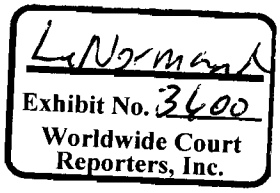
SUBSEA
MULTIPLEX BOP CONTROL SYSTEM



Basic Operation Manual

FOR
STANDARD SYSTEMS –3RD GENERATION

TABLE OF CONTENTS

AUTHOR'S NOTES

The BOP Manual contains simplified descriptions of the various control systems equipment available from Cameron Controls. Any given system will likely not include all of the equipment described in this Basic Operation Manual.

We like to advise that for detailed information we have the Rig Manuals, which give all information necessary to service and maintain our equipment. For functionality questions or for test questions please use the FAT Procedures or the Side Integration Test Procedures (SIT Procedures).

We also have technical bulletins on specific items. If you have other question, please use also the Standard Subsea BOP Multiplex Control Description we have in the beginning of the manual. The scope of supply for the standard multiplex control system gives a lot of technical detailed information which will normally get you into position to fully understand this system.

For rig engineers we have special training courses and classes and also we are able to train in the FAT in the factory rig engineers necessary to service and work with the system.

For the software and the electronic, we offer electronic and software engineer classes that they are able to change or re-configure the system. This is a special course will be done inside our organization in Celle or Houston and is only applicable for the engineers with electronic or software knowledge.

Cameron Controls, April 1999

1 DESCRIPTION

1.1 ABBREVIATIONS

ACS	Acoustic Control System
API	American Petroleum Institute
BOP	Blowout Preventer
CPU	Central Processing Unit
OIM CP	OIM Control Panel
DU	Diverter Unit
EID-Display	Error, Interlock and Diagnostic Display
HPP	Hydraulic Power Package
HPU	Hydraulic Power Unit
LRP	Lower Riser Package
LMRP	Lower Marine Riser Package
MCP	Modular Control Pod
MMCP	Multiplex Modular Control Pod
MP	Multiplex Package
NPD	Norwegian Petroleum Directory
PETU	Portable Electronic Test Unit
PLC	Programmable Logic Controller
RCB	Riser Control Box
RIS	Riser Instrumentation System
SEM	Subsea Electronics Module
SSECP	Subsea Engineer's Control Panel
WP	Working Pressure

SCOPE OF SUPPLY - TYPICAL STANDARD SUBSEA MULTIPLEX CONTROL SYSTEM

Item	Part Number	Typical Quantity	Description
1.	223010-34	1	Hydraulic Power Unit
2.	223130-42	2	Uninterruptable Power Supply
3.	223020-79	1	OIM Control Panel, EX
4.	223020-80	1	Subsea Engineers Control Panel, NON-EX
5.	223038-08 (04)	2	Cable Reel Yellow/Blue
6.	223050-58	2	Multiplex Subsea Modular Control Pod
7.	300753-14	1	Shuttle Valve 1/2"
8.	251423-01	4	Shuttle Valve 1/2" balanced
9.	307488-11	1	Pilot operated Check Valve 1.1/2"
10.	619010-03-97	300	Cable/Hose Clamps
11.	223190-07	2	Cable Turning Sheave for BOP Cable
12.	223050-65	2	Conduit Valve Module (2 conduit lines)
13.	223311-04	1	Mixing System (typically, part of HPU)
14.	223180-48	1	Portable Electronic Test Unit
15.	619002-56	4	Safety Valve
16.	714207	4	Bleed Valve
17.	223050-24	1	Gate Valve "Fail Safe Open" Kit
18.	223378-13 (12)	1	Event Logging System
19.	223376-04	1	Riser Inclination and Instrumentation System
20.	223160-23	2*	Accumulator Rack
21.	619012-02-02	7	Subsea LRP mounted Accumulator
22.	T.B.A.	2+	Pod Alignment Funnel
23.	223410-01	1	Accumulator Precharge Kit and Compressor
24.	223180-56	1	Portable BOP Test Box
25.	Per Project	1+	Set of Commissioning Spares
26.	Per Project	1+	Set of 2 year Spares

* Quantity depends on stack size, water depth and customer requirements for closing times.

\+ Will be tailor made to customer stack.

1.2 DESIGN BASIS

The multiplex BOP control system will comply with the following rules and standards:

Electrical Equipment - General -

Note: *All materials comply to the following specification unless stated differently in this actual product description.*

Codes and Standards:

The electrical equipment and components will be in accordance to the following codes and standards:

• IEC 79-8	Classification of maximum surface temperatures
• IEC 79-10	Hazardous area classification
• IEC 79-14	Electrical installations in explosive gas atmosphere
• IEC 332	Testing of cables submitted to fire (Characteristics of fire retardant cables)
• IEC 529	Classification of degrees of protection provided by enclosures
• IEC 617	Graphic symbols for diagrams
• EN 50014	Electrical apparatus for use in potentially explosive atmospheres: general requirements
• EN 50018	Electrical apparatus for use in potentially explosive atmospheres: flameproof enclosure "d"
• EN 50019	Electrical apparatus for use in potentially explosive atmospheres: increased safety "e"
• EN 50020	Electrical apparatus for use in potentially explosive atmospheres: intrinsic safety "i"

Hazardous Area Classification

The electrical equipment will be suitable for Zone 1, Gas Group IIA, Temperature Class T3, hazardous area.

A member of the CENELEC organization certifies all explosion proof components if applicable. The certificates will be delivered in the language of origin.

An English translation will accompany certificates, which are not in English. The translation will not be certified.

1.4 HYDRAULIC POWER UNIT (HPU)

The HPU provides the hydraulic power fluid, which operates the subsea BOP-Stack and Lower Riser Package (LRP) system functions. It provides fluid at a pressure level of 230 barg (3000 PSI) regulated or 345 barg (5000 psi) direct. The HPU and the related accumulators on surface and subsea are sized with sufficient fluid volume capacity to operate the BOP-Stack functions in accordance with either API 16D or NPD requirements.

The HPU consists of three main integrated systems: a Hydraulic Power Package (HPP), a Diverter Control Unit (DU) and a Mixing Unit (MU).

Typical functions controlled locally by the HPU include:

- Surface Accumulator Pressure
- Air Supply Pressure
- Flow Indication
- Fluid levels at the Reservoir
- Pump status

1.4.1 Hydraulic Power Package (HPP)

The Main Control Box (located on the Diverter Unit) electrically controls the HPP. It includes the electrical equipment for the Motor Control, Alarm System, the PLC system includes The communication controller and the interface parts to the Remote Control Panels.

The HPP is equipped with two, three or four pump systems with independent, dedicated electrical power sources configured as applicable for the project requirements. The pump system is designed in accordance with API 16D so that the combined systems are able to supply a sufficient quantity of hydraulic fluid to charge the entire accumulator system from precharge pressure to the maximum rated operating pressure within fifteen minutes.

One hydraulic fluid reservoir is provided to contain the hydraulic operating fluid and is designed to have a capacity equal to the usable hydraulic fluid capacity of the accumulator system. The fluid reservoir is complete with baffle plates, when necessary, fill and drain ports, vent piping, level sight gauge, access to tank bottom for cleaning and low-level float switch. See API requirements.

The HPP is assembled as a heavy-duty, oilfield-type skid, of welded construction for installation on a drilling rig.

The base frame assembly is constructed of seal-welded St 37-2, DIN 17100 (or equivalent) carbon steel structural members. Painting is in accordance with a Cameron approved paint specification. The skid-mounted unit is equipped with forklift slots in the skid base. The skid structure is designed to withstand four times the unit static weight. Fixing positions are provided to allow for the unit to be permanently located on the drilling rig.

All piping, tubing, fittings, valves, accumulators, pumps, connections and other components in contact with the control fluid are compatible with control fluid.

The HPU mounted electrical equipment is rated to IP55 as a minimum.

All electric cables are oil-resistant, seawater resistant and flame retardant (IEC 332 or equivalent). Internal HPU cables are not armored. The conductors have an appropriate cross section for the component and its function.

The electrical power supplies that are required to operate the HPU are typically 440 VAC, 3ph, 60Hz; 220 VAC, 60Hz and 24 VDC must be supplied by the customer. Other voltages are possible.

Technical Description

The HPU typically consists of the following main components:

- Hydraulic Reservoir
- Electric Motor Driven Hydraulic Pump System
- Air Supply Manifold
- Hydraulic Filtration System
- Surface Flow Meter
- Conduit Select Valve
- Air Solenoid Valves
- Hydraulic Pipe and Fitting
- HPU Control System (Motor - and Alarm System)

Hydraulic Reservoir

The hydraulic reservoir is located inside the structure of the HPU. The reservoir is constructed from type AISI 304 stainless steel or equivalent. The fluid volume capacity inside the reservoir is typically 1000 gallon (3800 liter) in the standard design, but is verified to meet system requirements according to API 16D guidelines.

All hydraulic surface outlets are flanged, threaded or welded to the reservoir wall.

The reservoir is designed with a sloped bottom with a minimum of 1 drain port, minimum size 1-inch, located at the low end and isolated with a ball valve and a metal plug.

The hydraulic reservoir is typically equipped with the following:

- Inspection hatch with cover for cleaning
- Visual Level Indicator
- Float control assembly for automatically refilling fluid reservoir
- Low level float switch (EEx-d) with alarm for indicating low reservoir fluid level

- Drain Valve
- Necessary piping and valving for pump suction

Electric Motor Driven Hydraulic Pump System

The pump system consists of electric motor driven hydraulic triplex pumps.

The pumping capacity depends on the type, size and number of pumps installed and is sized to meet system requirements.

A typical System consists of the following main equipment parts:

- Single electric motor driven hydraulic triplex pumps.
- Motors 440V AC, 60 Hz, 3ph EEx-e, direct on-line (Standard is Cenelec)
- Contact gauges (EEx-i) or transducers to start and stop the pumps
- Suction strainers
- Non return check valve in pump discharge lines
- Pressure relief valve at pump discharge lines and pressure switches

Hydraulic Filtration System

The hydraulic filtration system contains a duplex redundant, downstream, in-line filtration unit with 20-micron filter elements, rated at the specific system hydraulic working pressure. Each filter incorporates a high differential pressure, pop-up, blocked filter indicator and a hydraulic bypass check valve, which operates when the differential pressure across the filter element is excessive, but not sufficient to collapse the filter element.

The filter incorporates isolation valves, allowing on-line maintenance of the system.

Surface Flow Meter

The explosion-proof display on the Diverter Control Panel indicates the totaled flow rate for the hydraulic fluid circuit, which is measured by turbine flowmeter. A reset button for the counter changes the display to "zero."

The turbine, flow counter display and the associated push button are connected to the Main Control Box (EEx-d,e,i). Different types of protection, EEx-d, EEx-e, and EEx-i are used.

The surface flowmeter incorporates isolation valves for bypassing the turbine and allow on-line maintenance of the part.

1.1/2" Conduit Select Valve

Typically, two 2" stainless steel single air-piloted (2-way / 2-position) ball valves are installed inside the HPP for the "CONDUIT SELECT" function.

1/4" Solenoid Valves

Typically, three (3) 1/4" solenoid valves (3-way / 2-position) are installed inside the DU for the remote operation of functions via the Remote Control Panels.

Hydraulic Pipe and Fitting (for Diverter Unit, Mixing Unit and Hydraulic Pump Package)

All hydraulic high pressure tubing (1/4", 3/8", 1/2" OD) is seamless annealed ASTM A-269, type AISI 316 stainless steel or equivalent . The pressure rating of the hydraulic tubing is minimum 345 bar (5000 psi). All tubing of the hydraulic circuits is capable of withstanding the application of 1.1/2 time specified design pressure without any deformation or other damage.

The tubing of the hydraulic circuits are accurately cut by the use of an automatic sawing machine and bent by the use of standard tube benders. No burrs are allowed and each section of the tubing is blown and cleaned before assembly to ensure that no contamination (dirt) enters the control components.

Hydraulic fittings are of the double ferrule compression type (e.g.: Swagelok or equivalent) AISI 316 stainless steel.

PTFE tape is not used on any part of the hydraulic control system, except for drain plugs.

All high pressure pipe (1"size or larger) is ASTM A106 grade B, seamless carbon steel or equivalent with type ASTM A105, 5,000 psi, forged fittings. Next generation systems have 316 stainless steel pipe work with welded connections and SAE std code 62 flanged connections between branches.

Over pressure protection to prevent potential damage to hydraulic system parts is ensured by pressure relief valves and pressure switches (not used to detect overpressure), that are installed in the pressure circuit. These valves will limit the maximum operation pressure in the circuit to 110 % of the design working pressure of the related hydraulic circuit.

All air pressure pipes (1" size or larger) are 316 stainless steel.

All air pressure tubing (1/4" or 3/8" OD) is Dekabon tubing with brass tubing fittings of the twin ferrule type.

The complete system is equipped with all necessary gauges, check valves, bleed valves, safety valves, fittings and connections for proper operation. All water, air, high pressure discharge lines and fluid return lines connections to the skid are manifolded to a common point for easy access.

HPU Control System (Motor - and Alarm System)

An electronic Programmable Logic Controller (PLC) unit is installed in the explosion proof Main Control Box (inside the DU) to monitor the Hydraulic Power Unit and the fluid mixing system. Air and hydraulic fluid pressures, pump running status, fluid level alarms, etc. are monitored by the PLC and transmitted to the Remote Control Panels via serial link cables.

The PLC is equipped with one CPU board, two Power Supplies, Interface Cards and uses a redundant Communication Interface to the serial bus systems and is powered by the redundant UPS system.

Local HPU Control Panel

The Local HPU Control Panel is mounted in front of the DU and allows status indication and control of the following main functions:

Typically two (2) 1/4" stainless steel local or remote operated 4-way / 3-position valve for the surface "CONDUIT SELECT" pilot function are installed on the DU Control Panel.

The conduit select valve allows the hydraulic fluid supply to be transmitted to either the blue pod or the yellow pod; then the subsea conduit valve package is piloted by the MUX package remotely from either electric Remote Control Panel. The hydraulic fluid is supplied to each subsea pod through two conduit lines, which are mounted to the drilling riser alongside the choke and kill lines. It is possible to select the conduit supply line (Blue or Yellow) locally at the HPU Local Control Panel by operating the conduit select valve.. This valve can be operated into center position either manually at the Control Panel, or remotely at the Remote Control Panels. In center position the main supply to both conduit lines is isolated and both conduit lines are vented.

Up to Six (6) pressure gauges are installed on the local HPU Control Panel for local pressure indication:

- System Pressure E-Pumps 1 + 2 set points
- System Pressure E-Pumps 3 + 4 set points
- Diverter Accumulator Pressure
- Surface Accumulator Pressure
- Air Supply Pressure
- Conduit Select Pilot Pressure (when applicable)

Up to three (3) individual alarm-indicating lights are installed on the local HPU Control Panel for visual indication together with an alarm horn for audible indication of the following functions:

- Low Accumulator Pressure
- Low Air Pressure
- Low Rig Water Supply (when applicable)
- DU Alarm
- Low Glycol

Depending on pump configuration, up to Five (5) individual indicating lights are installed on the local HPU Control Panel for the following functions:

- Power ON (2) + 24 VDC Power On
- E-Pump 1 Running
- E-Pump 2 Running
- E-Pump 3 Running
- E-Pump 4 Running

Up to One (1) display for surface flow indication complete with "RESET" push button is installed on the local HPU Control Panel.

Up to Two (2) push buttons are installed on the local HPU Control Panel for the following functions:

- Lamp Test
- Alarm Quit

1.4.2 Diverter Control System

The Diverter Control System is supplied as an integrated part of the HPU. The Diverter Control System controls the Mixing Unit, which provides the hydraulic fluid, which in turn, operates the surface Diverter system valves. The HPU provides unregulated fluid pressure at 345 bar (5000 psi) to the Diverter Control System.

The Main Control Box electrically controls the Diverter Control System.

Hydraulic Accumulator

The hydraulic accumulator unit for the Diverter Control System typically consists of two (2) accumulators with a working pressure of 345 barg (5000 psig) or 517 bar (7500 psi), depending on system operation depth.

All the accumulators are made of carbon steel and painted in accordance to Cameron approved paint specification X-65390-03 (or A-018011-33).

The accumulators are designed according to BS 7201 (British Standard), BS 5045 Part 1 or ASME, Section VIII and have an approval by Lloyds Register of Shipping or by an equivalent agency. The accumulator banks are equipped with bleed and isolation valves such that the loss of any bank of accumulators will result in the loss of a maximum of 25% of the total accumulator volume, as per API 16D.

Diverter Control Panel

The Diverter Control Panel is mounted in front of the DU and allows control and operation of the surface Diverter Control System functions. Following functions are included:

Up to Three (3) 1/4" stainless steel manual or air operated 2-position valves for the following typical functions:

- Selector Diverter Packer
- Slip Joint Pressure
- Lower Slip Joint Packer

Up to Eight (8) 1/4" stainless steel manual or air operated 4-way / 3-position hydraulic valves for the following typical functions:

- Diverter Packer - OPEN / CLOSE
- Diverter Packer Lockdown Dogs - UNLATCH / LATCH
- Diverter Lockdown Dogs - UNLATCH / LATCH
- Slip Joint Selector - UNLOCK / LOCK
- Discharge Overboard Valve - STARBOARD / PORT
- Discharge in Circulation System Valve - OPEN / CLOSE
- Fill Up Valve - OPEN / CLOSE
- Flowline Seals - PRESSURE / VENT

Typically, up to one (1) 1/2" panel mounted air regulator for the local operation of the Slip Joint Packer Air Pressure.

Typically, up to one (1) 1/4" panel mounted air regulator for the local operation of the Diverter Packer Pressure.

Up to Three (3) 1/4" stainless steel manual operated hydraulic pressure regulators for the following typical functions:

- Diverter Panel Pressure - INCREASE / DECREASE
- Flowline Seals Pressure - INCREASE / DECREASE
- Lower Slip Joint Packer Pressure - INCREASE / DECREASE

NOTE: The maximum Set Pressure is typically as follows:

• Diverter Panel Pressure	set to max. 105 bar / 1520 psi
• Diverter Packer Pressure	set to max. 70 bar / 1000 psi
• Flowline Seals Pressure	set to max. 50 bar / 725 psi
• Slip Joint Packer Air Pressure	set to max. 10 bar / 145 psi
• Lower Slip Joint Packer Hydraulic Pressure	set to max. 35 bar / 500 psi

Up to six (6) pressure indicators are installed on the Diverter Control Panel for local pressure indication of the following typical functions:

- Diverter Packer Regulator
- Flowline Seals Regulator
- Diverter Panel Regulator
- Slip Joint Packer Air Pressure
- Lower Slip Joint Packer Hydraulic Pressure
- Lower Slip Joint Packer Pressure

Typically, one (1) 3/4" stainless steel hydro-pneumatic hydraulic pressure regulator complete with air regulator, air receiver and local/remote switch for the Diverter Packer function.

Typically, one (1) 3/4" stainless steel hydraulic piloted 4-way / 2-position valve for the operation of the Diverter Packer function.

Up to two (2) electric pressure transducers are installed inside the Diverter Control Unit for pressure indication and transmission to the Remote Control Panel for the following typical functions:

- Diverter Packer Pressure
- Slip Joint Packer Air Pressure

Up to four (4) air solenoid valves 3-way / 2-position are installed on the Diverter Control Panel for operation from the Remote Control Panel for the following functions:

- Diverter Packer Pressure - INCREASE / DECREASE
- Slip Joint Packer Air Pressure - INCREASE / DECREASE

Twenty-one (21) electric solenoid valves 3-way / 2-position together with twenty-one (21) pressure switches are installed inside the Diverter Control Panel for operation and indication from and at the Remote Control Panel for the Diverter functions.

Electronic PLC interlock circuit:

PLC is installed to be able to generate any interlock on the system. PLC energizes solenoid valves to provide pressure where needed in sequences chosen by customer. Unit is freely programmable.

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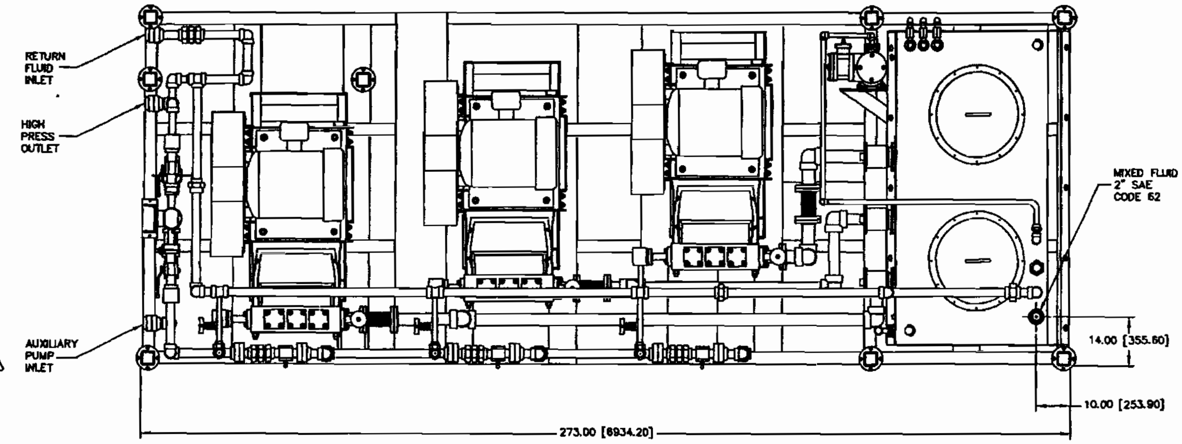
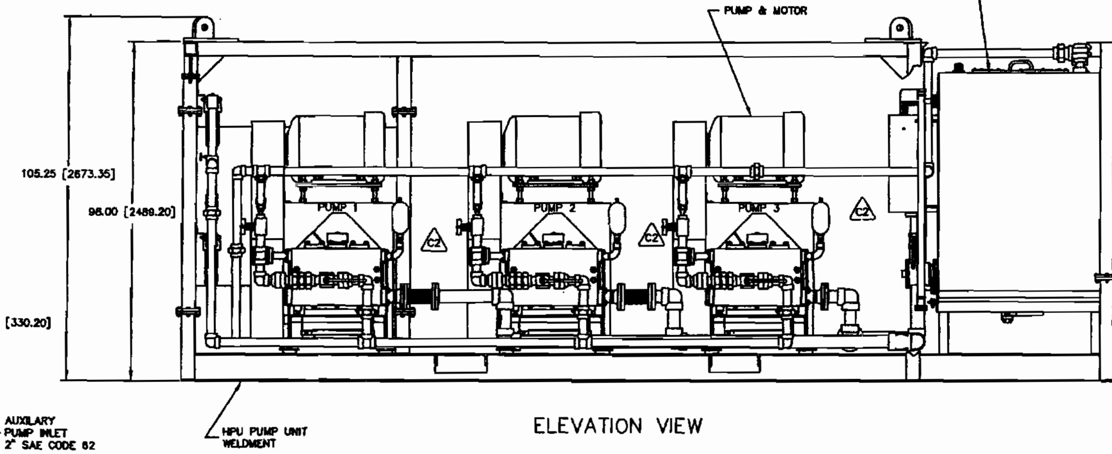
GENERAL NOTES:

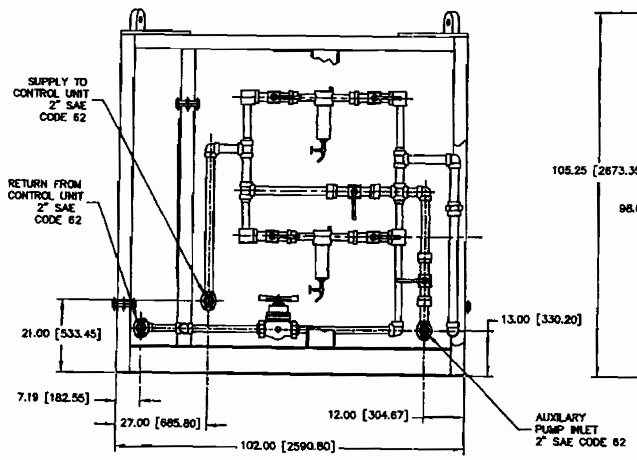
1. DIMENSIONS SHOWN ARE FOR GENERAL ARRANGEMENT ONLY.
2. DO NOT SCALE PARTS OR DRAWING.



PLAN VIEW
SHOWN WITHOUT FRAME TOP MEMBERS AND ELECTRICAL PANEL FOR CLARITY



ELEVATION VIEW



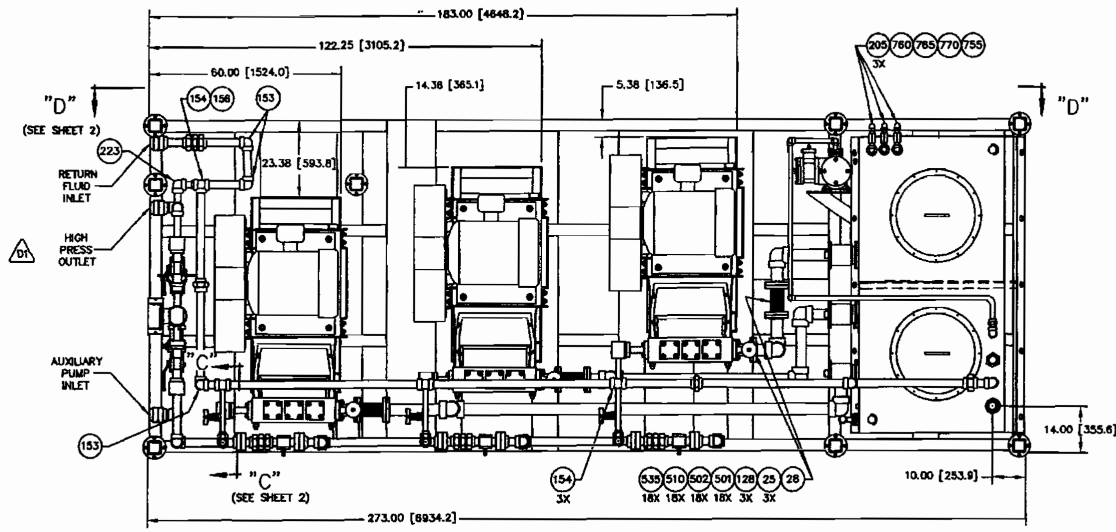
END VIEW
ONLY FRAME & END PIPING SHOWN FOR CLARITY

R & B FALCON
"DEEPWATER HORIZON"
P.O.#06700101

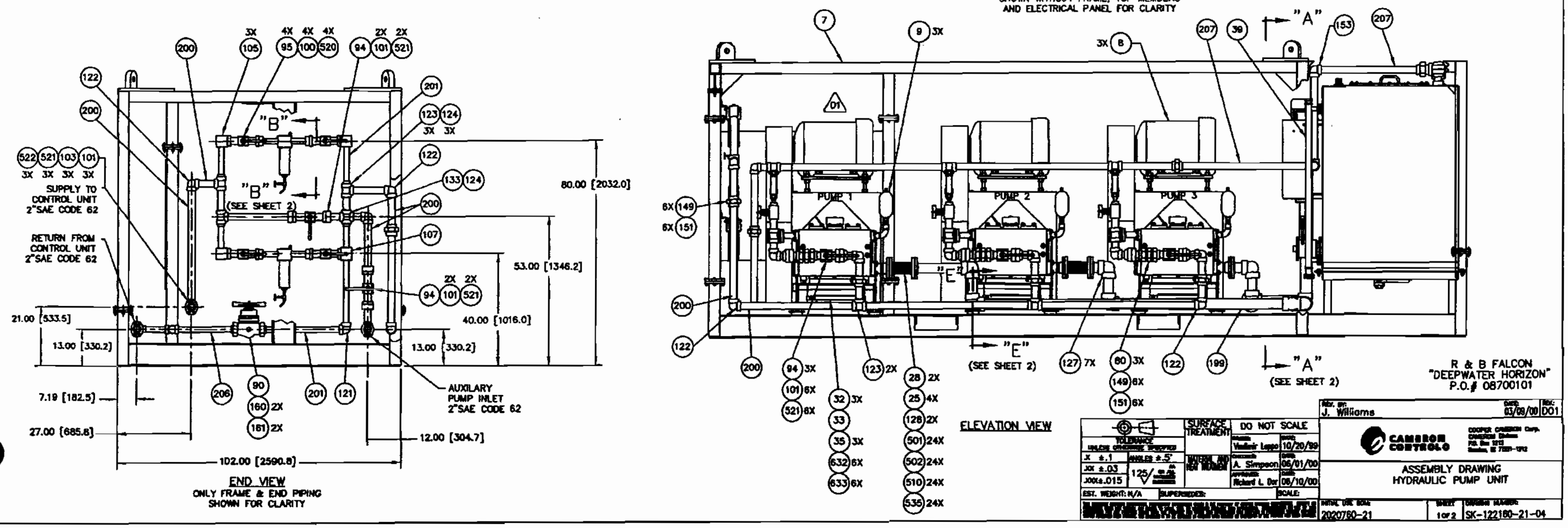
REV. BY: J. Williams	DATE: 05/30/00	REV: C02	
TOLERANCE UNLESS OTHERWISE SPECIFIED	SURFACE TREATMENT	DO NOT SCALE	CAMERON CONTROLS
.X ±.1 / ANGLES ±.5°		B. Schulda 09/28/99	
.XX ±.03	125	A. Simpson 06/01/00	GENERAL ARRANGEMENT HYDRAULIC PUMP UNIT
.XXX±.015		Richard L. Dor 08/10/00	
EST. WEIGHT: N/A	SUPERSEDES:	SCALE: 1:16	
		2020760-21	SHEET 1 of 1 / SK-122160-21

NOTES:

1.) FOR SECTIONS AND VIEWS SEE SHEET 2.
2.) ITEMS 525 THRU 533 ARE TO BE USED AS REQUIRED AT ASSEMBLY FOR PIPE SUPPORT.
3.) NO TEFLON TAPE TO BE USED ON PIPE THREADS.
4.) ALL WELDS TO BE 1/4" MIN. CONTINUOUS FILLET WELDS PER (3)
5.) WEIGHT:
    DRY: 29,880 LBS. (13553 KGS.)
    WET: 30,000 LBS. (13608 KGS.) D1

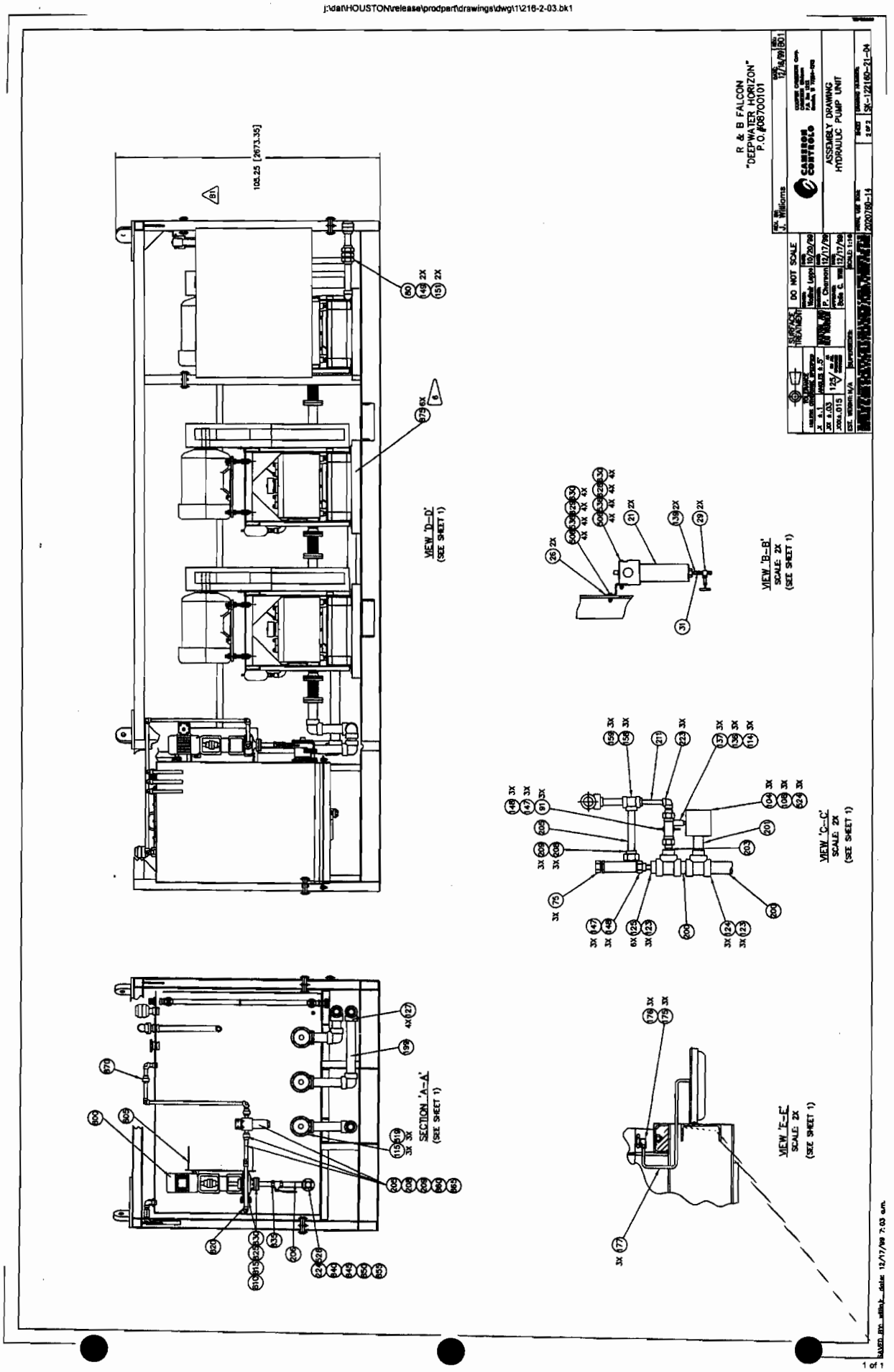


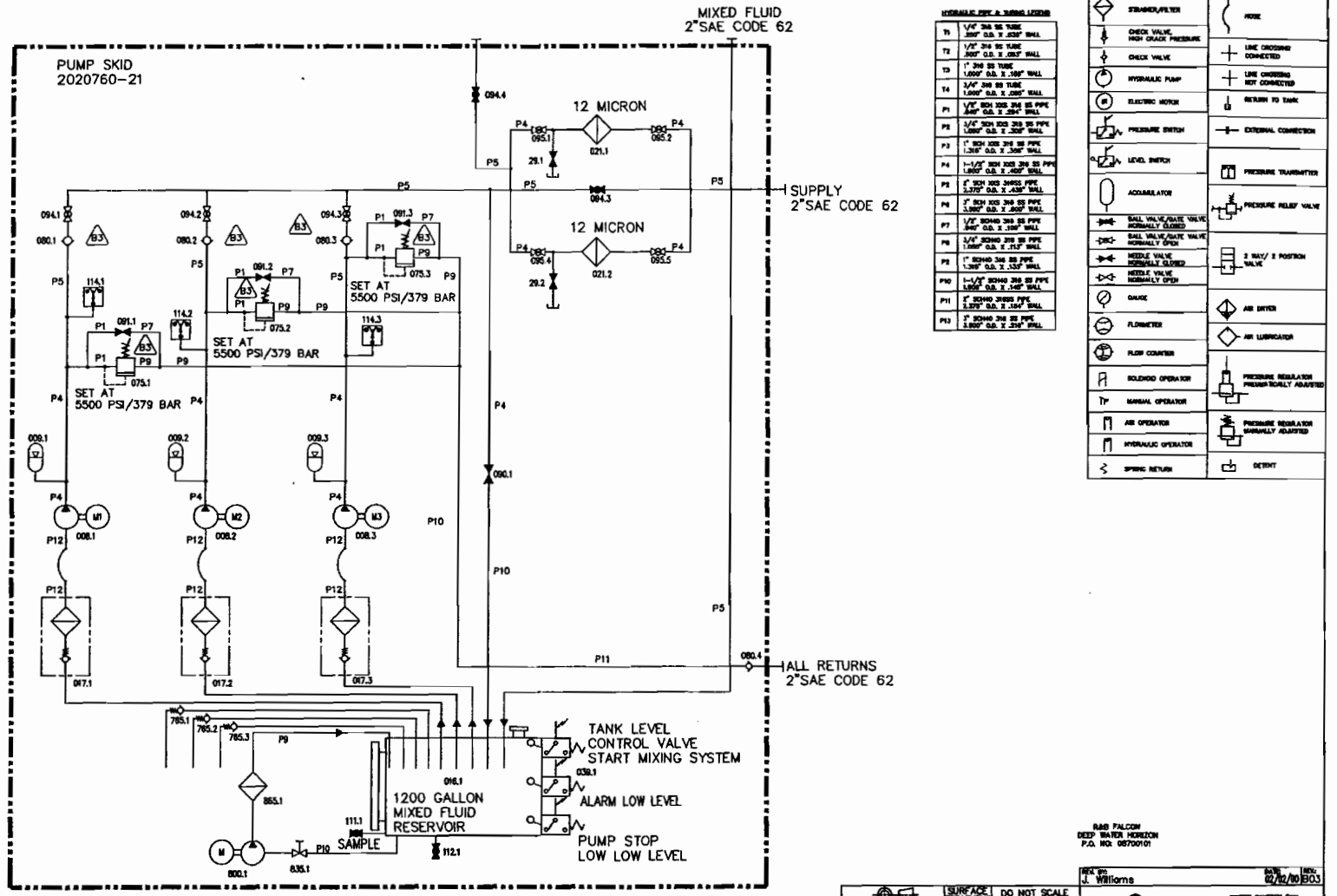
PLAN VIEW
SHOWN WITHOUT FRAME, TOP MEMBERS AND ELECTRICAL PANEL FOR CLARITY



END VIEW
ONLY FRAME & END PIPING SHOWN FOR CLARITY

ELEVATION VIEW





LINES:
HYDRAULIC
PNEUMATIC
CUSTOMER

NOTES:
1) CUSTOMER SHALL BE RESPONSIBLE FOR INTERCONNECTIONS BETWEEN SKIDS

R&B FALCON
DEEP WATER HORIZON
P.O. NO: 0870010

SURFACE TREATMENT:	DO NOT SCALE	
	J. Williams	08/15/99
	A. Simpson	02/02/00
	P. Charsen	02/02/00
EST. WEIGHT: N/A	SUPERSEDES:	SCALE:

REV. BY: J. Williams — DATE: 02/02/00 — REV: B03

CAMERON CONTROLS

PUMP UNIT

INITIAL DWG NO.: 2020760-21 — SHEET: 1 of 1 — DRAWING NUMBER: SK-122160-21-05

1 of 1

SAVED BY: willich4 date: 12/7/99 8:10 p.m.

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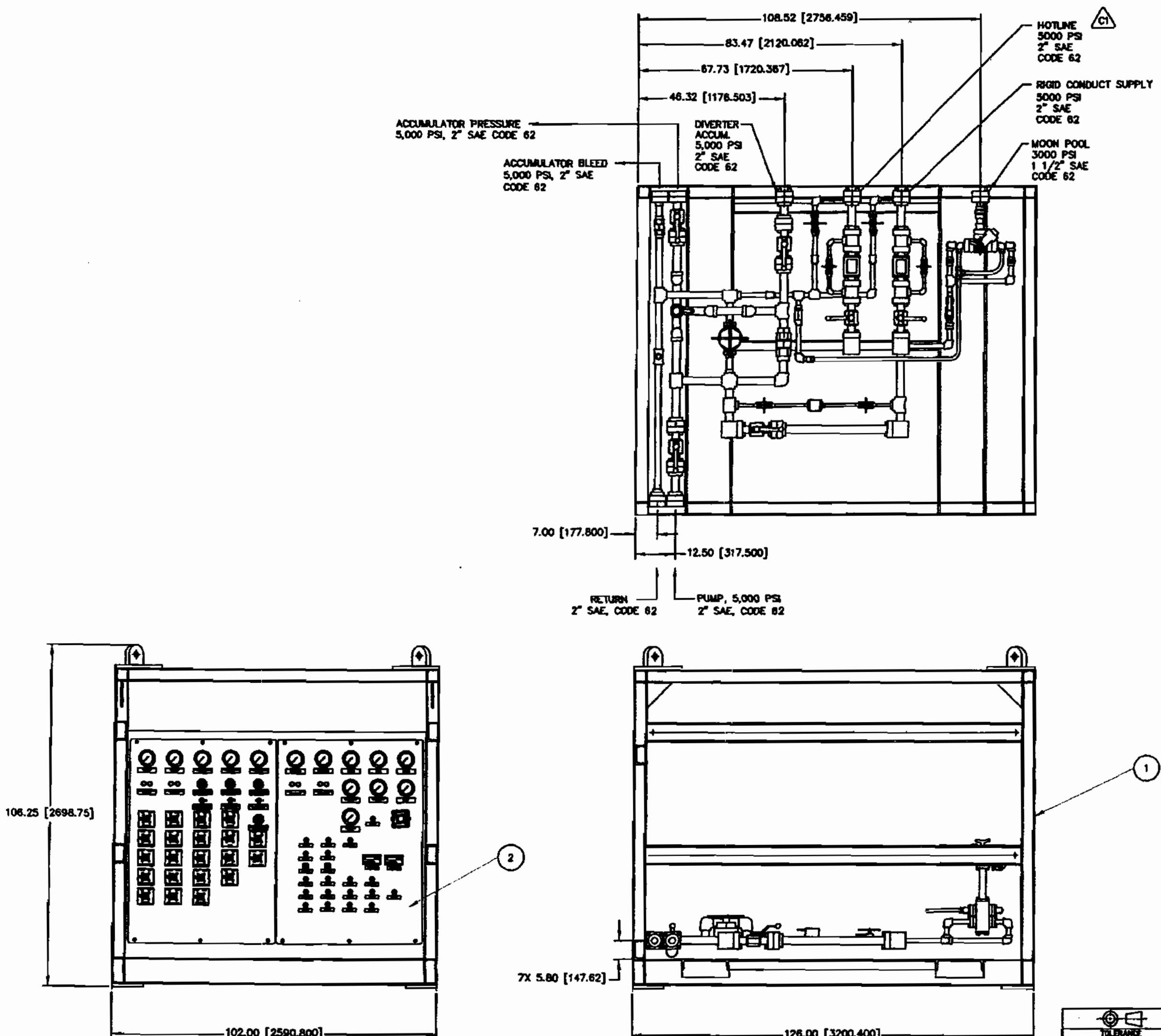

R & B FALCON
"DEEPWATER HORIZON"
P.O.#08700101

NOTES:

1. WEIGHT:
   DRY: 13,500 LBS [6425KG]
2. ITEMS 515 THRU 522 ARE TO BE USED AS REQUIRED AT ASSEMBLY FOR SUPPORTING PIPE.
3. NO TEFLON TAPE TO BE USED ON THREADS.

TOLERANCE UNLESS OTHERWISE SPECIFIED	SURFACE TREATMENT	DO NOT SCALE	A. Simpson — 12/17/99 — C01
.X ±.1 / ANGLES ±.5°		J. Williams 06/17/99	CAMERON CONTROLS
.XX ±.03 / 125		J. Williams 01/31/00	CONTROL SKID DIVERTER CONTROL UNIT
.XXX±.015		Bella C. Wi... 01/31/00	
EST. WEIGHT: N/A	SUPERSEDES:	SCALE:	2020761-21 — 1 OF 3 — SK-122159-21-04

CONFIDENTIAL
ACCESS
RESTRICTED

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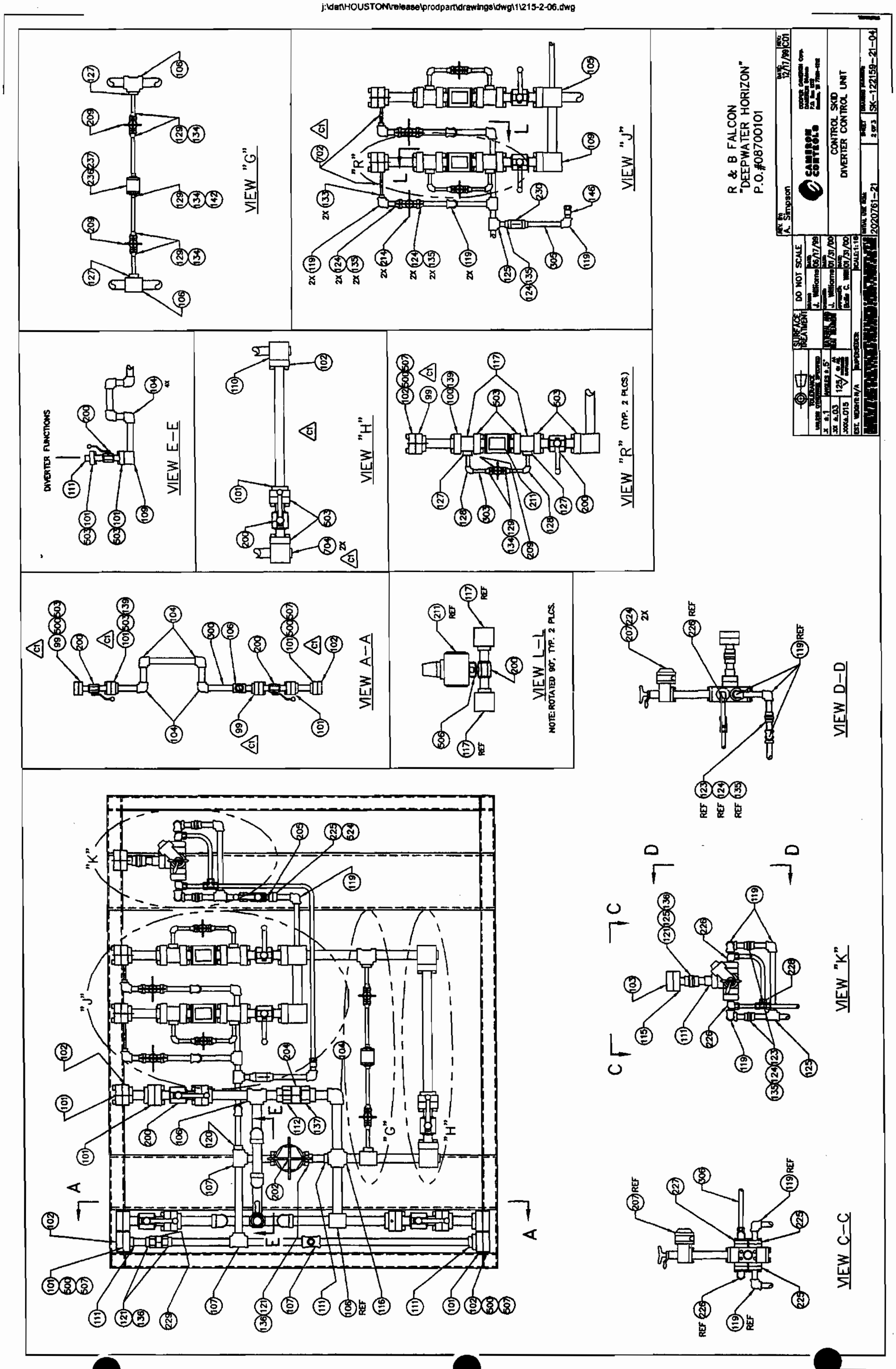

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CONFIDENTIAL
ACCESS
RESTRICTED

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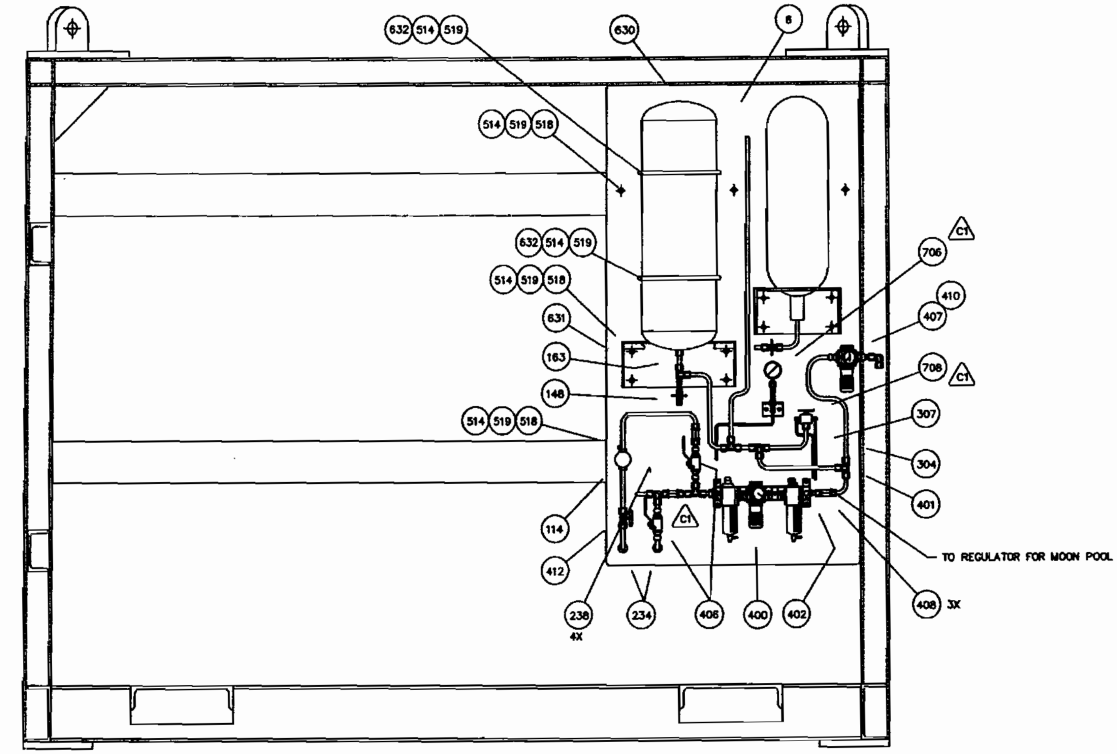


R & B FALCON
"DEEPWATER HORIZON"
P.O.#08700101

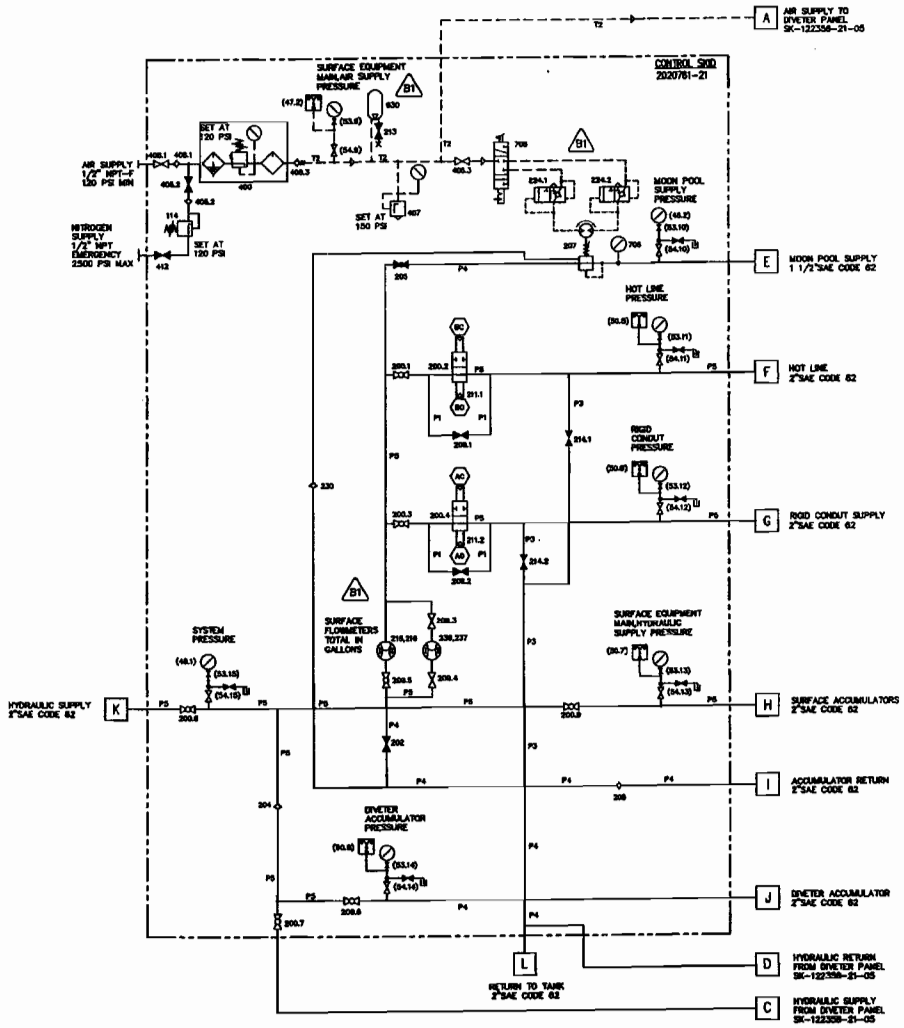
TOLERANCE UNLESS OTHERWISE SPECIFIED	SURFACE TREATMENT	DO NOT SCALE
.X ±.1 / .XX ±.03 / .XXX±.015	ANGLES ±.5°	J. Williams 08/17/99
		J. Williams 01/31/00
		Bolle C. 01/31/00
EST. WEIGHT: N/A	SUPERSEDES:	SCALE:

REV. BY: A. Simpson — DATE: 12/17/99 — REV: C01

CAMERON CONTROLS

CONTROL SKID
DIVERTER CONTROL UNIT

INITIAL USE SO#: 2020761-21 — SHEET 3 OF 3 — DRAWING NUMBER: SK-122159-21-04



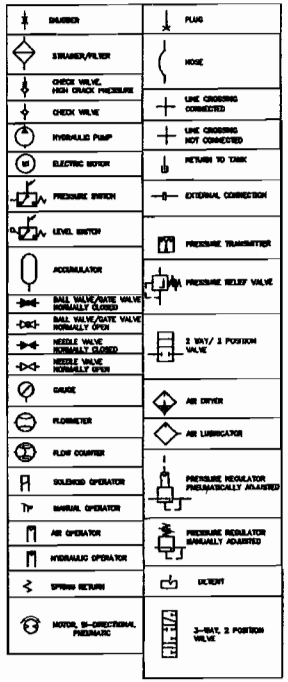
NOTES:

1) CUSTOMER SHALL BE RESPONSIBLE FOR INTERCONNECTIONS BETWEEN SKIDS

2) ITEMS IN ( ) ARE ON BOM: 2021006-21.

