1. WATER USED TO DILUTE DOWFROST GLYCOL IN THE PIPING TO HEAT REJECTION SYSTEM MUST BE

EITHER DISTILLED OR DI (DEIONIZED) WATER. IMPURITIES IN DILUTION WATER CAN INCREASE

METAL CORROSION, REDUCE EFFECTIVENESS OF CORROSION INHIBITORS, INCREASE INHIBITOR DEPLETION RATE, CAUSE FORMATION OF SCALE AND OTHER DEPOSITS ON HEAT TRRANSER

2. GAS COCK - APOLLO GAS BALL VALVE 80-100-27 UP TO 3", HOMESTEAD #612-LSD

4. LIQUID VOLUMES: POWER MODULE LG HEX - 7 GALLONS (CUSTOMER SIDE)

2" UP TO 120 LINEAR FEET

2 1/2" FOR 120 TO 320 LINEAR FEET

3" FOR 320 TO 420 LINEAR FEET

FROM CELL FLANGE TO COOLING MODULE CONNECTION):

6. COOLING MODULE RELIEF VALVE IS INTERNAL TO FUEL CELL.

SIZE TO SAFE LOCATION. SIZED FOR 1.1 MMBTH.

SIZE TO SAFE LOCATION. SIZED FOR 2.2 MMBTH.

SHOULD BE SIZED FOR 2 GPM GRAVITY FLOW.

DUE TO PIPE EXPANSION AND SEISMIC MOVEMENTS.

CELL. (PER NFPA 54)

LUBRICATED PLUG VALVE OVER 3", OR APPROVED EQUAL. VALVE MUST BE LOCKABLE.

3. A MAKE UP WATER QUALITY ANALYSIS IS REQUIRED. USE UTC POWER DOCUMENT "STANDARD

WORK FOR MAKE-UP WATER ANALYSIS" TO DETERMINE IF ADDITIONAL WATER TREATMENT

5. COOLING LOOP PIPE SIZING (BASED ON TOTAL LINEAR FEET OF SUPPLY AND RETURN PIPING

7. HIGH GRADE LOOP PRESSURE RELIEF VALVE, EQUAL TO WATTS MODEL 174A. SET HG RELIEF

8. LOW GRADE LOOP PRESSURE RELIEF VALVE, EQUAL TO WATTS MODEL 174A. SET LG RELIEF

PRESSURE APPROPRIATE TO APPLICATION, BUT NOT TO EXCEED 150 PSIG. PIPE FULL OUTLET

PRESSURE APPROPRIATE TO APPLICATION, BUT NOT TO EXCEED 136 PSIG. PIPE FULL OUTLET

9. THE FUEL CELL DRAIN (DEIONIZED WATER) AND AC UNIT DRAIN ARE REQUIRED TO BE PIPED TO A

DRYWELL OR SANITARY DRAIN (STORM DRAIN ONLY WITH LOCAL APPROVAL). THE DRAIN LINE

10. NITROGEN PURGE MANIFOLD AND FRAME ASSEMBLY: AS MANUFACTURED BY AIRGAS ENGINEERING

SOLUTIONS GROUP, PART #V89 ES1464 (FREE STANDING), OR PART #V89 ES1465 (WALL

11. FLEXIBLE CONNECTORS WILL BE INSTALLED AT THE FUEL CELL TO ALLOW FOR PIPE MOVEMENT

PRESSURE AT THE FUEL CELL INLET IS 10 TO 14 INCHES WC AT MAXIMUM GAS FLOW RATE OF

COMPRESSED AIR, NITROGEN, OR OTHER NONFLAMMABLE GAS PRIOR TO CONNECTING TO FUEL

14. PROVIDE A 20 MESH SCREEN Y-TYPE STRAINER WITH BLOW DOWN VALVE, IN THE LG AND HG

17. FOR PURE WATER SYSTEMS, PROVIDE A MAKE UP WATER CONNECTION WITH CODE COMPLIANT

18. IF THE HEAT RECOVERY PUMPS ARE CONTROLLED BY VARIABLE FREQUENCY DRIVES, THE VFD'S SHALL BE PROGRAMMABLE FOR AUTOMATIC RESET AFTER A MOMENTARY OR SHORT TERM POWER

