APPENDIX B

EQUIPMENT LIST

PBM - MORRISON COPPER / GOLD PROJECT
EQUIPMENT LIST - ALL EQUIPMENT SORTED BY AREA

WARDROP PROJECT No : 06527201.00
EQUIPMENT LIST : 0652720100-LST-M0001-03

EQUIPMENT NUMBER	DESCRIPTION	EQUIPMENT SIZE	POWER (kW)	OPERATING	STAND BY	MATERIAL	CAPACITY	MODEL	REMARKS
Area: A2 - POWER DISTRIBUTION									
A2-XEM-001	LIGHTING		20.0	☑	☐				
A2-XMM-004	HVAC		30.0	☑	☐				
A2-XMM-005	MISC POWER INCL HEAT TRACING		20.0	☑	☐				
	POWER DISTRIBUTION TOTAL kW:		**70.0**						
Area: A6 - YARD LIGHTING									
A6-XEM-001	MISCELLANEOUS - ELECTRICAL		100.0	☑	☐				
	YARD LIGHTING TOTAL kW:		**100.0**						
Area: B2 - OPEN PIT MOBILE EQUIPMENT									
B2-CRN-001	UTILITY 60 t ROUGH TERRAIN CRANE			☐	☐			GROVE RT760E	
B2-DOZ-001	WHEEL DOZER			☐	☐			CATERPILAR 834B	
B2-DRI-001	DRILL			☐	☐			SANDVIK D90KS	
B2-DRI-003	DRILL			☐	☐			SANDVIK PANTERA	
B2-EXC-001	UTILITY BACKHOE EXCAVATOR			☐	☐			CATERPILLAR	
B2-FOR-001	ROUGH TERRAIN FORKLIFT			☐	☐			SELLICK SD100	
B2-GRA-001	MOTOR GRADER			☐	☐			CATERPILLAR 16M	
B2-GRA-002	MOTOR GRADER			☐	☐			CATERPILLAR 16M	
B2-LOA-001	SKID STEER LOADER			☐	☐			CATERPILLAR 216B	
B2-LOA-003	WHEEL LOADER			☐	☐			CATERPILLAR 992G	
B2-LOA-004	WHEEL LOADER			☐	☐			CATERPILLAR 992G	
B2-SHO-001	DIESEL HYDRAULIC SHOVEL			☐	☐			KOMATSU PC4000	
B2-SHO-002	DIESEL HYDRAULIC SHOVEL			☐	☐			KOMATSU PC4000	
B2-TRA-001	TRACK-TYPE BULLDOZER			☐	☐			CATERPILLAR D10T	
B2-TRA-002	TRACK-TYPE BULLDOZER			☐	☐			CATERPILLAR D10T	
B2-TRA-003	TRACK-TYPE BULLDOZER			☐	☐			CATERPILLAR D9T	
B2-TRA-004	TRACTOR & LOWBOY			☐	☐			FREIGHTLINER	
B2-TRU-001	REAR DUMP OFF ROAD HAUL TRUCK			☐	☐			CATERPILLAR 793C	
B2-TRU-002	INTEGRATED TOOL CARRIER			☐	☐			CATERPILLAR IT14G	
B2-TRU-002	REAR DUMP OFF ROAD HAUL TRUCK			☐	☐			CATERPILLAR 793C	
B2-TRU-003	REAR DUMP OFF ROAD HAUL TRUCK			☐	☐			CATERPILLAR 793C	
B2-TRU-004	REAR DUMP OFF ROAD HAUL TRUCK			☐	☐			CATERPILLAR 793C	
B2-TRU-006	WELDING TRUCK			☐	☐				
B2-TRU-007	MECHANICS TRUCK			☐	☐				
B2-TRU-008	MECHANICS TRUCK			☐	☐				
B2-TRU-009	UTILITY HAUL TRUCK			☐	☐			CATERPILLAR 773E	
B2-TRU-010	UTILITY HAUL TRUCK			☐	☐			CATERPILLAR 773E	
B2-TRU-011	WATER TRUCK			☐	☐			CATERPILLAR D9T	
B2-TRU-012	SAND TRUCK			☐	☐				
B2-TRU-013	FUEL/LUBE TRUCK			☑	☐				
B2-TRU-014	FLATBED TRUCK			☑	☐				
B2-VEH-001	PICK-UP TRUCK			☐	☐				
B2-VEH-002	PICK-UP TRUCK			☐	☐				
B2-VEH-003	PICK-UP TRUCK			☐	☐				
B2-VEH-004	PICK-UP TRUCK			☐	☐				
B2-VEH-005	PICK-UP TRUCK			☐	☐				
B2-VEH-006	PICK-UP TRUCK			☐	☐				
B2-VEH-007	CREW-CAB/SUBURBAN			☐	☐				
B2-VEH-008	CREW-CAB/SUBURBAN			☐	☐				
B2-XEM-001	MISCELLANEOUS - ELECTRICAL		25.0	☑	☐				
	OPEN PIT MOBILE EQUIPMENT TOTAL kW:		**25.0**						
Area: B6 - OPEN PIT DEWATERING									
B6-PSU-001	PIT DEWATERING PUMP 1		75.0	☑	☐				
B6-PSU-002	PIT DEWATERING PUMP 2		75.0	☑	☐				
	OPEN PIT DEWATERING TOTAL kW:		**150.0**						
Area: B7 - OPEN PIT ELCTRICAL									
B7-XEM-001	OPEN PIT LIGHTING		5.0	☑	☐				

EQUIPMENT NUMBER	DESCRIPTION	EQUIPMENT SIZE	POWER (kW)	OPERATING	STAND BY	MATERIAL	CAPACITY	MODEL	REMARKS
		OPEN PIT ELCTRICAL TOTAL kW:	5.0						
Area: C0 - PRIMARY CRUSHING									
C0-ACL-001	PRIMARY CRUSHER CONTROL ROOM AIR CONDITIONING UNIT	1200 CFM	0.2	☑	☐				
C0-ACL-002	PRIMARY CRUSHER CONTROL ROOM AIR COOLED CONDENSING UNIT	2.5 tonne	3.7	☑	☐				
C0-AHU-001	PRIMARY CRUSHER DIRECT GAS FIRED AIR HANDLING UNIT	10000 CFM	5.5	☑	☐				
C0-AIC-015	CRUSHING AREA AIR COMPRESSOR	365 Nm3/h @ 690 kPag	40.0	☑	☐				
C0-AID-018	CRUSHING AREA INSTRUMENT AIR DRYER	50 Nm3/h @ 830 kPag		☐	☐				
C0-AIF-016	CRUSHING AREA AIR FILTER	365 Nm3/h @ 830 kPag		☐	☐				
C0-AIR-017	CRUSHING AREA AIR RECEIVER	0.9 m3 (240 US gal)		☐	☐				
C0-BAG-001	PRIMARY CRUSHER DUST COLLECTOR	10000 CFM	0.2	☑	☐				
C0-BAG-015	CRUSHING DUST COLLECTOR BAGHOUSE		0.2	☑	☐				
C0-CRN-003	PRIMARY CRUSHING OVERHEAD CRANE	50/10 tonne	35.0	☑	☐				
C0-CRU-004	PRIMARY GYRATORY CRUSHER	1,370 mm x 1,900 mm	450.0	☑	☐				
C0-DUC-001	PRIMARY CRUSHER DUST DUCTING			☐	☐				
C0-FAN-001	PRIMARY CRUSHER LUBE ROOM SUPPLY FAN / FILTER	1200 CFM	2.2	☑	☐				
C0-FAN-002	PRIMARY CRUSHER CONTROL ROOM SUPPLY FAN / FILTER	200 CFM	3.7	☑	☐				
C0-FAN-003	PRIMARY CRUSHER COMPRESSOR ROOM SUPPLY FAN / FILTER	2000 CFM	2.2	☑	☐				
C0-FAN-004	PRIMARY CRUSHER ELECTRICAL ROOM SUPPLY FAN / FILTER	5000 CFM	5.5	☑	☐				
C0-FAN-005	PRIMARY CRUSHER DUST COLLECTOR EXHAUST FAN	10000 CFM	29.8	☑	☐				
C0-FDR-015	PRIMARY CRUSHER APRON FEEDER	1,830 mm x 7,750 mm	75.0	☑	☐				
C0-HTR-001	PRIMARY CRUSHER ELECTRIC UNIT HEATER		10.0	☑	☐				
C0-HTR-002	PRIMARY CRUSHER ELECTRIC UNIT HEATER		10.0	☑	☐				
C0-HTR-003	PRIMARY CRUSHER ELECTRIC UNIT HEATER		10.0	☑	☐				
C0-HTR-004	PRIMARY CRUSHER ELECTRIC UNIT HEATER		10.0	☑	☐				
C0-HTR-005	PRIMARY CRUSHER ELECTRIC UNIT HEATER		10.0	☑	☐				
C0-HTR-006	PRIMARY CRUSHER ELECTRIC UNIT HEATER		10.0	☑	☐				
C0-HTR-007	PRIMARY CRUSHER ELECTRIC UNIT HEATER		10.0	☑	☐				
C0-HTR-008	PRIMARY CRUSHER CONTROL ROOM ELECTRIC DUCT HEATER	200 CFM	6.5	☑	☐				
C0-LUB-011	PRIMARY CRUSHER LUBE UNIT		3.7	☑	☐				
C0-PPK-001	APRON FEEDER HYDRAULIC DRIVE POWER PACK		75.0	☑	☐				
C0-PPK-002	ROCK BREAKER HYDRAULIC POWER PACK		1.5	☑	☐				
C0-PSU-013	CRUSHING AREA SUMP PUMP	100 mm	7.5	☑	☐				
C0-RKB-001	ROCK BREAKER	5,000 ft - lb	37.0	☑	☐				
C0-SCB-004	STOCKPILE FEED BELT SCALE		0.5	☑	☐				
C0-VLV-001	PRIMARY CRUSHER DUST COLLECTOR ROTARY VALVE	8" DIA	0.7	☑	☐				
C0-XEM-001	LIGHTING		25.0	☑	☐				
C0-XMM-004	HVAC		0.0	☐	☐				
C0-XMM-005	MISC POWER INCL HEAT TRACING		25.0	☑	☐				
		PRIMARY CRUSHING TOTAL kW:	905.8						
Area: D0 - COARSE ORE STOCKPILE AND RECLAIM									
D0-AHU-002	PRIMARY CRUSHER DIRECT GAS FIRED AIR HANDLING UNIT	25000 CFM	14.9	☑	☐				
D0-AIR-018	STOCKPILE AREA AIR RECEIVER	0.9 m3 (240 US gal)		☐	☐				
D0-BAG-002	STOCKPILE RECLAIM DUST COLLECTOR	22000 CFM	0.2	☑	☐				
D0-CNV-001	STOCKPILE RECLAIM DUST COLLECTOR SCREW CONVEYOR		3.7	☑	☐				
D0-CNV-020	STOCKPILE FEED BELT CONVEYOR	524 mm (60") x 172,700 mı	447.4	☑	☐				
D0-CNV-028	PRIMARY SIZING SCREEN FEED CONVEYOR	372 mm (54") x 201,300 mı	186.4	☑	☐				
D0-DUC-002	STOCKPILE RECLAIM DUST DUCTING			☐	☐				
D0-FAN-006	STOCKPILE RECLAIM DUST COLLECTOR EXHAUST FAN	22000 CFM	55.9	☑	☐				
D0-FAN-007	TUNNEL EXHAUST FAN	4000 CFM	3.7	☑	☐				
D0-FDR-004	STOCKPILE RECLAIM APRON FEEDER No. 1 VFD	1,200 mm x 5,500 mm	14.9	☑	☐				
D0-FDR-008	STOCKPILE RECLAIM APRON FEEDER No. 2 VFD	1,200 mm x 5,500 mm	14.9	☑	☐				
D0-FDR-012	STOCKPILE RECLAIM APRON FEEDER No. 3 VFD	1,200 mm x 5,500 mm	14.9	☐	☑				
D0-PSU-017	STOCKPILE AREA SUMP PUMP	100 mm	7.5	☑	☐				
D0-SCB-003	PRIMARY SIZING SCREEN BELT SCALE		0.5	☑	☐				
D0-VLV-002	STOCKPILE RECLAIM DUST COLLECTOR ROTARY VALVE	8" DIA	0.7	☑	☐				
D0-WSS-LOT	STOCKPILE RECLAIM FIRE PROTECTION SPRINKLERS/HOSES/EXTINGU			☐	☐				
D0-XEM-001	LIGHTING		25.0	☑	☐				
D0-XMM-004	HVAC		0.0	☐	☐				

EQUIPMENT NUMBER	DESCRIPTION	EQUIPMENT SIZE	POWER (kW)	OPERATING	STAND BY	MATERIAL	CAPACITY	MODEL	REMARKS
D0-XMM-005	MISC POWER INCL HEAT TRACING		25.0	☑	☐				
	COARSE ORE STOCKPILE AND RECLAIM TOTAL kW:		**800.9**						
Area: D1 - HPGR									
D1-BAG-003	CRUSHER SURGE BIN BIN VENT DUST COLLECTOR	2000 CFM	0.2	☑	☐				
D1-BAG-004	HPGR SURGE BIN BIN VENT DUST COLLECTOR	2000 CFM	0.2	☑	☐				
D1-BAG-005	HPGR DUST COLLECTOR	30000 CFM	0.2	☑	☐				
D1-BAG-006	SECONDARY SIZING SCREEN DUST COLLECTOR BAGHOUSE		112.0	☑	☐				
D1-BIN-001	CONE CRUSHER SURGE BIN	160 tonne		☐	☐				
D1-BIN-005	HPGR SURGE BIN	150 tonne		☐	☐				
D1-CNV-002	CONE CRUSHER SURGE BIN FEED CONVEYOR	372 mm (54") x 100,300 mı	55.0	☑	☐				
D1-CNV-010	HPGR DUST COLLECTOR SCREW CONVEYOR		3.7	☑	☐				
D1-CNV-026	HPGR SURGE BIN FEED CONVEYOR	372 mm (54") x 100,300 mı	55.0	☑	☐				
D1-COL-015	HPGR DUST COLLECTOR		112.0	☑	☐				
D1-COO-001	CONE CRUSHER LUBRICATION COOLER No. 1		5.0	☑	☐				
D1-COO-002	HPGR CRUSHER LUBRICATION COOLER		5.0	☑	☐				
D1-COO-003	CONE CRUSHER LUBRICATION COOLER No. 2		5.0	☑	☐				
D1-CRN-001	HPGR BUILDING AREA CRANE	100 tonne	70.8	☐	☑				
D1-CRU-001	CONE CRUSHER No.1	MP 1000	750.0	☑	☐				
D1-CRU-002	CONE CRUSHER No.2	MP 1000	750.0	☐	☑				
D1-DUC-003	HPGR DUST DUCTING			☐	☐				
D1-EQP-001	HPGR SURGE BIN VENT		20.0	☑	☐				
D1-FAN-008	CRUSHER BIN VENT DUST COLLECTOR EXHAUST FAN	2000 CFM	6.0	☑	☐				
D1-FAN-009	HPGR BIN VENT DUST COLLECTOR EXHAUST FAN	2000 CFM	6.0	☑	☐				
D1-FAN-010	HPGR DUST COLLECTOR EXHAUST FAN	30000 CFM	56.0	☑	☐				
D1-FAN-011	HPGR ROOF EXHAUST FAN	25000 CFM	7.5	☑	☐				
D1-FAN-012	HPGR ROOF EXHAUST FAN	25000 CFM	7.5	☑	☐				
D1-FAN-013	HPGR ROOF EXHAUST FAN	25000 CFM	7.5	☑	☐				
D1-FAN-014	HPGR ROOF EXHAUST FAN	25000 CFM	7.5	☑	☐				
D1-FAN-015	HPGR ELECTRICAL ROOM EXHAUST FAN	5000 CFM	7.5	☑	☐				
D1-FAN-016	HPGR LUBE ROOM SUPPLY FAN / FILTER	1500 CFM	3.7	☑	☐				
D1-FAN-017	CONE LUBE ROOM #1 SUPPLY FAN SUPPLY FAN / FILTER	1500 CFM	3.7	☑	☐				
D1-FAN-018	CONE LUBE ROOM #2 SUPPLY FAN SUPPLY FAN / FILTER	1500 CFM	3.7	☑	☐				
D1-FDR-001	CONE CRUSHER BELT FEEDER No. 1	,524 mm (60") x 11,000 mn	10.0	☑	☐				
D1-FDR-005	HPGR SURGE BIN FEEDER	1,220 mm x 7,700 mm	10.0	☑	☐				
D1-FDR-006	CONE CRUSHER BELT FEEDER No. 2	,524 mm (60") x 11,000 mn	10.0	☑	☐				
D1-FDR-010	HPGR BELT FEEDER (RAIL MOUNTED)	,524 mm (60") x 11,000 mn	10.0	☑	☐				
D1-LUB-020	HPGR CRUSHER LUBE UNIT		22.0	☑	☐				
D1-LUB-037	CONE CRUSHER No.1 LUBE UNIT		7.5	☐	☑				
D1-LUB-040	CONE CRUSHER No.2 LUBE UNIT		7.5	☑	☐				
D1-MED-001	CONE CRUSHER METAL DETECTOR		10.0	☑	☐				
D1-MED-002	HPGR CRUSHER METAL DETECTOR		10.0	☑	☐				
D1-MGT-002	HPGR SELF CLEANING BELT MAGNET		10.0	☑	☐				
D1-MTR-001	HPGR	2,400 DIA x 1,700 mm	5300.0	☑	☐				
D1-PPK-005	HPGR CRUSHER HYDRAULIC POWER PACK		9.0	☑	☐				
D1-PSU-001	HPGR AREA SUMP PUMP	100 mm	7.5	☑	☐				
D1-SCB-001	CONE CRUSHER BELT SCALE		0.5	☑	☐				
D1-SCB-005	HPGR SURGE BIN FEED BELT SCALE		0.5	☑	☐				
D1-VLV-003	HPGR DUST COLLECTOR ROTARY VALVE	8" DIA	0.7	☑	☐				
D1-WSS-LOT	HPGR SPRINKLERS		0.0	☐	☐				
D1-XEM-001	LIGHTING		30.0	☑	☐				
	HPGR TOTAL kW:		**6687.4**						
Area: E0 - MILL BUILDING									
E0-GEN-001	GENERATOR SET		1600.0	☐	☑				
E0-GEN-002	GENERATOR SET		1600.0	☐	☑				
E0-XEM-001	LIGHTING		100.0	☑	☐				
E0-XMM-004	HVAC		0.0	☐	☐				
E0-XMM-005	MISC POWER INCL HEAT TRACING		200.0	☑	☐				
	MILL BUILDING TOTAL kW:		**300.0**						

EQUIPMENT NUMBER	DESCRIPTION	EQUIPMENT SIZE	POWER (kW)	OPERATING	STAND BY	MATERIAL	CAPACITY	MODEL	REMARKS
Area: E1 - GRINDING AND CLASSIFICATION									
E1-ACL-003	GRINDING FURNACE CONTROL ROOM GAS FIRED HORIZONTAL	2000 CFM	0.4	☑	☐				
E1-ACL-004	GRINDING CONTROL ROOM AIR COOLED CONDENSING UNIT	6 tonne	5.6	☑	☐				
E1-ACL-005	GRINDING OFFICES HORIZONTAL GAS FIRED	5200 CFM	0.4	☑	☐				
E1-ACL-006	GRINDING OFFICES AIR COOLED CONDENSING	15 tonne	5.6	☑	☐				
E1-AHU-004	GRINDING GAS FIRED DIRECT UNIT	30000 CFM	14.9	☑	☐				
E1-AHU-005	GRINDING GAS FIRED DIRECT UNIT	30000 CFM	14.9	☑	☐				
E1-BIN-016	BALL MILL No. 1 BALL BIN	100 tonne		☐	☐				
E1-BIN-017	BALL MILL No. 1 TRASH BIN			☐	☐				
E1-BIN-025	BALL MILL No. 2 BALL BIN	100 tonne		☐	☐				
E1-BIN-026	BALL MILL No. 2 TRASH BIN			☐	☐				
E1-CNV-003	SECONDARY SIZING SCREEN OVER SIZE TRANSFER CONVEYOR	,219 mm (48") x 13,500 mn	11.2	☑	☐				
E1-CNV-004	PRIMARY SIZING SCREEN OVER SIZE TRANSFER CONVEYOR	,372 mm (54") x 10,000 mn	14.9	☑	☐				
E1-CNV-005	PRIMARY SIZING SCREEN UNDER SIZE TRANSFER CONVEYOR	,372 mm (54") x 11,500 mn	14.9	☑	☐				
E1-CNV-007	HPGR DISCHARGE CONVEYOR	372 mm (54") x 109,300 mı	55.9	☑	☐				
E1-CRN-030	GRINDING AREA CRANE	50/10 tonne	70.8	☑	☐				
E1-CYC-012	CYCLOPAC No.1	6 x 660 mm		☐	☐				
E1-CYC-021	CYCLOPAC No.2	6 x 660 mm		☐	☐				
E1-EQP-018	BALL CHARGING BUCKET	0.5 m3		☐	☐				
E1-FAN-019	GRINDING LUBE ROOM #1 SUPPLY FAN / FILTER	1500 CFM	3.7	☑	☐				
E1-FAN-020	GRINDING LUBE ROOM #2 SUPPLY FAN / FILTER	1500 CFM	3.7	☑	☐				
E1-FAN-021	GRINDING CONTROL ROOM PRESSURIZATION UNIT	400 CFM	3.7	☑	☐				
E1-FAN-022	GRINDING EXHAUST FAN	40000 CFM	11.2	☑	☐				
E1-FAN-023	GRINDING EXHAUST FAN	40000 CFM	11.2	☑	☐				
E1-FAN-024	GRINDING EXHAUST FAN	40000 CFM	11.2	☑	☐				
E1-FAN-025	GRINDING EXHAUST FAN	40000 CFM	11.2	☑	☐				
E1-FAN-026	GRINDING LUNCHROOM EXHAUST FAN	250 CFM	0.7	☑	☐				
E1-FAN-027	GRINDING WASHROOMS EXHAUST FAN	400 CFM	3.7	☑	☐				
E1-FAN-028	GRINDING COMPRESSOR ROOM EXHAUST FAN	3000 CFM	3.7	☑	☐				
E1-FAN-029	GRINDING COMPRESSOR ROOM EXHAUST FAN	3000 CFM	3.7	☑	☐				
E1-FAN-030	GRINDING BLOWER ROOM EXHAUST FAN	4000 CFM	3.7	☑	☐				
E1-FAN-031	GRINDING BLOWER ROOM EXHAUST FAN	4000 CFM	3.7	☑	☐				
E1-HAN-001	MILL LINER HANDLER		10.0	☑	☐				
E1-HTR-017	GRINDING GAS FIRED UNIT HEATER		0.2	☑	☐				
E1-HTR-018	GRINDING GAS FIRED UNIT HEATER		0.2	☑	☐				
E1-HTR-019	GRINDING GAS FIRED UNIT HEATER		0.2	☑	☐				
E1-HTR-020	GRINDING GAS FIRED UNIT HEATER		0.2	☑	☐				
E1-HTR-021	GRINDING GAS FIRED UNIT HEATER		0.2	☑	☐				
E1-HTR-022	GRINDING GAS FIRED UNIT HEATER		0.2	☑	☐				
E1-HTR-023	GRINDING GAS FIRED UNIT HEATER		0.2	☑	☐				
E1-HTR-024	GRINDING GAS FIRED UNIT HEATER		0.2	☑	☐				
E1-HTR-025	GRINDING GAS FIRED UNIT HEATER		0.2	☑	☐				
E1-HTR-026	GRINDING GAS FIRED UNIT HEATER		0.2	☑	☐				
E1-HTR-027	GRINDING GAS FIRED UNIT HEATER		0.2	☑	☐				
E1-HTR-028	GRINDING CONTROL ROOM ELECTRIC DUCT HEATER	400 CFM	13.0	☑	☐				
E1-LUB-038	BALL MILL No. 1 LUBE UNIT		15.0	☑	☐				
E1-LUB-039	BALL MILL No. 2 LUBE UNIT		15.0	☑	☐				
E1-MGT-001	SELF CLEANING BELT MAGNET		10.0	☑	☐				
E1-MIL-013	BALL MILL No. 1	6,096 mm x 10,211 mm	6700.0	☑	☐				
E1-MIL-022	BALL MILL No. 2	6,096 mm x 10,211 mm	6700.0	☑	☐				
E1-PBX-009	CYCLOPACS FEED PUMPBOX			☐	☐				
E1-PSL-002	CYCLOPAC No.1 & 2 FEED PUMP No. 2 (UNINSTALLED SPARE)	500 mm x 450 mm	572.0	☐	☑				
E1-PSL-003	CYCLOPAC No.2 FEED PUMP No. 1	500 mm x 450 mm	572.0	☑	☐				
E1-PSL-010	CYCLOPAC No.1 FEED PUMP No. 1	500 mm x 450 mm	572.0	☑	☐				
E1-PSU-040	GRINDING AREA SUMP PUMP	150 mm	7.5	☑	☐				
E1-SCN-001	PRIMARY SIZING SCREEN No.1	2,700 mm x 8,000 mm	26.0	☑	☐				
E1-SCN-002	PRIMARY SIZING SCREEN No.2	2,700 mm x 8,000 mm	26.0	☑	☐				
E1-SCN-003	SECONDARY SIZING SCREEN No.1	4,000 mm x 8,000 mm	37.0	☑	☐				
E1-SCN-004	SECONDARY SIZING SCREEN No.2	4,000 mm x 8,000 mm	37.0	☑	☐				

EQUIPMENT NUMBER	DESCRIPTION	EQUIPMENT SIZE	POWER (kW)	OPERATING	STAND BY	MATERIAL	CAPACITY	MODEL	REMARKS
E1-SMP-020	ON-STREAM SECONDARY GRINDING CYCLOPAC SAMPLER		7.5	☑	☐				
E1-WSS-LOT	GRINDING SPRINKLERS		0.0	☐	☐				
	GRINDING AND CLASSIFICATION TOTAL kW:		**15035.5**						
Area: E2 - SECONDARY CRUSHING									
E2-BAG-006	SEC SCREENING DUST COLLECTOR	55000 CFM	0.2	☑	☐				
E2-CNV-003	SEC SCREENING DUST COLLECTOR SCREW CONVEYOR		3.7	☑	☐				
E2-DUC-004	SEC SCREENING DUST DUCTING		0.0	☐	☐				
E2-FAN-032	SEC SCREENING DUST COLLECTOR EXHAUST FAN	55000 CFM	75.0	☑	☐				
E2-VLV-004	SEC SCREENING DUST COLLECTOR ROTARY VALVE	8" DIA	0.7	☑	☐				
	SECONDARY CRUSHING TOTAL kW:		**79.7**						
Area: E3 - FLOTATION									
E3-AGI-003	COPPER MOLYBDENUM CONC. STOCK TANK AGITATOR		1.1	☑	☐				
E3-AGI-004	MOLYBDENUM CONC. STOCK TANK AGITATOR		4.0	☑	☐				
E3-AHU-006	FLOTATION GAS FIRED DIRECT UNIT	30000 CFM	14.9	☑	☐				
E3-AHU-007	FLOTATION GAS FIRED DIRECT UNIT	30000 CFM	14.9	☑	☐				
E3-BIN-015	1st REGRIND MILL TRASH BIN			☐	☐				
E3-BIN-020	MOLYBDENUM CONC. BIN			☐	☐				
E3-BLO-084	FLOTATION AERATION BLOWER No. 1	4.7 m3/s	350.0	☑	☐				
E3-BLO-085	FLOTATION AERATION BLOWER No. 2	4.7 m3/s	350.0	☑	☐				
E3-CEL-003	COPPER ROUGHER FLOTATION CELL No. 1	200 m3	224.0	☑	☐				
E3-CEL-004	COPPER ROUGHER FLOTATION CELL No. 2	200 m3	224.0	☑	☐				
E3-CEL-005	COPPER ROUGHER FLOTATION CELL No. 3	200 m3	224.0	☑	☐				
E3-CEL-006	COPPER ROUGHER FLOTATION CELL No. 4	200 m3	224.0	☑	☐				
E3-CEL-007	MOLYBDENUM ROUGHER FLOTATION CELL No. 1	5 m3	11.0	☑	☐				
E3-CEL-008	MOLYBDENUM ROUGHER FLOTATION CELL No. 2	5 m3	11.0	☑	☐				
E3-CEL-009	MOLYBDENUM ROUGHER FLOTATION CELL No. 3	5 m3	11.0	☑	☐				
E3-CEL-021	COPPER ROUGHER SCAVENGER FLOTATION CELL No. 1	200 m3	224.0	☑	☐				
E3-CEL-022	COPPER ROUGHER SCAVENGER FLOTATION CELL No. 2	200 m3	224.0	☑	☐				
E3-CEL-023	COPPER ROUGHER SCAVENGER FLOTATION CELL No. 3	200 m3	224.0	☑	☐				
E3-CEL-024	COPPER ROUGHER SCAVENGER FLOTATION CELL No. 4	200 m3	224.0	☑	☐				
E3-CEL-030	COPPER 1st CLEANER FLOTATION CELL No. 1	70 m3	93.0	☑	☐				
E3-CEL-031	COPPER 1st CLEANER FLOTATION CELL No. 2	70 m3	93.0	☑	☐				
E3-CEL-032	COPPER 1st CLEANER FLOTATION CELL No. 3	70 m3	93.0	☑	☐				
E3-CEL-033	COPPER 1st CLEANER FLOTATION CELL No. 4	70 m3	93.0	☑	☐				
E3-CEL-039	COPPER 1st CLEANER SCAVENGER FLOTATION CELL No. 1	70 m3	93.0	☑	☐				
E3-CEL-040	COPPER 1st CLEANER SCAVENGER FLOTATION CELL No. 2	70 m3	93.0	☑	☐				
E3-CEL-041	COPPER 1st CLEANER SCAVENGER FLOTATION CELL No. 3	70 m3	93.0	☑	☐				
E3-CEL-042	COPPER 1st CLEANER SCAVENGER FLOTATION CELL No. 4	70 m3	93.0	☑	☐				
E3-CEL-052	COPPER 2nd CLEANER COLUMN FLOTATION CELL	3,100 mm DIA x 10,000 mm	1.1	☑	☐				
E3-CEL-060	MOLYBDENUM 1ST CLEANER COLUMN FLOTATION CELL		1.1	☑	☐				
E3-CNV-001	MOLYBDENUM CONCENTRATE BELT CONVEYOR	1,219 mm (48") x 8,000 mm	7.5	☑	☐				
E3-COL-001	DRYER DUST COLLECTOR		0.2	☑	☐				
E3-CRN-029	FLOTATION AREA CRANE	5 tonne	8.2	☑	☐				
E3-CYC-010	REGRIND CYCLOPAC	20 x 165 mm		☐	☐				
E3-DRY-006	MOLYBDENUM CONCENTRATE DRYER		5.0	☑	☐				
E3-EQP-017	BALL CHARGING BUCKET	0.5 m3		☐	☐				
E3-FAN-033	FLOTATION EXHAUST FANS	40000 CFM	11.2	☑	☐				
E3-FAN-034	FLOTATION EXHAUST FANS	40000 CFM	11.2	☑	☐				
E3-FAN-035	FLOTATION EXHAUST FANS	40000 CFM	11.2	☑	☐				
E3-FAN-036	FLOTATION EXHAUST FANS	40000 CFM	11.2	☑	☐				
E3-FAN-037	FLOTATION REGRIND LUBE ROOM SUPPLY FAN / FILTER	1500 CFM	3.7	☑	☐				
E3-FIL-005	MOLYBDENUM CONCENTRATE FILTER		4.0	☑	☐				
E3-HTR-029	MOLYBDENUM CONCENTRATE GAS FIRED UNIT HEATER		0.2	☑	☐				
E3-HTR-030	MOLYBDENUM CONCENTRATE GAS FIRED UNIT HEATER		0.2	☑	☐				
E3-HTR-031	MOLYBDENUM CONCENTRATE GAS FIRED UNIT HEATER		0.2	☑	☐				
E3-HTR-032	MOLYBDENUM CONCENTRATE GAS FIRED UNIT HEATER		0.2	☑	☐				
E3-HTR-033	MOLYBDENUM CONCENTRATE GAS FIRED UNIT HEATER		0.2	☑	☐				
E3-HTR-034	MOLYBDENUM CONCENTRATE GAS FIRED UNIT HEATER		0.2	☑	☐				

EQUIPMENT NUMBER	DESCRIPTION	EQUIPMENT SIZE	POWER (kW)	OPERATING	STAND BY	MATERIAL	CAPACITY	MODEL	REMARKS
E3-LUB-028	REGRIND MILL LUBE UNIT		15.0	☑	☐				
E3-MAC-001	BAGGING MACHINE		3.7	☑	☐				
E3-MIL-012	1st REGRIND VERTICAL MILL	4,267 mm x 5,486 mm	1119.0	☑	☐				
E3-MIL-065	2nd REGRIND VERTICAL MILL	4,267 mm x 5,486 mm	1119.0	☑	☐				
E3-PBX-007	REGRIND CYCLOPAC FEED PUMPBOX			☐	☐				
E3-PBX-018	ROUGHER TAILINGS PUMPBOX			☐	☐				
E3-PBX-048	FINAL TAILINGS FEED PUMPBOX No. 1			☐	☐				
E3-PBX-053	2nd CLEANER TAILINGS PUMPBOX			☐	☐				
E3-PSL-001	REGRIND CYCLOPAC FEED PUMP No. 1	250 mm x 200 mm	200.0	☑	☐				
E3-PSL-009	REGRIND CYCLOPAC FEED PUMP No. 2	250 mm x 200 mm	200.0	☐	☑				
E3-PSL-019	ROUGHER TAILINGS PUMP No.1	500 mm x 450 mm	450.0	☑	☐				
E3-PSL-020	ROUGHER TAILINGS PUMP No.2	500 mm x 450 mm	450.0	☐	☑				
E3-PSL-025	STOCK TANK FEED PUMP No.1	80 mm x 50 mm	8.0	☑	☐				
E3-PSL-026	STOCK TANK FEED PUMP No.2	80 mm x 50 mm	8.0	☐	☑				
E3-PSL-030	MOLYBDENUM ROUGHER FLOTATION FEED PUMP No.1	40 mm x 25 mm	10.0	☑	☐				
E3-PSL-031	MOLYBDENUM ROUGHER FLOTATION FEED PUMP No.2	40 mm x 25 mm	10.0	☐	☑				
E3-PSL-032	MOLYBDENUM CONC. FILTER FEED PUMP No.1	32 mm x 25 mm	15.0	☑	☐				
E3-PSL-033	MOLYBDENUM CONC. FILTER FEED PUMP No.2	32 mm x 25 mm	15.0	☐	☑				
E3-PSL-034	MOLYBDENUM FILTER FEED PUMP No.1	32 mm x 25 mm	3.0	☑	☐				
E3-PSL-035	MOLYBDENUM FILTER FEED PUMP No.2	32 mm x 25 mm	3.0	☐	☑				
E3-PSL-036	1st CLEANER CONC. PUMP No.1	150 mm x 100 mm	15.0	☑	☐				
E3-PSL-037	1st CLEANER CONC. PUMP No.2	150 mm x 100 mm	15.0	☐	☑				
E3-PSL-038	MOLYBDENUM CLEANER COLUMN UNDERFLOW PUMP	40 mm x 25 mm	7.0	☑	☐				
E3-PSL-039	MOLYBDENUM CLEANER COLUMN UNDERFLOW PUMP (STANDBY)	40 mm x 25 mm	7.0	☐	☑				
E3-PSL-040	MOLYBDENUM CLEANER FLOTATION FEED PUMP No.1	40 mm x 25 mm	7.0	☑	☐				
E3-PSL-041	MOLYBDENUM CLEANER FLOTATION FEED PUMP No.2	40 mm x 25 mm	7.0	☐	☑				
E3-PSL-042	MOLYBDENUM THICKENER FEED PUMP No.1	50 mm x 38 mm	3.0	☑	☐				
E3-PSL-043	MOLYBDENUM THICKENER FEED PUMP No.2	50 mm x 38 mm	3.0	☐	☑				
E3-PSL-045	1st CLEANER / SCAV CONC. PUMP No.1	100 mm x 75 mm	10.0	☑	☐				
E3-PSL-046	1st CLEANER / SCAV CONC. PUMP No.2	100 mm x 75 mm	10.0	☐	☑				
E3-PSL-054	2nd CLEANER TAILINGS PUMP No.1	150 mm x 100 mm	26.0	☑	☐				
E3-PSL-055	2nd CLEANER TAILINGS PUMP No.2	150 mm x 100 mm	26.0	☐	☑				
E3-PSL-057	2nd CLEANER CONC. PUMP No.1	150 mm x 100 mm	20.0	☑	☐				
E3-PSL-058	2nd CLEANER CONC. PUMP No.2	150 mm x 1050 mm	20.0	☐	☑				
E3-PSU-010	CONC. DEWATERING AREA SUMP PUMP	50 mm	1.0	☑	☐				
E3-PSU-026	FLOTATION AREA SUMP PUMP No. 1	100 mm	10.0	☑	☐				
E3-SCL-001	MOLYBDENUM CONC. SCALE		0.5	☑	☐				
E3-SMP-008	COPPER SAMPLER		7.5	☑	☐				
E3-SMP-011	REGRIND CYCLOPAC ON-STREAM SAMPLER		7.5	☑	☐				
E3-SMP-025	ROUGHER SCAVENGER ON-STREAM SAMPLER		7.5	☑	☐				
E3-SMP-038	1st CLEANER CONC. ON-STREAM SAMPLER		7.5	☑	☐				
E3-SMP-047	1st CLEANER / SCAV CONC. ON-STREAM SAMPLER		7.5	☑	☐				
E3-SMP-059	2nd CLEANER CONC. ON-STREAM SAMPLER		7.5	☑	☐				
E3-THI-001	COPPER MOLYBDENUM THICKENER	11,000 mm	6.0	☑	☐				
E3-THI-004	MOLYBDENUM THICKENER	2,500 mm	3.0	☑	☐				
E3-TNK-011	COPPER MOLYBDENUM CONC. STOCK TANK	1,500 mm DIA x 1,500 mm		☐	☐				
E3-TNK-012	MOLYBDENUM CONC. STOCK TANK	2,000 mm DIA x 2,500 mm		☐	☐				
E3-TNK-020	MOLYBDENUM ROUGHER CONC. STANDPIPE	1,500 mm DIA x 3,000 mm		☐	☐				
E3-TNK-025	MOLYBDENUM CLEANER CONC. STANDPIPE	1,000 mm DIA x 2,000 mm		☐	☐				
E3-TNK-035	1st CLEANER CONC. STANDPIPE	1,500 mm DIA x 3,000 mm		☐	☐				
E3-TNK-044	1st CLEANER / SCAVENGER CONC. STANDPIPE	1,500 mm DIA x 3,000 mm		☐	☐				
E3-TNK-056	2nd CLEANER CONC. STANDPIPE	2,000 mm DIA x 3,000 mm		☐	☐				
E3-WSS-LOT	FLOTATION FIRE PROTECTION SPRINKLERS/HOSES/EXTINGUISHERS			☐	☐				
		FLOTATION TOTAL kW:	**6476.8**						
Area: E4 - CONCENTRATE DEWATERING AND LOADOUT									
E4-AGI-009	COPPER CONCENTRATE STOCK TANK AGITATOR		22.0	☑	☐				
E4-AHU-008	LOADOUT DIRECT GAS FIRED AIR HANDLING UNIT	40000 CFM	18.7	☑	☐				
E4-AIR-020	CONCENTRATE DEWATERING AREA AIR RECEIVER	0.9 m3 (240 US gal)		☐	☐				

EQUIPMENT NUMBER	DESCRIPTION	EQUIPMENT SIZE	POWER (kW)	OPERATING	STAND BY	MATERIAL	CAPACITY	MODEL	REMARKS
E4-BAG-007	LOADOUT DUST COLLECTOR	40000 CFM	0.2	☑	☐				
E4-CNV-004	LOADOUT DUST COLLECTOR SCREW CONVEYOR	1220 mm x 17200 mm	3.7	☑	☐				
E4-CNV-015	COPPER CONCENTRATE TRANSFER BELT CONVEYOR	,219 mm (48") x 14,800 mn	7.5	☑	☐				
E4-CNV-016	COPPER CONCENTRATE LOADOUT BELT CONVEYOR	,219 mm (48") x 17,200 mn	7.5	☑	☐				
E4-DUC-LOT	CONCENTRATE THICKENING DUST DUCTING - LOADOUT			☐	☐				
E4-FAN-038	LOADOUT DUST COLLECTOR EXHAUST FAN	40000 CFM	56.0	☑	☐				
E4-FIL-013	COPPER CONCENTRATE PRESSURE FILTER		75.0	☑	☐				
E4-HTR-035	LOADOUT GAS FIRED UNIT HEATER		0.2	☑	☐				
E4-HTR-036	LOADOUT GAS FIRED UNIT HEATER		0.2	☑	☐				
E4-HTR-037	LOADOUT GAS FIRED UNIT HEATER		0.2	☑	☐				
E4-HTR-038	LOADOUT GAS FIRED UNIT HEATER		0.2	☑	☐				
E4-HTR-039	LOADOUT GAS FIRED UNIT HEATER		0.2	☑	☐				
E4-HTR-040	LOADOUT GAS FIRED UNIT HEATER		0.2	☑	☐				
E4-HTR-041	LOADOUT GAS FIRED UNIT HEATER		0.2	☑	☐				
E4-HTR-042	LOADOUT GAS FIRED UNIT HEATER		0.2	☑	☐				
E4-PMP-001	CLOTH WASH WATER PUMP	40 mm x 25 mm	10.0	☑	☐				
E4-PMP-003	COPPER FILTRATE PUMP	50 mm x 38 mm	5.0	☑	☐				
E4-PSL-007	COPPER THICKENER UNDERFLOW PUMP No. 1	40 mm x 25 mm	11.0	☑	☐				
E4-PSL-008	COPPER THICKENER UNDERFLOW PUMP No. 2	40 mm x 25 mm	11.0	☐	☑				
E4-PSL-011	COPPER CONCENTRATE FILTER FEED PUMP No. 1	80 mm x 50 mm	55.0	☑	☐				
E4-PSL-012	COPPER CONCENTRATE FILTER FEED PUMP No. 2	80 mm x 50 mm	55.0	☐	☑				
E4-PSO-004	COPPER THICKENER OVERFLOW PUMP No. 1	80 mm x 50 mm	20.0	☑	☐				
E4-PSO-027	COPPER THICKENER OVERFLOW PUMP No. 2	80 mm x 50 mm	20.0	☐	☑				
E4-PSU-019	COPPER DEWATERING AREA SUMP PUMP	100 mm	15.0	☑	☐				
E4-SCL-017	COPPER CONCENTRATE BELT SCALE		0.5	☑	☐				
E4-THI-002	COPPER THICKENER	11,400 mm	7.0	☑	☐				
E4-TNK-003	COPPER THICKENER OVERFLOW STANDPIPE	1,200 mm DIA x 5,000 mm		☐	☐				
E4-TNK-005	CLOTH WASH WATER TANK	3,000 mm DIA x 3,000 mm		☐	☐				
E4-TNK-007	COPPER FILTRATE TANK	1,500 mm DIA x 3,000 mm		☐	☐				
E4-TNK-010	COPPER CONCENTRATE STOCK TANK	7,000 mm x 6,000 mm		☐	☐				
E4-VLV-005	LOADOUT DUST COLLECTOR ROTARY VALVE	8" DIA	0.7	☑	☐				
E4-WSS-LOT	CONCENTRATE THICKENING FIRE PROTECTION SPRINKLERS/HOSES/E			☐	☐				
	CONCENTRATE DEWATERING AND LOADOUT TOTAL kW:		**316.3**						
Area: E5 - REAGENTS									
E5-AGI-006	FLOCCULANT MIXING TANK AGITATOR		0.6	☑	☐				
E5-AGI-022	LIME HOLDING TANK AGITATOR		55.5	☑	☐				
E5-AGI-030	PEX MIXING TANK AGITATOR		4.5	☑	☐				
E5-AGI-050	CMC MIXING TANK AGITATOR		1.1	☑	☐				
E5-BAG-008	LIME SILO BIN VENT DUST COLLECTOR	2000 CFM	0.2	☑	☐				
E5-COL-014	LIME AREA DUST COLLECTOR		0.2	☑	☐				
E5-CYC-021	LIME SLAKING CYCLONE			☐	☐				
E5-DRU-001	AERO DRUM CRADLE			☐	☐				
E5-DRU-002	MIBC DRUM CRADLE			☐	☐				
E5-EDU-005	FLOCCULANT EDUCTOR		2.0	☑	☐				
E5-FAN-039	PEX EXHAUST FAN	600 CFM	0.7	☑	☐				
E5-FAN-040	AERO 3302 EXHAUST FAN	600 CFM FRP	0.7	☑	☐				
E5-FAN-041	CMC EXHAUST FAN	600 CFM FRP	0.7	☑	☐				
E5-FAN-042	MIBC EXHAUST FAN	600 CFM FRP	0.7	☑	☐				
E5-FAN-043	KEROSENE EXHAUST FAN	600 CFM FRP	0.7	☑	☐				
E5-FAN-044	PINE OIL EXHAUST FAN	600 CFM FRP	0.7	☑	☐				
E5-FAN-045	LIME SILO DUST COLLECTOR EXHAUST FAN	2000 CFM	6.0	☑	☐				
E5-FDR-016	LIME SLAKING MILL SCREW FEEDER		19.0	☑	☐				
E5-FDR-020	FLOCCULANT SCREW FEEDER		19.0	☑	☐				
E5-HOI-001	FLOCCULANT HOIST		3.0	☑	☐				
E5-HPR-003	FLOCCULANT HOPPER			☐	☐				
E5-HTR-043	REAGENTS GAS FIRED UNIT HEATERS		0.2	☑	☐				
E5-HTR-044	REAGENTS GAS FIRED UNIT HEATERS		0.2	☑	☐				
E5-HTR-045	REAGENTS GAS FIRED UNIT HEATERS		0.2	☑	☐				

EQUIPMENT NUMBER	DESCRIPTION	EQUIPMENT SIZE	POWER (kW)	OPERATING	STAND BY	MATERIAL	CAPACITY	MODEL	REMARKS
E5-HTR-046	REAGENTS GAS FIRED UNIT HEATERS		0.2	☑	☐				
E5-HTR-047	REAGENTS GAS FIRED UNIT HEATERS		0.2	☑	☐				
E5-HTR-048	REAGENTS GAS FIRED UNIT HEATERS		0.2	☑	☐				
E5-MIL-017	LIME SLAKING VERTICAL MILL		27.9	☑	☐				
E5-PBX-022	LIME SLAKING CYCLONE FEED PUMPBOX			☐	☐				
E5-PMP-001	KEROSENE HOLDING PUMP No. 1	50 mm x 40 mm	1.0	☑	☐				
E5-PMP-002	KEROSENE HOLDING PUMP No. 2	50 mm x 40 mm	1.0	☐	☑				
E5-PMP-005	PINE OIL HOLDING PUMP No. 1	50 mm x 40 mm	1.0	☑	☐				
E5-PMP-006	PINE OIL HOLDING PUMP No. 2	50 mm x 450 mm	1.0	☐	☑				
E5-PMT-001	FLOCCULANT METERING PUMP No. 1	25 mm PC	2.3	☑	☐				
E5-PMT-002	FLOCCULANT METERING PUMP No. 2	25 mm PC	2.3	☐	☑				
E5-PMT-005	PEX METERING PUMP No. 1	12 mm x 25 mm	1.0	☑	☐				
E5-PMT-006	PEX METERING PUMP No. 2	12 mm x 25 mm	1.0	☑	☐				
E5-PMT-007	PEX METERING PUMP No. 3	12 mm x 25 mm	1.0	☑	☐				
E5-PMT-008	PEX METERING PUMP No. 4	12 mm x 25 mm	1.0	☐	☑				
E5-PMT-010	AERO 3302 METERING PUMP No. 1	12 mm x 25 mm	1.0	☑	☐				
E5-PMT-011	AERO 3302 METERING PUMP No. 2	12 mm x 25 mm	1.0	☐	☑				
E5-PMT-020	CMC METERING PUMP	12 mm x 25 mm	1.0	☑	☐				
E5-PMT-030	MIBC METERING PUMP No. 1	12 mm x 25 mm	1.0	☑	☐				
E5-PMT-031	MIBC METERING PUMP No. 2	12 mm x 25 mm	1.0	☑	☐				
E5-PMT-032	MIBC METERING PUMP No. 3	12 mm x 25 mm	1.0	☑	☐				
E5-PSL-004	LIME SLAKING CYCLONE FEED PUMP	75 mm x 50 mm	11.3	☑	☐				
E5-PSO-024	LIME DISTRIBUTION PUMP No. 1	50 mm	1.0	☑	☐				
E5-PSO-025	LIME DISTRIBUTION PUMP No. 2	50 mm	1.0	☐	☑				
E5-PSU-012	FLOCCULANT AREA SUMP PUMP	50 mm	2.0	☑	☐				
E5-PSU-027	LIME AREA SUMP PUMP	50 mm	2.0	☑	☐				
E5-PSU-043	MIBC AREA SUMP PUMP	50 mm	2.0	☑	☐				
E5-PSU-050	KEROSENE & PINE OIL AREA SUMP PUMP	50 mm	1.0	☑	☐				
E5-SIL-015	LIME SILO	300 tonne		☐	☐				
E5-SSW-028	LIME AREA SAFETY SHOWER EYEWASH			☐	☐				
E5-SSW-029	PEX AREA SAFETY SHOWER EYEWASH			☐	☐				
E5-SSW-039	PINE OIL AREA SAFETY SHOWER EYEWASH			☐	☐				
E5-SSW-041	AERO 3302 AREA SAFETY SHOWER EYEWASH			☐	☐				
E5-SSW-044	MIBC AREA SAFETY SHOWER EYEWASH			☐	☐				
E5-SSW-053	CMC AREA SAFETY SHOWER EYEWASH			☐	☐				
E5-SYS-002	FLOCCULANT SYSTEM			☐	☐				
E5-SYS-013	LIME SLAKING SYSTEM			☐	☐				
E5-TNK-009	FLOCCULANT HOLDING TANK	3,000 mm DIA x 3,500 mm		☐	☐				
E5-TNK-017	FLOCCULANT MIXING TANK	3,000 mm DIA x 3,500 mm		☐	☐				
E5-TNK-023	LIME HOLDING TANK	6,000 mm DIA x 6,000 mm		☐	☐				
E5-TNK-031	PEX MIXING TANK	2,000 mm DIA x 3,000 mm		☐	☐				
E5-TNK-032	PEX HOLDING TANK	2,000 mm DIA x 3,000 mm		☐	☐				
E5-TNK-036	PINE OIL HOLDING TANK	4,000 mm x 9,000 mm		☐	☐				
E5-TNK-040	MIBC HOLDING TANK	1,500 mm x 2,000 mm		☐	☐				
E5-TNK-045	AERO 3302 HOLDING TANK	1,000 mm x 1,500 mm		☐	☐				
E5-TNK-051	CMC MIXING TANK	1,000 mm x 1,500 mm		☐	☐				
E5-TNK-052	CMC HOLDING TANK	1,000 mm x 1,500 mm		☐	☐				
E5-TNK-055	KEROSENE HOLDING TANK	4,000 mm x 9,000 mm		☐	☐				
E5-WSS-LOT	REAGENTS SPRINKLERS		0.0	☐	☐				
		REAGENTS TOTAL kW:	**176.2**						
Area: F0 - TAILINGS									
F0-PBX-001	TAILINGS PUMP STATION NO. 2 PUMP BOX	7,500 x 5,000 x10,000mm		☐	☐				by KCBL
F0-PBX-001	TAILINGS PUMP STATION NO. 1 PUMP BOX	7,500 x 5,000 x10,000mm		☐	☐	RUBBER LINED STEEL			
F0-PSU-001	TAILINGS PUMP STATION NO. 1 VFD - PUMP 1 (DUTY) - BY KCBL	400mm x 350mm	820.0	☑	☐				by KCBL
F0-PSU-002	TAILINGS PUMP STATION NO. 1 PUMP 2 (DUTY)	400mm x 350mm	820.0	☑	☐				by KCBL
F0-PSU-003	TAILINGS PUMP STATION NO. 1 PUMP 3 (DUTY)	400mm x 350mm	820.0	☑	☐				by KCBL
F0-PSU-004	TAILINGS PUMP STATION NO. 1 VFD - PUMP 4 (DUTY)	400mm x 350mm	820.0	☑	☐				by KCBL
F0-PSU-005	TAILINGS PUMP STATION NO. 2 VFD - PUMP 1 (DUTY) - BY KCBL	400mm x 350mm	820.0	☑	☐				by KCBL

