PART 1 - GENERAL

1.1 DRAWING AND SPECIFICATIONS

- .2 THE INSTALLER IS REQUIRED TO VERIFY ALL DIMENSIONS AND ELEVATIONS PRIOR TO PROCEEDING WITH DEMOLITION AND NEW INSTALLATION OF EQUIPMENT OUTLINED IN THE MECHANICAL DRAWINGS SET.
- .3 COORDINATE CONSTRUCTION OF MECHANICAL WORK WITH OTHER TRADES (STRUCTURAL, ARCHITECTURAL, AND ELECTRICAL) AS REQUIRED.
- .4 PROVIDE ALL LABOUR, MATERIALS, EQUIPMENT AND ASSOCIATED SERVICES NECESSARY FOR, AND REQUIRED BY, THE INSTALLATION OF A COMPLETELY FINISHED, TESTED, BALANCED AND PROPERLY OPERATING MECHANICAL SYSTEM AS INCLUDED WITHIN THESE SPECIFICATIONS AND DRAWINGS.

.1 THIS MECHANICAL TRADE CONTRACTOR SHALL WARRANTY ALL THEIR WORK FREE FROM DEFECTS FOR A PERIOD OF ONE (1) YEAR, UNLESS NOTED OTHERWISE, AFTER FINAL ACCEPTANCE OF WORK BY THE OWNER. THIS MECHANICAL TRADE CONTRACTOR SHALL WARRANTY ALL WORK AND EQUIPMENT SUPPLIED BY THEM TO WORK QUIETLY AND SATISFACTORILY AND TO ACCOMPLISH THE WORK FOR WHICH IT WAS INSTALLED DURING THE LIFE OF THE ABOVE WARRANTY. AT ANY TIME DURING THIS PERIOD, THE MECHANICAL CONTRACTOR SHALL MAKE ANY NECESSARY CHANGES AND ADJUSTMENTS OR REPLACEMENTS, TO ACCOMPLISH THIS AT THEIR OWN EXPENSE.

.2 SUBMIT MANUFACTURERS' WRITTEN WARRANTEE'S TO OWNER AND CONSULTANT.

1.3 PERMITS AND REGULATIONS .1 ALL MECHANICAL TRADE CONTRACTORS SHALL COMPLY WITH ALL REGULATIONS OF

AUTHORITIES HAVING JURISDICTION (AHJ). .2 OBTAIN AND PAY FOR ANY PERMITS REQUIRED BY THE LOCAL CODES AND REGULATIONS, INCLUDING ARRANGEMENTS FOR INSPECTION. PROVIDE THE OWNER WITH

A FINAL INSPECTION CERTIFICATE AS REQUIRED. .3 OBSERVE OWNER'S POLICIES AND STANDARDS REGARDING SAFE WORK, SECURITY AS WELL AS APPLICABLE STATUTORY ACTS AND REGULATIONS. PROVIDE ADEQUATE AND APPROPRIATE ACCESSES TO WORK FOR WORKERS. PROVIDE ADEQUATE SAFETY BARRICADES AND OTHER PROTECTIONS AS REQUIRED FOR EXECUTION OF THIS WORK.

CONTRACTOR TO ENSURE ALL MATERIALS ARE IN ACCORDANCE WITH APPLICABLE CODE

1.4 SHOP DRAWINGS

REQUIREMENTS.

.1 THIS MECHANICAL TRADE CONTRACTOR SHALL PREPARE CLEAR AND CONCISE ELECTRONIC PDF SHOP DRAWINGS FOR ALL MECHANICAL EQUIPMENT AND SYSTEMS FOR THIS PROJECT. ALL SHOP DRAWINGS MUST BE FIRST QUALITY REPRODUCTIONS WITH ALL DETAILS, LETTERING, ETC. DISTINCT AND LEGIBLE, MODEL NUMBERS, ITEMS AND OPTIONS MUST BE CLEARLY IDENTIFIED

.2 THE CONSULTANTS REVIEW OF THESE DRAWINGS IS GENERAL. IT IS NOT INTENDED TO RELEASE THE MECHANICAL TRADE CONTRACTOR FROM NECESSITY OF FURNISHING SYSTEMS/EQUIPMENT OF ADEQUATE CAPACITY AND POWER SUPPLY AND PERFORMING THE WORK AS REQUIRED BY THE PLANS AND SPECIFICATIONS

.3 ALL SHOP DRAWINGS MUST BE CHECKED AGAINST THE REQUIREMENTS OF THE PLANS AND SPECIFICATIONS BY THIS MECHANICAL TRADE CONTRACTOR PRIOR TO FORWARDING THEM TO THE CONSULTANT.

.1 DO NOT SUBSTITUTE THE SPECIFIED MATERIALS WITHOUT APPROVAL IN WRITING, INSTALL AND CONCEAL MECHANICAL SYSTEMS IN THE SAME MANNER AS THE EXISTING MECHANICAL SYSTEMS WITHIN THE BUILDING.

.2 ARRANGE AND INSTALL PRODUCTS TO FIT THE DESIGNATED BUILDING SPACES.

1.6 CUTTING AND PATCHING

.1 CUTTING AND PATCHING TO BE PERFORMED BY THE MECHANICAL TRADE CONTRACTOR. .2 MAKE EVERY EFFORT TO MINIMIZE CUTTING AND PATCHING AND PROVIDE DIMENSIONS, LOCATIONS AND OTHER DATA FOR BASES, SLEEVES, BOXES, ETC., TO BE BUILT IN AS CONSTRUCTION PROCEEDS. SET SLEEVES AND MAKE OPENINGS IN CONCRETE FORMS AND MASONRY BEFORE PLACING CONCRETE AND MASONRY.

1.7 PENETRATIONS OF FIRE SEPARATIONS

.1 WHERE PIPES OR DUCTS PASS THROUGH WALLS OR FLOORS WHICH PROVIDE FIRE SEPARATIONS, SEAL AROUND OPENINGS WITH ULC CLASSIFIED FIRE STOP MATERIAL. MATERIAL SHALL BE INSTALLED TO MANUFACTURERS' RECOMMENDATIONS AND SHALL PROVIDE A FIRE RATING EQUAL TO THAT OF THE SEPARATION WHICH HAS BEEN

.2 ACCEPTABLE PRODUCTS: DOW CORNING FIRE STOP SYSTEM; 3M FIRE BARRIER PENETRATION SEALING SYSTEM; BIO-FIRE BIOTHERM OR BIO-K10 (SUPPLIED BY WORMALD); HILTI FIRE STOP SYSTEM.

