1.0 Process Description

PET (Polyethylene terephthalate) is commonly used in the packaging industry. PET bottles are light and shatterproof making them a good choice for packaging water and beverages. With the increasing demand for PET bottles, the impact on the environment had become a concern. PET bottles are non-biodegradable. Therefore, recycling PET bottles is essential to reduce waste and conserve the environment. In the process of recycling PET bottles, reactor, separator, distillation column, hopper, conveyor belt, condenser, crystallizer, tank, elevator, cyclone, storage tank, pump, cutter, gravity sorter, crusher, reboiler, heater, dryer, centrifuge, bag filter, heat exchanger, centrifugal fan, filter press, centrifuge in solid shell and rotary filter are required in the process.

The process starts with unpacked PET bottles. The bottles are collected in the V-100 hopper before they are processed further. V-100 hopper is a large container that is able to hold large amounts of PET bottles at a time, allowing the continuous feeding of bottles into subsequent stages. The V-100 hopper also helps to regulate the flow of the PET bottles in the system by preventing underloading or overloading of the stages. All the PET bottles are sent to the U-100 electromagnet by the B-100 conveyor belt. The iron and aluminum from the unpacked PET bottles are being removed by the U-100 electromagnet. Then, the PET bottles are sent to the K-100 crusher. The PET bottles are crushed into flakes of 2 to 30 mm in size. The separation components are different from PET with labels or flaky prices being separated by winnowing based on their weight and density. Water and gravity sorting also help in separating them. These components will elevate and be sent to the F-100 cyclone. The lighter component will exit from the top of the F-100 cyclone. The components will pass through an F-101 bag filter to filter out the large components. The water is sent to the V-101 gravity sorter to wash away the foreign materials such as PE and PP that are attached to the crushed bottle pieces. The large components such as sand and stones which has larger specific gravity than water will be removed through sedimentation at the bottom and sent to the V-102 centrifuge. Some of the water will be drained out while some being pumped by the P-101 pump as wastewater.

PET flakes, PET depolymerization catalyst and EG are being pumped from by different pump P-200 and P-201 to the R-200 depolymerization tank reactor at 175 ℃ to 190 ℃ under pressure of 0.1 to 0.5 MPa. BHET will be produced. The undissolved solid will be sent to F-300 filter press to undergo solid-liquid separation. All the undissolved solids will pump into V-300 centrifuge with solid shell. Then, the undissolved solid will be separated by F-300 filter press. The filter cloth is used trap the solid particles and allowing the liquid to pass through. Once the filter press is filled with solid, the filtration process will stop and the solid are being removed from the filter press as a cake. The depolymerization product after the depolymerization process will be sent to T-400 distillation column. EG is being removed by distillation and recycled back to the R-200 depolymerization tank.

The concentrated liquid of depolymerization reaction product, BHET is fed into V-500 crystallizer. MeOH from supply source and T-700 MeOH rectification tank is being pumped into V-500 crystallizer. An ester interchange reaction catalyst also added into the V-500 crystallizer. The V-500 is at the temperature of 65 ℃ to 85 ℃ under pressure of 0.1 to 0.3 MPa

and retention time of 0.5 hour to 5 hour. Thus, the depolymerization reaction product is converted into DMT and EG. After the cooling of DMT and EG, the mixture is being separated by F-600 filter press to produce DMT cake and a mixture of EG and MeOH.

Since the separated DMT cake contain MeOH, solid-liquid separation will be undergone again. The DMT cakes will be send to DMT distillation tower to get purified DMT and collected it at DMT recovery tank. A part of the liquid on the bottom will be recycled back to R-200 depolymerization tank and the rest will be disposed outside. The mixed liquid of EG and MeOH obtained from F-600 filter press is supplied to T-700 MeOH rectification tower. MeOH is distilled out. The distilled out MeOH can be used to supply to V-500 crystallizer. The residual liquid from the bottom of T-700 MeOH rectification tower can be supplied to T-800 EG distillation tower.

The DMT from T-1000 DMT distillation tower which has been purified will stored into V-1100 DMT storage tank. DMT will be pumped into V-1101 heating vessel to heat up as in molten state to a hydrolysis reaction temperature. The heated DMT with hot water heated in E-1200 water boiler is then supplied to R-1200 hydrolysis reaction tank. The reaction temperature and pressure in the tank is at 230 ℃ to 250 ℃ under 2.9 MPa to 4.0 MPa. The MeOH by product and entrained water are removed from the tank. The hot TA and water slurry which obtained at the bottom of the R-1200 hydrolysis reaction tank is supplied to T-1200 cooling tank for cooling purpose. The water in the slurry will be vaporized and led to the deficiency of water. So, water from V-1400 water supply tank will be supplied. The cooled TA and water slurry will supply to T-1400 solid-liquid separator for separation. TA cakes and water are being separated. TA cake will supply to T-1500 slurry tank.

The mixed vapor of water and MeOH which generated form R-1200 hydrolysis reaction tank is condensed by E-1201 steam condenser. They are supplied into T-1300 vacuum distillation column to separate MeOH from water at low temperature than in atmospheric distillation. This will create a vacuum inside the column which able to lower down the boiling point of liquid. As the mixed vapor enter T-1300 vacuum distillation column, different boiling point of MeOH and water will be able to separate. MeOH will obtain at the top is supplied to T-700 MeOH rectification tank for distillation again. Water which obtains at the bottom of the distillation column will send to T-1400 water supply tank, heated in the E-1301 reboiler.

TA cake and water from T-1200 cooling tank will channel into V-1400 separator. The water will send to T-1400 water supply rank to recycle and some of the water will send to wastewater treatment plant. The TA cake will send to the T-1500 slurry tank. The TA slurry form V-1400 separator and EG from T-1700, T-1900 and T-2100 EG distillation tower are supplied into V-1500 TA slurry tank. Both slurry is then supplied to R-1600 esterification tank.

PET oligomer will obtain esterification reaction. The temperature of R-1600 esterification tank is 260 ℃ to 270 ℃ and retention time is 1 hour to 5 hours. EG and water will be distilled out and separated at T-1700 EG distillation tower. PET oligomer obtained in R-1600 esterification tank is then supplied to R-1800 initial polycondensation reaction tank after the addition of germanium dioxide and trimethyl phosphate as catalyst and stabilizer. Polycondensation reaction take place under a condition of weak vacuum of 1.3 kPa to 4.0 kPa

from P-2100 vacuum pump under temperature of 260 ℃ to 300 ℃. The product generated will supply to R-2000 Latter Term Polycondensation Reaction Tank to carry out polycondensation reaction again. High vacuum from P-2101 vacuum pump is generated at 67 Pa to 0.7 kPa under temperature of 270 ℃ to 300 ℃. During the polycondensation reaction, EG byproduct will be produced in R-1800 initial polycondensation reaction tank and R-2000 Latter Term Polycondensation Reaction Tank. EG will be supplied to T-1900 EG distillation tower for distillation purpose.

PET oligomer in R-2000 Latter Term Polycondensation Reaction Tank is taken out and cooled in T-2200 cooling bath. PET oligomer will then cut into pellets by K-2200 cutter. The PET pellets are supplied into V-2300 solid phase polymerization tank equipped with dryer and preliminary crystallizer to adjust the degree of polycondensation at specific level that suitable for PET bottles. Vacuum pump from P-2100 is being pumped to carry out polycondensation reaction. The final product will be stored into T-2300 storage tank.

Wastes which produced from R-1800 initial polycondensation reaction tank, R-2000 Latter Term Polycondensation Reaction Tank and V-2300 solid phase polymerization tank will be send to R-200 depolymerization tank to depolymerize them. Water, EG and MeOH which generated in the process can be recycled back to their respective distillation tower. As a result, loses of waste can be minimize during the process of recycle PET bottles.

DRAWING NO.	REV	DRAWING TITLE
P-0001	0	PROCESS DRAWING INDEX
P-0002	0	SYMBOLS, LEGEND AND ABBREVIATIONS
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 1 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 2 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 3 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 4 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 5 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 6 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 7 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 8 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 9 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 10 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 11 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 12 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 13 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 14 OF 23)

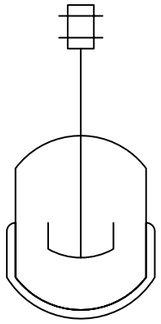
	DRAWN BY: WPY	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: CYJ	DRAWING TITLE: PROCESS DRAWING INDEX	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH		DRAWING NO.: P-0001 / SHEET NO.: 1/2 / REV NO.: 0

DRAWING NO.	REV	DRAWING TITLE
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 15 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 16 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 17 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 18 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 19 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 20 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 21 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 22 OF 23)
P-0003	0	PIPING AND INSTRUMENTATION DIAGRAM (SHEET 23 OF 23)

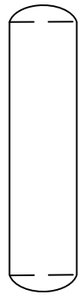
	DRAWN BY: WPY	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: CYJ	DRAWING TITLE: PROCESS DRAWING INDEX	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH		DRAWING NO.: P-0001 / SHEET NO.: 2/2 / REV NO.: 0

SYMBOLS FOR P-0003 PIPING AND INSTRUMENTATION DIAGRAM

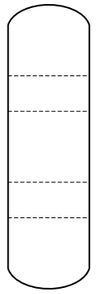
MECHANICAL AND PROCESS EQUIPMENT



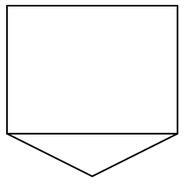
REACTOR



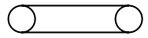
SEPARATOR



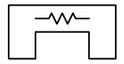
DISTILLATION COLUMN



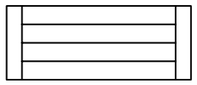
HOPPER



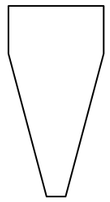
CONVEYOR BELT



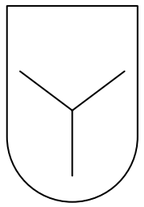
ELECTROMAGNET



CONDENSER

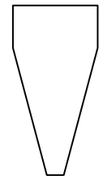


CRYSTALLIZER

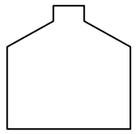


TANK/ AGITATOR TANK

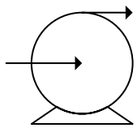
ELEVATOR



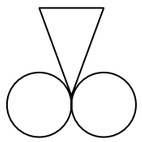
CYCLONE



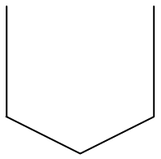
TANK,STORAGE TANK



PUMP

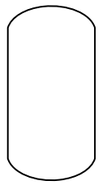


CUTTER

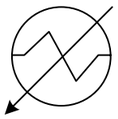


GRAVITY SORTER

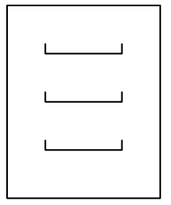
CRUSHER



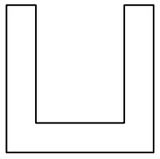
REFLUX DRUM, HEATING VESSEL



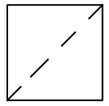
COOLER



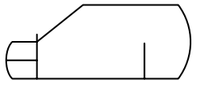
DRYER



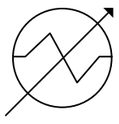
CENTRIFUGE



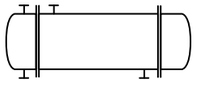
BAG FILTER



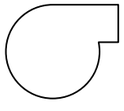
BOILER, REBOILER



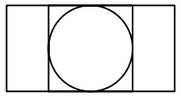
HEATER



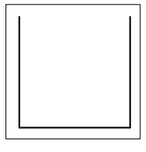
HEAT EXCHANGER



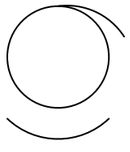
CENTRIFUGAL FAN



FILTER PRESS



CENTRIFUGE (SOLID SHELL)



ROTARY FILTER

MAJOR EQUIPMENT IDENTIFIER

C - COMPRESSORS, EXPANDER

B - CONVEYOR BELT, ELEVATOR

E - HEAT TRANSFER EQUIPMENTS

F - CYCLONE, FILTER

P - PUMPS

R - REACTORS

T - TOWERS, COLUMNS, STORAGE TANKS

V - VESSELS, TANKS, SEPARATORS

U - ELECTROMAGNET

ABBREVIATIONS

CHW	-	CHILLED WATER
CV	-	CHECK VALVE
CW	-	COOLING WATER
CHW		CHILLED WATER
H/O/A	-	HAND/OFF/AUTO
M	-	MOTOR
PSV	-	PRESSURE SAFETY VALVE
SDV	-	SHUT DOWN VALVE
S	-	SOURCE
R	-	RECYCLE
TS	-	TEMPORARY STORAGE
V	-	VALVE

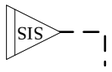
ABBREVIATIONS

PET	-	POLYETHYLENE TEREPHTHALATE
EG	-	ETHYLENE GYCOL
MEOH	-	METHANOL
DME	-	DIMETHYL ETHER
DMT	-	DIMETHYL TEREPHTHALATE
TA	-	TEREPHTHALIC ACID

	DRAWN BY: WPY	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: CYJ	DRAWING TITLE: SYMBOLS, LEGEND AND ABBREVIATIONS	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING NO.: P-0002	SHEET NO.: 1/2 / REV NO.: 0

SYMBOLS FOR P-0003 PIPING AND INSTRUMENTATION DIAGRAM

VALVE

NORMALLY OPEN	NORMALLY CLOSED	NAMING
		GATE VALVE
		ACTUATOR VALVE
		BALL VALVE
		FAIL CLOSED CONTROL VALVE
		FAIL OPEN CONTROL VALVE
		CHECK VALVE
		RELIEF VALVE
		PRESSURE SAFETY VALVE
		THREE WAY VALVE
		SAFETY INSTRUMENTATION SYSTEM

INSTRUMENT IDENTIFICATION

A		ALARM
C		CONTROLLER
F	FLOW	RATIO
G		GAUGE
H	HAND	
I		INDICATOR
L	LEVEL	
M	MOTOR	
P	PRESSURE	
S		SWITCH
T	TEMPERATURE	TRANSMITTER
V		VALVE
Z		EMERGENCY OR SAFETY ACTION

LINE CONNECTION

LOCALLY MOUNTED

CONTROL ROOM MOUNTED, BPCS

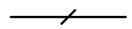
CONTROL ROOM MOUNTED, SIS

LINE AND CONNECTION

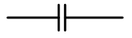
PROCESS LINE

INSTRUMENT LINE

ELECTRICAL SIGNAL



ELECTRICAL SIGNAL (TRIP)

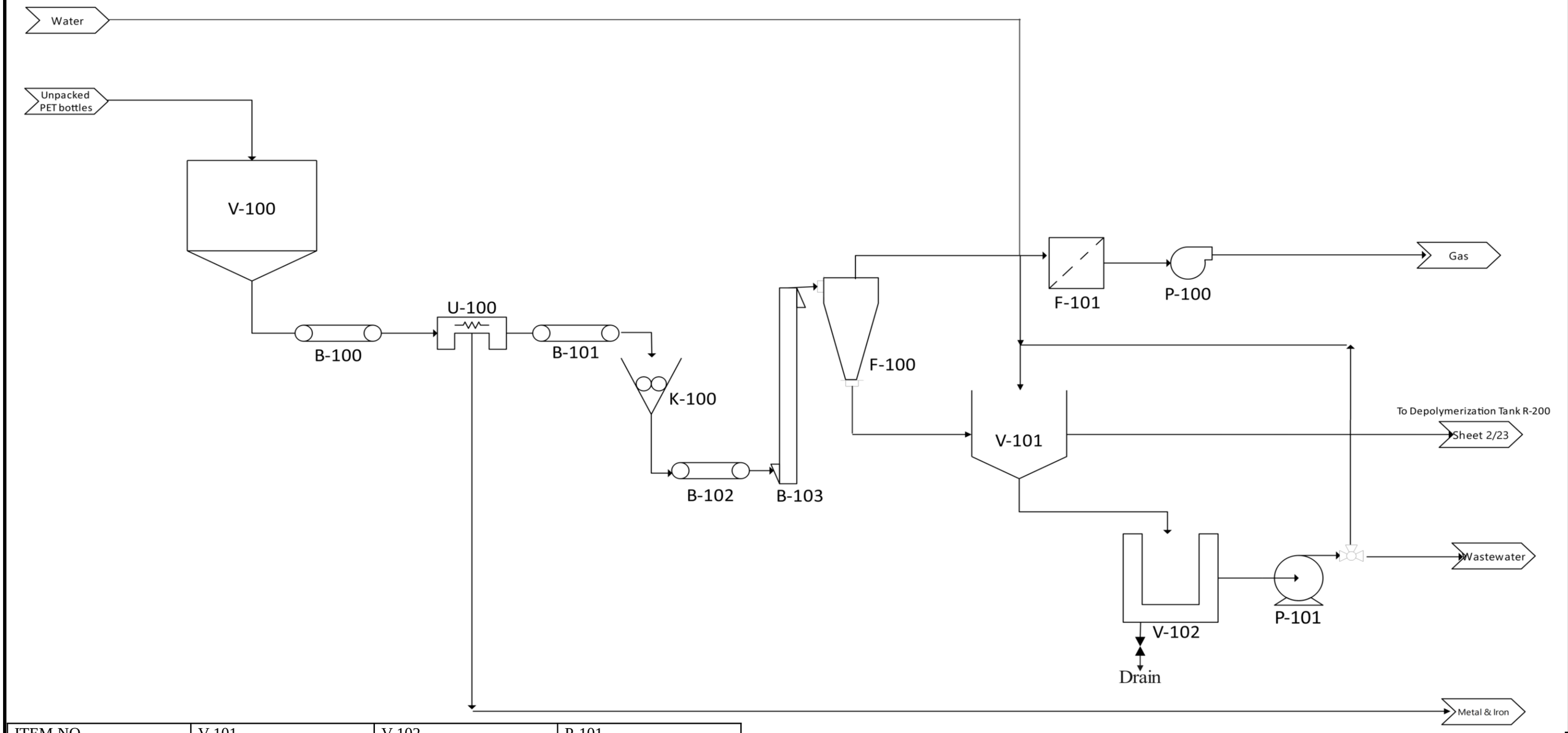


FLANGED CONNECTION

SPECTACLE BLIND

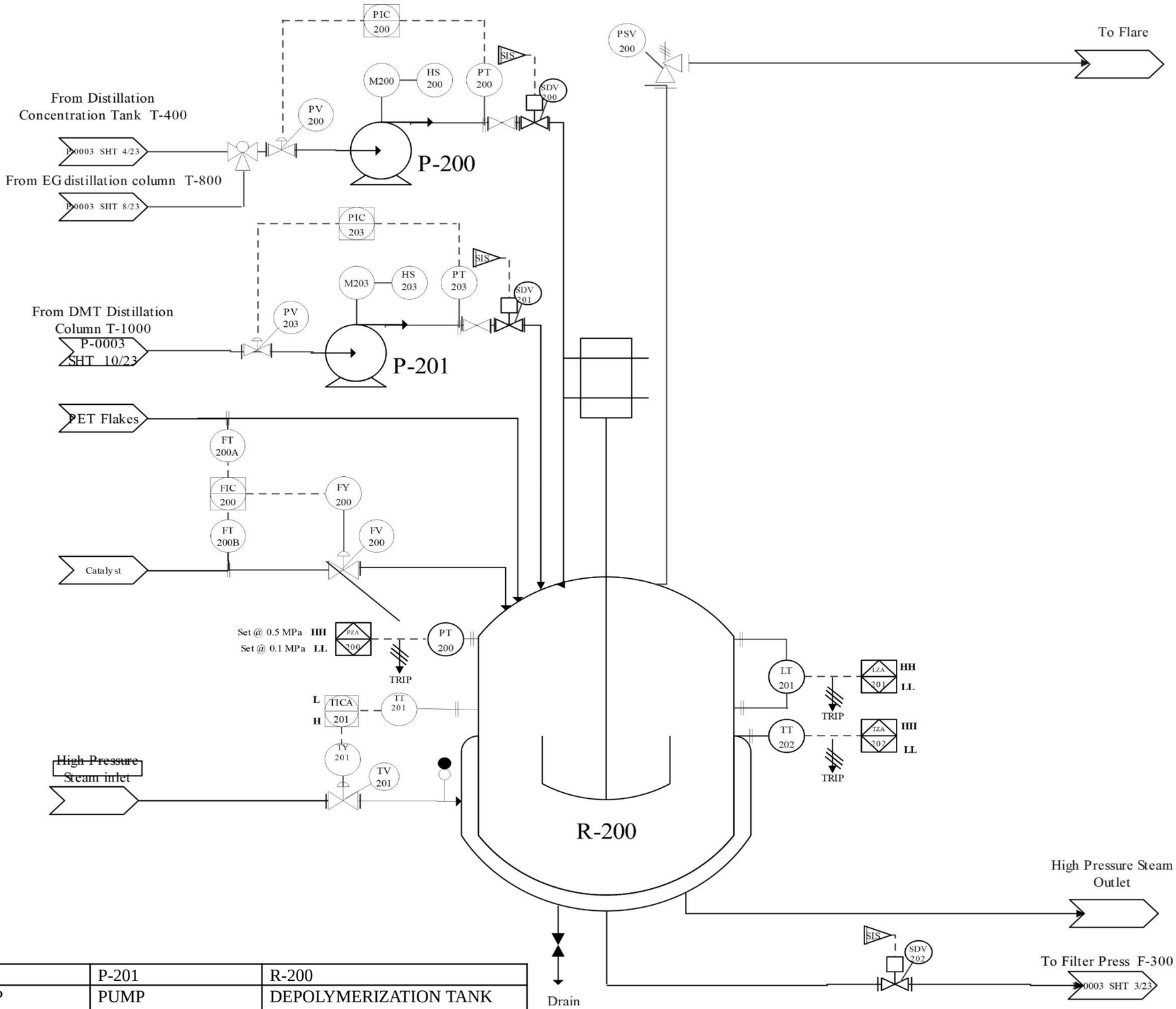
	DRAWN BY: WPY	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: CYJ	DRAWING TITLE: SYMBOLS, LEGEND AND ABBREVIATIONS	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING NO.: P-0002	SHEET NO.: 2/2 / REV NO.: 0

ITEM NO.	V-100	B-100	U-100	B-101	K-100	B-102	B-103	F-100	F-101	P-100
SERVICE	HOPPER	CONVEYOR BELT	ELECTROMAGNET	CONVEYOR BELT	CRUSHER	CONVEYOR BELT	ELEVATOR	CYCLONE	BAG FILTER	CENTRIFUGAL FAN
DESIGN PRESSURE (kPa)	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC
DESIGN TEMPERATURE (° C)	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC
DUTY(kW)	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL



ITEM NO.	V-101	V-102	P-101
SERVICE	GRAVITY SORTER	CENTRIFUGE	PUMP
DESIGN PRESSURE (kPa)	TBC	TBC	TBC
DESIGN TEMPERATURE (° C)	TBC	TBC	TBC
DUTY(kW)	TBC	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL	CARBON STEEL

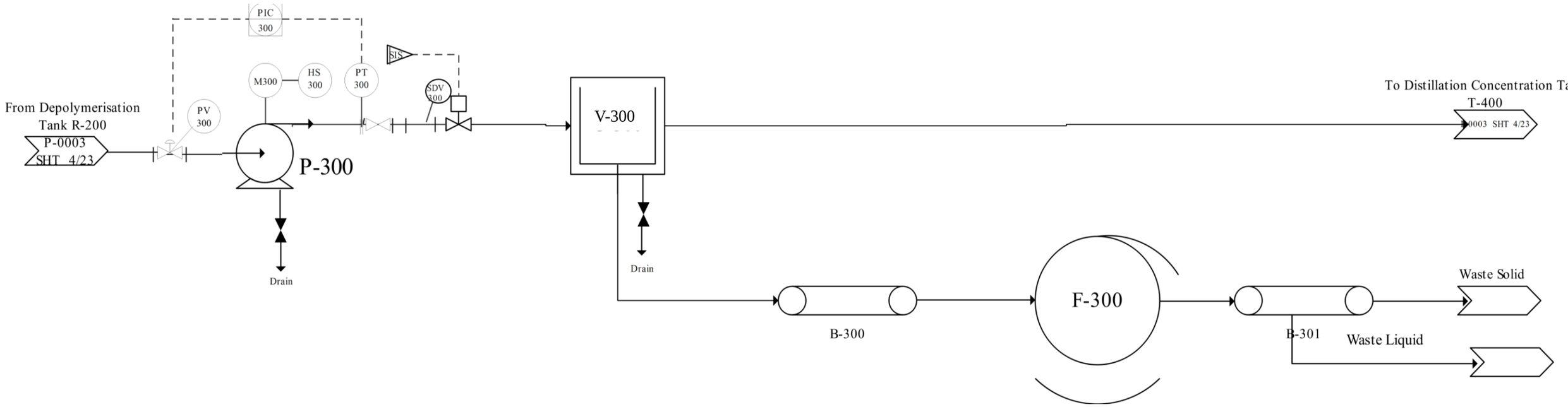
	DRAWN BY: CYJ	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: TTW	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH		DRAWING NO.: P-0003 / SHEET NO.: 1/23 / REV NO.: 0