EQUIPMENT NUMBER	DESCRIPTION	EQUIPMENT SIZE	POWER (kW)	OPERATING	STAND BY	MATERIAL	CAPACITY	MODEL	REMARKS
F0-PSU-006	TAILINGS PUMP STATION NO. 2 PUMP 2 (DUTY)	400mm x 350mm	820.0	☑	☐				by KCBL
F0-PSU-007	TAILINGS PUMP STATION NO. 2 PUMP 3 (DUTY)	400mm x 350mm	820.0	☑	☐				by KCBL
F0-PSU-008	TAILINGS PUMP STATION NO. 2 VFD - PUMP 4 (DUTY)	400mm x 350mm	820.0	☑	☐				by KCBL
F0-PSU-016	FRESHWATER MAKE-UP PUMP 1 (DUTY)	150mm	100.7	☑	☐				by KCBL
F0-PSU-017	FRESHWATER MAKE-UP PUMP 2 (STANDBY)	150mm	100.7	☐	☑				by KCBL
F0-XEM-001	LIGHTING		5.0	☑	☐				
F0-XMM-001	TAILINGS PUMP STATION NO. 2 PUMP STATION AUXILIARY LOADS		104.0	☑	☐				Includes small power and lighting,controls, HVAC, o/h crane
F0-XMM-004	HVAC		20.0	☑	☐				
F0-XMM-005	FRESHWATER MAKE-UP PUMP STATION AUXILIARY LOADS		27.0	☑	☐				Includes small power and lighting,controls, HVAC, o/h crane
F0-XMM-005	MISC POWER INCL HEAT TRACING		20.0	☑	☐				
	TAILINGS TOTAL kW:		**6836.7**						
Area: F1 - TAILINGS DISPOSAL AND RECLAIM									
F1-CYC-001	RECLAIM DAM FINAL TAILINGS CYCLOPAC	6 X 650 mm		☐	☐				by KCBL
F1-CYC-002	RECLAIM DAM FINAL TAILINGS CYCLOPAC	6 X 650 mm		☐	☐				by KCBL
F1-PSU-009	RECLAIM BARGE PUMP 1 (DUTY)	400mm	82.0	☑	☐				by KCBL
F1-PSU-010	RECLAIM BARGE PUMP 2 (DUTY)	400mm	82.0	☑	☐				by KCBL
F1-PSU-011	RECLAIM BARGE PUMP 3 (STANDBY)	400mm	82.0	☐	☑				by KCBL
F1-PSU-018	CYCLOWASH PUMP STATION NO. 1 PUMP 1 (DUTY)	100mm x 150mm	48.5	☑	☐				by KCBL
F1-PSU-019	CYCLOWASH PUMP STATION NO. 1 PUMP 2 (STANDBY)	100mm x 150mm	48.5	☐	☑				by KCBL
F1-PSU-020	CYCLOWASH PUMP STATION NO. 2 PUMP 1 (DUTY)	100mm x 150mm	55.9	☑	☐				by KCBL
F1-PSU-021	CYCLOWASH PUMP STATION NO. 2 PUMP 2 (STANDBY)	100mm x 150mm	55.9	☐	☑				by KCBL
F1-XMM-002	RECLAIM BARGE PUMP STATION AUXILIARY LOADS		40.0	☑	☐				Includes small power and lighting,controls, HVAC, o/h crane
F1-XMM-006	CYCLOWASH PUMP STATION NO. 1 PUMP STATION AUXILIARY LOADS		27.0	☑	☐				Includes small power and lighting,controls, HVAC, o/h crane
F1-XMM-007	CYCLOWASH PUMP STATION NO. 2 PUMP STATION AUXILIARY LOADS		27.0	☑	☐				Includes small power and lighting,controls, HVAC, o/h crane
	TAILINGS DISPOSAL AND RECLAIM TOTAL kW:		**362.4**						
Area: F2 - TAILINGS POND									
F2-PSU-012	NORTH SEEPAGE POND RECLAIM BARGE PUMP 1 (DUTY)	150mm	52.0	☑	☐				by KCBL
F2-PSU-013	NORTH SEEPAGE POND RECLAIM BARGE PUMP 2 (STANDBY)	150mm	52.0	☐	☑				by KCBL
F2-PSU-014	SOUTH SEEPAGE POND RECLAIM BARGE PUMP 1 (DUTY)	150mm	78.3	☑	☐				by KCBL
F2-PSU-015	SOUTH SEEPAGE POND RECLAIM BARGE PUMP 2 (STANDBY)	150mm	78.3	☐	☑				by KCBL
F2-XMM-003	NORTH SEEPAGE POND RECLAIM BARGE PUMP STATION AUXILIARY L		27.0	☑	☐				Includes small power and lighting,controls, HVAC, o/h crane
F2-XMM-004	SOUTH SEEPAGE POND RECLAIM BARGE PUMP STATION AUXILIARY L		27.0	☑	☐				Includes small power and lighting,controls, HVAC, o/h crane
	TAILINGS POND TOTAL kW:		**184.3**						
Area: G1 - FRESH/FIRE WATER									
G1-PSO-001	WELL WATER PUMP	150 mm	125.0	☑	☐				
G1-PSO-004	FRESH WATER PUMP No.1	80 mm x 100 mm	11.2	☑	☐				
G1-PSO-005	FRESH WATER PUMP No.2	80 mm x 100 mm	11.2	☐	☑				
G1-TNK-003	FRESH WATER TANK	6,000 mm DIA x 7,000 mm		☐	☐				
G1-TNK-004	FIRE/RECLAIM WATER HOLDING TANK	6,000 mm DIA x 16,000 mn		☐	☐				
	FRESH/FIRE WATER TOTAL kW:		**136.2**						
Area: G2 - PROCESS WATER									
G2-AGI-005	ANTISCALENT TANK AGITATOR		3.0	☑	☐				
G2-PSO-002	PROCESS WATER DISTRIBUTION PUMP No. 1	500 mm x 450 mm	259.0	☑	☐				
G2-PSO-003	PROCESS WATER DISTRIBUTION PUMP No. 2	500 mm x 450 mm	259.0	☐	☑				
G2-PSO-023	ANTISCALENT FEED PUMP No. 1	50 mm x 38 mm	1.0	☑	☐				
G2-PSO-024	ANTISCALENT FEED PUMP No. 2	50 mm x 38 mm	1.0	☐	☑				
G2-TNK-001	PROCESS WATER TANK	4,000 mm DIA x 14,000 mn		☐	☐				
G2-TNK-015	ANTISCALENT TANK	2000 mm x 2000 mm		☐	☐				
	PROCESS WATER TOTAL kW:		**263.0**						
Area: G5 - PLANT AND INSTRUMENT AIR									
G5-AIC-001	PROCESS PLANT AIR COMPRESSOR No. 1	680 Nm3/h @ 830 kPag	75.0	☑	☐				
G5-AIC-002	PROCESS PLANT AIR COMPRESSOR No. 2	680 Nm3/h @ 830 kPag	75.0	☑	☐				
G5-AIC-003	PROCESS PLANT AIR COMPRESSOR No. 3	680 Nm3/h @ 830 kPag	75.0	☐	☑				
G5-AIC-011	PROCESS PLANT AIR COMPRESSOR No. 4	680 Nm3/h @ 830 kPag	75.0	☑	☐				
G5-AID-008	INSTRUMENT AIR DRYER	360 Nm3/h @ 830 kPag		☐	☐				
G5-AIF-004	PROCESS PLANT AIR FILTER	1360 Nm3/h @ 830 kPag		☐	☐				

EQUIPMENT NUMBER	DESCRIPTION	EQUIPMENT SIZE	POWER (kW)	OPERATING	STAND BY	MATERIAL	CAPACITY	MODEL	REMARKS
G5-AIR-005	INSTRUMENT AIR RECEIVER No. 1	0.9 m3 (240 US gal)		☐	☐				
G5-AIR-009	PROCESS PLANT AIR RECEIVER	6.0 m3 (1600 US gal)		☐	☐				
G5-AIR-010	INSTRUMENT AIR RECEIVER No. 2	0.9 m3 (240 US gal)		☐	☐				
	PLANT AND INSTRUMENT AIR TOTAL kW:		**225.0**						
Area: G6 - SEWAGE TREATMENT									
G6-XEM-001	MISCELLANEOUS - ELECTRICAL		100.0	☑	☐				
	SEWAGE TREATMENT TOTAL kW:		**100.0**						
Area: J1 - ADMINISTRATION AND MINE DRY									
J1-ACL-007	ADMINISTRATION FAN COIL #1 AIR CONDITIONING UNIT	1200 CFM	0.7	☑	☐				
J1-ACL-008	ADMINISTRATION AIR COOLED CONDENSING UNIT #1	2.5 tonne	3.7	☑	☐				
J1-ACL-009	ADMINISTRATION FAN COIL #2 AIR CONDITIONING UNIT	1200 CFM	0.7	☑	☐				
J1-ACL-010	ADMINISTRATION AIR COOLED CONDENSING UNIT #2	2.5 tonne	3.7	☑	☐				
J1-ACL-011	ADMINISTRATION FAN COIL #3 AIR CONDITIONING UNIT	1200 CFM	0.7	☑	☐				
J1-ACL-012	ADMINISTRATION AIR COOLED CONDENSING UNIT #3	2.5 tonne	3.7	☑	☐				
J1-ACL-013	ADMINISTRATION FAN COIL #4 AIR CONDITIONING UNIT	1200 CFM	0.7	☑	☐				
J1-ACL-014	ADMINISTRATION AIR COOLED CONDENSING UNIT #4	2.5 tonne	3.7	☑	☐				
J1-ACL-015	ADMINISTRATION FAN COIL #5 AIR CONDITIONING UNIT	1200 CFM	0.7	☑	☐				
J1-ACL-016	ADMINISTRATION AIR COOLED CONDENSING UNIT #5	2.5 tonne	3.7	☑	☐				
J1-ACL-017	ADMINISTRATION FAN COIL #6 AIR CONDITIONING UNIT	1200 CFM	0.7	☑	☐				
J1-ACL-018	ADMINISTRATION AIR COOLED CONDENSING UNIT #6	2.5 tonne	3.7	☑	☐				
J1-ACL-019	ADMINISTRATION FAN COIL #7 AIR CONDITIONING UNIT	1200 CFM	0.7	☑	☐				
J1-ACL-020	ADMINISTRATION AIR COOLED CONDENSING UNIT #7	2.5 tonne	3.7	☑	☐				
J1-ACL-021	ADMINISTRATION FAN COIL #8 AIR CONDITIONING UNIT	1200 CFM	0.7	☑	☐				
J1-ACL-022	ADMINISTRATION AIR COOLED CONDENSING UNIT #8	2.5 tonne	3.7	☑	☐				
J1-ACL-023	ADMINISTRATION FAN COIL #9 AIR CONDITIONING UNIT	1200 CFM	0.7	☑	☐				
J1-ACL-024	ADMINISTRATION AIR COOLED CONDENSING UNIT #9	2.5 tonne	3.7	☑	☐				
J1-ACL-025	ADMINISTRATION FAN COIL #10 AIR CONDITIONING UNIT	1200 CFM	0.7	☑	☐				
J1-ACL-026	ADMINISTRATION AIR COOLED CONDENSING UNIT #10	2.5 tonne	3.7	☑	☐				
J1-AHU-009	ADMINISTRATION DIRECT GAS FIRED AIR HANDLING UNIT	3000 CFM	3.7	☑	☐				
J1-FAN-046	ADMINISTRATION SHOWERS EXHAUST FAN	2000 CFM	3.7	☑	☐				
J1-FAN-047	ADMINISTRATION LUNCHROOM EXHAUST FAN	240 CFM	0.2	☑	☐				
J1-FAN-048	ADMINISTRATION WASHROOMS EXHAUST FAN	240 CFM	0.2	☑	☐				
J1-FAN-049	ADMINISTRATION JANITORS EXHAUST FAN	100 CFM	0.2	☑	☐				
J1-FAN-050	ADMINISTRATION ELECTRICAL ROOM SUPPLY FAN / FILTER FAN	1200 CFM	3.7	☑	☐				
J1-HTR-049	ADMINISTRATION PROPANE HOT WATER HEATER		0.0	☐	☑				
J1-HTR-050	ADMINISTRATION ELECTRIC BASEBOARD HEATERS		0.7	☑	☐				
J1-HTR-051	ADMINISTRATION ELECTRIC BASEBOARD HEATERS		0.7	☑	☐				
J1-HTR-052	ADMINISTRATION ELECTRIC BASEBOARD HEATERS		0.7	☑	☐				
J1-HTR-053	ADMINISTRATION ELECTRIC BASEBOARD HEATERS		0.7	☑	☐				
J1-HTR-054	ADMINISTRATION ELECTRIC BASEBOARD HEATERS		0.7	☑	☐				
J1-HTR-055	ADMINISTRATION ELECTRIC BASEBOARD HEATERS		0.7	☑	☐				
J1-HTR-056	ADMINISTRATION ELECTRIC BASEBOARD HEATERS		0.7	☑	☐				
J1-HTR-057	ADMINISTRATION ELECTRIC BASEBOARD HEATERS		0.7	☑	☐				
J1-HTR-058	ADMINISTRATION ELECTRIC BASEBOARD HEATERS		0.7	☑	☐				
J1-HTR-059	ADMINISTRATION ELECTRIC BASEBOARD HEATERS		0.7	☑	☐				
J1-HTR-060	ADMINISTRATION ELECTRIC BASEBOARD HEATERS		0.7	☑	☐				
J1-WSS-LOT	ADMINISTRATION BUILDING SPRINKLERS		0.0	☐	☐				
J1-XEM-001	MISCELLANEOUS - ELECTRICAL		100.0	☑	☐				
	ADMINISTRATION AND MINE DRY TOTAL kW:		**164.6**						
Area: J2 - TRUCKSHOP AND WAREHOUSE									
J2-ACL-027	WAREHOUSE OFFICE AIR CONDITIONING UNIT	1500 CFM	0.7	☑	☐				
J2-ACL-028	WAREHOUSE OFFICE AIR COOLED CONDENSING UNIT	4 tonne	7.5	☑	☐				
J2-ACL-029	FIRST AID GAS FIRED AIR CONDITIONING UNIT	1300 CFM	0.7	☑	☐				
J2-ACL-030	FIRST AID AIR COOLED CONDENSING UNIT	3 tonne	3.7	☑	☐				
J2-AHU-010	TRUCK BAYS GAS FIRED AIR HANDLING UNIT #1	25000 CFM	14.9	☑	☐				
J2-AHU-011	TRUCK BAYS GAS FIRED AIR HANDLING UNIT #2	25000 CFM	14.9	☑	☐				
J2-AHU-012	WAREHOUSE GAS FIRED AIR HANDLING UNIT #3	6000 CFM	5.5	☑	☐				

EQUIPMENT NUMBER	DESCRIPTION	EQUIPMENT SIZE	POWER (kW)	OPERATING	STAND BY	MATERIAL	CAPACITY	MODEL	REMARKS
J2-AHU-013	TRUCK SHOP GAS FIRED AIR HANDLING UNIT #4	13000 CFM	7.5	☑	☐				
J2-AHU-014	TRUCK SHOP OFFICES GAS FIRED AIR HANDLING UNIT #5	3200 CFM	3.7	☑	☐				
J2-AHU-015	TRUCK WASH DIRECT GAS FIRED AIR HANDLING UNIT	25000 CFM	14.9	☑	☐				
J2-AIC-001	TRUCK SHOP AIR COMPRESSOR	200 Nm3/h @ 690 kPag	40.0	☑	☐				
J2-AIF-002	TRUCK SHOP AIR FILTER	365 Nm3/h @ 830 kPag		☐	☐				
J2-AIR-003	TRUCK SHOP AIR RECEIVER	0.9 m3 (240 US gal)		☐	☐				
J2-FAN-051	TRUCK SHOP HIGH BAYS EXHAUST FAN	12000 CFM	5.5	☑	☐				
J2-FAN-052	TRUCK SHOP HIGH BAYS EXHAUST FAN	12000 CFM	5.5	☑	☐				
J2-FAN-053	TRUCK SHOP HIGH BAYS EXHAUST FAN	12000 CFM	5.5	☑	☐				
J2-FAN-054	TRUCK SHOP HIGH BAYS EXHAUST FAN	12000 CFM	5.5	☑	☐				
J2-FAN-055	TRUCK WASH EXHAUST FAN	25000 CFM	7.5	☑	☐				
J2-FAN-056	TYRE CHANGE EXHAUST FAN	2000 CFM	2.2	☑	☐				
J2-FAN-057	TRUCK WASH COMPRESSOR ROOM EXHAUST FAN	1200 CFM	2.2	☑	☐				
J2-FAN-058	TRUCK SHOP LOW BAYS EXHAUST FAN	12000 CFM	3.7	☑	☐				
J2-FAN-059	TRUCK SHOP LOW BAYS EXHAUST FAN	12000 CFM	3.7	☑	☐				
J2-FAN-060	TRUCK SHOP LOW BAYS EXHAUST FAN	12000 CFM	3.7	☑	☐				
J2-FAN-061	WAREHOUSE EXHAUST FAN	8000 CFM	3.7	☑	☐				
J2-FAN-062	TRUCK SHOP SHOWERS EXHAUST FAN	4000 CFM	3.7	☑	☐				
J2-FAN-063	TRUCK SHOP COMPRESSOR ROOM EXHAUST FAN	1500 CFM	2.2	☑	☐				
J2-FAN-064	TRUCK SHOP BATTERY ROOM EXHAUST FAN	300 CFM	0.3	☑	☐				
J2-FAN-065	TRUCK SHOP ELECTRICAL ROOM EXHAUST FAN	1200 CFM	2.2	☑	☐				
J2-FAN-066	TRUCK SHOP LUBE STORAGE EXHAUST FAN	1500 CFM	2.2	☑	☐				
J2-FAN-067	TRUCK SHOP WELDING ARMS	1200 CFM	2.2	☑	☐				
J2-FAN-068	TRUCK SHOP WELDING ARMS	1200 CFM	2.2	☑	☐				
J2-FAN-069	TRUCK SHOP FIRST AID EXHAUST FAN	250 CFM	0.2	☑	☐				
J2-FAN-070	TRUCK SHOP CEILING FANS	48" DIA	0.1	☑	☐				
J2-FAN-071	TRUCK SHOP CEILING FANS	48" DIA	0.1	☑	☐				
J2-FAN-072	TRUCK SHOP CEILING FANS	48" DIA	0.1	☑	☐				
J2-FAN-073	TRUCK SHOP CEILING FANS	48" DIA	0.1	☑	☐				
J2-HTR-061	TRUCK SHOP GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-062	TRUCK SHOP GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-063	TRUCK SHOP GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-064	TRUCK SHOP GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-065	TRUCK SHOP GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-066	TRUCK SHOP GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-067	TRUCK SHOP GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-068	TRUCK SHOP GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-069	TRUCK SHOP GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-070	TRUCK SHOP GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-071	TRUCK SHOP AMBULANCE ELECTRIC UNIT HEATER		0.4	☑	☐				
J2-HTR-072	TRUCK SHOP AMBULANCE ELECTRIC UNIT HEATER		0.4	☑	☐				
J2-HTR-073	WAREHOUSE GAS FIRED UNIT HEATER		0.2	☑	☐				
J2-HTR-074	WAREHOUSE GAS FIRED UNIT HEATER		0.2	☑	☐				
J2-HTR-075	WAREHOUSE GAS FIRED UNIT HEATER		0.2	☑	☐				
J2-HTR-076	WAREHOUSE GAS FIRED UNIT HEATER		0.2	☑	☐				
J2-HTR-077	TRUCK WASH GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-078	TRUCK WASH GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-079	TRUCK WASH GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-080	TRUCK WASH GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-081	TRUCK WASH GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-082	TRUCK WASH GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-083	TRUCK WASH GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-HTR-084	TRUCK WASH GAS FIRED RADIANT HEATER		0.1	☑	☐				
J2-WSS-LOT	TRUCK SHOP & WAREHOUSE SPRINKLERS		0.0	☐	☐				
J2-XEM-001	MISCELLANEOUS - ELECTRICAL		300.0	☑	☐				
	TRUCKSHOP AND WAREHOUSE TOTAL kW:		**481.8**						
Area: J3 - ASSAY LABORATORY									
J3-AHU-016	ASSAY LAB GAS FIRED AIR HANDLING UNIT #1	10000 CFM	5.5	☑	☐				

EQUIPMENT NUMBER	DESCRIPTION	EQUIPMENT SIZE	POWER (kW)	OPERATING	STAND BY	MATERIAL	CAPACITY	MODEL	REMARKS
J3-AHU-017	ASSAY LAB GAS FIRED AIR HANDLING UNIT #2	10000 CFM	5.5	☑	☐				
J3-BAG-009	ASSAY LAB DUST COLLECTOR #1	10000 CFM	0.2	☑	☐				
J3-BAG-010	ASSAY LAB DUST COLLECTOR #2	10000 CFM	0.2	☑	☐				
J3-FAN-074	ASSAY LAB DUST COLLECTOR EXHAUST FAN #1	10000 CFM	29.8	☑	☐				
J3-FAN-075	ASSAY LAB DUST COLLECTOR EXHAUST FAN #2	10000 CFM	29.8	☑	☐				
J3-FAN-076	ASSAY LAB PERCHLORIC SCRUBBER EXHAUST FAN	1200 CFM	7.5	☑	☐				
J3-FAN-077	ASSAY LAB COMPRESSOR ROOM SUPPLY FAN / FILTER FAN	1200 CFM	7.5	☑	☐				
J3-FAN-078	ASSAY LAB WASHROOMS EXHAUST FAN	240 CFM	0.2	☑	☐				
J3-FAN-079	ASSAY LAB LECO EXHAUST FAN	400 CFM	0.2	☑	☐				
J3-FAN-080	ASSAY LAB GENERAL EXHAUST EXHAUST FAN	2000 CFM	3.7	☑	☐				
J3-FAN-081	ASSAY LAB LUNCH ROOM EXHAUST FAN	250 CFM	0.2	☑	☐				
J3-FAN-082	ASSAY LAB ELECTRICAL ROOM EXHAUST FAN	1200 CFM	3.7	☑	☐				
J3-FAN-083	ASSAY LAB DRYERS EXHAUST FAN	400 CFM	0.4	☑	☐				
J3-FAN-084	ASSAY LAB AA HOODS EXHAUST FAN	400 CFM	0.2	☑	☐				
J3-HTR-085	ASSAY LAB GAS FIRED HOT WATER HEATER		9.0	☑	☐				
J3-HTR-086	ASSAY LAB ELECTRIC BASEBOARD HEATER		0.8	☑	☐				
J3-HTR-087	ASSAY LAB ELECTRIC BASEBOARD HEATER		0.8	☑	☐				
J3-HTR-088	ASSAY LAB ELECTRIC BASEBOARD HEATER		0.8	☑	☐				
J3-HTR-089	ASSAY LAB ELECTRIC BASEBOARD HEATER		0.8	☑	☐				
J3-HTR-090	ASSAY LAB ELECTRIC BASEBOARD HEATER		0.8	☑	☐				
J3-HTR-091	ASSAY LAB ELECTRIC BASEBOARD HEATER		0.8	☑	☐				
J3-SCR-005	ASSAY LAB PERCHLORIC SCRUBBER	1200 CFM	0.0	☐	☐				
J3-VLV-006	LOADOUT DUST COLLECTOR ROTARY VALVE	8" DIA	0.7	☑	☐				
J3-VLV-007	LOADOUT DUST COLLECTOR ROTARY VALVE	8" DIA	0.7	☑	☐				
J3-WSS-LOT	ASSAY LAB SPRINKLERS		0.0	☐	☐				
	ASSAY LABORATORY TOTAL kW:		**109.6**						
Area: J4 - FUEL STORAGE AND DISTRIBUTION									
J4-XEM-001	MISCELLANEOUS - ELECTRICAL		100.0	☑	☐				
	FUEL STORAGE AND DISTRIBUTION TOTAL kW:		**100.0**						
Area: J5 - COLD STORAGE WAREHOUSE									
J5-XEM-001	MISCELLANEOUS - ELECTRICAL		20.0	☑	☐				
	COLD STORAGE WAREHOUSE TOTAL kW:		**20.0**						

PLANT TOTAL kW: **40,112**

APPENDIX C

POWER LOAD LIST

WARDROP
Wardrop Engineering Inc.

PBM - MORRISON COPPER / GOLD PROJECT
LOAD LIST

WARDROP PROJECT No : 06527201.00
LOAD LIST : 0652720100-LST-E0001-06

EQUIPMENT NUMBER	DESCRIPTION	OPER.	STND BY	CRITICAL LOAD	SPEED VFD/FIXED	VOLTAGE	POWER (kW)	POWER (HP)	EST. LOAD FACTOR	EST. USED FACTOR	EST. PWR FACTOR	EST EFF.	RUNNING kW	RUNNING kVA	EST UTIL. SUMMER	EST UTIL. WINTER	INFRA.	kW.hr SUMMER	kW.hr WINTER	kW.hr ANNUAL	INFRA. LOAD
Area: A2 - POWER DISTRIBUTION																					
A2-XEM-001	LIGHTING	☑	☐	☐	☐	600	20.0	26.8	0.80	0.90	0.90	0.95	15.2	16.8	0.80	0.90	☑	53,113	59,752	112,866	112,866
A2-XMM-004	HVAC	☑	☐	☐	☐	600	30.0	40.2	0.80	0.70	0.90	0.95	17.7	19.6	0.80	0.80	☑	61,965	61,965	123,931	123,931
A2-XMM-005	MISC POWER INCL HEAT TRACING	☑	☐	☐	☐	600	20.0	26.8	0.80	0.80	0.90	0.95	13.5	15.0	0.65	0.90	☑	38,360	53,113	91,473	91,473
					POWER DISTRIBUTION TOTAL kW:		**70.0**					*TOTAL RUNNING kW:*	**46.3**	**51.5**		*TOTAL kW.hr:*		**153,438**	**174,831**	**328,269**	**328,269**
Area: A6 - YARD LIGHTING																					
A6-XEM-001	MISCELLANEOUS - ELECTRICAL	☑	☐	☐	☐	600	100.0	134.1	0.80	0.70	0.90	0.95	58.9	65.5	0.50	0.90	☑	129,095	232,371	361,465	361,465
					YARD LIGHTING TOTAL kW:		**100.0**					*TOTAL RUNNING kW:*	**58.9**	**65.5**		*TOTAL kW.hr:*		**129,095**	**232,371**	**361,465**	**361,465**
Area: B2 - OPEN PIT MOBILE EQUIPMENT																					
B2-TRU-013	FUEL/LUBE TRUCK	☑	☐	☐	☐					1.00							☐				0
B2-TRU-014	FLATBED TRUCK	☑	☐	☐	☐					1.00							☐				0
B2-XEM-001	MISCELLANEOUS - ELECTRICAL	☑	☐	☐	☐	600	25.0	33.5	0.80	0.90	0.90	0.95	18.9	21.1	0.70	0.80	☑	58,093	66,392	124,484	124,484
					OPEN PIT MOBILE EQUIPMENT TOTAL kW:		**25.0**					*TOTAL RUNNING kW:*	**18.9**	**21.1**		*TOTAL kW.hr:*		**58,093**	**66,392**	**124,484**	**124,484**
Area: B6 - OPEN PIT DEWATERING																					
B6-PSU-001	PIT DEWATERING PUMP 1	☑	☐	☐	☐	600	75.0	100.6	0.80	1.00	0.90	0.90	66.7	74.1	0.60	0.60	☐	175,200	175,200	350,400	0
B6-PSU-002	PIT DEWATERING PUMP 2	☑	☐	☐	☐	600	75.0	100.6	0.80	1.00	0.90	0.90	66.7	74.1	0.60	0.60	☐	175,200	175,200	350,400	0
					OPEN PIT DEWATERING TOTAL kW:		**150.0**					*TOTAL RUNNING kW:*	**133.3**	**148.1**		*TOTAL kW.hr:*		**350,400**	**350,400**	**700,800**	**0**
Area: B7 - OPEN PIT ELCTRICAL																					
B7-XEM-001	OPEN PIT LIGHTING	☑	☐	☐	☐	600	5.0	6.7	0.80	1.00	0.90	0.90	4.4	4.9	0.80	0.80	☐	15,573	15,573	31,147	0
					OPEN PIT ELCTRICAL TOTAL kW:		**5.0**					*TOTAL RUNNING kW:*	**4.4**	**4.9**		*TOTAL kW.hr:*		**15,573**	**15,573**	**31,147**	**0**
Area: C0 - PRIMARY CRUSHING																					
C0-ACL-001	PRIMARY CRUSHER CONTROL ROOM AIR CONDITIONING UNI	☑	☐	☐	☐	600	0.2	0.3	0.80	0.70	0.90	0.95	0.1	0.2	0.90	0.60	☑	572	381	953	953
C0-ACL-002	PRIMARY CRUSHER CONTROL ROOM AIR COOLED CONDENSI	☑	☐	☐	☐	600	3.7	5.0	0.80	0.70	0.90	0.95	2.2	2.4	0.90	0.60	☑	8,667	5,778	14,446	14,446
C0-AHU-001	PRIMARY CRUSHER DIRECT GAS FIRED AIR HANDLING UNIT	☑	☐	☐	☐	600	5.5	7.4	0.80	0.70	0.90	0.95	3.2	3.6	0.95	0.95	☑	13,490	13,490	26,981	26,981
C0-AIC-015	CRUSHING AREA AIR COMPRESSOR	☑	☐	☐	☑	600	40.0	53.6	0.80	0.65	0.86	0.95	21.8	25.4	0.95	0.95	☑	90,722	90,722	181,444	181,444
C0-BAG-001	PRIMARY CRUSHER DUST COLLECTOR	☑	☐	☐	☐	600	0.2	0.3	0.80	0.90	0.87	0.90	0.2	0.2	0.95	0.95	☐	666	666	1,332	0
C0-BAG-015	CRUSHING DUST COLLECTOR BAGHOUSE	☑	☐	☐	☑	600	0.2	0.3	0.80	0.90	0.87	0.90	0.2	0.2	0.95	0.95	☐	666	666	1,332	0
C0-CRN-003	PRIMARY CRUSHING OVERHEAD CRANE	☑	☐	☐	☐	600	35.0	46.9	0.20	0.20	0.90	0.95	1.5	1.6	0.95	0.95	☐	6,132	6,132	12,264	0
C0-CRU-004	PRIMARY GYRATORY CRUSHER	☑	☐	☐	☑	4160	450.0	603.5	0.70	1.00	0.89	0.96	328.1	368.7	0.95	0.95	☐	1,365,328	1,365,328	2,730,656	0
C0-FAN-001	PRIMARY CRUSHER LUBE ROOM SUPPLY FAN / FILTER	☑	☐	☐	☐	600	2.2	3.0	0.80	0.70	0.90	0.95	1.3	1.4	0.95	0.95	☑	5,396	5,396	10,792	10,792
C0-FAN-002	PRIMARY CRUSHER CONTROL ROOM SUPPLY FAN / FILTER	☑	☐	☐	☐	600	3.7	5.0	0.80	0.70	0.90	0.95	2.2	2.4	0.95	0.95	☑	9,149	9,149	18,298	18,298
C0-FAN-003	PRIMARY CRUSHER COMPRESSOR ROOM SUPPLY FAN / FILT	☑	☐	☐	☐	600	2.2	3.0	0.80	0.70	0.90	0.95	1.3	1.4	0.95	0.95	☑	5,396	5,396	10,792	10,792
C0-FAN-004	PRIMARY CRUSHER ELECTRICAL ROOM SUPPLY FAN / FILTE	☑	☐	☐	☐	600	5.5	7.4	0.80	0.70	0.90	0.95	3.2	3.6	0.95	0.95	☐	13,490	13,490	26,981	0
C0-FAN-005	PRIMARY CRUSHER DUST COLLECTOR EXHAUST FAN	☑	☐	☐	☐	600	29.8	40.0	0.80	0.70	0.90	0.95	17.6	19.5	0.95	0.95	☐	73,192	73,192	146,383	0
C0-FDR-015	PRIMARY CRUSHER APRON FEEDER	☑	☐	☐	☑	600	75.0	100.6	0.80	0.90	0.84	0.92	58.7	69.9	0.95	0.95	☐	244,233	244,233	488,465	0
C0-HTR-001	PRIMARY CRUSHER ELECTRIC UNIT HEATER	☑	☐	☐	☐	600	10.0	13.4	1.00	0.80	1.00	1.00	8.0	8.0	0.50	0.95	☑	17,520	33,288	50,808	50,808
C0-HTR-002	PRIMARY CRUSHER ELECTRIC UNIT HEATER	☑	☐	☐	☐	600	10.0	13.4	1.00	0.80	1.00	1.00	8.0	8.0	0.50	0.95	☑	17,520	33,288	50,808	50,808
C0-HTR-003	PRIMARY CRUSHER ELECTRIC UNIT HEATER	☑	☐	☐	☐	600	10.0	13.4	1.00	0.80	1.00	1.00	8.0	8.0	0.50	0.95	☑	17,520	33,288	50,808	50,808
C0-HTR-004	PRIMARY CRUSHER ELECTRIC UNIT HEATER	☑	☐	☐	☐	600	10.0	13.4	1.00	0.80	1.00	1.00	8.0	8.0	0.50	0.95	☑	17,520	33,288	50,808	50,808
C0-HTR-005	PRIMARY CRUSHER ELECTRIC UNIT HEATER	☑	☐	☐	☐	600	10.0	13.4	1.00	0.80	1.00	1.00	8.0	8.0	0.50	0.95	☑	17,520	33,288	50,808	50,808
C0-HTR-006	PRIMARY CRUSHER ELECTRIC UNIT HEATER	☑	☐	☐	☐	600	10.0	13.4	1.00	0.80	1.00	1.00	8.0	8.0	0.50	0.95	☑	17,520	33,288	50,808	50,808
C0-HTR-007	PRIMARY CRUSHER ELECTRIC UNIT HEATER	☑	☐	☐	☐	600	10.0	13.4	1.00	0.80	1.00	1.00	8.0	8.0	0.50	0.95	☑	17,520	33,288	50,808	50,808
C0-HTR-008	PRIMARY CRUSHER CONTROL ROOM ELECTRIC DUCT HEATE	☑	☐	☐	☐	600	6.5	8.7	1.00	0.80	1.00	0.95	5.5	5.5	0.50	0.95	☑	11,987	22,776	34,763	34,763
C0-LUB-011	PRIMARY CRUSHER LUBE UNIT	☑	☐	☐	☑	600	3.7	5.0	0.80	0.60	0.87	0.90	2.0	2.3	0.95	0.95	☐	8,193	8,193	16,386	0
C0-PPK-001	APRON FEEDER HYDRAULIC DRIVE POWER PACK	☑	☐	☐	☑	600	75.0	100.6	0.80	0.60	0.89	0.96	37.4	42.0	0.95	0.95	☐	155,713	155,713	311,426	0
C0-PPK-002	ROCK BREAKER HYDRAULIC POWER PACK	☑	☐	☐	☑	600	1.5	2.0	0.80	0.50	0.87	0.90	0.7	0.8	0.95	0.95	☐	2,768	2,768	5,536	0
C0-PSU-013	CRUSHING AREA SUMP PUMP	☑	☐	☐	☑	600	7.5	10.1	0.80	0.25	0.84	0.92	1.6	1.9	0.95	0.95	☐	6,755	6,755	13,510	0
C0-RKB-001	ROCK BREAKER	☑	☐	☐	☑	600	37.0	49.6	0.80	0.50	0.86	0.95	15.5	18.0	0.95	0.95	☐	64,552	64,552	129,104	0
C0-SCB-004	STOCKPILE FEED BELT SCALE	☑	☐	☐	☑	600	0.5	0.7	0.80	1.00	0.87	0.90	0.4	0.5	0.95	0.95	☐	1,845	1,845	3,690	0
C0-VLV-001	PRIMARY CRUSHER DUST COLLECTOR ROTARY VALVE	☑	☐	☐	☐	600	0.7	1.0	0.80	1.00	0.90	0.95	0.6	0.7	0.95	0.95	☐	2,614	2,614	5,228	0
C0-XEM-001	LIGHTING	☑	☐	☐	☐	600	25.0	33.5	0.90	0.90	0.90	0.95	21.3	23.7	0.80	0.90	☑	74,691	84,027	158,717	158,717
C0-XMM-005	MISC POWER INCL HEAT TRACING	☑	☐	☐	☐	600	25.0	33.5	0.80	0.80	0.90	0.95	16.8	18.7	0.65	0.90	☑	47,949	66,392	114,341	114,341
					PRIMARY CRUSHING TOTAL kW:		**905.8**					*TOTAL RUNNING kW:*	**599.5**	**670.7**		*TOTAL kW.hr:*		**2,336,806**	**2,482,670**	**4,819,476**	**927,184**
Area: D0 - COARSE ORE STOCKPILE AND RECLAIM																					
D0-AHU-002	PRIMARY CRUSHER DIRECT GAS FIRED AIR HANDLING UNIT	☑	☐	☐	☐	600	14.9	20.0	0.80	0.70	0.80	0.90	9.3	11.6	0.50	0.95	☑	20,331	38,629	58,960	58,960
D0-BAG-002	STOCKPILE RECLAIM DUST COLLECTOR	☑	☐	☐	☐	600	0.2	0.3	0.80	0.90	0.90	0.95	0.2	0.2	0.95	0.95	☑	631	631	1,261	1,261
D0-CNV-001	STOCKPILE RECLAIM DUST COLLECTOR SCREW CONVEYOR	☑	☐	☐	☐	600	3.7	5.0	0.75	1.00	0.90	0.95	2.9	3.3	0.95	0.95	☐	12,253	12,253	24,506	0
D0-CNV-020	STOCKPILE FEED BELT CONVEYOR	☑	☐	☐	☑	4160	447.4	600.0	0.75	1.00	0.88	0.90	372.8	423.7	0.95	0.95	☐	1,551,359	1,551,359	3,102,719	0
D0-CNV-028	PRIMARY SIZING SCREEN FEED CONVEYOR	☑	☐	☐	☑	600	186.4	250.0	0.75	1.00	0.88	0.90	155.3	176.5	0.95	0.95	☐	646,342	646,342	1,292,684	0
D0-FAN-006	STOCKPILE RECLAIM DUST COLLECTOR EXHAUST FAN	☑	☐	☐	☐	600	55.9	75.0	0.80	1.00	0.90	0.95	47.1	52.3	0.95	0.95	☑	196,014	196,014	392,028	392,028
D0-FAN-007	TUNNEL EXHAUST FAN	☑	☐	☐	☐	600	3.7	5.0	0.80	1.00	0.90	0.95	3.1	3.5	0.95	0.95	☑	13,070	13,070	26,140	26,140
D0-FDR-004	STOCKPILE RECLAIM APRON FEEDER No. 1 VFD	☑	☐	☐	☑	600	14.9	20.0	0.75	0.90	0.84	0.90	11.2	13.4	0.95	0.95	☐	46,499	46,499	92,998	0
D0-FDR-008	STOCKPILE RECLAIM APRON FEEDER No. 2 VFD	☑	☐	☐	☑	600	14.9	20.0	0.75	0.90	0.84	0.90	11.2	13.4	0.95	0.95	☐	46,499	46,499	92,998	0
D0-FDR-012	STOCKPILE RECLAIM APRON FEEDER No. 3 VFD	☐	☑	☐	☑	600	14.9	20.0	0.75	0.25	0.84	0.90	0.0	0.0	0.95	0.95	☐	0	0	0	0

EQUIPMENT NUMBER	DESCRIPTION	OPER.	STND BY	CRITICAL LOAD	SPEED VFD/FIXED	VOLTAGE	POWER (kW)	POWER (HP)	EST. LOAD FACTOR	EST. USED FACTOR	EST. PWR FACTOR	EST EFF.	RUNNING kW	RUNNING kVA	EST UTIL. SUMMER	EST UTIL. WINTER	INFRA.	kW.hr SUMMER	kW.hr WINTER	kW.hr ANNUAL	INFRA. LOAD
D0-PSU-017	STOCKPILE AREA SUMP PUMP	☑	☐	☐	☐ ☑	600	7.5	10.1	0.80	0.25	0.84	0.92	1.6	1.9	0.95	0.95	☑	6,784	6,784	13,568	13,568
D0-SCB-003	PRIMARY SIZING SCREEN BELT SCALE	☑	☐	☐	☐ ☑	600	0.5	0.7	0.80	0.90	0.87	0.90	0.4	0.5	0.95	0.95	☐	1,661	1,661	3,321	0
D0-VLV-002	STOCKPILE RECLAIM DUST COLLECTOR ROTARY VALVE	☑	☐	☐	☐ ☐	600	0.7	1.0	0.80	0.90	0.90	0.95	0.6	0.6	0.95	0.95	☐	2,353	2,353	4,705	0
D0-XEM-001	LIGHTING	☑	☐	☐	☐ ☐	600	25.0	33.5	0.80	0.90	0.90	0.95	18.9	21.1	0.95	0.95	☑	78,840	78,840	157,680	157,680
D0-XMM-005	MISC POWER INCL HEAT TRACING	☑	☐	☐	☐ ☐	600	25.0	33.5	0.80	0.80	0.90	0.95	16.8	18.7	0.65	0.95	☐	47,949	70,080	118,029	0
					COARSE ORE STOCKPILE AND RECLAIM TOTAL kW:		**815.8**				*TOTAL RUNNING kW:*		**651.5**	**740.6**		*TOTAL kW.hr:*		**2,670,585**	**2,711,014**	**5,381,599**	**649,637**
Area: D1 - HPGR																					
D1-BAG-003	CRUSHER SURGE BIN BIN VENT DUST COLLECTOR	☑	☐	☐	☐ ☐	600	0.2	0.3	0.80	0.70	0.90	0.95	0.1	0.1	0.95	0.95	☐	491	491	981	0
D1-BAG-004	HPGR SURGE BIN BIN VENT DUST COLLECTOR	☑	☐	☐	☐ ☐	600	0.2	0.3	0.80	0.90	0.90	0.95	0.2	0.2	0.95	0.95	☐	631	631	1,261	0
D1-BAG-005	HPGR DUST COLLECTOR	☑	☐	☐	☐ ☐	600	0.2	0.3	0.80	0.90	0.90	0.95	0.2	0.2	0.95	0.95	☐	631	631	1,261	0
D1-BAG-006	SECONDARY SIZING SCREEN DUST COLLECTOR BAGHOUSE	☑	☐	☐	☐ ☑	600	112.0	150.2	0.80	0.90	0.90	0.95	84.9	94.3	0.95	0.95	☐	353,203	353,203	706,406	0
D1-CNV-002	CONE CRUSHER SURGE BIN FEED CONVEYOR	☑	☐	☐	☐ ☑	600	55.0	73.8	0.75	1.00	0.89	0.96	42.9	48.2	0.95	0.95	☐	178,421	178,421	356,843	0
D1-CNV-010	HPGR DUST COLLECTOR SCREW CONVEYOR	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	1.00	0.88	0.95	3.1	3.6	0.95	0.95	☐	13,070	13,070	26,140	0
D1-CNV-026	HPGR SURGE BIN FEED CONVEYOR	☑	☐	☐	☐ ☑	600	55.0	73.8	0.80	1.00	0.88	0.96	45.7	52.0	0.95	0.95	☐	190,316	190,316	380,632	0
D1-COL-015	HPGR DUST COLLECTOR	☑	☐	☐	☐ ☑	600	112.0	150.2	0.80	0.90	0.88	0.96	83.8	95.3	0.95	0.95	☐	348,797	348,797	697,595	0
D1-COO-001	CONE CRUSHER LUBRICATION COOLER No. 1	☑	☐	☐	☐ ☑	600	5.0	6.7	0.80	0.90	0.87	0.90	4.0	4.6	0.95	0.95	☐	16,607	16,607	33,214	0
D1-COO-002	HPGR CRUSHER LUBRICATION COOLER	☑	☐	☐	☐ ☑	600	5.0	6.7	0.80	0.90	0.90	0.95	3.8	4.2	0.95	0.95	☐	15,768	15,768	31,536	0
D1-COO-003	CONE CRUSHER LUBRICATION COOLER No. 2	☑	☐	☐	☐ ☑	600	5.0	6.7	0.80	0.90	0.87	0.90	4.0	4.6	0.95	0.95	☐	16,607	16,607	33,214	0
D1-CRN-001	HPGR BUILDING AREA CRANE	☐	☑	☐	☐ ☑	600	70.8	94.9	0.80	0.00	0.88	0.95	0.0	0.0	0.95	0.95	☐	0	0	0	0
D1-CRU-001	CONE CRUSHER No.1	☑	☐	☐	☐ ☑	4160	750.0	1005.8	0.80	1.00	0.91	0.96	625.0	686.8	0.95	0.95	☐	2,600,625	2,600,625	5,201,250	0
D1-CRU-002	CONE CRUSHER No.2	☐	☑	☐	☐ ☑	4160	750.0	1005.8	0.80	1.00	0.91	0.96	0.0	0.0	0.95	0.95	☐	0	0	0	0
D1-EQP-001	HPGR SURGE BIN VENT	☑	☐	☐	☐ ☑	600	20.0	26.8	0.80	1.00	0.85	0.93	17.2	20.2	0.95	0.95	☐	71,587	71,587	143,174	0
D1-FAN-008	CRUSHER BIN VENT DUST COLLECTOR EXHAUST FAN	☑	☐	☐	☐ ☐	600	6.0	8.0	0.80	0.90	0.90	0.95	4.5	5.0	0.95	0.95	☐	18,795	18,795	37,591	0
D1-FAN-009	HPGR BIN VENT DUST COLLECTOR EXHAUST FAN	☑	☐	☐	☐ ☐	600	6.0	8.0	0.80	0.90	0.90	0.95	4.5	5.0	0.95	0.95	☐	18,795	18,795	37,591	0
D1-FAN-010	HPGR DUST COLLECTOR EXHAUST FAN	☑	☐	☐	☐ ☐	600	56.0	75.0	0.80	0.90	0.90	0.95	42.4	47.1	0.95	0.95	☐	176,444	176,444	352,888	0
D1-FAN-011	HPGR ROOF EXHAUST FAN	☑	☐	☐	☐ ☐	600	7.5	10.0	0.80	0.90	0.90	0.95	5.7	6.3	0.95	0.95	☐	23,526	23,526	47,052	0
D1-FAN-012	HPGR ROOF EXHAUST FAN	☑	☐	☐	☐ ☐	600	7.5	10.0	0.80	0.70	0.90	0.95	4.4	4.9	0.95	0.95	☐	18,298	18,298	36,596	0
D1-FAN-013	HPGR ROOF EXHAUST FAN	☑	☐	☐	☐ ☐	600	7.5	10.0	0.80	0.70	0.90	0.95	4.4	4.9	0.95	0.95	☐	18,298	18,298	36,596	0
D1-FAN-014	HPGR ROOF EXHAUST FAN	☑	☐	☐	☐ ☐	600	7.5	10.0	0.80	0.70	0.90	0.95	4.4	4.9	0.95	0.95	☐	18,298	18,298	36,596	0
D1-FAN-015	HPGR ELECTRICAL ROOM EXHAUST FAN	☑	☐	☐	☐ ☐	600	7.5	10.0	0.80	0.70	0.90	0.95	4.4	4.9	0.95	0.95	☑	18,298	18,298	36,596	36,596
D1-FAN-016	HPGR LUBE ROOM SUPPLY FAN / FILTER	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.90	0.95	2.2	2.4	0.95	0.95	☑	9,149	9,149	18,298	18,298
D1-FAN-017	CONE LUBE ROOM #1 SUPPLY FAN SUPPLY FAN / FILTER	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.90	0.95	2.2	2.4	0.95	0.95	☑	9,075	9,075	18,151	18,151
D1-FAN-018	CONE LUBE ROOM #2 SUPPLY FAN SUPPLY FAN / FILTER	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.90	0.95	2.2	2.4	0.95	0.95	☑	9,075	9,075	18,151	18,151
D1-FDR-001	CONE CRUSHER BELT FEEDER No. 1	☑	☐	☐	☐ ☑	600	10.0	13.4	0.80	0.90	0.84	0.92	7.8	9.3	0.95	0.95	☐	32,423	32,423	64,847	0
D1-FDR-005	HPGR SURGE BIN FEEDER	☑	☐	☐	☐ ☐	600	10.0	13.4	0.80	0.90	0.84	0.95	7.6	9.0	0.95	0.95	☐	31,536	31,536	63,072	0
D1-FDR-006	CONE CRUSHER BELT FEEDER No. 2	☑	☐	☐	☐ ☑	600	10.0	13.4	0.80	0.90	0.84	0.92	7.8	9.3	0.95	0.95	☐	32,423	32,423	64,847	0
D1-FDR-010	HPGR BELT FEEDER (RAIL MOUNTED)	☑	☐	☐	☐ ☑	600	10.0	13.4	0.80	0.90	0.90	0.95	7.6	8.4	0.95	0.95	☐	31,536	31,536	63,072	0
D1-LUB-020	HPGR CRUSHER LUBE UNIT	☑	☐	☐	☐ ☑	600	22.0	29.5	0.80	0.90	0.90	0.95	16.7	18.5	0.95	0.95	☑	69,379	69,379	138,758	138,758
D1-LUB-037	CONE CRUSHER No.1 LUBE UNIT	☐	☑	☐	☐ ☑	600	7.5	10.1	0.80	0.00	0.84	0.92	0.0	0.0	0.95	0.95	☑	0	0	0	0
D1-LUB-040	CONE CRUSHER No.2 LUBE UNIT	☑	☐	☐	☐ ☑	600	7.5	10.1	0.80	0.80	0.84	0.92	5.2	6.2	0.95	0.95	☑	21,616	21,616	43,231	43,231
D1-MED-001	CONE CRUSHER METAL DETECTOR	☑	☐	☐	☐ ☑	600	10.0	13.4	0.80	0.90	0.84	0.92	7.8	9.3	0.95	0.95	☑	32,423	32,423	64,847	64,847
D1-MED-002	HPGR CRUSHER METAL DETECTOR	☑	☐	☐	☐ ☑	600	10.0	13.4	0.80	0.90	0.84	0.92	7.8	9.3	0.95	0.95	☑	32,423	32,423	64,847	64,847
D1-MGT-002	HPGR SELF CLEANING BELT MAGNET	☑	☐	☐	☐ ☑	600	10.0	13.4	0.80	0.90	0.84	0.92	7.8	9.3	0.95	0.95	☑	32,423	32,423	64,847	64,847
D1-MTR-001	HPGR	☑	☐	☐	☑ ☐	4160	5300.0	7107.4	0.85	1.00	0.91	0.96	4687.8	5128.9	0.95	0.95	☐	19,506,041	19,506,041	39,012,081	0
D1-PPK-005	HPGR CRUSHER HYDRAULIC POWER PACK	☑	☐	☐	☐ ☑	600	9.0	12.1	0.80	0.75	0.90	0.95	5.7	6.3	0.95	0.95	☐	23,652	23,652	47,304	0
D1-PSU-001	HPGR AREA SUMP PUMP	☑	☐	☐	☐ ☑	600	7.5	10.1	0.80	0.25	0.87	0.90	1.7	1.9	0.95	0.95	☐	6,920	6,920	13,839	0
D1-SCB-001	CONE CRUSHER BELT SCALE	☑	☐	☐	☐ ☑	600	0.5	0.7	0.80	0.80	0.87	0.90	0.4	0.4	0.95	0.95	☐	1,476	1,476	2,952	0
D1-SCB-005	HPGR SURGE BIN FEED BELT SCALE	☑	☐	☐	☐ ☑	600	0.5	0.7	0.80	0.80	0.87	0.90	0.4	0.4	0.95	0.95	☐	1,476	1,476	2,952	0
D1-VLV-003	HPGR DUST COLLECTOR ROTARY VALVE	☑	☐	☐	☐ ☐	600	0.7	1.0	0.80	0.80	0.90	0.95	0.5	0.6	0.95	0.95	☐	2,091	2,091	4,182	0
D1-XEM-001	LIGHTING	☑	☐	☐	☐ ☐	600	30.0	40.2	0.80	0.90	0.90	0.95	22.7	25.3	0.90	0.95	☑	89,629	94,608	184,237	184,237
					HPGR TOTAL kW:		**7,515.7**				*TOTAL RUNNING kW:*		**5791.2**	**6356.9**		*TOTAL kW.hr:*		**24,092,274**	**24,097,253**	**48,189,527**	**651,962**
Area: E0 - MILL BUILDING																					
E0-GEN-001	GENERATOR SET	☐	☑	☐	☐ ☐	600	1600.0	2145.6		1.00							☐				0
E0-GEN-002	GENERATOR SET	☐	☑	☐	☐ ☐	600	1600.0	2145.6		1.00							☐				0
E0-XEM-001	LIGHTING	☑	☐	☐	☐ ☐	600	100.0	134.1	0.90	0.80	0.90	0.95	75.8	84.2	0.80	0.90	☑	265,566	298,762	564,328	564,328
E0-XMM-005	MISC POWER INCL HEAT TRACING	☑	☐	☐	☐ ☐	600	200.0	268.2	0.80	0.90	0.90	0.95	151.6	168.4	0.50	0.90	☑	331,958	597,524	929,482	929,482
					MILL BUILDING TOTAL kW:		**3,500.0**				*TOTAL RUNNING kW:*		**227.4**	**252.6**		*TOTAL kW.hr:*		**597,524**	**896,286**	**1,493,811**	**1,493,811**
Area: E1 - GRINDING AND CLASSIFICATION																					
E1-ACL-003	GRINDING FURNACE CONTROL ROOM GAS FIRED HORIZONT	☑	☐	☐	☐ ☐	600	0.4	0.5	0.80	0.70	0.90	0.95	0.2	0.2	0.80	0.80	☑	770	770	1,541	1,541
E1-ACL-004	GRINDING CONTROL ROOM AIR COOLED CONDENSING UNIT	☑	☐	☐	☐ ☐	600	5.6	7.5	0.80	0.70	0.90	0.95	3.3	3.6	0.80	0.80	☑	11,484	11,484	22,969	22,969
E1-ACL-005	GRINDING OFFICES HORIZONTAL GAS FIRED	☑	☐	☐	☐ ☐	600	0.4	0.5	0.80	0.70	0.90	0.95	0.2	0.2	0.80	0.80	☑	770	770	1,541	1,541
E1-ACL-006	GRINDING OFFICES AIR COOLED CONDENSING	☑	☐	☐	☐ ☐	600	5.6	7.5	0.80	0.80	0.90	0.95	3.7	4.2	0.80	0.80	☑	13,125	13,125	26,250	26,250
E1-AHU-004	GRINDING GAS FIRED DIRECT UNIT	☑	☐	☐	☐ ☐	600	14.9	20.0	0.80	0.80	0.90	0.95	10.1	11.2	0.80	0.80	☑	35,220	35,220	70,440	70,440
E1-AHU-005	GRINDING GAS FIRED DIRECT UNIT	☑	☐	☐	☐ ☐	600	14.9	20.0	0.80	0.80	0.90	0.95	10.1	11.2	0.80	0.80	☑	35,220	35,220	70,440	70,440
E1-CNV-003	SECONDARY SIZING SCREEN OVER SIZE TRANSFER CONVEY	☑	☐	☐	☐ ☑	600	11.2	15.0	0.75	1.00	0.87	0.90	9.3	10.7	0.95	0.95	☐	38,750	38,750	77,500	0
E1-CNV-004	PRIMARY SIZING SCREEN OVER SIZE TRANSFER CONVEYOR	☑	☐	☐	☐ ☑	600	14.9	20.0	0.75	1.00	0.84	0.92	12.1	14.4	0.95	0.95	☐	50,324	50,324	100,648	0

WARDROP
Wardrop Engineering Inc.

