



DDC POINTS LIST						
		INPUT				
	POINT #	POINT DESCRIPTION	TREND	ALARM	GRAPHIC	
ANALOG	AI1	RANGE RETURN AIRFLOW RATE			X	
	AI2	RETURN AIR PRE-FILTER DIFFERENTIAL PRESSURE		X	X	
	AI3	RETURN AIR CARTRIDGE FILTER DIFFERENTIAL PRESSURE		X	X	
	AI4	RETURN AIR HEPA FILTER DIFFERENTIAL PRESSURE		X	X	
	AI5	RETURN FAN SPEED			X	
	AI6	EXHAUST AIR DAMPER POSITION (0-100%)			X	
	AI7	FIRING RANGE SPACE TEMPERATURE	X		X	
	AI8	RETURN AIR TEMPERATURE			X	
	AI9	BYPASS AIR TEMPERATURE			X	
	AI10	DISCHARGE AIR TEMPERATURE			X	
	AI11	CARBON MONOXIDE CONCENTRATION	X	X	X	
	AI12	RANGE SUPPLY AIR RELATIVE HUMIDITY			X	
	AI13	RANGE SUPPLY AIR TEMPERATURE			X	
	AI14	RANGE SUPPLY AIR FLOW RATE			X	
	AI15	RANGE RETURN AIR RELATIVE HUMIDITY	X		X	
	AI16	OUTSIDE AIR TEMPERATURE			X	
	AI17	OUTSIDE AIR RELATIVE HUMIDITY			X	
	AI18	FIRING RANGE SPACE STATIC PRESSURE	X	X	X	
BINARY	BI1	FIRING RANGE STATUS				X
	BI2	DOOR STATUS (TO RVCP ONLY)				X
	BI3	RETURN FAN STATUS				X
	BI4	RETURN FAN VFD FAULT				X
	BI5	DISCHARGE AIR HIGH LIMIT TEMPERATURE				X
	BI6	DISCHARGE AIR LOW LIMIT TEMPERATURE				X
	BI7	BYPASS AIR DAMPER STATUS				X
		OUTPUT				
	POINT #	POINT DESCRIPTION	TREND	ALARM	GRAPHIC	
ANALOG	AO1	FIRING RANGE SPACE STATIC PRESSURE SETPOINT			X	
	AO2	DISCHARGE AIR TEMPERATURE SETPOINT			X	
	AO3	FIRING RANGE SPACE TEMPERATURE SETPOINT			X	
BINARY	BO1	RETURN AIR - START / STOP				
	BO2	EXHAUST DAMPER - OPEN / CLOSE				
	BO3	BYPASS DAMPER - OPEN / CLOSE				

FIRING RANGE AIR HANDLING SYSTEM SEQUENCE OF OPERATION

OVERVIEW:
 THE RANGE AIR HANDLING SYSTEM SHALL BE CONTROLLED EITHER BY THE BUILDING AUTOMATION SYSTEM (BAS) OR LOCALLY THROUGH THE RANGE VENTILATION CONTROL PANEL. THE RANGE VENTILATION CONTROL PANEL SHALL BE LOCATED IN A RECESSED ENCLOSURE AT THE BACK WALL (BEHIND THE FIRING LINE) OF THE RANGE. THE SYSTEM SHALL OPERATE IN THREE MODES: "SAFE-TO-SHOOT", "RANGE SECURED" OR "UNOCCUPIED". MAU-1 AND FAU-1 WILL ALWAYS OPERATE SIMULTANEOUSLY AS A SYSTEM WHEN COMMANDED TO RUN. AN EQUIPMENT FAILURE ALARM ASSOCIATED WITH EITHER UNIT SHALL PREVENT THE SYSTEM FROM ACHIEVING "SAFE-TO-SHOOT" STATUS.

