

CHLOR-ALKALI II

PROCESS TECHNOLOGY

REVIEW

November 9 & 10, 1988

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Section 1

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CHLOR-ALKALI II

PROCESS TECHNOLOGY REVIEW

1. PROCESS

1.1 Basic Chemistry

Brine is electrolyzed in the chlorine cells

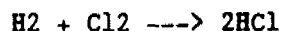


The chlorine is dried and liquefied and, for the most part, revaporized for feed to the EDC/VCM plant. Liquid chlorine can be transferred back and forth with CA1 depending on sales requirements.

The cell effluent is evaporated to 50% NaOH strength. Salt and iron are removed and the product shipped via rail car to terminals and customers.

Some cell effluent is used for scrubbing at the VCM plant.

The hydrogen is vented except for a small portion that is recovered for the manufacture of hydrochloric acid for sales and internal use.



Official Capacities (1988)

Chlorine	800 MMlbs/year
50% Regular Caustic	860 MMlbs/year
32% Hydrochloric Acid	36 MMlbs/year

1.2 Index Flowsheets

Please refer to the following drawings

Chlorine Process	FS-A91-5050
Caustic Process	FS-A91-5130
Brine System	FS-A91-5000

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1.3 Layout

Please refer to the plot plan FS-A444-1029.

1.3-1 Fire and Explosion Index

The F&E calculations were updated and reviewed in April 1988 using the 6th Edition (May 1987) of the Corporate Classification Guide.

FIRE AND EXPLOSION INDEX (1988)

PROCESS AREA	F&E INDEX	VALUE OF AREA OF EXPOSURE (\$MM)	BASE MPPD* (\$MM)	ACTUAL MPPD* (\$MM)	DAYS OUTAGE
1. CELLS	77.6	15.115	9.824	5.109	55 (31 - 91)
2. HCL BURNER	181.1	17.198	14.445	12.857	90 (45 - 150)
3. CL2 GUNK	160	7.316	6.219	3.917	48 (25 - 80)
4. IRON CELLS	55	1.368	0.753	0.512	15 (7 - 25)

*MPPD = MAXIMUM PROBABLE PROPERTY DAMAGE

1.3-2 Space Separation

There are no serious concerns. The HCl burner is a potential ignition source.

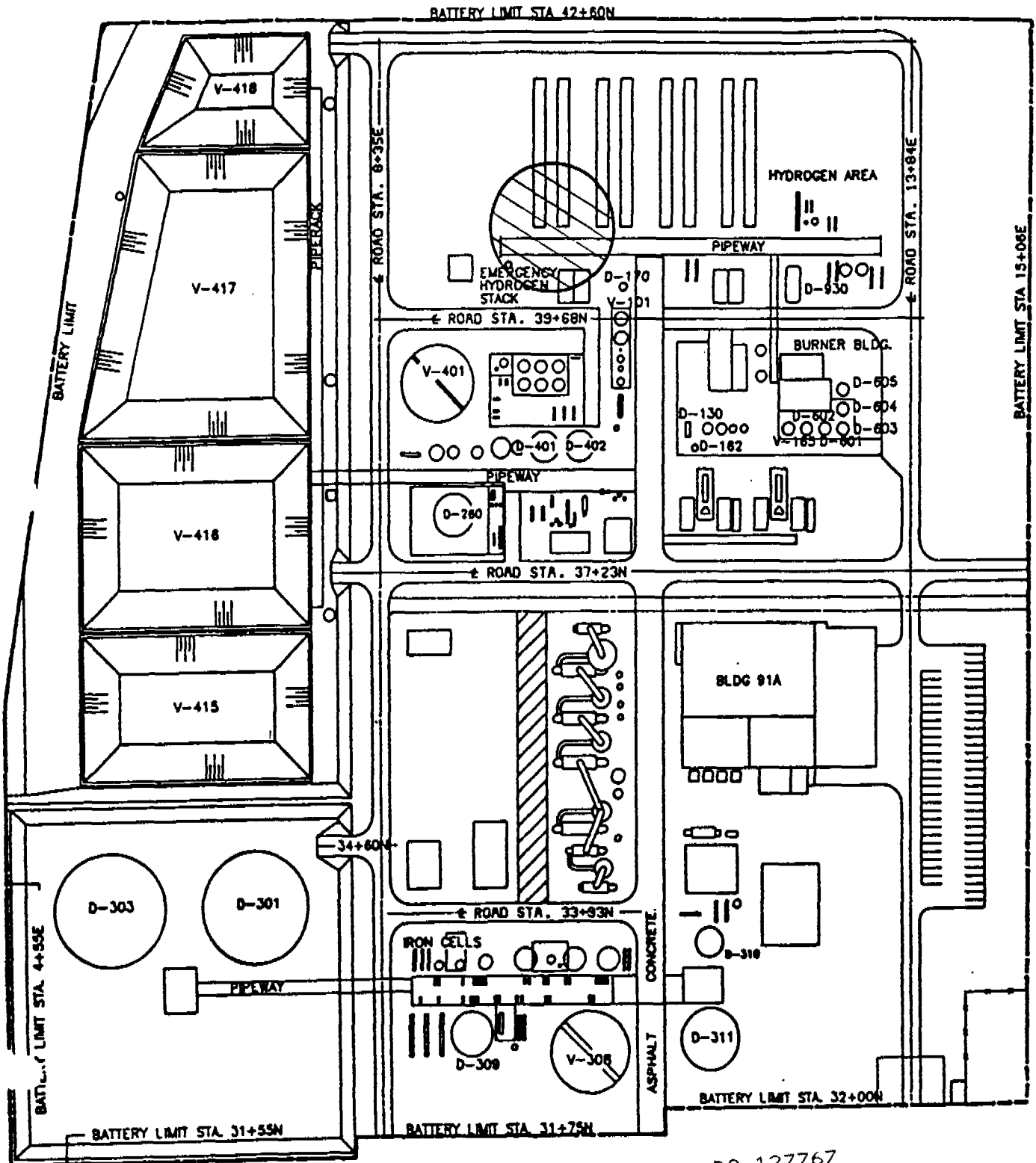
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FIRE & EXPLOSION RADIUS

