

APPENDIX H – DESIGN CALCULATION REQUIREMENTS

TABLE H1 CALCULATIONS FOR ELECTRICAL DESIGN

Calculation	Description	Required Tools ¹	Always Req'd	Cond. Req'd ₂	Resp. ³	Available for Review % Design Phase/Const
Load - facility, switchgear, MCC	Load at each load center per CEC to determine bus, protective device & circuit size	SKM PTW DAPPER, spreadsheet, hand calcs	X		Consultant	30/60/90
Load - panelboard	Load on each panelboard per CEC to determine panel, circuit, and transformer size	SKM PTW DAPPER, spreadsheet	X		Consultant	60 and 90
Generator sizing	To size engine generator based on critical run and start loads.	Cat, Kohler, Cummins, or other vendor software	X		Consultant	30/60/90
Short Circuit	Available fault current at each bus to determine equipment short circuit/interrupting ratings	SKM PTW DAPPER, Hand Calculation	X		Consultant	30/60/90
Lighting	To determine fixtures needed given desired light level; also energy calculations where required	AGI 32, Vendor, spreadsheets	X		Consultant	60 and 90
Conductor Sizing	To size circuit breakers and fuses per CEC	Tables, hand calcs	X		Consultant	60 and 90
Circuit breaker and fuse sizing	To size circuit breakers and fuses per CEC	Tables, hand calcs	X		Consultant	60 and 90
Conduit Fill/Tray Size	To size conduit and cable tray per CEC	CEC Tables, Cablematic Plus	X		Consultant	60 and 90
Voltage Drop	For heavily loaded and/or long circuits to confirm operation within CEC recommendations (min)	SKM PTW DAPPER, spreadsheets, hand calcs		X	Consultant	60 and 90
Transient Motor Starting	For starting large motors (largest motor at each load center) to determine if voltage drop on motor starting is magnitude to adversely impact other system equipment (i.e. 20% voltage dip could make control relays drop out)	SKM PTW TMS, hand calcs		X	Consultant	60 and 90
Harmonic Distortion	To confirm operation within IEEE 519 requirements (min) for non-linear loads	SKM PTW HI_WAVE, GE or		X	Consultant	30/60/90

Calculation	Description	Required Tools ¹	Always Req'd	Cond. Req'd ²	Resp. ³	Available for Review % Design Phase/ Const
Analysis		other vendor software				
Multiple circuit derating	For more than 3 current carrying conductors in a conduit per CEC	CEC Tables, Cablematic Plus		X	Consultant	60 and 90
Ambient temperature circuit derating	For higher than "normal" ambient temperatures-- could include heat from multiple circuits in duct bank	AMP CALC, NEC tables		X	Consultant	60 and 90
Protective device coordination	To minimize outages to smallest portion of system possible	SKM PTW CAPTOR		X	Consultant	90
Cable Pulling	To assure no damage to cable when pulled in conduit given conduit size, distance and bends. Rq'd for medium-voltage & some large/long low-voltage	Polywater or other vendor software		X	Consultant and Cont.	60, 90 and construction before pulling
Arc-flash	To label gear regarding arc-flash hazard and PPE required. CEC requires label, not calcs. Reference NFPA 70E and IEEE 1584	SKM PTW Arc Flash Evaluation		X	Consultant	90
Power factor correction	To size capacitors for single motor or systems.			X	Consultant	60 and 90
Battery/UPS sizing	To determine amp-hour based on load and duration.			X	Consultant	60 and 90
Transformer K-factor	To determine appropriate Kfactor for transformers with non-linear loads			X	Consultant	90, construction
VFD reflective wave	For motor distant from VFD			X	Consultant	90, construction
Lightning Protection Strike Distance	May be performance specified	Per NFPA 780		X	Consultant	60 and 90

¹ Suggested software/tools for use in Project

² Required conditionally. Required when applicable.

³ Responsible party. Contractor provided calculations may require CA provided criteria

TABLE H2 CALCULATIONS FOR MECHANICAL AND PROCESS DESIGN

Calculation	Description	Required Tools ¹	Always Req'd	Cond · Req'd ²	Resp. ³	Available for Review % Design Phase/ Const
Equipment and Piping Systems	Pressure losses in the piping system and equipment sizing requirements (e.g. power, NPSH, efficiency, etc.)	Pipe-Flow, spreadsheets or hand calcs using data from Crane Technical Paper 410 and ASHRAE Fundamentals	X		Consultant	30/60/90
Heat Exchangers	Heat loads per selected systems	Spreadsheets or hand calculations and vendor software	X		Consultant	30/60/90
Fluid Coolers	To size engine generator based on critical run and start loads.	Spreadsheets or hand calculations and vendor software	X		Consultant	30/60/90
Expansion Tanks	To determine appropriate expansion tank size	Hand or spreadsheet calculations using ASHRAE Fundamentals	X		Consultant	60 and 90
Pipe Insulation	To determine the thickness of pipe insulation to prevent condensation and/or personnel protection	3E Plus, equivalent hand or spreadsheet calculations	X		Consultant	60 and 90
Space Heating and Cooling Loads	Heating and cooling equipment sizing, air flow requirements, hydronic flow requirements	Carrier HAP, Trane Trace, equivalent hand or spreadsheet calculations using ASHRAE Fundamentals	X		Consultant	30/60/90
Ductwork and Air Distribution Systems	Pressure losses in the duct system and fan sizing requirements (power, efficiency, etc.)	Carrier HAP, Trane Trace, equivalent hand or spreadsheet calculations using ASHRAE Fundamentals and Duct Fitting Database	X		Consultant	30/60/90

Calculation	Description	Required Tools ¹	Always Req'd	Cond . Req'd ²	Resp. ³	Available for Review % Design Phase/ Const
Piping pressure classifications	Determine the appropriate pipe schedule based on materials used, fluid properties and corrosion allowance	ASME B31.9 methods using hand or spreadsheet calculations	X		Consultant	30/60/90
Natural or Propane Piping Sizing to End Devices	Determine the appropriate pipe size for gas or propane piping out to end devices from the main service or downstream of pressure regulators	CSA B149.1 – Natural Gas and Propane Code tables and equations. Hand calculations or spreadsheet	X		Consultant & Contractor	60, 90, and Const.
Potable Piping	Determine the appropriate pipe sizes for potable water systems within facilities	National Plumbing Code or acceptable spreadsheet calculations	X		Consultant	60 and 90
Drain Piping – Sanitary and Storm	Determine the appropriate pipe sizes for gravity drain systems within facilities	National Plumbing Code or acceptable spreadsheet calculations	X		Consultant & Contractor	60, 90, and Const.
Drain Vent Piping	Determine the appropriate pipe sizes for gravity drain systems within facilities	National Plumbing Code or acceptable spreadsheet calculations	X		Consultant & Contractor	60, 90, and Const.
Industrial Ventilation Requirements	Determine the air exchange rate, capture velocities and hood/ductwork design requirements for ventilation systems associated with hazardous chemicals	American Conference of Governmental Industrial Hygienists, Industrial Ventilation using hand or spreadsheet calculations	X		Consultant	30/60/60
General Ventilation Requirements	Determine the outside air and exhaust requirements for occupied spaces	ASHRAE 62.1	X		Consultant	30/60/90
Mass Balances	Chemical mass balances for dosing systems	Hand calculations or spreadsheets	X		Consultant	30/60/90

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