


Electrical Load Summary

CO₂ Capture Facility

Kårstø, Norway

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1.0 PURPOSE

This document outlines the estimated electrical load during different plant operating modes. The loads used for these operating scenarios are conservatively estimated but are not to be construed as plant guarantees.

2.0 FULL PRODUCTION

This mode provides the estimated load when the plant is operating at its intended design base. The first scenario is the maximum electrical load during full carbon capture with full output of the power plant. The second is the plant operating at minimum electrical load during full carbon capture with 60% power plant output. (Appendix 1)

3.0 EMERGENCY ESSENTIAL OPERATION

This mode provides the maximum load when all normal power to the facility is off and the emergency diesel generator is powering the essential loads. (Appendix 2)

4.0 STANDBY MODE

This mode provides estimated loads when CO₂ capturing is not occurring, but the capturing of carbon will begin within one shift. In this mode, some of the facility pumps will be operating in recirculation mode. (Appendix 3)

5.0 UPS LOAD

Maximum load required during the worst case (initial shutdown) of the CCC Facility. (Appendix 4)

Karsto - Electrical Load Summary
Full Production

Appendix 1

Item No.	Tag No.	Item Description	Type of Operation	Voltage (Input Rating)	Rated Power kW	Full Production Max Utilization Factor	Full Production Max Operation kW	Full Production Min Utilization Factor	Full Production Min Operation kW
1	IBAMA101	Flue gas blower (Absorber 1)	Continuous	22kv	6340	1	6340	1	6340
2	IBAMA102	Flue gas blower (Absorber 2)	Continuous	22kv	6340	1	6340	1	6340
3	IBAMA103	Seal Air Fans A	Standby	400	4	0	0	0	0
4	IBAMA104	Seal Air Fans B	Standby	400	4	0	0	0	0
5	IBAMA105	Seal Air Fans C	Standby	400	4	0	0	0	0
6	IQGMC103	CO2 Compressor	Continuous	22kv	20000	1	20000	1	20000
7	IPAMC101A	Instrument/Service Air Compressor A	Continuous	400	55	1	55	0.5	27.5
8	IPAMC101B	Instrument/Service Air Compressor B	Standby	400	55	0	0	0	0
9	IQGMC103	Air Cooler for Air Compressor A	Continuous	400	7.5	1	7.5	0.5	3.75
10	IQGMC103	Air Cooler for Air Compressor B	Standby	400	7.5	0	0	0	0
11	ICYME118	Fresh Amine Storage Tank Heaters	Continuous	400	11	1	11	0.7	7.7
12	ICYME119	Lean Amine Solvent Storage Tank Heater	Continuous	400	150	1	150	0.7	105
13	IWPME123	Process Water Tank Heater	Continuous	400	11	1	11	0.7	7.7
14	IWRME122	Softened Water Tank Heater	Continuous	400	5.5	1	5.5	0.7	3.85
15	ICNMP101A	Rich Amine Pumps (Absorber 1) A	Continuous	6.6kv	900	1	900	1	900
16	ICNMP101B	Rich Amine Pumps (Absorber 1) B	Standby	6.6kv	900	0	0	0	0