BLOCK 90

AREA A: CELL AREA

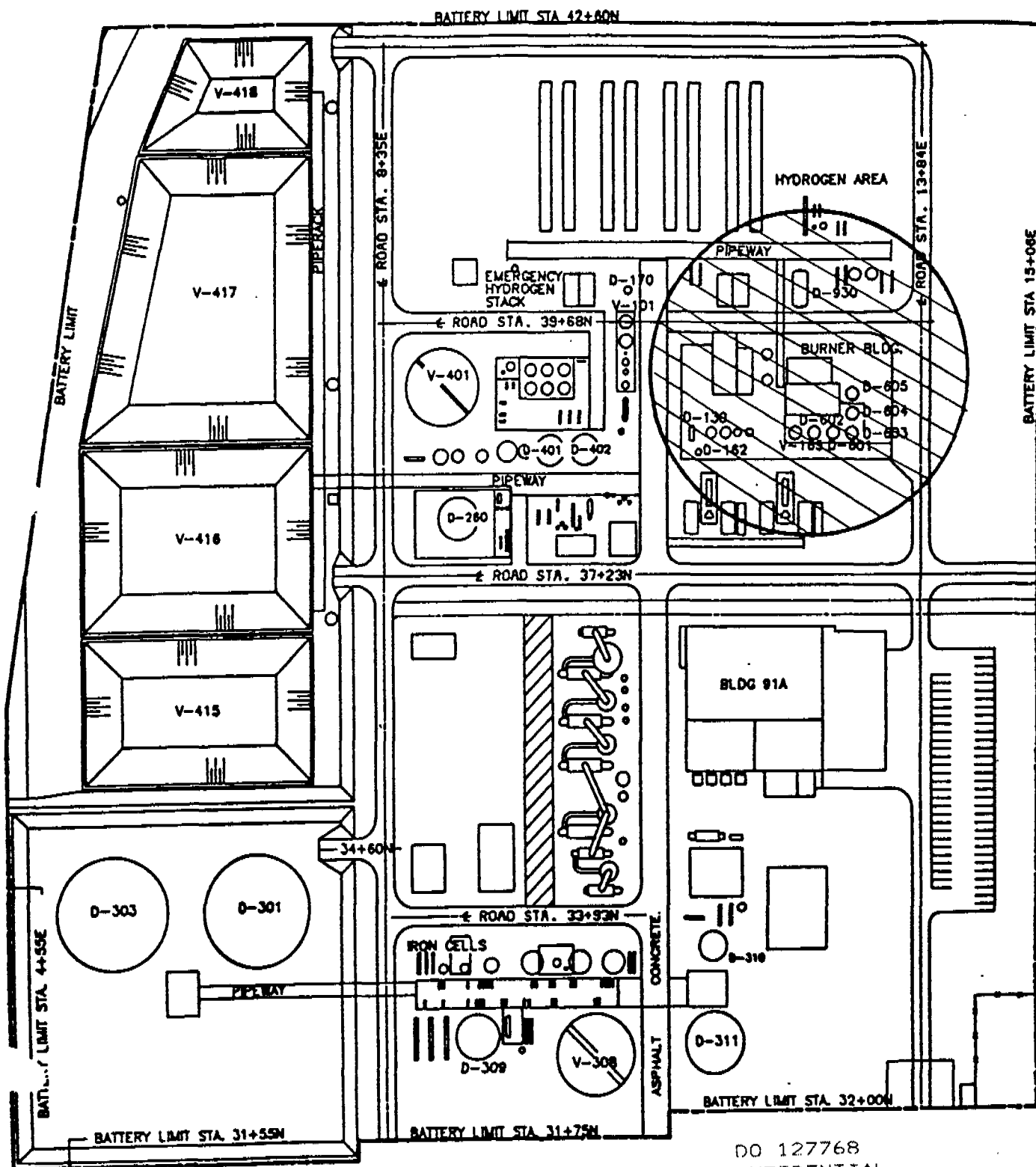


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AREA B: HCL BURNER

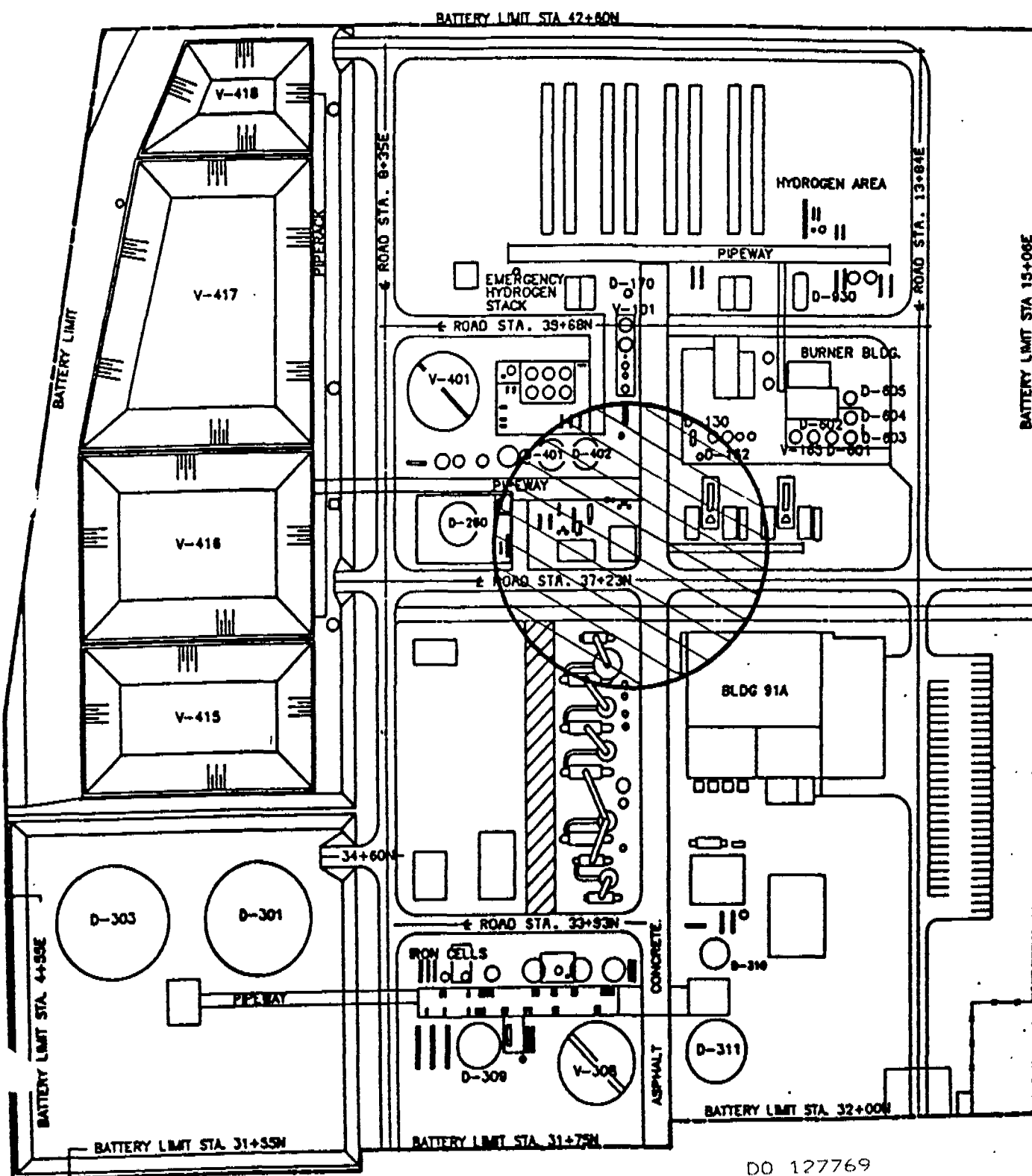
FIRE & EXPLOSION RADIUS

BLOCK 90



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BLOCK 90

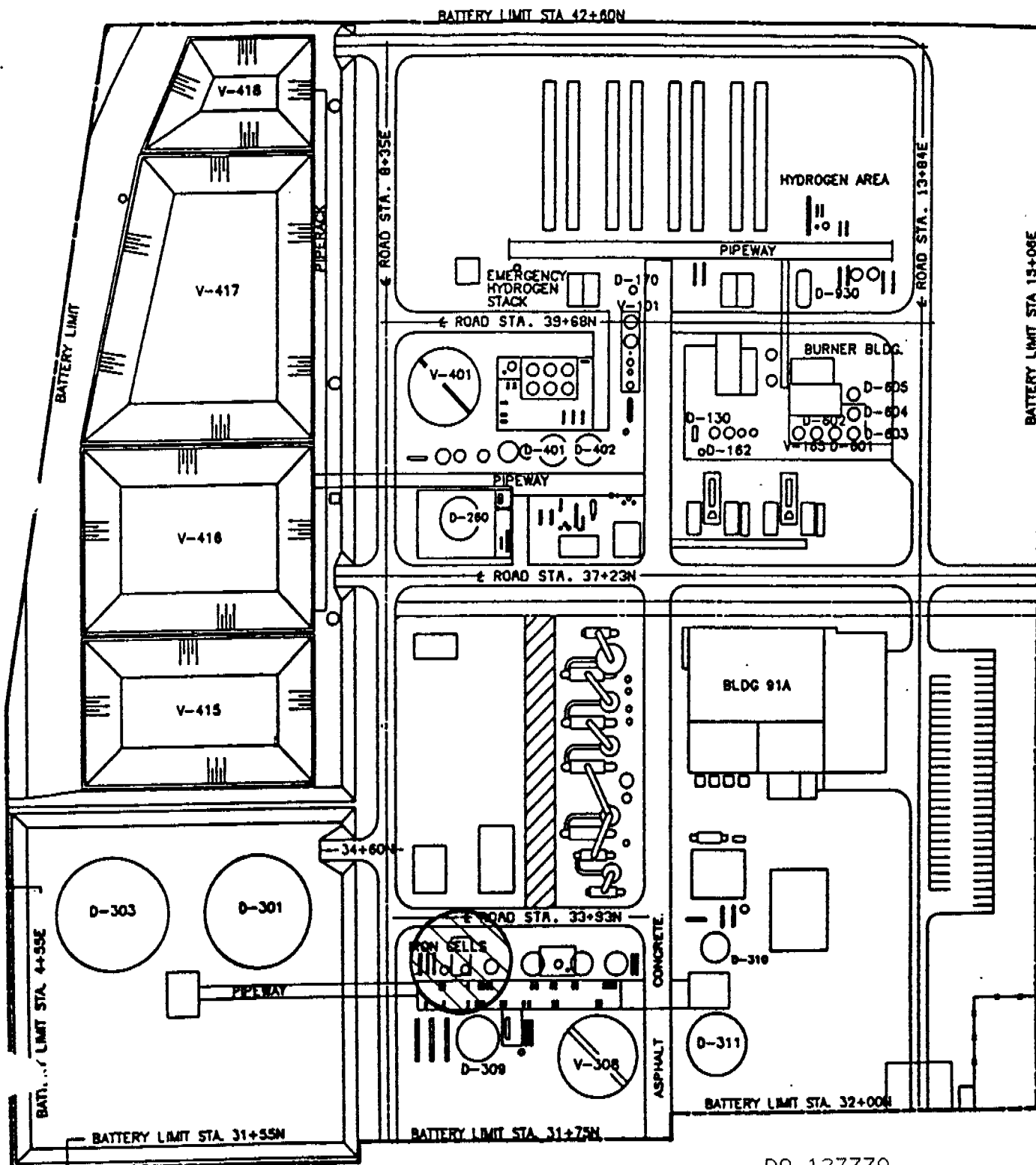


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FIRE & EXPLOSION RADIUS

AREA D: IRON CELLS

BLOCK 90



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1.3-3 Underground

The entire block drains by gravity into the injection water pond (V417). In addition, storm water from the Foam Plant and CA1 areas now are collected in V417.

The hypo contaminated and acid sewers are separate to avoid chlorine evolution should simultaneous spills occur.

The brine storage, injection water, and hypo (ongoing) pond have been rebuilt and relined with appropriate leak detection systems to avoid soil contamination.

1.3-4 Fire Protection Systems

See the attached plot plans for the location and details of all the systems. Basically, sprinkler protection is provided for 91A building and each of the two rectifiers. Halon protection is installed in the computer room, the vault, behind the control panel, the DC battery room, the MCC room, and inside the MCC panels.

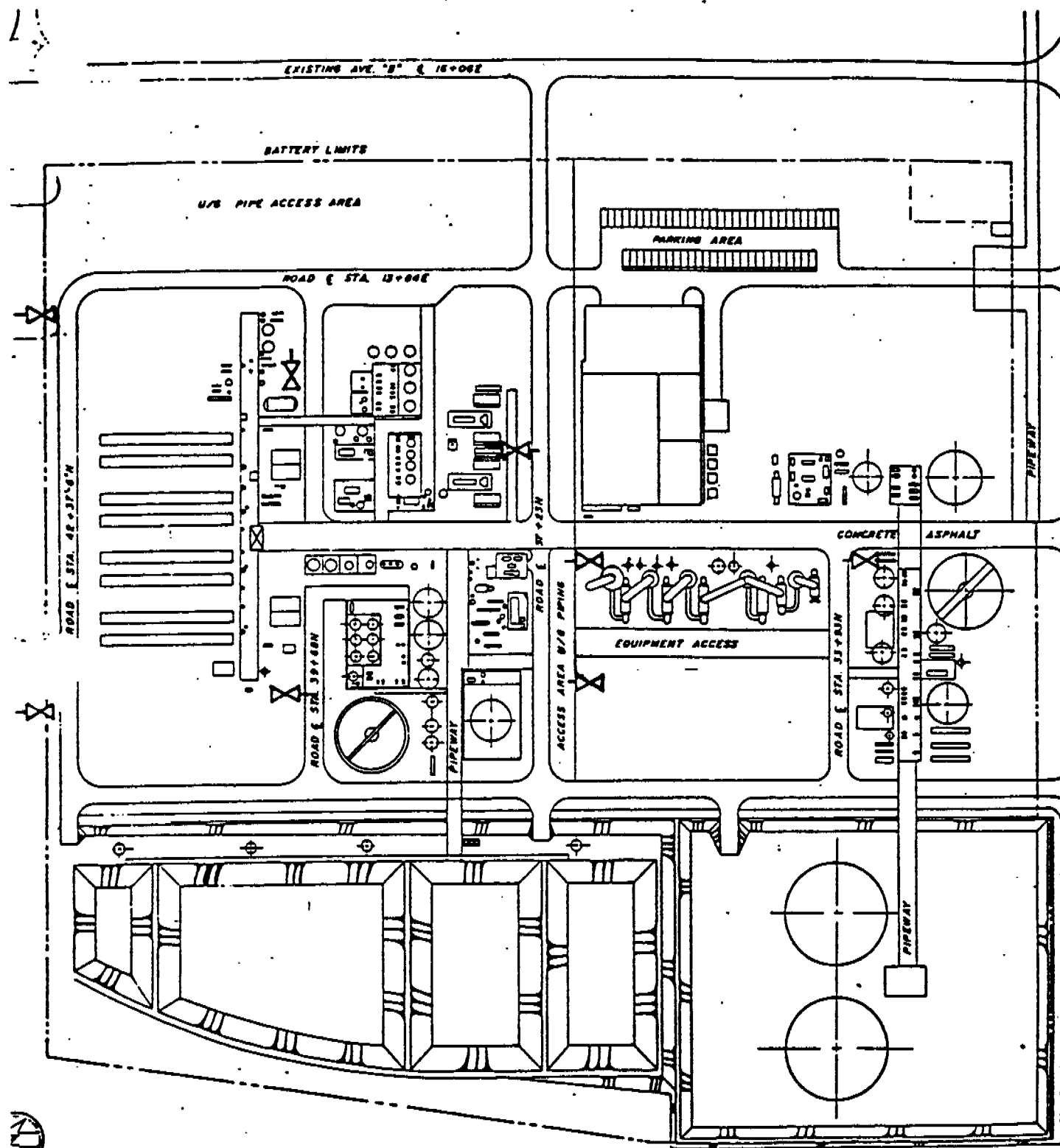
1.3-5 Buildings

Fire protection is noted above. The building ventilation does shutdown in the event of a chlorine release or a smoke detector signal.

