Equipment Tag #	Description	Status
	WAS P-205	
FE-XXX	Flowmeter associated with WAS P-206	On

7.5 Sequence of Normal Operation for Main PLC

Input	Action
COMP-601	Start Air Compressor
P-205 start	Start WAS (VFD) Pump in Aerobic Cell 3 in Bioreactor 1
P-206 start	Start WAS (VFD) Pump in Aerobic Cell 3 in Bioreactor 2
FE-XXX Active	FIT-XXX transmits flow measurement to Main PLC and totalizes flow associated with WAS P-205
FE-XXX Active	FIT-XXX transmits flow measurement to Main PLC and totalizes flow associated with WAS P-206

7.6 Abnormal Operation for Main PLC

Abnormal Condition	Action	Alarm	Annunciation
WAS P-205 Fails	No Action No Stby power provided	Alarm	Main PLC
WAS P-206 Fails	No Action No Stby power provided	Alarm	Main PLC
COMP-601 Fails	Start Stby COMP-602	Alarm	Main PLC
Both COMP-601 and 602 Fail	No Action	Alarm	Main PLC and Dial Out
No flow measured by FE-XXX while the WAS P-205 is the	Duty Pump WAS-P-205 Fails	FAL Alarms	Main PLC and Dial Out

Abnormal Condition	Action	Alarm	Annunciation
duty pump and is running (FE-XXX to be monitored after 1min timer elapses.)	See above		
No flow measured by FE-XXX while the WAS P-206 is the duty pump and is running (FE-XXX to be monitored after 1min timer elapses.)	Duty Pump WAS P-206 Fails See above	FAL Alarms	Main PLC and Dial Out
Low pressure detected by PSL-XXX in compressed air supply	No Action	Alarm	Main PLC and Dial out
PSH-XXX	High Pressure downstream of WAS P-205 Shutdown WAS P-205	Alarm	Main PLC
PSH-XXX	High Pressure downstream of WAS P-206 Shutdown WAS P-206	Alarm	Main PLC
PSL-XXX	Low flow upstream of WAS P-205 Shutdown WAS P-205	Alarm	Main PLC
PSL-XXX	Low flow upstream of WAS P-206 Shutdown WAS P-206	Alarm	Main PLC

8.0 SLUDGE THICKENING-BELT FILTER PRESS

8.1 Normal Operation

The belt filter press (BFP) unit will be controlled using the equipment PLC supplied with the unit itself. Communication between the BFP PLC and the main PLC will occur via an Ethernet

communication signal. The TWAS pumps and the aeration system will be controlled using the Main PLC. The BFP PLC and the Main PLC will communicate to control the TWAS pumps. Operation of the TWAS pumps and the BFP are to be manually initiated by the Operator as required (ie every 2 days).

Thickened Waste Activated Sludge (TWAS) from the TWAS Tank (T-408) is pumped to the Belt Filter Press BFP-407 using the duty/standby TWAS pumps P-404 and P-405. Polymer is added to enhance the efficiency of separation (polymer dosing system is part of the BFP supply package). Centrate from BFP-407 gravity discharges to the Anoxic 1 Cell in Bioreactors 1 and 2. Each centrate line leading to each Anoxic zone will be equipped with an isolation valve such that all the centrate flow can be directed to only one Anoxic zone if one of the Bioreactors is shutdown for maintenance. Dewatered cake from BFP-407 is discharged to a dump trailer (TRL-408) located below BFP-407 on the first floor.

TWAS P-404 and P-405 and BFP-407 are run with Operator intervention. The level in the TWAS tank are measured via a level element. The TWAS P-404 and P-405 are equipped with VFDs and are progressing cavity pumps. Each pump is equipped with a high pressure switch downstream, of the pump and a low flow switch upstream of the pump to shutdown the pump in case of a closed valve causing high pressures or the pump overheating from low flows.

