

SHELL INTERNATIONAL CHEMICALS B.V.
AMSTERDAM - THE NETHERLANDS

SHELL EO/EG PROCESS MEMORANDUM 114

SUBJECT : OTHER PROCESS SAFEGUARDING SYSTEMS

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This process memorandum describes those process safeguarding systems that are not covered by any of the other process memoranda as well as some special process requirements and other safeguarding actions. The main subjects covered are:

- Residual gas compressor safeguarding system
- General safeguarding requirements for pumps in EO service
- Safeguarding requirements for the LE column
- Process requirements for emergency relief in EO service

In the major part of the LE column overhead system the EO concentration exceeds 50%. Prior to compression of the light ends and recycling to the gas loop, EO has to be removed in the residual absorber in view of the hazards of compressing gas with high EO concentrations. A safeguarding system is required to protect the residual gas compressor against a too high residual EO concentration and against the ingress of air.

Several pumps in the EO/EG process are running in high concentration EO service (>10wt% EO). Therefore these pumps are provided with a dedicated isolation and safeguarding system. This concerns the LE column feed pumps, the LE column bottoms pumps and the glycol reactor feed pumps.

The LE column is protected by a shut-down system to avoid temperature excursions of aqueous EO and to prevent overfilling of the column.

The protection level by the instrumented safeguarding systems described in this memorandum is based on a classification of the various process risks in the above area in terms of safety, environment, equipment loss and production loss as well as the probability of occurrence. The systems are fit for purpose in terms of process risk protection, cost and operability. In order to ensure adequate instrumented

safeguarding, the trip initiators and actuators need to be field tested regularly. This test frequency should be determined by the detailed engineering contractor.

Any safeguarding systems other than the safeguarding required to ensure process safety are excluded from the scope of current Process Design Package.

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1 GENERAL

Alarms are required as early warning prior to a trip initiator being reached. Trip initiators should be separate from process control instruments. The instrumentation shall fail to a safe mode in case of loss of any utility.

All shut down system valves must be TSO valves. All valves that are part of the shut down and safeguarding systems described in this memorandum shall be fitted with proximity switches to indicate both open and closed position. Position mismatch alarms are required.

There are no maintenance override switches shown on the logic. However, some maintenance override switches may be required, although they should be minimised as much as possible.

In case maintenance override switches cannot be omitted, access to these switches should be strictly controlled and the use should be regulated. For requirements on the use and application of maintenance override switches see DEP 32.80.10.10, Chapter 4.5.9.

A graphics view on the DCS will show positions of all relevant valves and process variables for ease of overview by the operator.

2 RESIDUAL GAS COMPRESSOR SAFEGUARDING SYSTEM

Refer to figure 1 for a schematic overview of the residual gas compressor safeguarding system and to figure 2 for the logic diagram with trip settings.

The main hazard against which the residual gas compressor needs to be protected is the risk of a potential explosion. Therefore this safeguarding system is designed to avoid excessive EO concentration in the feed to the residual gas compressor. The safeguarding system will also prevent possible air ingress in case of too low suction pressure.

1. The source of excessive amounts of EO originates from the overhead of the residual absorber in case of a too low absorbent flow relative to the amount of EO fed to this column. This risk can be detected by:
 - A very low lean absorbent flow to the residual absorber (FZA-301-LL)

- A very high gas feed to the residual absorber (FZA-302-HH).

A high gas feed to the residual absorber could be caused by chilled water failure, which is required for condensation of EO in the EO stripper tops vent chiller. Reliable operation of this heat exchanger and the corresponding chilled water unit is essential.

The high gas feed trip setting is set closely to the normal operating flow at high activity end of EO catalyst cycle condition. Over catalyst lifetime the distance of the normal operating flow to the trip setting will become smaller due to deactivation of the catalyst and consequently higher CO₂ concentration in the loop gas. The current high gas feed trip setting (FZA-302 HH) provides sufficient margin to prevent a possible hazardous situation due to high EO concentration under all catalyst conditions for both high activity as well as high selectivity catalyst.

Upon activation of the residual gas compressor safeguarding system due to either a low absorbent flow or a high gas feed, the pressure controller in the inlet of the residual gas compressor will open a vent to safe location to discharge the residual gas to atmosphere. A considerable amount of EO will thus be released via the vent to safe location.

The oxygen shut down system is activated in order to minimise the duration of venting of EO. Increasing the pressure in the residual gas compressor suction K.O. drum will reduce the amount of EO released. However, this will affect the operation of the light ends column and the EO stripper. The CO₂ concentration in the bottom of the light ends column and the EO concentration in the bottom of the EO stripper will increase.

Upon initiation of the residual gas compressor safeguarding system by one of the above initiators following actions will be therefore taken:

- The compressor is stopped.
- The suction block valve of the residual gas compressor is closed (UZV-301).
- The oxygen safeguarding system is activated (refer to PM 111 for details).
- The set point of PICA-303 is increased by 0.25 bar.

An EO analyser in the top of the residual absorber would not be suitable as a trip initiator, since it does not provide an instantaneous, accurate and

reliable EO measurement. However, the common analyser will serve to monitor the EO concentration in this overhead stream and to alarm the operator in case of high EO concentration is detected.

2. The risk of possible air ingress can be detected by:
 - PIZA-304-LL in the suction of the residual gas compressor.

In addition to the hazard of compressing EO vapour, the system also protects the compressor against liquid in the feed, which may result in severe equipment damage and large downtime of the plant. This risk can be detected by:

- LZA-305-HH in the residual gas compressor suction KO drum.
- LZA-HH in each of the residual gas compressor suction KO drums (to be defined by contractor).

Finally the system may also be initiated by the panel operator in case of an unforeseen event through manual trip switch HZ-301.

When the compressor is shut down by these other three trip initiators the amount of EO vented is much lower, since in that case the suction stream will not differ much from normal operation.

Upon initiations of the residual gas compressor safeguarding system by these three initiators:

- The compressor is stopped.
- The suction block valve of the residual gas compressor is closed (UZV-301).

In case of operation without the residual gas compressor by virtue of the methane booster compressor, proper discharge of the residual gas to safe location shall be provided. Contractor to define appropriate safeguarding for the alternative line-up.

3 GENERAL SAFEGUARDING REQUIREMENTS FOR PUMPS IN EO SERVICE

Refer to figure 3 and 4 for a schematic overview of the pump isolation and safeguarding system for respectively the LE column feed pumps, the LE column bottoms pump and the glycol reactor feed pump. See also figure 5, 6, 7 and 8 for

the logic diagram with trip settings.

The main safety risk of pumps in EO service (>10 wt% EO) is overheating of EO in the pump, possibly resulting in auto-decomposition of the EO. An auto-decomposition reaction that is started in the pump will propagate further via the pump suction and/or discharge line into upstream and downstream equipment with severe consequences. This propagation could occur in case of loss of level in the suction vessel, resulting in an EO vapour phase in the pump suction line or in case of highly concentrated EO.