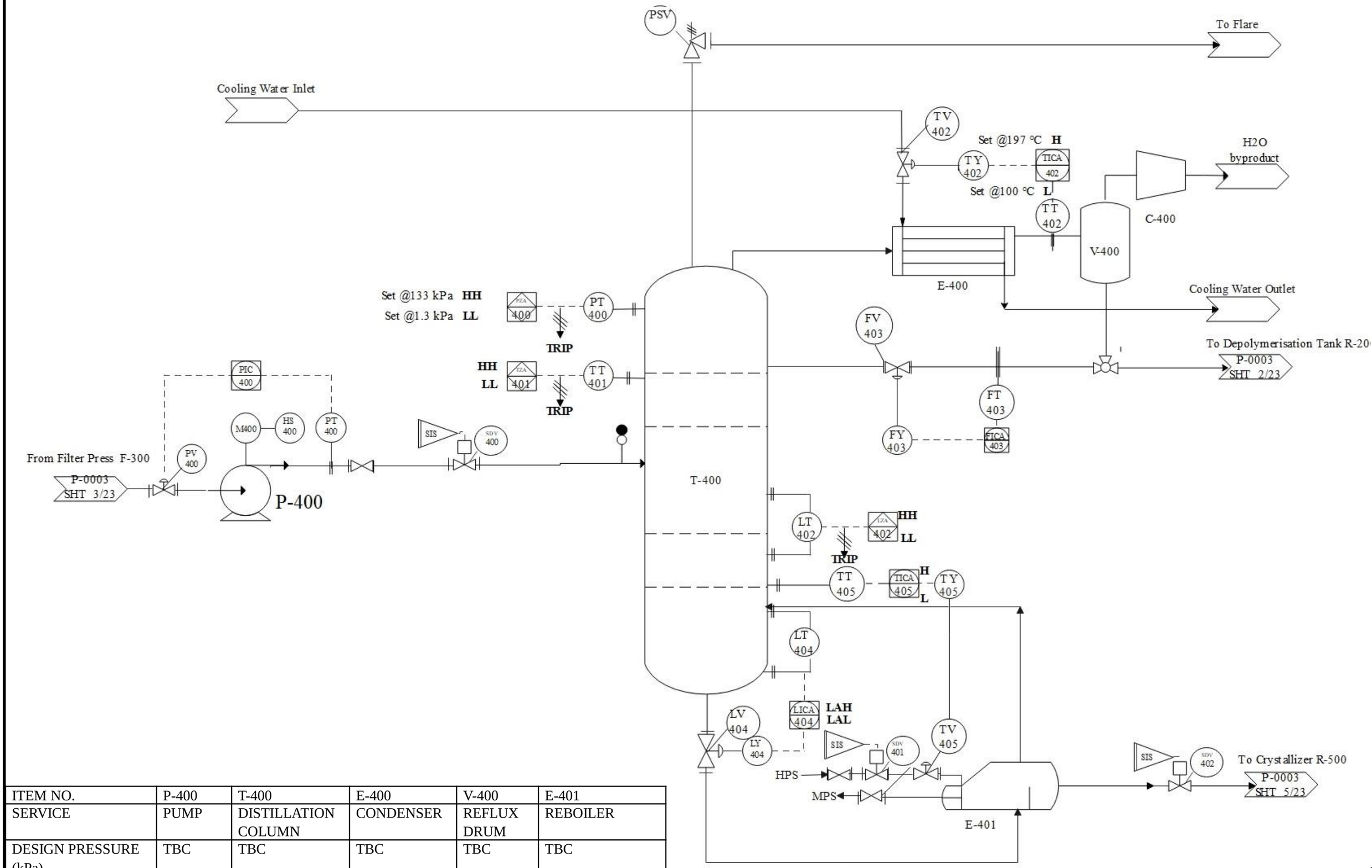
ITEM NO.	P-200	P-201	R-200
SERVICE	PUMP	PUMP	DEPOLYMERIZATION TANK REACTOR
DESIGN PRESSURE (kPa)	TBC	TBC	TBC
DESIGN TEMPERATURE (° C)	TBC	TBC	TBC
DUTY(kW)	TBC	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL	CARBON STEEL

	DRAWN BY: CYJ	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: TTW		UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	DRAWING NO.: P-0003 / SHEET NO.: 2/23 / REV NO.: 0

ITEM NO.	P-300	V-300	F-300
SERVICE	PUMP	CENTRIFUGE (SOLID SHELL)	ROTARY FILTER
DESIGN PRESSURE (kPa)	TBC	TBC	TBC
DESIGN TEMPERATURE (° C)	TBC	TBC	TBC
DUTY(kW)	TBC	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL	CARBON STEEL



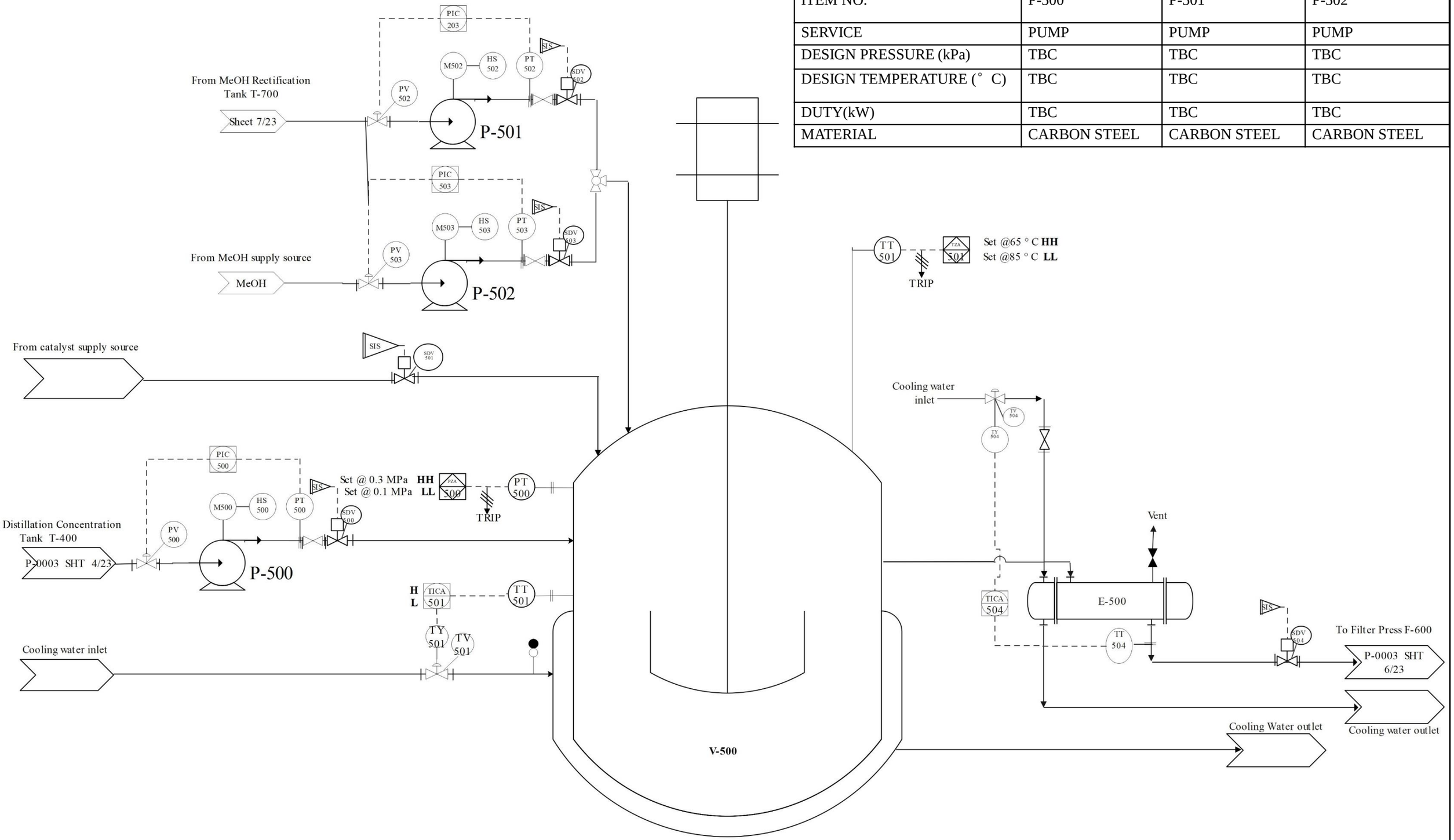
	DRAWN BY: CYJ	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11	
DATE: 01.04.2023	CHECKED BY: TTW	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	UNIVERSITI TUNKU ABDUL RAHMAN	
SCALE: Not to Scale	APPROVED BY: YYH		DRAWING NO.: P-0003	SHEET NO.: 3/23 / REV NO.: 0



ITEM NO.	P-400	T-400	E-400	V-400	E-401
SERVICE	PUMP	DISTILLATION COLUMN	CONDENSER	REFLUX DRUM	REBOILER
DESIGN PRESSURE (kPa)	TBC	TBC	TBC	TBC	TBC
DESIGN TEMPERATURE (° C)	TBC	TBC	TBC	TBC	TBC
DUTY(kW)	TBC	TBC	TBC	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL

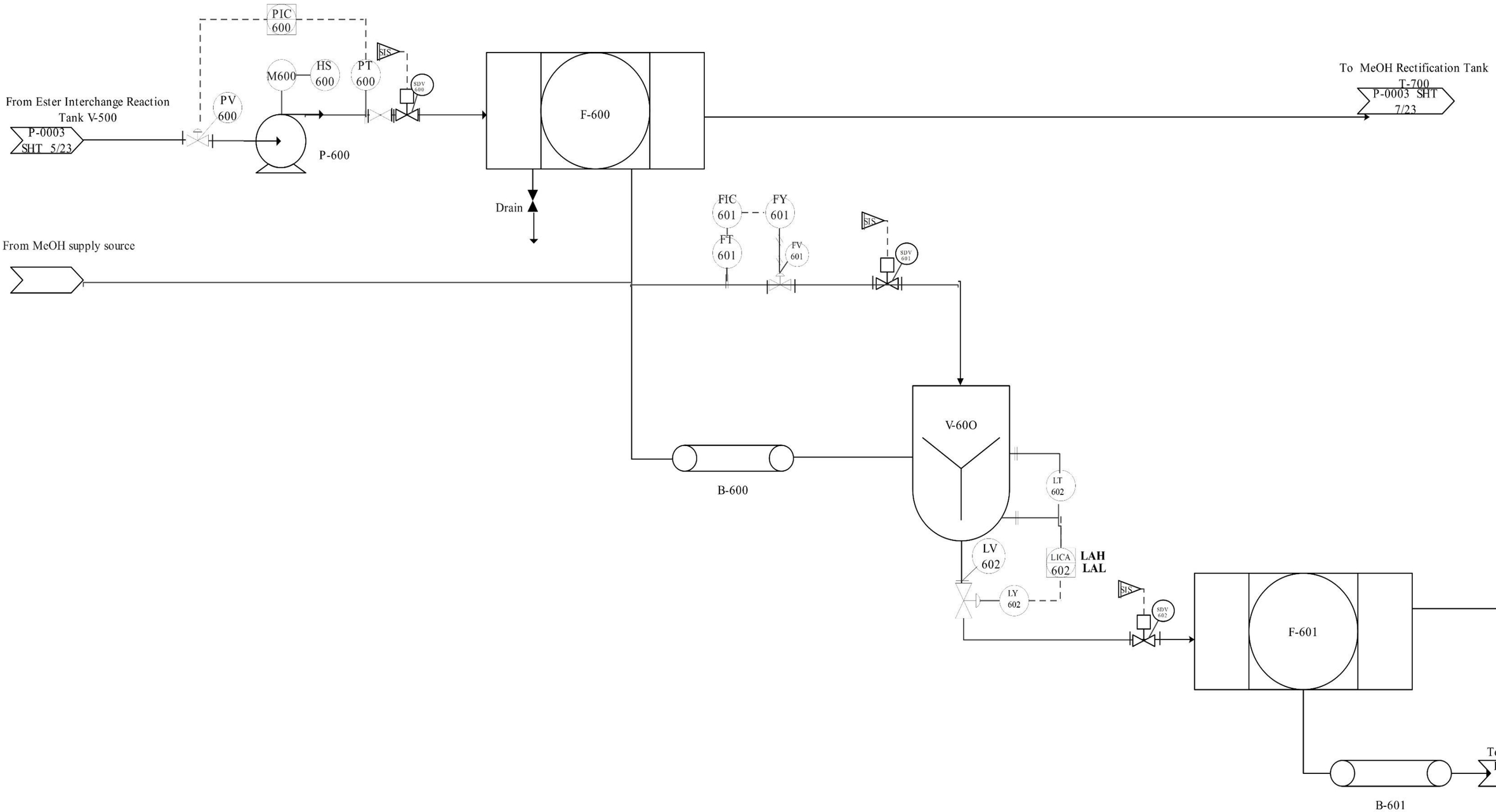
	DRAWN BY: CYJ	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: TTW	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING NO.: P-0003	SHEET NO.: 4/23
			REV NO.: 0

ITEM NO.	P-500	P-501	P-502
SERVICE	PUMP	PUMP	PUMP
DESIGN PRESSURE (kPa)	TBC	TBC	TBC
DESIGN TEMPERATURE (° C)	TBC	TBC	TBC
DUTY(kW)	TBC	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL	CARBON STEEL



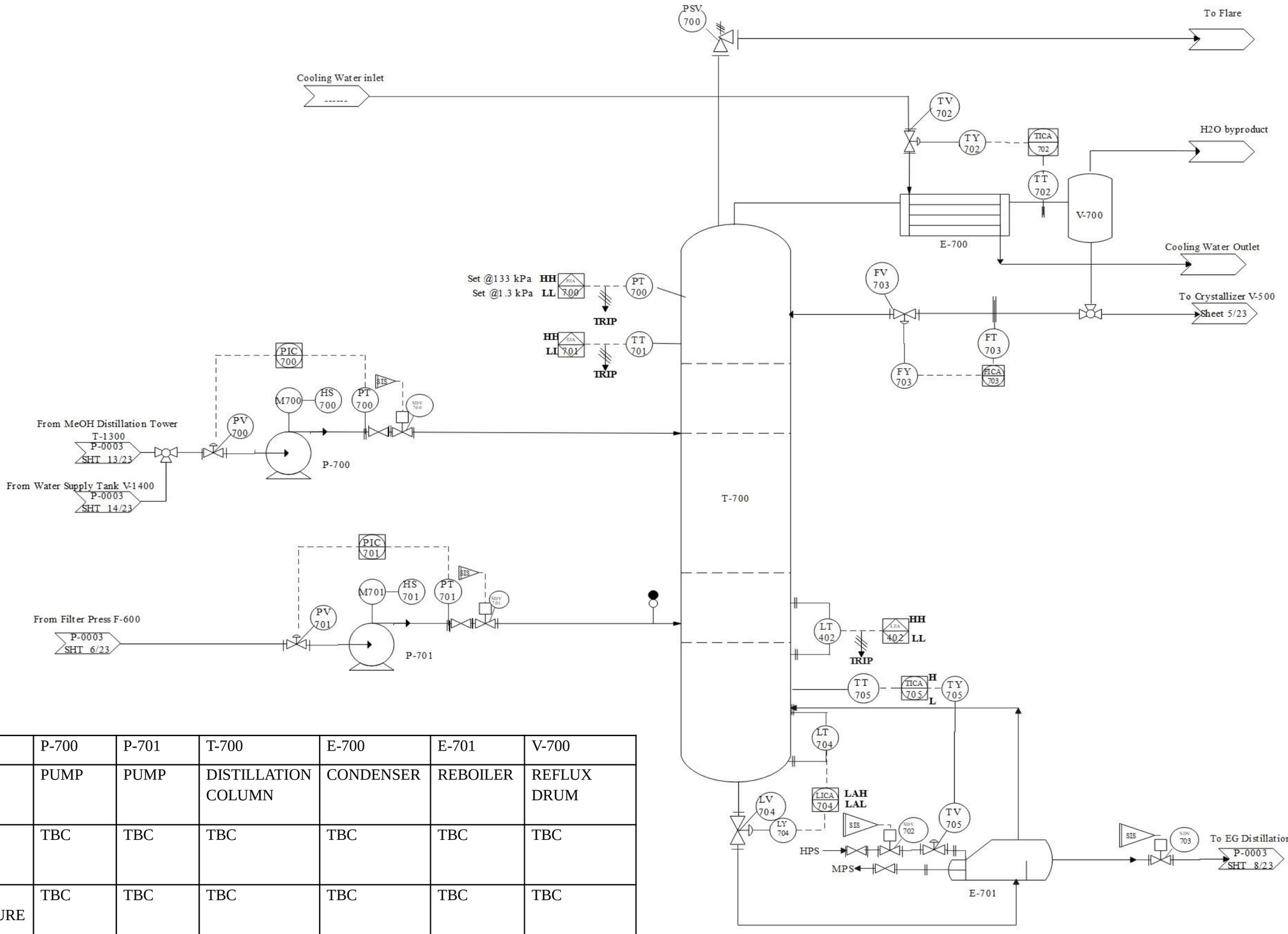
ITEM NO.	V-500	E-500
SERVICE	CRYSTALLIZER	HEAT EXCHANGER
DESIGN PRESSURE (kPa)	TBC	TBC
DESIGN TEMPERATURE (° C)	TBC	TBC
DUTY(kW)	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL

	DRAWN BY: CYJ	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: TTW	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING NO.: P-0003	SHEET NO.: 5/23 / REV NO.: 0



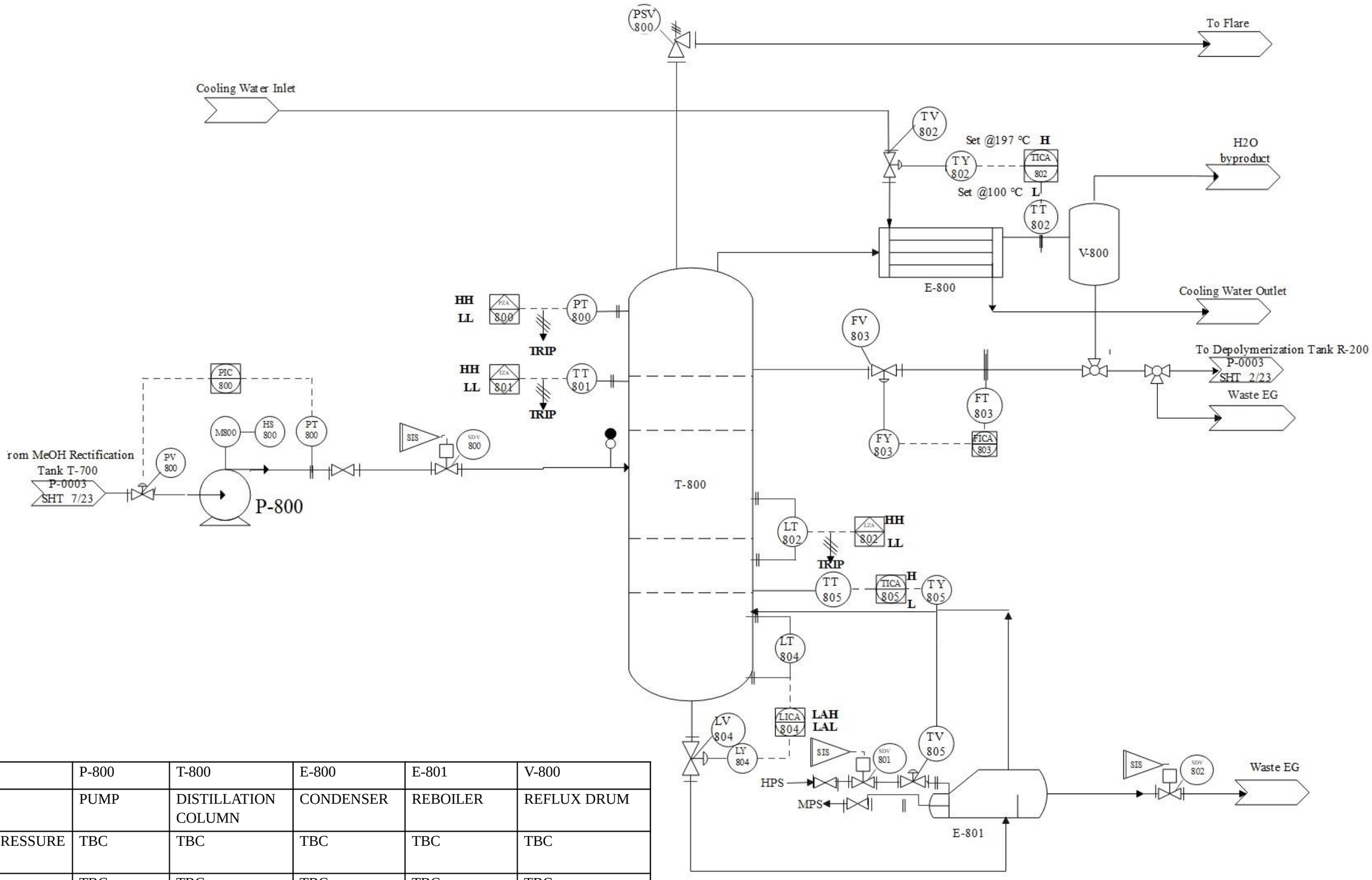
ITEM NO.	P-600	F-600	V-600	F-601
SERVICE	PUMP	FILTER PRESS	MIXER	FILTER PRESS
DESIGN PRESSURE (kPa)	TBC	TBC	TBC	TBC
DESIGN TEMPERATURE (° C)	TBC	TBC	TBC	TBC
DUTY(kW)	TBC	TBC	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL

	DRAWN BY: CYJ	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: TTW	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING NO.: P-0003	SHEET NO.: 6/23 / REV NO.: 0



ITEM NO.	P-700	P-701	T-700	E-700	E-701	V-700
SERVICE	PUMP	PUMP	DISTILLATION COLUMN	CONDENSER	REBOILER	REFLUX DRUM
DESIGN PRESSURE (kPa)	TBC	TBC	TBC	TBC	TBC	TBC
DESIGN TEMPERATURE (° C)	TBC	TBC	TBC	TBC	TBC	TBC
DUTY(kW)	TBC	TBC	TBC	TBC	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL

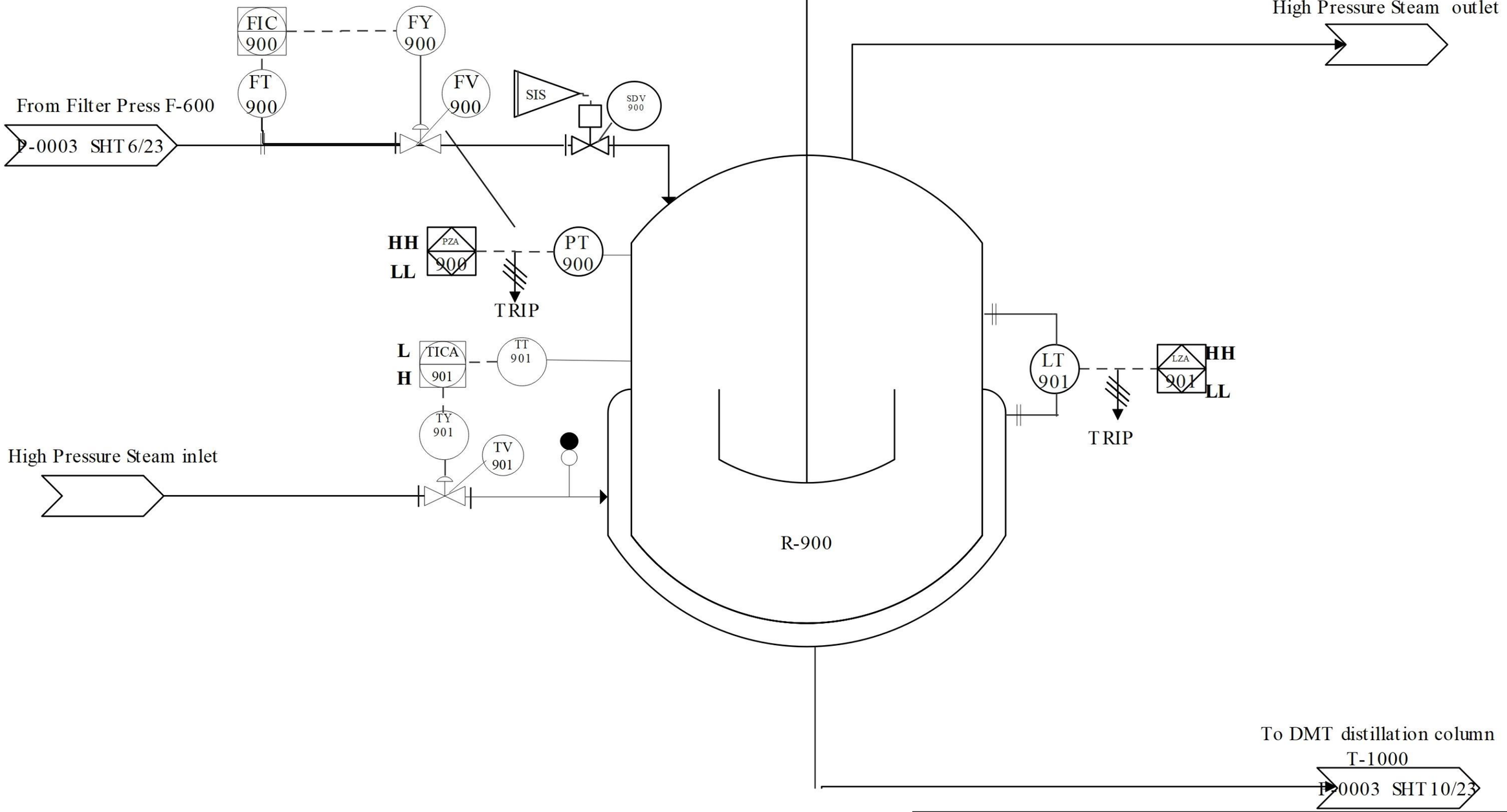
DRAWN BY: CYJ	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11	
DATE: 01.04.2023	CHECKED BY: TTW	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING NO.: P-0003	SHEET NO.: 7/23 / REV NO.: 0