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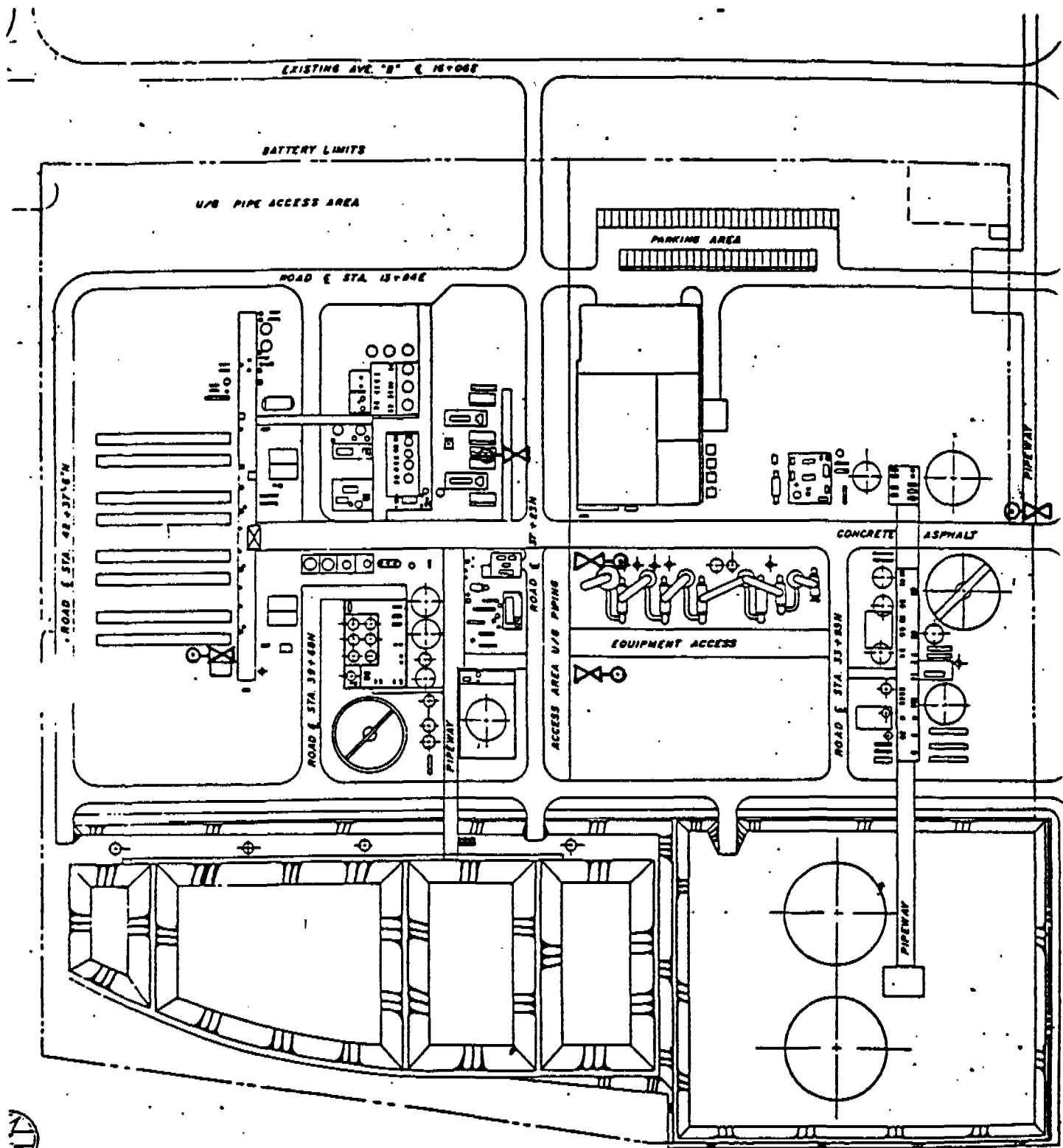
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~~SECRET~~ FIRE HYDRANTS



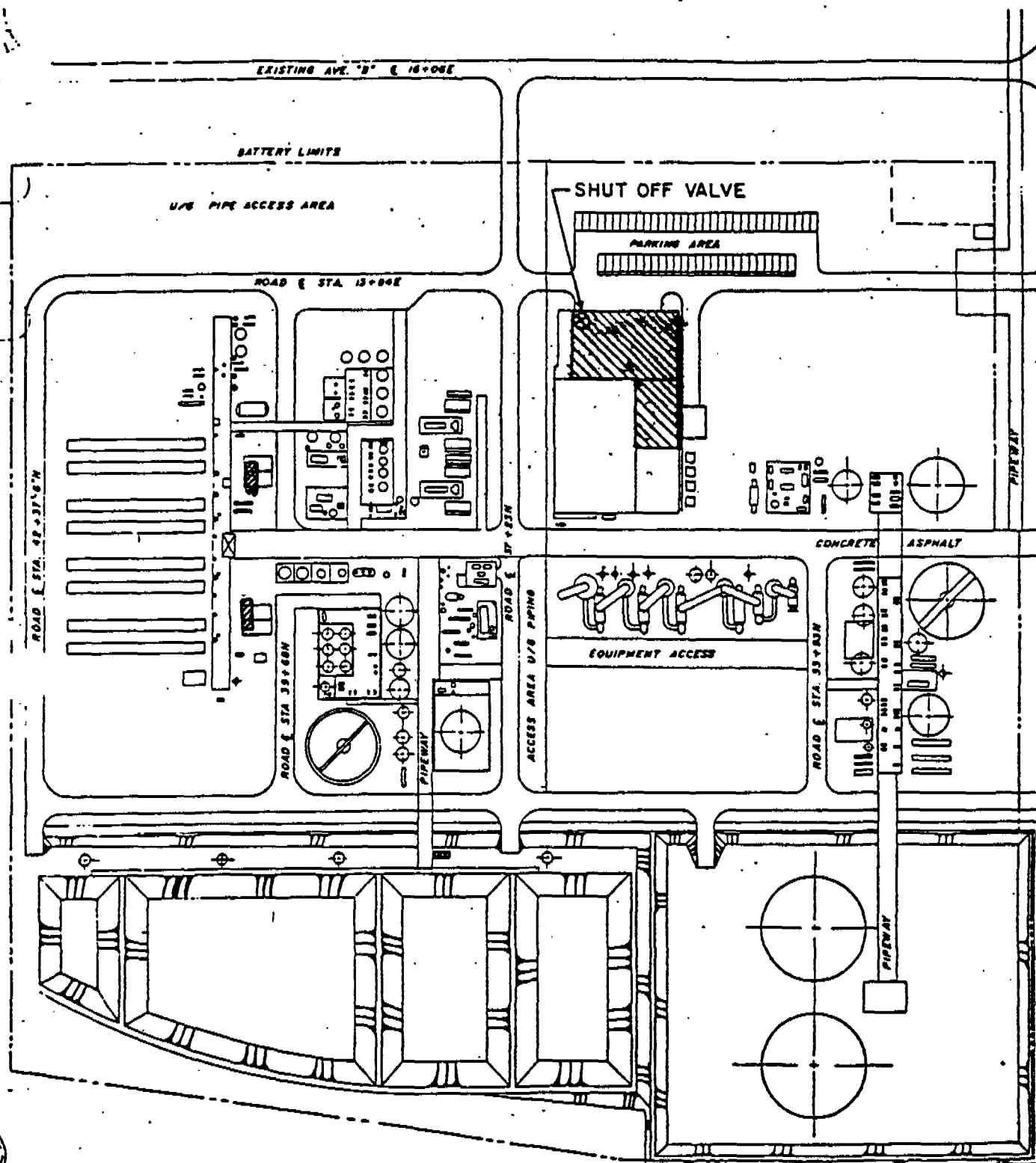
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 FIRE HYDRANT WITH MONITOR



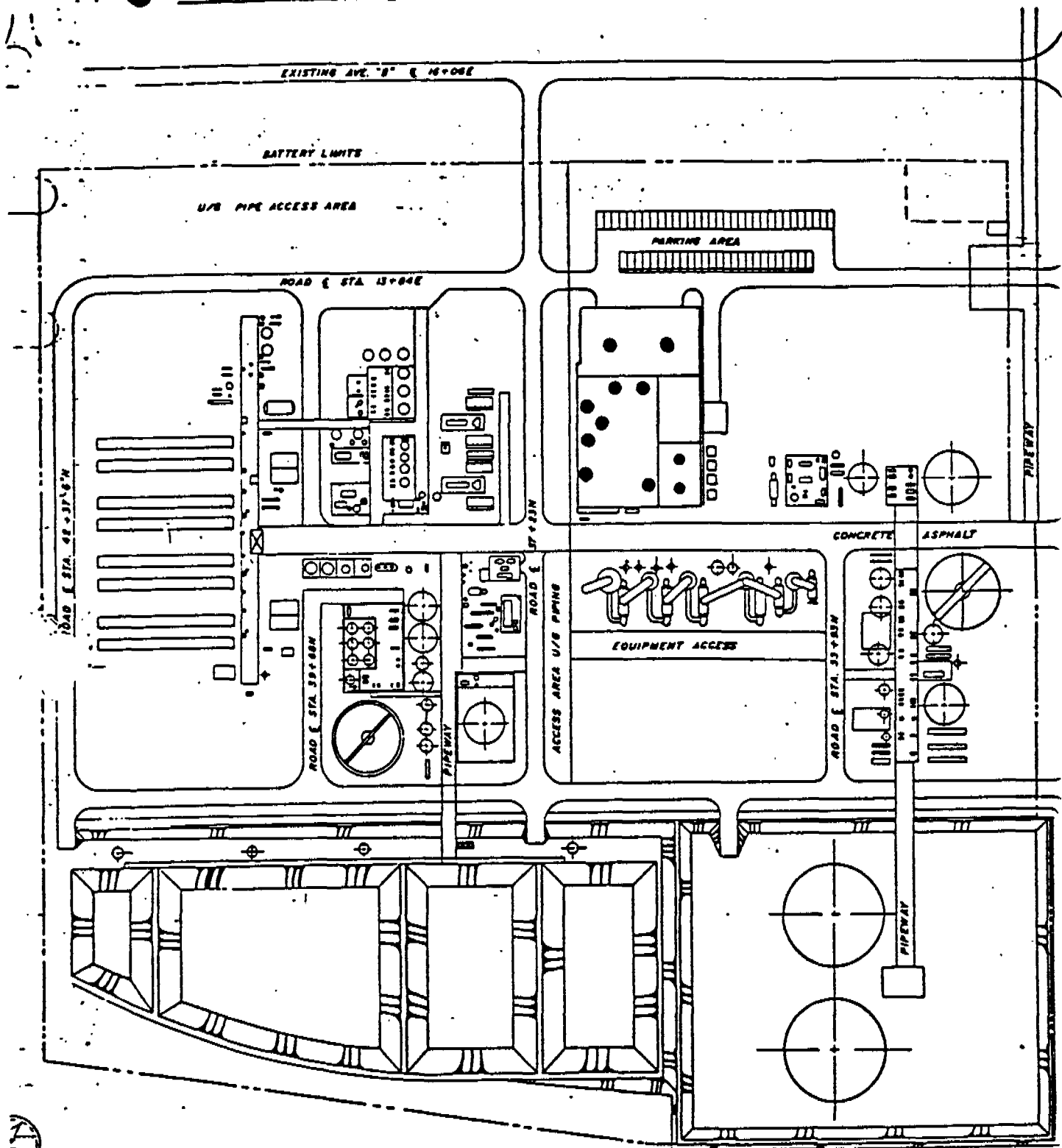
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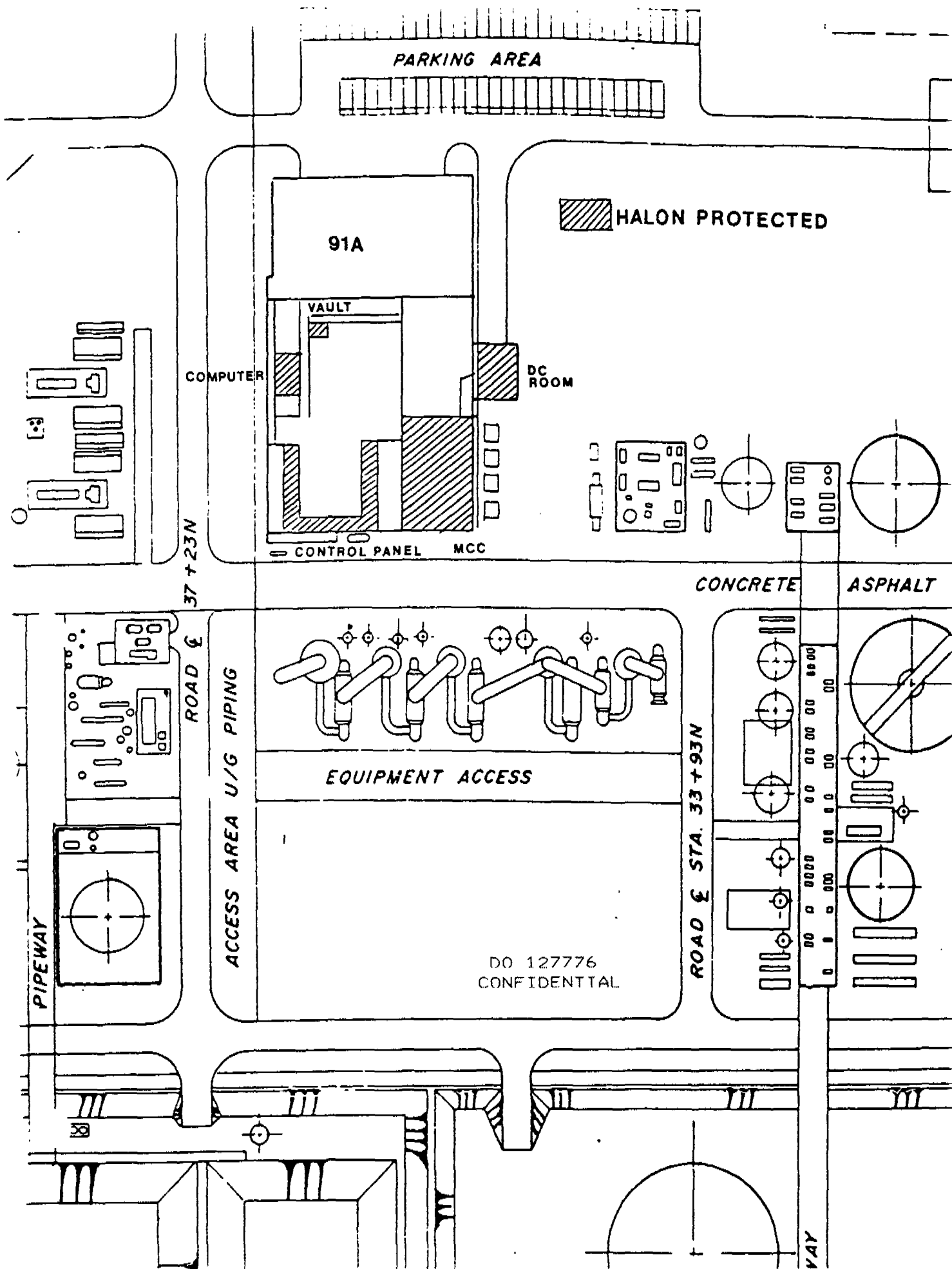
 SPRINKLED AREA



