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SECTION 2B

CELL AND HYDROGEN AREA

2.0 PROCESS STEPS FOR THE CELL AREA

2.1 Detailed chemistry

2.1-1 List of chemicals

Brine
Salt slurry
Burner grade HCL
Cell effluent
Wet chlorine
Hydrogen
Sodium sulphite
Ethylene glycol
Raw water
Carbon dioxide
Chlorinated water

2.1-2a Raw materials and products

Raw materials chemistry

BRINE

NaCl	
NaOH	
Ca	
Mg	

HYDROCHLORIC ACID

HCl	- 18 %
Fe	- < 5 ppm
Ca	- < 2 ppm

SALT SLURRY

NaCl	- 30 % settled volume

Product chemistry

CELL EFFLUENT

NaOH	- 120 gpl
NaCl	- 130 - 140 gpl
$NaClO_3$	- 0.1 gpl
Fe	- 0.2 ppm
Na_2SO_4	- < 4 gpl
Na_2SO_3	- < 5 ppm

HYDROGEN

O_2	- < 2000 ppm
Cl_2	- undetectable

WET CHLORINE

Cl_2	- 96.0 %
H_2	- 0.2 %
O_2	- 1.5 %
N_2	- 1.0 %
CO_2	- 0.3 %

Chlorine Cell Reactions

Anode Compartment Reactions

Primary reaction:

(1) $2\ Cl^{(-)} \longrightarrow Cl_2 + 2e$ electrolytic

Competing side reactions:

(2) $H_2O \longrightarrow O + 2\ H^{(+)} + 2e$ electrolytic

(3) $O + O \longrightarrow O_2(g)$ chemical

(4) $Cl_2 + H_2O \longleftrightarrow H^{(+)} + Cl^{(-)} + HOCl$ chemical

Cathode compartment reactions

Primary reaction:

(5) $2H_2O + 2e \longrightarrow 2OH^{(-)} + H_2(g)$ electrolytic

Side reaction:

(6) $2HOCl + OCl^{(-)} \longleftrightarrow ClO_3^{(-)} + 2Cl^{(-)} + 2H^{(+)}$ chemical

CELL CHEMISTRY

How to win

Winning can be measured in the following ways:

1) > 98% chlorine yield based on power input.

   That is > 98% chlorine current efficiency
   > 96% caustic current efficiency

2) Extending the series life beyond the expected 4-5 years. This delays the expensive cell capital investment and returns the most money on the existing series. The trick to this is to be able to increase the life without a decrease in the current efficiencies.

The key to success lies in the ability to control reactions (2) and (4).

(2) $H_2O \longrightarrow O + 2\,H^{+} + 2e$

(4) $Cl_2 + H_2O \longleftrightarrow H^{+} + Cl^{-} + HOCl$

Reaction (2) is largely limited by its overvoltage at the anode versus that of chlorine evolution. It is influenced somewhat by the molar ion concentration in the anolyte next to the anode. In this way, optimum control of the anolyte resaturation helps favour chlorine evolution.

Reaction (4) is promoted by high pH and low chloride ion concentration. High pH arises from back migration of OH^{-} ions through the diaphragm to accommodate charge transport to the anode. The amount of OH^{-} ions that backmigrates depends on the current density, hydraulic head differential in the cell, and the molar ratio of OH^{-} and Cl^{-} in the catholyte. Controlling cell effluent strength to strike a balance between evaporative energy to produce 50% NaOH and the ability to control anolyte pH yields optimum success.

In any case the OH^{-} ions have to be neutralized by pH controlling the cells with HCl according to the following reaction:

$$OH^{-} + H^{+} + Cl^{-} \longrightarrow H_2O + Cl^{-}$$

The lower limit for pH control is set by potential damage to the magnesium silicate (asbestos) diaphragm. Experience has indicated that this value is around pH 1.5.

Equation (2) can be suppressed by the presence of hydrogen ions. Equation (4) can be driven to the left by increasing the hydrogen and chloride ion concentrations. This indicates that good efforts to maintain a low pH in the cells will produce the desired results by suppression of hypochlorous production.

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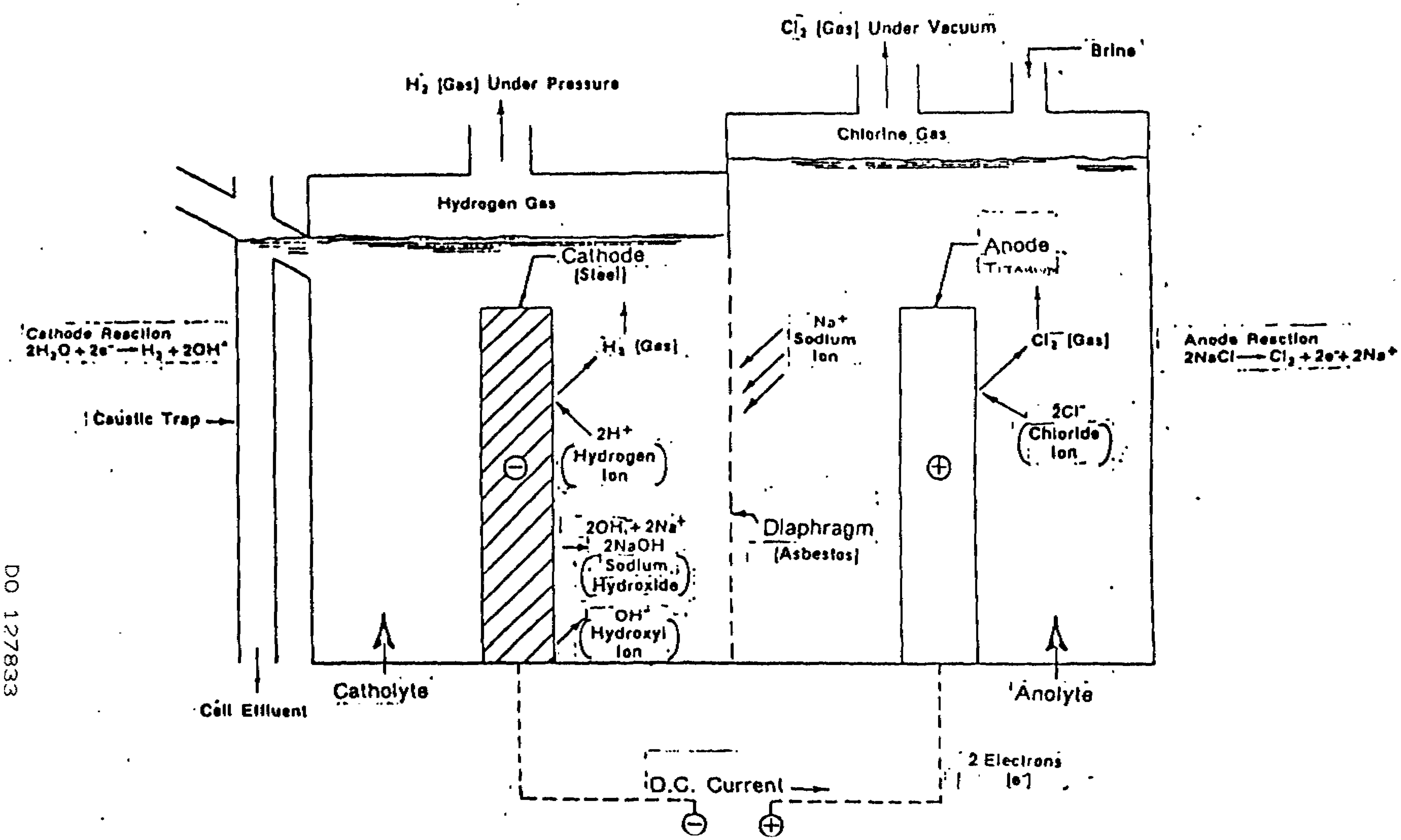
To increase the chloride concentration in the cell good control over the resaturation system is required. The only limitation here is that the saturation limit must not be exceeded lest a potentially serious situation arise from locally boiling and arcing a cell. This limit varies somewhat with cell effluent strength but can be usually fixed near 310 to 320 gpl NaCl in the anolyte. If reactions (2) and (4) can be suppressed we will be making efficient use of our electricity.

With the conversion to M83 (metal anode) cells from the M82 (graphite anode) cells, the life of a series is no longer set by the physical deterioration of the anode. Some M83 cells have been on line for more then 5 years. This brings up the question of when do we rebuild. There is a definite benefit financially to delay the capital expenditure required for a rebuild. However it has also been shown that cell efficiencies drop off with age. The normal procedures for treating and washing a series will return some of the efficiency but not all. The trend is still downwards. The drop in efficiencies are probably related to wear and tear on the diaphragm. With time the diaphragm may be getting thinner and "looser", leading to increased backmigration of the $OH(-)$ ions. Ions that have to be neutralized with HCl. This is represented by a drop in the caustic current efficiency for that series. The present challenges in the cell area is to define at what point the economic benefits of delaying capital costs are overshadowed by efficiency penalties, and to find a way to extend the life of the series while maintaining high cell efficiencies.

SIMPLIFIED DIAPHRAGM CHLORINE CELL



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Thermodynamic Calculations

Anode Side

Primary Reaction

1. $2Cl^- \longrightarrow Cl_2 + 2e^-$

$2(-39.952) \quad 0 \qquad\qquad \Delta H^o_f$

$H^o_r = +79.904$ Kcal or $\frac{79.9 \text{ Kcal}}{2 \text{ gm}}$ equiv.wt.

Competing Reactions

2. $2H_2O_{(l)} \longrightarrow O_{2(g)} + 4H^+ + 4e$

$2(-68.315) \quad 0 \quad 0 \qquad\qquad \Delta H^o_f$

$H^o_r = +136.6$ Kcal or $\frac{68.3 \text{ Kcal}}{2 \text{ gm}}$ equiv.wt.

3. $Cl_{2(g)} + H_2O_{(l)} \longrightarrow HOCl + H^+ + Cl^-$

$0 \quad (-68.315) \quad -28.9 \quad 0 \quad -39.952 \qquad \Delta H^o_f$

$H^o_r = -0.537$ Kcal

4. $6CLO^- + 3H_2O \longrightarrow 2ClO_3^- + 4Cl^- + 6H^+ + {}^3/_2O_2 + 6e^-$

$6(-25.6) \quad 3(-68.315) \quad 2(-23.7) \quad 4(-39.952) \quad 0 \quad 0 \qquad \Delta H^o_f$

$H^o_r = +151$ Kcal

5. $HOCl \longrightarrow H^+ + OCl^-$

$-28.9 \quad 0 \quad -25.6 \qquad\qquad \Delta H^o_f$

$H^o_r = +3.3$ Kcal

Cathode Reaction

Primary Reaction

6. $2H_2O \longrightarrow 2OH^- + H_2 + 2e$

$2(-68.315) \quad 2(-54.97) \quad 0 \qquad \Delta H_f^o$

$H_r^o = +26.69$ Kcal

Competing Side Reactions

7. $3HOCl + 3OH^- \longrightarrow 3H_2O + ClO_3^- + 2Cl^-$

$3(-28.9) \quad 3(-54.97) \quad 3(-68.315) \quad -23.7 \quad 2(-39.952) \qquad \Delta H_f^o$

$H_r^o = -56.939$ Kcal

8. $OCl^- + 2HOCl \longrightarrow 2H^+ + CLO_3^- + 2Cl^-$

$-25.6 \quad -2(28.9) \quad 0 \quad -23.7 \quad -2(39.952) \qquad \Delta H_f^o$

$H_r^o + -20.2$ Kcal

9. $H_2 + Cl_2 \longrightarrow 2HCl$

$0 \quad 0 \quad 2(-22.06) \qquad \Delta H_f^o$

$H_r^o = -44.12$ Kcal

10. $2H_2 + O_2 \longrightarrow 2H_2O$

$0 \quad 0 \quad 2(-59.56) \qquad \Delta H_f^o$

$H_r^o + -119.2$ Kcal

Free Energy Calculations

Primary Reaction

1. $2Cl^- \rightarrow Cl_2 + 2e$

   2(-31.372   0 ΔG^o_f

   dG System = +62.744 Kcal

2. $2H_2O_{(1)} \rightarrow O_2 + 4H^+ + 4e^-$

   2(56.687)   0   0 ΔG^o_f

   dG System = 113.37 Kcal

3. $6ClO^- + 3H_2O \rightarrow 2ClO_3^- + 4Cl^- + 6H^+ + {}^3/{}_2O_2 + 6e^-$

   6(-8.8)   3(-56.687)   2(-0.8)   4(-31.372)   0   0 ΔG^o_f

   dG System = 95.77 Kcal

4. $Cl_{2(g)} + H_2O \rightarrow HOCl + H^+ + Cl^-$

   0   -56.687   -19.1   -31.372 ΔG^o_f

   dG System = 6.215 Kcal   Would have to be checked @ actual conc. & temp.

