POWER PLANTS – FGD
LIMESTONE SLURRY PROCESSES

NEW PROCESS TECHNOLOGY VS. TRADITIONAL

Pulverized Limestone w/ Vacucam® Ejector Mixers
vs.
Crushed Limestone & Wet Ball Mills

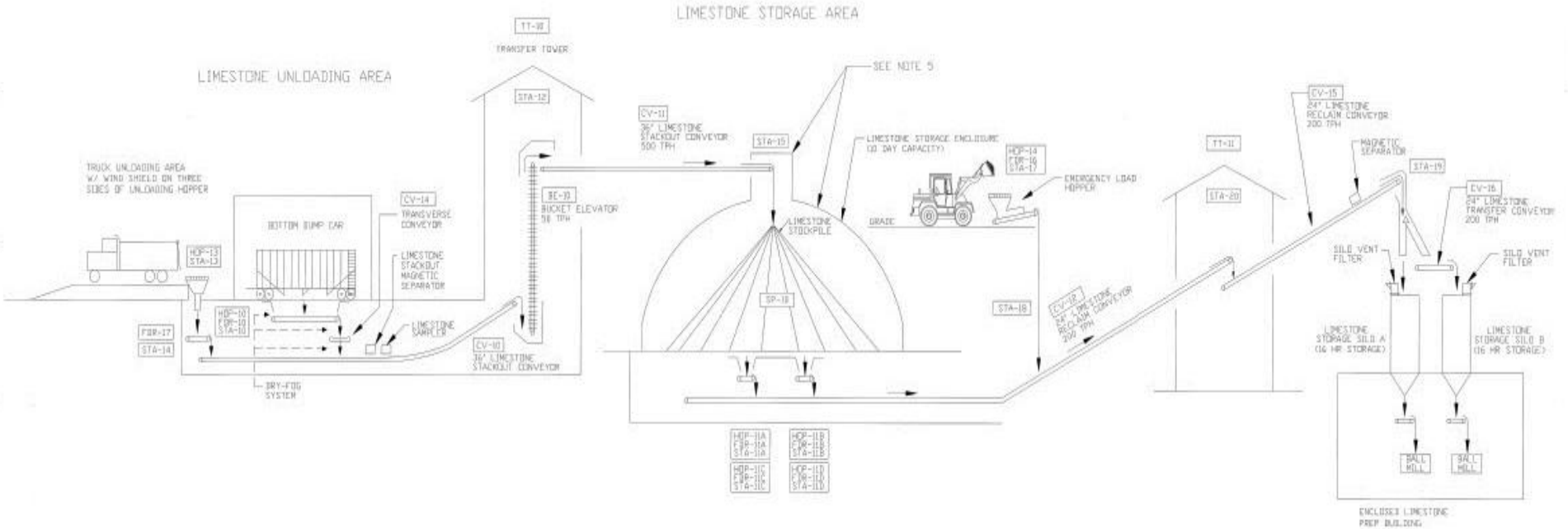
Presented at: EUEC-2011
Phoenix, AZ

Presented by: Charles S. Alack

Semi-Bulk Systems, Inc

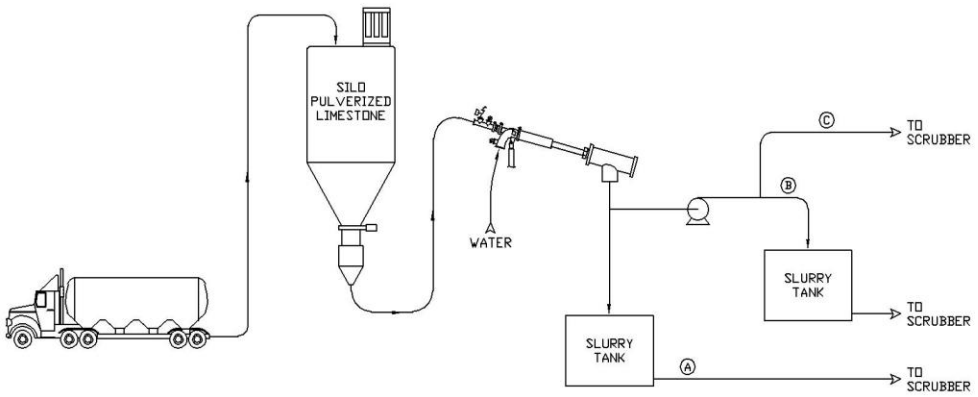
TRADITIONAL PROCESS [Crushed Limestone] FOR LIMESTONE UNLOADING,HANDLING, STORAGE & SLURRY PREP [Ball Mills]

- Limestone Supplier delivers crushed limestone to Power Plant
- Power Plant
  - Unload & mechanical convey to storage
  - Mechanical transfer to multiple day bins feeding Ball Mills
  - Operates Ball Mill processes
  - Slurry to storage tanks
  - Feed slurry to Scrubber

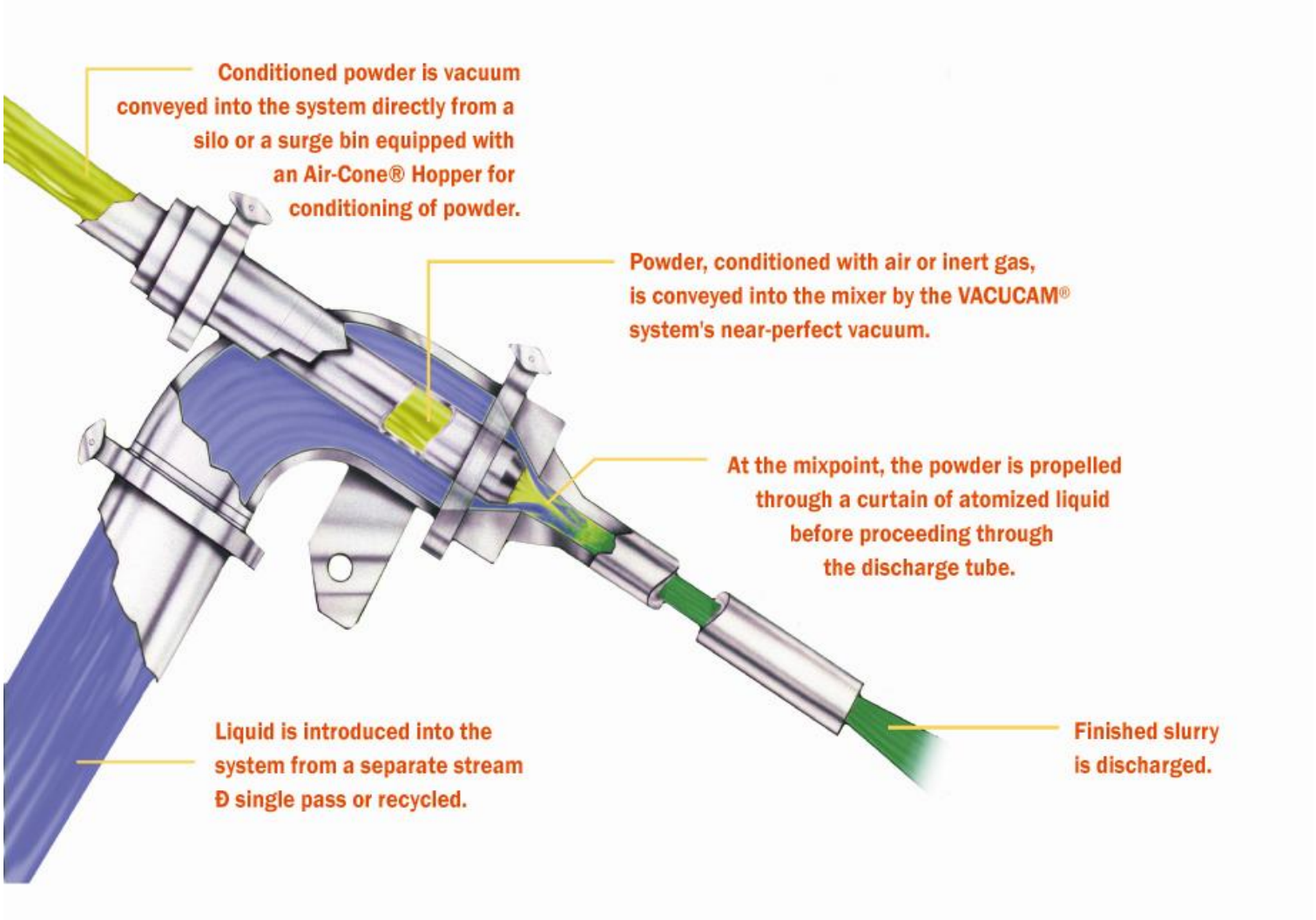


21st CENTURY PROCESSES [Pulverized Limestone] for LIMESTONE UNLOADING,HANDLING, STORAGE & SLURRY PREP [Vacucam® Ejector Mixer]