Therefore all pumps in EO service must be safeguarded to prevent hazardous conditions that could result in inadvertent temperature rise and or formation of EO vapour in the pump. The isolation & safeguarding system for pumps in EO service is designed to prevent following risks:

1. The risk of overheating will occur in case of insufficient liquid flow through the pump due to for example a blocked outlet or pump failure. This risk of overheating may be detected by:
 - Low discharge flow rate.
 - High temperature inside the pump.

In this case the EO pump isolation & safeguarding system will:

- Only trip the running pump in EO service (A or B).
- If the pump suction valve is fully open and sufficient liquid level is available in the suction vessel, restart of the other pump in EO service by the operator is possible.

The temperature transmitters in EO pumps must be exposed directly to the fluid temperature in the pump house. Measurement of skin temperatures is not allowed, as it is too slow. As alternative to a transmitter in the pump house, a temperature measurement may be provided in a line from discharge to suction, with a restriction orifice to limit the flow rate. Such a line must be exposed to the pumping temperature at all times. This means that it may not be possible to shut the flow through this line by any block valve.

Note: When no minimum flow control facility is provided, two initiators for low discharge flow must be provided for each pump in EO service.

2. The risk of propagation due to loss of level may be detected by:

- Low liquid level in the suction vessel, or
- Low pressure in the suction piping to the pump in EO service.

In this case the EO pump isolation & safeguarding system will:

- Trip both pumps in EO service.
- Restart of the other pump in EO service is in this case not allowed by the safeguarding system.

3. In case of a major seal leakage or fire, the pumps in EO service can be isolated by the panel operator through a manual trip switch to minimize the amount of EO that may be lost to atmosphere or to avoid further propagation of incidents.

In this case the pump safeguarding and isolation system will:

- Trip both pumps in EO service.
- Close the suction block valve.
- Close the block valve in the minimum flow line.
- Close the block valve in the main discharge line.

Upon activation of the pump isolation system the suction valve of the pump as well as the block valve in the minimum flow line are closed and the pump shut down system is also initiated. When applicable, the block valve in the common discharge line is also closed to isolate the pump system from large inventories of EO containing liquid.

Note: EO gas detection and active fire proofing is to be installed for all pumps in EO service (>10 wt% EO).

3.1 LE column feed pump isolation and safeguarding system

Refer to figure 5 for the logic diagram.

Abnormal operating conditions related to the LE column feed pumps will trip the pumps.

Both LE column feed pumps will be tripped on:

1. Activation of the LE column feed pump isolation (HZ-311, see 3.4 for further isolation actions).
2. Low liquid level in EO stripper tops surge drum (LZA-304-LL).
3. Suction valve UZV-302 not fully open (GBZ-312).

On the following conditions, the running LE column feed pump will trip, which still allows the other pump to run, if started:

4. High temperature inside the pump (TZA-304/05-HH).
5. Low discharge flow rate (FZA-304/05-LL).

3.2 LE column bottom pump isolation and safeguarding system

Refer to figures 6 and 8 for the logic diagram.

Abnormal operating conditions related to the LE column bottom pumps will trip the pumps. When both LE column bottom pumps are tripped, the glycol reactor feed pumps will have to be tripped as well. However, the water feed to the glycol reactor will continue and the glycol reactor control system will continue its normal control function (refer to PM 113 for details).

Both LE column bottom pumps will be tripped on:

1. Activation of the LE column bottoms pump isolation (HZ-321, see 3.4 for further isolation actions).
2. Low liquid level in LE column (LZA-302-LL).
3. Suction valve UZV-304 not fully open (GBZ-314).

On the following conditions, the running LE column bottom pump will trip, which still allows the other pump to run, if started:

1. High temperature inside the pump (TIZA-306/07-HH).
2. Low discharge flow rate (FZA-306/307-LL).

3.3 Glycol reactor feed pump isolation and safeguarding system

Refer to figures 7 and 8 for the logic diagram.

Abnormal operating conditions related to the glycol reactor feed pumps will trip the pumps. As a consequence the reactor feed flow will be shut down. However, the water feed will continue and the glycol reactor control system will continue its normal control function (refer to PM 113 for details).

Both glycol reactor feed pumps will be tripped in case of:

1. Activation of the glycol reactor feed pump isolation (HZ-433, see 3.4 for further isolation actions).
2. Low suction pressure (PZA-401-LL) in common suction line.
3. Suction valve UZV-401 not fully open (GBZ-421).
4. Shut down of both LE column bottoms pumps

When the suction valve is open, restart of the pumps is possible.

On the following conditions, the running glycol reactor feed pump will trip, which still allows the other pump to run, if started:

1. High temperature inside the pump (TIZA-404/05-HH).
2. Low discharge flow rate (FZA-402/03-LL).

The glycol reactor feed pump normally keeps running during total shut-down of the glycol reactor shut-down system (refer to PM 113 for details of this system). Therefore the block valve in the common suction line of the glycol reactor feed pumps is not connected to the main AND gate of the safeguarding logic of the glycol reactor shut-down system.

3.4 Activation of the pump isolation system

In case of major leakage or fire the LE column feed pumps can be isolated by the panel operator through HZ-311 (refer to figure 5 for details).

The LE column bottoms pumps can be isolated using HZ-321, in which case the glycol reactor feed pumps will be tripped simultaneously, as the suction flow to these pumps will be stopped (refer to figures 6, 7 and 8 for details).

HZ-433 will only isolate the glycol reactor feed pumps while keeping the LE column bottoms pumps running (refer to figures 7 and 8 for details).

Upon activation of HZ-311, the block valve in the common suction of the LE column feed pumps (UZV-302) is closed, as well as the block valve in the minimum flow line (UZV-303). Both pumps are stopped through the LE column feed pump isolation and safeguarding system. However, the discharge of the LE column feed pump is not closed automatically, because of the low inventory of EO containing liquid in this discharge line.

Activation of HZ-321 will simultaneously initiate the isolation of both LE column bottoms pumps as well as both glycol reactor feed pumps.

Upon activation of HZ-321, the block valve in the common suction of the LE column bottoms pumps (UZV-304) is closed, as well as the block valve in the emergency recycle line (UZV-305) in order to isolate the pump system from large inventories of EO containing liquid in the emergency recycle line. The LE column bottoms pumps are both stopped through the LE column bottoms pump isolation and safeguarding system.

Simultaneously both glycol reactor feed pumps will be isolated by closing the block valve in the common suction line (UZV-401) and in the minimum recycle flow line (UZV-403), as well as by closing of the reactor feed block valve (UZV-402) and control valve (FCV-408). The glycol reactor feed pump isolation and safeguarding system will also stop both glycol reactor feed pumps.

Activation of HZ-433 will only initiate the isolation of both glycol reactor feed pumps. Upon activation of HZ-433 both glycol reactor feed pumps will be isolated by closing the block valve in the common suction line (UZV-401) and in the minimum recycle flow line (UZV-403), as well as by closing of the reactor feed block valve (UZV-402) and control valve (FCV-408). The glycol reactor feed pump isolation and safeguarding system will also stop both glycol reactor feed pumps.

3.5 Safeguarding of the LE column

The LE column safeguarding system consists of two sub-systems (refer to figure 9 for details):

1. Establishing emergency cooling via the aqueous EO shutdown cooler ensures protection against a runaway reaction.
2. Protection against overfilling is ensured by isolation of the LE column from the upstream process.