HYDRAULIC PIPE & TUBING LEGEND

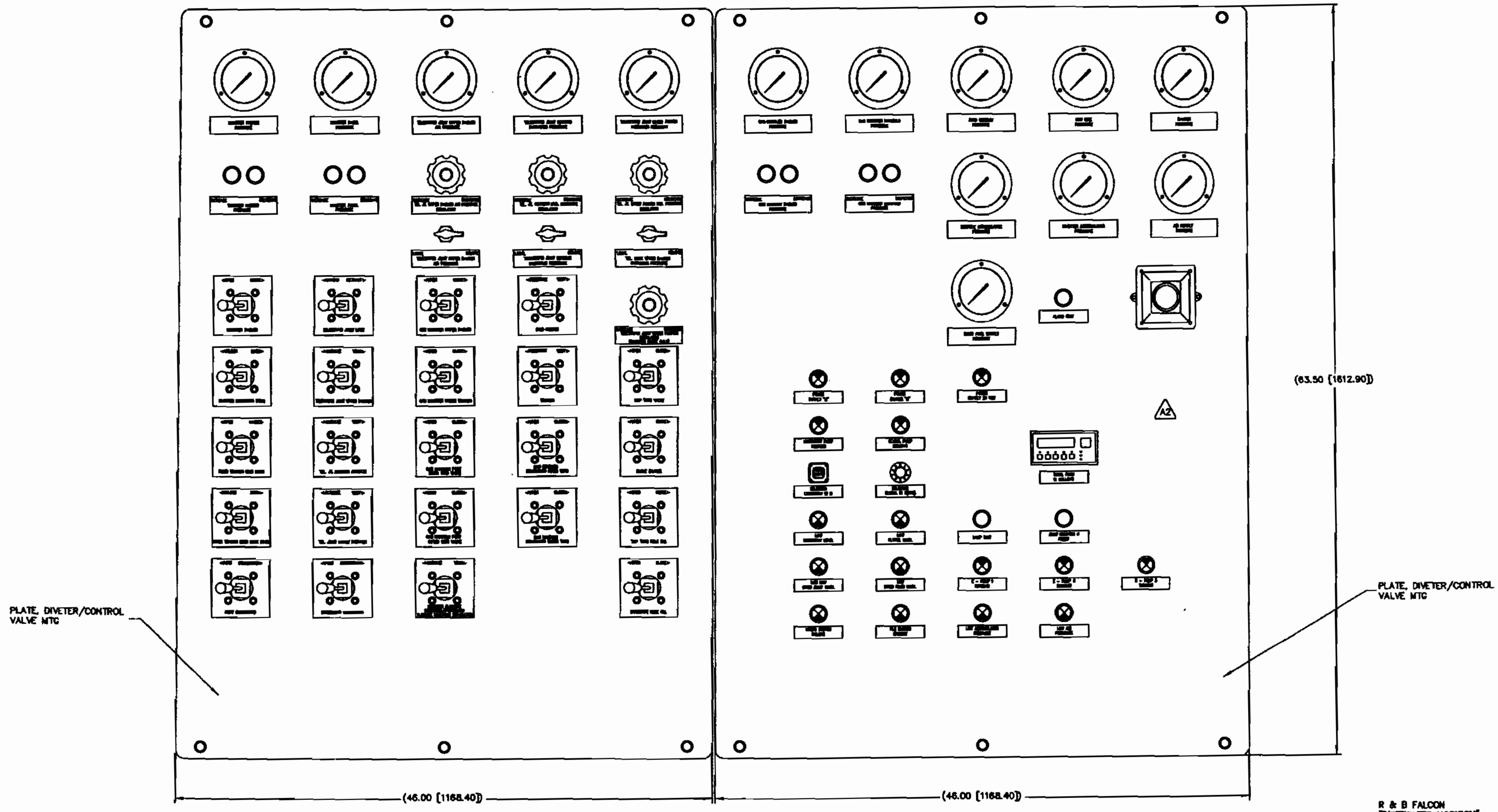
T1	1/4" 316 SS TUBE .035" O.D. X .035" WALL
T2	1/2" 316 SS TUBE .065" O.D. X .065" WALL
T3	1" 316 SS TUBE 1.000" O.D. X .109" WALL
T4	3/4" 316 SS TUBE 1.000" O.D. X .065" WALL
P1	1/2" SCH 160 316 SS PIPE .840" O.D. X .294" WALL
P2	3/4" SCH 160 316 SS PIPE 1.050" O.D. X .308" WALL
P3	1" SCH 160 316 SS PIPE 1.315" O.D. X .358" WALL
P4	1-1/2" SCH 160 316 SS PIPE 1.900" O.D. X .400" WALL
P5	2" SCH 160 316SS PIPE 2.375" O.D. X .436" WALL
P6	3" SCH 160 316 SS PIPE 3.500" O.D. X .600" WALL
P7	1/2" SCH40 316 SS PIPE .840" O.D. X .188" WALL
P8	3/4" SCH40 316 SS PIPE 1.050" O.D. X .113" WALL
P9	1" SCH40 316 SS PIPE 1.315" O.D. X .133" WALL
P10	1-1/2" SCH40 316 SS PIPE 1.900" O.D. X .145" WALL
P11	2" SCH40 316SS PIPE 2.375" O.D. X .154" WALL
P12	3" SCH40 316 SS PIPE 3.500" O.D. X .216" WALL



LINES:
HYDRAULIC
PNEUMATIC
CUSTOMER

R & B FALCON
"DEEPWATER HORIZON"

TOLERANCE UNLESS OTHERWISE SPECIFIED	SURFACE TREATMENT	DO NOT SCALE	REV. BY: A. Simpson DATE: 12/20/99 DWG: B01
X ±.1 ANGLES ±.5°	MATERIAL AND HEAT TREATMENT	DRAWN: J. Williams DATE: 05/15/99	CAMERON CONTROLS
XX ±.03 XXX±.015		CHECKED: J. Williams DATE: 01/28/00	FLOW DIAGRAM CONTROL SKID
EST. WEIGHT: N/A	SUPERSEDES	APPROVED: Bella C. Wu DATE: 01/31/00 SCALE:	INITIAL USE BOM: 2020761-21 SHEET: 1 OF 1 DRAWING NUMBER: SK-122159-21-05



R & B FALCON
"DEEPWATER HORIZON"
P.O.#06700101

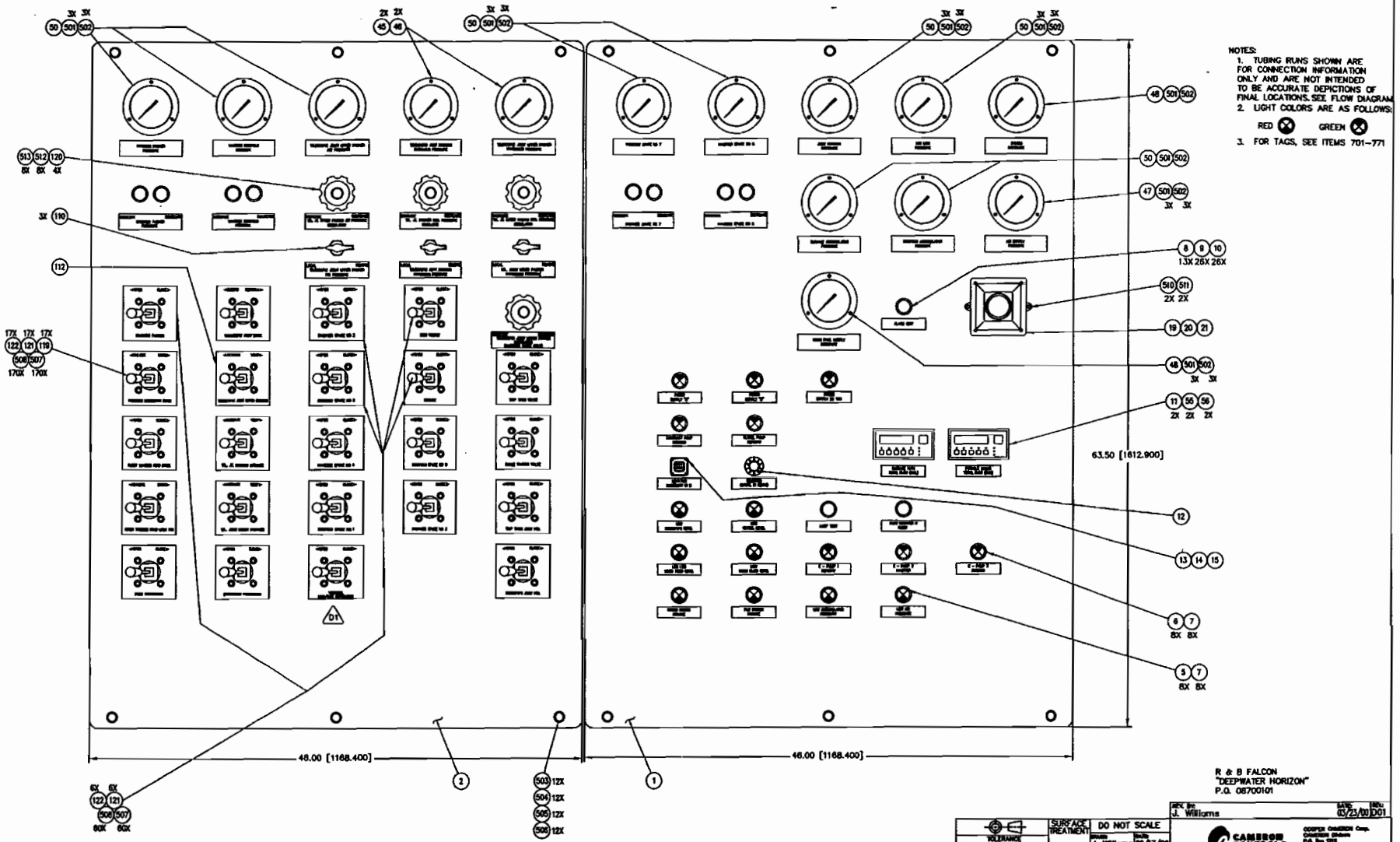
EXTERNAL VIEW OF PANEL

NOTES:

1. LIGHT COLORS ARE AS FOLLOWS:
   RED ⊗ GREEN ⊗

TOLERANCE UNLESS OTHERWISE SPECIFIED	SURFACE TREATMENT	DO NOT SCALE	REV. BY: J. Williams — DATE: 09/21/99 — REV: A02
.X ±.1 — ANGLES ±.5°		J. Williams 09/11/99	CAMERON CONTROLS
.XX ±.03 — 125		C. Garvin 09/21/99	GENERAL ARRANGEMENT DIVERTER CONTROL UNIT
.XXX±.015		Bolie C. 09/21/99	
EST. WEIGHT: N/A	SUPERSEDES:	SCALE: 1:4	2021006-21 — SHEET 1 of 1 — SK-122358-21

SAVED BY: williajr date: 9/21/99 10:56 a.m.



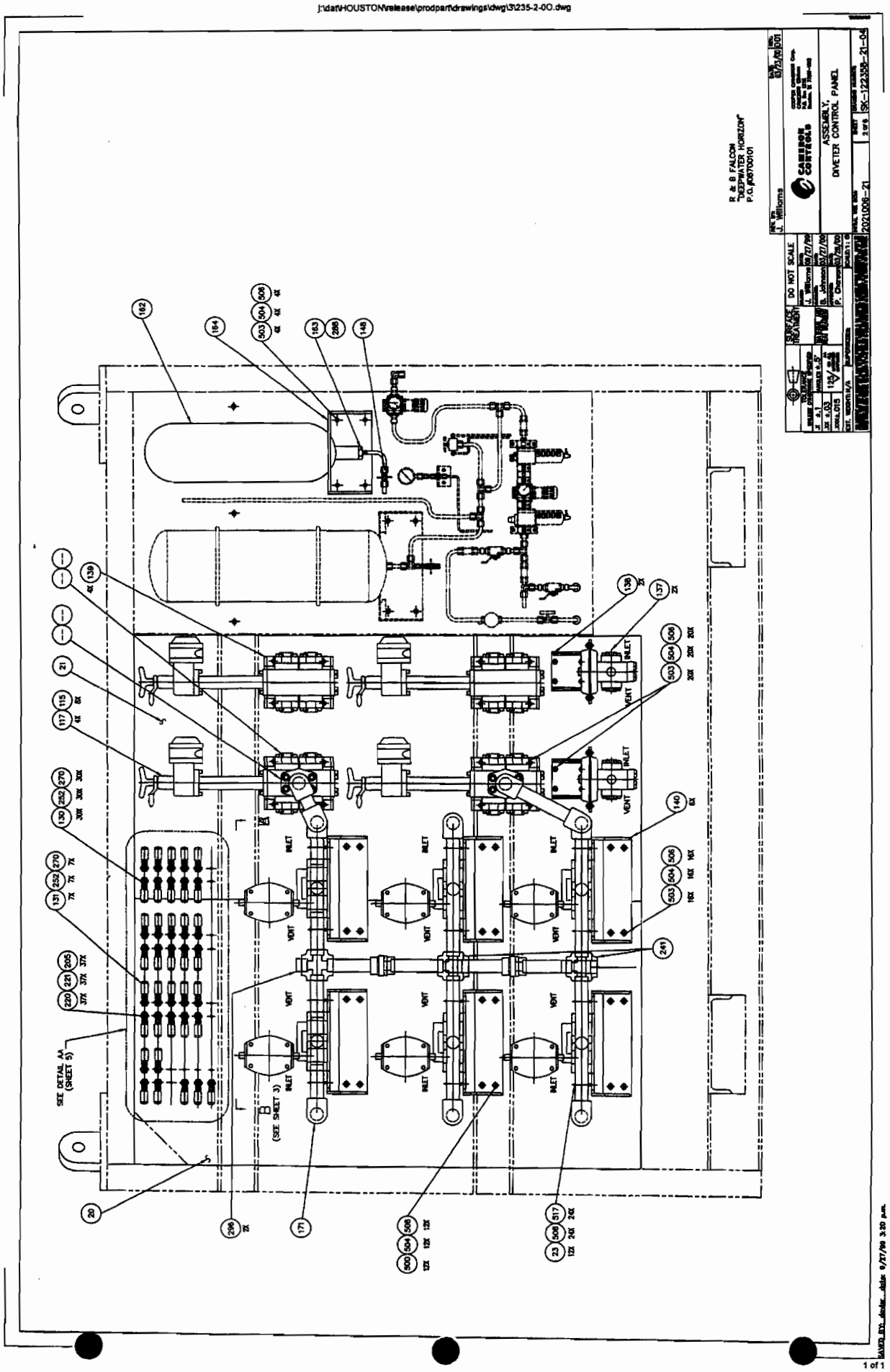
EXTERNAL VIEW OF PANEL

R & B FALCON
"DEEPWATER HORIZON"
P.O. 08700101

SURFACE TREATMENT	DO NOT SCALE	DRAWN J. Williams 08/17/99	CAMERON CONTROLS
		ENGINEER B. Johnson 03/27/00	ASSEMBLY, DIVERTER CONTROL PANEL
		APPROVED P. Chenevert 03/28/00	
SCALE 1:4			SERIAL AND DWG. NO. 2021006-21

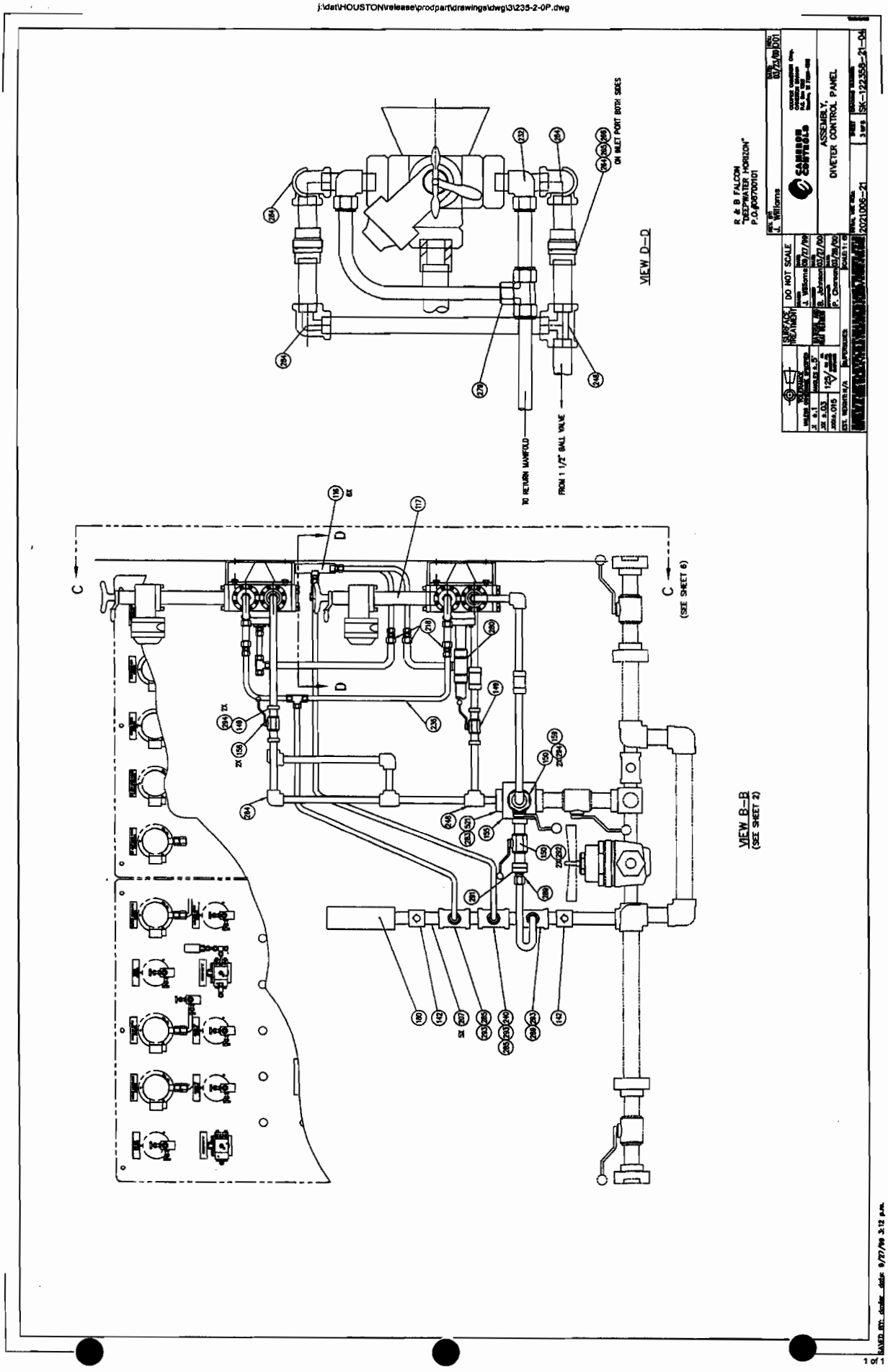
SAVED BY: davier date: 9/27/99 3:38 p.m.

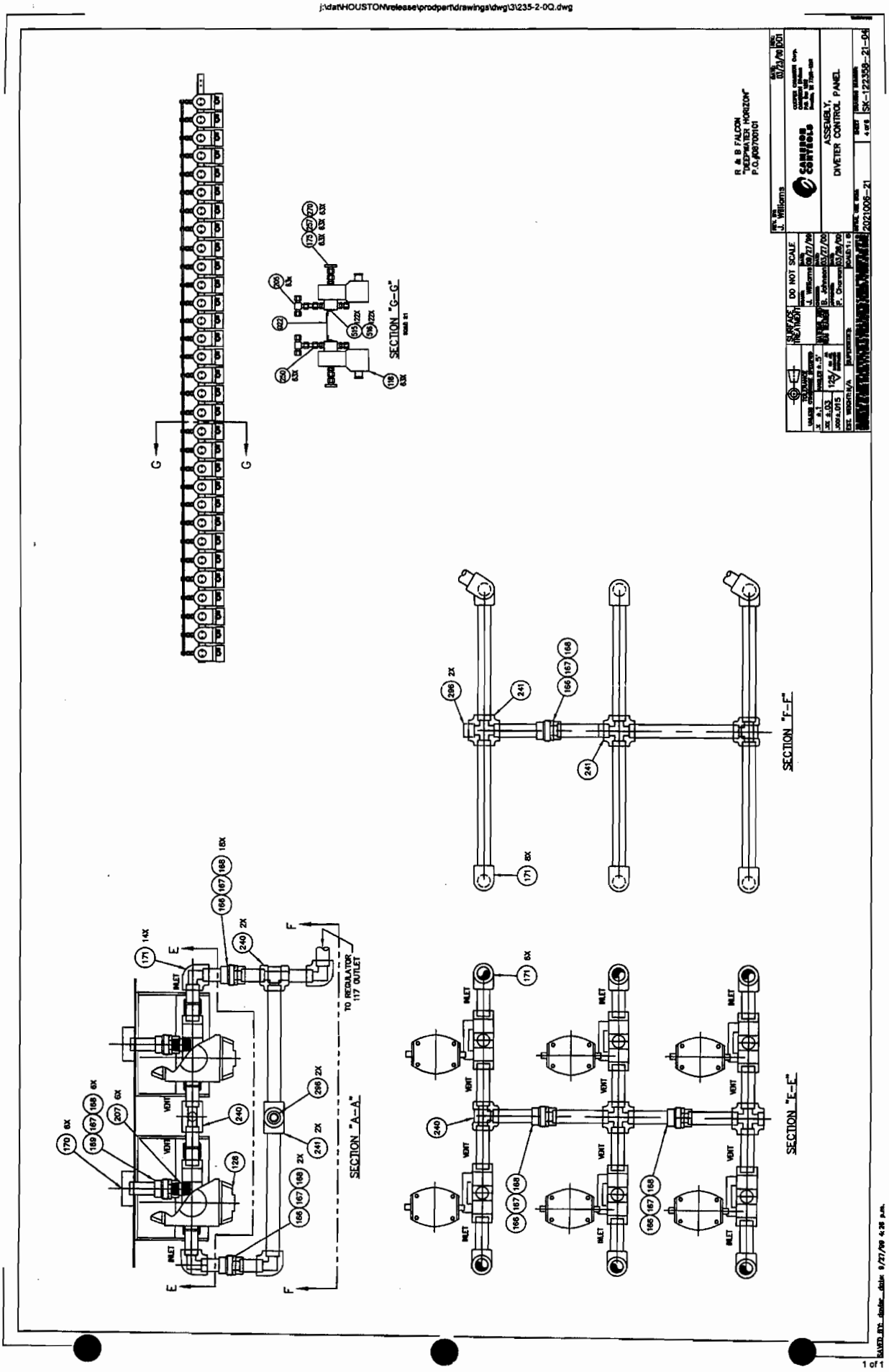
1 of 1

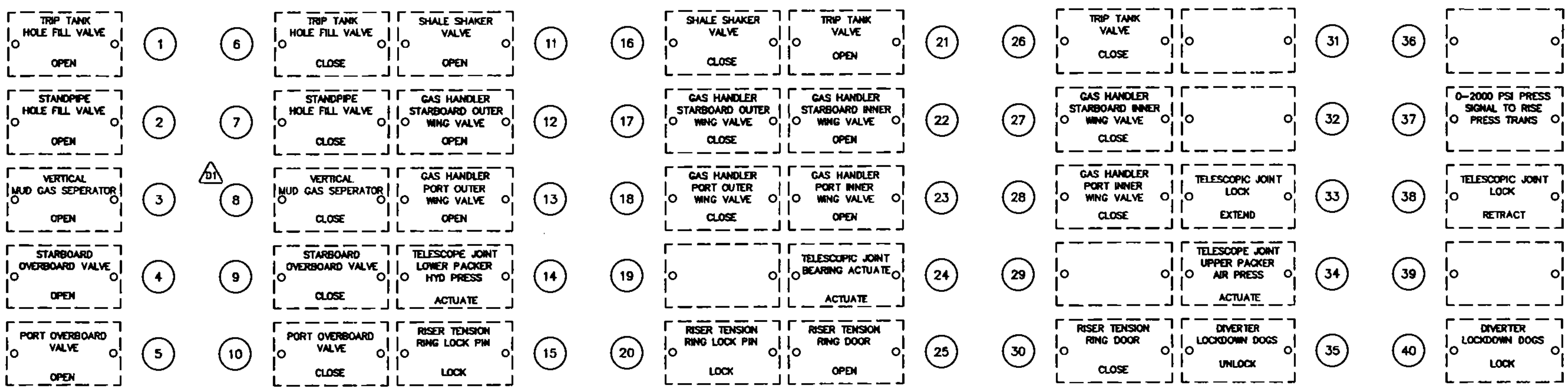


CONFIDENTIAL
ACCESS
RESTRICTED

CAM_CIV_0000272





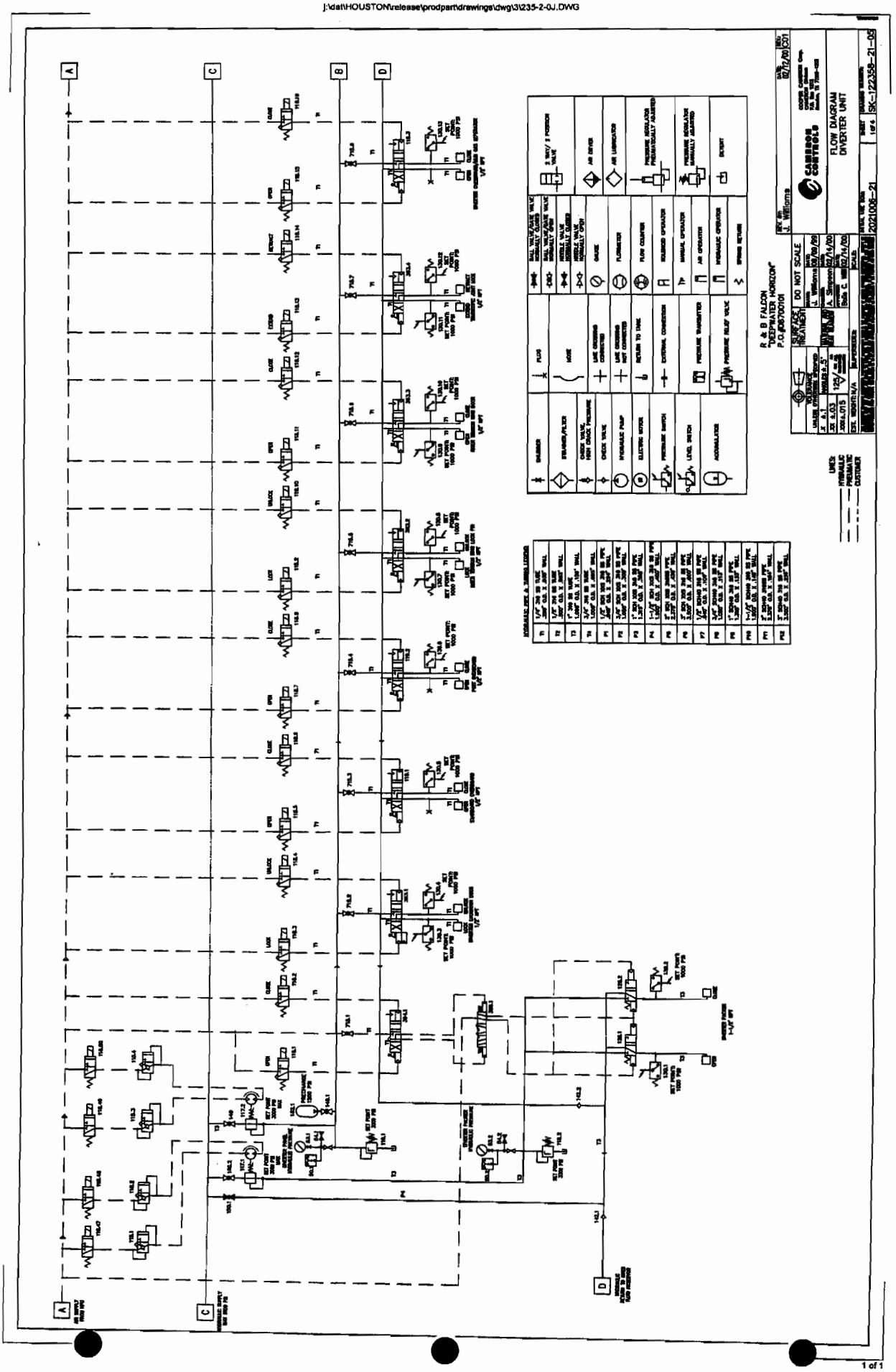


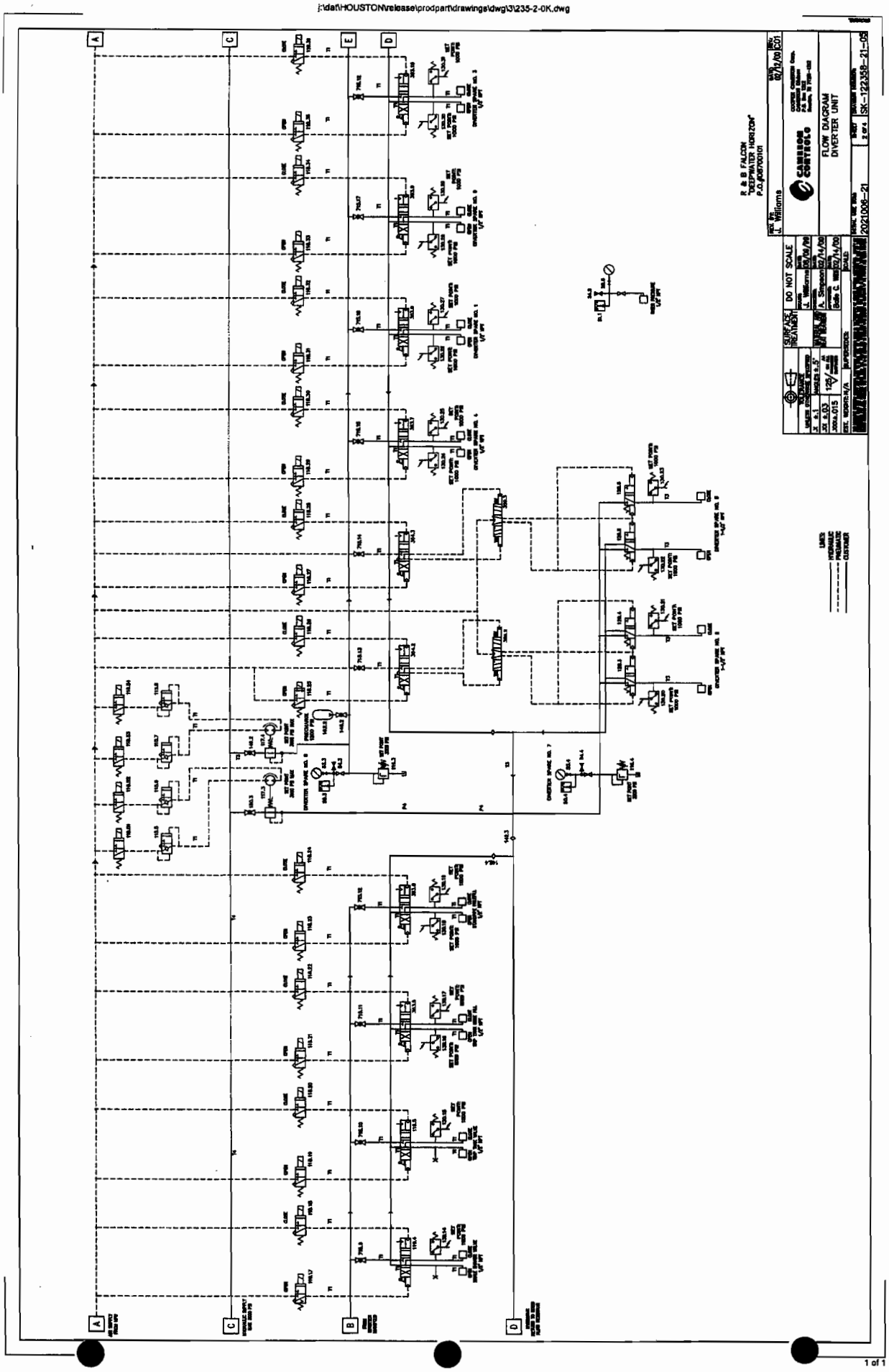
DETAIL AA
(SEE SHEET 2)

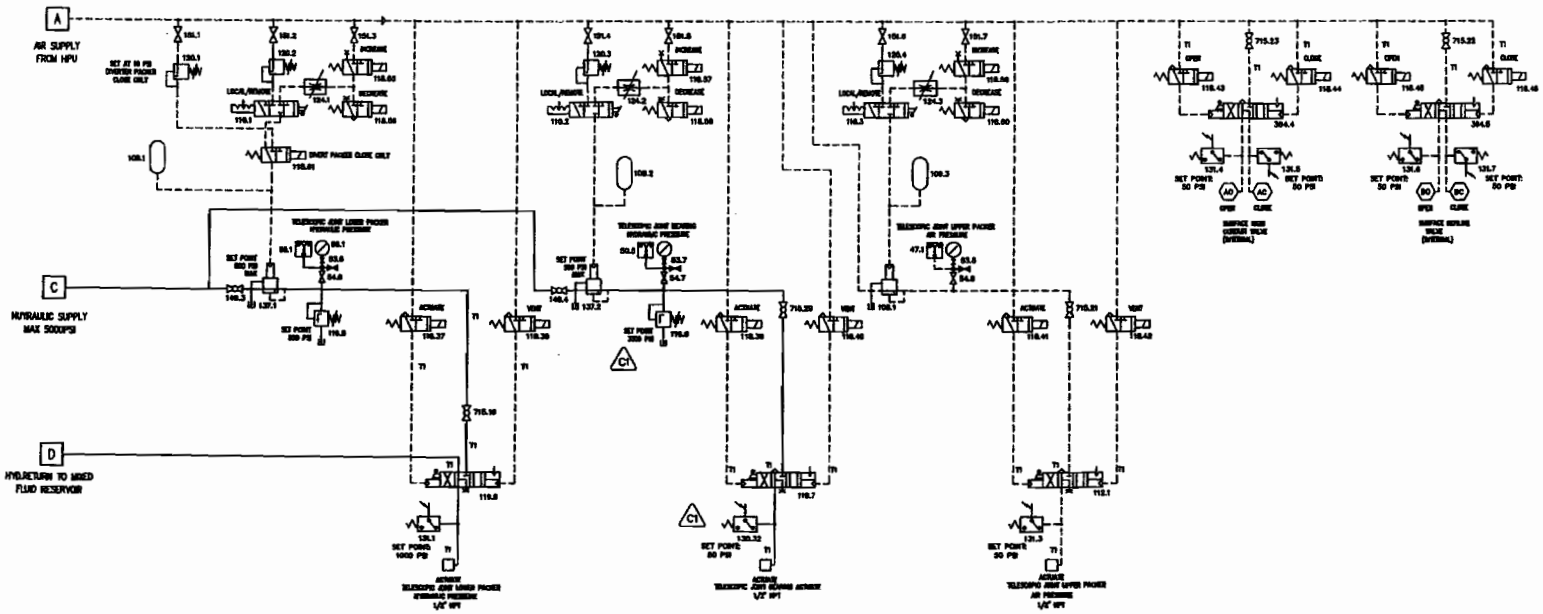
BULKHEAD PANEL DESIGNATION DETAIL
(TO BE IDENTIFIED BY FUNCTION, AS BUILT)

R & B FALCON
"DEEPWATER HORIZON"
P.O.#09700101

TOLERANCE UNLESS OTHERWISE SPECIFIED	SURFACE TREATMENT	DO NOT SCALE	J. Williams	03/23/00 D01
.X ±.1 ANGLES ±.5°		J. Williams 01/28/00	CAMERON CONTROLS	
.XX ±.03 125/		B. Johnson 03/27/00	ASSEMBLY, DIVETER CONTROL PANEL	
.XXX±.015		P. Charvon 03/28/00		
EST. WEIGHT:N/A	SUPERSEDES	SCALE 1:2	2021006-21	5 of 5 SK-122358-21-04







R & B FALCON
"DEEPWATER HORIZON"
P.O.#08700101

SURFACE TREATMENT	DO NOT SCALE	DRAWN J. Williams	DATE 02/08/00
TOLERANCE UNLESS OTHERWISE SPECIFIED		CHECKED J. Williams	DATE 02/08/00
.X ±.1	ANGLE ± .5°	MATERIAL AND/OR PART NUMBER A. Simpson	DATE 02/14/00
.XX ±.03	125	APPROVED Bolle C. Wilt	DATE 02/14/00
.XXX±.015			
EST. WEIGHT: N/A	SUPERSEDES:	SCALE:	

REV. BY: J. Williams	DATE: 02/12/00	REV: C01	
CAMERON CONTROLS			
FLOW DIAGRAM DIVERTER UNIT			
SERIAL USE NOS: 2021006-21	SHEET: 3 OF 4	DRAWING NUMBER: SK-122358-21-05	

j:\daf\HOUSTON\release\prodpart\drawings\dwg\3\235-2-0M.dwg

INTERLOCKS INFORMATION

1) TRIP TANK/SHAKER: THE SIGNALS TO OPEN THE TRIP TANK OR SHAKER ARE UNIMPEDED, BUT THE SIGNAL TO CLOSE IS GENERATED FROM THE OPEN SENSING POSITION SWITCH OF THE OPPOSITE VALVE. THAT IS TO SAY, WHEN THE TRIP TANK IS SELECTED, THE CONTROL SYSTEM IMMEDIATELY OPENS THE VALVE. WHEN THE TRIP TANK OPEN POSITION SWITCH IS CLOSED, THAT TELLS THE CONTROL SYSTEM TO CLOSE THE SHAKER VALVE. THE SITUATION IS SIMILAR BUT REVERSED WHEN THE SHAKER IS SELECTED.

INDICATION FOR OPEN GENERATED BY SAID POSITION INDICATION SWITCH.

2) PORT/BOTH/STBD & FLOWLINE DEGASSER/OVERBOARD SELECT:

2A) WHEN THE FLOWLINE DEGASSER IS SELECTED, IT IS OPENED. ONCE OPENED, THE OPEN SIDE POSITION SWITCH FOR THE FLOWLINE DEGASSER IS CLOSED, GENERATING THE CLOSE SIGNAL FOR BOTH PORT AND STARBOARD OVERBOARD VALVES.

INDICATION FOR OPEN FLOWLINE DEGASSER IS FROM OPEN SENSING POSITION SWITCH ON VALVE, CLOSE (OVERBOARD SELECT) FROM CLOSE SIDE PRESSURE SWITCH

2B) THE PORT/BOTH/STARBOARD SELECT OPERATION DEPENDS UPON THE FLOWLINE DEGASSER/OVERBOARD SELECT. THIS IS TO ALLOW THE PRESELECTION OF THE OVERBOARD VALVE CONFIGURATION PRIOR TO SELECTION TO GO OVERBOARD. I) IF THE FLOWLINE VALVE IS OPEN, THE SELECTION OF PORT/BOTH/STARBOARD IS STORED INTO PLC MEMORY, AND DISPLAYED ON THE REMOTE PANELS. II) IF THE OVERBOARD IS SELECTED, THEN THE SELECTION GENERATES THE VALVE OPEN COMMANDS FOR THE OVERBOARD VALVES. THE FLOWLINE DEGASSER CLOSE SIGNAL IS GENERATED FROM THE APPROPRIATE VALVE OPEN POSITION SWITCHES, AS DESCRIBED BELOW.

2C) WHEN PORT IS SELECTED, THE PORT OVERBOARD VALVE IS OPENED, AND THE OPEN POSITION SWITCH ON THE PORT VALVE GENERATES THE SIGNAL TO CLOSE THE STARBOARD AND FLOWLINE DEGASSER VALVES.

2D) THE SITUATION IS SIMILAR FOR SELECTING THE STARBOARD OVERBOARD VALVE, SEQUENCING THE OTHER TWO VALVES TO CLOSE VIA THE STARBOARD VALVE POSITION SWITCH.

2E) THE SITUATION IS SIMILAR FOR SELECTING BOTH PORT AND STARBOARD OVERBOARD, EXCEPT THAT I) BOTH PORT AND STARBOARD VALVES ARE SIGNALED TO OPEN AND II) EITHER OR BOTH OF THE PORT AND/OR STARBOARD OPEN POSITION SWITCH(S) WILL CAUSE THE FLOWLINE DEGASSER TO CLOSE.

2F) INDICATION OF PORT/BOTH/STARBOARD DEPENDS UPON CIRCUMSTANCES. IF THE FLOWLINE DEGASSER IS OPEN, PORT/BOTH/STARBOARD INDICATION IS FROM MEMORY, AS AT THIS POINT IT IS ONLY A PRESELECTION. IF THE OVERBOARD IS SELECTED, INDICATION IS FROM THE OPEN POSITION SWITCHES, "BOTH" BEING LIT ONLY IF BOTH POSITION SWITCHES ON THE OVERBOARD VALVES INDICATE OPEN.

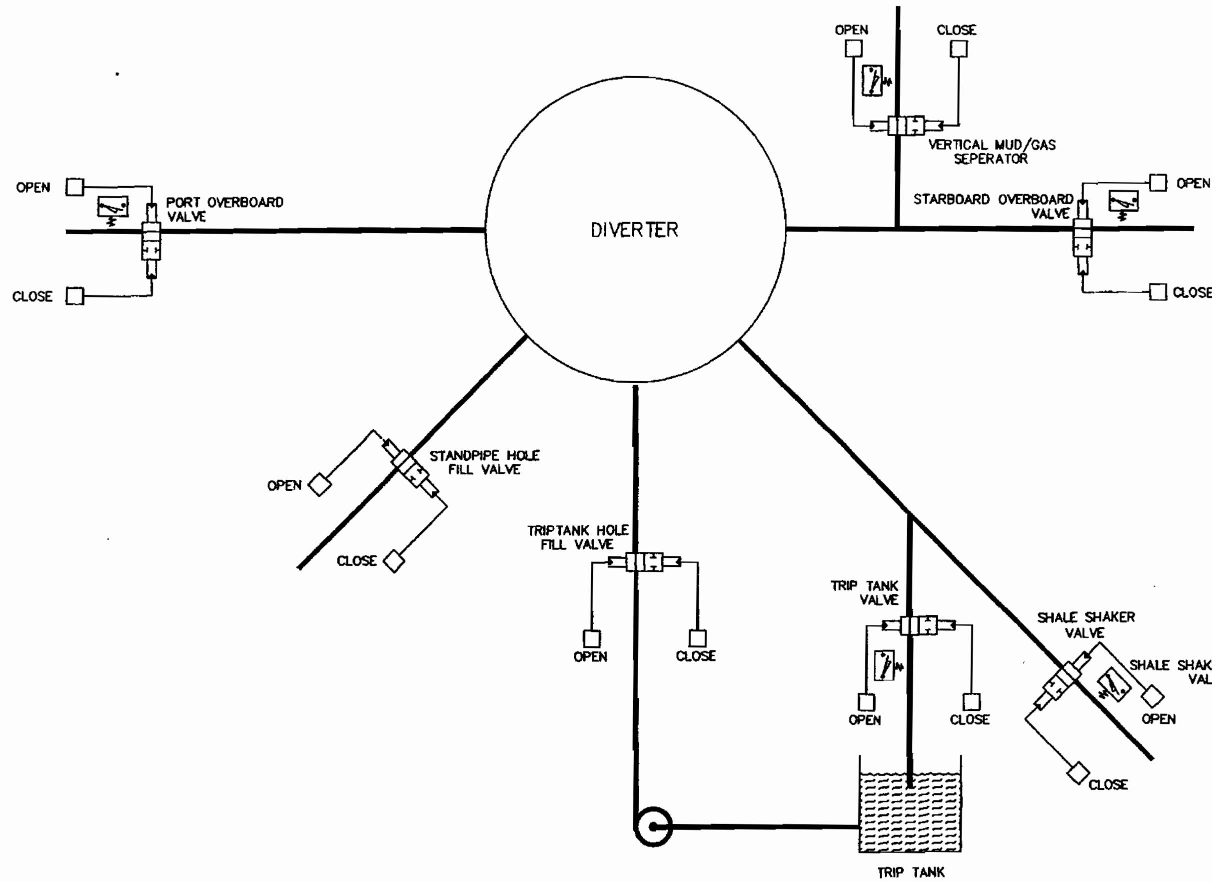
3) NONE OF THE VALVES ARE INTERLOCKED TO THE DIVERTER PACKER, AS THE PACKING SYSTEM HAS THE BUILT IN SLEEVE VALVE, ALLOWING THE TRIP TANK/SHAKER OR THE FLOWLINE DEGASSER/PORT/BOTH/STARBOARD TO BE PRESELECTED OR SELECTED AT ANY TIME. AT NO TIME IS THE SYSTEM SUBJECT TO VALVE RACES RISKING ACCIDENTAL MOMENTARY CLOSURE OF ALL VALVES AT THE SAME TIME, AS ALL VALVE CLOSING SIGNALS ARE GENERATED BY THE OPEN SENSING POSITION SWITCHES.

4) DIVERTER LOCKDOWN DOGS MUST BE LOCKED FOR AT LEAST 10 SECOND BEFORE DIVERTER PACKER WILL BE CLOSE .THE DIVERTER PACKER MUST BE OPENED BEFORE THE DIVERTER LOCKDOWN DOGS CAN BE UNLOCKED.
DIVERTER PACKER CLOSING TIME DELAY ORIGINALLY IN A HYDRAULIC/PNEUMATIC CIRCUIT WOULD BE REMOVED AND INCORPORATED INTO THE PLC LOGIC FOR THE REMOTE PANELS ONLY. THE DELAY WILL BE RECONFIGURED SO THAT THE DIVERTER PACKER WILL NOT CLOSE UNTIL AT LEAST 10 SECONDS HAVE PASSED SINCE THE LOCKDOWN DOGS WERE LOCKED. THIS WILL NOT IMPEDE THE TIMELY OPERATION OF THE PACKER IN NORMAL CIRCUMSTANCES, ONLY RIGHT AFTER INSTALLATION AND LOCKING OF THE DIVERTER LOCKDOWN DOGS.

5) TENSION RING INTERLOCK:
5A) THE TENSION RING MUST BE UNLOCKED TO CLOSE IT.
5B) THE TENSION RING MUST BE CLOSED TO UNLOCK IT.
5C) INDICATION FOR LOCK/UNLOCK AND OPEN/CLOSE IS FROM PRESSURE SWITCHES.

6) LOWER (HYDRAULIC) SLIP JOINT PACKER IS CAUSED TO CLOSE WHEN I) BUTTON IS PUSHED, AND/OR II) WHEN THE OVERBOARD AND DIVERTER PACKER CLOSE ARE BOTH SELECTED (DIVERT MODE). MANUAL SELECT IS RESTORED AFTER ACTUATION, IF DESIRED. INDICATION IS VIA PRESSURE SWITCH.

7) THERE ARE NO INTERLOCKS ON THE HYDRAULIC CONTROL PANEL, THE ONLY POSITION INDICATION AT THE HYDRAULIC PANEL IS FROM CONTROL VALVE HANDLE POSITION.



NOTE: PROXIMITY SWITCHES LOCATED ON VALVES BY CUSTOMERS

R & B FALCON
"DEEPWATER HORIZON"
P.O.#08700101

TOLERANCE UNLESS OTHERWISE SPECIFIED	SURFACE TREATMENT	DO NOT SCALE	REV. BY: J. Williams — DATE: 02/12/00 — REV: C01
.X ±.1 / ANGLES ±.5° / .XX ±.03 / .XXX±.015 / 125	MATERIAL AND HEAT TREATMENT	DRAWN: J. Williams — DATE: 08/09/99 / CHECKED: A. Simpson — DATE: 02/14/00 / APPROVED: Belle C. Will — DATE: 02/14/00	CAMERON CONTROLS — COOPER CAMERON Corp. CAMERON Division P.O. Box 1212 Houston, TX
EST. WEIGHT: N/A	SUPERSEDES:	SCALE:	FLOW DIAGRAM DIVERTER UNIT
			INITIAL USE: 2021006-21 — SHEET 4 OF 4 — DRAWING NUMBER: SK-122358-21-05

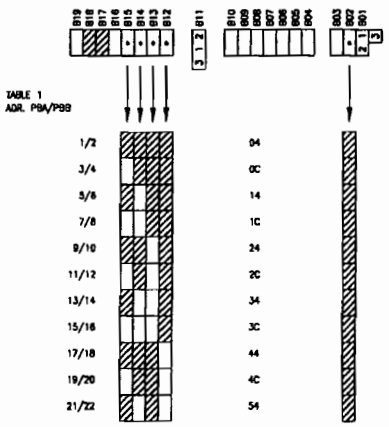
1 of 1

SHEET	DESINATION
2-3	POWER SUPPLY A/B (230VAC/24VDC)
4 & 20	CPU / POWER SUPPLY A/B 5V
5-10 & 21-26	OUTPUT — DIGITAL
11-17, 27-29	INPUT — DIGITAL
18,19 & 30	INPUT — ANALOG
31	RELAYS

CABLE NO.	TERMINAL
-W3	-X47, X-48 SHEET 2
-W4	-X53, -X54 SHEET 26
-W28	-U1, SHEET 2
-W29	-U2, SHEET 26

TERMINAL TYPE	TERMINAL
UK3N	-X1, -X1.2, -X2, -X3, -X31 -X4, -X5, -X6, -X10, -X11
USLKG	PE - TERMINALS

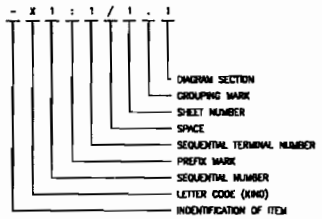
VA00 20
STANDARD JUMPER SETTING
• = SEE TABLE 1



LETTER CODES

- A = ASSEMBLIES, SUBASSEMBLIES
- B = TRANSDUCERS, NON-ELECTRICAL TO ELECTRICAL
- C = CAPACITORS
- D = BINARY ELEMENTS, DELAY DEVICES, STORAGE DEVICES
- E = MISCELLANEOUS
- F = PROTECTIVE DEVICES
- G = GENERATOR, POWER SUPPLIES
- H = SIGNALING DEVICES
- J = FREE
- K = RELAYS, CONTRACTORS
- L = INDUCTORS
- M = MOTORS
- N = AMPLIFIERS, CONTROLLERS
- P = MEASURING EQUIPMENT, TESTING EQUIPMENT
- Q = SWITCHING DEVICES FOR POWER CIRCUITS
- R = RESISTORS
- S = SWITCHS, SELECTORS
- T = TRANSFORMERS
- U = MODULATORS, CHARGERS
- V = TUBES, SEMICONDUCTORS
- W = TRANSMISSION PATHS, WAVEGUIDES, AERIALS
- X = TERMINALS, PLUGS, SOCKETS
- Y = ELECTRICALLY OPERATED MECHANICAL DEVICES
- Z = TERMINATIONS, HYBRID TRANSFORMERS, FILTERS EQUALIZERS, LIMITERS

ITEM DESIGNATION



LEGEND

- -X1 ∘ 1 TERMINALS
- RS - REED SWITCH
- RE - REFERENCE EARTH (VDC)
- PE - PHYSICAL EARTH (VAC)
- ——— PANEL SHOP WIRING
- — — — SKID/FIELD WIRING
- - - - - - CUSTOMER WIRING
- SCREEN

NOTES:

1. ALL INPUT AND OUTPUT WIRES SHALL BE 24AWG.
2. BUS WIRES SHALL BE 0.8 mm² OR NO. 18AWG.
3. INPUT POWER WIRES SHALL BE NO 14AWG.
4. 24VDC AND 5VDC OUTPUT WIRES SHALL BE NO. 14AWG.
5. ALL GROUND WIRING TO BE NO. 14 AWG. GREEN/YELLOW.

P.O. #08700101

B02	04/07/00	M. Caessens		
Rev.	Date	Name	Appr.	Remarks
CLNT DESIGN	06/29/99	A. Braussard	04/11/00	
Drawn	Date	Appr.	Date	

CAMERON CONTROLS

COOPER CAMERON Corp.
CAMERON Division
P.O. Box 1212
Houston, TX 77251-1212

Supersedes

Title: ELECTRICAL SCHEMATIC, HPU MAIN CONTROL PANEL

DWG. NO. SK-122147-21-06

B.O.M. NO. 2020994-21

= DEEPWATER HORIZON
+ R & B FALCON

SHEET 1 of 31

STATUSREL

1.5 UNINTERRUPTABLE POWER SUPPLY (UPS)

The UPS provides all the AC power necessary to keep the microprocessor based control system, both surface and subsea equipment, operational under all conditions. The only electrical parts excluded from the UPS are the electric motor driven pumps on the HPP.

Since all primary functions of the BOP stack are controlled through the multiplex system, a loss of power would results in a loss of control of these functions.

It should be noted, however, that partial operation of the stack is still possible if an optional, acoustic back-up control system is installed. This equipment is totally independent of the multiplex control system.

In keeping with the philosophy of maximizing availability and safety, redundant UPS systems are included. Each unit is sized to deliver all the AC power necessary to power the entire control system for at least 2 hours (assuming normal operation). The UPS power distribution system is arranged in a continuous configuration. In the normal operation mode the rig electrical supply system powers the UPS and the battery charging circuits of the UPS. The UPS Inverter converts the Battery Power into AC. In the event of rig power loss the UPS will continue to power the system using its batteries. The switchover is "bumpless."

The UPS is sized to provide power to the Panels, Diverter Controls, Event Logger and Pods for at least two hours of normal operation.

Typical Technical Data:

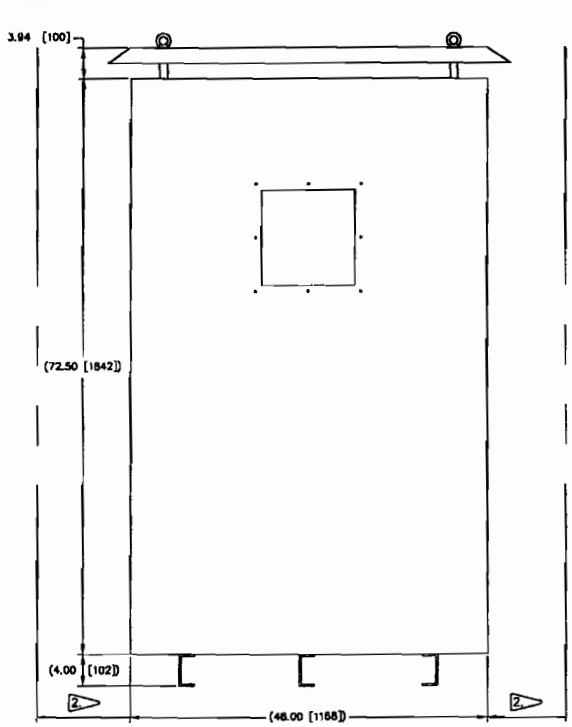
- Input Voltage: 230 VAC
- Input Frequency: 60 Hz +- 5%
- Power Factor: 0.7
- Output Voltage: 230 VAC +- 2%
- Output Frequency: with Input Voltage 60 Hz +- 1Hz
  Without Input Voltage 60 Hz +-0,1%
- Continuous Output Power: 6 kVA / 120 min
- Maximum Output Power: 200 %, 10 sec.

Each UPS unit includes the following main sections:

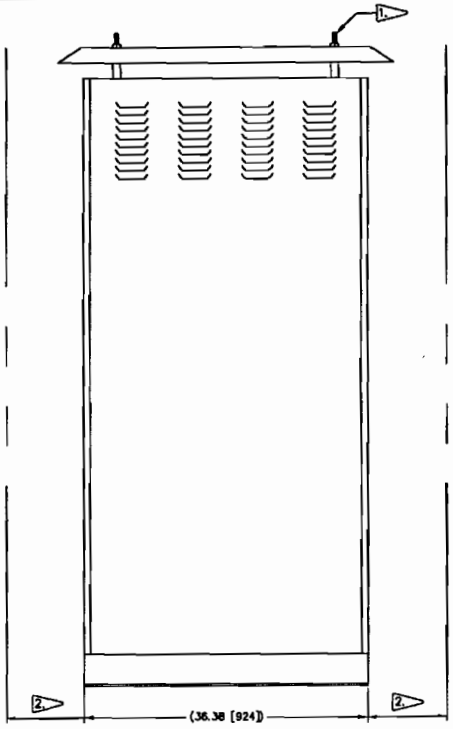
- Battery charger
- Battery bank
- Inverter

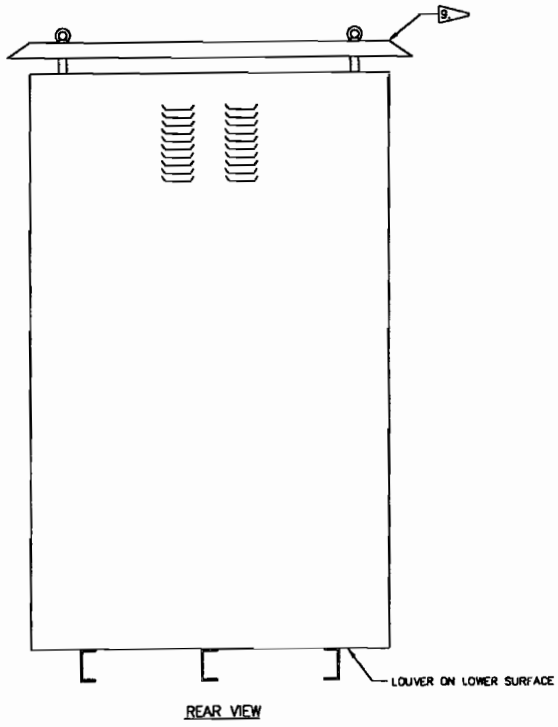
Alarm outputs are available at the UPS to actuate alarm indicators on the operator panels Local indicators and Readbacks of the UPS include the following:

- Input voltage
- Battery Status
- Overload
- Emergency Power "Off"
- Common Alarm
- Input Power consumption

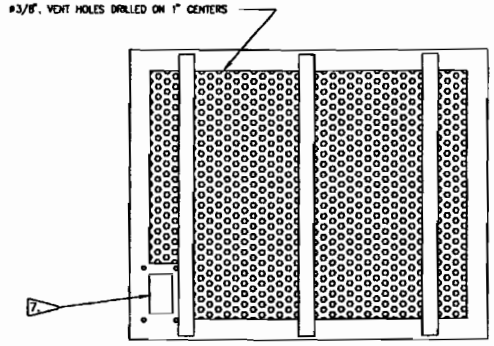


FRONT VIEW





REAR VIEW



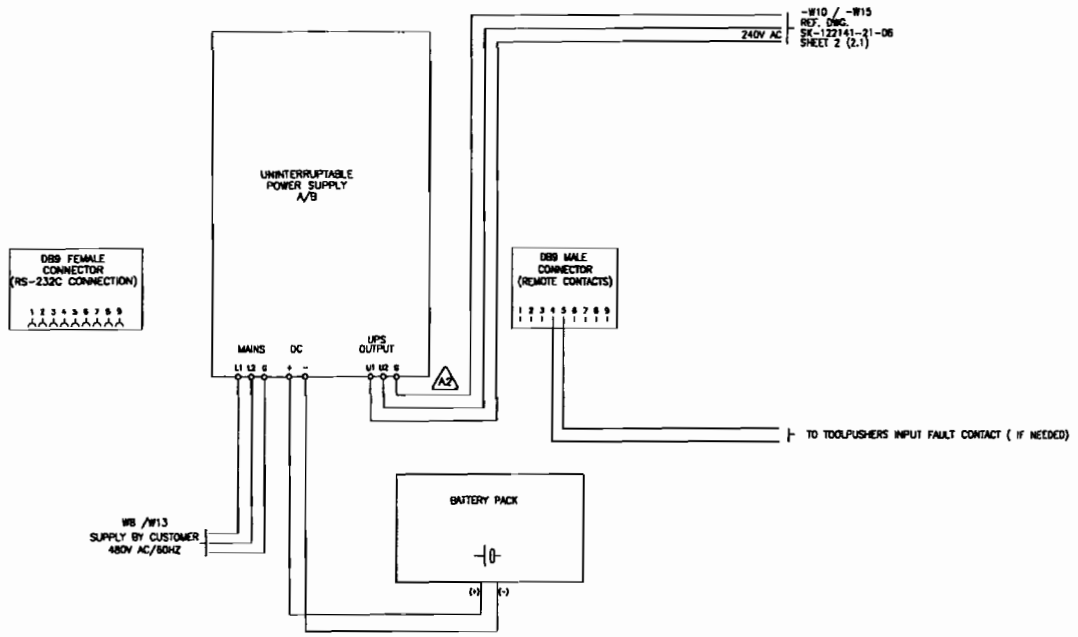
BOTTOM VIEW

NOTES:

1. 4X EYE BOLTS USED TO INSTALL DRIP SHIELD (AFTER TRANSPORT).
2. ALLOW 24" PERIMETER FOR WORK/ACCESS SPACE ALL AROUND UNIT.
3. HUMIDITY: 0-90% NON CONDENSING.
4. HEAT GENERATION: ~7500/HR.(BTU/HR)
5. MAX CURRENT DRAW: 30 AMPS
6. ENCLOSURE: TYPE NEMA 1
7. REMOVABLE GLAND PLATE FOR DRILLING CABLE ENTRY HOLES.
8. DRIPSHIELD
9. WEIGHT ~ 3250 LBS. (1462.5 KG)

R & B FALCON
"DEEPWATER HORIZON"
P.O.# 08700101

DO NOT SCALE	DES. BY: M. Graham	DATE: 09/21/99 REV: A01
DRAWN: CLINT DEMING 09/01/99	CAMERON CONTROLS	COOPER CAMERON Corp. Cameron Division P.O. Box 1212 Houston, TX 77251-1212
CHECKED: M. Weber 10/05/99	ASSEMBLY DRAWING	
APPROVED: R. Coronado 10/05/99	UNINTERUPTABLE POWER SUPPLY	
SCALE:	480VAC INPUT/230VAC OUTPUT 50/60HZ	
SUPERSEDES:	SERIAL USE RNG: 2020711-21	SHEET: 1 of 1 DRAWING NUMBER: SK-122111-21-04



R & B FALCON
"DEEPWATER HORIZON"
P.O.# 08700101

DO NOT SCALE	REV. By: M. Lira	DATE: 04/05/00	REV: A02
DRAWN: CLINT DEMING	DATE: 09/01/99	CAMERON CONTROLS	KOOPER CAMERON Corp. CAMERON Division P.O. Box 1212 Houston, TX 77251-1212
ENGINEER: M. Closserne	DATE: 04/06/00	ELECTRICAL SCHEMATIC UPS	
APPROVED: R. Corgnale	DATE: 04/06/00		
SUPERVISOR:	SCALE:	MTRL USE SUM: 2020745-21	SHEET: 1 OF 1
			DRAWING NUMBER: SK-122111-21-06

1.6 ACCUMULATOR RACK

The surface accumulator packages typically consist of stand-alone Accumulator Rack(s) populated with accumulators rated for the maximum system working pressure.

