

LOGIMAC 440

TECHNICAL SPECIFICATION

QUADRUPLEX PUMP CONTROL PANEL WITH UP TO 6 FLOATS

1. **General:**

The control panel shall be completed with all the components listed under this section and all necessary hardware and software to provide a trouble-free pumping station in accordance with the CSA norms. The control panel shall be specifically designed and manufactured for use with Flygt pumps and shall include the programmable logic control LOGIMAC 440 of ITT Flygt for the control and the surveillance of the pumping station.

All parts shall be of the best industrial quality. The control panel shall be supplied by the pump manufacturer and installed as indicated on the drawing.

2.0 **Standards and requirements**

The control panel shall be in accordance with all the CSA standards and requirements. Grounding shall also meet all the requirements of the electrical code.

The electrical contractor shall supply a fully assembled control panel for the quadruplex operation of four submersible pump(s) belonging to the following groups:

Group normal	N pumps	__ HP, __ volts
Group jockey	J pumps	__ HP, __ volts
Group storm	S pumps	__ HP, __ volts

Where **N,J,S** are number of pumps in each group .

The control panel is supplied with four (4) full voltage, direct-on-line starter as well as necessary components to operate the pumps.

The heavy industrial quality enclosure is in accordance with EEMAC 3 to provide reliable outdoor operation. The panel is fitted with a heavy steel inner door, which is hinge-mounted and an exterior door with a 135° angle opening to allow easy access to the components. the panel shall be in steel painted with a grey coating ASA61 and a minimum thickness of gage #16 (1.6 mm), all assembled and factory tested.

2.1 **Identification:**

Any component of the control panel shall be identified with a label bearing the same code or name described on the drawing. All wiring shall be numbered and identified at both ends to facilitate service and troubleshooting.

The control shall be equipped with a terminal board relaying alarms, power supply, pump wiring, digital inputs. The terminal board shall be located at the bottom of the panel.

2.2 Cabling

The control panel shall be wired according to the National Electricity Code. The level regulator shall also be supplied with necessary cable to provide direct connection to the panel without splicing. Control cable shall be rated #14 AWG with exemption for 24V DC PLC inputs and outputs which can be # 18 AWG or bigger.

Power cable shall be separated from signal cable. All cabling shall be routed in conduit.

3.0 Components

All components are of the best industrial quality, designed for extended, reliable and maintenance-free operation under extremely cold and warm weather conditions. Electro-mechanical components are limited to a strict minimum.

3.1 Programmable logic control: LOGIMAC 440

The control panel is equipped with the programmable logic controller LOGIMAC 440 of ITT Flygt or approved equivalent. The LOGIMAC 440 shall have necessary protection and be sturdy to remain operational in an hostile environment. Its power supply shall be protected against the network fluctuations and its inputs-outputs (I/O) shall also be protected against noise and interference to allow steady operation and maintain reliability of the pump station.

The LOGIMAC 440 programming shall be the pump manufacturer responsibility and be made in "LADDER". The LOGIMAC 440 receives discrete inputs, and controls discrete outputs in a manner dictated by the user specified logic called Relay Ladder Logic. The LOGIMAC 440 can also perform data handling operations and communicate with external devices. The programming software shall also be commercially available. The pump manufacturer shall supply a copy of the LOGIMAC 440 program, with the control.

The programmable logic control LOGIMAC 440 , from ITT Flygt , shall feature:

- Modular
- 16 Kwords programming memory
- 10 Kwords storage memory
- 32 digital inputs and 32 digital outputs
- Built-in real time clock
- User's Program stored in FLASH memory (no volatile)
- Battery back-up RAM memory
- Boolean function execution rate of .6 microseconds per instructions
- LED indication
- Programming software readily and commercially available
- Protected power supply against network surge
- Power supply at 120 VDC
- Plug-in cards

3.1.1 All products shall be designed, manufactured, and tested in accordance with recognized UL, CSA, IEC and JIS industrial standards. The system shall be operational during and after testing.

VIBRATION The method of testing is to be based upon the IEC 68-2-6 and JIS C 0911 standard specifications for vibration.

SHOCK The method of testing is to be based upon the IEC 68-2-27 and JIS C 0912 standard specifications for shock.

NOISE The method of testing is to be based upon the following:

- Showering Arc per NEMA ICS 2-230
- Ring Wave per ANSI C37.90A
- Fast Transient per IEC 801.4.