1.8 CLEANING MECHANICAL EQUIPMENT BEFORE USE

CLEAN INTERIOR AND EXTERIOR OF ALL SYSTEMS INCLUDING STRAINERS.

1.9 RECORD DRAWINGS

.1 MAINTAIN PROJECT "AS-BUILT" RECORD DRAWINGS AND ACCURATELY RECORD SIGNIFICANT DEVIATIONS FROM THE CONTRACT DOCUMENTS, CAUSED BY SITE CONDITION OR CONTRACT CHANGE. MARK CHANGES ON WHITE PRINTS IN "RED" AS CONSTRUCTION PROGRESSES. AT THE COMPLETION OF THE PROJECTS, AND PRIOR TO FINAL INSPECTION, NEATLY TRANSFER "AS-BUILT" CORRECTIONS AND NOTATIONS TO FINAL WHITE PRINTS, AND SUBMIT TO THE CONSULTING CONSULTANT FOR REVIEW. .2 RECORD DRAWINGS SHALL SHOW INVERTS AT THE BEGINNING AND END OF MAIN STORM AND SANITARY BRANCHES, AND AT THE EXIT FROM THE BUILDING. THE BURIED SANITARY MAINS SHALL DIMENSIONED OFF COLUMN CENTRE LINES.

1.10 RENOVATIONS

.1 CO-ORDINATE THE REMOVAL OR SHUTDOWN OF EXISTING SERVICES WITH THE OWNER OR THE OWNER'S REPRESENTATIVE. INDICATE INTENT TO REMOVE AND/OR DISCONNECT EXISTING SERVICES OR EQUIPMENT. BEFORE REMOVAL OF EQUIPMENT PROVIDE OWNER WITH FIRST RIGHT OF REFUSAL BEFORE DISCARDING EQUIPMENT

.2 THE DRAWINGS DO NOT NECESSARILY SHOW ALL EXISTING PIPING, DUCTS, OR EQUIPMENT. WHERE SUCH ITEMS ARE NOT SHOWN TO BE REUSED OR RELOCATED, THE CONTRACTOR, UPON CONFIRMATION SHALL COORDINATE INSTALLATION WITH SUCH

.3 MAINTAIN SERVICES TO, AND RECONNECT ALL EQUIPMENT, DUCTS AND PIPES THAT REMAIN SHOULD SUCH SERVICES BE DISRUPTED DURING THE RENOVATION WORK. .4 IT IS ASSUMED THAT ALL PIPE, DUCT AND EQUIPMENT BEING RETAINED IS SAFE AND ADEQUATE. SHOULD THE CONTRACTOR DISCOVER FAULTY OR QUESTIONABLE MATERIAL,

EQUIPMENT OR WORKMANSHIP, HE SHALL NOTIFY THE CONSULTANT FOR FURTHER INSTRUCTIONS. .5 MATING CONNECTIONS ON THE SYSTEM SHALL BE FIELD VERIFIED TO CONFIRM COMPATIBILITY WITH NEW INTERFACE. MANUFACTURER'S EQUIPMENT NAMEPLATES

.6 PROVIDE ON EACH PIECE OF EQUIPMENT A METAL NAMEPLATE, MECHANICALLY

FASTENED WITH RAISED OR RECESSED LETTERS. .7 LOCATE NAMEPLATES SO THAT THEY ARE EASILY READ. DO NOT INSULATE OR PAINT OVER PLATES

1.11 IDENTIFICATION

.1 IDENTIFY MEDIUM IN PIPING WITH (MARKERS OR) STENCILS SHOWING NAME AND SERVICE INCLUDING TEMPERATURE AND PRESSURE AND DIRECTIONAL FLOW ARROWS WHERE RELEVANT. .2 MATCH EXISTING BUILDING STANDARDS.

PART 2 - PRODUCTS

.1 SPRINKLER PIPING .1 FERROUS: TO NFPA 13, ROLL GROOVED: TO ASTM A795, STEEL, AND SCHEDULE 10 FOR

SIZES UP TO 10"/250 MM. .2 WELDED, THREADED OR CUT GROOVED: SCH. 40 FOR SIZES LESS THAN 8"200 MM, SCH. 30 FOR 8"/200 MM AND OVER.

.3 ABOVE GROUND FITTINGS AND JOINTS PIPE TO NFPA 13: FERROUS: CLASS 150 SCREWED, WELDED, FLANGED, OR ROLL GROOVED.

.4 BOLTS: SQUARE OR HEX HEAD TO ASTM A307. .5 FLANGE GASKETS: 1/16" / 1.5MM THICK CLOTH INSERTED RED RUBBER.

.6 ALL GROOVED PRODUCTS FOR SYSTEMS TO BE ULC LISTED. .7 ALL GROOVED COUPLINGS TO BE COMPLETE WITH ANGLE BOLT PADS TO PROVIDE A RIGID JOINT, EQUAL TO VICTAULIC STYLE 005 FIRELOCK. .8 ALL GROOVED PRODUCTS BY ONE MANUFACTURER.

2.2 PIPE HANGERS

.1EQUIVALENT TO FOLLOWING: .1 SPRINKLER PIPING HANGERS TO NFPA 13 REQUIREMENTS.

.1 ALL CONNECTIONS BETWEEN STEEL AND COPPER OR BRASS FOR PIPE 2"/50MM AND SMALLER SHALL BE MADE OF DI-ELECTRIC UNIONS, EXCEPT ON ALL CLOSED SYSTEMS. ON PIPE 2.1/2" / 65MM AND LARGER USE FLANGED CONNECTIONS WITH NON-METALLIC

GASKET AND PLASTIC SLEEVES FOR BOLTS .2 STANDARD OF ACCEPTANCE: WATTS 3000 SERIES OR EQUIVALENT

2.4 FIRE PROTECTION - SPRINKLERS

CERTIFICATE OF COMPLIANCE.

