

OWNER

Electrical Load Analysis

Calculation



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1. OBJECTIVE

This calculation lists every electrical load in the and establishes the connected load, the normal running demand and the coincident peak demand for winter and summer. From these it confirms the size of the utility transformer XF-101, the service voltage and the service rating, and it sizes the heating and cooling for analyzer shelter B-101 and control building B-102.

2. METHODOLOGY

TORUS assigned each load to its panelboard with its voltage, rating and power factor. Motor input was taken as rated horsepower divided by efficiency; circuit currents use the NFPA 70 full-load current tables. Running demand is the connected load multiplied by a load factor that reflects how the equipment runs in each season: in winter the line heater fires, the shelter heaters run and the lights are on through the long night; in summer the heater is bypassed and the air conditioners carry the building loads.

The coincident peak is the credible worst demand that can occur at one time. For this station it is a cold restart after a utility outage: every heater is at full output, the battery chargers and UPS are recharging, the heat tracing draws its cold-start current, the shutdown valve pumps restart after the emergency shutdown is reset, one meter run is changed over and the gate operates. The diversity factor is the sum of each load's own maximum divided by this coincident peak.

The service is checked two ways: by the NFPA 70 Article 220 calculated load, which applies 125 % to continuous loads and 25 % of the largest motor, and by the demand analysis. The transformer is checked for peak demand with 25 % growth and for the voltage dip of the largest motor starting step. Building heating and cooling follow the ASHRAE heat balance method with the design temperatures in GEN-DB-001, Basis of Design.

3. DESIGN INPUTS

Table 3-1 lists the inputs that govern the calculation.

Table 3-1: Design Inputs

Input	Value	Source
Utility service	Three-phase, 480Y/277 V from pad-mount XF-101, owned by the electric cooperative	GEN-DB-001; HOLD H-10
Ambient design temperatures	-5 °F minimum, 110 °F maximum; ASHRAE 0.4 % cooling 99 °F dry bulb / 74 °F wet bulb	GEN-DB-001
Valve actuation	Electric and self-contained electro-hydraulic actuators only	GEN-DB-001

Input	Value	Source
Stored energy for critical loads	24 VDC and 120 VAC, 8 h	ELE-CAL-003
Line heater operation	Fires in winter; bypassed in summer	GEN-DB-001
Fuel gas preheater E-161	5 kW rated, duty about 4.0 kW at the 105 °F outlet setpoint	PRO-CAL-010
Analyzer shelter ventilation	EF-101A/B, 250 cfm each, duty and standby	ELE-RPT-001; SAF-RPT-003
Area lighting	15 pole luminaires at 150 W, 6 canopy luminaires at 60 W, 4 wall packs at 30 W	ELE-CAL-007
Vendor equipment ratings	Typical values for actuators, analyzers, heaters, HVAC units, UPS and chargers	HOLD H-15

4. ASSUMPTIONS

1. Vendor equipment ratings are typical of the equipment specified. *Verification required against vendor data (HOLD H-15).*
2. The utility provides a three-phase primary to the site and selects XF-101 on the demand in this calculation. *Verification required (HOLD H-10).*
3. The 480 V portable equipment receptacle RCP-101 is used only under a work permit and is excluded from the demand; a 10 kVA allowance is carried in the NFPA 70 calculation.
4. Building envelope U-values are typical of an insulated prefabricated steel building (B-102) and a fiberglass sandwich-panel shelter (B-101). *Verification required against the building vendors' data.*
5. The power demand of the receiving pipeline operator's equipment at the demarcation panel is 100 W. *Verification required (HOLD H-14).*

5. REFERENCES

1. NFPA 70, National Electrical Code, 2023 Edition: Articles 220, 230, 424, 430 and 440, and Table 450.3(A).
2. IEEE 3001.8-2013, Recommended Practice for Evaluating the Electrical Service Requirements of Industrial and Commercial Power Systems.
3. IEEE 141-1993, Recommended Practice for Electric Power Distribution for Industrial Plants (Red Book).
4. ASHRAE Handbook, Fundamentals, 2021 Edition.
5. GEN-DB-001, Basis of Design.