17	ICNMP124A	Rich Amine Pumps (Absorber 2) A	Continuous	6.6kv	900	1	900	1	900
18	ICNMP124B	Rich Amine Pumps (Absorber 2) B	Standby	6.6kv	900	0	0	0	0
19	ICNMP102A	Wash Water Recirculation Pump (Absorber 1) A	Continuous	6.6kv	373	1	373	1	373
20	ICNMP102B	Wash Water Recirculation Pump (Absorber 1) B	Standby	6.6kv	373	0	0	0	0
21	ICNMP104A	Wash Water Recirculation Pump (Absorber 2) A	Continuous	6.6kv	373	1	373	1	373
22	ICNMP104B	Wash Water Recirculation Pump (Absorber 2) B	Standby	6.6kv	373	0	0	0	0
23	ICNMP105A	Lean Amine Pump A	Continuous	6.6kv	900	1	900	0.6	540
24	ICNMP105B	Lean Amine Pump B	Standby	6.6kv	900	0	0	0	0
25	ICNMP106A	Flash Drum Pump A	Continuous	6.6kv	300	1	300	0.6	180
26	ICNMP106B	Flash Drum Pump B	Standby	6.6kv	300	0	0	0	0
27	ICNMP107A	Reflux Pump A	Continuous	400	45	1	45	0.6	27
28	ICNMP107B	Reflux Pump B	Standby	400	45	0	0	0	0
29	IQGMP108A	CO2 Product Sendout Pump A	Continuous	6.6kv	1865	1	1865	0.6	1119
30	IQGMP108B	CO2 Product Sendout Pump B	Standby	6.6kv	1865	1	1865	0	0
31	IBAMP109A	Flue Gas Fogger Water Supply Pump A	Continuous	400	37	1	37	0.6	22.2
32	IBAMP109B	Flue Gas Fogger Water Supply Pump B	Standby	400	37	0	0	0	0
33	IBAMP109C	Flue Gas Fogger Water Supply Pump C	Continuous	400	37	1	37	0	0
34	IBAMP109D	Flue Gas Fogger Water Supply Pump D	Standby	400	37	0	0	0	0
35	ICYMP110A	Fresh Amine Metering Pump A	Continuous	400	1.1	1	1.1	0	0
36	ICYMP110B	Fresh Amine Metering Pump B	Standby	400	1.1	0	0	0	0
37	ICYMP111A	Lean Amine Solvent Fill Pump A	Continuous	400	45	1	45	0	0
38	ICYMP111B	Lean Amine Solvent Fill Pump B	Standby	400	45	0	0	0	0
39	IXWMT103A	Amine Waste Sump Pump A	Continuous	400	11	1	11	0	0
40	IXWMT103B	Amine Waste Sump Pump B	Standby	400	11	0	0	0	0
41	IXWMP113A	Wastewater Forwarding Pump A	Continuous	400	7.5	1	7.5	0.5	3.75
42	IXWMP113B	Wastewater Forwarding Pump B	Standby	400	7.5	0	0	0	0
43	ISCMPI14A	LP Condensate Return Pump A	Continuous	400	75	1	75	0.6	45
44	ISCMPI14B	LP Condensate Return Pump B	Standby	400	75	0	0	0	0
45	IWLMP115A	Sea Water Cooling Pump A	Continuous	6.6kv	1500	1	1500	0.6	900
46	IWLMP115B	Sea Water Cooling Pump B	Standby	6.6kv	1500	0	0	0	0
47	ICYMP116A	Chemical Additive Metering Pump A	Continuous	400	2.2	1	2.2	0	0
48	ICYMP116B	Chemical Additive Metering Pump B	Standby	400	2.2	0	0	0	0
49	ICYMP117A	Caustic Metering Pump A	Continuous	400	1.1	1	1.1	0	0
50	ICYMP117B	Caustic Metering Pump B	Standby	400	1.1	0	0	0	0
51	IWPMP119A	Absorber make-up water Pump A	Continuous	400	7.5	1	7.5	0.6	4.5
52	IWPMP119B	Absorber make-up water Pump B	Standby	400	7.5	0	0	0	0
53	IWLMP121A	Sea Water Booster Pump A	Continuous	400	224	1	224	0.6	134.4