PBM - MORRISON COPPER / GOLD PROJECT
LOAD LIST

WARDROP PROJECT No : 06527201.00
LOAD LIST : 0652720100-LST-E0001-06

EQUIPMENT NUMBER	DESCRIPTION	OPER.	STND BY	CRITICAL LOAD	SPEED VFD/FIXED	VOLTAGE	POWER (kW)	POWER (HP)	EST. LOAD FACTOR	EST. USED FACTOR	EST. PWR FACTOR	EST EFF.	RUNNING kW	RUNNING kVA	EST UTIL. SUMMER	EST UTIL. WINTER	INFRA.	kW.hr SUMMER	kW.hr WINTER	kW.hr ANNUAL	INFRA. LOAD
E1-CNV-005	PRIMARY SIZING SCREEN UNDER SIZE TRANSFER CONVEYO	☑	☐	☐	☐ ☑	600	14.9	20.0	0.75	1.00	0.84	0.92	12.1	14.4	0.95	0.95	☐	50,324	50,324	100,648	0
E1-CNV-007	HPGR DISCHARGE CONVEYOR	☑	☐	☐	☐ ☑	600	55.9	75.0	0.75	1.00	0.88	0.96	43.6	49.4	0.95	0.95	☐	181,341	181,341	362,682	0
E1-CRN-030	GRINDING AREA CRANE	☑	☐	☐	☐ ☑	600	70.8	94.9	0.80	0.10	0.88	0.95	5.9	6.8	0.15	0.15	☐	3,901	3,901	7,801	0
E1-FAN-019	GRINDING LUBE ROOM #1 SUPPLY FAN / FILTER	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	1.00	0.90	0.95	3.1	3.5	0.95	0.95	☑	13,070	13,070	26,140	26,140
E1-FAN-020	GRINDING LUBE ROOM #2 SUPPLY FAN / FILTER	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	1.00	0.90	0.95	3.1	3.5	0.95	0.95	☑	13,070	13,070	26,140	26,140
E1-FAN-021	GRINDING CONTROL ROOM PRESSURIZATION UNIT	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	1.00	0.90	0.95	3.1	3.5	0.95	0.95	☑	13,070	13,070	26,140	26,140
E1-FAN-022	GRINDING EXHAUST FAN	☑	☐	☐	☐ ☐	600	11.2	15.0	0.80	0.70	0.90	0.95	6.6	7.3	0.60	0.95	☑	17,335	27,447	44,782	44,782
E1-FAN-023	GRINDING EXHAUST FAN	☑	☐	☐	☐ ☐	600	11.2	15.0	0.80	0.70	0.90	0.95	6.6	7.3	0.60	0.95	☑	17,335	27,447	44,782	44,782
E1-FAN-024	GRINDING EXHAUST FAN	☑	☐	☐	☐ ☐	600	11.2	15.0	0.80	1.00	0.90	0.95	9.4	10.5	0.95	0.95	☑	39,210	39,210	78,420	78,420
E1-FAN-025	GRINDING EXHAUST FAN	☑	☐	☐	☐ ☐	600	11.2	15.0	0.80	1.00	0.90	0.95	9.4	10.5	0.95	0.95	☑	39,210	39,210	78,420	78,420
E1-FAN-026	GRINDING LUNCHROOM EXHAUST FAN	☑	☐	☐	☐ ☐	600	0.7	1.0	0.80	0.70	0.90	0.95	0.4	0.5	0.60	0.95	☑	1,156	1,830	2,985	2,985
E1-FAN-027	GRINDING WASHROOMS EXHAUST FAN	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.90	0.95	2.2	2.4	0.60	0.95	☑	5,778	9,149	14,927	14,927
E1-FAN-028	GRINDING COMPRESSOR ROOM EXHAUST FAN	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.90	0.95	2.2	2.4	0.60	0.95	☑	5,778	9,149	14,927	14,927
E1-FAN-029	GRINDING COMPRESSOR ROOM EXHAUST FAN	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.90	0.95	2.2	2.4	0.60	0.95	☑	5,778	9,149	14,927	14,927
E1-FAN-030	GRINDING BLOWER ROOM EXHAUST FAN	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.90	0.95	2.2	2.4	0.60	0.95	☑	5,778	9,149	14,927	14,927
E1-FAN-031	GRINDING BLOWER ROOM EXHAUST FAN	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.90	0.95	2.2	2.4	0.60	0.95	☑	5,778	9,149	14,927	14,927
E1-HAN-001	MILL LINER HANDLER	☑	☐	☐	☐ ☑	600	10.0	13.4	0.80	0.70	0.84	0.92	6.1	7.2	0.10	0.10	☐	2,655	2,655	5,309	0
E1-HTR-017	GRINDING GAS FIRED UNIT HEATER	☑	☐	☐	☐ ☐	600	0.2	0.3	0.80	0.70	0.90	0.95	0.1	0.2	0.50	0.95	☑	318	603	921	921
E1-HTR-018	GRINDING GAS FIRED UNIT HEATER	☑	☐	☐	☐ ☐	600	0.2	0.3	0.80	0.70	0.90	0.95	0.1	0.2	0.50	0.95	☑	318	603	921	921
E1-HTR-019	GRINDING GAS FIRED UNIT HEATER	☑	☐	☐	☐ ☐	600	0.2	0.3	0.80	0.70	0.90	0.95	0.1	0.2	0.50	0.95	☑	318	603	921	921
E1-HTR-020	GRINDING GAS FIRED UNIT HEATER	☑	☐	☐	☐ ☐	600	0.2	0.3	0.80	0.70	0.90	0.95	0.1	0.2	0.50	0.95	☑	318	603	921	921
E1-HTR-021	GRINDING GAS FIRED UNIT HEATER	☑	☐	☐	☐ ☐	600	0.2	0.3	0.80	0.70	0.90	0.95	0.1	0.2	0.50	0.95	☑	318	603	921	921
E1-HTR-022	GRINDING GAS FIRED UNIT HEATER	☑	☐	☐	☐ ☐	600	0.2	0.3	0.80	0.70	0.90	0.95	0.1	0.2	0.50	0.95	☑	318	603	921	921
E1-HTR-023	GRINDING GAS FIRED UNIT HEATER	☑	☐	☐	☐ ☐	600	0.2	0.3	0.80	0.70	0.90	0.95	0.1	0.2	0.50	0.95	☑	318	603	921	921
E1-HTR-024	GRINDING GAS FIRED UNIT HEATER	☑	☐	☐	☐ ☐	600	0.2	0.3	0.80	0.70	0.90	0.95	0.1	0.2	0.50	0.95	☑	318	603	921	921
E1-HTR-025	GRINDING GAS FIRED UNIT HEATER	☑	☐	☐	☐ ☐	600	0.2	0.3	0.80	0.70	0.90	0.95	0.1	0.2	0.50	0.95	☑	318	603	921	921
E1-HTR-026	GRINDING GAS FIRED UNIT HEATER	☑	☐	☐	☐ ☐	600	0.2	0.3	0.80	0.70	0.90	0.95	0.1	0.2	0.50	0.95	☑	318	603	921	921
E1-HTR-027	GRINDING GAS FIRED UNIT HEATER	☑	☐	☐	☐ ☐	600	0.2	0.3	0.80	0.70	0.90	0.95	0.1	0.2	0.50	0.95	☑	318	603	921	921
E1-HTR-028	GRINDING CONTROL ROOM ELECTRIC DUCT HEATER	☑	☐	☐	☐ ☐	600	13.0	17.4	0.80	0.80	1.00	1.00	8.3	8.3	0.50	0.95	☑	18,221	34,620	52,840	52,840
E1-LUB-038	BALL MILL No. 1 LUBE UNIT	☑	☐	☐	☐ ☑	600	15.0	20.1	0.80	0.90	0.84	0.92	11.7	13.9	0.95	0.95	☐	48,635	48,635	97,270	0
E1-LUB-039	BALL MILL No. 2 LUBE UNIT	☑	☐	☐	☐ ☑	600	15.0	20.1	0.80	0.90	0.84	0.92	11.7	13.9	0.95	0.95	☐	48,635	48,635	97,270	0
E1-MGT-001	SELF CLEANING BELT MAGNET	☑	☐	☐	☐ ☑	600	10.0	13.4	0.80	1.00	0.84	0.92	8.7	10.3	0.95	0.95	☐	36,026	36,026	72,052	0
E1-MIL-013	BALL MILL No. 1	☑	☐	☐	☑ ☐	13800	6700.0	8984.8	0.90	1.00	0.90	0.96	6274.7	6971.9	1.00	1.00	☐	27,483,247	27,483,247	54,966,493	0
E1-MIL-022	BALL MILL No. 2	☑	☐	☐	☑ ☐	13800	6700.0	8984.8	0.90	1.00	0.90	0.96	6274.7	6971.9	1.00	1.00	☐	27,483,247	27,483,247	54,966,493	0
E1-PSL-002	CYCLOPAC No.1 & 2 FEED PUMP No. 2 (UNINSTALLED SPARE)	☐	☑	☐	☑ ☐	4160	572.0	767.1	0.80	0.00	0.88	0.94	0.0	0.0	0.95	0.95	☐	0	0	0	0
E1-PSL-003	CYCLOPAC No.2 FEED PUMP No. 1	☑	☐	☐	☑ ☐	4160	572.0	767.1	0.80	1.00	0.88	0.94	486.3	550.1	0.95	0.95	☐	2,023,458	2,023,458	4,046,915	0
E1-PSL-010	CYCLOPAC No.1 FEED PUMP No. 1	☑	☐	☐	☑ ☐	4160	572.0	767.1	0.80	1.00	0.88	0.94	486.3	550.1	0.95	0.95	☐	2,023,458	2,023,458	4,046,915	0
E1-PSU-040	GRINDING AREA SUMP PUMP	☑	☐	☐	☐ ☑	600	7.5	10.1	0.80	0.25	0.86	0.95	1.6	1.8	0.95	0.95	☐	6,542	6,542	13,085	0
E1-SCN-001	PRIMARY SIZING SCREEN No.1	☑	☐	☐	☐ ☑	600	26.0	34.9	0.80	1.00	0.86	0.95	21.8	25.5	0.95	0.95	☐	90,722	90,722	181,444	0
E1-SCN-002	PRIMARY SIZING SCREEN No.2	☑	☐	☐	☐ ☑	600	26.0	34.9	0.80	1.00	0.86	0.95	21.8	25.5	0.95	0.95	☐	90,722	90,722	181,444	0
E1-SCN-003	SECONDARY SIZING SCREEN No.1	☑	☐	☐	☐ ☑	600	37.0	49.6	0.80	1.00	0.84	0.94	31.5	37.5	0.95	0.95	☐	131,027	131,027	262,054	0
E1-SCN-004	SECONDARY SIZING SCREEN No.2	☑	☐	☐	☐ ☑	600	37.0	49.6	0.80	1.00	0.84	0.94	31.5	37.5	0.95	0.95	☐	131,027	131,027	262,054	0
E1-SMP-020	ON-STREAM SECONDARY GRINDING CYCLOPAC SAMPLER	☑	☐	☐	☐ ☑	600	7.5	10.1	0.80	0.70	0.87	0.90	4.7	5.4	0.95	0.95	☐	19,418	19,418	38,836	0
	GRINDING AND CLASSIFICATION TOTAL kW:						**15,607.5**				*TOTAL RUNNING kW:*		**13846.3**	**15417.7**			*TOTAL kW.hr:*	**60,244,107**	**60,301,401**	**120,545,508**	**658,594**
Area: E2 - SECONDARY CRUSHING																					
E2-BAG-006	SEC SCREENING DUST COLLECTOR	☑	☐	☐	☐ ☐	600	0.2	0.3	0.80	0.90	0.90	0.95	0.2	0.2	0.95	0.95	☐	631	631	1,261	0
E2-CNV-003	SEC SCREENING DUST COLLECTOR SCREW CONVEYOR	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.90	0.90	0.95	2.8	3.1	0.95	0.95	☐	11,763	11,763	23,526	0
E2-FAN-032	SEC SCREENING DUST COLLECTOR EXHAUST FAN	☑	☐	☐	☐ ☐	600	75.0	100.6	0.80	0.90	0.90	0.95	56.8	63.2	0.95	0.95	☐	236,520	236,520	473,040	0
E2-VLV-004	SEC SCREENING DUST COLLECTOR ROTARY VALVE	☑	☐	☐	☐ ☐	600	0.7	1.0	0.80	0.60	0.90	0.95	0.4	0.4	0.95	0.95	☐	1,568	1,568	3,137	0
	SECONDARY CRUSHING TOTAL kW:						**79.7**				*TOTAL RUNNING kW:*		**60.2**	**66.9**			*TOTAL kW.hr:*	**250,482**	**250,482**	**500,964**	**0**
Area: E3 - FLOTATION																					
E3-AGI-003	COPPER MOLYBDENUM CONC. STOCK TANK AGITATOR	☑	☐	☑	☐ ☑	600	1.1	1.5	0.80	1.00	0.84	0.94	0.9	1.1	1.00	1.00	☐	4,100	4,100	8,201	0
E3-AGI-004	MOLYBDENUM CONC. STOCK TANK AGITATOR	☑	☐	☑	☐ ☑	600	4.0	5.4	0.80	1.00	0.84	0.94	3.4	4.1	0.95	0.95	☐	14,165	14,165	28,330	0
E3-AHU-006	FLOTATION GAS FIRED DIRECT UNIT	☑	☐	☐	☐ ☐	600	14.9	20.0	0.80	1.00	0.90	0.95	12.6	14.0	0.95	0.95	☐	52,280	52,280	104,559	0
E3-AHU-007	FLOTATION GAS FIRED DIRECT UNIT	☑	☐	☐	☐ ☐	600	14.9	20.0	0.80	1.00	0.90	0.95	12.6	14.0	0.95	0.95	☐	52,280	52,280	104,559	0
E3-BLO-084	FLOTATION AERATION BLOWER No. 1	☑	☐	☐	☐ ☑	4160	350.0	469.4	0.80	1.00	0.88	0.94	297.9	338.5	0.95	0.95	☐	1,239,447	1,239,447	2,478,894	0
E3-BLO-085	FLOTATION AERATION BLOWER No. 2	☑	☐	☐	☐ ☑	4160	350.0	469.4	0.80	1.00	0.88	0.94	297.9	338.5	0.95	0.95	☐	1,239,447	1,239,447	2,478,894	0
E3-CEL-003	COPPER ROUGHER FLOTATION CELL No. 1	☑	☐	☐	☐ ☑	4160	224.0	300.4	0.80	1.00	0.89	0.96	186.7	209.7	0.95	0.95	☐	776,720	776,720	1,553,440	0
E3-CEL-004	COPPER ROUGHER FLOTATION CELL No. 2	☑	☐	☐	☐ ☑	4160	224.0	300.4	0.80	1.00	0.89	0.96	186.7	209.7	0.95	0.95	☐	776,720	776,720	1,553,440	0
E3-CEL-005	COPPER ROUGHER FLOTATION CELL No. 3	☑	☐	☐	☐ ☑	4160	224.0	300.4	0.80	1.00	0.89	0.96	186.7	209.7	0.95	0.95	☐	776,720	776,720	1,553,440	0
E3-CEL-006	COPPER ROUGHER FLOTATION CELL No. 4	☑	☐	☐	☐ ☑	4160	224.0	300.4	0.80	1.00	0.89	0.96	186.7	209.7	0.95	0.95	☐	776,720	776,720	1,553,440	0
E3-CEL-007	MOLYBDENUM ROUGHER FLOTATION CELL No. 1	☑	☐	☑	☐ ☑	600	11.0	14.8	0.80	1.00	0.89	0.96	9.2	10.3	0.95	0.95	☐	38,143	38,143	76,285	0
E3-CEL-008	MOLYBDENUM ROUGHER FLOTATION CELL No. 2	☑	☐	☑	☐ ☑	600	11.0	14.8	0.80	1.00	0.89	0.96	9.2	10.3	0.95	0.95	☐	38,143	38,143	76,285	0
E3-CEL-009	MOLYBDENUM ROUGHER FLOTATION CELL No. 3	☑	☐	☑	☐ ☑	600	11.0	14.8	0.80	1.00	0.89	0.96	9.2	10.3	0.95	0.95	☐	38,143	38,143	76,285	0
E3-CEL-021	COPPER ROUGHER SCAVENGER FLOTATION CELL No. 1	☑	☐	☐	☐ ☑	4160	224.0	300.4	0.80	1.00	0.88	0.94	190.4	216.4	0.95	0.95	☐	792,403	792,403	1,584,806	0
E3-CEL-022	COPPER ROUGHER SCAVENGER FLOTATION CELL No. 2	☑	☐	☐	☐ ☑	4160	224.0	300.4	0.80	1.00	0.88	0.94	190.4	216.4	0.95	0.95	☐	792,403	792,403	1,584,806	0
E3-CEL-023	COPPER ROUGHER SCAVENGER FLOTATION CELL No. 3	☑	☐	☐	☐ ☑	4160	224.0	300.4	0.80	1.00	0.88	0.94	190.4	216.4	0.95	0.95	☐	792,403	792,403	1,584,806	0

EQUIPMENT NUMBER	DESCRIPTION	OPER.	STND BY	CRITICAL LOAD	SPEED VFD/FIXED	VOLTAGE	POWER (kW)	POWER (HP)	EST. LOAD FACTOR	EST. USED FACTOR	EST. PWR FACTOR	EST EFF.	RUNNING kW	RUNNING kVA	EST UTIL. SUMMER	EST UTIL. WINTER	INFRA.	kW.hr SUMMER	kW.hr WINTER	kW.hr ANNUAL	INFRA. LOAD
E3-CEL-024	COPPER ROUGHER SCAVENGER FLOTATION CELL No. 4	☑	☐	☐	☑	4160	224.0	300.4	0.80	1.00	0.88	0.94	190.4	216.4	0.95	0.95	☐	792,403	792,403	1,584,806	0
E3-CEL-030	COPPER 1st CLEANER FLOTATION CELL No. 1	☑	☐	☑	☑	600	93.0	124.7	0.80	1.00	0.89	0.96	77.3	86.9	0.95	0.95	☐	321,807	321,807	643,614	0
E3-CEL-031	COPPER 1st CLEANER FLOTATION CELL No. 2	☑	☐	☑	☑	600	93.0	124.7	0.80	1.00	0.89	0.96	77.3	86.9	0.95	0.95	☐	321,807	321,807	643,614	0
E3-CEL-032	COPPER 1st CLEANER FLOTATION CELL No. 3	☑	☐	☑	☑	600	93.0	124.7	0.80	1.00	0.89	0.96	77.3	86.9	0.95	0.95	☐	321,807	321,807	643,614	0
E3-CEL-033	COPPER 1st CLEANER FLOTATION CELL No. 4	☑	☐	☑	☑	600	93.0	124.7	0.80	1.00	0.89	0.96	77.3	86.9	0.95	0.95	☐	321,807	321,807	643,614	0
E3-CEL-039	COPPER 1st CLEANER SCAVENGER FLOTATION CELL No. 1	☑	☐	☑	☑	600	93.0	124.7	0.80	1.00	0.89	0.96	77.3	86.9	0.95	0.95	☐	321,807	321,807	643,614	0
E3-CEL-040	COPPER 1st CLEANER SCAVENGER FLOTATION CELL No. 2	☑	☐	☑	☑	600	93.0	124.7	0.80	1.00	0.89	0.96	77.3	86.9	0.95	0.95	☐	321,807	321,807	643,614	0
E3-CEL-041	COPPER 1st CLEANER SCAVENGER FLOTATION CELL No. 3	☑	☐	☑	☑	600	93.0	124.7	0.80	1.00	0.89	0.96	77.3	86.9	0.95	0.95	☐	321,807	321,807	643,614	0
E3-CEL-042	COPPER 1st CLEANER SCAVENGER FLOTATION CELL No. 4	☑	☐	☑	☑	600	93.0	124.7	0.80	1.00	0.89	0.96	77.3	86.9	0.95	0.95	☐	321,807	321,807	643,614	0
E3-CEL-052	COPPER 2nd CLEANER COLUMN FLOTATION CELL	☑	☐	☐	☐	600	1.1	1.5	0.80	1.00	0.90	0.95	0.9	1.0	0.95	0.95	☐	3,854	3,854	7,709	0
E3-CEL-060	MOLYBDENUM 1ST CLEANER COLUMN FLOTATION CELL	☑	☐	☐	☐	600	1.1	1.5	0.80	1.00	0.90	0.95	0.9	1.0	0.95	0.95	☐	3,854	3,854	7,709	0
E3-CNV-001	MOLYBDENUM CONCENTRATE BELT CONVEYOR	☑	☐	☐	☑	600	7.5	10.1	0.75	1.00	0.87	0.90	6.2	7.2	0.95	0.95	☐	25,949	25,949	51,897	0
E3-COL-001	DRYER DUST COLLECTOR	☑	☐	☐	☑	600	0.2	0.3	0.80	1.00	0.90	0.95	0.2	0.2	0.95	0.95	☐	701	701	1,402	0
E3-CRN-029	FLOTATION AREA CRANE	☑	☐	☐	☑	600	8.2	11.0	0.80	0.10	0.84	0.92	0.7	0.8	0.10	0.10	☑	311	311	622	622
E3-DRY-006	MOLYBDENUM CONCENTRATE DRYER	☑	☐	☐	☑	600	5.0	6.7	0.80	1.00	0.87	0.90	4.4	5.1	0.95	0.95	☐	18,452	18,452	36,905	0
E3-FAN-033	FLOTATION EXHAUST FANS	☑	☐	☐	☐	600	11.2	15.0	0.80	0.70	0.90	0.95	6.6	7.3	0.95	0.95	☑	27,447	27,447	54,894	54,894
E3-FAN-034	FLOTATION EXHAUST FANS	☑	☐	☐	☐	600	11.2	15.0	0.80	0.70	0.90	0.95	6.6	7.3	0.95	0.95	☑	27,447	27,447	54,894	54,894
E3-FAN-035	FLOTATION EXHAUST FANS	☑	☐	☐	☐	600	11.2	15.0	0.80	0.70	0.90	0.95	6.6	7.3	0.95	0.95	☑	27,447	27,447	54,894	54,894
E3-FAN-036	FLOTATION EXHAUST FANS	☑	☐	☐	☐	600	11.2	15.0	0.80	0.70	0.90	0.95	6.6	7.3	0.95	0.95	☑	27,447	27,447	54,894	54,894
E3-FAN-037	FLOTATION REGRIND LUBE ROOM SUPPLY FAN / FILTER	☑	☐	☐	☐	600	3.7	5.0	0.80	0.70	0.90	0.95	2.2	2.4	0.95	0.95	☑	9,149	9,149	18,298	18,298
E3-FIL-005	MOLYBDENUM CONCENTRATE FILTER	☑	☐	☑	☑	600	4.0	5.4	0.80	0.70	0.87	0.90	2.5	2.8	0.95	0.95	☑	10,333	10,333	20,667	20,667
E3-HTR-029	MOLYBDENUM CONCENTRATE GAS FIRED UNIT HEATER	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.60	0.95	☑	288	456	744	744
E3-HTR-030	MOLYBDENUM CONCENTRATE GAS FIRED UNIT HEATER	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.60	0.95	☑	288	456	744	744
E3-HTR-031	MOLYBDENUM CONCENTRATE GAS FIRED UNIT HEATER	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.60	0.95	☑	288	456	744	744
E3-HTR-032	MOLYBDENUM CONCENTRATE GAS FIRED UNIT HEATER	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.60	0.95	☑	288	456	744	744
E3-HTR-033	MOLYBDENUM CONCENTRATE GAS FIRED UNIT HEATER	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.60	0.95	☑	288	456	744	744
E3-HTR-034	MOLYBDENUM CONCENTRATE GAS FIRED UNIT HEATER	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.60	0.95	☑	288	456	744	744
E3-LUB-028	REGRIND MILL LUBE UNIT	☑	☐	☐	☑	600	15.0	20.1	0.80	0.80	0.84	0.92	10.4	12.4	0.95	0.95	☐	43,231	43,231	86,462	0
E3-MAC-001	BAGGING MACHINE	☑	☐	☐	☑	600	3.7	5.0	0.80	0.80	0.87	0.90	2.6	3.0	0.95	0.95	☐	10,924	10,924	21,848	0
E3-MIL-012	1st REGRIND VERTICAL MILL	☑	☐	☐	☑	4160	1119.0	1500.6	0.90	1.00	0.91	0.96	1048.0	1146.6	0.95	0.95	☐	4,360,607	4,360,607	8,721,214	0
E3-MIL-065	2nd REGRIND VERTICAL MILL	☑	☐	☐	☑	4160	1119.0	1500.6	0.90	1.00	0.91	0.96	1048.0	1146.6	0.95	0.95	☐	4,360,607	4,360,607	8,721,214	0
E3-PSL-001	REGRIND CYCLOPAC FEED PUMP No. 1	☑	☐	☐	☑	4160	200.0	268.2	0.80	1.00	0.88	0.94	170.0	192.3	0.95	0.95	☐	707,503	707,503	1,415,005	0
E3-PSL-009	REGRIND CYCLOPAC FEED PUMP No. 2	☐	☑	☐	☑	4160	200.0	268.2	0.80	0.00	0.88	0.94	0.0	0.0	0.95	0.95	☐	0	0	0	0
E3-PSL-019	ROUGHER TAILINGS PUMP No.1	☑	☐	☐	☑	4160	450.0	603.5	0.80	1.00	0.88	0.94	382.6	432.8	0.95	0.95	☐	1,591,881	1,591,881	3,183,762	0
E3-PSL-020	ROUGHER TAILINGS PUMP No.2	☐	☑	☐	☑	4160	450.0	603.5	0.80	0.00	0.88	0.94	0.0	0.0	0.95	0.95	☐	0	0	0	0
E3-PSL-025	STOCK TANK FEED PUMP No.1	☑	☐	☑	☐	600	8.0	10.7	0.80	1.00	0.84	0.92	6.9	8.3	0.95	0.95	☐	28,821	28,821	57,642	0
E3-PSL-026	STOCK TANK FEED PUMP No.2	☐	☑	☐	☐	600	8.0	10.7	0.80	0.00	0.84	0.92	0.0	0.0	0.95	0.95	☐	0	0	0	0
E3-PSL-030	MOLYBDENUM ROUGHER FLOTATION FEED PUMP No.1	☑	☐	☑	☐	600	10.0	13.4	0.80	1.00	0.84	0.92	8.7	10.3	0.95	0.95	☐	36,026	36,026	72,052	0
E3-PSL-031	MOLYBDENUM ROUGHER FLOTATION FEED PUMP No.2	☐	☑	☐	☐	600	10.0	13.4	0.80	0.00	0.84	0.92	0.0	0.0	0.95	0.95	☐	0	0	0	0
E3-PSL-032	MOLYBDENUM CONC. FILTER FEED PUMP No.1	☑	☐	☑	☐	600	15.0	20.1	0.80	1.00	0.84	0.92	13.0	15.5	0.95	0.95	☐	54,039	54,039	108,078	0
E3-PSL-033	MOLYBDENUM CONC. FILTER FEED PUMP No.2	☐	☑	☐	☐	600	15.0	20.1	0.80	0.00	0.84	0.92	0.0	0.0	0.95	0.95	☐	0	0	0	0
E3-PSL-034	MOLYBDENUM FILTER FEED PUMP No.1	☑	☐	☑	☐	600	3.0	4.0	0.80	1.00	0.84	0.92	2.6	3.1	0.95	0.95	☐	10,808	10,808	21,616	0
E3-PSL-035	MOLYBDENUM FILTER FEED PUMP No.2	☐	☑	☐	☐	600	3.0	4.0	0.80	0.00	0.84	0.92	0.0	0.0	0.95	0.95	☐	0	0	0	0
E3-PSL-036	1st CLEANER CONC. PUMP No.1	☑	☐	☑	☐	600	15.0	20.1	0.80	1.00	0.84	0.94	12.7	15.3	0.95	0.95	☐	53,006	53,006	106,013	0
E3-PSL-037	1st CLEANER CONC. PUMP No.2	☐	☑	☐	☐	600	15.0	20.1	0.80	0.00	0.84	0.94	0.0	0.0	0.95	0.95	☐	0	0	0	0
E3-PSL-038	MOLYBDENUM CLEANER COLUMN UNDERFLOW PUMP	☑	☐	☐	☐	600	7.0	9.4	0.80	1.00	0.84	0.92	6.1	7.2	0.95	0.95	☐	25,218	25,218	50,436	0
E3-PSL-039	MOLYBDENUM CLEANER COLUMN UNDERFLOW PUMP (STAN	☐	☑	☐	☐	600	7.0	9.4	0.80	0.00	0.84	0.92	0.0	0.0	0.95	0.95	☐	0	0	0	0
E3-PSL-040	MOLYBDENUM CLEANER FLOTATION FEED PUMP No.1	☑	☐	☐	☐	600	7.0	9.4	0.80	1.00	0.84	0.92	6.1	7.2	0.95	0.95	☐	25,218	25,218	50,436	0
E3-PSL-041	MOLYBDENUM CLEANER FLOTATION FEED PUMP No.2	☐	☑	☐	☐	600	7.0	9.4	0.80	0.00	0.84	0.92	0.0	0.0	0.95	0.95	☐	0	0	0	0
E3-PSL-042	MOLYBDENUM THICKENER FEED PUMP No.1	☑	☐	☑	☐	600	3.0	4.0	0.80	1.00	0.84	0.92	2.6	3.1	0.95	0.95	☐	10,808	10,808	21,616	0
E3-PSL-043	MOLYBDENUM THICKENER FEED PUMP No.2	☐	☑	☐	☐	600	3.0	4.0	0.80	0.00	0.84	0.92	0.0	0.0	0.95	0.95	☐	0	0	0	0
E3-PSL-045	1st CLEANER / SCAV CONC. PUMP No.1	☑	☐	☑	☐	600	10.0	13.4	0.80	1.00	0.84	0.94	8.5	10.2	0.95	0.95	☐	35,338	35,338	70,675	0
E3-PSL-046	1st CLEANER / SCAV CONC. PUMP No.2	☐	☑	☐	☐	600	10.0	13.4	0.80	0.00	0.84	0.94	0.0	0.0	0.95	0.95	☐	0	0	0	0
E3-PSL-054	2nd CLEANER TAILINGS PUMP No.1	☑	☐	☑	☐	600	26.0	34.9	0.80	1.00	0.84	0.94	22.1	26.4	0.95	0.95	☐	91,878	91,878	183,755	0
E3-PSL-055	2nd CLEANER TAILINGS PUMP No.2	☐	☑	☐	☐	600	26.0	34.9	0.80	0.00	0.84	0.94	0.0	0.0	0.95	0.95	☐	0	0	0	0
E3-PSL-057	2nd CLEANER CONC. PUMP No.1	☑	☐	☐	☐	600	20.0	26.8	0.80	1.00	0.84	0.94	17.0	20.3	0.95	0.95	☐	70,675	70,675	141,350	0
E3-PSL-058	2nd CLEANER CONC. PUMP No.2	☐	☑	☐	☐	600	20.0	26.8	0.80	0.00	0.84	0.94	0.0	0.0	0.95	0.95	☐	0	0	0	0
E3-PSU-010	CONC. DEWATERING AREA SUMP PUMP	☑	☐	☐	☐	600	1.0	1.3	0.80	0.10	0.84	0.94	0.1	0.1	0.95	0.95	☐	354	354	708	0
E3-PSU-026	FLOTATION AREA SUMP PUMP No. 1	☑	☐	☐	☐	600	10.0	13.4	0.80	0.10	0.84	0.92	0.9	1.0	0.95	0.95	☐	3,603	3,603	7,205	0
E3-SCL-001	MOLYBDENUM CONC. SCALE	☑	☐	☐	☐	600	0.5	0.7	0.80	1.00	0.87	0.90	0.4	0.5	0.95	0.95	☐	1,845	1,845	3,690	0
E3-SMP-008	COPPER SAMPLER	☑	☐	☐	☐	600	7.5	10.1	0.80	1.00	0.84	0.92	6.5	7.7	0.95	0.95	☐	27,019	27,019	54,039	0
E3-SMP-011	REGRIND CYCLOPAC ON-STREAM SAMPLER	☑	☐	☐	☐	600	7.5	10.1	0.80	1.00	0.84	0.92	6.5	7.7	0.95	0.95	☐	27,019	27,019	54,039	0
E3-SMP-025	ROUGHER SCAVENGER ON-STREAM SAMPLER	☑	☐	☐	☐	600	7.5	10.1	0.80	1.00	0.84	0.92	6.5	7.7	0.95	0.95	☐	27,019	27,019	54,039	0
E3-SMP-038	1st CLEANER CONC. ON-STREAM SAMPLER	☑	☐	☐	☐	600	7.5	10.1	0.80	1.00	0.84	0.92	6.5	7.7	0.95	0.95	☐	27,019	27,019	54,039	0
E3-SMP-047	1st CLEANER / SCAV CONC. ON-STREAM SAMPLER	☑	☐	☐	☐	600	7.5	10.1	0.80	1.00	0.84	0.92	6.5	7.7	0.95	0.95	☐	27,019	27,019	54,039	0
E3-SMP-059	2nd CLEANER CONC. ON-STREAM SAMPLER	☑	☐	☐	☐	600	7.5	10.1	0.80	1.00	0.84	0.92	6.5	7.7	0.95	0.95	☐	27,019	27,019	54,039	0
E3-THI-001	COPPER MOLYBDENUM THICKENER	☑	☐	☑	☐	600	6.0	8.0	0.80	1.00	0.87	0.90	5.3	6.1	0.95	0.95	☐	22,143	22,143	44,286	0
E3-THI-004	MOLYBDENUM THICKENER	☑	☐	☑	☐	600	3.0	4.0	0.80	1.00	0.87	0.90	2.7	3.1	0.95	0.95	☐	11,071	11,071	22,143	0

WARDROP
Wardrop Engineering Inc.

PBM - MORRISON COPPER / GOLD PROJECT
LOAD LIST

WARDROP PROJECT No : 06527201.00
LOAD LIST : 0652720100-LST-E0001-06

EQUIPMENT NUMBER	DESCRIPTION	OPER.	STND BY	CRITICAL LOAD	SPEED VFD/FIXED	VOLTAGE	POWER (kW)	POWER (HP)	EST. LOAD FACTOR	EST. USED FACTOR	EST. PWR FACTOR	EST EFF.	RUNNING kW	RUNNING kVA	EST UTIL. SUMMER	EST UTIL. WINTER	INFRA.	kW.hr SUMMER	kW.hr WINTER	kW.hr ANNUAL	INFRA. LOAD
					FLOTATION TOTAL kW:		7,250.8				TOTAL RUNNING kW:		5641.0	6309.3		TOTAL kW.hr:		23,468,934	23,469,942	46,938,876	263,627
Area: E4 - CONCENTRATE DEWATERING AND LOADOUT																					
E4-AGI-009	COPPER CONCENTRATE STOCK TANK AGITATOR	☑	☐	☐	☑	600	22.0	29.5	0.80	1.00	0.84	0.94	18.7	22.4	0.95	0.95	☐	77,743	77,743	155,485	0
E4-AHU-008	LOADOUT DIRECT GAS FIRED AIR HANDLING UNIT	☑	☐	☐	☐	600	18.7	25.1	0.80	0.70	0.80	0.90	11.6	14.5	0.95	0.95	☐	48,416	48,416	96,831	0
E4-BAG-007	LOADOUT DUST COLLECTOR	☑	☐	☐	☐	600	0.2	0.3	0.80	1.00	0.80	0.90	0.2	0.2	0.95	0.95	☐	740	740	1,479	0
E4-CNV-004	LOADOUT DUST COLLECTOR SCREW CONVEYOR	☑	☐	☐	☐	600	3.7	5.0	0.75	0.80	0.90	0.95	2.4	2.6	0.95	0.95	☐	9,802	9,802	19,605	0
E4-CNV-015	COPPER CONCENTRATE TRANSFER BELT CONVEYOR	☑	☐	☐	☑	600	7.5	10.1	0.75	1.00	0.87	0.90	6.2	7.2	0.95	0.95	☐	25,949	25,949	51,897	0
E4-CNV-016	COPPER CONCENTRATE LOADOUT BELT CONVEYOR	☑	☐	☐	☑	600	7.5	10.1	0.75	1.00	0.87	0.90	6.2	7.2	0.95	0.95	☐	25,949	25,949	51,897	0
E4-FAN-038	LOADOUT DUST COLLECTOR EXHAUST FAN	☑	☐	☐	☐	600	56.0	75.0	0.80	1.00	0.80	0.90	49.7	62.2	0.95	0.95	☐	206,977	206,977	413,955	0
E4-FIL-013	COPPER CONCENTRATE PRESSURE FILTER	☑	☐	☑	☑	600	75.0	100.6	0.80	1.00	0.90	0.95	63.2	70.2	0.95	0.95	☐	262,800	262,800	525,600	0
E4-HTR-035	LOADOUT GAS FIRED UNIT HEATER	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.60	0.95	☑	288	456	744	744
E4-HTR-036	LOADOUT GAS FIRED UNIT HEATER	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.60	0.95	☑	288	456	744	744
E4-HTR-037	LOADOUT GAS FIRED UNIT HEATER	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.60	0.95	☑	288	456	744	744
E4-HTR-038	LOADOUT GAS FIRED UNIT HEATER	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.60	0.95	☑	288	456	744	744
E4-HTR-039	LOADOUT GAS FIRED UNIT HEATER	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.60	0.95	☑	288	456	744	744
E4-HTR-040	LOADOUT GAS FIRED UNIT HEATER	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.60	0.95	☑	288	456	744	744
E4-HTR-041	LOADOUT GAS FIRED UNIT HEATER	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.60	0.95	☑	288	456	744	744
E4-HTR-042	LOADOUT GAS FIRED UNIT HEATER	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.60	0.95	☑	288	456	744	744
E4-PMP-001	CLOTH WASH WATER PUMP	☑	☐	☐	☑	600	10.0	13.4	0.80	1.00	0.87	0.90	8.9	10.2	0.95	0.95	☐	36,905	36,905	73,809	0
E4-PMP-003	COPPER FILTRATE PUMP	☑	☐	☑	☑	600	5.0	6.7	0.80	1.00	0.84	0.92	4.3	5.2	0.95	0.95	☐	18,013	18,013	36,026	0
E4-PSL-007	COPPER THICKENER UNDERFLOW PUMP No. 1	☑	☐	☑	☑	600	11.0	14.8	0.80	1.00	0.84	0.92	9.5	11.4	0.95	0.95	☐	39,629	39,629	79,257	0
E4-PSL-008	COPPER THICKENER UNDERFLOW PUMP No. 2	☐	☑	☐	☑	600	11.0	14.8	0.80	0.00	0.84	0.92	0.0	0.0	0.95	0.95	☐	0	0	0	0
E4-PSL-011	COPPER CONCENTRATE FILTER FEED PUMP No. 1	☑	☐	☑	☑	600	55.0	73.8	0.80	1.00	0.89	0.96	45.8	51.5	0.95	0.95	☐	190,713	190,713	381,425	0
E4-PSL-012	COPPER CONCENTRATE FILTER FEED PUMP No. 2	☐	☑	☐	☑	600	55.0	73.8	0.80	0.00	0.89	0.96	0.0	0.0	0.95	0.95	☐	0	0	0	0
E4-PSO-004	COPPER THICKENER OVERFLOW PUMP No. 1	☑	☐	☐	☑	600	20.0	26.8	0.80	1.00	0.84	0.92	17.3	20.7	0.95	0.95	☐	72,052	72,052	144,104	0
E4-PSO-027	COPPER THICKENER OVERFLOW PUMP No. 2	☐	☑	☐	☑	600	20.0	26.8	0.80	0.00	0.84	0.92	0.0	0.0	0.95	0.95	☐	0	0	0	0
E4-PSU-019	COPPER DEWATERING AREA SUMP PUMP	☑	☐	☐	☑	600	15.0	20.1	0.80	0.10	0.84	0.92	1.3	1.5	0.95	0.95	☐	5,404	5,404	10,808	0
E4-SCL-017	COPPER CONCENTRATE BELT SCALE	☑	☐	☐	☑	600	0.5	0.7	0.80	1.00	0.87	0.90	0.4	0.5	0.95	0.95	☐	1,845	1,845	3,690	0
E4-THI-002	COPPER THICKENER	☑	☐	☑	☑	600	7.0	9.4	0.80	1.00	0.87	0.90	6.2	7.1	0.95	0.95	☐	25,833	25,833	51,667	0
E4-VLV-005	LOADOUT DUST COLLECTOR ROTARY VALVE	☑	☐	☐	☐	600	0.7	1.0	0.80	1.00	0.90	0.95	0.6	0.7	0.95	0.95	☐	2,614	2,614	5,228	0
	CONCENTRATE DEWATERING AND LOADOUT TOTAL kW:						402.3				TOTAL RUNNING kW:		253.6	296.1		TOTAL kW.hr:		1,053,687	1,055,032	2,108,719	5,955
Area: E5 - REAGENTS																					
E5-AGI-006	FLOCCULANT MIXING TANK AGITATOR	☑	☐	☐	☑	600	0.6	0.8	0.80	1.00	0.87	0.90	0.5	0.6	0.95	0.95	☐	2,214	2,214	4,429	0
E5-AGI-022	LIME HOLDING TANK AGITATOR	☑	☐	☑	☑	600	55.5	74.4	0.80	1.00	0.86	0.95	46.5	54.4	0.95	0.95	☐	193,657	193,657	387,313	0
E5-AGI-030	PEX MIXING TANK AGITATOR	☑	☐	☐	☑	600	4.5	6.0	0.80	1.00	0.87	0.90	4.0	4.6	0.95	0.95	☐	16,607	16,607	33,214	0
E5-AGI-050	CMC MIXING TANK AGITATOR	☑	☐	☐	☑	600	1.1	1.5	0.80	1.00	0.87	0.90	1.0	1.1	0.95	0.95	☐	4,060	4,060	8,119	0
E5-BAG-008	LIME SILO BIN VENT DUST COLLECTOR	☑	☐	☐	☐	600	0.2	0.3	0.80	1.00	0.80	0.90	0.2	0.2	0.95	0.95	☐	740	740	1,479	0
E5-COL-014	LIME AREA DUST COLLECTOR	☑	☐	☐	☑	600	0.2	0.3	0.80	1.00	0.90	0.95	0.2	0.2	0.95	0.95	☐	701	701	1,402	0
E5-EDU-005	FLOCCULANT EDUCTOR	☑	☐	☐	☑	600	2.0	2.7	0.80	1.00	0.87	0.90	1.8	2.0	0.95	0.95	☐	7,381	7,381	14,762	0
E5-FAN-039	PEX EXHAUST FAN	☑	☐	☐	☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.95	0.95	☑	1,931	1,931	3,863	3,863
E5-FAN-040	AERO 3302 EXHAUST FAN	☑	☐	☐	☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.95	0.95	☑	1,931	1,931	3,863	3,863
E5-FAN-041	CMC EXHAUST FAN	☑	☐	☐	☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.95	0.95	☑	1,931	1,931	3,863	3,863
E5-FAN-042	MIBC EXHAUST FAN	☑	☐	☐	☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.95	0.95	☑	1,931	1,931	3,863	3,863
E5-FAN-043	KEROSENE EXHAUST FAN	☑	☐	☐	☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.95	0.95	☑	1,931	1,931	3,863	3,863
E5-FAN-044	PINE OIL EXHAUST FAN	☑	☐	☐	☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.95	0.95	☑	1,931	1,931	3,863	3,863
E5-FAN-045	LIME SILO DUST COLLECTOR EXHAUST FAN	☑	☐	☐	☐	600	6.0	8.0	0.80	1.00	0.80	0.90	5.3	6.6	0.95	0.95	☑	22,044	22,044	44,088	44,088
E5-FDR-016	LIME SLAKING MILL SCREW FEEDER	☑	☐	☐	☑	600	19.0	25.5	0.80	1.00	0.85	0.93	16.3	19.2	0.95	0.95	☐	68,008	68,008	136,015	0
E5-FDR-020	FLOCCULANT SCREW FEEDER	☑	☐	☐	☑	600	19.0	25.5	0.80	1.00	0.85	0.93	16.3	19.2	0.95	0.95	☐	68,008	68,008	136,015	0
E5-HOI-001	FLOCCULANT HOIST	☑	☐	☐	☑	600	3.0	4.0	0.80	1.00	0.90	0.95	2.5	2.8	0.10	0.10	☐	1,107	1,107	2,213	0
E5-HTR-043	REAGENTS GAS FIRED UNIT HEATERS	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.50	0.95	☑	240	456	696	696
E5-HTR-044	REAGENTS GAS FIRED UNIT HEATERS	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.50	0.95	☑	240	456	696	696
E5-HTR-045	REAGENTS GAS FIRED UNIT HEATERS	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.50	0.95	☑	240	456	696	696
E5-HTR-046	REAGENTS GAS FIRED UNIT HEATERS	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.50	0.95	☑	240	456	696	696
E5-HTR-047	REAGENTS GAS FIRED UNIT HEATERS	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.50	0.95	☑	240	456	696	696
E5-HTR-048	REAGENTS GAS FIRED UNIT HEATERS	☑	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.50	0.95	☑	240	456	696	696
E5-MIL-017	LIME SLAKING VERTICAL MILL	☑	☐	☐	☑	600	27.9	37.4	0.80	1.00	0.84	0.94	23.7	28.3	0.95	0.95	☐	98,802	98,802	197,603	0
E5-PMP-001	KEROSENE HOLDING PUMP No. 1	☑	☐	☐	☑	600	1.0	1.3	0.80	1.00	0.87	0.90	0.9	1.0	0.50	0.50	☐	1,942	1,942	3,885	0
E5-PMP-002	KEROSENE HOLDING PUMP No. 2	☐	☑	☐	☑	600	1.0	1.3	0.80	0.00	0.87	0.90	0.0	0.0	0.50	0.50	☐	0	0	0	0
E5-PMP-005	PINE OIL HOLDING PUMP No. 1	☑	☐	☐	☑	600	1.0	1.3	0.80	1.00	0.87	0.90	0.9	1.0	0.50	0.50	☐	1,942	1,942	3,885	0
E5-PMP-006	PINE OIL HOLDING PUMP No. 2	☐	☑	☐	☑	600	1.0	1.3	0.80	0.00	0.87	0.90	0.0	0.0	0.50	0.50	☐	0	0	0	0
E5-PMT-001	FLOCCULANT METERING PUMP No. 1	☑	☐	☐	☑	600	2.3	3.1	0.80	1.00	0.87	0.90	2.0	2.3	0.50	0.50	☐	4,467	4,467	8,935	0
E5-PMT-002	FLOCCULANT METERING PUMP No. 2	☐	☑	☐	☑	600	2.3	3.1	0.80	0.00	0.87	0.90	0.0	0.0	0.50	0.50	☐	0	0	0	0
E5-PMT-005	PEX METERING PUMP No. 1	☑	☐	☐	☑	600	1.0	1.3	0.80	1.00	0.87	0.90	0.9	1.0	0.50	0.50	☐	1,942	1,942	3,885	0
E5-PMT-006	PEX METERING PUMP No. 2	☑	☐	☐	☑	600	1.0	1.3	0.80	0.00	0.87	0.90	0.0	0.0	0.50	0.50	☐	0	0	0	0
E5-PMT-007	PEX METERING PUMP No. 3	☑	☐	☐	☑	600	1.0	1.3	0.80	1.00	0.87	0.90	0.9	1.0	0.50	0.50	☐	1,942	1,942	3,885	0
E5-PMT-008	PEX METERING PUMP No. 4	☐	☑	☐	☑	600	1.0	1.3	0.80	0.00	0.87	0.90	0.0	0.0	0.50	0.50	☐	0	0	0	0
E5-PMT-010	AERO 3302 METERING PUMP No. 1	☑	☐	☐	☑	600	1.0	1.3	0.80	1.00	0.87	0.90	0.9	1.0	0.50	0.50	☐	1,942	1,942	3,885	0

