A
Project Report
On

Operation involved for manufacturing of MEG in MEG plant. (IGL)

By

Prem Shankar
B.Sc (plant operation & maintenance)
In

University Of Petroleum and Energy Studies
Dehradun (Uttarakhand)

At

INDIAN GLYCOL LIMITED,
Kashipur, Uttarakhand

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INDIAN GLYCOL LIMITED,
Kashipur, Dehradun.
Uttarakhand

(Rakesh Arora)
MEG-II Mgr
18/12/07

(S. DEVARAJAN)
Sr Manager. HRD
INDIA GLYCOLS LTD.
A-1, Indl. Area, Bazpur Road,
KASHIPUR Distt U.S. Nagar
Uttaranchal State

ACKNOWLEDGEMENT

I am glad to take this opportunity to pay my sincere thanks to the management of INDIAN GLYCOL LIMITED for giving me this golden opportunity to undergo Study Project at their prestigious MEG plant.

With deep sense I would like to thank **Mr. R. Devrajan** for his kind help in providing me this opportunity.

I owe a debt of gratitude to **Mr. R. P. Bajaj(DGM) & Mr. Rakesh Arora(JT. Manager) of MEG Plant ,** for not only guiding me but also playing the role of a mentor during my training period.

I also express my heart-felt thanks to **Mr. S.P.Jugran** & **Entire operators cell** for their guidance & support to accomplish the training successfully.

My sincere thanks goes out to entire **operators** for their co–operation & friendliness which facilitated me to carry out this project successfully.

INDIA GLYCOLS LIMITED

ISO 9001 REGISTERED

A-1, INDUSTRIAL AREA, BAZPUR ROAD, KASHIPUR - 244713, DISTT. U. S. NAGAR (UTTARAKHAND) CABLE : GLYCOLS
PHONE : (05947) 275320 (HUNTING), 262313-314, FAX : 05947-275315

IGL/PERS/KSP/2007/87

December 19, 2007.

CERTIFICATE

This is to certify that **Mr. Prem Shankar**, student of **B.Sc. in Plant Maintenance and Operations** from **University of Petroleum and Energy Studies** was on a Practical Training in our factory from August 20, 2007 to December 19, 2007.

He was attached with our ProductionDepartment and studied the process of manufacture of Ethylene Glycols. He has produced an appreciable report on his study.

He was very regular and punctual during the period, showing keen interest in learning and applying his knowledge.

We wish him the best for the future.

For India Glycols Limited

(S.DEVARAJAN)
Senior Manager (HRD)

HEAD OFFICE : C-124, OKHLA INDUSTRIAL AREA, PHASE-I, NEW DELHI-110 020. TEL. NOS. 26815772, 26815185, 26815215 & 26815731
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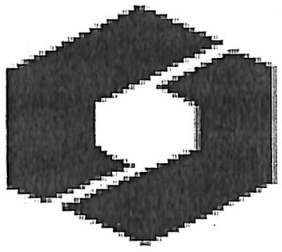


INTRODUCTION

TO

INDIAN GLYCOL LIMITED

The MEG plant is the one of the main manufacturing unit of **M/S INDIA GLYCOL LIMITED** engaged in production of high quality glycols and purified ethylene oxide (EO).plant uses the latest technology of the world of the production glycols and purified ethylene oxide from the agro based chemicals(ethyl alcohol).The basic process know-now is supplied by world-renowned foreign collaborator **M/S SCIENTIFIC DESIGN COMPANY U.S.A.**

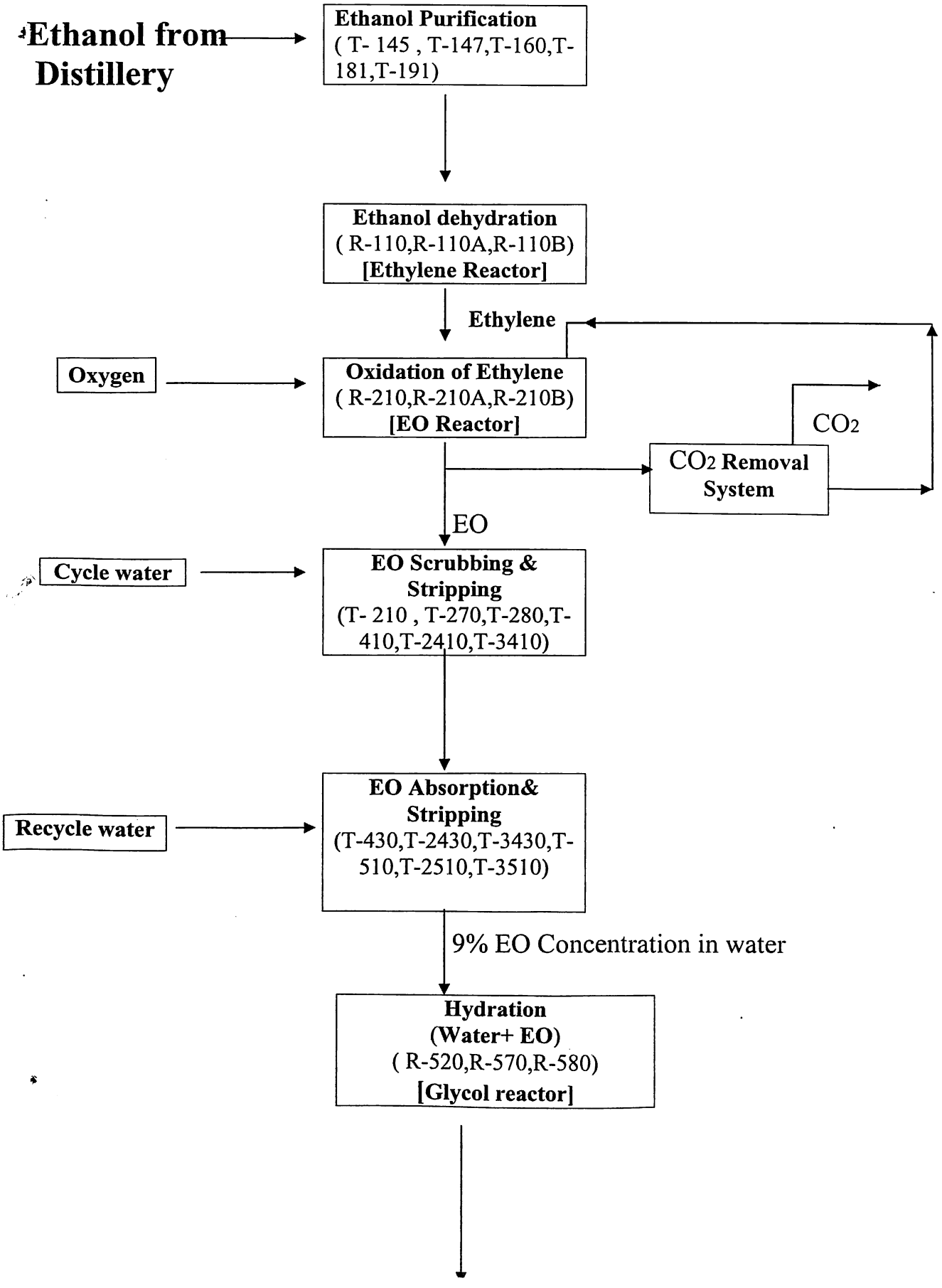
Ethyl alcohol and oxygen are used as major raw materials for the manufacture of glycols and purified EO. These raw materials are produced captively from distillery and air separation unit respectively and supplied to MEG plant on continuous basis. The plant consists of three parallel trains of ethanol dehydration. Ethylene oxide reaction system plus recovery facilities and glycols plants.

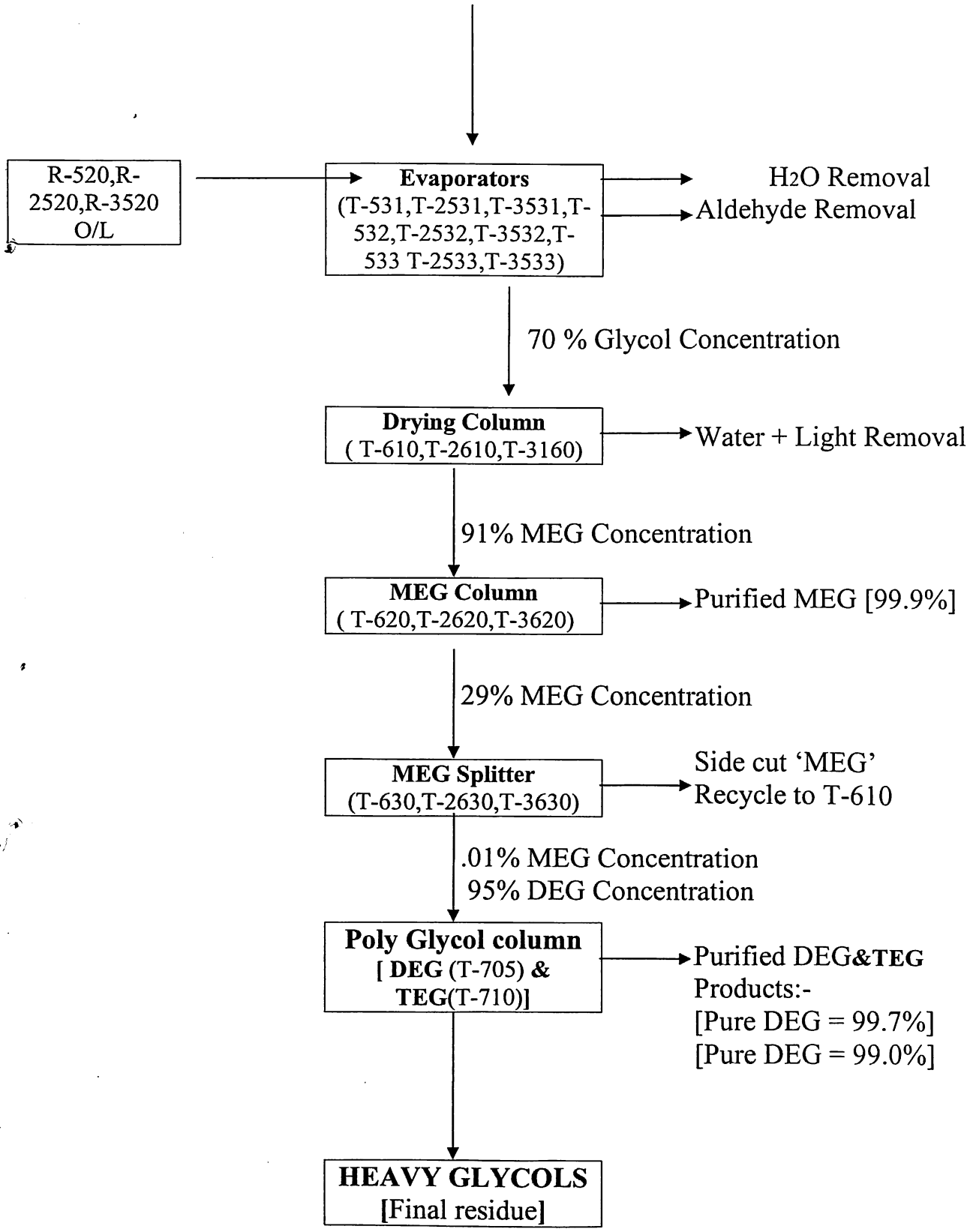
Ethylene oxide (EO) is the most important derivative of ethylene, next to polyethylene. The major portion of ethylene oxide produced worldwide is converted to ethylene glycol.

Major portion of ethylene oxide is converted to ethylene glycol and results in following production rate:-

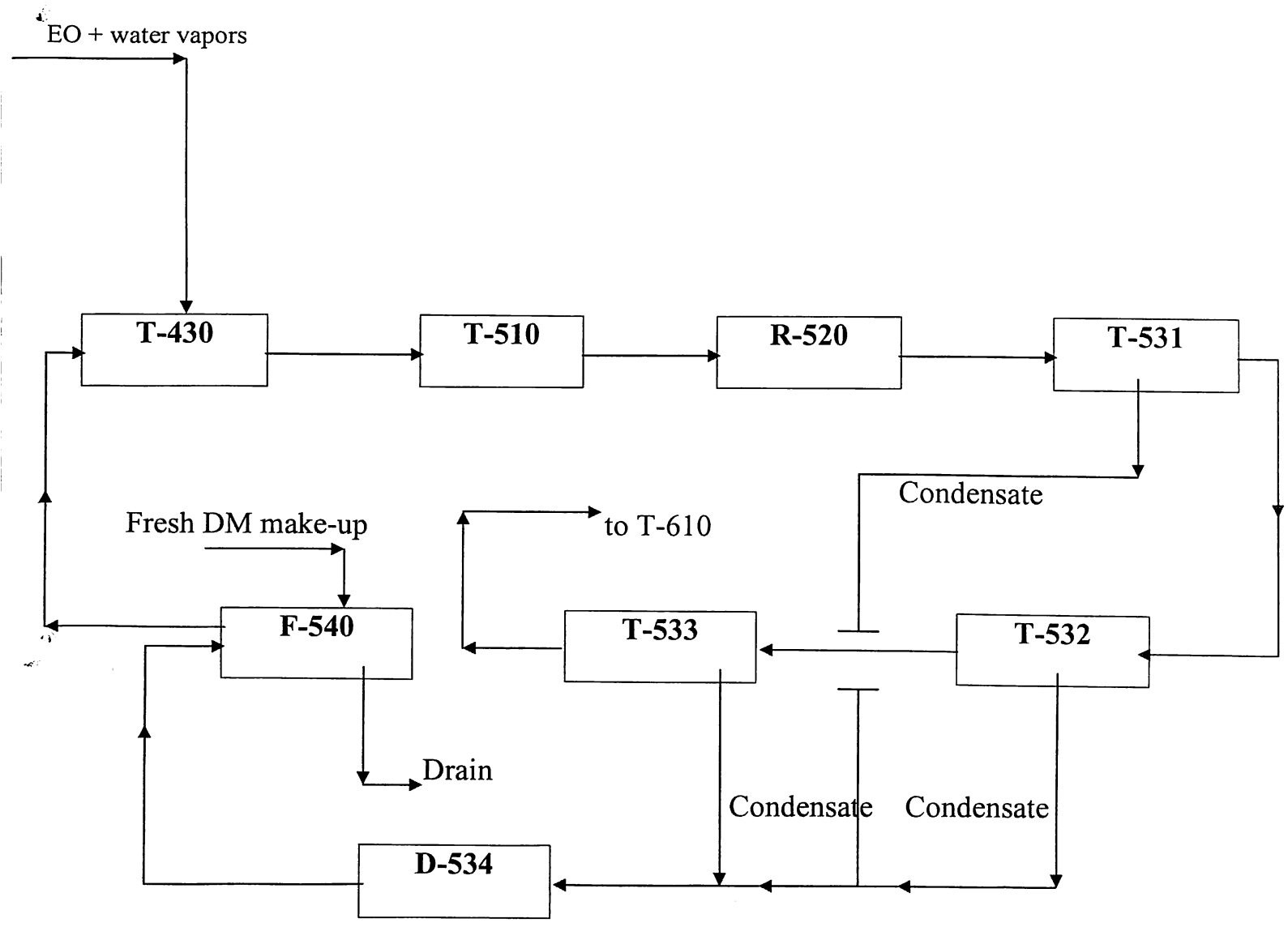
PRODUCTS	**MT/years.**
1. MONO EHTYLENE GLYCOL	**6**
2. PURE EHTYLENE OXIDE	**16**
3. DI-EHTYLENE GLYCOL	**19**
4. TRI- EHTYLENE GLYCOL	**6**
5. HIGH GLYCOL RESIDUE	**16**

BLOCK DIAGRAM OF MEG PROCESS

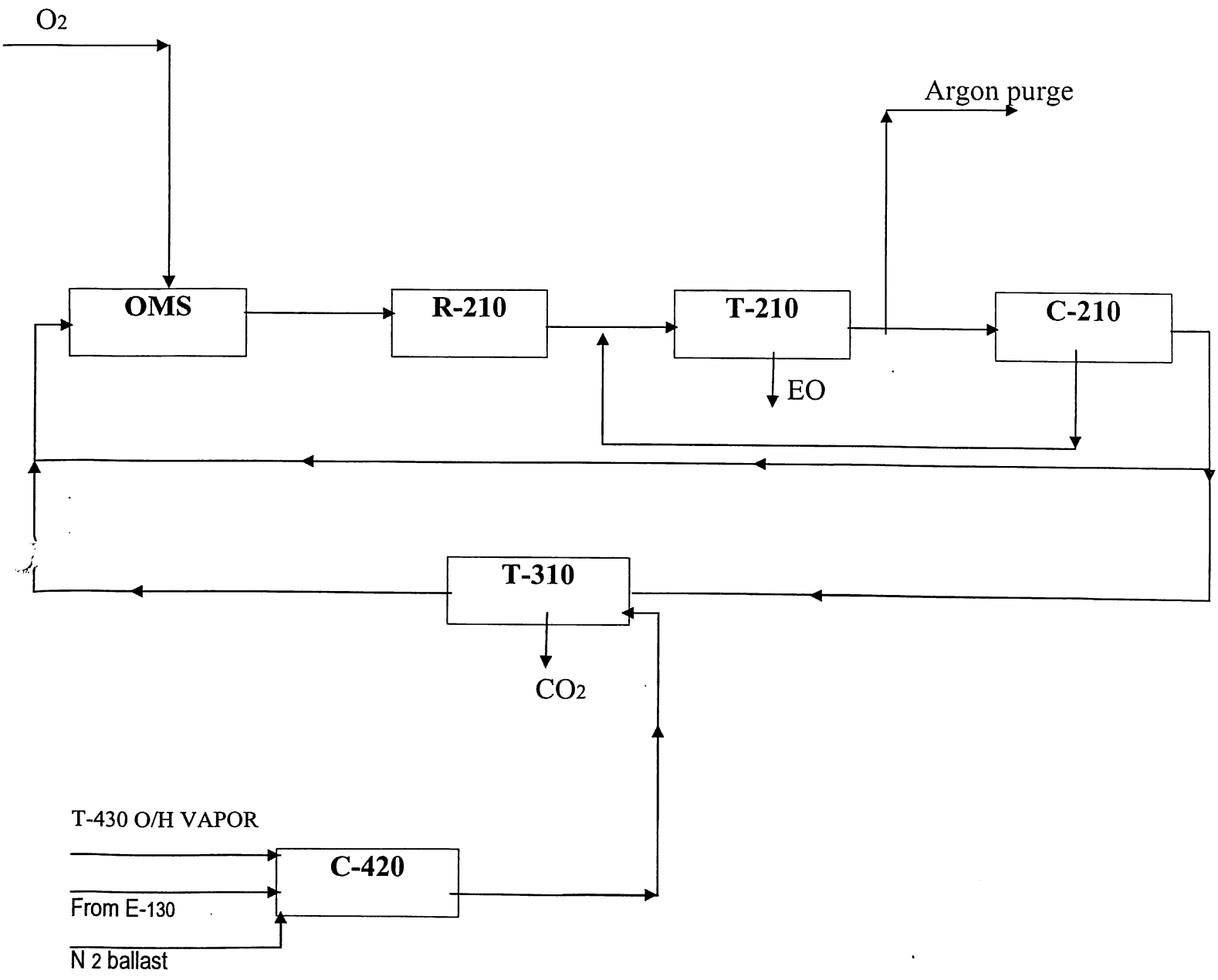



R-520,R-2520,R-3520 O/L
Evaporators (T-531,T-2531,T-3531,T-532,T-2532,T-3532,T-533 T-2533,T-3533)
H2O Removal
Aldehyde Removal
70 % Glycol Concentration
Drying Column (T-610,T-2610,T-3160)
Water + Light Removal
91% MEG Concentration
MEG Column (T-620,T-2620,T-3620)
Purified MEG [99.9%]
29% MEG Concentration
MEG Splitter (T-630,T-2630,T-3630)
Side cut 'MEG'
Recycle to T-610
.01% MEG Concentration
95% DEG Concentration
Poly Glycol column [DEG (T-705) & TEG(T-710)]
Purified DEG&TEG
Products:-
[Pure DEG = 99.7%]
[Pure DEG = 99.0%]
HEAVY GLYCOLS
[Final residue]

BLOCK DIAGRAM OF RECYCLE –WATER LOOP



BLOCK DIAGRAM OF CYCLE – GAS LOOP



DETAIL S OF CHEMICAL REACTIONS INVOLVED IN GLY COLS MANUFACTURING

MOLASSES TO ALCOHOL

$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{inversion}} 2C_6H_{12}O_6$ **[GLUCOSE]**

$C_6H_{12}O_6 \xrightarrow{\text{fermentation}} 2C_2H_5OH + 2CO_2$ **[ETHANOL]**

DEHYDRATION OF ETHANOL

$C_2H_5OH \xrightarrow{\text{harshaw catalyst}} C_2H_4 + H_2O$

$\Delta H = 10{,}940$ kcal/kg mole

$C_2H_5OH \longrightarrow CH_3.CHO + H_2$

$C_2H_4 + H_2 \longrightarrow C_2H_6$

$2C_2H_4 \underset{\longleftarrow}{\xrightarrow{\text{Demerization}}} C_4H_8$ **[BUTYLENE]**

$C_4H_8 + C_2H_4 \longrightarrow 2C_3H_6$ **[PROPYLENE]**

$2C_2H_5OH \longrightarrow 3C + CO + H_2O + 5H_2$

ETHANOL TO ETHYLENE [EO]

$C_2H_4 + 1/2O_2 \rightarrow C_2H_4O$ -25500 kcal /kg.mole OF C_2H_4 **ETHYLENE [EO]**

$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ -316220 kcal /kg.mole OF C_2H_4

$C_2H_4O \xrightarrow{\text{isomerization}} CH_3.CHO$

$CH_3.CHO + 5/2\ O_2 \rightarrow 2CO_2 + 2H_2O$

ABSORPTION AND STRIPPING OF CO2

IN CONTRACTOR

$K_2CO_3 + H_2O + CO_2 \xrightarrow[16\ kg/cm2g]{109°C} 2KHCO_3$ **[POTASSIUM BICARBONATRE]**

IN REGENERATOR

$2KHCO_3 \xrightarrow[0.44\ kg/cm2g]{109°C} K_2CO_3 + H_2O + CO_2$

GLYCOL REACTION: - [EXOTHERMIC IN NATURE]

$C_2H_4 + H_2O \xrightarrow[\text{Reaction}]{\text{non-catalytic}}$ CH_2OH | CH_2OH

[MEG]
[MONO-ETHYLENE GLYCOL]

EO + MEG → **[DEG]**
[DI-ETHYLENE GLYCOL]

EO + DEG → **[TEG]**
[TRI-ETHYLENE GLYCOL]

METHODS

PROCESS DISCRIPTION

METHODS

PROCESS DISCRIPTION

Section 100

(Sulphur removal section)

OSBL Ethanol is fed through OSBL Ethanol feed pump (G 1202 A/B) to the Light Sulfur Removal Column (T-145) to remove light sulphur compounds from ethanol feed. Heat required for distillation is provided by the hot ethylene-water vapors from the Dehydration Reactor effluent in the Light Sulfur Removal. Column Reboiler/ (E-145). Overhead vapors are condensed in the Light Sulfur Removal Column Condenser (E-146). The condensed Ethanol-water mixture is collected in the Light Sulfur Removal Column Reflux Drum (D-145) and then pumped back to the column as reflux by Light Sulfur Removal Column reflux Pumps (G_146A/B) after taking a small ethanol purge to control light sulfur compounds build-up in the system. The ethanol purge is sent to Aldehyde Removal Column (T-190) to reduce aldehyde content to acceptable limits (<50 ppm) for its re-use at Glycol Ether / MEG plant. (Refer PED No. 2819-X-100-5).

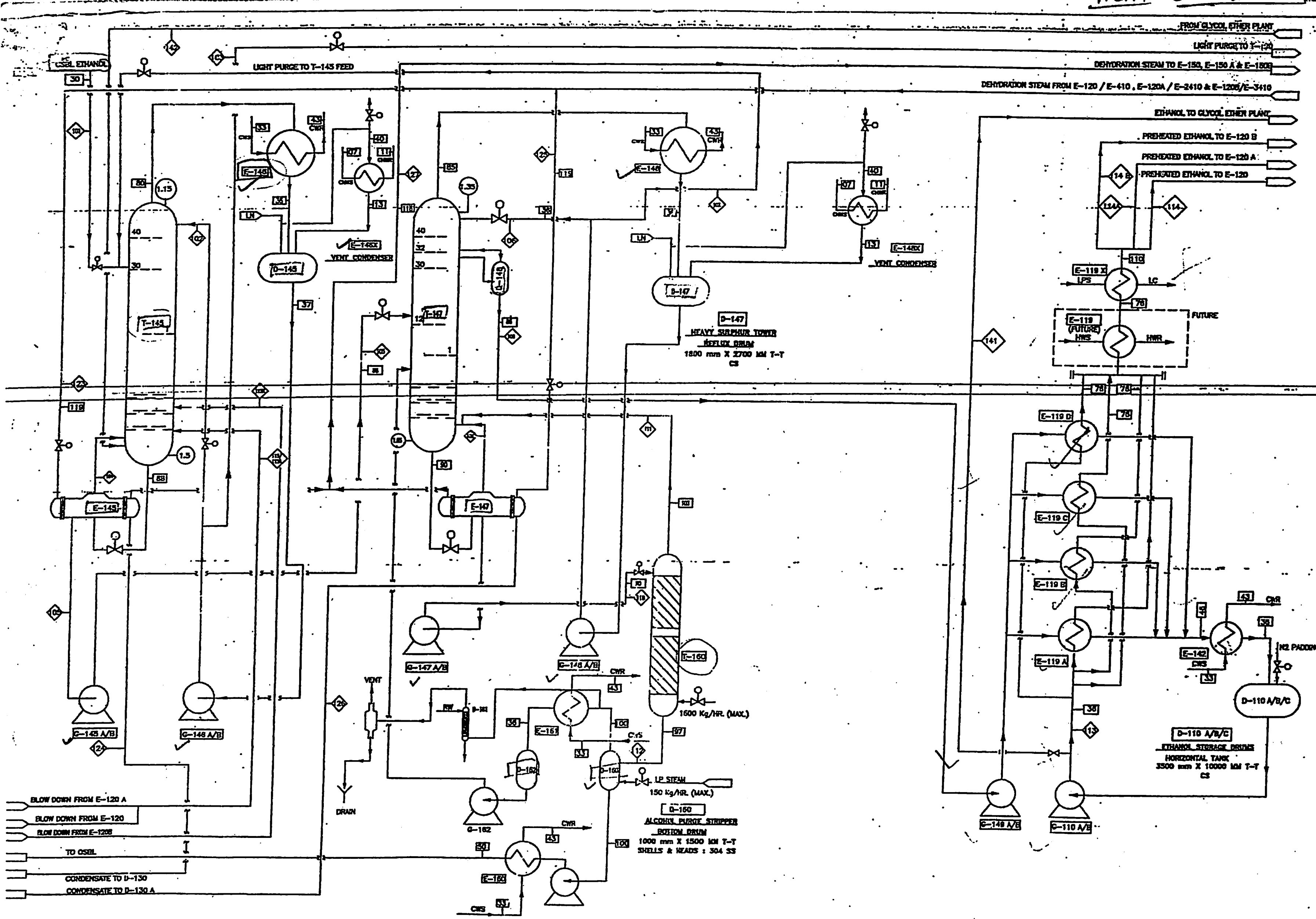
Sulfur Removal Column (T-147) feed is pumped from Reboiler (E-145) bottom by Sulfur Column Feed Pumps (G-145 A/B). Heat required for distillation is provided by the hot ethylene-water vapors from the Dehydration Reactor effluent in the Sulfur Removal Column Reboiler (E-147). Overhead vapors are condensed in the Sulfur Column Condenser (E-148). The condensed Ethanol-water mixture is collected in the Sulfur Removal Column Reflux Drum (D-147) and then pumped back to the column as reflux by Sulfur Removal Column Reflux Pumps (G-148 A/B). A small stream of condensed column overheads is recycled to Column, T-145.

A side-draw stream of purified Ethanol from T-147 is received in Sulfur Removal Column Side-draw receiver (D-148) and is then pumped by Sulfur Removal Column Side-draw pumps (G-149 A/B) to Ethanol Storage Drums (D-110 A/B/C) after cooling it in Ethanol Feed Pre-heaters (E-119A, E-119B & E-119C) and in the Sulfur Removal Column Side-draw Coolers (E-142).

Purge stream from Reboiler E-147, containing 60 - 70 % ethanol is pumped to Alcohol Purge Stripper (T-160) by Sulfur Removal Column Bottoms Pumps (G-147 A/B). LP

stream is injected to the Column T-160 bottom and practically all the ethanol contained in the purge is recovered and recycled back to Column, T-147. To minimize stripping of heavier alcohols, no liquid level is desired at the Stripper Bottom. A steam trap installed at the bottom of the Stripper removes aqueous stream to Alcohol Purge Stripper Bottom Drum (D-160). The temperature of the liquid in the drum D-160 is maintained at 100 – 103 deg.C to minimize alcohol losses. Drum D-160 bottoms are pumped to OSBL after cooling it in Alcohol Purge Stripper Cooler (E-160).

Drum D-160 overhead vapors are condensed in D-160 overhead condenser (E-161) to recover ethanol. The E-161 condensate is then stored in E-161 Condensate Drum (D-162) & pumped, as & when required, to Sulfur Removal column (T-147). For the removal of non-condensable, a vent with a water scrubber (D-161) is provided.



