

**DEPARTMENT OF WATER SUPPLY AND SEWERAGE**

**PROJECT MANAGEMENT SERVICES**

**CASWELL STREET PUMP STATION UPGRADE**

**OPERATIONS MANUAL**

**March 1994**

**Revision A**

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## CONTENTS

1. Overview
2. Description of Operation
  - 2.1 Design Criteria
  - 2.2 Process Description
  - 2.3 Control Philosophy
3. Plant Operation & Controls
  - 3.1 Sewage Pump Control Modes: Automatic/Manual/Emergency, Manual
  - 3.2 Start Up
  - 3.3 Alarms/Interlocks
  - 3.4 Shutdown
  - 3.5 Dry Well Sump Pump
  - 3.6 Electrical Isolation
  - 3.7 Electrical Installation
  - 3.8 PLC Code

Appendix 1 : Electrical Drawings

Appendix 2 : PLC Code Listing

## 1. OVERVIEW

The Caswell Street Pump Station Upgrade included replacement of the old pumps with three 210 kW Flygt pumps, new electrics and MCC, and the installation of a Remote Terminal Unit (RTU) to send information and alarms via telemetry to the Eagle Farm Pump Station.

The automatic pump operation at Caswell Street is performed by a Programmable Logic Controller with selector switches on the MCC to allow for manual pump operation if required.

A new rising main from Caswell Street to the Kingsbury Street interconnection was also installed together with a new valve pit located at the Caswell Street Pump Station which allows sewage to be directed to the old rising main or the new rising main.

## **2. DESCRIPTION OF OPERATION**

### **2.1 Design Criteria**

Pumps Installed	3
Maximum Flow	1000 l/s
Minimum Flow	340 l/s
Maximum Number of Pumps Operating	2
Wet Well Level - Pump Start	3.7m
Pump Stop	1.0m (revised from 0.3m during commissioning)

### **2.2 Process Description**

The Caswell Street Pump Station consists of a wet well to provide surge capacity for the sewage inflow and a dry well housing three sewage pumps and a dry well sump pump.

The three variable speed sewage pumps discharge into a common header in the dry well which connects to the rising main via a valve pit.

The three new pumps installed at Caswell Street are all variable speed, and have start and stop ramping to prevent water hammer.

Under normal inflow conditions to the pump station, one pump will operate intermittently. Each pump has a minimum flow limit to ensure that a minimum scour velocity is maintained in the rising main.

Under high inflow conditions to the pump station, a second pump will start, and the two pumps will then operate until the Wet Well Level (WWL) is reduced.

During normal operation under automatic control the pump speed is adjusted based on the wet well level. As the wet well level rises the pump speed will increase (and call up a second pump if necessary), and as the level falls the pump speed will decrease. When the inflow to the pump station is less than the pump minimum flow limit, the wet well level will decrease to the Bottom Water Level (BWL) and stop the pump.

## 2.3 Control Philosophy

### 2.3.1 System Control

Control of the system is from the Pump Station Motor Control Centre (MCC) mounted on the ground floor. The MCC doors contain drive stop/start control pushbuttons and indicating lights, mode selector switches and speed setting potentiometers for the pumps. A GE-FANUC PLC mounted within the MCC performs drive start/stop functions, mode determination, drive sequencing and control loop functions.

The general function of the control system is to control the sewage pumping rate to match the inflow rate where practicable based on wet well level, in order to keep the wet well level within an acceptable operating range.

The control system is effective only when the control mode selector switches for the sewage pumps (PP1, PP2, PP3) mounted on the respective MCC door are in AUTO mode. When they are in manual mode, the speeds of the pumps can be controlled directly using the potentiometers provided, but they will not maintain preset flowrates and starting/stopping will not be dependent on wet well level.

### 2.3.2 Pump Duty Rotation

The pumps are assigned specific temporary duties by the PLC. These duties are termed the "Lead" pump, the "Lag" pump and the "Standby" pump.

The Lead pump is the operating pump and the Lag pump is started to assist the Lead pump if the Lead pump is operating at its maximum flow and the wet well level continues to rise. The Standby pump is used to assume the duty of either Lead or Lag pump in the advent of a failure.

The duty allocation of the pumps will rotate whenever any of the following occurs:

- the Lead pump stops due to pumping down of the wet well
- the Lead pump has run continually for 24 hours
- the Switchboard Alarm Accept and Spare pushbuttons have been pressed simultaneously
- the PLC has recovered from a power loss

The Duty Rotation of the three pumps has the following sequence:

Duty	Spare	Standby
PP1	PP2	PP3
PP3	PP1	PP2
PP2	PP3	PP1

### **2.3.3 Lead Pump Operation**

The Lead pump will start when the wet well level reaches a Top Water Level (TWL) of 3.7 metres. The Lead pump will operate until the wet well falls to a Bottom Water Level (BWL) of 1.0 metre. Due to the extended ramp start time (90 sec) and the fact that the pump does not actually start to deliver until a frequency of approximately 30 Hz is reached, the wet well level may rise in excess of 4.0m before pump is operating at its desired speed.

The control system will slow the pump to deliver a progressively lower flow as the wet well level decreases, down to the minimum flow of 340 l/s (the minimum flow rate required to maintain a satisfactory scour velocity in the rising main).

The volume between the TWL and BWL is approximately 72000 litres, resulting in a pump out time of nominally 3 minutes under zero inflow conditions. Pump start and stop levels may be set inside of the TWL/BWL heights if desired, to allow for the start and stop ramp times of the pumps.

### **2.3.4 Dual Pump Operation**

When the lead pump is running, the wet well level will rise if the inflow exceeds the pumping rate. The rise in the wet well level will result in the control system increasing the pump speed to accommodate the high inflow.

If the lead pump is running at maximum speed (delivering approximately 550 l/s) and the wet well level continues to rise at a wet well level of approximately 5.5m, the lag pump will be started. The lag pump will (once ramped up to the required control speed) pump at a similar flow to the lead pump. When the lag pump initially comes online, the total flow may overshoot the flow required by the control system, though the flow will stabilise typically in less than one minute.

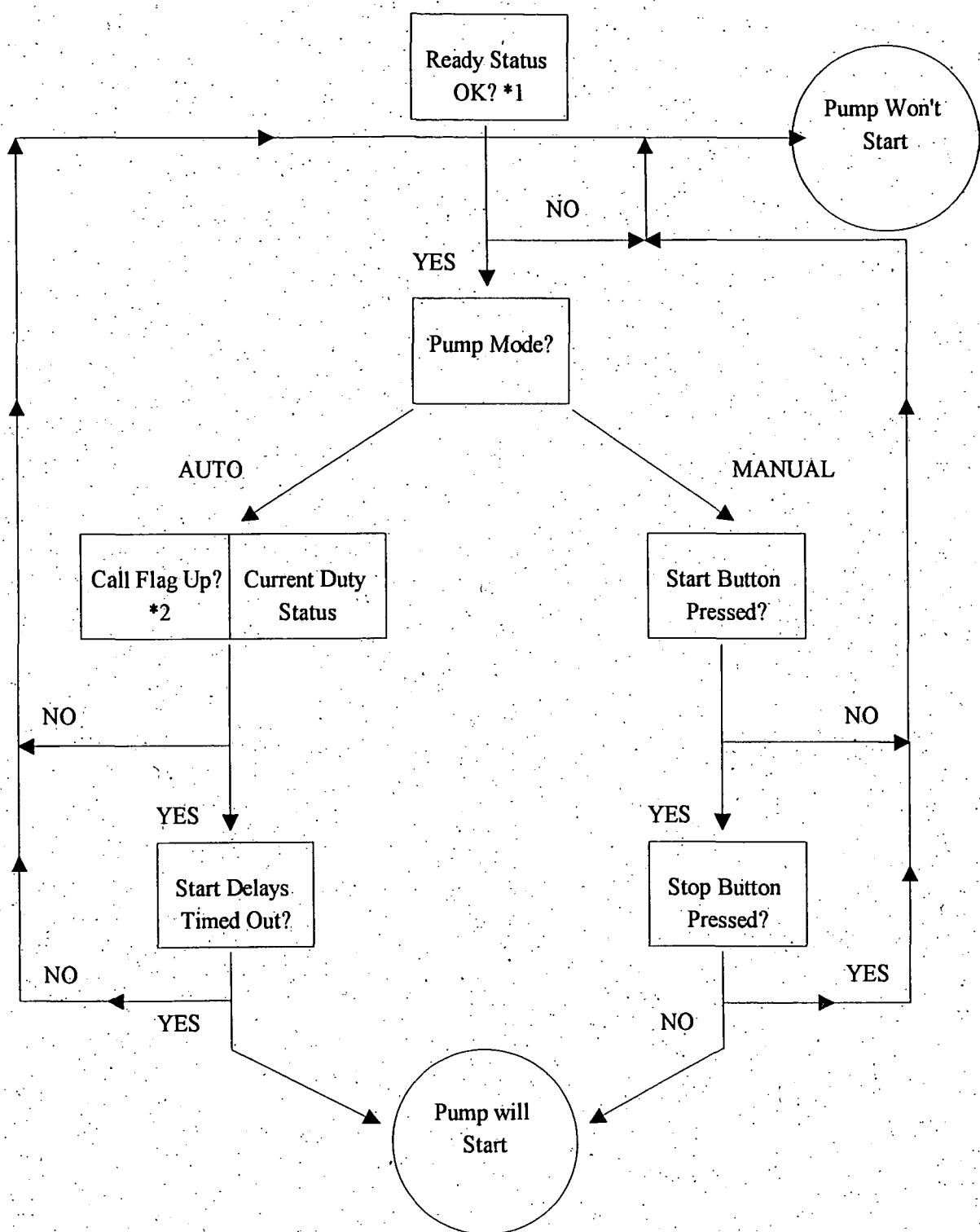
As the wet well level decreases and the pumps decrease in speed a point is reached (at approximately 3.7m) where the lag pump is no longer required and is shut down. The control of the lead, lag standby pumps is shown in the Pump Call Flags Logic Diagram.

### **2.3.5 Standby Pump**

The standby pump will start if either the lead or lag pump fails to start when required, or the lead or lag pump fails when operating. The standby pump performs the duty of the pump that has failed.

### **2.3.6 Control Loops**

The PLC based control system consists of a Demand Flow Controller, a Total Flow Controller and three Individual Flow Controllers (one for each pump).

**CASWELL STREET PUMP STATION****PUMP START LOGIC DIAGRAM**

\*1 Refer "Pump Ready/Trip Logic Diagram"

\*2 Refer "Pump Call Flags Logic Diagram"

### **Demand Flow Controller**

This Controller uses proportional control only, to output a required "demand" flow based on the wet well level. As the wet well level rises the controller will output a higher demand flow, and as the wet well level falls, the demand flow will decrease proportionally. The Demand Flow Controller output is cascaded as the set point to the Total Flow Controller.

### **Total Flow Controller**

The Total Flow Controller compares the actual totalised flow of the pumps, to that of the demand flow set point (which is cascaded from the Demand Flow Controller). The output from the Total Flow Controller is cascaded as the set point to the three individual pump flow controllers.

### **Individual Pump Flow Controllers**

Each pump has an Individual Flow Controller which compares the flow being delivered by the pump, to the cascaded setpoint from the Total Flow Controller. The output from each Individual Flow Controller is input to the variable speed drive of each pump to vary the pump speed, and hence flow.

### **3. PLANT OPERATION AND CONTROLS**

#### **3.1 Control Modes: Automatic/Manual/Emergency Manual**

There are three modes of operation for each sewage pump drive:

- Automatic
- Manual
- Emergency Manual

##### **Automatic**

In automatic mode the PLC will close or open the contactor as required by the wet well level, provided the auto/manual switch is in "automatic". Speed control is via the PLC.

In both automatic and manual mode, the PLC provides protection features to stop the drive when required, e.g. low flow for pumps.

##### **Manual**

In normal manual mode the emergency mode selector is in the "normal" position and the auto/manual switch in the "manual" mode. In this mode the PLC receives a start pulse when the start pushbutton is pressed and will close the contactor provided:

- all control devices will permit a pump start
- auto/manual switch for the drive is in the manual position

Speed control is via the manual MCC panel-mounted potentiometer.

##### **Emergency Manual**

The emergency manual mode is for use by electricians only under extreme circumstances. When running in emergency manual mode, the PLC is not operational and there is no equipment protection other than thermal overload for the motor. In this mode the emergency mode selector must be in the "emergency" position and the auto/manual switch in the "manual" position. The PLC output is bypassed when "emergency" is selected. The drive will run when the START pushbutton is pressed, which activates a self latching circuit for the drive contactor. The emergency mode selector switch is mounted within the MCC module to restrict access.

Speed control is via the manual MCC panel-mounted potentiometer.

### 3.2 Start Up

#### Automatic

When the model selector switch is set to Auto, the lead pump will automatically start when the wet well level reaches 3.7m.

If the level continues to rise (to approximately 5.5m) the demand flow will exceed 600 l/s, which will then initiate an automatic start of the lag pump.

#### Manual

When a pump mode selector switch is set to Man., the pump can be manually started by pressing the START pushbutton.

##### **NOTE:**

- When a pump is set to MAN and started, it is possible to pump the wet well level down to a level where the pump will aerate and lose its prime.
- If the potentiometer speed control is not set to a high enough value, it is possible for a low flow trip to occur due to the pump not delivering sufficient flow. If such a situation arises, reset the alarm and start the pump again at a higher speed control setting.

##### **Manual Start:**

- Set START MODE SELECTOR to MAN
- Set potentiometer SPEED CONTROL to 70%
- Press MANUAL START

Once started in Manual, the pump speed can be adjusted via the potentiometer SPEED CONTROL.

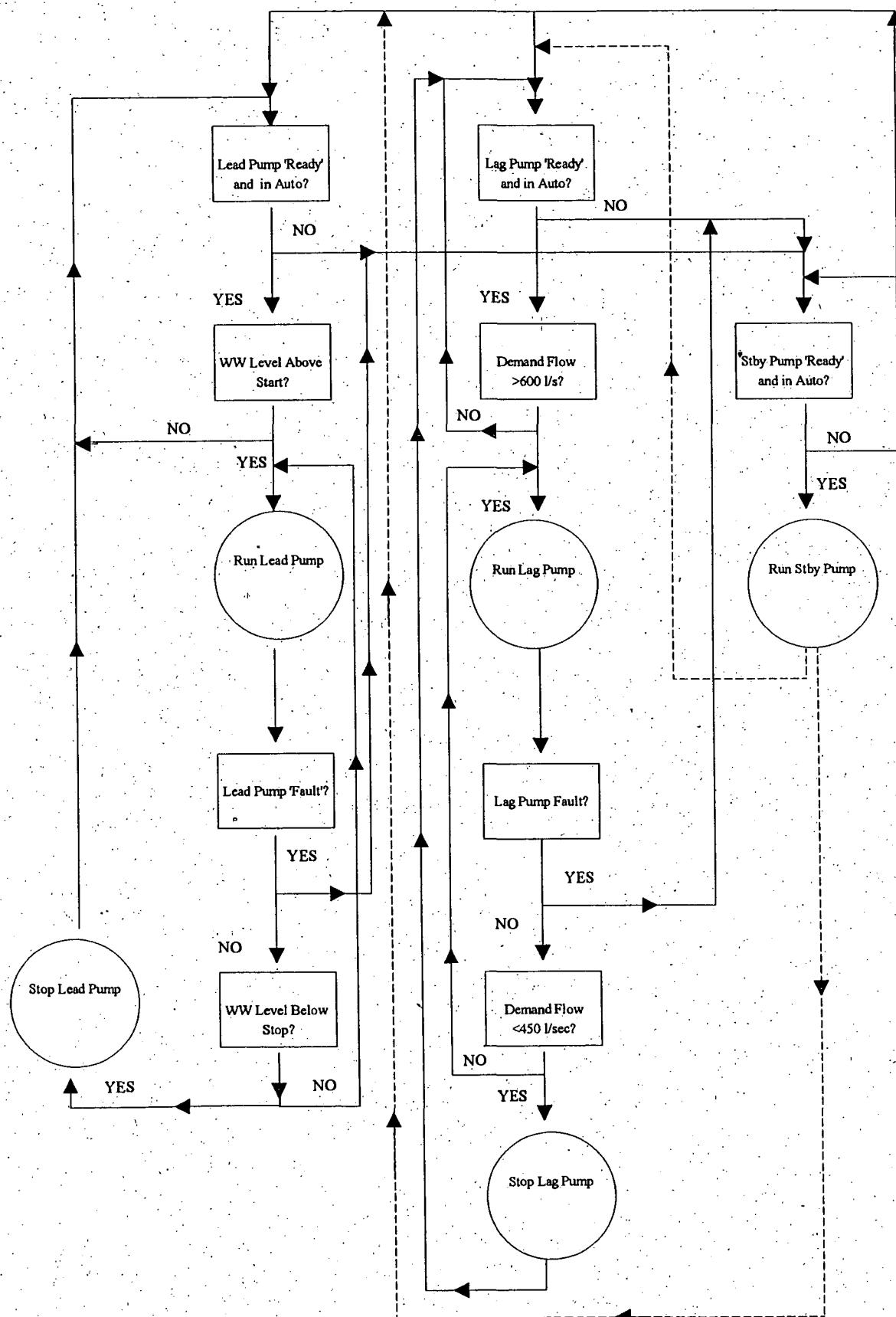
The logic steps for starting pumps in Automatic and Manual modes are shown in the Pump Start Logic Diagram.

#### Emergency Manual

The Emergency Manual mode is only to be used by electricians and is only intended for short term operation of a pump.

##### **Emergency Manual Start:**

- Set START MODE SELECTOR to MAN
- Open MCC door and set EMERGENCY SELECTOR to EMERGENCY
- Set potentiometer SPEED CONTROL to 70%
- Press MANUAL START

**CASWELL STREET PUMP STATION****PUMP CALL FLAGS LOGIC DIAGRAM**

### 3.3 Alarms/Interlocks

#### Sewage Pump Control Panels

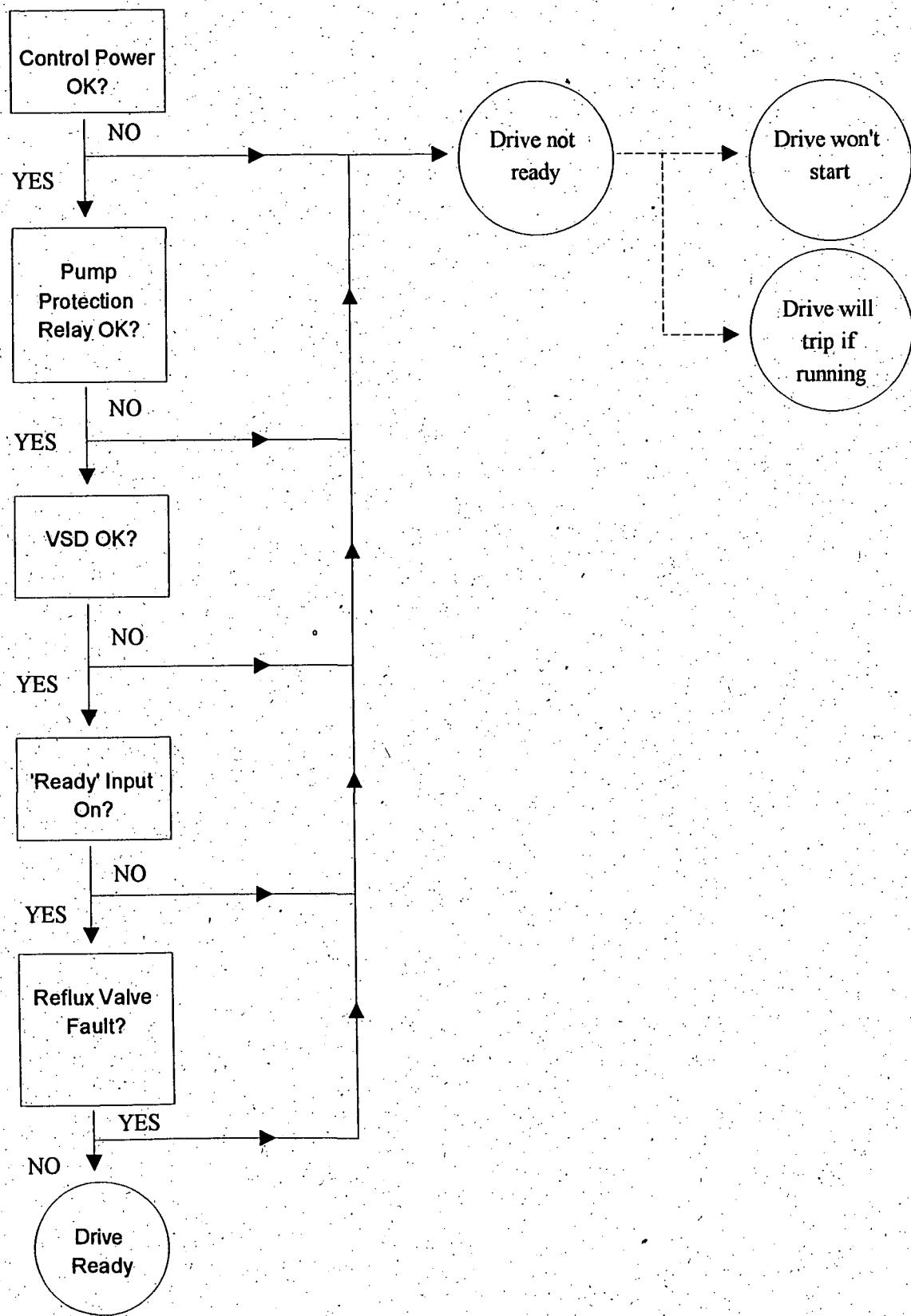
Each sewage pump has the following alarm lamps located on the respective MCC control panel.

- Bearing Overtemperature - Activated from a thermistor on the bottom bearing of the motor/pump.  
Interlocks: Trips out operating pump
- Motor Overtemperature - Activated from a RTD within the pump motor.  
Interlocks: Trips out operating pump
- Water In Motor Oil - Activated from a sensor within the oil reservoir.  
Interlocks: Trips out operating pump.

The above alarms are supplied as part of the Flygt pump protection system.

- Pump Protection Trip - If any of the above three alarms is activated, the Pump Protection Trip alarm will become activated.
- VF Drive Fault - This is a "group" fault which is a general alarm and is initiated from the Fuji VSD. Fault codes are displayed on the VSD key pad, and reference should be made to the Fuji VSD manual for details of specific faults.  
Interlocks: Trips out operating pump.
- Reflux Failed to Open - Activated if a pump is started and the reflux valve swing arm fails to move away from the proximity switch, or if the swing arm returns to the rest position at the proximity switch when the pump is operating.  
Interlocks: Trips out operating pump.
- Reflux Failed to Close - Activated if the reflux valve swing arm fails to return to its rest position at the proximity switch when a pump has been stopped.  
Interlocks: Trips out operating pump.

**NOTE:** Each sewage pump control panel has a READY TO RUN IN AUTO lamp which will not be lit if requirements as shown in the Pump "Ready"/Trip Logic Diagram are not met, and the mode selector switch is not set to Auto.

**CASWELL STREET PUMP STATION****PUMP "READY"/TRIP LOGIC DIAGRAM**

### **PLC Control Panel**

The PLC control panel on the MCC contains four alarms.

- Wet Well Level HI HI - Activated when the wet well level reaches 5.5m.  
Interlocks: none.
- Sump HI HI Level - Activated from a multitrode level sensor located in the dry well sump.  
Interlocks: Trips out operating pump(s) and inhibits starts of other pumps.
- Power Failure Bus 1 - Activated by a power failure on Bus 1 (Refer Section 3.6.1).
- Power Failure Bus 2 - Activated by a power failure on Bus 2 (Refer Section 3.6.1).

### **Sump Pump Control Panel**

The dry well sump pump controls are on the back panel of the MCC and includes one alarm lamp:

- Motor Overload Fault - Activated in the advent of a thermal overload.  
Interlocks: Trips dry well sump pump.

### 3.4 Shutdown

#### Automatic

When the mode selector switch is set to Auto., the lag pump will automatically shut down when the wet well decreases to approximately 3.7m and the lead pump will shutdown when the wet well level reaches 1.0m.

#### Manual

To stop a pump operating in Manual, the SPEED CONTROL should be slowly turned back to zero prior to pressing the STOP push button. This procedure will ramp down the pump speed to avoid water hammer and sudden closure of the reflux valve.

##### Manual Stop:

- Turn SPEED CONTROL slowly to 0%.
- Press STOP.

#### Emergency Manual

The stop procedure for Emergency Manual is the same as for Manual:

##### Emergency Manual Stop:

- Turn SPEED CONTROL slowly to 0%.
- Press STOP.

### **3.5 Dry Well Sump Pump**

The dry well sump pump operates from high and low level signals from a multitrode electrode located in the dry well sump.

An Auto/Man selector switch is located on the MCC panel.

#### **Automatic Mode**

When set to Auto, the dry well sump pump will automatically start when a HI level is detected by a multitrode electrode located in the dry well. When a low level is detected, the sump pump will automatically stop.

#### **Manual Mode**

When set to Man, the pump will continue to start and stop based on high and low levels detected by the multitrode.

If the MANUAL START push button is pressed when in Manual mode, the sump pump will start and continue to run until:

- The EMERGENCY STOP push button is pressed  
or
- The Auto/Man. switch is set to Auto and the dry well sump is at the low level.

The Sump Pump electrics are all hard wired. The PLC's only function with respect to the Sump Pump is to check for a Dry Well Sump HI alarm from the multitrode electrode, which the PLC then outputs to the RTU.

### **3.6 Electrical Isolation**

#### **Sewage Pumps**

Electrical isolation and tag out of sewage pumps is via the isolator switch located on the top left hand corner of each pumps MCC control panel.

The isolators should not be turned ON or OFF more than 5 times per hour.

#### **Sump Pump**

The sump pump isolation switch is located on the Distribution Board, behind an outer compartment panel.

### 3.7 Electrical Installation

#### 3.7.1 Switchboard Layout and Power Circuits

Drawing CST-E450 shows the Electrical Single Line Diagram for the Caswell Street MCC, and Power Electric Switchboard Pty Ltd drawings show the MCC layout. Electrical schematic and single line diagrams are contained in Appendix 1. The MCC is located on the ground level floor above the wet well, inside the station building. Power is supplied to this MCC from the site 11kV switchboard and three 11kV/415V (nominal) transformers outside the building.

The incoming supply to the MCC consists of three separate circuits - one from each transformer. Each incoming circuit has a Terasaki XS800NE circuit breaker which provides overcurrent and overload protection. The MCC busbar is split into two buses (1 and 2) which are joined by a 2500 A bus tie switch. Two sewage pumps (PP1 and PP2) and two transformers are on Bus 1. The bus tie switch is open under normal operation and all incomers are normally energised. The transformers and pump sizes are closely matched such that one transformer cannot run two pumps.

**Note:** If one of the two transformers feeding Bus 1 fails then it is recommended to close the bus tie switch until the incomer is re-energised.

The small power distribution board is fed from the two buses by two mechanically-interlocked switches such that both switches cannot simultaneously be on. Under normal operation it would be fed from Bus 1 as the two incomer supply configuration has greater availability than Bus 2. This distribution board supplies power to the PLC and the station instruments.

If Bus 1 power is lost the distribution board supply switch should be switched to Bus 2 to allow operation of sewage pump PP3 in auto or manual modes.

The MCC contains four motor starters for the three sewage pumps and one sump pump, as well as supplies for the control transformers and the building services distribution.

The MCC also has an instrument tier containing a Programmable Logic Controller (PLC) and door mounted indicating lights and push buttons for non-drive plant control.

All sewage pump motor starters contain a Terasaki XS400 moulded case circuit for overcurrent protection, a Sprecher & Schuh CA1 contactor for motor control, a Fuji VSD unit, and a Flygt<sup>TM</sup>CAS relay for motor and pump protection. The Fuji VSD includes earth-fault protection. Each motor has a field mounted control isolator.

### 3.7.2 Switchboard Control Circuits

The control voltage used is 110VAC supplied from one of two 415V/110V control transformers mounted within the switchboard and fed off the small power distribution board. Each transformer is fully wired for service, but one is kept as a spare with links and fuses removed. The control transformers should not be paralleled.

The PLC mounted in the instrument tier is used for equipment control, and a typical sewage pump motor control circuit (for PP1) is shown on drawings CST-E451 and -E452.

The circuit is designed so that the PLC controls the drive provided certain hard wired elements in the circuit are ready. As shown in drawing CST-E451, PLC output Q0001 will close the contactor, provided:

- control power is on
- control circuit breaker is closed
- motor circuit breaker is closed
- VSD has not tripped
- pump protection relay has not tripped
- local control isolator is closed
- emergency stop pushbutton is closed
- emergency mode selector is in normal position

The circuit has the following inputs to the PLC, with PLC pneumonics stated in brackets as shown in the PLC code (a copy of the PLC code is contained in Appendix 2).

- "Control Power Available" indicates circuit breakers are closed and control power is on. (PP1POW)
- "Drive Running" indicates contactor closed. (PP1RUN)
- "VF Drive Healthy" indicates VSD not tripped. (PP1VFD>)
- "Pump Protection Healthy" indicates PPR not tripped: (PP1PP>)
- "Ready to Run" indicates that all field equipment (stop button/isolator) is ready. (PP1RDY)
- "Auto" indicates all hard wired circuit elements are ready for an automatic start. A red indicating light in parallel with this input shows the operator that this drive is ready for a level-initiated start. (PP1AUT)
- "Local Start" from the start pushbutton. (PP1STT)

Outputs are "Close Contactor" (PP1GO) to control the contactor and "VF Drive Fault", "Pump Protection Trip" and "Low Flow Trip" fault lights. Each sewage pump starter also has an hour run meter, ammeter, a run light, an auto-ready light, three pump protection relay fault lights, an Auto/Manual selector switch and an Emergency Mode selector switch.

Auxiliary wiring to control the VF drive is as shown in the drawings and includes:

- Normally open C1 contact to FWD terminal to start the drive.
- Reset pushbutton contact to RST terminal to reset faults.
- Manual mode speed control wiring to terminals 11, 12 and 13 from the door-mounted potentiometer.
- Auto mode speed control wiring to terminals 11 and C1 from the PLC.
- Auto manual mode selector contact to AUT terminal when in Auto position to select PLC speed control signal.
- Link to THR terminal as no external-to-VSD fault device is used to directly shut down the VF drive.

The dry well sump pump wiring is shown on drawing CST-E465. This starter is hard-wired only. It incorporates MCB and TOL protection, and a compartment-mounted emergency stop pushbutton and field-mounted power/control isolator. The drive has an auto/manual run mode selector. Auto running is determined by a level instrument in the pump's local sump set into the dry well basement floor, with the pump starting when this sump level is near basement floor level and stopping with the level near the bottom of the sump. The auto run relay overrides the mode selector when the pump is required to be running due to a dry well sump high level. The starter also has an hour run meter, ammeter, a run light, an ready light, and an overload light. A separate level alarm relay and main panel light indicates high level in the local sump.

Drawing CST-E457 shows miscellaneous control wiring to the PLC and specific 24 VDC outputs to the station telemetry unit.

### 3.8 PLC Code

The PLC code is documented throughout the listing, however certain frequently used blocks of code are described in detail below. The PLC code is contained in Appendix 2.

The PLC controls all drives in manual and automatic modes.

The PLC code is arranged on a drive basis with each drive and its associated alarms being grouped.

#### 3.8.1 Motor Control

A typical motor control routine is shown for PP1 starting at rung 63. This should be read in conjunction with schematic drawings CST-E451 and -E452. The following standard drive code arrangement is used.

RPA : run permit flag indicating in any mode that all protection flags are ready for operation eg. PP1RPA at rung 64.

In the case of PP1 these flags are:

PP1POW : flag from power failure logic indicating MCC drive power supply is on and balanced.

PP1RDY : PP1 hardwired circuit is ready for service, i.e. control power on, VF drive healthy, local isolator closed, emergency stop button not operated.

PP1VFD# : PP1 VFD fault alarm latch set, i.e. alarm has occurred but has not been acknowledged and reset.

PP1PP# : PP1 pump protection fault alarm latch set, i.e. alarm has occurred but has not been acknowledged and reset.\*

PP1LF# : PP1 low flow alarm latch set, i.e. alarm has occurred but has not been acknowledged and reset.

PP1RF# : PP1 reflux valve fail-to-close alarm latch set, i.e. alarm has occurred but has not been acknowledged and reset.

Provided the above conditions are correct, the permit flag PP1RPA will permit a start at rung 75.

GO : PLC output which closes the drive contactor, e.g. PP1GO at rung 63. This rung functions as follows:

In manual mode when the local start button is pushed, (input PP1STT), the drive will start provided it is not in auto, (PP1AUT off) and the drive is permitted to run (PP1RPA on). The drive running input PP1RUN, will latch the drive after the contactor closes.

In automatic mode, the drive will start when the drive is in auto and the drive has received a start call aligning with its duty status. This logic is set elsewhere.

**REST** : Reset input. When the drive Reset pushbutton is pressed, a fault reset relay resets VFD and PPR devices and PLC logic alarm latches, e.g. PP1REST at rung 68.

The PLC provides a ramped deceleration of the pump when stopping in auto mode.

### 3.8.2 Field Alarms

Alarms resulting from field equipment signals are handled by the code and cause appropriate annunciation and shutdown.