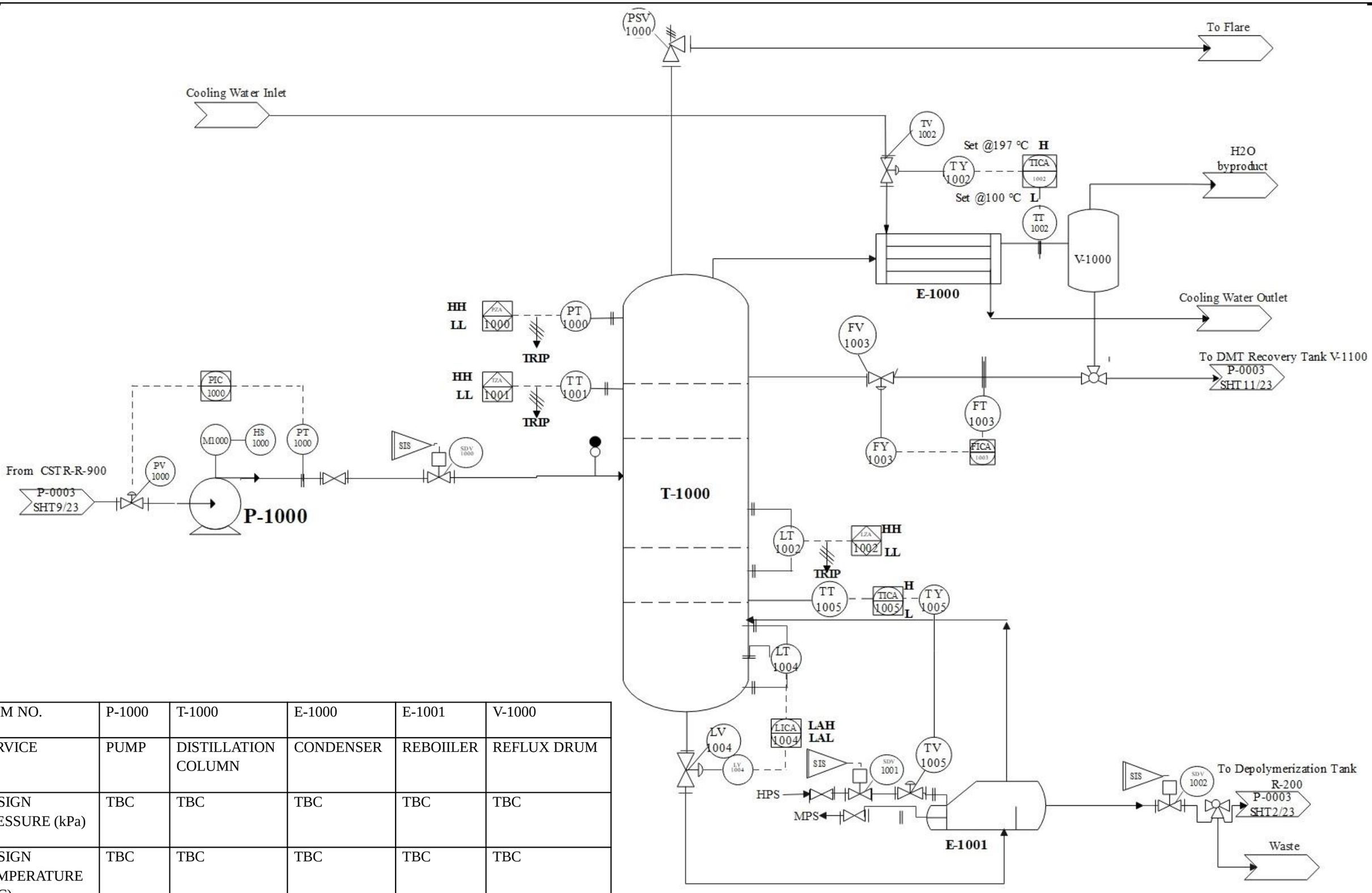
ITEM NO.	P-800	T-800	E-800	E-801	V-800
SERVICE	PUMP	DISTILLATION COLUMN	CONDENSER	REBOILER	REFLUX DRUM
DESIGN PRESSURE (kPa)	TBC	TBC	TBC	TBC	TBC
DESIGN TEMPERATURE (° C)	TBC	TBC	TBC	TBC	TBC
DUTY(kW)	TBC	TBC	TBC	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL

	DRAWN BY: CYJ	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: TTW	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING NO.: P-0003	SHEET NO.: 8/23 — REV NO.: 0

ITEM NO.	R-900
SERVICE	REACTOR
DESIGN PRESSURE (kPa)	TBC
DESIGN TEMPERATURE (° C)	TBC
DUTY(kW)	TBC
MATERIAL	CARBON STEEL



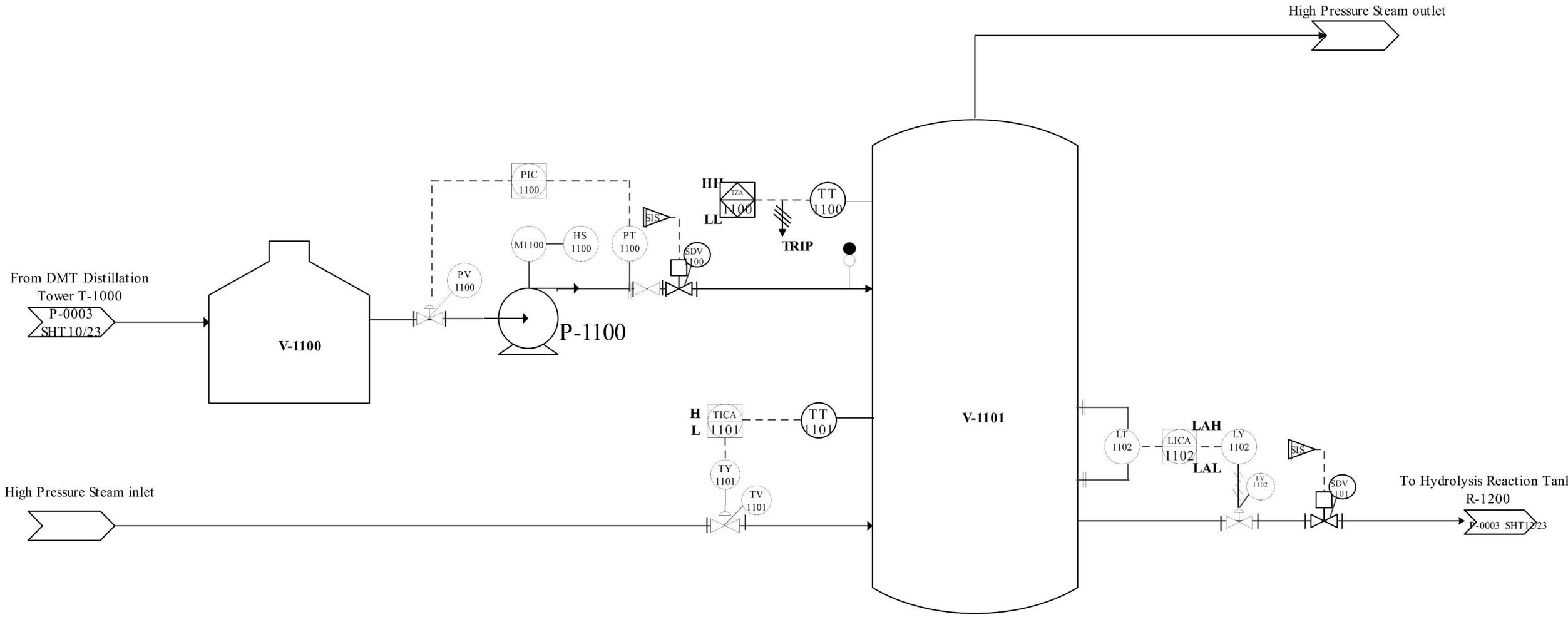
	DRAWN BY: CYJ	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: TTW	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING NO.: P-0003	SHEET NO.: 9/23 / REV NO.: 0



ITEM NO.	P-1000	T-1000	E-1000	E-1001	V-1000
SERVICE	PUMP	DISTILLATION COLUMN	CONDENSER	REBOIILER	REFLUX DRUM
DESIGN PRESSURE (kPa)	TBC	TBC	TBC	TBC	TBC
DESIGN TEMPERATURE (° C)	TBC	TBC	TBC	TBC	TBC
DUTY(kW)	TBC	TBC	TBC	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL

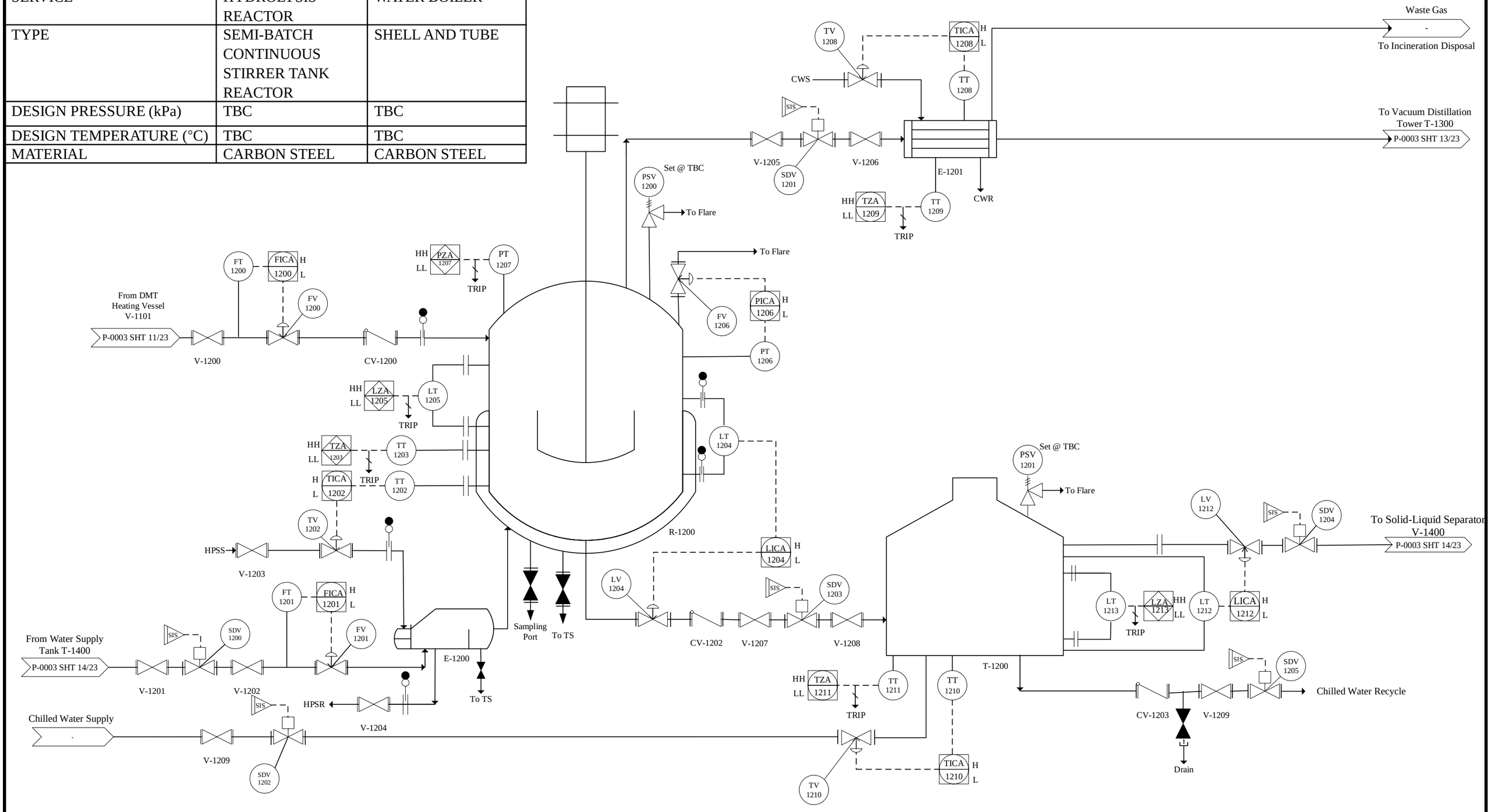
	DRAWN BY: CYJ	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: TTW		UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	DRAWING NO.: P-0003 / SHEET NO.: 10/23 / REV NO.: 0

ITEM NO.	V-1100	P-1100	V-1101
SERVICE	STORAGE TANK	PUMP	HEATING VESSEL
DESIGN PRESSURE (kPa)	TBC	TBC	TBC
DESIGN TEMPERATURE (° C)	TBC	TBC	TBC
DUTY(kW)	TBC	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL	CARBON STEEL



	DRAWN BY: CYJ	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: TTW	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING NO.: P-0003	SHEET NO.: 11/23 / REV NO.: 0

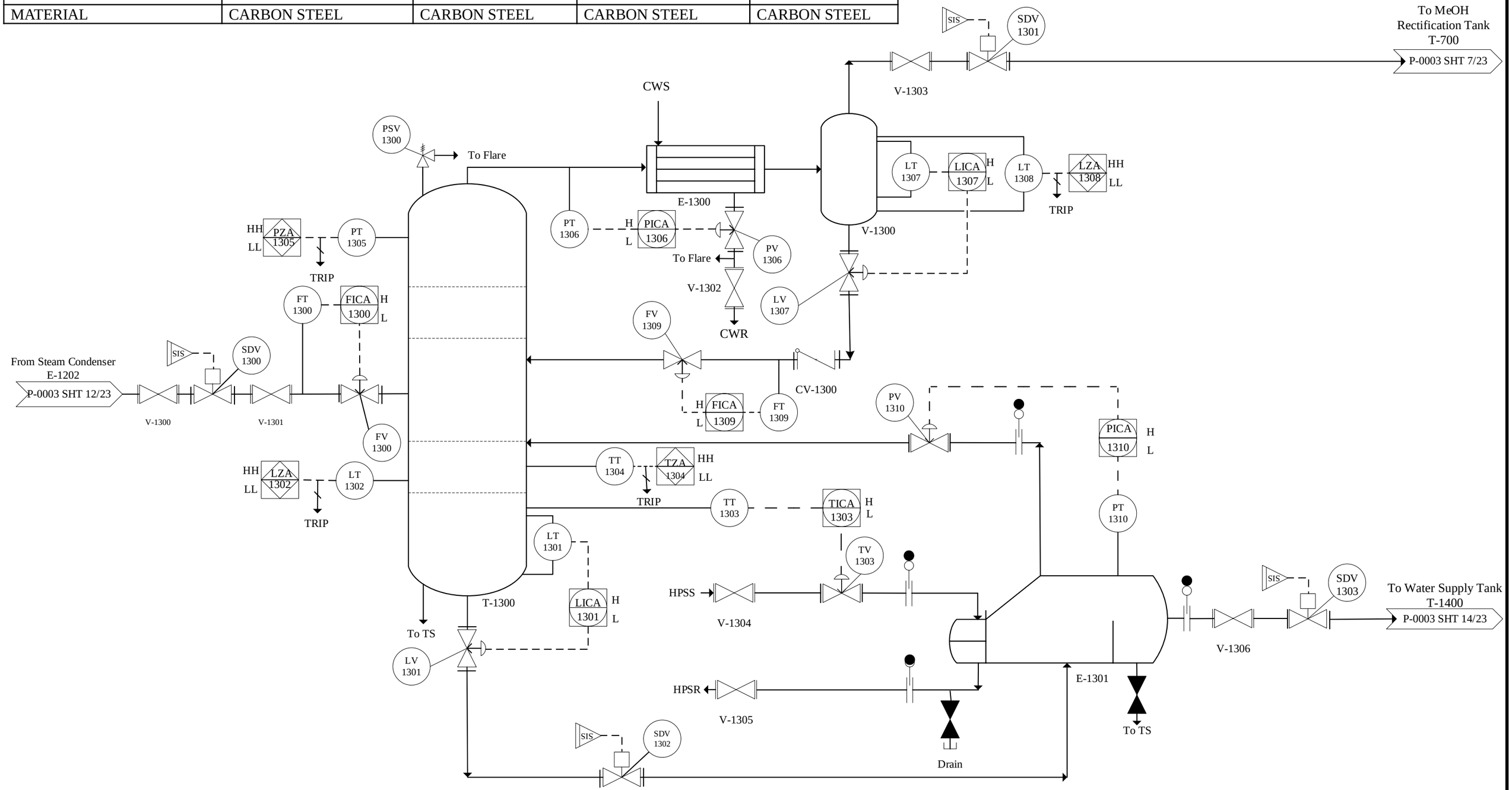
ITEM NO.	R-1200	E-1200
SERVICE	HYDROLYSIS REACTOR	WATER BOILER
TYPE	SEMI-BATCH CONTINUOUS STIRRER TANK REACTOR	SHELL AND TUBE
DESIGN PRESSURE (kPa)	TBC	TBC
DESIGN TEMPERATURE (°C)	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL



ITEM NO.	E-1201	T-1200
SERVICE	STEAM CONDENSER	COOLING TANK
TYPE	SHELL AND TUBE	CYLINDRICAL TANK
DESIGN PRESSURE (kPa)	TBC	TBC
DESIGN TEMPERATURE (°C)	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL

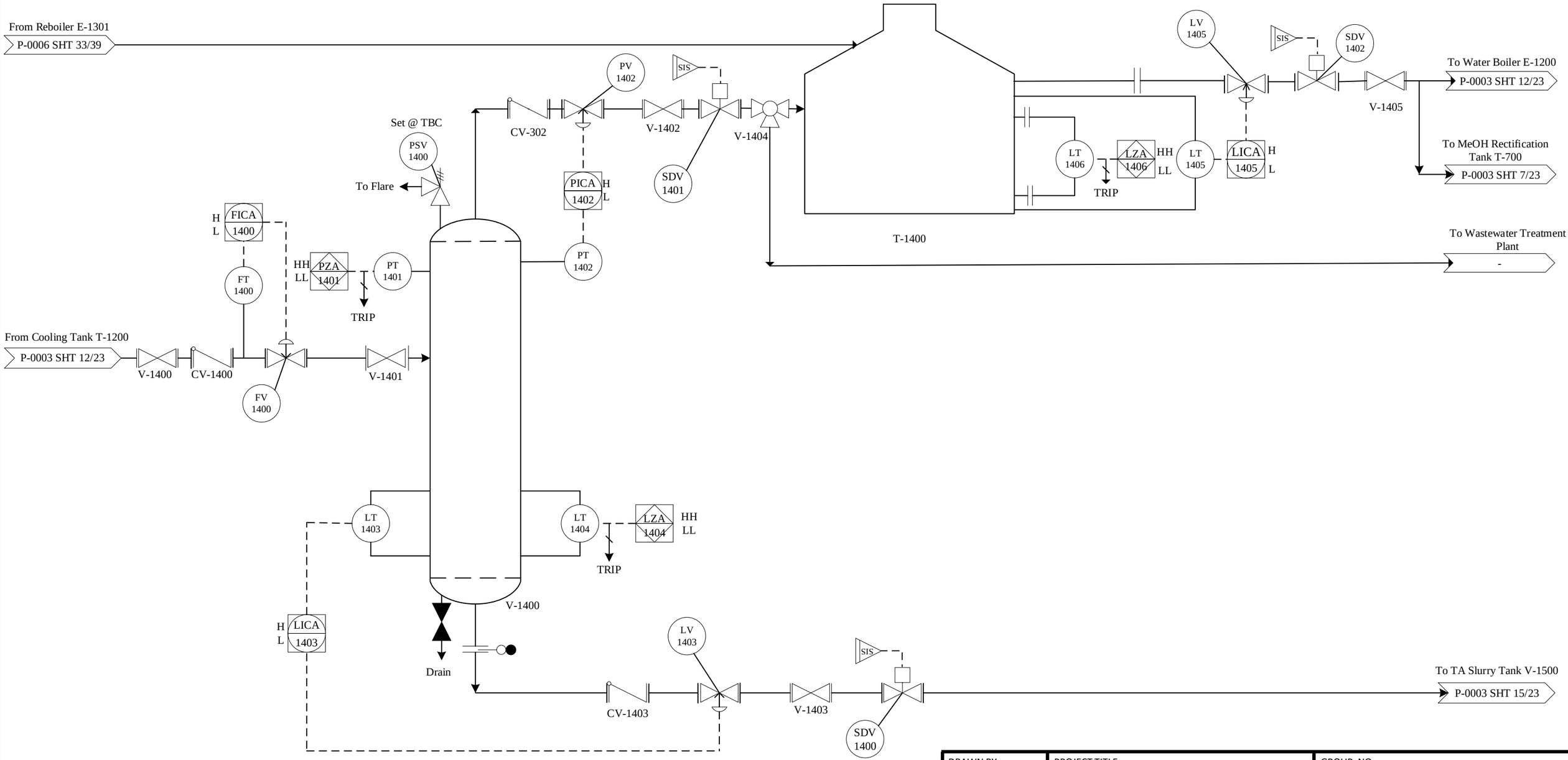
	DRAWN BY: WPY	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: JPQ		UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	DRAWING NO.: P-0003 / SHEET NO.: 12/23 / REV NO.: 0

ITEM NO.	T-1300	E-1300	V-1300	E-1301
SERVICE	VACUUM DISTILLATION COLUMN	CONDENSER	SEPARATOR	REBOILER
TYPE	TRAY COLUMN	SHELL AND TUBE	SOLVENT RECOVERY REFLUX DRUM	SHELL AND TUBE
DESIGN PRESSURE (kPa)	TBC	TBC	TBC	TBC
DESIGN TEMPERATURE (°C)	TBC	TBC	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL



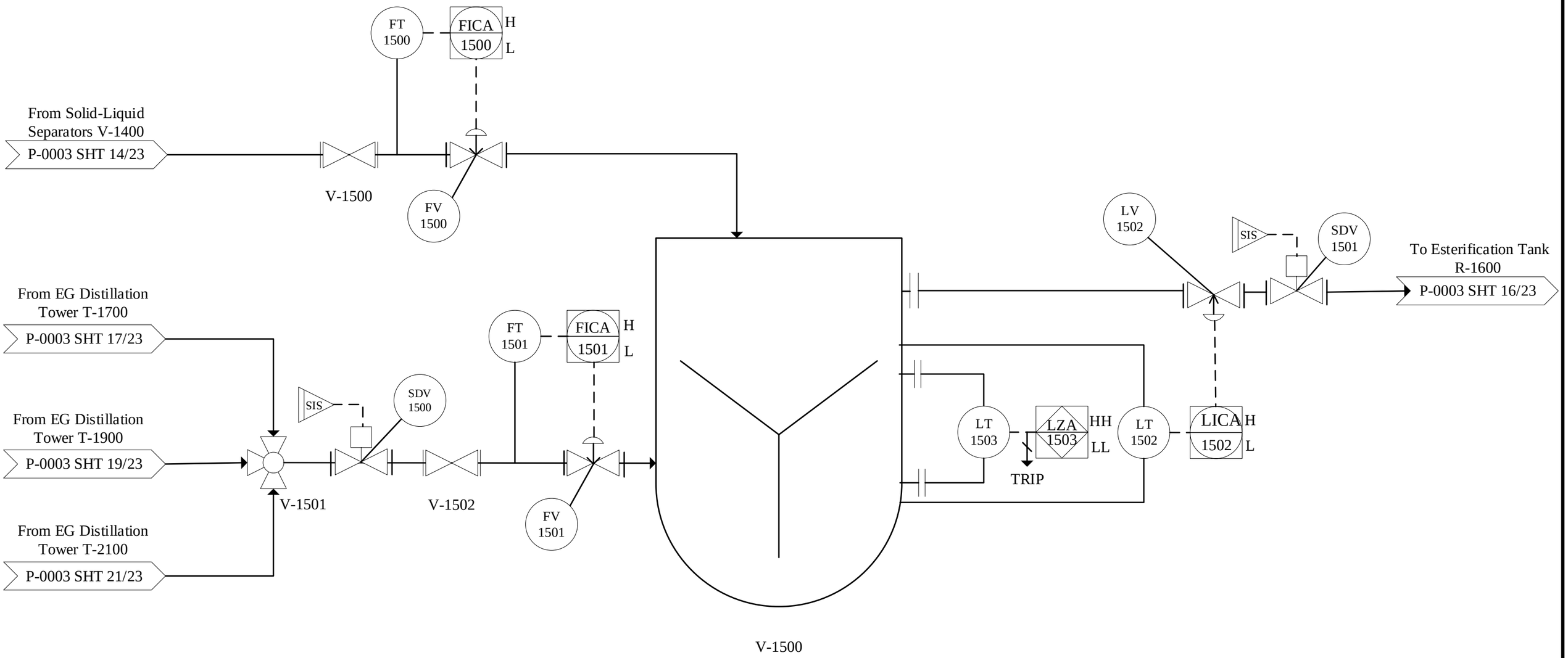
DRAWN BY: WPY	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11	
DATE: 01.04.2023	CHECKED BY: JPQ		UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	DRAWING NO.: P-0003 / SHEET NO.: 13/23 / REV NO.: 0

