WATER SUPPLIES DEPARTMENT

STANDARD SPECIFICATION E-11-04

PUMPSET CONTROL PANEL

1 SCOPE

This standard specification stipulates the requirements of the pumpset control panel for pump motors above 70kW.

It shall be read in conjunction with the following WSD Standard Specifications:-

E-11-03 Electrical and Instrumentation Panels and Cubicles

E-78-04 Programmable Logic Controller

2 GENERAL REQUIREMENTS

An individual panel shall be provided for each pumpset for installation adjacent to the pump motor.

The design of the panel shall be compatible with the pumpset.

The panel shall form part of the Distributed Control System (DCS) of the station. The panel shall be wired to the pumpset instruments and the switchgear panel via control cables such that local manual operation of the pumpset is fully functional when the panel is not connected to the data network of the DCS. The emergency stop push-button and the "Start" and "Stop" push-buttons (for low voltage (LV) motors) or "Neutral/Start" selector switch (for high voltage (HV) motors) shall also be wired in such a way that emergency operation of the motor is permissible when the Programmable Logic Controller (PLC) is out of order.

3 CONSTRUCTION

The panel shall be designed in compliance with WSD Standard Specification E-11-03.

The panel shall be rectangular, free floor standing, fabricated with sheet steel of a minimum thickness of 2 mm, suitably braced to afford rigidity. It shall have

a rear hinged access door with chromium plated car-type lockable handle. The degree of protection shall be IP 54 to IEC 60529.

One undercoat and two finishing coats of colour reference 18B21 (light grey) to BS 4800 shall be applied to give a durable gloss finish. The internal finish shall be white to BS 4800 shade 00E51.

The panel shall be equipped with a detachable brass gland plate and cable glands. The gland plate shall be located at least 300 mm from the finished floor level.

A swing door with glass viewing panel shall be provided over the flush-mounted touch screen described in Clause 4 below in case the display facia of the touch screen has a degree of protection lower than IP54.

4 EQUIPMENT DESIGN

4.1 General

The panel shall contain PLC, a touch screen, flow, temperature and vibration monitoring units and other auxiliary equipment to facilitate monitoring and control of the pumpset.

4.2 PLC

The PLC shall be designed in compliance with WSD Standard Specification E-78-04. The PLC shall be programmed to provide the control, indication and alarm functions for HV and LV pumps as shown in Annex A and Annex B respectively specified in Clause 6 below.

The PLC shall be suitable for connection to the DCS via dual optical fibre or Ethernet cables.

4.3 Touch Screen

The touch screen shall be mounted on the panel front and provide the following functions:-

(a) To display all the status signals, alarm signals and push-buttons for the local control of the pumpset

(b) To show the readings of all the temperature monitoring units and vibration monitoring units of the pumpset

The touch screen shall conform to the following requirements:-

(a) Display: 12.1" color active matrix TFT

(b) Resolution: 800 x 600 18-bit color graphics, 300 cd/m^2

(c) Backlight: 50,000 hr – field replaceable

(d) Real-time clock with battery-backed time clock and timestamps critical data

(e) Application memory: 64MB

(f) Touch screen type: Analog resistive

(g) Communication ports: Ethernet, RS-232 and 2 x USB

4.4 Flow Monitoring Unit

Flow monitoring units shall be provided to initiate alarm and tripping of the pumpset when the water flow in the mechanical seal or water-cooled bearings (if applicable) is below its threshold value. The monitoring unit for the pump delivery no-flow switch shall also be supplied and installed in the panel.

4.5 Temperature Monitoring Unit

Temperature monitoring units for the motor winding embedded temperature detectors (ETD), pump and motor bearing temperature detectors and motor exhaust air temperature detector shall be installed in the panel to provide temperature signals and initiate temperature high alarm and trip operation. The alarm and trip settings of the monitoring units shall be adjustable for individual detecting elements.

Temperatures of individual detecting elements, alarms and status signals shall be displayed on the touch screen and in the control room.

The ETD monitoring units for each motor shall have the following features:

(a) Alarm contacts shall operate and an alarm signal shall be initiated at 120^{o}C which shall be adjustable for individual detecting elements.

(b) Trip contacts shall operate and a trip signal shall be initiated at 140^{o}C which shall be adjustable for individual detecting elements.

(c) A 4-20mA output signal corresponding to the measured temperature with adjustable span and zero shall be provided.

Bearing and motor exhaust air temperature monitoring units shall have the following features:

(a) Alarms contacts shall operate and an alarm signal shall be initiated at 10^{o}C lower than the trip contacts/signal unless otherwise recommended by the motor manufacturer.

(b) The alarm and trip settings shall be adjustable for individual detecting elements.

(c) A 4-20mA output signal corresponding to the measured temperature with adjustable span and zero shall be provided.

4.6 Vibration Monitoring Unit

Vibration monitoring units for the pump and motor shall be installed in the panel and shall have a continuously adjustable alarm/trip setting from 50-300% of the normal vibration amplitude. The equipment shall output a 4-20mA signal corresponding to the measured vibration level in millimetres peak-to-peak with adjustable span and zero. The vibration level shall be displayed on the touch screen and in the control room. The overall error of the equipment shall not exceed 5% of the full scale reading of the instrument range.

The unit shall be fitted with an alarm reset push button and alarm indicating lights. The vibration monitoring unit and detector shall be designed to prevent false alarm due to transient shocks by incorporating a time-delay device of two seconds.

4.7 Power Supply and Circuitry of Monitoring Unit

Power supply to the PLC and all the monitoring units mentioned above shall be 24V d.c.

The alarm and trip contacts shall be volt free and rated at 24V d.c. The output contacts shall be normally open and shall close on detection of an alarm condition such that tripping of motor shall not occur due to failure of the auxiliary supply.

4.8 Auxiliary Equipment

The following power supply equipment and circuits shall be installed in the panel. The Contractor shall submit detailed load estimation and sizing calculations for the d.c./d.c. converter, diodes and power supply unit for the Engineer's approval.

(a) A 110V d.c. to 24V d.c. converter (where there is no 24V d.c. station battery available).

(b) A 32A DP isolating switch for isolation of the a.c. input supply.

(c) A 32A DPTT selector switch for selection among d.c. battery supply, rectified d.c. supply or both. Diodes shall be provided for connection made to both supplies.

(d) A 24V d.c. full bridge rectifier solid state regulated power supply unit. The transformer shall be of double wound type with tappings in 10V steps between 200V and 240V. The output of the unit shall be maintained at 24V d.c. with ripples within 100 mV over a loading range of 0 to 100% at 90 to 110% input voltage and 98 to 102% frequency.

