

February 1, 2022

Attn: Mr. Mark Fritz, Principal Mechanical Engineer
Stanley Consultants

Subj: UAF SO₂ Control Evaluation Study

Dear Mark,

The Babcock & Wilcox Company (B&W) is pleased to offer Proposal P-082524 to perform an engineering review of the available SO₂ control technologies (Wet Flue Gas Desulfurization (WFGD), Circulating Dry Scrubber (CDS), Spray Dry Absorbers (SDA), and Dry Sorbent Injection (DSI)) for the University of Alaska Fairbanks (UAF). The study will consist of finding a similarly sized application in B&W's experience for each technology to provide high level values for expected pricing and performance. The results of the study will be presented as a summary of findings report, and this report will include the following information for each technology option:

- Typical achievable removal efficiencies
- Budgetary pricing for material scope only, which will be defined for each technology
- Approximate size of enclosure for equipment
- Evaluation of existing baghouse for each technology
- Typical impacts to liquid or solid waste (including typical composition of waste stream for WFGD option) and fly ash (byproduct)
- Typical utility consumptions
 - Power
 - Reagent consumption rates
 - Water
 - Air
 - Expected equipment pressure drop

SCHEDULE:

It is anticipated that the summary of findings report will be provided 2 weeks after acceptance of a purchase order

PRICING:

The above scope can be provided for a firm price of \$40,000.

VALIDITY, PAYMENT & TERMS:

This proposal is open for acceptance for 7 days from the letterhead date. Invoices would be due Net 30 days. Invoices would be issued based on 100% on Receipt of an Order

Any contract would be according to the attached B&W standard terms for engineering studies

We appreciate this opportunity and if I can be of further assistance please do not hesitate to contact me via phone at (707) 265-1055 or via email at rtpon@babcock.com.

Sincerely,

Ronald Pon
Account Manager
The Babcock & Wilcox Company

Cc: J. Solan – Stanley
R. D. Hensel – B&W, Akron
S. D. Perkins – B&W, Akron

BACT DSI Email

Jahn, Mario

From: Solan, John
Sent: Monday, July 25, 2022 10:33 AM
To: Jahn, Mario
Cc: Payne, Mark
Subject: FW: BACT File No. 2209
Attachments: BACT File No. 2209.pdf

Mario,

Here is the updated number from Bala. A couple of notes:

- 1) I asked him for some idea of how big the reactor was going to be. I told him that we need to know the size/weight of the reactor so that we could estimate the amount of steel that we would need to reinforce the building and roof. He said he would have to get back to us early next week, so we might want to find a way to get a reasonable placeholder into the cost estimate in the mean time.
- 2) He said that he spoke with Solvay. They said that Healy was depositing their ash back into the coal mine as beneficial fill. Solvay said that they would ask their contacts at the plant to see if there was any way that the mine would accept ash from UAF. Bala said that he would get back to me with an answer when he got it.

-John

From: BALA <bala@bactprocess.com>
Sent: Monday, July 25, 2022 10:40 AM
To: Solan, John <SolanJohn@stanleygroup.com>
Subject: BACT File No. 2209

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

Good Morning John,

Please see the attached for your review.

Should you have any questions, please contact me.

Kind regards,

Bala
BACT Process Systems, Inc.
(847) 577-0950

CONFIDENTIALITY NOTICE: The contents of this email message and any attachments are intended solely for the addressee(s) and may contain confidential and/or privileged information and may be legally protected from disclosure. If you are not the intended recipient of this message or their agent, or if this message has been addressed to you in error, please immediately alert the sender by reply email and then delete this message and any attachments. If you are not the intended recipient, you are hereby notified that any use, dissemination, copying, or storage of this message or its attachments is strictly prohibited. E-mail cannot be guaranteed to be secure or error-free as information could be intercepted, corrupted, lost, destroyed, arrive late or incomplete, or contain viruses. Neither the sender nor Stanley Consultants, Inc. accept liability for any errors or omissions in the contents of this message, which arise as a result of e-mail transmission.



BACT PROCESS SYSTEMS, INC.

3345 N. ARLINGTON HEIGHTS RD. SUITE B
ARLINGTON HEIGHTS, IL 60004-1900
(847) 577-0950
FAX: (847) 577-6355
E-MAIL: bact_process@sbcglobal.net

July 25, 2022

Mr. John Solan, P.E.
Senior Mechanical Engineer
Stanley Consultants
8000 S. Chester Street, Suite 500
Centennial, CO 80112

RE: DSI with Hydrated Lime for University of Alaska – BACT File No. 2209

Dear John,

We have reviewed the possibility of using hydrated lime as a medium usage for DSI. The flue gas has a temperature of 330°f and a moisture level of 8.5%. For an ideal cage with lime for SO₂ removal, we need to maintain 280°f and 28% moisture.

This will require using atomization spray in the gas stream. Alternatively, it could also be done in the dry reactor or a combination of two. 85% removal of SO₂ could be achieved. TO lime usage will be 1.6 times stoichiometry. Thus, we required approximately 90 PPH of hydrated lime.

The budget price for engineering, storage silo (3-month supply), reactor, humidification: \$3,400,000. We trust this information is sufficient at this time.

If you need additional information, please let me know.

Best regards,

BACT PROCESS SYSTEMS, INC.

A handwritten signature in black ink, appearing to read "N.S. Balakrishnan", with a long horizontal flourish extending to the right.

N.S. ("Bala") Balakrishnan



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E-MAIL: bact_process@sbcglobal.net

August 22, 2022

Mr. John Solan, P.E.
Senior Mechanical Engineer
Stanley Consultants
8000 S. Chester Street, Suite 500
Centennial, CO 80112

RE: DSI with Hydrated Lime for University of Alaska – BACT File No. 2209

Dear John,

A review of duct layout shows the duct between economizer outlet and baghouse inlet shows the distance is approximately 20'. This does not provide sufficient retention time for humidification and DSI.

This inlet duct could be installed in a vertical plane towards the roof of the baghouse building and it could also be routed on top of the building. This duct needs to be insulated to maintain favorable temperature. We anticipate this change will require structural modifications to the roof to support the additional weight.

Budget price for these duct changes will be: \$1,300,000 on install basis.

If you have any questions, please do not hesitate to contact me.

Best regards,

BACT PROCESS SYSTEMS, INC.

A handwritten signature in black ink, appearing to read "N.S. Balakrishnan", written over a horizontal line.

N.S. ("Bala") Balakrishnan

BACT PROCESS SYSTEMS, INC. TERMS AND CONDITIONS

1. **ENTIRE AGREEMENT** – The attached proposal (the “Proposal”), these Terms and Conditions and the drawings and specifications (collectively the “Drawings”) furnished by BACT PROCESS SYSTEMS, INC. (the “Seller”) constitutes the entire agreement between the parties with respect to the purchase and sale of the equipment and/or services described herein (collectively the “Equipment”). Any additional or different terms proposed by Purchaser are hereby rejected and the Proposal, these Terms and Conditions and the Drawings shall together constitute a contract (the “Contract”) between the parties hereto when the Proposal is accepted by Purchaser (whether by written confirmation or by conduct that recognizes the existence of a contract). Any prior understandings, agreements or representations, whether oral or written, shall be deemed superseded and merged herein.
2. **PRICE** – The Equipment shall be sold at the price stated in the Proposal, unless otherwise agreed by Seller and Purchaser. However, Purchaser understands that such price does not include sale, use, excise or other taxes now or hereafter imposed by any federal, state or local governmental agency and all such taxes shall be paid by Purchaser. If Seller is required by law to collect any such tax, Purchaser shall pay to Seller the full amount of such tax immediately upon presentation of an invoice therefor. Component parts not manufactured by Seller are subject to any increase in price that may be charged by suppliers of Seller.
3. **DELIVERY AND TRANSPORTATION** – Unless otherwise stated in the Proposal, the Equipment is sold F.O.B. the place of manufacture, with all delivery and transportation charges to be paid by Purchaser. Notwithstanding the foregoing, title to the Equipment and risk of loss, damage or other incidents of ownership shall pass to Purchaser at Seller’s place of manufacture. The Equipment shall be shipped to Purchaser in accordance with the delivery schedule set forth in the Proposal after receipt of an order, all requested data and approved Drawings from Purchaser, provided, however, that the Seller not be liable for any loss or damage resulting from a delay in shipment caused by fire, strike, flood, accident, theft, a riot, governmental regulations, material shortages, or any other events beyond Seller’s reasonable control. If the shipment of the Equipment is postponed or delayed by Purchaser for any reason, Purchaser agrees to pay Seller reasonable storage costs and any other additional expenses resulting from such postponement or delay. At Seller’s option, partial shipments may be made and invoiced to Purchaser prior to completion of manufacture of all Equipment.
4. **PAYMENT** – Unless different terms are set forth in the Proposal, payment terms are net thirty (30) days from the date of shipment. If payment is not received within such thirty (30) day period (or such longer or shorter period of time set forth in the Proposal), the overdue amount shall be subject to a late payment charge of one and one-half percent (1 1/2%) per month. Whenever reasonable grounds for insecurity arise with respect to payment by Purchaser, Seller may demand different terms of payment from those specified in the Proposal and may demand assurance of Purchaser’s due performance. Seller may, upon making such demand, suspend manufacture, shipment or delivery of the Equipment. If Purchaser fails or refuses to agree to such different terms of payment or fails or refuses to give adequate assurance of due performance within fourteen (14) days after such demand, Seller by written notice to Purchaser may treat such failure or refusal as a repudiation of the portion of the Contract not then fully performed, whereupon Seller may (a) cancel all further deliveries and any amounts unpaid hereunder shall become immediately due and payable, together with interest at the rate of 1 1/2% per month, and liquidated damages of ten percent (10%) of the Contract price to compensate Seller for lost profits; or (b) make shipments under reservation of a security interest and demand payment against tender of documents of title. If Seller retains a collection agency or an attorney to collect overdue amounts, all collection costs, including without limitation reasonable attorney’s fees and expenses, shall be paid by Purchaser.

BACT PROCESS SYSTEMS, INC. TERMS AND CONDITIONS

5. **INSTALLATION** – Purchaser shall be responsible for the installation of the Equipment at its own cost and expense. Unless otherwise set forth in the Proposal, no installation services are included in the Contract price.
6. **LICENSES AND PERMITS** – Any and all licenses and permits which may be necessary to install and/or operate the Equipment shall be obtained by Purchaser at its sole cost and expense, unless otherwise provided in the Proposal. Seller shall not be liable for any loss or damage resulting from delay in obtaining such licenses or permits.
7. **LIMITED WARRANTY** – Seller warrants that the Equipment which is manufactured by Seller (a) will be free from defects in material and workmanship for a period of one (1) year from the date of initial operation or for a period of eighteen (18) months after the date of shipment by Seller, whichever occurs first; and (b) will meet the performance guarantee and equipment warranty set forth in the Proposal. Any component parts of the Equipment manufactured by Sellers suppliers shall only have the warranties given by such suppliers. Seller shall not be responsible for any damage to the Equipment arising out of corrosion, erosion or deterioration, improper handling, installation, operation, maintenance, repair, misuse, negligence or accident or for any Equipment that has been altered by person other than Seller so as to affect the Equipment's proper operation. **SELLER MAKES NO WARRANTY THAT THE EQUIPMENT SHALL BE MERCHANTABLE OR FIT FOR ANY PARTICULAR PURPOSE, NOR DOES SELLER MAKE ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, BY OPERATION OF LAW OR OTHERWISE, EXCEPT SUCH AS ARE EXPRESSLY SET FORTH HEREIN OR IN THE PROPOSAL.**
8. **REMEDIES** – **THE PARTIES AGREE THAT THE PURCHASER'S SOLE REMEDY FOR A BREACH OF ANY OF THE FOREGOING WARRANTIES SHALL BE LIMITED TO EITHER THE REPAIR OR THE REPLACEMENT OF THE DEFECTIVE EQUIPMENT OR COMPONENT PARTS AT SELLER'S SOLE COST AND EXPENSE. SELLER SHALL NOT BE LIABLE TO PURCHASER OR TO ANY THIRD PARTY FOR ANY LOST PROFITS OR SPECIAL, INCIDENTAL, CONSEQUENTIAL, EXEMPLARY, INDIRECT OR CONTINGENT DAMAGES FOR ANY BREACH OF WARRANTY OR OTHER BREACH OF SELLER'S OBLIGATIONS HEREUNDER, INCLUDING, BUT NOT LIMITED TO, LOSS BY REASON OF PLANT SHUTDOWN, INTERRUPTION IN THE OPERATION OF THE PLANT IN WHICH THE EQUIPMENT IS LOCATED OR ANY INCREASED EXPENSES OF THE EQUIPMENT OF SUCH PLANT.**
9. **CANCELLATION** – Once the offer to sell the Equipment upon the Terms and Conditions set forth in the Proposal, these Terms and Conditions and the Drawings have been accepted by Purchaser, the order for the Equipment may not be canceled without Seller's prior written consent. Seller shall have the absolute right to cancel and refuse to perform this order in the event any or all of the following conditions occur: (a) if at any time all of the Terms and Conditions are not strictly complied with by Purchaser; (b) if at any time Purchaser becomes bankrupt or insolvent or bankruptcy or insolvency proceedings are commenced against Purchaser; or (c) if Purchaser fails to post security acceptable to Seller within fourteen (14) days after Seller has requested such security based on a good faith doubt of Purchaser's ability to make prompt payment.
10. **DEFAULT IN PAYMENT** – In the event Purchaser defaults in making any of the payments required hereunder, Seller shall have the option to recover possession of the Equipment to the extent permitted by applicable law and the cost and expense incurred by Seller in recovering the Equipment, including without limitation reasonable attorney's fees and expenses, shall be paid by Purchaser. Seller and Purchaser agree that none of the Equipment furnished under this Contract shall be deemed a fixture attached to real estate until full payment of the purchase price for the Equipment has been made to Seller.

BACT PROCESS SYSTEMS, INC. TERMS AND CONDITIONS

11. **PATENT INFRINGEMENT** – Seller shall defend at its expense any suit or proceeding brought against Purchaser based on the claim that the Equipment or any component part of the Equipment manufactured by Seller infringes any United States patent. Seller shall pay any damages and costs awarded in such suit or proceeding against Purchaser if promptly notified by Purchaser in writing of such claim and if given full authority, information and assistance by Purchaser in conducting the defense of such suit or proceeding. If the use of the Equipment or any component part is enjoined in such suit or proceeding, Seller shall either at its expense and option obtain for Purchaser the right to use the Equipment or component part, or modify it so that it no longer infringes or replace it with non-infringing Equipment or component parts.
12. **CONFIDENTIALITY** – The Proposal, these Terms and Conditions and the Drawings are the property of the Seller and contain confidential information which is loaned to Purchaser on the condition that neither Purchaser nor its representative will copy or use all or parts of the Proposal, these Terms and Conditions or the Drawings without Seller's permission, nor to furnish information from them to others nor to make any use of them to others that is or may be injurious to Seller and to return them to Seller upon request. Seller also reserves the right to correct any typographical or clerical errors in the Proposal, these Terms and Conditions or the Drawings.
13. **GOVERNING LAW** – The purchase and sale of the Equipment in accordance with the terms and provisions of the Proposal, these Terms and Conditions and the Drawings shall be governed in all respects by the laws of the State of Illinois. In the event that any dispute arises between Seller and Purchaser concerning the purchase and sale of the Equipment, both parties agree that such dispute shall be settled either (a) by arbitration in the Chicago metropolitan area in accordance with the rules of the American Arbitration Association, with each party responsible for one-half (1/2) of the costs of the arbitrator, or (b) by litigation in the Circuit Court of Cook County, Illinois, with the prevailing party to be entitled to reimbursement from the non-prevailing party for all costs and expenses incurred by the prevailing party in such litigation, including without limitation reasonable attorney's fees and expenses.
14. **ASSIGNMENT AND SUB-CONTRACT** – Purchaser shall not assign any of its right title or interest in this Contract to a third party without the prior written consent of Seller. Purchaser agrees however that Seller may subcontract certain portions of work covered by this Contract to third parties.
15. **SUCCESSORS AND ASSIGNS** – The terms and provisions of this Contract shall inure to the benefit of and binding upon successors and permitted assigns of the parties.
16. **MISCELLANEOUS PROVISIONS**
 - (a) The waiver by either party of any term, condition or provision hereof shall not be construed to be waiver of any other term, condition or provision hereof, nor shall such waiver be deemed a waiver of subsequent breach of the same term, condition or provisions.
 - (b) The Contract may only be modified or amended by a written document signed by the parties hereto.
 - (c) In the event that any term or provision of the Contract shall be deemed by a court of competent jurisdiction to be unenforceable in whole or in part, such term or provision shall be deemed deleted from the Contract to the extent required by applicable law.

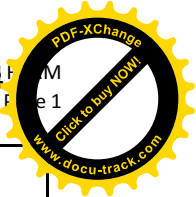
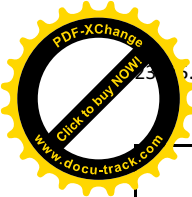
Jahn, Mario

From: Solan, John
Sent: Tuesday, August 9, 2022 3:44 PM
To: Jahn, Mario
Subject: FW: University of Alaska Fairbanks BACT Analysis - Budgetary Cost Estimate
Attachments: Boiler Data.pdf; CHPP Layout.pdf; UAF Exhaust Gas Data.docx; Baghouse Info.pdf; UAF AQCS Options And.docx

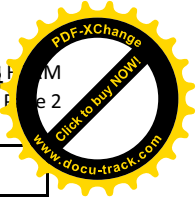
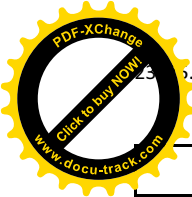
From: Solan, John
Sent: Tuesday, March 1, 2022 2:32 PM
To: N. S. Balakrishnan (bala@bactprocess.com) <bala@bactprocess.com>
Cc: Fritz, Mark <FritzMark@stanleygroup.com>
Subject: FW: University of Alaska Fairbanks BACT Analysis - Budgetary Cost Estimate

Apparently “shortly” was very short. Here is what we have collected so far. Let me know if we are missing something.

From: Fritz, Mark <FritzMark@stanleygroup.com>
Sent: Tuesday, March 1, 2022 2:29 PM
To: Solan, John <SolanJohn@stanleygroup.com>
Subject: FW: University of Alaska Fairbanks BACT Analysis - Budgetary Cost Estimate

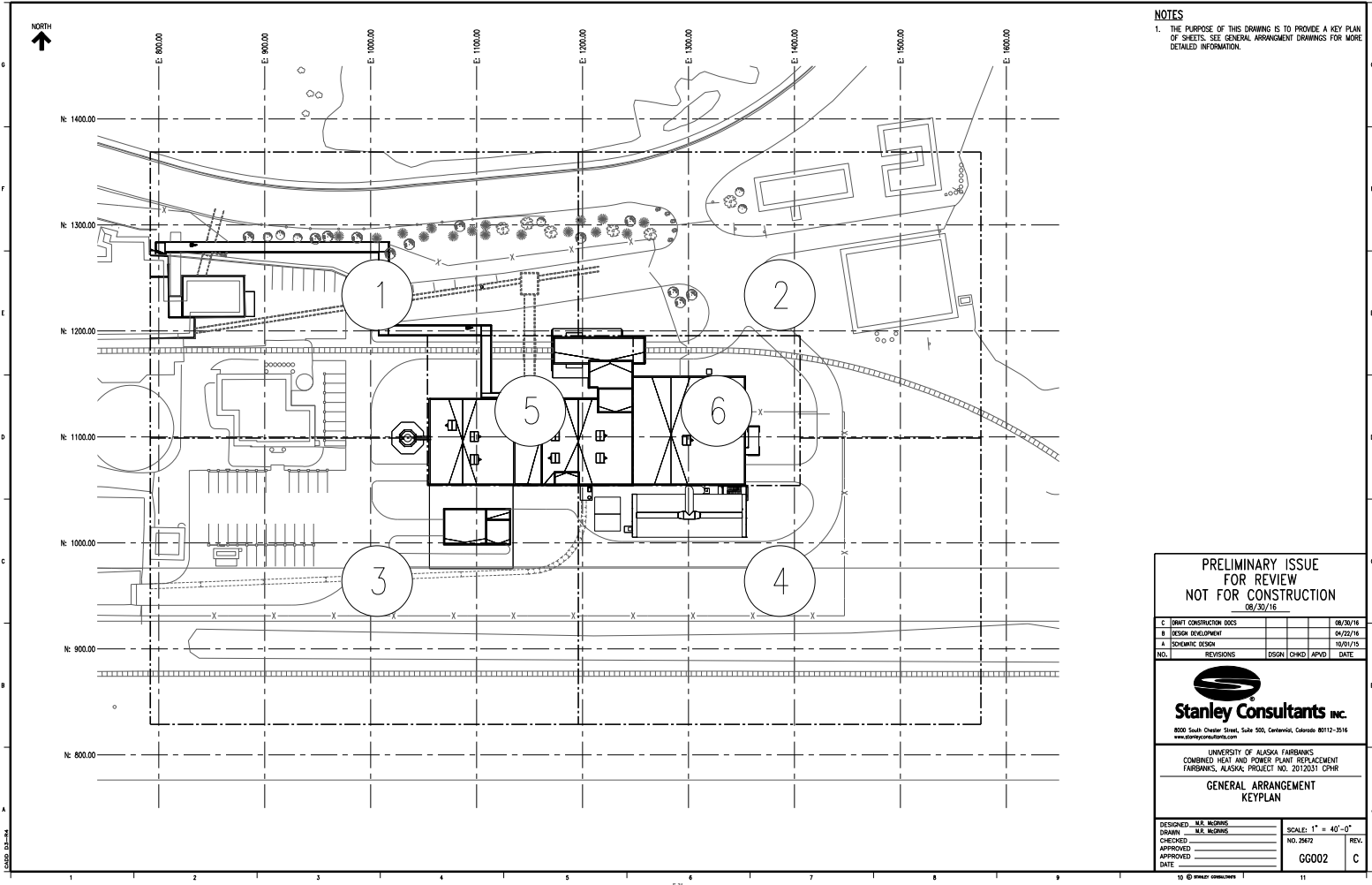


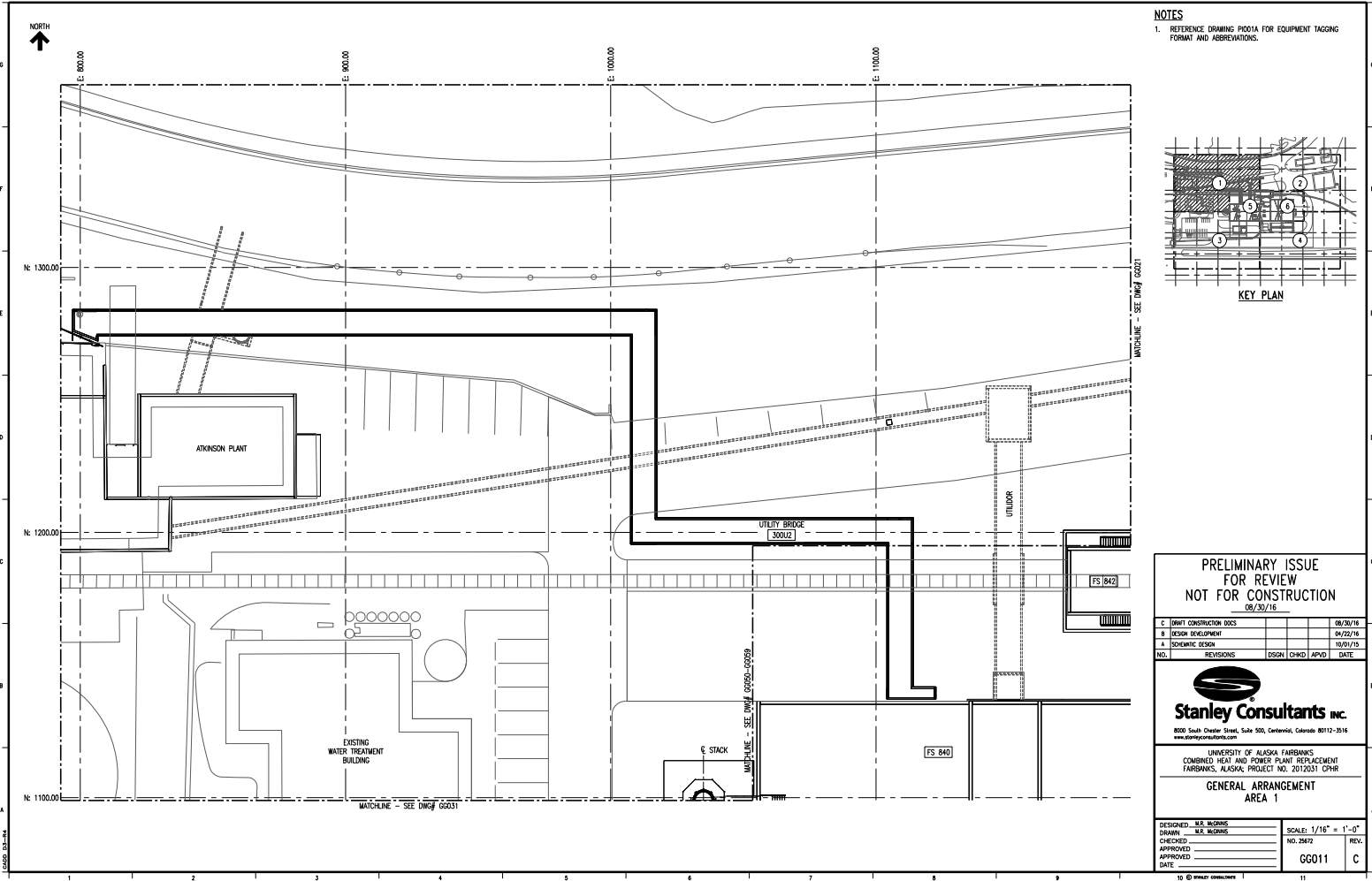
BAGHOUSE DATA SHEET		Equipment Name: Baghouse	
		Tag No.:	
DESCRIPTION	Units	SPEC DATA	VENDOR DATA
GUARANTEED PREDICTED PERFORMANCE DATA			
Particulate emissions, stack outlet:			
Particulate Matter (filterable), all baghouse modules on line	lb/MMBtu input	Reference Emissions Guarantees	
Particulate Matter (filterable), one baghouse module off line	lb/MMBtu input	0.030	
Particulate emissions, stack outlet:			
Particulate Matter (filterable), all baghouse modules on line	gr/scf	Reference Emissions Guarantees	
Particulate Matter (filterable), one baghouse module off line	gr/scf	0.05	
PM10 emissions, stack outlet:			
PM10 (filterable and condensable), all baghouse modules on line	lb/MMBtu input	Reference Emissions Guarantees	
PM10 (filterable and condensable), one baghouse module off line	lb/MMBtu input	0.012	
PM2.5 emissions, stack outlet:			
PM2.5 (filterable and condensable), all baghouse modules on line	lb/MMBtu input	Reference Emissions Guarantees	
PM2.5 (filterable and condensable), one baghouse module off line	lb/MMBtu input	0.012	
Opacity of flue gas leaving stack, percent, 6-minute average			
Bag Leak Detection System	mg/acm	10 or less	
System friction losses:			
Baghouse including manifolds, all modules on line	In. H ₂ O		<5 (est)
Baghouse including manifolds, one module off line	In. H ₂ O		≤6 (est)
Ductwork, inlet ⁽¹⁾	In. H ₂ O		0.3 (est)
Ductwork, outlet ⁽¹⁾	In. H ₂ O		0.3 (est)
Baghouse bypass duct	In. H ₂ O		3 (est)
Power requirements:			
Hopper heaters	kW		5 (est)
Hopper vibrators	kW		Not Included/Recommended
Other	kW		None
Other	kW		None
Compressed air requirements:			
Bag pulse cleaning air:			
Consumption	scfm		50 (est)
Normal pressure	psig		100
Minimum pressure	psig		80
Instrument air consumption:			
Maximum instantaneous	scfm		40 (est)
Average	scfm		>10 (est)
Other			
Bypass damper leakage	%		0% (with seal gas)
PHYSICAL DATA AND SPECIFICATIONS			
Installed Weight:			
Supporting steel including enclosure	lb		Included In Boiler Tab
Baghouse	lb		163,000 lbs per PJFF
Breeching and ducts	lb		Included In Boiler Tab
Baghouse equipment data:			
Seller			
Number of modules			
Air-to-cloth ratio with even distribution. (do not include area of cloth over cages, Venturis, bottom caps, or seams):			

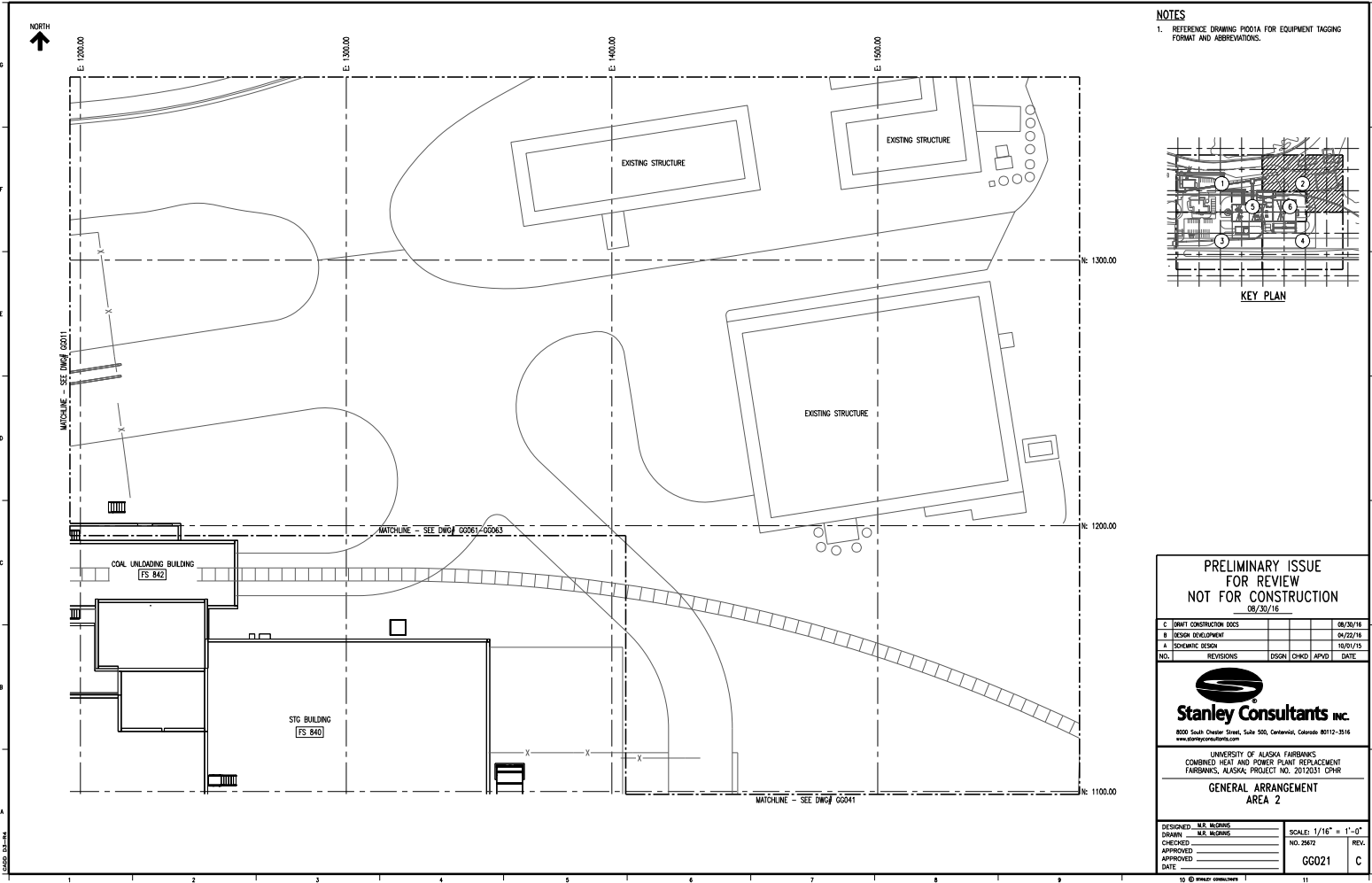


All modules in service under maximum operating conditions, gross			3.9
One module out for cleaning under maximum operating conditions, net			2.6
Filter bags:			
Fabric material/bag Seller			PPS with ePTFE membrane
Weight	oz/sq yd		16
Coating	% by weight		ePTFE membrane
Permeability (clean)	cfm/sq ft @ 1/2" wg		7 - 12 (est.)
Total bag weight without hardware	lb		4.5 (est.)
Cage construction:			
Wire size, and material			9 ga, Carbon Steel
Horizontal wire spacing			8"
Maximum opening size			5.9" Dia
Venturi material			N/A
Number of bags	per module		752
Bag size (diameter x length)	in.		6" x 19'8"
Bag spacing, center to center	in		8
Effective filter area per bag, used in computing air-to-cloth ratio	sq. ft.		29.52
Total filter area per module	sq. ft.		7438
Bag temperature rating:			
Continuous	F		330
Maximum short duration	F		350
Guaranteed bag life	Hrs		See Vendor's guarantee Section from proposal
Method of bag replacement (description - use separate sheet if necessary)			Remove blowpipe, pull out cage, drop bag into hopper,
Cleaning cycle time, minutes (isolation, pulse, settling, on-line):	Min		On-line cleaning, casing cleaned every 30 minutes
Adjustable cleaning cycle range per compartment	Min		Cleaning based on DP not time
Expected cleaning period per compartment, minutes	Min		3 min (est.)
Physical data:			
Baghouse overall dimensions (not including breeching, ducts):			
Length, parallel to gas flow	ft-in		See GA Drawing
Width, transverse to gas flow	ft-in		See GA Drawing
Height, above dust hopper flange connection	ft-in		See GA Drawing
Dimensions of each module:			
Height (overall)	ft-in		See GA Drawing
Width	ft-in		See GA Drawing
Length	ft-in		See GA Drawing
Side casing material and thickness	in.		A36 Carbon Steel, 3/16"
Hopper material and thickness	in		A36 Carbon Steel, 1/4"
Plenum casing material and thickness	in		A36 Carbon Steel, 3/16"

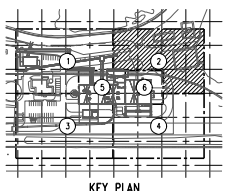
FUEL CHARACTERISTICS			LOAD CONDITION					
FUEL ANALYSIS		DESIGN	STEAM LEAVING SH, MLB/HR	MCR	70%	40%	33%	
A AREA	MINE	USIBELLI	TYPE OF FUEL	Coal	Coal	Coal	Coal	
	STATE/PROVINCE	HEALY, AK	EXCESS AIR LEAVING ECONOMIZER, %	15	15	66	102	
	COUNTRY	USA	NO. OF BURNERS IN OPERATION	0	0	0	0	
PROXIMATE ANALYSIS	% BY	WT	OUTPUT PER PTC 4-2013, MKB/HR	253.4	177.4	100.1	95.3	
	TOTAL MOIST.	28.50	FUEL INPUT, MKB/HR	295.6	206.0	118.8	118.0	
	VOL. MATTER	36.00	QUANTITY - MLB/HR	FUEL FLOW	39.1	27.3	15.7	15.6
	FIXED CARBON	26.50		FLUE GAS ENTERING AIR HEATER	284.7	199.0	157.8	187.0
	ASH	9.00		FLUG GAS ENTERING STACK (ACFM)	89,832	61,165	50,217	65,748
	TOTAL	100.00		TOTAL AIR TO BURNING EQUIPMENT	246.7	172.0	141.2	170.5
% BY	WT	SECONDARY AIR LEAVING AH		117.1	64.9	17.8	21.8	
ASH	9.00	PRIMARY AIR LEAVING AH		117.1	97.3	115.3	140.3	
ULTIMATE ANALYSIS	H2O	28.50	AIR HTR LEAKAGE (TOTAL AIR TO GAS)	1.0	1.4	2.5	2.5	
	C	43.75	SUPERHEAT SPRAY FLOW	7.88	7.48	0.00	0.74	
			BLOWDOWN	1.20	0.84	0.48	12.00	
			PRESSURE PSIG	FEEDWATER	740.00	692.00	660.00	656.00
				SPRAY WATER	720.00	702.00	0.00	0.00
				DRUM	693	658	636	633
				STEAM AT SH OUTLET	625	625	625	625
			TEMPERATURE - F	STEAM LEAVING SUPERHEATER	750	750	728	760
				WATER ENTERING ECONOMIZER	350	350	350	260
				FLUE GAS LEAVING AH (EXCL. LKG)	285	260	285	350
				ENTERING STACK	289	265	288	354
				AIR ENTERING PRI. AIR FAN (1)	77	88	111	123
		ENTERING SEC. AIR FAN (1)		77	77	77	77	
			LEAVING AIR HEATER (SEC)	335	335	275	337	
			LEAVING AIR HEATER (PRI)	335	309	380	508	
SORBENT CHARACTERISTICS			FUEL TO BURNING EQUIPMENT	40	40	40	40	
LIMESTONE ANALYSIS		DESIGN	DRY GAS	4.38	3.86	6.02	9.80	
ANALYSIS	% BY	WT	H2 & H2O IN FUEL	8.53	8.45	8.51	8.75	
	CaCO3	95.00	MOISTURE IN AIR	0.07	0.06	0.10	0.16	
	MgCO3	0.90	MOISTURE IN SORBENT	0.00	0.00	0.00	0.00	
	SiO2	3.30	UNBURNED COMBUSTIBLE IN RESIDUE	0.50	0.50	0.50	0.50	
	H2O	0.80	RADIATION	0.36	0.51	0.91	0.96	
	TOTAL	100.00	SENSIBLE HEAT IN REFUSE	0.07	0.10	0.09	0.13	
NOTES	(1) PTC 4 BOUNDARY IS AT FAN INLETS W/SPECIFIED ENTERING AIR TEMP OF 77°F & SPECIFIED 40°F AMBIENT (FUEL) TEMP (2) PREDICTED PERFORMANCE BASED ON CONDITIONS & EQUIPMENT SHOWN ON THIS SUMMARY SHEET & ON GENERAL ARRGT DRAWINGS B0312851 & B0312852 (3) BAROMETRIC PRESSURE = 29.40 IN HG 0.009 LB H2O PER LB COMBUSTION AIR (4) SPRAY WATER PRESSURE AT EXPECTED OPERATING CONDITIONS, FURTHER UPSET PERFORMANCE TO BE PROVIDED LATER		MANUFACTURER'S MARGIN	0.40	0.40	0.40	0.40	
			SORBENT CALCINATION/DEHYDRATION	0.23	0.23	0.23	0.23	
			OTHER LOSSES (UNMEASURED)	0.10	0.10	0.10	0.10	
			TOTAL LOSSES	14.64	14.21	16.87	21.03	
			HEAT LOSSES, %	ENTERING DRY AIR	0.00	0.12	0.81	1.36
			MOISTURE IN AIR	0.00	0.00	0.01	0.02	
			SENSIBLE HEAT IN FUEL	-0.16	-0.16	-0.16	-0.16	
			SULFATION	0.11	0.11	0.11	0.11	
			MOISTURE IN LIMESTONE	0.00	0.00	0.00	0.00	
			AUXILIARY EQUIPMENT POWER	0.42	0.23	0.42	0.42	
HEAT CREDITS, %	TOTAL CREDITS	0.37	0.30	1.19	1.76			
© 2015 THE BABCOCK & WILCOX COMPANY ALL RIGHTS RESERVED.			ASME PTC 4-2013 FUEL EFFICIENCY, %	85.73	86.10	84.32	80.73	







NOTES
 1. REFERENCE DRAWING PFD01A FOR EQUIPMENT TAGGING FORMAT AND ABBREVIATIONS.



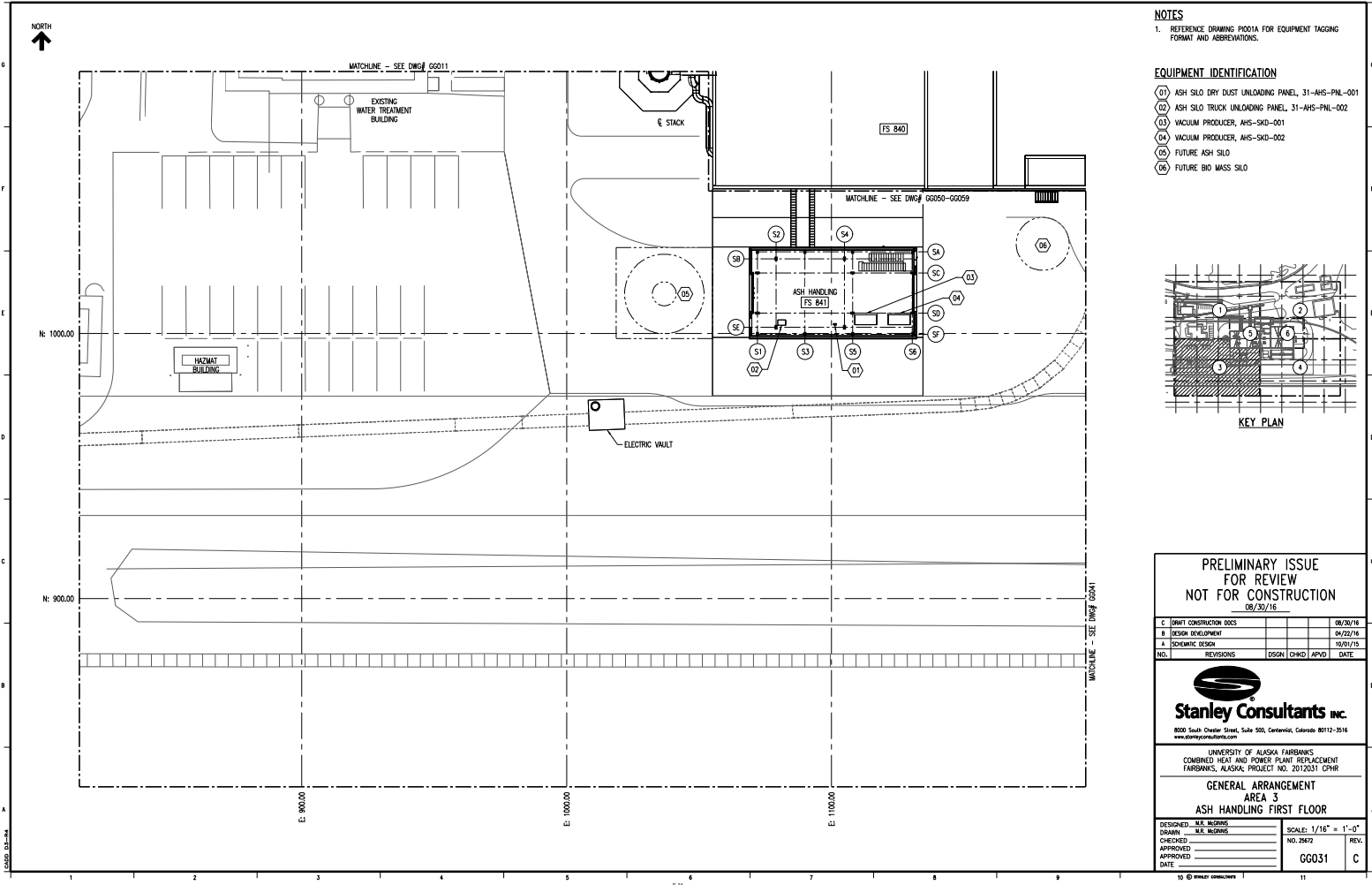
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C	LIMIT CONSTRUCTION BIDS				08/30/16
B	DESIGN DEVELOPMENT				04/22/16
A	SCHEMATIC DESIGN				10/01/15

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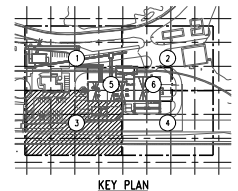
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 COMBINED HEAT AND POWER PLANT REPLACEMENT
 FAIRBANKS, ALASKA, PROJECT NO. 2012031 CPHR
**GENERAL ARRANGEMENT
 AREA 2**

DESIGNED BY: _____	SCALE: 1/16" = 1'-0"	REV. _____
DRAWN BY: _____	NO. 25672	_____
CHECKED BY: _____	GG021	C
APPROVED BY: _____		
DATE: _____		



NOTES
 1. REFERENCE DRAWING PFD01A FOR EQUIPMENT TAGGING FORMAT AND ABBREVIATIONS.

- EQUIPMENT IDENTIFICATION**
- (O1) ASH SILO DRY DUST UNLOADING PANEL, 31-AHS-PNL-001
 - (O2) ASH SILO TRUCK UNLOADING PANEL, 31-AHS-PNL-002
 - (O3) VACUUM PRODUCER, AHS-SKD-001
 - (O4) VACUUM PRODUCER, AHS-SKD-002
 - (O5) FUTURE ASH SILO
 - (O6) FUTURE BIO MASS SILO



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B	DESIGN DEVELOPMENT	04/22/16
A	SCHEMATIC DESIGN	10/01/15

NO.	REVISIONS	DSGN	CHKD	APVD	DATE

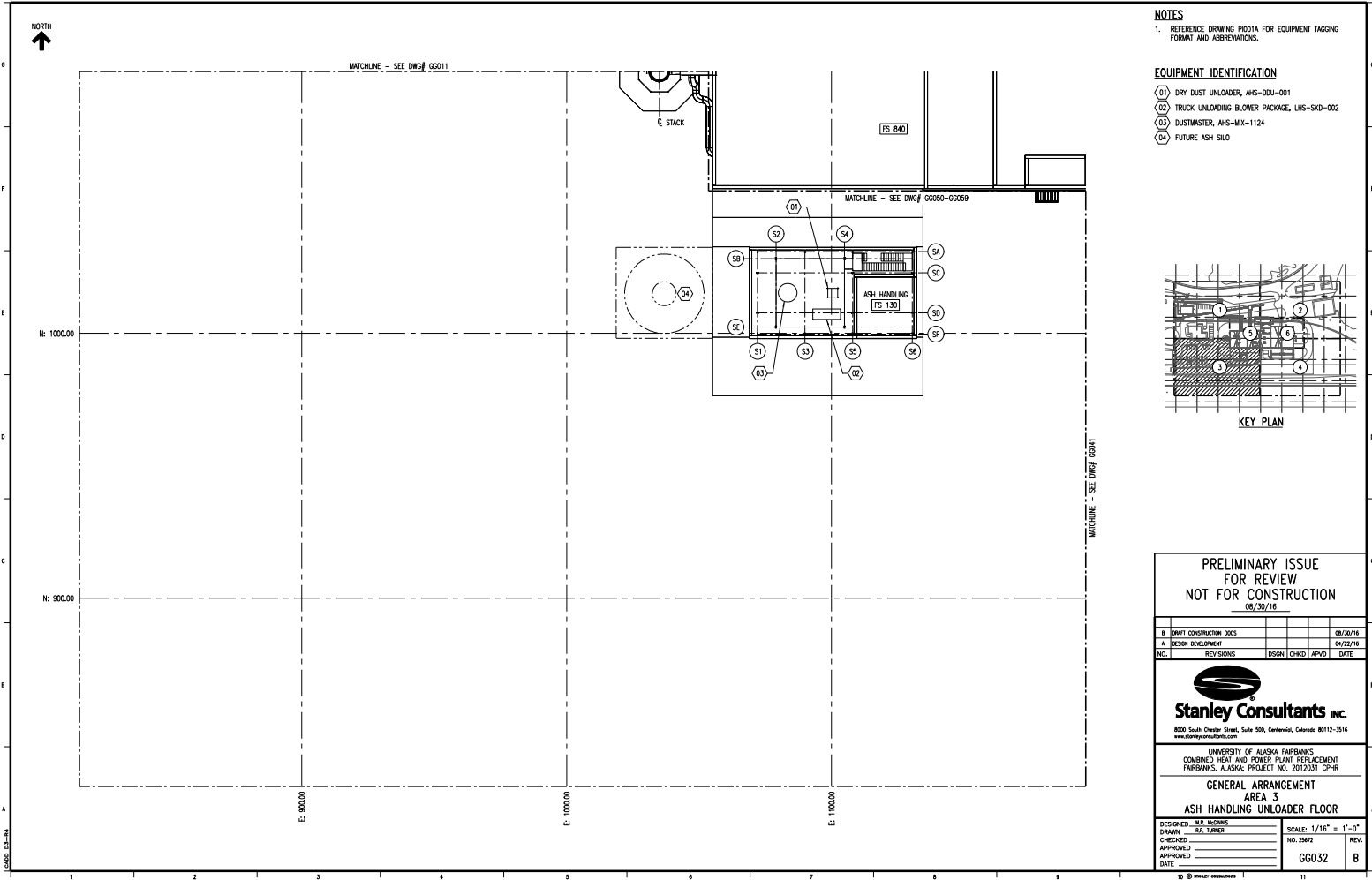
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 COMBINED HEAT AND POWER PLANT REPLACEMENT
 FAIRBANKS, ALASKA; PROJECT NO. 2012031 CPHR

**GENERAL ARRANGEMENT
 AREA 3
 ASH HANDLING FIRST FLOOR**

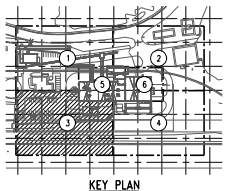
DESIGNED BY: MCKINNS	SCALE: 1/16" = 1'-0"	REV.
DRAWN BY: MCKINNS	NO. 25672	C
CHECKED BY: _____	GG031	
APPROVED BY: _____		
DATE: _____		

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NOTES
 1. REFERENCE DRAWING PFD01A FOR EQUIPMENT TAGGING FORMAT AND ABBREVIATIONS.

- EQUIPMENT IDENTIFICATION**
- (D1) DRY DUST UNLOADER, AHS-DDU-001
 - (D2) TRUCK UNLOADING BLOWER PACKAGE, LIS-SKD-002
 - (D3) DUSTMASTER, AHS-MX-1124
 - (D4) FUTURE ASH SILO



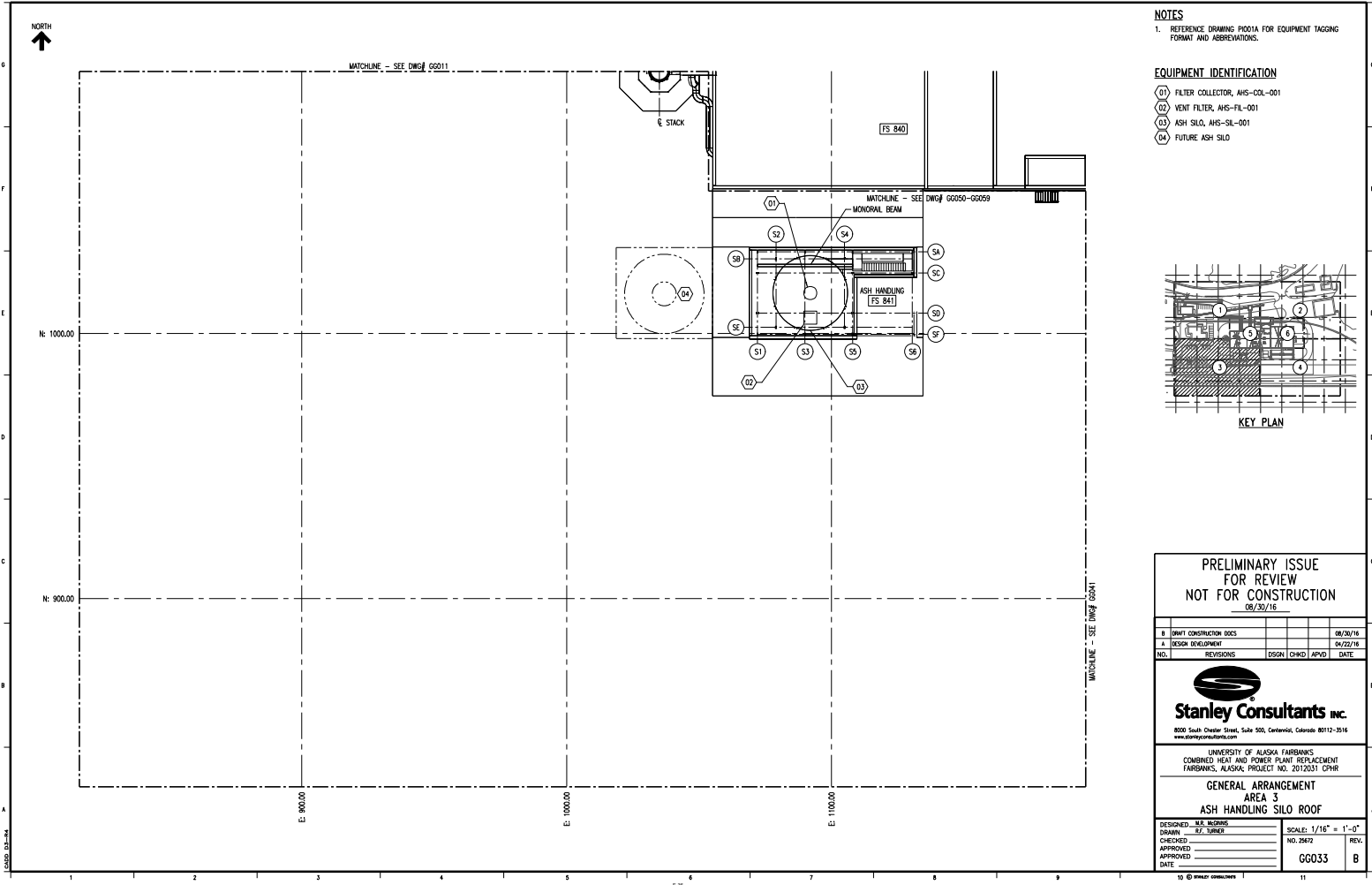
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B	DRAFT CONSTRUCTION INDEX			08/30/16	
A	DESIGN DEVELOPMENT			04/22/16	
NO.	REVISIONS	DSGN	CHKD	APVD	DATE

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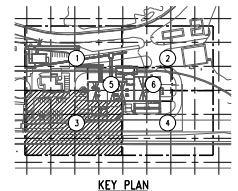
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 COMBINED HEAT AND POWER PLANT REPLACEMENT
 FAIRBANKS, ALASKA PROJECT NO. 2012031 CPHR
**GENERAL ARRANGEMENT
 AREA 3
 ASH HANDLING UNLOADER FLOOR**

DESIGNED BY	NO. 25672	SCALE: 1/16" = 1'-0"	REV.
DRAWN BY			
CHECKED BY			
APPROVED BY	GG032		8
DATE			



NOTES
 1. REFERENCE DRAWING P001A FOR EQUIPMENT TAGGING FORMAT AND ABBREVIATIONS.

- EQUIPMENT IDENTIFICATION**
- (D1) FILTER COLLECTOR, AHS-COL-001
 - (D2) VENT FILTER, AHS-FIL-001
 - (D3) ASH SILO, AHS-SL-001
 - (D4) FUTURE ASH SILO



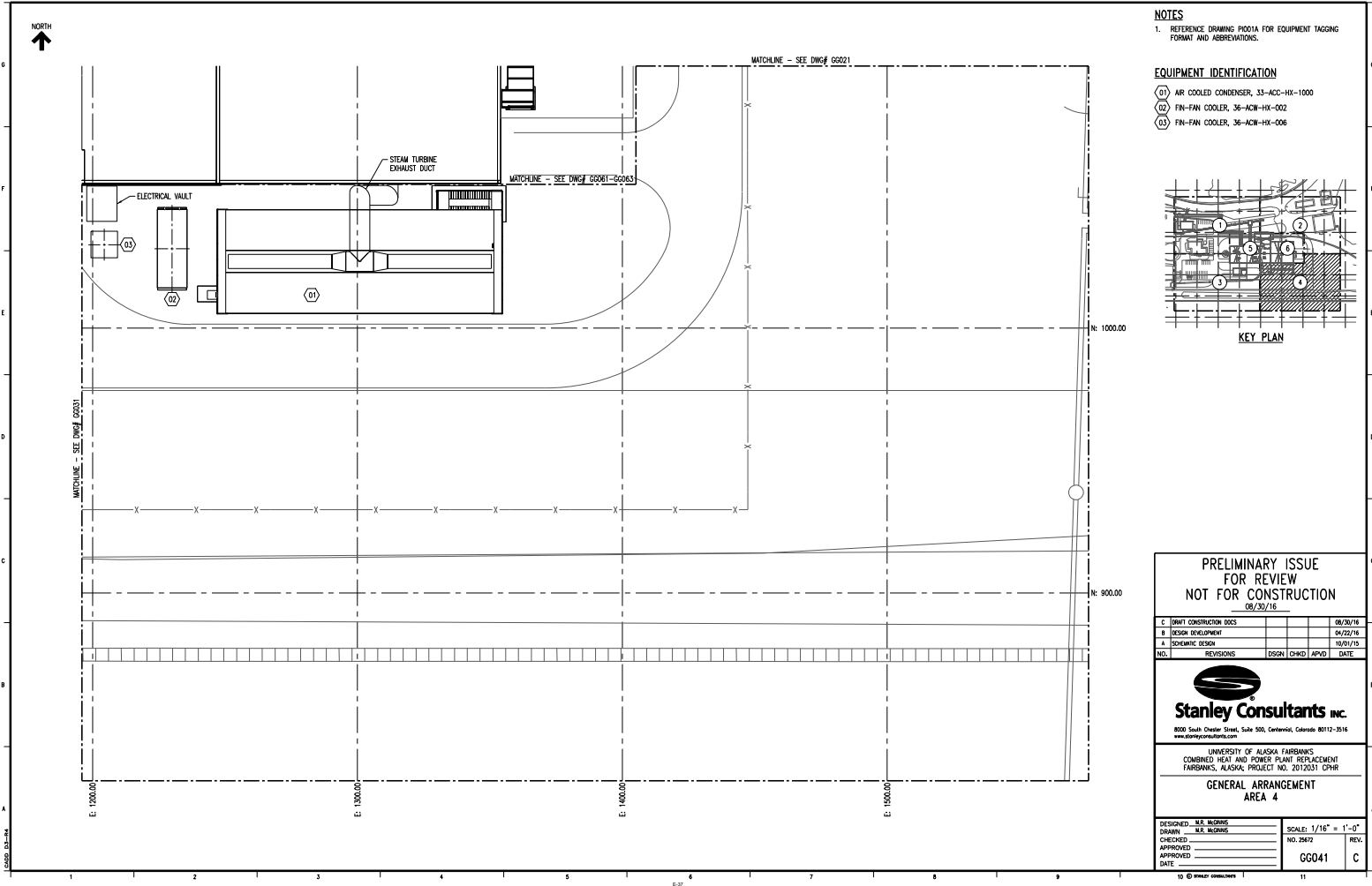
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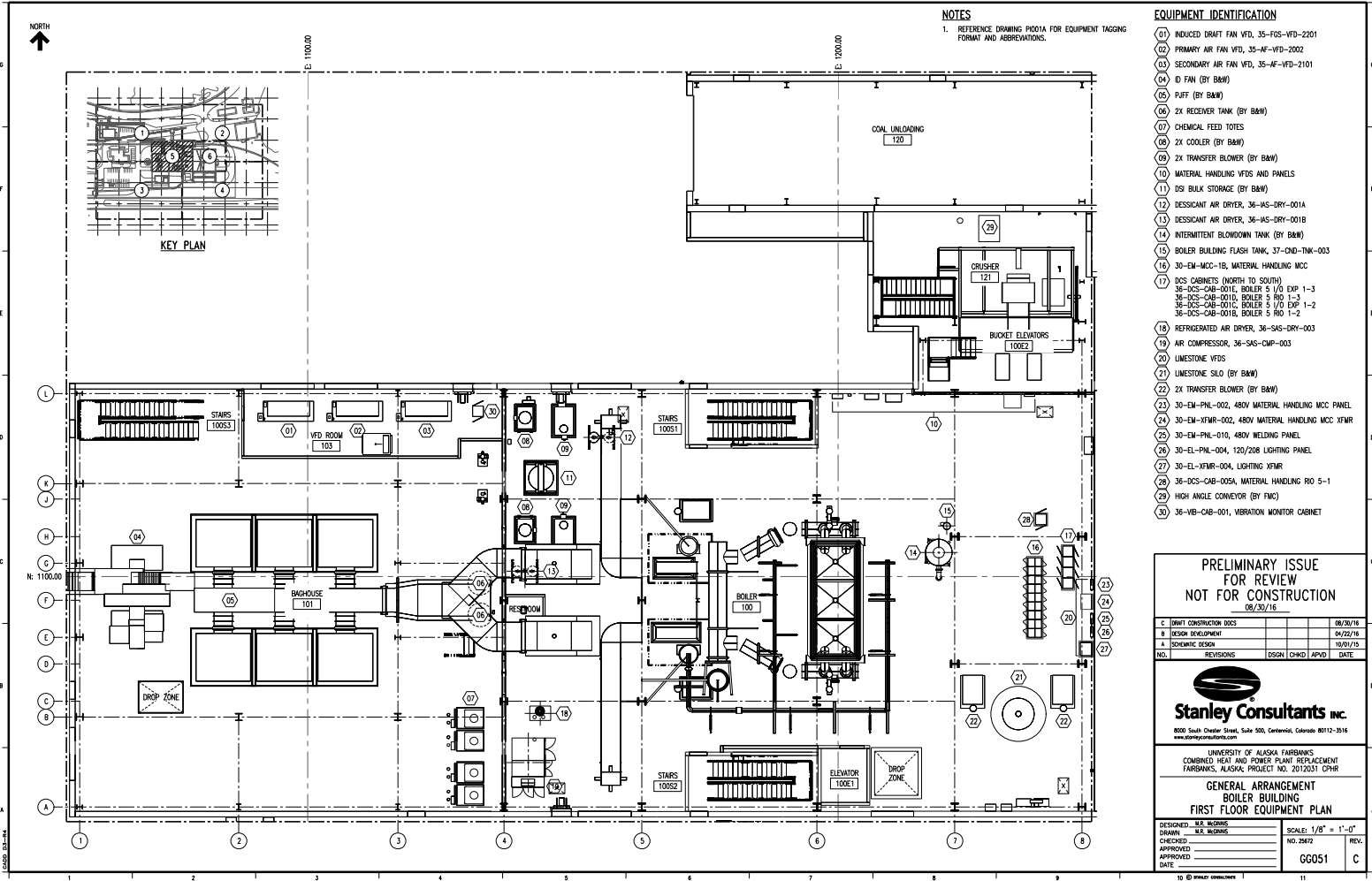
NO.	REVISIONS	DSGN	CHKD	APVD	DATE
B	DRWT CONSTRUCTION INDEX				08/20/16
A	DESIGN DEVELOPMENT				04/22/16



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 COMBINED HEAT AND POWER PLANT REPLACEMENT
 FAIRBANKS, ALASKA PROJECT NO. 2012031 CPHR
**GENERAL ARRANGEMENT
 AREA 3
 ASH HANDLING SILO ROOF**

DESIGNED BY: MGR	SCALE: 1/16" = 1'-0"	REV.
DRAWN BY: TJB	NO. 25672	8
CHECKED BY: _____	GG033	
APPROVED BY: _____		
DATE: _____		





NOTES
1. REFERENCE DRAWING PG01A FOR EQUIPMENT TAGGING FORMAT AND ABBREVIATIONS.