5. $HOCl \rightarrow H^+ + OCl^-$

   -19.1   0   -8.8 ΔG^o_f

   dG System = 10.3 Kcal   Would have to be checked @ actual conc. & temp.

6. $2e + 2H_2O \rightarrow H_2 + 2OH^-$

   2(-56.687)   0   2(-37.594 ΔG^o_f

   dG System = 38.186

7. $OCl^- + 2HOCl \longrightarrow 2H^+ + ClO_3^- + 2Cl^-$

$-8.8 \quad 2(-19.1) \qquad\qquad -0.8 \quad 2(-31.372) \qquad \Delta G_f^o$

dG System = <u>-16.544 Kcal</u>

8. $H_2 + Cl_2 \longrightarrow 2HCl$

$0 \quad 0 \quad 2(-22.78) \qquad \Delta G_f^o$

dG System = <u>-45.56 Kcal</u>

9. $2H_2 + O_2 \longrightarrow 2H_2O$

$0 \quad 0 \quad 2(-54.63) \qquad \Delta G_f^o$

dG System = <u>-109.26 Kcal</u>

Overall Reaction

Thermodynamic ΔH

$$2Cl^- + 2H_2O \longrightarrow Cl_2 + H_2 + 2OH^-$$

2(-39.952)	2(-68.315)	0	0	2(-54.97)	ΔH_f^o

H_r^o = +106.59 $\frac{Kcal}{g\ mole}$

Gibbs Free Energy
Table 9-2 Lange's Handbook Chemistry 11th. Ed.

$$2Cl^- + 2H_2O \quad Cl_2 + H_2 + 2OH^-$$

2(-31.372)	2(-56.687	0	0	2(-37.594)	ΔG_f^o

G_f^o = 100.93 Kcal

$2Cl^-$	$Cl_2 + 2e$	E = -1.359
$2H_2O$	$H_2 + 2OH^- + 2e$	E = -0.828
		-2.187

ΔG^o = nFE (eg 7.1) Daniels & Alberty. Pg.247

= -2(23,060 $\frac{Cal}{Volt}$) (2.187v) = 100.905 Kcal

Gibbs free energy from

dG System = ΔG_f^o products - ΔG_f^o Reactants

$2Cl^- \quad Cl_2 + 2e$

$2e + 2H_2O \quad H_2 + 2OH^-$

dG System = 62.744 + 38.186 = 100.830 Kcal

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2.1-2b By products and impurities.

IMPURITY	SOURCE	EFFECT
NaOH	brine	Increases acid consumption
Na2CO3		Increases acid consumption and produces CO2 when neutralized.
NaOCl		Corrosive to carbon steel.
Fe		Produces H2 in the anolyte compartment.
Ca		Plugs the diaphragm resulting in a wash.
Mg		Plugs the diaphragm resulting in a wash.
Trace metals		Poison the anode reducing efficiency.
Fe	HCl	Produces H2 in the anolyte compartment.
Ca		Leads to diaphragm plugging.
NaOH	Salt slurry	Increases acid consumption in the cells.
NaOCl	Cell effluent	Corrosive compound.
O2	Hydrogen	Reactive Chemical potential.
Cl2		Environmental concern.
H2	Chlorine	Reactive chemical potential.

2.2 Basis for Design

Equipment	Design capabilities	Actual
Rectifiers	70 ka 930 v each	68 ka 850 v
M83 cells	2.80 v @ 60 ka @ 77 Deg C.	v @ 60 ka
	98.7 % Cl2 eff.	98.5
	95.0 % CE eff.	95.0
	0.6 % O2 in Cl2	
	0.05 % H2 in Cl2	0.2
	1.01 ACKWH/LB Cl2	1.06
V101	1,000,000 lbs/hr brine outlet pH 1.9	1,100,000 lbs/hr brine outlet pH 1.9
P101	1,100,000 lbs/hr Cell eff.	1,220,000 lbs/hr Cell eff
EJ140	16,000 lbs/hr of H2/H20 at 80 Deg. C. 4 cm backpressure on the cells	25,000 lbs/hr H2/H20 at 75 Deg. C. 7 cm backpressure on the cells
T140	Scrub 4,700 lbs/hr H2/H20 at 35 Deg. C.	6,000 lbs/hr H2/H20 at 35 Deg. C
E140	Shell & tube 12,500,500 BTU/hr	Plate and frame 22,400,000 BTU/hr
P140	800,000 lbs.hr of H20	1,000,000 lbs/hr of H20

2.3 Process flowsheets

2.3-1 Process description and flowsheets.

Treated brine flows directly to E330 or to E331 via T250 the tailgas scrubber from the brine ponds (flowsheet 1). The brine is cross exchanged with condensate from the caustic plant to bring the temperature of the anolyte in the cells up to 80 degrees Celsius. Each series has an individual temperature controller that feeds auxiliary (cool) brine into the series to maintain the temperature of the anolyte at the desired set point.

The heated brine from the exchangers enters V101 (flowsheet 2) the head tank. Chlorinated water from V107 and from V109 also enters the head tank. 18% hydrochloric acid from V165 is added to the head tank to neutralize any caustic that may be present in the brine and to reduce the pH of the brine to 1.9. The brine then flows by gravity to the chlorine cells via a radial feeder system. Besides this system there is also an auxiliary system to supply cool brine directly to the cells from the treated brine pumps. This system is normally used on start up of the cells when the brine demand is higher due to loose diaphragms.

The chlorine cell area consists of 8 series of 72 M83 cells. The 8 series are divided up into two circuits of 4 series each. There is a rectifier for each circuit, R3 and R4. AC power is supplied to the rectifier and is converted to DC power before being fed into each circuit (flowsheets 3,4). The rectifiers are Fuji S-former outdoor type. Cooling for the rectifier is supplied by circulating deion water cross exchanged with cooling tower water. In the transformer, oil is circulated and is also cross exchanged with cooling tower water. The rectifier cubicles are cooled with air that is circulated by fans.

Each series in the cell area is coupled with the neighboring series to form a series pair. Each series pair can be isolated from its rectifier circuit by the means of Anderson switches illustrated in figures 1 and 2. Should a pair of series need to be isolated for rebuilds or washing, it can be done with minimal effect on the availability of the plant.

Salt is removed from the cell effluent in the caustic plant and forwarded to D150 (flowsheet 5). In D150 the salt is washed with brine through a sparger system to remove any caustic that has been carried over. The sparger system maintains the salt in D150 in a fluid state. The overflow from D150 flows into V413. V413 over flows into the brine ponds. The salt slurry is fed into the series through the radial feeder system to maintain anolyte salt strength at about 295 gpls. The salt concentration is maintained in D150 at about 30% settled volumes. There is enough salt in D150 to provide the cells with salt slurry for 5 hours if the caustic plant stops forwarding salt during a flywash.

HCl is added to V101 and to individual series through a header system from V165. Burner acid flows to T110 at a concentration of 34%. It is then diluted in T110 and forwarded to V165 where the concentration is maintained at 18% by a density controller (flowsheet 6). The acid is forwarded to V101 and the cells by P165. The acid is used to neutralize any caustic in the brine and caustic that has back migrated through the diaphragm.

The typical chlorine cell is illustrated in flowsheet 7. The main products from the cell are chlorine vapor, hydrogen vapor and cell effluent (10% caustic). These products leave the cells through separate collection headers. Figure 3 is general overview of the flows in and out of the cell area.

Due to impurities that are in the feed to the cells, the diaphragm plugs up with time to the point where it needs to be washed. A pair of series are washed at a time. The cells are washed with raw water that is heated in E104 (flowsheet 8). CO2 is also added to the raw water to lower the pH of the wash water.

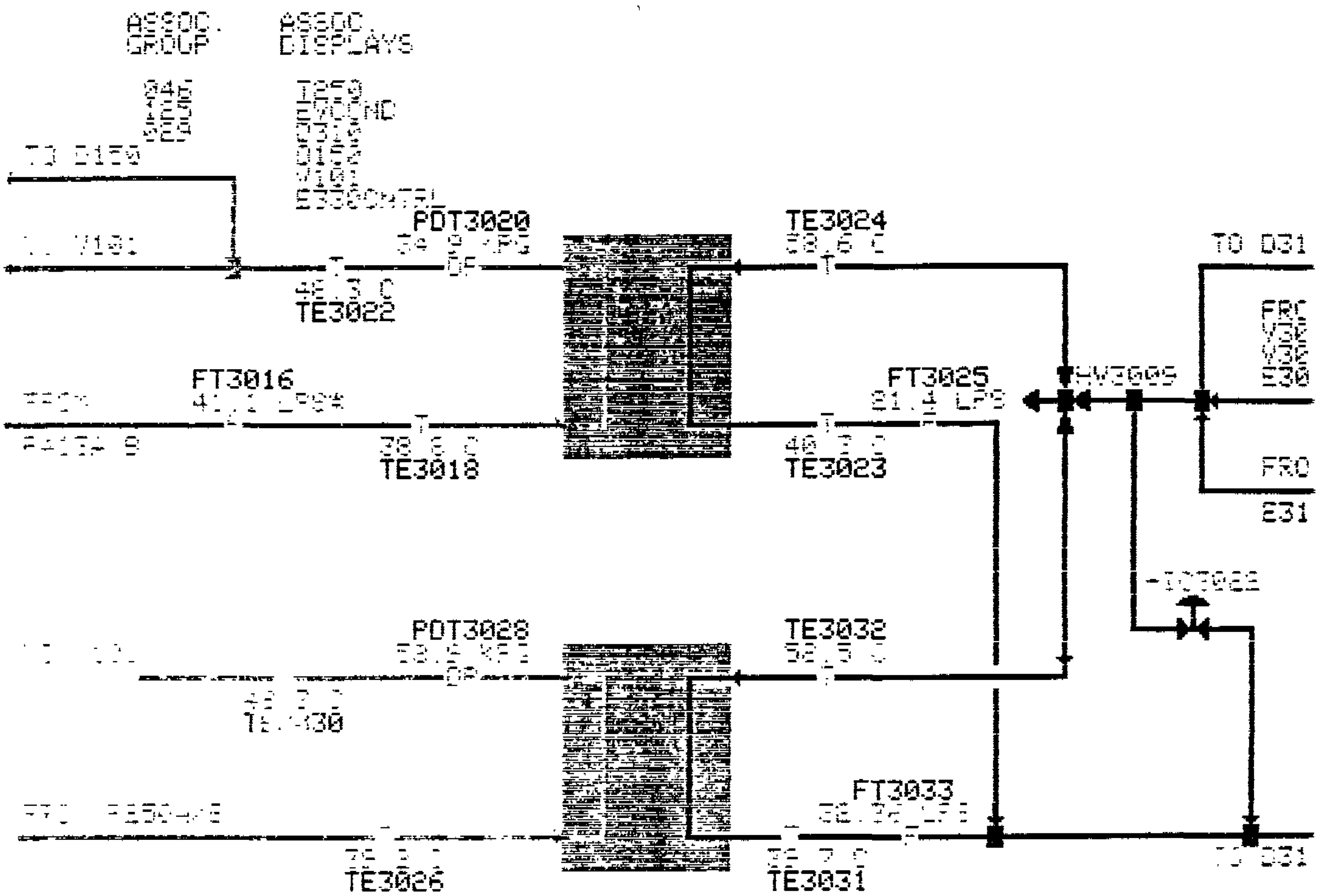
The cell effluent flows from the series and is collected in the sump S101. The cell effluent is then forwarded to the cell effluent storage tank D301 (flowsheet 9). Sulphite from D170 (flowsheet 10) is added to the sump to neutralize any hypo that may be present.