Auxiliary supply for the panel heaters and indicating instruments shall be 220V 50 Hz.

Other equipment such as emergency push-button, key-operated selector switches, indicating lamps, push-buttons, panel heater, auxiliary relays and timers, etc., as shown in Annex A and Annex B shall be installed in the panel.

5 EQUIPMENT LAYOUT

The following equipment shall be mounted in the panel:

(a) Motor winding temperature monitoring units (six nos. at motor winding U1, V1, W1, U2, V2 and W2 for HV motors and three nos. at motor winding U, V and W for LV motors)

(b) Motor driving end and non-driving end bearing temperature monitoring units

(c) Pump driving end and non-driving end bearing temperature monitoring units

(d) Motor exhaust air temperature monitoring unit (for HV motors of 1000kW and above)

(e) Motor driving end and non-driving end bearing vibration monitoring units (for HV motors of 750kW and above)

(f) Pump upper and lower bearing vibration monitoring units

(g) No-flow switch monitoring units for pump delivery flow, mechanical seal water flow and water-cooled bearing water flow (if applicable)

(h) Power supply units for the PLC

(i) "PSU/Normal/Battery" PLC power supply selector switch

(j) Isolation switches and protection fuses for a.c. and d.c. supply

(k) Anti-condensation heater complete with isolation switch and humidity sensor

(l) Sufficient terminals for external cable connections

The following control and indicating instruments shall be flush mounted with the front panel:

(a) Emergency stop push-button with two latched change-over contacts

(b) Key-operated "Emergency Start/Touch Screen/Auto/Control Room" selector switch with two pairs of change-over switches at each position

(c) Key-operated "Neutral/Start" spring-returned selector switch with two pairs of change-over switches at each position (for HV motors)

(d) Key-operated "Start" push-button with two change-over contacts (for LV motors)

(e) Two motor running indication beacons (green – 'Pump On', red – 'Pump Off') shall be mounted on the panel top

(f) "Emergency Start Control Available", "Motor Tripped on Fault" and "PLC Failed" indicating lamps

Components shall be so arranged that access for routine maintenance is not impeded.

Internal wiring shall be installed in plastic wiring channels and bundled neatly using insulated cleats. A space factor of 50% shall be used in designing wiring channels.

Terminal blocks for control wiring shall be located at least 150 mm from the gland plate. Cable cores shall be identified with PVC ferrules visible without dismantling covers or disturbing adjacent terminations.

6 SCHEMATIC DRAWINGS

The panel shall be designed and wired-up as shown in the following drawings:-

(a) Annex A – Typical Drawing – Pumpset Control Panel for High Voltage Pumpset Circuit Diagram

(b) Annex B – Typical Drawing – Pumpset Control Panel for Low Voltage Pumpset Circuit Diagram

- End of this Specification -

INCOMING CIRCUITS

(A) FROM PUMP STARTER PANEL

LINE REF.	DEVICE		CONTACT APPLICATION
		3-POSITION SWITCH OPEN / EARTH / CLOSE	
1		52a K403	PUMP PROTECTION MONITOR INITIATION
10		52b K423	DELIVERY VALVE AUTO CLOSE INITIATION
40		K455	MOTOR HEATER FAILED TIMER INITIATION
41		52b	
43		52a K459	PUMP AT AUTO RELAY INITIATION
	C.B. AUXILIARY SWITCH & EARTH/OPEN/CLOSE SELECTOR SWITCH	K401	
61		52a L31	'PUMP ON' INDICATION
62		L33	
63		52b L35	'PUMP OFF' INDICATION
		L1	
DD		52b K6037	PUMP DELAY START TIMER RESET INITIATION
		K603	
BB	START CONTROL RELAY & EARTH/OPEN/CLOSE SELECTOR SWITCH	STR-3 V3U	DELIVERY VALVE AUTO OPEN INITIATION
		V1U	
		V13U	
		SS1 OFF / SW. GR. / REMOTE; NEUTRAL SS2 (SPRING-RETURN) STOP / START(CLOSE)	
1	SW. GR./OFF/REMOTE & STOP/NEUTRAL/START SELECTOR SWITCH	K407	SEQUENCE STOP INITIATION
4		K409	
		K411	
		K405	
35		ES1 K453	EMERGENCY STOP RELAY INITIATION
36	EMERGENCY STOP P.B. (HARDWIRE CONNECTION)	ES2	
		K401	
111	TRIPPED ON FAULT RELAY	TR-3 A11	'TRIPPED' ALARM
135	UNDERVOLTAGE AUX. RELAY	UVR-3 A49	'UNDERVOLTAGE' ALARM
131	TRIP CIRCUIT SUPERVISION RELAY	TCSR-1 A41	'TRIP CIRCUIT FAULT' ALARM
132	GAS PRESSURE LOW RELAY	GPLA-1 A43	'GAS PRESSURE LOW' ALARM
113	MOTOR PROTECTION RELAY	MPR-2 A13	'MOTOR WINDING TEMP. HIGH' ALARM
137	MOTOR PROTECTION RELAY	MPR-3 A53	'MOTOR PROTECTION RELAY FAILED' ALARM
138	UNDERVOLTAGE RELAY	27-2 A55	'UNDERVOLTAGE RELAY FAILED' ALARM
134	PUMP PROTECTION IN/OUT SELECTOR	SS3 IN OUT A47	'PUMP PROTECTION SWITCHED OUT' ALARM
118	CAPACITOR FUSE FAILURE CONTACT	CFR-2 A21	'CAPACITOR FUSE BLOWN' ALARM
		A2	
70	C.B. AUXILIARY SWITCH	52a L51	'C.B. ON' INDICATION
71	C.B. AUXILIARY SWITCH	52b L53	'C.B. OFF' INDICATION
66	SW. GR./OFF/REMOTE SELECTOR SWITCH	SS1 OFF / SW. GR. / REMOTE L37	'CONTROL AVAILABLE' INDICATION
		3-POSITION SWITCH OPEN / EARTH / CLOSE	
73	EARTH/OPEN/CLOSE SELECTOR SWITCH	L55	'3-POSITION SWITCH EARTH' INDICATION
74		L57	'3-POSITION SWITCH OPEN' INDICATION
75		L59	'3-POSITION SWITCH CLOSE' INDICATION
		L1	
		3-POSITION SWITCH OPEN / EARTH / CLOSE	
161	C.B. AUXILIARY SWITCH & EARTH/OPEN/CLOSE SELECTOR SWITCH	52a L203	'PUMP ON' INDICATION
162		L205	
163		52b L207	'PUMP OFF' INDICATION
		SS1 OFF / SW. GR. / REMOTE	
166	SW. GR./OFF/REMOTE SELECTOR SWITCH	L209	'EMERGENCY START CONTROL AVAILABLE' INDICATION
168	TRIPPED ON FAULT RELAY	TR-4 L213	'MOTOR TRIPPED ON FAULT' ALARM
		L201	
301	2 TERMINALS – POWER METER (PW) (FOR CURRENTS, kVAr, kW, kVA, POWER FACTOR, TIME & DATE INDICATION)		FOR PANEL INDICATING LAMPS