- EQUIPMENT IDENTIFICATION**
- (01) INDUCED DRAFT FAN VFD, 35-FOS-VFD-2201
 - (02) PRIMARY AIR FAN VFD, 35-AF-VFD-2002
 - (03) SECONDARY AIR FAN VFD, 35-AF-VFD-2101
 - (04) D FAN (BY B&W)
 - (05) PUFF (BY B&W)
 - (06) 2X RECEIVER TANK (BY B&W)
 - (07) CHEMICAL FEED TOTES
 - (08) 2X COOLER (BY B&W)
 - (09) 2X TRANSFER BLOWER (BY B&W)
 - (10) MATERIAL HANDLING VFDs AND PANELS
 - (11) DSI BULK STORAGE (BY B&W)
 - (12) DESSICANT AIR DRYER, 36-AS-DRY-001A
 - (13) DESSICANT AIR DRYER, 36-AS-DRY-001B
 - (14) INTERMITTENT BLOWDOWN TANK (BY B&W)
 - (15) BOILER BUILDING FLASH TANK, 37-OND-TNK-003
 - (16) 30-EM-MCC-1B, MATERIAL HANDLING MCC
 - (17) DCS CABINETS (NORTH TO SOUTH)
36-DCS-CAB-001E, BOILER 5 1/0 EXP 1-3
36-DCS-CAB-001D, BOILER 5 R00 1-3
36-DCS-CAB-001C, BOILER 5 1/0 EXP 1-2
36-DCS-CAB-001B, BOILER 5 R00 1-2
 - (18) REFRIGERATED AIR DRYER, 36-SAS-DRY-003
 - (19) AIR COMPRESSOR, 36-SAS-CMP-003
 - (20) LIMESTONE VFDs
 - (21) LIMESTONE SILO (BY B&W)
 - (22) 2X TRANSFER BLOWER (BY B&W)
 - (23) 30-EM-PNL-002, 480V MATERIAL HANDLING MCC PANEL
 - (24) 30-EM-YTHR-002, 480V MATERIAL HANDLING MCC YTHR
 - (25) 30-EM-PNL-010, 480V WELDING PANEL
 - (26) 30-EL-PNL-004, 120/208 LIGHTING PANEL
 - (27) 30-EL-YTHR-004, LIGHTING YTHR
 - (28) 36-DCS-CAB-005A, MATERIAL HANDLING R00 5-1
 - (29) HIGH ANGLE CONVEYOR (BY FMC)
 - (30) 36-VB-CAB-001, VIBRATION MONITOR CABINET

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A	SCHEMATIC DESIGN	10/01/15
NO.	REVISIONS	DESIGN CHECK APPROVED DATE

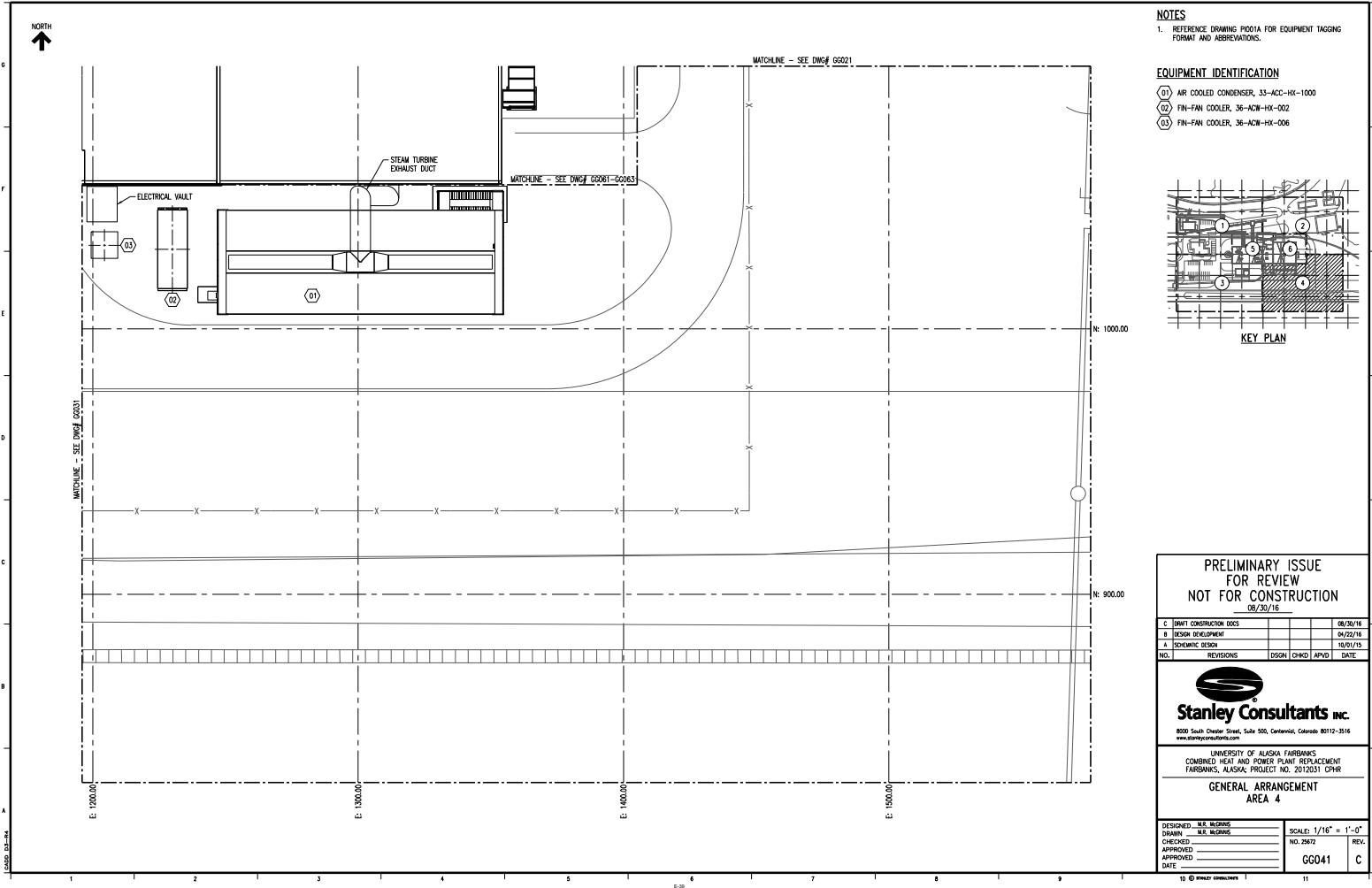
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FAIRBANKS, ALASKA PROJECT NO. 2012031 CPHR

**GENERAL ARRANGEMENT
BOILER BUILDING
FIRST FLOOR EQUIPMENT PLAN**

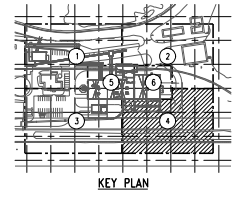
DESIGNED: <u>ME, INCORP</u>	SCALE: 1/8" = 1'-0"	REV.
DRAWN: <u>ME, INCORP</u>	NO. 26472	C
CHECKED: _____		
APPROVED: _____		
DATE: _____	GG051	

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NOTES
 1. REFERENCE DRAWING PFD01A FOR EQUIPMENT TAGGING FORMAT AND ABBREVIATIONS.

EQUIPMENT IDENTIFICATION
 01 AIR COOLED CONDENSER, 33-ACC-HX-1000
 02 FIN-FAN COOLER, 36-ACW-HX-002
 03 FIN-FAN COOLER, 36-ACW-HX-006



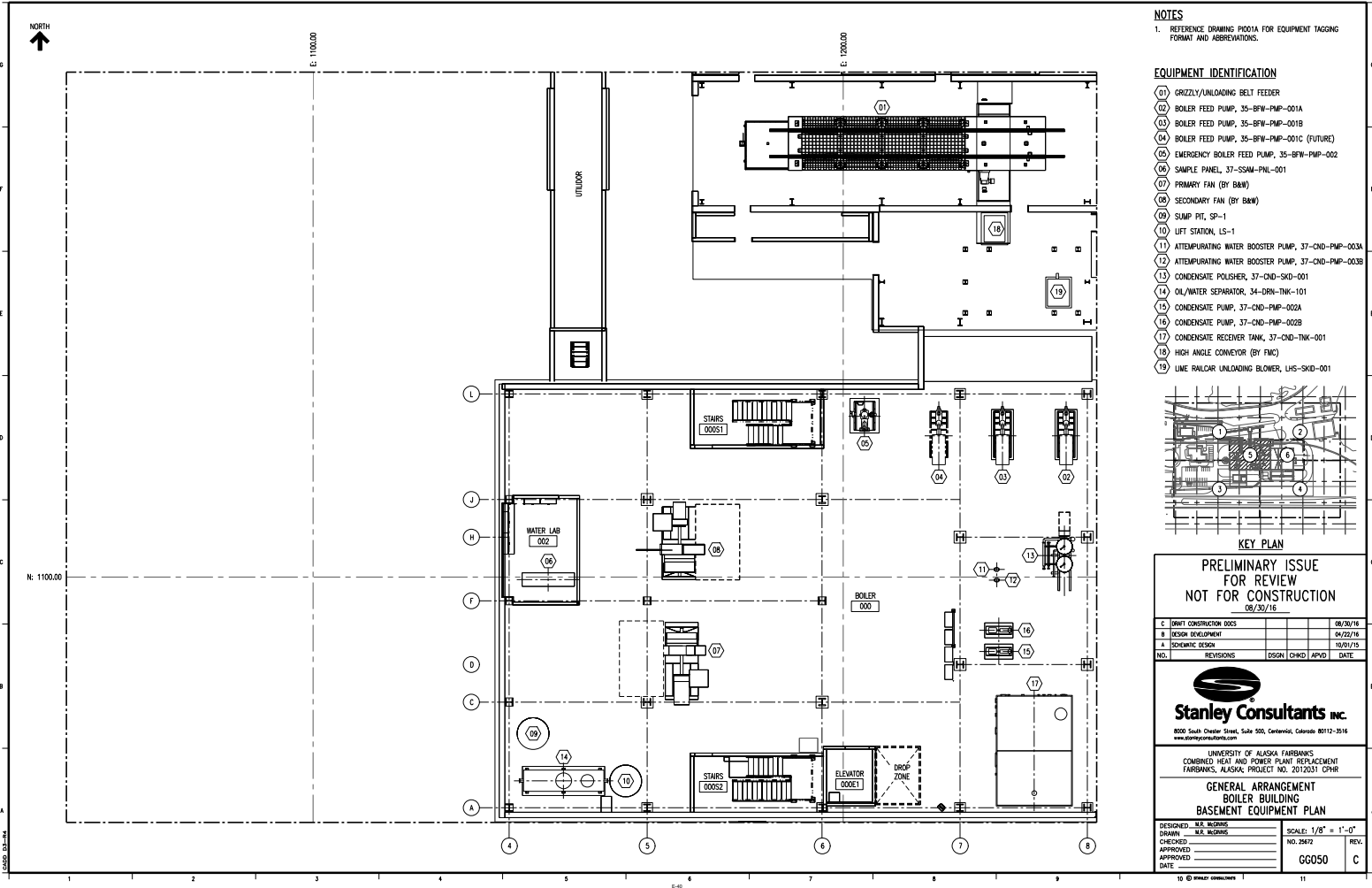
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C	INITIAL CONSTRUCTION ISSUES				08/30/16
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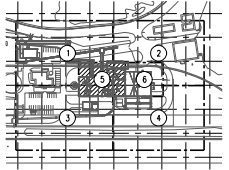
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 FAIRBANKS, ALASKA, PROJECT NO. 2012031 CPHR
**GENERAL ARRANGEMENT
 AREA 4**

DESIGNED BY: _____	SCALE: 1/16" = 1'-0"	REV. _____
DRAWN BY: _____	NO. 25672	_____
CHECKED BY: _____	GG041	C
APPROVED BY: _____		
DATE: _____		



NOTES
 1. REFERENCE DRAWING P001A FOR EQUIPMENT TAGGING FORMAT AND ABBREVIATIONS.

- EQUIPMENT IDENTIFICATION**
- 01 GRIZZLY/UNLOADING BELT FEEDER
 - 02 BOILER FEED PUMP, 35-BFW-PMP-001A
 - 03 BOILER FEED PUMP, 35-BFW-PMP-001B
 - 04 BOILER FEED PUMP, 35-BFW-PMP-001C (FUTURE)
 - 05 EMERGENCY BOILER FEED PUMP, 35-BFW-PMP-002
 - 06 SAMPLE PANEL, 37-SSAM-PNL-001
 - 07 PRIMARY FAN (BY B&W)
 - 08 SECONDARY FAN (BY B&W)
 - 09 SUMP PIT, SP-1
 - 10 LIFT STATION, LS-1
 - 11 ATTEMPURATING WATER BOOSTER PUMP, 37-CND-PMP-003A
 - 12 ATTEMPURATING WATER BOOSTER PUMP, 37-CND-PMP-003B
 - 13 CONDENSATE POLISHER, 37-CND-SKD-001
 - 14 OIL/WATER SEPARATOR, 34-DRN-TNK-101
 - 15 CONDENSATE PUMP, 37-CND-PMP-002A
 - 16 CONDENSATE PUMP, 37-CND-PMP-002B
 - 17 CONDENSATE RECEIVER TANK, 37-CND-TNK-001
 - 18 HIGH ANGLE CONVEYOR (BY FMC)
 - 19 LINE RAILCAR UNLOADING BLOWER, LHS-SKD-001



KEY PLAN

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 FAIRBANKS, ALASKA PROJECT NO. 2012031 CPHR

**GENERAL ARRANGEMENT
 BOILER BUILDING
 BASEMENT EQUIPMENT PLAN**

DESIGNED: J.R. MCKENZIE	SCALE: 1/8" = 1'-0"
DRAWN: J.R. MCKENZIE	NO. 26472
CHECKED: _____	REV. _____
APPROVED: _____	GG050
DATE: _____	C

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Scope of Work

Project: University of Alaska Fairbanks (UAF) - CHPP Plant AQCS Options for SO₂ Control Cost Estimate

PROJECT UNDERSTANDING

Stanley is performing a study level cost estimate to retrofit 3 different desulfurization options for the UAF campus utility plant.

» DSI

Stanley is requesting the following information to support our cost estimating effort. Option should be sized to assuming the boiler is operating at MCR with the SO₂ concentration in the flue gas out of the boiler at the permitted level SO₂, 0.2 lb/MMBTU.

The following information is requested.

INFORMATION REQUESTED

1. SO₂ removal efficiency.
2. Budget pricing, FOB UAF, assuming new technologies will be housed inside a new heated enclosure. The pricing will be for material only, installation will be estimated by others. The costs associated with enclosure and civil work will be estimated by others.
 - a. Mechanical work inside the new enclosure. Assume reagent storage silos are include inside the enclosure and sized for 30 day of storage except for limestone for WFGD which will be sized for 1 week (assuming bed limestone can be used in the WFGD process. All required tie-ins are assumed to at enclosure boundary.
 - b. Prepare a small write-up regarding the scope of the items estimated.
3. Electrical load and voltage for each major load.
4. Approximation of the size of enclosure, including a length, width, and height.
5. Reagent required type and consumption rates.
6. Utility usage water, air, etc.
7. Increase in fly ash (byproduct) from the technology, if any.
8. Increase in flue gas pressure drop.

SCHEDULE

Stanley requests the information in three weeks, if possible. Partial release of information, such as building sizes, removal efficiency, etc., will allow use to start our estimating work.

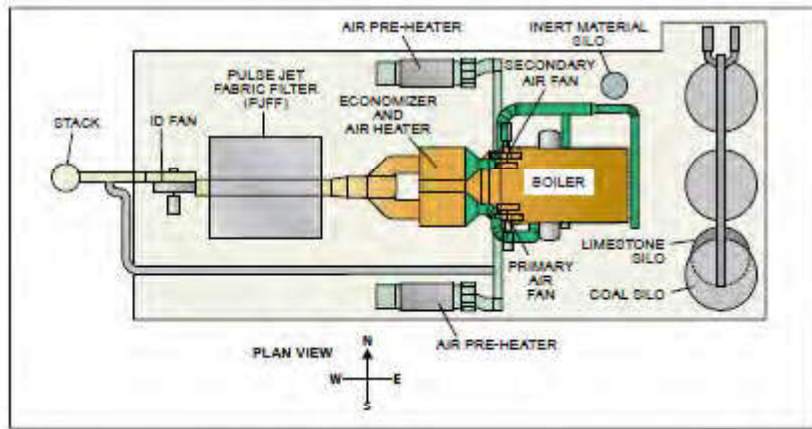
INFORMATION INCLUDED

The following information is included to support the information requested. If additional information is required please request.

1. Performance Data for the boiler
2. Typical Exhaust gas composition
3. Baghouse Information

Exhaust Gas Data at Tie-In

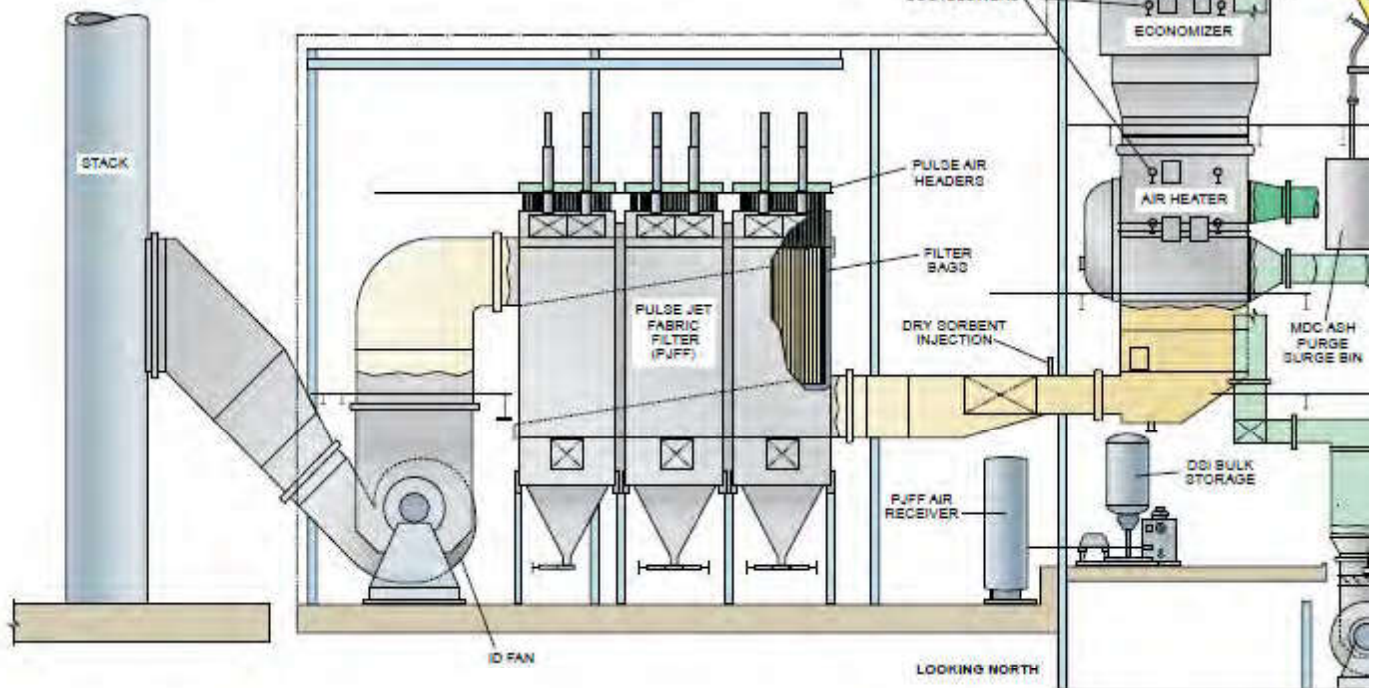
H2O	%	8.5
O2	%	3.7
N2	%	71.7
CO2	%	16.1
Inlet SO2	lb/MMBTU	.2
Inlet HCl	lb/MMBTU	0
Inlet PM	lb/MMBTU	9.0



UNIVERSITY OF ALASKA FAIRBANKS COMBINED HEAT and POWER PLANT

Babcock & Wilcox Circulating Fluidized-Bed Boiler

Steam Flow 240,000 lb/hr (30.24 kg/s)
 Steam Pressure 740 psig (5.1 MPa)
 Steam Temperature 750F (399C)



Thanks!



Lance Rowell, PE, PMP, Principal Mechanical Engineer
 STANLEYCONSULTANTS, 225 Iowa Avenue, Muscatine, Iowa 52761
 T: 563.264.6548 | stanleyconsultants.com

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Public Review Draft

August 19, 2024

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Tri-Mer DSI Email

Jahn, Mario

From: Martin Schroeter <mschroeter@tri-mer.com>
Sent: Tuesday, August 23, 2022 6:57 AM
To: Jahn, Mario
Cc: Asa Halliday; Ted Hornus; Deirdre Labert; Vincent DiGiorgio
Subject: RE: P-23.182 Stanley SO2 Removal Project for UAF Fairbanks, AK
Attachments: P-23.182 Stanley SO2 Removal Project University of Alaska Fairbanks AK R2 8-23-2022 SENT.pdf

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

Good morning Mario,

Enclosed please find the revised proposal P-23.182 for Stanley's SO2 removal project for UAF in Fairbanks, AK. Based on the recent discussion on converting the CDS model to hydrated lime, I have also updated that section of the proposal. Besides minor editorial changes, the proposal should now be consistent with your requirement of using hydrated lime as sorbent for the SO2.

In case of any further questions or recommendations, please let me know.

Best regards
Martin

From: Jahn, Mario <JahnMario@stanleygroup.com>
Sent: Monday, August 22, 2022 5:56 PM
To: Martin Schroeter <mschroeter@tri-mer.com>
Cc: Asa Halliday <ahalliday@tri-mer.com>; Ted Hornus <thornus@tri-mer.com>; Deirdre Labert <dlabert@tri-mer.com>; Vincent DiGiorgio <vdigiorgio@tri-mer.com>
Subject: RE: P-23.182 Stanley SO2 Removal Project for UAF Fairbanks, AK

Martin,

I wanted to double check with you on the last proposal you provided. The text in the proposal states sodium bicarbonate for the DSI system (see page 16 of 24 in the PDF). But the consumption table at the end of the document states hydrated lime consumption (page 21 of 24 in the PDF). Can you confirm the use of hydrated lime for the DSI system? It would be nice if the document can be updated to avoid any confusion in the future.

Thanks,
Mario

From: Martin Schroeter <mschroeter@tri-mer.com>
Sent: Tuesday, July 26, 2022 8:29 AM
To: Fritz, Mark <FritzMark@stanleygroup.com>
Cc: Asa Halliday <ahalliday@tri-mer.com>; Ted Hornus <thornus@tri-mer.com>; Deirdre Labert <dlabert@tri-mer.com>; Vincent DiGiorgio <vdigiorgio@tri-mer.com>
Subject: P-23.182 Stanley SO2 Removal Project for UAF Fairbanks, AK

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

Good morning Mark,

Enclosed please find the revised proposal P-23.182 Stanley SO2 removal for UAF Fairbanks, AK. We have updated the SorbSaver Pro (DSI) technology sections for hydrated lime injection (Sorbacal SPS or similar quality) and 90% SO2 removal.

We will be pleased to clarify any questions, once you have reviewed the proposal.

In case you have additional questions, please let me know.

Best regards

Martin Schroeter

Sales - Ceramics Technology Group (CTG)

Tri-Mer Corporation

1400 E Monroe Street

Owosso, MI 48867

Mobile Phone: (989)-627-1040

Office Phone: (989)-723-7838

Email: mschroeter@tri-mer.com



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SO2 MITIGATION SOLUTIONS

RANGE OF SO2 MITIGATION SOLUTIONS FOR UAF FAIRBANKS CFB BOILER

REFERENCE NUMBER: P-23.182

REVISION: 2

PREPARED FOR STANLEY CONSULTANTS

MARK FRITZ

225 IOWA AVENUE
MUSCATINE, IA 52657

(563) 607-1430

FRITZMARK@STANLEYGROUP.COM

PROPOSAL ISSUED:

AUGUST 23, 2022

PROPOSAL VALID TO:

SEPTEMBER 6, 2022

TRI-MER CORPORATION

1400 E MONROE STREET
OWOSSO, MI 48867

WWW.TRI-MER.COM

(989) 723-7838

PRINCIPAL CONTACT:

MARTIN SCHROETER

(989) 627-1040

MSCHROETER@TRI-MER.COM

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EXECUTIVE SUMMARY

Tri-Mer Corporation (TMC) is delighted to have the opportunity to work with Stanley Consultants (Stanley) to present a range of technical solutions for reducing SO₂ at the University of Alaska (UAF) CHPP plant in Fairbanks, Alaska. Our aim throughout this proposal is to introduce TMC and its technologies to both Stanley and UAF, highlighting our capabilities and experience to ensure we can be considered as a key partner for this project. All related scope and pricing are budgetary at this stage, and we welcome the opportunity to work closer with both Stanley and UAF to better detail these options with the aim of presenting the best available control technology for this project.

Following the initial RFI and subsequent clarifications with Stanley, we have spent considerable time to evaluate the best options, with the recommendations taking into consideration a range of factors including performance requirements, CapEx, OpEx, commodity availability, and risk. Following this review, we present four core solutions for consideration:

1. Circulating Dry Scrubber (CDS) – Adding a scrubber vessel inside the existing building, or in default of available space at the side of the existing building, to the existing baghouse with a forced recirculation of filtrate to the injection point of the sorbent. Turndown rate is maximized by distributing the flow from the boiler into 2 scrubbers.
2. SorbSaver Pro Injection (DSI) – Adding TMC's proprietary DSI injection technology at the inlet of the air preheater that ensures a minimum residence time and mixing. The DSI technology will be capable of handling a wide range of turndown rate.
3. Recirculating Dry Scrubber (RDS) – Adding an integrated scrubber and baghouse system in the designated footprint area, which ties in at the outlet of the boiler and replaces the existing baghouse. Turndown ratio is controlled by clean flue gas recirculation.
4. Caustic Soda Wet Scrubber (CSWS) – Adding a caustic soda wet scrubber in the designated footprint area, which ties in at the outlet of the existing baghouse. Turndown ratio is maximized by distributing the flow from the boiler into three (3) separate scrubber lines but operating only two (2) lines at reduced flow..

At TMC, we believe that selecting the right technology is only one element of the process, and as such, we have the capability to provide a wider range of lifecycle support options.

1. For many clients and projects, we work in partnership early in the process to help identify and solve the immediate need and solution. TMC have a range of pilot, mobile testing and predictive chemistry CFD modeling solutions that can help Stanley evaluate the best technical solution
2. In partnership, we believe that TMC is best served to support Stanley with upfront engineering support to be able to better detail the right solution. With over 60 years' experience and with over 6,500 global installations, TMC is unique in our focus on delivering the right solution. We can do this due to the wide range of technologies we offer, ensuring a more holistic review is achieved, rather than a preference for one technical solution.
3. For all of our projects, we provide our solutions from simple equipment design & supply, all the way through to full turnkey delivery. With in-house fabrication based in Michigan, combined with experience delivering turnkey projects throughout North America, we can work with Stanley to define the right package that suits all parties

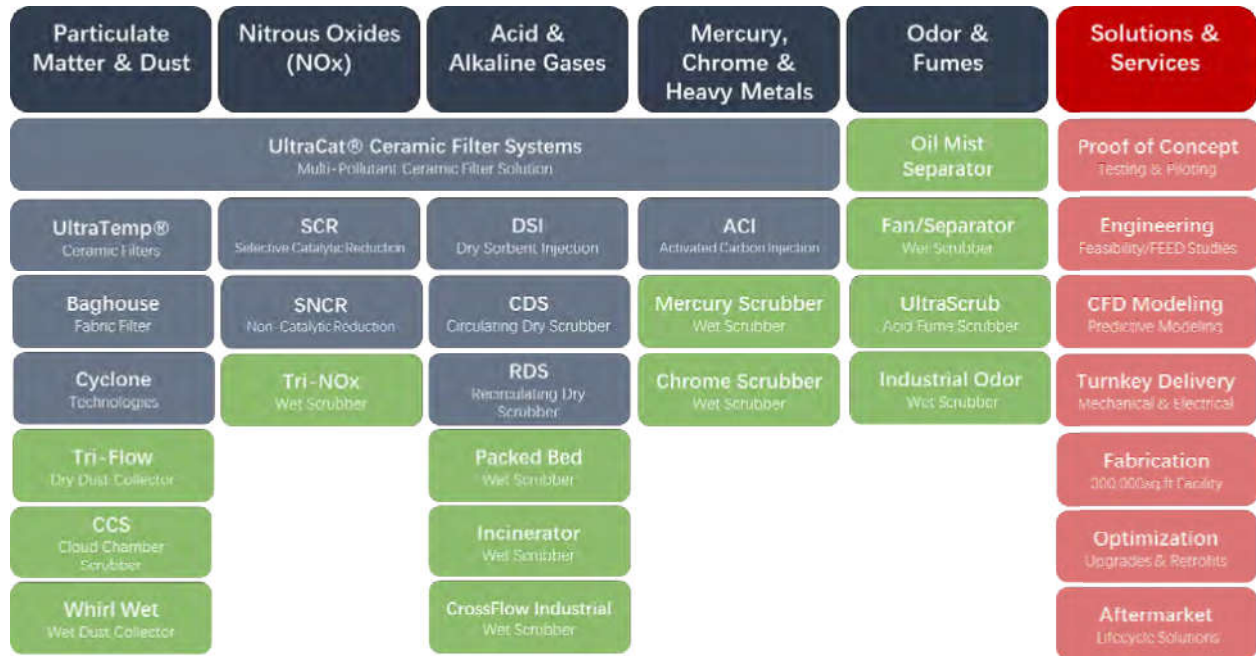
4. While our aim is to offer the right solution, our initial focus is on demonstrating the lowest achievable capital cost solution (LACC), in order to best evaluate what the lowest cost of compliance can be. From this point, we present a wide range of value-adding options, each demonstrating tangible benefits in areas such as lower OpEx, risk mitigation, and reduced maintenance that can be considered in their own merit.
5. The key to our lifecycle service is our continued dedication to support our clients in the long-term. TMC have a wide range of solutions that we can offer. From simple call-out support and spare parts, through to tailored operation & maintenance packages that are individually designed to best serve our clients.

We are confident that TMC has the right technology, can offer the right solution, and importantly is the right partner for both Stanley and UAF, and as such, we look forward to the opportunity to discuss this project with you in the near future.

ABOUT TRI-MER

ABOUT US

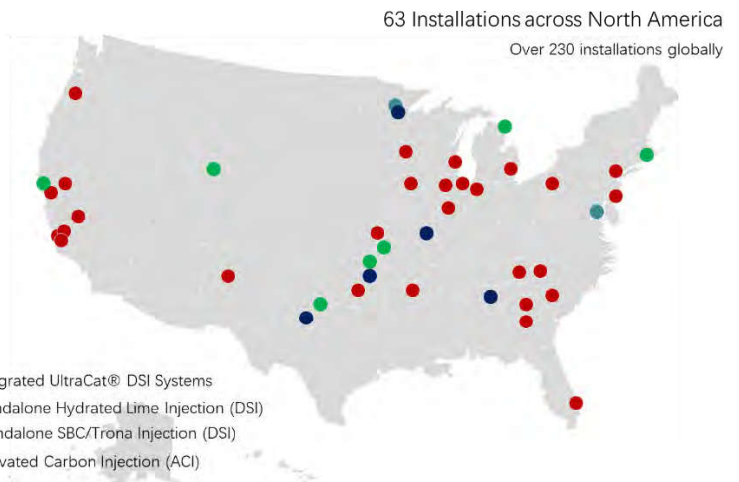
For over 60 years, Tri-Mer has developed a strong specialism in the area of air pollution control. The business has over 6,000 global installations for a wide range of technologies and solutions for clients that address all major pollutants. TMC has developed a large number of technologies in-house, and works with proven partners to allow for expanded scope where required.



Based in Owosso, Michigan, TMC is primarily a full-solution-integrator for air pollution control. The company headquarters includes over 200,000 sq. ft. of state-of-the-art steel fabrication and manufacturing facilities. While our wide range of technologies and solutions provide the strong foundation for the business, it is our dedication to exceed your needs through full and flexible lifecycle services, that help to set us apart.

EXPERIENCE

TMC, in combination with our partners, have successfully delivered over 60 sorbent injection systems across North America, together with over 200 systems worldwide. By working together, TMC and our partners are able to provide leading edge SO₂ mitigation technologies with full emission control process understanding. This, together with our capability to deliver full turnkey and aftermarket support, are some of the many ways we aim to better support our clients



AFTERMARKET SUPPORT

The following options present a range of solutions that TMC can provide the customer to support the operation and maintenance of your system. Our aim at this point is to show the range of services that can be provided, and then discuss building a tailored solution that can provide the customer exactly what the customer wants, both for this facility, but also when considering fleet-wide support.

The table below highlights the range of options available to the customer, together with the different tiers of service TMC can deliver depending on your individual requirements. Based on your preferences, TMC will build a tailored aftermarket support package to best suit your needs,

	TIER 1 LEVEL	TIER 2 LEVEL	TIER 3 LEVEL
System Inspections, Reporting, and Instrumentation Calibration	Annual System Inspections & report, combined with spare part inventory reviews. Pressure and temperature transmitter calibration performed by TMC.	Quarterly System Inspections & report, combined with spare part inventory reviews. Pressure and temperature transmitter calibration performed by TMC.	Monthly System Inspections & report, combined with spare part inventory reviews. Weigh scales, pressure and temperature transmitter calibration performed by TMC.
Remote Monitoring Diagnostics & Reporting	Remote Monitoring subscription with quarterly performance reporting	Remote Monitoring subscription with monthly performance reporting, plus proactive optimization analysis	Remote Monitoring subscription with weekly performance reporting, plus proactive optimization analysis
Critical Spare Parts Management	One-off spare part requests after Year 1, Customer stores all spare parts at your facility	Management of spare parts at customer's facility, with auto ordering of parts to maintain full set at all times	Management of spare parts at TMC facility, with auto ordering of parts to maintain full set at all times
Routine Maintenance & Consumable Management	All pre-defined routine maintenance, with consumables purchased by customer	All pre-defined routine maintenance, with consumables purchased by TMC	All routine and unscheduled maintenance, with TMC purchasing specified consumables
Programming & Automation	Provide suggestions to customer for programming and automation upgrades	Base support contract, including support during business hours	Upgraded support contract, including support 24/7
System Operation	Operator Oversight (in conjunction with preferred inspection schedule)	Full-time operation, 1 shift	Full-Time operation, with 2 nd /3 rd shift call-out support

DESIGN & PERFORMANCE CRITERIA

PROCESS CRITERIA

UAF combined heat and power plant CHPP consists of one high efficiency CFB boiler. The boiler is of a circulating bed type manufactured by B&W and has heat input of 295.6 MBtu/hr at a production capacity of 240 Mlb/hr of steam @ MCR. The boiler is fired with coal of Alaskan convenience with a higher heating value of 7,560 Btu/lb. Since the coal with 0.20 wt.% contains a considerable amount of sulfur the CHPP is required to reduce SO₂ emission, Presently, the boiler is equipped with furnace sorbent injection (FSI) of limestone and a baghouse for PM control. The CHPP typically operates between 33 – 100% MCR. The emission control system has to be design handle the full range of turndown.

EXHAUST GAS DATA AT THE FLUE TIE-IN DOWNSTREAM OF THE ECONOMIZER

The design is based on following data informed in the Request for Budgetary Quote received on 3/25/2021 as well as in an email dated of 4/1/2021 sent by Mr. Griffin Karr. You are kindly requested to review and confirm below shown design basis. In case you see any wrong information, please let us immediately know.

Condition		100% MCR	70% MCR	40% MCR	33% MCR
Fuel Input	MMBtu/hr	295.6	206	118.8	118.0
Elevation	ft	446	446	446	446
Flow Rate	acfm	89,832	61,165	50,217	65,748
Temperature	F	289	265	288	354
Pressure	inH ₂ O	-2.0	-2.0	-2.0	-2.0
Flue Gas Composition					
H ₂ O	%	8.5	8.5	8.5	8.5
N ₂	%				
O ₂	%	3.7	3.7	3.7	3.7
Ar	%	0.0	0.0	0.0	0.0
CO ₂	%	16.1	16.1	16.1	16.1
Inlet Conditions					
NO _x	lb/MMBtu	0.0	0.0	0.0	0.0
SO ₂	lb/MMBtu	0.2	0.2	0.2	0.2
HCl	lb/MMBtu	0.0	0.0	0.0	0.0
PM	lb/MMBtu	9.0	9.0	9.0	9.0

PERFORMANCE CRITERIA

The presented technical solutions are expected to meet following performance

SYSTEM	CDS	DSI	RDS	CSWS	MEASUREMENT METHOD at stack based on a 30-day rolling average
SO ₂ , %	90 %	90 %	89%	> 99%	US EPA Method 6C
PM, lb/MMBtu	0.012	0.012	0.012	0.012	US EPA Method 5
Pressure drop, in WC	5	0	10	7	@ 100% MCR

PROJECT APPROACH

Following the initial RFI and subsequent clarifications with Stanley, we understand that Stanley and UAF are investigating different technologies for control of SO₂ and PM emission with focus on main factors that drive a site-specific solution, consisting of, but not limited to, performance requirements and availability of the boilers, total cost of ownership (TOC) a.o.. Following this review, we present three core solutions for consideration:

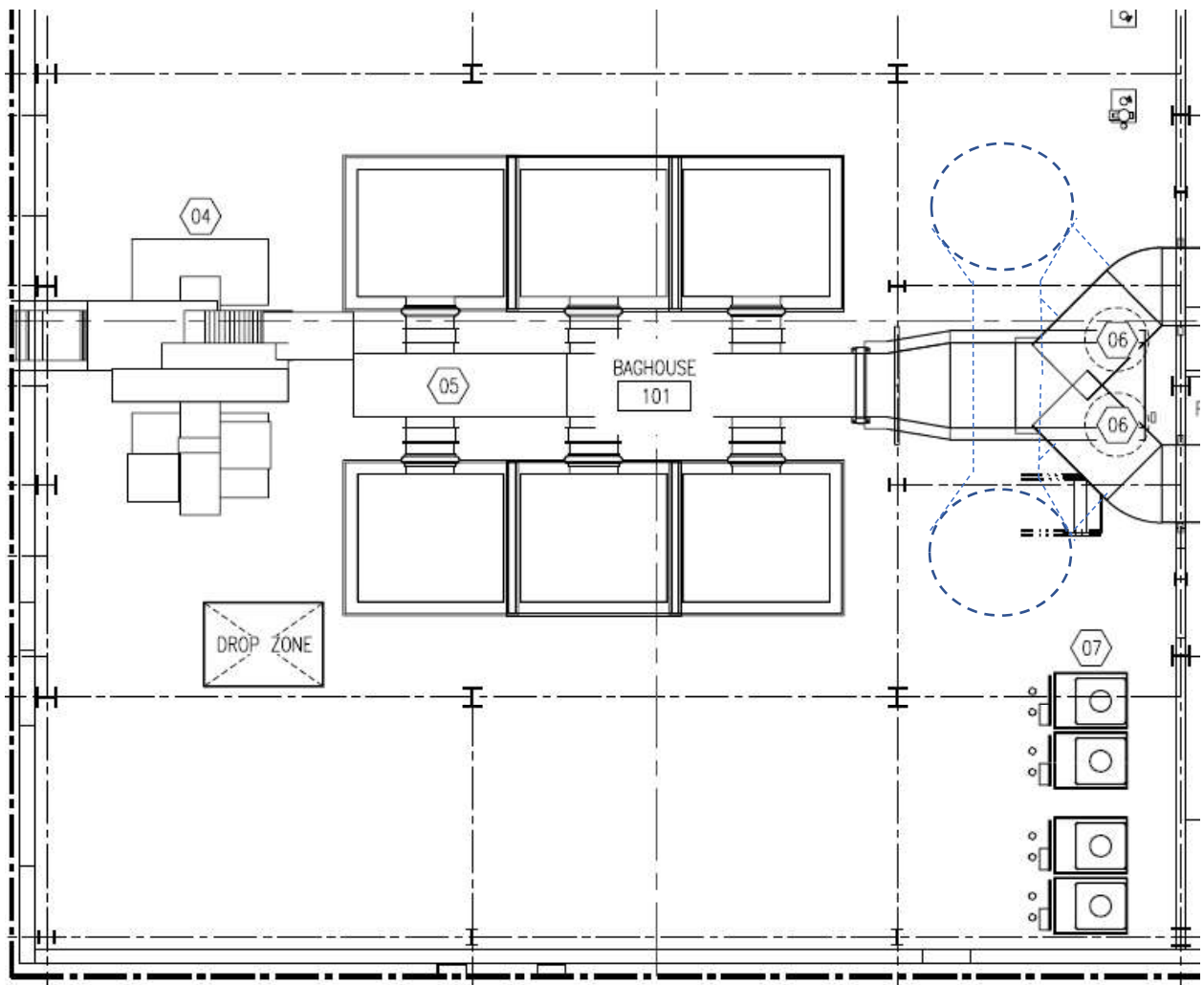
CIRCULATING DRY SCRUBBER (CDS)

The circulating dry scrubber solution will be installed as add-on equipment upstream of the existing PJFF. For optimum chemical reaction, hydrated lime-based sorbent (Sorbacal SPS or similar quality) is injected upstream of the economizer. Due to its high degree of integration with and short distance to existing equipment, the circulating dry scrubber represents the low capital cost (LCC) equipment solution for dry SO₂ emission control technologies.

Operational flexibility is achieved by splitting the flue gas coming from the economizer into 2 separate lines, each equipped with a dry scrubber. The exhaust of the dry scrubbers is recombined and returned to the inlet of the existing PJFF. The additional pressure drop of the added ductwork and dry scrubber equipment is expected to fall into the extra capacity of the existing ID-fans.

The solid waste stream extracted from the hopper section of the existing PJFF will be pneumatically returned to the injection point in the bottom of the dry scrubber. A purge stream corresponding to the incoming flow of fly ash and fresh sorbent will be extracted from the hopper section and returned to the existing ash handling system of the CHPP.

It is suggested to investigate placing the scrubber vessels inside the existing baghouse building.

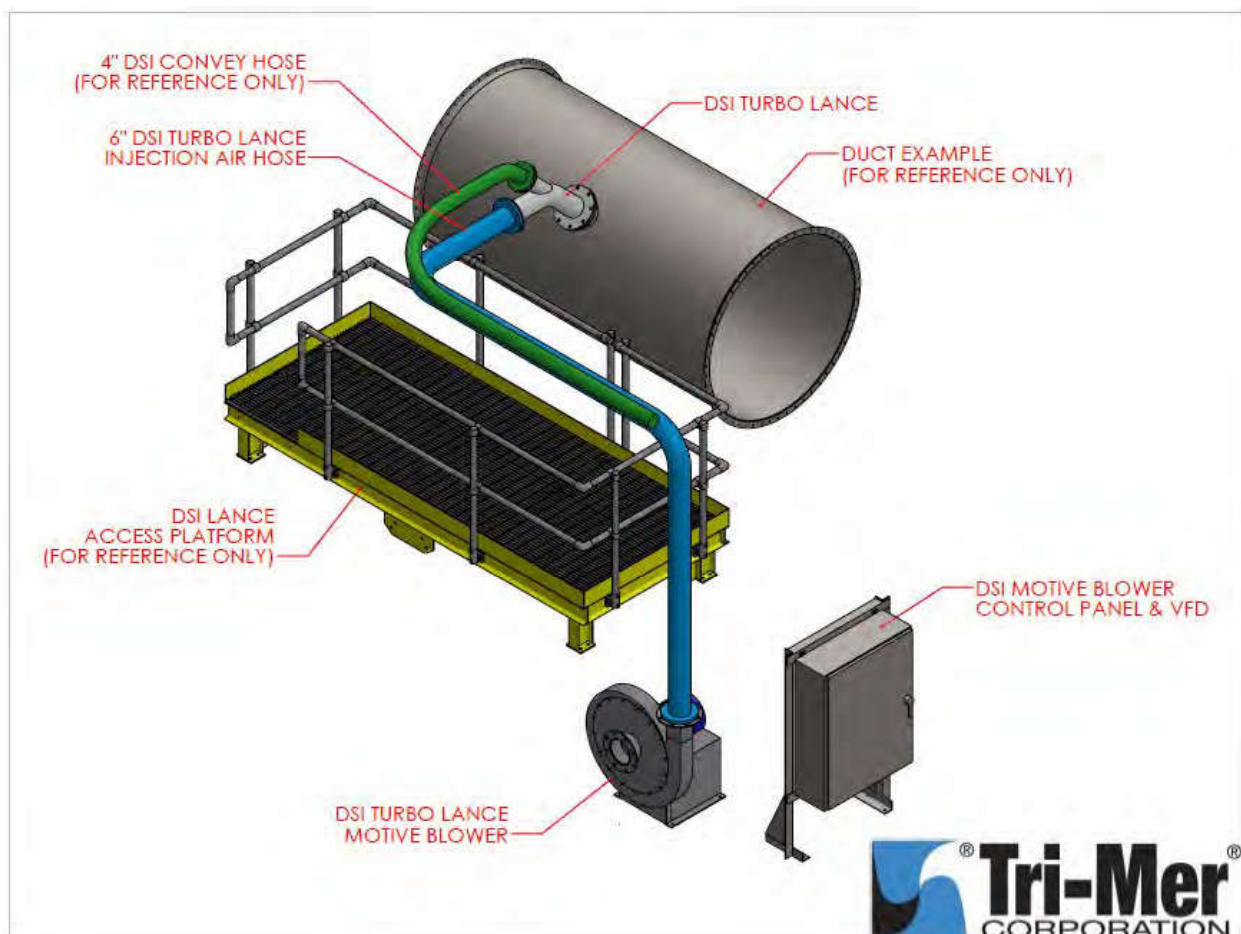


SORBSAVER PRO INJECTION (DSI)

The SorbSaver Pro injection solution consists of an air blower assisted injector, which is mounted on the outside of the duct. Since none of its parts is inserted into the gas flow, it is protected from deteriorating impact of flue gas constituents and allows for easy maintenance. Like in a bi-fluid nozzle the assisting blower air is atomizing the sorbent, while leaving the nozzle. The additional momentum contributes to distribute the sorbent over the complete cross section of the duct in a massive plume. This instant dispersion of the sorbent forms the basis of an improved inflight reaction. In comparison to conventional lance injection technology, improvement of inflight SO₂ removal efficiency of 60-80% have been monitored and combined with baghouse a still considerable 20-30%.

The SorbSaver Pro allows for a wide turndown rate in excess of 1:10.

Since SorbSaver Pro does not add any further equipment in the way of the flue gas flow, no additional pressure drop is expected. SorbSaver Pro is capable of being combined with any separation technology, like cyclone, ESP, baghouse or hot gas filter, whether pre-existing or tailor designed.

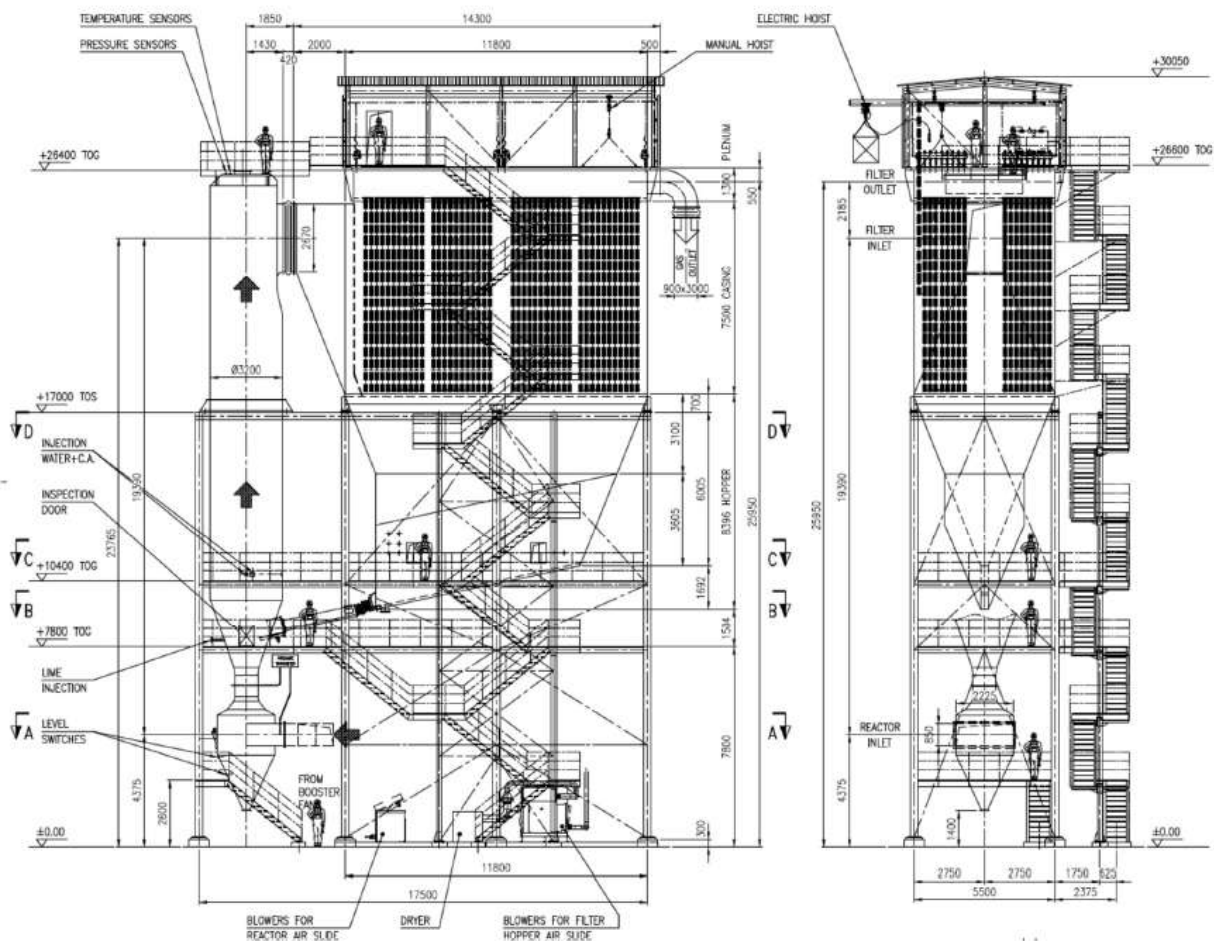


RECIRCULATING DRY SCRUBBER (RDS)

The recirculating dry scrubber solution is the most self-integrated technology and will replace all existing equipment from inlet of existing PJFFs to ID-fans and stack. While the recirculating dry scrubber is the most capital-intensive solution, it allows the use of lime-based sorbent at low fresh sorbent consumption. Although both the circulating as well as the recirculating scrubber technologies are based on the same principle of again and again exposing the sorbent material to the exhaust gas, the self-integration of the recirculating dry scrubber technology allows for a higher dust load. Increased recirculation rate of the sorbent material minimizes the consumption and subsequently allows for usage of less reactive sorbent material.

Operational flexibility is achieved by clean flue gas recycle to the inlet of the dry scrubber. New ID-fans will provide the energy to overcome the pressure drop of the recirculating dry scrubber and exhaust the treated flue gas to a new stack for each boiler.

Below drawing demonstrates the arrangement of a recirculation dry scrubber system.

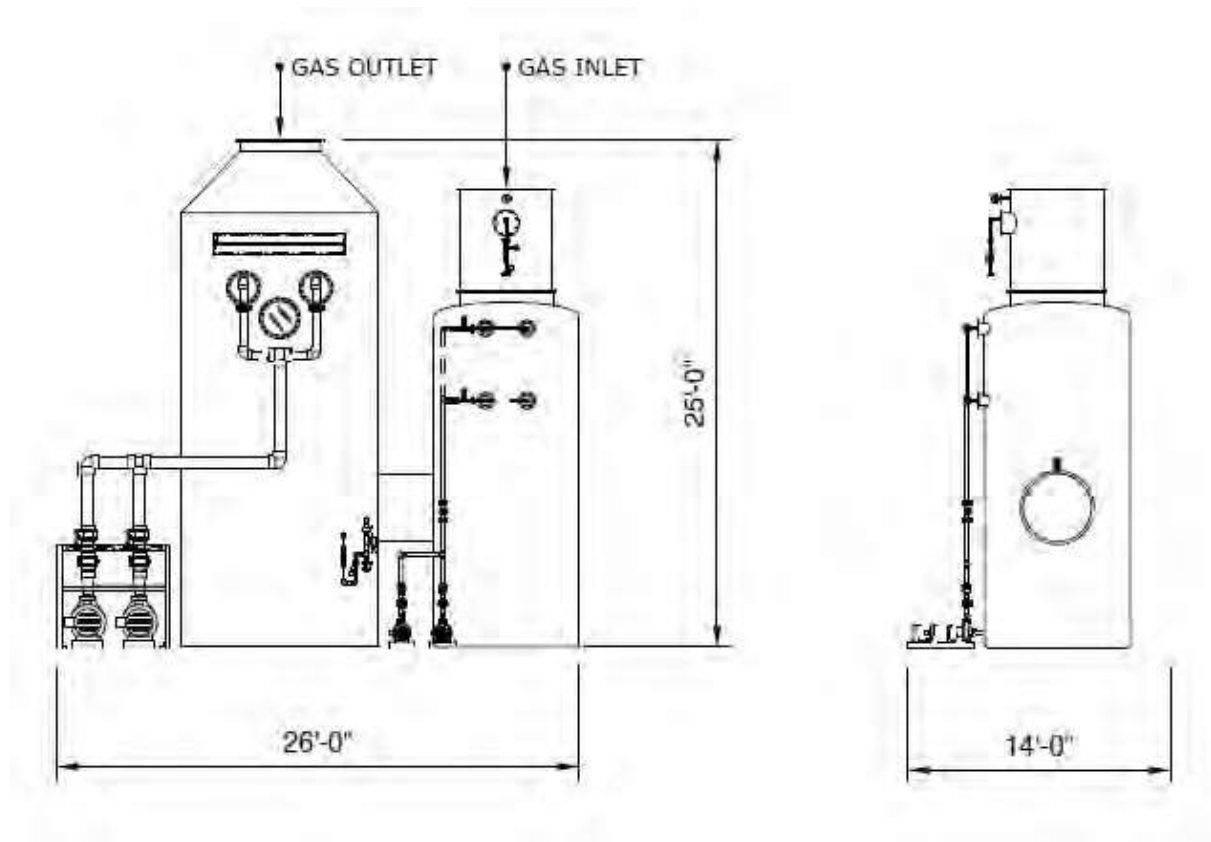


CAUSTIC SODA WET SCRUBBER (CSWS)

The caustic soda wet scrubber solution will be installed as add-on equipment downstream of the existing PJFF. Due to its high degree of integration into existing plant equipment, while utilizing the required existing PJFFs and ID-fans, as well as high performance efficiency for SO₂ control at the specified temperature level. caustic soda wet scrubber represents a low capital cost (LCC) equipment solution.

Flue gas from the boiler will be routed from tie-in point downstream of the PJFF. Operational flexibility is achieved by splitting the flue gas coming from the existing ID-fans to the designated footprint area, bridging the existing road between the baghouse building and the designated footprint area. The flue gas from each individual boiler will be split into three (3) separate lines consisting of a quench equipped to condition the flue gas temperature to optimal operation temperature for the downstream packed bed caustic soda scrubber unit. Additional booster ID-fans for each line provide the energy to overcome the pressure drop of the wet scrubber system and exhaust the treated flue gas to stack.

Below flow schematic demonstrates the arrangement of equipment for one individual line of the wet scrubber solution package.



SCOPE OF WORK

CIRCULATING DRY SCRUBBER (CDS)

In order to reduce the SO₂ to the required emission at stack we designed a circulating dry scrubber (CDS) system, which utilizes the existing baghouse (PJFF), flue gas fan and stack. The treatment takes mainly place in the reactor upstream of the existing baghouse.

The flue gases coming from the boiler will enter the reactor centrally from the bottom part of two (2) reactors treating half flow and it will move in turbulent flow with the fresh hydrated lime (Sorbacal SPS or similar quality) and back-flowing lime products to the top section of the reactor. The flue gases will exit from the top of the absorber as a dust/gas mixture and then will enter the existing bag filter.

Reagent injection rate will be controlled by a feedback signal for pollutants contents coming from CEMS (by Others).

The dust collected in the hopper part of the baghouse will be pneumatically transported to a buffer silo. A large portion of the material collected in the buffer silo will feed the solids recycling system by means of a control valve and a pneumatic transport system.

The by-product will be discharged from the buffer silo by pneumatic transportation to the existing dust handling system.

The split of the total flue gas flow into two separate reactors allows for operation of the reaction system over the large span of turn-down ratio required. The exhaust of both reactors will be recombined upstream of the baghouse inlet.

BASIC SCOPE

SORBENT SUPPLY

Hydrated lime supply consists of one (1) 3,700 cft silo with one (1) volumetric feeder. The hydrated lime will be pneumatically transported to the injection location upstream of the reactors.

REACTORS

The reactors will consist of two (2) parallel reactor vessels incl. support structure. Each reactor can be isolated by one (1) inlet and one (1) outlet damper. The existing duct will be equipped between tie-in point and return breach with one (1) pneumatic double blade damper with sealing air for bypass service.

DUST COLLECTION AND RECIRCULATION SYSTEM

The dust collection system will consist of one (1) screw transport system from extraction point of the hoppers of the baghouse to one (1) 1,100 cft buffer silo. From the buffer silo, the majority of the dust is recirculated by screws to the injection point of the back-flowing lime products into the reactors. A purge flow of dust is extracted to one (1) dense phase pneumatically transport line to connect the buffer silo with the existing dust handling system.

INTERCONNECTING DUCTWORK

Ductwork from economizer outlet to inlet of the CDS reactors and outlet of the CDS reactors to inlet of the existing baghouse, consisting of in total 250 ft of 58" diameter round duct fabricated of A36, including standard duct supports and seven (7) expansion joints.

SORBSAVER PRO INJECTION (DSI)

In order to reduce the SO₂ to the required emission at stack we designed a proprietary SorbSaver Pro injection system, which will inject the hydrated lime (Sorbacal SPS or similar quality) preferentially upstream of the economizer, utilizing the existing baghouse (PJFF), flue gas fan and stack. The treatment takes mainly place in the duct and in the filter cake of the baghouse.

Reagent injection rate will be controlled by a feedback signal for pollutants contents coming from CEMS (by Others).

The dust collected in the hopper part of the baghouse will be treated together with fly ash in the existing ash collection system.

The SorbSaver Pro injection has the capability to handle the full range of expected turndown rate.

BASIC SCOPE

SORBENT SUPPLY

Hydrated lime (Sorbacal SPS or similar quality) supply consists of two (2) 3,000 cft silo, including bin activator and fill rotary valve, with one (1) gravimetric feeder upstream of one (1) 250 ft long rubber hose, propelled by one (1) fan, each. The sorbent of each line will be equally split to two (2) SorbSaver Pro injectors per air pre-heater (APH) inlet duct.