RANGE VENTILATION CONTROL PANEL (RVCP):
 THE RANGE VENTILATION CONTROL PANEL SHALL ALLOW THE RANGE OPERATOR TO START OR STOP THE SYSTEM THROUGH AN ON/OFF SWITCH. WHEN INDEXED TO "OFF", THE SYSTEM SHALL BE UNDER FULL BAS CONTROL. WHEN INDEXED TO "ON", THE SYSTEM SHALL BE STARTED IN PREPARATION FOR LIVE FIRE TRAINING. THE PANEL SHALL HAVE AN INTERACTIVE DISPLAY MODULE THAT REPORTS EQUIPMENT AND SYSTEM STATUS, INCLUDING DOOR STATUSES, AS WELL AS ANY SYSTEM WARNINGS AND ALARMS REPORTED BY THE BAS. THE PANEL SHALL HAVE THE FOLLOWING LIGHTS WITH INDICATOR LABELS:
 1. GREEN - "SAFE-TO-SHOOT", ILLUMINATES ONLY AFTER THE VENTILATION SYSTEM IS BROUGHT TO OPERATIONAL LEVEL AND NO WARNINGS OR ALARMS ARE INDICATED.
 2. RED - "RANGE SECURED", ILLUMINATES ANY TIME THE SYSTEM IS NOT AT THE OPERATIONAL LEVEL.
 3. YELLOW - "WARNING", ILLUMINATES WHENEVER THE BAS REPORTS ANY MONITORED PARAMETER IS OUT OF RANGE.
 4. RED - "ALARM", ILLUMINATES WHENEVER THE BAS REPORTS ANY EQUIPMENT FAILURE OR OTHER ALARM CONDITION.

THE PANEL SHALL HAVE AN AUDIBLE ALARM THAT ACTIVATES WHENEVER AN ALARM CONDITION IS INDICATED AT THE PANEL. INDICATOR LIGHTS ON THE RVCP SHALL ALSO BE USED TO INDICATE THE STATUS OF THE OVERHEAD DOOR, THE PERSONNEL DOORS THAT OPEN ONTO THE RANGE AND THE BULLET TRAP MAINTENANCE AREA DOOR. THE RVCP ALSO INTERACTS WITH FIRING RANGE INTERIOR AND EXTERIOR WARNING LIGHTS. SPECIFICALLY, THE RVCP SHALL PERFORM THE FOLLOWING FUNCTIONS:

- PRIOR TO ACHIEVING "SAFE-TO-SHOOT" STATUS, ANY OPEN DOOR CONDITION SHALL PREVENT THE RVCP FROM ACHIEVING "SAFE-TO-SHOOT" STATUS AND SHALL ILLUMINATE THE YELLOW WARNING LIGHT ON THE RVCP. THE LIGHT SWITCH IN THE BULLET TRAP MAINTENANCE AREA IN THE "ON" POSITION INDICATING THAT SOMEONE MAY BE IN THE MAINTENANCE AREA ALSO PREVENTS THE RVCP FROM ACHIEVING "SAFE-TO-SHOOT" STATUS AND ILLUMINATES THE YELLOW WARNING LIGHT ON THE RVCP.
- IN "SAFE-TO-SHOOT" MODE: IF THE BULLET TRAP MAINTENANCE AREA DOOR STATUS SWITCH INDICATES A DOOR OPEN CONDITION, THE GREEN "SAFE-TO-SHOOT" LIGHT ON THE RVCP IS EXTINGUISHED, THE RED ALARM LIGHT ON THE RVCP ILLUMINATES, AND THE AMBER WARNING LIGHT ON THE RANGE ILLUMINATES. THE VENTILATION SYSTEM OPERATIONAL STATUS REMAINS UNCHANGED.
- IN "SAFE-TO-SHOOT" MODE: IF THE BULLET TRAP MAINTENANCE AREA LIGHT SWITCH IS IN THE "ON" POSITION, THE GREEN "SAFE-TO-SHOOT" LIGHT ON THE RVCP IS EXTINGUISHED, THE RED ALARM LIGHT ON THE RVCP ILLUMINATES, AND THE AMBER WARNING LIGHT ON THE RANGE ILLUMINATES. THE VENTILATION SYSTEM OPERATIONAL STATUS REMAINS UNCHANGED.
- IN "SAFE-TO-SHOOT" MODE: IF ANY OF THE DOOR STATUS SWITCHES FOR DOORS THAT OPEN ONTO THE RANGE INDICATES A DOOR OPEN CONDITION FOR LONGER THAN 2 MINUTES (ADJ.), THE GREEN "SAFE-TO-SHOOT" LIGHT ON THE RVCP IS EXTINGUISHED, THE RED ALARM LIGHT ON THE RVCP ILLUMINATES AND THE AMBER WARNING LIGHT ON THE RANGE VENTILATION CONTROL PANEL ILLUMINATES. THE VENTILATION SYSTEM OPERATIONAL STATUS REMAINS UNCHANGED.
- DOOR STATUS SWITCH AND MAINTENANCE AREA LIGHT SWITCH IN "ON" CONDITION SHALL CLEAR AUTOMATICALLY. WHEN ALL ALARM CONDITIONS HAVE CLEARED, ALL WARNING LIGHTS ON THE RANGE ARE EXTINGUISHED, THE RED ALARM LIGHT ON THE RVCP IS EXTINGUISHED AND THE GREEN "SAFE-TO-SHOOT" LIGHT ILLUMINATES.
- UPON ACHIEVING "SAFE-TO-SHOOT" STATUS, THE RVCP SHALL ACTIVATE THE RED WARNING LIGHTS ON THE EXTERIOR OF THE FACILITY TO INDICATE THAT THE RANGE IS IN USE.

