# FTE2.0 - MANUAL CONTROLLER

| *Rev.* | *Date* | *Modification* |
|---|---|---|
| | | |
| 0 | 22/03/18 | |

**This document is deemed as *Classified*. This means that first circulation is limited to selected people, who must diffuse it only as strictly necessary for correct operations.**

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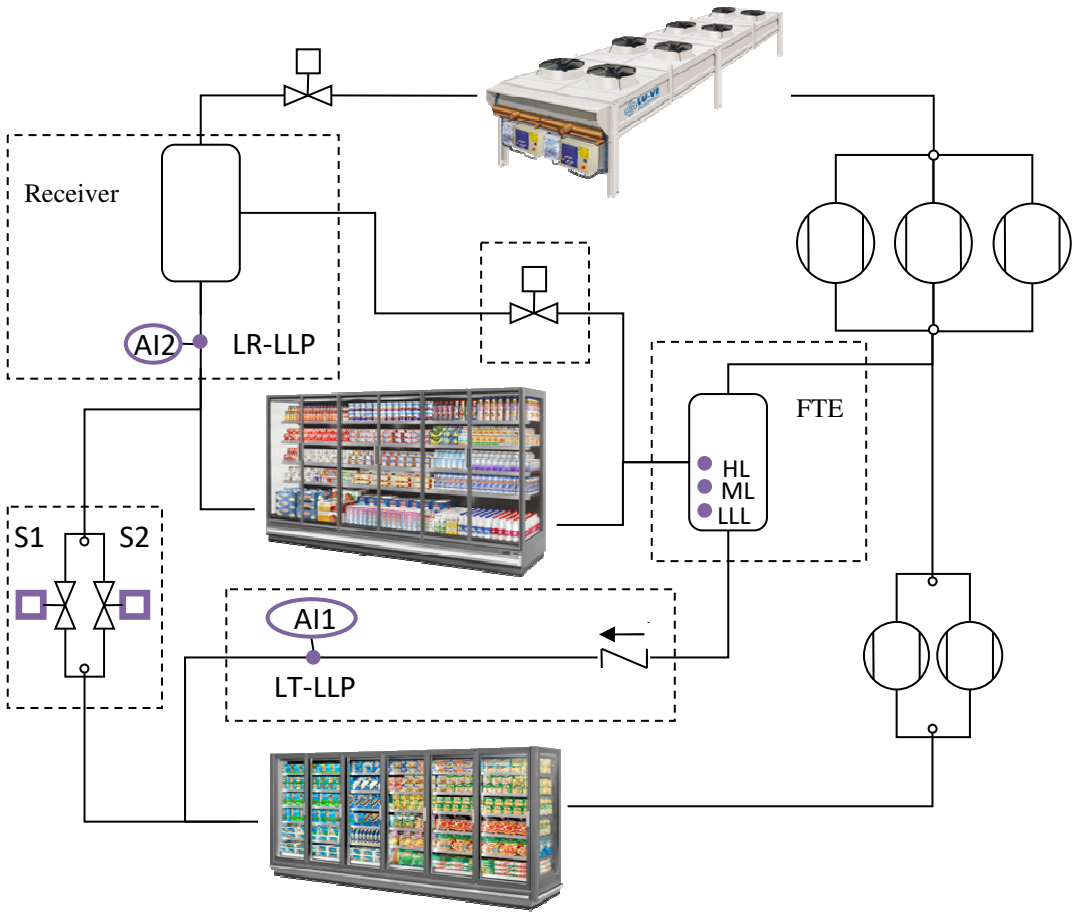
# 1. CONCEPT LAYOUT OF BOOSTER SYSTEM WITH FTE2.0

The system sensors for the FTE:

| CODE | NOMENCLATURE | DEFINITION | TYPE | DESCRIPTION |
|---|---|---|---|---|
| | LLL | Low liquid level | Liquid sensor | Located at bottom of the FTE |
| | MLL | Medium liquid level | Liquid sensor | Located at the medium of the FTE |
| | HLL | High liquid level | Liquid sensor | Located at the high of the FTE |
| | S1 | Solenoid one | NC solenoid | Located on the LT liquid line; |
| | S2 | Solenoid two | NC solenoid | Located on the LT liquid line in parallel (mechanically) with the S1. |
| | AI1<br>LT-LLP | LT liquid line pressure | Pressure probe | Located on the LT liquid line after the solenoid and the check valve |
| | AI2<br>LR-LLP | MAIN LIQUID RECEIVER liquid line pressure | Pressure probe | Located on the LT liquid line after the solenoid and the check valve |