(B) FROM PUMP DELIVERY VALVE ACTUATOR

46		1S1 K475	DELIVERY VALVE CLOSE RELAY INITIATION
47		1S2 K477	DELIVERY VALVE OPEN RELAY INITIATION
45		1MR K473	DELIVERY VALVE MONITOR RELAY INITIATION
	VALVE ACTUATOR OUTPUT CONTACTS & VALVE MONITOR RELAY	K401	
AA		1S3 K223	PUMP START INTERLOCK
		K221	
76		1S4 L61	'DELIVERY VALVE RUNNING' INDICATION
		L1	

(C) FROM PUMP SUCTION VALVE ACTUATOR △

49		2S1 K481	SUCTION VALVE CLOSE RELAY INITIATION
48		2MR K479	SUCTION VALVE MONITOR RELAY INITIATION
	VALVE ACTUATOR OUTPUT CONTACTS & VALVE MONITOR RELAY	K401	
AA		2S3 K225	PUMP START INTERLOCK
		K223	
81		2S2 L71	'SUCTION VALVE OPEN' INDICATION
79		2S4 L67	'SUCTION VALVE RUNNING' INDICATION
		L1	

(D) FROM STATION CONTROL PANEL

AA		SPTR-1 K231	PUMP TRIP INITIATION
	STATION PROTECTION TRIP RELAY	K229	
AA		SPTR-2 K221	PUMP START INTERLOCK
		K219	

(E) FROM MOTOR MARSHALLING BOX

234 – 242	9 TERMINALS –	RESISTANCE TEMPERATURE DETECTOR (RTD) (MOTOR EXHAUST AIR, MOTOR DRIVING END BEARING AND MOTOR NON-DRIVING END BEARING)
201 – 218	18 TERMINALS –	EMBEDDED TEMPERATURE DETECTOR (ETD) (MOTOR WINDING U1, V1, W1, U2, V2 & W2)
249 – 254	6 TERMINALS –	MOTOR VIBRATION DETECTOR (MVD) (MOTOR DRIVING END & MOTOR NON-DRIVING END) } FOR HV PUMPSETS OF 750kW AND ABOVE

(F) FROM PUMP MARSHALLING BOX

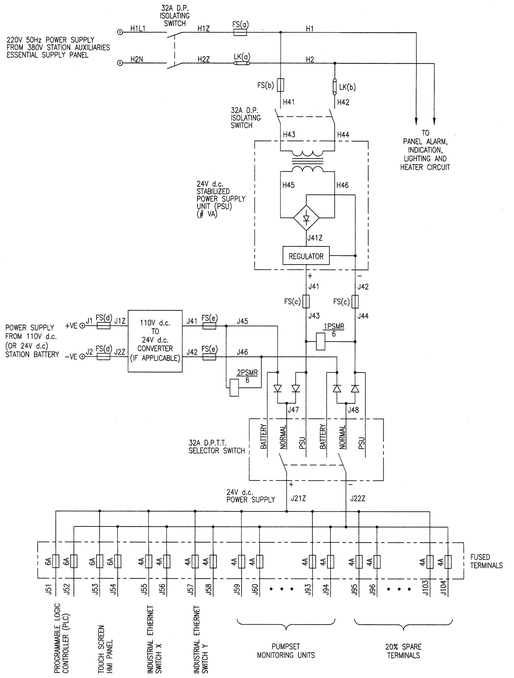
305	2 TERMINALS –	DELIVERY PRESSURE TRANSMITTER (DPT)
307	2 TERMINALS –	SUCTION PRESSURE TRANSMITTER (SPT)
16	2 TERMINALS –	SUCTION PRESSURE SWITCH (SPL)
243 – 248	6 TERMINALS –	RESISTANCE TEMPERATURE DETECTOR (RTD) (PUMP DRIVING END BEARING & PUMP NON-DRIVING END BEARING)
255 – 260	6 TERMINALS –	PUMP VIBRATION DETECTOR (PVD) (PUMP DRIVING END & PUMP NON-DRIVING END)
224 – 233	10 TERMINALS –	MECHANICAL SEAL/BEARING COOLANT FLOW SWITCH (MSFS)
219 – 223	5 TERMINALS –	NO-FLOW SWITCH (RVS)

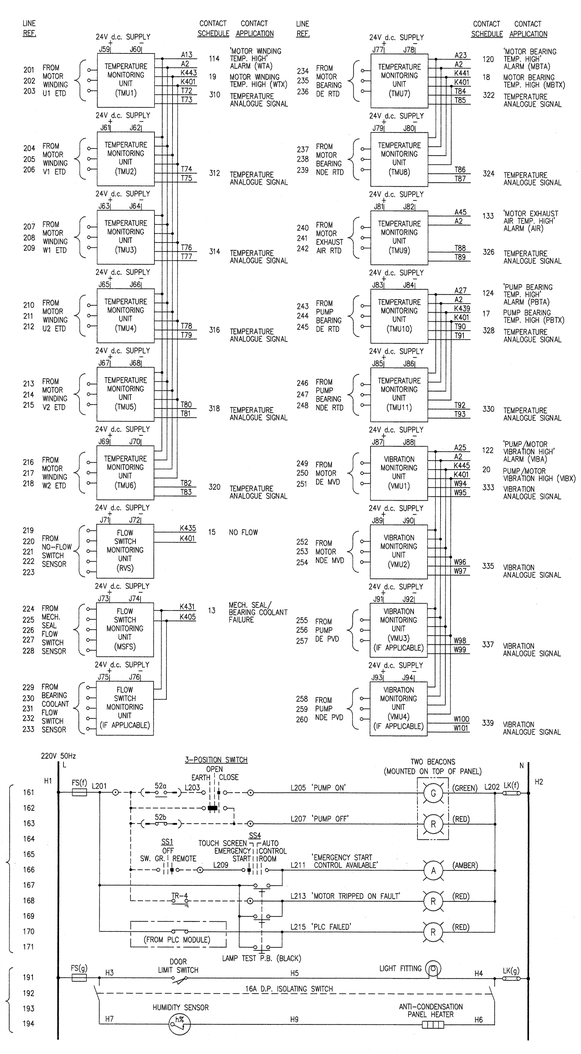
(G) FROM MOTOR HEATER MONITORING CUBICLE