SORBSAVER PRO INJECTOR

The SorbSaver Pro injectors will be mounter on the outside of the inlet duct of the APH. The injector will be equipped with a blower fan supplying the atomizing air for fast distribution of the sorbent in the flue gas.

RECIRCULATING DRY SCRUBBER (RDS)

To reduce the pollutants' content to the presented levels, we are offering a properly designed dry flue gas treatment system, with injection of hydrated lime as reagent. The treatment will be performed upstream the bag filter through a Reaction Tower (scrubber/absorber) and it will also take place in the bag filter thanks to its volume, and thanks to the cake effect.

The flue gases coming from the boiler will enter the reactor centrally from the bottom part of the reactor and it will move in turbulent flow with the fresh hydrated lime and back-flowing lime products to the top section of the reactor. Inside the reactor, after lime injection and dust recirculation, water will be injected to control temperature and improve abatement performance. The flue gases will exit from the top of the absorber as a dust/gas mixture and then will enter the bag filter.

Reagent injection rate will be controlled by a feedback signal for pollutants contents coming from CEMS (by Others).

A large portion of the material collected in the hoppers (which act as storage bins) will feed the solids recycling system by means of a control valve and a fluidized slides system.

The by-product will be discharged out through the filter hoppers by means of control valves into the new pneumatic dust transport system.

A flue gas recirculation will assure the correct minimum gas flow to the reactor in case the flow from the process is below approx. 75% of the nominal. A modulating damper will regulate the flow recirculation depending on the process variations.

BASIC SCOPE

SORBENT SUPPLY

Hydrated lime supply consists of one (1) 3,200 cft silo with one (1) loss in weight feeder. The hydrated lime will be pneumatically transported with two (2) parallel working blowers to the injection location in the bottom of the reaction vessel.

REACTOR

The reactor system is consisting of one (1) reactor vessel incl. support structure. Water will be injected for flue gas conditioning and agglomeration. The water injection system consists of two (2) spillback high pressure pumps, one (1) in service and one (1) in stand-by, feeding to spray lances downstream of the solids.

BAGHOUSE FILTER

The baghouse filter is consisting of two (2) parallel compartments, each of them capable to be fully isolated. The baghouse is equipped with a back pulse jet system allowing online filter cleaning, incl. pressurized air receiver tanks, solenoid valves and plow pipes (Compressed air supply Class 1/2/1, ISO 8573-1:2010, by customer). The baghouse contains 840 PPS Raiton bags or similar fabric quality. The dust will be collected in the hopper section, which is also the buffer for the recirculation material.

DUST COLLECTION AND RECIRCULATION SYSTEM

The dust recirculation system is designed to allow for a max flow of 90 US short tons/hr, based on the performance requirements. The dust recirculation system consists of one (1) hopper air slide transporting the dust directly from the hopper section of the baghouse to the re-injection point of the reacted hydrated lime. One (1) rotary valve at hopper outlet will dose the recirculation feed rate. One (1) cut-off valve at the end of the air slide controls the amount of extracted dust, which will be pneumatically transported to the dust handling system.

The extracted dust will be pneumatically transported to two (2) dust storage silos of a capacity of 5,300 cft, each.

ID FAN

One (1) 200 hp ID fan incl. motor and VFD

INTERCONNECTING DUCTWORK

Ductwork upstream of RDS inlet, consisting of 200 ft of 58" diameter round duct fabricated of A36, including standard duct supports and seven (7) expansion joints.

All interconnecting ductwork from outlet of the baghouse to stack, including the stack. Ductwork upstream of quench inlet is by others.

CAUSTIC SODA WET SCRUBBER (CSWS)

The caustic soda wet scrubber solution will be installed as add-on equipment downstream of the existing PJFF. Due to its high degree of integration into existing plant equipment, while utilizing the required existing PJFFs and ID fans, as well as high performance efficiency for SO₂ control at the specified temperature level. caustic soda wet scrubber represents a low capital cost equipment solution. Turndown will be realized by operating two (2) of the three (3) quench/packed bed scrubber lines.



BASIC SCOPE PER BOILER

QUENCH COLUMNS

Three (3) quench columns in vertical configuration (countercurrent) operating in parallel to facilitate evaporative cooling of gas stream prior to scrubber inlet. Quench columns to be constructed of 316 stainless steel. Liquid delivery to be supplied via downstream scrubber recirculation pumps. Fresh water supply should be supplied to spray header as an alternate to the re

VERTICAL FLOW (V/F) PACKED BED SCRUBBER

Three (3) wet packed bed scrubbers in vertical configuration (countercurrent) operating in parallel. Scrubbers shall be constructed of white polypropylene. Random dump packing to be Tri-Packs® type in polypropylene material of construction.

Mist eliminator to be mesh pad type in polypropylene material of construction. Integral recirculation system to consist of 100% redundant horizontal pumps, schedule 80 CPVC plumbing and internal sump.

EXHAUST BLOWER

(3) pressure blowers designed for operating in parallel. Exhaust blower housing and impeller to be constructed of FRP, base and pedestal to be constructed of carbon steel.

EXHAUST STACK

Exhaust stack to be breach-fitted type in UV-inhibited white polypropylene construction, 16-0" overall height. Not a freestanding assembly, guy-wire anchor points, support to be determined in design phase

CHEMICAL FEED PUMP ASSEMBLY

Three (3) polypropylene enclosures with clear polycarbonate doors to house 100% redundant chemical feed pump assemblies. Pumps to be electric metering or air-actuated type for supply of NaOH to scrubber system.

INTERCONNECTING DUCTWORK

Ductwork upstream of quench inlet consisting of 250 ft of 54" diameter round duct fabricated of A36, including standard duct supports and seven (7) expansion joints.

Interconnecting ductwork between outlets of three (3) scrubbers and three (3) exhaust blower inlets is included,

contingent on exhaust blower being located on grade immediately proximal to scrubber and quench columns. Ductwork to be constructed of white polypropylene.

Ductwork between three (3) exhaust blower outlets and (1) exhaust stack inlet to be constructed of white polypropylene, contingent on the stack being within 250 feet of the exhaust blowers.

PRE-ASSEMBLY AT TRI-MER CORPORATION

To include assembly and alignment of exhaust duct from scrubber outlet to exhaust fan inlet and setting of exhaust stack on exhaust fan. Match marking duct, exhaust stack or breech fitted exhaust stack, and pre drilling flanges as required.

SYSTEM CONSUMPTION ESTIMATES

The proposed systems are expected to have following consumption figures:

	CDS	DSI	RDS	CSWS
Power	120 kW ¹	48 kW	244 kW	310 kW
Water	-	-	16 gpm	44 gpm
Compressed air ²	62 scfm	-	292 scfm	-
Hydrated lime	280 lb/hr ³	563 lb/hr ³	144 lb/hr	-
Ash	2,895 lb/hr	3,195 lb/hr	2,875 lb/hr	-
50% NaOH	-	-	-	117 gph

¹ Estimated power consumption is based on booster fans to overcome the additional pressure drop

² Compressed air us of pre-existing PJFF is not included

³ Consumption figures are based on Sorbacal SPS or similar quality

CLARIFICATIONS & EXCLUSIONS

The basis for all pricing, design, engineering and performance requirements contained in this proposal are based solely on the information received from Stanley. As with any proposal of this complexity there are exclusions that require clarification and for this project those are listed below.

	CDS	DSI	RDS	CSWS
Any permits	X	X	X	X
Anchor bolts	X	X	X	X
Utilities – Power, water, sorbent, and drain	X	X	X	X
Gas analyzers or CEMS	X	X	X	X
Lightning	X	X	X	X
Spare parts	X	X	X	X
Control room	X	X	X	X
Unit DCS, MCC and control panels	X	X	X	
Compressor station and building	X	X	X	X
Compressed air piping	X	-	X	-
Electrical field material, junction boxes, cables, wiring	X	X	X	X
Dismantling of existing manifold or equipment	X	X	X	X
Thermal insulation supply and field insulation works	X	X	X	X
Civil engineering	X	X	X	X
Foundations, civil and building works	X	X	X	X
Interconnecting piping caused by fresh sorbent silo placing outside of designated installation area	X	X	X	X
Interconnecting piping to customer's solid waste handling system	X	X	X	X
Mechanical & Electrical installation	X	X	X	X
Start-up and field services				X
Duties, taxes, tariffs or insurance	X	X	X	X
Supports or catwalk assemblies		X		X
Supply and/or bulk storage of chemicals	-	-	-	X
CE documentation of certification	-	-	-	X
Heat tracing and thermal insulation of scrubber liquid recirculation system	-	-	-	X
Freight to jobsite	X	X	X	X
Seismic calculations, wind loading, foundational loading, and center of gravity calls	X	X	X	X
All materials and services not specifically listed in this proposal are to be supplied by Stanley.	X	X	X	X
Function tests will be performed with commissioning after equipment is installed to ascertain that the system is fully functional according to specifications. Emission tests shall be ordered and paid for by the client to an independent company a maximum of 30 days after installation to confirm the performance of the system.	X	X	X	X
Operator shall maintain strict adherence to the Operation and Maintenance manual and any sub-component maintenance manuals and schedules	X	X	X	X
Drawings are provided in standard 2-D format. 3-D modeling is available upon requests. Additional time and fees may apply. Pricing includes a maximum of two (2) revision rounds per submittal.	X	X	X	X

Additional revisions may be completed at an additional cost of \$125 per hour.				
Integration to additional site equipment is not included	X	X	X	X
Any interconnecting ductwork, expansion joints, dampers, and supports not specified above	X	X	X	X
Access platforms or catwalks		X		X
Motor Control Center (MCC) and all required VFDs shall be provided by Stanley				X
Integration of Tri-Mer supplied controls with site controls	X	X	X	X
All piping, installation, supports, anchors and hardware	X	X	X	X
Any required eyewash stations	-	-	-	X
Utilities, power, Switchgear or power distribution panels	X		X	X
Short Circuit and Arc-Flash Analysis	X	X	X	X
All CEMS equipment, installation, utilities and calibration gases	X	X	X	X
Professional engineer seals or stamps are excluded	X	X	X	X
Installation and field wiring to the main panel, J-boxes, motors, and instruments	X	X	X	X
Installation supervision and startup services				X
Site safety supervision	X	X	X	X
Air permit is required to confirm engineering design and pricing	X	X	X	X
All construction permits and associated fees	X	X	X	X
All air permits and associated fees, and any third-party source testing	X	X	X	X
All applicable duties, taxes, tariffs, or insurance	X	X	X	X
Bromine treated lumber for overseas crating	X	X	X	X
To avoid unnecessary contingency due to the uncertainty of future trucking costs, freight will be billed at cost plus 10% administrative/handling fee.	X	X	X	X

COMMERCIAL

PRICING

The following pricing is based on our current understanding of this project. All pricing is budgetary unless otherwise stated, and pricing is valid for 14 days from issuance of the proposal. All pricing is exclusive of shipping (cost plus 10% administrative fee), and taxes.

CIRCULATING DRY SCRUBBER (CDS)

- **Base Engineering & Equipment** _____ **\$3,028,950**

SORBSAVER PRO INJECTION (DSI)

- **Base Engineering & Equipment** _____ **\$782,780**

RE-CIRCULATING DRY SCRUBBER (RDS)

- **Base Engineering & Equipment** _____ **\$8,146,590**

CAUSTIC SODA WET SCRUBBER (CSWS)

- **Base Engineering & Equipment** _____ **\$1,689,320**

TERMS & CONDITIONS

TMC will be happy to further discuss commercial items such as payment terms, schedule implications, together with overall terms & conditions as the project moves to a firm status.

Jahn, Mario

From: Fritz, Mark
Sent: Friday, March 18, 2022 6:19 PM
To: mschroeter@tri-mer.com
Cc: Solan, John
Subject: University of Alaska Fairbanks BACT Analysis - Budgetary Cost Estimate
Attachments: Boiler Data.pdf; UAF AQCS Options And.docx; UAF Exhaust Gas Data.docx; Baghouse Info.pdf; CHPP Layout.pdf

Martin,

Stanley Consultants is doing a BACT analysis for the UAF. As part of this analysis, we need to have cost estimates for applicable technologies to reduce the SO₂ emissions. Attached is some applicable data.

Information attached:

Boiler data sheet (includes coal analysis)

Plant layout (CHPP Layout)

UAF Exhaust Gas Data (for exhaust gas entering the baghouse)

Baghouse data (for existing baghouse)

Unit is a 240,000 lb/hr B&W circulating fluidized bed boiler which was installed in 2017.

After reviewing the attached information, could you please call me to discuss. We look forward to hearing from you.

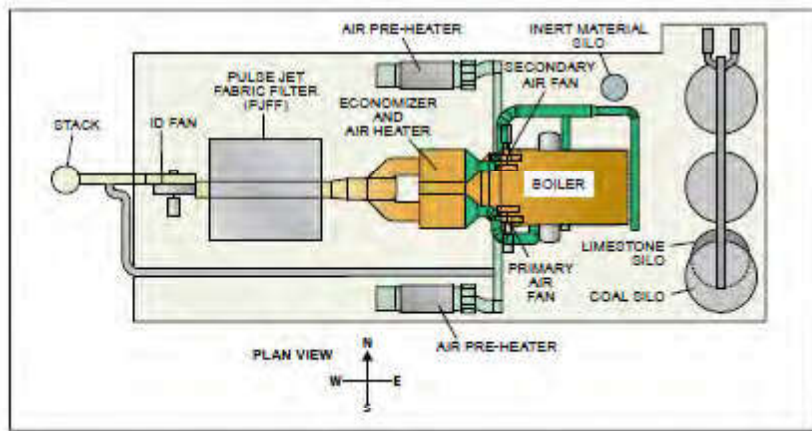
Mark



Mark Fritz, Principal Mechanical Engineer

STANLEYCONSULTANTS, 225 Iowa Avenue, Muscatine, Iowa 52657

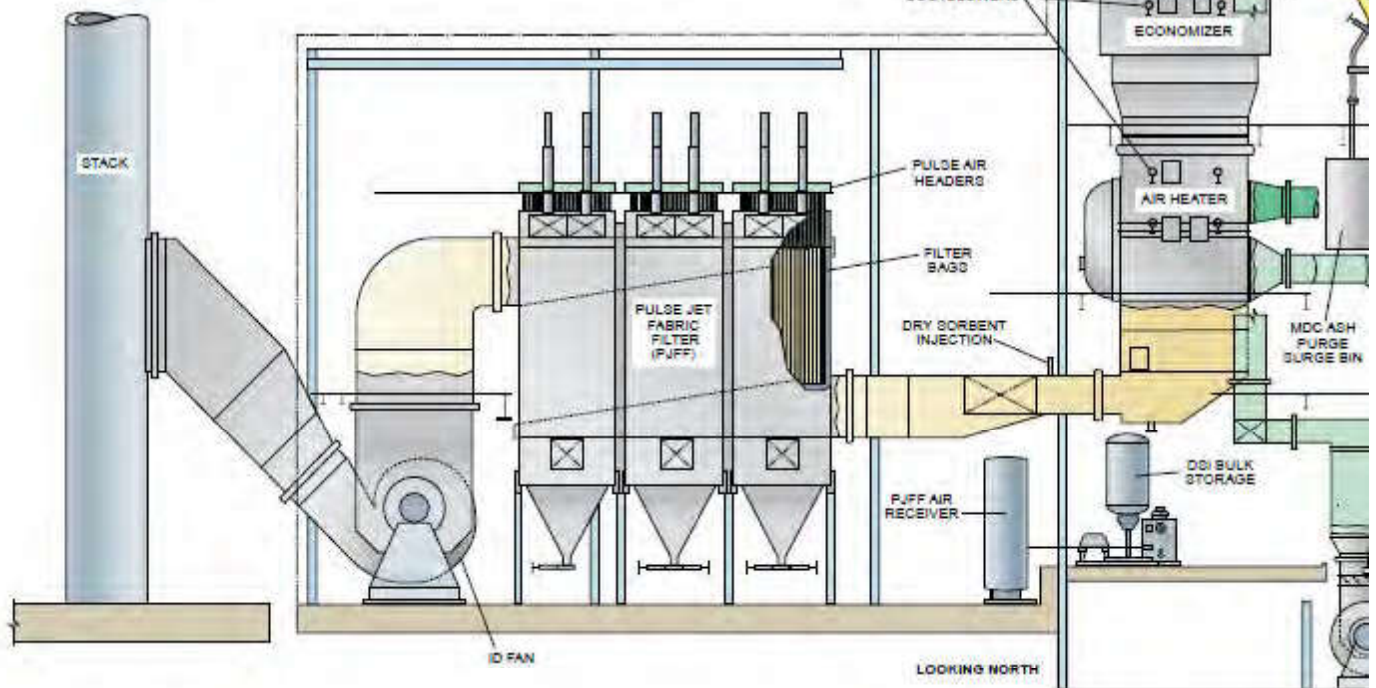
T: 563.264.6473 | M: 563-607-1430 | stanleyconsultants.com



UNIVERSITY OF ALASKA FAIRBANKS COMBINED HEAT and POWER PLANT

Babcock & Wilcox Circulating Fluidized-Bed Boiler

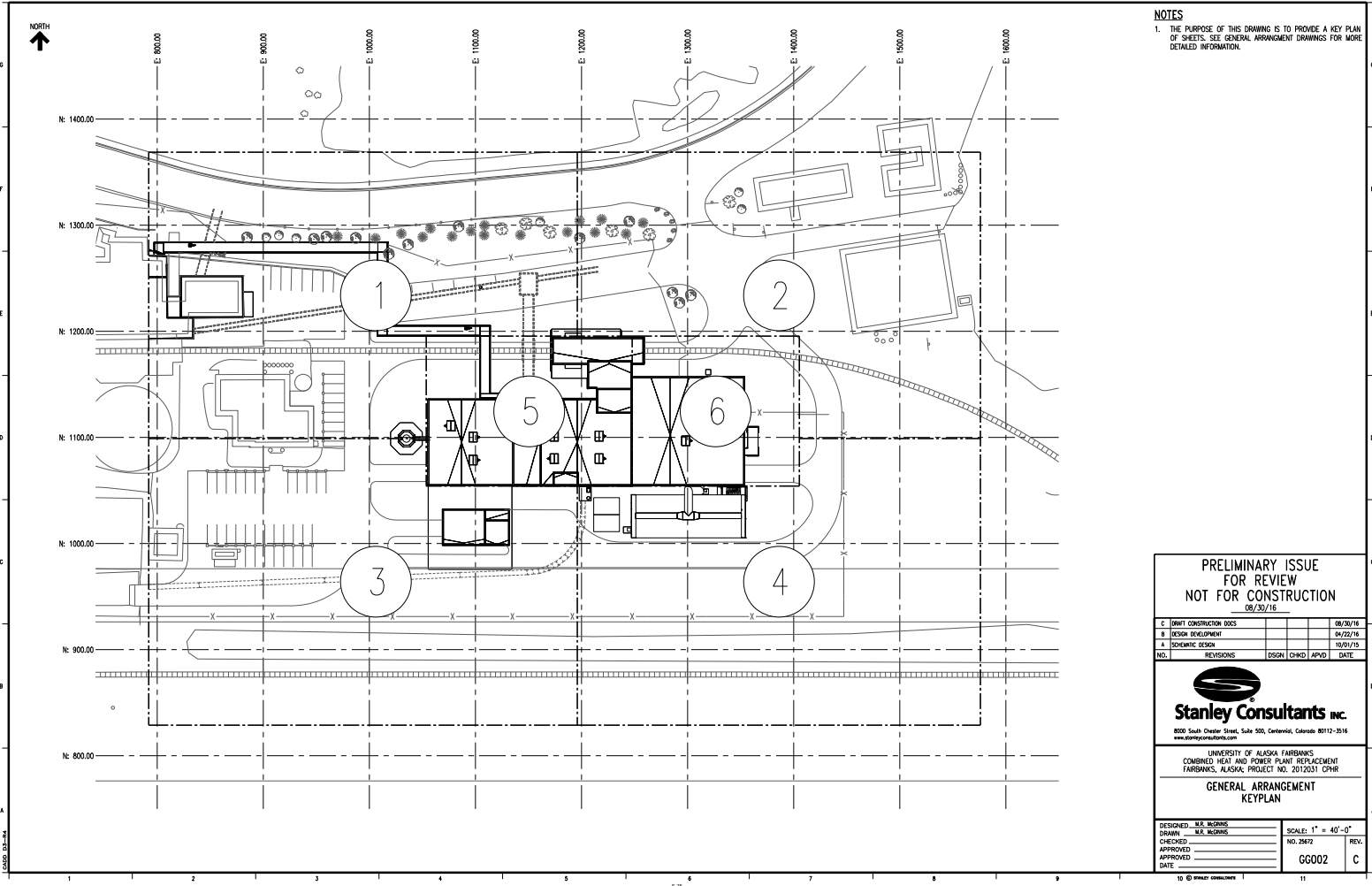
Steam Flow 240,000 lb/hr (30.24 kg/s)
 Steam Pressure 740 psig (5.1 MPa)
 Steam Temperature 750F (399C)

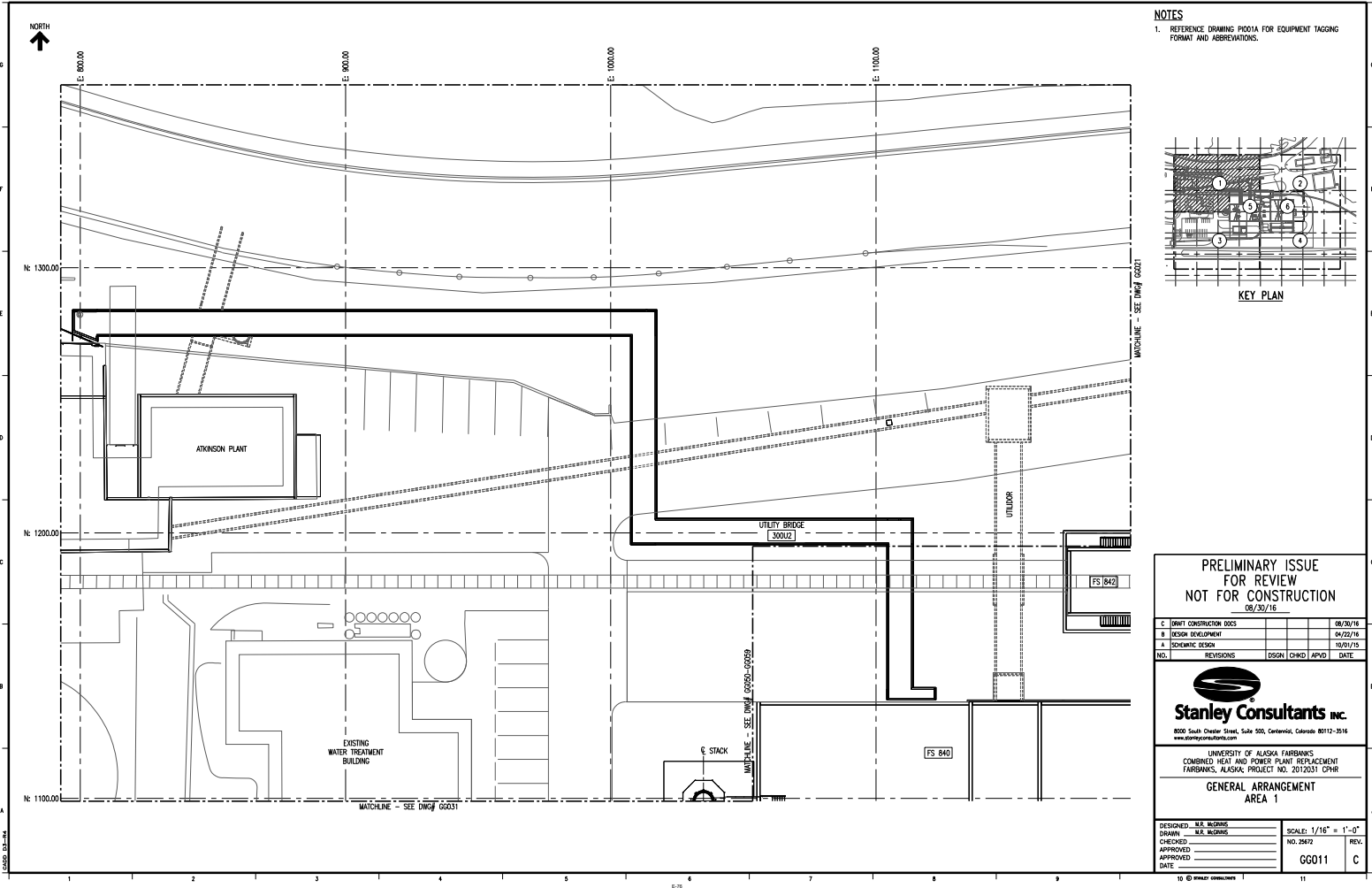


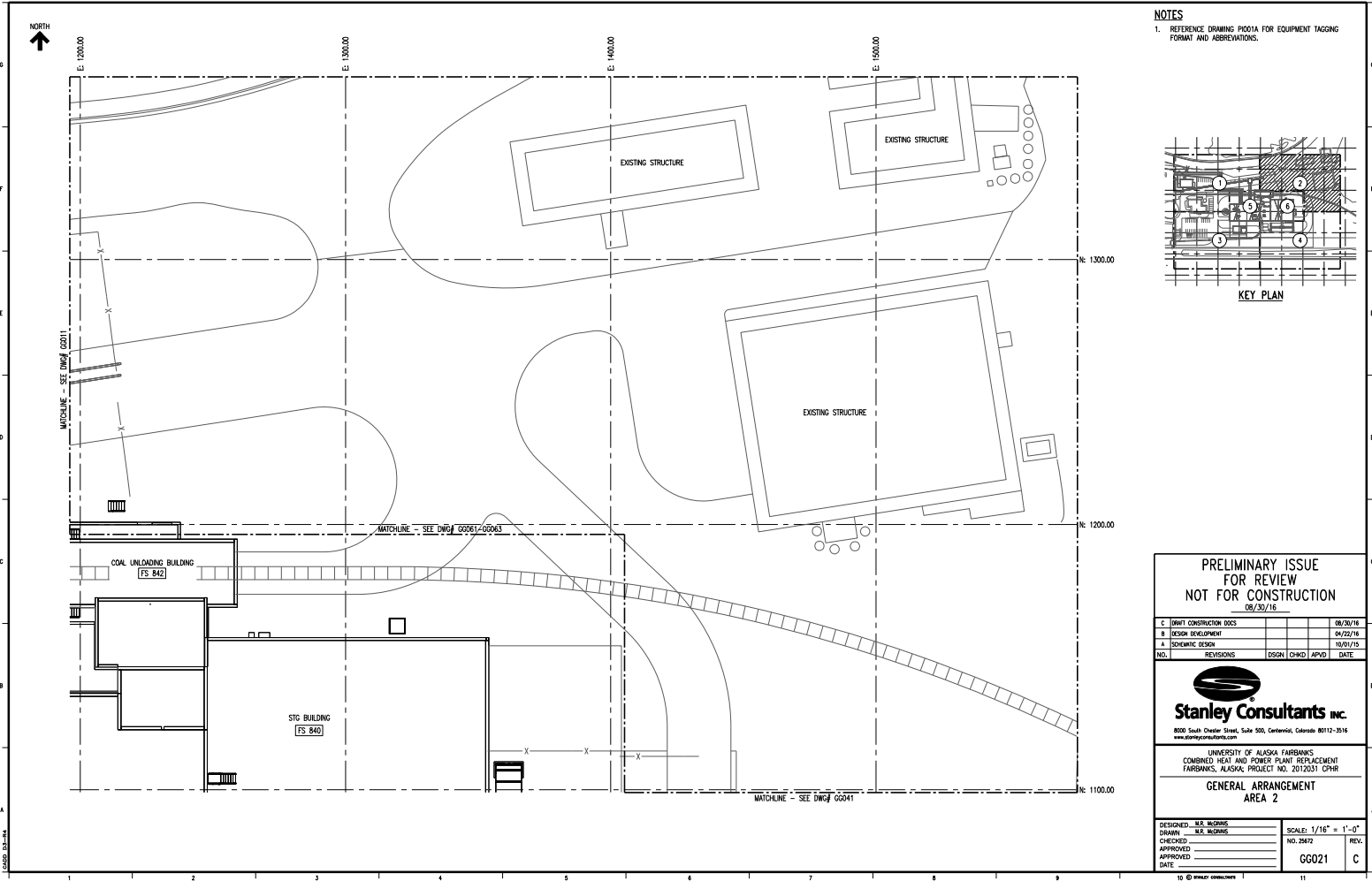
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Exhaust Gas Data at Tie-In

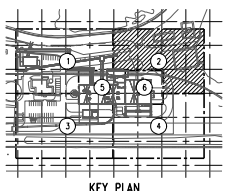
H2O	%	8.5
O2	%	3.7
N2	%	71.7
CO2	%	16.1
Inlet SO2	lb/MMBTU	.2
Inlet HCl	lb/MMBTU	0
Inlet PM	lb/MMBTU	9.0







NOTES
1. REFERENCE DRAWING PFD01A FOR EQUIPMENT TAGGING FORMAT AND ABBREVIATIONS.



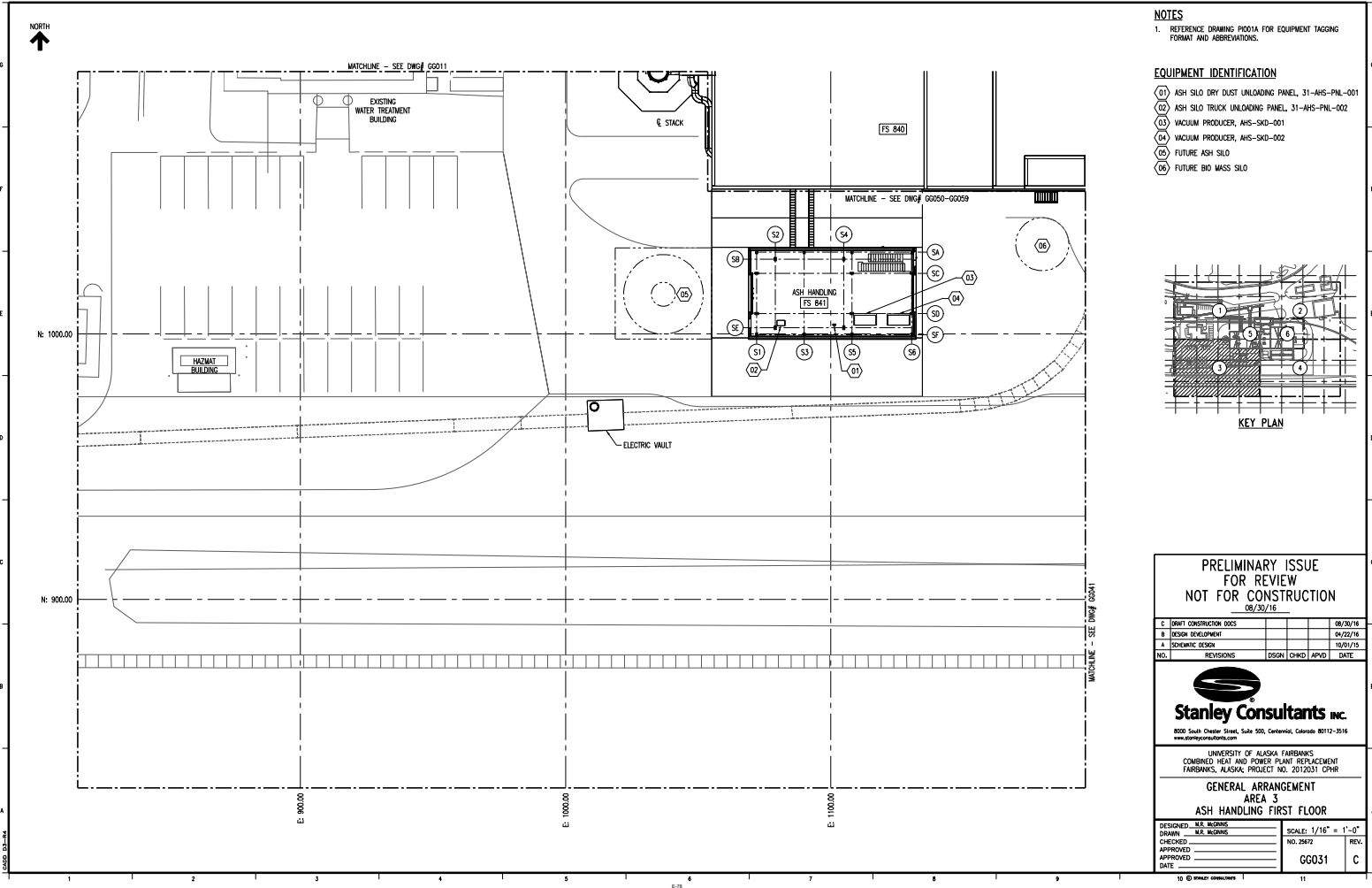
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08/30/16

C	INITIAL CONSTRUCTION ISSUES	08/30/16			
B	DESIGN DEVELOPMENT	04/22/16			
A	SCHEMATIC DESIGN	10/01/15			
NO.	REVISIONS	DSGN	CHKD	APVD	DATE

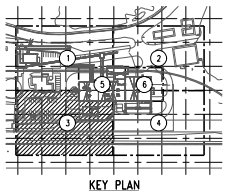
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UNIVERSITY OF ALASKA FAIRBANKS
COMBINED HEAT AND POWER PLANT REPLACEMENT
FAIRBANKS, ALASKA, PROJECT NO. 2012031 CPHR
**GENERAL ARRANGEMENT
AREA 2**

DESIGNED BY: <u>ME, INCORP</u>	SCALE: 1/16" = 1'-0"	REV.
DRAWN BY: <u>ME, INCORP</u>	NO. 25672	C
CHECKED BY: _____	GG021	
APPROVED BY: _____		
DATE: _____		



- NOTES**
1. REFERENCE DRAWING PFD01A FOR EQUIPMENT TAGGING FORMAT AND ABBREVIATIONS.
- EQUIPMENT IDENTIFICATION**
- (O1) ASH SLO DRY DUST UNLOADING PANEL, 31-AHS-PNL-001
 - (O2) ASH SLO TRUCK UNLOADING PANEL, 31-AHS-PNL-002
 - (O3) VACUUM PRODUCER, AHS-SKD-001
 - (O4) VACUUM PRODUCER, AHS-SKD-002
 - (O5) FUTURE ASH SLO
 - (O6) FUTURE BIO MASS SLO



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NO.	REVISIONS	DSGN	CHKD	APVD	DATE

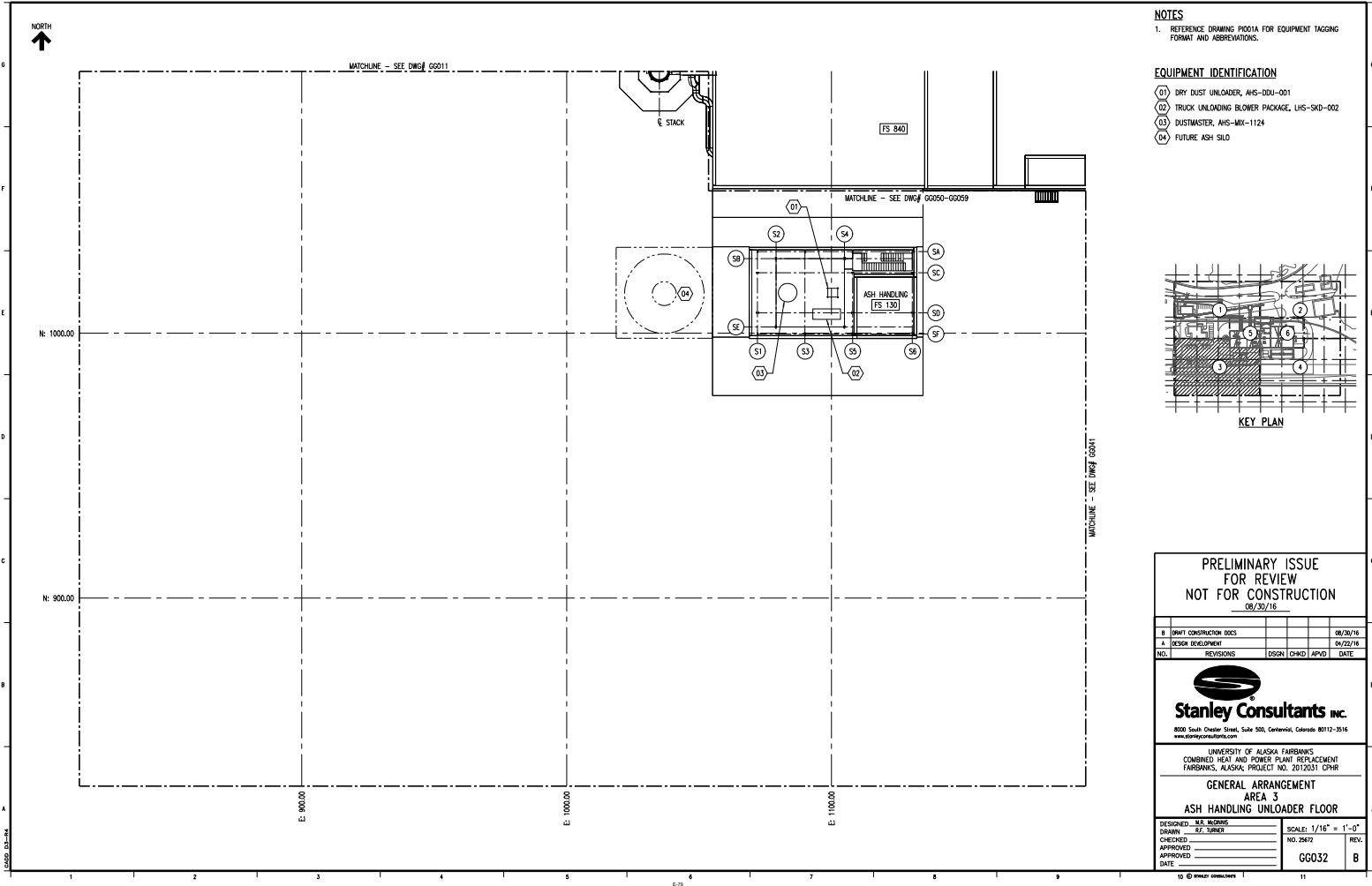
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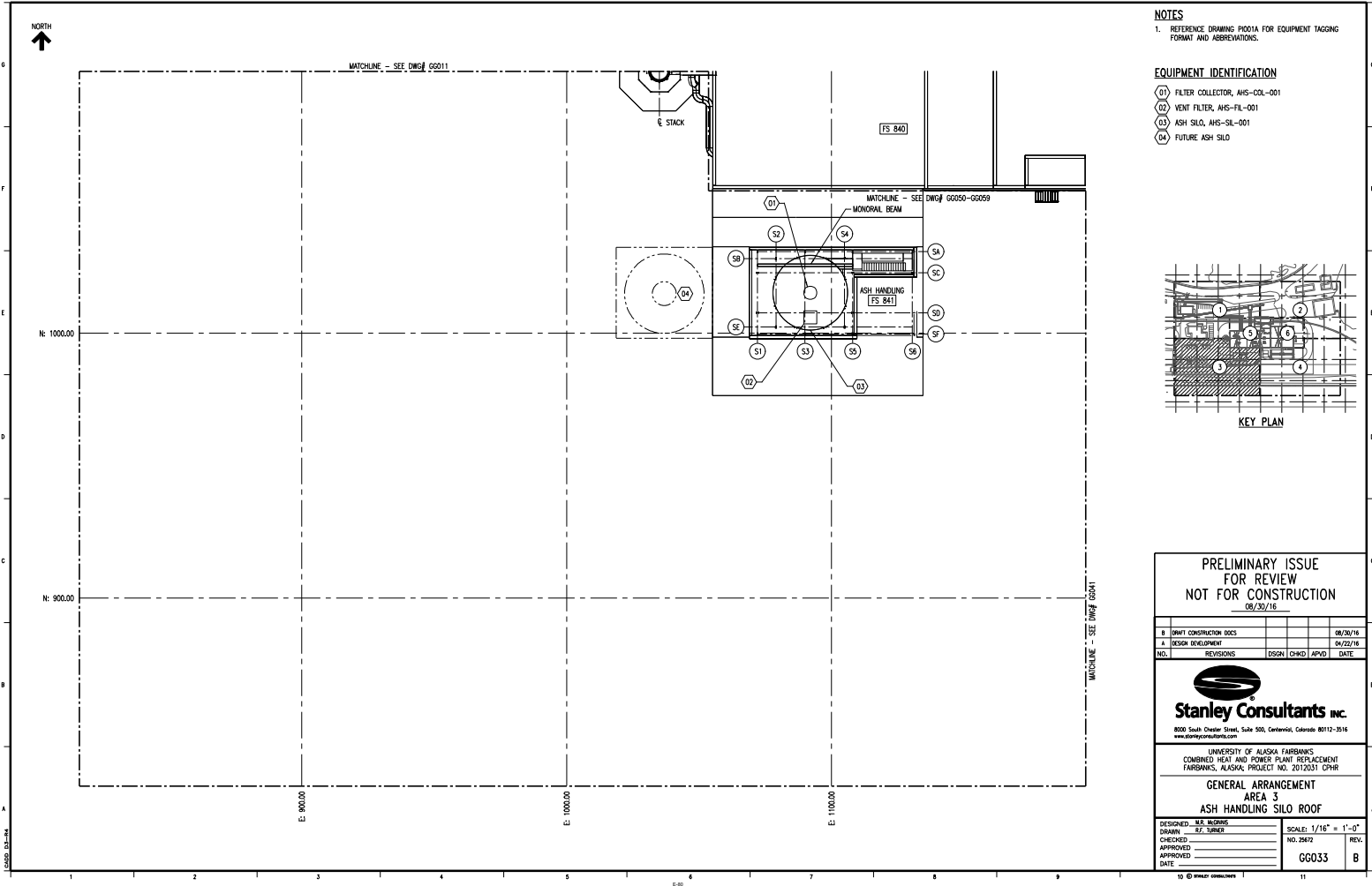
UNIVERSITY OF ALASKA FAIRBANKS
COMBINED HEAT AND POWER PLANT REPLACEMENT
FAIRBANKS, ALASKA; PROJECT NO. 2012031 CPHR

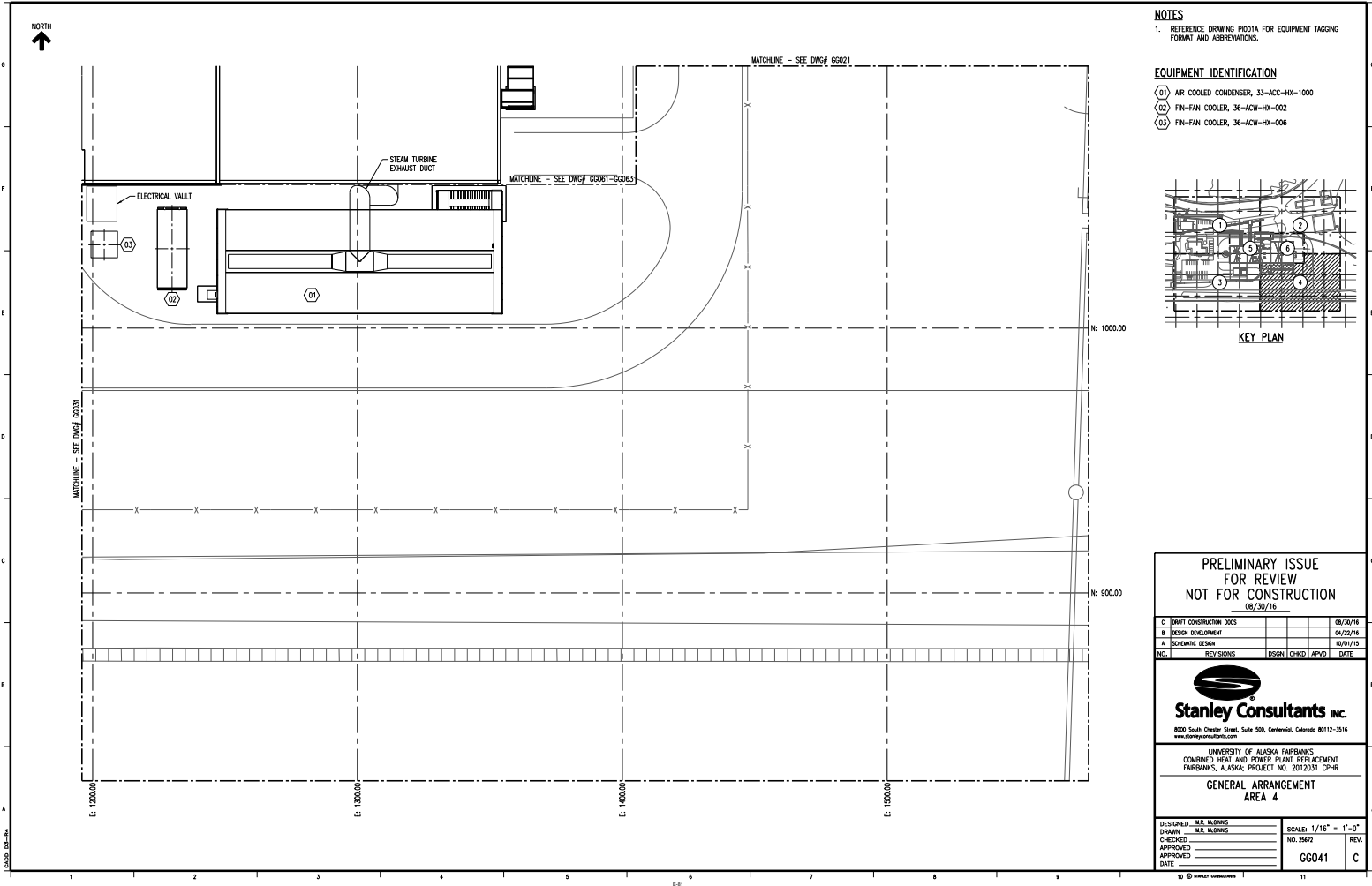
**GENERAL ARRANGEMENT
AREA 3
ASH HANDLING FIRST FLOOR**

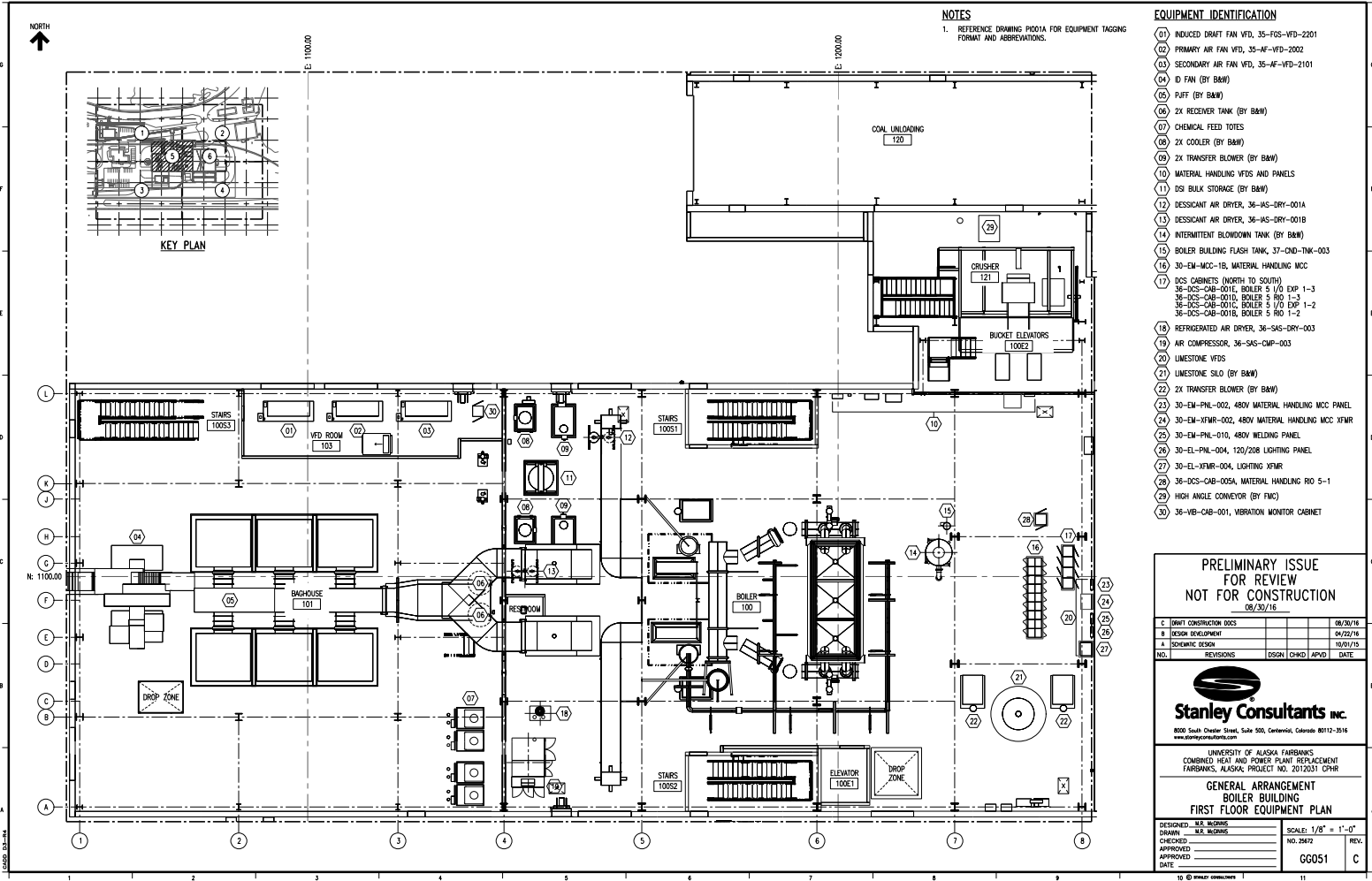
DESIGNED BY: MCKINNS	SCALE: 1/16" = 1'-0"	REV. C
DRAWN BY: MCKINNS	NO. 25672	
CHECKED BY: _____		
APPROVED BY: _____		
DATE: _____	GG031	

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NOTES
1. REFERENCE DRAWING P101A FOR EQUIPMENT TAGGING FORMAT AND ABBREVIATIONS.

- EQUIPMENT IDENTIFICATION**
- 01 INDUCED DRAFT FAN VFD, 35-FOS-VFD-2201
 - 02 PRIMARY AIR FAN VFD, 35-AF-VFD-2002
 - 03 SECONDARY AIR FAN VFD, 35-AF-VFD-2101
 - 04 D FAN (BY B&W)
 - 05 PUFF (BY B&W)
 - 06 2X RECEIVER TANK (BY B&W)
 - 07 CHEMICAL FEED TOTES
 - 08 2X COOLER (BY B&W)
 - 09 2X TRANSFER BLOWER (BY B&W)
 - 10 MATERIAL HANDLING VFDs AND PANELS
 - 11 DSI BULK STORAGE (BY B&W)
 - 12 DESSICANT AIR DRYER, 36-AS-DRY-001A
 - 13 DESSICANT AIR DRYER, 36-AS-DRY-001B
 - 14 INTERMITTENT BLOWDOWN TANK (BY B&W)
 - 15 BOILER BUILDING FLASH TANK, 37-OND-TNK-003
 - 16 30-EM-MCC-1B, MATERIAL HANDLING MCC
 - 17 DCS CABINETS (NORTH TO SOUTH)
36-DCS-CAB-001E, BOILER 5 1/0 EXP 1-3
36-DCS-CAB-001D, BOILER 5 R00 1-3
36-DCS-CAB-001C, BOILER 5 1/0 EXP 1-2
36-DCS-CAB-001B, BOILER 5 R00 1-2
 - 18 REFRIGERATED AIR DRYER, 36-SAS-DRY-003
 - 19 AIR COMPRESSOR, 36-SAS-CMP-003
 - 20 LIMESTONE VFDs
 - 21 LIMESTONE SILO (BY B&W)
 - 22 2X TRANSFER BLOWER (BY B&W)
 - 23 30-EM-PNL-002, 480V MATERIAL HANDLING MCC PANEL
 - 24 30-EM-YTHR-002, 480V MATERIAL HANDLING MCC YTHR
 - 25 30-EM-PNL-010, 480V WELDING PANEL
 - 26 30-EL-PNL-004, 120/208 LIGHTING PANEL
 - 27 30-EL-YTHR-004, LIGHTING YTHR
 - 28 36-DCS-CAB-005A, MATERIAL HANDLING R00 5-1
 - 29 HIGH ANGLE CONVEYOR (BY FMC)
 - 30 36-VB-CAB-001, VIBRATION MONITOR CABINET

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A	SCHEMATIC DESIGN	10/01/15
NO.	REVISIONS	DESIGN CHECK APPROVE DATE

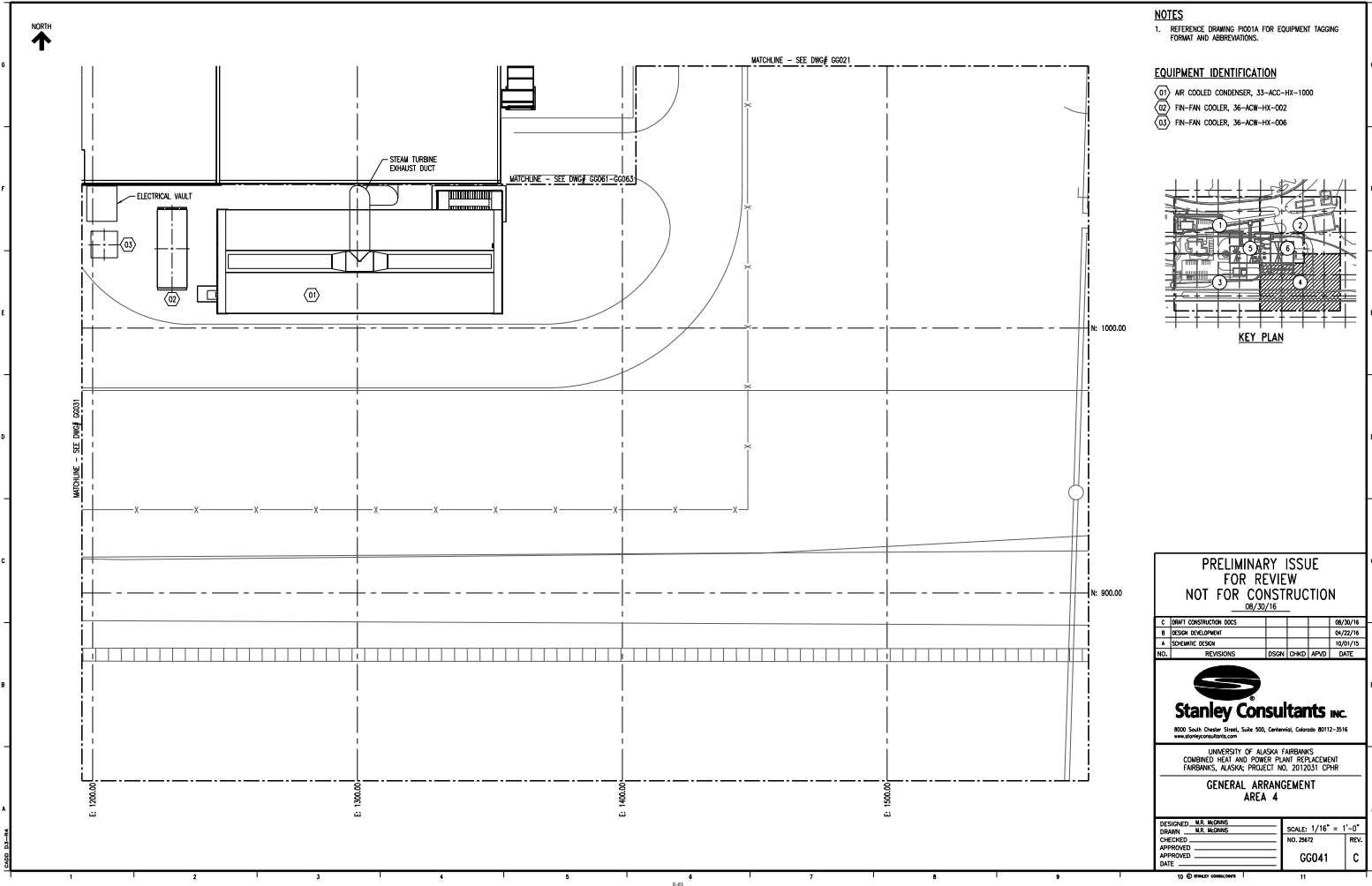
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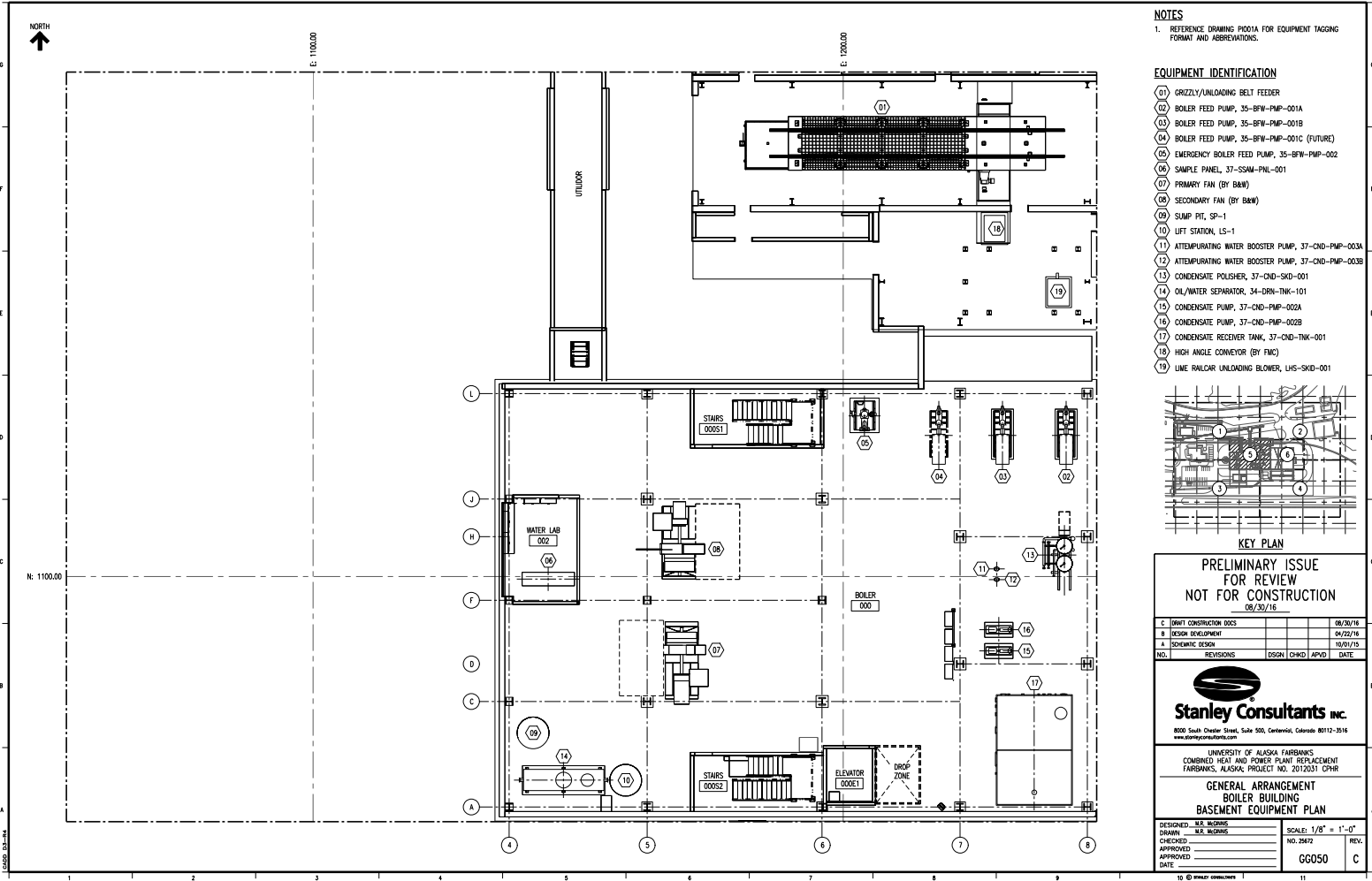
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COMBINED HEAT AND POWER PLANT REPLACEMENT
FAIRBANKS, ALASKA PROJECT NO. 2012031 CPHR

**GENERAL ARRANGEMENT
BOILER BUILDING
FIRST FLOOR EQUIPMENT PLAN**

DESIGNED: <u>ME, INCORP</u>	SCALE: 1/8" = 1'-0"	REV.
DRAWN: <u>ME, INCORP</u>	NO. 25472	C
CHECKED: _____		
APPROVED: _____		
DATE: _____	GG051	

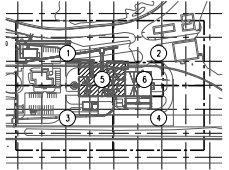
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NOTES
 1. REFERENCE DRAWING P001A FOR EQUIPMENT TAGGING FORMAT AND ABBREVIATIONS.