In case the glycol reactor unit is shut down, while the glycol reactor feed pump is still running through the minimum flow recycle, the pump power input will lead to a significant temperature rise of the aqueous EO. Since the recycle is a closed loop over the LE column bottom, it will be required to establish a full recycle flow over the aqueous EO shut-down cooler by operator action (HZ-331) to keep the temperature under control. Since aqueous EO is a reactive mixture, thermal hydration will continue and ultimately run away, if cooling would not be provided.

In case of too high temperature or pressure in the LE column, the full recycle flow over the aqueous EO shutdown cooler will also be established by de-energising the solenoid valve on FCV-308. This ensures proper cooling of the aqueous EO inventory of the system in order to prevent a runaway of the reactive aqueous EO mixture.

Emergency cooling will be initiated in case of:

1. Activation of LE column emergency cooling (HZ-331).
2. High LE column bottom temperature (TIZA-310-HH).
3. High LE column pressure (PZA-312-HH).

On activation of LE column emergency cooling the following actions will take place:

1. LE column open steam control valve is closed (FCV-313A).
2. LE column reboiler lean absorbent control valve is closed (FCV-313B).
3. Recycle flow control bypass is fully opened. (FCV-308)

In case of high level in the LE column bottom, the oxygen feed will be tripped to prevent overfilling of the system, and heat input into the system will be minimised. The LE column is isolated from upstream equipment in case of:

1. High LE column bottom liquid level (LZA-311-HH).

On activation of LE column isolation the following actions will take place:

1. The oxygen feed to the plant is tripped by activating the oxygen shut-down system (refer to PM 111 for details).
2. LE column open steam control valve is closed (FCV-313A).
3. LE column reboiler lean absorbent control valve is closed (FCV-313B).

The operation of the LE column bottom compartment is critical to the plant. The control time is approximately 20 minutes (LLA-HLA) and in case of either low or high level, trip actions will occur that will bring down the entire plant in a very short time. This requires proper level control and constant operator attention. The bottom compartment of the LE column has a control time of 20 minutes (LLA-HLA). The oxygen feed will be shut down by a high level trip in the LE column bottom.

Proper control of and attention to the level in the bottom of the LE column is critical to the smooth operation of the plant since an excursion to either side of the level will almost certainly lead to a total shut-down of the plant.

The EO stripper tops surge drum provides for an additional control time of 40 minutes to accommodate fluctuations in either the EO or the glycol section.

3.6 Additional information and requirements

The automatic actions on activation of the LE column emergency cooling will only establish cooling. For proper cooling of aqueous EO, the operator is urged to detect the reason for the trip and take corrective actions to cool the contents of the LE column system before a high temperature trip may occur of the pumps in the LE column system.

In order to establish maximum cooling, both LE column feed pumps and LE column bottoms pumps need to be running in parallel.

Emergency power supply for all pumps in the LE column system is required to enable circulation flow over aqueous EO shutdown cooler at power trip.

If aqueous EO remains in the LE column system while the glycol reactor trips, the glycol unit should be restarted to process the aqueous EO.

In case the aqueous EO is to be stored temporarily in the LE column system while the glycol reactor trips, it must be fully circulated over the aqueous EO shutdown cooler to cool down the aqueous EO inventory by means of the following additional manual actions:

1. Start of the hot stand-by pump of the LE column bottoms pump in parallel with the running LE column bottoms pump.
2. Start of the hot stand-by pump of the LE column feed pump in parallel with the running LE column feed pump.

3. In case of cooling water failure, fire water must be connected as cooling medium for aqueous EO shutdown cooler.
4. In order to recognise trends in the temperature of the stored aqueous EO in the LE column system, the temperature trends will have to be checked.

4 OTHER SAFEGUARDING ACTIONS

Some additional individual process safeguarding is applied in the EO section, which is not covered by any of the other Process Memoranda:

EO reaction section:

1. Backflow from any N₂ user into the N₂ system may result in hydrocarbons entering into the oxygen system through the N₂ purge system. Therefore an automatic backflow protection system and check valve is provided in the N₂ supply to the other consumers, which will isolate these consumers from the feed to the nitrogen safeguarding compressor.
2. An overfill protection LZA-HH is provided on the moderator feed vessel, which will stop the moderator loading pump.
3. An overfill protection LZA-HH is provided on the HP steam drum, which will isolate the boiler feed water control valve in the inlet of the HP steam drum.
4. A backflow protection PDZA-LL is provided on the boiler feed water feed to the HP steam drum, which will also isolate the boiler feed water control valve in the inlet of the HP steam drum.

EO recovery section:

5. Backflow from the EO absorber into the lean absorbent line is prevented by PDZA-LL in the lean absorbent feed to the absorber, which will isolate the block valve UZV in the column inlet.
6. Gas breakthrough from the EO absorber – operating at high pressure – to the EO stripper – operating at low pressure – is prevented by two LZA-LL initiators on the EO absorber fat absorbent draw-off tray. After initiation of one of the two low level trips both the level control valve and the TSO block valve in the fat absorbent line will be closed.
7. An overfill protection LZA-HH is provided on the caustic tank, which will automatically initiate a trip of the 50%wt caustic transfer from OBL.
8. A low dilution water flow protection is provided to automatically initiate a trip of the 50%wt caustic transfer from OBL in case of insufficient dilution.

LE removal section:

9. Breakthrough of EO containing vapours into the fat absorbent is prevented by PDZA-LL in the discharge of the residual absorber bottoms pump, which will isolate the block valve UZV in the residual absorber bottoms pump discharge.
10. Breakthrough of vapours with potential residual EO from the residual absorber overhead to the sewer system is prevented by LZA-306-LL on the residual gas compressor suction k.o. drum, which will isolate the block valve UZV-306 in the drain from the residual gas compressor suction k.o. drum to the sewer system.

5 EMERGENCY RELIEF

The contractor must specify location, sizing, height and type of emergency relief equipment. The maximum flow rate of the relief system depends on the relief case as calculated by the contractor and the code and regulations to be applied. Relief valves are normally not shown on the process flow schemes, unless special process requirements are identified.

All relief valves must vent to a safe location. Relief valve outlet pipes must have a small weeping hole to drain condensate. This weeping hole shall be diverted from the vessel to avoid impingement onto the vessel in case the relief valve opens.

In case a vent to safe location is specified, height, size and location shall be determined based on dispersion calculations of the vent stream to observe environmental and personnel exposure requirements and to prevent exposure of flammable material to potential ignition sources. If necessary for rapid dilution and proper dispersion, vents of flammable products must be equipped with automatic steam dilution systems.

5.1 Emergency EO vents

There are several emergency relief EO vapour vents in the EO recovery and LE removal sections.

The vent from the residual gas compressor suction k.o. drum, which could contain residual EO, must be vented to a safe location.

The emergency depressurization of the recycle gas loop will be sent to a dedicated MEG plant flare.

5.2 Relief valves in aqueous EO service

The calculation of the required capacity of safety relief valves installed on equipment in aqueous EO service is outlined below.

