

**GENERAL**  
SOFTWARE INTERLOCK THE OPERATION OF THE ENERGY RECOVERY VENTILATOR WITH THE OPERATION OF THE AIR-HANDLING SYSTEMS.  
START THE ENERGY RECOVERY VENTILATOR WHEN ANY ONE OF THE AIR-HANDLING UNITS ARE OPERATING IN AN OCCUPIED MODE. STOP THE ENERGY RECOVERY VENTILATOR WHEN ALL AIR-HANDLING UNITS ARE OPERATING IN AN UN-OCCUPIED MODE.

**START**  
THE DDC CONTROLLER SHALL BE PROVIDED WITH AN INTERNAL TIME CLOCK.  
A START COMMAND SHALL, THROUGH THE DDC CONTROLLER, PERFORM THE FOLLOWING:

- OPEN THE EXHAUST AIR ISOLATION DAMPER (ZZ1)
- ENERGIZE THE EXHAUST FAN VARIABLE FREQUENCY DRIVE (XS1)
- OPEN THE OUTDOOR AIR ISOLATION DAMPER (ZZ2)
- OPEN THE SUPPLY AIR ISOLATION DAMPER (ZZ3)
- ENERGIZE THE WHEEL (XS2), CONTROL SUPPLY AIR TEMPERATURE AND FREEZE PROTECTION
- CONTROL COOLING AND HEATING
- CONTROL SENSIBLE AND LATENT HEAT
- MONITOR SPEED AND FLOW
- MONITOR TEMPERATURE AND HUMIDITY
- PERFORM CALCULATIONS
- SIGNAL THE ECMS OF AN "ON" CONDITION

**STOP**  
A DDC CONTROLLER ISSUED STOP COMMAND SHALL:

- CLOSE THE EXHAUST AIR ISOLATION DAMPER (ZZ1)
- DE-ENERGIZE THE EXHAUST FAN (XS1)
- CLOSE THE OUTDOOR AIR ISOLATION DAMPER
- DE-ENERGIZE THE WHEEL (XS2)
- DE-ENERGIZE THE WHEEL (XS3)
- CLOSE CHILLED WATER CONTROL VALVE (TV5)
- INTERRUPT CALCULATIONS
- SIGNAL THE ECMS OF AN "OFF" CONDITION

**EXHAUST FAN**

A DUCT MOUNTED ELECTRONIC ANALOG STATIC PRESSURE SENSOR/TRANSMITTER (POT8) SHALL, THROUGH THE DDC CONTROLLER, CONTROL THE FAN'S VARIABLE FREQUENCY DRIVE (FZ8) TO MAINTAIN A STATIC PRESSURE SETPOINT OF 1.0 INCHES WATER COLUMN POSITIVE (ADJUSTABLE).

IN THE EVENT THE STATIC PRESSURE FALLS BELOW SETPOINT, MODULATE THE SPEED OF THE FAN (FROM MINIMUM TO MAXIMUM) TO MAINTAIN THE STATIC PRESSURE SETPOINT. IN THE REVERSE (FROM MAXIMUM TO MINIMUM) SHALL OCCUR ON A RISE ABOVE SETPOINT.

COORDINATE AND PROVIDE THE NECESSARY CONTROL INTERFACE WITH THE VARIABLE FREQUENCY DRIVE.

A TIME DELAY OF 20 MINUTES (ADJUSTABLE) SHALL PREVENT THE EXHAUST AIR FAN FROM DE-ENERGIZING ONCE ENERGIZED.

A DIGITAL CURRENT SENSING SWITCH (S1) SHALL, THROUGH THE DDC CONTROLLER, SIGNAL THE ECMS OF ON/OFF STATUS AND A FAILURE CONDITION. IN THE EVENT OF A FAILURE, THE DDC CONTROLLER SHALL ISSUE A STOP COMMAND AND SIGNAL AN ALARM.

A FAILURE OF THE FAN DRIVE AS DETERMINED BY A DIGITAL CURRENT SENSING SWITCH (S1) (PROVIDED WITH THE VFD) SHALL, THROUGH THE DDC CONTROLLER, ISSUE A STOP COMMAND AND SIGNAL THE ECMS OF A FAN FAILURE.