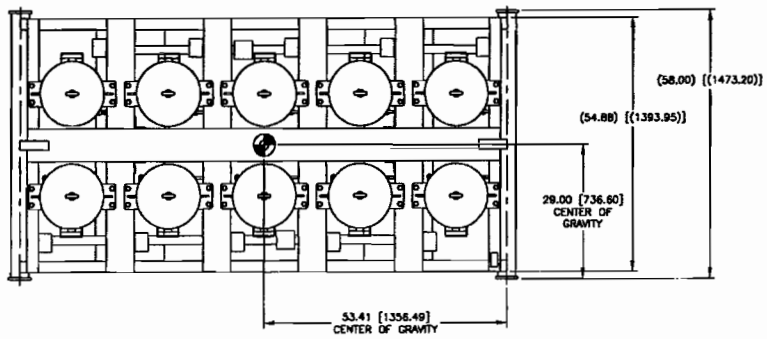
The required total stored hydraulic fluid volume (accumulator volume system capacity) to operate the BOP-Stack is calculated in accordance with API 16D or Norwegian Petroleum Directorate (NPD) rules.

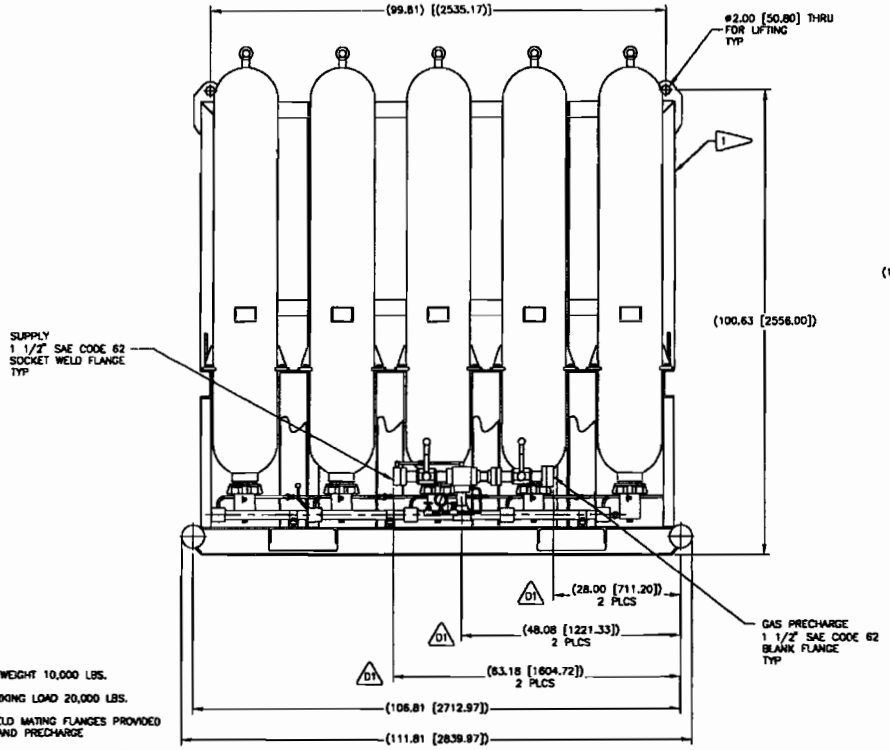
The typical surface accumulator package is divided into independent accumulator banks. Two accumulator banks can be mounted on a single, stand-alone Accumulator Rack. The accumulator rack is of heavy duty welded steel construction. The parts are constructed of seal-welded St 37-2, DIN 17100 or equivalent.

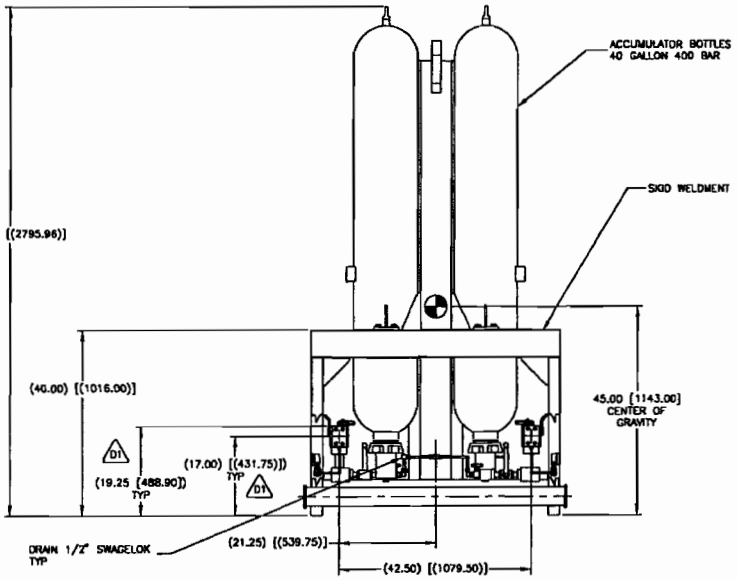
All welds are continuous to minimize ingress of salt laden moisture and internal corrosion of the structural steel members. The frame parts are painted in accordance to Cameron approved paint specification.

Supply pressure isolation valves and bleed valves are provided for each accumulator bank to allow accumulators to be isolated from the manifold and drained back to the control fluid reservoir for maintenance or replacement. The accumulator system is designed so that the loss of an individual accumulator or bank does not result in the loss of the total accumulator system capacity.

The subsea accumulator packages, which are mounted on the Lower Riser Package (LRP), are described in another section of this document. They are installed to provide the fluid required for running or retrieving the BOP-Stack or the LRP. It also functions to reduce BOP closing times and/or to serve as a backup supply of fluid power. Accumulators mounted subsea have a surface controlled valve to permit isolation of the supply pressure to the subsea accumulators so that the pump system can be directed straight through to a selected BOP-Stack function, such as the shear rams.







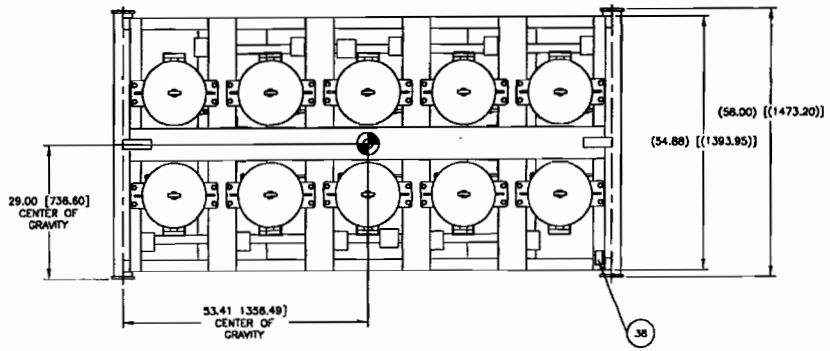
NOTES:

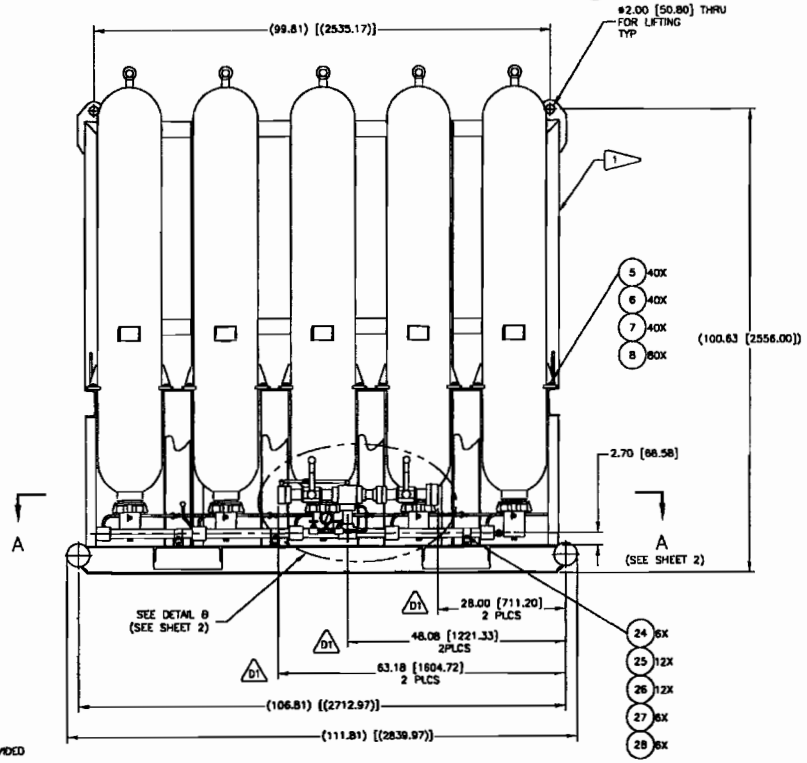
> EMPTY WEIGHT 10,000 LBS.
SAFE WORKING LOAD 20,000 LBS.

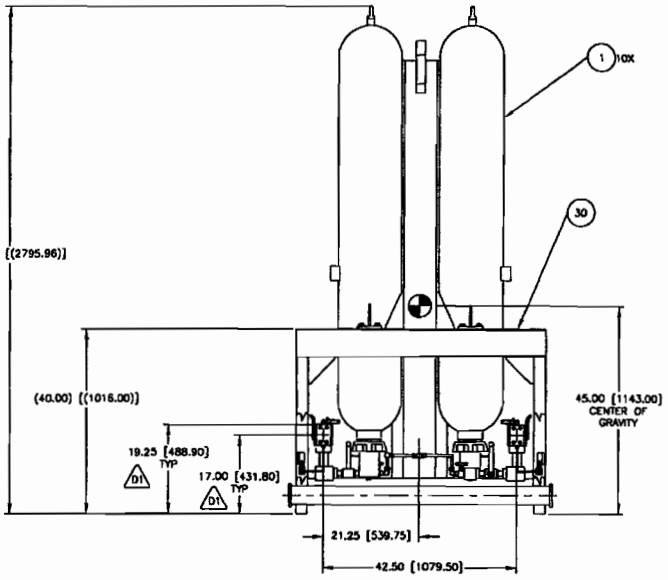
3. SOCKET WELD MATING FLANGES PROVIDED FOR SUPPLY AND PRECHARGE

4. SWAGELOK TUBE FITTINGS PROVIDED FOR DRAINS

REV BY: A. Simpson	DATE: 01/15/09	REV: D01	
SURFACE TREATMENT:	DO NOT SCALE		
DRAWN: J. Williams	DATE: 10/08/99	CAMERON CONTROLS	COOPER CAMERON Corp. CAMERON Division P.O. Box 1212 Houston, TX 77251-1212
CHECKED: J. Williams	DATE: 01/20/00		
APPROVED: Bob C. Hill	DATE: 01/21/00	GENERAL ARRANGEMENT, ACCUMULATOR RACK 10 X 40 GALLON BOTTLES	
EST. WEIGHT: N/A	SUPERSEDES:	SCALE: 1:12	
INITIAL USE: 2021891-10-01	SHEET: 1 OF 1	DRAWING NUMBER: SK-122601-10	







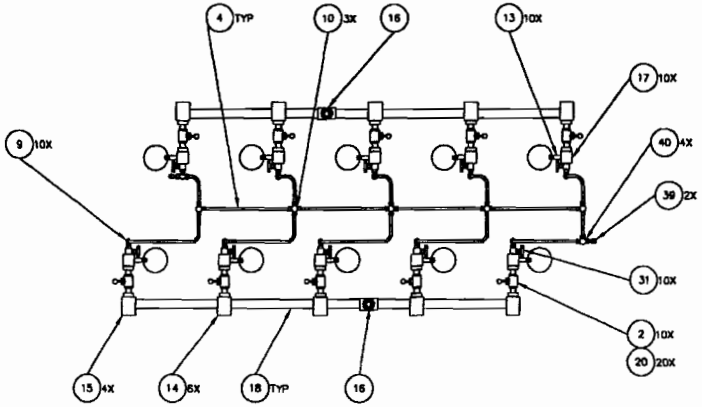
NOTES:
1. EMPTY WEIGHT 16,000 LBS.
2. SAFE WORKING LOAD 20,000 LBS.
3. SOCKET WELD MATING FLANGES PROVIDED FOR SUPPLY AND PRECHARGE.
4. COMPRESSION TYPE TUBE FITTINGS PROVIDED FOR DRAINS.

SURFACE TREATMENT	DO NOT SCALE	APP'D. BY: A. Simpson	DATE: 01/10/00
		DRAWN: J. Williams	DATE: 08/26/99
		DESIGNED: J. Williams	DATE: 01/20/00
		APPROVED: Belle C. Wei	DATE: 01/21/00
EST. WEIGHT: N/A	SUPERSEDES:	SCALE: 1:12	

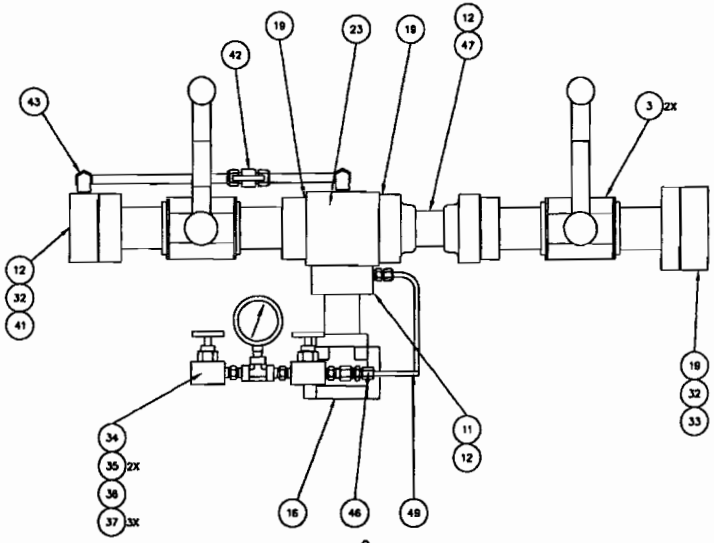
CAMERON CONTROLS

ASSEMBLY, ACCUMULATOR RACK
10 X 40 GALLON BOTTLES

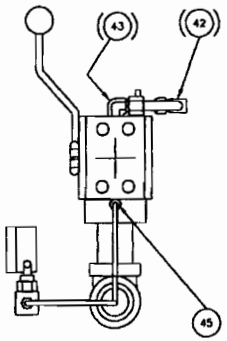
SERIAL USE NUM: 2021891-10-01
SHEET: 1 OF 2
DRAWING NUMBER: SK-122601-10-01

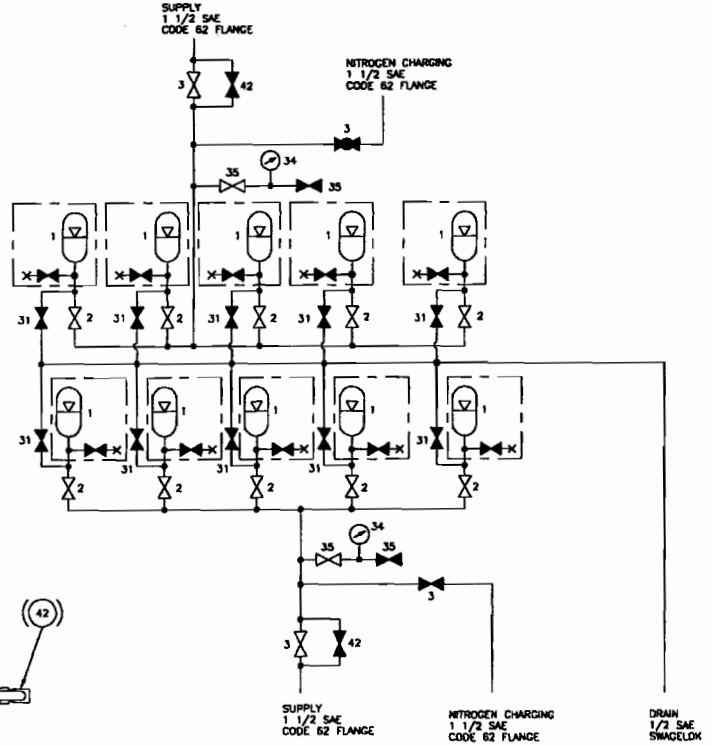


SECTION A–A
SEE SHEET 1

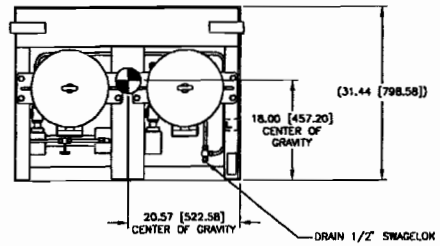


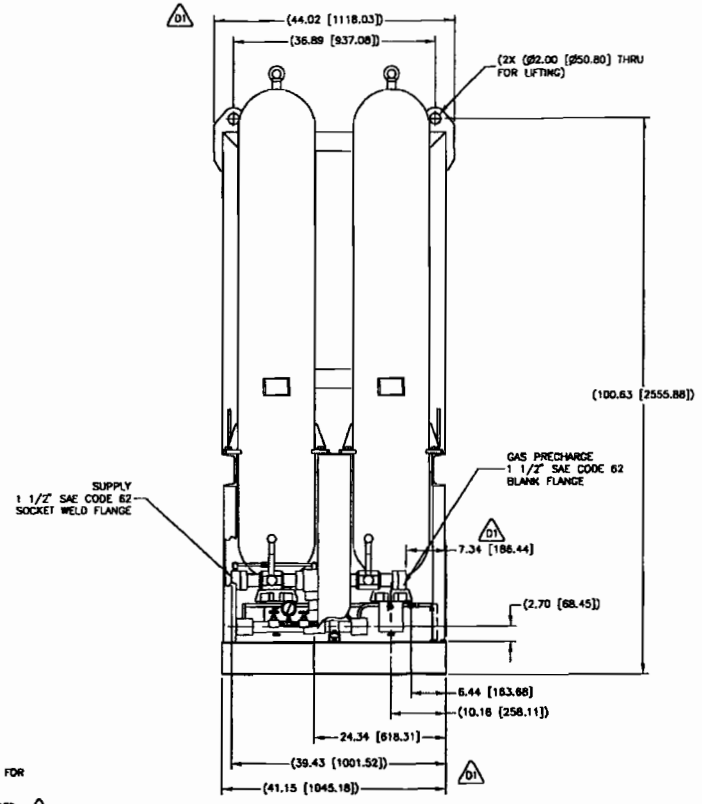
DETAIL B
SEE SHEET 1
TYP 2 PLCS

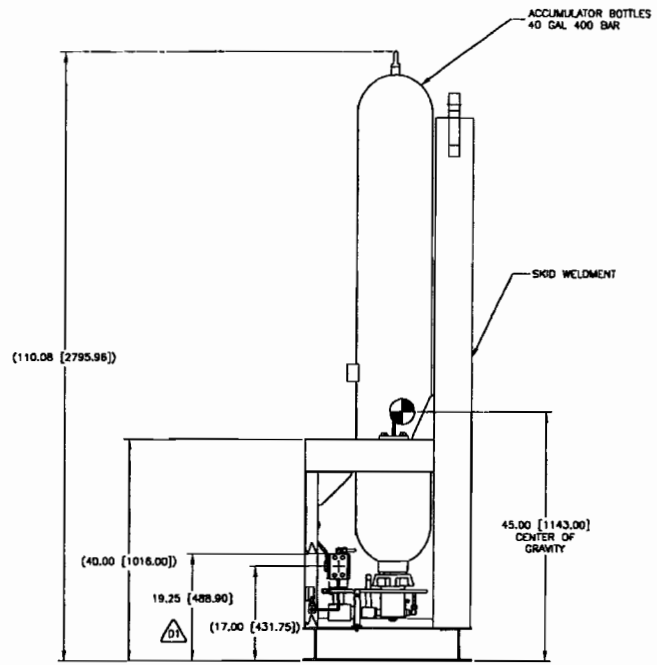




	SURFACE TREATMENT	DO NOT SCALE	REV BY: A. Simpson	DATE: 01/10/00 ECO: D01
TOLERANCE UNLESS OTHERWISE SPECIFIED		DRAWN: J. Williams DATE: 08/27/99	CAMERON CONTROLS	
.X ±	ANGLES ±	MATERIAL AND HEAT TREATMENT	CHECKED: J. Williams DATE: 01/20/00	ASSEMBLY, ACCUMULATOR RACK 10 X 40 GALLON BOTTLES
.XX ±			APPROVED: Sally C. DATE: 01/21/00	
.XXX ±				
EST. WEIGHT: n/a	SUPERSEDES	SCALE: 1:12	WORK ORDER: 2021991-10-01	SHEET: 2 of 2 DRAWING NUMBER: SK-122601-10-01







NOTES:

1. EST EMPTY WT.= 3540 LBS
2. SAFE WORKING LOAD 4200 LBS
3. SOCKET WELD MATING FLANGES PROVIDED FOR SUPPLY AND PRECHARGE
4. COMPRESSION TYPE TUBE FITTINGS PROVIDED FOR DRAINS D1

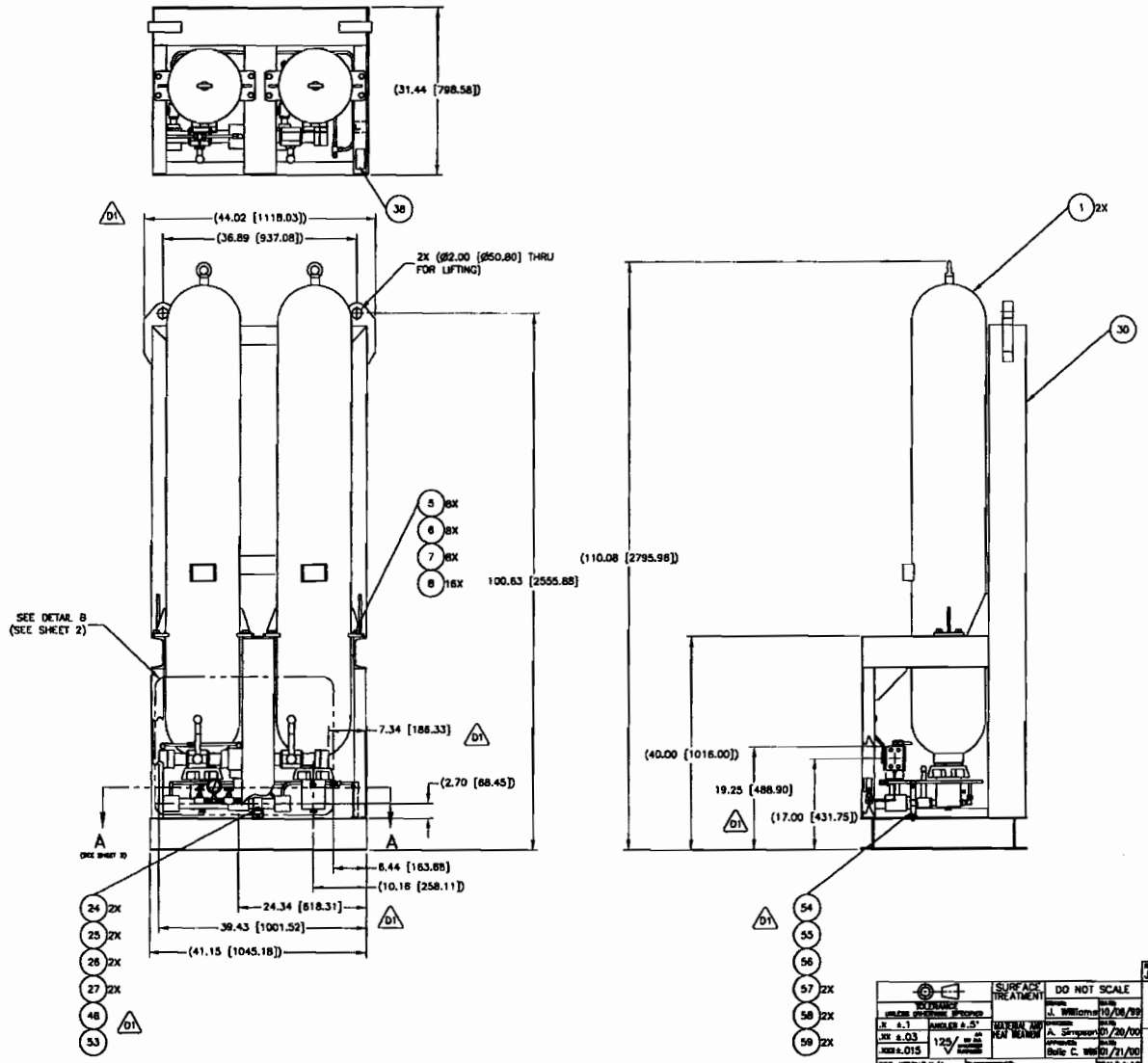
TOLERANCE UNLESS OTHERWISE SPECIFIED		SURFACE TREATMENT	DO NOT SCALE
.X ±.1	ANGLES ±.5°	MATERIAL AND HEAT TREATMENT	DRAWN J. Williams 10/07/99
.XX ±.03	125/		CHECKED A. Simpson 09/20/00
.XXX±.015			APPROVED Doris C. Wise 01/21/00
EST. WEIGHT: N/A	SUPERSEDES		SCALE: 1:10

REV. BY: J. Williams — DATE: 01/05/00 — REV: 001

CAMERON CONTROLS — COOPER CAMERON Corp. CAMERON Division P.O. Box 1212 Houston, TX 77251-1212

GENERAL ARRANGEMENT
ACCUMULATOR RACK SINGLE
2 X 40 GALLON BOTTLES

FINAL USE NUM: 2185083-02-01 — SHEET: 1 of 1 — DRAWING NUMBER: SK-122614-02



NOTES:

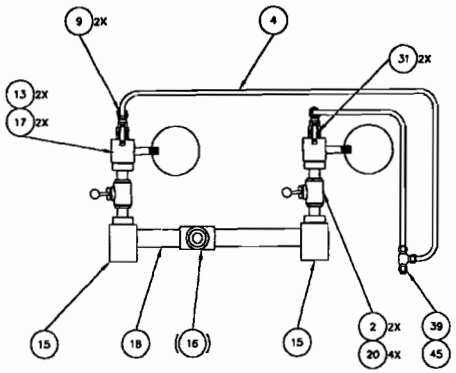
1. EST EMPTY WT.= 3500 LBS
2. SAFE WORKING LOAD 4200 LBS
3. SOCKET WELD MATING FLANGES PROVIDED FOR SUPPLY AND PRECHARGE
4. COMPRESSION TYPE TUBE FITTINGS PROVIDED FOR DRAINS (D1)

REV. BY: J. Williams	DATE: 01/05/00	REV: 001	
TOLERANCE UNLESS OTHERWISE SPECIFIED: .XX ±.1 ANGLES ±.5° .XXX ±.03 .XXXX ±.015	SURFACE TREATMENT: 125	DO NOT SCALE	
EST. WEIGHT: N/A	SUPERSEDES:	SCALE: 1:10	
DRAWN: J. Williams	DATE: 10/06/99		
MATERIAL AND HEAT TREATMENT	APPROVED: A. Simpson	DATE: 01/20/00	
	APPROVED: Sully C.	DATE: 01/21/00	

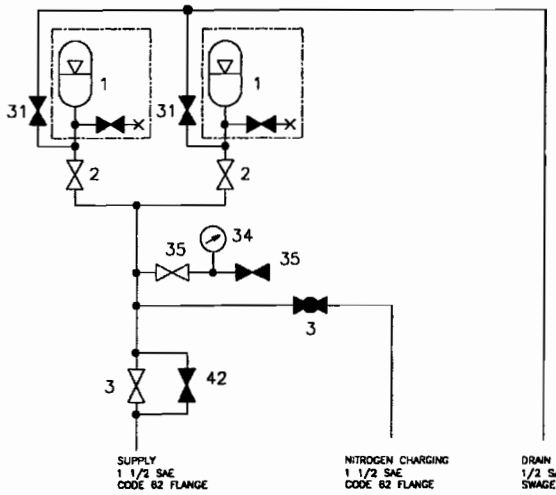
CAMERON CONTROLS

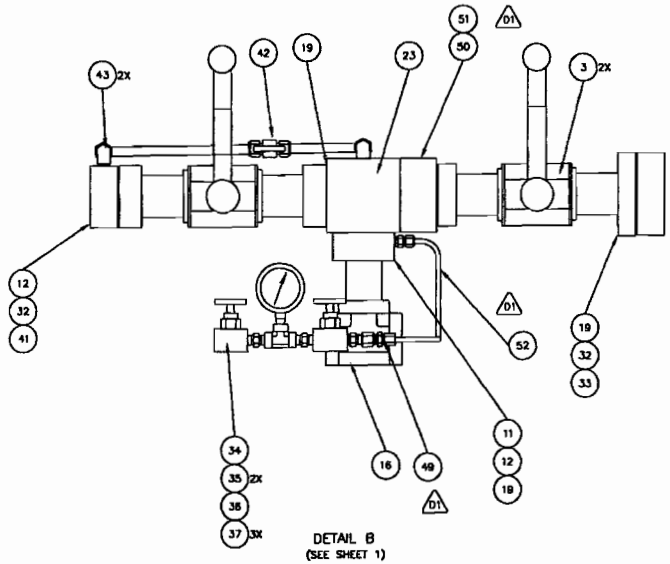
ASSEMBLY, ACCUMULATOR RACK
ACCUMULATOR RACK SINGLE
2 X 40 GALLON BOTTLES

ORIGINAL USE SIGN: 2185083-02-01	SHEET: 1 of 2	ORIGINAL NUMBER: SK-122614-02-01	

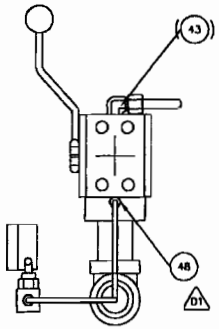


SECTION A-A
(SEE SHEET 1)



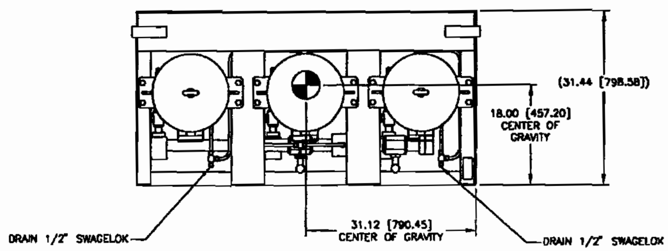


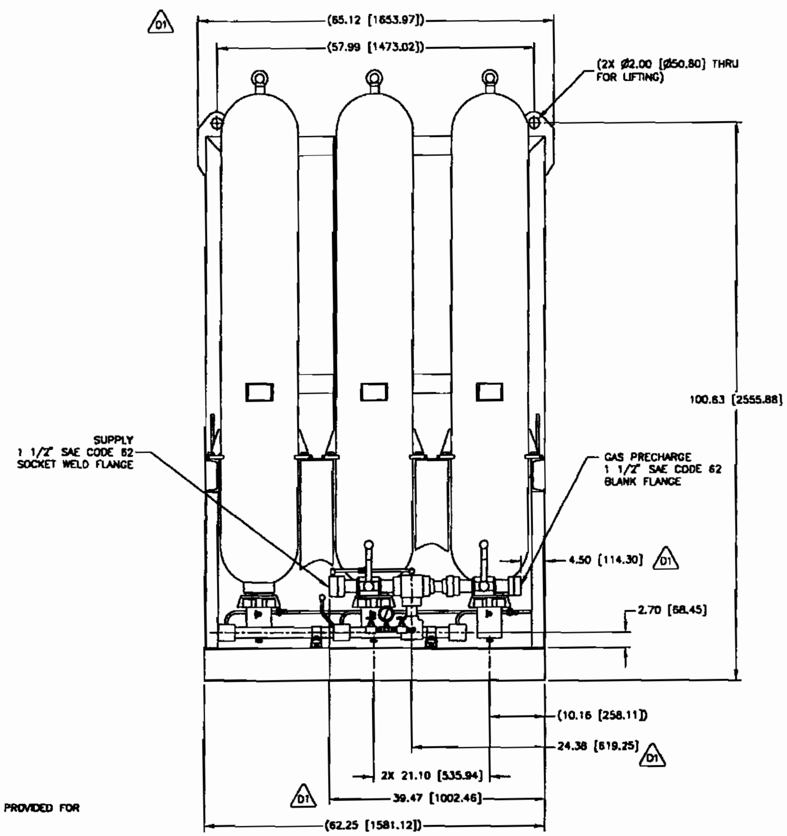
DETAIL B
(SEE SHEET 1)

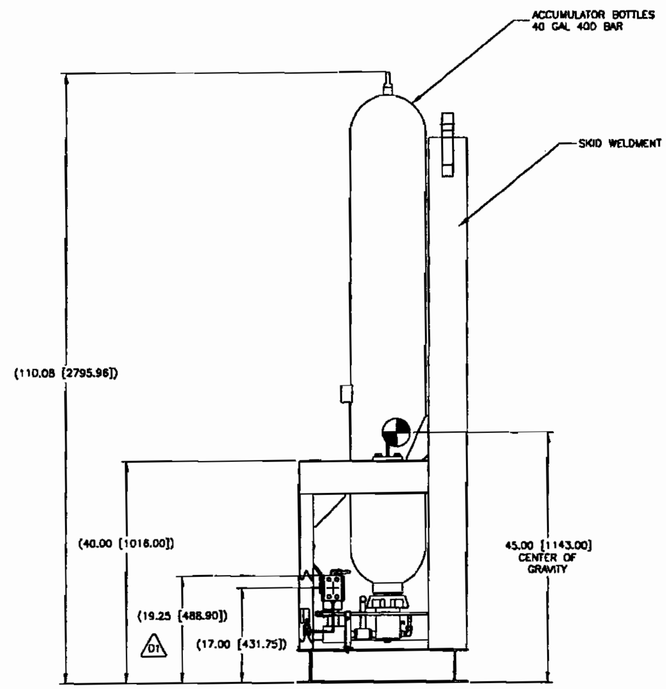


TOLERANCE UNLESS OTHERWISE SPECIFIED: .X ±.1, .XX ±.03, .XXX ±.015; ANGLES ±.5°; 125 µin	SURFACE TREATMENT / MATERIAL AND HEAT TREATMENT	DO NOT SCALE	DRN. J. Williams 10/11/99; CHK'D A. Simpson 01/20/00; APP'D Bella C. Wu 01/21/00; EST. WEIGHT: N/A; SUPERSEDES: ; SCALE: 1:6
REV. BY: J. Williams; DATE: 9/05/00; MOD: D01			
CAMERON CONTROLS — COOPER CAMERON Corp., CAMERON Division, P.O. Box 1212, Houston, TX 77251-1212			
ASSEMBLY, ACCUMULATOR RACK ACCUMULATOR RACK SINGLE 2 X 40 GALLON BOTTLES			
INITIAL USE FROM: 218508J-02-01	SHEET: 2 OF 2	DRAWING NUMBER: SK-122614-02-01	

SAVED BY: wblak date: 1/6/00 2:15 p.m.







D1

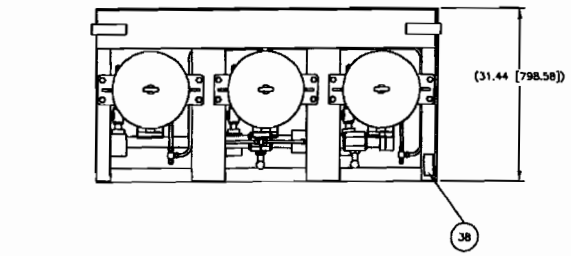
NOTES:

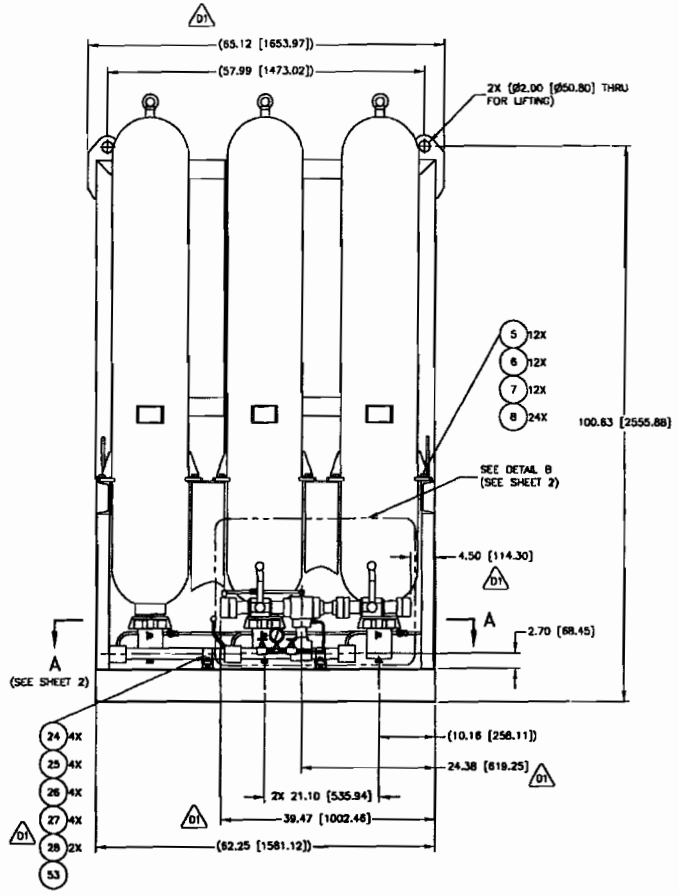
1. EST. EMPTY WT.= 5220 LBS.
2. SAFE WORKING LOAD 6200 LBS
3. SOCKET WELD MATING FLANGES PROVIDED FOR SUPPLY AND PRECHARGE.
4. COMPRESSION TYPE TUBE FITTINGS PROVIDED FOR DRAINS.

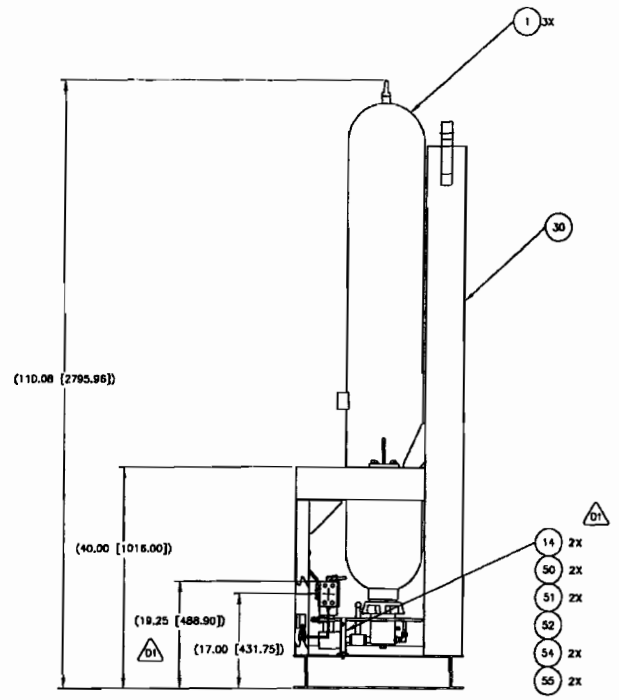
TOLERANCE UNLESS OTHERWISE SPECIFIED	SURFACE TREATMENT	DO NOT SCALE	REV. BY: A. Simpson — DATE: 01/08/00 — REV: D01
.X ± / .XX ± / .XXX± — ANGLES ±		J. Williams 10/07/99	CAMERON CONTROLS — COOPER CAMERON Corp.
		J. Williams 01/20/00	GENERAL ARRANGEMENT ACCUMULATOR RACK SINGLE 3 X 40 GALLON BOTTLES
EST. WEIGHT: N/A	SUPERSEDES:	Rollo C. Wei 01/21/00 — SCALE: 1:10	21B5083-03-01 — 1 OF 1 — SK-122614-03

CONFIDENTIAL
ACCESS
RESTRICTED

CAM_CIV_0000294



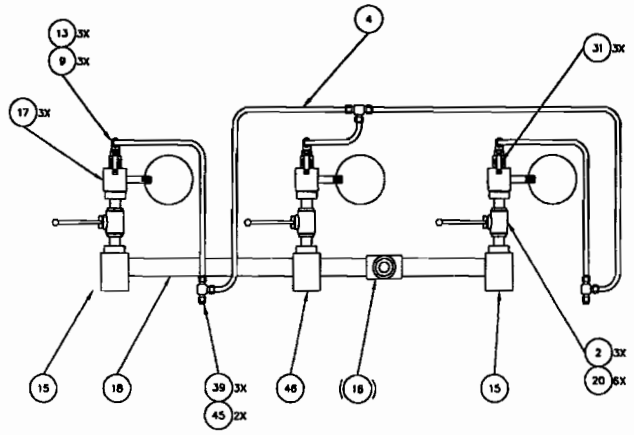




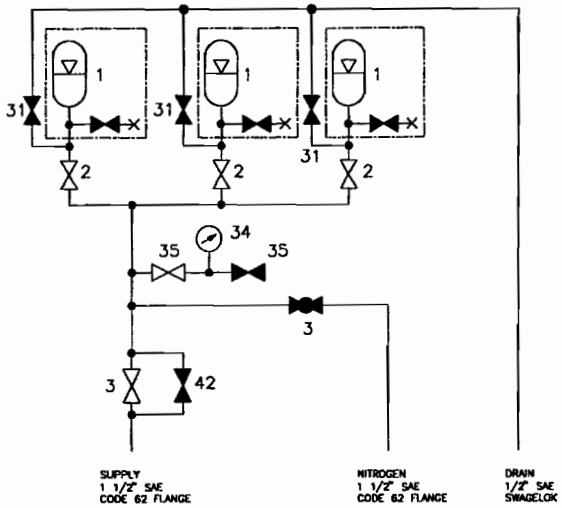
NOTES:

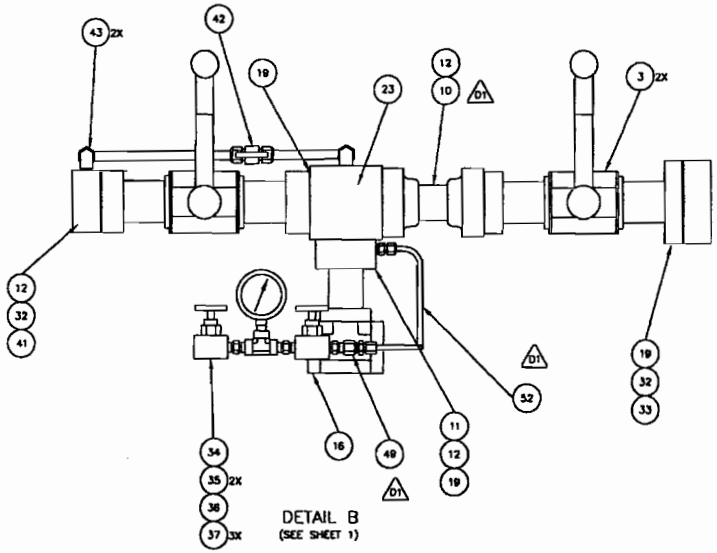
1. EST. EMPTY WT.= 5220 LBS.
2. SAFE WORKING LOAD 6200 LBS.
3. SOCKET WELD MATING FLANGES PROVIDED FOR SUPPLY AND PRECHARGE.
4. COMPRESSION TYPE TUBE FITTINGS PROVIDED FOR DRAINS.

TOLERANCE UNLESS OTHERWISE SPECIFIED	SURFACE TREATMENT	DO NOT SCALE	REV. BY: A. Simpson — DATE: 9/08/00 — DWG: D01
.X ±.1 ANGLES ±.5°		DRAWN: J. Williams 10/12/99	CAMERON CONTROLS — COOPER CAMERON Corp. CAMERON Division P.O. Box 1212 Houston, TX 77251-1212
.XX ±.03 125	MATERIAL AND HEAT TREATMENT	ENGINEER: J. Williams 01/18/00	ASSEMBLY, ACCUMULATOR RACK ACCUMULATOR RACK SINGLE 3 X 40 GALLON BOTTLES
.XXX ±.015		APPROVED: Sally C. Will 01/21/00	
EST. WEIGHT: N/A	SUPERSEDES:	SCALE: 1:10	
		NEXT USE DWG: 2185083-03-01	SHEET: 1 OF 2 — DRAWING NUMBER: SK-122614-03-01

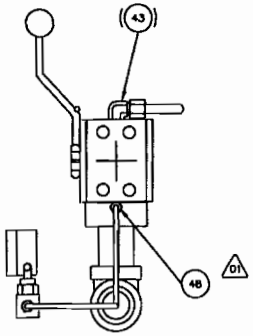


SECTION A–A
(SEE SHEET 1)

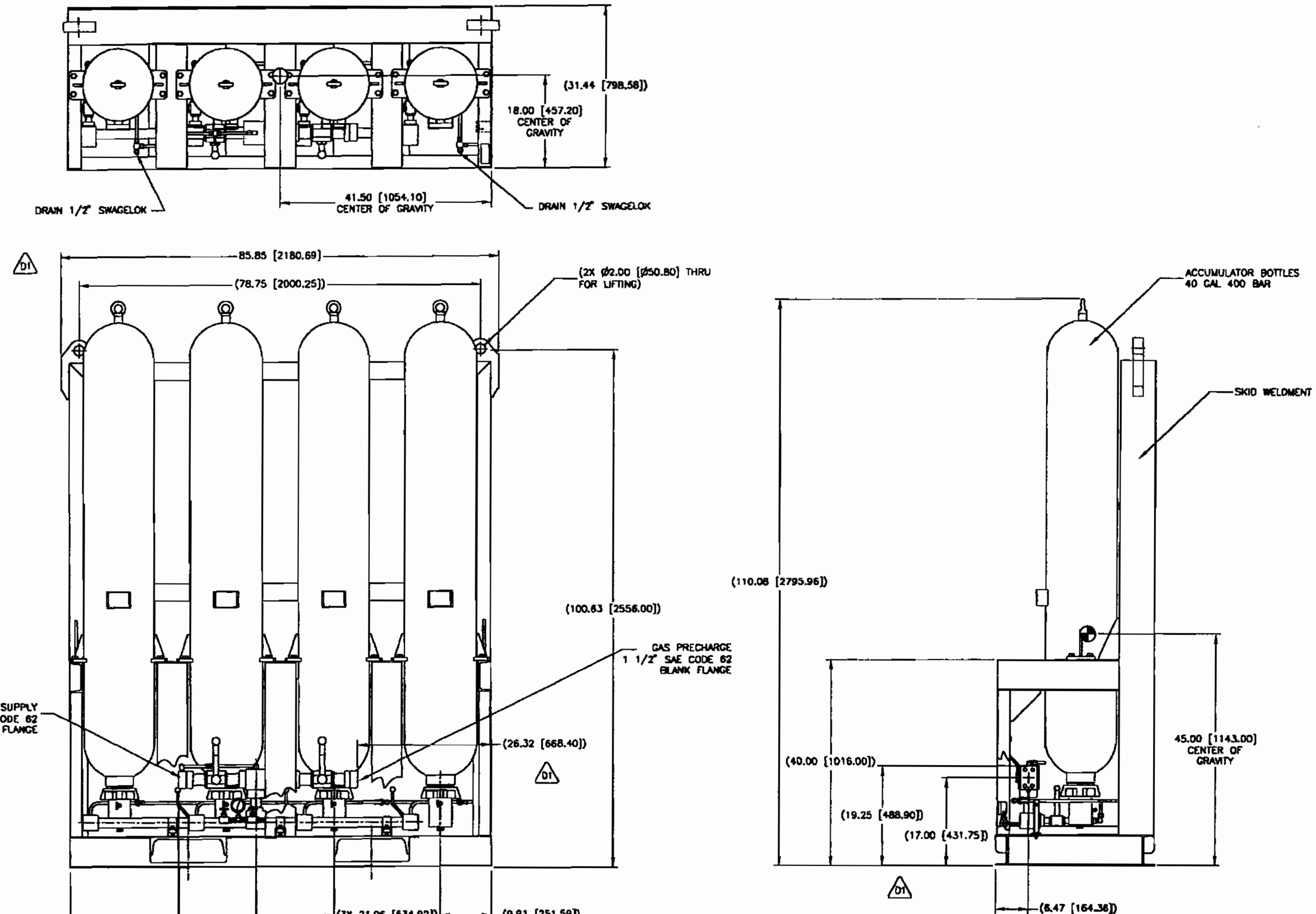




DETAIL B
(SEE SHEET 1)



SURFACE TREATMENT	DO NOT SCALE	REV. BY: A. Simpson	DATE: 01/08/00 ECO: D01
MATERIAL AND HEAT TREATMENT	DRAWN: J. Williams 10/12/99	CAMERON CONTROLS	COOPER CAMERON Corp. Cameron Division P.O. Box 1212 Houston, TX 77251-1212
SUPERSEDES	CHECKED: J. Williams 01/18/00	ASSEMBLY, ACCUMULATOR RACK ACCUMULATOR RACK SINGLE 3 X 40 GALLON BOTTLES	
EST. WEIGHT: N/A	APPROVED: Belle C. Wei 01/21/00	MATERIAL USE REQ. 2185083-03-01	SHEET 2 of 2 DRAWING NUMBER SK-122614-03-01



NOTES: D1

ST. EMPTY WT= 6600 LBS.

SAFE WORKING LOAD 8000 LBS.

3. SOCKET WELD MATING FLANGES PROVIDED FOR SUPPLY AND PRECHARGE

4. COMPRESSION TYPE TUBE FITTINGS PROVIDED FOR DRAINS

TOLERANCE	SURFACE TREATMENT	DO NOT SCALE	
.X ± / ANGLES ±		J. Williams	10/07/99
.XX ±	MATERIAL AND HEAT TREATMENT	A. Simpson	01/20/00
.XXX ±		Belle C. Will	01/21/00
EST. WEIGHT: N/A	SUPERSEDES:		SCALE: 1:10

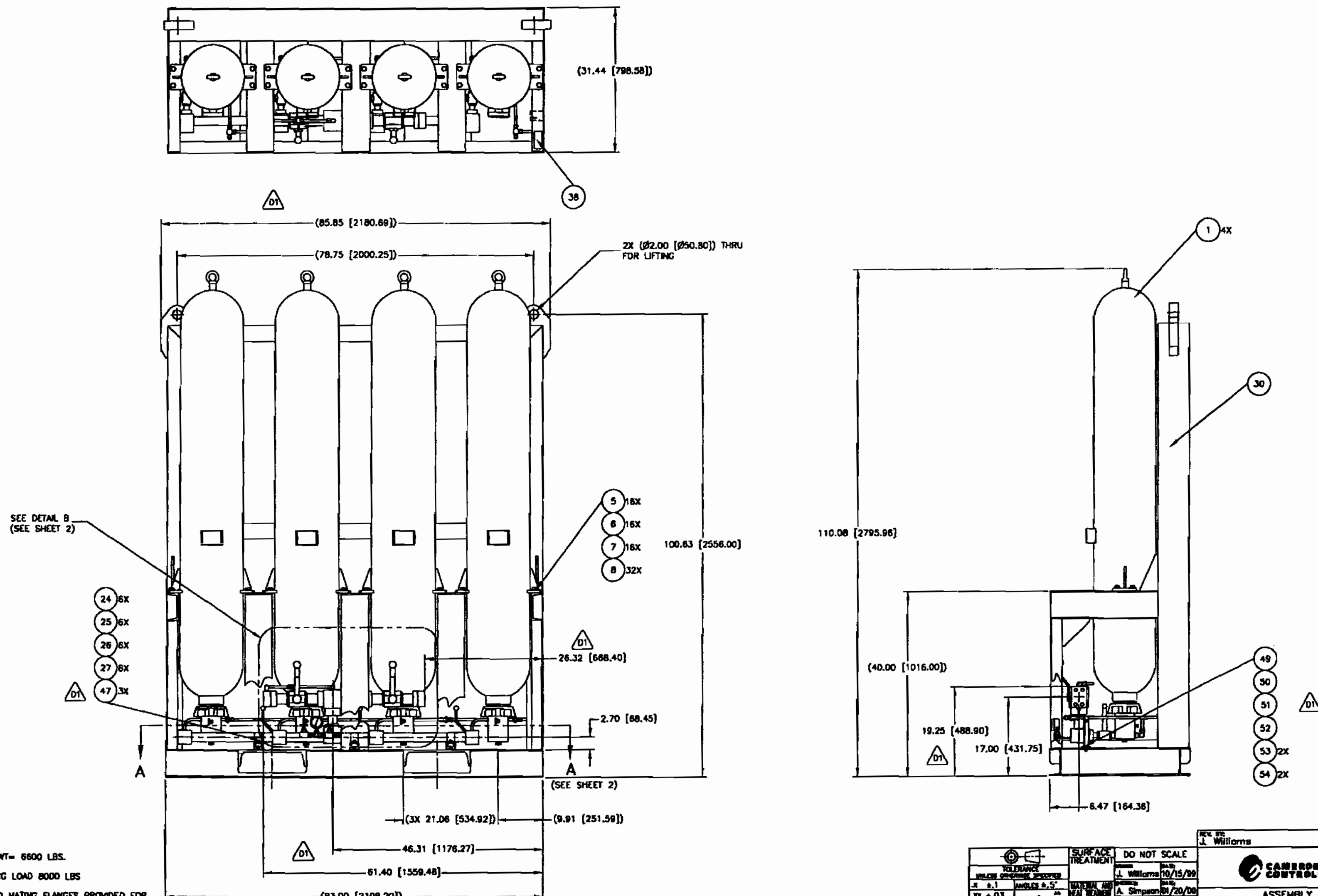
REV. BY: J. Williams DATE: 01/17/00 REV: D01

CAMERON CONTROLS

GENERAL ARRANGEMENT
ACCUMULATOR RACK SINGLE
4 X 40 GALLON BOTTLES

2185083-04-01 | SHEET 1 of 1 | SK-122614-04

AVED BY: [illegible] date: 12/10/99 4:46 p.m.



