# INPUT/OUTPUT SUMMARY FOR AIR HANDLING UNITS AH-01 & AH-02

| SYSTEM, APPARATUS, OR AREA POINT DESCRIPTION | INPUTS – ANALOG – MEASURED | | | | | | | INPUTS – ANALOG – CALCULATED | | | | | INPUTS – BINARY | | | | | | | OUTPUTS – DIGITAL | | | | | OUTPUTS – ANALOG | | | | | | | SYSTEM FEATURES – ALARMS | | | | | | | SYSTEM FEATURES – PROGRAMS | | | | | | | | | GENERAL | | | | | | | SUPPLEMENTARY NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TEMPERATURE | PRESSURE | RH | KW | AIR FLOW | LEVEL | GALLONS | VIBRATION | | KWH | ENTHALPY | RUN TIME | EFFICIENCY | WET BULB TEMP | | STATUS | FILTER | SMOKE | FREZE | AIR FLOW | METER | | OFF-ON | OFF-AUTO-ON | OFF-HI-LO | OPEN-CLOSE | MULT-STAGE | | DAMPER POSITION | VALVE POSITION | SET POINT ADJUSTMENT | VANE POSITION | SCR CONTROL | | HI ANALOG | LOW ANALOG | HI BINARY | LOW BINARY | PROOF | | TIME SCHEDULING | DEMAND LIMITING | DUTY CYCLE | START/STOP OPTION | ENTHALPY OPTION | SMOKE CNT | TREND | ALARM INSTRUCT | MAINT WK ORD | | COLOR GRAPHIC | | | | | | |
| OUTSIDE TEMERATURE | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | EACH AH-1 & 2 |
| OUTSIDE RELATIVE HUMIDITY (H) | | | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | EACH AH-1 & 2 |
| PREHEAT COIL, HC-07 | ● | | | | | | | | | | | | | | | ● | | | | | | | | | | ● | | | | | ● | | | | | ● | | | | | | | | ● | | | | ● | ● | | | | | | | |
| PREHEAT COIL, HC-08 | ● | | | | | | | | | | | | | | | ● | | | | | | | | | | ● | | | | | ● | | | | | ● | | | | | | | | ● | | | | ● | ● | | | | | | | |
| AIR FILTER, AF-01 (TYP 2) | | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | ● | | | | | | | 2 SENSORS |
| AIR FILTER, AF-02 (TYP 2) | | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | ● | | | | | | | 2 SENSORS |
| MIXING AIR DAMPER 01 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | | | | | | ● | ● | | | | | | |
| MIXING AIR DAMPER 02 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | | | | | | ● | ● | | | | | | |
| MIXING AIR DAMPER 03 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | | | | | | ● | ● | | | | | | |
| MIXING AIR DAMPER 04 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | | | | | | ● | ● | | | | | | |
| COOLING COIL, CC-01 | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | ● | | | ● | | | | | | | | | | | | | | ● | ● | | | | | | |
| COOLING COIL, CC-02 | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | ● | | | ● | | | | | | | | | | | | | | ● | ● | | | | | | |
| COOLING COIL, CC-03 | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | ● | | | ● | | | | | | | | | | | | | | ● | ● | | | | | | |
| COOLING COIL, CC-04 | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | ● | | | ● | | | | | | | | | | | | | | ● | ● | | | | | | |
| HUMIDIFIER, HU-01 | | | ● | | | | | | | | | | | | | ● | | | | | | | | | | ● | | | | | ● | | | | | ● | ● | | | | | | | ● | | | | ● | ● | | | | | | | |
| HUMIDIFIER, HU-02 | | | ● | | | | | | | | | | | | | ● | | | | | | | | | | ● | | | | | ● | | | | | ● | ● | | | | | | | ● | | | | ● | ● | | | | | | | |
| HUMIDIFIER, HU-03 | | | ● | | | | | | | | | | | | | ● | | | | | | | | | | ● | | | | | ● | | | | | ● | ● | | | | | | | ● | | | | ● | ● | | | | | | | |
| HUMIDIFIER, HU-04 | | | ● | | | | | | | | | | | | | ● | | | | | | | | | | ● | | | | | ● | | | | | ● | ● | | | | | | | ● | | | | ● | ● | | | | | | | |
| SUPPLY FAN, SF-01 | | | | | ● | | | ● | | | ● | | | | | ● | | | ● | | | | ● | | | | | | | | | ● | | | | ● | | | ● | | | ● | | | ● | | | | ● | ● | | | | | | | STATUS WITH CURRENT SWITCH |
| SUPPLY FAN, SF-02 | | | | | ● | | | ● | | | ● | | | | | ● | | | ● | | | | ● | | | | | | | | | ● | | | | ● | | | ● | | | ● | | | ● | | | | ● | ● | | | | | | | STATUS WITH CURRENT SWITCH |
| SUPPLY FAN, SF-03 | | | | | ● | | | ● | | | ● | | | | | ● | | | ● | | | | ● | | | | | | | | | ● | | | | ● | | | ● | | | ● | | | ● | | | | ● | ● | | | | | | | STATUS WITH CURRENT SWITCH |
| SUPPLY FAN, SF-04 | | | | | ● | | | ● | | | ● | | | | | ● | | | ● | | | | ● | | | | | | | | | ● | | | | ● | | | ● | | | ● | | | ● | | | | ● | ● | | | | | | | STATUS WITH CURRENT SWITCH |
| SUPPLY AIR TEMP | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | ● | | | | | | | | | | | | ● | | | | | | | |
| SUPPLY AIR RELATIVE HUMIDITY | | | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | ● | | | | | | | |
| ROOM TEMPERATURE (TYPICAL 9 ZONES) | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | ● | | | | | | | | | | | | ● | | | | | | | |
| SPACE AVERAGE RELATIVE HUMIDITY LVEA | | | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | ● | | | | | | | | | | | | ● | | | | | | | EACH AH-1 & 2 |
| ZONE DUCT HEATERS (TYPICAL 8 ZONES) LVEA | ● | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | | | ● | | | ● | | | | | | | | | | | | | ● | ● | | | | | | FOR LVEA |
| ZONE DUCT HEATER (MECH ROOM) | ● | | | | | | | | | | | | | | | ● | | | | | | | | | | ● | | | | | | | | | | ● | | | | | | | | | | | | | ● | ● | | | | | | FOR MECHANICAL ROOM |
| SMOKE DETECTOR (TYP 2) | | | | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | ● | | | | | | | EACH AH-1 & 2 |
| MIXED AIR TEMP | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MIXED AIR RELATIVE HUMIDITY | | | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AIR COMPRESSORS (TYP 2) | | ● | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | | | | | | ● | ● | | | | | | | | ● | | | | | | | | | | | |
| ROOM PRESSURE | | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | | | | | 2 REQ'D. -SEE PLANS FOR LOCATION |
| AIR FLOW DIAGRAM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | |
| HEPA FILTER | | ● | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | ● | | | | | | | LOCATED IN THE SUPPLY AIR PLENUM |
| RETURN & OUTSIDE AIR DAMPERS (TOTAL 5) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | | | | | | | ● | | | | | | | |
| FLOOR PLANS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ● | | | |