These safety relief valves are installed to ensure the equipment will not exceed the design pressure in case of an EO/water runaway reaction. The sizing procedure is based on an engineering diagram from which the required orifice area of the safety relief valve can be derived for a given set pressure and EO/water mixture volume.

Generally a relatively small relief valve should be sufficient and in most cases the installed relief valve (often sized on the basis of an assumed fire case) will be large enough. However, all the relief valves in duties where concentrations of EO above 10 wt% can be expected should at least be sized according to the criteria as explained below. Notably this concerns relief valves for the EO stripper tops surge drum, the LE column and related equipment.

Runaway conditions

Uncatalysed EO hydrolysis will take place in any EO/water mixture. In a running plant during normal operation the reaction heat is insignificant and can be easily removed via physical processes like evaporation and condensation or via the process heat exchangers.

A full adiabatic exotherm in an aqueous EO mixture culminating in an uncontrolled runaway reaction and subsequent pressure relief via the safety relief valve is therefore only likely to develop in stagnant aqueous EO mixtures where loss of cooling has occurred and where normal safeguarding systems fail. The probability of such an exotherm is remote but is known to occur under specific circumstances.

Safety relief valve sizing for EO/water mixtures

The sizing procedure makes use of the diagrams shown in graphs 1 and 2. In graph 1 the required orifice area per cubic meter of liquid inventory is plotted against the set pressure of the safety relief valve. This diagram can be used to check if safety relief valves installed in the plant are large enough to accommodate an EO/water runaway reaction.

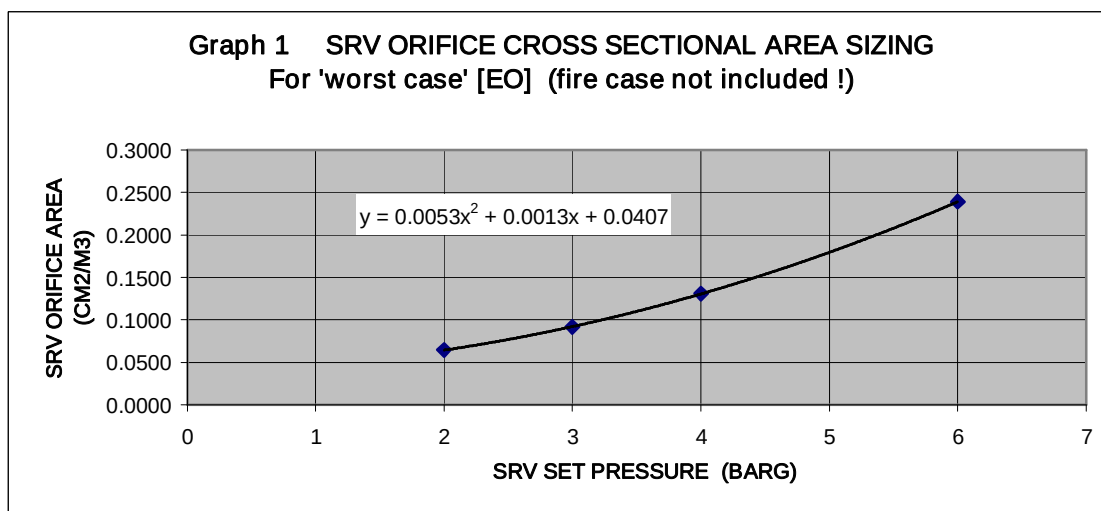
Checking procedure:

- Determine the liquid inventory of the vessel (V) using the maximum liquid volume that could be present in case of an unscheduled shut down.
- Derive the required orifice area per unit of liquid inventory (A) from the set pressure of the safety relief valve, using the diagram in graph 1.
- Calculate the required relief valve orifice area by multiplying V and A.
- Check if the sizing of safety relief valve is large enough from the required relief valve orifice area to accommodate an EO/water runaway reaction.

The installed safety relief valve should have an orifice area at least this size. It should be noted that an assumed fire case may require a larger safety relief valve to be installed.

A premise for the use of graph 1 is that vessels will not be left in a stagnant condition when liquid full, since the orifice area calculation assumes vapour phase relief only. A minimum vessel void fraction of 10% is required to ensure single phase relief. It is essential to ensure this requirement will always be met.

Safety relief valves would need to be sized at least a factor of 20 larger if designed for a liquid full situation.

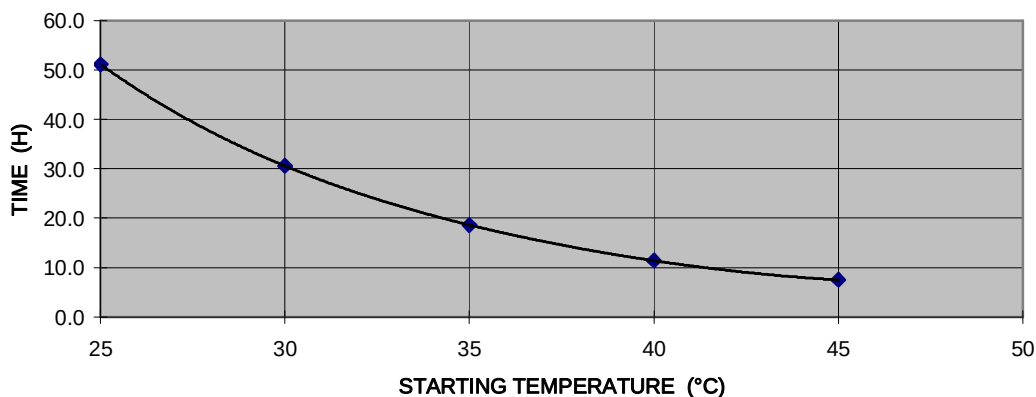


Graph 1 is only valid for uncatalysed EO/water runaway reactions. Furthermore it is based on the worst case scenario of an EO/water mixture containing 25-30 %wt EO. In this range the highest reaction rates and relief rates were observed. Consequently graph 1 is conservative for EO concentrations outside this range.

Graph 2 shows the effect of the vessel operating temperature (starting temperature of the exotherm reaction) on the time to reach 1 bar pressure rise. This figure is also based on the worst case scenario of an EO/water mixture

containing 25-30 % wt EO. For EO concentrations below 10 wt% sufficient heat sink is typically available to limit the pressure rise to values well below 1 bar.

**Graph 2 TIME TO 1 BAR PRESSURE RISE
For 'worst case' [EO]**



Rupture disks for relief valves in EO service

In order to eliminate EO leakage to atmosphere and to prevent blockage by EO polymers, rupture discs should be installed upstream of any relief valve in EO service.

The rupture discs should be reverse buckling, annealed and pre-scored. A pressure alarm, set at an absolute value of about 10% of the relief pressure, should be installed between the rupture disc and the relief valve to indicate a leaking disc. The bursting pressure has to be specified at ambient temperature. Bursting capacity has to be specified at relief conditions. The bursting disc must be of the type that tears open and shall not shatter into pieces. A continuous nitrogen purge is required directly upstream of the relief valve to prevent polymerisation and a continuous nitrogen purge directly downstream of the relief valve is needed to prevent unnoticed ignition in case of leaking EO.