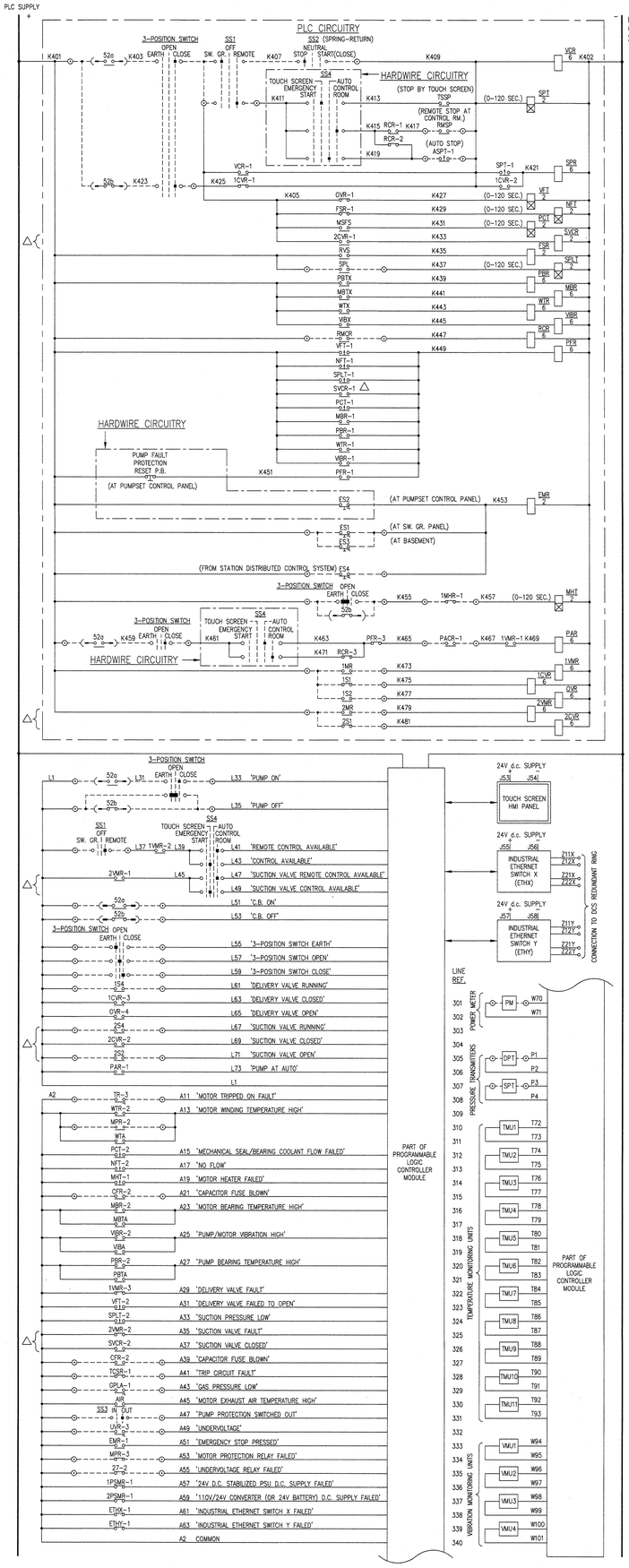
40	MOTOR HEATER FAILURE RELAY	1MHR-1 K457	MOTOR HEATER FAILED TIMER INITIATION
		K455	

(H) FROM STATION DISTRIBUTED CONTROL SYSTEM

38	EMERGENCY STOP CONTACT	ES4 K453	EMERGENCY STOP RELAY INITIATION
		K401	
AA	REMOTE MANUAL START CONTACT	RMST K213	REMOTE PUMP START INITIATION
		K227	
6	REMOTE MANUAL STOP CONTACT	RMSP K409	REMOTE PUMP STOP INITIATION
		K417	
21	REMOTE MANUAL CONTROL CONTACT	RMCR K447	REMOTE CONTROL RELAY INITIATION
		K401	
AA	AUTO START CONTACT	ASTT-1 K213	AUTO START INITIATION
		K229	
8	AUTO STOP CONTACT	ASPT-1 K409	AUTO STOP INITIATION
		K419	
43	PUMP AT AUTO CONTROL MONITOR CONTACT	PACR-1 K467	PUMP AT AUTO RELAY INITIATION
		K465	
CC	REMOTE SUCTION VALVE OPEN CONTACT	RO-1 V1L	SUCTION VALVE OPEN INITIATION
CC △	REMOTE SUCTION VALVE CLOSE CONTACT	RC-1 V9L	SUCTION VALVE CLOSE INITIATION
		(FROM PLC MODULE) V3L	







OUTGOING CIRCUITS

(AA) TO PUMP STARTER PANEL

RELAY CONTACTS SCHEDULE		CONTACT APPLICATION
9, (BB), BB	TOUCH SCREEN EMERGENCY START / AUTO CONTROL ROOM SS4	
	NEUTRAL START SS5 (SPRING-RETURN)	
9	K221 K213 (START BY TOUCH SCREEN) TSST	
	K223 (REMOTE START AT CONTROL RM.) RMST	PUMP START INITIATION
AA	K225 RCR-4 K227 RCR-5 (AUTO START) ASTT-1	
	K229 (FROM PLC MODULE)	
22, 126	K219	
23, 116	ES2 K261	PUMP TRIP INITIATION
26, 115	K201	
25, 129	1S3 K223 2S3 K225	PUMP START INTERLOCK
(12), DD	K221	
24, 127	SPTR-1 K231	PUMP TRIP INITIATION
28, 123	K229	
27, 119	SPTR-2 K221	PUMP START INTERLOCK
29, 112	K219	
30, 121	ES2 K261	PUMP TRIP INITIATION
6, (7), (44), AA, (AA)	K201	
31, AA	SPR-1 K261	PUMP STOP INITIATION
	K201	
	PFR-2 K277	PUMP TRIP INITIATION
	K201	
	EMR-2 K209	PUMP START INTERLOCK
	K207	
	PMP K229	PUMP START INTERLOCK
	(FROM PLC MODULE) K227	