- EQUIPMENT IDENTIFICATION**
- 01 GRIZZLY/UNLOADING BELT FEEDER
 - 02 BOILER FEED PUMP, 35-BFW-PMP-001A
 - 03 BOILER FEED PUMP, 35-BFW-PMP-001B
 - 04 BOILER FEED PUMP, 35-BFW-PMP-001C (FUTURE)
 - 05 EMERGENCY BOILER FEED PUMP, 35-BFW-PMP-002
 - 06 SAMPLE PANEL, 37-SSAM-PNL-001
 - 07 PRIMARY FAN (BY B&W)
 - 08 SECONDARY FAN (BY B&W)
 - 09 SUMP PIT, SP-1
 - 10 LIFT STATION, LS-1
 - 11 ATTEMPURATING WATER BOOSTER PUMP, 37-CND-PMP-003A
 - 12 ATTEMPURATING WATER BOOSTER PUMP, 37-CND-PMP-003B
 - 13 CONDENSATE POLISHER, 37-CND-SKD-001
 - 14 OIL/WATER SEPARATOR, 34-DRN-TNK-101
 - 15 CONDENSATE PUMP, 37-CND-PMP-002A
 - 16 CONDENSATE PUMP, 37-CND-PMP-002B
 - 17 CONDENSATE RECEIVER TANK, 37-CND-TNK-001
 - 18 HIGH ANGLE CONVEYOR (BY FMC)
 - 19 LINE ROLLER UNLOADING BLOWER, LHS-SKD-001



KEY PLAN

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NO.	REVISIONS	DSGN	CHKD	APVD	DATE

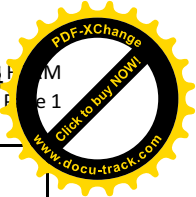
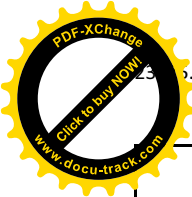
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 FAIRBANKS, ALASKA PROJECT NO. 2012031 CPHR

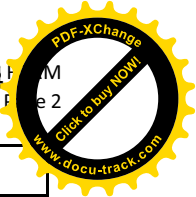
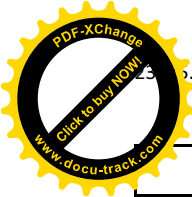
**GENERAL ARRANGEMENT
BOILER BUILDING
BASEMENT EQUIPMENT PLAN**

DESIGNED: J.E. MCKENZIE	SCALE: 1/8" = 1'-0"	REV.
DRAWN: J.E. MCKENZIE	NO. 26472	C
CHECKED: _____		
APPROVED: _____		
DATE: _____	GG050	

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BAGHOUSE DATA SHEET		Equipment Name: Baghouse	
		Tag No.:	
DESCRIPTION	Units	SPEC DATA	VENDOR DATA
GUARANTEED PREDICTED PERFORMANCE DATA			
Particulate emissions, stack outlet:			
Particulate Matter (filterable), all baghouse modules on line	lb/MMBtu input	Reference Emissions Guarantees	
Particulate Matter (filterable), one baghouse module off line	lb/MMBtu input	0.030	
Particulate emissions, stack outlet:			
Particulate Matter (filterable), all baghouse modules on line	gr/scf	Reference Emissions Guarantees	
Particulate Matter (filterable), one baghouse module off line	gr/scf	0.05	
PM10 emissions, stack outlet:			
PM10 (filterable and condensable), all baghouse modules on line	lb/MMBtu input	Reference Emissions Guarantees	
PM10 (filterable and condensable), one baghouse module off line	lb/MMBtu input	0.012	
PM2.5 emissions, stack outlet:			
PM2.5 (filterable and condensable), all baghouse modules on line	lb/MMBtu input	Reference Emissions Guarantees	
PM2.5 (filterable and condensable), one baghouse module off line	lb/MMBtu input	0.012	
Opacity of flue gas leaving stack, percent, 6-minute average			
Bag Leak Detection System	mg/acm	10 or less	
System friction losses:			
Baghouse including manifolds, all modules on line	In. H ₂ O		<5 (est)
Baghouse including manifolds, one module off line	In. H ₂ O		≤6 (est)
Ductwork, inlet ⁽¹⁾	In. H ₂ O		0.3 (est)
Ductwork, outlet ⁽¹⁾	In. H ₂ O		0.3 (est)
Baghouse bypass duct	In. H ₂ O		3 (est)
Power requirements:			
Hopper heaters	kW		5 (est)
Hopper vibrators	kW		Not Included/Recommended
Other	kW		None
Other	kW		None
Compressed air requirements:			
Bag pulse cleaning air:			
Consumption	scfm		50 (est)
Normal pressure	psig		100
Minimum pressure	psig		80
Instrument air consumption:			
Maximum instantaneous	scfm		40 (est)
Average	scfm		>10 (est)
Other			
Bypass damper leakage	%		0% (with seal gas)
PHYSICAL DATA AND SPECIFICATIONS			
Installed Weight:			
Supporting steel including enclosure	lb		Included In Boiler Tab
Baghouse	lb		163,000 lbs per PJFF
Breeching and ducts	lb		Included In Boiler Tab
Baghouse equipment data:			
Seller			
Number of modules			
Air-to-cloth ratio with even distribution. (do not include area of cloth over cages, Venturis, bottom caps, or seams):			



All modules in service under maximum operating conditions, gross			3.9
One module out for cleaning under maximum operating conditions, net			2.6
Filter bags:			
Fabric material/bag Seller			PPS with ePTFE membrane
Weight	oz/sq yd		16
Coating	% by weight		ePTFE membrane
Permeability (clean)	cfm/sq ft @ 1/2" wg		7 - 12 (est.)
Total bag weight without hardware	lb		4.5 (est.)
Cage construction:			
Wire size, and material			9 ga, Carbon Steel
Horizontal wire spacing			8"
Maximum opening size			5.9" Dia
Venturi material			N/A
Number of bags	per module		752
Bag size (diameter x length)	in.		6" x 19'8"
Bag spacing, center to center	in		8
Effective filter area per bag, used in computing air-to-cloth ratio	sq. ft.		29.52
Total filter area per module	sq. ft.		7438
Bag temperature rating:			
Continuous	F		330
Maximum short duration	F		350
Guaranteed bag life	Hrs		See Vendor's guarantee Section from proposal
Method of bag replacement (description - use separate sheet if necessary)			Remove blowpipe, pull out cage, drop bag into hopper,
Cleaning cycle time, minutes (isolation, pulse, settling, on-line):	Min		On-line cleaning, casing cleaned every 30 minutes
Adjustable cleaning cycle range per compartment	Min		Cleaning based on DP not time
Expected cleaning period per compartment, minutes	Min		3 min (est.)
Physical data:			
Baghouse overall dimensions (not including breeching, ducts):			
Length, parallel to gas flow	ft-in		See GA Drawing
Width, transverse to gas flow	ft-in		See GA Drawing
Height, above dust hopper flange connection	ft-in		See GA Drawing
Dimensions of each module:			
Height (overall)	ft-in		See GA Drawing
Width	ft-in		See GA Drawing
Length	ft-in		See GA Drawing
Side casing material and thickness	in.		A36 Carbon Steel, 3/16"
Hopper material and thickness	in		A36 Carbon Steel, 1/4"
Plenum casing material and thickness	in		A36 Carbon Steel, 3/16"

FUEL CHARACTERISTICS			LOAD CONDITION					
FUEL ANALYSIS		DESIGN	STEAM LEAVING SH, MLB/HR	MCR	70%	40%	33%	
A AREA	MINE	USIBELLI	TYPE OF FUEL	Coal	Coal	Coal	Coal	
	STATE/PROVINCE	HEALY, AK	EXCESS AIR LEAVING ECONOMIZER, %	15	15	66	102	
	COUNTRY	USA	NO. OF BURNERS IN OPERATION	0	0	0	0	
PROXIMATE ANALYSIS	% BY	WT	OUTPUT PER PTC 4-2013, MKB/HR	253.4	177.4	100.1	95.3	
	TOTAL MOIST.	28.50	FUEL INPUT, MKB/HR	295.6	206.0	118.8	118.0	
	VOL. MATTER	36.00	QUANTITY - MLB/HR	FUEL FLOW	39.1	27.3	15.7	15.6
	FIXED CARBON	26.50		FLUE GAS ENTERING AIR HEATER	284.7	199.0	157.8	187.0
	ASH	9.00		FLUG GAS ENTERING STACK (ACFM)	89,832	61,165	50,217	65,748
	TOTAL	100.00		TOTAL AIR TO BURNING EQUIPMENT	246.7	172.0	141.2	170.5
% BY	WT	SECONDARY AIR LEAVING AH		117.1	64.9	17.8	21.8	
ASH	9.00	PRIMARY AIR LEAVING AH		117.1	97.3	115.3	140.3	
ULTIMATE ANALYSIS	H2O	28.50	AIR HTR LEAKAGE (TOTAL AIR TO GAS)	1.0	1.4	2.5	2.5	
	C	43.75	SUPERHEAT SPRAY FLOW	7.88	7.48	0.00	0.74	
			BLOWDOWN	1.20	0.84	0.48	12.00	
			PRESSURE PSIG	FEEDWATER	740.00	692.00	660.00	656.00
				SPRAY WATER	720.00	702.00	0.00	0.00
				DRUM	693	658	636	633
				STEAM AT SH OUTLET	625	625	625	625
	S	0.20	TEMPERATURE - F	STEAM LEAVING SUPERHEATER	750	750	728	760
	O2	14.93		WATER ENTERING ECONOMIZER	350	350	350	260
	MERCURY, dry	< 0.07 mg/g		FLUE GAS LEAVING AH (EXCL. LKG)	285	260	285	350
				ENTERING STACK	289	265	288	354
	FLOURINE, dry	< 81 mg/g		AIR ENTERING PRI. AIR FAN (1)	77	88	111	123
CHLORINE, dry	< 18 mg/g	ENTERING SEC. AIR FAN (1)		77	77	77	77	
TOTAL	100.00		LEAVING AIR HEATER (SEC)	335	335	275	337	
HHV, BTU/LB	7,560		LEAVING AIR HEATER (PRI)	335	309	380	508	
SORBENT CHARACTERISTICS			FUEL TO BURNING EQUIPMENT	40	40	40	40	
LIMESTONE ANALYSIS		DESIGN	DRY GAS	4.38	3.86	6.02	9.80	
ANALYSIS	% BY	WT	H2 & H2O IN FUEL	8.53	8.45	8.51	8.75	
	CaCO3	95.00	MOISTURE IN AIR	0.07	0.06	0.10	0.16	
	MgCO3	0.90	MOISTURE IN SORBENT	0.00	0.00	0.00	0.00	
	SiO2	3.30	UNBURNED COMBUSTIBLE IN RESIDUE	0.50	0.50	0.50	0.50	
	H2O	0.80	RADIATION	0.36	0.51	0.91	0.96	
	TOTAL	100.00	SENSIBLE HEAT IN REFUSE	0.07	0.10	0.09	0.13	
NOTES	(1) PTC 4 BOUNDARY IS AT FAN INLETS W/SPECIFIED ENTERING AIR TEMP OF 77°F & SPECIFIED 40°F AMBIENT (FUEL) TEMP (2) PREDICTED PERFORMANCE BASED ON CONDITIONS & EQUIPMENT SHOWN ON THIS SUMMARY SHEET & ON GENERAL ARRGT DRAWINGS B0312851 & B0312852 (3) BAROMETRIC PRESSURE = 29.40 IN HG 0.009 LB H2O PER LB COMBUSTION AIR (4) SPRAY WATER PRESSURE AT EXPECTED OPERATING CONDITIONS, FURTHER UPSET PERFORMANCE TO BE PROVIDED LATER		MANUFACTURER'S MARGIN	0.40	0.40	0.40	0.40	
			SORBENT CALCINATION/DEHYDRATION	0.23	0.23	0.23	0.23	
			OTHER LOSSES (UNMEASURED)	0.10	0.10	0.10	0.10	
			TOTAL LOSSES	14.64	14.21	16.87	21.03	
			HEAT CREDITS, %	ENTERING DRY AIR	0.00	0.12	0.81	1.36
			MOISTURE IN AIR	0.00	0.00	0.01	0.02	
			SENSIBLE HEAT IN FUEL	-0.16	-0.16	-0.16	-0.16	
			SULFATION	0.11	0.11	0.11	0.11	
			MOISTURE IN LIMESTONE	0.00	0.00	0.00	0.00	
			AUXILIARY EQUIPMENT POWER	0.42	0.23	0.42	0.42	
TOTAL CREDITS	0.37	0.30	1.19	1.76				
© 2015 THE BABCOCK & WILCOX COMPANY ALL RIGHTS RESERVED.			ASME PTC 4-2013 FUEL EFFICIENCY, %	85.73	86.10	84.32	80.73	

Scope of Work

Project: University of Alaska Fairbanks (UAF) - CHPP Plant AQCS Options for SO₂ Control Cost Estimate

PROJECT UNDERSTANDING

Stanley is performing a study level cost estimate to retrofit desulfurization options for the UAF campus utility plant.

» Circulating Dry Scrubber (CDS)

Stanley is requesting the following information to support our cost estimating effort. The option should be sized to assuming the boiler is operating at MCR with the SO₂ concentration in the flue gas out of the boiler at the permitted level SO₂, 0.2 lb/MMBTU.

The following information is requested.

INFORMATION REQUESTED

1. SO₂ removal efficiency.
2. Budget pricing, FOB UAF, assuming new technologies will be housed inside a new heated enclosure. The pricing will be for material only, installation will be estimated by others. The costs associated with enclosure and civil work will be estimated by others.
 - a. Mechanical work inside the new enclosure. Assume reagent storage silos are include inside the enclosure and sized for 30 day of storage. All required tie-ins are assumed to at enclosure boundary.
 - b. Prepare a small write-up regarding the scope of the items included in the estimated.
3. Electrical load and voltage for each major load.
4. Approximation of the size of enclosure, including a length, width, and height.
5. Opinion if existing backhouse can be used unmodified with each technology. If technology requires new baghouse, provide a budgetary price for new baghouse.
6. If technology produces a liquid or solid waste, quantify the amount.
7. Reagent required type and consumption rates.
8. Utility usage water, air, etc.
9. Increase in fly ash (byproduct) from the technology, if any.
10. Increase in flue gas pressure drop.
11. CDS Qualifications:
 - a. List of specific experience with CDS.
 - b. Where are the CDS installations in the US?
 - c. For installation, is it still operating?
 - d. For each installation, what is the fuel type, size, and type of combustion unit from which emissions are controlled?

SCHEDULE

Stanley requests the information in three weeks, if possible. Partial release of information, such as building sizes, removal efficiency, etc., will allow use to start our estimating work.

INFORMATION INCLUDED

The following information is included to support the information requested. If additional information is required please request.

1. Performance Data for the boiler
2. Typical Exhaust gas composition

3. Baghouse Information

Jahn, Mario

From: Martin Schroeter <mschroeter@tri-mer.com>
Sent: Friday, June 24, 2022 3:27 PM
To: Jahn, Mario; Solan, John; Payne, Mark
Cc: Joe Riley; Ted Hornus; David Bennett
Subject: RE: P-23.182 Stanley UAF SO2 Control Project | List of Non - Tri-Mer References for CDS Technology
Attachments: CDS References R.2 6-24-2022.pdf

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

Hello Mario,

Enclosed please find the updated reference list for the CDS applications. I will then follow up with an updated proposal for the DSI solution with increased SO2 removal efficiency >90% during the week of July 4th.

In case of any questions, please let me know.

Best regards
Martin

From: Jahn, Mario <JahnMario@stanleygroup.com>
Sent: Friday, June 24, 2022 4:39 PM
To: Martin Schroeter <mschroeter@tri-mer.com>; Solan, John <SolanJohn@stanleygroup.com>; Payne, Mark <PayneMark@stanleygroup.com>
Cc: Joe Riley <jriley@stmecosystems.com>; Ted Hornus <thornus@tri-mer.com>; David Bennett <dbennett@tri-mer.com>
Subject: RE: P-23.182 Stanley UAF SO2 Control Project | List of Non - Tri-Mer References for CDS Technology

Good Afternoon Martin,

I wanted to check-in and see how things were going on your end with regards to the additional references that we asked for below, as well as an updated DSI quote. We are rapidly coming to the end of our evaluation and are still awaiting these key items. Let me know if you have run into any issues or need additional questions answered from us.

Best Regards,
Mario

From: Jahn, Mario
Sent: Wednesday, June 15, 2022 8:50 AM
To: Martin Schroeter <mschroeter@tri-mer.com>; Solan, John <SolanJohn@stanleygroup.com>; Payne, Mark <PayneMark@stanleygroup.com>
Cc: Joe Riley <jriley@stmecosystems.com>; Ted Hornus <thornus@tri-mer.com>; David Bennett <dbennett@tri-mer.com>
Subject: RE: P-23.182 Stanley UAF SO2 Control Project | List of Non - Tri-Mer References for CDS Technology

Martin,

Thank you very much for providing the additional references. I noticed that you have additional columns that weren't part of your last reference list. Is there a way you can add the additional columns to your previous reference list? I know that there might be confidentiality issues with this, but if you can also list the name of the plant that would help as well.

Industry	Location	Flow, acfm	Process	Year
WTE	Oklahoma, USA	< 100,000	Incineration	2010
Cement	Italy	400,000 – 800,000	Cement kiln	2009
Power	China	> 800,000	Coal fired boiler	2007
Hazardous waste	Pennsylvania, USA	100,000 – 400,000	Incineration	2005
Power	Alabama, USA	< 100,000	Coal fired boiler	2004
Power	France	100,000 – 400,000	Biomass fired boiler	2003
Minerals	New Jersey, USA	< 100,000	Dryer	2003

Kind regards,
Mario

From: Martin Schroeter <mschroeter@tri-mer.com>

Sent: Wednesday, June 15, 2022 8:16 AM

To: Jahn, Mario <JahnMario@stanleygroup.com>; Solan, John <SolanJohn@stanleygroup.com>

Cc: Joe Riley <jriley@stmecosystems.com>; Ted Hornus <thornus@tri-mer.com>; David Bennett <dbennett@tri-mer.com>

Subject: P-23.182 Stanley UAF SO2 Control Project | List of Non - Tri-Mer References for CDS Technology

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

Mario and John,

Enclosed please find a list of CDS installations during the period of late 1990-ties to early 2000-s performed by FLS Airtech.

Best regards

Martin Schroeter

Sales - Ceramics Technology Group (CTG)

Tri-Mer Corporation

1400 E Monroe Street

Owosso, MI 48867

Mobile Phone: (989)-627-1040

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Email: mschroeter@tri-mer.com



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SO₂ MITIGATION SOLUTIONS

List of Non – Tri-Mer References for CDS Technology of Relevant Size During Late 1990-ties to early 2000-s

REFERENCE NUMBER: P-23.182

PREPARED FOR STANLEY CONSULTANTS

As Part of Proposal No. P-23.182

Mario Jahn

8000 S Chester St, Suite 500
CENTENNIAL, CO 80112

(303) 725-1361

JAHNMARIO@STANLEYGROUP.COM

PROPOSAL ISSUED:

JUNE 24, 2022

PROPOSAL VALID TO:

-

TRI-MER CORPORATION

1400 E MONROE STREET
OWOSSO, MI 48867

WWW.TRI-MER.COM

(989) 723-7838

PRINCIPAL CONTACT:

MARTIN SCHROETER

(989) 627-1040

MSCHROETER@TRI-MER.COM

UPDATED REFERENCES FOR CDS TECHNOLOGY > 100,000 SCFM

Industry	Location	Flow, scfm	Process	Supplier	Technology	Year	Remark
WTE	Oklahoma, USA	100,000	Incineration	Boldeco	CDS	2010	Closed
Cement	Italy	400,000 – 800,000	Cement kiln	Boldrocchi	CDS	2009	operating
Power	China	> 800,000	Coal fired boiler	Boldeco	CDS	2007	Closed
Hazardous waste	Pennsylvania, USA	100,000 – 400,000	Incineration	Boldeco	CDS	2005	Status unknown
Power	Alabama, USA	< 100,000	Coal fired boiler	Boldeco	CDS	2004	Converted to Gas
Power	France	100,000 – 400,000	Biomass fired boiler	Boldrocchi	CDS	2003	operating
Minerals	New Jersey, USA	< 100,000	Dryer	Boldeco	CDS	2003	Status unknown
Mining	Kiruna, Sweden	227,700	135 MWe boiler	FLS Airtech	CDS / ESP	1994	Status unknown
Power	Hamilton, USA	146,000	80 MWe coal fired boiler	FLS Airtech	CDS	1995	Converted to gas
Power	Nichom Phatthana, Thailand	2 x 108,000	Coal fired boiler	FLS Airtech	CDS	1998	Status unknown
Power	Xiaolong Tan, China	310,000	125 MWe coal fired boiler	FLS Airtech	CDS	2000	Status unknown
Biomass	Elean, UK	100,000	38 MWe Straw fired boiler	FLS Airtech	CDS / FF	2000	Operational

Mining	Kiruna, Sweden	150,000	Boiler	FLS Airtech	CDS / ESP	2004	Status unknown
Power	Shuaiba, Kuwait	221,900	Coal fired boiler	FLS Airtech	CDS / FF	2005	Status unknown

MEETING NOTES

Date: June 9, 2022

Place: Web/Conference Call

Project/Purpose: University of Alaska Fairbanks
SO2 Best Available Control Technology Study

Attendees: Mark Payne (SCI)
Mario Jahn (SCI)
John Solan (SCI)
Martin Schroeter (Tri-Mer)
Ted Hornus (Tri-Mer)
Joe Riley (STM Ecosystems)

Notes By: John Solan

The following meeting notes set forth our understanding of the discussions and decisions made at this meeting. If no objections, questions, additions, or comments are received within 5 working days from issuance of the meeting notes, we will assume that our understandings are correct. We are proceeding based on the contents of these meeting notes.

Topics:**BACT Study Process:**

- SCI briefly reviewed the BACT Study process including the underlying reasoning and the protocol for conducting the study.
- SCI emphasized to Tri-Mer that any opinions that they had regarding the technology that might be “best” or “least expensive” or “most cost effective” were irrelevant. The BACT process was developed to provide a structured framework to determine which technologies were technically feasible and then to select the best available control technology from the technically feasible options.
- SCI further emphasized that, based on the BACT study protocol. The selected solution will be the technology that achieves the greatest reduction in SO2 emissions while still being cost effective.

References:

- Stanley requested additional references to provide additional, older references that indicate that the technology is fully mature and suitable for a 30-year design life.
 - Tri-Mer stated that they would try to find references of older plants, however they may be from projects that pre-date Tri-Mer.
 - They talked about an EPRI study conducted at an Alabama Power plant. This was an R&D study to test out a multi-pollutant system for proof of concept. This was only a 4 MW, 16,000 CFM side-stream test.
 - Additional information on provided references shall include whether the technology was full scale or slipstream.
 - CDS experience is lacking in coal power plants. They have some on non-coal glass plants. Tri-Mer made the comment they really do not have any references for coal power plants
 - SCI also requested additional information regarding previously provided reference so that performance and operating status can be verified.

Dry Sorbent Injection

- Tri-Mer stated that they were confident that they could achieve greater than 90% efficiency (SO2 capture)

with their SorbSaver Pro Dry Sorbent Injection System. To accomplish this efficiency, however, they would need to install the injection point upstream of the existing tubular air heaters.

- Tri-Mer requested that SCI provide flue gas temperature data immediately downstream of the economizers and also boiler drawings. This information will allow them to confirm their predicted performance numbers.
 - SCI stated that they would request the temperature data from the plant and would provide the data along with the drawings when it was available.

Tri-Mer Circulating Dry Scrubber

- Tri-Mer stated that their Circulating Dry Scrubber (CDS) system differed from traditional CDS systems in that their system recirculates a portion of the ash collected by the baghouse back to the CDS reactor(s) via pneumatic transport. This approach eliminates the need for an elevated baghouse, as is seen with traditional CDS systems. This would allow the UAF plant to keep their existing baghouse.
- The only verifiabl

Tri-Mer Recirculating Dry Scrubber

- Tri-Mer stated that their Recirculating Dry Scrubber (RDS) system is very similar to that of a traditional CDS system. This system would require that the existing plant baghouse be replaced with an elevated baghouse to facilitate the return of ash and sorbents from the baghouse to the reactors via an air slide.

Tri-Mer Caustic Soda Wet Scrubber

- Tri-Mer stated that their Caustic Soda Wet Scrubber system was an offering that the provided for other industrial flue gas applications, but one that does not often get employed on power projects.
- They stated that it differs from traditional Wet Flue Gas Desulfurization systems in that it uses a caustic soda liquid instead of the traditional reagent slurry.
- Tri-Mer further stated that, while the system works well on several industrial processes, it can be very sensitive to changes in the process. Therefore, while technically available for installation, it may not be the correct solution for this project due to the variable nature of plant operations.

Distribution:

file
Boreal

Courtney Kimball

From: Solan, John <SolanJohn@stanleygroup.com>
Sent: Friday, November 18, 2022 10:48
To: Courtney Kimball
Subject: FW: P-23.182 Stanley SO2 Removal Project for UAF Fairbanks, AK

Follow Up Flag: Follow up
Flag Status: Flagged

Here is the email.

From: Martin Schroeter <mschroeter@TRI-MER.COM>
Sent: Thursday, August 25, 2022 10:38 AM
To: Jahn, Mario <JahnMario@stanleygroup.com>
Cc: Asa Halliday <ahalliday@tri-mer.com>; Ted Hornus <thornus@tri-mer.com>; Deirdre Labert <dlabert@tri-mer.com>; Vincent DiGiorgio <vdigiorgio@tri-mer.com>; Solan, John <SolanJohn@stanleygroup.com>
Subject: RE: P-23.182 Stanley SO2 Removal Project for UAF Fairbanks, AK

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

Good morning Mario,

With respect to hydrated lime suppliers I have reached out to Carmeuse, Mississippi Lime and Graymont, while Graymont seems to be a good candidate with HQ in British Columbia, Canada, which at least has a border with Alaska. Unfortunately, I could not find any local champion in Alaska. That said, we will have to re-start the design process for each of the mentioned companies in order to get their injection rates. I suggest that Stanley Consultants and TMC team up, in order to cover the technical data with economic considerations. From our earlier experience, Lhoist's highly engineered products and the location of their hubs in relation to our project locations were the most cost effective choice considering both supply and disposal cost. But for Alaska we are talking major impact of shipping cost on top of that the fast rising energy costs that seem to minimize TCO advantages of highly engineered products, because their production is rather energy intensive.

For the enclosure of the unloading station, would it be possible to include the unloading station in the building / enclosure of the silos? It seems to be a logic step to place the silos between the rail track and the boiler building. If that solution would be considered, I will ask for GA drawing to show the dimensions of the rail car unloading station.

Let me know, what you think.

Best regards
Martin

From: Jahn, Mario <JahnMario@stanleygroup.com>
Sent: Wednesday, August 24, 2022 5:08 PM
To: Martin Schroeter <mschroeter@TRI-MER.COM>
Cc: Asa Halliday <ahalliday@tri-mer.com>; Ted Hornus <thornus@tri-mer.com>; Deirdre Labert <dlabert@tri-mer.com>; Vincent DiGiorgio <vdigiorgio@tri-mer.com>; Solan, John <SolanJohn@stanleygroup.com>
Subject: RE: P-23.182 Stanley SO2 Removal Project for UAF Fairbanks, AK

Thanks Martin. A couple of follow-up questions in red below.

From: Martin Schroeter <mschroeter@TRI-MER.COM>
Sent: Wednesday, August 24, 2022 10:44 AM
To: Jahn, Mario <JahnMario@stanleygroup.com>
Cc: Asa Halliday <ahalliday@tri-mer.com>; Ted Hornus <thornus@tri-mer.com>; Deirdre Labert <dlabert@tri-mer.com>; Vincent DiGiorgio <vdigiorgio@tri-mer.com>; Solan, John <SolanJohn@stanleygroup.com>
Subject: RE: P-23.182 Stanley SO2 Removal Project for UAF Fairbanks, AK

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Good morning Mario,

Please find below our answers to your questions:

1. The two 3,000 ft³ silos will cover about 14 days of continuous usage, which is about the same capacity of one rail car, which is loaded with about 95-100 tons of hydrated lime. That said, we would need 10 railcars to cover for 3 months of continuous usage. If rail cars are the means of choice to transport the hydrated lime, there will however be conditions to check with the supplier (Lhoist) as well as rail track capacity (blockage of track, parking of rail cars a.o.). According to Lhoist, storage of Sorbocal SPS in rail cars up to 6 month should not deteriorate their product as long as the internal of the rail car is kept dry. **The 3 month storage capacity is something that the University has requested. Rail car storage would not be preferred. I noticed that your reagent consumption increased by 4x from Sodium Bicarb to Hydrated Lime. Can the lime usage be reduced by humidification or other means? We've received hydrated lime pricing from L'hoist and it was pretty high. Do you know of any other bulk hydrated lime suppliers in Alaska that we can reach out to? Or in the lower 48 like Washington?**
2. For dimensions, please refer to enclosed drawing. The shipping weight of one silo is approximately 17,000 lbs. **Thank you.**
3. No, since trucks have an onboard blower solution, a typical hydrated lime storage and delivery design does not include any separate unloading. Rail cars however do not have any onboard solution and would need an unloading station. Tri-Mer has designs for unloading station of a rail car, which however should be limited in distance to the silo (< 100 ft) and considering the local weather conditions should be housed in a heated enclosure. **Can you provide pricing for an unloading enclosure?**
4. For demonstration purpose, please refer to enclosed generic P&ID drawings. Unfortunately, we did not yet have a project specific P&ID, hence please keep in mind that the displayed numbers are not related to our project. For project related values please refer to the PDF (cf. enclosed Excel file). **Thank you.**
5. Yes, this is a requirement for all injection points for maintenance. **Thank you.**

Best regards
Martin

From: Jahn, Mario <JahnMario@stanleygroup.com>
Sent: Tuesday, August 23, 2022 10:13 AM
To: Martin Schroeter <mschroeter@tri-mer.com>
Cc: Asa Halliday <ahalliday@tri-mer.com>; Ted Hornus <thornus@tri-mer.com>; Deirdre Labert <dlabert@tri-mer.com>; Vincent DiGiorgio <vdigiorgio@tri-mer.com>; Solan, John <SolanJohn@stanleygroup.com>
Subject: RE: P-23.182 Stanley SO2 Removal Project for UAF Fairbanks, AK

Thanks Martin.

A couple of questions on the DSI system.

1. Based on feed rates are the two 3,000 ft³ silos large enough for 3 months of continued usage?
2. Do you have general sizes and weights of each silo?
3. Does the price involve any unloading blowers to move material from the truck or rail car to each silo?

4. Do you have a general PFD or P&ID that you can provide to show how this system works?
5. Does the injection system at the duct need steel and access platforms?

Thanks,
Mario

From: Martin Schroeter <mschroeter@tri-mer.com>

Sent: Tuesday, August 23, 2022 6:57 AM

To: Jahn, Mario <JahnMario@stanleygroup.com>

Cc: Asa Halliday <ahalliday@tri-mer.com>; Ted Hornus <thornus@tri-mer.com>; Deirdre Labert <dlabert@tri-mer.com>; Vincent DiGiorgio <vdigiorgio@tri-mer.com>

Subject: RE: P-23.182 Stanley SO2 Removal Project for UAF Fairbanks, AK

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

Good morning Mario,

Enclosed please find the revised proposal P-23.182 for Stanley's SO2 removal project for UAF in Fairbanks, AK. Based on the recent discussion on converting the CDS model to hydrated lime, I have also updated that section of the proposal. Besides minor editorial changes, the proposal should now be consistent with your requirement of using hydrated lime as sorbent for the SO2.

In case of any further questions or recommendations, please let me know.

Best regards
Martin

From: Jahn, Mario <JahnMario@stanleygroup.com>

Sent: Monday, August 22, 2022 5:56 PM

To: Martin Schroeter <mschroeter@tri-mer.com>

Cc: Asa Halliday <ahalliday@tri-mer.com>; Ted Hornus <thornus@tri-mer.com>; Deirdre Labert <dlabert@tri-mer.com>; Vincent DiGiorgio <vdigiorgio@tri-mer.com>

Subject: RE: P-23.182 Stanley SO2 Removal Project for UAF Fairbanks, AK

Martin,

I wanted to double check with you on the last proposal you provided. The text in the proposal states sodium bicarbonate for the DSI system (see page 16 of 24 in the PDF). But the consumption table at the end of the document states hydrated lime consumption (page 21 of 24 in the PDF). Can you confirm the use of hydrated lime for the DSI system? It would be nice if the document can be updated to avoid any confusion in the future.

Thanks,
Mario

From: Martin Schroeter <mschroeter@tri-mer.com>

Sent: Tuesday, July 26, 2022 8:29 AM

To: Fritz, Mark <FritzMark@stanleygroup.com>

Cc: Asa Halliday <ahalliday@tri-mer.com>; Ted Hornus <thornus@tri-mer.com>; Deirdre Labert <dlabert@tri-mer.com>; Vincent DiGiorgio <vdigiorgio@tri-mer.com>

Subject: P-23.182 Stanley SO2 Removal Project for UAF Fairbanks, AK

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

Good morning Mark,

Enclosed please find the revised proposal P-23.182 Stanley SO2 removal for UAF Fairbanks, AK. We have updated the SorbSaver Pro (DSI) technology sections for hydrated lime injection (Sorbacal SPS or similar quality) and 90% SO2 removal.

We will be pleased to clarify any questions, once you have reviewed the proposal.

In case you have additional questions, please let me know.

Best regards

Martin Schroeter

Sales - Ceramics Technology Group (CTG)

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1400 E Monroe Street

Owosso, MI 48867

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Appendix F

Wet Flue Gas Desulfurization Cost Estimate

EPA Spreadsheet	Page F-1
Input Data for EPA Spreadsheet	Page F-11
Trend lines for Effectiveness verses MW Capacity	Page F-18

EPA Spreadsheet

Air Pollution Control Cost Estimation Spreadsheet For Wet and Dry Scrubbers for Acid Gas Control

U.S. Environmental Protection Agency
Air Economics Group
Health and Environmental Impacts Division
Office of Air Quality Planning and Standards
(May 2021)

This spreadsheet allows users to estimate the capital and annualized costs for installing and operating scrubbers for reducing sulfur dioxide and acidic gas emissions from fossil fuel-fired combustion units and other industrial sources of acid gases.

The calculation methodologies used in this spreadsheet are those presented in the U.S. EPA's Air Pollution Control Cost Manual. This spreadsheet is intended to be used in combination with the acid gas absorber chapter and cost estimation methodology in the Control Cost Manual. For a detailed description of acid gas absorbers and the cost methodologies, see Section 5, Chapter 1 (Wet and Dry Scrubbers for Acid Gas Control) of the Air Pollution Control Cost Manual (as updated in 2021). A copy of the Control Cost Manual is available on the U.S. EPA's "Technology Transfer Network" website at: <https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-reports-and-guidance-air-pollution>.

This spreadsheet can be used to estimate capital and annualized costs for three types of acid gas scrubbers:

- (1) Wet flue gas desulfurization (WFGD) systems used to control SO₂ emissions from coal-fired utility boilers over 100 MW.
- (2) Spray dryer absorber (SDA) used to control SO₂ emissions from coal-fired utility boilers of equal to or greater than 50 MW.
- (3) Wet packed-bed scrubbers used to control acid gases from industrial emission sources of any size.

WFGD and SDA Control Systems

The methodologies for WFGD and SDA systems are based on those from the U.S. EPA Clean Air Markets Division (CAMD)'s Integrated Planning Model (IPM version 6). The size and costs of a WFGD and SDA are based primarily on the size of the combustion unit and the sulfur content of the coal burned. The WFGD methodology include cost algorithms for capital and operating cost for wastewater treatment consisting of chemical pretreatment, low hydraulic residence time biological reduction and ultrafiltration to treat wastewater generated by the WFGD system. The IPM equations estimate the purchased equipment cost and the direct and indirect installation costs based on cost data for multiple lump-sum contracts. Turnkey contracts where the price is fixed at the time the contract is signed and the contractor undertakes responsibility for the completion of the project, are generally 10 to 15% higher than the multiple lump-sum contracts. For additional information regarding the IPM, see the EPA Clean Air Markets webpage at <http://www.epa.gov/airmarkets/power-sector-modeling>.

Users should complete the Wet & Dry FGD Data Inputs tab to estimate costs for WFGD and SDA systems.

Packed-Bed Scrubbers

The cost methodology for wet packed-bed scrubbers can be used for estimating costs for any size of packed tower absorber used to control flue gas containing any acidic pollutants (e.g., HCl and HF). The capital and operating costs are based on the waste gas composition and properties of the pollutant and sorbent. The waste gas is assumed to comprise a two-component waste gas mixture (pollutant/air), where the pollutant consists of a single compound present in dilute quantities. The waste gas is assumed to behave as an ideal gas and the solvent is assumed to behave as an ideal solution. Heat effects associated with absorption are considered to be minimal due to the low pollutant concentration. The procedures also assume that, in chemical absorption, the process is not reaction rate limited, i.e., the reaction of the pollutant with the solvent is considered fast compared to the rate of absorption of the pollutant into the solvent.

Users should complete the PB Scrubber Data Inputs tab to estimate costs for packed-bed scrubbers.

The calculations provide study-level estimates ($\pm 30\%$) of capital and annual costs. Default values included in the spreadsheet are taken from the Control Cost Manual and other sources, such as the U.S. Energy Information Administration (EIA), and are included only as an example of how to complete the data inputs sheets. The actual costs may vary from those calculated here due to site-specific conditions. Selection of the most cost-effective control option should be based on a detailed engineering study and cost quotations from control system suppliers.

Instructions

Step 1: Please select the *FGD Data Inputs* or *PB Scrubber Data Inputs* tab. Click the *Reset Form* button at the top of the sheet to reset all parameters to default values.

Step 2: Complete the cells highlighted in yellow. The highlighted cells are pre-populated with example or default values. Users should replace the pre-populated values with current values for each parameter that are specific to the facility. All data entry fields in the *PB Scrubber Data Inputs* tab should be completed. While most fields in the *FGD Data Inputs* tab apply to both WFGD and SDA systems, a few data entry fields are specific to the type of control system and may be left blank if the user does not wish to estimate costs for both systems. References documenting the source of each value should be documented in the *Data Sources for Default Values Used in Calculations* located on the *FGD Data Inputs* and *PB Scrubber Data Inputs* tabs.

Step 3: Once all of the data fields are complete, select the *SDA Design Parameters*, *WFGD Design Parameters*, or *PB Scrubber Design Parameters* tab (as applicable) to see the calculated design parameters. Select the *SDA Cost Estimate*, *WFGD Cost Estimate*, or *PB Scrubber Cost Estimate* tabs to view the calculated cost data for the installation and operation of the scrubber.

Data Inputs for Spray Dryer Absorber and Wet FGD

Enter the following data for your combustion unit:

Is the FGD for a new boiler or retrofit of an existing boiler?

Please enter a retrofit factor. Enter 1 for projects of average difficulty. Enter values >1 for more difficult retrofits and enter <1 for less difficult retrofits.

Directions: Enter data in highlighted data fields.

What is the gross MW rating at full load capacity (A)?

Provide the following information for the coal burned:

Select type of coal burned:

Enter the sulfur content (%S) **OR** SO₂ Emissions (SO_{2s})

Outlet SO₂ Emissions (SO_{2out})

What is the higher heating value of the fuel (HHV)? *Note: You do not need to enter a value for the HHV since you entered SO₂ emissions in lb/MMBtu above

*HHV is the weighted average value calculated using the values entered in the coal blend composition table.

What is the estimated actual annual MWh output?

Waste from a WFGD system disposed in an onsite or offsite landfill?

Gross heat input rate (GHR)

Enter the following design parameters for the proposed FGD System:

Number of hours the scrubber operates (t_{scrub})	8760 Hours	Plant Elevation	446 Feet above sea level
Number of hours the boiler operates (t_{plant})	8760 Hours		
Number of Full Time Operators (FT):			
SDA System			
WFGD system	6		
Estimated equipment life:			
SDA System	Years		
Wet FGD System	30 Years		
Estimated equipment life for mercury monitor for wastewater treatment system for Wet FGD Systems	6 Years		

Enter the cost data for the proposed FGD System:

Desired dollar-year for Capital Costs	2022		
CEPCI for 2022	708 Enter the CEPCI value for 2022	541.7	2016 CEPCI*
Annual Interest Rate (i)	7.5 Percent		
Sorbent Cost:			
Lime (for SDA)	\$/ton of Lime		
Limestone (for Wet FGD)	288.00 \$/ton of Limestone		
Water ($Cost_{water}$)	0.0122 \$/gallon		
Electricity ($Cost_{elec}$)	0.2050 \$/kWh		
Waste Disposal cost ($Cost_{waste}$)	257.00 \$/ton		
Labor Rate	49.00 \$/hour		
Purchase Equipment Cost for Mercury Monitor for wastewater treatment System (MMCost)	-\$/monitor		

*Note: CEPCI = Chemical Engineering Plant Cost Index. The use of CEPCI in this spreadsheet is not an endorsement of the index, but is there merely to allow for availability of a well-known cost index to spreadsheet users. Use of other well-known cost indexes (e.g., M&S) is acceptable.

Data Sources for Default Values Used in Calculations:

Data Element	Default Value	Sources for Default Value	If you used your own site-specific values, please enter the value used and the reference source . . .	Recommended data sources for site-specific information
Lime (\$/ton)	125	U.S. Environmental Protection Agency (EPA). Documentation for EPA's Power Sector Modeling Platform v6 Using the Integrated Planning Model. Office of Air and Radiation. January 2017. Available at: https://www.epa.gov/airmarkets/documentation-epas-power-sector-modeling-platform-v6 .	Not applicable	N/A
Limestone (\$/ton)	30	U.S. Environmental Protection Agency (EPA). Documentation for EPA's Power Sector Modeling Platform v6 Using the Integrated Planning Model. Office of Air and Radiation. January 2017. Available at: https://www.epa.gov/airmarkets/documentation-epas-power-sector-modeling-platform-v6 .	\$288/ton was used. This information was provided by UAF personnel for the limestone currently delivered to site and being burned in the boiler. Additional refinement needs to be accounted for as the current limestone particle sizes are too big for the a WFGD slurry feed stream. It is assumed that any particle refinement is being accounted for in the Reagent Preparation Equipment Costs that are calculated in the "WFGD Cost Estimate" tab. It is not fully understood what equipment is included in the EPA provided costs. If additional milling is not part of the Reagent Preparation Equipment Costs, then additional pricing of a mill should be included. For this scenario, additional pricing for a mill was not included.	Check with reagent vendors for current prices.
Water Cost (\$/gallon)	0.00420	Average water rates for industrial facilities (compiled by Black & Veatch. See '50 Largest Cities Water/Wastewater Rate Survey - 2018-2019'. Available at www.bv.com/sites/default/files/2019-10/50_Largest_Cities_Rate_Survey_2018_2019_Report.pdf .	\$0.0122/gallon of water pricing was provided by UAF Facility Services Utility Rates for 2022	Plant's utility bill or Black & Veatch's "50 Largest Cities Water/Wastewater Rate Survey." Available at http://www.saws.org/who_we_are/community/RAC/docs/2014/50-largest-cities-brochure-water-wastewater-rate-survey.pdf .
Electricity Cost (\$/kWh)	0.0361	U.S. Energy Information Administration. Electric Power Annual 2016, Table 8.4, Published December 2017. Available at: https://www.eia.gov/electricity/annual/pdf/epa.pdf	\$0.2050/kWh electricity pricing was provided by UAF Facility Services Utility Rates for 2022	Plant's utility bill or use U.S. Energy Information Administration (EIA) data for most recent year. Available at http://www.eia.gov/electricity/data.cfm#sales .
Waste Disposal Cost (\$/ton)	30	U.S. Environmental Protection Agency (EPA). Documentation for EPA's Power Sector Modeling Platform v6 Using the Integrated Planning Model. Office of Air and Radiation. January 2017. Available at: https://www.epa.gov/airmarkets/documentation-epas-power-sector-modeling-platform-v6 .	\$257/ton. Ash hauling rates provided by UAF personnel ranged from \$220-\$293/ton. The variance is mostly attributed to the moisture content in the ash as well as the water added prior to load out to mitigate dust during transportation. \$257 was used as it was an average of the low and high value. Email dated 7/8/22 from Frances Igrigg (UAF) to Mark Payne (SC) and Courtney Kimball (Boresal). It should be noted that the ash disposal does not include any additional costs for regulated or hazardous waste pollutants that may be captured during the WFGD process. The ash hauling rates being used in the spreadsheet may or may not increase due to additional pollutants in the ash. We believe that using the current average ash hauling rate will provide a conservatively low effective cost for SO2 removal per year.	Check with reagent vendors for current prices.
Higher Heating Value (HHV) (Btu/lb)	8,826	Average HHV based 2016 coal data compiled by the Office of Oil, Gas, and Coal Supply Statistics, U.S. Energy Information Administration (EIA) from data reported on EIA Form EIA-923, Power Plant Operations Report. Available at http://www.eia.gov/electricity/data/eia923/ .	N/A. Value was not needed as SO2 content was specified as lb/MMBtu.	Fuel supplier or use U.S. Energy Information Administration (EIA) data for most recent year. Available at http://www.eia.gov/electricity/data/eia923/ .
Average Sulfur Content (%)	0.41	Average sulfur content based on U.S. coal data for 2016 compiled by the U.S. Energy Information Administration (EIA) from data reported on EIA Form EIA-923, Power Plant Operations Report. Available at http://www.eia.gov/electricity/data/eia923/ .	Sulfur content is not being used because inlet SO2 emissions are provided instead. The inlet SO2 emission rate is 0.20 lb/MMBtu per Condition 13.1 of Permit AQ0316MSS06 Revision 2. That emission rate is the basis of the SO2 PTE for EU 113 (258.9 tpy per Condition 13 of Permit AQ0316MSS06 Revision	Fuel supplier or use U.S. Energy Information Administration (EIA) data for most recent year. Available at http://www.eia.gov/electricity/data/eia923/ .
Interest Rate	3.25	Default bank prime rate March 2, 2021 (available as the rates listed under 'bank prime loan' at https://www.federalreserve.gov/releases/h15/).	7.50%. Updated prime rate as of December 27, 2022.	Use current bank prime rate available at https://www.federalreserve.gov/releases/h15/ .
Hourly Labor Rate (\$/hour)	60	U.S. Environmental Protection Agency (EPA). Documentation for EPA's Power Sector Modeling Platform v6 Using the Integrated Planning Model. Office of Air and Radiation. January 2017. Available at: https://www.epa.gov/airmarkets/documentation-epas-power-sector-modeling-platform-v6 .	\$49/hour. Value provided by Frances Igrigg (UAF). This is a burdened rate of an individual who would be working on this equipment at the plant.	Plant data.

	Data Element	Default Value	Sources for Default Value	If you used your own site-specific values, please enter the value used and the reference source...	Recommended data sources for site-specific information
	Gross MW rating at full load capacity	N/A	The facility at UAF was designed and constructed as a Combined Heat Power facility which serves the University in two ways; providing distribution steam for campus heating and other processes, and electricity for electrical demand on the campus. The Boiler and Steam Turbine at UAF were design as a bottoming cycle facility which means that the boiler is ramped as needed to meet the amount of steam heating that is required on campus. The left over steam is sent to the steam turbine to convert the remaining energy to electricity. This differs to a traditional power plant that uses all of it's generated steam to generate electricity with little to no distribution of steam for processes or users. In order to utilize the EPA spreadsheet, a theoretical MW value needed to be calculated for the CHP facility. To calculate an electrical generation power plant equivalency, we used the BTU input of the Boiler (total coal flow into the boiler), then using the Boiler efficiency which equates the amount of BTU's that the boiler captures in the steam cycle. These BTU's were then divided by the Steam Turbine efficiency, also know has Heat Rate (BTU/MW) which yields a theoretical MW value based on how the steam turbine can convert BTU's to kW. The resultant was used as a electrical "equivalent" in the spreadsheet. It should be noted that the facility has no way of generating the calculated theoretical MW value as the existing Steam Turbine cannot operate beyond it's 17MW nameplate.	Value used: 29.5 MW "CHPP MW Equivalent" = Boiler BTU Input x Boiler Efficiency / Steam Turbine Heat Rate. Boiler input: 295,600,000 lb/hr (Provided by B&W) Boiler efficiency: 85.73% (Provided by B&W) Steam Turbine efficiency: 8,589 Btu/kWh (Provided by Shin Nippon)	
Cell C10	Outlet SO2 Emissions (SO2out) (lb/mmbtu)	N/A	SO2 output emissions	0.01 lb/mmbtu was entered to show the WFGD efficiency at 95%	
C17	Annual MWh output	N/A	This calculates the total MWh produced by the boiler. This was calculated using electrical capacity equivalent MW (rating) and multiplying by 8,760 hours per year for an annual MWh output	258,463 MWh Annual MWh output = Capacity x hours of operation/year Annual MWh output = 29.50MW x 8,760 hours/year	
Cell C34	Gross heat input rate	N/A	This calculates the total amount of heat input into the boiler by the coal per MW electrical capacity. Values of the equation include: Permitted Maximum Heat Input into the Boiler (MMBtu/hr) / MW capacity	10.02 MMBTU/MWh Gross Heat Input Rate (GHIR) = Max Heat Input / MW capacity GHIR = 295.6 MMBtu/hr / 29.5 MW GHIR = 10.02 MMBTU/MWh	
Cell C38	Number of hours of Scrubber Operation	N/A	Value set at total hours that Scrubber can operate per year, but no more than Boiler operation.	8,760 hours in one year.	
Cell C44	Number of hours of Boiler Operation	N/A	Value set at total hours that Boiler can operate per year.	8,760 hours in one year.	
Cell C45	SDA System Full Time Operators	8	EPA recommended default value of 8 operators for SDA system.	Not applicable	
Cell C47	WFGD System Full Time Operators	12	EPA recommended default value of 12 operators for WFGD system (<500MW plant size)	Value used: 6 The EPA default value is 12 for a plant that is between 100 MW and 500 MW. The theoretical electrical capacity of the UAF CHPP is 29.5 MW. Based on the size of the equipment and the EPA recommendation, the value was set at 6 operators. The plant operates and staff's the plants operation for Monday thru Sunday, 24 hours per day. The plant has a total of 4 shifts available during the week (2 weekly sections, with each weekly section staffed during the day and separately at night). WFGDs are material handling intensive and require support during material offloading, material transfer, material batching and during operational hours. 6 Full time operators averages to 1.25 fulltime equivalents during each shift. It should be noted that the sensitivity of operators on a WFGD cost effectiveness result is some what small. The difference in effectiveness between the currently used 6 operators and using no new additional operators is roughly \$2,500/ton of SO2 removed (\$28,500 to \$26,000).	
Cell C48	CEPCI for 2022	N/A	Provide latest Chemical Engineering Plant Cost Index (CEPCI)	Value used: 708 Value was taken from Chemical Engineering magazine, August 2022 Issue. Value was provided as a final 2021 index number.	
Cell C57					

Wet FGD Design Parameters

The following design parameters for the wet FGD system were calculated based on the values entered on the *FGD Data Inputs* tab. These values were used to prepare the costs shown on the *Wet*

Parameter	Equation	Calculated Value	Units
Maximum Annual Heat Input Rate (Q_b) =	$A \times \text{GHR} =$	296	MMBtu/hour
Maximum Annual MWh Output (B_{Mw}) =	$A \times 8760 =$	258,463	MWh
Estimated Actual Annual MWh Output (B_{output}) =	Value entered by user	258,463	MWh
Heat Rate Factor (HRF) =	Gross Plant Heat Rate/10 =	1.00	
Total System Capacity Factor (CF_{total}) =	$(B_{\text{output}}/B_{Mw}) \times (t_{\text{ABS}}/t_{\text{plant}}) =$	1.000	fraction
Total effective operating time for the scrubber (t_{op}) =	$CF_{\text{total}} \times 8760 =$	8,760	hours
SO ₂ Removal Efficiency (EF) =	$(SO_{2\text{in}} - SO_{2\text{out}})/SO_{2\text{in}} =$	95	percent
SO ₂ removed per hour =	$SO_{2\text{in}} \times \text{EF} \times Q_b =$	56	lb/hour
Total SO ₂ removed per year =	$(SO_{2\text{in}} \times \text{EF} \times Q_b \times t_{\text{op}})/2000 =$	246.00	tons/year
Coal Factor (Coal _f) =	1 for bituminous; 1.05 for sub-bituminous; 1.07 for lignite (weighted average is used for coal blends)	1.05	
Inlet SO ₂ Emissions ($SO_{2\text{in}}$) =	Value entered by user	0.20	lb/MMBtu
Elevation Factor (ELEV _F) =	$14.7 \text{ psia}/P =$		
Atmospheric pressure at 446 feet above sea level (P) =	$2116 \times [(59 - (0.00356 \times h)) + 459.7]/518.6]^{5.256} \times (1/144)^* =$	14.5	psia
Retrofit Factor (RF) =	Retrofit to existing boiler	1.00	

Not applicable; elevation factor does not apply to plants located at

* Equation is from the National Aeronautics and Space Administration (NASA), Earth Atmosphere Model. Available at <https://spaceflightsystems.grc.nasa.gov/education/rocket/atmos.html>.

Capital Recovery Factor:

Parameter	Equation	Calculated Value	
Capital Recovery Factor (CRF) =	$i(1+i)^n / [(1+i)^n - 1]$ Where n = Equipment Life and i = Interest Rate	0.0847	Wet FGD System
		0.2130	Mercury Monitor for Wastewater Treatment

Parameter	Equation	Calculated Value	Units
Electricity Usage: Electricity Consumption (P) =	$0.0112e^{-0.155 \times S} \times \text{CoalF} \times \text{HRF} \times A \times 1,000 =$	359	kW
Water Usage: Water consumption (q_{water}) =	$[(1.674 \times S + 74.68) \times A \times \text{CoalF} \times \text{HRF}] / 1,000$	2.3	kgallons/hour
Limestone Usage: Limestone consumption rate ($Q_{\text{limestone}}$) =	$[17.52 \times A \times S \times \text{HRF}] / 2,000 \times (\text{EF} / 0.98) =$	0.05	tons/hour
Waste Generation: Waste generation rate (q_{waste}) =	$1.811 \times Q_{\text{limestone}} \times (\text{EF} / 0.98) =$	0.1	tons/hour
Wastewater Flow Rate: Wastewater flow rate (F) =	$A \times (0.4 \text{ gallons/min/MW}) =$	12	gallons/minute

Wet FGD Cost Estimate

Total Capital Investment (TCI)

$$TCI = 1.3 \times (ABS_{cost} + RPE_{cost} + WHE_{cost} + BOP_{cost}) + WWT_{cost}$$

Capital costs for the absorber (ABS_{cost}) =	\$8,478,739
Reagent Preparation Equipment Costs (RPE_{cost}) =	\$1,839,172
Waste Handling Equipment (WHE_{cost}) =	\$758,320
Balance of Plant Costs (BOP_{cost}) =	\$16,102,837
Wastewater Treatment Facility Costs (WWT_{cost}) =	\$13,565,812
Total Capital Investment (TCI) =	\$52,968,345 in 2022 dollars with disposal at offsite landfill

Wet FGD Capital Costs (ABS_{cost})

$$ABS_{cost} = 584,000 \times (A)^{0.716} \times (CoalF \times HRF)^{0.6} \times (S/2)^{0.02} \times ELEV \times RF$$

Wet FGD Capital Costs (ABS_{cost}) =	\$8,478,739 in 2022 dollars
--	-----------------------------

Reagent Preparation Costs (RPE_{cost})

$$RPE_{cost} = 202,000 \times A^{0.716} \times (S \times HRF)^{0.3} \times RF$$

Reagent Preparation (RPE_{cost}) =	\$1,839,172 in 2022 dollars
--	-----------------------------

Waste Handling Equipment (WHE_{cost})

$$WHE_{cost} = 106,000 \times A^{0.716} \times (S \times HRF)^{0.45} \times RF$$

Waste Recycling/Handling (WHE_{cost}) =	\$758,320 in 2022 dollars
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Balance of Plant Costs (BOP_{cost})

$$BOP_{cost} = 1,070,000 \times (A)^{0.716} \times (CoalF \times HRF)^{0.4} \times ELEV \times RF$$

Balance of Plant Costs (BOP_{cost}) =	\$16,102,837 in 2022 dollars
---	------------------------------

Wastewater Treatment Facility Costs (WWT_{cost})	
Wastewater Treatment Facility Costs with Onsite Landfill	$WWT_{cost} = (41.36 F + 11,157,588) \times RF \times 0.898$
Wastewater Treatment Facility Costs with Offsite Landfill	$WWT_{cost} = (41.16 F + 11,557,843) \times RF \times 0.898$
Wastewater Treatment Facility Costs (WWT _{cost}) =	\$13,565,812 in 2022 dollars with disposal at offsite landfill

Total Annual Cost (TAC)
TAC = Direct Annual Costs + Indirect Annual Costs

Direct Annual Costs (DAC) =	\$3,075,590
Indirect Annual Costs (IDAC) =	\$4,514,299
Total annual costs (TAC) = DAC + IDAC	\$7,589,888 in 2022 dollars

Direct Annual Costs (DAC)
DAC = Annual Maintenance Cost + Annual Operator Cost + Annual Reagent Cost + Annual Make-up Water Cost + Annual Waste Disposal Cost + Annual Auxiliary Power Cost + Annual Wastewater

Annual Maintenance Cost =	$0.015 \times TCI =$	\$794,525
Annual Operator Cost =	$FT \times 2,080 \times \text{Hourly Labor Rate}$	\$611,520
Annual Reagent Cost =	$Q_{\text{limestone}} \times \text{Cost}_{\text{limestone}} \times t_{op} =$	\$126,658
Annual Electricity Cost =	$P \times \text{Cost}_{\text{elect}} \times t_{op} =$	\$643,921
Annual Make-up Water Cost =	$q_{\text{water}} \times \text{Cost}_{\text{water}} \times t_{op} =$	\$248,219
Annual Waste Disposal Cost =	$q_{\text{waste}} \times \text{Cost}_{\text{fuel}} \times t_{op} =$	\$198,422
Annual Wastewater Treatment Cost =	$(6.3225F + 472,080) \times 0.958 \times CF_{\text{total}} \times \text{ESC} =$	\$452,324 (with disposal at offsite landfill)
Replacement Cost for Mercury Monitor =	$CF_{\text{mm}} \times MM_{\text{Cost}} =$	\$0 (replaced once every 6 years.)
Direct Annual Cost =		\$3,075,590 in 2022 dollars

Indirect Annual Cost (IDAC)
IDAC = Administrative Charges + Capital Recovery Costs

Administrative Charges (AC) =	$0.03 \times (\text{Annual Operator Cost} + 0.4(\text{Annual Maintenance Cost})) =$	\$27,880
Capital Recovery Costs (CR)=	$CRF \times TCI =$	\$4,486,419
Indirect Annual Cost (IDAC) =	AC + CR =	\$4,514,299 in 2022 dollars

Cost Effectiveness = Total Annual Cost/ SO₂ Removed/year

Total Annual Cost (TAC) =	\$7,589,888 per year in 2022 dollars
SO ₂ Removed =	246 tons/year
Cost Effectiveness =	\$30,853 per ton of SO ₂ removed in 2022 dollars

Input Data for EPA Spreadsheet

Notes:

- Used as input in EPA spreadsheet in "Wet & Dry FGD Data Inputs" tab, Cell C10 to calculate a theoretical electrical capacity equivalent for the CHPP at UAF.
- Used as input in EPA spreadsheet in "Wet & Dry FGD Data Inputs" tab, Cell C38 to calculate Gross Heat Input Rate (GHIR).
- Used average of the UAF provided range for hauling ash. This was used as an input in EPA spreadsheet in "Wet & Dry FGD Data Inputs" tab. Cell C64 for Waste Disposal Cost.
- Used an input in EPA spreadsheet in "Wet & Dry FGD Data Inputs" tab. Cell C63 for Electricity Cost.
- Used an input in EPA spreadsheet in "Wet & Dry FGD Data Inputs" tab. Cell C62 for Water Cost.
- Used an input in EPA spreadsheet in "Wet & Dry FGD Data Inputs" tab. Cell C61 for Limestone Cost for WFGD.
- Chemical Engineering Plant Cost Index from August 2022 Edition. Number was final 2021 index number. Input used for Cell C57

Public Review Draft

August 19, 2024

FUEL CHARACTERISTICS		LOAD CONDITION					
FUEL ANALYSIS		DESIGN	MCR	70%	40%	33%	
AREA	MINE	USIBELLI	240.0	168.0	96.0	80.0	
	STATE/PROVINCE	HEALY, AK	Coal	Coal	Coal	Coal	
	COUNTRY	USA	EXCESS AIR LEAVING ECONOMIZER, %	15	15	66	102
			NO. OF BURNERS IN OPERATION	0	0	0	0
PROXIMATE ANALYSIS	% BY WT		OUTPUT PER PTC 4-2013, MKB/HR	253.4	177.4	100.1	95.3
	TOTAL MOIST.	28.50	FUEL INPUT, MKB/HR	295.6	206.0	118.8	118.0
	VOL MATTER	36.00	FUEL FLOW	39.1	27.3	15.7	15.6
	FIXED CARBON	26.50	FLUE GAS ENTERING AIR HEATER	284.7	199.0	157.8	187.0
ULTIMATE ANALYSIS	ASH	9.00	FLUG GAS ENTERING STACK (ACFM)	89,832	61,165	50,217	65,748
	TOTAL	100.00	TOTAL AIR TO BURNING EQUIPMENT	246.7	172.0	141.2	170.5
	% BY WT		SECONDARY AIR LEAVING AH	117.1	64.9	17.8	21.8
	ASH	9.00	PRIMARY AIR LEAVING AH	117.1	97.3	115.3	140.3
ULTIMATE ANALYSIS	H2O	28.50	AIR HTR LEAKAGE (TOTAL AIR TO GAS)	1.0	1.4	2.5	2.5
	C	43.75	SUPERHEAT SPRAY FLOW	7.88	7.48	0.00	0.74
			BLOWDOWN	1.20	0.84	0.48	12.00
			FEEDWATER	740.00	692.00	660.00	656.00
			SPRAY WATER	720.00	702.00	0.00	0.00
			DRUM	693	658	636	633
			STEAM AT SH OUTLET	625	625	625	625
			LEAVING SUPERHEATER	750	750	728	760
			ENTERING ECONOMIZER	350	350	350	260
			LEAVING AH (EXCL LKG)	285	260	285	350
			ENTERING STACK	289	265	288	354
			ENTERING PRI. AIR FAN (1)	77	88	111	123
		ENTERING SEC. AIR FAN (1)	77	77	77	77	
		LEAVING AIR HEATER (SEC)	335	335	275	337	
		LEAVING AIR HEATER (PRI)	335	309	380	508	
		FUEL TO BURNING EQUIPMENT	40	40	40	40	
SORBENT CHARACTERISTICS							
LIMESTONE ANALYSIS		DESIGN	DRY GAS	4.38	3.86	6.02	9.80
ANALYSIS	% BY WT		H2 & H2O IN FUEL	8.53	8.45	8.51	8.75
	CaCO3	95.00	MOISTURE IN AIR	0.07	0.06	0.10	0.16
	MgCO3	0.90	MOISTURE IN SORBENT	0.00	0.00	0.00	0.00
	SiO2	3.30	UNBURNED COMBUSTIBLE IN RESIDUE	0.50	0.50	0.50	0.50
	H2O	0.80	RADIATION	0.36	0.51	0.91	0.96
	TOTAL	100.00	SENSIBLE HEAT IN REFUSE	0.07	0.10	0.09	0.13
NOTES	(1) PTC 4 BOUNDARY IS AT FAN INLETS w/SPECIFIED ENTERING AIR TEMP OF 77°F & SPECIFIED 40°F AMBIENT (FUEL) TEMP		MANUFACTURER'S MARGIN	0.40	0.40	0.40	0.40
	(2) PREDICTED PERFORMANCE BASED ON CONDITIONS & EQUIPMENT SHOWN ON THIS SUMMARY SHEET & ON GENERAL ARRGT DRAWINGS B0312851 & B0312852		SORBENT CALCINATION/DEHYDRATION	0.23	0.23	0.23	0.23
	(3) BAROMETRIC PRESSURE = 29.40 IN HG @ 009 LB H2O PER LB COMBUSTION AIR		OTHER LOSSES (UNMEASURED)	0.10	0.10	0.10	0.10
	(4) SPRAY WATER PRESSURE AT EXPECTED OPERATING CONDITIONS, FURTHER UPSET PERFORMANCE TO BE PROVIDED LATER		TOTAL LOSSES	14.64	14.21	16.87	21.03
			ENTERING DRY AIR	0.00	0.12	0.81	1.36
			MOISTURE IN AIR	0.00	0.00	0.01	0.02
			SENSIBLE HEAT IN FUEL	-0.16	-0.16	-0.16	-0.16
			SULFATION	0.11	0.11	0.11	0.11
			MOISTURE IN LIMESTONE	0.00	0.00	0.00	0.00
			AUXILIARY EQUIPMENT POWER	0.42	0.23	0.42	0.42
		TOTAL CREDITS	0.37	0.30	1.19	1.76	
© 2015 THE BABCOCK & WILCOX COMPANY ALL RIGHTS RESERVED.			ASME PTC 4-2013 FUEL EFFICIENCY, %	85.73	86.10	84.32	80.73

See note 1

See note 2

See note 1

Jahn, Mario

From: Payne, Mark
Sent: Friday, July 8, 2022 10:56 AM
To: Jahn, Mario
Cc: Solan, John
Subject: FW: Ash Disposal

fyi



Mark Payne, PE, PMP, Senior Project Manager
STANLEYCONSULTANTS, 8000 South Chester St, Suite 500, Centennial, CO 80112
T: 303.925.8375 | M: 720.240.3271 | stanleyconsultants.com

From: Frances Isgrigg <fisgrigg@alaska.edu>
Sent: Friday, July 8, 2022 10:43 AM
To: Courtney Kimball <ckimball@boreal-services.com>; Payne, Mark <PayneMark@stanleygroup.com>
Subject: Ash Disposal

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

Below is information regarding the current cost of ash disposal. Since we are moving forward with limestone instead of bicarb there is no longer concern regarding sodium salts.