Item No.	Tag No.	Item Description	Type of Operation	Voltage (Input Rating)	Rated Power kW	Full Production Max Utilization Factor	Full Production Max Operation kW	Full Production Min Utilization Factor	Full Production Min Operation kW
54	1WLMP121B	Sea Water Booster Pump B	Standby	400	224	1	224	0	0
55	1QGMC103	CO2 Compressor Lube Oil Pumps A	Continuous	400	7.5	1	7.5	1	7.5
56	1QGMC103	CO2 Compressor Lube Oil Pumps B	Continuous	400	7.5	1	7.5	1	7.5
57	1BAMA101	Flue Gas Blower Lube Oil Pumps A	Continuous	400	4	1	4	1	4
58	1BAMA101	Flue Gas Blower Lube Oil Pumps B	Continuous	400	4	1	4	1	4
59	1BAMA102	Flue Gas Blower Lube Oil Pumps C	Continuous	400	4	1	4	1	4
60	1BAMA102	Flue Gas Blower Lube Oil Pumps D	Continuous	400	4	1	4	1	4
63	1PAMS105A	Instrument Air Dryer A	Continuous	400	11	1	11	0.5	5.5
64	1PAMS105B	Instrument Air Dryer B	Standby	400	11	0	0	0	0
65	1CYMS103	Reclaimer Chemical Feed Package	Continuous	400	5.5	1	5.5	0	0
66	1QGMS104	CO2 Drying Package	Continuous	400	11	1	11	1	11
67	1BAMD008A	Common Flue Gas Duct Isolation Dampers A	Standby	400	4	0	0	0	0
68	1BAMD008B	Common Flue Gas Duct Isolation Dampers B	Standby	400	4	0	0	0	0
69	1BAMD034A	Flue Gas Duct Isolation Damper (Absorber 1) A	Standby	400	4	0	0	0	0
70	1BAMD034B	Flue Gas Duct Isolation Damper (Absorber 1) B	Standby	400	4	0	0	0	0
71	1BAMD060A	Flue Gas Duct Isolation Damper (Absorber 2) A	Standby	400	4	0	0	0	0
72	1BAMD060B	Flue Gas Duct Isolation Damper (Absorber 2) B	Standby	400	4	0	0	0	0
106	Later	Control Bldg HVAC Units A	Continuous	400	110	1	110	0.5	55
107	Later	Control Bldg HVAC Units B	Standby	400	110	0	0	0	0
108	Later	Electric Building HV Units	Continuous	400	80	1	80	0.5	40
109	Later	Vent Fans (Compressor Building)	Continuous	400	100	1	100	0.25	25
110	Later	Vent Fans (Blower Buildings)	Continuous	400	64	1	64	0.25	16
111	Later	Stores/Workshop HV Units	Continuous	400	82	1	82	0.5	41
118	Later	Electrical Heat Tracing	Continuous	400/230	250	0.8	200	0.25	62.5
120	Later	Lighting	Continuous	400/230	160	1	160	0.5	80
121		UPS	Continuous	400/230	64	1	64	0.8	51.2
122	Later	Brine Solution Skid	Continuous	400	3	1	3	1	3
123	1WRMP122A	Softened Water Supply Pumps A	Continuous	400	400	1	400	1	400
124	1WRMP122B	Softened Water Supply Pumps B	Standby	400	400	1	400	0	0
		Sub-Total (kW)					44334.9		39179
		Operating Power Factor (Note 1)					0.9		0.9
		Total (kVA)					49261		43532

Note 1: The CCC Facility is equipped with power factor correction which maintains the system power factor at nominal 1.0. This load study conservatively assumes 0.9 operating power factor.

Karsto - Electrical Load Summary
 Emergency Essential Operation
 (Diesel Operation)

Item No.	Tag No.	Item Description	Type of Operation	Rated Power (kW)	Utilization Factor	Max Emergency Operation (kW)
1	1PAMC002A	Instrument/Service Air Compressor A	Continuous	55	0.5	28
2	1QGMC103	Air Cooler for Air Compressor A	Continuous	7.5	0.5	4
3	Later	Control Bldg HVAC Units A	Continuous	110	0.45	50
4	Later	Electric Building HV Units	Continuous	80	0.45	36
5	Later	Vent Fans (Compressor Building)	Continuous	100	0.45	45
6	Later	Vent Fans (Blower Buildings)	Continuous	64	0.45	29
7	Later	Stores/Workshop HV Units	Continuous	82	0.45	37
8	Later	Electrical Heat Tracing - Essential	Continuous	250	0.4	100
9	Later	Lighting	Continuous	160	0.5	80
10		UPS Loads		80	0.8	64
		Sub-Total (KW)				471
		Operating Power Factor				0.85
		Total KVA				555