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1.4 Interplant Relationships

Department	Receive from	Send to
Power & Utilities	15 KV power 150 psi steam Cooling water Raw Water Nitrogen Natural gas Demin waste water (future)	Condensate Cooling water return 50% caustic Hydrogen (future)
EDC/VCM	18% HCl Ecology "brine" Chlorinolysis waste Carbon tet	100% chlorine gas Cell effluent Chlorine taffy Waste carbon tet
Chlor-Alkali I	Cell effluent Sodium Sulfite "Neut" water Storm water 32% HCl Liquid chlorine	Cell Effluent 50% caustic Salt Slurry Brine 32% HCl Liquid chlorine
Wells	Brine	Injection water Sulfate purge
Car Wash	Caustic washings	
Solids Landfill		Miscellaneous material e.g. contaminated earth, asbestos bags, etc.

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1.5 Performance

1.5-1 Performance Comparisons

The attached Chlor-Alkali Tech Center Chlorine and Caustic Summary compare the performance of the plants opposite selected ratio's and quality items.

1.5-2 Energy/Yield

At CA2 we have chosen to use two Key Result areas to study energy consumption and product yield.

Power Efficiency: This is the net (i.e. final accounting) production of chlorine and caustic vs. cell energy consumption expressed as a % of an arbitrary theoretical. (2.174 volts/cell @ 100% efficiency.)

Steam Economy: This is the total steam consumption of the plant (not just the evaporators) KBtu's per lb of water evaporated from the cell effluent.

The elements impacting the Power Efficiency are:

- Cell Voltage
- Rectifier Efficiency
- Product Losses: Chlorine - 32 % acid usage
 - Scrubbing
 - Accounting
- Caustic - NaOH Current Eff
- Evaporator losses

The elements impacting the Steam Economy are:

- Wash water: Flywashes - frequency and duration
- Shoots
- T301

- Steam Utilization: EV300 limitations
- Other plant steam uses

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CHLORINE YEAR-TO-DATE SUMMARY
CHLOR-ALKALI TECH CENTER

REPORTING PERIOD: 1ST QTR 1980
RUN DATE: 8-AUG-1980

	ARAZU	FORT C/A 1	FORT C/A 2	LAD C/A 2	LAD CL1	OCB	SAKNTA C/A 1	SAKNTA CL2	STADE C/A 1	STADE CL2	TEXAS CL3	CL4	CL5	WESTERN	ROW AVE
BRINE GPL NAOL QTR	295	300	294	305	299	295	297	310	308	301	314	313	0	302	303
YTD	295	300	294	305	299	295	297	310	308	301	314	313	0	302	303
LAST YEAR	296	302	302	307	299	297	295	293	310	301	312	312	0	304	304
BRINE PPM CA QTR	1.1	4.1	3.0	6.1	3.0	3.1	2.3	1.8	2.3	2.3	1.3	1.3	0.0	1.0	2.4
YTD	1.1	4.1	3.0	6.1	3.0	3.1	2.3	1.8	2.3	2.3	1.3	1.3	0.0	1.0	2.4
LAST YEAR	1.2	3.1	2.8	4.7	2.2	2.8	2.1	2.5	2.0	2.6	1.1	1.1	0.0	2.6	2.1
HCL LB/KLB CL2 QTR	81	63	63	69	71	65	57	85	84	86	38	44	0	67	64
YTD	81	63	63	69	71	65	57	85	84	86	38	44	0	67	64
LAST YEAR	74	56	60	79	69	46	64	121	84	83	45	45	0	57	64
ANOLYTE PH QTR	2.9	3.0	2.7	2.9	2.5	2.5	3.0	3.6	2.4	2.7	2.8	2.8	0.0	2.3	2.7
YTD	2.9	3.0	2.7	2.9	2.5	2.5	3.0	3.6	2.4	2.7	2.8	2.8	0.0	2.3	2.7
LAST YEAR	2.7	2.6	2.6	2.6	2.5	2.5	3.1	3.4	2.4	2.8	3.0	2.9	0.0	2.2	2.7
ANOLYTE NAOL QTR	289	284	288	295	295	295	286	252	290	276	-	1	-	1	279
YTD	289	284	288	295	295	295	286	252	290	276	-	1	-	1	279
LAST YEAR	288	282	287	296	295	295	266	235	288	274	-	1	-	1	282
CELL GAS X CL2 QTR	93.0	96.2	95.4	95.1	95.5	95.6	95.4	96.0	95.2	96.0	95.3	93.9	0.0	97.4	95.2
YTD	93.0	96.2	95.4	95.1	95.5	95.6	95.4	96.0	95.2	96.0	95.3	93.9	0.0	97.4	95.2
LAST YEAR	92.2	96.0	94.8	95.2	95.7	95.3	95.6	95.9	95.2	95.4	94.5	92.5	0.0	95.1	94.8
CELL GAS X O2 QTR	1.85	1.31	1.13	1.03	1.02	1.32	2.16	1.55	0.73	0.82	1.04	0.86	0.00	1.04	1.13
YTD	1.85	1.31	1.13	1.03	1.02	1.32	2.16	1.55	0.73	0.82	1.04	0.86	0.00	1.04	1.13
LAST YEAR	2.26	1.25	0.83	1.18	0.90	1.30	1.91	1.51	1.00	0.96	1.11	0.83	0.00	1.84	1.15
CELL GAS X H2 QTR	0.14	0.07	0.16	0.03	0.05	0.09	0.29	0.47	0.14	0.05	0.13	0.26	0.00	0.13	0.14
YTD	0.14	0.07	0.16	0.03	0.05	0.09	0.29	0.47	0.14	0.05	0.13	0.26	0.00	0.13	0.14
LAST YEAR	0.19	0.09	0.18	0.02	0.04	0.07	0.31	0.60	0.16	0.14	0.19	0.26	0.00	0.19	0.16
ACKWH/LB CL2 QTR	1.04	1.09	1.11	1.02	1.06	1.04	1.08	1.07	1.04	1.01	1.07	1.08	0.00	1.06	1.06
YTD	1.04	1.09	1.11	1.02	1.06	1.04	1.08	1.07	1.04	1.01	1.07	1.08	0.00	1.06	1.06
LAST YEAR	1.06	1.10	1.13	1.03	1.04	1.04	1.07	1.07	1.08	1.05	1.05	1.09	0.00	1.09	1.07
X CAPACITY QTR	112	109	121	108	105	109	110	121	99	108	102	112	0	92	108
YTD	112	109	121	108	105	109	110	121	99	108	102	112	0	92	108
LAST YEAR	96	110	110	105	105	104	94	104	99	102	108	96	0	95	102
NAOH GPL IN CE QTR	113	134	125	121	105	124	115	126	126	122	102	102	0	118	114
YTD	113	134	125	121	105	124	115	126	126	122	102	102	0	118	114
LAST YEAR	113	128	125	118	111	119	120	119	128	120	105	104	0	119	115
MACLO3 IN CE QTR	0.19	0.12	0.23	0.26	0.29	0.23	0.81	0.25	0.14	0.17	0.14	0.24	0.00	0.39	0.25
YTD	0.19	0.12	0.23	0.26	0.29	0.23	0.81	0.25	0.14	0.17	0.14	0.24	0.00	0.39	0.25
LAST YEAR	0.25	0.16	0.18	0.21	0.15	0.21	0.32	0.27	0.17	0.19	0.17	0.15	0.00	0.63	0.21
STEAM/FUEL COST QTR	2118	673	1452	1382	106	4160	2435	0	3697	142	0	0	0	1321	17486
YTD	2118	673	1452	1382	106	4160	2435	0	3697	142	0	0	0	1321	17486
LAST YEAR	5566	2878	6237	15943	355	16702	10569	2780	10094	202	0	0	0	5187	76513
POWER COST M\$ QTR	5006	1504	3267	214	9783	653	4853	0	9583	15036	7663	8352	0	2269	68183
YTD	5006	1504	3267	214	9783	653	4853	0	9583	15036	7663	8352	0	2269	68183
LAST YEAR	16200	5544	12159	2098	39228	2927	17430	12423	34754	50352	32392	30745	0	9577	265828
MAINTENANCE M\$ QTR	1499	808	1531	608	1272	1693	1157	0	1536	819	1391	607	0	1364	14285
YTD	1499	808	1531	608	1272	1693	1157	0	1536	819	1391	607	0	1364	14285
LAST YEAR	6889	3637	5059	8325	5984	9584	4741	71661	6661	3973	4027	14636	0	3486	148660
\$/LB CL2 & NAOH QTR	.0552	.0326	.0254	.0240	.0000	.0278	.0324	.0000	.0532	.0000	.0000	.0000	.0000	.0530	.0361
YTD	.0552	.0326	.0254	.0240	.0000	.0278	.0324	.0000	.0532	.0000	.0000	.0000	.0000	.0530	.0361
LAST YEAR	.0551	.0352	.0276	.0253	.0000	.1098	.0338	.0000	.0467	.0000	.0000	.0000	.0000	.0516	.0473
\$/LB CL & LE QTR	.0000	.0000	.0000	.0000	.0181	.0000	.0000	.0000	.0000	.0322	.0181	.0100	.0000	.0000	.0183
YTD	.0000	.0000	.0000	.0000	.0181	.0000	.0000	.0000	.0000	.0322	.0181	.0100	.0000	.0000	.0183
LAST YEAR	.0000	.0000	.0000	.0000	.0180	.0000	.0000	.0000	.0000	.0295	.0180	.0232	.0000	.0000	.0220