BACKFLOW PREVENTION. FOR GLYCOL SYSTEMS, PROVIDE A PACKAGED GLYCOL MAKE UP WATER

12. GAS FLOW RATE IS BASED ON HIGH HEATING VALUE OF 1,030 BTU/SCF. REQUIRED GAS

4,500 SCFH. CONSULT UTC POWER IF OPERATION BELOW 10 IN. WC IS REQUIRED.

13. NATURAL GAS AND NITROGEN PIPING SHALL BE CLEARED OF FOREIGN MATERIAL USING

PIPING LOOPS. PERFORM INITIAL PIPE FLUSHING WITH A FINE STARTUP STRAINER.

15. PROVIDE A BALANCING VALVE AT DISCHARGE OF EACH HEAT RECOVERY PUMP.

16. PROVIDE AIR SEPARATOR AND EXPANSION TANK AT PUMP SUCTION.

BOTTLES, OR A REVERSE OSMOSIS SYSTEM (RO), IS REQUIRED. PIPING FROM AN RO UNIT TO THE FUEL CELL IS REQUIRED TO BE PVC OR SS. IF CUSTOMER HAS A DEIONIZED (DI) WATER

POWER MODULE HG HEX - 4 GALLONS (CUSTOMER SIDE)

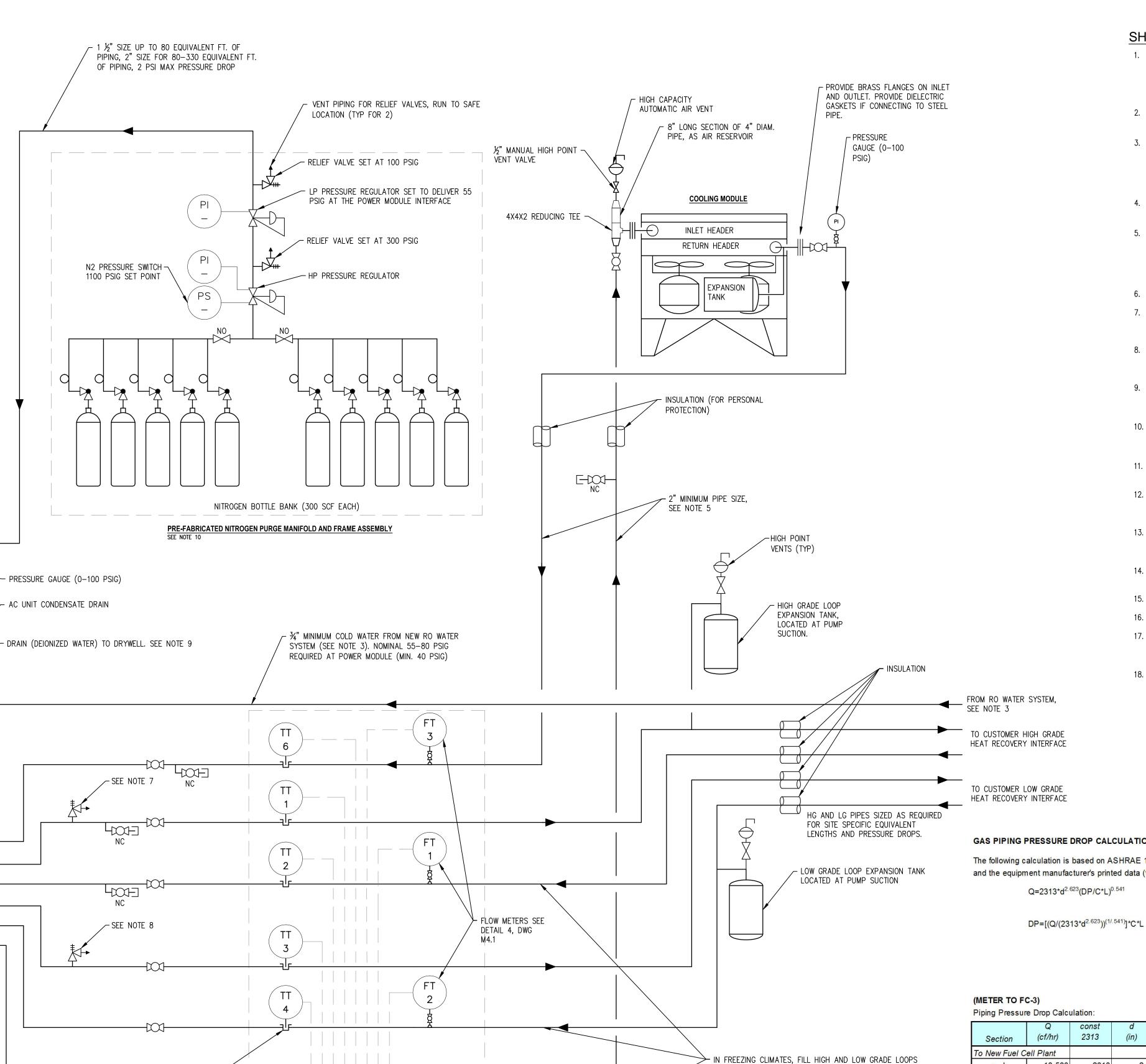
SURFACES, AND CAUSE CLOGGING OF SYSTEM COMPONENTS.

