Piperazine Advanced Stripper (PZAS[™]) Front End Engineering Design (FEED) Study [on NGCC at Denver City, Tx]

DE-FE0031844 2020 CCUS Integrated Project Review Meeting August 17-19, 2020

Gary T. Rochelle Department of Chemical Engineering The University of Texas at Austin





👡 Trimeric Corp

Takeaways **Objective:** accurate FEED with benefits **PZAS:** a superior capture technology Mustang Station: space, EOR & cheap energy Absorber: only 25 ft of solvent packing Stripper: CO₂ product at 80 psia Steam: gas-fired boilers with "free" fuel **Compression: 2 reciprocating machines**

AECOM

🦦 Trimeric Corp

PZAS[™] CO₂ Capture

The Objective: Accurate installed cost of *PZAS™* on NGCC at GSEC Mustang Station

Complementary Benefits:

- Develop commercial project at Mustang Station
- Qualify PZAS for use on NGCC cogeneration
- Provide commercial cost detail

To optimize PZAS & other 2G capture processes
To guide R&D of capture technology

Program Overview

- Funding (DOE and Cost Share)
 04.1 MM DOE
 - 1.1 MM cost sharing- ExxonMobil, Total, Chevron
 0.3 MM from Honeywell UOP outside DOE
- Performance Dates: 10/2019 9/2021
- Project Participants
 - Golden Spread Electric Cooperative (GSEC) host
 - O University of Texas at Austin (UT) Modeling/ Technology
 - Trimeric Process Engineering
 AECOM EPC

Milestones

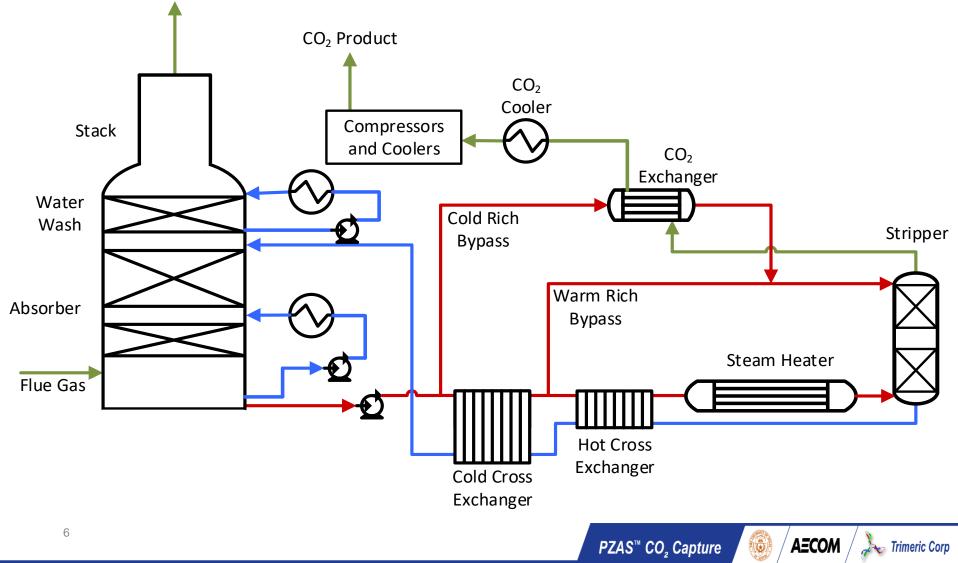
2.	Kick Off Meeting; DOE	Feb 3, 2020
3.	Virtual Kick Off; Mustang Station	Mar 30, 2020
4.	Project Design Basis	Aug 14, 2020
5.	2020 DOE-NETL Contractors Mtg	Aug 18, 2020
6.	Baseline Process Design	Oct 2020
13.	FEED Report	Sept 2021

Project team will request a no-cost extension to Dec 2021



PZAS for NGCC

5 m Piperazine with the Advanced Stripper



PZAS development includes comprehensive research & pilot plant demonstration

- (2000-20) Research by 43 graduate students
- (2006-09) UT Pilot of K₂CO₃/Piperazine (PZ)
- PZAS Pilot at 12% CO₂ for coal
 - (2010-18) UT Austin
 - (2018) at NCCC
- PZAS Pilot w 4% CO₂ For NGCC
 - (2016-18) UT Austin
 - (2019) NCCC



PZAS pilot at NCCC with CCP4 funding

- Heat duty 2.4 GJ/t
- Stripping at 302 F/90 psia with little degradation
- 90-95% CO₂ removal with 2 x 20 ft packing
- Pump-around intercooling of hot inlet gas
- Low PZ oxidation, <0.3 kg/t CO₂
- 304 SS works up to 150°C
- PZ emissions < 1 ppm

Piperazine Advanced Stripper (PZAS) FEED Study Host Site - Mustang Station Golden Spread Electric Cooperative, Denver City, TX

面 430 MW Combined Cycle Mustang Static Power Plant 2 gas turbines/1 steam turbine



Cheap, Stranded Gas available from Waha Hub Limited pipeline capacity from the Permian Basin

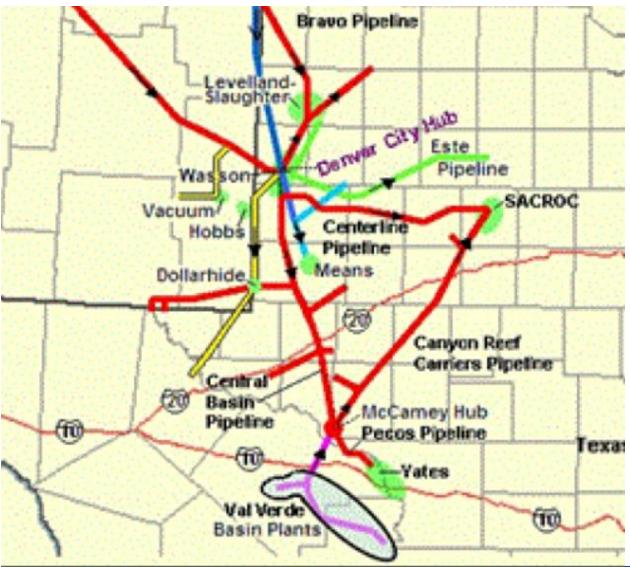
Permian

Denver

Current Price = \$1.60/MMBtu



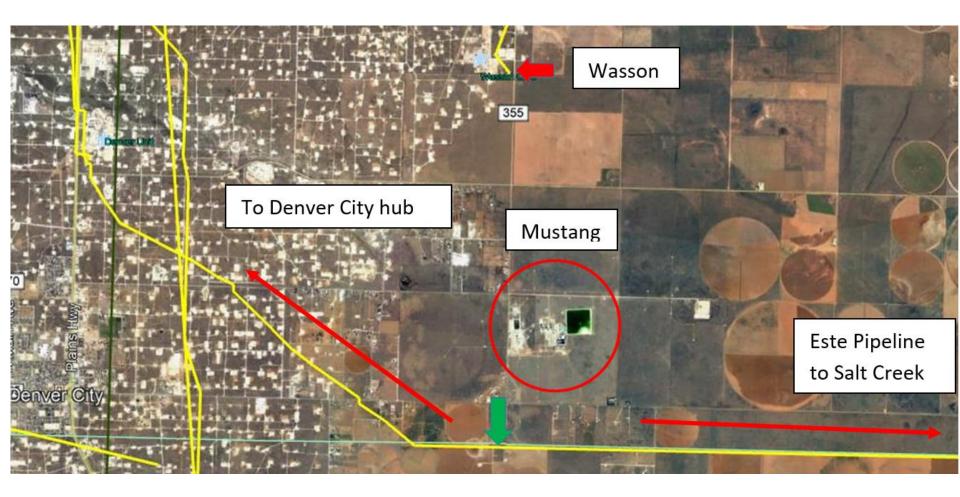
CO₂ pipelines converge on Denver City, TX