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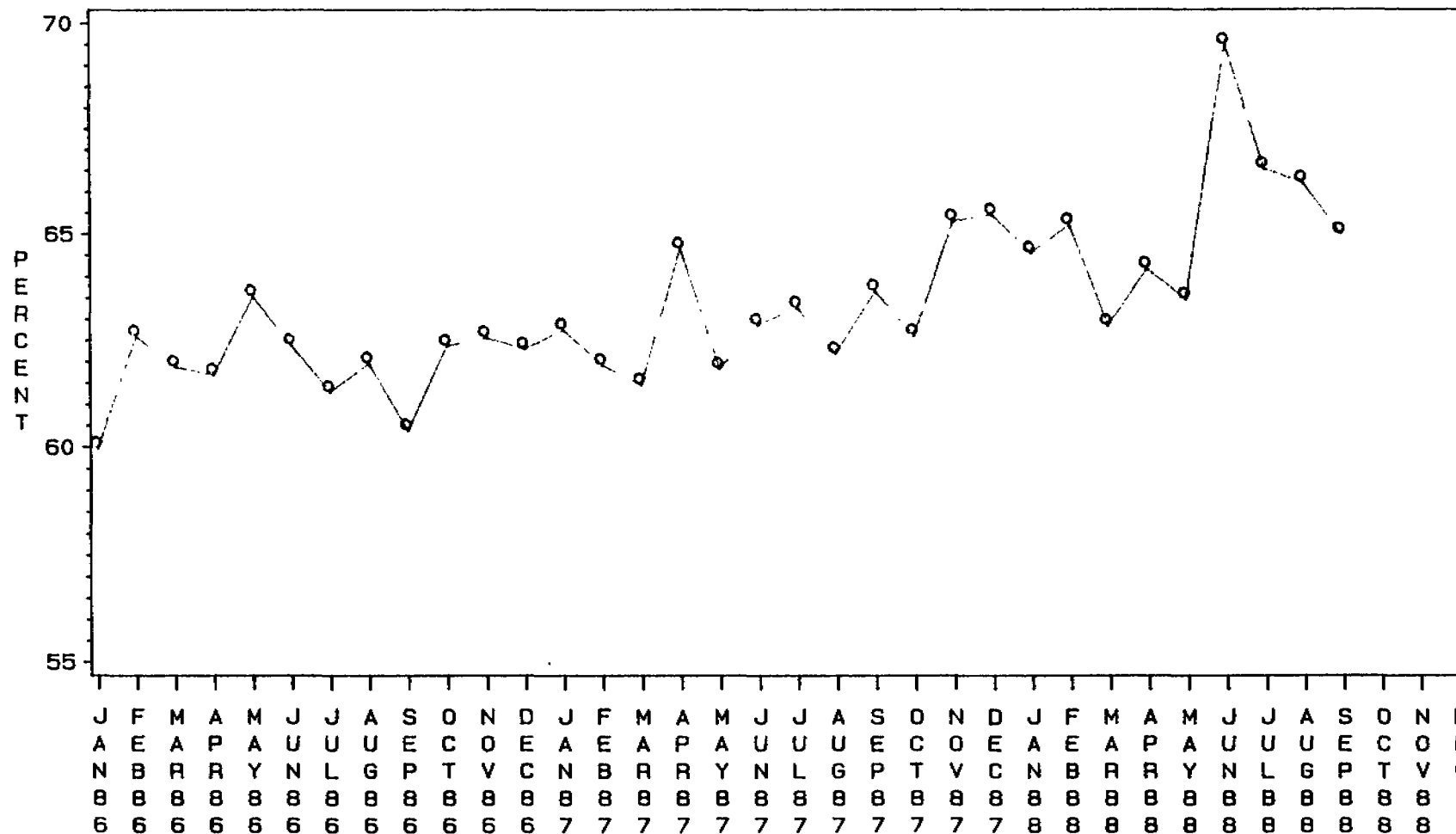
CAUSTIC YEAR-TO-DATE SUMMARY
CHLOR-ALKALI TECH CENTER

REPORTING PERIOD: 1ST QTR 1988
RUN DATE: 8-Aug-1988

		ARATU	FORT C/A 1	FORT C/A 2	LAD C-1	LAD C/A 2	UCD	SARNIA C/A 1	STAHE C/A 1	TEXAS C-1	WESTERN	DOW AVG
CELL EFF % NAOH	QTR	9.14	10.14	10.12	8.82	9.73	10.11	9.86	10.37	8.54	10.18	9.62
	YTD	9.14	10.14	10.12	8.82	9.73	10.11	9.86	10.37	8.54	10.18	9.62
	LAST YEAR	9.23	10.17	10.10	9.12	9.48	9.75	9.96	10.59	8.68	10.07	9.64
CELL EFF % NACL	QTR	16.87	15.19	16.30	16.35	17.63	16.92	15.71	16.53	15.74	17.33	16.46
	YTD	16.87	15.19	16.30	16.35	17.63	16.92	15.71	16.53	15.74	17.33	16.46
	LAST YEAR	16.27	15.51	16.48	17.19	17.69	17.14	15.96	16.48	14.90	17.34	16.52
EVAP FEED % NAOH	QTR	9.58	10.07	10.33	9.15	9.46	10.36	9.84	10.43	9.71	10.18	9.90
	YTD	9.58	10.07	10.33	9.15	9.46	10.36	9.84	10.43	9.71	10.18	9.90
	LAST YEAR	9.86	10.04	10.44	9.21	9.71	10.07	10.00	10.60	9.88	10.07	9.99
WASH WATER LB/LB	QTR	1.20	4.57	1.56	0.99	0.88	0.80	1.83	0.72	0.55	- 1.00	1.20
	YTD	1.20	4.57	1.56	0.99	0.88	0.80	1.83	0.72	0.55	- 1.00	1.20
	LAST YEAR	1.44	4.47	1.56	1.36	0.96	0.81	2.16	0.73	0.54	2.65	1.30
EVAP SMC WASH WTR	QTR	0.76	- 1.00	0.44	0.36	0.19	0.24	0.29	0.37	0.13	- 1.00	0.33
LB/LB	YTD	0.76	- 1.00	0.44	0.36	0.19	0.24	0.29	0.37	0.13	- 1.00	0.33
	LAST YEAR	0.76	- 1.00	0.47	0.28	0.21	0.26	0.34	0.35	0.13	1.07	0.41
EVAP SMC LOSS	QTR	2.28	5.28	2.31	1.33	0.54	0.46	0.65	0.60	0.25	- 1.00	1.20
% OF PROD	YTD	2.28	5.28	2.31	1.33	0.54	0.46	0.65	0.60	0.25	- 1.00	1.20
	LAST YEAR	2.00	4.12	2.30	1.26	1.21	0.45	0.64	0.82	0.24	4.39	1.26
EVAP SIM KBTU/LB	QTR	4.76	5.10	3.38	5.46	5.48	4.59	4.95	3.66	4.29	6.76	4.64
	YTD	4.76	5.10	3.38	5.46	5.48	4.59	4.95	3.66	4.29	6.76	4.64
	LAST YEAR	4.39	5.19	3.35	5.26	5.40	4.47	4.80	3.90	4.23	6.99	4.69
% CAPACITY	QTR	125	105	115	98	117	110	110	104	95	91	107
	YTD	125	105	115	98	117	110	110	104	95	91	107
	LAST YEAR	107	92	119	100	110	104	83	101	85	93	99
% LOSS	QTR	5.3	7.3	3.0	3.7	9.2	4.3	9.0	3.7	8.3	6.4	6.0
	YTD	5.3	7.3	3.0	3.7	9.2	4.3	9.0	3.7	8.3	6.4	6.0
	LAST YEAR	5.2	6.8	6.9	4.8	9.2	4.9	9.9	5.1	9.0	5.6	6.8
% NAOH IN PRODUCT	QTR	49.37	50.13	49.90	50.06	49.94	50.06	49.74	50.03	49.98	49.04	49.89
	YTD	49.37	50.13	49.90	50.06	49.94	50.06	49.74	50.03	49.98	49.04	49.89
	LAST YEAR	49.22	50.00	49.88	50.25	50.09	50.02	49.73	50.03	50.14	49.56	49.96
% NACL IN PRODUCT	QTR	1.08	0.98	0.95	0.97	0.96	0.98	0.98	0.97	0.89	0.97	0.97
	YTD	1.08	0.98	0.95	0.97	0.96	0.98	0.98	0.97	0.89	0.97	0.97
	LAST YEAR	1.06	0.97	0.94	0.95	0.96	0.97	0.99	0.97	0.93	0.97	0.96
PPM FE IN PRODUCT	QTR	4.3	2.3	1.9	1.3	1.6	- 1.0	2.4	1.2	0.6	3.7	1.8
	YTD	4.3	2.3	1.9	1.3	1.6	- 1.0	2.4	1.2	0.6	3.7	1.8
	LAST YEAR	4.2	2.5	1.9	1.5	1.9	0.9	2.4	1.2	0.7	3.7	1.8
STEAM/FUEL COST	QTR	2118	673	1452	2672	1382	4160	2435	3697	2959	1321	22869
M\$	YTD	2118	673	1452	2672	1382	4160	2435	3697	2959	1321	22869
	LAST YEAR	5566	2878	6237	9986	15943	16702	10569	10094	6715	5187	89877
POWER COST M\$	QTR	5006	1504	3267	302	214	653	4853	9583	433	2269	28084
	YTD	5006	1504	3267	302	214	653	4853	9583	433	2269	28084
	LAST YEAR	16200	5344	12159	1259	2098	2927	17410	34754	1310	9577	103258
MAINTENANCE M\$	QTR	1499	808	1531	2657	608	1693	1157	1536	936	1364	13789
	YTD	1499	808	1531	2657	608	1693	1157	1536	936	1364	13789
	LAST YEAR	6889	3637	5059	3048	8325	9584	4741	6661	2541	3486	53971
\$/LB CL2 & NAOH	QTR	.0552	.0326	.0254	.0000	.0240	.0278	.0324	.0522	.0000	.0530	.0361
	YTD	.0552	.0326	.0254	.0000	.0240	.0278	.0324	.0522	.0000	.0530	.0361
	LAST YEAR	.0551	.0352	.0276	.0000	.0253	.1098	.0338	.0467	.0000	.0516	.0473
\$/LB NAOH	QTR	.0000	.0000	.0000	.0379	.0000	.0000	.0000	.0000	.0349	.0000	.0367
	YTD	.0000	.0000	.0000	.0379	.0000	.0000	.0000	.0000	.0349	.0000	.0367
										.0767	.0000	.0769