NOTES:

1. ...T. EMPTY WT= 6600 LBS.
2. ...FE WORKING LOAD 8000 LBS
3. SOCKET WELD MATING FLANGES PROVIDED FOR SUPPLY AND PRECHARGE
4. COMPRESSION TYPE TUBE FITTINGS PROVIDED FOR DRAINS

TOLERANCE UNLESS OTHERWISE SPECIFIED	SURFACE TREATMENT	DO NOT SCALE	
.X ±.1 / ANGLES ±.5°		J. Williams	10/15/99
.XX ±.03 / 125	MATERIAL AND HEAT TREATMENT	A. Simpson	01/20/00
.XXX ±.015		Bollo C. Will	01/21/00
EST. WEIGHT: N/A	SUPERSEDES		SCALE: 1:10

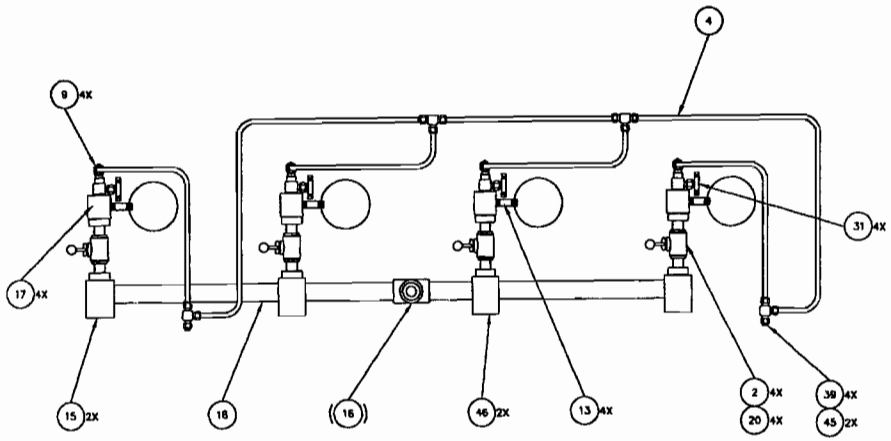
REV. BY: J. Williams — DATE: 01/14/00 — REV: D01

CAMERON CONTROLS

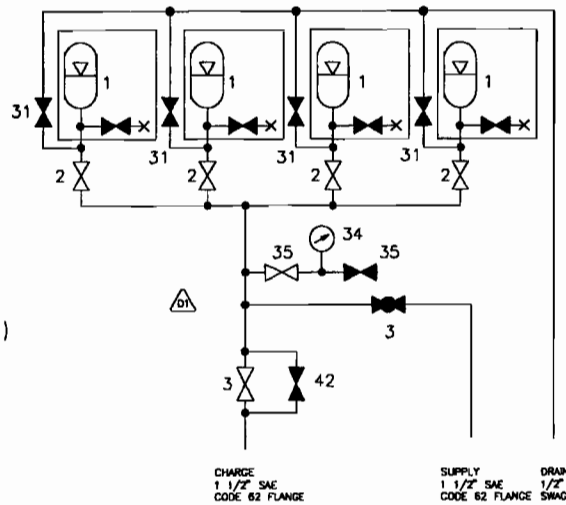
ASSEMBLY, ACCUMULATOR
RACK SINGLE
4 X 40 GALLON BOTTLES

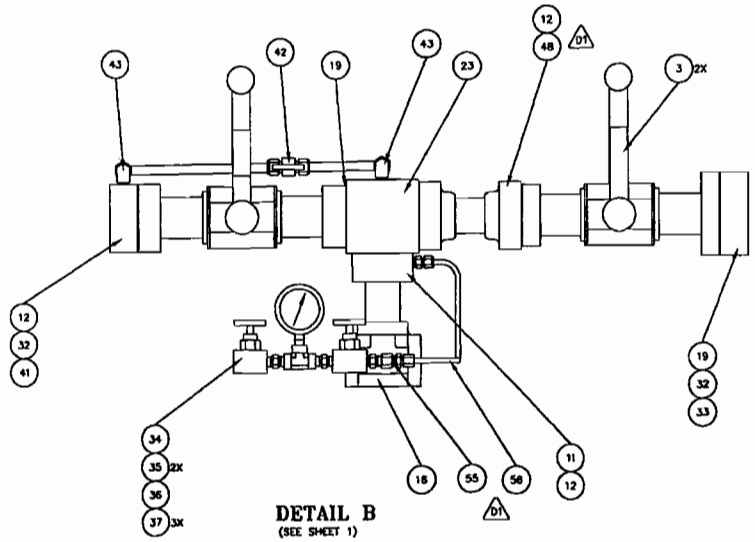
2185083-04-01 — SHEET 1 OF 2 — SK-122614-04-01

...VED BY: ... date: 12/13/99 3:25 p.m.

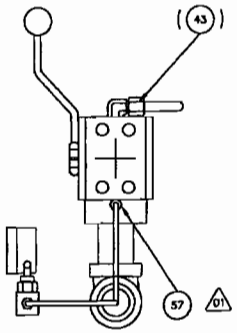


SECTION A–A
(SEE SHEET 2)





DETAIL B
(SEE SHEET 1)



SURFACE TREATMENT: DO NOT SCALE	Drawn: J. Williams 10/15/99	REV. BY: J. Williams	DATE: 01/14/00 REV: D01
TOLERANCE UNLESS OTHERWISE SPECIFIED: .X ±.1 ANGLES ±.5° .XX ±.03 .XXX ±.015 125	Material and Heat Treatment: A. Simpson 01/20/00	CAMERON CONTROLS	ASSEMBLY, ACCUMULATOR RACK SINGLE 4 X 40 GALLON BOTTLES
EST. WEIGHT: n/a SUPERSEDES:	Approved: Bala C. 986 01/21/00 SCALE: 1:10	DETAIL USE BOM: 2185083-04-01	SHEET: 2 of 2 DRAWING NUMBER: SK-122614-04-01

1.7 OIM´S CONTROL PANEL (OIM CP)

The OIM CP is housed in a stainless steel enclosure. The panel is suitable for installation in a Zone 1, Gas Group IIA, Temperature Class T3, Hazardous Area. A member of the CENELEC (is this typical of all components) organization certifies all explosion proof components. Certificates are provided in the *language of the manufacturer's origin.*

A PLC unit, equipped with single Communication controller and single I/O module is mounted in a 19-inch relay rack configuration and installed in an explosion proof junction box and is used to control and monitor all I/O functions (buttons, lamps, meters etc.). The communication between the various I/O- Controller within the DU, SSECP and OIM CP will be via a redundant serial bus system (PROFIBUS).

The control panel typically includes the following controls:

- Up to Fifty-five (55) sets of illuminated push buttons complete with nametags for the BOP-Stack and Lower Riser Package valve functions are configured graphically on the panel to ensure easy identification. Depending on system configuration, the following subsea valve functions can be operated from the OIM Control Panel:

  - Pod Select - BLUE / VENT / YELLOW
  - Upper Annular Preventer - OPEN / VENT / CLOSE
  - Riser Connector - UNLATCH / VENT / LATCH
  - Riser Connector Secondary - UNLATCH / VENT
  - Lower Annular Preventer - OPEN / VENT / CLOSE
  - Shear Ram Preventer - OPEN / VENT / CLOSE
  - Upper Pipe Ram Preventer - OPEN / VENT / CLOSE
  - Middle Pipe Ram Preventer - OPEN / VENT / CLOSE
  - Lower Pipe Ram Preventer - OPEN / VENT / CLOSE
  - Wellhead Connector - UNLATCH / VENT / LATCH
  - Wellhead Connector Secondary - UNLATCH / VENT
  - Blue Conduit Isolation Valve - OPEN / CLOSE
  - Choke/Kill Isolation Valve - OPEN / CLOSE
  - Upper Outer Kill Valve - OPEN / CLOSE
  - Upper Inner Kill Valve - OPEN / CLOSE
  - Lower Outer Kill Valve - OPEN / CLOSE
  - Lower Inner Kill Valve - OPEN / CLOSE
  - Blue Riser Stinger - RETRACT / EXTEND
  - Blue Riser Stinger Seals - DEENERGIZE / ENERGIZE
  - Blue Stack Stinger - RETRACT / EXTEND
  - Blue Stack Stinger Seals - DEENERGIZE / ENERGIZE
  - Blue Pod Lock - UNLOCK / LOCK
  - Yellow Conduit Isolation Valve - OPEN / CLOSE
  - Conduit Flush Valve - OPEN / CLOSE
  - Upper Outer Choke Valve - OPEN / CLOSE

- Upper Inner Choke Valve - OPEN / CLOSE
- Lower Outer Choke Valve - OPEN / CLOSE
- Lower Inner Choke Valve - OPEN / CLOSE
- Yellow Riser Stinger - RETRACT / EXTEND
- Yellow Riser Stinger Seals - DEENERGIZE / ENERGIZE
- Yellow Stack Stinger - RETRACT / EXTEND
- Yellow Stack Stinger Seals - DEENERGIZE / ENERGIZE
- Yellow Pod Lock - UNLOCK / LOCK
- Solenoid Valve Supply Pilot Function - OPEN / CLOSE
- Yellow Solenoid Valve Supply - OPEN / CLOSE
- Acoustic System - RESET / VENT / ISOLATION
- Acoustic Accumulator - SUPPLY / VENT / DUMP
- LRP Accumulator Isolation - OPEN / CLOSE
- Orientation Pin - OPEN / VENT / CLOSE
- Optional Wellhead Connector - UNLATCH / VENT /LATCH
- LMRP Connector Gasket Release – RELEASE
- Booster Line Test Valve – OPEN / CLOSE
- Choke Kill Line Connector – UNLATCH / LATCH
- Outer Gas Bleed Valve – OPEN / (CLOSE)
- Inner Gas Bleed Valve – OPEN / CLOSE
- E-Connector – EXTEND / RETRACT
- Casing Shear Ram Preventer – OPEN / VENT / CLOSE
- High Pressure Shear Function - CLOSE / (OPEN)
- Stack Accumulator – (CHARGE / DUMP) Isolation
- BOP Connector Gasket Release – RELEASE / (CLOSE)
- Upper Annular Regulator – INCREASE / DECREASE
- Lower Annular Regulator – INCREASE / DECREASE
- BOP Manifold Regulator – INCREASE / DECREASE
- Spare Valve I – OPEN / CLOSE
- Spare Valve II – OPEN / CLOSE

NOTE: Protective guards are provided for the connector functions and the shear ram function related to customer specification or NPD requirements.

- Up to Eighteen (18) indication lamps for the following typical functions:

  - Lubricant Level
  - Blue Solenoid Pilot Pressure
  - Yellow Solenoid Pilot Pressure
  - Low Accumulator Pressure
  - Low Air Pressure
  - Low/Low Fluid Level
  - Low Lub. Level
  - Low Glycol Level
  - HPU Failure
  - E-Pump 1 Running

- Upper Inner Choke Valve - OPEN / CLOSE
- Lower Outer Choke Valve - OPEN / CLOSE
- Lower Inner Choke Valve - OPEN / CLOSE
- Yellow Riser Stinger - RETRACT / EXTEND
- Yellow Riser Stinger Seals - DEENERGIZE / ENERGIZE
- Yellow Stack Stinger - RETRACT / EXTEND
- Yellow Stack Stinger Seals - DEENERGIZE / ENERGIZE
- Yellow Pod Lock - UNLOCK / LOCK
- Solenoid Valve Supply Pilot Function - OPEN / CLOSE
- Yellow Solenoid Valve Supply - OPEN / CLOSE
- Acoustic System - RESET / VENT / ISOLATION
- Acoustic Accumulator - SUPPLY / VENT / DUMP
- LRP Accumulator Isolation - OPEN / CLOSE
- Orientation Pin - OPEN / VENT / CLOSE
- Optional Wellhead Connector - UNLATCH / VENT /LATCH
- LMRP Connector Gasket Release – RELEASE
- Booster Line Test Valve – OPEN / CLOSE
- Choke Kill Line Connector – UNLATCH / LATCH
- Outer Gas Bleed Valve – OPEN / (CLOSE)
- Inner Gas Bleed Valve – OPEN / CLOSE
- E-Connector – EXTEND / RETRACT
- Casing Shear Ram Preventer – OPEN / VENT / CLOSE
- High Pressure Shear Function - CLOSE / (OPEN)
- Stack Accumulator – (CHARGE / DUMP) Isolation
- BOP Connector Gasket Release – RELEASE / (CLOSE)
- Upper Annular Regulator – INCREASE / DECREASE
- Lower Annular Regulator – INCREASE / DECREASE
- BOP Manifold Regulator – INCREASE / DECREASE
- Spare Valve I – OPEN / CLOSE
- Spare Valve II – OPEN / CLOSE

NOTE: Protective guards are provided for the connector functions and the shear ram function related to customer specification or NPD requirements.

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  - Low Accumulator Pressure
  - Low Air Pressure
  - Low/Low Fluid Level
  - Low Lub. Level
  - Low Glycol Level
  - HPU Failure
  - E-Pump 1 Running

- E-Pump 2 Running
- Lub. Pump Running
- Glycol Pump Running
- Spare 1
- Spare 2
- Lamp Test
- Alarm Test

- Depending on system configuration, the Following subsea regulator control functions will be operated from the OIM CP:

  - Lower Annular Regulator Pilot Pressure -- INCREASE / DECREASE
  - Upper Annular Regulator Pilot Pressure - INCREASE / DECREASE
  - BOP Manifold Regulator Pilot Pressure- INCREASE / DECREASE

- Depending on system configuration, up to fifteen (15) pressure meter indicating systems complete with nametags are provided for the indication of the following pressures:

  - Surface Accumulator Pressure
  - Surface Air Supply Pressure
  - Upper Subsea Annular Regulator Pilot Pressure
  - Lower Subsea Annular Regulator Pilot Pressure
  - Upper Subsea Annular Readback Pressure
  - Lower Subsea Annular Readback Pressure
  - Subsea BOP-Manifold Regulator Pilot Pressure
  - Subsea BOP-Manifold Readback Pressure
  - Subsea Blue LRP Accumulator Readback Pressure
  - Subsea Yellow LRP Accumulator Readback Pressure
  - Subsea Blue Solenoid Valve Supply Readback Pressure
  - Subsea Yellow Solenoid Valve Supply Readback Pressure
  - Diverter Packer Pressure
  - Slip Joint Lower Packer Pressure
  - Slip Joint Upper Packer Pressure

- Typically Error-, Interlock- and Diagnostic Display are provided

  - Provides an alphanumerically indication on system status, alarm or diagnostic information via a two line (each with 20 characters) display. The display will show clear text in case of a certain situation.

- The appropriate section in the Rig Book will give additional hints to detect the problem area and provide more guidance for repair.

- Typically one (1) Lamp test pushbutton are provided on the OIM CP.

- Typically, one (1) Alarm acknowledge pushbutton is provided on the OIM CP
- Typically, one (1) Enable (Push-and-Hold-to-Operate) pushbutton are provided on the OIM CP
- Depending on system configuration, up two (2) digital flow totalizer indicators, complete with reset push button, are provided on the OIM CP for the following flowmeter indications:
  - Subsea Blue / Yellow Flowmeter
  - Surface Flow Meter Indication

One section of the OIM CP is equipped with push buttons for the remote operation of the surface Diverter Control System functions. The following functions are typically included:

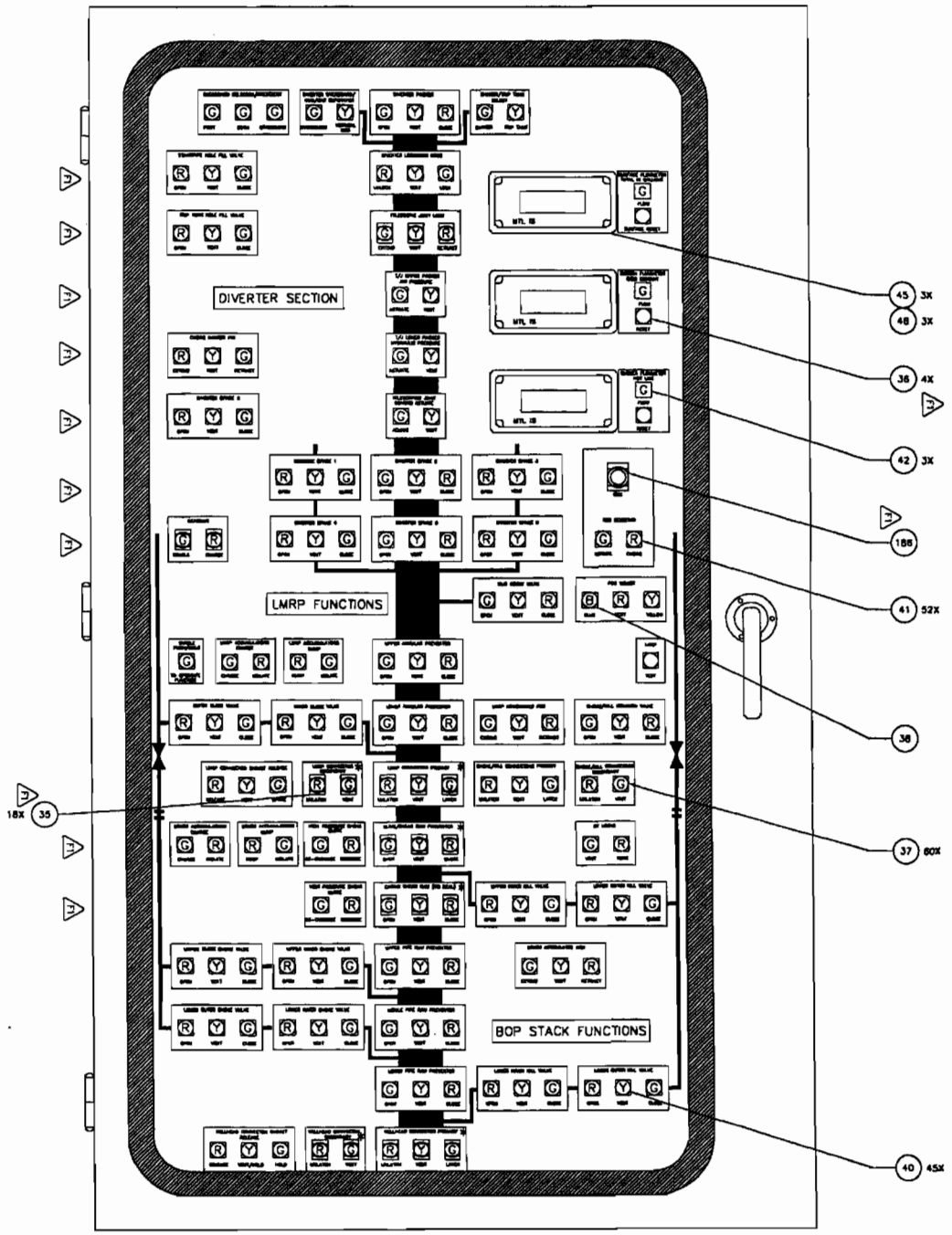
- Up to twenty-one (21) sets of illuminated push buttons complete with nametags for the surface Diverter Control System:
  - Diverter Packer - OPEN / CLOSE
  - Insert Packer Lockdown Dogs - UNLATCH / LATCH
  - Diverter Lockdown Dogs - UNLATCH / LATCH
  - Diverter Support Dogs - UNLATCH / LATCH
  - Support Ring Support Dogs - UNLOCK / LOCK
  - Slip Joint Support Dogs - UNLOCK / LOCK
  - Flowline Seals - PRESSURE / VENT
  - Overboard Selector - STARBOARD / PORT
  - Trip Tank Valve - OPEN / CLOSE
  - Brine Line - OPEN / CLOSE
  - Main Overboard Valve - OPEN / CLOSE
  - Shale Shaker Valve - OPEN / CLOSE
  - Pin Connector - UNLOCK / LOCK
  - Subsea Dump Valves - OPEN / CLOSE
  - Riser Fill Up Valve - OPEN / CLOSE
  - 6 Spare Functions / Push Buttons
- Up to Three (3) sets of push button controls complete with nametags are typically provided for the surface Diverter Control System pressure regulator controls.
  - Slip Joint Upper Packer Pressure – INCREASE / DECREASE
  - Slip Joint Lower Packer Pressure - INCREASE / DECREASE
  - Diverter Packer Pressure - INCREASE / DECREASE

NOTE: The Maximum Set Pressure is typically as follows:

Diverter Packer Pressure	set to max. 70 bar / 1000 psi
Slip Joint Packer Air Pressure	set to max. 10 bar / 145 psi

- Up to Three (3) pressure meter indicating systems complete with nametags are typically provided for the indication of the following pressures:

- Slip Joint Upper Packer Pressure
- Slip Joint Lower Packer Pressure
- Diverter Packer Pressure



LEFT DOOR FRONT VIEW

LEGEND

- = ILLUMINATED PUSHBUTTON WITH LENS COVER
- G = GREEN (ILLUMINATED PUSHBUTTON)
- R = RED (ILLUMINATED PUSHBUTTON)
- Y = YELLOW (ILLUMINATED PUSHBUTTON)
- B = BLUE (ILLUMINATED PUSHBUTTON)
- W = WHITE (ILLUMINATED PUSHBUTTON)
- = BLACK (PUSHBUTTON)
- R = RED (INDICATOR LIGHT ONLY)
- G = GREEN (INDICATOR LIGHT ONLY)
- * = RED BACKGROUND

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"DEEPWATER HORIZON"
P.O.# 08700101

DO NOT SCALE

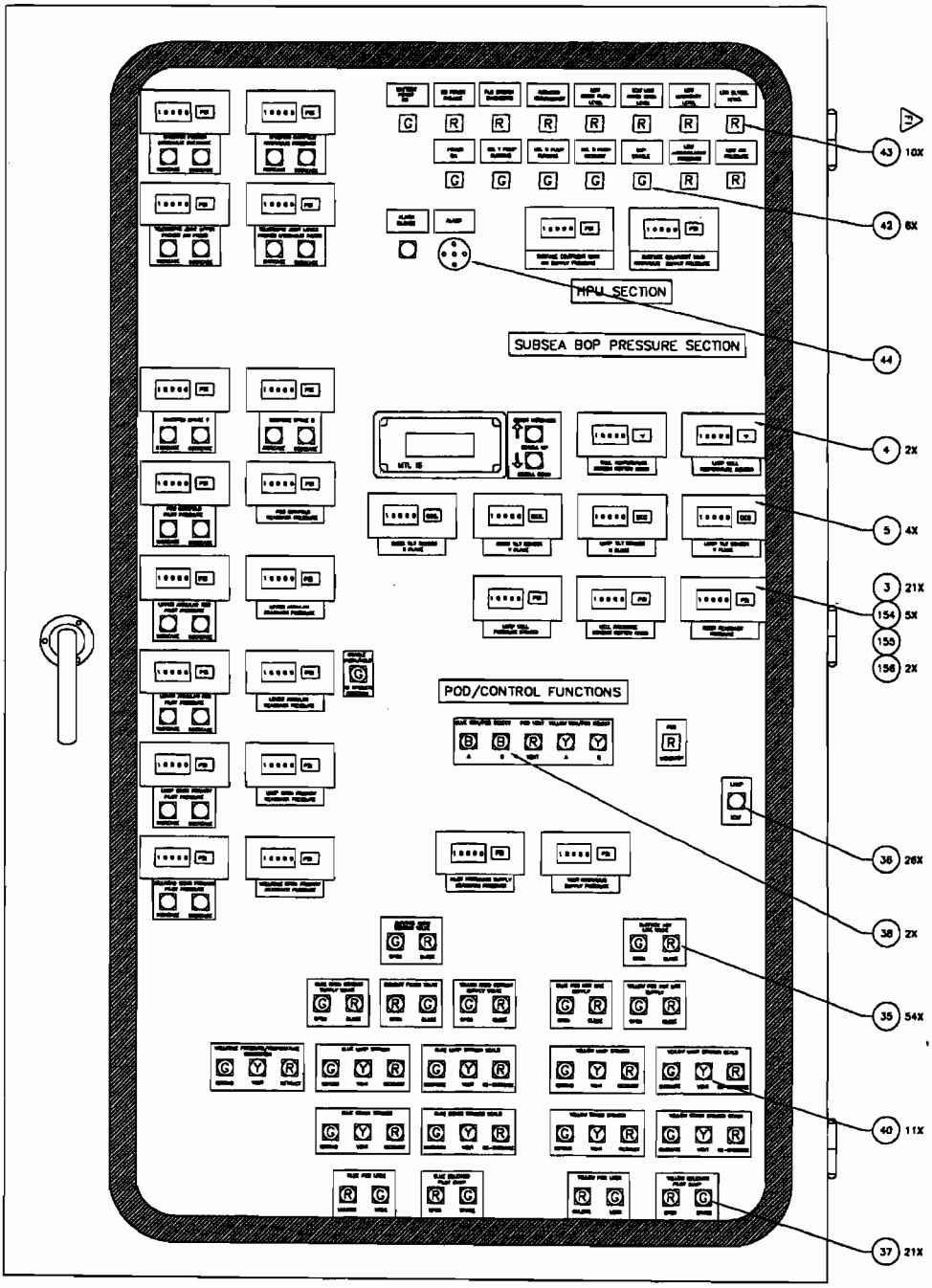
CAMERON CONTROLS

ASSEMBLY DRAWING
DRILLER CONTROL PANEL

20207106-21

SHEET 2 of 11

SK-122105-21-04



RIGHT DOOR FRONT VIEW

LEGEND

- = ILLUMINATED PUSHBUTTON WITH LENS COVER
- G = GREEN (ILLUMINATED PUSHBUTTON)
- R = RED (ILLUMINATED PUSHBUTTON)
- Y = YELLOW (ILLUMINATED PUSHBUTTON)
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R & B FALCON
"DEEPWATER HORIZON"
P.O.# 08700101

DO NOT SCALE

CAMERON CONTROLS

ASSEMBLY DRAWING,
DRILLER CONTROL PANEL

SK-122106-21-04

1.8 TOOLPUSHER'S CONTROL PANEL (TCP)

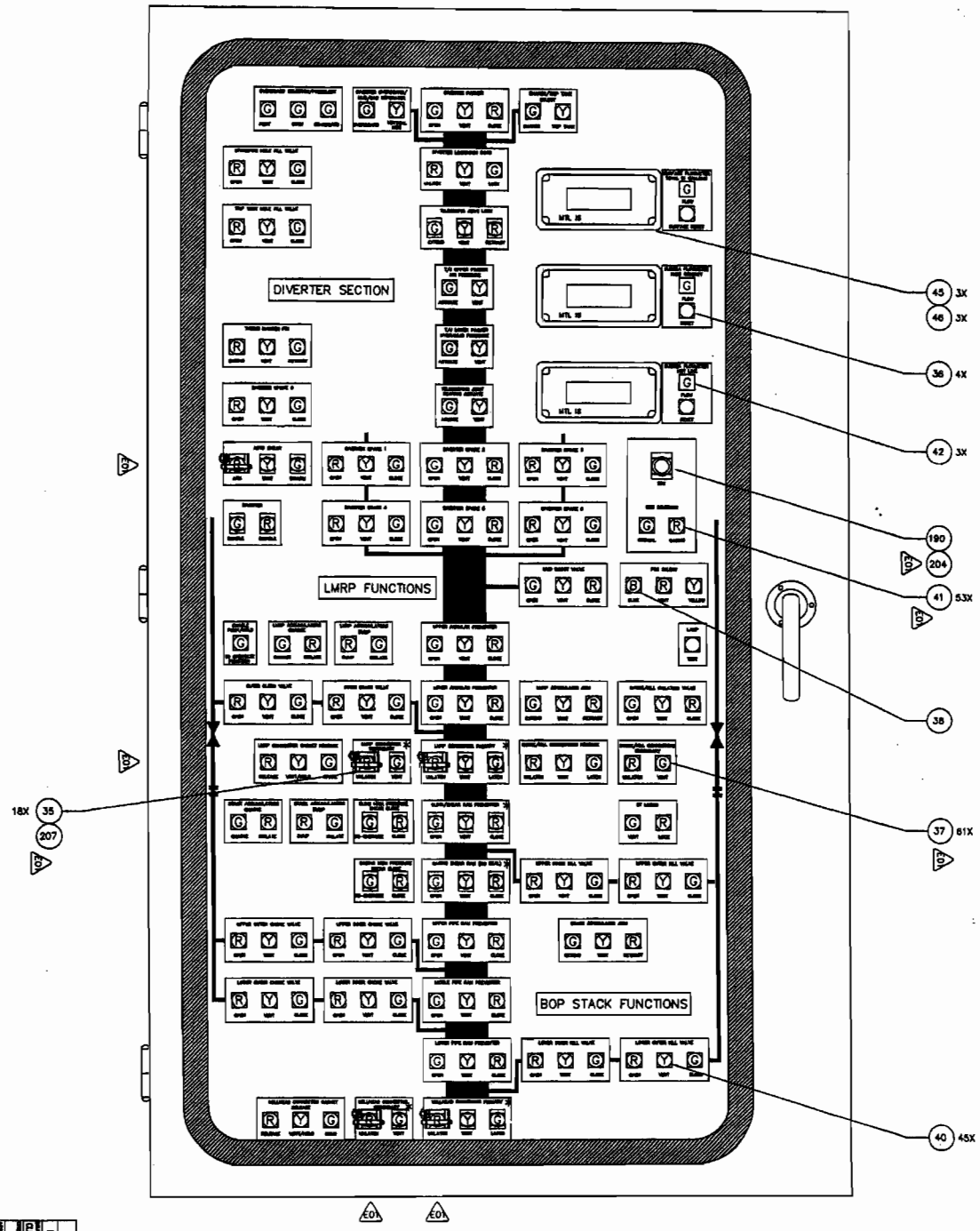
The TCP of a Cameron Multiplex BOP Control System is the second, redundant, control station in the system. Therefore, it is functionally identical to the DCP. The panel is designed for installation in a safe area on the rig and is *not* explosion proof. It is housed in a stainless steel enclosure with hinged doors.

A PLC unit, equipped with redundant Communication controllers, mounted in a 19-inch rack configuration is used to control and monitor all I/O functions (buttons, lamps, meters etc.). The communication between the various I/O- Controller within the DU, TCP and DCP is via a redundant serial bus system (PROFIBUS).

SURFACE INTERCONNECTION

The surface interconnection cable between the various remote panels, the DU and the UPS should be unarmored, oil-resistant, seawater resistant and flame retardant in accordance to IEC 332 or equivalent. Twisted-screened pairs will be used for power and signal transmission between the units.

Each unit should be interconnected with the next unit by two redundant cables each containing buses and power lines. The two cables should be routed on separate ways on the rig to avoid mechanical damage to both cables at the same time.



LEFT DOOR FRONT VIEW

LEGEND

- = ILLUMINATED PUSHBUTTON WITH LENS COVER
- = GREEN (ILLUMINATED PUSHBUTTON)
- = RED (ILLUMINATED PUSHBUTTON)
- = YELLOW (ILLUMINATED PUSHBUTTON)
- = BLUE (ILLUMINATED PUSHBUTTON)
- = WHITE (ILLUMINATED PUSHBUTTON)
- = BLACK (PUSHBUTTON)
- = RED (INDICATOR LIGHT ONLY)
- = GREEN (INDICATOR LIGHT ONLY)
- = RED BACKGROUND

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P.O.# 08700101

CUNT DEMING

DO NOT SCALE

ASSEMBLY DRAWING,
TOOLPUSHER REMOTE
CONTROL PANEL

SK-122107-21-04

2020707-21

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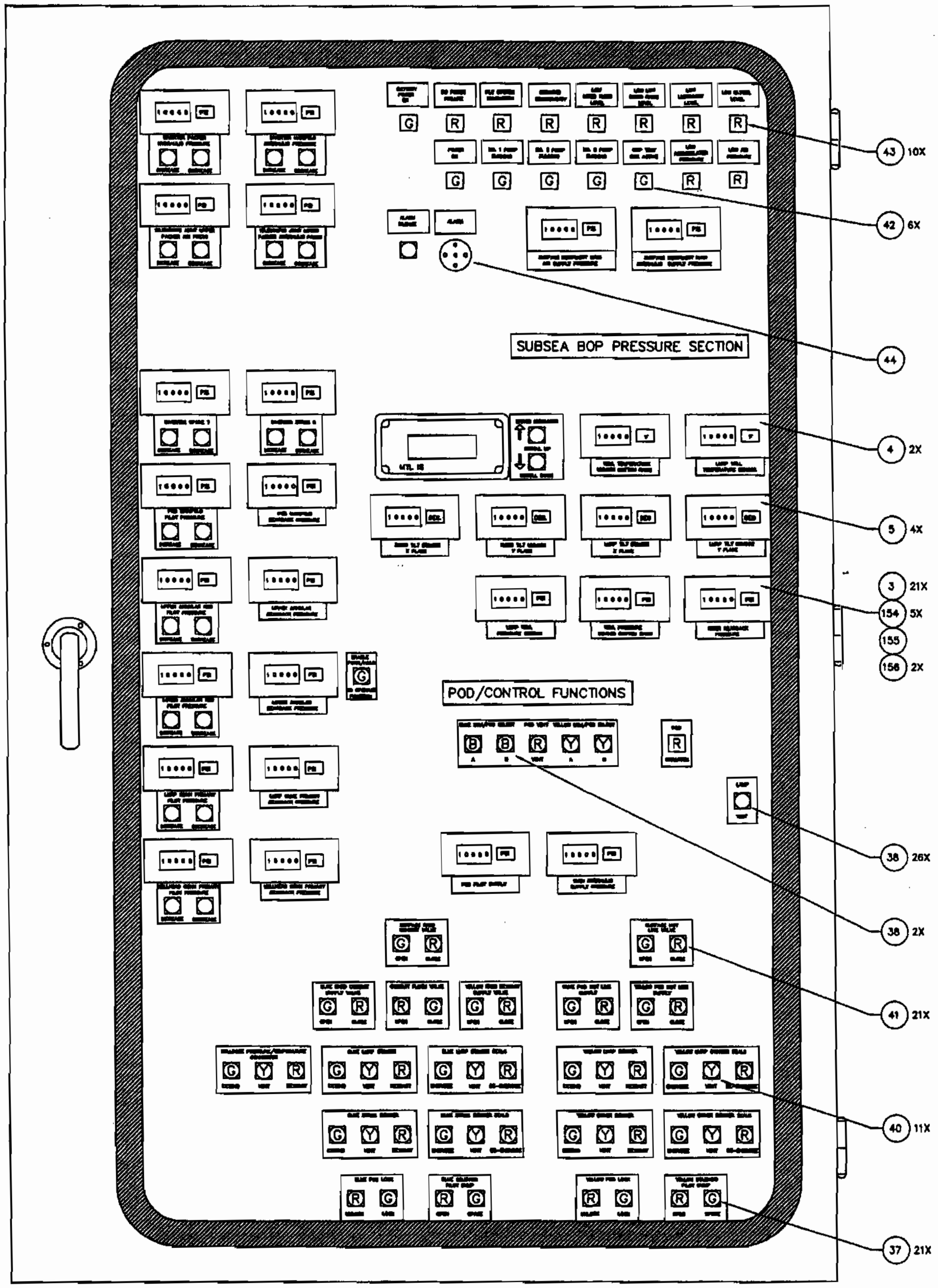


RIGHT DOOR FRONT VIEW

R & B FALCON
"DEEPWATER HORIZON"
P.O.# 08700101

DO NOT SCALE

M. Li 12/03/99

CAMERON CONTROLS

ASSEMBLY DRAWING, TOOLPUSHER REMOTE CONTROL PANEL

2020702-21

SK-122107-21-04

LEGEND

- ▢ = ILLUMINATED PUSHBUTTON WITH LENS COVER
- G = GREEN (ILLUMINATED PUSHBUTTON)
- R = RED (ILLUMINATED PUSHBUTTON)
- Y = YELLOW (ILLUMINATED PUSHBUTTON)
- B = BLUE (ILLUMINATED PUSHBUTTON)
- W = WHITE (ILLUMINATED PUSHBUTTON)
- ▢ = BLACK (PUSHBUTTON)
- R = RED (INDICATOR LIGHT ONLY)
- G = GREEN (INDICATOR LIGHT ONLY)
- * = RED BACKGROUND

1.9 CABLE REELS

Two reels are required for the subsea control electrical cables. The reels are constructed as a compact unit with all components required for operation, mounted on the reel drum and within the reel structure. Air-motor units drive these reels. Pneumatic power has to be provided from the rig air supply with minimum 6 barg (87 psi). A fail-safe, pneumatically controlled automatic brake ("fail-on") will be used to hold and stop the drum rotation. A level wind assembly assists in spooling and un-spooling the cable in uniform layers.

Drum and Stand

The standard cable reels are designed to store, deploy and retrieve 2100-meter (6825 feet) or 3600 meter (11700 feet) lengths of electrical cable. The drum will be designed to have a minimum outside diameter of twice the electrical cable minimum bend radius. Each drum will have an opening to allow the electrical cable to pass inside for termination and connection to the slip ring assemblies. Sufficient reinforcement of the flanges will be provided to contain the electrical cable. Flange edges will be free of sharp edges to prevent cutting into the cable sheath. A shaft is installed within and connected to the drum and flange weldment, and extending outboard for installation in the stand mounted pillow block bearing. The pillow block bearing at one end of the shaft will be suitably protected from the environment.

Electrical power and communication signals are continuously fed to the cables through explosion proof, slip rings assemblies mounted on the reel shaft ends. The slip ring assemblies will be mounted in the center of the reel shafts. The slip ring assembly includes an explosion proof plug for interface to the interconnection cable.

The electrical cable will be an armored umbilical with signal and power lines. It will contain in a typical configuration one twisted screened quad of PE insulated 2.5mm² cores for signal and up to nine PE insulated 2.5mm² cores for power transmission. The cable will be armored with two contra-wounded layers of steel wires. Each single core has been insulation resistance tested prior to cabling into the complete cable. The electrical cable is manufactured per Cameron Spec. X-006950-03 (Houston) and X-006950-01 (Celle).

The subsea end of the cable is equipped with a diver. The Connector is of a field installable design and will be connected to the Control Pod.

The stand structure is designed to support the weight of the drum and the weight of the 2100- meter (6825 feet) or 3600 meter (11700 feet) electrical cable. The design considers forces incurred during transportation of the completed assembly, as well as forces incurred during running operations.

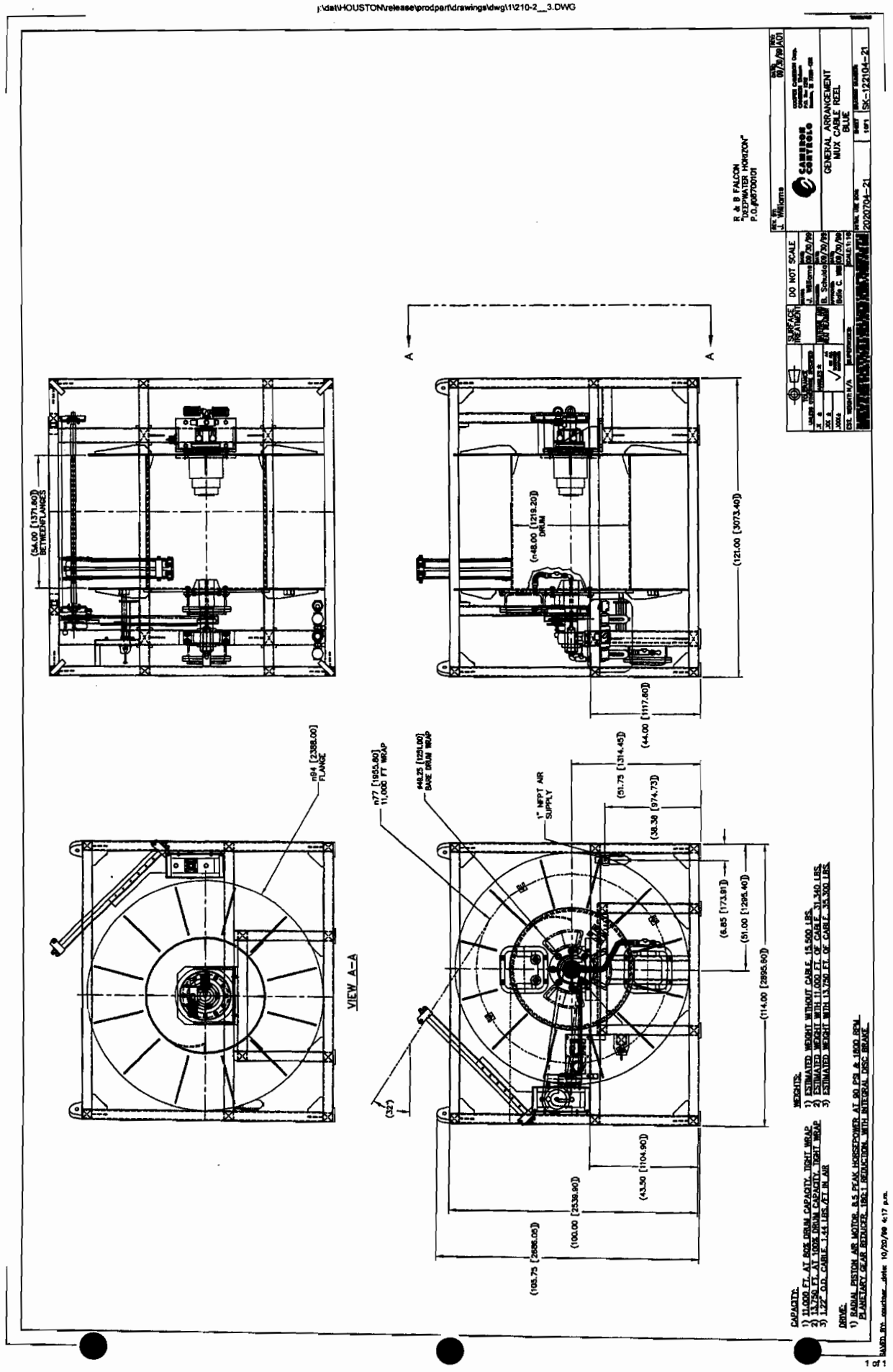
The cable reels consist of two weldments: a drum and a heavy duty steel stand. The parts are constructed of seal-welded St 37-2, DIN 17100 or equivalent carbon steel structural members. All welds are continuous to minimize ingress of salt laden moisture and internal corrosion of the structural steel members. Both weldments are painted in accordance to Cameron approved paint specification.

Pneumatic Motor and Drive System

A shaft mounted pneumatic motor and gearbox unit drives the cable reels. The pneumatic motor as well as the gearbox is sized for operational conditions, sufficient to deploy and retrieve the required cable length and incorporate variable speed controls for:

- Forward
- Reverse
- Stop

The pneumatic power to drive the pneumatic motors must be supplied from the rig air supply. The air conditioning units in the air powered cable reels provide clean and lubricated air for the motors during operation. The maximum speed of the electrical cable is estimated to be 1m/sec. (3,28ft/sec.) Power from the pneumatic motor is transmitted directly to a gearbox to rotate the drum. The cable reel drive is equipped with a brake of the fail-on type for stopping and preventing drum rotation. A mechanical locking pin is provided to prevent reel drum rotation during periods of operation inactivity and transport. The pin will lock the drum in 90° intervals. A manual control valve, spring centered 3 position / two way- type, for the reel operations is permanently installed at the reel drive motor.



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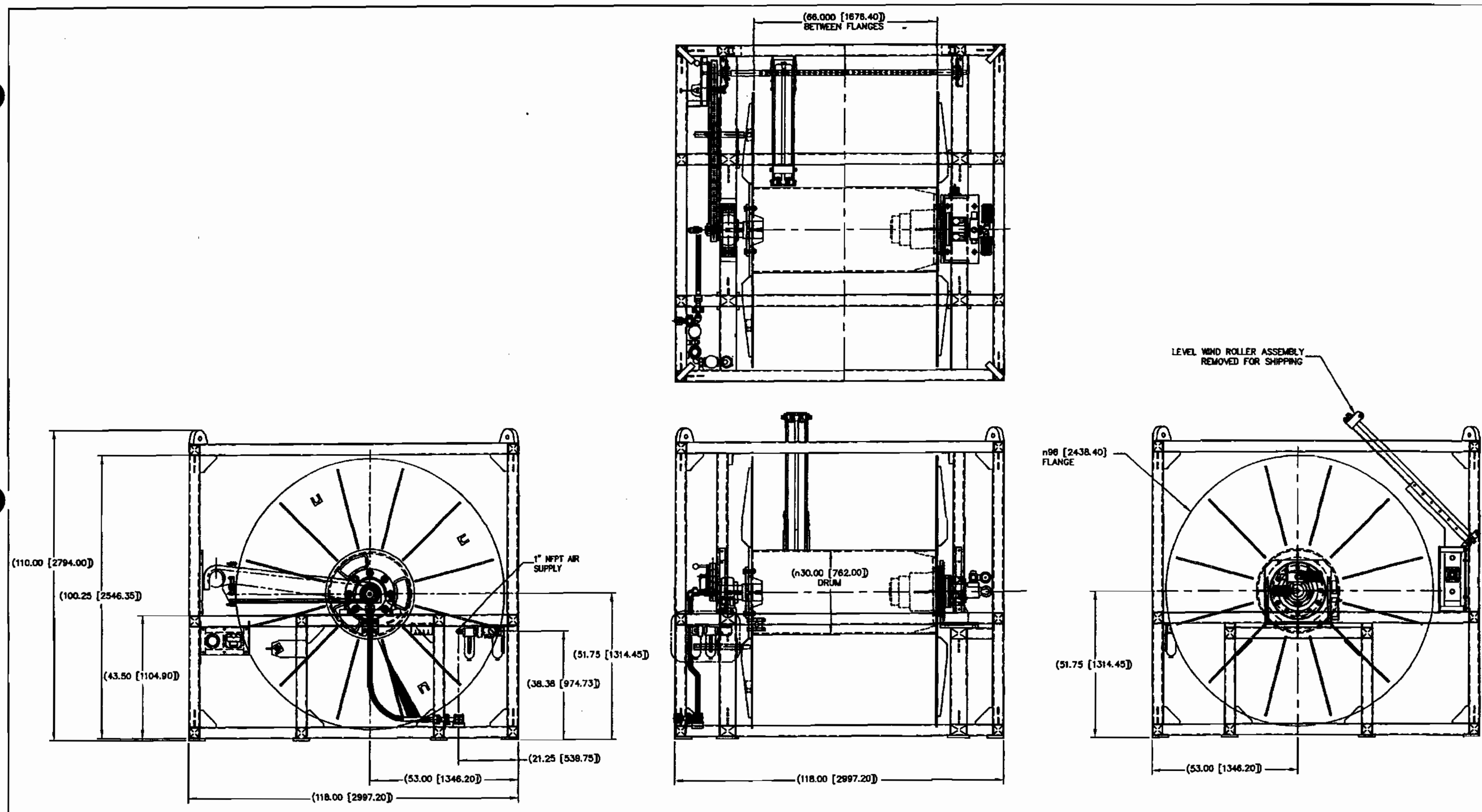

R & B FALCON
"DEEPWATER HORIZON"
P.O.#08700101

CAPACITY:
1) 11,000 FT. AT 80% DRUM CAPACITY, TIGHT WRAP
2) 13,750 FT. AT 100% DRUM CAPACITY, TIGHT WRAP
3) 1.75" O.D. CABLE, 0.83 LBS./FT IN AIR, FILLED WITH WATER

WEIGHTS:
1) ESTIMATED WEIGHT WITHOUT CABLE, 16,550 LBS.
2) ESTIMATED WEIGHT WITH 11,000 FT. OF CABLE, 25,680 LBS.
3) ESTIMATED WEIGHT WITH 13,750 FT. OF CABLE, 27,963 LBS.

DRIVE:
1) RADIAL PISTON AIR MOTOR, 6.5 PEAK HORSEPOWER AT 90 PSI & 1800 RPM
PLANETARY GEAR REDUCER, 180:1 REDUCTION, WITH INTEGRAL DISC BRAKE

TOLERANCE UNLESS OTHERWISE SPECIFIED	SURFACE TREATMENT	DO NOT SCALE	
.X ± / .XX ± / .XXX±	ANGLES ±	J. Williams 09/30/99	
	MATERIAL AND HEAT TREATMENT	B. Schulde 09/30/99	
		Bolle C. Wil 09/30/99	
EST. WEIGHT: N/A	SUPERSEDES:	SCALE: 1:16	

DR. BY: J. Williams — DATE: 09/30/99 — REV: A01

CAMERON CONTROLS — COOPER CAMERON Corp. CAMERON Division

GENERAL ARRANGEMENT
HOT LINE HOSE REEL
BLUE

[redacted]

INITIAL USE AREA: 2020702-21 — SHEET: 1 OF 1 — DRAWING NUMBER: SK-122102-21

SAVED BY: willak date: 9/30/99 11:25 a.m.

1 of 1

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ACCESS
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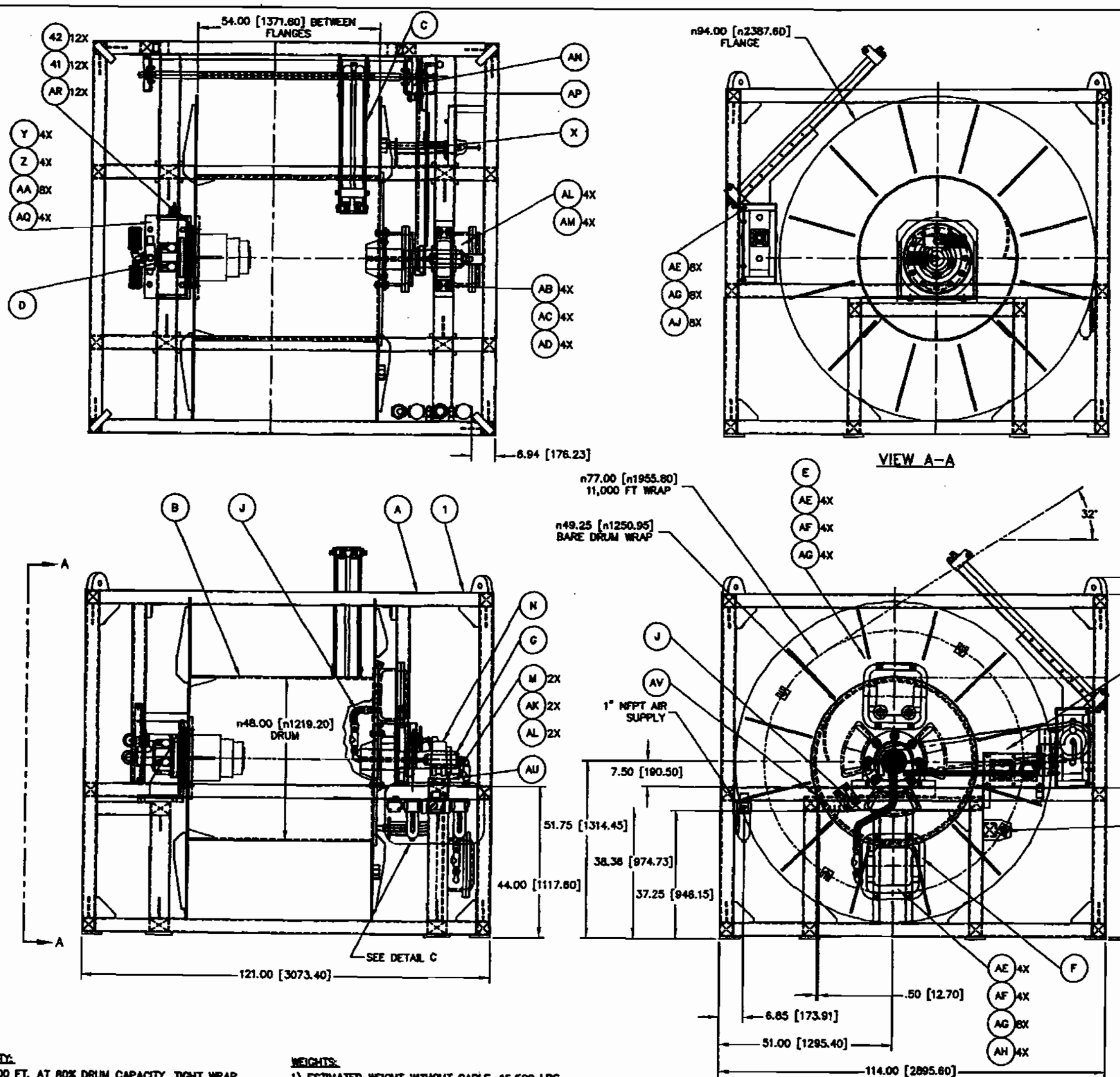
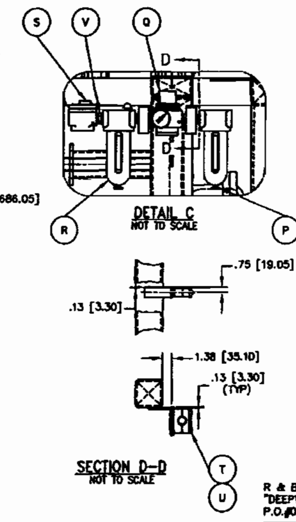




Appen.	ITEM	QTY	DWG No	DESCRIPTION		WT
	A	1	D41670	WELDMENT - FRAME BASE	•	3650
	B	1	D41851	ASSEMBLY - CABLE REEL	•	4778
	C	1	D41863	LEVEL WIND SUBASSEMBLY	•	605
	D	1	D41663	REDUCER/BRAKE/AIR MOTOR & BRACKET SUBASSEMBLY	•	1050
18A	E	1	D41754	REEL MOUNTED ELECTRICAL ENCLOSURE SUBASSEMBLY	•	98
18B	F	1	D41755	FRAME MOUNTED ELECTRICAL ENCLOSURE SUBASSEMBLY	•	98
1	G	1	•	SLIP RING FOCAL TECHNOLOGIES, INC. #180-X, EXPLOSION PROOF, MODEL #SM182	•	15
	H	1	D41655	CONTROL PANEL ASSEMBLY	•	35
	J	1	D41658	ELECTRICAL CONDUIT ASSEMBLY	•	•
	K	1	B41616	BRAKE PIN DETAIL	•	10
	L	1	B41508	DETAIL - BRAKE PIN LATCH ARM	•	1
	M	1	B41617	SLIP RING TORQUE ARRESTOR	•	1
2	N	1	•	PILLOW BLOCK, DODGE #[illegible], #5" SHAFT	•	133
7	P	1	•	AIR FILTER, 1" FNPT, NORGREN #F17-800-A3DA	•	28
8	Q	1	•	AIR REGULATOR, 1" FNPT, NORGREN #R17-800-RGLA	•	35
9	R	1	•	LUBRICATOR, 1" FNPT, NORGREN #L17-800-MPBA	•	28
10	S	1	•	RELAY VALVE, 1" FNPT, WABCO #D-S-P50143	•	3
	T	2	•	PIPE CLAMP, #1" STD., WEHRINGER #51315-PP-COP-STW	•	1
	U	2	•	PIPE NIPPLE, 1" NPT x 4" LG, Sch. 40	•	1
	V	1	•	PIPE NIPPLE, 1" NPT, AEROQUIP #2083-16-16-SST	•	1
12	W	1	B41623	ROLLER CHAIN SPROCKET, #2" BORE, 1/2" SQ. KEYWAY, MARTIN #40B530	•	2
13	X	10'	•	ROLLER CHAIN, RIVETED, REX #40	•	4
	Y	4	•	HEX HEAD CAP SCREW, #1"-8UNC-2A x 4" LG.	18-8 SST	•
	Z	4	•	LOCK WASHER, HELICAL SPRING, #1" NOM.	18-8 SST	•
	AA	8	•	FLAT WASHER, #1" NOM.	18-8 SST	•
	AB	4	•	HEX HEAD CAP SCREW, #7/8"-9UNC-2A x 4-3/4" LG.	18-8 SST	•
	AC	4	•	LOCK WASHER, HELICAL SPRING, #7/8" NOM.	18-8 SST	•
	AD	4	•	FLAT WASHER, #7/8" NOM.	18-8 SST	•
	AE	8	•	HEX HEAD CAP SCREW, #1/2"-13UNC-2A x 2" LG.	18-8 SST	•
	AF	16	•	LOCK WASHER, HELICAL SPRING, #1/2" NOM.	18-8 SST	•
	AG	20	•	FLAT WASHER, #1/2" NOM.	18-8 SST	•
	AH	4	•	HEX NUT, #1/2" NOM.	18-8 SST	•
	AJ	8	•	HEX HEAD CAP SCREW, #1/2"-13UNC-2B x 1 1/4" LG.	18-8 SST	•
	AK	2	•	HEX HEAD CAP SCREW, #1/4"-20UNC-2B x 3/4" LG.	18-8 SST	•
	AL	6	•	LOCK WASHER, HELICAL SPRING, #1/4" NOM.	18-8 SST	•
	AM	4	•	HEX HEAD CAP SCREW, #1/4"-28UNF-2B x 3/4" LG.	18-8 SST	•
	AN	1	B41724	LEVEL WIND CHAIN TENSIONER PLATE	•	2
	AP	1	D41672	WELDMENT - LEVEL WIND CHAIN GUARD	•	52
	AQ	4	•	NUT, HEX, #1" NOM.	18-8 SST	•
	AR	12	•	HEX HEAD CAP SCREW, #5/8-11UNC-2A x 2" LG.	18-8 SST	•
	AS	12	•	LOCK WASHER, HELICAL SPRING, #5/8" NOM.	18-8 SST	•
	AT	12	•	FLAT WASHER, #5/8" NOM.	18-8 SST	•
	AU	1	•	ANGLE DETAIL	•	•
	AV	1	B41530	REMOTE PANEL BULKHEAD CONNECTIONS	•	•

CAPACITY:
1) 11,000 FT. AT 80% DRUM CAPACITY, TIGHT WRAP
2) 13,750 FT. AT 100% DRUM CAPACITY, TIGHT WRAP
3) 1.22" O.D. CABLE, 1.44 LBS./FT IN AIR

WEIGHTS:
1) ESTIMATED WEIGHT WITHOUT CABLE 15,500 LBS.
2) ESTIMATED WEIGHT WITH 11,000 FT. OF CABLE 31,340 LBS.
3) ESTIMATED WEIGHT WITH 13,750 FT. OF CABLE 35,300 LBS.