.1 PROVIDE ALL LABOUR, MATERIAL, PRODUCTS, EQUIPMENT AND SERVICES TO SUPPLY AND INSTALL THE SPRINKLER SYSTEM MODIFICATIONS AS INDICATED ON DRAWINGS. PROVIDE

.2 THE SPRINKLER CONTRACTOR SHALL HYDRAULICALLY DESIGN ALL NEW AND MODIFIED FIRE PROTECTION SYSTEMS AND SHALL BECOME THE ENGINEER OR RECORD FOR THE

.3 PROVIDE ADDITIONAL HEADS AS REQUIRED BY CODE TO ACHIEVE A FULLY SPRINKLERED BUILDING. CENTRE HEADS BOTH WAYS IN CEILING TILES.

.4 INSTALLATION SHALL BE IN COMPLIANCE WITH NFPA 13, GOVERNING AUTHORITIES, OWNER'S INSURANCE UNDERWRITER. ALL COMPONENTS SHALL BE ULC LISTED.

.5 SPRINKLER AND LIFE SAFETY SYSTEMS SHALL REMAIN IN SERVICE AT ALL TIMES. IF SHUTDOWN IS REQUIRED, NOTIFY OWNER 48 HOURS PRIOR TO WORK. ARRANGE AND PAY .6 SPRINKLER SHOP DRAWINGS INCLUDING HYDRAULIC CALCULATIONS SHALL BE SUBMITTED TO

MECHANICAL CONSULTANT IN DUPLICATE FOR REVIEW. DRAWINGS AND CALCULATIONS SHALL BE CERTIFIED BY A PROFESSIONAL ENGINEER. .7 TEST ALL SPRINKLER SYSTEMS TO NFPA 13 REQUIREMENTS. CARRY OUT ANY ADDITIONAL TEST REQUIRED BY THE AUTHORITIES HAVING JURISDICTION.

.1 GENERAL:

.1 ALL DUCTWORK AND HANGERS SHALL BE CONSTRUCTED TO ASHRAE AND SMACNA LOW PRESSURE DUCT CONSTRUCTION STANDARDS.

.2 RECTANGULAR DUCTWORK:

.1 RECTANGULAR DUCT SHALL BE GALVANIZED STEEL. .2 HANGER RODS MUST BE ATTACHED TO THE SHELF ANGLE WITHIN 2"/50MM OF THE

DUCT ON BOTH SIDES. .3 FOR DUCTS 20"/500MM AND SMALLER, 1"/25MM WIDE STRAP HANGERS EXTENDING DOWN TWO SIDES OF THE DUCT AND A MINIMUM OF 6"/150MM UNDER THE BOTTOM OF

.4 STRAP HANGERS MUST BE ATTACHED TO THE DUCT A MAXIMUM OF 2"/50MM FROM THE CORNER AND AT MAXIMUM OF 48"/1200MM CENTRES. HANGERS SHALL BE THE SAME MATERIAL AS THE DUCT

.5 LONGITUDINAL JOINTS SHALL BE PITTSBURG LOCKED OR BUTTON PUNCH SNAP LOCK AND SHALL MEET SMACNA LOW PRESSURE DUCT CONSTRUCTION STANDARDS.

.6 DUCTS 18"/450MM WIDE AND LARGER SHALL BE CROSS BROKEN OR BEADED. .7 ON DUCTS WHICH WILL BE UNDER NEGATIVE PRESSURE DUCTS WILL BE CROSS BROKEN FOR INWARD DEFLECTION.

.3 ROUND DUCT: .1 ROUND DUCTWORK SHALL BE GALVANIZED STEEL OF THE FOLLOWING U.S. STANDARD

.1 DUCT DIAMETER: 3"/75MM - 8"/200MM, SPIRAL DUCT GAUGE 28, PLAIN DUCT GA.

.2 DUCT DIAMETER: 9"/225MM - 14"/350MM, SPIRAL DUCT GAUGE 26, PLAIN DUCT

.3 DUCT DIAMETER: 15"/375MM - 26"/650MM, SPIRAL DUCT GAUGE 24, PLAIN DUCT .2 ON CONCEALED DUCTS UP TO 16"/400MM DIAMETER LONGITUDINAL JOINTS ARE PERMITTED, IN ACCORDANCE WITH SMACNA TYPE RL4 OR SMACNA TYPE RL5.

.3 CONCEALED ROUND DUCTS OVER 16"/400MM DIAMETER AND ALL EXPOSED ROUND DUCTS SHALL BE FACTORY FABRICATED CONDUIT CONSISTING OF HELICALLY WOULD GALVANIZED IRON STRIPS WITH SPIRAL LOCK SEAMS. FITTINGS FOR THESE CONDUITS SHALL BE FABRICATED OF 20 GAUGE GALVANIZED SHEET STEEL WITH BUTT WELDED SEAMS OF STANDARD DIMENSIONS.

.4 ALL LONGITUDINAL JOINTS ARE TO BE SEALED WITH DUCT SEALER OR ALUMINUM TAPE. .5 TRANSVERSE JOINTS BEADED CRIMP JOINTS WITH AT LEAST 1"/25MM LAP TO

ACCOMMODATE SCREWS AT 15"/375MM CENTRES OR A MINIMUM OF 3 PER JOINT. .6 LONG RADIUS ELBOWS SHALL BE USED WHERE SPACE PERMITS, WHERE 90DEG. TAKE-OFFS ARE NECESSARY, CONICAL T'S SHALL BE USED.

2.6 FLEXIBLE DUCTWORK

NEGATIVE

.1 UL LISTED FOR CLASS 1 AIR DUCT MATERIAL, UL181.

.2 IN ACCORDANCE WITH NFPA STANDARD 90A. .3 CONSTRUCTED OF CORROSION RESISTANT, COATED SPRING WIRE BONDED TO A WOVEN

FIBRE GLASS IMPREGNATED FABRIC OR 22 MIL P.V.C. CLOTH. .4 CAPABLE OF OPERATING PRESSURES OF 10"/2.49 KPA POSITIVE AND 2"W.G./O.5 KPA

.5 CAPABLE OF OPERATING TEMPERATURES OF FROM 180C TO 930C.

.6 ACCEPTABLE PRODUCTS: DYN-AIR, THERMAFLEX M-KE OR ATLAS TYPE LD, INSULATED, FOR BOTH INSULATED AND NON-INSULATED DUCT SYSTEMS

2.7 VEHICLE EXHAUST HOSE .1 SIZES UP TO 200mm TO BE NEOPRENE COATED HIGH TEMPERATURE FABRIC WITH

INTERNAL STEEL HELIX.

.2 INTERNAL SPIRAL TO BE GALVANIZED STEEL.

.3 HOSE THICKNESS MINIMUM 0.4mm.