Flame arresters on relief lines in EO service

In case pressure relief valves on equipment in EO service are connected to a common relief header of significant length (>20 m) a flame arrester in the relief header shall be installed to prevent possible back-flashing of a flame front into the relief header in case of an EO release. The arrester should be made of stainless steel and be regularly checked for fouling since plugging of the arrester could compromise the safety relief function. The header should be continuously purged with a small flow of nitrogen to prevent ingress of air, oxygen and water.

It is essential to ensure the integrity of the safety relief valve configuration.

6 SYSTEM SKETCH AND LOGIC DIAGRAMS

Refer to next pages for all system sketches and logic diagrams including trip settings.

Figure 1 - Residual Gas Compressor System Sketch

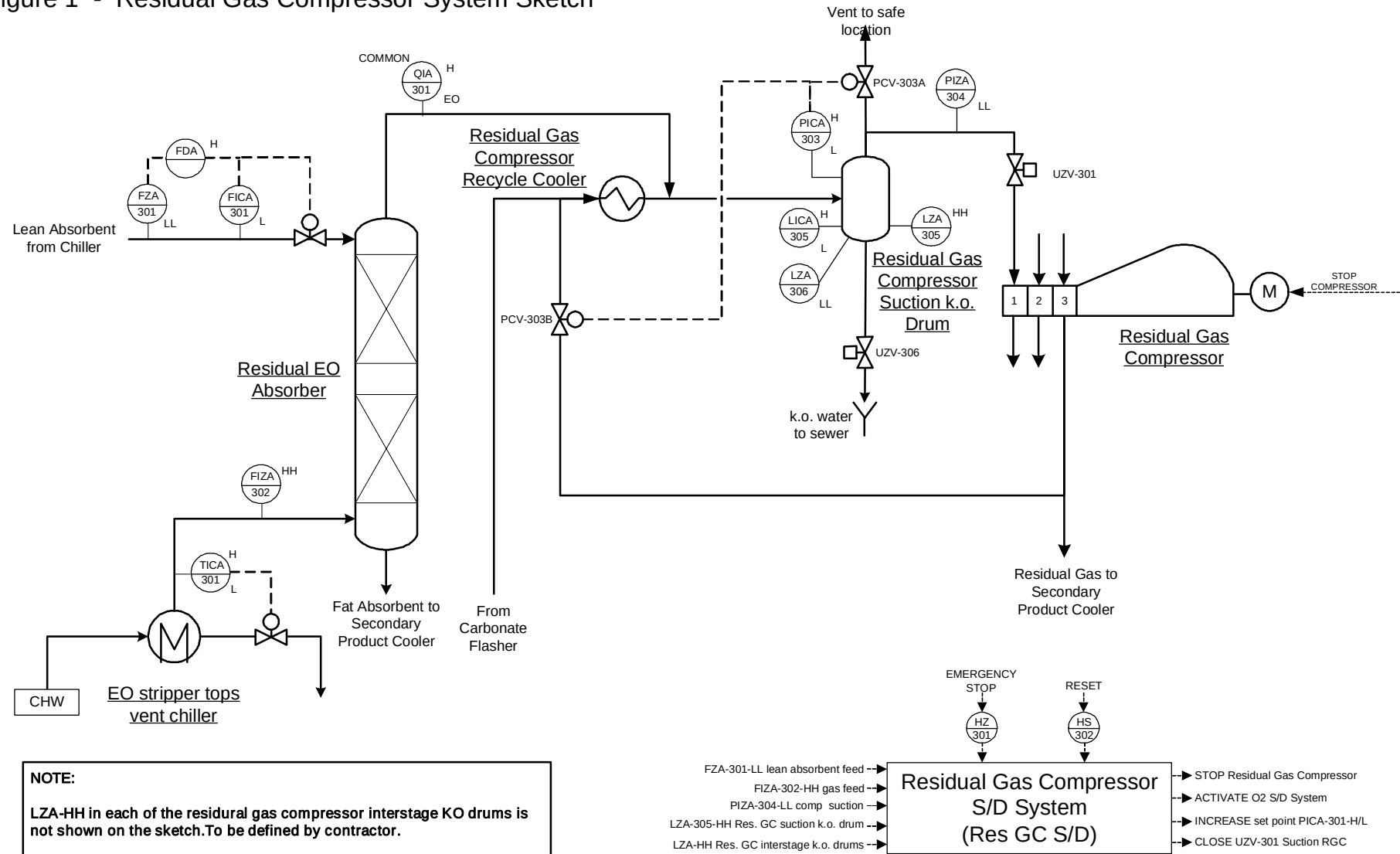


Figure 1: Residual gas compressor system sketch



Figure 2 - Residual Gas Compressor Shut-down System

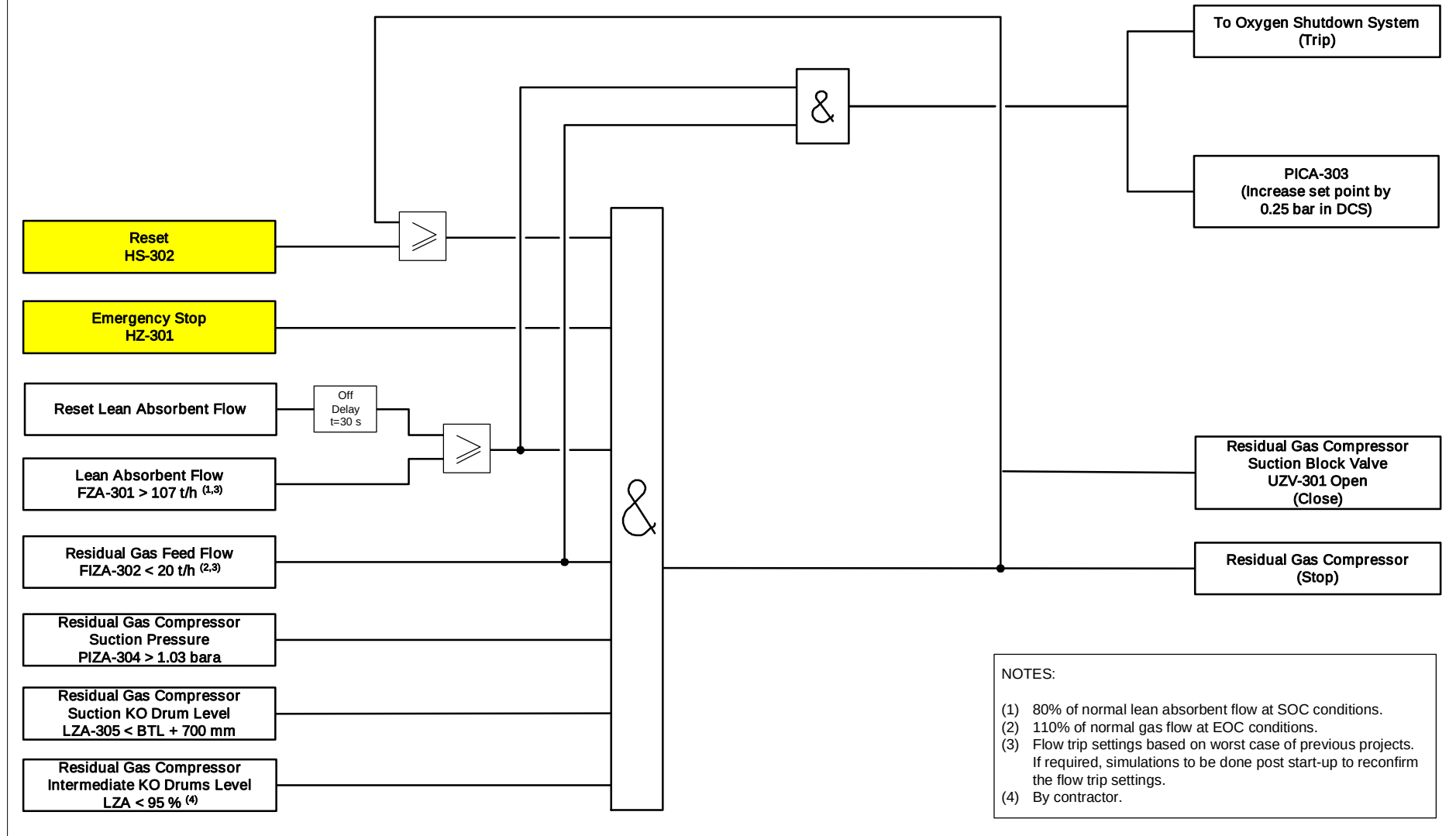


Figure 2: Residual gas compressor safeguarding system



Figure 3 - LE Column Feed Pump Sketch

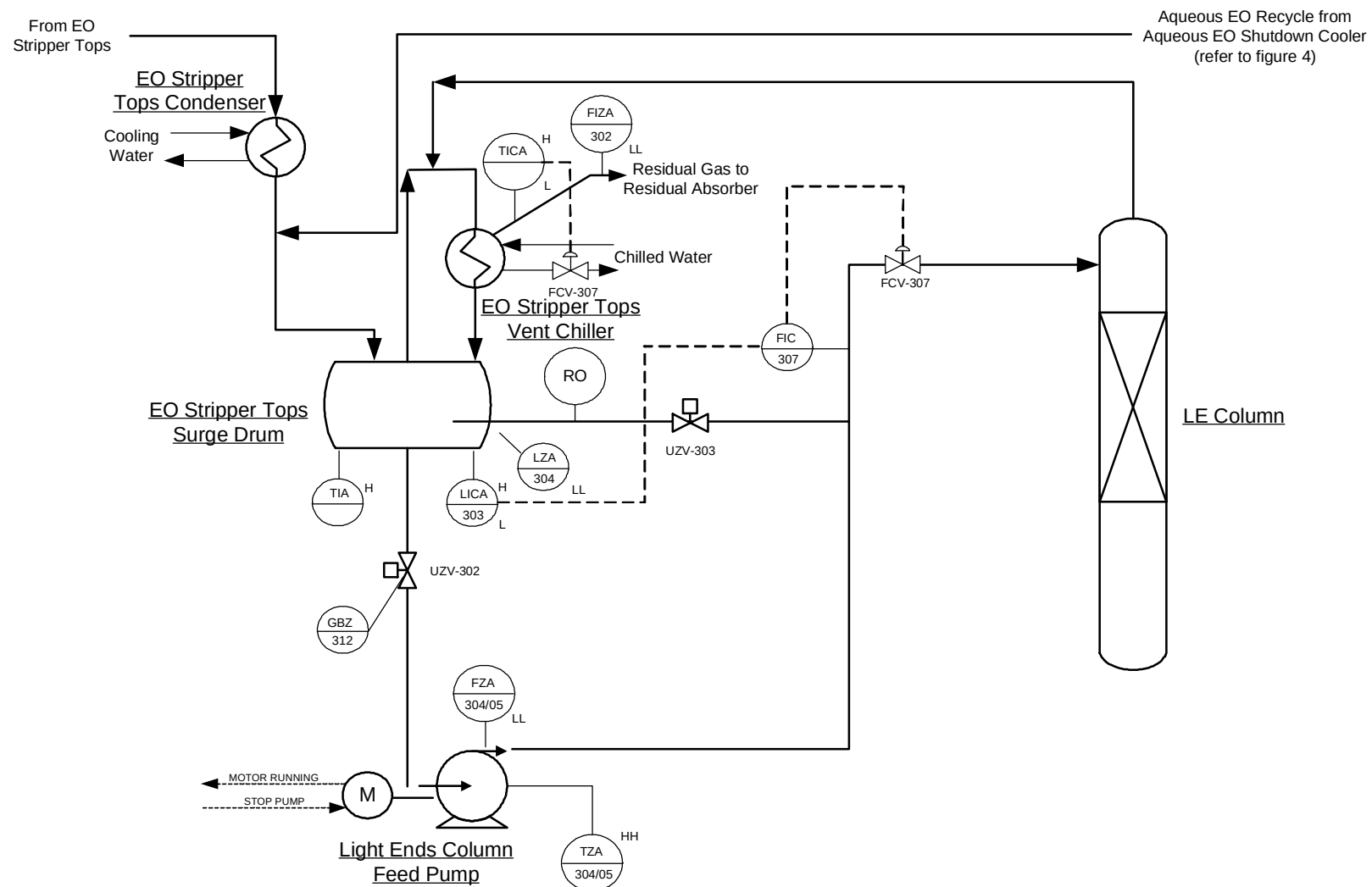


Figure 3: LE column feed pump sketch



Figure 4: LE column bottoms pump and glycol reactor feed pump sketch



Figure 5 - LE Column Feed Pump Safeguarding and Isolation System logic and trip settings