PZAS[™] CO₂ Capture



Ample open land CO₂ to Este Pipeline for EOR



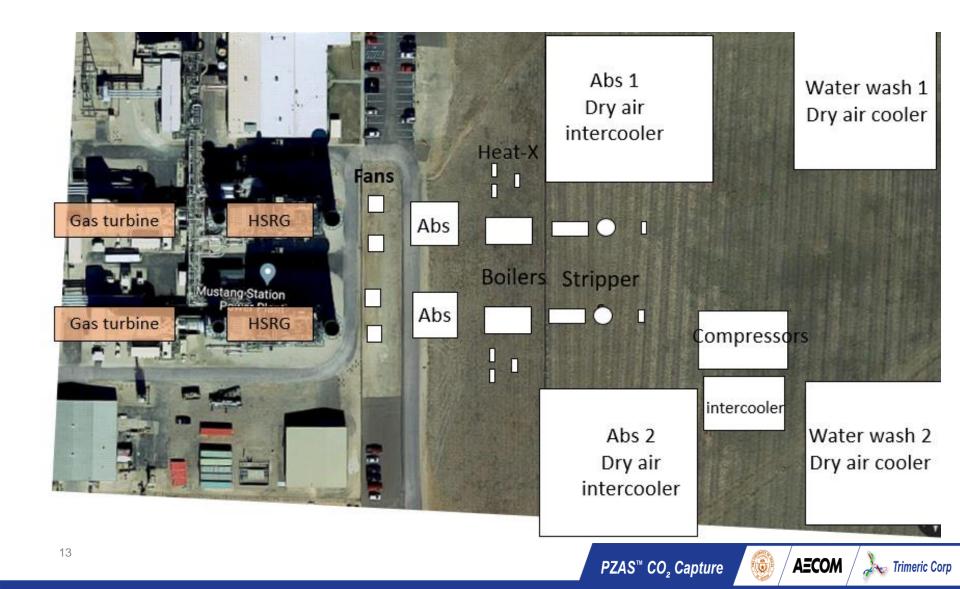
PZAS[™] CO₂ Capture

AECOM

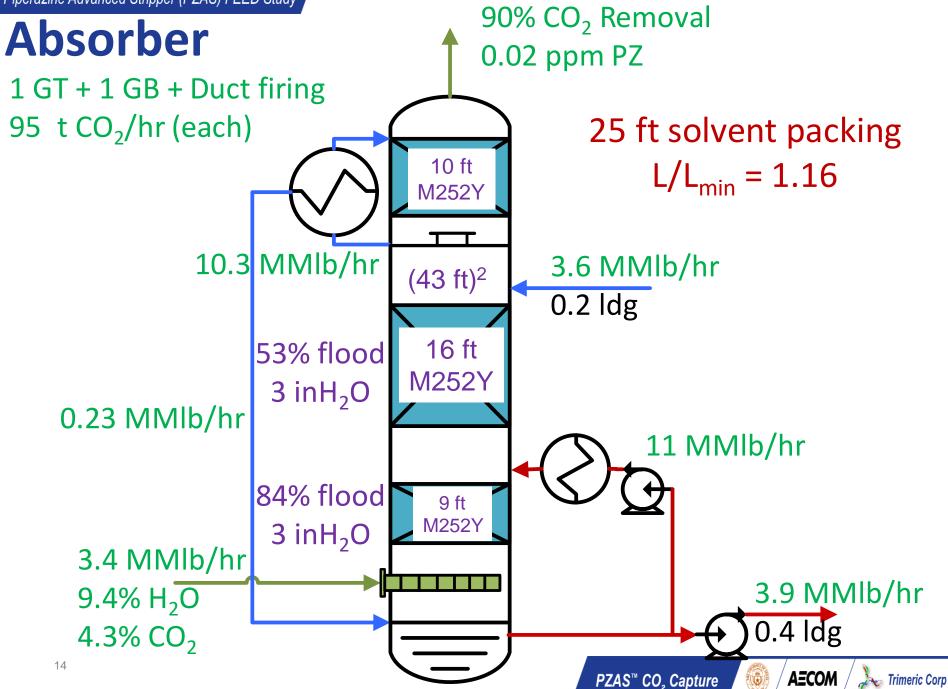
🍾 Trimeric Corp

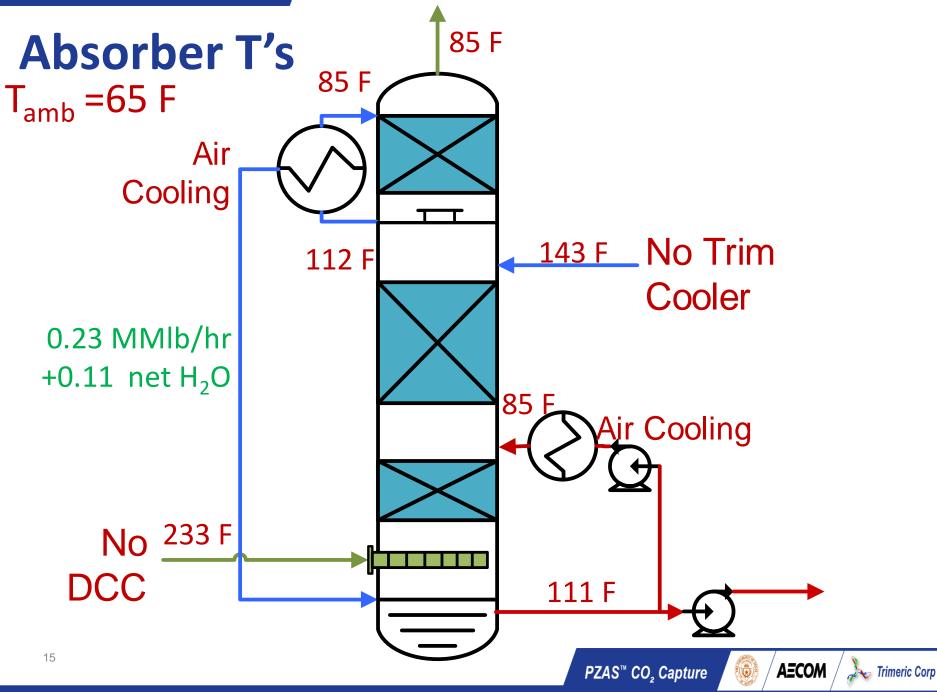
Two trains: Plot Space dominated by air coolers