6. ELE-CAL-002, Standby Generator and Transfer Switch; ELE-CAL-003, UPS and Battery Sizing; ELE-CAL-004, Cable Sizing, Short Circuit and Arc-Flash Assessment; ELE-CAL-007, Lighting Design.
7. ELE-RPT-001, Hazardous Area Classification; PRO-CAL-010, Fuel Gas System; SAF-RPT-003, Fire and Gas Detection.
8. ELE-LST-002, Panel Schedules; ELE-DWG-001, One-Line Diagram.

6. CALCULATION

6.1. CONNECTED LOAD AND DEMAND

The complete load register, with each load's rating, running demand and the basis of its load factor, is in Appendix A. Table 6-1 summarizes it by panelboard. The 120 V UPS panel UP-101 and the 24 VDC panel DCP-101 are fed through UPS-101 and the battery chargers, whose input demand on LP-101 already includes their efficiency and battery recharge. The station demand at the service is therefore the sum of DP-101 and LP-101.

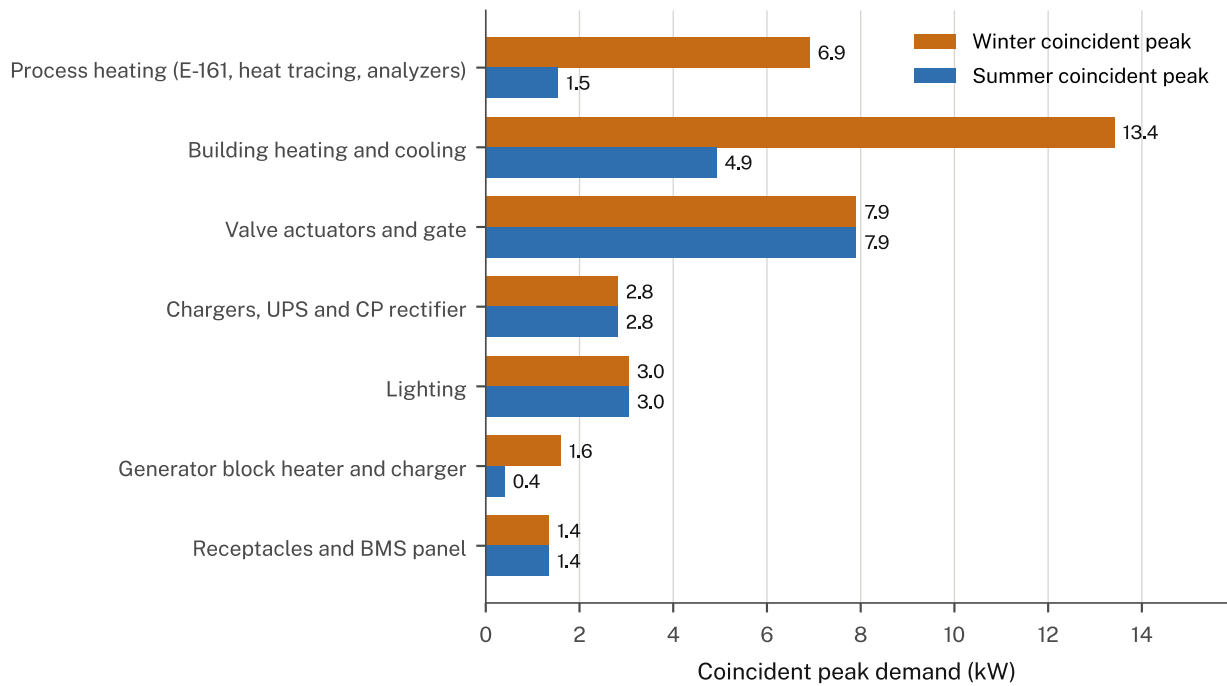
Table 6-1: Load Summary by Panelboard

Panel	Connected, kW	Winter running, kW	Summer running, kW	Winter peak, kW	Winter peak, kVA	Summer peak, kW
DP-101	49.8	17.3	6.6	28.7	31.5	14.2
LP-101	12.6	3.8	3.9	8.3	8.9	7.7
UP-101	0.6	0.4	0.4	0.6	0.7	0.6
DCP-101	0.6	0.6	0.6	0.6	0.6	0.6
Station at service	62.4	21.0	10.4	37.0	40.4	22.0

Note 1: The station totals are DP-101 plus LP-101; UP-101 and DCP-101 are supplied through LP-101.

Figure 6-1 breaks the coincident peak down by type of load. Building heating and cooling and the process heating loads make winter the governing season: the shelter heater, the building heat strips and E-161 all run at full output on a cold restart, while in summer the line heater is bypassed and only the air conditioners add to the base load.