A DIGITAL AIR PRESSURE DIFFERENTIAL SWITCH (PDS3) LOCATED IN THE FAN DISCHARGE AND (PDS4) LOCATED IN THE FAN INLET SHALL, THROUGH A HARDWIRED INTERLOCK, DE-ENERGIZE THE SUPPLY FAN WHEN THE PRESSURE REACHES 3.0 INCHES WATER COLUMN (ADJUSTABLE). THE SWITCH SHALL BE HARDWIRED INTO THE FAN STARTING CIRCUIT AND DE-ENERGIZE THE FAN IN THE MANUAL AND AUTOMATIC MODE OF OPERATION. IN ADDITION TO DE-ENERGIZING THE FAN, THE SWITCH SHALL, THROUGH THE DDC CONTROLLER, ISSUE A STOP COMMAND AND SIGNAL THE ECMS OF AN ALARM CONDITION.

**SUPPLY AIR FAN**

A DUCT MOUNTED ELECTRONIC ANALOG STATIC PRESSURE SENSOR/TRANSMITTER (POT7) SHALL, THROUGH THE DDC CONTROLLER, CONTROL THE FAN'S VARIABLE FREQUENCY DRIVE (FZ7) TO MAINTAIN A STATIC PRESSURE SETPOINT OF 0.50 INCHES WATER COLUMN POSITIVE (ADJUSTABLE).

IN THE EVENT THE STATIC PRESSURE FALLS BELOW SETPOINT, MODULATE THE SPEED OF THE FAN (FROM MINIMUM TO MAXIMUM) TO MAINTAIN THE STATIC PRESSURE SETPOINT. IN THE REVERSE (FROM MAXIMUM TO MINIMUM) SHALL OCCUR ON A RISE ABOVE SETPOINT.

COORDINATE AND PROVIDE THE NECESSARY CONTROL INTERFACE WITH THE VARIABLE FREQUENCY DRIVE.

A TIME DELAY OF 20 MINUTES (ADJUSTABLE) SHALL PREVENT THE SUPPLY AIR FAN FROM DE-ENERGIZING ONCE ENERGIZED.

A DIGITAL CURRENT SENSING SWITCH (S2) SHALL, THROUGH THE DDC CONTROLLER, SIGNAL THE ECMS OF ON/OFF STATUS AND A FAILURE CONDITION. IN THE EVENT OF A FAILURE, THE DDC CONTROLLER SHALL ISSUE A STOP COMMAND AND SIGNAL AN ALARM.

A FAILURE OF THE FAN DRIVE AS DETERMINED BY A DIGITAL CURRENT SENSING SWITCH (S2) (PROVIDED WITH THE VFD) SHALL, THROUGH THE DDC CONTROLLER, ISSUE A STOP COMMAND AND SIGNAL THE ECMS OF A FAN FAILURE.

A DIGITAL AIR PRESSURE DIFFERENTIAL SWITCH (PDS1) LOCATED IN THE FAN DISCHARGE AND (PDS2) LOCATED IN THE FAN INLET SHALL, THROUGH A HARDWIRED INTERLOCK, DE-ENERGIZE THE SUPPLY FAN WHEN THE PRESSURE REACHES 3.0 INCHES WATER COLUMN (ADJUSTABLE). THE SWITCH SHALL BE HARDWIRED INTO THE FAN STARTING CIRCUIT AND DE-ENERGIZE THE FAN IN THE MANUAL AND AUTOMATIC MODE OF OPERATION. IN ADDITION TO DE-ENERGIZING THE FAN, THE SWITCH SHALL, THROUGH THE DDC CONTROLLER, ISSUE A STOP COMMAND AND SIGNAL THE ECMS OF AN ALARM CONDITION.

**SUPPLY DUCT STATIC PRESSURE SETPOINT RESET**

WHEN THE SYSTEM OPERATING UNDER NORMAL MODE, THE SUPPLY DUCT STATIC PRESSURE SETPOINT SHALL BE RESET IN RESPONSE TO THE POSITION OF VAV UNIT PRIMARY AIR DAMPERS.

THE ECMS SHALL MONITOR THE DAMPER POSITION OF EACH VAV UNIT CONNECTED TO THE FAN SYSTEM. THE ECMS SHALL, THROUGH THE DDC CONTROLLER, LOWER THE SUPPLY DUCT STATIC PRESSURE SETPOINT IN 0.10 INCHES WATER COLUMN (ADJUSTABLE) INCREMENTS AT 30 MINUTE INTERVALS (ADJUSTABLE) UNTIL THE VAV UNIT WITH THE LARGEST DEMAND (DAMPER CLOSEST TO FULL OPEN) REACHES 90 PERCENT (ADJUSTABLE) OPEN.