3.1.2 Complete product documentation describing installation and simple field maintenance shall be available.

- 3.1.3 The manufacturer or its authorized representative shall provide complete technical support for all of the products. This shall include headquarters or local training, regional application centers, and local or headquarters technical assistance.
- 3.1.4 The system shall consist of rugged components designed specifically for industrial environments. A complete system shall consist of one or more racks containing I/O modules, interconnected by signal cables.
- 3.1.5 The LOGIMAC 440 CPU shall be modular . The CPU shall be fully enclosed within a durable plastic shroud.
- 3.1.6 All signal cables furnished by the manufacturer shall be constructed so as to withstand, without damage, all normal use and handling.
- 3.1.7 The I/O system shall be modular. Each module shall be fully enclosed within a durable plastic shroud. When mounted on the system base, each I/O module shall not occupy more than one available slot.
- 3.1.8 I/O modules shall be installed in any available slot in the CPU or expansion baseplates, and shall require no tools for insertion and extraction. I/O modules shall connect electrically to the baseplate via a pin and socket connector.
- Wherever possible, all assemblies and sub-assemblies performing similar functions shall be interchangeable
- 3.1.9 The system design shall accommodate the replacement of assemblies without having to disconnect field wiring. Wherever possible, removable connectors shall be used to connect field wiring to the individual circuit board assemblies.
- 3.1.10 All components within the controller family shall be manufactured with a high degree of durability.

- 3.1.11 All major assemblies and sub-assemblies, circuit boards, and devices shall be identified using permanent labels or markings each of which indicates the manufacturer's catalog number, product manufacturing date code, UL and CSA certifications.
- 3.1.12 All components of the LOGIMAC 440, except CRT terminals and programming workstations, shall meet the following environmental specifications:
- Storage conditions: Temperature -40 to 85 degrees Celsius
 - Operating conditions: Temperature 0 to 60 degrees Celsius
 - Humidity: 5 to 95% relative humidity, non-condensing
- 3.1.13 The LOGIMAC 440 shall have a DC power supply for the CPU and the power supply shall be rated 24 VDC.
- 3.1.14 The power supply shall be modular in design, separate from the CPU and baseplate for easy replacement in the unlikely event of failure. The power supply shall provide + 5 VDC to the bus.
- 3.1.15 The power supply shall not use a slot available for an I/O card.
- 3.1.16 The central processing unit (CPU) of the LOGIMAC 440 shall be modular. It shall possess the capability to solve application logic, store the application program, store numerical values related to the application processes and logic, and interface to the I/O systems.
- 3.1.17 The modular type CPU shall contain a dedicated VLSI Instruction Sequencer Coprocessor (ISCP - Boolean Coprocessor) for performing Boolean operations, and interfaces to a serial port and the system bus.
- 3.1.18 The modular and embedded CPU's shall contain an alarm processor that is special PLC feature designed to receive and process faults. The diagnostics shall provide information on the configuration and CPU, memory, communications and I/O status.

- 3.1.19 The alarm processor function shall log I/O and system faults in two fault tables that shall be accessible for display on the IBM compatible programming software screen or uploaded to a host computer or other coprocessor.

The alarm processor shall maintain the states system diagnostic bits to be read by a host or incorporated as contacts into the ladder program for customized diagnostic routines.

- 3.1.20 The CPU shall be programmed by an external peripheral IBM compatible via a serial port. The software shall execute on DOS operating system and shall provide on-screen help information throughout its execution paths.

The programming interface shall be capable of being remotely or locally connected to the CPU while the CPU is running. The Hand-Held Programmer shall be able to access the application program, the system configuration, the registers and the diagnosis system.

The programming devices shall have access to the application program, the CPU and I/O system configurations, all registers, CPU and I/O status, system diagnostic relays, and I/O over-ride capabilities

It shall have the capability of programming the relay ladder program, store the program to the PLC, monitor program and reference address status while the PLC is in Run or Stop mode

- 3.1.21 All application memory shall be available to the user program. Executive level operations performed by the CPU shall not consume application memory.

The register values shall be stored in battery backed, CMOS static RAM memory. The application program will be stored on EPROM memory.

- 3.1.22 The LOGIMAC 440 shall have a long-life Lithium battery used to maintain the contents of the CMOS RAM memory in the CPU. There shall be an easily accessible battery compartment in the power supply with dual battery connectors. The battery shall be replaceable with power applied to the PLC and without removing the CPU.

The battery shall allow register memory to be maintained in the CPU without power applied. Additionally, a low battery condition shall be alarmed with a system diagnostic bit.

3.1.23 The CPU shall calculate the application program checksum at the end of every sweep. A fixed number of program memory checksum shall be calculated each sweep. If the calculated checksum does not equal the reference checksum, a fault shall be recorded, and the CPU mode will change to STOP.

3.1.24 The CPU shall be capable of solving an application program whose source format shall be relay ladder diagram. The language shall support relay, timers and counters, arithmetic, relational, bit operation, data move, conversion, and control functions.

The arithmetic function block shall use simple data types, under a 16 or 32 bits integer configuration. The arithmetic operations shall support two data types, Signed Integer (INT), and Double Precision Integer (DINT).