KEY

Symbol	Meaning
◇	STREAM No.
▭	TEMPERATURE(0 c)
○	PRESSURE(Kg/cm2 g)

TAG NO.	DESCRIPTION
T-145	LIGHT SULPHAR REMOVAL COLUMN
T-147	LIGHT SULFUR REMOVAL COLUMN
T-160	ALCOHOL PURGE STOPPER
E-145	LIGHT SULFUR TOWER REBOILER
E-147	LIGHT SULFUR TOWER REBOILER
G-145 A/B	SULFUR TOWER BOTTOM PUMP
G-146 A/B	SULFUR TOWER REFLUX PUMP
G-147 A/B	SULFUR TOWER BOTTOM PUMP
G-148 A/B	SULFUR TOWER REFLUX PUMP
G-149 A/B	SULFUR TOWER SIDE DRAW PUMPS
G-110 A/B	ETHANOL FEED PUMPS
G-119 A/B/C/D	ETHANOL FEED PRE-HEATERS.
G-110 A/B/C	ETHANOL STORAGE PUMPS

T-145
LIGHT SULFUR REMOVAL

D-145
LIGHT SULFUR TOWER REFLUX DRUM
1600 mm X 2400 MM T-T
CS

T-147
HEAVY SULFUR REMOVAL
2700 mm ID X 22000 mm T-T(EST)
40 SINGLE PASS TRAYS
450 mm TRAY SPACING
TRAYS: SS 304 DECK & SS -410 VALVE
SS 304 FROM BOTTOM TO 12TH TRAY &
CS FROM 13TH & ABOVE

D-161
OVERHEAD SCRUBBER
200 mm X 1000 MM T-T
SHELLS & HEADS:304 SS
1 BED, 500 mm DEEP
25 mm IMTP TYPE PACKING
PACKINGS: SS

D-162
CONDENSATE DRUM
900 mm X 1800 MM T-T
SHELLS & HEADS:304 SS

D-148
SULPHUR TOWER SIDEDRAW DRUM
1800 mm X 2700 MM T-T
CS

E-161
OVERHEAD CONDENSER
Q= 143000 Kcal/HR
U=392 Kcal/HR M²°C
A= 17.3 M²
MTD= 21.1°C
SHELLS & TUBES : 304 SS
CHANNEL & BONNET: CS

T-160
ALCOHOL PURGE STRIPPER
800 mm ID X 13250 mm T-T(EST)
TWO BEDS, TOP BED 2700 mm DEEP
BOTTOM BED 7300 mm DEEP
PACKING 25 mm IMTP TYPE

E-119
ETHANOL PREHEATER-1

E-119X
ETHANOL PREHEATER-2

REV.	DESCRIPTION	DATE	BY	CHKD.	APPR.
1	E-119X,E-119 ADDED	29.03.07	SG	RB	AS

INDIA GLYCOLS LIMITED
KASHIPUR (UTTARANCHAL) INDIA

PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

SULFUR REMOVAL

100-2 (ETHANOL DEHYDRATION LOOP-1 & DM WATER Pre-heating)

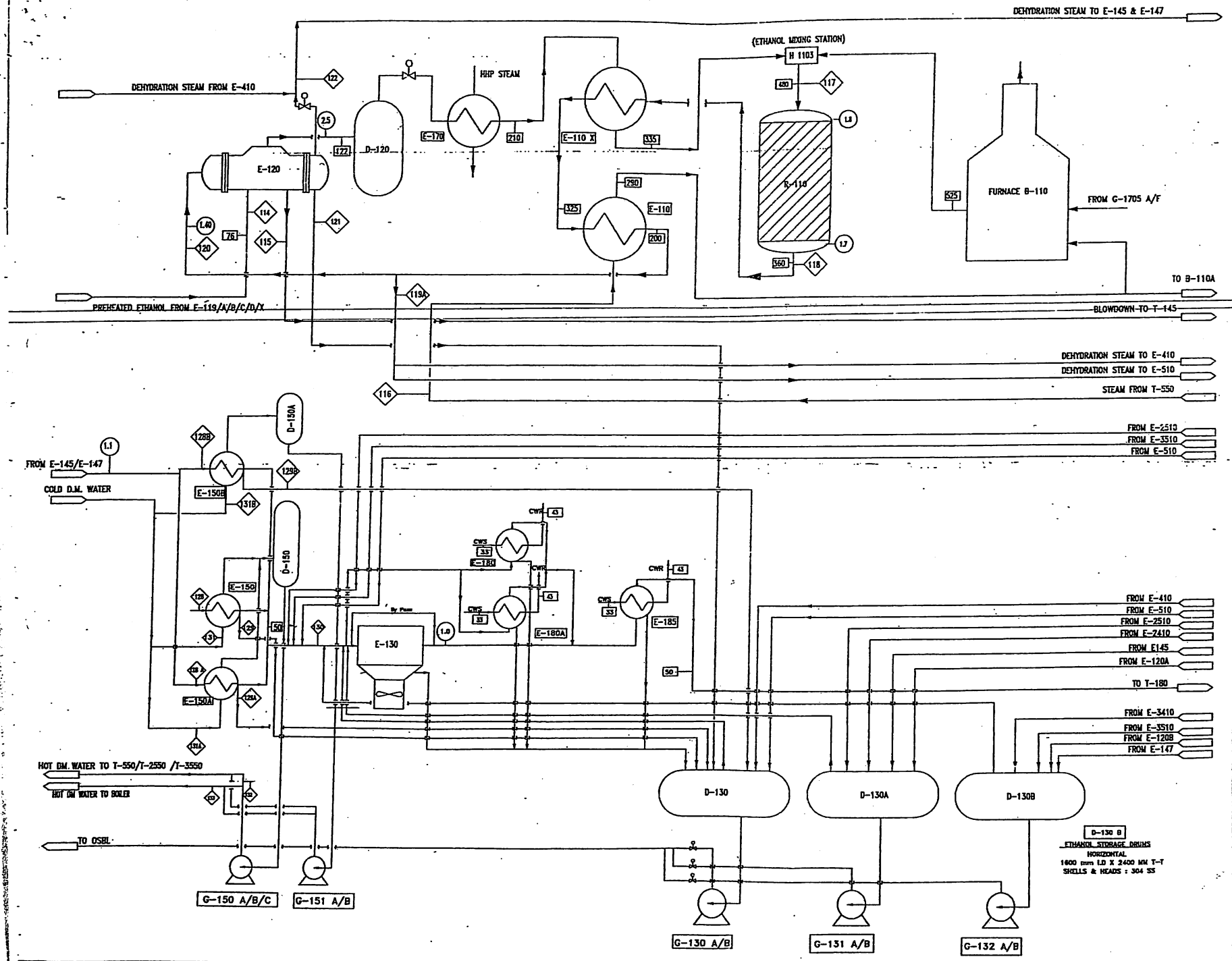
100-3 (ETHANOL DEHYDRATION Loop-2 & 3) –

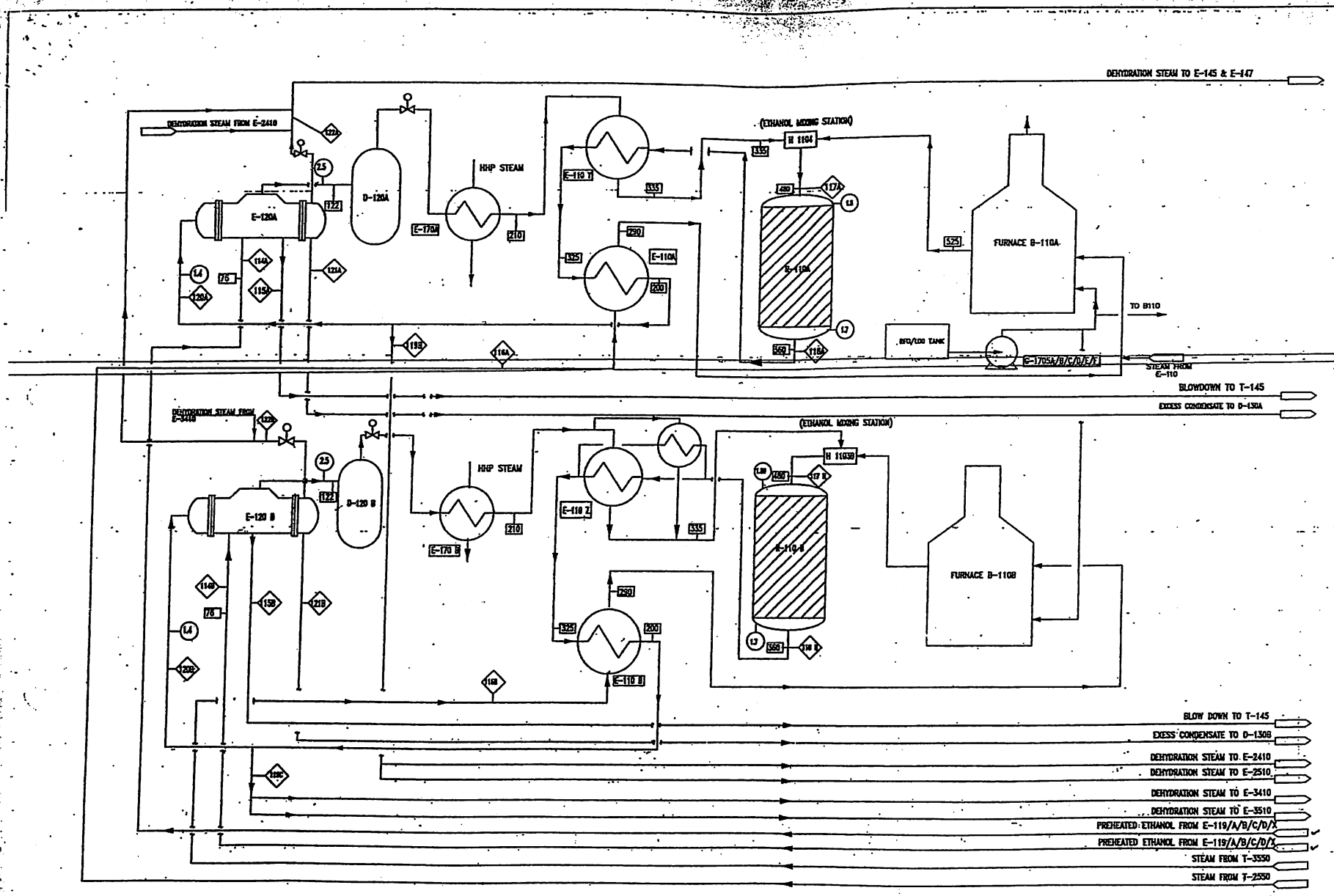
Ethanol dehydration section, essentially, comprises of 02 Process Heaters (B-110A & B-110) and 03 Ethanol Dehydration steam from three Evaporators trains is distributed to these two heaters, heated to required temperature and than supplied to three dehydration reactor loops (R-110/110A/110B).

Ethanol Feed Pumps (G-110 A/B) transfer purified ethanol from Ethanol Storage Drums (D-110 A/B/C) to Ethanol Feed Pre-heaters (E-119 A/ E-119B/ E-119C), where it is heated by T-147 Side-draw stream. Heated Ethanol stream is then fed to Ethanol Feed Vaporizer (E-120/ E-120A/ E-120B), where it is vaporized by the reactor effluent from the Feed/Effluent exchanger (E-110/ E-110A/ E-120B). Vaporized Ethanol is passed through Ethanol Vapor Knockout Drum (D-120/ D-120A/ D-120B) and then further heated in two stages. First it passes through Ethanol Pre-heaters (E-170/ E-170A/ E-170B/ E-170C) (using HP Stream as heating medium), and then through Ethanol Dehydration Effluent Cooler (E-110X/ E-110Y/ E-110Z).
Stream from Third Effect Overhead Wash Column (T-2550/ T-3550) is superheated in two stages. First it passes through the Ethanol Dehydration Reactor Feed / Effluent Exchanger (E-110/ E-110A/ E-110B) and then through the Ethanol Dehydration Reactor Feed Heater (B-110/ B-110A).
Dehydration Reactor Feed Heater (B-110A & B-110B) are vertical cylindrical heater with overhead convection section. The heater has three natural draft Low-NOX burners suitable for firing both fuel gas and heavy fuel oil. The burners are equipped with a self inspiring gas pilot with fixed igniter and ionsation rod, and UV scanners for flame detection. Firing control is by means of burner Management System. The flue gas from the heater is vented through self supporting stack mounted on top of convection section. In heater B-110A vapors feed, divided into six parallel streams, enters first convection section, which consists of 13 rows of 6 horizontal tubes; the upper 10 rows use studding as extended surface for improved heat transfer, the lower 3 rows are bare. Stream vapors heated to 410 deg.C existing via external crossovers enters the radiant section. The radiant has total of 24 vertical tubes arranged along the cylindrical walls, and the heated vapors feed exists through the outlet terminals at 525 deg.C.
The convection surface can be kept clean of fouling by ash etc. from oil firing by means of 4 retraceable soft blowers
Heated Ethanol vapors from Ethanol Dehydration Effluent Cooler (E110X/ E-110Y/ E-110Z) and superheated steam from Ethanol Dehydration Reactor Feed Heater (B-110/ B-110A) are mixed at Ethanol Mixing Stations, H-1103/ H-1103A.
The heated ethanol vapors and steam are mixed in in-line mixer and the hot feed mixture flows downward through the Ethanol Dehydration Reactor (R-110/ R-110A/ R110B) catalyst bed where ethanol is converted to ethylene. A small amount of by products are produced which are either destroyed in the ethylene oxide reaction system or purged in the glycol plant. The hot ethylene steam mixture leaving the

reactor Ethanol Dehydration Feed / Effluent Cooler (E-110X/ E-110Y/ E-110Z) and then ethanol dehydration reactor feed/effluent exchanger (E-110/ E-110A/ E-110B) where it is cooled by interchange with the Ethanol vapors and stream from T-550/ T-2550/ T-3550.
A portion of the cooled reactor effluent is used as heating medium in the Stripping Column Reboiler (E-410/ E-2410/ E-3410) and is the Glycol Feed Stripper Reboiler (E-510/ E-2510/ E-3510). The remainder is sent to the Ethanol Feed Vaporizer (E-120/ E-120A/ E-120B). The resulting vapors from E-120/ E-120A are mixed with vapors from Stripping Column Reboiler (E-410/ E-2410/ E-3410) and are then fed to Light Sulfur Removal Column Reboiler (E-145) and Sulfur Removal Column Reboiler (E-147).
The resulting ethylene-water vapors from E-147/ E-145 are mixed and then fed to DM Water Pre-heater (E-150/ E-150A/ E-150B) to Pre heat DM water to be used at T-550/ T-2550/ T3550 and boilers.

Ethylene-water Vapors from E-150/E-150A/ E-150B are mixed with vapors from Glycol Feed Stripper Reboiler (E-510/ E-2510/ E3510) and with the flash vapors from Dehydration Excess Steam Condensate Drum (D-130/ D-130A/ D-130B). Most of the remaining Stream is condensed in the Dehydration Excess Stream Condenser E-130) & in exchangers E-180/ E-180A placed in parallel to E-130. An Ethylene Wash column Feed cooler, (E-185) is placed at the down stream of E-130/ E-180/ E-180A further cooling of Ethylene-water vapors and to address excess stream load due to any imbalance in upstream process. The cooled Ethylene rich vapors are then sent to Ethylene wash section for further treatment (Refer PFD No. 2819-X-100-5).
Condensate from the Ethanol Feed Vaporizer (E-120), DM water preheater (E-150/E-150A/E-150B), Dehydration Excess Stream Condensers (E-130/E-180/E-180A/E-185),stripping column reboiler (E-410) and glycol feed stripper reboiler (E-510), flow to the dehydration excess steam condensate drum, D-130. The condensate is then pumped to effluent treatment plant by dehydration steam condensate transfer pumps, G-130A/B.
Condensate from the Ethanol Feed Vaporizer (E-120A), Light Sulfur Removal. Column Reboiler/(E-145),stripping column reboiler (E-2510), flow to the dehydration excess steam condensate drum,D-130A. The condensate is then pumped to effluent treatment plant by dehydration steam condensate transfer pumps, G-131A/B.
Condensate from the Ethanol Feed Vaporizer (E-120B), Light Sulfur Removal. Column Reboiler/(E-147),stripping column reboiler (E-3410), Glycol Feed Stripper Reboiler (E-3510) flow to the dehydration excess steam condensate drum,D-130B. The condensate is then pumped to effluent treatment plant by dehydration steam condensate transfer pumps, G-132A/B.


DEHYDRATION STEAM TO E-145 & E-147
(ETHANOL MIXING STATION)
H 1103
DEHYDRATION STEAM FROM E-410
HHP STEAM
E-120
D-120
E-170
E-110 X
R-110
FURNACE B-110
FROM G-1705 A/F
TO B-110A
PREHEATED ETHANOL FROM E-119/A/B/C/D/X
BLOWDOWN TO T-145
DEHYDRATION STEAM TO E-410
DEHYDRATION STEAM TO E-510
STEAM FROM T-550
FROM E-2510
FROM E-3510
FROM E-510
FROM E-145/E-147
COLD D.M. WATER
D-150A
E-150B
D-150
E-150
E-150A
E-130
E-180
E-180A
E-185
FROM E-410
FROM E-510
FROM E-2510
FROM E-2410
FROM E145
FROM E-120A
TO T-180
FROM E-3410
FROM E-3510
FROM E-1208
FROM E-147
HOT DM. WATER TO T-550/T-2550 /T-3550
HOT DM WATER TO BOILER
TO OSBL
G-150 A/B/C
G-151 A/B
D-130
D-130A
D-130B
G-130 A/B
G-131 A/B
G-132 A/B
D-130 B
ETHANOL STORAGE DRUMS
HORIZONTAL
1600 mm I.D X 2400 MM T-T
SHELLS & HEADS : 304 SS
KEY
TAG NO. DESCRIPTION
E-120 ETHANOL FEED VAPORIZER
E-110 ETHANOL DEHYDRATION EFFLUENT COOLER
E-110X DEHYDRATION FEED EFFLUENT EXCHANGER
E-110 ETHANOL PREHEATER
R-110 DEHYDRATION REACTOR-1
E-130 DEHYDRATION EXCESS STEAM CONDENSOR
E-180 DEHYDRATION EXCESS STEAM CONDENSOR
E-180A DEHYDRATION EXCESS STEAM CONDENSOR
E-180B DEHYDRATION EXCESS STEAM CONDENSOR
E-150 DM WATER PREHEATERS
E-150A DM WATER PREHEATERS
E-150B DM WATER PREHEATERS
D-130 A/B DEHYDRATION EXCESS STEAM CONDENSOR DRUM
1 B-110 MODIFIED 29.03.07 SG KB AS
REV. DESCRIPTION DATE BY CHKD. APPR.
INDIA GLYCOLS LIMITED
KASHIPUR (UTTARANCHAL) INDIA
PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT
ETHANOL DEHYDRATION-1 & DM WATER PRE-HEATING



KEY

TAG NO.	DESCRIPTION
E-120A	ETHANOL FEED VAPORIZER
E-120B	ETHANOL FEED VAPORIZER
D-120A	ETHANOL VAPORIZER K.O. DR
D-120B	ETHANOL VAPORIZER K.O. DR
E-170A	ETHANOL PREHEATER
E-170B	ETHANOL PREHEATER
E-110Y	ETHANOL DEHYDRATION EFFLUENT CO
E-110Z	ETHANOL DEHYDRATION EFFLUENT CO
E-110A	ETHANOL DEHYDRATION REACTOR FEE EFFLUENT EXCHANGER
E-110B	ETHANOL DEHYDRATION REACTOR FEE EFFLUENT EXCHANGER
R-110A	ETHANOL DEHYDRATION REACTOR
R-110B	ETHANOL DEHYDRATION REACTOR
B-110A	ETHANOL DEHYDRATION REACTOR FEE HEATER
B-110B	ETHANOL DEHYDRATION REACTOR FEE HEATER
G-1705A/B/C/D	BFO TRANSFER PUMP.

D-120 B
1100 mm X 2200 mm T-T
SHELLS & HEADS: 304 SS

E-120 B
ETHANOL VAPORISER
FIXED TUBE SHEET, KETTLE TYPE
Q = 2400000 Kcal/HR
U=500 Kcal/HR M²°C
A= 445 M²
MTD= 10.8°C
SHELL : CS
TUBES : SS-316L
CHANNEL: 304 SS

E-110 B
ETHANOL DEHYDRATION REACTOR
FEED EFFLUENT EXCHANGER
Q = 2587512 Kcal/HR
U=80 Kcal/HR M²°C
A= 742 M²
MTD= 43.7°C
SHELL : CS
TUBES : 304 SS
CHANNEL: CS

E-110 Z A/B
ETHANOL DEHYDRATION REACTOR
FEED EFFLUENT COOLER
Q = 455500 Kcal/HR
U= Kcal/HR M²°C
A= 117.25 M²
MTD= 69.25°C
SHELL : 304 SS
TUBES : 304 SS

R-110B
ETHANOL DEHYDRATION REACTOR
3900mm I.D. x 4600mm T-T
CATALYST BED DEPTH -3350 mm
CATALYST SUPPORT - NORTON DENSTONE 57, EQUAL
304 SS

D-150A
HOT DM WATER DRUM
1850mm I.D. x 3700mm T-T
304 SS

NO.	DESCRIPTION	DATE	BY	CHKD.	APP
1	H-1104 ADDED	29.03.07	SG	MB	AS

INDIA GLYCOLS LIMITED
KASHIPUR (UTTARANCHAL) INDIA

PROCESS FLOW DIAGRAM - ETHYLENE GLYCOL PLAN

ETHANOL DEHYDRATION-2

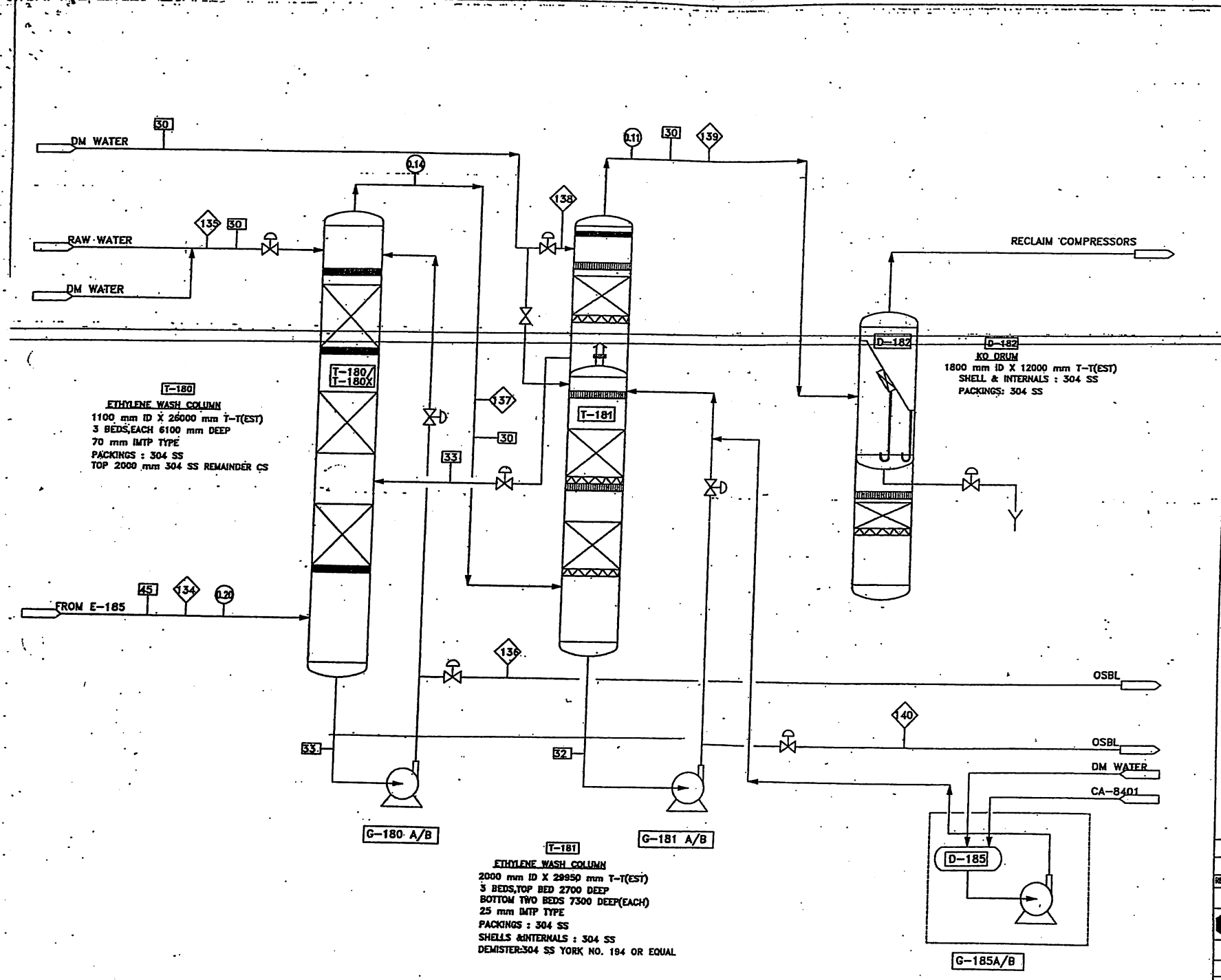
100-4 {Ethylene Wash Section}

Ethylene-water vapors from E-130, cooled in Ethylene Wash column Feed colours, E-180/E-180A and E-185 fed to Ethylene Wash Column, T-180 to remove Aldehydes from the gas by washing it with raw water. DM water provision is also provided with spectacle blind.Aldehydes-rich raw water is then pumped to Effluent Treatment Plant, by T-180 Bottoms Transfer Pump, G-180 A/B.

Aldehydes-lean Ethylene gas stream is then fed to packed bed column, T-181, in this column; Ethylene gas is washed in the bottom beds of the column by 1% caustic solution to remove carbon dioxide present in the ethylene gas stream. In addition to carbon di-oxide removal, caustic wash help in further removal of remaining sulphur compounds and aldehydes in the gas. Caustic solution is circulated through the bottom bed by T-181 Bottoms Pump, G-181 A/B.A purge stream is taken from pump discharge to control impurity build up in the system.

Ethylene gas is further washed with DM Water in the top bed of the column and then sent to K.O.Drum {D-182} to remove any carry over of moisture through a entertainment separator.Level of D-182 is controlled by LV-1806 and HV-1805.

Purified Ethylene is then sent to cycle gas loop via Reclaim Compressor, C-420 A/B/C/D/E.



NOTES:-

1. FOR GENERAL NOTES SEE DWG. 2819-X-00.

KEY

◇ STREAM No.

▭ TEMPERATURE(0 c)

○ PRESSURE(Kg/cm2 g)

TAG NO.	DESCRIPTION
T-180	ETHYLENE WASH COLUMN
G-180 A/B	BOTTOM TRANSFER PUMP
T-181	PACKED BED COLUMN
G-181 A/B	BOTTOMS PUMP
D-182	K.O.DRUM
D-185	CAUSTIC STORAGE DRUM
G-185 A/B	CAUSTIC TRASFER PUMP

REV.	DESCRIPTION	DRN.	DATE	BY	CHKD.

INDIA GLYCOLS LIMITED
KASHIPUR (UTTARANCHAL) INDIA

PROCESS FLOW DIAGRAM - ETHYLENE GLYCOL PLANT

ETHALENE WASH SECTION

CAD FILE NAME:-2819100-4

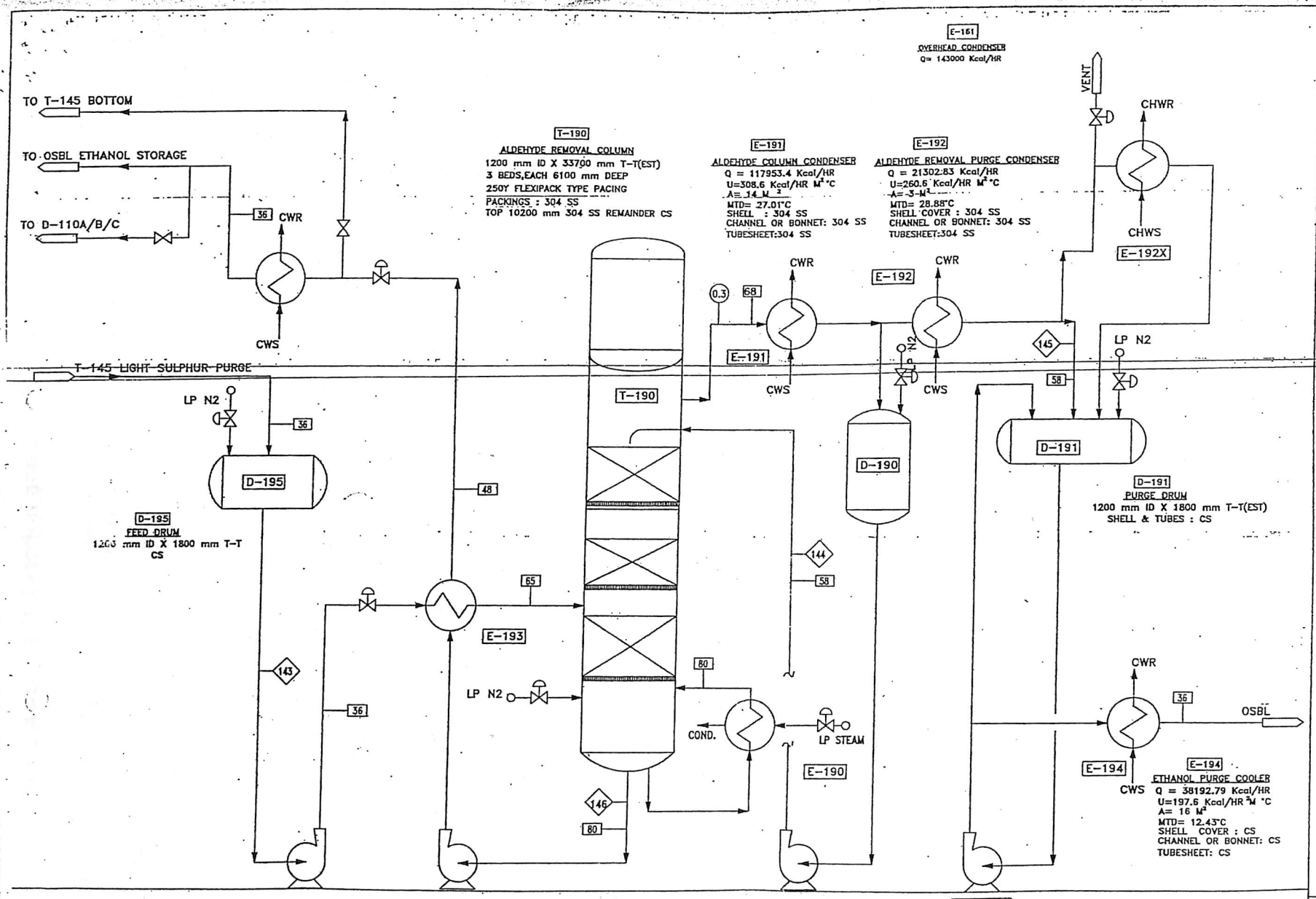
100-5{Aldehydes Removal Section}

Aldehydes Removal Section,T-190,is designed to reduce Acetaldehyde content in Light Sulphur purge{from Light Sulphur column,T-145 from 4000 ppm [max] to acceptable 20 ppm for its consumption at Glycol Ether/MEG Plant.