A typical alarm routine is shown at rung 73 for PP1 Pump Protection Fault. The following standard notation is used throughout the program for alarms:

- > Field input indicating alarm, e.g. PP1PP>
- F Alarm flag which is triggered after time delay, e.g. PP1PPF
- # Alarm latch which latches when alarm occurs even if field input resets, e.g. PP1PP#
- % Accept latch which latches when operator pushes the alarm accept pushbutton, e.g. PP1PP%
- + Indicator lamp which flashes quickly (using %M0001) when alarm occurs, is steady after alarm is acknowledged and goes out when reset.
- @ Trigger to cause flashing alarm light to operate, e.g. PP1PP@

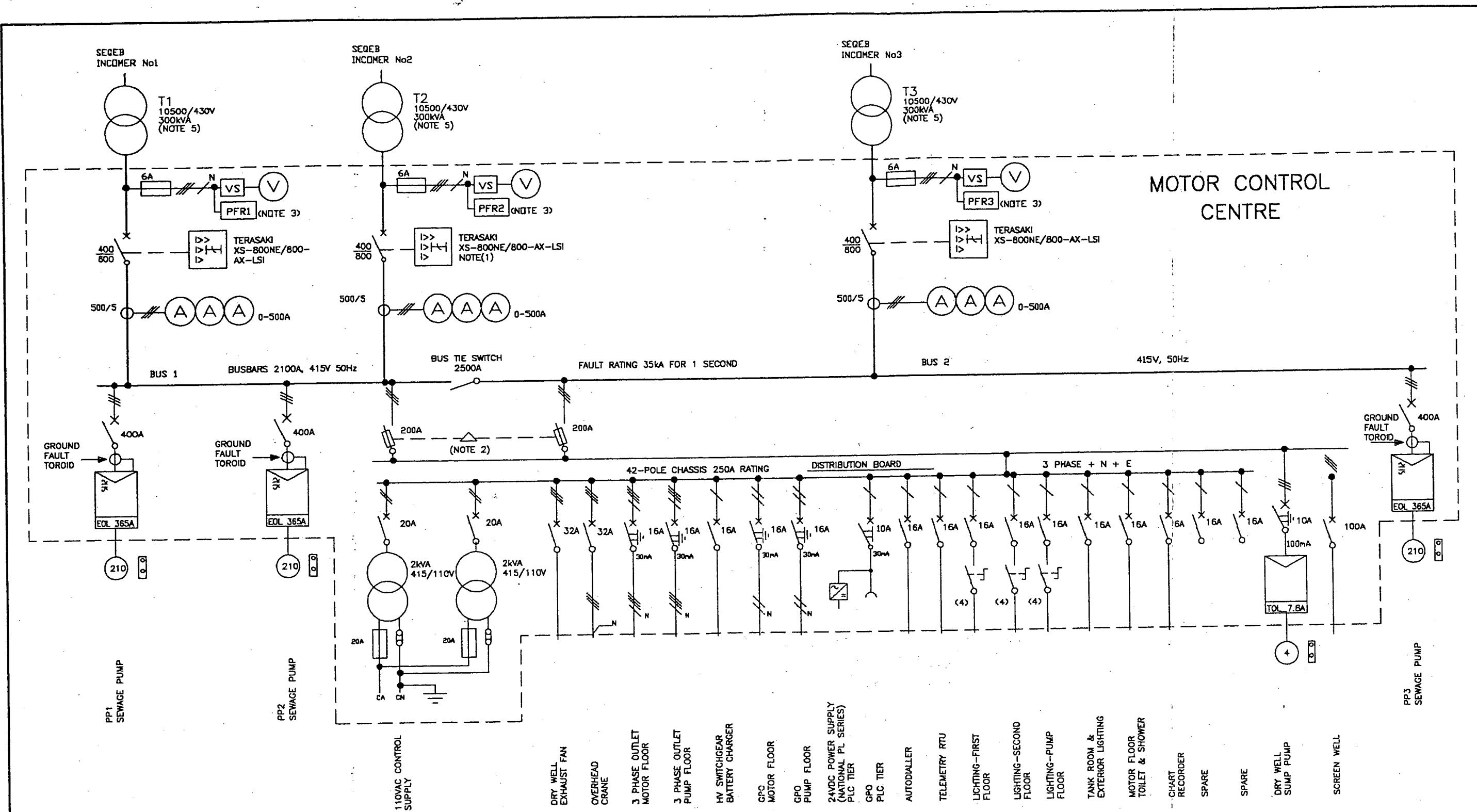
The action of each alarm and consequent events are stated at each alarm page.

### 3.8.3 As-Built Control Alterations

During commissioning of the pump station, a limitation on the station maximum discharge flowrate was implemented on a temporary basis, prior to permanent higher level weirs being installed at the Hawthorn Park overflow. This involved suitable setting of the overall flow loop upper clamp limits, for the two cases when the lag pump is and is not running. The wet well level/demand flow characteristic was limited to the same value as the overall flow controller.

Rungs 236 and 237 contain the overall flow controller upper clamp limit settings. Rung 321 contains the demand flow characteristic (upper clamp) limit setting. These should be set to the same value at all times.

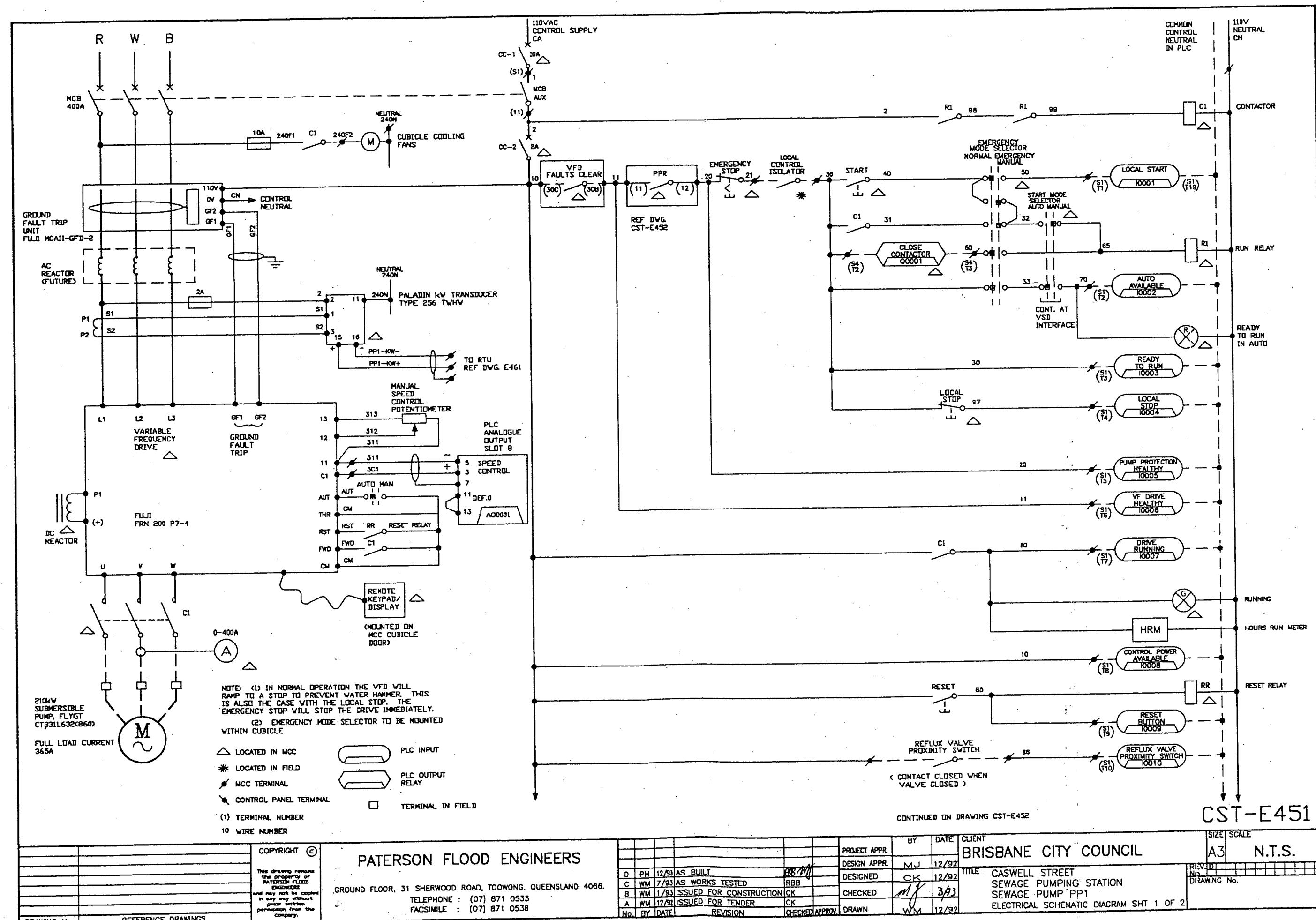
## APPENDIX 1 : ELECTRICAL DRAWINGS

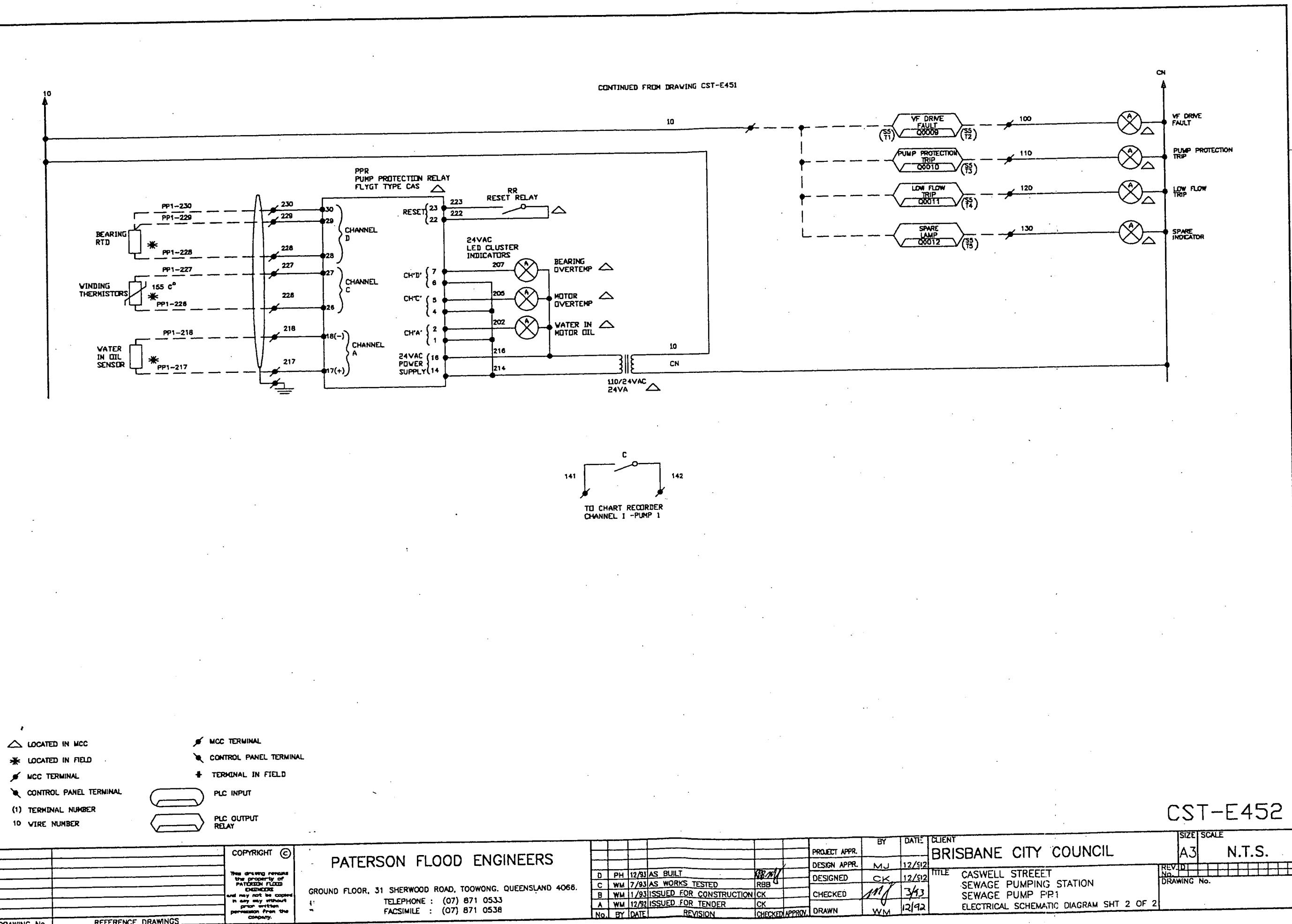


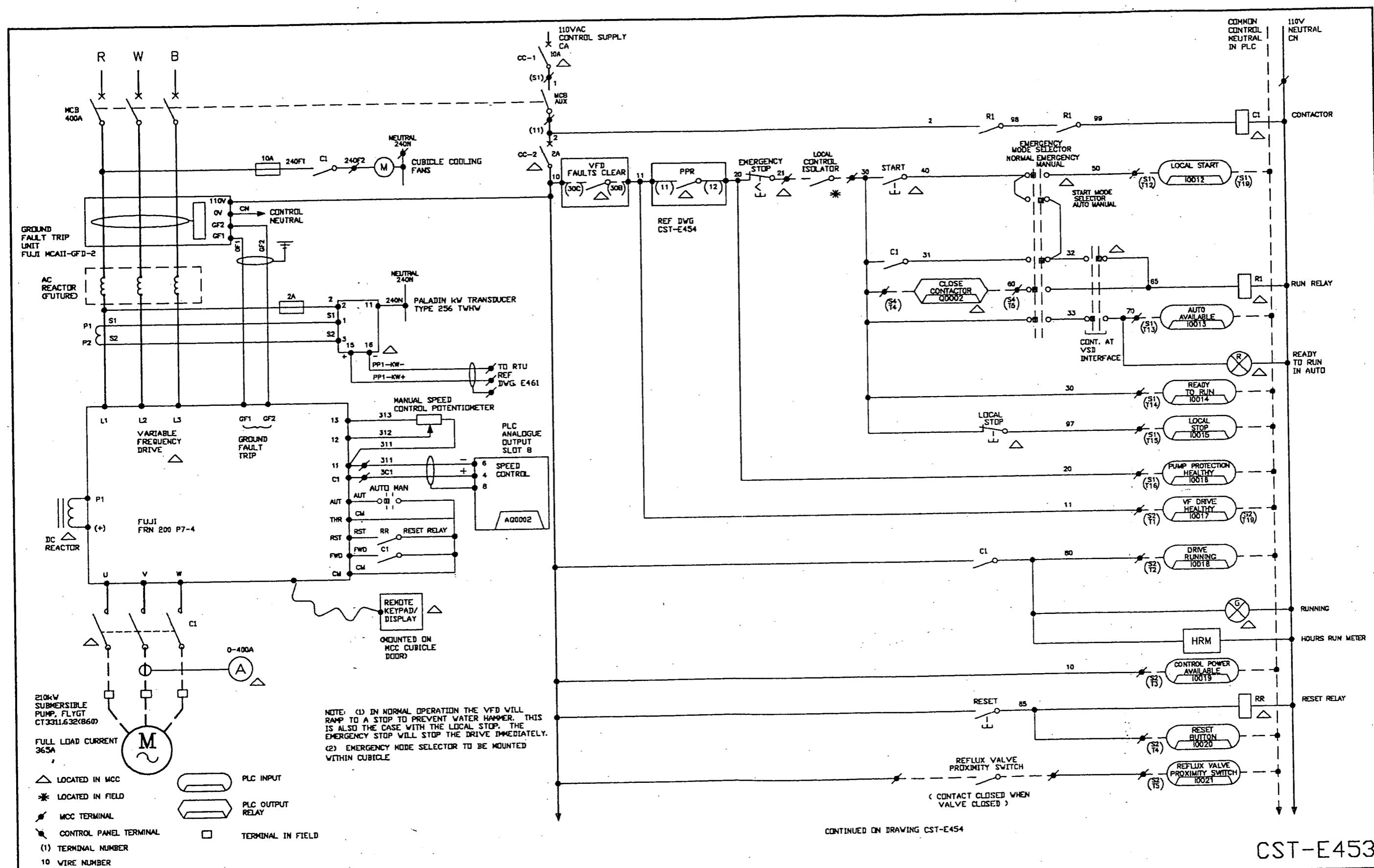
- NOTES**
- 1) INCOMER No2 INCOMER COMPARTMENT HAS BEEN SIZED TO PROVIDE MOUNTING FACILITIES TO ALLOW SUBSTITUTION OF EXISTING CIRCUIT BREAKER WITH A 2500A UNIT (TERASAKI XS-2500NE) IN THE FUTURE. INCOMER No2 BUSBARS ARE RATED FOR 2100A.
  - 2) MECHANICAL INTERLOCK-1 ONLY TO BE CLOSED
  - 3) PHASE UNBALANCE/UNDER VOLTAGE RELAY
  - 4) FRONT OF PANEL MOUNTED SWITCHES
  - 5) TRANSFORMERS BY SEQEB.
- VOLTAGE IMPEDANCES: T1 4.98%, T2 4.69%, T3 4.80%

CST-E450

DRAWING NO	REFERENCE DRAWINGS	COPYRIGHT ©	PATERSON FLOOD ENGINEERS GROUND FLOOR, 31 SHERWOOD ROAD, TOOOWONG QUEENSLAND 4066. TELEPHONE : (07) 871 0533 FACSIMILE : (07) 871 0538	CLIENT				SIZE	SCALE
				PROJECT APPR.	BY	DATE	BRISBANE CITY COUNCIL		
D	PH	12/93	AS BUILT	RBB	MJ	12/92			
C	VM	7/93	AS WORKS TESTED	RBB	CK	12/92			
B	VM	1/93	ISSUED FOR CONSTRUCTION	CK					
A	VM	12/92	ISSUED FOR TENDER	CK					
No.	BY	DATE	REVISION	CHECKED	APPROV	DRAWN	WM	12/92	



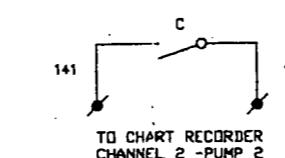
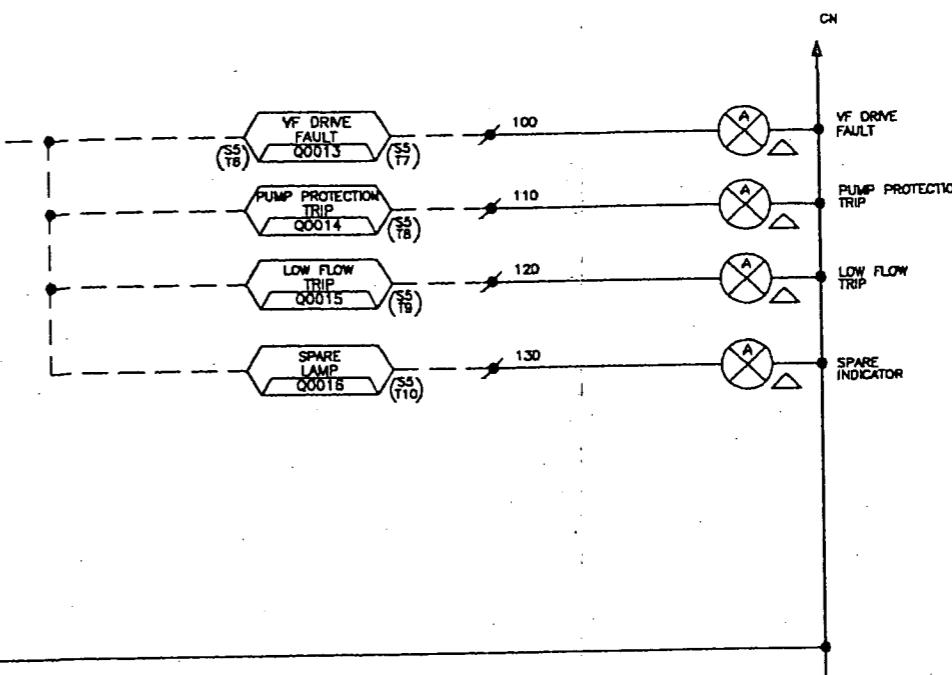
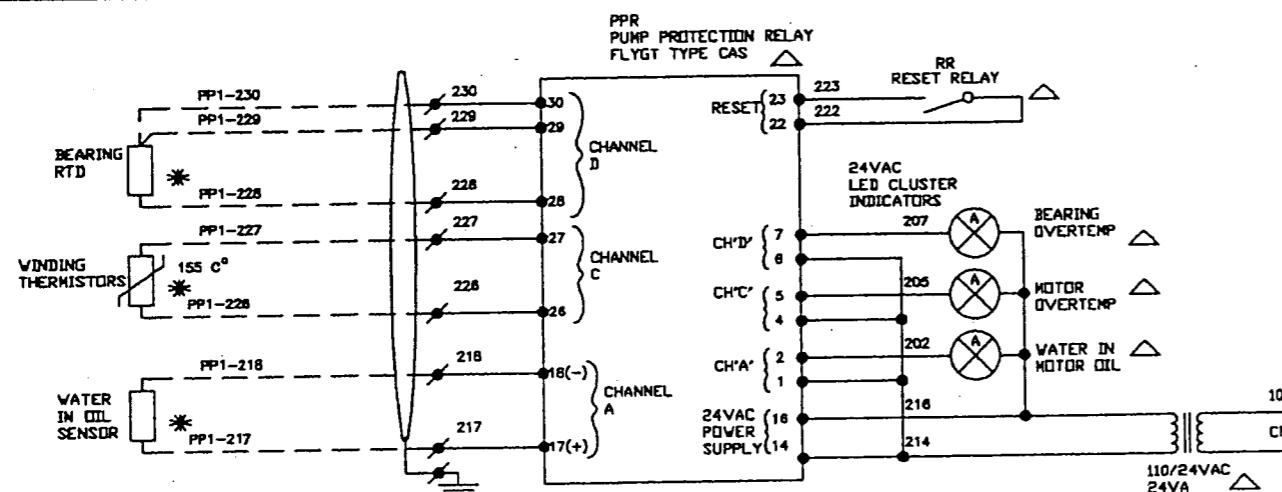




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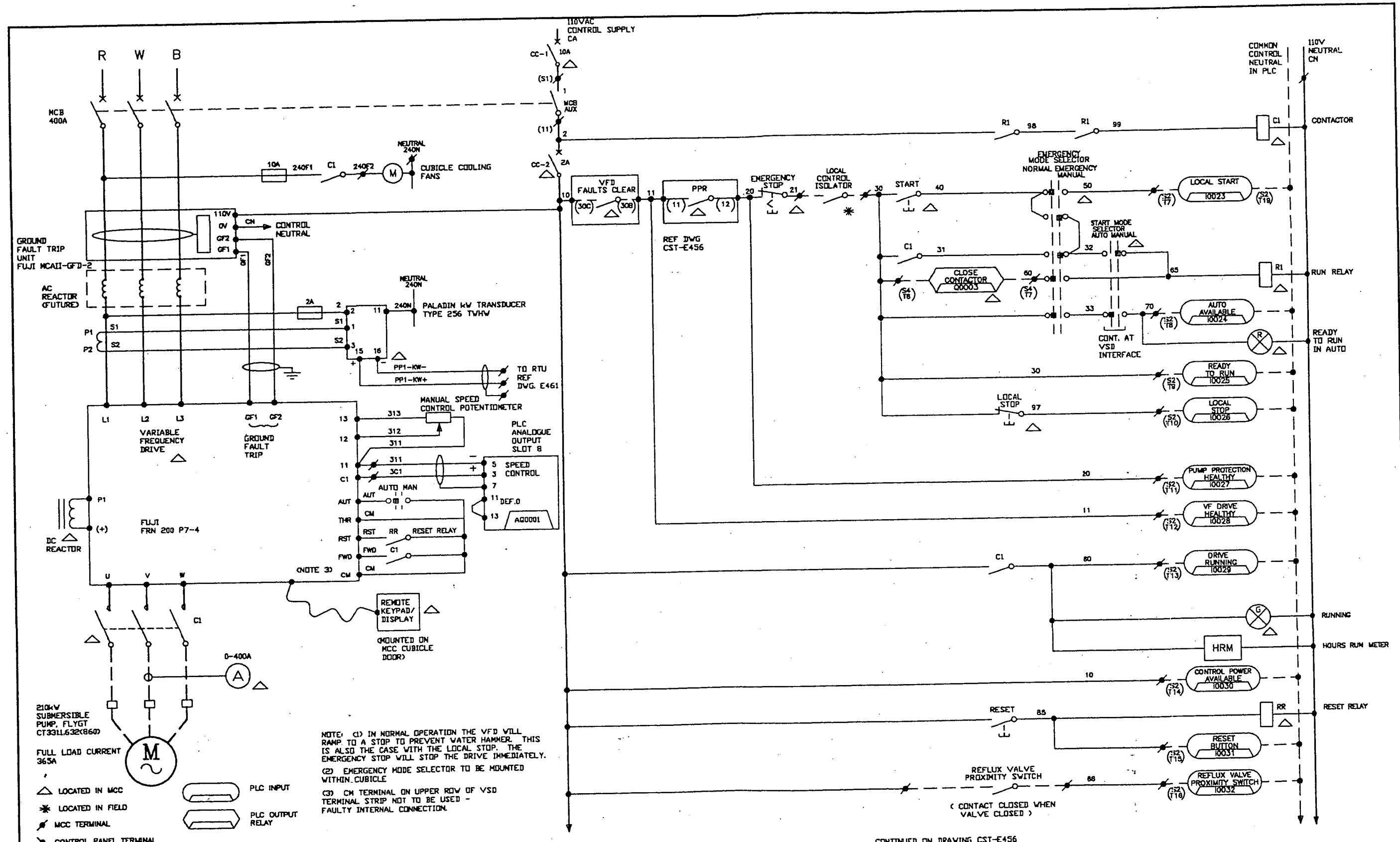
10



- LOCATED IN MCC
- LOCATED IN FIELD
- MCC TERMINAL
- CONTROL PANEL TERMINAL
- PLC INPUT
- PLC OUTPUT RELAY
- (1) TERMINAL NUMBER
- 10 WIRE NUMBER
- TERMINAL IN FIELD

CST-E454

		COPYRIGHT ©	PATERSON FLOOD ENGINEERS	GROUND FLOOR, 31 SHERWOOD ROAD, TOOWONG, QUEENSLAND 4066.	TELEPHONE : (07) 871 0533	FACSIMILE : (07) 871 0538	PROJECT APPR.	BY	DATE	CLIENT	SIZE	SCALE	
D	PH 12/93 AS BUILT						KSC/M	DESIGN APPR.	M.J	12/92	BRISBANE CITY COUNCIL	A3	N.T.S.
C	WM 7/93 AS WORKS TESTED						RBB	DESIGNED	C.K	12/92	TITLE	CASWELL STREET SEWAGE PUMPING STATION	REV'D
B	WM 1/93 ISSUED FOR CONSTRUCTION						CK	CHECKED	M.J	3/93	SEWAGE PUMP PP2		DRAWING No.
A	WM 12/92 ISSUED FOR TENDER						CK	DRAWN	W.M	12/92	ELECTRICAL SCHEMATIC DIAGRAM SHT 2 OF 2		
No.	BY DATE						REVISION	CHECKED/ APPROV					



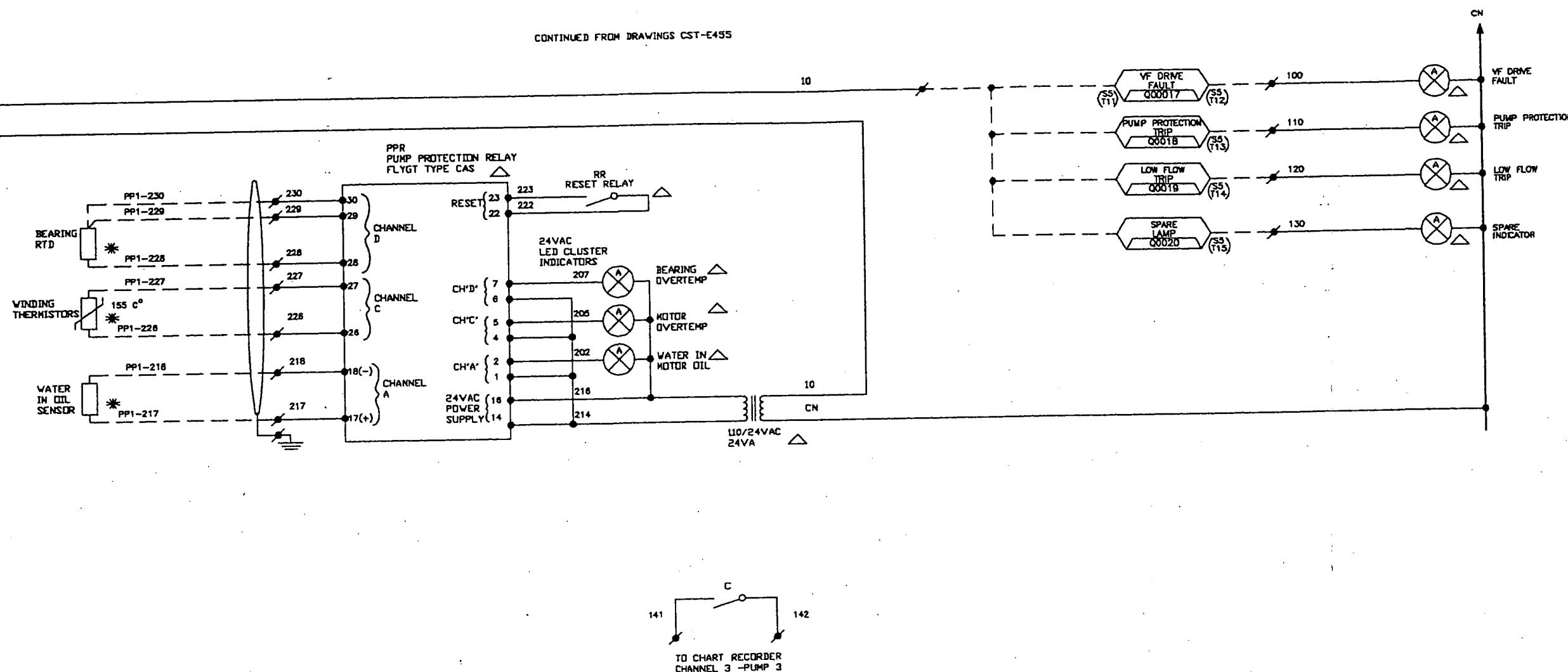
CONTINUED ON DRAWING CST-E456

CST-E455

		COPYRIGHT ©	PATERSON FLOOD ENGINEERS	CLIENT						SIZE	SCALE
				PROJECT APPR.	DESIGN APPR.	BY	DATE	BRISBANE CITY COUNCIL			
D	PH	12/93	AS BUILT	RBM	RBB	M.J.	12/92	TITLE	CASWELL STREET	REV'D	
C	WM	7/93	AS WORKS TESTED	RBM	CK	12/92		SEWAGE PUMPING STATION		NO.	
B	WM	1/93	ISSUED FOR CONSTRUCTION	CK	CK	MM	3/93	SEWAGE PUMP PP3		DRAWING NO.	
A	WM	12/92	ISSUED FOR TENDER	CK	CK	W.M.	12/92	ELECTRICAL SCHEMATIC DIAGRAM SHT 1 OF 2			
No.	BY	DATE	REVISION	CHECKED/APPV.	DRAWN						