From: **Ciara Villalobos** <cdvillalobos@alaska.edu>
Date: Thu, Jul 7, 2022 at 11:58 AM
Subject: Re: Cost for ash disposal
To: Frances Isgrigg <fisgrigg@alaska.edu>
Cc: Karen Mallette <kamallette@alaska.edu>

Hi Frances,

Currently we are paying \$880.00 per 20 cubic yard truckloads. I believe that is about 3-4 tons per truckload, so about \$220.00- \$293.33 per ton. We also pay about \$65.00 per hour for standby time.

Let me know if you need any more information on that, or need invoices as well.

See note 3

Cheers,
Ciara

--
Frances M. Isgrigg, PE
Division of Design and Construction
907-590-5809

FS Utility Rates

FY	Utility	Rate	
22Q4	Electric	\$ 0.205000 per 1 Kilowatt Hour	see note 4
	Sewer	\$ 10.810000 per 1000 Gallons	
	Steam	\$ 12.390000 per 1000 Pounds	
	Water	\$ 12.170000 per 1000 Gallons	see note 5
2022	Electric	\$ 0.197000 per 1 Kilowatt Hour	
	F&A	38.500000 %	
	Sewer	\$ 10.150000 per 1000 Gallons	
	Steam	\$ 11.640000 per 1000 Pounds	
	Water	\$ 11.300000 per 1000 Gallons	
2021	Electric	\$ 0.208000 per 1 Kilowatt Hour	
	F&A	38.500000 %	
	Sewer	\$ 8.020000 per 1000 Gallons	
	Steam	\$ 16.130000 per 1000 Pounds	
	Water	\$ 8.500000 per 1000 Gallons	
2020	Electric	\$ 0.214000 per 1 Kilowatt Hour	
	F&A	38.500000 %	
	Sewer	\$ 7.350000 per 1000 Gallons	
	Steam	\$ 16.250000 per 1000 Pounds	
	Water	\$ 7.460000 per 1000 Gallons	
2019	Electric	\$ 0.203000 per 1 Kilowatt Hour	
	F&A	37.200000 %	
	Sewer	\$ 7.000000 per 1000 Gallons	
	Steam	\$ 15.470000 per 1000 Pounds	
	Water	\$ 7.100000 per 1000 Gallons	
2018			

PERFORMANCE TABLE (1/2)

<u>OPERATION CASE</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
	Guarantee (Heat Rate)	Guarantee (KW)			
Inlet steam					
Pressure (psi.A)	625	625	625	625	625
Temperature (deg F)	750	750	750	750	750
Flow (lbs/hr)	171,450	218,810	240,000	240,000	240,000
Energy (BTU/s)	65,648	83,782	91,895	91,895	91,895
1st Extraction (Un-controlled Extraction) at turbine nozzle					
Pressure (psi.A)	110	134	145	145	126
Temp (deg F)	429	448	454	454	429
Extraction flow(lbs/hr)	11,190	16,630	19,640	19,670	51,990 *5
Enthalpy (BTU/Lb)	1,241	1,249	1,250	1,250	1,240
Energy (BTU/s)	3,859	5,769	6,822	6,832	17,903
2nd Extraction (Controlled Extraction) at turbine nozzle					
Pressure (psi.A)	45	45	45	45	45
Temp (deg F)	283	274	274	274	274
Extraction flow(lbs/hr)	123,130	115,440	205,130	114,650	170,590
Enthalpy (BTU/Lb)	1,177	1,168	1,164	1,164	1,164
Energy (BTU/s)	40,253	37,454	66,325	37,070	55,162
Exhaust press (inHg.A)	2.00	2.00	2.00	2.00	2.00
Exhaust temp (deg F)	101.1	101.1	101.1	101.1	101.1
Gland leakage (lbs/hr) <i>App.</i>	220	220	220	220	220
Exhaust flow (lbs/hr) <i>App.</i>	36,910	86,520	15,010	105,460	17,200
Enthalpy (BTU/Lb)	1,022	985	1,063	983	1,052
Energy (BTU/s)	10,475	23,682	4,434	28,808	5,027
Generator power (KW)	11,000	17,000	14,360	19,370 *4	13,830
Turbine heat rate (BTU/kWh)	7,048	8,589	4,700	8,920	4,901

See note 1

REMARKS

1. Guarantee Point: Case-1 & 2
2. The measured steam consumption figures are subject to a tolerance margin of +0%.
3. Extraction control will be started from 20% load.
4. The case-4 is the theoretical max output of the STG (information only).
5. For case-5, 1st extraction will be used for feed water heater and process. For other cases, the isolation valves (and others) for the process shall be closed.

Jahn, Mario

From: Solan, John
Sent: Wednesday, July 20, 2022 4:08 PM
To: Jahn, Mario
Subject: FW: Limestone \$

From: Courtney Kimball <ckimball@boreal-services.com>
Sent: Wednesday, July 20, 2022 1:58 PM
To: Solan, John <SolanJohn@stanleygroup.com>
Subject: FW: Limestone

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

--Courtney

From: Frances Isgrigg <fisgrigg@alaska.edu>
Sent: Thursday, January 6, 2022 08:40
To: Courtney Kimball <ckimball@boreal-services.com>; Mark Fitz <FritzMark@stanleygroup.com>
Subject: Limestone

Courtney, Mark

Limestone is \$287.63 per ton along with \$180.42 for standby unloading time.

See note 6

Frances

--
Frances M. Isgrigg, PE
Division of Design and Construction
907-590-5809

Kurt confirmed that standby time during unloading is for anything over 1.5 hours. Waiting on reply to see what typical unloading times are. Time gets billed in 1/4 hour increments.

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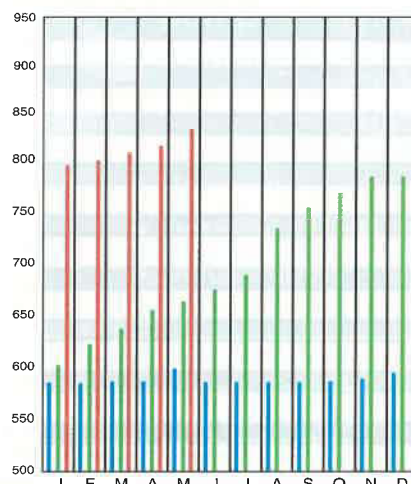
2020 2021 2022

Download the CEPCI two weeks ahead at www.chemengonline.com/pci

See note 7

CHEMICAL ENGINEERING PLANT COST INDEX (CEPCI)

(1957-59 = 100)	May '22 Prelim.	Apr. '22 Final	May '21 Final	Annual Index:
CE Index	831.7	816.3	686.7	2014 = 576.1
Equipment	1,057.1	1,037.1	848.5	2015 = 556.8
Heat exchangers & tanks	902.4	876.0	726.6	2016 = 541.7
Process machinery	1,074.9	1,063.9	862.9	2017 = 567.5
Pipe, valves & fittings	1,496.7	1,472.8	1,160.6	2018 = 603.1
Process instruments	575.5	573.5	507.5	2019 = 607.5
Pumps & compressors	1,255.1	1,248.9	1,115.6	2020 = 596.2
Electrical equipment	757.3	751.8	601.0	2021 = 708.0
Structural supports & misc.	1,176.8	1,144.7	915.0	
Construction labor	354.6	348.3	341.7	
Buildings	847.2	827.0	739.2	
Engineering & supervision	311.5	311.8	310.4	

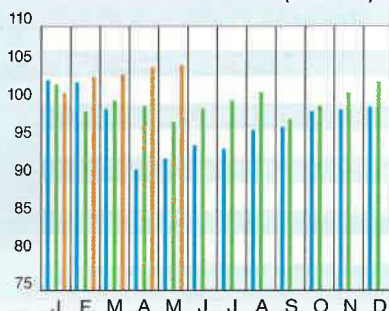


Starting in April 2007, several data series for labor and compressors were converted to accommodate series IDs discontinued by the U.S. Bureau of Labor Statistics (BLS). Starting in March 2018, the data series for chemical industry special machinery was replaced because the series was discontinued by BLS (see *Chem. Eng.*, April 2018, p. 76-77.)

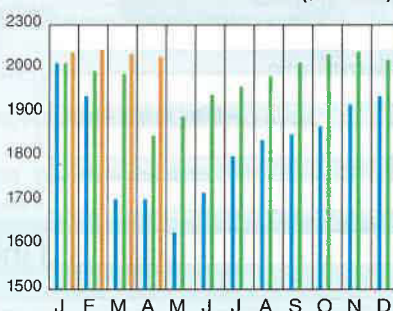
CURRENT BUSINESS INDICATORS

	LATEST		PREVIOUS		YEAR AGO	
CPI output index (2017 = 100)	May '22 = 101.7	Apr. '22 = 101.3	Mar. '22 = 101.0	May. '21 = 97.5		
CPI value of output, \$ billions	Apr. '22 = 2,082.8	Mar. '22 = 2,088.1	Feb. '22 = 2,004.7	Apr. '21 = 1,706.0		
CPI operating rate, %	May '22 = 80.8	Apr. '22 = 80.5	Mar. '22 = 80.3	May. '21 = 77.7		
Producer prices, industrial chemicals (1982 = 100)	May '22 = 367.8	Apr. '22 = 358.5	Mar. '22 = 354.2	May. '21 = 310.7		
Industrial Production in Manufacturing (2017 = 100)*	May '22 = 103.1	Apr. '22 = 103.2	Mar. '22 = 102.4	May. '21 = 98.4		
Hourly earnings index, chemical & allied products (1992 = 100)	May '22 = 199.6	Apr. '22 = 196.7	Mar. '22 = 195.9	May. '21 = 196.4		
Productivity index, chemicals & allied products (1992 = 100)	May '22 = 91.8	Apr. '22 = 93.8	Mar. '22 = 93.5	May. '21 = 93.8		

CPI OUTPUT INDEX (2017 = 100)†



CPI OUTPUT VALUE (\$ BILLIONS)



CPI OPERATING RATE (%)



*Due to discontinuance, the Index of Industrial Activity has been replaced by the Industrial Production in Manufacturing index from the U.S. Federal Reserve Board.
†For the current month's CPI output index values, the base year was changed from 2012 to 2017
Current business indicators provided by Global Insight, Inc., Lexington, Mass.

CURRENT TRENDS

The preliminary value for the CE Plant Cost Index (CEPCI; top) for May 2022 (most recent available) is once again higher than the previous month's value, continuing the string of monthly increases that has been observed since autumn 2020. In May of this year, increases occurred in the Equipment, Buildings and Construction Labor sub-indices, while the Engineering & Supervision subindices saw a very small decrease. The current CEPCI value now sits at 21.1% higher than the corresponding value from May 2021. Meanwhile, the Current Business Indicators (middle) show increases in the CPI output index and the CPI operating rate for May 2021, and a small decrease in the CPI value of output for April 2021.

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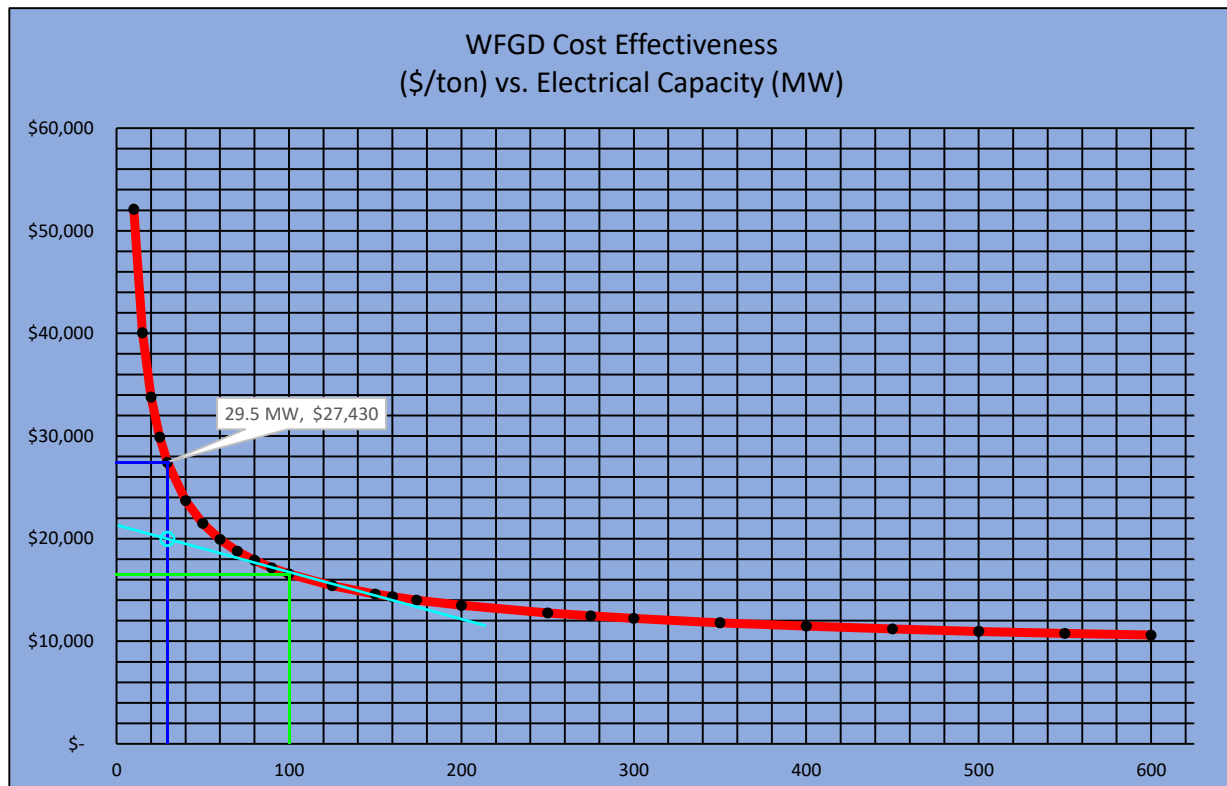
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PETRA TRAUTES
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+49 69 58604760

27206

Trend lines for Effectiveness verses MW Capacity

Wet Flue Gas Desulfurization (WFGD)				
Unit Megawatt (MW)	Total Capital Investment (TCI)	Total Annual Cost (TAC)	Tons removed per year (tons/year)	Cost Effectiveness (\$/ton)
10	\$ 33,917,925	\$ 4,343,112	83	\$ 52,092
15	\$ 39,402,865	\$ 5,010,021	125	\$ 40,061
20	\$ 44,381,890	\$ 5,634,443	167	\$ 33,790
25	\$ 49,015,643	\$ 6,229,869	208	\$ 29,889
29.5	\$ 52,968,127	\$ 6,747,657	246	\$ 27,430
40	\$ 61,570,313	\$ 7,903,060	333	\$ 23,698
50	\$ 69,181,860	\$ 8,954,844	417	\$ 21,481
60	\$ 76,369,968	\$ 9,971,068	500	\$ 19,932
70	\$ 83,224,041	\$ 10,959,240	584	\$ 18,778
80	\$ 89,804,563	\$ 11,924,439	667	\$ 17,878
90	\$ 96,154,909	\$ 12,870,308	750	\$ 17,152
100	\$ 102,307,543	\$ 13,799,573	834	\$ 16,551
125	\$ 116,976,601	\$ 16,062,897	1042	\$ 15,413
150	\$ 130,829,612	\$ 18,257,690	1251	\$ 14,599
160	\$ 136,183,107	\$ 19,119,843	1334	\$ 14,333
174	\$ 143,521,272	\$ 20,313,695	1451	\$ 14,003
200	\$ 156,720,948	\$ 22,494,878	1667	\$ 13,490
250	\$ 180,816,881	\$ 26,581,288	2084	\$ 12,753
275	\$ 192,341,712	\$ 28,580,560	2293	\$ 12,465
300	\$ 203,572,358	\$ 30,555,126	2501	\$ 12,216
350	\$ 225,270,396	\$ 34,440,161	2918	\$ 11,802
400	\$ 246,102,469	\$ 38,252,472	3335	\$ 11,470
450	\$ 266,205,883	\$ 42,003,590	3752	\$ 11,195
500	\$ 285,683,414	\$ 45,702,147	4169	\$ 10,963
550	\$ 304,614,572	\$ 49,354,819	4586	\$ 10,763
600	\$ 323,062,497	\$ 52,966,909	5002	\$ 10,588





Appendix G

Circulating Dry Scrubber Cost Estimate

Stanley Consultants Circulating Dry Scrubber Cost Estimate	Page G-1
ID Fan Backup Costs	Page G-4
Fire System Backup Costs	Page G-13
HVAC Backup Costs	Page G-16
Water Treatment Building Demolition Backup.....	Page G-21
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Insulation Backup Costs	Page G-45
Piping Backup Costs	Page G-47
Existing Buildings Square Footage Calculation	Page G-54
Golden Heart Relocation Backup Costs	Page G-56
CEPCI Index Backup.....	Page G-60
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UAF Construction Outage Costs.....	Page G-72
UAF Operating and Maintenance Labor Costs.....	Page G-87

**STANLEY CONSULTANTS
CIRCULATING DRY SCRUBBER
COST ESTIMATE**

Total Capital Investment - CDS (Circulating Dry Scrubber)						Shaded cells indicate user inputs.	
Project: UAF - BACT Analysis		Date: 12/28/2022		Prepared By: M. Jahn		Updated By: C. Kimball	
Vendor: Andritz		Rev: B					
Capital Costs							
DIRECT COSTS							
	QTY	UNIT	UNIT COST	TOTAL MATERIALS COST	TOTAL LABOR COST		
(1) Purchased equipment and material costs							
(a) Basic equipment							
CDS System	1	EA	\$ 16,950,000.00				
ID Fan	1	EA	\$ 567,879.00				
Fire System	1	EA	\$ 134,000.00				
HVAC	1	EA	\$ 445,000.00				
Demo of existing Water Treatment Building	1	EA	\$ 500,000.00				
Total CDS System						TOTAL = \$	18,596,879
(b) Instrumentation							
Total Instrumentation	1	EA	\$ 760,000.00			TOTAL = \$	760,000
(c) Freight							
ID Fan System Freight	1	LOT	\$ 112,000.00			TOTAL = \$	112,000
(d) Extended Outage Costs							
Additional days beyond a typical 3 week outage	21	days	\$ 48,028.00			TOTAL = \$	1,008,588
(e) Vendor representatives fees							
Onsite Vendor Representatives fees (enter no. of days and daily rate)	7	Days	2000			\$	14,000
						TOTAL = \$	14,000
Purchased Equipment and Material Cost (PEMC)						PEMC = \$	20,491,467
(2) Direct Installation Costs							
(a) Concrete (CDS Building, Duct Supports)	1	LOT	\$ 800,000.00			\$	800,000
(b) Site Vibro Compaction (CDS Building, Supports)	1	LOT	\$ 423,000.00			\$	423,000
(c) Structural Steel (CDS Building, Supports, Duct)	1	LOT	\$ 3,064,000.00			\$	3,064,000
(d) Electrical	1	LOT	\$ 883,000.00			\$	883,000
(e) Insulation	1	LOT	\$ 66,000.00			\$	66,000
(f) Abovegrade piping	1	LOT	\$ 442,000.00			\$	442,000
(g) Golden Heart Utility Relocation	1	LOT	\$ 856,212.16			\$	856,212
Direct Installation Costs (DIC) - Estimate for new building, foundation, piping, electrical, etc.						DIC = \$	6,534,212
Total Direct Costs (TDC)						TDC = (PEMC) + (DIC) = \$	27,025,679
INDIRECT COSTS							
(3) Engineering, Procurement & Construction Support Services	10%	% TDC				\$	2,702,568
(4) Performance tests	1	EA	\$ 75,000			\$	75,000
Total Indirect Costs (TIC)						TIC = \$	2,777,568
MANAGEMENT AND CONTINGENCY COSTS							
(5) Contingency	10%	% TDC				\$	2,702,568
Total Management and Contingency Costs (TM&CC)						TM & CC = \$	2,702,568
TOTAL CAPITAL INVESTMENT (TCI)						TCI = (TDC)+(TIC)+(TM&CC) = \$	32,505,815

Line Number/Description	Title	Comment
Line Number 1a	Total CDS System	CDS price provided by OEM Vendor. Cost includes equipment supply and installation costs. Andritz provided a rough installation factor based on material supply. Assumed installation costs were the same as equipment supply.
Line Number 1a	ID Fan	Pricing provided by Clarage for new ID Fan. Fan shipping is provided in line number 1c.
Line Number 1a	Fire System	Fire System costs for the new CDS Building. Costs were derived from the original UAF estimate and scaled based on a cost/square foot and escalated using CEPCI.
Line Number 1a	HVAC	HVAC costs for the new CDS Building. Costs were derived from the original UAF estimate and scaled based on a cost/square foot and escalated using CEPCI.
Line Number 1a	Water Treatment Building Demolition	Water Treatment Building Demolition costs to demolish the existing water treatment building. The new CDS building will be built in it's place. Estimated costs were derived on a level of effort basis
Line Number 1b	Total Instrumentation	Total costs for new cabinets and integrating CDS I/O into existing UAF DCS.
Line Number 1c	ID Fan Shipping Costs	Costs to ship ID fan to site.
Line Number 1d	Extended Outage Costs	UAF typically schedules for a 3 week outage on Boiler #5. A CDS outage will take 6 weeks and University will incur 3 additional weeks of outage costs that include purchasing electric power and running additional boilers for steam generation. Costs per day were provided by UAF personnel. The daily outage cost calculations are presented in the last section of Appendix G beginning on page G-73.
Line Number 1e	Vendor Representative Costs	Costs incurred for OEM to send a Field Technician to the field to confirm installation and provide technical guidance if needed. Cost per day includes hourly burdened rate for employee daily allowances and travel expenses. Based on general engineering and project experience.
Line Number 2a thru 2g	Direct Install Costs	Costs broken down into individual disciplines for balance of plant equipment, materials and labor for the CDS System. Cost estimate basis for each discipline are provided as attachments.
Line Number 3	Engineering Services	Costs for Preliminary Engineering costs to assist the University in soliciting bidders with specifications, preliminary drawings and procurement support for the AQCS system. Additional services include home office support for shop drawing review and occasional site support during construction for potential issues. Engineering is a percentage of the Total Direct Costs of the Project.
Line Number 4	Performance Test	Costs for a 3rd party performance testing company to validate emissions and performance guarantees by CDS vendor during operation
Line Number 5	Construction Contingency	Construction Contingency is an allotment for additional or unexpected costs during the project. RS Means defines contingency allowances and ranges between 3-20% depending on what design stage the project is in. A 10% contingency is a project that is in Design Development, whereas a Conceptual Design phase allows for a 20% contingency. A 10% contingency for this cost estimate is considered low as the project is still in a Development phase.

Shaded cells indicate user inputs

Annualized Costs						
DIRECT ANNUAL COSTS	QTY	UNIT	UNIT COST	TOTAL MATERIALS COST	TOTAL LABOR COST	TOTAL
(1) Operating Labor	8,864	MH	49.09	Excluded	\$ 435,134	\$ 435,134
(2) Supervisory Labor		MH		Excluded	Excluded	Excluded
(3) Maintenance Labor	520	MH	49.09	Excluded	\$ 25,527	\$ 25,527
(4) Maintenance Materials	1	LOT	25,527	\$ 25,527	Excluded	\$ 25,527
(5) Utilities						
(a) Reagent:		TON	-	N/A	N/A	N/A
(b) Electricity:	5,452,399	kWh	0.205	\$ 1,117,742	Excluded	\$ 1,117,742
(c) Water:	8,935	(K) Gallons	11.30	\$ 100,968	Excluded	\$ 100,968
Total Direct Annual Costs (TDAC)					TDAC =	\$ 1,704,897
INDIRECT ANNUAL COSTS						
(6) Overhead	1%	%		\$ 325,058		\$ 325,058
(7a) Administrative Charges, Insurance	3%	% total capital		\$ 975,174		\$ 975,174
(7b) Capital Recovery Factor [see inputs below]	0.0847					
(8) Capital Recovery						CRF * TCI = \$ 2,752,308
Total Indirect Annual Costs (TIAC)					TIAC =	\$ 4,052,540
TOTAL ANNUALIZED COSTS (TAC)					TAC = (TDAC) + (TIAC) =	\$ 5,757,437

Data Inputs for Capital Recovery Factor:		
Annual Interest Rate (EPA OAQPS Control Cost Manual)	7.50	%
Project Life (EPA OAQPS Control Cost Manual)	30	years

Line Number/Description	Title	Comment
Line Number 1 and 3	Operating/Maintenance Labor	Provided by UAF. Rate is burdened rate for level of personnel operating and performing maintenance on this type of equipment. Additional FT operations person is assumed per shift. Four total shifts per week. Quarter FT maintenance persons is assumed for the new CDS system.
Line Number 4	Maintenance Material	Allotment for maintenance materials. Item is equal to the maintenance labor allotment in line 3.
Line Number 5a	Reagent	CDS vendor will not require injection of reagent for SO ₂ reduction.
Line Number 5b	Electricity	Pricing provided by UAF for published utility rates on campus. Electrical consumption rate provided by CDS vendor. Additional consumption by larger ID Fan was also included.
Line Number 5c	Water	Pricing provided by UAF for published utility rates on campus. Water consumption rate provided by CDS vendor.
Line Number 6	Overhead	Calculated as percent of Total Capital Investment
Line Number 7a	Admin Charges, etc	Calculated as percent of Total Capital Investment
Line Number 7b	Capital Recovery Factor	EPA calculated factor using Interest Rate and Project Life Span
Line Number 8	Capital Recovery	Capital Recovery Factor times Total Capital Investment.
Annual Interest Rate (EPA OAQPS Control Cost Manual)	Annual Interest Rate	Latest federal prime rate. https://www.federalreserve.gov/releases/h15/
Project Life (EPA OAQPS Control Cost Manual)	Project Life	Project Life expectancy in years.

**CIRCULATING DRY SCRUBBER
COST ESTIMATE
ID FAN BACKUP COSTS**



Quotation

No: 24257DM22

Date: 06/07/2022

Validity: 30 days

Page: 1 of 7

A Twin City Fan Company ~ 5959 Trenton Lane ~ Minneapolis ~ MN 55442 ~ Tel (763) 551-7600 ~ Fax (763) 551-7601

To: Mario Jahn, Mechanical Engineer
From: Darren Miller, Senior Sales Application Engineer
Project: Feasibility Study - Replacement of Clarage S0# 711053-3-1.
Customer Reference: University of Alaska Fairbanks (UAF), I.D. Fan System Upgrade
Clarage Proposal: 24257DM22

We refer to our above and are pleased to offer the attached pricing and construction of the Clarage Fan. This proposal is good for 30 days from date above for placement of order.

Pricing is based on fans being ordered within the above time frame. Shipping terms are. FCA - Point of Manufacture Pulaski TN for fans & supplier's works for buy outs per INCOTERMS 2010. No freight is included unless otherwise stated in this proposal. Export boxing if required is by others unless otherwise stated in this proposal. All products are subject to a weekly storage fee of \$0.025/pound starting 5 business days after notification of readiness to ship.

Price quoted is valid for 30 days from the date above for placement of order and is good for shipment of the product within 6 months of order. Shipment after 6 months from order date is subject to pricing escalation.

General Arrangement Approval Drawings: 3 – 4 weeks after receipt of approved Purchase Order. Fan Manufacturing: 22 – 24 weeks after drawing approval and subject to motor lead time if supplied by Clarage. Add another two weeks for Mechanical Run and / or Performance Testing if required. Delivery dates above are subject to motor and other vendor lead times. Delivery does not reflect customer approval time.

Clarage proposes the following contract payment terms subject to Clarage's Credit department's approval:

Clarage proposes the following progress payments for quotations over \$75,000.00 subject to credit approval:
10% Invoiced Upon Customer Receipt of Approval Drawings
40% Invoiced Upon Customer Release to Production
30% Invoiced Upon Notification of Clarage's Readiness to Ship
20% Invoiced Upon Shipment
- See Exceptions and clarifications for deviations.

Scope of fan supply and pricing is as listed in the following pages.

This quotation is per Clarage's attached terms and conditions.

We trust this information is complete. Should you require additional information, contact undersigned at

Darren Miller

Senior Sales Application Engineer | Clarage
202 Commerce Way | Pulaski, TN 38478
Cell: 931.787.2921 | Main: 931.424.2500
Web: clarage.com | Email: dmiller@clarage.com



Quotation

No: 24257DM22

Date: 06/07/2022

Validity: 30 days

Page: 2 of 7

A Twin City Fan Company ~ 5959 Trenton Lane ~ Minneapolis ~ MN 55442 ~ Tel (763) 551-7600 ~ Fax (763) 551-7601

Clarage Fan Selection:

Input Parameters:

Static Pressure: 54 inches w.g.
Volume: 120,000 cfm
Density: 0.0536 lb/ft3
Temperature: 170°F
Elevation: 450 ft above sea level

Fan Model: 5123-AF
Fan Size: 102.75" Airfoil
Design Speed: 1200 RPM
Design Temperature: 400°F

Features:

- Fan housing constructed of: 0.5 in. ASTM A-36
- Fan housing discharge: 90 deg. (Customer to determine at later date)
- Inlet piece of: ASTM A-36
- Inlet box constructed of: 0.5 in. ASTM A-36
- Inlet box inlet angle: 360 deg. (Customer to determine at later date)
- Impeller material: ASTM A-514S or equal.
- Shaft material: SAE 1045 Forge or equal
- Hub material: SAE 1026 Forge or equal
- Impeller rotation: CW. (Customer to determine at later date)
- Sandblast and Paint entire fan
 - Surface Prep: SSPC-SP-2 – Hand Tool Cleaning
 - Paint: One coat of Stabler 4559A heat resistant dark gray primer at 2.0 - 3.0 mils per coat DFT.
- Housing & inlet box split for wheel removal (split location to be determined after order)
- Access doors, drain w/plugs (1 per inlet box, and 1 per housing), inlet box and outlet flanges.
- Outlet area: 26.3 ft2
- Motor and Bearing support pedestal. Arrangement: 7
- Volume control: SPD (Speed control by others)
- OSHA approved guards
- Sandblast and Paint entire fan
- Bearings: Dodge Sleeveoil RTL.
- Coupling: Renold/Holset Series PM size 60 or equivalent.
- Shaft seal: single

Price for one (1) fan with above features: **\$425,808.00**

Option features and pricing:

Motor

- Motor: Frame: 500C, 1250hp, 1200rpm. Motor is designed for full voltage starting only unless otherwise stated. To confirm reduced voltage starting capability, please consult factory.

Price for one (1) motor with above features: **\$142,071.00**

ID Fan Upgrade Proposal



Quotation

No: 24257DM22

Date: 06/07/2022

Validity: 30 days

Page: 3 of 7

A Twin City Fan Company ~ 5959 Trenton Lane ~ Minneapolis ~ MN 55442 ~ Tel (763) 551-7600 ~ Fax (763) 551-7601

ID Fan Upgrade Program

Project Reference:

1. Fan Details:	Quantity	Price Each	Extended Price
	1	\$425,808.00	\$425,808.00
Fan Type:	5123-AF SWSI	Volume:	120000 cfm
Blade Design:	Airfoil	Static Pressure	54 in.wg
Diameter:	102.75 in	Density:	0.0536 lb/ft3
Width:	100 %	Temperature:	170 F
Speed:	1180 rpm	Elevation:	450 ft
Brake Horsepower:	1231 hp	Outlet Area:	26.3 ft2
Static Efficiency:	83 %		

2. Fan Configuration:

Rotation:	CW	Inlet Angle:	360 deg.
Volume Control:	SPD	Discharge Angle:	90 deg.
Arrangement:	7		

3. Construction Details:

Impeller Material:	ASTM A-514S or equal.	Liners:	No blade liners
Housing Material:	0.5 in. ASTM A-36	Shaft Material:	SAE 1045 Forge or equal
Bearings:	Dodge Sleeveoil RTL.	Coupling:	Renold Series PM size 60
		Optional Motor:	Frame: 500C, 1250hp, 1200rpm

4. Performance Ratings

Ratings	Rating Point
Volume:	120000 cfm
Static Pressure:	54 in.wg
Density:	0.0536 lb/ft3
Temperature:	170 F
Speed:	1180 rpm
Brake Horsepower:	1231 hp
Static Efficiency:	83 %
Noise Level:	111 dBA



Quotation

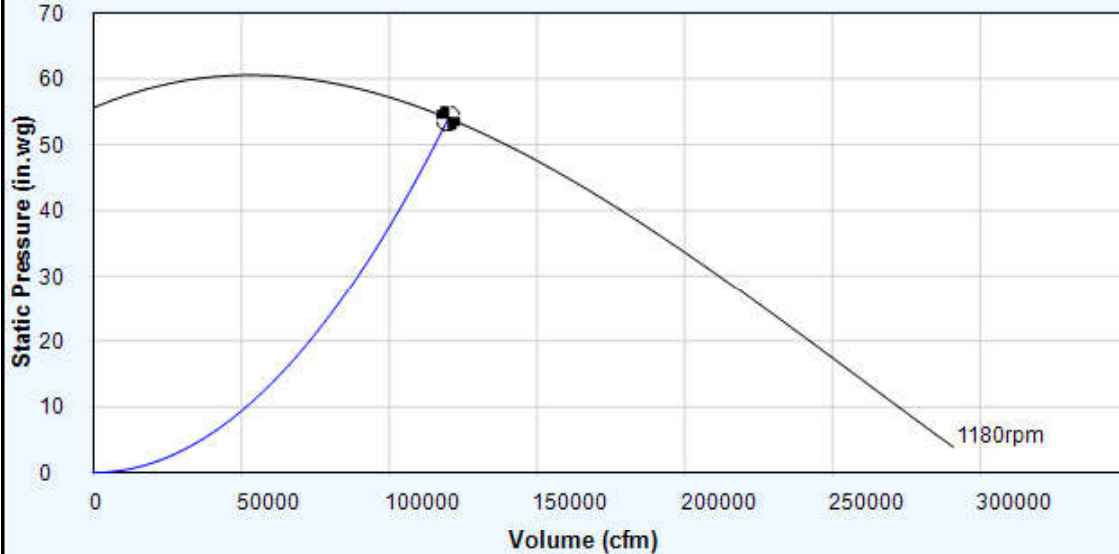
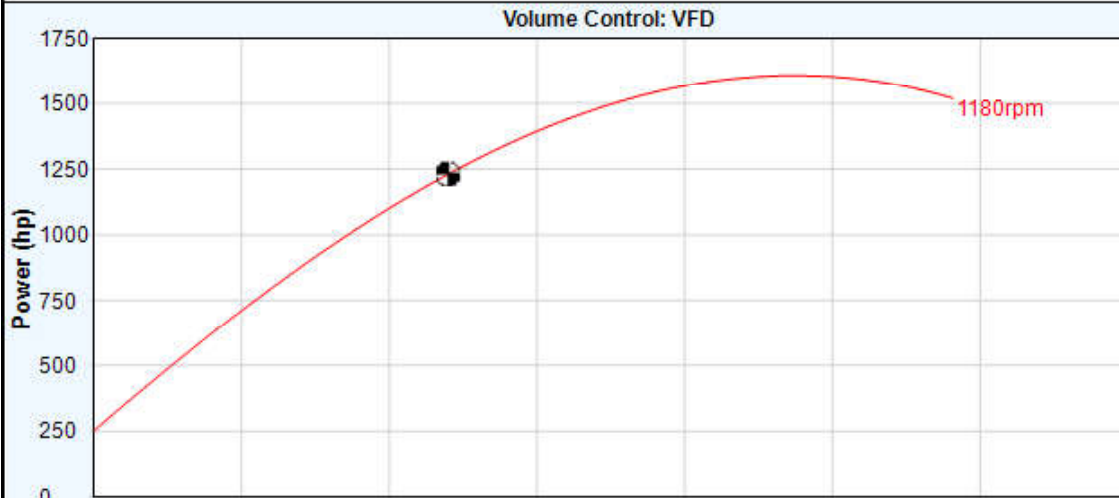
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Fan Performance Curve

Fan Type: AF5123 SWSI

Diameter (in): 102.75	Volume (cfm): 120000
Design: AF	Static Pressure (in.wg): 54
Width (%): 100	Density (lb/ft3): 0.0536
Speed (rpm): 1180	Temperature (F): 170
Brake Horsepower (hp): 1230.9	Elevation (ft): 450
Static Efficiency (%): 83	Outlet Area (ft2): 26.3



----- Static Pressure ——— Power - - - - - System Resistance

ID Fan Upgrade



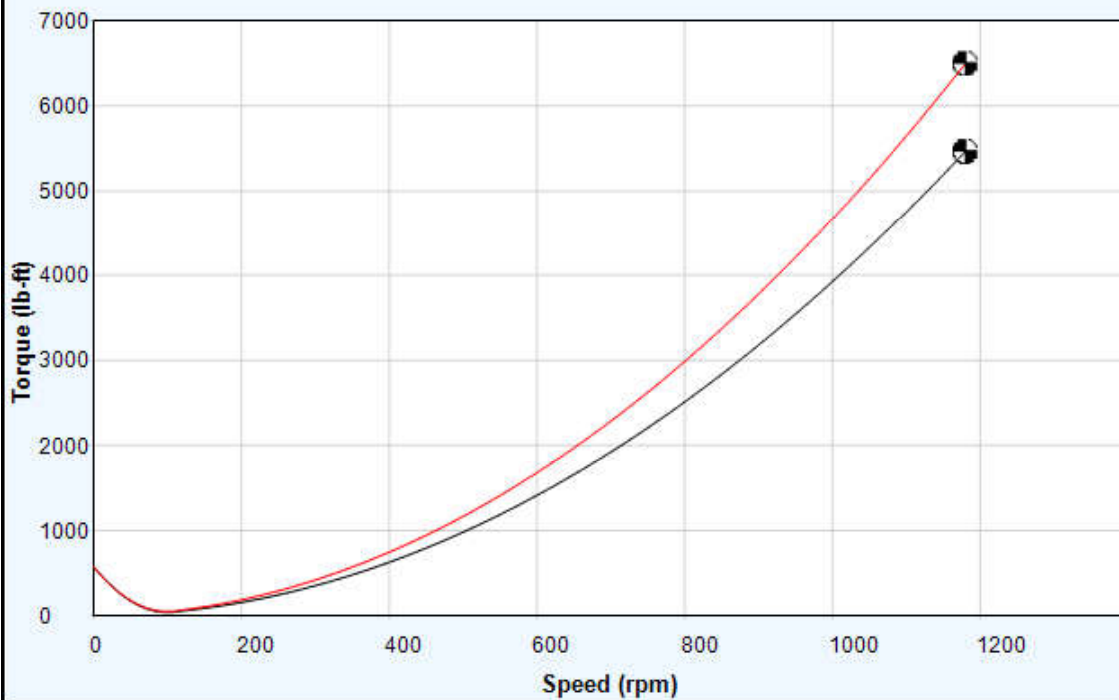
Quotation

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Torque-Speed Curve Fan Type: AF 5123 SWSI

Diameter (in): 102.75	Rotor Inertia (lb-ft ²): 54766
Design: AF	Elevation (ft): 450
Width (%): 100	Hp at Min.Start Temp. (hp): 1463
Speed (rpm): 1180	Maximum Torque (lb-ft): 6500
Op. Temp. Density (lb/ft ³): 0.0536	Min Starting Density (lb/ft ³): 0.0637
Operating Temp. (F): 170	Minimum Starting Temp. (F): 70



----- Operating Temperature

----- Minimum Starting Temperature

ID Fan Upgrade



Quotation

No: 24257DM22

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7. Fan Noise Levels:

Fan sound power levels are certified by Clarage to have been tested and rated in accordance with AMCA Standard 300. Sound pressure levels are estimates based on the installation conditions and attenuations as shown with noise from all other sources such as fan drives, duct radiation, etc. considered to be more than 8 db lower, and that on-job sound measurements are made off-axis of any air system inlet or outlet. Exception is taken to specifications requiring guarantee of sound pressure level because on-site conditions beyond Clarage control may deviate from the conditions below.

Noise levels based on Free Field conditions.
Directivity = 1, Measurement Distance = 3 ft

Point	dBA	Sound Type	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
		Sound Pwr. (Lw dB)	125	123	125	116	114	111	104	99
Rating Point	111	Sound Pres. (Lp dB)	112	112	115	106	104	101	94	89

ID Fan Upgrade



Quotation

No: 24257DM22

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A Twin City Fan Company ~ 5959 Trenton Lane ~ Minneapolis ~ MN 55442 ~ Tel (763) 551-7600 ~ Fax (763) 551-7601

Proposed
Twin
City
Fan
Co

A. Exceptions and Clarifications:

Clarage standard welding is to AWS standards including the allowances for weld splatter per AWS. Any additional requirements not included unless expressly mentioned as an alternative in the proposal. Standard paint is a Stabler 4559A heat resistant dark gray primer. which provides good adhesion and toughness to ferrous metal surfaces. This primer is weldable which renders it an ideal coating for field erected equipment. Alternative coatings must be expressly mentioned as an alternative in the proposal.

B. Optional Extended Warranty:

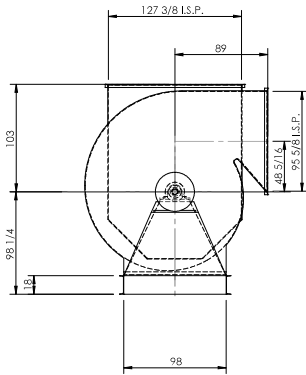
Clarage offers to extend the Standard Parts Only warranty for up to 48 months from delivery at an additional cost of ¼ % of the contract price per month of requested extension period (3% per year).

Additional warranty coverage for costs beyond the Clarage Standard Parts Only warranty is also available for purchase:

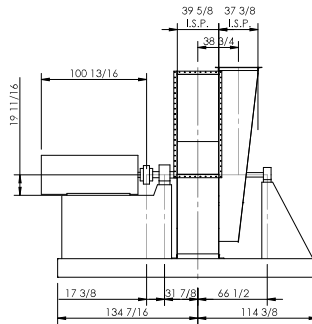
1. Site labor for the repair or replacement (excluding equipment rentals and access charges such as a crane and any costs for plant or closures), - add 5% to the proposal price.
2. All costs of the warranty repair or replacement, - add 10% to the proposal price.

TERMS AND CONDITIONS OF SALE:

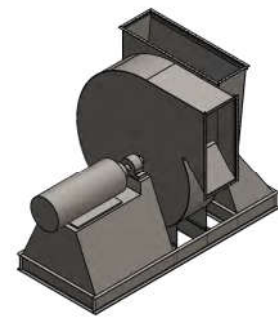
Twin City Clarage, LLC's offer is expressly limited to the express terms of this offer, which are located at <https://clarage.com/terms-conditions> and any purported acceptance that that modifies, omits, or alters the terms of this offer regardless of whether the change is material or immaterial shall be not be a valid acceptance.



DRIVE SIDE
FAN ROTATION: CW
HOUSING ORIENTATION PER AMCA
DISCHARGE: 90°
INLET: 360°



SIDE ELEVATION



ISOMETRIC VIEW - DRIVE SIDE

PRELIMINARY PROPOSAL DRAWING - DO NOT USE FOR CONSTRUCTION

LARGE FANS MAY REQUIRE REMOVAL OF THE TOP OF THE FAN HOUSING FOR TRANSPORTATION PURPOSES AND WILL REQUIRE ASSEMBLY AT THE JOBSITE

MOTOR DATA		PERFORMANCE DATA		DESIGN DATA			
		DATA	IMPERIAL	METRIC	DATA	IMPERIAL	METRIC
HP	1250	VOLUME	120,000 CFM	56.63 m ³ /s	WHEEL DIAMETER	102.75"	2609.88 mm
SYNC RPM	1180	PRESSURE	54 in.wg.	13.43 kPa	FIXED BEARING	RTL - 6"	
VOLTAGE	2000/4160 V	TEMPERATURE	170 F	76.75 C	EXPANSION BEARING	RTL - 4.4375"	
FRAME SIZE	500C	DENSITY	0.05363 LB/FT ³	0.86 kg/m ³	TIP SPEED	31,742 FTP	161 m/s
CATALOG #	JH12506	RPM	1180	1180			
MAX.WK2	63700 LB-FT2	BHP	1231 HP	918 kW			

CUSTOMER	Later
USER	Later
DRAWING TITLE	
102.75" SI(100%)SW 5123 AF FAN	
GENERAL FAN LAYOUT	
SCALE	1:92
DRAWING NUMBER	F3610rev0
REV.	A
WORK ORDER NUMBER	F3610rev0
SHEET	1 OF 1

NOTICE
 THIS DRAWING IS THE PROPERTY OF TWIN CITY CLARGE, LLC. AND IS LOANED TO THE CUSTOMER FOR THE PROJECT ONLY. IT SHALL NOT BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF TWIN CITY CLARGE, LLC.
 ALL ITEMS OF MATERIAL AND EQUIPMENT SHOWN ARE FOR ILLUSTRATIVE PURPOSES ONLY AND TWIN CITY CLARGE, LLC SHALL NOT BE HELD RESPONSIBLE FOR PERFORMANCE, OPERATION OR INSTALLATION OF SUCH EQUIPMENT.

NO.	BY	DATE	REVISIONS
A	DW	6/7/2022	ORIGINAL

NO.	BY	DATE	REVISIONS

NO.	BY	DATE	REVISIONS

NO.	BY	DATE	REVISIONS

**CIRCULATING DRY SCRUBBER
COST ESTIMATE
FIRE SYSTEM BACKUP COSTS**

Fire System Equipment Supply and Installation

Fire System total in 2017 dollars	
\$	37,932.00
Fire System total square footage	
	3,538.00
Total Fire System costs/ square foot in 2017 dollars	
	10.72
2021 CEPCI Index	
	708
2017 Base Case CEPCI Index	
	567.5
CEPCI Factor from 2015 to 2021	
	1.25
Updated 2021 Fire System \$/sqft	
\$	13.38
New CDS square footage	
	10,000.00
New Fire System Price for CDS	
\$	133,756.63
PROBABLE CONSTRUCTION COSTS	
\$	134,000

Fire System Cost Estimate Basis:

1. Fire System costs from 2017 were obtained from the original UAF cost estimate and broken down into a price/square foot. The Material Handling Building was used as the basis for the \$/sqft.
2. 2017 Fire System price/square foot was escalated using the CEPCI cost index ratio number between 2017 and 2021 year end.
3. The 2017 \$/sqft cost was multiplied by the CEPCI index ratio to obtain 2021 Fire System costs/ square foot.
4. A new square footage was calculated for the new CDS system building based on preliminary arrangement provided by CDS vendor.
5. The new CDS square footage was multiplied by the CEPCI index ratio to obtain a Fire Alarm cost for the CDS building in 2021 dollars.

NSE Estimate No.: N1412075
 Date: 01/22/2015
 Customer: Stanley Consultants
 Location: University of Alaska Fairbanks
 Fairbanks, AK

ESTIMATE SUMMARY: Electronic Safety and Security
 Revision: 03/06/2017

DESCRIPTION	QUANTITY No. UNITS	EQUIPMENT		MATERIAL		LABOR				UNIT COST	TOTAL COST	
		UNIT PRICE	EQUIP COST	PRICE PER UNIT	MATERIAL COST	HRS/ UNIT	MULT FACT	TOTAL HRS.	LABOR RATE			LABOR COST
DA - Material Handling												
FIRE ALARM SYSTEM												
HAZ. MANUAL PULL STATION	6 Each	\$ -	\$ -	\$ 500.00	\$ 3,000	2.00	1	12.00	\$ 88.43	\$ 1,061	\$ 6,413	
HAZ. HORN	7 Each	\$ -	\$ -	\$ 1,250.00	\$ 8,750	2.00	1	14.00	\$ 88.43	\$ 1,238	\$ 1,428	
HAZ. STROBE	9 Each	\$ -	\$ -	\$ 1,000.00	\$ 9,000	2.00	1	18.00	\$ 88.43	\$ 1,592	\$ 1,160	
HORN/ STROBE	1 Each	\$ -	\$ -	\$ 100.00	\$ 100	1.00	1	1.00	\$ 88.43	\$ 88	\$ 188	
FA CONDUIT & CONDUCTORS												
3/4" R.S.C.	500 Lin.Ft	\$ -	\$ -	\$ 7.52	\$ 3,760	6.00	100	30.00	\$ 88.43	\$ 2,653	\$ 6,413	
FITTINGS & ASSEMBLY	1 Matl	\$ -	\$ -	\$ -	\$ 3,760	0.50 Lab		15.00	\$ 88.43	\$ 1,326	\$ 5,086	
18/2 STP SLC CONDUCTORS	300 Lin.Ft	\$ -	\$ -	\$ 0.35	\$ 105	10.00	1000	3.00	\$ 88.43	\$ 265	\$ 370	
12 AWG THHN	1000 Lin.Ft	\$ -	\$ -	\$ 0.35	\$ 350	10.00	1000	10.00	\$ 88.43	\$ 884	\$ 1,234	
											sqft	3538
DA - Bridge												\$ 37,932

Square footage of Material Handling Area.

Total cost for Fire Alarm System in Material Handling Building in 2017 dollars.

2017 \$/sqft for HVAC is: 10.72

**CIRCULATING DRY SCRUBBER
COST ESTIMATE
HVAC BACKUP COSTS**

HVAC Equipment Supply and Installation

HVAC total in 2017 dollars for Material Handling Building	\$ 126,069.03
Material Handling Building Square Footage	3,538.00
Total HVAC costs/ square foot in 2017 dollars for Material Handling Building	35.63
2021 CEPCI Index	708
2017 Base Case CEPCI Index	567.5
CEPCI Factor from 2017 to 2021	1.25
Updated 2021 HVAC Costs \$/sqft	\$ 44.45
New CDS square footage	10,000.00
New HVAC Costs for CDS Building	\$ 444,547.30
PROBABLE CONSTRUCTION COSTS	
\$ 445,000	

HVAC Cost Estimate Basis:

1. HVAC costs from 2017 were obtained from the original UAF cost estimate and broken down into a price/square foot. The Material Handling Building was used as the basis for the \$/sqft.
2. 2017 HVAC price/square foot was escalated using the CEPCI cost index ratio number between 2017 and 2021 year end.
3. The 2017 \$/sqft cost was multiplied by the CEPCI index ratio to obtain 2021 HVAC costs/ square foot.
4. A new square footage was calculated for the new CDS system building based on preliminary arrangement provided by CDS vendor.
5. The new CDS square footage was multiplied by the CEPCI index ratio to obtain an HVAC cost for the CDS building in 2021 dollars.