Figure 6-1. Coincident Peak Demand by Load Category, Winter and Summer



The diversity and demand factors are:

IEEE 141, demand and diversity factors

$$F_{div} = \frac{\sum P_{max,i}}{P_{coinc}} = \frac{39.1}{37.0} = 1.05, \quad F_{dem} = \frac{P_{coinc}}{P_{conn}} = \frac{37.0}{62.4} = 0.59$$

The diversity factor is close to unity because the peak was deliberately defined as the cold restart, when almost every load is at its own maximum. This is the right basis for the transformer and generator: a restart after an outage on the coldest night is exactly when the station must not trip its supply.

Connected load 62.4 kW (69.9 kVA). Normal running demand 21.0 kW in winter and 10.4 kW in summer. Coincident peak 37.0 kW, 40.4 kVA, in winter.

6.2. SERVICE RATING

Table 6-2 sets out the NFPA 70 Article 220 calculated load for the service.

Table 6-2: NFPA 70 Article 220 Calculated Service Load

Load group	Connected, kVA	Factor	Calculated, kVA	Basis
Lighting (area, canopy, wall packs, interior)	3.2	1.25	4.0	Continuous, 210.19 / 215.2

Load group	Connected, kVA	Factor	Calculated, kVA	Basis
General receptacles, 12 x 180 VA	2.2	1.00	2.2	220.14(I), 220.44 first 10 kVA at 100 %
RCP-101 480 V portable equipment receptacle	10.0	1.00	10.0	Assumed 10 kVA portable load, 220.14(A)
Motors, 15 actuator/fan/gate motors at NEC FLC	25.6	1.00	25.6	430.24, Table 430.250 / 430.248
25 % of largest motor (MOV-111)	2.5	0.25	0.6	430.24
Fixed electric heating: UH-101, E-161, heat tracing, analyzer, block heater	15.3	1.25	19.2	Continuous; 424.3(B)
B-102 HVAC (one unit; heating 5.4 kW governs over cooling 2.4 kW; lag unit noncoincident)	5.7	1.00	5.7	220.60 noncoincident, 440.34
B-101 AC-101 (noncoincident with UH-101 heating; omitted)	2.2	0.00	0.0	220.60
Chargers, UPS input, CP rectifier (nameplate input)	5.3	1.25	6.6	Continuous
BMS panel, generator battery charger	0.4	1.25	0.5	Continuous
Total			74.4	

The service current is:

NFPA 70-2023, 230.42 and Article 220

$$I_{svc} = \frac{S_{calc}}{\sqrt{3} V_{LL}} = \frac{74.4 \times 1000}{\sqrt{3} \times 480} = 89.4 \text{ A}$$

The demand analysis gives 40.4 kVA, or 48.6 A. A 125 A service is selected. It carries the calculated load with 28 % spare, and it is the largest standard rating that the 75 kVA transformer secondary can supply: NFPA 70 Table 450.3(A) limits secondary protection to 125 % of the transformer's 90.2 A rated current, 113 A, rounded up to the next standard size of 125 A. The service entrance conductors, 4-1/C 1/0 AWG copper, are rated 150 A.

The service is 480Y/277 V, three-phase, four-wire, rated 125 A, with service entrance breaker MCB-101.

6.3. UTILITY TRANSFORMER

With 25 % growth on the coincident peak, the load on XF-101 is:

IEEE 3001.8, transformer loading

$$S_{XF} = 1.25 S_{peak} = 1.25 \times 40.4 = 50.5 \text{ kVA} \leq 75 \text{ kVA}$$

The largest motor step is the three shutdown valve pumps restarting together, 28.5 kVA at starting. With an infinite primary and the transformer's assumed 1.5 % impedance, the secondary short-circuit capacity is 5.00 MVA and the dip is:

IEEE 3001.8, motor starting

$$\Delta V = \frac{S_{start}}{S_{sc} + S_{start}} \times 100 = \frac{28.5}{5000 + 28.5} \times 100 = 0.57 \%$$

The calculated load in Table 6-2, 74.4 kVA, is close to the 75 kVA nameplate only because it applies 125 % to continuous loads, counts every motor at its full-load current and includes the portable receptacle allowance. It sizes the service conductors and equipment; the utility sizes its transformer on the demand, and pad-mount transformers carry short-term overloads well above nameplate. A 45 kVA transformer would be loaded beyond its rating at peak with growth and was rejected.