.4 HOSE MINIMUM LENGTH 6000mm. .5 ALL COMPONENTS AND ACCESSORIES SHALL BE SUITABLE FOR 500°C APPLICATIONS. HOSE SHALL BE ABLE TO WITHSTAND 537°C FOR 72 HOURS.

.6 HOSE TO BE SUPPLIED WITH STEEL PULLEY AND ROPE AND LIFTING ELBOW FOR .7 ACCEPTABLE PRODUCTS: PLYMOVENT FABRIC COMPOSITE HOSE, MONOXIVENT, U-LOK 1500./

2.8 BALANCING DAMPERS .1 SINGLE BLADE DAMPERS: OF SAME MATERIAL AS DUCT, BUT ONE SHEET METAL THICKNESS

HEAVIER. V-GROOVE STIFFENED. .1 SIZE AND CONFIGURATION TO RECOMMENDATIONS OF SMACNA. .2 LOCKING QUADRANT WITH SHAFT EXTENSION TO ACCOMMODATE INSULATION THICKNESS.

.3 INSIDE AND OUTSIDE NYLON OR BRONZE END BEARINGS. .4 CHANNEL FRAME OF SAME MATERIAL AS ADJACENT DUCT, COMPLETE WITH ANGLE STOP. .2 MULTI-BLADE DAMPERS:

.1 FACTORY MANUFACTURED OF MATERIAL COMPATIBLE WITH DUCT. .2 OPPOSED BLADE: CONFIGURATION, METAL THICKNESS AND CONSTRUCTION TO

RECOMMENDATIONS OF SMACNA. .3 MAXIMUM BLADE HEIGHT: 4"/100MM.

.4 BEARINGS: PIN IN BRONZE BUSHINGS OR SELF-LUBRICATING NYLON. .5 LINKAGE: SHAFT EXTENSION WITH LOCKING QUADRANT. .6 CHANNEL FRAME OF SAME MATERIAL AS ADJACENT DUCT, COMPLETE WITH ANGLE STOP.

.1 PERFORMANCE RATING: CONFORM TO ANSI/AMCA STANDARDS 210 AND 300. FANS MUST BE

TESTED IN ACCORDANCE TO AMCA PUBLICÁTIONS 211 AND 311 IN AN AMCA ACCREDITED LABORATORY AND CERTIFIED FOR AIR PERFORMANCE. .2 CLASSIFICATION FOR SPARK RESISTANT CONSTRUCTION SHALL CONFORM TO ANSI/AMCA STANDARD 99. .3 FAN WHEEL SHALL BE MANUFACTURED WITH CONTINUOUSLY WELDED STEEL BLADES AND

COATED WITH A MINIMUM OF 2-4 MILS OF PERMATECTOR (POLYESTER URETHANE), ELECTROSTATICALLY APPLIED AND BAKED. .4 MOTORS TO BE NEMA T-FRAME, 690, 870, 1170, 1770 OR 3500 RPM IN 60HZ (720, 950, 1425 OR 2900 IN 50 HZ), OPEN DRIP PROOF (ODP). TOTALLY ENCLOSED FAN COOLED (TEFC), EXPLOSION PROOF (EXP) WITH A 1.15 SERVICE FACTOR.

2.10 HEAT TRACE

.1 REPLACEMENT OF HEAT TRACE COMPONENTS AND CABLING TO CONFORM TO ZONE 2

APPLICATION. .2 CONSTRUCTION

.1 NICKEL-PLATED COPPER BUS WIRES (14 AWG).

.2 NICKEL-PLATED COPPER BRAID. .3 FLUOROPOLYMER OVERJACKET

NOT BE KINKED OR COLLAPSED.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION .1 INSTALL STRAIGHT, PARALLEL AND CLOSE TO WALLS AND CEILINGS, WITH SPECIFIED PITCH.

USE STANDARD FITTINGS FOR DIRECTION CHANGES. .2 INSTALL GROUPS OF PIPING PARALLEL TO EACH OTHER; SPACED TO PERMIT APPLICATION

OF INSULATION, IDENTIFICATION, AND SERVICE ACCESS .3 ALL PIPING SHALL BE RUN CONCEALED IN PIPE SPACES, CHASES AND CEILING SPACES WHERE POSSIBLE. PIPING THAT IS RUN EXPOSED IN FINISHED AREAS SHALL BE LOCATED IN CORNERS, AND BOXED IN. WHERE NOT BOXED IN, PIPING TO BE CHROME PLATED.

.4 RIGHT ANGLE CONNECTIONS IN DRAIN PIPES SHALL BE MADE WITH Y-BRANCHES AND 1/8 BENDS. THE USE OF 90° TEES & ELBOWS IS NOT PERMITTED. .5 EACH FIXTURE SHALL BE PROVIDED WITH BACK VENT CONNECTIONS AND AN INDIVIDUAL

.6 REAM ENDS OF PIPES AND TUBES BEFORE BEING MADE UP. .7 LAY COPPER TUBING SO THAT IT IS NOT IN CONTACT WITH DISSIMILAR METAL AND WILL

.8 USE NON-CORROSIVE LUBRICANT OR TEFLON TAPE APPLIED TO MALE THREAD. .9 CLEAN ALL EXCESS FLUX AND SOLDER FROM JOINTS. .10 GROOVED PIPE ENDS: CUT SQUARE, SEATING SURFACE CLEAN AND FREE FROM INDENT

.11 INSTALL DI-ELECTRIC COUPLINGS WHEREVER PIPING OF DISSIMILAR METALS ARE JOINED. .12 ALL PIPES PASSING UNDER OR THROUGH WALLS OR UNDERGROUND SHALL BE PROTECTED FROM BREAKAGE. ALL PIPES BELOW GRADE SHALL BE CAREFULLY SUPPORTED AND EVERY

PRECAUTION TAKEN AGAINST DAMAGE TO PIPE OR JOINTS. .13 KEEP PIPING FREE FROM SCALE AND DIRT. PROTECT OPEN PIPES DURING CONSTRUCTION, TO PREVENT FOREIGN BODIES ENTERING OR LODGING, USING TEMPORARY PLUGS, TAPE OR OTHER APPROVED MATERIALS FOR PROTECTION.

