INPUT/OUTPUT SUMMARY

SYSTEM DESCRIPTION		UNIT OPERATION				SENSORS																			
PLAN MARK	SYSTEM/ITEM	1 STATUS- (OPEN-CLOSE)	2 STATUS - DP OR FS	3 MODE STATUS (ON/OFF)	4 SHEDDABLE PRIORITY	5 O.A. TEMPERATURE	6 M.A. TEMPERATURE	7 COLD DECK TEMPERATURE	8 HOT DECK TEMPERATURE	9 R.A. RELATIVE HUMIDITY	10 E.W. TEMPERATURE	11 L.W. TEMPERATURE	12 AIR PRESSURE (STATIC)	13 FILTER PRESSURE DIFF.	14 WATER PRESSURE DIFF.	15 ICE STORAGE TON/HRS.	16 AIR PRESSURE DIFF.	17 O.A. DAMPER POSITION	18 VAR. SPEED - R.P.M.	19 FUEL FLOW - G.P.H.	20 MAKE-UP/GALLONS	21 SPACE OR ZONE TEMP.	22 DEW POINT	23 AIR FLOW - C.F.M.	24 WATER FLOW INDICATION
CH-1	CHILLER			●							●	●													●
P-1	HOT WATER PUMP			●																					
P-2	CHILLED WATER PUMP			●																					
P-3	CHILLED WATER PUMP			●																					
P-4	CONDENSER WATER PUMP			●																					
P-4A	CONDENSER WATER PUMP			●																					
CT-1	COOLING TOWER			●							●	●													
B-1	HOT WATER BOILER			●		●						●													
RTU-1	ROOFTOP AIR HANDLER			●		●	●											●				●			
RTU-2	ROOFTOP AIR HANDLER			●		●	●											●				●			
FC-1	FAN COIL			●			●															●			
FC-2	FAN COIL			●			●															●			
FC-3	FAN COIL			●			●															●			
FC-4	FAN COIL			●			●															●			
FC-5	FAN COIL			●			●															●			
FC-6	FAN COIL			●			●															●			
FC-7	FAN COIL			●			●															●			
FC-8	FAN COIL			●			●															●			
FC-9	FAN COIL			●			●															●			
FC-10	FAN COIL			●			●															●			
FC-11	FAN COIL			●			●															●			
FC-12	FAN COIL			●			●															●			
FC-13	FAN COIL			●			●															●			
FC-14	FAN COIL			●			●															●			
FC-15	FAN COIL			●			●															●			
FC-16	FAN COIL			●			●															●			
FC-17	FAN COIL			●			●															●			
FC-18	FAN COIL			●			●															●			
FC-19	FAN COIL			●			●															●			
FC-20	FAN COIL			●			●															●			
FC-21	FAN COIL			●			●															●			
FC-22	FAN COIL			●			●															●			
FC-23	FAN COIL			●			●															●			
FC-24	FAN COIL			●			●															●			
FC-25	FAN COIL			●			●															●			
FC-26	FAN COIL			●			●															●			
IH-1	INTAKE HOOD	●																							
IH-2	INTAKE HOOD	●																							
CTF-1	CT-1 FILTER					●																			
	FREE COOLING BYPASS VALVE																						●		

PLAN MARK		COMPONENT CONTROL											CONTROL SET POINT											
	25 GRAPHICS	26 OFF - ON	27 SLOW - FAST	28 VARY SPEED	29 GEN. ICE STOR.-TON/HRS.	30 CON. ICE STOR.-TON/HRS.	31 OPEN - CLOSE	32 PRIMARY DAMPER MODUL.	33 FAN MTR. ON/OFF	34 CURRENT LIMITER	35 RUN TIME TOTALIZATION	36 BTU TOTALIZATION	37 AIR TEMPERATURE	38 SPACE DEMAND	39 SPACE TEMP.	40 WATER TEMPERATURE	41 FILTER PRESS. DIFF.ALARM	42 CO_2	43 MAKE-UP ALARM	44 AIR PRESSURE	45 WATER PRESSURE DIFF.	46 DEMAND	47 HUMIDITY-HI LIMIT	48 OPEN - CLOSE
CH-1		●									●					●								
P-1		●									●													
P-2		●									●													
P-3		●									●													
P-4		●									●													
P-4A		●									●													
CT-1		●		●							●					●								
B-1		●									●					●								
RTU-1		●						●	●		●				●									
RTU-2		●						●	●		●				●									
FC-1		●							●		●				●									
FC-2		●							●		●				●									
FC-3		●							●		●				●									
FC-4		●							●		●				●									
FC-5		●							●		●				●									
FC-6		●							●		●				●									
FC-7		●							●		●				●									
FC-8		●							●		●				●									
FC-9		●							●		●				●									
FC-10		●							●		●				●									
FC-11		●							●		●				●									
FC-12		●							●		●				●									
FC-13		●							●		●				●									
FC-14		●							●		●				●									
FC-15		●							●		●				●									
FC-16		●							●		●				●									
FC-17		●							●		●				●									
FC-18		●							●		●				●									
FC-19		●							●		●				●									
FC-20		●							●		●				●									
FC-21		●							●		●				●									
FC-22		●							●		●				●									
FC-23		●							●		●				●									
FC-24		●							●		●				●									
FC-25		●							●		●				●									
FC-26		●							●		●				●									
IH-1							●																	
IH-2							●																	
CTF-1		●											●											
FREE COOLING BYPASS VALVE							●																	