ITEM NO.	V-1400	T-1400
SERVICE	SEPARATOR	WATER STORAGE TANK
TYPE	SOLID-LIQUID SEPARATOR	CYLINDRICAL STORAGE TANK
DESIGN PRESSURE (kPa)	TBC	TBC
DESIGN TEMPERATURE (°C)	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL



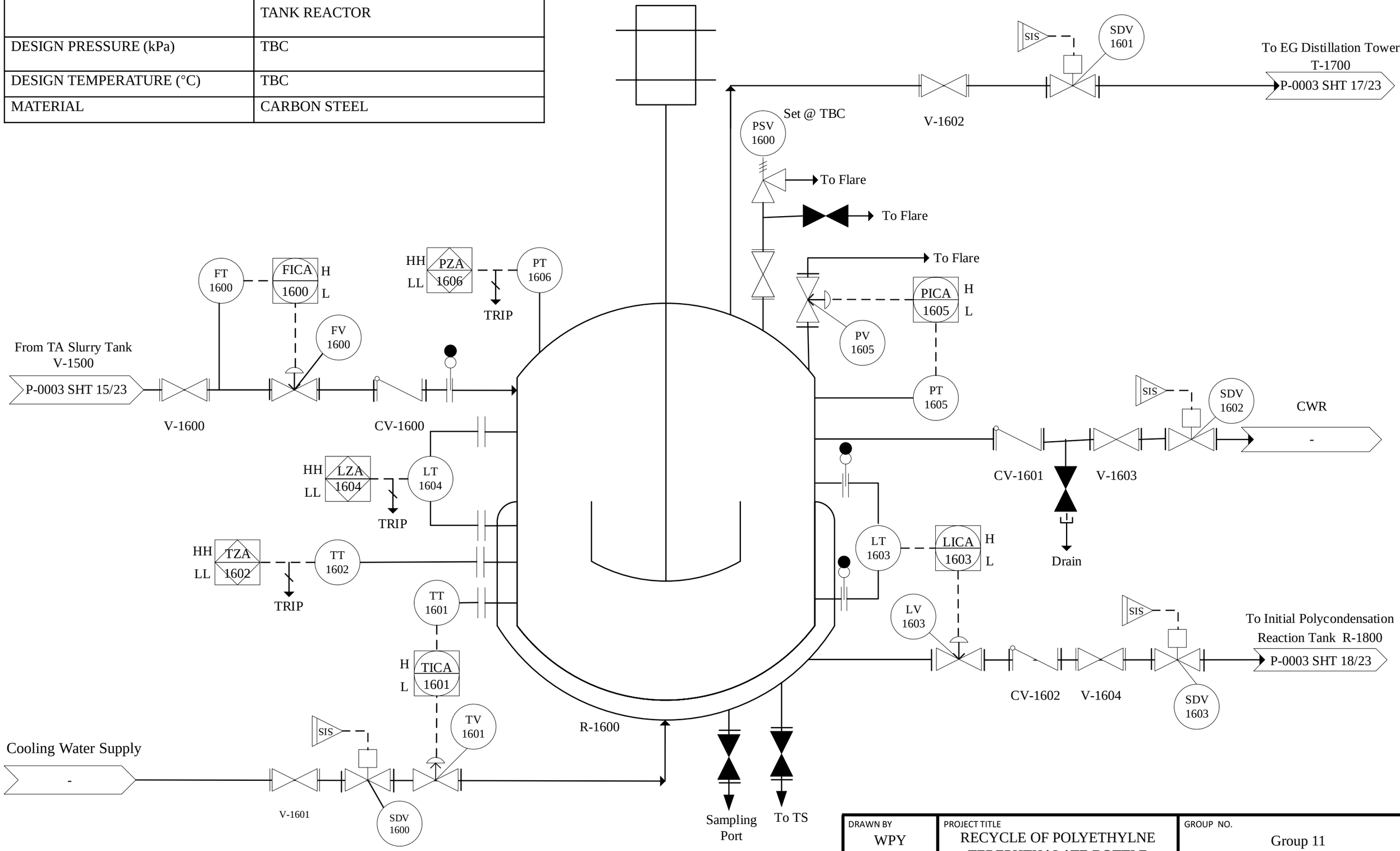
DRAWN BY: WPY	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11	
DATE: 01.04.2023	CHECKED BY: JPQ		UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	DRAWING NO.: P-0003 / SHEET NO.: 14/23 / REV NO.: 0

ITEM NO.	V-1500
SERVICE	TA SLURRY TANK
TYPE	AGITATED TANK
DESIGN PRESSURE (kPa)	TBC
DESIGN TEMPERATURE (°C)	TBC
MATERIAL	CARBON STEEL



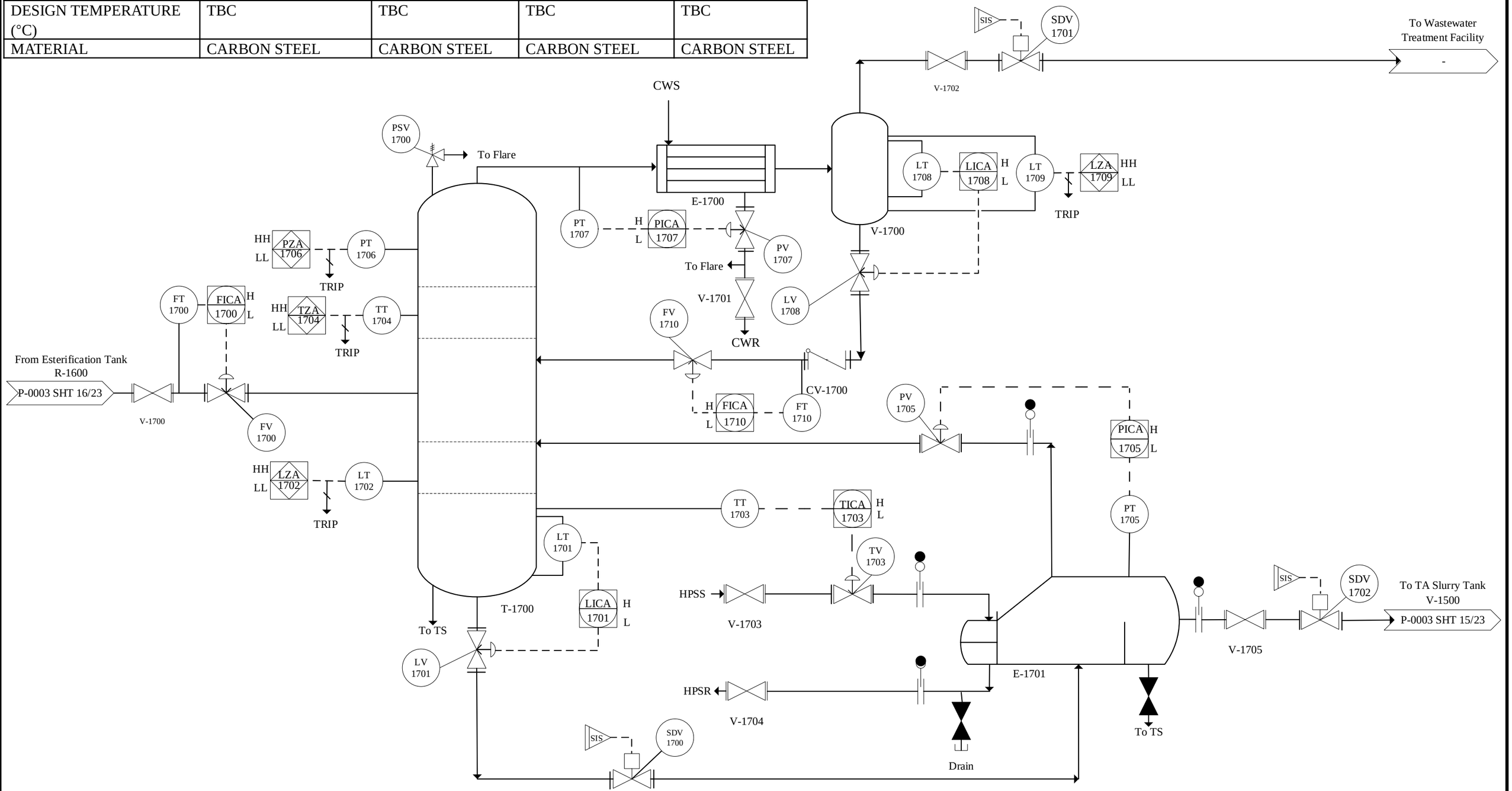
	DRAWN BY: WPY	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: JPQ	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING NO.: P-0003	SHEET NO.: 15/23 / REV NO.: 0

ITEM NO.	R-1600
SERVICE	ESTERIFICATION REACTOR
TYPE	SEMI-BATCH CONTINUOUS STIRRER TANK REACTOR
DESIGN PRESSURE (kPa)	TBC
DESIGN TEMPERATURE (°C)	TBC
MATERIAL	CARBON STEEL



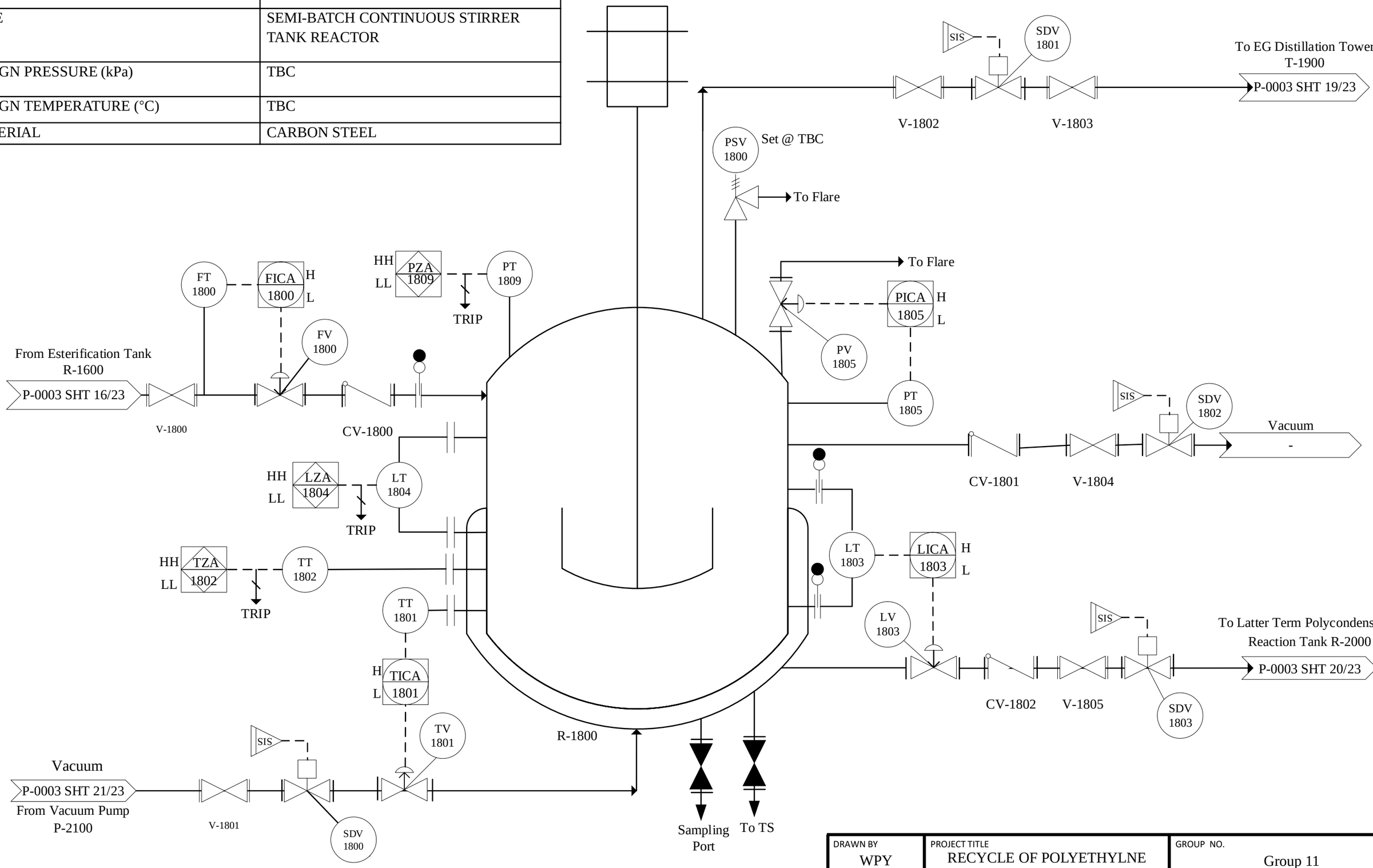
DRAWN BY: WPY	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11	
DATE: 01.04.2023	CHECKED BY: JPQ		UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	DRAWING NO.: P-0003 / SHEET NO.: 16/23 / REV NO.: 0

ITEM NO.	T-1700	E-1700	V-1700	E-1701
SERVICE	EG DISTILLATION COLUMN	CONDENSER	SEPARATOR	REBOILER
TYPE	TRAY COLUMN	SHELL AND TUBE	SOLVENT RECOVERY REFLUX DRUM	SHELL AND TUBE
DESIGN PRESSURE (kPa)	TBC	TBC	TBC	TBC
DESIGN TEMPERATURE (°C)	TBC	TBC	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL



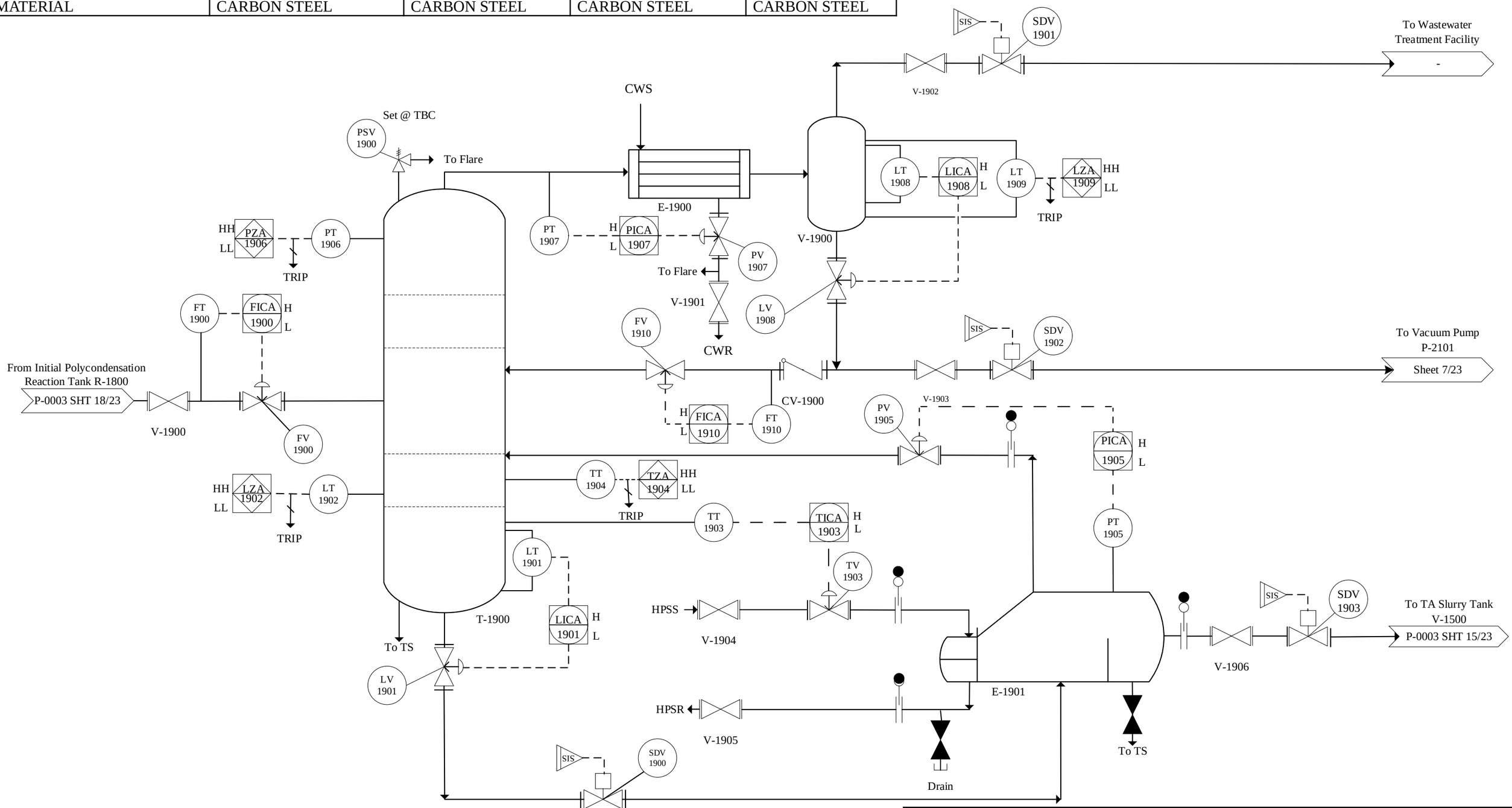
	DRAWN BY: WPY	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: JPQ	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING NO.: P-0003	SHEET NO.: 17/23 / REV NO.: 0

ITEM NO.	R-1800
SERVICE	INITIAL POLYCONDENSATION REACTOR
TYPE	SEMI-BATCH CONTINUOUS STIRRER TANK REACTOR
DESIGN PRESSURE (kPa)	TBC
DESIGN TEMPERATURE (°C)	TBC
MATERIAL	CARBON STEEL



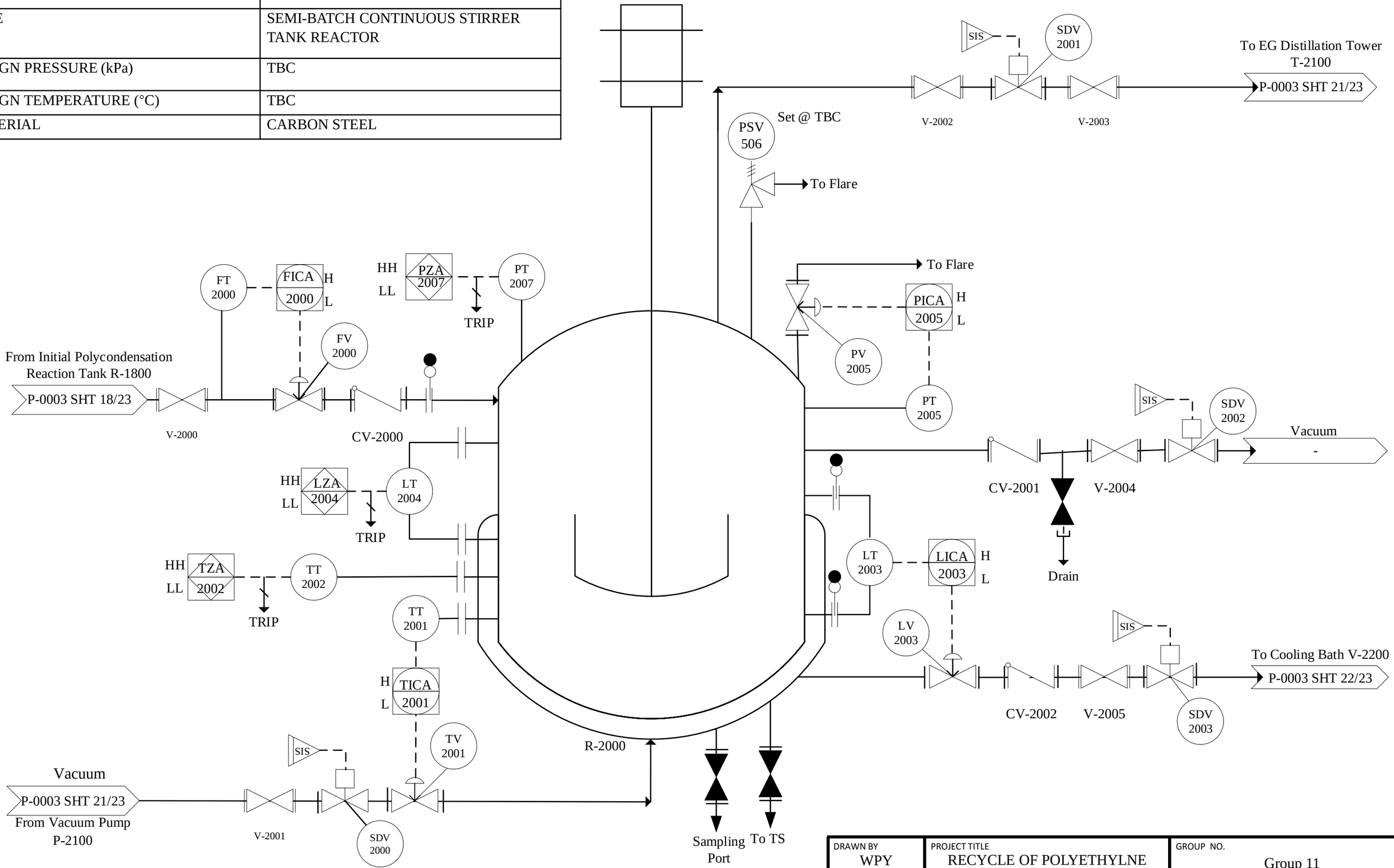
DRAWN BY: WPY	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11	
DATE: 01.04.2023	CHECKED BY: JPQ		UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	DRAWING NO.: P-0003 / SHEET NO.: 18/23 / REV NO.: 0

ITEM NO.	T-1900	E-1900	V-1900	E-1901
SERVICE	EG DISTILLATION COLUMN	CONDENSER	SEPARATOR	REBOILER
TYPE	TRAY COLUMN	SHELL AND TUBE	SOLVENT RECOVERY REFLUX DRUM	SHELL AND TUBE
DESIGN PRESSURE (kPa)	TBC	TBC	TBC	TBC
DESIGN TEMPERATURE (°C)	TBC	TBC	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL



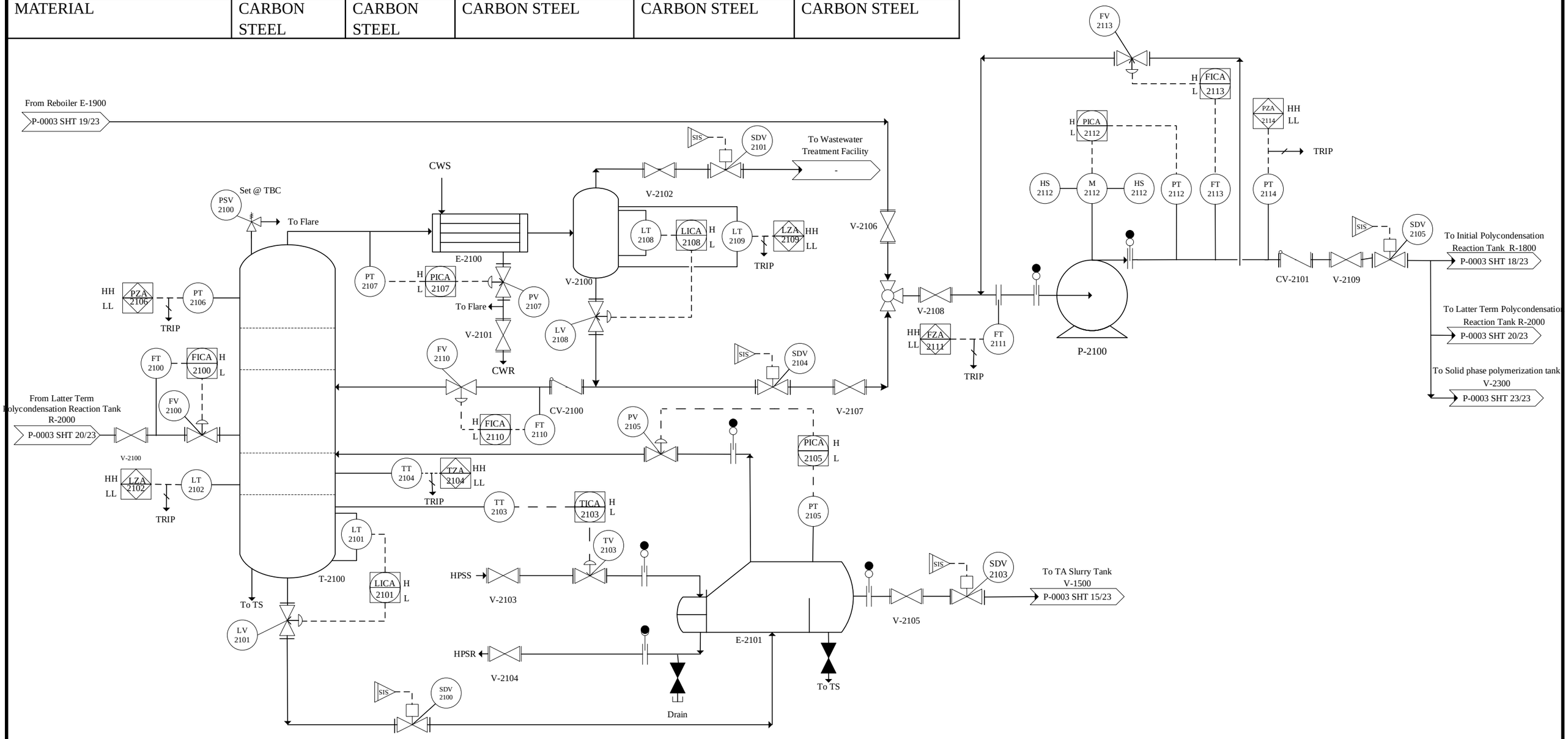
DRAWN BY: WPY	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11	
DATE: 01.04.2023	CHECKED BY: JPQ		UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	DRAWING NO.: P-0003 / SHEET NO.: 19/23 / REV NO.: 0