EQUIPMENT NUMBER	DESCRIPTION	OPER.	STND BY	CRITICAL LOAD	SPEED VFD/FIXED	VOLTAGE	POWER (kW)	POWER (HP)	EST. LOAD FACTOR	EST. USED FACTOR	EST. PWR FACTOR	EST EFF.	RUNNING kW	RUNNING kVA	EST UTIL. SUMMER	EST UTIL. WINTER	INFRA.	kW.hr SUMMER	kW.hr WINTER	kW.hr ANNUAL	INFRA. LOAD
E5-PMT-011	AERO 3302 METERING PUMP No. 2	☐	☑	☐	☐ ☑	600	1.0	1.3	0.80	0.00	0.87	0.90	0.0	0.0	0.50	0.50	☐	0	0	0	0
E5-PMT-020	CMC METERING PUMP	☑	☐	☐	☐ ☑	600	1.0	1.3	0.80	1.00	0.87	0.90	0.9	1.0	0.50	0.50	☐	1,942	1,942	3,885	0
E5-PMT-030	MIBC METERING PUMP No. 1	☑	☐	☐	☐ ☑	600	1.0	1.3	0.80	1.00	0.87	0.90	0.9	1.0	0.50	0.50	☐	1,942	1,942	3,885	0
E5-PMT-031	MIBC METERING PUMP No. 2	☑	☐	☐	☐ ☑	600	1.0	1.3	0.80	1.00	0.87	0.90	0.9	1.0	0.50	0.50	☐	1,942	1,942	3,885	0
E5-PMT-032	MIBC METERING PUMP No. 3	☑	☐	☐	☐ ☑	600	1.0	1.3	0.80	1.00	0.87	0.90	0.9	1.0	0.50	0.50	☐	1,942	1,942	3,885	0
E5-PSL-004	LIME SLAKING CYCLONE FEED PUMP	☑	☐	☐	☐ ☑	600	11.3	15.2	0.80	1.00	0.84	0.92	9.8	11.7	0.50	0.50	☐	21,426	21,426	42,852	0
E5-PSO-024	LIME DISTRIBUTION PUMP No. 1	☑	☐	☐	☐ ☑	600	1.0	1.3	0.80	1.00	0.87	0.90	0.9	1.0	0.50	0.50	☐	1,942	1,942	3,885	0
E5-PSO-025	LIME DISTRIBUTION PUMP No. 2	☐	☑	☐	☐ ☑	600	1.0	1.3	0.80	0.00	0.87	0.90	0.0	0.0	0.50	0.50	☐	0	0	0	0
E5-PSU-012	FLOCCULANT AREA SUMP PUMP	☑	☐	☐	☐ ☑	600	2.0	2.7	0.80	0.25	0.87	0.90	0.4	0.5	0.50	0.50	☐	971	971	1,942	0
E5-PSU-027	LIME AREA SUMP PUMP	☑	☐	☐	☐ ☑	600	2.0	2.7	0.80	0.25	0.87	0.90	0.4	0.5	0.50	0.50	☐	971	971	1,942	0
E5-PSU-043	MIBC AREA SUMP PUMP	☑	☐	☐	☐ ☑	600	2.0	2.7	0.80	0.25	0.87	0.90	0.4	0.5	0.50	0.50	☐	971	971	1,942	0
E5-PSU-050	KEROSENE & PINE OIL AREA SUMP PUMP	☑	☐	☐	☐ ☑	600	1.0	1.3	0.80	0.25	0.87	0.90	0.2	0.3	0.50	0.50	☐	486	486	971	0
					REAGENTS TOTAL kW:		**183.5**				*TOTAL RUNNING kW:*		**144.1**	**169.5**		*TOTAL kW.hr:*		**545,072**	**546,369**	**1,091,441**	**71,443**
Area: F0 - TAILINGS																					
F0-PSU-001	TAILINGS PUMP STATION NO. 1 VFD - PUMP 1 (DUTY) - BY KCB	☑	☐	☐	☑ ☐	4160	820.0	1099.6	0.80	1.00	0.90	0.98	669.4	743.8	0.92	0.92	☐	2,697,365	2,697,365	5,394,730	0
F0-PSU-002	TAILINGS PUMP STATION NO. 1 PUMP 2 (DUTY)	☑	☐	☐	☐ ☑	4160	820.0	1099.6	0.80	1.00	0.90	0.98	669.4	743.8	0.92	0.92	☐	2,697,365	2,697,365	5,394,730	0
F0-PSU-003	TAILINGS PUMP STATION NO. 1 PUMP 3 (DUTY)	☑	☐	☐	☐ ☑	4160	820.0	1099.6	0.80	1.00	0.90	0.98	669.4	743.8	0.92	0.92	☐	2,697,365	2,697,365	5,394,730	0
F0-PSU-004	TAILINGS PUMP STATION NO. 1 VFD - PUMP 4 (DUTY)	☑	☐	☐	☑ ☐	4160	820.0	1099.6	0.80	1.00	0.90	0.98	669.4	743.8	0.92	0.92	☐	2,697,365	2,697,365	5,394,730	0
F0-PSU-005	TAILINGS PUMP STATION NO. 2 VFD - PUMP 1 (DUTY) - BY KCB	☑	☐	☐	☑ ☐	4160	820.0	1099.6	0.80	1.00	0.90	0.98	669.4	743.8	0.92	0.92	☐	2,697,365	2,697,365	5,394,730	0
F0-PSU-006	TAILINGS PUMP STATION NO. 2 PUMP 2 (DUTY)	☑	☐	☐	☐ ☑	4160	820.0	1099.6	0.80	1.00	0.90	0.98	669.4	743.8	0.92	0.92	☐	2,697,365	2,697,365	5,394,730	0
F0-PSU-007	TAILINGS PUMP STATION NO. 2 PUMP 3 (DUTY)	☑	☐	☐	☐ ☑	4160	820.0	1099.6	0.80	1.00	0.90	0.98	669.4	743.8	0.92	0.92	☐	2,697,365	2,697,365	5,394,730	0
F0-PSU-008	TAILINGS PUMP STATION NO. 2 VFD - PUMP 4 (DUTY)	☑	☐	☐	☑ ☐	4160	820.0	1099.6	0.80	1.00	0.90	0.98	669.4	743.8	0.92	0.92	☐	2,697,365	2,697,365	5,394,730	0
F0-PSU-016	FRESHWATER MAKE-UP PUMP 1 (DUTY)	☑	☐	☐	☐ ☑	600	100.7	135.0	0.80	1.00	0.95	0.97	83.1	87.4	0.34	0.34	☐	123,680	123,680	247,361	0
F0-PSU-017	FRESHWATER MAKE-UP PUMP 2 (STANDBY)	☐	☑	☐	☐ ☑	600	100.7	135.0	0.80	1.00	0.95	0.97	0.0	0.0	0.00	0.00	☐	0	0	0	0
F0-XEM-001	LIGHTING	☑	☐	☐	☐ ☐	600	5.0	6.7	0.80	0.90	0.90	0.95	3.8	4.2	0.80	0.90	☑	13,278	14,938	28,216	28,216
F0-XMM-001	TAILINGS PUMP STATION NO. 2 PUMP STATION AUXILIARY LO	☑	☐	☐	☐ ☐	600	104.0	139.5	0.75	1.00	0.90	0.98	79.6	88.4	1.00	1.00	☑	348,612	348,612	697,224	697,224
F0-XMM-004	HVAC	☑	☐	☐	☐ ☐	600	20.0	26.8	0.80	0.90	0.90	0.95	15.2	16.8	0.80	0.90	☑	53,113	59,752	112,866	112,866
F0-XMM-005	FRESHWATER MAKE-UP PUMP STATION AUXILIARY LOADS	☑	☐	☐	☐ ☐	600	27.0	36.2	0.75	1.00	0.90	0.98	20.7	23.0	1.00	1.00	☑	90,505	90,505	181,010	181,010
F0-XMM-005	MISC POWER INCL HEAT TRACING	☑	☐	☐	☐ ☐	600	20.0	26.8	0.80	0.80	0.65	0.95	13.5	20.7	0.40	0.90	☐	23,606	53,113	76,719	0
					TAILINGS TOTAL kW:		**6,937.4**				*TOTAL RUNNING kW:*		**5570.8**	**6190.7**		*TOTAL kW.hr:*		**22,231,714**	**22,269,521**	**44,501,235**	**1,019,317**
Area: F1 - TAILINGS DISPOSAL AND RECLAIM																					
F1-PSU-009	RECLAIM BARGE PUMP 1 (DUTY)	☑	☐	☐	☐ ☑	600	82.0	110.0	0.80	1.00	0.95	0.98	66.9	70.5	0.76	0.82	☐	222,826	240,417	463,243	0
F1-PSU-010	RECLAIM BARGE PUMP 2 (DUTY)	☑	☐	☐	☐ ☑	600	82.0	110.0	0.80	1.00	0.95	0.98	66.9	70.5	0.76	0.82	☐	222,826	240,417	463,243	0
F1-PSU-011	RECLAIM BARGE PUMP 3 (STANDBY)	☐	☑	☐	☐ ☑	600	82.0	110.0	0.80	1.00	0.95	0.98	0.0	0.0	0.00	0.00	☐	0	0	0	0
F1-PSU-018	CYCLOWASH PUMP STATION NO. 1 PUMP 1 (DUTY)	☑	☐	☐	☐ ☑	600	48.5	65.0	0.80	1.00	0.95	0.97	40.0	42.1	0.92	0.25	☐	161,184	43,800	204,984	0
F1-PSU-019	CYCLOWASH PUMP STATION NO. 1 PUMP 2 (STANDBY)	☐	☑	☐	☐ ☑	600	48.5	65.0	0.80	1.00	0.95	0.97	0.0	0.0	0.00	0.00	☐	0	0	0	0
F1-PSU-020	CYCLOWASH PUMP STATION NO. 2 PUMP 1 (DUTY)	☑	☐	☐	☐ ☑	600	55.9	75.0	0.80	1.00	0.95	0.97	46.1	48.5	0.92	0.31	☐	185,777	62,599	248,376	0
F1-PSU-021	CYCLOWASH PUMP STATION NO. 2 PUMP 2 (STANDBY)	☐	☑	☐	☐ ☑	600	55.9	75.0	0.80	1.00	0.95	0.97	0.0	0.0	0.00	0.00	☐	0	0	0	0
F1-XMM-002	RECLAIM BARGE PUMP STATION AUXILIARY LOADS	☑	☐	☐	☐ ☐	600	40.0	53.6	0.75	1.00	0.90	0.98	30.6	34.0	1.00	1.00	☑	134,082	134,082	268,163	268,163
F1-XMM-006	CYCLOWASH PUMP STATION NO. 1 PUMP STATION AUXILIAR	☑	☐	☐	☐ ☐	600	27.0	36.2	0.75	1.00	0.90	0.98	20.7	23.0	1.00	1.00	☑	90,505	90,505	181,010	181,010
F1-XMM-007	CYCLOWASH PUMP STATION NO. 2 PUMP STATION AUXILIAR	☑	☐	☐	☐ ☐	600	27.0	36.2	0.75	1.00	0.90	0.98	20.7	23.0	1.00		☑	90,505			
					TAILINGS DISPOSAL AND RECLAIM TOTAL kW:		**548.8**				*TOTAL RUNNING kW:*		**291.9**	**311.5**		*TOTAL kW.hr:*		**1,107,704**	**811,820**	**1,829,019**	**449,173**
Area: F2 - TAILINGS POND																					
F2-PSU-012	NORTH SEEPAGE POND RECLAIM BARGE PUMP 1 (DUTY)	☑	☐	☐	☐ ☑	600	52.0	69.7	0.80	1.00	0.95	0.97	42.9	45.1	0.75	0.25	☐	140,882	46,961	187,843	0
F2-PSU-013	NORTH SEEPAGE POND RECLAIM BARGE PUMP 2 (STANDBY)	☐	☑	☐	☐ ☑	600	52.0	69.7	0.80	1.00	0.95	0.97	0.0	0.0	0.00	0.00	☐	0	0	0	0
F2-PSU-014	SOUTH SEEPAGE POND RECLAIM BARGE PUMP 1 (DUTY)	☑	☐	☐	☐ ☑	600	78.3	105.0	0.80	1.00	0.95	0.97	64.6	68.0	0.75	0.25	☐	212,137	70,712	282,849	0
F2-PSU-015	SOUTH SEEPAGE POND RECLAIM BARGE PUMP 2 (STANDBY)	☐	☑	☐	☐ ☑	600	78.3	105.0	0.80	1.00	0.95	0.97	0.0	0.0	0.00	0.00	☐	0	0	0	0
F2-XMM-003	NORTH SEEPAGE POND RECLAIM BARGE PUMP STATION AU	☑	☐	☐	☐ ☐	600	27.0	36.2	0.75	1.00	0.90	0.98	20.7	23.0	1.00	1.00	☑	90,505	90,505	181,010	181,010
F2-XMM-004	SOUTH SEEPAGE POND RECLAIM BARGE PUMP STATION AU	☑	☐	☐	☐ ☐	600	27.0	36.2	0.75	1.00	0.90	0.98	20.7	23.0	1.00	1.00	☑	90,505	90,505	181,010	181,010
					TAILINGS POND TOTAL kW:		**314.6**				*TOTAL RUNNING kW:*		**148.8**	**159.0**		*TOTAL kW.hr:*		**534,029**	**298,683**	**832,712**	**362,020**
Area: G1 - FRESH/FIRE WATER																					
G1-PSO-001	WELL WATER PUMP	☑	☐	☐	☐ ☑	600	125.0	167.6	0.80	0.60	0.90	0.95	63.2	70.2	0.70	0.70	☑	193,642	193,642	387,284	387,284
G1-PSO-004	FRESH WATER PUMP No.1	☑	☐	☐	☐ ☑	600	11.2	15.0	0.80	1.00	0.90	0.95	9.4	10.5	0.95	0.90	☐	39,245	37,179	76,424	0
G1-PSO-005	FRESH WATER PUMP No.2	☐	☑	☐	☐ ☑	600	11.2	15.0	0.80	1.00	0.90	0.95	0.0	0.0	0.95	0.90	☐	0	0	0	0
					FRESH/FIRE WATER TOTAL kW:		**147.4**				*TOTAL RUNNING kW:*		**72.6**	**80.7**		*TOTAL kW.hr:*		**232,887**	**230,821**	**463,708**	**387,284**
Area: G2 - PROCESS WATER																					
G2-AGI-005	ANTISCALENT TANK AGITATOR	☑	☐	☐	☐ ☑	600	3.0	4.0	0.80	1.00	0.90	0.95	2.5	2.8	0.95	0.95	☐	10,512	10,512	21,024	0
G2-PSO-002	PROCESS WATER DISTRIBUTION PUMP No. 1	☑	☐	☐	☐ ☑	4160	259.0	347.3	0.80	1.00	0.88	0.94	220.2	249.1	0.95	0.95	☐	916,216	916,216	1,832,432	0
G2-PSO-003	PROCESS WATER DISTRIBUTION PUMP No. 2	☐	☑	☐	☐ ☑	4160	259.0	347.3	0.80	0.00	0.88	0.94	0.0	0.0	0.95	0.95	☐	0	0	0	0
G2-PSO-023	ANTISCALENT FEED PUMP No. 1	☑	☐	☐	☐ ☑	600	1.0	1.3	0.80	1.00	0.87	0.90	0.9	1.0	0.95	0.95	☐	3,690	3,690	7,381	0
G2-PSO-024	ANTISCALENT FEED PUMP No. 2	☐	☑	☐	☐ ☑	600	1.0	1.3	0.80	0.00	0.87	0.90	0.0	0.0	0.95	0.95	☐	0	0	0	0
					PROCESS WATER TOTAL kW:		**523.0**				*TOTAL RUNNING kW:*		**223.6**	**252.9**		*TOTAL kW.hr:*		**930,418**	**930,418**	**1,860,837**	**0**
Area: G5 - PLANT AND INSTRUMENT AIR																					
G5-AIC-001	PROCESS PLANT AIR COMPRESSOR No. 1	☑	☐	☐	☐ ☑	600	75.0	100.6	0.70	0.80	0.89	0.96	43.7	49.3	0.80	0.60	☐	152,981	114,736	267,717	0

EQUIPMENT NUMBER	DESCRIPTION	OPER.	STND BY	CRITICAL LOAD	SPEED VFD/FIXED	VOLTAGE	POWER (kW)	POWER (HP)	EST. LOAD FACTOR	EST. USED FACTOR	EST. PWR FACTOR	EST EFF.	RUNNING kW	RUNNING kVA	EST UTIL. SUMMER	EST UTIL. WINTER	INFRA.	kW.hr SUMMER	kW.hr WINTER	kW.hr ANNUAL	INFRA. LOAD
G5-AIC-002	PROCESS PLANT AIR COMPRESSOR No. 2	☑	☐	☐	☐ ☑	600	75.0	100.6	0.70	0.80	0.89	0.96	43.7	49.3	0.80	0.60	☐	152,981	114,736	267,717	0
G5-AIC-003	PROCESS PLANT AIR COMPRESSOR No. 3	☐	☑	☐	☐ ☑	600	75.0	100.6	0.70	0.00	0.89	0.96	0.0	0.0	0.80	0.60	☐	0	0	0	0
G5-AIC-011	PROCESS PLANT AIR COMPRESSOR No. 4	☑	☐	☐	☐ ☑	600	75.0	100.6	0.70	1.00	0.89	0.96	54.6	61.7	0.80	0.60	☐	191,227	143,420	334,647	0
	PLANT AND INSTRUMENT AIR TOTAL kW:						**300.0**				*TOTAL RUNNING kW:*		**141.9**	**160.3**		*TOTAL kW.hr:*		**497,189**	**372,892**	**870,081**	**0**
Area: G6 - SEWAGE TREATMENT																					
G6-XEM-001	MISCELLANEOUS - ELECTRICAL	☑	☐	☐	☐ ☐	600	100.0	134.1	0.80	1.00	0.90	0.95	84.2	93.6	0.92	0.92	☑	339,335	339,335	678,669	678,669
	SEWAGE TREATMENT TOTAL kW:						**100.0**				*TOTAL RUNNING kW:*		**84.2**	**93.6**		*TOTAL kW.hr:*		**339,335**	**339,335**	**678,669**	**678,669**
Area: J1 - ADMINISTRATION AND MINE DRY																					
J1-ACL-007	ADMINISTRATION FAN COIL #1 AIR CONDITIONING UNIT	☑	☐	☐	☐ ☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.80	0.60	☑	1,626	1,220	2,846	2,846
J1-ACL-008	ADMINISTRATION AIR COOLED CONDENSING UNIT #1	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.80	0.60	☑	8,132	6,099	14,232	14,232
J1-ACL-009	ADMINISTRATION FAN COIL #2 AIR CONDITIONING UNIT	☑	☐	☐	☐ ☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.80	0.60	☑	1,626	1,220	2,846	2,846
J1-ACL-010	ADMINISTRATION AIR COOLED CONDENSING UNIT #2	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.80	0.60	☑	8,132	6,099	14,232	14,232
J1-ACL-011	ADMINISTRATION FAN COIL #3 AIR CONDITIONING UNIT	☑	☐	☐	☐ ☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.80	0.60	☑	1,626	1,220	2,846	2,846
J1-ACL-012	ADMINISTRATION AIR COOLED CONDENSING UNIT #3	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.80	0.60	☑	8,132	6,099	14,232	14,232
J1-ACL-013	ADMINISTRATION FAN COIL #4 AIR CONDITIONING UNIT	☑	☐	☐	☐ ☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.80	0.60	☑	1,626	1,220	2,846	2,846
J1-ACL-014	ADMINISTRATION AIR COOLED CONDENSING UNIT #4	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.80	0.60	☑	8,132	6,099	14,232	14,232
J1-ACL-015	ADMINISTRATION FAN COIL #5 AIR CONDITIONING UNIT	☑	☐	☐	☐ ☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.80	0.60	☑	1,626	1,220	2,846	2,846
J1-ACL-016	ADMINISTRATION AIR COOLED CONDENSING UNIT #5	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.80	0.60	☑	8,132	6,099	14,232	14,232
J1-ACL-017	ADMINISTRATION FAN COIL #6 AIR CONDITIONING UNIT	☑	☐	☐	☐ ☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.80	0.60	☑	1,626	1,220	2,846	2,846
J1-ACL-018	ADMINISTRATION AIR COOLED CONDENSING UNIT #6	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.80	0.60	☑	8,132	6,099	14,232	14,232
J1-ACL-019	ADMINISTRATION FAN COIL #7 AIR CONDITIONING UNIT	☑	☐	☐	☐ ☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.80	0.60	☑	1,626	1,220	2,846	2,846
J1-ACL-020	ADMINISTRATION AIR COOLED CONDENSING UNIT #7	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.80	0.60	☑	8,132	6,099	14,232	14,232
J1-ACL-021	ADMINISTRATION FAN COIL #8 AIR CONDITIONING UNIT	☑	☐	☐	☐ ☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.80	0.60	☑	1,626	1,220	2,846	2,846
J1-ACL-022	ADMINISTRATION AIR COOLED CONDENSING UNIT #8	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.80	0.60	☑	8,132	6,099	14,232	14,232
J1-ACL-023	ADMINISTRATION FAN COIL #9 AIR CONDITIONING UNIT	☑	☐	☐	☐ ☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.80	0.60	☑	1,626	1,220	2,846	2,846
J1-ACL-024	ADMINISTRATION AIR COOLED CONDENSING UNIT #9	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.80	0.60	☑	8,132	6,099	14,232	14,232
J1-ACL-025	ADMINISTRATION FAN COIL #10 AIR CONDITIONING UNIT	☑	☐	☐	☐ ☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.80	0.60	☑	1,626	1,220	2,846	2,846
J1-ACL-026	ADMINISTRATION AIR COOLED CONDENSING UNIT #10	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.80	0.60	☑	8,132	6,099	14,232	14,232
J1-AHU-009	ADMINISTRATION DIRECT GAS FIRED AIR HANDLING UNIT	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.80	0.60	☑	8,132	6,099	14,232	14,232
J1-FAN-046	ADMINISTRATION SHOWERS EXHAUST FAN	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.90	0.95	2.2	2.4	0.80	0.60	☑	7,704	5,778	13,483	13,483
J1-FAN-047	ADMINISTRATION LUNCHROOM EXHAUST FAN	☑	☐	☐	☐ ☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.80	0.60	☑	310	232	542	542
J1-FAN-048	ADMINISTRATION WASHROOMS EXHAUST FAN	☑	☐	☐	☐ ☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.80	0.60	☑	310	232	542	542
J1-FAN-049	ADMINISTRATION JANITORS EXHAUST FAN	☑	☐	☐	☐ ☐	600	0.2	0.2	0.80	0.70	0.90	0.95	0.1	0.1	0.80	0.60	☑	310	232	542	542
J1-FAN-050	ADMINISTRATION ELECTRICAL ROOM SUPPLY FAN / FILTER F	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.90	0.95	2.2	2.4	0.80	0.60	☑	7,704	5,778	13,483	13,483
J1-HTR-049	ADMINISTRATION PROPANE HOT WATER HEATER	☐	☑	☐	☐ ☐	208	0.0	0.0	1.00	0.80	1.00	1.00	0.0	0.0	0.70	0.70	☑	0	0	0	0
J1-HTR-050	ADMINISTRATION ELECTRIC BASEBOARD HEATERS	☑	☐	☐	☐ ☐	208	0.7	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	523	2,091	2,614	2,614
J1-HTR-051	ADMINISTRATION ELECTRIC BASEBOARD HEATERS	☑	☐	☐	☐ ☐	208	0.7	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	523	2,091	2,614	2,614
J1-HTR-052	ADMINISTRATION ELECTRIC BASEBOARD HEATERS	☑	☐	☐	☐ ☐	208	0.7	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	523	2,091	2,614	2,614
J1-HTR-053	ADMINISTRATION ELECTRIC BASEBOARD HEATERS	☑	☐	☐	☐ ☐	208	0.7	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	523	2,091	2,614	2,614
J1-HTR-054	ADMINISTRATION ELECTRIC BASEBOARD HEATERS	☑	☐	☐	☐ ☐	208	0.7	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	523	2,091	2,614	2,614
J1-HTR-055	ADMINISTRATION ELECTRIC BASEBOARD HEATERS	☑	☐	☐	☐ ☐	208	0.7	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	523	2,091	2,614	2,614
J1-HTR-056	ADMINISTRATION ELECTRIC BASEBOARD HEATERS	☑	☐	☐	☐ ☐	208	0.7	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	523	2,091	2,614	2,614
J1-HTR-057	ADMINISTRATION ELECTRIC BASEBOARD HEATERS	☑	☐	☐	☐ ☐	208	0.7	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	523	2,091	2,614	2,614
J1-HTR-058	ADMINISTRATION ELECTRIC BASEBOARD HEATERS	☑	☐	☐	☐ ☐	208	0.7	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	523	2,091	2,614	2,614
J1-HTR-059	ADMINISTRATION ELECTRIC BASEBOARD HEATERS	☑	☐	☐	☐ ☐	208	0.7	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	523	2,091	2,614	2,614
J1-HTR-060	ADMINISTRATION ELECTRIC BASEBOARD HEATERS	☑	☐	☐	☐ ☐	208	0.7	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	523	2,091	2,614	2,614
J1-XEM-001	MISCELLANEOUS - ELECTRICAL	☑	☐	☐	☐ ☐	600	100.0	134.1	0.80	1.00	0.90	0.95	84.2	93.6	0.95	0.95	☑	350,400	350,400	700,800	700,800
	ADMINISTRATION AND MINE DRY TOTAL kW:						**164.6**				*TOTAL RUNNING kW:*		**125.6**	**143.0**		*TOTAL kW.hr:*		**478,210**	**464,948**	**943,158**	**943,158**
Area: J2 - TRUCKSHOP AND WAREHOUSE																					
J2-ACL-027	WAREHOUSE OFFICE AIR CONDITIONING UNIT	☑	☐	☐	☐ ☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.90	0.50	☑	1,830	1,017	2,846	2,846
J2-ACL-028	WAREHOUSE OFFICE AIR COOLED CONDENSING UNIT	☑	☐	☐	☐ ☐	600	7.5	10.0	0.80	0.70	0.80	0.90	4.6	5.8	0.90	0.50	☑	18,298	10,165	28,463	28,463
J2-ACL-029	FIRST AID GAS FIRED AIR CONDITIONING UNIT	☑	☐	☐	☐ ☐	600	0.7	1.0	0.80	0.70	0.80	0.90	0.5	0.6	0.90	0.50	☑	1,830	1,017	2,846	2,846
J2-ACL-030	FIRST AID AIR COOLED CONDENSING UNIT	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.90	0.50	☑	9,149	5,083	14,232	14,232
J2-AHU-010	TRUCK BAYS GAS FIRED AIR HANDLING UNIT #1	☑	☐	☐	☐ ☐	600	14.9	20.0	0.80	0.70	0.80	0.90	9.3	11.6	0.50	0.90	☑	20,331	36,596	56,927	56,927
J2-AHU-011	TRUCK BAYS GAS FIRED AIR HANDLING UNIT #2	☑	☐	☐	☐ ☐	600	14.9	20.0	0.80	0.70	0.80	0.90	9.3	11.6	0.50	0.90	☑	20,331	36,596	56,927	56,927
J2-AHU-012	WAREHOUSE GAS FIRED AIR HANDLING UNIT #3	☑	☐	☐	☐ ☐	600	5.5	7.4	0.80	0.70	0.80	0.90	3.4	4.3	0.50	0.90	☑	7,495	13,490	20,985	20,985
J2-AHU-013	TRUCK SHOP GAS FIRED AIR HANDLING UNIT #4	☑	☐	☐	☐ ☐	600	7.5	10.0	0.80	0.70	0.80	0.90	4.6	5.8	0.50	0.90	☑	10,165	18,298	28,463	28,463
J2-AHU-014	TRUCK SHOP OFFICES GAS FIRED AIR HANDLING UNIT #5	☑	☐	☐	☐ ☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.50	0.90	☑	5,083	9,149	14,232	14,232
J2-AHU-015	TRUCK WASH DIRECT GAS FIRED AIR HANDLING UNIT	☑	☐	☐	☐ ☐	600	14.9	20.0	0.80	0.70	0.80	0.90	9.3	11.6	0.50	0.90	☑	20,331	36,596	56,927	56,927
J2-AIC-001	TRUCK SHOP AIR COMPRESSOR	☑	☐	☐	☐ ☑	600	40.0	53.6	0.80	0.70	0.86	0.95	23.5	27.4	0.60	0.60	☑	61,706	61,706	123,411	123,411
J2-FAN-051	TRUCK SHOP HIGH BAYS EXHAUST FAN	☑	☐	☐	☐ ☐	600	5.5	7.4	0.80	0.70	0.80	0.90	3.4	4.3	0.90	0.80	☑	13,490	11,991	25,482	25,482
J2-FAN-052	TRUCK SHOP HIGH BAYS EXHAUST FAN	☑	☐	☐	☐ ☐	600	5.5	7.4	0.80	0.70	0.80	0.90	3.4	4.3	0.90	0.80	☑	13,490	11,991	25,482	25,482
J2-FAN-053	TRUCK SHOP HIGH BAYS EXHAUST FAN	☑	☐	☐	☐ ☐	600	5.5	7.4	0.80	0.70	0.80	0.90	3.4	4.3	0.90	0.80	☑	13,490	11,991	25,482	25,482
J2-FAN-054	TRUCK SHOP HIGH BAYS EXHAUST FAN	☑	☐	☐	☐ ☐	600	5.5	7.4	0.80	0.70	0.80	0.90	3.4	4.3	0.90	0.80	☑	13,490	11,991	25,482	25,482
J2-FAN-055	TRUCK WASH EXHAUST FAN	☑	☐	☐	☐ ☐	600	7.5	10.0	0.80	0.70	0.80	0.90	4.6	5.8	0.90	0.80	☑	18,298	16,265	34,563	34,563
J2-FAN-056	TYRE CHANGE EXHAUST FAN	☑	☐	☐	☐ ☐	600	2.2	3.0	0.80	0.70	0.80	0.90	1.4	1.7	0.90	0.80	☑	5,396	4,797	10,193	10,193

EQUIPMENT NUMBER	DESCRIPTION	OPER.	STND BY	CRITICAL LOAD	SPEED VFD/FIXED		VOLTAGE	POWER (kW)	POWER (HP)	EST. LOAD FACTOR	EST. USED FACTOR	EST. PWR FACTOR	EST EFF.	RUNNING kW	RUNNING kVA	EST UTIL. SUMMER	EST UTIL. WINTER	INFRA.	kW.hr SUMMER	kW.hr WINTER	kW.hr ANNUAL	INFRA. LOAD
J2-FAN-057	TRUCK WASH COMPRESSOR ROOM EXHAUST FAN	☑	☐	☐	☐	☐	600	2.2	3.0	0.80	0.70	0.80	0.90	1.4	1.7	0.90	0.80	☑	5,396	4,797	10,193	10,193
J2-FAN-058	TRUCK SHOP LOW BAYS EXHAUST FAN	☑	☐	☐	☐	☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.90	0.80	☑	9,149	8,132	17,281	17,281
J2-FAN-059	TRUCK SHOP LOW BAYS EXHAUST FAN	☑	☐	☐	☐	☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.90	0.80	☑	9,149	8,132	17,281	17,281
J2-FAN-060	TRUCK SHOP LOW BAYS EXHAUST FAN	☑	☐	☐	☐	☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.90	0.80	☑	9,149	8,132	17,281	17,281
J2-FAN-061	WAREHOUSE EXHAUST FAN	☑	☐	☐	☐	☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.90	0.80	☑	9,149	8,132	17,281	17,281
J2-FAN-062	TRUCK SHOP SHOWERS EXHAUST FAN	☑	☐	☐	☐	☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.90	0.80	☑	9,149	8,132	17,281	17,281
J2-FAN-063	TRUCK SHOP COMPRESSOR ROOM EXHAUST FAN	☑	☐	☐	☐	☐	600	2.2	3.0	0.80	0.70	0.80	0.90	1.4	1.7	0.90	0.80	☑	5,396	4,797	10,193	10,193
J2-FAN-064	TRUCK SHOP BATTERY ROOM EXHAUST FAN	☑	☐	☐	☐	☐	600	0.3	0.4	0.80	0.70	0.80	0.90	0.2	0.2	0.90	0.80	☑	736	654	1,390	1,390
J2-FAN-065	TRUCK SHOP ELECTRICAL ROOM EXHAUST FAN	☑	☐	☐	☐	☐	600	2.2	3.0	0.80	0.70	0.80	0.90	1.4	1.7	0.90	0.80	☑	5,396	4,797	10,193	10,193
J2-FAN-066	TRUCK SHOP LUBE STORAGE EXHAUST FAN	☑	☐	☐	☐	☐	600	2.2	3.0	0.80	0.70	0.80	0.90	1.4	1.7	0.90	0.80	☑	5,396	4,797	10,193	10,193
J2-FAN-067	TRUCK SHOP WELDING ARMS	☑	☐	☐	☐	☐	600	2.2	3.0	0.80	0.70	0.80	0.90	1.4	1.7	0.80	0.80	☑	4,797	4,797	9,593	9,593
J2-FAN-068	TRUCK SHOP WELDING ARMS	☑	☐	☐	☐	☐	600	2.2	3.0	0.80	0.70	0.80	0.90	1.4	1.7	0.80	0.80	☑	4,797	4,797	9,593	9,593
J2-FAN-069	TRUCK SHOP FIRST AID EXHAUST FAN	☑	☐	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.80	0.90	0.1	0.1	0.80	0.80	☑	392	392	785	785
J2-FAN-070	TRUCK SHOP CEILING FANS	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	0.90	0.1	0.1	0.80	0.80	☑	218	218	436	436
J2-FAN-071	TRUCK SHOP CEILING FANS	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	0.90	0.1	0.1	0.80	0.80	☑	218	218	436	436
J2-FAN-072	TRUCK SHOP CEILING FANS	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	0.90	0.1	0.1	0.80	0.80	☑	218	218	436	436
J2-FAN-073	TRUCK SHOP CEILING FANS	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	0.90	0.1	0.1	0.80	0.80	☑	218	218	436	436
J2-HTR-061	TRUCK SHOP GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-062	TRUCK SHOP GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-063	TRUCK SHOP GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-064	TRUCK SHOP GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-065	TRUCK SHOP GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-066	TRUCK SHOP GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-067	TRUCK SHOP GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-068	TRUCK SHOP GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-069	TRUCK SHOP GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-070	TRUCK SHOP GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-071	TRUCK SHOP AMBULANCE ELECTRIC UNIT HEATER	☑	☐	☐	☐	☐	208	0.4	0.5	1.00	0.80	0.80	1.00	0.3	0.4	0.30	0.80	☑	392	1,046	1,438	1,438
J2-HTR-072	TRUCK SHOP AMBULANCE ELECTRIC UNIT HEATER	☑	☐	☐	☐	☐	208	0.4	0.5	1.00	0.80	0.80	1.00	0.3	0.4	0.30	0.80	☑	392	1,046	1,438	1,438
J2-HTR-073	WAREHOUSE GAS FIRED UNIT HEATER	☑	☐	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	137	365	502	502
J2-HTR-074	WAREHOUSE GAS FIRED UNIT HEATER	☑	☐	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	137	365	502	502
J2-HTR-075	WAREHOUSE GAS FIRED UNIT HEATER	☑	☐	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	137	365	502	502
J2-HTR-076	WAREHOUSE GAS FIRED UNIT HEATER	☑	☐	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	137	365	502	502
J2-HTR-077	TRUCK WASH GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-078	TRUCK WASH GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-079	TRUCK WASH GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-080	TRUCK WASH GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-081	TRUCK WASH GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-082	TRUCK WASH GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-083	TRUCK WASH GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	0.70	0.80	1.00	0.1	0.1	0.30	0.80	☑	74	196	270	270
J2-HTR-084	TRUCK WASH GAS FIRED RADIANT HEATER	☑	☐	☐	☐	☐	600	0.1	0.1	0.80	1.00	0.80	1.00	0.1	0.1	0.30	0.80	☑	105	280	385	385
J2-XEM-001	MISCELLANEOUS - ELECTRICAL	☑	☐	☐	☐	☐	600	300.0	402.3	0.50	1.00	0.90	0.95	157.9	175.4	0.90	0.90	☑	622,421	622,421	1,244,842	1,244,842
	TRUCKSHOP AND WAREHOUSE TOTAL kW:							**481.8**				*TOTAL RUNNING kW:*		**269.6**	**313.2**		*TOTAL kW.hr:*		**958,235**	**999,687**	**1,957,922**	**1,957,922**
Area: J3 - ASSAY LABORATORY																						
J3-AHU-016	ASSAY LAB GAS FIRED AIR HANDLING UNIT #1	☑	☐	☐	☐	☐	600	5.5	7.4	0.80	0.70	0.80	0.90	3.4	4.3	0.50	0.90	☑	7,495	13,490	20,985	20,985
J3-AHU-017	ASSAY LAB GAS FIRED AIR HANDLING UNIT #2	☑	☐	☐	☐	☐	600	5.5	7.4	0.80	0.70	0.80	0.90	3.4	4.3	0.50	0.90	☑	7,495	13,490	20,985	20,985
J3-BAG-009	ASSAY LAB DUST COLLECTOR #1	☑	☐	☐	☐	☐	600	0.2	0.3	0.80	0.70	0.80	0.90	0.1	0.2	0.90	0.90	☑	491	491	981	981
J3-BAG-010	ASSAY LAB DUST COLLECTOR #2	☑	☐	☐	☐	☐	600	0.2	0.3	0.80	0.70	0.80	0.90	0.1	0.2	0.90	0.90	☑	491	491	981	981
J3-FAN-074	ASSAY LAB DUST COLLECTOR EXHAUST FAN #1	☑	☐	☐	☐	☐	600	29.8	40.0	0.80	0.70	0.80	0.90	18.6	23.2	0.80	0.80	☑	65,059	65,059	130,118	130,118
J3-FAN-075	ASSAY LAB DUST COLLECTOR EXHAUST FAN #2	☑	☐	☐	☐	☐	600	29.8	40.0	0.80	0.70	0.80	0.90	18.6	23.2	0.80	0.80	☑	65,059	65,059	130,118	130,118
J3-FAN-076	ASSAY LAB PERCHLORIC SCRUBBER EXHAUST FAN	☑	☐	☐	☐	☐	600	7.5	10.0	0.80	0.70	0.80	0.90	4.6	5.8	0.80	0.80	☑	16,265	16,265	32,530	32,530
J3-FAN-077	ASSAY LAB COMPRESSOR ROOM SUPPLY FAN / FILTER FAN	☑	☐	☐	☐	☐	600	7.5	10.0	0.80	0.70	0.90	0.95	4.4	4.9	0.80	0.80	☑	15,409	15,409	30,817	30,817
J3-FAN-078	ASSAY LAB WASHROOMS EXHAUST FAN	☑	☐	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.80	0.90	0.1	0.1	0.80	0.80	☑	406	406	811	811
J3-FAN-079	ASSAY LAB LECO EXHAUST FAN	☑	☐	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.80	0.90	0.1	0.1	0.80	0.80	☑	406	406	811	811
J3-FAN-080	ASSAY LAB GENERAL EXHAUST EXHAUST FAN	☑	☐	☐	☐	☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.80	0.80	☑	8,132	8,132	16,265	16,265
J3-FAN-081	ASSAY LAB LUNCH ROOM EXHAUST FAN	☑	☐	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.80	0.90	0.1	0.1	0.80	0.80	☑	406	406	811	811
J3-FAN-082	ASSAY LAB ELECTRICAL ROOM EXHAUST FAN	☑	☐	☐	☐	☐	600	3.7	5.0	0.80	0.70	0.80	0.90	2.3	2.9	0.80	0.80	☑	8,132	8,132	16,265	16,265
J3-FAN-083	ASSAY LAB DRYERS EXHAUST FAN	☑	☐	☐	☐	☐	600	0.4	0.5	0.80	0.70	0.80	0.90	0.2	0.3	0.80	0.80	☑	813	813	1,626	1,626
J3-FAN-084	ASSAY LAB AA HOODS EXHAUST FAN	☑	☐	☐	☐	☐	600	0.2	0.2	0.80	0.70	0.80	0.90	0.1	0.1	0.80	0.80	☑	406	406	811	811
J3-HTR-085	ASSAY LAB GAS FIRED HOT WATER HEATER	☑	☐	☐	☐	☐	208	9.0	12.1	0.80	0.70	1.00	1.00	5.0	5.0	0.20	0.80	☑	4,415	17,660	22,075	22,075
J3-HTR-086	ASSAY LAB ELECTRIC BASEBOARD HEATER	☑	☐	☐	☐	☐	208	0.8	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	526	2,102	2,628	2,628
J3-HTR-087	ASSAY LAB ELECTRIC BASEBOARD HEATER	☑	☐	☐	☐	☐	208	0.8	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	526	2,102	2,628	2,628
J3-HTR-088	ASSAY LAB ELECTRIC BASEBOARD HEATER	☑	☐	☐	☐	☐	208	0.8	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	526	2,102	2,628	2,628
J3-HTR-089	ASSAY LAB ELECTRIC BASEBOARD HEATER	☑	☐	☐	☐	☐	208	0.8	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	526	2,102	2,628	2,628
J3-HTR-090	ASSAY LAB ELECTRIC BASEBOARD HEATER	☑	☐	☐	☐	☐	208	0.8	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	526	2,102	2,628	2,628
J3-HTR-091	ASSAY LAB ELECTRIC BASEBOARD HEATER	☑	☐	☐	☐	☐	208	0.8	1.0	1.00	0.80	1.00	1.00	0.6	0.6	0.20	0.80	☑	526	2,102	2,628	2,628
J3-VLV-006	LOADOUT DUST COLLECTOR ROTARY VALVE	☑	☐	☐	☐	☐	600	0.7	1.0	0.80	1.00	0.90	0.95	0.6	0.7	0.90	0.90	☑	2,476	2,476	4,953	4,953
J3-VLV-007	LOADOUT DUST COLLECTOR ROTARY VALVE	☑	☐	☐	☐	☐	600	0.7	1.0	0.80	1.00	0.90	0.95	0.6	0.7	0.90	0.90	☑	2,476	2,476	4,953	4,953

WARDROP
Wardrop Engineering Inc.

PBM - MORRISON COPPER / GOLD PROJECT
LOAD LIST

WARDROP PROJECT No : 06527201.00
LOAD LIST : 0652720100-LST-E0001-06

EQUIPMENT NUMBER	DESCRIPTION	OPER.	STND BY	CRITICAL LOAD	SPEED VFD/FIXED	VOLTAGE	POWER (kW)	POWER (HP)	EST. LOAD FACTOR	EST. USED FACTOR	EST. PWR FACTOR	EST EFF.	RUNNING kW	RUNNING kVA	EST UTIL. SUMMER	EST UTIL. WINTER	INFRA.	kW.hr SUMMER	kW.hr WINTER	kW.hr ANNUAL	INFRA. LOAD
					ASSAY LABORATORY TOTAL kW:		109.6				TOTAL RUNNING kW:		68.5	82.7			TOTAL kW.hr:	208,984	243,681	452,665	452,665
Area: J4 - FUEL STORAGE AND DISTRIBUTION																					
J4-XEM-001	MISCELLANEOUS - ELECTRICAL	☑	☐	☐	☐	600	100.0	134.1	0.50	1.00	0.90	0.95	52.6	58.5	0.90	0.90	☑	207,474	207,474	414,947	414,947
					FUEL STORAGE AND DISTRIBUTION TOTAL kW:		100.0				TOTAL RUNNING kW:		52.6	58.5			TOTAL kW.hr:	207,474	207,474	414,947	414,947
Area: J5 - COLD STORAGE WAREHOUSE																					
J5-XEM-001	MISCELLANEOUS - ELECTRICAL	☑	☐	☐	☐	600	20.0	26.8	0.80	1.00	0.90	0.95	16.8	18.7	0.90	0.90	☑	66,392	66,392	132,783	132,783
					COLD STORAGE WAREHOUSE TOTAL kW:		20.0				TOTAL RUNNING kW:		16.8	18.7			TOTAL kW.hr:	66,392	66,392	132,783	132,783
					PLANT TOTAL kW:		46,358.2				PLANT TOTAL RUNNING kW:		34543.9	38436.2			PLANT TOTAL kW.hr:	143,758,643	143,885,688	287,553,825	12,334,372

SYNCHRONOUS MOTOR TABLE

EQUIPMENT NUMBER	DESCRIPTION	RUNNING kW	LEAD. PWR FACTOR	CORRECTED kVAR
E1-MIL-013	BALL MILL No. 1	6275	0.90	3039
E1-MIL-022	BALL MILL No. 2	6275	0.90	3039

UNCORRECTED PF	0.90
UNCORRECTED kVAR	16,854
AVAIL. CORRECTION	12,156
NEW kVAR	4,698
EST kVA	34,862
EST PF	0.99

	OVERALL AVAILABILITY	TOTAL kW.hr	ADJUSTED ANNUAL kW.hr
PROCESS TOTAL	0.92	275,219,453	253,201,897
INFRASTRUCTURE	1.00	12,334,372	12,334,372
	SUBTOTAL:	287,553,825	265,536,269
Estimate Distribution Losses (%) = 1.50		4,313,307	3,983,044
Estimate energy not including any contingency		291,867,133	269,519,313

NOTES:
- No contingencies included for power (kW) or energy (kWh) per owner's preference
- No allowance for future growth included

SITE KVA AND POWER FACTOR:
Projected kVA and power factor based on:
- values included in current equipment database
- operation of major synchronous motors at leading power factor
- amount of correction = .9 lag to .9 lead for synchronous motors

APPENDIX D

LIST OF SITE CONDITIONS AND DESIGN CRITERIA'S

LIST OF SITE CONDITIONS AND DESIGN CRITERIA'S

List Design Criteria		
Document No.	**Rev. No.**	**Document Titles**
0652720100-TS-G0001-00	00	Project Conditions & Standards
0652720100-DBM-P0001-00	L	Process Design Criteria
0652720100-DBM-R0005-01	01	Mechanical Design Criteria
0652720100-DBM-R0011-01	00	Piping Design Criteria
0652720100-DBM-R0002-01	01	Dust Control Design Criteria
0652720100-DBM-R0003-01	01	Fire Protection Design Criteria
0652720100-DBM-R0004-01	01	HVAC Design Criteria
0652720100-DBM-R0001-03	03	Civil Design Criteria
0652720100-DBM-R0006-02	02	Instrumentation Design Criteria
0652720100-DBM-R0007-03	03	Electrical Design Criteria

Section Type: **Project Conditions & Standards**

Document Type: **Technical Specification**

Document Number: **0652720100-TS-G0001-00**

This sheet records the issue and revisions of the document.

Revision No.	Date Revised	Chapter/section/page revised, plus any remarks	Signatures				
			Prepared By	Discipline Engineer	Process Engineer	Project Manager	Client
A	March 21, 2007	Issued for Squad Check	DS	HG	**HG**	**DS**	**ET**
00	March 29, 2007	Issued for Procurement	DS	HG	**HG**	**DS**	**ET**

1.0 INTRODUCTION

1.1 GENERAL

Project **Morrison Porphyry Copper Gold Project**
Owner/Operator **Pacific Booker Minerals Inc.**

1.1.1 Process Description

Process operations consist of crushing, grinding, and flotation to produce copper/gold concentrate and molybdenum concentrate from the ore, open pit mined on site. The production rate for mining and process will be 30,000 tonne per day. The concentrate will be shipped to the Port of Stewart where it will be loaded onto ocean vessels and delivered to international smelting operations.

1.2 LOCATION

1.2.1 The Morrison property is a greenfield site located in Western Central British Columbia. The property is located approximately 65 kilometers northeast of Smithers on the southeastern end of Morrison Lake, latitude 55° 11' 26" and longitude 126° 19' 11".

1.2.2 The site climatic conditions are extreme with a record high temperature of 35.8 and a record low temperature of -43.9. The humidex and wind chill temperatures have reached 37.1 and -50.1 respectively. Daily winter precipitation has been recorded as high as 60cm of snow, a daily rain fall of 60mm has also been recorded. The average relative humidity in the area is 85.9%

1.2.3 The Project site elevation ranges from approximately 736 m above sea level at Morrison Lake to 1372 m above sea level at the top of the surrounding hills.

1.3 ACCESS TO SITE

Road Access: To access site from Smithers turn off highway 16, four km south of Smithers, travel 100 km along Babine Lake Road and Nilkitwa Forest Service Road (FSR), and 40 km along Morrison FSR to site.

To access site from Topley turn off Highway 16 at Topley, travel 40 km along Granisle Road to Topley Landing, barge across Babine Lake, and drive 50 km along Hagan Road to site.

Smithers and Topley are both serviced by Highway 16 (Yellowhead Highway) a major road route through Northern Canada.

Air Access: The Smithers Airport is situated in the northeast sector of Smithers and has a 5,000 ft. by 150 ft. asphalt runway suitable for light to medium aircraft with a 24-hour Flight Service Station.

Rail Access: The Canadian National Railroad has direct service to Smithers from most Canadian and US origins.

2.0 GENERAL CLIMATIC CONDITIONS

2.1 ANNUAL PRECIPITATION

Average Annual Precipitation	Rain	354 mm
	Snow	204 cm

2.2 TEMPERATURES

Annual Daily Average Temperature	3.9°C
Winter Design Temperature*	-32°C
Summer Design Temperature*	31°C

All Equipment shall be capable of operating continuously over a temperature range of -40°C to 40°C

2.3 WIND

Basic Wind Velocities

Annual high average	7 km/h
Maximum hourly reached	66 km/h
Maximum gust reached	120 km/h

National Building Code (NBC) data for hourly wind pressure*

Hourly wind pressure for a 1/10 year return period	0.31 kPa
Hourly wind pressure for a 1/50 year return period	0.40 kPa

2.4 SEISMIC

The project site is located in a moderately active earthquake zone.

NBC Seismic Data*

Sa(0.2) = 0.120
Sa(0.5) = 0.078
Sa(1.0) = 0.052
Sa(2.0) = 0.033
PGA = 0.059

2.5 SNOW LOAD

NBC Snow Data*

Snow Load kPa, 1/50 year return period	Ss =3.2 kPa
	Sr =0.2 kPa

*All NBC Data is based on Smithers BC statistics

3.0 SPECIFICATIONS

3.1.1 Where the term 'or equivalent' is specified, 'equivalents' shall be subject to approval by the Consultant.

3.1.2 Where the term 'specified' is used in context in documentation, such shall mean 'in accordance with the specifications, drawings and other requirements forming part of the Purchase Order/Contract'.

4.0 DESIGN AND CONSTRUCTION

4.1 GENERAL

4.1.1 The operating life for this plant and all static equipment shall be a minimum of 20 years.

4.1.2 Equipment design shall be based on long term operation.

4.1.3 All equipment shall be capable of operating in accordance with the operating schedule given below, at 100% full running loads, with minimal unscheduled downtime.

Operating weeks per year	52
Operating days per week	7
Operating hours per day	24

4.1.4 All design shall facilitate ease of access for handling, transportation, installation, adjustment, control, maintenance and repair.

4.1.5 The equipment shall be manufactured in accordance with standard, robust, heavy-duty design provided this is not in conflict with the specification. The equipment shall be capable of continuous operation, outdoor where applicable, with downtime only for normal maintenance, and without excessive noise, vibration, wear, overheating, stress, and deflection. The operating availability shall not be less than 98%. The minimum working life of the equipment shall not be less than 20 years.

4.1.6 The equipment shall be designed and constructed in accordance with current and modern technology, and the latest engineering practice. Only equipment with proven service in a similar application shall be offered. The equipment shall be manufactured of new and unused material of the highest quality and fit for purpose. Workmanship throughout shall be in accordance with the best and modern practices carried out by suitably qualified personnel.

4.1.7 The substitution of components and materials shall be subject to prior written approval of Wardrop.

4.1.8 Equipment shall be capable of operating at the site under at least the following conditions (unless specified otherwise):

- location as specified on the drawings
- dusty and wet environment
- extremes of the specified ambient temperatures
- high pressure hose washdown.

4.2 STANDARDS

4.2.1 All Equipment shall be CSA approved

4.2.2 As a minimum, all mechanical and plant equipment shall be designed and constructed in conformance with the latest version of standards and codes published by the following Institutes and societies:

- ASME American Society of Mechanical Engineers
- ANSI American National Standards Institute
- SAE Society of Automotive Engineers
- SSPC Structural Steel Painting Council
- OSHA Occupational Safety and Health Act
- MSHA Miners Safety and Health Administration
- AGMA American Gear Manufacturers Association
- ASTM American Society for Testing Of Materials.

4.2.3 As a minimum, all electrical equipment accompanying mechanical and plant equipment shall be constructed in conformance with the latest version of standards and codes published by the following Institutes and societies:

- NEMA National Electrical Manufacturers Association
- EEMAC Electrical and Electronic Manufacturers of Canada.

4.2.4 As a minimum, all instrumentation accompanying mechanical and plant equipment shall be constructed in conformance with the latest version of standards and codes published by the following Institutes and societies:

- ANSI American National Standards Institute
- API American Petroleum Institute
- ISA Instrument Society of America
- ISO International Standards Organization.

4.2.5 All structural steel and concrete design and construction shall conform to the latest editions of the following codes and standards, including revisions and errata:

- CISC — Code of Standard Practice for Structural Steel
- NBC — National Building Code of Canada
- CWB — Canadian Welding Bureau
- CSA-S16.1 — Limit States Design of Steel Structures
- CAN/CSA-G40.20 — General Requirements for Rolled or Welded Structural Quality Steel
- CAN/CSA-G40.21 — Structural Quality Steels
- ASTM A307 — Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
- ASTM A325 — Specification for High Strengths Bolts for Structural Steel Joints
- CSA-A23.1/A23.2 — Concrete Materials and Methods of Concrete Construction /Methods of Test for Concrete
- CSA-A23.3 — Design of Concrete Structures
- CSA-G40.20 /G40.21 — General Requirements for Rolled or Welded Structural Quality Steel /Structural Quality Steel.

4.3 UNITS

4.3.1 Metric units shall be used for all design work and shall be shown on all drawings and calculations. Units shall be International System (SI).

4.4 HAZARDOUS MATERIALS

4.4.1 The following materials shall not be used:

- asbestos and compounds thereof
- poly-chlorinated bi-phenyl's (PCB's) and compounds thereof.

4.4.2 The following materials shall not be used without specific approval:

- polyurethane and compounds thereof
- chloro-fluoro-hydrocarbons (CFC's) and compounds thereof
- radioactive materials.