PLAN MARK	ALARMS								NOTES
	49 ABNORMAL OFF	50 ICE STORAGE - TONS	51 TEMPERATURE: HIGH/LOW	52 SPACE TEMP. HI/LOW	53 PRESSURE: HIGH/LOW	54 FREEZESTAT	55 FILTER ΔP: HIGH/LOW	56 AB NORMAL CONDITION	
CH-1	●							●	
P-1	●								
P-2	●								
P-3	●								
P-4	●								
P-4A	●								
CT-1	●								
B-1	●								
RTU-1	●			●		●			③
RTU-2	●			●		●			③
FC-1	●			●		●			③
FC-2	●			●		●			③
FC-3	●			●		●			③
FC-4	●			●		●			③
FC-5	●			●		●			③
FC-6	●			●		●			③
FC-7	●			●		●			③
FC-8	●			●		●			③
FC-9	●			●		●			
FC-10	●			●		●			③②
FC-11	●			●		●			③
FC-12	●			●		●			③
FC-13	●			●		●			
FC-14	●			●		●			③②
FC-15	●			●		●			③
FC-16	●			●		●			③②
FC-17	●			●		●			③②
FC-18	●			●		●			③
FC-19	●			●		●			③②
FC-20	●			●		●			③②
FC-21	●			●		●			
FC-22	●			●		●			②
FC-23	●			●		●			
FC-24	●			●		●			
FC-25	●			●		●			
FC-26	●			●		●			
IH-1									①
IH-2									①
CTF-1									
FREE COOLING BYPASS VALVE									

① INTERLOCK INTAKE HOOD DAMPER TO FAN COIL UNITS SERVED BY EACH INTAKE.
② INTERLOCK EXHAUST FAN SERVING SAME SPACE AS FAN COIL UNIT.
③ UNITS HAVE SMOKE DETECTOR IN SUPPLY AIR DUCT.

NOTE:
INPUT/OUTPUT SUMMARY IS FOR REFERENCE ONLY. CONTRACTOR TO PROVIDE ALL DEVICES REQUIRED TO MEET THE SEQUENCE OF OPERATION.

SEQUENCE OF OPERATION

ROOFTOP AIR HANDLER (RTU-1 & RTU-2)

A. TIME SCHEDULE: START AND STOP SUPPLY FANS IN ACCDORDANCE TO THE SCHEDULE DETERMINED BY OWNER. DETERMINE FAN STATUS BY THE CURRENT RELAY SWITCHES. IF FAN FAILS TO TO START AS COMMANDED, SIGNAL ALARM.

B. SAFETY DEVICES:
1. FREEZE PROTECTION: STOP FANS, OPEN HEATING COIL VALVE, AND CLOSE OSA DAMPERS IF MIXED AIR TEMPERATURE IS BELOW 37°F.; SIGNAL ALARM. IF TEMPERATURE REMAINS BELOW 37°F, STOP FANS AND ALARM DDC SYSTEM.
2. SMOKE DETECTOR: IF SMOKE IS DETECTED, THE FIRE ALARM SYSTEM SHALL STOP THE FANS.

C. WALL MOUNTED TEMPERATURE SENSORS SHALL SEND A SIGNAL TO IN TURN MODULATE THE HEATING AND COOLING VALVES TO MAINTAIN PROGRAMMABLE HEATING AND COOLING SETPOINTS. BOTH RTU-1 & RTU-2 SHALL EITHER BE IN THE COOLING OR THE HEATING MODE. AT NO TIME WILL THE HEATING AND COOLING COILS OPERATE SIMULTANEOUSLY.