The TWAS Tank T-408 is equipped with a fine bubble aeration system, FBD-409. The existing blowers will supply the airflow to FBD-301. An actuated valve will be installed on the branch line to allow Operations Staff to throttle air to T-408. This line will also be provided with a local instantaneous flow indicator not tied to the Main PLC.

The tables under 8.2 and 8.3 describe the required input/output signals from the BFP-407 package PLC to the main PLC and vice versa.

8.2 Input Signals from BFP-407 Package PLC

Inputs to Main PLC	Action
Run Status	N/a
Common Alarm (equipment failure or overflow condition)	Stop or inhibit TWAS P-404 and P-405 from running Main PLC and Dial Out

8.3 Output Signals to BFP-407 Package PLC from Main PLC

Outputs to BFP-407 Package PLC	Action
Permissive to Run	BFP-407 enabled to run

8.4 Normal Equipment Status for Main PLC

Equipment Tag #	Description	Status

Equipment Tag #	Description	Status
P-404	Duty TWAS Pump	Auto-Duty
P-405	Stby TWAS Pump	Auto-Stby
FCV-XXX	Flow Control Valve on aeration header to a FB-301 in T-408	Remote and Throttling
FI-XXX	Flow Indicator on PA line to TWAS Tank.	Active
FE-XXX	Flowmeter on TWAS line to BFP-407	Active

8.5 Sequence of Normal Operation for Main PLC

Input	Action
PSH-XXX Alarm to Operator that need to Empty TWAS tank	Operator to Start duty TWAS P- 404 and BFP-407 at Pressure Switch High 1(@ elevation 9.7 m, 3.3 m above the TWAS Tank floor-to be determined in the field)
PSL-XXX Stop TWAS P-404	Stop duty TWAS P- 404 at Pressure Switch Low 1(@ elevation 7.0 m, 0.6 m above the TWAS Tank floor-to be determined in the field)
FE- XXX Active	FIT- XXX transmits flow measurement to Main PLC and totalizes flow to BFP-407.

8.6 Abnormal Operation in Main PLC

Abnormal Condition	Action	Alarm	Annunciation
P-404 Fails	Duty TWAS pump fails Start Stby TWAS P-405	Alarm	Main PLC
P-405 Fails	TWAS stby pump fails No action	Alarm	Main PLC

Abnormal Condition	Action	Alarm	Annunciation
PSLL-XXX in TWAS Tank	Low low pressure in TWAS Tank. Shutdown and inhibit TWAS P-404 and P-405 from running (low low pressure at elevation 6.9 m, 0.5 m above the TWAS Tank floor- to be determined on site)	LAL Alarm	Main PLC and Dial Out
PSHH-XXX in TWAS Tank	High high pressure in TWAS Tank Operator to send TWAS to BFP-407 immediately Start standby pump, P-405. Stop DAF-402 (interlock-Main PLC-removes permissive to DAF-402 control panel) (high high pressure at elevation 10.3 m, 3.9 m above the TWAS floor – to be determined on site)	LAH Alarms	Main PLC and Dial Out
PSH-XXX	High Pressure downstream of TWAS P-404 Shutdown TWAS P-404	Alarm	Main PLC
PSH-XXX	High Pressure downstream of TWAS P-405 Shutdown TWAS P-405	Alarm	Main PLC

Abnormal Condition	Action	Alarm	Annunciation
FSL-XXX	Low flow upstream of TWAS P-404 Shutdown TWAS P-404	Alarm	Main PLC
FSL-XXX	Low flow upstream of TWAS P-405 Shutdown TWAS P-405	Alarm	Main PLC
No flow measured by FE-XXX while the duty TWAS P-404 is running (FE- XXX to be monitored after 1min timer elapses.)	Duty TWAS Pump Fails See Above	Alarms	Main PLC
No flow measured by FE-XXX while the stby TWAS P-405 is running (FE- XXX to be monitored after 1min timer elapses.)	Standby TWAS Pump Fails See Above	Alarms	Main PLC and Dial out

9.0 ALKALINITY ADJUSTMENT – HYDRATED LIME FEED SYSTEM

9.1 Normal Operation

The bulk hydrated lime feed system will be controlled using the equipment PLC supplied with the unit itself. Communication between the hydrated lime feed system PLC and the main PLC will occur via an Ethernet communication signal.

