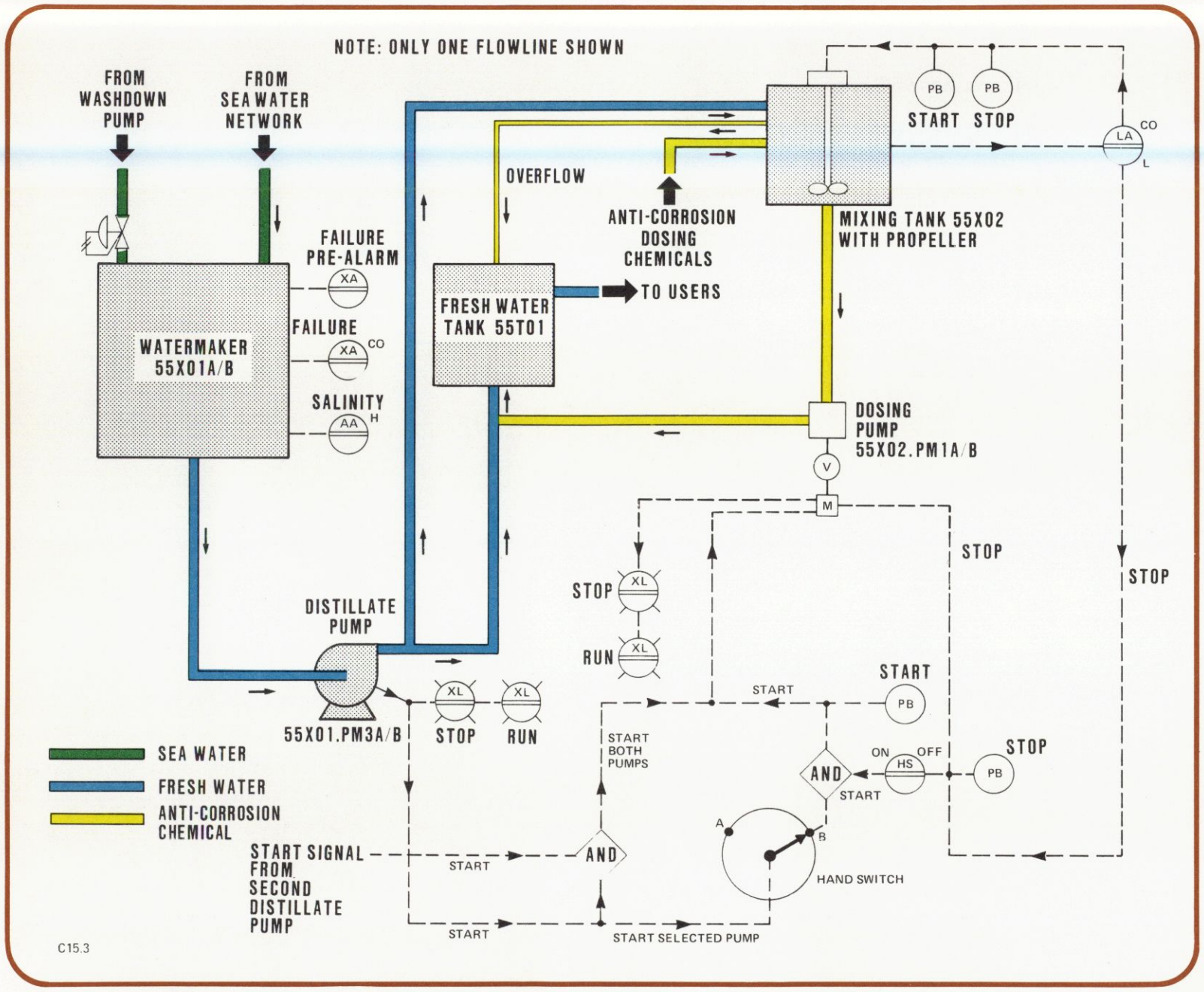
(b) Main Sea Water Cooling System.

(c) Fresh Water Cooling Systems.

(d) Turbine Washing Systems (11KG01A/B/C).

(e) Turbine Compressor Washwater Systems (11KG01A/B/C).

(f) Fresh water users on Upper and Main Decks, and some Pancakes.


NOTE: ONLY ONE FLOWLINE SHOWN
FROM WASHDOWN PUMP
FROM SEA WATER NETWORK
FAILURE PRE-ALARM
XA
FAILURE
XA
CO
SALINITY
AA
H
WATERMAKER 55X01A/B
OVERFLOW
ANTI-CORROSION DOSING CHEMICALS
FRESH WATER TANK 55T01
TO USERS
PB
PB
START
STOP
LA
CO
L
MIXING TANK 55X02 WITH PROPELLER
DOSING PUMP 55X02.PM1A/B
V
M
STOP
STOP
STOP
XL
RUN
XL
START
START
PB
DISTILLATE PUMP
55X01.PM3A/B
XL
STOP
XL
RUN
START BOTH PUMPS
AND
ON
OFF
HS
AND
START
PB
STOP
A
B
HAND SWITCH
SEA WATER
FRESH WATER
ANTI-CORROSION CHEMICAL
START SIGNAL FROM SECOND DISTILLATE PUMP
START
START
START SELECTED PUMP
C15.3

SECTION 2 – OPERATION AND CONTROLS

1 OPERATING PHILOSOPHY

1.1 During initial start-up, source water for the Desalinated Water Network will be the Washdown System.

1.2 Once the main fresh water tank (55T01) has been filled by the Watermakers and the Fresh Water Cooling Systems are operational, the Main Sea Water Cooling System will become the source water and the Washdown System supply inlet will be shut off. This supply then acts as a standby source.

2 CONTROLS AND INDICATORS

See illustrations C15.3 and C15.4

2.1 The washdown pump discharge is fitted with a PCV set at 10 barg.

2.2 The source water line from the Washdown System is fitted with a pressure indicator and a PCV set at 3.5 barg.

2.3 The Main Sea Water Cooling System inlet is fitted with a pressure indicator and a PCV set at 2.4 to 2.75 barg.

2.4 The dosing pump of the anti-corrosion package will automatically start when the Watermaker distillate pump starts (one Watermaker on stream). If both Watermakers are operational, both distillate pumps are operational and both anti-corrosion dosing pumps operating.

2.5 A local pushbutton will start and stop the mixer in the anti-corrosion chemical tank.

2.6 A local hand selector is used to select the duty dosing pump if only one Watermaker is on stream. Local pushbuttons start and stop the pump.

2.7 TCP2 Control Room has a hand selector and PUMP RUNNING lamps for both dosing pumps.

2.8 The fresh water make-up pumps (55P01A/B) mounted in the fresh water tank (55T01) are fitted with pressure indicators on their discharge.

2.9 The make-up pumps are started and stopped by local pushbuttons and their status is shown in TCP2 Control Room by illuminated lamps.

2.10 The turbine washing pump (55P03) has a hand selector for control from the TCP2 Control Room or locally. The appropriate water wash control system is hand selected in TCP2 Control Room. If local selection is made, the pump has Stop/ Start pushbuttons and pump status is shown by illuminated lamps in TCP2 Control Room. A pressure indicator is mounted in the discharge line.

2.11 The electrical heaters (55Y01A/B/C/D) mounted in the fresh water tank have individual On/Off temperature controllers, set at 5°C. A local hand selector can initiate auto start of the heaters or stop them. Illuminated lamps in TCP2 Control Room show the status of the heaters.

2.12 Flow control valves in the discharge lines of the fresh water make-up pumps and the turbine washing pump will allow water to be diverted back to the fresh water tank, should there be a limited demand from the users.

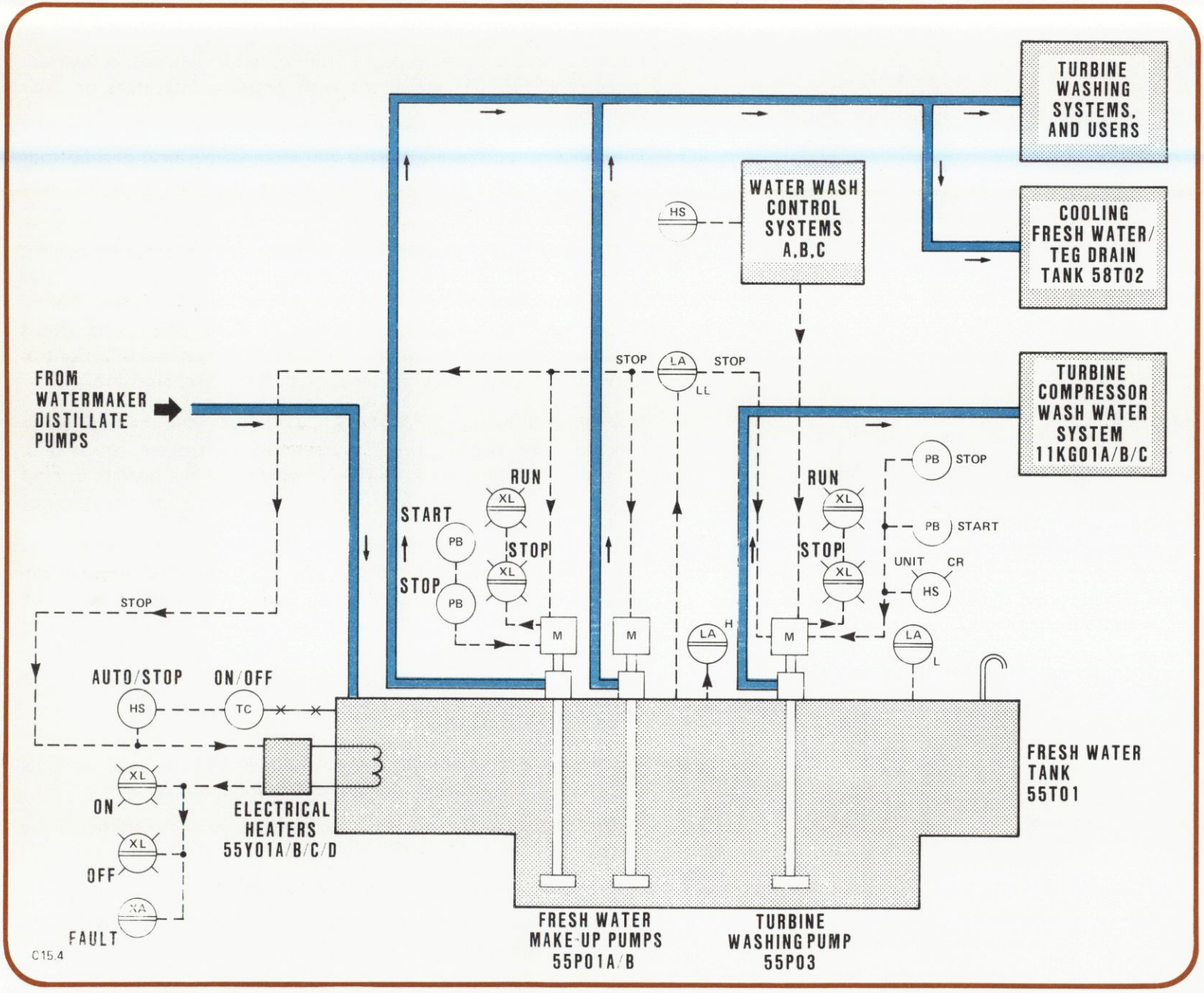
3 PRESTART CHECKS

3.1 Ensure that instrument air, electrical power and chemical products (AC2–AC6 and anti-corrosion chemical) are available.

3.2 Ensure that all valves are set in accordance with the start-up valve schedule.

3.3 Ensure that the Washdown System is operational.

3.4 The dosing pump hand selector switches located in TCP2 Control Room must be in the OFF position.


TURBINE WASHING SYSTEMS, AND USERS
WATER WASH CONTROL SYSTEMS A,B,C
HS
COOLING FRESH WATER/ TEG DRAIN TANK 58T02
FROM WATERMAKER DISTILLATE PUMPS
STOP
LA
STOP
LL
TURBINE COMPRESSOR WASH WATER SYSTEM 11KG01A/B/C
RUN
START
PB
XL
STOP
STOP
PB
XL
M
M
LA
H
M
RUN
XL
STOP
XL
PB
STOP
PB
START
UNIT
CR
HS
LA
L
STOP
AUTO/STOP
ON/OFF
HS
TC
XL
ON
XL
OFF
XA
FAULT
ELECTRICAL HEATERS 55Y01A/B/C/D
FRESH WATER TANK 55T01
FRESH WATER MAKE-UP PUMPS 55P01A/B
TURBINE WASHING PUMP 55P03
C15.4

4 START-UP

4.1 When all prestart checks have been carried out, start the system as follows:

(1) Start up a Watermaker.

(2) When the Watermaker is producing water of the required salinity and the distillate pump is discharging the water into the fresh water tank (55T01), the anti-corrosion chemical can be mixed.

(3) Fill the chemical tank to the required level with fresh water and add the correct quantity of NORUST anti-corrosion chemical.

(4) Start the electric mixer with the local pushbutton and allow sufficient time for thorough mixing. The mixer will run continuously unless a low level is detected in the tank, at which point the mixer will automatically stop.

(5) Select either pump A or pump B on the local hand selector.

(6) Position the hand switches for pump A and pump B to ON in TCP2 Control Room. The selected pump will now start and its RUN lamp illuminate in TCP2 Control Room. The other pump will only start if the second Watermaker distillate pump is started.

(7) Calibrate the duty dosing pump to give the correct flow for the appropriate chemical dose.

(8) When the level in the fresh water tank is approximately 50 per cent, start the duty fresh water make-up pump locally.

(9) Set the flow control valve on the recirculation line back to the tank to $10m^3/h$.

(10) Vent air from the system if necessary.

4.2 The Desalinated Water Network is now pressurised.

4.3 When the main sea water pumps (58P01A/B/C) are operational, open the discharge valve on the line from the sea water pumps to the Watermaker and start the booster pump for one Watermaker. Stop the washdown pump.

4.4 The system will now operate with sea water rather than washdown water as its source.

4.5 When conditions warrant the use of the electrical heaters in the fresh water tank, they are started by selecting AUTO on the local hand selector. Switch on the temperature controller and set to 5°C.

4.6 When the turbine washing pump is required, the relevant hand switch for the Water Wash Control System is operated from TCP2 Control Room. However, the local hand switch must be in the CONTROL ROOM position.

4.7 Start the pump locally by pushbutton and set the flow control valve on the recirculation line back to the tank to $22.7m^3/h$.

5 CHECKS AFTER START-UP

5.1 The anti-corrosion dosing rate should be checked to ensure that correct chemical quantities are entering the storage and distribution system.

5.2 Pressure indicators should be checked regularly to ensure that pump discharges are correct.

6 SHUTDOWN

6.1 Close the valve on the discharge side of the sea water pump.

6.2 Stop the corrosion inhibitor dosing pump and also the fresh water make-up pump (55P01).

6.3 Stop the Watermakers.

SECTION 3 – ALARMS AND TRIPS

1 GENERAL

See illustrations C15.3 and C15.4

1.1 A high salinity level (above 4mg/l TDS, as NaCl) detected on the distillate analyser will annunciate in the Control Room and cause distillate to be dumped overboard from the Watermaker.

1.2 A Watermaker failure pre-alarm will annunciate in the Control Room and, shortly after this, the Watermaker will be shut down automatically and a failure alarm annunciated in the Control Room.

1.3 A low level in the anti-corrosion tank will give an alarm in the Control Room and cause the shutdown of the corrosion package, mixer and dosing pumps.

1.4 The fresh water tank is fitted with the following level alarms:

(a) High level.

(b) Low level.

(c) Low low level.

All three will annunciate in the TCP2 Control Room.

1.5 The tank low low level signal will automatically stop the fresh water make-up pump and the turbine washing pump. The water heaters in the tank will be shut down by the same signal.

1.6 The electric heaters have a FAULT alarm annunciating in the TCP2 Control Room.

Symptom	Possible Cause	Action
1. Pump fails to start on manual command.	(a) No electrical supply.	Check supply source.
	(b) Start selector hand switch incorrectly positioned.	Select correct mode, ie LOCAL/ CONTROL ROOM.
	(c) Motor malfunction.	Check cut-out alarms and rectify fault.
	(d) Low low level in fresh water tank.	Fill tank and reset.
2. Turbine washing pump fails to start on auto command.	(a) Low low level in fresh water tank.	Check level. Fill tank and reset.
3. Dosing pumps fail to start	(a) Low level in chemical tank.	Fill chemical tank.
4. No fresh water production.	(a) Salinity analyser set incorrectly.	Reset and check Watermaker.
	(b) Malfunction in Watermaker.	Correct malfunction.

CHAPTER C16

WASHDOWN SYSTEM

CONTENTS

SECTION 1 DESCRIPTION

1. Summary
2. Equipment Details
3. External Utilities and Interfaces

SECTION 2 OPERATION AND CONTROLS

1. Operating Philosophy
2. Controls
3. Prestart Checks
4. Start-up

SECTION 3 ALARMS AND EMERGENCY SHUTDOWN

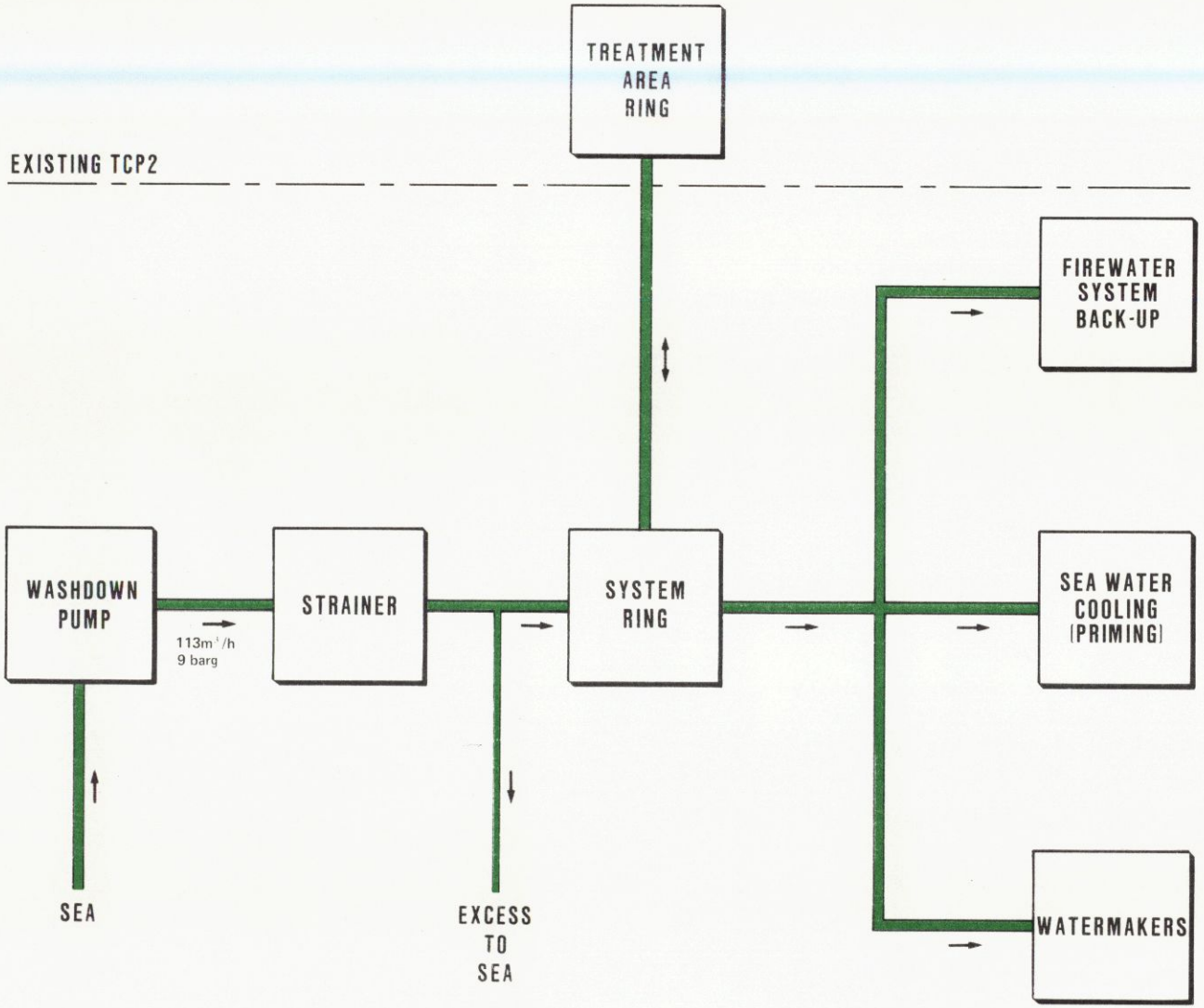
1. Alarms
2. Emergency Shutdown

SECTION 4 TROUBLESHOOTING

SECTION 5 OPERATOR MAINTENANCE

ILLUSTRATIONS

C16.1 Block Diagram
C16.2 System Schematic
C16.3 Instrumentation and Controls


TREATMENT AREA RING
EXISTING TCP2
FIREWATER SYSTEM BACK-UP
WASHDOWN PUMP
113m³/h
9 barg
STRAINER
SYSTEM RING
SEA WATER COOLING (PRIMING)
SEA
EXCESS TO SEA
WATERMAKERS

SECTION 1 – DESCRIPTION

Reference: PID 5424W 50 0040 010

1 SUMMARY

See illustrations C16.1 and C16.2

1.1 The Gas Compression area Washdown System consists of a ring main, supplying sea water to hose reels at twelve of the Utility Stations. The system is pressurised to 9 barg by a submersible vertical 3-stage centrifugal pump (50P02) sited in Column 3.

1.2 The system is interconnected with the main Platform Washdown System. It is also used to prime the Main Sea Water Cooling System and can be used as a back-up to the Gas Compression area Firewater System. A standby supply to the Watermakers is also provided.

1.3 Remote pushbuttons at each Utility Station hose reel enable control of the washdown pump, provided that the hand selector switch adjacent to the pump local controller has been switched to REMOTE.

2 EQUIPMENT DETAILS

2.1 Washdown Pump 50P02

Design flowrate	113.6m^3/h.
Discharge pressure	9 barg.
Power supply	380V 50Hz.
Power consumption	135A (62.5kW).
Speed	2905/3000 rev/min.

The pump is water-lubricated and water-cooled. On initial installation, the water reservoir is primed with clean fresh water and requires no operator maintenance.

2.2 Utility Stations Supplied with Washdown Water

(Hose reel and remote control pushbuttons for washdown pump):

Utility Station	Location	
	Deck	Module/Pancake
US1	Upper	Module 30
US2	Upper	Module 30
US3	Upper	Module 32
US5	Upper	Module 33
US6	Upper	Module 33
US7	Main	Module 30
US15	Main	Module 33
US18	Cellar	Pancake 40 (West)
US19	Cellar	Pancake 40 (East)
US21	Cellar	Area 63
US22	Cellar	Pancake 42 (South)
US24	Cellar	Pancake 45

3 EXTERNAL UTILITIES AND INTERFACES

3.1 External Utilities Required

(a) Instrument air.

(b) Power supplies for instruments and remote pushbuttons.

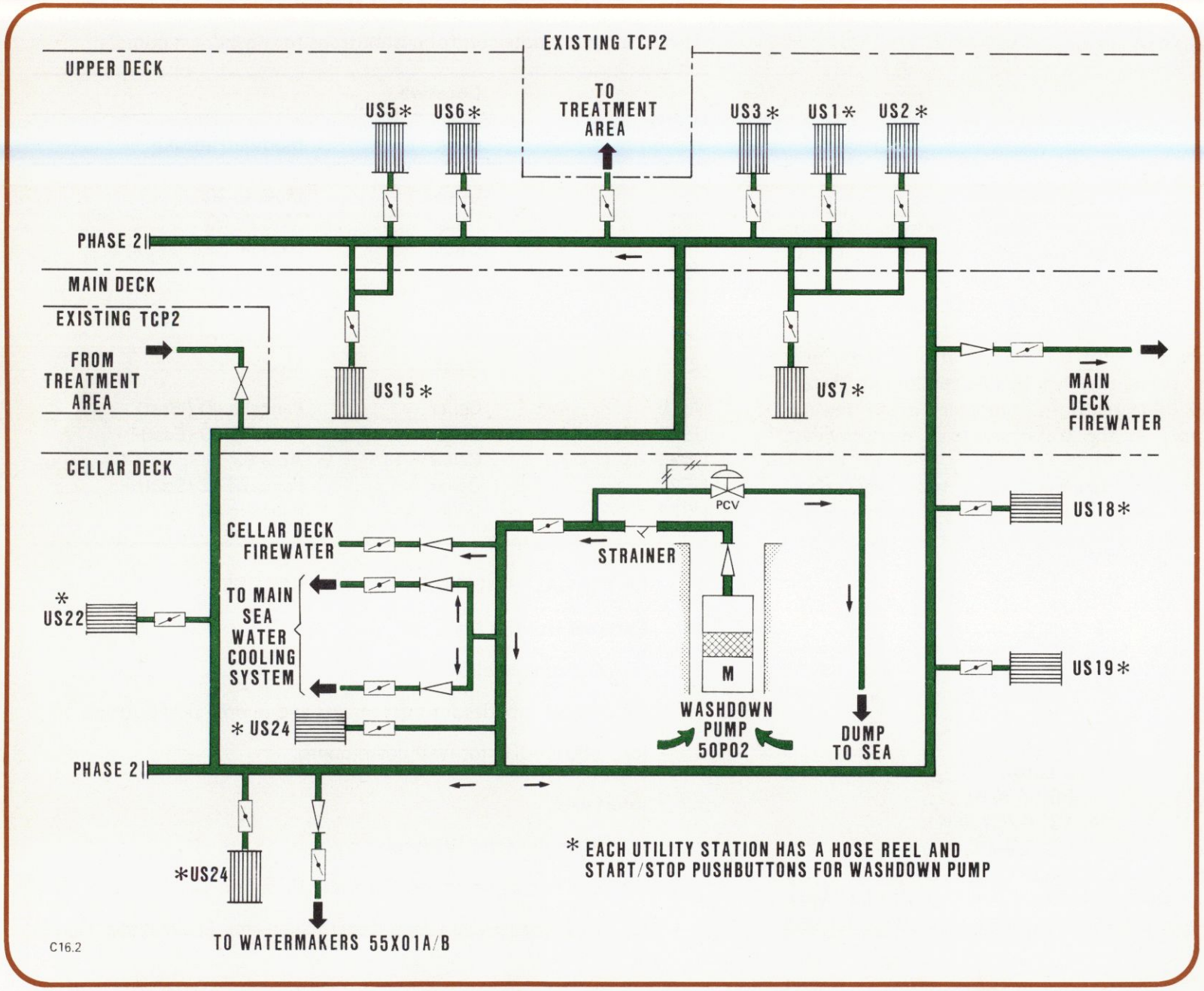
(c) 380V 50Hz for washdown pump.

3.2 Interfaces

(a) Main Platform Washdown System.

(b) Gas Compression area Firewater System.

(c) Gas Compression area Watermakers for Fresh Water Cooling Systems.



* EACH UTILITY STATION HAS A HOSE REEL AND START/STOP PUSHBUTTONS FOR WASHDOWN PUMP

SECTION 2 – OPERATION AND CONTROLS

1 OPERATING PHILOSOPHY

See illustrations C16.2 and C16.3

1.1 The Gas Compression area Washdown System is used as required, to supply sea water to Utility Stations and/or supplement other systems.

1.2 The Local/Remote changeover switch at the washdown pump local controller is normally set to REMOTE so that the pump can be started and stopped from any Utility Station as required.

1.3 Should excess pressure build up in the Washdown System, a pressure control valve (PCV) set at 10 barg will dump excess water direct to sea.

2 CONTROLS

2.1 Control of the washdown pump can be effected at the pump by setting the adjacent Local/Remote changeover switch to LOCAL and operating the locally mounted Start/Stop pushbuttons. Normally, the changeover switch is positioned to REMOTE and control of the pump can then be effected by the Start/Stop push-buttons at the appropriate Utility Stations.

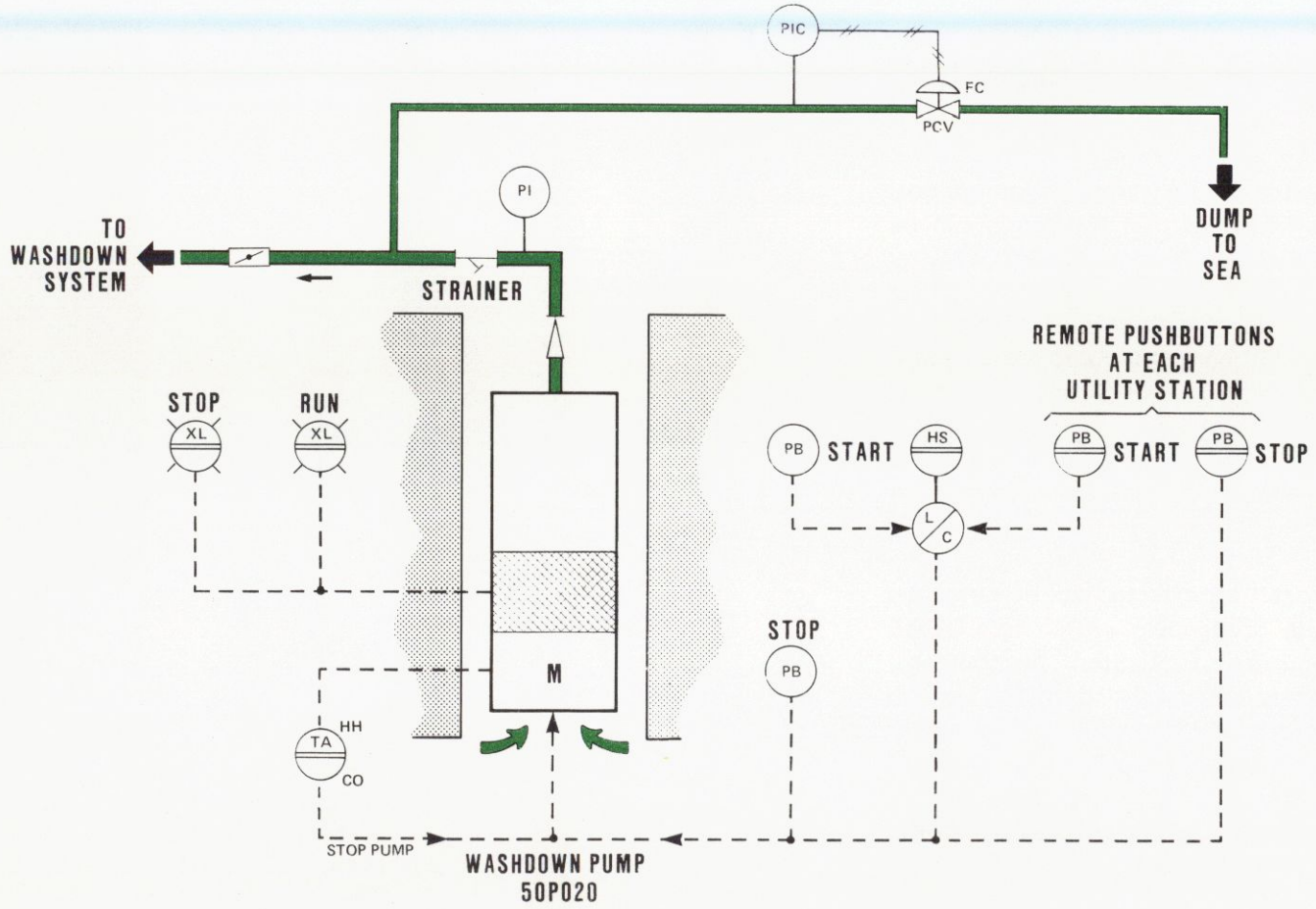
2.2 Remote STOP and RUN indicator lamps for washdown pump utilisation are displayed in TCP2 Control Room.