ENABLEMENT:
 1. PRIOR TO COMMENCING LIVE FIRE TRAINING ACTIVITIES, THE RANGE OPERATOR SHALL ENABLE THE SYSTEM FROM THE RANGE CONTROL PANEL THROUGH THE SYSTEM ON/OFF SWITCH, UNLESS THE SYSTEM IS MANUALLY SHUT DOWN OR THE SYSTEM IS DIRECTED BY THE BAS TO SHUT DOWN.
 2. IF AT ANYTIME THE BAS NETWORK LOSES CONTACT WITH THE RANGE VENTILATION CONTROL PANEL, THE SYSTEM SHALL SHUT DOWN. AN EQUIPMENT FAILURE ALARM CONDITION IS INDICATED AT THE RANGE VENTILATION CONTROL PANEL.

RANGE SYSTEM ON/OFF SWITCH:
 1. ON - WHEN THE SYSTEM SWITCH IS INDEXED TO "ON", MAU-1 AND FAU-1 ARE ENABLED.
 2. OFF - THE OUTSIDE AIR DAMPER CLOSURES (MAU-1)
 3. THE RETURN AIR DAMPER OPENS (MAU-1)
 4. ECONOMIZER RELIEF DAMPER IS CLOSED (MAU-1).
 5. THE EXHAUST AIR DAMPER OPENS.
 6. THE BYPASS AIR DAMPER OPENS.
 7. WHEN EACH DAMPER END SWITCH INDICATES THE EACH DAMPER IS FULLY OPEN (ECONOMIZER RELIEF DAMPER REMAINS CLOSED), THE MAU SUPPLY FAN AND FAU RETURN FAN START AND RAMP UP TO THEIR OPERATING SPEEDS THROUGH THEIR VARIABLE FREQUENCY DRIVES (VFD).

- WHEN THE FANS ARE AT THEIR DESIGN AIR FLOW AS INDICATED BY THEIR RESPECTIVE AIR FLOW MEASURING STATIONS AND NO ALARM OR TROUBLE CONDITIONS ARE ACTIVATED, A SIGNAL SHALL BE SENT TO THE RANGE VENTILATION CONTROL PANEL TO DE-ENERGIZE THE RED "RANGE SECURED" LIGHT AND ENERGIZE THE GREEN "READY-TO-SHOOT" LIGHT ON THE RVCP.
 I. IF EITHER FAN OPERATION IS NOT VERIFIED BY A CURRENT SENSING RELAY ON IT MOTOR LEADS WITHIN 60 SECONDS OF ITS START SIGNAL OR AT ANY OTHER TIME WHEN IT IS SUPPOSED TO BE OPERATING, AN EQUIPMENT FAILURE ALARM IS ISSUED FOR THE FAN AND THE SYSTEM IS COMMANDED TO STOP.
 J. IF EITHER FAN HAS NOT REACHED ITS DESIGN AIR FLOW WITHIN 5 MINUTES OF ITS START SIGNAL OR AT ANY OTHER TIME WHEN IT IS SUPPOSED TO BE RUNNING AT DESIGN CAPACITY, AN EQUIPMENT FAILURE ALARM IS ISSUED FOR THE FAN AND THE SYSTEM IS COMMANDED TO STOP.
 K. FAILURE OF ANY OF THESE CONTROL POINTS TO BE SATISFIED SHALL ENERGIZE THE RED "RANGE SECURED" LIGHT ON THE RANGE CONTROL PANEL, ALARM AT THE BAS AND THE RANGE CONTROL PANEL, SOUND AN ALARM HORN AFTER A 5-MINUTE (ADJ) DELAY AND DE-ENERGIZE THE GREEN LIGHT.
- OFF - WHEN THE SYSTEM SWITCH IS INDEXED TO "OFF":
 A. THE SYSTEM IS RETURNED TO BAS CONTROL STATUS.
 B. THE GREEN "READY TO SHOOT" LIGHT IS DE-ENERGIZED.
 C. THE RED "RANGE SECURED" LIGHT IS ENERGIZED.

