

INPUT/OUTPUT SUMMARY FOR AIR HANDLING UNIT AH-01 (TYP 2 SYSTEMS)

SYSTEM, APPARATUS, OR AREA POINT DESCRIPTION	INPUTS						OUTPUTS						SYSTEM FEATURES						GENERAL	SUPPLEMENTARY NOTES
	ANALOG			BINARY	DIGITAL	ANALOG	ALARMS	PROGRAMS	ALARMS	PROGRAMS	ALARMS	PROGRAMS	ALARMS	PROGRAMS						
	MEASURED	CALCULATED																		
OUTSIDE TEMPERATURE	●																			
OUTSIDE RELATIVE HUMIDITY		●																		
PREHEAT COIL, HC-14	●																			
PREHEAT COIL, HC-15	●																			
AIR FILTER AF-01 (TYP 2)		●																		2 SENSORS
AIR FILTER AF-02 (TYP 2)		●																		2 SENSORS
MIXING AIR DAMPER 01																				
MIXING AIR DAMPER 02																				
COOLING COIL CC-01	●																			
COOLING COIL CC-02	●																			
SUPPLY FAN SF-01			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SUPPLY FAN SF-02			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SUPPLY AIR TEMP (TYP 2)	●																			
SUPPLY AIR RELATIVE HUMIDITY		●																		
ROOM TEMPERATURE (TYPICAL 5 ZONES)	●																			
SPACE AVERAGE RELATIVE HUMIDITY		●																		
ZONE DUCT HEATER (VEA)	●																			
ZONE DUCT HEATERS (TYPICAL 5 ZONES)	●																			
SMOKE DETECTOR (SD-01)																				
MIXING AIR TEMP	●																			
AIR COMPRESSORS (TYP 2)	●																			
TOILET EXHAUST FAN, EF-01																				
AIR FLOW DIAGRAM																				
HEPA FILTERS	●																			
FLOOR PLANS																				

INPUT/OUTPUT SUMMARY FOR WATER CHILLERS CH-01 & CH-02 (TYP 2 SYSTEMS)

SYSTEM, APPARATUS, OR AREA POINT DESCRIPTION	INPUTS						OUTPUTS						SYSTEM FEATURES						GENERAL	SUPPLEMENTARY NOTES
	ANALOG			BINARY	DIGITAL	ANALOG	ALARMS	PROGRAMS	ALARMS	PROGRAMS	ALARMS	PROGRAMS	ALARMS	PROGRAMS						
	MEASURED	CALCULATED																		
WATER CHILLER, CH-01	●																			
WATER CHILLER, CH-02	●																			
CHILLED WATER PUMP, WP-01	●																			
CHILLED WATER PUMP, WP-02	●																			
CHILLED WATER RETURN TEMP	●																			
CHILLED WATER SUPPLY TEMP	●																			
CHILLED WATER BOOSTER PUMP	●																			PUMP BY VE CONTRACTOR
CHILLED WATER FLOW DIAGRAM																				
FLOOR PLANS																				

NOTES:

- FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES SEE SHEETS LA-H-001 AND LA-H-002.
- SMOKE DETECTORS WILL BE HARD WIRED TO THE SUPPLY FANS SF-01 & SF-02 MOTOR STARTER TO STOP FANS WHEN SMOKE DETECTED IN THE RETURN AIR STREAM. ALSO SMOKE DETECTORS WILL BE SOFTWARE CONNECTED TO DDC CONTROL PANEL AND THE FACILITY CONTROL ROOM.
- CONTROL SYSTEM SHALL BE STAND ALONE TYPE AND CONNECTED TO THE MAIN CONTROL AND MONITORING SYSTEM AT THE FACILITY CONTROL ROOM IN THE CORNER STATION BUILDING.
- VACUUM EQUIPMENT ROOM WILL BE PROVIDED WITH FOUR TEMPERATURE SENSORS TO CONTROL THE RESPECTIVE DUCT HEATER. SYSTEM MAY AVERAGE THE READING OF THE FOUR ROOM TEMPERATURE SENSORS OR SELECT ANY SENSOR TO CONTROL THE DUCT HEATER.