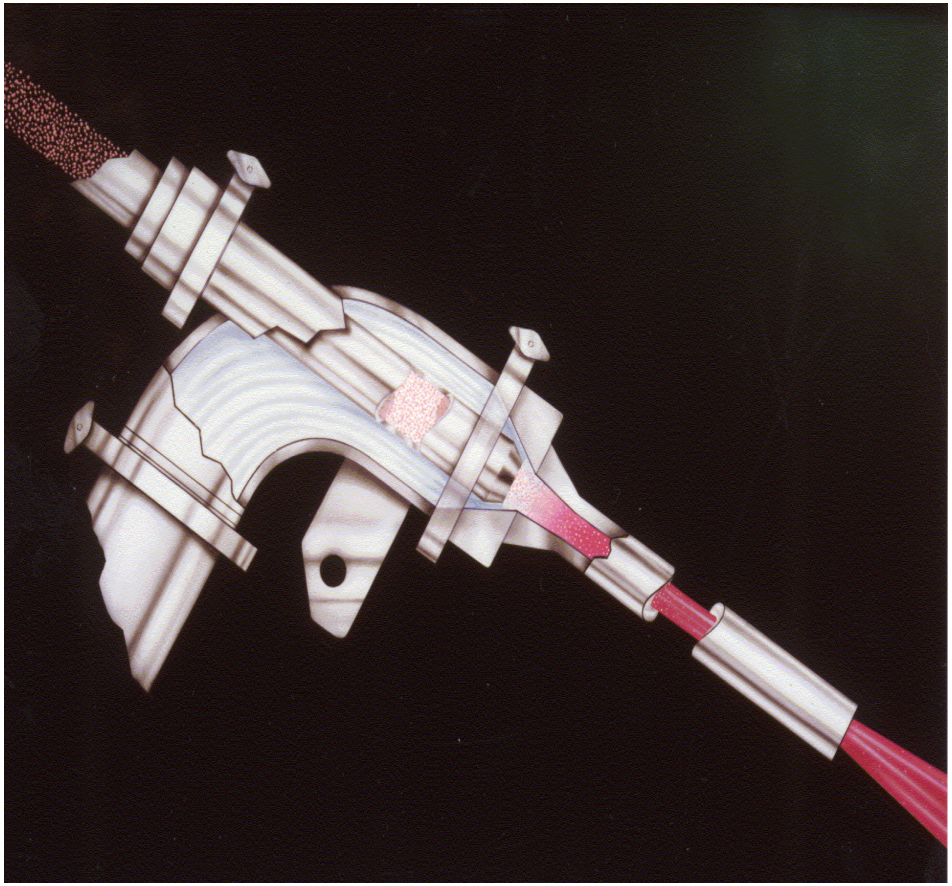
- Limestone Supplier:
  - Produces pulverized limestone w/ roller mills.
  - Provide logistics for supplier storage and regional distribution
  - Deliver and unload pulverized limestone to Power Plant silo.
- Power Plant
  - Supervision monitors automated slurry making process



VACUCAM® EJECTOR MIXER



VACUCAM® Ejector Mixer



- High Performance
- High Wetting/Dispersion Efficiency
- Operates under high vacuum for exposing maximum surface area of liquid to dry product
- No moving parts
- No maintenance

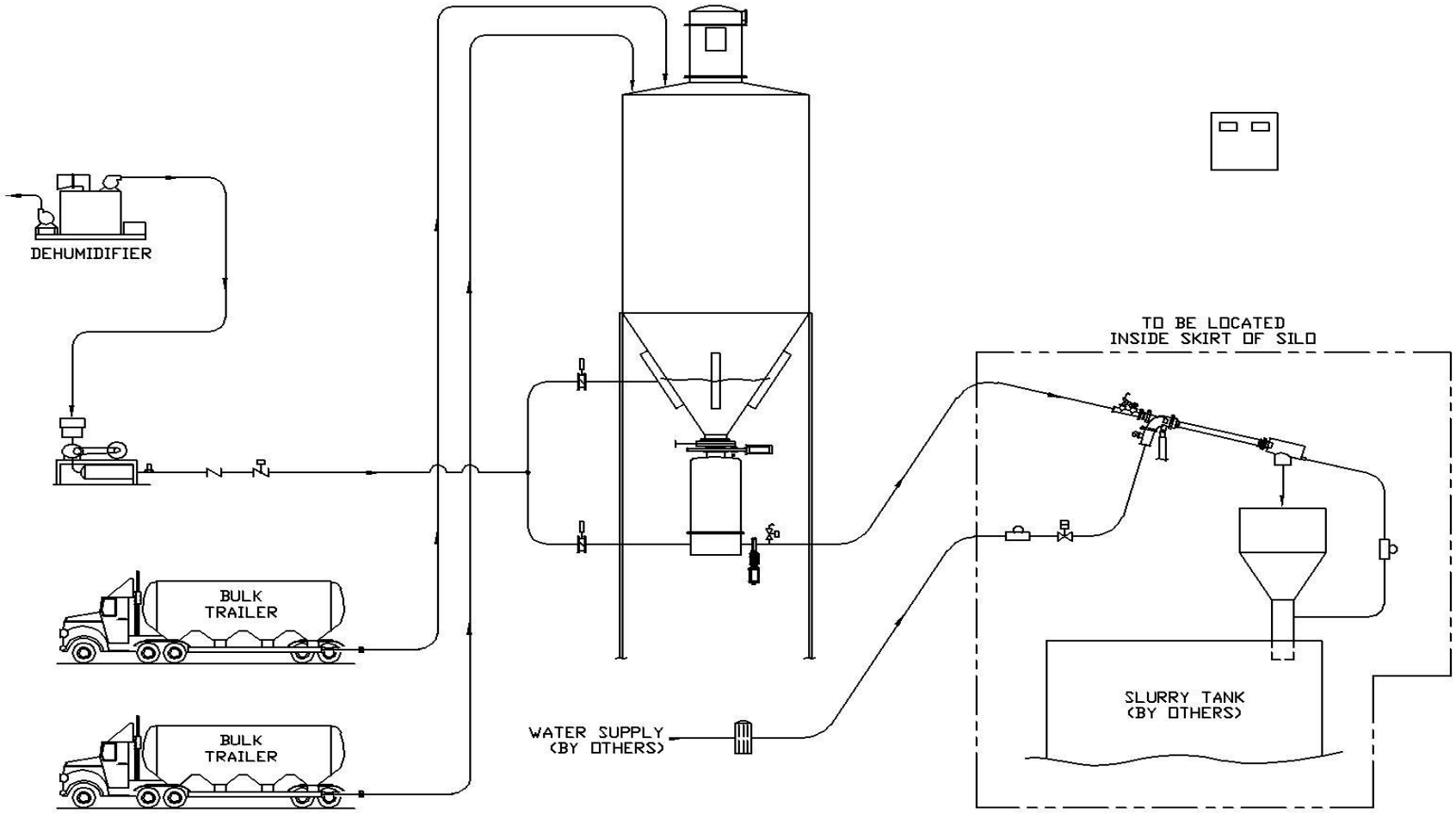
VACUCAM® Ejector Mixer

- Four main components:
  - powder tube
  - housing
  - orifice
  - discharge tube
- No moving parts
- No dynamic adjustment required