OPERATION:
 1. "SAFE-TO-SHOOT" - UPON SYSTEM ACHIEVING "SAFE-TO-SHOOT" STATUS:
 A. THE MAU SUPPLY FAN VARIABLE SPEED DRIVE MODULATES THE MAU SUPPLY FAN SPEED TO MAINTAIN DESIGN SUPPLY AIR FLOW.
 B. THE OUTSIDE DAMPER MODULATES, BASED ON THE OUTSIDE AIRFLOW MEASURING STATION, TO MAINTAIN OUTSIDE AIRFLOW AT 25% OF SUPPLY FAN AIR FLOW.
 C. THE FAU RETURN FAN VARIABLE SPEED DRIVE MODULATES THE FAU RETURN FAN SPEED AND THE EXHAUST AIR DAMPER MODULATES TO MAINTAIN 10% (ADJ.) POSITIVE DIFFERENTIAL OF RANGE RETURN AIR FLOW ABOVE RANGE SUPPLY AIR FLOW.

- COOLING REQUIRED - ON A RISE IN SPACE TEMPERATURE ABOVE THE UNOCCUPIED COOLING SET POINT, THE MAU STAGES THE COMPRESSORS AND MODULATES HOT GAS REHEAT TO MAINTAIN THE UNOCCUPIED SPACE COOLING TEMPERATURE SET POINT. ON A FALL IN SPACE TEMPERATURE BELOW THE UNOCCUPIED COOLING SET POINT, THE REVERSE OPERATION SHALL OCCUR.
- HEATING REQUIRED - ON A CONTINUED FALL IN SPACE TEMPERATURE BELOW THE UNOCCUPIED HEATING SET POINT, THE MAU GAS HEAT IS ENABLED AND MODULATES TO MAINTAIN THE UNOCCUPIED SPACE HEATING TEMPERATURE SET POINT. ON A RISE IN SPACE TEMPERATURE ABOVE THE UNOCCUPIED HEATING SET POINT, THE REVERSE OPERATION SHALL OCCUR.

- SPACE PRESSURIZATION
 A. REGARDLESS OF OCCUPANCY MODE, THE BAS SHALL MONITOR FIRING RANGE SPACE PRESSURE. INITIAL RANGE PRESSURE SET POINT SHALL BE -0.03 INCHES WC (ADJ.).
 B. SPACE PRESSURE SHALL BE MAINTAINED BY MODULATING THE RETURN FAN SPEED AND EXHAUST DAMPER. IF SPACE PRESSURE FALLS BY MORE THAN 10% BELOW SET POINT (LESS NEGATIVE), RETURN FAN SPEED SHALL INCREASE AND EXHAUST DAMPER SHALL MODULATE OPEN TO INCREASE RETURN/EXHAUST AIR FLOW UNTIL SET POINT IS SATISFIED. IF SPACE PRESSURE INCREASES MORE 10% ABOVE SET POINT (MORE NEGATIVE), RETURN FAN SPEED SHALL DECREASE AND EXHAUST DAMPER SHALL MODULATE CLOSED UNTIL SET POINT IS SATISFIED.
 C. WHENEVER SPACE PRESSURE IS WITHIN ± 10% OF SET POINT, RETURN FAN SPEED SHALL MODULATE TO MAINTAIN AIR FLOW QUANTITY AS INDICATED IN OPERATION PARAGRAPH ABOVE.

CARBON MONOXIDE (CO) SENSOR:
 ON SENSING CO CONCENTRATION ABOVE 50 PPM (ADJ.) THE BAS COMMANDS THE MAU OUTSIDE AIR DAMPER TO MODULATE OPEN UNTIL THE CO CONCENTRATION FALLS BELOW 50 PPM. ON A FURTHER RISE IN CO CONCENTRATION ABOVE 75 PPM (ADJ.), AN AUDIBLE ALARM IS GENERATED AT THE RVCP AND SENT TO THE BAS. THE ALARM SHALL AUTOMATICALLY RESET ON A FALL IN CO CONCENTRATION BELOW 50 PPM.