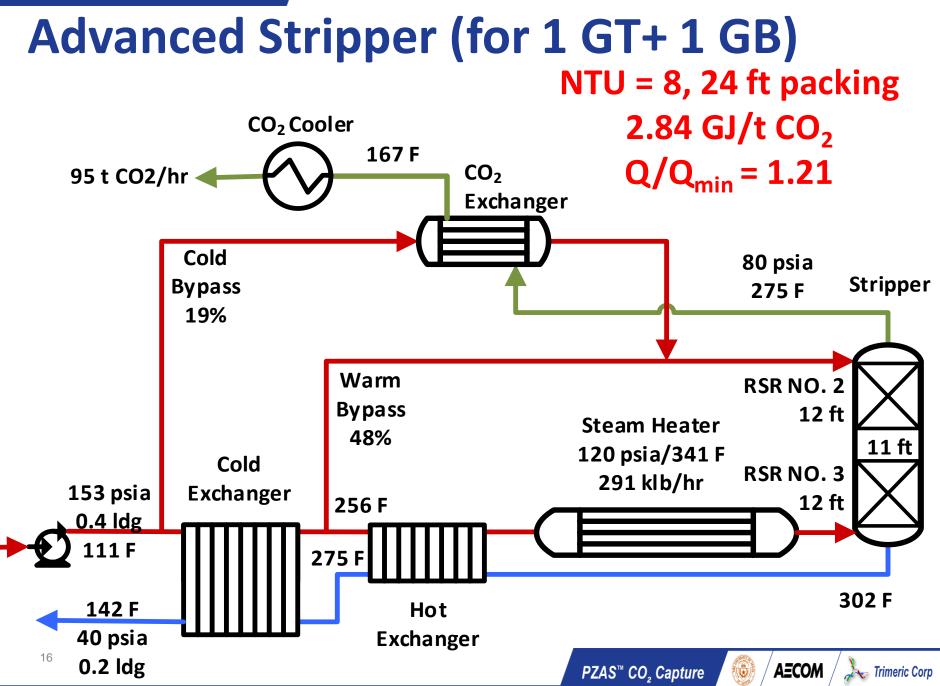
[Preliminary unvetted layout by UT]





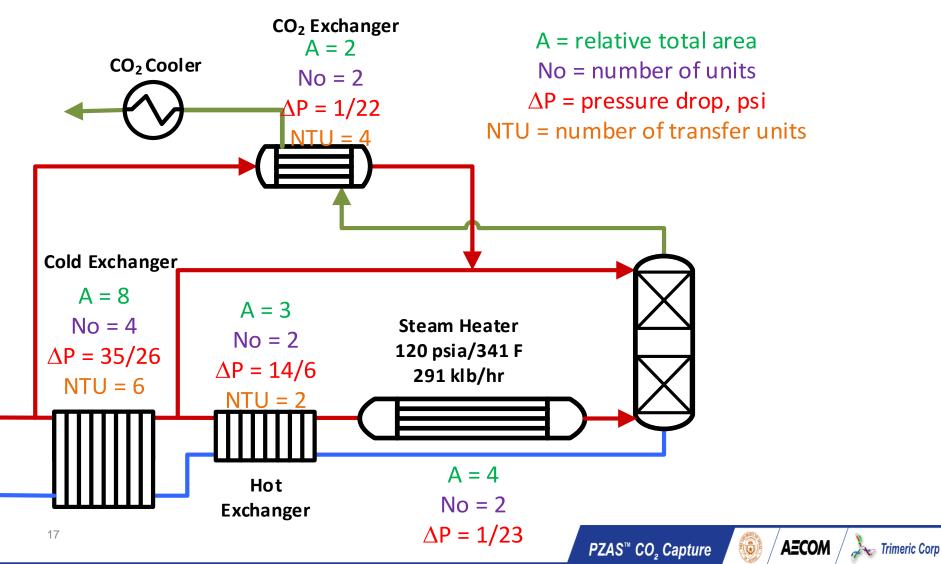






Exchangers for both trains low cost energy \rightarrow less area, larger ΔP

Total Exchanger purchase cost = \$3.6 MM



Steam provided by 2 gas-fired boilers

- 2 x 290,000 lbs/hr, one for each absorber
 - Saturated steam at 140 psia
 - $\,\circ\,$ Air preheater to reduce flue gas to 250 F
 - $\,\circ\,$ Flue gas fed to absorber for 90% removal
- @ \$50/t CO₂ for 45Q and EOR, the C in natural gas is worth \$2.66/MMBtu.
- @ 29 t CO₂/hr \$13 MM/yr
- With 90% removal the incr fuel cost < zero if gas< \$2.4/MMBtu.

○ Current gas price is 1.2 – 2 \$/MMBtu

Design: One Reciprocating Compressor/Absorber

- Recip consistent with high inlet P
- Recip provides better turndown than centrifugal
- Purchase Cost about \$700/hp
- Cost Comparison with 1 machine per absorber

	Reciprocating	Integrally Geared Centrifugal
Power per machine, HP	9,075	8,708
Relative Cost	1.0	1.3

1 IGC machine for 2 absorbers: relative total cost = 0.85

Profitability

- Cash Flow w capture, \$65 MM/yr
 - Fuel cost, \$2/MMBtu, \$18/MWh
 - Variable maintenance & operating, \$5/MWH
 - \circ 45Q tax credit, \$35/t CO₂, \$14/MWh
 - \circ EOR value, \$15/t CO₂, \$6/MWh
 - Electricity sales price, \$18/MWh
 - Annual load factor, 75%
- Total cash flow w/o capture, \$15 MM/yr
 - 50% annual load factor
- Net cash flow created by capture, \$50 MM/yr
- With \$300 MM investment, 6 yr payout

Conclusions

- PZAS uses 25 ft of absorber packing even w no DCC
- Air cooling feasible, even with swings in T_{amb}
- 80 psia stripper permits reciprocating compressors
- With cheap energy, PZAS uses 2.84 GJ/t CO2
- With cheap gas, gas boiler provides zero incr fuel cost
- 6 year payout expected
- Detailed FEED on schedule for Fall 2021

Appendix

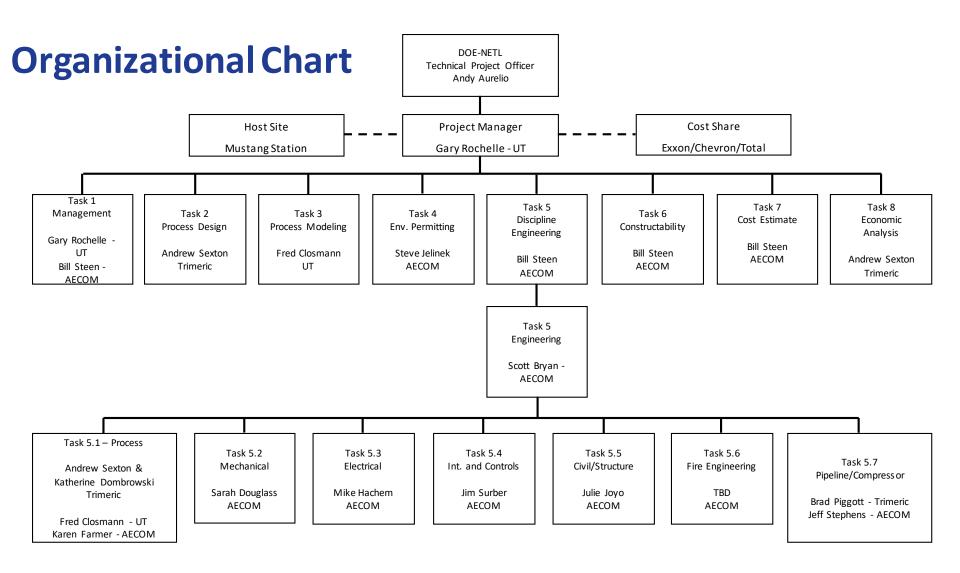
.