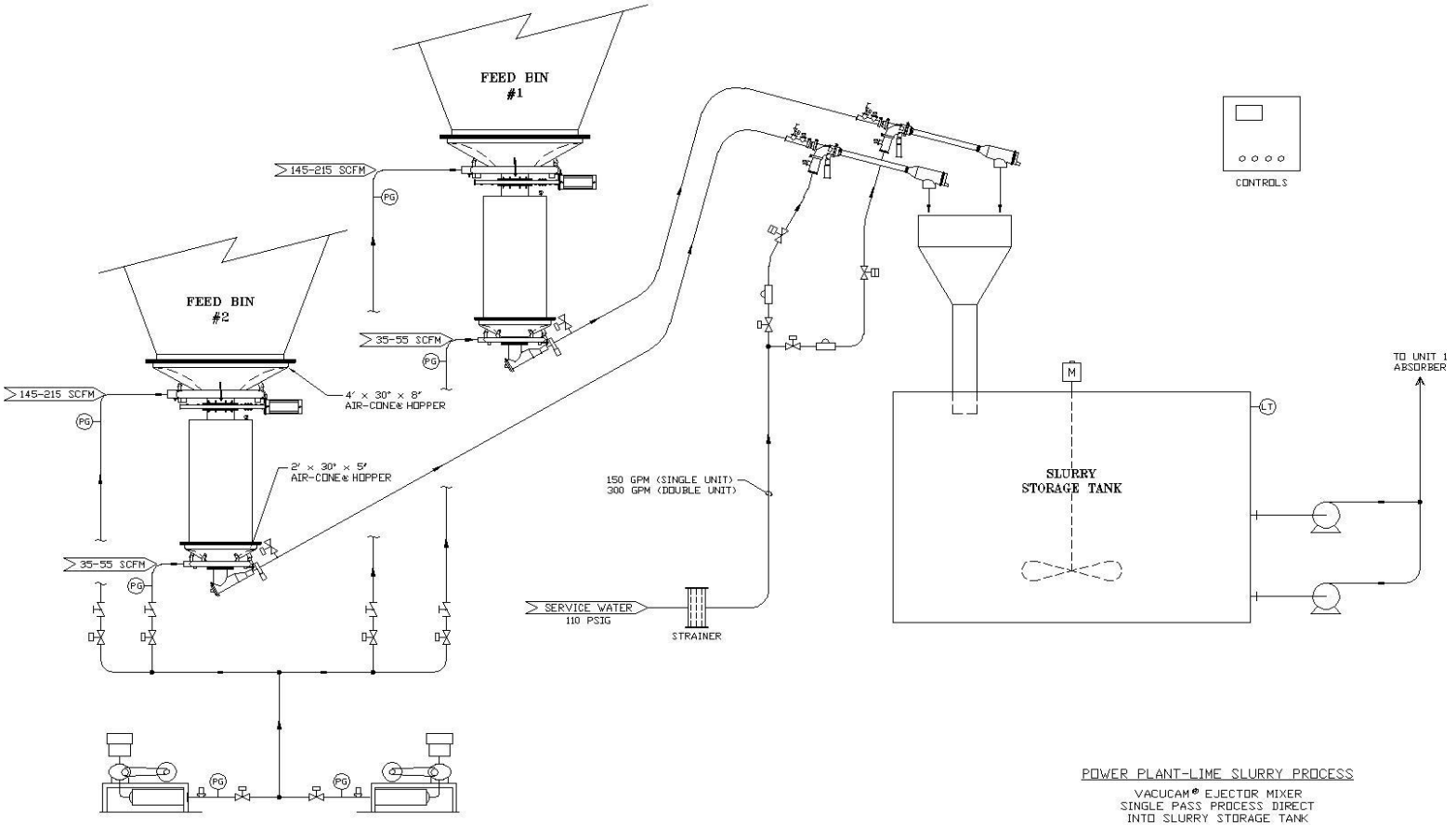
POWER PLANT
Process Options

1. Single Pass Process Direct Into Slurry Storage Tank

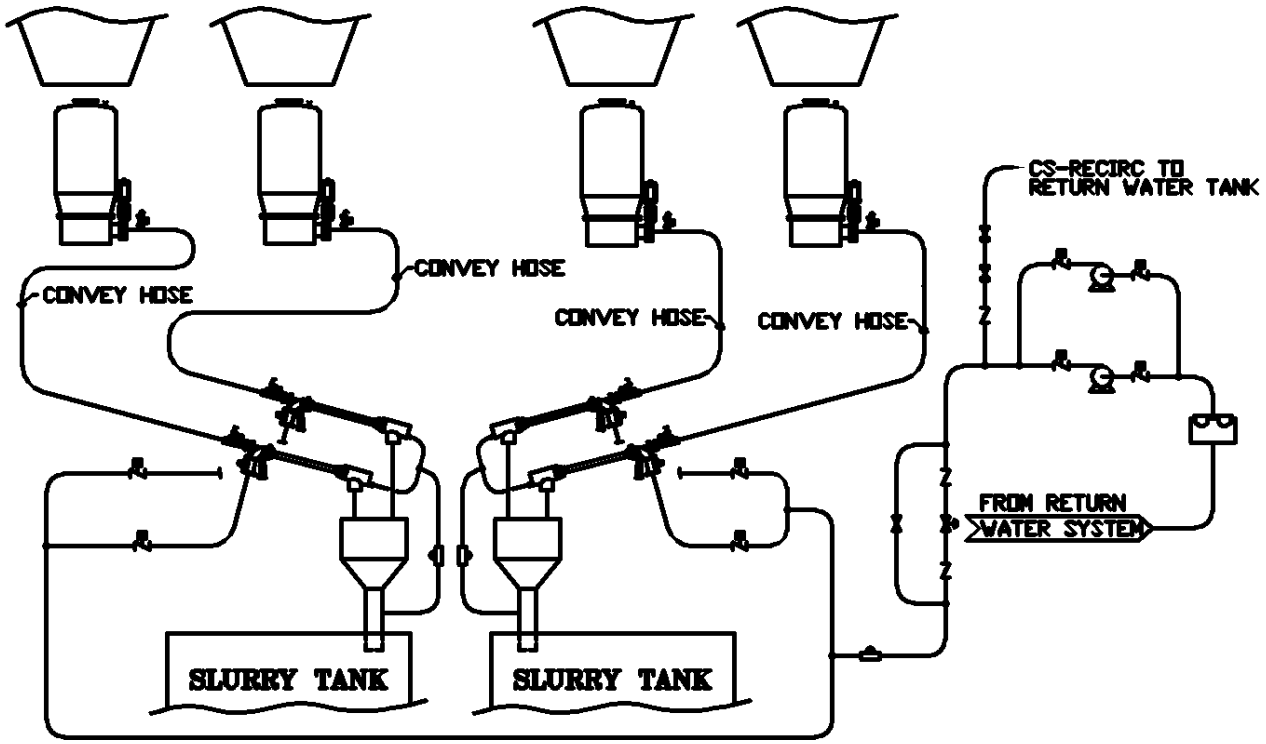
POWER PLANT-LIMESTONE SLURRY PROCESS
SINGLE PASS PROCESS DIRECT INTO SLURRY STORAGE



POWER PLANT-LIMESTONE SLURRY PROCESS
SINGLE PASS PROCESS DIRECT INTO SLURRY STORAGE
Dual Silo Feed to Dual Mixer System