10

CONTINUED FROM DRAWINGS CST-E455

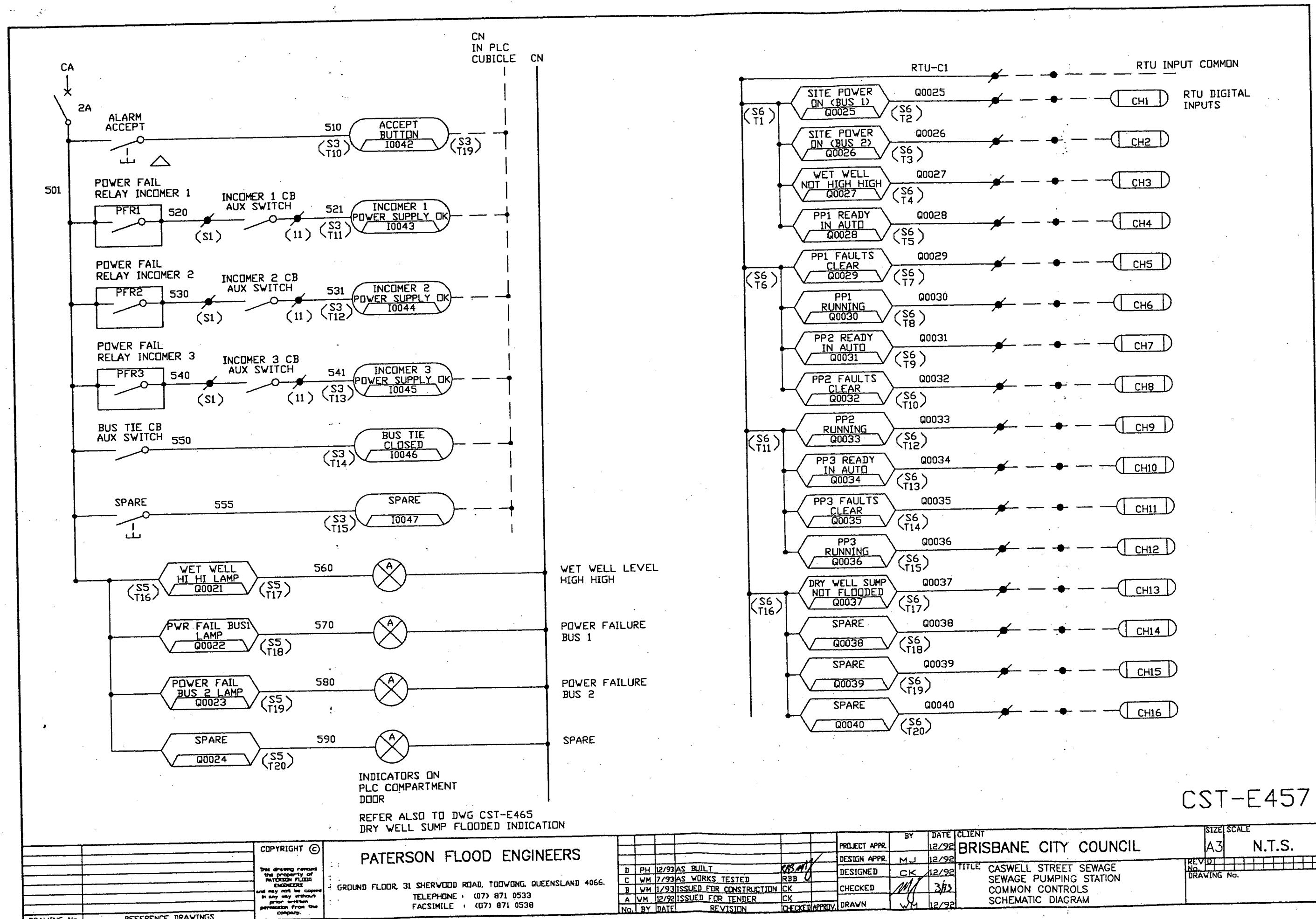


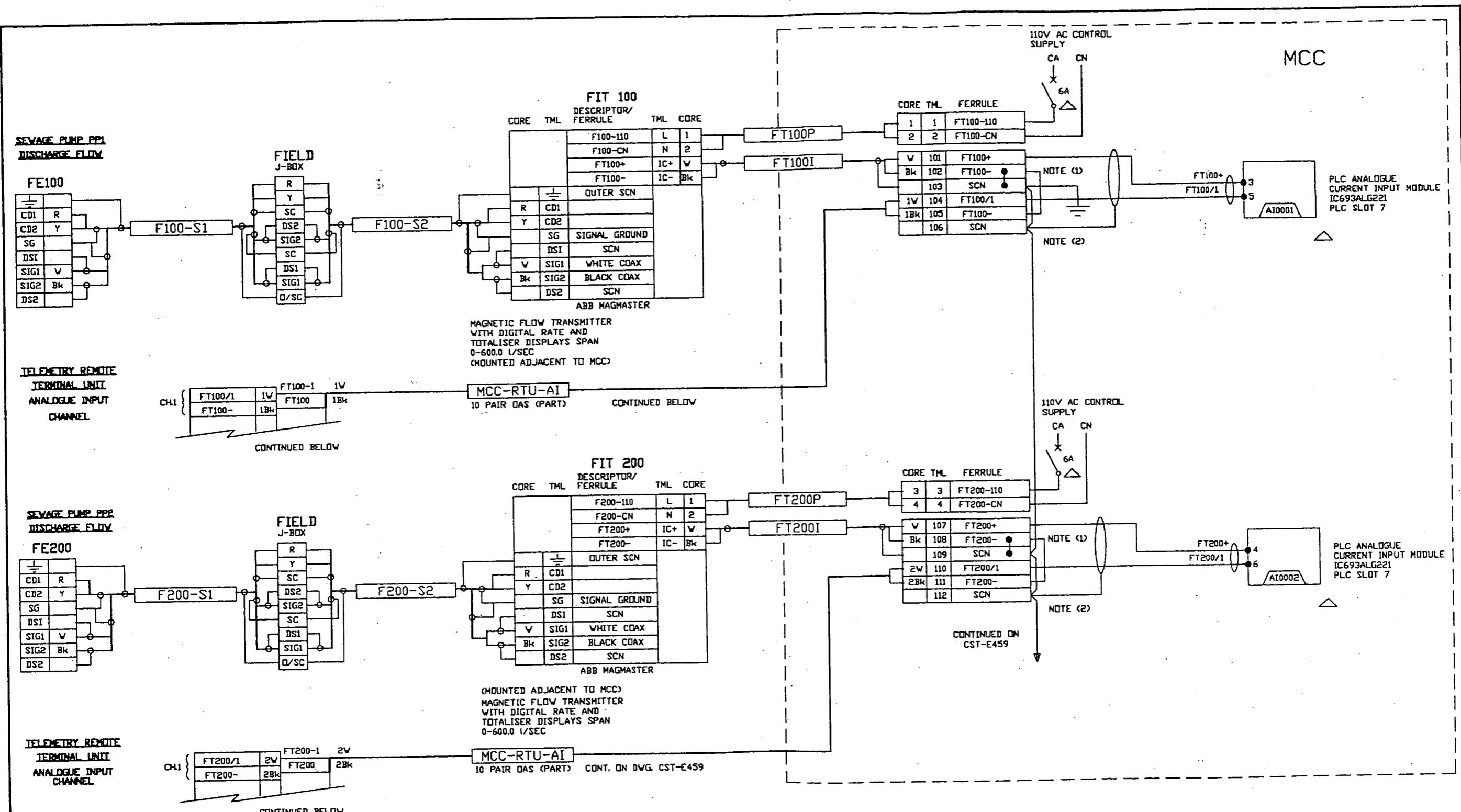
- △ LOCATED IN MCC
- \* LOCATED IN FIELD
- MCC TERMINAL
- ▲ CONTROL PANEL TERMINAL
- (1) TERMINAL NUMBER
- 10 WIRE NUMBER

- PLC INPUT
- PLC OUTPUT RELAY
- TUTORIAL IN FIELD

CST-E456

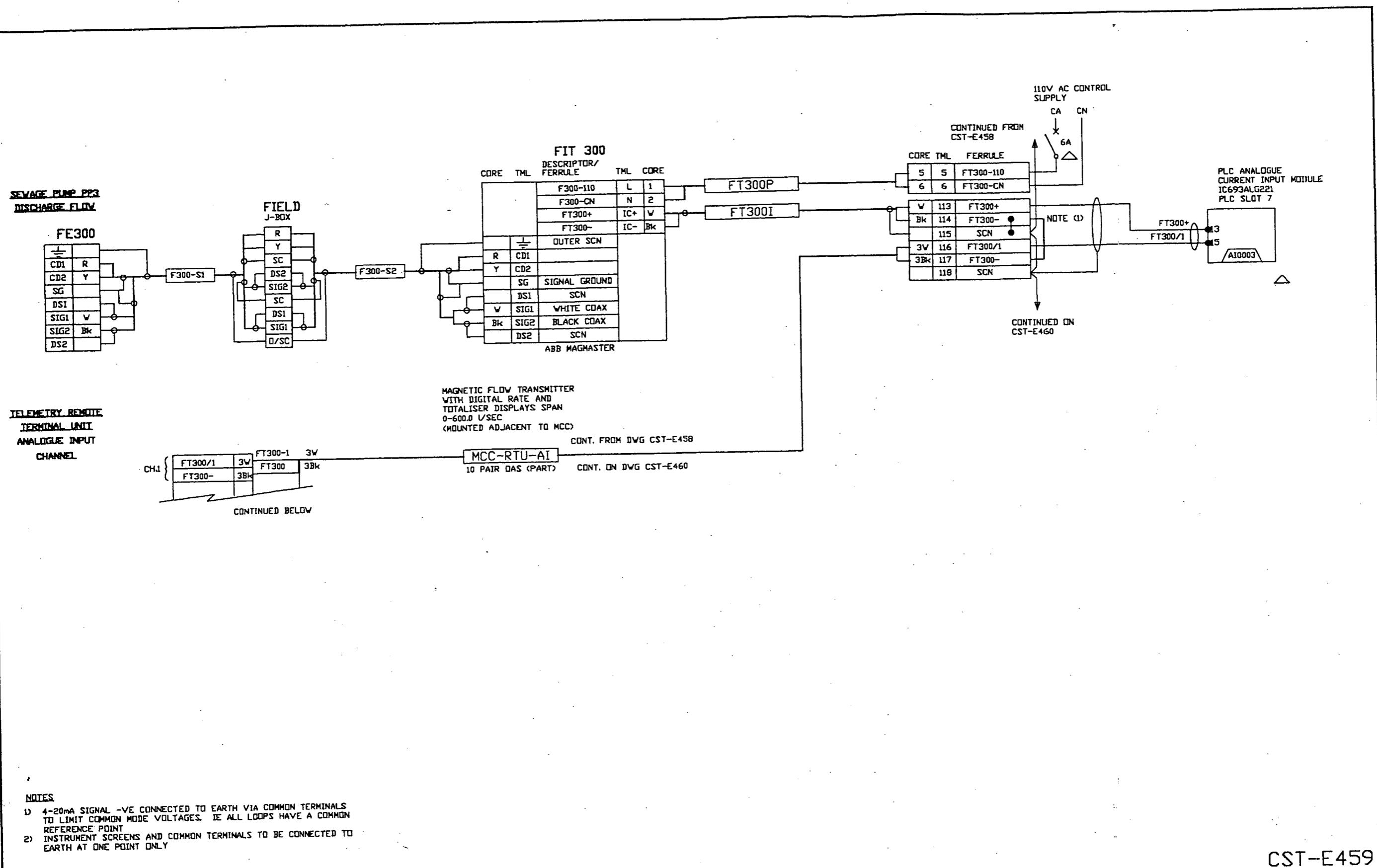
		COPYRIGHT ©	PATERSON FLOOD ENGINEERS GROUND FLOOR, 31 SHERWOOD ROAD, TOOOWONG, QUEENSLAND 4066. TELEPHONE : (07) 871 0533 FACSIMILE : (07) 871 0538	PROJECT APPR.				BY	DATE	CLIENT	SIZE	SCALE
D	P.H.			12/93 AS BUILT	DESIGN APPR.	M.J.	12/92					
C	W.M.	7/93 AS WORKS TESTED	RBB		DESIGNED	C.K.	12/92					
B	W.M.	1/93 ISSUED FOR CONSTRUCTION	C.K.		CHECKED	M.J.	3/93					
A	W.M.	12/92 ISSUED FOR TENDER	C.K.		DRAWN	W.M.	12/92					
		No.	BY DATE	REVISION	CHECKED APPROV.							



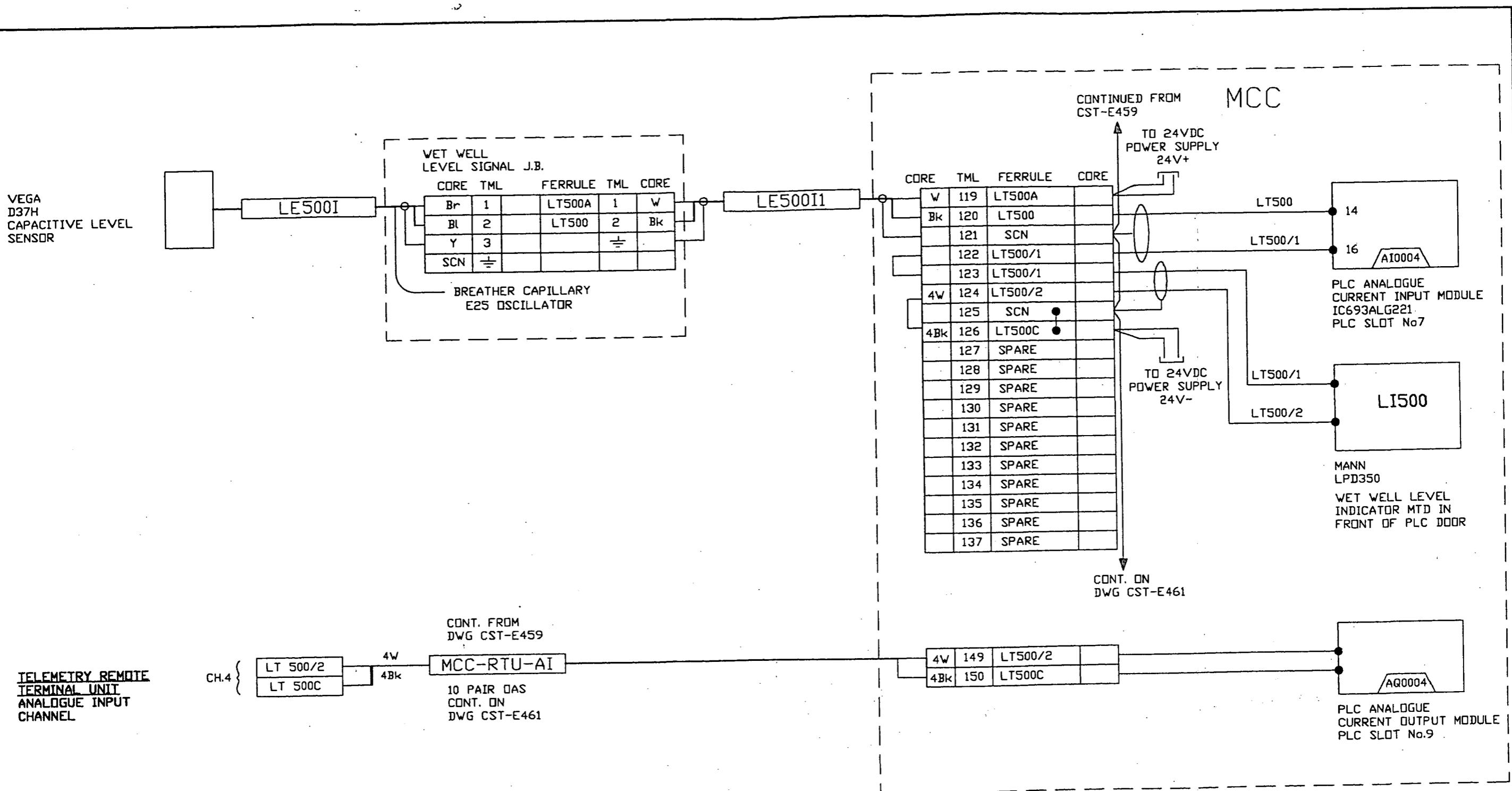


CST-E458

COPYRIGHT ©	PATERSON FLOOD ENGINEERS		PROJECT APPR.	BY	DATE	CLIENT	SIZE	SCALE
This drawing remains the property of PATERSON FLOOD ENGINEERS and may not be copied in any way without written permission from the company.			DESIGN APPR.	MJ	12/92	BRISBANE CITY COUNCIL	A3	N.T.S.
			DESIGNED	CK	12/92	TITLE	CASWELL STREET SEWAGE	REV/C
						SEWAGE PUMPING STATION		NO.
			CHECKED		3/93	SEWAGE PUMP DISCHARGE FLOWS		DRAWING NO.
			No.	BY DATE	REVISION	INSTRUMENT LOOPS F-100,F-200		
DRAWING NO.	REFERENCE DRAWINGS		DRAWN	WM	12/92			



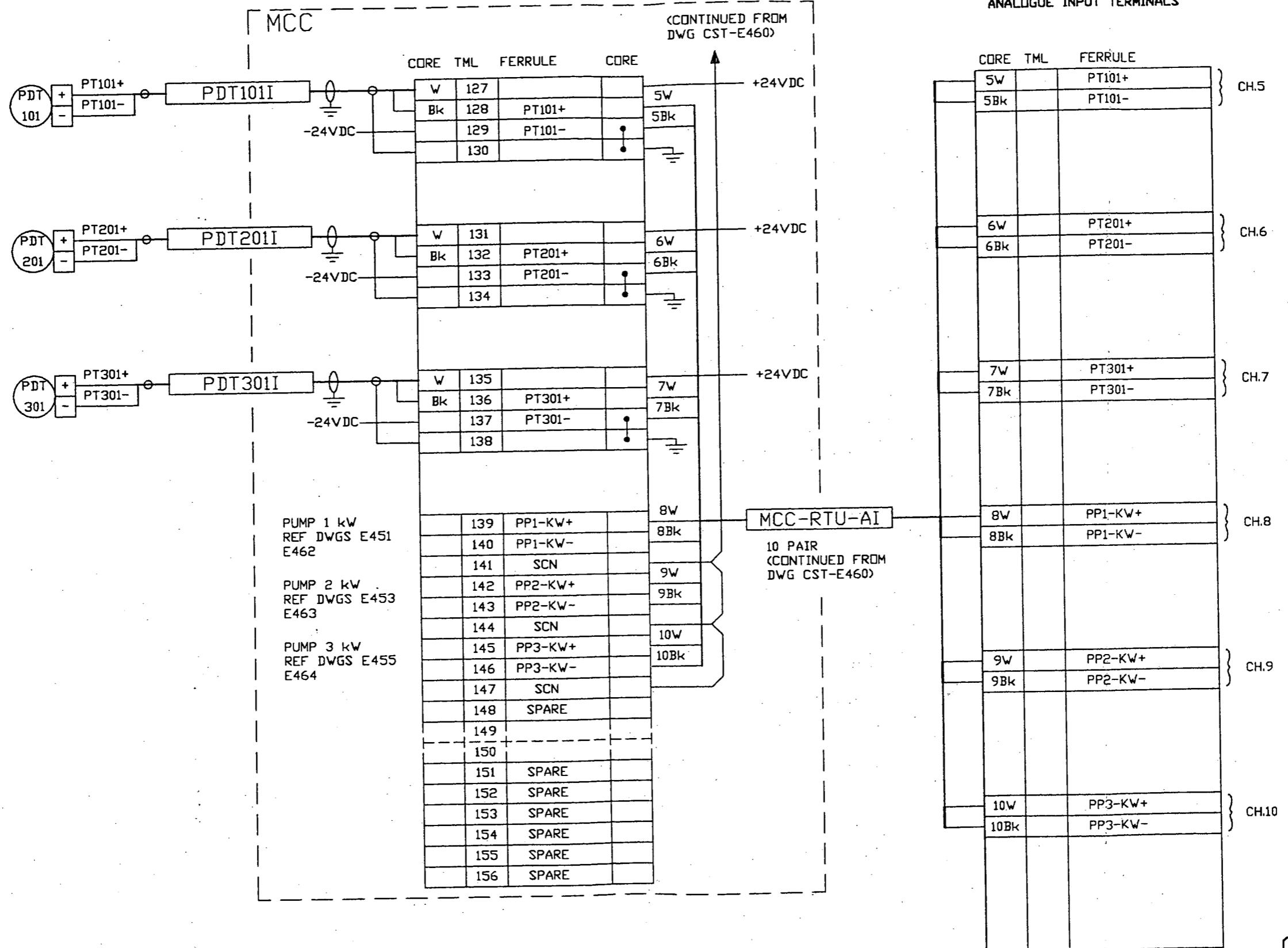
		COPYRIGHT ©	PATERSON FLOOD ENGINEERS	PROJECT APPR.	BY	DATE	CLIENT	SIZE	SCALE
				DESIGN APPR.	12/92	12/92	BRISBANE CITY COUNCIL	A3	N.T.S.
				DESIGNED	CK	12/92			
			C PH 12/92 AS BUILT	12/92			TITLE	CASWELL STREET SEWAGE	
			B WM 1/93 ISSUED FOR CONSTRUCTION	CK	12/92		REV'D NO.	SEWAGE PUMPING STATION	
			A WM 12/92 ISSUED FOR TENDER	CK	12/92		DRAWING NO.	SEWAGE PUMP DISCHARGE FLOWS	
			NO. BY DATE	REVISION	CHECKED APPROV.	DRAWN		INSTRUMENT LOOPS F-300	
DRAWING NO.	REFERENCE DRAWINGS								



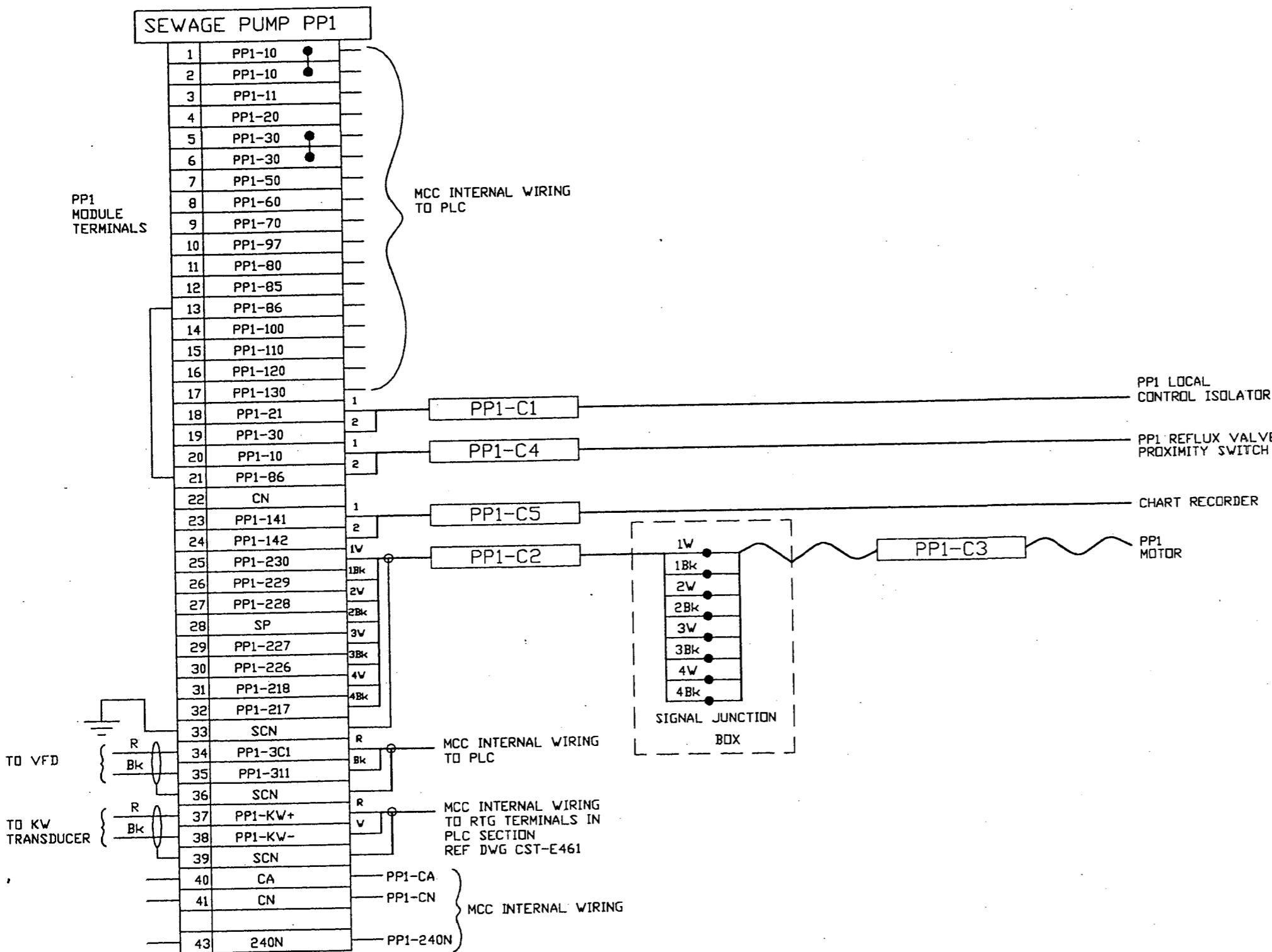
NOTE (1)  
REMOVE LINK ON PLC ANALOGUE INPUT

CST-E460

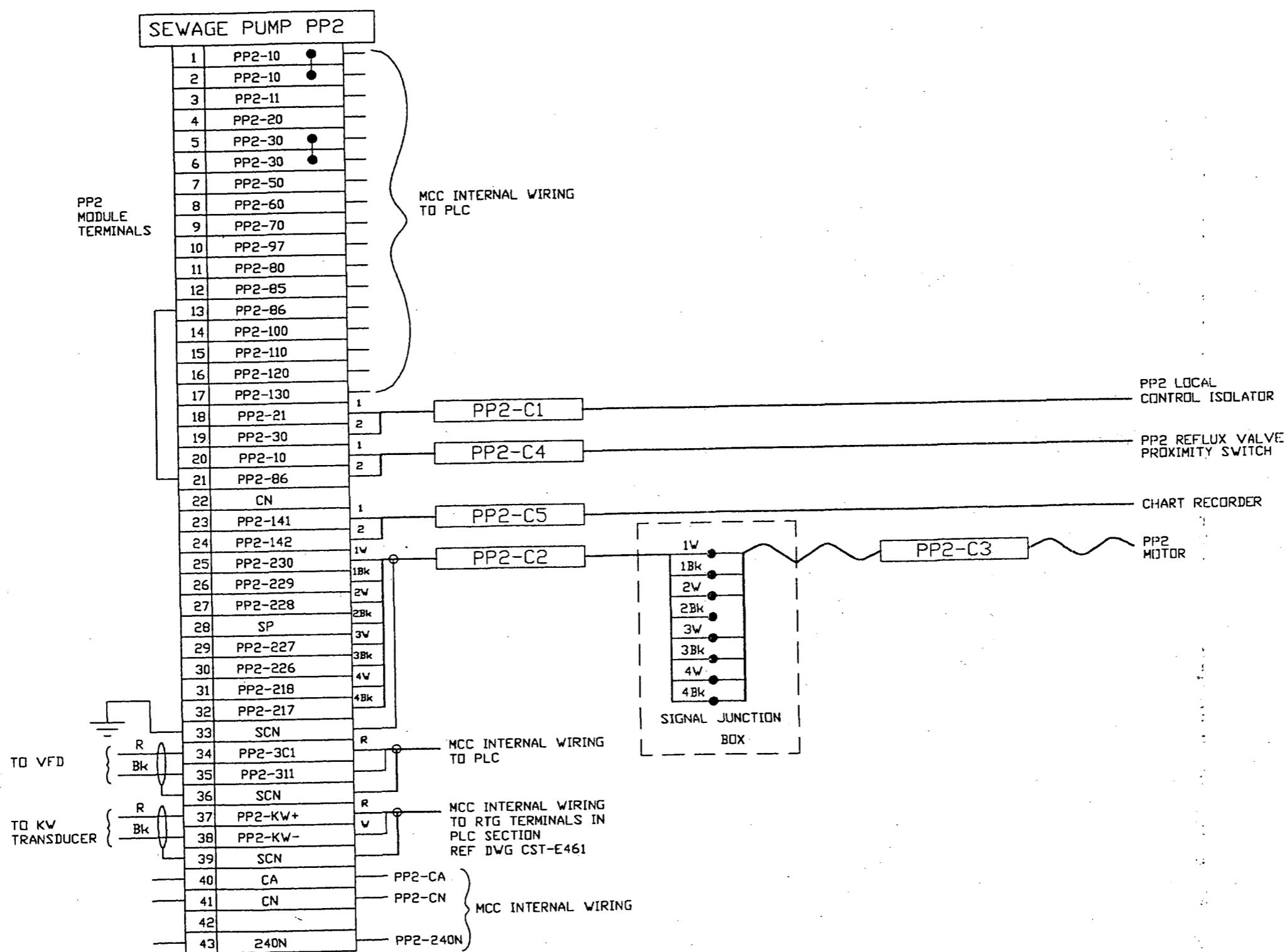
		COPYRIGHT ©  This drawing remains the property of PATERSON FLOOD ENGINEERS and may not be copied in any way without prior written permission from the company.	PATERSON FLOOD ENGINEERS						PROJECT APPR. DESIGN APPR. DESIGNED CHECKED DRAWN	BY M.J CK WM	DATE 12/92 12/92 12/92 12/92	CLIENT BRISBANE CITY COUNCIL	SIZE A3 SCALE N.T.S.	
			GROUND FLOOR, 31 SHERWOOD ROAD, TOOOWONG, QUEENSLAND 4066. TELEPHONE : (07) 871 0533 FACSIMILE : (07) 871 0538											
DRAWING NO.	REFERENCE DRAWINGS		C PH	12/93 AS BUILT	R&M	B VM	1/93 ISSUED FOR CONSTRUCTION	CK	CHECKED APPROV.	REVISION	NO. BY DATE		TITLE CASWELL STREET SEWAGE SEWAGE PUMPING STATION SEWAGE WET WELL LEVEL INSTRUMENT LOOP L-500	REV/C No. DRAWING NO.



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								DESIGN APPR.	M.J	12/92	BRISBANE CITY COUNCIL	A3	N.T.S.								
								DESIGNED	CK	12/92	TITLE CASWELL STREET SEWAGE SEWAGE PUMPING STATION DIFFERENTIAL PRESSURE AND PUMP KW INSTRUMENT LOOPS	REV/C No.	DRAWING No.								
								CHECKED	MM	3/93											
								DRAWN	WM	12/92											
								REVISION	checked/approval												
DRAWING NO.	REFERENCE DRAWINGS		GROUND FLOOR, 31 SHERWOOD ROAD, TOOOWONG QUEENSLAND 4066.		TELEPHONE : (07) 871 0533		FACSIMILE : (07) 871 0538		C PH 12/93 AS BUILT	B VM 1/93 ISSUED FOR CONSTRUCTION	A WM 12/92 ISSUED FOR TENDER	NO. BY DATE	REVISION	checked/approval	DRAWN	REVISION	checked/approval	DRAWN	REVISION	checked/approval	DRAWN