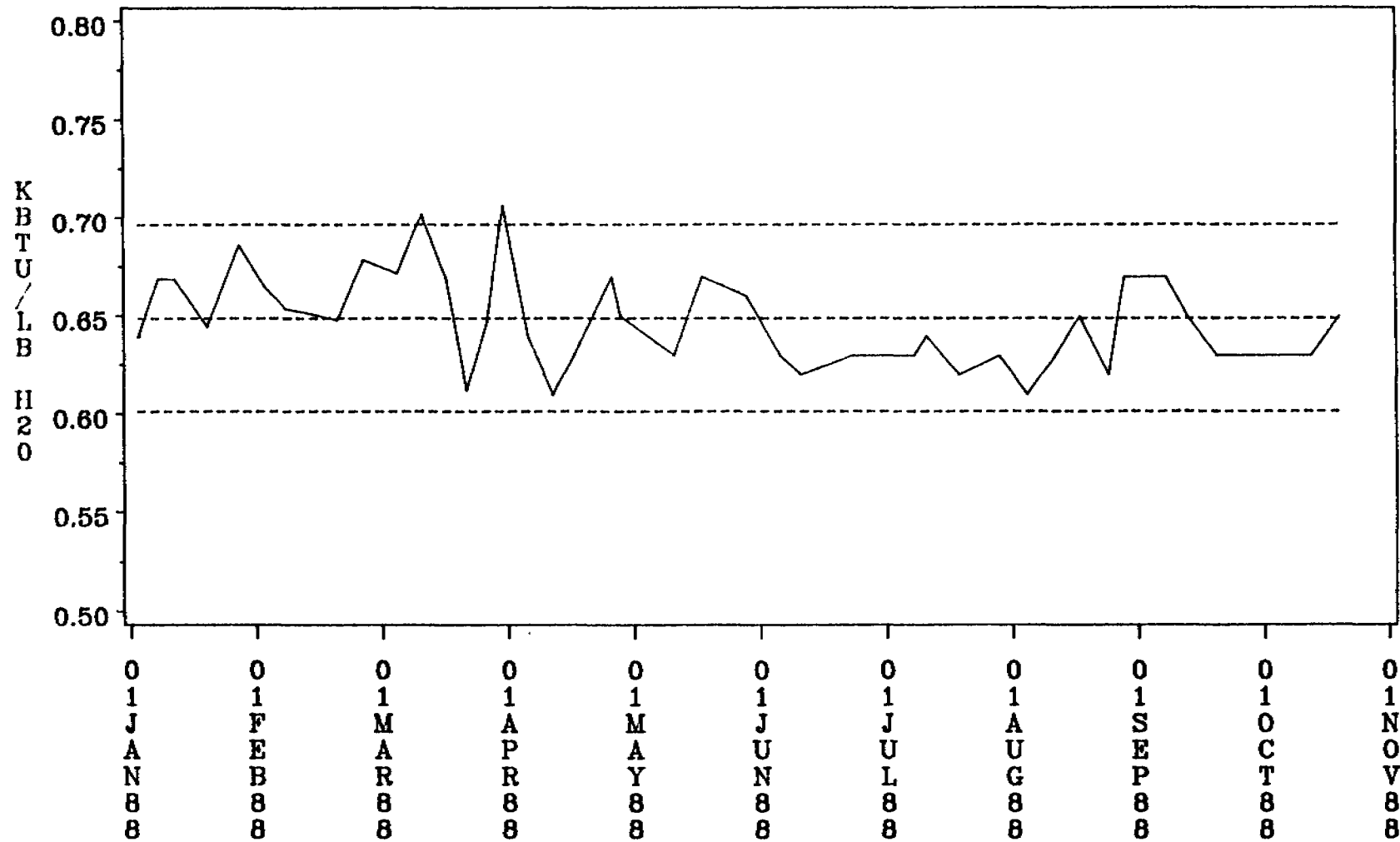
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CHLOR-ALKALI II POWER EFFICIENCY (NET)



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C/A II STEAM ECONOMY



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1.5-3 Reliability

Please refer to the attached graph (Production Chlorine).

Year	Instantaneous Cell Capability	Standard Capacity	Reliability to Achieve Capacity	Actual Reliability
1979	98,333 lb/hr	750 MMlb/yr	87 %	
1980	98,333 lb/hr	750 MMlb/yr	87 %	67 %
1981	98,333 lb/hr	750 MMlb/yr	87 %	75 %
1982	98,333 lb/hr	750 MMlb/yr	87 %	75 %
1983	98,333 lb/hr	750 MMlb/yr	87 %	83 %
1984	97,500 lb/hr	750 MMlb/yr	88 %	85 %
1985	97,500 lb/hr	750 MMlb/yr	88 %	86 %
1986	98,700 lb/hr	750 MMlb/yr	87 %	88 %
1987	101,940 lb/hr	750 MMlb/yr	84 %	92 %
1988	109,088 lb/hr	800 MMlb/yr	84 %	** 91 %
1989	109,088 lb/hr	860 MMlb/yr	90 %	

** year end forecast

The attached pareto chart "Chlorine Plant Reliability: % of Lost Production" identifies the major causes of downtime or reduced rates in 1988.

1.5-4

A comparison was made between CA2 at the Fort and CA2 in Louisiana in April of this year based on 1987 costs. Please see the April 1988 memo and backup.

Major opportunities highlighted for the Fort are:

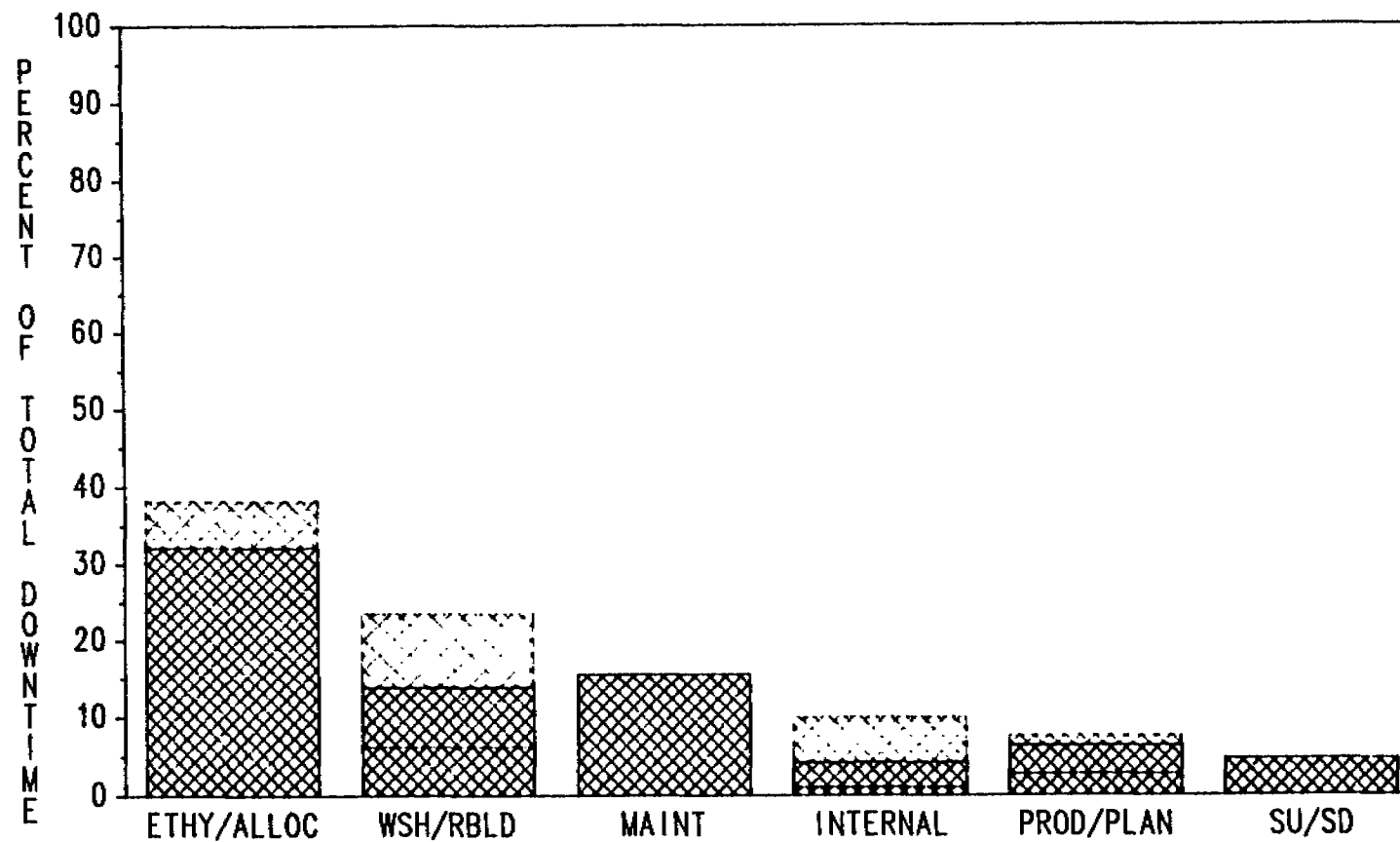
1. Collect hydrogen
2. Install higher efficiency chlorine cells