Light Sulphur Removal [T-140] overhead purge, taken from G-141 A/B discharge is collected in D-195.This liquid is then pre-heated upto 60-65 in exchanger,E-193 by Aldehydes Removal column,T-190,bottoms.The heated purge is then fed above the bottom packed bed of Aldehydes Removal Column,T190.

The column is operated under Atmospheric Pressure. It has three structured packing beds. The Thermosyphon type Aldehyde Column Reboiler,E-190 supplies the heat to the column using LP Steam. The column bottoms having around 94 wt% Ethanol and 20 ppm [max] acetaldehyde is pumped by Aldehyde Column Bottoms pump,G-190 A/B at 78-79 to Aldehydes Column Feed Pre-heater,E-193 to cool it to 50 by Column feed. The cooled column bottoms are then fed to Ethanol Storage Drums,D-110 A/B/C after its further cooling to 36 in Aldehyde Column Product cooler,E-195.provision is made to divert the column bottoms to T-145.Provision is also made to divert column bottoms to OSBL Ethanol storage tank during process upset,shutdown,etc.Hook-up is also taken for its further line-up to any other intermediate storage tank/Glycol Ether Plant.

Overhead vapors at 66-68 C are partially condensed in Aldehyde Column Condenser, E-191 and uncondensed vapors are further condensed in Aldehyde Column Purge Condenser, E-192.Vent on condenser, E-192 allows venting of the low volatiles including Acetaldehyde to atmosphere. The condensate from Condenser,E-191 is taken to the Reflux Drum, D-190.The condenser is pumped back to the column as reflux by Aldehyde Column Reflux pumps, G-191 A/B.The condensate from Aldehyde Column Purge Condenser ,E-192 is essentially an impure alcohol having around 11-12% acetaldehyde. The condenser is stored in Aldehyde Column Purge drum, D-191, and is intermittently transferred to OSBL Storage tank.



NOTES:-

1. FOR GENERAL NOTES SEE DWG. 2815-X-00.

KEY

◇ STREAM No.

□ TEMPERATURE(° c)

○ PRESSURE(Kg/cm² g)

TAG NO.	DESCRIPTION
D-195	LIGHT SULPHAR PURGE DRUM
E-195	ALDEHYDE COLUMN PRODUCT COOLER
G-195 A/B	
E-193	ALDEHYDE COLUMN FEED PRE-HEATER
T-190	ALDEHYDE REMOVAL COLUMN
E-190	THERMOSYPHON TYPE ALDEHYDE COLUMN REBOILER
G-190 A/B	ALDEHYDE COLUMN BOTTOM PUMP.
G-191 A/B	ALDEHYDE COLUMN REFLUX PUMP.
D-190	REFLUX DRUM
E-192	ALDEHYDE COLUMN PURGE CONDENSER
D-191	ALDEHYDE COLUMN PURGE DRUM
E-194	
E-191	ALDEHYDE COLUMN CONDENSER

REV.	DESCRIPTION	DRN.	DATE	BY	CHKD.

INDIA GLYCOLS LIMITED
KASHIPUR (UTTARANCHAL) INDIA

PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

ALDEHYDE REMOVAL SECTION

DRAWN BY [illegible] DATE 13/12/05 CHECKED BY AJ DATE 14/12/05
APPROVED BY PG DATE 15/12/05 SCALE NONE
APPROVED FOR CONSTRUCTION BY _____ DATE _____ DRG.No. 2815-X-100-2

CAD FILE NAME:-PFD1005

200-1,2 AND 3 [EO Reaction and Scrubbing]

Oxygen received from Air Separation Units is blended thoroughly with the reactor feed gas in a special injection device which consists of sparger pipes placed perpendicularly to the flow path, with the holes facing downstream. This device is used for oxygen feed injection to provide rapid mixing with essentially zero pressure drop in the cycle gas.

The concentration of ethylene entering the reactor is approximately 25-35 vol%, and the oxygen concentration is maintained closely at 7.0 vol%.

Nitrogen is added via the Reclaim Compressor [C-420 A/B/C/D/E] to make up the balance of the gas and acts as ballast. Impurity build-up is controlled by purging a steam of cycle gas to the Ethanol Dehydration Reactor Feed Heaters for inclinations.

In order to control the oxidation at the optimum point, and to suppress undesirable side reactions, a small stream of ethylene chloride inhibitor is introduced into the feed gas to the reactors. The inhibitor is introduced as a liquid stream.

The gas mixture is preheated in the tube side of the Gas-Gas Exchanger [E-211/ E-271/ E-281] by heat exchange with reactor effluent gas. The feed gas then flows downward through the Reactors, R-210/R-270/R-280, where contained ethylene is partially converted to ethylene oxide and by-products, CO2 and water. The top section of the reactor is used to heat the inlet gas to reaction temperature. The hot gas then enters the catalyzed section of the reactor where 9 vol% [approx] of the ethylene is reacted per pass with a selectivity to ethylene oxide of 88.0 mol% at SOR [Catalyst selectivity at SOR, however, varies with the nature of EO Catalyst charged].

The reactor operates at an average pressure of 16 Kg/cm2a and at cycle gas temperatures, which are slightly higher than the boiling water temperature. The shell side temperature of boiling water will vary from approximately 235deg.C for new active catalyst to approximately 275 deg.C for old, less active catalyst.

The heat of reaction is removed by boiling water in the shell of reactor. Water circulation is by thermosyphon action with 2-4 wt% vaporization. The two phase mixture leaving the shell of the reactor flows to the reactor steam drums,[D-210A/B, D-270 A/B, D-280 A/B] where the steam and water are separated. The water is returned to the reactor circulation loop. A portion of the steam is used to preheat the makeup boiler feed water to the saturation temperature in a direct contact heat exchange section packed with 50 mm Pall Rings. The remaining steam is freed of any entrained water and sent to the HP steam header, and utilized in other sections of the plant. The reaction temperature is regulated by controlling the pressure in the steam drums.

The hot reactor effluent is cooled by 25 C in the Reactor Gas Coolers [E-212/ E-272/ E-282] by generating Medium Pressure steam. The maximum operating outlet gas temperature is kept below 226 C to limit the temperature of the reactor feed gas

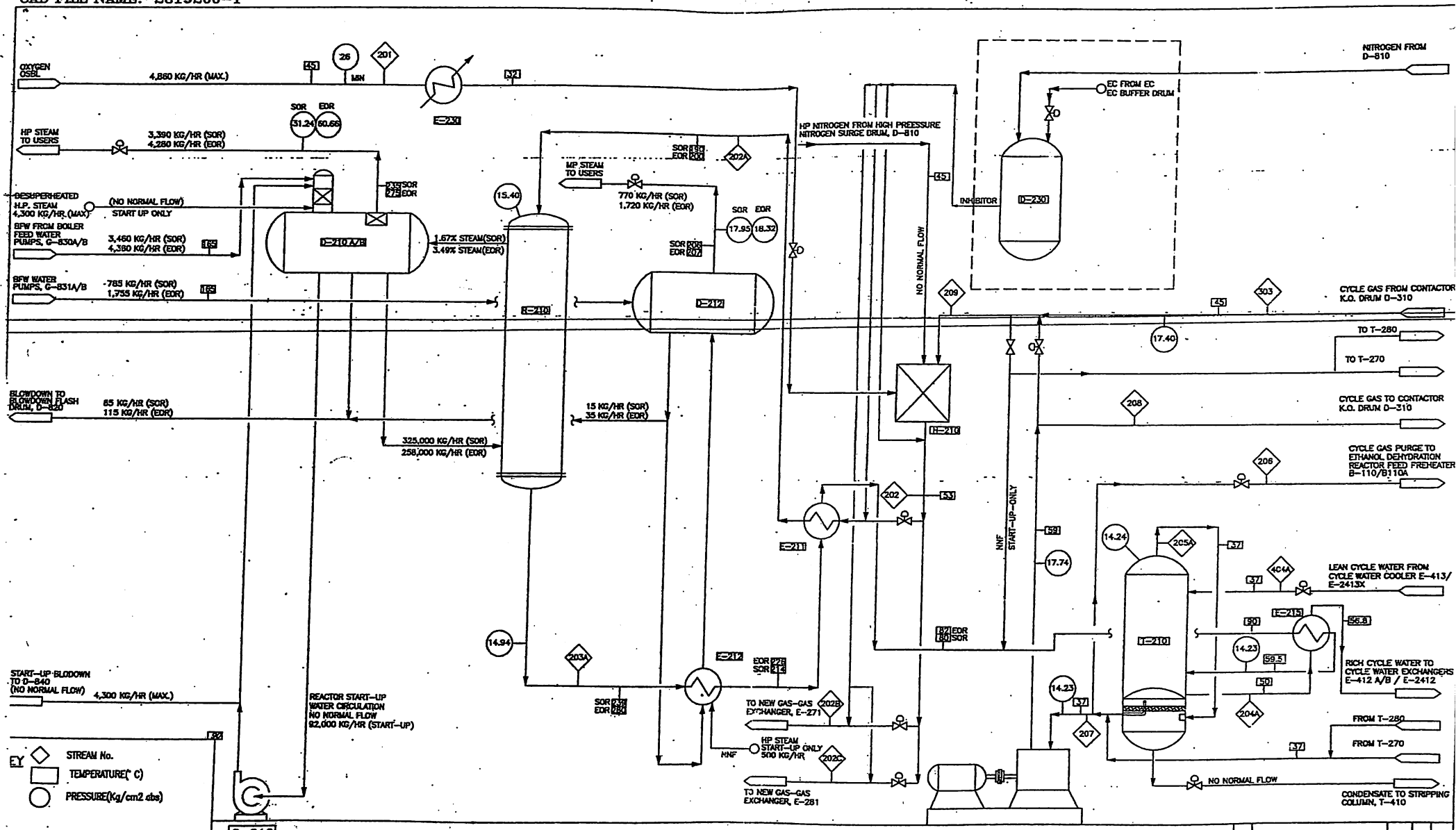
leaving the Gas-Gas Exchanger [E-211/ E-271/ E-281] to 200 C.The reactor effluent is then passed through the shell side of the Gas-Gas Exchanger[E-211/ E-271/ E-281] and cooled to about 80 C.The cooled gas is then passed into the Scrubber and KO Drum[T-210/ T-270/ T-280] where is contacted counter-currently with lean cycle water ,to absorb the ethylene oxide.

Small quantities of other gases, which also dissolve in the scrubbing water, are recovered in the Reabsorber overhead [EO Re-absorption and Reclaim Compressor Section] and compressed back to the reaction section via the CO2 Removal Section. By product water made in the Reactors is condensed in the scrubber.

The scrubber bottoms liquid [rich cycle water] then flows to the Stripping Columns,T-410/T-2410/T-3410 [EO Stripping Section] for recovery of the ethylene oxide. The scrubbed gas from the scrubber overhead passes through the knockout [KO] Drum[the bottom part of T-210/ T-270/ T-280] to the Recycle Compressor, C-270, where it is compressed to restore the pressure lost in the reaction loop. The compressor gas from C-270 is sent to the CO2 Removal Section for removal as CO2 formed in the oxide reactors. The CO2 lean cycle gas from the CO2Removal Section is then recycled back to the Reactor Feed System.

K-280

CAD FILE NAME:-2819200-1



GENERAL NOTES:-

COOLING WATER FOULING FACTOR=0.0003 HR-SQ.M.-°C/KCAL
(-) DENOTES NO NORMAL FLOW COOLING WATER SUPPLY
TEMP.=33°C

NOTES:-

1. REACTOR SELECTIVITY AT START OF RUN (SOR)= 82% & END OF RUN (EOR)=80%

G-210

TAG NO.	DESCRIPTION
D-210 A/B	REACTOR STEAM DRUM
G-210	REACTOR START-UP PUMP
R-210	REACTOR
D-212	REACTOR GAS COOLER STEAM DRUM
E-212	REACTOR GAS COOLER
E-211	GAS-GAS EXCHANGER
H-210	OXYGEN MIXING STATION
D-230	INHIBITOR FEED DRUM
C-280	RECYCLE COMPRESSOR
T-210	SCRUBBER AND K.O. DRUM

C-280

T-210
SCRUBBER/K.O DRUM
1900 mm I.D X 26700mm T-T(EST)
30 SINGLE PASS VALVE TRAYS
TRAYS 1-7 @ 750 mm TRAY SPACING
TRAYS 8-30 @ 600 mm TRAY SPACING
TRAYS-410 SS

E-215

REV.	DESCRIPTION	DATE	BY	CHKD.
0				

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

PROCESS FLOW DIAGRAM - ETHYLENE GLYCOL PLANT

ETHYLENE OXIDE REACTION AND SCRUBBING-1

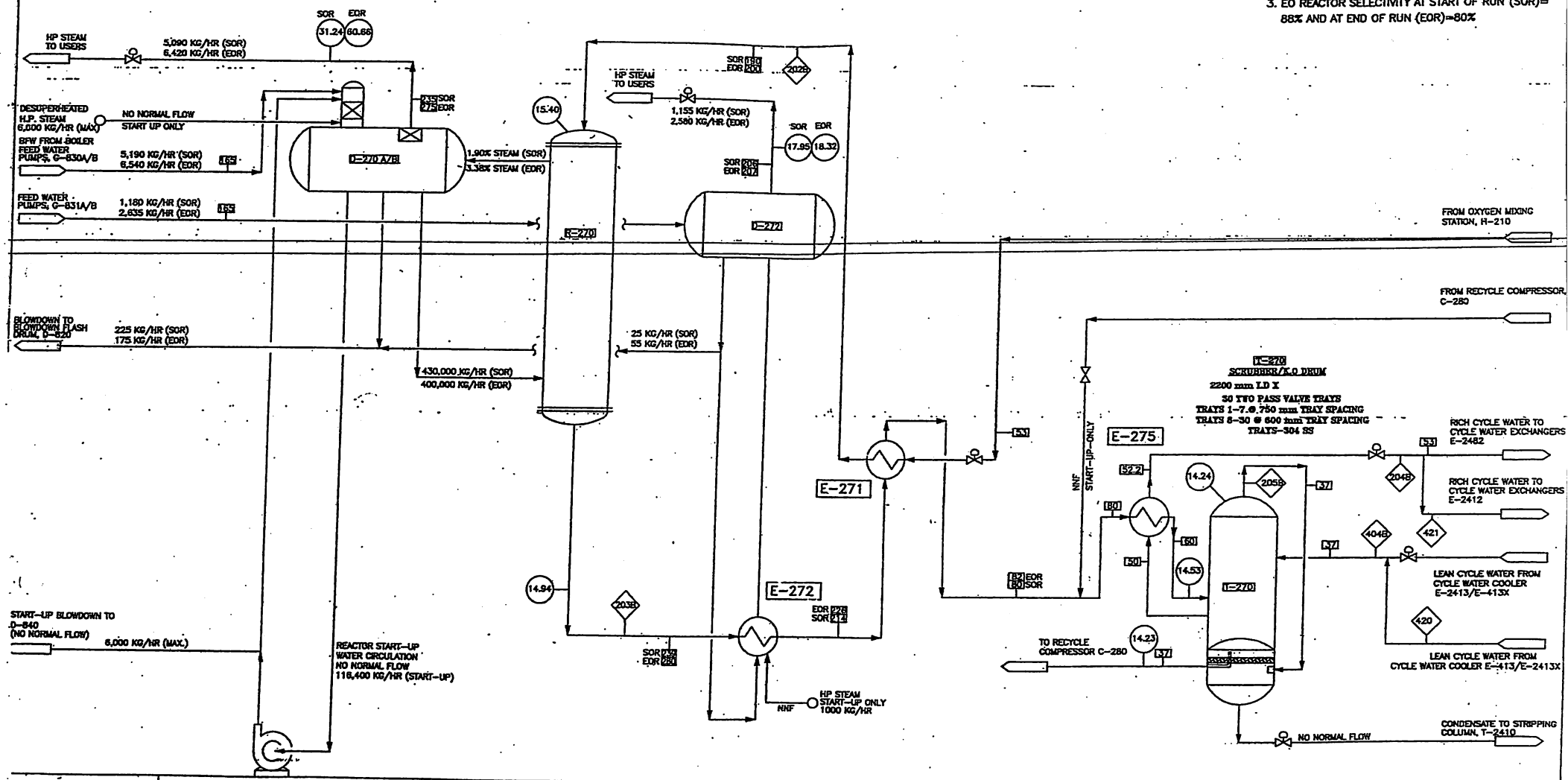
DRAWN BY [illegible] DATE 28/10/03 CHECKED BY AS DATE 07/10/03
APPROVED BY [illegible] DATE 28/10/03 SCALE [illegible]
APPROVED FOR CONSTRUCTION BY _____ DATE _____ DWG.NO=2819-X-200-

CAD FILE NAME-2819200-1

CAD FILE NAME:-2819200-2

NOTES:-

1. FOR GENERAL NOTES SEE DWG. 28192-X-00
2. EO PRODUCTION FOR NEW REACTOR R-270 IS 25420 MTPY OF ETHYLENE OXIDE.
3. EO REACTOR SELECTIVITY AT START OF RUN (SOR)= 88% AND AT END OF RUN (EOR)=80%



KEY

- STREAM No.
- TEMPERATURE(° C)
- PRESSURE(Kg/cm2 abs)

G-270 A/B

TAG NO.	DESCRIPTION
D-210 A/B	REACTOR STEAM DRUM
G-270	REACTOR START-UP PUMP
R-270	REACTOR
D-272	REACTOR GAS COOLER STEAM DRUM
E-272	REACTOR GAS COOLER
E-271	GAS-GAS EXCHANGER
T-270	SCRUBBER AND K.O. DRUM

REV.	DESCRIPTION	DATE	BY	CHKD.
a				

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

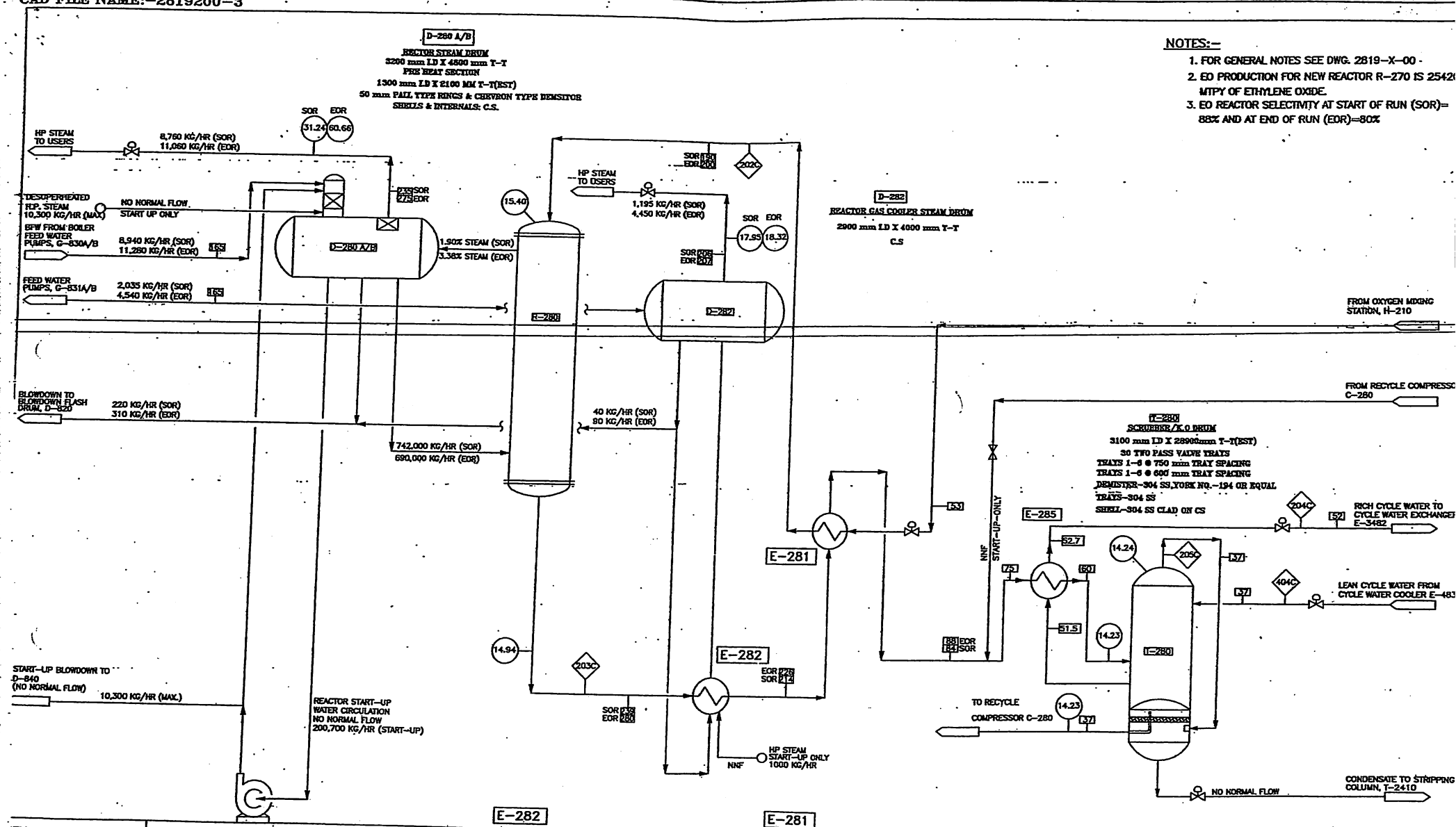
PROCESS FLOW DIAGRAM - ETHYLENE GLYCOL PLANT

ETHYLENE OXIDE REACTION AND SCRUBBING-2

DRAWN BY _____ DATE 08/10/03 CHECKED BY AS DATE 07/10/03
APPROVED BY SD DATE 08/10/03 SCALE NONE
APPROVED FOR CONSTRUCTION BY _____ DATE _____ DRWG. NO. 28192-X-200-2

CAD FILE NAME:-2819200-2

CAD FILE NAME:-2819200-3



NOTES:-

1. FOR GENERAL NOTES SEE DWG. 2819-X-00 -
2. EO PRODUCTION FOR NEW REACTOR R-270 IS 2542(MTPY OF ETHYLENE OXIDE.
3. EO REACTOR SELECTIVITY AT START OF RUN (SOR)= 88% AND AT END OF RUN (EOR)=80%

KEY

- STREAM No.
- TEMPERATURE(° C)
- PRESSURE(Kg/cm2 abs)
- OPRT. TEMPERATURE(° C)

G-280 A/B

REACTOR START UP PUMPS

250 M^3/HR X 14.1 MTDH @ 250°C

C.S

E-282

REACTOR GAS COOLER

Q (SOR) = 1005000 KCaL/Hr
Q (EOR) = 2586000 KCaL/Hr
A = 390 M^2
U(SOR) = 169 Kcal/Hr M^2-°C
U(SOR) = 172 Kcal/Hr M^2-°C
MTD=15.3°C
MTD=38.6°C
SHELLS & TUBES : CS

E-281

REACTOR GAS EXCHANGER

Q (SOR) = 6796000 KCaL/Hr
Q (EOR) = 7291000 KCaL/Hr
A = 1245. M^2
U(SOR) = 173.4 Kcal/Hr M^2-°C
U(SOR) = 172.3 Kcal/Hr M^2-°C
MTD=31.48°C
MTD=34.44°C
SHELLS & TUBES : 304 SS

TAG NO.	DESCRIPTION
D-280 A/B	REACTOR STEAM DRUM
G-280 A/B	REACTOR START-UP PUMPS.
R-280	REACTOR
D-282	REACTOR GAS COOLER STEAM DRUM
E-282	REACTOR GAS COOLER
E-281	REACTOR GAS EXCHANGER
T-280	SCRUBBER AND K.O.DRUM

REV.	DESCRIPTION	DATE	BY	CHKD.
0				

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

PROCESS FLOW DIAGRAM - ETHYLENE GLYCOL PLANT

ETHYLENE OXIDE REACTION AND SCRUBBING-3

DRAWN BY ___ DATE 06/10/03 CHECKED BY AS DATE 07/10/03
APPROVED BY SD DATE 08/10/03 SCALE NONE
APPROVED FOR CONSTRUCTION BY ___ DATE ___ DRG. No. 2819-X-00-3

CAD FILE NAME:-2819200-3

300-1 [CO2 Removal System]

The gas from the Recycle Compressors C-270, containing approximately 1.30 vol% CO2 [@ 88% catalyst selectivity] is combined with gas from the Reclaim Compressor,C-420A/B/C/D/E. The total gas is feed to the middle section of the cycle Gas K.O/Presaturator,D-310.Here the feed gas temperature is raised by direct heat exchange with a stream of heated wash water flowing from the top section of D-310. The heated gas is then sent to the lower section of the Contactor,T-310, where it is contacted with cooled lean potassium carbonate/borate/vandate solution from the regenerator, T-310, and the CO2 content's reduced to a concentration of approximately 0.70 vol%. The CO2 lean cycle gas from the contactor is cooled in the top section of the gas K.O/Presaturator by direct heat exchange with cooled water from the Wash Water Cooler, E-312 and Wash Water Trim Cooler, E-312. This reduces the water content in the reactor feed gas to a level that does not inhibit catalyst activity. This process of scrubbing with water also ensures the complete removal of entrained carbonate before the gas is returned to the reaction section. A portion of scrubbing water from the Wash Water Pumps, G-310A/B, is sent to the flash drum of the Regenerator. The water leaving the bottom of the cycle Gas K.O/Presaturator is recirculated, via the Wash Water Pumps to the top of the cycle Gas K.O/presaturator through the wash Water Trim Cooler. The vapor lean CO2 gas leaving the wash section of the Cycle Gas K.O/Presaturator is returned to the EO section via the bottom section of the Cycle Gas K.O/Presaturator, D-310

The rich carbonate solution from the bottom of the contractor is heated in the Regenerator Feed/Bottoms Exchanger, E-321, by heat exchange with the Regenerator bottoms. It is further heated in the Regenerator Feed Heater, E-322, using LP steam. The solution then flows to the Regenerator Feed Flash Drum [top of the Regenerator] by pressure letdown. The Contractor bottoms pressure is normally at 17.95 Kg/Cm2 abs. In the Regenerator Flash Drum, essentially all the hydrocarbons dissolved in the rich carbonate solution are liberated into the vapor phase which are taken overhead and recycled,together with the reabsorber .[T-430, T-2430 & T-3430] overhead and ethylene -water vapor from the Ethylene Wash Section to the Contactor KO Drum through the Reclaim Compressors. This step reduces the total hydrocarbons in the Regenerator overhead vapor vented to atmosphere.

The remaining solution from the flash drum to the Regenerator flows by pressure letdown to the Regenerator operating at near atmospheric pressure. The top of the Regenerator has special internals designed to accommodate the flashing feed and to minimize solution entrainment in the vapor.