At the beginning of Aerobic Cell 1 in each of the Bioreactors, hydrated lime will be added for alkalinity supplementation. The hydrated lime will be mixed into the effluent with the aeration system. The hydrated lime feed system consists of a hopper, which is fed from bulk tote bags, which feed the hopper from the top end. The hopper then feeds a lime slurry mixing tank equipped with mixers with a volumetric vacuum feeder. The vacuum feeder draws from the hopper and meters lime at a rate proportional to the flow into the lime slurry mixing tank. Dilution water is added continuously to maintain a constant level in the lime slurry mixing tank. Lime slurry is gravity fed into the Bioreactors via piping and valves. The mixers are used to prevent settlement in the tank. Chlorinated, filtered effluent water is fed into the lime slurry mixing tank to make a 2% lime solution. The amount of hydrated lime that is dosed into the bioreactors is set based on a pre-determined weight of lime required per day for the average dry weather flow. The required daily hydrated lime dosage is set manually during commissioning.

9.2 Input Signals from LFS-207 Package PLC to Main PLC

Inputs to Main PLC	Action
Run Status	HOA Switch is in Auto
Common Alarm (equipment failure, low lime level, etc)	Main PLC and Dial Out

9.3 Output Signals to LFS-207 Package PLC from Main PLC

Outputs to LFS-207 Package PLC	Action
Permissive to Run	LFS-207 enabled to run

10.0 EFFLUENT SUPPLY/CHLORINATION

10.1 Normal Operation

The effluent (EFF) supply system will supply effluent water to various parts of the WWTP for various purposes. The effluent water system consists of an effluent equalization vault, two EFF pumps, P-501 and P-502, one strainer (STR-503), a sodium hypochlorite dosing system and two filtered effluent (FEW) storage tanks (T-505 and T-506). The FEW pumping to the various locations in the plant will be designed by building mechanical.

The effluent from the secondary clarifiers will be filtered, disinfected and chlorinated prior to re-use at the WWTP. The EFF P-501 and P-502 will be started and stopped based on the level in the FEW T-505 and T-506. The FEW tanks will be treated as one tank with an interconnecting pipe between the two tanks. There will be one level indicator in one of the FEW tanks.

The sodium hypochlorite will be interlocked with the EFF pumps P-501 and P-502. When EFF P-501 and P-502 are called to start, the sodium hypochlorite dosing pumps P-509 and P-510 will also be started. It will be dosed without dilution at 12.5% available chlorine.

The automatic self-cleaning strainer (STR-503) will strain the effluent water prior to chlorine dosing point. STR-503 will have a backwash control package for continuous or intermittent operation of the backwash cycle.

10.1.1 Normal Equipment Status

Equipment Tag #	Description	Status
P-501	Duty Effluent Pump	Auto-Duty
P-502	Stby Effluent Pump	Auto-Stby.
STR-503	Automatic Self-cleaning Strainer	Available-On. -Own Control Panel
LE-XXX	Level Transmitter LIT-XXX in FEW Tank T-505	On
P-509	Duty Chlorine Pump	Auto-Duty

Equipment Tag #	Description	Status
P-510	Stby Chlorine Pump	Auto-Stby

10.1.2 Sequence of Normal Operation

Input	Action
LSH1 Start EFF P-501	Start duty EFF P- 501 at Level Switch High 1(@ elevation XXm, XXm above the FEW Tank floor Start Duty Chlorine Dosing Pump P-509 Start STR-503-Permissive to equipment Control Panel
LSL1 Stop EFF P-404	Stop duty EFF P- 501 at Level Switch Low 1(@ elevation XXm, XXm above the FEW Tank floor Stop Duty Chlorine Dosing Pump P-509 Stop STR-503- non-permissive to equipment control panel