4.5 NOISE

4.5.1 Noise levels of emissions from any equipment shall not exceed 85 dBa at one (1) meter.

4.6 ELECTRICAL AND INSTRUMENTATION

4.6.1 Electrical power supply:

- 13.8 kV three phase, 60 Hz, resistance grounding
- 4160 V three phase, 60 Hz, resistance grounding
- 600 V, three phase, 60 Hz, resistance grounding
- 120 V, single phase, 60 Hz, grounded.

4.6.2 Control voltage (motor starters, external control devices, etc.):

- 120 V, 60 Hz, single phase, single pole grounded.

4.6.3 Instrument power supply:

- 120 V, 60 Hz, or 24 V DC via regulated power supply.

4.6.4 Instrument signal voltage:

- 4–20mA DC fully isolated.

4.6.5 Control Systems supply voltage:

- 120 V, 60 Hz via regulated power supply.

4.6.6 Control Systems inputs:

- 120 V, 60 Hz and 24 V DC.

4.6.7 Control Systems outputs:

- Voltage free contacts suitable for 120 V, 60 Hz and 24 V DC.

4.7 AIR SUPPLY

4.7.1 Plant air will be supplied as follows:

Pressure, kPa	750
Approach Temperature, °C	8–10
Liquid Phase Oil Carry-over, mg/m³	2–3

4.7.2 Instrument air will be supplied as follows:

Pressure, kPa	500
Approach Temperature, °C	3
Liquid Phase Oil Carry-over, mg/m³	0.1

5.0 SURFACE PROTECTION FOR PROPRIETARY EQUIPMENT

5.1.1 Unless otherwise specified in the Standard Specification, the Manufacturer's standard surface protection system for all proprietary plant and equipment shall be provided. This system shall be suitable for the conditions on site.

6.0 PACKAGING FOR TRANSPORTATION AND STORAGE

6.1.1 The equipment will be stored in open warehousing on site and any items that would be subject to damage by the elements must be adequately protected.

END OF SPECIFICATION

Client: Pacific Booker Minerals Inc.
Project Name: Morrison Copper/Gold Project
Project Number: 06527201.00
Date: 10-Dec-08
Revision Date: 10-Dec-08
Revision: L

Daily tonne milled	30,000 tonne/day
Mill availability	92%
Annual operating days	365 days
Annual throughput	10,950,000 tonne

CODES	Source
1	Client
2	Industry / Experience
3	Calculation
4	Mass Balance
5	PRA Met Lab
6	SGS Met Lab
7	Beacon Hill Consultants
8	Suppliers
9	Others

PROCESS DESIGN CRITERIA

Document: 0652720100-DBM-P0001-00

All values are in metric units

DESCRIPTION	UNIT	VALUE	SOURCES
GENERAL			
Type Of Deposit		Porphyry Copper Gold Ore	
Ore Characteristics			
Specific Gravity	g/cm³	2.7	6
Bulk Density	t/m^3	1.6	2
Moisture Content	%	3.0	1
Abrasion Index (Average)	g	0.320	6
Operating Schedule			
Shift/Day		2	1
Crusher Plant Hours/Shift	h	8	1
Crusher Plant Hours/Day	h	16	1
Grinding and Flotation Hours/Shift	h	12	1
Grinding and Flotation Hours/Day	h	24	1
Days/Year	days	365	1
Plant Availability/Utilization			
Overall Plant Feed	t/y	10,950,000	2,1
Overall Plant Feed	t/d	30,000	1
Primary Crushing Plant Availability	%	75.0	2
Secondary and Tertiary (HPGR) Crushing Availability	%	92.0	2
Grinding and Flotation Plant Availability	%	92.0	2
Primary Crushing Rate	t/h	2,500.0	3
Secondary and Tertiary (HPGR) Crushing Rate	t/h	1,358.7	3
Grinding Rate	t/h	1,358.7	3
Flotation Rate	t/h	1,358.7	3
Head Grades	% Cu	0.40	6
	% Mo	0.006	6
	g/t Au	0.19	6
	g/t Ag	1.60	6
Recovery:	Cu %	84.00	5,6
	Mo %	78.00	5,6
	Au %	56.00	5,6
	Ag %	56.00	5,6
Cu Concentrate Grade	% Cu	26.50	5,6
	% Mo	0.37	5,6
	g/t Au	9.00	5,6
	g/t Ag	75.00	5,6
Mo Concentrate Grade	% Cu	0.83	5,6
	% Mo	53.60	5,6
Cu Concentrate Mass Recovery	%	1.27	3
Mo Concentrate Mass Recovery	%	0.009	3
Cu Concentrate Production	t/y	138,838	3
Mo Concentrate Production	t/y	956	4
CRUSHING			
Primary Crushing Production Parameters			
Feed Particle Size	mm	1,500	2
Crusher Type	type	Gyratory	2
Number of Crushers		1	3
Primary Crushing Availability	%	75	
Crushing Rate	t/h	2,500.0	4
Product Size, P_{80}	mm	150	2
Liner Wear Rate	kg/kW·h	0.022	3

Crushed Ore Stockpile Parameters			
Crushed Ore Stockpile (Live Capacity)	t	30,000	2
Crushed Ore Bulk Density	t/m^3	1.6	2
Angle of Repose	degrees	37	2
Angle of Reclaim	degrees	60	2
No of Feeders		3	3
Average Tonnage Rate (Each), Operating	t/h	453	4
Type of Discharge Feeders	type	Apron	2
SECONDARY CRUSHING & SCREENING			
Crusher Type		Cone	
Number of Crushers		2 (1 in operation)	
Operating Shifts/Day		2	
Operating Hours/Shift		12	
Secondary Crushing Availability	%	92	
Processing Rate	mtph	1,019.0	
Product Size, P80	mm	45.0	
No of Discharge Feeders		2 (1 in operation)	
Type of Discharge Feeders		Belt Feeder	
Crushed Ore Bulk Density	t/m^3	1.6	
Screen Type	double deck	Vibratory/Dry	
Number of Screens		2	
Processing Rate		2,377.7	
Screen Appertures	mm	75 and 45	
TERTIARY CRUSHING			
Crusher Type		HPGR	
Number of Units		1	
Tertiary Crushing Plant Availability	%	92	
Processing Rate (Fresh Feed)	t/h	1,358.7	
Type of Feeders		Belt Feeder	
Number of Feeders		1	
Specific Energy Consumption	kWh/t	2.0	
Average Specific Throughput	ts/hm^3	220	
Feed Size, 80% Passing	mm	45.0	
Product Size, 80% Passing	mm	3.8	
Screen Type	double deck	Vibratory/Wet	
Number of Screens		2	
Screen Availability	%	92	
Processing Rate	t/h	1,834.2	
Screen Appertures	mm	15 and 6	
GRINDING			
Mill Type		Ball mill	2
Number of Mills		2	3
Processing Rate	t/h	1,358.7	4
Bond Ball Mill Work Index	kWh/t	16.1	6
Feed Solids	%w/w	72.0	2
Abrasion Index, Ai		0.320	6
Liner Wear Rate	kg/kW·h	0.008	3
Feed Size, F_{80}	mm	3.6	6
Product Size, P_{80}	µm	150	1, 5
Mill Speed	% CS	72	2
Ball Mill Charge	%	35	
Recirculation Load	%	300	2
Classification	type	Cyclones	
FLOTATION CIRCUIT			
Copper and Gold Flotation			
Conditioning			
Solids Flow Rate	t/h	1,358.8	4
Pulp Flow Rate	m^3/h	3,022.9	4
Solids/Pulp Density	%	35.0	4
Conditioning Residence Time	min	2.0	3
Pulp pH		9.8	6
Rougher/Scavenger Flotation			
Solids Flow Rate	t/h	1,358.8	4
Pulp Flow Rate	m^3/h	3,022.9	4
Solids/Pulp Density	%	35.0	4
Plant Retention Time	min	30.0	4
Batch Retention Time	min	12.0	2
Flotation Time Scale-up		2.5	6
Pulp pH		9.5	6
Rougher Concentrate Weight Recovery	%	8.0	3

Concentrate Regrind Circuit			
Throughput	t/h	147.6	
Mill Type	type	Tower Mill	
Number of Mills		2	
Primary Ball Mill Bond Work Index	kWh/t	17.0	
Pulp Density	% solids	65.0	
Feed Size, P_{80}	µm	150.0	
Product Size, P_{80}	µm	25.0	
Mill Ball Charge	%	35.0	
Recirculation Load	%	300	
Classification		Cyclones	
Cyclone Feed Density	%	42.4	2
1st Cleaner Flotation			
Solids/Pulp Density	%	24.9	4
Solids Flow Rate	t/h	159.2	4
Pulp Flow Rate	m^3/h	481.3	4
Plant Retention Time	min	33.6	4
Residence Time Scale-up		2.8	2
Batch Retention Time	min	12.0	6
Flotation pH		11.0	6
1st Cleaner Scavenger Flotation			
Solids/Pulp Density	%	23.9	4
Solids Flow Rate	t/h	130.3	4
Pulp Flow Rate	m^3/h	452.1	4
Plant Retention Time	min	33.6	4
Residence Time Scale-up		2.8	2
Batch Retention Time	min	12.0	6
Flotation pH		11.0	6
2nd Cleaner Flotation			
Solids/Pulp Density	%	27.3	4
Solids Flow Rate	t/h	29.0	4
Pulp Flow Rate	m^3/h	86.4	4
Plant Retention Time	min	16.8	4
Residence Time Scale-up		2.8	2
Batch Retention Time	min	6.0	6
Flotation pH		11.5	6
Moly Flotation			
Thickening			
Thickener	type	High Rate	
Copper-Moly Concentrate Thickener Feed Solids Flowrate	t/h	17.6	4
Thickener U/F Density	% solids	50.0	
Thickener Diameter	m	11.4	3
Thickener Unit Area-required	$t/m^2/h$	0.20	
Slurry Storage Tank Capacity	h	12	
Moly Rougher Flotation			
Solids/Pulp Density	%	38.1	4
Solids Flow Rate	t/h	24.0	4
Pulp Flow Rate	m^3/h	45.5	4
Moly Cleaner Flotation			
Solids/Pulp Density	%	24.9	4
Solids Flow Rate	t/h	6.8	4
Pulp Flow Rate	m^3/h	22.2	4

CONCENTRATE DEWATERING			
Copper Concentrate			
Thickening			
Thickener	type	High Rate	
Copper Concentrate Thickener Feed Solids Flowrate	t/h	17.2	4
Thickener U/F Density	% solids	60.0	4
Thickener Diameter	m	11.4	3
Thickener Unit Area-required	$t/m^2/h$	0.20	
Slurry Storage Tank Capacity	h	12	
Filtration			
Filter	type	Pressure	
Solids Feed Rate	t/h	25.8	4
Slurry Feed Flowrate	m^3/h	26.0	4
Filter Rate	$t/(h \cdot m^2)$	0.3	
Filter Unit Area Required	$kg/m^2/h$	TBA	
Filter Operating Time	%	85	
Filter Area	m^2	101.3	3
Filter Cake Moisture	%	8	4
Filtered Copper Concentrate Storage Capacity	t	2,067	3
Filtered Copper Concentrate Storage Capacity	m^3	984	3
Moly Concentrate			
Thickening			
Thickener	type	High Rate	
Moly Concentrate Thickener Feed Solids Flowrate	t/h	0.33	4
Thickener U/F Density	% solids	60.0	4
Thickener Diameter	m	2.5	3
Thickener Unit Area-required	$t/m^2/h$	0.20	
Slurry Storage Tank Capacity	h	12	
Filtration			
Filter	type		
Solids Feed Rate	t/h	0.41	4
Slurry Feed Flowrate	m^3/h	2.77	4
Filter Rate	$t/(h \cdot m^2)$	0.3	
Filter Unit Area Required	$kg/m^2/h$	TBC	
Filter Operating Time	%	85	
Filter Area	m^2	1.6	3
Filter Cake Moisture	%	20	4
Filtered Copper Concentrate Storage Capacity	t	39	3
Filtered Copper Concentrate Storage Capacity	m^3	19	3
Dryer			
Dryer	type		
Solids Feed Rate	t/h	0.41	4
Concentrate Feed Moisture	%	20	4
Concentrate Product Moisture	%	5	4
Pyrite Flotation (OPTIONAL)			
Solids/Pulp Density	%	55.0	
Solids Flow Rate	t/h	872.0	
Pulp Flow Rate	m^3/h	1,048.9	
Concentrate Production Rate	t/h	282.5	
REAGENTS			
Lime (Hydrated)	g/t	500	6
Potasium Ethyl Xanthate (PEX)	g/t	55	6
Cytec Aero 3302	g/t	15	6
Carboxyl Methyl Cellulos (CMC)	g/t	5	6
MIBC	g/t	55	6
Kerosene	g/t	6	6
Fuel Oil	g/t	6	6
Flocculant	g/t	10	

Client: Pacific Booker Minerals Inc.
Project Name: Morrison Copper/Gold Project
Project Number: 06527201.00
Date: 10-Dec-08
Revision Date: 10-Dec-08
Revision: L

Daily tonne milled	30,000 tonne/day
Mill availability	92%
Annual operating days	365 days
Annual throughput	10,950,000 tonne

PROCESS DESIGN CRITERIA - MATERIAL BALANCE

Document: 0652720100-DBM-P0001-00

All values are in metric units
Blue font - Water
Red font - Reagent
Green font - Reagent

	Flow ID	Solids, t/h	Solids SG	Solids, m^3/h	Water, t/h	% Solids	Water, m^3/h	Pulp, t/h	Pulp SG	Pulp, m^3/h	Com/s
ROM Ore	**100**	1,250.00	2.72	459.56	38.66	97.00	38.66	1,288.66	2.59	498.22	
Feed to Gyratory Crusher - Design with 85% Availability	**101**	2,500.00	2.72	919.12	77.32	97.00	77.32	2,577.32	2.59	996.44	
Grinding Feed - Design with 92% Availability	**210**	1,358.70	2.72	499.52	42.02	97.00	42.02	1,400.72	2.59	541.54	
Feed to Cone Crusher	**211**	1,019.02	2.72	374.64	31.52	97.00	31.52	1,050.54	2.59	406.16	75.00%
Primary Sizing Screen Feed	**212**	2,377.72	2.72	874.16	73.54	97.00	73.54	2,451.26	2.59	947.70	
Primary Sizing Screen Product	**213**	1,358.70	2.72	499.52	42.02	97.00	42.02	1,400.72	2.59	541.54	
HPGR Feed	**214**	1,834.24	2.72	674.35	94.86	95.08	94.86	1,929.10	2.51	769.21	
Secondary Screen Feed	**215**	1,834.24	2.72	674.35	94.86	90.00	94.86	1,929.10	2.51	769.21	
Secondary Screen Oversize Product	**216**	475.54	2.72	174.83	52.84	90.00	52.84	528.38	2.32	227.67	35.00%
Process Water to Secondary Screen Feed	**217**	0.00	1.00	0.00	955.50	0.00	955.50	955.50	1.00	955.50	
Secondary Screed Undersize Product	**218**	1,358.70	2.72	499.52	997.52	57.66	997.52	2,356.21	1.57	1,497.04	
Process Water to Ball Mill Discharge	**219**	0.00	1.00	0.00	60.00	0.00	60.00	60.00	1.00	60.00	
Ball Mill Lube Unit #1 Process Water to Ball Mill Pump Box	**220**	0.00	1.00	0.00	15.00	0.00	15.00	15.00	1.00	15.00	
Ball Mill Lube Unit #2 Process Water to Ball Mill Pump Box	**221**	0.00	1.00	0.00	15.00	0.00	15.00	15.00	1.00	15.00	
Total Ball Mill Discharge Pumpbox	**222**	1,358.72	2.72	499.53	1,087.55	55.54	1,087.55	2,446.27	1.54	1,587.08	
GSW Cyclopac #1 Feed Pump	**223**	0.00	1.00	0.00	5.00	0.00	5.00	5.00	1.00	5.00	
Process Water to Cyclopac Feed Pump Box	**224**	0.00	1.00	0.00	1,425.75	0.00	1,425.75	1,425.75	1.00	1,425.75	
Feed to Cyclone Feed Pump Box	**225**	5,434.81	2.72	1,998.09	4,350.19	55.54	4,350.19	9,785.00	1.54	6,348.28	
Ball Mill #1 Discharge	**226**	2,038.04	2.72	749.28	913.45	69.05	913.45	2,951.49	1.78	1662.73	
Additional Process Water Grinding	**227**	0.00	1.00	0.00	1,485.75	0.00	1,485.75	1,485.75	1.00	1,485.75	
Cyclone #1 Feed	**228**	2,717.39	2.72	999.04	2,175.09	55.54	2,175.09	4,892.48	1.54	3,174.13	400.00%
Cyclone #1 U/F	**229**	2,038.04	2.72	749.28	913.45	69.05	913.45	2,951.49	1.78	1,662.73	
Cyclone #1 O/F	**230**	679.35	2.72	249.76	1,261.65	35.00	1,261.65	1,940.99	1.28	1,511.41	
Ball Mill #2 Discharge	**231**	2,038.04	2.72	749.28	913.45	69.05	913.45	2,951.49	1.78	1,662.73	
GSW Cyclopac #2 Feed Pump	**232**	0.00	1.00	0.00	5.00	0.00	5.00	5.00	1.00	5.00	
Cyclone #2 Feed	**233**	2,717.39	2.72	999.04	2,175.09	55.54	2,175.09	4,892.48	1.54	3,174.13	400.00%

Client: Pacific Booker Minerals Inc.
Project Name: Morrison Copper/Gold Project
Project Number: 06527201.00
Date: 10-Dec-08
Revision Date: 10-Dec-08
Revision: L

Daily tonne milled	30,000 tonne/day
Mill availability	92%
Annual operating days	365 days
Annual throughput	10,950,000 tonne

PROCESS DESIGN CRITERIA - MATERIAL BALANCE

Document: 0652720100-DBM-P0001-00

All values are in metric units
Blue font - Water
Red font - Reagent
Green font - Reagent

	Flow ID	Solids, t/h	Solids SG	Solids, m^3/h	Water, t/h	% Solids	Water, m^3/h	Pulp, t/h	Pulp SG	Pulp, m^3/h	Com/s
Cyclone #2 U/F	**234**	2,038.04	2.72	749.28	913.45	69.05	913.45	2,951.49	1.78	1,662.73	
Cyclone #2 O/F	**235**	679.35	2.72	249.76	1,261.65	35.00	1,261.65	1,940.99	1.28	1,511.41	
Feed to Rougher Flotation	**236**	1,358.70	2.72	499.52	2,523.29	35.00	2,523.29	3,881.99	1.28	3,022.81	
Feed to Ball Mill Discharge Pumpbox	**237**	1,358.70	2.72	499.52	997.52	57.66	997.52	2,356.21	1.57	1,497.04	
Feed to Rougher Flotation	**129**	1,358.80	2.72	499.56	2,523.35	35.00	2,523.35	3,882.15	1.28	3,022.91	
Launder Water to Rougher Concentrate Flotation	**130**	0.00	1.00	0.00	34.78	0.00	34.78	34.78	1.00	34.78	
Rougher Concentrate to Regrinding Mills	**131**	108.70	2.90	37.48	253.62	30.00	253.62	362.32	1.24	291.10	8.00%
Rougher Tailings	**132**	1,250.10	2.60	480.81	2,269.72	35.52	2,269.72	3,519.83	1.28	2,750.53	
GSW Rougher Tailings Pump	**133**	0.00	1.00	0.00	5.00	0.00	5.00	5.00	1.00	5.00	
Feed to Rougher Scavenger Flotation	**134**	1,250.12	2.60	480.81	2,274.72	35.47	2,274.72	3,524.84	1.28	2,755.54	
Rougher Scavenger Concentrate	**135**	27.17	2.90	9.37	63.41	30.00	63.41	90.58	1.24	72.78	2.00%
Rougher Scavenger Tailings to Final Tailings Pumpbox	**136**	1,222.94	2.60	470.36	2,211.32	35.61	2,211.32	3,434.26	1.28	2,681.68	
Fresh Water Regrind Mill Lube Units	**137**	0.00	1.00	0.00	10.00	0.00	10.00	10.00	1.00	10.00	
Lime Slurry	**138**	0.34	1.30	0.26	1.36	20.00	1.36	1.70	1.05	1.62	
GSW Regrind Cyclopac Feed Pump	**139**	0.00	1.00	0.00	1.60	0.00	1.60	1.60	1.00	1.60	
Regrind Cyclone Feed	**140**	443.73	2.90	153.01	602.14	42.43	602.14	1,045.87	1.38	755.15	300.00%
Regrind Cyclone U/F	**141**	296.17	2.90	102.13	159.48	65.00	159.48	455.65	1.74	261.61	
Fresh Water Cone Crusher Lub Unit	**142**	0.00	1.00	0.00	5.00	0.00	5.00	5.00	1.00	5.00	
Regrind Cyclone O/F	**143**	147.56	2.90	50.88	442.67	25.00	442.67	590.22	1.20	493.55	
Launder Water to 1st Cleaner Flotation	**144**	0.00	1.00	0.00	4.00	0.00	4.00	4.00	1.00	4.00	
MIBC Feed to Rougher Flotation	**145**	0.04	0.81	0.05	0.00	100.00	0.00	0.04	0.81	0.05	
Feed to 1st Cleaner Flotation	**146**	159.24	2.90	54.91	481.35	24.86	481.35	640.58	1.19	536.25	
1st Cleaner Flotation Concentrate	**147**	28.94	3.00	9.65	67.53	30.00	67.53	96.47	1.25	77.18	2.13%
GSW 1st Cleaner Concentrate Pump	**148**	0.00	1.00	0.00	1.60	0.00	1.60	1.60	1.00	1.60	
1st Cleaner Concentrate to 2nd Cleaner Flotation	**149**	28.94	3.20	9.04	73.13	28.35	73.13	102.07	1.24	82.18	
1st Cleaner Tailings	**150**	130.29	3.40	38.32	413.81	23.95	413.81	544.11	1.20	452.13	

Client: Pacific Booker Minerals Inc.
Project Name: Morrison Copper/Gold Project
Project Number: 06527201.00
Date: 10-Dec-08
Revision Date: 10-Dec-08
Revision: L

Daily tonne milled	30,000 tonne/day
Mill availability	92%
Annual operating days	365 days
Annual throughput	10,950,000 tonne

PROCESS DESIGN CRITERIA - MATERIAL BALANCE

Document: 0652720100-DBM-P0001-00

All values are in metric units
Blue font - Water
Red font - Reagent
Green font - Reagent

	Flow ID	Solids, t/h	Solids SG	Solids, m^3/h	Water, t/h	% Solids	Water, m^3/h	Pulp, t/h	Pulp SG	Pulp, m^3/h	Com/s
Launder Water to 1st Cleaner Scavenger Flotation	151	0.00	1.00	0.00	4.00	0.00	4.00	4.00	1.00	4.00	
1st Cleaner Scavenger Flotation Tailings	152	118.61	2.60	45.62	386.55	23.48	386.55	505.16	1.17	432.17	
1st Cleaner Scavenger Flotation Concentrate	153	11.69	3.20	3.65	27.27	30.00	27.27	38.95	1.26	30.92	0.86%
GSW 1st Cleaner Tailings Pump	154	0.00	1.00	0.00	16.00	0.00	16.00	16.00	1.00	16.00	
GSW 1st Cleaner Scav Concentrate Pump	155	0.00	1.00	0.00	1.60	0.00	1.60	1.60	1.00	1.60	
1st Cleaner Scavenger Tailings to Final Tailings Pumpbox	156	118.61	2.60	45.62	402.55	22.76	402.55	521.16	1.16	448.17	
Launder Water to Rougher Scavenger Flotation	157	0.00	1.00	0.00	25.00	0.00	25.00	25.00	1.00	25.00	
Launder Water to Copper 2nd Cleaner Flotation	158	0.00	1.00	0.00	4.00	0.00	4.00	4.00	1.00	4.00	
Feed to 2nd Cleaner Flotation	159	29.01	3.20	9.07	77.33	27.28	77.33	106.34	1.23	86.40	
2nd Cleaner Concentrate	160	17.55	3.50	5.02	40.96	30.00	40.96	58.52	1.27	45.98	1.29%
GSW 2nd Cleaner Concentrate Pump	161	0.00	1.00	0.00	1.60	0.00	1.60	1.60	1.00	1.60	
2nd Cleaner Concentrate Feed to Cu-Mo Thickener	162	17.55	3.50	5.02	42.56	29.20	42.56	60.12	1.26	47.58	
2nd Cleaner Tailings	163	11.46	3.20	3.58	36.37	23.96	36.37	47.83	1.20	39.95	
GSW 2nd Cleaner Tailings Pump	164	0.00	1.00	0.00	1.60	0.00	1.60	1.60	1.00	1.60	
2nd Cleaner Tailings Feed to 1st Cleaner Flotation	165	11.46	3.20	3.58	37.97	23.18	37.97	49.43	1.19	41.55	
Process Water to Regrind Pump Box	166	0.00	1.00	0.00	20.00	0.00	20.00	20.00	1.00	20.00	
Process Water to Ball Mill Discharge	300	0.00	1.00	0.00	80.00	0.00	80.00	80.00	1.00	80.00	
Ball Mill Process Water	167	0.00	1.00	0.00	40.00	0.00	40.00	40.00	1.00	40.00	
Total Process Water Rougher Flotation	168	0.00	1.00	0.00	59.78	0.00	59.78	59.78	1.00	59.78	
1st Cleaner Process Water	169	0.00	1.00	0.00	8.00	0.00	8.00	8.00	1.00	8.00	
Total Cooling Water	170	0.00	1.00	0.00	45.00	0.00	45.00	45.00	1.00	45.00	
Final Copper Concentrate to Thickener	171	17.55	3.70	4.74	42.56	29.20	42.56	60.12	1.27	47.31	
Potable Water	172	0.00	1.00	0.00	3.15	0.00	3.15	3.15	1.00	3.15	
Final Mo Concentrate	173	0.33	1.00	0.33	0.76	30.00	0.76	1.09	1.00	1.09	0.02%
Final Tailings	174	1,341.55	2.60	515.98	2,613.87	33.92	2,613.87	3,955.42	1.26	3,129.85	
GSW Filter Feed Pump	175	0.00	1.00	0.00	0.60	0.00	0.60	0.60	1.00	0.60	

Client: Pacific Booker Minerals Inc.
Project Name: Morrison Copper/Gold Project
Project Number: 06527201.00
Date: 10-Dec-08
Revision Date: 10-Dec-08
Revision: L

Daily tonne milled	30,000 tonne/day
Mill availability	92%
Annual operating days	365 days
Annual throughput	10,950,000 tonne

PROCESS DESIGN CRITERIA - MATERIAL BALANCE

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Blue font - Water
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	Flow ID	Solids, t/h	Solids SG	Solids, m^3/h	Water, t/h	% Solids	Water, m^3/h	Pulp, t/h	Pulp SG	Pulp, m^3/h	Com/s
Feed to Copper Thickener	**176**	17.23	3.70	4.66	48.20	26.33	48.20	65.43	1.24	52.86	
Copper Thickener U/F	**177**	17.23	3.70	4.66	11.49	60.00	11.49	28.71	1.78	16.14	1.27%
Copper Thickener O/F + Filtrates	**178**	0.00	3.70	0.00	47.90	0.00	47.90	47.90	1.00	47.90	
Copper Concentrate	**179**	17.23	3.70	4.66	1.50	92.00	1.50	18.73	3.04	6.15	
Tailings Thickener O/F	**180**	0.00	2.60	0.00	2,319.38	0.00	2,319.38	2,319.38	1.00	2,319.38	
Settled Tailings	**181**	1,341.55	2.60	515.98	294.49	82.00	294.49	1,636.04	2.02	810.47	
Concentrate Filter Feed	**182**	17.23	3.70	4.66	12.69	57.59	12.69	29.91	1.72	17.34	
GSW Final Tailings Pump	**183**	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	
GSW Process Water Distribution Pump	**184**	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	
Total Gland Seal Water	**185**	0.00	1.00	0.00	43.20	0.00	43.20	43.20	1.00	43.20	
Total Reagents Water	**186**	0.84	1.30	0.65	2.83	0.01	2.83	3.67	1.06	3.48	
Filter Filtrate Waters	**187**	0.00	3.70	0.00	11.19	0.00	11.19	11.19	1.00	11.19	
GSW Tailings Reclaim Booster Pump #1	**188**	0.00	1.30	0.00	0.00	0.00	0.00	0.00	1.00	0.00	
Cu-Mo Thickener Feed	**189**	17.55	3.70	4.74	42.56	29.20	42.56	60.12	1.27	47.31	
Cu-Mo Thickener O/F	**190**	0.00	1.00	0.00	25.01	0.00	25.01	25.01	1.00	25.01	
Cu-Mo Thickener U/F	**191**	17.55	3.70	4.74	17.55	50.00	17.55	35.11	1.57	22.30	
GSW Thickener U/F Pump	**192**	0.00	1.00	0.00	0.60	0.00	0.60	0.60	1.00	0.60	
Feed to Mo Rougher Flotation	**193**	24.02	3.70	6.49	39.05	38.09	39.05	63.07	1.38	45.54	
Process Water to Mo Rougher Flotation	**194**	0.00	1.00	0.00	2.00	0.00	2.00	2.00	1.00	2.00	
Mo Rougher Concentrate	**195**	6.79	4.00	1.70	15.85	30.00	15.85	22.65	1.29	17.55	0.50%
Mo Rougher Tailings	**196**	17.23	3.70	4.66	23.19	42.62	23.19	40.42	1.45	27.85	
Process Water to Mo Cleaner Flotation	**197**	0.00	1.00	0.00	2.00	0.00	2.00	2.00	1.00	2.00	
Feed to Mo Cleaner Flotation	**198**	6.79	4.00	1.70	20.45	24.94	20.45	27.25	1.23	22.15	
Mo Cleaner Concentrate	**199**	0.33	4.60	0.07	0.76	30.00	0.76	1.09	1.31	0.83	0.02%
Mo Cleaner Tailings	**200**	6.47	4.00	1.62	20.29	24.17	20.29	26.76	1.22	21.91	
Feed to Mo Thickener	**201**	0.33	4.60	0.07	2.70	10.79	2.70	3.02	1.09	2.77	

Client: Pacific Booker Minerals Inc.
Project Name: Morrison Copper/Gold Project
Project Number: 06527201.00
Date: 10-Dec-08
Revision Date: 10-Dec-08
Revision: L

Daily tonne milled	30,000 tonne/day
Mill availability	92%
Annual operating days	365 days
Annual throughput	10,950,000 tonne

PROCESS DESIGN CRITERIA - MATERIAL BALANCE

Document: 0652720100-DBM-P0001-00

All values are in metric units
Blue font - Water
Red font - Reagent
Green font - Reagent

	Flow ID	Solids, t/h	Solids SG	Solids, m^3/h	Water, t/h	% Solids	Water, m^3/h	Pulp, t/h	Pulp SG	Pulp, m^3/h	Com/s
Mo Thickener U/F	202	0.33	4.60	0.07	0.22	60.00	0.22	0.54	1.89	0.29	
Mo Thickener O/F	203	0.00	4.60	0.00	2.48	0.00	2.48	2.48	1.00	2.48	
GSW Mo Thickener U/F Pump	204	0.00	1.00	0.00	0.60	0.00	0.60	0.60	1.00	0.60	
Feed to Mo Filter	205	0.33	4.60	0.07	1.42	18.70	1.42	1.74	1.17	1.49	
Mo Concentrate	206	0.33	4.60	0.07	0.08	80.00	0.08	0.41	2.67	0.15	
Mo Filter Flitrate Waters	207	0.00	4.60	0.00	1.34	0.00	1.34	1.34	1.00	1.34	
Total Process Water to Moly Flotation	208	0.00	1.00	0.00	4.00	0.00	4.00	4.00	1.00	4.00	
Total Process Water to Cyclones Feed Pumpbox	209	0.00	1.00	0.00	1,380.74	0.00	1,380.74	1,380.74	1.00	1,380.74	
PEX Feed to Grinding Circuit	238	0.02	1.26	0.02	0.00	100.00	0.00	0.02	1.26	0.02	
Aero 3302 Feed to Grinding Circuit	239	0.01	1.03	0.01	0.03	20.00	0.03	0.04	1.01	0.03	
	240	0.00	0.81	0.00	0.00	100.00	0.00	0.00	0.81	0.00	
MIBC Feed to Rougher Scavenger Flotation	241	0.01	0.81	0.02	0.00	100.00	0.00	0.01	0.81	0.02	
PEX Feed to Rougher Flotation	242	0.09	1.26	0.07	0.00	100.00	0.00	0.09	1.26	0.07	
PEX Feed to Regrind Circuit	243	0.01	1.26	0.01	0.00	100.00	0.00	0.01	1.26	0.01	
Aero3302 Feed to Rougher Flotation	244	0.01	1.03	0.01	0.06	20.00	0.06	0.07	1.01	0.07	
Aero3302 Feed to Regrind Circuit	245	0.01	1.03	0.01	0.03	20.00	0.03	0.04	1.01	0.03	
PEX Feed to 1st Cleaner Scavenger Flotation	246	0.01	1.26	0.01	0.00	100.00	0.00	0.01	1.26	0.01	
Lime Feed to 1st Cleaner Flotation	247	0.18	1.30	0.14	0.71	20.00	0.71	0.89	1.05	0.84	
Lime Feed to 2nd Cleaner Flotation	248	0.05	1.30	0.04	0.20	20.00	0.20	0.25	1.05	0.24	
MIBC Feed to 2nd Cleaner Flotation	249	0.02	0.81	0.02	0.00	100.00	0.00	0.02	0.81	0.02	
Flocculant Feed to Copper Thickener	250	0.05	1.30	0.04	0.45	10.00	0.45	0.50	1.02	0.49	
GSW Moly Flotation Feed Pump	251	0.00	1.00	0.00	0.60	0.00	0.60	0.60	1.00	0.60	
GSW Moly Filter Feed	252	0.00	1.00	0.00	0.60	0.00	0.60	0.60	1.00	0.60	
GSW Moly Thickener Feed	253	0.00	1.00	0.00	0.60	0.00	0.60	0.60	1.00	0.60	
GSW Copper Thickener U/F Pump	254	0.00	1.00	0.00	0.60	0.00	0.60	0.60	1.00	0.60	

Client: Pacific Booker Minerals Inc.
Project Name: Morrison Copper/Gold Project
Project Number: 06527201.00
Date: 10-Dec-08
Revision Date: 10-Dec-08
Revision: L

Daily tonne milled	30,000 tonne/day
Mill availability	92%
Annual operating days	365 days
Annual throughput	10,950,000 tonne

PROCESS DESIGN CRITERIA - MATERIAL BALANCE

Document: 0652720100-DBM-P0001-00

All values are in metric units
Blue font - Water
Red font - Reagent
Green font - Reagent

	Flow ID	Solids, t/h	Solids SG	Solids, m^3/h	Water, t/h	% Solids	Water, m^3/h	Pulp, t/h	Pulp SG	Pulp, m^3/h	Com/s
GSW Tailings Reclaim Booster Pump #2	255	0.00	1.30	0.00	0.00	0.00	0.00	0.00	1.00	0.00	
GSW Mo Cleaner Column U/F Pump	256	0.00	1.30	0.00	0.60	0.00	0.60	0.60	1.00	0.60	
GSW Mo Cleaner Flotation Feed Pump	257	0.00	1.30	0.00	0.60	0.00	0.60	0.60	1.00	0.60	
Feed to Final Tailings Cyclopac	258	1,341.55	2.60	515.98	2,613.87	33.92	2,613.87	3,955.42	1.26	3,129.85	
Final Tailings Cyclone U/F	259	872.01	2.60	335.39	713.46	55.00	713.46	1,585.47	1.51	1048.85	65.00%
Final Tailings Cyclone O/F	260	469.54	2.60	180.59	1,900.40	19.81	1,900.40	2,369.95	1.14	2,081.00	
PEX Feed to Pyrite Flotation Cell	261	0.01	1.00	0.01	0.00	100.00	0.00	0.01	1.00	0.01	
Feed to Pyrite Flotation Cell	262	872.02	2.60	335.39	713.46	55.00	713.46	1,585.48	1.51	1,048.85	
Pyrite Flotation Cell Concentrate	263	282.53	4.80	58.86	345.32	45.00	345.32	627.85	1.55	404.18	36.00%
Pyrite Flotation Cell Tailings Sand	264	589.48	2.60	226.72	368.14	61.56	368.14	957.63	1.61	594.87	
Water to Grinding	265	0.00	4.80	0.00	2,441.24	0.00	2,441.24	2,441.24	1.00	2,441.24	
Water to 1st Copper Cleaning	266	0.00	2.60	0.00	12.00	0.00	12.00	12.00	1.00	12.00	

Client: Pacific Booker Minerals Inc.
Project Name: Morrison Copper/Gold Project
Project Number: 06527201.00
Date: 10-Dec-08
Revision Date: 10-Dec-08
Revision: L

Daily tonne milled	30,000 tonne/day
Mill availability	92%
Annual operating days	365 days
Annual throughput	10,950,000 tonne

PROCESS DESIGN CRITERIA - WATER BALANCE

Document: 0652720100-DBM-P0001-00

All values are in metric units

Flow ID	Description	Water Flowrate (m3/hr)		Process Water Tank		Fresh Water Tank
		In	Out	In	Out	Out
	Grinding					
210	Grinding Feed - Design with 92% Ava	42.02				
217	Process Water to Secondary Screen	955.50			955.50	
219	Process Water to Ball Mill Discharge	60.00			60.00	
220	Ball Mill Lube Unit #1 Process Water	15.00				15.00
221	Ball Mill Lube Unit #2 Process Water	15.00				15.00
223	GSW Cyclopac #1 Feed Pump	5.00				5.00
224	Process Water to Cyclopac Feed Pun	1425.75			1425.75	
232	GSW Cyclopac #2 Feed Pump	5.00				5.00
238	PEX Feed to Grinding Circuit	0.00				0.00
239	Aero 3302 Feed to Grinding Circuit	0.03				0.03
236	Feed to Rougher Flotation		2523.29			
	Totals	2523.29	2523.29			
	Copper Rougher Flotation / Concentrate Regrind					
236	Feed to Rougher Flotation	2523.29				
131	Rougher Concentrate to Regrinding Mills		253.62			
135	Rougher Scavenger Concentrate		63.41			
133	GSW Rougher Tailings Pump	5.00				5.00
244	Aero3302 Feed to Rougher Flotation	0.06				0.06
242	PEX Feed to Rougher Flotation	0.00				0.00
136	Rougher Scavenger Tailings to Final Tailings Pumpb		2211.32			
	Totals	2528.35	2528.35			
130	Launder Water to Rougher Concentra	34.78			34.78	
131	Rougher Concentrate to Regrinding M	253.62				
135	Rougher Scavenger Concentrate	63.41				
137	Fresh Water Regrind Mill Lube Units	10.00				10.00
138	Lime Slurry	1.36				1.36
139	GSW Regrind Cyclopac Feed Pump	1.60				1.60
243	PEX Feed to Regrind Circuit	0.00				0.00
241	MIBC Feed to Rougher Scavenger Flo	0.00				0.00
245	Aero3302 Feed to Regrind Circuit	0.03				0.03
143	Regrind Cyclone O/F		442.67			
151	Launder Water to 1st Cleaner Scaver	4.00			4.00	
153	1st Cleaner Scavenger Flotation Conc	27.27				
155	GSW 1st Cleaner Scav Concentrate	1.60				1.60
157	Launder Water to Rougher Scavenge	25.00			25.00	
166	Process Water to Regrind Pump Box	20.00			20.00	
	Totals	442.67	442.67			
	Copper 1st and 2nd Cleaner Flotations					
143	Regrind Cyclone O/F	442.67				
144	Launder Water to 1st Cleaner Flotatio	4.00			4.00	
145	MIBC Feed to Rougher Flotation	0.00				0.00
246	PEX Feed to 1st Cleaner Scavenger F	0.00				0.00
247	Lime Feed to 1st Cleaner Flotation	0.71				0.71
248	Lime Feed to 2nd Cleaner Flotation	0.20				0.20

249	MIBC Feed to 2nd Cleaner Flotation	0.00				0.00
148	GSW 1st Cleaner Concentrate Pump	1.60				1.60
153	1st Cleaner Scavenger Flotation Concentrate		27.27			
154	GSW 1st Cleaner Tailings Pump	16.00				16.00
156	1st Cleaner Scavenger Tailings to Final Tailings Pum		402.55			
158	Launder Water to Copper 2nd Cleane	4.00			4.00	
161	GSW 2nd Cleaner Concentrate Pump	1.60				1.60
162	2nd Cleaner Concentrate Feed to Cu-Mo Thickener		42.56			
164	GSW 2nd Cleaner Tailings Pump	1.60				1.60
	Totals	472.37	472.37			
	Moly Flotation					
162	2nd Cleaner Concentrate Feed to Cu-	42.56				
192	GSW Thickener U/F Pump	0.60				0.60
251	GSW Moly Flotation Feed Pump	0.60				0.60
256	GSW Mo Cleaner Column U/F Pump	0.60				0.60
257	GSW Mo Cleaner Flotation Feed Pum	0.60				0.60
194	Process Water to Mo Rougher Flotati	2.00			2.00	
197	Process Water to Mo Cleaner Flotatio	2.00			2.00	
196	Mo Rougher Tailings		23.19			
199	Mo Cleaner Concentrate		0.76			
190	Cu-Mo Thickener O/F		25.01			
	Totals	48.96	48.96			
	Copper Concentrate Dewatering					
176	Feed to Copper Thickener	48.20				
175	GSW Filter Feed Pump	0.60				0.60
254	GSW Copper Thickener U/F Pump	0.60				0.60
179	Copper Concentrate		1.50			
178	Copper Thickener O/F + Filtrates		47.90	47.90		
	Totals	49.40	49.40			
	Moly Concentrate Dewatering					
199	Mo Cleaner Concentrate	0.76				
204	GSW Mo Thickener U/F Pump	0.60				0.60
252	GSW Moly Filter Feed	0.60				0.60
253	GSW Moly Thickener Feed	0.60				0.60
206	Mo Concentrate		0.08			
203	Mo Thickener O/F		2.48			
	Totals	2.56	2.56			
	Final Tailings					
174	Final Tailings	2613.87				
181	Settled Tailings		294.49			
180	Tailings Thickener O/F		2319.38	2319.38		
	Totals	2613.87	2613.87			

Water Tank		**Tank**	
In	**Out**	**Out**	
Tank Totals	2367.28	2537.02	86.78

Excess process water to GSW Tank	-169.74
GSW Tank Makeup Required	169.74

Process Water & Reagent Makeup Required	256.52		50	gpd/person
Potable Water Distribution	3.15		400	persons
Fresh Water Supply	259.67	9.9	% Fresh Water	
Total Water In (Average Rate) (Fresh Water and Ore)	301.70			
Total Water Out with Concentrate (Average Rate)	1.58	300.1		
Total Water Out Retained in Tailings (Average Rate)	179.45	120.7		
Reclaim Water Returned	2367.28			
Fresh Water	259.67			
Total Water Required to Operate Plant	2626.95	m3/hr	11,585	USgpm

DESIGN CRITERIA REVISION INDEX

Revision No.	Date Revised	Engineering Specification	Signatures				
			Prepared By	Discipline Engineer	Project Engineering	Project Manager	PBM
00	November 2, 2007	Issued For Client Information	DS	DS		DS	
01	October 16, 2008	Issued for Client Approval	JR	JR	AS	JCR	

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1.0 SCOPE OF WORK AND BATTERY LIMITS

- Design of the mechanical works for the main process plant and surrounding ancillary buildings for the Morrison Porphyry processing areas are broken into five distinct areas of the immediate process plant main site are:
  - Primary Crushing, Conveying and Crushed Ore Storage
  - Secondary & Tertiary Crushing
  - Process Plant
  - Water Supply and Distribution System
  - Ancillary Facilities
- All mechanical work on the Pacific Booker – Morrison Copper/Gold project will fall under the scope of this document.

2.0 CODES AND STANDARDS

- The design and manufacture of mechanical systems and components shall conform to the latest versions of the following codes and standards:
  - Local Codes and Standards (TSA or equivalent)
  - American National Standards Institute (ANSI)
  - Confromite Europeenne (CE)
- The current editions of the following codes, standards, and specifications published by the following societies and institutions will be considered as a part of these criteria, unless otherwise noted. Whenever a difference exists between these criteria and any referenced publication, these criteria will govern.

AFBMA	Anti-friction Bearing Manufacturer's Association
AGMA	American Gear Manufacturer's Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ASA	American Standards Association
ASME	American Society of Mechanical Engineers
ASNT	American Society of Non-destructive Testing

ASTM	American Society of Testing and Materials
AWS	American Welding Society
MPTA	Mechanical Power Transmission Association
CEMA	Conveyor Equipment Manufacturers Association
CSA	Canadian Standards Association
EEMAC	Electrical and Electronic Manufacturers Association of Canada
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineer's Society - Lighting Handbook
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
JIC	Joint Industrial Conference
MGI	Metal Grating Institute
MSHA	Mining Safety and Health Administration
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NFPA	National Fluid Power Association
OSHA	Occupation Safety and Health Act
RMA	Rubber Manufacturers Association
SAE	Society of Automotive Engineers
SSPC	Steel Structures Painting Council
UBC	Uniform Building Code

- All equipment shall be rated for a minimum elevation of 750 m feet above sea level and an ambient temperature range of -40°C to 30°C and shall have CE Marking.

- Manufacturer’s recommended design, installation practices and procedures shall be adhered to whenever such practices and procedures are available.

- Metric units of measurement will be used throughout.

- Design of all materials handling equipment will comply with these criteria. Items not covered herein will conform to the appropriate referenced publications. Details will comply with all the relevant drawings.

3.0 MECHANICAL DESIGNS AND CONSTRUCTION

3.1 General

- Layout of Facilities

- Adequate clearances for proper operation, maintenance and clean-up will be provided in the layout of equipment.

- Space will be provided for the largest normal unit recommended by any of the recognized equipment manufacturers.

3.2 Materials Specifications: Shafting, Bearings and Idlers

- Pulleys and Shafts

  - This section covers only Non-Engineered Class pulleys as defined by CEMA/ANSI B105.1. If any of the pulleys contained on the project fall within the scope of an Engineered Class pulley, these will be supplied. Pulleys will be designed to CEMA Standards unless operating tensions dictate otherwise where they will be designed as engineered pulleys.

  - Each pulley will be of welded steel drum type construction having two solid type end discs, each of which will be complete with solid end hubs with a compression fit type locking device, to provide a clamp fit on the shaft. Additional stiffeners or discs may be incorporated in the pulley, if required by the Manufacturer's standard pulley design or manufacturing methods.

  - End discs will be continuously welded to the rim with full penetration welds.

  - All pulleys will be of the diameter and face width suitable for the design.

  - Pulley face widths will be equal to belt width + 51 mm (2") for belt widths up to and including 1067 mm (42") and belt width + 76 mm (3") for belt widths greater than this size.

  - Pulleys on conveyors for which a fabric belt type is specified will have a crowned face. Crowned pulleys will be crowned to maximum of 3 mm (1/8") per foot of total face width. Crown is defined as the amount per foot of total face width by which the diameter at the centre of the face exceeds the diameter at the edge. Pulleys on conveyors that have steel cord belts will be of the flat face design.

  - Drive pulleys will be lagged with 12 mm thick ceramic or diamond patterned synthetic or natural rubber, having a Shore "A" Scale Durometer Harness value of 55 to 65, A scale. It will be hot vulcanized to the pulley. Drive pulleys will only contact the non-dirty side of the belt.

  - Lagging will be provided for all pulleys that contact the dirty side of the belt. Lagging will be 10 mm thick plain synthetic or natural rubber, having a Shore

Durometer Hardness value of 45 to 50, "A" Scale. It will be hot vulcanized to the pulley.

- All pulley shafts will be of one-piece design, furnished with keyseats and keys to match the pulley hubs and drive components. Shafts will be made from the steel grade as defined by the American Iron and Steel Institute. The grade specified may be upgraded. Depending on the grade specified, acceptable upgrades from a minimum C1018 are C1045 or C4140.

- Wherever a shaft is reduced in diameter, a fillet radius of at least half of the difference in diameters will be used to a minimum of 12 mm. Shaft ends will be chamfered 3 mm x 3 mm. The diameter of the necked portion of the shaft will not be less than 80% of the non-necked portion.

- Shafts 100 mm diameter or less will not be necked at bearings, but may be necked for shaft mounted reducers.

- All keys and keyseats will have semi-circular ends. Square keys will be used.

- All pulleys will be locked to the shaft using a keyless compression type locking device.

- The slope of the shaft at the pulley end disc resulting from deflection of the pulley shaft, for normal running conditions, will not exceed 0.0023 mm per millimetre.

- One shaft on each conveyor (usually the tail shaft) will be extended at one end for a distance of 165 mm from the centre-line of the pillow block bearing. This end of the shaft will be machined and have several tapped holes for mounting the speed switch pulse plate.

- For shaft mounted speed reducers, it will be assumed that the resultant of all overhung loads will act at an angle of 90° to the resultant of the belt tension and pulley weight.

- Bearings and Pillow Blocks

  - Pillow block bearings will be of the self-aligning, double row, spherical roller, adapter mount type, in split housings.

  - Bearings will be rated for a B10 life of [100,000 hours).

  - All pillow blocks will be of the Manufacturer's standard design and will be identified by specific reference to a catalogue number. All bearing pillow blocks

will be of the four mounting bolt type, with slotted mounting holes. Adjusting screws will be installed on both sides of pillow blocks.

- All pillow blocks will be suitable for installation on supports prepared in accordance with AFBMA standard mounting dimensions for SAF 225 series pillow blocks up to and including 200 mm diameter bore and for SAF 230 series above this size.
- Pillow blocks will be fitted with taconite type seals, which will effectively exclude micron size dust particles. All pillow blocks will be provided with standard lubrication fittings.
- Each shaft will be provided with one "fixed" type and one "floating" type pillow block. The fixed type will be on the drive end if it is a drive shaft.
- Wherever the shaft does not extend through the pillow block, a housing end closure will be provided.

- Idlers
  - Idlers will be selected to provide optimum standardization.
  - All idler design and selection will be in accordance with the minimum requirements recommended by CEMA.
  - All idlers will be of the Manufacturer's standard design and construction. They will be complete with roll supporting frames and brackets.
  - Idlers will have taper roller bearings or ball bearings, rated for a minimum BU life of [90,000) hours, sealed for life, with triple labyrinth seals, suitable for operation in a dusty, and abrasive environment.
  - The idlers will be located to limit the amount of belt sag during normal running conditions to the percentage of spacing shown in the following schedule.

Coarse Ore Conveyors:	Carry side	1 ½%
Fine Ore Conveyors:	Carry side	2%
All Conveyors:	Carry side under skirts	1%
	Return side	2%

  - The maximum spacing for all the idlers and the maximum belt wrap angles for the return idlers will be determined by design requirements.
  - Idler frames will be suitable for hold-down bolts spaced at belt width plus 225 mm (9").

- Carrying idlers for conveyors will have three equal length rolls with 35° trough angles. Belt feeders will have 20° trough picking type idlers.
- Normal carrying idlers will be equipped with steel rolls. Non-tilted idler stands will be used.
- Impact carrying idlers will be equipped with rolls composed of closely spaced rubber discs. The rolls will be mounted in a fixed frame.
- Transition carrying idlers will be of the same general design as the normal carry idlers, but the inclined rolls will be adjustable in 5° increments from a minimum of 5° to within 5° of the specified full troughing angle.
- Picking type carrying idlers will have the same overall design features as normal impact and carrying idlers, except that they will have a long horizontal center roll and short end rolls inclined at 20°.
- Return idlers will be of the vee-type design, inclined at 10°, equipped with rubber discs, with disc grouping at each end of the roll to prevent the belt edge from becoming caught between discs.
- Carry training idlers for conveyors will be of the same general design as the normal carrying idlers, but will be designed to pivot horizontally and will be equipped with vertical belt edge rollers.
- Weigh scales will be equipped with idlers that will be modified according to manufacturers' recommendations for use on weigh scales, if required.

3.3 Materials Specifications: Drive Components

- General
  - Drive components will be selected to provide optimum standardization.
  - Heating and/or cooling requirements and the quantity and type of oil to be used, for winter and summer operation, will be stated for each component.
  - The drive components will be suitable for outdoor operation, not covered and operating continuously, in environmental conditions specified.
  - All drive components will be suitable for up to 6 starts per hour.

- Drive units 100 kW and above will be provided with fluid couplings. Drives below this will be connected with flexible couplings or V-belts unless design requirements dictate otherwise.
- The overall drive ratio will be within 4% of that specified, including any fluid coupling slippage.