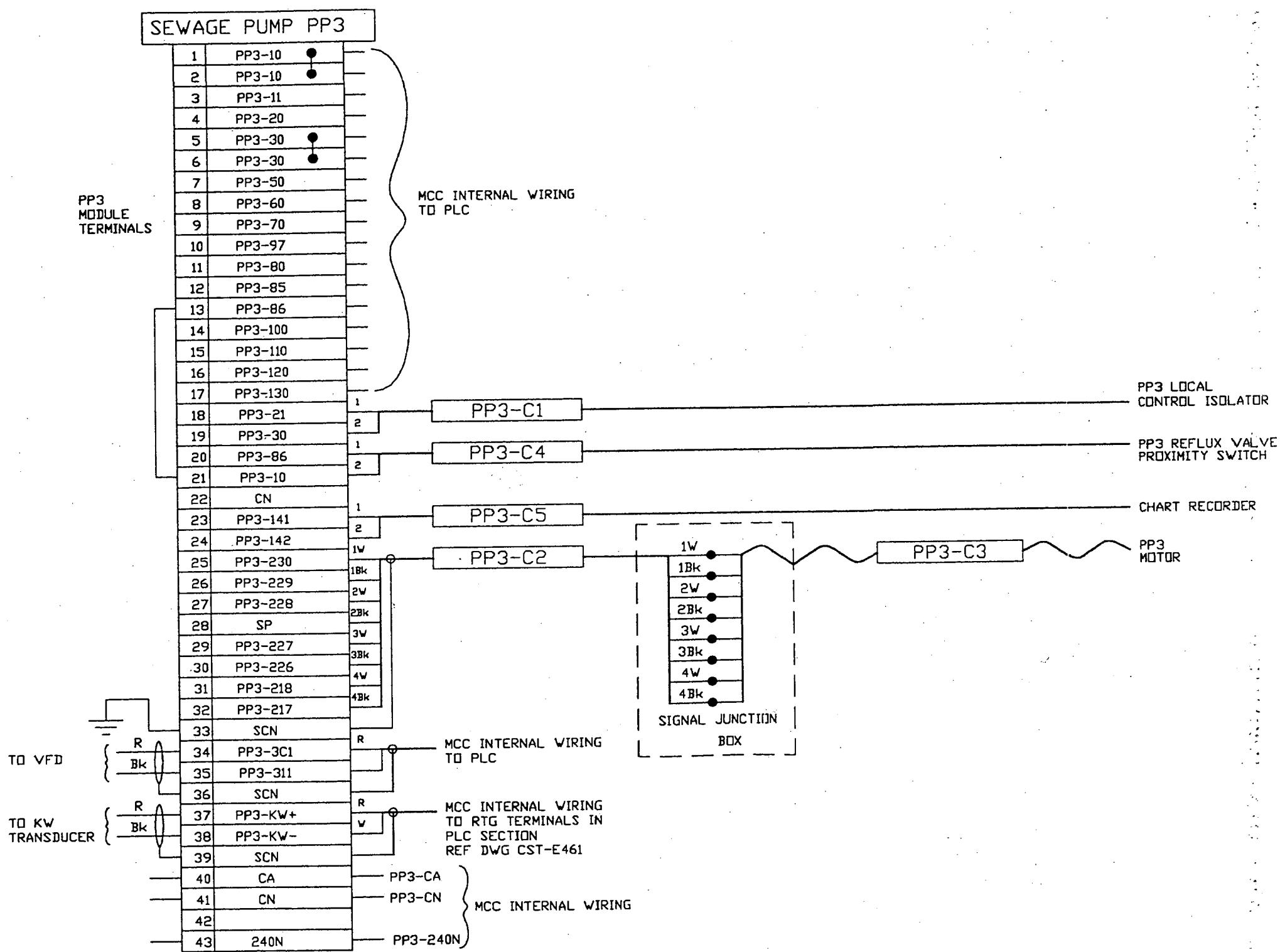


CST-E462



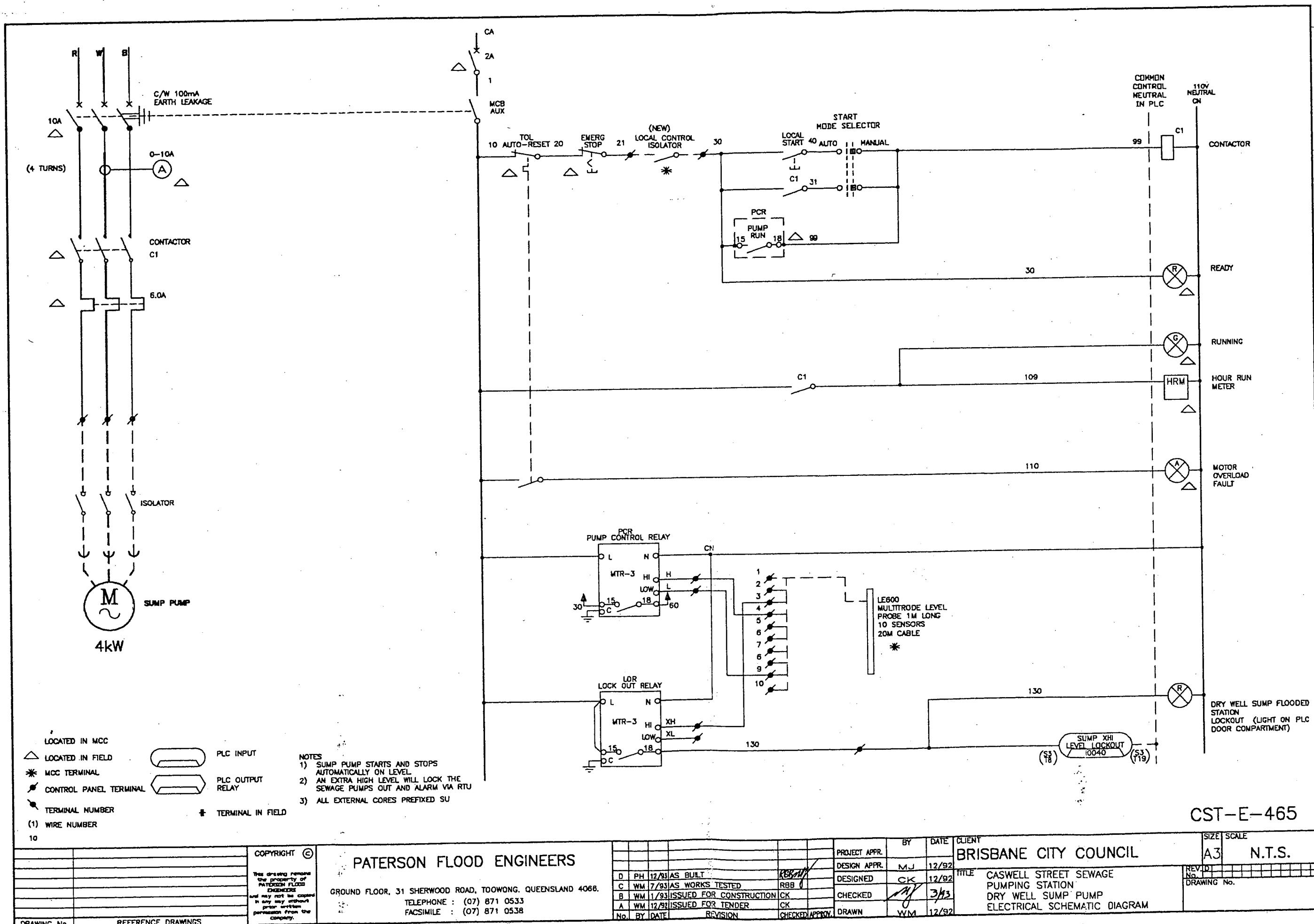
CST-E463

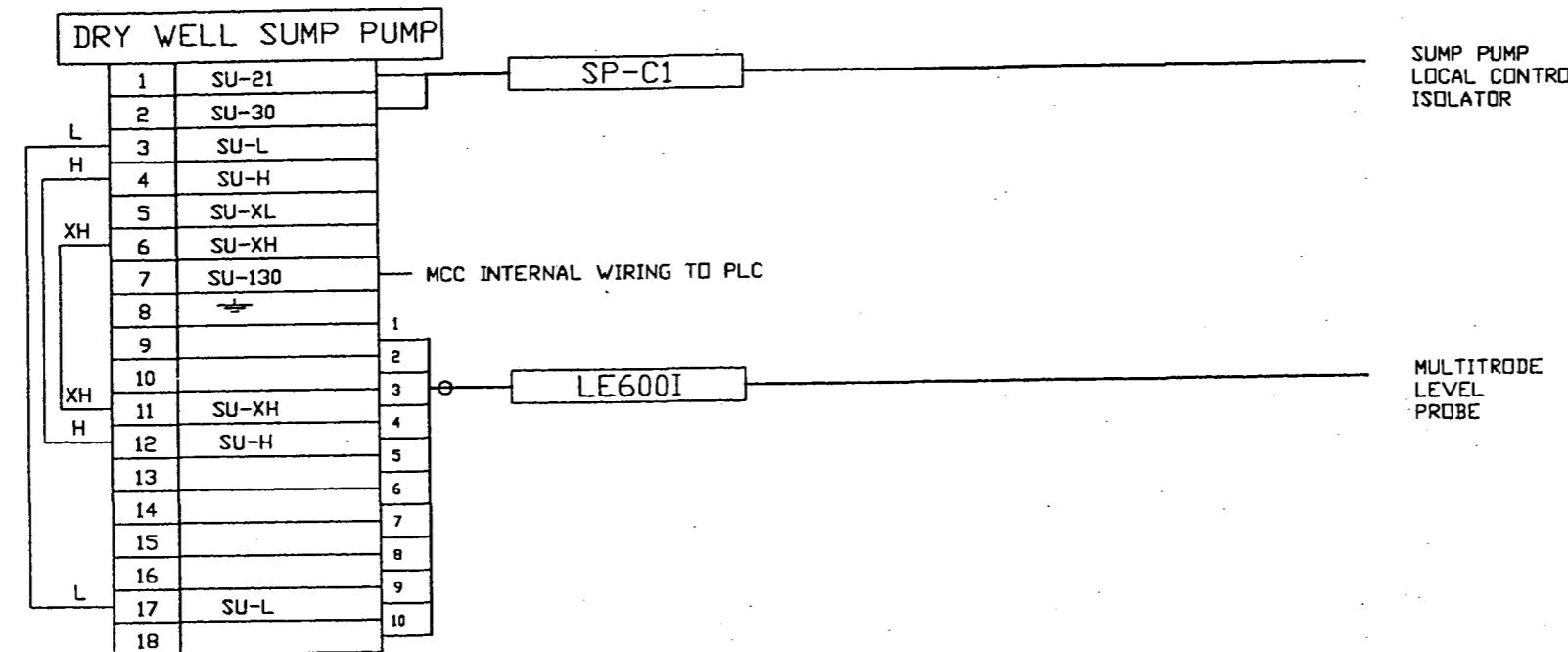
COPYRIGHT ©		PATERSON FLOOD ENGINEERS		CLIENT				SIZE	SCALE
				PROJECT APPR.	BY	DATE	BRISBANE CITY COUNCIL	A3	N.T.S.
D	PH	12/93 AS BUILT	RBB	DESIGN APPR.	M.J	12/92	REV'D		
C	WM	7/93 WORKS AS TESTED	RBB	DESIGNED	CK	12/92	NO.		
B	WM	1/93 ISSUED FOR CONSTRUCTION	CK	CHECKED	MJ	3/93	TITLE	CASWELL STREET SEWAGE	
A	WM	12/92 ISSUED FOR TENDER	CK	APPROV	WM	12/92	SEWAGE PUMP STATION	SEWAGE PUMP 2	
								TERMINATION DIAGRAM	
DRAWING NO.		REFERENCE DRAWINGS		NO.	BY	DATE	REVISION	CHECKED	



CST-E464

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				C	WM	7/93	AS WORKS TESTED	RBB	DESIGNED	CK	12/92	TITLE		
				B	WM	1/93	ISSUED FOR CONSTRUCTION	CK	CHECKED	MJ	3/93	CASWELL STREET SEWAGE SEWAGE PUMPING STATION SEWAGE PUMP 3 TERMINATION DIAGRAM		
				A	WM	12/92	ISSUED FOR TENDER	CK	REVISI ON NO.			REV'D No.		
				NO.	BY	DATE	REVISION	APPROV	DRAWN	WM	12/92	DRAWING No.		
DRAWING No.		REFERENCE DRAWINGS												





CST-E466

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				DESIGN APPR.	MJ	12/92	DESIGNED	CK	12/92	TITLE			
				D PH	12/92	AS BUILT	RBB			CASWELL STREET SEWAGE PUMPING STATION DRY WELL SUMP PUMP TERMINATION DIAGRAM			
				C WM	7/93	AS WORKS TESTED	RBB						
				B WM	1/93	ISSUED FOR CONSTRUCTION	CK						
				A WM	12/92	ISSUED FOR TENDER	CK						
				No.	BY DATE	REVISION	CHECKED APPROV	DRAWN	WM	12/92			

## APPENDIX 2 : PLC CODE LISTING

GGGG EEEEE	FFFFF AAA N N U U CCCC
G E	F A A NN N U U C
G GGG EEEE	FFF AAAAA N N N U U C
G G E	F A A N NN U U C
GGG EEEEE	F A A N N UUU CCCC

```

AAA U U TTTTT 000 M M AAA TTTTT IIIII 000 N N
A A U U T O O MM MM A A T I O O NN N
AAAAAA U U T O O M M M AAAAAA T I O O N N N
A A U U T O O M M A A T I O O N N N
A A UUU T 000 M M A A T IIIII 000 N N

```

```
(* ****)
(*
(*                                Program:  CASWELL
(*
(*      PLC PROGRAM ENVIRONMENT          HIGHEST REFERENCE USED
(* -----
(*          INPUT (%I):      512           INPUT:   %I0047
(*          OUTPUT (%Q):     512           OUTPUT:  %Q0040
(*          INTERNAL (%M):   1024          INTERNAL: %M0276
(*          GLOBAL DATA (%G): 1280          GLOBAL DATA: NONE
(*          TEMPORARY (%T):   256           TEMPORARY: NONE
(*          REGISTER (%R):    2048          REGISTER:  %R0995
(*          ANALOG INPUT (%AI): 128          ANALOG INPUT: %AI0004
(*          ANALOG OUTPUT (%AQ): 64           ANALOG OUTPUT: %AQ004
(*
(*          PROGRAM SIZE (BYTES):    4224
(*
(* ****)
```

## \*\*\*\*\* LOGIC TABLE OF CONTENTS \*\*\*\*\*

CASWELL	1
MAIN	2
logic	3

```
(*****)
(*
(*          BLOCK: _MAIN
(*
(*
(*          BLOCK SIZE (BYTES): 4217
(*          DECLARATIONS (ENTRIES): 518
(*
(*
(*          HIGHEST REFERENCE USED
(*
-----
```

04-11-94 11:27 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.01)  
CASWELL STREET SEWAGE PUMPING STATION

Page 3

[ START OF LD PROGRAM CASWELL ]	(*)	*)
[ VARIABLE DECLARATIONS ]		
[ BLOCK DECLARATIONS ]		
[ START OF PROGRAM LOGIC ]		

04-11-94 10:05 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.01) Page 4  
**CASWELL STREET SEWAGE PUMP STATION PLC DOCUMENTATION**  
 Miscellaneous Utilities

```
*****
(*      MISCELLANEOUS UTILITIES
(*
(* The following drive I/O notation is used in this PLC:
(*
(*  ???STT - LOCAL START PUSHBUTTON
(*  ???AUT - DRIVE READY IN AUTO
(*  ???RDY - DRIVE READY TO RUN
(*  ???RUN - DRIVE RUNNING
(*  ???POW - DRIVE CONTROL POWER AVAILABLE
(*  ???GO - OUTPUT WHICH CLOSES CONTACTOR
(*
(* The following alarm notation is used in this PLC:
(*
(*  > - INPUT WHICH INITIATES THE ALARM
(*  F - ALARM FLAG
(*  # - ALARM LATCH
(*  % - ACCEPT LATCH
(*  + - ALARM LIGHT
(*  @ - ALARM TRIGGER
(*
*****
```

Delay alarms, etc, after power is restored to ensure control supply is on and inputs are stable.

<< RUNG 6 STEP #0003 >>

```
PSBUS2H                                PSH
%M0183          +----+                %M0161
+--] [---+-----+ TMR +-----+-----( )--+
     |           |0.10s|
PSBUS1H|           |
%M0184|           |
+--] [---+ CONST -+PV                PSHDT
     +00050   |           |
           +----+
           %R0712
```

<< RUNG 7 STEP #0007 >>

```
PSH                                PUDF
%M0161 +----+                %M0005
+--] [---+ TMR +-----+-----( )--+
     |           |0.10s|
CONST -+PV
+00020 |
+----+
     PSHDT
     %R0001
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%R0712		
%M0184	PSBUS1H	Power Supply Healthy - Bus 1
%M0183	PSBUS2H	Power Supply Healthy - Bus 2
%M0161	PSH	Power supply healthy
%R0001	PSHDT	Power Supply Healthy Delay Timer
%M0005	PUDF	Power-up Delay Flag (for Alarms)

Free-running oscillator with 0.7s on and 0.7s off times to drive  
 flashing lamps etc.

<< RUNG 9 STEP #0011 >>

```
LPAUXA          LPFLH
%M0003 +----+ %M0001
+--]/[---+ TMR +----- ( )--
|0.10s|
CONST -+PV
+00007 |
+----+
LPFT1
%R0004
```

<< RUNG 10 STEP #0014 >>

```
LPFLH          LPAUXA
%M0001 +----+ %M0003
+--]/[---+ TMR +----- ( )--
|0.10s|
CONST -+PV
+00007 |
+----+
LPFT2
%R0007
```

<< RUNG 11 STEP #0017 >>

```
LPFLH          LPAUXB
%M0001 +----+ %M0004
+--]/[---+ TMR +----- ( )--
|0.10s|
CONST -+PV
+00002 |
+----+
LPFT3
%R0010
```

Lamp flasher with 0.2s ON and 1.2s OFF times for secondary lamp flash  
 code ("Blink").

<< RUNG 13 STEP #0021 >>

```
LPFLH  LPAUXB          LPBLK
%M0001  %M0004          %M0002
+--]/[----]/[----- ( )--
```

REFERENCE	NICKNAME	DESCRIPTION
%M0003	LPAUXA	Lamp Flasher aux A
%M0004	LPAUXB	Lamp Flasher aux B
%M0002	LPBLK	Lamp Blinker
%M0001	LPFLH	Lamp Flasher
%R0004	LPFT1	Lamp Flasher Timer 1
%R0007	LPFT2	Lamp Flasher Timer 2
%R0010	LPFT3	Lamp Flasher Timer 3

Spare lamps do nothing except to flash during a lamp test.  
Each coil needs to be deleted from this rung when to be used elsewhere in the program.

<< RUNG 15 STEP #0025 >>

ACCBUT	LPFLH	SPLAMP
%I0042	%M0001	%Q0024
[---]	[-----]	( )--

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0001	LPFLH	Lamp Flasher
%Q0024	SPLAMP	Spare Lamp

Program: CASWELL

C:\LM90\CASWELL

Block: MAIN

CASWELL STREET SEWAGE PUMP STATION PLC DOCUMENTATION  
Power Supply Failure Bus 1

```
(*****  
(*          POWER SUPPLY FAILURE BUS 1 ALARM      *)  
(*  
(* Bus 1 power comes directly from feeder 3, and indirectly from feeders 2      *)  
(* and 3 via the bus-switch. This alarm indicates that there is no power      *)  
(* available on Bus 1.      *)  
(*  
(* The following drawings show the electrical connections:-      *)  
(*  
(*      CST-E450      *)  
(*      CST-E457.      *)  
(*  
(* The code for this alarm is standard alarm code as described in the      *)  
(* program description. This alarm is also triggered on power-up to      *)  
(* indicate a loss of power has occurred and power has been restored.      *)  
(*  
(* This alarm causes the following events in sequence:      *)  
(*  
(* Possible loss of small power distribution, depending on current      *)  
(* status of distribution main switches and which bus the      *)  
(* distribution board is being fed from.      *)  
(* Pump PP3 stops or becomes unavailable if bus-switch is open.      *)  
(*  
(*****
```

<< RUNG 17 STEP #0029 >>

IN1POW		PSBUS1H
%I0043		%M0184
+--]	[---+-----+( )--	
IN2POW		
%I0044		
+--]	[---	
IN3POW	BTCLD	
%I0045	%I0046	
+--]	[----] [---+	

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0046	BTCLD	Bus Tie Closed
%I0043	IN1POW	Incomer 1 Power Supply O.K.
%I0044	IN2POW	Incomer 2 Power Supply O.K.
%I0045	IN3POW	Incomer 3 Power Supply O.K.
%M0184	PSBUS1H	Power Supply Healthy - Bus 1

04-11-94 10:05 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.01) Page 8  
**CASWELL STREET SEWAGE PUMP STATION PLC DOCUMENTATION**  
 Power Supply Failure Bus 1

<< RUNG 18 STEP #0035 >>

```
PFB1#  PFB1%
%M0010  %M0011
+--] [----]/[----+(M)--
```

```
PSBUS1H
%M0184
+--]/[----+
```

```
FST_SCN
%S0001
+--] [----+
```

<< RUNG 19 STEP #0040 >>

```
ACCBUT  PFB1#
%I0042  %M0010
+--] [---+(M)--
```

```
PFB1%
%M0011
+--] [---+
```

<< RUNG 20 STEP #0044 >>

```
PFB1% ACCBUT
%M0011  %I0042
+--] [----/( )--
```

```
PFB1# LPFLH
%M0010  %M0001
+--] [---+(--+
```

```
ACCBUT
%I0042
+--] [---+
```

<< RUNG 21 STEP #0051 >>

```
PFB1#
%M0010
+--] [----(^)--
```

REFERENCE	NICKNAME
%I0042	ACCBUT
%S0001	FST_SCN
%M0001	LPFLH
%M0010	PFB1#
%M0011	PFB1%
%Q0022	PFB1+
%M0113	PFB1@
%M0184	PSBUS1H

REFERENCE	DESCRIPTION
	Accept Button
	Lamp Flasher
	Power failure-bus 1-alarm latch
	Power failure-bus 1-accept latch
	Power Fail Bus 1 Lamp
	Mstr Alm Trig-Pow fail alm bus 1
	Power Supply Healthy - Bus 1

```
(*****  
(*          POWER SUPPLY FAILURE BUS 2 ALARM  
(*  
(* Bus 2 power comes from feeders 2 and 3 directly, and from feeder 1  
(* via the bus-switch. This alarm indicates that there is no power  
(* available on Bus 2.  
(*  
(* The following drawings show the electrical connections:-  
(*  
(*      CST-E450  
(*      CST-E457.  
(*  
(* The code for this alarm is standard alarm code as described in the  
(* program description. This alarm is also triggered on power-up, to  
(* indicate a power loss has occurred and power has been restored.  
(*  
(* This alarm causes the following events in sequence:  
(*  
(*      Possible loss of small power distribution, depending on current  
(* status of distribution main selector switches and which bus the  
(* distribution board is being fed from.  
(*      Pumps 1 and 2 stop or become unavailable if bus-switch is open.  
(*  
(*****)
```

&lt;&lt; RUNG 23 STEP #0054 &gt;&gt;

IN3POW		PSBUS2H
%I0045		%M0183
+--]	[-----+-----+-----+( )--	
IN1POW	BTCLD	
%I0043	%I0046	
+--]	[---+---] [---+---]	
IN2POW		
%I0044		
+--]	[---+---]	

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0046	BTCLD	Bus Tie Closed
%I0043	IN1POW	Incomer 1 Power Supply O.K.
%I0044	IN2POW	Incomer 2 Power Supply O.K.
%I0045	IN3POW	Incomer 3 Power Supply O.K.
%M0183	PSBUS2H	Power Supply Healthy - Bus 2

&lt;&lt; RUNG 24 STEP #0060 &gt;&gt;

PSBUS2H	PFB2#
%M0183	%M0026
+---]/[-----+-----]	(M)---
PFB2# PFB2%	
%M0026 %M0027	
+---] [-----]/[---+	
FST_SCN	
%S0001	
+---] [-----+-----]	

&lt;&lt; RUNG 25 STEP #0066 &gt;&gt;

ACCBUT PFB2#	PFB2%
%I0042 %M0026	%M0027
+---] [---+---] [-----+-----]	(M)---
PFB2%	
%M0027	
+---] [---+-----]	

&lt;&lt; RUNG 26 STEP #0070 &gt;&gt;

PFB2% ACCBUT	PFB2+
%M0027 %I0042	%Q0023
+---] [-----]/[---+-----]	( )---

PFB2# LPFLH	
%M0026 %M0001	
+---] [---+---] [---+-----]	

ACCBUT	
%I0042	
+---] [---+-----]	

&lt;&lt; RUNG 27 STEP #0077 &gt;&gt;

PFB2#	PFB2@
%M0026	%M0127
+---] [-----+-----]	(^)---

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%S0001	FST_SCN	
%M0001	LPFLH	Lamp Flasher
%M0026	PFB2#	Power Failure-Bus 2-Alarm Latch
%M0027	PFB2%	Power Failure-Bus 2-Accept Latch
%Q0023	PFB2+	Power Fail Bus 2 Lamp
%M0127	PFB2@	Mstr Alm Trig-Pow fail alm bus 2
%M0183	PSBUS2H	Power Supply Healthy - Bus 2

04-11-94 10:05 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.01)  
 CASWELL STREET SEWAGE PUMP STATION PLC DOCUMENTATION  
 Wet Well Level High-High Alarm

Page 11

```
*****
(*          WET WELL LEVEL HIGH-HIGH ALARM
(*
(* Wet well level is monitored by the Vega capacitive level sensor and
(* the level is controlled using multiple pumps and variable pump speeds
(* to a level below the hi-hi level. This alarm indicates that the pump
(* system has failed.
(*
(* The following drawings show the electrical connections:-
(*
(*      CST-E460
(*
(* The code for this alarm is standard alarm code as described in the
(* program description.
(*
(* This alarm causes the following events in sequence:
(*
(*      Alarm only - no further action.
(*
*****
```

&lt;&lt; RUNG 29 STEP #0080 &gt;&gt;

WWLH#	WWLH%	WWLH#
%M0012	%M0013	%M0012
---]	[-----]/[-----]	---(M)---

WWLHF	
%M0199	
---]	[-----+-----]

&lt;&lt; RUNG 30 STEP #0084 &gt;&gt;

ACCBUT	WWLH#	WWLH%
%I0042	%M0012	%M0013
---]	[-----]	---(M)---

WWLH%	
%M0013	
---]	[--+

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0012	WWLH#	Wet well level high alarm latch
%M0013	WWLH%	Wet well level high accept latch
%M0199	WWLHF	W/Well Level Hi (Surcharge) Flag

<< RUNG 31 STEP #0088 >>

WWLH% ACCBUT  
%M0013 %I0042  
---] [----]/[---+-----  
WWLH# LPFLH  
%M0012 %M0001  
---] [---+---] [---+  
ACCBUT  
%I0042  
---] [---+

<< RUNG 32 STEP #0095 >>

WWLH#  
%M0012  
---] [-----  
WWLH@  
%M0114  
---(^)--

REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%I0042	ACCBUT		Accept Button
%M0001	LPFLH		Lamp Flasher
%M0012	WWLH#		Wet well level high alarm latch
%M0013	WWLH%		Wet well level high accept latch
%Q0021	WWLH+		Wet Well Hi Hi Lamp
%M0114	WWLH@		Mstr Alm Trig-Wetwell lev hihi

04-11-94 10:05 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.01) Page 13  
 CASWELL STREET SEWAGE PUMP STATION PLC DOCUMENTATION  
 Pump Common Controis: Lead Duty Pump Sequencing

(\*\*\*\*\*  
 (\* PUMP SEQUENCING \*)  
 \*\*\*\*\*)

Duty sequencer can be advanced to next step, and duty timer reset to zero, by pressing the ACCEPT and SPARE buttons at the same time.  
 Normal (Auto) step advance occurs when duty timer times out after 24 hours of continuous running or whenever the lead duty pump stops.

<< RUNG 35 STEP #0099 >>

ACCBUT	SPPBUT	CHDF
%I0042	%I0047	%M0019
[-----]	[-----]	( )--

PDTTO  
 %M0023

LDPSTT  
 %M0223

<< RUNG 36 STEP #0104 >>

LEDPCF	LDPSTT
%M0014	%M0223
[-----]	(^)--

Obtain a per-minute one-shot trigger from the system timebase:  
 This avoids spurious counts in the Pump Duty Timer as pumps start.

<< RUNG 38 STEP #0107 >>

T_MIN	DTTOS
%S0006	%M0024
[-----]	(^)--

While any pump is running, this counter counts the passing minutes.  
 After 1440 minutes (24 hours) continuous running, the sequencer below is triggered to advance 1 step; this counter is reset to zero; and the timing begins again.

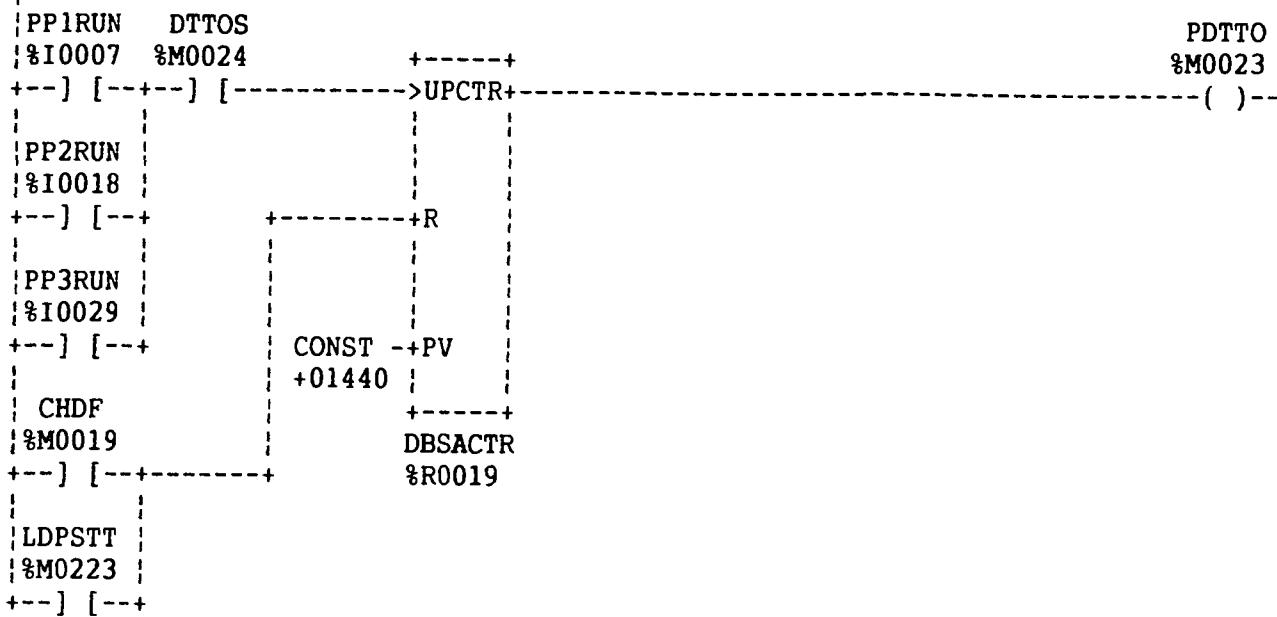
When no pumps are running, the counting stops. It resets to zero when the lead pump call flag goes inactive.

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0019	CHDF	Change Duty flag
%M0024	DTTOS	Duty Timer Trigger Oneshot
%M0223	LDPSTT	Lead Pump Stopped Trigger
%M0014	LEDPCF	Lead Duty Pump Call Flag
%M0023	PDTTO	Pump Duty Timer Timed Out
%I0047	SPPBUT	Spare Push Button
%S0006	T_MIN	

04-11-94 10:05 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.01)  
 CASWELL STREET SEWAGE PUMP STATION PLC DOCUMENTATION  
 Pump Common Controls: Lead Duty Pump Sequencing

Page 14

&lt;&lt; RUNG 40 STEP #0110 &gt;&gt;



Each time pump duty timer times out, this bit sequencer advances 1 step, rotating the pump duties as a result. After 3 steps, the sequencer cycles back to STEP 1.

The sequencer sets the pump duty flags as follows.

Sequencer Step	Pump Duty Flag Set On
1	DUTY123 %M0033
2	DUTY312 %M0034
3	DUTY231 %M0035

Bits %M0036 to %M0048 in the same memory word are reserved, and should not be used. The bit sequencer retains its status through a power failure.

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%M0019	CHDF	Change Duty flag
%R0019	DBSACTR	Dty Bit Seqr. Advancing Counter
%M0024	DTTOS	Duty Timer Trigger Oneshot
%M0223	LDPSTT	Lead Pump Stopped Trigger
%M0023	PDTTO	Pump Duty Timer Timed Out
%I0007	PP1RUN	Pump PP1 Drive Running
%I0018	PP2RUN	Pump PP2 Drive Running
%I0029	PP3RUN	Pump PP3 Drive Running

04-11-94 10:05 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.01)  
 CASWELL STREET SEWAGE PUMP STATION PLC DOCUMENTATION  
 Pump Common Controls: Lead Duty Pump Sequencing

Page 15

&lt;&lt; RUNG 42 STEP #0119 &gt;&gt;

```

CHDF
%M0019 +----+
+--] [----+ BIT_+-
|           SEQ
ALW_OFF
%S0008
+--] [----+R
|           LEN
ALW_ON    00003
%S0007
+--] [----+DIR
|           --+STEP
DBSOTT
%M0033 --+ST
|           +----+
|           DBS
|R0022

```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%S0008	ALW_OFF	
%S0007	ALW_ON	
%M0019	CHDF	Change Duty flag
%R0022	DBS	Duty Bit Sequencer
%M0033	DBSOTT	Dty Bit Sequencer=1lead2lag3stby

```
*****
(* LEAD/LAG DUTY PUMP START DELAYS *)
(*
(* When pump duty changes, old lead duty pump moves to lag duty (and if lag *)
(* duty call is up, it will continue to run); old lag duty pump retires to *)
(* standby duty, and old standby duty pump moves to lead duty. *)
(*
(* The lead pump timer inserts a delay of 2 seconds between the shutdown of *)
(* the retiring pump and the starting of the new lead duty pump, to *)
(* minimise glitches in the electrical supply and surges in the pump *)
(* discharge. *)
(*
(* The lag pump delay guards against the risk of a simultaneous start after *)
(* a power failure, reflux valve fail-to-close trip, or any other condition *)
(* which could synchronise pump starts. *)
(*
(*
*****
```

&lt;&lt; RUNG 44 STEP #0124 &gt;&gt;

```
CHDF LEDPSTD LADSDF
%M0019 %M0021 +----+
+---)/[----] [----+ TMR +----- ( )--+
| 0.10s |
|
CONST -+PV
+00020 |
+----+
LGDPSD
%R0028
```

&lt;&lt; RUNG 45 STEP #0128 &gt;&gt;

```
PSH CHDF LEDPSTD
%M0161 %M0019 +----+
+---] [----]/[----+ TMR +----- ( )--+
| 0.10s |
|
CONST -+PV
+00010 |
+----+
LEDPSD
%R0025
```

REFERENCE	NICKNAME	DESCRIPTION
%M0019	CHDF	Change Duty flag
%M0025	LADSDF	Lag Duty Start Delay Flag
%R0025	LEDPSD	Lead Duty Pump Start Delay
%M0021	LEDPSTD	Lead Duty Pump Start Delay Flag
%R0028	LGDPSD	Lag Duty Pump Start Delay
%M0161	PSH	Power supply healthy