Project Team and Key Personnel

Party	Person	Role
NETL	Isaac Aurelio	Technical Project Officer
UT-Austin	Dr. Gary Rochelle	Principal Investigator
	Dr. Fred Closmann	Technical Proj Manager
AECOM	Dr. Bill Steen	AECOM Proj Manager
	Scott Bryan	Project Engineer
	Karen Farmer	AECOM Process Lead / Dept Project Manager
Trimeric	Dr. Andrew Sexton	Trimeric PjM
	Katherine Dombrowski	Process Lead

AECOM



AECOM

🍾 Trimeric Corp

Gantt Chart

	Rev. G 07.16.20			 Schedule Revi 																					
# Activity	ID	Activity Name	Original Start Duration	Finish	Total Float	Qtr 3, 2	-	ep O	_	4, 2020 Nov	Dec	Q Jan	tr 1, 20 Feb	21 Mar	Apr	tr 2, 20. May	21 Jun	_	Aug	_	Oct	Nov	_	Qir 1, 3 Jan	
	PZAS FEED Rev	4 G 07.16.20	509 03-Feb-20 A	10-Feb-22	-30				-		-									unp	-			-	÷
2	h Milestones		414 03-Feb-20 A	30-Sep-21	65	_	-	_	-	-	_			_	_	_	-	_	-	-	30-Se	p-21, N	estone	4	
3	MS - 02	Kick Off Meeting; DOE (1.3)	0	03-Feb-20 A					- 1		- 1														
4	MS - 01	Updated Project Management Plan (1.2)	0	13-Jul-20*	-73	Updated	Proje	ct Mena	aemer	t Plan (1.21														
5	MS - 03	Kick Off Meeting: Mustang Station (1.3; remote meeting)	0	13-Jul-20*		Kick Off						ote me	eting).												
6	MS - 04	Project Design Basis (2)	0	13-Jul-20*	-8	Project D	Design	Basis (2	1					·	<u> </u>	†	t	†	t	†	t	†	<u>†</u>	†	
7	MS - 05	Presentation at 2020 DOE-NETL Contractors Meeting (1.4)	0	31-Aug-20*	0			resentat		2020 0	E-NE	TL Cont	actors	Meeting	(1.4)										
8	MS - 06	Baseline Process Design (3,5.1)	0	30-Sep-20*	0			🖕 Ві	aseline	Proces	s Desi	an (3,5.	ŋ.												
9	MS - 07	HAZOP Report (5.1)	0	31-Dec-20*	0						- 4	HAZO	P Repo	t (5.1),											
10	MS - 08	Equipment List (5.2)	0	26-Feb-21*	0								•	Equip	hent Lk	(5.2),									
11	MS - 09	Electrical One-Lines (5.3)	0	30-Apr-21*	0											Elect	tal One	dLines (9.3),	†	1	1	1	1	1
12	🔲 MS - 10	60% Model Review (5)	0	30-Jun-21*	0													60%	Model R	view (5	i				
13	🔲 MS - 11	Process Modeling Report (3)	0	30-Jul-21*	0														Proce	ss Mod	aing Rep	brt (3),			
14	MS - 12	Presentation at 2021 DOE-NETL Contractors Meeting (1.4)	0	31-Aug-21*	0															🛉 Pres	antation	at 2021	DOE-N	ETL Co	nteac
15	📟 MS - 13	FEED Report (1.5)	0	30-Sep-21*	0																🛉 FEED	Report	1.5),		
16	📟 MS - 14	Project Close-Out Meeting (1)	0	30-Sep-21*	0								ľ			ľ	[ľ	T	T	Proje	d Close	Out Me	dting ().
17	🖕 Task 1 - Manag	jement	319 13-Jul-20	30-Sep-21	65	-	-	-	-	-+	-			_		-	-			-	30-Se	p-21, T	sk 1 - N	Manage	mer
18	A1280	AECOM Labor	0 13-Jul-20	13-Jul-20	384	AECOM	Labor																		
19	Substask 01.01 F	Program Management (UT)	319 13-Jul-20	30-Sep-21	65	_	+		-	-	_	_	_	_	-	-	-	-	-	-	30-Se	p-21, S	bstask	01.01	Piog
20	A1030	Overall management (Teleconferences and other communications, schedule ad budget tracking, e	319 13-Jul-20	30-Sep-21	65		-								-		-			-		mana			
21	Substask 01.02 F	PMP	0 13-Jui-20	13-Jul-20	-73	13 Jul-20), Sub	stask 01	.02 1	MP						†	†	†	1	<u>†</u>	t	†	1	†	1
22	A1040	PMP	0 13-Jul-20	13-Jul-20	-73	PMP																			
23	Substask 01.03 H	Kickoff Meetings	0 13-Jui-20	13-Jul-20	-73	13Jul-20), Sub	stask 01	.03 6	ckoff Me	etings														
24	A1050	Kickoff Meeting	0 13-Jul-20	13-Jul-20	-73	Kiekoff N	Neisting																		
25	Substask 01.04 1	Technical Presentations	297 13-Jul-20	31-Aug-21	0		-	-	-	-	-	_		_	-	-	-	-	-	31-A	g-21, S	obstask	01.04 1	Idchnics	al Po
26	A1060	DOE Contractors Meeting	297 13-Jul-20	31-Aug-21	0															DOE	Contrac	tors Mee	ding	1	T
27	Substask 01.05 F	Reporting (Including FEED)	319 13-Jul-20	30-Sep-21	65		÷	-	÷	- †	- 1			-	-	÷ –		-	<u>.</u>	÷ –	7 30-Se	p-21, S	ébstask	01.05	Répr
28	A1070	Reporting	319 13-Jul-20	30-Sep-21	0																Repo	ding			
29	A1290	Q1-2020 Report	0 13-Jul-20	13-Jul-20	65	Q1-2020																			
30	A1300	Q2-2020 Report	0 13-Jul-20	13-Jul-20	65	QZ-2020	Repo	rt								l	l	l	l	l	l	l	l	l	1
31	A1310	Q3-2020 Report	58 13-Jul-20	30-Sep-20	65	:		a	3-2020	0 Report								1	1	1	1	1		T	T
32	A1320	Q4-2020 Report	66 01-Oct-20	31-Dec-20	65				÷	;	=	Q4-20	20 Rep	brt											
33	A1330	Q1-2021 Report	64 01-Jan-21	31-Mar-21	65						3		-		Q1-2	021 Rep	ort 🛛								
34	A1340	Q2-2021 Report	65 01-Apr-21	30-Jun-21	65													Q2-2	21 Rep	on 👘					
35	A1350	Q3-2021 Report	66 01-Jul-21	30-Sep-21	65										l	<u>j</u>	l				Q3-2	121 Rep	brt	1	1.
	🛓 Task 2 - Projec	t Design Basis (Trimeric)	95 30-Mar-20 A	10-Aug-20	364	1	0-Aug	-20, Tasi	k 2 - P	roject D	esign 🖡	Basis (Tr	meric)												
37	A1430	Finalize Technology Implementation-1	0 30-Mar-20 A	04-Jun-20 A		Techhology	y Impli	emehtati	on-t		- 1														
38	A1860	Finalize Design Basis-39	1 09-Jun-20 A	22-Jul-20 A		Finaliz																			
39	A1820	Update PFD-35	0 10-Aug-20	10-Aug-20	364			PFD-35																	
40		Design Basis, PFD, and Guidelines	0 13-Jul-20	13-Jul-20	-75	13 Jul-20	0, Sub	task 02.0	01 D	esign Ba	sis, Pf	D, and	Guideli	es		L				1	l	L		1	1
41	A1530	Phase 1 - Design Basis, PFD, and Guidelines	0 13-Jul-20*	13-Jul-20	-75	Phase 1										1	F	1	1	1	1	1		T	Т
42		Host Site and Design Information	0 13-Jul-20	13-Jul-20	-75	13 Jul-20						isign Inf	ormatio	n											
43	A1520	Phase 2 · Host Site and Design Information	0 13-Jul-20*	13-Jul-20	-75	Phase 2	- Host	Site and	d Desi	gn Infor	nation													1	1
	Task 3 - Proces	ss Modeling (Trimeric & UT)	314 26-Jun-20 A	30-Jul-21	97	_	-	-	-	-	-				-	-	-	-	30-Ju	121, Tai	k 3 - Pro	cess M	ddeling	(İrimeri	z∔ι
45	A1760	Finalize Process Simulation-30	8 26-Jun-20 A	17-Jul-20 A		Finalize	Proce	iss Simu	lation-	30															
46	A1770	Review Process Simulation-31	7 20-Jul-20 A	24-Jul-20	362	Revie			ulation	n-31						1	[1	T	1	1		T	T
47	A1840	Update H&MB-37	1 22-Jul-20*	22-Jul-20	0	I Updat	e H&A	(B-37																	
48	A1210	Process Modeling	4 27-Jul-21	30-Jul-21*	0														Proce	s Mod	aing				
49	Task 4 - Enviro	onmental Permitting	414 13-Jul-20	10-Feb-22	-30	-	+	-	-	-	-				-		-	-	-			-		1	÷
50	Subtask 04.01 Ai		414 13-Jul-20	10-Feb-22	-30		-	_	_	_	_	_			_	_	-	_	-	-	-	_	_	-	÷
51	A1000	Air	110 13-Jul-20	11-Dec-20	-30						Air					†	†	†	+	†	1	†	·	†	+
	ctual Level of Effort	Remaining Work Milestone Critical Remaining Work	F	Page 1 of 3			<u> </u>		<u> </u>	TA	SK fille	er: HID	e del	ETED .									acle Co		<u> </u>