ITEM NO.	R-2000
SERVICE	LATTER TERM POLYCONDENSATION REACTOR
TYPE	SEMI-BATCH CONTINUOUS STIRRER TANK REACTOR
DESIGN PRESSURE (kPa)	TBC
DESIGN TEMPERATURE (°C)	TBC
MATERIAL	CARBON STEEL



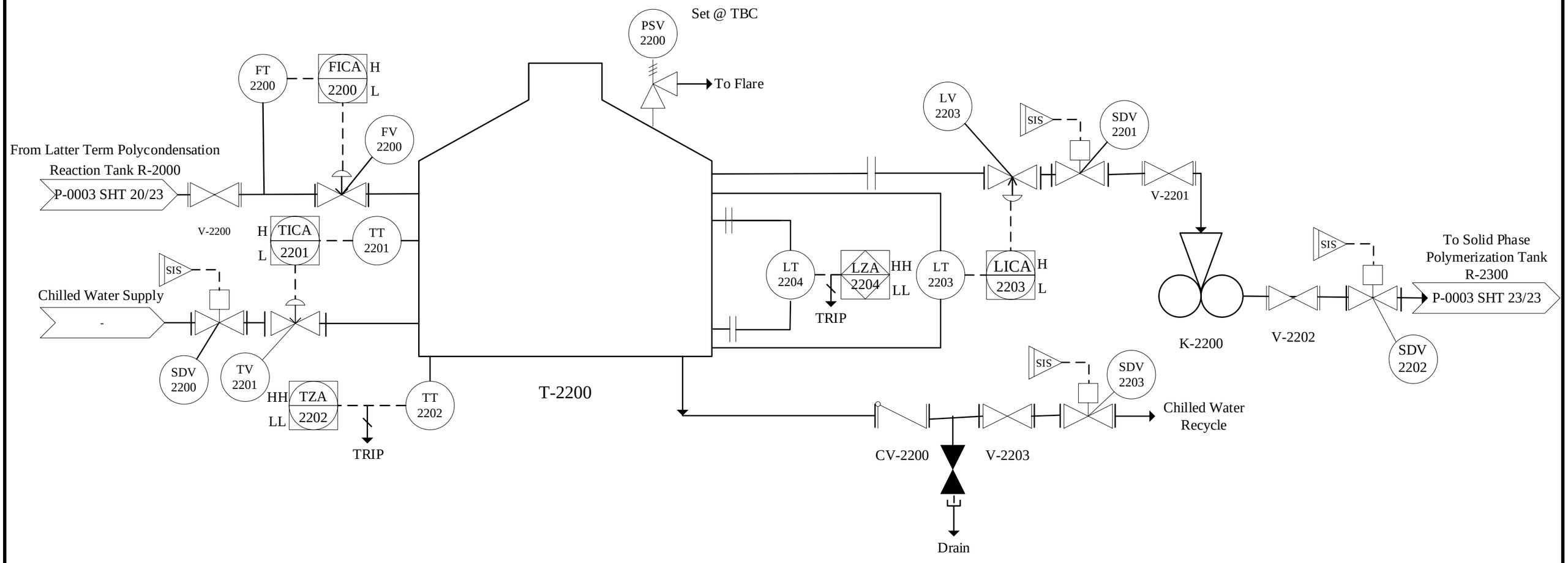
DRAWN BY: WPY	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11	
DATE: 01.04.2023	CHECKED BY: JPQ		UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	DRAWING NO.: P-0003 / SHEET NO.: 20/23 / REV NO.: 0

ITEM NO.	T-2100	E-2100	V-2100	E-2101	P-2100
SERVICE	EG DISTILLATION COLUMN	CONDENSER	SEPARATOR	REBOILER	VACUUM PUMP
TYPE	TRAY COLUMN	SHELL AND TUBE	SOLVENT RECOVERY REFLUX DRUM	SHELL AND TUBE	CENTRIFUGAL PUMP
DESIGN PRESSURE (kPa)	TBC	TBC	TBC	TBC	TBC
DESIGN TEMPERATURE (°C)	TBC	TBC	TBC	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL



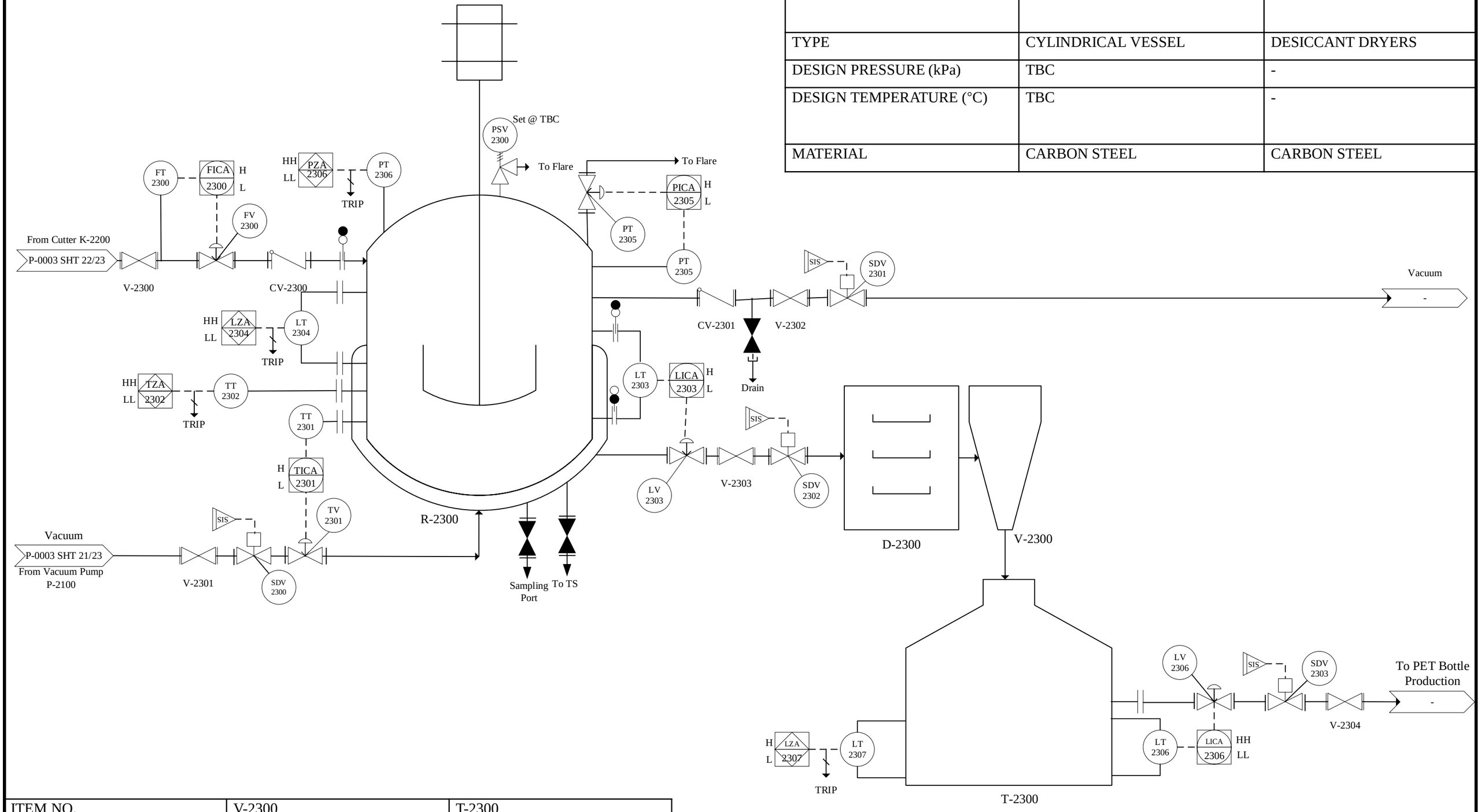
	DRAWN BY: WPY	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: JPQ	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING NO.: P-0003	SHEET NO.: 21/23 / REV NO.: 0

ITEM NO.	T-2200	K-2200
SERVICE	COOLING BATH	CUTTER
TYPE	CYLINDRICAL TANK	STRAND PELLETIZER
DESIGN PRESSURE (kPa)	TBC	TBC
DESIGN TEMPERATURE (°C)	TBC	TBC
MATERIAL	CARBON STEEL	CARBON STEEL



	DRAWN BY: WPY	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: JPQ	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH		DRAWING NO.: P-0003 / SHEET NO.: 22/23 / REV NO.: 0

ITEM NO.	R-2300	D-2300
SERVICE	SOLID PHASE POLYMERIZATION	DRYER
TYPE	CYLINDRICAL VESSEL	DESICCANT DRYERS
DESIGN PRESSURE (kPa)	TBC	-
DESIGN TEMPERATURE (°C)	TBC	-
MATERIAL	CARBON STEEL	CARBON STEEL



ITEM NO.	V-2300	T-2300
SERVICE	CRYSTALLIZER	PET STORAGE TANK
TYPE	BATCH CRYSTALLIZER	CYLINDRICAL TANK
DESIGN PRESSURE (kPa)	-	TBC
DESIGN TEMPERATURE (°C)	-	TBC
MATERIAL	CARBON STEEL	CARBON STEEL

	DRAWN BY: WPY	PROJECT TITLE: RECYCLE OF POLYETHYLNE TEREPHTHALATE BOTTLE	GROUP NO.: Group 11
DATE: 01.04.2023	CHECKED BY: JPQ	DRAWING TITLE: PIPING AND INSTRUMENTATION DIAGRAM	UNIVERSITI TUNKU ABDUL RAHMAN
SCALE: Not to Scale	APPROVED BY: YYH	DRAWING NO.: P-0003	SHEET NO.: 23/23 / REV NO.: 0

2.0 Control Loop

Table 2.1: Control Loop with Description

Loop	Description
200	The flow rate of feed from T-400 and T-800 entering R-200 is maintained by setting a pressure setpoint at the inlet stream of R-200. PT-200 is used to detect the inlet stream pressure and transmit the signals to PIC-200. The deviation of pressure is detected by PIC-200 so it will regulate the opening and closing of PV-200 to bring the inlet pressure back to setpoint.
201	It is important to control the temperature in R-200. The temperature in R-200 is monitored by TT-201 and the signals are transmitted to TICA-201. TICA-201 is then analyze the deviation and send the signals to TV-201 to adjust the temperature by controlling the valve. High temperature will decrease the opening of valve while low temperature will increase the opening of valve. TICA-201 will trigger the alarm when the deviation of temperature exceeds the desired condition.
203	The flow rate of feed form T-1000 entering R-200 is maintained by setting a pressure setpoint at inlet stream of R-200. PT-203 is used to detect the inlet stream pressure and transmit the signals to PIC-203. The deviation is detected PIC-203 and it will regulate the motor speed of P-201 to bring the pressure back to setpoint. PV-203 is used to regulate the opening and closing of valve.
300	The flow rate of feed from R-200 entering V-300 is maintained by setting a pressure setpoint at inlet stream of V-300. PT-300 is used to detect the inlet stream pressure and transmit the signals to PIC-300. The deviation is detected PIC-300 and it will regulate the motor speed of P-300 to bring the pressure back to setpoint. PV-300 is used to regulate the opening and closing of valve.
400	The flow rate of feed form F-300 entering T-400 is maintained by setting a pressure setpoint at inlet stream of T-400. PT-400 is used to detect the inlet stream pressure and transmit the signals to PIC-400. The deviation is detected PIC-400 and it will regulate the motor speed of P-400 to bring the pressure back to setpoint. PV-400 is used to regulate the opening and closing of valve.
402	It is important to control the temperature in V-400. The column temperature is monitored by TT-402 and the signal are transmitted to TICA-402. TICA-402 is then analyze the deviation and send the signals to TV-402 to adjust the flow rate by controlling the valve. High temperature decreases the valve opening to decrease the heat input and when low temperature increase valve opening. TICA-402 will trigger the alarm when the deviation of temperature exceeds the desired condition which is higher than 197 ℃ and lower than 100 ℃.
403	Flowrate of removed EG from T-400 should be maintain. The flowrate is detected by FT-402 and signals are transmitted to FICA-403. FICA-403 will

	analyze the deviation from setpoint and it will send signals to FV-403 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-403 alarm will be triggered if the flowrate of EG exceeded desired condition.
404	It is important to maintain the level of fluid in T-400 because it will affect the efficiency of T-400. Level will be detected by LT-404, signals are generated will send to LICA-404 for analysis. Then, the signals will send to LV-404 for adjusting the value. High liquid increase valve opening to let more liquid flow out from T-400. Low liquid decreases the valve opening to allow the liquid to increase to setpoint. LICA-404 alarm will trigger when then deviation of liquid level exceeds the desired level
405	It is important to control the temperature in T-400. The column temperature is monitored by TT-405 and the signal are transmitted to TICA-405. TICA-405 is then analyze the deviation and send the signals to TV-405 to adjust the temperature by controlling the valve. High temperature decreases the valve opening to decrease the heat input and low temperature increase valve opening. TICA-405 will trigger the alarm when the deviation of temperature exceeds the desired condition.
500	The flowrate of BHET entering V-500 is maintained by setting a pressure setpoint at the inlet stream of V-500. PT-500 is used to detect the inlet stream pressure and transmit signals to PIC-500. Deviation detected by PIC-500 will regulate the motor speed of P-500 to bring the inlet stream pressure back to setpoint, maintaining the feed flowrate.
501	It is important to control the temperature in V-500. The column temperature is monitored by TT-501 and the signal are transmitted to TICA-501. TICA-501 is then analyze the deviation and send the signals to TV-501 to adjust the temperature in V-500. High temperature decreases the valve opening to decrease the heat input and low temperature increase valve opening. TICA-501 will trigger the alarm when the deviation of temperature exceeds the desired condition which is higher than 85 ℃ and lower than 65 ℃.
502	The flowrate of MeOH from T-700 entering V-500 is maintained by setting a pressure setpoint at the inlet stream of V-500. PT-502 is used to detect the inlet stream pressure and transmit signals to PIC-502. Deviation detected by PIC-502 will regulate the motor speed of P-501 to bring the inlet stream pressure back to setpoint, maintaining the feed flowrate. PV-502 is used to regulate the opening and closing of valve to allow the flow rate back to setpoint.
503	The flowrate of MeOH from supply source entering V-500 is maintained by setting a pressure setpoint at the inlet stream of V-500. PT-503 is used to detect the inlet stream pressure and transmit signals to PIC-503. Deviation detected by

	PIC-503 will regulate the motor speed of P-502 to bring the inlet stream pressure back to setpoint, maintaining the feed flowrate. PV-503 is used to regulate the opening and closing of valve to allow the flow rate back to setpoint.
504	The temperature in E-500 is monitored by TT-501 and the signal are transmitted to TICA-504. TICA-504 is then analyze the deviation and send the signals to TV-504 to adjust the temperature by controlling the valve of cooling water. Ester interchange recrystallization process is an exothermic reaction which will generate heat during the process. Cooling water is needed to lower down the temperature of EG and DMT before goes for solid-liquid separation.
600	The flowrate of product from V-500 entering P-600 is maintained by setting a pressure setpoint at the inlet stream of P-600. PT-600 is used to detect the inlet stream pressure and transmit signals to PIC-600. Deviation detected by PIC-600 will regulate the motor speed of P-600 to bring the inlet stream pressure back to setpoint, maintaining the feed flowrate. PV-600 is used to regulate the opening and closing of valve to allow the flow rate back to setpoint.
601	Flowrate of MeOH entering V-600 should be maintained. Besides that, too much of MeOH entering V-600 may damage to the motor or other parts of the equipment. MeOH flowrate is detected by FT-601 and signals are transmitted to FIC-601. FIC-601 will analyze the deviation from setpoint and it will send signals to FV-601 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening.
602	It is important to maintain the level of fluid in V-600 because it will affect the efficiency of V-600. Level will be detected by LT-602, signals are generated will send to LICA-602 for analysis. Then, the signals will send to LV-602 for adjusting the value. High liquid increase valve opening to let more liquid flow out from V-600. Low liquid decreases the valve opening to allow the liquid to increase to setpoint. LICA-602 alarm will trigger when then deviation of liquid level exceeds the desired level.
700	The flowrate of MeOH and water from T-1300 and V-1400 entering T-700 is maintained by setting a pressure setpoint at the inlet stream of T-700. PT-700 is used to detect the inlet stream pressure and transmit signals to PIC-700. Deviation detected by PIC-700 will regulate the motor speed of P-700 to bring the inlet stream pressure back to setpoint, maintaining the feed flowrate. PV-700 is used to regulate the opening and closing of valve to allow the flow rate back to setpoint.
701	The flow rate of product from F-600 entering T-700 is maintained by setting a pressure setpoint at the inlet stream of T-700. PT-701 is used to detect the inlet stream pressure and transmit signals to PIC-701. Deviation detected by PIC-701 will regulate the motor speed of P-701 to bring the inlet stream pressure back to

	setpoint, maintaining the feed flowrate. PV-701 is used to regulate the opening and closing of valve to allow the flow rate back to setpoint.
702	It is important to control the temperature in V-700. The column temperature is monitored by TT-702 and the signal are transmitted to TICA-702. TICA-702 is then analyze the deviation and send the signals to TV-702 to adjust the temperature by controlling the valve. The liquid will go into E-700 to condense before entering V-700.
703	Flowrate of product from T-700 should be. Flowrate is detected by FT-703 and signals are transmitted to FICA-703. FICA-703 will analyze the deviation from setpoint and it will send signals to FV-703 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-703 alarm will be triggered if the flowrate of slurry exceeded desired condition
704	It is important to maintain the level of EG at bottom of T-700 because it will serve as a coolant for reboiler which help to vaporize the liquid mixture. Level will be detected by LT-704, signals are generated will send to LICA-704 for analysis. Then, the signals will send to LV-704 for adjusting the value. High liquid increase valve opening to let more liquid flow out from T-700. Low liquid decreases the valve opening to allow the liquid to increase to setpoint. LICA-704 alarm will trigger when then deviation of liquid level exceeds the desired level.
705	It is important to maintain the temperature of EG at the bottom of T-700 because it will affect the efficiency of distillation process. The temperature is monitored by TT-705 and the signal are transmitted to TICA-705. TICA-705 is then analyze the deviation and send the signals to TV-705 to adjust the flow rate by controlling the valve. TICA-705 will trigger the alarm when the deviation of temperature exceeds the desired condition.
800	The flow rate of MeOH from T-700 entering T-800 is maintained by setting a pressure setpoint at the inlet stream of T-800. PT-800 is used to detect the inlet stream pressure and transmit signals to PIC-800. Deviation detected by PIC-800 will regulate the motor speed of P-800 to bring the inlet stream pressure back to setpoint, maintaining the feed flowrate. PV-800 is used to regulate the opening and closing of valve to allow the flow rate back to setpoint.
802	The temperature in E-800 is monitored by TT-802 and the signal are transmitted to TICA-802. TICA-802 is then analyze the deviation and send the signals to TV-802 to adjust the temperature by controlling the valve of cooling water. TICA-802 alarm will be trigger when the temperature exceeds 197 ℃ and lower than 100 ℃.
803	Flowrate of EG should be maintained. EG flowrate is detected by FT-803 and signals are transmitted to FICA-803. FICA-803 will analyze the deviation from

	setpoint and it will send signals to FV-803 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-803 alarm will be triggered if the flowrate of slurry exceeded desired condition.
804	It is important to maintain the level of EG at bottom of T-800 because it will serve as a coolant for reboiler which help to vaporize the liquid mixture. Level will be detected by LT-804, signals are generated will send to LICA-804 for analysis. Then, the signals will send to LV-804 for adjusting the value. High liquid increase valve opening to let more liquid flow out from T-800. Low liquid decreases the valve opening to allow the liquid to increase to setpoint. LICA-804 alarm will trigger when then deviation of liquid level exceeds the desired level.
805	It is important to maintain the temperature of EG at the bottom of T-800 because it will affect the efficiency of distillation process. The temperature is monitored by TT-805 and the signal are transmitted to TICA-805. TICA-805 is then analyze the deviation and send the signals to TV-805 to adjust the flow rate by controlling the valve. TICA-805 will trigger the alarm when the deviation of temperature exceeds the desired condition.
900	Flowrate of product from F-600 should be maintained. Flowrate is detected by FT-900 and signals are transmitted to FICA-900. FICA-900 will analyze the deviation from setpoint, and it will send signals to FV-900 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-900 alarm will be triggered if the flowrate of product exceeded desired condition.
901	It is important to control the temperature in R-900. The reactor temperature is monitored by TT-901 and the signal are transmitted to TICA-901. TICA-901 is then analyze the deviation and send the signals to TV-901 to adjust the flow rate by controlling the valve. TICA-901 will trigger the alarm when the deviation of temperature exceeds the desired condition.
1000	The flow rate of product from R-900 entering T-1000 is maintained by setting a pressure setpoint at the inlet stream of T-1000. PT-1000 is used to detect the inlet stream pressure and transmit signals to PIC-1000. Deviation detected by PIC-1000 will regulate the motor speed of P-1000 to bring the inlet stream pressure back to setpoint, maintaining the feed flowrate. PV-1000 is used to regulate the opening and closing of valve to allow the flow rate back to setpoint.
1002	The temperature in E-1000 is monitored by TT-1002 and the signal are transmitted to TICA-1002. TICA-1002 is then analyze the deviation and send the signals to TV-1002 to adjust the temperature by controlling the valve of cooling water. TICA-1002 alarm will be trigger when the temperature exceeds 197 ℃ and lower than 100 ℃.

1003	Flowrate of DMT should be maintained. DMT flowrate is detected by FT-1003 and signals are transmitted to FICA-1003. FICA-1003 will analyze the deviation from setpoint and it will send signals to FV-1003 for appropriate action. High flow rate will lead to incomplete separation of DMT while low flow rate lead to thermal degradation of DMT. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-1003 alarm will be triggered if the flowrate of slurry exceeded desired condition.
1004	It is important to maintain the level of DMT at bottom of T-1000. Level will be detected by LT-1004, signals are generated will send to LICA-1004 for analysis. Then, the signals will send to LV-1004 for adjusting the value. High liquid increase valve opening to let more liquid flow out from T-1000. Low liquid decreases the valve opening to allow the liquid to increase to setpoint. LICA-1004 alarm will trigger when then deviation of liquid level exceeds the desired level.
1005	It is important to control the temperature in T-1000. The reactor temperature is monitored by TT-1000 and the signal are transmitted to TICA-1000. TICA-1000 is then analyzing the deviation and send the signals to TV-1000 to adjust the flow rate by controlling the valve. TICA-1000 will trigger the alarm when the deviation of temperature exceeds the desired condition.
1100	The flow rate of DMT from V-1100 entering V-1101 is maintained by setting a pressure setpoint at the inlet stream of V-1101. PT-1100 is used to detect the inlet stream pressure and transmit signals to PIC-1100. Deviation detected by PIC-1100 will regulate the motor speed of P-1100 to bring the inlet stream pressure back to setpoint, maintaining the feed flowrate. PV-1100 is used to regulate the opening and closing of valve to allow the flow rate back to setpoint.
1101	It is important to control the temperature in V-1101. The column temperature is monitored by TT-1101 and the signal are transmitted to TICA-1101. TICA-1101 is then analyze the deviation and send the signals to TV-1101 to adjust the flow rate by controlling the valve. TICA-1101 will trigger the alarm when the deviation of temperature exceeds the desired condition.
1102	It is important to maintain the level of DMT at V-1101. Level will be detected by LT-1102, signals are generated will send to LICA-1102 for analysis. Then, the signals will send to LV-1102 for adjusting the value. High liquid increase valve opening to let more liquid flow out from T-1102. Low liquid decreases the valve opening to allow the liquid to increase to setpoint. LICA-1102 alarm will trigger when then deviation of liquid level exceeds the desired level.
1200	Flowrate DMT from V-1101 should be maintained. DMT flowrate is detected by FT-1200 and signals are transmitted to FICA-1200. FICA-1200 will analyze the deviation from setpoint and it will send signals to FV-1200 for appropriate action. Less flow will increase valve opening whereas more flow will decrease

	valve opening. FICA-1200 alarm will be triggered if the flowrate of DMT exceeded desired condition.
1201	Flowrate of water from T-1400 should be maintained. Water flowrate is detected by FT-1201 and signals are transmitted to FICA-1201. FICA-1201 will analyze the deviation from setpoint and it will send signals to FV-1201 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-1201 alarm will be triggered if the flowrate of water exceeded desired condition.
1204	It is important to maintain the level of hot TA and water slurry which obtained at the bottom of R-1200. Level will be detected by LT-1204, signals are generated will send to LICA-1204 for analysis. Then, the signals will send to LV-1204 for adjusting the value. High liquid increase valve opening to let more liquid flow out from R-1200. Low liquid decreases the valve opening to allow the liquid to increase to setpoint. LICA-1204 alarm will trigger when then deviation of liquid level exceeds the desired level.
1208	The temperature of water and MeOH which generated from R-1200 is condensed by E-1201. The temperature is monitored by TT-1208 and the signal are transmitted to TICA-1208. TICA-1208 is then analyze the deviation and send the signals to TV-1208 to adjust the flow rate by controlling the valve. TICA-1208 will trigger the alarm when the deviation of temperature exceeds the desired condition.
1210	It is important to control the temperature in T-1200. The temperature is monitored by TT-1210 and the signal are transmitted to TICA-1210. TICA-1210 is then analyze the deviation and send the signals to TV-1210 to adjust the flow rate by controlling the valve. High temperature in T-1200 will increase the valve opening to allow chilled water to go into T-1200. Low temperature in T-1200 will decrease the opening of valve. TICA-1210 will trigger the alarm when the deviation of temperature exceeds the desired condition.
1212	It is important to maintain the level of cooled TA and water slurry which obtained at the bottom of R-1200. If the level too low, it may cause insufficient cooling in T-1200 while high level will cause overflow. Level will be detected by LT-1212, signals are generated will send to LICA-1212 for analysis. Then, the signals will send to LV-1212 for adjusting the value. High level of liquid increase valve opening to let more liquid flow out from R-1200. Low liquid decreases the valve opening to allow the liquid to increase to setpoint. LICA-1212 alarm will trigger when then deviation of liquid level exceeds the desired level.