```
(*****  
(*          PUMP RUN CALLS          *)  
*****)
```

## Normal mode:

Start and stop lead duty pump at appropriate sewage well levels. Flow rate is variable down to a minimum of 300 l/sec while the pump is running. Wet well level is 'controlled' between a set level range using the lead duty pump only.

Lead pump starts at wet well level of 3.70 m and stops at a level of 1.0 m.

## High Inflow mode:

Once the level has risen above the normal range, lead duty pump operates at maximum speed and an the lag duty pump is started as the wet well level and hence overall station flow demand rises. The lead and lag pumps share the station flow. The lag pump runs until the station demand drops to a preset value.

<< RUNG 48 STEP #0134 >>

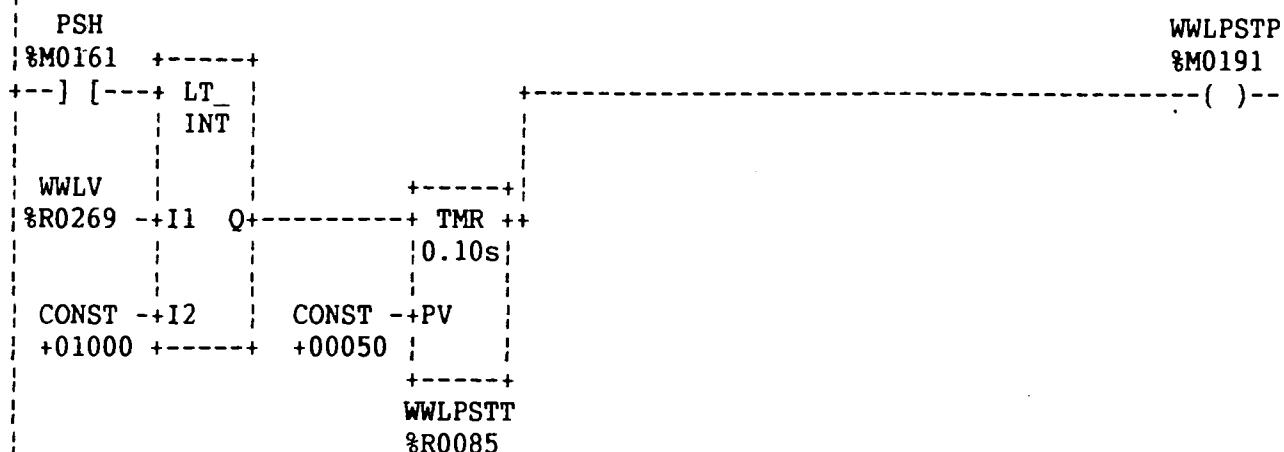
WWLPSTR	WWLPSTP	LEDPCF
%M0195	%M0191	%M0014
---]	[---+---]/[-----	(M)---
LEDPCF		
%M0014		
---]	[--+	

<< RUNG 49 STEP #0138 >>

PSH	WWLPSTR
%M0161	%M0195
---]	( )--
GT_	
INT	
WWLV	
%R0269	-+I1 Q+-----+ TMR ++
	0.10s
CONST -+I2	CONST -+PV
+03700 +----+	+00050
	+----+
	WWLPSRT
	%R0082

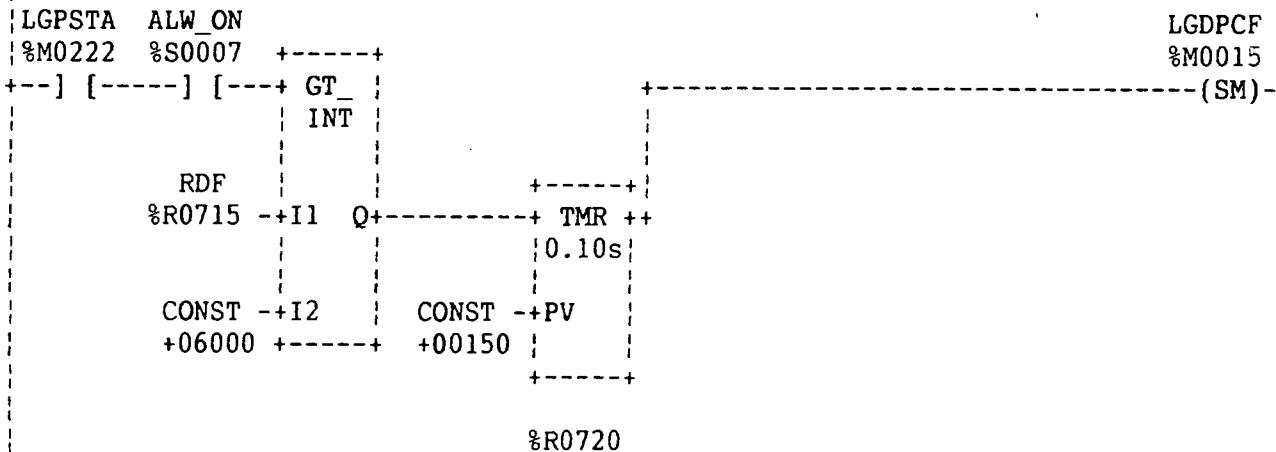
REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%M0014	LEDPCF	Lead Duty Pump Call Flag
%M0161	PSH	Power supply healthy
%R0082	WWLPSRT	Wet Well Level - Pump Strt - Dly
%M0191	WWLPSTP	W/Well Level Pump Stop
%M0195	WWLPSTR	W/Well Level Pump Start
%R0269	WWLV	Wet Well Level Value

&lt;&lt; RUNG 50 STEP #0142 &gt;&gt;



Set flag when lag pump is required to assist lead pump (or standby pump if lead duty pump has failed) to meet station flow demand - station demand > 600 l/sec.

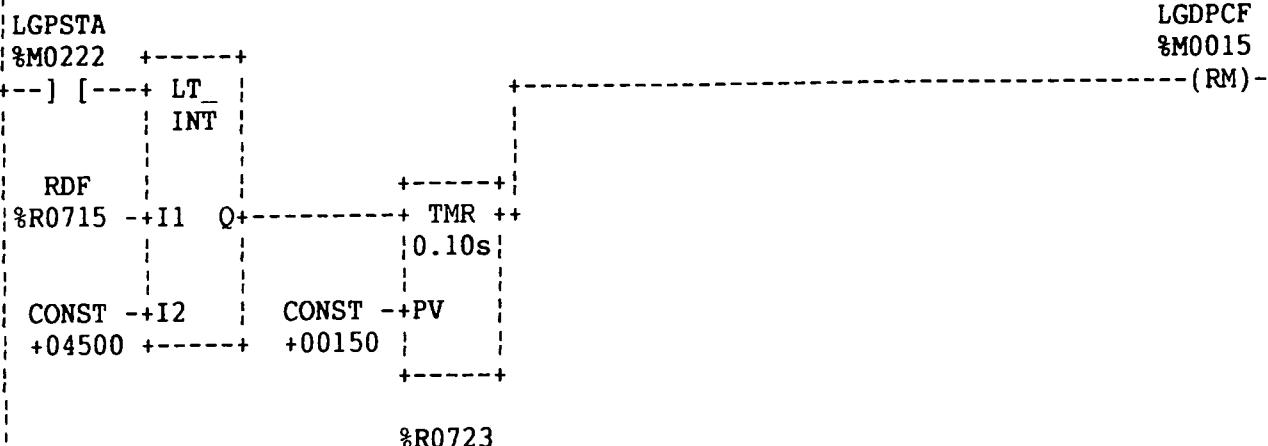
&lt;&lt; RUNG 52 STEP #0147 &gt;&gt;



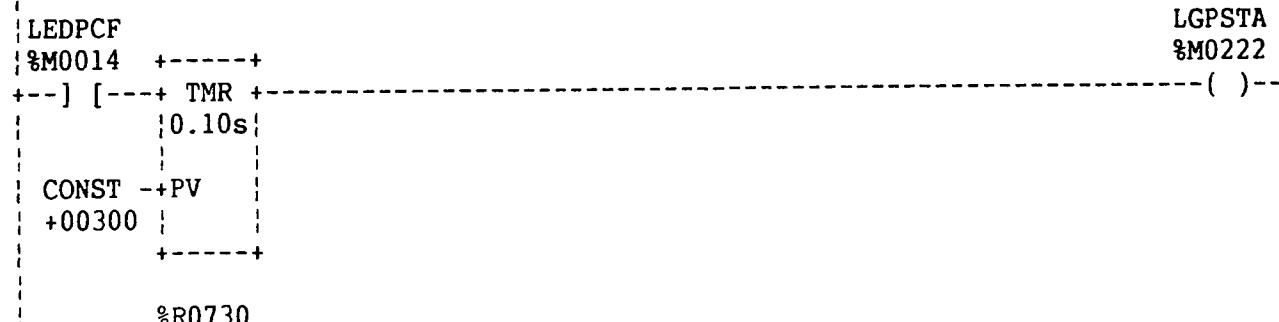
REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%R0720		
%S0007	ALW_ON	
%M0015	LGDPCF	Lag Duty Pump Call Flag
%M0222	LGPSTA	Lag Pump Start Aux
%M0161	PSH	Power supply healthy
%R0715	RDF	Raw Demand Flow
%M0191	WWLPSTP	W/Well Level Pump Stop
%R0085	WWLPSTT	Wet Well Level - Pump Stop - Dly
%R0269	WWLV	Wet Well Level Value

04-11-94 10:05 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.01) Page 19  
 CASWELL STREET SEWAGE PUMP STATION PLC DOCUMENTATION  
 Pump Common Controls: Lead, Lag and Standby Duty Pump Calls

<< RUNG 53 STEP #0152 >>



<< RUNG 54 STEP #0156 >>



If lead duty call is up, and lead duty pump fails to run, \_\_\_\_

REFERENCE	NICKNAME	DESCRIPTION
%R0723		
%R0730		
%M0014	LEDPCF	Lead Duty Pump Call Flag
%M0015	LGDPCF	Lag Duty Pump Call Flag
%M0222	LGPSTA	Lag Pump Start Aux
%R0715	RDF	Raw Demand Flow

04-11-94 10:05 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.01) Page 20  
 CASWELL STREET SEWAGE PUMP STATION PLC DOCUMENTATION  
 Pump Common Controls: Lead, Lag and Standby Duty Pump Calls

<< RUNG 56 STEP #0160 >>

```
DBSOTT  PP1RUN  LEDPCF  LEDPSTD          LEDPFRT
%M0033  %I0007  %M0014  %M0021  +----+  %M0016
+---] [----]/[---+---] [----] [---+ TMR +-----+( )--+
|                                | 0.10s |
DBSTOT  PP3RUN   |
%M0034  %I0029   |
+---] [----]/[---+ CONST -+PV
|                                | +00400 |
DBSTTO  PP2RUN   |
%M0035  %I0018   LDDPFSD
+---] [----]/[---+             %R0013
```

)OR if lag duty call is up, and lag duty pump fails to run, \_\_

<< RUNG 58 STEP #0173 >>

```
DBSOTT  PP2RUN  LGDPCF  LADSDF          LGDPFRT
%M0033  %I0018  %M0015  %M0025  +----+  %M0017
+---] [----]/[---+---] [----] [---+ TMR +-----+( )--+
|                                | 0.10s |
DBSTOT  PP1RUN   |
%M0034  %I0007   |
+---] [----]/[---+ CONST -+PV
|                                | +00050 |
DBSTTO  PP3RUN   |
%M0035  %I0029   LGDPFSD
+---] [----]/[---+             %R0016
```

\_\_ THEN start the standby pump, and run in the same way as for the pump it replaces.

<< RUNG 60 STEP #0186 >>

```
LEDPFRT                      STPCF
%M0016                      %M0018
+---] [---+-----+( )--+
LGDPFRT
%M0017
+---] [---+
```

REFERENCE	NICKNAME	DESCRIPTION
%M0033	DBSOTT	Dty Bit Sequencer=1lead2lag3stby
%M0034	DBSTOT	Dty Bit Sequencer=3lead1lag2stby
%M0035	DBSTTO	Dty Bit Sequencer=2lead3lag1stby
%M0025	LADSDF	Lag Duty Start Delay Flag
%R0013	LDDPFSD	Lead Dty Pmp Fail to Start Dly
%M0014	LEDPCF	Lead Duty Pump Call Flag
%M0016	LEDPFRT	Lead Duty Pump Failed to Run
%M0021	LEDPSTD	Lead Duty Pump Start Delay Flag
%M0015	LGDPCF	Lag Duty Pump Call Flag
%M0017	LGDPFRT	Lag Duty Pump Failed to Run
%R0016	LGDPFSD	Lag Duty Pump Fail to Start Dly
%I0007	PP1RUN	Pump PP1 Drive Running
%I0018	PP2RUN	Pump PP2 Drive Running
%I0029	PP3RUN	Pump PP3 Drive Running
%M0018	STPCF	Standby Pump Call Flag

```
(*****  
(*          PUMP PP1 - MOTOR CONTROL      *)  
(*          *)  
(* The code for this drive is standard drive code as described in the      *)  
(* program description.          *)  
(*          *)  
(* Pump runs in auto mode, controlled by well levels and the automatic duty      *)  
(* change mechanism. On duty change, power-up, reflux valve fault alarm      *)  
(* cleared, and any other conditions which could cause a simultaneous start      *)  
(* of two pumps, the start of the lead duty pump is delayed to prevent      *)  
(* this.          *)  
(*          *)  
(* The pump is protected in both auto and manual modes against low flow      *)  
(* (reflux valve failed to open on start), reflux valve fail to close      *)  
(* (ie, this pump's own reflux valve), motor overtemperature, vsd fault      *)  
(* (including motor overload), pump failure, and emergency stop.      *)  
(*          *)  
(* Low flow (but not reflux failure) can be overridden in manual mode by      *)  
(* holding the start button in: while the start button is held in the      *)  
(* alarm light will indicate a flow/no flow condition, but the pump      *)  
(* will not trip.          *)  
(*          *)  
(* The following drawings show the electrical connections:-      *)  
(*          *)  
(*      CST-E451      *)  
(*      CST-E452.      *)  
(*****)
```

&lt;&lt; RUNG 63 STEP #0191 &gt;&gt;

```

DBSOTT LEDPCF LEDPSTD PP1AUT PP1RPA SPPHHHL          PP1GO
%M0033 %M0014 %M0021 %I0002 %M0050 %I0040          %Q0001
+---] [----] [----] [----] [----]/[-----( )--]

DBSTOT LGDPCF LADSDF
%M0034 %M0015 %M0025
+---] [----] [----] [---]

DBSTTO STPCF
%M0035 %M0018
+---] [----] [-----+]

PP1RDA
%M0254
+---] [-----+]

PP1STT PP1LST PP1AUT
%I0001 %I0004 %I0002
+---] [----+][----]/[-----+]

PP1RUN
%I0007
+---] [---+

```

&lt;&lt; RUNG 64 STEP #0211 &gt;&gt;

```

PP1POW PP1PP# PP1VFD# PP1RDY PP1LF# PP1RF#          PP1RPA
%I0008 %M0054 %M0052 %I0003 %M0057 %M0060          %M0050
+---] [----]/[----]/[----] [----]/[----]/[-----( )--]

```

Inhibit drive-specific alarms when control power supply is not present (eg, motor isolated or power failure). Continue to inhibit alarms for a short time after power is restored to allow PLC inputs to stabilise.

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%M0033	DBSOTT	Dty Bit Sequencer=1lead2lag3stby
%M0034	DBSTOT	Dty Bit Sequencer=3lead1lag2stby
%M0035	DBSTTO	Dty Bit Sequencer=2lead3lag1stby
%M0025	LADSDF	Lag Duty Start Delay Flag
%M0014	LEDPCF	Lead Duty Pump Call Flag
%M0021	LEDPSTD	Lead Duty Pump Start Delay Flag
%M0015	LGDPCF	Lag Duty Pump Call Flag
%I0002	PP1AUT	Pump PP1 Auto Available
%Q0001	PP1GO	Pump PP1 Close Contactor
%M0057	PP1LF#	Pump PP1-Low Flow alarm latch
%I0004	PP1LST	Pump PP1 Local Stop
%I0008	PP1POW	Pump PP1 Control Power Available
%M0054	PP1PP#	Pump PP1-Pmp Protect. alarm latch
%M0254	PP1RDA	Pump PP1 Ramp Down Aux Flag
%I0003	PP1RDY	Pump PP1 Ready to Run
%M0060	PP1RF#	Pump PP1-Reflux fail alarm latch
%M0050	PP1RPA	Pump PP1-Run permit aux
%I0007	PP1RUN	Pump PP1 Drive Running
%I0001	PP1STT	Pump PP1 Local Start
%M0052	PP1VFD#	Pump PP1-VFD fault alarm latch
%I0040	SPPHHHL	Sump Pump HiHiHi Level (Lockout)
%M0018	STPCF	Standby Pump Call Flag

&lt;&lt; RUNG 66 STEP #0219 &gt;&gt;

```

PP1POW                               PP1CSFL
%I0008      +----+
+---] [---+ TMR +-----+
| 0.10s |
CONST -+PV
+00020  |
+----+
PP1CSFD
%R0031

```

REFERENCE	NICKNAME
%R0031	PP1CSFD
%M0051	PP1CSFL
%I0008	PP1POW

REFERENCE	DESCRIPTION
	Pump PP1 Control Supply Fail Dly
	Pump PP1-supply on (dlyed) flag
	Pump PP1 Control Power Available

Program: CASWELL

C:\LM90\CASWELL

Block: \_MAIN

```
(*****  
(*          PUMP PP1 VSD FAULT ALARM      *)  
(*  
(* Pump PP1 VSD has a 'fault' relay contact, used in the pump      *)  
(* hard-wired main control circuit. Activation of this contact      *)  
(* initiates this alarm and indicates one of the following:      *)  
(*  
(*      motor overload      *)  
(*      VSD hardware fault      *)  
(*      starter ground fault.      *)  
(*  
(* The following drawings show the electrical connections:-      *)  
(*  
(*      CST-E451      *)  
(*  
(* The code for this alarm is standard alarm code as described in the      *)  
(* program description.      *)  
(*  
(* This alarm causes the following events in sequence:      *)  
(*  
(*      Pump PP1 immediate shutdown      *)  
(*      Start-up of standby drive when system in auto      *)  
(*  
(*****)
```

<< RUNG 68 STEP #0223 >>

```
|PP1CSFL PP1VFD>                                PP1VFD#  
|%M0051  %I0006                                %M0052  
+--] [----]/[-----(M)--
```

```
|PP1VFD# PP1REST  
|%M0052  %I0009  
+--] [----]/[--+
```

<< RUNG 69 STEP #0229 >>

```
|ACCBUT  PP1VFD#                                PP1VFD%  
|%I0042  %M0052                                %M0053  
+--] [---+---] [-----(M)--
```

```
|PP1VFD%  
|%M0053  
+--] [--+  
|
```

REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%I0042	ACCBUT	Accept Button	
%M0051	PP1CSFL	Pump PP1-supply on (dlyed) flag	
%I0009	PP1REST	Pump PP1 Reset	
%M0052	PP1VFD#	Pump PP1-VFD fault alarm latch	
%M0053	PP1VFD%	Pump PP1-VFD fault accept latch	
%I0006	PP1VFD>	Pump PP1 VF Drive Healthy	

&lt;&lt; RUNG 70 STEP #0233 &gt;&gt;

```

PP1VFD% ACCBUT          PP1VFD+
%M0053  %I0042          %Q0009
+--] [----]/[---+-----( )--+
|           |
PP1VFD# LPFLH
%M0052  %M0001
+--] [---+---] [---+
|           |
ACCBUT
%I0042
+--] [---+

```

&lt;&lt; RUNG 71 STEP #0240 &gt;&gt;

```

PP1VFD#
%M0052
+--] [-----( ^ )--+
|           |

```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0001	LPFLH	Lamp Flasher
%M0052	PP1VFD#	Pump PP1-VFD fault alarm latch
%M0053	PP1VFD%	Pump PP1-VFD fault accept latch
%Q0009	PP1VFD+	Pump PP1 VFD Fault Lamp
%M0115	PP1VFD@	Mstr Alm Trig-PP1 vfd fault

```
(*****  
(*          PUMP PP1 PUMP PROTECTION FAULT ALARM      *)  
(*  
(* Pump PP1 pump protection relay has a 'fault' relay contact, used in the *)  
(* hard-wired main control circuit for this pump. Activation of this      *)  
(* contact initiates this alarm and indicates one of the following:-    *)  
(*  
(*      pump bearing overtemperature                      *)  
(*      motor overtemperature (by thermistors)            *)  
(*      presence of water in pump lubricating oil.       *)  
(*  
(* The following drawings show the electrical connections:-           *)  
(*  
(*      CST-E451                                         *)  
(*      CST-E452                                         *)  
(*  
(* The code for this alarm is standard alarm code as described in the   *)  
(* program description. A delayed-off reset action is required to match   *)  
(* the relay's resetting action.                                     *)  
(*  
(* This alarm causes the following events in sequence:             *)  
(*  
(*      Pump PP1 immediate shutdown                         *)  
(*      Start-up of standby drive when system in auto       *)  
(*  
(*****
```

<< RUNG 73 STEP #0243 >>

```
PP1PPP>  
%I0005 +----+ PP1PPF  
+---]/[---+ TMR +----- %M0162  
|0.10s| ( )--  
|  
CONST -+PV  
+00002 |  
+----+  
PP1PPTD  
%R0034
```

Extend reset state to cover reset delay in protection relay.

REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%I0005	PP1PPP>	Pump PP1 Protection	Healthy
%M0162	PP1PPF	Pump PP1 Pump Prot.	I/P Delayed
%R0034	PP1PPTD	Pump PP1 Pump Prot.	Trip Delay

&lt;&lt; RUNG 75 STEP #0247 &gt;&gt;

```

PP1REST                                PP1RSTT
%I0009 +----+
+--]/[---+ TMR +-----(
          | 0.10s |
          |
CONST -+PV
+00005 |
+----+
PP1RSTD
%R0168

```

&lt;&lt; RUNG 76 STEP #0250 &gt;&gt;

```

PP1REST                                PP1RSTX
%I0009
+--] [-----(
          |
PP1RSTT
%M0166
+--]/[---+

```

&lt;&lt; RUNG 77 STEP #0253 &gt;&gt;

```

PP1CSFL PP1PPF  PP1VFD>                PP1PP#
%M0051 %M0162  %I0006                  %M0054
+--] [-----] [-----] [-----(M)-
          |
PP1PP#  PP1RSTX
%M0054  %M0167
+--] [-----]/[-----+

```

&lt;&lt; RUNG 78 STEP #0260 &gt;&gt;

```

ACCBUT  PP1PP#                            PP1PP%
%I0042  %M0054                          %M0055
+--] [---+---] [-----(M)-
          |
PP1PP%
%M0055
+--] [---+

```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0051	PP1CSFL	Pump PP1-supply on (dlyed) flag
%M0054	PP1PP#	Pump PP1-Pmp Protect. alarm latch
%M0055	PP1PP%	Pump PP1-Pmp Protect. acpt latch
%M0162	PP1PPF	Pump PP1 Pump Prot. I/P Delayed
%I0009	PP1REST	Pump PP1 Reset
%R0168	PP1RSTD	Pump PP1 Reset Extension Timer
%M0166	PP1RSTT	Pump PP1 Reset Extension Aux
%M0167	PP1RSTX	Pump PP1 Reset Extended
%I0006	PP1VFD>	Pump PP1 VF Drive Healthy

&lt;&lt; RUNG 79 STEP #0264 &gt;&gt;

```

PP1PP% ACCBUT          PP1PPT+
%M0055 %I0042          %Q0010
+--] [----]/[---+-----( )--+
|           |
PP1PP# LPFLH
|M0054 |M0001
+--] [--+---] [---+
|           |
ACCBUT
%I0042
+--] [---+

```

&lt;&lt; RUNG 80 STEP #0271 &gt;&gt;

```

PP1PP#
|M0054
+--] [----+-----(^)--
|           |

```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0001	LPFLH	Lamp Flasher
%M0054	PP1PP#	Pump PP1-Pmp Protect. alrm latch
%M0055	PP1PP%	Pump PP1-Pmp Protect. acpt latch
%M0116	PP1PP@	Mstr Alm Trig-PP1 Pump protect.
%Q0010	PP1PPT+	Pump PP1 Pump Prot. Trip Lamp

```

(*****)
(*      PUMP PP1 LOW FLOW ALARM
(*
(* This alarm represents the following function:-
(*
(*      . pump low flow, given by the reflux valve failing to remain open
(*      with the pump running.
(*
(* The following drawings show the electrical connections:-
(*
(*      CST-E451
(*      CST-E452
(*
(* The code for this alarm is standard alarm code as described in the
(* program description, except as follows:-
(*
(*      . the operator can override the low flow alarm condition in
(*      manual mode by holding in the start button
(*      . while the operator holds in the start button to override the
(*      low flow trip, the lamp glows to indicate to the operator that
(*      the reflux valve has not yet opened
(*      . common master alarm trigger used with reflux valve alarm.
(*
(* This alarm causes the following events in sequence:
(*
(*      Pump PP1 immediate shutdown
(*      Start-up of standby drive when system in auto
(*
(*****)

```

## Pump PP1 Low Flow

&lt;&lt; RUNG 83 STEP #0275 &gt;&gt;

```

PP1RLSW          PP1RVT
%I0010  +----+
+--] [---- TMR +----- ( ) --
| 0.10s |
|
CONST -+PV
+00050 |
+----+
%
%R0740

```

REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%R0740			
%I0010	PP1RLSW		Pump PP1 Reflux Limit Switch
%M0245	PP1RVT		Pump PP1 Reflux Valvw Pos Sw Dly

&lt;&lt; RUNG 84 STEP #0278 &gt;&gt;

```

PP1RUN  PP1RVT          PP1LFF
%I0007  %M0245 +-----+
+--] [----] [---+ TMR +-----+
| 0.10s |
|
CONST -+PV
+00900 |
+-----+
PP1LFT
%R0150

```

&lt;&lt; RUNG 85 STEP #0282 &gt;&gt;

```

PP1CSFL PP1STT  PP1LFF          PP1LF#
%M0051  %I0001  %M0056        %M0057
+--] [---+---]/[---+---] [---+---+(M)---+
|  |
| PP1AUT |
| %I0002 |
+--] [---+
|
PP1LF#  PP1REST
%M0057  %I0009
+--] [----]/[----+

```

&lt;&lt; RUNG 86 STEP #0291 &gt;&gt;

```

ACCBUT  PP1LF#          PP1LF%
%I0042  %M0057        %M0058
+--] [---+---] [---+---+(M)---+
|
PP1LF%
%M0058
+--] [---+

```

REFERENCE	NICKNAME	DESCRIPTION
%I0042	ACCBUT	Accept Button
%I0002	PP1AUT	Pump PP1 Auto Available
%M0051	PP1CSFL	Pump PP1-supply on (dlyed) flag
%M0057	PP1LF#	Pump PP1-Low Flow alarm latch
%M0058	PP1LF%	Pump PP1-Low Flow accept latch
%M0056	PP1LFF	Pump PP1-Low Flow Flag
%R0150	PP1LFT	Pump PP1 Flow Low Delay
%I0009	PP1REST	Pump PP1 Reset
%I0007	PP1RUN	Pump PP1 Drive Running
%M0245	PP1RVT	Pump PP1 Reflux Valvw Pos Sw Dly
%I0001	PP1STT	Pump PP1 Local Start

|| << RUNG 87 STEP #0295 >>

```

| PP1LF% ACCBUT          PP1LF+
| %M0058 %I0042          %Q0011
+--] [----]/[-----] ( ) --
| PP1LF# LPFLH
| %M0057 %M0001
+--] [---+---] [---+
| ACCBUT
| %I0042
+--] [---+
| PP1STT PP1AUT PP1LFF
| %I0001 %I0002 %M0056
+--] [----]/[----] [---+
|
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0001	LPFLH	Lamp Flasher
%I0002	PP1AUT	Pump PP1 Auto Available
%M0057	PP1LF#	Pump PP1-Low Flow alarm latch
%M0058	PP1LF%	Pump PP1-Low Flow accept latch
%Q0011	PP1LF+	Pump PP1 Low Flow Trip Lamp
%M0056	PP1LFF	Pump PP1-Low Flow Flag
%I0001	PP1STT	Pump PP1 Local Start

## Pump PP1 Reflux Valve Alarm

```
*****
(*          PUMP PP1 REFLUX VALVE ALARM
(*
(* This alarm represents the reflux valve fail-to-close, given by the
(* valve failing to close within a certain time of stopping the pump.
(*
(* The following drawings show the electrical connections:-
(*
(*      CST-E451
(*      CST-E452
(*
(* The code for this alarm is standard alarm code as described in the
(* program description except that a common master alarm trigger is
(* shared with the low flow alarm.
(*
(* This alarm causes the following events in sequence:
(*
(*      Pump PP1 immediate shutdown
(*      Start-up of standby drive when system in auto
(*
*****
```

## Pump PP1 Reflux Valve Fail-to-Close

&lt;&lt; RUNG 90 STEP #0308 &gt;&gt;

```
PP1CSFL PP1RUN  PP1RLSW          PP1PVLC
%M0051  %I0007  %I0010 +----+
+--] [----]/[----]/[---+ TMR +----- ( ) --
                           | 0.10s |
                           |
                           CONST -+PV
                           +00100 |
                           +----+
                           PP1RVFT
                           %R0159
```

&lt;&lt; RUNG 91 STEP #0313 &gt;&gt;

```
PP1PVLC PP1CSFL          PP1RF#
%M0059  %M0051          %M0060
+--] [----] [----- (M) --
                           |
                           PPIRF#  PP1REST
                           %M0060  %I0009
+--] [----]/[---+
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%M0051	PP1CSFL	Pump PP1-supply on (dlyed) flag
%M0059	PP1PVLC	PP1-Rflx vlive cls w/dot tmed out
%I0009	PP1REST	Pump PP1 Reset
%M0060	PP1RF#	Pump PP1-Reflux fail alarm latch
%I0010	PP1RLSW	Pump PP1 Reflux Limit Switch
%I0007	PP1RUN	Pump PP1 Drive Running
%R0159	PP1RVFT	Pump PP1 Reflux Valve Fail Dly

&lt;&lt; RUNG 92 STEP #0319 &gt;&gt;

```

ACCBUT  PP1RF#
%I0042  %M0060
---] [---+---] [-----] PP1RF%
%M0061
---] [---+

```

&lt;&lt; RUNG 93 STEP #0323 &gt;&gt;

```

PP1RF% ACCBUT
%M0061 %I0042
---] [----]/[----] PP1RF+
%Q0012
LPFLH
%M0060 %M0001
---] [---+---] [---+
ACCBUT
%I0042
---] [---+

```

Common master alarm trigger

&lt;&lt; RUNG 95 STEP #0331 &gt;&gt;

```

PP1LF#
%M0057
---] [---+-----] PP1LF@
%M0117
( ^ )--+
PP1RF#
%M0060
---] [---+

```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0001	LPFLH	Lamp Flasher
%M0057	PP1LF#	Pump PP1-Low Flow alarm latch
%M0117	PP1LF@	Mstr Alm Trig-PP1 Low flow
%M0060	PP1RF#	Pump PP1-Reflux fail alarm latch
%M0061	PP1RF%	Pump PP1-Reflux fail accpt latch
%Q0012	PP1RF+	Pump PP1 Reflux FTC Lamp

```
(*****  
(*          PUMP PP2 - MOTOR CONTROL      *)  
(*  
(* The code for this drive is standard drive code as described in the  *)  
(* program description.          *)  
(*  
(* Pump runs in auto mode, controlled by well levels and the automatic duty  *)  
(* change mechanism. On duty change, power-up, reflux valve fault alarm    *)  
(* cleared, and any other conditions which could cause a simultaneous start  *)  
(* of two pumps, the start of the lead duty pump is delayed to prevent    *)  
(* this.                      *)  
(*  
(* The pump is protected in both auto and manual modes against low flow   *)  
(* (reflux valve failed to open on start), reflux valve fail to close     *)  
(* (ie, this pump's own reflux valve), motor overtemperature, vsd fault    *)  
(* (including motor overload), pump failure, and emergency stop.        *)  
(*  
(* Low flow (but not reflux failure) can be overridden in manual mode by  *)  
(* holding the start button in: while the start button is held in the      *)  
(* alarm light will indicate a flow/no flow condition, but the pump       *)  
(* will not trip.            *)  
(*  
(* The following drawings show the electrical connections:-      *)  
(*  
(*      CST-E453          *)  
(*      CST-E454.          *)  
*****)
```

&lt;&lt; RUNG 97 STEP #0335 &gt;&gt;

```

DBSTTO LEDPCF LEDPSTD PP2AUT PP2RPA SPPHHHL          PP2GO
%M0035 %M0014 %M0021 %I0013 %M0070 %I0040          %Q0002
+---] [-----] [-----] [---+---] [-----]/[-----] ( )--
```

```

DBSOTT LGDPCF LADSDF
%M0033 %M0015 %M0025
+---] [-----] [-----] [---+
```

```

DBSTOT STPCF
%M0034 %M0018
+---] [-----] [-----+]
```

```

PP2RDA
%M0264
+---] [-----+]
```

```

PP2STT PP2LST PP2AUT
%I0012 %I0015 %I0013
+---] [---+---] [-----]/[-----+]
```

```

PP2RUN
%I0018
+---] [---+
```

&lt;&lt; RUNG 98 STEP #0355 &gt;&gt;

```

PP2POW PP2PP# PP2VFD# PP2RDY PP2LF# PP2RF#          PP2RPA
%I0019 %M0074 %M0072 %I0014 %M0077 %M0080          %M0070
+---] [-----]/[-----]/[-----] [-----]/[-----]/[-----] ( )--
```

Inhibit drive-specific alarms when control power supply is not present (eg, motor isolated or power failure). Continue to inhibit alarms for a short time after power is restored to allow PLC inputs to stabilise.

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%M0033	DBSOTT	Dty Bit Sequencer=1lead2lag3stby
%M0034	DBSTOT	Dty Bit Sequencer=3lead1lag2stby
%M0035	DBSTTO	Dty Bit Sequencer=2lead3lag1stby
%M0025	LADSDF	Lag Duty Start Delay Flag
%M0014	LEDPCF	Lead Duty Pump Call Flag
%M0021	LEDPSTD	Lead Duty Pump Start Delay Flag
%M0015	LGDPCF	Lag Duty Pump Call Flag
%I0013	PP2AUT	Pump PP2 Auto Available
%Q0002	PP2GO	Pump PP2 Close Contactor
%M0077	PP2LF#	Pump PP2-Low flow alarm latch
%I0015	PP2LST	Pump PP2 Local Stop
%I0019	PP2POW	Pump PP2 Control Power Available
%M0074	PP2PP#	PP2-Pump protection alarm latch
%M0264	PP2RDA	Pump PP2 Ramp Down Aux Flag
%I0014	PP2RDY	Pump PP2 Ready to Run
%M0080	PP2RF#	Pump PP2-Reflux fail alarm latch
%M0070	PP2RPA	Pump PP2-Run permit aux
%I0018	PP2RUN	Pump PP2 Drive Running
%I0012	PP2STT	Pump PP2 Local Start
%M0072	PP2VFD#	Pump PP2-VFD fault alarm latch
%I0040	SPPHHHL	Sump Pump HiHiHi Level (Lockout)
%M0018	STPCF	Standby Pump Call Flag

&lt;&lt; RUNG 100 STEP #0363 &gt;&gt;

```

PP2POW          PP2CSD
%I0019 +-----+
+--] [---+ TMR +-----( )--
| 0.10s
CONST -+PV
+00020 |
+----+
PP2CSFD
%R0046

```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%M0071	PP2CSD	PP2-Ctl supply on (dlyed) flag
%R0046	PP2CSFD	Pump PP2 Control Supply Fail Dly
%I0019	PP2POW	Pump PP2 Control Power Available

Program: CASWELL

C:\LM90\CASWELL

Block: \_MAIN

04-11-94 10:05 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.01)  
 CASWELL STREET SEWAGE PUMP STATION PLC DOCUMENTATION  
 Pump PP2 VSD Fault Alarm

Page 37