XF-101 is confirmed at 75 kVA, 480Y/277 V. It is loaded to 54 % at the coincident peak.

6.4. SERVICE VOLTAGE

TORUS compared the 480Y/277 V three-phase service in the Basis of Design with a 240/120 V single-phase service, which a rural cooperative sometimes offers where no three-phase line is available. Table 6-3 compares the two, and Table 6-4 shows the conductor each would need for three representative loads at their routed lengths.

Table 6-3: Service Voltage Comparison

Criterion	480Y/277 V, three-phase	240/120 V, single-phase
Coincident peak current	49 A	168 A
Calculated service current	89 A: 125 A service	310 A: 400 A service
Valve actuator motors	Standard three-phase 460 V designs	Single-phase versions limited; phase converters needed for some
Area lighting	277 V, three circuits of #12 AWG	About twice the current
Utility supply	Needs a three-phase primary (HOLD H-10)	Single-phase line extension is cheaper where no three-phase exists

Table 6-4: Conductor Size for 3 % Voltage Drop

Load	Routed length, ft	Current at 480 V, A	Conductor at 480 V	Current at 240 V, A	Conductor at 240 V
UH-101 7.5 kW heater at B-101	235	9.0	#12	31.2	#6
E-161 5 kW heater at FG-101	190	6.0	#12	20.8	#8

Load	Routed length, ft	Current at 480 V, A	Conductor at 480 V	Current at 240 V, A	Conductor at 240 V
MOV-111 1.5 hp actuator at SK-110	235	2.1	#12	7.3	#12

The 480Y/277 V service is selected. It carries a third of the current of the 240 V option, keeps every actuator on a standard three-phase motor and every branch circuit at #12 or #10 AWG, and matches the generator voltage. The 240/120 V service remains a fallback only if the cooperative cannot extend three-phase to the site; it would need a 400 A service and single-phase actuator motors.

6.5. BUILDING HEATING AND COOLING

The heating load of each building is the conduction loss through walls, roof and floor plus the ventilation air heated from the outdoor design temperature. The cooling load adds solar gain (taken as an equivalent temperature rise of 10 °F on walls and 40 °F on the roof) and internal heat from equipment and occupants:

ASHRAE Fundamentals, heat balance

$$Q_h = \sum UA (T_i - T_o) + 1.08 \dot{V} (T_i - T_o), \quad Q_c = \sum UA (T_o - T_i + \Delta T_{sol}) + 1.08 \dot{V} (T_o - T_i) + Q_{int} + Q_{lat}$$

Table 6-5 gives the results.

Table 6-5: Building Heating and Cooling Loads

Building	Size	Air, cfm	Heat loss, Btu/h	Heater, kW	Cooling with margin, Btu/h	Cooling, ton	Cooling input, kW
B-101	12 x 10 x 9 ft	250	20,000	7.5	11,099	1.5	2.00
B-102	24 x 12 x 10 ft	100	12,168	5.0	16,931	2.0	2.40

Note 1: Heater rating is the heat loss plus 25 %, rounded up to a standard size. Cooling includes 15 % margin and is met by the rated capacity derated 15 % at 110 °F.

Note 2: B-102 internal gains of 1447 W include a 20 % allowance for future equipment.

The analyzer shelter's load is dominated by its ventilation air. B-101 must be adequately ventilated to stay a Division 2 location (ELE-RPT-001), so 250 cfm of outdoor air passes through it continuously and must be heated from -5 °F to 60 °F. The worked heating load is:

ASHRAE Fundamentals, heat balance

$$Q_h = 34.9(65) + 12.0(15) + 1.08(250)(65) = 20,000 \text{ Btu/h} = 5.86 \text{ kW}$$

B-101: unit heater UH-101 7.5 kW and air conditioner AC-101 1.5 ton, both rated Class I, Division 2, with exhaust fans EF-101A/B. B-102: two 2.0 ton wall-mount air conditioners with 5 kW electric heat each, lead and lag, with 100 cfm of filtered outdoor air and a damper that closes on gas detection at the intake.

7. RESULTS AND CONCLUSIONS

Table 7-1 summarizes the results.