The system concept layout for the FTE:




**Elements of FTE2.0**

# 2. ABOUT CONTROLLER

FTE2.0 has three new level of integration:

- Mechanical integration: FTE 2.0 is integrated in the rack;
- Electrical integration: FTE 2.0 electrical supply integrated in the rack;
- Control integration: from electromechanical control to PLC control.

The main purpose of this document is to describe the features of the FTE 2.0 with a focus on the control integration.

FTE 2.0 does not have anymore an electromechanical control system. The control part has been replaced with a programmable PLC made by EPTA.

It has been developed a programmable controller able to manage:

- basic logics: the same that are currently implemented in electromechanical board of FTE;
- advanced logics: to permit to the FTE2.0 to became able to perform analysis of its own status in order to become more reliable and more safe.

Elements of the new structure are:

- FTE tank: integrated in the packs for EC91 and EC93 4+3;
- PLC controller: integrated in the packs and based on a neutral platform developed by EPTA;
- Sensors level: KL1 – KL2.1 – KL3.

Hereafter the logic implemented into the controller in order to manage:

- the cycles of charging and discharging of FTE;
- the diagnostic and the alarm conditions.

## 2.1 Structure of software

Menu ALL (Level 0):
- no password

Menu USER (Level 1):
- with password (PASS 1 = 11)

Menu MANUFACTER (Level 2):
- with password (PASS 2 = 22)

Menu ADVANCED (Level 3):
- with password (PASS 3 = 81)
- here there are all the parameters that manage the logic not just implemented in electromechanical FTE

Menu EPTA (Level 4):
- with password (PASS 4 = 5371) – **ATTENTION: THIS PASSWORD MUST BE SHARED ONLY WITHIN EPTA PEOPLE. THIS MEANS THAT FIRST CIRCULATION IS LIMITED TO SELECTED PEOPLE, WHO MUST NOT DIFFUSE IT TO OTHERS.**
- permit to enable the advanced control

The intended purpose of the advantage functions is to link the selling of the New Equipment to the Service. The advanced functions remain available for a specific timeframe after which the costumer has to ask to EPTA Service people to re-activated the features. So advantage function are available only if a service contract with EPTA is in place. When/If advanced functions are switched off the FTE maintains the same features as in the electro-mechanical configuration.