```
*****
(* PUMP PP2 VSD FAULT ALARM
(*
(* Pump PP2 VSD has a 'fault' relay contact, used in the pump
(* hard-wired main control circuit. Activation of this contact
(* initiates this alarm and indicates one of the following:
(*
(* motor overload
(* VSD hardware fault
(* starter ground fault.
(*
(* The following drawings show the electrical connections:-
(*
(* CST-E453
(*
(* The code for this alarm is standard alarm code as described in the
(* program description.
(*
(* This alarm causes the following events in sequence:
(*
(* Pump PP2 immediate shutdown
(* Start-up of standby drive when system in auto
(*
*****
```

&lt;&lt; RUNG 102 STEP #0367 &gt;&gt;

PP2CSD	PP2VFD>	PP2POW	PP2VFD#
%M0071	%I0017	%I0019	%M0072
---]	[----]/[----]	[---	(M)---

PP2VFD#	PP2REST
%M0072	%I0020
---]	[----+-----+

&lt;&lt; RUNG 103 STEP #0374 &gt;&gt;

ACCBUT	PP2VFD#	PP2VFD%
%I0042	%M0072	%M0073
---]	[----+-----]	(M)---

PP2VFD%	
%M0073	
---]	[---

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0071	PP2CSD	PP2-Ctl supply on (dlyed) flag
%I0019	PP2POW	Pump PP2 Control Power Available
%I0020	PP2REST	Pump PP2 Reset
%M0072	PP2VFD#	Pump PP2-VFD fault alarm latch
%M0073	PP2VFD%	Pump PP2-VFD fault accept latch
%I0017	PP2VFD>	Pump PP2 VF Drive Healthy

<< RUNG 104 STEP #0378 >>

PP2VFD% ACCBUT PP2VFD+  
%M0073 %I0042 %Q0013  
+--] [----]/[-----( )--  
  
PP2VFD# LPFLH  
%M0072 %M0001  
+--] [---+---] [---+  
  
ACCBUT  
%I0042  
+--] [---+

<< RUNG 105 STEP #0385 >>

PP2VFD# PP2VFD@  
%M0072 %M0119  
+--] [-----(^)--

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0001	LPFLH	Lamp Flasher
%M0072	PP2VFD#	Pump PP2-VFD fault alarm latch
%M0073	PP2VFD%	Pump PP2-VFD fault accept latch
%Q0013	PP2VFD+	Pump PP2 VFD Fault Lamp
%M0119	PP2VFD@	Mstr Alm Trig-PP2 vfd fault

04-11-94 10:05 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.01)  
 CASWELL STREET SEWAGE PUMP STATION PLC DOCUMENTATION  
 Pump PP2 Pump Protection Fault Alarm

Page 39

```
(*****  

(*          PUMP PP2 PUMP PROTECTION FAULT ALARM      *)  

(*  

(*  Pump PP2 pump protection relay has a 'fault' relay contact, used in the  *)  

(*  hard-wired main control circuit for this pump. Activation of this      *)  

(*  contact initiates this alarm and indicates one of the following:-    *)  

(*  

(*    pump bearing overtemperature                         *)  

(*    motor overtemperature (by thermistors)                *)  

(*    presence of water in pump lubricating oil.          *)  

(*  

(*  The following drawings show the electrical connections:-           *)  

(*  

(*    CST-E453                                         *)  

(*    CST-E454                                         *)  

(*  

(*  The code for this alarm is standard alarm code as described in the  *)  

(*  program description. A delayed-off reset action is required to match   *)  

(*  the relay's reset action.                                         *)  

(*  

(*  This alarm causes the following events in sequence:            *)  

(*  

(*    Pump PP2 immediate shutdown                         *)  

(*    Start-up of standby drive when system in auto       *)  

(*  

(*****
```

&lt;&lt; RUNG 107 STEP #0388 &gt;&gt;

```
PP2PPP>                                                 PP2PPF
%I0016 +----+                                         %M0163
+--]/[----+ TMR +-----( )--  

|0.10s|  

|  

CONST --+PV  

+00002 |  

+----+  

PP2PPTD  

%R0037
```

Extend reset state to cover reset delay in protection relay.

REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%I0016	PP2PP>	Pump PP2 Protection	Healthy
%M0163	PP2PPF	Pump PP2 Pump Prot.	I/P Delayed
%R0037	PP2PPTD	Pump PP2 Pump Prot.	Trip Delay

&lt;&lt; RUNG 109 STEP #0392 &gt;&gt;

```

PP2REST                                PP2RSTT
%I0020 +-----+
+--]/[---- TMR +-----+
| 0.10s|
|      |
CONST -+PV
+00005 |
+-----+
PP2RSTD
%R0171

```

&lt;&lt; RUNG 110 STEP #0395 &gt;&gt;

```

PP2REST                                PP2RSTX
%I0020
+--] [----+-----+
|      |
PP2RSTT
%M0168
+--]/[---+

```

&lt;&lt; RUNG 111 STEP #0398 &gt;&gt;

```

PP2CSD  PP2PPF  PP2VFD>                PP2PP#
%M0071  %M0163  %I0017                  %M0074
+--] [----] [----] [----+-----+ (M) --
|      |
PP2PP#  PP2RSTX
%M0074  %M0169
+--] [----]/[----+-----+

```

&lt;&lt; RUNG 112 STEP #0405 &gt;&gt;

```

ACCBUT  PP2PP#                PP2PP%
%I0042  %M0074                  %M0075
+--] [----+-----+ (M) --
|      |
PP2PP%
%M0075
+--] [--+

```

REFERENCE	NICKNAME	DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0071	PP2CSD	PP2-Ctl supply on (dlyed) flag
%M0074	PP2PP#	PP2-Pump protection alarm latch
%M0075	PP2PP%	PP2-Pump protection accept latch
%M0163	PP2PPF	Pump PP2 Pump Prot. I/P Delayed
%I0020	PP2REST	Pump PP2 Reset
%R0171	PP2RSTD	Pump PP2 Reset Extension Timer
%M0168	PP2RSTT	Pump PP2 Reset Extension Aux
%M0169	PP2RSTX	Pump PP2 Reset Extended
%I0017	PP2VFD>	Pump PP2 VF Drive Healthy

<< RUNG 113 STEP #0409 >>

PP2PP% ACCBUT PP2PP+  
%M0075 %I0042 %Q0014  
+--] [----]/[----+( )--

PP2PP# LPFLH  
%M0074 %M0001  
+--] [---+ [---+

ACCBUT  
%I0042  
+--] [---+

<< RUNG 114 STEP #0416 >>

PP2PP# PP2PP@  
%M0074 %M0120  
+--] [----+(^)--

REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%I0042	ACCBUT		Accept Button
%M0001	LPFLH		Lamp Flasher
%M0074	PP2PP#		PP2-Pump protection alarm latch
%M0075	PP2PP%		PP2-Pump protection accept latch
%Q0014	PP2PP+		Pump PP2 Pump Prot. Trip Lamp
%M0120	PP2PP@		Mstr Alm Trig-PP2 Pump protect.

```
(*****  
(*          PUMP PP2 LOW FLOW ALARM      *)  
(*  
(* This alarm represents the following function:-      *)  
(*  
(*     . pump low flow, given by the reflux valve failing to remain open      *)  
(*     with the pump running.      *)  
(*  
(* The following drawings show the electrical connections:-      *)  
(*  
(*      CST-E453      *)  
(*      CST-E454      *)  
(*  
(* The code for this alarm is standard alarm code as described in the      *)  
(* program description, except as follows:-      *)  
(*  
(*     . the operator can override the low flow alarm condition in      *)  
(*     manual mode by holding in the start button      *)  
(*     . while the operator holds in the start button to override the      *)  
(*     low flow trip, the lamp glows to indicate to the operator that      *)  
(*     the reflux valve has not yet opened      *)  
(*     . common master alarm trigger used with reflux valve alarm.      *)  
(*  
(* This alarm causes the following events in sequence:      *)  
(*  
(*     Pump PP2 immediate shutdown      *)  
(*     Start-up of standby drive when system in auto      *)  
(*  
(*****
```

Pump PP2 Low Flow

<< RUNG 117 STEP #0420 >>

```
PP2RLSW                                PP2RVT  
%I0021 +----+                          %M0246  
+--] [----+ TMR +----- ( )--  
     |0.10s|  
  
CONST -+PV  
+00050 |  
      +----+  
  
      %R0703
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%R0703		
%I0021	PP2RLSW	Pump PP2 Reflux Limit Switch
%M0246	PP2RVT	Pump PP2 Reflux Valve Pos Sw Dly

<< RUNG 121 STEP #0440 >>

```
|PP2LF% ACCBUT          PP2LF+  
|%M0078 %I0042          %Q0015  
+--] [----]/[----+----- ( )--  
  
|PP2LF# LPFLH  
|%M0077 %M0001  
+--] [---+--] [--+  
  
|ACCBUT  
|%I0042  
+--] [--+  
  
|PP2STT PP2AUT PP2LFF  
|%I0012 %I0013 %M0076  
+--] [----]/[----] [--+  
|
```

REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%I0042	ACCBUT		Accept Button
%M0001	LPFLH		Lamp Flasher
%I0013	PP2AUT		Pump PP2 Auto Available
%M0077	PP2LF#		Pump PP2-Low flow alarm latch
%M0078	PP2LF%		Pump PP2-Low flow accept latch
%Q0015	PP2LF+		Pump PP2 Low Flow Trip Lamp
%M0076	PP2LFF		Pump PP2-Low flow flag
%I0012	PP2STT		Pump PP2 Local Start

```
*****
(*          PUMP PP3 - MOTOR CONTROL      *)
(*
(* The code for this drive is standard drive code as described in the      *)
(* program description.                                              *)
(*
(* Pump runs in auto mode, controlled by well levels and the automatic duty  *)
(* change mechanism. On duty change, power-up, reflux valve fault alarm      *)
(* cleared, and any other conditions which could cause a simultaneous start  *)
(* of two pumps, the start of the lead duty pump is delayed to prevent      *)
(* this.                                                               *)
(*
(* If ANY reflux valve fails to close when a pump stops, the operation of      *)
(* all pumps (in auto) is inhibited, as there is a risk of material passing   *)
(* back through the open valve and de-energised pump, to the sewage well.    *)
(*
(* The pump is protected in both auto and manual modes against low flow      *)
(* (reflux valve failed to open on start), reflux valve fail to close        *)
(* (ie, this pump's own reflux valve), motor overtemperature, vsd fault       *)
(* (including motor overload), pump failure, and emergency stop.            *)
(*
(* Low flow (but not reflux failure) can be overridden in manual mode by      *)
(* holding the start button in: while the start button is held in the         *)
(* alarm light will indicate a flow/no flow condition, but the pump           *)
(* will not trip.                                                       *)
(*
(* The following drawings show the electrical connections:-                  *)
(*
(*      CST-E455                                         *)
(*      CST-E456                                         *)
*****
```

&lt;&lt; RUNG 126 STEP #0464 &gt;&gt;

```

ACCBUT  PP2RF#
%I0042  %M0080
+---] [---+---] [-----] PP2RF%
%M0081
+---] [---+

```

&lt;&lt; RUNG 128 STEP #0469 &gt;&gt;

```

PP2RF% ACCBUT
%M0081 %I0042
+---] [----]/[----] PP2RF+
%Q0016
( )---

PP2RF# LPFLH
%M0080 %M0001
+---] [---+---] [---+
ACCBUT
%I0042
+---] [---+

```

Common master alarm trigger

&lt;&lt; RUNG 130 STEP #0477 &gt;&gt;

```

PP2LF#
%M0077
+---] [---+-----] PP2LF@
%M0121
( ^ )---

PP2RF#
%M0080
+---] [---+

```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0001	LPFLH	Lamp Flasher
%M0077	PP2LF#	Pump PP2-Low flow alarm latch
%M0121	PP2LF@	Mstr Alm Trig-PP2 Low flow
%M0080	PP2RF#	Pump PP2-Reflux fail alarm latch
%M0081	PP2RF%	Pump PP2-Reflux fail accpt latch
%Q0016	PP2RF+	Pump PP2 Reflux FTC Lamp

&lt;&lt; RUNG 132 STEP #0481 &gt;&gt;

DBSTOT	LEDPCF	LEDPSTD	PP3AUT	PP3RPA	SPPHHHL	PP3GO
%M0034	%M0014	%M0021	%I0024	%M0090	%I0040	%Q0003
+---] [-----] [-----] [---+---] [-----]/[-----]						( )--
DBSTTO	LGDPCF	LADSDF				
%M0035	%M0015	%M0025				
+---] [-----] [-----] [---+---]						
DBSOTT	STPCF					
%M0033	%M0018					
+---] [-----] [-----+-----]						
PP3RDA						
%M0274						
+---] [-----+-----]						
PP3STT	PP3LST	PP3AUT				
%I0023	%I0026	%I0024				
+---] [---+---] [-----]/[-----+-----]						
PP3RUN						
%I0029						
+---] [---+-----]						

&lt;&lt; RUNG 133 STEP #0501 &gt;&gt;

PP3POW	PP3PP#	PP3VFD#	PP3RDY	PP3LF#	PP3RF#	PP3RPA
%I0030	%M0094	%M0092	%I0025	%M0097	%M0100	%M0090
+---] [-----]/[-----]/[-----] [-----]/[-----]/[-----]						( )--

Inhibit drive-specific alarms when control power supply is not present (eg, motor isolated or power failure). Continue to inhibit alarms for a short time after power is restored to allow PLC inputs to stabilise.

REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%M0033	DBSOTT	Dty Bit Sequencer=1lead2lag3stby	
%M0034	DBSTOT	Dty Bit Sequencer=3lead1lag2stby	
%M0035	DBSTTO	Dty Bit Sequencer=2lead3lag1stby	
%M0025	LADSDF	Lag Duty Start Delay Flag	
%M0014	LEDPCF	Lead Duty Pump Call Flag	
%M0021	LEDPSTD	Lead Duty Pump Start Delay Flag	
%M0015	LGDPCF	Lag Duty Pump Call Flag	
%I0024	PP3AUT	Pump PP3 Auto Available	
%Q0003	PP3GO	Pump PP3 Close Contactor	
%M0097	PP3LF#	Pump PP3-Low flow alarm latch	
%I0026	PP3LST	Pump PP3 Local Stop	
%I0030	PP3POW	Pump PP3 Control Power Available	
%M0094	PP3PP#	PP3-Pump protection alarm latch	
%M0274	PP3RDA	Pump PP3 Ramp Down Aux Flag	
%I0025	PP3RDY	Pump PP3 Ready to Run	
%M0100	PP3RF#	Pump PP3-Reflux fail alarm latch	
%M0090	PP3RPA	Pump PP3-Run permit aux	
%I0029	PP3RUN	Pump PP3 Drive Running	
%I0023	PP3STT	Pump PP3 Local Start	
%M0092	PP3VFD#	Pump PP3-VFD fault alarm latch	
%I0040	SPPHHHL	Sump Pump HiHiHi Level (Lockout)	
%M0018	STPCF	Standby Pump Call Flag	

<< RUNG 135 STEP #0509 >>

```
PP3POW          PP3CSDF
%I0030 +-----+
+--] [---+ TMR +-----+
| 0.10s | ( )--
CONST -+PV
+00020 |
+-----+
PP3CSFD
%R0091
```

REFERENCE NICKNAME  
%M0091 PP3CSDF  
%R0091 PP3CSFD  
%I0030 PP3POW

REFERENCE DESCRIPTION  
PP3-Ctrl supply on (dlyed) flag  
Pump PP3 Control Supply Fail Dly  
Pump PP3 Control Power Available

Program: CASWELL

C:\LM90\CASWELL

Block: \_MAIN

(\*\*\*\*\*  
(\* PUMP PP3 VSD FAULT ALARM \*)  
(\*  
(\* Pump PP3 VSD has a 'fault' relay contact, used in the pump \*)  
(\* hard-wired main control circuit. Activation of this contact \*)  
(\* initiates this alarm and indicates one of the following: \*)  
(\*  
(\* motor overload \*)  
(\* VSD hardware fault \*)  
(\* starter ground fault. \*)  
(\*  
(\* The following drawings show the electrical connections:- \*)  
(\*  
(\* CST-E455 \*)  
(\*  
(\* The code for this alarm is standard alarm code as described in the \*)  
(\* program description. \*)  
(\*  
(\* This alarm causes the following events in sequence: \*)  
(\*  
(\* Pump PP3 immediate shutdown \*)  
(\* Start-up of standby drive when system in auto \*)  
(\*  
(\*\*\*\*\*)

<< RUNG 137 STEP #0513 >>

PP3CSDF PP3VFD> PP3POW PP3VFD#  
%M0091 %I0028 %I0030 %M0092  
+--] [----]/[----] [----+(M)--

PP3VFD# PP3REST  
%M0092 %I0031  
+--] [----]/[-----+

<< RUNG 138 STEP #0520 >>

ACCBUT PP3VFD# PP3VFD%  
%I0042 %M0092 %M0093  
+--] [---+---] [----+(M)--

PP3VFD%  
%M0093  
+--] [---+

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0091	PP3CSDF	PP3-Ctrl supply on (dlyed) flag
%I0030	PP3POW	Pump PP3 Control Power Available
%I0031	PP3REST	Pump PP3 Reset
%M0092	PP3VFD#	Pump PP3-VFD fault alarm latch
%M0093	PP3VFD%	Pump PP3-VFD fault accept latch
%I0028	PP3VFD>	Pump PP3 VF Drive Healthy

&lt;&lt; RUNG 139 STEP #0524 &gt;&gt;

```
PP3VFD% ACCBUT          PP3VFD+
%M0093 %I0042          %Q0017
+---] [----]/[----]-----( )--
```

```
PP3VFD# LPFLH
%M0092 %M0001
+---] [---+---] [---+
```

```
ACCBUT
%I0042
+---] [---+
```

&lt;&lt; RUNG 140 STEP #0531 &gt;&gt;

```
PP3VFD#
%M0092          PP3VFD@
+---] [----]-----( ^)--
```

REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%I0042	ACCBUT	Accept Button	
%M0001	LPFLH	Lamp Flasher	
%M0092	PP3VFD#	Pump PP3-VFD fault alarm latch	
%M0093	PP3VFD%	Pump PP3-VFD fault accept latch	
%Q0017	PP3VFD+	Pump PP3 VFD Fault Lamp	
%M0123	PP3VFD@	Mstr Alm Trig-PP3 vfd fault	

```
*****
(*      PUMP PP3 PUMP PROTECTION FAULT ALARM      *)
(*
(* Pump PP3 pump protection relay has a 'fault' relay contact, used in the   *)
(* hard-wired main control circuit for this pump. Activation of this       *)
(* contact initiates this alarm and indicates one of the following:-        *)
(*
(*      pump bearing overtemperature             *)
(*      motor overtemperature (by thermistors)    *)
(*      presence of water in pump lubricating oil. *)
(*
(* The following drawings show the electrical connections:-                  *)
(*
(*      CST-E455                         *)
(*      CST-E456                         *)
(*
(* The code for this alarm is standard alarm code as described in the       *)
(* program description. A delayed-off reset action is required to match      *)
(* the relay's reset action.                                              *)
(*
(* This alarm causes the following events in sequence:                      *)
(*
(*      Pump PP3 immediate shutdown          *)
(*      Start-up of standby drive when system in auto            *)
(*
*****
```

<< RUNG 142 STEP #0534 >>

```
PP3PP>                                         PP3PPF
%I0027  +----+                                         %M0164
---]/[---+ TMR +----- ( )--+
      |0.10s|
      |
CONST -+PV
+00002 |
      +----+
PP3PPTD
%R0040
```

Extend reset state to cover reset delay in protection relay.

REFERENCE	NICKNAME
%I0027	PP3PP>
%M0164	PP3PPF
%R0040	PP3PPTD

REFERENCE	DESCRIPTION
	Pump PP3 Protection Healthy
	Pump PP3 Pump Prot. I/P Delayed
	Pump PP3 Pump Prot. Trip Delay

&lt;&lt; RUNG 144 STEP #0538 &gt;&gt;

```
PP3REST                                PP3RSTT
%I0031 +----+
+--]/[---+ TMR +-----+( )--
| 0.10s |
|
CONST -+PV
+00005 |
+-----+
PP3RSTD
%R0174
```

&lt;&lt; RUNG 145 STEP #0541 &gt;&gt;

```
PP3REST                                PP3RSTX
%I0031
+--] [---+-----+( )--
|
PP3RSTT
%M0170
+--]/[---
```

&lt;&lt; RUNG 146 STEP #0544 &gt;&gt;

```
PP3CSDF PP3PPF  PP3VFD>                PP3PP#
%M0091  %M0164  %I0028
+--] [----] [----] [---+-----+(M)--
|
PP3PP#  PP3RSTX
%M0094  %M0171
+--] [----]/[-----+
```

&lt;&lt; RUNG 147 STEP #0551 &gt;&gt;

```
ACCBUT  PP3PP#                  PP3PP%
%I0042  %M0094
+--] [---+---] [---+-----+(M)--
|
PP3PP%
%M0095
+--] [---+
```

REFERENCE	NICKNAME	DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0091	PP3CSDF	PP3-Ctrl supply on (dlyed) flag
%M0094	PP3PP#	PP3-Pump protection alarm latch
%M0095	PP3PP%	PP3-Pump protection accept latch
%M0164	PP3PPF	Pump PP3 Pump Prot. I/P Delayed
%I0031	PP3REST	Pump PP3 Reset
%R0174	PP3RSTD	Pump PP3 Reset Extension Timer
%M0170	PP3RSTT	Pump PP3 Reset Extension Aux
%M0171	PP3RSTX	Pump PP3 Reset Extended
%I0028	PP3VFD>	Pump PP3 VF Drive Healthy

&lt;&lt; RUNG 148 STEP #0555 &gt;&gt;

PP3PP%	ACCBUT	PP3PP+
%M0095	%I0042	%Q0018
---] [----]/[-----		( )--
PP3PP#	LPFLH	
%M0094	%M0001	
---] [----+ [---		
ACCBUT		
%I0042		
---] [---		

&lt;&lt; RUNG 149 STEP #0562 &gt;&gt;

PP3PP#	PP3PP@
%M0094	%M0124
---] [-	
	(^)--

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0001	LPFLH	Lamp Flasher
%M0094	PP3PP#	PP3-Pump protection alarm latch
%M0095	PP3PP%	PP3-Pump protection accept latch
%Q0018	PP3PP+	Pump PP3 Pump Prot. Trip Lamp
%M0124	PP3PP@	Mstr Alm Trig-PP3 Pump protect.

```
(*****  
(*      PUMP PP3 LOW FLOW ALARM      *)  
(*  
(* This alarm represents the following function:-      *)  
(*  
(*     . pump low flow, given by the reflux valve failing to remain open      *)  
(*     with the pump running.      *)  
(*  
(* The following drawings show the electrical connections:-      *)  
(*  
(*      CST-E455      *)  
(*      CST-E456      *)  
(*  
(* The code for this alarm is standard alarm code as described in the      *)  
(* program description, except as follows:-      *)  
(*  
(*     . the operator can override the low flow alarm condition in      *)  
(*     manual mode by holding in the start button      *)  
(*     . while the operator holds in the start button to override the      *)  
(*     low flow trip, the lamp glows to indicate to the operator that      *)  
(*     the reflux valve has not yet opened      *)  
(*     . common master alarm trigger used with reflux valve alarm.      *)  
(*  
(* This alarm causes the following events in sequence:      *)  
(*  
(*      Pump PP3 immediate shutdown      *)  
(*      Start-up of standby drive when system in auto      *)  
(*  
(*****)
```

## Pump PP3 Flow Flow

&lt;&lt; RUNG 152 STEP #0566 &gt;&gt;

```
PP3RLSW                                PP3RVT
%I0032 +----+                         %M0247
+--] [---+ TMR +-----+-----+-----+ ( )--+
    |0.10s|  

    |  

CONST -+PV  
+00050 ;  
+----+  
  
%R0706
```

REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%R0706			
%I0032	PP3RLSW		Pump PP3 Reflux Proximity Switch
%M0247	PP3RVT		Pump PP3 Reflux Valve Pos Sw Dly

&lt;&lt; RUNG 153 STEP #0569 &gt;&gt;

```

PP3RUN  PP3RVT          PP3LFF
%I0029  %M0247 +-----+
+---] [-----] [---+ TMR +-----+-----( )--+
|           |           |           |
|           0.10s|           |
|           |           |
CONST --+PV
+00900  |
+-----+
PP3LFT
%R0156

```

&lt;&lt; RUNG 154 STEP #0573 &gt;&gt;

```

PP3CSDF  PP3STT  PP3LFF          PP3LF#
%M0091  %I0023  %M0096        %M0097
+---] [---+---]/[---+---] [---+-----+(M)--+
|           |           |           |
|           PP3AUT|           |
|           %I0024|           |
+---] [---+
PP3LF#  PP3REST
%M0097  %I0031
+---] [-----+-----+

```

&lt;&lt; RUNG 155 STEP #0582 &gt;&gt;

```

ACCBUT  PP3LF#          PP3LF%
%I0042  %M0097        %M0098
+---] [---+---] [-----+-----+(M)--+
|           |           |
|           PP3LF%|           |
|           %M0098|           |
+---] [---+

```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%I0024	PP3AUT	Pump PP3 Auto Available
%M0091	PP3CSDF	PP3-Ctrl supply on (dlyed) flag
%M0097	PP3LF#	Pump PP3-Low flow alarm latch
%M0098	PP3LF%	Pump PP3-Low flow accept latch
%M0096	PP3LFF	Pump PP3-Low flow flag
%R0156	PP3LFT	Pump PP3 Flow Low Delay
%I0031	PP3REST	Pump PP3 Reset
%I0029	PP3RUN	Pump PP3 Drive Running
%M0247	PP3RVT	Pump PP3 Reflux Valve Pos Sw Dly
%I0023	PP3STT	Pump PP3 Local Start

<< RUNG 156 STEP #0586 >>

```
PP3LF% ACCBUT          PP3LF+
%M0098 %I0042          %Q0019
+---] [----]/[----+( )--+
PP3LF# LPFLH
%M0097 %M0001
+---] [---+---] [---+
ACCBUT
%I0042
+---] [---+
PP3STT PP3AUT PP3LFF
%I0023 %I0024 %M0096
+---] [----]/[----] [---+
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0001	LPFLH	Lamp Flasher
%I0024	PP3AUT	Pump PP3 Auto Available
%M0097	PP3LF#	Pump PP3-Low flow alarm latch
%M0098	PP3LF%	Pump PP3-Low flow accept latch
%Q0019	PP3LF+	Pump PP3 Low Flow Trip Lamp
%M0096	PP3LFF	Pump PP3-Low flow flag
%I0023	PP3STT	Pump PP3 Local Start

```
(*****  
(*          PUMP PP3 REFLUX VALVE ALARM      *)  
(*  
(* This alarm representing the reflux valve fail-to-close, given by the      *)  
(* valve failing to close within a certain time of stopping the pump.      *)  
(*  
(* The following drawings show the electrical connections:-      *)  
(*  
(*          CST-E455      *)  
(*          CST-E456      *)  
(*  
(* The code for this alarm is standard alarm code as described in the      *)  
(* program description, except that a common master alarm trigger is      *)  
(* shared with the low flow alarm.      *)  
(*  
(* This alarm causes the following events in sequence:      *)  
(*  
(*      Pump PP3 immediate shutdown      *)  
(*      Start-up of standby drive when system in auto      *)  
(*  
(*****
```

<< RUNG 159 STEP #0599 >>

```
PP3CSDF PP3RUN  PP3RLSW          PP3PVCT  
%M0091  %I0029  %I0032  +----+          %M0099  
+--] [----]/[----]/[---+ TMR +----- ( )--  
          | 0.10s |  
          |  
          | CONST -+PV |  
          | +00100 |  
          | +----+ |  
          |          PP3RVFT  
          |          %R0165
```

<< RUNG 160 STEP #0604 >>

```
PP3PVCT PP3CSDF          PP3RF#  
%M0099  %M0091          %M0100  
+--] [----] [----- (M)--  
|  
| PP3RF#  PP3REST  
| %M0100  %I0031 |  
+--] [----]/[--+
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%M0091	PP3CSDF	PP3-Ctrl supply on (dlyed) flag
%M0099	PP3PVCT	PP3-Rflx vlve cls w/dog tmmed out
%I0031	PP3REST	Pump PP3 Reset
%M0100	PP3RF#	Pump PP3-Reflux fail alarm latch
%I0032	PP3RLSW	Pump PP3 Reflux Proximity Switch
%I0029	PP3RUN	Pump PP3 Drive Running
%R0165	PP3RVFT	Pump PP3 Reflux Valve Fail Dly

1 << RUNG 161 STEP #0610 >>

|ACCBUT PP3RF# PP3RF%  
|%I0042 %M0100 %M0101  
+--] [---+---] [-----] (M)-----

PP3RF%  
%M0101  
--- ] [ ---

<< RUNG 163 STEP #0615 >>

|PP3RF% ACCBUT  
|%M0101 %I0042  
+--] [---]/[--- PP3RF+  
+-----] (% )----- %Q0020

|PP3RF# LPFLH |  
|%M0100 %M0001 |  
+--] [--+--] [---]

ACCBUT  
810042

## Common master alarm trigger

<< RUNG 165 STEP #0623 >>

|PP3LF#  
|%M0097  
+--] [--+-----(^)

PP3RF#  
%M0100  
+-- ] [ ---+

REFERENCE	NICKNAME	DESCRIPTION
%I0042	ACCBUT	Accept Button
%M0001	LPFLH	Lamp Flasher
%M0097	PP3LF#	Pump PP3-Low flow alarm latch
%M0125	PP3LF@	Mstr Alm Trig-PP3 Low flow
%M0100	PP3RF#	Pump PP3-Reflux fail alarm latch
%M0101	PP3RF%	Pump PP3-Reflux fail accpt latch
%Q0020	PP3RF+	Pump PP3 Reflux FTC Lamp

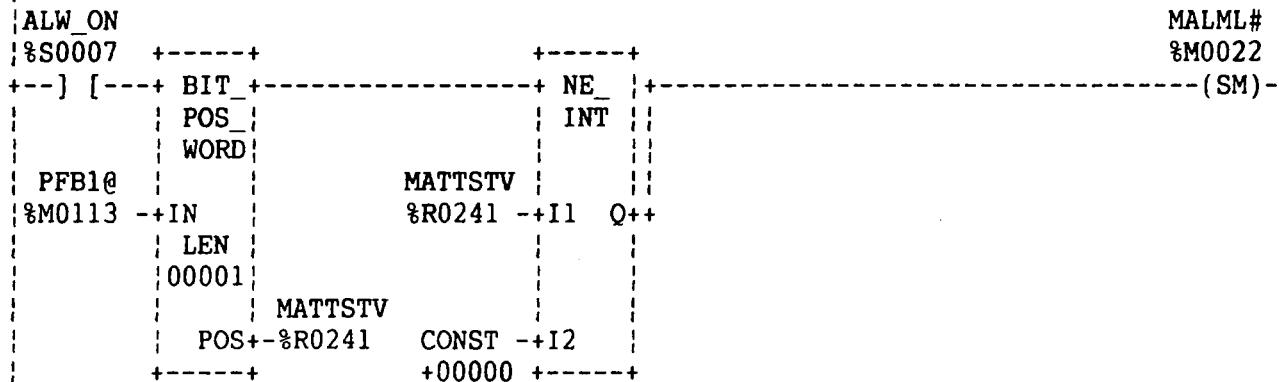
Program: CASWELL

C:\LM90\CASWELL

**Block: MAIN**

```
(*****  
(*          MASTER ALARM CONTROL          *)  
(*  
(* When an alarm occurs, the master alarm initiates lamp flashes until the *)  
(* operator presses the ACCEPT button. Each alarm is individually          *)  
(* signalled by one of the alarm trigger coils (%M0113 to %M0160), which      *)  
(* turn on for one scan when an alarm first occurs. The BITPOS function      *)  
(* block will determine when one of these coils is ON, and will turn on      *)  
(* the masteralarm latch if this is the case.                           *)  
(*****)
```

<< RUNG 167 STEP #0627 >>



Cancel master alarm when operator hits the ACCEPT button.