DRIVE:
1) RADIAL PISTON AIR MOTOR, 8.5 PEAK HORSEPOWER AT 90 PSI & 1800 RPM
PLANETARY GEAR REDUCER, 180:1 REDUCTION, WITH INTEGRAL DISC BRAKE

R & B FALCON
"DEEPWATER HORIZON"
P.O.#08700101

TOLERANCE UNLESS OTHERWISE SPECIFIED: .X ±.1 ANGLES ±.5° .XX ±.03 .XXX ±.015 125/
SURFACE TREATMENT — DO NOT SCALE
DRAWN J. Williams 08/18/99
CHECKED R. Davis 10/14/99
APPROVED P. Chorsan 10/14/99
EST. WEIGHT: N/A — SCALE 1:16
REV. BY J. Williams — DATE 08/18/99 — REV. A01

CAMERON CONTROLS

ASSEMBLY,
MUX CABLE REEL
YELLOW

2020705-21 — SHEET 1 OF 1 — SK-122105-21-04

SAVED BY: courtner date: 10/15/99 8:33 a.m.

1.10 MULTIPLEX MODULAR CONTROL POD

The subsea Multiplex Modular Control Pods are designed in a way that they can be individually retrieved (that is, retrievable without the LMRP), and re-run, for maintenance. The hydraulic portion of a control pod consists of the standard, Cameron, Modular Control Pod. Guide funnels are used when the pods are used in a guideline-drilling situation. If the pods are to be run and retrieved in a guideline-less situation, an ROV or other means, must be used to guide them into alignment with the base-plate on the subsea BOP-Stack. The pods are color-coded blue and yellow for identification.

An extended function control pod (Mark II) is also available for larger BOP Stacks. The Mark II Pod is capable of controlling a six Ram BOP Stack with two Annular Preventers and extends the total number of functions from the maximum of 72 available on the Standard Pod to a maximum of 112 available functions.

The Mark II Pod can also incorporate all the retrievability and testing features of the Standard Cameron Control Pod.

Modular Control Pod

The lower section of the complete subsea Multiplex Modular Control Pod consists of the standard, Cameron, Modular Control Pod.

The pod frame is of heavy duty welded steel construction. The parts are constructed of seal-welded carbon steel immersion coated. All welds are continuous to minimize ingress of salt laden moisture and internal corrosion of the structural steel members. Anodes are also installed to provide additional cathodes protection. The covers are painted in accordance to Cameron approved paint specification for subsea used parts. The pod frame with the main base and the removable covers includes the following main items:

- Up to three (3) 1.1/2" stainless steel piloted regulators, installed for the following typical functions:
  - Annular Regulator - INCREASE / DECREASE (may be 1 or 2 regulators)
  - BOP Manifold Regulator - INCREASE / DECREASE
- Up to Four (4) 1.1/2" stainless steel single piloted 3-way / 2-position slide valves with spring return, installed for the following typical functions:
  - Annular Preventer, Upper - OPEN
  - Annular Preventer, Lower - OPEN
  - Annular Preventer, Upper - CLOSE
  - Annular Preventer, Lower - CLOSE
- Typically, one (1) 3/4" stainless steel double piloted 4-way / 3-position slide valves with spring center or two(2) ¼" SST double piloted 4-way/3-position slide valve spring center.

- Riser Connector – UNLATCH / LATCH

NOTE: Typically, one Annular Preventer is located on the LMRP and another Annular Preventer is in the BOP Stack, however both may be located on the LRP.

- Up to Five (5) 1" stainless steel double piloted 4-way / 3-position slide valves with spring centered, installed for the following typical functions:

  - Shear Ram Preventer - OPEN / CLOSE
  - Upper Pipe Ram Preventer - OPEN / CLOSE
  - Middle Pipe Ram Preventer - OPEN / CLOSE
  - Lower Pipe Ram Preventer - OPEN / CLOSE
  - Casing Shear Ram – OPEN / CLOSE

- Up to Ten (10) 1/4" stainless steel double piloted 4-way / 3-position slide valves with spring center, installed for the following typical functions on the stack section of the subsea pods:

  - Acoustic Accumulator - SUPPLY / DUMP
  - Acoustic Arms - UP / DOWN
  - Wellhead Connector – UNLATCH / LATCH
  - Wellhead Connector Secondary – UNLATCH / LATCH
  - Stack Accumulator – CHARGE / ISOLATION
  - Stack Stinger – RETRACT / EXTEND
  - Stack Stinger Seals – ENGERGIZE / DEENERGIZE
  - Choke / Kill Isolation Valve – OPEN / CLOSE
  - Choke / Kill Line Connector – UNLATCH / LATCH
  - Booster Line Test Valve – OPEN / CLOSE

- Up to Eighteen (18) 1/4" stainless steel single piloted 3-way / 2-position slide valves with spring return, installed for the following typical functions on the LMRP section of the subsea pods:

  - Riser Connector Secondary – UNLATCH / LATCH
  - Pod Select Function – BLUE / YELLOW
  - Upper Outer Kill Valve - OPEN / CLOSE
  - Upper Inner Kill Valve - OPEN / CLOSE
  - Lower Outer Kill Valve - OPEN / CLOSE
  - Lower Inner Kill Valve - OPEN / CLOSE
  - Lower Outer Choke Valve - OPEN / CLOSE
  - Lower Inner Choke Valve - OPEN / CLOSE
  - Upper Outer Choke Valve - OPEN / CLOSE
  - Upper Inner Choke Valve - OPEN / CLOSE
  - Shear Ram Lock – OPEN / CLOSE
  - Upper Pipe Ram Lock – OPEN / CLOSE
  - Middle Pipe Ram Lock – OPEN / CLOSE

- Lower Pipe Ram Lock - OPEN / CLOSE
- Inner Gas Bleed Valve - OPEN / CLOSE
- Outer Gas Bleed Valve - OPEN / CLOSE
- Spare Valve I – OPEN / CLOSE
- Spare Valve II – OPEN / CLOSE

- Typically, one (1) 1/4" stainless steel single piloted 3-way / 2-position slide valve with spring return for the Modular Control Pod open supply and bleed function as well as for a the test function.

  The 1/4" stainless steel single piloted 3-way / 2-position slide valve with spring return mentioned above is installed inside the Modular Control Pod supply line in such a way that this line is vented whenever the other pod has been selected. The 3-way / 2-position slide valve is piloted to "CLOSE" position by the Pod Select pilot line for the Multiplex Modular Control Pod. This valve is necessary to vent the "unselected" Multiplex Modular Control Pod supply line to ensure that the shuttle valves on the LRP functions and on the BOP-Stack functions can shift properly. [In addition to this, the valve is used to ensure the testing possibility for the unselected Multiplex Modular Control Pod while the selected Pod is still operational. In this mode the valve is piloted to "CLOSE" position commanded by the PETU, that needs to be connected to the surface installed SSECP or the DU The active Multiplex Modular Control Pod will be controlled via the surface installed OIM CP during this period of time.

All valves and pressure regulators are designed for easy access and replacement. All normal maintenance processes are done without disturbing any hydraulic hose or tubing fittings.

All valves and regulators are constructed of stainless steel and other corrosion resistant materials. The pilot ports of all valves are equipped with purge fittings so that air and stagnant fluid can be flushed without disconnecting tubing or hoses.

Following direct hydraulic function lines from the Solenoid Valve Package can be connected to items that are installed inside the lower section of the complete subsea Multiplex Modular Control Pod or will run through it (the following are typical of what can be done)

Run Through:

- Yellow Conduit Isolation Valve - CLOSE
- Blue Conduit Isolation Valve - OPEN
- Yellow Conduit Isolation Valve - OPEN
- Blue Conduit Isolation Valve - CLOSE
- Pod Select Function - OPEN
- Conduit Flush Function - FLUSH
- Solenoid Valve Supply Function
- Solenoid Valve Supply Pilot Function - OPEN
- LRP Accumulator Isolation - OPEN / CLOSE
- Acoustic System - ISOLATION
- Acoustic System - RESET
- Orientation Pin - EXTEND
- Orientation Pin - RETRACT

- Spare(s) (depending on the system configuration)

Internal Function:

- Annular Regulator - INCREASE / DECREASE (for 1 or 2 regulators)
- Annular Regulator Pilot Pressure (for 1 or 2 regulators)
- Annular Readback Pressure (for 1 or 2 regulators)
- BOP-Manifold Regulator - INCREASE / DECREASE
- BOP-Manifold Regulator Pilot Pressure
- BOP-Manifold Readback Pressure
- LRP Accumulator Readback Pressure
- Stack Stinger - EXTEND / RETRACT
- Stack Stinger Seals - ENERGIZE / DEENERGIZE
- Riser Stinger - EXTEND / RETRACT
- Riser Stinger Seals - ENERGIZE / DEENERGIZE
- Pod Lock - LOCK / UNLOCK
- Main Return (used only on Close Loop Systems)

All hydraulic supply and outlet connections are made through two, pressure-balanced, male, multi-port connectors extending from the bottom of the pod. One is for all of the BOP-Stack functions (riser stingers), and the other is for the Lower Riser Package (LRP) functions and accumulator supply connection. The two connectors may be independently extended and retracted. The connectors are typically retracted during pod installation, retrieval and pod leak testing. The primary reason for retracting these connectors is to protect them from damage during running and retrieval operations. The individual port seals on the male stabs are easily replaced and are extremely durable; they can be successfully disconnected under full pressure without damage.

NOTE: Pod leak testing can be accomplished subsea without having to retrieve the Control Pod to the surface by retracting the stinger into the test ring, which is internal to the pod. [These tests can be performed without making the BOP-Stack function and while the other Multiplex Modular Control Pod completely controls the BOP-Stack.

On close loop systems, an included configuration of the valves and pressure regulators is the installation of a fluid recovery manifold, which returns all exhausted hydraulic fluid to the surface through one of the two hydraulic conduits on the riser. This closed loop system configuration has several benefits, including:

- Conservation of potable water
- Conservation of water lubricant and ethylene glycol
- Pollution of seawater is eliminated
- Higher lubricant concentrations are possible to improve the hydraulic fluid properties
- Improved valve reliability by elimination of seawater entry into subsea valves

The closed loop system also has a disadvantage that of a slower response time to close the rams (due to the return of fluid to the surface).

Multiplex Package

The Multiplex Package will be installed on top of the Modular Control Pod. Each Multiplex Package typically consists of the following main items:

- Typically, one (1) mounting frame of heavy duty welded steel construction constructed of immersion coated carbon steel (standard control pod) or 316 stainless steel (Mark II control pod).
- The MUX Package carries all the solenoid valves needed for the pod functions. There are mounting plates assemblies which carry up to 8 or up to16 solenoid valves
- Typically, one (1) 1/2" stainless steel inlet high pressure filter for the solenoid valve supply fluid including one (1) 1/4" stainless steel check valve, ensuring subsea fluid storage for the solenoid valve supply function.
- Typically, one (1) 1/2" stainless steel manual adjustable hydraulic regulator for the solenoid valve supply pressure. (The Regulator is connected to the main accumulator supply at the inlet and can produce a 3000 psi pressure at the outlet for the pilot lines:
- Regulators pilot lines are provided with 1-liter (1 quart) bladder accumulators.
- The MUX package is provided with 1 bladder accumulator on the pilot fluid supply line.
- Typically, one (1) multiplex pressure vessel suitable for 3500-meter (11550 feet) water depth.
- Typically, one (1) subsea transducer module suitable for 3500 meter (11550 feet) water depth including mounting possibilities for up to ten (10) system transducers and one (1) inclinometer. The transducer vessel also includes the batteries for when the deadman system sequence is requested.
- Typically, one (1) jumper cable for electrical connection from a subsea transducer module to the Multiplex pressure vessel.
- Retrievable Pods, one (1) jumper cable for electrical connection from the Multiplex pressure vessel to the Base Plate of the Multiplex Modular Control Pod.

The mounting frame is constructed of seal-welded stainless steel 316 structural members for the Mark II control pod and painted carbon steel for the standard control pod. All welds are continuous to minimize ingress of salt laden moisture and internal corrosion of the structural steel members. The mounting frame will include a top plate with single lift point and removable covers. All the components like solenoid valve mounting assemblies, jumper cables, multiplex pressure vessel and accumulators are mounted within the frame structure. For the standard control pod, a hydraulic stab plate assembly, which fits onto the stab plate of the lower Modular Control Pod is located in the lower section of the mounting frame. The plate contains a quantity of up to eighty-six (86) male plate mounted, self-sealing, stainless steel, hydraulic couplers:

The plate is fabricated from type AISI stainless steel or equivalent.

The male plate can include popped type hydraulic couplers with elastomeric seals (as per customer request). The couplers are typically manufactured from type AISI 316 stainless steel. They are designed to ensure that all lines are sealed after disconnection. The maximum working pressure for the installed hydraulic couplers is 345 barg (5000 psig) for all functions. The sealing materials are compatible with the control fluid.

During the installation of a retrievable pod, the first contact with the Modular Control Pod stab plate a central locking pin holds the stab plate in position. A second pin (smaller diameter) orientates the stab plates during connecting operation. Spacers are used to ensure correct distance between both stab plate assemblies. Hex head screws provided from the frame mounted stab plate secure both stab plate assemblies in position after make up. Screws are fabricated from type AISI stainless steel or equivalent

The solenoid valve mounting assemblies contains all the necessary solenoid valves and the electrical connectors for the complete system functions. The solenoid valves are sub-plate mounted and equipped with electrical jumpers having a penetrator on the solenoid side and an underwater mateable connector at the jumper end. The electrical connectors are connected directly to the multiplex subsea pressure vessel (SEM) housing assembly. The solenoid valve mounting plate and the multiplex subsea pressure vessel housing assembly are fabricated from type AISI stainless steel or equivalent. No special instructions during installation or removal of the solenoid valves need to be followed. The multiplex subsea pressure vessel housing assembly together with the electrical connectors assures maximum reliability and isolation of the valve electrical connections from the seawater. The valves are of a low power design using only 8 watts. The hydraulic section of the valves incorporates sliding, metal-to-metal, shear type seals. The valves are manufactured from stainless steel and other corrosion resistant materials. Magnetic circuit materials are special steels, which are electroless nickel-plated and externally sheathed with stainless steel housing components.

- Up to ten (10) Pressure Transducers are installed inside the subsea transducer module for the following subsea pressure read-back functions:

  - Upper Annular Regulator Pilot Pressure
  - Upper Annular Readback Pressure
  - Lower Annular Regulator Pilot Pressure
  - Lower Annular Readback Pressure
  - BOP-Manifold Regulator Pilot Pressure
  - BOP-Manifold Readback Pressure
  - Subsea LRP Accumulator Readback Pressure
  - Solenoid Valve Supply Readback Pressure
  - Hydrostatic Head Pressure
    Internal Housing Pressure

- Up to seventy-two (72) solenoid valves are installed on different solenoid valve mounting assemblies for the following typical subsea valve pilot functions:

  - Upper Annular Preventer - OPEN
  - Upper Annular Preventer - CLOSE
  - Riser Connector - UNLATCH
  - Riser Connector - LATCH
  - Riser Connector Secondary - UNLATCH
  - LMRP Connector Gasket Release - RELEASE
  - Booster Line Test Valve – OPEN
  - Booster Line Test Valve – CLOSE
  - Choke/Kill Isolation Valve - OPEN
  - Choke/Kill Isolation Valve – CLOSE
  - Choke/Kill Line Connector - UNLATCH
  - Choke/Kill Line Connector - LATCH
  - Outer Gas Bleed Valve - OPEN
  - Inner Gas Bleed Valve – OPEN
  - Lower Annular Preventer – OPEN

- Lower Annular Preventer – CLOSE
- E-Connector – EXTNED
- E-Connector – RETRACT
- Casing Shear Ram Preventer – OPEN
- Casing Shear Ram Preventer – CLOSE
- High Pressure Casing Shear – CLOSE
- Shear Ram Preventer – OPEN
- Shear Ram Preventer – CLOSE
- Shear Ram Preventer Lock – CLOSE
- High Pressure Shear Function – CLOSE
- Upper Pipe Ram Preventer – OPEN
- Upper Pipe Ram Preventer – CLOSE
- Upper Pipe Ram Preventer Lock - CLOSE
- Middle Pipe Ram Preventer – OPEN
- Middle Pipe Ram Preventer – CLOSE
- Middle Pipe Ram Preventer Lock – CLOSE
- Lower Pipe Ram Preventer – OPEN
- Lower Pipe Ram Preventer – CLOSE
- Lower Pipe Ram Preventer Lock – CLOSE
- Upper Outer Kill Valve – OPEN
- Upper Inner Kill Valve – OPEN
- Lower Outer Kill Valve – OPEN
- Lower Inner Kill Valve – OPEN
- Lower Outer Choke Valve – OPEN
- Lower Inner Choke Valve – OPEN
- Upper Outer Choke Valve – OPEN
- Upper Inner Choke Valve – OPEN
- Orientation Pin – EXTEND
- Orientation Pin – RETRACT
- Stack Accumulator – CHARGE
- Stack Accumulator – DUMP
- Stack Accumulator – ISOLATION
- LMRP Accumulator Isolation – OPEN
- Wellhead Connector – UNLATCH
- Wellhead Connector – LATCH
- Wellhead Connector Secondary – UNLATCH
- Wellhead Connector Secondary – LATCH
- BOP Connector Gasket Release – RELEASE
- Pod Select Function – OPEN
- Conduit Flush Function – FLUSH
- Solenoid Valve Supply Pilot Function – OPEN
- Stack Stinger – EXTEND
- Stack Stinger – RETRACT
- Stack Stinger Seals – ENERGIZE
- Stack Stinger Seals – DEENERGIZE
- Riser Stinger – EXTEND

- Riser Stinger – RETRACT
- Riser Stinger Seals – ENERGIZE
- Riser Stinger Seals – DEENERGIZE
- Upper Annular Regulator – INCREASE
- Upper Annular Regulator – DECREASE
- Lower Annular Regulator – INCREASE
- Lower Annular Regulator – DECREASE
- BOP Manifold Regulator – INCREASE
- BOP Manifold Regulator – DECREASE
- Pod Lock - LOCK
- Spare Valve I - OPEN
- Spare Valve II - OPEN

Accumulator banks are installed to provide pilot pressures for the three (3) or two (2), pod pressure regulators (two or one Annular Preventers and the BOP-Manifold Regulator). Each accumulator pilot line contains three (3) or four (4) small accumulators. All these accumulators are installed inside the frame of the Multiplex Package. The precharge pressure for each accumulator is different, in a series of increasing pressures. The pressures are specified as a function of water depth. The staggered precharge pressures ensure that the charge pressure of the bank can be easily controlled throughout the required setting range by "feeding" and "bleeding" pressure with short pulses of the controlling solenoid valves. If only a single, small, pilot accumulator is used, the pressure changes too rapidly in the higher range to be controlled by the solenoid valves.

- Six (6) or Four (4) Solenoid Valves are installed on different solenoid valve mounting assemblies for the following subsea regulator pilot functions:

  - Upper Annular Regulator - INCREASE
  - Upper Annular Regulator - DECREASE
  - Lower Annular Regulator - INCREASE
  - Lower Annular Regulator - DECREASE
  - BOP-Manifold Regulator - INCREASE
  - BOP-Manifold Regulator - DECREASE

Remote control of the valves in the Modular Control Pod is accomplished with the redundant subsea electronic module that is installed in a vessel, which is fitted on top of the hydraulic pod. It communicates via modem with one of the Communication Controllers in the surface electronic system. Dual electronics are used to provide full subsea redundancy in each control pod, including redundant coils in the solenoid valves. Redundant control wiring is provided in the control cable and the surface Communication Controller has redundant modems. A complete loss of one electronic system will not cause a system shutdown. This configuration gives the electronic system a high degree of reliability and availability.

The electronic units, power supplies and the power conditioning equipment is located in a cylindrical pressure vessel mounted inside the structure of the Multiplex Package. The interior of the vessel is purged with dry nitrogen. This ensures a humidity-free, inert environment for the electronics equipment. The main electrical supply connection is made with a diverless, underwater mateable, pin connector located in the base plate of the Modular Control Pod. All the other subsea electrical connections are made at the surface using subsea environmental connectors. Connections are required for the control cables, the solenoid valves and the subsea

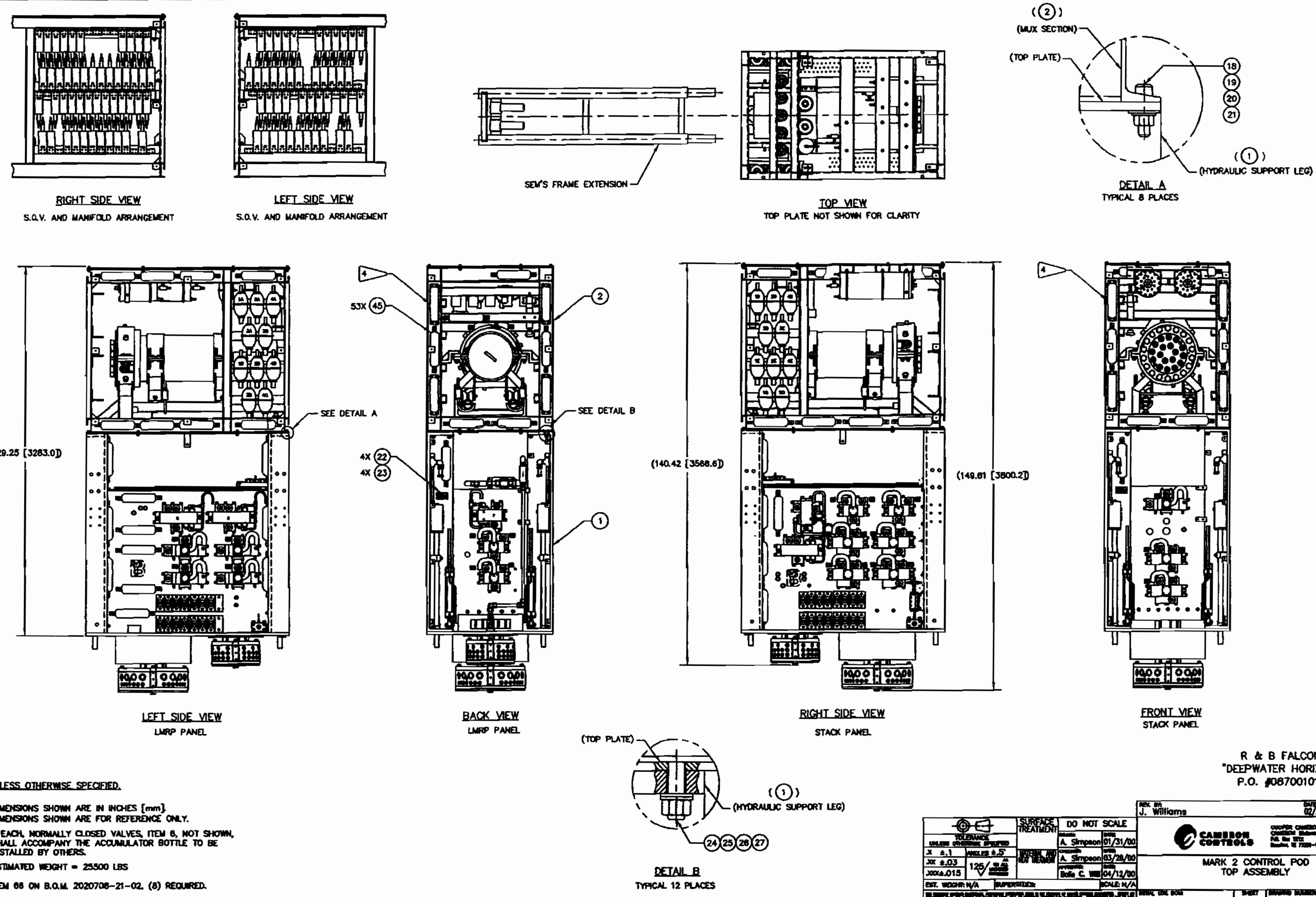
transmitter module. The solenoid driver units continuously monitor the status of all of the solenoid valve coils, whether energized or de-energized. The circuitry determines if each coil is normal, shorted, open circuit, energized or de-energized. Any coil, which is shorted or open-circuit, initiates an alarm at the surface control panels.

The hydraulic piloting connections between the Multiplex Package and the Modular Control Pod are made through the standard hydraulic stab plate located in the top plate of the Modular Control Pod. Using this interface, the Multiplex Package can be removed from the Modular Control Pod for easier access in maintenance situations.

The hydraulic filtration system for the solenoid valve supply fluid contains one (1) single, downstream, in-line filtration unit with a 20-micron (β rates= 200) filter element, rated at the specific system hydraulic working pressure. The filter incorporates a hydraulic bypass check valve, which operates when the differential pressure across the filter element is excessive, but not sufficient to collapse the filter element.

One (1) 10 liter (2.6 gallon) gross capacity 345 bar (5000 psi) WP hydro-pneumatic accumulator, designed according to BS 7201, BS 5045 Part 1 or ASME Section VIII, for the solenoid valve supply pressure is installed inside the frame structure of the Multiplex Package. The accumulator stores the fluid required to operate some of the valve functions, prior to when, or after disconnection, when the complete Multiplex Modular Control Pod is not connected to the main fluid supply system nor to a hot line or an LMRP mounted fluid supply. This happens, when it is intended to individually retrieve or install a Multiplex Modular Control Pod prior to or after surface maintenance. Charging of this accumulator prior to any reinstallation of the Pod after surface maintenance is extremely important and an additional warning tag on the Multiplex Package cover panel near the charging needle valve should be installed.

The accumulator is made of carbon steel and will be painted in accordance to Cameron approved paint specification for subsea used parts.



R & B FALCON
"DEEPWATER HORIZON"
P.O. #067001011

NOTES: UNLESS OTHERWISE SPECIFIED.

1. DIMENSIONS SHOWN ARE IN INCHES [mm]. DIMENSIONS SHOWN ARE FOR REFERENCE ONLY.
2. 1 EACH, NORMALLY CLOSED VALVES, ITEM 6, NOT SHOWN, SHALL ACCOMPANY THE ACCUMULATOR BOTTLE TO BE INSTALLED BY OTHERS.
3. ESTIMATED WEIGHT = 25500 LBS
4. ITEM 66 ON B.O.M. 2020708-21-02, (8) REQUIRED.

TOLERANCE UNLESS OTHERWISE SPECIFIED	SURFACE TREATMENT	DO NOT SCALE	
.X ±.1 ANGLES ±.5°		A. Simpson	01/31/00
.XX ±.03 125	MATERIAL AND HEAT TREATMENT	A. Simpson	03/28/00
.XXX±.015		Bolle C.	04/12/00
EST. WEIGHT: N/A	SUPERSEDES:	SCALE: N/A	

REV. BY: J. Williams — DATE: 02/28/00 — REV: A01

CAMERON CONTROLS — COOPER CAMERON Corp.

MARK 2 CONTROL POD
TOP ASSEMBLY

2020708-21 — SHEET 1 of 2 — DRAWING NUMBER: SK-122108-21-04

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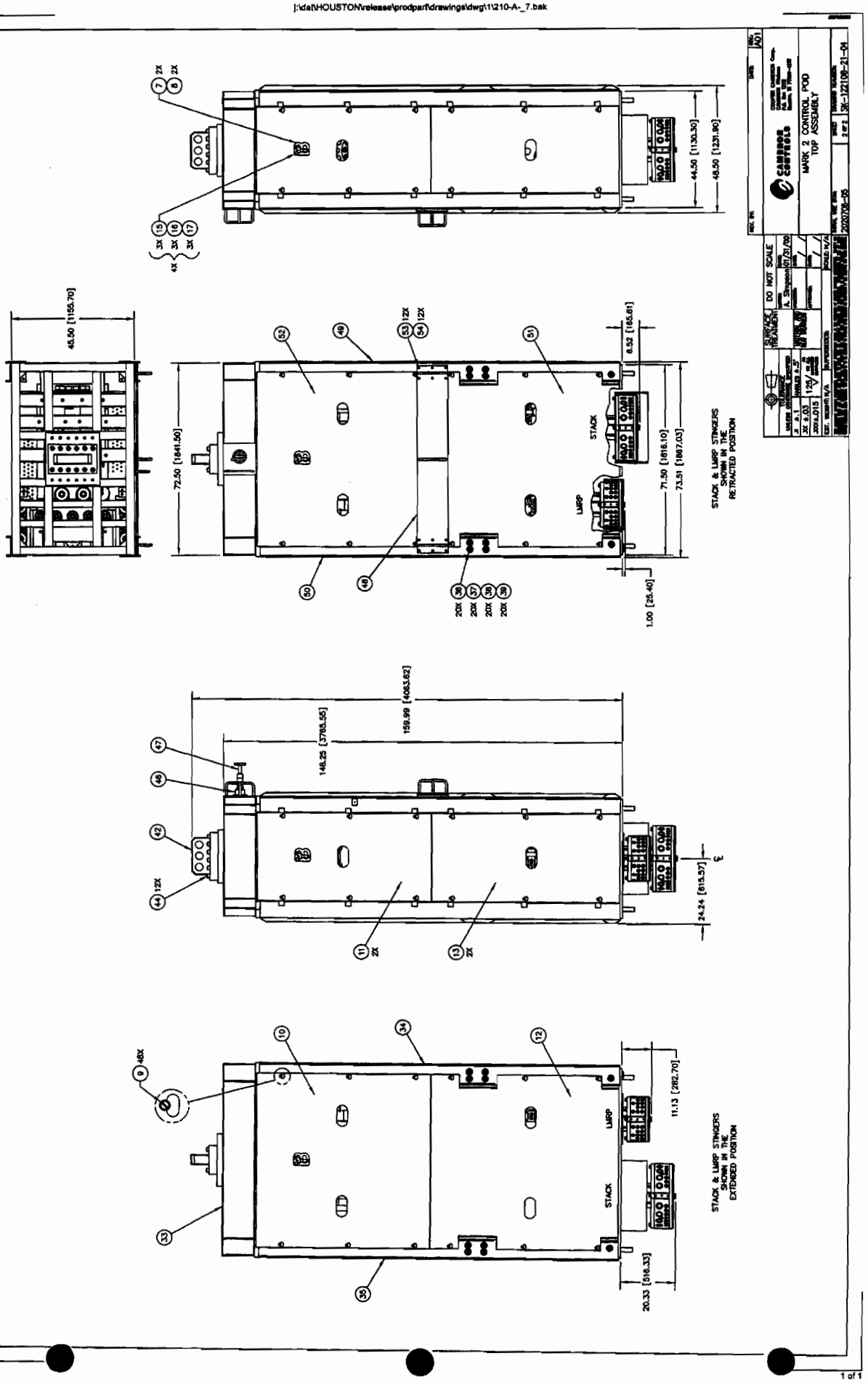
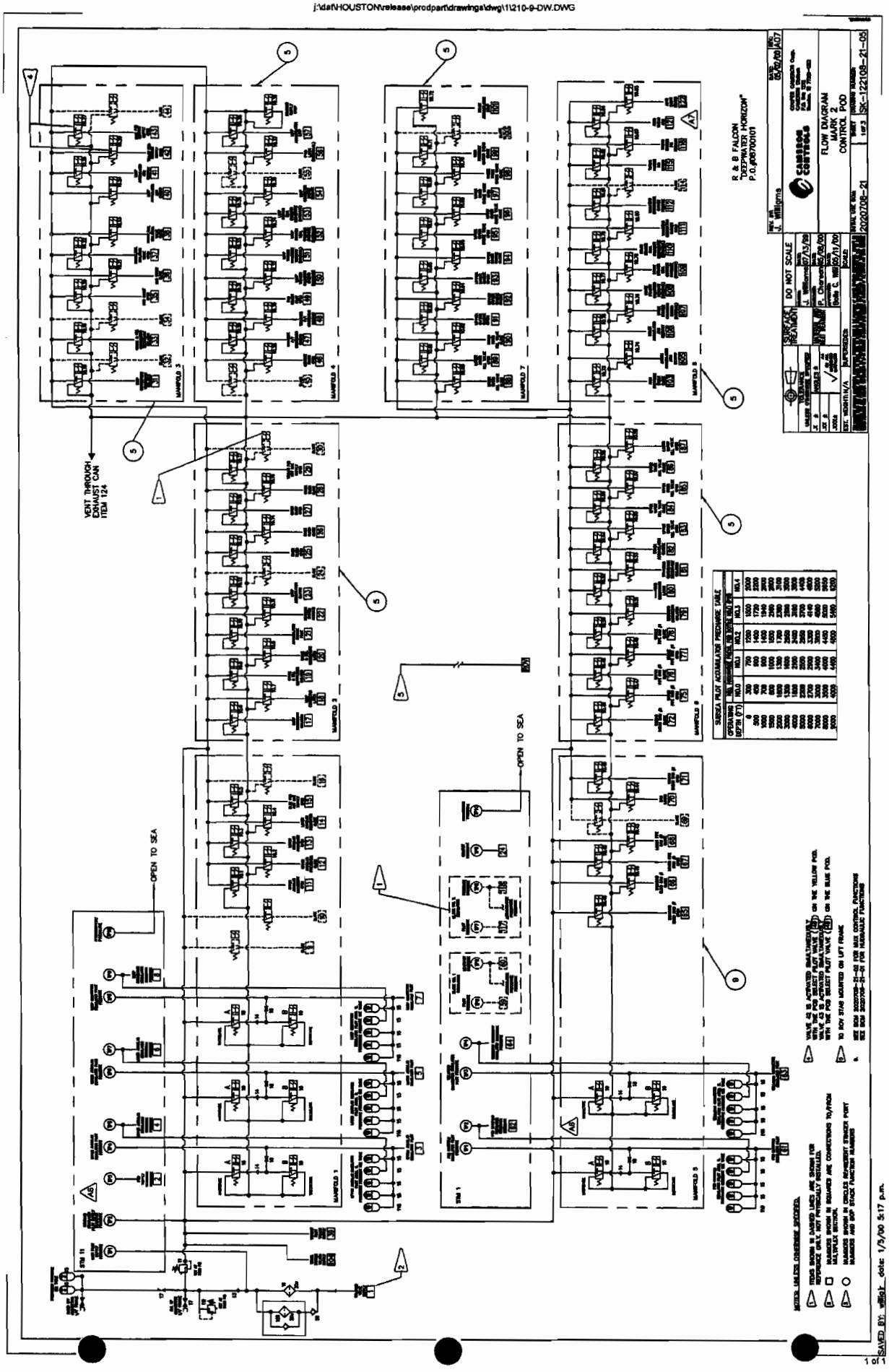


1 of 1



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ACCESS
RESTRICTED

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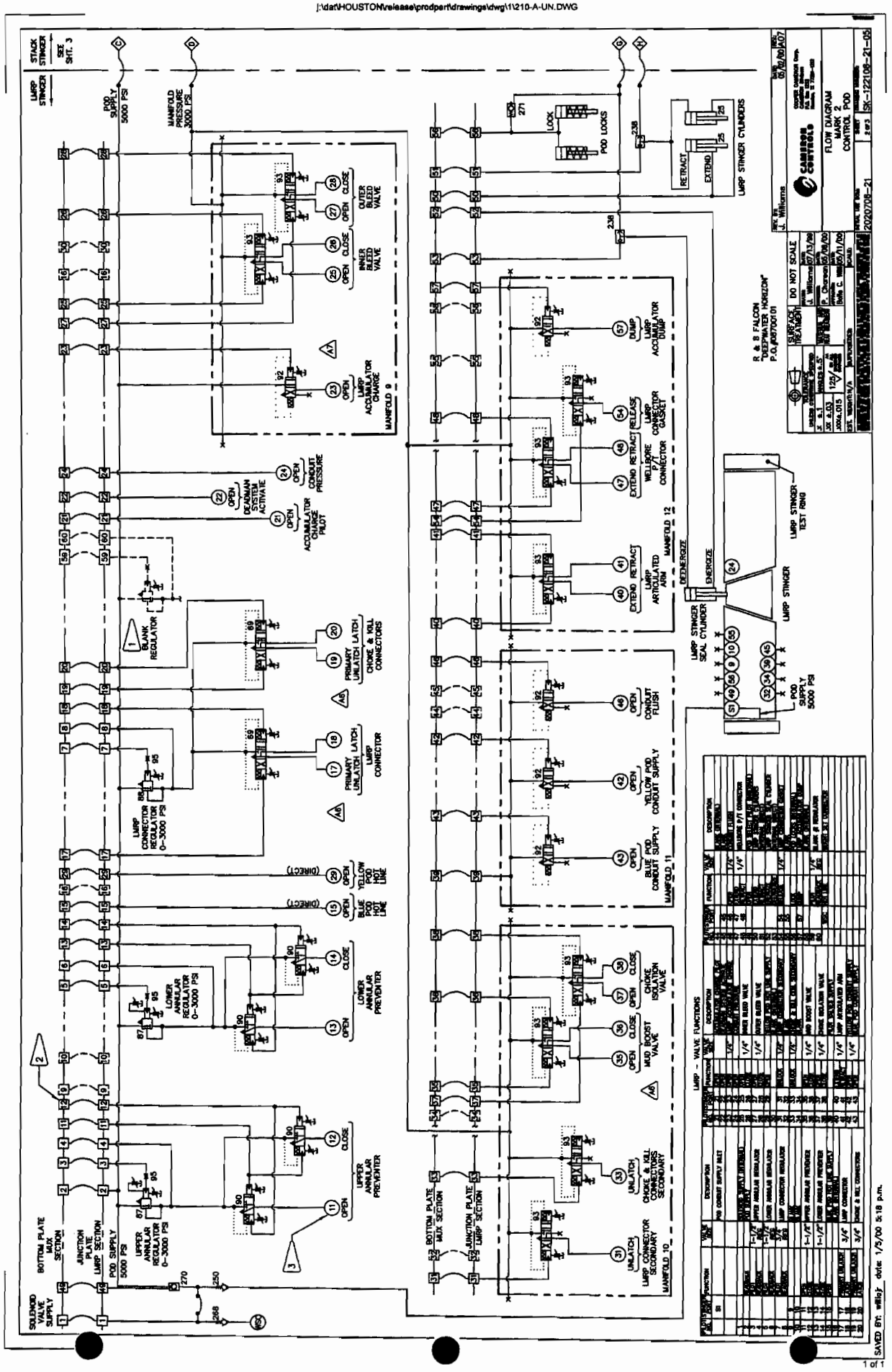

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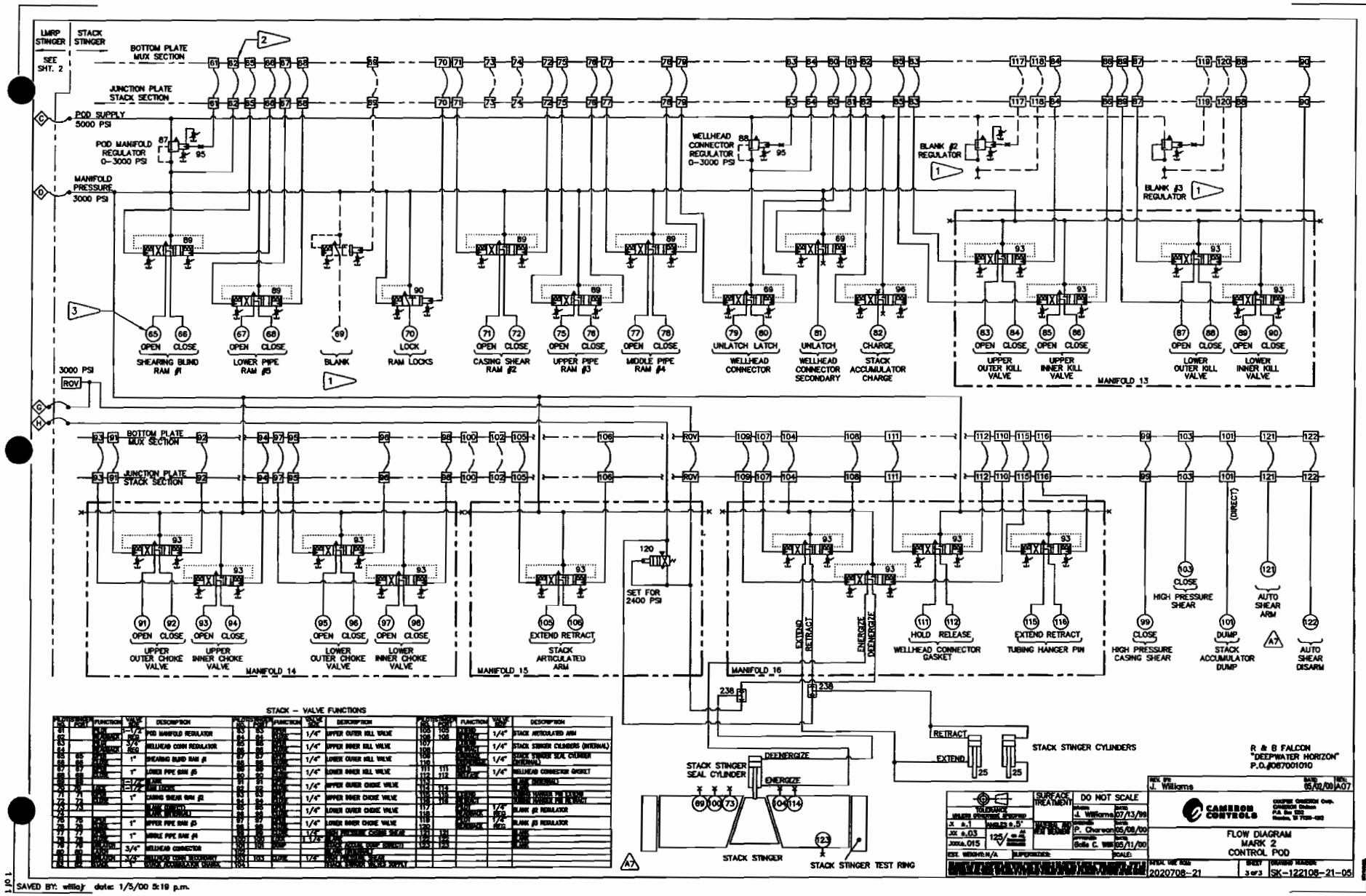


STACK – VALVE FUNCTIONS

PLATE NUMBER PORT	FUNCTION	VALVE SIZE	DESCRIPTION	PLATE NUMBER PORT	FUNCTION	VALVE SIZE	DESCRIPTION	PLATE NUMBER PORT	FUNCTION	VALVE SIZE	DESCRIPTION
61		1-1/2"	POD MANIFOLD REGULATOR	83	83	1/4"	UPPER OUTER KILL VALVE	105	105	EXTEND	1/4"	STACK ARTICULATED ARM
62		REG		84	84			106	106	RETRACT		
63		3/4"	WELLHEAD CONN REGULATOR	85	85	1/4"	UPPER INNER KILL VALVE	107		EXTEND	1/4"	STACK STINGER CYLINDERS (INTERNAL)
64		REG		86	86			108		RETRACT		
65	65	1"	SHEARING BLIND RAM #1	87	87	1/4"	LOWER OUTER KILL VALVE	110		DEENERGIZE	1/4"	STACK STINGER SEAL CYLINDER (INTERNAL)
66	66			88	88			109		ENERGIZE		
67	67	1"	LOWER PIPE RAM #5	89	89	1/4"	LOWER INNER KILL VALVE	111	111	HOLD	1/4"	WELLHEAD CONNECTOR GASKET
68	68			90	90			112	112	RELEASE		
69	69	1-1/2"	BLANK	91	91	1/4"	UPPER OUTER CHOKE VALVE	113				BLANK (INTERNAL)
70	70	1-1/2"	LOCK RAM LOCKS	92	92			114				BLANK
71	71	1"	CASING SHEAR RAM #2	93	93	1/4"	UPPER INNER CHOKE VALVE	115	115	EXTEND		TUBING HANGER PIN HOUSING
72	72			94	94			116	116	RETRACT		TUBING HANGER PIN HOUSING
73	73		BLANK (INTERNAL)	95	95	1/4"	LOWER OUTER CHOKE VALVE	117				BLANK
74			BLANK (INTERNAL)	96	96			118			1/4"	BLANK #2 REGULATOR
75	75	1"	UPPER PIPE RAM #3	97	97	1/4"	LOWER INNER CHOKE VALVE	119			1/4"	
76	76			98	98			120			REG	BLANK #3 REGULATOR
77	77	1"	MIDDLE PIPE RAM #4	99	99	1/4"	HIGH PRESSURE CASING SHEAR	121	121			
78	78			100	100			122	122			
79	79	3/4"	WELLHEAD CONNECTOR	101	101	1/4"	DUMP STACK ACCUMULATOR DUMP	123	123			
80	80			102	102			124				
81	81	3/4"	WELLHEAD CONN SECONDARY	103	103	1/4"	HIGH PRESSURE SHEAR	125				
82	82	3/4"	WELLHEAD CONN CHARGE	104								

SAVED BY: williaj date: 1/5/00 5:19 p.m.

R & B FALCON
"DEEPWATER HORIZON"
P.O.#067001010

J. Williams 05/02/00 A07

CAMERON CONTROLS

FLOW DIAGRAM
MARK 2
CONTROL POD

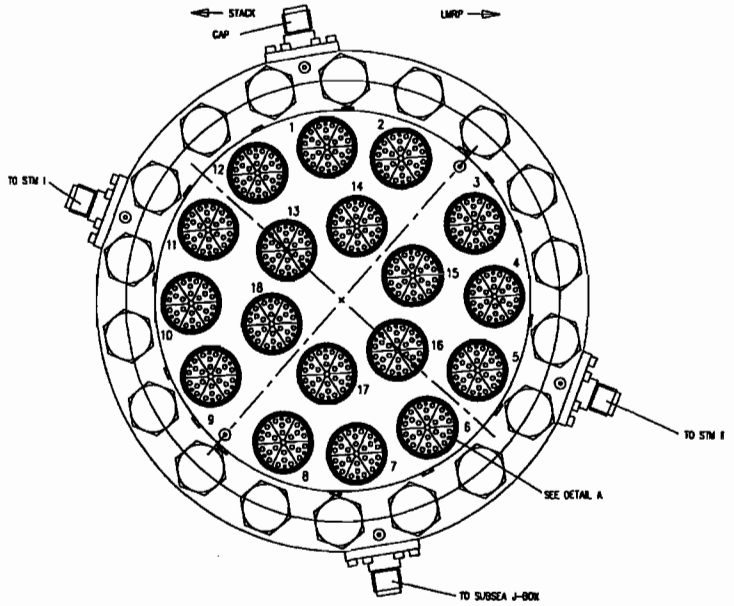
SURFACE TREATMENT: DO NOT SCALE
J. Williams 07/13/99
P. Chavon 05/08/00
Bolle C. 05/11/00

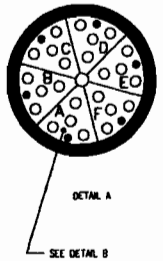
INITIAL USE BOM: 2020708-21
SHEET: 3 of 3
DRAWING NUMBER: SK-122108-21-05

DIAGNOSTIC POINT	SOLENOID	CONNECTION	FUNCTION NAME	FUNCTION
01	85	1A	UPPER INNER KILL VALVE	OPEN
02	86	1B	UPPER INNER KILL VALVE	CLOSE
03	87	1C	LOWER OUTER KILL VALVE	OPEN
04	88	1D	LOWER OUTER KILL VALVE	CLOSE
05	105	1E	STACK ARTICULATED ARM	EXTEND
06	106	1F	STACK ARTICULATED ARM	RETRACT
07	3A	2A	UPPER ANNULAR REGULATOR PILOT	INCREASE
08	3B	2B	UPPER ANNULAR REGULATOR PILOT	DECREASE
09	3A	2C	LOWER ANNULAR REGULATOR PILOT	INCREASE
10	3B	2D	LOWER ANNULAR REGULATOR PILOT	DECREASE
11	7A	2E	LMRP CONNECTOR REGULATOR PILOT	INCREASE
12	7B	2F	LMRP CONNECTOR REGULATOR PILOT	DECREASE
13	11	3A	UPPER ANNULAR PREVENTER	OPEN
14	12	3B	UPPER ANNULAR PREVENTER	CLOSE
15	13	3C	LOWER ANNULAR PREVENTER	OPEN
16	14	3D	LOWER ANNULAR PREVENTER	CLOSE
17	15	3E	BLUE POD HOT LINE SUPPLY	OPEN
18	57	3F	LMRP ACCUMULATOR DUMP	DUMP
19	49	4A	(INTERNAL DIRECT) POD SELECT PILOT	OPEN
20	54	4B	LMRP CONNECTOR GASKET RELEASE	RELEASE
21	55	4C	SPARE	
22	56	4D	POD LOCKS	LOCK
23	31	4E	LMRP CONNECTOR SECONDARY	UNLATCH
24	33	4F	CHOKE & KILL CONNECTOR SECONDARY	UNLATCH
25	35	5A	MUD BOOST VALVE	OPEN
26	36	5B	MUD BOOST VALVE	CLOSE
27	39	5C	QUICK START ACCUMULATOR PILOT	
28	40	5D	LMRP ARTICULATED ARM	EXTEND
29	41	5E	LMRP ARTICULATED ARM	RETRACT
30	46	5F	CONDUIT FLUSH	OPEN
31	47	6A	WELLBORE P/T CONNECTOR	EXTEND
32	48	6B	WELLBORE P/T CONNECTOR	RETRACT
33	50	6C	(INTERNAL DIRECT) LMRP STINGER CYLINDERS	EXTEND
34	51	6D	(INTERNAL DIRECT) LMRP STINGER CYLINDERS	RETRACT
35	52	6E	(INTERNAL DIRECT) LMRP STINGER SEAL CYLINDERS	ENERGIZE
36	53	6F	(INTERNAL DIRECT) LMRP STINGER SEAL CYLINDER	DE-ENERGIZE

DIAGNOSTIC POINT	SOLENOID	CONNECTION	FUNCTION NAME	FUNCTION
37	111	7A	WELLHEAD CONNECTOR GASKET RELEASE	HOLD
38	112	7B	WELLHEAD CONNECTOR GASKET RELEASE	RELEASE
39	19	7C	CHOKE/KILL CONNECTOR PRIMARY	UNLATCH
40	20	7D	CHOKE/KILL CONNECTOR PRIMARY	LATCH
41	37	7E	CHOKE/KILL ISOLATION VALVE	OPEN
42	38	7F	CHOKE/KILL ISOLATION VALVE	CLOSE
43	107	8A	(INTERNAL) STACK STINGER CYLINDERS	EXTEND
44	108	8B	(INTERNAL) STACK STINGER CYLINDERS	RETRACT
45	109	8C	(INTERNAL) STACK STINGER SEAL CYLINDER	ENERGIZE
46	110	8D	(INTERNAL) STACK STINGER SEAL CYLINDER	DE-ENERGIZE
47	103	8E	HIGH PRESSURE SHEAR	CLOSE
48		8F		
49	95	9A	LOWER OUTER CHOKE VALVE	OPEN
50	96	9B	LOWER OUTER CHOKE VALVE	CLOSE
51	97	9C	LOWER INNER CHOKE VALVE	OPEN
52	98	9D	LOWER INNER CHOKE VALVE	CLOSE
53	99	9E	HIGH PRESSURE CASING SHEAR	CLOSE
54	101	9F	STACK ACCUMULATOR DUMP (DIRECT)	DUMP
55	91	10A	LOWER OUTER CHOKE VALVE	OPEN
56	92	10B	UPPER OUTER CHOKE VALVE	CLOSE
57	75	10C	UPPER PIPE RAM	OPEN
58	76	10D	UPPER PIPE RAM	CLOSE
59	77	10E	MIDDLE PIPE RAM	OPEN
60	78	10F	MIDDLE PIPE RAM	CLOSE
61A	61A	11A	POD MANIFOLD REG PILOT	INCREASE
61B	61B	11B	POD MANIFOLD REG PILOT	DECREASE
63A	63A	11C	WELLHEAD CONNECTOR REG PILOT	INCREASE
63B	63B	11D	WELLHEAD CONNECTOR REG PILOT	DECREASE
65	65	11E	BLIND/SHEAR RAM	OPEN
66	66	11F	BLIND/SHEAR RAM	CLOSE
67	67	12A	LOWER PIPE RAM	OPEN
68	68	12B	LOWER PIPE RAM	CLOSE
69	69	12C	SPARE	
70	70	12D	ST LOCKS	LOCK
71	71	12E	CASING SHEAR RAM	OPEN
72	72	12F	CASING SHEAR RAM	CLOSE

DIAGNOSTIC POINT	SOLENOID	CONNECTION	FUNCTION NAME	FUNCTION
73	79	13A	WELLHEAD CONNECTOR PRIMARY	UNLATCH
74	80	13B	WELLHEAD CONNECTOR PRIMARY	LATCH
75	81	13C	WELLHEAD CONNECTOR SECONDARY	UNLATCH
76	82	13D	STACK ACCUMULATOR CHARGE	CHARGE
77	83	13E	UPPER OUTER KILL VALVE	OPEN
78	84	13F	UPPER OUTER KILL VALVE	CLOSE
79	17	14A	LMRP CONNECTOR PRIMARY	UNLATCH
80	18	14B	LMRP CONNECTOR PRIMARY	LATCH
81	21	14C	ACCUMULATOR CHARGE	PILOT
82	22	14D	DEADMAN SYSTEM	ACTIVATE
83	23	14E	LMRP ACCUMULATOR CHARGE	CHARGE
84	24	14F	SPARE	
85	25	15A	INNER BLEED VALVE	OPEN
86	26	15B	INNER BLEED VALVE	CLOSE
87	27	15C	OUTER BLEED VALVE	OPEN
88	28	15D	OUTER BLEED VALVE	CLOSE
89	29	15E	YELLOW POD HOT LINE SUPPLY	OPEN
90	30	15F	SPARE	
91	89	16A	LOWER INNER KILL VALVE	OPEN
92	90	16B	LOWER INNER KILL VALVE	CLOSE
93	42	16C	YELLOW POD CONDUIT SUPPLY	OPEN
94	43	16D	BLUE POD CONDUIT SUPPLY	OPEN
95	93	16E	UPPER INNER CHOKE VALVE	OPEN
96	94	16F	UPPER INNER CHOKE VALVE	CLOSE
97	73	17A	SPARE	
98	74	17B	SPARE	
99	58	17C	(BLUE/YELLOW) SOLENOID PILOT SUPPLY DUMP	OPEN
100	115	17D	TUBING HANGER PIN	EXTEND
101	116	17E	TUBING HANGER PIN	RETRACT
102		17F	SPARE	
103	121	18A	AUTOSHEAR	ARM
104	122	18B	AUTOSHEAR	DISARM
105		18C	SPARE	
106		18D	BATTERY TEST	
107		18E	RS 232	
108		18F	SPARE	

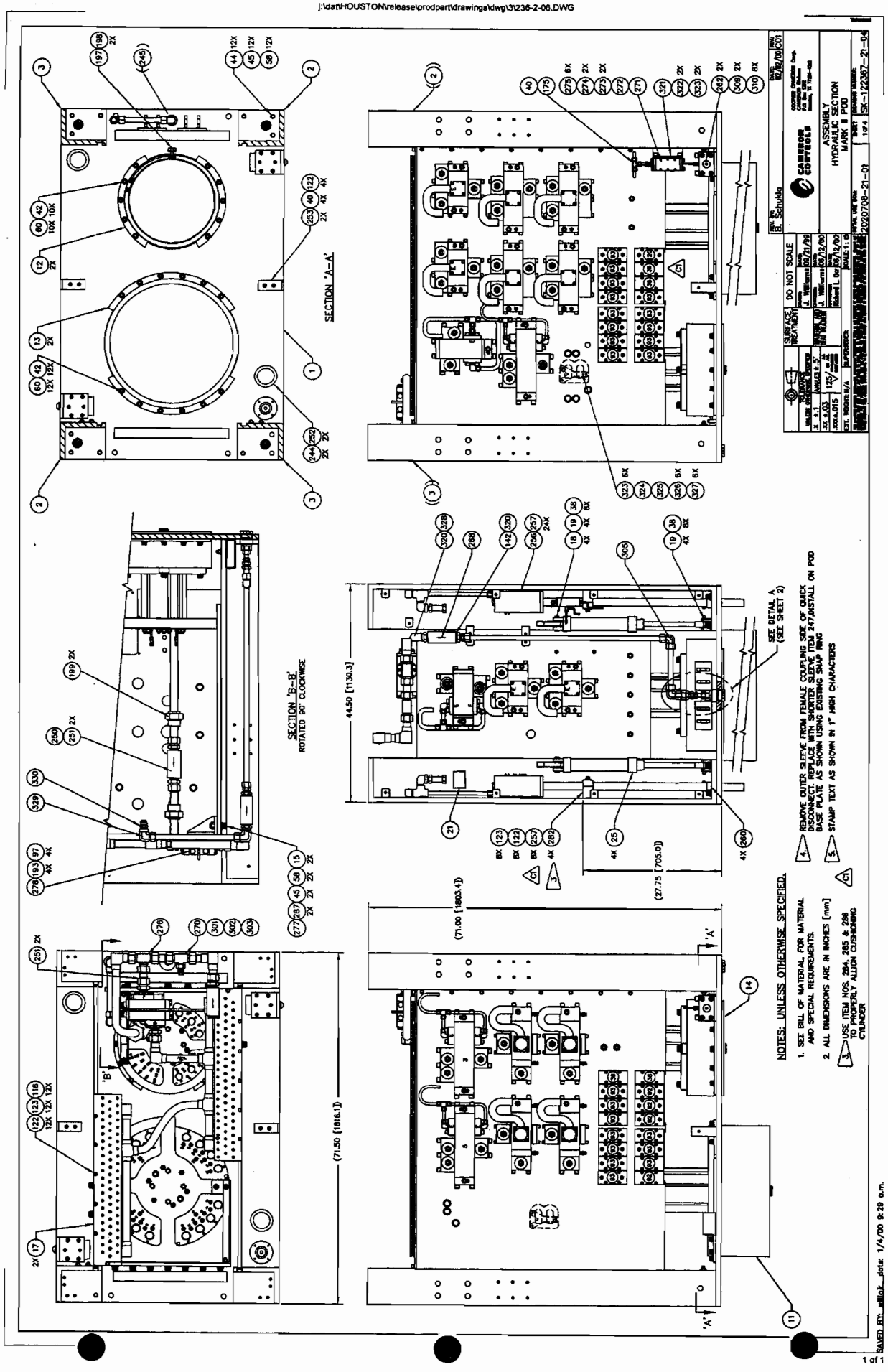


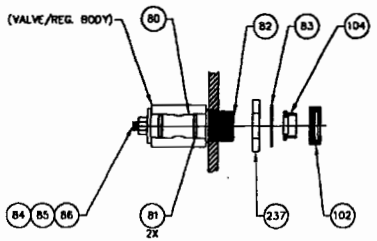


R&B FALCON
"DEEPWATER HORIZON"
PO# 08700101

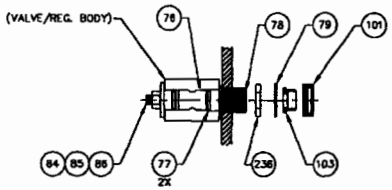
DRN. BY: CLINT DEMING	DATE: 05/24/00	REV: 801	
SURFACE TREATMENT:	DO NOT SCALE		
TOLERANCE UNLESS OTHERWISE SPECIFIED: .X ±.1, ANGLES ±.5°, .XX ±.03, .XXX±.015, 125/	MATERIAL AND HEAT TREATMENT:	CHKD: CLINT DEMING	DATE: 06/17/00
		APPD: M. Lira	DATE: 05/25/00
		APPROVED: Richard L. Dar	DATE: 06/19/00
EST. WEIGHT: N/A	SUPERSEDES:	SCALE:	
CAMERON CONTROLS			
SUBSEA ELECTRONIC MODULE MARK II CONTROL POD			
INITIAL USE WITH: 2020722-21	SHEET: 1 of 1	DRAWING NUMBER: SK-122178-21	

AVEVA 07: deminc date: 1/6/00 9:27 a.m.