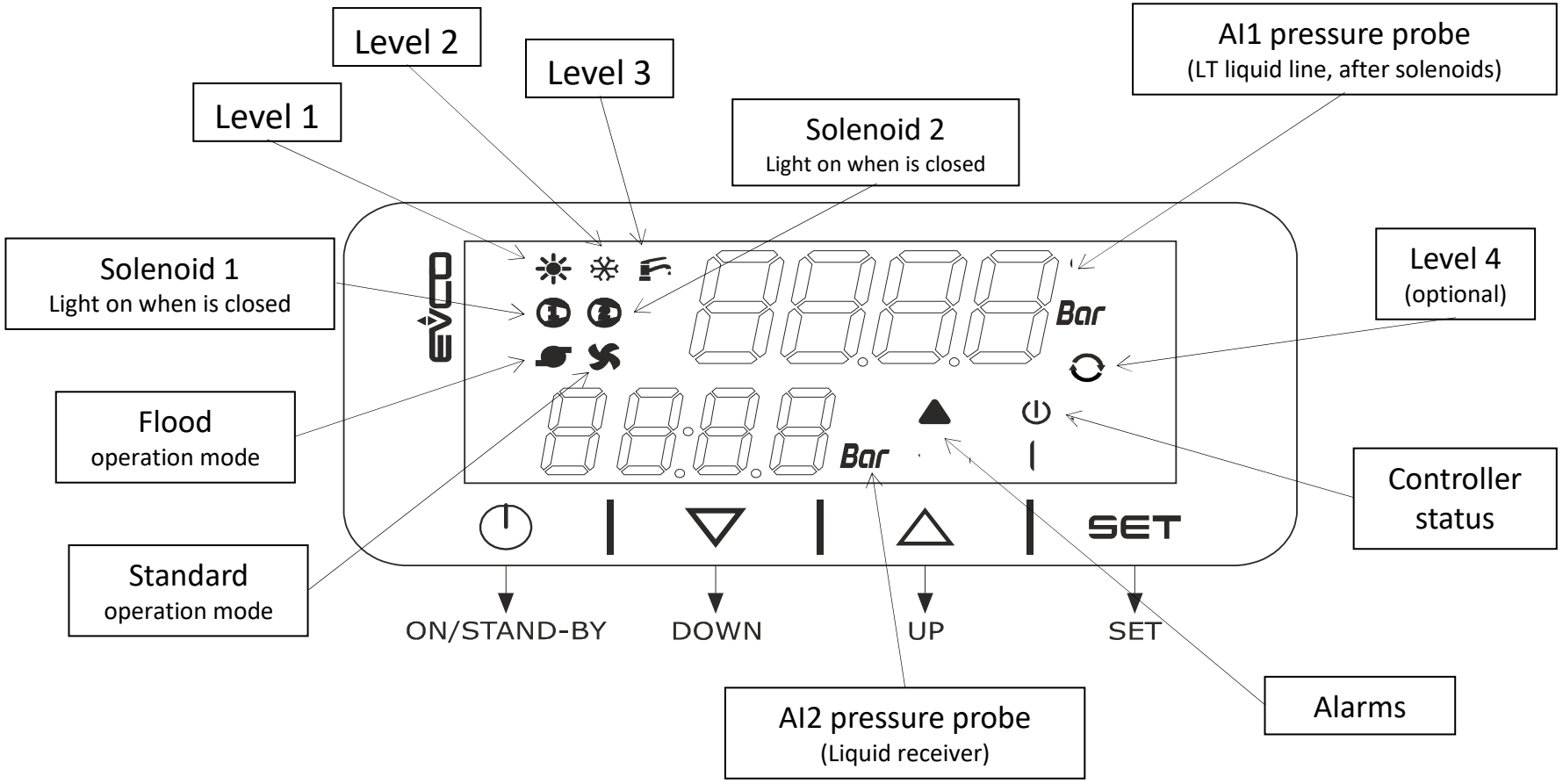
## 2.2 Legend (main variables)

| VARIABLE | LEVEL | DESCRIPTION | VALUE | MEANING | REFERENCE TIME |
|---|---|---|---|---|---|
| ***LEV1*** | BASIC | FTE 10% SENSOR | 1 | ON | |
| | | | 0 | OFF | |
| ***LEV2*** | BASIC | FTE 30% SENSOR | 1 | ON | Ti3 |
| | | | 0 | OFF | |
| ***LEV3*** | BASIC | FTE 50% SENSOR | 1 | ON | |
| | | | 0 | OFF | |
| ***LEV4*** | ADVA (*1) | FTE 80% SENSOR | 1 | ON | |
| | | | 0 | OFF | |
| ***CSol*** | ADVA (*1) | SOLENOIDS STATUS | 1 | SOLENOIDS CLOSED (NOT ELECTRICALLY SUPPLY AND DISABLE) | |
| | | | 0 | SOLENOID OPEN (EX-CHANGE FROM THE 2 SO-LENOIDS DURING FTE CHARGING) | |
| ***FSol*** | AVDA (*1) | FORCE CLOSING OF SOLENOIS | 1 | SOLENOIDS CLOSED FOR TIME TiFS | |
| ***SOL1*** | ADVA (*1) | SOLENOID 1 | 1 | SOLENOID CLOSED | Ti4 |
| | | | 0 | SOLENOID OPEN | |