3.2 PIPE HANGERS

.1 FURNISH AND INSTALL ALL HANGERS REQUIRED FOR THE PROPER SUPPORT OF PIPING IN

.2 SPACE HANGERS FOR HORIZONTAL STEEL AND COPPER PIPING AS FOLLOWS: .1 NOMINAL PIPE SIZE UP TO 1.1/4"/32MM HANGER ROD 3/8" / 10MM AT MAX. SPACING

7'-0"/2.1M STEEL, 6'-0"/1.8M COPPER. .2 NOMINAL PIPE SIZE: 1.1/2"/38MM HANGER ROD 3/8" / 10MM AT MAX. SPACING

9'-0"/2.7M STEEL, 8'-0"/2.4M COPPER. .3 NOMINAL PIPE SIZE 2"/50MM HANGER ROD 3/8"/ 10MM AT MAX. SPACING

10'-0"/3.0M STEEL, 9'-0"/2.7M COPPER. .4 NOMINAL PIPE SIZE: 2.1/2"/65MM HANGER ROD 3/8" / 10MM AT MAX. SPACING 12'-0" 3.3M STEEL, 10'-0"/3.0M COPPER.

.5 NOMINAL PIPE SIZE: 3"/75MM HANGER ROD 3/8" / 10MM AT MAX. SPACING 12'-0"/3.3M STEEL, 10'-0"/3.0M COPPER. .4 BEAM CLAMPS SHALL BE USED WHEN HANGING FROM ANY STRUCTURAL STEEL MEMBERS. NO DRILLING OR WELDING OF THESE MEMBERS SHALL BE PERMITTED UNLESS APPROVED

BY THE STRUCTURAL CONSULTANT. .5 ALL PIPING SHALL BE SECURELY HUNG FROM THE BUILDING STRUCTURE USING APPROVED

.6 HANG ALL PIPING TO AND FROM ANY CIRCULATING PUMPS 2HP/1.5KW AND LARGER WITHIN MECHANICAL ROOM WITH SPRING HANGERS. .7 SUPPORTING BOLTS SHALL BE MAXIMUM SIZE USEABLE WITH THE SPECIFIED HANGER, WITH ADJUSTABLE AND LOCKING STOP UNITS.

.8 HANGER PIPE AND STRUCTURAL ATTACHMENTS SHALL BE OFFSET IN SUCH A MANNER THAT THE ROD IS VERTICAL WHERE THE PIPING IS HOT. .9 HANGERS FOR HEATING PIPING 4"/100MM AND SMALLER SHALL BE LINE SIZE LONG CLEVIS TYPE MYATT 124L OR EQUAL. PRÓVIDE OVERSIZED HANGERS AND SADDLES ON PIPING OVER 4"/100MM WITH CALCIUM SILICATE OR BUCKAROOS BETWEEN THE PIPE AND THE

3.3 FIRE PROTECTION SYSTEM

.1 ALL INSTALLATION WORK TO BE IN ACCORDANCE WITH THE RULES AND REGULATIONS OF THE FIRE MARSHAL'S OFFICE, LOCAL AHJ AND NFPA 13.

.2 ALL PIPING TO RUN CONCEALED EXCEPT WHERE NOTED ON DRAWINGS. ALL MAIN LINES TO BE KEPT AS HIGH AND NEAT AS POSSIBLE. IN UNFINISHED AREAS, SEE NOTES REGARDING PIPING ON DRAWINGS.

.3 ALL PIPING SHALL BE SECURELY HUNG FROM THE BUILDING STRUCTURE USING APPROVED

.4 INSTALL VALVES AND CHECK VALVES AS REQUIRED TO COMPLETE THE SYSTEM AND AS REQUIRED BY THE DRAWINGS. .5 ALL VALVES CONTROLLING WATER SUPPLY TO BE COMPLETE WITH SUPERVISORY SWITCH.

ALARM SYSTEM, TO BE CARRIED OUT BY THE ELECTRICAL CONTRACTOR. .7 EXPOSED PIPING PASSING THROUGH WALLS TO BE SUPPLIED WITH WALL PLATES ON BOTH

.8 EXPOSED PIPING PASSING THROUGH FLOOR AND CEILINGS TO BE SUPPLIED WITH FLOOR AND CEILING PLATES.

.9 PROVIDE EXTENDED ESCUTCHEONS WHERE NECESSARY AND WHERE SHOWN TO CLEAR OBSTRUCTIONS LOCATED BELOW SPRINKLER DEFLECTORS. .10 CO-ORDINATE LOCATIONS OF ALL HOLES REQUIRED FOR PIPES WITH THE WORK OF OTHER TRADES AND PROVIDE PIPE SLEEVES WHERE PIPES PASS THROUGH WALLS AND FLOORS. PACK VOIDS BETWEEN PIPES AND SLEEVES WITH MINERAL WOOL AND OR FIRE STOP MATERIAL AND BETWEEN PIPES AND WALLS AND FLOORS. PIPING MAY BE GROUTED

SOLID AT WALLS, WITHOUT THE USE OF SLEEVES, INSTALLATION OF SLEEVES BY GENERAL .11 INSTALL SYSTEM IN ACCORDANCE WITH APPROVED SHOP DRAWINGS AND MANUFACTURERS' RECOMMENDATIONS.

.12 INSTALL HORIZONTAL VALVES WITH HANDLES PLACED VERTICALLY ON TOP, WHERE SPACE .13 ARRANGE DRAINS AS REQUIRED SO THAT ALL PARTS OF THE SYSTEM CAN BE DRAINED. .14 THIS CONTRACTOR IS TO ENSURE FLOW SWITCH AND SUPERVISED VALVES ARE INSTALLED

WITH SUPERVISORY COMPONENTS PROPERLY CALIBRATED.

3.4 FIRE PROTECTION - FIELD QUALITY CONTROL .1 TEST SYSTEMS IN ACCORDANCE WITH THE APPROPRIATE NFPA CODE AND REQUIREMENTS OF THE OFFICE OF THE FIRE MARSHAL AND OR AHJ.

3.5 DUCTWORK

LOCATION

.1 DUCTWORK AT ALL OTHER LOCATIONS WHERE MOISTURE MAY COLLECT, SHALL BE WELDED OR MADE SUITABLY WATER TIGHT. AT THESE PLACES DUCTWORK SHALL BE SLOPED TOWARDS A LOW POINT WHERE A 1.1/4"/32MM DRAIN WITH A DEEP SEAL TRAP SHALL BE PROVIDED, DISCHARGING THROUGH A COPPER PIPE TO A FUNNEL FLOOR DRAIN.