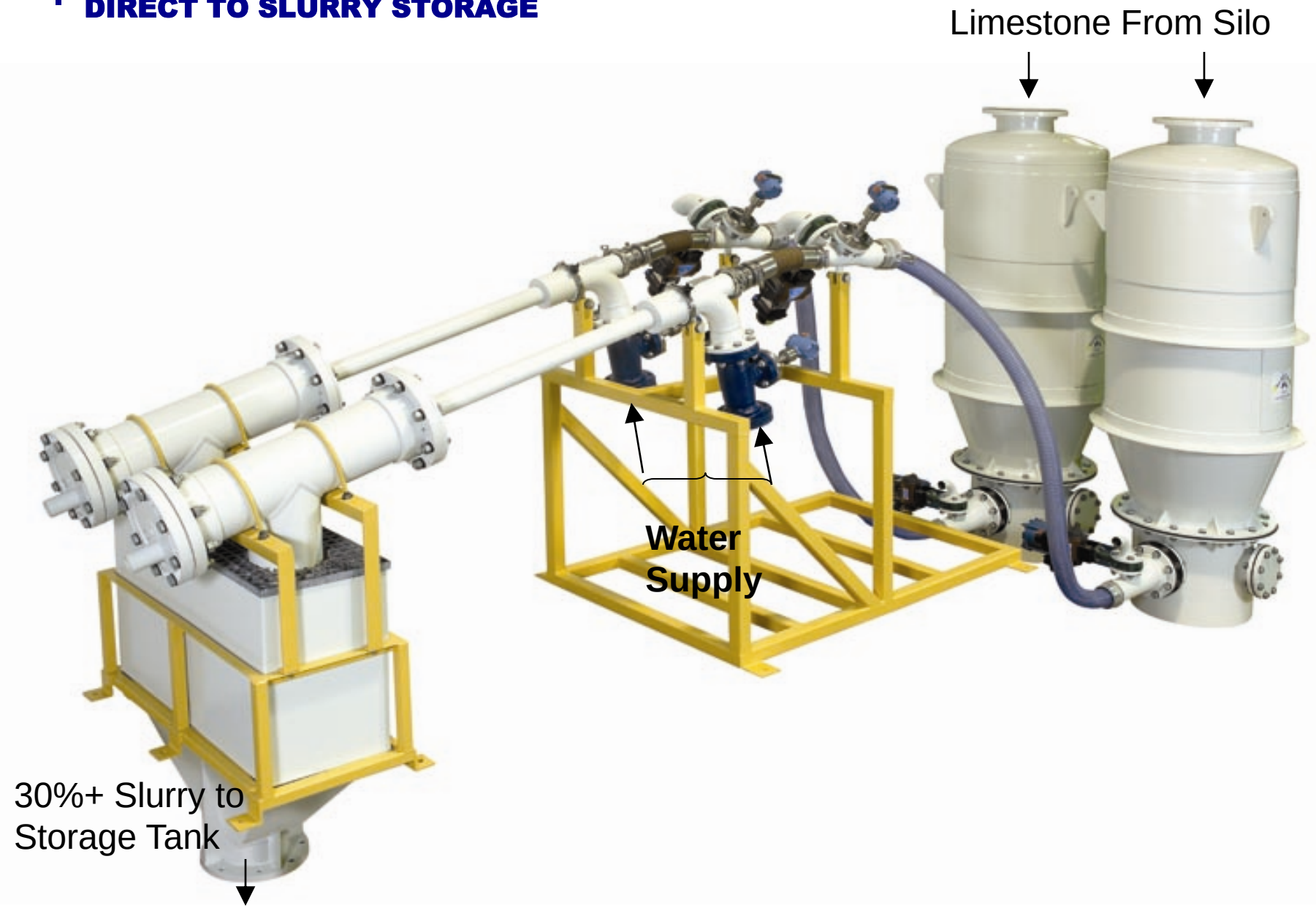


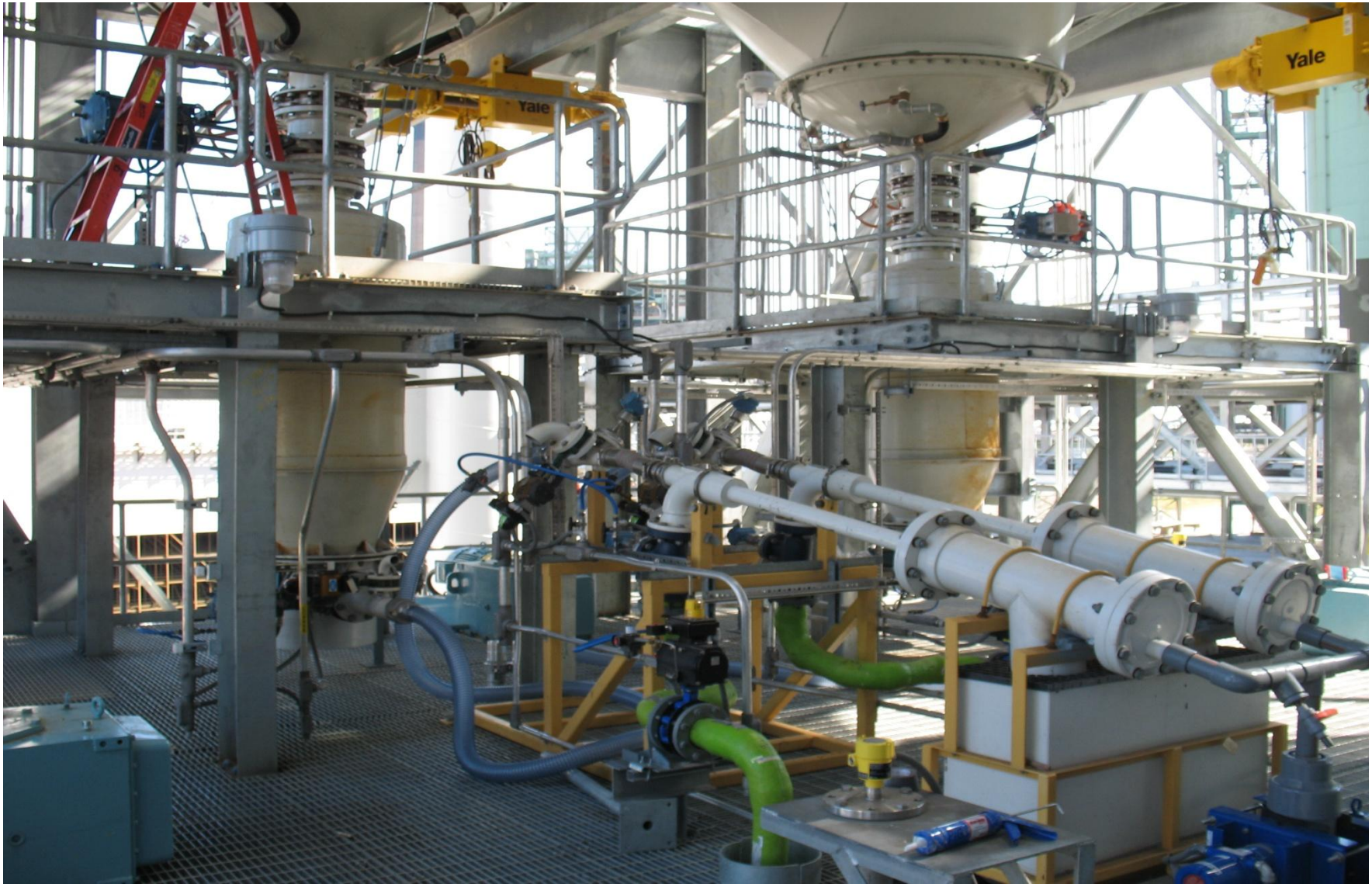
POWER PLANT-LIMESTONE SLURRY PROCESS
SINGLE PASS PROCESS
Two Silos w/ Dual Outlets Direct to Two Dual Mixer Processes



Pulverized Limestone Storage
Two silos w/ Dual Cone Outlets