- Fluid Couplings
  - Fluid couplings will be of the hydraulic delay-fill type. Any subsidiary couplings or V-belt sheaves necessary to complete the connection between the motor and the speed reducer will be included.
  - The complete fluid coupling or combination unit will be finish bored and keyseated to suit the related component shafts and will incorporate features that will permit its assembly and removal, without disturbance of the motor or speed reducer.
  - The fluid coupling will be capable of limiting the starting torque to a maximum value of 140% of the motor normal running full load torque. (unless alternative stated)
  - Couplings will be provided with standard non-contracting thermal switches and fused plugs.

- V-Belt Drives
  - V-belt drives will utilize standard “narrow” V-belt (3V, 5V and 8V) cross sections and standard lengths, in matched sets.
  - All sheaves will be statically balanced.
  - Sheaves will have compression type bushings, finish bored and keyseated to suit the related component shafts.
  - V-belt drives will be selected on the basis of a service factor of at least 1.5, applied to the motor nameplate power rating.

- Speed Reducers - General
  - All speed reducers will be designed in accordance with the standards of the American Gear Manufacturers Association (AGMA).
  - Speed reducers will incorporate adequate seals, in combination with other design features, to effectively exclude micron size dust particles and other contaminants.

- Speed reducers will be complete with any necessary oil level indicators, drains, and breathers. Reducers will be designed to operate without external oil coolers.
- Air breathers will be complete with removable filters for cleaning or replacement. The filter will be capable of retaining microscopic dust particles. Magnetic drain plugs will be provided to remove any metal particles in the oil.
- Lubrication will be automatic and adequate for the conditions and service specified.
- Built-in backstops will be integral with the reducer, completely enclosed and sealed. They will be of the all mechanical, automatic, over-running, one way clutch type, utilizing hardened rollers or sprags. The backstop torque rating will be equal to the normal operating or peak overload torque rating of the reducer, whichever governs the selection.
- The thermal power rating of speed reducers will equal or exceed the motor nameplate rating at the specified site elevation.

- Speed Reducers - Shaft Mounted
  - Helical type gearing will be used in all shaft mounted speed reducers.
  - The service factor for selection of reducers will be in accordance with AGMA Class II, with a minimum value of 1.4, applied to the motor nameplate power rating.
  - The conveyor drive shaft will be necked to accommodate the reducer maximum bore, if required.
  - The motor mounts for mounting the motor on top of the reducer will be adjustable for V-belt tensioning.

- Speed Reducers - Foot Mounted
  - Helical type gearing will be used in all foot mounted speed reducers, in combination with bevel or spiral-bevel gears if in right angle shaft configuration.
  - All foot mounted speed reducers will be arranged for standard horizontal floor mounting and will have horizontally split housings.
  - Foot mounted speed reducers will be selected on the basis of a service factor of at least 1.5 applied to the motor nameplate power rating.
  - The gearing in foot mounted reducers will be AGMA Class 12.

- All bearings will have a B10 life rating of a minimum of (60,000 hours), in accordance with AFBMA.

- Flexible Couplings
  - High and low speed couplings will be of the flexible grid member or gear type.
  - Flexible couplings will be selected on the basis of a service factor of at least 1.5, applied to the motor nameplate power rating.
  - The coupling hubs will be finish bored and keyseated to suit the related component shafts. Square keys will be used.

- Chain Drives
  - Roller chain drives will be used only in cases where other types of power transmission are difficult or impossible.
  - Chain drives will be of the standard ASA roller chain type.
  - Chain drives will be enclosed in a dust free, oil tight chain casing.
  - Chain drives will be selected on the basis of a service factor of at least 1.3 applied to the motor nameplate power rating.

- Drive Bases
  - Drive bases will be of rigid construction longitudinally, transversely and torsionally and will be designed to withstand all static and dynamic loads during operation, transportation and installation.
  - Fabricated bases will be stress relieved after welding and prior to machining. All holes will be drilled. Punched or burned holes are not acceptable.
  - Mounting surfaces on the drive bases will be machined for the speed reducer and motor to ensure accurate alignment.
  - Adjustment bolts and shims will be provided on the drive bases to facilitate alignment of components.
  - All drive components will be installed and aligned on the drive base.
  - Lifting lugs will be provided on the drive bases for lifting the complete drive assembly including motor in a balanced condition.

3.4 Materials Specifications: Conveyor Components

- Conveyor Belt
  - Belt construction will be selected and rated for operation with hot vulcanized splices.
  - Conveyors equipped with steel cord belting will be equipped with mechanical or electronic rip detection systems as required.
  - Maximum standardization of belt type will be maintained for the various belt widths.
  - All belting will be constructed free of longitudinal and transverse twisting, wavy cords or other irregularities.
  - Belt will have sufficient flexibility for proper bending around pulleys and proper troughing on idlers at the angles specified.
  - Belt widths will be within a tolerance of ± 1%.
  - Belting with repaired carcass faults will not be acceptable.
  - Belting will be equipped with standard covers of suitable thickness.
  - Fabric belts will have molded rubber or cut edges.
- Take-Ups
  - Take-up travel will provide allowance for the belt splicing operation, permanent stretch, and stretch due to take-up tensioning, temporary stretch due to variation of conveyor loadings, and temporary stretch resulting from starting loads.
  - If a take-up trolley is required for mounting the take-up pulley, it will be equipped with self cleaning vee-groove wheels and hold-down rollers to prevent the trolley from derailing.
  - Where screw take-ups are required, they will be of the bottom guide type with a protected screw. They will also be suitable for mounting the standard pillow blocks described herein.
  - Hydraulically assisted screw take-ups will be provided for high tension belt feeders, if necessary.

- All wire ropes and wire rope hardware used for take-ups will have a minimum breaking strength of 5 times the imposed maximum load. Wire rope sheaves will have a minimum tread diameter of 24 times the wire rope diameter.
- Conveyors 30 m or less in length will be provided with screw take-ups. For conveyors over 30 m in length, or when constant belt operating tension is required, gravity take-ups will be provided.

- Tramp Iron Magnets
  - Tramp iron magnets will be of the suspended, electromagnetic type and positioned over the head pulley of conveyors where required.
  - The position of each magnet relative to the head pulley will be based on manufacturers' recommendations.
  - Where required, self-cleaning magnets will discharge tramp metal in the direction of conveyor belt travel.
  - Magnet support structures will be designed to allow easy removal of the magnet for maintenance and, in the case of manually cleaned magnets, de-energizing.

- Belt Weigh Scales
  - Belt weigh scales will be of the single idler, pivoted weigh bridge type with static test weight.
  - Belt weigh scales will be located where belt tensions are low and tension variations are minimal.
  - Belt weigh scales will not be located on or near concave or convex curves.

- Belt Scrapers and Plows
  - One primary scraper and one secondary scraper will be provided for the head pulley of each conveyor.
  - The primary scraper will be a single blade type that removes most of the loose material clinging to the belt.
  - The secondary scraper will be of the multiple-blade type with tungsten carbide scrapers.

- Both the primary and secondary scrapers will be supplied with all the required mounting and tensioning hardware.
- Scrapers will be located such that material cleaned off the belt will fall into the discharge chute. All areas of the discharge chute which contact scrapings will be lined with UHMW polymer.
- Vee-Plows will be installed on the clean side of the belt before tail pulleys.
- The design of the plow will be such that the steel frame will not come into contact with the belt after the rubber blade has completely worn out.
- Safety chains or other means will be installed to prevent the plow from travelling with the belt in the event of a mounting failure.
- Head pulleys on all conveyors will be arranged to allow easy access to belt scrapers from floor or walkway level.

- Chutework and Skirting
  - The transfer or lower portion of chutes for coarse ore conveyors will be fabricated from 10 mm thick mild steel plate, with 100 x 10 mm flat bar stiffeners. Split line flanges will be fabricated from 100 x 10 mm flat bar. Hoods or upper portions of chutes not subject to material contact will be fabricated from 6 mm thick mild steel plate, with 75 x 6 mm flat bar stiffeners.
  - Chutes for conveyors other than those handling coarse ore will be fabricated from 6 mm thick mild steel plate, with 75 x 6 mm flat bar stiffeners. Split line flanges will be fabricated from 75 x 6 mm flat bar.
  - Chute surfaces subject to material impact or abrasion will be lined with abrasion resistant metal liners.
  - Chute dimensions will be based on the maximum surge capacity of the related conveyor and on the type of material being transferred, with a minimum amount of throat constriction, sufficiently braced for impact loading. Supporting steelwork will be designed to withstand plugged chute conditions.
  - Chute fabrication will be of welded, dust tight construction in suitable sections for easy handling during erection and maintenance. If supported from the floor above, chutes will be split below the floor and provided with rubber seals for ease of removal.

- The section of chute immediately above the head pulley, from the horizontal centerline of the shaft and above, will be readily removable, without disturbing the remainder of the chute, to facilitate access to the head pulley.

- The drop height of material through chutes will be minimized to prevent damage due to high impact loads and to prevent excessive generation of dust.

- The rear wall of chutes on which fines tend to accumulate will be lined with UHMW polymer. The top edge of the liner will be located behind the rear face of the pulley and extended up to the return belt.

- Trajectories will be plotted for all conveyor discharge chutes. Both upper and lower limits of the trajectory will be shown.

- Transferred material will not strike the front plate of the chute. For crushed ore, the main discharge stream will strike material contained in a rock box. For concentrates, the transfer will be made in as direct a trajectory as possible, not interrupted by a rock box, feed plate or other device.

- Material discharging to stockpiles will not contact the chute.

- The valley angle within chutes will not be less than 65^{o}.

- The withdrawal angle used for material being discharged from storage will be 65^{o}.

- Chute widths will be standardized as much as possible for uniform liner sizes. Inside width of head chutes will be equal to pulley face width plus 75 mm.

- Chutes for crushed ore will be provided with a V-shaped loading plate, set between the skirts. The apex of the V will be located just ahead of the calculated trajectory of the conveyor discharge.

- If possible, discharge from scrapers will fall vertically down the main chute.

- Chute design will permit convenient installation, inspection and adjustment access to scrapers.

- Skirts will be fabricated from minimum 6 mm thick mild steel and provided with minimum 12 mm thick, adjustable rubber with a Shore Durometer Hardness value of 40, A scale. The distance between skirts will be set at 2/3 belt width. Skirts will be provided with a 3 mm thick top cover plate and dust take-off flange.

- Conveyors with multiple load points will have continuous skirting between the load points.

- Rubber dust curtains will be provided at chute entrances, at the rear of skirts and at belt exit points from the skirts. Dust seals will be provided where pulley shafts protrude through chute walls.
- Provision will be made for the installation of plugged chute detectors in the chutes.
- Chutes will be provided with at least one latched inspection door that does not require tools for opening or removal. Minimum opening size will be 450 x 450 mm
- Skirt lengths will be 2400 mm minimum.

3.5 Materials Specifications: Safety Components

- Deck Plates
  - Steel deck plate will be provided over load points and prior to discharge chute locations, mounted on top of the stringer, to prevent material from falling onto the return side belt. Minimum thickness of deck plate will be 3 mm.
  - Feeders and short conveyors will be provided with full-length deck plates.
- Guards
  - All hazardous revolving or reciprocating parts not guarded by the frame of the equipment or by remote location will be provided with guards.
  - Protection screens will be provided to prevent access to the areas directly under gravity take-up weights.
  - Where remote take-up weights are connected to the conveyor take-up trolley by cables, all sheaves will be guarded. Guarding of these areas will be by individual local guards or by area guarding.
  - Guards will prevent physical access to the nip points of pulleys. Where guarding is local to a pulley, it will extend not less than one metre from a nip point.
  - Guards that must be removed to perform regular maintenance will not normally exceed 20 kg and will never exceed 30 kg in mass.
  - Guards will be designed to provide quick and easy access to the equipment.
- Switches

- Pull cord switches will be mounted on all sides of a conveyor where personnel access is possible.
- Speed switches will be provided on all conveyors, either on the tail pulley or adjacent to a non-driven pulley.
- Belt misalignment switches will be provided near the head end and tail pulleys of conveyors.

- Galleries and Pre-Assembled Conveyor Stringers And Idlers
  - The Vendor must include within the scope of supply pre-fabricated tubular or other cross-section (e.g. Cam-Span or similar) galleries.
  - The galleries shall be designed and detailed for connection to structural steel work as required.
  - The galleries shall be supplied complete with conveyor stringers, troughing and return idlers.
  - The gallery cross section shall be such as to accommodate necessary cable trays, a walkway (2'-6") wide plus the belt conveyor. The relationship between the walkways and conveyors in each gallery shall be as shown on the layout drawings.
  - Lighting and associated wiring and terminal boxes, etc. shall be supplied as listed in the section below.
  - Support bents are to be supplied in locations shown on the drawings. Support on other structures shall be as shown on the drawings and in consultation with the engineer.
  - Included within the scope of supply is the head and tail frames for the conveyors, all stringer support legs and bracing. Walkways for the conveyor from the tail or head frame to the connection with the conveyor galleries. The chutes shall be supplied by others. The head and tail frame support legs shall be supplied which shall generally be supported on the platform steel provided by others.
  - Vertical take-up frames, complete with bearing supports, shall be compatible with Purchaser’s take-up guides. Details and size of the guides will be provided at a later date.
  - Conveyors shall be provided with a (2 mm, 3 mm) thick deck plate on the top of the stringers at all loading points and head end, where spillage is a safety concern. The

deck plate shall extend approximately 6 meters (20 ft) beyond the end of the skirt at loading points.

- All conveyors shall be housed in galleries supplied by the Vendor. Galleries and supporting steelwork shall be designed according to Simons Civil Specification 21.0-C-08, "Design & Supply of Conveyor Galleries & Support Bents".

- Assembly of all conveyor components shall be supplied as complete and operable units, including all necessary auxiliaries, and shall be shop assembled to the conveyors and belt feeders, where applicable.

- All bearings shall be fully shop lubricated as per the manufacturer's instructions.

3.6 Materials Specifications: Surface Preparations and Finish

- The painting system and colour for the conveyor hardware shall be of the manufacturer's standards with due regard for the duty and service as expressed in this specification.

- All exposed shafting and machined surfaces, including keyways, shall be protected from damage or corrosion during shipping by a coating of Rustveto or wrapping such as oil impregnated Denso tape. The manufacturers' standard surface preparation and paint shall be applied. (Unless a corrosive atmosphere exists).

- The painting system and colours for the fabricated steelwork shall be provided during the procurement.

4.0 SAFETY FACTORS

- All mechanical equipment will be design with appropriate safety factors typical of the design loads, usage, and equipment type.

5.0 EQUIPMENT AVAILABILITY

- Equipment will be designed to maximize availability and at minimum of 98% unless specified otherwise. Equipment maintenance schedules will allow for routine maintenance of all systems.

6.0 EQUIPMENT DESIGN CRITERIA

- Individual specifications will be written for all major equipment and will be the basis for the quoting and procurement of major equipment.

End of Section

REVISION INDEX

Revision No.	Date Revised	Engineering Specification	Signatures				
			Prepared By	Discipline Engineer	Project Engineering	Project Manager	PBM
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SCOPE

This design criteria outlines the basis for the overall design of piping systems, general requirements of components and drawings.

All measurements (lengths, flows, pressures, temperatures) will be expressed in units of the metric system.

The base design codes shall be CSA Standard B51-2003.

1.0 CODES AND STANDARDS

1.1 Requirements

- The components of piping systems will comply, as a minimum and as appropriate, with the following standards. In the event of a conflict between codes and the technical specifications, the requirements of the more stringent shall govern:

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASME B31.1	Code for pressure Piping “Power Piping”
ASTM B31.3	Code for "Chemical Plant and Petroleum Refinery Piping”
ASTM	American Society for Testing and Materials
AWWA	American Water Works Associations
AWS	American Welding Society
CSA	Canadian Standards Association
HIS	Hydraulic Institute Standards
NBC	National Building Code of Canada
NFC	National Fire Code
NFPA	National Fire Protection Association
PFI	Pipe Fabricators Institute
PPI	Plastic Pipe Institute
ULC/FM	Underwriters Laboratories Canada/Factory Mutual

1.2 Other Requirements

- Pressure piping systems, which are subject to design registration, shall be submitted for approval by the appropriate authorities.
- All drawings associated with fire protection shall be submitted to the local Fire Marshal and to the insurance underwriter for approval (not required for the DFS).

2.0 GENERAL DESIGN DEFINITIONS

2.1 Design Pressure

- Design pressure shall be the most severe condition of internal or external pressure under normal operating conditions.
- Normal operating condition is the most severe condition of pressure and temperature expected to exist when continuous operating conditions are in progress.
- Normal operating conditions do not include pipe pressure testing and abnormal system operation.
- Design pressure for unrelieved piping on pumped systems shall be the pump shut-off discharge pressure.
- Design pressure for vacuum piping shall be full vacuum pressure.
- Minimum design pressure shall be 1034 kPa.
- Where two piping systems of different design pressures are connected, the piping system with the higher pressure will extend to the first block valve on the lower system.

2.2 Design Temperature

- Design temperature will be the maximum temperature under normal operating conditions as defined above.
- Design temperature will be consistent though out the complete system.

3.0 PIPING MATERIALS AND METHODS

3.1 General

- Pipes, pipe components and valves will be classified primarily in accordance with material of pipe and components and each class group will be given a secondary classifications based on service performed and/or pressure/temperature ratings.
- The specification for the materials includes the following:
  - Piping Specification General

- Piping Materials Class Index
- Pipe Support Specification Index
- Line List
- Valve List
- Tie-in list
- Pipe Materials Specifications
- Valve Specifications
- Rubber Lining
- Thermal Insulation
- Painting Labels & Colours

4.0 PIPING DESIGN

4.1 Line Sizing Criteria

Table 1 – Line Sizes

Description		Velocity m/s
Slurries General	pump discharge gravity flow	1.2 - 2.1* 0.5 - 1
Process Solutions **Lines** **Air** **Steam** **Water**	pump discharge gravity flow pump discharge gravity flow	2.0 -2.5 2.0 -3.0 15.0 - 30.0 30.0 - 45.0 2.0 - 3.0 2.0 -3.0
Flocculant	pump discharge	0.25 - 0.5
Fuel Oil	pump discharge	1.0
Reagent	pump discharge	0.7

**Velocities dependent upon density. Specific gravity, particle size and pipe diameter calculated using Durand formula.*

4.2 Line Sizing

- All piping sizes will be expressed in nominal pipe size using Metric Units.
- Piping shall be sized for flowsheet design rated flow conditions. Provision for future increase capacity shall be made only when specifically requested by client.
- Nominal Pipe size diameters 125mm, 175mm, 225mm, 325mm, 550mm, shall not be used, except where required to connect to equipment. Conversion to standard piping shall be as near the equipment as possible.

- Minimum pipe size run shall be 25mm except for connections to equipment, instrument services, lube oil piping and auxiliary services such as pump and x-ray tube cooling.
- In pipe utilidors the minimum pipe size shall be 50mm
- Generally pipe sizing will be based on:
  - Historic data for similar projects.
  - Economics
  - Available pressure drop and power consumption
  - Velocity limitations
- Pump suction lines will be at least one size larger than pump suction flange size.
- Gravity piping shall be sized in general to provide maximum design flow at 50 – 60% full pipe.
- Control valve bypasses on slurry piping shall be line size and on solution, air, and steam piping shall be control valve size.

4.3 Pipe slopes

Table 2 – Pipe Slopes

Description	Nominal Size Fraction (mm)	Percent Solids (%)	Minimum Slope (angle)
Slurries	-	-	1 – 2
Solutions	-	-	0.5 – 1
Air and Vents	-	-	0.5 - 1
Steam and Condensate	-	-	0.5 – 1
Water	-	-	0.5 - 1

4.4 Launders

Launders are defined as an open channel for carrying suspended solids in water under gravity flow conditions. Although launder sizes are calculated, specified and verified by the Process and Mechanical Engineering groups, Launder design generally conform to the following guidelines:

- The quantity that will flow in an open channel is dependant on several factors, which are the cross-sectional area of the flow stream, the slope of the launders, the roughness condition of the sides and bottom of the launder and the shape of the launder as well as the flow characteristics of the pulp itself. The preferred shape of the launder is the semi-circular bottom-type, where possible. This particular shape reduces the hydraulic radius, thus allowing for a lesser slope and still maintaining a required velocity. Flat bottom launders may be used where connections to distributors are rectangular in

shape. Flat bottom launders may also be used where gravity flow pipelines are collected by a common launder.

- For each Launder, minimum geometric parameters to ensure adequate flow, including slopes and sizes, shall be determined by appropriate calculation methods – the Colebrook White Formula, Manning formula or an approved equivalent.
- Slurry launders will have a minimum total depth of four times the flow depth.

4.5 Slurry Piping

- All piping shall be routed as direct as possible to its destination minimizing the use of bends, abrasions and plugging.
- All piping shall be routed above ground whenever possible.
- Pipe bends shall have a minimum radius of three pipe diameters (3D) for pipe size 76mm and above. Five pipe diameters (5D) for pipe sizes 50mm and below unless layout constraints determine otherwise. Where necessary, material conducting hose will be used in place of bends.
- Piping will be jointed to allow the pipe to be rotated to distribute wear due to abrasion.
- Drain and flushing connections shall be provided on all pump suctions. Flushing connections shall be the quick disconnect type. Flushing and drain connections shall have ball type block valves. On larger slurry lines drain valves shall be knife gate type. All piping will be self draining with one high point.
- Block valves shall be knifegate type fitted with replaceable natural gum rubber sleeves which allow full port flow and eliminate seat cavities preventing packing of the sleeve with solids. On smaller line sizes full port fully enclosed body style replaceable natural gum rubber sleeve pinch valves shall be provided.
- Pump suction lines shall be minimum length and the use of bends or valves will be kept to a minimum. Suction piping shall be sloped down from the pumpbox to the pump suction inlet and have fabrication reducers with 10° included angle wherever possible.
- High abrasion slurries shall be C.S. extra heavy wall pipe butt welded and flanged, or Standard wall rubber lined pipe.
- Low abrasion slurries shall be standard wall pipe butt welded and flanged.
- Slurry lines outside of buildings or heated areas shall be either C.S. extra heavy wall pipe, C.S. Standard wall rubber lined, standard wall pipe, or HDPE flanged pipe and fittings. Wall thickness to suit pressure rating of system.
- Piping at pumps shall be arranged to avoid interference with access to pumps, the surrounding maintenance areas, and pull spaces during maintenance. Removable spool pieces to be provided where required (eg. pump suction and discharges) to permit maintenance with a minimum of piping disassembly.

- Suitable supports and anchors shall be provided for piping at pumps such that excessive weight and stresses will not be transmitted to the pump casings. Temporary start-up strainers will be provided on non-slurry pump suctions.
- The number and location of sampling connections shall be provided as per P&ID. All sampling points shall have an isolating or sampling value.

4.6 Gravity Flow Pipelines

- Pipelines carrying slurries will be designed to flow from 3% to 75% full, however they are generally sized 1/3 or 2/3 full.
- Slopes shall be identified on P&ID's with the minimum slope.
- Gravity flow pipeline slopes and sizes shall be determined by appropriate calculation methods – the Colebrook White Formula, Manning formula or an approved equivalent.

4.7 Solution Piping

- Pressurized solution lines shall be sized as noted in Table 1 with the exception for special conditions, such as high viscosity fluids, low pressure drop requirements, long lines where lower velocity would be used to optimize system and operating cost.
- All piping will be self draining. Drain and vent connections shall be provided at high and low points of the piping system to facilitate maintenance and hydro testing.
- Generally solution piping shall be standard wall carbon steel pipe and butt welded fittings. Pipe fittings 50mm and below shall be 3000 # socket welded or threaded. If solution is corrosive, use stainless steel or Hastelloy specifications.
- Block valves shall be ball type unless permitted otherwise by piping equipment specification.
- Pockets and dead ends shall be avoided.

4.8 Water Piping

- Where feasible, water systems primary headers shall be "looped" so that all branch lines are fed from two directions.
- Suitable allowance shall be made for future demands on the system such as spray bars. Design to have a 10% additional capacity to accommodate future loads.
- Generally water piping shall be standard wall carbon steel pipe with butt weld fittings. Pipe fittings 50mm and below shall be 3000# threaded. If water is corrosive, use stainless steel.
- Block valves shall be butterfly type for 50mm and above and ball type for 50mm and below.

- Combinations safety shower/eyewash stations are required adjacent to all locations where the release of harmful fluids, airborne dust, or non-toxic particles occurs.

4.9 Air Piping

- Compressed air piping shall be sized so that the pressure drop along the line shall not exceed 10% of the initial line pressure, with full capacity being delivered at the end of the line. Air piping shall be looped.
- All take-offs shall be from the top of the header for horizontal piping to avoid oil pockets.
- All instrument air branch piping shall be run to within 6 metres of the instrument and terminate with a valve. Where clusters of instruments occur a single centrally located valved connection shall be provided.
- All plant air piping shall be standard wall carbon steel pipe with butt weld fittings. Pipe fittings 50mm and below shall be 3000 # socket welded.
- All instrument air piping shall be standard wall carbon steel pipe with butt weld fittings. Fittings 50mm and below shall be 150# malleable iron threaded. Run out pipe and fittings from branch block valve shall be stainless steel tube and fittings.

4.10 Utility Piping

- Utility stations shall supply plant air and water at convenient locations on all floors such that all parts of the floor can be reached with a 15 metre flexible hose.
- All air and water utility stations shall be 25mm, equipped with 25mm ball valve and quick disconnect type hose connections.
- Utility headers shall be located on the top deck of pipeways whenever possible. The minimum size of process and utility headers on pipeways shall be 50mm.
- Propane shall be supplied from a vendor package which shall include all necessary storage tanks, pressurization pumps, vapourizers and first stage regulators.
- Propane distribution piping shall be threaded carbon steel Sch. 80 for sizes 50mm and below Sch. 40 for sizes 80mm and above. (ASTM A333M Gr. 6 for low temp applications)
- Where propane piping is buried underground, it shall be “Yellow Jacket” coated.
- Where propane serves a building it shall rise up outside the building and be provided with a shut off valve and a second stage regulator, before entering the building. The riser shall be protected from physical damage.

4.11 Steam Piping

- Steam piping shall be sized so that the pressure drop along the line shall not exceed 10% of the original line pressure, with full capacity being delivered at the end of the line.
- All take-offs shall be from the top of the header for horizontal piping to avoid condensate pockets.
- Steam piping shall slope in the direction of the flow.
- Drip legs and steam traps shall be provided at all low points and dead ends. Block valves shall be installed either side of steam traps.
- Discharge from steam traps shall tie into a lower pressure steam or condensate system.
- All steam piping shall be standard wall carbon steel pipe and butt welded fittings. Pipe fittings 50mm and below shall be 3000# socket welded.
- To minimize condensation and prevent erosion induced by relative movement all steam and condensate lines shall be fitted with pipe shoes and shall be fully insulated as indicated by HC on the P&ID's.

4.12 Personnel Protection

- Eye wash/emergency showers shall be provided in areas where operating personnel are subject to hazardous sprays or spills.
- Pipes carrying hazardous chemicals shall have dual containment and safety shields at all flanges mechanical joints and valves to protect personnel.
- Acid, lime, or other pipe lines carrying hazardous liquids shall be located close to grade level whenever possible. These lines shall be identified clearly with signs to avoid unnecessary risks.

4.13 Insulation and Heat Tracing

- Personnel protection shall be provided on uninsulated lines operating above 60°C where they constitute a hazard to the operating personnel during normal operating routine.
- Piping subject to freezing weather shall have insulation and heat tracing or the capability of being drained down.
- Insulation shall be used on heated lines to minimize heat losses.
- Cold water lines in concealed spaces shall be insulated with anti-sweat type insulation.

5.0 GENERAL PIPING LAYOUT

5.1 Installation

- Piping within buildings shall generally be installed in 6 metre (random) lengths, unless on a pipe rack or trestle where 12 metre lengths (double random, maximum) may be utilized. In highly congested areas or areas where maintaining piping will be difficult, 3 metre lengths may be used.
- Flange bolts holes shall straddle centre lines unless otherwise indicated on the drawings.
- Headroom clearance for piping in the aisles is 5 metres. Clearance of 2.1 metres is provided over operating platforms. Minimum clearance of 5 metres for Pipe Rack to road is required.
- All slurry and utility valves shall be accessible from floors and operating platforms (maximum height 1.5 metres). Spindle extensions and chain wheel operators are only to be installed where it is not practical due to space constraints.
- Piping shall be routed in piping corridors grouped together as practically allowable. The arrangement of the piping should allow operations and maintenance to be carried out with minimum of effort.
- Piping systems shall be designed to allow for expansion and contraction. Expansion effects due to exposure to direct to direct sunlight shall also be considered.
- Piping shall be arranged to maximize inherent flexibility. Expansion joints shall only be used when it is absolutely necessary.
- Piping shall not be routed through electrical rooms.
- All walls and floor penetrations shall be sleeved.
- All control valves shall have adequate clearance for disassembly without disturbing other equipment or piping.
- Valves shall be oriented so that stems and hand wheels do not project into platform or passageway areas. However, valves should be situated so that they are readily accessible.
- Vents and drain connections shall be provided at all high and low points on tanks. Drains shall never be less than 18mm in diameter. Vents consisting of plugged bosses shall be provided at the highpoints of all piping for hydrostatic testing. The plugs should be sealed after the hydrostatic test.
- Valved connections shall be provided on piping and equipment to be drained.
- After installation, all piping shall be cleaned by flushing with water until free of dirt, grit, welding slag, and foreign materials.

5.2 Pipe Identification

- Pipes shall be marked by a system of identification set out in the following standards:
  - ANSI Z53.1-1979, “Safety Colour Code for Marking Physical Hazards”,
  - ANSI A13.1-1981 (R1985), Scheme for the Identification of Piping Systems.
- Pipes shall be labelled as to contents and direction of flow as follows:
  - Hazard shall be identified using the following colour codes:

Table 3 – Classification of Hazards of Materials and Designation of colours

Classification	Background Colour	Colour of Letters for Legend
Materials of Inherently Hazardous		
Flammable of Explosive	Yellow	Black
Chemically Active or Toxic	Yellow	Black
Extreme Temperatures or Pressures	Yellow	Black
Radioactive	Yellow	Black
Materials of Inherently Low Hazardous		
Liquid or Liquid Mixture	Green	White
Gas or Gaseous Mixture	Blue	White
Fire Quenching Hazard		
Water, Foam, Carbon Dioxide, Halon etc.	Red	White

Table 3 – Size of Legend Letters and Banding

Outside Diameter of Pipe or Covering	Length of Colour Background	Size of Letters	Width of Banding Tape
mm	mm	mm	mm
10 to32	200	13	25
38 to 51	200	19	25
64 to 150	300	32	50
200 to 250	600	64	100
over 250	800	80	100

5.3 Labelling and Colour may be either:

Paint and stencil: Pipe is painted as per hazard colour code then text and flow direction arrows are stencilled in.

Adhesive labels: Hazard colour Code adhesive label with flow direction arrows, banding tape applied either side of label.

5.4 Location of text and arrows:

- maximum of 12 m centres on straight pipe;
- at all valves;
- at all changes in direction;
- at fittings for hose or other terminal connection;
- at 1.5 m above floor on vertical pipes;

- at 1.5 m from wall where pipe passes through the wall;
- at 1.5 m from equipment to which pipe is connected.;

When the contents of a container or pipe is a controlled product, there shall also be a WHMIS product identification label.

6.0 STRESS ANALYSIS

- Piping stress analysis shall be performed on lines of thermal expansion or lines where weight or fluid dynamics may cause excessive stresses.
- Piping stress analysis shall apply with applicable CSA codes.
- Piping stress analysis shall be done using computer program, manual calculation or calculation tables from the “Piping Guide” published by Syentek Inc.
- For pipe supporting guidelines, flexibility and pipe stress, refer to Piping Materials and Methods 40 05 02.
- The stress analysis of lines shall be carried out using Ceasar II.

7.0 VALVES

- Piping will be responsible for all manual general severe service gate, globe, check, butterfly, ball & diaphragm valves.
- On/Off activated valves (XV’s), control valves and PSV’s.
    - This package falls outside the piping scope. The Instrument and Process Engineering group shall be responsible for carrying out the control valve sizing. The Instrument Engineering group shall furnish piping with information required for piping hook-up.

End of Section

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SCOPE

1.0 DUST CONTROL

- This specification defines the design criteria, which shall be applied to dust control systems during detailed design of the Project

2.0 CODES AND STANDARDS

2.1 Requirements

- All systems and equipment shall be designed, manufactured and tested in accordance with the latest applicable sections of the following regulations, codes, standards or specifications. Equipment specifications shall include references to specific sections of the following codes and standards where appropriate.
- The publications listed below shall be the reference documents for the dust control design criteria. Each publication shall be the latest revision.

ACGIH	American Conference of Governmental Industrial Hygienists – Industrial Ventilation Handbook.
AISI	American Iron and Steel Institute
AISC	American Institute of Steel Construction, Inc.
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers, Inc.
ASNT	American Society for Non-destructive Testing, Inc.
ASTM	American Society for Testing and Materials
AWS	American Welding Society, Inc.
ISO	International Organization for Standardization
MSHA	Mining Safety and Health Administration
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
RMA	Rubber Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association, Inc. (Industrial Duct Construction Standards only)

- In the event of conflict between the codes, the requirements of the more stringent shall govern.

3.0 GENERAL DESIGN DEFINITIONS

3.1 General

- Design pressure shall be the most severe condition of internal or external pressure under normal operating conditions.
- The basic requirements of dust control systems shall be to:
  - Minimize emissions to atmosphere.
  - Minimize loss of product from the process.
  - Maintain stack emissions below established criteria.
  - Maintain air quality standards
- The dust control systems shall be designed based on the premise that the material handling equipment, such as screens, conveyors, chutes, and skirting, are designed and maintained to prevent spillage and loss of material, and that the skirting lengths and heights are suitable for the intended dust control systems.
- Aspirated systems shall be dedicated to individual process circuits, in order to provide flexibility with operations.
- Scrubber discharges to atmosphere shall not exceed 7% opacity.

3.2 Aspirated System

- Exhaust hoods shall be provided whenever the material handling process generates dust.
- All exhaust hoods shall be flanged and bolted.
- The velocity of air entering exhaust hoods shall be such that it does not remove excess material from the process flow.
- Hoods shall be provided at the rear of transfer chutes, wherever the fall of material exceeds 3 metres, or if the receiving conveyor is inclined.
- All dust conveying ducting shall be round.
- All ducting shall be flanged in lengths that will enable ease of installation and future removal.

- Duct diameters shall be sized to ensure complete conveyance of all collected dust, from the point of collection, to the dust collection equipment.
- In no case shall the duct velocity, in dust conveying ducting, be less than 20 m/s.
- The duct velocity in "clean" air ducting shall not be less than 15.3 m/s.
- Duct cleanouts shall be provided such that the internals of all sections of dust conveying ducting can be inspected and cleaned out.
- Air flow measuring ports shall be provided in all branch ducts and all main ducts, to enable trouble shooting and for each section of the system to be tested and balanced.
- Air flow test ports shall not be located within six duct diameters upstream of any turbulence and not less than two duct diameters downstream of any turbulence.
- Dampers shall be provided in all branch ducts for air flow balancing. The dampers shall only be blast-gate type, with means to lock the gates in the final balanced position.
- Branch entries into a main duct shall preferably enter at an angle of 30 degrees, but in no case shall the angle exceed 45 degrees.
- Branch entries shall enter a main such that the duct velocities are maintained throughout the fitting.
- The included angle for duct contractions and expansions shall not exceed 15 degrees.
- No two branch entries shall enter the main duct opposite each other in the same plane.
- 90 degree bends shall be constructed of seven segments of straight ducting, (5 equal segments and 2 half segments) and shall have a centreline radius of two and a half times the duct diameter.
- Bends of less than 90 degrees shall be constructed of a pro-rated number of segments of straight duct, and have a centreline radius of two and a half times the duct diameter.
- Exhaust stacks from dry dust collection equipment, shall not have any impediment to straight through flow. The only allowable arrangement of weather protection is the stack head configuration, where the head length is at least four times the stack diameter and the head diameter is 25 mm larger than the stack diameter.
- Exhaust stack discharge velocities shall be at least 15.3 m/s.
- Exhaust stacks from dust collection equipment shall be equipped with sample ports for emission testing. The sample ports shall be 100 mm half couplings, welded to the stack at a distance of at least 4 duct diameters downstream of any turbulence and at least 2 duct diameters upstream of the point of discharge.

- Emission sample ports shall be accessible from a platform with hand railing and access ladder.
- Fan inlet ducts shall be configured to prevent uneven loading of the fan wheel.
- Fan discharge ducts shall remain straight for at least one fan inlet diameter before any bend, and that bend shall only be turned in the direction of fan rotation.
- Where ducts or fittings are rubber lined, the design duct velocities relate to the internal diameter of the rubber lining.
- Where fittings-only are rubber lined, the internal diameter of the rubber lining shall be the same diameter as the adjacent non-lined duct.
- Rubber lining shall be shop applied using the hot-cure process. Prepare internal surfaces to SSPC-10.
- All exposed edges of rubber linings shall be protected from the air stream.
- All exterior surfaces of ducts shall be prepared to SSPC-3 prior to application of paint.
- Paint shall be applied to all exterior duct surfaces.
- Ducts shall be supported at the following intervals: 3 m spacing for 200 mm diameter and smaller: 4.5 m for 210 mm diameter through 480 mm and 6 m spacing for ducts larger than 480 mm diameter.
- Duct supports shall be designed for the weight of the ducting and fittings, plus the following allowance for material:

Mains Dust Load	% Full:33 Vertical & 33 Horizontal
Sub mains Dust Load	% Full:50 Vertical & 50 Horizontal
Branches Dust Load	% Full:100 Vertical & 100 Horizontal

Vertical ducts shall be supported at the base of the riser.

3.3 Specific Application of Dust Control Systems

- Dust control shall be provided in the following areas of the project:
- Primary Crusher – Dry Dust collector and exhaust fan
  - Truck Dump Pocket – Water Sprays in summer only
  - Crusher discharge onto Apron Feeder – Dry Dust collector and exhaust fan
  - Apron Feeder discharge onto Stockpile Feed Conveyor – Dry Dust collector and exhaust fan
- Coarse Ore Stockpile

  - Water Sprays – Summer Only
- Coarse Ore Stockpile Reclaim - Dry Dust collector and exhaust fan
  - Head end of apron feeders (3 Qty)
  - Chute onto receiving belt from apron feeders (3 Qty)
- Screening Grinding – Dry Dust collector and exhaust fan
  - Head end of coarse ore reclaim conveyor
  - Primary sizing screen No 1
  - Primary sizing screen #2
  - Oversize discharge chute onto primary sizing screen o/s conveyor from screen #1
  - Oversize discharge chute onto primary sizing screen o/s conveyor from screen # 2
  - Undersize discharge chute onto primary sizing screen o/s conveyor from screen #1
  - Undersize discharge chute onto primary sizing screen o/s conveyor from screen # 2
  - Receiving belt at discharge of primary sizing screen o/s conveyor onto cone crusher surge bin feed conveyor
  - Tail end of Cone crusher surge bin feed conveyor
  - Receiving belt at discharge of primary sizing screen u/s transfer conveyor
  - Tail end of HPGR surge bin feed conveyor
  - Head chute of HPGR discharge conveyor
- Cone Crusher Surge Bin
  - Aspirated Bin Vent
- HPGR Surge Bin
  - Aspirated Bin Vent
- HPGR Building – Dry Dust collector and exhaust fan
  - Head chute of cone crusher belt feeder No 1
  - Head chute of cone crusher belt feeder No 2
  - Receiving belt at discharge from cone crusher No 1
  - Receiving belt at discharge from cone crusher No 2
  - Discharge of HPGR belt feeder
  - HPGR
  - Discharge of HPGR onto HPGR discharge conveyor
  - Tail end of HPGR discharge conveyor

- Molybdenum Concentrator Dryer – Dry Dust collector and Exhaust Fan
  - Body of dryer
  - Molybdenum concentrate bin
  - Bagging machine
- Loadout - Dry Dust collector and Exhaust Fan
  - Stockpile area
- Lime Silo – Aspirated Bin Vent and Exhaust Fan

End of Section

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SCOPE

1.0 HVAC

- The Fire protection Design Criteria establishes the engineering standards and practices to be followed in the execution of the following:
  - Fire protection design/build packages
  - Detailed design
  - Standard detail drawings

2.0 CODES AND STANDARDS

- All systems and equipment shall be designed, manufactured and tested in accordance with the latest applicable sections of the following regulations, codes, standards or specifications. Equipment specifications shall include references to specific sections of the following codes and standards where appropriate.

NBC	National Building Code
CEC	Canadian Electrical Code
NFC	National Fire Code
NFPA	National Fire Protection Association
FM	Factory Mutual – Relating to equipment / material approvals only
UL/ULC	Underwriters Laboratories/ Canada

- In the event of conflict between the codes, the requirements of the more stringent shall govern.

3.0 GENERAL REQUIREMENTS

3.1 General

- Operation of any fire protection device, including tamper switches, pressure switches, flow switches and alarm valves shall be supervised and monitored by a central fire alarm panel, (CFP) which will be monitored 24 hours a day.
- In addition to requirements of this design criteria, NFPA 13 shall be the design standard for all sprinkler systems. The most stringent requirements shall prevail.
- In addition to requirements of this design criteria, NPFA 14 shall be the design standard for all standpipe systems. The most stringent requirements shall prevail.

- All automatic sprinkler system control valves, standpipe water supply control valves, and fire water tank isolating valves shall be provided with padlock and chains.
- All hydraulic equipment and lube oil systems with fluid reservoirs over 378 litres, or a combined total in excess of 378 litres within 6 metres, shall be protected with automatic sprinklers with 71 degrees Celsius heads. Sprinklers shall extend 3 meters beyond the hazard or to the closest solid wall, whichever is closest.
- Mechanical equipment, such as hydraulic units, lube units and conveyors, which are protected by sprinkler systems, shall be equipped with interlocks to automatically shut down the equipment in the event of sprinkler flow.
- UL/ULC approved fire stop systems, with UL/ULC listed and/or FM approved materials, and UL/ULC listed fire/smoke dampers shall be provided wherever fire rated walls or floors are penetrated by piping, cables and ductwork. Combustible insulation or sealants, such as polyurethane foam, will not be accepted.
- All construction material for electrical rooms, including insulation, shall be constructed of 100% non-combustible materials.
- Hand held all-purpose ABC fire extinguishers shall be provided in all buildings for local emergency fire fighting. Fire extinguishers shall be located at spacing as specified by NFPA 10, with additional units being located at each exit door from the area.
- Clean agent hand held fire extinguishers shall be provided in all electrical rooms and control rooms, with spacing in accordance with NFPA 10, plus additional units being located at each exit door from the area.
- Water velocities shall not exceed 6 metres per second in any section of above ground fire protection piping.
- The entire fire protection system shall be designed in accordance with the seismic requirements of NFPA 13 and FM data sheet FM-2-8.
- All fire protection equipment and materials shall be UL/ULC listed and / or FM approved for the intended purpose.
- Hydraulic sprinkler calculations shall include for internal and external hose allowance of 113.5 cubic metres per hour, taken at the base of the riser.
- Where conveyor belts are enclosed in galleries, sprinklers are required - the design shall include for 10 heads flowing on horizontal belts with a minimum pressure of 69kPag, and 15 heads flowing on belts, inclined at more than 10°, with a minimum discharge pressure of 103 kPag at the most hydraulically remote head.
- Provide 305 mm x 305 mm x 50 mm high heat collector plates, constructed of galvanized sheet metal, wherever the vertical distance between the sprinkler heads and a solid horizontal surface exceeds NFPA requirements. Ensure that the plates are supported such that the sprinkler discharge pattern is not disrupted.

- All buildings and structures in excess of 14 meters in height, or have any dimension in excess of 30 metres, will be provided with wet class 2 standpipe systems with fixed hoses. Hoses shall be located such that all areas at all levels of the buildings, enclosed conveyor transfer towers and enclosed structures are within reach of a fire hose stream.
- Mineral oil insulated transformers shall be physically separated from each other, and from adjacent buildings and property lines, in accordance with NFPA 851, otherwise physical barriers shall be provided, in accordance with NFPA 851. Spill containment shall be provided in accordance with NFPA 851.
- Exterior non-enclosed belt conveyors and non-enclosed transfer towers, within 12 metres of grade, will be protected with fire hoses which will be manually connected to yard hydrants.
- Exterior non-enclosed belt conveyors and non-enclosed transfer towers, beyond 12 metres of grade will be protected with dry standpipes from grade elevation. The standpipe will be manually connected to a yard hydrant with in 15 m. Spacing between standpipes shall not exceed 72 metres.
- Cable trays shall be protected by hand held fire hoses. Where cable tray configurations are so congested, or in tunnels, where fire fighting with hand held fire hoses becomes impractical, the cables shall be sprinklered.
- The fire protection systems shall be designed and installed by professionals who are experienced in the proper design, installation and testing of fire protection and fire alarm systems.
- All like-equipment shall be by the same manufacturer.
- The sprinkler system piping will be hydraulically sized, designed, installed and tested by the “Fire Protection” contractor .
- Buildings in excess of 465m² shall be constructed of non-combustible construction - or be protected by an automatic sprinkler system.
- Flow switches in individual sprinkler systems shall include a shut off valve with padlocks and chains.
- All sprinkler systems shall include an inspectors test connection, located at the most hydraulically remote part of the system.
- Where clean agent suppression systems are specified, the system shall conform to NFPA 2001, and in addition, the agent shall have an ozone depletion potential (ODP) of zero and a global warming potential (GWP) of no greater than one.

3.2 Water Supplies

- The fire water storage tank will be sized to provide a minimum live dedicated storage capacity of 120 minutes of maximum fire water flow.

- Where the water pressure exceeds 690kPag at a class 2 hose connection the pressure shall be regulated using UL/ULC listed pressure reducing angle valves to limit the pressure to a maximum of 690kPag.
- Fire water piping and valves shall be rated for the maximum system pressure anticipated.
- The fire water supplies will be designed, supplied, installed, and tested in accordance with NFPA 24.

3.3 Plant Site Fire Water Supply Loop

- A buried firewater loop will serve yard hydrants, and will also feed buildings and structures with fire water for automatic sprinkler systems and standpipe systems.
- The buried fire water supply piping shall be installed a minimum of 0.5m below the frost line.
- A single, buried, fire water supply pipe will leave the fire water tank, and split into a distribution system which will be looped, and sectionalized, in such a way as to supply water to the majority of the plant-site from two directions, and have a maximum of six branches out of service at any one time between isolating valves.
- Yard hydrants which serve high risk areas such as fuel tanks, shall be equipped with a minimum of two monitors each capable of being adjusted and locked in both the vertical and horizontal directions.
- Yard hydrants will be spaced at a maximum distance of 90 metres apart, and, where possible, at a minimum perpendicular distance of 12 metres from the protected facility. The branch connections to the hydrants shall be at least 150 mm diameter.
- Yard hydrants shall be dry barrel type.
- Supply piping serving building systems shall include a post indicator valve, located at the branch connection to the mains.
- Fire hydrants, monitors, and post indicator valves shall be protected from vehicular damage with bollards.
- All buried piping will be HDPE. All risers and above grade piping will be steel. The pipe sizes shall be hydraulically verified but in no case shall they be less than 150 mm diameter.

4.0 SPECIFIC FIRE PROTECTION METHODS

4.1 General

- Yard hydrants will be the prime system for first response to a fire situation – yard hydrants will be located throughout the plant site to provide manual fire fighting capabilities to all buildings and structures.
- Hand held fire extinguishers will be provided in all areas, at all levels of structures, transfer towers and along all conveyor walkways.

4.2 Fuel Storage

- Physical separation and containment dykes will be provided as passive fire protection.
- Two Yard hydrants, with monitors will protect the fuel storage tanks from diagonally opposite locations.
- Provide a 63kg mobile (wheeled) foam fire extinguisher for manual fire fighting.

4.3 Primary Crushing

- Automatic Wet Sprinklers will be provided to protect the crusher lube unit, the apron feeder lube unit and the lube oil coolers – design density, 8.2 mm/min over 232m^2 – 71 degree Celsius heads.
- Automatic Wet Sprinklers will be provided to protect the floor area which contains the crusher apron feeder and the tail end of the stockpile feed conveyor, within the crusher building – design density, 8.2 mm/min over entire area – 71 degree Celsius heads.
- A yard hydrant located in the vicinity of the primary crusher truck dump, will protect the control room and the haulage trucks.

4.4 Stockpile Feed Conveyor

- The section of the conveyor that is within 12metres of grade will be protected from hand lines which will be manually connected to yard hydrants along the length of the conveyor.
- The section of conveyor that is above 12metres from grade will be provided with dry standpipes, terminating at grade with 100 mm hose connections and at the conveyor level with 2 x 40mm hose valves.

4.5 Stockpile Reclaim

- Automatic Wet Sprinklers will be provided to protect each level of the reclaim area (reclaim apron feeders and belt conveyor with tunnel) – design density, 8.2 mm/min over entire area – 71 degree Celsius heads.

4.6 Conveyor Galleries

- The sections of conveyors that are within buildings or within a conveyor gallery, shall be provided with a wet sprinkler system along its entire length at a design criteria of 15 heads flowing with103kPag at the most hydraulically remote head.
- Enclosed take up towers shall be provided with fire hose cabinets such that all levels are reachable by a fire hose stream. It is permissible to take the hose up one level and down one level from the cabinet location.

4.7 Mill Building

- Automatic Wet Sprinklers will be provided to protect each of the Mill Lube units, the regrind mill lube units and the lube oil coolers – design density, 8.2 mm/min over lube unit plus 3 metres all around it – 71 degree Celsius heads.
- Automatic Wet Sprinklers will be provided above the kerosene holding tank and the pine oil holding tank.
- Automatic Wet Sprinklers will be provided above the compressor and lube room area.
- Automatic Wet Sprinklers will be provided in the blower room area.
- The control room and the sub-floor will be protected by an automatic clean agent suppression system.
- Automatic Wet Sprinklers will be provided in the elevated lunch room and offices.
- Provide smoke detectors in the electrical room.
- Provide a wet, Class II standpipe hose system throughout the building such that all equipment and all areas are within reach of a hose stream.

4.8 HPGR Building

- Automatic Dry Sprinklers will be provided to protect each of the HPGR Lube units, the Cone crusher lube units, and the lube oil coolers – design density, 8.2 mm/min over lube unit plus 3 metres all around it – 71 degree Celsius heads.
- Automatic Dry Sprinklers will be provided to protect each of the conveyor belts – design density 69kPag at the most hydraulically remote head with 10 heads flowing.
- Provide a dry, Class II standpipe hose system throughout the building such that all equipment and all areas are within reach of a hose stream.

- Provide smoke detection in the electrical room.

4.9 Administration Offices

- Smoke detection will be provided throughout the building.
- The IT server room and the sub-floor will be protected by an automatic clean agent suppression system. The clean agent storage cylinder shall be located within the server room.
- Yard hydrants will protect the area from outside.

4.10 Laboratory

- Automatic Wet Sprinklers will be provided throughout the building – design density, 8.2 mm/min over 186 m2.
- Class 2 wet standpipe hose systems will be provided so that all interior areas of the building are within reach of a hose stream.
- Yard hydrants will protect the area from outside.

4.11 Truck Shop and Warehouse

- Automatic Dry Sprinklers will be provided to protect all floor areas of the truck shops – design density, 8.2 mm/min over 361m2.
- Automatic Dry Sprinklers will be provided to protect the warehouse and office areas – design density, 8.2 mm/min over 241m2.
- Provide a wet, Class II standpipe hose system throughout the building such that all equipment and all areas are within reach of a hose stream.
- Yard hydrants will protect the area from outside.

5.0 INSTALLATION AND TESTING

- Design, install, inspect and test to acceptance, in accordance with all applicable standards including NFPA 13, The Canadian Electrical Code and the National Building Code of Canada. The equipment installations shall also be in accordance with the manufacturers' recommendations.
- Provide "Contractors Material Test Certificate" in accordance with NFPA 13, for insertion into the Contractor supplied O & M Manual.
- Assemble the systems so that no excessive stress is imposed on connections. Carry out all Work required to place the fire protection equipment in proper operating condition.

- Carefully and accurately set the fire protection equipment in place, plumb and to the required elevations. Supply and set anchors and supports as required.
- Install flow switches, pressure switches and tamper switches into the system at accessible locations.
- Charge air for dry sprinkler systems shall be from a reliable source of compressed air complete with all necessary automatic controls.
- Provide quick-opening devices for dry sprinkler systems if, after testing, it is determined that water is not delivered to the system test connections within the time frame allowed by NFPA.
- All exposed fire piping shall be prepared, primed, and finish painted. The paint colour shall be fire red, equal to Devoe 7100.