2.3 The washdown pump motor is fitted with a temperature element. In the event of high motor temperature, a HIGH-HIGH alarm is annunciated in TCP2 Control Room and a pump cut-out will operate.

3 PRESTART CHECKS

(1) Ensure that instrument air and electrical supplies are available.

(2) Ensure that all system valves are SHUT.


PIC
FC
PCV
PI
TO
WASHDOWN
SYSTEM
STRAINER
DUMP
TO
SEA
REMOTE PUSHBUTTONS
AT EACH
UTILITY STATION
STOP
XL
RUN
XL
PB
START
HS
PB
START
PB
STOP
L
C
STOP
PB
M
TA
HH
CO
STOP PUMP
WASHDOWN PUMP
50P020

4 START-UP

(1) With the washdown pump control changeover switch set to LOCAL, start the washdown pump at the local Start push-button. Check that the washdown pump RUN indicator lamp is illuminated in TCP2 Control Room.

(2) Check that the pump delivery pressure is correct (9 barg at local pressure indicator) and that the dump-to-sea PCV opens at a pressure of 10 barg under control of its pressure indicator controller (PIC).

(3) Open the delivery valve to the Washdown System ring main.

(4) Open the interconnection supply and return valves to the main Platform Washdown System.

(5) Open the supply valves to the Main and Cellar Deck Firewater ring mains.

(6) If required, open the supply valves to the Watermakers and/or to the Main Sea Water Cooling System.

(7) Stop the washdown pump locally and set the control changeover switch to REMOTE. Check that the washdown pump STOP indicator lamp is illuminated and the RUN indicator lamp is off in TCP2 Control Room.

(8) At two or more appropriate Utility Stations, check that the washdown pump operates under control of the Utility Station Start and Stop pushbuttons, with appropriate lamp indication in TCP2 Control Room.

(9) Stop the washdown pump and leave the control changeover switch set to REMOTE. The Washdown System is now in readiness to meet demands for washdown water.

SECTION 3 – ALARMS AND EMERGENCY SHUTDOWN

1 ALARMS

1.1 The washdown pump motor is protected against excessive temperature by a temperature element which initiates a High-High alarm in TCP2 Control Room.

1.2 Should excessive motor temperature occur, a cut-out will operate to stop the pump.

2 EMERGENCY SHUTDOWN

There are no emergency shutdown facilities.

Symptom	Possible Cause	Action
1. Pump fails to start.	(a) Control changeover switch incorrectly positioned.	Place changeover switch to LOCAL or REMOTE as appropriate.
	(b) No electrical supply.	Check supply source.
	(c) Temperature cut-out operated. (Alarm indication).	Check integral motor cooling arrangements.
2. Pump stops after periods of running, without STOP command.	(a) Electrical supply failure.	Check supply source.
	(b) Temperature cut-out operated. (Alarm indication).	See 1(c) above. Also check for excessive back-pressure.
	(c) Excessive system back-pressure.	Check that discharge valve is open. Check that dump-to-sea PCV operating correctly.
3. System pressure low, washdown pump running.	(a) Excessive demand.	Reduce demand.
	(b) Pump strainer blocking.	Clean strainer.
	(c) Dump-to-sea pressure setting too low.	Check PIC setting.

SECTION 5 – OPERATOR MAINTENANCE

Periodically carry out the following:

(a) Clean washdown pump inlet strainer.

(b) Check that washdown pump delivery pressure is correct (9 barg).

(c) Check that excess dump-to-sea PCV setting is correct (10 barg).

CHAPTER C17

HYDRAULIC SYSTEM

CONTENTS

SECTION 1 DESCRIPTION

1. Summary
2. Equipment Details
3. External Utilities and Interfaces

SECTION 2 OPERATION AND CONTROLS

1. Operating Philosophy
2. Controls and Indicators
3. Alarms and Trips

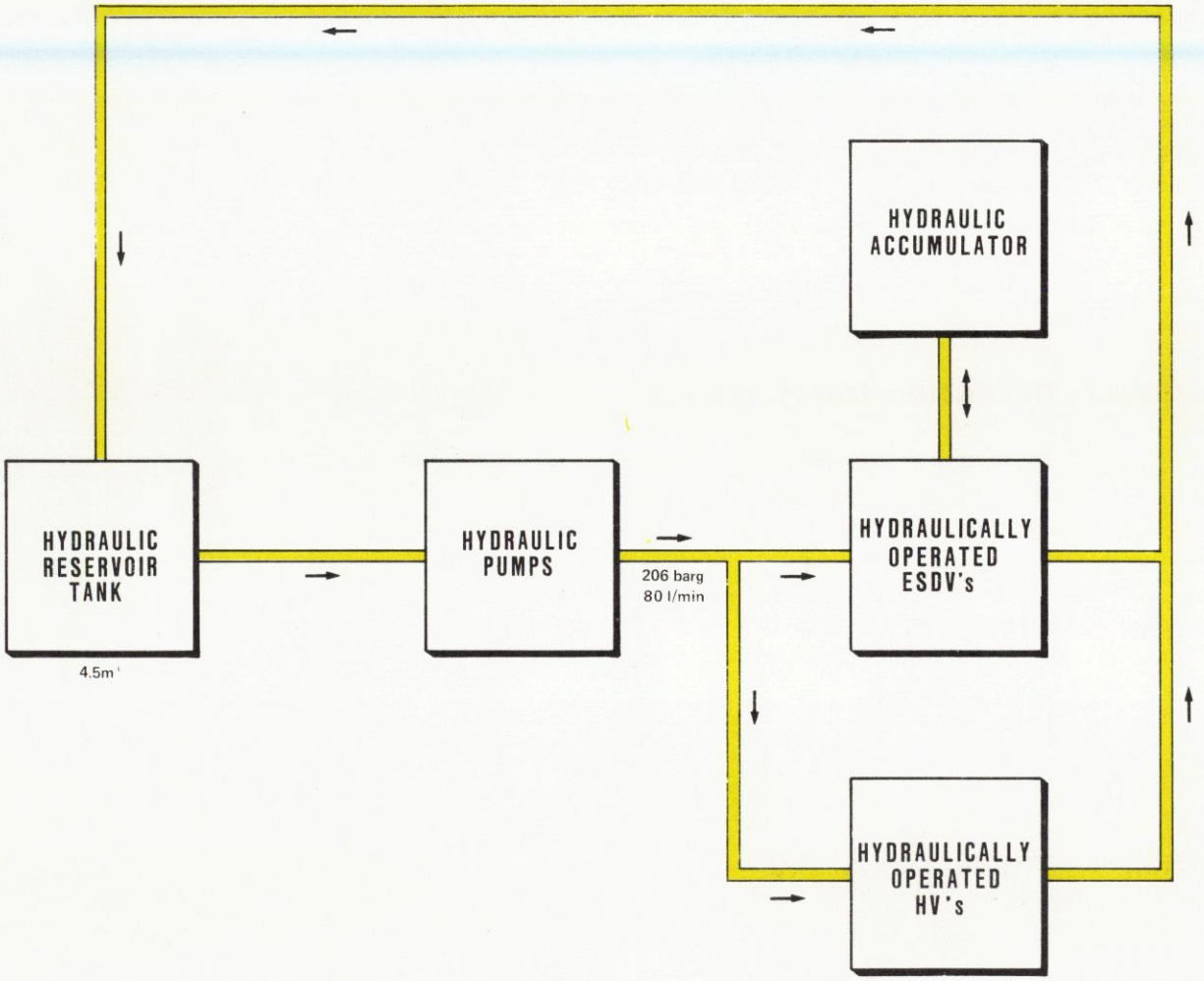
SECTION 3 SYSTEM START-UP

1. Prestart Checks
2. Start-up
3. Checks After Start-up

SECTION 4 TROUBLESHOOTING

ILLUSTRATIONS

C17.1 Block Diagram
C17.2 System Schematic
C17.3 Control and Instrumentation


HYDRAULIC ACCUMULATOR
HYDRAULIC RESERVOIR TANK
4.5m³
HYDRAULIC PUMPS
206 barg
80 l/min
HYDRAULICALLY OPERATED ESDV's
HYDRAULICALLY OPERATED HV's

SECTION 1 – DESCRIPTION

Reference: PID 5424W 56 0040 01

1 SUMMARY

See illustrations C17.1 and C17.2

1.1 The Gas Compression area Hydraulic System provides oil at a pressure of 206 barg as the actuating medium for the hydraulically operated Emergency Shutdown valves (ESDV) and Hand isolating valves (HV) fitted in the Gas Compression System.

1.2 System pressure is maintained by a hydraulic pump which runs continuously. A second pump is kept at auto standby. The pumps and their associated hydraulic oil reservoir tank are contained within the Hydraulic Power Unit 56X01 located on the Upper Deck in Module 32.

1.3 Six accumulators (fitted with internal bladders pressurised with nitrogen) are connected to the discharge manifold of the pumps. The accumulators act as dampeners and also maintain system pressure for a restricted period should both hydraulic pumps fail.

1.4 Hydraulic oil displaced on actuation of any of the ESDVs or HVs bleeds back to the oil reservoir tank via a filter. A second filter is available should the duty filter become blocked.

1.5 Each ESDV actuating system is fitted with two 56.8 litre capacity accumulators which are used to provide emergency back-up pressure in the event of system pressure failing to be maintained by the pumps or their associated accumulators.

1.6 Each hydraulically operated valve has its own local control panel fitted with the required controls and indications relating to that valve.

2 EQUIPMENT DETAILS

2.1 **Hydraulic Pumps 56X01.P01A/B**

Power supply	380V ac
Discharge capacity	80 l/min at 300 barg

2.2 **Hydraulic Oil Reservoir Tank 56X01.T01**

Capacity	4.5m^3

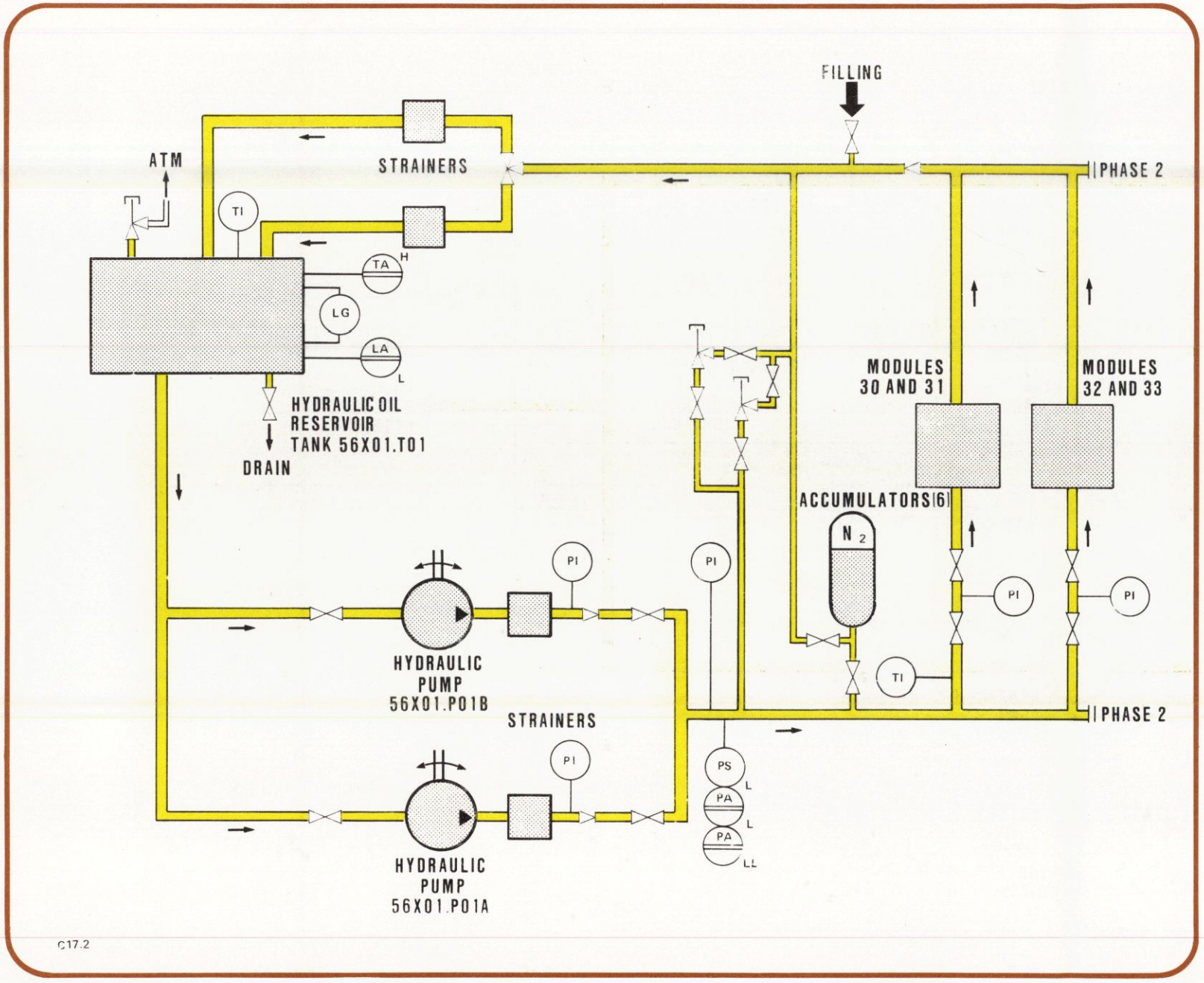
3 EXTERNAL UTILITIES AND INTERFACES

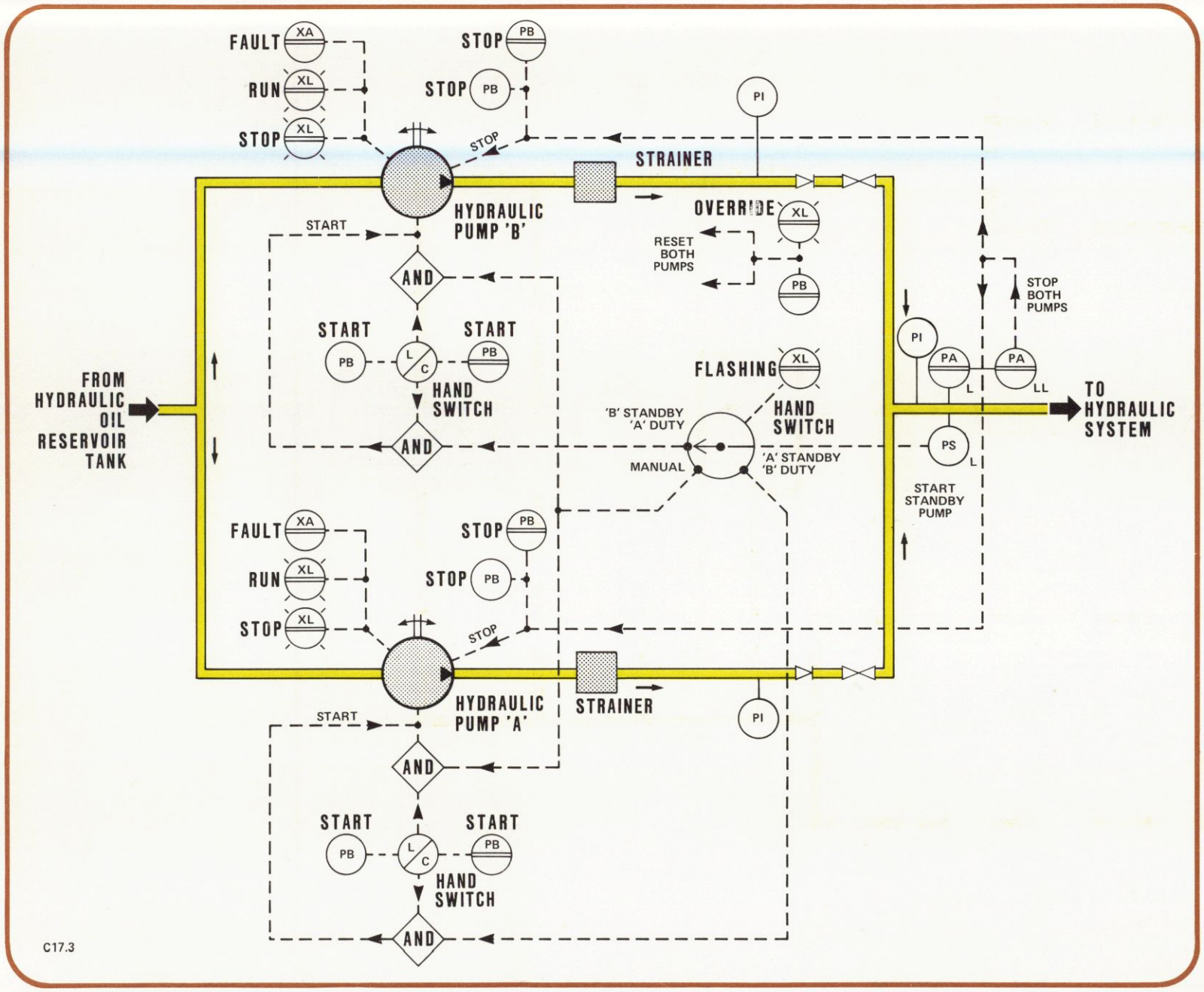
3.1 The system requires the following external utilities:

(a) Instrument air.

(b) Electrical supply of 380V ac for the pumps and 220V ac and/or 110V dc for instrumentation and alarm transmission.

3.2 The only interface with this system is the Gas Compression System where all the hydraulically operated valves are located.


FILLING
ATM
STRAINERS
PHASE 2
TI
TA H
LG
LA L
HYDRAULIC OIL
RESERVOIR
TANK 56X01.T01
DRAIN
MODULES
30 AND 31
MODULES
32 AND 33
ACCUMULATORS (6)
N 2
PI
PI
PI
PI
TI
HYDRAULIC
PUMP
56X01.P01B
STRAINERS
PI
PS L
PA L
PA LL
HYDRAULIC
PUMP
56X01.P01A
PHASE 2


FAULT
XA
RUN
XL
STOP
XL
STOP
PB
STOP
PB
STOP
HYDRAULIC PUMP 'B'
STRAINER
PI
OVERRIDE
XL
RESET BOTH PUMPS
PB
START
AND
START
PB
L
C
START
PB
HAND SWITCH
AND
FROM HYDRAULIC OIL RESERVOIR TANK
'B' STANDBY 'A' DUTY
FLASHING
XL
HAND SWITCH
MANUAL
'A' STANDBY 'B' DUTY
PI
PA
L
PA
LL
STOP BOTH PUMPS
TO HYDRAULIC SYSTEM
PS
L
START STANDBY PUMP
FAULT
XA
RUN
XL
STOP
XL
STOP
PB
STOP
PB
STOP
HYDRAULIC PUMP 'A'
STRAINER
PI
START
AND
START
PB
L
C
START
PB
HAND SWITCH
AND
C17.3

SECTION 2 – OPERATION AND CONTROLS

1 OPERATING PHILOSOPHY

1.1 The two hydraulic pumps are run in parallel during charging of the system accumulators with oil. When a system operating pressure of 206 barg is established, one pump is to be stopped and maintained at auto standby. The duty pump will run continuously, maintaining system pressure and recirculating excess oil back to the oil reservoir tank through the system pressure safety valves which are set at 214 barg.

1.2 Should system pressure fall to 173 barg, the standby pump will start automatically. If (even with both pumps running) the system pressure falls to 124 barg, an alarm will annunciate on the TCP2 control panel. A continued pressure drop to 103 barg, which would indicate a serious system leak or lack of oil in the reservoir tank, will cause both of the pumps to trip. In this event, a low-low pressure alarm will annunciate on the TCP2 control panel.

2 CONTROLS AND INDICATORS

See illustration C17.3

2.1 The hydraulic pumps are each fitted with the following controls and indicators:

(a) Start and Stop pushbuttons, local to the pump.

(b) Remote Start and Stop pushbuttons, located on the TCP2 control panel.

(c) A Local/Control Room Start selector hand switch located on the TCP2 control panel.

(d) Remote STOP and RUN indicating lamps located on the TCP2 control panel.

(e) Local pump discharge and line pressure indicators.

2.2 Both pumps are linked electrically by a single three-position hand selector switch, the positions of which denote the following:

(a) Position 1 – Pump 'A' duty, pump 'B' auto standby.

(b) Position 2 – Pump 'B' duty, pump 'A' auto standby.

(c) Position 3 – Manual operation of both pumps.

This hand switch must be positioned at MANUAL when starting the pumps locally. Incorrect positioning of this switch will cause a FAULT IN SELECTION lamp to flash on the TCP2 control panel.

2.3 An Override pushbutton linked with an associated lamp is fitted on the TCP2 control panel and, when depressed, will reset both pumps when required.

2.4 The common discharge manifold from both pumps and the individual module supply lines are fitted with pressure and temperature indicators.

2.5 The hydraulic oil reservoir tank is fitted with a level gauge and a thermometer.

3 ALARMS AND TRIPS

3.1 The following alarms and trips are fitted to the Hydraulic System. Action to be taken on receipt of these alarms or tripping actions are shown alongside the relevant malfunction.

Alarm	Set Point	Action
System pressure LOW	124 barg	Check that the standby pump has started. (This should have occurred at a system pressure of 173 barg). If not, then start the standby pump. Check that the required reservoir tank level is being maintained.
System pressure LOW-LOW	103 barg	Automatic trip of both pumps. Investigate cause of low-low pressure.
Reservoir tank temperature HIGH		Investigate cause.
Reservoir tank oil level LOW		Fill reservoir tank. Check system for leaks.
Pump motor fault		Investigate cause.

SECTION 3 – SYSTEM START-UP

1 PRESTART CHECKS

1.1 **Check the following:**

(a) Electrical power supplies available for pumps and alarm transmission.

(b) Instrument air available and all instrument root valves open.

(c) System valves set in their start-up configuration.

(d) Hydraulic oil reservoir tank full.

(e) Hydraulic power unit accumulators charged with nitrogen.

(f) Duty filter on the hydraulic return line selected.

2 START-UP

(1) Select MANUAL on the three-position hand selector switch.

(2) Position both Start selector hand switches to LOCAL.

(3) Start both hydraulic pumps locally and check that their relevant RUN lamps are illuminated.

(4) Continue running both pumps until the system and accumulators are charged to 206 barg, then stop the pump which is to be standby.

(5) Select the required position on the three-position hand selector switch for auto start of the respective standby pump when required.

(6) Position both Start selector hand switches to CONTROL ROOM.

The Hydraulic System is now operational.

3 CHECKS AFTER START-UP

3.1 Monitor system pressure and temperature indicators and the reservoir tank level.

Symptom	Possible Cause	Action
Pump fails to start on manual command.	(a) No electrical supply.	Check supply source.
	(b) Start selector hand switch incorrectly positioned.	Select appropriate mode.
	(c) Three-position hand selector switch incorrectly positioned.	Select MANUAL.
	(d) Motor malfunction	Investigate cause.
Standby pump fails to start on auto command.	(a) Three-position hand selector switch incorrectly positioned.	Select Position 2 for pump 'B' or Position 1 for pump 'A'.
	(b) Start selector hand switch incorrectly positioned.	Select CONTROL ROOM.
	(c) Motor malfunction.	Investigate cause.

CHAPTER C18

AIR CONDITIONING AND VENTILATION

CONTENTS

SECTION 1 DESCRIPTION

1. Summary
2. Equipment Details
3. External Utilities and Interfaces

SECTION 2 OPERATION AND CONTROL

1. Operating Philosophy
2. Controls and Indicators
3. Alarms and Trips

SECTION 3 SYSTEM START-UP

1. Prestart Checks
2. Start-up
3. Normal Shutdown

SECTION 4 TROUBLESHOOTING

ILLUSTRATIONS

C18.1 Dual Fan System
C18.2 Single Fan System
C18.3 Control Room System (1), (2) & (3)

SECTION 1 – DESCRIPTION

Reference: PID 5424W 54 2080 3001
PID 5424W 54 2080 3202
PID 5424W 54 2080 4404

1 SUMMARY

1.1 General

1.1.1 The air conditioning and ventilation system in the TCP2 gas compression area is designed to provide an acceptable operating environment within platform areas, and to maintain a positive differential pressure in safe and hazardous areas.

1.1.2 The system is divided into 13 plants, each having separate ducting, fans, dampers and accessories. The majority of the plants are fitted with a dual fan system, but some are fitted with a single fan system. The automation for the plants is partly pneumatic and partly electronic.

1.1.3 The main controls, instrumentation and alarms are located on Panel 4A in the TCP2 Control Room.

1.2 Compressor Modules 30, 31 and 33

System	Dual fan
Classification	Zone 1 without ventilation Zone 2 with ventilation
Pressurisation	Not required
Air change rate	12 air changes per hour

1.3 Fan Room and Substation

System	Dual fan
Classification	Safe with or without ventilation
Pressurisation	6mm WG overpressure
Air change rate	12 air changes per hour

1.4 Control Room

System	Dual fan
Classification	Safe with or without ventilation
Pressurisation	6mm WG overpressure
Air change rate	12 air changes per hour
Temperature	23°C (summer) 20°C (winter)
Humidity	45 to 55 per cent RH (adjustable)

1.5 Workshop

System	Single fan
Classification	Safe with ventilation Zone 1 without ventilation
Pressurisation	6mm WG overpressure
Air change rate	12 air changes per hour
Temperature	25°C maximum

1.6 Turbogenerator Room (Pancake 41)

System	Dual fan
Classification	Safe with ventilation Zone 1 without ventilation
Pressurisation	6mm WG overpressure
Air change rate	12 air changes per hour

1.7 Diesel Firepump Room

System	Dual fan
Classification	Safe with ventilation Zone 1 without ventilation
Pressurisation	6mm WG overpressure
Air change rate	12 air changes per hour

1.8 Battery Room (Pancake 44)

System	Dual fan
Classification	Safe with or without ventilation
Pressurisation	10mm WG underpressure

1.9 Emergency Substation (Pancake 44)

System	Single fan
Classification	Safe with or without ventilation
Pressurisation	6mm WG overpressure
Air change rate	12 air changes per hour

1.10 Diesel Generator Room (Pancake 44)

System	Extraction fan
Classification	Safe with or without ventilation
Pressurisation	Not required

1.11 Transformer Rooms

System	Dual fan
Classification	Zone 1 without ventilation Zone 2 with ventilation
Pressurisation	Not required
Air change rate	12 air changes per hour

2 EQUIPMENT DETAILS

2.1 Modules 30, 31 and 33

2.1.1 Axial fans:

Capacity	24 000m^3/h
Speed	1420 rev/min
Power supply	380V 3-phase 50Hz
Power consumption	3.7kW

2.2 Fan Room and Substation

2.2.1 Radial fans:

Capacity	15 500m^3/h
Speed	2860 rev/min
Power supply	380V 3-phase 50Hz
Power consumption	10kW

2.3 Control Room

2.3.1 Preheater 54X05.007

Power consumption	50kW

2.3.2 Humidifier 54X05.008

Capacity	1200m^3/h

2.3.3 Pump 54X05.009

Capacity	1.08m^3/h
Speed	1500 rev/min
Power supply	380V 3-phase 50Hz
Power consumption	1.0kW

2.3.4 Cooler 54X05.010

Rating	72 000kcal/h

2.3.5 Reheater 54X05.011

Power consumption	40kW

2.3.6 Centrifugal Fan 54X05.014

Capacity	12 000m^3/h
Speed	2400 rev/min
Power supply	380V 3-phase 50Hz
Power consumption	5kW

2.3.7 Centrifugal Fan 54X05.015

Capacity	12 000m^3/h
Speed	2400 rev/min
Power supply	110V dc
Power consumption	6kW

2.3.8 Refrigeration Unit 54X05.030

Power supply	380V 3-phase 50Hz
Speed	1450 rev/min
Operating pressure	4.7 barg
Water inlet temperature	15°C
Water outlet temperature	25°C

2.4 Workshop

2.4.1 Heater 54X07.003

Power supply	380V 3-phase 50Hz
Power consumption	40kW

2.4.2 Radial Fans 54X07.004 and 54X07.005

Capacity	3500m^3/h
Speed	2950 rev/min
Power supply	380V 3-phase 50Hz
Power consumption	

2.5 Turbogenerator Room

2.5.1 Axial Fans 54X07.007 and 54X07.008

Capacity	2700m^3/h
Speed	1430 rev/min
Power supply	380V 3-phase 50Hz
Power consumption	6.5kW

2.5.2 Heater 54X07.016

Power supply	380V 3-phase 50Hz
Power consumption	26kW

2.6 Diesel Firepump Room

2.6.1 Axial Fan 54X20/14.004

Capacity	2100m^3/h
Speed	2820 rev/min
Power supply	380V 3-phase 50Hz
Power consumption	

2.6.2 Axial Fan 54X20/14.005

Capacity	2100m^3/h
Speed	2880 rev/min
Power supply	110V dc
Power consumption	1.4kW

2.7 Battery Room

2.7.1 Axial Fans 54X12.004 and 54X12.005

Capacity	1500m^3/h
Speed	2820 rev/min
Power supply	380V 3-phase 50Hz
Power consumption	0.75kW

2.8 Emergency Substation

2.8.1 Radial Fans 54X13.003 and 54X13.004

Capacity	5200m^3/h
Speed	4000 rev/min
Power supply	380V 3-phase 50Hz
Power consumption	1.35kW

2.8.2 Heater 54X13.005

Power supply	380V 3-phase 50Hz
Power consumption	20kW

2.9 Transformer Rooms

2.9.1 Axial Fans 54X16.005 and 54X16.006

Capacity	7000m^3/h
Speed	2900 rev/min
Power supply	380V 3-phase 50Hz
Power consumption	2.6kW

2.10 Common Equipment

2.10.1 The following equipment is fitted to most of the plant systems:

(a) Filter Sections — The filter is of a low velocity, throwaway type, made of fire resistant non-organic fibres. Each filter is fitted with a filter blockage alarm.

(b) Shutoff Dampers — The damper is installed in gastight walls, AO firewalls and A60 firewalls. In the event of a fire, the fusible link will melt and the damper motor will close the damper.

(c) Modulating Dampers — These are modulated by comparison of an atmospheric reference pressure to control room pressure.

(d) Fire Dampers — These are fusible link type dampers (similar to shutoff dampers) with a fire rating of A60.

(e) Non-return Dampers — These must be manually locked closed when a fan is dismantled from the plant.

(f) Balancing Dampers — These are manually controlled and are used to adjust the air flow to each ventilated area of the plant.

(g) Intermediate Sections — These connect two fans in parallel, one section on the suction side and the other on the discharge side. The section on the suction side is fitted with motorised dampers which automatically follow the fan sequence. The section on the discharge side is fitted with manually operated non-return dampers.

(h) Diffusers, Grilles, Protective Screens, Air Inlet and Outlet Louvres and Demisters.

3 EXTERNAL UTILITIES AND INTERFACES

3.1 External Utilities Required

(a) Electrical power supply of 380V, 3-phase, 50Hz for heaters and fan motors (except (b)).