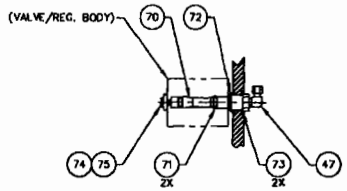




INSTALLATION DETAIL – ITEM #80



INSTALLATION DETAIL – ITEM #76



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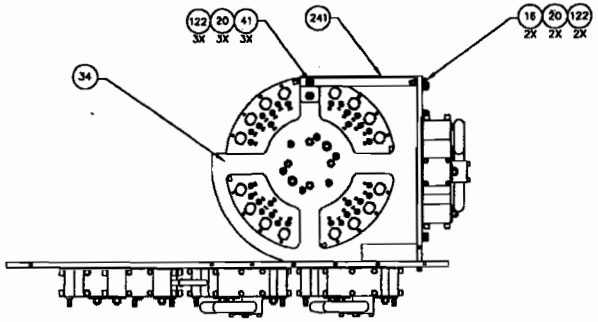
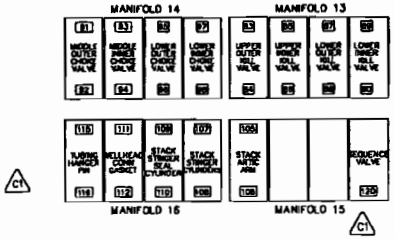
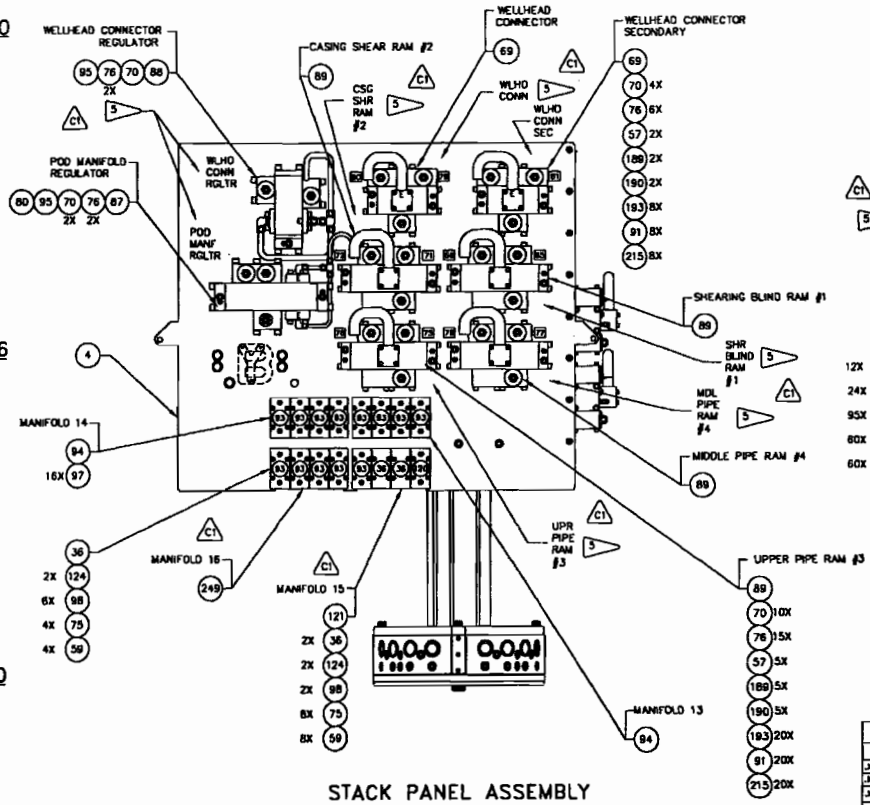
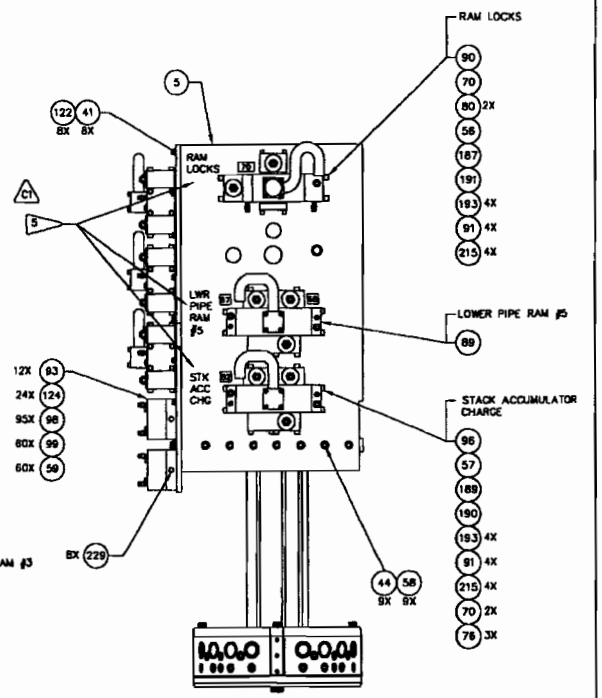




MANIFOLD DETAIL

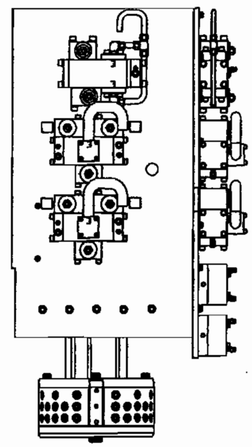


STACK PANEL ASSEMBLY

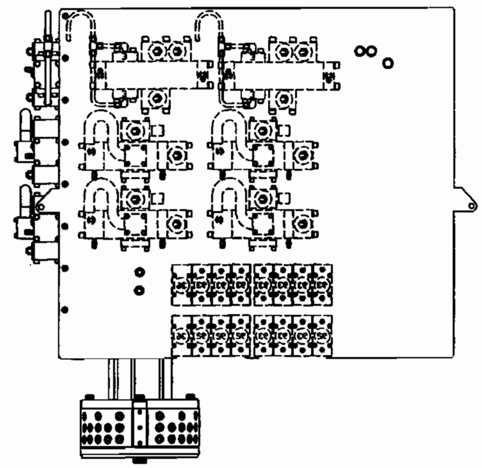


TOLERANCE UNLESS OTHERWISE SPECIFIED: .X ±.1, ANGLES ±.5°; .XX ±.03; .XXX ±.015	SURFACE TREATMENT 125	DO NOT SCALE	S. Schukla 02/02/00 CO1
	MATERIAL AND HEAT TREATMENT	J. Williams 08/21/99	CAMERON CONTROLS
		J. Williams 05/12/00	ASSEMBLY HYDRAULIC SECTION MARK II POD
EST. WEIGHT: N/A	SUPERSEDES	Richard L. Orr 05/12/00 SCALE: 1:6	SERIAL USE WITH: 2020708-21-01 SHEET 3 of 4 DRAWING NUMBER: SK-122367-21-04

SAVED BY: willisjr date: 12/31/99 9:03 a.m.



RISER LOOKING INSIDE



RISER LOOKING INSIDE

TOLERANCE UNLESS OTHERWISE SPECIFIED	SURFACE TREATMENT	DO NOT SCALE	
.X ±.1 / ANGLES ±.5°		J. Williams	04/14/00
.XX ±.03 / 125/		J. Williams	06/12/00
.XXX±.015		Richard L. Dar	06/12/00
EST. WEIGHT: N/A	SUPERSEDES:		SCALE: 1:

B. Schulda — DATE 02/02/00 — REV. C01

CAMERON CONTROLS

ASSEMBLY
HYDRAULIC SECTION
MARK II POD

2020708-21-01 — 4 of 4 — SK-122367-21-04

1.11 BOP-STACK AND LRP MOUNTED EQUIPMENT

1.11.1 Gate Valve "Fail-safe Close" Kit

The BOP-Stack can be provided with up to Six (6) Gate Valve "Fail-safe Close" Kits, that can be installed for the following typical functions:

- Upper Outer Choke Valve & Upper Inner Choke Valve - CLOSE (Fail-safe)
- Lower Outer Choke Valve & Lower Inner Choke Valve - CLOSE (Fail-safe)
- Upper Outer Kill Valve & Upper Inner Kill Valve - CLOSE (Fail-safe)
- Lower Outer Kill Valve & Lower Inner Kill Valve - CLOSE (Fail-safe)
- Outer Bleed Valve – CLOSE (Fail-safe)
- Inner Bleed Valve – CLOSE (Fail-safe)

Stainless steel relief valves are installed on the Fail-safe Kits, ensuring over-pressure protection of the accumulator when the BOP-Stack is retrieved from deep water.

Stainless steel manual bleed valves are installed on the Fail-safe Kits, for bleeding the accumulator fluid.

1.11.2 Conduit Valve Module on Lower Riser Package

Two (2) Conduit Valve Modules are required for selecting the yellow or the blue pods working with a conduit line on a dual conduit system or for flushing the conduit lines. Each unit typically consists of the following main items:

- One (1) 1.1/2" stainless steel double piloted 3-way / 2-position slide valve spring return for the conduit supply function.
- Two (2) 1.1/2" stainless steel pilot operated check valves for the Modular Control Pod supply function and the conduit line flush function.
- One (1) 2" stainless steel check valve for subsea fluid storage.
- One (1) 1/4" stainless steel pilot operated check valve for the Solenoid Valve supply function.
- One (1) 1/4" Start-up Valve

The Hydraulic Conduit Valve Module is a compact, integrated hydraulic valve block, which is mounted near the top of the Lower Riser Package (LRP). It functions to control the flow of hydraulic fluid from the riser-mounted conduit to (and from) a Multiplex Modular Control Pod All the valves on the Module are sub-plate mounted to a electroless nickel plated block for compactness and reliability. The first valve in the block is the Conduit Isolation Valve, which is a 1.1/2" stainless steel double piloted 3-way / 2-position, 3000 (5000 psi available), slide valve, spring return (normally close) that blocks the bottom end of the conduit line. When it is piloted to "OPEN", fluid is ported to the following downstream valves in the block:

- Conduit Flush Valve (1.1/2" stainless steel pilot operated check valve)
- Associated Pod Supply Valve (1.1/2" stainless steel pilot operated check valve)
- Solenoid Supply Valve (1/4" stainless steel pilot operated check valve)

The Conduit Flush Valve is a 1.1/2" stainless steel pilot operated check valve. The primary function of this valve is to flush out the drill water, which has been used to fill and test the conduit while the BOP-Stack has been run, and replace it with clean hydraulic operating fluid. The flushed fluid is discharged either to the sea (or returned to the surface if a fluid recovery system is purchased with the system.

The associated Pod Supply Valve is another 1.1/2"stainless steel pilot operated check valve which ports fluid to the associated Multiplex Modular Control Pod when it is piloted to "OPEN" position.

The Solenoid Supply Valve is a 1/4" stainless steel pilot operated check valve, which can be used to isolate hydraulic pressure from the solenoid valves in the Multiplex Modular Control Pod. The initial supply to the solenoid valves is stored in an accumulator so that the hydraulic system can "bootstrap" start itself after the BOP-Stack has been run.

The Start-up Valve is a 1/4" size pilot operated 3/2-way valve with non-interflow and in normally open position.

In the instance of high accumulator precharge pressures on the surface due to water depth) the conduit line hydraulic fluid is able to pass through this valve to supply fluid to the necessary solenoid functions for start-up of the controls system. When the pressure in the conduit lines builds up to operation or test level, the valve closes automatically and you can perform testing of conduit lines or operated the system normal. Cameron also provides Conduit Valve Modules for Single Conduit System, with or without hot line connections.

1.11.3 Gate Valve "FAIL-SAFE OPEN" Kit

Typically, one (1) Gate Valve "fail-safe Open" Kit is required as part of the Multiplex BOP Control System for the LRP choke & kill isolation valves (i.e., two gate valve actuators). The Gate Valve "fail-safe Open" Kit is necessary to ensure that the LRP Choke & Kill Isolation Gate Valves on the Lower Riser Package (LRP) will fully open whenever hydraulic closing pressure is vented from the valve actuators. The kit typically consists of the following components for the pair of gate valves on the LRP:

- One (1) accumulator, 345 bar (5000 psi) WP hydro-pneumatic accumulator, designed according to BS 7201, BS 5045 Part 1 or ASME Section VIII.
  The accumulator is made of carbon steel and is painted in accordance to Cameron approved paint specification for subsea used parts. The accumulator is nitrogen pre-charged to 104 bar (1500 psi) plus the hydrostatic head pressure as a function of the water depth.
- One (1) stainless steel check valve, ensuring storage of the fluid inside the accumulator.
- One (1) 1/4" stainless steel single piloted 3-way / 2-position, normally closed, non-interflow valve with spring return for the activation of the "Fail-safe " function.
- One (1) stainless steel relief valve, ensuring over-pressure protection of the accumulator when the LRP is retrieved from deep water.

- One (1) stainless steel manual bleed valve for bleeding the accumulator fluid.

The valves are connected at BOP-Stack integration. Application of "CLOSE" pressure to the two gate valves first applies pressure to the "CLOSE" port of the gate valve and shifts the associated 1/4" stainless steel 3-way / 2 position, non-interflow valve to its "CLOSED" position, venting pressure from the "OPEN" port of both gate valve actuators. The "CLOSE" pressure charges the accumulator through the associated stainless steel check valve and, at the same time, closes the gate valve. When "CLOSE" pressure for the gate valves is vented as a result of an "OPEN" command, the 1/4" stainless steel 3-way / 2 position, non-interflow valve immediately shifts to its "OPEN" position applying pressure from the charged accumulator to the "OPEN" port of the two gate valve actuators, causing them to shift open. The accumulator stores enough fluid to open both gate valves. The relief valve is required to prevent over-pressure of the accumulator when the LRP is retrieved from deep water.

According to the accumulators capacity and the number of ¼" valves, 3-way, 2-positions, the kits can operate 1 or 2 manifolds (kill or choke) valves.

1.11.4 Shuttle Valve,1/2"

Typically, one (1) stainless steel shuttle valve, ½", 5000 psi WP, is provided for each Choke and Kill Valve, Riser Connector and Wellhead Connector. A typical function is:

- LRP Choke/Kill Isolation Valve - CLOSE

1.11.5 Shuttle Valve, 1/2" Unbalanced

Up to four (4) stainless steel shuttle valves, 1/2" unbalanced 5000 psi WP can be provided for the following typical functions:

- Blue Conduit Isolation Valve - OPEN
- Yellow Conduit Isolation Valve - OPEN
- Conduit Flush
- LRP Accumulator Isolation - OPEN

Typically, Shuttle Valves are required for each LRP, BOP-Stack and auxiliary function that are operated from both Control Pods. All of the shuttle valves are made from stainless steel. Cameron ½" positive (unbalanced) shuttle valves are used for all such piloting functions and low volume actuators. These valves use Cameron metal-to-metal, shear type seals in an unbalanced, non-interflow configuration to ensure that a positive shift is accomplished, even if the valve has supplied from both of its alternate supply ports. One of the pilot pistons of these valves has twice the area as the other so that the valve always feeds the outlet port when supplied with pressure.

1.11.6 Pilot Operated Check Valve, 1-1/2

Typically, one (1) stainless steel pilot operated check valve, 1.1/2" Size, 5000 psi WP is provided for the subsea accumulator isolation function and also for dumping fluid into the sea.

Accumulators mounted subsea require a surface controlled valve to permit isolation of the supply pressure to the subsea accumulators so the surface pump system can be directed straight through to a selected BOP-Stack function, such as the shear rams. This is a requirement of API 16D and is achieved by installation of a pilot operated check valve, with 1.1/2" ports, in this line.

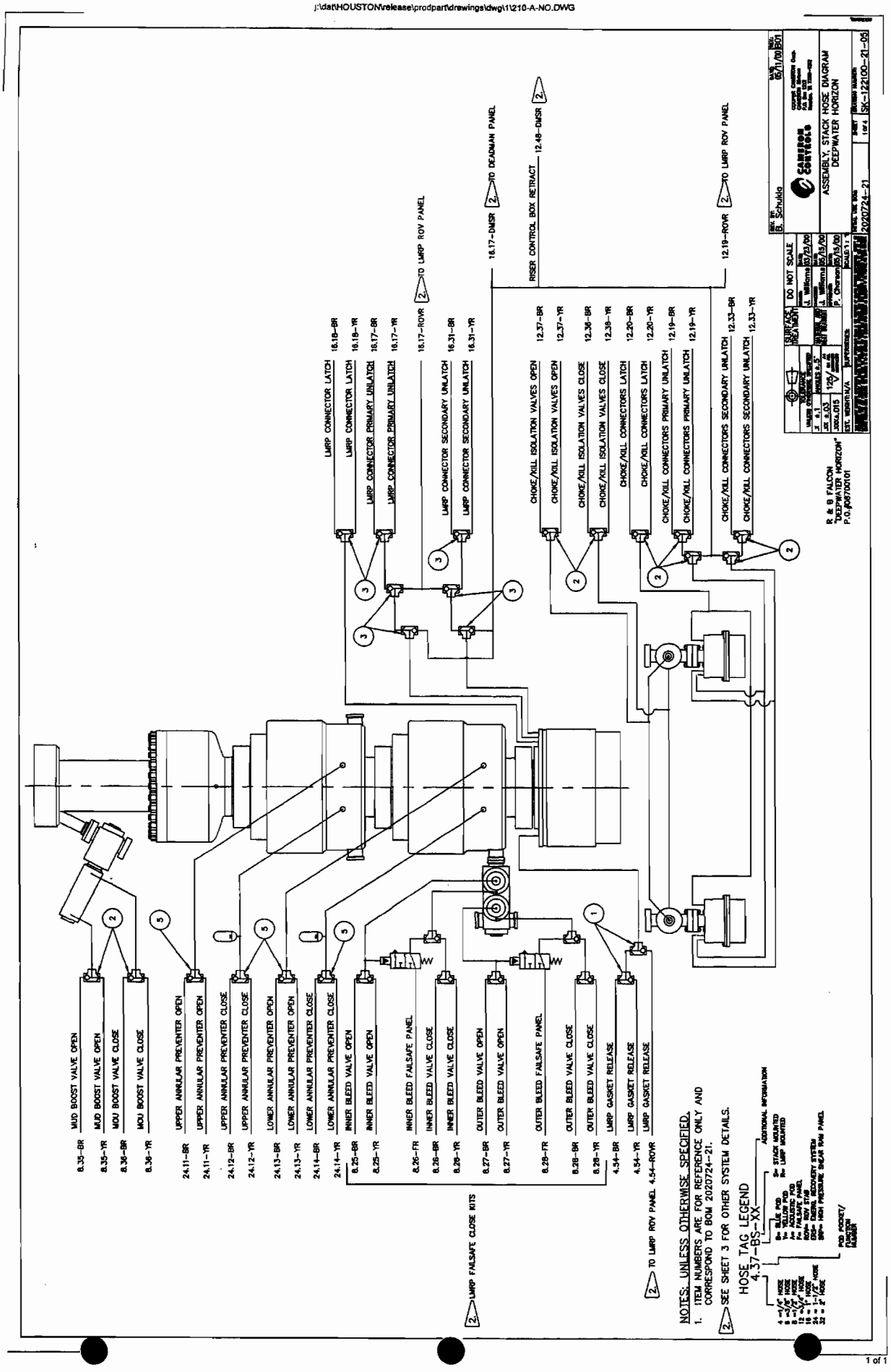
1.11.7 Subsea LRP Mounted Accumulator

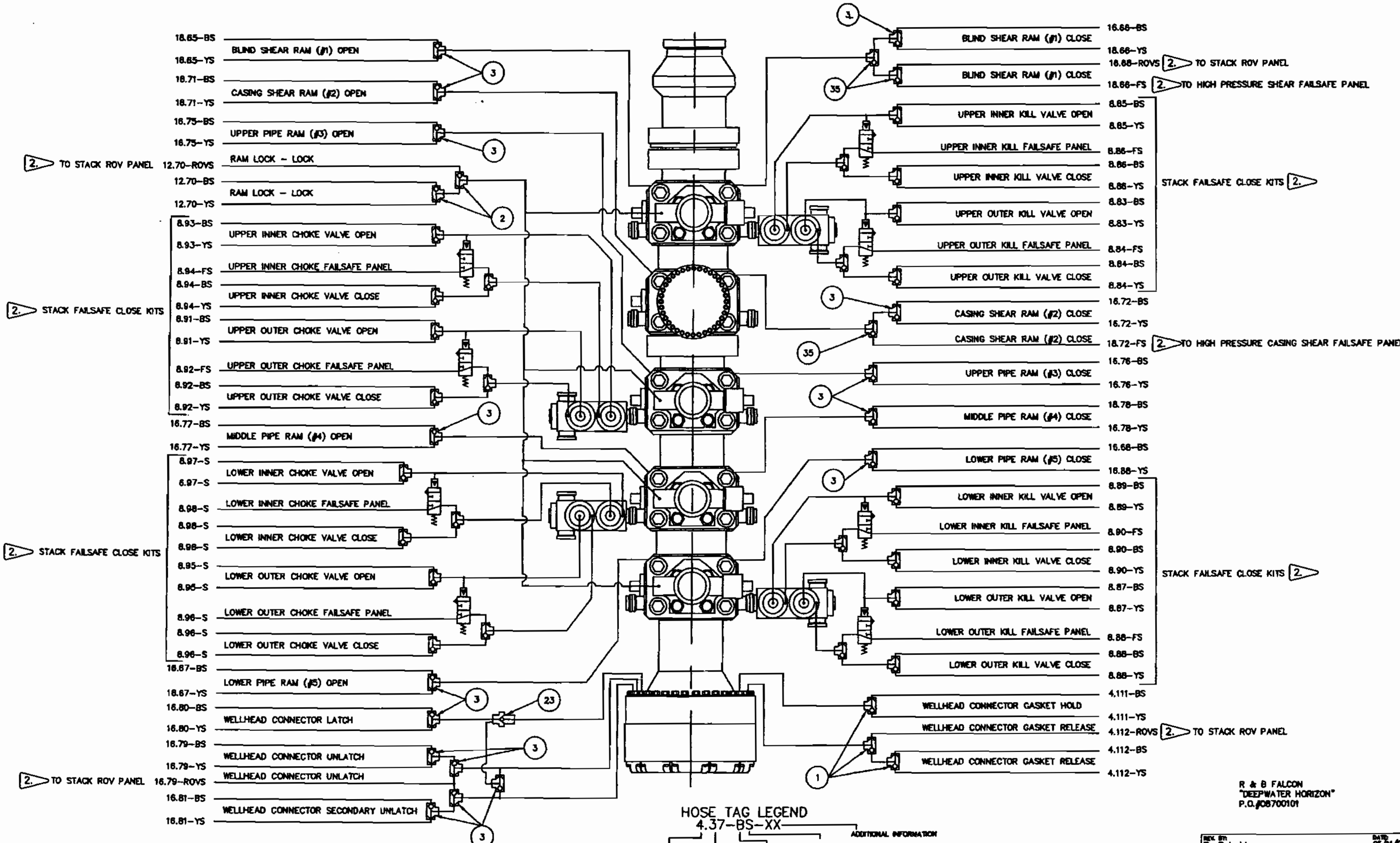
The required total stored hydraulic fluid volume (accumulator volume system capacity) to operate the BOP-Stack is calculated in accordance with API 16D and Norwegian Petroleum Directorate (NPD) rules.

The accumulators are installed so as to provide the fluid required for running or retrieving the BOP-Stack or the LRP. They also function to reduce BOP closing times and/or to serve as a backup supply of power fluid. The LRP Mounted Accumulators have a surface controlled valve to permit isolation of the supply pressure to these accumulators so that the surface pump system can be directed straight through to a selected BOP-Stack function. This is achieved by installation of a pilot operated check valve.

The accumulators are made of carbon steel and are painted in accordance to Cameron approved paint specification for subsea used parts. The accumulators will be nitrogen pre-charged to 62 bar (900 psi) plus the hydrostatic head pressure as a function of the water depth.

Typically, one (1) overpressure protection device (e.g., burst disk or relief valve) installed in the subsea accumulator supply line will ensure an additional over-pressure protection of the accumulators when the BOP-Stack is retrieved from deep water., a piloted dump valve is typically used.





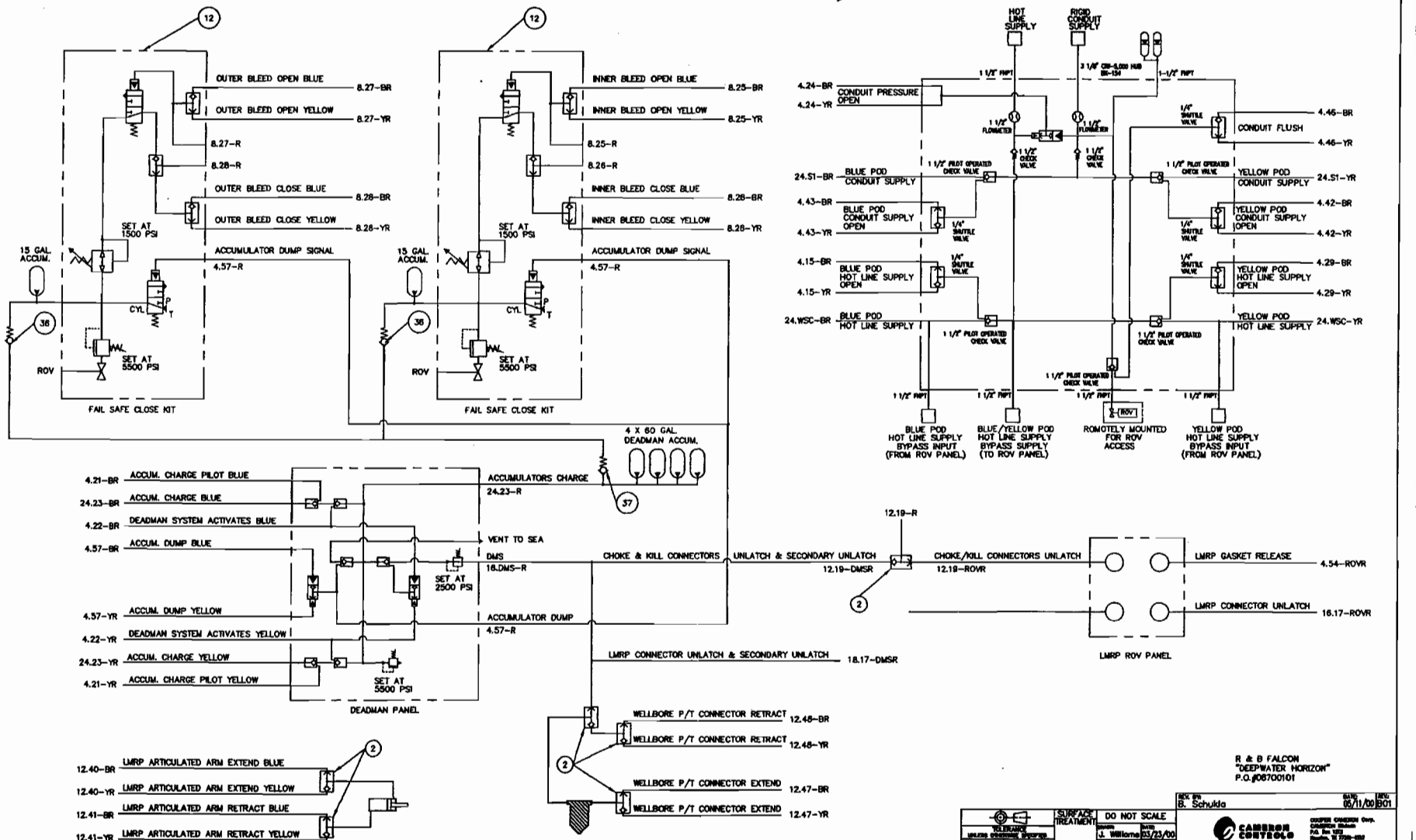
R & B FALCON
"DEEPWATER HORIZON"
P.O.#08700101

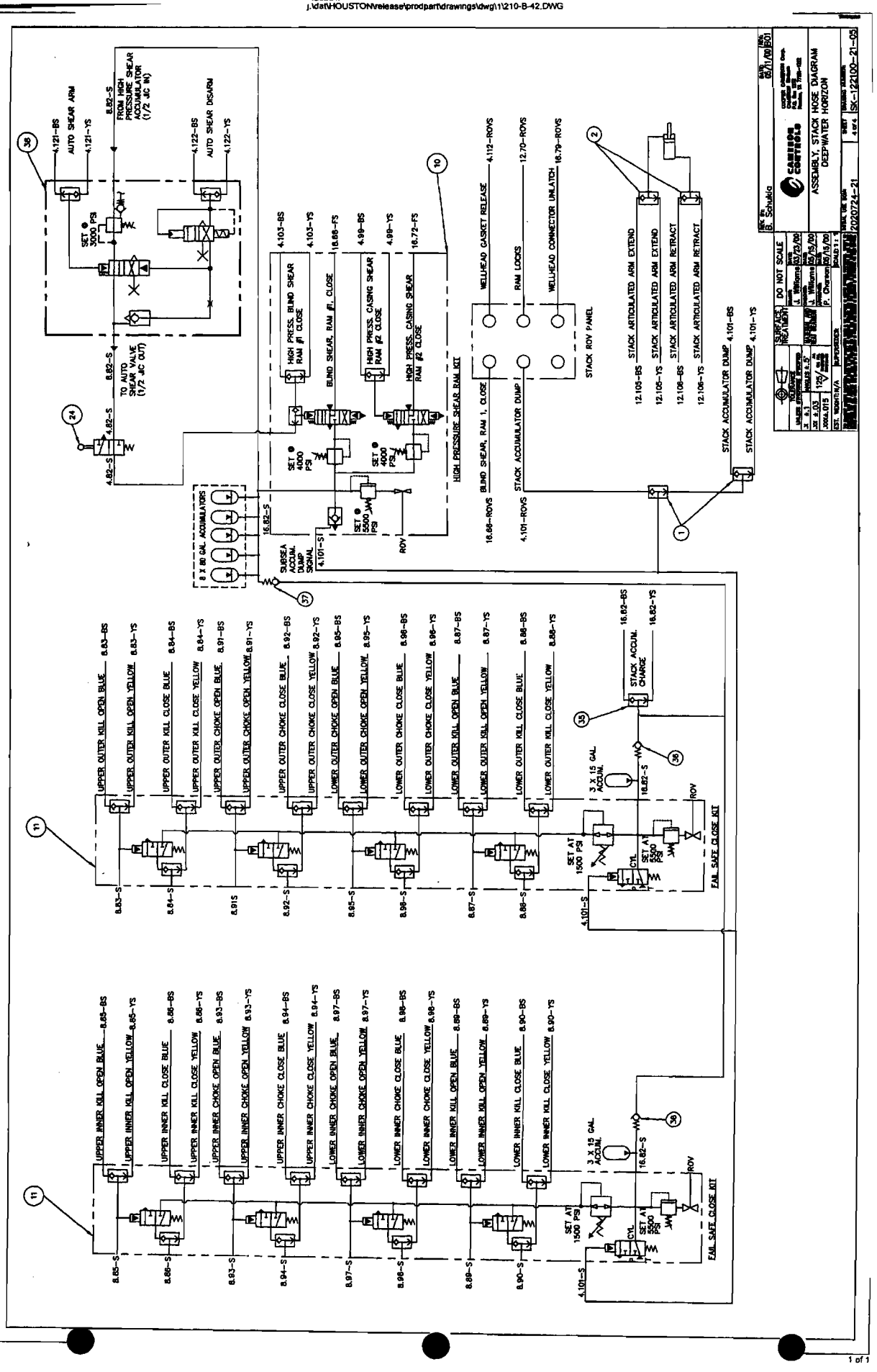
NOTES: UNLESS OTHERWISE SPECIFIED.

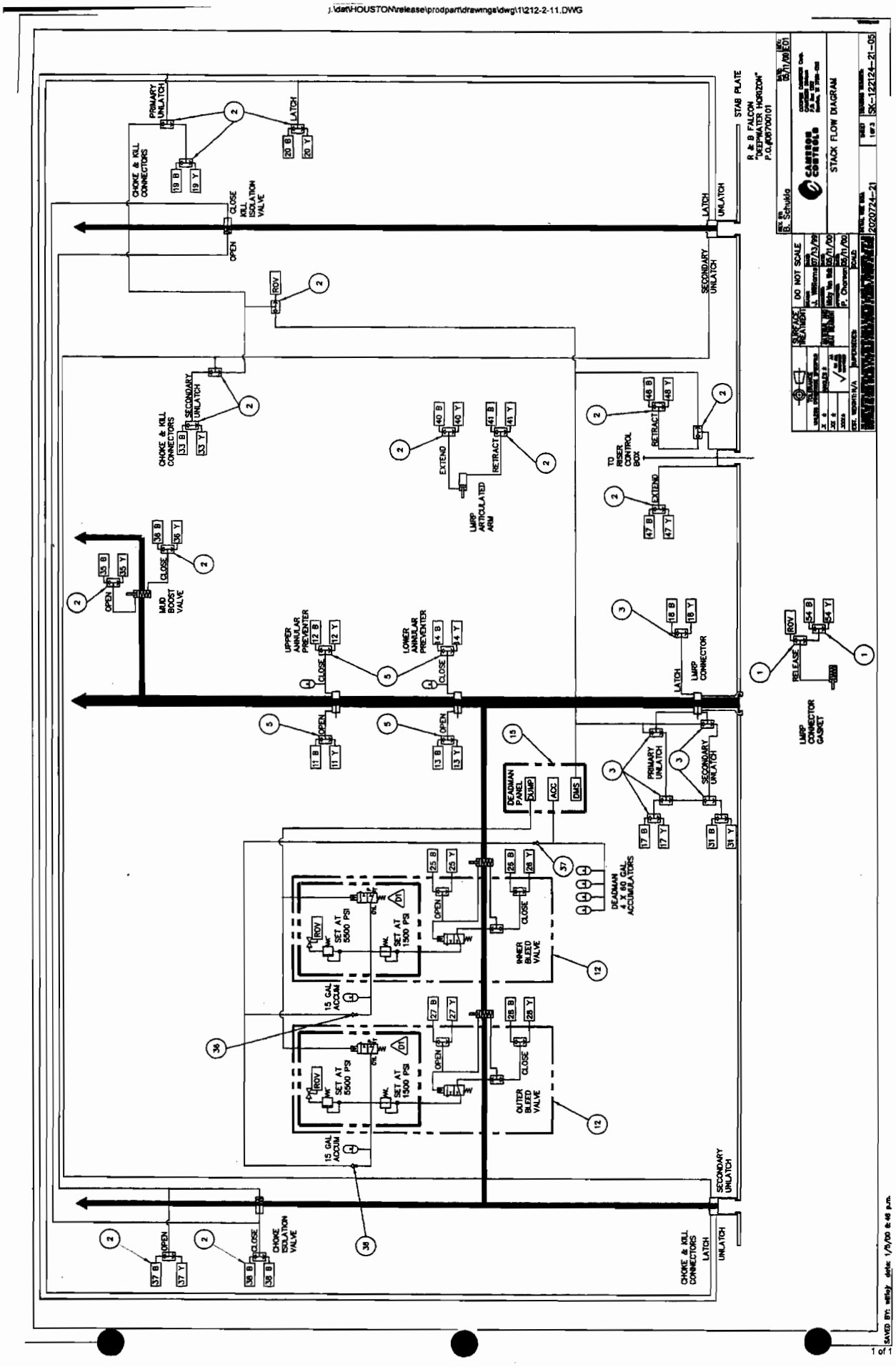
1. ITEM NUMBERS ARE FOR REFERENCE ONLY AND CORRESPOND TO BOM 2020724-21.

2. SEE SHEET 4 FOR OTHER SYSTEM DETAILS.

SURFACE TREATMENT	DO NOT SCALE
DRAWN	J. Williams 03/23/00
TOLERANCE UNLESS OTHERWISE SPECIFIED	.X ±.1 / .XX ±.03 / .XXX±.015 / ANGLES ±.5° / 125
EST. WEIGHT: N/A	SUPERSEDES:
REV. BY	B. Schukla
DATE	05/11/00
REV.	B01
	CAMERON CONTROLS
TITLE	ASSEMBLY, STACK HOSE DIAGRAM DEEPWATER HORIZON
	2020724-21
SHEET	2 of 4
DRAWING NUMBER	SK-122100-21-05







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ACCESS
RESTRICTED

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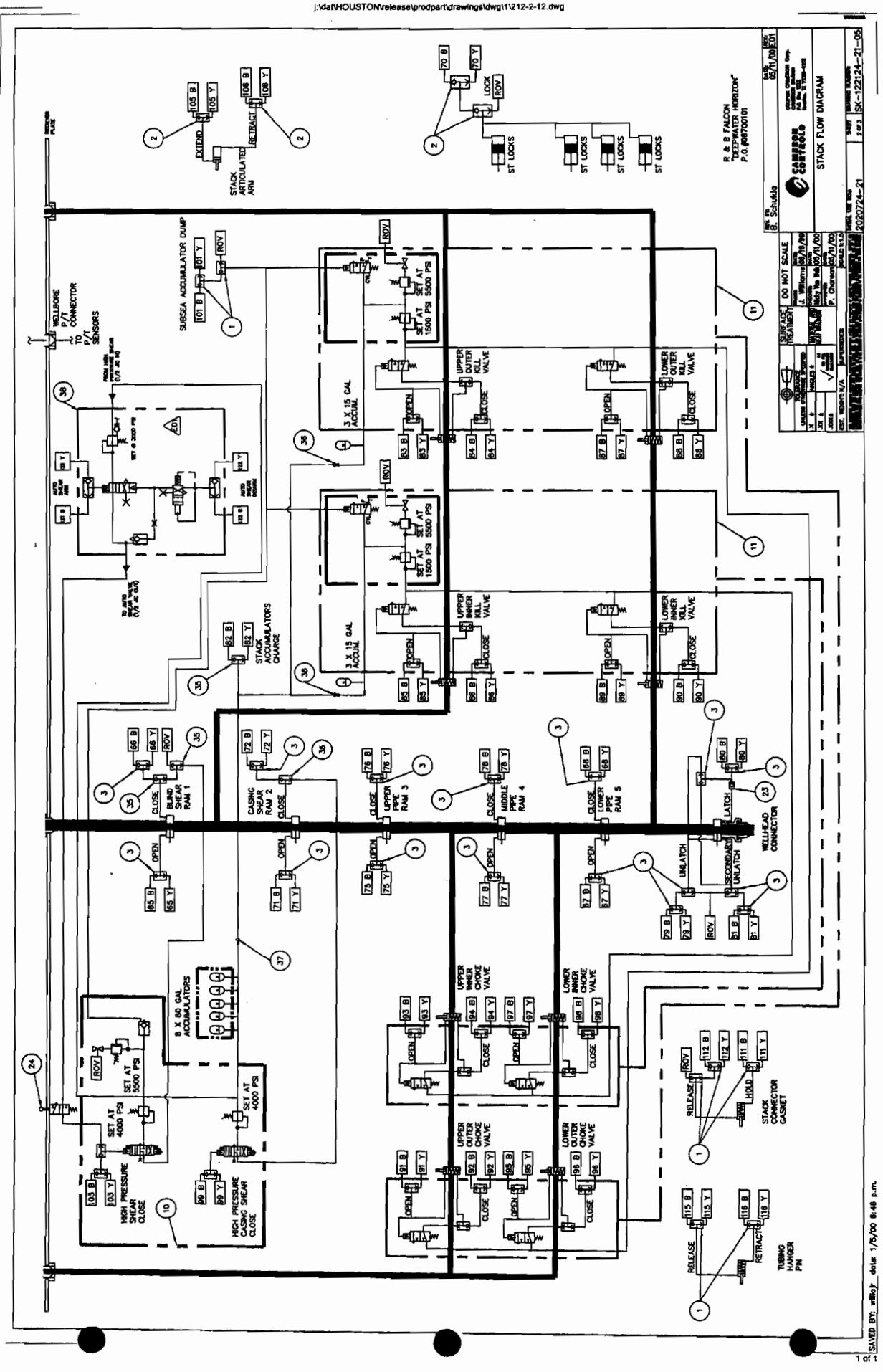

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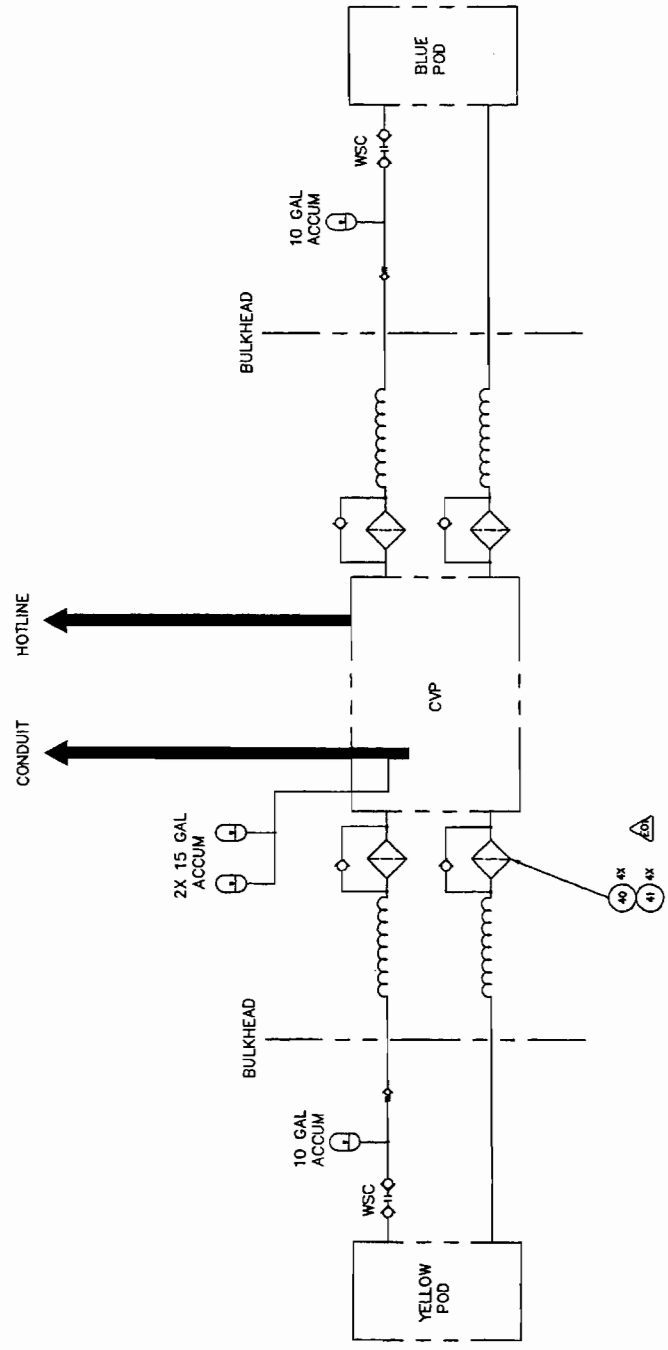

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"DEEPWATER HORIZON"
P.O.#0870010101

DO NOT SCALE

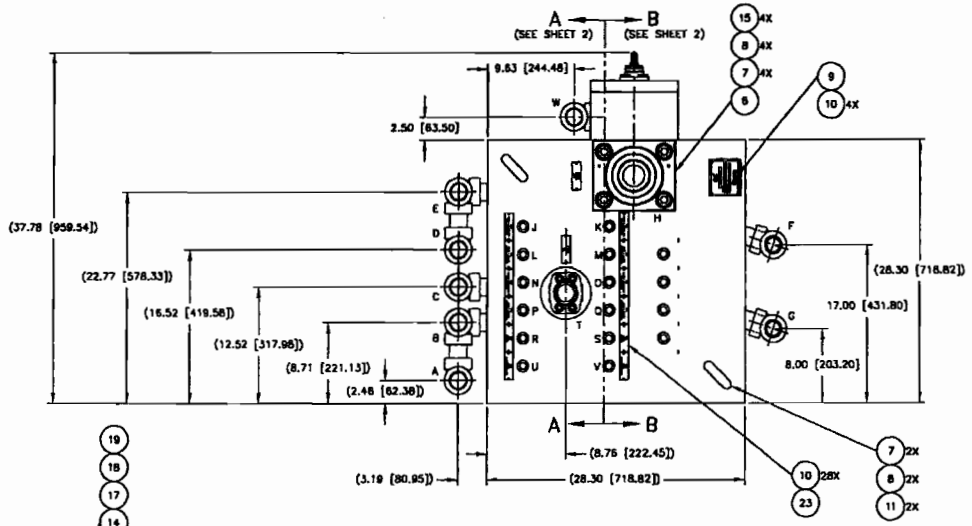
STACK FLOW DIAGRAM

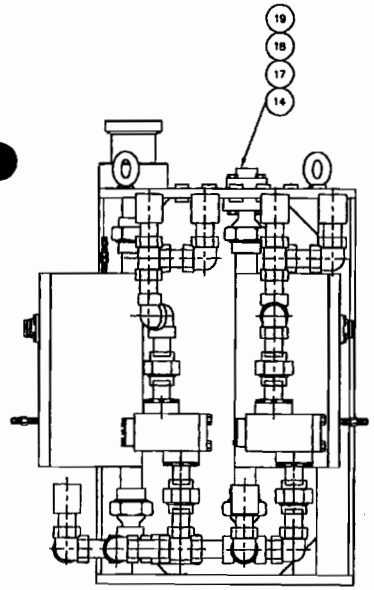
SK-122124-21-05

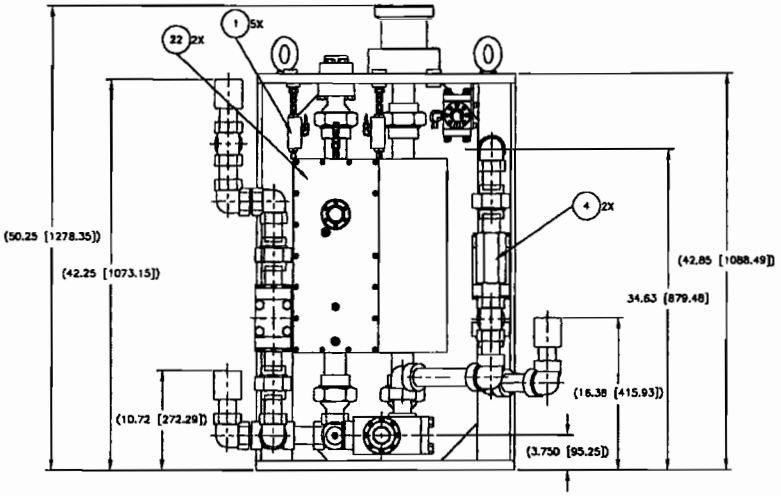
2020724-21

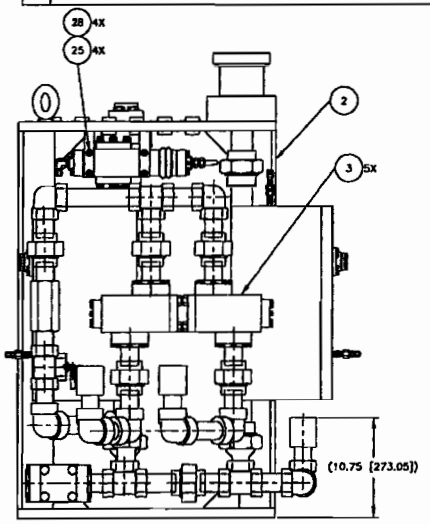
3 of 3

1 of 1









REF.	FUNCTION	CONNECTION
A	BLUE POD HOT LINE SUPPLY (WSC)	1 1/2" FNPT
B	BLUE POD HOT LINE SUPPLY BYPASS INPUT (FROM ROV PANEL)	1 1/2" FNPT
C	BLUE/YELLOW POD HOT LINE SUPPLY BYPASS SUPPLY (TO ROV PANEL)	1 1/2" FNPT
D	YELLOW POD HOT LINE SUPPLY (WSC)	1 1/2" FNPT
E	YELLOW POD HOT LINE SUPPLY BYPASS INPUT (FROM ROV PANEL)	1 1/2" FNPT
F	BLUE POD CONDUIT SUPPLY (S1B)	1 1/2" FNPT
G	YELLOW POD CONDUIT SUPPLY (S1Y)	1 1/2" FNPT
H	RIGID CONDUIT SUPPLY	3 1/8"-5000PSI (6X-154) CLAMP HUB
J	YELLOW POD HOT LINE SUPPLY - OPEN (29B)	1/2" FNPT
K	YELLOW POD HOT LINE SUPPLY - OPEN (29Y)	1/2" FNPT
L	BLUE POD CONDUIT SUPPLY - OPEN (43B)	1/2" FNPT
M	BLUE POD CONDUIT SUPPLY - OPEN (43Y)	1/2" FNPT
N	BLUE POD HOT LINE SUPPLY - OPEN (15B)	1/2" FNPT
O	BLUE POD HOT LINE SUPPLY - OPEN (15Y)	1/2" FNPT
P	YELLOW POD CONDUIT SUPPLY - OPEN (42B)	1/2" FNPT
Q	YELLOW POD CONDUIT SUPPLY - OPEN (42Y)	1/2" FNPT
R	CONDUIT FLUSH (46B)	1/2" FNPT
S	CONDUIT FLUSH (46Y)	1/2" FNPT
T	HOT LINE SUPPLY	1 1/2" FNPT
U	CONDUIT PRESSURE - OPEN (24B)	1/2" FNPT
V	CONDUIT PRESSURE - OPEN (24Y)	1/2" FNPT
W	CONDUIT SURGE ACC.	1 1/2" FNPT

R & B FALCON
"DEEPWATER HORIZON"
P.O.#08700101

NOTES

1. WEIGHT: 850 LBS. [385.56 KG.] (APPROX.)
2. DIMENSIONS SHOWN ARE FOR GENERAL ARRANGEMENT ONLY.
3. ALL DIMENSIONS ARE FOR REFERENCE ONLY.

TOLERANCE UNLESS OTHERWISE SPECIFIED	SURFACE TREATMENT	DO NOT SCALE	DRAWN J. Williams 08/21/98
.x ±.1 ANGLES ±.5°			CHECKED A. Simpson 05/11/00
.xx ±.03 125/			APPROVED P. Chereson 05/11/00
.xxx±.015			
EST. WEIGHT: N/A	SUPERSEDES	SCALE: 1:6	

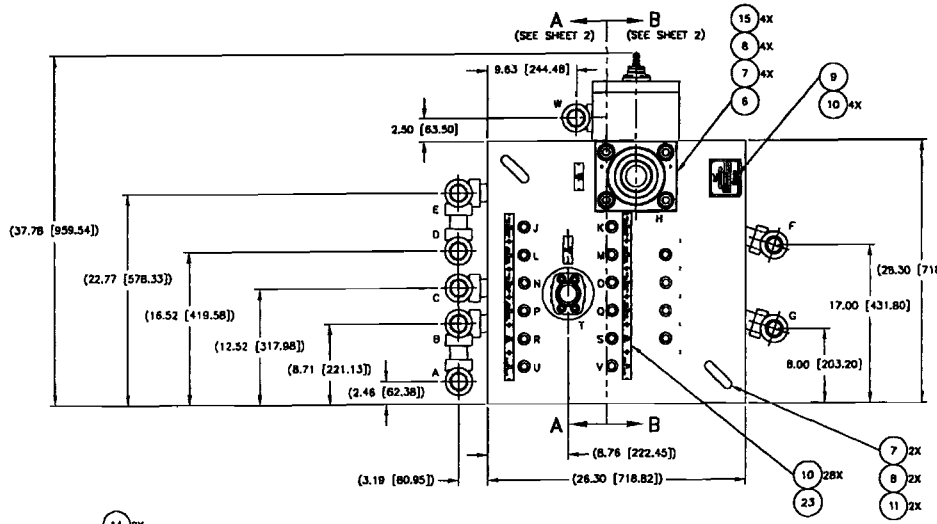
CAMERON CONTROLS

GENERAL ARRANGEMENT
CONDUIT VALVE PACKAGE

ENG. APP.	DATE	REV.
J. Williams	05/10/00	D01

INITIAL USE BOM	SHEET	DRAWING NUMBER
2020720-21	1 OF 1	SK-122120-21

SAVED BY: walkerm date: 10/22/98 1:36 p.m.