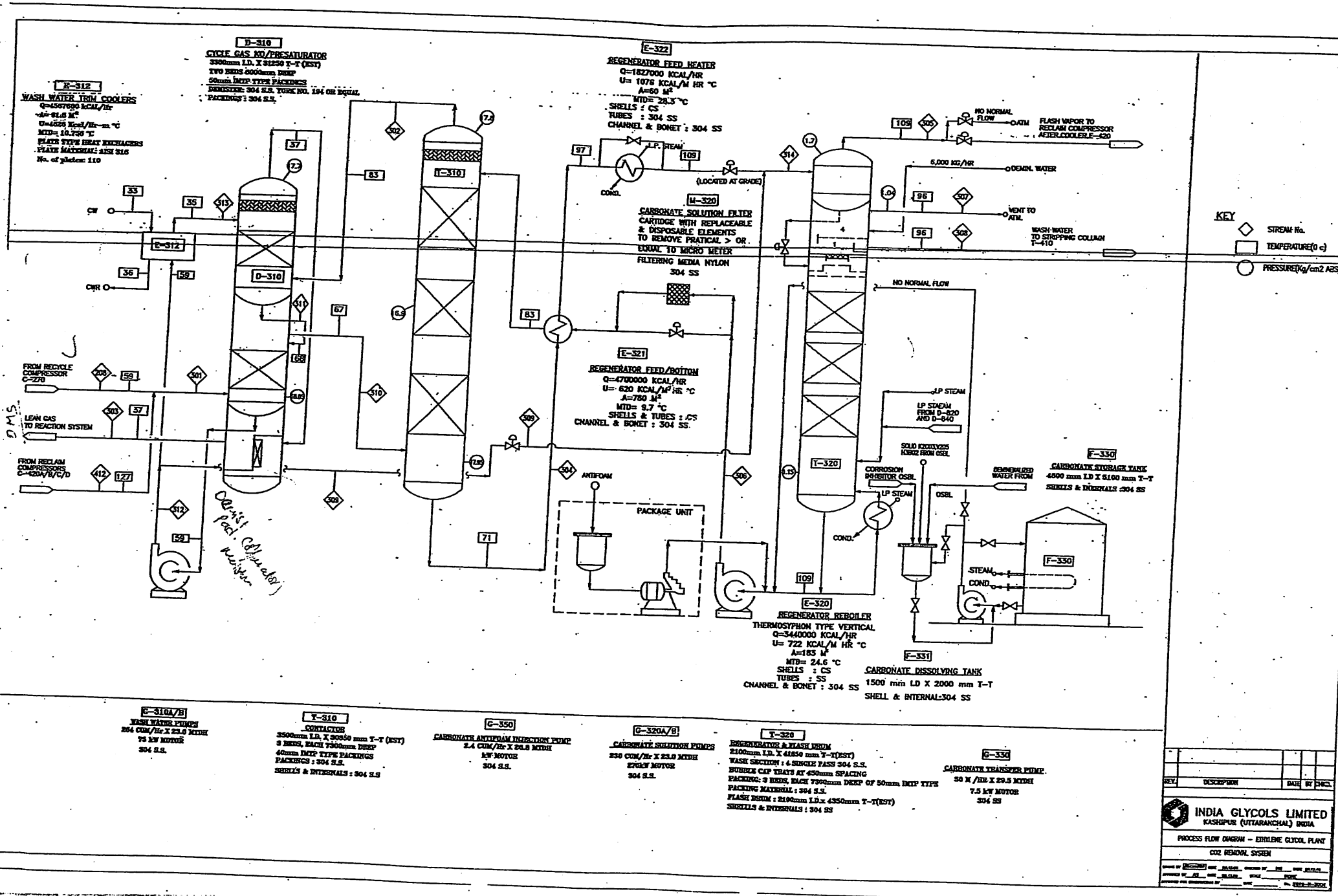
In the Regenerator, the CO2 is stripped out of the rich carbonate solution using steam with the heat supplied both directly [by live steam injection] and indirectly [by Regenerator Reboiler, E-320]. The steam provides heat to strip out the CO2 and to make up sensible heat lost to the gas in the contractor. The balance between the steam added directly and indirectly is adjusted to maintain the solution strength at approximately 30 wt% equivalent of potassium carbonate [25 wt% equivalent

potassium carbonate ,4 wt% potassium borate and 1.5 wt% potassium vanadate], i.e. to maintain the water balance around the unit.

The bottom of the Regenerator is sent to the Contractor via the Carbonate Solution Pumps, G-320A/B. Before entering to the Contactor, the lean carbonate solution is first cooled in the Regenerator Feed/Bottoms Exchanger; E-321.To remove particulate matter larger than 10 microns, a portion of the lean carbonate solution is passed through the Carbonate Solution Filter, M-320.

In the rich solution approximately 45% of the carbonate is converted to bicarbonate, i.e the fractional conversion is 0.45. In contrast, in the lean solution the fractional conversion is about 0.29. To avoid excessive foaming the solution strength must be kept above 25 wt% equivalent K2CO3. At design solution concentration foaming is minimized by a continuous addition of a small amount of an antifoam agent via the Carbonate Antifoam Injection System, G-350; into the lean carbonate solution upstream of the Carbonate Solution Pumps.

Makeup activated carbonate solution is provided by dissolving K2CO3, H3BO3 [boric acid] and V2O5 [vanadium pent oxide] in dematerialized water in the Carbonate Dissolving Tank, F-331. The fresh carbonate solution is stored in the Carbonate Storage Tank, F-330 and pumped into the lean carbonate solution line via the Carbonate Transfer Pump, G-330.


D-310
CYCLE GAS KO/PRESATURATOR
3300mm I.D. X 31250 T-T (EST)
TWO BEDS 6000mm DEEP
50mm IMTP TYPE PACKINGS
DEMISTER: 304 S.S. TORC RD. 194 OR EQUAL
PACKINGS : 304 S.S.
E-312
WASH WATER TRIM COOLERS
Q=4567600 kCAL/Hr
A=61.6 M²
U=4626 K-cl/Hr-m °C
MTD= 10.756 °C
PLATE TYPE HEAT EXCHAGERS
PLATE MATERIAL: AISI 316
No. of plates: 110
E-322
REGENERATOR FEED HEATER
Q=1827000 KCAL/HR
U= 1076 KCAL/M HR °C
A=60 M²
MTD= 28.3 °C
SHELLS : CS
TUBES : 304 SS
CHANNEL & BONET : 304 SS
M-320
CARBONATE SOLUTION FILTER
CARTIDGE WITH REPLACEABLE
& DISPOSABLE ELEMENTS
TO REMOVE PRATICAL > OR .
EQUAL TO MICRO METER
FILTERING MEDIA NYLON
304 SS
E-321
REGENERATOR FEED/BOTTOM
Q=4700000 KCAL/HR
U= 620 KCAL/M² HR °C
A=780 M²
MTD= 9.7 °C
SHELLS & TUBES : CS
CNANNEL & BONET : 304 SS.
E-320
REGENERATOR REBOILER
THERMOSYPHON TYPE VERTICAL
Q=3440000 KCAL/HR
U= 722 KCAL/M HR °C
A=185 M²
MTD= 24.6 °C
SHELLS : CS
TUBES : SS
CNANNEL & BONET : 304 SS
T-320
F-330
CARBONATE STORAGE TANK
4500 mm I.D X 5100 mm T-T
SHELLS & INTERNALS :304 SS
F-331
CARBONATE DISSOLVING TANK
1500 mm I.D X 2000 mm T-T
SHELL & INTERNAL=304 SS
PACKAGE UNIT
ANTIFOAM
CW
CWR
FROM RECYCLE COMPRESSOR C-270
LEAN GAS TO REACTION SYSTEM
FROM RECLAIM COMPRESSORS C-420A/B/C/D
LP STEAM
COND.
NO NORMAL FLOW
FLASH VAPOR TO RECLAIM COMPRESSOR AFTER COOLER E-420
6,000 KG/HR
DEMIN. WATER
VENT TO ATM.
WASH WATER TO STRIPPING COLUMN T-410
LP STEAM FROM D-820 AND D-840
CORROSION INHIBITOR OSBL
DEMINERALIZED WATER FROM
OSBL
STEAM
COND
KEY
STREAM No.
TEMPERATURE(0 c)
PRESSURE(Kg/cm2 ABS)
E-310A/B
WASH WATER PUMPS
254 CUM/Hr X 23.6 MTSH
75 kW MOTOR
304 S.S.
T-310
CONTACTOR
3500mm I.D. X 30850 mm T-T (EST)
3 BEDS, EACH 7300mm DEEP
40mm IMTP TYPE PACKINGS
PACKINGS : 304 S.S.
SHELLS & INTERNALS : 304 S.S
G-350
CARBONATE ANTIFOAM INJECTION PUMP
2.4 CUM/Hr X 26.8 MTSH
kW MOTOR
304 S.S.
G-320A/B
CARBONATE SOLUTION PUMPS
230 CUM/Hr X 23.0 MTSH
270kW MOTOR
304 S.S.
T-320
REGENERATOR & FLASH DRUM
2100mm I.D. X 41850 mm T-T(EST)
WASH SECTION : 4 SINGLE PASS 304 S.S.
BUBBLE CAP TRAYS AT 450mm SPACING
PACKING: 3 BEDS, EACH 7300mm DEEP OF 50mm IMTP TYPE
PACKING MATERIAL : 304 S.S.
FLASH DRUM : 2100mm I.D x 4350mm T-T(EST)
SHELLS & INTERNALS : 304 SS
G-330
CARBONATE TRANSFER PUMP
30 M /HR X 29.5 MTSH
7.5 kW MOTOR
304 SS
REV. DESCRIPTION DATE BY CHKD.
INDIA GLYCOLS LIMITED
KASHIPUR (UTTARANCHAL) INDIA
PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT
CO2 REMOVAL SYSTEM

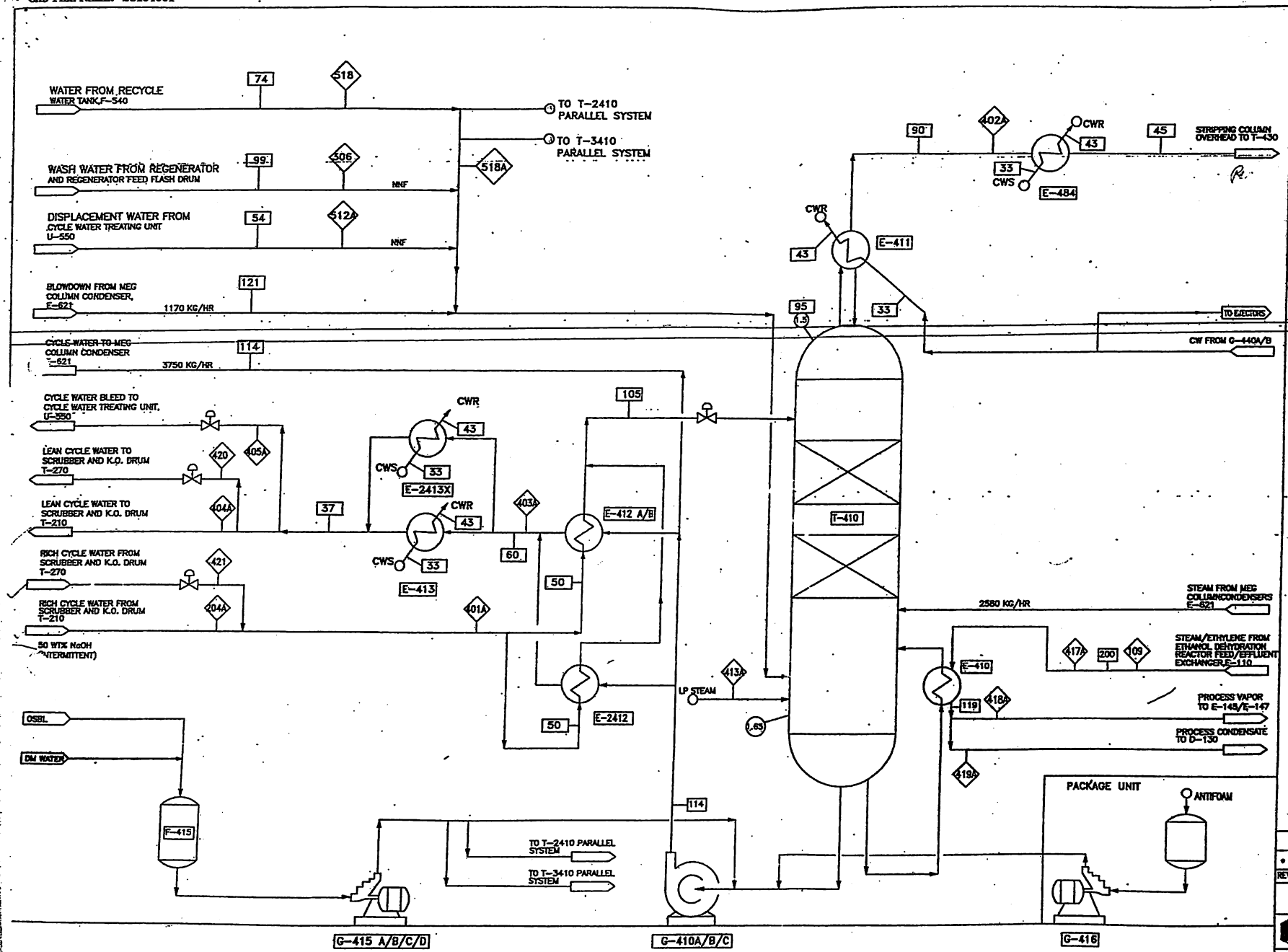
400-1,2& 3 [ETO Stripping]

The rich cycle water from the Scrubbers (T-210, T-270, &T-280) is fed to the cycle Water exchangers (E-412 A/B, E-2412 E-2482, & E-3482) which are feed bottoms exchangers for the Stripping Columns (T-410, T-2410 & T-3410). The heated rich cycle water at 105 C is flashed into top of the Stripping Columns (T-410, T-2410 & T-3410) where the oxide is stripped overhead. These columns are operated at a top pressure of approximately 1.5 Kg/cm2 Abs. The Stripping Columns Reboilers (E-410, E-2410 & E-3410) supply necessary stripping heat requirement. The additional heat for stripping is supplied by the live injection of steam generated in the MEG Column Condensers (E-621, E-2621 & E-3621) and 3 Kg/cm2g. The bottoms are stripped to an ethylene oxide concentration of 12 Wt.ppm (5Mol ppm) .In additions, the dissolved carbon dioxide; ethane, oxygen, nitrogen and argon are also stripped out.

The lean (stripped) water from the bottom of the Stripper at 114 C is pumped by the Stripping Column Bottoms Pumps (G-410 A/B/C, G-2410 A/B/C & G-3410 A/B/C) through Cycle Water Exchangers (E-412 A/B, E-2412, E-2482 & E-3482) and Cycle Water Coolers (E-413, E-2413X, E-2413, E-413X ,E-483 &E-483X) where it is cooled to about 37 C before being returned to the top of the scrubber (T-210, T-270 & T-280). A small portion of the stripper bottoms is sent to the MEG Column Condensers (E-621, E-2621 & E-3621) which acts as a waste heat reboiler for the Stripping Column Bottoms.
The glycol concentration in the cycle water builds up due to a small amount of glycol formation in the cycle water loop and from the glycols present in stripping steam from the MEG Column Condenser which is fed into the stripping Column bottoms. The expected glycol concentration in the cycle water bled will be about 1.25 Wt%.
The cycle Water bleed is taken after the cycle Water Coolers and is sent to the Cycle Water Treating Units (U-550/
U-555).
A 10 wt% caustic solution is injected into the suction of G-410 A/B/C, G-2410 A/B/C & G-3410 A/B/C to neutralize the trace organic acids made in the oxide reactor and build up in the cycle water. A small amount of anti foam is also continuously added to the cycle water via the cycle water anti-foam injection system pumps (G-416, G-2416 &G-3416 to prevent excessive foaming.

The ethylene, ethylene oxide, inerts and water vapors from the stripping Columns pass through the Stripping Column Condensers (E-411, E-2411 &-3411) which are knock back condensers. In this unit most of the water and heavy compounds are condensed and flow back to the top bed of the Stripping Columns as reflux. The Stripping Column Condensers (E-411 & E-2411) in old train are augmented with Stripping Column Trim Condensers (E-484 &E-2484) for further cooling of Stripping Column overhead vapors. The cooled vapor are mixed together with the overhead vapor from the Glycol Feed Strippers (T-510, T-2510 & T-3510) are sent to the Reabsorber (T-430, T-2410 &
T-3430).

CAD FILE NAME:-28194001



KEY

◇ STREAM No.

▭ TEMPERATURE(0 c)

○ PRESSURE(Kg/cm2 abs)

NOTES:-

1. FOR GENERAL NOTES SEE DWG.2819-0-00

TAG NO.	DESCRIPTION
T-410	STRIPPING COLUMN
E-413	CYCLE WATER COOLER
E-2413	CYCLE WATER COOLER
E-412 A/B	CYCLE WATER EXCHANGER
E-2412	CYCLE WATER EXCHANGER
G-415 A/B/C	-
G-410 A/B/C	STRIPPING COLUMN BOTTOM PUMP
E-411	STRIPPING COLUMN CONDENSER
E-410	STRIPPING COLUMN REBOILER
E-416	CYCLE WATER ANTI FOAM INJECTION SYSTEM PUMP
E-484	STRIPPING COLUMN TRIM CONDENSER

REV.	DESCRIPTION	DATE	BY	CHKD.

INDIA GLYCOLS LIMITED
KASHIPUR (UTTARANCHAL) INDIA

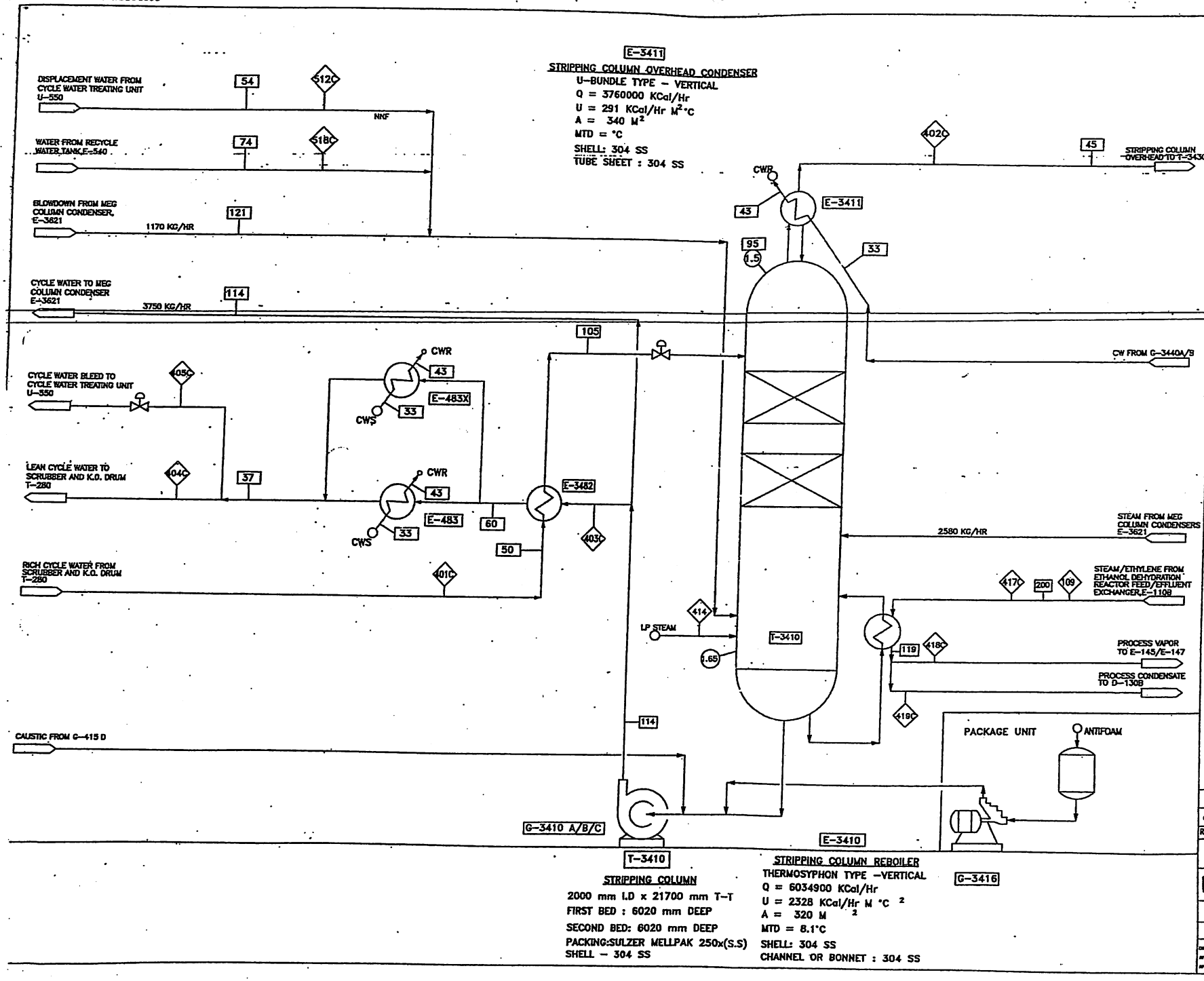
PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

EO STRIPPING-1

No. 2819-X-4001

CAD FILE NAME:-28194001

CADFILE NAME:-28194003



KEY

◇ STREAM No.

▭ TEMPERATURE(0 c)

○ PRESSURE(Kg/cm2 abs)

NOTES:-

1. FOR GENERAL NOTES SEE DRG. 2819-D-00

TAG NO.	DESCRIPTION
E-3484	CYCLE WATER EXCHANGER
G-3410 A/B/C	STRIPPING COLUMN BOTTOM PUMP
E-3411	STRIPPING COLUMN CONDENSER
T-3410	STRIPPING COLUMN
E-3410	STRIPPING COLUMN REBOILER
G-3416	CYCLE WATER ANTI FOAM INJECTION PUMP

REV.	DESCRIPTION	DATE	BY	CHKD.
0				

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

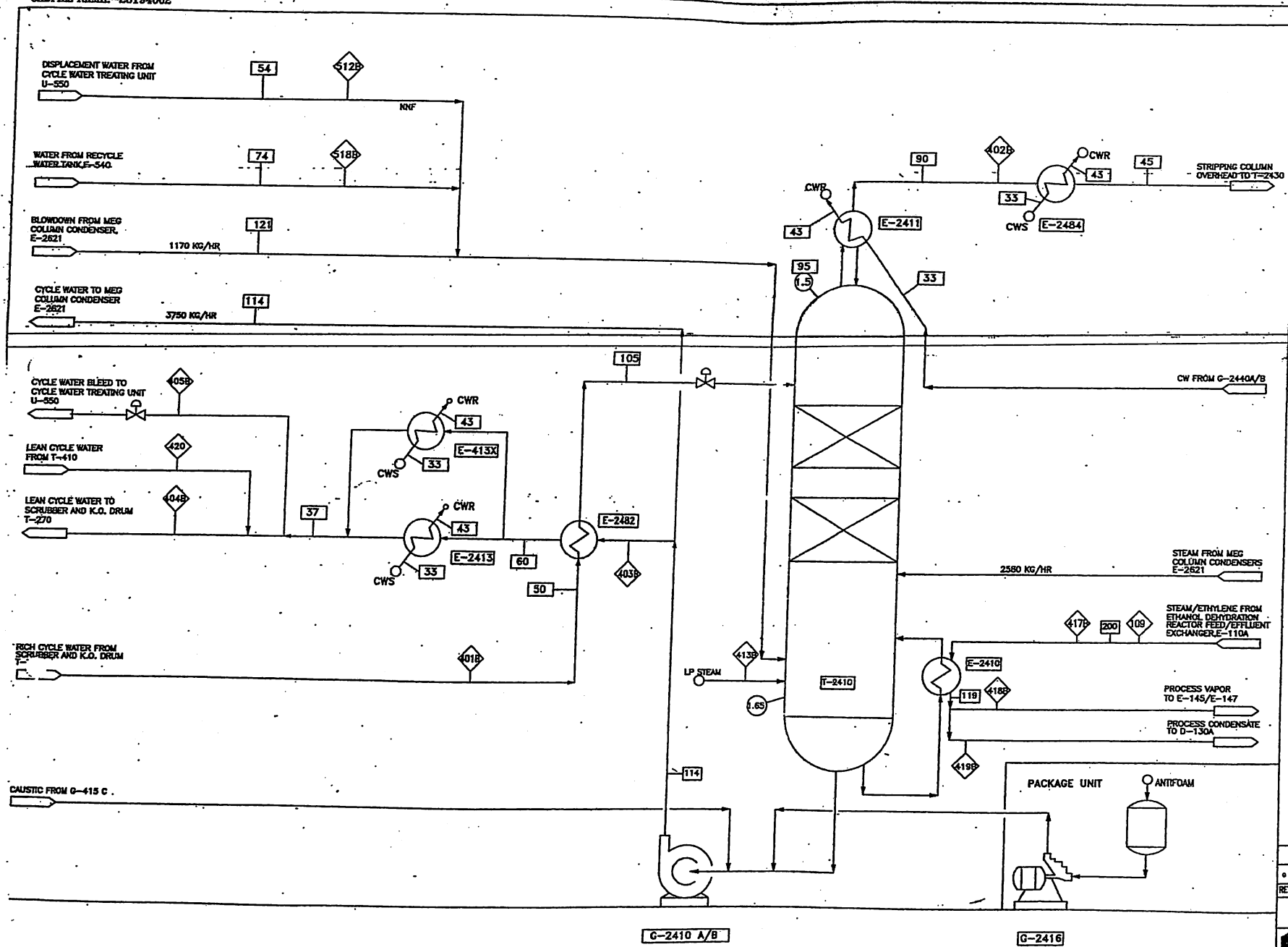
PROCESS FLOW DIAGRAM - ETHYLENE GLYCOL PLANT

EO STRIPPING-2

DRAWN BY [illegible] DATE 30/05/05 CHECKED BY AS DATE 27/05/05
APPROVED BY SS DATE 30/05/05 SCALE NONE
APPROVED FOR CONSTRUCTION BY _____ DATE _____ No. 2819-X-4003

CADFILE NAME:-28194003

CADFILE NAME:-28194002



KEY

- ◇ STREAM No.
- ▭ TEMPERATURE(0 c)
- ○ PRESSURE(Kg/cm2 abs)

NOTES:-

1. FOR GENERAL NOTES SEE DRG. 2819-D-00

TAG NO.	DESCRIPTION
E-413	CYCLE WATER COOLER
E-2413	CYCLE WATER COOLER
E-2482	CYCLE WATER EXCHANGER
G-2410 A/B/C	STRIPPING COLUMN WATER PUMP
T-2410	STRIPPING COLUMN
E-2411	STRIPPING COLUMN CONDENSER
E-2410	STRIPPING COLUMN REBOILER
E-2484	STRIPPING COLUMN TRIM CONDENSER
G-2416	ANTI FOAM INJECTION SYSTEM PUMP

REV.	DESCRIPTION	DATE	BY	CHKD.
0				

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

EO STRIPPING-3

DRAWN BY Deepak DATE 25/05/05 CHECKED BY [illegible] DATE 27/05/05
APPROVED BY [illegible] DATE 28/05/05 SCALE NONE
APPROVED FOR CONSTRUCTION BY _____ DATE _____ No. 2819-K-4002

CADFILE NAME:-28194002

400-4,5 & 6 (ETO Reabsorption and Reclaim Compression)

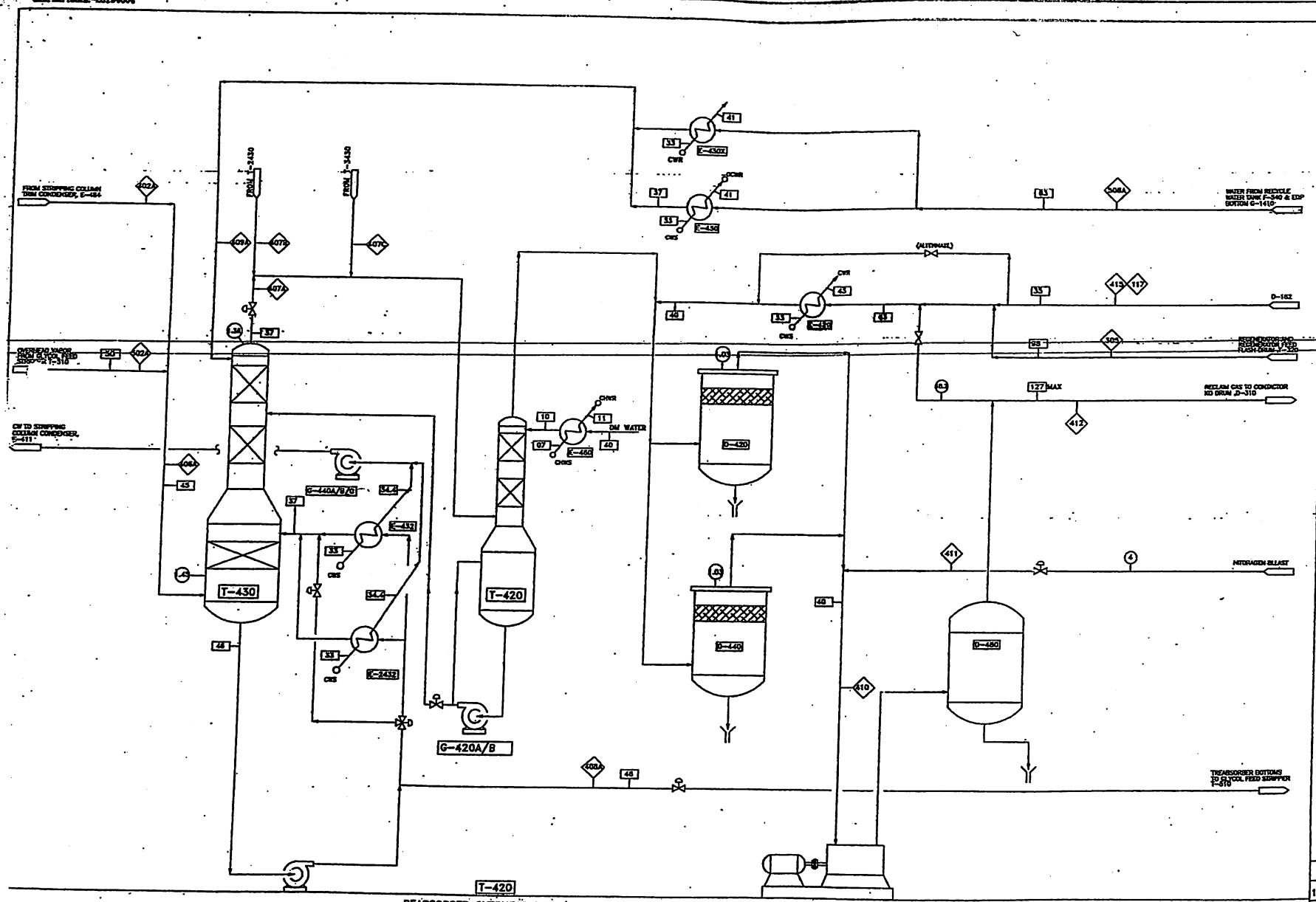
Ethylene oxide contained in the vapor feed is absorbed by cooled water in the Reabsorber (T-430, T-2430 &
T-3410) which are packed with IMTP rings. Ethylene and other non-condensable gases leaving the top of these columns is water washed to remove traces of EO in Reabsorper overhead wash column, T-420. Washed gas from T-420 overhead is mixed with Ethylene Water Vapors from Ethylene Dehydration Excess Steam Condenser (E-130) and the Regenerator feed flash drum overhead, before being returned to reaction section via Reclaim Compressor (C-420 A/B/C/D) and CO2 Removal System.