| | | | | | |
|---|---|---|---|---|---|
| ***SOL2*** | ADVA (*1) | SOLENOID 2 | 1 | SOLENOID CLOSED | |
| | | | 0 | SOLENOID OPEN | |
| ***SHuP*** | BASIC | REQUEST OF INCREASE MT SH | 0 | OFF (LOW SH) | |
| | | | 1 | ON (HIGH SH) | |
| ***SHdW*** | BASIC | REQUEST OF DECREASE MT SH | 0 | OFF (HIGH SH) | |
| | | | 1 | ON (LOW SH) | |
| ***AI1*** | BASIC | PRESSURE PROBE IN LIQUID LINE | | | |
| ***AI2*** | ADVA (*2) | (IF PRESENT) PRESSURE PROBE REFERED TO MAIN LIQUID RECEIVER | | | |

(*1): AVAILABLE ONLY IF ADVANCED PARAMETERES ARE ENABLE → ***AdEn*** = 1
(*2): AVAILABLE ONLY IF AI2 PRESSURE PROBE IS ENABLE → ***A2En*** = 1

## 2.3 Structure of display



## 2.3 Display tree structure

**MENU**
- →**ALL**
  - →Status **Lev1** (R)
  - →Status **Lev2** (R)
  - →Status **Lev3** (R)
  - →Status **Lev4** (R)
  - →Value pressure probe 1 – **AI 1** (R)
  - →Value pressure probe 2 – **AI 2** (R) *IF ABLE*
  - →Status **SHup** (R)
  - →Status **SHdU** (R)
  - (Loop)
- →**USER** (Pass Lev1 = 11)
  - →**AlrM**
    - →parameter **P1** (R/W)
    - →parameter **d_P1** (R/W)
    - →parameter **tiP1** (R/W)
    - →parameter **ti 2** (R/W)
    - →parameter **P1Lo** (R/W)
    - →parameter **P1Hi** (R/W)
    - (Loop)
  - →**PCnf**
    - →parameter **A1CF** (R/W)
    - →parameter **A1Lo** (R/W)

```
          →parameter A1Hi (R/W)
          →parameter A1cA (R/W)
          →parameter AiFt (R/W)
          →parameter Ai0V (R/W)
          →parameter Ai5V (R/W)
          (Loop)
     →rE
          →parameter ti 3 (R/W)
          →parameter ti 4 (R/W)
          (Loop)
     →rtC
          →data (R/W)
→ManF (Pass Lev2 = 22)
     →parameter SM (R/W)
     →parameter EnSM (R/W)
     →parameter EnSr (R/W)
→AdvA (Pass Lev3 = 81 / 685)
     →ALrM
          →parameter ti 5 (R/W)
          →parameter ti 7 (R/W)
          →parameter ti Ai (R/W)
          →parameter P1A2 (R/W)
          →parameter d_A2 (R/W)
          →parameter tiA2 (R/W)
          (Loop)
     →ConF
```

```
      →parameter A2En (R/W)
      →parameter A2CF (R/W)
      →parameter A2Lo (R/W)
      →parameter A2Hi (R/W)
      →parameter A2cA (R/W)
      →parameter dELt (R/W)
      →status Sol1 (R)
      →status Sol2 (R)
      (Loop)
→StAt
      →status CSol (R)
      →parameter tiFS (R/W)
      →parameter FSol (R/W)
      →value tFSo (R)
      (Loop)
→rEG
      →parameter nuMr (R/W)
      →value cntr (R)
      (Loop)
→MdbS
      →parameter Mb01 (R/W)
      →parameter Mb02 (R/W)
      →parameter Mb03 (R/W)
      →parametro Mb04 (R/W)
      (Loop)
→MAP
```

→SAvE
→MEM
→KEY
→StAt
→Ok
→USb
→rESt
→MEM
→KEY
→StAt
→Ok
→USb
→dEFt
→parameter HdEL (R/W)
→parameter rdEF (R/W)
(Loop)

→EptA (Pass Lev4 = 5371)
→parameter AdEn (R/W)
→parameter PdAy (R/W)
→parameter CdAy (R/W)
→parameter PSd4
→PSd
→parameter PSd1 (R/W)
→parameter PSd2 (R/W)
→parameter PSd3 (R/W)

(Loop)