REF.	FUNCTION	CONNECTION
A	BLUE POD HOT LINE SUPPLY (WSC)	1 1/2" FNPT
B	BLUE POD HOT LINE SUPPLY BYPASS INPUT (FROM ROV PANEL)	1 1/2" FNPT
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D	YELLOW POD HOT LINE SUPPLY (WSC)	1 1/2" FNPT
E	YELLOW POD HOT LINE SUPPLY BYPASS INPUT (FROM ROV PANEL)	1 1/2" FNPT
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G	YELLOW POD CONDUIT SUPPLY (S1Y)	1 1/2" FNPT
H	RIGID CONDUIT SUPPLY	3 1/8"-5000PSI (6X-154) CLAMP HUB
J	YELLOW POD HOT LINE SUPPLY - OPEN (29B)	1/2" FNPT
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M	BLUE POD CONDUIT SUPPLY - OPEN (43Y)	1/2" FNPT
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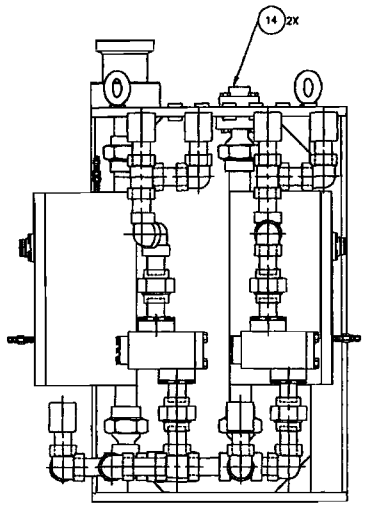
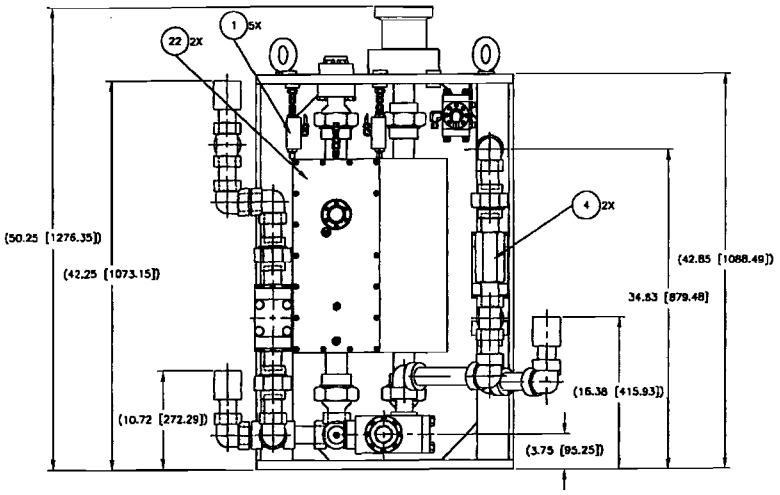
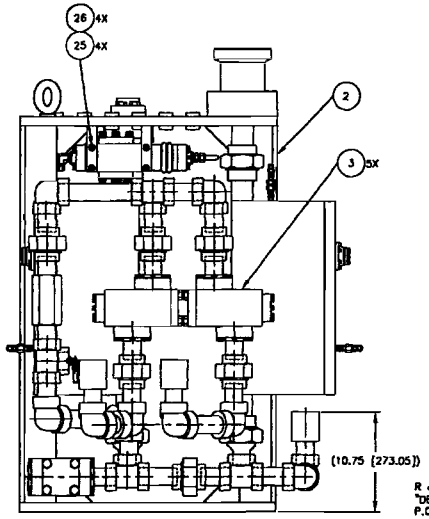
U	CONDUIT PRESSURE - OPEN (24B)	1/2" FNPT
V	CONDUIT PRESSURE - OPEN (24Y)	1/2" FNPT
W	CONDUIT SURGE ACC.	1 1/2" FNPT





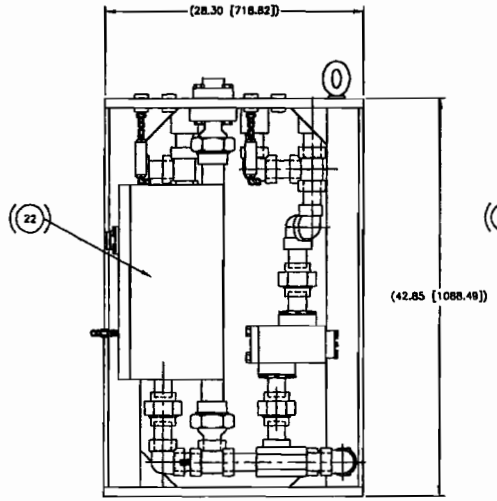


R & B FALCON
"DEEPWATER HORIZON"
P.O.#08700101

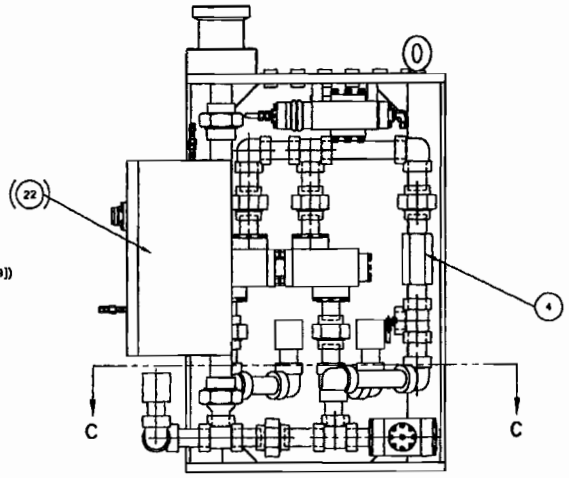
NOTES
1. WEIGHT: 850 LBS. [385.56 KG.] (APPROX.)
2. DIMENSIONS SHOWN ARE FOR REFERENCE ONLY
3. FOR ALL PIPE FITTINGS SEE BOM (2020720-21-80)
4. FOR ALL TUBE FITTINGS SEE BOM (2020720-21-81)

REV. BY: J. Williams		DATE: 05/01/00	REV: C01
SURFACE TREATMENT:	DO NOT SCALE		
TOLERANCE UNLESS OTHERWISE SPECIFIED: .X ±.1, .XX ±.03, .XXX±.015; ANGLES ±.5°		DRAWN: J. Williams	DATE: 08/31/99
	MATERIAL AND RAW MATERIAL: 125	APPROVED: A. Simpson	DATE: 05/15/00
		APPROVED: Richard L. Orr	DATE: 08/16/00
EST. WEIGHT: n/a	SUPERCEDES:	SCALE: 1:6	
CAMERON CONTROLS		ASSEMBLY DRAWING CONDUIT VALVE PACKAGE	
MATERIAL USE FROM: 2020720-21		SHEET: 1 of 2	DRAWING NUMBER: SK-122120-21-04

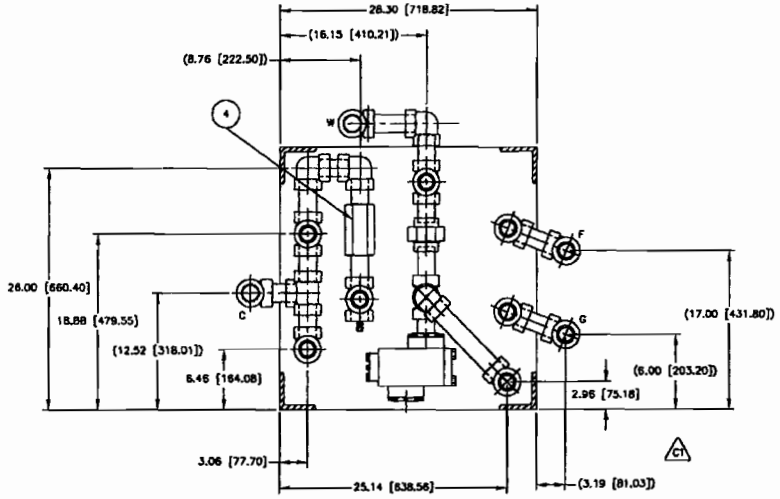
SAVED BY: charsonp date: 11/23/99 9:46 a.m.



SECTION A–A
(SEE SHEET 1)



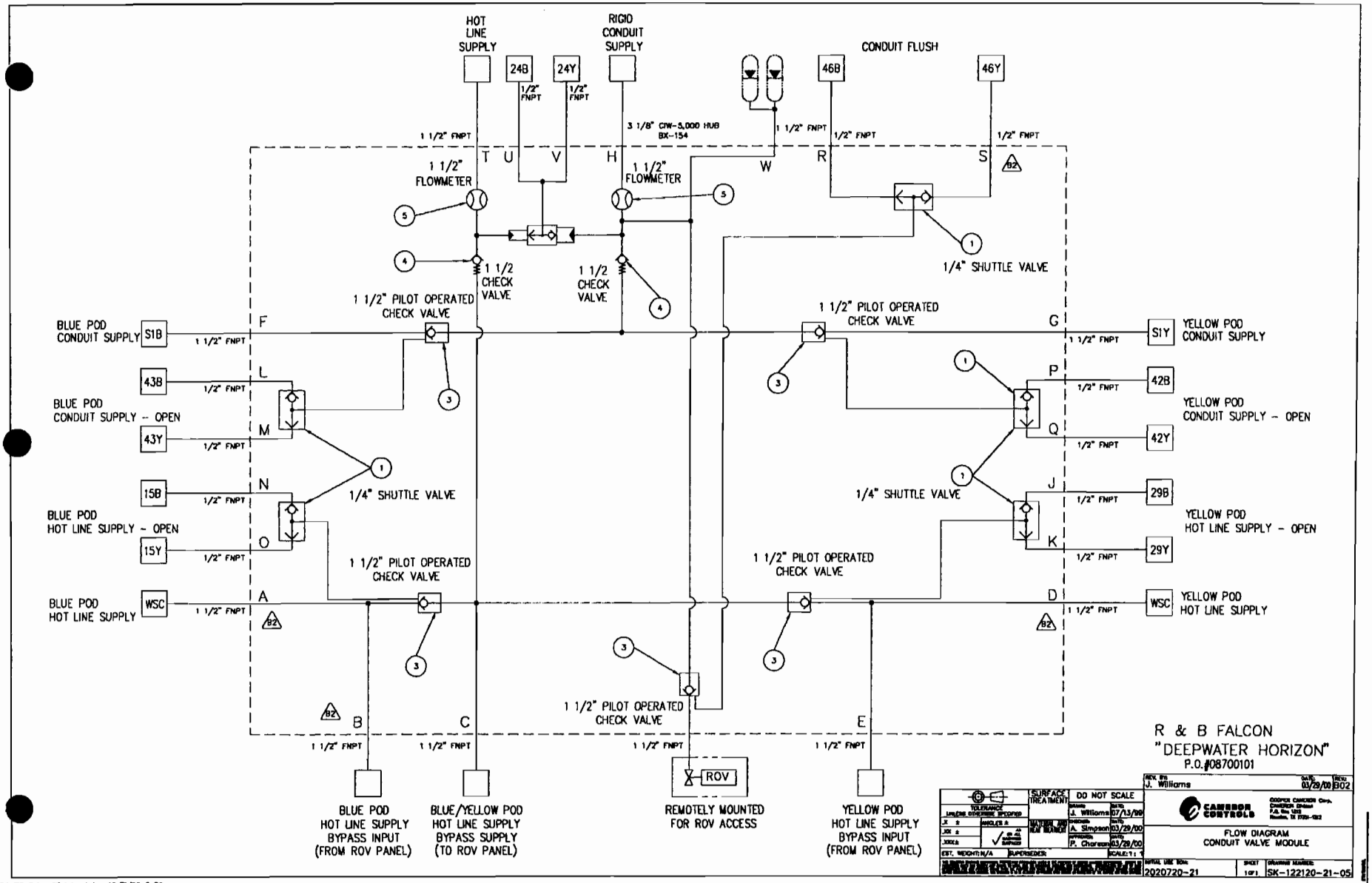
SECTION B–B
(SEE SHEET 1)



SECTION C–C

R & B FALCON
"DEEPWATER HORIZON"
P.O.#08700101

REV. BY: J. Williams		DATE: 05/01/09	REV: C01
TOLERANCE UNLESS OTHERWISE SPECIFIED: .X ±.1, .XX ±.03, .XXX±.015, ANGLES ±.5°, 125	SURFACE TREATMENT: DO NOT SCALE	DRAWN: J. Williams 03/02/09	CAMERON CONTROLS
	MATERIAL AND HEAT REQUIRED	CHECKED: A. Simpson 05/15/09	ASSEMBLY DRAWING CONDUIT VALVE PACKAGE
WT. WEIGHTS N/A	SUPERSEDES	APPROVED: Richard L. Orr 06/10/09	
	SCALE: 1:6	INITIAL USE FROM: 2020720-21	SHEET: 2 OF 2 — DRAWING NUMBER: SK-122120-21-04



1.12 MISCELLANEOUS

1.12.1 Cable/Hose Clamps

300 Dual Cable/Hose Clamps are provided to securely attach the one or two electrical control cables to the Kill and Choke pipelines on the drilling riser. The clamps are designed to be permanently attached to the riser pipes and permit easy installation of the electrical cable as the BOP-Stack and Riser is run. The clamps ensure that the cable is supported and protected from damage throughout its length.

1.12.2 Cable Turning Sheave

Up to two (2) Cable Turning Sheaves are supplied for the system. The control cable Sheave is semi-circular in shape and is sized to ensure that the control cable cannot be bent to less than the manufacturer's recommended minimum bend radius. The Sheave utilizes a standard roller design to give cable support throughout its turning radius.

The Sheave has keepers with rollers to prevent the cable from jumping out. A sturdy pad-eye is suitably located for attachment of the Sheave to the rig structure. The keepers and lifting eye mechanism are attached to the Sheave frame with pins and are retained in place with stainless steel, hairpin style clips. These pins permit installation and removal of the cable without disassembling the roller units. The hairpin clips are permanently attached to the cable Sheave frame with sturdy lanyards. The structure parts of the Sheave are constructed of seal-welded St 37-2, DIN 17100 or equivalent carbon steel, painted. All other hardware parts are manufactured from corrosion resistant materials.

1.12.3 Accumulator Precharge Kit

The Accumulator Precharge Kit comprises all the fittings, adapters, pressure gauges and hoses necessary to service all the accumulators in the Multiplex BOP Control System to maintain the proper precharge pressures throughout the system. The kit is supplied in a sturdy, steel box for use on the rig.

A nitrogen compressor is necessary to achieve precharge pressures for subsea accumulators at depths greater than about 1000 feet because precharge pressures are then greater than about 1400 psi (97 bar), and compressed nitrogen is normally furnished at a maximum pressure for about 2200 psi (152 bar).

1.13 RISER INSTRUMENTATION SYSTEM (RIS)

A RIS is typically custom-configured for a project. However, a typical system includes the following general components:

The RIS provides the System with all relevant data collected at the Riser and the LMRP. The RIS is equipped with several sensors. A Riser mounted Riser Control Box (RCB) reads all sensor data and provides a dedicated serial interface with each MCP.

This RCB is powered from one power supply line of each electrical umbilical in a way that a defect on one umbilical will not interfere with its functioning.

The electrical lines (power and signals) from surface to the MCPs are fed through the RCB. The basic features are typically as follows:

- Riser mounted RCB including:
  - Pressure Vessel, filled with dry Nitrogen
  - Redundant Power Supplies
  - Redundant Communication Links (RS485)
  - Industrial Grade Analog to Digital Converter (ADC)
  - Industrial Grade Strain Gauge Converter
  - Industrial Grade Microcontroller (uC)
  - Riser Inclinometer (x and y direction; ± 14,5°)
  - Electrical receptacles for Strain Gauge connections
  - Electrical receptacles for Cable Reel Connections
  - Electrical receptacles for MCP Connections

Communications

The interface to the Multiplex Control Module Electronics is via two dedicated RS485 links (one per MCP). The MCP will request data from the RCB periodically and relays the data to the surface system where it will be sent to the Vessel Positioning System.

The Protocol between the MCP and the RCB is equipped with extensive data checking including a CRC check to detect data corruption.

Connectors

The interfaces to the sensors are made using dry mateable electrical jumper cables. The cables are of an oil-filled pressure balanced design and will be attached to the structure to prevent them from damage.

The interface to the Cable Reel is accomplished using two receptacles where the Cable Reel Connectors fit.

The interface to the MCP is accompiished using two jumper cables with a single entry subsea environmental connector on one side to allow retrieval of the MCP subsea.

Stress Sensors

To measure the load of the riser there are strain gauges installed at 4 positions at the circumference of the riser. At each position there are two strain gauges installed, one for axial and one for circumferential strain. The strain gauges are protected against seawater by oil filled pressure compensated caps. They are connected via jumper cables to the RCB. A heavy protection cover prevents damages during handling and installation of the riser.

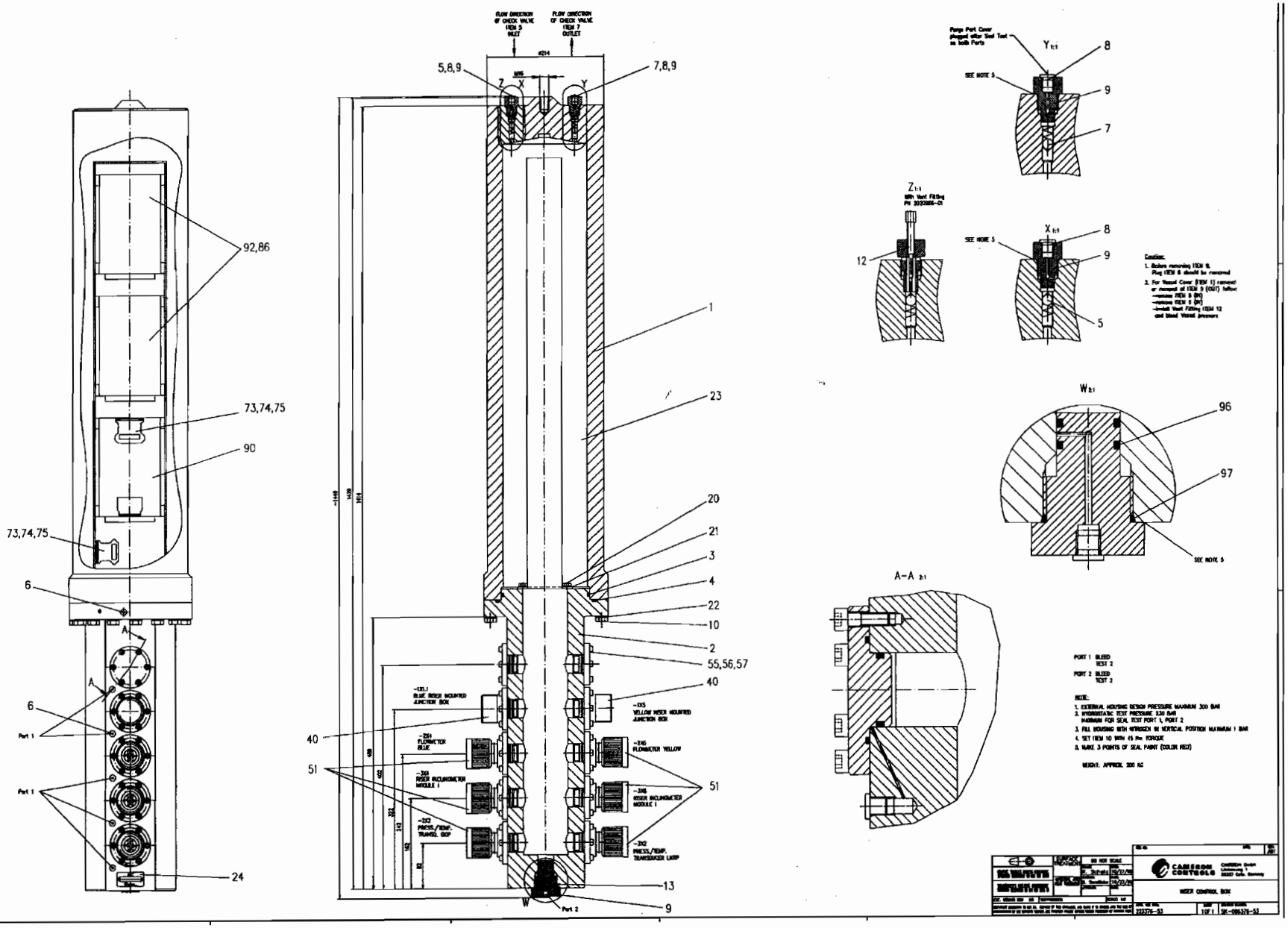
Riser Inclinometer (T223 series)

The inclinometer is designed specifically for long term use in subsea drill strings to measure the angle in x- and y-direction. The sensors have been developed for use in Drilling locations, Vessel- and Platform stabilization and Level control on Missile- and Radar platforms. The design is extremely robust against shock and vibration and hermetically sealed to provide the best resistance against aggressive fluids.

The LMRP inclinometer is installed inside the RCB.

Technical Data:

Measurement Range:	± 14,5 degree
Resolution (without ADC):	type 28 * 10^{-6} degree
Resolution (with ADC):	type 0,003 degree
Linearity:	< 0.02 %
Repeatability:	< 0.002 %
Temperature impact:	< 0.006 % / °C
Temperature Range:	-18°C to +71°C (continuous operating)
	-40°C to +75°C (maximum, short term)
Shock:	max. 1250g
Vibration:	max. 50g peak (sinus)
	max. 35g rms (20-2000Hz, random)



1.14 TEST EQUIPMENT

1.14.1 Portable Electronic Test Unit (PETU)

The (PETU) permits the user to test Control Pods and other system functions with a pod either fully installed on the BOP stack or with the Pod sitting on the deck. The Test unit is housed in a robust case designed to IP 65 environmental standards. It typically consists of the following:

- IBM compatible industrial Laptop PC
- Control Pod electrical power supply
- Modem
- Interconnection Cable to TCB or Distribution Unit
- Interconnection Cable to Cable Reel
- Interconnection Cable to Electronic Vessel
- Power Cable to 230 VAC Power Supply
- Closed IP 65 rating, open IP 20 rating

The software offers an easy to use interface. Test sequences may be changed easily. Information and data is displayed on a simple overview screen and can be broken down into clear and easily understandable analog and digital data displays.

The software typically features the following:

- Commanding of Valves (Open, Vent, Close)
- Requesting of Analog, Status and Diagnostic Data

The unit can also be used to simulate a Control Pod to test the functionality of the surface system. This feature is extremely helpful to test the Surface System without affecting the BOP installed pods. The interface cable will interface with the SSECP.

1.15 Distribution Unit

The Distribution Unit / Cabinet is a carbon steel painted housing with front door access. It typically has the following main features:

- Standard design for all systems
- Two units as subsea communication controller
- Profibus Interface via optical link module
- Crossover connectors for PETU
- Interface for UPS

The Distribution Unit provides the downlink to the control pods via subsea cables. Two dual processor systems are included, each in dual configuration independent:

Total: 4 x Profibus Interface Cards
4 x Power Supply Cards
4 x CPU Cards
4 x Modem Cards

All necessary electric and mechanic hardware to provide a professional unit.

1.16 BOP TEST BOX

The BOP Test Box is used to function test the BOP Stack onboard the Rig. It consists of a small box equipped with a carrying belt to walk around with, when the tests are carried out.

The Test Box is typically equipped with:

- Alphanumerically Display, 2 Lines, 20 Characters each, fluorescent type
- Two push buttons for function select
- Three illuminated pushbuttons for functions
- One enable button
- 50 m of oil resistant cable c/w connectors at both ends

Detail Description

The Test Box will be connected to the SSECP or Distribution Unit when the BOP Stack shall be operated from a remote location.

As the Test Box is not explosion proof, the operator has to enable the use of this box by a remote key switch installed in the SSECP. This will disable both panels as long as the test box is enabled. In this case, both panels will indicate that they are disabled.

Once the Test Box is enabled, it will display the selected Function on its display. The function can be changed by pressing the UP or DOWN Button on the right side of the Test Box. All functions accessible will 'scroll' through the Display.

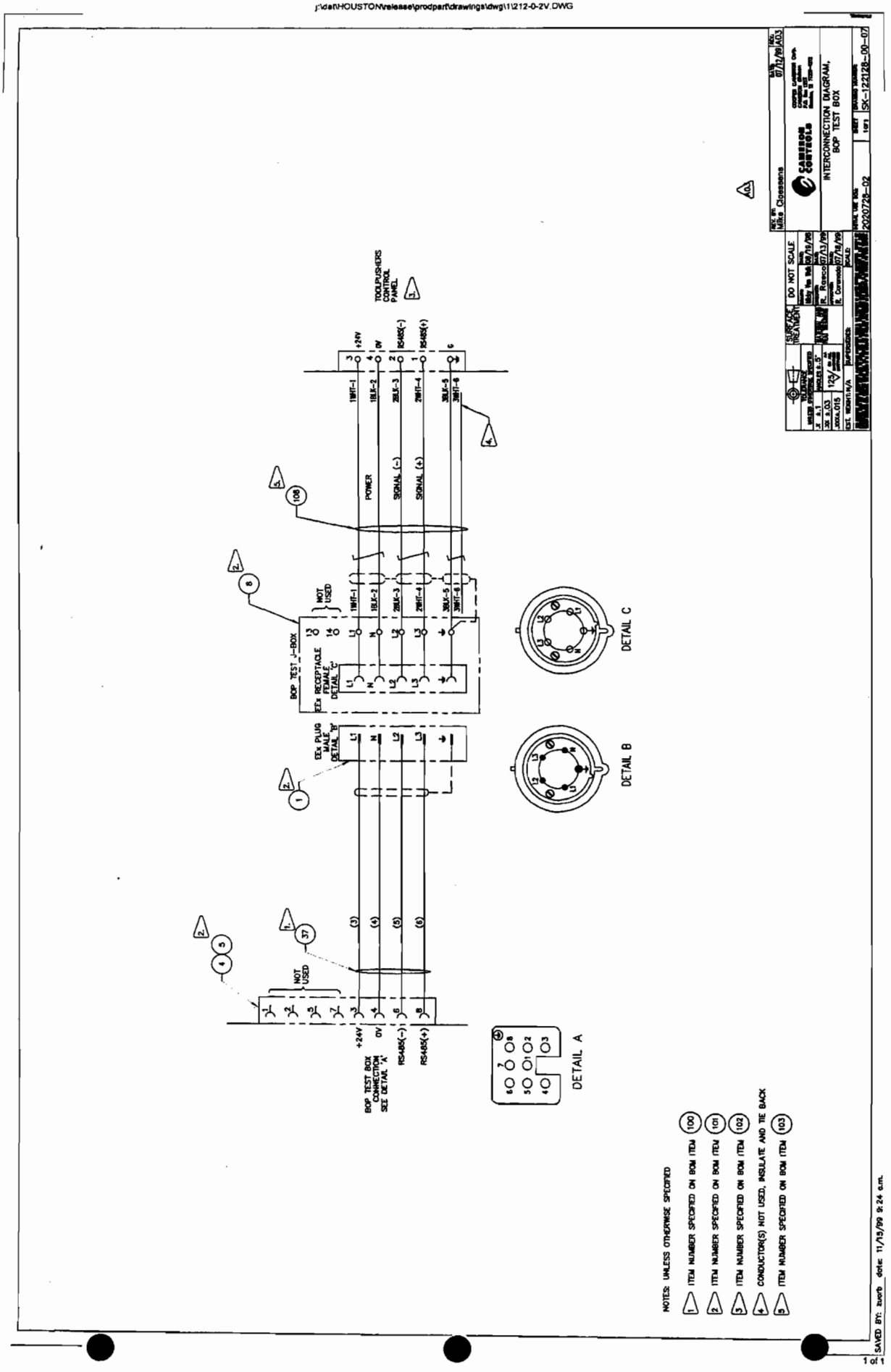
After selecting the function, the first line displays the function and the second line displays the possible actions (OPEN, CLOSE sometimes also VENT).

The function can be activated by pressing the ENABLE Button and the appropriate function button.

Technical Details

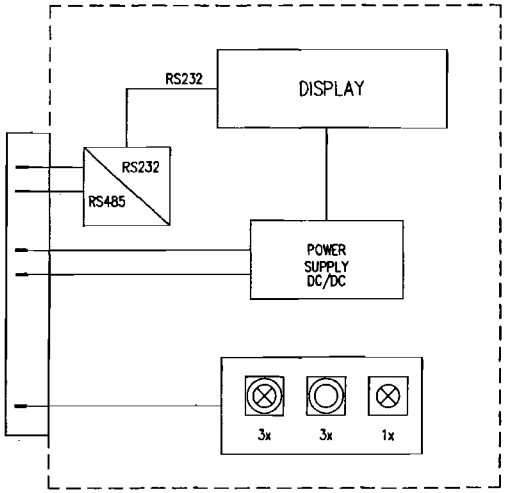
The fluorescent type display was selected due to the superior visibility compared to LC type displays.

The Box is fabricated of glass reinforced epoxy. It is fully weatherproof IP66 and can be used with gloves. To prevent mistakes, the ENABLE button has to be pressed when forcing a function.



CONFIDENTIAL
ACCESS
RESTRICTED

CAM_CIV_0000366



INTERFACE CABLES

TEST BOX — 50m — TOOLPUSHER PANEL

Rev.	Date	Name	Appr.	Remarks
B1	25.02.97	Rd	JJ	DETAIL REVISION
A1	16.10.96	Rd	Me	INITIAL RELEASE

Supersedes

CAMERON

Cameron GmbH
Lütchenweg 1
29227 Celle, Germany

Title: BLOCK DIAGRAM TEST BOX

SK-066180-22-27

PL223180-22

+ TEST BOX

Sheet 1 of 1

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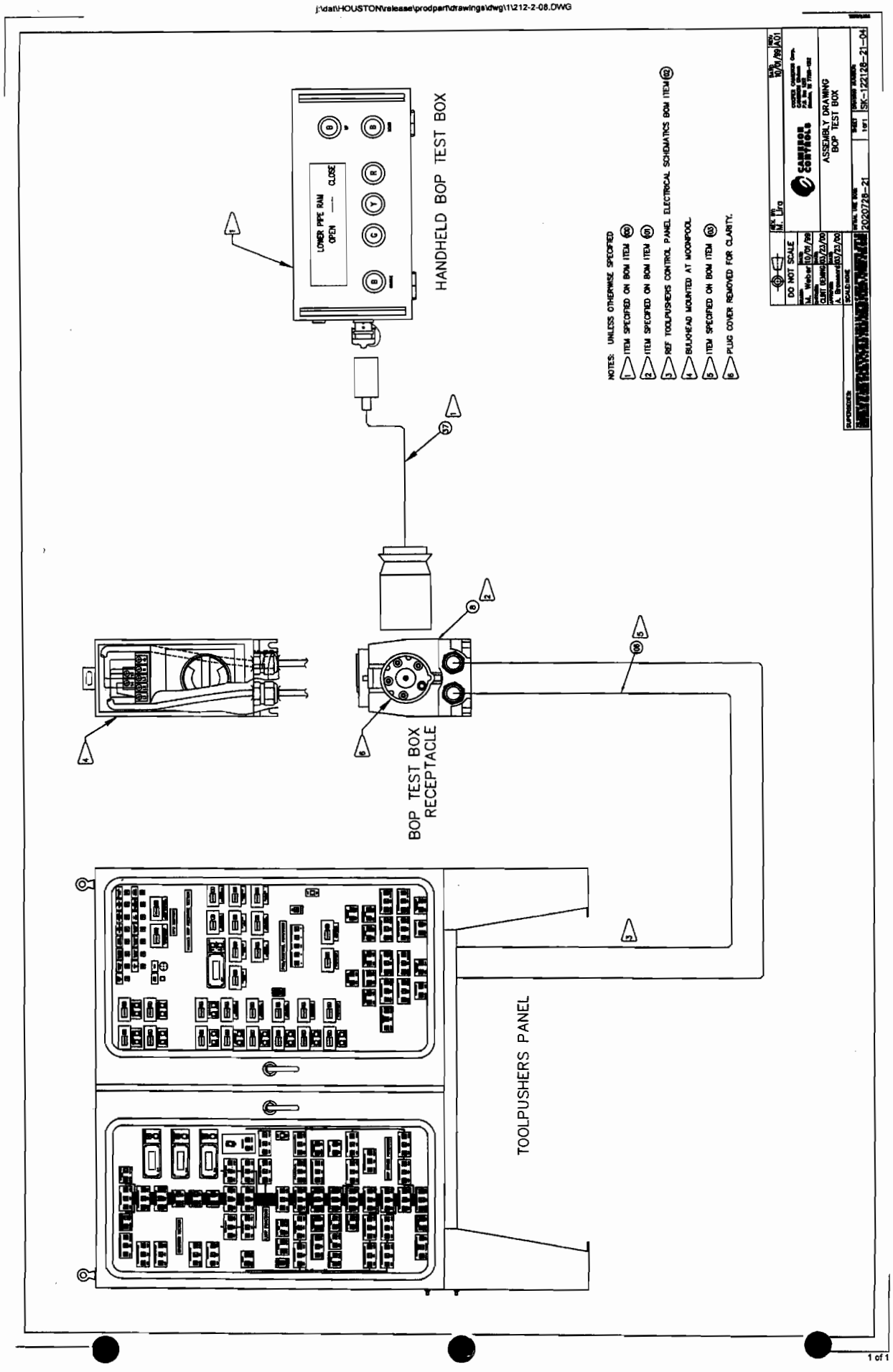


1.17 EVENT LOGGING SYSTEM (Standard version – Desk Top)

The Event Logging System is a customized unit, which is connected to the surface bus system. All system data can be recorded and analyzed and/or printed at a later stage.

The software typically features the following:

- User configurable function names and display point names
- Powerful search functions

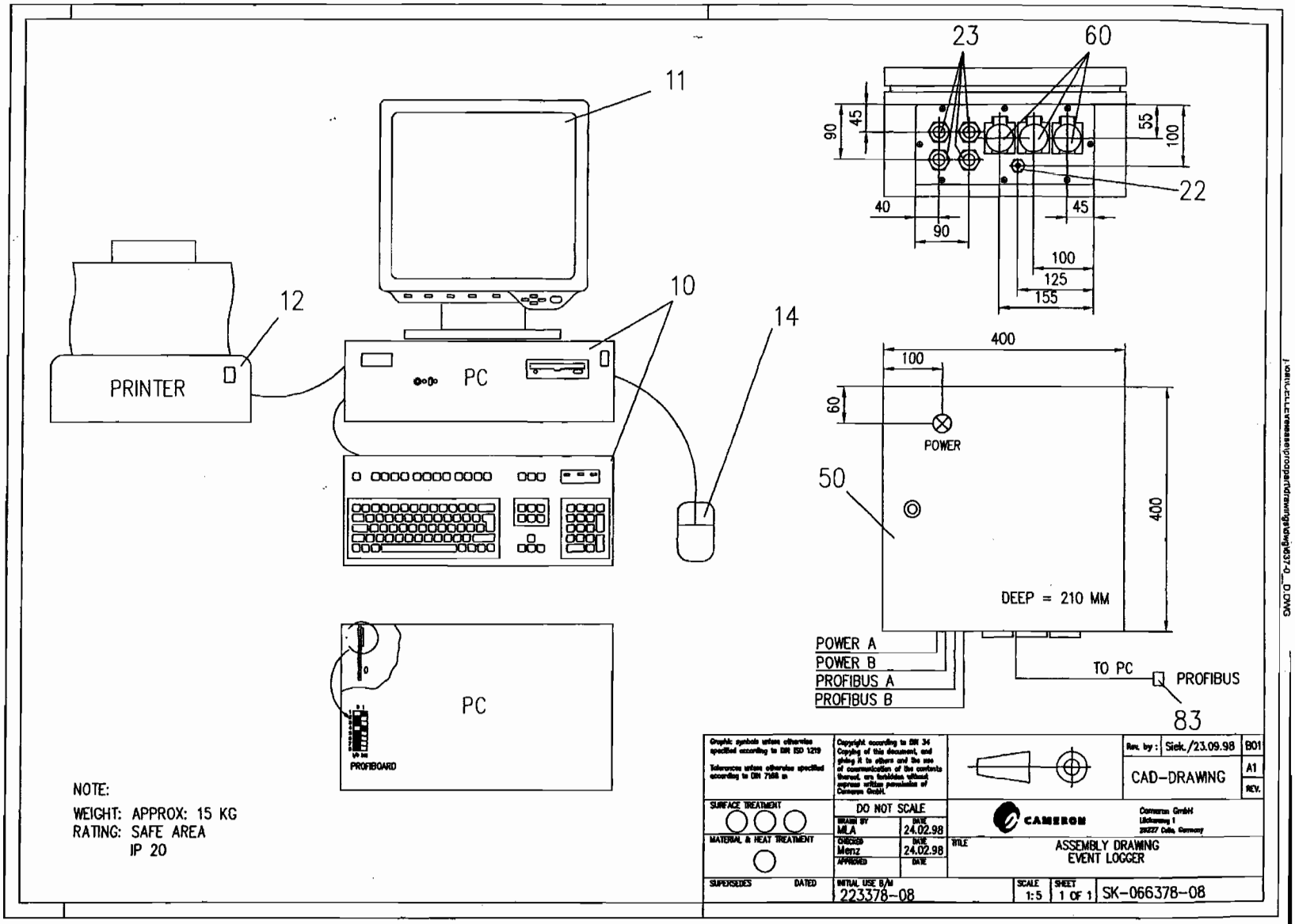
Report and data export functions including:

- Full report, all messages
- Changes initiated from the OIM Panel
- Changes initiated from the Subsea Engineer's Panel
- Changes in subsea transducer values (Deadband is free selectable)
- Inter- Panel communications

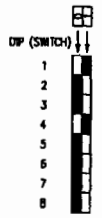
The Event Logging System is based around a desktop computer consisting of:

- IBM compatible PC
- 15" Color VGA monitor in industrial case
- Keyboard with separate trackball
- Bubble jet printer
- Profibus Interface
- Interconnection cables

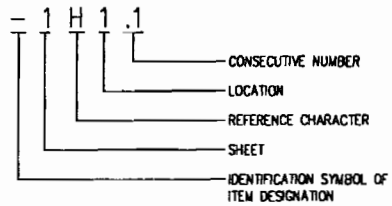
The software offers an easy-to-use interface. Information and data are displayed either on an overview screen or on a scrollable text screen. All events and significant data changes can be logged into the file system. Reports are available off-line; alternatively, the results can be exported to text processing software packages for generation of customized, printed reports.



PROFIBOARD
STANDARD JUMPER SETTING
DEFAULT: (240 hex)



ITEM DESIGNATION



LIST OF REFERENCE CHARACTER

A → AMPLIFIER; SPS COMPONENT
B → CONVERTER
C → CAPACITOR
F → FUSE; MOTOR PROTECTION
H → LAMP; HORN
K → RELAY
M → MOTOR
P → MEASURING INSTRUMENT
R → RESISTOR
S → SWITCH
T → TRANSFORMER
V → DIODE
X → TERMINAL
Y → VALVE

TERMINAL TYPE	TERMINALS
UK3N	-X1; -X2; -X3; -X4
USLKG 5	PE-TERMINALS

REMARKS:

-X1 TERMINAL BAR NO.1 FOR INPUT

-X01 TERMINAL BAR NO.1 FOR OUTPUT

-X1 TWIN TERMINALS

-X1 DOUBLE TERMINAL BLOCKS

LINE OF DEMARCATION

SCREEN

FOR INFORMATION

Rev.	Date	Name	Appr.	Remarks
B02	08.12.98	Siek.	TIM	DETAIL REVISION
B01	23.09.98	Siek.	TIM	COMPLETET REVISION
A01	24.02.98	MLA	ME	INITIAL RELEASE

CAMERON

Cameron GmbH
Lüdenweg 1
26227 Celle, Germany

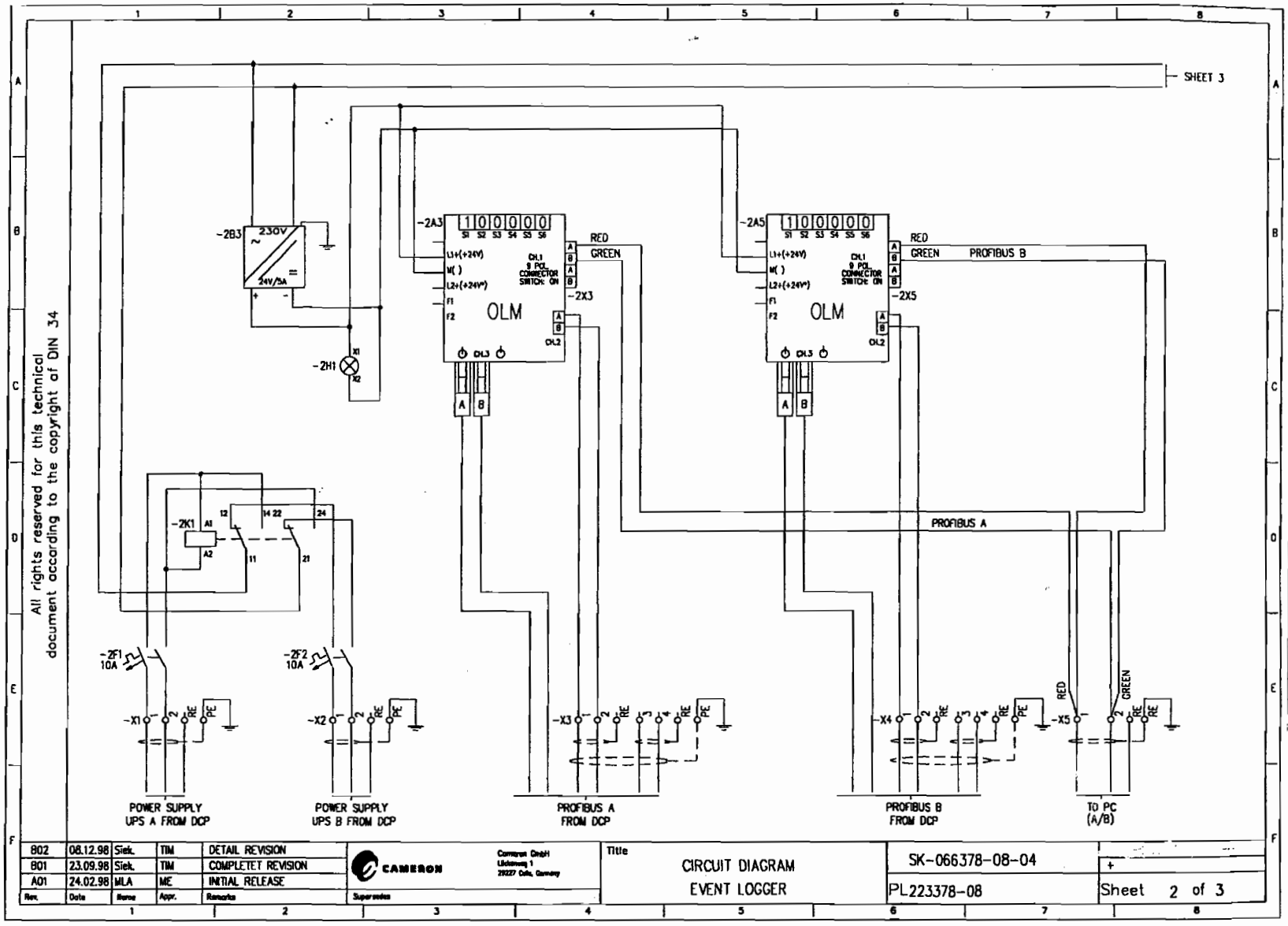
Supersedes

Title: CIRCUIT DIAGRAM EVENT LOGGER

SK-066378-08-04

PL223378-08

Sheet 1 of 3



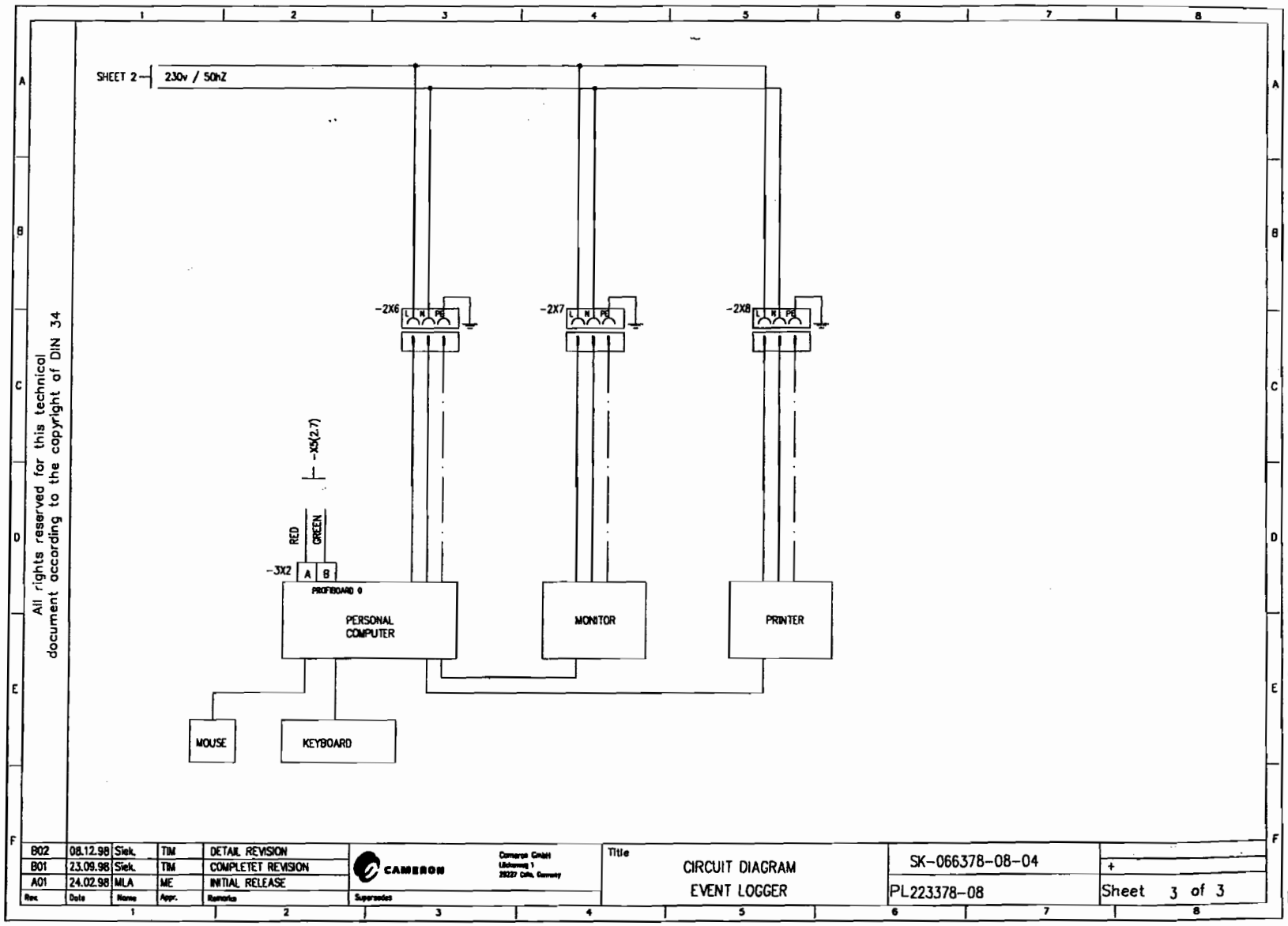
Rev.	Date	Name	Appr.	Remarks
B02	08.12.98	Siek.	TIM	DETAIL REVISION
B01	23.09.98	Siek.	TIM	COMPLETET REVISION
A01	24.02.98	MLA	ME	INITIAL RELEASE

CAMERON
Cameron GmbH
Lilienweg 1
29227 Celle, Germany
Supersedes

Title
CIRCUIT DIAGRAM
EVENT LOGGER

SK-066378-08-04
PL223378-08

Sheet 2 of 3



Rev.	Date	Name	Appr.	Remarks
B02	08.12.98	Siek.	TIM	DETAIL REVISION
B01	23.09.98	Siek.	TIM	COMPLETET REVISION
A01	24.02.98	MLA	ME	INITIAL RELEASE

CAMERON

Cameron GmbH
Ulichstraße 1
28227 Celle, Germany

Superseded

Title: CIRCUIT DIAGRAM EVENT LOGGER

SK-066378-08-04

PL223378-08

Sheet 3 of 3

1.18 FACTORY ACCEPTANCE TEST (FAT)

The control system is tested in accordance to Cameron FAT procedures with the following tests:

- Pressure test with 1.5 of the required working pressure of single units
- Function test of single unit

A function test of the complete system can be performed for an additional charge.

Customer representatives, Cameron QA personnel and service personnel typically witness the tests. DNV or an equivalent agency witnesses the tests when appropriate.

1.19 System Overview – Overall Arrangement of the MuX Drilling System

1.19.1 General Arrangement Interconnection Diagram - Multiplex BOP Control System

A general overview drawing of the system shows you that the system is located in two different areas. One area is classified as safe area and the other area is classified as hazardous area. You will find this in the above-mentioned drawing on the left top and right topside. Both of these areas will be interconnected with the two independent data bus and two independent power supply systems. All lines are indicated in black in the middle of the drawing. Basically, the hazardous area will be connected to the safe area via the data lines but also receive from two independent power supplies power. Both are the black lines called power signal "A" and power signal "B".

"Safe Area" Discussion

The safe area is typically classified as a non-explosion proof area. In the safe area, the following equipment will be located: TSP the wheelhouse panel, Junction box no. 1, the distribution cabinet A, distribution cabinet B, event logger, BOP test box and the PETU.

In looking at the General Arrangement drawing, one will notice how the equipment are inter-connected. Some of the equipment also has other electrical supply lines, which are supply lines that are not permanently mounted. The safe area includes the wall socket mounted connection cable.

Also indicated are the cables for the RS232, distribution rack cable and the BOP control pod test cable. These cables will be used in different modes. "Hazardous Area" Discussion.

The hazardous area is connected to the safe area again via the two power and two signal bus lines called power signal "A" and power signal "B. The first big unit in the hazardous area, fully explosion proof, is the HPU / and Control Box located on the Diverter Unit. Also the main control items such as the OIM CP, fully explosion -proof, is located in the hazardous area and it is connected with four independent lines to the data and power supply bus lines. The hazardous area also has junction box no. 2, junction box no. 3 and junction box no. 4.

The blue and yellow cable reels are located in the hazardous area. All the signals and the power will go from the two main data / power boxes "A" and "B" to the cable reels and via the cable reels into the subsea area. There are two signal lines and two power lines on each cable reels.

"Subsea" Discussion.

From the cable reels the system goes subsea. At the bottom of the system is the RCB. Connected to the RCB are strain gauges, the compass, and optional temperature and pressure transducers.

The RCB monitors the angle of the riser, versus the position of the bop stack. The main subsea components are the Multiplex Subsea BOP Control Pods, one Subsea Control Pod (blue) on one side and the same subsea Control Pod (yellow) on the other side.

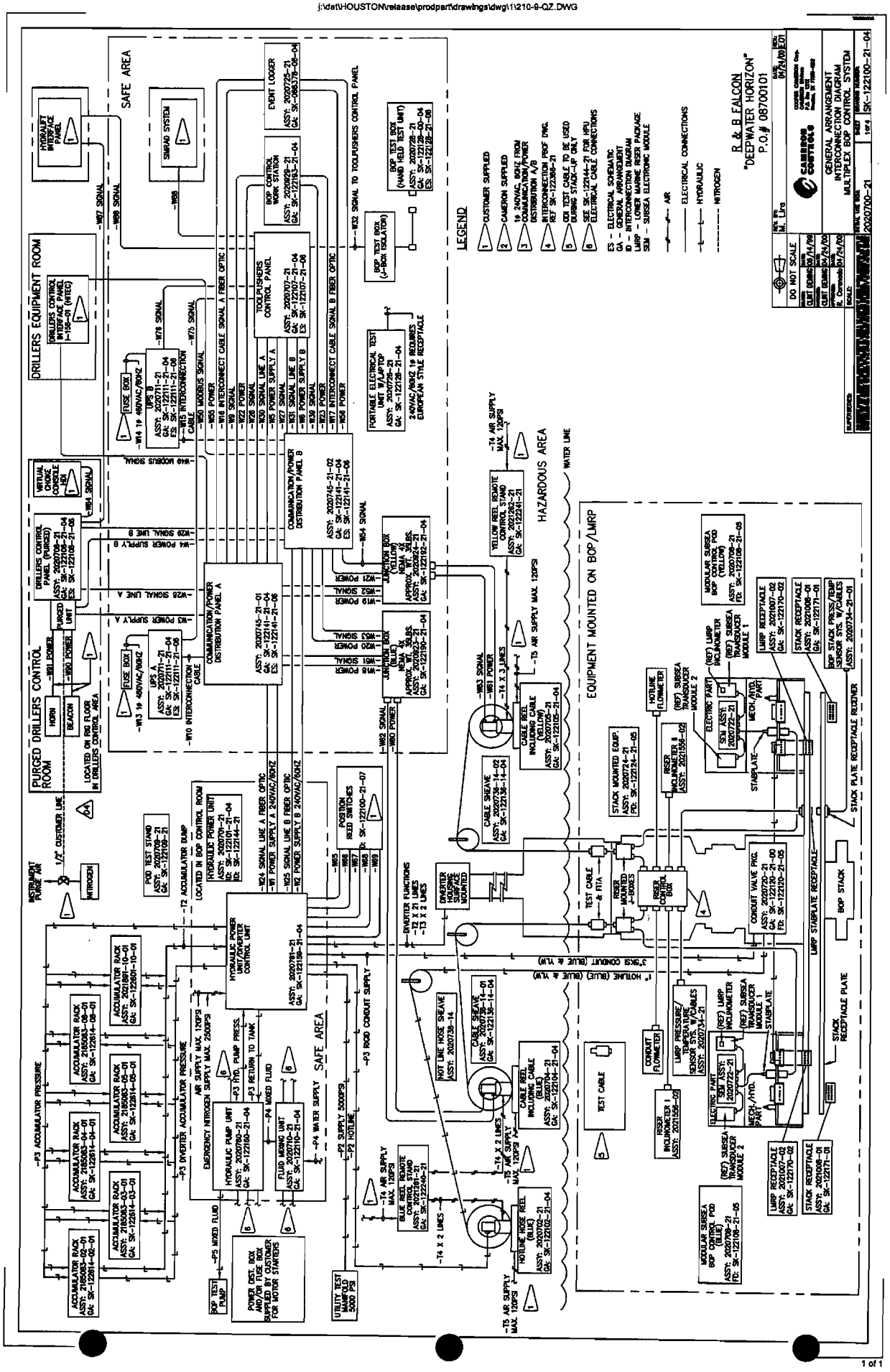
Located in the control pods are independent inclinometers that provide constant monitoring of the stack position.

On the bottom of the two pods are the hydraulic stingers and the electric connection, which transfer the electric, electronic, multiplex and hydraulic signals / functions from the pod into the base plate of the LMRP. The base plate of the LMRP is the main base to permanent or retrievably mount the control pod.

Also located on the LMRP is the mini pod assembly, which is used to connect the BOP instrumentation and the pressure temperature transducer, which is used to monitor the pressure and temperature in the bop stack. The general arrangement inter-connection drawing includes a table called connection inter-connection cable interface diagram. The table is used to give the rig engineers an overview of which cables are used to supply electrical or electronic signals from the safe area into the hazardous area. It also specifies the cable type.

The system overview drawing gives a full overview about all the components or items added to build up a multiplex drilling system for deep sea subsea drilling application. Also, the interconnection diagrams provide information about the cables needed to connect a typical Cameron system together while also indicate the interfaces provided for your rig.

All the items shown in these drawings can also be found in the Cameron Rig Manuals. The Rig Manuals include a detailed description of each system component, how it works and how it's designed. Maintenance will be shown and Cameron recommends each customer to get acquainted with the system by reviewing the applicable rig manual for the system and studying each section to identify each component shown in the general arrangement inter-connection drawing.