10.2 Abnormal Operation

Abnormal Condition	Action	Alarm	Annunciation
P-501 Fails	Duty Effluent Pump Fails Start Stby EFF P-502	Alarm	Main PLC
P-502 Fails	Both Effluent Pumps fail No action	Alarm	Main PLC and Dial Out
STR-503 Fails	Backwash System for Strainer Fails-*Input to Main PLC from STR-503 PLC.* No stby provided No Action	Alarm	Main PLC

Abnormal Condition	Action	Alarm	Annunciation
LSLL in FEW Tank T-505 or T-506	Low low level in FEW Tank T-505 or T-506. Shutdown and inhibit Mechanical FEW P-507 and P-508 from running Start Stby EFF P-502 (low low level at elevation XX m, XX m above the FEW Tank floor)	LAL Alarm	Main PLC and Dial Out
LSHH in FEW Tank T-505 or T-506	High high level in FEW T-505 or T-506 Shutdown and Inhibit EFF P-501 and P-502 (high high level at elevation XX m, XX m above the FEW floor)	LAH Alarms	Main PLC and Dial Out
P-509 Fails	Duty Chlorine Pump Fails Start Stby Chlorine Pump P-510	Alarm	Main PLC
P-510 Fails	Both Chlorine Pumps Fail No Action	Alarm	Main PLC and Dial Out

11.0 GENERAL ALARM HANDLING

The following table lists the facilities non process alarms, related set points, forms of annunciation, and subsequent interlocks or actions. All alarms will be stored in an alarm log file consisting of the 200 most recent alarms. The alarm log file will include the date, time, alarm descriptor info, and the acknowledgement date and time.

11.1 General Facility Alarms

Alarm No.	Tripped By	Set Point	Annunciation

Alarm No.	Tripped By	Set Point	Annunciation

12.0 STANDARD CONTROL LOGIC

Unless stated otherwise in this document the following general device control strategies shall apply.

12.1 Pumps

Pumps shall operate in the following manner:

Pumps are equipped with HAND-OFF-AUTO (HOA) switches located at the motor starters. When in HAND the Plant Operator can control the manually regardless of the process conditions. In the OFF position the pump will not operate. In the Auto position the Main PLC controls when the pumps turn on and off.

Pump Status signals:

- Run Enable (MN)
- Pump Status (YI)
- Auto Mode (YS)
- Pump Alarm signals:
- Flow Indication (FI)
- Pump Enable (YC)
- Low Flow (FAL)

12.1.1 Duty / Standby systems

Duty status is assigned at the operator HMI. Where a pump is part of a Duty/Standby pair then the following shall apply:

Where a duty pump enters a fault condition the device shall be stopped and alarmed according. The standby device shall then be called to run. There shall be no duty changeover initiated. When the duty device's fault is cleared and its status is available then the standby pump shall be stopped and the duty pump again called to run.

12.2 Flow Control Valves

Flow Control Valves shall operate in the following manner:

Flow control valves are equipped with locally mounted REMOTE-OFF-LOCAL (ROL) and OPEN-STOP-CLOSE (OSC) hand switches. When the ROL hand switch is in the REMOTE position the Main PLC controls the position and movement of the flow control valve. In the OFF position the ROL hand switch will not operate the flow control valve. When the ROL hand switch is in the LOCAL position the OSC switch is used to operate the valve the Plant Operator can control the raw water pumps manually regardless of the process conditions. The flow control valves are equipped with valve position indicators. ZSO indicates to the Main PLC when the valve is in the open position while ZSC indicates when the valve is in the closed position.

Flow Control Valve Status signals:

- Valve is Open, ROL hand switch is in REMOTE position (HSO)
- Valve is Closed, ROL hand switch is in REMOTE position (HSC)
- Valve is Open, ROL hand switch is in LOCAL position (ZSO)
- Valve is Closed, ROL hand switch is in LOCAL position (ZSC)

13.0 UTILITY POWER FAILURE

Upon failure of the incoming utility power the standby-generator will start and the plant will fail to the following status:

-

The size of the standby generator does not permit the operation of more than one of the four facility pump motors at a time. The control system will ensure that in the event of a utility power failure any one of the four pumps may be operated, but while that pump is operating a second pump will not be permitted to start.