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CHLORINE PLANT RELIABILITY

% OF LOST PRODUCTION
1988



QUARTER

1ST

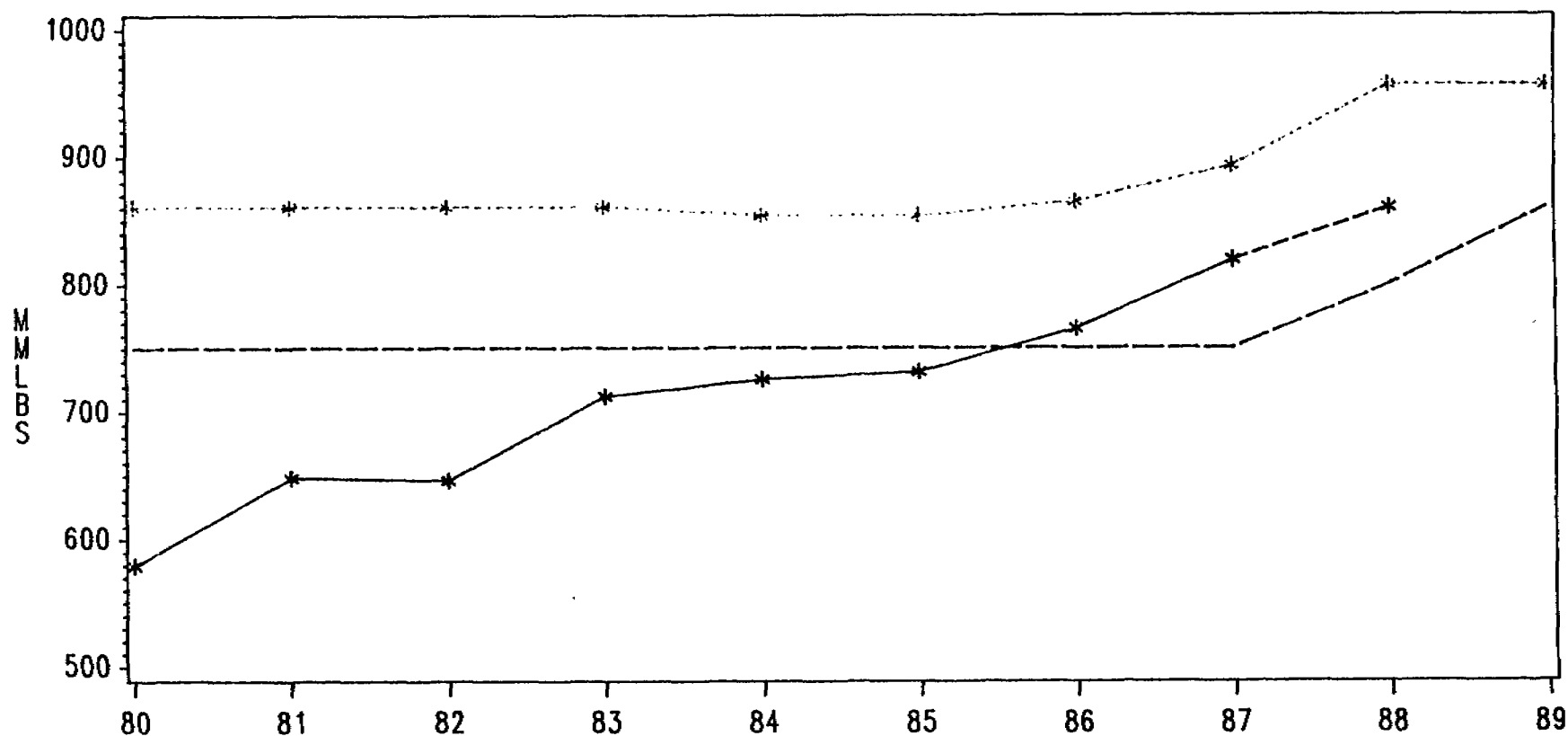
2ND

3RD

4TH

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PRODUCTION CHLORINE



LEGEND

*** Production
*** Forecast

--- Capacity
*** Pot. Capability

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88-04-19

To: Paul Bilello

xc. Tom Austin
Reg Daniels

Cost Comparisons

Paul,

With the help of my accountant, we completed a cost analysis to compare your plant with mine, based on the cost sheets that we exchanged.

As best as we can tell, the comparison is on an "apples to apples" basis. Everything in \$US.

The idea was to try to identify some areas of opportunity for improvement here at the Fort and I think this may help.

As you can see from the chart, some opportunities we can do something about and some we can't.

Raw Materials: mostly hydrogen and brine pricing.

Brine costs, I think are attributable to dome salt vs bedded and the number of wells required to maintain production. Our wells are young on average, so costs may come down some more.

Hydrogen. We sure need to find a way not to waste 1/3 of our production.

Depreciation: this includes cells. Can't do much about this. The book value of my plant is much higher.

Cell Service: We just completed our M83 cell conversion last year-- rebuilt 4 series. This should come down.

Storage and Handling: These are site railroad costs. Because we ship the most product on site, we pay a big portion of the costs. This is over and above storage and loading costs. I guess you don't ship anything.

Factory Burden: the penalty for being a small site.

Utilities: In spite of the fact that we have a significant advantage due to the lower gas costs, we are missing an \$0.850 MM per year opportunity due to poor cell power efficiency.

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Product Losses: I couldn't reconcile this directly. It looks like your caustic losses are much better than ours but that is contradicted by your higher HCl consumption. I know our salt column operates poorly and our cell caustic efficiencies may be higher but I don't know for sure. I may wish to talk with you about this in the future.

Thanks for your help. If any of this doesn't make any sense or if you see anything else that might help me, please call. I enjoyed the brief visit.

Pete Fraser
Ft. Sask CA2

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Summary of LAD CA2 and Ft. Sask CA2 Costs for 1987

- Notes:
1. All costs in US funds (\$Cdn=\$0.7526 US)
 2. Ft Sask 1740 (chlorine and caustic) account was compared against LAD cost centre 35 (chlorine) and 39 (caustic).
 3. LAD does no product loading. Ft. Sask loads caustic only.

	LAD	Ft. Sask.
Production MMLbs		
Chlorine	700.8	819.4
Caustic	858.4	889.4
Total	1559.2	1708.8
Cost of manufacturing	\$0.0268	\$0.0277
Cost components		
Brine/Ton	\$1.36	\$3.86
Natural gas price	\$1.88	\$1.25
Motive power	\$0.02351	\$0.01642
Electrolytic power	\$0.02093	\$0.01314
Steam/MMBtu	\$1.64	\$1.83
ACKWH/lb	\$1.050	1.129
Power Efficiency	69%	63.1%
Power Efficiency w/o HCl	69%	64.2%
KBtu/lb NaOH	5.46	3.83
HCl lb/1000 lb Cl2	86.4	60.3

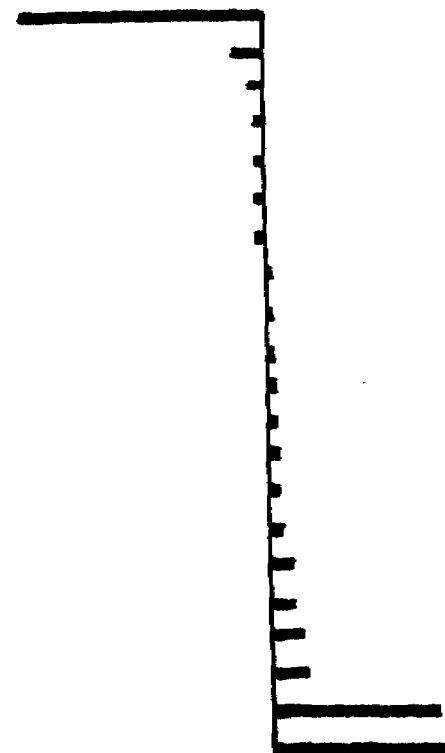
COST COMPARISON

FT. SASK CA2 VS. LOUISIANA CA2

1987 in \$ US.

UTILITIES	+ 5.330
SPECIAL SUPPLIES	+ 0.656
LABORATORY	+ 0.382
INSURANCE	+ 0.087
ROYALTIES	+ 0.074
GENERAL SUPPLIES	+ 0.066
MAINTENANCE	+ 0.041
TRAVEL	- 0.030
DATA PROCESSING	- 0.072
OTHER	- 0.108
SALARIES + FRINGES	- 0.114
WASTE DISPOSAL	- 0.130
LABOUR ASSESSMENT	- 0.151
NON-MAINTENANCE SERVICES	- 0.237
ENGINEERING	- 0.262
TAXES	- 0.583
FACTORY BURDEN	- 0.729
STORAGE AND HANDLING	- 0.881
CELL SERVICE	- 0.888
DEPRECIATION + CELLS	- 3.902
RAW MATERIALS	- 4.089

TOTAL	- 5.540



Note: + = advantage to the Fort

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CHORA ALKALI COMPARISON
LOUISIANA DIVISION VS CA II FORT SASKATCHEWAN

DESCRIPTION	LOUISIANA Amount	Per Unit	FORT SASK. Amount	Per Unit	DIFFERENCE
Raw Materials	-1,872,214	-.00120	2,217,041	.00130	-4,089,255
Utilities	26,925,647	.01727	21,595,653	.01264	5,329,994
Special Supplies	2,500,618	.00160	1,844,747	.00108	655,871
Cell Service	349,278	.00023	1,236,965	.00072	-887,687
Cell Depreciation (included in dep)			2,146,652	.00126	-2,146,652
Depreciation	3,257,708	.00209	5,013,644	.00293	-1,755,936
Taxes	233,364	.00015	816,389	.00048	-583,025
Insurance	238,563	.00015	151,193	.00009	87,370
Royalties	362,997	.00023	288,519	.00017	74,478
Salaries	1,704,027	.00109	2,035,540	.00119	-331,513
Fringe Benefits	397,769	.00026	179,565	.00011	218,204
Lab ur Assesment	176,927	.00011	327,971	.00019	-151,044
Total Mtc	5,369,426	.00344	5,054,490	.00296	314,936
Non Mtce Services	3,317	.00000	240,793	.00014	-237,476
Tavel	9,758	.00001	40,014	.00002	-30,256
Laboratory	518,840	.00033	131,893	.00008	386,947
Waste Disposal	90,053	.00006	59,305	.00003	30,748
Engineering	53,008	.00003	386,105	.00023	-333,097
Storage & Handling	42,721	.00003	835,463	.00049	-792,742
Data Processing	113,108	.00007	182,707	.00011	-69,599
Fact ry Burden	870,577	.00056	2,059,213	.00121	-1,188,636
Gen Supplies	354,732	.00023	288,794	.00016	65,938
Other Costs	39,415	.00003	147,063	.00008	-107,648
TOTAL	41,739,639	.02677	47,279,724	.02767	-5,540,085

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CHORAL ALI COMPARISON

LOUISIANA DIVISION VS CA II PORT SASKATCHEWAN

Breakdown of the Factory Burden Account

DESCRIPTION	LOUISIANA		PORT SASK.		DIFFERENCE
	Amount	Per Unit	Amount	Per Unit	
Raw Materials	-1,872,214	-.00120	2,217,041	.00130	-4,089,255
Utilities	26,925,647	.01727	21,595,653	.01264	5,329,994
Special Supplies	2,500,618	.00160	1,844,747	.00108	655,871
Cell Service	349,278	.00023	1,236,965	.00072	-887,687
Cell Depreciation (included in dep)			2,146,652	.00126	-2,146,652
Depreciation	3,257,708	.00209	5,013,644	.00293	-1,755,936
Taxes	233,364	.00015	816,389	.00048	-583,025
Insurance	238,563	.00015	151,193	.00009	87,370
Royalties	362,997	.00023	288,519	.00017	74,478
Salaries	1,704,027	.00109	2,035,540	.00119	-331,513
Fringe Benefits	397,769	.00026	179,565	.00011	218,204
Labour Assessment	176,927	.00011	327,971	.00019	-151,044
Total Mtce	5,369,426	.00344	5,327,853	.00312	41,573
Non Mtce Services	3,317	.00000	240,793	.00014	-237,476
Tavel	9,758	.00001	40,014	.00002	-30,256
Laboratory	518,840	.00033	137,183	.00008	381,657
Waste Disposal	90,053	.00006	220,014	.00013	-129,961
Engineering	53,008	.00003	314,572	.00018	-261,564
Storage & Handling	42,721	.00003	924,073	.00054	-881,352
Data Processing	113,108	.00007	184,951	.00011	-71,843
*Factory Burden	870,577	.00056	1,600,530	.00094	-729,953
Gen Supplies	354,732	.00023	288,794	.00017	65,938
Other Costs	39,415	.00003	147,063	.00008	-107,648
TOTAL	41,739,639	.02677	47,279,724	.02767	-5,540,085

* In 1987 most accounts being charged to factory burden were recharged based on replacement capital in both Louisiana and in Port Saskatchewan.
 The CA II 1740 replacement capital spread accounts for approximately 20% of the total "manufacturing site"
 The Louisiana Division Chlorine & Caustic functions account for between 4.98% and 6.5% depending on which account is spreading.

I have sent Louisiana division a electronic mail message to confirm that these are fair comparisons. I should find next week. They might not include the cells in the replacement capital calculation for this unit.