D. TEMPERATURE SHALL BE MAINTAINED BY MODULATING 3-WAY CONTROL VALVES.

E. OUTSIDE, RETURN, AND RELIEF DAMPERS:
1. WHEN SUPPLY FAN IS "OFF", OUTSIDE AND RELIEF DAMPERS ARE CLOSED.
2. WHEN OCCUPIED MODE IS FIRST INITIALIZED, SYSTEM IS IN MORNING WARM-UP / COOL-DOWN MODE, OUTSIDE AND RELIEF DAMPERS ARE CLOSED.
3. WHEN MORNING WARM-UP / COOL-DOWN CYCLE ENDS , AND SYSTEM BEGINS NORMAL OCCUPIED OPERATION, OUTSIDE AND RELIEF DAMPERS OPEN MOVES TO PRESET POSITIONS FOR PROPER VENTILATION RATE.
4. THE DDC SYSTEM SHALL MODULATE THE 0-100% ECONOMIZER TO PROVIDE "FREE" COOLING WHEN OUTSIDE AIR TEMPERATURE IS BELOW 78°F. WHEN OUTSIDE AIR TEMPERATURE IS ABOVE 78°F MIXED AIR DAMPERS SHALL MOVE TO MIN. OUTSIDE AIR POSITION AS SCHEDULED.

FAN COIL UNITS:

A. TIME SCHEDULE: START AND STOP SUPPLY FANS IN ACCDORDANCE TO THE SCHEDULE DETERMINED BY OWNER.
B. SAFETY DEVICES:
1. FREEZE PROTECTION: STOP FANS, OPEN HEATING COIL VALVE, AND CLOSE OSA DAMPERS IF MIXED AIR TEMPERATURE IS BELOW 37°F.; SIGNAL ALARM. IF TEMPERATURE REMAINS BELOW 37°F, STOP FANS AND ALARM DDC SYSTEM.
2. SMOKE DETECTOR: IF SMOKE IS DETECTED, THE FIRE ALARM SYSTEM SHALL STOP THE FANS.

C. WALL MOUNTED TEMPERATURE SENSORS SHALL MODULATE 2-WAY AND / OR 3-WAY HEATING AND COOLING CONTROL VALVES. TO MAINTAIN SPACE TEMPERATURE. AT NO TIME WILL THE HEATING AND COOLING COILS OPERATE SIMULTANEOUSLY.

D. OUTSIDE, RETURN, AND RELIEF DAMPERS:
1. WHEN THE SYSTEM IS OFF OR IN UNOCCUPIED MODE THE DAMPER ON THE COMMON OUTSIDE AIR INTAKE SHALL BE CLOSED. (ALL UNITS SERVED BY THAT INTAKE MUST BE INACTIVE).
2. WHEN OCCUPIED MODE IS FIRST INITIALIZED, SYSTEM IS IN MORNING WARM-UP / COOL-DOWN MODE, OUSIDE AIR DAMPERS ARE CLOSED.
3. WHEN MORNING WARM-UP / COOLING-DOWN CYCLE ENDS, AND SYSTEM BEGINS NORMAL OCCUPIED OPERATION, OUTSIDE AIR DAMPERS OPEN TO PRESET POSITIONS FOR PROPER VENTILATION RATE.

CHILLER / COOLING TOWER

A. CHILLER: THE CHILLER WILL BE CONTROLLED VIA THE MANUFACTURER'S SUPPLIED INTEGRAL CONTROLS. UPON A CALL FOR COOLING AT ANY OF THE ROOM OR ZONE SENSOR LOCATIONS, THE DDC SYSTEM WILL SEND A START SIGNAL TO A CHILLED WATER PUMP AND OPEN THE RESPECTIVE ISOLATION VALVES. UPON PUMP STARTUP AND UPON DETECTION OF WATER FLOW THRU THE RESPECTIVE FLOW SWITCH, THE CHILLER SHALL START. THE LEAD-LAG START-UP FOR THE PUMPS SHALL BE ROTATED ON AN ACTUAL RUNTIME BASIS AS RECORDED AT THE DDC PANEL. THE DDC SYSTEM SHALL GO INTO ALARM WHENEVER A CHILLER OR PUMP FAILS TO START WHEN COMMANDED ON OR WHEN ANY OF THE MONITORED TEMPERATURES ARE OUT OF TOLERANCE. SEE SPECIFICATIONS FOR CHILLER RESET.

B. TOWER: UPON STARTING A CHILLED WATER PUMP, THE COOLING TOWER SHALL OPERATE IN ACCORDANCE TO THE CHILLER MANUFACTURER'S REQUIRED CONDENSER WATER SUPPLY TEMPERATURE. THE DDC SYSTEM SHALL CONTROL THE SPEED OF THE COOLING TOWER FAN THRU THE VFD AS REQUIRED TO MAINTAIN CWS SETPOINT. WHEN THE OUTSIDE AIR IS BELOW 35°F (ADJ), START THE COOLING TOWER FILTER PUMP FOR 30 MINUTES EVERY HOUR.