To improve the absorption of oxide in the bottom section of the Reabsorper, a part of the bottoms solutions (at approximately 46 C) is cooled and recirculated through the bottom packed bed. This recirculated solution is cooled to 37 C in the Reabsorber Bottoms Coolers (E-432, E-2432, and E-2492 & E-3492) using bypass control to maintain the desired temperature.

The process water fed to the top of the Reabsorber is water from the Recycle Water Tank (F-540) via the Recycle Water Pumps (G-1410 A/B). The water is cooled to 37 C in the Reabsorper Water Coolers (E-430, E-430X, E-2430, E-2430X & E-3430). The flow of water is adjusted to maintain a Reabsorper bottoms concentration of approximately 9.8 Wt% ethylene oxide. The Reabsorber bottoms Pumps (G-430 A/B/C, G-2430 A/B & G-3430 A/B) transfer the solution to the glycol Feed Strippers (T-510, T-2510 & T-3510).

The vents from the purification Column Receiver (D-1410) and the Purified EO Rundown Tanks (D-1810 A/B) are sent to the Reabsorber for ethylene Oxide recovery.

CADFILE NAME:-28194004



KEY

- STREAM No.
- TEMPERATURE(0 c)
- PRESSURE(Kg/cm2 abs)

NOTES:-

1. FOR GENERAL NOTES SEE DRG. 2819-D-00

TAG NO.	DESCRIPTION
T-430	REABSORBER
G-430 A/B/C	REABSORBER BOTTOM PUMP
E-432	REABSORBER BOTTOM COOLER
E-2432	REABSORBER BOTTOM COOLER
G-440 A/B/C	COOLING WATER BOOSTER PUMP
T-430	VENT SCRUBBER
E-430X	REABSORBER WATER COOLER
E-430	REABSORBER WATER COOLER
E-420	RECLAIM COMPRESSOR INTER COOLER
C-420 A/B/C/D	RECLAIM COMPRESSOR
D-420	RECLAIM COMPRESSOR K.O DRUM
D-440	RECLAIM COMPRESSOR K.O DRUM
D-480	RECLAIM COMPRESSOR K.O DRUM
E-460	DM WATER COOLER

T-420

REABSORBER OVERHEAD WASH COLUMN

TWO BEDS
TOP BED:
750 mm I.D X 1000 MM HEIGHT
BOTTOM BED:
750mm I.D X 6000 MM HEIGHT
50 mm SS PALL RINGS.
OVERALL HEIGHT OF TOWER :
SHELL-SA-240 TP .304

REV.	DESCRIPTION	DATE	BY	CHKD.
1	T-420 REVAMPED	01.04.07	SG	AS

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

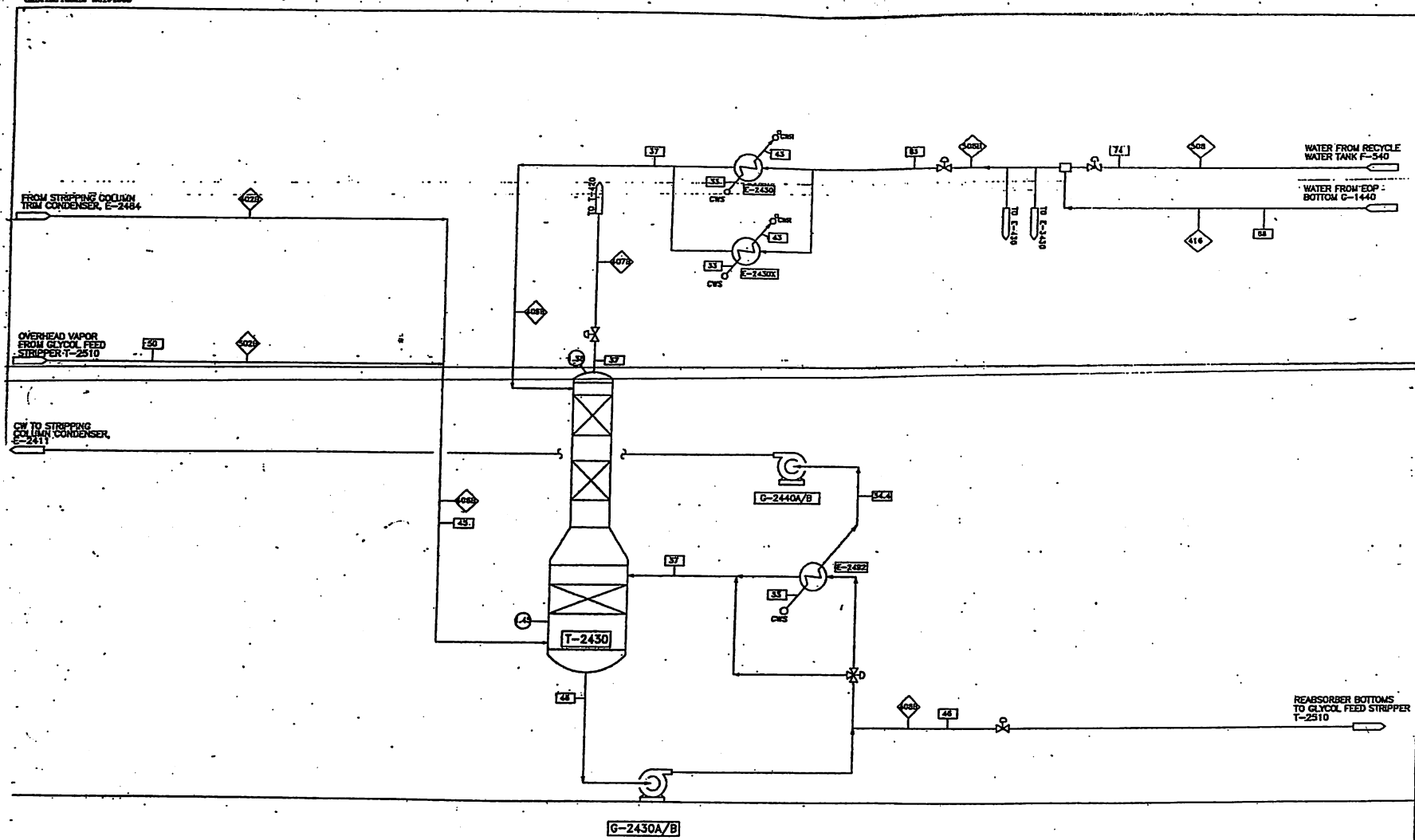
PROCESS FLOW DIAGRAM - ETHYLENE GLYCOL PLANT

EO REABSORPTION AND RECLAIM COMPRESSION-1

DRAWN BY [illegible] DATE 28/08/03 CHECKED BY AS DATE 27/08/03
APPROVED BY SD DATE 28/08/03 SCALE NONE
APPROVED FOR CONSTRUCTION BY _____ DATE _____ No. 2819-K-4004

CADFILE NAME:-28194004

CADFILE NAME:-28194005



KEY

STREAM No.

TEMPERATURE(0 c)

PRESSURE(Kg/cm2 ab

NOTES:-

1. FOR GENERAL NOTES SEE DRG. 2819-D-00

TAG NO.	DESCRIPTION
T-2430	REABSORBER
G-2430 A/B	REABSORBER BOTTOM PUMP
E-2430	REABSORBER WATER COOLER
E-2430X	REABSORBER WATER COOLER
E-2402	REABSORBER BOTTOM PUMP
G-2440 A/B	-

REV.	DESCRIPTION	DATE	BY	CHKD.
0				

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

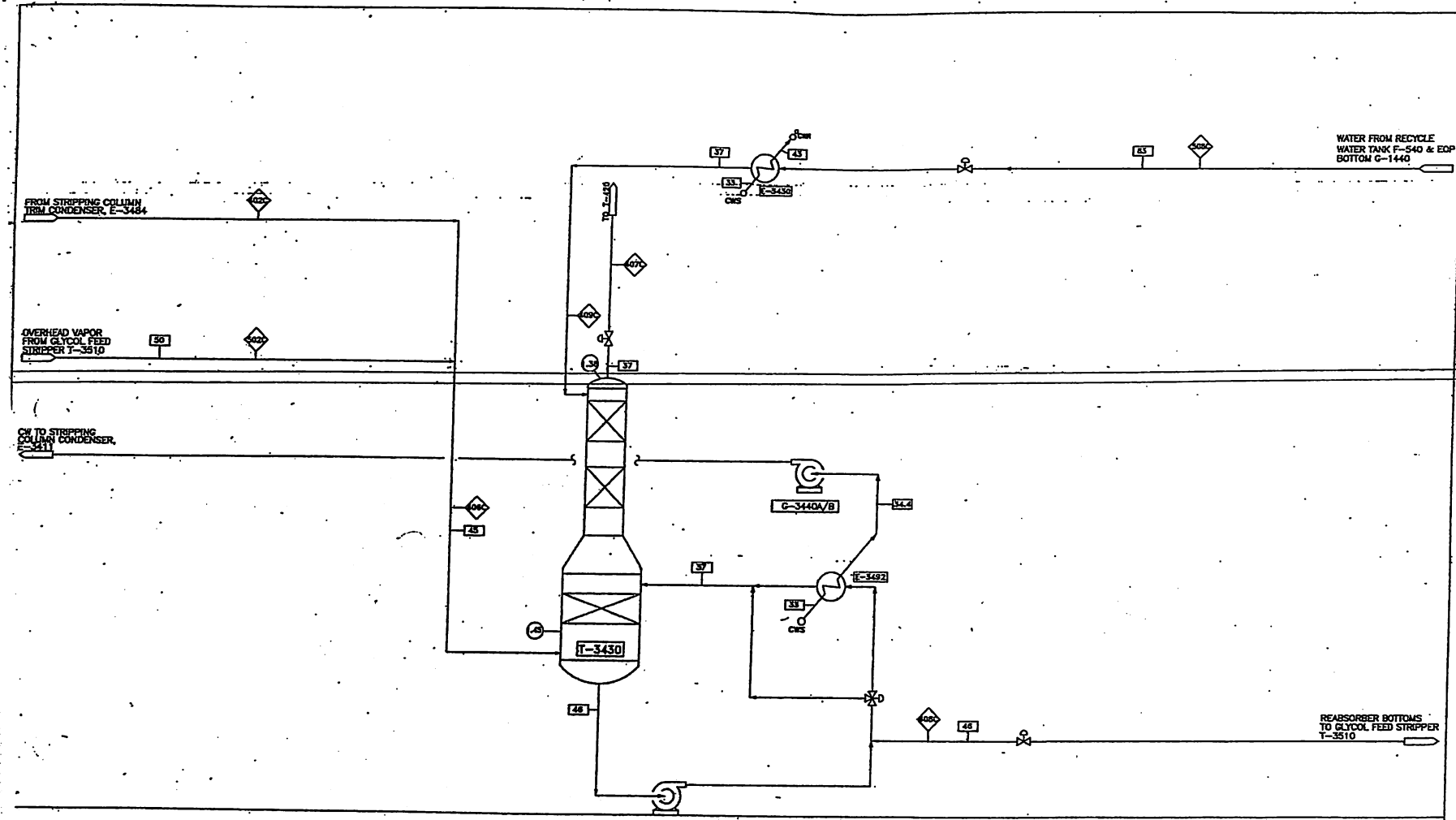
PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

EO REABSORPTION-2

No. 2819-X-4005

CADFILE NAME:-28194005

CADFILE NAME:-28194006



G-3430A/B

T-3430

REABSORBER

OVERALL HEIGHT: 25400 mm (EST)
TOP SECTION
950 mm I.D x 12220 mm T-T (EST)
TWO PACKED BEDS 4900 mm DEEP
IMTP TYPE PACKINGS
BOTTOM SECTION
1400 mm I.D x 12700 mm T-T (EST)
ONE BED 4900 mm DEEP
IMTP TYPE PACKINGS
SHELLS & INTERNALS-304 SS

KEY

STREAM No.

TEMPERATURE(0 c)

PRESSURE(Kg/cm2 abs)

NOTES:-

1. FOR GENERAL NOTES SEE DRG. 2819-0-00

TAG NO.	DESCRIPTION
T-3430	REABSORBER
G-3430 A/B	REABSORBER BOTTOM PUMP
E-3430	REABSORBER WATER COOLER
E-3492	REABSORBER BOTTOM PUMP
G-3440 A/B	-

REV.	DESCRIPTION	DATE	BY	CHKD.

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

EO REABSORPTION-3

DRAWN BY _____ DATE _____ CHECKED BY _____ DATE _____
APPROVED BY _____ DATE _____ SCALE _____
APPROVED FOR CONSTRUCTION BY _____ DATE _____ No. 2819-X-4006

CADFILE NAME:-28194006

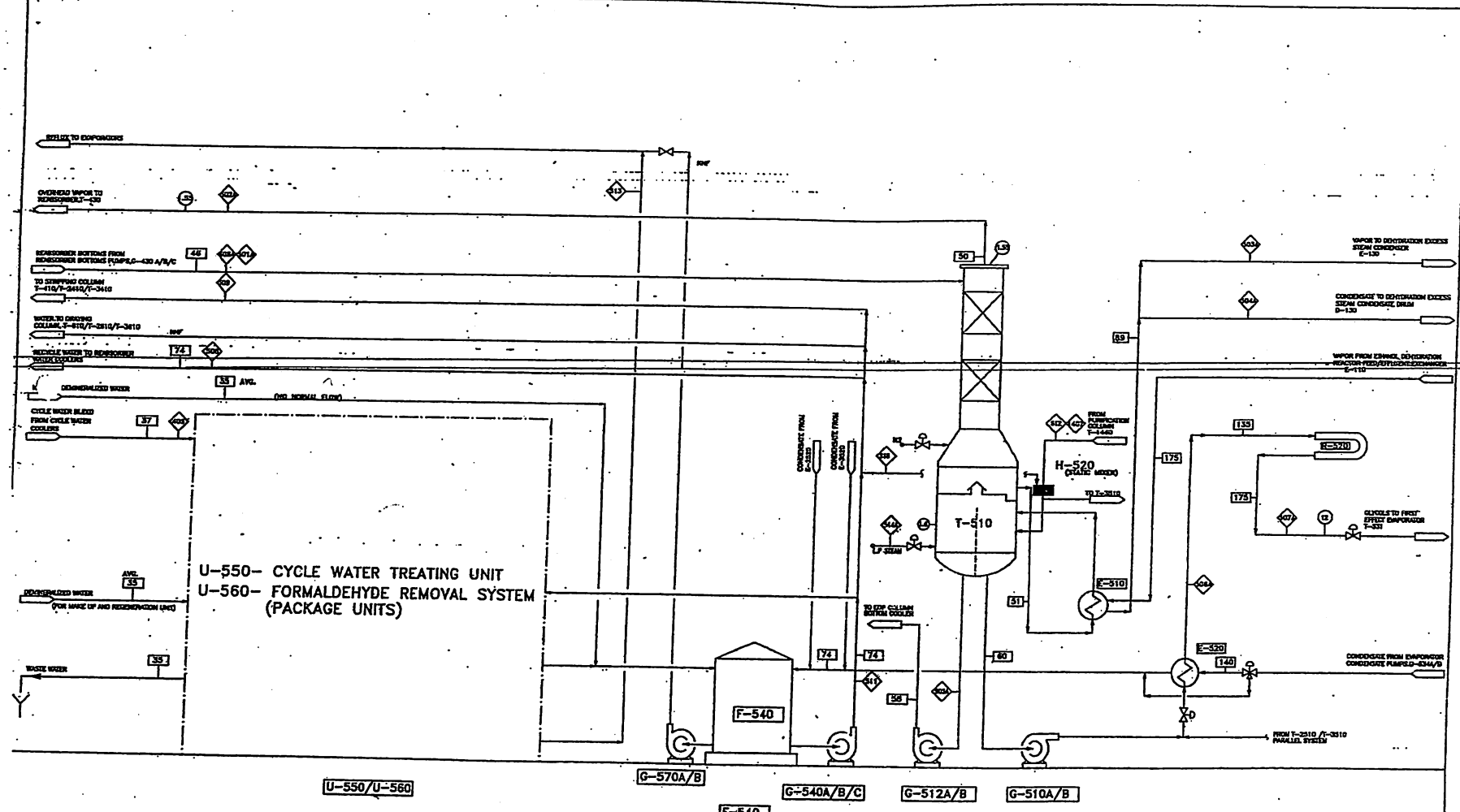
Glycol Reaction Section

PFD NO. 2819-X-500-1 ,2,3 (Glycol Reaction)

The ethylene oxide solution in the Reabsorber contains dissolved CO2 which would present a corossion problem in the glycol plant, where a good deal of carbon steel equipment is used. It is therefore stripped of itsCO2 in the Glycol Feed Strippers (T-510, T-2510 &-T3510) via Glycol Feed Strippers Reboilers (E-510 E-2510 & E-3510) where hot Ethylene Water Vapors from the Ethanol Dehydration section are used for heating. The over-head vapor from the Glycol Feed Strippers containing about 90 mol% of Ethylene oxide is recycled back to the reabsorber (T-430, T-2430 & T-3430). One section of T-3510 bottom feeds EO Purification Column (T-1410) via EO Purification Column feed pumps (G-3512 A/B/C). T-510/T-2510 bottoms and the other section of T-3510 bottoms are pumped by the reactor Feed Pumps (G-510 A/B G-2510 A/B/C & G-3510 A/B) to the Glycol Reactors. Prior to entry into the Glycol Reactors (R-520, R-570 & R-580), the feed is heated to 1350C in the Reactor Feed Preheators (E-520, E-2510 & E-3510) by heat exchange with evaporator condensate returning from the Evaporator Condensate Drums (D-534, D-2534 & D-3534).

The hot oxide water mixture is fed to the Glycol Reactors (R-520, R-570 & R-580) adiabatic, pipeline reactors which are designed to produce a maximum amount of monoethylene glycol (MEG) based on the water to oxide molar ratio of 25/1 in the Reactor Feed. The reaction is non\catalytic and essentially complete conversion of the ethylene oxide is attained. The effluents from the Glycol Reactors (R-520, R-570 & R-580) go directly to the parallel vaporator system for the removal of water.
The reactor effluent at approximately 1750C passes directly into the First Effect Evaporators (T-530, T-2531 & T-3531).
Condensate from Evaporators is pumped by the Evaporator Condensate pumps (G-534 A/B G-2534 A/B & G-3534 A/B) for cooling by heat exchange with the Glycol Reactor' feed in E-520 E-2520 & E-3520 and then sent to the Recycle Water Tank (F-540).
Interconnections have been provided for transferring/ redistribution of Ethylene Oxide + Water Solution at Glycol Feed Stripper (T-510, T-2510 & T-3510) bottoms.
Existing link-ups between EOP Unit and First/ Second Train of Reabsorber / Glycol Feed Stripper are retrained for future use, if so required.

CADFILE NAME:-2819500-1



F-540

RECYCLE WATER TANK
4000 mm I.D X 4500 MM T-T
CS

KEY

STREAM No.

TEMPERATURE(0 c)

PRESSURE(Kg/cm2 c

NOTES:-

1. FOR GENERAL NOTES SEE DRG. 2819-D-00

TAG NO.	DESCRIPTION
F-540	RECYCLE WATER TANK
T-510	GLYCOL FEED STRIPPER
R-520	GLYCOL REACTOR
E-520	REACTOR FEED PREHEATER
E-510	GLYCOL FEED STRIPPER REBOILER
G-510 A/B	GLYCOL REACTOR FEED PUMP
G-540 A/B	RECYCLE WATER PUMPS

REV.	DESCRIPTION	DATE	BY	CHKD.
0				

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

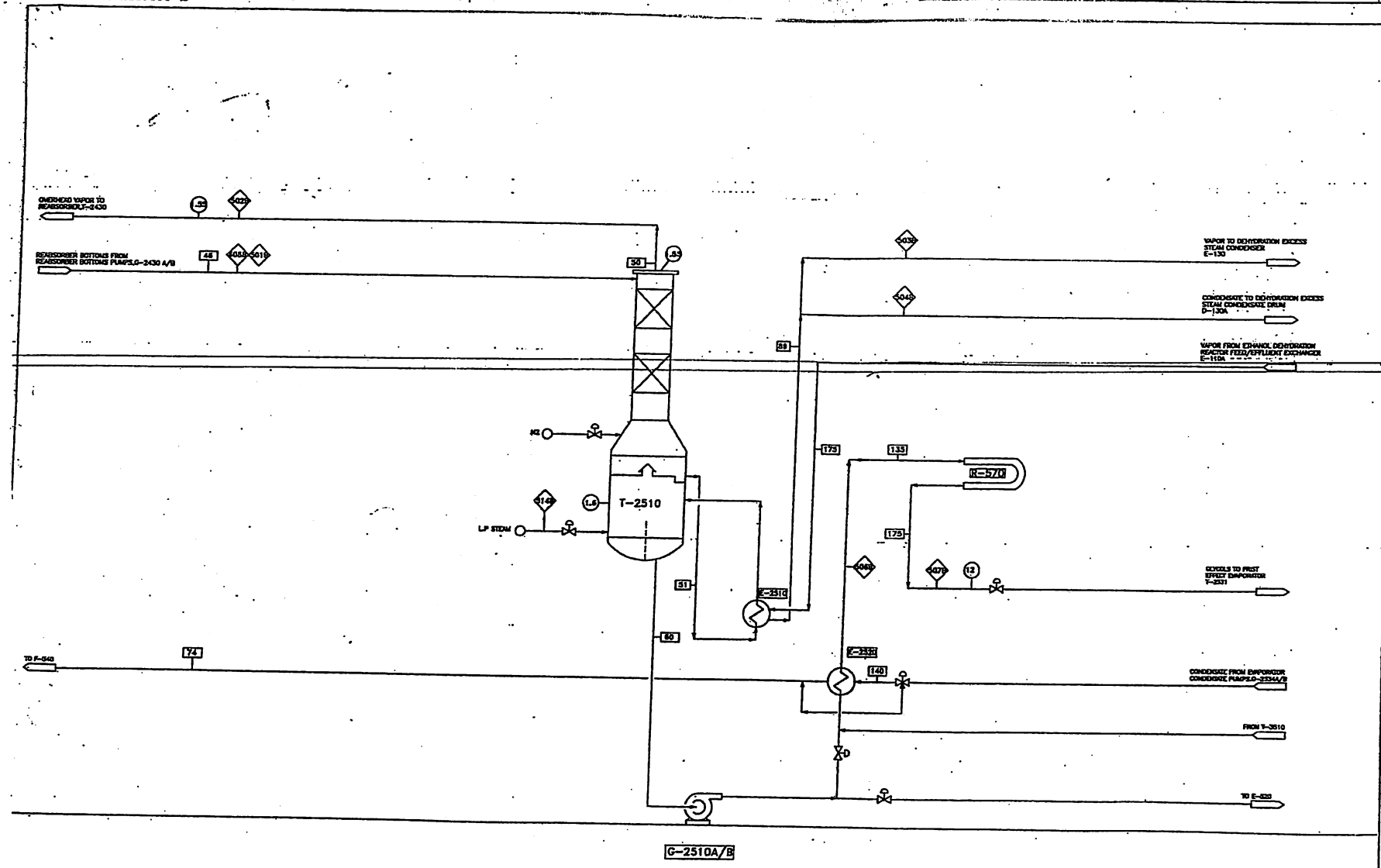
PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

GLYCOL REACTION-I

DRAWN BY _____ DATE 03.11.03 CHECKED BY _____ DATE 03.11.03
APPROVED BY _____ DATE 04.11.03 SCALE NONE
APPROVED FOR CONSTRUCTION BY _____ DATE _____ No.2819-X-500-1

CADFILE NAME: 2819500-1

CADFILE NAME:-2819500-2



KEY

- STREAM No.
- TEMPERATURE(0 c)
- PRESSURE(Kg/cm2 abs)

NOTES:-

1. FOR GENERAL NOTES SEE DRG. 2819-D-00

TAG NO.	DESCRIPTION
T-2510	GLYCOL FEED STRIPPER
E-2510	GLYCOL FEED STRIPPER REBOIL
G-2510 A/B	GLYCOL REACTOR FEED PUMP
R-570	GLYCOL REACTOR
E-2520	GLYCOL FEED PREHEATER

REV.	DESCRIPTION	DATE	BY	CHKD.
0				

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

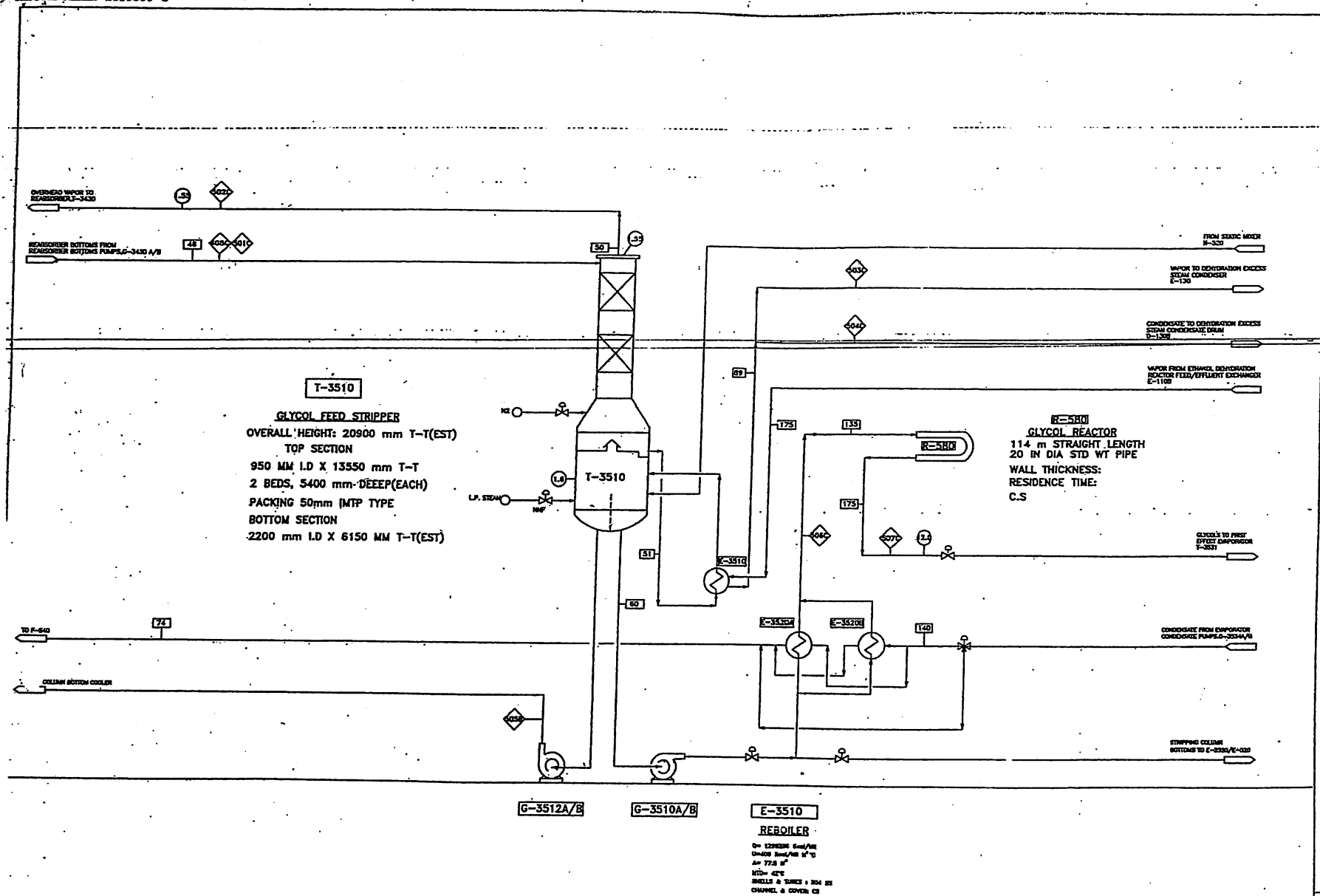
PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

GLYCOL REACTION-2

DRAWN BY ____ DATE 01.11.01 CHECKED BY ____ DATE 09.11.01
APPROVED BY ____ DATE 09.11.01 SCALE NONE
APPROVED FOR CONSTRUCTION BY ____ DATE ____ No.2819-X-500-2