(b) Electrical power supply of 110V dc for fan motors 54X10.005, 54X14.005 and 54X05.015.

(c) Electrical power supply of 110V dc for the electrical control cabinets.

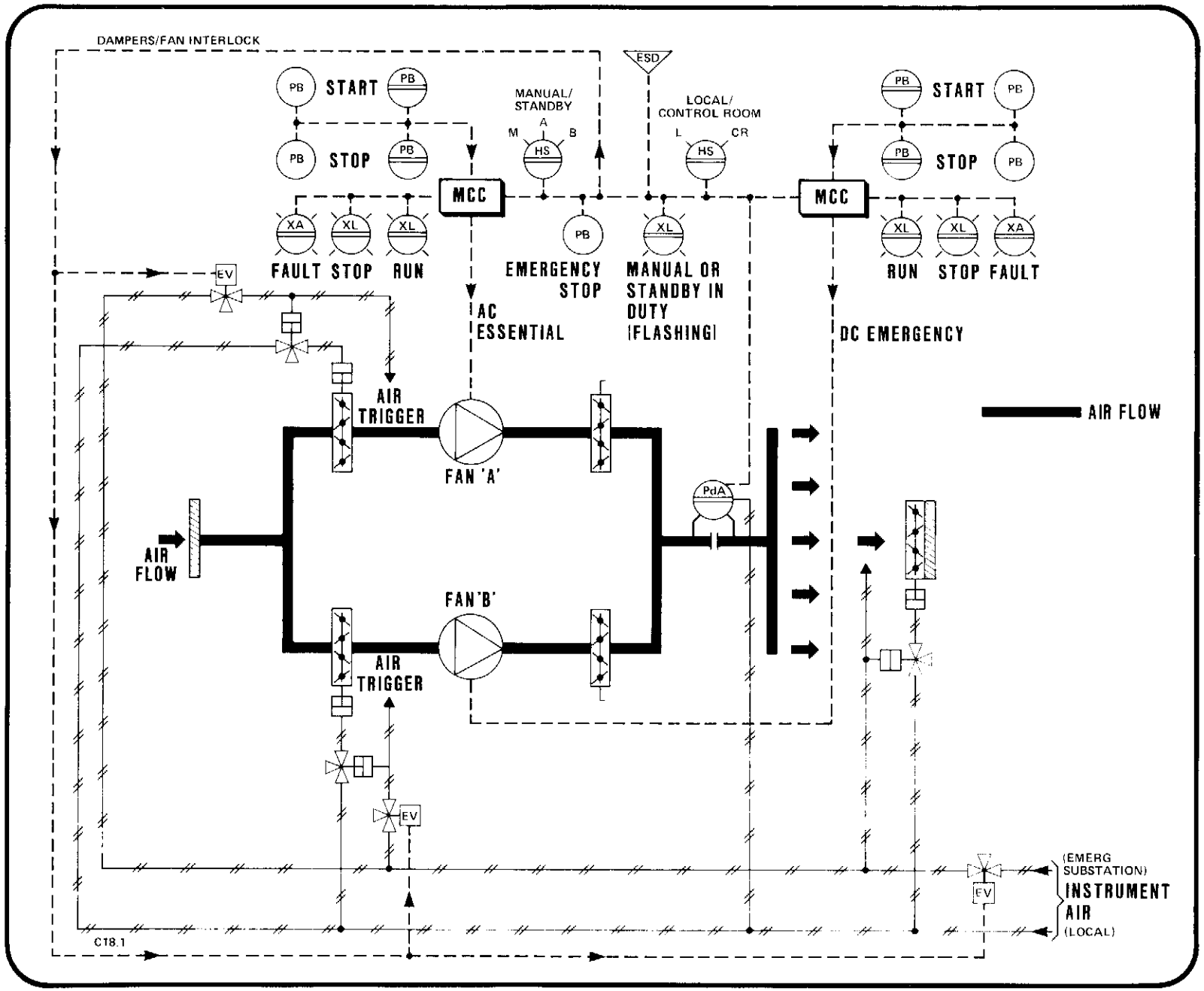
(d) Instrument air (max pressure 10 barg) for the pneumatic control cabinets.

(e) Fresh water from the TCP2–C Cooling Fresh Water Network for the Control Room refrigeration package.

(f) Potable water from the TP1 Potable Water Distribution Network for the Control Room humidifier unit.

3.2 Interfaces

3.2.1 The Air Conditioning and Ventilation System interfaces with the Open Drainage System as required for drainage.


DAMPERS/FAN INTERLOCK
ESD
PB START PB
PB STOP PB
MANUAL/ STANDBY
M A B
HS
LOCAL/ CONTROL ROOM
L CR
HS
MCC
MCC
XA XL XL
FAULT STOP RUN
PB
EMERGENCY STOP
XL
MANUAL OR STANDBY IN DUTY (FLASHING)
XL XL XA
RUN STOP FAULT
AC ESSENTIAL
DC EMERGENCY
EV
AIR TRIGGER
FAN 'A'
AIR FLOW
PdA
AIR FLOW
FAN 'B'
AIR TRIGGER
EV
EV
(EMERG SUBSTATION)
INSTRUMENT AIR
(LOCAL)
C18.1

SECTION 2 – OPERATION AND CONTROL

1 OPERATING PHILOSOPHY

See illustrations C18.1, C18.2 and C18.3(1), (2) and (3).

1.1 Dual Fan System

See illustration C18.1

1.1.1 The system comprises two fans mounted in parallel which are operated as one duty and one standby. Only one fan and its corresponding dampers can operate at the same time. The duty fan is started manually, but the standby fan can be started manually or automatically as required. The fans can be controlled locally or from the TCP2 Control Room.

1.1.2 Shutoff dampers are electrically interlocked with their respective fans and will open and close automatically as the fans start and stop.

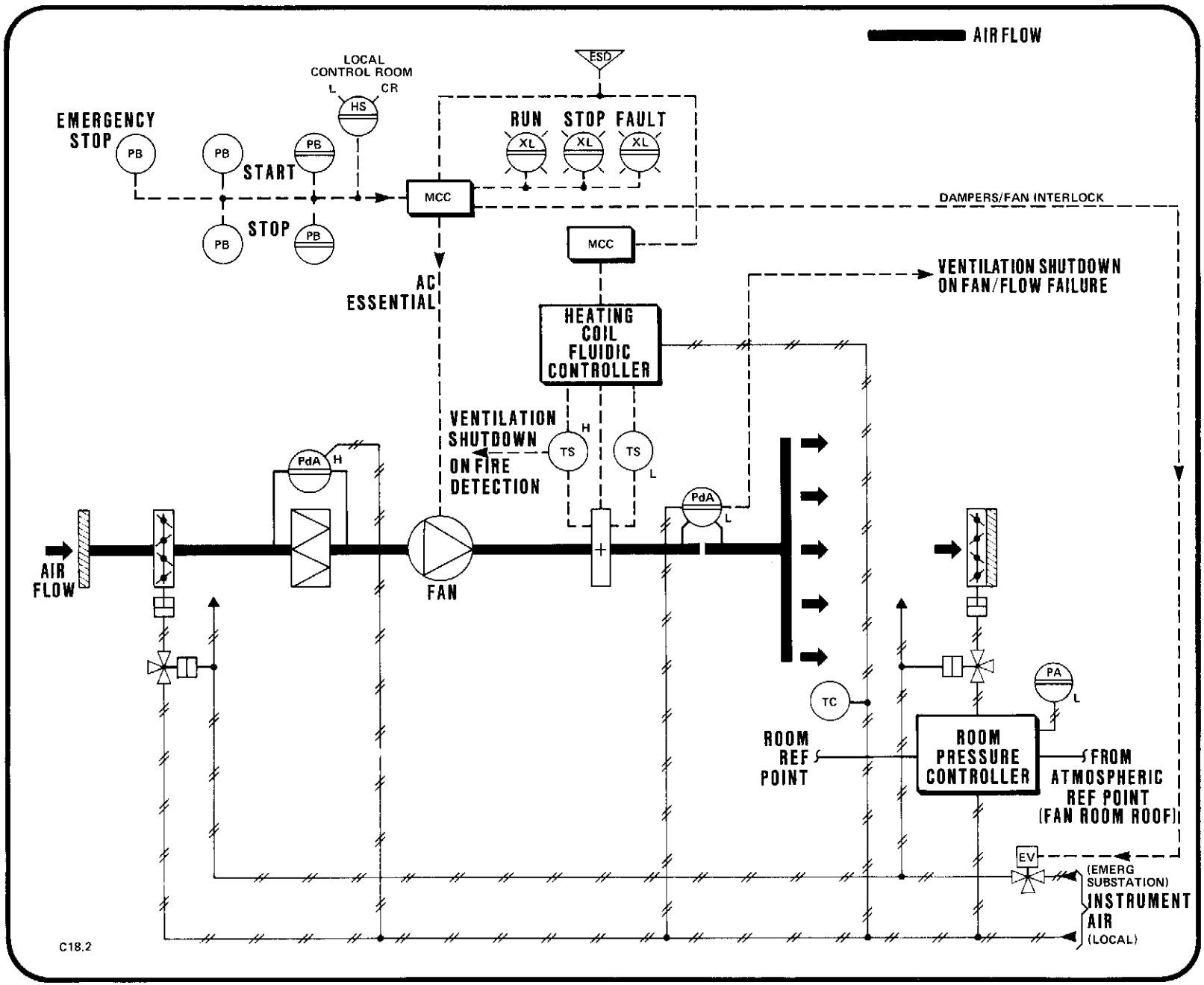
1.1.3 A flow sensor is fitted in the ducting to measure air flow. If no air flow is measured in the ducting a LOSS OF FLOW alarm will annunciate in the Control Room. The shutoff dampers for the duty fan will close, the fan will stop, the dampers for the standby fan will open and the standby fan will start.

1.1.4 Should the LOSS OF FLOW alarm occur again, the standby fan will stop, all motorised dampers will close and (with the exception of the Battery Room) an alarm signal will be sent to the Shutdown System. In the Battery Room, all battery charging will stop but no alarm will be given to the Shutdown System.

1.2 Single Fan System

See illustration C18.2

1.2.1 The fan is manually controlled locally or remotely from the TCP2 Control Room. A flow sensor is fitted in the ducting; on loss of flow, the motorised dampers will close, the fan will stop and an alarm signal passes to the Shutdown System.


AIR FLOW
LOCAL CONTROL ROOM
L
CR
HS
ESD
EMERGENCY STOP
PB
START
STOP
RUN
STOP
FAULT
XL
MCC
DAMPERS/FAN INTERLOCK
AC ESSENTIAL
VENTILATION SHUTDOWN ON FAN/FLOW FAILURE
HEATING COIL FLUIDIC CONTROLLER
VENTILATION SHUTDOWN ON FIRE DETECTION
TS
H
L
PdA
AIR FLOW
FAN
TC
PA
ROOM REF POINT
ROOM PRESSURE CONTROLLER
FROM ATMOSPHERIC REF POINT (FAN ROOM ROOF)
EV
(EMERG SUBSTATION)
INSTRUMENT AIR
(LOCAL)
C18.2

1.3 Control Room System

See illustrations C18.3(1), (2) and (3)

1.3.1 The Control Room is ventilated by a dual fan system fitted with humidity and temperature control equipment. The inlet ducting is fitted with automatically controlled heaters, cooler and humidifier.

1.3.2 The cooling battery is supplied with refrigerant from a refrigeration package. The compressor starts if the room temperature or air supply temperature reaches a high level. Manual control is also available at the local control panel.

1.3.3 A humidifier unit is fitted in the inlet ducting and is supplied with water by a circulating pump. The circulating pump starts and the water control valve opens if the humidity in the Control Room reaches low level or if the temperature in the mixing section falls to 8°C.

1.4 Heating

1.4.1 Several of the plant systems are fitted with heater batteries which operate automatically in response to room temperature controllers and high and low temperature switches. The high temperature switch will initiate a ventilation shutdown on fire detection.

1.5 Diesel Generator Room

1.5.1 The Diesel Generator Room is ventilated by a single extraction fan which starts when the diesel generator starts. The air inlet and outlet dampers open automatically on air pressurisation.

1.5.2 When the diesel generator stops, the fan stops and the dampers close automatically.

1.6 Pressure Control

1.6.1 Rooms which are controlled over or under pressure compared to atmospheric pressure have a common reference point located on top of the Fan Room roof.

1.6.2 The set pressure valve is maintained automatically by a modulating damper located in the room outlet.

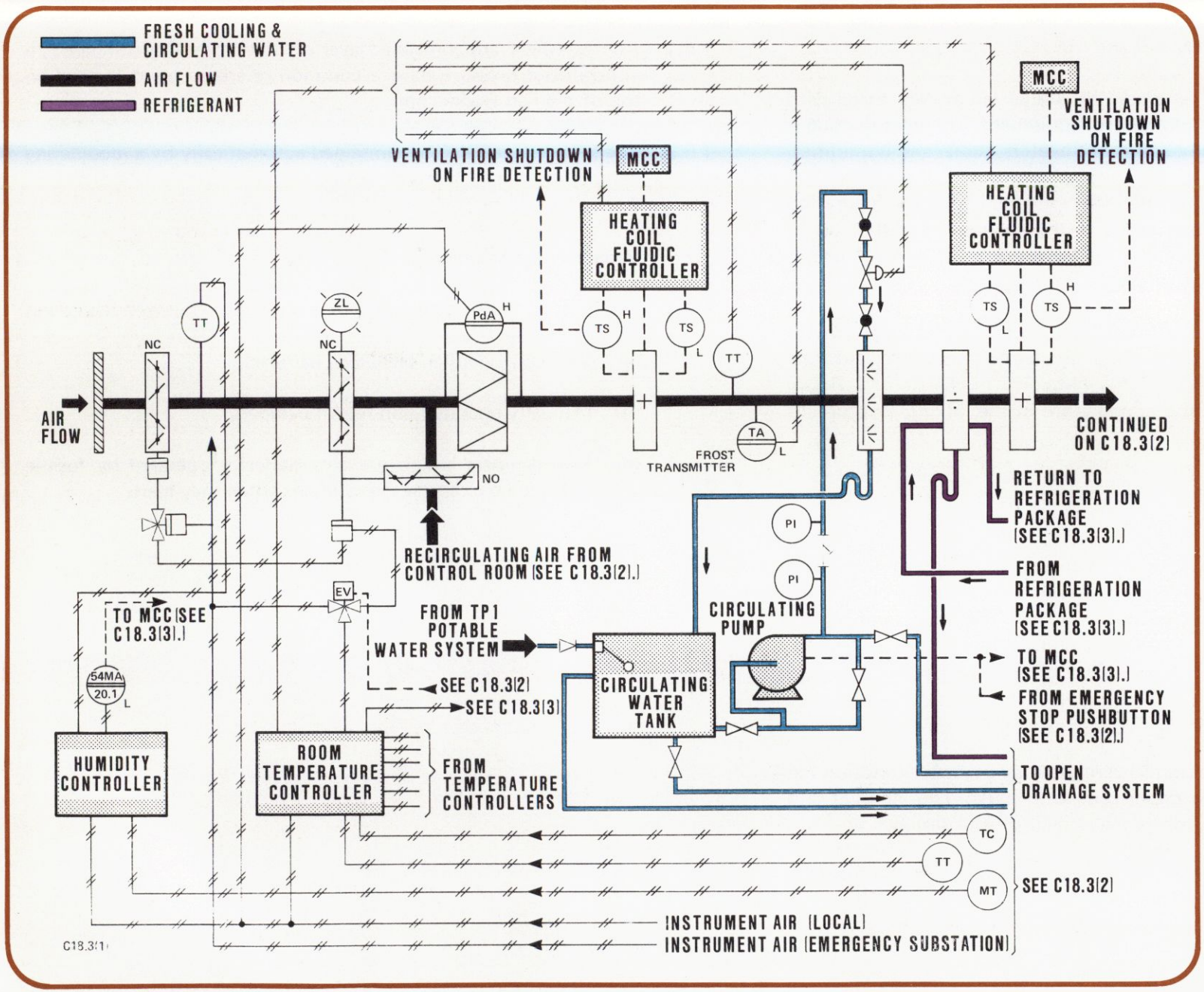
1.7 Miscellaneous Dampers

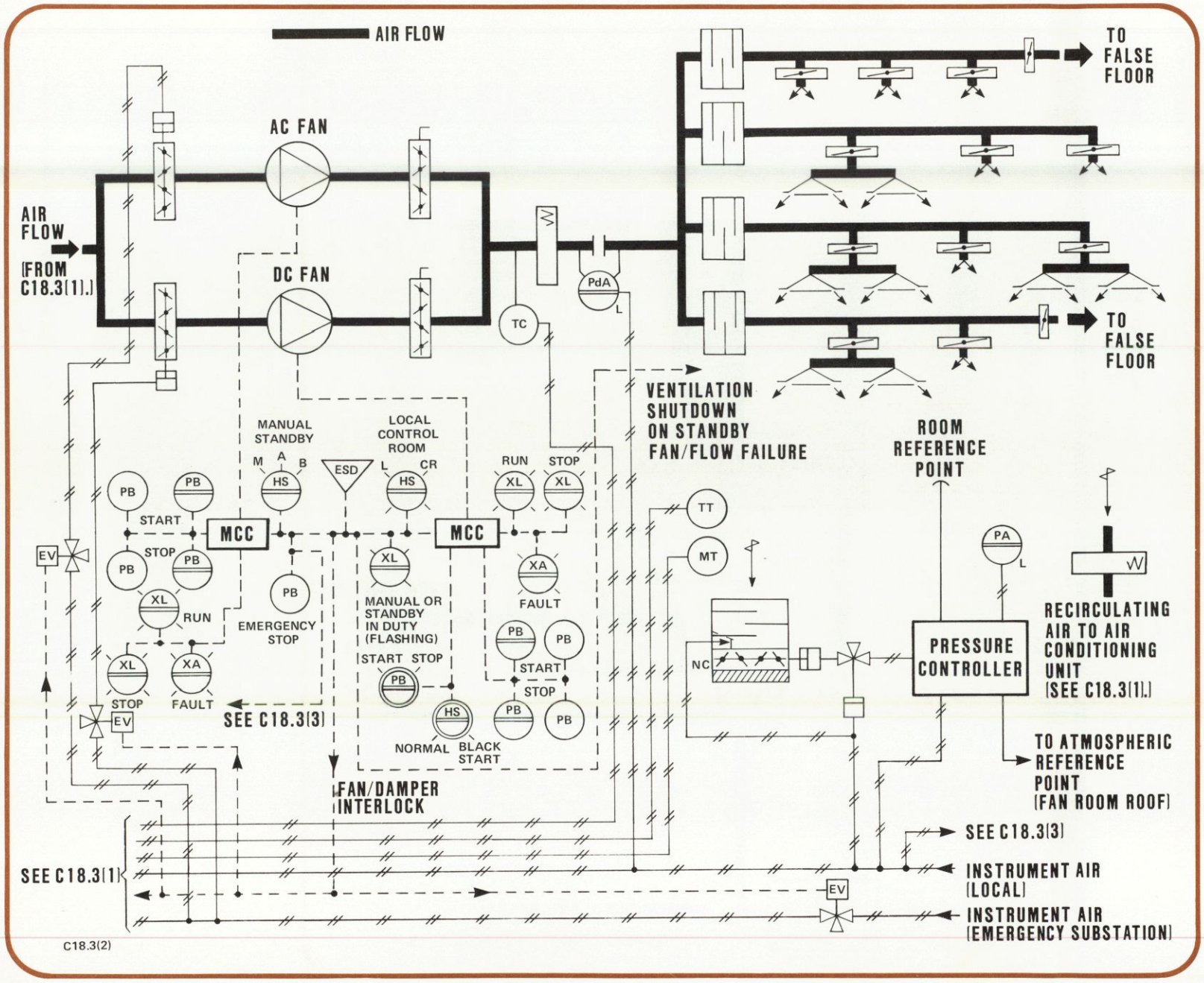
1.7.1 Each system is also fitted with some or all of the following dampers:

(a) Manually operated balancing dampers.

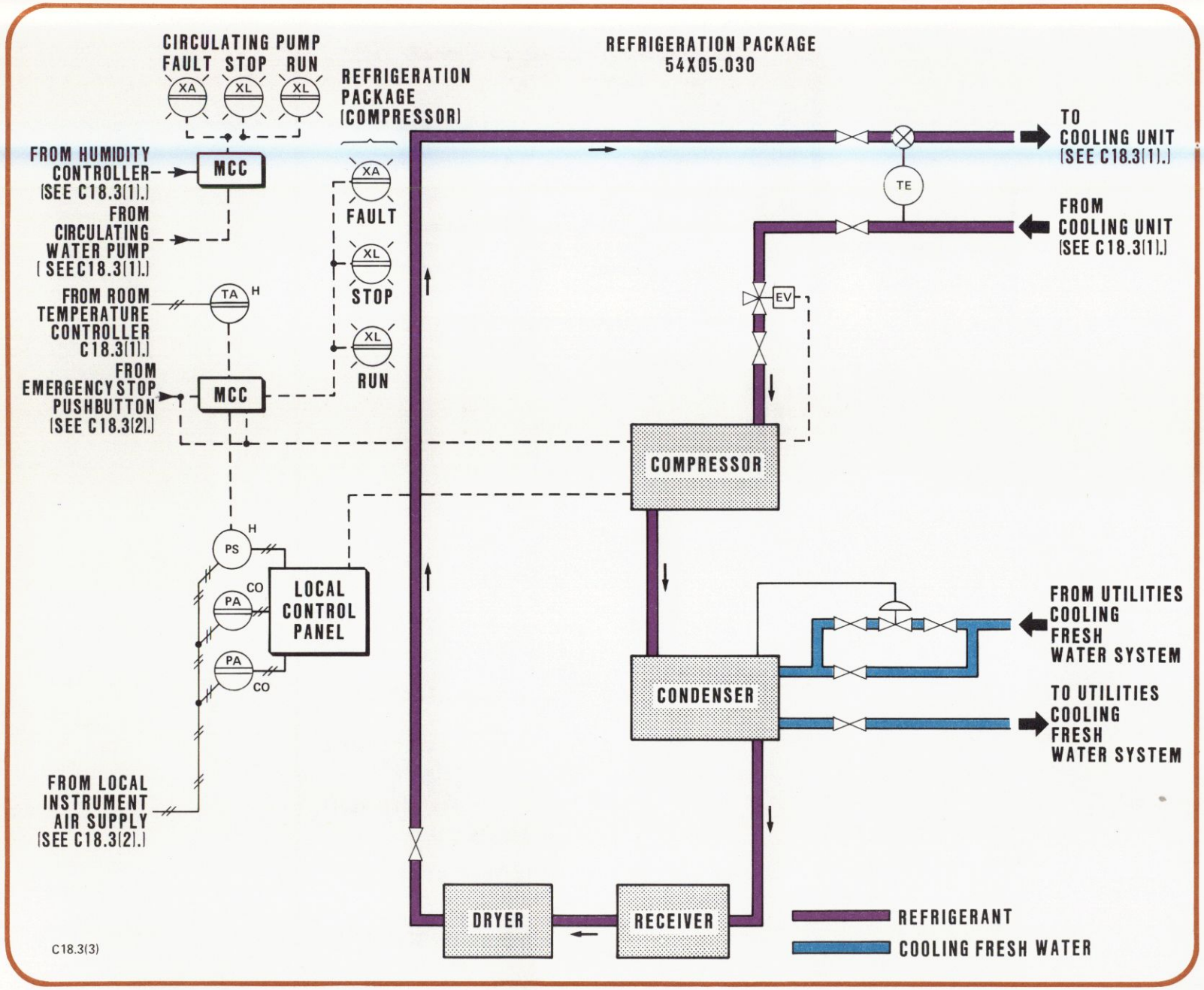
(b) Manually operated non-return dampers.

(c) Fire dampers which are automatically operated by fusible links; these close the fire dampers when they melt.


FRESH COOLING & CIRCULATING WATER
AIR FLOW
REFRIGERANT
VENTILATION SHUTDOWN ON FIRE DETECTION
MCC
HEATING COIL FLUIDIC CONTROLLER
MCC
VENTILATION SHUTDOWN ON FIRE DETECTION
HEATING COIL FLUIDIC CONTROLLER
ZL
PdA
H
TT
NC
NC
TS
H
TS
L
TT
TS
L
TS
H
AIR FLOW
TA
L
FROST TRANSMITTER
CONTINUED ON C18.3(2)
NO
RECIRCULATING AIR FROM CONTROL ROOM (SEE C18.3(2).)
RETURN TO REFRIGERATION PACKAGE (SEE C18.3(3).)
PI
PI
FROM REFRIGERATION PACKAGE (SEE C18.3(3).)
EV
TO MCC (SEE C18.3(3).)
FROM TP1 POTABLE WATER SYSTEM
CIRCULATING PUMP
TO MCC (SEE C18.3(3).)
54MA
20.1
L
SEE C18.3(2)
SEE C18.3(3)
CIRCULATING WATER TANK
FROM EMERGENCY STOP PUSHBUTTON (SEE C18.3(2).)
HUMIDITY CONTROLLER
ROOM TEMPERATURE CONTROLLER
FROM TEMPERATURE CONTROLLERS
TO OPEN DRAINAGE SYSTEM
TC
TT
MT
SEE C18.3(2)
INSTRUMENT AIR (LOCAL)
INSTRUMENT AIR (EMERGENCY SUBSTATION)
C18.3(1)


AIR FLOW
AIR FLOW (FROM C18.3(1).)
AC FAN
DC FAN
TO FALSE FLOOR
TO FALSE FLOOR
PdA
L
TC
VENTILATION SHUTDOWN ON STANDBY FAN/FLOW FAILURE
ROOM REFERENCE POINT
MANUAL STANDBY
M A B
HS
LOCAL CONTROL ROOM
L CR
HS
ESD
RUN STOP
XL XL
PB PB
START
MCC
MCC
EV
PB PB
STOP
XL
RUN
PB
EMERGENCY STOP
XL
MANUAL OR STANDBY IN DUTY (FLASHING)
START STOP
PB
HS
NORMAL BLACK START
XA
FAULT
PB PB
START
STOP
PB PB
XL XA
STOP FAULT
EV
SEE C18.3(3)
FAN/DAMPER INTERLOCK
TT
MT
NC
PA
L
PRESSURE CONTROLLER
RECIRCULATING AIR TO AIR CONDITIONING UNIT (SEE C18.3(1).)
TO ATMOSPHERIC REFERENCE POINT (FAN ROOM ROOF)
SEE C18.3(3)
SEE C18.3(1)
EV
INSTRUMENT AIR (LOCAL)
INSTRUMENT AIR (EMERGENCY SUBSTATION)

C18.3(2)


CIRCULATING PUMP
FAULT STOP RUN
XA XL XL
REFRIGERATION PACKAGE (COMPRESSOR)
REFRIGERATION PACKAGE 54X05.030
FROM HUMIDITY CONTROLLER (SEE C18.3(1).)
MCC
FROM CIRCULATING WATER PUMP (SEE C18.3(1).)
FROM ROOM TEMPERATURE CONTROLLER C18.3(1).)
TA H
FROM EMERGENCY STOP PUSHBUTTON (SEE C18.3(2).)
MCC
XA FAULT
XL STOP
XL RUN
TO COOLING UNIT (SEE C18.3(1).)
TE
FROM COOLING UNIT (SEE C18.3(1).)
EV
COMPRESSOR
PS H
PA CO
PA CO
LOCAL CONTROL PANEL
FROM UTILITIES COOLING FRESH WATER SYSTEM
CONDENSER
TO UTILITIES COOLING FRESH WATER SYSTEM
FROM LOCAL INSTRUMENT AIR SUPPLY (SEE C18.3(2).)
DRYER
RECEIVER
REFRIGERANT
COOLING FRESH WATER
C18.3(3)

2 CONTROLS AND INDICATORS

See illustrations C18.1, C18.2 and C18.3(1), (2) and (3)

2.1 Dual Fan Systems

2.1.1 Controls

(a) Local Stop and Start pushbuttons.

(b) Remote Stop and Start pushbuttons; TCP2 control panel.

(c) Local/Control Room selector hand switch; TCP2 control panel.

(d) Manual/Standby selector hand switch; TCP2 control panel.

(e) Emergency Stop pushbutton; outside Module door.

2.1.2 Indicators

(a) RUN and STOP lamps; TCP2 control panel.

(b) MANUAL OR STANDBY IN DUTY lamp (flashing); TCP2 control panel.

2.2 Single Fan Systems

2.2.1 Controls

(a) Local Stop and Start pushbuttons.

(b) Remote Stop and Start pushbuttons; TCP2 control panel.

(c) Emergency Stop pushbutton; outside room door.

2.2.2 Indicators

RUN and STOP lamps; TCP2 control panel.

2.3 Control Room System

2.3.1 Controls

(a) Local Stop and Start pushbuttons.

(b) Remote Stop and Start pushbuttons; TCP2 control panel.

(c) Local/Control Room selector hand switch; TCP2 control panel.

(d) Manual/Standby selector hand switch; TCP2 control panel.

(e) Emergency Stop pushbutton; outside room door.

(f) Normal/Black Start selector hand switch; local panel in Emergency Substation.

(g) Start/Stop pushbutton; local panel in Emergency Substation.

2.3.2 Indicators

(a) RUN and STOP lamps (fan motors); TCP2 control panel.

(b) RUN and STOP lamps (refrigeration package); TCP2 control panel.

(c) RUN and STOP lamps (circulating pump); TCP2 control panel.

(d) MANUAL OR STANDBY IN DUTY lamp (flashing); TCP2 control panel.

3 ALARMS AND TRIPS

NOTE
All alarms are located on Panel 4A in the TCP2 Control Room. Action to be taken on receipt of these alarms or automatic tripping actions are shown below, alongside the relevant alarm.