IF ANY VAV UNIT DAMPER CONNECTED TO THE AIR HANDLING SYSTEM IS 100 PERCENT OPEN CONTINUOUSLY FOR MORE THAN A ONE MINUTE (ADJUSTABLE) TIME PERIOD, INCREMENTALLY INCREASE THE SUPPLY DUCT STATIC PRESSURE SETPOINT IN 0.10 INCHES WATER COLUMN (ADJUSTABLE) INCREMENTS AT 2 MINUTE (ADJUSTABLE) INTERVALS UNTIL ALL DAMPERS ARE 95 PERCENT (ADJUSTABLE) OPEN OR LESS.

THE RESET ROUTINE SHALL BE EASILY ENABLED AND DISABLED BY THE ECMS OPERATOR THROUGH A SOFTWARE TOGGLE ON THE SYSTEM GRAPHIC.

**EXHAUST DUCT STATIC PRESSURE SETPOINT RESET**

WHEN THE SYSTEM OPERATING UNDER NORMAL MODE, THE EXHAUST DUCT STATIC PRESSURE SETPOINT SHALL BE RESET IN RESPONSE TO THE POSITION OF VAV UNIT EXHAUST AIR DAMPERS.

THE ECMS SHALL MONITOR THE DAMPER POSITION OF EACH VAV UNIT CONNECTED TO THE FAN SYSTEM. THE ECMS SHALL, THROUGH THE DDC CONTROLLER, LOWER THE EXHAUST DUCT STATIC PRESSURE SETPOINT IN 0.10 INCHES WATER COLUMN (ADJUSTABLE) INCREMENTS AT 30 MINUTE INTERVALS (ADJUSTABLE) UNTIL THE VAV UNIT WITH THE LARGEST DEMAND (DAMPER CLOSEST TO FULL OPEN) REACHES 90 PERCENT (ADJUSTABLE) OPEN.

IF ANY VAV UNIT DAMPER CONNECTED TO THE AIR HANDLING SYSTEM IS 100 PERCENT OPEN CONTINUOUSLY FOR MORE THAN A ONE MINUTE (ADJUSTABLE) TIME PERIOD, INCREMENTALLY INCREASE THE EXHAUST DUCT STATIC PRESSURE SETPOINT IN 0.10 INCHES WATER COLUMN (ADJUSTABLE) INCREMENTS AT 2 MINUTE (ADJUSTABLE) INTERVALS UNTIL ALL DAMPERS ARE 95 PERCENT (ADJUSTABLE) OPEN OR LESS.

THE RESET ROUTINE SHALL BE EASILY ENABLED AND DISABLED BY THE ECMS OPERATOR THROUGH A SOFTWARE TOGGLE ON THE SYSTEM GRAPHIC.

**TOTAL ENERGY WHEEL**

A DIGITAL ROTATION SENSING SWITCH (PROVIDED WITH THE WHEEL CONTROL) SHALL, THROUGH THE DDC CONTROLLER, ISSUE A STOP COMMAND AND AN ALARM SIGNAL IN THE EVENT OF A FAILURE CONDITION.

PROVIDE A SIGNAL TO THE WHEEL VFD THAT IS COMPATIBLE WITH THE VFD PROVIDED WITH THE EQUIPMENT.

COOLING MODE: IN THE EVENT THE OUTDOOR TEMPERATURE (TE2) IS GREATER THAN THE WHEEL EXHAUST INLET AIR TEMPERATURE (TE1), MODULATE THE WHEEL SPEED TO MAXIMUM SPEED.

HEATING MODE: IN THE EVENT THE OUTDOOR TEMPERATURE (TE2) IS LESS THAN THE WHEEL EXHAUST INLET AIR TEMPERATURE (TE1) AND THE WHEEL EXHAUST DISCHARGE AIR TEMPERATURE (TE3) IS GREATER THAN THE FRESH TEMPERATURE SETPOINT, MODULATE THE WHEEL SPEED TO MAINTAIN A WHEEL SUPPLY DESCRIBED AND TEMPERATURE (TE5) SETPOINT OF 55 DEGREES F (ADJUSTABLE).