<< RUNG 169 STEP #0632 >>



REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0042	ACCBUT	Accept Button
%S0007	ALW_ON	
%M0022	MALML#	Master Alarm Latch
%R0241	MATTSTV	Master Alarm Trigger Test Value
%M0113	PFB1@	Mstr Alm Trig-Pow fail alm bus 1

04-11-94 10:05 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.01)  
 CASWELL STREET SEWAGE PUMP STATION PLC DOCUMENTATION  
 Telemetry Outputs

Page 61

```
(*****  

(*      TELEMTRY OUTPUTS      *)  

(*      *)  

(* The PLC outputs selected logic and I/O states to the telemetry      *)  

(* interface. These are outputs Q0025 thru to Q0040. Reverse states      *)  

(* are used as required to preserve fail-safe capabilities.      *)  

*****)
```

Bus 1 Power Supply Healthy

<< RUNG 172 STEP #0636 >>

PSBUS2H	SPONBU1
%M0183	%Q0025
+--] [-----	( )--

Bus 2 Power Supply Healthy

<< RUNG 174 STEP #0639 >>

PSBUS1H	SPONBU2
%M0184	%Q0026
+--] [-----	( )--

Wet Well Level OK

<< RUNG 176 STEP #0642 >>

WWLSEWI	WWNHIHI
%M0198	%Q0027
+--]/[-----	( )--

Pump 1 Status - Faults Clear, Running, Ready in Auto

<< RUNG 178 STEP #0645 >>

PP1RPA PP1AUT	PP1AUTR
%M0050 %I0002	%Q0028
+--] [-----	( )--

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0002	PP1AUT	Pump PP1 Auto Available
%Q0028	PP1AUTR	PP1 Ready in Auto
%M0050	PP1RPA	Pump PP1-Run permit aux
%M0184	PSBUS1H	Power Supply Healthy - Bus 1
%M0183	PSBUS2H	Power Supply Healthy - Bus 2
%Q0025	SPONBU1	Site Power On Bus 1
%Q0026	SPONBU2	Site Power On Bus 2
%M0198	WWLSEWI	W/Well Level Sewer Inlet
%Q0027	WWNHIHI	Wet Well not High High

<< RUNG 179 STEP #0648 >>

```
PP1POW  PP1VFD#  PP1PP#  PP1LF#  PP1RF#      PP1FLTR
%I0008  %M0052  %M0054  %M0057  %M0060      %Q0029
+---] [----]/[----]/[----]/[----]/[-----]-( )--
```

<< RUNG 180 STEP #0654 >>

```
PP1RUN      PP1RUNR
%I0007      %Q0030
+---] [-----]-( )--
```

Pump 2 Status - Faults Clear, Running, Ready in Auto

<< RUNG 182 STEP #0657 >>

```
PP2RPA  PP2AUT      PP2AUTR
%M0070  %I0013      %Q0031
+---] [----]-( )--
```

<< RUNG 183 STEP #0660 >>

```
PP2POW  PP2VFD#  PP2PP#  PP2LF#  PP2RF#      PP2FLTR
%I0019  %M0072  %M0074  %M0077  %M0080      %Q0032
+---] [----]/[----]/[----]/[----]/[-----]-( )--
```

<< RUNG 184 STEP #0666 >>

```
PP2RUN      PP2RUNR
%I0018      %Q0033
+---] [-----]-( )--
```

Pump 3 Status - Faults Clear, Running, Ready in Auto

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%Q0029	PP1FLTR	PP1 Faults Clear
%M0057	PP1LF#	Pump PP1-Low Flow alarm latch
%I0008	PP1POW	Pump PP1 Control Power Available
%M0054	PP1PP#	Pump PP1-Pmp Protect. alarm latch
%M0060	PP1RF#	Pump PP1-Reflux fail alarm latch
%I0007	PP1RUN	Pump PP1 Drive Running
%Q0030	PP1RUNR	PP1 Running
%M0052	PP1VFD#	Pump PP1-VFD fault alarm latch
%I0013	PP2AUT	Pump PP2 Auto Available
%Q0031	PP2AUTR	PP2 Ready in Auto
%Q0032	PP2FLTR	PP2 Faults Clear
%M0077	PP2LF#	Pump PP2-Low flow alarm latch
%I0019	PP2POW	Pump PP2 Control Power Available
%M0074	PP2PP#	PP2-Pump protection alarm latch
%M0080	PP2RF#	Pump PP2-Reflux fail alarm latch
%M0070	PP2RPA	Pump PP2-Run permit aux
%I0018	PP2RUN	Pump PP2 Drive Running
%Q0033	PP2RUNR	PP2 Running
%M0072	PP2VFD#	Pump PP2-VFD fault alarm latch

&lt;&lt; RUNG 186 STEP #0669 &gt;&gt;

PP3RPA PP3AUT  
%M0090 %I0024PP3AUTR  
%Q0034  
---( )---

&lt;&lt; RUNG 187 STEP #0672 &gt;&gt;

PP3POW PP3VFD# PP3PP# PP3LF# PP3RF#  
%I0030 %M0092 %M0094 %M0097 %M0100PP3FLTR  
%Q0035  
---( )---

&lt;&lt; RUNG 188 STEP #0678 &gt;&gt;

PP3RUN  
%I0029PP3RUNR  
%Q0036  
---( )---

Dry Well Sump Not Flooded

&lt;&lt; RUNG 190 STEP #0681 &gt;&gt;

SPPHHHL  
%I0040DWNHIHI  
%Q0037  
---( )---

The following outputs are left in for potential use in telemetry but are currently not utilised.

&lt;&lt; RUNG 192 STEP #0684 &gt;&gt;

PP1FTXF PP2FTXF PP3FTXF WWLTXF  
%M0180 %M0181 %M0182 %M0189%Q0038  
---( )---

## REFERENCE NICKNAME

## REFERENCE DESCRIPTION

%Q0038	DWNHIHI	Dry Well not Hi Hi
%Q0037	PP1FTXF	Pump PP1 Flow Tx Fail
%M0180	PP2FTXF	Pump PP2 Flow Tx Fail
%M0181	PP3AUT	Pump PP3 Auto Available
%I0024	PP3AUTR	PP3 Ready in Auto
%Q0034	PP3FLTR	PP3 Faults Clear
%M0182	PP3FTXF	Pump PP3 Flow Tx Fail
%M0097	PP3LF#	Pump PP3-Low flow alarm latch
%I0030	PP3POW	Pump PP3 Control Power Available
%M0094	PP3PP#	PP3-Pump protection alarm latch
%M0100	PP3RF#	Pump PP3-Reflux fail alarm latch
%M0090	PP3RPA	Pump PP3-Run permit aux
%I0029	PP3RUN	Pump PP3 Drive Running
%Q0036	PP3RUNR	PP3 Running
%M0092	PP3VFD#	Pump PP3-VFD fault alarm latch
%I0040	SPPHHHL	Sump Pump HiHiHi Level (Lockout)
%M0189	WWLTXF	Wet Well Level Tx Fail

|| << RUNG 193 STEP #0689 >>

|| MALML# %Q0040  
|| %M0022 ( )--  
|| +---]/[-----

REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%Q0040			
%M0022	MALML#		Master Alarm Latch

Program: CASWELL

C:\LM90\CASWELL

Block: MAIN

```
(*****  
(*          TRANSMITTER HEALTHY CHECKS      *)  
(*          *)  
(* Check analog input signals being less than 2 mA as an indicator of      *)  
(* loss-of-signal. This current value corresponds to a register value of      *)  
(* approx. 3200. All analog inputs are 4-20 mA format which allows this      *)  
(* check.                                         *)  
(*****
```

## Pump PP1 Flow Transmitter

&lt;&lt; RUNG 196 STEP #0693 &gt;&gt;

```
ALW_ON                                PP1FTXF  
%S0007 +----+                         %M0180  
+--] [---+ LT_ | +-----+ ( )--  
     | INT |  
  
AIPP1FL                                +----+  
%AI0001---+I1 Q+-----+ TMR ++  
                           | 0.10s |  
  
CONST -+I2      CONST -+PV  
+03200 +----+ +00020 |  
                           +----+  
                           PP1TXFT  
                           %R0050
```

## Pump PP2 Flow Transmitter

&lt;&lt; RUNG 198 STEP #0698 &gt;&gt;

```
ALW_ON                                PP2FTXF  
%S0007 +----+                         %M0181  
+--] [---+ LT_ | +-----+ ( )--  
     | INT |  
  
AIPP2FL                                +----+  
%AI0002---+I1 Q+-----+ TMR ++  
                           | 0.10s |  
  
CONST -+I2      CONST -+PV  
+03200 +----+ +00020 |  
                           +----+  
                           PP2TXFT  
                           %R0053
```

## Pump PP3 Flow Transmitter

REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%AI0001	AIPP1FL	PP1	Flow Input
%AI0002	AIPP2FL	PP2	Flow Input
%S0007	ALW_ON		
%M0180	PP1FTXF	Pump	PP1 Flow Tx Fail
%R0050	PP1TXFT	Pump	PP1 Tx Fault Delay
%M0181	PP2FTXF	Pump	PP2 Flow Tx Fail
%R0053	PP2TXFT	Pump	PP2 Tx Fault Delay

<< RUNG 200 STEP #0703 >>

```

ALW_ON                                PP3FTXF
%S0007 +----+                         %M0182
+--] [---+ LT_                         +-----( )--
      | INT |
      +-----+
AIPP3FL                                +----+
%AI0003-+I1 Q+-----+ TMR ++
      |          | 0.10s |
      +-----+
CONST -+I2   CONST -+PV
+03200 +----+ +00020 |
      +-----+
PP3TXFT
%R0056

```

Wet Well Level Transmitter

<< RUNG 202 STEP #0708 >>

```

ALW_ON                                WWLTXF
%S0007 +----+                         %M0189
+--] [---+ LT_                         +-----( )--
      | INT |
      +-----+
AIWWLVL                                +----+
%AI0004-+I1 Q+-----+ TMR ++
      |          | 0.10s |
      +-----+
CONST -+I2   CONST -+PV
+03200 +----+ +00020 |
      +-----+
WWLTXFT
%R0059

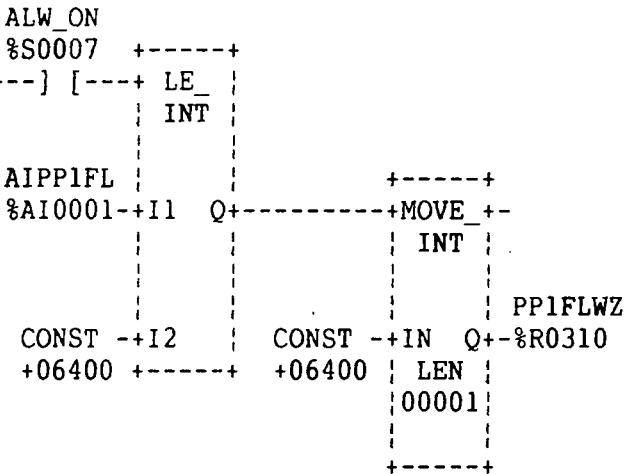
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%AI0003	AIPP3FL	PP3 Flow Input
%AI0004	AIWWLVL	Wet Well Level Input
%S0007	ALW_ON	
%M0182	PP3FTXF	Pump PP3 Flow Tx Fail
%R0056	PP3TXFT	Pump PP3 Tx Fault Delay
%M0189	WWLTXF	Wet Well Level Tx Fail
%R0059	WWLTXFT	Wet Well Level Tx Fault Delay

```
(*****
(*      ANALOG INPUT SCALING/COMPARISONS      *)
(*
(* Analog signals of 4-20 mA represents a register value of 6400 - 32000.   *)
(* and represent:-                                *)
(*     . flowrates of 0 - 600 l/sec            *)
(*     . level of 0 - 6400 cm.                  *)
(*
(* All analog signals are normalised to a register value of 0, after       *)
(* firstly checking for signal healthy status, if the input is even          *)
(* the slightest amount less than 4 mA (6400) to avoid negative register    *)
(* values in the scaling.                                                 *)
(*
(* After removing the 6400 suppression value the remaining register value  *)
(* of 0 - 25600 is scaled:-                                              *)
(*     . to 0 - 6000 for pump flowrates                                     *)
(*     . to 0 - 6400 for wet well level,                                     *)
(* and the conversion uses a div/mod combination to preserve accuracy and *)
(* to reduce the size of the incremental stepping of the scaled value to   *)
(* provide a smoother analog output response from the PID loop.           *)
(*
(* The ten-times factoring of the register value compared to the actual    *)
(* value for the flow scaling means the units are changed to 0.1x1/sec,      *)
(* but this has no effect on the PID loop output scale and aids loop       *)
(* smoothness by expanding the working range of the loop algorithm. The    *)
(* setpoint value must be scaled similarly.                                 *)
(*
(* Register comparisons are made to ascertain various control switching   *)
(* states.                                                               *)
(*****)
```

## Pump PP1 Flowrate - FIT100

&lt;&lt; RUNG 205 STEP #0714 &gt;&gt;



REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%AI0001	AIPP1FL	PP1 Flow Input
%S0007	ALW_ON	
%R0310	PP1FLWZ	Pump PP1 Flow Value - Zero Corr.

&lt;&lt; RUNG 206 STEP #0717 &gt;&gt;

```

ALW_ON
$S0007 +----+
+--] [----+ GT_
|      | INT
AIPP1FL +----+
$AI0001-I1 Q+-----+MOVE_+-+
|      | INT
|      | AIPP1FL PP1FLWZ
CONST -+I2 | $AI0001-IN Q+-%R0310
+06400 +----+ | LEN
|      | 00001
+----+

```

&lt;&lt; RUNG 207 STEP #0720 &gt;&gt;

```

ALW_ON
$S0007 +----+ +----+ +----+
+--] [----+ SUB_+-----+ DIV_+-----+ MUL_+-+
|      | INT |      | INT |      | INT
PP1FLWZ
%R0310 -+I1 Q+-%R0300 %R0300 -+I1 Q+-%R0301 %R0301 -+I1 Q+-%R0302
CONST -+I2 CONST -+I2 CONST -+I2
+06400 +----+ +00010 +----+ +00006 +----+

```

&lt;&lt; RUNG 208 STEP #0724 &gt;&gt;

```

ALW_ON
$S0007 +----+ +----+ +----+
+--] [----+ DIV_+-----+ MOD_+-----+ MUL_+-+
|      | INT |      | INT |      | INT
%R0302 -+I1 Q+-%R0305 %R0302 -+I1 Q+-%R0306 %R0305 -+I1 Q+-%R0307
CONST -+I2 CONST -+I2 CONST -+I2
+00256 +----+ +00256 +----+ +00100 +----+

```

REFERENCE NICKNAME	
%R0300	Dummy
%R0301	Dummy
%R0302	Dummy
%R0305	Dummy
%R0306	Dummy
%R0307	Dummy
\$AI0001	AIPP1FL
\$S0007	ALW_ON
%R0310	PP1FLWZ

REFERENCE DESCRIPTION
Dummy
PP1 Flow Input
Pump PP1 Flow Value - Zero Corr.

&lt;&lt; RUNG 209 STEP #0728 &gt;&gt;

```

ALW_ON
%S0007 +----+
+--] [---+ DIV_ +-----+ ADD_ ++
| INT | | INT |
|      | |      |
|      | |      PP1FV
%R0306 -+I1 Q+-%R0308 %R0307 -+I1 Q+-%R0309
|      | |      |
| CONST -+I2 | %R0308 -+I2 |
| +00003 +----+ |      |

```

Pump 2 Flowrate - FIT200

&lt;&lt; RUNG 211 STEP #0732 &gt;&gt;

```

ALW_ON
%S0007 +----+
+--] [---+ LE_ +
| INT |
|      |
AIPP2FL +----+
%AI0002 -+I1 Q+-----+MOVE_ ++
|      | | INT |
|      | |      |
| CONST -+I2 | CONST -+IN Q+-%R0410
| +06400 +----+ | LEN |
|      | | 00001 |
|      |
|      +----+

```

&lt;&lt; RUNG 212 STEP #0735 &gt;&gt;

```

ALW_ON
%S0007 +----+
+--] [---+ GT_ +
| INT |
|      |
AIPP2FL +----+
%AI0002 -+I1 Q+-----+MOVE_ ++
|      | | INT |
|      | |      |
| CONST -+I2 | AIPP2FL | PP2FVZ
| +06400 +----+ | %AI0002 -+IN Q+-%R0410
|      | | LEN |
|      | | 00001 |
|      |
|      +----+

```

REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%R0306		Dummy	
%R0307		Dummy	
%R0308		Dummy	
%AI0002	AIPP2FL	PP2	Flow Input
%S0007	ALW_ON		
%R0309	PP1FV	Pump	PP1 Flow Value
%R0410	PP2FVZ	Pump	PP2 Flow Value - Zero Corr

<< RUNG 213 STEP #0738 >>

```

ALW_ON
%S0007 +----+          +----+          +----+
+--] [---+ SUB_+-----+ DIV_+-----+ MUL_+-
           INT          INT          INT
PP2FVZ
%R0410 -+I1 Q+-%R0400 %R0400 -+I1 Q+-%R0401 %R0401 -+I1 Q+-%R0402
           |           |           |
           CONST -+I2      CONST -+I2      CONST -+I2
           +06400 +----+    +00010 +----+    +00006 +----+

```

<< RUNG 214 STEP #0742 >>

```

ALW_ON
%S0007 +----+          +----+          +----+
+--] [---+ DIV_+-----+ MOD_+-----+ MUL_+-
           INT          INT          INT
%R0402 -+I1 Q+-%R0405 %R0402 -+I1 Q+-%R0406 %R0405 -+I1 Q+-%R0407
           |           |           |
           CONST -+I2      CONST -+I2      CONST -+I2
           +00256 +----+    +00256 +----+    +00100 +----+

```

<< RUNG 215 STEP #0746 >>

```

ALW_ON
%S0007 +----+          +----+          +----+
+--] [---+ DIV_+-----+ ADD_+-
           INT          INT          PP2FV
%R0406 -+I1 Q+-%R0408 %R0407 -+I1 Q+-%R0409
           |           |
           CONST -+I2      %R0408 -+I2
           +00003 +----+    +----+

```

Pump 3 Flowrate - FIT300

REFERENCE NICKNAME	REFERENCE DESCRIPTION
%R0400	Dummy
%R0401	Dummy
%R0402	Dummy
%R0405	Dummy
%R0406	Dummy
%R0407	Dummy
%R0408	Dummy
%S0007	ALW_ON
%R0409	PP2FV
%R0410	PP2FVZ

<< RUNG 217 STEP #0750 >>

```

ALW_ON
%S0007 +----+
+--] [---+ LE_
|      INT

AIPP3FL      +----+
%AI0003-+I1 Q+-----+MOVE_+-+
|           |           INT
|           |
|           PP3FVZ
CONST -+I2   | CONST -+IN Q+-%R0510
+06400 +----+ +06400 | LEN
|           | 00001
|           |
+----+

```

<< RUNG 218 STEP #0753 >>

```

ALW_ON
%S0007 +----+
+--] [---+ GT_
|      INT

AIPP3FL      +----+
%AI0003-+I1 Q+-----+MOVE_+-+
|           |           INT
|           |
|           AIPP3FL | PP3FVZ
CONST -+I2   | %AI0003-+IN Q+-%R0510
+06400 +----+ | LEN
|           | 00001
|           |
+----+

```

<< RUNG 219 STEP #0756 >>

```

ALW_ON
%S0007 +----+ +----+ +----+
+--] [---+ SUB_+-----+ DIV_+-----+ MUL_+-
|      INT |           INT |           INT
|           |           |
PP3FVZ
%R0510 -+I1 Q+-%R0500 %R0500 -+I1 Q+-%R0501 %R0501 -+I1 Q+-%R0502
|           |           |           |
CONST -+I2   | CONST -+I2   | CONST -+I2
+06400 +----+ +00010 +----+ +00006 +----+

```

REFERENCE NICKNAME	REFERENCE DESCRIPTION
%R0500	Dummy
%R0501	Dummy
%R0502	Dummy
%AI0003	AIPP3FL
%S0007	ALW_ON
%R0510	PP3FVZ
	Pump PP3 Flow Value - Zero Corr.

&lt;&lt; RUNG 220 STEP #0760 &gt;&gt;

```

ALW_ON
%S0007 +----+
+--] [---+ DIV_+-----+ MOD_+-----+ MUL_+-
|      INT |           INT |           INT |
%R0502 --I1 Q+-%R0505 %R0502 --I1 Q+-%R0506 %R0505 --I1 Q+-%R0507
|           |           |           |
CONST -+I2 CONST -+I2 CONST -+I2
+00256 +----+ +00256 +----+ +00100 +----+

```

&lt;&lt; RUNG 221 STEP #0764 &gt;&gt;

```

ALW_ON
%S0007 +----+
+--] [---+ DIV_+-----+ ADD_+-
|      INT |           INT |
%R0506 --I1 Q+-%R0508 %R0507 --I1 Q+-%R0509 PP3FV
|           |           |
CONST -+I2 %R0508 --I2
+00003 +----+ +----+

```

Wet Well Level - LIT500

&lt;&lt; RUNG 223 STEP #0768 &gt;&gt;

```

ALW_ON
%S0007 +----+
+--] [---+ LE_+
|      INT |
AIWWLVL +----+
%AI0004 --I1 Q+-----+MOVE_+-
|           INT |
CONST -+I2 CONST -+IN Q+-%R0270 WWLVZ
+06400 +----+ +06400 LEN
|           |
|           00001
|           |
+----+

```

REFERENCE NICKNAME	REFERENCE DESCRIPTION
%R0502	Dummy
%R0505	Dummy
%R0506	Dummy
%R0507	Dummy
%R0508	Dummy
%AI0004	AIWWLVL
%S0007	ALW_ON
%R0509	PP3FV
%R0270	WWLVZ

&lt;&lt; RUNG 224 STEP #0771 &gt;&gt;

```

ALW_ON
%S0007 +----+
+--] [---+ GT_
|      INT

AIWWLVL +-----+
%AI0004 -+I1 Q+-----+MOVE_+-+
|           | INT
|           AIWWLVL      WWLVZ
CONST -+I2 | %AI0004 -+IN Q+-%R0270
+06400 +----+ | LEN
|           00001
|           |
+-----+

```

&lt;&lt; RUNG 225 STEP #0774 &gt;&gt;

```

ALW_ON
%S0007 +----+ +----+
+--] [---+ SUB_+-----+ DIV_+-+
|      INT |           | INT
|           |           WWLV
WWLVZ      |           |
%R0270 -+I1 Q+-%R0260 %R0260 -+I1 Q+-%R0269
CONST -+I2 |           CONST -+I2
+06400 +----+           +00004 +----+

```

## Wet Well Level Comparisons

&lt;&lt; RUNG 227 STEP #0778 &gt;&gt;

```

PSH
%M0161 +----+          WWLSEWI
|           |          %M0198
+--] [---+ GT_ +-----+-----+ ( ) --
|      INT |
|           |
WWLV +----+          |
%R0269 -+I1 Q+-----+ TMR ++
|           |           0.10s
|           |
CONST -+I2 |           CONST -+PV
+05500 +----+           +00050 |
|           |
|           WWLHHT
|           %R0073

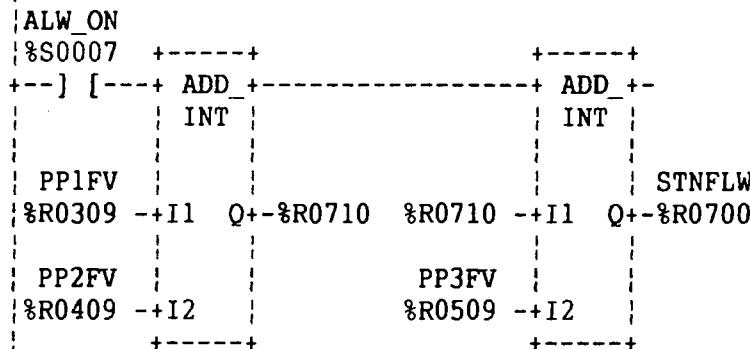
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%R0260		Dummy
%AI0004	AIWWLVL	Wet Well Level Input
%S0007	ALW_ON	
%M0161	PSH	Power supply healthy
%R0073	WWLHHT	Wet Well Level - HiHi - Dly
%M0198	WWLSEWI	W/Well Level Sewer Inlet
%R0269	WWLV	Wet Well Level Value
%R0270	WWLVZ	Wet Well Level Value - Xero Corr

```
(*****  
(*          STATION TOTAL FLOW          *)  
*****)
```

Calculate station total discharge flow, as the summation of the individual pump flows, for use in the overall flow control loop.

<< RUNG 230 STEP #0784 >>



REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%R0710			Dummy
%S0007	ALW_ON		
%R0309	PP1FV		Pump PP1 Flow Value
%R0409	PP2FV		Pump PP2 Flow Value
%R0509	PP3FV		Pump PP3 Flow Value
%R0700	STNFLW		Station Combined Discharge Flow

```
(*****  

(*          OVERALL STATION FLOW CONTROL LOOP      *)  

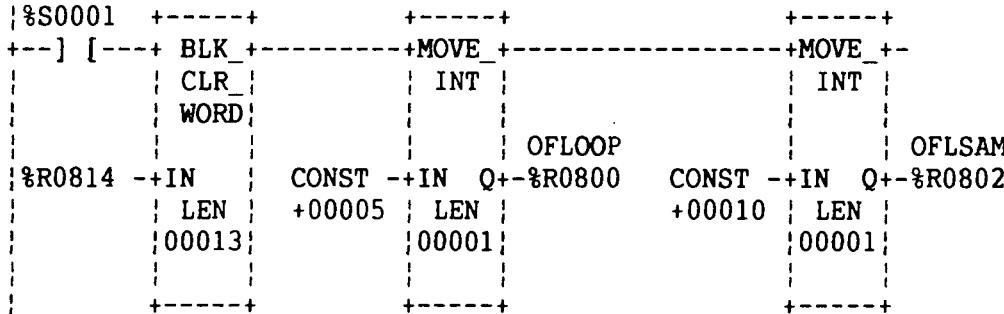
*****)
```

Initialise the following loop parameters:

- . clear temp registers (scratchpad)
- . loop number
- . loop sampling rate, in steps of 10 mSec
- . output slew rate limit, set at "unlimited"

<< RUNG 233 STEP #0789 >>

FST\_SCN

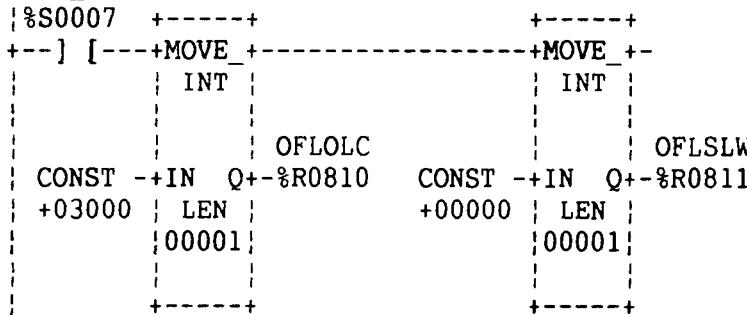


Set pump minimum flowrate in OFLOLC - normally 3000 - 3500,  
 corresponding to 300 - 350 l/sec.

(note: this value is adjustable on-line)

<< RUNG 235 STEP #0794 >>

ALW\_ON



Set station maximum flowrate in OFLOUC:

- . normally 5500 for lead pump only (first rung following),  
 corresponding to 550 l/sec
- . normally 5500 - 10000 for lead/lag pump combination  
 (second rung following), corresponding to 550 - 1000 l/sec
- . limit the controller when no pumps are running to just above the  
 minimum flowrate, say 3600, corresponding to 360 l/sec

(note: these values are adjustable on-line).

#### REFERENCE NICKNAME

#### REFERENCE DESCRIPTION

%R0814	
%S0007	ALW_ON
%S0001	FST_SCN
%R0810	OFLOLC
%R0800	OFLOOP
%R0802	OFLSAM
%R0811	OFLSW

<< RUNG 237 STEP #0798 >>

```
LEDPCF LGDPCF
%M0014 %M0015 +----+
+--] [----]/[---+MOVE_+-+
| INT |
|
OFLOUC
CONST -+IN Q+-%R0809
+04000 | LEN |
| 00001 |
+----+
```

<< RUNG 238 STEP #0801 >>

```
LEDPCF LGDPCF
%M0014 %M0015 +----+
+--] [----] [---+MOVE_+-+
| INT |
|
OFLOUC
CONST -+IN Q+-%R0809
+04000 | LEN |
| 00001 |
+----+
```

<< RUNG 239 STEP #0804 >>

PP1RUN	PP2RUN	PP3RUN	LEDPCF	STNIDLE
%I0007	%I0018	%I0029	%M0014	%M0226
+--]/[----]/[----]/[----]/[----]				( ) --

<< RUNG 240 STEP #0809 >>

```
STNIDLE
%M0226 +----+
+--] [---+MOVE_+-+
| INT |
|
OFLOUC
CONST -+IN Q+-%R0809
+03600 | LEN |
| 00001 |
+----+
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%M0014	LEDPCF	Lead Duty Pump Call Flag
%M0015	LGDPCF	Lag Duty Pump Call Flag
%R0809	OFLOUC	O/all Flow Loop Upper O/P Clamp
%I0007	PP1RUN	Pump PP1 Drive Running
%I0018	PP2RUN	Pump PP2 Drive Running
%I0029	PP3RUN	Pump PP3 Drive Running
%M0226	STNIDLE	Station Idle Flag

Load in loop PID algorithm tuning parameters:  
 . proportional gain, in units of 0.01 %/  
 . derivative action, in units of 0.01 secs  
 . integral rate, in units of repeats/1000 sec

<< RUNG 242 STEP #0812 >>

```
ALW_ON
%S0007 +----+
+--] [----+MOVE_+-----+MOVE_+-----+MOVE_+-
| INT |           | INT |           | INT |
|      | OFLPG |      | OFLDER |      | OFLINT |
CONST -+IN Q+-%R0805 CONST -+IN Q+-%R0806 CONST -+IN Q+-%R0807
+00065 | LEN | +00000 | LEN | +00035 | LEN |
| 00001 |          | 00001 |          | 00001 |
+----+           +----+           +----+
```

<< RUNG 243 STEP #0816 >>

```
ALW_ON
%S0007 +----+
+--] [----+ PID_+-
| ISA |
|      | ODF
RDF -+SP CV+-%R0716
STNFLW
%R0700 -+PV
|
ALW_OFF
%S0008
+--] [----+MAN
|
ALW_OFF
%S0008
+--] [----+UP
|
ALW_OFF
%S0008
+--] [----+DN
|
+----+
OFLOOP
%R0800
```

REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%S0008	ALW_OFF		
%S0007	ALW_ON		
%R0716	ODF		Overall Demand Flow
%R0806	OFLDER		Overall Flow Loop Derivative
%R0807	OFLINT		Overall Flow Loop Integral
%R0800	OFLOOP		Overall Flow Control Loop
%R0805	OFLPG		Overall Flow Loop Prop. Gain
%R0715	RDF		Raw Demand Flow
%R0700	STNFLW		Station Combined Discharge Flow

```
(*****)
(*          PUMP PP1 FLOW CONTROL LOOP      *)
(*****)
```

Initialise the following loop parameters:

- . clear temp registers (scratchpad)
- . loop number
- . loop sampling rate, in steps of 10 mSec
- . output clamp, set at maximum equal to 20 mA
- . output slew rate limit, set at "unlimited"

<< RUNG 246 STEP #0823 >>

```
FST_SCN
%S0001 +----+           +----+           +----+
+--] [---+ BLK_ +-----+MOVE +-----+MOVE_ +
|   | CLR_ |           | INT |           | INT |
|   | WORD |           +-----+           +-----+
%R0364 -+IN   CONST -+IN Q+-%R0350  CONST -+IN Q+-%R0352
|   | LEN  +00001 | LEN |           +00001 | LEN |
|   | 00013 | 00001 |           00001 |
+----+           +----+           +----+
```

<< RUNG 247 STEP #0827 >>

```
FST_SCN
%S0001 +----+           +----+
+--] [---+MOVE_ +-----+MOVE_ +
|   | INT |           | INT |
|   |       +-----+           +-----+
|   | PP1LCL |           | PP1LSLW
CONST -+IN Q+-%R0359  CONST -+IN Q+-%R0361
+32000 | LEN  +00000 | LEN |
| 00001 | 00001 |
+----+           +----+
```

Load in loop PID algorithm tuning parameters:

- . proportional gain, in units of 0.01 %/%
- . derivative action, in units of 0.01 secs
- . integral rate, in units of repeats/1000 sec

REFERENCE NICKNAME	REFERENCE DESCRIPTION
%R0364	
%S0001	FST_SCN
%R0359	PP1LCL
%R0350	PP1LOOP
%R0352	PP1LSAM
%R0361	PP1LSLW

<< RUNG 249 STEP #0831 >>

```

ALW_ON
%$0007 +----+ +----+ +----+
+--] [---+MOVE_+-----+MOVE_+-----+MOVE_+-
| INT | | INT | | INT |
PP1LPG PP1LDER PP1LINT
CONST -+IN Q+-%R0355 CONST -+IN Q+-%R0356 CONST -+IN Q+-%R0357
+00250 | LEN | +00000 | LEN | +00150 | LEN |
00001 | | 00001 | | 00001 |
+----+ +----+ +----+

```

<< RUNG 250 STEP #0835 >>

```

PP1RUN PP1LPHF
%I0007 +----+ %M0230
+--] [---+ PID_+-----+( )--
| ISA |
ODF AQPP1SP
%R0716 -+SP CV+-%AQ001
PP1FV
%R0309 -+PV
PP1LMAN
%M0235
+--] [---+MAN
ALW_OFF
%S0008
+--] [---+UP
ALW_OFF
%S0008
+--] [---+DN
+----+
PP1LOOP
%R0350

```

#### PUMP PP1 LOOP RAMP-DOWN ALGORITHM

REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%\$0008	ALW_OFF		
%\$0007	ALW_ON		
%AQ001	AQPP1SP		PP1 Speed Output
%R0716	ODF		Overall Demand Flow
%R0309	PP1FV		Pump PP1 Flow Value
%R0356	PP1LDER		Pump PP1 Loop Derivative
%R0357	PP1LINT		Pump PP1 Loop Integral
%M0235	PP1LMAN		Pump PP1 Loop - Manual
%R0350	PP1LOOP		Pump PP1 Loop (and No.)
%R0355	PP1LPG		Pump PP1 Loop Prop. Gain
%M0230	PP1LPHF		Pump PP1 Loop Healthy Flag
%I0007	PP1RUN		Pump PP1 Drive Running

Pump 1 Flow Control Loop

Keep updating auto-stopping ramp down start and decrement values - ready for when ramp down is initiated.

<< RUNG 253 STEP #0843 >>

PP1RDIP

```
%M0251 +----+ +----+ +----+
+---]/[---+MOVE_+-----+MOVE_+-----+ DIV_+-
| INT | | INT | | INT |
AQPP1SP PP1RDV AQPP1SP | | | | | |
%AQ001 --IN Q+-%R0390 %AQ001 -+IN Q+-%R0391 %R0391 -+I1 Q+-%R0392
| LEN | | LEN | | | |
| 00001 | | 00001 | | | |
+----+ +----+ CONST -+I2
+----+ +----+ +00020 +----+
```

Ramp down is initiated when the call flag is removed when a drive is running in Auto mode.

<< RUNG 255 STEP #0848 >>

```
PP1RUN PP1AUT DBSOTT LEDPCF PP1RDS
%I0007 %I0002 %M0033 %M0014 %M0255
+---] [----] [---+-----] ( )--+
| |
| DBSTOT LGDPCF
| %M0034 %M0015
+---] [----] [---+
| |
| DBSTTO STPCF
| %M0035 %M0018
+---] [----] [---+
```

<< RUNG 256 STEP #0860 >>

```
PP1RDS %M0255 PP1RDI %M0250
+---] [-----] (v)--
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%R0391	Dummy	
%AQ001	AQPP1SP	PP1 Speed Output
%M0033	DBSOTT	Dty Bit Sequencer=1lead2lag3stby
%M0034	DBSTOT	Dty Bit Sequencer=3lead1lag2stby
%M0035	DBSTTO	Dty Bit Sequencer=2lead3lag1stby
%M0014	LEDPCF	Lead Duty Pump Call Flag
%M0015	LGDPCF	Lag Duty Pump Call Flag
%I0002	PP1AUT	Pump PP1 Auto Available
%R0392	PP1DECR	Pump PP1 Ramp Down Decrement
%M0250	PP1RDI	Pump PP1 Ramp Down Initiation
%M0251	PP1RDIP	Pump PP1 Ramp Down In Progress
%M0255	PP1RDS	Pump PP1 Ramp Down Start
%R0390	PP1RDV	Pump PP1 Ramp Down Value
%I0007	PP1RUN	Pump PP1 Drive Running
%M0018	STPCF	Standby Pump Call Flag

<< RUNG 257 STEP #0862 >>

```
PP1RDS PP1NRD
%M0255 +----+
+--]/[----+ TMR +-----(
| 0.1s |
|-----+
CONST --+PV %M0256
+00005 |
+----+
%R0296
```

Ramp down is latched in after initiation until the ramped variable has been decremented down to zero.