3.1 Compressor Modules 30, 31 and 33:

(a)	Fan motor fault alarm	Investigate cause
(b)	Loss of flow alarm	Duty pump stops and standby pump starts automatically. If alarm trips again then standby pump stops, all dampers close and an alarm signal passes to the Shutdown System

3.2 Fan Room and Substation:

(a)	Fan motor fault alarm	Investigate cause
(b)	Loss of flow alarm	Duty pump stops and standby pump starts automatically. If alarm trips again then standby pump stops, all dampers close and alarm signal passes to the Shutdown System
(c)	Filter clogged alarm	Replace clogged filter elements and clean filter casing
(d)	Loss of pressurisation (Fan Room)	Investigate cause
(e)	Loss of pressurisation (substation)	Investigate cause

3.3 Control Room:

(a)	Fan motor fault	Investigate cause
(b)	Refrigeration pump motor fault	Investigate cause
(c)	Circulating pump motor fault	Investigate cause
(d)	Low humidity alarm	
(e)	High temperature, outlet alarm	
(f)	Loss of flow alarm	Duty pump stops and standby pump starts automatically. If alarm trips again then standby pump stops, all dampers close and an alarm signal passes to the Shutdown System
(g)	Low temperature, inlet alarm	
(h)	Loss of pressurisation alarm	
(j)	HP cut out (refrigeration package)	
(k)	LP cut out (refrigeration package)	

3.4	**Workshop**	
	(a) Fan motor fault	Investigate cause
	(b) Filter clogged alarm	Replace clogged filter elements and clean casing
	(c) Loss of flow alarm	Duty pump stops and standby pump starts automatically. If alarm trips again then standby pump stops, all dampers close and an alarm signal passes to the Shutdown System
	(d) Loss of pressurisation alarm	
3.5	**Turbogenerator Room**	
	(a) Fan motor fault	Investigate cause
	(b) Filter clogged alarm	Replace clogged filter elements and clean casing
	(c) Loss of flow alarm	Duty pump stops and standby pump starts automatically. If alarm trips again then standby pump stops, all dampers close and an alarm signal passes to the Shutdown System
	(d) Loss of pressurisation (Mezzanine)	
	(e) Loss of pressurisation (Turbine Room)	
3.6	**Diesel Firepump Rooms:**	
	(a) Fan motor fault	Investigate cause
	(b) Loss of flow alarm	Duty pump stops and standby pump starts automatically. If alarm trips again then standby pump stops, all dampers close and alarm signal passes to the Shutdown System
	(c) Loss of pressurisation alarm	
3.7	**Battery Room**	
	(a) Fan motor fault	Investigate cause
	(b) Loss of flow alarm	Duty pump stops and standby pump starts automatically. If alarm trips again then standby pump stops. All battery charging will stop
	(c) Loss of pressurisation	
3.8	**Emergency Substation**	
	(a) Fan motor fault	Investigate cause
	(b) Filter clogged alarm	Replace clogged filter elements and clean casing
	(c) Loss of flow alarm	Duty pump stops and standby pump starts automatically. If alarm trips again then standby pump stops, all dampers close and an alarm signal passes to the Shutdown System
	(d) Loss of pressurisation alarm	

3.9 Transformer Room

(a)	Fan motor fault	Investigate cause
(b)	Loss of flow alarm	Duty pump stops and standby pump starts automatically. If alarm trips again then standby pump stops, all dampers close and an alarm signal passes to the Shutdown System
(c)	Clogged filter (Room 'A')	Replace clogged filter elements and clean casing
(d)	Clogged filter (Room 'B')	Replace clogged filter elements and clean casing

SECTION 3 – SYSTEM START-UP

1 PRESTART CHECKS (all plant systems)

(a) Electrical power available for equipment and alarms.

(b) Instrument air available and all required instrument root valves open.

(c) All system alarms cancelled in the TCP2 Control Room.

(d) All system drain valves closed.

(e) Fresh water available to the refrigeration package.

(f) Potable water available to the humidifier circulating tank.

2 START-UP

NOTE
Before starting up, Pancake 44 must be checked and classified as safe in respect of explosive gases. Then the Control Room system should be started, followed by the Main Substation System.

2.1 Dual Fan System (Fan 'A' duty with fan 'B' standby)

(1) Set the Local/Control Room selector hand switch to the CONTROL ROOM position.

(2) Set the Manual/Standby selector hand switch to the MANUAL position.

(3) Check that the MANUAL OR STANDBY AS DUTY lamp on the TCP2 control panel is flashing.

(4) When the NO FLOW alarm lamp on the TCP2 control panel goes out, flow has been established.

(5) Set the Manual/Standby selector switch to the 'A' DUTY–'B' STANDBY position.

(6) Check that the MANUAL OR STANDBY AS DUTY lamp on the TCP2 control panel goes out. The system will now operate automatically.

2.2 Single Fan System

(1) Set the Local/Control Room selector hand switch to the CONTROL ROOM position.

(2) Start the fan by pressing the Start pushbutton on the TCP2 control panel.

(3) Check that the STOP lamp on the TCP2 control panel is extinguished and that the RUN lamp is illuminated. The system will now operate automatically.

2.3 Control Room System

2.3.1 'Black' Start Procedure

(1) Set the Normal/Black Start hand selector switch to the BLACK START position.

(2) Press the Start/Stop pushbutton. This will start fan 'B' and open the necessary dampers.

(3) Check the Control Room with manually operated gas detectors at this stage, to ensure that there is no explosion danger before energising equipment. Allow fan to run for 30 minutes.

(4) Start system in the same way as other dual fan systems (see para 2.1).

2.3.2 Normal Start Procedure

(1) Start the system in the same way as the other dual fan systems (para 2.1).

(2) About 30 minutes after start (purging time) the recirculating damper opens automatically and the preheater, heater, circulating pump for humidifier and the refrigeration package are powered.

3 NORMAL SHUTDOWN (all plant systems)

(1) Stop the duty fan by pressing the fan Stop pushbutton at the selected control location (ie Local or Control Room).

(2) Check that the RUN lamp on the TCP2 control panel is extinguished and that the STOP lamp is illuminated. The system should now shut down automatically.

Symptom	Possible Cause	Action
Fan fails to start on manual start command. (Fault lamp illuminated)	(a) No electrical supply.	Check supply source.
	(b) Start selector hand switch incorrectly positioned.	Select appropriate mode, ie Local/Control Room.
	(c) Running/Auto Start/Manual selector switch incorrectly positioned.	Position both selector arms to MANUAL.
	(d) Motor malfunction.	Check all cut-out alarms for appropriate fan. Rectify fault.
Fan fails to start on automatic start command.	(a) Manual/Auto selector switch incorrectly positioned inside TCP2 control panel.	Select correct mode.
	(b) Running/Auto Start/Manual selector switch incorrectly positioned.	Position selector arms to correct modes.
No Flow alarm stops standby fan and closes all dampers. (No Flow alarm)	(a) Blockage in inlet ducting.	Check ducting.
	(b) Filter blocked.	Check filter elements, replace if necessary.
	(c) Faulty damper.	Check dampers.
Heater battery not functioning.	(a) No electrical supply.	Check supply source.
	(b) Faulty thermostat.	Check thermostat.
Circulating pump fails to start. (Fault lamp illuminated)	(a) No electrical supply.	Check supply source.
	(b) Motor malfunction.	Check motor.
Compressor fails to start. (Fault lamp illuminated)	(a) No electrical supply.	Check supply source.
	(b) Motor malfunction.	Check motor.

PART E

SAFETY

CONTENTS

CHAPTER E1 SAFETY DESIGN CONCEPT

CHAPTER E2 FIRE DETECTION SYSTEM

CHAPTER E3 GAS DETECTION SYSTEM

CHAPTER E4 HALON SYSTEMS

CHAPTER E5 FIREWATER SYSTEMS

CHAPTER E6 PERSONNEL SAFETY

CHAPTER E7 CHEMICAL HAZARDS

CHAPTER E1

SAFETY DESIGN CONCEPT

CONTENTS

SECTION 1 SUMMARY

SECTION 1 – SUMMARY

1 The Safety Design Concept for the TCP2 Gas Compression area employs the same principles as those used in the design, construction and operation of the existing TCP2 Treatment facility and for the other platforms in the Frigg complex.

2 These design principles ensure the safety of equipment and personnel in respect of:

(a) Structural detail and tolerances of modules, pancakes and installed equipment.

(b) Automated and logic-controlled instrumentation and controls.

(c) Emergency Shutdown, which provides for automatic and/or manual shutdowns at process, plant and equipment level and is fully integrated with TCP2–T and all other Frigg platforms.

(d) Standby and emergency electrical power supplies, also integrated with the Frigg power network.

(e) Detection of potentially explosive hydrocarbon gas mixtures, and fire.

(f) Protection of personnel and equipment against explosion or fire hazards by means of Halon, CO_2 and dry chemical powder extinguishing systems; firewater deluge and water spray/sprinkler systems; and both fixed and portable firefighting equipment.

(g) Personnel evacuation and lifesaving facilities and equipment.

3 The six succeeding chapters in this part of the manual summarise the operational aspects of the foregoing, viz:

Fire Detection
Gas Detection
Halon Systems
Firewater Systems
Personnel Safety
Chemical Hazards

CHAPTER E2

FIRE DETECTION SYSTEM

CONTENTS

SECTION 1 DESCRIPTION

1. Summary
2. Detection Equipment
3. Fire Detection Panel
4. External Alarms

SECTION 2 PROTECTED AREAS

1. Cellar Deck
2. Main and Upper Decks

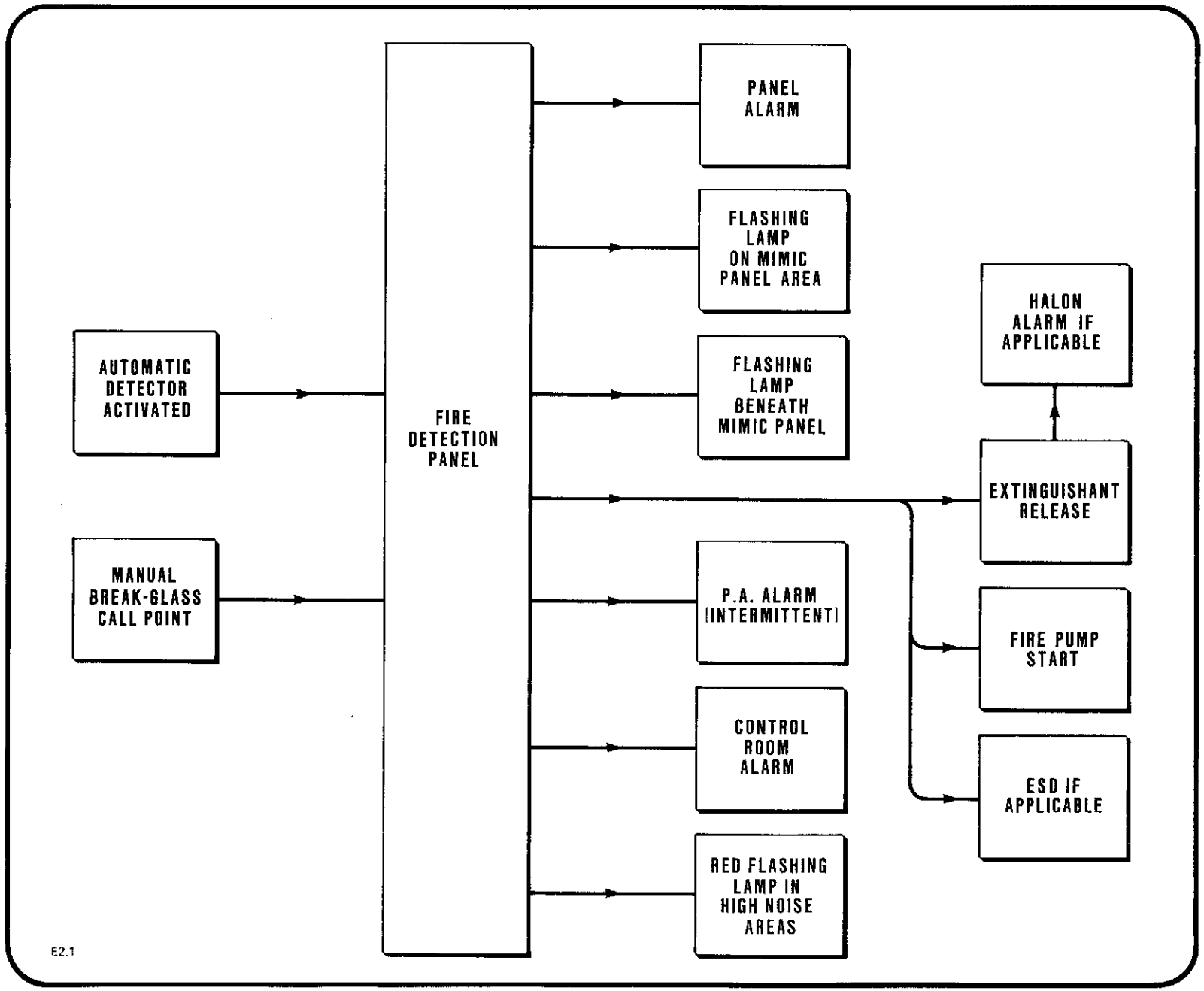
SECTION 3 OPERATION

1. Operating Philosophy
2. Start-up
3. Checks After Start-up

ILLUSTRATIONS

E2.1 Block Diagram
E2.2 Detection Equipment
(A) Heyes Type 1026F/A Break Glass Fire Alarm Pushbutton
(B) Cerberus Type F6AEX Smoke Detector
(C) DetTronics Type U7600A Flame Detector
(D) Fenwal Type 27121–20 Heat Detector
E2.3 Fire Detection Panel
E2.4 Operating Method

E2.1	FIRE DETECTION SYSTEM. BLOCK DIAGRAM	ISSUE 1. OCT 1980



SECTION 1 – DESCRIPTION

1 SUMMARY

See illustration E2.1

1.1 The Gas Compression area Fire Detection System is fitted to perform the following:

(a) Cause alarms to annunciate and thus inform personnel in the event of a fire.

(b) Initiate automatic actions to avoid the extension of the fire and, if possible, to extinguish it.

1.2 Automatic fire detectors are strategically located throughout the protected areas (see Section 2). Activation of a detector or detectors will send a signal to the Fire Detection Panel located in the TCP2 Control Room.

1.3 The automatic detectors are fitted in detection loops located within each protected area. Each detection loop is duplicated to ensure that failure or isolation of one loop does not leave the respective area unprotected.

1.4 Several detectors may be fitted to an individual loop. However, to prevent the inadvertent activation of one detector initiating extinguishant release, they are coincidence-linked. This coincidence linking operates as follows:

(a) One detector within a loop activated:

Alarm only.

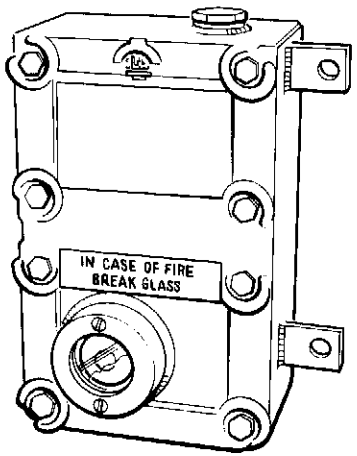
(b) Second detector within the same loop activated, irrespective of the number of detectors fitted to that loop:

(i) Alarm.

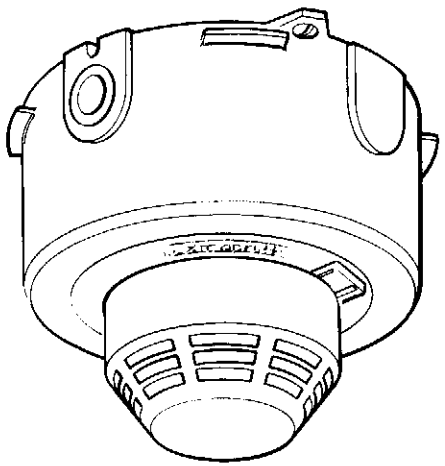
(ii) Initiation of extinguishant release.

(iii) Activation of required safety systems and relevant ESD.

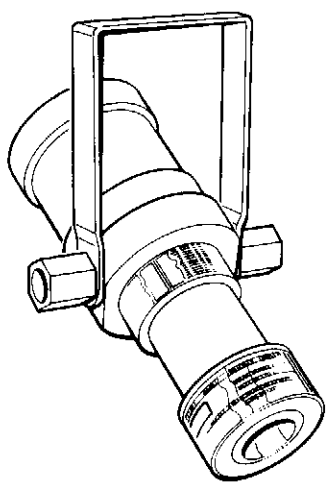
1.5 Manual break-glass fire alarm boxes (FABs) incorporating push-buttons are located in all protected areas. These allow manual initiation of the fire detection system should the automatic detectors fail, or the fire be visually observed before the detectors activate. (See illustration E2.2(A).)



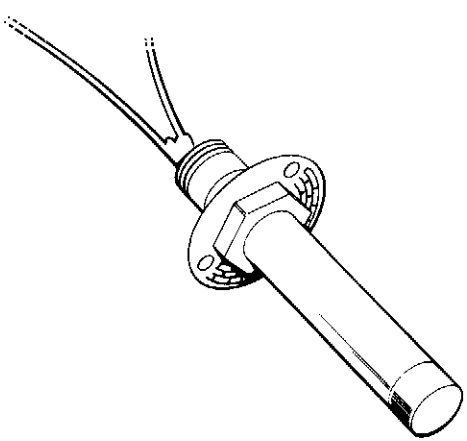
A HEYES TYPE 1026F/A
BREAK GLASS FIRE ALARM
PUSHBUTTON



B CERBERUS TYPE F6AEX
SMOKE DETECTOR



C DET TRONICS TYPE U7600A
FLAME DETECTOR



D FENWAL TYPE 27121-20
HEAT DETECTOR

2 DETECTION EQUIPMENT

See illustration E2.2

2.1 Three different types of fire detector are fitted (smoke, flame and heat), each designed to sense the type of fire that is liable to ignite within the area in which they are located. Each type is described individually in the following text.

2.2 Smoke Detector (E2.2(B))

2.2.1 The Cerberus Type F6AEX smoke detector is used to detect and respond to the visible and invisible products of combustion. The detector comprises two chambers, one open and one closed. Relatively harmless radioactive sources ionise the air in both chambers.

WARNING
THE DETECTOR HEAD CONTAINS A SMALL QUANTITY OF RADIOACTIVE MATERIAL AND SHOULD NEVER BE DISMANTLED UNDER ANY CIRCUMSTANCES.

2.2.2 The chambers are linked electrically, forming a balanced circuit in a quiescent condition. The presence of even a minute quantity of combustion particles in the open chamber will disturb the electrical balance and cause a sensitive, cold cathode tube within the detector to switch to an alarm condition. Simultaneously, a response indicator, located on the base of the detector, will illuminate.

2.2.3 The detector has a 'self hold' facility which will maintain the alarm condition, even if the combustion particles have dispersed, until it is reset at the fire protection panel.

2.2.4 The detectors are sensitive to wind, humidity and dust of any kind. They are also sensitive to smoke produced by welding. Therefore, prior to any operation which would knowingly produce any of the aforementioned sensitive products, the detectors must be isolated.

2.3 Flame Detector (E2.2(C))

2.3.1 The DetTronics Type U7600A flame detector is used to detect ultra-violet (U/V) transmission and is therefore insensitive to very smoky fires. The detector uses a Geiger-Muller type tube incorporating a tungsten cathode to detect U/V radiation in wavelengths from 1850 to 2450 Ångströms. This range is outside that of sunlight and artificial light and therefore the detector is insensitive to them.

2.3.2 However, the U/V sensor is sensitive to arc welding which is an intense source of U/V radiation. It is also sensitive to both gamma and X-rays. The glass envelope of the detector is thick enough to prevent the detection of alpha and beta particles. If any of the aforementioned sensitive products are going to be knowingly produced, the detectors must be isolated.

2.3.3 A time delay of 3 seconds is incorporated in the detector sensing system to prevent false alarms caused by lightning, which is within the U/V detection range.

2.3.4 All the electrical components within the detector, and the cleanliness of the viewing lens can be checked by using the 'Optical Integrity' facility incorporated in the detector.

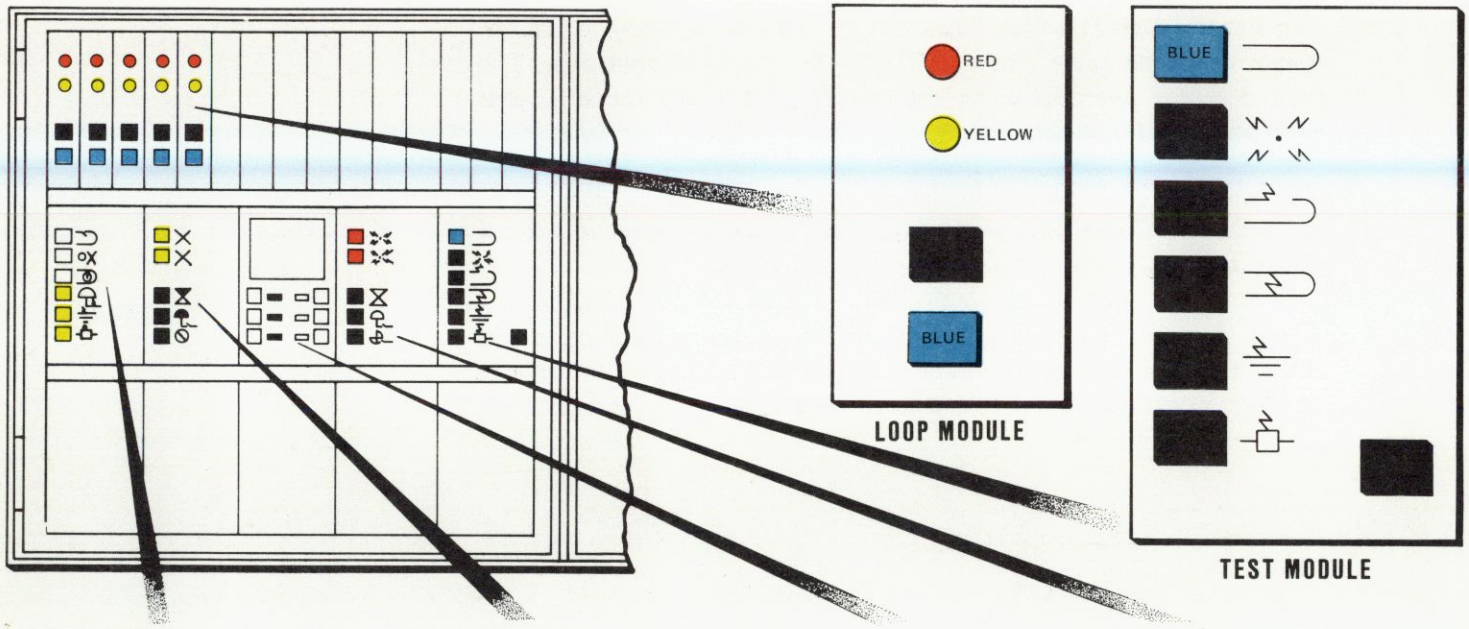
2.3.5 In the event of the detector responding to U/V within its range, an alarm condition will be transmitted to the fire detection panel. Simultaneously, a response indicator, visible through the quartz window of the detector, will illuminate.

2.4 Heat Detector (E2.2(D))

2.4.1 The Fenwal Detect-a-Fire Type 27121–20 heat detector is used to detect a temperature rise to 57°C within its protected area. The heat detector operates using the principle of differing coefficients of expansion of metals.

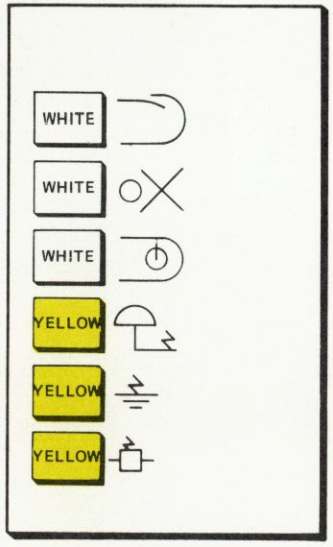
2.4.2 The stainless steel barrel of the detector has a high coefficient of expansion, whereas the sprung metal bow inside the barrel (which is fitted with electrical contacts) has a lower coefficient.

2.4.3 A rise in ambient temperature will cause the barrel to expand and thus allow the normally open contacts to close and, in turn, initiate an alarm condition at the fire detection panel.

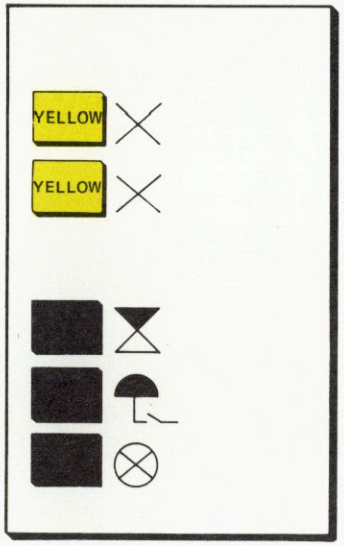


LOOP MODULE

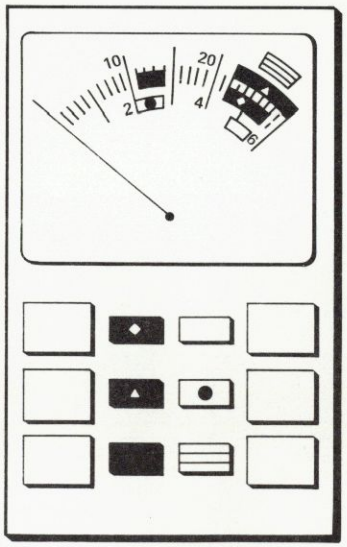
TEST MODULE



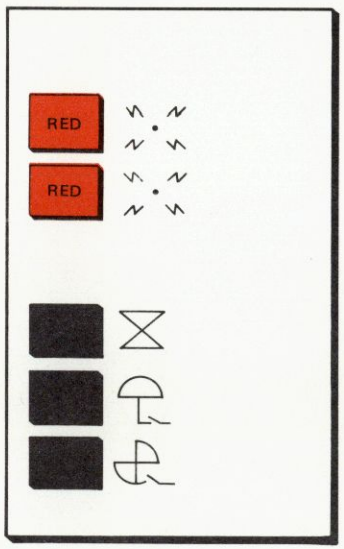
CHECKING MODULE



FAULT MODULE



METERING MODULE



ALARM MODULE

E2.3

3 FIRE DETECTION PANEL

See illustration E2.3

3.1 The Fire Detection Panel (Panel 6A) is located in the TCP2 Control Room and comprises three frames marked Frame 1, Frame 2 and Frame 3. Each frame contains several fire detection Loop Modules, one for each detection loop fitted inside a protected area. The Loop Module is clearly marked with the area that it is monitoring. Each frame is also fitted with a Control Board which incorporates five separate panels (see paragraph 3.8).

3.2 The Fire Detection Panel has two distinct internal alarms, annunciating FIRE and FAULT. A similar acoustic warning is used for both conditions. However, the FIRE alarm is intermittent whereas the FAULT alarm is continuous. The Control Room alarm will also annunciate if a fire condition arises.

3.3 The individual Loop Modules are electrically linked to a detector loop within a protected area. On actuation of at least two detectors on that loop, the Loop Module analyses the signal, initiates the correct alarm actions and also commands its two duplicate Programmable Logic Controllers (PLCs) to initiate operation of the relevant safety systems associated with that particular area.

3.4 A red flashing FIRE lamp will illuminate on the Loop Module in an alarm condition. Simultaneously, the panel FIRE alarm will annunciate.

3.5 Individual fire detection loops can be isolated by depressing the black Isolation pushbutton fitted on the respective Loop Module.

3.6 Should a fault occur in a detection loop, the steady yellow FAULT lamp incorporated in the respective Loop Module will illuminate. Simultaneously, the panel FAULT alarm will annunciate (see paragraphs 3.8.1(d), (e), (f) and 3.8.2(NOTE) for probable faults).

3.7 A blue Test pushbutton is fitted to each Loop Module. When depressed, it provides the facility to test the various monitored malfunctions associated with that loop (see paragraph 3.8.5).

3.8 The Control Board in each frame comprises five panels marked Checking Module, Fault Module, Metering Module, Alarm Module and Test Module. Each of these modules has a variety of lamps, pushbuttons and indicators, the functions of which are as follows:

3.8.1 Checking Module

Six lamps are fitted to this module and (reading from top to bottom) when illuminated, indicate the following abnormal situations:

(a) White lamp – One or more detector loops electrically disconnected (black Isolation pushbutton depressed on relevant Loop Modules). This signifies that no detection signals can be originated from these loops.

(b) White lamp – Panel Controlled Devices Disconnected, ie Fault Bells (see Fault Module) or Alarm Bells (see Alarm Module) or Controlled Devices (see Alarm Module) pushbuttons depressed.

(c) White lamp – This lamp illuminates if both the Alarm Bells and the Controlled Devices pushbuttons are depressed on the Alarm Module. In this condition, Control Boards and detector loops can be tested without the risk of alarms.

(d) Yellow lamp – Fault in an alarm bell circuit.

(e) Yellow lamp – Earth fault in a detector loop.

NOTE
This fault does not cause an individual Loop Module FAULT lamp to illuminate. The only way to determine which loop is affected is to individually isolate and then de-isolate each Loop Module in turn until such time as the EARTH FAULT lamp extinguishes.

(f) Yellow lamp – Fault in power supply, ie failure of battery, rectifier, 5V logic voltage, 21V regulated voltage or a ruptured fuse.

3.8.2 Fault Module

Two lamps and three pushbuttons are fitted vertically in this module. The lamps are both coloured yellow and, when illuminated, indicate a system fault. The type of fault will be ascertained by observing which fault lamp is illuminated on the Checking Module. When these fault lamps are illuminated, the panel FAULT alarm will annunciate. The three pushbuttons are coloured black and (reading from top to bottom) when depressed, perform the following:

(a) Resets the FAULT alarm. The FAULT lamps will extinguish and the FAULT alarm will stop. However, the lamp on the Checking Module denoting the nature of the fault will remain illuminated until the fault is repaired.

(b) Inhibits the FAULT alarm. This may be desirable when checking the installation.

(c) Tests all lamps on the control panel.

NOTE
The following faults are denoted by alarm only, without any corresponding lamp to denote the nature of the fault.

(i) Ruptured main fuse (6A).

(ii) Failure of both battery supply and rectifier.

(iii) Ruptured control loop (strap).

(iv) Ruptured internal (2.4V) battery circuit.

(v) Failure of the 21V regulated voltage.

3.8.3 Metering Module

This module comprises a voltmeter and six pushbuttons. A display of voltage for various parts of the system can be obtained by depressing the relevant pushbutton. Each pushbutton has a symbol code alongside. The code is duplicated on the instrument scale. When one of the pushbuttons is depressed, the instrument pointer should lie within the relevant symbol code on the scale. The system voltages, with their allowable voltage ranges are as follows:

(a) Working Supply 22 to 28V.

(b) Logic 4.4 to 5.5V.

(c) External Rectifier 22 to 30V.

(d) Internal Reference 11 to 14V.

(e) Converter 248 to 272V.

(f) Built-in Battery 2.0 to 2.8V.

NOTE
On commissioning or after prolonged periods of being switched off, the battery may have discharged. Full working capacity will however be restored after a few hours following switching on.

3.8.4 Alarm Module

The two red lamps in this module will flash when a fire condition prevails in a protected area. Simultaneously, the Control Room and panel FIRE alarms will annunciate. The three black pushbuttons (reading from top to bottom) when depressed, perform the following:

(a) When the fire warning has registered and the necessary counter-measures have been taken, this pushbutton will reset the alarm condition.

(b) Disconnects the alarm bell.

(c) Disconnects the controlled devices, ie the panel ventilation fans and the electromagnetic panel doors.

3.8.5 Test Module

This module is used to ascertain that all the relevant monitored malfunctions for each individual Loop Module are operating correctly and to test the fire alarms. Prior to testing, the required Loop Module blue Test pushbutton must be depressed. Each Loop Module is to be tested independently and, on completion of the test, the blue Test pushbutton should be pressed to release. When a Loop Module is ready for test, the top blue lamp on the Test Module will illuminate. Each of the black pushbuttons on the Test Module should now be depressed individually and (reading from top to bottom) will test the following:

(a) This will test the Loop Module FIRE alarm lamp which should flash three times and then automatically reset. Simultaneously, the FIRE alarm lamps on the Alarm Module will flash and automatically reset.

(b) To test for a ruptured loop. The yellow FAULT lamps on the Loop Module and Fault Module will illuminate. To reset, depress the black Reset pushbutton on the Fault Module.

(c) Test for short circuit, this will react in an identical manner as when testing the FIRE alarm.

(d) This pushbutton tests the earth fault. The FAULT lamps on the Fault Module should illuminate and the corresponding EARTH FAULT lamp on the Checking Module. To reset, depress the black Reset pushbutton on the Fault Module.