ECONOMIZER:
 MAU SHALL OPERATE IN ECONOMIZER MODE WHENEVER THE UNIT IS IN COOLING MODE AND THE OUTDOOR ENTHALPY IS LESS THAN 28 BTU/LB. ECONOMIZER SHALL PROVIDE UP TO 100% OF THE DESIGN SUPPLY AIR QUANTITY AS OUTDOOR AIR FOR COOLING. ECONOMIZER SHALL AUTOMATICALLY REDUCE OUTDOOR AIR INTAKE TO THE DESIGN MINIMUM WHEN OUTDOOR AIR INTAKE WILL NO LONGER SATISFY COOLING DEMAND. ECONOMIZER MODE SHALL BE DISABLED AND MECHANICAL COOLING ENABLED WHENEVER THE UNIT IS IN THE COOLING MODE AND THE OUTDOOR TEMPERATURE IS GREATER THAN 85°F.

- SAFETIES:**
- VFD FAULT - IF A SUPPLY OR RETURN FAN VFD INDICATES A FAULT CONDITION:
 A. THE SYSTEM IS SHUT DOWN
 B. AN EQUIPMENT FAILURE ALARM IS ISSUED, AND
 C. THE CONDITION MUST BE MANUALLY RESET.
 - EQUIPMENT FAILURE ALARMS SHALL BE ISSUED AS FOLLOWS:
 A. FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF
 B. FAN RUNNING IN HAND: COMMANDED OFF, BUT THE STATUS IS ON
 - FILTER DIFFERENTIAL PRESSURE - UPON SENSING EXCESSIVE DIFFERENTIAL PRESSURE ACROSS ANY OF THE FILTER MODULES IN THE AIR HANDLING UNIT:
 A. A WARNING SIGNAL IS SENT TO THE BAS AND TO THE RANGE CONTROL PANEL. SEE FILTER SCHEDULE ON SHEET M-601 FOR RECOMMENDED FILTER FINAL PRESSURES.
 - RANGE SPACE PRESSURE - UPON SENSING SPACE DIFFERENTIAL PRESSURE > -0.01 IN. WC FOR 5 MINUTES:
 A. A WARNING SIGNAL IS SENT TO THE BAS AND TO THE RANGE CONTROL PANEL.
 - HIGH RANGE SPACE PRESSURE - IF RANGE PRESSURE > +0.25 IN. WC FOR 1 MINUTE:
 A. A WARNING SIGNAL IS SENT TO THE BAS AND TO THE RANGE CONTROL PANEL.
 - LOW RANGE SPACE PRESSURE - IF RANGE PRESSURE IS < -0.25 IN. WC FOR 1 MINUTE:
 A. A WARNING SIGNAL IS SENT TO THE BAS AND TO THE RANGE CONTROL PANEL.
 - CARBON MONOXIDE (CO) - UPON SENSING CARBON MONOXIDE (CO) LEVEL ABOVE THE SET POINT (INITIALLY 70-PPM (ADJ.)):
 A. AN ALARM IS ISSUED TO THE BAS AND TO THE RANGE CONTROL PANEL.
 - LOW LIMIT TEMPERATURE (FREEZE/ST) - UPON SENSING A SUPPLY AIR TEMPERATURE BELOW 38°F (ADJ.):
 A. THE SYSTEM SHALL SHUT DOWN
 B. AN ALARM IS ISSUED TO THE BAS AND TO THE RANGE CONTROL PANEL, AND
 C. THE CONDITION MUST BE MANUALLY RESET
 - HIGH LIMIT TEMPERATURE - UPON SENSING A SUPPLY AIR TEMPERATURE ABOVE 100°F (ADJ.):
 A. THE SYSTEM SHALL SHUT DOWN
 B. AN ALARM IS ISSUED TO THE BAS AND TO THE RANGE CONTROL PANEL, AND
 C. THE CONDITION MUST BE MANUALLY RESET

WILMINGTON, NC
HAYNES / LACEWELL
POLICE AND FIRE
TRAINING FACILITY
 3102 LUFKIN STREET, WILMINGTON, NC 28405

DESIGNER
CLARK NEXSEN
 213 South Jefferson, Suite 1011
 Roanoke, Virginia 24011
 540-982-0800
 www.clarknexsen.com
 Clark Nexsen License Number: C-1028



SUBMITTAL
 4 MAY 2018
CONSTRUCTION DOCUMENTS

REVISIONS

NO.	DESCRIPTION

SHEET
CONTROLS

M-802

DESIGN: JLD
 DRAWN: DRL
 REVIEW: EES
 CN 5938