(BB) TO PUMP DELIVERY VALVE ACTUATOR

136, (AA)	3-POSITION SWITCH OPEN / EARTH / CLOSE; STR-3 VCR-2 V11U; V13U	DELIVERY VALVE AUTO OPEN INITIATION
	1MR-4 V5U	
117	VCR-3 V9U (FROM PLC MODULE) V1U	DELIVERY VALVE AUTO CLOSE INITIATION

(CC) TO PUMP SUCTION VALVE ACTUATOR △

82	SS4 TOUCH SCREEN EMERGENCY START / AUTO CONTROL ROOM	
43, 66, (125), (BB)	V3L RO-1 V11L	SUCTION VALVE OPEN INITIATION
(10), 10, 77	V13L RC-1 V9L	SUCTION VALVE CLOSE INITIATION
(11), 78	(FROM PLC MODULE) V1L	
68, (128)		
14, 80		

(DD) TO STATION DISTRIBUTED CONTROL SYSTEM

	3-POSITION SWITCH OPEN / EARTH / CLOSE; 52b K6037	
	K603	PUMP DELAY START TIMER RESET INITIATION
	K601	
	FSR-2 K573	DELIVERY MAIN PRESSURE LOW TIMER INITIATION
	K501 (TO PLC MODULE)	

18 REPEATED PLC SIGNALS FOR CONTROL & INDICATION (L33, L35, L41, L43, L47, L49, L51, L53, L55, L57, L59, L81, L83, L65, L67, L69, L71, L73)

27 REPEATED PLC SIGNALS FOR ALARM INDICATION (A11, A13, A15, A17, A19, A21, A23, A25, A27, A29, A31, A33, A35, A37, A39, A41, A43, A45, A47, A49, A51, A53, A55, A57, A59, A61, A63)

2 REPEATED PLC SIGNALS FOR POWER METER INDICATION (W70, W71)

4 REPEATED PLC SIGNALS FOR PRESSURE INDICATION (P1, P2, P3, P4)

22 REPEATED PLC SIGNALS FOR TEMPERATURE INDICATION (T72, T73, T74, T75, T76, T77, T78, T79, T80, T81, T82, T83, T84, T85, T86, T87, T88, T89, T90, T91, T92, T93)

8 REPEATED PLC SIGNALS FOR VIBRATION INDICATION (W94, W95, W96, W97, W98, W99, W100, W101)

8 CONNECTION TO DCS REDUNDANT RING (Z11X, Z12X, Z21X, Z22X, Z11Y, Z12Y, Z21Y, Z22Y)

(EE) SPARE

20% SPARE TERMINALS

VALVE ACTUATOR INDICATION CONTACTS OPERATION CHART				
CONTACT	VALVE POSITION			FUNCTION APPLICATION
	OPEN	INTERMEDIATE	CLOSE	
S1			▬	VALVE CLOSED INDICATION
S2			▬	VALVE OPEN INDICATION
S3			▬	PUMP START INTERLOCK
S4	▬			VALVE MOTOR RUNNING

▬ DENOTE CONTACT MAKE POSITION

HBC FUSE & LINK TABLE					
REF.	FUSE HOLDER	FUSE RATING	SOLID LINK	NOMINAL VOLTAGE	INSCRIPTION
FS(a)	20A	20A	LK(a)	220V 50Hz	PANEL 220V 50Hz SUPPLY
FS(b)	20A	10A	LK(b)	220V 50Hz	24V PSU 220V 50Hz SUPPLY
FS(c)	32A	#	–	24V DC	24V PSU d.c. OUTPUT
FS(d)	32A	#	–	110V OR 24V DC	110V (OR 24V) BATTERY d.c. SUPPLY
△ FS(e)	32A	#	–	24V DC	110V/24V CONVERTER d.c. OUTPUT
FS(f)	20A	6A	LK(f)	220V 50Hz	PANEL INDICATION
FS(g)	20A	4A	LK(g)	220V 50Hz	PANEL HEATER AND LIGHTING

NOTES:

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LEGEND	DESCRIPTION
CVR	VALVE CLOSE RELAY
DCS	DISTRIBUTED CONTROL SYSTEM
EMR	EMERGENCY STOP RELAY
FS	HBC FUSE
FSR	FLOW SWITCH REPEAT RELAY
HMI	HUMAN MACHINE INTERFACE
LK	SOLID COPPER LINK IN HBC FUSE HOLDER
MBR	MOTOR BEARING TEMPERATURE HIGH TRIP RELAY
MHT	MOTOR HEATER FAILURE TIMER
NFT	NO FLOW TRIP TIMER
OVR	VALVE OPEN RELAY
PAR	PUMP AT AUTO RELAY
PBR	PUMP BEARING TEMPERATURE HIGH TRIP RELAY
PCT	PUMP SEAL COOLANT FAILURE TIMER
PFR	PUMP FAULT TRIP RELAY
PSMR	24V d.c. POWER SUPPLY MONITORING RELAY
RCR	REMOTE CONTROL RELAY
SPLT	SUCTION PRESSURE LOW TIMER
SPR	STOP RELAY
SPT	PUMP MOTOR PROGRAMMED STOP TIMER
SS1	CONTROL MODE SELECTION SWITCH AT PUMP STARTER PANEL (KEY-OPERATED)
SS2	CIRCUIT BREAKER CONTROL SWITCH AT PUMP STARTER PANEL (KEY-OPERATED AND SPRING-RETURN)
SS3	PUMP PROTECTION IN/OUT SELECTION SWITCH AT PUMP STARTER PANEL (KEY-OPERATED)
SS4	CONTROL MODE SELECTION SWITCH (KEY-OPERATED)
SS5	CIRCUIT BREAKER CONTROL SWITCH (KEY-OPERATED AND SPRING-RETURN)
SVCR	SUCTION VALVE CLOSED RELAY
VCR	VALVE CONTROL RELAY
VFT	VALVE FAILED TO OPEN TIMER
VMR	PUMP/MOTOR VIBRATION HIGH RELAY
WTR	MOTOR WINDING TEMPERATURE HIGH TRIP RELAY
52a	C.B. AUX. SW. CONTACTS MADE AT "ON" POSITION
52b	C.B. AUX. SW. CONTACTS MADE AT "OFF" POSITION

1. FOR UNDEFINED SYMBOLS, SEE B.S. 3939.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH WSD STANDARD SPECIFICATION E–11–04.
3. △ DENOTES OPTIONAL EQUIPMENT AND CIRCUIT.

編號 no.	日期 date	修訂 REVISION	簽署 initial

	姓名 name	簽署 initial	日期 date
設計 designed	K.S. LEUNG	EE/P(6)	17/12/2013
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核對 checked	K.S. YU K.S. LEUNG	TO(E)/P4 EE/P(6)	12/2013 17/12/2013
加簽 endorsed	S.C. LI	SEE/P(3)	18/12/2013
核准 approved	M.H. LEUNG, CLEMENT CEME/P		18/12/2013

合約編號 contract no.