(e) This pushbutton tests for faulty supply. The FAULT lamps on the Fault Module and the corresponding FAULT IN SUPPLY lamp on the Checking Module should illuminate. To reset, depress the black Reset pushbutton on the Fault Module.

4 EXTERNAL ALARMS

4.1 In addition to the internal alarm system incorporated in the Fire Detection Panel and the Control Room alarm, the following alarms annunciate if a fire condition exists:

(a) Flashing lamp in the affected area on the mimic panel.

(b) Flashing FIRE alarm lamp located beneath the mimic panel.

(c) Flashing lamp, located beneath the mimic panel, to indicate the type of extinguishant released into the affected area.

(d) PA alarm in TCP2–C, TCP2–T, TP1 and QP.

(e) Local HALON RELEASED alarm, if applicable.

SECTION 2 – PROTECTED AREAS

1 CELLAR DECK

1.1 The following detection equipment and fire alarm boxes (FABs) are fitted on the Cellar Deck (excluding those inside turbine hoods). The numbers alongside the detectors correspond with those on the respective Loop Modules on the Fire Detection Panel:

1.1.1 **Pancake 40**

(a) Two U/V detectors AUV 40–1, AUV 40–2.

(b) Two FABs FAB 40–1, FAB 40–2.

1.1.2 **Pancake 41**

(a) Four heat detectors AEF 41–1/3, AEF 41–2/4.

(b) Six smoke detectors AES 41–1/3, AES 41–2/4, AES 41–5, AES 41–6.

(c) Two FABs FAB 41–1, FAB 41–2.

1.1.3 **Pancake 42**

(a) Two heat detectors AEF 42–1, AEF 42–2.

(b) Six smoke detectors AES 42–3/4/6, AES 42–1/2/5.

(c) Two FABs FAB 42–1, FAB 42–2.

1.1.4 **Pancake 43**

Two smoke detectors AES 43–1, AES 43–2.

1.1.5 **Pancake 44**

(a) Two heat detectors AEF 44–1/2.

(b) Four smoke detectors AES 44–1, AES 44–2, AES 44–3, AES 44–4.

(c) Two FABs FAB 44–1, FAB 44–2.

1.1.6 **Pancake 46**

Two heat detectors AEF46–1, AEF 46–2.

1.1.7 **Column 3 (Area 63)**

(a) Two heat detectors AEF 63–1, AEF 63–2.

(b) Four smoke detectors AES 63–1/3, AES 63–2/4.

(c) One FAB FAB 63–1.

2 MAIN AND UPPER DECKS

2.1 The following detection equipment and fire alarm boxes (FABs) are fitted on the Main and Upper Decks. (Some of the smoke detectors in the substation in Module 32 are located beneath the false floor.) The numbers alongside the detectors correspond with those on their respective Loop Module on the Fire Detection Panel:

2.1.1 **Module 30**

(a) Eight U/V detectors AUV 30–1, AUV 30–2, AUV 30–3, AUV 30–4, AUV 30–6/7/8/9.

(b) Four smoke detectors AES 30–1/4, AES 30–2/3.

(c) Six FABs FAB 30–1, FAB 30–2/3, FAB 30–4/5, FAB 30–6.

2.1.2 **Module 31**

(a) Eight U/V detectors AUV 31–1, AUV 31–2, AUV 31–3, AUV 31–4, AUV 31–6/7/8/9.

(b) Four smoke detectors AES 31–1/4, AES 31–2/3.

(c) Six FABs FAB 31–1, FAB 31–2/3, FAB 31–4, FAB 31–5/6.

2.1.3 **Module 32 (including the Substation and Control Room)**

(a) Four U/V detectors AUV 32–5/3, AUV 32–6/2.

(b) Thirty smoke detectors AES 32–1, AES 32–2, AES 32–3/39, AES 32–4/38, AES 32–5, AES 32–6, AES 32–7, AES 32–8, AES 32–9, AES 32–10, AES 32–18/21/23, AES 32–19/24/29, AES 32–20/26/28, AES 32–22/25/27, AES 32–31, AES 32–32, AES 32–33, AES 32–34, AES 32–36, AES 32–37.

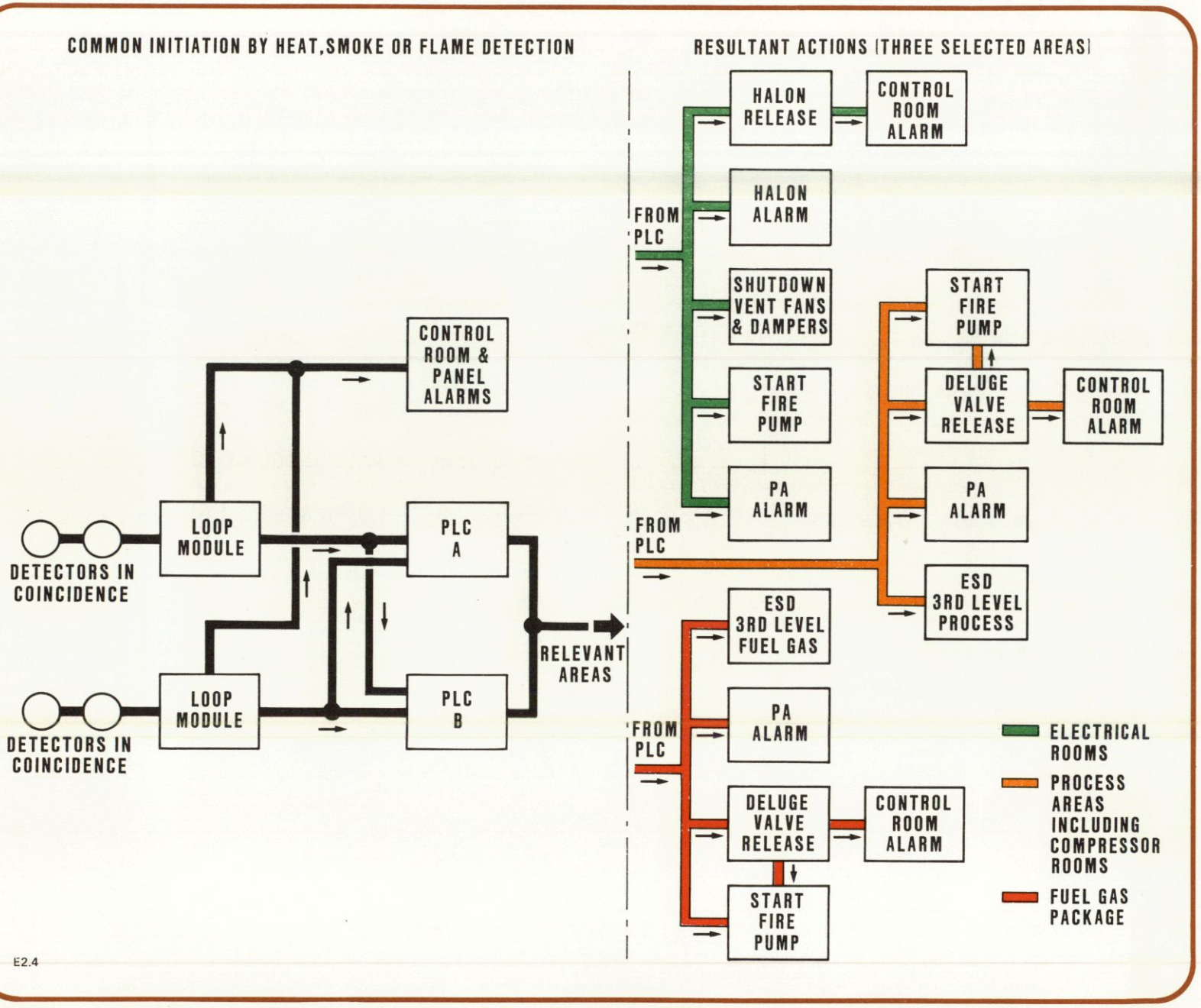
(c) Eleven FABs FAB 32–1/2, FAB 32–3, FAB 32–4, FAB 32–5, FAB 32–6/9, FAB 32–7/10, FAB 32–8, FAB 32–11.

2.1.4 **Module 33**

(a) Eight U/V detectors AUV 33–1, AUV 33–2, AUV 33–5, AUV 33–4, AUV 33–6/7, AUV 33–8/9.

(b) Four smoke detectors AES 33–1/4, AES 33–2/3.

(c) Seven FABs FAB 33–1, FAB 33–2/3, FAB 33–4/5/6/7.


COMMON INITIATION BY HEAT,SMOKE OR FLAME DETECTION
RESULTANT ACTIONS (THREE SELECTED AREAS)
CONTROL ROOM & PANEL ALARMS
LOOP MODULE
DETECTORS IN COINCIDENCE
PLC A
LOOP MODULE
DETECTORS IN COINCIDENCE
PLC B
RELEVANT AREAS
FROM PLC
HALON RELEASE
CONTROL ROOM ALARM
HALON ALARM
SHUTDOWN VENT FANS & DAMPERS
START FIRE PUMP
PA ALARM
FROM PLC
START FIRE PUMP
DELUGE VALVE RELEASE
CONTROL ROOM ALARM
PA ALARM
ESD 3RD LEVEL PROCESS
FROM PLC
ESD 3RD LEVEL FUEL GAS
PA ALARM
DELUGE VALVE RELEASE
CONTROL ROOM ALARM
START FIRE PUMP
ELECTRICAL ROOMS
PROCESS AREAS INCLUDING COMPRESSOR ROOMS
FUEL GAS PACKAGE

SECTION 3 – OPERATION

1 OPERATING PHILOSOPHY

See illustration E2.4

1.1 If at least two coincidence-linked detectors sense a fire in their area, a signal from the respective Loop Modules will activate the Programmable Logic Controllers (PLCs) to initiate the required safety systems for that particular protected area.

1.2 Not all areas are linked into the ESD system. However, the individual PLCs are pre-programmed to initiate the required ESDs as explained in Part F (Emergency Shutdown) of this manual.

1.3 Three typical PLC programmes are shown in illustration E2.4.

2 START-UP

2.1 The following prestart requisites are necessary:

(a) Alarm system in the Control Room, commissioned.

(b) Power supplies available.

(c) PLCs commissioned and operational.

(d) PA system operational.

(e) Control Room personnel on duty.

2.2 When all the prestart requisites are confirmed, switching on power supply to the panel will render the system fully operational.

3 CHECKS AFTER START-UP

3.1 The panel should be checked at least twice daily to ensure normal operation.

3.2 If any zone is to be isolated, the Safety Officer is to be informed.

CHAPTER E3

GAS DETECTION SYSTEM

CONTENTS

SECTION 1 DESCRIPTION

1. Summary
2. Detectors
3. Gas Detection Panel
4. Alarms

SECTION 2 PROTECTED AREAS

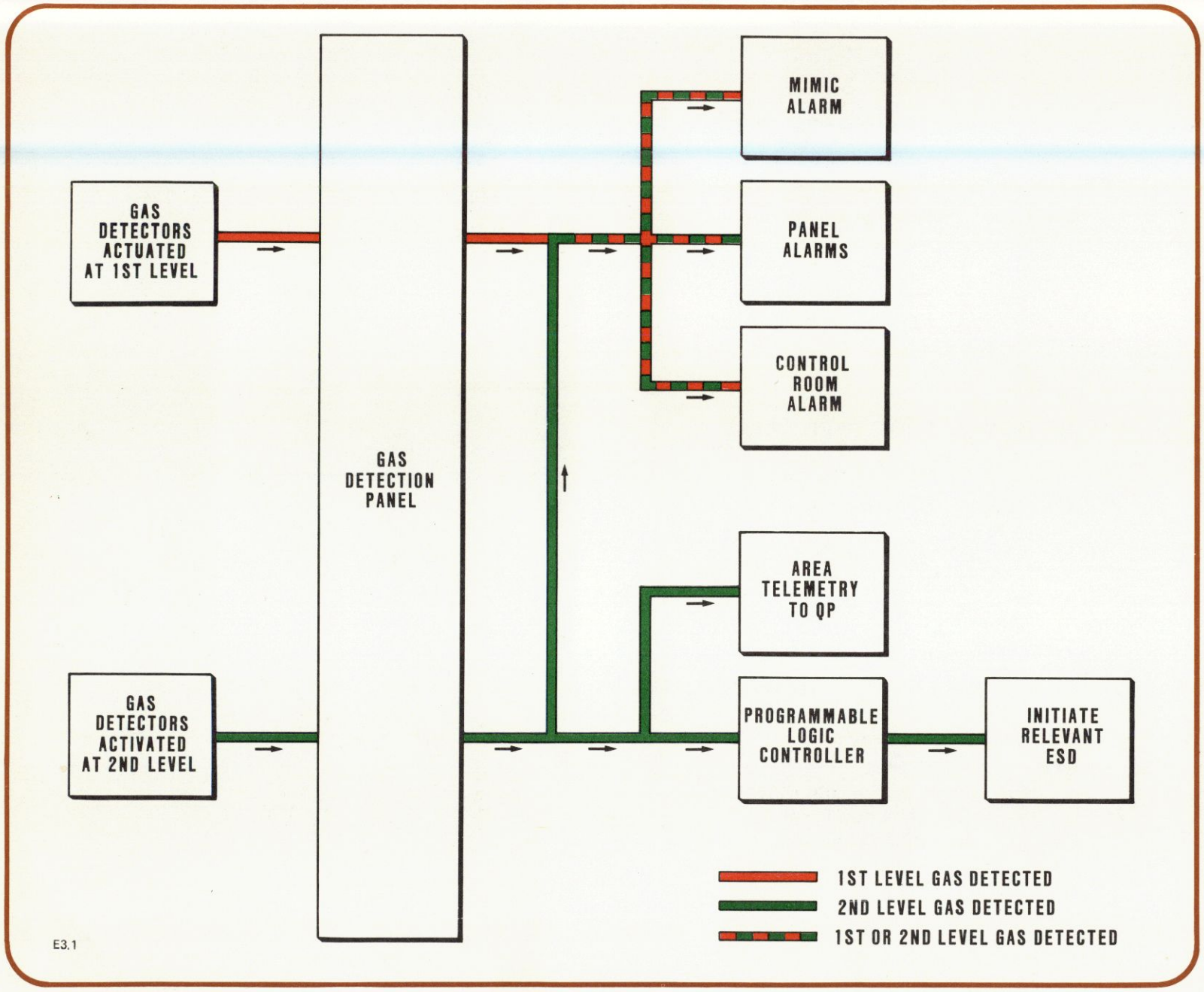
SECTION 3 OPERATION

1. Operating Philosophy
2. Start-up
3. Checks After Start-up

ILLUSTRATIONS

E3.1 Block Diagram
E3.2 Equipment
(A) Icare Type M Gas Detector
(B) Gas Detection Panel
E3.3 Initiation Schematic

E3.1	GAS DETECTION SYSTEM. BLOCK DIAGRAM	ISSUE 1. OCT 1980



E3.1

SECTION 1 – DESCRIPTION

1 SUMMARY

See illustration E3.1

1.1 The presence of gas in any part of the platform is a dangerous situation that requires prompt action. The Gas Detection System is fitted to detect the presence of hydrocarbon gases and to initiate the following actions:

(a) Cause alarms to annunciate (and thus warn personnel of a potentially hazardous situation) in the event of 20 per cent LEL being detected inside a monitored area.

NOTE
LEL is the 'Lower Explosive Limit', ie the lowest concentration of hydrocarbon gas in air that could ignite and cause an explosion.

(b) Cause further alarms to annunciate and also to initiate the relevant safety and emergency shutdown systems should 60 per cent LEL be detected.

The purpose of these actions is to avoid ignition of the gas and to reduce (and if possible stop) the gas leak.

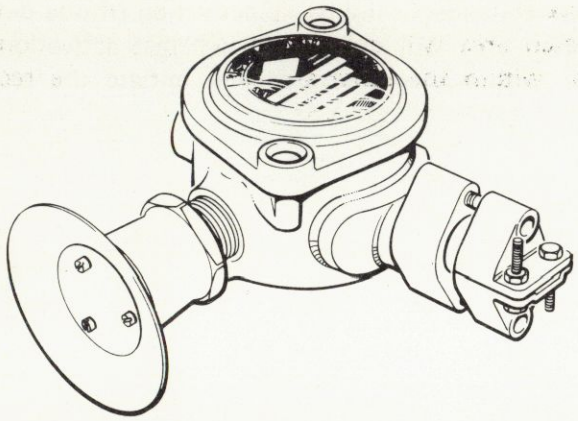
1.2 Automatic gas detectors are strategically located throughout areas where the danger of gas leakage is prevalent. This includes some ventilation ducting. Icare Type M detectors (see paragraph 2 for description) are used in these areas. However, Icare Type THX detectors are used underneath the turbine hoods.

NOTE
This chapter does not describe the gas detection equipment fitted in the UTI (gas compression) and Stal Laval (generator) gas turbines.

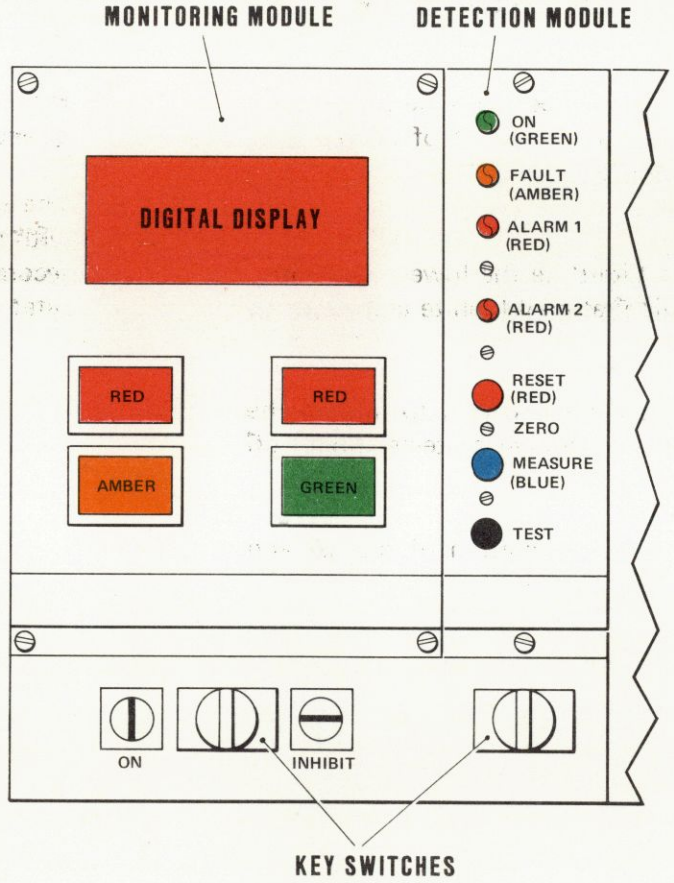
1.3 Activation of a detector will transmit a signal to the Gas Detection Panel located in the TCP2 Control Room. This signal, depending on the level of gas detected, will activate the required alarms and safety devices.

1.4 The detectors are coincidence-linked, ie activation of one detector within a protected area will only alarm, whereas activation of a second detector within the same area will initiate the required safety devices.

(A) ICARE TYPE M GAS DETECTOR



(B) GAS DETECTION PANEL



2 DETECTORS

See illustration E3.2(A)

2.1 Within the detector housing are two sets of finely wound platinum filaments (the compensating and sensitised filaments) which are impregnated with chemicals of different catalytic properties. The filaments form two arms of a Wheatstone Bridge circuit and the operating current flowing through the circuit supplies the heat to bring the catalysts to their correct operating temperature. Under normal conditions the bridge is balanced and there is no output across it.

2.2 The compensating filament is insensitive to flammable gas but balances out the small resistance changes due to fluctuations in ambient temperature. The sensitised filament reacts to the presence of flammable gas.

2.3 In the presence of flammable gas, catalytic oxidation takes place at the sensitised filament. This raises its temperature and hence its electrical resistance, thus unbalancing the bridge. The out of balance voltage produced is proportional to the amount of gas present. The signal thus derived is transmitted to the respective Detector Module located on the Gas Detection Panel.

3 GAS DETECTION PANEL (PANEL 6B)

See illustration E3.2(B)

3.1 The Gas Detection Panel is located in the TCP2 Control Room and comprises three cabinets. Each cabinet contains several gas Detector Modules and one Monitoring Module. The centre cabinet is also fitted with POWER FAILURE indicating lamps for each of the three cabinets.

3.2 The gas Detector Modules are individually connected electrically to a single gas detector head located within a protected area. Each gas Detector Module is clearly marked with the relevant area that it is monitoring.

3.2.1 The functions of the Detector Module are as follows:

(a) To analyse the signal from the detector head.

(b) To initiate the correct action signals to the Monitoring Module, alarm systems and the programmable logic controllers (PLCs); these in turn activate the required ESD.

(c) The Detector Module front plate displays (by means of illuminated lamps) the following:

(i) POWER ON (green).

(ii) FAULT (amber).

(iii) First level gas detection (ALARM 1) (red).

(iv) Second level gas detection (ALARM 2) (red).

3.2.2 Activation of the FAULT lamp and corresponding FAULT alarm would indicate one or more of the following malfunctions.

(a) Short circuit.

(b) Break in loop.

(c) The ZERO adjustment has drifted below −5 per cent.

3.2.3 Activation of the FAULT alarm only would indicate lack of power supply or a defective fuse. Corresponding FAULT IN GAS DETECTION SYSTEM alarms will annunciate on the mimic and on QP if a fault condition arises.

3.2.4 Activation of the first level alarm would cause the following corresponding alarms to annunciate:

(a) 20 per cent GAS on mimic.

(b) Zone alarm on mimic.

3.2.5 Activation of the second level alarm would cause the following corresponding alarms to annunciate:

(a) 60 per cent GAS on mimic.

(b) Zone alarm on mimic.

(c) 60 per cent GAS plus zone on QP.

3.2.6 The gas Detector Module is also fitted with the following push-buttons:

(a) Reset (red) — When gas is no longer being detected by the detector head, this button is to be depressed to reset alarms 1 and 2.

(b) Measure (blue) — When the monitored area is in an alarm condition, depressing this button will indicate the concentration of gas within the area. The reading can be observed on the Monitoring Module digital indicator. If the corresponding detector head is no longer detecting gas, the reading should be ZERO. The adjustable screw located above the Measure button is used to obtain zero if the observed reading is incorrect.

(c) Test (black) — Depressing this pushbutton will successively activate alarms 1 and 2 without corresponding actions on the alarm relays. Simultaneously, by observing the Monitoring Module digital indicator, the level at which the alarms activate can be checked. If the alarms activate at incorrect levels, these can be adjusted by manipulation of the adjustable screws located below the individual alarm lamps, in conjunction with the adjustable screw located above the Test pushbutton as follows:

(1) Depress and hold the Test and Measure pushbuttons simultaneously and keep them depressed throughout this procedure. Turn the Test adjusting screw (potentiometer) anticlockwise until the Monitoring Module digital indicator reads zero.

(2) Turn the same adjusting screw clockwise until the required first level set-point is observed on the digital indicator.

(3) Turn the first level alarm adjusting screw clockwise until the first level alarm lamp illuminates.

(4) Turn the Test adjusting screw clockwise again to increase the digital indication to the second level set-point.

(5) Turn the second level alarm adjusting screw clockwise until the second level alarm lamp illuminates.

(6) Release the Test and Measure pushbuttons and briefly press them again. Both alarm lamps should illuminate simultaneously if the required settings have been established.

3.2.7 A keyswitch, located at the base of each Detector Module, has two positions, vertical for ON and horizontal for INHIBIT. If the keyswitch is positioned at ON, the module is working normally. However, if the INHIBIT position is selected, the relays for FAULT, ALARM 1 and ALARM 2 are inhibited; this will be necessary when replacing a module, or during calibration of the loop. The INHIBIT CHANNEL lamp on the Monitoring Module will illuminate if the INHIBIT position is selected on any Detector Module.

3.3 The main function of the Monitoring Module is to give a reading of the gas concentration being transmitted by the gas Detector Modules on operation of their individual Test or Measure push-buttons (see paragraph 3.2).

3.3.1 The indicating dial gives a digital display between −100 and +100 per cent of the lower explosive limit (LEL). If the gas concentration is above +100, the indicating display lamp will 'flash'.

3.3.2 The first and second level alarm pushbutton indicator lamps on the Monitoring Module are repetitions of the corresponding lamps on any Detector Module. If these alarms are activated, they require to be reset by depressing their pushbuttons when the respective alarms on the Detector Modules are cleared.

3.3.3 An Inhibit keyswitch is fitted to the base of the Monitoring Module. The switch has two positions, vertical for ON and horizontal for INHIBIT. The ON position is to be selected for normal working. However, if the Monitoring Module is to be removed, INHIBIT is to be selected. The corresponding amber INHIBIT CHANNEL lamp will illuminate if INHIBIT is selected.

NOTE
This switch must also be positioned at INHIBIT during calibration of a Detector Module, ie the same position as the keyswitch of the respective Detector Module.

4 ALARMS

4.1 Generally the gas alarm set-points in the Gas Compression area are:

(a) First level alarm — 20 per cent of LEL.

(b) Second level alarm — 60 per cent of LEL.

4.2 There are some areas that are exceptions, ie:

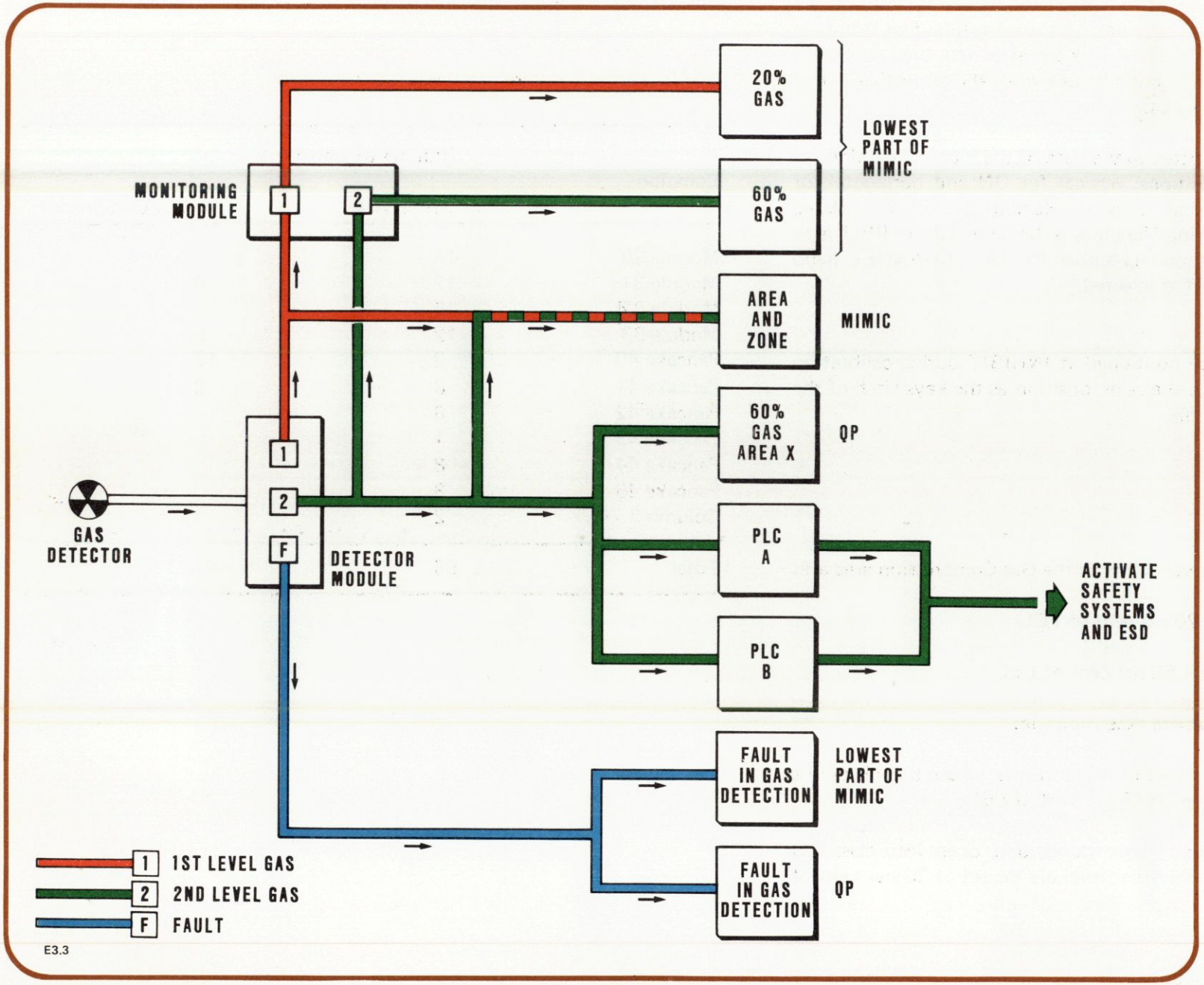
(a) The air combustion inlet for the turbines, where there is only a second level alarm set at 15 per cent of LEL.

(b) All detectors located above doors that open into classified areas. These have only first level alarms set at 20 per cent of LEL.

SECTION 2 — PROTECTED AREAS

The following areas are fitted with gas detectors:

Location	Number of Detectors	
	Within Area	Within Compressor
Module 30	14	8
Module 31	12	8
Module 32	15	
Module 33	12	8
Pancake 40	2	12
Pancake 41	8	8
Pancake 42	8	
Pancake 43	1	
Pancake 44	8	
Pancake 46	3	
Column 3	2	
Total	85	44


20% GAS
LOWEST PART OF MIMIC
MONITORING MODULE
1
2
60% GAS
AREA AND ZONE
MIMIC
60% GAS AREA X
QP
1
2
F
GAS DETECTOR
DETECTOR MODULE
PLC A
PLC B
ACTIVATE SAFETY SYSTEMS AND ESD
FAULT IN GAS DETECTION
LOWEST PART OF MIMIC
FAULT IN GAS DETECTION
QP
1 1ST LEVEL GAS
2 2ND LEVEL GAS
F FAULT
E3.3

SECTION 3 – OPERATION

1 OPERATING PHILOSOPHY

See illustration E3.3

1.1 Detection of 20 per cent LEL within a protected area will cause the panel alarm and Control Room alarm to annunciate; simultaneously the 20 per cent GAS alarm lamp and the respective area warning lamp on the mimic will illuminate.

1.2 Detection of 60 per cent LEL will cause the panel and Control Room alarm to annunciate. In addition, the 60 per cent GAS alarm lamp and the respective area warning lamp on the mimic will illuminate. Simultaneously, a 60 per cent GAS and respective area warning alarm will annunciate on QP. The Programmable Logic Controllers (PLC), two of which are fitted for each Detector Module, will initiate the required safety systems for the respective area and also the relevant ESD.

1.3 The ESD will vary depending on which area is affected, as follows:

(a) Process Areas: Third level shutdown of the compression area and, after a time delay, third level shutdown of the TCP2 Treatment area.

(b) Fuel Gas Package: This will initiate shutdown of the turbo-generators and, consequently, field shutdown.

(c) Ventilation System: Detection in the compressor rooms ventilation outlets will initiate shutdown of the respective compressor and isolation of the electrical equipment located within that compartment. Detection in the ventilation inlets will initiate the shutdown of the respective ventilation fans and dampers and, if necessary, isolation of any interfacing electrical equipment.

(d) Compressor Rooms: Shutdown of the respective compressor.