Table 7-1: Load Analysis Summary

Item	Result
Connected load	62.4 kW, 69.9 kVA
Normal running demand	21.0 kW winter, 10.4 kW summer
Coincident peak demand	37.0 kW, 40.4 kVA (winter)
Calculated service load	74.4 kVA, 89 A
Service	480Y/277 V, three-phase, four-wire, 125 A
Utility transformer XF-101	75 kVA, 54 % loaded at peak

TORUS draws the following conclusions:

1. The 75 kVA, 480Y/277 V utility transformer in the Basis of Design is confirmed, with 33 % spare after 25 % growth.
2. The service shall be 480Y/277 V, three-phase, four-wire, 125 A.
3. Winter governs the peak demand. The standby generator in ELE-CAL-002 is sized on this peak.
4. The load summary in Table 6-1 and the peak demand shall be sent to the electric cooperative with the service application.

The following items remain open: the utility service and transformer data (HOLD H-10), vendor equipment ratings (HOLD H-15) and the receiving pipeline operator's demarcation load (HOLD H-14).

APPENDIX A. LOAD REGISTER



The tables below list every load by panelboard. Rating is horsepower for motors and kilowatts for other loads. Peak is the larger of the winter and summer coincident values. The load factor basis for each load follows in the last table.

Table A-1: Load Register, DP-101

Tag	Description	Voltage	Rating	Connected, kVA	Winter running, kW	Summer running, kW	Peak, kW
SDV-101	Inlet SDV NPS 12, electro-hydraulic spring-return actuator, pump motor	480 V, 3-ph	1 hp	1.20	0.05	0.05	0.93
SDV-102	OPSS SDV NPS 12, electro-hydraulic spring-return actuator, pump motor	480 V, 3-ph	1 hp	1.20	0.05	0.05	0.93
SDV-103	Outlet SDV NPS 12, electro-hydraulic spring-return actuator, pump motor	480 V, 3-ph	1 hp	1.20	0.05	0.05	0.93
MOV-111	Meter run valve MOV-111 NPS 10 Cl 600, electric quarter-turn actuator 480 V	480 V, 3-ph	1.5 hp	1.75	0.00	0.00	0.00
MOV-112	Meter run valve MOV-112 NPS 10 Cl 600, electric quarter-turn actuator 480 V	480 V, 3-ph	1.5 hp	1.75	0.00	0.00	0.00
MOV-121	Meter run valve MOV-121 NPS 10 Cl 600, electric quarter-turn actuator 480 V	480 V, 3-ph	1.5 hp	1.75	0.00	0.00	1.40
MOV-122	Meter run valve MOV-122 NPS 10 Cl 600, electric quarter-turn actuator 480 V	480 V, 3-ph	1.5 hp	1.75	0.00	0.00	1.40
MOV-115	Meter run valve MOV-115 NPS 10 Cl 600, electric quarter-turn actuator 480 V	480 V, 3-ph	1.5 hp	1.75	0.00	0.00	0.00
FCV-131	Flow control valve FCV-131, electric modulating actuator 480 V (duty)	480 V, 3-ph	1 hp	1.20	0.23	0.23	0.93

Tag	Description	Voltage	Rating	Connected, kVA	Winter running, kW	Summer running, kW	Peak, kW
FCV-132	Flow control valve FCV-132, electric modulating actuator 480 V (standby)	480 V, 3-ph	1 hp	1.20	0.02	0.02	0.00
UH-101	B-101 electric unit heater 7.5 kW, Class I Div 2, thermostat	480 V, 3-ph	7.50 kW	7.50	5.86	0.00	7.50
E-161	Fuel gas electric preheater on 2"-F-1050 upstream of PCV-161 (FG-101), explosion-proof Class I Div 2, 5 kW rated, outlet 105 F	480 V, 3-ph	5.00 kW	5.00	3.98	1.00	5.00
EF-101A	B-101 ventilation exhaust fan duty 250 cfm, Class I Div 2 motor	480 V, 3-ph	0.5 hp	0.72	0.52	0.52	0.52
EF-101B	B-101 ventilation exhaust fan standby 250 cfm, Class I Div 2 motor	480 V, 3-ph	0.5 hp	0.72	0.00	0.00	0.00
AC-102A	B-102 wall-mount AC 2.0 ton with 5 kW electric heat (lead)	480 V, 3-ph	5.40 kW	5.68	3.77	1.92	5.40
AC-102B	B-102 wall-mount AC 2.0 ton with 5 kW electric heat (lag)	480 V, 3-ph	5.40 kW	5.68	0.00	0.00	0.00
GO-101A	Main gate swing operator 0.5 hp 480 V 3-phase (one per leaf)	480 V, 3-ph	0.5 hp	0.74	0.01	0.01	0.53
GO-101B	Main gate swing operator 0.5 hp 480 V 3-phase (one per leaf)	480 V, 3-ph	0.5 hp	0.74	0.01	0.01	0.53
RCP-101	Portable equipment receptacle 480 V 3-phase 30 A, Class I Div 2 (interlocked)	480 V, 3-ph	10.00 kW	11.76	0.00	0.00	0.00
LTG-1	Area lighting circuit LTG-1: South area poles, B-102 and G-101 wall packs	277 V, 1-ph	0.99 kW	1.04	0.99	0.99	0.99