檔案編號 file no.

工務編號 PWP no.

合約 contract

圖則名稱 drawing title

TYPICAL DRAWING

PUMPSET CONTROL PANEL FOR HIGH VOLTAGE PUMPSET CIRCUIT DIAGRAM

圖則編號 drawing no. W88504/0023

比例 scale NIL

水務署 Water Supplies Department

B1 1000 x 707 A

PC REV. NO.

CAD REF.

PLOTTING SCALE

INCOMING CIRCUITS

(A) FROM PUMP STARTER PANEL

LINE REF.	DEVICE	CONTACT APPLICATION
1	CONTACTOR	SEQUENCE STOP INITIATION
10		DELIVERY VALVE AUTO CLOSE INITIATION
11	START/RUN CONTROL RELAY	PUMP PROTECTION MONITOR INITIATION
39		FUSE-SWITCH '29a' REPEAT RELAY INITIATION
40	MOTOR SUPPLY FUSE-SWITCH AUX. CONTACTS	FUSE-SWITCH '29b' REPEAT RELAY INITIATION
DD	CONTACTOR	PUMP DELAY START TIMER RESET INITIATION
DD	START/RUN CONTROL RELAY	DELIVERY MAIN PRESSURE LOW TIMER INITIATION
1	SW. GR./REMOTE SELECTOR SWITCH & STOP PUSH-BUTTON (P.B.)	SEQUENCE STOP INITIATION
BB	START CONTROL RELAY	DELIVERY VALVE AUTO OPEN INITIATION
133	EMERGENCY STOP P.B. (HARDWIRE CONNECTION)	'EMERGENCY STOP PRESSED' ALARM
43	TRIPPED ON FAULT RELAY	PUMP AT AUTO RELAY INITIATION
111	TRIPPED ON FAULT RELAY	'MOTOR TRIPPED ON FAULT' ALARM
113	MOTOR PROTECTION RELAY	'MOTOR WINDING TEMP. HIGH' ALARM
137	MOTOR PROTECTION RELAY	'MOTOR PROTECTION RELAY FAILED' ALARM
132	PUMP PROTECTION IN/OUT SELECTOR	'PUMP PROTECTION SWITCHED OUT' ALARM
24		PUMP FAULT TRIP RELAY INITIATION
61	START/RUN CONTROL RELAY	'PUMP ON' INDICATION
63		'PUMP OFF' INDICATION
66	SW. GR./REMOTE SELECTOR SWITCH	'CONTROL AVAILABLE' INDICATION
117	MOTOR HEATER ALARM TIMER	'MOTOR HEATER FAILED' ALARM
161	START/RUN CONTROL RELAY	'PUMP ON' INDICATION
163		'PUMP OFF' INDICATION
166	SW. GR./REMOTE SELECTOR SWITCH	'EMERGENCY START CONTROL AVAILABLE' INDICATION
168	TRIPPED ON FAULT RELAY	'MOTOR TRIPPED ON FAULT' ALARM
301	2 TERMINALS – POWER METER (PM). (FOR CURRENTS, kVAr, kW, kVA, POWER FACTOR, TIME & DATE INDICATION)	

FOR PANEL INDICATING LAMPS

(B) FROM PUMP DELIVERY VALVE ACTUATOR

46		DELIVERY VALVE CLOSE RELAY INITIATION
47		DELIVERY VALVE OPEN RELAY INITIATION
45	VALVE ACTUATOR OUTPUT CONTACTS & VALVE MONITOR RELAY	DELIVERY VALVE MONITOR RELAY INITIATION
AA		PUMP START INTERLOCK
76		'DELIVERY VALVE RUNNING' INDICATION

(C) FROM PUMP SUCTION VALVE ACTUATOR △

49		SUCTION VALVE CLOSE RELAY INITIATION
48		SUCTION VALVE MONITOR RELAY INITIATION
AA	VALVE ACTUATOR OUTPUT CONTACTS & VALVE MONITOR RELAY	PUMP START INTERLOCK
81		'SUCTION VALVE OPEN' INDICATION
79		'SUCTION VALVE RUNNING' INDICATION

(D) FROM STATION CONTROL PANEL

AA	STATION PROTECTION TRIP RELAY	PUMP TRIP INITIATION AND START INTERLOCK

(E) FROM MOTOR MARSHALLING BOX

216 – 221	6 TERMINALS –	RESISTANCE TEMPERATURE DETECTOR (RTD) (MOTOR DRIVING END BEARING AND MOTOR NON-DRIVING END BEARING)
201 – 209	9 TERMINALS –	EMBEDDED TEMPERATURE DETECTOR (ETD)

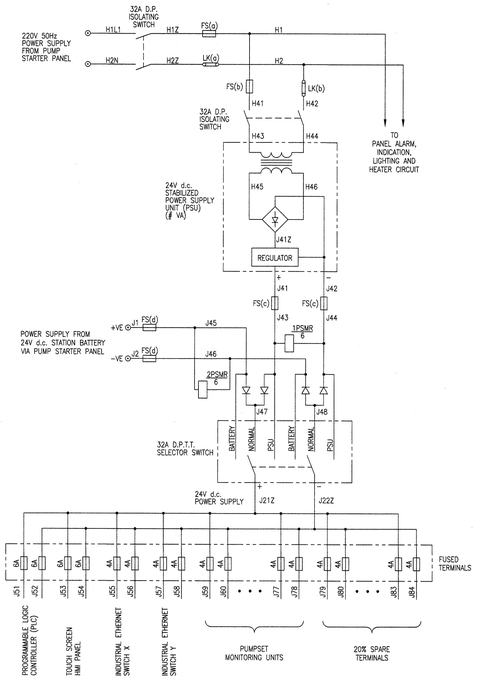
(F) FROM PUMP MARSHALLING BOX

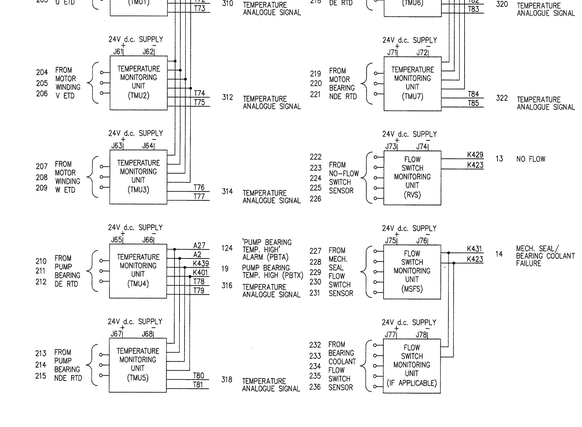
305	2 TERMINALS –	DELIVERY PRESSURE TRANSMITTER (DPT)
307	2 TERMINALS –	SUCTION PRESSURE TRANSMITTER (SPT)
18	2 TERMINALS –	SUCTION PRESSURE SWITCH (SPS)
210 – 215	6 TERMINALS –	RESISTANCE TEMPERATURE DETECTOR (RTD) (PUMP DRIVING END BEARING & PUMP NON-DRIVING END BEARING)
227 – 236	10 TERMINALS –	MECHANICAL SEAL/BEARING COOLANT FLOW SWITCH (MSFS)
222 – 226	5 TERMINALS –	NO-FLOW SWITCH (RVS)