3.1.25 The battery shall maintain the application program for six months without power supply.

3.1.26 The LOGIMAC 440 CPU shall have a real-time clock battery protected, accessible by both the application program and the fault processor.

3.1.27 The LOGIMAC 440 CPU shall support high level diagnostic functions together with the distributed intelligent I/O system.

3.1.28 The LOGIMAC 440 shall record the system and I/O malfunctions with the date and the time of occurrences.

3.1.29 The LOGIMAC 440 shall record the faults in registers assigned respectively for the CPU and the I/O. These registers shall be accessible via the programming interface or a PC.

3.1.30 I/O reference addressing for each I/O module shall be assigned through the use of the IBM compatible configuration and programming software or the hand held programmer. There shall be no jumpers or DIP switch settings required to address modules

3.1.31 The circuit status of each I/O point on a module shall be indicated by a LED mounted at the top of the module. Also each I/O status shall be available through the programming interface

- 3.1.32 The LOGIMAC 440 shall support an operator interface, based on high level performing characters. This intelligent module shall communicate with the central processing unit via a cable connected to a serial port.

This list is partial and the Electrical Contractor shall supply the programming and the components to render operational the control panel as described in the section: “Functions of the control panel”.

3.2 Main disconnect

The control panel is equipped with a main disconnect switch mechanically interlocked with the inner door to electrically isolate the components of the control panel when the inner door is opened.

For ratings up to 100A, the main disconnect switch is of the fusible type with fuses rated at 100,000A short circuit capacity. For capacities above 100A, the main disconnect switch is a thermal-magnetic circuit breaker having a fast response, high interrupting capacity and sealed contact chambers with clear covers for inspection.

3.3 Pump protection

Each pump circuit is fitted with a three-pole thermal-magnetic circuit breaker or current limiting motor protector with instantaneous magnetic trip and overload relay. The response time under short circuit conditions is less than one-quarter of a cycle; the action opens all poles thus avoiding single phase operation of three-phase pumps.

Isolated rotary handles for each motor protector are mounted on the inner door.

The circuit breaker and overload relay exhibit stable operation under changing temperature conditions from 25°C below zero up to 40° above zero. The circuit breaker has a high interrupting capacity independent of the thermal setting.

3.4 Pump selector switch

The control panel is fitted with a MANUAL/OFF/AUTO switch for each pump to allow manual pump operation.

3.5 Pump contactor

Each pump circuit is fitted with a three-pole fast-acting magnetic contactor, designed for a minimum of twenty (20) years of service under normal operating conditions. Under overload conditions, the circuit is designed to clear the fault by opening the motor protector or circuit breaker and then the contactor.

3.6 Control relay

The necessary electromechanical relays for control and alarm function shall be protected against malfunctioning. They shall be rated for a service factor up to 600 VAC and 300 VDC.

3.7 Heating element

The control panel is equipped with a heating element with a thermostat, of not less than 50 Watt. A protective shield around the heating element shall be supplied to prevent accidental injuries.

3.8 Control circuit protection

The pump control circuit shall be protected by circuit breakers and fuses on the primary shall protect auxiliary circuits.

3.9 Annunciator panels

The control panel shall include the annunciator panels . The annunciator panels shall indicate the following alarms and status:

- High level
- Low level
- Power failure
- Leakage P1
- Leakage P2
- Leakage P3
- Leakage P4
- High temperature P1
- High temperature P2
- High temperature P3
- High temperature P4
- Overload P1
- Overload P2

- Overload P3
- Overload P4
- Run P1
- Run P2
- Run P3
- Run P4
- FL1 float failure
- FL2 float failure
- FL3 float failure
- FL4 float failure
- FL5 float failure
- FL6 float failure
- EMERGENCY/FAULT

The control identifies the degree of urgency of all fault conditions and classified them as malfunction "FAULT" or "EMERGENCY". The annunciator panels shall have one reset button and a lamp test button.

4.0 Control panel functions

The control panel shall be equipped with a programmable logic control LOGIMAC 440 specifically chosen and programmed to provide a safe and reliable operation of the pumping station. The LOGIMAC 440 shall provide, but is not limited to the following functions:

- 4.1. Control the starting, stopping and alternation of up to four pumps. The number of pumps to control and the number of pumps allowed to parallel operation shall be user configurable.
- 4.2. Monitor any failure in any of the level regulator circuits. If any of the level regulators is out of service, the next higher level regulator shall assume automatically the duties of the faulty regulator; at the same time an LED, on the annunciator panel, will identify the faulty level regulator.

For example, if float 1 is faulty, float 2 will assume the duties of float 1; float 3 the duties of float 2, and float 4 the duties of floats 3 and so on. Even in the event of fault occurrences in all the level regulator circuits, the control shall operate the pumps continuously to prevent flooding.