PLC EQUIPMENT

1. GENERAL

1.1 References - General

.1 Equipment, Products and Execution must meet all requirements detailed in Section 17010.

.2 The PLC interconnectivity and locations are shown on the PLC Schematic drawing.

.3 The contractor will procure all PLC, operator interface and components required for installation.

2. PRODUCTS

2.1 PLC and Operator Interface

.1 The PLC type will be based on the Allen Bradley SLC product range including the series SLC 505 processor.

.2 The specification for the Operator Interface (OI) will be Rockwell RAC6182, using RSVIEW software.

.3 Provide Windows-based PLC control systems programming software.

.4 Provide communication interface modules between PLC controllers and PLC workstations.

.5 Provide and install communications cable between PLC controllers and the workstations.

2.2 PLC Communications

.1 Plant control PLC to be located_____. Each marshalling panel to have an operator interface unit mounted on the panel door.

.2 Allow room for future plant expansion in the form of mounting space for additional I/O racks in each panel.

.3 The respective operator interface nodes will communicate with the PLC on Ethernet protocol over CAT5 cable via a network switch.

.1 The network cable shall be afforded suitable mechanical protection for the length of its route (i.e. conduit/tray work etc.)

2.3 PLC/LCP Installation Requirements

.1 Contractor to terminate control signals to I/O modules as indicated on the PLC I/O index specification Section 17600.

.2 The Contractor will verify the PLC I/O layout schematics, local control panel design, and check accuracy / dimensions for equipment layout in the panels. The Contractor will submit to the Engineer details of any changes from the proposed layout.

.3 Following verification and agreement between the Engineer and Contractor, the Contractor will install the PLC and associated equipment in the Local Control Panel.

.4 The Contractor will wire all field instrumentation signals, equipment status and control outputs up to PLC I/O terminals including any interconnection to interface terminal rails.

.5 The Contractor will install the Marshalling UPS within the PLC Panel and the Office PC unit UPS within the office and provide suitable cableways for distribution to the intended locations.

.1 The Marshalling Panel UPS will be sized to accommodate backup supply to the PLC, Operator Interfaces (OI) and Dialer unit equipment. The office UPS will be sized to accommodate backup supply to the PC and its ancillary equipment. The UPS will provide a continuous supply to the system for a minimum of 1 hour prior to backup power being supplied.

.2 The UPS manufacturer will be based on and will be in accordance with Section 17130.

2.4 Wiring to Dialer Unit

.1 The Contractor will wire the auto dialer unit to the main PLC IO as directed in the schematic drawings and IO schedule.

2.5 Spares

.1 Provide one spare PLC module of each type used in the facility. The spare Processor module is to be configured with the final operating program for the facility upon completion of commissioning.

.2 Provide a single spare operator interface terminal.

3. EXECUTION

3.1 References - General

.1 Refer To Section 17010, Part 3.

3.2 CDACS Program and Documentation

.1 Provide one spare PLC module of each type used in the facility. The spare Processor module is to be configured with the final operating program for the facility upon completion of commissioning.

.2 Provide a single spare operator interface terminal.

.3 Layout the I/O and advise the owner's representative of the exact I/O assignments within 30 days of contract award.

.4 Turn over programming software and interface cable to owner within 30 days of contract award.