CADFILE NAME:-2819500-2

CADFILE NAME:-2819500-3



REV.	DESCRIPTION	DATE	BY	CHKD.
0				

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

GLYCOL REACTION-3

DRAWN BY ____ DATE 05.11.02 CHECKED BY ____ DATE 05.11.02
APPROVED BY ____ DATE 06.11.02 SCALE NONE
APPROVED FOR CONSTRUCTION BY ____ DATE ____ No.2819-X-500-3

CADFILE NAME:-2819500-3

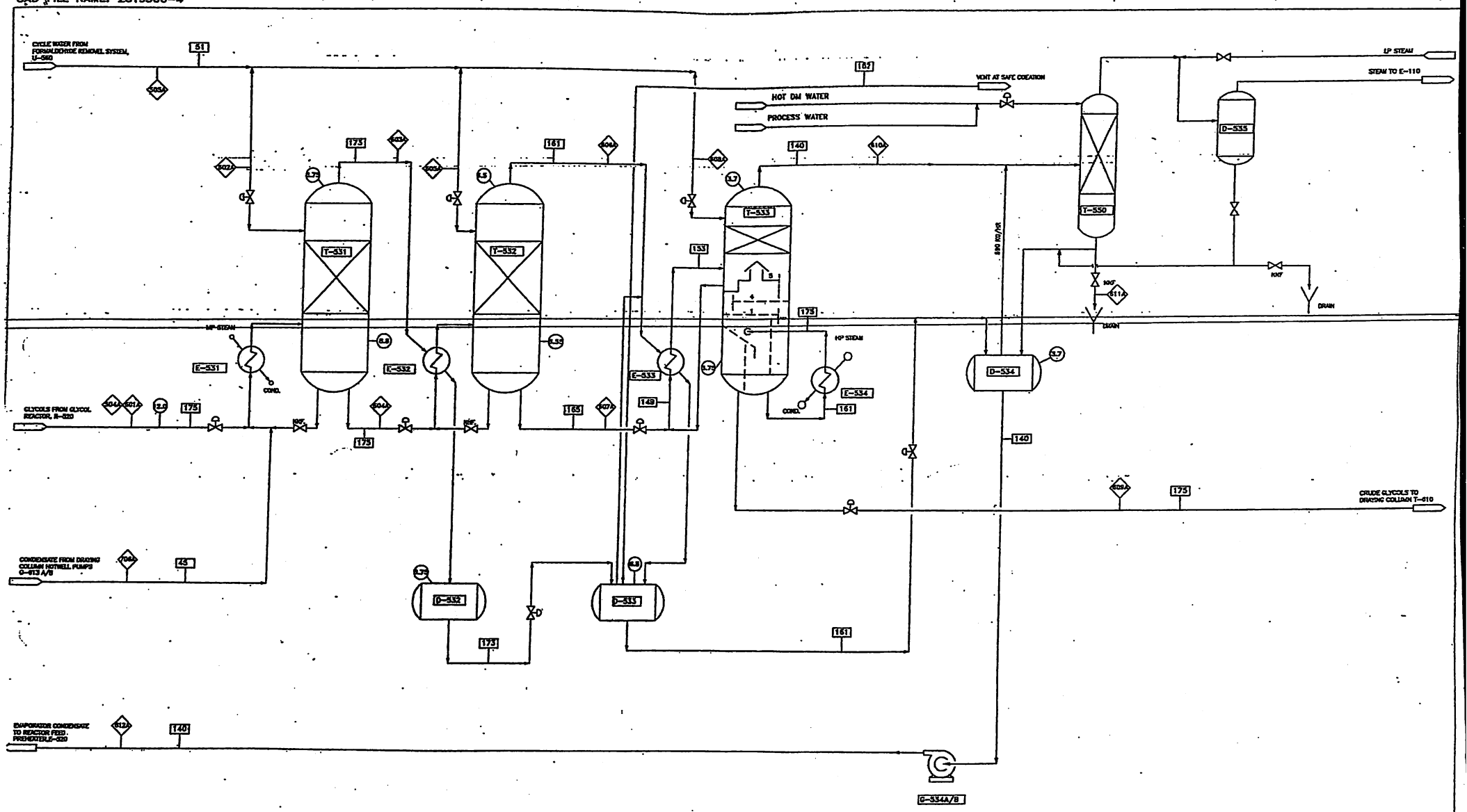
500-4,5 & 6 (Glycol Evaporation Section)

The Glycol reactors (R-520/R-570/R-580) effluent at approximately 175 C passes directly into the First Effect Evaporators (T-531/T-2531/T-3531). Each of the three parallel evaporator trains consists of three effects operating at successively pressures of 8.75, 6.5, and 3.7 Kg/cm2A respectively. All the three effects are provided with packed beds. The third effect (T533/T-2533/T-3533) is divided into two sections. The upper section containing a packed bed acts as a third effect in the evaporation system and the bottom section containing 5 trays and reboiled by the H.P. Steam acts as an additional level of evaporation in the system. Deionized cycle water bleed and water from the recycle water tank are used to provide reflux for the evaporators. The reflux prevents glycol from passing overhead and recycling to the Glycol Reactor. Glycol cycle would increase the make of higher glycols. Cycle water bleed from the oxide unit is passed through the Treating Unit U-550 / U-555 to remove sodium salts and ionized impurities that have been formed in the reactor and the cycle water loop. It is then passed through the Formaldehyde Removal System, U-560 to remove formaldehyde made in the Ethylene Oxide Reactor. Deionization of the cycle water bleed is necessary to prevent corossion problems in the glycol plant and to enable the use of this stream in fiber grade glycol production.

The first effect has been provided with the reboilers (E-530/E-2531/E-3531).Stem condensate from the first Effect Reboilers is returned to HP Condensate Drum (D-830). Condensate from the Second Effect Reboilers (E-532/ E-2532/E-3532) is flashed into the Third Effect Reboilers Condensate Drum (D-533/D-2533/D-3533). The third effect has been provided with two reboilers. Condensate from E-533/E2533/E-3533 flows into the Third Effect Reboiler Condensate Tank(D-533/D2533 D-3533) while condensate from E-534/E-2534/E-3534 is sent to the HP Condensate drum (D-830).The condensate from the Third Effect Reboilers Condensate Drum(D-533/D-2533/D-3533) is flashed in the Evaporator Condensate Drums (D-534/D-2534/D-3534).This condensate is pumped by the Evaporator Condensate Pumps(G-534 A/B, G-2534 A/B & G-3534 A/B) for cooling by heat exchange with the Glycol Reactor feed in Glycol Reactor Feed Pre-heaters (E-520/E-570/E-580) and then sent to the Recycle Water Tank (F-540).

Water and traces of glycol passing overhead in the Third Effect Evaporation (T-533/T-2533/T-3533) is condensed in the overhead Wash Column (T-550/T-2550/T-3550) and is collected in the Evaporator Condensate Drum (D-534/D-2534/D-3534). The crude glycol effluent from the Third Effect Evaporator is sent directly to the Drying Column (T-610/T-2610/T-3610).Alternately, crude glycol can be sent to the Crude Glycol Tanks(F-615/F-675) via Crude Glycol Tank Feed Coolers (E-615/E-675/E-685).

CAD FILE NAME:-2819500-4



KEY

◇ STREAM No.

▭ TEMPERATURE(0 c)

○ PRESSURE(Kg/cm2 ata)

N.B:-

*FOR GENERAL NOTES SEE DWG. 2819-0-00

TAG NO.	DESCRIPTION
T-531	FIRST EFFECT EVAPORATOR
T-532	SECOND EFFECT EVAPORATOR
T-533	THIRD EFFECT EVAPORATOR
E-531	FIRST EFFECT REBOILER
E-532	SECOND EFFECT REBOILER
E-533	THIRD EFFECT DM REBOILER
D-532	SECOND EFFECT REBOILER CONDENSATE DRUM
D-533	THIRD EFFECT REBOILER CONDENSATE DRUM
D-534	EVAPORATOR CONDENSATE DRUM
T-550	OVERHEAD WASH COLUMN

E-533
THIRD EFFECT REBOILER
THERMOSYPHON TYPE VERTICAL
Q = 6110000 Kcal/HR
U=4650 Kcal/HR M²°C
MTD= 68.3°C
SHELL : CS
CHANNEL OR BONNET: CS
TUBES: 90/10CI

REV.	DESCRIPTION	DATE	BY	CHKD.

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

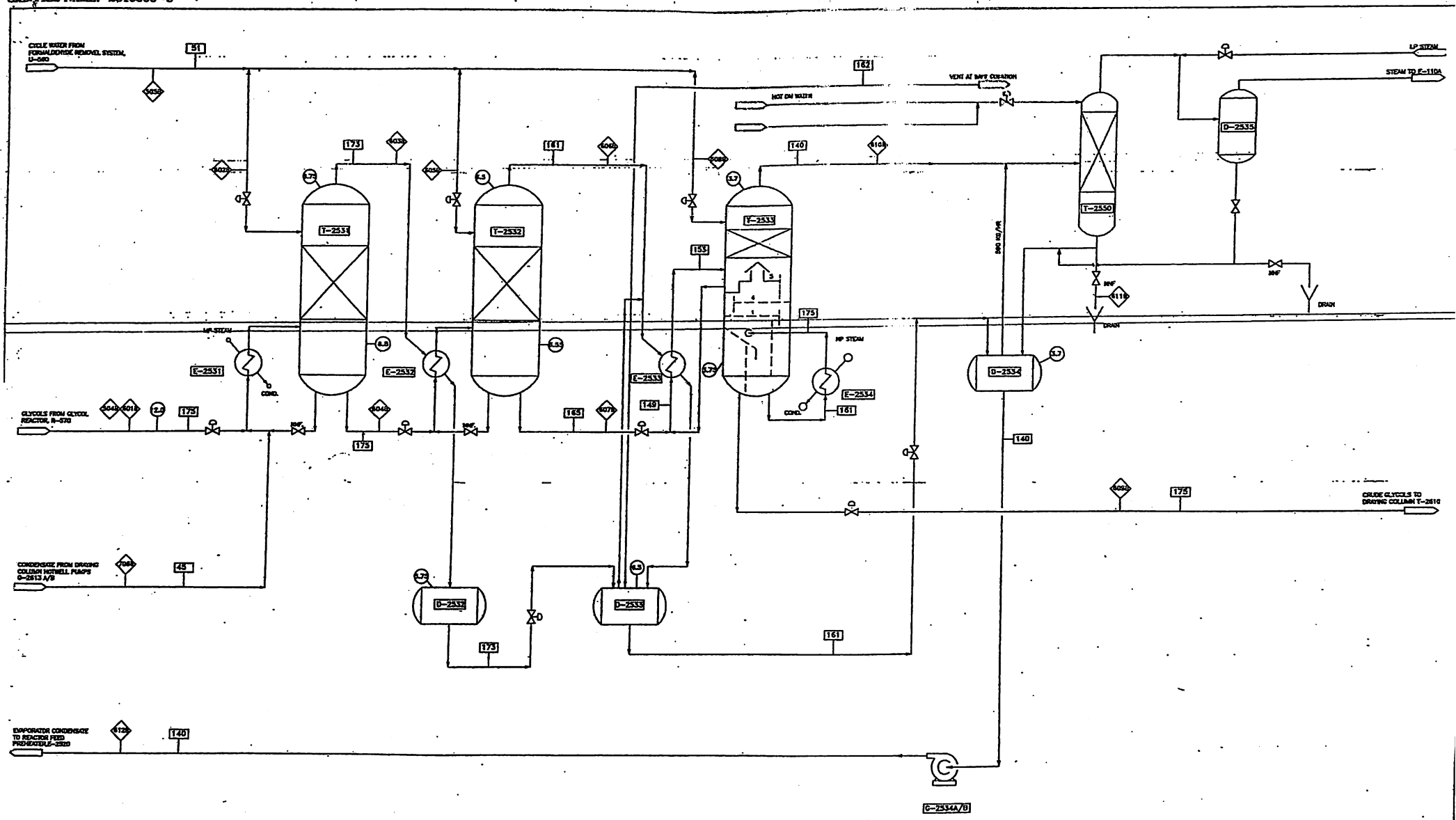
PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

GLYCOL EVAPORATION-1

DRAWN BY ____ DATE 08.01.04 CHECKED BY ____ DATE 10.01.04
APPROVED BY ____ DATE 12.01.04 SCALE NONE
APPROVED FOR CONSTRUCTION BY ____ DATE ____ No.2819-X-500-4

CADFILE NAME:-2819500-4

CAD FILE NAME:-2819500-5



KEY

- ◇ STREAM No.
- ▭ TEMPERATURE(0 c)
- ○ PRESSURE(kg/cm2 abs)

NOTE:-

OR GENERAL NOTES SEE DRG. 2819-0-00

TAG NO.	DESCRIPTION
T-2531	FIRST EFFECT EVAPORATOR
T-2532	SECOND EFFECT EVAPORATOR
T-2533	THIRD EFFECT EVAPORATOR
E-2531	FIRST EFFECT REBOILER
E-2532	SECOND EFFECT REBOILER
E-2533	THIRD EFFECT REBOILER
E-2534	THIRD EFFECT VAN REBOILER
D-2532	SECOND EFFECT REBOILER CONDENSATE DRUM
D-2533	THIRD EFFECT REBOILER CONDENSATE DRUM
D-2534	EVAPORATOR CONDENSATE DRUM
D-2535	-
T-2550	OVERHEAD WASH COLUMN
T-2534 A/B	EVAPORATOR CONDENSATE PUMPS.

REV.	DESCRIPTION	DATE	BY	CHKD.

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

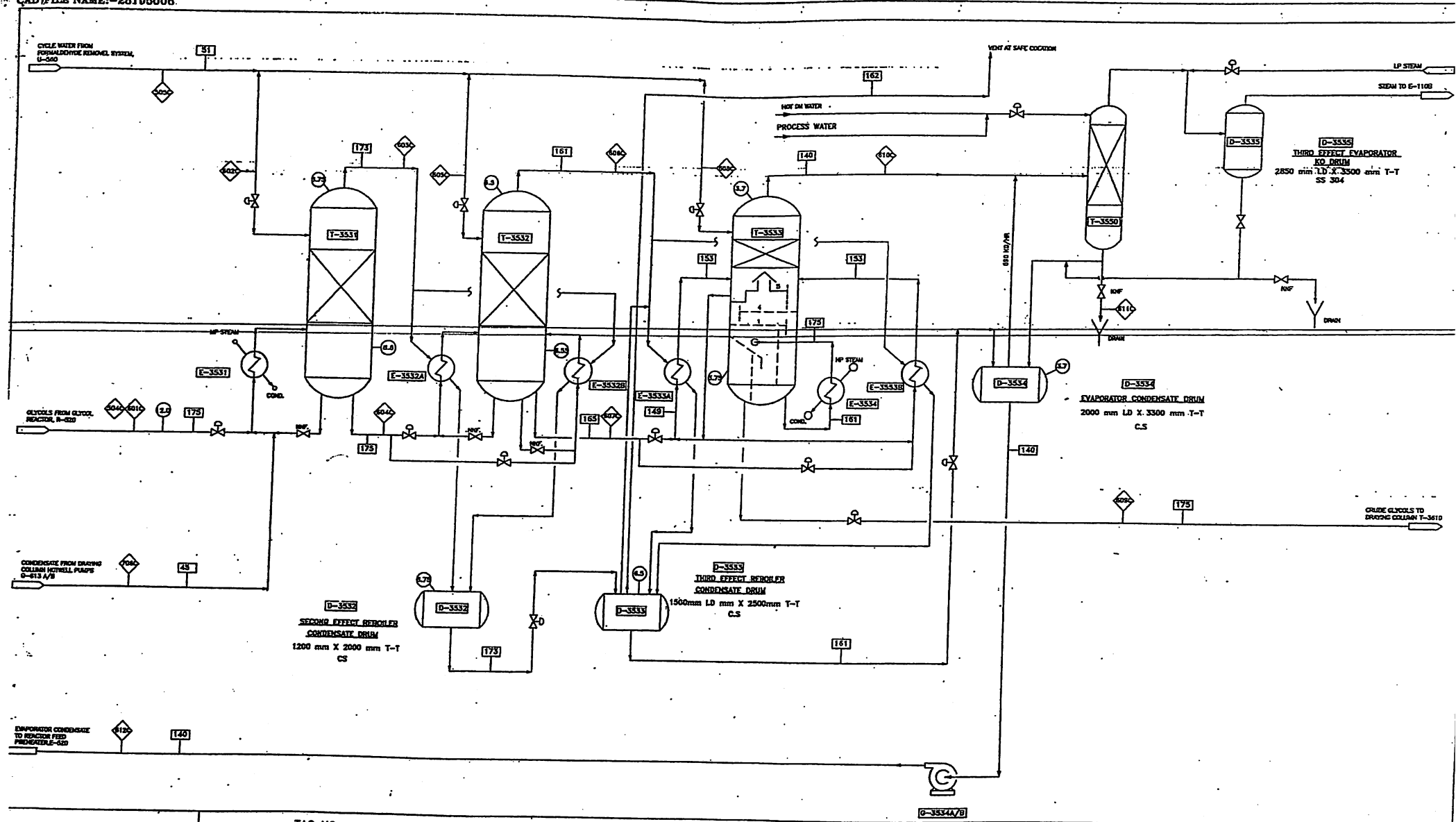
PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

GLYCOL EVAPORATION-2

DRAWN BY ___ DATE 09.01.04 CHECKED BY ___ DATE 10.01.04
APPROVED BY ___ DATE 12.01.04 SCALE NONE
APPROVED FOR COMMISSION BY ___ DATE ___ No.2819-X-500-5

CADFILE NAME:-2819500-5

CAD FILE NAME:-2819500G



KEY

- STREAM No.
- TEMPERATURE(0 c)
- PRESSURE(Kg/cm2 abs)

NOTE:-

FOR GENERAL NOTES SEE DRG. 2819-0-00

TAG NO.	DESCRIPTION
T-3531	FIRST EFFECT EVAPORATOR
T-3532	SECOND EFFECT EVAPORATOR
T-3533	THIRD EFFECT EVAPORATOR
E-3531	FIRST EFFECT REBOILER
E-3532A	SECOND EFFECT REBOILER
E-3533A	THIRD EFFECT REBOILER
E-3533B	THIRD EFFECT REBOILER
E-3534	THIRD EFFECT TRIM REBOILER
D-3532	SECOND EFFECT REBOILER CONDENSATE DRUM
D-3533	THIRD EFFECT REBOILER CONDENSATE DRUM
D-3534	EVAPORATOR CONDENSATE DRUM
D-3535	--
T-3550	OVERHEAD WASH COLUMN
T-3534 A/B	EVAPORATOR CONDENSATE PUMPS.

E-3532A
FIRST EFFECT REBOILER
THERMOSYPHON TYPE VERTICAL
Q = 5000000 Kcal/HR
U=5630 Kcal/HR M²°C
MTD= 8°C
SHELL : CS
CHANNEL OR BONNET: CS
TUBES: 90/10CI

E-3534
THIRD EFFECT TRIM REBOILER
THERMOSYPHON TYPE VERTICAL
Q = 1500000 Kcal/HR
U=970 Kcal/HR M²°C
A= 45.4 M²
MTD= 4°C
SHELLS : CS
CHANNEL OR BONNET: CS
TUBES: CS

REV.	DESCRIPTION	DATE	BY	CHKD.

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

GLYCOL EVAPORATION-3

DRAWN BY ____ DATE 05.01.04 CHECKED BY AS DATE 10.01.04
APPROVED BY ____ DATE 11.01.04 DATE ____
APPROVED FOR CONSTRUCTION BY ____ DATE ____ No.2819-X-500-6

CADFILE NAME:-2819500-6

PROCESS DESCRIPITION
(600) SECTION

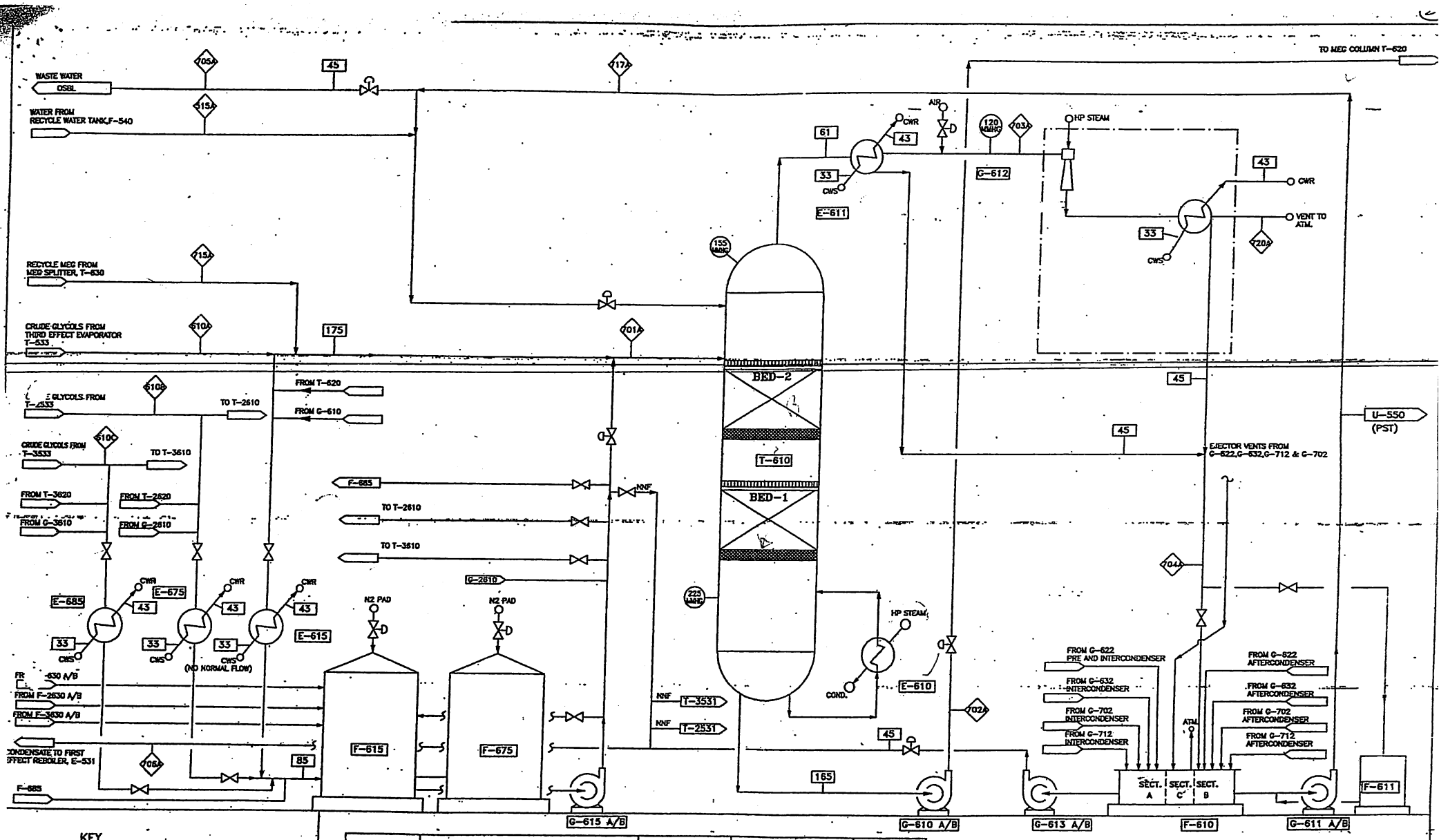
600-1, 2 & 3 (Glycol Drying Section)

600- 4, 5 & 6 (Glycol Purification Section)

Crude Glycol containing 30 Wt% water is dried in the Drying Columns (T-610/T-2610/T-3610). The overhead vapors at 155 mm Hg Abs. Pressure is considered in the drying Column Condensers (E-611/E-2611/E-3611). The condensate from E-611/E-2611/E-3611, along with condensate from the Ejector System after condensers is collected in Section B of the Drying Column Howells (F-610/F-2610/F-3610). This condensate is then pumped by the Drying Column Reflux pumps (G-611 A/B, G-2611 A/B & G-3611 A/B) to OSBL is an aqueous waste stream. During start-up this pump can also be used to provide reflux to the Drying Column.

The Drying Column bottoms are pumped by the Drying Column Bottom pumps (G-610 A/B, G-2610 A/B & G-3610 A/B) to the MEG Columns (T-620/G-2620/G-3620). The MEG Column operates at an overhead pressure of 100 mm Hg Abs. It has an external condenser (E-621/E-2621/E-3621) which is used to boil up part of the Stripping Column Bottoms, and is connected to the MEG Column Ejector System (G-622/G-2622/G-3622). Boil up heat is provided by HP Steam in the MEG Column Reboilers (E-620/E-2620/E-3620).

The mono ethylene glycol product is withdrawn as a liquid side stream and cooled in the MEG Product Coolers (E-622/E-2622/E-3622) and sent to the MEG rundown Tanks (F-630 A/B F-2630 A/B & F-3630 A/B).MEG product is ultimately pumped to OSBL storage by MEG Product Transfer Pumps (G-630 A/B ,G-2630 A/B & G-3630 A/B).
The MEG Column overhead system has been designed to purge a small fraction of the MEG feed as vapor from the MEG column Condensers (E-621/E-2621/E-3621) to reduce aldehyde concentration in the product. The MEG in this purge is condensed in the Ejector System pre-condenser and inter -condenser. This condensate, containing the recovered MEG is then collected in Section A of Drying Column Hot well from which it is pumped to the First Effect Reboilers(E-531 / E-2531 / E-3531) by the Drying Column Hot well pumps (G-613 A/B, G-2613 A/B & G-3613 A/B).
The MEG Column Bottom Pumps (G-620 A/B, G--2620 A/B & G-3620 A/B) pump the Column bottoms to the MEG Splitter Columns (T-630/T-2630/T-3630). The MEG Splitter operates at a top pressure of 10 mm Hg A, and has a top- mounted, knock-back condensers (E-631/E-2631/E-3631). In the Splitter, The MEG is separated from the heavier glycols, withdrawn as a liquid side stream and recycled back to the Crude Glycol Tanks(F-615/F-675).Boil-up heat to T-630/T-2630T-3630, is provided by HP Steam in the MEG Splitter Reboilers (E-630/E2630/E-3630) which is designed for suppressed vaporization to reduce fouling.



KEY

◇ STREAM No.