SEQUENCE OF OPERATION:

- CHILLED WATER PLANT:
  - UPON A SIGNAL FROM THE CENTRAL CONTROL SYSTEM THE PACKAGED CONTROLS PROVIDED WITH THE WATER CHILLER WILL PERFORM THE FOLLOWING:
    - THE LEAD CHILLED WATER PUMP (WP-01) WILL START TO ESTABLISH STEADY WATER FLOW THROUGH THE SYSTEM.
    - UPON PROOF OF ESTABLISHED WATER FLOW THE LEAD CHILLER (CH-01) WILL START TO MAINTAIN THE LEAVING CHILLED WATER TEMPERATURE SETPOINT (42°F).
    - THE PACKAGED DDC CONTROLS ON THE WATER CHILLER WILL CYCLE THE REFRIGERATION COMPRESSORS IN SEQUENCE TO MATCH THE SYSTEM THERMAL LOAD.
    - WHEN THE THERMAL LOAD DROPS BELOW THE MINIMUM OPERATING CAPACITY OF THE WATER CHILLER, THE PACKAGED CONTROL WILL ACTIVATE THE HOT GAS BYPASS CYCLE.
    - PACKAGED CONTROLS WILL RUN SELF DIAGNOSTICS TEST BEFORE STARTING THE REFRIGERATION COMPRESSORS TO PROVE THAT ALL OPERATING CONDITIONS ARE WITHIN THE NORMAL LIMITS.
    - PACKAGED CONTROLS WILL CONTINUOUSLY MONITOR THE CHILLER OPERATION AND REPORT ANY OPERATIONAL OR SAFETY ALARMS TO THE OPERATOR COMPUTER IN THE FACILITY CONTROL ROOM. PACKAGED CONTROLS WILL AUTOMATICALLY STOP THE MALFUNCTIONING WATER CHILLER AND START THE STANDBY CHILLER.
    - CENTRAL CONTROL SYSTEM WILL ALTERNATE THE LEAD AND STANDBY WATER CHILLERS TO MAINTAIN EQUAL OPERATING PERIODS ON BOTH WATER CHILLERS.
- AIR HANDLING SYSTEM:
  - UPON A SIGNAL FROM THE CENTRAL CONTROL SYSTEM THE LEAD SUPPLY AIR FAN (SF-01) WILL START TO ESTABLISH A STEADY AIR FLOW THROUGH THE SYSTEM. THE DDC CONTROLS WILL PERFORM THE FOLLOWING:
    - MODULATE THE CONTROLLABLE PITCH VANES ON THE SUPPLY AIR FANS TO MAINTAIN THE DESIRED CONSTANT AIR VOLUME FLOW RATE REGARDLESS OF THE SYSTEM STATIC PRESSURE.
    - THE TEMPERATURE SENSORS LOCATED DOWN STREAM OF THE OUTSIDE AIR PREHEAT COILS WILL BE USED TO CONTROL THE CAPACITY OF THE DUCT ELECTRIC HEATERS TO MAINTAIN THE OUTSIDE AIR DRY BULB TEMPERATURE AT 50°F.
    - THE TEMPERATURE SENSOR LOCATED DOWN STREAM OF THE COOLING COIL WILL BE USED TO MODULATE THE 3-WAY CONTROL VALVE ON THE CHILLED WATER LOOP TO MAINTAIN THE LEAVING AIR DRY BULB TEMPERATURE AT THE SET POINT (50°F).
    - THE DDC CONTROLS WILL COMPARE THE SPACE ROOM TEMPERATURE SENSORS AND MODULATE THE FACE AND BYPASS DAMPER BASED ON THE MOST DEMANDING ZONE.
    - THE ROOM TEMPERATURE SENSORS (TOTAL 4) OF VACUUM EQUIPMENT AREA SHALL BE USED TO MODULATE THE SCR CONTROLS ON THE RESPECTIVE ELECTRIC DUCT HEATER TO MAINTAIN THE ROOM TEMPERATURE SETPOINT (72°F).
    - THE ROOM TEMPERATURE SENSORS FOR OTHER ROOMS SHALL BE USED TO SEQUENCE THE CAPACITY CONTROL STAGES OF THEIR RESPECTIVE DUCT HEATERS TO MAINTAIN THE ROOM TEMPERATURE SET POINT.
    - WHEN THE ROOM TEMPERATURE RISES 5 DEGREES F ABOVE THE SETPOINT, THE CONTROL SYSTEM SHALL REPORT AN ALARM SIGNAL TO THE FACILITY CONTROL ROOM.
    - THE RELATIVE HUMIDITY SENSOR LOCATED IN VACUUM EQUIPMENT ROOM SHALL BE USED TO MONITOR THE SPACE RELATIVE HUMIDITY.
    - THE SMOKE DETECTOR IN THE RETURN AIR DUCTS SHALL STOP THE SUPPLY AIR FANS WHEN SMOKE IS DETECTED IN THE RETURN AIR STREAM AND REPORT AN ALARM SIGNAL (AUDIO AND VISUAL) AT THE FACILITY CONTROL ROOM AND LOCAL CONTROL PANEL. THE SPACE DIFFERENTIAL PRESSURE SENSORS SHALL BE USED TO MODULATE THE MOTORIZED CONTROL DAMPERS ON THE RETURN AIR DUCTS AND THE OUTSIDE AIR DUCTS TO MAINTAIN THE SPACE PRESSURIZATION AT THE SETPOINT.
- EQUIPMENT START UP:
  - ALL WATER CHILLER SHALL BE SOFT START
  - THE SUPPLY AIR FANS SF-01 & SF-02 SHALL START AT THE MINIMUM STATIC PRESSURE AND GRADUALLY INCREASE THE SYSTEM STATIC PRESSURE TO MAINTAIN THE DESIRED AIR FLOW RATE.
  - THE BUILDING PRESSURIZATION SENSORS FOR LVEA AND OSB (LAB AREA) SHALL MODULATE THE MOTORIZED DAMPERS LOCATED ON THE RETURN AIR & OUTSIDE AIR DAMPERS TO START AT 100% RETURN AIR AND GRADUALLY MODULATE THE DAMPERS TO MAINTAIN THE BUILDING PRESSURIZATION SETPOINT.
- TOILET EXHAUST FAN:
  - THE TOILET EXHAUST FAN WILL RUN CONTINUOUSLY.