1300	Flowrate of mixed vapor of water and MeOH should be maintained. The flowrate is detected by FT-1300 and signals are transmitted to FICA-1300. FICA-1300 will analyze the deviation from setpoint and it will send signals to FV-1300 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-1300 alarm will be triggered if the flowrate of slurry exceeded desired condition.
1301	It is important to maintain the level of water which obtained at the bottom of T-1300. Level will be detected by LT-1301, signals are generated will send to LICA-1301 for analysis. Then, the signals will send to LV-1301 for adjusting the value. High level of liquid increase valve opening to let more liquid flow out from T-1300. Low liquid decreases the valve opening to allow the liquid to increase to setpoint. LICA-1301 alarm will trigger when then deviation of liquid level exceeds the desired level.
1307	It is important to maintain the level of MeOH in V-1300. Level will be detected by LT-1307, signals are generated will send to LICA-1307 for analysis. Then, the signals will send to LV-1307 for adjusting the value. High level of liquid increase valve opening to let more liquid flow out from V-1300 into T-1300. Low liquid decreases the valve opening to allow the liquid to increase to setpoint. LICA-1307 alarm will trigger when then deviation of liquid level exceeds the desired level.
1309	Flowrate of MeOH from V-1300 should be maintained. The flowrate is detected by FT-1309 and signals are transmitted to FICA-1309. FICA-1309 will analyze the deviation from setpoint and it will send signals to FV-1309 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-1309 alarm will be triggered if the flowrate of slurry exceeded desired condition.
1310	The pressure of reboiler should be maintained to avoid formation of unwanted byproducts and cause damage to the reboiler. PT-1310 is used to detect the inlet stream pressure and transmit the signals to PICA-1310. The deviation is detected by PICA-1310 and it will regulate the pressure of E-1301 to bring the pressure back to setpoint. PV-1310 is used to regulate the opening and closing of valves.
1400	The flowrate of feed from Cooling Tank, T-1200 is maintained by setting a volume setpoint at inlet stream of V-1400. FT-1400 is used to detect the inlet stream volume and transmit the signals to FICA-1400. The deviation is detected by FICA-1400 and it will regulate the volume of feed flowrate of V-1400 to bring the volume back to setpoint. FV-1400 is used to regulate the opening and closing of valve
1402	The pressure of V-1400 is regulated and maintained by setting a pressure setpoint at the stream of V-1402. PT-1402 is used to detect the inlet stream pressure and transmit the signals to PICA-1402. The deviation is detected by

	PICA-1402 and it will regulate the pressure of V-1400 to bring the pressure back to setpoint. PV-1402 is used to regulate the opening and closing of valves.
1403	The level of V-1400 is regulated and maintained by setting a level setpoint at the stream going to a Slurry Tank, V-1500. LT-1403 is used to detect the tank level and transmit signals to LICA-1403. The deviation is detected by LICA-1403 and it will adjust the level of V-1400 to an appropriate level by opening and closing the valve, LV-1403.
1405	It is important to maintain the level of fluid in T-1400 because it will affect the efficiency of T-1400. The level will be detected by LT-1405, and the signals are generated and will be sent to LICA-1405 for analysis. Then, the signals will be sent to LV-1405 for volume adjustment. High liquid increases valve opening to let more liquid flow out from T-1400. Low liquid decreases the valve opening to allow the liquid to increase to the setpoint. LICA-1405 alarm will get triggered when the deviation of the liquid level exceeds the desired level.
1500	The flow rate from V-1500 should be maintained. The flow rate is detected by FT-1500 and signals are transmitted to FICA-1500. FICA-1500 will analyze the deviation from the setpoint and it will send signals to FV-1500 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-1500 alarm will be triggered if the flow rate of the slurry exceeded the desired condition.
1501	A three-way valve (V-1501) connects the flow rate from T-1700, T-1900, and T-2100. The flow rate from V-1500 should be maintained. The flow rate is detected by FT-1501 and the signals are transmitted to FICA-1501. FICA-1501 will analyze the deviation from the setpoint and it will send signals to FV-1501 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-1501 alarm will be triggered when the flow rate of the slurry exceeded the desired condition.
1502	The level of V-1500 is regulated and maintained by setting a level setpoint at the stream going to an esterification tank (R-1600). LT-1502 is used to detect the tank level and transmit signals to LICA-1502. The deviation is detected by LICA-1502 and it will adjust the level of V-1500 to an appropriate level by opening and closing the valve, LV-1502.
1600	The flow rate from V-1500 should be maintained for R-1600 to work effectively. The flow rate is detected by FT-1600 and signals are transmitted to FICA-1600. FICA-1600 will analyze the deviation from the setpoint and it will send signals to FV-1600 for appropriate action. Less flow will increase valve

	opening whereas more flow will decrease valve opening. FICA-1600 alarm will be triggered if the flow rate of the slurry exceeded the desired condition.
1601	The temperature from the water supply will be regulated before sending it into R-1600. The temperature is monitored by TT-1601 and the signal is transmitted to TICA-1601. TICA-1601 then analyzes the deviation and sends the signals to TV-1601 to adjust the flow rate by controlling the valve. High temperature in R-1600 will increase the valve opening to allow chilled water to go into R-1600. Low temperature in R-1600 will decrease the opening of the valve. TICA-1601 will trigger the alarm when the deviation of temperature exceeds the desired condition.
1603	It is important to maintain the level of R-1600. The level will be detected by LT-1603, and the signals are generated to be sent to LICA-1603 for analysis. Then, the signals will be sent to LV-1603 for adjusting the value. High level of liquid increases the valve opening to let more liquid flow into R-1600. Low liquid decreases the valve opening to allow the liquid to increase to the setpoint. LICA-1603 alarm will get triggered when the deviation of liquid level exceeds the desired level.
1605	The pressure of the reactor should be maintained to avoid the formation of unwanted byproducts that causes damage to the reactor. PT-1605 is used to detect the inlet stream pressure and transmit the signals to PICA-1605. The deviation is detected by PICA-1605 and it will regulate the pressure of R-1600 to bring the pressure back to setpoint. PV-1605 is used to regulate the opening and closing of valves.
1700	From the esterification tank (R-1600), the flow rate is detected by FT-1700 before sending it to T-1700, and signals are transmitted to FICA-1700. FICA-1700 will analyze the deviation from the setpoint and it will send signals to FV-1700 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-1700 alarm will be triggered if the flow rate of the slurry exceeded the desired condition
1701	The level is regulated before going into E-1701. The level of T-1700 is maintained by setting a level setpoint. LT-1701 is used to detect the tank level and transmit signals to LICA-1701. The deviation is detected by LICA-1701 and it will adjust the level of T-1700 to an appropriate level by opening and closing the valve, LV-1701.
1705	The pressure of the tank (T-1700) should be maintained to avoid the formation of unwanted byproducts that causes damage to the tank. PT-1705 is used to detect the inlet stream pressure and transmit the signals to PICA-1705. The deviation is detected by PICA-1705 and it will regulate the pressure of T-1700

	to bring the pressure back to setpoint before sending it to E-1701. PV-1705 is used to regulate the opening and closing of valves.
1707	The pressure of the tank (T-1700) should be maintained to avoid the formation of unwanted byproducts that causes damage to the tank. PT-1707 is used to detect the inlet stream pressure and transmit the signals to PICA-1707. The deviation is detected by PICA-1707 and it will regulate the pressure of T-1700 to bring the pressure back to setpoint before sending it to E-1700 and then V-1700. PV-1707 is used to regulate the opening and closing of valves.
1708	The level is regulated in V-1700. The level of V-1700 is maintained by setting a level setpoint. LT-1708 is used to detect the tank level and transmit signals to LICA-1708. The deviation is detected by LICA-1708 and it will adjust the level of T-1700 to an appropriate level by opening and closing the valve, LV-1708.
1710	The flow rate from V-1700 is regulated before sending it back to T-1700. The flow rate is detected by FT-1710 and signals are transmitted to FICA-1710. FICA-1710 will analyze the deviation from the setpoint and it will send signals to FV-1710 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-1710 alarm will be triggered if the flow rate of the slurry exceeded the desired condition.
1800	The flow rate from the esterification tank (R-1600) is manipulated before entering R-1800. The flow rate is detected by FT-1800 and signals are transmitted to FICA-1800. FICA-1800 will analyze the deviation from the setpoint and it will send signals to FV-1800 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-1800 alarm will be triggered if the flow rate of the slurry exceeded the desired condition.
1801	The temperature in the reactor (R-1800) will be regulated before sending it into R-1600. The temperature is monitored by TT-1801 and the signal is transmitted to TICA-1801. TICA-1801 then analyzes the deviation and sends the signals to TV-1801 by regulating the motor speed of P-2100 in order to bring the inlet stream pressure back to setpoint, maintaining the feed flowrate. High temperature in R-1800 will transmit signals and TICA-1801 will trigger the alarm when the deviation of temperature exceeds the desired condition.
1803	The level is regulated in R-1800. The level of R-1800 is maintained by setting a level setpoint. LT-1803 is used to detect the tank level and transmit signals to

	LICA-1803. The deviation is detected by LICA-1803 and it will adjust the level of R-1800 to an appropriate level by opening and closing the valve, LV-1803.
1805	The pressure of the reactor (R-1800) should be maintained to avoid the formation of unwanted byproducts that cause damage to the reactor. PT-1805 is used to detect the inlet stream pressure and transmit the signals to PICA-1805. The deviation is detected by PICA-1805 and it will regulate the pressure of R-1800 to bring the pressure back to setpoint. PV-1805 is used to regulate the opening and closing of valves.
1900	The flow rate from the initial Polycondensation Reaction Tank (R-1800) is controlled before entering T-1900. The flow rate is detected by FT-1900 and signals are transmitted to FICA-1900. FICA-1900 will analyze the deviation from the setpoint and it will send signals to FV-1900 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-1900 alarm will be triggered if the flow rate of the slurry exceeded the desired condition.
1901	The level is regulated in T-1900. The level of T-1900 is maintained by setting a level setpoint. LT-1901 is used to detect the tank level and transmit signals to LICA-1901. The deviation is detected by LICA-1901 and it will adjust the level of T-1900 to an appropriate level by opening and closing the valve, LV-1901 before entering E-1901.
1905	The pressure of E-1901 is controlled before entering T-1900 to avoid the formation of unwanted byproducts that cause damage to the reactor. PT-1905 is used to detect the inlet stream pressure and transmit the signals to PICA-1905. The deviation is detected by PICA-1905 and it will regulate the pressure of T-1900 to bring the pressure back to setpoint. PV-1905 is used to regulate the opening and closing of valves.
1907	The pressure of T-1900 and E-1900 is controlled to prevent the formation of unwanted byproducts that cause damage to the tank. PT-1907 is used to detect the inlet stream pressure and transmit the signals to PICA-1907. The deviation is detected by PICA-1907 and it will regulate the pressure of T-1900 to bring the pressure back to setpoint. PV-1907 is used to regulate the opening and closing of valves.
1908	The level in V-1900 is controlled by setting a level setpoint. LT-1908 is used to detect the tank level and transmit signals to LICA-1908. The deviation is

	detected by LICA-1908 and it will adjust the level of V-1900 to an appropriate level by opening and closing the valve, LV-1908.
1910	The flow rate from V-1900 is regulated before allowing it to enter T-1900. The flow rate is detected by FT-1910 and signals are transmitted to FICA-1910. FICA-1910 will analyze the deviation from the setpoint and it will send signals to FV-1910 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-1910 alarm will be triggered if the flow rate of the slurry exceeded the desired condition.
2000	The flow rate from the initial Polycondensation Reaction Tank (R-1800) is controlled before entering R-2000. The flow rate is detected by FT-2000 and signals are transmitted to FICA-2000. FICA-2000 will analyze the deviation from the setpoint, and it will send signals to FV-2000 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-2000 alarm will be triggered if the flow rate of the slurry exceeded the desired condition.
2001	The temperature in the reactor (R-2000) will be regulated. The temperature is monitored by TT-2001 and the signal is transmitted to TICA-2001. TICA-2001 then analyzes the deviation and sends the signals to TV-2001 by regulating the motor speed of P-2100 in order to bring the inlet stream pressure back to the setpoint, maintaining the feed flow rate. High temperature in R-2000 will transmit signals and TICA-2001 will trigger the alarm when the deviation of temperature exceeds the desired condition.
2003	The level of R-2000 is controlled before entering the cooling bath (V-2200) by setting a level setpoint. LT-2003 is used to detect the tank level and transmit signals to LICA-2003. The deviation is detected by LICA-2003 and it will adjust the level of R-2000 to an appropriate level by opening and closing the valve, LV-2003.
2005	The pressure of R-2000 is controlled to prevent the formation of unwanted byproducts that cause damage to the tank. PT-2005 is used to detect the inlet stream pressure and transmit the signals to PICA-2005. The deviation is detected by PICA-2005 and it will regulate the pressure of R-2000 to bring the pressure back to setpoint. PV-2005 is used to regulate the opening and closing of valves.
2100	The flow rate from Latter Term Polycondensation Reaction Tank (R-2000) before entering T-2100. The flow rate is detected by FT-2100 and signals are

	transmitted to FICA-2100. FICA-2100 will analyze the deviation from the setpoint and it will send signals to FV-2100 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-2100 alarm will be triggered if the flow rate of the slurry exceeded the desired condition.
2101	The level of T-2100 is controlled before entering E-2101 by setting a level setpoint. LT-2101 is used to detect the tank level and transmit signals to LICA-2101. The deviation is detected by LICA-2101 and it will adjust the level of T-2100 to an appropriate level by opening and closing the valve, LV-2101.
2105	The pressure of E-2101 is regulated to prevent the formation of unwanted byproducts that cause damage to the tank. PT-2105 is used to detect the inlet stream pressure and transmit the signals to PICA-2105. The deviation is detected by PICA-2105 and it will regulate the pressure of T-2100 to bring the pressure back to setpoint. PV-2105 is used to regulate the opening and closing of valves.
2107	The pressure of T-2100 and E-2100 is controlled before entering V-2100 to prevent the formation of unwanted byproducts that cause damage to the tank. PT-2107 is used to detect the inlet stream pressure and transmit the signals to PICA-2107. The deviation is detected by PICA-2107 and it will regulate the pressure of T-2100 to bring the pressure back to setpoint. PV-2107 is used to regulate the opening and closing of valves.
2108	The level of V-2100 is controlled before entering the Wastewater Treatment Facility by setting a level setpoint. LT-2108 is used to detect the tank level and transmit signals to LICA-2108. The deviation is detected by LICA-2108 and it will adjust the level of V-2100 to an appropriate level by opening and closing the valve, LV-2108.
2110	The flow rate coming out from V-2100 is controlled before entering T-2100. The flow rate is detected by FT-2110 and signals are transmitted to FICA-2110. FICA-2110 will analyze the deviation from the setpoint and it will send signals to FV-2110 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-2110 alarm will be triggered if the flow rate of the slurry exceeded the desired condition.
2112	The flow rate is controlled by pump (P-2100) before entering R-1800, R-2000, and V-2300. The flow rate is detected by FT-2112 and signals are transmitted to FICA-2112. FICA-2112 will analyze the deviation from the setpoint and it will send signals to FV-2112 for appropriate action. Less flow will increase

	valve opening whereas more flow will decrease valve opening. FICA-2112 alarm will be triggered if the flow rate of the slurry exceeded the desired condition.
2200	The flow rate from Latter Term Polycondensation Reaction Tank (R-2000) is maintained before entering T-2200. The flow rate is detected by FT-2200 and signals are transmitted to FICA-2200. FICA-2200 will analyze the deviation from the setpoint and it will send signals to FV-2200 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-2200 alarm will be triggered if the flow rate of the slurry exceeded the desired condition
2203	The level of T-2200 is controlled by setting a level setpoint. LT-2203 is used to detect the tank level and transmit signals to LICA-2203. The deviation is detected by LICA-2203 and it will adjust to an appropriate level by opening and closing the valve, LV-2203.
2300	The flow rate from Cutter K-2200 is controlled before entering R-2300. The flow rate is detected by FT-2300 and signals are transmitted to FICA-2300. FICA-2300 will analyze the deviation from the setpoint and it will send signals to FV-2300 for appropriate action. Less flow will increase valve opening whereas more flow will decrease valve opening. FICA-2300 alarm will be triggered if the flow rate of the slurry exceeded the desired condition.
2301	The temperature from the Vacuum Pump (P-2100) is regulated using TT-2301 before entering R-2300, and the signal is transmitted to TICA-2301. TICA-2301 then analyzes the deviation and sends the signals to TV-2301 by regulating the motor speed of P-2100 in order to bring the inlet stream pressure back to the setpoint, maintaining the feed flow rate. High temperature in R-2300 will transmit signals and TICA-2301 will trigger the alarm when the deviation of temperature exceeds the desired condition.
2303	The level of R-2300 is adjusted by setting a setpoint before entering D-2300, V-2300, then T-2300. LT-2303 is used to detect the tank level and transmit signals to LICA-2303. The deviation is detected by LICA-2303 and it will adjust to an appropriate level by opening and closing the valve, LV-2303.
2305	The pressure of R-2300 is controlled to prevent the formation of unwanted byproducts that cause damage to the reactor. PT-2305 is used to detect the inlet stream pressure and transmit the signals to PICA-2305. The deviation is detected by PICA-2305 and it will regulate the pressure of R-2300 to bring the pressure back to setpoint. PV-2305 is used to regulate the opening and closing of valves.

2306	The level of T-2300 is adjusted by setting a setpoint before going to PET bottle production. LT-2306 is used to detect the tank level and transmit signals to LICA-2306. The deviation is detected by LICA-2306 and it will adjust to an appropriate level by opening and closing the valve, LV-2306.

3.0 Safety Intrrumented System

Table 3.1: SIS Loop with Description

SIS loop	Objective	Device involved	Description
200	To prevent overpressure of R-200.	SDV-200 SDV-201 SDV-202 PZA-200	If the pressure of R-200 reaches high high and low set point, PZA-200 will alert the operators and open PSV-200 to vent out the excess gas to the flare system to reduce the pressure in R-200. PS-200 will trigger the P-200 to stop pumping action as too much feed is pumped into R-200 which cause the pressure to become too high or too low when there is less feed are pumping into R-200.
201	To prevent the content inside R-200 from being flooded or emptied.	SDV-200 SDV-201 SDV-202 LZA-201	If the level of R-200 reaches high high or low low set point, LZA-201 will alert the operator to close SDV-200, SDV-201 and SDV-202. LS-201 will trigger P-201 to stop the pumping action if the level is too high.
202	To prevent thermal escape from R-200.	SDV-200 SDV-201 SDV-202 TZA-202	If the temperature of R-200 reaches high high or low set point, TZA-202 will alert the operator to close the SDV-200, SDV-201 and SDV-202 to stop the operation. TS-202 will trigger the pump to stop the pumping action as too much feed is fed into R-200 which causes the temperature to rise.
400	To prevent overpressure of T-400.	SDV-400 SDV-401 SDV-402 PZA-400	If the pressure in T-400 reaches the high high and low low setpoint, PZA-400 will alert the operators to open SDV-400, SDV-401 and SDV-402 to vent out the excess gas to flare system in order to reduce the pressure inside T-400. PS-400 will trigger pump to stop pumping as excess air supply will increase the pressure in T-400 and prevent the breaking down of pump if the pressure is too low in T-400.

402	To prevent T-400 from flooded or emptied.	SDV-400 SDV-401 SDV-402 LZA-402	When the level of T-400 reaches high high or low low set point, LZA-402 will alert the operator to close SDV-400, SDV-401 and SDV-402. LS-402 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into T-400.
401	To prevent thermal run away in T-400.	SDV-400 SDV-401 SDV-402 TZA-401	If the temperature of T-400 reaches high high or low low set point, TZA-401 will alert the operator to close SDV-400, SDV-401 and SDV-402. TS-401 will trigger the pump to stop pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
500	To prevent overpressure in V-500.	SDV-500 SDV-501 SDV-502 SDV-503 SDV-504 PZA-500	If the pressure in V-500 reaches the high high and low low setpoint, PZA-500 will alert the operators to open SDV-500, SDV-501, SDV-502, SDV-503 and SDV-504 to vent out the excess gas to flare system to reduce the pressure inside V-500. PS-500 will trigger pump to stop pumping as excess air supply will increase the pressure in T-400 and prevent the breaking down of pump if the pressure is too low in V-500.
501	To prevent overpressure due to high temperature.	SDV-500 SDV-501 SDV-502 SDV-503 SDV-504 TZA-501	If the temperature of V-500 reaches high high or low low set point, TZA-501 will alert the operator to close SDV-500, SDV-501, SDV-502, SDV-503 and SDV-504. TS-501 will trigger the pump to stop pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
700	To prevent overpressure of T-700.	SDV-700 SDV-701 SDV-702 SDV-703 PZA-700	If the pressure in T-700 reaches the high high and low low setpoint, PZA-700 will alert the operators to open SDV-700, SDV-701, SDV-702, SDV-703 to vent out the excess gas to flare system to reduce the pressure inside T-700. PS-700

			will trigger pump to stop pumping as excess air supply will increase the pressure in T-700 and prevent the breaking down of pump if the pressure is too low in T-700.
702	To prevent the flooded or emptied of T-700.	SDV-700 SDV-701 SDV-702 SDV-703 LZA-702	When the level of T-700 reaches high high or low low set point, LZA-702 will alert the operator to close SDV-700, SDV-701, SDV-702 and SDV-703. LS-702 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into T-700.
701	To prevent overpressure due to high temperature and ensure the temperature of T-700 is at normal condition.	SDV-700 SDV-701 SDV-702 SDV-703 TZA-701	If the temperature of T-700 reaches high high or low low set point, TZA-701 will alert the operator to close SDV-700, SDV-701, SDV-702, and SDV-703. TS-701 will trigger the pump to stop pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
800	To prevent the overpressure in T-800.	SDV-800 SDV-801 PZA-800	If the pressure in T-800 reaches the high high and low low setpoint, PZA-800 will alert the operators to open SDV-800, SDV-802 to vent out the excess gas to flare system to reduce the pressure inside T-800. PS-800 will trigger pump to stop pumping as too many gases are pumped out from T-800 which cause the pressure to be low.
802	To prevent flooded or emptied in T-800.	SDV-800 SDV-801 LZA-802	When the level of T-800 reaches high high or low low set point, LZA-802 will alert the operator to close SDV-800, SDV-801, LS-802 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into T-800.