NOTE
For detailed description of the relevant ESD systems refer to Part F of this manual.

2 START-UP

2.1 The following prestart requisites are necessary:

(a) Power supply available.

(b) All keyswitches in their working position.

(c) No FAULT alarms on.

(d) All detector heads and detector modules calibrated recently (within 30 days).

(e) Operator permanently in the Control Room.

2.2 When all the prestart requisites are confirmed, switching on the power supply to each cabinet will render the system fully operational.

3 CHECKS AFTER START-UP

(a) Each shift, check the panel for malfunctions.

(b) Monthly, check the ZERO on each Detector Module.

(c) Monthly, check that each Detector Module first and second level alarms lamps illuminate when the Test pushbutton is pressed. Recalibrate if necessary.

CHAPTER E4

HALON SYSTEMS

CONTENTS

SECTION 1 DESCRIPTION

1. Summary
2. Equipment

SECTION 2 PROTECTED AREAS

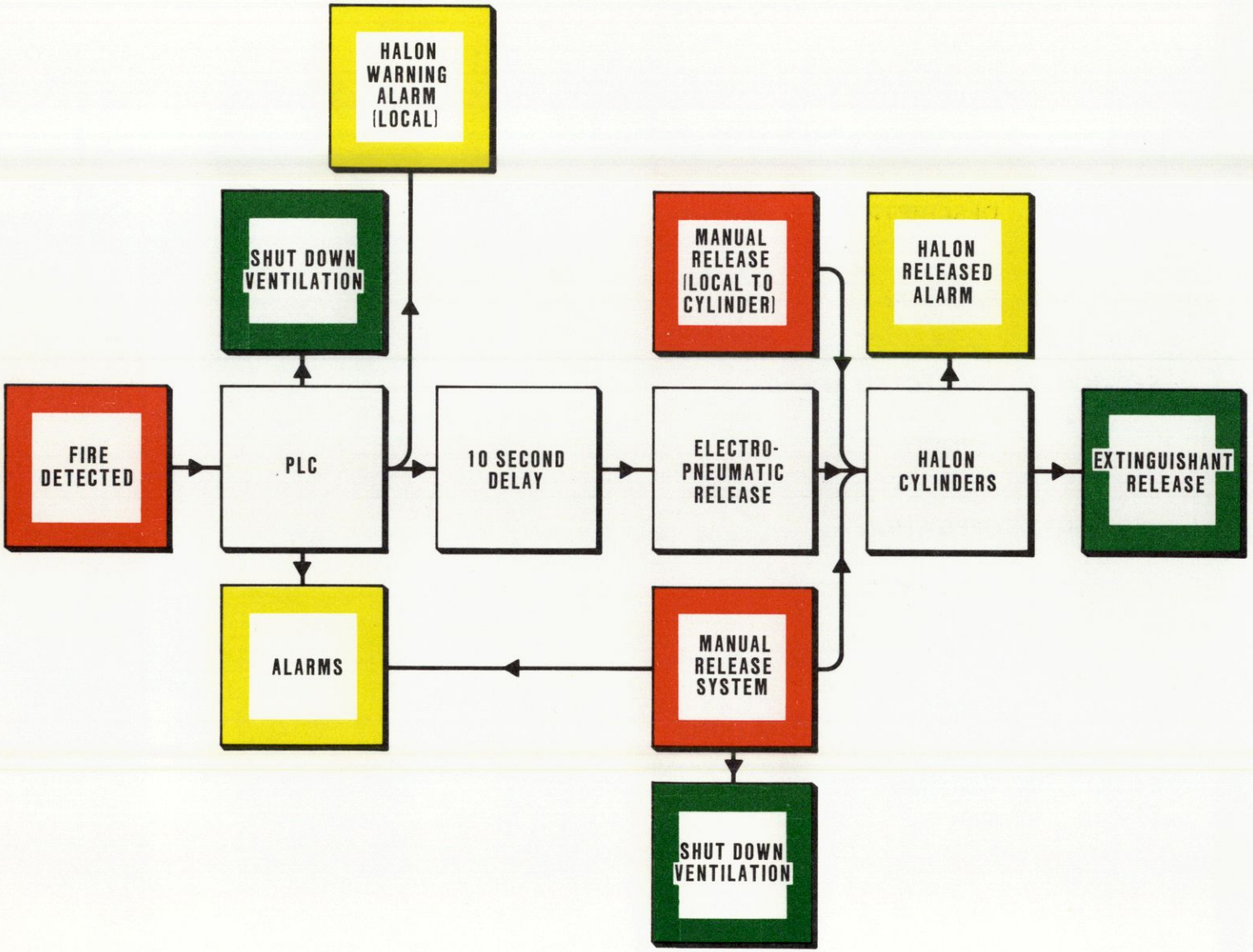
1. Summary

SECTION 3 OPERATION

1. Operating Philosophy
2. Start-up
3. Checks After Start-up

ILLUSTRATIONS

E4.1 Block Diagram
E4.2 Equipment


HALON WARNING ALARM (LOCAL)
SHUT DOWN VENTILATION
MANUAL RELEASE (LOCAL TO CYLINDER)
HALON RELEASED ALARM
FIRE DETECTED
PLC
10 SECOND DELAY
ELECTRO-PNEUMATIC RELEASE
HALON CYLINDERS
EXTINGUISHANT RELEASE
ALARMS
MANUAL RELEASE SYSTEM
SHUT DOWN VENTILATION

SECTION 1 – DESCRIPTION

Reference: PID 5424W 68 0040 07

1 SUMMARY

See illustration E4.1

1.1 Because water must not be used to fight electrical fires, a Halon extinguishant BTM (bromotrifluoromethane) is used in areas containing electrical equipment such as generators and switchgear.

1.2 BTM is a colourless, odourless, electrically non-conductive gas which extinguishes or prevents ignition by inhibiting the chemical reaction between fuel and oxygen.

1.3 The discharge of BTM to extinguish a fire may create a hazard to personnel from the natural Halon itself, and from the products of decomposition that result from the exposure of Halon to the fire or other hot surfaces. Exposure to the natural Halon is generally of less concern than is exposure to the decomposition products; however, unnecessary exposure of personnel to either the natural agent or the decomposition products should be avoided.

1.4 BTM is normally released by automatic action initiated from the Fire Detection Panel. If necessary, it can be released by operating a local control at the entrances to the protected area. A second manual release, located on the Halon bottles themselves, is only to be used in exceptional circumstances.

1.5 Halon is a gas when exposed to atmospheric conditions. Therefore, to enable an adequate amount to be stored for firefighting purposes, it is liquefied by pressurising it with dry nitrogen (42 barg at 21°C) and containing it in 67.5 litre capacity steel bottles. The number of bottles for each area has been designed to provide the necessary concentration of Halon (minimum of 6 per cent) to extinguish a fire.

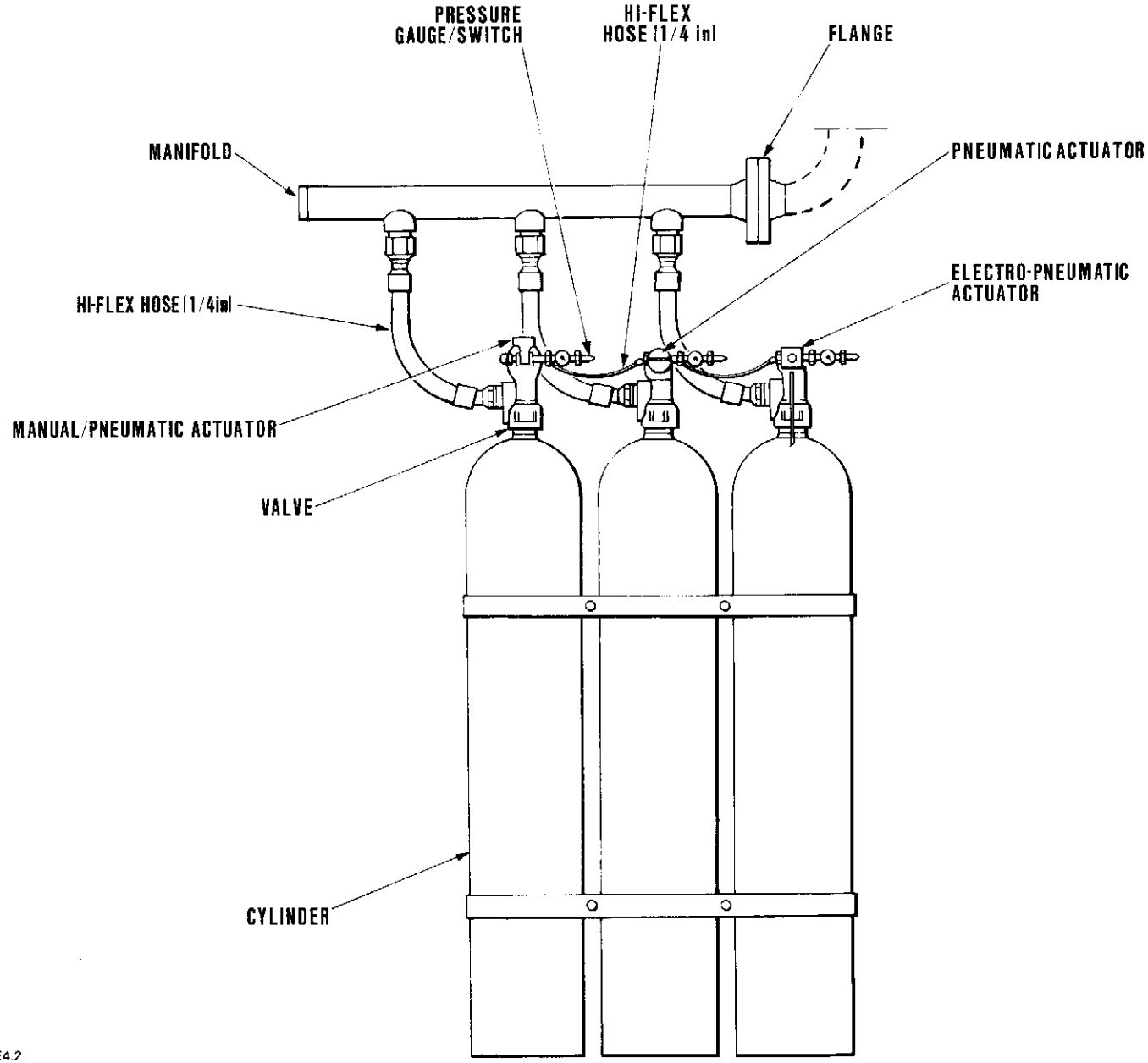
1.6 When Halon is to be released into a protected area it is important that the respective area ventilation system must be shut down in order to achieve the required Halon concentration. (This will also help to avoid the extension of the fire.) This is achieved automatically when the alarm is originated from a fire detector. However, when the Halon release is initiated manually using the manual release system (see paragraph 2.4) an electrical switch, which is operated on opening the manual release box, initiates ventilation shutdown. When operating the system from the second manual release position at the Halon bottles themselves, the ventilation system will have to be stopped either by opening the aforementioned manual release box door, or by manually stopping the fans and dampers.

1.7 All Halon-protected areas are fitted with self-closing doors.

1.8 A local alarm will annunciate 10 seconds before the initiation of Halon release into a protected area, to warn personnel to leave immediately.

1.9 The Halon and CO_2 systems in the UTI (gas compressor) and Stal Laval (main generator) gas turbine hoods are not included in this chapter.

1.10 The LP Vent Snuffing System is described in Chapter C5.


PRESSURE GAUGE/SWITCH
HI-FLEX HOSE (1/4 in)
FLANGE
MANIFOLD
PNEUMATIC ACTUATOR
HI-FLEX HOSE (1/4in)
ELECTRO-PNEUMATIC ACTUATOR
MANUAL/PNEUMATIC ACTUATOR
VALVE
CYLINDER

2 EQUIPMENT

See illustration E4.2

2.1 Summary

2.1.1 Each respective protected area is provided with its own independent Halon System, each comprising the following equipment:

(a) Halon cylinder(s).

(b) Control Unit.

(c) Manual release system.

(d) Signalling lamp panels.

2.2 Halon Cylinders

2.2.1 The Halon cylinders are located inside the protected area, the number of cylinders being dependent on the area size.

2.2.2 Halon is released through pneumatically operated valves, either directly through a nozzle connected to the cylinder or via a piping system connected with several nozzles.

2.2.3 The medium used to operate the valves is Halon from within the cylinders. However, the actuators which release the operating medium to open the valves can be operated as follows:

(a) Electrically – Remotely actuated from the PLC signal in the Fire Detection Panel.

(b) Pneumatically – On operation of the Manual Release System (see paragraph 2.4).

(c) Manually – Local manual release, physically located on the bottles themselves. (This method should not be confused with (b) above.)

NOTE
On a system where more than one Halon bottle is used, the actuators are linked by a Hi-Flex hose which allows all discharge valves to be pneumatically opened simultaneously, no matter how the operation was initiated.

2.3 Control Unit

2.3.1 The Control Unit is housed in an explosion-proof box. The top part of the box houses the unit electrics and the bottom part contains five indicating lamps. The unit is located outside or near the main entrance door to the protected area.

2.3.2 The functions of the unit are as follows:

(a) To give visual indication of system status by means of the following illuminated lamps:

(i) Red lamp – Halon released.

(ii) Amber lamp – Halon on automatic release.

(iii) Green lamp – Halon on manual release.

(iv) Two lamps indicating FAULT on the system and POWER ON.

(b) To provide a keyswitch facility (key held in Safety Officer's office) for switching the system from automatic release to manual release, in the event of prolonged work being carried out within the area.

NOTE
Operation of the Manual Release System will still initiate extinguishant release even if AUTOMATIC is selected.

(c) To provide a facility for checking the system.

(d) To initiate Halon release in response to a signal from the PLCs.

(e) To transmit the following information to the Control Room and the local signalling lamp panels:

(i) FAULT (indicated in Control Room only).

(ii) Halon release mode (AUTO or MANUAL).

(iii) HALON RELEASED.

2.4 **Manual Release System**

2.4.1 The Manual Release System is located adjacent the Control Unit and comprises the following:

(a) Manual Release Box.

(b) Nitrogen Bottle)
) inside box (a)
(c) Manual Release Valve)

2.4.2 If manual release is required, opening the release box door will operate an electrical switch to initiate ventilation shutdown and the required alarms.

2.4.3 The manual release valve, when pulled forward, allows nitrogen pressure to operate the Halon release valve actuators.

NOTE
The release box door must be left open until reinstatement of the system.

2.5 The signalling lamp panels are located adjacent all entrance doors into a protected area other than the main entrance door. The panel is fitted with three lamps which, when illuminated, denote the following:

Red lamp — Halon released
Amber lamp — System on automatic
Green lamp — System on manual

SECTION 2 — PROTECTED AREAS

1 SUMMARY

1.1 The following platform areas are protected by Halon release:

(a) H & V Fan Room 54X04 (Module 32).

(b) Transformer Room (Module 32).

(c) Substation (Module 32).

(d) Control Room (Module 32).

(e) Emergency Generator Room (Pancake 44).

(f) Battery Room (Module 32).

(g) Emergency Substation (Pancake 44).

(h) Firepump Rooms (Pancakes 42 and 46).

(j) Turbogenerator Room (Pancake 41).

SECTION 3 – OPERATION

1 OPERATING PHILOSOPHY

1.1 If at least two coincidence-linked detectors sense a fire in their area, a signal from the respective Loop Module will activate the Programmable Logic Controllers (PLC) to initiate ventilation shutdown and annunciate the required alarms, then (after 10 seconds delay period) to initiate Halon release.

1.2 A HALON RELEASED alarm will annunciate locally and also in the Control Room as soon as the Halon bottle pressure drops.

2 START-UP

2.1 The following prestart requisites are necessary:

(a) Alarm systems commissioned and operational.

(b) Electrical supplies available.

(c) PLCs commissioned and operational.

(d) Fire Detection System on automatic.

(e) All Halon release systems switched to MANUAL.

(f) All Hand Release System nitrogen bottles de-isolated.

(g) Control Room personnel on duty.

2.2 When all the prestart requisites are confirmed, switching on the power supply to the panel will render the system fully operational.

NOTE
Providing that no malfunctions are observed on the system for one week, all keyswitches can be positioned at AUTOMATIC.

3 CHECKS AFTER START-UP

3.1 All lamps on the control units and signalling lamp panels and all cylinder pressures (both Halon and nitrogen) are to be checked at least once a month.

3.2 A complete check of all the system electrics is to be carried out annually.

3.3 The weights of all Halon and nitrogen cylinders are to be checked every two years.

CHAPTER E5

FIREWATER SYSTEMS

CONTENTS

SECTION 1 DESCRIPTION

1. Summary
2. Equipment Details
3. External Utilities and Interfaces

SECTION 2 OPERATION AND CONTROLS

1. Operating Philosophy
2. Controls
3. Prestart Checks
4. Start-up
5. Shutdown

SECTION 3 ALARMS AND TRIPS

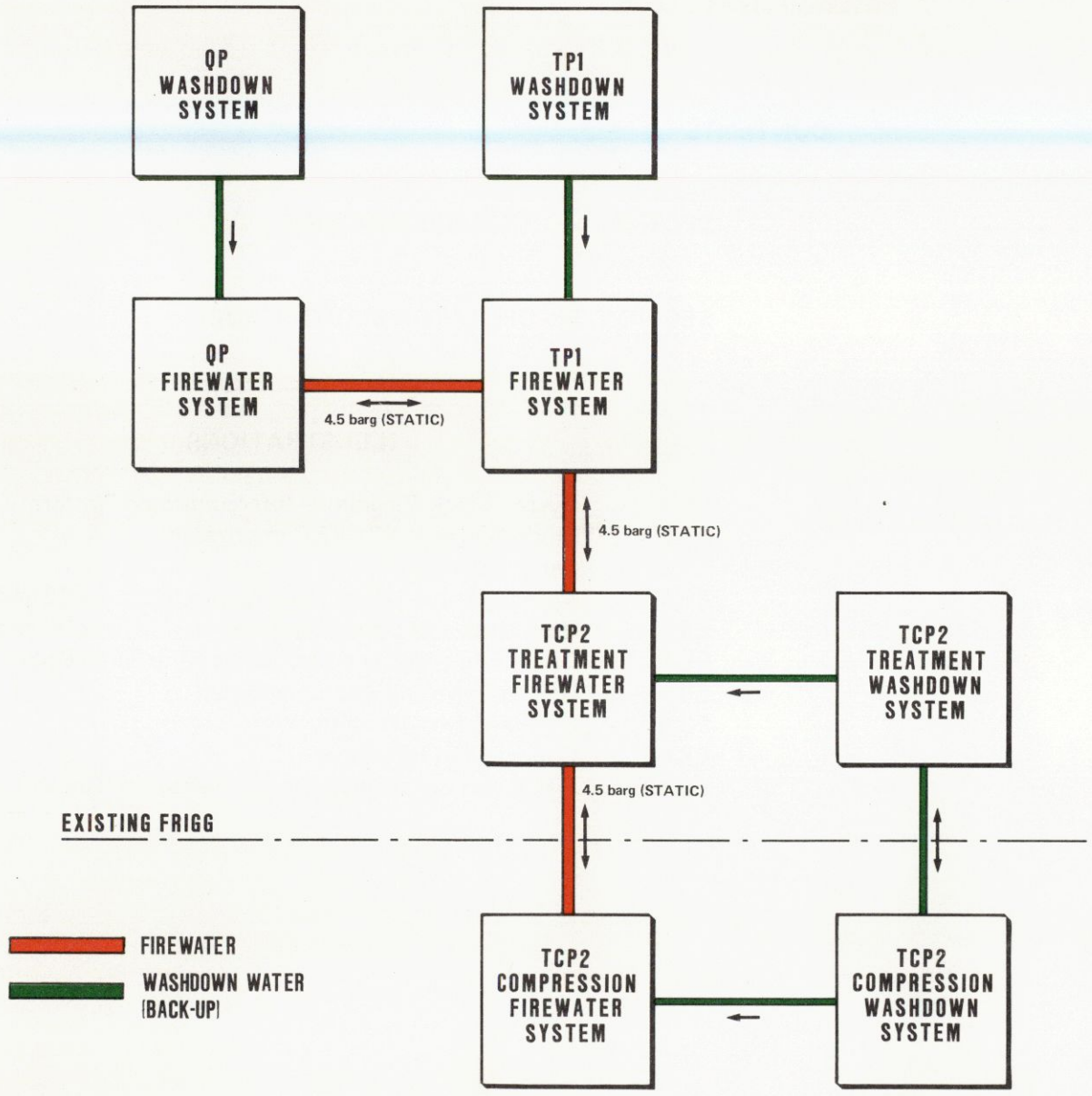
1. Alarms and Trips

SECTION 4 TROUBLESHOOTING

SECTION 5 OPERATOR MAINTENANCE

ILLUSTRATIONS

E5.1	Overall Block Diagram – Interconnected Platforms
E5.2	Block Diagram – TCP2 Compression
E5.3	Cellar Deck
E5.4	Main Deck and Upper Deck, South (Modules 32 and 33)
E5.5	Main Deck and Upper Deck, North (Modules 30 and 31)
E5.6	Diesel Fire Pump and Ancillaries (One Pump Only)
E5.7	Deluge Valve and Instrumentation
E5.8	Deluge Valve – Detail
E5.9	Controls and Interfaces
E5.10	Fire Pump Controls and Instrumentation (One Pump Only)


QP WASHDOWN SYSTEM
TP1 WASHDOWN SYSTEM
QP FIREWATER SYSTEM
4.5 barg (STATIC)
TP1 FIREWATER SYSTEM
4.5 barg (STATIC)
TCP2 TREATMENT FIREWATER SYSTEM
TCP2 TREATMENT WASHDOWN SYSTEM
4.5 barg (STATIC)
EXISTING FRIGG
FIREWATER
WASHDOWN WATER (BACK-UP)
TCP2 COMPRESSION FIREWATER SYSTEM
TCP2 COMPRESSION WASHDOWN SYSTEM

SECTION 1 – DESCRIPTION

Reference: PID 5424W 68 0040 01
PID 5424W 68 0040 08
PID 5424W 68 0040 09 Sheets 1 & 2

1 SUMMARY

See illustrations E5.1, E5.2, E5.3, E5.4 and E5.5

1.1 The purpose of the firewater system is to provide a constant supply of sea water for firefighting purposes.

1.2 The gas compression area (TCP2–C) is protected by a separate firewater system, interconnected to the ring mains of the firewater systems on TCP2 treatment area (TCP2–T), QP and TP1.

1.3 Interconnections between firewater systems allow the overall system to be fed with pressurised sea water from the following pumps:

(a) Pump P1 on QP.

(b) Pumps P6A and P6B on TP1.

(c) Pumps CP6A and CP6B on TCP2–T.

(d) Pumps 68P01A and 68P01B on TCP2–C.

1.4 The individual firewater systems can be run individually or in parallel.

1.5 The firewater system in the gas compression area consists of a main header linked into ring mains for the Cellar Deck, Main Deck North and Main Deck South. The Upper Deck is supplied by firemains from the Main Deck.

1.6 Each ring main has a crossover pipe and valves which allow isolation in sections. Equipment items are fed by branch pipes from the main ring mains.

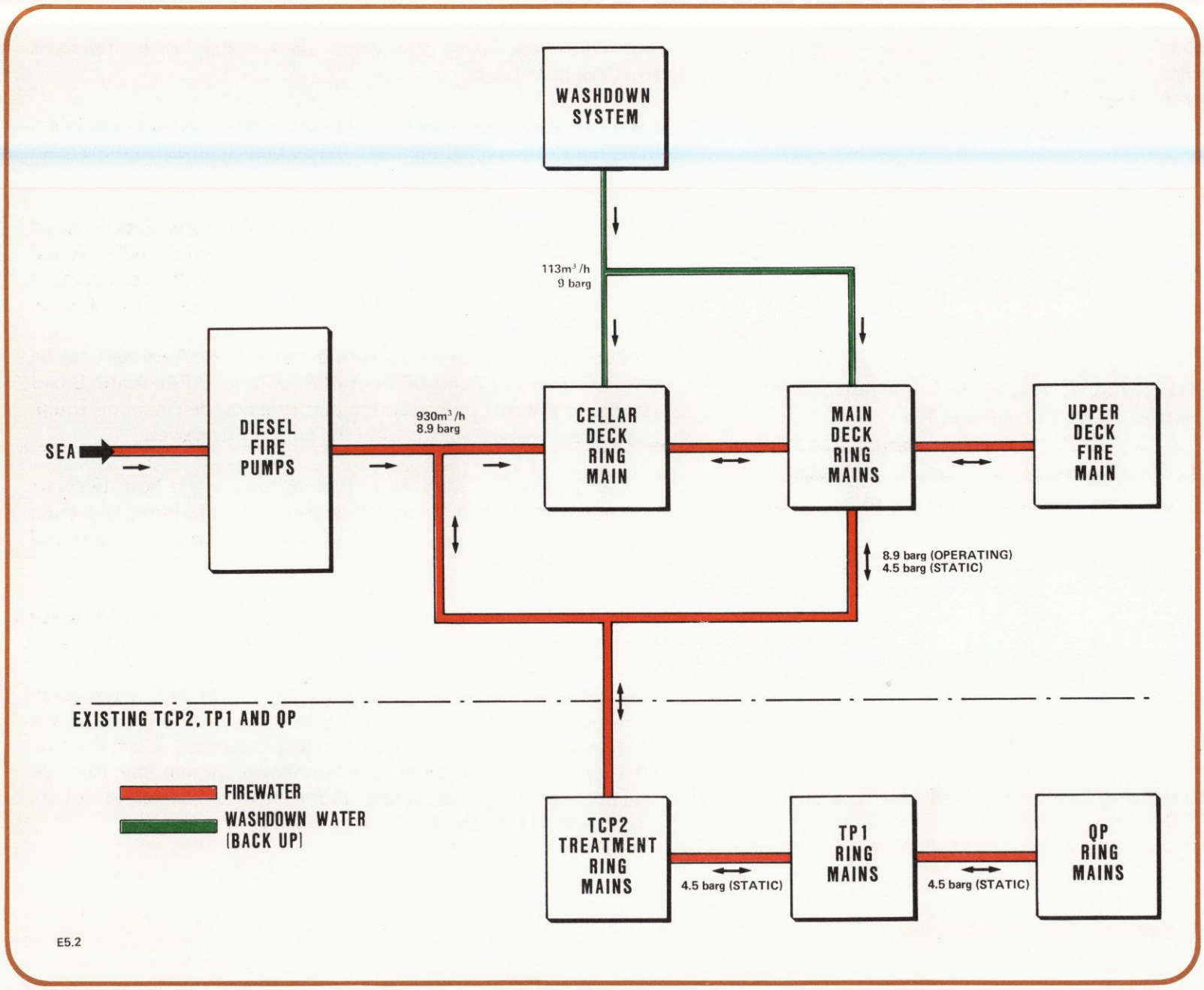
1.7 The main header of the gas compression Firewater System is fed with pressurised sea water by two diesel fire pumps (68P01A and 68P01B) located on Cellar Deck Pancakes 42 and 46. Each pump is capable of delivering 454m^3/h at a discharge pressure of 8.6 barg.

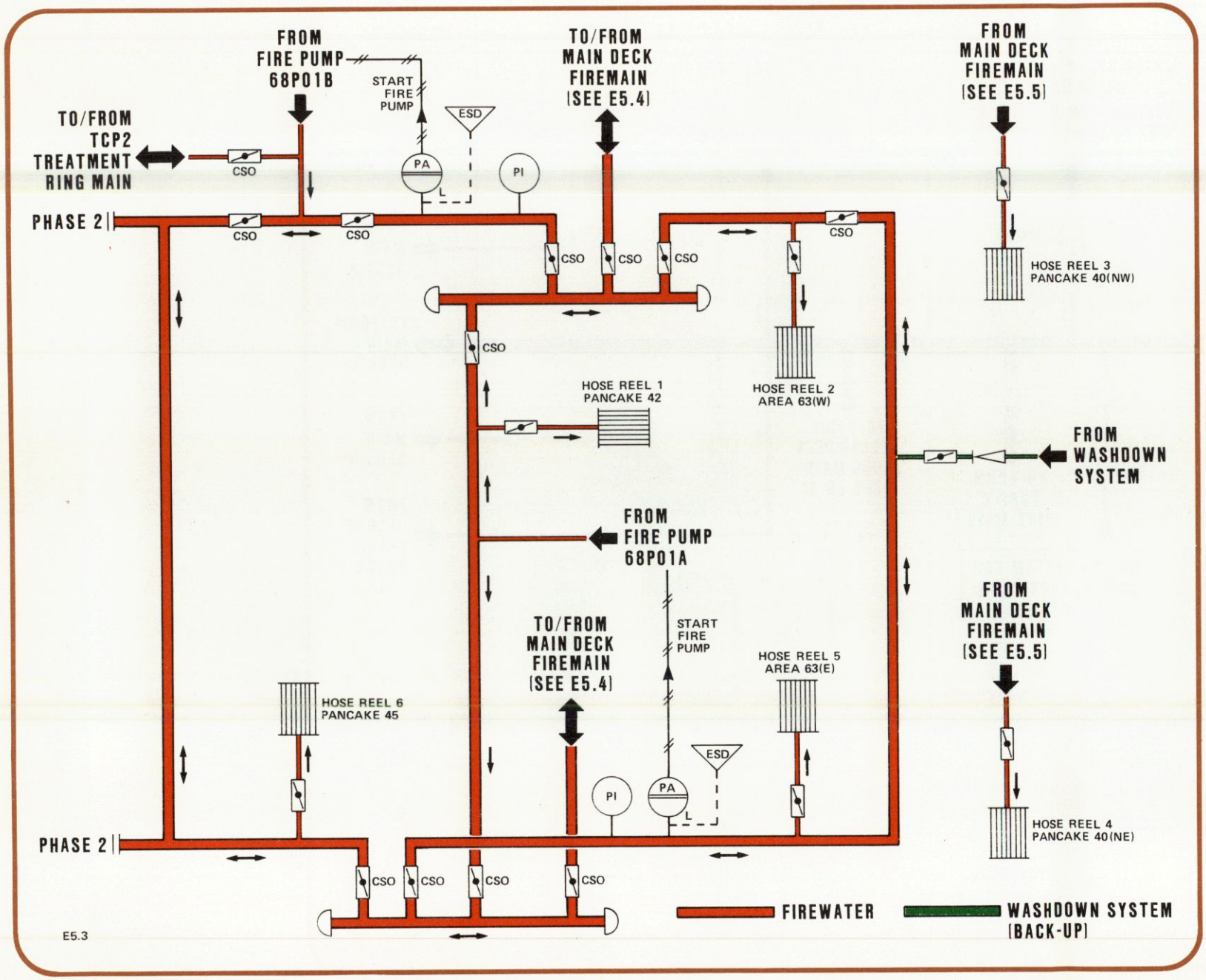
1.8 Fire pumps are started manually or automatically. Auto start can be effected from TCP2 and QP Control Rooms, local Fire Alarm Boxes (FABs) at selected points on the platform and detectors on equipment items. Manual start is from the pumps themselves.