.2 AT EACH MAIN BRANCH TAKE-OFF AND IN SUCH OTHER LOCATIONS WHERE REQUIRED TO PROPERLY BALANCE THE AIR DISTRIBUTION SYSTEM, FURNISH AND INSTALL VOLUME DAMPERS WHICH SHALL BE PROVIDED WITH DAMPER REGULATORS. WHERE REGULATORS ARE MOUNTED ON INSULATED DUCTS THE REGULATOR SHALL BE MOUNTED ON TOP OF THE INSULATION. .3 A BALANCING DAMPER SHALL BE INSTALLED IN ALL BRANCHES OFF THE MAIN TRUNK

DUCT. ADDITIONAL DAMPERS SHALL BE INSTALLED IN ANY SHORT BRANCHES LEADING TO SUPPLY OR RETURN OUTLETS. IN ALL CASES. SUFFICIENT DAMPERS SHALL BE INSTALLED IN THE BRANCHES SO THAT THE DAMPERS AT THE DIFFUSERS ARE USED FOR "FINE .4 DUCTWORK SHALL BE FREE FROM PULSATION OR OBJECTIONABLE NOISES. SHOULD THESE

DEFECTS APPEAR, THEY SHALL BE CORRECTED BY REPLACING OR REINFORCING THE WORK AS DIRECTED BY THE CONSULTANT AT THE SITE AND WITHOUT CHARGE .5 THE DIMENSIONS OF ANY DUCT MUST BE AS INDICATED ON THE DRAWINGS, EXCEPT WHEREVER ANY CONSTRUCTION IMPEDIMENT OR REQUIREMENT RENDERS SUCH DIMENSIONS IMPOSSIBLE, IN WHICH CASE IT MUST BE ALTERED TO GIVE AN EFFECTIVE CROSS SECTIONAL AREA EQUAL TO THAT WHICH COULD HAVE BEEN OBTAINED FROM THE ORIGINAL AT NO COST TO THE OWNER. WHERE CONFLICTS OCCUR WITH OTHER TRADES, THE CONSULTANT RESERVES THE RIGHT TO MAKE CHANGES IN SITE AND LOCATIONS

WITHOUT EXTRA COST. .6 INSTALL DUCT ELBOWS HAVING A THROAT RADIUS 1.1/2 TIMES THE DIAMETER OR FABRICATED WITH SQUARE THROATS AND BACKS, FITTED WITH DUCT TURNS. DUCT TURNS SHALL BE FABRICATED WITH BLADES OF APPROVED CONSTRUCTION.

.7 ALL DUCT JOINTS SHALL BE COATED WITH DUCT SEALER APPLIED ACCORDING TO

MANUFACTURER'S RECOMMENDATIONS BEFORE ASSEMBLING. .8 ALL DUCTWORK SHALL BE SECURELY HUNG FROM THE BUILDING STRUCTURE USING APPROVED HANGERS.

.1 WHERE SPACE PERMITS ROUND DUCTS OF EQUAL AIR CARRYING CAPACITY MAY BE USED

IN PLACE OF RECTANGULAR DUCTS.

.2 LONG RADIUS ELBOWS SHALL BE USED WHERE SPACE PERMITS. WHERE SPACE IS LIMITED USE MAXIMUM RADIUS POSSIBLE.

.3 90 DEGREE BRANCH TAKE-OFFS SHALL BE MADE WITH CONICAL TEE'S. .4 WHERE SPACE PERMITS BRANCH 45 DEGREE CONICAL BRANCH TAKE-OFFS SHALL BE

.5 BALANCING DAMPERS SHALL BE PROVIDED IN ALL TAKE-OFFS FROM MAINS OR BRANCH

3.6 FLEXIBLE CONNECTIONS

.1 WHERE SHOWN ON THE DRAWINGS AND ON THE INLET AND OUTLET CONNECTIONS OF EACH FAN AND OUTLET OF EACH UNIT, THERE SHALL BE INSTALLED A FLEXIBLE CONNECTION. FLEXIBLE CONNECTIONS SHALL PROVIDE A MINIMUM 3"/75MM OF FABRIC BETWEEN THE

METAL ENDS WHETHER THE EQUIPMENT IS ON OR OFF AND A GROUND STRAP. .2 FLEXIBLE DUCTWORK SHALL NOT HAVE MORE THAN A 15° CHANGE IN DIRECTION. FOR CHANGES IN DIRECTION MORE THAN 15' USE RIGID DUCTWORK FOR THE CHANGE.

3.7 GRILLES, REGISTERS AND DIFFUSERS

.1 ALL GRILLES AND REGISTERS SHALL BE SUPPLIED AND INSTALLED BY THIS SUB-CONTRACTOR. ALL DOOR GRILLES WILL BE SUPPLIED BY THIS SUB-CONTRACTOR AND INSTALLED BY THE MILLWORK OR HOLLOW METAL SUB-CONTRACTOR.

.2 ALL DIFFUSERS, GRILLES AND REGISTERS SHALL BE FREE OF FLUTTERING, CHATTERING AND VIBRATION. A FELT OR SPONGE RUBBER GASKET SHALL BE PROVIDED BEHIND EACH OUTLET AND INLET AND ADEQUATE FASTENING PROVIDED TO PREVENT LEAKING AND DIRT STREAKS BETWEEN THE OUTLET OR INLET AND THE DUCT WALL OR CEILING.

3.8 BALANCING DAMPERS .1 INSTALL BALANCING DAMPERS IN ACCORDANCE WITH RECOMMENDATIONS OF SMACNA AND IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

.2 INSTALL BALANCING DAMPERS WHERE INDICATED ON THE DRAWINGS. IN ADDITION TO LOCATIONS INDICATED, BALANCING DAMPERS ARE TO BE INSTALLED AT ALL TEE'S IN MAIN DUCTS, BRANCH TAKE-OFFS FROM MAIN DUCTS AND IN ALL BRANCH DUCTS TO GRILLES,

DIFFUSERS AND TERMINAL DEVICES. .3 RUNOUTS TO REGISTERS AND DIFFUSERS: INSTALL SINGLE BLADE DAMPERS LOCATED AS CLOSE AS POSSIBLE TO MAIN DUCTS.

.4 ALL DAMPERS ARE TO BE VIBRATION FREE AND SUPPORTED AT BOTH ENDS.