NSE Estimate No.: N1412075
 Date: 01/22/2015
 Customer: Stanley Consultants
 Location: University of Alaska Fairbanks
 Fairbanks, AK

ESTIMATE SUMMARY: HVAC
 Revision: 03/06/2017

DESCRIPTION	QUANTITY No. UNITS	EQUIPMENT		MATERIAL		LABOR			LABOR		UNIT		TOTAL	
		UNIT PRICE	EQUIP COST	PRICE PER UNIT	MATERIAL COST	HRS/UNIT	MULT FACT	TOTAL HRS.	LABOR RATE	LABOR COST	COST	COST	COST	COST
DA - Material Handling														
HYDRONIC SYSTEM														
GLYCOL														
HYDRONIC PIPING														
1" TYPE 'L' COPPER	100 Lin.Ft	\$0.00	\$0.00	\$7.87	\$787.00	0.12	1.00	12.00	\$ 89.38	\$1,072.56	\$18.60	\$1,859.56	\$18.60	\$1,859.56
FITTINGS	1 Elbow/20	\$0.00	\$0.00	\$17.03	\$85.15	0.50	1.00	2.50	\$ 89.38	\$223.45		\$308.60		\$308.60
INSULATION	100 Lin.Ft	\$0.00	\$0.00	\$1.20	\$138.00	0.07	1.00	7.00	\$ 82.18	\$575.26	\$7.13	\$713.26	\$7.13	\$713.26
1 1/4" TYPE 'L' COPPER	40 Lin.Ft	\$0.00	\$0.00	\$11.27	\$450.80	0.14	1.00	5.60	\$ 89.38	\$500.53	\$23.78	\$951.33	\$23.78	\$951.33
FITTINGS	1 Elbow/20	\$0.00	\$0.00	\$25.55	\$51.10	0.53	1.00	1.06	\$ 89.38	\$94.74		\$145.84		\$145.84
INSULATION	40 Lin.Ft	\$0.00	\$0.00	\$1.30	\$59.80	0.08	1.00	3.20	\$ 82.18	\$262.98	\$8.07	\$322.78	\$8.07	\$322.78
1 1/2" TYPE 'L' COPPER	74 Lin.Ft	\$0.00	\$0.00	\$14.38	\$1,064.12	0.15	1.00	11.10	\$ 89.38	\$992.12	\$27.79	\$2,056.24	\$27.79	\$2,056.24
FITTINGS	1 Elbow/20	\$0.00	\$0.00	\$40.58	\$150.15	0.62	1.00	2.28	\$ 89.38	\$203.79		\$353.94		\$353.94
INSULATION	74 Lin.Ft	\$0.00	\$0.00	\$1.41	\$119.99	0.08	1.00	5.92	\$ 82.18	\$486.51	\$8.20	\$606.50	\$8.20	\$606.50
2" TYPE 'L' COPPER	110 Lin.Ft	\$0.00	\$0.00	\$22.04	\$2,424.40	0.19	1.00	20.90	\$ 89.38	\$1,868.04	\$39.02	\$4,292.44	\$39.02	\$4,292.44
FITTINGS	1 Elbow/20	\$0.00	\$0.00	\$72.65	\$399.58	0.73	1.00	4.02	\$ 89.38	\$359.31		\$758.89		\$758.89
INSULATION	110 Lin.Ft	\$0.00	\$0.00	\$1.52	\$192.28	0.08	1.00	8.80	\$ 82.18	\$723.18	\$8.32	\$915.46	\$8.32	\$915.46
2 1/2" BLACK STEEL	30 Lin.Ft	\$0.00	\$0.00	\$11.53	\$345.90	0.34	1.00	10.20	\$ 89.38	\$911.68	\$41.92	\$1,257.58	\$41.92	\$1,257.58
FITTINGS	1 Elbow/20	\$0.00	\$0.00	\$27.56	\$41.34	2.00	1.00	3.00	\$ 89.38	\$268.14		\$309.48		\$309.48
INSULATION	30 Lin.Ft	\$0.00	\$0.00	\$1.73	\$59.69	0.08	1.00	2.40	\$ 82.18	\$197.23	\$8.56	\$256.92	\$8.56	\$256.92
CHILLED WATER PIPING														
GATE VALVES														
1" GATE VALVE	4 Each	\$0.00	\$0.00	\$75.15	\$300.60	0.42	1.00	1.68	\$ 91.40	\$153.55	\$113.54	\$454.15	\$113.54	\$454.15
1-1/4" GATE VALVE	4 Each	\$0.00	\$0.00	\$115.23	\$460.92	0.53	1.00	2.12	\$ 91.40	\$193.77	\$163.67	\$654.69	\$163.67	\$654.69
1 1/2" GATE VALVE	4 Each	\$0.00	\$0.00	\$129.26	\$517.04	0.62	1.00	2.48	\$ 91.40	\$226.67	\$185.93	\$743.71	\$185.93	\$743.71
2" GATE VALVE	2 Each	\$0.00	\$0.00	\$182.36	\$364.72	0.73	1.00	1.46	\$ 91.40	\$133.44	\$249.08	\$498.16	\$249.08	\$498.16
GLOBE VALVES														
CHECK VALVES														
BALANCING COCKS														
1" BALANCING COCK	2 Each	\$0.00	\$0.00	\$96.19	\$192.38	0.44	1.00	0.88	\$ 91.40	\$80.43	\$136.41	\$272.81	\$136.41	\$272.81
FLOW CONTROL VALVES														
1" FCV	2 Each	\$0.00	\$0.00	\$165.33	\$330.66	0.42	1.00	0.84	\$ 91.40	\$76.78	\$204.14	\$408.28	\$204.14	\$408.28
1 1/4" FCV	2 Each	\$0.00	\$0.00	\$200.40	\$400.80	0.53	1.00	1.06	\$ 91.40	\$96.88	\$249.37	\$498.74	\$249.37	\$498.74
1 1/2" FCV	2 Each	\$0.00	\$0.00	\$415.83	\$831.66	0.62	1.00	1.23	\$ 91.40	\$112.42	\$472.66	\$945.31	\$472.66	\$945.31
CONTROL VALVES														
1" MIXING VALVE	2 Each	\$0.00	\$0.00	\$846.69	\$1,693.38	0.50	1.00	1.00	\$ 91.40	\$91.40	\$892.39	\$1,784.78	\$892.39	\$1,784.78
1-1/4" CONTROL VALVE	2 Each	\$0.00	\$0.00	\$1,152.30	\$2,304.60	0.62	1.00	1.24	\$ 91.40	\$113.34	\$1,208.97	\$2,417.94	\$1,208.97	\$2,417.94
1-1/2" CONTROL VALVE	2 Each	\$0.00	\$0.00	\$1,402.80	\$2,805.60	0.80	1.00	1.60	\$ 91.40	\$146.24	\$1,475.92	\$2,951.84	\$1,475.92	\$2,951.84
STRAINERS														
1-1/4" STRAINER	2 Each	\$0.00	\$0.00	\$130.00	\$260.00	0.62	1.00	1.24	\$ 91.40	\$113.34	\$186.67	\$373.34	\$186.67	\$373.34
1-1/2" STRAINER	2 Each	\$0.00	\$0.00	\$181.00	\$362.00	0.67	1.00	1.34	\$ 91.40	\$122.48	\$242.24	\$484.48	\$242.24	\$484.48
UNIT HEATERS (new name)														
60-S (60-S)	0 Each	\$0.00	\$0.00	\$710.00	\$0.00	2.29	1.00	0.00	\$ 91.40	\$0.00		\$0.00		\$0.00
UH-4 (A,B) LJ WING HU-26	0 Each	\$0.00	\$0.00	\$710.00	\$0.00	2.29	1.00	0.00	\$ 91.40	\$0.00		\$0.00		\$0.00
LJ WING HU-23	3 Each	\$0.00	\$0.00	\$2,700.00	\$8,100.00	5.00	1.00	15.00	\$ 91.40	\$1,371.00	\$3,162.00	\$9,486.00	\$3,162.00	\$9,486.00

NSE Estimate No.: N1412075
 Date: 01/22/2015
 Customer: Stanley Consultants
 Location: University of Alaska Fairbanks
 Fairbanks, AK

ESTIMATE SUMMARY: HVAC
 Revision: 03/06/2017

DESCRIPTION	QUANTITY	EQUIPMENT		MATERIAL		LABOR			LABOR		UNIT COST	TOTAL COST
		UNIT PRICE	EQUIP COST	PRICE PER UNIT	MATERIAL COST	HRS/UNIT	MULT FACT	TOTAL HRS.	LABOR RATE	LABOR COST		
LJ WING HU-26	2 Each	\$0.00	\$0.00	\$4,000.00	\$8,000.00	6.80	1.00	13.60	\$ 91.40	\$1,243.04	\$4,628.32	\$9,256.64
CABINET UNIT HEATERS AIR DISTRIBUTION SYSTEM -- SUPPLY FANS WITH COILS (SEE PLUMBING SECTION) VENT FANS												
31-HVAC-VF-001A/B/C	3 Each	\$1.00	\$3.00	\$3,500.00	\$10,500.00	15.00	1.00	45.00	\$ 91.40	\$4,113.00	4872	\$14,616.00
31-HVAC-VF-002	1 Each	\$1.00	\$1.00	\$1,500.00	\$1,500.00	15.00	1.00	15.00	\$ 91.40	\$1,371.00	2872	\$2,872.00
RECTANGULAR DUCT												
20" SEMI-PERIMETER	40 Lin.Ft	\$0.00	\$0.00	\$2.16	\$86.40	0.40	1.00	16.00	\$ 91.40	\$1,462.40	38.72	\$1,548.80
32" SEMI-PERIMETER	70 Lin.Ft	\$0.00	\$0.00	\$3.48	\$243.60	0.53	1.00	37.10	\$ 91.40	\$3,390.94	51.922	\$3,634.54
36" SEMI-PERIMETER	25 Lin.Ft	\$0.00	\$0.00	\$3.90	\$97.50	0.59	1.00	14.75	\$ 91.40	\$1,348.15	57.826	\$1,445.65
60" SEMI-PERIMETER	20 Lin.Ft	\$0.00	\$0.00	\$8.34	\$166.80	1.53	1.00	30.60	\$ 91.40	\$2,796.84	148.182	\$2,963.64
70" SEMI-PERIMETER	15 Lin.Ft	\$0.00	\$0.00	\$11.82	\$177.30	1.79	1.00	26.85	\$ 91.40	\$2,454.09	175.426	\$2,631.39
DAMPERS MOTORIZED DAMPERS X / X"												
	50 SQFT	\$0.00	\$0.00	\$120.00	\$6,000.00	2.00	1.00	100.00	\$ 91.40	\$9,140.00	302.8	\$15,140.00
LOUVERS (BAKED ENAMEL) 40 X 30												
	3 Each	\$0.00	\$0.00	\$350.00	\$1,050.00	0.29	1.00	0.87	\$ 91.40	\$79.52	376.5066667	\$1,129.52
CANNED ROTOR (GRUNDFOS) UP 15-42 B - RADIANT SLAB												
	2 Each	\$0.00	\$0.00	\$506.01	\$1,012.02	2.67	1.00	5.34	\$ 91.40	\$488.08	\$750.05	\$1,500.10
RADIANT SLAB HEATING 3/4" RAUPEX 02 BARRIER PIPE 6" On Center												
	1260 Sq.Ft.	\$0.00	\$0.00	\$9.34	\$11,768.40	0.00	1.00	0.00	\$ 91.40	\$0.00	\$9.34	\$11,768.40
MANIFOLD COST PER SQFT 6" On Center												
	1260 Sq.Ft.	\$0.00	\$0.00	\$0.75	\$945.00	0.00	1.00	0.00	\$ 91.40	\$0.00	0.75	\$945.00
STEAM HEATING SYSTEM STEAM PIPING CONDENSATE PIPING STEAM SPECIALTIES CONTROLS												
VF-1	4 Each	\$0.00	\$0.00	\$350.00	\$1,400.00	7.00	1.00	28.00	\$ 90.15	\$2,524.20	\$988.05	\$3,952.20
CUH/UH THERMOSTAT	4 Each		1 pts	\$150.00	\$600.00	5.00	1.00	20.00	\$ 90.15	\$1,803.00	\$600.75	\$2,403.00
SF	0 Each	\$0.00	\$0.00	\$150.00	\$0.00	5.00	1.00	0.00	\$ 90.15	\$0.00		\$0.00
RF	0 Each	\$0.00	\$0.00	\$150.00	\$0.00	5.00	1.00	0.00	\$ 90.15	\$0.00		\$0.00
SLAB	2 Each		5 pts	\$350.00	\$3,500.00	7.00	1.00	70.00	\$ 90.15	\$6,310.50	\$4,905.25	\$9,810.50
HEATING PUMP	0 Each	\$0.00	\$0.00	\$350.00	\$0.00	7.00	1.00	0.00	\$ 90.15	\$0.00		\$0.00
HX	0 Each	\$0.00	\$0.00	\$350.00	\$0.00	7.00	1.00	0.00	\$ 90.15	\$0.00		\$0.00
EF/VF	0 Each	\$0.00	\$0.00	\$350.00	\$0.00	7.00	1.00	0.00	\$ 90.15	\$0.00		\$0.00

NSE Estimate No.: N1412075
 Date: 01/22/2015
 Customer: Stanley Consultants
 Location: University of Alaska Fairbanks
 Fairbanks, AK

ESTIMATE SUMMARY: HVAC
 Revision: 03/06/2017

DESCRIPTION	QUANTITY No. UNITS	EQUIPMENT		MATERIAL		LABOR			LABOR RATE	LABOR COST	UNIT COST	TOTAL COST	sqft	
		UNIT PRICE	EQUIP COST	PRICE PER UNIT	MATERIAL COST	HRS/ UNIT	MULT FACT	TOTAL HRS.						
SEISMIC EQUIPMENT BRACING														
UNIT HEATERS	5 Each	\$0.00	\$0.00	\$100.00	\$500.00	6.00	1.00	30.00	\$ 95.62	\$2,868.60	\$673.72	\$3,368.60	3,538	
													\$126,069.03	

Square footage of
Material Handling Area.

Total cost for HVAC in
Material Handling
Building in 2017
dollars.

2017 \$/sqft for
HVAC is: 35.63

**CIRCULATING DRY SCRUBBER
COST ESTIMATE
WATER TREATMENT BUILDING DEMOLITION BACKUP**

Water Treatment Building Demo

Cost Estimate Basis for Water Treatment Building Demo costs were not obtained thru bidders.

A high level estimation was used to come up with demo costs based on estimated project duration and level of effort

Demo Personnel

Demo Crew size consists of 5 people

1 Superintendent, 1 Foreman, 1 Equipment Operator, 2 Craft

Duration of Demo was estimated for 3 months.

Labor rates from the original UAF estimate ranged between \$88 and \$94/hour.

\$88/hr was used to be on the conservative side. We used the CEPCI index ratio between 2017 and 2021 of 1.25 for escalation of the labor rate.

Total hours for crew over 3 months is calculated as follows:

5 personnel, 12 weeks, 50 hours per week

Total hours for demo duration of water treatment building is: 3,000

Labor costs for 3 month duration is hours times labor rate times CEPCI ratio: (3000*88*1.25)

Total labor costs \$ 330,000

Demo Equipment

Demo Equipment includes, 20 Ton Crane, 60 foot boom lift and a JLG Telehandler

25T Crane Costs: \$9,750/month

Crane Operator Costs: \$1,150/day

Total duration for crane onsite is 1.5 month:

Crane Costs: \$14,625

Crane Operator Costs: 1.5 month, 5 days per week, total of 30 operator days: \$34,500

Total Crane Costs: \$ 49,125

60 Foot Boom Lift Costs: \$3,875/month

Operator Costs are included in the base crew

Total duration for boom lift onsite is 2 months:

Total Boom Lift Costs: \$ 7,750

60' JLG Telehandler Costs: \$2,750/month

Operator Costs are included in the base crew

Total duration for Telehandler onsite is 2 months:

Total Telehandler Costs: \$ 5,500

Total Equipment Costs: \$ 62,375

Sub-Total \$ 392,375

Inflation - 5.4% \$ 3,368.25 (Inflation was only calculated on equipment costs)

Contractor Overhead - 10% \$ 39,574.33


Contractor Profit - 15% \$ 65,297.64

Total \$ 500,000

Total Estimate Demolition Costs for Water Treatment Building is approximately: \$500,000


		01 54 33 Equipment Rental	Crew	Daily Output	Labor Hours	Unit	Hourly Oper. Cost	Rent Per Day	Rent Per Week	Rent Per Month	Crew Equipment Cost/Day
50	0010	HIGHWAY EQUIPMENT RENTAL without operators									
60	0010	LIFTING AND HOISTING EQUIPMENT RENTAL without operators									
	0150	Crane, flatbed mounted, 3 ton capacity				Ea.	16.30	930	2,475	6,000	625
	0200	Crane, climbing, 106' jib, 6000 lb. capacity, 410 fpm				Fa	45	3,025	9,075	27,200	2,175
	0300	101' jib, 10,250 lb. capacity, 270 fpm				Ea.	52.50	3,175	9,550	28,700	2,325
	0500	Tower, static, 130' high, 106' jib, 6200 lb. capacity at 400 fpm				Ea.	51	2,600	7,825	23,400	1,975
	0520	Mini crawler spider crane, up to 24" wide, 1990 lb. lifting capacity				Ea.	14.15	610	1,900	5,500	495
	0525	Up to 30" wide, 6450 lb. lifting capacity				Ea.	16.45	725	2,250	6,525	585
	0530	Up to 52" wide, 6680 lb. lifting capacity				Ea.	26	890	2,775	8,000	760
	0535	Up to 55" wide, 8920 lb. lifting capacity				Ea.	29	980	3,050	8,850	845
	0540	Up to 66" wide, 13,350 lb. lifting capacity				Ea.	39.50	1,525	4,750	13,700	1,275
	0600	Crawler mounted, lattice boom, 1/2 C.Y., 15 tons at 12' radius				Fa	42	965	2,900	8,675	910
Crane	0700	3/4 C.Y., 20 tons at 12' radius				Ea.	61	1,075	3,250	9,750	1,150
	0800	1 C.Y., 25 tons at 12' radius				Ea.	76	1,150	3,425	10,300	1,300
	0900	1-1/2 C.Y., 40 tons at 12' radius				Ea.	75	1,300	3,925	11,800	1,375
	1000	2 C.Y., 50 tons at 12' radius				Ea.	100	1,550	4,650	14,000	1,725
	1100	3 C.Y., 75 tons at 12' radius				Ea.	73.50	2,725	8,150	24,400	2,225
	1200	100 ton capacity, 60' boom				Ea.	97	1,275	3,850	11,500	1,550
	1300	165 ton capacity, 60' boom				Ea.	120	1,525	4,600	13,800	1,875
	1400	200 ton capacity, 70' boom				Ea.	156	1,700	5,125	15,400	2,275
	1500	350 ton capacity, 80' boom				Ea.	206	3,575	0,800	32,300	3,800
	1600	Truck mounted, lattice boom, 6 x 4, 20 tons at 10' radius				Ea.	45	1,050	2,675	7,900	895
	1700	25 tons at 10' radius				Ea.	48.50	2,725	8,150	24,400	2,025
	1800	8 x 4, 30 tons at 10' radius				Ea.	61	2,900	8,725	26,200	2,225
	1900	40 tons at 12' radius				Ea.	61	3,175	9,550	28,600	2,400
	2000	60 tons at 15' radius				Ea.	60.50	3,325	0,000	30,000	2,475
	2050	82 tons at 15' radius				Ea.	67	3,425	0,300	30,900	2,600
	2100	90 tons at 15' radius				Ea.	75	3,525	0,600	31,800	2,725
	2200	115 tons at 15' radius				Ea.	84.50	3,650	0,900	32,700	2,850
	2300	150 tons at 18' radius				Ea.	91.50	3,150	9,425	28,300	2,625
	2350	165 tons at 18' radius				Ea.	98.50	3,200	9,600	28,800	2,700
	2400	Truck mounted, hydraulic, 12 ton capacity				Ea.	33.50	3,175	9,550	28,600	2,175
	2500	25 ton capacity				Ea.	41	3,275	9,825	29,500	2,300
	2550	33 ton capacity				Ea.	61	3,275	9,825	29,500	2,450
	2560	40 ton capacity				Ea.	61	3,300	9,925	29,800	2,475
	2600	55 ton capacity				Ea.	61	3,325	0,000	30,000	2,500
	2700	80 ton capacity				Ea.	79.50	3,400	0,200	30,500	2,675
	2720	100 ton capacity				Ea.	84.50	3,550	0,600	31,900	2,800
	2740	120 ton capacity				Ea.	119	3,600	0,800	32,300	3,100
	2760	150 ton capacity				Ea.	127	3,825	1,400	34,300	3,300
	2800	Self-propelled, 4 x 4, with telescoping boom, 5 ton				Ea.	17.10	405	1,225	3,650	380
	2900	12-1/2 ton capacity				Ea.	24	720	2,175	6,500	625
	3000	15 ton capacity				Ea.	39	825	2,475	7,400	805
	3050	20 ton capacity				Ea.	25	925	2,775	8,300	755
	3100	25 ton capacity				Ea.	41.50	985	2,950	8,875	925
	3150	40 ton capacity				Ea.	50.50	1,200	3,575	10,800	1,125

2022 Costs for Fairbanks, AK (997)

Union 

		01 54 33 Equipment Rental	Crew	Daily Output	Labor Hours	Unit	Hourly Oper. Cost	Rent Per Day	Rent Per Week	Rent Per Month	Crew Equipment Cost/Day
40	0010	GENERAL EQUIPMENT RENTAL without operators									
	0040	Over 30' high, 1500 lb. capacity				Ea.	5.80	370	855	1,800	218
	0070	Articulating boom to 45' high, 500 lb. capacity, diesel				Fa	11.25	2,625	5,150	10,700	1,125
Boom Lift	0075	To 60' high, 500 lb. capacity				Ea.	15.45	710	1,775	3,875	480
	0080	To 80' high, 500 lb. capacity				Ea.	18.20	1,200	2,975	6,225	740
	0085	To 125' high, 500 lb. capacity				Ea.	21	2,175	5,800	14,900	1,325
	0100	Telescoping boom to 40' high, 500 lb. capacity, diesel				Ea.	12.75	540	1,275	2,675	360
	0105	To 45' high, 500 lb. capacity				Ea.	14.15	560	1,275	2,750	370
Telehandler	0110	To 60' high, 500 lb. capacity				Ea.	18.55	560	1,275	2,750	405
	0115	To 80' high, 500 lb. capacity				Ea.	24	1,075	2,600	5,425	715
	0120	To 100' high, 500 lb. capacity				Ea.	32.50	1,200	2,975	6,225	855
	0125	To 120' high, 500 lb. capacity				Ea.	33	1,750	4,650	12,100	1,200

**CIRCULATING DRY SCRUBBER
COST ESTIMATE
CONTROL SYSTEM BACKUP COSTS**

 Stanley Consultants Inc. Computed by <u>A. Szalaj</u> Checked by _____ Approved by _____	Date <u>19-Jul-22</u> Date _____ Date _____	Job No. <u>30431.01.00</u> Page No. _____ Subject <u>UAF - BACT Analysis Control System</u> _____ _____																																																															
	Sheet No. <u>1</u> of <u>1</u>																																																																
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="width: 45%;">Item Description</th> <th colspan="2" style="text-align: center;">Quantity</th> <th rowspan="2" style="text-align: center;">Unit Cost</th> <th rowspan="2" style="text-align: center;">Total Cost</th> </tr> <tr> <th style="text-align: center;">No. of Unit</th> <th style="text-align: center;">UOM</th> </tr> </thead> <tbody> <tr> <td colspan="5">Control System</td> </tr> <tr> <td>Processor Cabinet</td> <td style="text-align: center;">1.0</td> <td style="text-align: center;">ea</td> <td style="text-align: right;">\$ 217,100.00</td> <td style="text-align: right;">\$ 217,100</td> </tr> <tr> <td>Remote I/O Cabinet</td> <td style="text-align: center;">1.0</td> <td style="text-align: center;">ea</td> <td style="text-align: right;">\$ 217,100.00</td> <td style="text-align: right;">\$ 217,100</td> </tr> <tr> <td>Field Time for Integration</td> <td style="text-align: center;">216</td> <td style="text-align: center;">hrs</td> <td style="text-align: right;">422.5</td> <td style="text-align: right;">\$ 91,260</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td style="text-align: right;">\$ 525,460</td> </tr> <tr> <td></td> <td></td> <td></td> <td style="text-align: right;">Location Factor 14.3%</td> <td style="text-align: right;">\$ 75,141</td> </tr> <tr> <td></td> <td></td> <td></td> <td style="text-align: right;">Contractor Overhead - 10%</td> <td style="text-align: right;">\$ 60,060</td> </tr> <tr> <td></td> <td></td> <td></td> <td style="text-align: right;">Contractor Profit - 15%</td> <td style="text-align: right;">\$ 99,099</td> </tr> <tr> <td></td> <td></td> <td></td> <td style="text-align: right;">Subtotal</td> <td style="text-align: right;">\$ 759,760</td> </tr> <tr> <td></td> <td></td> <td></td> <td style="text-align: right;">TOTAL COST</td> <td style="text-align: right;">\$ 759,760</td> </tr> <tr> <td></td> <td></td> <td></td> <td style="text-align: right;">PROBABLE CONSTRUCTION COST</td> <td style="text-align: right;">\$ 760,000</td> </tr> </tbody> </table>			Item Description	Quantity		Unit Cost	Total Cost	No. of Unit	UOM	Control System					Processor Cabinet	1.0	ea	\$ 217,100.00	\$ 217,100	Remote I/O Cabinet	1.0	ea	\$ 217,100.00	\$ 217,100	Field Time for Integration	216	hrs	422.5	\$ 91,260					\$ 525,460				Location Factor 14.3%	\$ 75,141				Contractor Overhead - 10%	\$ 60,060				Contractor Profit - 15%	\$ 99,099				Subtotal	\$ 759,760				TOTAL COST	\$ 759,760				PROBABLE CONSTRUCTION COST	\$ 760,000
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Cost Estimate Basis:

1. Cabinet pricing was taken from a project Stanley designed in 2016. Plant was located in Iowa
2. Onsite field personnel pricing was taken from a project Stanley designed in 2016. Plant was located in Iowa
3. Cabinet and Personnel costs were escalated by 30% to coincide with the CEPCI ratio between 2021 and 2016 (708/541.7 = 1.3)
4. Location factor was included for Fairbanks Alaska as the reference plant costs were taken from a plant in Iowa. Location Factor is in accordance with RS Means City Cost Index

**CIRCULATING DRY SCRUBBER
COST ESTIMATE
ID FAN SHIPPING BACKUP COSTS**

Jahn, Mario

From: Darren Miller <DMiller@clarage.com>
Sent: Friday, June 24, 2022 7:30 AM
To: Jahn, Mario
Subject: RE: QUOTE: Upgrade Feasibility Study on Existing Clarage ID Fan - - Clarage Quote 24257DM22

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

Mario,

Sorry for the delay. We will need at least 2 stepdecks for these pieces. They will cost around \$56,000 per truck. At least one escort will be required in the US and at least 2 escorts once they cross into Canada for the width.

This is just a budgetary estimate at this time.

Regards,

Darren Miller

Senior Sales Application Engineer | Clarage
202 Commerce Way | Pulaski, TN 38478
Cell: 931.787.2921 | Main: 931.424.2500
Web: clarage.com | Email: dmiller@clarage.com



All quotes are valid for 30 days unless otherwise noted and Clarage's offer is expressly limited to the express terms of this offer, which are located at <https://www.clarage.com/terms-and-conditions/> and any purported acceptance that modifies, omits, or alters the terms of this offer regardless of whether the change is material or immaterial shall be not be a valid acceptance.

From: Darren Miller
Sent: Thursday, June 16, 2022 3:32 PM
To: Jahn, Mario <JahnMario@stanleygroup.com>
Subject: RE: QUOTE: Upgrade Feasibility Study on Existing Clarage ID Fan - - Clarage Quote 24257DM22

Mario,

I have your request out for quote. I'll quote once I have feedback.

Regards,

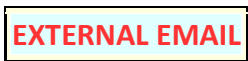
Darren Miller

Senior Sales Application Engineer | Clarage
202 Commerce Way | Pulaski, TN 38478
Cell: 931.787.2921 | Main: 931.424.2500
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From: Jahn, Mario <JahnMario@stanleygroup.com>
Sent: Tuesday, June 14, 2022 5:45 PM
To: Darren Miller <DMiller@clarage.com>
Subject: RE: QUOTE: Upgrade Feasibility Study on Existing Clarage ID Fan - - Clarage Quote 24257DM22



Darren,

Any luck on shipping prices yet?

Thanks,
Mario

From: Darren Miller <DMiller@clarage.com>
Sent: Thursday, June 9, 2022 10:53 AM
To: Jahn, Mario <JahnMario@stanleygroup.com>
Subject: RE: QUOTE: Upgrade Feasibility Study on Existing Clarage ID Fan - - Clarage Quote 24257DM22

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

Mario,

I was out a little and will get shipping pricing for you. Do you have an address or port you want shipping to?

Regards,

Darren Miller

Senior Sales Application Engineer | Clarage
202 Commerce Way | Pulaski, TN 38478
Cell: 931.787.2921 | Main: 931.424.2500
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From: Jahn, Mario <JahnMario@stanleygroup.com>
Sent: Wednesday, June 8, 2022 9:34 AM
To: Darren Miller <DMiller@clarage.com>
Subject: RE: QUOTE: Upgrade Feasibility Study on Existing Clarage ID Fan - - Clarage Quote 24257DM22

EXTERNAL EMAIL

Darren,

Thank you very much for putting this together. I'm assuming this does not include shipping to Fairbanks? Would you be able to find a rough estimate number we can plug in for shipping?

Thanks,
Mario

From: Darren Miller <DMiller@clarage.com>
Sent: Tuesday, June 7, 2022 11:03 AM
To: Jahn, Mario <JahnMario@stanleygroup.com>
Subject: QUOTE: Upgrade Feasibility Study on Existing Clarage ID Fan - - Clarage Quote 24257DM22

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

Mario,

Per our conversation, please see attached budgetary quote for you upgrade project. The drawing provided is for proposal use only and not for construction.

If you have any questions or need additional information please let me know.

Regards,

Darren Miller

Senior Sales Application Engineer | Clarage
202 Commerce Way | Pulaski, TN 38478
Cell: 931.787.2921 | Main: 931.424.2500
Web: clarage.com | Email: dmiller@clarage.com



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From: Jahn, Mario <JahnMario@stanleygroup.com>
Sent: Tuesday, June 7, 2022 10:30 AM
To: Darren Miller <DMiller@clarage.com>
Cc: Clarage Sales <sales@clarage.com>
Subject: RE: Existing Clarage ID Fan

EXTERNAL EMAIL

Darren,

This is just a feasibility study at the moment, and we don't have a lot of hard numbers that I can share with you. We definitely know that the fan would need to be able to handle another 30" W.C. Based on the drawing I sent you earlier I don't believe that the fan can do the dP given its current configuration. Are there options for a larger rotor that would get us that dP?

As far as temperature is concerned, we do know that the flue gas temperature will be lower than the design for the original fan. I would guess it would be closer to 170 degF. Same flows.

Would this be enough information to see if the existing fan can be retrofitted or would need to be replaced by a new fan?

Thanks,
Mario

From: Darren Miller <DMiller@clarage.com>
Sent: Tuesday, June 7, 2022 7:58 AM
To: Jahn, Mario <JahnMario@stanleygroup.com>
Cc: Clarage Sales <sales@clarage.com>
Subject: RE: Existing Clarage ID Fan

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

Mario,

I can't answer that question until we know what the performance requirements will be. Depending on what is required, we could determine what possible options we might have.

Do you know the new flow, pressure, operating temp etc...? I assume you are adding negative pressure resistance that the fan needs to overcome. Need to determine as this impacts density.

You will also be limited by your existing 650 HP 1200 RPM motor potentially depending on your new requirements.

Anything you can provide will help.

Regards,

Darren Miller

Senior Sales Application Engineer | Clarage
202 Commerce Way | Pulaski, TN 38478
Cell: 931.787.2921 | Main: 931.424.2500



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From: Jahn, Mario <JahnMario@stanleygroup.com>
Sent: Tuesday, June 7, 2022 9:31 AM
To: Darren Miller <DMiller@clarage.com>
Cc: Clarage Sales <sales@clarage.com>
Subject: RE: Existing Clarage ID Fan

EXTERNAL EMAIL

Good Morning Darren,

I've attached the drawing that I have for the fan. The fan is installed at the University of Alaska Fairbanks (UAF). We are in the process of evaluating additional backend emission controls for the power generation unit which means there would be additional pressure drop that the fan would need to make up for new ducting and equipment. Can this fan handle an increase in pressure drop with a impeller changeout?

Thanks,



Mario Jahn, Mechanical Engineer
STANLEYCONSULTANTS, 8000 South Chester Street Suite 500, Centennial, CO 80112
T: 303.649.7895 | M: 303.725.1361 | stanleyconsultants.com

From: Darren Miller <DMiller@clarage.com>
Sent: Tuesday, June 7, 2022 6:26 AM
To: Jahn, Mario <JahnMario@stanleygroup.com>
Cc: Clarage Sales <sales@clarage.com>
Subject: RE: Existing Clarage ID Fan

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

Mario,

I have one reference for a fan in Fairbanks, AK. It is for an ID fan on our SO 711053 (713845). You can confirm this is the correct SO by the information in the fan nameplate.

How can we assist?

Regards,

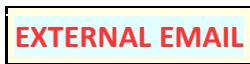
Darren Miller

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From: Jahn, Mario <JahnMario@stanleygroup.com>
Sent: Monday, June 6, 2022 4:45 PM
To: Clarage Sales <sales@clarage.com>
Subject: Existing Clarage ID Fan
Importance: High



To whom it may concern,

I'm looking to get in touch with somebody with regards to an existing Clarage ID Fan installed in Fairbanks Alaska. Can somebody please reach out to me as soon as they can?


Thank you in advance.

Regards,

Mario Jahn
Mechanical Engineer
Stanley Consultants, Inc.
Phone: (303) 649-7895


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**CIRCULATING DRY SCRUBBER
COST ESTIMATE
STRUCTURAL BACKUP COSTS**

 Stanley Consultants INC.		Job No. <u>30431.01.00</u> Page No. _____ Subject <u>UAF - BACT Analysis Structural</u>		
Computed by <u>L.G. Jensen</u> Date <u>19-Jul-22</u> Checked by _____ Date _____ Approved by _____ Date _____	Sheet No. <u>1</u> of <u>1</u>			
Item Description	Quantity		Unit Cost	Total Cost
	No. of Unit	UOM		
Concrete				
CDS Building Foundation	676	CY	\$ 700.00	\$ 473,200
Supply Duct Support Foundations	43	CY	\$ 700.00	\$ 30,100
Return Duct Support Foundations	31	CY	\$ 700.00	\$ 21,700
				\$ 525,000
			Location Factor 14.3%	\$ 75,075
			Inflation - 5.4%	\$ 32,404
			Contractor Overhead - 10%	\$ 63,248
			Contractor Profit - 15%	\$ 104,359
			Subtotal	\$ 800,086
			TOTAL COST	\$ 800,086
			PROBABLE CONSTRUCTION COST	\$ 800,000

Cost Estimate Basis:

1. Material quantities were calculated based on preliminary design provided by Andritz for CDS system.
2. Material and Labor costs are from 2022 RS Means
3. Location Factor for Fairbanks Alaska was used in accordance with 2022 RS Mean City Cost Index
4. Inflation was calculated using online CPI Inflation Calculator as published by U.S. Bureau of Labor Statistics. The inflation accounts for the increase in price between 2022 RS Means costs (January) and July when this estimate was assembled.

		Job No. <u>30431.01.00</u> Page No. _____ Subject <u>UAF - BACT Analysis Structural</u>		
Computed by <u>L.G. Jensen</u> Date <u>19-Jul-22</u> Checked by _____ Date _____ Approved by _____ Date _____	Sheet No. <u>1</u> of <u>1</u>			
Item Description	Quantity		Unit Cost	Total Cost
	No. of Unit	UOM		
Steel				
CDS Building				
Heavy (>40lb/ft)	24.3	TON	\$ 5,000.00	\$ 121,500
Medium (>20-≤40lb/ft)	123.0	TON	\$ 6,000.00	\$ 738,000
Light (≤20lb/ft)	3.4	TON	\$ 7,000.00	\$ 23,800
Grating	8,440	SF	\$ 50.00	\$ 422,000
Roll-up door (10' x 10')	2	EA	\$ 4,500.00	\$ 9,000
Man door (3' x 7')	4	EA	\$ 1,000.00	\$ 4,000
Girts	15.0	TON	\$ 3,000.00	\$ 45,000
Purlins	5.6	TON	\$ 3,000.00	\$ 16,800
Roofing	5,625	SF	\$ 9.00	\$ 50,625
Siding	10,800	SF	\$ 6.00	\$ 64,800
Supply Duct Supports				
Heavy (>40lb/ft)	7.7	TON	\$ 5,000.00	\$ 38,500
Medium (>20-≤40lb/ft)	2.8	TON	\$ 6,000.00	\$ 16,800
Light (≤20lb/ft)	3.5	TON	\$ 7,000.00	\$ 24,500
Return Duct Supports				
Heavy (>40lb/ft)	5.5	TON	\$ 5,000.00	\$ 27,500
Medium (>20-≤40lb/ft)	2.0	TON	\$ 6,000.00	\$ 12,000
Light (≤20lb/ft)	2.5	TON	\$ 7,000.00	\$ 17,500
Supply Ducts				
Light (≤20lb/ft)	26.5	TON	\$ 7,000.00	\$ 185,150
Return Ducts				
Light (≤20lb/ft)	27.6	TON	\$ 7,000.00	\$ 193,200
				\$ 2,010,675
Location Factor 14.3%				\$ 287,527
Inflation - 5.4%				\$ 124,103
Contractor Overhead - 10%				\$ 242,230
Contractor Profit - 15%				\$ 399,680
Subtotal				\$ 3,064,215
TOTAL COST				\$ 3,064,215
PROBABLE CONSTRUCTION COST				\$ 3,064,000

Cost Estimate Basis:

1. Material quantities were calculated based on preliminary design provided by Andritz for CDS system.
2. Material and Labor costs are from 2022 RS Means
3. Location Factor for Fairbanks Alaska was used in accordance with 2022 RS Mean City Cost Index
4. Inflation was calculated using online CPI Inflation Calculator as published by U.S. Bureau of Labor Statistics. The inflation accounts the increase in price between 2022 RS Means costs (January) and July when this estimate was assembled.

Vibro compaction total in 2015 dollars	
\$ 1,730,000.00	
Vibro compaction total square footage	
71,300.00	
Total Vibro Compaction costs/ square foot in 2015 dollars	
24.26367461	
2021 CEPCI Index	
708	
2015 Base Case CEPCI Index	
556.8	
CEPCI Factor from 2015 to 2021	
1.271551724	
Updated 2021 Vibro Compaction \$/sqft	
\$ 30.85	
New CDS square footage	
13,700.00	
New Vibro Price for CDS	
\$ 422,679.49	
PROBABLE CONSTRUCTION COSTS	
\$ 423,000	

Cost Estimate Basis:

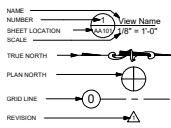
1. Vibro Compaction costs from 2015 were obtained from the original UAF cost estimate and broken down into a price/square foot.
2. 2015 vibro compaction price/square foot was escalated using the CEPCI cost index ratio number between 2015 and 2021 year end.
3. The 2015 number was multiplied by the CEPCI index ratio to obtain 2021 vibro compaction costs/ square foot.
4. A drawing of the site was marked up to obtain the square footage of the CDS system that requires vibro compaction. The area includes the CDS building and area to the east which contains the duct support foundations.
5. The new CDS square footage was multiplied by the CEPCI index ratio to obtain a vibro compaction cost for the CDS system.

UNIVERSITY OF ALASKA FAIRBANKS COMBINED HEAT AND POWER PLANT - WORK PACKAGE 1

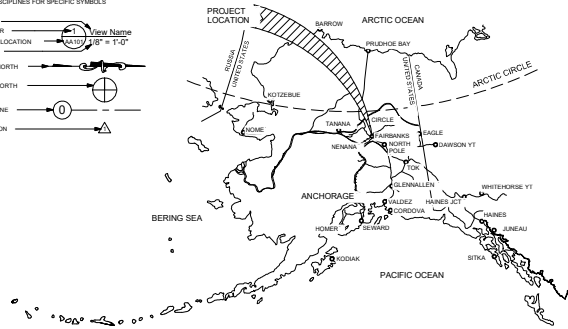
FAIRBANKS, ALASKA; PROJECT NO.: 2012031 CPHR

GENERAL SYMBOLS

SEE DISCIPLINES FOR SPECIFIC SYMBOLS



ALASKA MAP



VICINITY MAP



CODE SUMMARY

IMC 2009 INTERNATIONAL MECHANICAL CODE
 NEC 2011 NATIONAL ELECTRICAL CODE
 AUTHORITY HAVING JURISDICTION (AHJ):
 UAF FIRE MARSHAL

PROJECT TEAM

OWNER REPRESENTATIVE
 UNIVERSITY OF ALASKA FAIRBANKS
 MIKE RUCKHAUS
 907-474-5797
 MORUCKHAUS@ALASKA.EDU

LEAD DESIGNER
 STANLEY CONSULTANTS, INC.
 JEREMY SCHMIDT
 303-925-8328
 SCHMIDT.JEREMY@STANLEYGROUP.COM

DESIGNER
 DESIGN ALASKA
 CHRIS MILLER
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 CHRISM@DESIGNALASKA.COM

GENERAL CONTRACTOR
 HASKELL DAVIS JV
 JED SHANDY
 907-562-2336
 JED@DAVISCONSTRUCTORS.COM

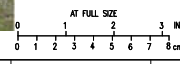
VIEW FROM ALUMNI DRIVE LOOKING WEST

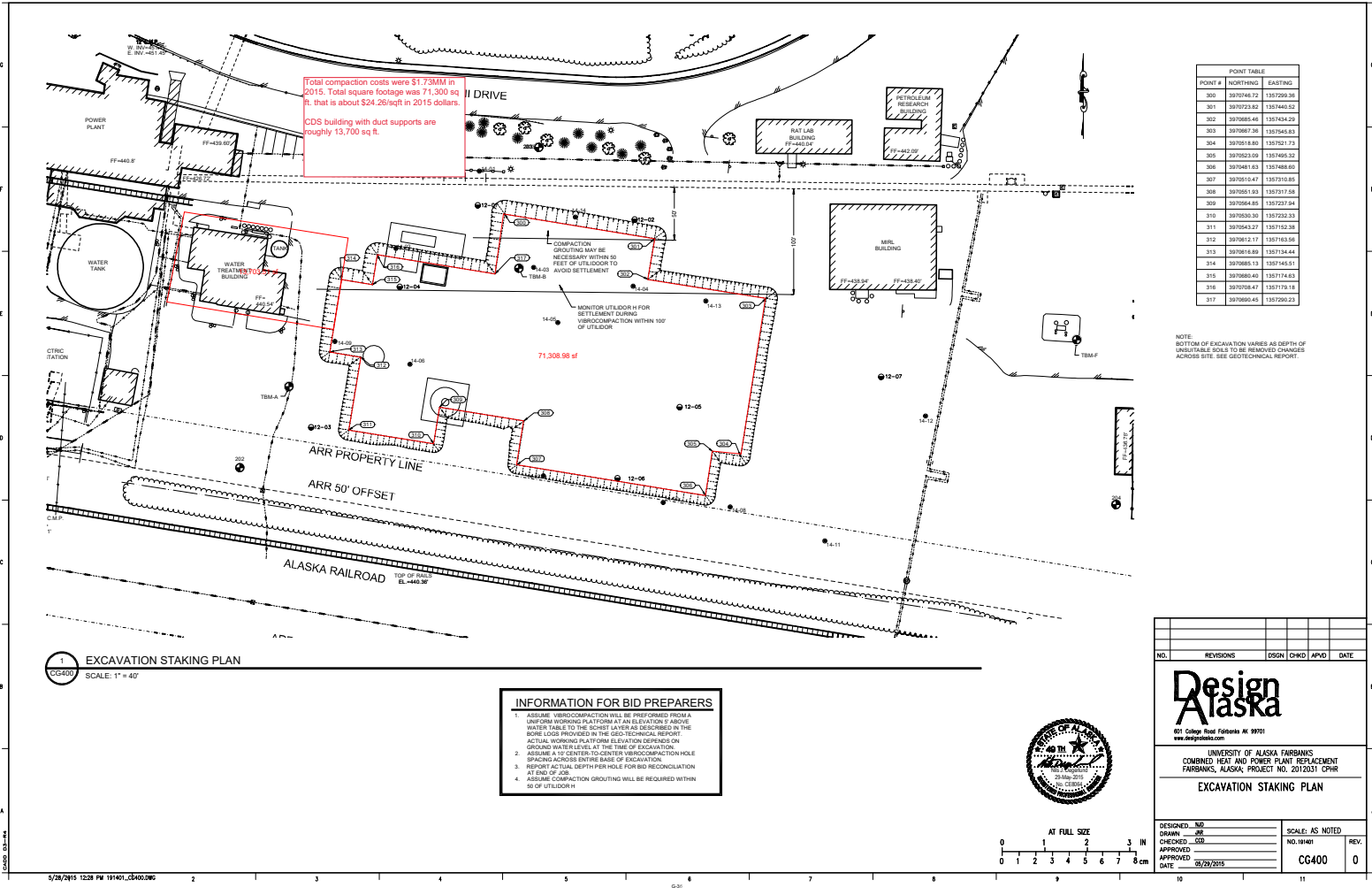


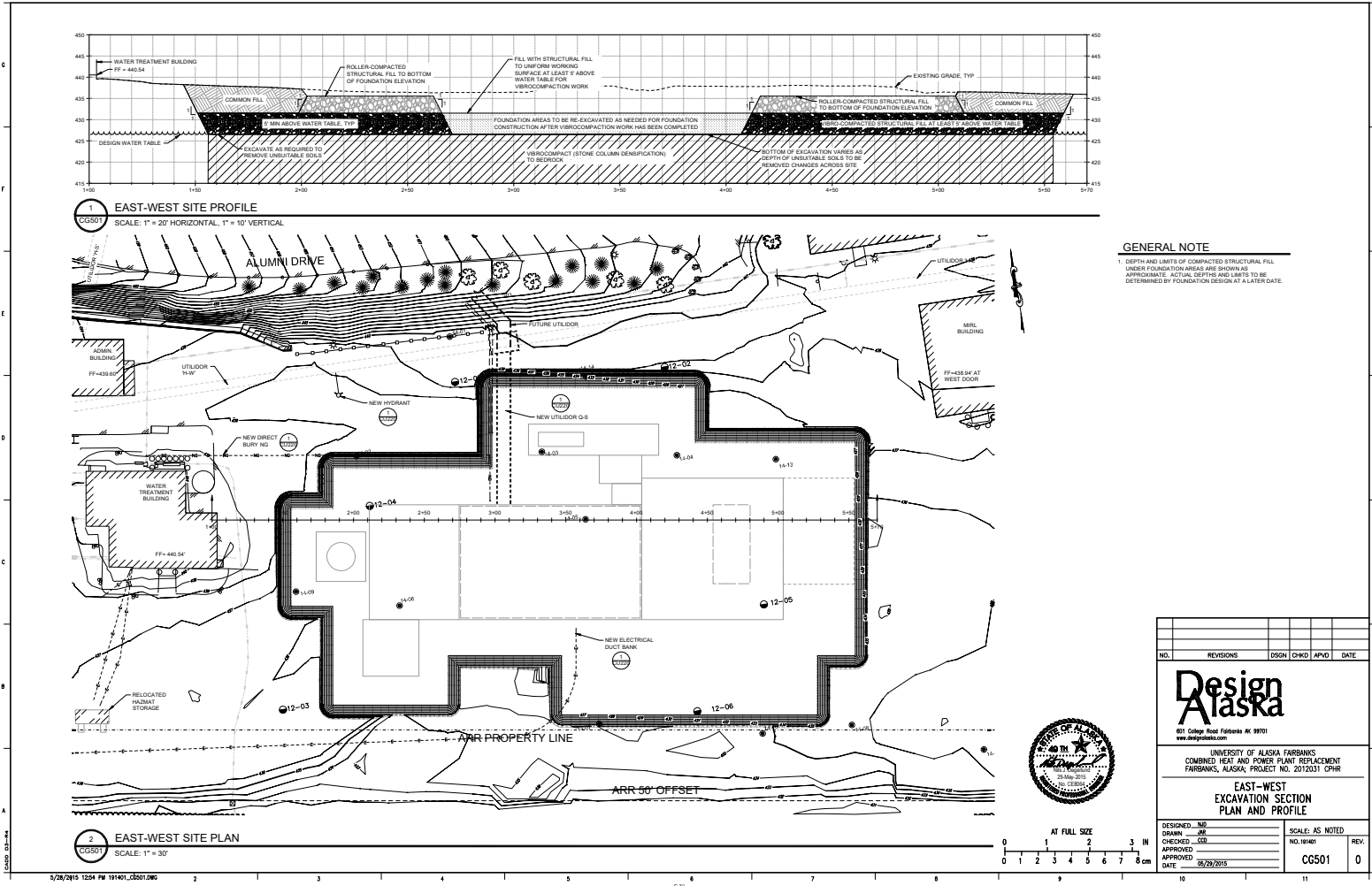
Reference drawing CG400 for Vibro Compaction Basis based on 2015 design package.

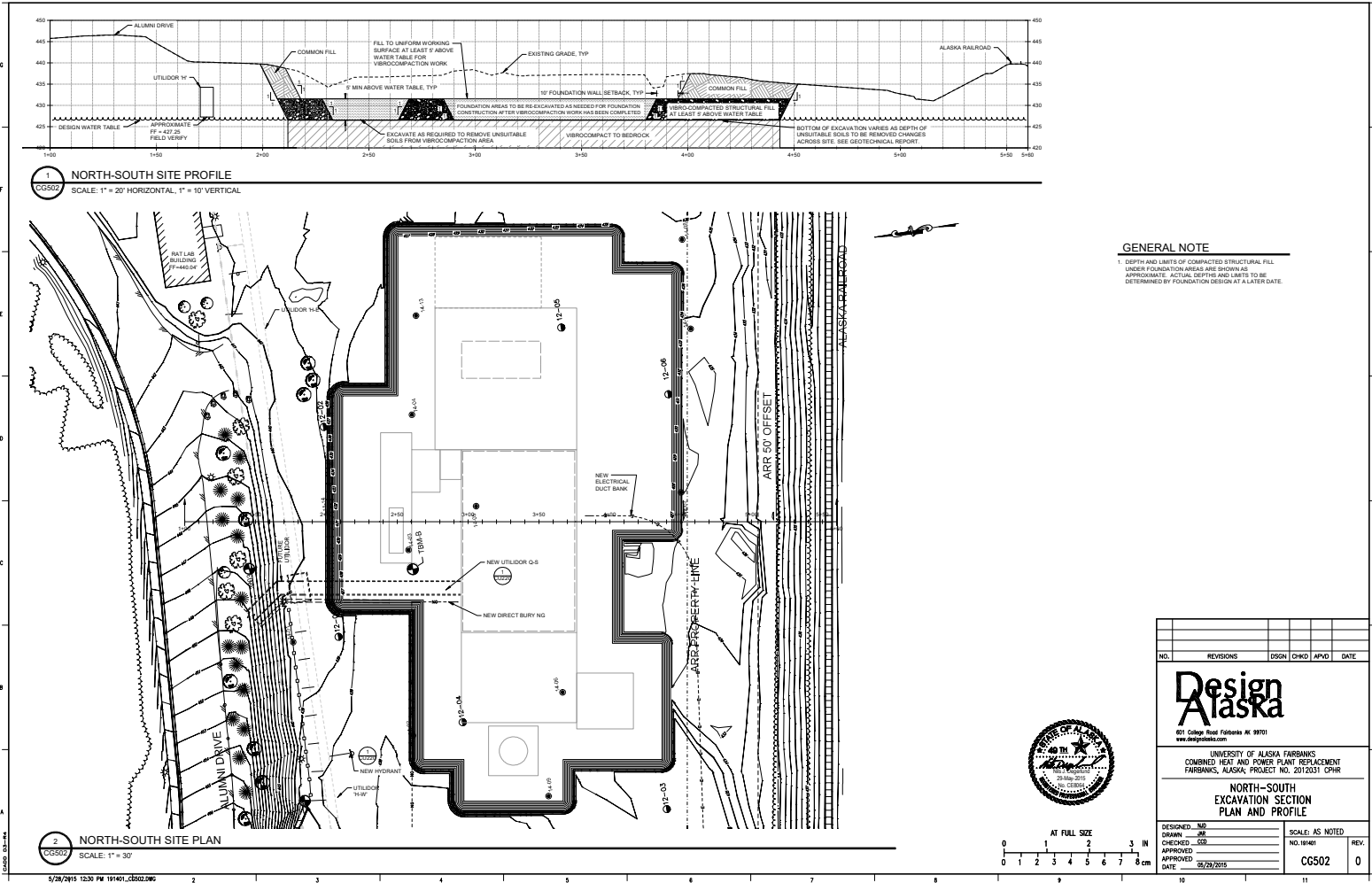
NO.	REVISIONS	DSGN	CHKD	APVD	DATE
0	PRELIMINARY - ISSUED FOR BID	ENG	IMP	VMP	05-29-15

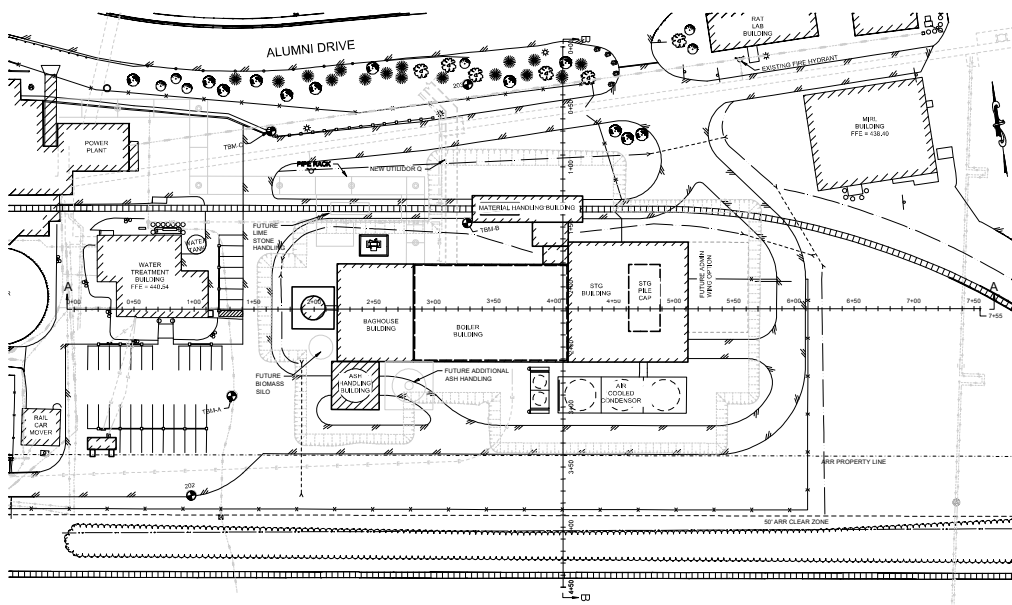
Design Alaska	
801 College Road Fairbanks AK 99701 www.designalaska.com	
UNIVERSITY OF ALASKA FAIRBANKS COMBINED HEAT AND POWER PLANT REPLACEMENT FAIRBANKS, ALASKA; PROJECT NO. 2012031 CPHR	
GENERAL INFORMATION	
DESIGNED: JMS	SCALE: AS NOTED
DRAWN: JMS	NO. 191401
CHECKED: JMS	REV. B
APPROVED:	GC000
DATE:	



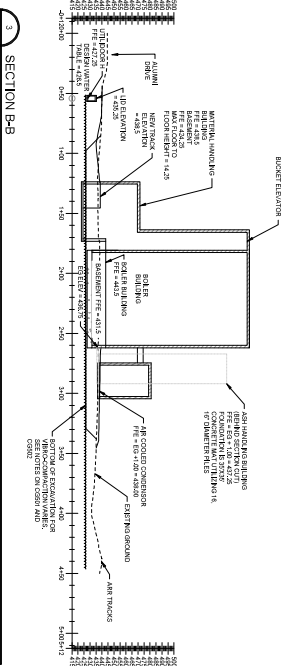




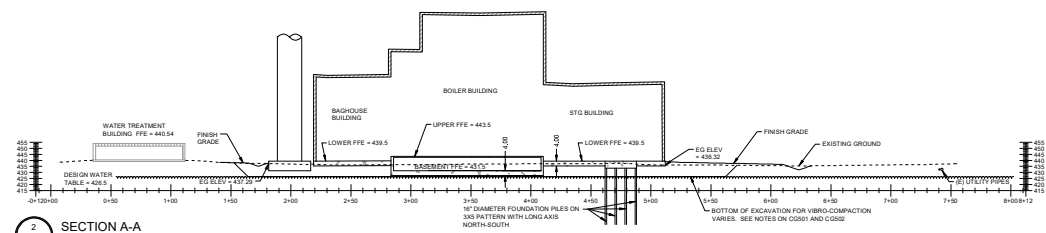




1 SITE PLAN
CG505
1" = 40'

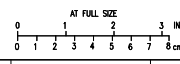


3 SECTION B-B
1" = 40'




2 SECTION A-A
CG505
1" = 40'

NOT FOR CONSTRUCTION
INFORMATION ONLY
FOR REVIEW ONLY



8 PRELIMINARY - ISSUED FOR BID		05/29/2015
NO.	REVISIONS	DSGN CHKD APVD DATE
801 College Road Fairbanks AK 99701 www.designalaska.com		
UNIVERSITY OF ALASKA FAIRBANKS COMBINED HEAT AND POWER PLANT REPLACEMENT FAIRBANKS, ALASKA; PROJECT NO. 2012031 CPHR		
EXCAVATION PLAN AND SECTIONS		
DESIGNED: <u>MG</u>	SCALE: AS NOTED	REV.
DRAWN: <u>SR</u>	NO. 191401	B
CHECKED: <u>GB</u>		
APPROVED:		
DATE:	CG505	


**CIRCULATING DRY SCRUBBER
COST ESTIMATE
ELECTRICAL BACKUP COSTS**

 Stanley Consultants Inc. Computed by Checked by Approved by						
	D. Akselrod	Date 19-Jul-22	Job No. 30431.01.00	Page No.		
			Subject UAF - BACT Analysis Electrical			
			Sheet No. 1 of 1			

Item Description	Quantity		Unit Cost	Total Cost
	No. of Unit	UOM		
Labor for Equipment Installation				
MV VFD - 1250 hp; 12470 input/4160 output	200	hrs	\$ 110.32	\$ 22,065
MV cable 2/0; 15kV; CU; MV-105	160	hrs	\$ 110.32	\$ 17,652
MV VFD cable 2/0; 5kV; CU; MV-105	60	hrs	\$ 110.32	\$ 6,619
LV cable 250 MCM; 600V; CU	100	hrs	\$ 110.32	\$ 11,032
480V panel board; 225 amp; 42 pole	80	hrs	\$ 110.32	\$ 8,826
480-120/208V transformer; 45 kVA	80	hrs	\$ 110.32	\$ 8,826
120/208 volt panel board	80	hrs	\$ 110.32	\$ 8,826
Misc power cable	300	hrs	\$ 110.32	\$ 33,097
Bare copper ground cable 2/0	180	hrs	\$ 110.32	\$ 19,858
Ground rods	90	hrs	\$ 110.32	\$ 9,929
Misc. Conduit	300	hrs	\$ 110.32	\$ 33,097
Misc. Cable tray	200	hrs	\$ 110.32	\$ 22,065
Misc. Hardware (tray hangers, fittings, etc.)	Included above	hrs	\$ 110.32	\$ -
Lightning protection system (aluminum)	120	hrs	\$ 110.32	\$ 13,239
Duct Bank	80	hrs	\$ 110.32	\$ 8,826
Lights and receptacles	200	hrs	\$ 110.32	\$ 22,065
				\$ 246,021
			Contractor Overhead - 10%	\$ 24,602
			Contractor Profit - 15%	\$ 40,593
			Subtotal	\$ 311,216
			TOTAL COST	\$ 311,216
			PROBABLE CONSTRUCTION COST	\$ 311,000

Cost Estimate Basis:


1. Hours for labor were estimated based on equipment being installed and historical data.
2. Labor costs were escalated from 2017 UAF cost estimate by 25% based on CEPCI ratio for 2021 and 2017 (708/567.5)

 Stanley Consultants Inc. Computed by <u>D. Akselrod</u> Date <u>19-Jul-22</u> Checked by _____ Date _____ Approved by _____ Date _____	Job No.	<u>30431.01.00</u>	Page No.	_____
	Subject	<u>UAF - BACT Analysis Electrical</u>		
	Sheet No.	<u>1</u>	of	<u>1</u>
Item Description	Quantity		Unit Cost	Total Cost
	No. of Unit	UOM		
Equipment Costs				
MV VFD - 1250 hp; 12470 input/4160 output	1	ea	\$ 300,000.00	\$ 300,000
MV cable 2/0; 15kV; CU; MV-105	500	feet	\$ 50.00	\$ 25,000
MV VFD cable 2/0; 5kV; CU; MV-105	125	feet	\$ 55.00	\$ 6,875
LV cable 250 MCM; 600V; CU	500	feet	\$ 29.00	\$ 14,500
480V panel board; 225 amp; 42 pole	1	ea	\$ 3,000.00	\$ 3,000
480-120/208V transformer; 45 kVA	1	ea	\$ 3,000.00	\$ 3,000
120/208 volt panel board	1	ea	\$ 3,000.00	\$ 3,000
Misc power cable	400	feet	\$ 12.00	\$ 4,800
Bare copper ground cable 2/0	500	feet	\$ 6.00	\$ 3,000
Ground rods	10	ea	\$ 58.00	\$ 580
Misc. Conduit	250	feet	\$ 25.00	\$ 6,250
Misc. Cable tray	250	feet	\$ 25.00	\$ 6,250
Misc. Hardware (tray hangers, fittings, etc.)	1	lot	\$ 15,000.00	\$ 15,000
Lightning protection system (aluminum)	1	lot	\$ 15,000.00	\$ 15,000
Duct Bank	75	feet	\$ 50.00	\$ 3,750
Lights and receptacles	1	lot	\$ 15,000.00	\$ 15,000
Heat Tracing	1	lot	\$ 27,400.00	\$ 27,400
				\$ 452,405
			Contractor Overhead - 10%	\$ 45,241
			Contractor Profit - 15%	\$ 74,647
			Subtotal	\$ 572,292
			TOTAL COST	\$ 572,292
			PROBABLE CONSTRUCTION COST	\$ 572,000

Cost Estimate Basis:

1. VFD costs were estimated based on internet research and linear interpolation of historical project data
2. Quantities were estimated based preliminary CDS layout.
3. Equipment and Material costs were escalated from 2017 UAF cost estimate by 25% based on CEPCI ratio for 2021 and 2017 (708/567.5)

**CIRCULATING DRY SCRUBBER
COST ESTIMATE
INSULATION BACKUP COSTS**


 Stanley Consultants Inc.		Job No. <u>30431.01.00</u> Page No. _____ Subject <u>UAF - BACT Analysis Mechanical</u>		
Computed by <u>M. Jahn</u> Date <u>19-Jul-22</u> Checked by _____ Date _____ Approved by _____ Date _____	Sheet No. <u>1</u> of <u>1</u>			
Item Description	Quantity		Unit Cost	Total Cost
	No. of Unit	UOM		
Piping Insulation				
Insulation, Fiber	400	feet	\$ 130.55	\$ 52,219
				\$ 52,219
			Contractor Overhead - 10%	\$ 5,222
			Contractor Profit - 15%	\$ 8,616
			Subtotal	\$ 66,057
			TOTAL COST	\$ 66,057
			PROBABLE CONSTRUCTION COST	\$ 66,000

Cost Estimate Basis:

1. Material quantities were calculated based on preliminary general arrangement of CDS system and location at UAF site.
2. Costs were obtained from original UAF cost estimate and escalated from 2017 costs with CEPCI ratio to 2021 costs.

See page G-52 for the 2017 unit cost and page G-53 for calculation of the linear feet.

**CIRCULATING DRY SCRUBBER
COST ESTIMATE
PIPING BACKUP COSTS**

 Stanley Consultants Inc.		Job No. <u>30431.01.00</u> Page No. _____	
		Subject <u>UAF - BACT Analysis Mechanical</u>	
Computed by <u>M. Jahn</u>	Date <u>19-Jul-22</u>	_____	
Checked by _____	Date _____	_____	
Approved by _____	Date _____	_____	
		Sheet No. <u>1</u>	of <u>1</u>

Item Description	Quantity		Unit Cost	Total Cost
	No. of Unit	UOM		
Mechanical Piping				
Air Pipe, 2", 304 SST	500	feet	\$ 191.29	\$ 95,645
Air Pipe Supports	40	ea	\$ 2,240.65	\$ 89,626
Air Pipe, 1", CS	300	feet	\$ 127.88	\$ 38,363
Air Pipe Supports	45	ea	\$ 2,240.65	\$ 100,829
Air Receiver	1	ea	\$ 24,951.54	\$ 24,952
				\$ 349,415
Contractor Overhead - 10%				\$ 34,942
Contractor Profit - 15%				\$ 57,654
Subtotal				\$ 442,010
TOTAL COST				\$ 442,010
PROBABLE CONSTRUCTION COST				\$ 442,000

Cost Estimate Basis:

1. Material quantities were calculated based on preliminary general arrangement of CDS system and location at UAF site.
2. Costs were obtained from original UAF cost estimate and escalated from 2017 costs with CEPCI ratio to 2021 costs.

NSE Estimate No.: N1412075
 Date: 01/22/2015
 Customer: Stanley Consultants
 Location: University of Alaska Fairbanks
 Fairbanks, AK

CEPCI Index 2022
 CEPCI Index 2017
 Scale Factor

Costs used for additional air receiver in CDS building.