SHEET M3.2

No.028188

Exp. <u>06/30/13</u>

SAME CHANICH OR WAY



WITH 40% DOWFROST BRAND

MANUAL.

PROPYLENE GLYCOL/60% DEIONIZED WATER MIXTURE (SEE

NOTE 1). UTC POWER FILLS COOLING LOOP.

CORROSION INHIBITOR INSTEAD OF DOWFROST.

IN NON-FREEZE CLIMATES A 3%-5% DIPOTASSIUM

PHOSPHATE/DI WATER SOLUTION CAN BE USED AS A

PRESSURE TEST COOLING LOOP PNEUMATICALLY, WITH PIPING CONNECTIONS BLANKED OFF AT POWER MODULE.

PROCEDURES DESCRIBED IN THE MODEL 400 INSTALLATION

FLUSH ALL PIPING SYSTEMS IN ACCORDANCE WITH

GAS PIPING PRESSURE DROP CALCULATION

The following calculation is based on ASHRAE 1993 Fudamentals Handbook, Chapter 33 Gas Pipe Sizing formula (16) and the equipment manufacturer's printed data (total gas consumption = 13,500 SCFH (4,500 SCFM ea. unit)

SHEET NOTES:

SOURCE, THAT CAN BE USED.

d = inside diameter of pipe, (in.) DP = pressure drop, (in. H₂0)

C = factor of viscosity, density, and temperature

 $= 0.00354 (t + 460) s^{0.848} *u^{0.152}$ t = temperature, (degree F)

Q = flow rate at 60 degrees F and 30 in. Hg., (cf/hr)

s = ratio of density of gas to density of air at 60 degree F and 30 in Hg u = viscosity of gas, centipoise (0.012 for natural gas, 0.008 for propane)

L = pipe length, (ft)