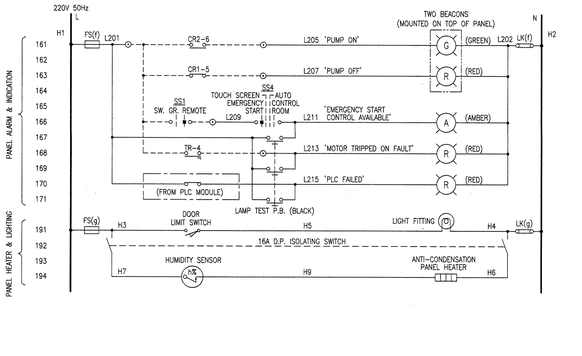
(G) FROM STATION DISTRIBUTED CONTROL SYSTEM

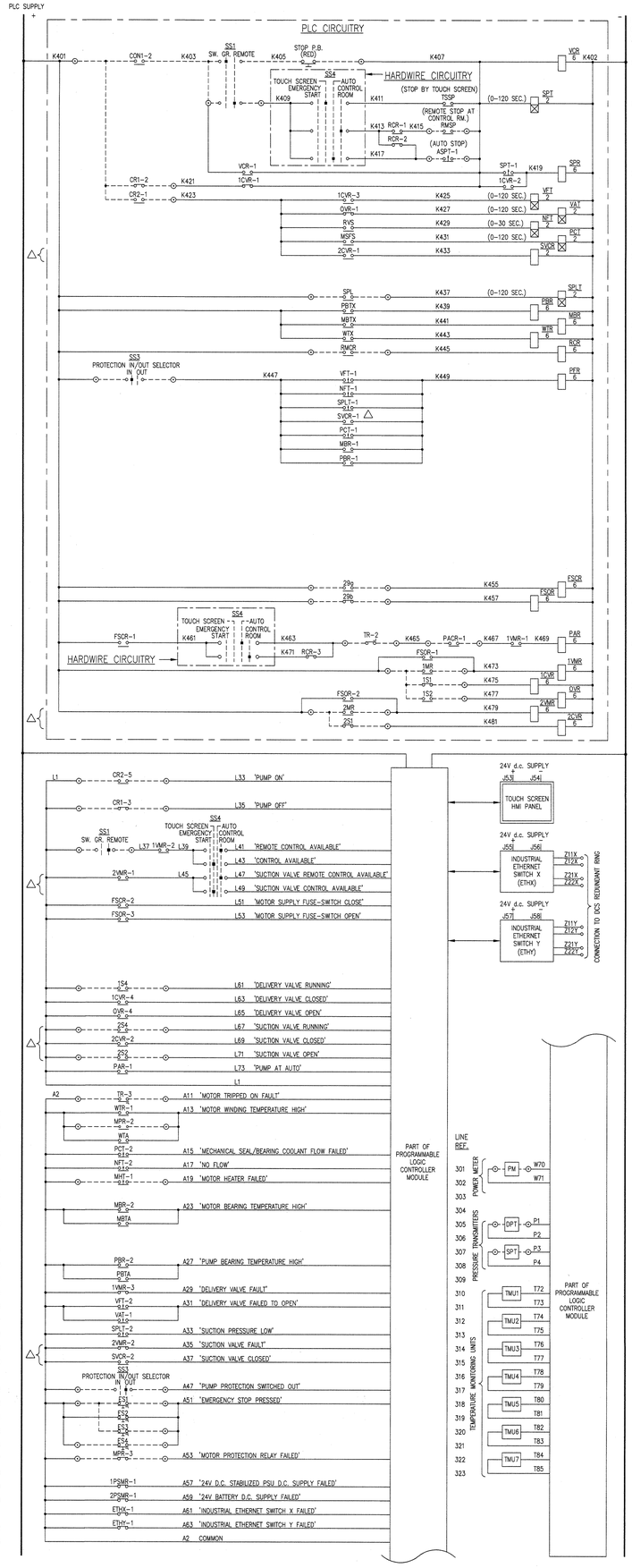
136	EMERGENCY STOP CONTACT	'EMERGENCY STOP PRESSED' ALARM
AA	REMOTE MANUAL START CONTACT	REMOTE PUMP START INITIATION
6	REMOTE MANUAL STOP CONTACT	REMOTE PUMP STOP INITIATION
22	REMOTE MANUAL CONTROL CONTACT	REMOTE CONTROL RELAY INITIATION
AA	AUTO START CONTACT	AUTO START INITIATION
8	AUTO STOP CONTACT	AUTO STOP INITIATION
43	PUMP AT AUTO CONTROL MONITOR CONTACT	PUMP AT AUTO RELAY INITIATION
CC	SUCTION VALVE REMOTE OPEN CONTACT	SUCTION VALVE OPEN INITIATION
CC	SUCTION VALVE REMOTE CLOSE CONTACT	SUCTION VALVE CLOSE INITIATION

(FROM PLC MODULE)









OUTGOING CIRCUITS

(AA) TO PUMP STARTER PANEL

RELAY CONTACTS SCHEDULE	CONTACT APPLICATION
9, (BB), BB	PUMP START INITIATION
9	
(AA)	
24, 126	PUMP TRIP INITIATION
127	
25, 116	PUMP START INTERLOCK
28, 115	
27, 130	PUMP TRIP INITIATION AND START INTERLOCK
26, 128	PUMP TRIP INITIATION
30, 123	
29, 119	PUMP STOP INITIATION
112, AA	PUMP TRIP INITIATION
6, (7), (44), AA, (AA)	PUMP TRIP INITIATION
AA	

(FROM PLC MODULE)