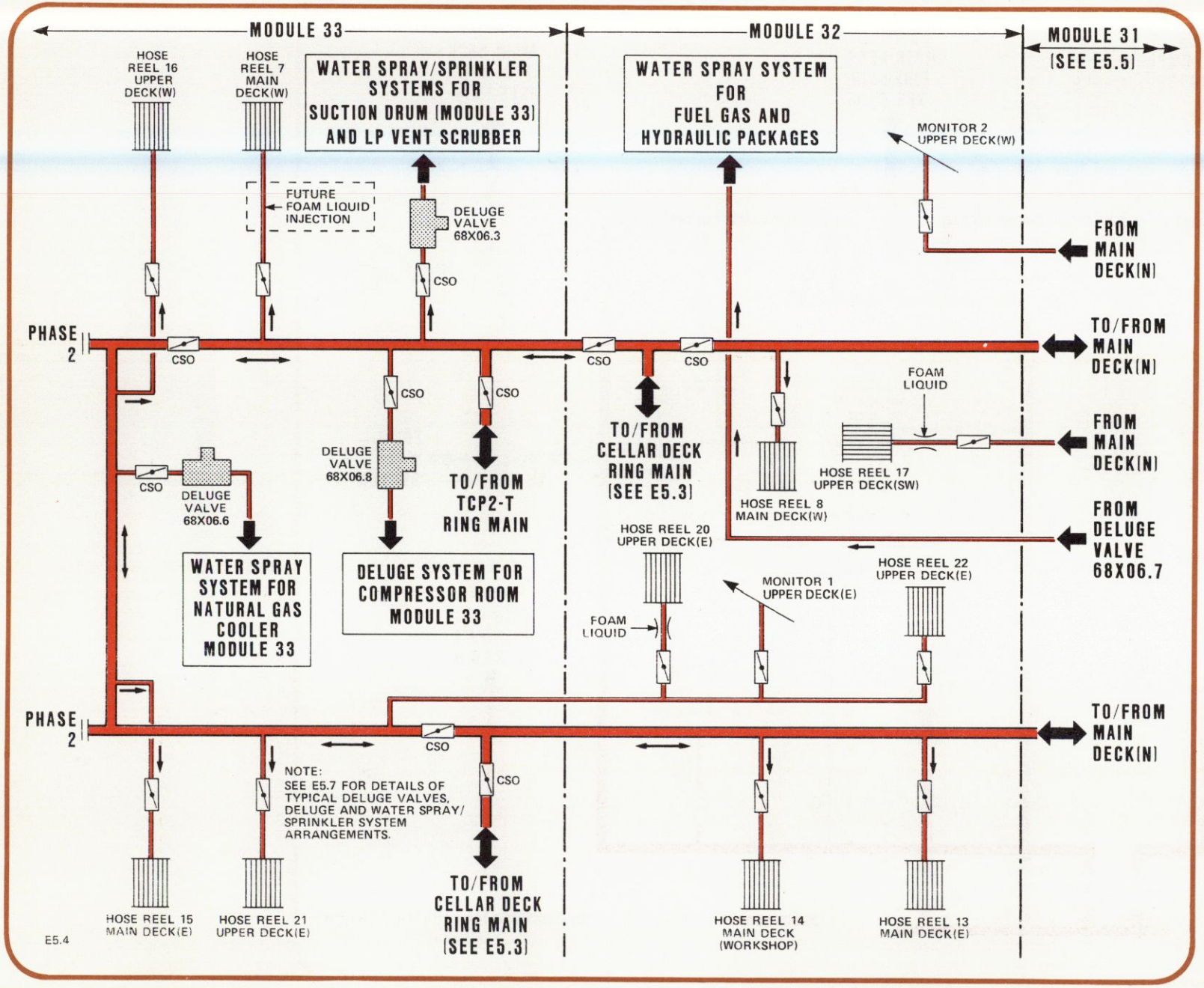
1.9 Fire is detected by ultra-violet (flame), smoke and heat detectors protecting equipment items and areas of the platform. Detection automatically initiates emergency shutdown, which in turn will start the fire pumps.

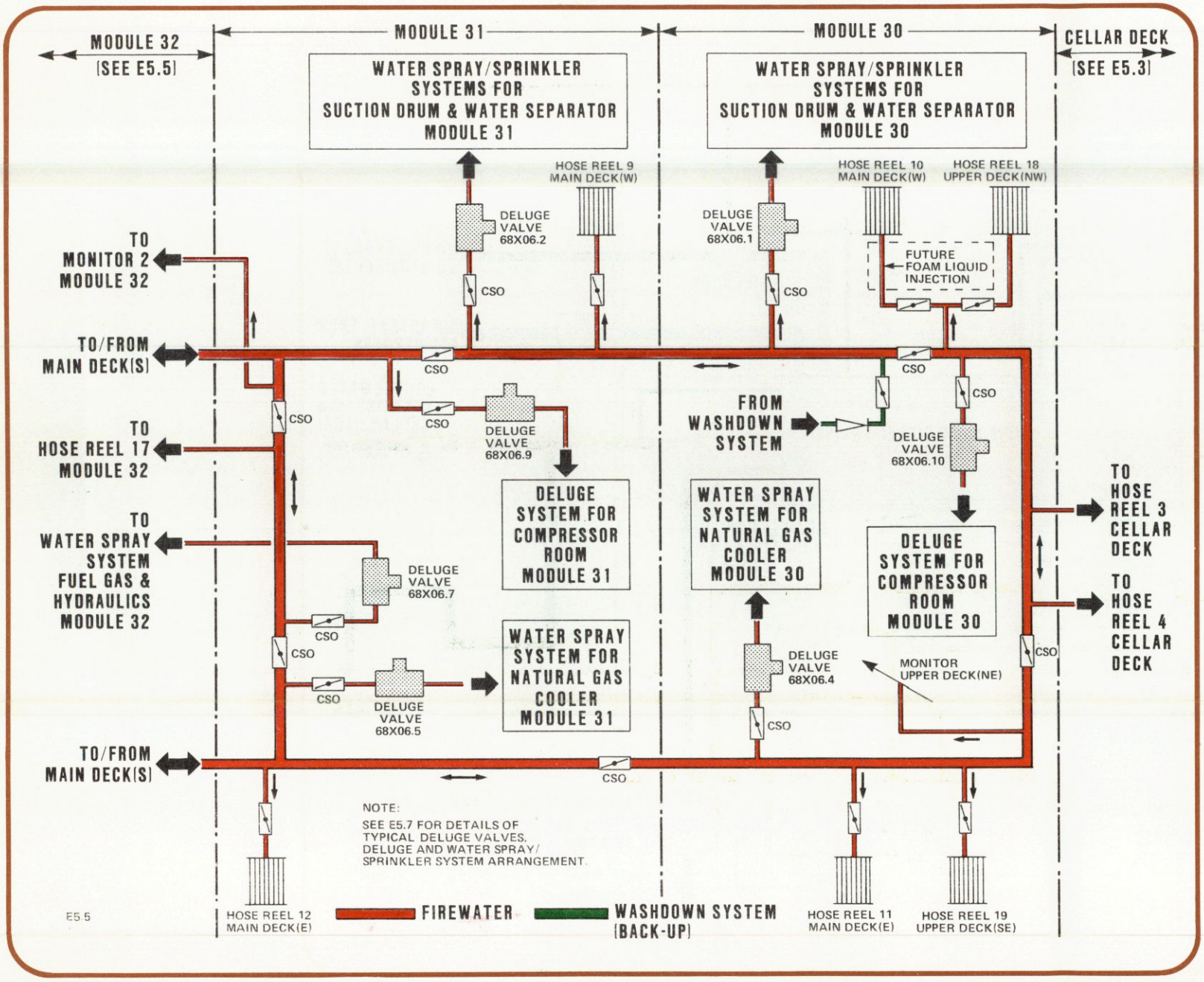
1.10 Ring mains supply fire monitors, hose reels, deluge and waterspray systems, located at strategic points.

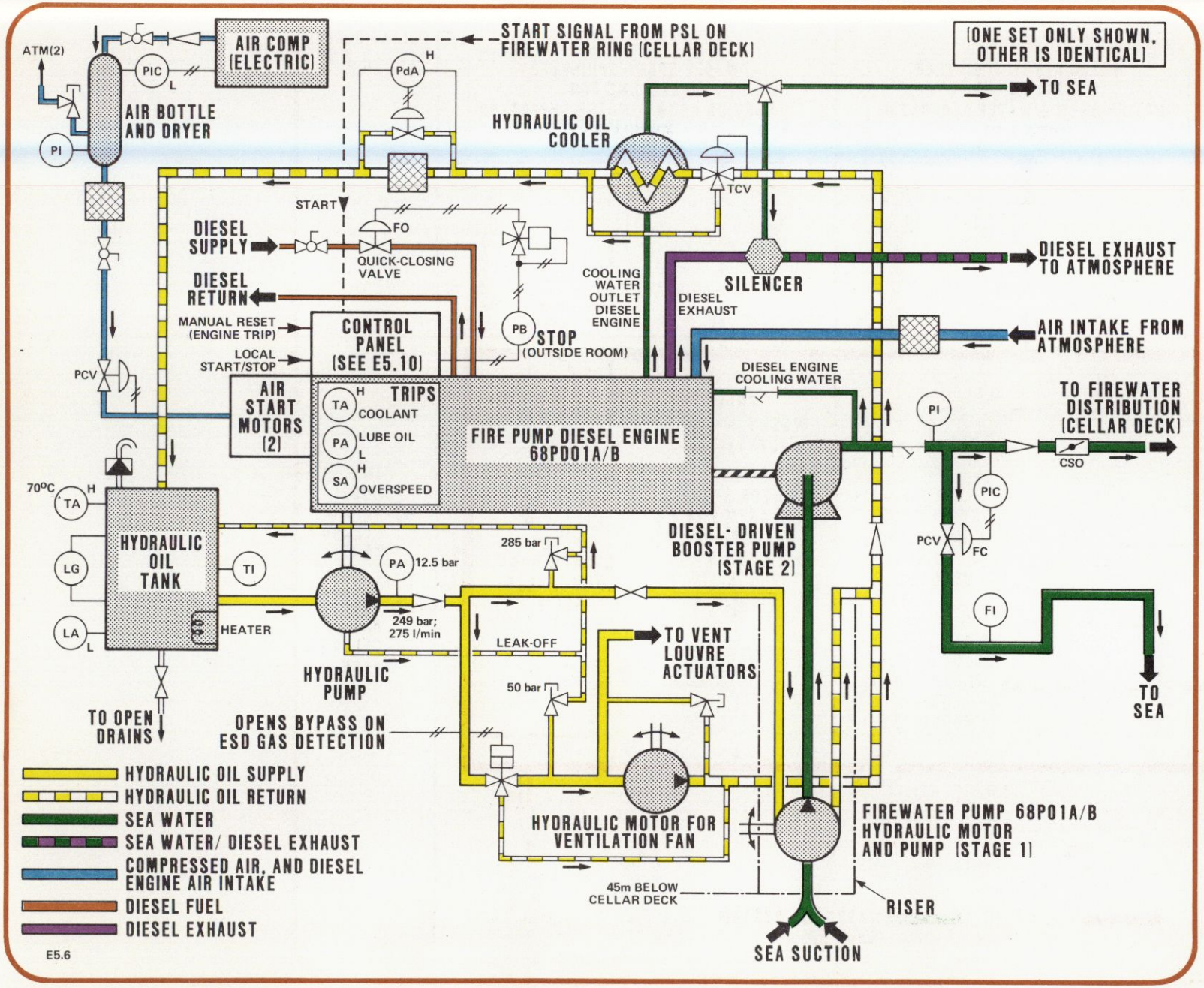
1.11 The firewater mains on the gas compression area have cross-connections to the Washdown System. The main purpose of the Washdown System is for deck cleaning. However, when the firewater system is operating, the Washdown System can form an integral part of it, delivering 113m^3/h of sea water at 9 barg pressure from the washdown pump (50P02).


WASHDOWN SYSTEM
113m³/h
9 barg
SEA
DIESEL FIRE PUMPS
930m³/h
8.9 barg
CELLAR DECK RING MAIN
MAIN DECK RING MAINS
UPPER DECK FIRE MAIN
8.9 barg (OPERATING)
4.5 barg (STATIC)
EXISTING TCP2, TP1 AND QP
FIREWATER
WASHDOWN WATER (BACK UP)
TCP2 TREATMENT RING MAINS
4.5 barg (STATIC)
TP1 RING MAINS
4.5 barg (STATIC)
QP RING MAINS
E5.2


FROM FIRE PUMP 68P01B
START FIRE PUMP
ESD
TO/FROM MAIN DECK FIREMAIN (SEE E5.4)
FROM MAIN DECK FIREMAIN (SEE E5.5)
TO/FROM TCP2 TREATMENT RING MAIN
CSO
PA
PI
PHASE 2
HOSE REEL 3 PANCAKE 40(NW)
HOSE REEL 1 PANCAKE 42
HOSE REEL 2 AREA 63(W)
FROM WASHDOWN SYSTEM
FROM FIRE PUMP 68P01A
TO/FROM MAIN DECK FIREMAIN (SEE E5.4)
START FIRE PUMP
HOSE REEL 5 AREA 63(E)
FROM MAIN DECK FIREMAIN (SEE E5.5)
HOSE REEL 6 PANCAKE 45
HOSE REEL 4 PANCAKE 40(NE)
PHASE 2
FIREWATER
WASHDOWN SYSTEM (BACK-UP)
E5.3


MODULE 33
MODULE 32
MODULE 31
(SEE E5.5)
HOSE REEL 16 UPPER DECK(W)
HOSE REEL 7 MAIN DECK(W)
WATER SPRAY/SPRINKLER SYSTEMS FOR SUCTION DRUM (MODULE 33) AND LP VENT SCRUBBER
WATER SPRAY SYSTEM FOR FUEL GAS AND HYDRAULIC PACKAGES
MONITOR 2 UPPER DECK(W)
FUTURE FOAM LIQUID INJECTION
DELUGE VALVE 68X06.3
CSO
FROM MAIN DECK(N)
PHASE 2
TO/FROM MAIN DECK(N)
FOAM LIQUID
DELUGE VALVE 68X06.8
TO/FROM TCP2-T RING MAIN
TO/FROM CELLAR DECK RING MAIN (SEE E5.3)
HOSE REEL 17 UPPER DECK(SW)
HOSE REEL 8 MAIN DECK(W)
DELUGE VALVE 68X06.6
HOSE REEL 20 UPPER DECK(E)
HOSE REEL 22 UPPER DECK(E)
MONITOR 1 UPPER DECK(E)
FROM DELUGE VALVE 68X06.7
WATER SPRAY SYSTEM FOR NATURAL GAS COOLER MODULE 33
DELUGE SYSTEM FOR COMPRESSOR ROOM MODULE 33
NOTE:
SEE E5.7 FOR DETAILS OF TYPICAL DELUGE VALVES, DELUGE AND WATER SPRAY/ SPRINKLER SYSTEM ARRANGEMENTS.
HOSE REEL 15 MAIN DECK(E)
HOSE REEL 21 UPPER DECK(E)
HOSE REEL 14 MAIN DECK (WORKSHOP)
HOSE REEL 13 MAIN DECK(E)
E5.4


MODULE 32
(SEE E5.5)
MODULE 31
MODULE 30
CELLAR DECK
(SEE E5.3)
WATER SPRAY/SPRINKLER SYSTEMS FOR SUCTION DRUM & WATER SEPARATOR MODULE 31
WATER SPRAY/SPRINKLER SYSTEMS FOR SUCTION DRUM & WATER SEPARATOR MODULE 30
HOSE REEL 9 MAIN DECK(W)
HOSE REEL 10 MAIN DECK(W)
HOSE REEL 18 UPPER DECK(NW)
DELUGE VALVE 68X06.2
DELUGE VALVE 68X06.1
FUTURE FOAM LIQUID INJECTION
CSO
TO MONITOR 2 MODULE 32
TO/FROM MAIN DECK(S)
TO HOSE REEL 17 MODULE 32
TO WATER SPRAY SYSTEM FUEL GAS & HYDRAULICS MODULE 32
FROM WASHDOWN SYSTEM
DELUGE VALVE 68X06.9
DELUGE VALVE 68X06.10
DELUGE SYSTEM FOR COMPRESSOR ROOM MODULE 31
WATER SPRAY SYSTEM FOR NATURAL GAS COOLER MODULE 30
DELUGE SYSTEM FOR COMPRESSOR ROOM MODULE 30
DELUGE VALVE 68X06.7
DELUGE VALVE 68X06.5
WATER SPRAY SYSTEM FOR NATURAL GAS COOLER MODULE 31
DELUGE VALVE 68X06.4
MONITOR UPPER DECK(NE)
TO HOSE REEL 3 CELLAR DECK
TO HOSE REEL 4 CELLAR DECK
NOTE:
SEE E5.7 FOR DETAILS OF TYPICAL DELUGE VALVES, DELUGE AND WATER SPRAY/ SPRINKLER SYSTEM ARRANGEMENT.
HOSE REEL 12 MAIN DECK(E)
HOSE REEL 11 MAIN DECK(E)
HOSE REEL 19 UPPER DECK(SE)
FIREWATER
WASHDOWN SYSTEM (BACK-UP)
E5.5


ATM(2)
AIR COMP (ELECTRIC)
PIC
L
AIR BOTTLE AND DRYER
PI
START SIGNAL FROM PSL ON FIREWATER RING (CELLAR DECK)
PdA
H
(ONE SET ONLY SHOWN, OTHER IS IDENTICAL)
TO SEA
HYDRAULIC OIL COOLER
TCV
START
DIESEL SUPPLY
FO
QUICK-CLOSING VALVE
DIESEL RETURN
COOLING WATER OUTLET DIESEL ENGINE
SILENCER
DIESEL EXHAUST
DIESEL EXHAUST TO ATMOSPHERE
MANUAL RESET (ENGINE TRIP)
LOCAL START/STOP
CONTROL PANEL (SEE E5.10)
PB
STOP (OUTSIDE ROOM)
AIR INTAKE FROM ATMOSPHERE
PCV
AIR START MOTORS (2)
TA
H
TRIPS
COOLANT
PA
LUBE OIL
L
SA
H
OVERSPEED
FIRE PUMP DIESEL ENGINE 68PD01A/B
DIESEL ENGINE COOLING WATER
TO FIREWATER DISTRIBUTION (CELLAR DECK)
PI
CSO
70°C
TA
H
PIC
HYDRAULIC OIL TANK
LG
TI
LA
L
HEATER
PA
12.5 bar
285 bar
DIESEL- DRIVEN BOOSTER PUMP (STAGE 2)
PCV
FC
FI
249 bar; 275 l/min
LEAK-OFF
TO VENT LOUVRE ACTUATORS
HYDRAULIC PUMP
50 bar
TO SEA
TO OPEN DRAINS
OPENS BYPASS ON ESD GAS DETECTION
HYDRAULIC OIL SUPPLY
HYDRAULIC OIL RETURN
SEA WATER
SEA WATER/ DIESEL EXHAUST
COMPRESSED AIR, AND DIESEL ENGINE AIR INTAKE
DIESEL FUEL
DIESEL EXHAUST
HYDRAULIC MOTOR FOR VENTILATION FAN
FIREWATER PUMP 68P01A/B HYDRAULIC MOTOR AND PUMP (STAGE 1)
45m BELOW CELLAR DECK
RISER
SEA SUCTION
E5.6

2 EQUIPMENT DETAILS

2.1 Diesel Fire Pumps 68P01A/B

See illustration E5.6

2.1.1 Summary

Both diesel-driven fire pumps are located in ventilated and pressurised rooms. They are two-stage pumps; the first stage is a submerged hydraulic-driven pump located at the base of a riser (42m below Cellar Deck level). The second stage booster pump is centrifugal; the diesel engine drives the centrifugal pump and also drives the hydraulic pump providing the hydraulic power for the first stage of the pump. Details are given in paragraph 2.2 below.

2.1.2 Diesel Engine (Frank Mohn)

Rating	453 HP (338kW).
Speed	2000 rev/min.
Overspeed trip	2300 rev/min (115%).
Low lube oil press trip	1.4 bar (±0.1 bar).
High coolant water temp trip	97 to 98°C.

2.1.3 Hydraulic Pump (Framo)

Capacity	454m^3/h.
Discharge pressure	5.3 barg.
Speed	2500 rev/min.
Hydraulic oil pressure	249 barg.
Hydraulic oil flow	275 l/min.
Power consumption	141.4 HP.

2.1.4 Booster Pump (Framo)

Capacity	454m^3/h.
Discharge pressure	8.6 barg.
Speed	2000 rev/min.
Power consumption	203 HP max.

2.2 Diesel Fire Pump and Ancillaries

See illustration E5.6

NOTE
The two fire pumps are identical. Only one has been illustrated and the following description is applicable to both.

2.2.1 Fuel Supply and Air Start System

Diesel fuel is supplied from the Diesel Oil System via a pneumatically operated quick-closing valve (fails open) which is closed either by the local diesel engine Stop pushbutton or, in the event of fire or other emergency, by a pushbutton sited outside the fire pump room; operating air is provided from the diesel engine control panel supply line. Each fire pump diesel engine 68PD01A/B has its own air start system (consisting of two air start motors and associated controls) which is supplied with starting air by two electrically driven compressors and associated air bottles, adsorption dryers and filters. The air compressor motors require 380V 3-phase 50Hz supplies and are rated at 2.2kW; they start under control of a 'low' signal from a PIC on their associated air bottle.

2.2.2 Cooling Water

Diesel engine cooling water is provided from a take-off at the engine-driven firewater booster pump discharge, via a strainer. This cooling water passes through a heat exchanger in the diesel engine closed circuit fresh water cooling system. On leaving the diesel engine, the salt cooling water is also used as the cooling medium for the hydraulic oil cooler (see below) and for the diesel engine exhaust silencer, before being discharged to sea.

2.2.3 Hydraulic Oil

The hydraulic oil circulates in a closed circuit comprising a hydraulic oil tank, a hydraulic pump driven by the fire pump diesel engine, three hydraulic pressure users (see below) and an oil cooler from which the oil returns to the tank. The hydraulic oil pressure is produced by the engine-driven hydraulic pump which draws oil from the hydraulic oil tank and maintains pressure at 249 bar (flow 275 l/min) to provide motive power for

(a) Submerged firewater pumps 68P01A/B hydraulic motors (Stage 1), situated at the lower extremity of the sea water intake riser on the circumference of Column 3/5.

(b) Hydraulic actuators for the vent openers, which open the ventilation fan inlet louvres on engine start. Should the diesel engine stop, hydraulic oil pressure will be lost and the inlet louvres will close automatically under spring action.

(c) Hydraulic motor for the fan which ventilates and pressurises the diesel fire pump engine enclosure.

NOTE
In the event of an ESD gas detection, a bypass valve in the hydraulic oil pressure supply line upstream of the hydraulic actuators for the vent openers and the ventilation fan hydraulic motor will open. The ventilation louvres will close and the vent fan will stop.

The hydraulic oil returns to the hydraulic oil tank either through the hydraulic oil cooler or direct (under control of a TCV), thus completing the closed circuit. The oil cooler is cooled by the diesel engine salt cooling water, as mentioned in paragraph 2.2.2 above. Relief valves on the hydraulic oil pressure lines relieve excess pressure back to the hydraulic oil tank; this relief line also accepts any leak-off from the engine-driven hydraulic pump. The following alarms are fitted in the hydraulic oil circuit:

Hydraulic pump output pressure low	—	12.5 bar
Hydraulic oil filter ΔP high ('dirty' filter)	—	0.6 bar
Hydraulic oil tank temperature high	—	70°C
Hydraulic oil tank level low		

2.2.4 Diesel Engine Air Intake and Exhaust

Diesel engine intake air is drawn from atmosphere under Pancake 42/46 via an air filter. The exhaust discharges via a silencer to atmosphere, exiting under Pancake 42/46. The exhaust silencer is injected with sea water cooling from the diesel engine cooling water discharge line (see paragraph 2.2.2 above).

2.2.5 Firewater Supply

Sea water is lifted by the submerged hydraulic pump (Stage 1) at the base of the riser, pressure-boosted by the diesel engine-driven booster pump (Stage 2) and discharged to the firewater distribution ring main at Cellar Deck level. Each fire pump is rated at $454 m^3/h$ to provide an operating pressure of 8.9 bar. In the event of low or nil firewater demand while fire pumps are running, a PCV will open (under control of a PIC in the discharge line) to divert fire pump output to sea.

2.2.6 Fire Pump Controls and Instrumentation

Details are shown on illustration C5.10 and described in Section 3 of this chapter. Local controls consist of a Start/Stop facility and the Manual Reset which must be operated in the event of an engine trip (fresh water coolant temperature high, lube oil pressure low, engine overspeed).

2.3 Fire Monitors

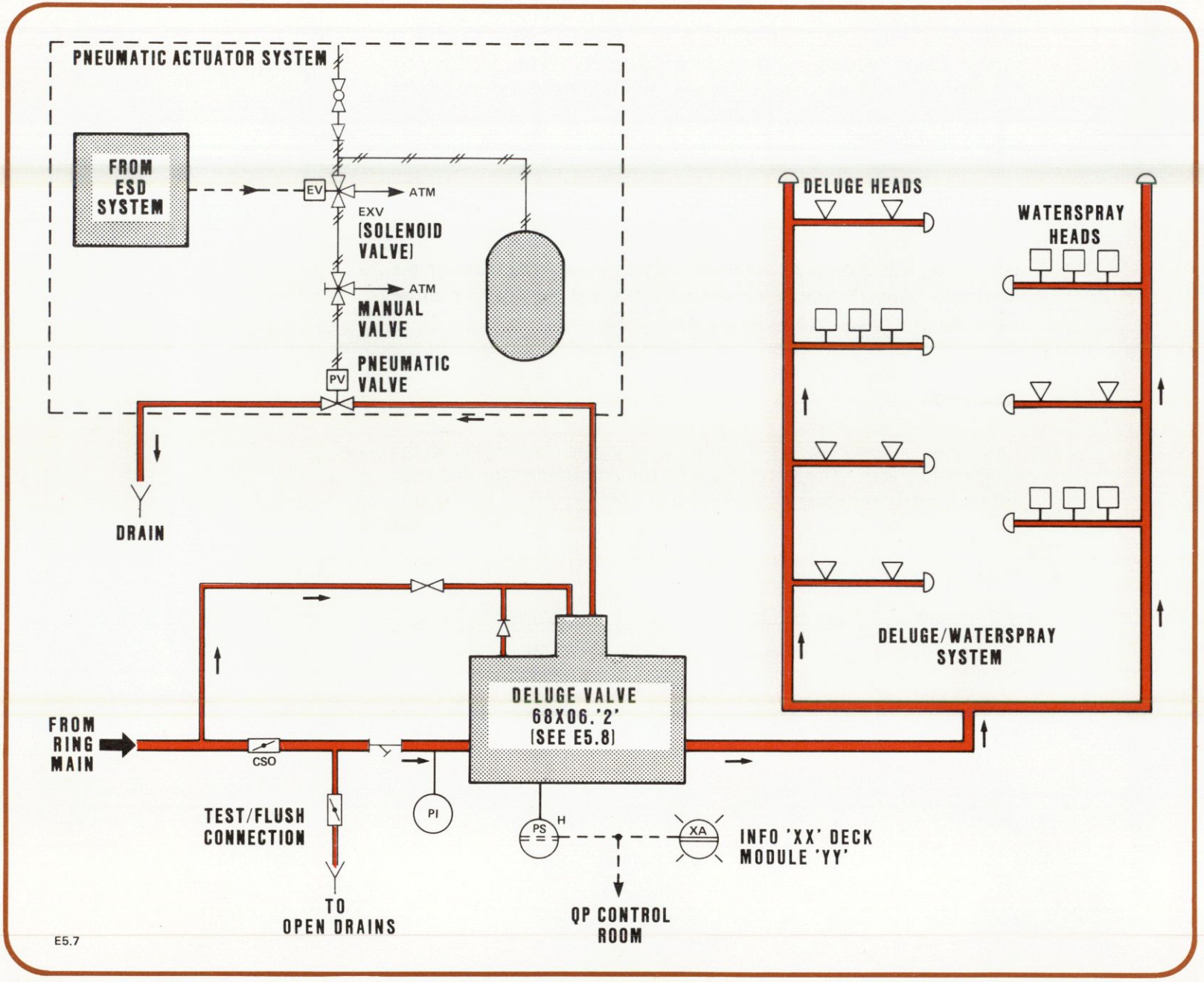
The three fire monitors installed on the Upper Deck are of the adjustable type. They are operated manually and can produce either a straight or conical jet at a flowrate of 1300 l/min.

2.4 Hose Reels

Twenty-two hose reels are installed at strategic points around the compression area. The nozzles are of the adjustable type and each hose is capable of delivering 385 l/min.

2.5 Foam-making Equipment

Five mobile foam-making appliances are provided; three are located on the Upper Deck and two on the Main Deck. They are used to produce foam for firefighting as required.