→**HISt** (alarm historic)
→**HISt** (R)
→**Info** (software info)
→value **ProJ** (R)
→value **Uer** (R)
→value **rEU** (R)
→value **YEAr** (R)
→value **MotH** (R)
→value **dAY** (R)
(Loop)

## 2.4 Description of alarms

| AL01. FAULTY *AI1* PRESSURE PROBE | |
|---|---|
| WHY: | PRESSURE PROBE BROKED OR OUT OF RANGE |
| EFFECT: | DISABLE ALLARMS LINKS TO THIS PRESSURE PROBE (AL06 – AL07 – AL08 – AL11) |
| DELAY TIME: | TiAi |
| RESET: | AUTOMATIC |
| PROTECTION LEVEL: | BASIC |

| AL02. FAULTY *AI2* PRESSURE PROBE | |
|---|---|
| WHY: | PRESSURE PROBE BROKED OR OUT OF RANGE |
| EFFECT: | DISABLE ALLARMS LINKS TO THIS PRESSURE PROBE (AL06 – AL07 – AL08 – AL11) |
| DELAY TIME: | TiAi |
| RESET: | AUTOMATIC |
| PROTECTION LEVEL: | IF ***A2En*** = 1 |

| AL03. *LEV1* = 1 ALWAYS | |
|---|---|
| WHY: | SENSOR DOESN'T WORK PROPERLY |
| GENERATE ALARM IF: | ***CSol*** = 1 AND ***LEV1***=1 for time T > ***Ti7*** → AL03 = 1 |
| EFFECT: | 1. IF ***LEV2*** = 1 → ***CSol*** = 1 for time ***TiFS***. After time ***TiFS*** → ***CSol*** = 0 unless ***LEV2*** = 1 yet; |
| | 2. IF ***LEV2*** = 0 → ***CSo***l = 0 |
| ALARM DELAY TIME: | ***Ti7*** |
| RESET: | AUTOMATIC WHEN ***LEV1*** = 0 |
| PROTECTION LEVEL: | IF ***AdEn*** = 1 |

| AL04. LEV2 = 0 ALWAYS | |
|---|---|
| WHY: | SENSOR DOESN'T WORK PROPERLY / WIRING DOESN'T MAKE PROPERLY |
| GENERATE ALARM IF: | THROUGH COMPARISONG BETWEEN 2 VARIABLES<br>➔ *VARIABLE A*:<br>• ***CSol*** = 1<br>• ***FSol*** = 0,<br>• ***LEV1*** =1,<br>• ***LEV2*** = 0,<br>• ***LEV3*** = 1 OR ***LEV4*** = 1.<br>SET A = 1.<br>➔ *VARIABLE B*:<br>• ***CSol*** = 0,<br>• ***FSol*** = 0,<br>• ***LEV1*** =0,<br>• ***LEV2*** = 0,<br>• ***LEV3*** = 0 AND ***LEV4*** = 0.<br>SET B = 1.<br>IF A = 1 AND AFTER B = 1 → AL04 = 1 |
| EFFECT: | IF (***LEV1***) = 1 AND (***LEV3***) = 1 → ***CSol***=1<br>WHEN ***LEV1***, ***LEV2***, ***LEV3*** = 0 → ***CSol***=0 |
| ALARM DELAY TIME: | |
| RESET: | AUTOMATIC WHEN ***LEV2*** = 1 |
| PROTECTION LEVEL: | IF ***AdEn*** = 1 |

| AL05. *LEV3* = 1 | |
|---|---|
| WHY: | LIQUID HAS REACHED ***LEV3*** OF FTE |
| GENERATE ALARM IF: | ***LEV3*** = 1 for T > ***Ti2*** → AL05 = 1 |
| EFFECT: | IF (***LEV1*** AND/OR ***LEV2*** =1 AND ***LEV3***=1) → ***SHuP*** = 1 & ***SHdW*** = 0 until ***LEV1***, ***LEV2***, ***LEV3*** = 0 |
| ALARM DELAY TIME: | ***Ti2*** |
| RESET: | AUTOMATIC WHEN ***LEV3*** = 0 |
| PROTECTION LEVEL: | BASIC |