The chlorine leaves the cells under a slight vacuum and flows to the primary chlorine cooler E101. Each pair of series is coupled through a knockout pot which serves to disengage any entrained water in the chlorine.

The hydrogen leaves the cells under a slight pressure. Each pair of series connected through a knockout pot. From the pot the hydrogen can flow to either the start up header to T142 or to the primary hydrogen scrubber T140. In the event of a problem with the primary stack the flow can be diverted with a seal to T141 the primary relief stack. Each knockout pot is also equipped with a relief stack to protect each pair from excessive hydrogen backpressure.

The hydrogen system (flowsheet 11) consists of an ejector which provides cooling and a slight draft to force the hydrogen through T140. All of the hydrogen in this plant is vented except for a small portion which is compressed and forwarded to the HCl burner by K150. The motive fluid for the ejector EJ140 is recirculated through E140 by P140. E140 provides the cooling necessary to cool the hydrogen from 75 degrees to 40 degrees. Because of the cooling the H2 system has a net gain of water which overflows to the brine ponds at T140. Sulphite from D170 is added to P140 suction to neutralize any hypo that may be present. The brine is cross exchanged with condensate from the caustic plant to bring the temperature of the anolyte in the cells up to 80 degrees Celsius. Each series has an individual temperature controller that feeds auxiliary (cool) brine into the series to maintain the temperature of the anolyte at the desired set point.

BRINE HEATING



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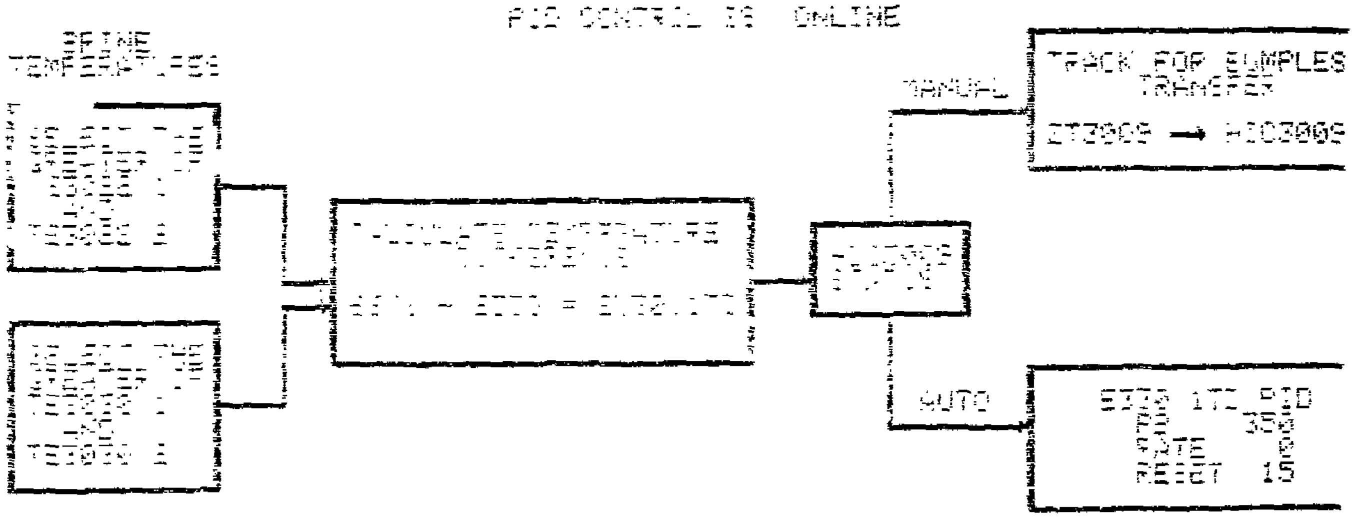
BRINE HEATING CONTROL

THIS CONTROL SYSTEM IS SET UP TO HANDLE 5 SCENARIOS:

1. HIC3009 IN AUTO, E330 AND E331 ONLINE, NO FLYWASH → PID CONTROL *ACT
2. HIC3009 IN AUTO, E330 AND E331 ONLINE, FLYWASH → OUTPUT 50%
3. HIC3009 IN AUTO, E330 ONLINE, E331 OFFLINE → OUTPUT 0%
4. HIC3009 IN AUTO, E330 OFFLINE, E331 ONLINE → OUTPUT 100%
5. HIC3009 IN MANUAL → TRACK ZT3009 FOR BUMPLESS TRANSFER

PRESENT VALVE OUTPUT IS 98.47 PCT.

PID CONTROL IS ONLINE



USE GRILLE ... FOR SETPOINT CHANGES AND TROUBLESHOOTING

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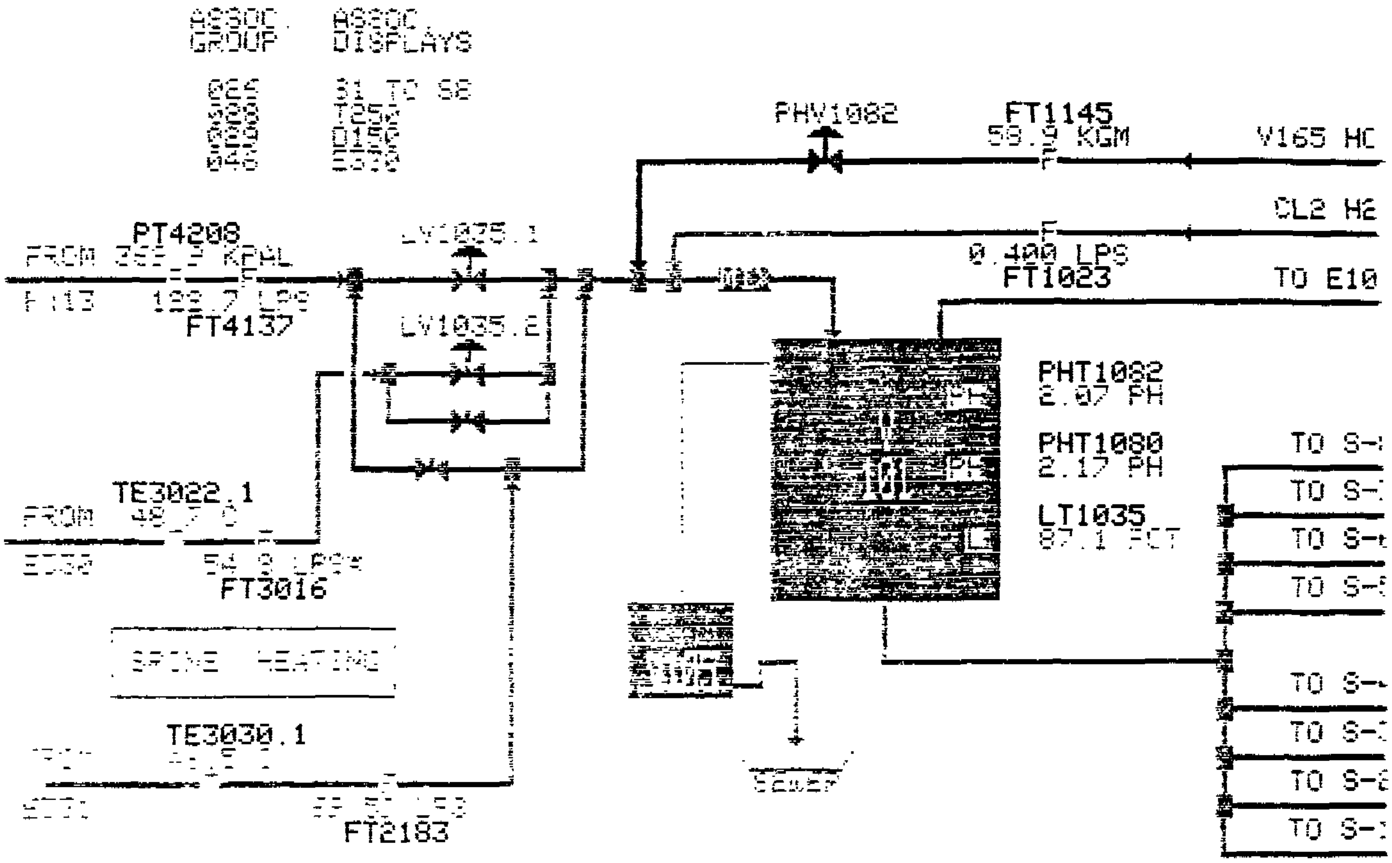
CELL FEED HEAD TANK
V101