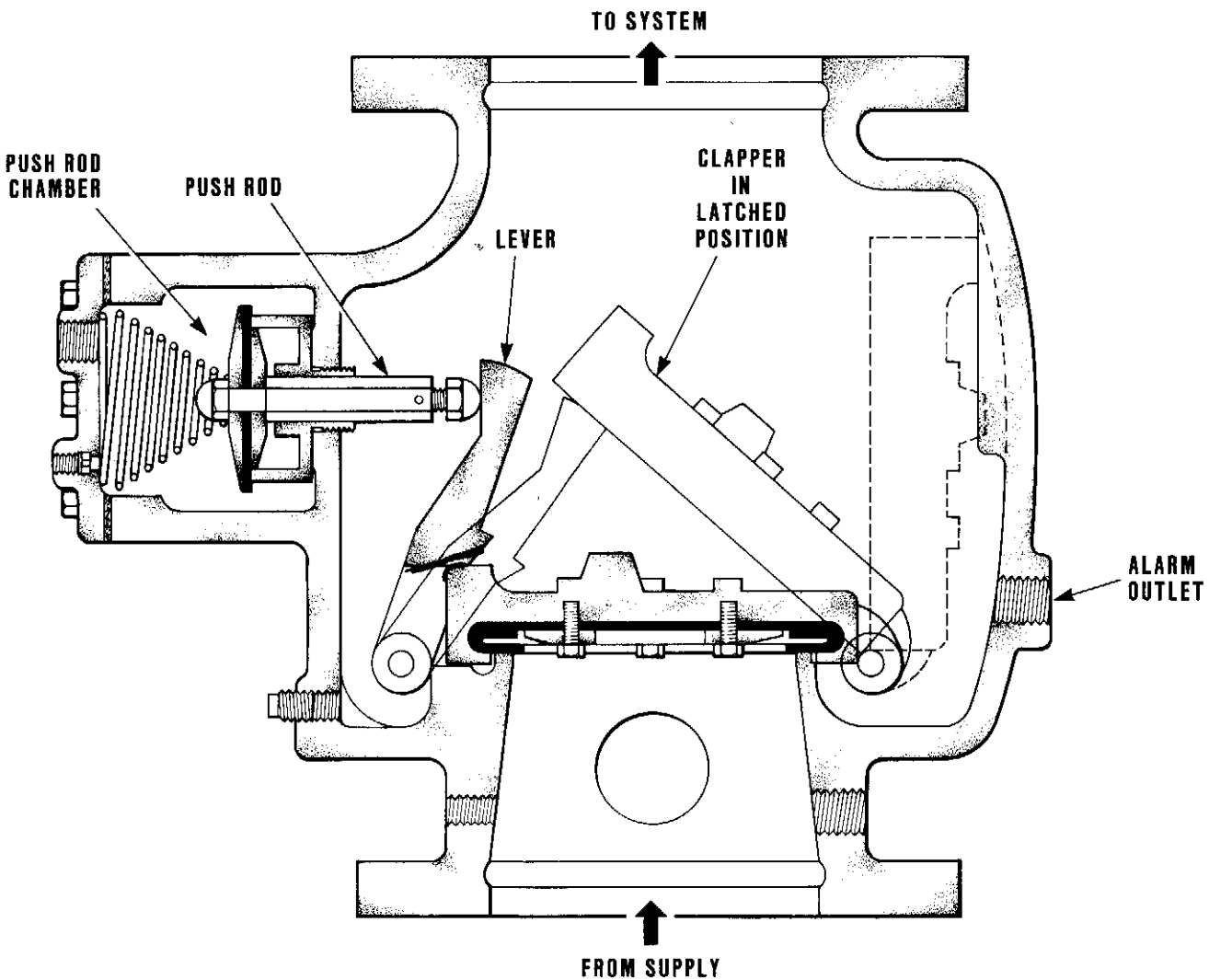

PNEUMATIC ACTUATOR SYSTEM
FROM ESD SYSTEM
EV
ATM
EXV
(SOLENOID VALVE)
ATM
MANUAL VALVE
PNEUMATIC VALVE
PV
DRAIN
DELUGE HEADS
WATERSPRAY HEADS
DELUGE/WATERSPRAY SYSTEM
DELUGE VALVE 68X06.'2' (SEE E5.8)
FROM RING MAIN
CSO
TEST/FLUSH CONNECTION
PI
PS
H
XA
INFO 'XX' DECK MODULE 'YY'
TO OPEN DRAINS
QP CONTROL ROOM
E5.7

2.6 **Deluge/Sprinkler/Waterspray Systems**

See illustrations E5.7 and E5.8

2.6.1 Ten separate deluge/sprinkler/waterspray systems are installed on the Main Deck and Upper Deck of the new gas compression area. Each system is located to extinguish a fire around an item or items of equipment. The items of equipment and type of system installed are detailed below:

Equipment	Deck	System Type
1. Suction Drum of Mod 33 and LP Vent Scrubber	Main South	Waterspray/sprinkler
2. Compressor Room, Mod 33	Main South	Deluge
3. Fuel Gas and Hydraulic Package	Upper South	Waterspray
4. Natural Gas Cooler, Mod 33	Upper South	Waterspray
5. Suction Drum and Water Separator, Mod 31	Main North	Waterspray/sprinkler
6. Compressor Room, Mod 31	Main North	Deluge
7. Compressor Room, Mod 30	Main North	Deluge
8. Water Separator and Suction Drum, Mod 30	Main North	Waterspray/sprinkler
9. Natural Gas Cooler, Mod 31	Upper North	Waterspray
10. Natural Gas Cooler, Mod 30	Upper North	Waterspray


TO SYSTEM
PUSH ROD CHAMBER
PUSH ROD
LEVER
CLAPPER IN LATCHED POSITION
ALARM OUTLET
FROM SUPPLY

E5.8

2.6.2 Each deluge/sprinkler/waterspray system is equipped with a deluge valve.

2.6.3 The deluge valve consists of a valve body with a clapper inside which is maintained in the closed position by a lever. The lever is kept in position by the push rod connected to the push rod chamber.

2.6.4 In the working position, the water header below the deluge valve is under pressure and pushes up on the clapper. The push rod chamber is at the same pressure as the fire header, due to the pressurisation pipe. This pressure acts on the push rod and sufficient force is exerted on the lever to keep the clapper in the closed position.

NOTE
Operation of a deluge valve is described in Section 2.

3 EXTERNAL UTILITIES AND INTERFACES

3.1 External Utilities Required

(a) Electrical Power – Instrumentation and 380V 3-phase 50Hz for diesel fire pump air start system compressors.

(b) Instrument Air.

(c) Diesel Fuel.

(d) Hydraulic Oil (replenishment only).

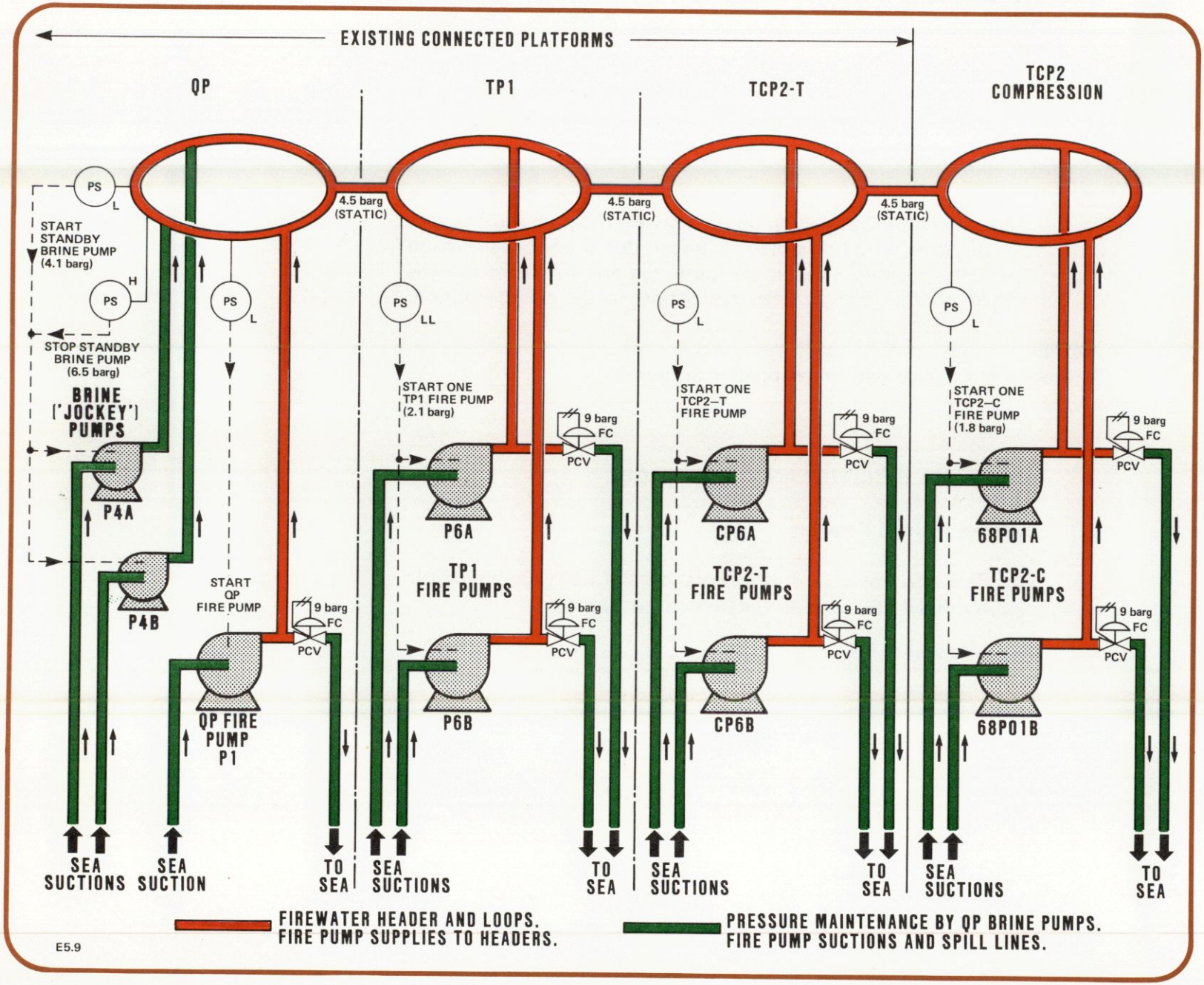
3.2 Interfaces

(a) Washdown System.

(b) TCP2–T Ring Main.

(c) TP1 Ring Main.

(d) QP Ring Main.


EXISTING CONNECTED PLATFORMS
QP
TP1
TCP2-T
TCP2 COMPRESSION
4.5 barg (STATIC)
4.5 barg (STATIC)
4.5 barg (STATIC)
PS L
START STANDBY BRINE PUMP (4.1 barg)
PS H
STOP STANDBY BRINE PUMP (6.5 barg)
PS L
PS LL
START ONE TP1 FIRE PUMP (2.1 barg)
PS L
START ONE TCP2–T FIRE PUMP
PS L
START ONE TCP2–C FIRE PUMP (1.8 barg)
BRINE ['JOCKEY'] PUMPS
P4A
P4B
START QP FIRE PUMP
QP FIRE PUMP P1
9 barg FC PCV
P6A
P6B
TP1 FIRE PUMPS
CP6A
CP6B
TCP2-T FIRE PUMPS
68P01A
68P01B
TCP2-C FIRE PUMPS
SEA SUCTIONS
SEA SUCTION
TO SEA
SEA SUCTIONS
TO SEA
SEA SUCTIONS
TO SEA
SEA SUCTIONS
TO SEA
FIREWATER HEADER AND LOOPS. FIRE PUMP SUPPLIES TO HEADERS.
PRESSURE MAINTENANCE BY QP BRINE PUMPS. FIRE PUMP SUCTIONS AND SPILL LINES.

SECTION 2 – OPERATION AND CONTROLS

1 OPERATING PHILOSOPHY

See illustration E5.9

1.1 The primary function of the firewater systems on QP, TP1, TCP2–T and TCP2– C is to spray water onto equipment and extinguish fires.

1.2 To this end, the firewater systems are all interconnected.

1.3 The main compression area header and ring mains are kept 'wet' and pressurised to 4.5 barg by two brine pumps located on QP. This pressurisation minimises start-up time during emergencies.

1.4 One brine pump is normally running; if the pressure in the header drops below 4.1 barg, the standby brine pump will start.

1.5 If the pressure drops below 2.1 barg, one fire pump on TP1 will start.

1.6 The standby brine pump will stop when the pressure in the header reaches 6.5 barg.

1.7 Should the pressure in the gas compression ring main fall below 1.8 barg when the brine pumps and TP1 fire pump are running, then one diesel fire pump in the compression area system will start.

1.8 The compression area firewater system operates at 8.6 barg when the fire pumps are running. If the pressure at the discharge rises above 9 barg, a PCV opens and excess water is dumped overboard.

1.9 The TCP2–C fire pumps will start automatically in the event of fire detection (via the PLC); see Chapter E2.

2 CONTROLS

See illustrations E5.7, E5.8 and E5.10

2.1 Fire Pumps

2.1.1 The control of the fire pumps and diesel engines are detailed in Section 3.

2.2 Deluge Valves

2.2.1 Deluge valves can be operated automatically or manually. Valves are normally maintained closed by the pressure of water in the ring mains. Activation is by a pneumatic actuation system.

2.2.2 The pneumatic actuator system is supplied with instrument air. Under normal operation, the pneumatically operated solenoid valve is maintained closed by air passing through the solenoid and manual valves.

2.2.3 Either by operating the solenoid valve automatically or the manual valve manually, the air pressure on the pneumatic valve is vented and the valve opens. This action results in a pressure drop in the push rod chamber of the deluge valve and water passes to drain.

2.2.4 The upward force of the firewater in the header exerts pressure on the clapper and, as this is greater than the downward force of the lever, the deluge valve opens.

2.2.5 Once the clapper is open, the lever acts as a latch, preventing the clapper returning to the closed position.

3 PRESTART CHECKS

3.1 Electrical supply and instrument air is available.

3.2 All instrument root valves are open.

3.3 Hand valves are in positions as designated in the valve schedule.

3.4 Firewater main is under pressure (interconnection valve with TCP2—T ring main is open).

3.5 Deluge valves are closed.

3.6 Diesel oil tank and hydraulic oil tank are full.

3.7 Ventilation is operational.

3.8 MANUAL START is selected.

3.9 Diesel engine panel is supplied with instrument air.

3.10 Diesel starting air bottles are under pressure.

3.11 Discharge valve to the ring main is closed.

3.12 Discharge valve to sea is ready to operate.

3.13 Alarm system is operational.

3.14 Valves on cooling system are set correctly.

3.15 Once the above checks are complete, the diesel engine can be started manually. Once the pumps are checked, select the Auto/ Manual Start selector on the panel for AUTO.

4 START-UP

4.1 Start-up of the firewater system is initiated automatically by FABs at selected points, from TCP2 or QP Control Rooms, and by detectors in modules.

4.2 Manual start-up can be initiated locally from the fire pumps.

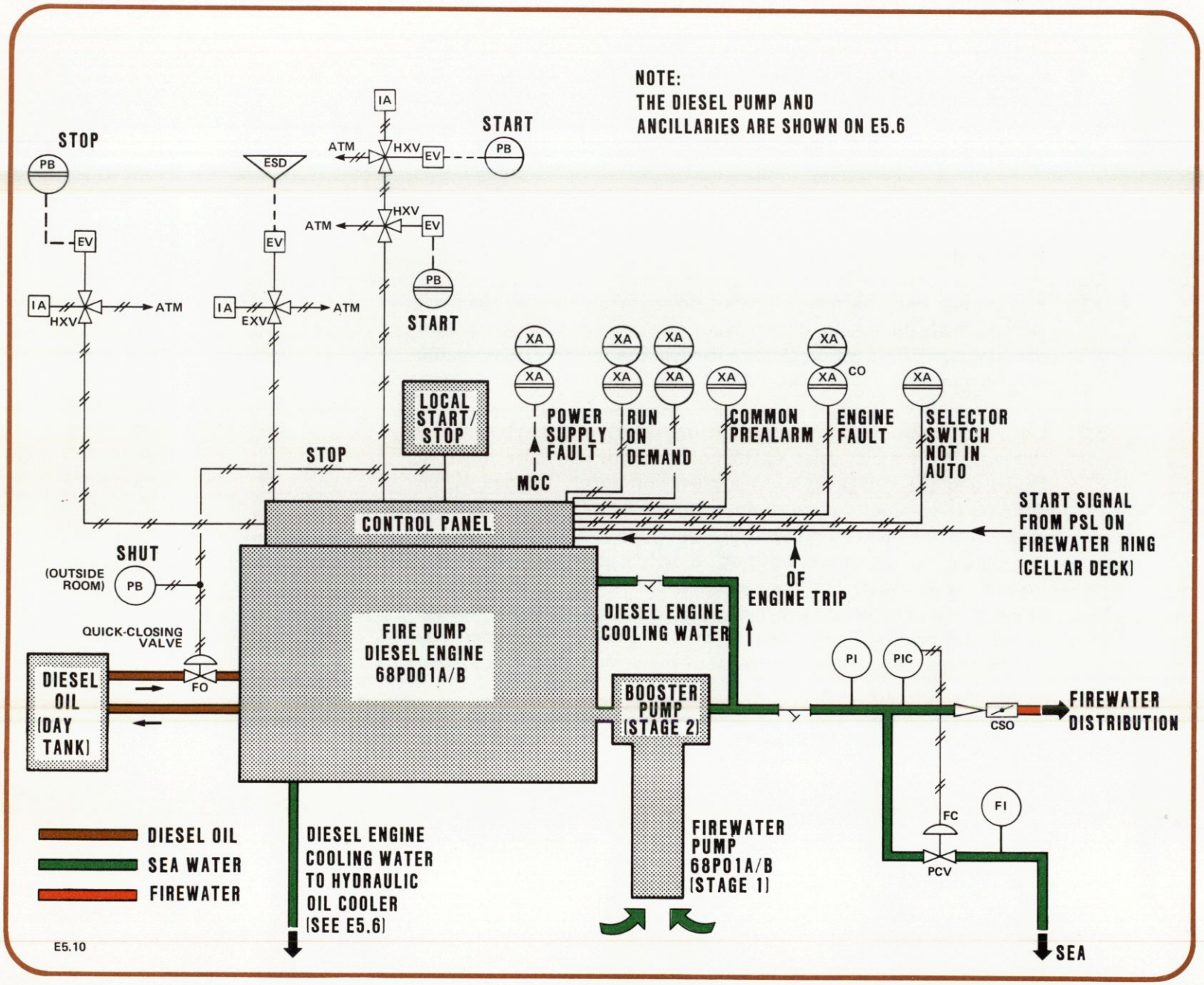
5 SHUTDOWN

5.1 Fire pumps must be manually shut down. When the fire has been extinguished, the manual Stop Engine button must be depressed on the fire pump. This action closes a valve in the fuel line between the diesel engine and its day tank.

5.2 Once the fire pumps are stopped, deluge valves must be re-armed as follows: The manual valve upstream of the deluge valve must be closed and the deluge/sprinkler system completely drained. When draining is complete, close drain valves and reset the deluge valve lever using the handle on the deluge valve body. This action returns the clapper to the closed position. Slowly open the valve on the manual valve bypass line and, when water is flowing at the drain point of the pneumatic valve, close it by resetting either the manual or solenoid valves. Then close the manual valve on the bypass line and open the manual valve upstream of the deluge valve. The system is now re-armed and ready for operation.

5.3 Reset the AUTO START select on the diesel fire pump control panel.

5.4 If the fire alarm initiating signal is still present, the Auto/Manual start selector should be switched to OFF to prevent pumps restarting.


NOTE:
THE DIESEL PUMP AND
ANCILLARIES ARE SHOWN ON E5.6
STOP
START
ESD
IA
ATM
HXV
EV
PB
EXV
START
STOP
LOCAL START/ STOP
XA
CO
POWER SUPPLY FAULT
MCC
RUN ON DEMAND
COMMON PREALARM
ENGINE FAULT
SELECTOR SWITCH NOT IN AUTO
CONTROL PANEL
START SIGNAL FROM PSL ON FIREWATER RING (CELLAR DECK)
OF ENGINE TRIP
SHUT
(OUTSIDE ROOM)
QUICK-CLOSING VALVE
FO
DIESEL OIL (DAY TANK)
FIRE PUMP DIESEL ENGINE 68PD01A/B
DIESEL ENGINE COOLING WATER
BOOSTER PUMP (STAGE 2)
PI
PIC
CSO
FIREWATER DISTRIBUTION
FC
FI
PCV
DIESEL OIL
SEA WATER
FIREWATER
DIESEL ENGINE COOLING WATER TO HYDRAULIC OIL COOLER (SEE E5.6)
FIREWATER PUMP 68P01A/B (STAGE 1)
SEA
E5.10

SECTION 3 – ALARMS AND TRIPS

See illustration E5.10

1 ALARMS AND TRIPS

1.1 General Fire Alarm Boxes (FABs) are located throughout the new gas compression area.

1.2 Low pressure in the Cellar Deck ring main is annunciated in the TCP2 Control Room.

1.3 Individual deluge valves on the ring mains are fitted with high pressure switches. If a deluge valve is actuated manually before a fire alarm has been activated, the high pressure switch will automatically start the fire pumps. The high pressure will annunciate on an alarm light in the TCP2 and QP Control Rooms.

1.4 The diesel-driven fire pumps are fitted with the following alarms annunciating in the TCP2 Control Room. Some alarms also annunciate in the QP Control Room.

Alarm	TCP2 Control Room	QP Control Room
1. Power Supply Fault	X	X
2. Pump Run	X	X
3. Common Pre-alarm	X	
4. Engine Fault	X	X
5. Selector Switch Not in Automatic	X	
6. On Demand	X	X
7. High Level Diesel Day Tank	X	
8. Low Level Diesel Day Tank	X	

1.5 The diesel engine driving the fire pumps is fitted with an overspeed trip, which must be reset manually.

SECTION 4 – TROUBLESHOOTING

Symptom	Possible Cause	Action
1. Fire pump fails to start on manual or auto command.	1. No diesel fuel.	Check fuel level and refill if necessary.
	2. Selector switch not on automatic.	Select automatic; inform safety officer.
	3. Pump has not been reset after overspeed trip.	Reset manually.
	4. Fault in diesel engine control panel.	Check panel and investigate fault.
	5. No electrical power for start transmission signal.	Investigate power supply.
2. Pressure loss in ring mains.	1. Pressure control valve on discharge side of fire pump jammed open.	Check valve and correct if necessary by hand.
3. Pump stops while running.	1. Overspeed on diesel.	Rectify fault and reset manually.

SECTION 5 – OPERATOR MAINTENANCE

1 At predetermined intervals, the diesel fire pumps should be run up and tested.

2 This operation should be carried out in accordance with maintenance and safety schedules. Only one pump should be tested at a time, leaving the other pump for emergency duty.

CHAPTER E6

PERSONNEL SAFETY

CONTENTS

SECTION 1 DESCRIPTION

1. Summary
2. Area Classification
3. Telephone System
4. Public Address System
5. Firewalls
6. Gas/Fire Detection and Firefighting
7. Escape Facilities
8. General Safety Equipment

SECTION 1 – DESCRIPTION

1 SUMMARY

1.1 The new Gas Compression area is not segregated from the existing TCP2 Treatment area facilities in terms of personnel safety.

1.2 Alarm systems, telephones, escape routes and lifesaving equipment have been supplied to the same standards as exist already and are totally compatible with them.

1.3 It is essential that personnel working in the new Gas Compression area familiarise themselves with safety plans and alarms and also know what to do should a hazardous condition arise.

2 AREA CLASSIFICATION

2.1 The Area Classification of the new Gas Compression area is based on the identical code used in the existing TCP2 Treatment area.

2.2 The gas compressor rooms (Modules 30, 31 and 33) are classed as Division 2. All other spaces are classified Safe as long as the specified ventilation is operative.

2.3 The LP vent outlet is classified Division I.

3 TELEPHONE SYSTEM

3.1 Telephone sets are placed strategically in the Gas Compression area and are in accordance with the appropriate hazard classification.

3.2 The monitoring exchange for telephones is located on QP, with slave equipment in the TCP2 Treatment interface room.

4 PUBLIC ADDRESS SYSTEM

4.1 A system of loudspeakers (connected into the existing system) is installed in the Gas Compression area. It is controlled from QP. The system can broadcast general information, as well as 'Muster Alarm' and 'Fire Alarm' signals.

5 FIREWALLS

5.1 Firewalls are installed around the following areas in the new Gas Compression area:

(a) Firewater pumps.

(b) Emergency equipment.

(c) Control Room.

(d) Workshops.

(e) Between main generators and emergency generator.

5.2 Airtight walls are installed around pressurised areas.

6 GAS/FIRE DETECTION AND FIREFIGHTING

6.1 Detectors are installed for gas and fire and are covered in Chapters E2 and E3.

6.2 Firefighting systems are covered in Chapters E4 and E5.

7 ESCAPE FACILITIES

7.1 Access ways are provided in the Cellar Deck and Modules.

7.2 Stairways are provided between all levels.

7.3 The main emergency escape route will be over the connecting bridge to Platform TP1. If this route is blocked, lifeboats and liferafts will be used.

7.4 All escape routes are illuminated by the emergency lighting system in the event of main power failure.

7.5 Manual firefighting equipment, alarm stations and shutdown stations are located on the escape routes.

7.6 A lifeboat for the Compression area is located external to the Cellar Deck.

7.7 The lifeboat and liferaft launching area is provided with a supply of lifejackets.

7.8 The lifeboat is enclosed and carries 50 persons. It is equipped with all the necessary safety devices and survival equipment.

8 GENERAL SAFETY EQUIPMENT

The Gas Compression area is supplied with adequate numbers of first aid kits, stretchers, fire suits, hand fire extinguishers and breathing apparatus.

CHAPTER E7

CHEMICAL HAZARDS

CONTENTS

SECTION 1 SUMMARY

1. Precautions
2. Storage and Handling

SECTION 2 PHYSICAL PROPERTIES OF CHEMICALS

1. Methanol
2. Triethylene Glycol (TEG)
3. BTM Halon 1301
4. Polyacrylate (AC–6)
5. Powdered Acid (AC–2 or AC–7)
6. Norust Anti-corrosion Chemical

ILLUSTRATION

E7.1 Typical Toxicological and Safety Data Sheet – Methanol

SECTION 1 – SUMMARY

1 PRECAUTIONS

1.1 The safe handling and storage of chemicals used in the new Gas Compression area is crucial to the safety of the personnel operating the plant installed.

1.2 Some of the chemicals used in the Gas Compression area are deemed to be hazardous.

1.3 Operators should familiarise themselves with the relevant Codes of Practice and Materials Safety Data Sheets for each chemical in use.

1.4 Hazard pre-recognition can lower the overall incidence of accidents due to toxicity and flammability of chemicals.

1.5 The following chemicals are used in the Gas Compression area. They are identified chemically with their particular purpose and use:

Chemical	Purpose	Where Found/Used
(a) Methanol. (METHYL ALCOHOL)	Prevention of hydrate formation in water-saturated gas.	Fuel gas package, when compressor discharge source is used.
(b) Triethylene glycol. (TEG)	As an anti-freeze. (Also used elsewhere for prevention of hydrate formation.)	Utilities and process fresh water cooling systems.
(c) Bromotrifluoromethane. (BTM – HALON 1301)	Firefighting.	Electrical rooms, pump rooms and workshops.
(d) Polyacrylate. (AC–6)	Scale prevention.	Watermakers.
(e) Powdered Acid. (AC–2 or AC–7)	Chemical cleaning.	Watermakers.
(f) NORUST	Anti-corrosion.	Fresh water distribution system.

2 STORAGE AND HANDLING

2.1 Whenever chemicals are replenished, the labels on containers should be checked against what was ordered.

2.2 Containers should be inspected for damage.

2.3 Chemicals should be stored in cool, dry and well ventilated areas. Stocks of chemicals should be checked on a regular basis to ensure that corrosion, pressure build-up and decomposition are eliminated.

2.4 Wherever possible, containers should be raised off the deck. This allows leaking containers to be easily identified and allows adequate ventilation and dispersion of flammable or toxic vapours.

2.5 It is advisable to check stoppers of containers before they are handled. Blocks and wedges should be used during transport and correct lifting procedures adhered to at all times.

2.6 As a general rule, it is advisable to wear goggles, PVC aprons and PVC gloves when handling any chemical. Make sure that the position of safety showers and eyebath facilities are known.

2.7 Contact between chemicals and skin, clothing and eyes should be avoided. Prolonged inhalation of vapours and taking chemicals internally should be immediately followed by the necessary remedial actions.

2.8 If in any doubt as to the nature of the chemical hazard after an accident, immediately consult the relevant First Aid personnel on the platform.

METHANOL

DANGER! FLAMMABLE
HARMFUL IF INHALED
MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED
CANNOT BE MADE NON-POISONOUS

KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.
KEEP CONTAINER CLOSED.
AVOID CONTACT WITH EYES.
AVOID PROLONGED OR REPEATED BREATHING OF VAPOUR.
USE ONLY WITH ADEQUATE VENTILATION.
IN CASE OF EYE CONTACT, FLUSH WITH PLENTY OF WATER AND CALL A PHYSICIAN.

IN CASE OF FIRE, USE WATER SPRAY, FOAM, DRY CHEMICAL, OR CO_2.

FLUSH SPILL AREA WITH WATER SPRAY.

POISON

CALL A PHYSICIAN

FIRST AID

IF SWALLOWED: GIVE A TABLESPOONFUL OF SALT IN A GLASS OF WARM WATER AND REPEAT UNTIL VOMIT FLUID IS CLEAR. GIVE TWO TEASPOONFULS OF BAKING SODA IN A GLASS OF WATER. HAVE PATIENT LIE DOWN AND KEEP WARM.

SECTION 2 – PHYSICAL PROPERTIES OF CHEMICALS

1 METHANOL

See illustration E7.1

1.1 Methanol is a colourless, non-corrosive liquid, with a pungent oily odour. It is not dangerously reactive and is miscible (ie 'may be mixed') with water.

1.2 Methanol is harmful by inhalation of the vapours and by prolonged or repeated contact of the liquid or vapour with the skin. It is highly toxic when taken orally.

1.3 Methanol is flammable and is thus a potential fire hazard.

1.4 Safety goggles, overalls and gloves should be worn when handling Methanol. If storage tanks are to be entered for cleaning, the necessary breathing apparatus should be used.

1.5 Any contaminated clothing should be washed before further use. Areas of skin splashed with Methanol should be immediately washed with soap and water. If the eyes are splashed, they should be washed with copious quantities of water.

1.6 Methanol fires should be controlled and extinguished with either carbon dioxide or dry chemical powder. Water spray is also effective through sprinklers or hose lines with spray nozzles.

1.7 All Methanol areas should be designated 'NO SMOKING'. Storage areas should be well ventilated and all spills must be promptly flushed away with water.

1.8 First aid and/or a doctor should be summoned if skin or eyes are splashed. If Methanol is taken orally, urgent medical care is necessary and a doctor should be consulted.

1.9 A typical toxicological and safety sheet (for methanol) is shown in illustration E7.1

2 TRIETHYLENE GLYCOL (TEG)

2.1 Triethylene glycol (TEG) is a colourless, non-corrosive liquid, which is miscible in water.

2.2 TEG can cause irritation to both the skin and eyes in both vapour and liquid form. This is particularly so where hot liquid is involved.

2.3 TEG must not be taken internally.

2.4 Goggles, gloves and overalls should be worn at all times during handling.

2.5 Accidental skin or eye contamination should be washed with copious quantities of water.

2.6 Medical attention should be sought after the accident.

3 BTM HALON 1301

3.1 BTM Halon is a colourless, odourless, electrically non-conductive gas. It is used in firefighting systems and inhibits the chemical reaction between the fuel and oxygen.

3.2 The discharge of Halon may create a hazard to personnel either from the gas itself or from the decomposition products resulting from the exposure of Halon to heat sources.

3.3 The decomposition products can cause unconsciousness on prolonged exposure and may be toxic in severe cases.

3.4 Before entering any room protected by Halon, the system should be switched to MANUAL.

3.5 After a Halon release, the area should be well ventilated and then checked by personnel using breathing apparatus.

4 POLYACRYLATE (AC–6)

4.1 Polyacrylate is used as an anti-scale chemical in the Watermakers. It is known as AC–6 and is used in conjunction with acid solutions to keep the Watermakers working at maximum efficiency.

4.2 The chemical contains no polyphosphates or heavy metals and is not subject to reversion at elevated temperature or decomposition by hydrolysis (chemical reaction with water). It has no flash point and has a pH of 7.0.

4.3 Although it is non-corrosive and non-toxic, it should not be taken orally or splashed in eyes or on skin.

4.4 Generous amounts of fresh water should be used to flush the chemical from skin and eyes.

5 POWDERED ACID (AC–2 or AC–7)

5.1 Powdered acid is used approximately every 72 hours to 'acid-slug' the Watermakers. This procedure, in conjunction with anti-scale dosing, keeps the Watermakers free of scale.

WARNING
WHEN MAKING UP SOLUTIONS IN THE WATERMAKER ACID POT, NEVER ADD WATER TO CONCENTRATED ACID. ACID SHOULD ALWAYS BE ADDED TO WATER SLOWLY AND CAREFULLY.

5.2 Contact of powdered or liquid acid with skin and eyes should be avoided and all possible precautions taken to avoid spillages of liquid acid.

5.3 Any gases generated during cleaning operations should be vented to the external atmosphere outside platform modules.

5.4 Safety goggles, gloves and overalls should be worn at all times. Rubber boots should be worn if possible.

6 NORUST ANTI-CORROSION CHEMICAL

6.1 The Norust corrosion inhibitor is a yellow liquid, with a flash-point of about 15°C, which is soluble in water. No special storage or handling precautions are necessary other than those applicable to all flammable chemicals.

6.2 Since it is also a bactericide, it should not be taken orally or splashed in the eyes or on skin; observe the normal precautions for chemical handling.