| AL06. FTE DOESN'T EMPTY | | |
|---|---|---|
| WHY: | LIQUID HAS NOT REACHED ***LEV2*** OF FTE FOR MORE THEN ***TiP1*** TIME | |
| GENERATE ALARM IF: | 1. IF ***AI1*** >= ***P1*** for time T > ***TiP1*** → AL06 = 1 | |
| | 2. IF ***A2En*** = 1 & IF ABS(***AI1***-***AI2***) <= ***Delt*** for time T > ***TiP1*** → AL06 | |
| EFFECT: | ***Fsol*** = 1 for time ***TiFS***.<br>(at the end of ***TiFS*** time, ***FSol***= 0) | |
| ALARM DELAY TIME: | ***TiP1*** | |
| RESET: | AUTOMATIC WHEN: | 1. ***AI1*** < ***P1*** – ***D_P1*** AND ***FSol*** = 0 |
| | | 2. ***AI1*** < ***AI2*** – ***D_P1*** AND ***FSol*** = 0 |
| PROTECTION LEVEL: | BASIC | |

| AL07. COIL OF *SOL1* DOESN'T WORK | | |
|---|---|---|
| WHY: | ELECTRICAL PROBLEMS ON ***SOL1*** | |
| GENERATE ALARM IF: | 1. IF ***A2En*** = 1 & IF {***Sol1*** = 0 AND ABS(***AI1*** - ***AI2***) > ***Delt***} → AL07 | |
| | 2. IF ***A2En*** = 0 & IF {***Sol1*** = 0 AND ***AI1*** <= ***P1***} → AL07 | |
| EFFECT: | ***SOL 2*** = 0 UNTIL :<br>1. AL07 = 0 (NOT CONSIDERING ***Ti4***)<br>2. ***CSol*** = 1 (→ ***SOL1*** = 1 AND ***SOL2*** = 1) | |
| ALARM DELAY TIME: | ***Ti5*** | |
| RESET: | MANUALLY WHEN: | 1. ABS(***AI1*** – ***AI2)*** < ***Delt*** AND ***Sol1*** = 0 |
| | | 2. ***AI1*** > ***P1*** AND ***Sol1*** = 0 |
| PROTECTION LEVEL: | IF ***AdEn*** = 1 | |

| AL08. COIL OF *SOL2* DOESN'T WORK | | |
|---|---|---|
| WHY: | ELECTRICAL PROBLEMS ON ***SOL2*** | |
| GENERATE ALARM IF: | 1. IF ***A2En*** = 1 & IF {***Sol2*** = 0 AND ABS(***AI1*** - ***AI2***) > ***Delt***} → AL08 | |
| | 2. IF ***A2En*** = 0 & IF {***Sol2*** = 0 AND ***AI1*** <= ***P1***} → AL08 | |
| EFFECT: | ***SOL 1*** = 0 UNTIL :<br>1. AL08 = 0 (NOT CONSIDERING ***Ti4***)<br>2. ***CSol*** = 1 (→ ***SOL1*** = 1 AND ***SOL2*** = 1) | |
| ALARM DELAY TIME: | ***Ti5*** | |
| RESET: | MANUALLY WHEN: | 1. ABS(***AI1*** – ***AI2***) < ***Delt*** AND ***Sol2*** = 0 |
| | | 2. ***AI1*** > ***P1*** AND ***Sol2*** = 0 |
| PROTECTION LEVEL: | IF ***AdEn*** = 1 | |

| AL09. REDUCTION OF DAILY CYCLES | |
|---|---|
| WHY: | |
| GENERATE ALARM IF: | IF N° AL06 IN 24 HOURS (04:00 – 04:00) > ***numR*** → AL09 (IN ALARM HISTORY). IF AL09 IS ACTIVE FOR MORE THAN 3 DAYS IT WILL APPARE ON SUPERVISOR AND DISPLAY. |
| EFFECT: | ONLY REPORTING |
| ALARM DELAY TIME: | |
| RESET: | MANUALLY WHEN N° AL06 IN 24 HOURS (04:00 – 04:00) < ***numR*** |
| PROTECTION LEVEL: | IF ***AdEn*** = 1 |