801	To prevent overpressure due to high temperature and ensure the temperature of T-800 is at normal condition.	SDV-800 SDV-801 TZA-801	If the temperature of T-800 reaches high high or low low set point, TZA-801 will alert the operator to close SDV-800, SDV-801. TS-801 will trigger the pump to stop pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
900	To prevent overpressure of R-900.	SDV-900 PZA-900	If the pressure in R-900 reaches the high high and low low setpoint, PZA-900 will alert the operators to open SDV-900 to vent out the excess gas to flare system to reduce the pressure inside R-900. PS-900 will trigger pump to stop pumping as too many gases are pumped out from R-900 which cause the pressure to be low and prevent the breaking down of pump which cause the pressure to be high.
901	To prevent flooding or emptied in R-900.	SDV-900 LZA-901	When the level of R-900 reaches high high or low low set point, LZA-901 will alert the operator to close SDV-900. LS-901 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into R-900.
1000	To prevent overpressure of T-1000.	SDV-1000 SDV-1001 SDV-1002 PZA-1000	If the pressure in T-1000 reaches the high high and low low setpoint, PZA-1000 will alert the operators to open SDV-1000, SDV-1002, SDV-1002 to vent out the excess gas to flare system to reduce the pressure inside T-1000. PS-1000 will trigger pump to stop pumping as too many gases are pumped out from T-1000 which cause the pressure to be low and prevent the breaking down of pump which cause the pressure to be high.
1002	To prevent flooded or	SDV-1000 SDV-1001	When the level of T-1000 reaches high high or low low set point, LZA-1002 will

	emptied in T-1000.	SDV-1002 LZA-1002	alert the operator to close SDV-1000, SDV-1001, SDV-1002. LS-1002 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into T-1000.
1001	To prevent the overpressure of T-1000 due to high temperature and ensure it is operated under normal condition.	SDV-1000 SDV-1001 SDV-1002 TZA-1001	If the temperature of T-1000 reaches high high or low low set point, TZA-1001 will alert the operator to close SDV-1000, SDV-1001, SDV-1002. TS-1001 will trigger the pump to stop pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
1100	To prevent the overpressure of V-1101 due to high temperature and ensure it is operated under normal condition.	SDV-1100 SDV-1101 TZA-1100	If the temperature of V-1101 reaches high high or low low set point, TZA-1100 will alert the operator to close SDV-1100, SDV-1101. TS-1100 will trigger the pump to stop pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
1207	To prevent overpressure of R-1200.	SDV-1200 SDV-1201 SDV-1202 SDV-1203 PZA-1207	If the pressure in R-1200 reaches the high high and low low setpoint, PZA-1207 will alert the operators to open SDV-1200, SDV-1201, SDV-1202 and SDV-1203 to vent out the excess gas to flare system to reduce the pressure inside R-1200. PS-1207 will trigger pump to stop pumping as too many gases are pumped out from R-1200 which cause the pressure to be low and prevent the breaking down of pump which cause the pressure to be high.
1205	To prevent flooded or emptied of R-1200.	SDV-1200 SDV-1201 SDV-1202 SDV-1203 LZA-1205	When the level of R-1200 reaches high high or low low set point, LZA-1205 will alert the operator to close SDV-1200, SDV-1201, SDV-1202 and SDV-1203. LS-1205 will trigger the pump to stop the pumping action if the level is too high and

			prevent the pump from breaking down if the level is too low as less feed is pumped into R-1200.
1203	To prevent the overpressure of R-1200 due to high temperature and ensure it is operate under normal condition	SDV-1200 SDV-1201 SDV-1202 SDV-1203 TZA-1203	If the temperature of R-1200 reaches high high or low low set point, TZA-1203 will alert the operator to close SDV-1200, SDV-1201, SDV-1202, and SDV-1203. TS-1203 will trigger the pump to stop pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
1213	To prevent the flooded or emptied of T-1200.	SDV-1203 SDV-1204 SDV-1205 LZA-1213	When the level of T-1200 reaches high high or low low set point, LZA-1213 will alert the operator to close SDV-1203, SDV-1204, SDV-1205. LS-1213 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into T-1200.
1211	To prevent the overpressure of T-1200 due to high temperature and ensure it is operates under normal condition	SDV-1203 SDV-1204 TZA-1211	If the temperature of T-1200 reaches high high or low low set point, TZA-1211 will alert the operator to close SDV-1203, SDV-1204. TS-1211 will trigger the pump to stop pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
1305	To prevent the overpressure of T-1300.	SDV-1300 SDV-1302 PZA-1305	If the pressure in T-1300 reaches the high high and low low setpoint, PZA-130 will alert the operators to open SDV-1300, SDV-1302 to vent out the excess gas to flare system to reduce the pressure inside T-1300. PS-1305 will trigger pump to stop pumping as too many gases are pumped out from T-1300 which cause the pressure to be low and prevent the breaking down of pump which cause the pressure to be high.
1302	To prevent the flooded or	SDV-1300 SDV-1302	When the level of T-1300 reaches high high or low low set point, LZA-1302 will

	emptied of T-1300.	LZA-1302	alert the operator to close SDV-1300, SDV-1302. LS-1302 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into T-1300.
1304	To prevent the overpressure of T-1300 due to high temperature and ensure it is operate under normal condition.	SDV-1300 SDV-1302 TZA-1304	If the temperature of T-1300 reaches high high or low low set point, TZA-1304 will alert the operator to close SDV-1300, SDV-1302. TS-1304 will trigger the pump to stop pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
1308	To prevent the flooded or emptied of V-1300.	SDV-1300 SDV-1302 LZA-1308	When the level of V-1300 reaches high high or low low set point, LZA-1308 will alert the operator to close SDV-1300, SDV-1302. LS-1308 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into V-1300.
1401	To prevent the overpressure or under pressure of V-1400.	SDV-1400 SDV-1401 PZA-1401	If the pressure in V-1400 reaches the high high and low low setpoint, PZA-1401 will alert the operators to open SDV-1400, SDV-1401 to vent out the excess gas to flare system to reduce the pressure inside V-1400. PS-1401 will trigger pump to stop pumping as too many gases are pumped out from V-1400 which cause the pressure to be low and prevent the breaking down of pump which cause the pressure to be high.
1404	To prevent the flooding or emptied of V-1400.	SDV-1400 SDV-1401 LZA-1404	When the level of V-1400 reaches high high or low low set point, LZA-1404 will alert the operator to close SDV-1400, SDV-1401. LS-1404 will trigger the pump to stop the pumping action if the level is too high and prevent the pump

			from breaking down if the level is too low as less feed is pumped into V-1400.
1406	To prevent the flooding or emptied of T-1400.	SDV-1303 SDV-1402 LZA-1406	When the level of T-1400 reaches high high or low low set point, LZA-1303 will alert the operator to close SDV-1303, SDV-1402. LS-1406 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into T-1400.
1503	To prevent the flooding or emptied of V-1500.	SDV-1500 SDV-1501 SDV-1702 SDV-1903 SDV-2103 LZA-1503	When the level of V-1500 reaches high high or low low set point, LZA-1503 will alert the operator to close SDV-1500, SDV-1501, SDV-1702, SDV-1903, and SDV-2103. LS-1503 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into V-1500.
1606	To prevent the overpressure or under pressure of R-1600.	SDV-1600 SDV-1601 SDV-1603 PZA-1606	If the pressure in R-1600 reaches the high high and low low setpoint, PZA-1606 will alert the operators to open SDV-1600, SDV-1601, and SDV-1603 to vent out the excess gas to flare system to reduce the pressure inside R-1600. PS-1606 will trigger pump to stop pumping as too many gases are pumped out from V-1400 which cause the pressure to be low and prevent the breaking down of pump which cause the pressure to be high.
1604	To prevent the flooding or emptied of R-1600.	SDV-1600 SDV-1601 SDV-1603 LZA-1604	When the level of R-1600 reaches high high or low low set point, LZA-1604 will alert the operator to close SDV-1600, SDV-1601, and SDV-1603. LS-1604 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into R-1600.

1602	To prevent the overpressure of R-1600 due to high temperature and ensure it is operated under normal condition	SDV-1600 SDV-1601 SDV-1602 SDV-1603 TZA-1602	If the temperature of R-1600 reaches high high or low low set point, TZA-1602 will alert the operator to close SDV-1600, SDV-1601, SDV-1602, and SDV-1603. TS-1602 will trigger the pump to stop pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
1706	To prevent the overpressure or under pressure of T-1700.	SDV-1700 PZA-1706	If the pressure in T-1700 reaches the high high and low low setpoint, PZA-1706 will alert the operators to open SDV-1700 to vent out the excess gas to flare system to reduce the pressure inside T-1700. PS-1706 will trigger pump to stop pumping as too many gases are pumped out from T-1700 which cause the pressure to be low and prevent the breaking down of pump which cause the pressure to be high.
1702	To prevent the flooding or emptied of T-1700.	SDV-1700 LZA-1702	When the level of T-1700 reaches high high or low low set point, LZA-1702 will alert the operator to close SDV-1700. LS-1702 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into T-1700.
1704	To prevent the overpressure of T-1700 due to high temperature and ensure it is operated under normal condition	SDV-1700 TZA-1704	If the temperature of T-1700 reaches high high or low low set point, TZA-1704 will alert the operator to close SDV-1700. TS-1704 will trigger the pump to stop pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
1709	To prevent the flooding or	SDV-1701 LZA-1709	When the level of V-1700 reaches high high or low low set point, LZA-1709 will

	emptied of V-1700.		alert the operator to close SDV-1701. LS-1709 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into V-1700.
1809	To prevent the overpressure or under pressure of R-1800.	SDV-1800 SDV-1801 SDV-1803 SDV-2105 PZA-1809	If the pressure in R-1800 reaches the high high and low low setpoint, PZA-1809 will alert the operators to open SDV-1800, SDV-1801, SDV-1803, amd SDV-2105 to vent out the excess gas to flare system to reduce the pressure inside R-1800. PS-1809 will trigger pump to stop pumping as too many gases are pumped out from R-1800 which cause the pressure to be low and prevent the breaking down of pump which cause the pressure to be high.
1804	To prevent the flooding or emptied of R-1800.	SDV-1800 SDV-1801 SDV-1803 SDV-2105 LZA-1804	When the level of R-1800 reaches high high or low low set point, LZA-1804 will alert the operator to close SDV-1800, SDV-1801, SDV-1803, and SDV-2105. LS-1804 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into R-1800.
1802	To prevent the overpressure of R-1800 due to high temperature and ensure it is operated under normal condition	SDV-1800 SDV-1801 SDV-1802 SDV-1803 SDV-2105 TZA-1802	If the temperature of R-1800 reaches high high or low low set point, TZA-1802 will alert the operator to close SDV-1800, SDV-1801, SDV-1802, SDV-1803, and SDV-2105. TS-1802 will trigger the pump to stop pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
1906	To prevent the overpressure or	SDV-1900 PZA-1906	If the pressure in T-1900 reaches the high high and low low setpoint, PZA-1906 will

	under pressure of T-1900.		alert the operators to open SDV-1900 to vent out the excess gas to flare system to reduce the pressure inside T-1900. PS-1906 will trigger pump to stop pumping as too many gases are pumped out from T-1900 which cause the pressure to be low and prevent the breaking down of pump which cause the pressure to be high.
1902	To prevent the flooding or emptied of T-1900.	SDV-1900 LZA-1902	When the level of T-1900 reaches high high or low low set point, LZA-1902 will alert the operator to close SDV-1900. LS-1902 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into T-1900.
1904	To prevent the overpressure of T-1900 due to high temperature and ensure it is operated under normal condition	SDV-1900 TZA-1904	If the temperature of T-1900 reaches high high or low low set point, TZA-1904 will alert the operator to close SDV-1900. TS-1904 will trigger the pump to stop pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
1909	To prevent the flooding or emptied of V-1900.	SDV-1901 LZA-1909	When the level of V-1900 reaches high high or low low set point, LZA-1909 will alert the operator to close SDV-1901. LS-1909 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into V-1900.
2007	To prevent the overpressure or under pressure of R-2000.	SDV-2000 SDV-2001 SDV-2003 SDV-2105 PZA-2007	If the pressure in R-2000 reaches the high high and low low setpoint, PZA-2007 will alert the operators to open SDV-2000, SDV-2001, SDV-2003, and SDV-2105 to vent out the excess gas to flare system to

			reduce the pressure inside R-2000. PS-2007 will trigger pump to stop pumping as too many gases are pumped out from R-2000 which cause the pressure to be low and prevent the breaking down of pump which cause the pressure to be high.
2004	To prevent the flooding or emptied of R-2000.	SDV-2000 SDV-2001 SDV-2003 SDV-2105 LZA-2004	When the level of R-2000 reaches high high or low low set point, LZA-2004 will alert the operator to close SDV-2000, SDV-2001, SDV-2003, and SDV-2105. LS-2004 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into R-2000.
2002	To prevent the overpressure of R-2000 due to high temperature and ensure it is operated under normal condition	SDV-2000 SDV-2001 SDV-2002 SDV-2003 SDV-2105 TZA-2002	If the temperature of R-2000 reaches high high or low low set point, TZA-2002 will alert the operator to close SDV-2000, SDV-2001, SDV-2002, SDV-2003, and SDV-2105. TS-2002 will trigger the pump to stop pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
2106	To prevent the overpressure or under pressure of T-2100	SDV-2100 PZA-2106	If the pressure in T-2100 reaches the high high and low low setpoint, PZA-2007 will alert the operators to open SDV-2100 to vent out the excess gas to flare system to reduce the pressure inside T-2100. PS-2106 will trigger pump to stop pumping as too many gases are pumped out from T-2100 which cause the pressure to be low and prevent the breaking down of pump which cause the pressure to be high.
2102	To prevent the flooding or	SDV-2100 LZA-2102	When the level of T-2100 reaches high high or low low set point, LZA-2102 will alert the operator to close SDV-2100. LS-

	emptied of T-2100.		2102 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into T-2100.
2104	To prevent the overpressure of T-2100 due to high temperature and ensure it is operated under normal condition	SDV-2100 TZA-2104	If the temperature of T-2100 reaches high high or low low set point, TZA-2104 will alert the operator to close SDV-2100. TS-2104 will trigger the pump to stop pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
2109	To prevent the flooding or emptied of T-2100.	SDV-2101 SDV-2104 LZA-2109	When the level of T-2100 reaches high high or low low set point, LZA-2109 will alert the operator to close SDV-2101, and SDV-2104. LS-2109 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into T-2100.
2111	To prevent overflow and underflow of component into P-2100	SDV-1902 SDV-2104 SDV-2105 FT-2111 FZA-2111 M-2112	When the inlet molar flow rate of P-2100 not in the range between high high-alarm set point and low low-alarm setpoint, FZA-2111 will be triggered and close SDV-2104 to allow no more flow into P-2100. SDV-2105 will be closed as well to allow no flow into the next stage.
2114	To prevent P-2100 from overpressure and too low pressure	SDV-1902 SDV-2104 SDV-2105 PZA-2114 M-2112	When the outlet pressure of P-2100 not in the range between high high-alarm set point and low low-alarm setpoint, PZA-2114 will be triggered and close SDV-2105 to allow no flow into the next stage.
2204	To prevent the flooding or emptied of T-2200.	SDV-2200 SDV-2201 LZA-2204	When the level of T-2200 reaches high high or low low set point, LZA-2204 will alert the operator to close SDV-2200, and SDV-2201. LS-2204 will trigger the

			pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into T-2200.
2202	To prevent the overpressure of T-2200 due to high temperature and ensure it is operated under normal condition	SDV-2200 SDV-2201 TZA-2202	If the temperature of T-2200 reaches high high or low low set point, TZA-2202 will alert the operator to close SDV-2200, and SDV-2201. TS-2202 will trigger the pump to stop pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
2306	To prevent the overpressure or under pressure of R-2300	SDV-2105 SDV-2202 SDV-2300 SDV-2302 PZA-2306	If the pressure in R-2300 reaches the high high and low low setpoint, PZA-2306 will alert the operators to open SDV-2105, SDV-2202, SDV-2300, and SDV-2302 to vent out the excess gas to flare system to reduce the pressure inside R-2300. PS-2306 will trigger pump to stop pumping as too many gases are pumped out from R-2300 which cause the pressure to be low and prevent the breaking down of pump which cause the pressure to be high.
2304	To prevent the flooding or emptied of R-2300.	SDV-2105 SDV-2202 SDV-2300 SDV-2302 LZA-2304	When the level of R-2300 reaches high high or low low set point, LZA-2304 will alert the operator to close SDV-2105, SDV-2202, SDV-2300, and SDV-2302. LS-2304 will trigger the pump to stop the pumping action if the level is too high and prevent the pump from breaking down if the level is too low as less feed is pumped into R-2300.
2302	To prevent the overpressure of R-2300 due to high temperature and ensure it is	SDV-2105 SDV-2202 SDV-2300 SDV-2302 TZA-2302	If the temperature of R-2300 reaches high high or low low set point, TZA-2302 will alert the operator to close SDV-2105, SDV-2202, SDV-2300, and SDV-2302. TS-2302 will trigger the pump to stop

	operated under normal condition		pumping as excessive heat will be produced and prevent the breaking of pump when the temperature is low.
2307	To prevent the flooding or emptied of T-2300.	SDV-2303 LZA-2307	When the level of T-2300 reaches high high or low low set point, LZA-2307 will alert the operator to close SDV-2303 to prevent the component flow to PET Bottle production stage.

Cause and Effect Diagram for Area 1 to Area 11

TITLE	TAG NO.	DESCRIPTION	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	REMARKS
EFFECTS			TITLE	VALVE																							ALARM																		
CAUSES / DEVICES			TAG NO.	SDV-200	SDV-201	SDV-202	SDV-400	SDV-401	SDV-402	SDV-500	SDV-501	SDV-502	SDV-503	SDV-504	SDV-700	SDV-701	SDV-702	SDV-703	SDV-800	SDV-801	SDV-900	SDV-1000	SDV-1001	SDV-1002	SDV-1100	SDV-1101	PZA-200	LZA-201	TZA-202	PZA-400	TZA-401	LZA-402	PZA-700	TZA-701	LZA-702	PZA-800	TZA-801	LZA-802	PZA-900	LZA-901	PZA-1000	TZA-1001	LZA-1002	TZA-1100	
			DESCRIPTION	Trigger SDV-200 to close the outlet stream from pump P-200 to reactor R-200	Trigger SDV-201 to close the outlet stream from pump P-201 to reactor R-200	Triggers SDV-202 to close the inlet stream into filter press F-300 from the reactor R-200	Triggers SDV-400 to close the inlet stream to distillation column T-400 from pump P-400	Triggers SDV-401 to close the inlet stream of high pressure steam into reboiler E-401	Triggers SDV-402 to close the outlet stream of reboiler E-401 into crystallizer V-500	Triggers SDV-500 to close the outlet stream of pump P-500 into crystallizer V-500	Triggers SDV-501 to close the inlet stream of catalyst supply into crystallizer V-500	Triggers SDV-502 to close the outlet stream of pump P-501 into crystallizer V-500	Triggers SDV-503 to close the outlet stream of pump P-502 into crystallizer V-500	Triggers SDV-504 to close the outlet stream of pump heat exchanger E-500 into filter press F-600	Triggers SDV-700 to close the inlet stream to distillation column T-700 from pump P-700	Triggers SDV-701 to close the outlet stream of pump P-701 into distillation column T-700	Triggers SDV-702 to close the inlet stream of high pressure steam into reboiler E-401	Triggers SDV-703 to close the outlet stream of reboiler E-401 into EG Distillation Column T-800	Triggers SDV-800 to close the inlet stream to distillation column T-800 from pump P-800	Triggers SDV-801 to close the inlet stream of high pressure steam into reboiler E-801	Triggers SDV-900 to close the inlet stream of reactor R-900 from filter press F-600	Triggers SDV-1000 to close the inlet stream to distillation column T-1000 from pump P-1000	Triggers SDV-1001 to close the inlet stream of high pressure steam into reboiler E-1001	Triggers SDV-1002 to close the outlet stream of reboiler E-1001 into depolymerization tank R-200	Triggers SDV-1100 to close the inlet stream to heating vessel V-1101 from pump P-1100	Triggers SDV-1101 to close the outlet stream of heating vessel V-1101 into hydrolysis reactor R-1200	Triggers pressure emergency alarm and trip reactor R-200.	Triggers level emergency alarm and trip reactor R-200	Triggers temperature emergency alarm and trip reactor R-200	Triggers pressure emergency alarm and trip distillation column T-400.	Triggers temperature emergency alarm and trip distillation column T-400.	Triggers level emergency alarm and trip distillation column T-400	Triggers pressure emergency alarm and trip distillation column T-700.	Triggers temperature emergency alarm and trip distillation column T-700.	Triggers level emergency alarm and trip distillation column T-700	Triggers pressure emergency alarm and trip distillation column T-800.	Triggers temperature emergency alarm and trip distillation column T-800	Triggers level emergency alarm and trip distillation column T-800	Triggers pressure emergency alarm and trip reactor R-900.	Triggers level emergency alarm and trip reactor R-900	Triggers pressure emergency alarm and trip distillation column T-1000	Triggers temperature emergency alarm and trip distillation column T-1000.	Triggers level emergency alarm and trip distillation column T-1000	Triggers temperature emergency alarm and trip heating vessel V-1101	
Depolymerization Reactor R-200	PZAHH-200	DEPOLYMERIZATION REACTOR R-200 PRESSURE HIGH HIGH	1	X	X	X																					X																		
	PZALL-200	DEPOLYMERIZATION REACTOR R-200 PRESSURE LOW LOW	2	X	X	X																					X																		
	LZAHH-201	DEPOLYMERIZATION REACTOR R-200 LEVEL HIGH HIGH	3	X	X	X																						X																	
	LZALL-201	DEPOLYMERIZATION REACTOR R-200 LEVEL LOW LOW	4	X	X	X																						X																	
	TZAHH-202	DEPOLYMERIZATION REACTOR R-200 TEMPERATURE HIGH HIGH	5	X	X	X																							X																
	TZALL-202	DEPOLYMERIZATION REACTOR R-200 TEMPERATURE LOW LOW	6	X	X	X																							X																
Distillation Column T-400	PZAHH-400	DISTILLATION COLUMN T-400 PRESSURE HIGH HIGH	7				X	X	X																					X															
	PZALL-400	DISTILLATION COLUMN T-400 PRESSURE LOW LOW	8				X	X	X																					X															
	LZAHH-402	DISTILLATION COLUMN T-400 LEVEL HIGH HIGH	9				X	X	X																							X													
	LZALL-402	DISTILLATION COLUMN T-400 LEVEL LOW LOW	10				X	X	X																							X													
	TZAHH-401	DISTILLATION COLUMN T-400 TEMPERATURE HIGH HIGH	11				X	X	X																						X														
	TZALL-401	DISTILLATION COLUMN T-400 TEMPERATURE LOW LOW	12				X	X	X																						X														
Crytallizer V-500	PZAHH-500	CRYTALLIZER V-500 PRESSURE HIGH HIGH	13							X	X	X	X	X																															
	PZALL-500	CRYTALLIZER V-500 PRESSURE LOW LOW	14							X	X	X	X	X																															
	TZAHH-501	CRYTALLIZER V-500 TEMPERATURE HIGH HIGH	15							X	X	X	X	X																															
	TZALL-501	CRYTALLIZER V-500 TEMPERATURE LOW LOW	16							X	X	X	X	X																															
Rectification Column T-700	PZAHH-700	RECTIFICATION COLUMN T-700 PRESSURE HIGH HIGH	17												X	X	X	X															X												
	PZALL-700	RECTIFICATION COLUMN T-700 PRESSURE LOW LOW	18												X	X	X	X															X												
	LZAHH-702	RECTIFICATION COLUMN T-700 LEVEL HIGH HIGH	19												X	X	X	X																	X										
	LZALL-702	RECTIFICATION COLUMN T-700 LEVEL LOW LOW	20												X	X	X	X																	X										
	TZAHH-701	RECTIFICATION COLUMN T-700 TEMPERATURE HIGH HIGH	21												X	X	X	X																X											
	TZALL-701	RECTIFICATION COLUMN T-700 TEMPERATURE LOW LOW	22												X	X	X	X																X											
Distillation Column T-800	PZAHH-800	DISTILLATION COLUMN T-800 PRESSURE HIGH HIGH	23																X	X																X									
	PZALL-800	DISTILLATION COLUMN T-800 PRESSURE LOW LOW	24																X	X																X									
	LZAHH-802	DISTILLATION COLUMN T-800 LEVEL HIGH HIGH	25																X	X																		X							
	LZALL-802	DISTILLATION COLUMN T-800 LEVEL LOW LOW	26																X	X																		X							
	TZAHH-801	DISTILLATION COLUMN T-800 TEMPERATURE HIGH HIGH	27																X	X																	X								
	TZALL-801	DISTILLATION COLUMN T-800 TEMPERATURE LOW LOW	28																X	X																	X								
Reactor R-900	PZAHH-900	REACTOR R-900 PRESSURE HIGH HIGH	29																		X																		X						
	PZALL-900	REACTOR R-900 PRESSURE LOW LOW	30																		X																		X						
	LZAHH-901	REACTOR R-900 LEVEL HIGH HIGH	31																		X																			X					
	LZALL-901	REACTOR R-900 LEVEL LOW LOW	32																		X																			X					
Distillation Column T-1000	PZAHH-1000	DISTILLATION COLUMN T-1000 PRESSURE HIGH HIGH	33																			X	X	X																	X				
	PZALL-1000	DISTILLATION COLUMN T-1000 PRESSURE LOW LOW	34																			X	X	X																	X				
	LZAHH-1002	DISTILLATION COLUMN T-1000 LEVEL HIGH HIGH	35																			X	X	X																			X		
	LZALL-1002	DISTILLATION COLUMN T-1000 LEVEL LOW LOW	36																			X	X	X																			X		
	TZAHH-1001	DISTILLATION COLUMN T-1000 TEMPERATURE HIGH HIGH	37																			X	X	X																		X			
	TZALL-1001	DISTILLATION COLUMN T-1000 TEMPERATURE LOW LOW	38																			X	X	X																		X			
Heating Vessel V-1101	TZAHH-1100	HEATING VESSEL V-1101 TEMPERATURE HIGH HIGH	39																						X	X																			X	
	TZALL-1100	HEATING VESSEL V-1101 TEMPERATURE LOW LOW	40																						X	X																			X	