## NOTES:

1. FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES SEE SHEETS WA-H-001 AND WA-H-002.
2. SMOKE DETECTORS SHALL BE HARD WIRED TO THE SUPPLY FANS SF-01 THRU SF-04 MOTOR STARTER TO STOP FANS WHEN SMOKE IS DETECTED IN THE RETURN AIR STREAM. ALSO SMOKE DETECTORS SHALL BE SOFTWARE CONNECTED TO DDC CONTROL PANEL AND THE FACILITY CONTROL ROOM.
3. 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.
4. LVEA ROOM SHALL BE PROVIDED WITH MULTIPLE TEMPERATURE SENSORS TO CONTROL THE RESPECTIVE DUCT HEATER. SYSTEM MAY AVERAGE THE READING OF THE ROOM TEMPERATURE SENSORS OR SELECT ANY SENSOR TO CONTROL THE DUCT HEATER. SEE FLOOR PLANS FOR LOCATION AND NUMBER OF SENSORS FOR EACH ZONE.
5. CHILLED WATER FLOW DIAGRAM AND I/O SUMMARY SHEETS SHALL BE THE SAME AS THE BASE DESIGN (2 INTERFEROMETERS).

## SEQUENCE OF OPERATION:

I. AIR HANDLING SYSTEM OF LVEA (AH-01 & AH-02):

UPON A SIGNAL FROM THE CENTRAL CONTROL SYSTEM THE SUPPLY AIR FANS (SF-01, SF-02, SF-03, SF-04) WILL START TO ESTABLISH A STEADY AIR FLOW THROUGH THE SYSTEM. THE DDC CONTROLS WILL PERFORM THE FOLLOWING:

A. MODULATE THE CONTROLLABLE PITCH VANES ON THE SUPPLY AIR FANS TO MAINTAIN CONSTANT AIR VOLUME FLOW RATE REGARDLESS OF THE SYSTEM STATIC PRESSURE.