3.3 Commissioning and Startup

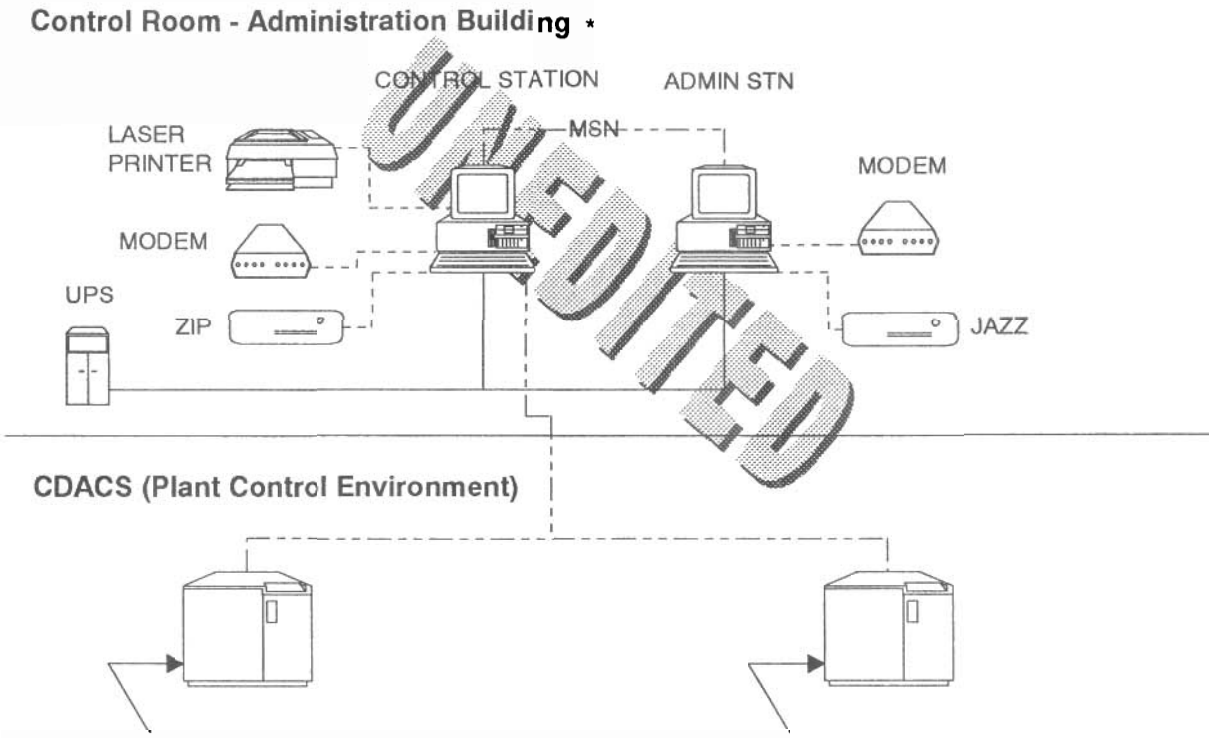
.1 The Contractor will verify and submit appropriate test documentation to the Engineer that all PLC I/O are wired to the proper inputs and outputs.

.2 The Contractor will markup any changes to the PLC I/O list and verify that each I/O address is documented. A copy will be forwarded to the Engineer to revise to the 'as built' status.

.3 The Contractor will be available onsite to ensure that all instrumentation signals are verified from sensor to the OI, and that all devices operate properly.

END OF SECTION

PLC EQUIPMENT



CDACS PANEL 1: (main electrical room)
EQUIPMENT - Control equipment, I/O terminal strips, power supplies, UPS
I/O requirement - 160 DI, 48 DO, 48 AI, 16 AO

