DATE: 09/10:96 TIME: 07:30:30 DESIGN FILE: I:\ligo\site2\mu\lah231.soz  $\mathbb{O}$  $\nabla$ 1. FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES SEE SHEETS LA-H-001 AND LA-H-002.  $\bigcirc$  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. INPUT/OUTPUT SUMMARY FOR AIR HANDLING UNIT AH-OI (TYP 2 SYSTEMS) 0 OUTPUTS 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. GENERAL DIGITAL **ANALOG** CALCULATED 9.5 4. VACUUM EOUIPMENT 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. SYSTEM, APPARATUS, OR AREA POINT SUPPLEMENTARY NOTES 0 SEQUENCE OF OPERATION: اف OUTSIDE TEMERATURE 0 OUTSIDE RELATIVE HUMIDITY I. CHILLED WATER PLANT: UPON A SIGNAL FROM THE CENTRAL CONTROL SYSTEM THE PACKAGED CONTROLS PROVIDED WITH THE WATER CHILLER WILL PERFORM THE FOLLOWING: PREHEAT COIL, HC-14 S PREHEAT COIL, HC-15 A. THE LEAD CHILLED WATER PUMP (MP-01) WILL START TO ESTABLISH STEADY WATER FLOW THROUGH THE SYSTEM. AIR FILTER AF-OI (TYP 2) B. UPON PROOF OF ESTABLISHED WATER FLOW THE LEAD CHILLER (CH-OI) WILL START TO MAINTAIN THE LEAVING CHILLED WATER TEMPERATURE 1867 In from AIR FILTER AF-02 (TYP 2) 2 SENSORS MIXING AIR DAMPER OF C. THE PACKAGED DDC CONTROLS ON THE WATER CHILLER WILL CYCLE THE REFRIGERATION COMPRESSORS IN SEQUENCE TO MATCH THE SYSTEM MIXING AIR DAMPER 02 N copied, loaned, exhibited, coxcept by written conset the barrower. COOLING COIL CC-01 D. WHEN THE THERMAL LOAD DROPS BELOW THE MINIMUM OPERATING CAPACITY OF THE WATER CHILLER, THE PACKAGED CONTROL WILL ACTIVATE THE HOT GAS BYPASS CYCLE. COOLING COIL CC-02 E. PACKAGED CONTROLS WILL RUN SELF DIAGNOSTICS TEST BEFORE STARTING THE REFRIGERATION COMPRESSORS TO PROVE THAT ALL OPERATING CONDITIONS ARE WITHIN THE NORMAL LIMITS. F. 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. SUPPLY FAN SF-01 SUPPLY FAN SF-02 SUPPLY AIR TEMP (TYP 2) Landuced, c G. CENTRAL CONTROL SYSTEM WILL ALTERNATE THE LEAD AND STANDBY WATER CHILLERS TO MAINTAIN EQUAL OPERATING PERIODS ON BOTH WATER SUPPLY AIR RELATIVE HUMIDITY ROOM TEMPERATURE (TYPICAL 5 ZONES) SPACE AVERAGE RELATIVE HUMIDITY II. 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 DOC CONTROLS WILL PERFORM THE FOLLWING: ZONE DUCT HEATER (VEA) ZONE DUCT HEATERS (TYPICAL 5 ZONES) A. 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. SMOKE DETECTOR (SD-01) S \V18 B. 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 <u>(C)</u> AIR COMPRESSORS (TYP 2)  $\varpi$ C. 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). TOILET EXHAUST FAN, EF-01 # # ty Id "IEZNM\Z it covers are the property e loaned only with the agreement that they will AIR FLOW DIAGRAM HEPA FILTERS D. THE DDC CONTROLS WILL COMPARE THE SPACE ROOM TEMPERATURE SENSORS AND MODULATE THE FACE AND BYPASS DAMPER BASED ON THE MOST DEMANDING ZONE. FLOOR PLANS E. 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) 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. INPUT/OUTPUT SUMMARY FOR WATER CHILLERS CH-01 & CH-02 (TYP 2 SYSTEMS) design it of They are written agre G. WHEN THE ROOM TEMPERATURE RISES 5 DEGREES F ABOVE THE SETPOINT, THE CONTROL SYSTEM SHALL REPORT AN ALARM SIGNAL TO THE FACILITY SYSTEM FEATURES GENERAL CONTROL ROOM. H. THE RELATIVE HUMIDITY SENSOR LOCATED IN VACUUM EQUIPMENT ROOM SHALL
BE USED TO MONITOR THE SPACE RELATIVE HUMIDITY.

I. THE SMOKE DUCT 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 VISIUAL) 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. DIGITAL CALCULATED APPARATUS, OR AREA POINT DESCRIPTION SUPPLEMENTARY III. EQUIPMENT START UP: WATER CHILLER, CH-01 A. ALL WATER CHILLER SHALL BE SOFT START • • B. 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. WATER CHILLER, CH-02 CHILLED WATER PUMP, WP-01 C. 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. . CHILLED WATER PUMP, WP-02 CHILLED WATER RETURN TEMP CHILLED WATER SUPPLY TEMP IV. TOILET EXHAUST FAN: CHILLED WATER BOOSTER PUMP A. THE TOILET EXHAUST FAN WILL RUN CONTINUOUSLY. CHILLED WATER FLOW DIAGRAM FLOOR PLANS LASER INTERFEROMETER DRAWN 2 GRAVITATIONAL-WAVE OBSERVATORY HECKED ENGINEER SITE NO. 2 - LIVINGSTON, LOUISIANA **PARSONS** NONE | PP150969 8094 C 9-10-96 CLP WV AA PUM BID ADDENDUM \*2

B 7-24-96 CLP ME AA TDM ISSUED FOR BID

A 6-14-96 CLP ME AA TDM FINAL DESIGN REVIEW

NO. DATE BY CHKD ENGR PROJ DESI **END STATION** CALIFORNIA INSTITUTE OF TECHNOLOGY 100 WEST WALNUT STREET PASADENA, CALIFORNIA SEQUENCES OF OPERATION & LA-H-231 MASSACHUSETTS INSTITUTE OF TECHNOLOGY I/O SUMMARY SHEET DESCRIPTION DESCRIPTION 4 LIGO-D960989-C-O LIGOLAF.BDR