<< RUNG 259 STEP #0866 >>

```
PP1RDI PP1RDIP
%M0250 %M0251
+--] [-----(
|-----+ (SM)-
```

<< RUNG 260 STEP #0868 >>

```
PP1RDIP PP1RDC PP1RDIP
%M0251 %M0252 %M0251
+--] [----] [-----(
|-----+ (RM)-
```

<< RUNG 261 STEP #0871 >>

```
PP1RDIP PP1RDA
%M0251 %M0254
+--] [----+ ( )-
PP1RDI
%M0250
+--] [--+
PP1NRD
%M0256
+--]/[--+
```

Decrement the output variable every 1 second - duration of the ramp being then given by the value of the constant in calculation of the decrement value four rungs earlier.

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%R0296		
%M0256	PP1NRD	Pump PP1 Not Ramping Down
%M0254	PP1RDA	Pump PP1 Ramp Down Aux Flag
%M0252	PP1RDC	Pump PP1 Ramp Down Completed
%M0250	PP1RDI	Pump PP1 Ramp Down Initiation
%M0251	PP1RDIP	Pump PP1 Ramp Down In Progress
%M0255	PP1RDS	Pump PP1 Ramp Down Start

<< RUNG 263 STEP #0876 >>

```
T_SEC          PP11SP
%$0005         %M0253
+--] [-----(^)--
```

<< RUNG 264 STEP #0878 >>

```
PP11SP  PP1RDIP
%M0253  %M0251 +----+
+--] [----] [---+ SUB_+-+
|           | INT |
|           |
PP1RDV      PP1RDV
%R0390 -+I1  Q+-%R0390
|
PP1DECR
%R0392 -+I2
+----+
```

Transfer the decremented ramp variable to the output register.

<< RUNG 266 STEP #0882 >>

```
PP1RDIP
%M0251 +----+
+--] [---+MOVE_+-+
|           | INT |
|           |
PP1RDV      AQPP1SP
%R0390 -+IN  Q+-%AQ001
|           | LEN |
|           | 00001 |
|           |
+----+
```

Check whether the ramp has reached zero.

<< RUNG 268 STEP #0885 >>

```
PP1RDIP          PP1RDC
%M0251 +----+          %M0252
+--] [---+ LE_ | +-----(^)--
|           | INT |
|           |
PP1RDV
%R0390 -+I1  Q++
|
CONST -+I2
+00000 +----+
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%AQ001	AQPP1SP	PP1 Speed Output
%M0253	PP11SP	Pump PP1 1 Second Pulse
%R0392	PP1DECR	Pump PP1 Ramp Down Decrement
%M0252	PP1RDC	Pump PP1 Ramp Down Completed
%M0251	PP1RDIP	Pump PP1 Ramp Down In Progress
%R0390	PP1RDV	Pump PP1 Ramp Down Value
%\$0005	T_SEC	

(\*\*\*\*\*  
(\* PUMP PP2 FLOW CONTROL LOOP \*)  
\*\*\*\*\*)

Initialise the following loop parameters:

- . clear temp registers (scratchpad)
- . loop number
- . loop sampling rate, in steps of 10 mSec
- . output clamp, set at maximum equal to 20 mA
- . output slew rate limit, set at "unlimited"

<< RUNG 271 STEP #0890 >>

FST\_SCN  
S0001 +----+ +----+ +----+  
] [---+ BLK\_+-----+MOVE\_+-----+MOVE\_+-  
| CLR\_ | INT | INT |  
| WORD | | |  
| | PP2LOOP | | PP2LSAM  
R0464 -+IN CONST -+IN Q+-%R0450 CONST -+IN Q+-%R0452  
| LEN +00002 | LEN | +00010 | LEN |  
| 00013 | 00001 | | 00001 |  
+----+ +----+ +----+

<< RUNG 272 STEP #0894 >>

FST\_SCN  
S0001 +----+ +----+  
] [---+MOVE\_+-----+MOVE\_+-  
| INT | INT |  
| | PP2LCL | | PP2LSLW  
CONST -+IN Q+-%R0459 CONST -+IN Q+-%R0461  
+32000 | LEN | +00000 | LEN |  
| 00001 | | 00001 |  
+----+ +----+

Load in loop PID algorithm tuning parameters:

- . proportional gain, in units of 0.01 %/%
- . derivative action, in units of 0.01 secs
- . integral rate, in units of repeats/1000 sec

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%R0464		
S0001	FST_SCN	
R0459	PP2LCL	Pump PP2 Loop Output Clamp
%R0450	PP2LOOP	Pump PP2 Loop (and No.)
R0452	PP2LSAM	Pump PP2 Loop Sampling Period
R0461	PP2LSLW	Pump PP2 Loop Slew Limit

<< RUNG 274 STEP #0898 >>

```

ALW_ON
%S0007 +----+
+---+ [---+MOVE_+-----+MOVE_+-----+MOVE_+-
| INT |           | INT |           | INT |
PP2LPG          PP2LDER          PP2LINT
CONST -+IN Q+-%R0455 CONST -+IN Q+-%R0456 CONST -+IN Q+-%R0457
+00250 LEN      +00000 LEN      +00100 LEN
00001          00001          00001
+----+           +----+           +----+

```

<< RUNG 275 STEP #0902 >>

```

PP2RUN
%I0018 +----+
+---+ [---+PID_+-----+( )--+
| ISA |
ODF          AQPP2SP
%R0716 -+SP CV+-%AQ002

PP2FV
%R0409 -+PV

PP2LMAN
%R0236
+---+ [---+MAN

ALW_OFF
%R0008
+---+ [---+UP

ALW_OFF
%R0008
+---+ [---+DN

PP2LOOP
%R0450

```

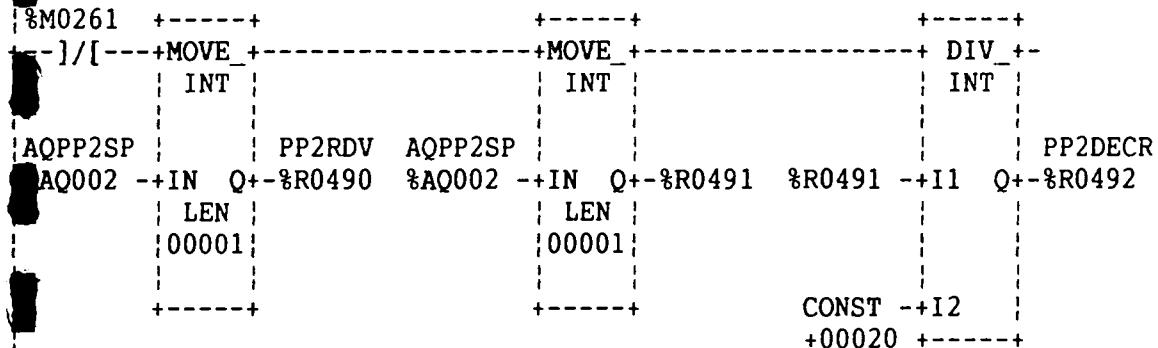
#### PUMP PP2 LOOP RAMP-DOWN ALGORITHM

REFERENCE	NICKNAME	REFERENCE	DESCRIPTION
%R0008	ALW_OFF		
%R0007	ALW_ON		
%AQ002	AQPP2SP		PP2 Speed Output
%R0716	ODF		Overall Demand Flow
%R0409	PP2FV		Pump PP2 Flow Value
%R0456	PP2LDER		Pump PP2 Loop Derivative
%R0457	PP2LINT		Pump PP2 Loop Integral
%R0236	PP2LMAN		Pump PP2 Loop - Manual
%R0450	PP2LOOP		Pump PP2 Loop (and No.)
%R0455	PP2LPG		Pump PP2 Loop Prop. Gain
%M0231	PP2LPHF		Pump PP2 Loop Healthy Flag
%I0018	PP2RUN		Pump PP2 Drive Running

Keep updating auto-stopping ramp down start and decrement values - ready for when ramp down is initiated.

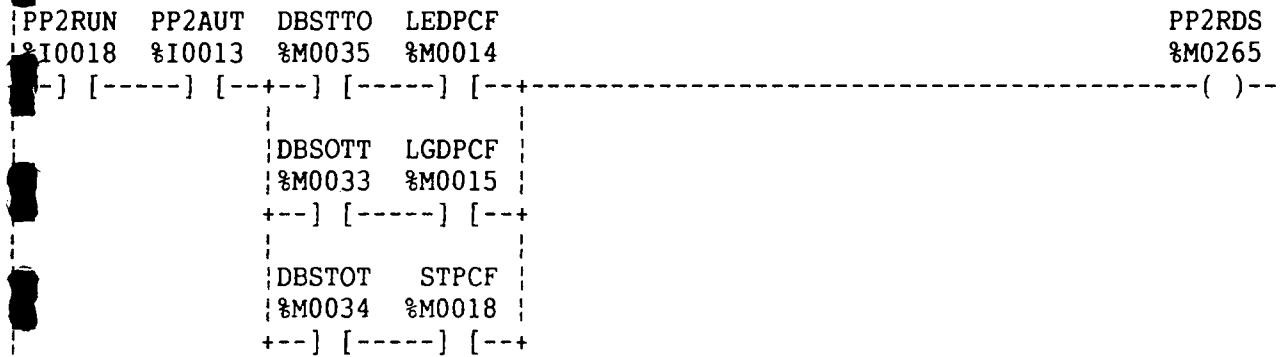
<< RUNG 278 STEP #0910 >>

P2RDIP



Ramp down is initiated when the call flag is removed when a drive is running in Auto mode.

<< RUNG 280 STEP #0915 >>



<< RUNG 281 STEP #0927 >>



REFERENCE	NICKNAME	REFERENCE DESCRIPTION
R0491	Dummy	
AQ002	AQPP2SP	PP2 Speed Output
%M0033	DBSOTT	Dty Bit Sequencer=1lead2lag3stby
M0034	DBSTOT	Dty Bit Sequencer=3lead1lag2stby
%M0035	DBSTTO	Dty Bit Sequencer=2lead3lag1stby
%M0014	LEDPCF	Lead Duty Pump Call Flag
%M0015	LGDPCF	Lag Duty Pump Call Flag
I0013	PP2AUT	Pump PP2 Auto Available
%R0492	PP2DECR	Pump PP2 Ramp Down Decrement
%M0260	PP2RDI	Pump PP2 Ramp Down Initiation
M0261	PP2RDIP	Pump PP2 Ramp Down In Progress
M0265	PP2RDS	Pump PP2 Ramp Down Start
%R0490	PP2RDV	Pump PP2 Ramp Down Value
I0018	PP2RUN	Pump PP2 Drive Running
M0018	STPCF	Standby Pump Call Flag

<< RUNG 282 STEP #0929 >>

```
PP2RDS          PP2NRD
%M0265 +-----+
---]/[---+ TMR +-----+
      |0.10s|-----+
      |-----+ ( )--+
CONST -+PV
+00005 |
+-----+
```

%R0496

Ramp down is latched in after initiation until the ramped variable has been decremented down to zero.

<< RUNG 284 STEP #0933 >>

```
PP2RDI          PP2RDIP
%M0260          %M0261
---] [-----+-----+(SM)-
```

<< RUNG 285 STEP #0935 >>

```
PP2RDIP PP2RDC          PP2RDIP
%M0261 %M0262          %M0261
---] [----+-----+-----+(RM)-
```

<< RUNG 286 STEP #0938 >>

```
PP2RDIP          PP2RDA
%M0261          %M0264
---] [-----+-----+( )--+
PP2RDI          PP2RDA
%M0260          %M0264
---] [---+
PP2NRD          PP2RDA
%M0266          %M0264
---]/[---+
```

Decrement the output variable every 1 second - duration of the ramp being then given by the value of the constant in calculation of the decrement value four rungs earlier.

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%R0496		
%M0266	PP2NRD	Pump PP2 Not Ramping Down
%M0264	PP2RDA	Pump PP2 Ramp Down Aux Flag
%M0262	PP2RDC	Pump PP2 Ramp Down Completed
%M0260	PP2RDI	Pump PP2 Ramp Down Initiation
%M0261	PP2RDIP	Pump PP2 Ramp Down In Progress
%M0265	PP2RDS	Pump PP2 Ramp Down Start

<< RUNG 288 STEP #0943 >>

T\_SEC PP21SP  
%S0005 %M0263  
---( )---

<< RUNG 289 STEP #0945 >>

PP21SP PP2RDIP  
%M0263 %M0261 +----+  
+--] [----] [---+ SUB\_+-  
| INT |  
| PP2RDV | | PP2RDV |  
| %R0490 -+I1 Q+-%R0490 |  
  
| PP2DECR | |  
| %R0492 -+I2 |  
+----+

Transfer the decremented ramp variable to the output register.

<< RUNG 291 STEP #0949 >>

PP2RDIP  
%M0261 +----+  
+--] [---+MOVE\_+-  
| INT |  
  
PP2RDV AQPP2SP  
%R0490 -+IN Q+-%AQ002  
| LEN |  
| 00001 |  
+----+

Check whether the ramp has reached zero.

<< RUNG 293 STEP #0952 >>

PP2RDIP PP2RDC  
%M0261 +----+ %M0262  
+--] [---+ LE\_ +----+  
| INT |  
  
PP2RDV  
%R0490 -+I1 Q++  
  
CONST -+I2  
00000 +----+

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%AQ002	AQPP2SP	PP2 Speed Output
%M0263	PP21SP	Pump PP2 1 Second Pulse
%R0492	PP2DECR	Pump PP2 Ramp Down Decrement
%M0262	PP2RDC	Pump PP2 Ramp Down Completed
%M0261	PP2RDIP	Pump PP2 Ramp Down In Progress
%R0490	PP2RDV	Pump PP2 Ramp Down Value
%S0005	T_SEC	

## Pump 3 Flow Control Loop

```
(*****)
*      PUMP PP3 FLOW CONTROL LOOP
*)
*****)
```

Initialise the following loop parameters:

- . clear temp registers (scratchpad)
- . loop number
- . loop sampling rate, in steps of 10 mSec
- . output clamp, set at maximum equal to 20 mA
- . output slew rate limit, set at "unlimited"

< RUNG 296 STEP #0957 >

FST\_SCN

```
%S0001 +----+      +----+      +----+
+ ] [---+ BLK_+-----+MOVE_+-----+MOVE_+-
|     | CLR_ |      INT |      INT |
|     | WORD |      |      |      |
|     |          PP3LOOP |          PP3LSAM
R0564 -+IN      CONST -+IN Q+-%R0550  CONST -+IN Q+-%R0552
| LEN      +00003 | LEN |          +00010 | LEN |
| 00013 |          00001 |          00001 |
+----+      +----+      +----+
```

< RUNG 297 STEP #0961 >

FST\_SCN

```
%0001 +----+      +----+
+ ] [---+MOVE_+-----+MOVE_+-
|     | INT |      INT |
|     |          PP3LCL |          PP3LSLW
CONST -+IN Q+-%R0559  CONST -+IN Q+-%R0561
+32000 | LEN |          +00000 | LEN |
| 00001 |          00001 |
+----+      +----+
```

Load in loop PID algorithm tuning parameters:

- . proportional gain, in units of 0.01 %/%
- . derivative action, in units of 0.01 secs
- . integral rate, in units of repeats/1000 sec

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%R0564		
%0001	FST_SCN	
%R0559	PP3LCL	Pump PP3 Loop Output Clamp
%R0550	PP3LOOP	Pump PP3 Loop (and No.)
%R0552	PP3LSAM	Pump PP3 Loop Sampling Period
%R0561	PP3LSLW	Pump PP3 Loop Slew Limit

<< RUNG 299 STEP #0965 >>

```
LW_ON
%S0007 +----+ +----+ +----+
--] [---+MOVE_+-----+MOVE_+-----+MOVE_+-
| INT | | INT | | INT |
PP3LPG PP3LDER PP3LINT
CONST -+IN Q+-%R0555 CONST -+IN Q+-%R0556 CONST -+IN Q+-%R0557
+00250 LEN +00000 LEN +00150 LEN
00001 00001 00001
+----+ +----+ +----+
```

<< RUNG 300 STEP #0969 >>

```
PP3RUN PP3LPHF
%I0029 +----+ %M0232
--] [---+ PID_+-----+( )--
| ISA |
ODF AQPP3SP
R0716 --SP CV--%AQ003
PP3FV R0509 --PV
PP3LMAN M0237
--] [---+MAN
LW_OFF S0008
--] [---+UP
LW_OFF S0008
--] [---+DN
PP3LOOP %R0550
```

#### PUMP PP3 LOOP RAMP-DOWN ALGORITHM

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%S0008	ALW_OFF	
%S0007	ALW_ON	
%AQ003	AQPP3SP	PP3 Speed Output
%R0716	ODF	Overall Demand Flow
R0509	PP3FV	Pump PP3 Flow Value
%R0556	PP3LDER	Pump PP3 Loop Derivative
%R0557	PP3LINT	Pump PP3 Loop Integral
M0237	PP3LMAN	Pump PP3 Loop - Manual
%R0550	PP3LOOP	Pump PP3 Loop (and No.)
%R0555	PP3LPG	Pump PP3 Loop Prop. Gain
%M0232	PP3LPHF	Pump PP3 Loop Healthy Flag
I0029	PP3RUN	Pump PP3 Drive Running

Keep updating auto-stopping ramp down start and decrement values - ready for when ramp down is initiated.

<< RUNG 303 STEP #0977 >>

```
P3RDIP
%M0271 +----+ +----+ +----+
+--]/[---+MOVE_+-----+MOVE_+-----+ DIV_+-
| INT | | INT | | INT |
AQPP3SP PP3RDV AQPP3SP PP3DECR
AQ003 -+IN Q+-%R0590 %AQ003 -+IN Q+-%R0591 %R0591 -+I1 Q+-%R0592
| LEN | | LEN |
| 00001 | | 00001 |
+----+ +----+ CONST -+I2
+00020 +----+
```

Ramp down is initiated when the call flag is removed when a drive is running in Auto mode.

< RUNG 305 STEP #0982 >>

```
PP3RUN PP3AUT DBSTOT LEDPCF PP3RDS
%I0029 %I0024 %M0034 %M0014 %M0275
+ ] [----] [---+ ] [----] [----] ( )--
| DBSTTO LGDPCF
| %M0035 %M0015
+--] [----] [--+
| DBSOTT STPCF
| %M0033 %M0018
+--] [----] [--+
```

< RUNG 306 STEP #0994 >>

```
PP3RDS PP3RDI
%M0275 %M0270
+ ] [----] (v)--
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%R0591		Dummy
%Q003	AQPP3SP	PP3 Speed Output
%M0033	DBSOTT	Dty Bit Sequencer=1lead2lag3stby
%M0034	DBSTOT	Dty Bit Sequencer=3lead1lag2stby
%M0035	DBSTTO	Dty Bit Sequencer=2lead3lag1stby
%M0014	LEDPCF	Lead Duty Pump Call Flag
%M0015	LGDPCF	Lag Duty Pump Call Flag
%I0024	PP3AUT	Pump PP3 Auto Available
%R0592	PP3DECR	Pump PP3 Ramp Down Decrement
%M0270	PP3RDI	Pump PP3 Ramp Down Initiation
%M0271	PP3RDIP	Pump PP3 Ramp Down In Progress
%M0275	PP3RDS	Pump PP3 Ramp Down Start
%R0590	PP3RDV	Pump PP3 Ramp Down Value
%I0029	PP3RUN	Pump PP3 Drive Running
%I0018	STPCF	Standby Pump Call Flag

<< RUNG 307 STEP #0996 >>

P3RDS PP3NRD  
%M0275 +----+ %M0276  
-]/[---+ TMR +----- ( )--  
| 0.10s |  
CONST -+PV  
+00005 |  
+----+  
  
%R0596

Ramp down is latched in after initiation until the ramped variable has been decremented down to zero.

<< RUNG 309 STEP #1000 >>

P3RDI PP3RDIP  
%M0270 %M0271  
+--] [----- (SM)-

<< RUNG 310 STEP #1002 >>

PP3RDIP PP3RDC PP3RDIP  
%M0271 %M0272 %M0271  
+--] [----] [----- (RM)-

<< RUNG 311 STEP #1005 >>

PP3RDIP PP3RDA  
%M0271 %M0274  
-] [----- ( )--

PP3RDI  
%M0270  
-] [--+

P3NRD  
%M0276  
+--]/[--+

Decrement the output variable every 1 second - duration of the ramp being then given by the value of the constant in calculation of the decrement value four rungs earlier.

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%R0596		
%M0276	PP3NRD	Pump PP3 Not Ramping Down
%M0274	PP3RDA	Pump PP3 Ramp Down Aux Flag
%M0272	PP3RDC	Pump PP3 Ramp Down Completed
%M0270	PP3RDI	Pump PP3 Ramp Down Initiation
%M0271	PP3RDIP	Pump PP3 Ramp Down In Progress
%M0275	PP3RDS	Pump PP3 Ramp Down Start

<< RUNG 313 STEP #1010 >>

T\_SEC PP31SP  
%S0005 %M0273  
---] [----- ( ^ ) --

<< RUNG 314 STEP #1012 >>

PP31SP PP3RDIP  
%M0273 %M0271 +----+  
+--] [----] [---+ SUB +-  
| | | INT  
| | |  
PP3RDV | PP3RDV  
%R0590 -+I1 Q+-%R0590  
  
PP3DECLR |  
%R0592 -+I2  
+----+

Transfer the decremented ramp variable to the output register.

<< RUNG 316 STEP #1016 >>

PP3RDIP  
%M0271 +----+  
-] [---+MOVE\_+-  
| | INT  
  
P3RDV AQPP3SP  
%R0590 -+IN Q+-AQ003  
| LEN  
| 00001  
+----+

Check whether the ramp has reached zero.

<< RUNG 318 STEP #1019 >>

PP3RDIP PP3RDC  
%M0271 +----+ %M0272  
-] [---+ LE\_ +----- ( ) --  
| | INT  
  
P3RDV  
%R0590 -+I1 Q++  
  
CONST -+I2  
+00000 +----+

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%AQ003	AQPP3SP	PP3 Speed Output
%M0273	PP31SP	Pump PP3 1 Second Pulse
%R0592	PP3DECLR	Pump PP3 Ramp Down Decrement
%M0272	PP3RDC	Pump PP3 Ramp Down Completed
%M0271	PP3RDIP	Pump PP3 Ramp Down In Progress
%R0590	PP3RDV	Pump PP3 Ramp Down Value
%S0005	T_SEC	

```
(*****  
(* WET WELL LEVEL/STATION RAW DEMAND FLOW CHARACTERISTIC *)  
*****)
```

Use a PID loop to set the relationship - a straight line is sufficient and this is obtainable using a PID controller with P only. Loop 'SP' (level offset) is at nominal BWL and the gain (slope of the line) is then set to ensure that station flow capacity is demanded before the maximum desired operating level of the wet well, say 5.50 m.

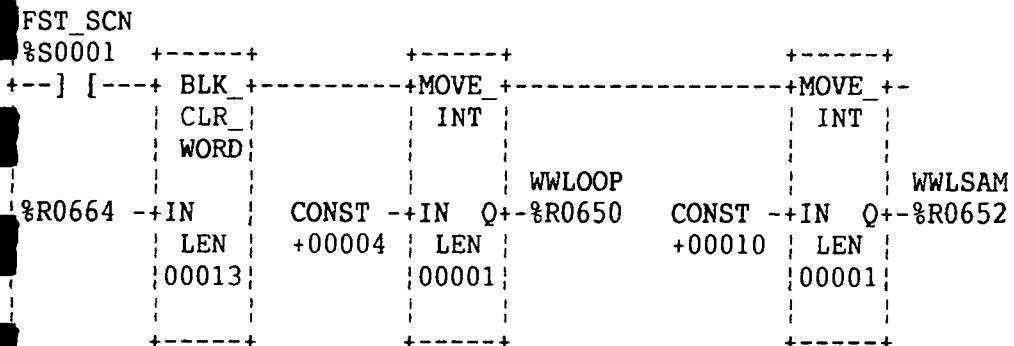
In this way the station demand flow rises in proportion to the rise in wet well level, which is intuitively correct - if the wet well level rises then the station must have to pump harder.

This approach allows the wet well level to track between across a band of operating levels, and not try to stay at a preset level.

Initialise the following loop parameters:

- . clear temp registers (scratchpad)
- . loop number
- . loop sampling rate, in steps of 10 mSec
- \*\*. output upper clamp, set at station maximum flow capacity \*\*  
(note: this value is adjustable on-line)
- . output lower clamp, set at zero
- . output slew rate limit, set at "unlimited"

<< RUNG 321 STEP #1024 >>



REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%R0664		
%S0001	FST_SCN	
%R0650	WWLOOP	Wet Well Loop (and No.)
%R0652	WWLSAM	Wet Well Loop Sampling Period

<< RUNG 322 STEP #1028 >>

```
ALW_ON
%S0007 +----+ +----+ +----+
[-] [---+MOVE_+-----+MOVE_+-----+MOVE_+-
     | INT |     | INT |     | INT |
     |      |     |      |     |      |
     | WWLOUC |     | WWLSLW |     | WWLCW |
CONST -+IN Q+-%R0659 CONST -+IN Q+-%R0661 CONST -+IN Q+-%R0662
+07000 | LEN | +00000 | LEN | +00001 | LEN |
        | 00001 | 00001 | 00001 |
+----+ +----+ +----+
```

<< RUNG 323 STEP #1032 >>

```
FST_SCN
%S0001 +----+
[-] [---+MOVE_+-
     | INT |
     |      |
     | WWLOLC |
CONST -+IN Q+-%R0660
+00000 | LEN |
        | 00001 |
+----+
```

Load in loop PID algorithm tuning parameters:

- . proportional gain, in units of 0.01 %/%
- . derivative action, in units of 0.01 secs
- . integral rate, in units of repeats/1000 sec

<< RUNG 325 STEP #1035 >>

```
ALW_ON
%S0007 +----+ +----+ +----+
[-] [---+MOVE_+-----+MOVE_+-----+MOVE_+-
     | INT |     | INT |     | INT |
     |      |     |      |     |      |
     | WWLPG |     | WWLDER |     | WWLINT |
CONST -+IN Q+-%R0655 CONST -+IN Q+-%R0656 CONST -+IN Q+-%R0657
+00130 | LEN | +00000 | LEN | +00000 | LEN |
        | 00001 | 00001 | 00001 |
+----+ +----+ +----+
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%S0007	ALW_ON	
S0001	FST_SCN	
%R0662	WWLCW	Wet Well Loop Control Word
%R0656	WWLDER	Wet Well Loop Derivative
%R0657	WWLINT	Wet Well Loop Integral
%R0660	WWLOLC	Wet Well Loop Output Lower Clamp
%R0659	WWLOUC	Wet Well Loop Output Upper Clamp
%R0655	WWLPG	Wet Well Loop Prop. Gain
%R0661	WWLSLW	Wet Well Loop Slew Limit

<< RUNG 326 STEP #1039 >>

```

ALW_ON                               WWLPHF
%S0007 +----+ %M0233
+--] [---+ PID_+-----( )--+
     | ISA
     |
     RDF
CONST -+SP CV+-%R0715
+00200
WWLFYN
%R0994 -+PV
WWLMAN
%M0238
+--] [---+MAN
LW_OFF
%S0008
+--] [---+UP
LW_OFF
%S0008
+--] [---+DN
+----+
WWLOOP
%R0650

```

Scale the raw demand flow to match the station total flow value range,  
 for use in the station total flow PID loop.

<< RUNG 328 STEP #1046 >>

```

PSH
M0161 +----+ +----+
+--] [---+ DIV_+-----+ MUL_+-
     | INT |           | INT |
     |
     RDF
%R0715 -+I1 Q+-%R0718 %R0718 -+I1 Q+-%R0717 SDF
     |
     CONST -+I2           CONST -+I2
     +00032 +----+       +00012 +----+

```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%R0718		
%S0008	ALW_OFF	
%S0007	ALW_ON	
M0161	PSH	Power supply healthy
%R0715	RDF	Raw Demand Flow
%R0717	SDF	Scaled Demand Flow
%R0994	WWLFYN	Wet Well Level Filter - Y(new)
%M0238	WWLMAN	Wet Well Loop - Manual
%R0650	WWLOOP	Wet Well Loop (and No.)
%M0233	WWLPHF	Wet Well Loop Healthy Flag

```
(*****  
(*          WET WELL LEVEL INPUT FILTER ALGORITHM      *)  
(*****  
  
(* The wet well level analog input signal has continual minor perturbations *)  
(* about its mean signal which are inherent due to the transducer type   *)  
(* and its location. A first-order filter algorithm is used to smooth     *)  
(* out the signal for use in the cascaded control loops to benefit       *)  
(* system smoothness.                                                 *)  
(*                                                 *)  
(* The algorithm is:   Y(new) = Y(old) + X(new) - Y(old)      *)  
(*           -----                                         *)  
(*           K                                         *)  
(*           *)  
(* where Y(new) = new filter output value             *)  
(*      Y(old) = old filter output value            *)  
(*      X(new) = new filter input value            *)  
(*      K = T + dt = constant,                      *)  
(*           -----                                         *)  
(*           dt                                         *)  
(*           *)  
(*      with T = filter time constant in seconds,      *)  
(*      and dt = sample time in seconds.            *)  
(*           *)  
(* As currently set, dt = 0.3 seconds and K = 10, giving a filter lag time *)  
(* constant of 2.7 seconds.                                *)  
(*           *)  
(*           *)  
(*           *)  
(*****
```

<< RUNG 331 STEP #1051 >>

```
ALW_ON WWLFSF                               WWLFSF  
%S0007 %M0225 +----+                   %M0225  
+--] [----]/[---+ TMR +----- ( )--  
      | 0.10s |  
      |  
      CONST --+PV  
      +00003 |  
      +----+  
      WWLFST  
      %R0987
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%S0007	ALW_ON	
%M0225	WWLFSF	Wet Well Level Filter Sample Flg
%R0987	WWLFST	Wet Well Level Filter Sample Tmr

<< RUNG 332 STEP #1055 >>

```
WWLFSF
%M0225 +----+ +----+ +----+
--] [---+MOVE_+-----+ SUB_+-----+ DIV_+-
| INT | | INT | | INT |
WWLV WWLFXN WWLFXN
%R0269 -+IN Q+-%R0991 %R0991 -+I1 Q+-%R0992 %R0992 -+I1 Q+-%R0993
| LEN |
| 00001 |
WWLFYO
%R0995 -+I2 | CONST -+I2
+----+ +----+ +----+ +----+
| LEN |
| 00001 |
| 00010 |
```

<< RUNG 333 STEP #1059 >>

```
WWLFSF
%M0225 +----+ +----+
--] [---+ADD_+-----+MOVE_+-
| INT | | INT |
WWLFYO WWLFYN WWLFYN WWLFYO
%R0995 -+I1 Q+-%R0994 %R0994 -+IN Q+-%R0995
| LEN |
| 00001 |
%R0993 -+I2 | +----+
+----+
```

```
(*****)
(*      *)
(* \b   *)
(* Pump PP3 Reflux Valve Fail-to-Close  *)
(*****)
```

The wet well level is sent to the telemetry analog input by the PLC analog output.

The scaled value is exactly 4 times the 6400 mm span of the instrument but the output is 0-20 mA hence the offset of 6400 must be added, giving an overall scaling factor of 5 times. Note that this simple approach can not be used when the instrument span is altered.

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%R0992		Wet Well Level Filter Calc Temp
%R0993		Wet Well Level Filter Calc Temp
%M0225	WWLFSF	Wet Well Level Filter Sample Flg
%R0991	WWLFXN	Wet Well Level Filter - X(new)
%R0994	WWLFYN	Wet Well Level Filter - Y(new)
%R0995	WWLFYO	Wet Well Level Filter - Y(old)
%R0269	WWLV	Wet Well Level Value

<< RUNG 336 STEP #1064 >>

ALW\_ON  
%S0007 +----+  
--] [---+ MUL\_+-  
| | INT  
WWLFYN AQWWLVL  
R0994 -+I1 Q+-%AQ004  
CONST -+I2  
+00005 +----+  
[ END OF PROGRAM LOGIC ]

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%S0007	ALW_ON	
%AQ004	AQWWLVL	Wet Well Level Output
R0994	WWLFYN	Wet Well Level Filter - Y(new)

Program: CASWELL

C:\LM90\CASWELL

Block: \_MAIN