VACUCAM® LIMESTONE SLURRY PROCESS
DUAL EJECTOR MIXER SINGLE PASS IN-LINE SLURRY
DIRECT TO SLURRY STORAGE

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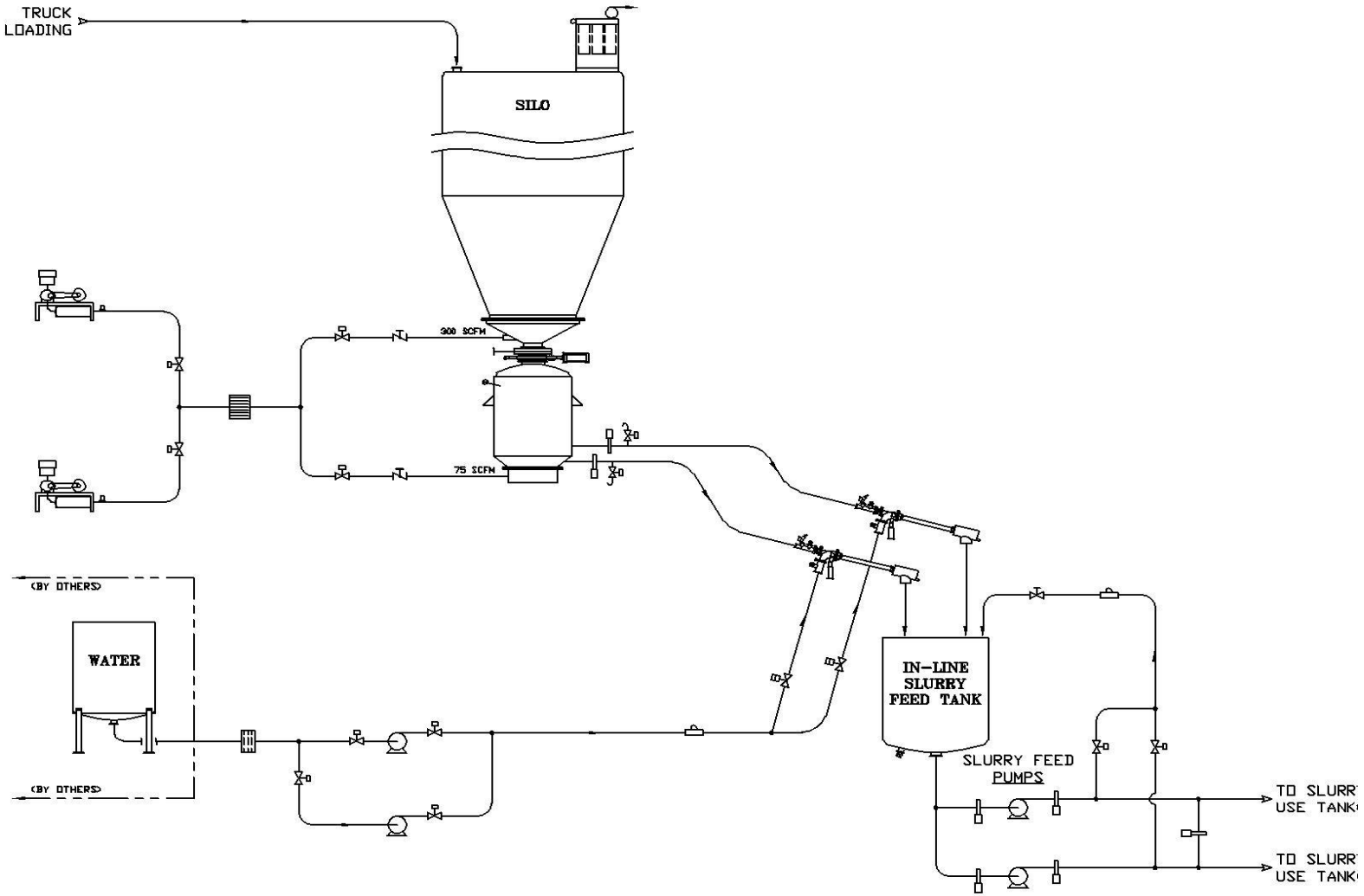
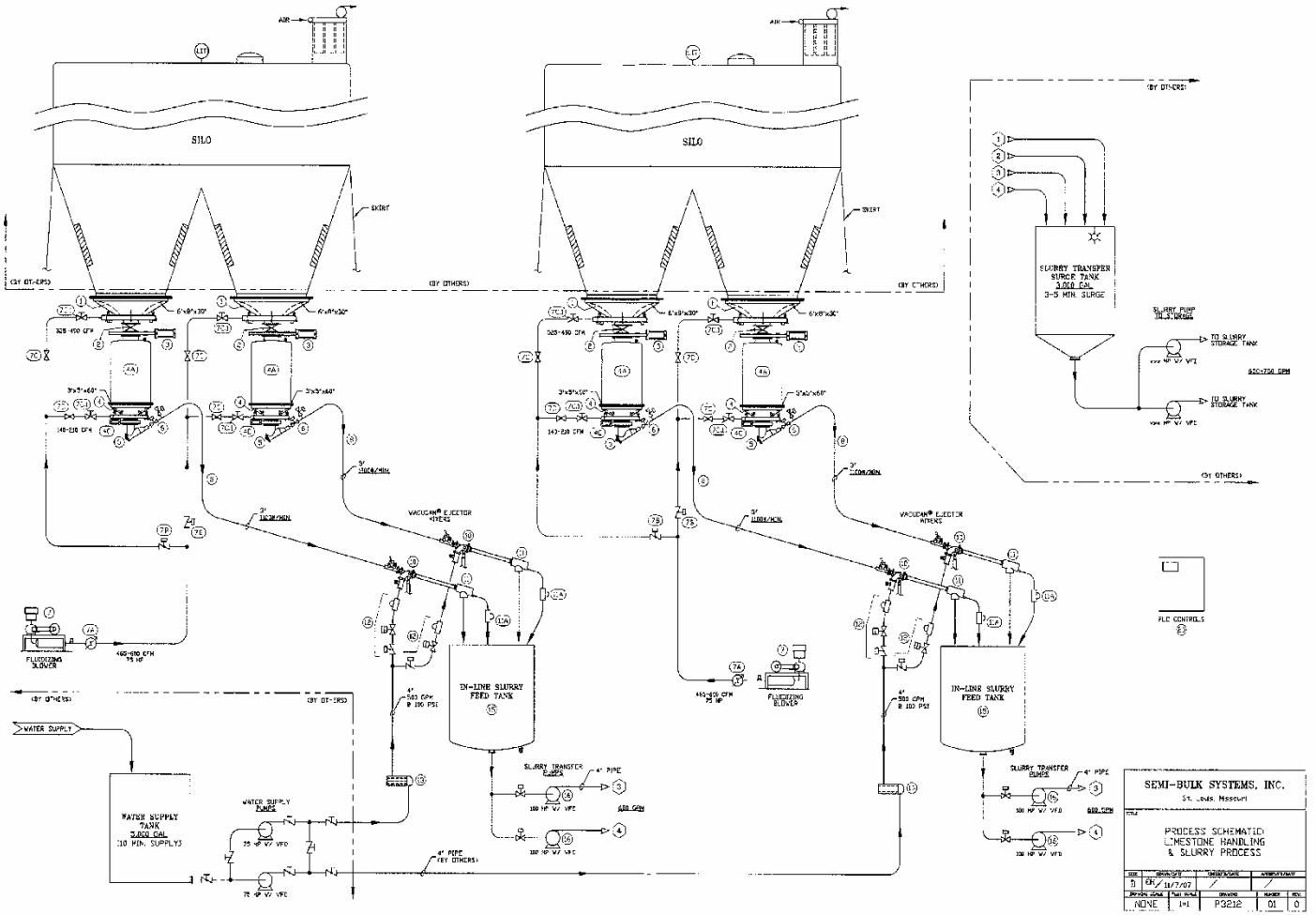
POWER PLANT
Process Options