Cause and Effect Diagram for Area 12 to Area 23

EFFECTS

TITLE	No.	TAG NO.	DESCRIPTION
VALVE	1	SDV-1200	Trigger SDV-1200 to close the water supply to water boiler E-1200 from water supply tank V-1400
	2	SDV-1201	Trigger SDV-1201 to close the outlet stream from reactor R-1200 to condenser E-1201
	3	SDV-1202	Triggers SDV-1202 to close the inlet stream of chilled water into cooling tank T-1200
	4	SDV-1203	Triggers SDV-1203 to close the outlet stream of reactor R-1200 to cooling tank T-1200
	5	SDV-1204	Triggers SDV-1204 to close the inlet stream of solid-liquid separator T-1400 from cooling tank T-1200
	6	SDV-1205	Triggers SDV-1205 to close the outlet stream to chilled water recycle from cooling tank T-1200.
	7	SDV-1300	Triggers SDV-1300 to close the inlet stream to T-1300 from steam condenser E-1202
	8	SDV-1301	Triggers SDV-1301 to close the inlet stream to T-700 from reflux drum V-1300
	9	SDV-1302	Triggers SDV-1302 to close the outlet stream of T-1300 into reboiler E-1301
	10	SDV-1303	Triggers SDV-1303 to close the outlet stream of reboiler E-1301 into water supply tank V-1400
	11	SDV-1400	Triggers SDV-1400 to close the outlet stream of solid-liquid separator V-1400 into TA Slurry tank T-1501
	12	SDV-1401	Triggers SDV-1401 to close the top outlet stream of solid-liquid separator into water tank T-1400.
	13	SDV-1402	Triggers SDV-1402 to close the outlet stream of water tank T-1400 into water boiler E-1200 and T-700
	14	SDV-1500	Triggers SDV-1500 to close the inlet stream of EG distallation column T-1700, T-1900 and T-2100 into V-1500
	15	SDV-1501	Triggers SDV-1501 to close the outlet stream of TA Slurry Tank V-1500 into esterification tank R-1600
	16	SDV-1600	Triggers SDV-1600 to close the cooling water supply stream into reactor R-1600
	17	SDV-1601	Triggers SDV-1601 to close the outlet stream of R-1600 into EG Distillation Tower T-1700
	18	SDV-1602	Triggers SDV-1602 to close the cooling water stream coming out from reactor R-1600
	19	SDV-1603	Triggers SDV-1603 to close the bottom outlet stream from reactor R-1600 to reactor R-1800
	20	SDV-1700	Triggers SDV-1700 to close the outlet stream of T-1700 into reboiler E-1701
	21	SDV-1701	Triggers SDV-1701 to close the stream from reflux drum V-1700 to wastewater treatment facility
	22	SDV-1702	Triggers SDV-1702 to close the inlet stream into TA slurry tank T-1501 from reboiler E-1701
	23	SDV-1800	Triggers SDV-1800 to close the inlet stream of vacuum into reactor R-1800
	24	SDV-1801	Triggers SDV-1801 to close the outlet of reactor R-1800 into EG distillation column T-1900
	25	SDV-1802	Triggers SDV-1802 to close the vacuum stream coming out from reactor R-1800
	26	SDV-1803	Triggers SDV-1803 to close the outlet stream of R-1800 into reactor R-2000
	27	SDV-1900	Triggers SDV-1900 to close the outlet stream of T-1900 into reboiler E-1901
	28	SDV-1901	Triggers SDV-1901 to close the stream from reflux drum V-1900 to wastewater treatment facility
	29	SDV-1902	Triggers SDV-1902 to close the inlet stream of vacuum pump P-2101 from reflux drum V-1900.
	30	SDV-1903	Triggers SDV-1903 to close the inlet stream into TA slurry tank T-1501 from reboiler E-1901
	31	SDV-2000	Triggers SDV-2000 to close the inlet stream of vacuum into reactor R-2000
	32	SDV-2001	Triggers SDV-2001 to close the outlet of reactor R-2000 into EG distillation column T-2100
	33	SDV-2002	Triggers SDV-2002 to close the vacuum stream coming out from reactor R-2000
	34	SDV-2003	Triggers SDV-2003 to close the outlet stream of R-2000 into cooling bath V-2200
	35	SDV-2100	Triggers SDV-2100 to close the outlet stream of T-2100 into reboiler E-2101
	36	SDV-2101	Triggers SDV-2101 to close the stream from reflux drum V-2100 to wastewater treatment facility
	37	SDV-2103	Triggers SDV-2103 to close outlet stream of reboiler E-2101 into TA slurry tank T-1501
	38	SDV-2104	Triggers SDV-2104 to close the inlet stream into vacuum pump P-2100 from reflux drum V-2100.
	39	SDV-2105	Triggers SDV-2105 to close the outlet stream of P-2100 into R-1800, R-2000 and V-2300
	40	SDV-2200	Triggers SDV-2200 to close the chilled water supply stream into cooling bath T-2200.
	41	SDV-2201	Triggers SDV-2201 to close the outlet stream of cooling bath T-2200 into cutter K-2200
	42	SDV-2202	Triggers SDV-2202 to close the outlet stream of cutter K-2200 into solid polymerization tank V-2300
	43	SDV-2300	Triggers SDV-2300 to close the vacuum supply stream from P-2100 into R-2300
	44	SDV-2301	Triggers SDV-2301 to close the vacuum stream from reactor R-2300
	45	SDV-2302	Triggers SDV-2302 to close the outlet stream of R-2300 into dryer D-2300
	46	SDV-2303	Triggers SDV-2303 to close the outlet stream of PET storage tank T-2300 to PET bottle production
ALARM	47	PZA-1207	Triggers pressure emergency alarm and trip reactor R-1200.
	48	LZA-1205	Triggers level emergency alarm and trip reactor R-1200
	49	TZA-1203	Triggers temperature emergency alarm and trip reactor R-1200
	50	LZA-1213	Triggers level emergency alarm and trip cooling tank T-1200
	51	TZA-1211	Triggers temperature emergency alarm and trip cooling tank T-1200
	52	PZA-1305	Triggers pressure emergency alarm and trip vacuum distillation column T-1300
	53	LZA-1302	Triggers level emergency alarm and trip vacuum distillation column T-1300
	54	TZA-1304	Triggers temperature emergency alarm and trip vacuum distillation column T-1300
	55	LZA-1308	Triggers level emergency alarm and trip reflux drum V-1300
	56	PZA-1401	Triggers pressure emergency alarm and trip solid-liquid separator V-1400
	57	LZA-1404	Triggers level emergency alarm and trip solid-liquid separator V-1400
	58	LZA-1406	Triggers level emergency alarm and trip water storage tank T-1400
	59	LZA-1503	Triggers level emergency alarm and trip TA slurry tank V-1500
	60	PZA-1606	Triggers pressure emergency alarm and trip reactor R-1600
	61	LZA-1604	Triggers level emergency alarm and trip reactor R-1600
	62	TZA-1602	Triggers temperature emergency alarm and trip reactor R-1600
	63	PZA-1706	Triggers pressure emergency alarm and trip EG distillation column T-1700
	64	LZA-1702	Triggers level emergency alarm and trip EG distillation column T-1700
	65	TZA-1704	Triggers temperature emergency alarm and trip EG distillation column T-1700
	66	LZA-1709	Triggers level emergency alarm and trip reflux drum V-1700
	67	PZA-1809	Triggers pressure emergency alarm and trip reactor R-1800.
	68	LZA-1804	Triggers level emergency alarm and trip reactor R-1800
	69	TZA-1802	Triggers temperature emergency alarm and trip reactor R-1800
	70	PZA-1906	Triggers pressure emergency alarm and trip EG distillation column T-1900
	71	LZA-1902	Triggers level emergency alarm and trip EG distillation column T-1900
	72	TZA-1904	Triggers temperature emergency alarm and trip EG distillation column T-1900
	73	LZA-1909	Triggers level emergency alarm and trip reflux drum V-1900
	74	PZA-2007	Triggers pressure emergency alarm and trip reactor R-2000.
	75	LZA-2004	Triggers level emergency alarm and trip reactor R-2000
	76	TZA-2002	Triggers temperature emergency alarm and trip reactor R-2000
	77	PZA-2106	Triggers pressure emergency alarm and trip EG distillation column T-2100
	78	LZA-2102	Triggers level emergency alarm and trip EG distillation column T-2100
	79	TZA-2104	Triggers temperature emergency alarm and trip EG distillation column T-2100
	80	LZA-2109	Triggers level emergency alarm and trip reflux drum V-2100
	81	FZA-2111	Triggers flow rate emergency alarm and trip pump P-2100
	82	PZA-2114	Triggers pressure emergency alarm and trip pump P-2100
	83	LZA-2204	Triggers level emergency alarm and trip cooling bath T-2200
	84	TZA-2202	Triggers temperature emergency alarm and trip cooling bath T-2200
	85	PZA-2306	Triggers pressure emergency alarm and trip reactor R-2300.
	86	LZA-2304	Triggers level emergency alarm and trip reactor R-2300
	87	TZA-2302	Triggers temperature emergency alarm and trip reactor R-2300
	88	LZA-2307	Triggers level emergency alarm and trip PET storage tank T-2300
MOTOR	89	M-2112	To shut down the current supplied to vacuum pump P-2100 motor

CAUSES / DEVICES

TITLE	TAG NO.	DESCRIPTION	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
Hydrolysis Reactor R-1200	PZAHH-1207	HYDROLYSIS REACTOR R-1200 PRESSURE HIGH HIGH	1	X	X	X	X																																								
	PZALL-1207	HYDROLYSIS REACTOR R-1200 PRESSURE LOW LOW	2	X	X	X	X																																								
	LZAHH-1205	HYDROLYSIS REACTOR R-1200 LEVEL HIGH HIGH	3	X	X	X	X																																								
	LZALL-1205	HYDROLYSIS REACTOR R-1200 LEVEL LOW LOW	4	X	X	X	X																																								
	TZAHH-1203	HYDROLYSIS REACTOR R-1200 TEMPERATURE HIGH HIGH	5	X	X	X	X																																								
	TZALL-1203	HYDROLYSIS REACTOR R-1200 TEMPERATURE LOW LOW	6	X	X	X	X																																								
Cooling Tank T-1200	LZAHH-1213	COOLING TANK T-1200 LEVEL HIGH HIGH	7				X	X																																							
	LZALL-1213	COOLING TANK T-1200 LEVEL LOW LOW	8				X	X	X																																						
	TZAHH-1211	COOLING TANK T-1200 TEMPERATURE HIGH HIGH	9				X	X																																							
	TZALL-1211	COOLING TANK T-1200 TEMPERATURE LOW LOW	10				X	X																																							
Vacuum Distillation Column T-1300	PZAHH-1305	VACUUM DISTILLATION COLUMN T-1300 PRESSURE HIGH HIGH	11							X		X																																					
	PZALL-1305	VACUUM DISTILLATION COLUMN T-1300 PRESSURE LOW LOW	12							X		X																																					
	LZAHH-1302	VACUUM DISTILLATION COLUMN T-1300 LEVEL HIGH HIGH	13							X		X																																					
	LZALL-1302	VACUUM DISTILLATION COLUMN T-1300 LEVEL LOW LOW	14							X		X																																					
	TZAHH-1304	VACUUM DISTILLATION COLUMN T-1300 TEMPERATURE HIGH HIGH	15							X		X																																					
	TZALL-1304	VACUUM DISTILLATION COLUMN T-1300 TEMPERATURE LOW LOW	16							X		X																																					
	LZAHH-1308	REFLUX DRUM LEVEL HIGH HIGH	17								X																																						
	LZALL-1308	REFLUX DRUM LEVEL LOW LOW	18								X																																						
Solid-Liquid Separator V-1400	PZAHH-1401	SOLID-LIQUID SEPARATOR V-1400 PRESSURE HIGH HIGH	19											X	X																																		
	PZALL-1401	SOLID-LIQUID SEPARATOR V-1400 PRESSURE LOW LOW	20											X	X																																		
	LZAHH-1404	SOLID-LIQUID SEPARATOR V-1400 LEVEL HIGH HIGH	21											X	X																																		
	LZALL-1404	SOLID-LIQUID SEPARATOR V-1400 LEVEL LOW LOW	22											X	X																																		
Water Storage Tank T-1400	LZAHH-1406	WATER STORAGE TANK T-1400 LEVEL HIGH HIGH	23										X			X																																	
	LZALL-1406	WATER STORAGE TANK T-1400 LEVEL LOW LOW	24										X			X																																	
TA Slurry Tank V-1500	LZAHH-1503	TA SLURRY TANK V-1500 LEVEL HIGH HIGH	25														X	X							X								X							X									
	LZALL-1503	TA SLURRY TANK V-1500 LEVEL LOW LOW	26														X	X							X								X							X									
Esterification Reactor R-1600	PZAHH-1606	ESTERIFICATION REACTOR R-1600 PRESSURE HIGH HIGH	27																X	X		X																											
	PZALL-1606	ESTERIFICATION REACTOR R-1600 PRESSURE LOW LOW	28																X	X		X																											
	LZAHH-1604	ESTERIFICATION REACTOR R-1600 LEVEL HIGH HIGH	29																X	X		X																											
	LZALL-1604	ESTERIFICATION REACTOR R-1600 LEVEL LOW LOW	30																X	X		X																											
	TZAHH-1602	ESTERIFICATION REACTOR R-1600 TEMPERATURE HIGH HIGH	31																	X		X																											
	TZALL-1602	ESTERIFICATION REACTOR R-1600 TEMPERATURE LOW LOW	32																X	X	X	X																											
EG Distillation Column T-1700	PZAHH-1706	EG DISTILLATION COLUMN T-1700 PRESSURE HIGH HIGH	33																				X																										
	PZALL-1706	EG DISTILLATION COLUMN T-1700 PRESSURE LOW LOW	34																				X																										
	LZAHH-1702	EG DISTILLATION COLUMN T-1700 LEVEL HIGH HIGH	35																				X																										
	LZALL-1702	EG DISTILLATION COLUMN T-1700 LEVEL LOW LOW	36																				X																										
	TZAHH-1704	EG DISTILLATION COLUMN T-1700 TEMPERATURE HIGH HIGH	37																				X																										
	TZALL-1704	EG DISTILLATION COLUMN T-1700 TEMPERATURE LOW LOW	38																				X																										
	LZAHH-1709	REFLUX DRUM LEVEL HIGH HIGH	39																					X																									
	LZALL-1709	REFLUX DRUM LEVEL LOW LOW	40																					X																									
Initial Polycondensation Reactor R-1800	PZAHH-1809	INITIAL POLYCONDENSATION REACTOR R-1800 PRESSURE HIGH HIGH	41																							X	X		X													X							
	PZALL-1809	INITIAL POLYCONDENSATION REACTOR R-1800 PRESSURE LOW LOW	42																							X	X		X													X							
	LZAHH-1804	INITIAL POLYCONDENSATION REACTOR R-1800 LEVEL HIGH HIGH	43																							X	X		X													X							
	LZALL-1804	INITIAL POLYCONDENSATION REACTOR R-1800 LEVEL LOW LOW	44																							X	X		X													X							
	TZAHH-1802	INITIAL POLYCONDENSATION REACTOR R-1800 TEMPERATURE HIGH HIGH	45																								X		X													X							
	TZALL-1802	INITIAL POLYCONDENSATION REACTOR R-1800 TEMPERATURE LOW LOW	46																							X	X	X	X													X							
EG Distillation Column T-1900	PZAHH-1906	EG DISTILLATION COLUMN T-1900 PRESSURE HIGH HIGH	47																											X																			
	PZALL-1906	EG DISTILLATION COLUMN T-1900 PRESSURE LOW LOW	48																											X																			
	LZAHH-1902	EG DISTILLATION COLUMN T-1900 LEVEL HIGH HIGH	49																											X																			
	LZALL-1902	EG DISTILLATION COLUMN T-1900 LEVEL LOW LOW	50																											X																			
	TZAHH-1904	EG DISTILLATION COLUMN T-1900 TEMPERATURE HIGH HIGH	51																											X																			
	TZALL-1904	EG DISTILLATION COLUMN T-1900 TEMPERATURE LOW LOW	52																											X																			
	LZAHH-1909	REFLUX DRUM LEVEL HIGH HIGH	53																												X	X																	
	LZALL-1909	REFLUX DRUM LEVEL LOW LOW	54																												X	X																	
Latter Term Polycondensation Reactor R-2000	PZAHH-2007	LATTER TERM POLYCONDENSATION REACTOR R-2000 PRESSURE HIGH HIGH	55																															X	X		X					X							
	PZALL-2007	LATTER TERM POLYCONDENSATION REACTOR R-2000 PRESSURE LOW LOW	56																															X	X		X					X							
	LZAHH-2004	LATTER TERM POLYCONDENSATION REACTOR R-2000 LEVEL HIGH HIGH	57																															X	X		X					X							
	LZALL-2004	LATTER TERM POLYCONDENSATION REACTOR R-2000 LEVEL LOW LOW	58																															X	X		X					X							
	TZAHH-2002	LATTER TERM POLYCONDENSATION REACTOR R-2000 TEMPERATURE HIGH HIGH	59																																X		X					X							
	TZALL-2002	LATTER TERM POLYCONDENSATION REACTOR R-2000 TEMPERATURE LOW LOW	60																															X	X	X	X					X							
EG Distillation Column T-2100	PZAHH-2106	EG DISTILLATION COLUMN T-2100 PRESSURE HIGH HIGH	61																																			X											
	PZALL-2106	EG DISTILLATION COLUMN T-2100 PRESSURE LOW LOW	62																																			X											
	LZAHH-2102	EG DISTILLATION COLUMN T-2100 LEVEL HIGH HIGH	63																																			X											
	LZALL-2102	EG DISTILLATION COLUMN T-2100 LEVEL LOW LOW	64																																			X											
	TZAHH-2104	EG DISTILLATION COLUMN T-2100 TEMPERATURE HIGH HIGH	65																																			X											
	TZALL-2104	EG DISTILLATION COLUMN T-2100 TEMPERATURE LOW LOW	66																																			X											
	LZAHH-2109	REFLUX DRUM LEVEL HIGH HIGH	67																																				X		X								
	LZALL-2109	REFLUX DRUM LEVEL LOW LOW	68																																				X		X								
Vacuum Pump P-2100	FZAHH-2111	VACUUM PUMP INLET FLOW RATE HIGH HIGH	69																													X									X	X							
	FZALL-2111	VACUUM PUMP INLET FLOW RATE LOW LOW	70																													X									X	X							
	PZALL-2114	VACUUM PUMP OUTLET PRESSURE LOW LOW	71																													X									X	X							
	PZAHH-2114	VACUUM PUMP OUTLET PRESSURE HIGH HIGH	72																													X									X	X							
Cooling Bath T-2200	LZAHH-2204	COOLING BATH T-2200 LEVEL HIGH HIGH	73																																								X	X					
	LZALL-2204	COOLING BATH T-2200 LEVEL LOW LOW	74																																								X	X					
	TZAHH-2202	COOLING BATH T-2200 TEMPERATURE HIGH HIGH	75																																									X					
	TZALL-2202	COOLING BATH T-2200 TEMPERATURE LOW LOW	76																																								X	X					
Solid Phase Polymerization Reactor R-2300	PZAHH-2306	SOLID PHASE POLYMERIZATION REACTOR R-2300 PRESSURE HIGH HIGH	77																																						X			X	X		X	
	PZALL-2306	SOLID PHASE POLYMERIZATION REACTOR R-2300 PRESSURE LOW LOW	78																																						X			X	X		X	
	LZAHH-2304	SOLID PHASE POLYMERIZATION REACTOR R-2300 LEVEL HIGH HIGH	79																																						X			X	X		X	
	LZALL-2304	SOLID PHASE POLYMERIZATION REACTOR R-2300 LEVEL LOW LOW	80																																						X			X	X		X	
	TZAHH-2302	SOLID PHASE POLYMERIZATION REACTOR R-2300 TEMPERATURE HIGH HIGH	81																																						X			X			X	
	TZALL-2302	SOLID PHASE POLYMERIZATION REACTOR R-2300 TEMPERATURE LOW LOW	82																																						X			X	X	X	X	
PET Storage Tank T-2300	LZAHH-2307	PET STORAGE TANK T-2300 LEVEL HIGH HIGH	83																																												X
	LZALL-2307	PET STORAGE TANK T-2300 LEVEL LOW LOW	84																																												X

TAG NO.	0	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	REMARKS
PZAHH-1207	1	X																																											
PZALL-1207	2	X																																											
LZAHH-1205	3		X																																										
LZALL-1205	4		X																																										
TZAHH-1203	5			X																																									
TZALL-1203	6			X																																									
LZAHH-1213	7				X																																								
LZALL-1213	8				X																																								
TZAHH-1211	9					X																																							
TZALL-1211	10					X																																							
PZAHH-1305	11						X																																						
PZALL-1305	12						X																																						
LZAHH-1302	13							X																																					
LZALL-1302	14							X																																					
TZAHH-1304	15								X																																				
TZALL-1304	16								X																																				
LZAHH-1308	17									X																																			
LZALL-1308	18									X																																			
PZAHH-1401	19										X																																		
PZALL-1401	20										X																																		
LZAHH-1404	21											X																																	
LZALL-1404	22											X																																	
LZAHH-1406	23												X																																
LZALL-1406	24												X																																
LZAHH-1503	25													X																															
LZALL-1503	26													X																															
PZAHH-1606	27														X																														
PZALL-1606	28														X																														
LZAHH-1604	29															X																													
LZALL-1604	30															X																													
TZAHH-1602	31																X																												
TZALL-1602	32																X																												
PZAHH-1706	33																	X																											
PZALL-1706	34																	X																											
LZAHH-1702	35																		X																										
LZALL-1702	36																		X																										
TZAHH-1704	37																			X																									
TZALL-1704	38																			X																									
LZAHH-1709	39																				X																								
LZALL-1709	40																				X																								
PZAHH-1809	41																					X																							
PZALL-1809	42																					X																							
LZAHH-1804	43																						X																						
LZALL-1804	44																						X																						
TZAHH-1802	45																							X																					
TZALL-1802	46																							X																					
PZAHH-1906	47																								X																				
PZALL-1906	48																								X																				
LZAHH-1902	49																									X																			
LZALL-1902	50																									X																			
TZAHH-1904	51																										X																		
TZALL-1904	52																										X																		
LZAHH-1909	53																											X																	
LZALL-1909	54																											X																	
PZAHH-2007	55																												X																
PZALL-2007	56																												X																
LZAHH-2004	57																													X															
LZALL-2004	58																													X															
TZAHH-2002	59																														X														
TZALL-2002	60																														X														
PZAHH-2106	61																															X													
PZALL-2106	62																															X													
LZAHH-2102	63																																X												
LZALL-2102	64																																X												
TZAHH-2104	65																																	X											
TZALL-2104	66																																	X											
LZAHH-2109	67																																		X										
LZALL-2109	68																																		X										
FZAHH-2111	69																																			X								X	
FZALL-2111	70																																			X								X	
PZALL-2114	71																																				X							X	
PZAHH-2114	72																																				X							X	
LZAHH-2204	73																																					X							
LZALL-2204	74																																					X							
TZAHH-2202	75																																						X						
TZALL-2202	76																																						X						
PZAHH-2306	77																																							X					
PZALL-2306	78																																							X					
LZAHH-2304	79																																								X				
LZALL-2304	80																																								X				
TZAHH-2302	81																																									X			
TZALL-2302	82																																									X			
LZAHH-2307	83																																										X		
LZALL-2307	84																																										X		

4.0 Selection of Appropriate Control Valve

In response to a signal from the regulating system, a control valve is a power-operated device that can modulate flow to various degrees between minimal flow and full capacity. Control valves can be generally categorized as either an "on-off" type or a "flow regulating" type based on their purpose. A control valve consists of an actuator mechanism that may adjust the position of the valve's flow-controlling component. Through the movement of a valve plug with respect to the port or ports inside the valve body, the valve regulates flow. The actuator is linked to the valve stem to which the valve stopper is fastened. The actuator, which can be electrically or pneumatically powered, controls how the stem moves in response to external control signals. An external signal, which often originates from a controller, triggers the actuator's response. Combined, the controller and valve make up a fundamental control loop.

Before selecting the suitable valve, an actuator is an important factor that must be considered. A mechanism or system can be moved or controlled by an actuator, a mechanical or electromechanical device that transforms energy into motion. An actuator is used with control valves to open, close, or vary the position of the valve in response to a control signal from a process controller. Some actuators can also activate the valve using hydraulic or mechanical power. Because they are very simple, respond quickly, and can produce large forces, pneumatic actuators are frequently utilized in control valve applications. Actuators may also be categorized according to the sort of motion they use, which can be either rotary or linear. Rotating actuators are utilized for ball or butterfly valves, while linear actuators travel in a straight line and are often used for globe or diaphragm valves.

The butterfly valve (Shown in Figure 1) is one of the most suited control valves for the given condition. Butterfly valves are made from a disc that is fastened to a shaft via bearings. Since just the disc obstructs the valve flow route, these are regarded as high recovery valves. Both the flow capacity and the pressure drop over the valve are often large. When only a little amount of throttling is needed and a tight shutoff is not necessary, butterfly valves are employed. The butterfly produces little turbulence or flow resistance when completely opened. It is crucial to take into account the unique application requirements, such as torque output, operating speed, and control signal, as well as the working environment of the valve when choosing an actuator for a butterfly valve. The type of actuator best suited for butterfly valves is a pneumatic actuator. The most popular kind of actuators used for butterfly valves are pneumatic ones. They can be found in double-acting or spring-return versions and are powered by compressed air. Pneumatic actuators are comparatively easy to use, respond quickly and can generate large amounts of force. In addition, a pneumatic actuator is more cost-effective than electric or hydraulic actuators, as it is convenient to produce and has low maintenance.

Figure 4.1: Butterfly valve

References

Nakao, T., 2003. METHOD FOR RECYCLING PET BOTTLE. Retrieved from:< http://ewble-sl.utar.edu.my/file.php/13710/US7462649.pdf>. [Accessed 24 April 2022]