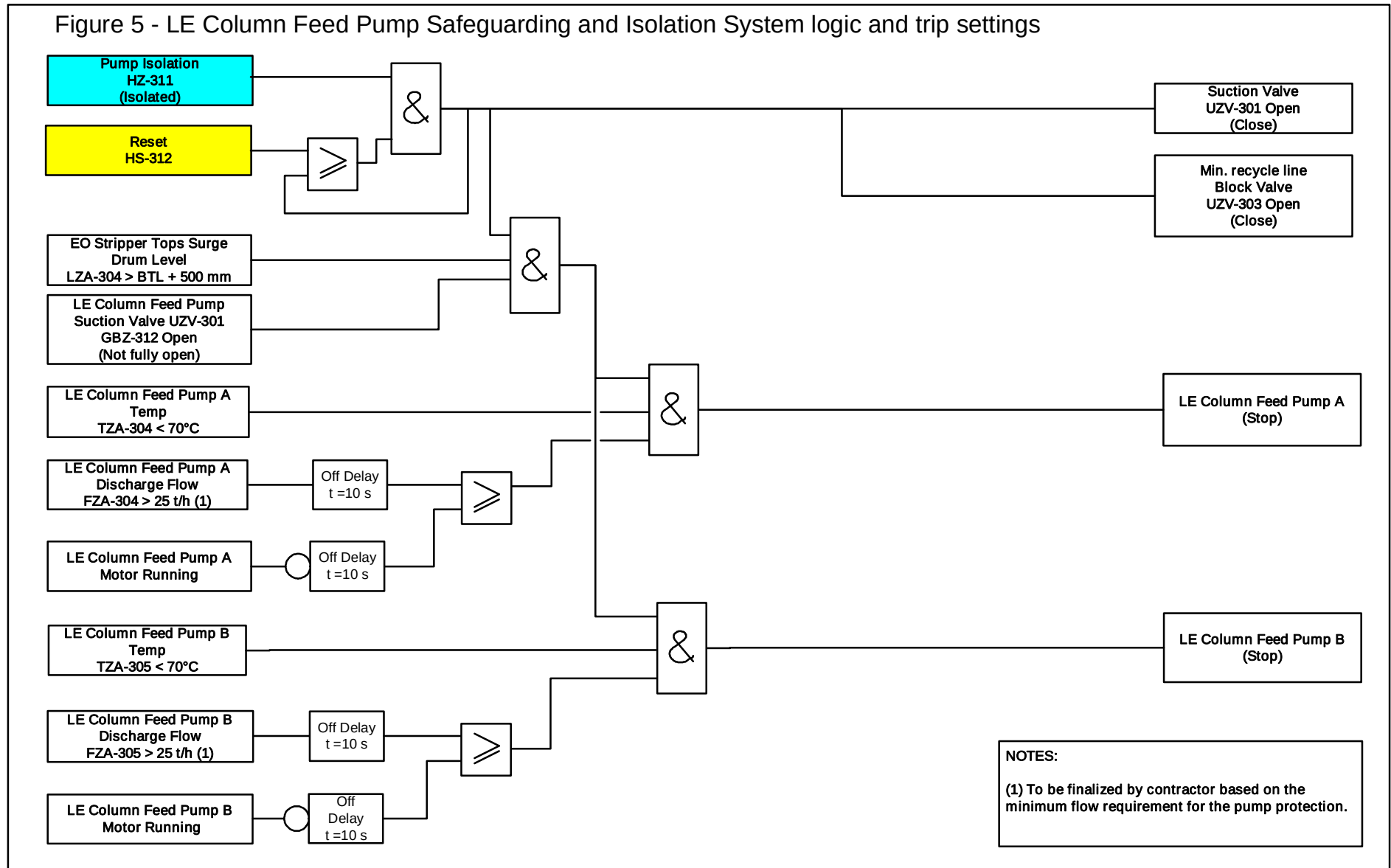


Figure 5: Glycol reactor feed pump safeguarding system logic and trip settings



Figure 6 - LE Column Bottoms Pump Isolation & Safeguarding System

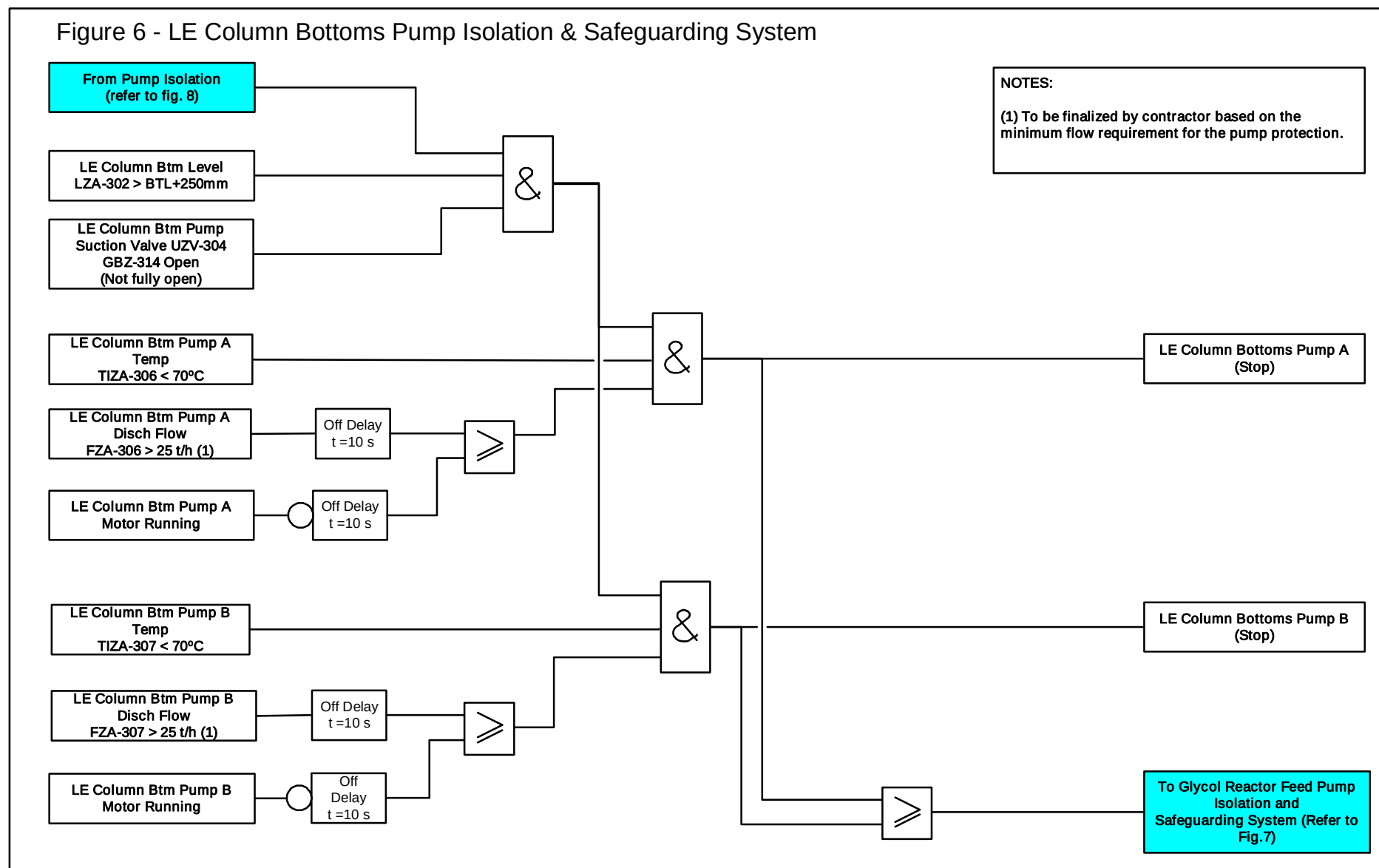


Figure 6: LE column bottom pump safeguarding system logic and trip settings