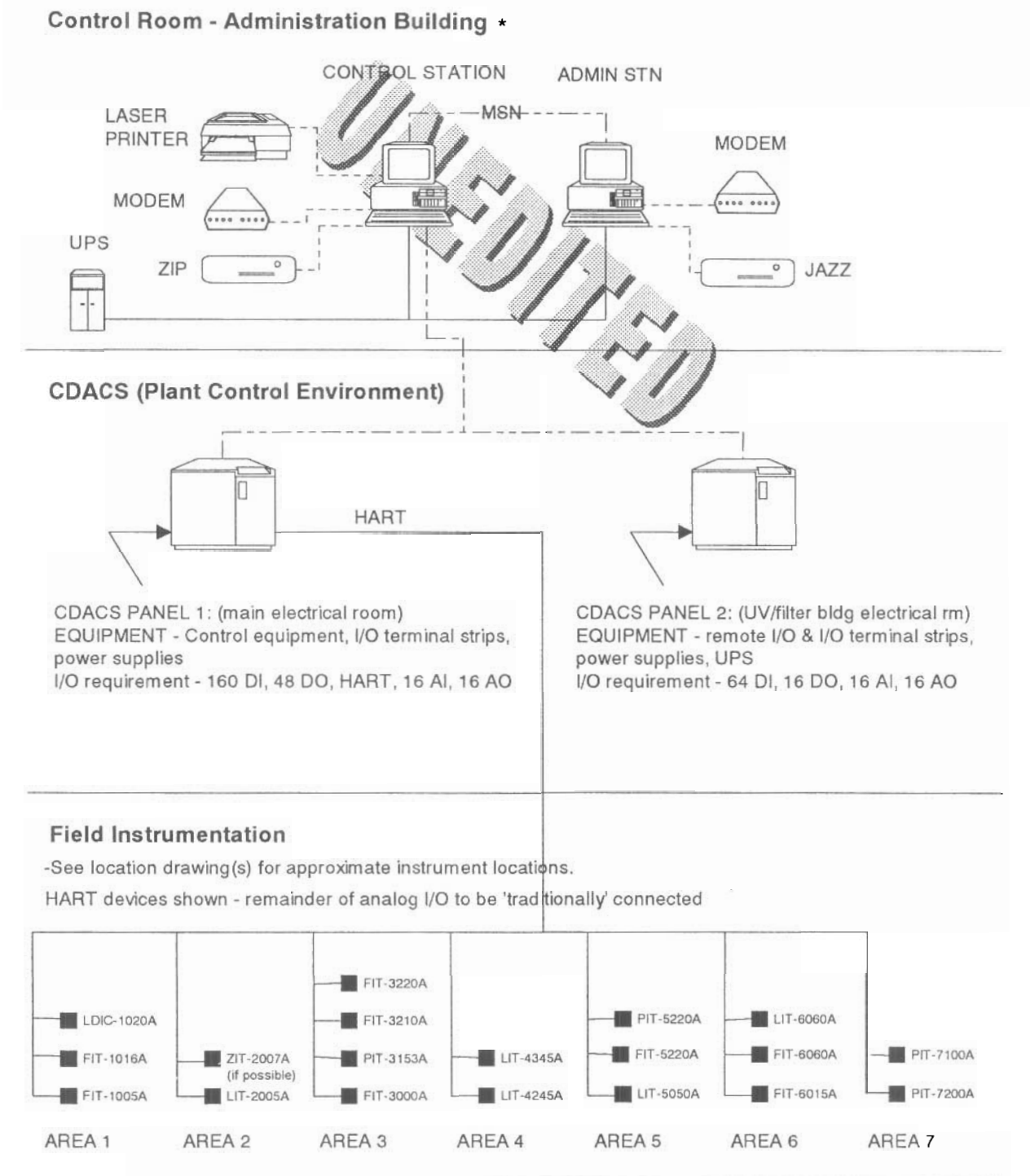
CDACS PANEL 2: (UV/filter bldg electrical rm)
EQUIPMENT - remote I/O & I/O terminal strips, power supplies, UPS
I/O requirement - 64 DI, 16 DO, 16 AI, 16 AO

Field Instrumentation

See location drawing(s) for approximate instrument locations.
Under this option, 'traditional' I/O wiring is used.

* Computer equipment is described in Section 17500 of the spec.

PLC EQUIPMENT



* Computer equipment is described in Section 17500 of the spec.

PLC I/O INDEX

1. GENERAL

1.1 References - General

.1 Refer To Section 17010.

1.2 PLC I/O Index

.1 The following spreadsheet gives an itemized list of the input and output between the PLC and the field devices. It is intended to serve as an aid for determining the cabling requirements for the work specified in this Division.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION