UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola d'Enginyeria de Barcelona Est

TRABAJO DE FIN DE GRADO

Grado en Ingeniería Electrónica Industrial y Automática

MIGRATION AND REDESIGN OF THE CONTROL SYSTEM FOR THE PROCESS OF SYNTHESIS AND UNLOAD OF LIQUEFIED PETROLEUM GAS

Annexes

Autor: Àlex Forner Gómez
Director: Guillermo Ramírez Sanz
Co-Directores: Joan Domingo Peña

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A1. User manual

This is a user manual for the Experion HS control interface of the LPG synthesis and unload process.

- When you open Experion HS, you must enter your user name and password with access permission to the Experion system in order to control the process. The user manager can configure the permissions and users of the system in the CONFIGURE window (Indicator 1 in **Figure *2***).

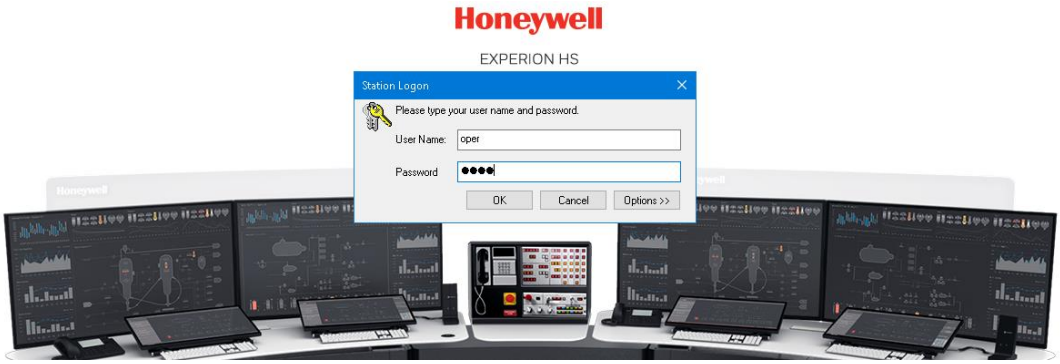


Figure 1 Experion HS main screen (Source: Experion HS)

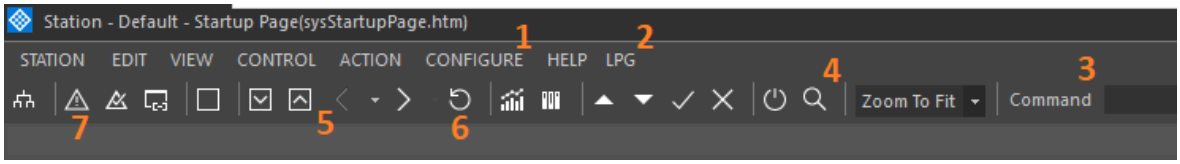


Figure 2 Experion HS Toolbar (Source: Experion HS)

- From the tabs on the top bar, the LPG tab (Indicator 2 in **Figure *2***) must be selected to access the main process control display. A specific display can also be accessed by typing the file name in the Command box (Indicator 3 in **Figure *2***) and pressing enter.

- If you wish to access the detail screen of a point, you can double click on the figure of the display representing the point, or type the name of the point in the Command box and click on the search loupe (Indicator 4 in **Figure *2***).

- To access the alarm control screen, press the triangle (Indicator 7 in **Figure *2***)

- The navigation arrows (Indicator 5 in Figure 3.79) can be used to return to a previous, posterior, upper or lower screen. To refresh a display, press the circle with arrow (Indicator 6 in **Figure *2***).
- To manually control the system devices, click on them and select the Manual mode (Indicator 1 of **Figure *3***), then the desired value can be given by modifying the OP value (Indicator 2 of **Figure *3***).

Figure 3 HV_1 control faceplate (Source: Experion HS)

- To start an automatic unload, you must first write the configuration data of the unload. First choose the percentage of butane of the unload (Indicator 1 in ***Figure 4***), then determine the unit of quantity to unload (Indicator 2 in ***Figure 4***) and last write the desired quantity of product (Indicator 3 in ***Figure 4***).

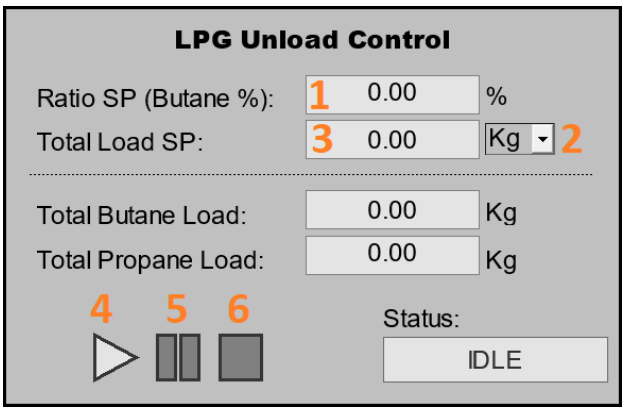


Figure 4 LPG Unload Control box (Source: Experion HS)

- When the previous setting is right, the Play button can be clicked (Indicator 4 in ***Figure 4***). If during the unload, you want to pause the unload or stop and reset the unload settings to 0, click the buttons PAUSE and STOP respectively (Indicator 5 and 6 in ***Figure 4*** respectively).

- While unloading, you can consult the graph of the quantity of product unloaded in the right lower part of the display. You can configure the lower and upper limit of the graph by editing its value (Indicator 1 and 2 in **Figure *5*** respectively), to move through the time base you must configure the time and date of the graph's Y axis (Indicator 3 in **Figure *5***).

Figure 5 Unload control graph (Source: Experion HS)

- To access the PID control graph of the automatic butane or propane regulating valve, double-click on the respective PID Config buttons (Indicators 1 and 2 in **Figure *6*** respectively).

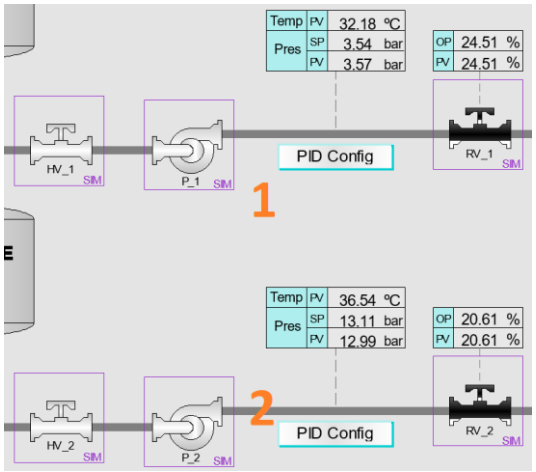


Figure 6 Main LPG control display example (Source: Experion HS)

- The simulation configuration can be accessed by clicking on the button at the right side of the display. In the pop-up, the simulation variables of the devices can be activated individually (Indicator 1 in **Figure *7***) or they can be activated or deactivated all together (Indicator 2 in Figure 3.84). Clicking the lower buttons activates the butane and propane simulations (Indicators 3 and 4 in **Figure *7*** respectively).

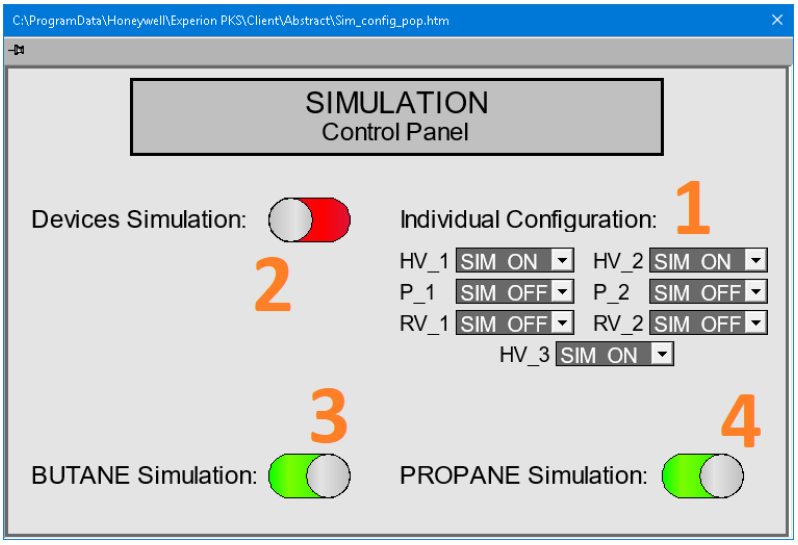


Figure 7 Simulation control panel (Source: Experion HS)

- Once the unload is finished, to access the Unload Report, click on the button that will appear above the control buttons (Indicator 1 in **Figure *8***). In the popup, you can visualize the information related to the unload, to return to the idle state you must press the Okay button (Indicator 1 in **Figure *8***) and then close the popup.

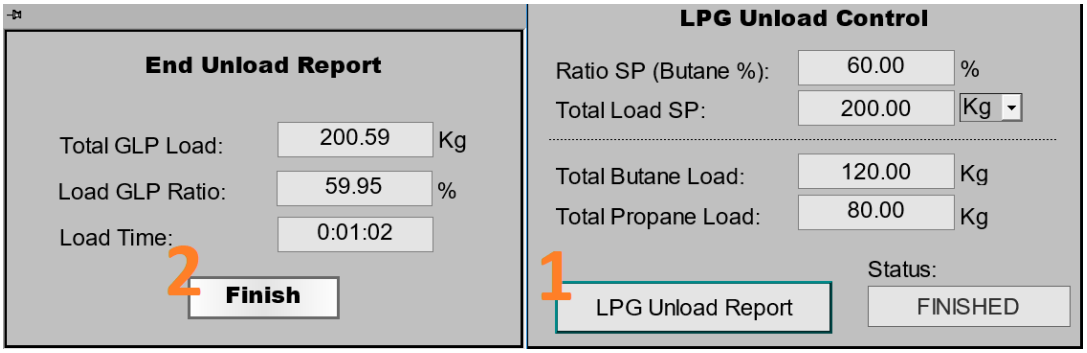
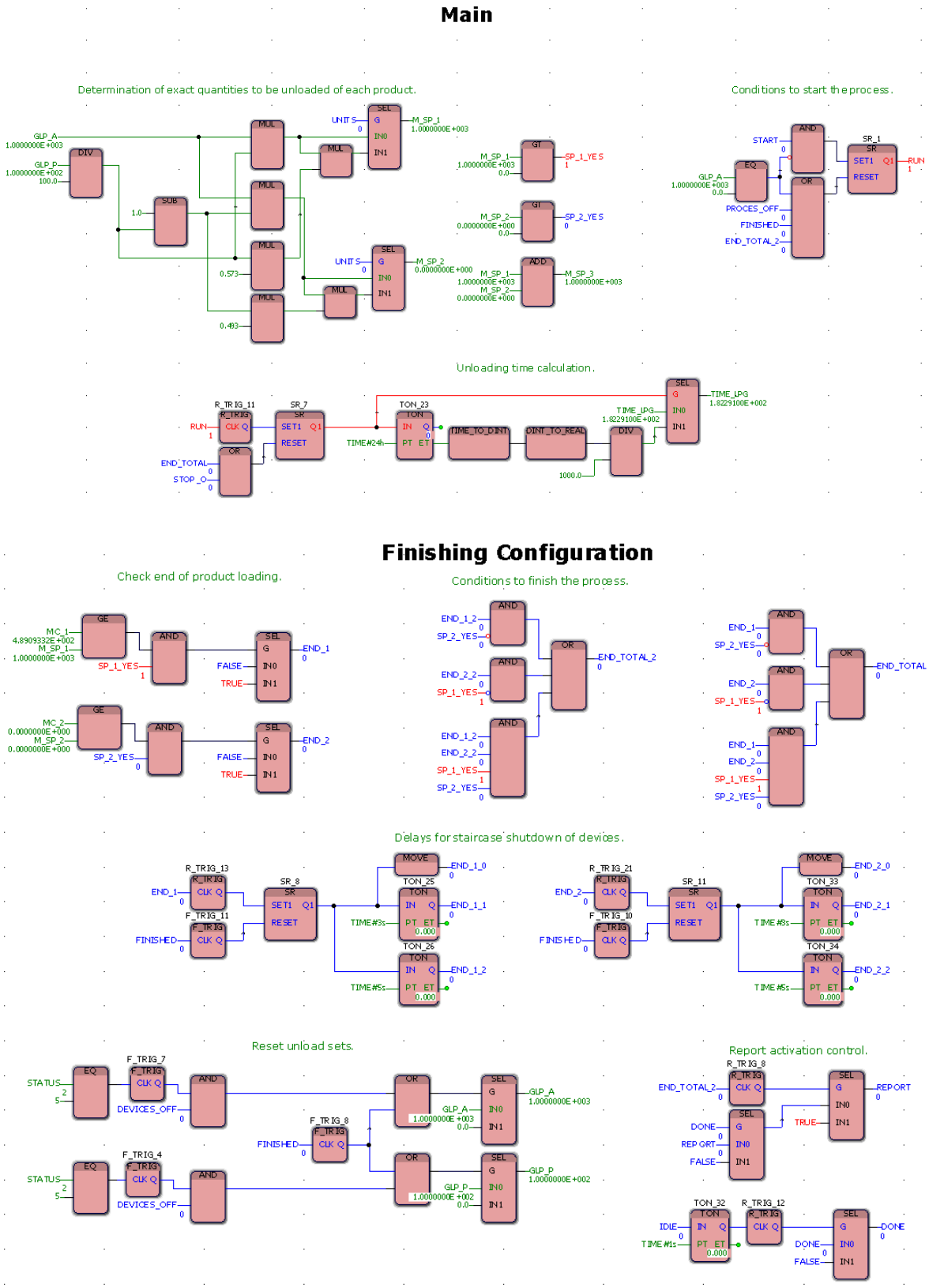
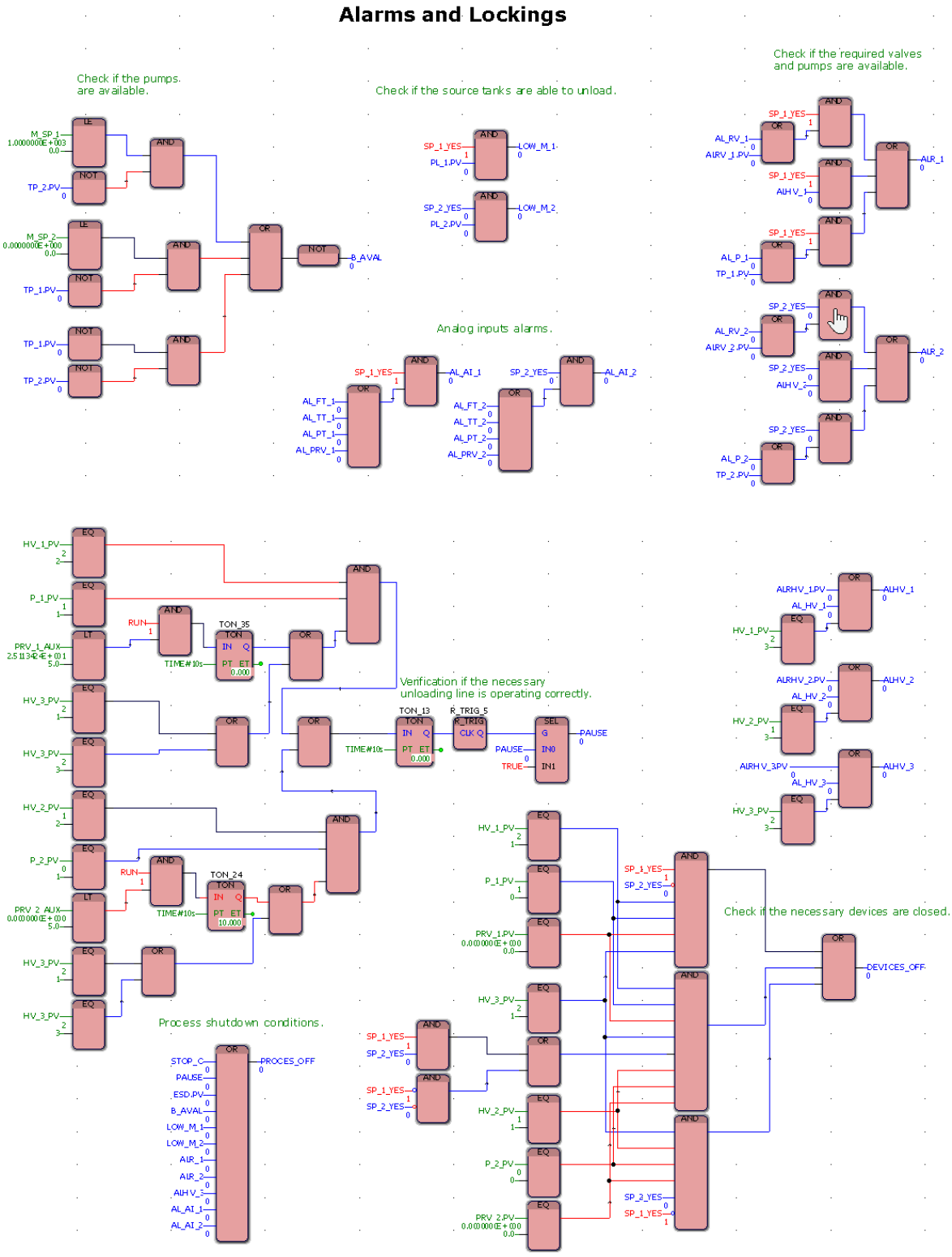


Figure 8 Unload Report (Source: Experion HS)

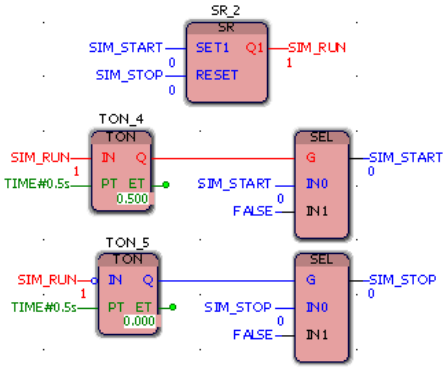
A2. ControlEdge Builder program



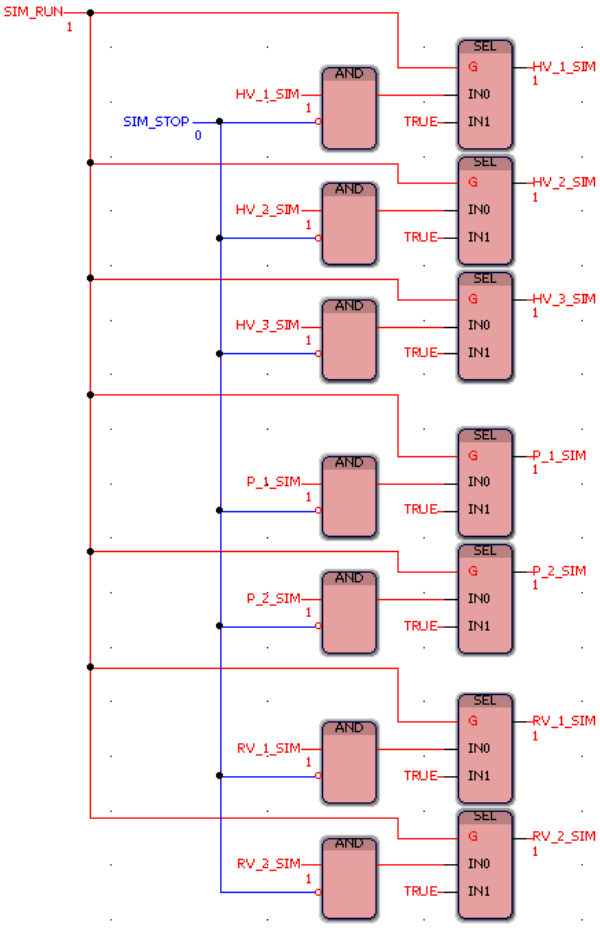

Alarms and Lockings
Check if the pumps are available.
Check if the source tanks are able to unload.
Check if the required valves and pumps are available.
Analog inputs alarms.
Verification if the necessary unloading line is operating correctly.
Process shutdown conditions.
Check if the necessary devices are closed.

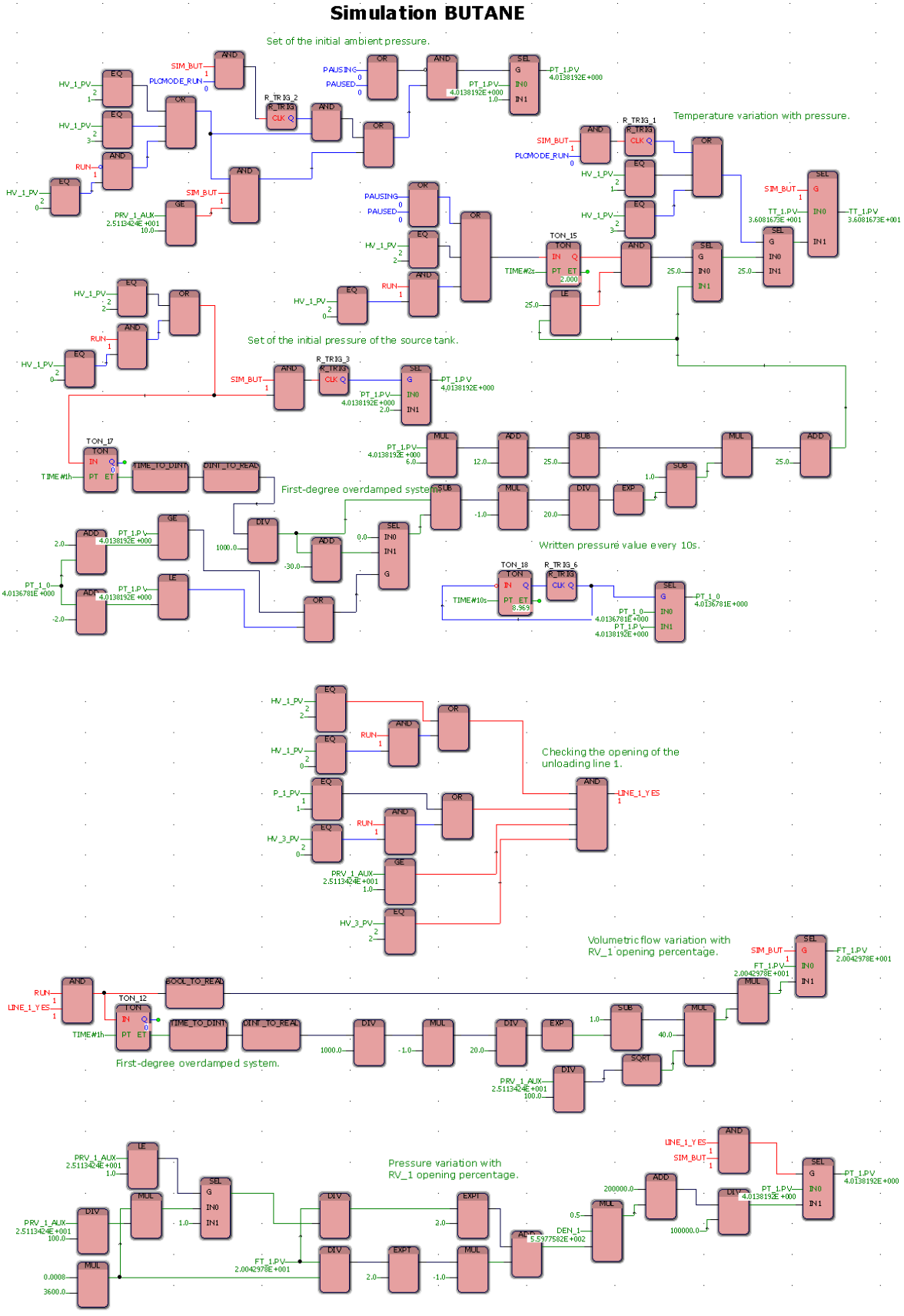
Simulation DEVICES

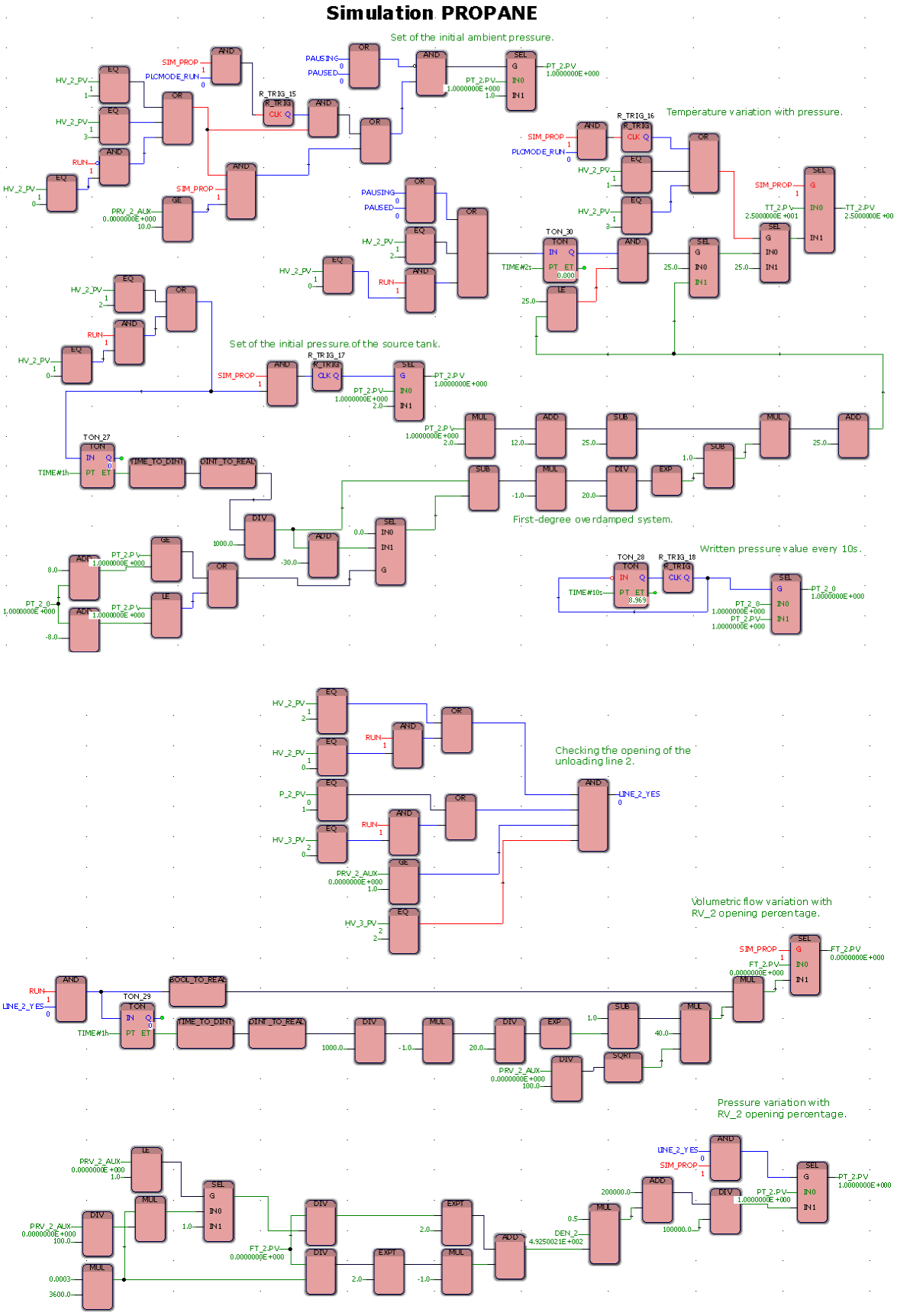
Devices Simulation control.



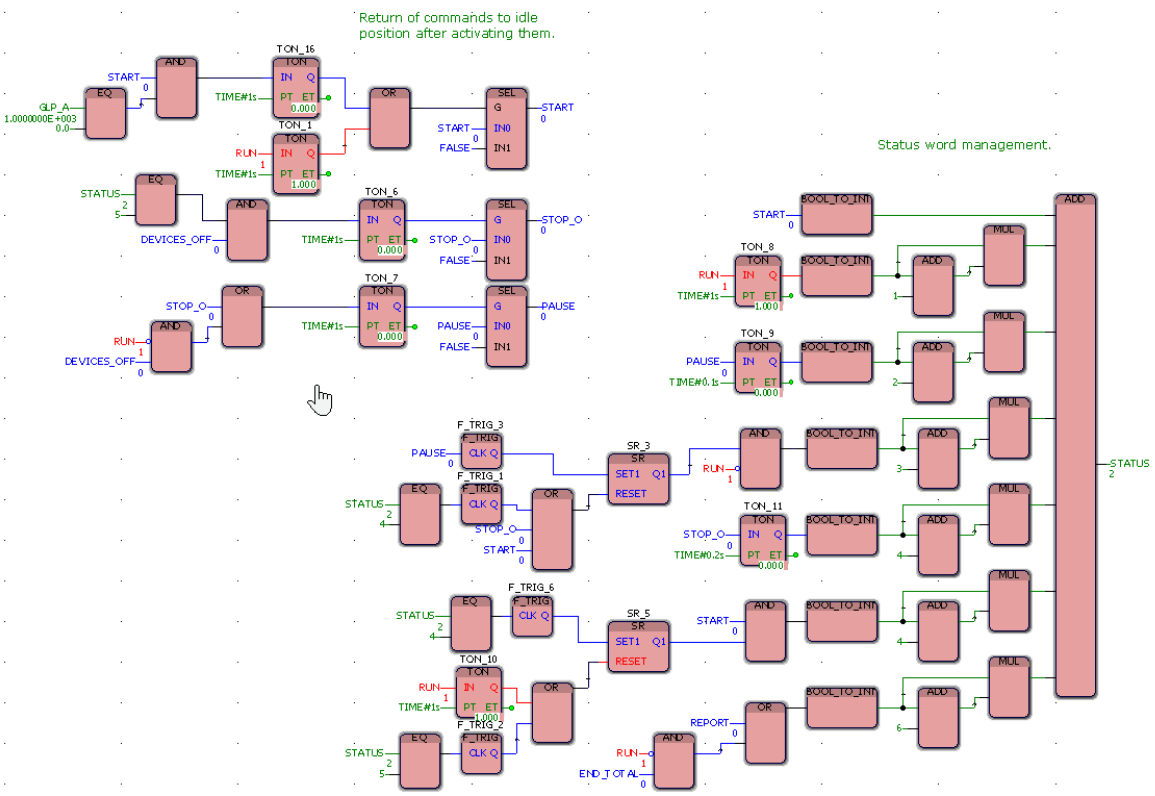
Devices Simulation activation.



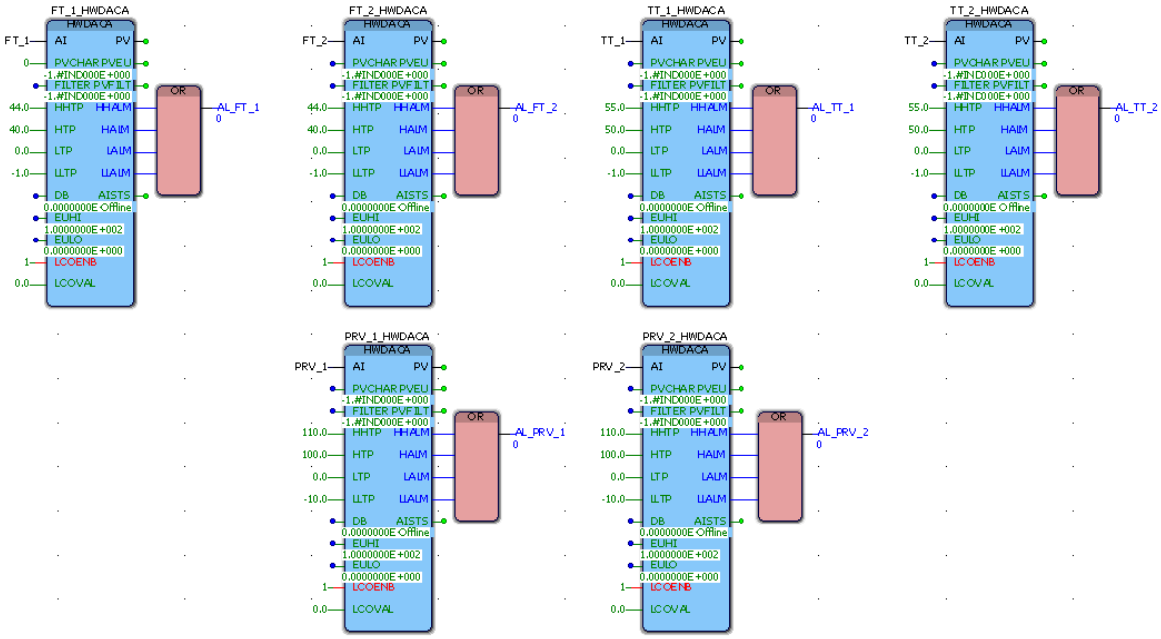

Simulation BUTANE
Set of the initial ambient pressure.
Temperature variation with pressure.
Set of the initial pressure of the source tank.
First-degree overdamped system.
Written pressure value every 10s.
Checking the opening of the unloading line 1.
Volumetric flow variation with RV_1 opening percentage.
First-degree overdamped system.
Pressure variation with RV_1 opening percentage.


Simulation PROPANE
Set of the initial ambient pressure.
Temperature variation with pressure.
Set of the initial pressure of the source tank.
First-degree overdamped system.
Written pressure value every 10s.
Checking the opening of the unloading line 2.
Volumetric flow variation with RV_2 opening percentage.
Pressure variation with RV_2 opening percentage.

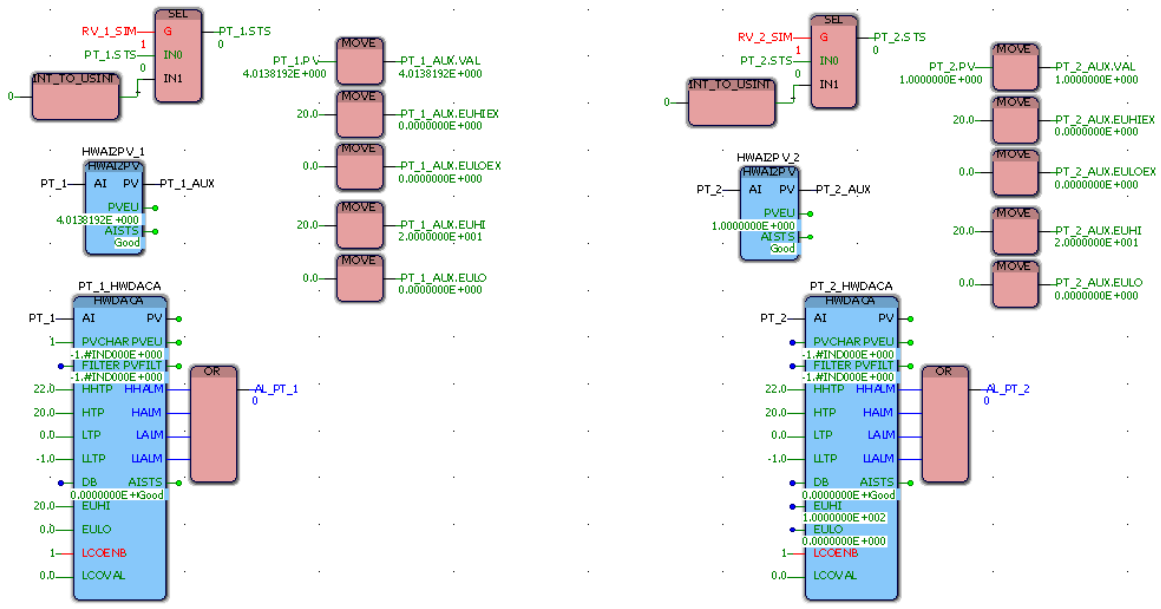
Process Status Word

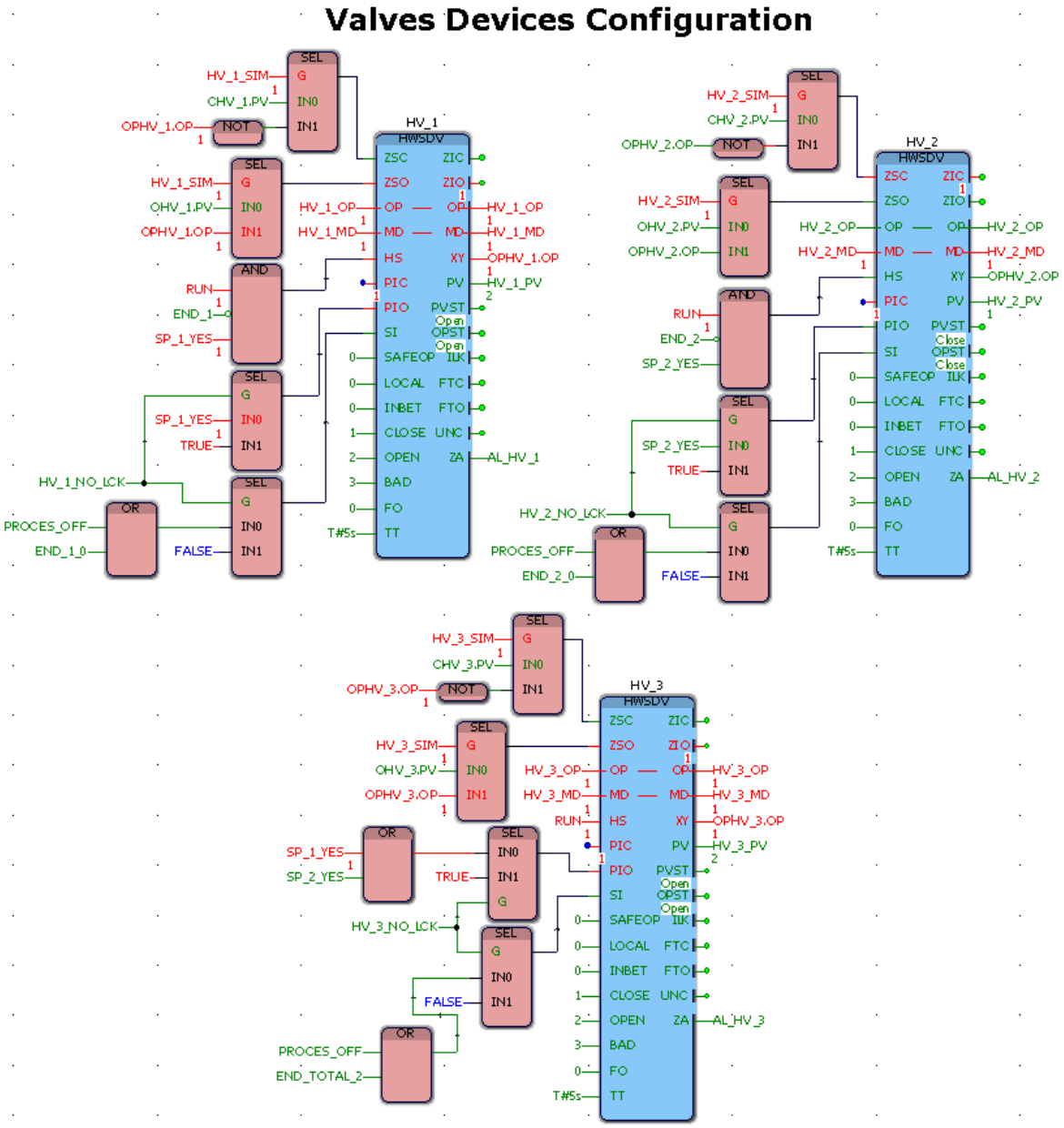


Analog Inputs

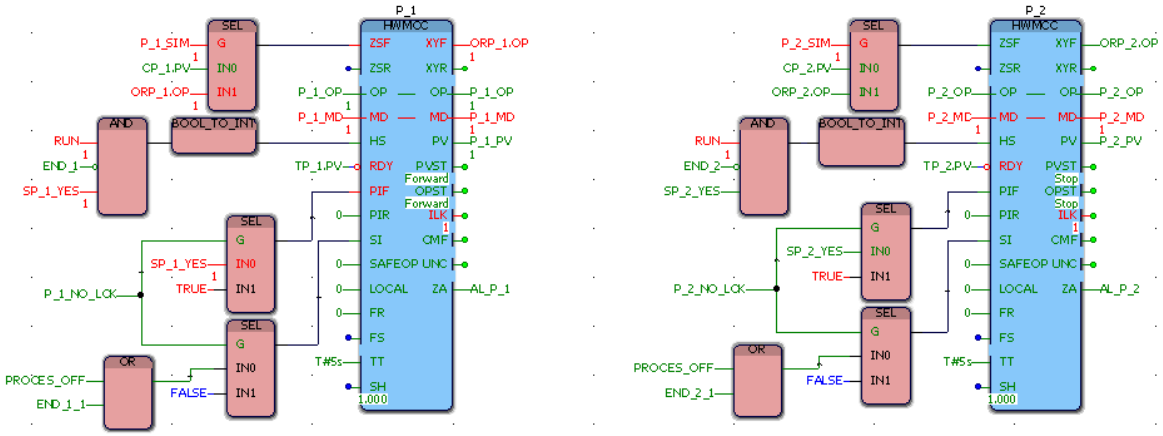


Auxiliar Pressure Analog Inputs

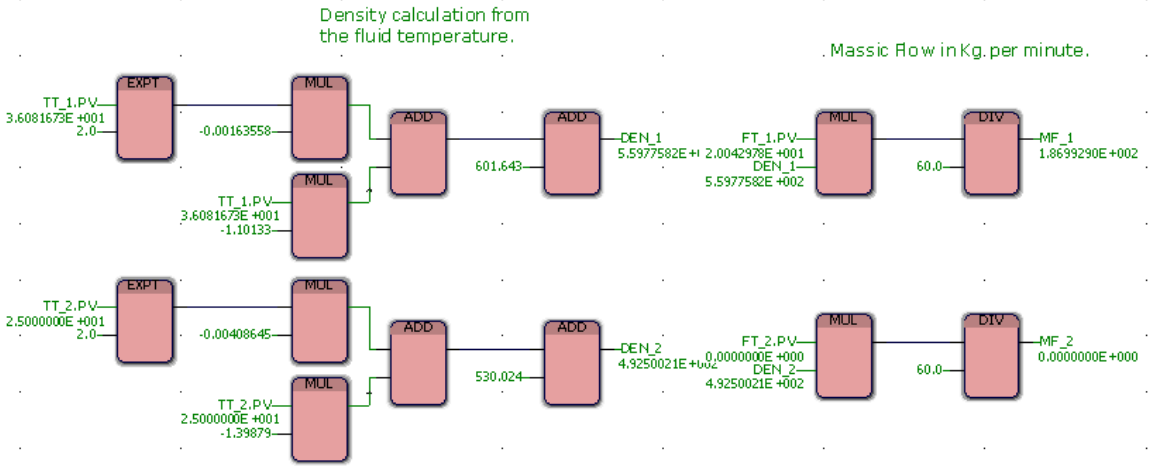


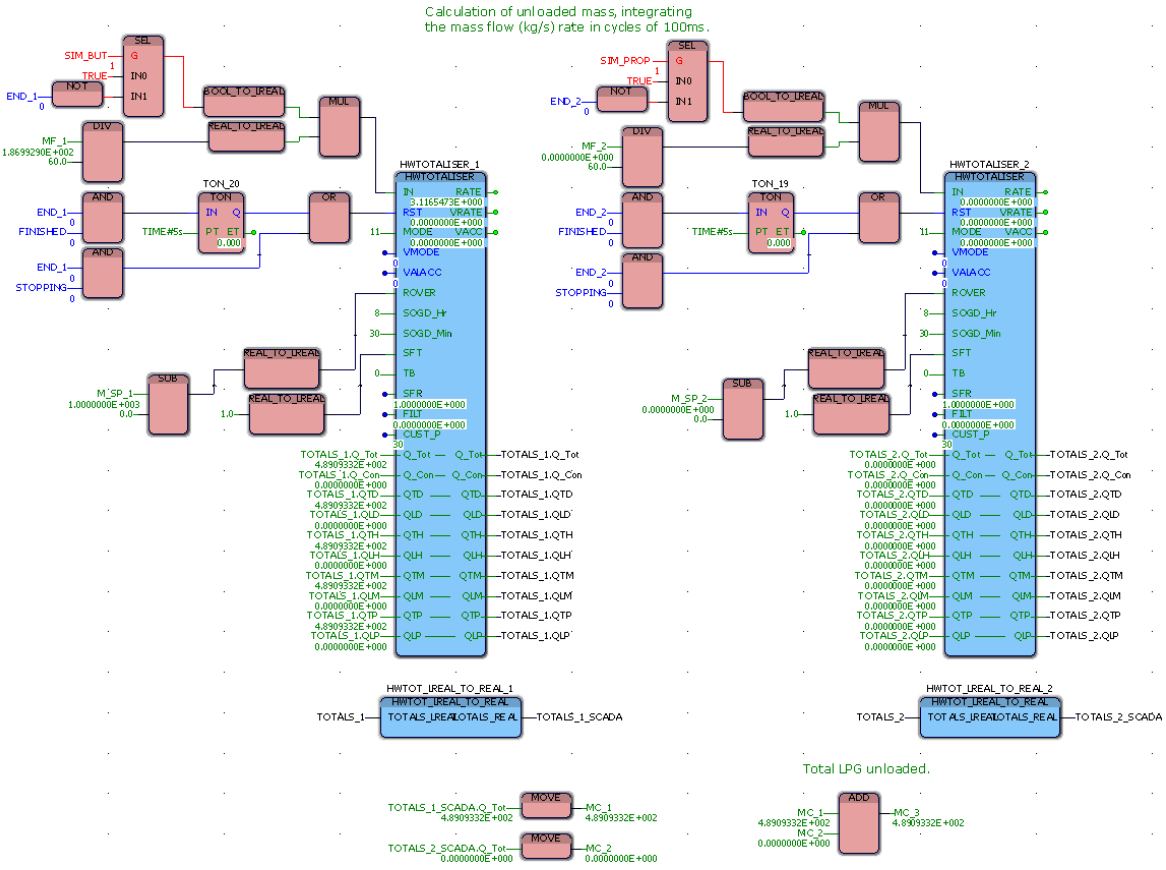

Valves Devices Configuration
HV_1
HV_2
HV_3
HWSDV
SEL
AND
OR
NOT
HV_1_SIM
CHV_1.PV
OPHV_1.OP
OHV_1.PV
HV_1_OP
HV_1_MD
RUN
END_1
SP_1_YES
TRUE
HV_1_NO_LCK
PROCES_OFF
END_1_0
FALSE
AL_HV_1
HV_2_SIM
CHV_2.PV
OPHV_2.OP
OHV_2.PV
HV_2_OP
HV_2_MD
END_2
SP_2_YES
HV_2_NO_LCK
END_2_0
AL_HV_2
HV_3_SIM
CHV_3.PV
OPHV_3.OP
OHV_3.PV
HV_3_OP
HV_3_MD
SP_1_YES
SP_2_YES
HV_3_NO_LCK
END_TOTAL_2
AL_HV_3

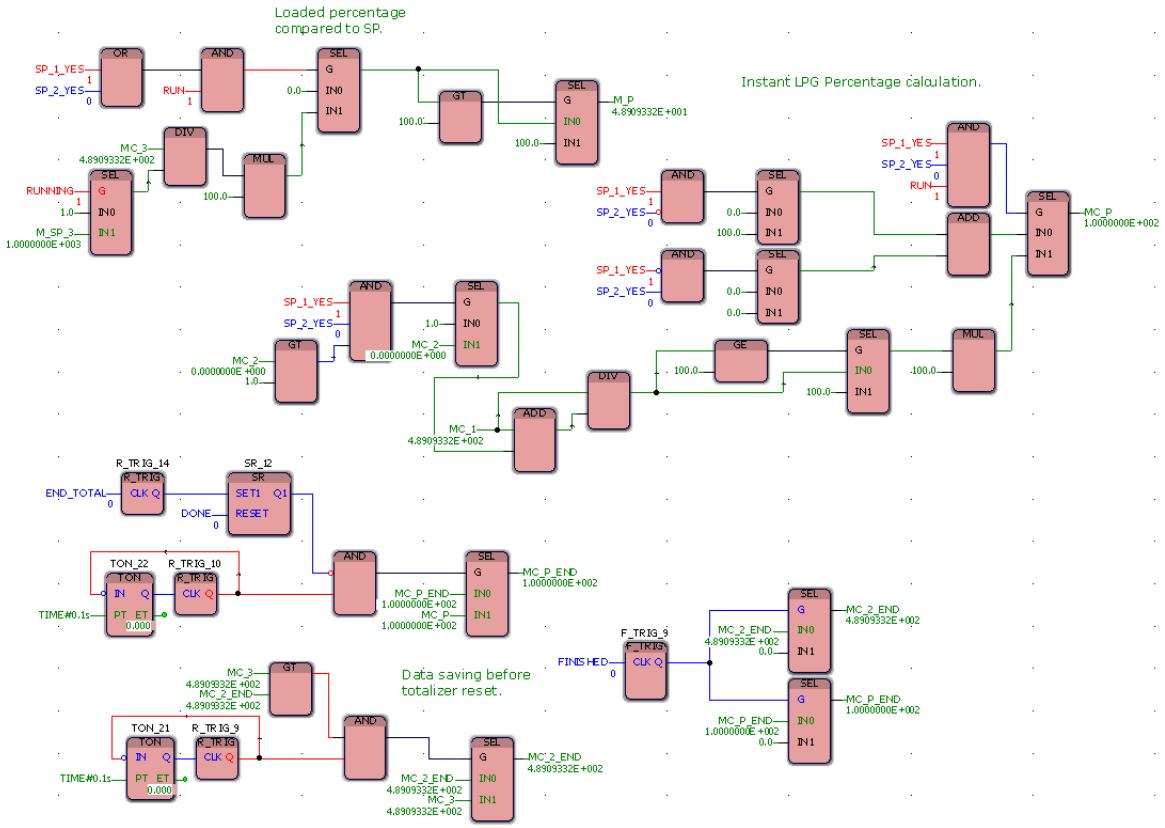
Pumps Devices Configuration



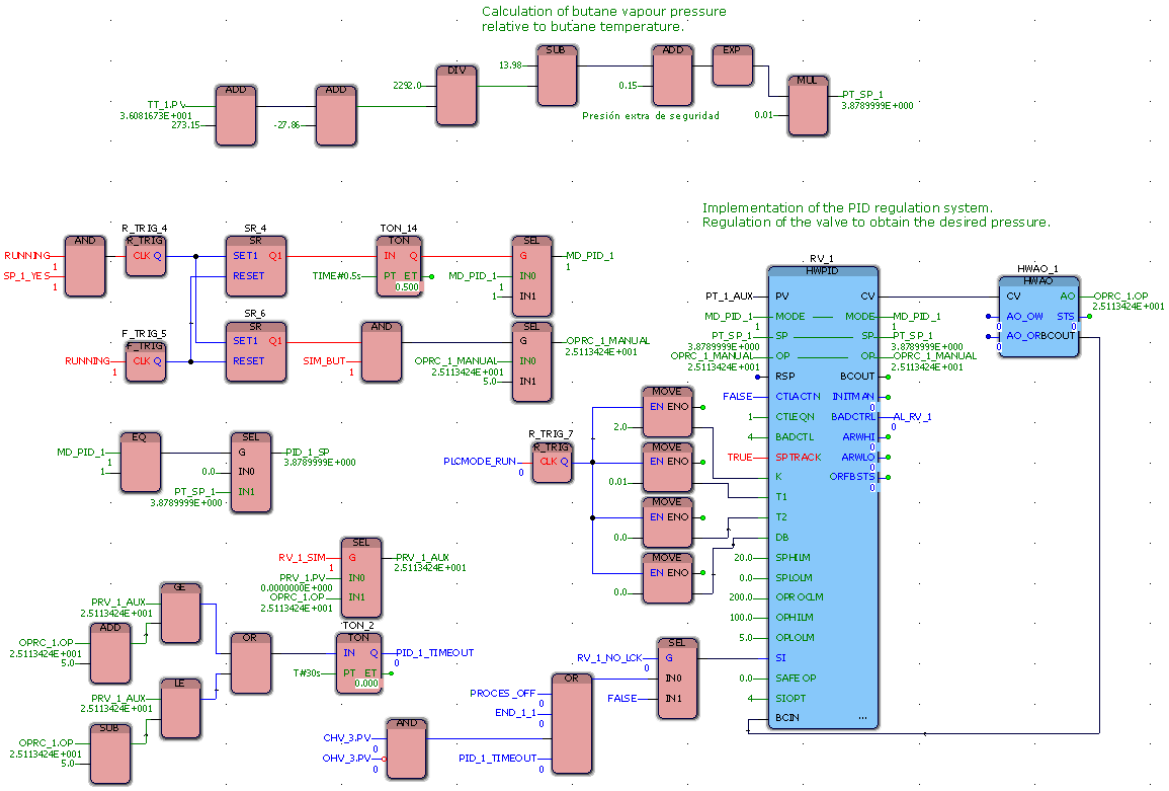
Totalisers and Flow Configuration



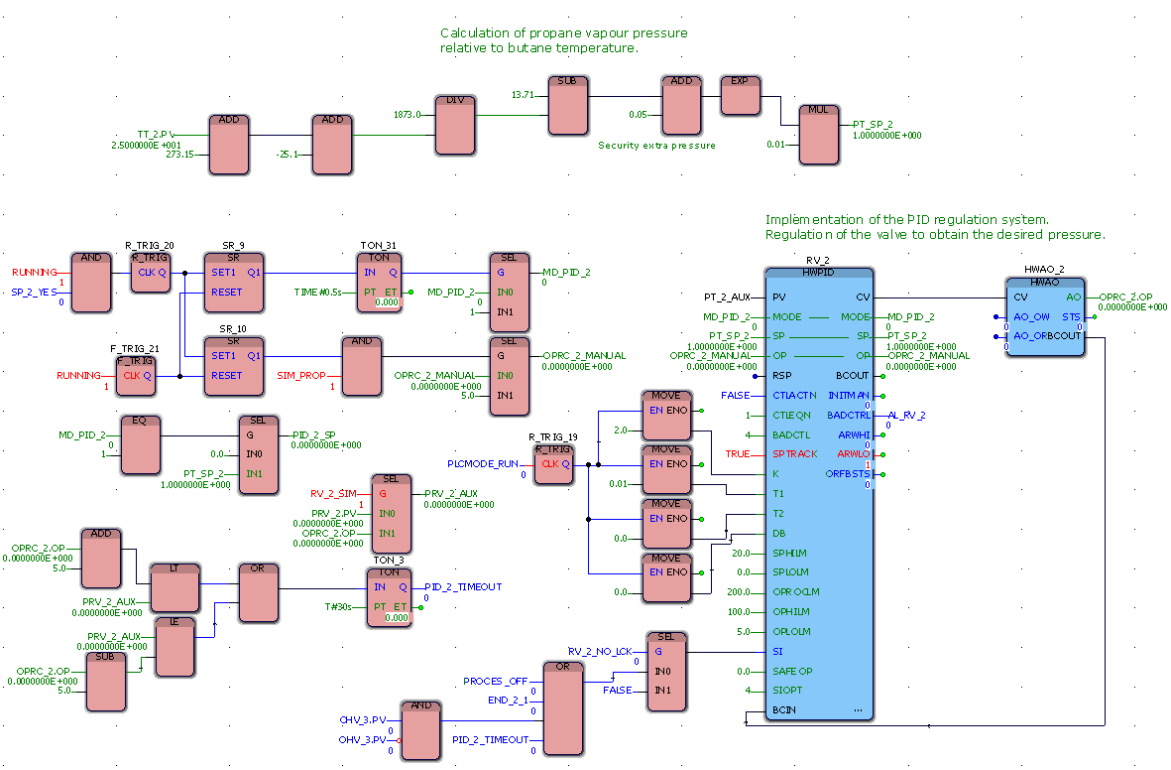




Control PID BUTANO



Control PID PROPANO



Global and I/O variables table:

Name	Type	Usage	Description	Address
ALHV_1	BOOL	VAR_GLOBAL	BUTANE automatic valve general alarm	
ALHV_2	BOOL	VAR_GLOBAL	PROPANE automatic valve general alarm	
ALHV_3	BOOL	VAR_GLOBAL	UNLOAD automatic valve general alarm	
ALR_1	BOOL	VAR_GLOBAL	BUTANE unload alarm valve failure	
ALR_2	BOOL	VAR_GLOBAL	PROPANE unload alarm valve failure	
ALRHV_1	DIGITAL_INPUT_TYPE	VAR_GLOBAL	BUTANE automatic valve Alarm	%IB242
ALRHV_2	DIGITAL_INPUT_TYPE	VAR_GLOBAL	PROPAPANE automatic valve Alarm	%IB244
ALRHV_3	DIGITAL_INPUT_TYPE	VAR_GLOBAL	UNLOAD automatic valve Alarm	%IB246
ALRV_1	DIGITAL_INPUT_TYPE	VAR_GLOBAL	BUTANE Regulator Valve Alarm	%IB266
ALRV_2	DIGITAL_INPUT_TYPE	VAR_GLOBAL	PROPANE Regulator Valve Alarm	%IB268
B_AVAL	BOOL	VAR_GLOBAL	Pumos not avaliable	
CHV_1	DIGITAL_INPUT_TYPE	VAR_GLOBAL	BUTANE automatic valve closed indicator	%IB276
CHV_2	DIGITAL_INPUT_TYPE	VAR_GLOBAL	PROPANE automatic valve closed indicator	%IB278
CHV_3	DIGITAL_INPUT_TYPE	VAR_GLOBAL	UNLOAD automatic valve closed indicator	%IB280
CP_1	DIGITAL_INPUT_TYPE	VAR_GLOBAL	BUTANE pump confirmation	%IB282
CP_2	DIGITAL_INPUT_TYPE	VAR_GLOBAL	PROPANE pump confirmation	%IB284
ESD	DIGITAL_INPUT_TYPE	VAR_GLOBAL	Emergency Shutdown	%IB240
FINISHED	BOOL	VAR_GLOBAL	Status 7	
FT_1	ANALOG_INPUT_TYPE	VAR_GLOBAL	BUTANE flow rate	%IB0
FT_2	ANALOG_INPUT_TYPE	VAR_GLOBAL	PROPANE flow rate	%IB24
GLP_A	REAL	VAR_GLOBAL	Setpoint of total LPG quantity	
GLP_P	REAL	VAR_GLOBAL	BUTANE Percentage in LPG	
HV_1_MD	BOOL	VAR_GLOBAL	BUTANE automatic valve Operating mode	
HV_1_NO_LCK	BOOL	VAR_GLOBAL	BUTANE automatic valve interlocks deactivation	
HV_1_OP	BOOL	VAR_GLOBAL	Open BUTANE automatic valve order in MANUAL mode	
HV_1_PV	INT	VAR_GLOBAL	BUTANE Automatic Valve Status Indicator	
HV_1_SIM	BOOL	VAR_GLOBAL	BUTANE Automatic Valve Simulation Activation	
HV_2_MD	BOOL	VAR_GLOBAL	PROPANE automatic valve Operating mode	
HV_2_NO_LCK	BOOL	VAR_GLOBAL	BUTANE automatic valve interlocks deactivation	
HV_2_OP	BOOL	VAR_GLOBAL	Open PROPANE automatic valve order in MANUAL mode	
HV_2_PV	INT	VAR_GLOBAL	PROPANE Automatic Valve Status Indicator	
HV_2_SIM	BOOL	VAR_GLOBAL	PROPANE Automatic Valve Simulation Activation	
HV_3_MD	BOOL	VAR_GLOBAL	UNLOAD automatic valve Operating mode	
HV_3_NO_LCK	BOOL	VAR_GLOBAL	UNLOAD automatic valve interlocks deactivation	
HV_3_OP	BOOL	VAR_GLOBAL	Open UNLOAD automatic valve order in MANUAL mode	
HV_3_PV	INT	VAR_GLOBAL	UNLOAD Automatic Valve Status Indicator	
HV_3_SIM	BOOL	VAR_GLOBAL	UNLOAD Automatic Valve Simulation Activation	
IDLE	BOOL	VAR_GLOBAL	Status 0	
LOW_M_1	BOOL	VAR_GLOBAL	BUTANE source tank low pressure indicator	
LOW_M_2	BOOL	VAR_GLOBAL	PROPAANE source tank low pressure indicator	

M_P	REAL	VAR_GLOBAL	LPG percentage of loaded mass in relation to SP	
M_SP_1	REAL	VAR_GLOBAL	Desired BUTANE Quantity (Mass)	
M_SP_2	REAL	VAR_GLOBAL	Desired PROPANE Quantity (Mass)	
M_SP_3	REAL	VAR_GLOBAL	Total LPG set point	
MC_1	REAL	VAR_GLOBAL	BUTANE total unloaded mass	
MC_2	REAL	VAR_GLOBAL	PROPANE total unloaded mass	
MC_2_END	REAL	VAR_GLOBAL	Total GLP Load at instant 'i'	
MC_3	REAL	VAR_GLOBAL	LPG total unloaded mass	
MC_P	REAL	VAR_GLOBAL	LPG total percentage	
MC_P_END	REAL	VAR_GLOBAL	Total GLP Ratio at instant 'i'	
MD_PID_1	INT	VAR_GLOBAL	BUTANE PID Operating mode	
MD_PID_2	INT	VAR_GLOBAL	PROPANE PID Operating mode	
MF_1	REAL	VAR_GLOBAL	BUTANE mass flow	
MF_2	REAL	VAR_GLOBAL	PROPANE mass flow	
OHV_1	DIGITAL_INPUT_TYPE	VAR_GLOBAL	BUTANE automatic valve open indicator	%IB270
OHV_2	DIGITAL_INPUT_TYPE	VAR_GLOBAL	PROPANE automatic valve open indicator	%IB272
OHV_3	DIGITAL_INPUT_TYPE	VAR_GLOBAL	UNLOAD automatic valve open indicator	%IB274
OPHV_1	DIGITAL_OUTPUT_TYPE	VAR_GLOBAL	BUTANE automatic valve open order	%QB10
OPHV_1_READBACK	DIGITAL_OUTPUT_READBACK_TYPE	VAR_GLOBAL	BUTANE automatic valve open order	%IB252
OPHV_2	DIGITAL_OUTPUT_TYPE	VAR_GLOBAL	PROPANE automatic valve open order	%QB11
OPHV_2_READBACK	DIGITAL_OUTPUT_READBACK_TYPE	VAR_GLOBAL	PROPANE automatic valve open order	%IB254
OPHV_3	DIGITAL_OUTPUT_TYPE	VAR_GLOBAL	UNLOAD automatic valve open order	%QB12
OPHV_3_READBACK	DIGITAL_OUTPUT_READBACK_TYPE	VAR_GLOBAL	UNLOAD automatic valve open order	%IB256
OPRC_1	ANALOG_OUTPUT_TYPE	VAR_GLOBAL	BUTANE Regulating Valve Position order	%QB0
OPRC_1_MANUAL	REAL	VAR_GLOBAL	Position BUTANE regulating valve order in MANUAL mode	
OPRC_1_READBACK	ANALOG_OUTPUT_READBACK_TYPE	VAR_GLOBAL	BUTANE Regulator Valve Position order	%IB192
OPRC_2	ANALOG_OUTPUT_TYPE	VAR_GLOBAL	PROPANE Regulating Valve Position order	%QB4
OPRC_2_MANUAL	REAL	VAR_GLOBAL	Position PROPANE automatic	
OPRC_2_READBACK	ANALOG_OUTPUT_READBACK_TYPE	VAR_GLOBAL	PROPANE Regulator Valve Position order	%IB216
ORP_1	DIGITAL_OUTPUT_TYPE	VAR_GLOBAL	BUTANE pump run order	%QB8
ORP_1_READBACK	DIGITAL_OUTPUT_READBACK_TYPE	VAR_GLOBAL	BUTANE pump run order	%IB248
ORP_2	DIGITAL_OUTPUT_TYPE	VAR_GLOBAL	PROPANE pump run order	%QB9
ORP_2_READBACK	DIGITAL_OUTPUT_READBACK_TYPE	VAR_GLOBAL	PROPANE pump run order	%IB250
P_1_MD	BOOL	VAR_GLOBAL	BUTANE pump Operating mode	
P_1_NO_LCK	BOOL	VAR_GLOBAL	BUTANE pump interlocks deactivation	
P_1_OP	INT	VAR_GLOBAL	Run BUTANE pump order in MANUAL mode	
P_1_PV	INT	VAR_GLOBAL	BUTANE pump Status Indicator	
P_1_SIM	BOOL	VAR_GLOBAL	BUTANE pump Simulation Activation	
P_2_MD	BOOL	VAR_GLOBAL	PROPANE pump Operating mode	
P_2_NO_LCK	BOOL	VAR_GLOBAL	PROPANE pump interlocks deactivation	
P_2_OP	INT	VAR_GLOBAL	Run PROPANE pump order in MANUAL mode	
P_2_PV	INT	VAR_GLOBAL	PROPANE pump Status Indicator	
P_2_SIM	BOOL	VAR_GLOBAL	PROPANE pump Simulation Activation	