Tag	Description	Voltage	Rating	Connected, kVA	Winter running, kW	Summer running, kW	Peak, kW
LTG-2	Area lighting circuit LTG-2: West/meter area poles and SK-110 canopy	277 V, 1-ph	0.96 kW	1.01	0.96	0.96	0.96
LTG-3	Area lighting circuit LTG-3: Control valve, heater area poles, B-101 wall pack	277 V, 1-ph	0.78 kW	0.82	0.78	0.78	0.78

Table A-2: Load Register, LP-101

Tag	Description	Voltage	Rating	Connected, kVA	Winter running, kW	Summer running, kW	Peak, kW
BC-101A	24 VDC battery charger 50 A, 208 V 1-phase input	208 V, 1-ph	1.66 kW	1.84	0.34	0.34	0.66
BC-101B	24 VDC battery charger 50 A, 208 V 1-phase input	208 V, 1-ph	1.66 kW	1.84	0.34	0.34	0.66
UPS-101	UPS 1.5 kVA on-line, 120 V input	120 V, 1-ph	1.20 kW	1.26	0.65	0.65	1.20
AC-101	B-101 wall-mount AC 1.5 ton, Class I Div 2 package, 208 V 1-phase	208 V, 1-ph	2.00 kW	2.22	0.00	1.60	2.00
LTG-B102	B-102 interior lighting, 6 x 40 W LED	120 V, 1-ph	0.24 kW	0.25	0.00	0.00	0.24
LTG-B101	B-101 interior lighting, 2 x 40 W LED Class I Div 2	120 V, 1-ph	0.08 kW	0.08	0.00	0.00	0.08
REC-B102-1	B-102 duplex receptacles, north wall (3 x 180 VA)	120 V, 1-ph	0.49 kW	0.54	0.05	0.05	0.27
REC-B102-2	B-102 duplex receptacles, south wall (3 x 180 VA)	120 V, 1-ph	0.49 kW	0.54	0.05	0.05	0.27
REC-B101	B-101 duplex receptacles, Class I Div 2 factory sealed (2 x 180 VA)	120 V, 1-ph	0.32 kW	0.36	0.04	0.04	0.18

Tag	Description	Voltage	Rating	Connected, kVA	Winter running, kW	Summer running, kW	Peak, kW
REC-EXT-1	Exterior GFCI receptacles, Class I Div 2: SK-110 and FCV station (2 x 180 VA)	120 V, 1-ph	0.32 kW	0.36	0.04	0.04	0.18
REC-EXT-2	Exterior GFCI receptacle, Class I Div 2: inlet area (1 x 180 VA)	120 V, 1-ph	0.16 kW	0.18	0.02	0.02	0.09
REC-EXT-3	Exterior GFCI receptacle, H-101 burner end (1 x 180 VA)	120 V, 1-ph	0.16 kW	0.18	0.02	0.02	0.09
AE-141H	GC oven / analytical heater (generator-backed, not on UPS)	120 V, 1-ph	0.35 kW	0.35	0.15	0.10	0.35
SCS-141	GC sample conditioning enclosure heater 200 W	120 V, 1-ph	0.20 kW	0.20	0.12	0.02	0.20
HT-1080	Heat tracing circuit HT-1080: 3/8 in analyzer transport 1080, 16 ft x 15 W/ft self-regulating, plus SP-141 heated regulator 100 W, controller + GFEP	120 V, 1-ph	0.34 kW	0.34	0.27	0.10	0.68
HT-1139	Heat tracing circuit HT-1139: 1/4 in composite sampler line 1139, 16 ft x 15 W/ft self-regulating, controller + GFEP	120 V, 1-ph	0.24 kW	0.24	0.19	0.07	0.48
AHT-142/143	AT-142 and AT-143 analyzer enclosure heaters 2 x 100 W	120 V, 1-ph	0.20 kW	0.20	0.10	0.00	0.20

Tag	Description	Voltage	Rating	Connected, kVA	Winter running, kW	Summer running, kW	Peak, kW
CP-150	BMS-150 panel (SIL 2 BMS): controller, igniter BY-153, XV-150A/B/C, TCV-152 actuator, flame rod BE-153A and UV scanner BE-153B	120 V, 1-ph	0.27 kW	0.32	0.12	0.04	0.27
SDV-165	Fuel gas SDV NPS 1, electro-hydraulic actuator pump 0.25 hp 120 V	120 V, 1-ph	0.25 hp	0.44	0.02	0.02	0.31
G-101BH	G-101 engine block heater 1,500 W 120 V	120 V, 1-ph	1.50 kW	1.50	1.20	0.30	1.50
G-101BC	G-101 starting battery charger 12 VDC 6 A, 120 V	120 V, 1-ph	0.10 kW	0.11	0.03	0.03	0.10
RECT-101	CP rectifier (ICCP) 24 V / 8 A rated, 120 V 1-phase input, B-102 south wall	120 V, 1-ph	0.30 kW	0.35	0.04	0.04	0.30

Table A-3: Load Register, UP-101

Tag	Description	Voltage	Rating	Connected, kVA	Winter running, kW	Summer running, kW	Peak, kW
HMI-101	Operator / engineering workstation and monitor	120 V, 1-ph	0.17 kW	0.18	0.17	0.17	0.17
NVR-101	Network video recorder and 4 PoE cameras	120 V, 1-ph	0.11 kW	0.12	0.11	0.11	0.11
JB-W01	demarcation panel 120 VAC supply (HOLD H-14)	120 V, 1-ph	0.10 kW	0.11	0.10	0.10	0.10
LCV-104	V-101 dump valve electric actuator (running 60 W, standby 10 W)	120 V, 1-ph	0.06 kW	0.07	0.01	0.01	0.06

Tag	Description	Voltage	Rating	Connected, kVA	Winter running, kW	Summer running, kW	Peak, kW
SDV-106	V-101 liquid outlet SDV, electric spring-return fail-closed actuator (holding 20 W, stroke 100 W)	120 V, 1-ph	0.10 kW	0.12	0.02	0.02	0.10
ANT-201	Mast base enclosure: surge-protected 120 VAC outlet for mast-mounted telecom equipment (typical, HOLD H-15)	120 V, 1-ph	0.05 kW	0.06	0.03	0.03	0.05

Table A-4: Load Register, DCP-101

Tag	Description	Voltage	Rating	Connected, kVA	Winter running, kW	Summer running, kW	Peak, kW
CP-102A	RTU panel CP-102A (RTU, display, switch, relays, field loop power)	24 V DC	0.11 kW	0.11	0.11	0.11	0.11
CP-102B	Safety PLC panel CP-102B, with SDV solenoids, gas / fire / smoke detectors and beacons it powers	24 V DC	0.21 kW	0.21	0.17	0.17	0.21
CP-102C	Measurement panel CP-102C (flow computer, switch, isolators)	24 V DC	0.05 kW	0.05	0.05	0.05	0.05
TR-102	Telecommunications rack TR-102 (router, secondary path, firewall, switch, time server)	24 V DC	0.09 kW	0.09	0.09	0.09	0.09
WDP-101	Demarcation interface panel, B-102 side	24 V DC	0.01 kW	0.01	0.01	0.01	0.01
JB-140D	B-101 analyzer DC distribution: AT-141, AT-142, AT-143, AT-144, SMP-146	24 V DC	0.12 kW	0.12	0.10	0.10	0.12
JB-110D	SK-110 ultrasonic meter electronics FT-111, FT-121	24 V DC	0.02 kW	0.02	0.02	0.02	0.02
FT-163	FG-101 Coriolis transmitter FT-163	24 V DC	0.01 kW	0.01	0.01	0.01	0.01