BOILER

A. THE BOILER SHALL BE CONTROLLED VIA THE MANUFACTURER'S SUPPLIED INTEGRAL CONTROLS. UPON A CALL FOR HEATING AT ANY OF THE ROOM OR ZONE SENSOR LOCATIONS, THE DDC SYSTEM WILL SEND A START SIGNAL TO THE HOT WATER PUMP. UPON DETECTION OF WATER FLOW THE BOILER WILL START. IT SHALL OPERATE ACCORDING TO IT'S INTERNAL CONTROLS TO MAINTAIN THE REQUIRED HOT WATER SUPPLY TEMPERATURE. SEE THE SPECIFICATIONS FOR BOILER RESET.

CENTRAL PLANT OPERATION CONTROL

A. THE CHILLED WATER AND CONDENSER WATER PUMPS SHALL BE INDIVIDUALLY STARTED AND STOPPED THROUGH THE LOCAL DDC CONTROLLER. THERE ARE TWO CHILLED WATER PUMPS ONE OF WHICH SHALL BE USED AS STANDBY. THE PUMPS SHALL ROTATE FROM LEAD TO STANDBY EVERY 200 HOURS OF ELAPSED RUN TIME. THE DDC PANEL SHALL MONITOR PUMP STATUS AND SHALL AUTOMATICALLY SWITCH TO THE BACKUP PUMP IF THE PRIMARY PUMP FAILS. ONCE THE PUMPS HAVE STARTED AND UPON THE DETECTION OF FLOW BY THE LOCAL FLOW SWITCHES, THE CHILLER SHALL BE ENABLED TO START AND OPERATE THROUGH ITS INTERNAL TEMPERATURE CONTROL SYSTEM.

B. THE COOLING TOWER SHALL OPERATE WHENEVER THE CONDENSER WATER PUMP IS OPERATING. AN ELECTRONIC CONDENSER WATER SUPPLY TEMPERATURE SENSOR, SHALL INPUT TO THE LOCAL DDC CONTROLLER FOR CONTROL OF THE COOLING TOWER. THE CONTROLLER SHALL OPERATE THE VARIABLE FREQUENCY DRIVE SERVING THE COOLING TOWER AS REQUIRED IN ORDER TO MAINTAIN 85° CONDENSER WATER SUPPLY TEMPERATURE DURING CHILLER OPERATION.

C. THE DDC SYSTEM SHALL ALLOW FOR ANY COMBINATION OF CHILLERS, COOLING TOWERS AND PUMPS TO OPERATE AS DESIRED BY THE SYSTEM OPERATOR.

D. THE HOT WATER WATER PUMP SHALL BE STARTED AND STOPPED THROUGH THE LOCAL DDC CONTROLLER. ONCE THE PUMP HAS STARTED AND UPON THE DETECTION OF FLOW BY THE LOCAL FLOW SWITCH, THE BOILER SHALL BE ENABLED TO START AND OPERATE THROUGH ITS INTERNAL TEMPERATURE CONTROL SYSTEM.

E. THE DDC SYSTEM SHALL EMPLOY A DEW POINT SENSOR TO CONTROL THE WATER SIDE ECONOMIZER. THE CONTROLLER SHALL OPERATE THE 3-WAY VALVES TO BYPASS THE CHILLER AND PROVIDE "FREE" COOLING WHEN AMBIENT CONDITIONS PERMIT.
TEMPERATURE SET POINTS FOR CHILLED WATER SUPPLY AND COOLING TOWER WATER SUPPLY SHALL BE FULLY ADJUSTABLE AND AS DETERMINED BY OWNER.

OPERATION MANUAL:

A BOUND OPERATION MANUAL SHALL BE PROVIDED GIVING STEP-BY-STEP INSTRUCTIONS ON HOW TO OPERATE DDC SYSTEM AND MODIFY SET POINTS. ALL SET POINTS SHALL BE LISTED AND INDEXED TO THE PROPER PAGE OF THE MANUAL. SEE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

RECORD DRAWINGS

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Sheet Title MECHANICAL & ELECTRICAL COORDINATION SHEET

Job Title CITY OF LAS VEGAS DEPARTMENT OF PARK AND LEISURE ACTIVITIES
DURANGO RECREATION FACILITY

Verify all Dimensions and Conditions at the Site

Job 960901

Date 2-20-98

Drawn By DGD

Check KJK

Sheet M5.2

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