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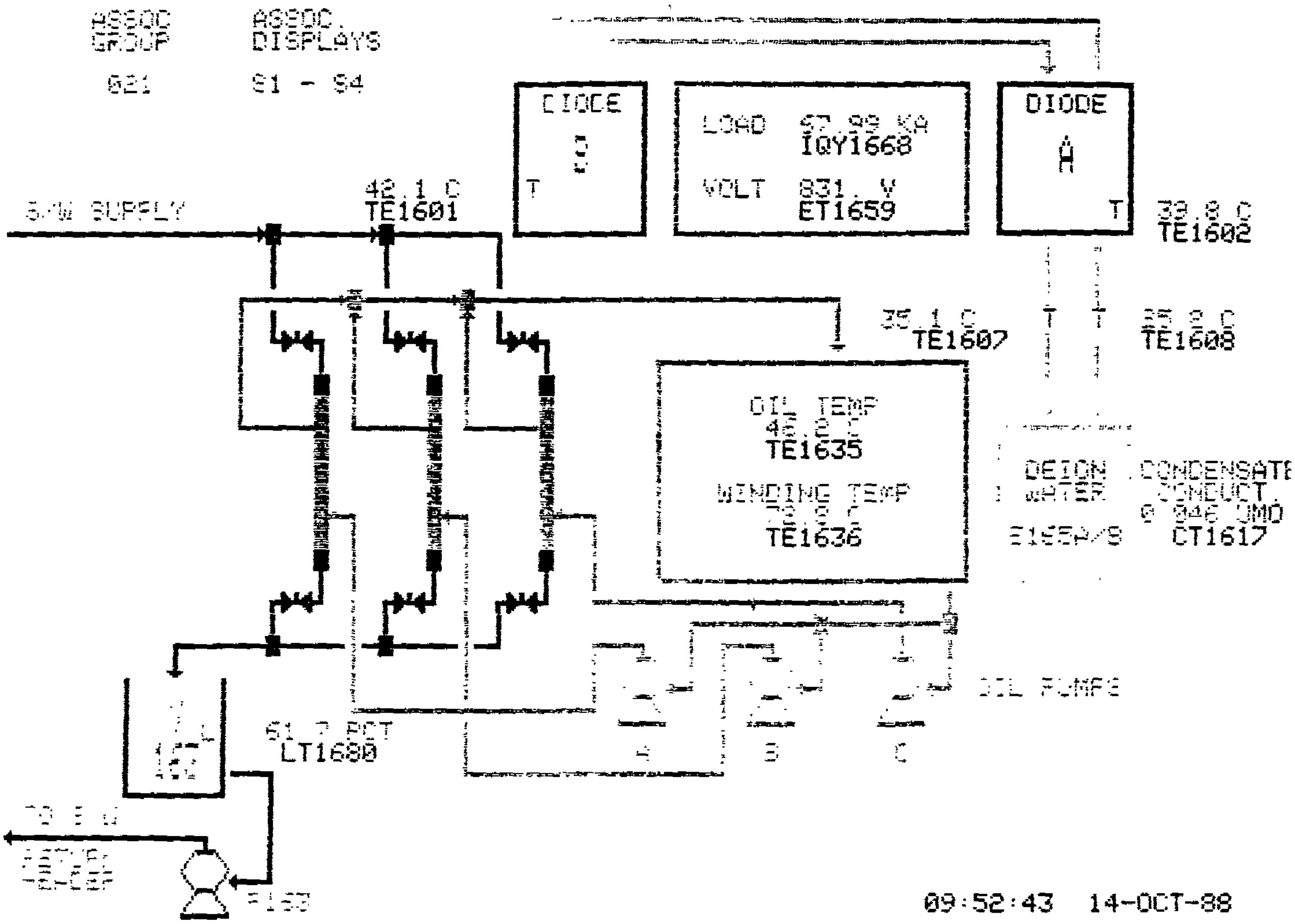
FUJI RECTIFIER R3



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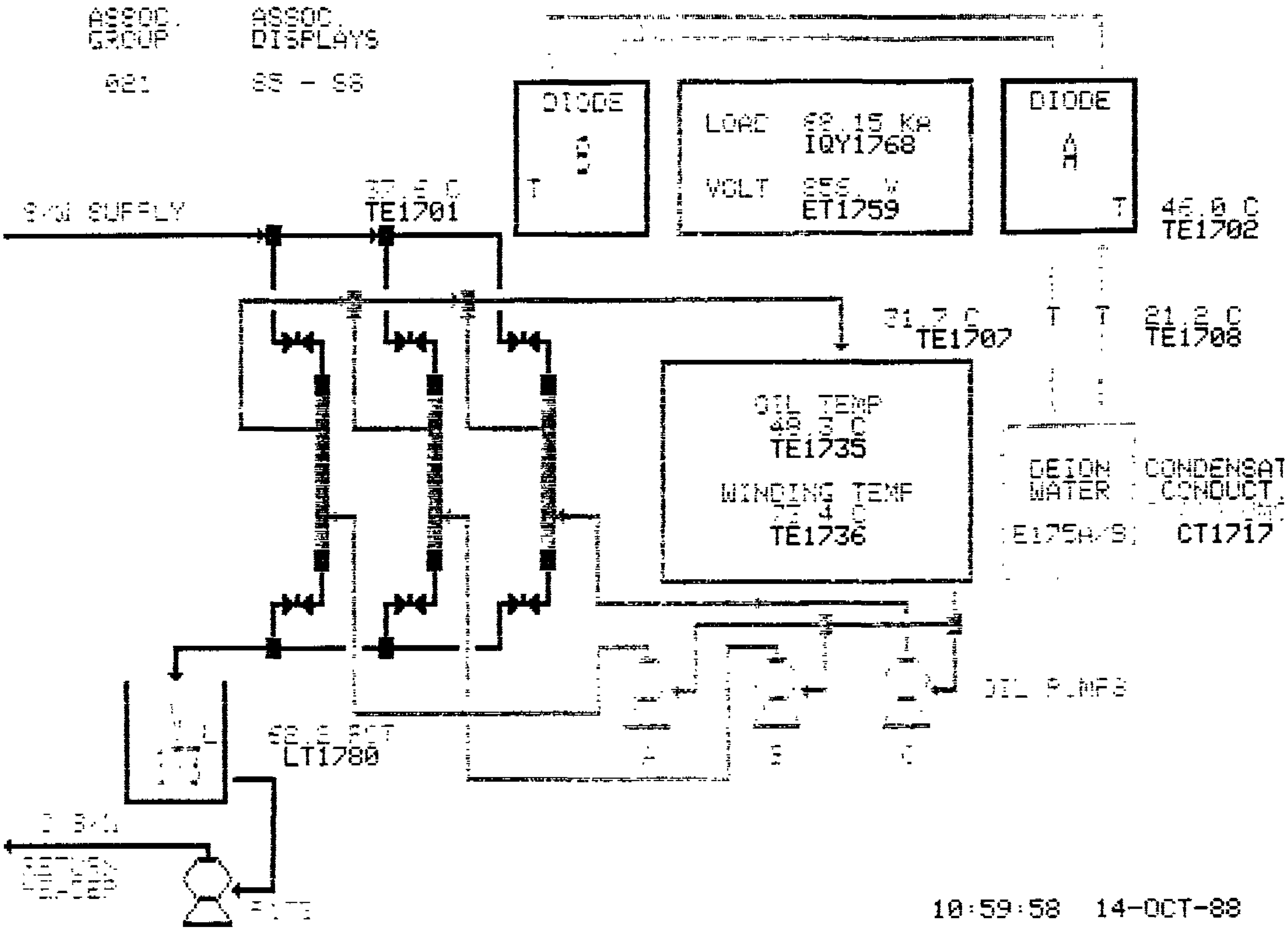
FUJI RECTIFIER R4



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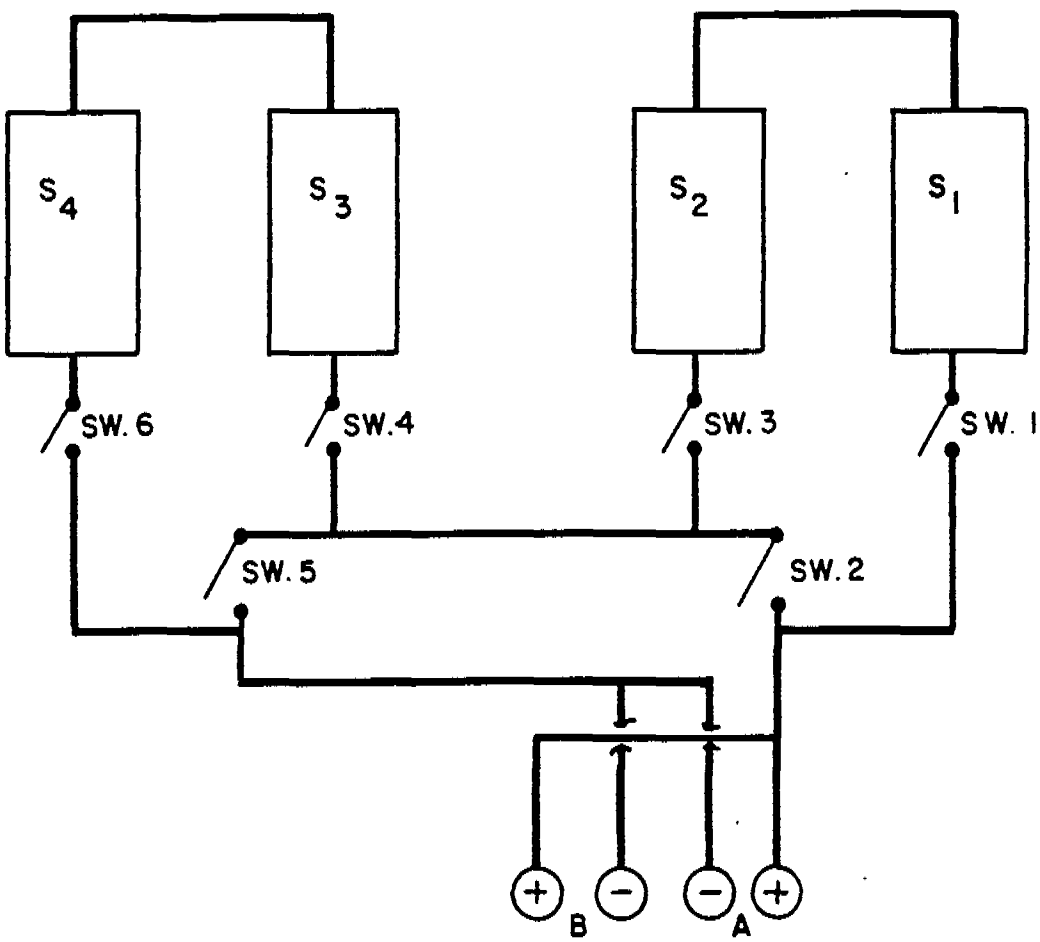
R3 CIRCUIT SWITCHING PROCEDURE

DATE: ___________



R3

(a) REASON FOR SWITCHING: ___________

(b) OPEN THE FOLLOWING SWITCHES: 1.______ 2.______ 3.______ 4.______ 5.______ 6.______

(c) CLOSE THE FOLLOWING SWITCHES 1.______ 2.______ 3.______ 4.______ 5.______ 6.______

DIAGRAM COMPLETED BY: ___________

SWITCHING COMPLETED BY: ___________

SWITCHING CHECKED BY: ___________

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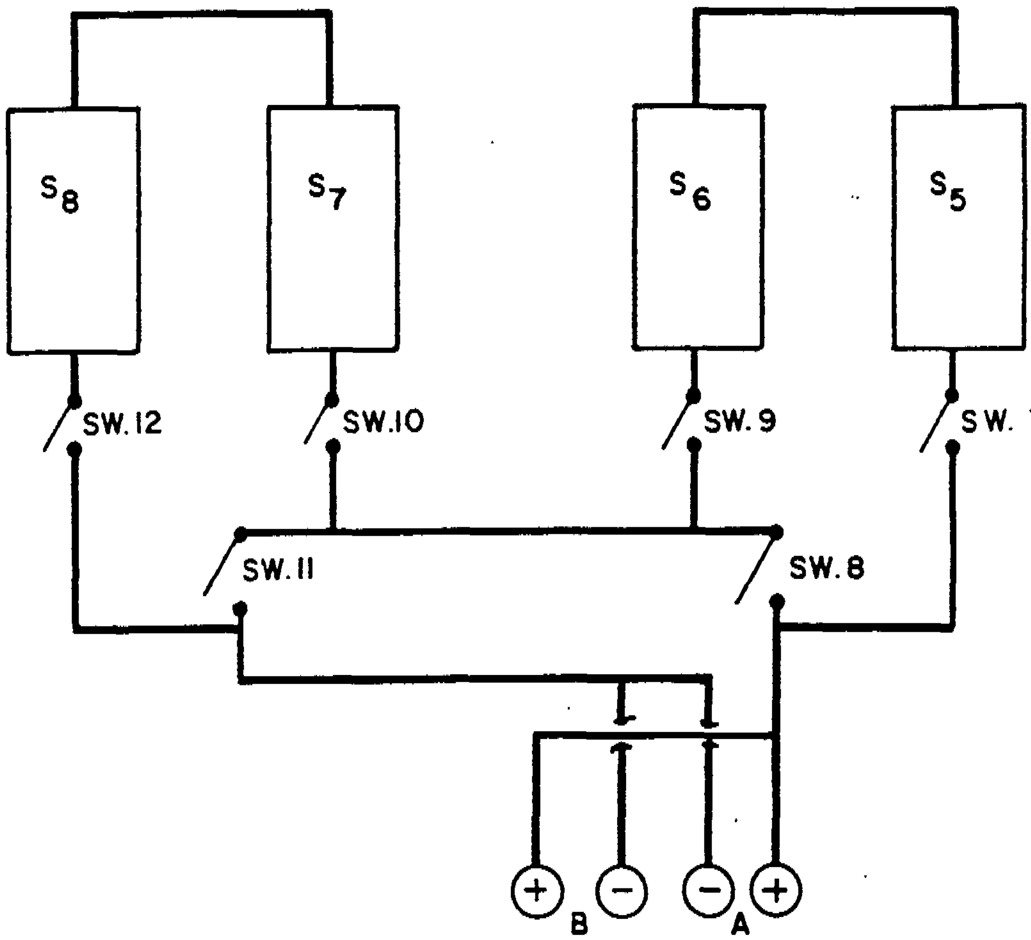
R4 CIRCUIT SWITCHING PROCEDURE