CABLE INTERCONNECTIONS

CABLE NO.	CONDUCTOR QTY/SIZE	CABLE CONST.	OVERALL OD (IN.)	PWR/SIG	FROM	TO	LENGTH (FT)	MFG	MFG. PART NO.	CAMERON PART NO.
-W1 [1]	3(C) #12 AWG 600V FLAME RETARDANT	UNARMORED	0.455	POWER	COMM/POWER DISTRIBUTION PANEL A	HPU/DIVERTER MAIN CONTROL PANEL	164	AMERCABLE	37-102-516	
-W2 [1]	3(C) #12 AWG 600V FLAME RETARDANT	UNARMORED	0.455	POWER	COMM/POWER DISTRIBUTION PANEL B	HPU/DIVERTER MAIN CONTROL PANEL	164	AMERCABLE	37-102-516	
-W3 [1]	3(C) #12 AWG 600V FLAME RETARDANT	UNARMORED	0.455	POWER	COMM/POWER DISTRIBUTION PANEL A	PURGED CONTROL UNIT	456	AMERCABLE	37-102-516	
-W4 [1]	3(C) #12 AWG 600V FLAME RETARDANT	UNARMORED	0.455	POWER	COMM/POWER DISTRIBUTION PANEL B	PURGED CONTROL UNIT	456	AMERCABLE	37-102-516	
-W5 [1]	3(C) #12 AWG 600V FLAME RETARDANT	UNARMORED	0.455	POWER	COMM/POWER DISTRIBUTION PANEL A	TOOLPUSHERS CONTROL PANEL	361	AMERCABLE	37-102-516	
-W6 [1]	3(C) #12 AWG 600V FLAME RETARDANT	UNARMORED	0.455	POWER	COMM/POWER DISTRIBUTION PANEL B	TOOLPUSHERS CONTROL PANEL	361	AMERCABLE	37-102-516	
-W9 [2]	6 CORE (62.5M) FIBER OPTIC MULTIMODE	UNARMORED	0.547	SIGNAL	COMM/POWER DISTRIBUTION PANEL A	BOP CONTROL WORK STATION	98	NORSK-KABEL	694134	2710983-02
-W10 [1]	3(C) #8 AWG 600V FLAME RETARDANT	UNARMORED	0.623	POWER	UPS A	COMM/POWER DISTRIBUTION PANEL A	82	AMERCABLE	37-102-309	
-W11 [1]	3(C) #12 AWG	UNARMORED	.0455	POWER 460VAC, 3ø, 60HZ, CUSTOMER	MOTOR STARTER - GLYCOL	GLYCOL MOTOR	197	AMERCABLE	37-102-516	
-W12 [1]	3(C) #12 AWG	UNARMORED	.0455	POWER 460VAC, 3ø, 60HZ, CUSTOMER	MOTOR STARTER - LUBE	LUBE MOTOR	197	AMERCABLE	37-102-516	
-W13 [1]	3(C) #10 AWG 600V FLAME RETARDANT	UNARMORED	0.508	POWER 460VAC, 1ø, 60HZ, CUSTOMER	POWER PANEL	UPS A FUSE BOX	295	AMERCABLE	37-102-308	
-W14 [1]	3(C) #10 AWG 600V FLAME RETARDANT	UNARMORED	0.508	POWER 460VAC, 1ø, 60HZ, CUSTOMER	POWER PANEL	UPS B FUSE BOX	213	AMERCABLE	37-102-308	
-W15 [1]	3(C) #8 AWG 600V FLAME RETARDANT	UNARMORED	0.623	POWER	UPS B	COMM/POWER DISTRIBUTION PANEL B	82	AMERCABLE	37-102-309	
-W16 [2]	6 CORE (62.5M) FIBER OPTIC MULTIMODE	UNARMORED	0.547	SIGNAL	COMM/POWER DISTRIBUTION PANEL A	EVENT LOGGER	98	NORSK-KABEL	694134	2710983-02
-W17 [2]	6 CORE (62.5M) FIBER OPTIC MULTIMODE	UNARMORED	0.547	SIGNAL	COMM/POWER DISTRIBUTION PANEL B	EVENT LOGGER	98	NORSK-KABEL	694134	2710983-02
-W18 [1]	3(C) #12 AWG 600V FLAME RETARDANT	UNARMORED	0.455	POWER	COMM/POWER DISTRIBUTION PANEL A	NEMA 4X BLUE J-BOX	82	AMERCABLE	37-102-516	
-W19 [1]	3(C) #12 AWG 600V FLAME RETARDANT	UNARMORED	0.455	POWER	COMM/POWER DISTRIBUTION PANEL A	NEMA 4X YELLOW J-BOX	82	AMERCABLE	37-102-516	
-W20 [1]	3(C) #12 AWG 600V FLAME RETARDANT	UNARMORED	0.455	POWER	COMM/POWER DISTRIBUTION PANEL B	NEMA 4X BLUE J-BOX	82	AMERCABLE	37-102-516	
-W21 [1]	3(C) #12 AWG 600V FLAME RETARDANT	UNARMORED	0.455	POWER	COMM/POWER DISTRIBUTION PANEL B	NEMA 4X YELLOW J-BOX	82	AMERCABLE	37-102-516	
-W22 [1]	3(C) #12 AWG 600V FLAME RETARDANT	UNARMORED	0.455	POWER	COMM/POWER DISTRIBUTION PANEL A	BOP CONTROL WORK STATION	82	AMERCABLE	37-102-516	
-W23 [1]	3(C) #12 AWG 600V FLAME RETARDANT	UNARMORED	0.455	POWER	COMM/POWER DISTRIBUTION PANEL B	BOP CONTROL WORK STATION	82	AMERCABLE	37-102-516	
-W24 [2]	6 CORE (62.5M) FIBER OPTIC MULTIMODE	UNARMORED	0.547	SIGNAL	COMM/POWER DISTRIBUTION PANEL A	HPU/DIVERTER MAIN CONTROL PANEL	197	NORSK-KABEL	694134	2710983-02
-W25 [2]	6 CORE (62.5M) FIBER OPTIC MULTIMODE	UNARMORED	0.547	SIGNAL	COMM/POWER DISTRIBUTION PANEL B	HPU/DIVERTER MAIN CONTROL PANEL	197	NORSK-KABEL	694134	2710983-02
-W26 [2]	1 TSP #16 AWG	UNARMORED	0.362	SIGNAL	COMM/POWER DISTRIBUTION PANEL A	TOOLPUSHERS CONTROL PANEL	433	AMERCABLE	37-102-610	2711847-02-16
-W27 [2]	1 TSP #16 AWG	UNARMORED	0.362	SIGNAL	COMM/POWER DISTRIBUTION PANEL B	TOOLPUSHERS CONTROL PANEL	433	AMERCABLE	37-102-610	2711847-02-16
-W28 [2]	6 CORE (62.5M) FIBER OPTIC MULTIMODE	UNARMORED	0.547	SIGNAL	COMM/POWER DISTRIBUTION PANEL A	DRILLERS CONTROL PANEL	512	NORSK-KABEL	694134	2710983-02
-W29 [2]	6 CORE (62.5M) FIBER OPTIC MULTIMODE	UNARMORED	0.547	SIGNAL	COMM/POWER DISTRIBUTION PANEL B	DRILLERS CONTROL PANEL	512	NORSK-KABEL	694134	2710983-02
-W30 [2]	6 CORE (62.5M) FIBER OPTIC MULTIMODE	UNARMORED	0.547	SIGNAL	COMM/POWER DISTRIBUTION PANEL A	TOOLPUSHERS CONTROL PANEL	433	NORSK-KABEL	694134	2710983-02
-W31 [2]	6 CORE (62.5M) FIBER OPTIC MULTIMODE	UNARMORED	0.547	SIGNAL	COMM/POWER DISTRIBUTION PANEL B	TOOLPUSHERS CONTROL PANEL	433	NORSK-KABEL	694134	2710983-02
-W32 [2]	3 TSP #16 AWG	UNARMORED	0.847	SIGNAL	TOOLPUSHERS CONTROL PANEL	BOP TEST BOX (J-BOX ISOLATOR)	39	AMERCABLE	37-102-612	2711847-06-16

NOTES:

ALL POWER CABLES SUPPLYING 240VAC, 60HZ UNLESS OTHERWISE INDICATED.
(C) - # OF COPPER CONDUCTORS
TSP - # OF TWISTED SHIELDED PAIRS
ALL SPARE CONDUCTORS MUST BE GROUNDED AT ONE END ONLY

CONTINUED ON SHEET 3

R & B FALCON
"DEEPWATER HORIZON"
P.O. #08700101

DO NOT SCALE	DRAWN M. Graham 10/26/09	REV. BY M. Lira	DATE 04/24/09 REV. E01
	CHECKED	APPROVED	
SUPERSEDES	SCALE		

CAMERON CONTROLS — COOPER CAMERON Corp.

GENERAL ARRANGEMENT
INTERCONNECTION DIAGRAM
MULTIPLEX BOP CONTROL SYSTEM

SERIAL USE NOS.	SHEET	DRAWING NUMBER
2020700-21	2 OF 4	SK-122100-21-04

CABLE INTERCONNECTIONS

CABLE NO.	CONDUCTOR QTY/SIZE	CABLE CONST.	OVERALL OD (IN.)	PWR/SIG	FROM	TO	LENGTH (FT)	MFG	MFG PART NO.	CAMERON PART NO.
-W38 (2)	3 TSP #16 AWG	UNARMORED	0.647	SIGNAL	HPU/DIVERTER CONTROL UNIT	PUMP SKID ELECTRICAL J-BOX 1	98	AMERCABLE	37-102-612	2711847-06-16
-W39 (2)	6 CORE (62.5M) FIBER OPTIC MULTIMODE	UNARMORED	0.547	SIGNAL	COMM/POWER DISTRIBUTION PANEL B	BOP CONTROL WORK STATION	98	NORSK-KABLE	694184	2710983-02
-W40 (2)	24(C) #16 AWG	UNARMORED	0.879	SIGNAL	HPU/DIVERTER CONTROL UNIT	PUMP SKID ELECTRICAL J-BOX 1	98	AMERCABLE	37-102-525	2711846-24-16
-W41 (2)	4C) #16 AWG	UNARMORED	0.412	SIGNAL	HPU/DIVERTER CONTROL UNIT	MIXING UNIT	157	AMERCABLE	37-102-529	2711846-04-16
-W42 (2)	24(C) #16 AWG	UNARMORED	0.879	SIGNAL	HPU/DIVERTER CONTROL UNIT	MIXING UNIT	157	AMERCABLE	37-102-525	2711846-24-16
-W43 (2)	7(C) #14 AWG	UNARMORED	0.527	SIGNAL: START, RUN & OVERCURRENT TO PLC (24VDC)	PUMP SKID ELECTRICAL J-BOX 1	MOTOR STARTER 1 - CUSTOMER SUPPLIED	216	AMERCABLE	37-102-521	2711846-07-14
-W44 (2)	7(C) #14 AWG	UNARMORED	0.527	SIGNAL: START, RUN & OVERCURRENT TO PLC (24VDC)	PUMP SKID ELECTRICAL J-BOX 1	MOTOR STARTER 2 - CUSTOMER SUPPLIED	433	AMERCABLE	37-102-521	2711846-07-14
-W45 (2)	7(C) #14 AWG	UNARMORED	0.527	SIGNAL: START, RUN & OVERCURRENT TO PLC (24VDC)	PUMP SKID ELECTRICAL J-BOX 1	MOTOR STARTER 3 - CUSTOMER SUPPLIED	216	AMERCABLE	37-102-521	2711846-07-14
-W46 (2)	7(C) #14 AWG	UNARMORED	0.527	SIGNAL: START, RUN & OVERCURRENT TO PLC (24VDC)	MIXING SKID ELECTRICAL J-BOX 1	GLYCOL MOTOR STARTER - CUSTOMER SUPPLIED	236	AMERCABLE	37-102-521	2711846-07-14
-W47 (2)	7(C) #14 AWG	UNARMORED	0.527	SIGNAL: START, RUN & OVERCURRENT TO PLC (24VDC)	MIXING SKID ELECTRICAL J-BOX 1	LUBE MOTOR STARTER - CUSTOMER SUPPLIED	236	AMERCABLE	37-102-521	2711846-07-14
-W49 (2)	6 CORE (62.5M) FIBER OPTIC MULTIMODE	UNARMORED	0.609	SIGNAL	COMM/POWER DISTRIBUTION PANEL A	HITEC LOGGER WORK STATION	512	NORSK-KABEL	694134	2710983-02
-W50 (2)	6 CORE (62.5M) FIBER OPTIC MULTIMODE	UNARMORED	0.609	SIGNAL	COMM/POWER DISTRIBUTION PANEL B	HITEC LOGGER WORK STATION	512	NORSK-KABEL	694134	2710983-02
-W51 (2)	1 TSP #16 AWG	UNARMORED	0.362	SIGNAL	COMM/POWER DISTRIBUTION PANEL A	NEMA 4X BLUE J-BOX	98	AMERCABLE	37-102-610	2711847-02-16
-W52 (2)	1 TSP #16 AWG	UNARMORED	0.362	SIGNAL	COMM/POWER DISTRIBUTION PANEL A	NEMA 4X YELLOW J-BOX	98	AMERCABLE	37-102-610	2711847-02-16
-W53 (2)	1 TSP #16 AWG	UNARMORED	0.362	SIGNAL	COMM/POWER DISTRIBUTION PANEL B	NEMA 4X BLUE J-BOX	98	AMERCABLE	37-102-610	2711847-02-16
-W54 (2)	1 TSP #16 AWG	UNARMORED	0.362	SIGNAL	COMM/POWER DISTRIBUTION PANEL B	NEMA 4X YELLOW J-BOX	98	AMERCABLE	37-102-610	2711847-02-16
-W55 (1)	3(C) #12 AWG, 600V FLAME RETARDANT	UNARMORED	0.455	POWER	COMM/POWER DISTRIBUTION PANEL A	EVENT LOGGER	82	AMERCABLE	37-102-516	
-W56 (1)	3(C) #12 AWG, 600V FLAME RETARDANT	UNARMORED	0.455	POWER	COMM/POWER DISTRIBUTION PANEL B	EVENT LOGGER	82	AMERCABLE	37-102-516	
-W57 (1)	3(C) #2/0 AWG, 600V	UNARMORED	1.440	POWER 460VAC, 3ø, 60HZ	MOTOR STARTER 1, CUSTOMER SUPPLIED	PUMP SKID - MOTOR 1	184	AMERCABLE	37-102-317	
-W58 (1)	3(C) #2/0 AWG, 600V	UNARMORED	1.440	POWER 460VAC, 3ø, 60HZ	MOTOR STARTER 2, CUSTOMER SUPPLIED	PUMP SKID - MOTOR 2	361	AMERCABLE	37-102-317	
-W59 (1)	3(C) #2/0 AWG, 600V	UNARMORED	1.440	POWER 460VAC, 3ø, 60HZ	MOTOR STARTER 3, CUSTOMER SUPPLIED	PUMP SKID - MOTOR 3	184	AMERCABLE	37-102-317	
-W60 (1)	6(C) #12 AWG, 600V	UNARMORED	0.584	POWER	NEMA 4X BLUE J-BOX	BLUE CABLE REEL J-BOX	213	AMERCABLE	37-102-547	
-W61 (1)	6(c) #12 AWG, 600V	UNARMORED	0.584	POWER	NEMA 4X YELLOW J-BOX	YELLOW CABLE REEL J-BOX	246	AMERCABLE	37-102-547	
-W62 (2)	2 TSP #16 AWG	UNARMORED	0.609	SIGNAL	NEMA 4X BLUE J-BOX	BLUE CABLE REEL J-BOX	256	AMERCABLE	37-102-611	2710946-02-16
-W63 (2)	2 TSP #16 AWG	UNARMORED	0.609	SIGNAL	NEMA 4X YELLOW J-BOX	YELLOW CABLE REEL J-BOX	295	AMERCABLE	37-102-611	2710946-02-16

CONTINUED ON SHEET 4

NOTES:

ALL POWER CABLES SUPPLYING 240VAC, 60HZ UNLESS OTHERWISE INDICATED.
(C) - # OF COPPER CONDUCTORS
TSP - # OF TWISTED SHIELDED PAIRS
ALL SPARE CONDUCTORS MUST BE GROUNDED AT ONE END ONLY

R & B FALCON
"DEEPWATER HORIZON"
P.O.# 08700101

REV. BY: M. Lira	DATE: 04/24/09	REV: E01
DO NOT SCALE		
DRAWN: M. Graham	DATE: 10/28/99	
CHECKED:	DATE:	
APPROVED:	DATE:	
SUPERSEDES:	SCALE:	

CAMERON CONTROLS — COOPER CAMERON Corp., CAMERON Division, P.O. Box 1212, Houston, TX 77251-1212

GENERAL ARRANGEMENT
INTERCONNECTION DIAGRAM
MULTIPLEX BOP CONTROL SYSTEM

SPOOL DWG NO.	SHEET	DRAWING NUMBER
2020700-21	3 OF 4	SK-122100-21-04

CABLE INTERCONNECTIONS

CABLE NO.	CONDUCTOR QTY/SIZE	CABLE CONST.	OVERALL OD (IN.)	PWR/SIG	FROM	TO	LENGTH (FT)	MFG	MFG. PART NO.	CAMERON PART NO.
-W65 [2]	2(C) #16 AWG	UNARMORED	0.383	SIGNAL	NEMA 4X J-BOX	CUSTOMER INTERFACE (REED SWITCHES)	411 [E1]	AMERCABLE	37-102-501	2711846-02-16
-W66 [2]	2(C) #16 AWG	UNARMORED	0.383	SIGNAL	NEMA 4X J-BOX	CUSTOMER INTERFACE (REED SWITCHES)	411 [E1]	AMERCABLE	37-102-501	2711846-02-16
-W67 [2]	2(C) #16 AWG	UNARMORED	0.383	SIGNAL	NEMA 4X J-BOX	CUSTOMER INTERFACE (REED SWITCHES)	411 [E1]	AMERCABLE	37-102-501	2711846-02-16
-W68 [2]	2(C) #16 AWG	UNARMORED	0.383	SIGNAL	NEMA 4X J-BOX	CUSTOMER INTERFACE (REED SWITCHES)	411 [E1]	AMERCABLE	37-102-501	2711846-02-16
-W69 [2]	2(C) #16 AWG	UNARMORED	0.383	SIGNAL	NEMA 4X J-BOX	CUSTOMER INTERFACE (REED SWITCHES)	411 [E1]	AMERCABLE	37-102-501	2711846-02-16
-W71 [1]	4(C) #16 AWG	UNARMORED	0.412	MOTOR CONTROL: HEATERS & THERM 120VAC 1Ø	PUMP SKID PUMP 1 - MOTOR STARTER J-BOX 1	PUMP SKID - MOTOR 1	164	AMERCABLE	37-102-529	
-W72 [1]	4(C) #16 AWG	UNARMORED	0.412	MOTOR CONTROL: HEATERS & THERM 120VAC 1Ø	PUMP SKID PUMP 2 - MOTOR STARTER J-BOX 1	PUMP SKID - MOTOR 2	361	AMERCABLE	37-102-529	
-W73 [1]	4(C) #16 AWG	UNARMORED	0.412	MOTOR CONTROL: HEATERS & THERM 120VAC 1Ø	PUMP SKID PUMP 3 - MOTOR STARTER J-BOX 1	PUMP SKID - MOTOR 3	164	AMERCABLE	37-102-529	
-W75 [2]	1 TSP #16 AWG	UNARMORED	0.362	SIGNAL	UPS A	TOOLPUSHERS CONTROL PANEL	433	AMERCABLE	37-102-610	2711847-02-16
-W76 [2]	1 TSP #16 AWG	UNARMORED	0.362	SIGNAL	UPS B	TOOLPUSHERS CONTROL PANEL	433	AMERCABLE	37-102-610	2711847-02-16
-W77 [1]	4(C) #14 AWG	UNARMORED	0.448	MOTOR CONTROL: HAND - OFF - AUTO	LOCAL CONTROL STATION	MOTOR STARTER 1 - CUSTOMER SUPPLIED	164	AMERCABLE	37-102-509	
-W78 [1]	4(C) #14 AWG	UNARMORED	0.448	MOTOR CONTROL: HAND - OFF - AUTO	LOCAL CONTROL STATION	MOTOR STARTER 2 - CUSTOMER SUPPLIED	361	AMERCABLE	37-102-509	
-W79 [1]	4(C) #14 AWG	UNARMORED	0.448	MOTOR CONTROL: HAND - OFF - AUTO	LOCAL CONTROL STATION	MOTOR STARTER 3 - CUSTOMER SUPPLIED	164	AMERCABLE	37-102-509	
-W80 [1]	3(C) #12 AWG 600V FLAME RETARDANT	UNARMORED	0.455	POWER 460VAC, 3Ø, 60HZ	MOTOR STARTER - CUSTOMER SUPPLIED	PUMP SKID - RECIRCULATING PUMP	TBD	AMERCABLE	37-102-516	
-W81 [1]	4(C) #14 AWG	UNARMORED	0.448	MOTOR CONTROL: ON - OFF	LOCAL CONTROL STATION	RECIRCULATING PUMP MOTOR STARTER - CUSTOMER SUPPLIED	TBD	AMERCABLE	37-102-509	
-W82 [1]	4(C) #14 AWG	UNARMORED	0.448	MOTOR CONTROL: HAND - OFF - AUTO	LOCAL CONTROL STATION	GLYCOL MOTOR STARTER - CUSTOMER SUPPLIED	197	AMERCABLE	37-102-509	
-W83 [1]	4(C) #14 AWG	UNARMORED	0.448	MOTOR CONTROL: HAND - OFF - AUTO	LOCAL CONTROL STATION	LUBE MOTOR STARTER - CUSTOMER SUPPLIED	197	AMERCABLE	37-102-509	
-W84 [2]	4 TSP #16 AWG	UNARMORED	0.671	SIGNAL	DRILLERS CONTROL PANEL	VIRTUAL CHOKE CONSOLE HDI	66	AMERCABLE	37-102-613	2711847-08-16
-W86 [2]	1 TSP #16 AWG	UNARMORED	0.362	SIGNAL	TOOLPUSHERS CONTROL PANEL	HYDRALIFT INTERFACE PANEL	263	AMERCABLE	37-102-610	2711847-02-16
-W87 [2]	1 TSP #16 AWG	UNARMORED	0.362	SIGNAL	DRILLERS CONTROL PANEL	HYDRALIFT INTERFACE PANEL	492	AMERCABLE	37-102-610	2711847-02-16
-W88 [2]	2 TSP #16 AWG	UNARMORED	0.609	SIGNAL	TOOLPUSHERS CONTROL PANEL	SIMRAD (DPC-32 IN PROCESS EQUIP. ROOM, STBD)	100	AMERCABLE	37-102-611	2710846-02-16
-W90 [1]	3(C) #16 AWG	UNARMORED	0.392	POWER	DRILLERS CONTROL PANEL	BEACON	TBD	AMERCABLE	37-102-502	
-W91 [1]	3(C) #16 AWG	UNARMORED	0.392	POWER	DRILLERS CONTROL PANEL	HORN	TBD	AMERCABLE	37-102-502	

NOTES:

ALL POWER CABLES SUPPLYING 240VAC, 60HZ UNLESS OTHERWISE INDICATED.

(C) - # OF COPPER CONDUCTORS

TSP - # OF TWISTED SHIELDED PAIRS

ALL SPARE CONDUCTORS MUST BE GROUNDED AT ONE END ONLY

R & B FALCON
"DEEPWATER HORIZON"
P.O.# 087001D1

DO NOT SCALE	REV. BY: M. Lira	DATE: 04/24/00	REV: E.01
DRAWN: M. Graham 10/26/99	CAMERON CONTROLS		
CHECKED: CURT DEMEO 04/24/00	GENERAL ARRANGEMENT INTERCONNECTION DIAGRAM MULTIPLEX BOP CONTROL SYSTEM		
APPROVED: R. Consoeda 04/24/00			
SUPERSEDES:	SCALE:	ORIGINAL DWG. SIZE: 2020700-21	SHEET: 4 of 4
			DRAWING NUMBER: SK-122100-21-04

1 of 1

1.20 General Arrangement Subsea BOP Control System

This drawing will be used to show you the hydraulic power generation and the hydraulic flow of the overall system. Also, the electronic panels are listed and drawn and the inter-connection is shown.

On this drawing you see on the top left side the hydraulic power unit. This hydraulic power unit generates with the pump assemblies, the hydraulic pressure and flow for the overall system. On a four pump system where two pumps have sufficient capacity to power the system, two of the four pumps are connected to the normal power supply of the rig. The two other pumps are connected to the emergency electrical system of the rig in the case of power failure of the standard system. The emergency system will then supply the two hydraulic pump units with the electric motors, the necessary energy for the system in an emergency operation. The hydraulic power unit is built in a frame, which contains the tank on the left side, sometimes also, a lubricant tank, but the system is also available with a separate lubricant unit. In the middle you see the hydraulic pumps and on the right side the explosion proof control boxes to start and stop the pumps and monitor the system. The hydraulic power unit is connected with the bus interface to the overall system.

The hydraulic power unit generates water-based fluids as hydraulic media as recommended in the rig manuals. The hydraulic fluid power is supplied first to the accumulator racks. The size of the accumulator racks depends on the system and certification requirements.

Rig air must be supplied to the air valves in the hydraulic power unit. The hydraulic supply connection line to the accumulator racks should be at least 1½ inch. There is also a return line from the accumulators into the HPU for bleeding the accumulators. There are two standardized pressures for the hydraulic power units, the normal version is 3000 psi; up while the deep-sea version is 5000 psi WP.

All rig components must be sized to the relevant pressure level.

The HPU also supplies hydraulic power to the conduit lines "blue" and "yellow". These are lines on the left side in the middle of the drawing going subsea to the conduit valve assembly. These conduit lines are mounted on the riser. The minimum requirement, which is dependent of the water depths, is 2 inch. . The size of the conduit lines depends on the pressure, the water depths of the rig, the accumulator fluid storage you have on the surface, and also the accumulators located on the BOP stack.

The hydraulic fluid will be supplied subsea by the "yellow" or "blue" conduit lines into the subsea conduit valve assemblies. Which line will be used can be selected. This will be done via the panels or by hand in the HPU so either lines can be used for supply. In the standard system, the conduit valve assembly exhausts the return fluid into the sea.

An option available for conduit valve assembly is to have one conduit line used for supplying hydraulic fluid subsea and one conduit line used to retrieve fluid to the surface. Thus, no fluid is discharged into the sea.

The conduit valve assembly is described in the rig manual. The conduit valve assembly will supply the fluid to the receptacles of the Cameron control pod. You see the two control pods at the bottom of the drawing left and middle. Via the stingers, the hydraulic fluid will be transferred into the bottom section of the pod

where the main valves are located. The top section of the multiplex modular control pod is designed to implement the electronic vessel and also the solenoid valves. The solenoid valves are used to supply hydraulic into the bottom section and operating main valves and the main valves will operate through the receptacles, the hydraulic fluid through the LRP to plate and rings into the BOP stack.

1.22 Hydraulic Fluid Supply Diverter System

The other hydraulic supply also used from the HPU is for the Diverter System. This supply in volume and pressure is always tailor made and customer specific. One possible system is shown in principle on the right bottom side of the drawing. There you will see the following valve functions:

- Fill Up Valve
- Discharge Overboard Valve
- Discharge Circulation System
- Diverter Packer
- Insert Packer Lockdown Dogs
- Fluid Seals
- Diverter Log Down Dogs
- Upper Slip Joint
- Lower Slip Joint

These functions are located on the Diverter Control Panel.

1.21 How does it work?

The hydraulics will be controlled by the OIM CP, SSECP or the PETU. An electrical signal is supplied via the cable reels into the subsea multiplex electronics. The electronics energize the solenoid valves in the top multiplex package. The solenoid valves supply hydraulic fluid through the middle pod connection plate, which separates the top and bottom package of the pod. The hydraulic fluid flowing from the solenoid shifts one of the main valves or adjusts the regulators to the relevant/ chosen pressure.

The main supply is sent via the conduit valve assembly through the bottom section, the main valves or regulators and directly into the BOP Stack / Units. The hydraulic fluid operates the BOP Pistons or Gate Valve Actuators.

2 HOW THE ELECTRONIC SYSTEM WORKS – MUX CONTROL SYSTEM ELECTRONICS

2.1 MULTIPLEX CONTROLS SYSTEM ELECTRONIC OVERVIEW

This drawing shows the complete Cameron Multiplex Drilling System. The drilling system in this drawing consists of six main sections. a) Touchscreen Control Panel, b) OIM Control Panel, c) Subsea Engineer Control Panel, d & e) Communication Distribution Panels A&B, f) hydraulic power unit. These four panels are located at the deck in the safe or explosion proof area, and connected with the distribution cabinets (A & B).

The other key items that you see is the subsea part: The multiplex package of the yellow pod on the bottom of the left side of the drawing and the multiplex package blue pod on the right side on the bottom of the drawing.

All this is connected to the distribution cabinets by the yellow MUX cable and the blue MUX cable. The drawing also shows on the middle right side the uninterruptable power supply called UPS "A" and UPS "B" (Not to be supplied to Transocean by Cameron). On the right side top of the drawing you see the connection points to the event logger, which is the item that monitors the complete system surface and the subsea.

The multiplex control system electronic overview drawing shows also the key items of the overall systems. The main components are exchangeable so that the daughter boards that you will see in the drawing for the output/input CPU's and interfaces are same on surface as subsea, so a maximum interchangeability is given for the system. The Subsea Engineer's Control Panel, OIM & HPU are equipped with the same type of hardware: analog output card, digital input card, digital output card, CPU, Profibus interfaces and the power supplies. The same components exist in all three locations.

The same daughter boards exist in the distribution cabinets "A" and "B", which are Profibus interface, power supply, CPU and modems. In the next chapter, we will explain the signal flow, so that you have an understanding of the system. Before, I would like to point out, that similar elements would be found in the subsea package. You also have the CPU's, the power supplies, the modems, the solenoid power supply, the solenoid driver cards, the analog input cards and the RS 485 interface cards. So everywhere the system has similar components in use. As you will see in the drawings, we have one processor in each panel on the surface, dual processors in the distribution cabinets (one in each distribution cabinet) for the important subsea communication part and we also have dual CPUs in the multiplex yellow pod and multiplex blue pod. So, it's a fully dual redundant system with dual independent highways. This dual concept is distributed through the whole unit.

You see that the Profibus interface marked black in the drawing and the Profibus interface marked red in the drawing are totally independent from each other, so you have two independent systems from top to bottom. Also, the uninterruptable powers supplies "A" and uninterruptable power supply "B" supplying independent the power to the different data bus and power distribution system. This guaranties that a failure in one of the

system will not effect the availability of the overall system. The UPS "A" and "B" can be also be switched so that the breakdowns in one of the UPS will not shutdown the system. Also, be aware that the UPS system is monitored by all processors. We will now explain how the data transfer will be done in the system.

2.2 Control and Data-Acquisition

The key element in the systems is the input/output devices and the communication that interconnect them all. The communication system depends on various programmable logic controllers (PLC) and the way they communicate. These PLCs you see in each of the main items shown in the drawing: Multiplex Control System Electronic Overview. The PLCs are configured in the following way: they have the analog output cards, the digital input cards, the digital output cards, the CPU's, the Profibus cards and the power supply. All this is what the electronic engineers call PLC (Programmable Logic Controllers). So, every key element of the drilling system is equipped with one of these PLCs or in dual mode with dual PLCs. Basically, all the surface PLCs are connected to a common bus pair of conductors shown in the drawing in red and black. Each PLC, depending on how its logic has been programmed, reads certain or all binary "messages" created by another PLC on the bus. Each PLC can generate a message. The bus requires that a valid message meets certain requirements of the bus with the regards to number, arrangement and size of pulses. This is the bus "protocol". We use in our system: Profibus. Message security is assured by two check routines: first, each message must be in the right format, and second a 16-bit message is generated at the end of each message on which a cyclic redundancy check (CRC) is performed. Years of use in military, industrial, and computer applications have proved the CRC technique.

When a message passes these two security checks, there is virtually nor chance that a faulty message will be accepted, nor that a message will reach the wrong address or initiate any but the desired action. To your understanding of the system that means every single message is equipped with addresses or numbers so that the right processor will do the right action as needed.

Messages between the surface units and the subsea pods are handled through modems, in the drawing you will see this distribution cabinet "A" and distribution cabinet "B" include inside each two of each modems, that means in totally four modems for safety reasons. An uninterruptable power supply (UPS) supplies 24 volt DC to the power PLCs and other electronic components. The hydraulic power unit supplies hydraulic fluid as explained before to actuate cylinders on the BOPs and also related units, like gate valves or connectors. As you will remember on the bottom of the drawing you will see the solenoid valves which are trigged from both sides of independent computer systems because they are dual coiled solenoids. This is clearly shown in the multiplex package "yellow" pod and "blue" pod. You will see that the solenoid driver card get from each side an output line into the solenoid valve and the dual coils are independent activated by the processor system. This guaranties maximum availability and also state of the art technology.

The blue and yellow subsea pods both operate continuously.

One is the active pod and the other is operating in a "hot standby mode" so it can take over should fault develop in the active pod.

2.3 Multiplex Control System Message Overview

We will go through a simplified communication review of the system to give you an impression how the data's get exchanged in the units. For simplification this drawing shows only one Profibus, that is the red colored Profibus connection. So you will see again the main components the Subsea Engineers' Control Panel, OIM and the hydraulic power unit. Connected is the red Profibus, that means the red data communication bus, also for simplification for explanation views the red data bus subsea via modem as indicated in the drawing in the middle on the subsea communication controller called controller "B" and the downlink is the modem in green color to the blue pod, this means the system working now in the blue mode that means that all processors working the in blue communication arrangement.

In general form, as you see in this drawing each of the panels supplies unit status data's simultaneously. They also receive subsea analog data, subsea status data and unit status data. That means that each panel knows in which condition the panels or the partner panels are, but they also know the conditions of the communication controllers and the subsea PLCs. What happened in simple form is the full exchange or permanent communication between all the controllers or PLCs. On the subsea side there is a permanent exchange of valve command going subsea if directed or controlled by the PLCs on the surface and there is a permanent data flow of analog data, starter data and valve command answers. This will guarantee a permanent active and self-checking and safe system.

2.4 How does the Communication work?

The PLCs in the OIM, the SSECP and the four communication units are connected to the Profibus and each read all messages appearing on the bus.

A PLC in the HPU interface reads only the pushbuttons on the OIM and SSECP and send backs a status signal to confirm a control action. Subsea communication controllers in the blue and yellow pods communicate with the Profibus communication controllers via modems. The communication controllers communicate with the SEM PLCs. Essentially, all PLCs and communication controllers constantly scan the bus looking for a message, or for messages that meet the specific format for which a PLCs logic has been programmed to be read. Depressing a pushbutton causes a PLC associated with the panel on which the pushbutton is mounted to create a message. Other PLCs those on the Profibus and those subsea connected to the bus through modem reading the message, they de-code it and can tell which pushbutton on which panel has been pushed.

The internal logic then tells the affected PLC what sort of output has been requested and initiates that action.

Hydraulic action takes place when an electronic signal results in a solenoid operated pilot valve being energized. The valve controls the hydraulic fluid path from hydraulic accumulators to the power cylinder in the BOPs to get action for the desired function. Look again at the chapter "Hydraulic System" to see how it works.

A similar sequence of events takes place when analog inputs or status switch changes are detected by the associated PLC, which then generates an appropriate message. Each multiplex pod has a pair of system called "A" and "B" or blue and yellow. The subsea electronic module buttons on the OIM and SSECP allows selecting which system is active.

2.5 What happens when various buttons get pushed?

All control pushbuttons except control of viewing information on the "A" or "B" systems of the multiplex pod or multiplex pod require also depressing the ENABLE button on the panel simultaneously. An "E" preceding the button to be pressed indicates this in the following text.

We will go through some examples to show and illustrate.

For example, E-OPEN means to hold the enable button while pressing the desired open button.

For information, please look again at the drawing of multiplex control system electronic overview and the multiplex control system message overview. Also, look in the section where you will find some drawings of the Cameron standard panels showing you different messages and pushbuttons possible to be operated. We have also added to this operation manual the function list where you can see where the functions of each Cameron standard control system can perform. Use this also as indicated to understand this section of the operation book. To come back to our operation what happens when the pushbutton gets pushed?

We have the following control:

3-button controls

OPEN	VENT CLOSE
UNLATCH	VENT LATCH
RETRACT	VENT EXTEND
CHARGE	VENT DUMP

When system starts cold, all VENT lights will be on. There is a separate solenoid for the other two functions (i.e., one for OPEN and one for CLOSED). Operation of the valves then is:

VENT -	neither solenoid energized.
OPEN -	OPEN solenoid energized, CLOSED solenoid not energized
CLOSE-	CLOSE solenoid energized, OPEN solenoid not energized

When E-OPEN is pressed, the ENABLE and OPEN lights will flash. A report back to surface when SEM solenoid is in its commanded position results in the OPEN light illuminating steadily. Other panel will indicate when valve is open but not blink while valve moving.

When pressing VENT, light will blink until solenoids become de-energized. The last position a solenoid was in will remain lit.

2-button controls

OPEN	CLOSE
VENT	ENERGIZE

LOCK	UNLOCK
EXTEND	RETRACT
INCREASE	DECREASE

When system starts cold, all VENT lights on. There is only one solenoid involved.

VENT means the solenoid is not energized.

When E-ENERGIZE are pressed, lights on both buttons flash, become steady when solenoid energized and reported so back to the surface.

If ENERGIZE light is on, operator can press E-VENT, and both lights will flash until the solenoid is de-energized. VENT light then comes on steady. The two button together act like a latching circuit.

1-button controls

Examples:

SEM CONNECTION RELEASE.

System start: lamp off, and solenoid valve not energized.

Press E-CONNECTION RELEASE. Indication lights begin to blink for both buttons; when lights light steadily, solenoid for connection release is energized. Operator can now release both ENABLE AND RELEASE buttons.

The solenoid will then de-energize, and lamps for button will of off. (This function has only one solenoid and one button with no latching).

INCREASE / DECREASE:

When system starts cold, pressure for BOPs should be zero.

Press E-INCREASE and BAR gauge for pressure being commanded will start increasing. Release both buttons when desired pressure reached. BAR Gauge will drop back to zero as surface PLC sends set point to active SEM; ENABLE light will blink.

When SEM has received signal, the INCREASE solenoid will energize and stay energized until SEM achieves the set point pressure. SEM will continue to monitor and report pressure.

DECREASE works similarly with matching Decrease solenoid.

There is again a chapter describing how pushbutton works in the start-up procedures in the next chapter following this chapter. So, we recommend if you want to get more information how system works in start-up that you continue reading into the next chapter called "How to start operating this System."

Before we come to this chapter we would like to inform you about other details you need to know.

SEM analog and alarm signals are sent direct to the surface and displayed in the BOP section in the OIM control panel or Subsea Engineers control panel. Subsea hydraulic pressure is not displayed but is fed to the computer so that ambient sea pressure on the SEM is subtracted by the computer from pressure transmitter readings.

Alarms are set from analog-output readings displayed on the OIM control panel or Subsea Engineers control panel gauges. Alarm calibration takes into account hydrostatic head.

The riser location pin signal is actuated by a magnetic switch, which feeds a signal to an analog input board in the surface computer system. Response time is several seconds.

A water detector is located in each SEM. Indication lamps are water in "YELLOW" pod and water in "BLUE" pod. Alarm trip points have been factory set if water enters the SEMs.

2.6 *Emergency Disconnect, Emergency Shear and Hydr Connector Stack Retract*

The emergency disconnect sequence is initiated by pressing the emergency disconnect button. This is a press and hold button. The button must be pulled out to reset. The surface computer logic automatically creates the sequence as programmed for the customer.

A typical example is as follows:

Actions:

Kill and chock lines subs	RETRACTED
Stack pilot isolation	CLOSED
Hydraulic connector stack	RETRACTED
Riser connector – primary	UNLATCHED
Riser connection - secondary	UNLATCHED
Sequence complete.	

Another example for emergency shear

Action

If rams OPEN or VENT, nothing occurs
If rams CLOSED, VENT will be actuated
Vent annular preventer #2
Vent outer kill valve
Vent inner kill valve
Vent lower inner choke valve
Vent lower outer choke valve
Vent upper inner choke valve
Vent upper outer choke valve
Vent wellhead connector
Close shear ram
Energize 3000 psi or 5000 psi increase valve (depending on the system the customer has ordered)
Lock Wedgelocks and
End interlock

This can take up, depending on sizes, water depths and volumes, between to 13 to 14 seconds.

For the functions hydraulic connector stack retract

Pod selection and SEM selection and also the alarms and panel functions will be described in our next chapter "How to Start and Operate the System". Therefore this will not be mentioned in this chapter. Please continue to read how the systems will be started and operate and you will get the necessary information for these functions.

The deadman sequence is software based and can be programmed as per customer request. The only limitation is the capacity of the batteries installed on the transducer modules, and the volume of accumulators assigned to the job.

3 HOW TO START AND OPERATE THE SYSTEM

Remarks:

This start procedure is ONLY VALID if the system passed a factory expectation test at the Cameron facility or SIT on the drilling rig or drilling ship and the operator is aware that the system is in operation and of the standard condition as designed.

If the equipment is not tested properly or connected in the way to be a complete operational subsea drilling system, this start-up and operation following cannot be used. Prior to start-up, the system must be tested per the Factory Acceptance Test Manual and/or in the SIT Manual. Then only can you use the following operational description to start to operate the system. This is important and necessary without any deviation.

To understand the start-up and operation instruction use the drawing supplied in this manual. For the first start and best understanding you can use the multiplex controlling system electronic overview drawing or in certain areas other drawings supplied with this manual.

3.1 Distribution Unit

To start this system at first you need to open the Distribution Unit. After you open the Distribution Unit you have to switch on the fuses supplying the current and energy for the panels and the HPU.

The first fuse that you switch on, which is clearly indicated is the OIM control panel fuse called OIM CP fuse. After this fuse is on - the second fuse, the Subsea Engineers control panel can be switched on. It is marked SSECP fuse.

Third, you switch on the fuse for the HPU (Hydraulic Power Unit).

Fourth, you have to switch on the fuse for the Event logger and you have to switch on both SEMs. The SEMs are for the blue pod "A" and yellow "B" or vice-versa. After this the system is ready and has power in all items connected in the system.

3.2 OIM Panel (OIM CP)

You start the OIM CP after the power is supplied by the distribution unit but first push the alarm re-set knob. Check if the emergency disconnect or ESD display has no indication. Push the reset button as long as it is necessary to stop the alarm until the system shows that it is ready to work - ready OK available.

3.3 Subsea Engineers CONTROL PaneL (SSECP)

Follow the same procedure as indicated in OIM CP

First, use the reset button to put the alarm out of function.

Secondly, check if the ESD display is in workable condition.

Third, push as long as the alarm reset button shows in workable condition and Subsea Engineers panel is started. All alarms on both panels must be OFF this is an indication that both panels are in workable condition. You will find the indication of the alarms in the alarm lamp at any panel.

Study the possible functions and also the alarm indication of the standard Cameron system on the supplied drawings. We have included panel drawings where you see the indicated functions and alarms, but we have also included in the manual reference list with the functionality of the system.

Study these lists and drawings and then you will get verification that all the points listed in the start-up procedures can be found in the panels or relevant equipment.

3.4 Hydraulic Power Unit (HPU)

Check on the HPU if all alarms are out and quiet and look through the unit to see if there is any leakage or lost of fluid. Look to the diverter system if any alarm or if any other non-operational condition is visible in the system. This can be checked by visual go through the system, but it can also be checked with the rig manual if you follow the drawings from the HPU and the interconnection diagrams supplied in the Cameron Rig Manuals. Normally, the HPU after site integration tests or FAT is in proper condition so that a visual checkout is sufficient. Only after a long period of time it is advised to have a more detailed test to verify condition of the HPU.

3.5 Action – Status of Subsea Pods

To verify the system the pods must be in the status where you know which function or which condition any pod is in. Therefore, the following action needs to be done.

- With the SSECP or with the OIM CP do the following steps:
    - Riser stack stinger de-energize, wait 60 seconds until verification and then continue.
    - Riser and stack stinger extend, wait 60 seconds until verification.
    - Riser and stack stingers energize, do this, wait some seconds until you get verification by the lamps in the panel that the system reacted as necessary for the commands. After this you can use every general function of the panel in the following way. That means preventer functions, gate valve functions, connector functions as follows:

- Push and hold Enable button.

- Push selected Function button.

- The lamp of the function will flash every half-second in interval sections. You will get a feedback if a positive action was achieved by the system and by the applicable SEM, because the lamp will be illuminated permanently after this situation.

- Slow lamp flashing, second by second cycle. This is applicable for SEM lamps and indicates communication loss to the selected SEM subsea.

- Did you have the slow frequency of the lamp twinkling, blinking on the diverter functions and the HPU? This indicates that you have no communication with the HPU and diverter panel.

- If the selected function is still flashing second by second, for example, shear ram open continues to twinkle every second, then a malfunction or malfunction to the solenoid valve has occurred, that means you have a wire break or a shortage in this system to this selected applicable function.

- The Cameron standard system has an automatic changeover frequency if one of the selected subsea electronic modules - OPEN - SEM – CLOSE is out of process. There will be an automatic changeover to the next SEM in the same control pod. If you want to change pods, you can only do it manually; it is not programmed automatically into the system. It can be changed, but the standard system pod changes is done on manual bases with the system.

3.6 Regulator Pressure Adjustment

Pressure Adjustment

- Push the ENABLE button and hold it steady pressed.
- Increase or decrease, as needed the pressure by permanent actuation of the decrease or increase function.
- If the selected value is visible in the pilot pressure display stop this process.
- Release also the ENABLE button
- You will see on the pressure display that at first the value will be as you have started the regulation process, but then automatically it will increase (or decrease) and the pressure will be regulated by the system fully automatically to the value you have selected and will be on end to the final selected value of the pressure.

3.7 Alarms

In the process the alarms will be shown as follows:

- The horn will start to sound.
- The alarm lamp, for example, LOW AIR will start to light up or twinkle. If no alarm lamp is available, then you will see on the ISD display the malfunction of the system.
- If you push the ALARM RESET, the horn will stop sounding.
- If you push for the second time the ALARM RESET button, also the indication on the panel will be illuminated and no alarm will be shown on the display anymore.

3.8 Portable Electronic Test Unit - PETU

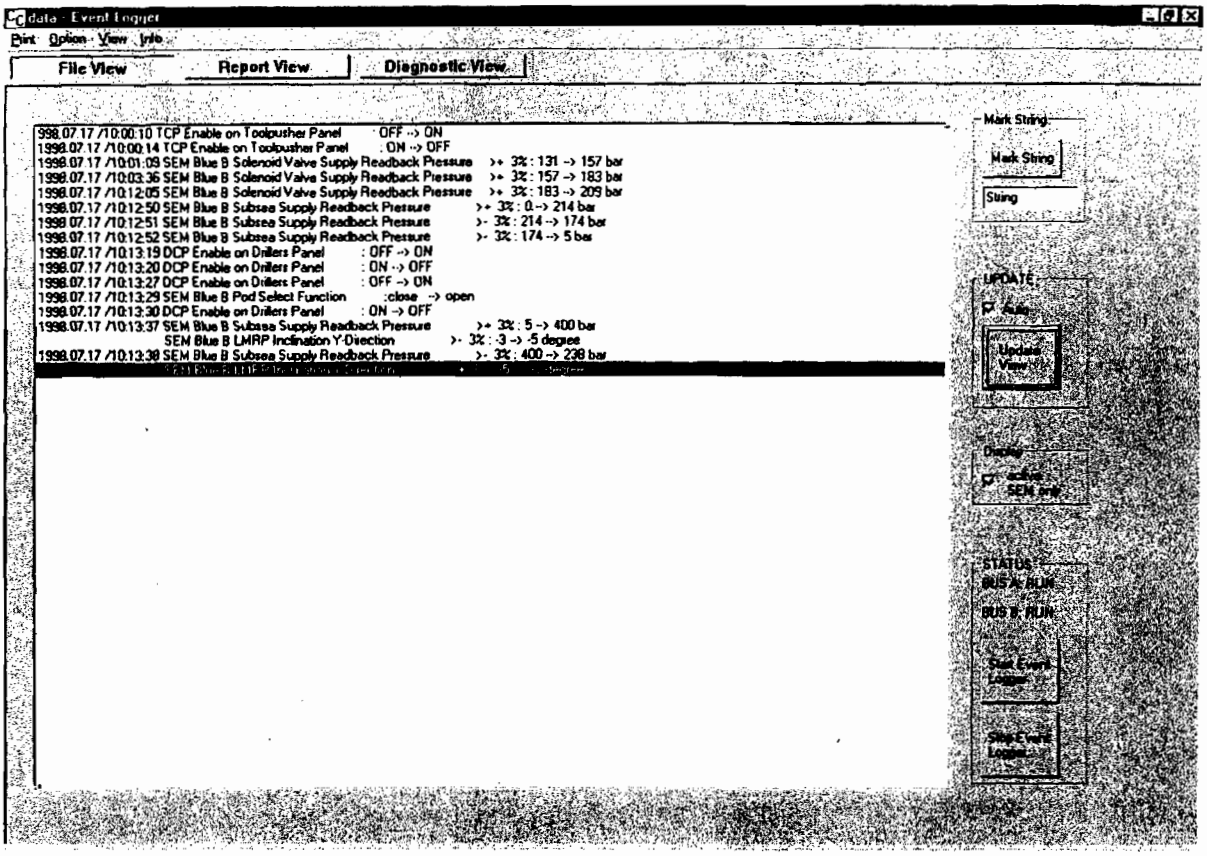
First, connect the cable as indicated in the electronic diagram for the PETU to the system. Switch on the PETU to get operational. Switch on the laptop to get operational. It is a manual driven system. You only have to select the function and to push the ENABLE pushbutton and then the FUNCTION button. Automatically, the chosen function will be executed by the system. It is a self-guided process so that more explanations are not necessary. Follow the instructions shown on the screen.

3.9 BOP Test Box

The BOP Test box will be operated in the same way like you operate the SSECP and OIM CP. There is no difference. Look to the description of the SSECP or OIM CP. There is only one exception, related to the regulator. The regulators can be adjusted as described on the panels but there is the enable function in the middle of the three-actuation button of the BOP Test Box. This middle button needs to be pushed and hold like the ENABLE button on the panels. This is a safety feature so that the "Dead-Man-Concept" as used on the panels is also implemented in the BOP Test Box to guarantee dual handed execution of system functions. Also it avoids uncontrolled actions in the handling process of the BOP Test Box.

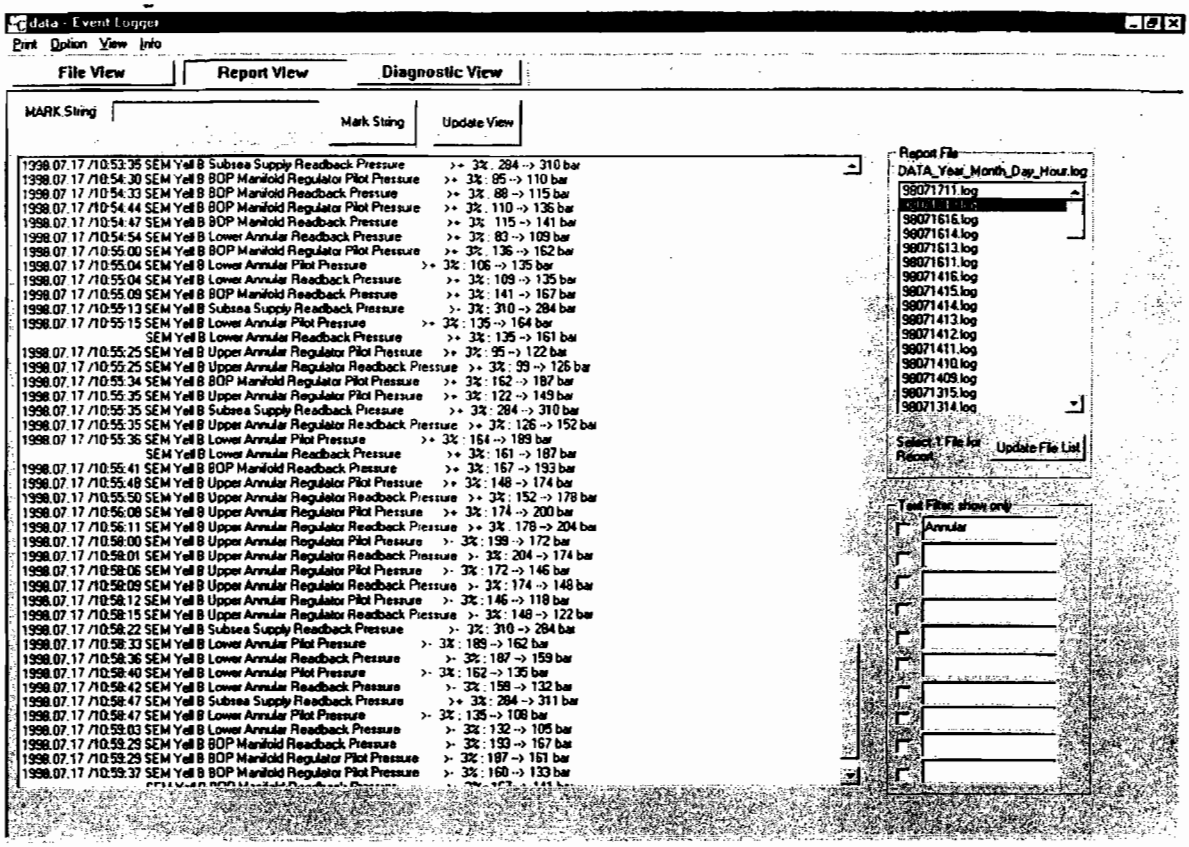
3.10 Event Logger

- Switch on the PC and also switch on the monitor
- You will be automatically in the file view where you can select the applicable file you wanted to work with or to review. If you want to have a special report, go into the report view section as described.

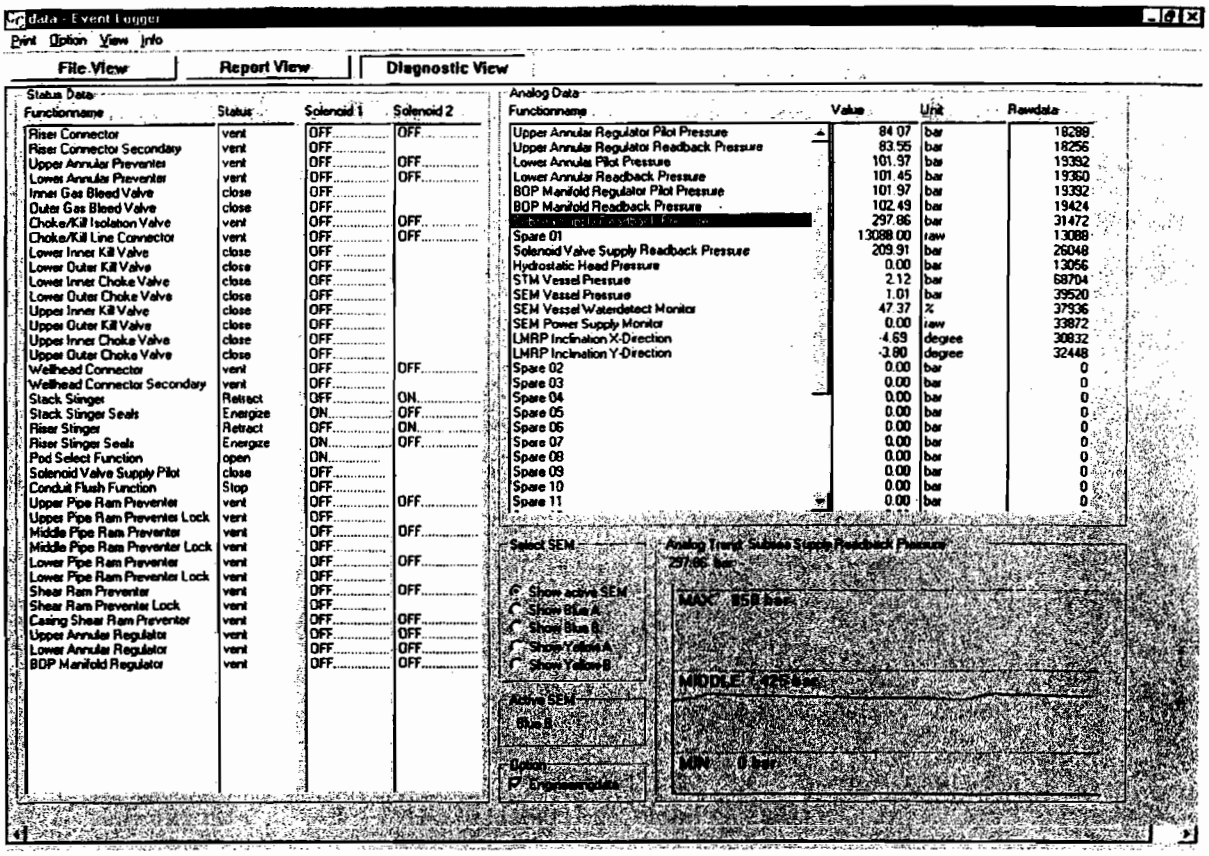


- Report view will be selected via the mouse click supplied. You have to indicate year, month, day and hour. Then you can see the report and can also review it.

- You can also select filters into the text elements that you will only see certain activities or data's from the report view or if you want to select certain functions you can also separate file them and print them or supply them in your own dictionary.



- With the mouse you can also select the diagnostic view. The diagnostic view will show you the functionality of the system online. You will see all the analog data online, all the values and the status. You can also select certain values and you can also get them graphically indicated on the screen. Also you can get inactive SEM or other inactive status data of the system and can monitor them. This section is especial section where the applicable customer electronic engineer gets training in the Cameron FAT section of the system and therefore it will not be shown in the normal operational manual.



- All dates are stored on the hard disk. The last 25 days are stored in the standard system. After 25 days the first date will be overwritten with the new data. This can be changed or tailored made to customer needs.

3.11 Conduit Valve Package Start-up

- Blue yellow pod isolation valve needs to be open after few seconds.
- LMRP accumulators to be closed. This will be done with the panel.
- Conduit flush valve open. This will be done with the panel.
- Manual conduit selective valve shift into blue or yellow conduit. This will be done on the HPU. After this flush the conduit lines on the riser to the conduit valve package for approximate 30 seconds.
- Close the conduit flush function from the panel.
- Elect the blue or yellow pod for working condition from the panel.
- Open the solenoid supply blue or yellow as selected before from the panel.
- LMRP (Lower Marine Riser Package) Accumulators need to be open from the panel. Now you are ready with a full system to start drilling.