▭ TEMPERATURE(0 c)

○ PRESSURE(Kg/cm2 abs)

NOTES:-

1. FOR GENERAL NOTES SEE DRG. 2802-X-102A

TAG NO.	DESCRIPTION	TAG NO.	DESCRIPTION
E-685	CRUDE GLYCOL TANK COOLER	G-615 A/B	DRYING COLUMN FEED PUMP
E-675	CRUDE GLYCOL TANK COOLER	G-610 A/B	DRYING COLUMN BOTTOM PUMP
E-615	CRUDE GLYCOL TANK COOLER	G-613 A/B	DRYING COLUMN HOTWELL PUMP
F-615	CRUDE GLYCOL TANK	F-610	DRYING COLUMN HOTWELL
F-675	CRUDE GLYCOL TANK	G-611 A/B	DRYING COLUMN REFLUX PUMP
T-610	DRYING COLUMN	G-612	DRYING COLUMN EJECTOR SYSTEM
E-611	DRYING COLUMN CONDENSER		
E-610	DRYING COLUMN REBOILER		

REV.	DESCRIPTION	DATE	BY	CHKD.	APPR.
1	F-611 ADDED, F-615 LINES CORRECTED,BED IN T-610	30.03.07	SG	NB	AS

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

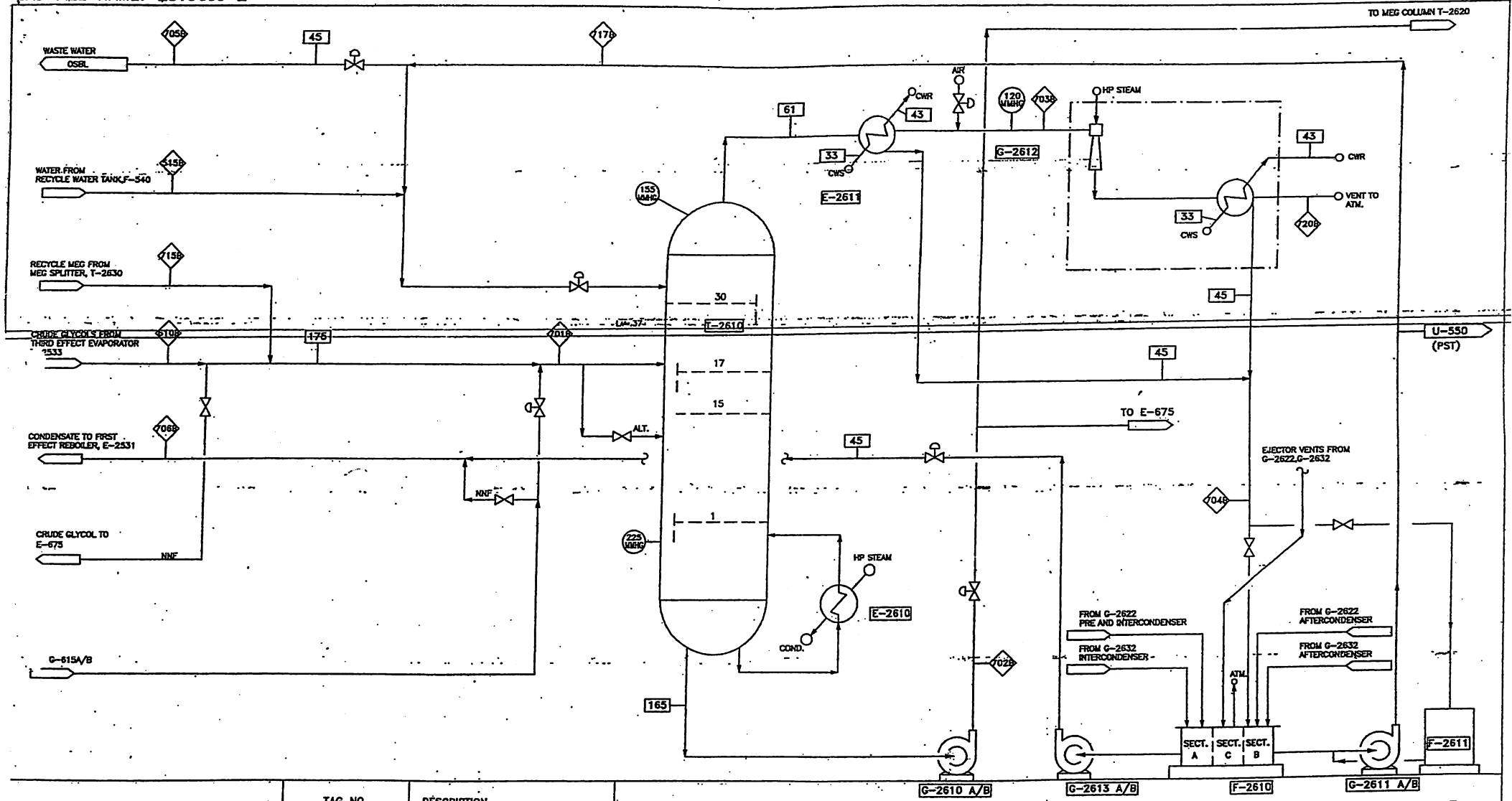
PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

GLYCOL DRYING-1

No.2819-X-600-1

CADFILE NAME:-2819600-1

CAD FILE NAME:-2819600-2



KEY

- ◇ STREAM No.
- ▭ TEMPERATURE(0 c)
- ○ PRESSURE(Kg/cm2 abs)

NOTES:-

FOR GENERAL NOTES SEE DRG. 2602-X-102A

TAG NO.	DESCRIPTION
T-2610	DRYING COLUMN
E-2610	DRYING COLUMN REBOILER
E-2611	DRYING COLUMN CONDENSER
G-2612	DRYING COLUMN EJECTOR SYSTEM
G-2610 A/B	DRYING COLUMN BOTTOM PUMP
G-2613 A/B	DRYING COLUMN HOTWELL PUMP
F-2610	DRYING COLUMN HOTWELL
G-2611 A/B	DRYING COLUMN REFLUX PUMP

REV.	DESCRIPTION	DATE	BY	CHKD.	APPR.
1	F-2611 ADDED, F-615 LINES CORRECTED	30.03.07	SG	NB	AS

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

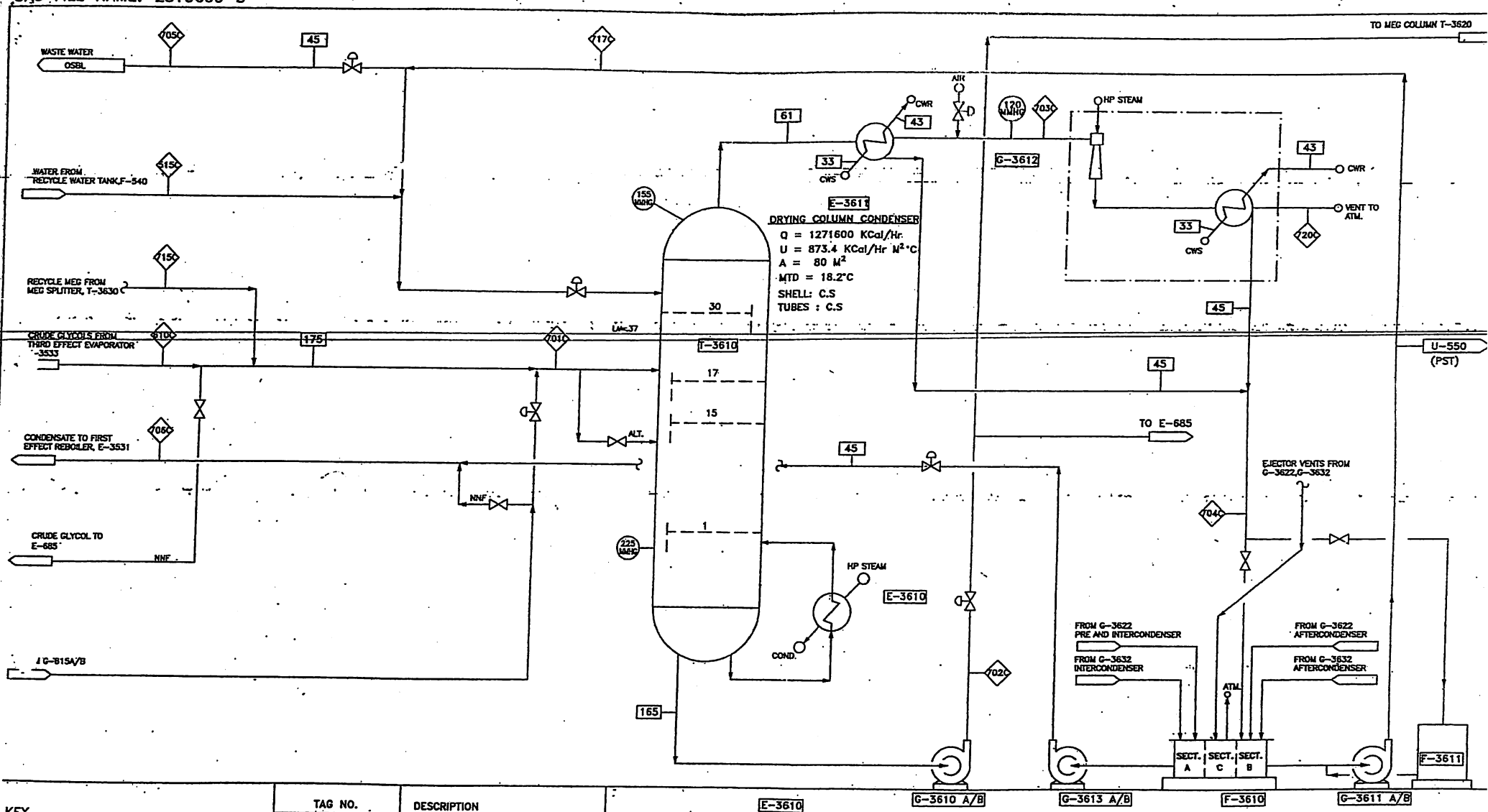
PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

GLYCOL DRYING-2

DRAWN BY SSD DATE 04.04.07 CHECKED BY BB DATE 04.04.07
APPROVED BY AS DATE 04.04.07 SCALE NONE
APPROVED FOR CONSTRUCTION BY ____ DATE ____ No. 2819-X-600-2

CADFILE NAME:-2819600-2

CAD FILE NAME:-2819600-3



KEY

- ◇ STREAM No.
- ▭ TEMPERATURE(0 c)
- ○ PRESSURE(Kg/cm2 abs)

NOTES:-

FOR GENERAL NOTES SEE DRG. 2602-X-102A

TAG NO.	DESCRIPTION
T-3610	DRYING COLUMN
E-3610	DRYING COLUMN REBOILER
E-3611	DRYING COLUMN CONDENSER
G-3612	DRYING COLUMN EJECTOR SYSTEM
G-3610 A/B	DRYING COLUMN BOTTOM PUMP
G-3613 A/B	DRYING COLUMN HOTWELL PUMP
F-3610	DRYING COLUMN HOTWELL
G-3611 A/B	DRYING COLUMN REFLUX PUMP

E-3610

DRYING COLUMN REBOILER

Q = 1600000 KCal/Hr
U = 597 KCal/Hr M °C
A = 67 M²
MTD = 40°C
SHELL: C.S
TUBES : 316L SS

REV.	DESCRIPTION	DATE	BY	CHKD.	APPR.
1	MPTS ADDED, F-615 LINES CORRECTED.	30.03.07	SG	NB	AS

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

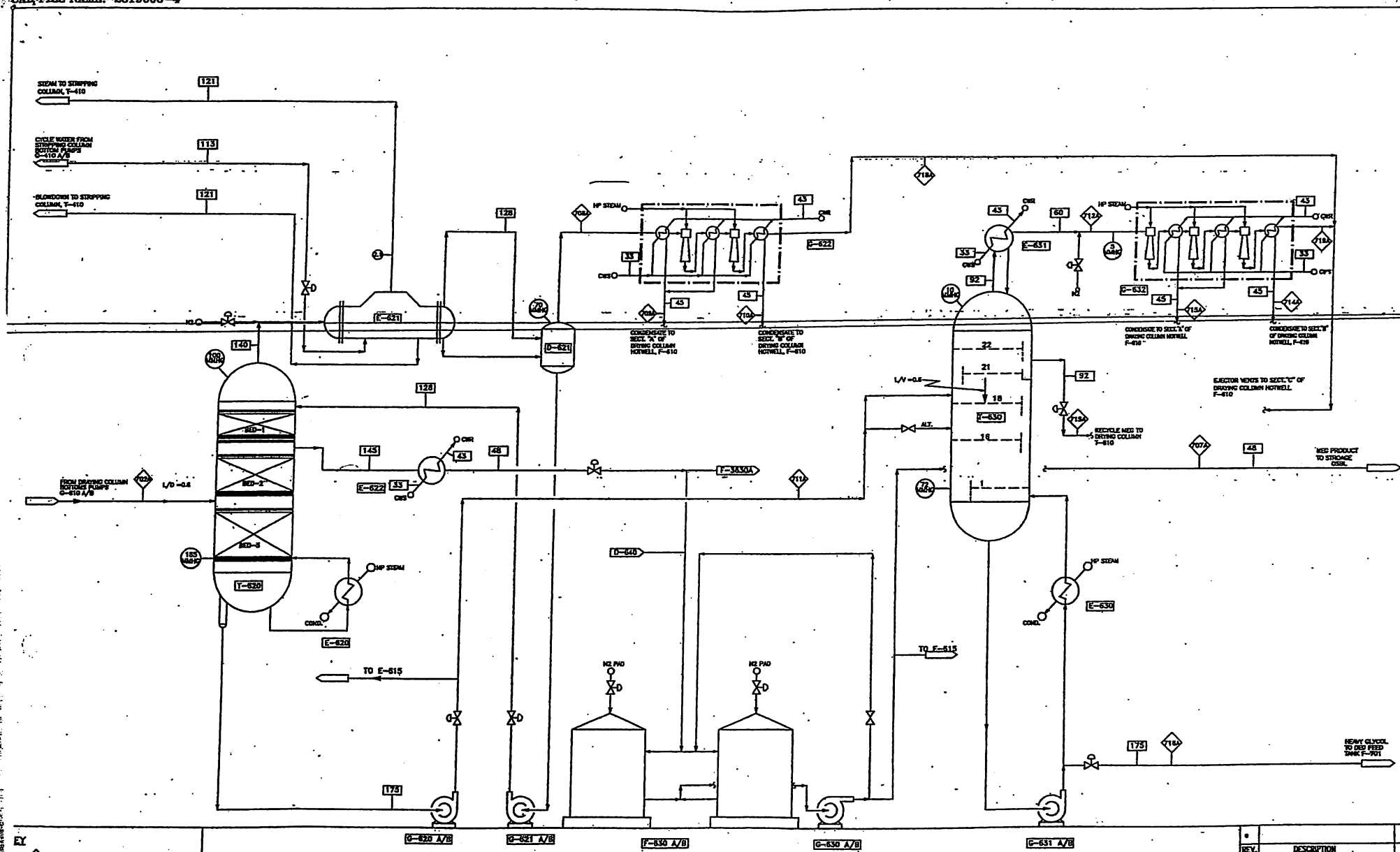
PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

GLYCOL DRYING-3

DRAWN BY ____ DATE 21.11.03 CHECKED BY AS DATE 22.11.03
APPROVED BY NB DATE 23.11.03 SCALE NONE
APPROVED FOR CONSTRUCTION BY ____ DATE ____ No.2819-X-600-3

CADFILE NAME:-2819600-

CAD FILE NAME:-2819600-4



KEY

- STREAM No.
- TEMPERATURE(0 c)
- PRESSURE(Kg/cm2 abs)

NOTE:

01 GENERAL NOTES SEE DRG. 2802-X-102A

TAG NO.	DESCRIPTION	TAG NO.	DESCRIPTION
T-620	MEG COLUMN TOP	F-630 A/B	MEG RUN DOWN TANK
E-620	MEG COLUMN REBOILER	T-630	MEG SPLITTER
E-621	MEG COLUMN CONDENSER	G-631 A/B	MEG SPLITTER BOTTOMS PUMP
E-622	MEG PRODUCT COOLER	E-630	MEG SPLITTER REBOILER
D-621	MEG COLUMN REFLUX DRUM	E-631	MEG SPLITTER CONDENSER
G-620 A/B	MEG COLUMN BOTTOM PUMPS	G-632	MEG SPLITTER EJECTOR SYSTEM
G-621 A/B	MEG COLUMN REFLUX PUMPS	G-630 A/B	MEG PRODUCT TRANSFER PUMPS.
G-622 A/B	MEG COLUMN EJECTOR SYSTEM RECONDENSER		

REV.	DESCRIPTION	DATE	BY	CHKD.

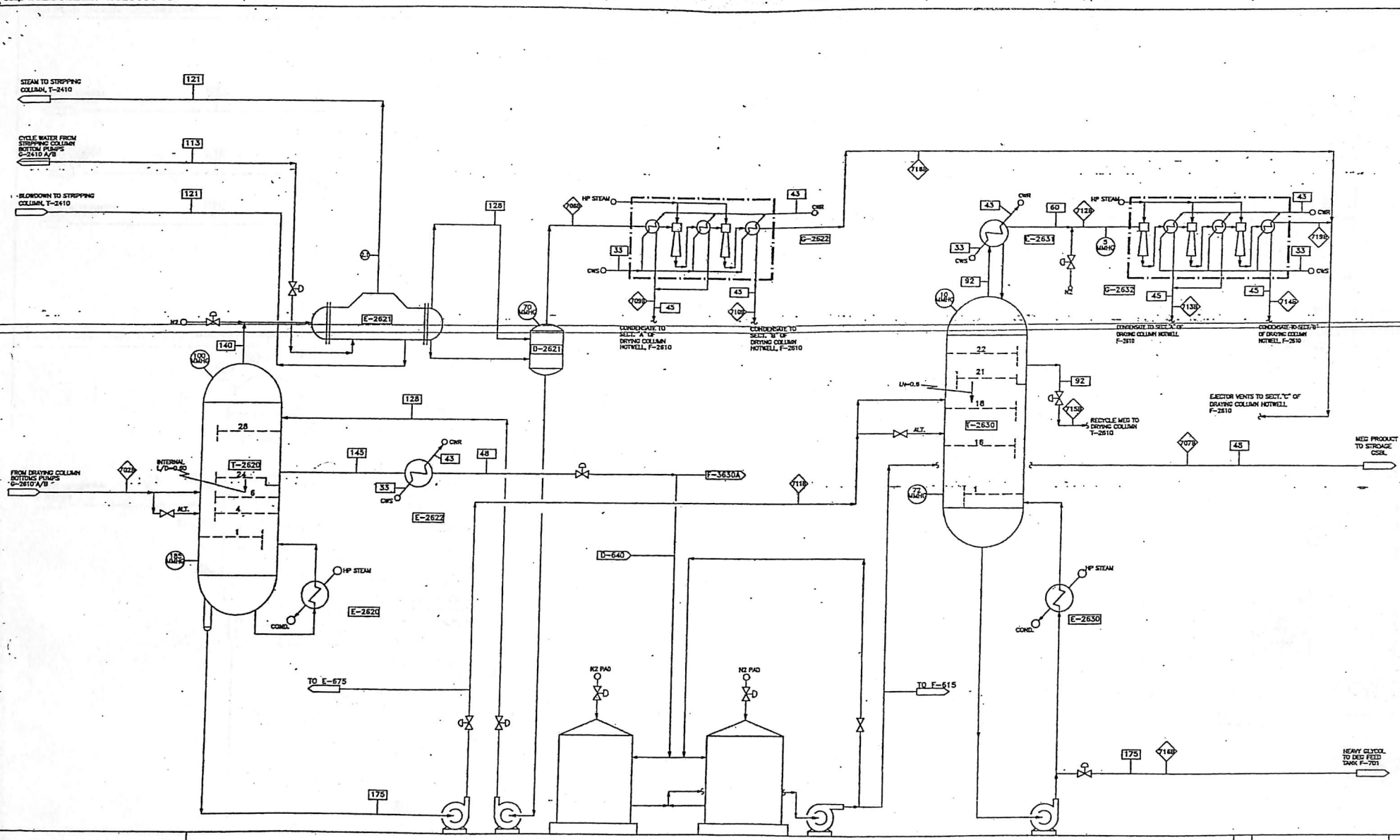
INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

PROCESS FLOW DIAGRAM - ETHYLENE GLYCOL PLANT

GLYCOL PURIFICATION-1

DRAWN BY [illegible] DATE 23.11.05 CHECKED BY [illegible] DATE 23.11.05
APPROVED BY [illegible] DATE 23.11.05 SCALE NONE
APPROVED FOR CONSTRUCTION BY [illegible] DATE [illegible] No. 2819-X-600-4

CADFILE NAME:-2819600-4



KEY

- STREAM No.
- TEMPERATURE(0 c)
- PRESSURE(Kg/cm2 dia)

Note:

OR GENERAL NOTES SEE DRG. 2602-X-102A

TAG NO.	DESCRIPTION	TAG NO.	DESCRIPTION
T-2620	MEG COLUMN TOP	F-2630 A/B	MEG RUN DOWN TANK
E-2620	MEG COLUMN REBOILER	T-2630	MEG SPLITTER
E-2621	MEG COLUMN CONDENSER	G-2631 A/B	MEG SPLITTER BOTTOMS PUMP
E-2622	MEG PRODUCT COOLER	E-2630	MEG SPLITTER REBOILER
D-2621	MEG COLUMN REFLUX DRUM	E-2631	MEG SPLITTER CONDENSER
G-2620 A/B	MEG COLUMN BOTTOM PUMPS	G-2632	MEG SPLITTER EJECTOR SYSTEM
G-2621 A/B	MEG COLUMN REFLUX PUMPS	G-2630 A/B	MEG PRODUCT TRANSFER PUMPS.
G-2622 A/B	MEG COLUMN EJECTOR SYSTEM RECONDENSER		

REV.	DESCRIPTION	DATE	BY	CHKD.
0				

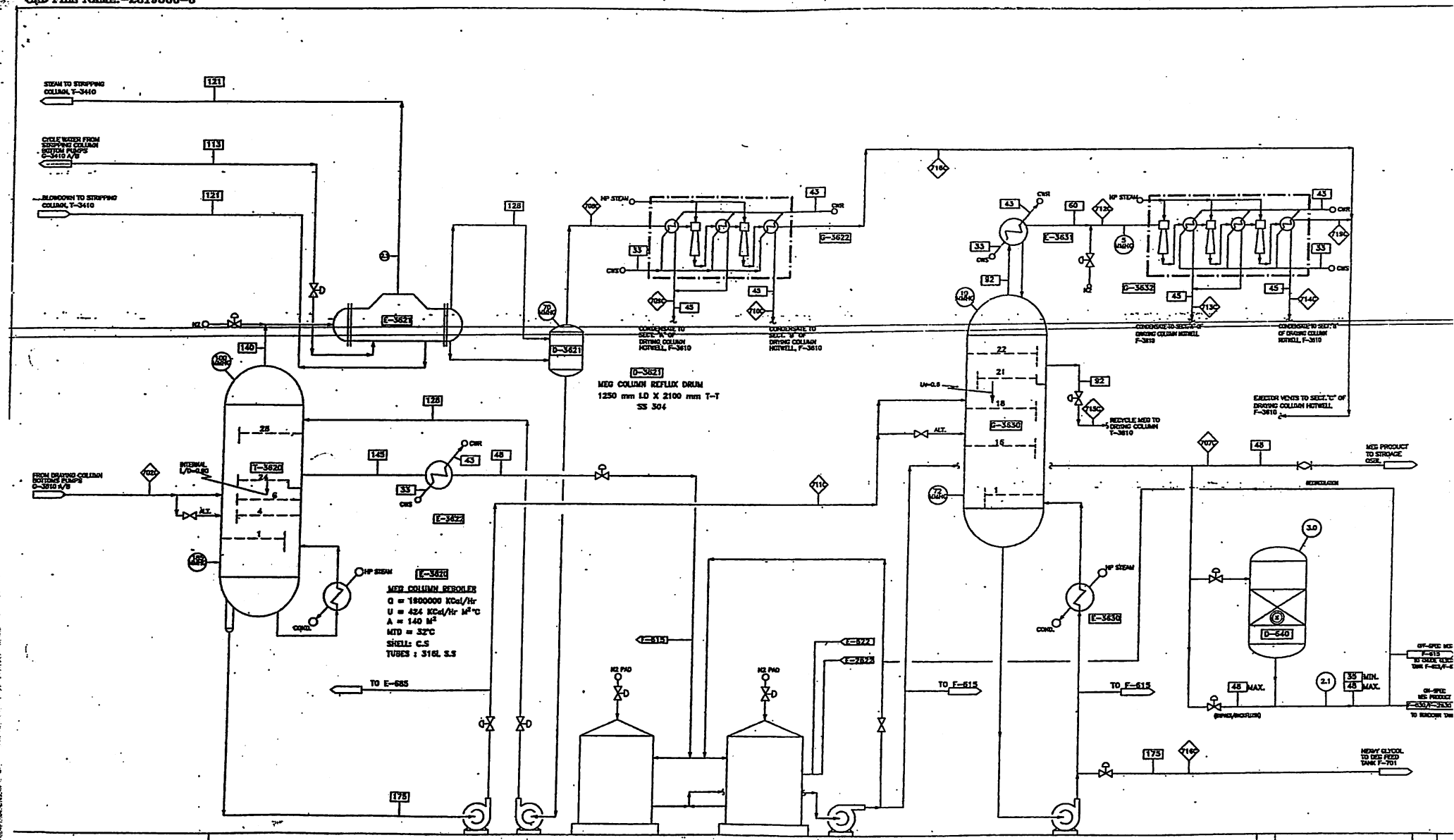
INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

PROCESS FLOW DIAGRAM - ETHYLENE GLYCOL PLANT

GLYCOL PURIFICATION-2

DRAWN BY [illegible] DATE 23.11.03 CHECKED BY AS DATE 23.11.03
APPROVED BY BS DATE 23.11.03 SCALE NONE
APPROVED FOR CONSTRUCTION BY _____ DATE _____ No. 2819-X-600-5

CAD FILE NAME:-2819600-6



G-3620 A/B | G-3621 A/B | F-3630 A/B | G-3630 A/B | G-3631 A/B

KEY

◇ STREAM No.

▭ TEMPERATURE(0 c)

○ PRESSURE(Kg/cm2 abs)

NOTE:-

FOR GENERAL NOTES SEE DRG. 2802-S-102A

TAG NO.	DESCRIPTION	TAG NO.	DESCRIPTION
T-3620	MEG COLUMN TOP	F-3630 A/B	MEG RUN DOWN TANK
E-3620	MEG COLUMN REBOILER	T-3630	MEG SPLITTER
E-3621	MEG COLUMN CONDENSER	G-3631 A/B	MEG SPLITTER BOTTOMS PUMP
E-3622	MEG PRODUCT COOLER	E-3630	MEG SPLITTER REBOILER
D-3621	MEG COLUMN REFLUX DRUM	E-3631	MEG SPLITTER CONDENSER
G-3620 A/B	MEG COLUMN BOTTOM PUMPS	G-3632	MEG SPLITTER EJECTOR SYSTEM
G-3621 A/B	MEG COLUMN REFLUX PUMPS	G-3630 A/B	MEG PRODUCT TRANSFER PUMPS.
G-3622 A/B	MEG COLUMN EJECTOR SYSTEM RECONDENSER		

REV.	DESCRIPTION	DATE	BY
0			

INDIA GLYCOLS LIMI
KASHIPUR (UTTRANCHAL) INDIA

PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PL

GLYCOL PURIFICATION-3

DRAWN BY ____ DATE 21.01.03 CHECKED BY ____ DATE ____
APPROVED BY ____ DATE 22.01.03 SCALE NONE
APPROVED FOR CONSTRUCTION BY ____ DATE ____ No. 2819-

CADFILE NAME:-281960

PROCESS DESCRIPTION (700 section)

The bottom from the MEG splitter columns (T-630/T-2630/T-3630) are pumped to the deg column (T-705) which is a packed column operating at a top pressure of 10 mm Hg Abs. the DEG column overheads are condensed in the top- mounted, knock-back DEG condensers (E-706). vacuum is maintained in the system by the DEG Column Ejector System (G-702).Boil-up heat to DEG column is supplied by HP Steam in the DEG column Reboiler (E-705) which is designed for suppressed vaporization to reduce fouling.

The DEG column overhead condensate accumulates in a chimney draw off tray located below a pasteurization packed section. Part of the condensate is returned as reflux to the column via DEG column reflux pump (G-706 A/B). The remainder is taken as DEG product which is then cooled in the DEG product cooler (E-707) before flowing into the DEG rundown drums (D-720 A/B). DEG product is ultimately pumped to OSBL storage by DEG Product Transfer Pumps (G-720 A/B).

To purge impurities from the DEG column system, a liquid purge stream can be taken at the top of the column to Section A of Drying Column Hot well.

The DEG column bottoms are distilled in the TEG column (T-710) which is a packed column operating at a top pressure of 10 mm Hg Abs. The TEG Column overhead are condensed in the top-mounted knock-back TEG Column Condenser (E-711).Vacuum is maintained in the system by the TEG Column Ejector System (G-712) .Boil up heat the TEG Column is supplied by HP Steam in the TEG Column Reboiler (E-710) which is designed for suppressed vaporization to reduce fouling.

The HG Column operates in a two cycle campaign operation consisting of a DIG Ship cycle and a HG purification cycle. During the DIG strip cycle ,the DIG Column bottoms are led to the HG Column via the DEG Column Bottoms pumps (G-705 A/B).Also fed to the column are the glycols accumulated (during the TEG purification cycle) in the Crude DEG Drum (d-710) via the TEG Column Feed Pumps (G-715)A/B . In This distillation cycle, the DEG in the feed is stripped out, condensed in the TEG Column.

Condenser and recycled back to the DEG Column. The Column bottoms, containing crude TEG are pumped to the other Crude TEG Drum (D-715) by the TEG Column Bottoms Pumps (G-770 A/B). After 80 hours of DEG strip operation, the cycle is changed to TEG Purification. In this cycle, the DEG Column bottoms are temporarily routed to the Crude DEG Drum (D-710). The Crude TEG, which has accumulated in the Crude TEG Drum (D-715) during the DEG strip cycle, is then fed to the TEG Column via the TEG Column Feed Pumps. The TEG Column overhead are

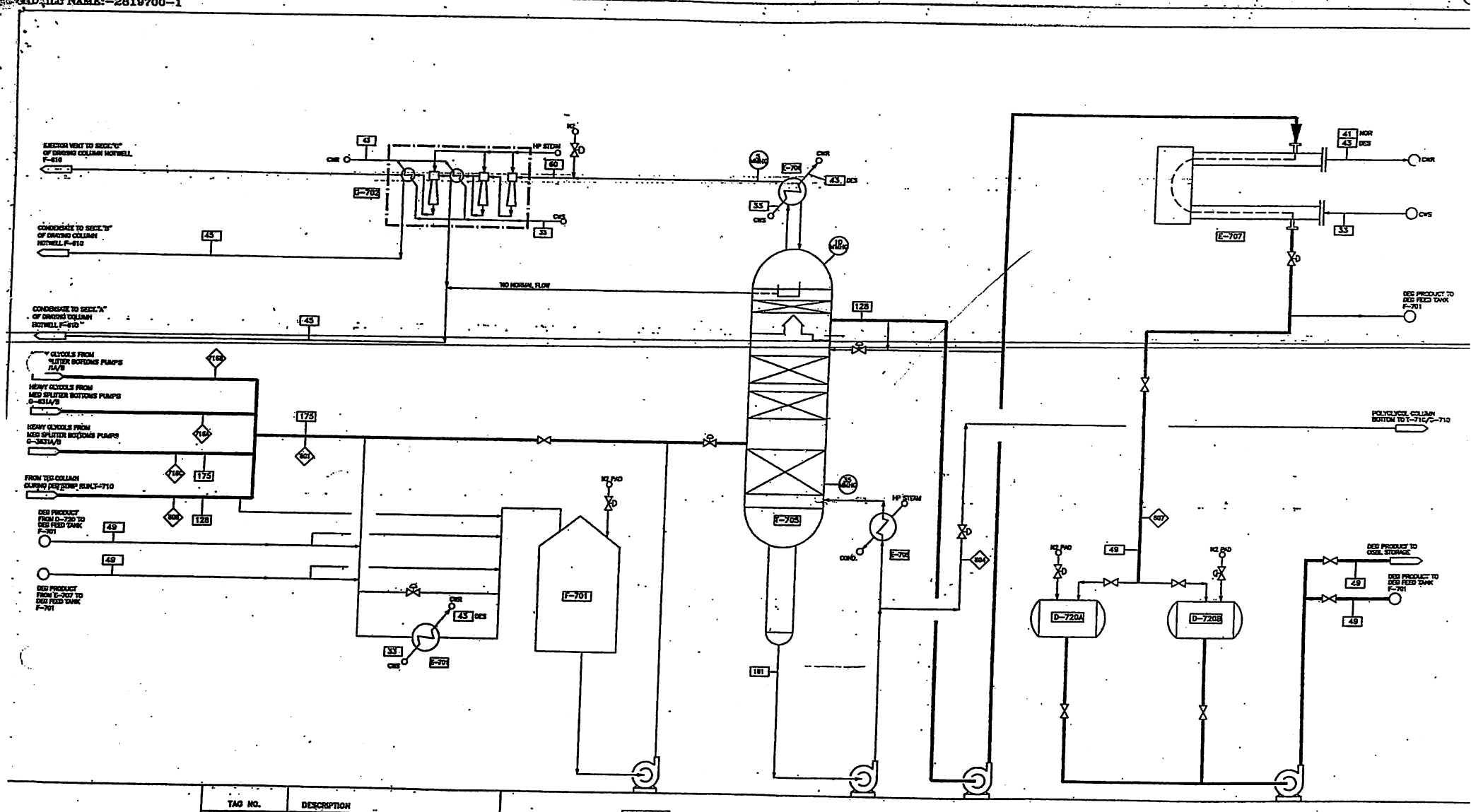
condensed in the TEG Column Condenser, and accumulates in the chimney draw-off tray at the top of the column.