DATE: ____________



R 4

(a) REASON FOR SWITCHING: ______________________________

____

____

(b) OPEN THE FOLLOWING SWITCHES: 1. ________ 4. ________

2. ________ 5. ________

3. ________ 6. ________

(c) CLOSE THE FOLLOWING SWITCHES 1. ________ 4. ________

2. ________ 5. ________

3. ________ 6. ________

DIAGRAM COMPLETED BY: ____________

SWITCHING COMPLETED BY: ____________

SWITCHING CHECKED BY: ____________

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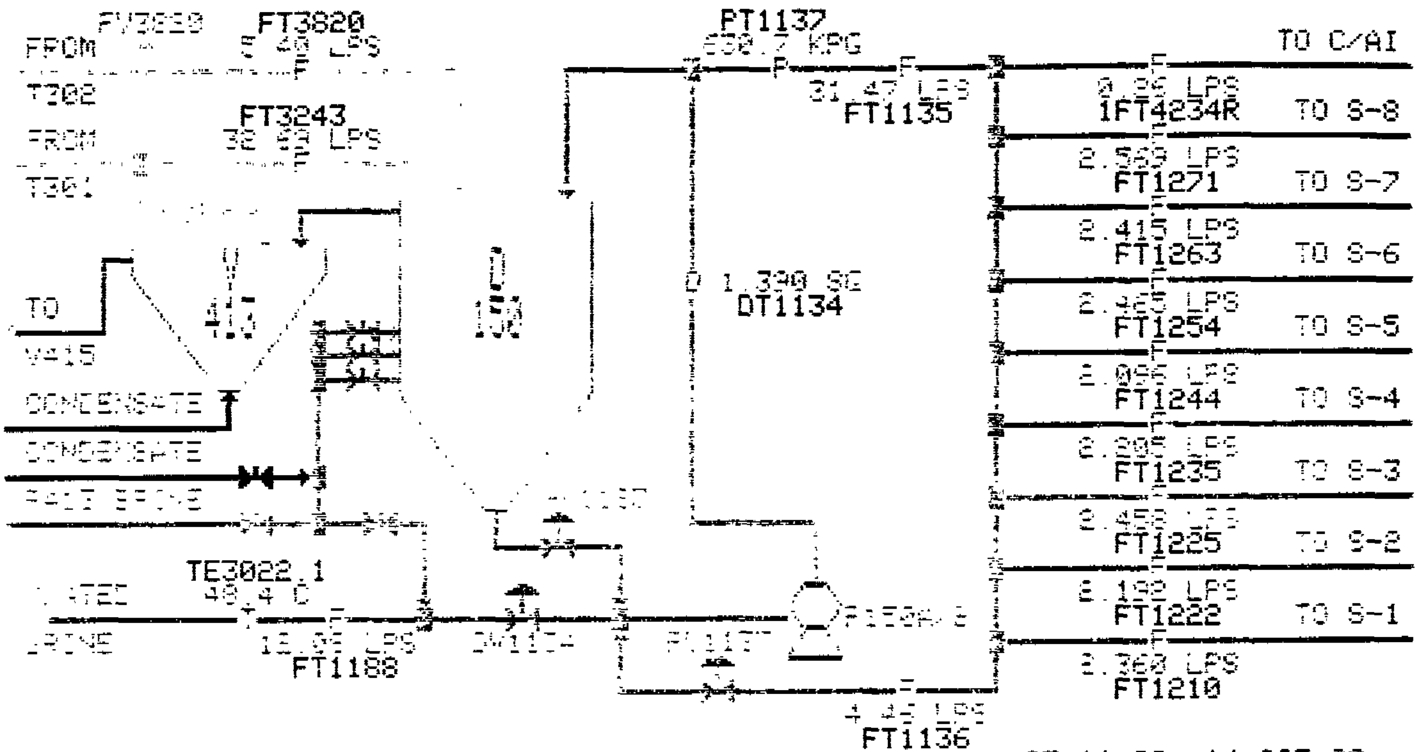
ANOLYTE RESATURATION

ASSOC. GROUP

ASSOC. DISPLAYS

V413
S1 TO S8
E330



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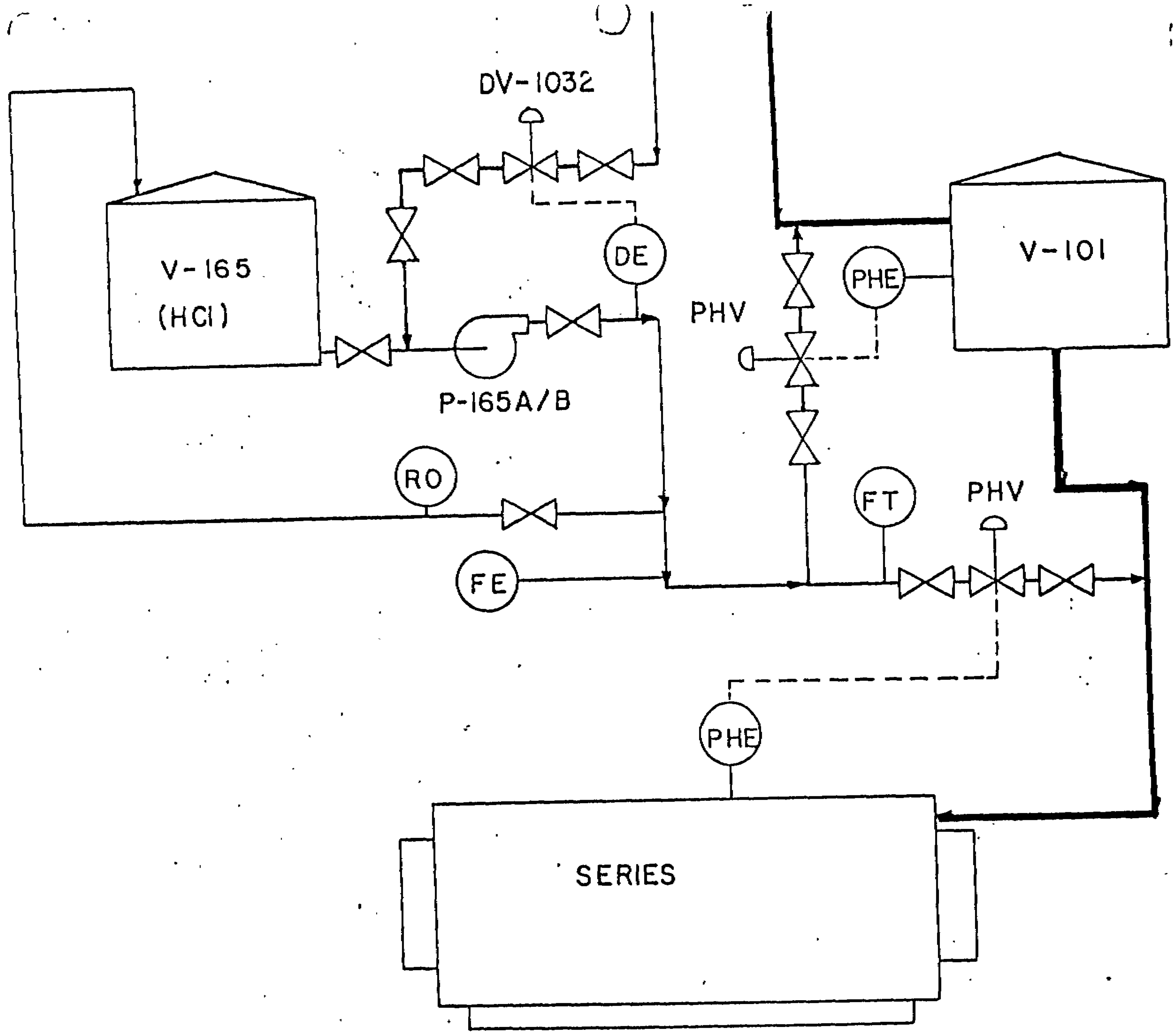

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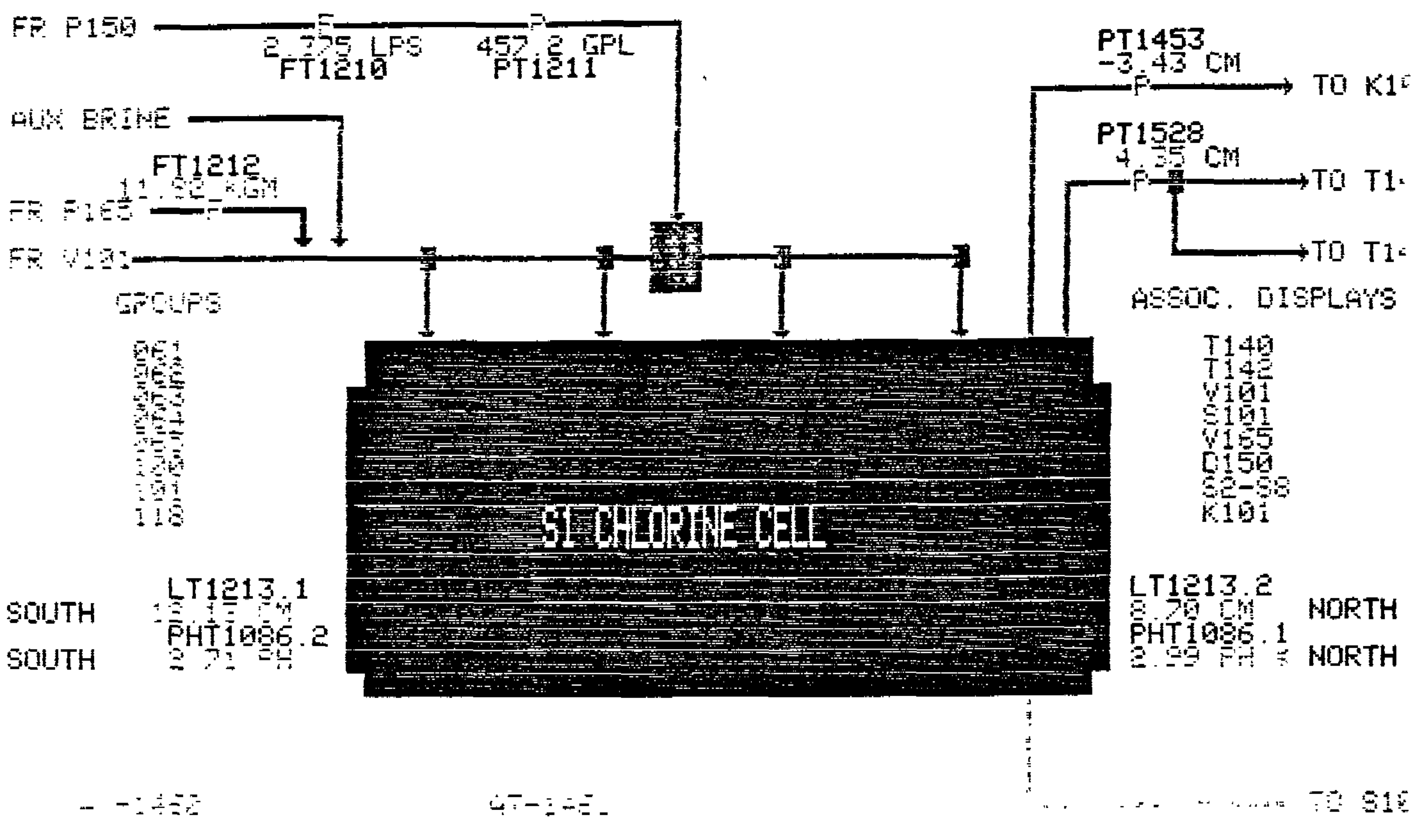