۲

AECOM

lineric Corp



Gantt Chart

# Activity Name Original Duration State Finish Finish Oral Finish	PZAS	FEED	Rev. G 07.16.20		,	AECOM - Schedule Rev	iew																			٦.
Nome Applie				Activity Name	Original Start Finish Total Float			at Qtr 3, 2020			Qtr 4, 20	20	0	tr 1, 202	1	0	tr 2, 202	21	Otr 3, 2021					21	ptr 1, 2	122
C ADD Manany C Name C Name C Name Name </th <th></th> <th></th> <th></th> <th></th> <th>Duration</th> <th></th> <th></th> <th></th> <th>a Se</th> <th>0 00</th> <th>Nov</th> <th>Dec</th> <th>Jan</th> <th>Feb</th> <th>Mar</th> <th>Apr</th> <th>May</th> <th>Jun</th> <th>Jul</th> <th>Aug</th> <th>Sep</th> <th>Oct</th> <th>Nov</th> <th>Dec</th> <th>Jan</th> <th>eb.</th>					Duration				a Se	0 00	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	eb.
Display Display <thdisplay< th=""> <thdisplay< th=""> <thdisplay< th=""></thdisplay<></thdisplay<></thdisplay<>	52		A1230	Air Remaining	42 15-De	c-21 10-Feb-22	-30												-			-				۲.
0 0.0 0.0 0.00 0.0000 0.000 0.000 </td <th>53</th> <th></th> <td></td> <td>ter</td> <td>414 13-Jul</td> <td>-20 10-Feb-22</td> <td>-30</td> <td>_</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>_</td> <td></td> <td></td> <td>_</td> <td>_</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>—</td> <td>—</td> <td>-</td>	53			ter	414 13-Jul	-20 10-Feb-22	-30	_	-	-	-	-	_			_	_	-	-	-	-	-	-	—	—	-
0 0.0 0.0 0.00 0.0000 0.000 0.000 </td <th>54</th> <th></th> <td>A1010</td> <td>Water</td> <td>110 13-34</td> <td>20 11-Dec-20</td> <td>-30</td> <td>:</td> <td></td> <td></td> <td></td> <td>i wa</td> <td>Ber</td> <td></td> <td>11</td>	54		A1010	Water	110 13-34	20 11-Dec-20	-30	:				i wa	Ber													11
0 0									-	-		Τ													<u> </u>	<u> </u>
Image: Control Image							-30												÷		÷		÷		+	-
Image: market interpretation of the state interpretatio							-30			1		50	d Wast													11
No. Table 3. Use control length services representing the service of the services repres																								i 🕳	<u> </u>	-
No. N			_				14	_	_	_	-	-	_			_		_	_	-	-	-	-	10	Dec.21	
0 APP Normal Price Name 30 1.3.00 1.0001 1.0001 1.0001 1.0000 Normal Price Name Nor			· · · ·	· · ·																					1	
0 0 0.00000000000000000000000000000000000							14										.		÷	÷	÷	.	÷			÷
0 0.00000 0.0000							14																			
No. No. <th></th> <th></th> <td></td> <td>1</td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td>																				1	1					
0 0 0.400 Wite Proces Deciption tead Allow 21 0 0.400.40 7.00 Non-specified and allow 20 0.400.40 1.00.40<									-	-	:	1								1		AE	GOM - F	ROCESS E	ngineer	19
0 1000 Asses for d copared masked for map copared to g at all market registron (market for large copared registro								1		1				otask (5.01 · P	ocess :	smulatio	In, PFD	and H&	MB						
Image: Section of the construction of the c																			÷		<u>.</u>	.	÷	·		÷
0 0 Part 4								A	sess typ						it (e.g.s	eam he	ater typ,		ansor typ	e, etc.)	34					
90 0 Ax000 Device PCP Duties 41 1 1 AxA00 377 77 Ax700 Rever duting table with 822 0 1 77.428										_				ocume	nation C	ontrol t	AECO	171		1						
70 A 7170 Nove and Summaries VMM-02 0 77-4.30 10 77-4.30<												ntrol Plan	43							1						
71 Normal with weaking with some matched to the process 3 1 17 1 7 4 4 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5																				1						
72 A 4000 Update UFD/B 2 64.09.20 0.40.00 <								I Re	ew and	summa	IZE H&M	5-32					L	ļ	Ļ	÷	Ļ	ļ	Ļ	. .	.	÷
72 1 A 1450 Deer top case PAGLe 00 0 0.5 deg 20 0 77 A 1500 Deer top case PAGLe 00 0 0.6 deg 20 0.6											valiability	with amo	unt nee	eed for	ne prod	855-33				1						
74. A 1050 Deer for jass Uby PADG-40 17 (4																									1	
75 A 1870							0						6-59													
78 1 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				and the second			0																			
77 A 1480 Control value starspin 12 112 7 Jug 207 14 58,920 0 78 A 1480 PS 100 top Update preve Chaot.180 16 0 58,920 335 78 A 1480 PS 100 top Update preve Chaot.180 16 0 58,920 335 78 A 1480 PS 100 top Update preve Chaot.180 16 0 458,920 335 78 A 1480 PS 100 top Update preve Chaot.180 16 0 458,920 2359,20 237 78 A 1480 PS 100 top Update preve Chaot.180 16 0 458,920 2369,20 237 78 A 1480 Person transpect top A 200 top Update preve Chaot.180 16 0 459,920 2369,20 237 78 A 1480 Develop Instarment Data Sheets 181 21 0 589,20 2369,20 237 78 A 1480 Update preve Chaot.164 11 0 459,20 11 0 589,20 336 78 A 1480 Update preve Chaot.164 11 0 459,20 336 11 0 459,20 336 79 A 1480 Update preve Chaot.164 11 0 459,20 336 11 0 459,20 336 11 0 459,20 336 11 0 459,20 336 11 0 459,20 1									Review	Design E	asis PFD	UFD, an	а наме	40			L	l	Ļ		Ļ	l	Ļ		4	÷
78 A M440 PM Sang Usaba per Per Chack-100 100 Subg-20* 25.89-20 0.0 78 A M450 Less Sang-15 Ferry Sang Usaba per Per Chack-100 Ferry Sang Usaba per Per Chack-100 Ferry Sang Usaba per Per Chack-100 78 A M450 Dess Sang 155 Ferry Sang Usaba per Per Chack-100 Ferry Sang Usaba per Per Chack-100 Ferry Sang Usaba per Per Chack-100 78 A M450 Dess Sang 155 Ferry Sang Usaba per Per Chack-100 Ferry Sang Usaba per Per Chack-100 Ferry Sang Usaba per Per Chack-100 78 A M450 Dess Per Dament Data Data Data Dess 161 Ferry Sang Usaba per Per Chack-100 Ferry Sang Usaba per Per Chack-100 78 A M450 Dess Per Dament Data Data Dess 161 Ferry Sang Usaba per Per Chack-100 Ferry Sang Usaba per Per Chack-100 78 A M450 Dess Per Dament Data Data Dess 161 Ferry Sang Usaba per Per Chack-100 Ferry Sang Usaba per Per Chack-100 78 A M450 Dess Per Dament Data Data Data Data Data Data Data Da							362						UFD, an	d H&ME	41										1	
79 A 1490 Lies Biorg-165 6 4.5sp-20 10 49.5p-20 10							0													1						
00 Atto:0 Pretmany PPV Calculation-18 11 04-59-20 18-59-20 0 Pretmany PPV Calculation-18 1							0					date per	Peer Ch	eck-160												