Piping Pressure Drop Calculation:				Gas Type:	natural gas						
	Q	const	d	.2 623		L	DP	density	density		
Section	(cf/hr)	2313	(in)	d ^{2.623}	С	(ft)	(in H ₂ 0)	gas	air	s	и
To New Fuel Cell Plant											
a - b	13,500	2313	2.5	11.061	0.598	3	0.5504	0.044	0.075	0.5867	0.012
b - c	13,500	2313	2.5	11.061	0.598	4	0.7339	0.044	0.075	0.5867	0.012
c - d	13,500	2313	2.5	11.061	0.598	1	0.1835	0.044	0.075	0.5867	0.012
d - e	13,500	2313	2.5	11.061	0.598	16	2.9355	0.044	0.075	0.5867	0.012
e - j	9,000	2313	2.5	11.061	0.598	4	0.3469	0.044	0.075	0.5867	0.012
j - k	4,500	2313	2.0	6.160	0.598	<u>17</u>	1.2079	0.044	0.075	0.5867	0.012
k - l	4,500	2313	2.0	6.160	0.598	31	2.2027	0.044	0.075	0.5867	0.012
l - m	4,500	2313	2.0	6.160	0.598	2	0.1421	0.044	0.075	0.5867	0.012
m - n	4,500	2313	2.0	6.160	0.598	4	0.2842	0.044	0.075	0.5867	0.012
n - o	4,500	2313	2.0	6.160	0.598	2	0.1421	0.044	0.075	0.5867	0.012
o - p	4,500	2313	2.0	6.160	0.598	0.5	0.0355	0.044	0.075	0.5867	0.012
Fittings	gs (assume fitting loss equals 110% of line losses)						9.6412				
				1							

1.10 PSI ** 30.45 in WC Starting Pressure: Pressure Drop: 0.67 PSI 18.41 in WC 0.43 PSI ** 12.04 in WC Final Pressure:

* Refer to KAP sketch dated 7/30/12 for gas piping diagram **Regulator delivery at 5 PSIG per R. Stanton; Step down to 10-14 in WC at Fuel Cell per UTC 1 IN WC = 0.036126 PSI

(TYPICAL) FUEL CELL PIPING AND INSTRUMENTATION DIAGRAM

HEAT RECOVERY MONITORING SYSTEM

SYSTEM (OPTIONAL)

-BALL DRAIN VALVE WITH 34" HOSE END CONNECTION

(TYP) AT LOW POINT

INSTRUMENTATION WIRED TO EXTERNAL HRM

TEMPERATURE SENSOR (TYP FOR -

6) SEE DETAIL 3, DWG M4.1

2 1/2"ø GAS LINE FROM NEW METER LOCATED AT THE —

NORTH EAST CORNER OF THE EXISTING CENTRAL PLANT

PSIG DROPPED DOWN TO 1.1 PSIG AT METER.

2 1/2"X2 1/2"X2" TEE WITH 2"Ø NG LINE TO -

FUEL CELL FC-1. EACH FUEL CELL RATED FOR

4,500 SCFH AT 10 TO 14 IN WC GAS PRESSURE.

2 1/2"X2 1/2"X2" TEE WITH 2"ø NG LINE TO -

PROVIDE 1/2" NPT ANALYSIS PORT -

DROP IS ACCEPTABLE. SEE NOTE 2.

GAS COCK SHUTOFF VALVE, AS REQUIRED BY

AND LOCKABLE. 2" VALVE SIZE IF PRESSURE

GAS PRESSURE REGULATOR EXIT PRESSURE 10-

UNUSED HIGH GRADE HEAT IS

INTERNALLY TRANSFERED TO

HIGH GRADE HEX

LOW GRADE HEX

MANUAL MAINTENANCE DISCONNECT

SWITCH (GRID CONNECT)

THE LOW GRADE HEX

NATURAL

GAS

(PI)+xxx+

NITROGEN

WATER TANK

-FLEXIBLE

NOTE 11

AC UNIT

CONNECTORS, SEE

-PIPING SIDE ENTRY

2, DWG M4.1

CONNECTIONS-SEE DETAIL

APPLICABLE CODES, TO BE READILY ACCESSIBLE

(TYPICAL AT EA. FUEL CELL)

PURECELL MODEL 400

POWER MODULE

/ INTERNAL RELIEF VALVE

LOOP, SET AT 150 PSIG

PUMP

HEAT REJECTION BYPASS TO MAINTAIN INTERNAL

WATER BALANCE

ON COOLING MODULE

TO 14 IN. WC

FUEL CELL FC-1. EACH FUEL CELL RATED FOR

4,500 SCFH AT 10 TO 14 IN WC GAS PRESSURE.

BUILDING. INCOMING GAS PRESSURE FROM UTILITY AT 5