Part of the condensate is returned to the column as reflux via the TEG Column Reflux Pumps (G-771 A/B) while the remainder (TEG product) is cooled in the TEG Product Cooler (E-717) before flowing into the TEG Rundown Drums (D-730 A/B). The TEG product is then transferred to OSBL storage, via the TEG Transfer Pump (G-730). The column bottoms, consisting of heavier DEG are pumped to the PEG Storage Drum (D-740) and subsequently pumped to OSBL storage via the PEG Transfer Pump (G-740).After 80 hours of TEG purification, the column is idled for 34 hours before the DEG strip cycle is repeated.

To purge impurities from the TEG Column system, a liquid purge stream can be taken at the top of the TEG Column (T-710) to DEG Column (T-705).

The condensate from the intercondensers of the DEG & TEG column ejector System (G-702 & G-712) is sent to section "A" of the drying column hot well (F-610) while the condensate from the after condensers of the ejector System is sent to section "B" of the hot well.

CAD FILE NAME:-2819700-1



KEY

- STREAM No.
- TEMPERATURE(0 c)
- PRESSURE(Kg/cm2 abs)

NOTE:-

FOR GENERAL NOTES SEE DRG. 2819-D-00

TAG NO.	DESCRIPTION
G-702	DEG COLUMN EJECTOR SYSTEM
T-705	DEG COLUMN
E-705	DEG COLUMN REBOILER
E-706	TOP MOUNTED KNOCK-BACK DEG CONDENSER
G-705 A/B	DEG COLUMN BOTTOM PUMP
G-706 A/B	DEG COLUMN REFLUX PUMP
E-707	DEG PRODUCT COOLER
D-720 A	DEG RUN DOWN DRUM
D-720 B	DEG RUN DOWN DRUM
G-720 A/B	DEG TRANSFER PUMPS

REV.	DESCRIPTION	DATE	BY	CHKD.	APPR.
1	F-701 ADDED	04.04.07	SG	HB	AS

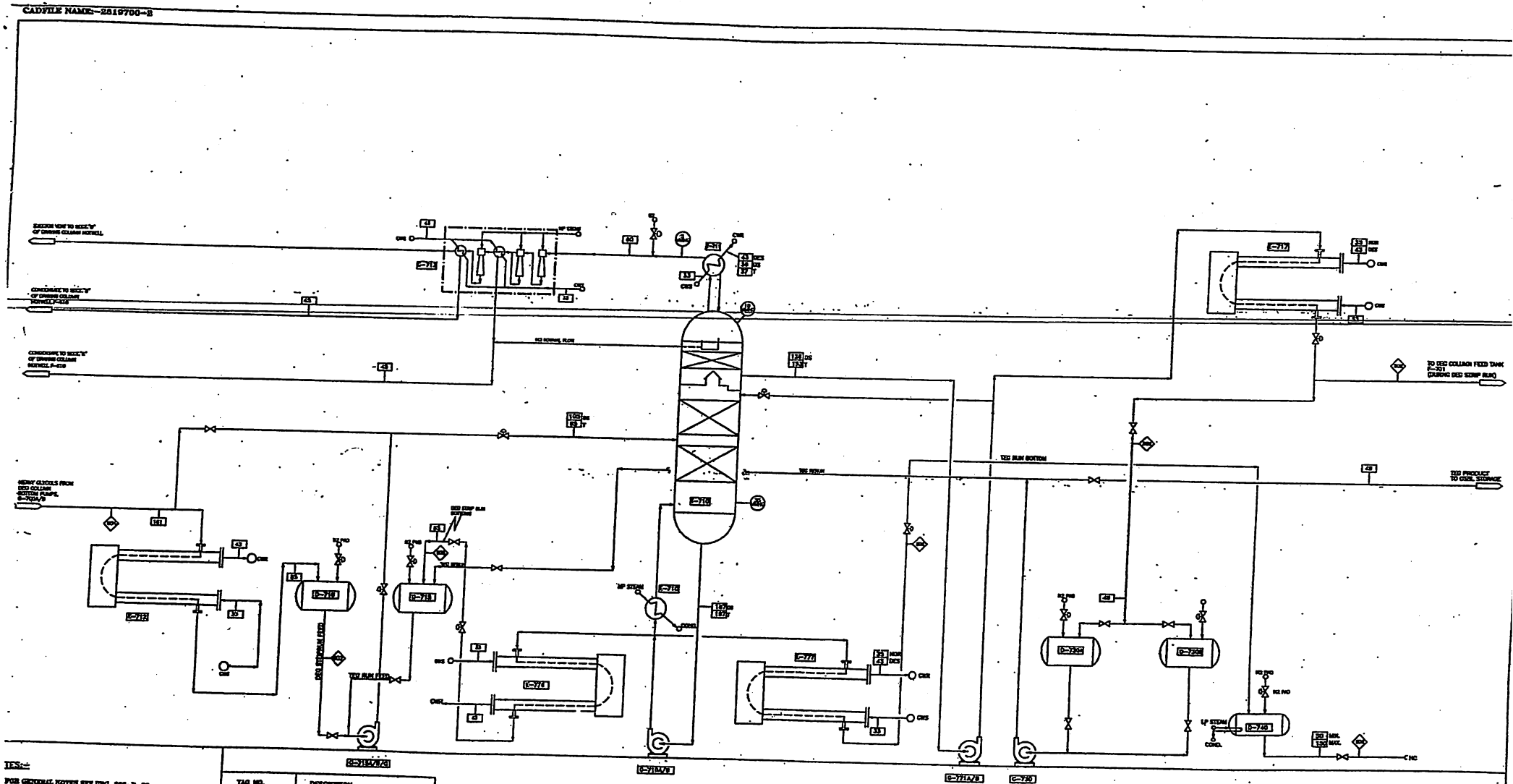
INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

DEG PURIFICATION

DRG. No. 2819-X-700-1

CADFILE NAME:-2819700-2



NOTES:-

FOR GENERAL NOTES SEE DRG. 289-D-00

KEY

- STREAM No.
- TEMPERATURE(0 c)
- PRESSURE(Kg/cm2 abs)

TAG NO.	DESCRIPTION
E-712	CRUDE DEG COOLER
D-710	CRUDE DEG DRUM
G-715 A/B/C	TEG COLUMN FEED PUMP
D-715	CRUDE DEG DRUM
E-776	CRUDE DEG COOLER
G-712	TEG COLUMN EJECTOR SYSTEM
T-710	TEG COLUMN
E-710	TEG COLUMN REBOILER
E-711	TEG COLUMN CONDENSER
G-710 A/B	TEG COLUMN BOTTOM PUMP
E-777	--
E-717	TEG PRODUCT COOLER
G-771 A/B	TEG COLUMN REFLUX PUMP
G-730	TEG TRANSFER PUMP
D-730 A	TEG RUNDOWN PUMP
D-730 B	TEG RUNDOWN PUMP
D-740	PEG STORAGE DRUM
G-740	PEG TRANSFER PUMP

D-715
CRUDE DEG DRUM
2100 mm LD X 4300 mm LD
CS

REV.	DESCRIPTION	DATE	BY	CHKD.	APPR.
1	D-730 A/B,D-740 MODIFIED	29.03.07	SG	NB	AS

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

TEG PURIFICATION

DRAWN BY _____ DATE ___ CHECKED BY AS DATE ___
APPROVED BY ___ DATE ___ SCALE NONE
APPROVED FOR CONSTRUCTION BY _____ DATE _____ No.2819-X-700-2

(EOP SECTION)

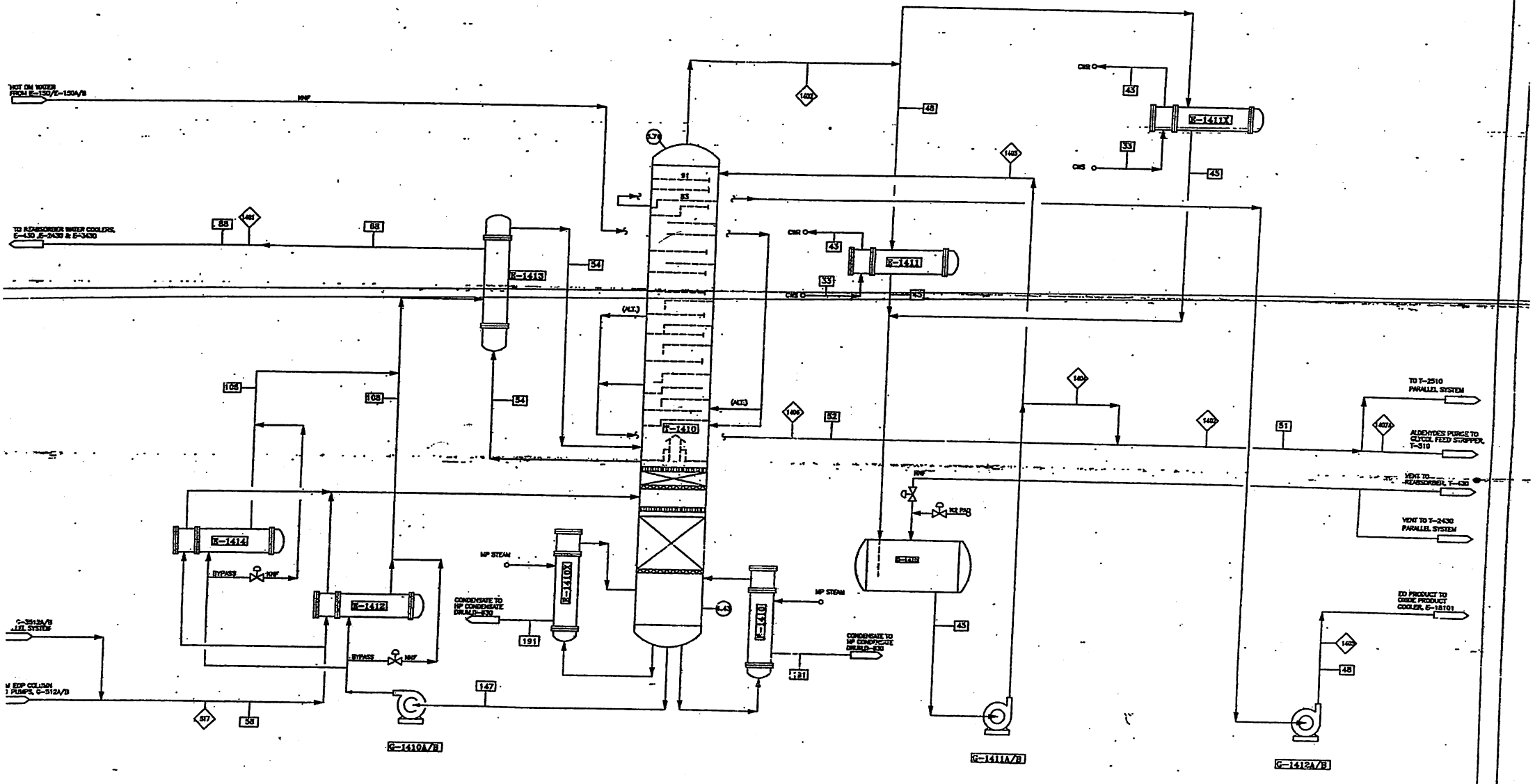
1400-1 (ethylene oxide purification)

ethylene oxide solution from the EOP column feed pumps, (G-3512 A/B), is preheated to 95 deg.C in the purification column feed bottoms exchangers, E-1412 &E-1414 , before entering the Purification Column T-1410, which produces a purified ethylene oxide product, containing a maximum of 10 ppm wt total aldehydes (formaldehyde and acetaldehyde). The column has 91 trays and 02 nos. Structured packing beds. It operates at a external reflux ratio of 4:5:1. Approximately 82% of the boil up heat requirement is provided by 14 kg/cm2g steam in the Purification Column Reboilers, E-1410 and E-1410X, and the remaining heat duty is supplied by cooling the Purification Column bottoms in the Purification Column side stream Reboiler, E-1413, which is located above the feed tray. The overhead vapor, relatively rich in formaldehyde, is condensed in the Purification Column Condensers, E-1411 and E-1411X, and collected in the Purification Column Reflux Drum, D-1410. Part of the condensate is returned to the column as reflux via the Purification Column Reflux Pumps, G-1411 A/B, and the remainder ,containing about 5% of the ethylene oxide in the column feed, is sent to the Glycol Feed Stripper, T-3510, to keep the formaldehyde impurity from building up in the system.

The bottoms from the Purification Column contain a small amount of glycol formed by the hydrolysis of ethylene oxide. The bottoms (oxide-free water) are pumped by the Purification Column Bottoms pumps, G-1410 A/B, to the Purification Column Feed-Bottoms Exchangers, E-1412/ E-1414, where they are cooled from 147 Deg.C to 108 Deg.C. The bottoms from the Purification Column Feed Bottoms Exchangers are then further cooled to 68 Deg.C in the Purification Column Side stream Reboiler,E-1413, and then sent to the reabsorber Water Cooler, E-3430.

The Purification Column is equipped with a pasteurization section, consisting of 8 trays above the product draw off tray. The pasteurization trays are used to concentrate the formaldehyde in the column overhead and allow the purified ethylene oxide to be withdrawn as a liquid side stream product on tray 83 below the pasteurization section. The purified ethylene oxide product at 48 Deg.C is pumped to the Ethylene Oxide Storage Section by the Oxide Product Pumps, G-1412 A/B. Before storing it in EO storage drums,D-1810 A/B purified Ethylene Oxide is cooled in Oxide product Pre-cool. E-1801 and Oxide product coolers,E-1805 and 1805X up to -5 C. Hook-ups are taken in existing EOS Refrigeration unit for its augmentation in future, as & when required.

Acetaldehyde which enters with the feed is removed by taking a side stream purge to the Glycol Feed Stripper. The aldehyde containing about 20%of the Ethylene Oxide in the feed is taken near bottom of the rectification section.
Existing link-up between EOP Unit and First/Second Train of Reabsorber/ Glycol Feed Stripper are retained for future use, if so required.



STREAM No.

TEMPERATURE(0 c)

PRESSURE(Kg/cm2 abs)

FOR NOTES SEE DWG. 2819-0-00

REV.	DESCRIPTION	DATE	BY	CHKD.

INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

PROCESS FLOW DIAGRAM – ETHYLENE OXIDE PLANT

ETHYLENE OXIDE PURIFICATION

DRAWN BY ____ DATE 28.11.03 CHECKED BY ____ DATE 28.11.03

APPROVED BY ____ DATE 28.11.03 SCALE NONE

APPROVED FOR CONSTRUCTION DATE ____ DWG. NO. IG-2819-0-1400

800 (Utility System)

Nitrogen System:-

Low pressure nitrogen at 4.5 Kg/cm2a enters from battery limits and supplies nitrogen for ballast gas in ETO reaction system (via Reclaim Compressor),carrier gas for inhibitor feed system, ejector suction pressure control, tank padding and purging, and vacuum breaking services. In addition, the nitrogen will be used for initial pressurization of the reaction system.

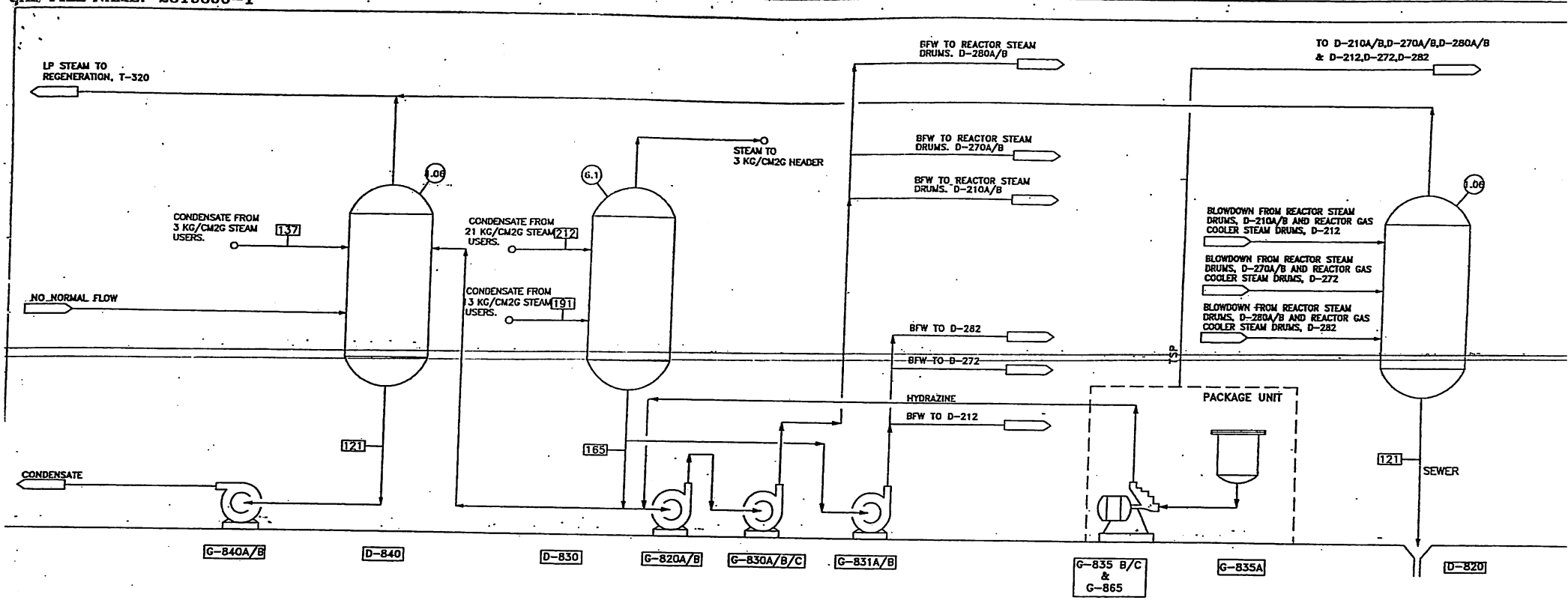
A dedicated supply of high-pressure nitrogen is provided by intermittently compressing a portion of the low Pressure Nitrogen in the High Pressure Nitrogen Compressor, C-810/ C-2810. The H.P. Nitrogen is stored in the High Pressure Nitrogen Surge Drum, D-810. D-2810, at 60 Kg/cm2a and used for start-up/shutdown purging of the Oxygen Mixing Station, H-280 (ETO Reaction and Recovery Section)

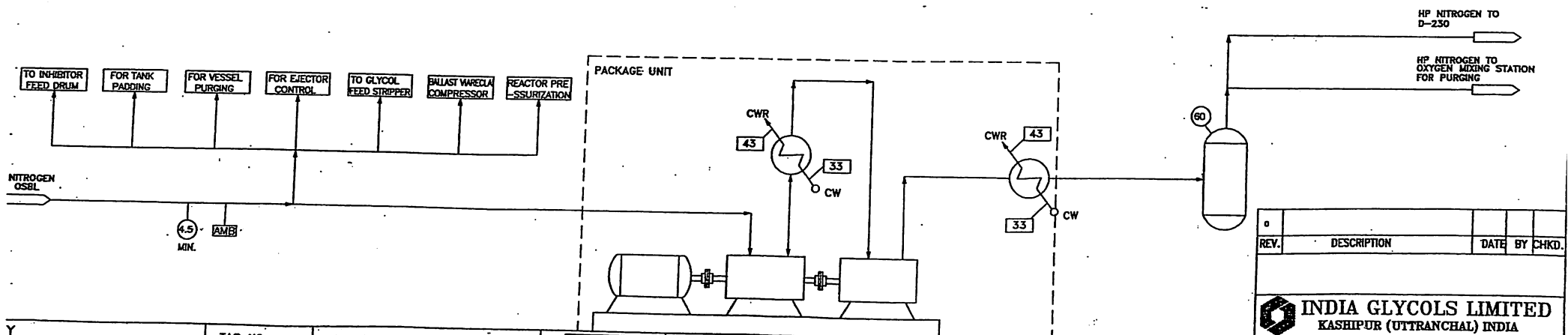
BFW system:-

Condensate from 21 Kg/cm2 G steam users (at 212 deg.C) and condensate from 13 Kg/cm2g steam users (at 191 deg.C) is collected in the High Pressure Condensate Drum, D-830, which operates at 6.1 Kg/cm2g. Flash steam raised in D-830 is returned to 3 Kg/cm2g steam header. Condensate from D-830 is pumped to the Rector Steam Drums (D-210 A/B D-270 A/B & D-280 A/B) and Reactor Gas Cooler Steam Drums (D-212, D-272 & D-282) as Boiler Feed Water for steam generation. The Boiler Feed Water is treated by injecting BFW Chemicals via G-835 A/B/C & G-865, BFW Chemical system.

Condensate from the Regenerator Reboiler, E-320, and excess condensate from H.P. Condensate Drum, D-830, is collected in the Low Pressure Condensate Drum,D-840, which operates at 1.06 Kg/cm2G. Blow down from Reactor Steam Drums (D-210 A/B, D-270 A/B & D-280 A/B)and Reactor Gas Cooler Steam Drums (D-212, D-272 & D-282)is collected in the Blow down Flash Drum, D-820, which operates at 1.06 Kg/cm2G. Flash steam from D-820 and D-840 is injected in Regenerator, T-320. Condensate from D-840 is pumped to OSBL via Low Pressure Condensate Pumps G-840 A/B. Condensate from D-820 is drained to the Sewer.

CAD FILE NAME:-2819800-1





Y		TAG NO.	DESCRIPTION
>	STREAM No.	D-840	LOW PRESSURE CONDENSATE DRUM
-	TEMPERATURE(0 c)	D-830	HIGH PRESSURE CONDENSATE DRUM
]		G-840 A/B	LOW PRESSURE CONDENSATE PUMPS
)	PRESSURE(Kg/cm2 abs)	G-820 A/B	–
		G-830 A/B	–

C-810/C-2810

TAG NO.	DESCRIPTION
G-831 A/B	–
C-810/C-2810	HIGH PRESSURE NITROGEN COMPRESSOR
D-810/D-2810	HIGH PRESSURE NITROGEN SURGE DRUM
G-835B/C & G-865	BFW CHEMICAL SYSTEM
D-820	BLOW DOWN FLASH DRUM

D-810/D-2810

REV.	DESCRIPTION	DATE	BY	CHKD.
0				

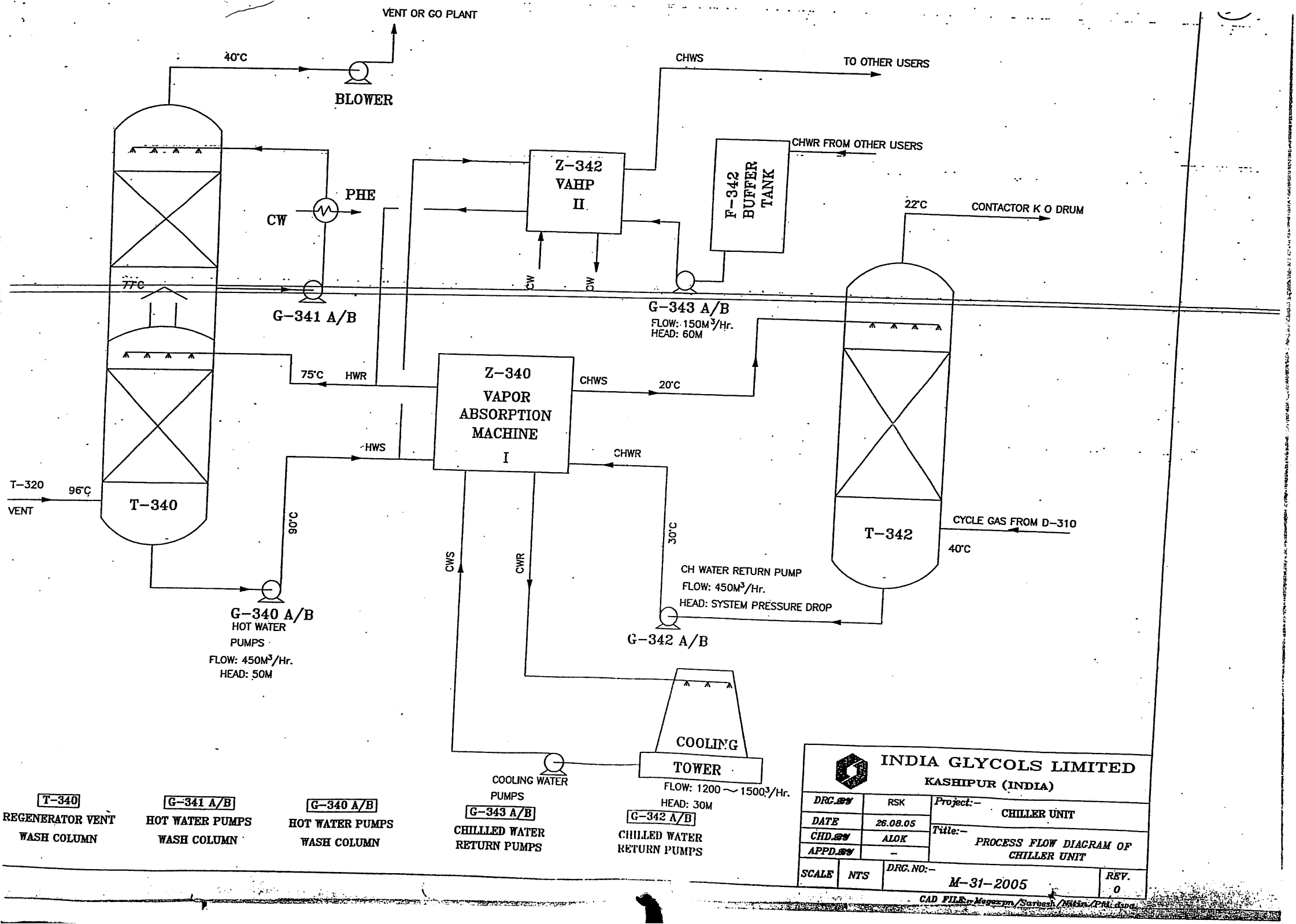
INDIA GLYCOLS LIMITED
KASHIPUR (UTTRANCHAL) INDIA

PROCESS FLOW DIAGRAM – ETHYLENE GLYCOL PLANT

MISCELLANEOUS UTILITIES, STEAM & CONDENSATE SYSTEM

DRAWN BY [illegible] DATE 12.11.03 CHECKED BY AS DATE 13.11.03
APPROVED BY SG DATE 14.11.03 SCALE NTS
APPROVED FOR CONSTRUCTION BY DATE No. 2819-X-800-1

CAD FILE NAME:-2819800-1



T-340	REGENERATOR VENT WASH COLUMN
G-341 A/B	HOT WATER PUMPS WASH COLUMN
G-340 A/B	HOT WATER PUMPS WASH COLUMN
G-343 A/B	CHILLLED WATER RETURN PUMPS
G-342 A/B	CHILLED WATER RETURN PUMPS

INDIA GLYCOLS LIMITED
KASHIPUR (INDIA)

DRG.BY	RSK	Project:- CHILLER UNIT
DATE	26.08.05	
CHD.BY	ALOK	Title:- PROCESS FLOW DIAGRAM OF CHILLER UNIT
APPD.BY	-	
SCALE	NTS	DRG. NO:- M-31-2005
		REV. 0

CAD FILE:-Megesan/Sarvesh/Mitin/Pfd.dwg

Glossary

SYNDOX	Solid **silver** based catalyst
OSBL	Outside battery limit.
PALL, IMPT RING	Pall ring packing for **liquid** distillation Impt **[intermetallic type packing]** for **gas** distillation
RICH CYCLE WATER	Contents maximum ethylene oxide
LEAN CYCLE WATER	Contents maximum ethylene oxide
LC	Level control value
FC	Flow control value.
FT	Flow transmitter
PC	Pressure control value.
TC	Temperature control value
PT	Pressure transmitter
TI	Temperature indicator.
HC	For emergency trip
PI	Pressure indicator

PSV	Pressure safety value
PRV	Pressure regulating value
PSL	Pressure switch low
PSLL	Pressure switch low low
PSH	Pressure switch high
PSHH	Pressure switch high high
PAL	Pressure alarm low
PALL	Pressure alarm low low
PAH	Pressure alarm high
PAHH	Pressure alarm high high
LG	Level gauge
FI	Flow indicator
LT	Level transmitter
SELECTIVITY	Moles of EO formed / moles of ethylene reacted
CONVERSION	C_2H_4 reacted / moles of ethylene reacted