(BB) TO PUMP DELIVERY VALVE ACTUATOR

	DELIVERY VALVE AUTO OPEN INITIATION
	DELIVERY VALVE STOP
	DELIVERY VALVE AUTO CLOSE INITIATION

(FROM PLC MODULE)

(CC) TO PUMP SUCTION VALVE ACTUATOR △

43, 70	SUCTION VALVE OPEN INITIATION
44, 47, 71	
82	SUCTION VALVE CLOSE INITIATION
43, 66, (125), BB	
(10), 10, 11, 77	
(12), 78	
68, (129)	
14, 80	

(FROM PLC MODULE)

(DD) TO STATION DISTRIBUTED CONTROL SYSTEM

	PUMP DELAY START TIMER RESET INITIATION
	DELIVERY MAIN PRESSURE LOW TIMER INITIATION

(TO PLC MODULE)

15 REPEATED PLC SIGNALS FOR CONTROL & INDICATION (L33, L35, L41, L43, L47, L49, L51, L53, L61, L63, L65, L67, L69, L71, L73)

19 REPEATED PLC SIGNALS FOR ALARM INDICATION (A11, A13, A15, A17, A19, A23, A27, A29, A31, A33, A35, A37, A47, A51, A53, A57, A59, A61, A63)

2 REPEATED PLC SIGNALS FOR POWER METER INDICATION (W70, W71)

4 REPEATED PLC SIGNALS FOR PRESSURE INDICATION (P1, P2, P3, P4)

14 REPEATED PLC SIGNALS FOR TEMPERATURE INDICATION (T72, T73, T74, T75, T76, T77, T78, T79, T80, T81, T82, T83, T84, T85)

8 CONNECTION TO DCS REDUNDANT RING (Z11X, Z12X, Z21X, Z22X, Z11Y, Z12Y, Z21Y, Z22Y)

(EE) SPARE

20% SPARE TERMINALS

VALVE ACTUATOR INDICATION CONTACTS OPERATION CHART

CONTACT	VALVE POSITION: OPEN	INTERMEDIATE	CLOSE	FUNCTION APPLICATION
S1			▬	VALVE CLOSED INDICATION
S2	▬			VALVE OPEN INDICATION
S3			▬	PUMP START INTERLOCK
S4		▬		VALVE MOTOR RUNNING

▬ DENOTE CONTACT MAKE POSITION

HBC FUSE & LINK TABLE

REF.	FUSE: HOLDER	FUSE: RATING	SOLID LINK	NOMINAL VOLTAGE	INSCRIPTION
FS(a)	20A	20A	LK(a)	220V 50Hz	PANEL 220V 50Hz SUPPLY
FS(b)	20A	10A	LK(b)	220V 50Hz	24V PSU 220V 50Hz SUPPLY
FS(c)	32A	#	–	24V DC	24V PSU d.c. OUTPUT
FS(d)	32A	#	–	24V DC	24V BATTERY d.c. SUPPLY
FS(e)	–	–	–	–	–
FS(f)	20A	6A	LK(f)	220V 50Hz	PANEL INDICATION
FS(g)	20A	4A	LK(g)	220V 50Hz	PANEL HEATER AND LIGHTING

NOTES:

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LEGEND	DESCRIPTION
CVR	VALVE CLOSE RELAY
DCS	DISTRIBUTED CONTROL SYSTEM
FSCR	MOTOR SUPPLY FUSE–SWITCH AUX. CONTACT '29a' REPEAT RELAY
FSOR	MOTOR SUPPLY FUSE–SWITCH AUX. CONTACT '29b' REPEAT RELAY
FS	HBC FUSE
HMI	HUMAN MACHINE INTERFACE
LK	SOLID COPPER LINK IN HBC FUSE HOLDER
MBR	MOTOR BEARING TEMPERATURE HIGH TRIP RELAY
MHT	MOTOR HEATER FAILURE TIMER
NFT	NO FLOW TRIP TIMER
OVR	VALVE OPEN RELAY
PAR	PUMP AT AUTO RELAY
PBR	PUMP BEARING TEMPERATURE HIGH TRIP RELAY
PCT	PUMP SEAL COOLANT FAILURE TIMER
PFR	PUMP FAULT TRIP RELAY
PSMR	24V d.c. POWER SUPPLY MONITORING RELAY
RCR	REMOTE CONTROL RELAY
SPLT	SUCTION PRESSURE LOW TIMER
SPR	STOP RELAY
SPT	PUMP MOTOR PROGRAMMED STOP TIMER
SS1	CONTROL MODE SELECTION SWITCH AT PUMP STARTER PANEL (KEY–OPERATED)
SS3	PUMP PROTECTION IN/OUT SELECTION SWITCH AT PUMP STARTER PANEL (KEY–OPERATED)
SS4	CONTROL MODE SELECTION SWITCH (KEY–OPERATED)
SVCR	SUCTION VALVE CLOSED RELAY
VAT	VALVE FAILED TO OPEN ALARM TIMER
VCR	VALVE CONTROL RELAY
VFT	VALVE FAILED TO OPEN TRIP TIMER
VMR	VALVE MONITOR RELAY
WTR	MOTOR WINDING TEMPERATURE HIGH TRIP RELAY
29a	MOTOR SUPPLY FUSE–SWITCH AUX. SW. CONTACTS MADE AT 'ON' POSITION
29b	MOTOR SUPPLY FUSE–SWITCH AUX. SW. CONTACTS MADE AT 'OFF' POSITION

1. FOR UNDEFINED SYMBOLS, SEE B.S. 3939.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH WSD STANDARD SPECIFICATION E–11–04.
3. △ DENOTES OPTIONAL EQUIPMENT AND CIRCUIT.

編號 no.	日期 date	摘要 description	簽署 initial
修訂 REVISION			

	姓名 name	簽署 initial	日期 date
設計 designed	K.S. LEUNG	EE/P(6)	17/12/2013
繪製 drawn	LEYUN HO	TO(E)/P4	12/2013
核對 checked	K.S. YU	STO(E)/P4	12/2013
	K.S. LEUNG	EE/P(6)	17/12/2013
加簽 endorsed	S.C. LI	SEE/P(3)	18/12/2013
核准 approved	M.H. LEUNG, CLEMENT CEME/P		18/12/2013

合約編號 contract no.

檔案編號 file no.

工務編號 PWP no.

合約 contract

圖則名稱 drawing title

TYPICAL DRAWING

PUMPSET CONTROL PANEL FOR LOW VOLTAGE PUMPSET CIRCUIT DIAGRAM

圖則編號 drawing no. W88504/0024

比例 scale NIL

水務署 Water Supplies Department