A A600 Develop Inducement Data Shades-161 16 0.4569-20 292 reg. 20 207 reg. 20 16 main from the main							330		_															1	1	
12 A 1570 Review retra pass P4Dus with 1762 2 07.892.0 08.692.00 1446 33 A 1560 Mainty Spacably Items 61 3 16.56p.20 1468p.20 3386 34 A 1660 Live Starge Pace Act 56 0 11.68p.20 11.68p.20 3386 37 A 1670 Live Starge Pace Act 167 2 14.68p.20 15.68p.20 16.68p.20 16.69p.20 16.6							0										L	l	Ļ		Ļ		Ļ		↓	L
81 A 1690 Market/Specially lame-61 31 10.598-20 14.589-20 338 Imputy Specially lame-61 Imputy Specially lame-61 61 A 1650 Len Sung, Paer Chack-166 0 11.589-20 11.589-20 338 62 A 1650 Len Sung, Paer Chack-166 0 11.589-20 14.589-20 338 63 A 1610 Len Sung, Paer Chack-164 2 15.589-20 338 64 A 1650 Per Chack-Chat 2 15.589-20 338 7 A 1650 Per Chack-Chat 2 15.589-20 338 8 A 1650 Per Chack-154 2 15.589-20 336 9 A 1650 Per Chack-164 2 15.589-20 336 1 A 1650 Per Chack-164 2 15.589-20 336 1 A 1650 Per Chack-164 2 15.589-20 336 1 A 1650 Per Chack-165 2 15.599-20 10.599 10.599 10.599 10.599 10.599 10.599 15.599 15.599 15.599 15.599 <t< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>ts-161</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></t<>														ts-161												
4 2 0.5ap.20 11.5ap.20 333 1 1.1cb Sking Paer Check 157 5 A1600 Line Sking Paer Check 157 21.45ap.20 11.5ap.20 335 1 Line Sking Paer Check 157 7 A1617 Peer Check - Control Value Sking Pier Check 157 21.45ap.20 155ap.20 335 1 Line Sking Paer Check 157 21.45ap.20 155ap.20 335 1 Under Sking Paer Check 157 21.45ap.20 155ap.20 335 1 Under Sking Paer Check 157 1 1.5ap.30 15.5ap.20 335 1 Under Sking Paer Check 157 1 1.5ap.30 1.5ap.30 1 Under Sking Paer Check 157 1 1.5ap.30																										
85 A 1600 Lie Stang, Peer Check-156 I 1.6ep-20 13.6ep-20 14.6ep-20 15.6ep-20 15.6ep-20 15.6ep-20 15.6ep-20 16.6ep-20 <li< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>1</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></li<>													1													
8 A 1610 Lie schrg update per ger chock-157 2 11-Sep-20 14-Sep-20 338 87 A 1670 Peer Chock. Control Valve Starg-163 2 14-Sep-20 15-Sep-20 15-Sep-20 336 87 A 1670 Peer Chock. Control Valve Starg-163 2 14-Sep-20 15-Sep-20 336 87 A 1680 PLobate per peer chock-164 2 15-Sep-20 330 90 A 16700 Peer Chock. 159 5 18-Sep-20 22-Sep-20 330 90 A 16700 Second pass PAID Peter Weternal-167 2 30-Sep-20 0 91 A 1700 Second pass PAID Peter Weternal-167 2 30-Sep-20 0 0 92 A 1710 Second pass PAID Peter Weternal-167 2 30-Sep-20 0 0 Second pass PAID Peter Weternal-167 2 30-Sep-20 0 0 Second pass PAID Peter Weternal-167 1 30-Sep-20 2 30-Sep-20 0 0 Second pass PAID Peter Weternal-167 2 30-Sep-20 0 0 Second pass PAID Peter Weternal-167 1 30-Sep-20 2 30-Sep-20 0 0 Second pass PAID Peter Weternal-167 1 30-Sep-20 310 1 30-Sep-20 310 1 30-Sep-20																				1					1	
27 A1670 Peer Chack. Control Valve Sizing-163 2 14.58p-20 15.58p-20 336 88 A1680 Update per peer chack.164 2 15.58p-20 336 90 A1630 PSV Sing-Peer Chack.159 2 24.58p-20 336 90 A1630 PSV Sing-Peer Chack.159 2 24.58p-20 24.58p-20 306 91 A1700 Second pass PAID review informal-167 2 305,620 19 Second pass PAID review informal-167 2 305,620 19 Second pass PAID review informal-167 2 305,620 316 19 PSV Sing-Peir Chack.159 Second pass PAID review informal-167 2 305,620 316 19 PSV Sing-Peir Chack.159 Second pass PAID review informal-167 3 12 Col-20 316 15 Second pass PAID review informal-167 33 15 Sub 20 28 Aug 20 16 16 Second pass PAID review informal-167 33 15 Sub 20 28 Aug 20 316 16 Second pass PAID review informal-167 33 15 Sub 20 28 Aug 20 316 16 Second pass PAID review informal-16																	Ļ	ļ	Ļ	ļ	Ļ	ļ	Ļ		4	
88 A 1880 Update par peer check-164 2 15 Sap-20 16 Sap-20 336 89 A 1690 PkD mekee and explorment specification sheed coss check-165 5 16 Sap-20 24 Sap-20 336 91 A 1630 PsV Sizep-Pser Check-164 2 2 Sap-20 00 91 A 1700 Second pass PAID review internal-167 2 30 Sap-20 0 0 9 Second pass PAID review internal-167 2 30 Sap-20 0 0 9 Second pass PAID review internal-167 2 30 Sap-20 0 0 9 Second pass PAID review internal-167 2 30 Sap-20 0 0 9 Second pass PAID review internal-167 2 30 Sap-20 0 5 Oc-20 2 2 Sap-20 0 0 92 A 1720 Second pass PAID review internal-167 2 30 Sap-20 10 Soc.20 2 2 Sap-20 0 0 93 A 1720 Second pass PAID review internal-167 2 30 Sap-20 10 Soc.20 2 Sap-20 0 0 94 A 1720 Second pass PAID review internal-167 3 12 Oc-20 12 Oc-20 316 9 Sap-10 Review internal-168 9 Sap-10 Review in																										
89 0 A1690 P&UD review and equipment specification sheet cross check-165 5 18.50p-20 24.50p-20 330 0 P P P 100 P 100									-					163						1						
90 PSV Subg. Peer Check:158 21 Sep-20 22 Sep-20 0 PSV Subg. Petr Check:158 1																										
91 A 1700 Second pase PAD Update-166 4 24 Sep-20 C A 1710 Second pase PAD Inview Internat-167 C A 1720 Second pase PAD Inview Internat-168 Second pase PAD Internat-168 Seco							330							oficatio	n sheet	oross d	eck-165			1						
92 A 1710 Second pass PAID review internal-167 2 30.58p-20 01.0c.20 23 93 A 1720 Second pass PAID review internal-167 2 20.0c.20 05.0c.20 23 94 A 1720 Second pass PAID review internal-167 2 20.0c.20 12.0c.10 12.0c.10 13.0c.10 90.0c.10 90.0							0										Ļ	.	Ļ	÷	Ļ	.	÷	. .	.	÷
93 ▲ A1720 Second pass P&ID review updates-168 2 02-Oc120 05-Oc120 23 94 ▲ A1740 Publich Process Design Package-169 5 06-Oc120 12-Oc120 316 Publich Process Design Package-169 12-Oc120 316 94 ▲ A1740 Transfer files to AECOM-170 12-Oc120 14-Oc120 316 12-Oc120 316 12-Oc1																				1						
94 A 1730 Publish Process Design Package-169 5 06-Oc-20 12-Oc-20 316 Image: Package-169 Image: Package-169 95 A 1740 Transfer files to AECOM-170 3 12-Oc-20 316 Image: Package-169 Image: Package-169 96 A 1740 Transfer files to AECOM-170 3 15-Ju2-02 14-Oc-20 316 Image: Package-169 Image: Package-169 97 A 1890 Size Equipment Process Design Package-169 3 15-Ju2-02 28-Aug-20 0 316 28-Aug-20 10 316 317 28-Aug-20 10 316							_													1						