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UTILITIES

DESCRIPTION	Amount	LOUISIANA Per Unit	Amount	PORT SASK. Per Unit	DIFFERENCE
<u>Utilities</u>					
LP Steam	8,963,829		6,235,052	1,83256 Unit Cost	2,728,777
MLBS/MMBTU Qty	3,833,881		3,402,378	.00199 Unit Cost	
Motive Power	2,216,634	.02351	1,989,909	.01642	226,725
KWH Qty	89,340,000	.05730	121,212,054	.07093	
Electrolitic Power	15,593,742	.02093	12,159,631	.01314	3,434,111
KWH Qty	745,165,000	.47793	925,218,708	.54143	
Service Water	64,956		1,042,487	.05297	-977,531
MGAL/MIG Qty	484,836		19,681,200	.01152	
Treated Water	0		139,308	.28428	-139,308
MGAL/MIG Qty	0		490,041	.00029	
Portable Water	6,416		1,855	.28423	4,561
MGAL/MIG Qty	6,337		6,528	.000003	
Natural Gas	0		15,442	1.24683	-15,442
MMBTU Qty	0		12,385	.00001	
Nitrogen	80,070		11,969	.10034	68,101
HSCF/CCF	105,961		119,279	.00007	
(As a Supply)					
T tal Utilities	26,925,647		21,595,653		5,329,994

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RAW MATERIALS

DESCRIPTION	Amount	LOUISIANA Per Unit	Amount US\$	PORT SASK. Per Unit	DIFFERENCE
<u>Raw Materials</u>					
Raw Brine	912,673	1.45436	2,959,712	3.85955 unit cost	-2,047,039
TONS Qty	627,543	.00040	766,855	.00045 unit cost	
Cell Effluent	9,486,170	.01090	8,195,421	.00855	1,290,749
LBS Qty	870,190,577	.55812	958,225,862	.56074	
Cell Effluent Credit	-8,251,935	-.01090	-8,042,824	-.00855	-209,111
LBS Qty	-757,261,698	-.48569	-940,380,534	-.55030	
Hydrogen	-2,381,865		-65,166	-.08731	-2,316,699
MMBT/LBS Qty	-1,140,835		-746,333	-.00044	
Condensate	-1,637,258		-830,102	-.17305	-807,156
MLBS/LBS Qty	-8,182,001		-4,796,897	-.00281	
(As a Utility)					
Total Raw Materials	-1,872,214		2,217,041		-4,089,255

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SPECIAL SUPPLIES

DESCRIPTION	LOUISIANA Amount	Per Unit	Amount US\$	FORT SASK. Per Unit	DIFFERENCE
<u>Special Supplies</u>					
Carbon Dioxide	98,146	.00006	10,053	.000005	88,093
Carbon Tet	43,487	.00003	8,628	.000005	34,859
Freon			43,352	.00003	-43,352
Sodium Sulphite (sodium thiosulfate)	174,021	.00011	103,471	.00006	70,550
Sulfuric Acid	117,755	.00007	75,076	.00004	42,679
Tars			40,195	.00002	-40,195
HCL AC 20 Baume			1,548,395)	.00091	-1,548,395
HCL 18X Iron			15,577)	.00001	-15,577
AQ HCL Average	2,067,209	.00133			2,067,209
Total Special Supplies	2,500,618	.00160	1,844,747	.00108	655,871

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1.5-5 Projects

The following is a listing of the projects completed, underway, or planned that impact the Key Result areas identified in 1.5-2.

These and other projects will be elaborated in the other sections and/or during the presentation.

Cell Voltage: M-83 cell conversion
 Louisiana Standard Diaphragms
 Cell washes
 Brine Heating
 Hydrogen collection

Product Losses - Chlorine:

18% Low Iron Acid from VCM
T250 performance

Product Losses - Caustic:

EV300 Demister
T301
EV304 Concentration Control
Cell washing and pulping

Wash water: - Flywash process
 T301 operation
 EV300 demister wash
 EV300 demister studies
 Sparkler filter optimization

Steam utilization:

R601 steam ejector elimination
EV300 studies
Surface condenser U-values
Steam pressure reduction

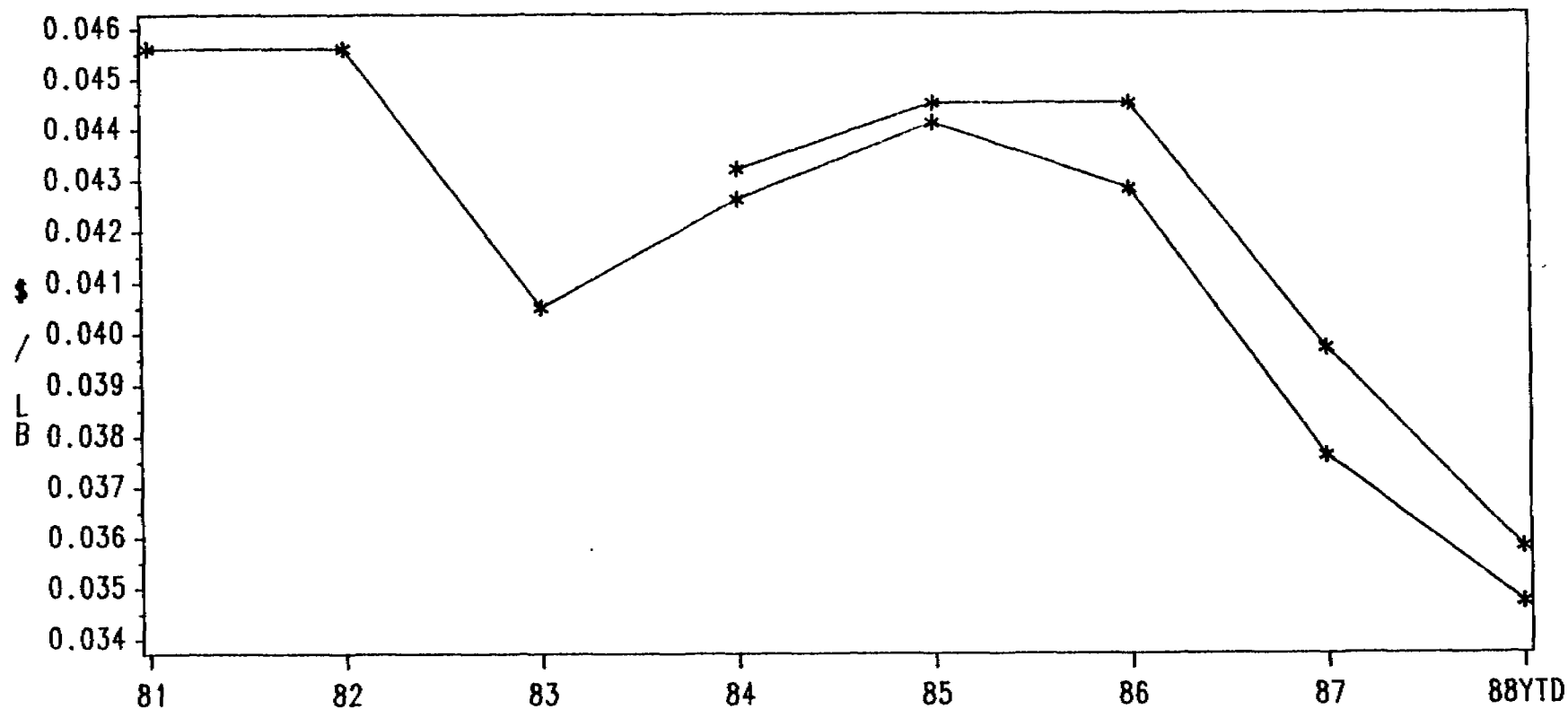
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CHLOR-ALKALI II

COST OF MANUFACTURING

\$ CAN/LB CHLORINE AND CAUSTIC



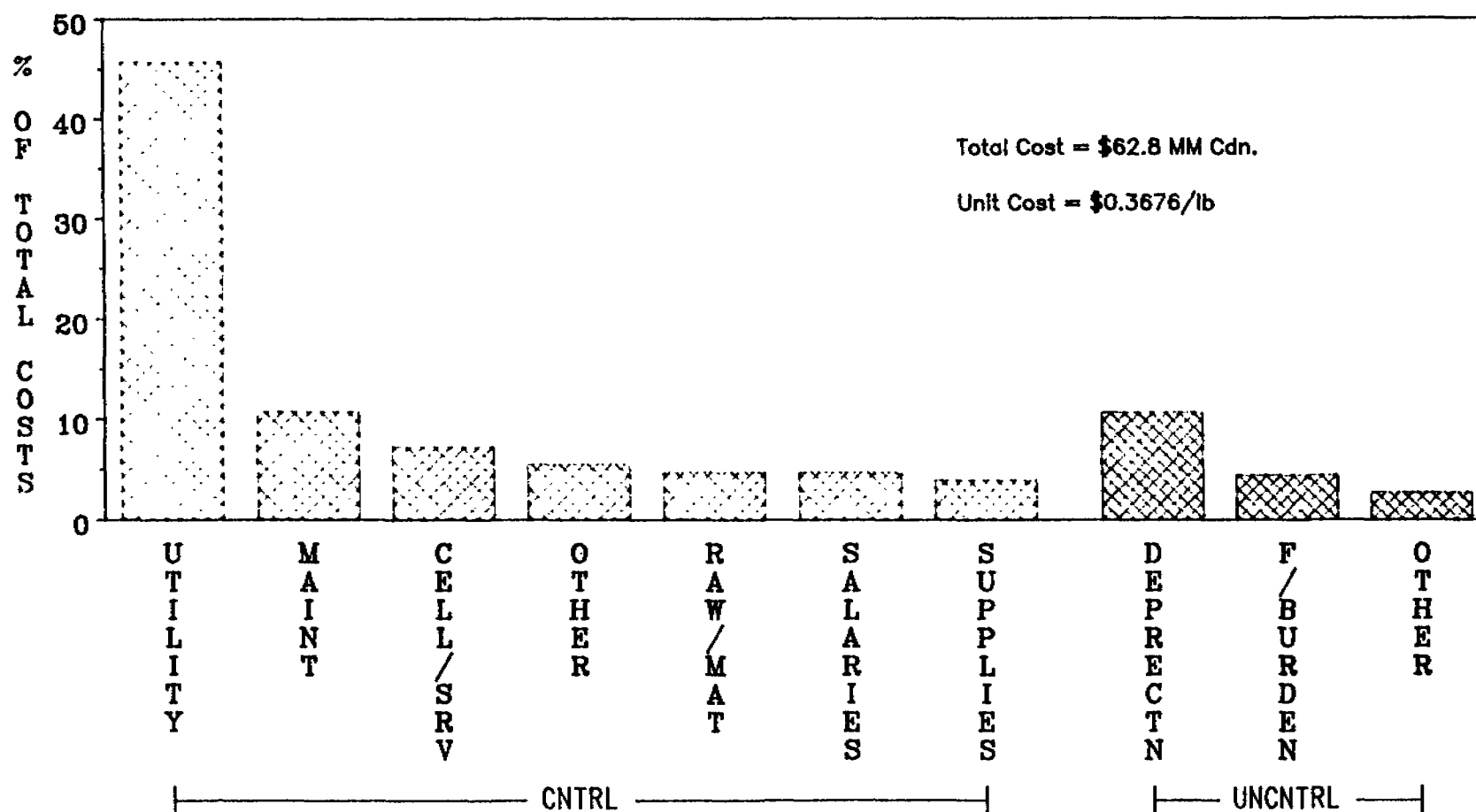
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LEGEND *-*-* Actual Cost *-*-* 'Capacity' Cost

CHLOR-ALKALI II

MANUFACTURING COST BREAKDOWN

1987



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