3.9 BALANCING .1 UPON COMPLETION OF THE INSTALLATION OF THE SYSTEM THE CONTRACTOR SHALL

BALANCE THE SYSTEMS: .1 BALANCE SUPPLY AIR, RETURN AIR AND EXHAUST SYSTEMS TO OBTAIN AIR QUANTITIES

AS SHOWN ON THE DRAWINGS (+/-5%).2 SUBMIT A COPY OF THE BALANCING REPORT TO THE OFFICE OF THE OWNER AND TO THE CONSULTANT.

BUILDING AUTOMATION SYSTEM

1. ALL CONTROLS SHALL BE SUPPLIED AND INSTALLED BY MECHANICAL CONTRACTOR. PROVIDE ALL TRANSFORMERS, SOLENOIDS, WIRING AND ANY OTHER HARDWARE AS REQUIRED TO BY A COMPLETE AND FULLY FUNCTIONING CONTROL SYSTEM COMPATIBLE WITH THE EXISTING FOUIPMENT AND JOHNSON CONTROLS METASYS SYSTEM

a.ALL CONTROLS MUST BE ABLE TO INTERFACE WITH METASYS CONTROL SYSTEM. b.CONTROLS CONTRACTOR TO PROVIDE COMMISSIONING SHEETS FOR ALL NEW AND

2.CO/NO2 GAS DETECTION SYSTEM (EXISTING)

FAN.

b.EXISTING SETPOINTS:

EXISTING SYSTEMS OUTLINED IN THIS SPECIFICATION

b.a. 1ST/ ALARM SETPOINT: CO @50 PPM / NO2 @ 0.7 PPM b.b. 2ND/ ALARM SETPOINT: CO @ 100 PPM / NO2 @2.0 PPM O TEST AND COMMISSION EXISTING GAS DETECTION SYSTEM AT END OF

a.EXISTING SYSTEM TO REMAIN. PANEL IS INTERLOCKED WITH MAU-01 SUPPLY/EXHAUST

CONSTRUCTION AND ENSURE SETPOINTS AND ALARMS ARE FUNCTIONAL. 3.GAS-FIRED UNIT HEATERS (EXISTING)

DETECTION SYSTEM. GAS-FIRED UNIT HEATERS SHALL STOP UPON ALARM FROM HYDROGEN DETECTION SYSTEM. 4.MAKE-UP AIR UNIT (EXISTING)

a.MAU-1 IS AN EXISTING 100% FRESH AIR UNIT THAT PROVIDES VENTILATION AND

EXHAUST TO THE SPACE. THE UNIT IS EQUIPPED WITH VARIABLE SPEED DRIVES AND AN

a.PROVIDE NEW INTERLOCK FOR BOTH GAS FIRED UNIT HEATERS WITH HYDROGEN

INDIRECT GAS FIRED HEAT EXCHANGER. THE EXISTING UNIT AND SEQUENCE OF OPERATION TO REMAIN, WITH THE MODIFICATIONS NOTED HERE WITHIN.

b.EXISTING ANALOG INPUTS: b.a. OUTSIDE AIR TEMPERATURE

b.b. SUPPLY AIR TEMPERATURE

b.c. SUPPLY FAN STATIC PRESSURE

b.d. OUTSIDE AIR STATIC PRESSURE

b.e. SPACE STATIC PRESSURE b.f. SUPPLY AIR FLOWRATE

b.g. EXHAUST FAN PLENUM PRESSURE b.h. SUPPLY FAN VFD OUTPUT

b.i. EXHAUST FAN VFD OUTPUT c.EXISTING ANALOG OUTPUTS:

c.b. SUPPLY FAN VFD CONTROL

c.a. GAS CONTROL VALVE POSITION

c.c. EXHAUST FAN VFD CONTROL

c.d. RELIEF AIR DAMPER d.EXISTING BINARY INPUTS

d.a. EXHAUST FAN STATUS d.b. AIR FILTER STATUS

d.c. BUILDING FIRE ALARM STATUS d.d. OUTSIDE AIR DAMPER POSITION

e.EXISTING BINARY OUTPUTS

e.a. OUTSIDE AIR DAMPER OPEN/CLOSE e.b. RELIEF AIR DAMPER OPEN/CLOSE

e.c. SUPPLY FAN START/STOP

e.d. EXHAUST FAN START/STOP

f. SEQUENCE OF OPERATION (EXISTING)

f.a. THE SUPPLY FAN WILL BE STARTED UNDER THE FOLLOWING CONDITIONS:

CONSTRUCTION

f.a.a. THE SOFTWARE HAND-OFF-AUTO SWITCH (HOA) IS SWITCHED TO ON POSITION;

f.a.b. THE SOFTWARE HAND-OFF-AUTO SWITCH (HOA) IS IN AUTO POSITION AND

f.a.c. THE BUILDING OCCUPANCY SCHEDULE IS INDICATING THAT THE SYSTEM SHOULD BE OPERATION; OR,

f.a.d. SPACE TEMPERATURE SENSOR INDICATED SPACE TEMPERATURE FALLING BELOW UNOCCUPIED SET POINT, IN THIS CASE THE SUPPLY FAN WILL RUN UNTIL THE NIGHT SETBACK TEMPERATURE PLUS 1°C (ADJUSTABLE) IS ACHIEVED.

f.a.e. VENTILATION RATE SETBACK WILL ADJUST THE FAN SPEED. f.b. WHEN A FIRE ALARM SIGNAL IS DETECTED, THE FAN WILL SHUT DOWN UNTIL THE

FIRE ALARM SYSTEM IS RESET. f.c. THE SPEED CONTROL PROGRAM WILL BE ENABLED WHENEVER THE SUPPLY FAN

f.d. WHEN THE VFD IS ENABLED, THE SUPPLY FAN WILL HAVE A MINIMUM SPEED OF

30% (ADJUSTABLE).

f.e. THE STATIC PRESSURE AT THE FAN DISCHARGE WILL BE LIMITED TO THE DISCHARGE PRESSURE HIGH LIMIT SET POINT.

f.f. THE FOLLOWING CONDITIONS WILL CAUSE AN ALARM IN THE SYSTEM:

f.f.a. HIGH OR LOW DUCT STATIC PRESSURE

f.f.b. HIGH OR LOW DISCHARGE AIR STATIC PRESSURE f.f.c. SUPPLY FAN FAILURE

f.f.d. EXHAUST FAN FAILURE f.f.e. HIGH OR LOW DISCHARGE AIR TEMPERATURE

f.f.f. AIR FILTER TROUBLE f.g. SUPPLY AIR TEMPERATURE CONTROL:

ACCOMMODATE SPACE HEATING LOAD CHANGES. f.g.b. ON SYSTEM SHUT DOWN GAS FIRED HEAT EXCHANGER WILL BE DISABLED AND OUTSIDE/EXHAUST AIR DAMPERS WILL GO TO FULLY CLOSE.

f.g.a. GAS FIRED HEAT EXCHANGER WILL MODULATE SUPPLY AIR TEMPERATURE TO

f.h. EXHAUST/SUPPLY AIRFLOW CONTROL: THE NEW ADDITION HAS LOW/HIGH SETPOINTS OF CO AND NO2 CONCENTRATION

(REFER TO THE PARAGRAPH OF "GAS DETECTION"). WHEN ANY CONCENTRATION EXCEEDS A THRESHOLD (PPM LEVEL IN AIR) THE FOLLOWING SHALL HAPPENED:

SUPPLY FAN IN MAU-1 WILL BE AT THE SPEED CARRYING 50% (ADJUSTABLE) DESIGN AIRFLOW TO REDUCE THE CO/NO2 LEVEL.

f.h.b. 2ND/ ALARM: f.h.b.a. USE THE ANALOG OUTPUT OF GAS DETECTION PANEL ASSOCIATED WITH THE SUPPLY FAN IN MAU-1 TO RAMP UP THE VFD BETWEEN FIRST ALARM SETPOINTS AND 125PPM(CO)/1.4PPM(NO2) PROPORTIONALLY TO THE DESIGN AIRFLOW. IF CONCENTRATIONS ARE REDUCED AND LOWER THAN FIRST ALARM SETPOINTS, SUPPLY FAN VFD WILL BE BACK TO MINIMUM SPEED AT 35% OF

DESIGN AIRFLOW. f.h.b.b. TURN ON REMOTE HORNS/STROBES LOCATED IN AREA WHERE SECURITY OR MAINTENANCE PERSONNEL CAN BE WARNED OF HIGH CO NO2

f.h.b.c. NOTIFY HIGH ALARM LEVEL CONDITION TO THE BMS AND FIRE ALARM.

COORDINATE WITH DIVISION 16. f.h.c. 3RD/ALARM f.h.c.a. FIRE ALARM SYSTEM TO CALL FIRE DEPARTMENT. COORDINATE WITH DIVISION

g.REVISIONS TO EXISTING SEQUENCE OF OPERATION g.a. THE SUPPLY AIR FAN WILL HAVE A MINIMUM SPEED OF 55% (1400 L/S) UNDER

ALL OPERATING CONDITIONS. g.b. EXHAUST/SUPPLY AIRFLOW CONTROL: AT 1ST/ ALARM FROM GAS DETECTION SYSTEM FOR CO/NO2 OR HYDROGEN SYSTEM, SUPPLY FAN IN MAU-1 TO REMAIN AT 55%

DETECTION SYSTEM: EXHAUST FAN IN MAU-1 TO OPERATE AT 100% SPEED. SUPPLY FAN TO STOP AND OVERHEAD DOORS TO OPEN. g.d. PROVIDE NEW MANUAL EMERGENCY SHUTOFF FOR MAU-1 SYSTEM AND ALARM TO

g.c. EXHAUST/SUPPLY AIRFLOW CONTROL: AT 2ND/ ALARM FROM HYDROGEN GAS

BAS IN EVENT OF ACTIVATION. REFER TO MECHANICAL FLOOR PLANS FOR LOCATION.

5. HYDROGEN GAS DETECTION SYSTEM (NEW): a.GAS DETECTORS ARE CONNECTED TO A MAIN CONTROL PANEL WITH TWO LEVEL ALARM OUTPUTS. REFER TO ELECTRICAL DRAWINGS FOR COORDINATION.

b.a. WARNING AUDIBLE AND VISUAL ALARM PROVIDE WITHIN SPACE

b.b. ALARM NOTIFICATION AT BUILDING AUTOMATION SYSTEM c.SECOND ALARM: 25% LEL

c.d. DEACTIVATION OF EXISTING GAS-FIRED UNIT HEATERS

c.e. SIGNAL TO EXISTING BUILDING FIRE ALARM PANEL

c.a. PROVIDE DISTINCT AUDIBLE AND VISUAL ALARM WITHIN SPACE

c.b. ALARM NOTIFICATION AT BUILDING AUTOMATION SYSTEM c.c. EXHAUST FAN IN MAU-1 TO OPERATE AT 100% AND OVERHEAD DOORS TO OPEN

(REFER TO MAU-1 SEQUENCE)

WHEN MAU-1 IS NOT OPERATING. ALARM TO BE PROVIDED AT BAS FOR OPERATOR. 7. VEHICLE EXHAUST SYSTEM:

a.A VISUAL AND AUDIBLE ALARM WITHIN THE SPACE TO BE PROVIDED AND TO OPERATE

a.a. EXHAUST FANS SHALL BE ACTIVATED BY WALL MOUNTED MANUAL SWITCHES. a.b. INPUT/OUTPUT POINTS F-1 AND F-3

a.b.a. BINARY INPUTS: EXHAUST FAN STAUS

a.b.b. BINARY OUTPUTS: EXHAUST FAN ON/OFF

a.VEHICLE TAIL EXHAUST FANS (F-1 AND F-3)

JCY DRAWN CHECKED JCY DILLON CONSULTING PPROVED JCY

HOR. SCALE

VERTICAL

2023/10/06 JCY

DATE

ESIGNED

JNDERGROUND STRUCTURES SUPV. U/G STRUCTURES DATE ISSUED FOR ADDENDUM 1 2023/11/10 CAL O I ISSUED FOR TENDER

APPROVEI

DATE NOVEMBER 10, 2023

ORIGINAL SEALED BY J. YABLECKI

ENGINEER'S SEAL

ON 2023/10/06

ONSULTANT PROJECT NO.

23-6412

Winnipeg

WINNIPEG TRANSIT ARTIC ROOM MODIFICATIONS

MECHANICAL

THE CITY OF WINNIPEG

TRANSIT DEPARTMENT

DRAWING NUMBER

P-XXXX-

13

CONSULTANT DRAWING NUMBER

21

SPECIFICATION & CONTROL SEQUENCE

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ENGINEERS