ESTIMATE SUMMARY: **Electrical Power Generation**
 Revision: 03/06/2017

DESCRIPTION	QUANTITY	EQUIPMENT	EQUIPMENT		MATERIAL		LABOR				UNIT COST	TOTAL COST	
			UNIT PRICE	EQUIP COST	PRICE PER UNIT	MATERIAL COST	HRS/UNIT	MULT FACT	TOTAL HRS	LABOR RATE			LABOR COST
41.22.13.13 Bridge Cranes	1.0	EA	\$ -	\$ -	\$ 160,000.00	\$ 160,000.00		1.00		\$ 88.00	\$ -	\$ 160,000.00	\$ 160,000
41.22.13.13 Bridge Cranes	1.0	EA	\$ -	\$ -	\$ -	\$ -	500.0	1.00	500	\$ 88.00	\$ 44,000	\$ 44,000.00	\$ 44,000
Misc. Misc. & Materials	8.0	EA	\$ -	\$ -	\$ 18,000.00	\$ 18,000.00	40.0	1.00	330	\$ 88.00	\$ 29,160	\$ 18,000.00	\$ 148,160
22.15.19 Station Instrument air receivers (using B&Ws)	-	EA	\$ -	\$ -	\$ 20,000.00	\$ -	40.0	1.00	-	\$ 88.00	\$ -	#DIV/0!	\$ -
125PSI, 600 CFM Air Compressor	2.0	LS	\$ -	\$ -	\$ 130,000.00	\$ 260,000.00		1.00	40	\$ 88.00	\$ 3,520	\$ 130,000.00	\$ 260,000
125PSI, 600 CFM Air Compressor	2.0	LS	\$ -	\$ -	\$ -	\$ -	20.0	1.00	40	\$ 88.00	\$ 3,520	\$ 1,760.00	\$ 3,520
150PSI, 300 CFM Air Compressor	1.0	LS	\$ -	\$ -	\$ 25,000.00	\$ 25,000.00		1.00	-	\$ 88.00	\$ -	\$ 25,000.00	\$ 25,000
150PSI, 300 CFM Air Compressor	1.0	LS	\$ -	\$ -	\$ -	\$ -	20.0	1.00	20	\$ 88.00	\$ 1,760	\$ 1,760.00	\$ 1,760
Silencer in Transition Duct (Provided by B&W)	1	EA	\$ -	\$ -	\$ -	\$ -	320	1.00	320	\$ 88.00	\$ 28,160	\$ 28,160	\$ 28,160
Fuel Gas Tie & PRV/Metering Sta	1	EA	\$ -	\$ -	\$ 40,000	\$ 40,000	120	1.00	120	\$ 88.00	\$ 10,560	\$ 50,560	\$ 50,560
Fuel Oil Forwarding Skid (With Misc Pumps)	1	EA	\$ -	\$ -	\$ 20,000	\$ 20,000	1.00	1.00	-	\$ 88.00	\$ -	\$ 20,000	\$ 20,000
Fuel Oil Forwarding Skid (With Misc Pumps)	1	EA	\$ -	\$ -	\$ -	\$ -	60	1.00	60	\$ 88.00	\$ 5,280	\$ 5,280	\$ 5,280
Feedwater Heater 1-DA	1	EA	\$ -	\$ -	\$ 190,000	\$ 190,000		1.00	-	\$ 88.00	\$ -	\$ 190,000	\$ 190,000
Feedwater Heater 1-DA	1	EA	\$ -	\$ -	\$ -	\$ -	320	1.00	320	\$ 88.00	\$ 28,160	\$ 28,160	\$ 28,160
Feedwater Heater2	1	EA	\$ -	\$ -	\$ 140,000	\$ 140,000		1.00	-	\$ 88.00	\$ -	\$ 140,000	\$ 140,000
Feedwater Heater2	1	EA	\$ -	\$ -	\$ -	\$ -	320	1.00	320	\$ 88.00	\$ 28,160	\$ 28,160	\$ 28,160
Condensate Receiver	1	EA	\$ -	\$ -	\$ 82,000	\$ 82,000		1.00	-	\$ 88.00	\$ -	\$ 82,000	\$ 82,000
Condensate Receiver	1	EA	\$ -	\$ -	\$ -	\$ -	40	1.00	40	\$ 88.00	\$ 3,520	\$ 3,520	\$ 3,520
Condensate Polishes	1	EA	\$ -	\$ -	\$ 200,000	\$ 200,000		1.00	-	\$ 88.00	\$ -	\$ 200,000	\$ 200,000
Condensate Polishes	1	EA	\$ -	\$ -	\$ -	\$ -	60	1.00	60	\$ 88.00	\$ 5,280	\$ 5,280	\$ 5,280
Hotwell Forwarding Pumps (Vertical)	2	EA	\$ -	\$ -	\$ 67,000	\$ 134,000		1.00	-	\$ 88.00	\$ -	\$ 67,000	\$ 134,000
Hotwell Forwarding Pumps (Vertical)	2	EA	\$ -	\$ -	\$ -	\$ -	40	1.00	80	\$ 88.00	\$ 7,040	\$ 3,520	\$ 7,040
Condensate Pumps (With Misc Pumps)	2	EA	\$ -	\$ -	\$ 110,000	\$ 110,000		1.00	-	\$ 88.00	\$ -	\$ 55,000	\$ 110,000
Condensate Pumps (With Misc Pumps)	2	EA	\$ -	\$ -	\$ -	\$ -	40	1.00	80	\$ 88.00	\$ 7,040	\$ 3,520	\$ 7,040
Aux Cooling Water Pumps (With Misc Pumps)	2	EA	\$ -	\$ -	\$ 10,000	\$ 20,000		1.00	-	\$ 88.00	\$ -	\$ 10,000	\$ 20,000
Aux Cooling Water Pumps (With Misc Pumps)	2	EA	\$ -	\$ -	\$ -	\$ -	60	1.00	120	\$ 88.00	\$ 10,560	\$ 5,280	\$ 10,560
Steam Desuperheating Pumps (With Misc Pumps)	2	EA	\$ -	\$ -	\$ 50,000	\$ 100,000		1.00	-	\$ 88.00	\$ -	\$ 50,000	\$ 100,000
Steam Desuperheating Pumps (With Misc Pumps)	2	EA	\$ -	\$ -	\$ -	\$ -	60	1.00	120	\$ 88.00	\$ 10,560	\$ 5,280	\$ 10,560
Misc Pumps	12	EA	\$ -	\$ -	\$ 10,000	\$ 120,000		1.00	-	\$ 88.00	\$ -	\$ 10,000	\$ 120,000
Misc Pumps	12	EA	\$ -	\$ -	\$ -	\$ -	30	1.00	360	\$ 88.00	\$ 31,680	\$ 2,640	\$ 31,680
Boiler Feed Pumps	2	EA	\$ -	\$ -	\$ 192,000	\$ 384,000		1.00	-	\$ 88.00	\$ -	\$ 192,000	\$ 384,000
Boiler Feed Pumps	2	EA	\$ -	\$ -	\$ -	\$ -	100	1.00	200	\$ 88.00	\$ 17,600	\$ 8,800	\$ 17,600
Aux Cooling Water Heat Exchanger	1	EA	\$ -	\$ -	\$ 195,000	\$ 195,000		1.00	-	\$ 88.00	\$ -	\$ 195,000	\$ 195,000
Aux Cooling Water Heat Exchanger	1	EA	\$ -	\$ -	\$ -	\$ -	100	1.00	100	\$ 88.00	\$ 8,800	\$ 8,800	\$ 8,800
Well Water Heat Recovery Heat Ex	1	EA	\$ -	\$ -	\$ 25,000	\$ 25,000		1.00	100	\$ 88.00	\$ 8,800	\$ 33,800	\$ 33,800
Air comp Heat Exchanger and Fan fan	1	LS	\$ -	\$ -	\$ 90,000	\$ 90,000		1.00	-	\$ 88.00	\$ -	\$ 90,000	\$ 90,000
Air comp Heat Exchanger and Fan fan	1	LS	\$ -	\$ -	\$ -	\$ -	200	1.00	200	\$ 88.00	\$ 17,600	\$ 17,600	\$ 17,600
Sample Panels	1	EA	\$ -	\$ -	\$ 100,000	\$ 100,000		1.00	-	\$ 88.00	\$ -	\$ 100,000	\$ 100,000
Sample Panels	1	EA	\$ -	\$ -	\$ -	\$ -	400	1.00	400	\$ 88.00	\$ 35,200	\$ 35,200	\$ 35,200
Chemical Feed	1	EA	\$ -	\$ -	\$ 99,000	\$ 99,000		1.00	-	\$ 88.00	\$ -	\$ 99,000	\$ 99,000
Chemical Feed	1	EA	\$ -	\$ -	\$ -	\$ -	200	1.00	200	\$ 88.00	\$ 17,600	\$ 17,600	\$ 17,600
Oil/Water Separator	1	EA	\$ -	\$ -	\$ 32,000	\$ 32,000		1.00	-	\$ 88.00	\$ -	\$ 32,000	\$ 32,000
Oil/Water Separator	1	EA	\$ -	\$ -	\$ -	\$ -	80	1.00	80	\$ 88.00	\$ 7,040	\$ 7,040	\$ 7,040
Steam Driven Feedwater Pump	1	LS	\$ -	\$ -	\$ 215,000	\$ 215,000		1.00	-	\$ 88.00	\$ -	\$ 215,000	\$ 215,000
Steam Driven Feedwater Pump	1	LS	\$ -	\$ -	\$ -	\$ -	100	1.00	100	\$ 88.00	\$ 8,800	\$ 8,800	\$ 8,800
Material Handling Equip		Min-Hrs	\$ -	\$ -	\$ 4,024,000	\$ 4,024,000		1.00	-	\$ 88.00	\$ -	#DIV/0!	\$ 4,024,000
Material Handling Equip (was 38K man hours) & 77 Tons of Steel	23,500	Min-Hrs	\$ -	\$ -	\$ -	\$ -	1.0	1.00	23,500	\$ 88.00	\$ 2,068,000	\$ 88	\$ 2,068,000
Ash Limestone Handling		Min-Hrs	\$ -	\$ -	\$ 2,751,000	\$ 2,751,000		1.00	-	\$ 88.00	\$ -	#DIV/0!	\$ 2,751,000
Ash Limestone Handling (was 35K man-hours) & 70-90 Tons of Steel	28,000	Min-Hrs	\$ -	\$ -	\$ -	\$ -	1.0	1.00	28,000	\$ 88.00	\$ 2,464,000	\$ 88	\$ 2,464,000
Boiler Erection	105,600	Min-Hrs	\$ -	\$ -	\$ -	\$ -	1	1.00	105,600	\$ 93.50	\$ 9,873,600	\$ 93.50	\$ 9,873,600
Scal Weld Tubes		ea	\$ -	\$ -	\$ -	\$ -	13	1.00	-	\$ 88.00	\$ -	#DIV/0!	\$ -
PJFF, Duct, ID Fan, Ash Silos	30,000	Min-Hrs	\$ -	\$ -	\$ -	\$ -	1	1.00	30,000	\$ 93.50	\$ 2,805,000	\$ 93.50	\$ 2,805,000
Refract supply & install	1	ls	\$ -	\$ -	\$ 1,000,000	\$ 1,000,000		1.00	-	\$ 79.31	\$ -	\$ 1,000,000	\$ 1,000,000
Scaffolding	1	ls	\$ -	\$ -	\$ 792,000	\$ 792,000	27,000.0	1.00	27,000	\$ 79.31	\$ 2,141,370	\$ 2,933,370	\$ 2,933,370
Surface Water Condenser	-	EA	\$ -	\$ -	\$ 300,000.00	\$ -	120	1.00	-	\$ 88.00	\$ -	#DIV/0!	\$ -
Air Cooled Condenser	1	EA	\$ -	\$ -	\$ -	\$ -	14,500	1.00	14,500	\$ 88.00	\$ 1,276,000	\$ 1,276,000	\$ 1,276,000
Steam Turbine 22Mw Skid	1,000	Min-Hrs	\$ -	\$ -	\$ -	\$ -	1	1.00	1,000	\$ 88.00	\$ 88,000	\$ 88,000	\$ 88,000
Generator Skid (in ST)	1,000	Min-Hrs	\$ -	\$ -	\$ -	\$ -	1	1.00	1,000	\$ 88.00	\$ 88,000	\$ 88,000	\$ 88,000
Lube Oil Pkg w/instr, aux, pump	1	EA	\$ -	\$ -	\$ -	\$ -	500	1.00	500	\$ 88.00	\$ 44,000	\$ 44,000.00	\$ 44,000
Stack Supply & Install	1	EA	\$ -	\$ -	\$ 958,150	\$ 958,150		1.00	-	\$ 88.00	\$ -	\$ 958,150	\$ 958,150

NSE Estimate No.: N1412075
 Date: 01/22/2015
 Customer: Stanley Consultants
 Location: University of Alaska Fairbanks
 Fairbanks, AK

CEPCI Index 2022
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Scale Factor

ESTIMATE SUMMARY: **Electrical Power Generation**

Revision: **03/06/2017**

DESCRIPTION	QUANTITY No. UNITS	EQUIPMENT UNIT PRICE	EQUIP COST	MATERIAL		LABOR			UNIT COST	TOTAL COST			
				PRICE PER UNIT	MATERIAL COST	HRS/ UNIT	MULT FACT	TOTAL HRS			LABOR RATE	LABOR COST	
Modeled Piping													
40.11.13 ACC System 6" Sch 40	90	LF	\$ -	\$ -	\$ 57.00	\$ 5,130	3,2687	1.00	294.18	\$ 93.50	\$ 27,506	\$ 362.62	\$ 32,636
40.11.13 ACC System 4" Sch 40	97	LF	\$ -	\$ -	\$ 33.00	\$ 3,201	3,1200	1.00	302.64	\$ 93.50	\$ 28,297	\$ 324.72	\$ 31,498
40.11.13 Aux Cooling Water System 10" Sch 40	289	LF	\$ -	\$ -	\$ 123.00	\$ 35,547	4,2730	1.00	1,234.90	\$ 93.50	\$ 115,463	\$ 522.53	\$ 151,010
40.11.13 Aux Cooling Water System 8" Sch 40	253	LF	\$ -	\$ -	\$ 87.00	\$ 22,011	3,9000	1.00	986.70	\$ 93.50	\$ 92,256	\$ 451.65	\$ 114,267
40.11.13 Aux Cooling Water System 6" Sch 40	183	LF	\$ -	\$ -	\$ 57.00	\$ 10,431	3,2687	1.00	598.17	\$ 93.50	\$ 55,929	\$ 362.62	\$ 66,360
40.11.13 Aux Cooling Water System 4" Sch 40	68	LF	\$ -	\$ -	\$ 33.00	\$ 2,244	3,1200	1.00	212.16	\$ 93.50	\$ 19,837	\$ 324.72	\$ 22,081
40.11.13 Aux Cooling Water System 3" Sch 40	569	LF	\$ -	\$ -	\$ 22.50	\$ 12,803	2,3158	1.00	1,317.69	\$ 93.50	\$ 123,204	\$ 239.03	\$ 136,007
40.11.13 Boiler Feed System 10" Sch 40	47	LF	\$ -	\$ -	\$ 123.00	\$ 5,781	4,2730	1.00	200.83	\$ 93.50	\$ 18,778	\$ 522.53	\$ 24,559
40.11.13 Boiler Feed System 8" Sch 40	0	LF	\$ -	\$ -	\$ 141.00	\$ -	4,9280	1.00	0.00	\$ 93.50	\$ -	#DIV/0!	\$ -
40.11.13 Boiler Feed System 6" Sch 40	245	LF	\$ -	\$ -	\$ 87.00	\$ 21,315	3,9000	1.00	955.50	\$ 93.50	\$ 89,339	\$ 451.65	\$ 110,654
40.11.13 Boiler Feed System 4" Sch 40	307	LF	\$ -	\$ -	\$ 93.00	\$ 28,551	3,8980	1.00	1,196.69	\$ 93.50	\$ 111,891	\$ 457.47	\$ 140,442
40.11.13 Boiler Feed System 3" Sch 40	5	LF	\$ -	\$ -	\$ 45.00	\$ 225	2,2900	1.00	16.40	\$ 93.50	\$ 1,533	\$ 351.90	\$ 1,758
40.11.13 Boiler Feed System 2" Sch 40	54	LF	\$ -	\$ -	\$ 33.00	\$ 1,782	3,1200	1.00	168.48	\$ 93.50	\$ 15,753	\$ 324.72	\$ 17,535
40.11.13 Boiler Feed System 1.5" Sch 40	18	LF	\$ -	\$ -	\$ 30.00	\$ 540	2,8472	1.00	51.25	\$ 93.50	\$ 4,792	\$ 296.22	\$ 5,332
40.11.13 Boiler Feed System 1" Sch 40	330	LF	\$ -	\$ -	\$ 22.50	\$ 7,425	2,3158	1.00	764.21	\$ 93.50	\$ 71,454	\$ 239.03	\$ 78,879
40.11.13 Boiler Feed System 2" Sch 40	0	LF	\$ -	\$ -	\$ 15.00	\$ -	2,6118	1.00	0.00	\$ 93.50	\$ -	#DIV/0!	\$ -
40.11.13 Boiler Feed System 2" Sch 40	0	LF	\$ -	\$ -	\$ 12.00	\$ -	1,5116	1.00	0.00	\$ 93.50	\$ -	#DIV/0!	\$ -
40.11.13 Boiler Feed System 1.5" Sch 40	0	LF	\$ -	\$ -	\$ 12.00	\$ -	1,6794	1.00	0.00	\$ 93.50	\$ -	#DIV/0!	\$ -
40.11.13 Boiler Feed System 1" Sch 40	33	LF	\$ -	\$ -	\$ 9.00	\$ 297	1,0000	1.00	33.00	\$ 93.50	\$ 3,086	\$ 102.52	\$ 3,383
40.11.13 Boiler Drains 6" Sch 80	12	LF	\$ -	\$ -	\$ 93.00	\$ 1,116	3,8980	1.00	46.76	\$ 93.50	\$ 4,374	\$ 457.50	\$ 5,490
40.11.13 Boiler Drains 4" Sch 80	69	LF	\$ -	\$ -	\$ 45.00	\$ 3,105	3,2800	1.00	236.32	\$ 93.50	\$ 21,161	\$ 351.68	\$ 24,266
40.11.13 Boiler Drains 2.5" Sch 80	143	LF	\$ -	\$ -	\$ 22.50	\$ 3,218	2,7120	1.00	387.82	\$ 93.50	\$ 36,261	\$ 276.08	\$ 39,479
40.11.13 Boiler Drains 2" Sch 80	26	LF	\$ -	\$ -	\$ 12.00	\$ 312	1,5116	1.00	39.30	\$ 93.50	\$ 3,675	\$ 153.35	\$ 3,987
40.11.13 Boiler Drains 1.5" Sch 80	2	LF	\$ -	\$ -	\$ 12.00	\$ 24	1,2114	1.00	2.42	\$ 93.50	\$ 226	\$ 125.00	\$ 250
40.11.13 Boiler System 1" Sch 40	202	LF	\$ -	\$ -	\$ 9.00	\$ 1,818	0,8946	1.00	180.71	\$ 93.50	\$ 16,896	\$ 92.64	\$ 18,714
40.11.13 Blowdown System 18" Sch 40	43	LF	\$ -	\$ -	\$ 206.00	\$ 8,858	8,1099	1.00	348.73	\$ 93.50	\$ 32,606	\$ 964.28	\$ 11,464
40.11.13 Blowdown System 8" Sch 40	105	LF	\$ -	\$ -	\$ 87.00	\$ 9,135	3,6000	1.00	409.50	\$ 93.50	\$ 38,288	\$ 451.65	\$ 47,423
40.11.13 Blowdown System 4" Sch 40	66	LF	\$ -	\$ -	\$ 33.00	\$ 2,178	3,1200	1.00	205.92	\$ 93.50	\$ 19,254	\$ 324.72	\$ 21,432
40.11.13 Blowdown System 2.5" Sch 40	87	LF	\$ -	\$ -	\$ 22.50	\$ 1,958	2,7120	1.00	235.94	\$ 93.50	\$ 22,060	\$ 276.07	\$ 24,018
40.11.13 Blowdown System 1.5" Sch 40	0	LF	\$ -	\$ -	\$ 12.00	\$ -	1,2114	1.00	0.00	\$ 93.50	\$ -	#DIV/0!	\$ -
40.11.13 Chilled Water System 8" Sch 40	740	LF	\$ -	\$ -	\$ 87.00	\$ 64,380	3,9000	1.00	2,886.00	\$ 93.50	\$ 269,841	\$ 451.65	\$ 334,221
40.11.13 Chilled Water System 6" Sch 40	17	LF	\$ -	\$ -	\$ 57.00	\$ 969	3,2687	1.00	55.57	\$ 93.50	\$ 5,196	\$ 362.65	\$ 6,165
40.11.13 Condensate System 10" Sch 40	0	LF	\$ -	\$ -	\$ 123.00	\$ -	4,2730	1.00	0.00	\$ 93.50	\$ -	#DIV/0!	\$ -
40.11.13 Condensate System 10" Sch 80	152	LF	\$ -	\$ -	\$ 153.00	\$ 23,256	5,4000	1.00	820.80	\$ 93.50	\$ 76,745	\$ 657.90	\$ 100,001
40.11.13 Condensate System 8" Sch 40	42	LF	\$ -	\$ -	\$ 87.00	\$ 3,654	3,9000	1.00	163.80	\$ 93.50	\$ 15,315	\$ 451.64	\$ 18,969
40.11.13 Condensate System 6" Sch 40	0	LF	\$ -	\$ -	\$ 57.00	\$ -	3,2687	1.00	0.00	\$ 93.50	\$ -	#DIV/0!	\$ -
40.11.13 Condensate System 6" Sch 80	238	LF	\$ -	\$ -	\$ 93.00	\$ 22,134	3,8980	1.00	927.72	\$ 93.50	\$ 86,742	\$ 457.46	\$ 108,876
40.11.13 Condensate System 4" Sch 40	215	LF	\$ -	\$ -	\$ 33.00	\$ 7,095	3,1200	1.00	670.80	\$ 93.50	\$ 62,720	\$ 324.72	\$ 69,815
40.11.13 Condensate System 4" Sch 80	258	LF	\$ -	\$ -	\$ 45.00	\$ 11,610	3,2800	1.00	846.24	\$ 93.50	\$ 79,123	\$ 351.68	\$ 90,733
40.11.13 Condensate System 3" Sch 40	223	LF	\$ -	\$ -	\$ 22.50	\$ 5,018	2,3158	1.00	516.42	\$ 93.50	\$ 48,285	\$ 239.03	\$ 53,303
40.11.13 Condensate System 2.5" Sch 40	0	LF	\$ -	\$ -	\$ 18.75	\$ -	1,9137	1.00	0.00	\$ 93.50	\$ -	#DIV/0!	\$ -
40.11.13 Condensate System 2" Sch 40	0	LF	\$ -	\$ -	\$ 12.00	\$ -	1,5116	1.00	0.00	\$ 93.50	\$ -	#DIV/0!	\$ -
40.11.13 Condensate System 2" Sch 80	8	LF	\$ -	\$ -	\$ 15.00	\$ 120	2,6118	1.00	20.89	\$ 93.50	\$ 1,953	\$ 259.13	\$ 2,073
40.11.13 Condensate System 1.5" Sch 40	0	LF	\$ -	\$ -	\$ 12.00	\$ -	1,2114	1.00	0.00	\$ 93.50	\$ -	#DIV/0!	\$ -
40.11.13 Condensate System 1" Sch 40	100	LF	\$ -	\$ -	\$ 3.00	\$ 300	0,8946	1.00	89.46	\$ 93.50	\$ 8,365	\$ 86.65	\$ 8,665
40.11.13 Condensate System 1" Sch 80	0	LF	\$ -	\$ -	\$ 3.00	\$ -	0,8946	1.00	0.00	\$ 93.50	\$ -	#DIV/0!	\$ -
40.11.13 Condensate System 5" Sch 80	39	LF	\$ -	\$ -	\$ 9.00	\$ 351	1,0000	1.00	39.00	\$ 93.50	\$ 3,647	\$ 102.51	\$ 3,998
40.11.13 Condensate System 5" SST tubing	0	LF	\$ -	\$ -	\$ 3.00	\$ -	0,8946	1.00	0.00	\$ 93.50	\$ -	#DIV/0!	\$ -
40.11.13 Fuel Gas System 8" Sch 40	0	LF	\$ -	\$ -	\$ 87.00	\$ -	3,9000	1.00	0.00	\$ 93.50	\$ -	#DIV/0!	\$ -
40.11.13 Fuel Gas System 6" Sch 40	165	LF	\$ -	\$ -	\$ 57.00	\$ 9,405	3,2687	1.00	539.34	\$ 93.50	\$ 50,428	\$ 362.62	\$ 59,833
40.11.13 High Pressure Steam 12" Sch 40	0	LF	\$ -	\$ -	\$ 195.00	\$ -	6,1300	1.00	0.00	\$ 93.50	\$ -	#DIV/0!	\$ -
40.11.13 High Pressure Steam 12" Sch 80	298	LF	\$ -	\$ -	\$ 135.00	\$ 40,230	4,8541	1.00	1,446.52	\$ 93.50	\$ 135,250	\$ 588.86	\$ 75,480
40.11.13 High Pressure Steam 10" Sch 40	0	LF	\$ -	\$ -	\$ 153.00	\$ -	5,4000	1.00	0.00	\$ 93.50	\$ -	#DIV/0!	\$ -
40.11.13 High Pressure Steam 10" Sch 80	200	LF	\$ -	\$ -	\$ 123.00	\$ 24,600	4,2730	1.00	854.60	\$ 93.50	\$ 79,905	\$ 522.53	\$ 104,505
40.11.13 High Pressure Steam 8" Sch 40	92	LF	\$ -	\$ -	\$ 141.00	\$ 12,972	4,9280	1.00	453.38	\$ 93.50	\$ 42,391	\$ 601.77	\$ 55,363
40.11.13 High Pressure Steam 6" Sch 40	2	LF	\$ -	\$ -	\$ 93.00	\$ 186	3,8980	1.00	7.80	\$ 93.50	\$ 729	\$ 457.50	\$ 915
40.11.13 High Pressure Steam 6" Sch 80	68	LF	\$ -	\$ -	\$ 57.00	\$ 3,876	3,2687	1.00	222.21	\$ 93.50	\$ 20,782	\$ 362.62	\$ 24,658
40.11.13 High Pressure Steam 4" Sch 40	0	LF	\$ -	\$ -	\$ 45.00	\$ -	3,2800	1.00	0.00	\$ 93.50	\$ -	#DIV/0!	\$ -
40.11.13 High Pressure Steam 3" Sch 40	2	LF	\$ -	\$ -	\$ 22.50	\$ 45	2,3158	1.00	4.63	\$ 93.50	\$ 433	\$ 239.00	\$ 478

NSE Estimate No.: N1412075
Date: 01/22/2015
Customer: Stanley Consultants
Location: University of Alaska Fairbanks
Fairbanks, AK

CEPCI Index 2022
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ESTIMATE SUMMARY: Electrical Power Generation
Revision: 03/06/2017

Table with columns: DESCRIPTION, QUANTITY, EQUIPMENT, MATERIAL, LABOR, UNIT, TOTAL. Includes handwritten annotations: 'Costs used for 1" carbon steel pipe for water make up to CDS building' and 'Costs used for 2" stainless steel pipe for air make up to CDS building'.

NSE Estimate No.: N1412075
 Date: 01/22/2015
 Customer: Stanley Consultants
 Location: University of Alaska Fairbanks
 Fairbanks, AK

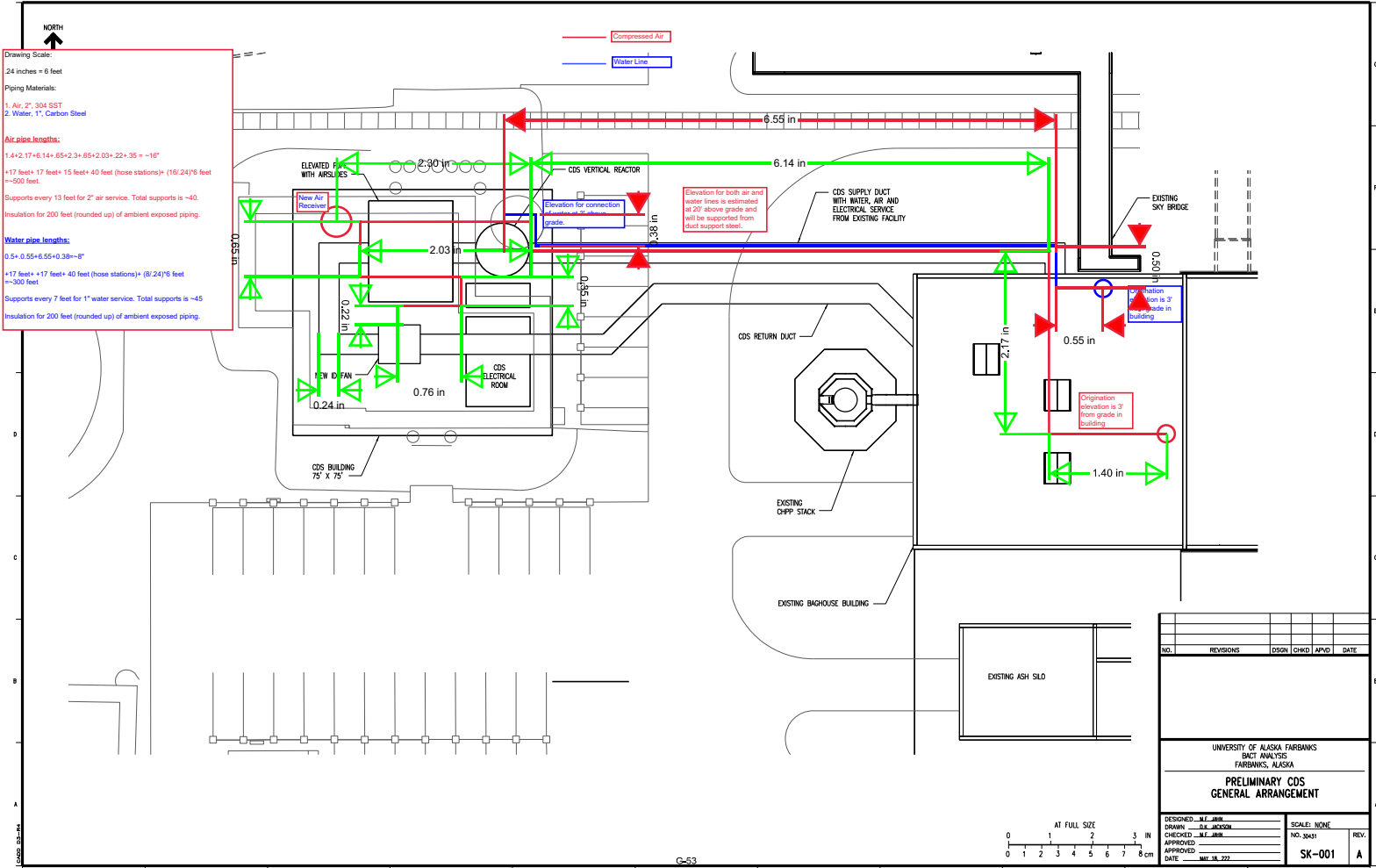
CEPCI Index 2022
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Scale Factor

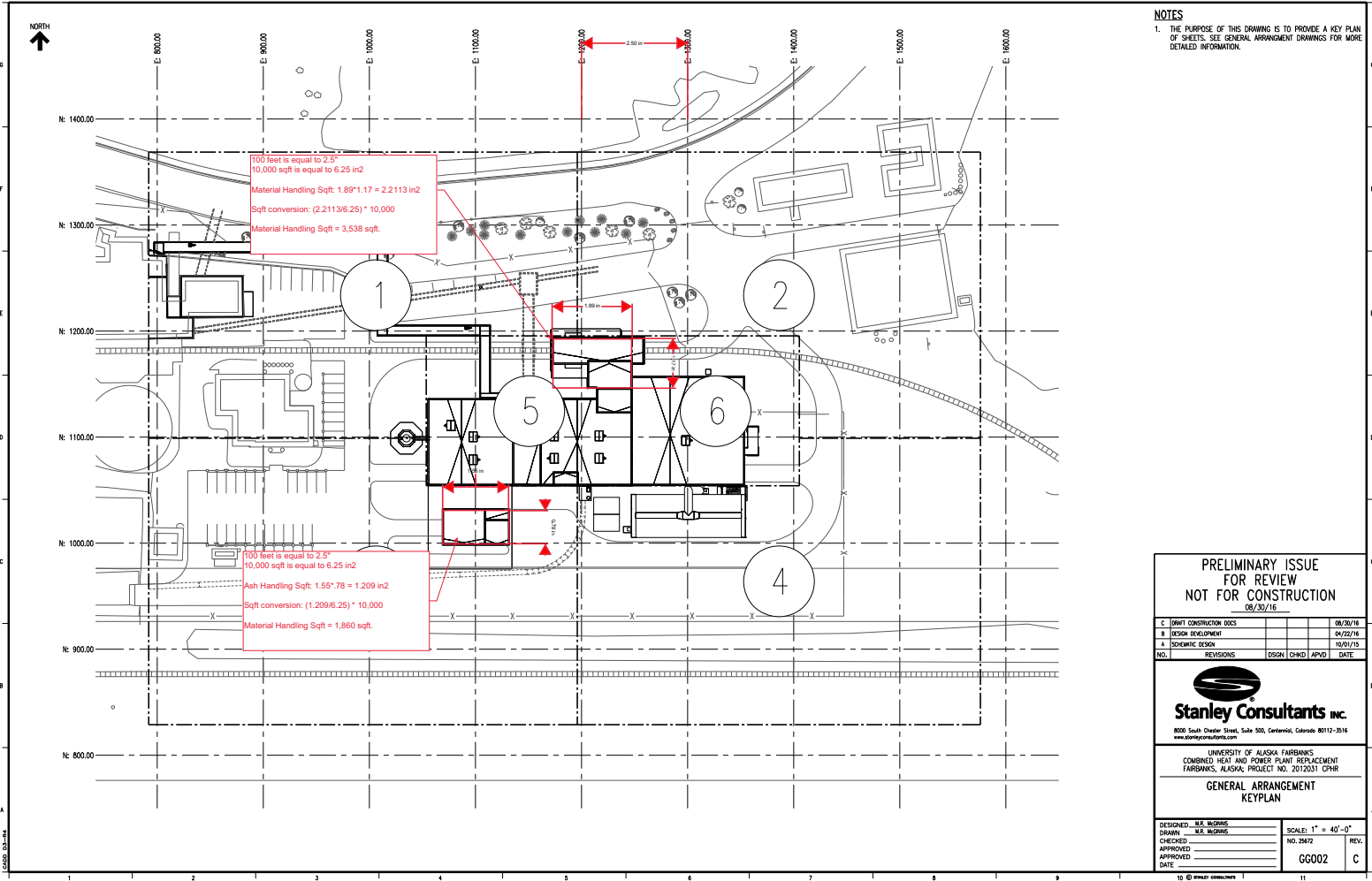
ESTIMATE SUMMARY: **Electrical Power Generation**
 Revision: 03/06/2017

DESCRIPTION	QUANTITY No. UNITS	EQUIPMENT UNIT PRICE	EQUIP COST	MATERIAL PRICE PER UNIT	MATERIAL COST	HRS/ UNIT	MULT FACT	LABOR TOTAL HRS	LABOR RATE	LABOR COST	UNIT COST	TOTAL COST
Additional SB Piping- Fuel Gas System	100	LF	\$ -	\$ -	12.00	\$ -	1.00	150.00	\$ 93.50	\$ 14,025	\$ 152.25	\$ 15,225
Additional SB Piping- Fuel Oil System	900	LF	\$ -	\$ -	12.00	\$ -	1.00	1,350.00	\$ 93.50	\$ 126,225	\$ 152.25	\$ 137,025
Additional SB Piping- Inst Air System	3800	LF	\$ -	\$ -	12.00	\$ -	1.00	5,700.00	\$ 93.50	\$ 532,950	\$ 152.25	\$ 578,550
40.11.13 Low Pressure Steam 1.5" Sch 40	75	LF	\$ -	\$ -	12.114	\$ -	1.00	90.86	\$ 93.50	\$ 8,495	\$ 125.27	\$ 9,395
40.11.13 Low Pressure Steam 1" Sch 40	90	LF	\$ -	\$ -	0.8946	\$ -	1.00	80.51	\$ 93.50	\$ 7,528	\$ 92.64	\$ 8,338
40.11.13 Additional SB Piping- Service Air System	1600	LF	\$ -	\$ -	1.50	\$ -	1.00	2,400.00	\$ 93.50	\$ 224,400	\$ 152.25	\$ 243,600
40.11.13 Sample Panel 1.5" Sch 40	10	LF	\$ -	\$ -	1.2114	\$ -	1.00	12.11	\$ 93.50	\$ 1,132	\$ 125.20	\$ 1,252
40.11.13 Service Water System 2" Sch 40	225	LF	\$ -	\$ -	1.5116	\$ -	1.00	340.11	\$ 93.50	\$ 31,800	\$ 153.33	\$ 34,500
40.11.13 Service Water System 1.5" Sch 40	455	LF	\$ -	\$ -	1.2114	\$ 5,460	1.00	551.19	\$ 93.50	\$ 51,536	\$ 125.27	\$ 56,996
40.11.13 Service Water System 1" Sch 40	295	LF	\$ -	\$ -	0.8946	\$ 2,655	1.00	263.91	\$ 93.50	\$ 24,676	\$ 92.65	\$ 27,331
40.11.13 Additional SB Piping- Service Water System Sample System Tubing	1025	LF	\$ -	\$ -	1.50	\$ 12,300	1.00	1,537.50	\$ 93.50	\$ 143,756	\$ 152.25	\$ 156,056
40.11.13 Piping Specialties- BOP Only	1500	LF	\$ -	\$ -	1.00	\$ 18,000	0.8	1,200.00	\$ 93.50	\$ 112,200	\$ 92.80	\$ 139,200
40.11.13 Plant Manual Valves - BOP Only	1	LS	\$ -	\$ -	30,000	\$ 30,000	1.00	0.00	\$ 93.50	\$ -	\$ 30,000.00	\$ 30,000
40.11.13 Plant Control Valves - BOP Only	1	LS	\$ -	\$ -	400,000	\$ 400,000	2,200	2,200.00	\$ 93.50	\$ 205,700	\$ 605,700.00	\$ 605,700
40.11.13 Plant Control Valves - BOP Only	1	LS	\$ -	\$ -	331,000	\$ 331,000	1.00	0.00	\$ 93.50	\$ -	\$ 331,000.00	\$ 331,000
40.11.13 Plant Desuperheater Valves - BOP Only	1	LS	\$ -	\$ -	-	\$ -	2,500	2,500.00	\$ 93.50	\$ 233,750	\$ 233,750.00	\$ 233,750
40.11.13 Plant Desuperheater Valves - BOP Only	1	LS	\$ -	\$ -	145,400	\$ 145,400	1.00	0.00	\$ 93.50	\$ -	\$ 145,400.00	\$ 145,400
40.11.13 Plant Desuperheater Valves - BOP Only	1	LS	\$ -	\$ -	-	\$ -	40	40.00	\$ 93.50	\$ 3,740	\$ 3,740.00	\$ 3,740
Slide Supports	13	EA	\$ -	\$ -	3,200.00	\$ 34,000	2.0	26.00	\$ 93.50	\$ 2,425	\$ 2,425.00	\$ 2,425
Slide Supports	750	EA	\$ -	\$ -	300.00	\$ 216,000	16.0	11,920.00	\$ 93.50	\$ 1,077,120	\$ 1,796.00	\$ 1,293,120
Piping Insulation- Fiber	9000	LF	\$ -	\$ -	10.00	\$ 90,000	1.2	10,440.00	\$ 81.59	\$ 851,800	\$ 104.54	\$ 941,800
Piping Insulation- neoprene	3100	LF	\$ -	\$ -	3.33	\$ 9,990	0.2567	791.00	\$ 81.59	\$ 64,583	\$ 34.06	\$ 104,893
Insulation	92,600	SP	\$ -	\$ -	10.00	\$ 926,000	0.250	23,150	\$ 81.59	\$ 1,888,809	\$ 30	\$ 2,814,809
Pipe Painting	6000	LF	\$ -	\$ -	48.08	\$ 288,480	1.00	0.00	\$ 74.80	\$ -	\$ 48.08	\$ 288,480
40.76.13 CEMS (Continuous Emissions Monitoring System)	1	LS	\$ -	\$ -	298,000	\$ 298,000	1.00	0.00	\$ 88.00	\$ -	\$ 298,000.00	\$ 298,000
40.76.13 CEMS (Continuous Emissions Monitoring System)	1	LS	\$ -	\$ -	-	\$ -	200	200.00	\$ 88.00	\$ 17,600	\$ 17,600.00	\$ 17,600
DCS	1	EA	\$ -	\$ -	1,100,000	\$ 1,100,000	1.00	200	\$ 88.00	\$ 17,600	\$ 1,117,600	\$ 1,117,600
DCS	1	EA	\$ -	\$ -	-	\$ -	200.0	200	\$ 88.00	\$ 17,600	\$ 17,600	\$ 17,600
Instrument Tubing BOP Valves	900	IF	\$ -	\$ -	18.00	\$ 16,200	0.8	720.00	\$ 93.50	\$ 67,320	\$ 92.80	\$ 83,520
Instrument Tubing UAF/HD BOP Supplier Valves	1665	IF	\$ -	\$ -	18.00	\$ 29,970	0.8	1,332.00	\$ 93.50	\$ 124,542	\$ 92.80	\$ 154,512
Instrument Tubing Pressure and Flow Transmitters	2805	IF	\$ -	\$ -	18.00	\$ 50,490	0.8	2,244.00	\$ 93.50	\$ 209,814	\$ 92.80	\$ 260,304
Plant Instrumentation Install UAF Provided Equipment	1	LS	\$ -	\$ -	-	\$ -	500	500	\$ 93.50	\$ 46,750	\$ 46,750	\$ 46,750
Plant Instrumentation Install UAF Provided Equipment	1	LS	\$ -	\$ -	559,000	\$ 559,000	1,674	1,674	\$ 93.50	\$ 156,519	\$ 715,519	\$ 715,519
Vibration Monitoring System (Bentley Nevada)	1	LS	\$ -	\$ -	75,000	\$ 75,000	300	300	\$ 88.00	\$ 26,400	\$ 101,400	\$ 101,400
			\$ -	\$ -		\$ 17,824,534		347,793		\$ 31,316,543		\$ 49,141,077

Costs used 1" and 2" pipe supports and insulation to CDS system from main plant



**CIRCULATING DRY SCRUBBER
COST ESTIMATE
EXISTING BUILDINGS
SQUARE FOOTAGE CALCULATION**



**PRELIMINARY ISSUE
 FOR REVIEW
 NOT FOR CONSTRUCTION**
 08/30/16

C	LIMIT CONSTRUCTION ISSUES	08/30/16
B	DESIGN DEVELOPMENT	04/22/16
A	SCHEMATIC DESIGN	10/01/15
NO.	REVISIONS	DSGN CHKD APVD DATE

Stanley Consultants INC.
 800 South Chester Street, Suite 500, Centennial, Colorado 80112-3516
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UNIVERSITY OF ALASKA FAIRBANKS
 COMBINED HEAT AND POWER PLANT REPLACEMENT
 FAIRBANKS, ALASKA, PROJECT NO. 2012031 CPHR

**GENERAL ARRANGEMENT
 KEYPLAN**

DESIGNED: <u>ME, INCORP</u>	SCALE: 1" = 40'-0"	REV.
DRAWN: <u>ME, INCORP</u>	NO. 25672	
CHECKED: _____		
APPROVED: _____	GG002	C
DATE: _____		

10 © STANLEY CONSULTANTS 11

**CIRCULATING DRY SCRUBBER
COST ESTIMATE
GOLDEN HEART RELOCATION BACKUP COSTS**

Jahn, Mario

From: Frances Isgrigg <fisgrigg@alaska.edu>
Sent: Tuesday, August 23, 2022 3:27 PM
To: Jahn, Mario
Cc: Courtney Kimball; Solan, John; Payne, Mark
Subject: Re: Cost of GHU Connection

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

I added the drawings to BOX. That might help.

On Tue, Aug 23, 2022 at 12:55 PM Jahn, Mario <JahnMario@stanleygroup.com> wrote:

Thanks for forwarding Courtney. If we have anything that explains exactly what this entails that would be great. I'm still trying to wrap my head around what the scope for the connection is. Do we have a quote from 2017 that we can attached for reference as well?

From: Courtney Kimball <ckimball@boreal-services.com>
Sent: Tuesday, August 23, 2022 2:29 PM
To: Jahn, Mario <JahnMario@stanleygroup.com>
Subject: FW: Cost of GHU Connection

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

Mario,

Please feel free to reply to Frances and me if you have follow-up questions on this.

--Courtney

From: Frances Isgrigg <fisgrigg@alaska.edu>
Sent: Tuesday, August 23, 2022 11:59
To: Courtney Kimball <ckimball@boreal-services.com>; Mark Payne <PayneMark@stanleygroup.com>
Subject: Cost of GHU Connection

Courtney and Mark,

Total \$s for new connection to GHU was \$686,300 in 2017 dollars. I should have your numbers today or tomorrow regarding the cost associated with downtime on EU 113.

Frances

Using CEPCI index to scale from
2017 to 2021 costs.

$$708/567.5 = 1.25$$

$$\$683,300 * 1.25 = \$856,212$$

Frances M. Isgrigg, PE
Division of Design and Construction
907-590-5809

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Frances M. Isgrigg, PE
Division of Design and Construction
907-590-5809

	BUDGET	EXPENSES	ENCUMBRANCE	CALC'D RECHARGE	BALANCE
D16052 - WTUC WATER TREATMENT PLANT COLLEGE UTILITY CONNECTION					
173012-50268	686,300.19	686,300.19	-	-	0.00
Grand Total	686,300.19	686,300.19	-	-	0.00

	BUDGET	EXPENSES	ENCUMBRANCE	CALC'D RECHARGE	BALANCE
D16052 - WTUC WATER TREATMENT PLANT COLLEGE UTILITY CONNECTION					
Project Budget	686,300.19	-	-	-	
DDC Labor*	-	46,508.25	-	-	
Professional Fees-Other	-	1,840.00	-	-	
DEC FAIRBANKS 1805	-	440.00	-	-	
FAIRBANKS PUBLIC INFO	-	500.00	-	-	
PNP00124_115 FBKS PLB INFO 5/17/16	-	900.00	-	-	
Recharge Expense	-	16,590.82	-	-	
Recruitment & Procurement Advertising	-	437.13	-	-	
Shop/Warehouse Support	-	1,060.45	-	-	
Utilities Costs	-	17,850.00	-	-	
11014259 COLLEGE UTIL 3/16/16	-	17,850.00	-	-	
Consultant Contract	-	70,948.90	-	-	
Design Alaska	-	70,948.90	-	-	
Construction Contract	-	531,064.64	-	-	
Patrick Mechanical	-	107,124.00	-	-	
Western Mechanical Inc	-	423,940.64	-	-	
Grand Total	686,300.19	686,300.19	-	-	(0.00)

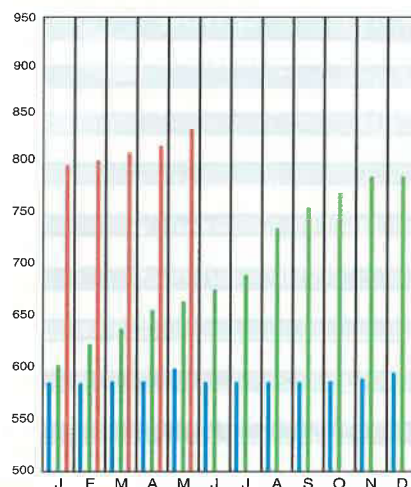
**CIRCULATING DRY SCRUBBER
COST ESTIMATE
CEPCI INDEX BACKUP**

2020 2021 2022

Download the CEPCI two weeks sooner at www.chemengonline.com/pci

CHEMICAL ENGINEERING PLANT COST INDEX (CEPCI)

(1957-59 = 100)	May '22 Prelim.	Apr. '22 Final	May '21 Final	Annual Index:
CE Index	831.7	816.3	686.7	2014 = 576.1
Equipment	1,057.1	1,037.1	848.5	2015 = 556.8
Heat exchangers & tanks	902.4	876.0	726.6	2016 = 541.7
Process machinery	1,074.9	1,063.9	862.9	2017 = 567.5
Pipe, valves & fittings	1,496.7	1,472.8	1,160.6	2018 = 603.1
Process instruments	575.5	573.5	507.5	2019 = 607.5
Pumps & compressors	1,255.1	1,248.9	1,115.6	2020 = 596.2
Electrical equipment	757.3	751.8	601.0	2021 = 708.0
Structural supports & misc.	1,176.8	1,144.7	915.0	
Construction labor	354.6	348.3	341.7	
Buildings	847.2	827.0	739.2	
Engineering & supervision	311.5	311.8	310.4	

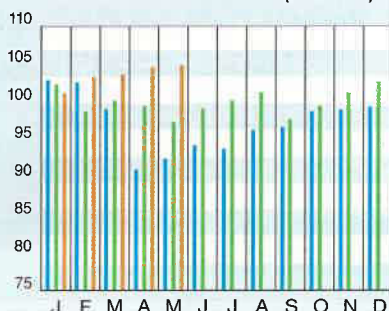


Starting in April 2007, several data series for labor and compressors were converted to accommodate series IDs discontinued by the U.S. Bureau of Labor Statistics (BLS). Starting in March 2018, the data series for chemical industry special machinery was replaced because the series was discontinued by BLS (see *Chem. Eng.*, April 2018, p. 76-77.)

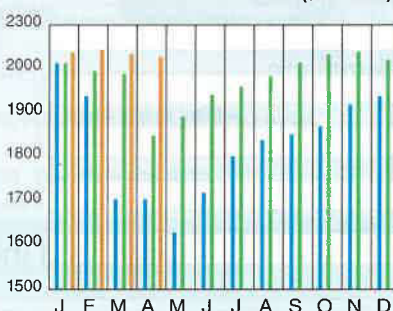
CURRENT BUSINESS INDICATORS

	LATEST	PREVIOUS	YEAR AGO
CPI output index (2017 = 100)	May '22 = 101.7	Apr. '22 = 101.3	Mar. '22 = 101.0
CPI value of output, \$ billions	Apr. '22 = 2,082.8	Mar. '22 = 2,088.1	Feb. '22 = 2,004.7
CPI operating rate, %	May '22 = 80.8	Apr. '22 = 80.5	Mar. '22 = 80.3
Producer prices, industrial chemicals (1982 = 100)	May '22 = 367.8	Apr. '22 = 358.5	Mar. '22 = 354.2
Industrial Production in Manufacturing (2017 = 100)*	May '22 = 103.1	Apr. '22 = 103.2	Mar. '22 = 102.4
Hourly earnings index, chemical & allied products (1992 = 100)	May '22 = 199.6	Apr. '22 = 196.7	Mar. '22 = 195.9
Productivity index, chemicals & allied products (1992 = 100)	May '22 = 91.8	Apr. '22 = 93.8	Mar. '22 = 93.5

CPI OUTPUT INDEX (2017 = 100)†



CPI OUTPUT VALUE (\$ BILLIONS)



CPI OPERATING RATE (%)



*Due to discontinuance, the Index of Industrial Activity has been replaced by the Industrial Production in Manufacturing index from the U.S. Federal Reserve Board.
†For the current month's CPI output index values, the base year was changed from 2012 to 2017
Current business indicators provided by Global Insight, Inc., Lexington, Mass.

CURRENT TRENDS

The preliminary value for the CE Plant Cost Index (CEPCI; top) for May 2022 (most recent available) is once again higher than the previous month's value, continuing the string of monthly increases that has been observed since autumn 2020. In May of this year, increases occurred in the Equipment, Buildings and Construction Labor sub-indices, while the Engineering & Supervision subindices saw a very small decrease. The current CEPCI value now sits at 21.1% higher than the corresponding value from May 2021. Meanwhile, the Current Business Indicators (middle) show increases in the CPI output index and the CPI operating rate for May 2021, and a small decrease in the CPI value of output for April 2021.

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27206

**CIRCULATING DRY SCRUBBER
COST ESTIMATE
INFLATION CALCULATOR BACKUP**



Bureau of Labor Statistics > Data Tools > Charts and Applications > Inflation Calculator

CPI Inflation Calculator

CPI Inflation Calculator

\$ 1,000.00

in January ▼ 2022 ▼

has the same buying power as

in July ▼ 2022 ▼

About the CPI Inflation Calculator

The CPI inflation calculator uses the [Consumer Price Index](#) for All Urban Consumers (CPI-U) U.S. city average series for all items, not seasonally adjusted. [This data](#) represents changes in the prices of all goods and services purchased for consumption by urban households.

U.S. BUREAU OF LABOR STATISTICS Postal Square Building 2 Massachusetts Avenue NE Washington, DC 20212-0001

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**CIRCULATING DRY SCRUBBER
COST ESTIMATE
CITY COST INDEX BACKUP**

City Cost Indexes

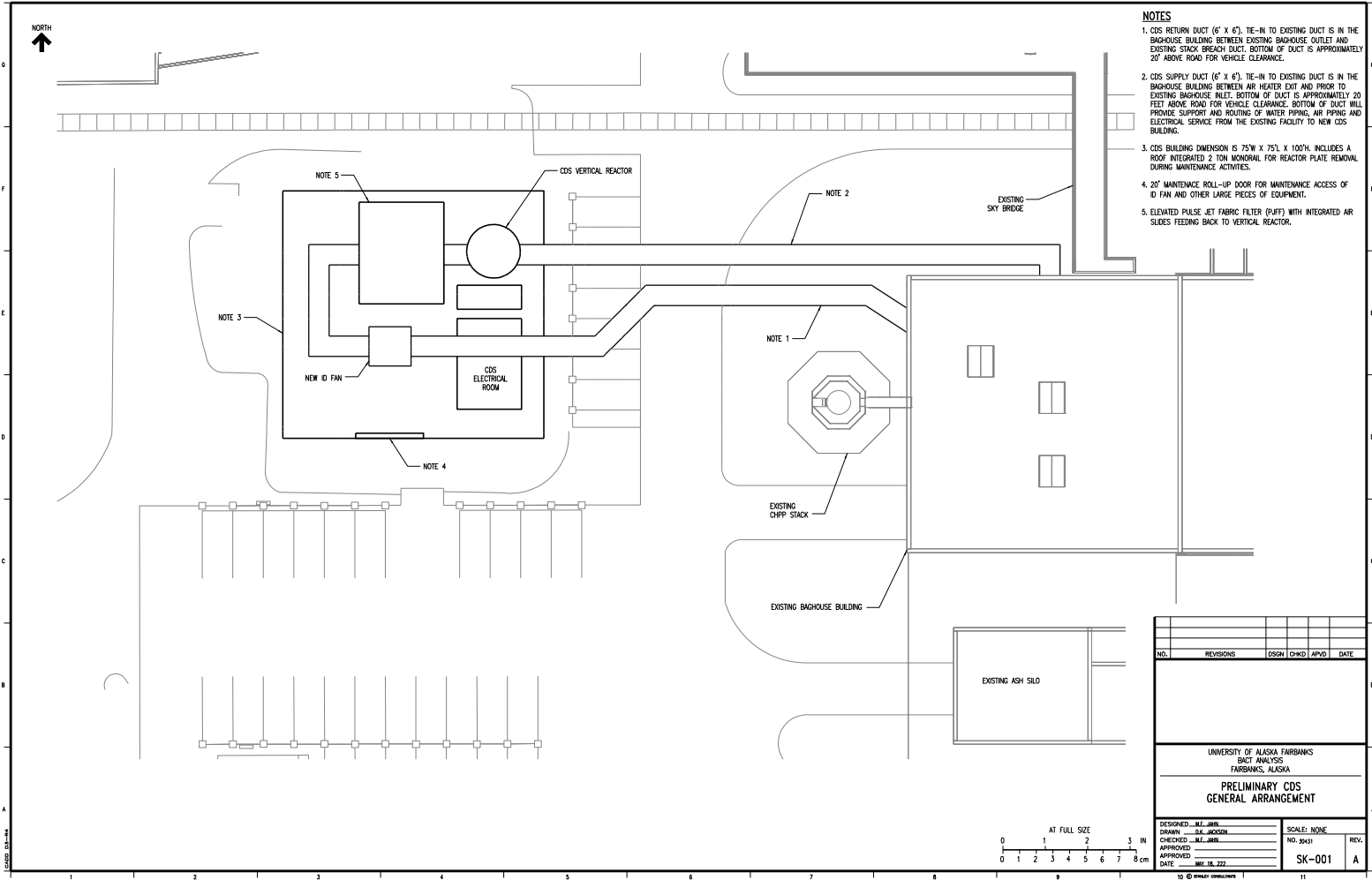
DIVISION		UNITED STATES						ALABAMA											
		30 CITY			ANNISTON			BIRMINGHAM			BUTLER			DECATUR			DOTHAN		
		AVERAGE			362			350 - 352			369			356			363		
	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	
015433	CONTRACTOR EQUIPMENT	100.0	100.0	100.0	99.3	99.3	104.4	104.4	97.0	97.0	99.3	99.3	97.0	97.0	113.4	81.8	91.9	97.0	97.0
0241, 31 - 34	SITE & INFRASTRUCTURE, DEMOLITION	100.0	100.0	100.0	100.7	85.6	90.4	99.5	94.2	95.9	116.3	81.8	92.8	90.4	85.2	86.9	113.4	81.8	91.9
0310	Concrete Forming & Accessories	100.0	100.0	100.0	86.2	65.3	69.4	99.6	68.3	74.3	81.1	67.6	70.2	99.0	64.2	70.9	93.1	67.8	72.7
0320	Concrete Reinforcing	100.0	100.0	100.0	88.4	69.0	82.2	99.0	69.2	89.4	93.2	69.9	85.7	92.2	66.8	84.1	93.2	69.3	85.5
0330	Cast-in-Place Concrete	100.0	100.0	100.0	88.0	66.6	80.6	106.8	69.9	94.0	85.8	66.8	79.2	99.1	66.5	87.8	85.8	67.0	79.3
03	CONCRETE	100.0	100.0	100.0	92.1	68.2	82.5	100.0	70.4	88.2	93.1	69.4	83.6	93.6	67.2	83.0	92.9	69.5	83.5
04	MASONRY	100.0	100.0	100.0	98.2	61.2	74.8	98.0	62.9	75.9	103.1	61.2	76.7	92.3	61.0	72.5	104.7	62.7	78.2
05	METALS	100.0	100.0	100.0	101.3	94.2	99.6	99.3	91.7	97.5	100.2	95.1	99.0	101.1	92.9	99.2	100.3	95.3	99.1
06	WOOD, PLASTICS & COMPOSITES	100.0	100.0	100.0	80.7	65.9	74.6	95.8	68.7	84.6	74.9	68.5	72.2	99.1	64.0	84.6	88.7	68.3	80.3
07	THERMAL & MOISTURE PROTECTION	100.0	100.0	100.0	98.2	60.7	81.8	99.5	66.5	85.0	98.2	64.3	83.3	96.5	63.8	82.1	98.3	63.9	83.2
08	OPENINGS	100.0	100.0	100.0	91.0	66.9	85.2	98.2	68.9	91.1	91.0	68.9	85.7	102.8	65.7	93.9	91.1	68.7	85.7
0920	Plaster & Gypsum Board	100.0	100.0	100.0	89.6	65.6	74.6	99.7	68.0	79.9	85.5	68.2	74.7	99.1	63.7	76.9	103.6	68.1	81.4
0950, 0980	Ceilings & Acoustic Treatment	100.0	100.0	100.0	90.1	65.6	74.2	104.0	68.0	80.7	90.1	68.2	75.9	101.3	63.7	76.9	90.1	68.1	75.8
0960	Flooring	100.0	100.0	100.0	85.9	66.7	80.0	99.4	68.1	89.8	89.6	66.7	82.6	93.1	66.7	85.0	93.5	69.4	86.1
0970, 0990	Wall Finishes & Painting/Coating	100.0	100.0	100.0	96.3	52.3	69.5	101.8	52.3	71.6	96.3	44.3	64.6	90.3	58.9	71.2	96.3	80.7	86.8
09	FINISHES	100.0	100.0	100.0	89.6	64.2	75.8	100.7	66.4	82.0	92.4	64.8	77.4	95.3	63.8	78.2	96.1	69.3	81.5
COVERS	DIVS. 10 - 14, 25, 28, 41, 43, 44, 46	100.0	100.0	100.0	100.0	83.7	96.5	100.0	85.2	96.8	100.0	84.8	96.7	100.0	81.5	96.0	100.0	84.9	96.7
21, 22, 23	FIRE SUPPRESSION, PLUMBING & HVAC	100.0	100.0	100.0	102.8	50.6	81.4	100.8	63.9	85.7	98.5	62.8	83.8	100.9	63.2	85.4	98.5	62.8	83.9
26, 27, 3370	ELECTRICAL, COMMUNICATIONS & UTIL.	100.0	100.0	100.0	96.9	55.5	77.0	96.4	64.9	81.2	98.3	55.7	77.7	93.5	62.7	78.7	97.5	74.8	86.6
MF2018	WEIGHTED AVERAGE	100.0	100.0	100.0	97.5	65.3	84.4	99.4	71.0	87.8	97.4	68.2	85.5	98.1	68.6	86.1	97.8	71.7	87.1

DIVISION		ALABAMA																	
		EVERGREEN			GADSDEN			HUNTSVILLE			JASPER			MOBILE			MONTGOMERY		
		364			359			357 - 358			355			365 - 366			360 - 361		
	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	
015433	CONTRACTOR EQUIPMENT	97.0	97.0	97.0	99.3	99.3	99.3	99.3	99.3	99.3	99.3	99.3	97.0	97.0	105.1	105.1	105.1	105.1	
0241, 31 - 34	SITE & INFRASTRUCTURE, DEMOLITION	116.8	81.7	93.0	97.5	85.6	89.4	90.1	85.5	87.0	97.4	85.6	89.4	107.6	81.8	90.1	105.9	95.5	98.8
0310	Concrete Forming & Accessories	77.0	65.5	67.7	87.7	65.8	70.0	99.0	66.5	72.8	95.2	65.7	71.4	91.8	67.5	72.2	98.0	68.0	73.8
0320	Concrete Reinforcing	93.3	69.9	85.7	97.4	69.2	88.3	92.2	77.2	87.4	92.2	69.1	84.8	91.5	69.9	84.6	100.5	69.2	90.5
0330	Cast-in-Place Concrete	85.8	66.8	79.2	99.1	66.8	88.0	96.5	66.7	86.2	109.9	66.8	95.0	90.0	66.9	82.0	89.9	69.5	82.8
03	CONCRETE	93.2	68.5	83.3	97.3	68.5	85.7	92.5	70.1	83.5	100.6	68.4	87.7	90.0	69.4	81.7	92.8	70.2	83.7
04	MASONRY	103.1	61.2	76.7	90.9	61.9	72.6	93.7	61.8	73.6	88.9	61.2	71.4	101.9	62.1	76.8	101.9	62.2	76.9
05	METALS	100.2	94.9	99.0	98.7	94.7	97.8	101.1	97.7	100.3	98.6	94.6	97.7	102.6	95.0	100.8	101.8	91.7	99.4
06	WOOD, PLASTICS & COMPOSITES	70.9	65.9	68.9	87.0	65.9	78.3	99.1	66.9	85.8	95.5	65.9	83.3	86.8	68.3	79.2	90.8	68.7	81.6
07	THERMAL & MOISTURE PROTECTION	98.1	63.3	82.8	96.6	64.2	82.4	96.4	64.3	82.3	96.7	63.5	82.2	97.9	63.8	82.9	98.9	66.2	84.6
08	OPENINGS	91.0	67.5	85.4	99.7	67.3	91.9	102.6	69.9	94.7	99.7	67.3	91.9	93.4	68.9	87.5	92.1	68.9	86.5
0920	Plaster & Gypsum Board	84.5	65.6	72.7	86.2	65.6	73.3	99.1	66.6	78.8	93.4	65.6	76.0	97.1	68.1	78.9	99.1	68.0	79.7
0950, 0980	Ceilings & Acoustic Treatment	90.1	65.6	74.2	93.8	65.6	75.5	102.8	66.6	79.3	93.8	65.6	75.5	98.5	68.1	78.7	100.5	68.0	79.5
0960	Flooring	87.9	66.7	81.4	89.8	68.1	83.1	93.1	68.1	85.4	91.6	66.7	84.0	93.5	68.1	85.7	93.0	68.1	85.4
0970, 0990	Wall Finishes & Painting/Coating	96.3	44.3	64.6	90.3	52.3	67.1	90.3	60.2	72.0	90.3	52.3	67.1	99.4	44.3	65.8	101.8	52.3	71.6
09	FINISHES	91.8	63.3	76.3	91.1	64.5	76.6	95.6	65.9	79.5	92.7	64.2	77.2	96.3	65.0	79.3	99.0	66.2	81.2
COVERS	DIVS. 10 - 14, 25, 28, 41, 43, 44, 46	100.0	84.6	96.6	100.0	83.8	96.5	100.0	81.8	96.0	100.0	83.7	96.5	100.0	84.9	96.7	100.0	85.0	96.7
21, 22, 23	FIRE SUPPRESSION, PLUMBING & HVAC	98.5	56.7	81.3	104.1	63.9	87.6	100.8	63.6	85.6	104.1	63.3	87.4	100.8	59.9	84.0	100.8	62.9	85.3
26, 27, 3370	ELECTRICAL, COMMUNICATIONS & UTIL.	96.5	55.7	76.8	93.7	64.9	79.8	94.3	62.6	79.0	93.3	55.5	75.1	99.0	59.2	79.8	99.2	71.9	86.1
MF2018	WEIGHTED AVERAGE	97.2	66.4	84.7	98.2	69.8	86.6	98.1	70.1	86.7	98.7	68.2	86.3	98.4	68.2	86.1	98.8	71.7	87.8

DIVISION		ALABAMA																	
		PHENIX CITY			SELMA			TUSCALOOSA			ANCHORAGE			ALASKA FAIRBANKS			JUNEAU		
		368			367			354			995 - 996			997			998		
	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	
015433	CONTRACTOR EQUIPMENT	97.0	97.0	97.0	97.0	97.0	99.3	99.3	105.0	105.0	109.7	109.7	105.0	105.0	105.0	105.0	105.0	105.0	
0241, 31 - 34	SITE & INFRASTRUCTURE, DEMOLITION	121.3	81.8	94.5	113.1	81.8	91.9	90.7	85.6	87.2	138.8	112.8	121.2	136.6	119.0	124.7	153.4	112.8	125.9
0310	Concrete Forming & Accessories	86.1	67.3	71.0	82.9	65.8	69.1	99.0	67.6	73.7	103.0	111.1	109.5	108.9	110.7	110.4	105.0	111.1	109.9
0320	Concrete Reinforcing	93.2	66.6	84.7	93.2	69.1	85.5	92.2	69.2	84.8	124.6	118.4	122.6	120.1	118.4	119.5	124.6	118.4	122.6
0330	Cast-in-Place Concrete	85.8	66.8	79.2	85.8	66.8	79.2	100.5	66.9	88.9	131.5	113.6	125.3	130.3	110.8	123.6	131.4	113.6	125.2
03	CONCRETE	95.9	68.7	85.0	92.1	68.5	82.7	94.2	69.3	84.3	117.6	112.7	115.6	110.3	111.7	110.9	122.4	112.7	118.5
04	MASONRY	103.1	61.2	76.7	107.6	61.2	78.3	92.6	62.1	73.4	202.3	114.5	147.0	202.5	113.4	146.4	182.0	114.5	139.5
05	METALS	100.2	93.7	98.7	100.2	94.7	98.9	100.4	94.8	99.1	127.5	103.2	121.8	122.6	105.7	118.7	122.7	103.2	118.1
06	WOOD, PLASTICS & COMPOSITES	80.5	68.0	75.3	77.0	65.9	72.4	99.1	68.3	86.4	100.5	108.4	103.8	113.4	108.3	111.3	105.0	108.4	106.4
07	THERMAL & MOISTURE PROTECTION	98.6	64.2	83.6	98.0	64.0	83.1	96.5	64.6	82.5	134.6	111.6	124.5	143.8	110.2	129.1	145.8	111.6	130.8
08	OPENINGS	91.0	67.8	85.4	91.0	67.3	85.3	102.6	68.6	94.4	125.9	112.2	122.6	128.4	111.6	124.4	126.8	112.2	123.3
0920	Plaster & Gypsum Board	92.0	67.7	76.8	88.6	65.6	74.2	99.1	68.0	79.7	116.5	108.6	111.						