B. THE TEMPERATURE SENSORS DOWNSTREAM OF OUTSIDE AIR PREHEAT COILS SHALL BE USED TO CONTROL THE CAPACITY OF THE DUCT ELECTRIC HEATERS (HC-07 & HC-08) TO MAINTAIN THE OUTSIDE AIR TEMPERATURE AT 50°F.

C. THE TEMPERATURE SENSORS DOWNSTREAM OF THE COOLING COILS (CC-01, CC-02, CC-03, & CC-04) SHALL BE USED TO MODULATE THE 3-WAY CONTROL VALVE ON THE CHILLED WATER LOOP TO MAINTAIN THE LEAVING AIR TEMPERATURE AT THE SET POINT (50°F).

D. THE DDC CONTROLS SHALL COMPARE THE SPACE ROOM TEMPERATURES AND MODULATE THE FACE AND BYPASS DAMPERS TO SATISFY THE MOST DEMANDING ZONE.

E. THE ROOM TEMPERATURE SENSORS OF LVEA ZONES (TOTAL EIGHT) SHALL BE USED TO MODULATE THE SCR CONTROLS ON THE RESPECTIVE ELECTRIC DUCT HEATERS TO MAINTAIN THE ROOM TEMPERATURE SETPOINT (72°F).

F. THE ROOM TEMPERATURE SENSOR FOR THE MECHANICAL ROOM SHALL BE USED TO MODULATE ITS RESPECTIVE DUCT HEATER TO MAINTAIN THE ROOM TEMPERATURE BETWEEN 80 TO 65°F.

G. WHEN THE ROOM TEMPERATURE RISES 5°F ABOVE THE SETPOINT, THE CONTROL SYSTEM SHALL REPORT AN ALARM SIGNAL TO THE FACILITY CONTROL ROOM.

H. THE RELATIVE HUMIDITY SENSOR LOCATED IN THE LVEA ROOM SHALL BE USED TO MODULATE THE CAPACITY OF THE ELECTRIC HUMIDIFIERS (HU-01, HU-02, HU-03, & HU-04) TO MAINTAIN THE SPACE MINIMUM RELATIVE HUMIDITY SETPOINT (30 % RH).

I. THE DUCT SMOKE DETECTOR IN THE MIXED AIR PLENUM SHALL STOP THE SUPPLY AIR FANS WHEN SMOKE IS DETECTED IN THE RETURN AIR STREAM AND SHALL REPORT AN ALARM SIGNAL (AUDIO AND VISUAL) AT THE FACILITY CONTROL ROOM AND LOCAL CONTROL PANEL.

J. THE SPACE DIFFERENTIAL PRESSURE SENSOR 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 SETPOINT.

II. EQUIPMENT START UP:

A. SUPPLY AIR FANS (SF-01 THRU SF-04) SHALL START AT THE MINIMUM STATIC PRESSURE AND GRADUALLY INCREASE THE SYSTEM STATIC PRESSURE TO MAINTAIN THE DESIRED AIR FLOW RATE.

B. BUILDING PRESSURIZATION SENSORS FOR LVEA 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.

LIGO-D960385-01-O

| REFERENCES | |
|---|---|
| DRAWING NO. | DESCRIPTION |

| REVISIONS | | | | | | |
|---|---|---|---|---|---|---|
| NO. | DATE | BY | CHKD | ENGR | PROJ | DESCRIPTION |
| 1 | 5-15-98 | CP | AA | AA | PE | ISSUED FOR AS-BUILT |

| ISSUED FOR CONSTRUCTION | | |
|---|---|---|
| DRAWN | CLP | 6-24-96 |
| CHECKED | ME | 7/3/96 |
| ENGINEER | AA | 7/3/96 |
| PROJ | MPW | 7/8/96 |

**AS-BUILT DRAWINGS**

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100 WEST WALNUT STREET
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CALIFORNIA INSTITUTE OF TECHNOLOGY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

LASER INTERFEROMETER GRAVITATIONAL-WAVE OBSERVATORY
SITE NO. 1 - HANFORD, WASHINGTON

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

| SCALE | CONTRACT NUMBER | PROJECT NUMBER |
|---|---|---|
| NONE | PP150969 | 8094 |

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