| AL10. *LEV4* = 1 | |
|---|---|
| WHY: | LIQUID HAS REACHED ***LEV4*** OF FTE |
| GENERATE ALARM IF: | IF ***LEV4*** = 1 → AL10 = 1 |
| EFFECT: | IF (***LEV1*** AND/OR ***LEV2*** =1 AND ***LEV4***=1) ***SHuP*** = 1 & ***SHdW*** = 0 until ***LEV1***, ***LEV2***, ***LEVE4*** = 0 |
| ALARM DELAY TIME: | |
| RESET: | AUTOMATIC WHEN ***LEV4*** = 0 |
| PROTECTION LEVEL: | IF ***AdEn*** = 1 |

| AL11. SOLENOIDS LEAKAGE | |
|---|---|
| WHY: | |
| GENERATE ALARM IF: | 1. IF ***A2En*** = 1 & ***CSol*** = 1 & ABS(***AI2*** – ***AI1***) <= ***Delt*** → AL11 |
| | 2. IF ***A2En*** = 0 & ***CSol*** = 1 & ***AI1*** >= ***P1*** → AL11 |
| EFFECT: | ***SHuP*** = 1 UNTIL RESET |
| ALARM DELAY TIME: | ***Ti5*** |
| RESET: | MANUAL |
| PROTECTION LEVEL: | IF ***AdEn*** = 1 |

| AL12. LEV2 = 1 ALWAYS | |
|---|---|
| WHY: | SENSOR DOESN'T WORK PROPERLY |
| GENERATE ALARM IF: | THROUGH COMPARISONG BETWEEN 2 VARIABLES<br>➔ *VARIABLE C*:<br>• ***CSol*** = 1<br>• ***FSol*** = 0,<br>• ***LEV1*** =1,<br>• ***LEV2*** = 1,<br>SET C = 1.<br>➔ *VARIABLEDB*:<br>• ***CSol*** = 1,<br>• ***FSol*** = 0,<br>• ***LEV1*** =0,<br>• ***LEV2*** = 1,<br>SET D = 1.<br>IF C = 1 AND AFTER D = 1 → AL12 = 1 |
| EFFECT: | IF AL12 = 1 → ***CSol*** = 1 UNTIL ***LEV1***, ***LEV2*** = 1<br>IF AL12 = 1 AND { ***LEV1*** = 0 AND ***LEV3*** = 0 } → ***CSol*** = 0 |
| ALARM DELAY TIME: | |
| RESET: | AUTOMATIC WHEN ***LEV2*** = 0 |
| PROTECTION LEVEL: | IF ***AdEn*** = 1 |

| AL13. *LEV1* = 0 ALWAYS | |
|---|---|
| WHY: | DOESN'T WORK PROPERLY / WIRING DOESN'T MAKE PROPERLY |
| GENERATE ALARM IF: | IF ***LEV1*** = 0 AND {***LEV2*** = 1 AND ***LEV3*** = 1} → AL13 =1 |
| EFFECT: | ***FSol*** = 1 FOR TIME ***TiFS*** IF ***CSol***=1 |
| ALARM DELAY TIME: | |
| RESET: | AUTOMATIC WHEN ***LEV1*** = 1 |
| PROTECTION LEVEL: | IF ***AdEn*** = 1 |

| AL14. RTC FAILURE | |
|---|---|
| WHY: | |
| GENERATE ALARM IF: | |
| EFFECT: | DISABLE AL09 |
| ALARM DELAY TIME: | |
| RESET: | |
| PROTECTION LEVEL: | BASIC |

| AL15. MAIN RECEIVER LOW PRESSURE (AI2) | |
|---|---|
| WHY: | DOESN'T WORK PROPERLY / WIRING DOESN'T MAKE PROPERLY |
| GENERATE ALARM IF: | IF ***AI2*** < ***PIA2*** → AL15 = 1 |
| EFFECT: | |
| ALARM DELAY TIME: | ***TiA2*** |
| RESET: | AUTOMATIC WHEN ***AI2*** > (***PIA2*** + ***D_A2***) |
| PROTECTION LEVEL: | BASIC |