1. Single Pass Process Direct Into Slurry Storage Tank
2. Single Pass In-Line Process to Remote Slurry Storage Tanks

Single Pass In-Line Process to Remote Slurry Storage Tanks

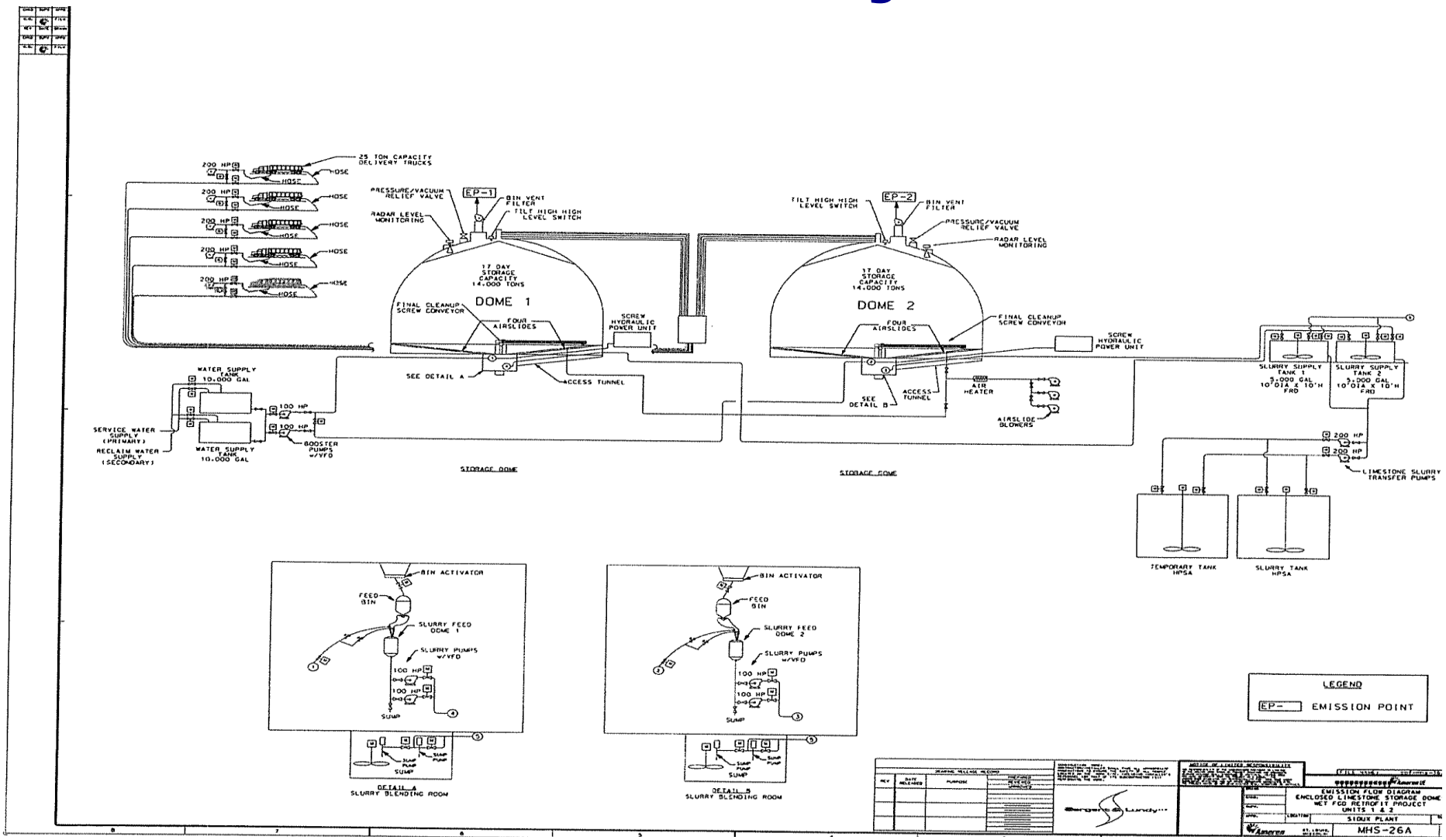


Limestone Slurry Process
Dual Silos & Slurry Processes

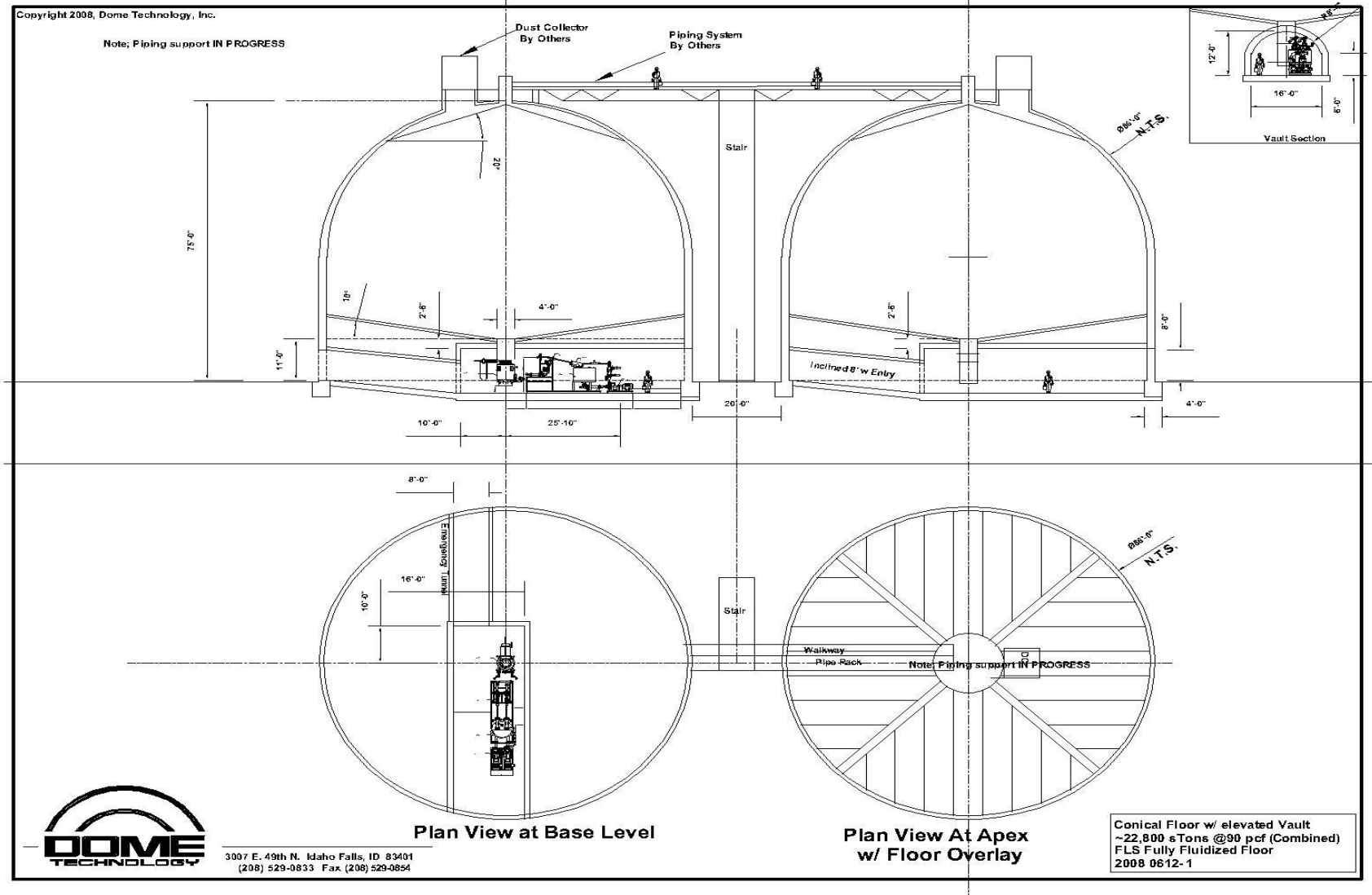


DUAL DOME STORAGE
PULVERIZED LIMESTONE

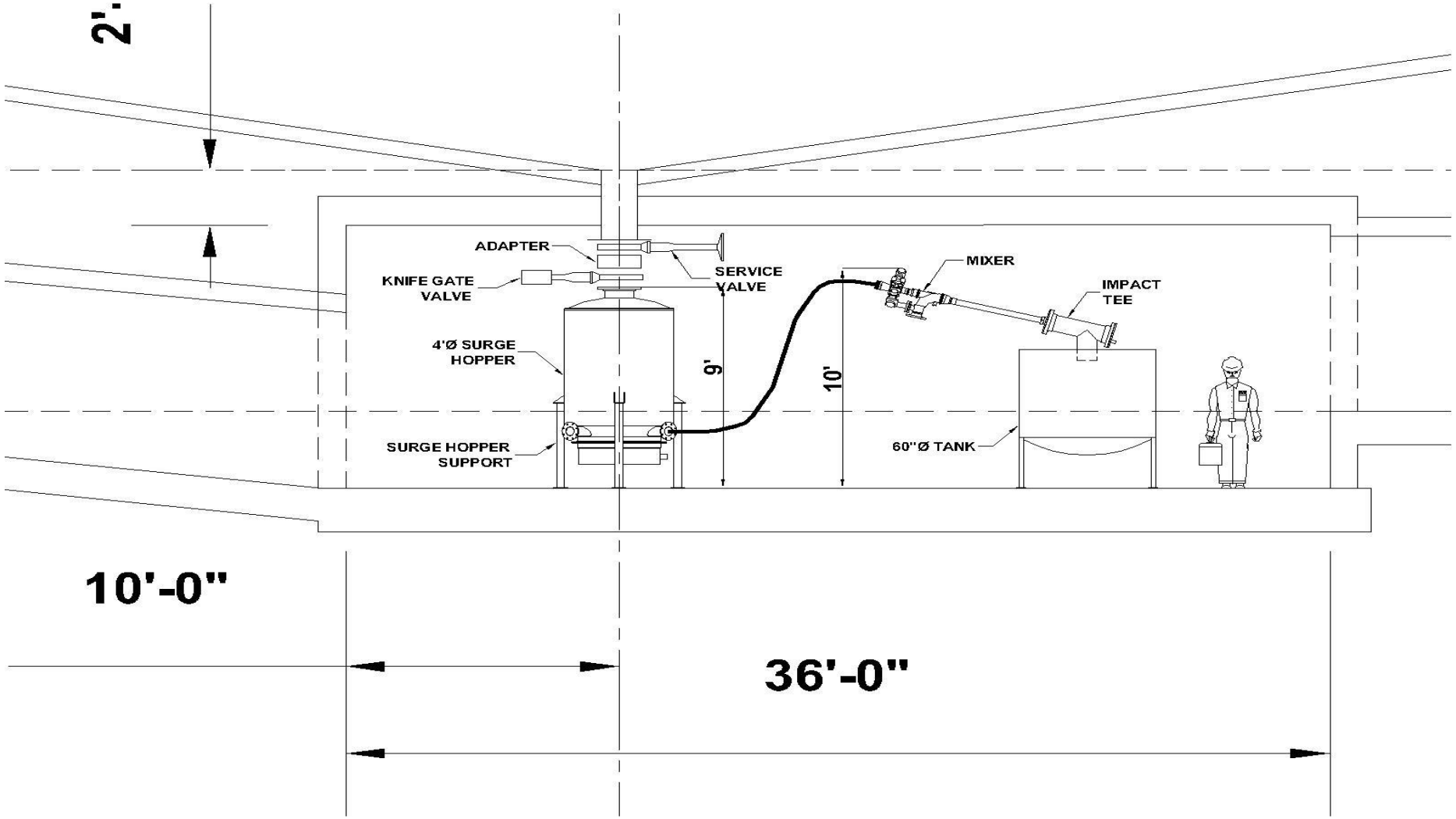
Limestone Slurry Process
Dual Domes & Slurry Processes



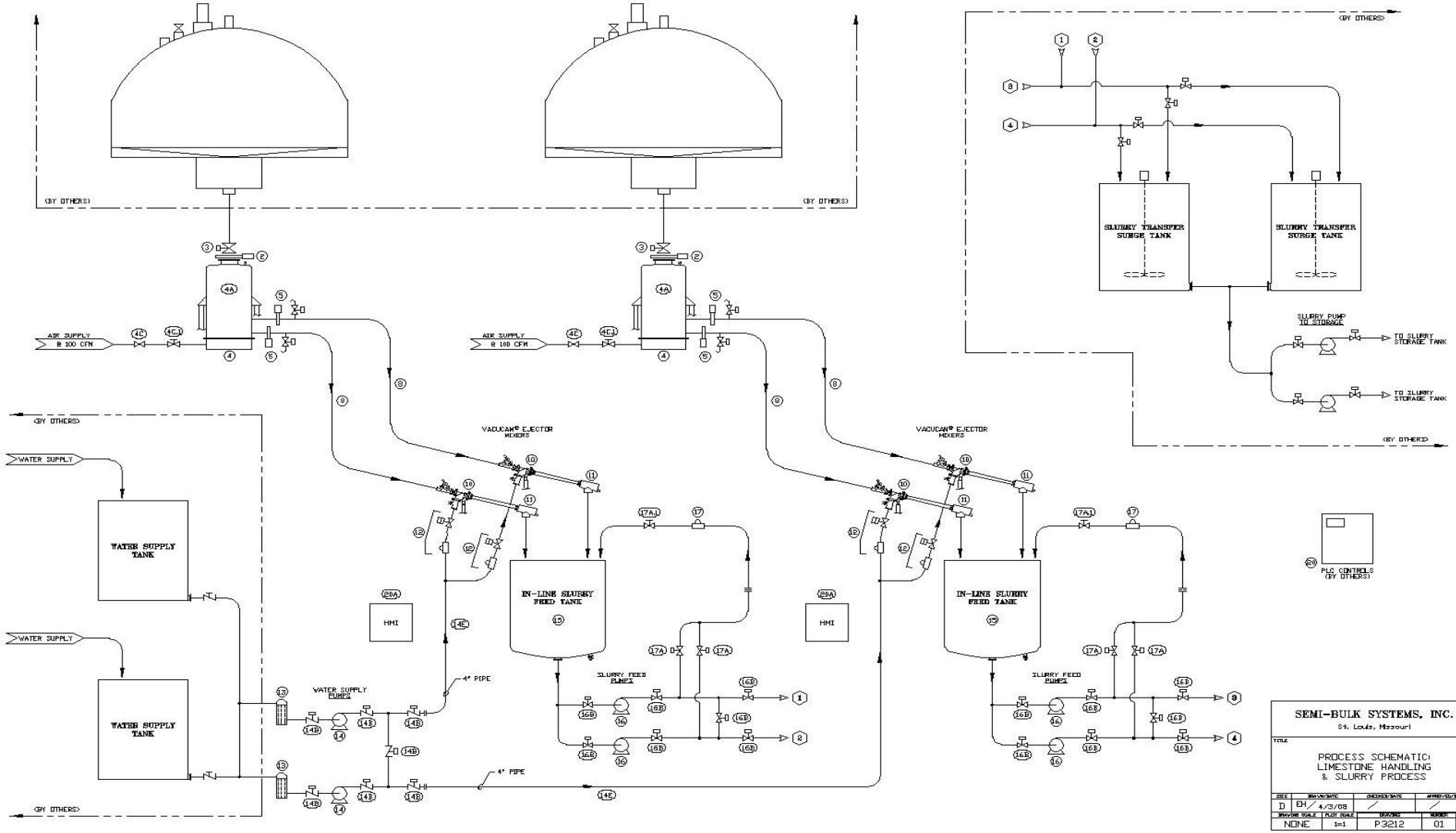
Limestone Slurry System w/ Dome Storage Supply