Item No.	Tag No.	Item Description	Type of Operation	Voltage (Input Rating)	Rated Power kW	Standby Mode Utilization Factor	Standby Operation kW
1	1BAMA101	Flue gas blower (Absorber 1)	Continuous	22kv	6340	0	0
2	1BAMA102	Flue gas blower (Absorber 2)	Continuous	22kv	6340	0	0
3	1BAMA103	Seal Air Fans A	Standby	400	4	0	0
4	1BAMA104	Seal Air Fans B	Standby	400	4	0	0
5	1BAMA105	Seal Air Fans C	Standby	400	4	0	0
6	1QGMC103	CO2 Compressor	Continuous	22kv	20000	0	0
7	1PAMC101A	Instrument/Service Air Compressor A	Continuous	400	55	0.35	19.25
8	1PAMC101B	Instrument/Service Air Compressor B	Standby	400	55	0	0
9	1QGMC103	Air Cooler for Air Compressor A	Continuous	400	7.5	0.35	2.625
10	1QGMC103	Air Cooler for Air Compressor B	Standby	400	7.5	0	0
11	1CYME118	Fresh Amine Storage Tank Heaters	Continuous	400	11	0.35	3.85
12	1CYME119	Lean Amine Solvent Storage Tank Heater	Continuous	400	150	0.35	52.5
13	1WPME123	Process Water Tank Heater	Continuous	400	11	0.35	3.85
14	1WRME122	Softened Water Tank Heater	Continuous	400	5.5	0.35	1.925
15	1CNMP101A	Rich Amine Pumps (Absorber 1) A	Continuous	6.6kv	900	0.8	720
16	1CNMP101B	Rich Amine Pumps (Absorber 1) B	Standby	6.6kv	900	0	0
17	1CNMP124A	Rich Amine Pumps (Absorber 2) A	Continuous	6.6kv	900	0.8	720
18	1CNMP124B	Rich Amine Pumps (Absorber 2) B	Standby	6.6kv	900	0	0
19	1CNMP102A	Wash Water Recirculation Pump (Absorber 1) A	Continuous	6.6kv	373	0.8	298.4
20	1CNMP102B	Wash Water Recirculation Pump (Absorber 1) B	Standby	6.6kv	373	0	0
21	1CNMP104A	Wash Water Recirculation Pump (Absorber 2) A	Continuous	6.6kv	373	0.8	298.4
22	1CNMP104B	Wash Water Recirculation Pump (Absorber 2) B	Standby	6.6kv	373	0	0
23	1CNMP105A	Lean Amine Pump A	Continuous	6.6kv	900	0.8	720
24	1CNMP105B	Lean Amine Pump B	Standby	6.6kv	900	0	0
25	1CNMP106A	Flash Drum Pump A	Continuous	6.6kv	300	0	0
26	1CNMP106B	Flash Drum Pump B	Standby	6.6kv	300	0	0
27	1CNMP107A	Reflux Pump A	Continuous	400	45	0	0
28	1CNMP107B	Reflux Pump B	Standby	400	45	0	0
29	1QGMP108A	CO2 Product Sendout Pump A	Continuous	6.6kv	1865	0	0
30	1QGMP108B	CO2 Product Sendout Pump B	Standby	6.6kv	1865	0	0
31	1BAMP109A	Flue Gas Fogger Water Supply Pump A	Continuous	400	37	0	0
32	1BAMP109B	Flue Gas Fogger Water Supply Pump B	Standby	400	37	0	0
33	1BAMP109C	Flue Gas Fogger Water Supply Pump C	Continuous	400	37	0	0
34	1BAMP109D	Flue Gas Fogger Water Supply Pump D	Standby	400	37	0	0
35	1CYMP110A	Fresh Amine Metering Pump A	Continuous	400	1.1	0	0
36	1CYMP110B	Fresh Amine Metering Pump B	Standby	400	1.1	0	0
37	1CYMP111A	Lean Amine Solvent Fill Pump A	Continuous	400	45	0	0
38	1CYMP111B	Lean Amine Solvent Fill Pump B	Standby	400	45	0	0
39	1XWMT103A	Amine Waste Sump Pump A	Continuous	400	11	0	0
40	1XWMT103B	Amine Waste Sump Pump B	Standby	400	11	0	0
41	1XWMP113A	Wastewater Forwarding Pump A	Continuous	400	7.5	0	0
42	1XWMP113B	Wastewater Forwarding Pump B	Standby	400	7.5	0	0
43	1SCMP114A	LP Condensate Return Pump A	Continuous	400	75	0	0
44	1SCMP114B	LP Condensate Return Pump B	Standby	400	75	0	0
45	1WLMP115A	Sea Water Cooling Pump A	Continuous	6.6kv	1500	0.8	1200