End of Section

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SCOPE

1.0 HVAC

- The scope of Heating, Ventilation and Air Conditioning for the project site will include:
  - Primary crusher
  - Stockpile Reclaim
  - Conveyor galleries
  - Truck Shop and warehouse
  - Mill Building
  - Administration building
  - Assay Laboratory
  - Pump House
  - Truck Wash
  - HPGR Building

1.1 HVAC DESIGN CONDITIONS

- The following outdoor conditions will apply to the design of HVAC systems:

Summer design outdoor dry bulb temperature	31°C
Summer design outdoor coincidental wet bulb temperature	18°C
Condensing temperature (air temperature)	35°C
Winter design outdoor temperature	Minus 32°C

- Building heating and cooling systems shall be designed with sufficient capability to maintain the indoor conditions and the minimum ventilation rates as shown in Table

Table 1

Service	Minimum Room Temp. °C (Winter)	Maximum Room Temp. °C (Summer)	Min. Winter Air Changes Per Hour / Flow rate (Outdoor)	Min. Summer Air Changes Per House / Flow rate (Outdoor)	Air Conditioning
HPGR Building	Not heated	36	1 a/c	4 a/c	No
Mill Building	5	36	1 a/c	4 a/c	No
Lube unit rooms	5	36	**	**	No
Conveyor Galleries	5	36	0.25 $\ell/s/m^2$	**	No

Service	Minimum Room Temp. °C (Winter)	Maximum Room Temp. °C (Summer)	Min. Winter Air Changes Per Hour / Flow rate (Outdoor)	Min. Summer Air Changes Per House / Flow rate (Outdoor)	Air Conditioning
Conference / Board rooms	20	26	10 ℓ/s/pers	**	Yes
Communication Rooms	20	26	0.25 ℓ/s/m^2	**	Yes
Storage Rooms	15	28	0.25 ℓ/s/m^2	0.25 ℓ/s/m^2	No
Open or Private Offices	20	26	10 ℓ/s/pers	10 ℓ/s/pers	yes
Washrooms	18	30	15 a/c	15 a/c	no
Lunch Rooms	20	26	10 ℓ/s/pers	10 ℓ/s/pers	Yes
Utility Rooms	15	30	0.25 ℓ/s/m^2	0.25 ℓ/s/m^2	no
Janitor Rooms	15	30	15 a/c	15 a/c	No
Laboratory	20	36	**	**	No
Corridors	18	26	0.25 ℓ/s/m^2	0.25 ℓ/s/m^2	yes
Ambulance/Fire Truck Storage	15	36	3.9 ℓ/s/m^2	3.9 ℓ/s/m^2	No
Sample Prep	15	36	2.5 ℓ/s/m^2	2.5 ℓ/s/m^2	No
Ore sample room	15	36	10 ℓ/s/pers	10 ℓ/s/pers	No
AA Room	20	26	10 ℓ/s/pers	10 ℓ/s/pers	Yes
Assay	15	36	10 ℓ/s/pers	10 ℓ/s/pers	No
Wet Lab	15	36	**	**	No
Balance Room	20	26	10 ℓ/s/pers	10 ℓ/s/pers	Yes
LECO room	20	26	10 ℓ/s/pers	10 ℓ/s/pers	Yes
Concentrate Sample room	15	36	**	**	No
Concentrate Drying room	15	36	**	**	No
Locker Rooms	18	36	2.5 ℓ/s/m^2	2.5 ℓ/s/m^2	No
Electrical Rooms	15	36	0.25 ℓ/s/m^2	**	No
Battery Room	18	24	6 a/c	6 a/c	Yes
Control Rooms	20	24	10 ℓ/s/pers	10 ℓ/s/pers	Yes
Substation	15	36	0.25 ℓ/s/m^2	**	No
Emergency Power Plant	10	36	0.25 ℓ/s/m^2	**	No
Lube Storage	10	36	0.25 ℓ/s/m^2	0.25 ℓ/s/m^2	No
Vehicle Bays	15	36	7.5 ℓ/s/m^2	7.5 ℓ/s/m^2	No
Warehouse	15	36	0.25 ℓ/s/m^2	0.25 ℓ/s/m^2	No
Vehicle Repair Shop	15	36	7.5 ℓ/s/m^2	7.5 ℓ/s/m^2	No
Compressor Rooms	15	36	4 a/c	**	No
Welding Bay	15	36	7.5 ℓ/s/m^2	7.5 ℓ/s/m^2	No
Pump House	10	36	0.25 ℓ/s/m^2	**	No
Water Treatment Plant	10	36	0.25 ℓ/s/m^2	**	No
Sanitary Sewage Treatment Plant	10	36	0.25 ℓ/s/m^2	**	No
Potable Water Treatment Plant	10	36	0.25 ℓ/s/m^2	**	No
Truck Wash	10	32	**	**	No

** Denotes air flow rate is dependent upon heat gains or exhaust flow rates within space

- Ventilation shall be greater than the above minimum where necessary to restrict contaminants or control space temperatures, in accordance with Occupational Health and Hygiene requirements.
- Occupied area such as offices will be provided with filtered outdoor air at a supply rate of no less than required by ASHRAE Standard 62-2001.
- Contaminants will be exhausted from as close to the source as possible.
- "Dirty" spaces (such as lockers, washrooms, change rooms and laboratories) will be maintained at a negative air pressure relative to adjacent "cleaner" spaces.
- Washrooms, showers and "dirty" locker room areas will be exhausted at a rate of no less than 15 air changes per hour.
- Ducting which conveys moist air, such as shower exhausts, will be constructed to slope back to the moisture source and be constructed of aluminium.
- Heat gain and heat loss calculations will be performed in accordance with ASHRAE methods and coefficients, including a 5% safety factor.
- Heat gain calculations will include all known internal gains from people, appliances, lighting, transformers, electrical equipment, hot equipment and piping.
- Cooling systems will be sized for the maximum simultaneous heat gains, including solar gains, infiltration and all internal loads.
- Heat loss calculations will not include for any internal or external heat gains.
- HVAC systems will be "zoned" with respect to solar heat gains. The zone widths will not exceed 5 metres from the north, south, east and west outside walls. The interior zone will not be integral with any other zone.
- Air conditioning supply air ducting will be insulated where routed through non-air conditioned spaces, or outdoors.
- All ducts handling outdoor air will be externally insulated to prevent condensation.
- All outdoor air intake openings will be provided with snow hoods with a maximum capture velocity of 2.54m/s. Bird screens will be removable, and also be provided with a minimum opening of 20mm x 20mm, to minimize the potential problems associated with haw frost.
- Sound levels within occupied spaces will not exceed values recommended by ASHRAE - sound absorbing internal duct liner will be used to reduce duct conveyed sound, and if that proves insufficient, sound attenuators will be provided.
- Electrical rooms and control rooms will be pressurized with filtered air to minimize ingress of dust.
- Air handling fans will be shutdown in the event of a fire alarm, in accordance with NFPA requirements.
- Fire dampers will be provided wherever a fire separation is penetrated.

- Areas where the flow rate and/or temperature of the return air to air handling units is insufficient to bring the outdoor air up to room temperature, the supply air will be heated by other means (electricity or propane).
- Air temperatures in mechanically ventilated (non-air conditioned) spaces will not exceed the coincidental outdoor air temperature by more than 5 degree Celsius.
- The density of the air at the site elevation will be taken into consideration when calculating heat transfer volume flows.
- Air conditioning will be limited to areas where internal heat gains are high, or where it will be impractical to offset the loads with outdoor air only – these areas could include electrical rooms, control rooms and offices.
- Air conditioning systems will utilize air-cooled condensing units.
- Control systems for the HVAC systems will be electronic and electric.
- HVAC equipment will be heavy duty, suitable for an industrial environment. Residential and light commercial equipment will not be specified.
- Air filters will be sized for a maximum face velocity of 2.54m/s.
- Supply, exhaust and return air ducting systems will be designed to minimize duct sizes without generating air noise and without creating excessive pressure losses.
- The heating medium for the majority of the plant will be propane. Electricity will be used for smaller spaces, electrical rooms and remote areas of the site.
- Propane will be stored in a central storage area with two vaporizers and first a stage pressure reducing station. The distribution piping will be maintained at 69kPag. The second stage regulators are each of the heated buildings will be set to 34kPag.
- Air to air heat recovery will be implemented where the exhaust air stream is not contaminated.
- Energy efficient systems will be utilized wherever possible, including free cooling controls, heat pumps, capture of stratified air, air to air heat exchangers and air compressor heat recovery ducting.
- Provision for testing and balancing will be incorporated into all sections of all ducting systems.

2.0 SYSTEMS

2.1 Space Heating

- The HPGR building will be unheated.
- All other enclosed process type buildings, including conveyor galleries, will be heated to a minimum of 5 degrees Celsius whenever the outdoor air temperature is at, or above the specified winter design condition.

- Process and ancillary plant site buildings will be heated using propane gas as the heating medium.
- Heaters will be located around the perimeter of the buildings to counteract heat losses from the building walls and doors.
- Offices shall be provided with thermostatic control with each office having the same exposure and occupancy. Each conference, training, assembly type room and specialty rooms shall be treated as separate zones.
- The outdoor air volume, for making up air that will be exhausted from the building, will be heated before being supplied into the building during cold weather. The air will be heated by air handling units, or direct fired make up air units.
- Air from laboratories shall not be recirculated and the air pressure shall be negative with respect to corridors and non-laboratory areas.
- Water heating for large end-users such as such as showers, kitchens will be performed with propane fired hot water heaters.
- Water heating for small end-users such as individual washrooms or lunch rooms will be performed with electric hot water heaters.
- Filtration systems to control the influx of dust particulate through outdoor air shall be no less than 30% efficiency per ASHRAE 52-70 rated Dust Spot Efficiencies:

End of Section

REVISION INDEX

Revision No.	Date Revised	Engineering Specification	Signatures				
			Prepared By	Discipline Engineer	Project Engineering	Project Manager	PBM
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1.0 GENERAL INFORMATION

1.1 Location

- Pacific Booker Mine Inc. (PBM) Morrison property is located in Central British Columbia approximately 65 km northeast of Smithers and 35 km north of Granisle. The Morrison deposit elevation ranges from approximately 795 m to 890 m above see level at the top of the southeast ridge of the deposit.

1.2 Climatic Conditions

- The following design data for the town of Smithers and are taken from Appendix C, Table C-2, National Building Code of Canada (NBCC) 2005 Volume 2. Project site specific climatic data subjects to confirmation by the Meteorological Service of Canada.
- Precipitation

15 Min. Rain	13 mm
One Day Rain	64 mm
Annual Rain	325 mm
Annual Total Precipitation	500 mm

- Design Temperature

Minimum (Jan. 1%)	-31°C
Maximum (July 2.5% dry)	25°C
Degree Days Below 18°C	5200

- Snow Loads

Ground Snow Load – Ss (1/50)	3.2 kPa
Rain Load – Sr (1/50)	0.2 kPa

- Wind

Hourly Wind Pressure (1/10)	0.31 kPa
Hourly Wind Pressure (1/50)	0.40 kPa

- Seismic

5% Damped Horizontal Spectral Acceleration Sa (0.2 s periods)	0.12
(0.5% s periods)	0.078
(1.0% s periods)	0.055
(2.0 s periods)	0.035
Peak Ground Acceleration GA	0.059

1.3 Foundation and Soil Data

- Foundations governed by static loads, dynamic loads and transitory loads produced by wind or earthquake shall be designed in accordance with the Plantsite Foundation Report, dated December 7, 2008 by Geotechnical Consultant, Klohn Crippen Berger.
  - Bearing resistances (ULS – Ultimate Limit State):
    - Sandstone – 700 kPa
    - Undisturbed Till – 400 kPa
    - Structural Fill – 200 kPa
- Minimum depth of footing below finished grade (frost depth) – 2 m.

2.0 STRUCTURAL STEEL AND CONCRETE

2.1 Scope and Battery Limits

- As indicated on the general drawings required for the proposed process plant and associated infrastructure.

2.2 Codes and Standards

- All work will be carried out in accordance with the latest edition of the following standards, specifications and codes:
  - National Building Code of Canada (NBCC)
  - Supplement to the National Building Code of Canada (SNBCC)
  - Canadian Standards Association (CSA) Standards
  - Occupational Safety and Health Administration Standards (OSHA)

- American Society for Testing Materials (ASTM)
- Mine Safety and Health Administration (MSHA)
- National Fire Protection Association (NFPA)
- Society for Fire Protection Engineering (SFPE)
- Canadian Institute of Steel Construction (CISC)
- National Lumber Grades Authority (NLGA)
- American Petroleum Institute (API)
- American Water Works Association (AWWA)

CAN/CSA-A23.1	Concrete Materials and Methods of Concrete Construction
CAN/CSA-A23.2	Methods of Test for Concrete
CAN/CSA-A23.3	Design of Concrete Structures
CAN/CSA-G30.5	Welded Steel Wire Fabric for Concrete Reinforcement
CAN/CSA-G30.18	Billet Steel Bars for Concrete Reinforcement
CAN/CSA-086.1	Engineered Design in Wood (Limit States Design)
CAN/CSA-S304.1	Masonry Design for Buildings (Limit States Design)
CAN/CSA-S16.1	Limit States Design of Steel Structures
CAN/CSA-S136	Cold Formed Steel Structural Members
CAN/CSA-G40.20	General Requirements for Rolled or Welded Structural Quality Steel
CAN/CSA-G40.21	Structural Quality Steels
CAN/CSA-W59-M	Welded Steel Construction
API 650	Welded Steel Tanks for Oil Storage
AWWA D100	Welded Steel Tanks for Water Storage
ASTM A36	Structural Steel
ASTM A53	Specification for Steel Pipe, Welded & Seamless
ASTM A307	Specification for Carbon Steel Bolts and Studs
ASTM A325 M	Specification for High-Strength Bolts for Structural Steel Joints
CGSB/CISC/CPMA	Standards for Primer and Paint
SSPC	Specifications for Cleaning Steel Surface

- Reference Handbooks
  - Concrete Design Handbook by CPCA
  - Handbook of Steel Construction by CISC
  - Wood Design Manual by Canadian Wood Council
  - Engineered Masonry – Limit State Design
  - Soils Reports and correspondences by Klohn Crippen Berger.

2.3 Design

- Preliminary design will be carried out for reinforced concrete structures, foundations, structural steel supports, steel structures, access ways and platforms for:
  - Primary crushing
  - HPGR building
  - Mill building
  - Stockpile tunnel
  - Conveyors
  - Explosives store
  - Maintenance Shop Warehouse
  - Fuel storage
  - Administration building
  - Assay office
  - Electrical buildings
  - Truckwash
- Design Limits
  - Do not exceed the following deflection (D) to span (L) or height (H) ratios under live loads:
    - Vertical D/L

Crane runway beams	1/800
Floor members	1/360
Roof members supporting plaster	1/360
Roof framing with sheet metal cladding	1/180

    - Lateral H/L

Walls with sheet metal cladding	1/180
Walls with un-insulated cladding	1/90
Interior walls with permanent partitions subjected to 0.5 kN/m2 normal to the walls:	
With brittle finishes	1/240
With flexible finishes	1/120
Crane runway beams* (subject to crane lateral force)	1/600

Building column*	
(subject to crane lateral force or wind force)	1/300
Building frames	
(subject to wind forces)	1/300

* Follow manufacturers standards or the following additional crane runway tolerance criteria, whichever produces the most adverse effect:

Maximum permissible tolerance between rail centers	+/- 5mm
Height tolerance between rails	
(S = crane span)	S/1000
Permissible height tolerance between two crane rail supports	
(L = distance between supports)	L/1500

- Member Depths

Recommended depth (d) to span (L) ratios for steel beams and trusses:

	d/L
Trusses	1/14
Equipment Support Beams*	1/16
General Platform Beams	1/20
Walkway Beams	1/24

** A deeper section may be required to avoid the beam resonating at the natural frequency of equipment.*

2.4 Materials Specifications

- Structural Steel
  - Conform to latest edition of NBCC and CAN/CSA-S16.1.

Rolled structural steel shapes, plates and bars	CAN/CSA-G40.20/G40.21-350W General Requirements for Rolled or Welded Structural Quality Steel Grade 350W
Hollow sections	CAN/CSA-G40.21-M Class C Grade 350W
Structural Pipes	ASTM A53-96 Grade 240 MPa
Sag rods & Pins	ASTM 207
Bolted connections	ASTM A325
Welded connections	AWS D1.1 CSA-W59 Series E480XX low hydrogen type
Anchor bolts	CAN/CSA-G40.12 Grade 300W
Floor grating	32 mm x 4.8 mm Welded Standard “Flowforge” type Serrated grating : 38 mm x 4.8 mm

Trench grating	32 mm x 4.8 mm Welded Standard "Flowforge" type Serrated grating: 38 mm x 4.8 mm
Checkered plates	8 mm minimum checker plate with raised pattern 6 mm minimum for lightly loaded area
Stair treads	Grating tread with checker plate nosing 32 mm x 4.8 mm Welded Standard "Flowforge" type Treads with serrated grating: 38 mm x 4.8 mm Stair tread width – 308 mm
Railing and handrails	DN 40 STD pipe typical
Kickplates	150 mm high

- Concrete
  - Conform to NBCC and CAN/CSA-A23.3-M latest edition.
  - Cement shall conform to CAN/CSA-A5 Portland Cement Type 10 Normal UNO. Use corrosive resistant cement where applicable.
  - The specified compressive strength of concrete shall be as follows:

	28 Day Strength	**Max. Aggregate**	**W/C ratio**
Structural Concrete	30 MPa	20 mm	0.45 0.40 (corrosive)
Mass foundation	30 MPa	40 mm	0.45 0.40 (corrosive)
Blinding Concrete	15 MPa	20 mm	0.45 0.40 (corrosive)

- Reinforcing Steel

Deformed type billet steel bar	CAN/CSA-G30.18-M Billet Steel Bars for Concrete Reinforcement fy = 400 MPa
Welded Wire Fabric	CAN/CSA-G30.5-M

- Grout
  - Normal grout shall be non-shrink, non-metallic and non-corrosive cementitious grout.
  - Epoxy base non-shrink grout shall be used under sensitive equipment only.
- Masonry
  - Modular metric size as per CAN/CSA-A165 Series.
  - Minimum compressive strength of hollow core concrete block unit shall be 15 MPa. Mortar shall be Type M or S.

- Compressive strength of masonry grout shall not be less than that of the concrete block used.

3.0 CIVIL

3.1 Scope and Battery Limits

- This will include the areas indicated on the general layouts associated with the process plant area and facilities.
  - Overall Process site and surface facilities
  - Site grading
  - Site services
  - Raw water supply
  - Reclaim water
  - Sewage treatment
  - Potable water treatment
  - Bulk fuel storage
  - Roads
  - Site piping
  - Camp
- An estimate of the cut-to-fill quantities required to construct the plant and associated infrastructure. Site preparation quantities shall be prepared using computer software models (Autodesk Land Desktop Civil Design).

3.2 Codes and Standards

- All work will be carried out in accordance with the latest edition of local and national Codes.
  - National Building Code of Canada
  - Supplement No. 1 - Climatic Information for Building Design in Canada
  - National Fire Code of Canada
  - Explosives Act
  - Guidelines for Canadian Drinking Water Quality, latest edition.
  - Health and Safety Act

- Canadian Environmental Protection Act
- Water Rights Act
- Hazardous Products Act
- Hazardous Materials Information Review Act
- Transportation of Dangerous Goods Act
- Environmental Operating Guidelines, Access Roads and Trails
- Environmental Code of Practice for Mines
- AWWA M11 Steel Pipe Design and Installation
- AWWA A100 Standard for Water Wells
- AWWA D100 Standard for Welded Steel Tanks for Water Storage
- Distribution system requirements for the Fire Protection ManualM31
- Design of Surface Mine Haulage Roads-Bureau of Mines Information Circular 8758
- Geometric Design Standards for Canadian Roads and Streets
- Drainage Manual
- Standard For The Installation Of Centrifugal Fire Water Pumps - NFPA 20
- Installation of Private Fire Service Mains and their Appurtenances – NFPA 24
- Flammable and combustible liquids code - NFPA30
- National Fire Code of Canada
- Environmental Code of Practice for Above Ground Storage Tank Systems Containing Petroleum Products

3.3 Design

- Earthwork
  - The earthworks will be optimised for balance cut-to-fill volumes of material. Refer to soils report (KCBL).
- Yard Grading
  - Yard grading shall have minimum 2% slope, preferred max. slope of 6%; slope will be site specific.
- Foundation Design
  - Refer to soils report by (KCBL)

- Roads
  - Site Access / Ancillary Roads:
    - Min. radius 33 m
    - Max. grade 8%
    - Min. width, shoulder to shoulder 12 m
  - Haul Road:
    - Min. radius 33 m
    - Max. grade 10%
    - Min. width, shoulder to shoulder 30 m
  - Culverts shall be designed for loading from 620 tonne off-highway truck such as 793D CAT.
  - Explosives Road:
    - Min. radius 33 m
    - Max. grade 8%
    - Min. width, shoulder to shoulder 6 m
- Storm Drainage
  - Runoff, resulting from rainfall, shall be conveyed to drainage ditches by sloping the tributary surface area. Surface slopes shall be minimum 2 percent.
  - Drainage ditch slopes shall be minimum 0.5 percent.
- Sanitary System
  - Sanitary flows from the Mill Building, Warehouse, Administration building shall be calculated on the basis of the greater of a) or b) below, for the applicable building occupancy:

    a) 200 litres per capita per day

    b) Number of equivalent fixture units.
  - Sanitary sewers shall be at least 100mm in diameter. The minimum slope shall be 2 percent.
- Yard Fire Protection
  - Yard pipe for the fire protection system shall be of high density polyethylene pipe minimum 150 mm in diameter. Minimum cover below grade shall be

depth of frost penetration.

- Fire hydrants around structures shall be placed at a spacing of not more than 90m. A separate DBM has been prepared for the fire protection system.

3.4 Materials Specifications

- The terraces and embankments will be formed using existing materials on site.
- Refer to soils reports by (KCBL)

4.0 ARCHITECTURAL WORK

4.1 Scope and Battery Limits

- The work will include architectural work of the following pre-engineered and "stick-built" structures:
  - Primary crushing
  - HPGR building
  - Mill building
  - Maintenance shop warehouse
  - Administration building – Pre-engineered
  - Assay Office – Pre-engineered
  - Truckwash – Pre-engineered
  - Electrical Buildings.

4.2 Codes and Standards

- All work will be carried out in accordance with the latest edition of the following codes, standards and specifications:
  - National Building Code of Canada
  - Industrial Health and Safety Regulations
  - Health Safety and Reclamation Code for mines in British Columbia
- Reference Standards
  - Canadian Institute of Steel Construction

- American National Standard Institute
- American Society for Testing and Materials
- Canadian General Standards Board
- Canadian Standards Association
- Metal Building Manufacturer's Association
- National Fire Protection Association
- National Lumber Grades Authority
- Underwriters Laboratories of Canada

4.3 Design

- Preliminary design will be carried for interior and exterior architectural components of structures to derive pricing quotations to the level consistent with the feasibility report in conformance to the relevant codes and standards list in this memorandum.

4.4 Materials Specifications

- Roof Systems
  - Factory manufactured insulated metal sandwich panels (R=30) consists of an exterior sheet, a layer of insulation, and an interior liner sheet connected by a system of subgirts.
- Wall systems
  - Factory manufactured insulated Metal sandwich panels (R=30) consists of an exterior sheet, a layer of insulation, and a interior liner sheet connected by a system of subgirts.
- Flashing
  - Flashing material shall generally be of same quality and finish of galvanized sheet metals as specified for cladding and liner panels. Colour shall match adjoining roof cladding unless otherwise specified.
  - Unless otherwise approved, flashing shall be a minimum thickness of 0.610 mm (24 Ga).
- Interior Walls
  - Concrete Block Walls

- Internal concrete block walls will be single wythe of varying thickness depending on structural loads and fire ratings required. Where internal concrete block walls are separating, heated and unheated areas, insulation (as specified above) will be filled in voids.
- All concrete blockwork shall be standard 400 mm by 200 mm by varying thickness.

- Metal Clad Walls
  - Where internal single skin metal panel walls are required, siding shall be as described for uninsulated metal walls. The factory-applied baked on paint finish, shall be applied to both exposed surfaces.
- Steel Stud Walls
  - Galvanized 25 ga. Nominal electro-galvanized steel stud framing faced with painted or vinyl covered gypsum wallboard.
  - Regular gypsum wallboard shall be gypsum core, ivory paper faced, grey paper backed, 0.12 mm thick to ASTM C36. Fire rated gypsum wallboards shall be ULC rated.
- Wall Finishes
  - Concrete blockwalls in finished areas shall receive a three coat paint finish – one coat block sealer and two coats matt or gloss as required.

- Floors
  - Exposed concrete floors shall be treated with non-dusting hardener. Nonslip paint finishes may be applied to exposed concrete floors where deemed necessary for cleaning or appearance purposes.
  - Quarry tile or similar ceramic tile floors shall be used in locker, shower and washroom areas, with non-slip finish where required.
  - Vinyl composition floor tiles shall be used in control rooms, lunchrooms, and other areas requiring a high degree of finish. Carpets shall be used in office areas for noise reduction.
  - Bases shall be quarry or ceramic tile where the same is used for flooring.
  - 100 mm vinyl cove base shall be used where areas are finished with vinyl tiles or painted concrete floors.

- In areas where demountable office partition systems are used, bases shall be 100 mm PVC as required by partitioning manufacturer.

- Ceiling
  - Suspended ceilings shall be 600 mm by 1200 mm acoustical ceiling system by Armstrong Ltd or equal.
  - Suspension grid shall be exposed “Tee” system of galvanized steel with baked enamel paint finish on visible portions.
  - Ceiling in shower rooms shall be suspended moisture resistant gypsum board with taped joint and shall receive three coat paint finish.
- Doors
  - Truck doors shall be sectional vertical lift doors, insulated to minimum R12 and to the sizes required by each application. All truck doors are to be electrically operated.
  - Equipment doors shall be metal, vertical rolling doors.
  - Exterior mandoors shall be commercial type swing doors, insulated hollow metal, 1.5 mm sheet steel, 45 mm thick, flush type, weather-stripped, galvanized and shop prime painted. Door frames shall be 1.52 mm sheet metal and shall be thermally broken. Double doors with dimensions other than catalogue standards shall be constructed of minimum 1.5 mm thick galvanized sheet steel, stiffened and insulated.
  - Interior doors shall be hollow metal, 1.2 mm sheet steel, 45 mm thick, flush type, galvanized and shop prime painted.
  - Office area doors shall be solid core wood.
  - Door frames, with appropriate anchors, shall be minimum 1.5 mm thick, hot rolled steel sheet, depth as shown in accordance with the Manufacturer’s Standard. Frames shall be galvanized and shop primed painted.
- Labelled Fire Doors and Frames
  - Unless noted otherwise, labelled fire doors shall be flush metal doors of the same appearance to match others. Construction of doors shall be as required by U/L for the class of door required, and door shall have the proper label affixed thereon. Double doors shall have over-lapping, two-piece astragal. Labelled doors shall be hung in U/L Labelled frames. Unless otherwise

required, frames shall be formed of 1.52 Ga. Steel and shall have anchors for securing to wall and floor.

- Plumbing fixtures
  - Vitreous china or stainless steel fixtures with exposed plumbing brass and metal work to be heavy triple chromium plated. Plumbing fixtures and trim shall be brand new free from flaws or blemishes. Surfaces shall be clean, smooth and bright and have dimensional stability. Similar plumbing fixtures shall be of one manufacturer.

    Manufacturer – America Standard.
- Windows
  - Windows shall be commercial duty, fibre glass units with triple glazing, top hung vents completed with insect screens.
- Wall Louvers
  - Wall louvers shall be AMCA (Air Movement & Control Association International Inc.) certified formed metal louvers fabricated in 16Ga. galvanized steel with all welded construction:
    - 100 mm minimum deep with blades at 45 deg angle and completed with factory installed galvanized bird screen with 12 mm screen.
    - Minimum 45 % free area.
    - Manufacturer's standard baked enamel finish with color to match the building claddings.

END OF SECTION

DESIGN CRITERIA REVISION INDEX

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4.0 INSTRUMENTATION BY AREA 8

1.0 SCOPE AND BATTERY LIMITS

- Electronic instrumentation and control systems shall be provided in four distinct areas of the Morrison Plant:
  - Primary Crushing, Conveying and Crushed Ore Storage
  - Secondary Crushing & Screening
  - Process Plant
  - Tailings Handling
- A local operator control station shall be provided for the Primary Crushing, Conveying and Crushed Ore Storage operation.
- The remaining process areas shall be controlled via operator consoles located in the process plant central control room.

2.0 CODES AND STANDARDS

- The design and manufacture of electrical, instrumentation and controls equipment shall conform to the latest versions of the following codes and standards:
  - Canadian Electric Code (C22.1)
  - Canadian Standards Association (CSA)
  - Local Codes and Standards
  - American National Standards Institute (ANSI)
  - Instrument Society of America (ISA)
- All equipment shall be rated for a minimum elevation of 700 - 1100 meters above sea level and an ambient temperature range of -40C to 40C and shall have CSA Approval Marking.
- Manufacturer’s recommended design, installation practices and procedures shall be adhered to whenever such practices and procedures are available.

3.0 INSTRUMENTATION DESIGNS AND CONSTRUCTION

3.1 General

- Electrical Supply – Electrical supply to field instruments, relays, solenoids where required shall be 120V-60Hz. Electrical supply to Control System's panel and back of panel Instruments shall be 120V-60Hz.
- Pneumatic transmitters shall have an output signal of 3-15 psig. Electronic transmitters shall have an output signal of 4-20 mA DC. Where possible, electronic transmitters shall be smart, programmable, microprocessor based 2-wire and powered by the signal receiver. If the electronic transmitter is externally powered (4-wire), its output signal must be isolated or floating with respect to ground so that the 4-20 mA DC signal could be transmitted to receiver without ground loop problem. If ground loop is a problem, then a signal isolator must be used.
- The materials of components that come into contact with process fluids (instrument wetted parts) shall be resistant to stress resulting from pressure, temperature, corrosion and erosion, and shall be made of 316 stainless steel minimum unless the process and piping specifications require a different or higher grade material.
- Control valves shall have integrally mounted smart electro-pneumatic positioners.
- Instrument Air – Instrument air supply shall be dust-free, oil-free and dry. The minimum instrument air dew point at line pressure shall be at least –40 °C or –10 °C below the minimum locally recorded ambient temperatures at the plant site, whichever is lower. No condensation shall occur in the distribution system or in the instruments. The minimum instrument air supply pressure on the header shall be 700 kPag.
- The capacity of the instrument air system shall be rated for all the connected loads plus 20%. An air receiver shall be provided for protection against loss of air. A low-pressure alarm shall be provided to indicate that the air pressure has fallen below 500 kPag. The air receiver shall be sized such that 15 minutes after the low air pressure alarm the instrument air header pressure shall not be below 250 kPag.
- Field Wiring – In general, multi-conductor cables shall be used between the Electrical Rooms and field junction boxes. Single pair cables shall be used between field junction boxes and individual instruments or electrical devices.

3.2 Control System

- The control system shall be capable of integrated process control, PID (Proportional. Integral and Derivative) loops and sequence logic control. The Control System shall have DeviceNet I/O cards for interface to motor starters for motor control, monitoring and implementing interlocks.

- The Control System shall have, as a minimum, redundancies on: controllers, operator consoles, power supplies, and communications data highways.

- An Uninterruptible Power Supply (UPS) shall be installed to power the Control System and field instruments. The UPS should have a minimum capacity of 30 minutes. The UPS system will be sized so that the connected load is only 60% of the nameplate full load rating of the UPS. The inverter units will be redundant so that in the event that a failure of one of the units the additional load will be handled by the balance of the Inverter units.

- A diesel generator, normally installed to supply emergency power to the plant, shall be connected to the UPS. This shall allow the Control System to remain online to monitor the process even during power outages.

- The Control System shall operate with a global database to allow easy engineering and operational data access, modification and troubleshooting. The Control System has capacity to interface to a Mill information System to provide a maximum data of 1 second data for all I/O attached to the system.

- The Control System shall have built-in diagnostics to allow system troubleshooting down to device I/O level.

- Configurations of control strategies on the Control System shall be via graphical means such as function blocks. This type of configuration is self documenting and provides ease of control system documentation and troubleshooting.

- The interlock system shall be designed to be “fail-safe”. On device failure, loss of power or loss of instrument air, the outputs to control process streams shall fail to a pre-defined safe state, e.g. output contact fails open, solenoid valve fails de-energized, and control valve fails closed, motor fails stopped.

- The Control System shall include a continuous Historian to collect process data. The Control System shall allow easy access to the data historian via the Control System consoles.

3.3 Grounding

- Plant electronic instrument system shall have its own dedicated grounding system. In the event that several instrument systems exist, these grounding systems shall be connected in common.
- Manufacturers recommended grounding procedures and installations shall take precedence over all grounding designs and installations.
- All signal cable shields shall only be grounded at the control system end of the circuit. The field end shall be trimmed flush with the cable jacket and taped to prevent accidental ground contact.

3.4 Mounting And Location Of Field Instruments

- All field instruments shall be mounted at grade or platform to provide easy access for operation and maintenance.
- All field mounted remote transmitters with indicators shall be mounted so that the transmitter is 1.37 meters above grade or platform and shall be located as close to the primary connection/element as possible consistent with instrument accessibility.
- Dial thermometers and pressure gauges that are line mounted shall be plainly visible and accessible from grade or platform.

3.5 Field Mounted Instruments And Equipment

- All field instruments shall meet the electrical classification of the area. Field mounted instrument electrical devices shall be supplied in weatherproof enclosures (NEMA 4), watertight and dust-tight as a minimum.
- Instruments shall be installed with flanges or unions and isolation valves to permit removal without process shutdown. Isolation valves shall be provided so that inline valves and instruments can be removed for maintenance without draining tanks and equipment.
- Separate process connections are required for each instrument including pressure gauges. Process connections for instruments on vessels shall be dedicated to the instrument and not shared with process piping.
- Test points should be provided to allow in place testing and/or calibration of instruments and equipment.

- Junction boxes shall be in accordance with the requirements of the associated electrical area classification. In an unclassified area the enclosures shall be NEMA 4X corrosion resistant, non-metallic, watertight and dust tight construction. Hinges and latches shall be 316 stainless steel. Cable entries shall be through cable glands in the bottom of the box where feasible. Watertight seals shall be used. Terminal rails shall be mounted vertically complete with sufficient grounding terminals. All connections within the junction box shall be made via terminal blocks. Splicing of wires is not permitted.
- All cables, wires, terminals and any other device shall be tagged uniquely in each box. A junction box layout and wiring diagram shall be provided and placed in a pocket in the rear side of the front door. Junction boxes shall be tagged uniquely with a lamacoid nameplate attached to the front panel. Lamacoids shall be white with black lettering.

3.6 INSTRUMENT ELECTRICAL WIRING

- Armored multi-pair instrument cables shall be individually twisted shielded pairs of stranded #16 AWG copper conductors with drain wire, cable overall shield with drain wire, FRPVC inner jacket, aluminum interlock armour, FRPVC outer jacket, Wire pairs shall be coloured black and white. Black is positive, white is negative. The number of pairs shall be as per drawings.
- Armored control and instrument power cables shall be Teck cable with stranded copper conductors, aluminum interlock armour, and PVC outer jacket. The number of conductors and conductor size shall be as per drawings.
- Power cables shall be supplied with bare copper grounding conductor.
- All wiring shall be clearly identified at every termination with a permanent marking system. Wire markers shall be the heat-shrunk type unless otherwise specified. The preferred method of identification is the loop number as specified on the loop diagrams.
- Fiber optic cables shall be multi-strand armoured, multimode for short runs up to 2 km, single mode for longer distances. The number of fiber strands shall be as per drawings.

3.7 Instrument Air Tubing

- Instrument air tubing to an instrument shall be 1/4" OD 316 SS seamless unless specified larger on drawings. Instrument air tubing fittings shall be 316 SS compression type.

4.0 INSTRUMENTATION BY AREA

- The control system in the Primary Crushing and Secondary Crushing areas shall provide monitoring and controls for:
  - Primary gyratory crusher
  - Primary crushing apron feeder
  - Stockpile feed belt conveyor
  - Crushing dust collector
  - Stockpile reclaim feeders
  - Primary sizing & screening conveyors
  - Primary sizing screens
  - Cone crushers
  - Secondary sizing & screening conveyors
  - Secondary sizing screens
  - High pressure grinding rolls crusher
- Grinding and Classification
  - Cyclopacs feed pumpbox
  - Cyclopac feed pumps
  - Cyclopacs
  - Ball mills
- Flotation Circuits
  - Rougher flotation cells
  - Rougher tailings pumpbox
  - Rougher tailings pumps
  - Rougher scavenger flotation cells

- Regrind cyclones feed pumpbox
- Regrind cyclopac feed pumps
- Regrind cyclopac
- Regrind vertical miills
- 1st cleaner flotation cells
- 1st cleaner concentrate pumps
- 1st cleaner scavenger flotation cells
- 1st cleaner/scavenger concentrate standpipe
- 1st cleaner/scavenger concentrate pumps
- 2nd cleaner flotation cell
- 2nd cleaner flotation tailings pumpbox
- 2nd cleaner tailings pumps
- 2nd cleaner concentrate standpipe
- 2nd cleaner concentrate pumps

- Cu / Mo Thickening and Filtration
  - Cu / mo thickener
  - Stock tank feed pumps
  - Cu / mo concentrate stock tank
  - Mo rougher flotation feed pumps
  - Mo rougher flotation cells
  - Mo rougher concentrate standpipe
  - Mo cleaner flotation feed pumps
  - Mo column cleaner flotation cell
  - Mo cleaner concentrate standpipe
  - Mo thickener feed pumps
  - Mo thickener
  - Mo filter feed pumps
  - Mo concentrate stock tank

- Mo concentrate filter feed pumps
- Mo concentrate filter
- Mo concentrate dryer
- Cu thickener
- Cu thickener underflow pumps
- Cu concentrate stock tank
- Cu concentrate filter feed pumps
- Cu concentrate pressure filter
- Cu concentrate belt conveyors
- Cu filtrate tank
- Cu filtrate pump
- Cu thickener overflow standpipe
- Cu thickener overflow pumps

- Tailings Disposal
  - Final tailings pumpboxes
  - Final tailings feed pumps
  - Final tailings cyclopac
  - Py concentrate cell
  - Py concentrate pumpbox
  - Py concentrate pumps
  - Reclaim barge pumps
- Reagents
  - Reagent area safety showers
  - Flocculant mix system
  - Flocculant holding tank
  - Flocculant metering pumps
  - Mibc holding tank
  - Mibc metering pumps

- Cmc depressant mixing tank
- Cmc depressant holding tank
- Cmc depressant metering pump
- Aero 3302 holding tank
- Aero 3302 metering pumps
- Lime slaking system
- Lime holding tank
- Lime system distribution pumps
- Kerosene holding tank
- Kerosene holding pumps
- Pine oil holding tank
- Pine oil holding pumps
- Pex mixing tank
- Pex holding tank
- Pex metering pumps

- Process, Potable & Gland Water / Instrument & Plant Air
  - Crushing area air compressor
  - Process plant air compressors
  - Flotation aeration blowers
  - Crushing area instrument air dryer
  - Process plant instrument air dryer
  - Crushing area instrument air receiver
  - Crushing area plant air receiver
  - Process plant instrument air receiver
  - Process plant plant air receivers
  - Fresh / fire water tank
  - Gland water pumps
  - Gland water tank

- Potable water pumps
- Potable water tank
- Potable water chlorinator package
- Process water tank
- Process water pumps
- Safety shower header tank
- Safety shower water feed pump

END OF SECTION

REVISION INDEX

Revision No.	Date Revised	Engineering Specification	Signatures				
			Prepared By	Discipline Engineer	Project Engineering	Project Manager	PBM
00	March 12, 2008	Issued For Client Information	KL	KL/JM		DS	
01	October 31, 2008	Issued for Client Approval	TK	GI	AS	JCR	
02	December 22, 2008	Issued for Client Acceptance	TK	GI	AS	JCR	
03	January 7, 2009	Issued for Client Acceptance	TK	GI	AS	JCR	

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SCOPE

1.0 WORK AND BATTERY LIMITS

- Design the electrical works from the secondary side of the two Owner supplied 138 - 13.8 kV power transformers to the main process plant, surrounding ancillary buildings and remote areas. (Incoming substation and high voltage transmission line are not in scope). Numerous ancillary buildings are pre-packaged and supplied as turn-key therefore no detailed electrical allowances or design work is required for these. No camp exists for this facility.

- The distinct areas of the project are:
    - Main plant areas:
        - Primary Crushing
        - Conveyors and Crushed Ore Stockpile
        - HPGR building
        - Main Process Plant (tailings pumping by KCBL)
    - Ancillary Buildings and Facilities:
        - Sewage treatment
        - Administration Building/Assay Office
        - Maintenance Shop/Warehouse
        - Truck wash
        - Fuel Storage
    - Remote Ancillary Buildings and Facilities including:
        - Water Storage (Wardrop)
        - Explosives Storage
        - Tailings booster pump stations as required (KCBL)
        - Tailings Pond Area as required (KCBL)
        - Lake water pump station as required (KCBL)
        - Open pit (initial lighting and dewatering pumps)

- Critical loads (defined as those who require power upon normal electrical supply failure) are and are so indicated on the project electrical load list. The process plant loads in this category are primarily items such as agitators which must be able to operate when normal electrical power fails to avoid settling. The restart of such

equipment on emergency systems will be controlled by operations and maintenance personnel with electrical power derived from emergency diesel generation sources provided.

2.0 CODES AND STANDARDS

- The design and manufacture of electrical equipment will conform to the latest versions of the following International codes and standards:
  - CSA Standard M421-00, Use of Electricity in Mines
  - Canadian Electrical Code (CEC C22.1)
  - American National Standards Institute (ANSI)
  - Institute of Electrical and Electronics Engineers (IEEE)
  - Canadian Standards Association
  - National Electrical Manufacturer's Association (NEMA)
  - Health, Safety and Reclamation Code for Mines in British Columbia

3.0 POWER SYSTEM

3.1 General

- Main power will be provided from a 138 kV step down substation facility and distributed at 13.8 kV on the plant site. The power system at this interface point will have the capacity and characteristics to support the plant electrical load and equipment.

3.2 System Voltage

- Voltage is AC at 60 Hz
- Voltage levels will be as follows:

Equipment	Distribution System Voltage
Grinding mill motors	13.8 kV, 3-phase, high resistance grounded
All other drives over 200 HP	4.16 kV, 3-phase, high resistance grounded
All drives from 0.5 HP to 200 HP	600 V, 3-phase, high resistance grounded
Motors with VFD up to 800 HP , 600 V	600 V, 3-phase, high resistance grounded (these items to be decided on case by case basis)
Small drives below 0.5 HP	120/208 V, 3- or 1-phase, solidly grounded

Electrical heaters over 2 kW	600 V, 3-phase-
Electrical heaters 2.0 kW or less	120/208 V, 3- or 1-phase, solidly grounded
Lighting 120 or 347 V	1-phase solidly grounded
Small power & controls 120 V	1-phase solidly grounded
Heat tracing short lengths 208 V	1-phase solidly grounded
Heat tracing long lengths 600 V	3- or 1-phase solidly grounded

4.0 POWER DISTRIBUTION

4.1 General

- Electrical distribution configuration for the project is s shown on the project single line diagrams. Components will consist of :
  - Medium voltage switchgear, power cables and motor control for major motors. Motor control and feeder breakers will be provided in common equipment line-ups.
  - Medium voltage electronic soft-starts or adjustable speed drives will be provided in stand-alone equipment enclosures.
  - Step down power transformers from 13.8 kV to 4.16 kV or 600 V, sized to provide capacity for planned loads.
  - Low voltage power distribution will generally be provided by power distribution centers.
  - Power for motors will be supplied from factory assembled motor control centers. Remote disconnect switches will not be installed at motor locations. A local “Start/Stop” pushbutton and H-O-A selector will be used. Lockout is to be done at the motor control center by qualified electricians in accordance with Owner developed lockout procedure.
  - Power for lighting and receptacles will be supplied from lighting and power panel boards.
  - Overhead power lines will be 13.8kV or 4.16 kV.
  - Underground cables at 13.8 kV and/or 4.16 kV will be utilized where practical to minimize future access issues and where so indicated in plant areas designed by others.
- Transformers shall be design loaded to not more than load to 70 % of full capacity. Dedicated purpose transformers which are part of specific equipment systems (e.g. conveyor or pump variable frequency drive systems) shall be sized according to the duty anticipated.

4.2 Voltage Drop, Power Factor and Large Motor Starting

- Overall voltage drop from source distribution transformer secondary to the end of last feeder shall not be more than 3 %. Overall voltage drop from the supply to point of utilization shall not exceed 5 %..
- The single line diagram includes 6 MVAR of 13.8 kV power factor correction to assist in site power factor correction. The leading reactive power available from the two ball mills will add to this capacity and provide an adjustable variable method to correct power factor.
- The two significant ball mill motors will be provided with a switched reactor starting method.
- Large motor starting and site reactive power control are a function of the electrical parameters of the source of supply and driven equipment. The power system study to further refine the methods outlined above requires detailed utility electrical parameters along with equipment details as input to a next phase power system study..

5.0 EQUIPMENT DESIGN CRITERIA

5.1 Enclosures

- Equipment and device enclosures will have the following ratings:

Location	Rating
Control Room, Electrical Room	NEMA 1A
All Other Areas (Non-Classified)	NEMA 12 or 4 as needed

5.2 Cables

- All power and control cables will be copper and generally be installed in underground non-metallic ducts or above ground in ladder type cable trays. Cables will have interlocking aluminium armour with a PVC FT4 rated jacket, suitable to -40 °C and as follows:

13.8 kV System	15 kV rated
600 V System	1,000 V rated, #12 AWG minimum
Controls	600 V rated, #14 AWG minimum. A minimum of 10% spare conductors will be left in each control cable where possible.
Colour Coding	All power wiring will be colour coded to suit local standards.

5.3 Electric Motors

- For standard applications motors will be TEFC, 1.15 SF, high efficiency. Inverter duty motors shall be IEEE 841 rated. No areas are anticipated to be classified as hazardous due to the presence of an explosive dust or gas concentration under normal or process upset conditions.

5.4 Low Voltage Power Distribution Centres

- Low voltage power distribution centres shall be fully rated at the site elevation. Enclosure type shall be equivalent to NEMA 1A for installation in indoor electrical rooms.
- Each low voltage switchboard shall be complete with an incoming main breaker section and suitable digital protective relaying including ground fault detection and alarms.
- Individual distribution feeder cells will be circuit breaker type with digital protective relaying.
- Design loading for low voltage distribution centres shall not exceed 75% of calculated running loads including spares.

5.5 Medium Voltage Distribution

- Medium voltage distribution equipment and motor control centres shall be metal-clad and fully rated at the elevation of utilization. Enclosure type shall be equivalent to NEMA 1A for indoor electrical room applications.
- Each medium voltage switchboard shall be complete with an incoming main breaker or load break rated disconnect switch section and have suitable digital protective relaying.
- Individual distribution feeder cells will be vacuum contactor type with current limiting fusing, digital protective relaying and zero sequence type ground fault detection.
- Individual motor cells will be vacuum contactor type with current limiting fusing, digital protective relaying and zero sequence type ground fault detection.

5.6 Low Voltage Motor Control Centres

- Motor Control Centres shall be 600 V, 3 phase, 3 wire complete with copper bus, top mounted ground bar and bus bracing as noted on other design documents. Enclosures

shall be NEMA 1A for installation in an indoor, modular electrical rooms or major building electrical rooms.

- MCC's shall have incoming sections with digital meter display of instantaneous three phase voltage, current and power parameters. All transformer fed MCC's require a main breaker sized to the transformer secondary current complete with digital protection relay.

- Individual MCC starters shall be complete with door mounted H-O-A selector switches, start-stop push buttons and LED type pilot lights.

- MCC starters shall be connected to local plant control system I/O racks for control purposes where control is not strictly manual.

5.7 Lighting

- Lighting will be high intensity discharge and fluorescent. High intensity discharge lighting will be provided in exterior locations, for roadway lighting and where specified indoors. Fluorescent lighting will be provided in the control rooms, motor control centre rooms, offices and other plant buildings. Note that, where possible at the design stage, steps will be taken to reduce energy use in all areas by:
  - Use of two level switches for larger lighting area – activated by personnel entering area when needed for operations or maintenance
  - Use of detection type switches to turn off lights in office areas after periods of room being empty
  - Photocell controlled exterior lighting

- Control room lighting will be electronically dimmable and fixtures shall be complete with louvers to minimize glare from operating monitors. Lighting for offices and control rooms will be via 120 V, high efficiency fluorescent type fixtures.

- Battery powered emergency lights and exit signs will be included for offices, labs, electrical rooms, the control room and major egress routes indoors.

- Where required by the nature of the process, lighting fixtures shall be of the corrosion resistant type. Outdoor floodlight circuits will be automatically controlled by photocells with a "Manual-Off-Auto" bypass selector switch. Main indoor lighting circuits will be supplied from 600/347v lighting panels. In general, plant lighting will be switched from the supply panels, in all other areas local switching will be provided. Offices, control room, leave 10 % of fixtures unswitched

- **In areas with rotating or moving equipment, lighting sources shall be frequency selected to illustrate relative motion and avoid stroboscopic effects.**

5.8 Lighting Illumination Levels

- Illumination levels shall meet the following requirements:

AREAS	LEVEL
Electrical Room	300 lux
Control Room	500 lux
Offices	600 lux
Loading	30 lux
Yard	10 lux

5.9 Grounding

- The ground grid will be connected wherever possible to building steel, tanks, and equipment and the ground wire will be installed exposed wherever possible. The ground grid will also be connected to the main substation ground. Where corrosion presents a problem, ground wire shall have PVC insulation. All underground connections on the main ground grid will be exothermic type. Exposed connections and taps will be made with pressure type connectors.

- Ground rods will be installed at corners of buildings and around buildings at intervals not to exceed 25 m, and connected to the ground grid with soft drawn bare copper ground wire. Motor control centres, medium and low voltage switchgear, unit substations, transformers, etc., will be provided with two connections to the ground grid. All medium voltage motors, control panels, tanks, vessels, and other equipment will have at least one direct connection to the ground grid. All 120 V receptacles will be grounded by means of a separate green coloured insulated wire. Ground fault circuit interrupter type receptacles will be located in as required throughout the plant site. A #2/0 AWG bare ground cable will be installed in all cable trays. The ground cable will be connected to all sections and fittings at intervals of not less than 15 m. Final resistance of the grounding system will be in accordance with the local codes and standards.

5.10 Fire Alarm

- An allowance for a basic fire alarm system will form part of the design package.

End of Section

APPENDIX E

HPGR TRADE OFF STUDY

A Company of ThyssenKrupp Technologies **Polysius**

December 06, 2007

High-Pressure Grinding Tests

on

Copper/Gold/Molybdenum Ore

from the

Morrison Project

British Columbia, Canada

for Pacific Booker Minerals Inc.

at the

Polysius Research Centre

Project No. 2337 2844 / 2220-7959
WE no. 11815

By: Rene Klymowsky/Holger Plath

Polysius AG
Graf-Galen-Straße 17,
D-59269 Beckum-Neubeckum, Germany
Phone: +49-(0)2525-99-0
Telefax: +49-(0)2525-99-2100, Telex: 89481-0 PBK D
E-Mail: Polysius@tkt-pol.thyssenkrupp.com
Internet: www.Polysius.com

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1. Introduction

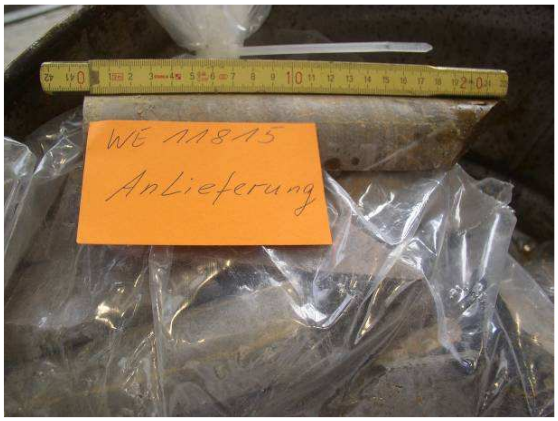
Pacific Booker Minerals Inc., consulted by Wardrop Engineering, initiated a test program at Polysius AG in Germany to investigate the application of High Pressure Grinding Rolls (HPGR's) at their copper/gold/molybdenum porphyry project in the Morrison Lake area, Northern BC.