95 A1740 Transfer files to AECOM-170 3 12-Oci 20 316 1 Tender files to AECOM-170 96 1 A1800 Size Equipment Process) Design 28-Aug-20 345 28-Aug-20, Eduipment Process) Design 28-Aug-20, Eduipment Process) Design 97 A1800 Size Equipment - Regenerator-71 33 15-Jul-20 28-Aug-20 16 Size Equipment - Studber of Quench-78 99 A1910 Size Equipment - Filters-85 33 15-Jul-20 28-Aug-20 340 Size Equipment - Studber of Quench-78 100 A1920 Size Equipment - Filters-85 33 15-Jul-20 28-Aug-20 340 Size Equipment - Filters-85 101 A1920 Size Equipment - Filters-85 33 15-Jul-20 28-Aug-20 340 Size Equipment - Studber of Quench-78 102 A1930 Size Equipment - Filters-85 33 15-Jul-20 28-Aug-20 340 Size Equipment - Studber of Quench-78 102 A1940 Size Equipment - Filters-85 33 15-Jul-20 28-Aug-20 340 Size Equipment - Studber of Quench - 78 103 Size Equipment - Redamer-99 33																		1	1	1	1			1		
96 15 Equipment (Process) Design 33 15.J.J.20 28.Aug.20 340 28.Aug.20, Equipment (Process) Design 97 A 1896 Size Equipment - Absober-64 33 15.J.J.20 28.Aug.20 0 Size Equipment - Absober-64 98 A 1900 Size Equipment - Regenerator 71 31 15.J.J.20 28.Aug.20 10 99 A 1910 Size Equipment - Regenerator 71 10 15.J.4.20 28.Aug.20 349 Size Equipment - Soubber or Quench - 78 99 A 1910 Size Equipment - Fagenerator 71 10 15.J.4.20 28.Aug.20 349 Size Equipment - Soubber or Quench - 78 100 A 1920 Size Equipment - Fagenation System -92 33 15.J.4.20 28.Aug.20 349 Size Equipment - Soubber or Quench -78 101 A 1930 Size Equipment - Regenation System -92 33 15.J.4.20 28.Aug.20 349 Size Equipment - Regenation System -92 102 A 1940 Size Equipment - Regenation System -92 33 15.J.4.20 28.Aug.20 349 Size Equipment - Regenation System -92 103 Size Equipment - Compresson-106 33 15.J.4.20<															69					1						
97 A 1890 Size Equipment - Absorber-64 33 15.Ju20* 28.Aug-20 0 Size Equipment - Regenerator-71 33 15.Ju20* 28.Aug-20 10 Size Equipment - Regenerator-71 33 15.Ju20* 28.Aug-20 10 Size Equipment - Regenerator-71 Size Equipment - Regenerator-71 33 15.Ju20* 28.Aug-20 10 Size Equipment - Regenerator-71 Size Equipment - Size Equipment - Size Equipment - Regenerator-71 Size Equipment - Regnerator-71 Size Equipment - Regnerator-72 Size Equipment													*******					ļ	Ļ	÷	Ļ	ļ	÷	. .	.	÷
98 A 1900 Size Equipment - Regenerator-71 33 15-Jd-20 28-Jug-20 18 Size Equipment - Regenerator-71 99 A 1910 Size Equipment - Soubber or Quench-78 10 15-Jd-20 28-Jug-20 349 Size Equipment - Soubber or Quench-78 100 A 1920 Size Equipment - Fiten-85 33 15-Jd-20 28-Jug-20 349 Size Equipment - Soubber or Quench-18 101 A 1920 Size Equipment - Fiten-85 33 15-Jd-20 28-Jug-20 349 Size Equipment - Fiten-85 102 A 1920 Size Equipment - Reclamer99 35 15-Jd-20 28-Jug-20 349 Size Equipment - Fiten-85 102 A 1940 Size Equipment - Reclamer99 33 15-Jd-20 28-Jug-20 349 Size Equipment - Fiten-85 103 A 1940 Size Equipment - Reclamer99 Size Equipment - Compressor-106 Size Equipment - Compressor-06 Size Equipment - Compressor-06 103 L-20 28-Jug-20 349 Size Equipment - Compressor-06 Size Equipment - Compressor-06 103 L-20 28-Jug-20 349 Size Equipment - Compressor-06 Size Equipment - Compressor-06 </td <th></th> <th></th> <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>																				1						
99 A 1910 Size Equipment - Scrubber or Quench-78 10 15-Jd-20 28-Jd-20 349 Size Equipment - Scrubber or Quench-78 100 A 1920 Size Equipment - Filter-85 33 15-Jd-20 28-Jd-20 349 Size Equipment - Scrubber or Quench-78 101 A 1930 Size Equipment - Paraton System -92 33 15-Jd-20 28-Jd-20 349 Size Equipment - Scrubber or Quench-78 102 A 1940 Size Equipment - Paraton System -92 33 15-Jd-20 28-Jd-20 349 Size Equipment - Scrubber or Quench-78 102 A 1940 Size Equipment - Paraton System -92 33 15-Jd-20 28-Jd-20 349 Size Equipment - Reduiner-98 103 A 1950 Size Equipment - Compresson-106 33 15-Jd-20 28-Jd-20 349 Size Equipment - Compresson-106 Size Equipment - Compresson-106				A REAL PROPERTY OF A REAL PROPER			-													1						
100 A 1920 Size Equipment - Filters &5 33 15-Jul-20 28-Aug-20 349 Size Equipment - Filters &5 1 1 101 A 1930 Size Equipment - Filters &5 33 15-Jul-20 28-Aug-20 349 Size Equipment - Filters &5 1 </td <th></th> <th></th> <td></td> <td>1</td> <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>																		1		1						
101 A 1930 Size Equipment - PZ Preparation System-92 33 15-Jul-20 28-Aug-20 349 Size Equipment - PZ Preparation System-92 102 A 1940 Size Equipment - Rodamer-99 33 15-Jul-20 28-Aug-20 349 Size Equipment - Rodamer-99 103 A 1950 Size Equipment - Compressor-106 33 15-Jul-20 28-Aug-20 349 Size Equipment - Compressor-106 Actual Level of Effort Permining Work Milestone Page 2 of 3 TASK filter: HIDE DELETED . 													a d							1						
102 A1940 Size Equipment - Radaimer-99 33 15-Jul-20 28 Aug-20 349 Size Equipment - Radaimer-98 103 19-Jul-20 33 15-Jul-20 28 Aug-20 349 Size Equipment - Compressor-106 Size Equipment - Compressor-106 Adual Level of Effort ■ Remaining Work									500	English	AND PILL	00	e Curt	0.07				ļ	÷	÷	÷	ł	÷	. !	÷	÷
103 ▲ 1950 Size Equipment - Compressor-106 33 15-Jul-20 28-Aug-20 349 Size Equipment - Compressor-206 1 ▲ Adual Level of Effort ■ Remaining Work ◆ Milestone Page 2 of 3 TASK filter: HIDE DELETED .								:						1-92				1		1			1		1	
Adual Level of Effort Remaining Work Miestone Page 2 of 3 TASK filter: HIDE DELETED .																				1						
	103		A1950	Size Equipment - Compressor-106	33 15-Jul	28-Aug-20	349		820	r equipr	ent - Cor	npressor-	406				:	:	:	1	:	:	:	:	:	4
Actual Work Citical Remaining Work summary	_	Actu	ual Level of Effort	Remaining Work		Page 2 of 3						TASK fil	ter: HID	E DELI	ETED .											1
		Actu	ual Work	Critical Remaining Work www.www.www.		-					- 1												00	racle Co	rporatir	m