**CIRCULATING DRY SCRUBBER
COST ESTIMATE
RS MEANS CONTINGENCY TABLE**

**CIRCULATING DRY SCRUBBER
COST ESTIMATE
PRELIMINARY SITE ARRANGMENT**



- NOTES**
1. CDS RETURN DUCT (6' X 6'), TIE-IN TO EXISTING DUCT IS IN THE BAKHOUSE BUILDING BETWEEN EXISTING BAKHOUSE OUTLET AND EXISTING STACK BREAK DUCT. BOTTOM OF DUCT IS APPROXIMATELY 20' ABOVE ROAD FOR VEHICLE CLEARANCE.
 2. CDS SUPPLY DUCT (6' X 6'), TIE-IN TO EXISTING DUCT IS IN THE BAKHOUSE BUILDING BETWEEN AIR HEATER EXIT AND PRIOR TO EXISTING BAKHOUSE INLET. BOTTOM OF DUCT IS APPROXIMATELY 20 FEET ABOVE ROAD FOR VEHICLE CLEARANCE. BOTTOM OF DUCT WILL PROVIDE SUPPORT AND ROUTING OF WATER PIPING, AIR PIPING AND ELECTRICAL SERVICE FROM THE EXISTING FACILITY TO NEW CDS BUILDING.
 3. CDS BUILDING DIMENSION IS 75'W X 75'L X 100'H. INCLUDES A ROOF INTEGRATED 2 TON MOMORAL FOR REACTOR PLATE REMOVAL DURING MAINTENANCE ACTIVITIES.
 4. 20' MAINTENANCE ROLL-UP DOOR FOR MAINTENANCE ACCESS OF 10 FAN AND OTHER LARGE PIECES OF EQUIPMENT.
 5. ELEVATED PULSE JET FABRIC FILTER (P/JFT) WITH INTEGRATED AIR SLIDES FEEDING BACK TO VERTICAL REACTOR.

NO.	REVISIONS	ESGN	CHKD	APVD	DATE
UNIVERSITY OF ALASKA FAIRBANKS SOIL ANALYSIS FAIRBANKS, ALASKA					
PRELIMINARY CDS GENERAL ARRANGEMENT					
DESIGNED	M.J. JARVIS		SCALE:	NONE	
DRAWN	M.J. JARVIS		NO.	3543	
CHECKED	M.J. JARVIS		REV.	A	
APPROVED	M.J. JARVIS		SK-001		
DATE	MAY 18, 2022				

**CIRCULATING DRY SCRUBBER
COST ESTIMATE
UAF FACILITY COSTS**

FS Utility Rates

FY	Utility	Rate
22Q4	Electric	\$ 0.205000 per 1 Kilowatt Hour
	Sewer	\$ 10.810000 per 1000 Gallons
	Steam	\$ 12.390000 per 1000 Pounds
	Water	\$ 12.170000 per 1000 Gallons
2022	Electric	\$ 0.197000 per 1 Kilowatt Hour
	F&A	38.500000 %
	Sewer	\$ 10.150000 per 1000 Gallons
	Steam	\$ 11.640000 per 1000 Pounds
	Water	\$ 11.300000 per 1000 Gallons
2021	Electric	\$ 0.208000 per 1 Kilowatt Hour
	F&A	38.500000 %
	Sewer	\$ 8.020000 per 1000 Gallons
	Steam	\$ 16.130000 per 1000 Pounds
	Water	\$ 8.500000 per 1000 Gallons
2020	Electric	\$ 0.214000 per 1 Kilowatt Hour
	F&A	38.500000 %
	Sewer	\$ 7.350000 per 1000 Gallons
	Steam	\$ 16.250000 per 1000 Pounds
	Water	\$ 7.460000 per 1000 Gallons
2019	Electric	\$ 0.203000 per 1 Kilowatt Hour
	F&A	37.200000 %
	Sewer	\$ 7.000000 per 1000 Gallons
	Steam	\$ 15.470000 per 1000 Pounds
	Water	\$ 7.100000 per 1000 Gallons
2018		

G-71

**CIRCULATING DRY SCRUBBER
COST ESTIMATE
UAF CONSTRUCTION OUTAGE COSTS**

UAF Calculations - Daily Plant Outage Costs

Actual & Estimated Costs				
	Cost per Day		Notes/Assumptions	Reference
<i>These costs/savings are associated with a turbine outage that began on Dec 28, 2021 and ended on June 3, 2022. Support invoicing can be provided if requested.</i>				
Costs				
	Electricity \$	8,002	Purchase of Electricity	Table A
	Fuel \$	54,066	Purchase of Diesel	Table B
	Natural Gas \$	1,794	Boilers go down, we need to light them for a longer duration. In prior year, no natural gas was used during these months	Table C
Avoided Costs				
	Coal Delivery \$	(2,459)		Table D
	Coal \$	(10,255)		Table E
	Ash Haul \$	(1,712)		Table F
	Limestone \$	(1,408)		Table G
	Grand Total \$	48,028		

This spreadsheet does not include the lost revenue from electricity sales to Golden Valley Electric.

Table A.
UAF Plant Outage Costs - Electricity

Vendor: GVEA	Utility	Usage	Cost Break Down	Total	Days per Month
01/01/2022- 02/01/2022	ELECTRIC				
		Fuel & Purchased	4,690,000 kwh @ \$0.1045	\$ 490,105.00	
		Utility Charge	4,690,000 kwh @ \$0.01257	\$ 58,953.30	
		Demand Charge	7207.2 KW @30.06	\$ 216,648.43	
		RCC	4,690,000 kwh @ \$0.001016	\$ 4,765.04	
		Customer Charge		\$ 220.00	
		Total:		\$ 770,691.77	31
		(About \$24,861.02 per day)	1/28-1/31 (4 days)	\$99,444.08	
02/01/2022- 03/01/2022	Electric	Fuel & Purchased	4,424,000 kwh @ \$0.12969	\$573,748.56	
		Utility Charge	4,424,000 kwh @ \$0.01257	\$55,609.68	
		Demand Charge	7737.80 KW @30.06	\$232,598.27	
		RCC	4424000 kwh @ \$0.001016	\$4,494.78	
		Customer Charge		\$220.00	
		Total:		\$866,671.29	28
		(About \$30,952.55 per day)			
03/01/2022- 04/01/2022	Electric	Fuel & Purchased	4,564,000 kwh @0.12969	\$591,905.16	
		Utility Charge	4,564,000 kwh @0.01257	\$57,369.48	
		Demand Charge	6941.20 KW @30.06	\$208,652.47	
		RCC	4,564,000 kwh @0.001016	\$4,637.02	
		Customer Charge		\$220.00	
		Total:		\$862,784.13	31
		(About \$27,831.75 per day)			
04/01/2022- 05/01/2022	Electric	Fuel & Purchased	4,368,000 kwh @0.12969	\$566,485.92	
		Utility Charge	4,368,000 kwh @0.01257	\$54,905.76	
		Demand Charge	6,844.6 KW @30.06	\$205,748.68	
		RCC	4,368,000 kwh @0.001016	\$4,437.89	
		Customer Charge		\$220.00	
		Total:		\$831,798.25	30
		(About \$27,726.61 per day)			
05/01/2022- 06/01/2022	Electric	Fuel & Purchased	3,906,000 kwh @0.14036	\$548,246.16	
		Utility Charge	3,906,000 kwh @0.01257	\$49,098.42	
		Demand Charge	7,267.4 KW @30.06	\$218,458.04	
		RCC	3,906,000 kwh @0.001016	\$3,968.50	
		Customer Charge		\$220.00	
		Total:		\$819,991.12	31
		(About \$26,637.69 per day)			
06/01/2022- 07/01/2022	Electric	Fuel & Purchased	42,000 kwh @0.14036	\$5,895.12	
		Utility Charge	42,000 kwh @0.01257	\$527.94	
		Demand Charge	7,827.4 KW @30.06	\$235,291.64	
		RCC	42,000 kwh @0.000893	\$37.51	
		Customer Charge		\$220.00	
		Total:		\$241,972.21	30
		(About \$146,282.96 per day)			
					181 total Days
Grand Electric Total (1/28-6/3/22):				\$ 3,722,661.08	
Remove "Customer Charge"				\$ (1,320.00)	Paid monthly regardless of usage
Electric Costs (1/28-6/3/22)				\$ 3,721,341.08	
12/01/2021- 01/01/2022	ELECTRIC				
		Fuel & Purchased	1,694,000 kwh @ \$0.1045	\$ 177,023.00	
		Utility Charge	1,694,000 kwh @ \$0.01257	\$ 21,293.58	
		Demand Charge	6,804 KW @30.06	\$ 204,528.24	
		RCC	1,694,000 kwh @ \$0.001016	\$ 1,721.10	
		Customer Charge		\$ 220.00	
		Total:		\$ 404,785.92	4 Days

01/01/2022- 02/01/2022 ELECTRIC

Fuel & Purchased	4,690,000 kwh @ \$0.1045	\$	490,105.00
Utility Charge	4,690,000 kwh @ \$0.01257	\$	58,953.30
Demand Charge	7207.2 KW @30.06	\$	216,648.43
RCC	4,690,000 kwh @ \$0.001016	\$	4,765.04
Customer Charge		\$	220.00
Total:		\$	770,691.77
(About \$24,861.02 per day)	1/1-1/27 (27 days)		\$671,247.54

Grand Electric Total (12/19/21-1/27/22): \$ 1,076,033.46

Remove "Customer Charge" \$ (440.00) Paid monthly regardless of usage

Electric Costs (12/19/21-1/27/22) \$ 1,075,593.46

Total Electric costs (12/19/2021 - 6/3/2022) \$ 1,480,379.38

Total Days \$ 185.00

Cost Per Day \$ 8,002.05

Table B.
UAF Plant Outage Costs - Diesel Fuel

Vendor & Delivery Date	Invoice #	Delivery	Cost Break Down	Total	# Days/ Month
Alaska Petroleum		Gallons	per gal & SOA Fee		
21-Dec	651087	8,904	\$2.87	\$ 25,936.35	
21-Dec	651088	8,900	\$2.87	\$ 25,924.70	
24-Dec	677512	8,206	\$3.02	\$ 25,180.01	
24-Dec	677513	8,204	\$3.02	\$ 25,173.87	
24-Dec	677514	8,204	\$3.02	\$ 25,173.87	
26-Dec	677518	6,801	\$3.02	\$ 20,868.78	
26-Dec	677517	7,120	\$3.02	\$ 21,847.63	
28-Dec	681603	9,598	\$3.02	\$ 29,451.34	
28-Dec	681602	9,599	\$3.02	\$ 29,454.41	
29-Dec	677526	3,802	\$3.08	\$ 11,897.93	
29-Dec	677527	3,802	\$3.08	\$ 11,897.93	
29-Dec	677528	3,802	\$3.08	\$ 11,897.93	
29-Dec	677636	11,067	\$3.08	\$ 34,632.93	
30-Dec	677633	10,622	\$3.10	\$ 33,383.74	
30-Dec	677635	9,801	\$3.10	\$ 30,803.43	
30-Dec	672948	9,703	\$3.10	\$ 30,495.43	
30-Dec	672949	9,602	\$3.10	\$ 30,178.00	
31-Dec	616240	9,602	\$3.12	\$ 30,372.92	10
1-Jan	677544	8,705	\$3.09	\$ 27,284.61	
1-Jan	672918	9,603	\$3.09	\$ 30,099.26	
1-Jan	616239	9,602	\$3.09	\$ 30,096.13	
1-Jan	616241	9,602	\$3.09	\$ 30,096.13	
2-Jan	672919	9,603	\$3.09	\$ 30,099.26	
2-Jan	672499	9,603	\$3.09	\$ 30,099.26	
3-Jan	672920	9,607	\$3.09	\$ 30,111.80	
3-Jan	672925	9,603	\$3.09	\$ 30,099.26	
3-Jan	672926	9,608	\$3.09	\$ 30,114.94	
3-Jan	677553	8,705	\$3.09	\$ 27,284.61	
4-Jan	672910	9,606	\$3.22	\$ 31,347.90	
4-Jan	672908	9,605	\$3.22	\$ 31,344.64	
5-Jan	672922	9,602	\$3.30	\$ 32,130.13	
5-Jan	672497	9,602	\$3.30	\$ 32,130.13	
6-Jan	672911	9,605	\$3.34	\$ 32,545.73	
6-Jan	672921	9,604	\$3.34	\$ 32,542.34	
7-Jan	672913	9,603	\$3.34	\$ 32,578.91	
7-Jan	672914	9,605	\$3.34	\$ 32,585.70	
8-Jan	672887	9,703	\$3.34	\$ 32,918.17	
8-Jan	672923	9,703	\$3.34	\$ 32,918.17	
8-Jan	672888	9,703	\$3.34	\$ 32,918.17	
11-Jan	676832	9,703	\$3.40	\$ 33,526.81	
11-Jan	676833	9,703	\$3.40	\$ 33,526.81	
11-Jan	676834	9,705	\$3.40	\$ 33,533.72	
12-Jan	676835	9,704	\$3.43	\$ 33,782.41	
12-Jan	676836	9,703	\$3.43	\$ 33,778.93	

Vendor & Delivery Date	Invoice #	Delivery	Cost Break Down	Total	# Days/ Month
12-Jan	676837	9,704	\$3.43	\$ 33,782.41	
13-Jan	676838	9,703	\$3.40	\$ 33,476.58	
13-Jan	676839	9,700	\$3.40	\$ 33,466.23	
13-Jan	676840	9,699	\$3.40	\$ 33,462.78	
14-Jan	676841	9,698	\$3.44	\$ 33,811.73	
14-Jan	676842	9,700	\$3.44	\$ 33,818.70	
14-Jan	676843	9,700	\$3.44	\$ 33,818.70	
15-Jan	676844	9,602	\$3.43	\$ 33,477.03	
15-Jan	676845	9,603	\$3.43	\$ 33,480.51	
15-Jan	676846	9,451	\$3.43	\$ 32,950.57	
15-Jan	676847	9,450	\$3.43	\$ 32,947.09	
15-Jan	677560	9,396	\$3.43	\$ 32,758.82	
16-Jan	676848	9,792	\$3.43	\$ 34,139.46	
16-Jan	676849	9,790	\$3.43	\$ 34,132.48	
16-Jan	676850	9,802	\$3.43	\$ 34,174.32	
16-Jan	676851	9,958	\$3.43	\$ 34,718.21	
17-Jan	677565	8,300	\$3.43	\$ 28,937.65	
19-Jan	677574	8,200	\$3.45	\$ 28,738.82	
19-Jan	677575	8,200	\$3.45	\$ 28,738.82	
19-Jan	677576	8,205	\$3.45	\$ 28,756.34	
20-Jan	677577	8,200	\$3.43	\$ 28,568.20	
20-Jan	677578	8,200	\$3.43	\$ 28,567.20	
20-Jan	677579	8,200	\$3.43	\$ 28,568.20	
21-Jan	676852	9,453	\$3.45	\$ 33,119.70	
21-Jan	676853	9,453	\$3.45	\$ 33,119.70	
21-Jan	676854	9,453	\$3.45	\$ 33,119.70	
22-Jan	676855	8,802	\$3.45	\$ 30,838.84	
22-Jan	676856	8,803	\$3.45	\$ 30,842.35	
24-Jan	676857	8,971	\$3.34	\$ 30,394.74	
24-Jan	670007	9,053	\$3.34	\$ 30,672.57	
24-Jan	670008	9,058	\$3.34	\$ 30,689.51	
25-Jan	670009	9,275	\$3.38	\$ 31,817.29	
25-Jan	670010	9,285	\$3.38	\$ 31,851.60	
25-Jan	670011	9,286	\$3.38	\$ 31,855.03	
26-Jan	670012	9,309	\$3.45	\$ 32,641.63	
26-Jan	670013	9,302	\$3.45	\$ 32,617.09	
26-Jan	670014	9,294	\$3.45	\$ 32,589.04	
27-Jan	670017	9,294	\$3.50	\$ 33,018.26	
27-Jan	670018	9,307	\$3.50	\$ 33,064.44	
28-Jan	670019	9,307	\$3.49	\$ 32,979.42	
28-Jan	670020	9,308	\$3.49	\$ 32,982.96	
28-Jan	670021	9,315	\$3.49	\$ 33,007.77	
29-Jan	670022	9,309	\$3.49	\$ 32,986.51	
31-Jan	670028	9,324	\$3.46	\$ 32,790.76	
31-Jan	670027	9,338	\$3.46	\$ 32,840.00	
3-Feb	670050	9,342	\$3.45	\$ 32,667.27	
3-Feb	670051	9,335	\$3.45	\$ 32,642.79	
3-Feb	675818	4,509	\$3.45	\$ 15,767.15	

Vendor & Delivery Date	Invoice #	Delivery	Cost Break Down	Total	# Days/ Month
4-Feb	670055	9,328	\$3.48	\$ 32,955.37	
7-Feb	670060	8,929	\$3.41	\$ 30,914.03	
16-Feb	686694	8,901	\$3.31	\$ 29,932.61	
23-Feb	686728	9,512	\$3.28	\$ 31,714.08	
25-Feb	686734	9,092	\$3.36	\$ 31,008.65	
25-Feb	686735	9,094	\$3.36	\$ 31,015.47	
25-Feb	686736	9,084	\$3.36	\$ 30,981.36	
28-Feb	686548	9,506	\$3.52	\$ 34,005.88	28
1-Mar	680982	9,705	\$3.74	\$ 36,882.92	
1-Mar	680983	4,500	\$3.74	\$ 17,101.82	
1-Mar	680984	5,214	\$3.74	\$ 19,815.30	
1-Mar	680985	5,526	\$3.74	\$ 21,001.03	
1-Mar	671050	8,584	\$3.74	\$ 32,622.66	
1-Mar	671051	8,481	\$3.74	\$ 32,231.22	
1-Mar	680553	9,812	\$3.74	\$ 37,289.56	
5-Mar	686765	8,373	\$4.45	\$ 37,792.74	
5-Mar	686766	8,364	\$4.45	\$ 37,752.12	
5-Mar	686767	8,355	\$4.45	\$ 37,711.50	
7-Mar	687520	8,352	\$4.62	\$ 39,183.17	
7-Mar	676634	8,172	\$4.62	\$ 38,338.71	
7-Mar	671017	8,159	\$4.62	\$ 38,277.72	
8-Mar	687522	8,350	\$5.15	\$ 43,630.08	
8-Mar	687523	8,346	\$5.15	\$ 43,609.18	
9-Mar	687835	9,310	\$4.17	\$ 39,451.72	
9-Mar	660744	8,953	\$4.17	\$ 37,938.91	
9-Mar	660745	8,951	\$4.17	\$ 37,930.44	
10-Mar	687537	9,069	\$4.02	\$ 36,975.15	
10-Mar	687538	9,068	\$4.02	\$ 36,971.08	
10-Mar	687539	9,067	\$4.02	\$ 36,967.00	
12-Mar	687544	9,083	\$4.15	\$ 38,243.64	
12-Mar	687545	9,086	\$4.15	\$ 38,256.27	
12-Mar	687546	9,080	\$4.15	\$ 38,231.01	
13-Mar	687856	9,093	\$4.15	\$ 38,285.75	
13-Mar	687857	9,067	\$4.15	\$ 38,176.27	
14-Mar	687549	9,089	\$3.97	\$ 36,642.48	
14-Mar	687550	9,083	\$3.97	\$ 36,618.29	
14-Mar	688722	8,624	\$3.97	\$ 34,767.82	
14-Mar	688723	8,619	\$3.97	\$ 34,747.66	
14-Mar	687859	9,335	\$3.97	\$ 37,634.23	
16-Mar	688291	9,381	\$3.80	\$ 36,141.95	
16-Mar	688292	9,370	\$3.80	\$ 36,099.58	
17-Mar	687551	9,090	\$4.30	\$ 38,640.32	
17-Mar	687552	9,073	\$4.30	\$ 38,568.06	
18-Mar	687554	9,082	\$4.30	\$ 39,626.77	
18-Mar	687555	9,073	\$4.30	\$ 39,587.51	
19-Mar	687556	9,097	\$4.30	\$ 39,692.22	
19-Mar	687557	9,088	\$4.30	\$ 39,652.95	
19-Mar	687558	9,079	\$4.30	\$ 39,613.68	

Vendor & Delivery Date	Invoice #	Delivery	Cost Break Down	Total	# Days/ Month
20-Mar	671021	9,382	\$4.30	\$ 40,935.74	
20-Mar	671022	9,390	\$4.30	\$ 40,970.65	
21-Mar	687928	9,081	\$4.50	\$ 41,491.66	
22-Mar	671026	8,682	\$4.56	\$ 40,226.42	
22-Mar	671027	8,682	\$4.56	\$ 40,226.42	
22-Mar	671028	8,688	\$4.56	\$ 40,254.22	
22-Mar	688435	8,377	\$4.56	\$ 38,813.26	
22-Mar	687933	9,359	\$4.56	\$ 43,363.17	
24-Mar	687936	9,085	\$4.81	\$ 44,345.48	
24-Mar	687937	9,076	\$4.81	\$ 44,301.55	
24-Mar	687938	9,067	\$4.81	\$ 44,257.62	
24-Mar	670083	8,375	\$4.81	\$ 40,879.85	
24-Mar	670084	8,359	\$4.81	\$ 40,801.75	
27-Mar	687943	9,046	\$4.77	\$ 43,798.86	
27-Mar	687944	9,038	\$4.77	\$ 43,760.13	
28-Mar	687566	9,047	\$4.44	\$ 40,762.39	
28-Mar	687567	9,042	\$4.44	\$ 40,739.87	
28-Mar	687568	9,032	\$4.44	\$ 40,694.81	
29-Mar	687570	8,846	\$4.37	\$ 39,252.50	
29-Mar	687571	8,834	\$4.37	\$ 39,199.25	
29-Mar	687572	8,824	\$4.37	\$ 39,154.88	
29-Mar	669595	8,333	\$4.37	\$ 36,976.16	
30-Mar	687573	9,050	\$4.14	\$ 38,007.33	
30-Mar	687574	9,047	\$4.14	\$ 37,994.73	
2-Apr	671033	8,502	\$4.13	\$ 35,680.00	
5-Apr	687963	9,060	\$4.18	\$ 38,428.19	
5-Apr	687964	9,051	\$4.18	\$ 38,390.02	
6-Apr	687576	9,049	\$4.06	\$ 37,251.82	
6-Apr	671036	8,848	\$4.06	\$ 36,424.36	
6-Apr	671037	8,829	\$4.06	\$ 36,346.15	
6-Apr	671038	8,834	\$4.06	\$ 36,366.73	
7-Apr	687970	8,540	\$3.98	\$ 34,485.52	
7-Apr	688837	9,063	\$3.98	\$ 36,597.45	
7-Apr	688838	9,046	\$3.98	\$ 36,528.80	
7-Apr	688839	9,051	\$3.98	\$ 36,548.99	
8-Apr	672486	9,877	\$4.03	\$ 40,383.73	
8-Apr	672487	9,882	\$4.03	\$ 40,404.17	
9-Apr	672485	9,919	\$4.03	\$ 40,555.45	
9-Apr	474187	9,874	\$4.03	\$ 40,371.46	
10-Apr	687972	9,067	\$4.03	\$ 37,071.91	
11-Apr	671042	9,141	\$3.93	\$ 36,424.39	
13-Apr	671046	8,630	\$4.37	\$ 38,314.18	
13-Apr	671047	8,614	\$4.37	\$ 38,243.15	
13-Apr	688847	9,034	\$4.37	\$ 40,107.80	
13-Apr	688848	9,043	\$4.37	\$ 40,147.76	
14-Apr	688849	9,046	\$4.51	\$ 41,413.46	
14-Apr	688850	9,032	\$4.51	\$ 41,349.37	
14-Apr	688851	9,018	\$4.51	\$ 41,285.28	

31

Vendor & Delivery Date	Invoice #	Delivery	Cost Break Down	Total	# Days/ Month
15-Apr	688852	9,048	\$4.51	\$ 41,422.62	
15-Apr	688853	9,039	\$4.51	\$ 41,381.42	
15-Apr	688854	9,028	\$4.51	\$ 41,331.06	
17-Apr	663673	9,026	\$4.51	\$ 41,321.90	
18-Apr	663607	8,607	\$4.51	\$ 39,062.97	
18-Apr	671049	8,624	\$4.51	\$ 39,140.12	
19-Apr	688866	9,019	\$4.42	\$ 40,485.19	
19-Apr	688867	9,002	\$4.42	\$ 40,408.88	
20-Apr	688869	9,023	\$4.53	\$ 41,521.56	
20-Apr	688870	9,006	\$4.53	\$ 41,443.33	
21-Apr	688871	9,040	\$4.46	\$ 40,936.39	
21-Apr	688872	9,024	\$4.46	\$ 40,863.94	
21-Apr	688873	8,999	\$4.46	\$ 40,750.73	
22-Apr	688878	3,828	\$4.50	\$ 17,481.44	
25-Apr	669938	8,798	\$4.65	\$ 41,538.11	
26-Apr	688887	8,992	\$4.62	\$ 42,193.02	
26-Apr	688888	3,816	\$4.62	\$ 17,905.76	
27-Apr	651134	8,484	\$4.65	\$ 40,040.12	
27-Apr	688891	8,993	\$4.65	\$ 42,442.34	
27-Apr	688892	8,995	\$4.65	\$ 42,451.78	
28-Apr	651137	4,037	\$4.71	\$ 19,316.04	
28-Apr	688893	9,008	\$4.71	\$ 43,101.03	
28-Apr	688894	8,997	\$4.71	\$ 43,048.40	
28-Apr	688895	8,969	\$4.71	\$ 42,914.43	
29-Apr	688899	3,836	\$4.72	\$ 18,388.57	
30-Apr	688900	9,009	\$4.72	\$ 43,186.29	
30-Apr	688901	8,975	\$4.72	\$ 43,023.30	30
3-May	688904	8,966	\$4.79	\$ 43,621.74	
3-May	688905	8,960	\$4.79	\$ 43,592.55	
5-May	688906	8,993	\$4.75	\$ 43,329.57	
5-May	688907	8,970	\$4.75	\$ 43,218.75	
5-May	688908	8,976	\$4.75	\$ 43,247.66	
9-May	688922	8,992	\$4.54	\$ 41,440.96	
11-May	672428	9,831	\$4.66	\$ 46,468.11	
11-May	672429	9,805	\$4.66	\$ 46,345.22	
12-May	672837	9,832	\$4.60	\$ 45,873.07	
12-May	672837	9,821	\$4.60	\$ 45,821.75	
13-May	672839	9,837	\$4.71	\$ 47,045.63	
13-May	672840	9,823	\$4.71	\$ 46,978.67	
17-May	662097	8,955	\$4.56	\$ 41,355.88	
17-May	662098	8,974	\$4.56	\$ 41,443.63	
18-May	662101	8,960	\$4.42	\$ 40,185.79	
18-May	662102	8,953	\$4.42	\$ 40,154.39	
19-May	662105	8,948	\$4.62	\$ 41,983.83	
19-May	662106	8,932	\$4.62	\$ 41,908.76	
21-May	676350	9,664	\$4.60	\$ 45,167.71	
21-May	676351	9,647	\$4.60	\$ 45,088.26	
21-May	676352	9,649	\$4.60	\$ 45,097.60	

Vendor & Delivery Date	Invoice #	Delivery	Cost Break Down	Total	# Days/ Month
23-May	662118	8,922	\$4.69	\$ 42,466.77	
24-May	662275	8,411	\$4.70	\$ 40,145.51	
26-May	662125	8,936	\$4.89	\$ 44,340.16	
26-May	662126	8,917	\$4.89	\$ 44,245.88	
26-May	662127	8,906	\$4.89	\$ 44,191.30	
29-May	662136	8,681	\$4.98	\$ 43,888.13	
31-May	662245	8,704	\$5.03	\$ 44,399.32	
31-May	662139	3,792	\$5.03	\$ 19,343.09	
31-May	662140	3,787	\$5.03	\$ 19,317.58	31
Totals		2,170,984			

Fuel Delivered (12/21/22-5/31/22):

NET EXPENSE

Total Fuel Expenses	8,704,637
Total Days	161

Cost Per Day	\$ 54,066
---------------------	------------------

Table C.
UAF Plant Outage Costs - Natural Gas

Vendor	Utility	Usage (CCF)	Cost (per CCF)	Total	Days in a month
Interior Gas Utilty	Natural Gas				
2022-01		5,855	\$ 19.50	\$ 114,172.50	31
2022-01				\$ 500.00	
2022-02		4,360	\$ 19.50	\$ 85,020.00	28
2022-02				\$ 500.00	
2022-03		992	\$ 19.50	\$ 19,344.00	31
2022-03				\$ 500.00	
2022-04		0		\$ 500.00	
2022-05		1,397	\$ 19.50	\$ 27,241.50	31
2022-05				\$ 500.00	

Total Natural Gas Charges (1/28-6/03/22) \$ 219,536.50

Remove "Service Charge" \$ (2,500.00) Paid monthly regardless of usage

NET EXPENSE

NG Expense	\$ 217,036.50
Total Days	121

Cost per Day	\$ 1,793.69
---------------------	--------------------

Table D.
UAF Plant Outage Costs - Coal Transport (Avoided Cost Calculation)

Vendor	Utility	Usage	AKRR Invoices	Invoice #	Tons	Cost (per ton)	Total	
Usibelli	Coal							
		931.00		1/31/2022	226005543	442.2	14.39	6,363.26
				2/1/2022	226005646	265.8		3,824.86
		9,117.80		2/3/2022	226005655	271.4		3,905.45
				2/7/2022	226005662	262		3,770.19
		8,887.50		2/8/2022	226005669	730.55		10,512.62
				2/9/2022	226005786	258		3,712.62
		6,848.20		2/11/2022	226005794	459		6,605.01
				2/14/2022	226005809	262.8		3,781.69
		1,718.40		2/15/2022	226005813	357.3		5,141.54
				2/16/2022	226005825	261.5		3,763.00
		1,216.30		2/17/2022	226005844	351.85		5,063.12
				2/18/2022	226005854	341.8		4,918.50
				2/22/2022	226005858	425.95		6,129.42
				2/23/2022	226005881	339.85		4,890.44
				2/24/2022	226005883	364.55		5,245.87
				2/25/2022	226005887	454.7		6,543.13
				2/28/2022	226005907	357.5		5,144.43
				5/16/2022	226006619	582.7		8,385.06
				5/25/2022	226006728	178.9		2,574.37
				5/26/2022	226006737	183.05		2,634.09
				5/31/2022	226006768	540.2		7,773.48
				6/1/2022	226006878	551.5		7,936.09
				6/2/2022	226006881	452.45		6,510.76
				6/3/2022	226006896	526.8		7,580.65
Actual Spent 1/28-6/3							132,709.65	

Average Daily Burn: 226.14

Average Daily Burn:	226.14
Transport Cost per ton (ARR):	14.39
Days coal would be burned (1/28/22-6/3/22):	127
Would be consumed Coal (tons):	28,719.20
Cost for Transport (ARR):	413,269.29
Net Savings (1/28-6/3/22):	280,559.64
Days coal would be burned (12/19/21-1/27/22):	40
Would be consumed Coal (tons):	9,045.42
Cost for Transport (ARR):	130,163.56
Net Savings (12/19/21-1/27/22):	130,163.56

NET SAVINGS	
Coal Delivery Cost	\$ 410,723.19
Total Days	167
Savings per Day	\$ 2,459.42

**Table F.
UAF Plant Outage Costs - Ash Hauling (Avoided Cost Calculation)**

Vendor	Utility	Usage (truckful)	Cost (per truckful)	Total	Days/Month
Aurora Energy	Ash Haul				
2nd half	December 2020	22.00	\$880.00	\$19,360.00	15.5
	January 2021	48.00	\$880.00	\$42,240.00	31
	February 2021	58.00	\$880.00	\$51,040.00	28
	March 2021	60.00	\$880.00	\$52,800.00	31
	April 2021	56.00	\$880.00	\$49,280.00	30
	May 2021	12.00	\$880.00	\$10,560.00	31
	June 2021	50.00	\$880.00	\$44,000.00	30
	July 2021	59.00	\$880.00	\$51,920.00	31
	Aug 2021	81.00	\$880.00	\$71,280.00	31
	Sept 2021	74.00	\$880.00	\$65,120.00	30
	Oct 2021	66.00	\$880.00	\$58,080.00	31
	Nov 2021	69.00	\$880.00	\$60,720.00	30
1st half	Dec 2021	55.00	\$880.00	\$48,400.00	15.5

NET SAVINGS

Ash Haul Expenses	\$624,800
Total Days	\$365
Savings per Day	\$ 1,712

Table G.
UAF Plant Outage Costs - Limestone (Avoided Cost Calculation)

Vendor	Utility	Usage (tons or hours)	Cost (per ton)	Total	Days in Month
Globe Creek	Limestone				
	July 2021	206.79 tons	\$290.86	\$60,146.94	31
	July 2021	13.25 hours	\$182.85	\$2,422.76	
	Aug 2021	194.92 tons	\$287.63	\$56,064.84	31
	Aug 2021	12.25 hours	\$180.42	\$2,210.15	
	Sept 2021	114.10 tons	\$287.63	\$32,818.58	30
	Sept 2021	7.25 hours	\$180.42	\$1,308.05	
	Oct 2021	171.28 tons	\$287.63	\$49,265.27	31
	Oct 2021	10.75 hours	\$180.42	\$1,939.52	
	Nov 2021	214.27 tons	\$287.63	\$61,630.48	30
	Nov 2021	14.75 hours	\$180.42	\$2,661.20	
1st half	Dec 2021	84.22 tons	\$287.63	\$24,224.20	15.5
1st half	Dec 2021	3.75 hours	\$180.42	\$676.58	
Total Spent 7/1-12/14				\$270,467.77	

	Average monthly tons:	180.27
	Average monthly hours:	11.65
	Cost per ton:	\$287.63
	Cost per hour:	\$180.42
	Months of usage (1/28/22-06/03/22):	4.23
	Expected tons:	763
	Expected hours:	49
	Total Cost (1/28/22-06/03/22):	228,223.42

Total cost for Limestone (Savings Projection): 228,223.42

Vendor	Utility	U/M	Usage	Rate	Total	Invoice #
Globe Creek	Limestone					
	2/4/2022	hours	27	\$175.00	\$4,725.00	21102
	2/8/2022	tons	30	\$287.63	\$8,628.90	21105
	2/8/2022	hours	2	\$180.42	\$360.84	21105
	2/16/2022	tons	50.04	\$287.63	\$14,393.01	21106
	2/16/2022	hours	3	\$180.42	\$541.26	21106
	2/22/2022	tons	27.52	\$287.63	\$7,915.58	21108
	2/22/2022	hours	1.75	\$180.42	\$315.74	21108
Total Spent 1/28-6/3			27		\$36,880.32	

Net Savings (1/28-6/3/22): 191,343.11

Vendor	Utility	U/M	Usage	Cost (per ton)	Total	Invoice #
Globe Creek	Limestone					
	12/21/2021	Dec-21 tons	28.02	\$287.63	\$8,059.39	21098
	12/21/2021	Dec-21 hours	1.75	\$180.42	\$315.74	21098
Total Spent 1/28-6/3			198.08		\$8,375.13	

	Months of usage (12/19/21-01/	1.33
	Expected tons:	240
	Expected hours:	16
	Total Cost (12/19/21-01/27/22)	71,938.04
	Net Savings (12/19/21-1/27/22):	63,562.91

Total Net Saving (112/19/21 - 6/3/22)	\$ 254,906
Total Days	181
Totals Net Saving per Day	\$ 1,408

**CIRCULATING DRY SCRUBBER
COST ESTIMATE
UAF OPERATING AND MAINTENANCE LABOR COSTS**

Jahn, Mario

From: Payne, Mark
Sent: Friday, July 8, 2022 10:35 AM
To: Solan, John; Jahn, Mario
Subject: FW: Labor rate

Is this what you were expecting? Will it work?

Mark



Mark Payne, PE, PMP, Senior Project Manager
STANLEYCONSULTANTS, 8000 South Chester St, Suite 500, Centennial, CO 80112
T: 303.925.8375 | M: 720.240.3271 | stanleyconsultants.com

From: Frances Isgrigg <fisgrigg@alaska.edu>
Sent: Friday, July 8, 2022 10:28 AM
To: Courtney Kimball <ckimball@boreal-services.com>; Payne, Mark <PayneMark@stanleygroup.com>
Subject: Labor rate

***** EXTERNAL EMAIL - Use caution and verify authenticity before trusting any contents. *****

Please see below from our accounting department.

For each CT3, Step 1: salary (\$69,300) + staff benefits (\$32,800) is about \$102,100. This includes the new salary grid in effect for FY23 with the CBA extension agreement. It also includes the 12% Utilities shift premium. This does not include exceptional placement (if we hired at anything higher than Step 1) or any overtime.

Frances

--

Frances M. Isgrigg, PE
Division of Design and Construction
907-590-5809

Annual burdened salary = \$102,100
Divide by 2,080 work hours per year.
Hourly rate = \$49.09/hr

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Appendix H

Dry Sorbent Injection Cost Estimate

Stanley Consultants Dry Sorbent Injection Cost Estimate	Page H-1
Dry Sorbent Injection Cost Estimate Alternate (Tri-Mer)	Page H-4
ID Fan Backup Costs	Page H-7
Control System Backup Costs	Page H-16
ID Fan Shipping Backup Costs	Page H-20
Structural Backup Costs	Page H-27
Electrical Backup Costs	Page H-37
Piping Backup Costs	Page H-41
CEPCI Index Backup.....	Page H-47
Inflation Calculator Backup.....	Page H-49
City Cost Index Backup.....	Page H-51
UAF Facility Costs.....	Page H-53
Hydrated Lime Cost.....	Page H-55
Preliminary Site Arrangement	Page H-64
UAF Operating and Maintenance Labor Costs.....	Page H-69
RS Means Contingency Table.....	Page H-71
UAF Construction Outage Costs.....	Page H-73

**STANLEY CONSULTANTS
DRY SORBENT INJECTION
COST ESTIMATE**

Shaded cells indicate user inputs.

Total Capital Investment - DSI (Dry Sorbent Injection)

Project: UAF - BACT Analysis
 Vendor: BACT Process Systems, Inc.

Date: 12/28/2022
 Prepared By: M. Jahn
 Updated By: C. Kimball
 Rev: B

Capital Costs					
DIRECT COSTS	QTY	UNIT	UNIT COST	TOTAL MATERIALS COST	TOTAL LABOR COST
(1) Purchased equipment and material costs					
(a) Basic equipment					
DSI System	1	EA	5,875,000		
ID Fan	1	EA	431,588		
Total DSI System					TOTAL = \$ 6,306,588
(b) Instrumentation					
Total Instrumentation	1	EA	142,000		TOTAL = \$ 142,000
(c) Freight					
ID Fan Freight	1	EA	\$ 85,120		TOTAL = \$ 85,120
(d) Extended Outage Costs					
Additional days beyond a typical 3 week outage	35	Days	\$ 48,028.00		TOTAL = \$ 1,680,980
(e) Vendor representatives Costs					
Onsite Vendor Representatives Costs (enter no. of days and daily rate)	5	Days	2000		TOTAL = \$ 10,000
Purchased Equipment and Material Cost (PEMC)				All above costs included in vendor scope.	
				PEMC = \$ 8,224,688	
(2) Direct Installation Costs					
(a) Concrete	1	LOT	\$ 98,000		\$ 98,000
(b) Site Vibro Compaction (DSI Unloading Building/Storage Silo)	1	LOT	\$ 31,000		\$ 31,000
(c) Structural steel	1	LOT	\$ 84,000		\$ 84,000
(d) Electrical	1	LOT	\$ 771,000		\$ 771,000
(e) Abovegrade piping	1	LOT	\$ 367,000		\$ 367,000
Direct Installation Costs (DIC) - Guess at new building, foundation, piping, electrical, etc.				DIC = \$ 1,351,000	
Total Direct Costs (TDC)				TDC = (PEMC) + (DIC) = \$ 9,575,688	
INDIRECT COSTS					
(3) Engineering, Procurement & Construction Support Services	10%	% TDC		\$ 957,569	
(4) Performance tests	1	EA	\$ 75,000	\$ 75,000	
Total Indirect Costs (TIC)				TIC = \$ 1,032,569	
MANAGEMENT AND CONTINGENCY COSTS					
(5) Contingency	10%	% TDC		\$ 957,569	
Total Management and Contingency Costs (TM&CC)				TM & CC = \$ 957,569	
TOTAL CAPITAL INVESTMENT (TCI)				TCI = (TDC)+(TIC)+(TM&CC) = \$ 11,565,826	

Line Number/Description	Title	Comment
Line Number 1a	Total DSI System	DSI price provided by OEM Vendor. Cost includes equipment supply and installation costs. Installation costs of vendor supplied equipment was assumed to be 25% of equipment cost.
Line Number 1a	ID Fan	Pricing provided by Clarage for new ID Fan for CDS system. Fan pricing was scaled from 1250 HP to 950 HP. Fan shipping is provided in line number 1c.
Line Number 1b	Total Instrumentation	Total costs for new communication links and I/O integration into existing DCS room.
Line Number 1c	ID Fan Shipping Costs	Costs to ship ID fan to site. CDS pricing was used and scaled from 1250 HP to 950 HP.
Line Number 1d	Extended Outage Costs	UAF typically schedules for a 3 week outage on Boiler #5. A DSI outage will take 8 weeks and the University will incur 5 additional weeks of outage costs that include purchasing electric power and running additional boilers for steam generation. Costs per day were provided by UAF personnel. The daily outage cost calculations are presented in the last section of Appendix H beginning on page H-74.
Line Number 1e	Vendor Representative Costs	Costs incurred for OEM to send a Field Technician to the field to confirm installation and provide technical guidance if needed. Cost per day includes hourly burdened rate for employee daily allowances and travel expenses.
Line Number 2a thru 2e	Direct Install Costs	Costs broken down into individual disciplines for balance of plant equipment, materials and labor for the DSI System. Cost estimate basis for each discipline are provided as attachments.
Line Number 3	Engineering Services	Costs for Preliminary Engineering costs to assist the University in soliciting bidders with specifications, preliminary drawings and procurement support for the AQCS system. Additional services include home office support for shop drawing review and occasional site support during construction for potential issues. Engineering is a percentage of the Total Direct Costs of the Project.
Line Number 4	Performance Test	Costs for a 3rd party performance testing company to validate emissions and performance guarantees by DSI vendor during operation
Line Number 5	Construction Contingency	Construction Contingency is an allotment for additional or unexpected costs during the project. RS Means defines contingency allowances and ranges between 3-20% depending on what design stage the project is in. A 10% contingency is a project that is in Design Development, whereas a Conceptual Design phase allows for a 20% contingency. A 10% contingency for this cost estimate is considered low as the project is still in a Development phase.

Shaded cells indicate user inputs

Annualized Costs						
DIRECT ANNUAL COSTS	QTY	UNIT	UNIT COST	TOTAL MATERIALS COST	TOTAL LABOR COST	TOTAL
(1) Operating Labor	8,864	MH	49.09	Excluded	\$ 435,134	\$ 435,134
(2) Supervisory Labor		MH		Excluded	Excluded	Excluded
(3) Maintenance Labor	520	MH	49.09	Excluded	\$ 25,527	\$ 25,527
(4) Maintenance Materials	1	LOT	25,527	\$ 25,527	Excluded	\$ 25,527
(5) Utilities						
(a) Hydrated Lime:	394	TON	1,377	\$ 542,813	Excluded	\$ 542,813
(b) Electricity:	2,683,276	kWh	0.205	\$ 550,071	Excluded	\$ 550,071
(c) Water:	8,935	(k)Gallons	11.30	\$ 100,968	Excluded	\$ 100,968
Total Direct Annual Costs (TDAC)					TDAC =	\$ 1,680,040
INDIRECT ANNUAL COSTS						
(6) Overhead	1%	%		\$ 115,658		\$ 115,658
(7a) Administrative Charges, Insurance	3%	% total capital		\$ 346,975		\$ 346,975
(7b) Capital Recovery Factor [see inputs below]	0.0847					
(8) Capital Recovery						CRF * TCI = \$ 979,293
Total Indirect Annual Costs (TIAC)					TIAC =	\$ 1,441,926
TOTAL ANNUALIZED COSTS (TAC)					TAC = (TDAC) + (TIAC) =	\$ 3,121,966

Data Inputs for Capital Recovery Factor:		
Annual Interest Rate (EPA OAQPS Control Cost Manual)	7.50	%
Project Life (EPA OAQPS Control Cost Manual)	30	years

Line Number/Description	Title	Comment
Line Number 1 and 3	Operating/Maintenance Labor	Provided by UAF. Rate is burdened rate for level of personnel operating and performing maintenance on this type of equipment. Additional FT operations person is assumed per shift. Four total shifts per week. Quarter FT maintenance persons is assumed for the new DSI system.
Line Number 4	Maintenance Material	Allotment for maintenance materials. Item is equal to the maintenance labor allotment in line 3.
Line Number 5a	Hydrated Lime	Hydrated Lime consumption rates provided by DSI vendor. Hydrated Lime costs provided by L'hoist.
Line Number 5b	Electricity	Pricing provided by UAF for published utility rates on campus. Electrical consumption rate provided by DSI vendor. Additional consumption by larger ID Fan was also included.
Line Number 5c	Water	Pricing provided by UAF for published utility rates on campus. Water consumption rate provided by DSI vendor.
Line Number 6	Overhead	Calculated as percent of Total Capital Investment
Line Number 7a	Admin Charges, etc	Calculated as percent of Total Capital Investment
Line Number 7b	Capital Recovery Factor	EPA calculated factor using Interest Rate and Project Life Span
Line Number 8	Capital Recovery	Capital Recovery Factor times Total Capital Investment.
Annual Interest Rate (EPA OAQPS Control Cost Manual)	Annual Interest Rate	Latest federal prime rate. https://www.federalreserve.gov/releases/h15/
Project Life (EPA OAQPS Control Cost Manual)	Project Life	Project Life expectancy in years.

**STANLEY CONSULTANTS
DRY SORBENT INJECTION
COST ESTIMATE
ALTERNATE (TRI-MER)**

Shaded cells indicate user inputs.

Total Capital Investment - DSI (Dry Sorbent Injection)						Date:	12/28/2022
Project: UAF - BACT Analysis						Prepared By:	M. Jahn
Vendor: Tri-Mer						Updated By:	C. Kimball
						Rev:	B
Capital Costs							
DIRECT COSTS		QTY	UNIT	UNIT COST	TOTAL MATERIALS COST	TOTAL LABOR COST	
(1) Purchased equipment and material costs							
(a) Basic equipment							
DSI System	1	EA	978,475				
ID Fan	1	EA	431,588				
Total DSI System							TOTAL = \$ 1,410,063
(b) Instrumentation							
Total Instrumentation	1	EA	142,000				TOTAL = \$ 142,000
(c) Freight							
ID Fan Freight	1	EA	\$ 85,120				TOTAL = \$ 85,120
(d) Extended Outage Costs							
Additional days beyond a typical 3 week outage	35	MH	\$ 48,028.00				TOTAL = \$ 1,680,980
(e) Vendor representatives fees							
Onsite Vendor Representatives fees (enter no. of days and daily rate)	5	Days	2000		\$ 10,000		TOTAL = \$ 10,000
Purchased Equipment and Material Cost (PEMC)				All above costs included in vendor scope.		PEMC = \$ 3,328,163	
(2) Direct Installation Costs							
(a) Concrete	1	LOT	\$ 196,000	\$ 196,000			\$ 196,000
(b) Site Vibro Compaction (DSI Unloading Building/Storage Silo)	1	LOT	\$ 62,000	\$ 62,000			\$ 62,000
(c) Structural steel	1	LOT	\$ 42,000	\$ 42,000			\$ 42,000
(d) Electrical	1	LOT	\$ 771,000	\$ 771,000			\$ 771,000
(e) Abovegrade piping	1	LOT	\$ 367,000	\$ 367,000			\$ 367,000
Direct Installation Costs (DIC) - Guess at new building, foundation, piping, electrical, etc.						DIC = \$ 1,438,000	
Total Direct Costs (TDC)						TDC = (PEMC) + (DIC) = \$ 4,766,163	
INDIRECT COSTS							
(3) Engineering, Procurement & Construction Support Services	10%	% TDC			\$ 476,616		
(4) Performance tests	1	EA	\$ 75,000		\$ 75,000		
Total Indirect Costs (TIC)						TIC = \$ 551,616	
MANAGEMENT AND CONTINGENCY COSTS							
(5) Contingency	10%	% TDC			\$ 476,616		
Total Management and Contingency Costs (TM&CC)						TM & CC = \$ 476,616	
TOTAL CAPITAL INVESTMENT (TCI)						TCI = (TDC)+(TIC)+(TM&CC) = \$ 5,794,396	

Line Number/Description	Title	Comment
Line Number 1a	Total DSI System	DSI price provided by OEM Vendor. Cost includes equipment supply and installation costs. Installation costs of vendor supplied equipment was assumed to be 25% of equipment cost.
Line Number 1a	ID Fan	Pricing provided by Clarage for new ID Fan for CDS system. Fan pricing was scaled from 1250 HP to 950 HP. Fan shipping is provided in line number 1c.
Line Number 1b	Total Instrumentation	Total costs for new communication links and I/O integration into existing DCS room.
Line Number 1c	ID Fan Shipping Costs	Costs to ship ID fan to site. CDS pricing was used and scaled from 1250 HP to 950 HP.
Line Number 1d	Extended Outage Costs	UAF typically schedules for a 3 week outage on Boiler #5. A DSI outage will take 8 weeks and the University will incur 5 additional weeks of outage costs that include purchasing electric power and running additional boilers for steam generation. Costs per day were provided by UAF personnel. The daily outage cost calculations are presented in the last section of Appendix H beginning on page H-74.
Line Number 1e	Vendor Representative Costs	Costs incurred for OEM to send a Field Technician to the field to confirm installation and provide technical guidance if needed. Cost per day includes hourly burdened rate for employee daily allowances and travel expenses.
Line Number 2a thru 2e	Direct Install Costs	Costs broken down into individual disciplines for balance of plant equipment, materials and labor for the DSI System. Cost estimate basis for each discipline are provided as attachments.
Line Number 3	Engineering Services	Costs for Preliminary Engineering costs to assist the University in soliciting bidders with specifications, preliminary drawings and procurement support for the AQS system. Additional services include home office support for shop drawing review and occasional site support during construction for potential issues. Engineering is a percentage of the Total Direct Costs of the Project.
Line Number 4	Performance Test	Costs for a 3rd party performance testing company to validate emissions and performance guarantees by DSI vendor during operation
Line Number 5	Construction Contingency	Construction Contingency is an allotment for additional or unexpected costs during the project. RS Means defines contingency allowances and ranges between 3-20% depending on what design stage the project is in. A 10% contingency is a project that is in Design Development, whereas a Conceptual Design phase allows for a 20% contingency. A 10% contingency for this cost estimate is considered low as the project is still in a Development phase.

Shaded cells indicate user inputs

Annualized Costs						
DIRECT ANNUAL COSTS	QTY	UNIT	UNIT COST	TOTAL MATERIALS COST	TOTAL LABOR COST	TOTAL
(1) Operating Labor	8,864	MH	49.09	Excluded	\$ 435,134	\$ 435,134
(2) Supervisory Labor		MH		Excluded	Excluded	Excluded
(3) Maintenance Labor	520	MH	49.09	Excluded	\$ 25,527	\$ 25,527
(4) Maintenance Materials	1	LOT	25,527	\$ 25,527	Excluded	\$ 25,527
(5) Utilities						
(a) Hydrated Lime:	2,466	TON	1,377	\$ 3,395,599	Excluded	\$ 3,395,599
(b) Electricity:	2,380,180	kWh	0.205	\$ 487,937	Excluded	\$ 487,937
(c) Water:	8,935	(k)Gallons	11.30	\$ 100,968	Excluded	\$ 100,968
Total Direct Annual Costs (TDAC)					TDAC =	\$ 4,470,691
INDIRECT ANNUAL COSTS						
(6) Overhead	1%	%		\$ 57,944		\$ 57,944
(7a) Administrative Charges, Insurance	3%	% total capital		\$ 173,832		\$ 173,832
(7b) Capital Recovery Factor [see inputs below]	0.0847					
(8) Capital Recovery						CRF * TCI = \$ 490,619
Total Indirect Annual Costs (TIAC)					TIAC =	\$ 722,394
TOTAL ANNUALIZED COSTS (TAC)					TAC = (TDAC) + (TIAC) =	\$ 5,193,086

Data Inputs for Capital Recovery Factor:		
Annual Interest Rate (EPA OAQPS Control Cost Manual)	7.50	%
Project Life (EPA OAQPS Control Cost Manual)	30	years

Line Number/Description	Title	Comment
Line Number 1 and 3	Operating/Maintenance Labor	Provided by UAF. Rate is burdoned rate for level of personnel operating and performing maintenance on this type of equipment. Additional FT operations person is assumed per shift. Four total shifts per week. Quarter FT maintenance persons is assumed for the new DSI system.
Line Number 4	Maintenance Material	Allotment for maintenance materials. Item is equal to the maintenance labor allotment in line 3.
Line Number 5a	Hydrated Lime	Hydrated Lime consumption rates provided by DSI vendor. Hydrated Lime costs provided by L'hoist.
Line Number 5b	Electricity	Pricing provided by UAF for published utility rates on campus. Electrical consumption rate provided by DSI vendor. Additional consumption by larger ID Fan was also included.
Line Number 5c	Water	Pricing provided by UAF for published utility rates on campus. Water consumption rate provided by DSI vendor.
Line Number 6	Overhead	Calculated as percent of Total Capital Investment
Line Number 7a	Admin Charges, etc	Calculated as percent of Total Capital Investment
Line Number 7b	Capital Recovery Factor	EPA calculated factor using Interest Rate and Project Life Span
Line Number 8	Capital Recovery	Capital Recovery Factor times Total Capital Investment.
Annual Interest Rate (EPA OAQPS Control Cost Manual)	Annual Interest Rate	Latest federal prime rate. https://www.federalreserve.gov/releases/h15/
Project Life (EPA OAQPS Control Cost Manual)	Project Life	Project Life expectancy in years.