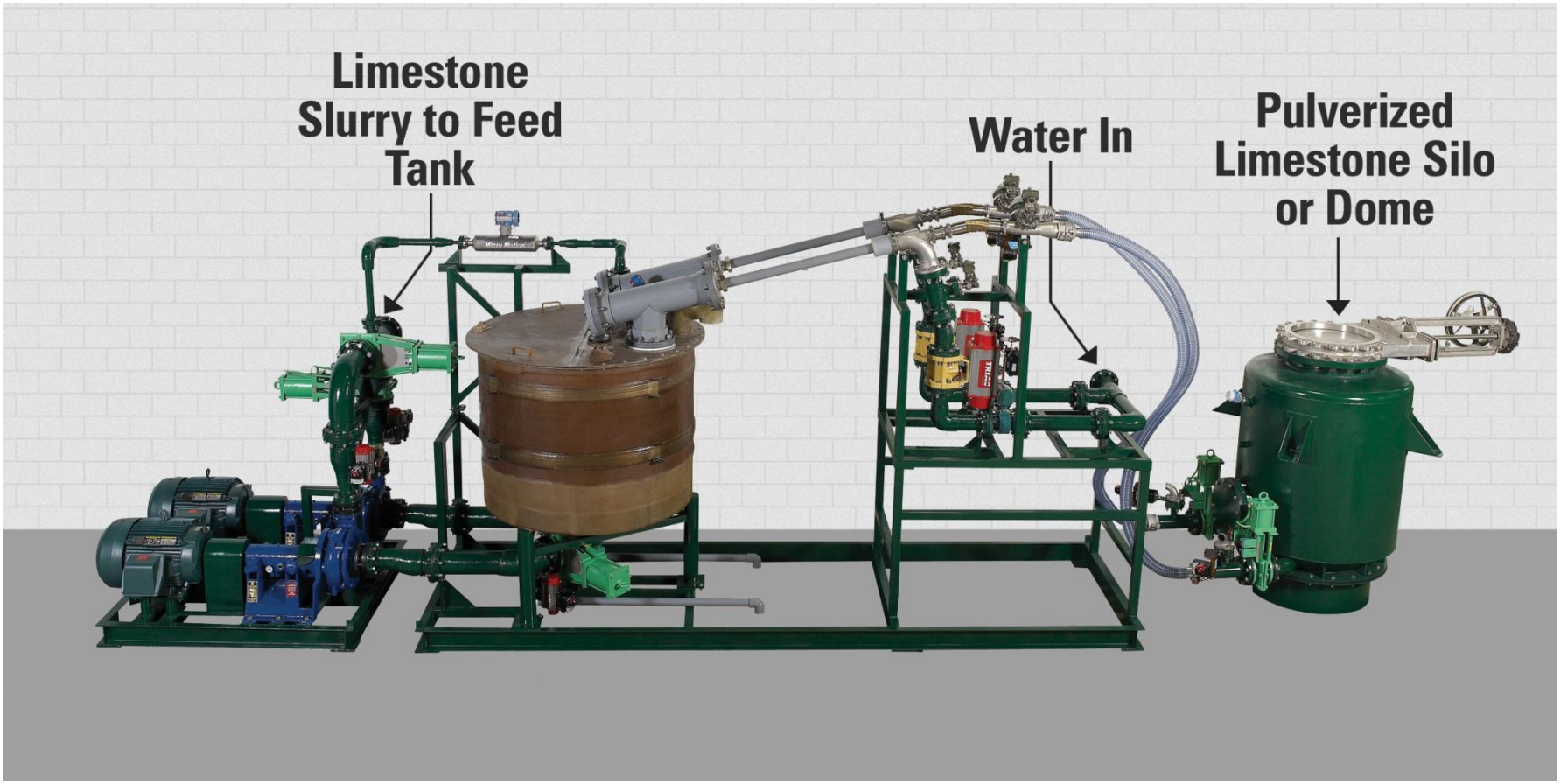
Limestone Slurry Process in Dome Vault



Limestone Slurry Process
Dual Domes & Slurry Processes

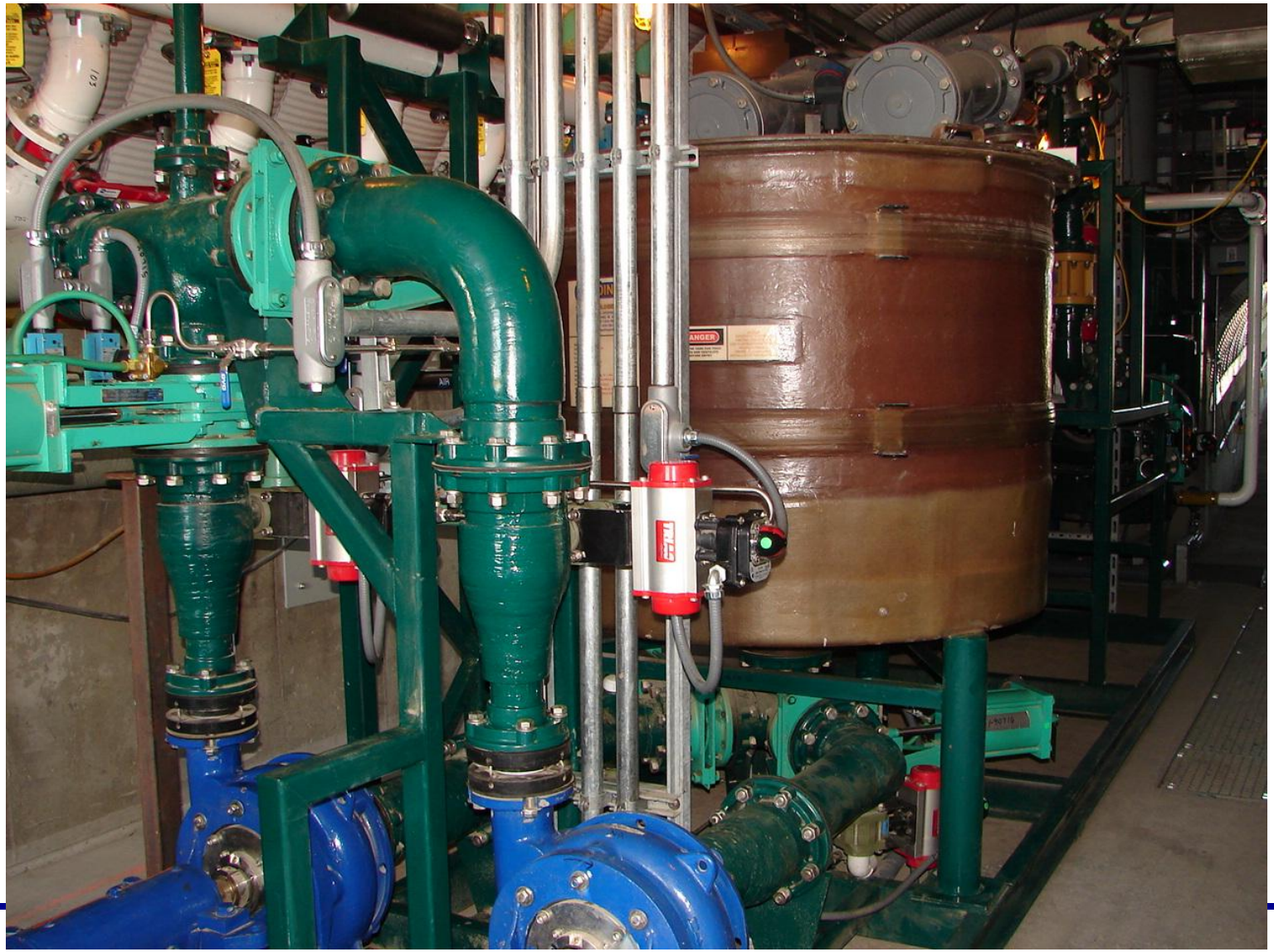


VACUCAM® DUAL EJECTOR MIXER PROCESS W/ LIMESTONE SUPPLY HOPPER W/ SLURRY TRANSFER PUMP



WATER SUPPLY PUMP SKID

LIMESTONE SLURRY PROCESS IN VAULT OF DOME



LIMESTONE SLURRY PROCESS IN VAULT OF DOME

POWER PLANT
Process Options

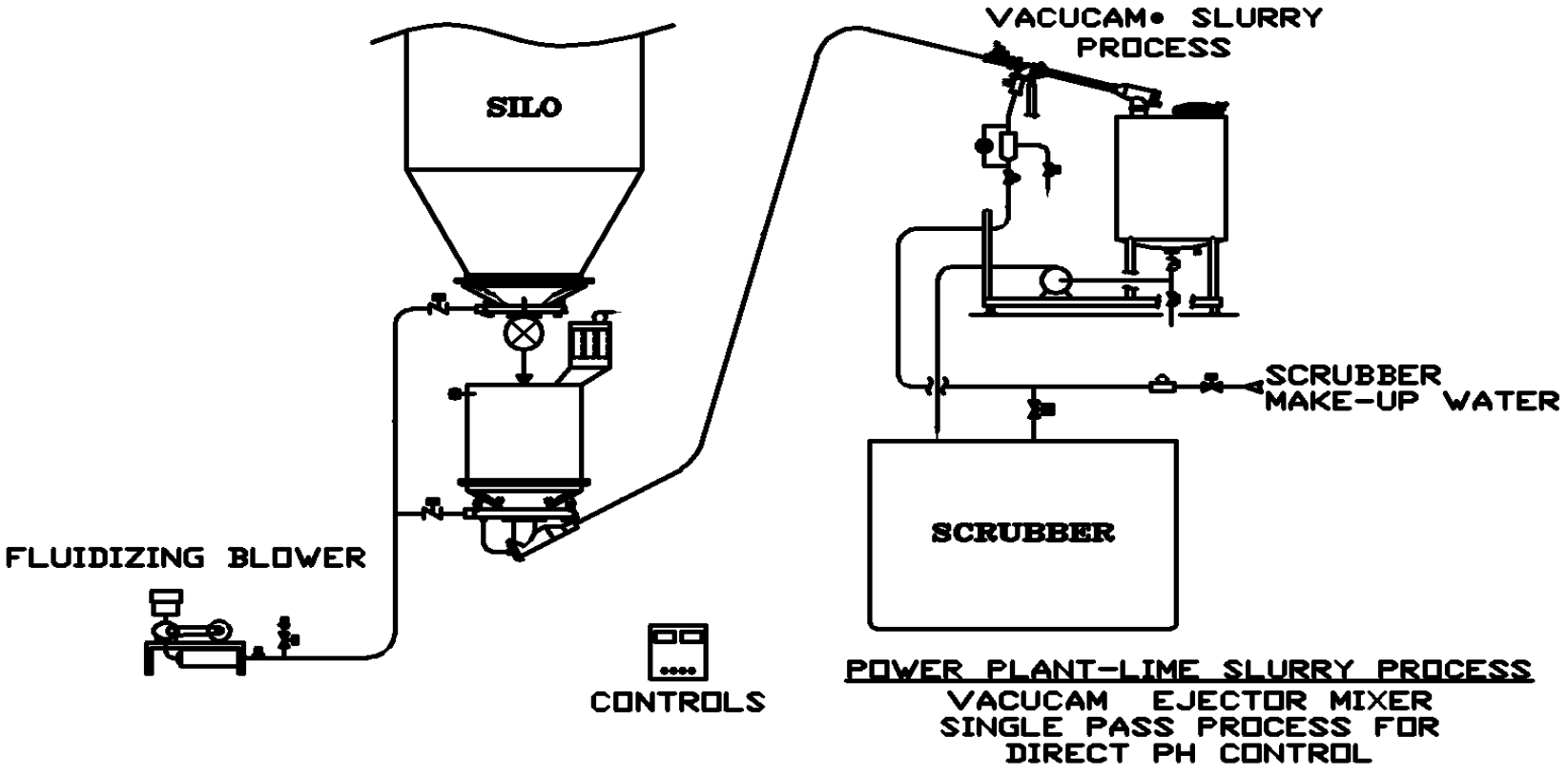
1. Single Pass Process Direct Into Slurry Storage Tank
2. Single Pass In-Line Process to Remote Slurry Storage Tanks
3. Single Pass Process for Direct PH Control

POWER PLANT-LIMESTONE SLURRY PROCESS

SINGLE PASS PROCESS FOR DIRECT PH CONTROL TO SCRUBBER

-DIRECT INJECTION TO SCRUBBER

-ELIMINATE LIMESTONE SLURRY STORAGE



ENERGY REQUIREMENTS
TYPICAL MIXING PROCESSES

TYPICAL SLURRY PROCESSES	KWH/TON CaCO3	$/TON CaCO3 @ $0.08/KWH		
SINGLE PASS VACUCAM EJETOR MIXER FROM SILO [12HP/100GPM@100PSI]—WATER SUPPLY PUMP ONLY	.97	$0.077		
SINGLE PASS VACUCAM® EJM IN-LINE FROM SILO TO REMOTE SLURRY STORAGE-WATER SUPPLY +SLURRY DELIVERY PUMP TO STORAGE	1.94	$0.15		
PNEUMATIC CONVEY [150HP/25TPH] NOTE: DOES NOT INCLUDE MAKING SLURRY	4.98	$0.40		
SLURRY STORAGE MIXERS [4@30HP EACH] [AGITATOR MIXER IN A SLURRY TANK]	4.15	$0.33		
BALL MILL SLAKER PROCESS [12.5HP/ TON]	10.4	$0.83		

TYPICAL MIX PROCESSES
VS.
COSTS FOR 24TPH $CaCO_3$ CAPACITY [Example]

TYPICAL SLURRY PROCESSES	$/TON $CaCO_3$ @ $0.08/KWH	$ / HR	$ / DAY	$ / YR
SINGLE PASS VACUCAM EJETOR MIXER FROM SILO [12HP/100GPM@100PSI]—WATER SUPPLY PUMP ONLY	$0.077	$1.85	$44.40	$16,206
SINGLE PASS VACUCAM® EJM IN-LINE FROM SILO TO REMOTE SLURRY STORAGE-WATER SUPPLY +SLURRY DELIVERY PUMP TO STORAGE	$0.15	$3.6	$86.40	$31,536
PNEUMATIC CONVEY [150HP/25TPH] NOTE: DOES NOT INCLUDE MAKING SLURRY	$0.40	$9.6	$230.40	$84,096
SLURRY STORAGE MIXERS [4@30HP EACH] [AGITATOR MIXER IN A SLURRY TANK]	$0.33	$7.92	$190.08	$69,379
BALL MILL SLAKER PROCESS [12.5HP/ TON]	$0.83	$19.92	$478.08	$174,499

Limestone Mixer– Capacity Size Chart

MIXER MODEL/SIZE --SINGLE UNIT

	125B/C	150B/C	200C	250C	340C
Limestone [TPD]	322	386	515	644	876
[TPH]	13	16	22	28	38
[#/HR]	26,807	32,168	42,900	53,625	72,930
[#/MIN]	447	536	715	894	1,216
WATER [#/HR]	62,550	75,060	100,080	125,100	170,136
[#/MIN]	1,042	1,250	1,668	2,085	2,836
[GPM]	125	150	200	250	340
SLURRY [30%SOLIDS]					
[TPD]	1,072	1,286	1,715	2,144	2,916
[#/HR]	89,357	107,228	142,980	178,725	243,066
@9.97#/GAL [GPM]	149	179	239	299	407

Feb. 2008

AMEREN ELECTRIC **SIOUX PLANT - PLANT REQUIREMENTS VS. SLURRY CAPACITY OPTIONS:**