- 4.3. An adjustable software time delay from 0 to 60 seconds, before the starting of a pump is available to prevent the high inrush current which would result if both pumps were started at the same time.
- 4.4. Registers the running time and the number of starts of each pump.

- 4.5. The LOGIMAC 440 constantly monitors the pumps to verify that there is no leakage or excessive temperature in the motor windings. The signal for motor over temperature or leakage is coming from the supervision relay (miniCAS II as per ITT Flygt). If a pump overheats, the LOGIMAC 440 stops it before overheating. The LOGIMAC 440 provides the same protection for leakage. For either one of these abnormal situations, the LOGIMAC 440 stops the faulty pump and activates an alarm.
- 4.6. The following alarms indication shall be latched by the LOGIMAC 440 until manually resetted. The LOGIMAC 440 shall activate the following alarms without any delay:

For each pump:

Motor overload
 stator High temperature
 Leakage
 Low level (option)
 High level
 Power failure

- 4.7. The LOGIMAC 440 is fitted with a real time clock. A battery back-up is provided to maintain correct alarm registration.
- 4.8. The LOGIMAC 440 is protected against signal interference that could occur in the pumping stations. In order to reduce the sensibility to interference, all inputs and outputs are galvanically isolated from ground.
- 4.9. The LOGIMAC 440 is equipped with LED type lights indicating the operational functions and the alarm status.
- 4.10. The LOGIMAC 440 shall have an interface operator allowing:
- Easy access to set points and operating parameters, password protected.
 - Normal text displayed
 - Key-in station data (read-only)
 - Alarm display

- 4.11. Logimac 440 can control 3 different groups of pumps: **Normal**, **Jockey** (usually smaller than normal pump) , and **Storm**(usually bigger than normal pump). The groups can be set by operator using the operator interface If 4 pumps are set in different groups they will alternate within their group after each stop.
- 4.12. The pump in Jockey group can work only one at the time. They stop, if the first pump from Normal group starts.
- 4.13. Pumps in Normal group can work in parallel. They can stop if the first pump from the Storm group starts or they can continue to run in parallel with Storm group's pump depending on the number of pumps allowed for parallel operation (sett by operator)
- 4.14. In the automatic mode, if all 4 pumps are in the same (Normal) group, the LOGIMAC 440 and the control panel operate the pumps according to the following level signals:
- Float 1: Stops all pumps and alternates pumps
 - Float 2: Starts first pump
 - Float 3: Starts 2nd pump
 - Float 4: Starts 3rd pump
 - Float 5: Starts 4th pump
 - Float 6: High level & Emergency alarm,

The level floats shall be mercury and lead free, compatible with the latest environmental laws and approved by CSA Floats shall be model ENM-10 as fabricated by ITT Flygt.

The float shall be mounted on a galvanised steel guide rail and each float shall be supplied with an adjustable vertical support.

5.0 Accessories

- 5.1 The panel shall be equipped with a monitoring relay for leakage detection and stator high temperature model MiniCas II as fabricated by ITT Flygt. In case of a malfunction, the monitoring relay should stop the pump. On a high temperature detection a pump shall not be made available until a manual reset has been performed.
- 5.2 The floats shall be equipped with intrinsically safe, CSA approved relays to render the float installation conform for operation in Class I, Division 2, Group C and D hazardous environments.
- 5.3 The LOGIMAC 440 shall be equipped with UPS (Uninterrupted Power Supply) to provide approximately three (3) hours of back-up.
- 5.4 The control panel can be supplied with the following equipment mounted on the inner door:
- An ammeter per pump with phase selector.
 - A voltmeter with phase selector.
- 5.5 The control panel shall be supplied with a protective relay against phase failure and phase reversal.
- 5.6 An alarm circuit with circuit breaker protection shall be provided with the panel. This circuit will energise an alarm light mounted on top of the panel for outdoor installation.
- 5.7 A 120V outlet shall be provided for connection of convenience equipment with a maximum load of 100W. The maximum rating shall be clearly identified in the panel with a label. A control transformer, dry type single phase with 120 volts secondary shall be added if the supply is different than 120 VAC. The transformer rating shall be calculated according to the control load.
- 5.8 An alarm silencing push button shall be present to stop the alarm from unnecessary operation once the station operator has taken notice of the fault.
- 5.9 The control panel shall be in accordance to the specifications and the wiring diagram provided under the electrical section.

6.0 Start-up:

The contractor shall insure proper start-up of the pump station and provide total reliability of the control panel. The contractor shall include in his price a day for the control start-up to perform:

- Simulate and verify each control loop
- Calibrate the instrumentation and sensors
- Adjust each alarm contact or level
- verify the cabling and wiring
- Verify the component identification
- Co-ordinate start-up
- Render operational the control panel according to the specifications and drawings.

7.0 Documentation

The contractor shall submit for approval the following

- Complete As per built drawing
- Complete instruction manuals
- A bill of material.