Ore samples were received in two shipments, 4 drums each, containing a gross weight of 1720 kg. The samples consisted entirely of drill core, which was crushed to < 1¼" for testing. The tests were carried out in a semi-industrial HPGR at three different pressure levels. Closed-circuit tests were simulated using a 6 mm screen. Standard Bond and POLYSIUS laboratory mill (LABMILL) grinding tests were done on the material before and after pressing to determine the extent of weakening of the material. Furthermore, abrasion tests were carried out at different moisture contents to determine the wear life of the rolls.

Earlier testwork carried out on drill core at SGS Lakefield indicated Bond Work Indices ranging from 11- 23.5 kWh/t, with an average value of 16.4 kWh/t.



Shipment - 2 of 8 drums - 1620 kg net



Drill Core Samples

2. Summary

The feed and product size distributions from open circuit runs in the HPHR on the ore are shown in Figure 1. Increasing pressure had very little effect on the product particle size distributions. Also, moisture content variation had little effect on product PSD's. The main effect of these variables was on the throughput and specific energy consumption. These effects are examined in more detail in the report.

Results from closed-circuit tests with a 6 mm screen are shown in Figure 2. The actual cut size was about 5 mm. The screening was conducted dry, and was quite efficient, resulting in > 90% recovery of the amount of < 5 mm in the HPGR product. The P80 size was about 2.8 mm. It is expected that wet screening would yield very similar results.

The material was of low to medium abrasiveness, with an ATWAL wear index (ATWI) of 9-15 g/t. Wear life for the rolls was estimated at 7000 hours. Bond WI was 17.8 kWh/t before, and 16.1 kWh/t after HPGR, a reduction of 10% in ore hardness.

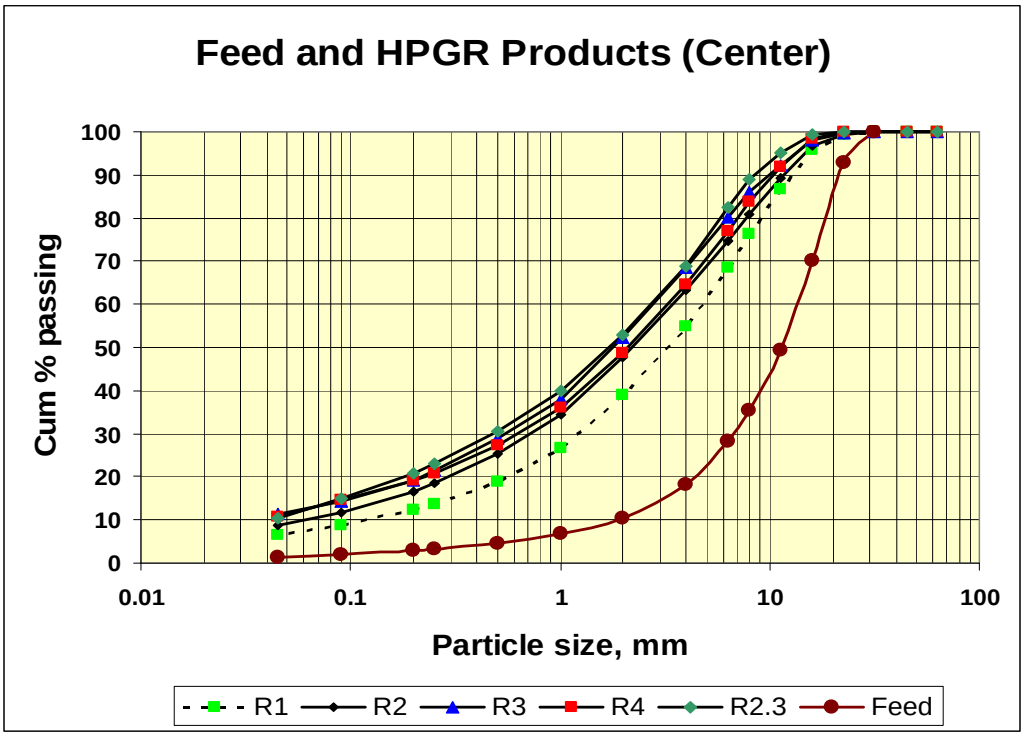


Figure 1. Results of a single pass through the HPGR.

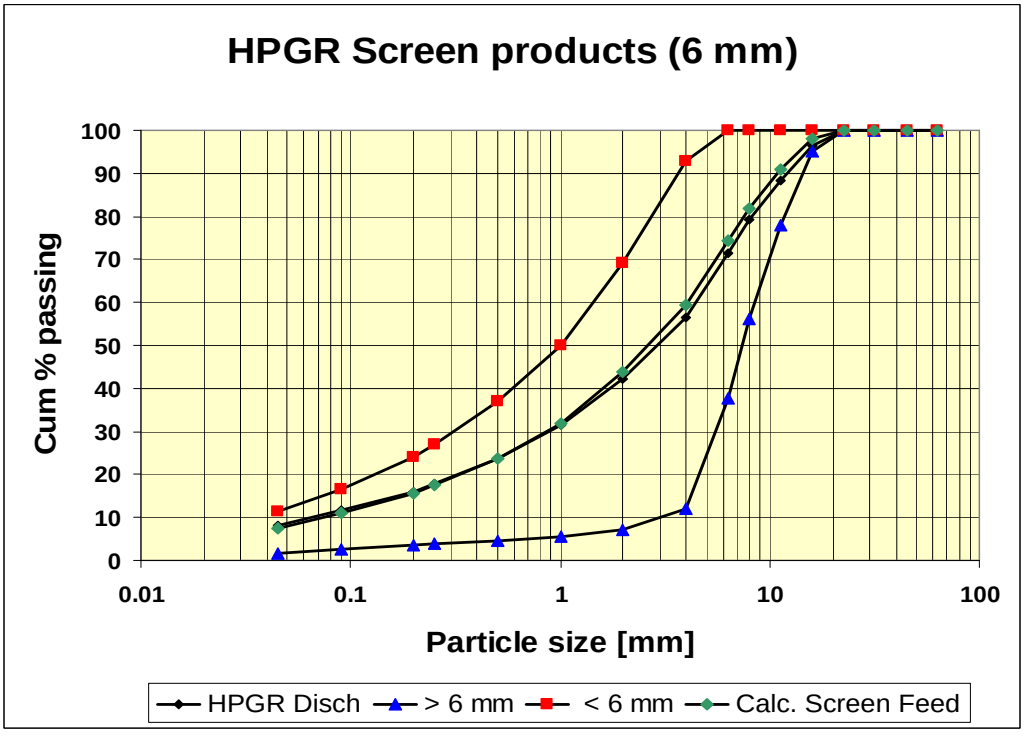


Figure 2. Results of closed-circuit testing in the HPGR.

3. Definition of terms used in testing of High-pressure Grinding Rolls

The key parameters derived from the results of testing in a HPGR are:
- the specific throughput rate
- the specific press force which should be applied to obtain a certain comminution effect
- the specific energy consumption
- the power required for a given throughput and size of rolls.

3.1 Specific Throughput Rate $\dot{m}$

The **specific throughput rate $\dot{m}$** is defined as the throughput of a given size of machine divided by the projected area and circumferential speed of the rolls:

$$\dot{m} = M / (D * L * u) \quad [ts/hm^3]$$

M	[tph]	:	throughput rate
D	[m]	:	diameter of rolls
L	[m]	:	width of rolls
u	[m/s]	:	circumferential speed of rolls

Note: The **specific throughput rate $\dot{m}$** has units of ts/hm³, corresponding to the throughput of a HPGR with rolls 1 m in diameter x 1 m wide operating at a roll speed of 1 m/s.

The **specific throughput rate** mainly depends on the properties of the material *(e.g., hardness, the physical density of the material, the particle-size distribution of the feed, and the moisture content);* the grinding pressure, and the type of roll surface employed.

However, the **specific throughput rate** depends only to a limited extent on the diameter and speed of the rolls and is therefore useful for scaling-up from a test unit to a full size industrial unit. HPGRs (and vertical roller mills) are unique among comminution devices in having a specific capacity term which can be assigned to the material and operating conditions.

3.2 Specific Press Force

The **specific press or grinding force** is defined as the total hydraulic force exerted on the rolls divided by the projected area of the rolls in units of N/mm² :

$$F_{(sp)} = F / (1000 * L * D) \quad [N/mm^2]$$

$F_{(sp)}$	[N/mm²]	:	specific grinding force
F	[kN]	:	grinding force
L	[m]	:	width of rolls
D	[m]	:	diameter of rolls

This form is useful for comparing pressures on different sizes of HPGR units.

Note: The maximum grinding pressure in the gap between the rolls will be between 40 and 60 times the applied **specific grinding force**, depending on the nip angle. For mineral applications it is sufficient to define the **specific grinding force**.

3.3 Specific Energy Consumption

The **specific energy consumption $W_{(sp)}$** is the energy input which is absorbed per ton of material. It is proportional to the applied specific grinding force.

$$W_{(sp)} \sim c(F_{(sp)}, \dot{m}) * (F_{(sp)} / m) \quad [kWh/t]$$

$W_{(sp)}$	[kWh/t]	:	specific energy input
$F_{(sp)}$	[N/mm²]	:	specific grinding force
m	[(t*s)/(m³*h)]	:	specific throughput rate
$c(F_{(sp)}, \dot{m})$		:	factor (function of $F_{(sp)}$ and $\dot{m}$)

The proportionality is usually linear.

3.4 Power requirements.

The net power required for a given size of rolls is the product of the specific energy input $W_{(sp)}$ and the throughput rate M :

$$P = W_{(sp)} * M \quad [kW]$$

P	[kW]	:	power draw
$W_{(sp)}$	[kWh/t]	:	specific energy input
M	[tph]	:	throughput rate

The minimum motor power required is determined by multiplying the net power by a factor of 1.15 to account for any unevenness in the power draw of each roll. Final motor power is determined by the maximum power that can be transmitted by the gear boxes fitted to a given size of machine.

3.5 Specific Power

The net power required for a given size of rolls may also be derived from the specific power function.

The **specific power P_{SP}** is defined as the power used by a given size of machine divided by the projected area and circumferential speed of the rolls:

$$P_{SP} = P / (D * L * u) \quad [ts/hm^3]$$

P	[kW]	:	power draw
D	[m]	:	diameter of rolls
L	[m]	:	width of rolls
u	[m/s]	:	circumferential speed of rolls

The specific power varies linearly with the specific press force applied, and may be used to determine whether sufficient power has been provided for a unit with a given pressing capacity.

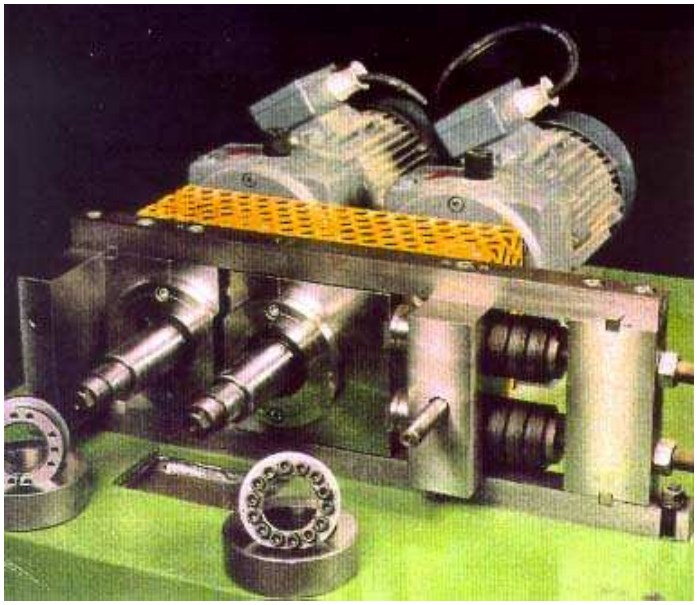
4. Description of Test Facilities

4.1 ATWAL Abrasion Testing High Pressure Grinding Roll

The ATWAL unit is used to determine the wear rates of different ores in High Pressure Grinding Rolls. About 100 kg of material are needed for one test run.

The ATWAL is equipped with smooth solid tyres made of Nihard IV. To ensure nipping of the material between the rolls, the feed is crushed to < 3.15 mm. The rolls are weighed before and after each test, and a specific wear rate is determined from the weight loss divided by the amount of material treated. This specific wear rate is then used to calculate the wear life to be expected on a industrial size HPGR unit.

The ATWAL is choke fed in order to achieve the maximum possible throughput. The grinding force, energy and specific throughput are measured, and the grinding force adjusted, if required.



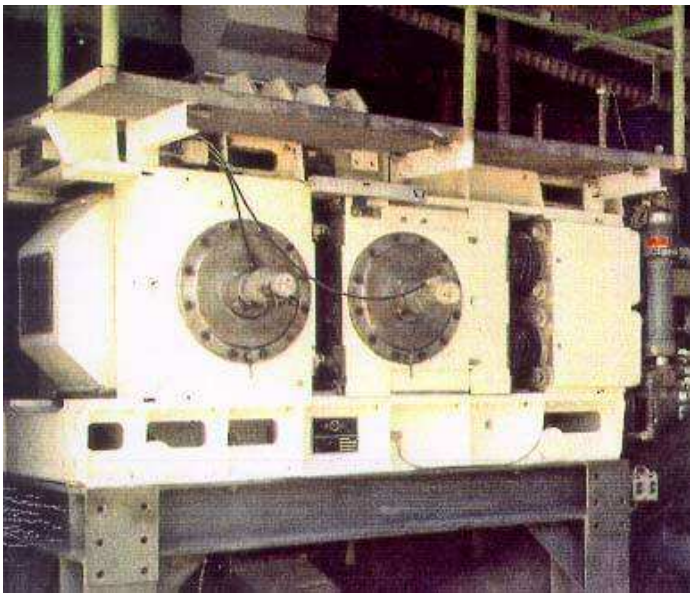
Data of test unit:

Diameter of rolls	: 0.10 m
Width of rolls	: 0.03 m
Speed of rolls	: 0.46 m/s
Top feed size	: 3.15 mm

4.2 REGRO Semi-industrial High Pressure Grinding Roll

Data of test unit:

Diameter of rolls	: 0.71 m	Speed of rolls	: 0.29 - 1.10 m/s
Width of rolls	: 0.21 m	Top feed size	: 16 - 35 mm



The REGRO is equipped with an autogenous wear protection surface in the form of studded liners.

Process data obtained from test work allows the sizing of industrial scale machines.

Data logging:
feed rate,
zero gap ,cake thickness
preset nitrogen pressure, zero hydraulic pressure
operating hydraulic pressure
power draw of motors
circumferential speed of rolls

These data allow the calculation of process data such as:

- specific throughput rate
- grinding force and specific energy input
  required for achieving a certain product fineness

5. Test Programme & Results

5.1 Test Programme

The following test programme was approved by Wardrop Engineering. The client, Pacific Booker Minerals, witnessed the tests.

TEST PROGRAMME:

200 KLY
19/09/2007

Project: 2337 2992
WE: 11815

Provided material < 25 mm 1500 kg

REGRO feed < 25 mm
ATWAL feed < 3.15 mm

Analysis

PSD, MC, BD, PD

PSD, MC, BD
Fineness at 90, 250 and 1000 µm

	Test	Feed size	Quantity	Moisture	Pressure	Analysis Centre	Edge	Discharge
ATWAL	A1	< 3.15 mm	100 kg	1%	4 N/mm²			
	A2	< 3.15 mm	100 kg	3%	4 N/mm²			
REGRO	R1	< 25 mm	150 kg	natural	30/25	**PSD**, CD	**PSD**	
	R2	< 25 mm	150 kg	natural	40/30	**PSD**, CD	**PSD**	
	R3	< 25 mm	150 kg	natural	50/40	**PSD**, CD	**PSD**	
	R4	< 25 mm	150 kg	6%	40/30	**PSD**, CD	**PSD**	
Feed preparation: cont'd with product of R2								
Locked-cycle	R2.2	< 25 mm	150 kg	natural	40/30	**PSD**, CD	**PSD**	
with 6 mm screen	R2.3	< 25 mm	150 kg	natural	40/30			
	R2.4	< 25 mm	150 kg	natural	40/30	**PSD**, CD	**PSD**	
Screen products								**PSD**
Bond	B1 (before)	< 3.15 mm	10 kg	dry				**PSD**
	B2 (after)	< 3.15 mm	10 kg	dry		*		**PSD**
LaborMühle	LM1	Crush < 6 m	10 kg	dry				
	LM2	R2.3 < 6 mm	10 kg	dry				

Abbreviations and comments

PSD: Particle size analysis
45, 90, 200, 250 and 500 µm
1, 2, 4, 8, 11.2, 16, 22.4, 31.5 mm, etc.

MC: Moisture content
BD: Bulk density
CD: Cake density
PD: Material density

5.2 ATWAL Wear Test Results

Two ATWAL Wear Tests were carried out on the test material, one on dry material with 1% moisture, and one on wet material with 3% moisture. The results of these tests are given below.

Test	Material	Feed size	Moisture	Specific throughput	Spec. grinding force	Specific wear rate
		[mm]	[%]	[ts/(h m^3)]	[N/mm^2]	[g/t]
A 1	copper ore	0 x 3.15	1.0	118.4	4.0	9.84
A 2	copper ore	0 x 3.15	3.0	155.8	4.0	15.7

Table 2: ATWAL high pressure grinding wear tests

The tests indicated a low to medium wear rates of 9-15 g/t for the material on the ATWAL testing unit. The wear rates given refer to Nihard IV at the specific conditions on the ATWAL abrasion test unit. They do not reflect the wear rate on full size industrial rolls.

Corresponding wear rates on the ATWAL for other ores are given below:

Other ores	:	very abrasive	> 40 g/t
		medium abrasive	10 to 40 g/t
		low abrasive	< 10 g/t

Scale-up to full size industrial rolls takes into account the final roll diameter and speed of the rolls selected, type and length of the studs employed, as well as the feed characteristics of the material to be treated, i.e. size and moisture. The scale-up is based on a data collected on various ores treated in industrial High Pressure Grinding Rolls.

Preliminary estimates for an industrial size unit would indicate a wear life for the rolls of approx. 7000 h.

5.3 Semi-industrial High-pressure Grinding Tests on the REGRO

Preliminary REGRO tests were run at three different press forces on dry material. Then locked-cycle tests were run with medium pressure in closed-circuit with a 6mm dry screen. The influence of press force and recycle of the oversize on:

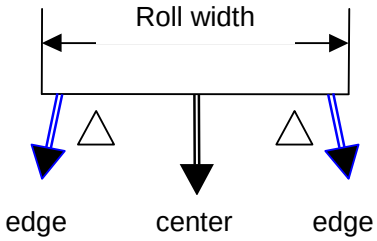
- the specific throughput
- the specific energy input
- the product fineness.

is given in the Table below.

Test no:	Moisture	Specific	Specific	Specific	Specific	Product fineness (center)		
		Press Force	Throughput	Power	Energy	Cumulative % passing		
	[%]	[N/mm²]	[ts/hm³]	[kWs/m³]	[kWh/t]	8 mm	2 mm	0.025 mm
Open- circuit								
R1	1.00	2.59	229.6	320	1.40	76.18	38.80	13.70
R 2/2.1	1.00	3.49	218.0	386	1.77	80.95	47.60	18.40
R3	1.00	4.22	210.6	445	2.11	86.17	52.40	21.60
R4	4.10	3.45	221.8	438	1.97	83.68	48.80	20.70
R2.2	1.00	3.59	220.6	383	1.74	-	-	-
Closed-circuit with 6mm screen								
R2.3	1.00	3.69	225.8	384	1.70	88.87	52.80	23.00

Table 3: Summary of REGRO semi-industrial scale test results.

The feed and product particle size distributions were analysed by dry screening. The discharge of the REGRO was split into a centre and an edge portion. Both portions were analysed separately. Part of the products from the rolls were in the form of compacted flakes, which required de-agglomeration for sizing. The material was de-agglomerated in a rotating drum prior to screen analysis.



The size analysis of the feed and HPGR products are shown in Figures 3-4. The average P80 size achieved in the total discharge was 10 mm; the avg. P80 size in the centre product was 7 mm. The size distributions varied narrowly around these points, indicating that the effect of pressure and recycle on the size reduction was minimal.

The material formed weak flakes, and screening was quite efficient even on a dry basis, Figures 5-6. The circulating load obtained from the dry screening was < 60%, and was expected to be slightly lower from the wet screening.

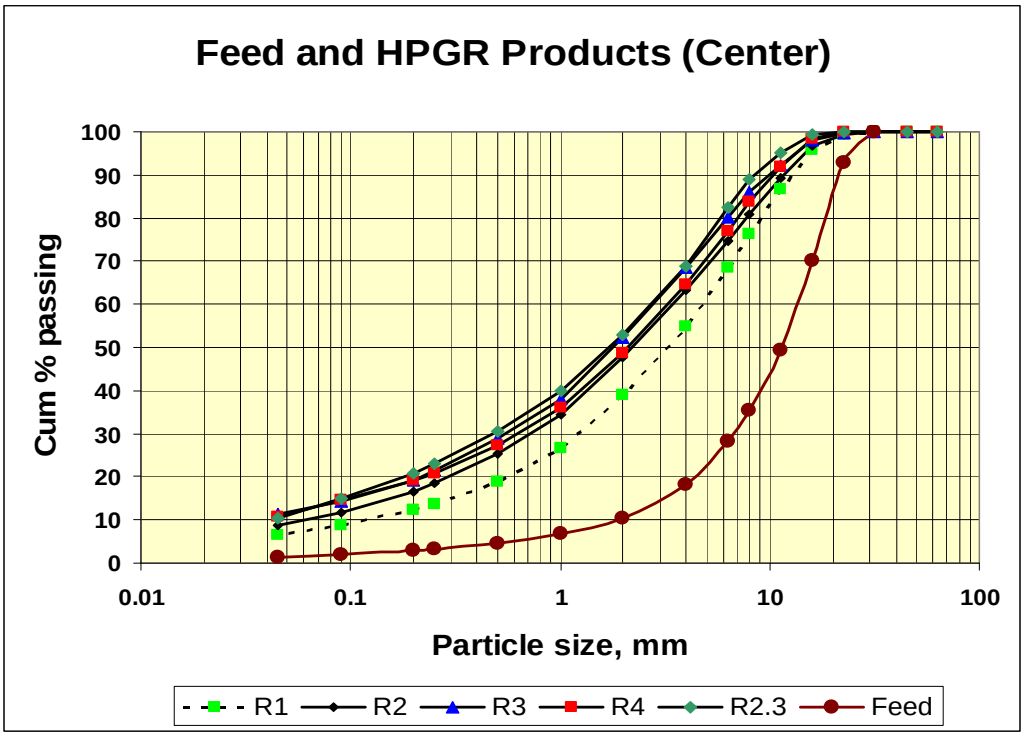


Figure 3. Size distributions feed and center products.

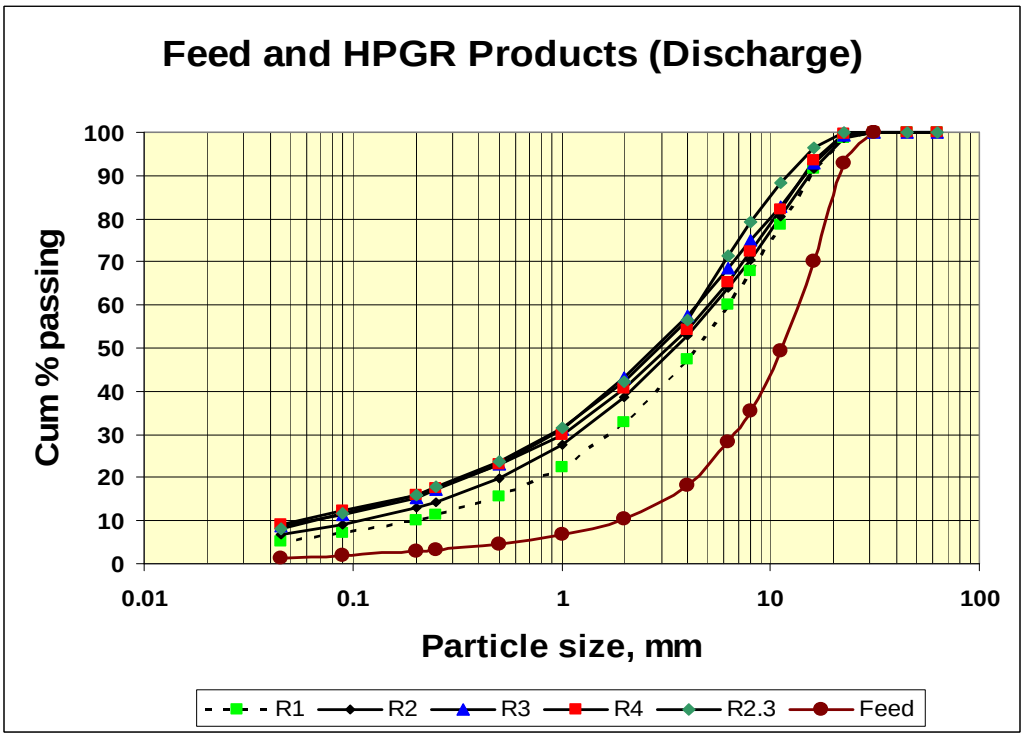


Figure 4. Size distributions feed and total discharge.

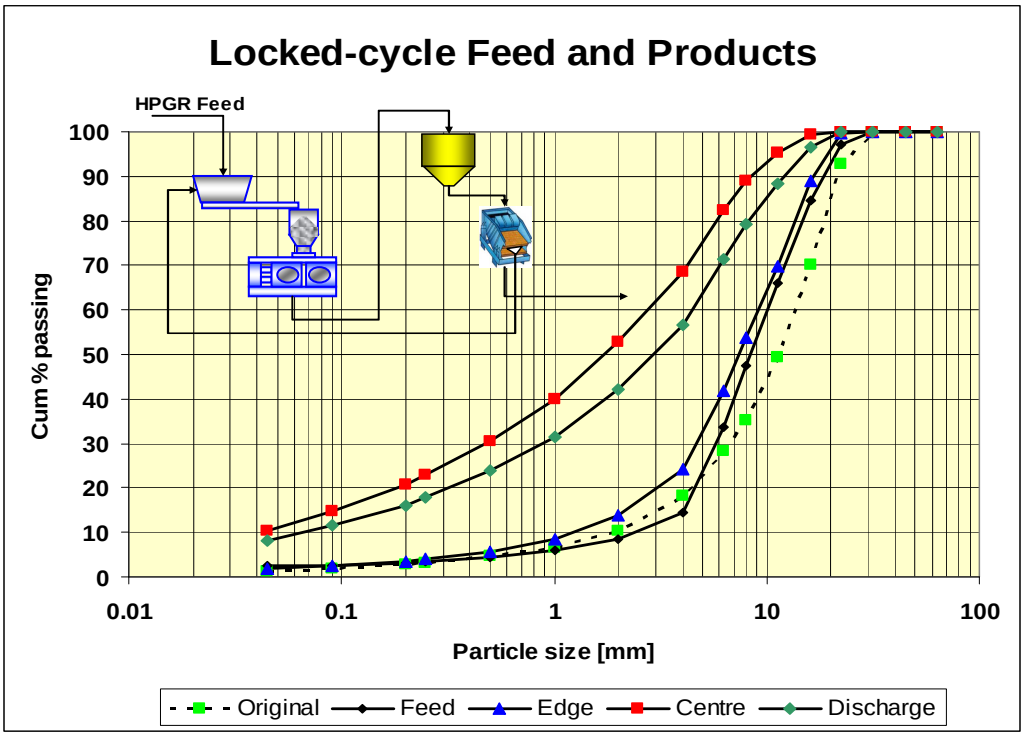


Figure 5. Locked-cycle test results, Test R2.3.

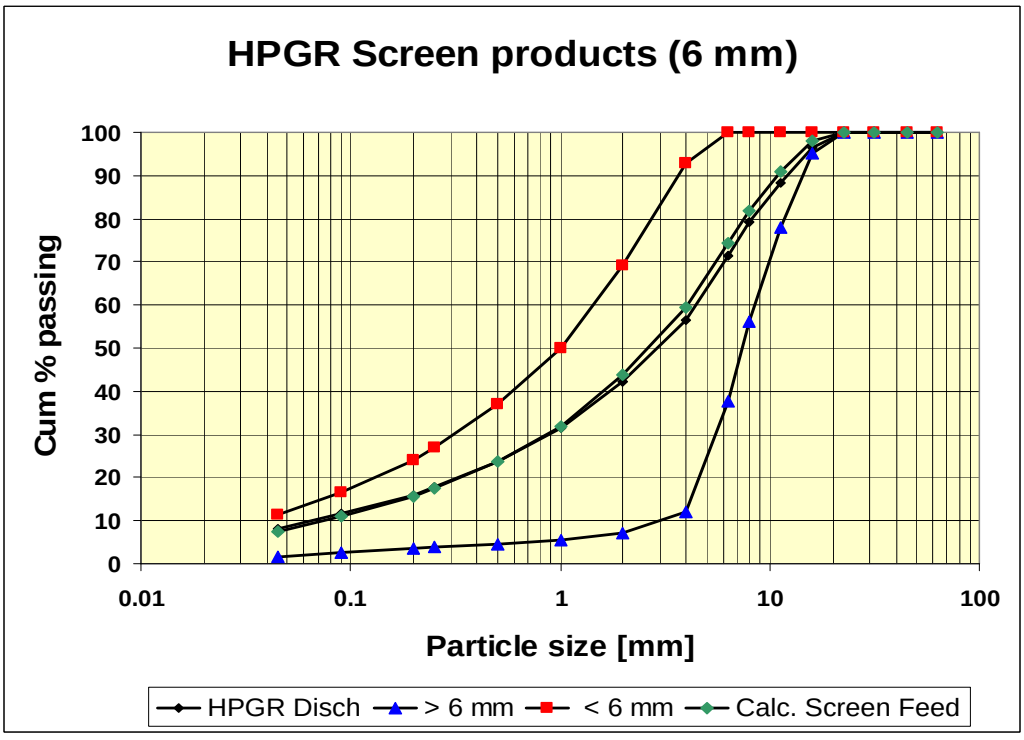
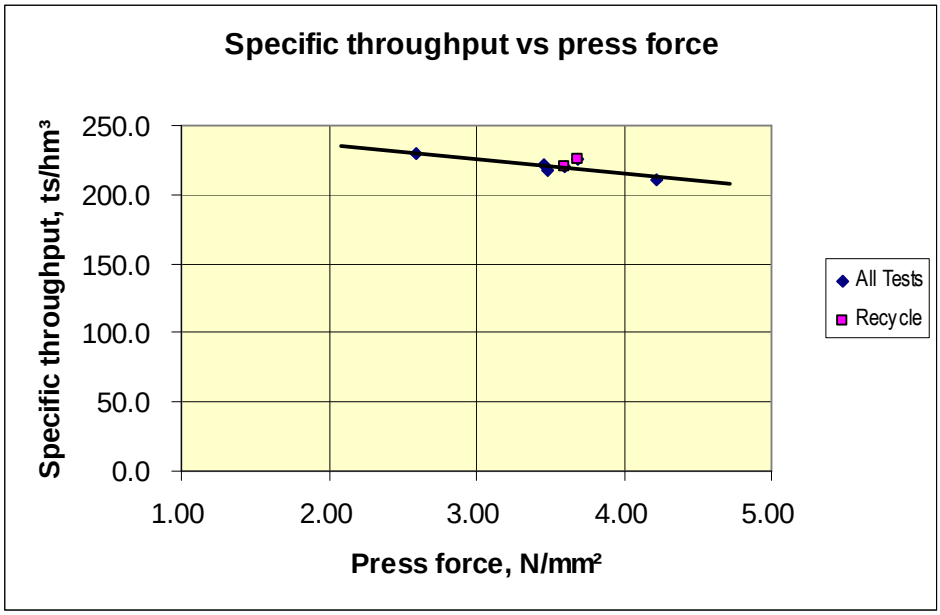


Figure 6. Size distributions dry screen products, Test R2.3.

5.4 Influence of operating conditions.

The influence of the specific press force and moisture on the specific throughput and power draw is shown in Figures 7 and 8. Both press force and moisture had little effect on the throughput. Average specific throughput was 220 ts/hm³ at 3.5 N/mm². However they had a significant effect on the power draw. Fig. 8. Moisture increased the power draw by 20%.



Figures 7. Variation of specific throughput with pressure.

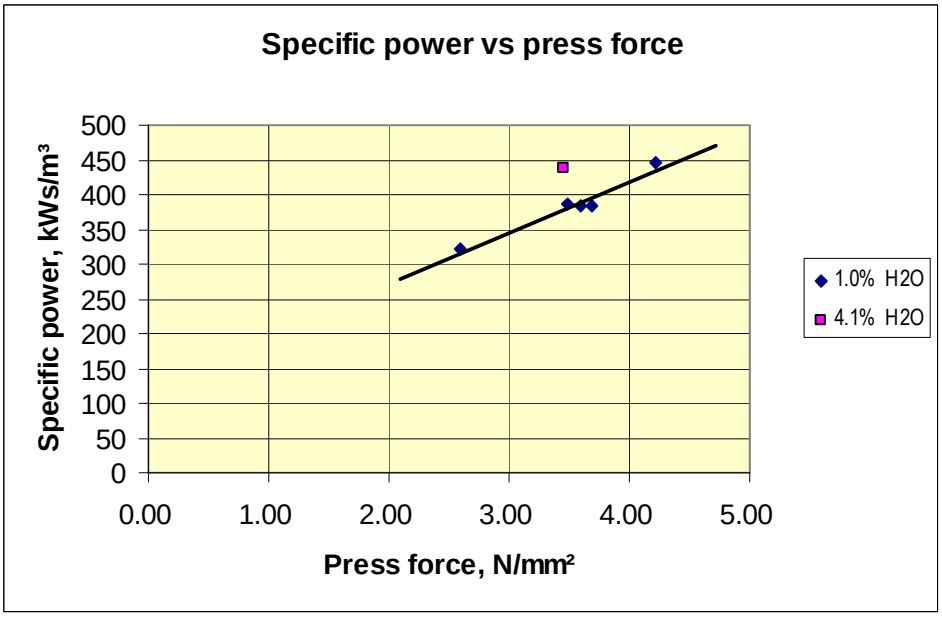


Figure 8. Variation of specific power with pressure.

For dry material, the specific power draw at 3.5 N/mm² was average for copper ores, 380 kWs/m³. Moisture increased this value to about 450 kWs/m³. The specific energy mirrored the specific power trend, resulting in 1.7 kWh/t for dry material and 2.0 kWh/t for wet material at a press force of 3.5 N/mm².

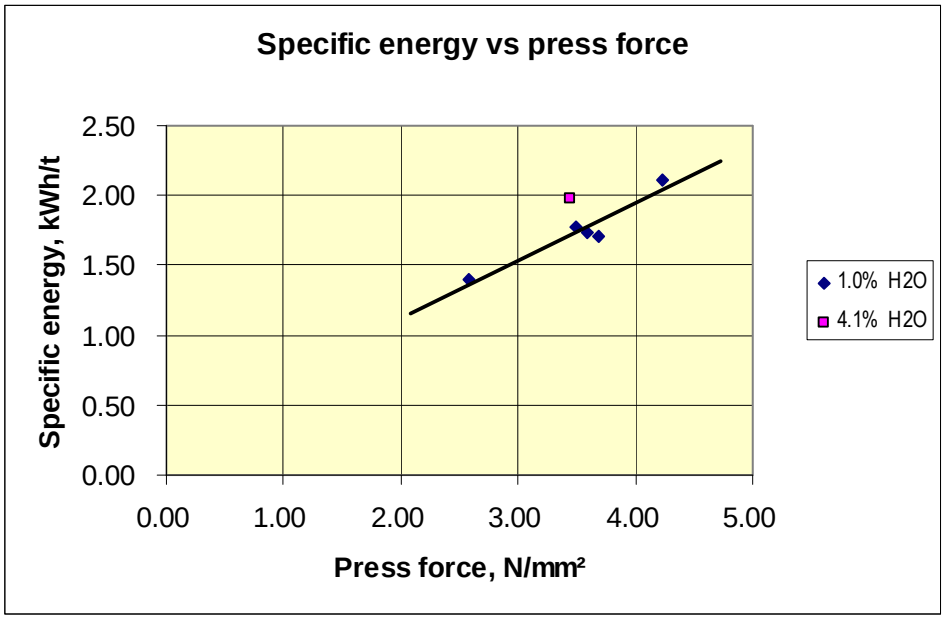


Figure 9. Variation of specific energy with pressure.

Figures 10 and 11 show the effect of grinding pressures on the product fineness. At pressures > 3.5 mm, there was little increase in product fineness, Figure 10. The optimum press force necessary was found to be 3.5 N/mm², see Figure 11.

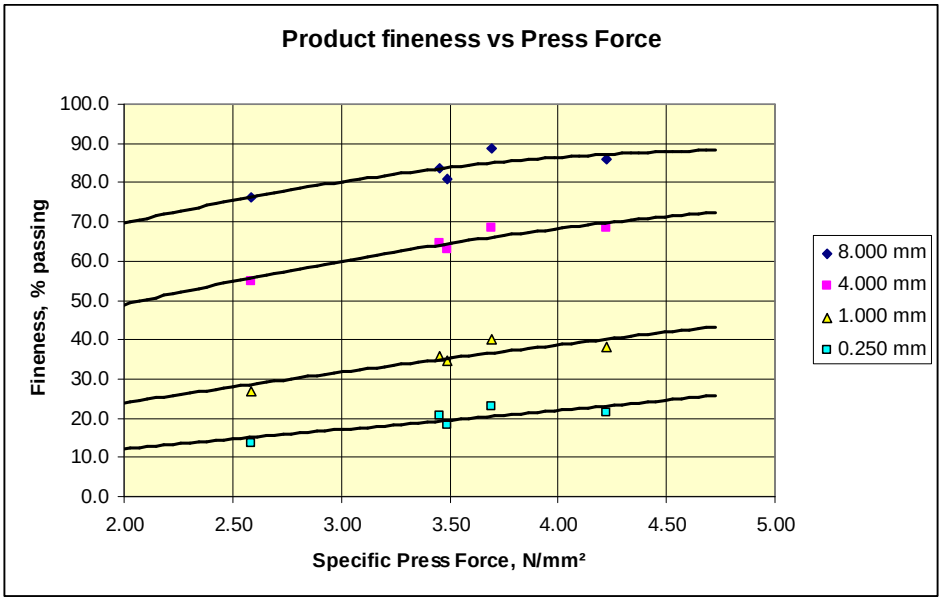


Figure 10. Variation of Product fineness with pressure.

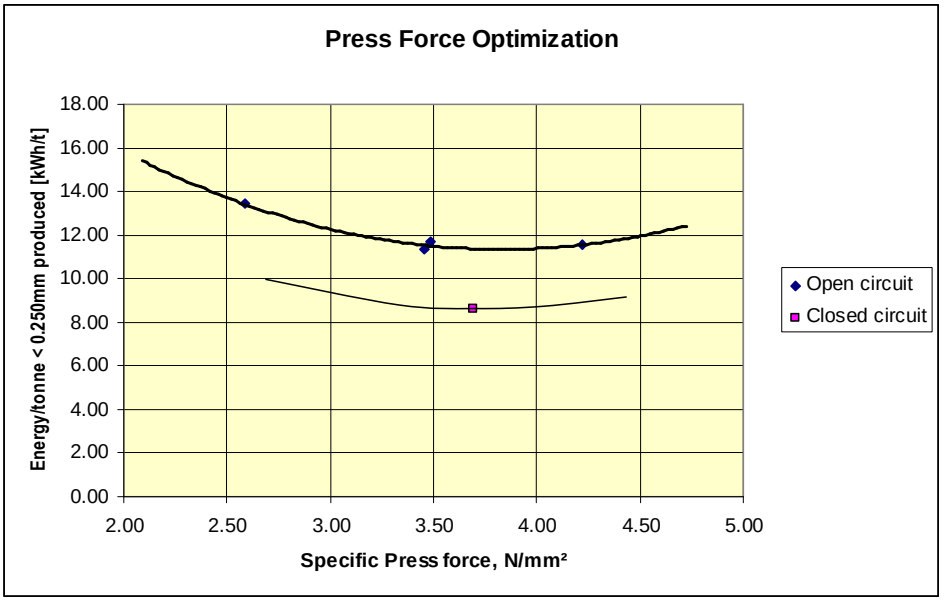


Figure 11. Variation of Product fineness with pressure.

6. Grinding Tests

6.1 Standard Bond Tests

Two standard Bond grinding tests were performed on the material: one on the original feed; the second on product of Test R 2.3 (from closed-circuit with dry screening). The results are given in the Table below. Size analyses of the Bond test feed and products are shown in Figures 12 & 13. The value obtained on the original feed was 17.8 kWh/mt. Treatment in HPGR resulted in a 10% reduction in the WI to 16.1 kWh/t.

Table 4. Summary of Standard Bond Test Results.

	Pi	Gbp	F80	P80	Wi (st)	Wi (mt)
Original ore	90	0.92	2541	64.7	16.2	17.8
R2.3 Product	90	1.06	2108	64.5	14.6	16.1

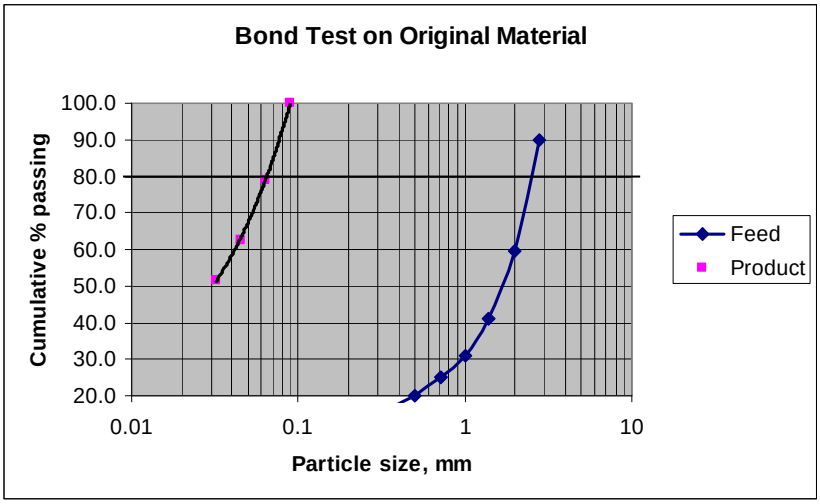


Figure 12.

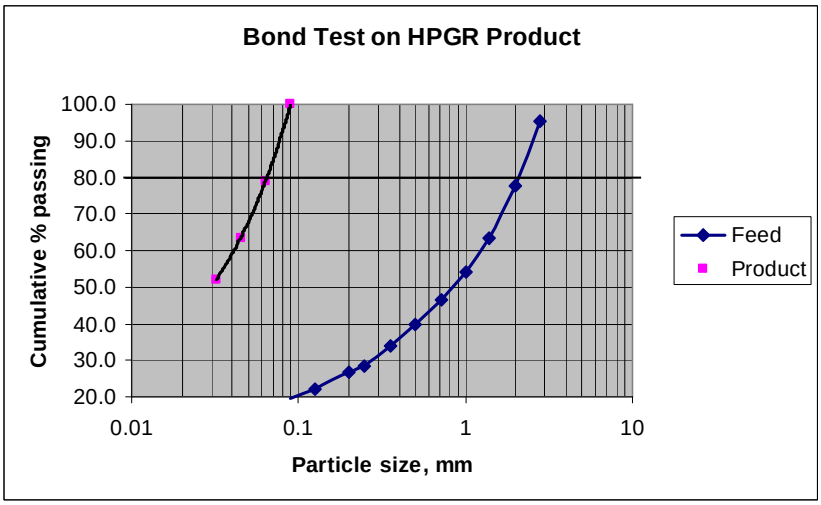
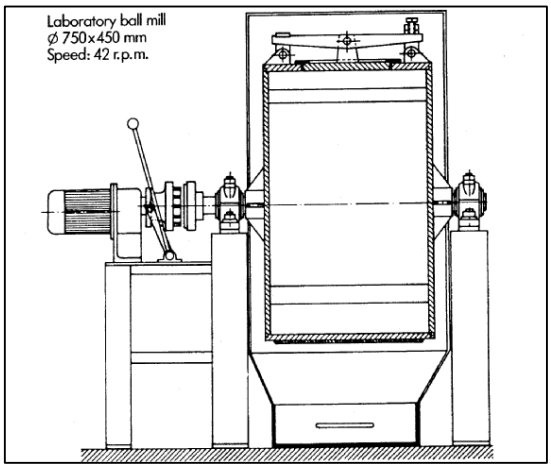


Figure 13.

6.2 POLYSIUS LABMILL Grinding Tests

The LABMILL grinding test was designed specifically for testing HPGR products without pre-crushing of the product for the test. The test is conducted dry in a 750 mm diam. x 450 mm wide ball mill on 7.5 litres of material. The feed, up to 30 mm in size, is ground stepwise using different ball gradings. The ball grading for each step is selected according to the material fineness. The energy consumption and material fineness is determined after each step.

The results are evaluated by plotting the specific energy consumption, in kWh/t, against the product fineness at a given size. Usually two sizes are selected, 90 µm and 200 µm. Linear regression lines are drawn through the points, and estimates are made of the energy required to achieve 80% passing a given size.



A comparison is then made between the energy required for the original feed and for the HPGR product, and the energy savings are calculated from the results. To even up the comparison, the feed was crushed to the top size of the product.

Industrial energy requirements may be calculated from the test results by applying scale-up factors. The LABMILL test is able to provide a realistic comparison of the ball mill energy required for materials with different size distributions. A summary of the LABMILL test results is given in the Table below.

Table 5. Summary LABMILL test results.

	LABMILL Grindability Test Results				
GRIND	**HPGR Feed**		**HPGR Prod.**		**Savings, %**
80% < 200µm	7.07	**kWh/t**	6.06	**kWh/t**	14.2
80% < 90µm	10.62	**kWh/t**	9.27	**kWh/t**	12.7
100% < 90µm	13.76	**kWh/t**	12.28	**kWh/t**	10.8

These indicated a potential energy saving at a P80 of 200 µm of 14% and at a P80 of 90 µm of 12%. Size analyses of the feed size distributions used in the tests are shown in Figure 14.

The energy-size relationships obtained in the tests are shown in Figure 15.

The results indicated higher energy savings than the Bond Tests. The difference in the results is attributable to the larger amount of fines generated in the product by the HPGR, which is not accounted for in the Bond calculations.

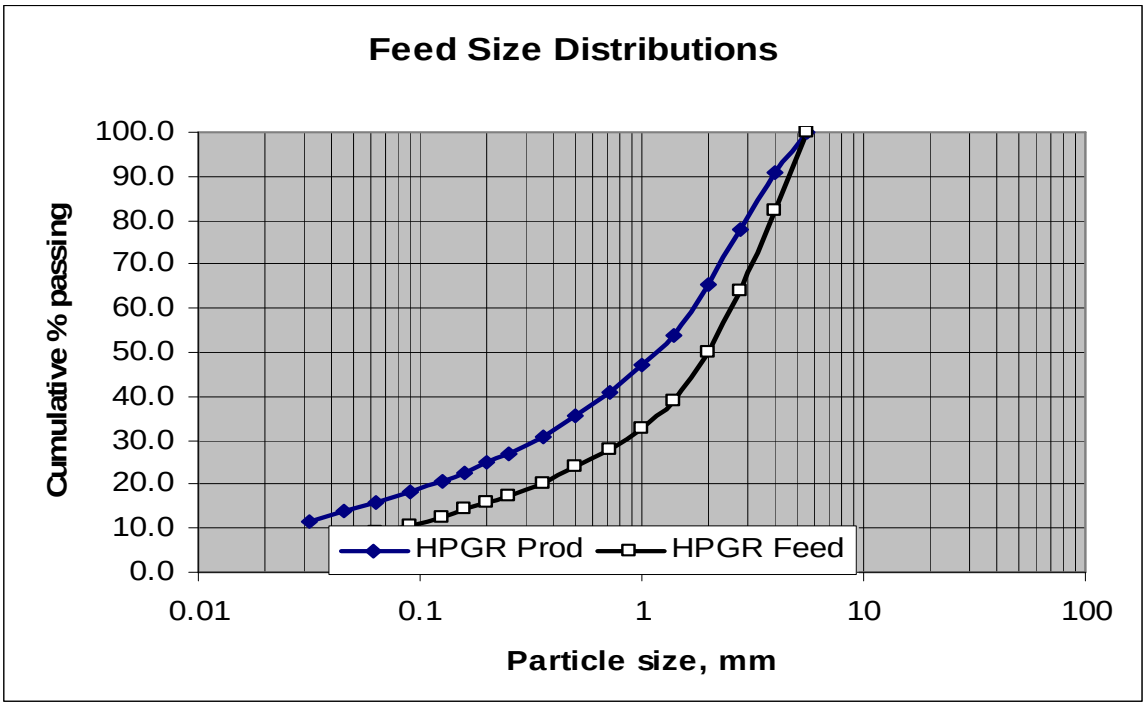


Figure 14. Feed to the LABMILL tests.

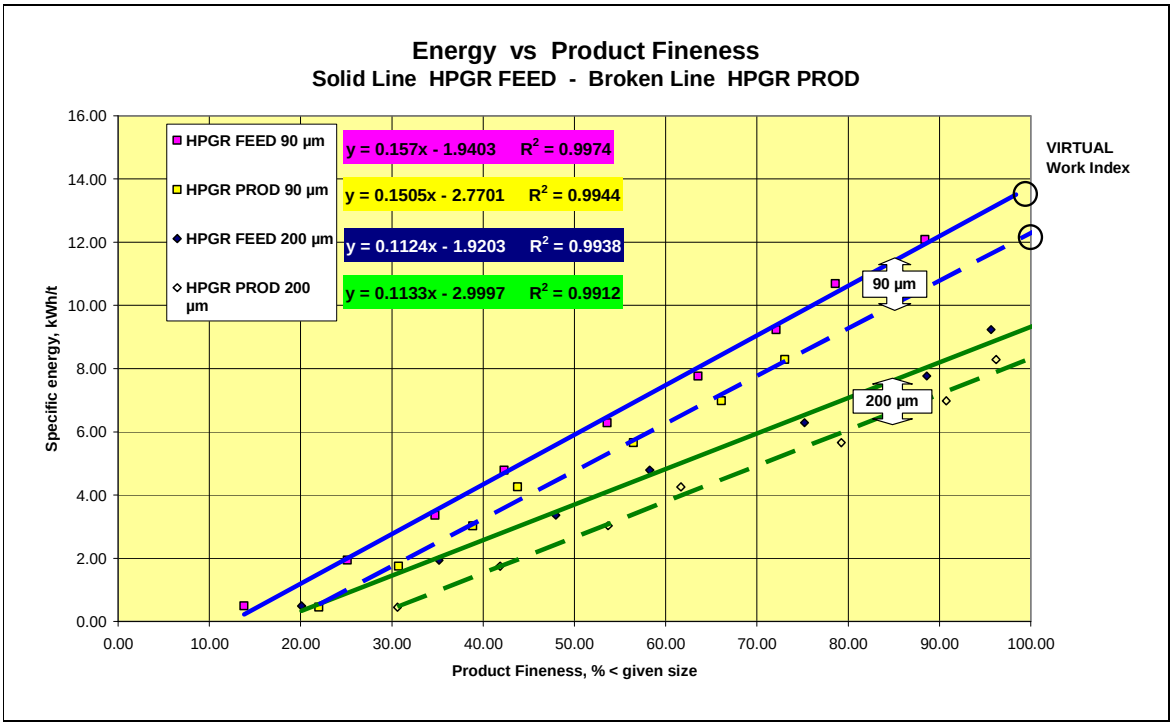


Figure 15. LABMILL energy vs product fineness.

7. Conclusions

1. The material was found to be of low to medium abrasiveness, ATWI index 9-15 g/t. The wear life of the rolls was estimated at 7000 h.

2. The size reduction achieved was better than average for copper ores, > 80% < 8.0 mm, >50% < 2 mm, >20% < 0.2 mm. Increasing pressure had a minimal effect. The max specific press force necessary was 3.5 N/mm².

3. The specific throughput for design purposes was 220 ts/hm³. Recycling of oversize in a closed-circuit operation had no significant effect.

4. The net specific energy consumption was 1.7 kWh/t at a specific press force of 3.5 N/mm² for dry material, and 2.0 kWh/t for wet material with 4-5% moisture content.

5. The material did not form competent flakes on pressing, and could be screened with relatively high efficiency.

6. The Bond Work index of the sample tested was 17.8 kWh/t before and 16.1 kWh/t after HPGR. Pressing in the HPGR resulted in a 10% weakening of the material, through the formation of micro-cracks.

7. LABMILL tests indicated potential energy savings in the order of 14% at a P80 size of 200 µm and 12% at 90 µm from the greater amount of fines created by the HPGR.