Karsto - Electrical Load Summary
Standby Mode

Item No.	Tag No.	Item Description	Type of Operation	Voltage (Input Rating)	Rated Power kW	Standby Mode Utilization Factor	Standby Operation kW
46	1WLMP115B	Sea Water Cooling Pump B	Standby	6.6kv	1500	0	0
47	1CYMP116A	Chemical Additive Metering Pump A	Continuous	400	2.2	0	0
48	1CYMP116B	Chemical Additive Metering Pump B	Standby	400	2.2	0	0
49	1CYMP117A	Caustic Metering Pump A	Continuous	400	1.1	0	0
50	1CYMP117B	Caustic Metering Pump B	Standby	400	1.1	0	0
51	1WPMP119A	Absorber make-up water Pump A	Continuous	400	7.5	0	0
52	1WPMP119B	Absorber make-up water Pump B	Standby	400	7.5	0	0
53	1WLMP121A	Sea Water Booster Pump A	Continuous	400	224	0.8	179.2
54	1WLMP121B	Sea Water Booster Pump B	Standby	400	224	0	0
55	1QGMC103	CO2 Compressor Lube Oil Pumps A	Continuous	400	7.5	1	7.5
56	1QGMC103	CO2 Compressor Lube Oil Pumps B	Continuous	400	7.5	0	0
57	1BAMA101	Flue Gas Blower Lube Oil Pumps A	Continuous	400	4	1	4
58	1BAMA101	Flue Gas Blower Lube Oil Pumps B	Continuous	400	4	0	0
59	1BAMA102	Flue Gas Blower Lube Oil Pumps C	Continuous	400	4	1	4
60	1BAMA102	Flue Gas Blower Lube Oil Pumps D	Continuous	400	4	0	0
63	1PAMS105A	Instrument Air Dryer A	Continuous	400	11	0.35	3.85
64	1PAMS105B	Instrument Air Dryer B	Standby	400	11	0	0
65	1CYMS103	Reclaimer Chemical Feed Package	Continuous	400	5.5	0	0
66	1QGMS104	CO2 Drying Package	Continuous	400	11	0	0
67	1BAMD008A	Common Flue Gas Duct Isolation Dampers A	Standby	400	4	0	0
68	1BAMD008B	Common Flue Gas Duct Isolation Dampers B	Standby	400	4	0	0
69	1BAMD034A	Flue Gas Duct Isolation Damper (Absorber 1) A	Standby	400	4	0	0
70	1BAMD034B	Flue Gas Duct Isolation Damper (Absorber 1) B	Standby	400	4	0	0
71	1BAMD060A	Flue Gas Duct Isolation Damper (Absorber 2) A	Standby	400	4	0	0
72	1BAMD060B	Flue Gas Duct Isolation Damper (Absorber 2) B	Standby	400	4	0	0
106	Later	Control Bldg HVAC Units A	Continuous	400	110	0.5	55
107	Later	Control Bldg HVAC Units B	Standby	400	110	0	0
108	Later	Electric Building HV Units	Continuous	400	80	0.5	40
109	Later	Vent Fans (Compressor Building)	Continuous	400	100	0.25	25
110	Later	Vent Fans (Blower Buildings)	Continuous	400	64	0.25	16
111	Later	Stores/Workshop HV Units	Continuous	400	82	0.5	41
118	Later	Electrical Heat Tracing	Continuous	400/230	250	0.25	62.5
120	Later	Lighting	Continuous	400/230	160	0.75	120
121		UPS	Continuous	400/230	64	0.8	51.2
122	Later	Brine Solution Skid	Continuous	400	3	1	3
123	1WRMP122A	Softened Water Supply Pumps A	Continuous	400	1	1	1
124	1WRMP122B	Softened Water Supply Pumps B	Standby	400	1	0	0
		Sub-Total (kW)					4654
		Operating Power Factor					0.9
		Total (kVA)					5171