	Plant Requirements @ 30% slurry	Capacity @ 30% solids 1 X 250 Mixer	2 X 250 Dual Mixer	Capacity @ 35% solids 1 X 250 Mixe	2 X 250 Dual Mixer
DRY CaCO3					
TPH	**34**	27	**54**	34	**68**
TPD	816	643	1286	808	1616
#/HR	68,000	53,580	107,160	67,361	134,722
#/MIN	**1133**	893	**1786**	1123	**2246**
WATER					
#/MIN	2644	2085	4170	2085	4170
GPM	**317**	250	**500**	250	**500**
SLURRY					
#/min	3777	2978	5956	3208	6416
TPH	113	89	178	96	192
TPD	2719	2144	4288	2310	4620
GPM (est. 10#/gal)	**378**	298	**596**		
gpm (est. 10.5#/gal)				306	**612**
% CAPACITY	100	78.8	**158**	100	**200**
OPERATING HOURS/DAY			**15.2**		**12**

Use Requirements vs. Mix Capacity Options:

1. Plant CaCO3 requirements for a 24 hr. day would be 34TPH dry; requiring 317gpm water to produce 378 gpm of 30% slurry.

RECOMMENDATIONS:

OPTION 1: One option to produce this capacity would be to use a dual pair of Mixers @ 250gpm each for a total of 500gpm of water to produce 596gpm of 30% slurry. This process will produce 158% of required daily usage requiring 15.2 hours of operating time.

OPTION 2: A Second option to produce this capacity would be to use a dual pair of Mixers @ 250gpm each for a total of 500gpm of water to produce 612 gpm of 35% slurry. This process will produce 200% of required daily usage requiring 12 hours of operating time.

LIMESTONE HANDLING & MIXING
INCORPORATING THE VACUCAM® EJECTOR MIXER PROCESS

- Semi-Bulk Systems has applied its technology and experience in Powder Handling & Powder/Liquid Mixing to provide the most efficient Limestone Handling/ Slurry Processes for FGD. The Technology offers many benefits over conventional slurry processes.
  - **The VACUCAM® Mixing Systems incorporate no mechanical mixing devices and has no moving parts (other than liquid pumps).**
  - Lower Initial Capital Costs
  - Lower Installation costs
  - Less real estate required for installation.
  - Lower Operating Cost in terms of manpower, maintenance and operating costs
  - System never requires scheduled downtime for prolonged maintenance or preventative maintenance.
  - Capacities to meet any requirements
  - Energy—90%+savings per ton of slurry
  - Much greater Operation Flexibility
    - Instant start and stop of slurry process
    - Total System Automation
    - Simple wash down of slurry process
    - 100% Reliability
  - Quality- efficient dispersion of dry powder to provide maximum surface area contact for scrubbing efficiency –no dry dust collection required.
  - Lowest Cost of Ownership

Questions and Answers

Thank you ……..