Table A-5: Load Factor and Peak Basis

Tag	Basis
SDV-101	Pump runs only to open / recharge accumulator: 5 % average; all three run together on ESD reset
SDV-102	Pump runs only to open / recharge accumulator: 5 % average; all three run together on ESD reset
SDV-103	Pump runs only to open / recharge accumulator: 5 % average; all three run together on ESD reset
MOV-111	Stroked only for run changes; two valves (one run) stroke together in the peak case
MOV-112	Stroked only for run changes; two valves (one run) stroke together in the peak case
MOV-121	Stroked only for run changes; two valves (one run) stroke together in the peak case
MOV-122	Stroked only for run changes; two valves (one run) stroke together in the peak case
MOV-115	Stroked only for run changes; two valves (one run) stroke together in the peak case
FCV-131	Duty valve modulating, 25 % motor-on time; standby idle
FCV-132	Standby, electronics only
UH-101	Winter design-day heat loss / heater rating; full output at cold start
E-161	Winter duty about 4.0 kW (PRO-CAL-010) at 105 F setpoint; 20 % summer (G-101 standby fuel only); full 5 kW at cold start
EF-101A	Continuous (RP 500 ventilation, RPT-001)
EF-101B	Standby, starts on FSL-208
AC-102A	Lead unit carries the load; lag starts on lead failure or high temperature
AC-102B	Lead unit carries the load; lag starts on lead failure or high temperature
GO-101A	Intermittent; both leaves move together
GO-101B	Intermittent; both leaves move together
RCP-101	Maintenance use only under work permit; excluded from demand (Section 7)
LTG-1	Dusk to dawn via photocell (design point is night)
LTG-2	Dusk to dawn via photocell (design point is night)
LTG-3	Dusk to dawn via photocell (design point is night)
BC-101A	Float + DC load shared; peak = recharge after outage (ELE-CAL-003)
BC-101B	Float + DC load shared; peak = recharge after outage (ELE-CAL-003)
UPS-101	Critical load + recharge (ELE-CAL-003)
AC-101	Summer only; 80 % run time at design day
LTG-B102	Occupancy switched; on during maintenance visits (peak)
LTG-B101	Switched at door
REC-B102-1	NEC 220.14(I) 180 VA each; 10 % running, 50 % during maintenance

Tag	Basis
REC-B102-2	NEC 220.14(I) 180 VA each; 10 % running, 50 % during maintenance
REC-B101	NEC 220.14(I) 180 VA each; 10 % running, 50 % during maintenance
REC-EXT-1	NEC 220.14(I) 180 VA each; 10 % running, 50 % during maintenance
REC-EXT-2	NEC 220.14(I) 180 VA each; 10 % running, 50 % during maintenance
REC-EXT-3	NEC 220.14(I) 180 VA each; 10 % running, 50 % during maintenance
AE-141H	Steady 150 W winter / 100 W summer; 350 W warm-up after restart
SCS-141	Thermostatic
HT-1080	Maintain 120 F: 80 % winter, 30 % summer; cold start inrush 2 x at -5 F
HT-1139	Maintain 120 F: 80 % winter, 30 % summer; cold start inrush 2 x at -5 F
AHT-142/143	Thermostatic, winter
CP-150	Heater on in winter (C1), bypassed in summer (GEN-DB-001); igniter at relight
SDV-165	As SDV pumps
G-101BH	Thermostatic; off when engine runs
G-101BC	Float
RECT-101	Operating output per CP-CAL-001; rated input at peak
HMI-101	Critical 120 VAC (ELE-CAL-003)
NVR-101	Critical 120 VAC (ELE-CAL-003)
JB-W01	Critical 120 VAC (ELE-CAL-003)
LCV-104	Critical 120 VAC (ELE-CAL-003)
SDV-106	Critical 120 VAC (ELE-CAL-003)
ANT-201	Critical 120 VAC (ELE-CAL-003)
CP-102A	24 VDC (ELE-CAL-003)
CP-102B	24 VDC (ELE-CAL-003)
CP-102C	24 VDC (ELE-CAL-003)
TR-102	24 VDC (ELE-CAL-003)
WDP-101	24 VDC (ELE-CAL-003)
JB-140D	24 VDC (ELE-CAL-003)
JB-110D	24 VDC (ELE-CAL-003)
FT-163	24 VDC (ELE-CAL-003)