Karsto - Electrical Load Summary
UPS Loads

Appendix 4

Item No.	Tag No.	Item Description	Voltage (Input Rating)	Rated Power kW	Utilization Factor	Sizing Power kW
1	1ESEYU01	Power Factor Correction Capacitors (Control Power)	110DC	0.5	1	0.5
2	1ESEVV01	CO2 Compressor ASD (Control Power)	110DC	2	1	2
3	1ESEVV02	Flue Gas Blower ASD - Blower A (Control Power)	110DC	1	1	1
4	1ESEVV03	Flue Gas Blower ASD - Blower B (Control Power)	110DC	1	1	1
5	1ESETP01	CCC Facility Transformer (Relay Panel)	110DC	1	1	1
6	1ESESIO1	22kV Switchgear (Relays & Lights, Coils)	110DC	5	1	5
7	1ESESIO2	6.6kV Switchgear (Relays & Lights, Coils)	110DC	11	1	11
8	1ECEKL01	400V Load Center 1 (Control Power)	110DC	1	1	1
9	1ECEKL02	400V Load Center 2 (Control Power)	110DC	1	1	1
10	1ECECM01	400V MCC 1 (Control Power)	110DC/230AC	1.5	1	1.5
11	1ECECM02	400V MCC 2 (Control Power)	110DC/230AC	1.5	1	1.5
12	1ECECM03	Essential MCC (Control Power)	110DC/230AC	1.5	1	1.5
13	Later	ESD (Control Cabinet)	230	1	1	1
14	Later	PSD (Control Cabinet)	230	0.5	1	0.5
15	Later	CEMS	230	2.5	1	2.5
16	Later	Communication Systems		0.5	1	0.5
17	Later	F&G Detection System	230	1	1	1
18	Later	DCS (Control Cabinet)	230	0.5	1	0.5
19	Later	Emergency Lighting	230	15	1	15
20	Later	IMS Server	230	1	1	1
21	Later	Domain Controller	230	1	1	1
22	Later	Interface Server	230	1.5	1	1.5
23	Later	DCS Operator Station	230	2	1	2
24	Later	DCS Engineer Station	230	1	1	1
25	Later	CEMS DAHS	230	1	1	1
26	Later	Historian	230	0.25	1	0.25
27	Later	Printer - Laser	230	2	1	2
28	Later	132" Multiscreen	230	2.5	1	2.5
29	Later	Compressor Building I/O	230	2.5	1	2.5
30	Later	Electrical Building I/O	230	0.5	1	0.5
		Total				64