HEATING/PROTECT MODE: IN THE EVENT THE OUTDOOR TEMPERATURE (TE2) IS LESS THAN THE WHEEL EXHAUST INLET AIR TEMPERATURE (TE1) AND THE WHEEL EXHAUST DISCHARGE AIR TEMPERATURE (TE3) IS GREATER THAN THE FRESH TEMPERATURE SETPOINT OF 15 DEGREES F (ADJUSTABLE), MODULATE THE WHEEL SPEED TO MAINTAIN THE WHEEL EXHAUST DISCHARGE AIR TEMPERATURE (TE4) FROM TEMPERATURE SETPOINT.

**COOLING AND HEATING**

A DUCT MOUNTED ELECTRONIC ANALOG TEMPERATURE SENSOR (TES) SHALL, THROUGH THE DDC CONTROLLER, CONTROL A CHILLED WATER CONTROL VALVE (TV5) AND AN ELECTRIC HEATING COIL (TES) TO MAINTAIN SUPPLY AIR TEMPERATURE AT SETPOINT.

IN THE EVENT THE SUPPLY AIR TEMPERATURE RISES ABOVE COOLING SETPOINT, MODULATE THE CHILLED WATER CONTROL VALVE, FROM CLOSED TO OPEN, TO MAINTAIN THE SUPPLY TEMPERATURE AT SETPOINT.

IN THE EVENT THE SUPPLY AIR TEMPERATURE FALLS BELOW COOLING SETPOINT, MODULATE THE CHILLED WATER CONTROL VALVE, FROM OPEN TO CLOSED, TO MAINTAIN THE SUPPLY TEMPERATURE AT SETPOINT.

IN THE EVENT THE SUPPLY AIR TEMPERATURE DROP BELOW HEATING SETPOINT, ENERGIZE THE ELECTRIC HEATING COIL AND MODULATE THE SCR DRIVE, FROM MIN. TO MAX. TO MAINTAIN THE SUPPLY TEMPERATURE AT SETPOINT.

IN THE EVENT THE SUPPLY AIR TEMPERATURE RISES ABOVE HEATING SETPOINT, MODULATE THE SCR DRIVE, FROM MAX. TO MIN., AND DE-ENERGIZE THE ELECTRIC HEATING COIL TO MAINTAIN THE SUPPLY TEMPERATURE AT SETPOINT.

THE SUPPLY AIR TEMPERATURE SENSOR COOLING SETPOINT SHALL BE 55 DEGREES F AND THE HEATING SETPOINT SHALL BE 52 DEGREES F (ADJUSTABLE).

**ELITE**

ELECTRONIC PRESSURE DIFFERENTIAL SENSOR/TRANSMITTERS (PDS1, PDS2) SHALL, THROUGH THE DDC CONTROLLER, SIGNAL THE ECMS OF PRESSURE DIFFERENTIAL ACROSS THE FILTER BANK AND SIGNAL AN ALARM WHEN THE SETPOINT (ADJUSTABLE) IS REACHED. REFER TO EQUIPMENT SCHEDULE FOR DIRTY FILTER CONDITION TO ESTABLISH SETPOINT.

**FREEZE PROTECTION SYSTEM**

A LOW LIMIT TEMPERATURE SWITCH (TS6) LOCATED ON THE INLET FACE OF THE COOLING COIL SHALL, THROUGH A HARDWIRED INTERLOCK, DE-ENERGIZE THE SUPPLY FAN AND SHALL, THROUGH THE DDC CONTROLLER, ISSUE A STOP COMMAND AND SIGNAL THE ECMS OF AN ALARM CONDITION WHEN A SETPOINT OF 38 DEGREES F (ADJUSTABLE) IS REACHED.

**AIRFLOW CALCULATIONS**

THE SUPPLY AND EXHAUST AIRFLOW SHALL BE MEASURED AND MONITORED. THE TOTAL ENV AIRFLOW FOR BOTH SUPPLY AND EXHAUST SHALL BE CALCULATED BY SUMMING THE AIRFLOW OF EACH VAV UNIT CONNECTED TO THE SYSTEM.