This document and the design it covers are the property of PARSONS. They are loaned only with the borrower's expressed agreement that they will not be reproduced, copied, loaned, exhibited, or used in any other way, except by written consent from PARSONS to the borrower.

ISSUED FOR CONSTRUCTION  
 DRAWN CLP 11-15-96  
 CHECKED MN 10-25-96  
 ENGINEER AA 1-23-96  
 PROJ TDM 11-15-96

**AS-BUILT DRAWINGS**

**PARSONS**  
 100 WEST WALNUT STREET  
 PASADENA, CALIFORNIA

**LIGO**  
 CALIFORNIA INSTITUTE OF TECHNOLOGY  
 MASSACHUSETTS INSTITUTE OF TECHNOLOGY

**LIGO-D960989-01-O**  
 LASER INTERFEROMETER  
 GRAVITATIONAL-WAVE OBSERVATORY  
 SITE NO. 2 - LIVINGSTON, LOUISIANA

TITLE: HVAC END STATION SEQUENCES OF OPERATION & I/O SUMMARY SHEET

SCALE: NONE CONTRACT NUMBER: PPI50969 PROJECT NUMBER: 8094

SHEET NUMBER: LA-H-231

NO.	DATE	BY	CHKD	ENGR	PROJ	DESCRIPTION
1	8-7-98	DJB	AA	AA	AA	ISSUED FOR AS-BUILT