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N2S1.1	2.55 PCT	N2S1.2	2.30 PCT
CO2S1.1	0.31 PCT	CO2S1.2	0.12 PCT
CL2S1.1	97.44 PCT	CL2S1.1	97.44 PCT

R3 AMPS IQY1668	62.25 KA
S1 VOLTS ET1215	209.6 V
V/CELL ET1215S1	2.911 V

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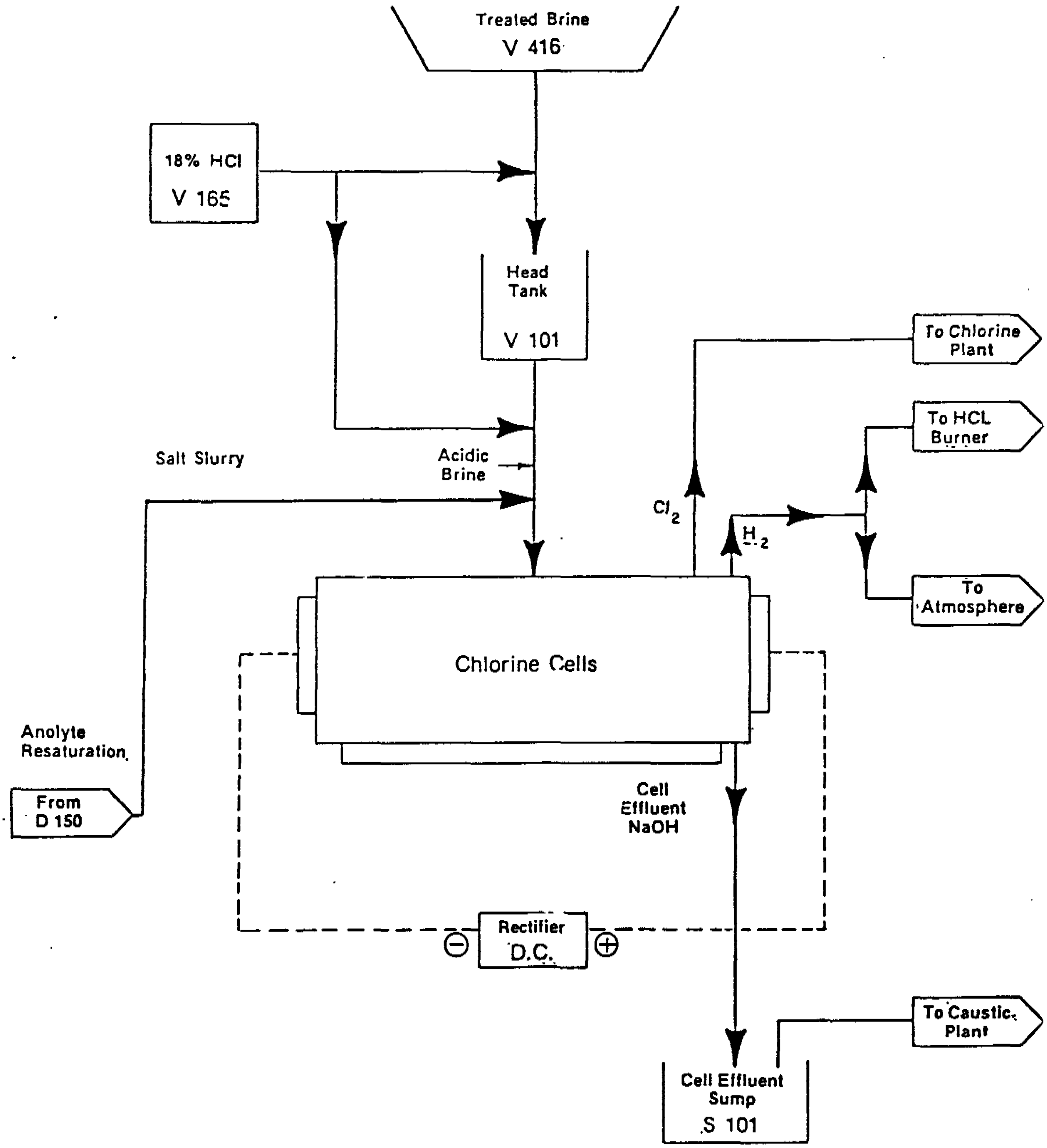
CHLOR ALKALI II CELL AREA FLOW SHEET



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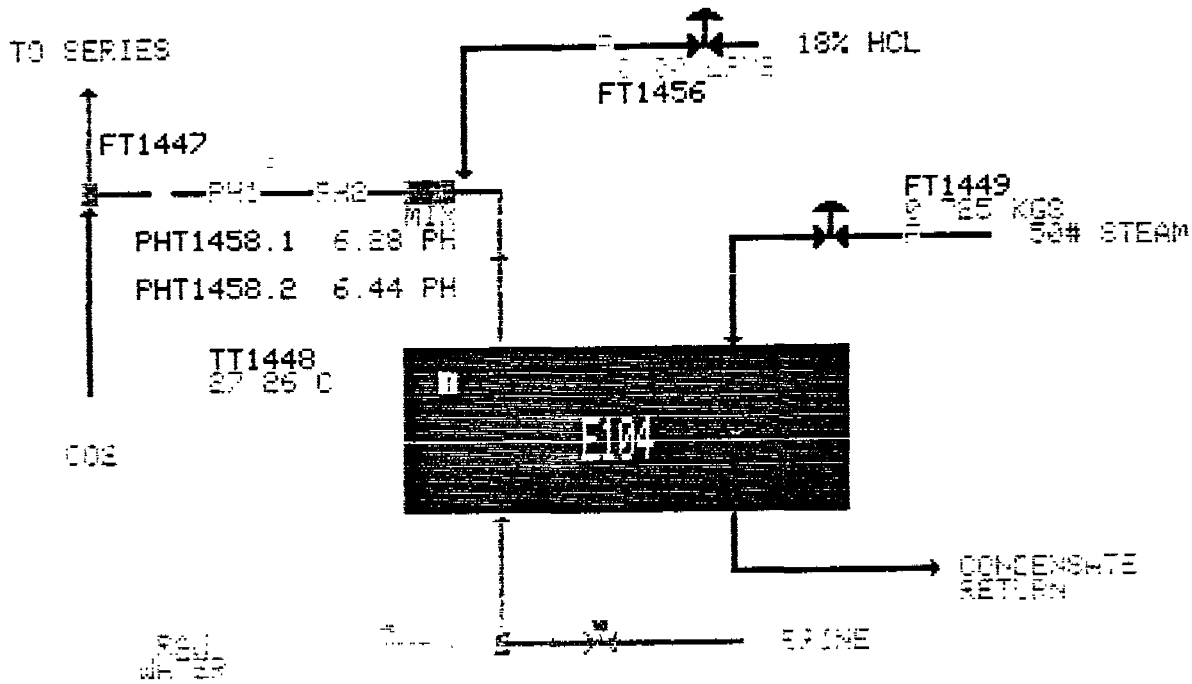

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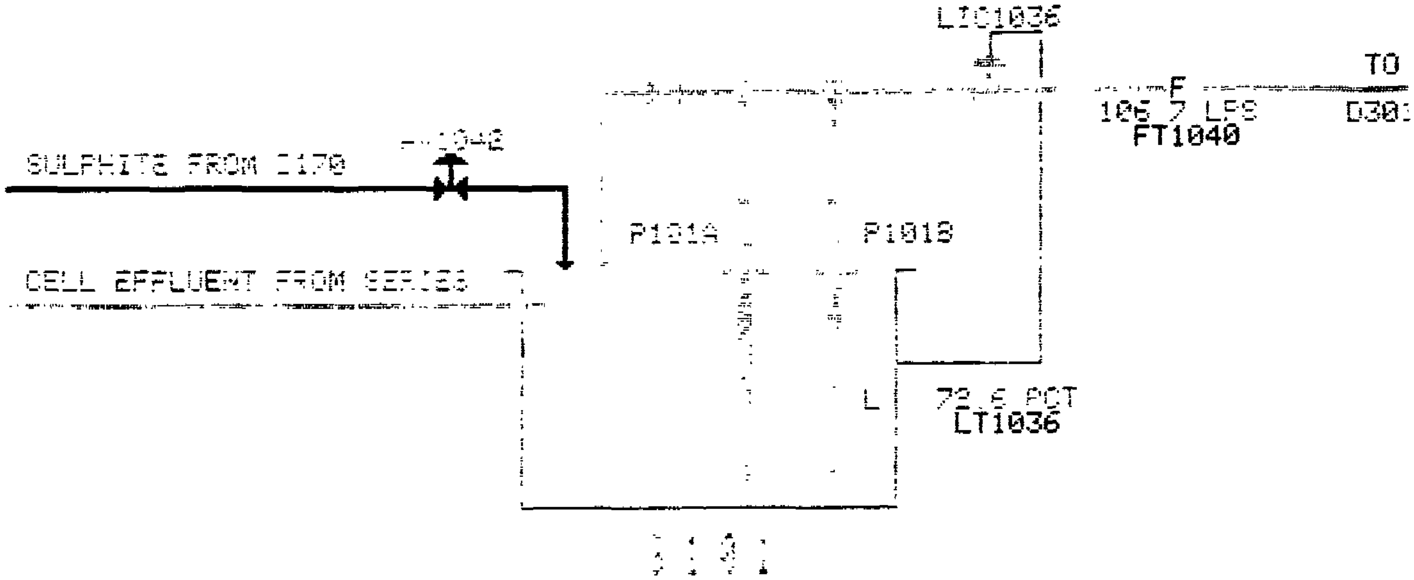
CELL EFFLUENT SUMP