**ENERGY CALCULATIONS**

THE DDC CONTROLLER SHALL CALCULATE THE ENERGY RECOVERY VENTILATOR ENERGY SAVINGS AND USAGE USING THE AIRFLOWS AND THE TEMPERATURES AND HUMIDITY VALUES MEASURED.

THE DDC CONTROLLER SHALL RE-CALCULATE THE VALUE EVERY 1 MINUTE (ADJUSTABLE). TOTALIZE THE VALUES BY HOUR, DAY, MONTH, YEAR AND SINCE INSTALLED.

USE TEMPERATURE AND HUMIDITY VALUES MEASURED TO CALCULATE ENTHALPY FOR USE IN CALCULATING TOTAL COOLING AND HUMIDIFICATION REQUIREMENTS.

CALCULATE ENERGY SAVINGS AND USAGE FOR THE FOLLOWING:

- TOTAL COOLING (TONS AND TON-HOURS)
- SENSIBLE COOLING (TONS AND TON-HOURS)
- HEATING (MBH AND MBTUH)
- HUMIDIFICATION (MBH AND MBTUH)

**CHILLED WATER FLOW CALCULATIONS**

AN ELECTRONIC ANALOG FLOW SENSOR/TRANSMITTER (FT1) SHALL SIGNAL, THROUGH THE DDC CONTROLLER OF FLOW. THE DDC CONTROLLER SHALL CALCULATE THE FLOW RATE IN (GPM) AND TOTALIZE CHILLED WATER CONSUMPTION IN GALLONS FOR EACH HOUR, DAY, WEEK, MONTH, YEAR AND SINCE INSTALLED.

**CHILLED WATER CONSUMPTION CALCULATIONS**

THE DDC CONTROLLER SHALL CALCULATE CHILLED WATER CONSUMPTION IN TONS AND TOTALIZE THE COOLING IN TON-HOURS FOR EACH HOUR, DAY, WEEK, MONTH, YEAR AND SINCE INSTALLED.

THE ECMS SHALL, THROUGH THE DDC CONTROLLER, SIGNAL THE ECMS OF ON/OFF STATUS AND PERFORM A RUNTIME CALCULATION.

**LV LIGHTS**

AUXILIARY CONTACTS FURNISHED WITH LIGHTS SHALL, THROUGH THE DDC CONTROLLER, SIGNAL THE ECMS OF ON/OFF STATUS AND PERFORM A RUNTIME CALCULATION. INTERRUPT CALCULATION WHEN LIGHTS ARE OFF.

**VFD/ECMS INTERFACE**

PROVIDE A COMMUNICATIONS INTERFACE BETWEEN THE ECMS AND EACH VARIABLE FREQUENCY DRIVE (VFD). THE COMMUNICATIONS INTERFACE SHALL ALLOW THE ECMS OPERATION, THROUGH THE ECMS ACCESS TO MONITOR ALL INFORMATION THAN IS AVAILABLE LOCALLY AT THE VFD CONTROL PANEL DISPLAY.

- POWER DEMAND (KW)
- ENERGY USAGE (KWH)

THE ECMS SHALL TOTALIZE ENERGY USAGE FOR EACH VFD BY HOUR, DAY, MONTH, YEAR AND SINCE INSTALLED.

**EQUIPMENT OVERRIDES**

EQUIPMENT SHALL BE MANUALLY CONTROLLED THROUGH THEIR RESPECTIVE HAND-OFF-AUTO SWITCHES AT THEIR RESPECTIVE MOTOR DRIVES.



**BUILDING**

INITIATE A RUNTIME CALCULATION UPON A START COMMAND. CALCULATE RUNTIME IN HOURS AND TOTALIZE THE HOURS FOR EACH DAY, WEEK, MONTH, YEAR AND SINCE INSTALLED. INTERRUPT THE RUNTIME CALCULATION UPON A STOP COMMAND.



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Δ	7-10-07	ADDENDUM 01	
REVISION	DATE	FOR BID	DESCRIPTION
SIGNATURES	DATE		
DR. JS ENG		NATIONAL AERONAUTICS & SPACE ADMINISTRATION LYNNON B. JOHNSON SPACE CENTER HOUSTON, TEXAS	
CH. KW APPR			
REV	PROJECT NO.	SHEET NO.	DATE
DISCP	1640F-247	M705	1640F-247
PE	PROJECT ID	DWG NO.	DATE
APPR	1640F-247	M705	1640F-247