🍌 Trimeric Corp

AECOM

۲



Gantt Chart

	Rev. G 07.16.20			AECON	I - Schedule Re																				_
Activity ID)	Activity Name	Original Duration	Start	Finish	Total Float		-	-	otr 4, 20			_	, 2021	_	_	r 2, 202	_	_	tr 3, 202	_		4, 2021	_	r1,3
	A1960	Size Equipment - Dehydration Unit-113		15-Jul-20	28-Aug-20	349	ul Aug	Sep	Oct	Nov	Dec	_		eb I	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov D	Dec J	Jan
	A1960	Size Equipment - Denydration Unit-113 Size Equipment - Pumps (21)-120		15-Jul-20	28-Aug-20 28-Aug-20	349			auiome				113												
										÷				·÷-		 									
	A1980	Size Equipment - Blowers (2)-127		15-Jul-20	28-Aug-20	349			quipme	1	1														
	A1990	Size Equipment - Heat Exchangers (15)-134		15-Jul-20	28-Aug-20	349			quipme		(Exana	angers	(15)-13	54											
	A2000	Size HRSG-140		20-Jul-20	28-Aug-20	349			RSG-14	:	L _	1													
	A2010	Size Equipment-Storeage Tanks & Vessels (11) - 147		20-Jul-20	28-Aug-20	349		Size	quipme	nt-Store					147										
	HAZOP			26-Oct-20	30-Nov-20	283	L						HAZO	P		Ļ									
	🚍 A1480	Prep for HAZOP-173		26-Oct-20	09-Nov-20	23				<mark>Р</mark> Р	1														
	🚍 A1490	Conduct Process Hazard Review · HAZOP-174		10-Nov-20	23-Nov-20	23		1							eview	- HAZO	P-174								
	A1500	Attend HAZOP-175		10-Nov-20	23-Nov-20	288		1			Attend														
	🚍 A1510	HAZOP Report-176		24-Nov-20	30-Nov-20	23		1	I		HAZ	ZOP Re	pon-17	76											
		echanical Engineering		13-Oct-20	10-Dec-21	14										į								10-Dec	
	A1100	Mechanical Engineering		13-Oct-20	10-Dec-21	14				:	!	1	1	:	1		_							Metha	
	Subtask 05.03 El			13-Oct-20	10-Dec-21	14				1	1	1	1											10-Dec	
	A1120	Electrical Engineering		13-Oct-20	10-Dec-21	14				:					:		_	_				:		Electric	
	Subtask 05.04 18			13-Oct-20	10-Dec-21	14		1		1	1	1		1									- T.	10-Dec	
	A1130	I&C Engineering		13-Oct-20	10-Dec-21	14					4					į								I&C En	
		vil/Structural Engineering		13-Oct-20	10-Dec-21	14		1	-															10-Dec	
	A1090	Civil/Structural Engineering		13-Oct-20	10-Dec-21	14				:	;						_							CMUS	
	Subtask 05.07 Fin			13-Oct-20	10-Dec-21	14		1	-															10-Dec	
	A1360	Fire Engineering		13-Oct-20	10-Dec-21	14						-	-		-		_						-	Fire Er	1
		ompressor Station Engineering		13-Oct-20	10-Dec-21	14	L																	10-Dec	
	A1110	Compressor Station Engineering		13-Oct-20	10-Dec-21	14					,					-	_	_						Compr	0.0
- - -	Task 6 - Constr	uctability	280	01-Sep-20	27-Sep-21	68		_	-			-			_						_	27-Sep-2	21, Task 6	i - Const	tr
	Subtask 06.01 Fa	cility/Security/Logistics	290	01-Sep-20	27-Sep-21	0		, 	-	-	.	+	-		-	-	-	-			_	27-Sed-3	1, Supta	sk 06.01	1
	A1140	Facility/Security/Logistics	280	01-Sep-20*	27-Sep-21	0			<u> </u>	<u> </u>	÷ –	÷	<u> </u>		_	_						FacilityS	ecurty/Lo	gistięs	
	Subtask 06.02 Co	onstructability Assessment	280	01-Sep-20	27-Sep-21	68		, 	-	-	+	-			-	-	-	-	_	-	_		1, Subta		
	A1150	Constructability Assessment	280	01-Sep-20	27-Sep-21	68			4	· · · · · · · · · ·						ý					_	Construc	tability As	sessme	ñ
	Subtask 06.03 Co	onstruction Schedule	280	01-Sep-20	27-Sep-21	68		, 	-	-	-	+	-	-	-		-				_	27-Seg-2	1, Subta	sk 06.03	a
	A1160	Construction Schedule	280	01-Sep-20	27-Sep-21	68							-	i								Construc	tion Sche	dule	
1 R.	Task 7 - Cost E	stimate	193	01-Jan-21	28-Sep-21	0						+	-	-	-	-	_				_	28-Se	21, Taik 7	/ - Cost I	1
	A1170	Cost Estimate	193	01-Jan-21*	28-Sep-21	0		1				-	-				_					Cost Est			
	-	mic Analysis (By Trimeric)		01-Sep-21	28-Sep-21	0			1	1	1													3 - Egonr	ŝ
				01.Sec.211	28. Cap. 24																	Frank			
	A1220	Economic Analysis	20	01-Sep-21*	28-Sep-21	0		1			1											Econom	ic A	inalysis	Inalysis

Still working to add fragments & detail to discipline engineering tasks

(

AECOM

lineric Corp