PAUSE	BOOL	VAR_GLOBAL	Pause Process Order	
PAUSED	BOOL	VAR_GLOBAL	Status 4	
PAUSING	BOOL	VAR_GLOBAL	Status 3	
PID_1_SP	REAL	VAR_GLOBAL	BUTANE automatic regulating valve SP mode PID_1	
PID_1_TIMEOUT	BOOL	VAR_GLOBAL	BUTANE regulating valve Timeout indicator PID_1	
PID_2_SP	REAL	VAR_GLOBAL	PROPANE automatic regulating valve SP mode PID_2	
PID_2_TIMEOUT	BOOL	VAR_GLOBAL	PROPANE regulating valve Timeout indicator PID_2	
PL_1	DIGITAL_INPUT_TYPE	VAR_GLOBAL	BUTANE tank low pressure indicator	%IB258
PL_2	DIGITAL_INPUT_TYPE	VAR_GLOBAL	PROPANE tank low pressure indicator	%IB260
PROCES_OFF	BOOL	VAR_GLOBAL	Process interlocks	
PRV_1	ANALOG_INPUT_TYPE	VAR_GLOBAL	BUTANE Regulating Valve Position	%IB144
PRV_1_AUX	REAL	VAR_GLOBAL	AUXILIAR BUTANE Regulating Valve Position	
PRV_2	ANALOG_INPUT_TYPE	VAR_GLOBAL	PROPANE Regulating Valve Position	%IB168
PRV_2_AUX	REAL	VAR_GLOBAL	AUXILIAR PROPANE Regulating Valve Position	
PT_1	ANALOG_INPUT_TYPE	VAR_GLOBAL	BUTANE pressure	%IB96
PT_1_AUX	ANALOG_TYPE	VAR_GLOBAL	Writing Auxiliar ANALOG_TYPE	
PT_2	ANALOG_INPUT_TYPE	VAR_GLOBAL	PROPANE pressure	%IB120
PT_SP_1	REAL	VAR_GLOBAL	BUTANE calculated pressure SP	
PT_SP_2	REAL	VAR_GLOBAL	PROPANE calculated pressure SP	
PT_SP_AUTO_1	REAL	VAR_GLOBAL	BUTANE pressure SP in AUTO mode	
PT_SP_AUTO_2	REAL	VAR_GLOBAL	PROPANE pressure SP in AUTO mode	
RESTARTING	BOOL	VAR_GLOBAL	Status 6	
RUN	BOOL	VAR_GLOBAL	Running Process	
RUNNING	BOOL	VAR_GLOBAL	Status 2	
RV_1_NO_LCK	BOOL	VAR_GLOBAL	BUTANE regulating valve interlocks deactivation	
RV_1_SIM	BOOL	VAR_GLOBAL	BUTANE Regulating Valve Simulation Activation	
RV_2_NO_LCK	BOOL	VAR_GLOBAL	PROPANE regulating valve interlocks deactivation	
RV_2_SIM	BOOL	VAR_GLOBAL	PROPANE Regulating Valve Simulation Activation	
SIM_RUN	BOOL	VAR_GLOBAL	Simulation running	
SIM_START	BOOL	VAR_GLOBAL	Simulation activation	
SIM_STOP	BOOL	VAR_GLOBAL	Simulation deactivation	
START	BOOL	VAR_GLOBAL	Start up process	
STARTING	BOOL	VAR_GLOBAL	Status 1	
STATUS	INT	VAR_GLOBAL	Process Status indicator	
STOP_O	BOOL	VAR_GLOBAL	Stop process order	
STOPPING	BOOL	VAR_GLOBAL	Status 5	
TIME_LPG	REAL	VAR_GLOBAL	Total LPG Download Time	
TP_1	DIGITAL_INPUT_TYPE	VAR_GLOBAL	BUTANE pump fail indicator	%IB286
TP_2	DIGITAL_INPUT_TYPE	VAR_GLOBAL	PROPANE pump fail indicator	%IB288
TT_1	ANALOG_INPUT_TYPE	VAR_GLOBAL	BUTANE temperature	%IB48
TT_2	ANALOG_INPUT_TYPE	VAR_GLOBAL	PROPANE temperature	%IB72

A3. HMIWeb Display Builder scripts

- **Automatic regulating valve:**
  - **General.**

```
sub inline_SI_onupdate(elem)

 dim varLock

 set varLock = elem.parentElement.parentElement.Objects("Lock")

 if (elem.value = 1) then
  varLock.style.visibility = "visible"
 else
  varLock.style.visibility = "hidden"
 end if

end sub

sub inline_AL1_onupdate(elem)

 dim varAl1

 set varAl1 = elem.parentElement.parentElement.Objects("Alarm")

 if (elem.value = 1) then
  varAl1.style.visibility = "visible"
 else
  varAl1.style.visibility = "hidden"
 end if

end sub

sub inline_SIM_onupdate(elem)

 dim varSim

 set varSim = elem.parentElement.parentElement.Objects("Simulation")
```

```
 if (elem.value = 1) then
  varSim.style.visibility = "visible"
 else
  varSim.style.visibility = "hidden"
 end if

end sub

sub inline_NOLCK_onupdate(elem)

 dim varNOLCK

 set varNOLCK = elem.parentElement.parentElement.Objects("Nolock")

 if (elem.value = 1) then
  varNOLCK.style.visibility = "visible"
 else
  varNOLCK.style.visibility = "hidden"
 end if

end sub

sub inline_AL2_onupdate(elem)

 dim varAl2

 set varAl2 = elem.parentElement.parentElement.Objects("Timeout")

 if (elem.value = 1) then
  varAl2.style.visibility = "visible"
 else
  varAl2.style.visibility = "hidden"
 end if

end sub
```

```
sub inline_MD_onupdate(elem)

 dim varMD

 set varMD = elem.parentElement.parentElement.Objects("cascada")

 if (elem.value = 2) then
  varMD.style.visibility = "visible"
 else
  varMD.style.visibility = "hidden"
 end if

end sub
```

- **Objects:**

```
Sub AL1_onupdate

call inline_AL1_onupdate(me)

End Sub

Sub NOLCK_onupdate

call inline_NOLCK_onupdate(me)

End Sub

Sub SI_onupdate

call inline_SI_onupdate(me)

End Sub

Sub AL2_onupdate

call inline_AL2_onupdate(me)
```

```
End Sub

Sub MD_onupdate

call inline_MD_onupdate(me)

End Sub

Sub SIM_onupdate

call inline_SIM_onupdate(me)

End Sub
```

- **Two-state automatic valve:**
  - **General:**

```
sub inline_SI_onupdate(elem)

 dim varLock

 set varLock = elem.parentElement.parentElement.Objects("Lock")

 if (elem.value = 1) then
  varLock.style.visibility = "visible"
 else
  varLock.style.visibility = "hidden"
 end if

end sub

sub inline_AL1_onupdate(elem)

 dim varAl

 set varAl = elem.parentElement.parentElement.Objects("Alarm")
```

```
  if (elem.value = 1) then
   varAl.style.visibility = "visible"
  else
   varAl.style.visibility = "hidden"
  end if

end sub

sub inline_SIM_onupdate(elem)

  dim varSim

  set varSim = elem.parentElement.parentElement.Objects("Simulation")

  if (elem.value = 1) then
   varSim.style.visibility = "visible"
  else
   varSim.style.visibility = "hidden"
  end if

end sub

sub inline_NOLCK_onupdate(elem)

  dim varNOLCK

  set varNOLCK = elem.parentElement.parentElement.Objects("Nolock")

  if (elem.value = 1) then
   varNOLCK.style.visibility = "visible"
  else
   varNOLCK.style.visibility = "hidden"
  end if

end sub
```

- **Objects:**

```
Sub AL1_onupdate

call inline_AL1_onupdate(me)

End Sub

Sub NOLCK_onupdate

call inline_NOLCK_onupdate(me)

End Sub

Sub SI_onupdate

call inline_SI_onupdate(me)

End Sub

Sub SIM_onupdate

call inline_SIM_onupdate(me)

End Sub
```

- **Two-state automatic pump:**
  - **General:**

```
sub inline_SI_onupdate(elem)

 dim varLock

 set varLock = elem.parentElement.parentElement.Objects("Lock")

 if (elem.value = 1) then
  varLock.style.visibility = "visible"
 else
  varLock.style.visibility = "hidden"
```

```
  end if

end sub

sub inline_AL1_onupdate(elem)

  dim varAl

  set varAl = elem.parentElement.parentElement.Objects("Alarm")

  if (elem.value = 1) then
   varAl.style.visibility = "visible"
  else
   varAl.style.visibility = "hidden"
  end if

end sub

sub inline_SIM_onupdate(elem)

  dim varSim

  set varSim = elem.parentElement.parentElement.Objects("Simulation")

  if (elem.value = 1) then
   varSim.style.visibility = "visible"
  else
   varSim.style.visibility = "hidden"
  end if

end sub

sub inline_NOLCK_onupdate(elem)

  dim varNOLCK

  set varNOLCK = elem.parentElement.parentElement.Objects("Nolock")
```

```
 if (elem.value = 1) then
  varNOLCK.style.visibility = "visible"
 else
  varNOLCK.style.visibility = "hidden"
 end if

end sub
```

- **Objects:**

```
Sub AL1_onupdate

call inline_AL1_onupdate(me)

End Sub

Sub NOLCK_onupdate

call inline_NOLCK_onupdate(me)

End Sub

Sub SI_onupdate

call inline_SI_onupdate(me)

End Sub

Sub SI_onupdate

call inline_SI_onupdate(me)

End Sub
```

- **Status viewer:**
  - **General:**

```
sub inline_num_onupdate(elem)

 dim varLock

 set varLock = elem.parentElement.parentElement.Objects("text")

 if (elem.value = 1) then
  varLock.style.visibility = "visible"
 else
  varLock.style.visibility = "hidden"
 end if

end sub
```

  - **Object:**

```
Sub num_onupdate

call inline_num_onupdate(me)

End Sub
```

- **Main display:**
  - **Control Buttons:**

```
Sub Start_onclick

        numero_start.value = 1

End Sub

Sub Stop_onclick

        numero_stop.value = 1
```

```
End Sub

Sub Pause_onclick

    numero_pause.value = 1

End Sub
```

- **Report:**

```
Sub numpv_onupdate

    if numpv.value = 1 then
        pushbutton003.style.visibility = "visible"
    else
        pushbutton003.style.visibility = "hidden"
    end if

End Sub
```