ASSOC. DISPLAYS

S1 - S8
D170
D201



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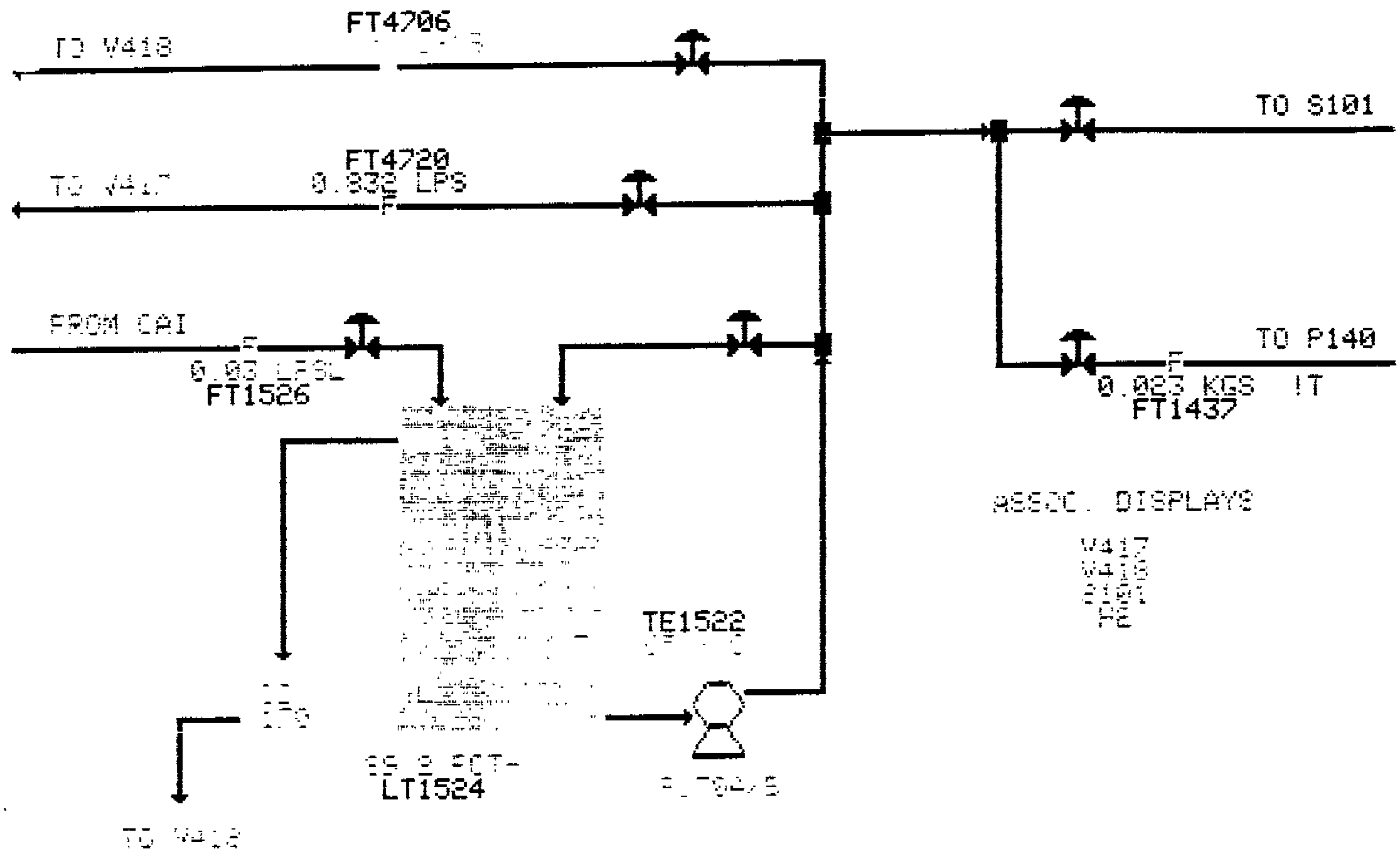

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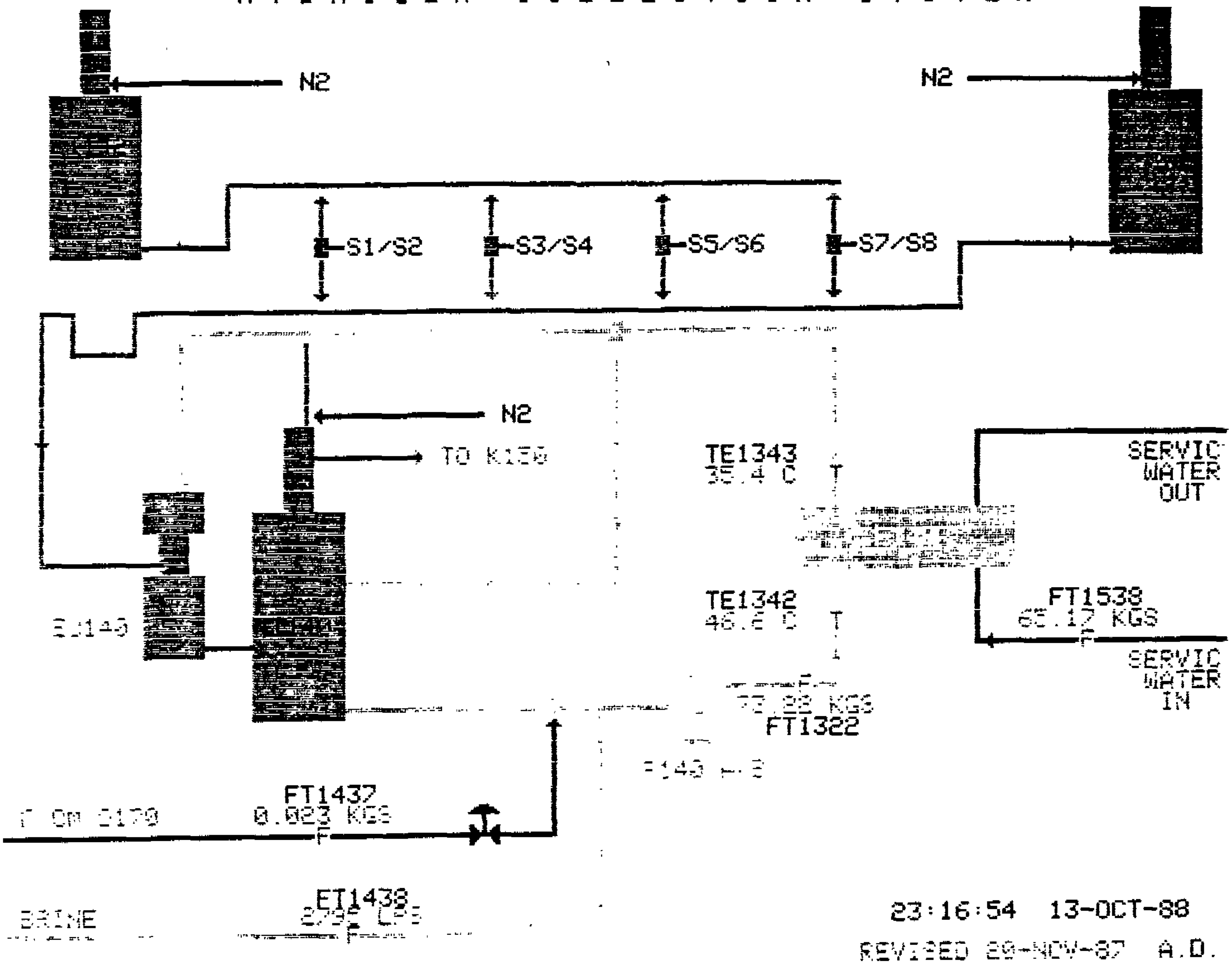
HYDROGEN COLLECTION SYSTEM



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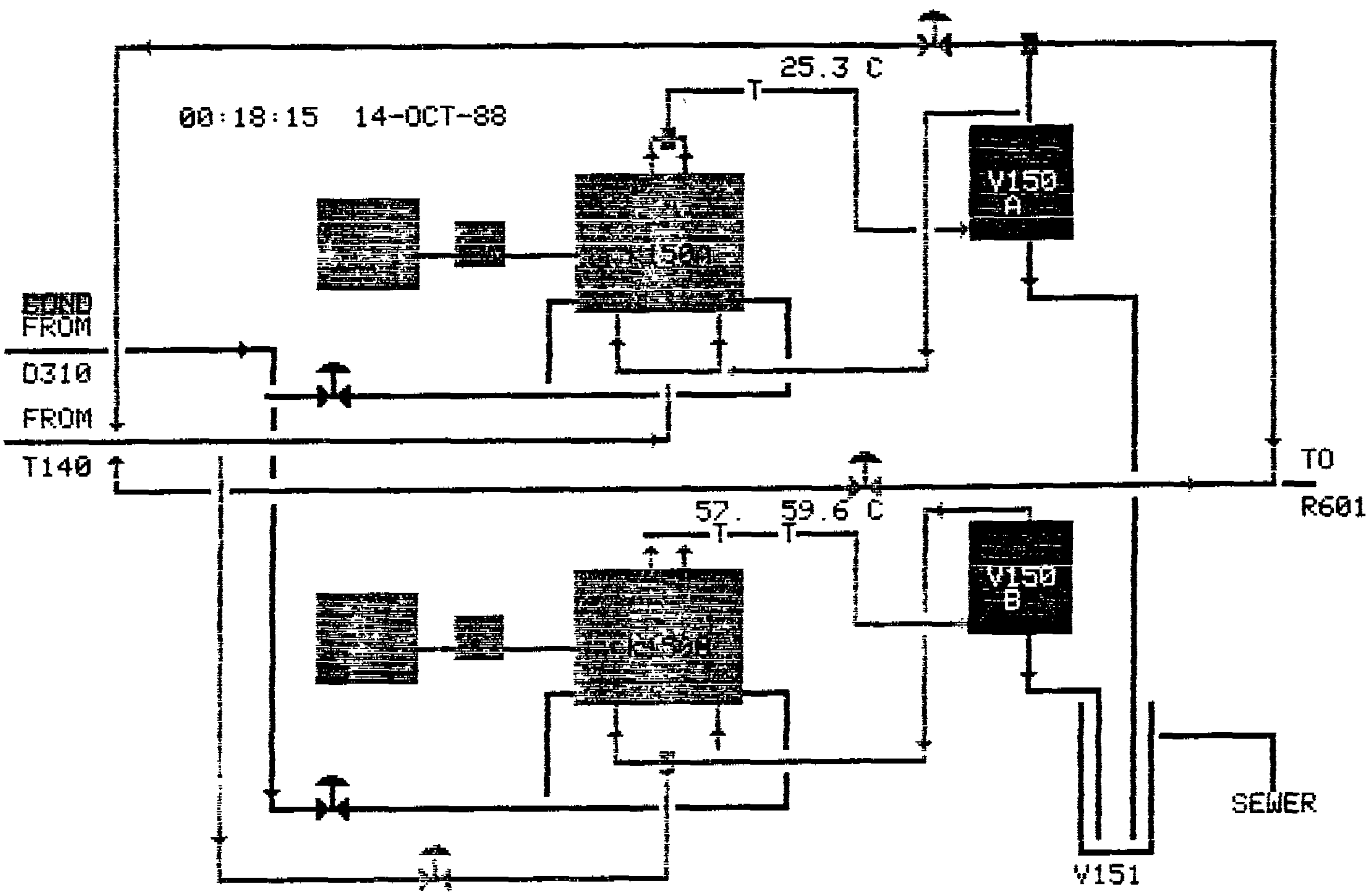