Figure 7 - Glycol Reactor Feed Pump Isolation and Safeguarding System

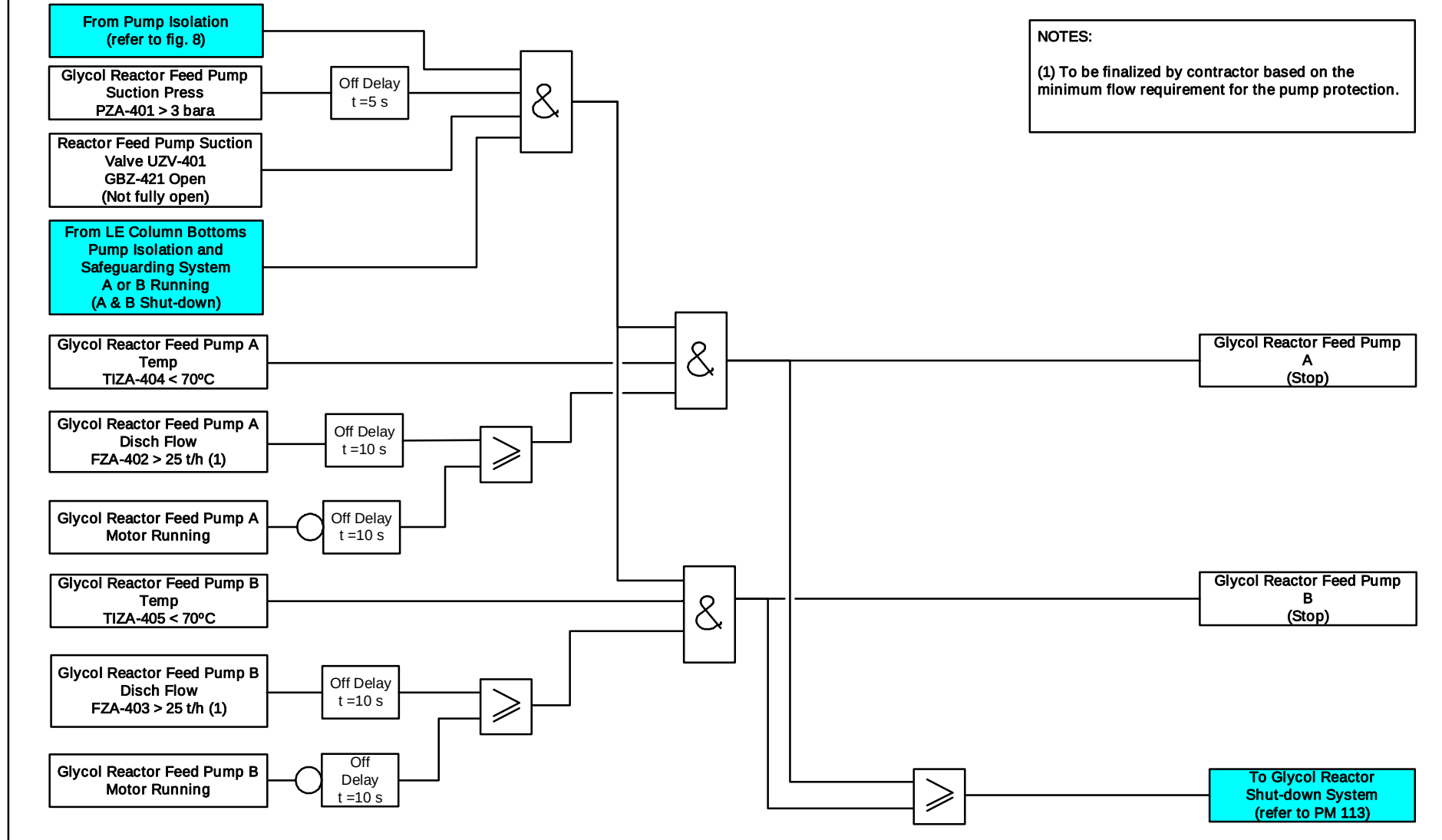


Figure 7: LE column feed pump safeguarding system logic and trip settings



Figure 8: Pump isolation system logic and trip settings



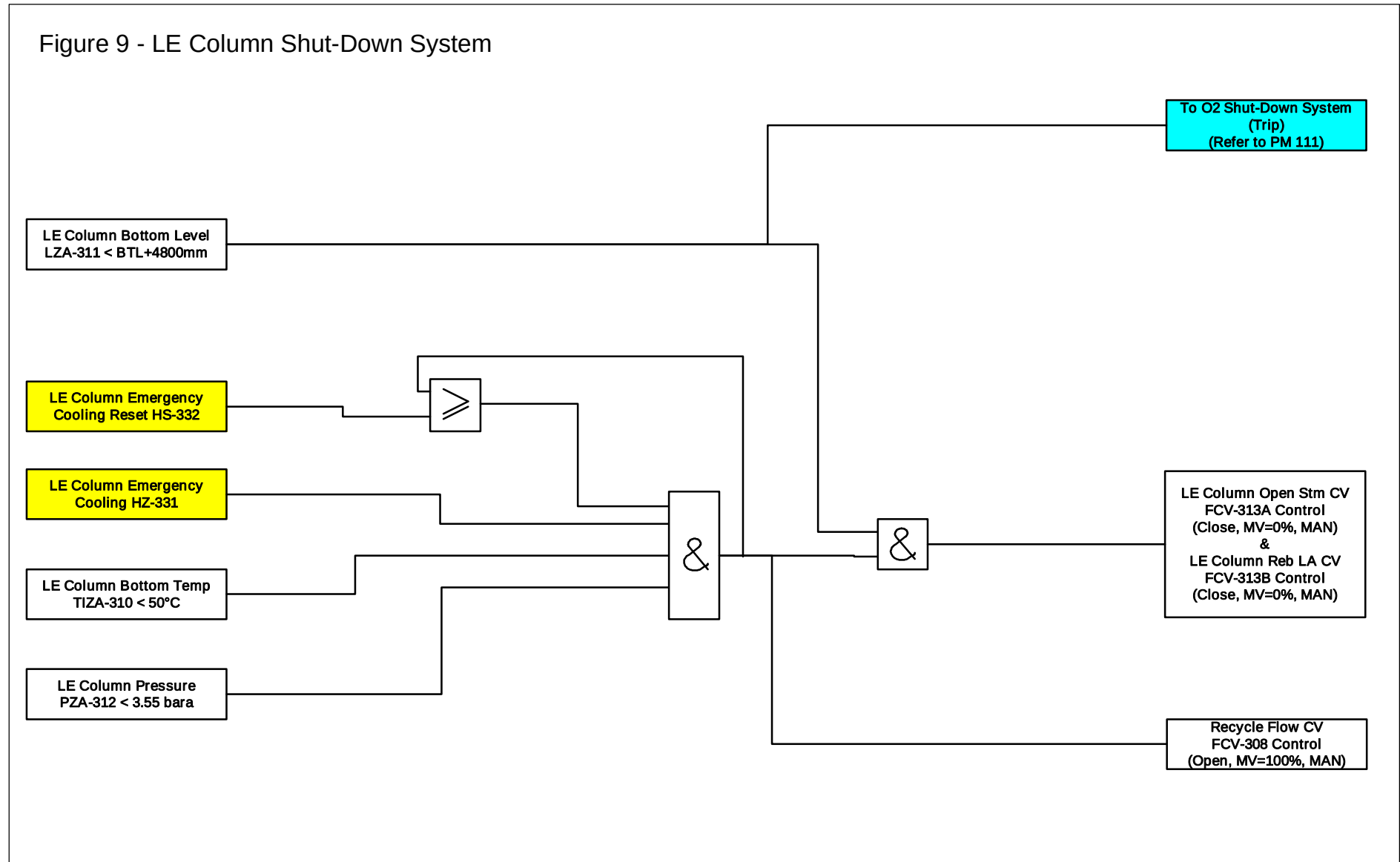


Figure 9: LE column safeguarding system logic and trip settings