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3.0 Process control unit

3.5-2 Critical variables

Variable	Reason critical	Low	Normal	High	Control logic / protective devices
V101 level	An overflow results in a chlorine emission to the environment.	50%	80%	90%	- overflow alarms. - Dual level indicators
	Low level could starve the cells of brine hence lowering head levels to a dangerous point.				- Low level alarms on V101 - Low level alarms on cells - Automatic make up of brine through auxiliary system to cells.
V101 pH	Low pH could put the cells in danger of being acidized.	1.0	1.9	3.0	- Dual pH probes with feedback control. - Dual pH probes on cells with auto selection of the lowest reading. - Deviation alarms to warn of bad pH readings
	High pH out of V101 leads to high flow of acid to individual series leading to localized acidizing of the diaphragm.				- High flow limit on the acid to the series.
V165 HCl concentration	Concentration swings upset the pH control in V101 and the series leading to poor efficiencies and possibility of acidizing the diaphragm	15%	18%	20%	- Density control loop on V165 with condensate make up.
SERIES					
ANOLYTE Head levels	Low head level could lead to mixing of H2 with Cl2	8cm		45cm	- Two level transmitters with alarms and select - Low low level alarm. Audible in the field, visible lights

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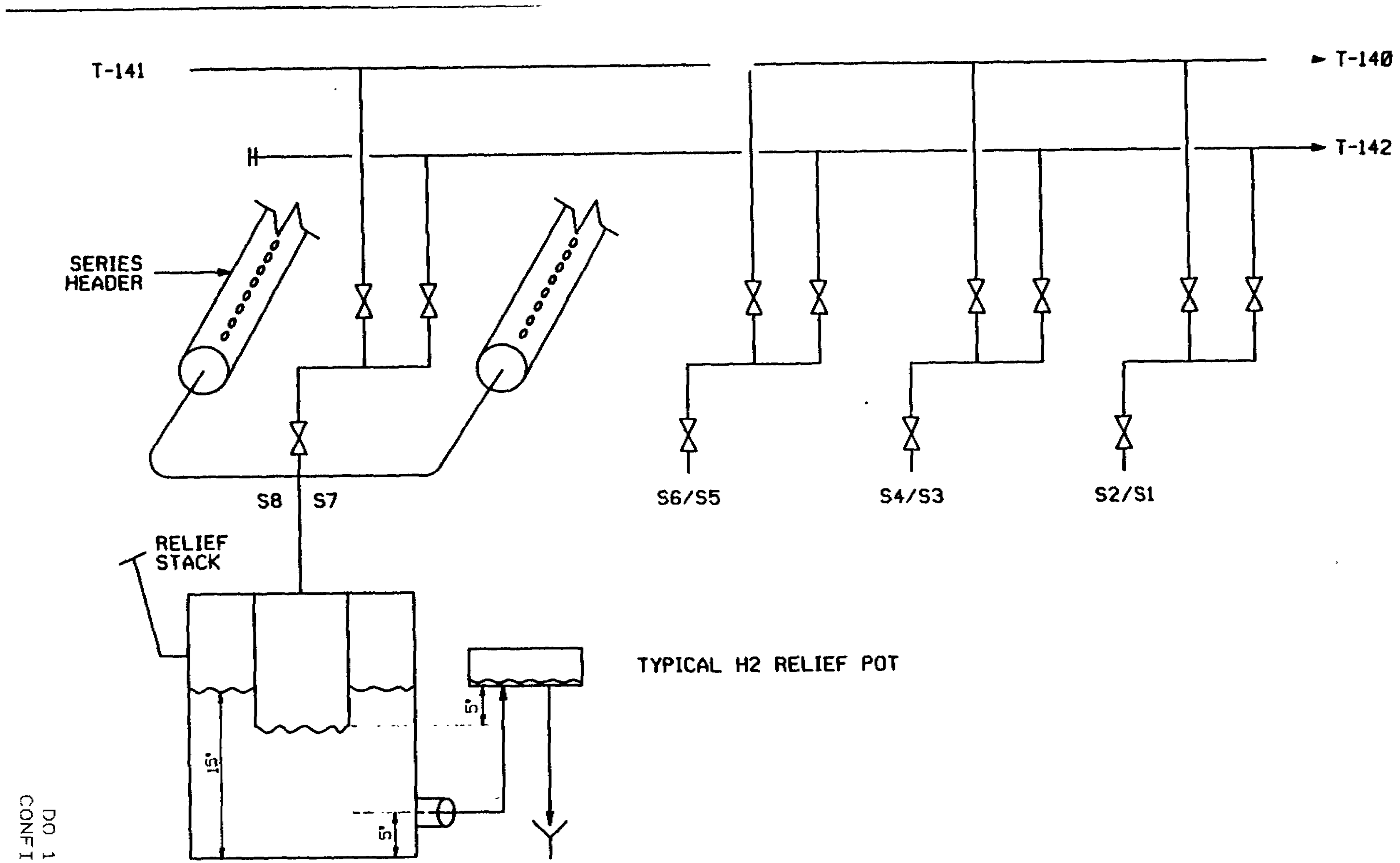
Variable	Reason critical	Low	Normal	High	Control logic / protective devices
pH	Low pH could lead to acidizing the diaphragm.	1.0	2.0	4.0	- Two pH probes in the same cell with an auto select of the lower reading - Flow limit through the control valve - Manual samples each shift to check - Weekly profiles of series to determine lowest cell for probes. - Treatment program to line out pH's. - Trip control valve close if series shut down.
salt	High salt could lead to arcing in cell. Low salts lead to inefficient operation.	270	295	315gpls	- Samples each shift - Trip slurry flow if series shut down
Temp	High temp could lead to damage to the cell body.			85 c	- Two temperature probes in the same cell with alarms - Deviation alarms - Tie in to aux brine loop to provide cooling.
CELL EFFLUENT Strength	High caustic strength in cell leads to high temperatures and inefficient cell operation.	100	120	140gpls	- Manual samples each shift and head changes to correct - Washing of cells to reduce gpls - Weekly profiles and treatment with asbestos pulp to line out individual cell strengths
Hypo	High hypo indicates a week diaphragm and inefficient cell performance.		0.0	5.0ppm	- Samples each shift - Profiles when needed and treatment - of cells containing hypo.
GENERAL Volts	Very high voltage could indicate a an arcing cell.		3.0 v	4.0 v	- Rate of change alarms on the voltage - Weekly profiles to monitor for changes

Variable	Reason critical	Low	Normal	High	Control logic / protective devices
High start up brine flows.	If the series does not get get enough brine upon start up loss of head levels could be experienced. Pinching back the CE header valves to maintain head could lead to cathode compartment being flooded. Both situations could lead to an explosive condition.		3.5	20gpm	- Start up to trench and not to sump - close monitoring of head levels - Modifications to aux brine system to provide more brine
H2 conc in Cl2	Reactive chemical potential		0.0	0.5%	- Two on-line G.C.s - Fast scanning of individual series available for start ups
High H2 pressure	Reactive chemical potential H2 could back up into Cl2	0.0	4.0	10.0 cm wc	- Each series pair has a relief pot see attached diagram - H2 pressure transmitter with alarms
Low H2 pressure	Reactive chemical potential could pull O2 into H2	vac	4.0	10.0 cm wc	- O2 analyzers on the H2 system with trips
High Cl2 Pressure	Industrial hygiene concern Release Cl2 to atmosphere.	-6	-3	pos cm wc	- Pressure transmitters and alarms
Low Cl2 Pressure	Reactive chemical potential Could pull H2 into Cl2. Could collapse Cl2 piping	-6	-3	pos cm wc	- G.C.s and alarms - Pressure transmitters and alarms - Vacuum break on the piping

Note: Please see the attached diagram for an over view of all the equipment available on the series.



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H2 RELIEF/COLLECTION

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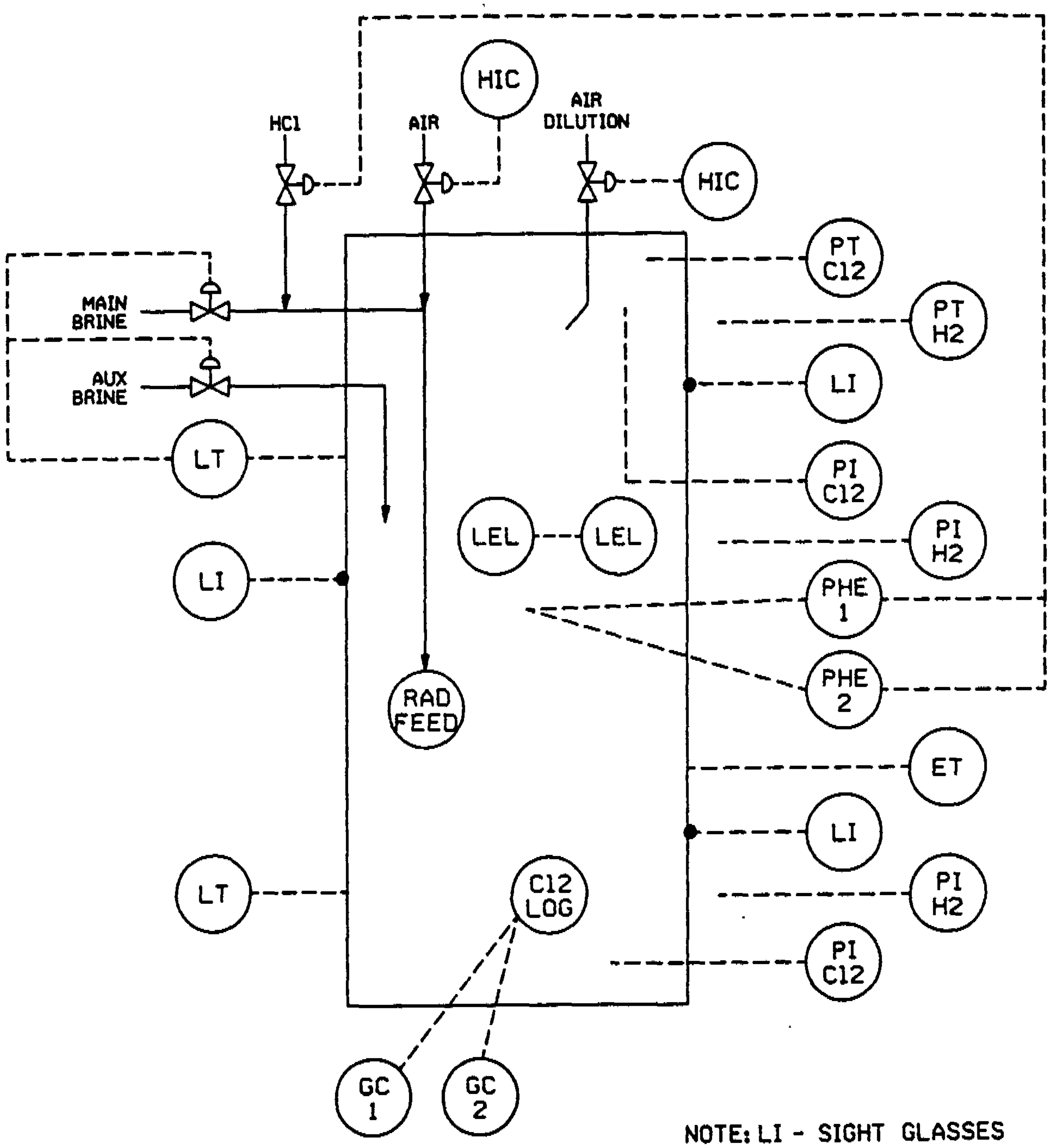
DWN BY: S.POTTER



NOTE: LI - SIGHT GLASSES
PI - MANOMETERS

INSTRUMENTATION ON TYPICAL SERIES

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