A4. Quick Builder

- **HV_1 User defined parameters:**

Parameter Na...	Link Type	Value Type	Value or Reference
AL1	Scanned - Status		PLC_1 N EDGPLC $ "DftInst.HV_1.ZA"
NO_LCK	Scanned - Status		PLC_1 N EDGPLC $ "@GV.HV_1_NO_LCK"
SI	Scanned - Status		PLC_1 N EDGPLC $ "DftInst.HV_1.SI"
SIM	Scanned - Status		PLC_1 N EDGPLC $ "@GV.HV_1_SIM"

- **HV_2 User defined parameters:**

Parameter Na...	Link Type	Value Type	Value or Reference
AL1	Scanned - Status		PLC_1 N EDGPLC $ "DftInst.HV_2.ZA"
NO_LCK	Scanned - Status		PLC_1 N EDGPLC $ "@GV.HV_2_NO_LCK"
SI	Scanned - Status		PLC_1 N EDGPLC $ "DftInst.HV_2.SI"
SIM	Scanned - Status		PLC_1 N EDGPLC $ "@GV.HV_2_SIM"

- **HV_3 User defined parameters:**

Parameter Na...	Link Type	Value Type	Value or Reference
AL1	Scanned - Status		PLC_1 N EDGPLC $ "DftInst.HV_3.ZA"
NO_LCK	Scanned - Status		PLC_1 N EDGPLC $ "@GV.HV_3_NO_LCK"
SI	Scanned - Status		PLC_1 N EDGPLC $ "DftInst.HV_3.SI"
SIM	Scanned - Status		PLC_1 N EDGPLC $ "@GV.HV_3_SIM"

- **P_1 User defined parameters:**

Parameter Na...	Link Type	Value Type	Value or Reference
AL1	Scanned - Status		PLC_1 N EDGPLC $ "DftInst.P_1.ZA"
NO_LCK	Scanned - Status		PLC_1 N EDGPLC $ "@GV.P_1_NO_LCK"
SI	Scanned - Status		PLC_1 N EDGPLC $ "DftInst.P_1.SI"
SIM	Scanned - Status		PLC_1 N EDGPLC $ "@GV.P_1_SIM"

- **P_2 User defined parameters:**

Parameter Na...	Link Type	Value Type	Value or Reference
AL1	Scanned - Status		PLC_1 N EDGPLC $ "DftInst.P_2.ZA"
NO_LCK	Scanned - Status		PLC_1 N EDGPLC $ "@GV.P_2_NO_LCK"
SI	Scanned - Status		PLC_1 N EDGPLC $ "DftInst.P_2.SI"
SIM	Scanned - Status		PLC_1 N EDGPLC $ "@GV.P_2_SIM"

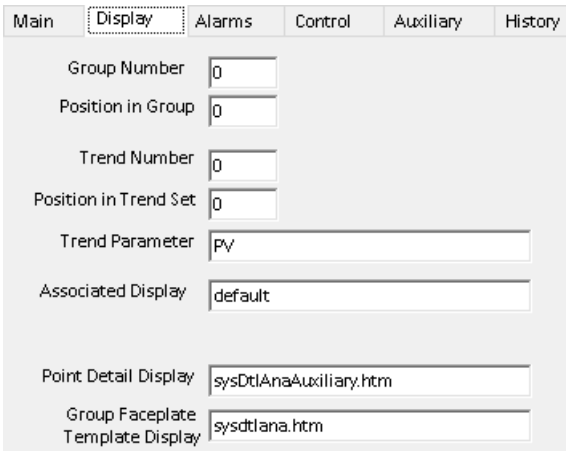
- **RV_1 User defined parameters:**

Parameter Na...	Link Type	Value Type	Value or Reference
ALARM	Scanned - Status		PLC_1 N EDGPLC $ "DftInst.RV_1.BADCTRL"
NO_LCK	Scanned - Status		PLC_1 P:RV_1_NO_LCK PV
OP_1	Scanned - Analog		PLC_1 N EDGPLC $ @GV.OPRC_1.OP
PV_1	Scanned - Analog		PLC_1 N EDGPLC $ "@GV.PRV_1_AUX"
SI	Scanned - Status		PLC_1 N EDGPLC $ "DftInst.RV_1.SI"
SIM	Scanned - Status		PLC_1 P:RV_1_SIM PV
TIMEOUT	Scanned - Status		PLC_1 P:PID_1_TIMEOUT PV

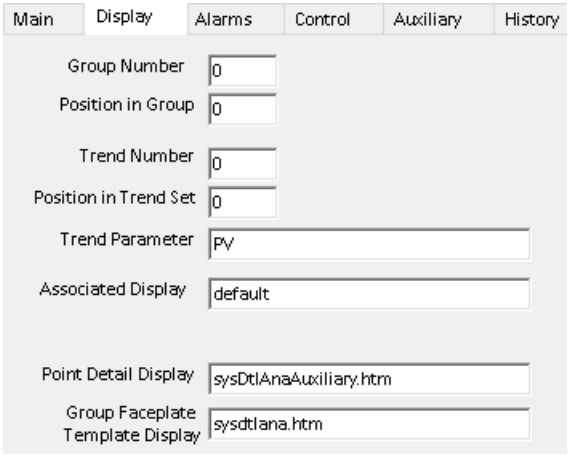
- **RV_1 User defined parameters:**

Parameter Na...	Link Type	Value Type	Value or Reference
ALARM	Scanned - Status		PLC_1 N EDGPLC $ "DftInst.RV_2.BADCTRL"
NO_LCK	Scanned - Status		PLC_1 P:RV_2_NO_LCK PV
OP_1	Scanned - Analog		PLC_1 N EDGPLC $ @GV.OPRC_2.OP
PV_1	Scanned - Analog		PLC_1 N EDGPLC $ "@GV.PRV_2_AUX"
SI	Scanned - Status		PLC_1 N EDGPLC $ "DftInst.RV_2.SI"
SIM	Scanned - Status		PLC_1 P:RV_2_SIM PV
TIMEOUT	Scanned - Status		PLC_1 P:PID_2_TIMEOUT PV

- **RV_1_CONF Display configuration:**



- **RV_2_CONF Display configuration:**



A5. Data tables

- Simulation Test Error data table:

Test number	% SP	Kg SP	% Report	Kg Report	% Abs_error	Kg Abs_error
1	100,00	400,00	100,00	385,48	0,00	0,04
2	100,00	500,00	100,00	515,02	0,00	15,02
3	100,00	100,00	100,00	83,17	0,00	16,83
4	100,00	100,00	100,00	93,01	0,00	6,99
5	100,00	500,00	100,00	504,56	0,00	4,56
6	100,00	200,00	100,00	182,36	0,00	17,64
7	100,00	500,00	100,00	486,35	0,00	13,65
8	100,00	400,00	100,00	411,69	0,00	11,69
9	100,00	400,00	100,00	401,19	0,00	1,19
10	100,00	500,00	100,00	486,64	0,00	13,36
11	100,00	100,00	100,00	109,61	0,00	9,61
12	100,00	300,00	100,00	286,28	0,00	13,72
13	100,00	200,00	100,00	183,55	0,00	16,45
14	100,00	100,00	100,00	84,24	0,00	15,76
15	100,00	200,00	100,00	212,65	0,00	12,65
16	100,00	500,00	100,00	487,19	0,00	12,81
17	100,00	100,00	100,00	101,57	0,00	1,57
18	100,00	500,00	100,00	518,71	0,00	18,71
19	100,00	400,00	100,00	398,06	0,00	1,94
20	100,00	100,00	100,00	110,85	0,00	10,85
21	100,00	300,00	100,00	292,35	0,00	7,65
22	100,00	200,00	100,00	198,29	0,00	1,71
23	100,00	500,00	100,00	489,40	0,00	10,60
24	100,00	500,00	100,00	514,87	0,00	14,87
25	100,00	100,00	100,00	103,28	0,00	3,28
26	100,00	300,00	100,00	309,91	0,00	9,91
27	100,00	300,00	100,00	298,90	0,00	1,10
28	100,00	400,00	100,00	411,09	0,00	11,09
29	100,00	300,00	100,00	302,12	0,00	2,12
30	100,00	200,00	100,00	208,79	0,00	8,79
31	100,00	300,00	100,00	306,40	0,00	6,40
32	100,00	100,00	100,00	114,20	0,00	14,20
33	0,00	400,00	0,00	385,48	0,00	14,52
34	0,00	500,00	0,00	513,79	0,00	13,79
35	0,00	100,00	0,00	103,12	0,00	3,12
36	0,00	100,00	0,00	105,74	0,00	5,74
37	0,00	400,00	0,00	399,60	0,00	0,40
38	0,00	100,00	0,00	101,52	0,00	1,52

39	0,00	500,00	0,00	497,53	0,00	2,47
40	0,00	300,00	0,00	290,26	0,00	9,74
41	0,00	200,00	0,00	208,63	0,00	8,63
42	0,00	400,00	0,00	398,65	0,00	1,35
43	0,00	200,00	0,00	204,33	0,00	4,33
44	0,00	200,00	0,00	199,54	0,00	0,46
45	0,00	500,00	0,00	492,16	0,00	7,84
46	50,00	200,00	47,83	200,94	2,17	0,94
47	50,00	300,00	53,52	296,12	3,52	3,88
48	50,00	300,00	54,50	300,29	4,50	0,29
49	50,00	400,00	48,06	399,41	1,94	0,59
50	50,00	100,00	42,54	100,86	7,46	0,86
51	50,00	400,00	53,77	404,62	3,77	4,62
52	60,00	600,00	53,10	599,46	6,90	0,54
53	60,00	200,00	67,27	201,59	7,27	1,59
54	60,00	400,00	58,97	396,54	1,03	3,46
55	40,00	300,00	41,53	304,06	1,53	4,06
56	40,00	400,00	31,70	398,18	8,30	1,82
57	40,00	200,00	43,56	204,54	3,56	4,54
58	73,00	400,00	70,72	404,12	2,28	4,12
59	23,00	600,00	17,54	601,85	5,46	1,85
60	28,00	300,00	25,81	299,63	2,19	0,37
61	82,00	200,00	86,67	203,96	4,67	3,96
62	95,00	600,00	98,76	601,40	3,76	1,40
63	13,00	400,00	11,20	400,34	1,80	0,34
64	45,00	300,00	48,46	304,04	3,46	4,04
65	26,00	300,00	27,53	297,13	1,53	2,87
66	83,00	200,00	79,17	200,75	3,83	0,75
67	9,00	400,00	8,66	399,45	0,34	0,55
68	2,00	400,00	-1,57	399,34	3,57	0,66
69	12,00	400,00	16,77	398,18	4,77	1,82
70	36,00	400,00	41,00	401,55	5,00	1,55
71	94,00	200,00	95,86	199,51	1,86	0,49
72	2,00	200,00	-1,80	200,27	3,80	0,27
73	16,00	400,00	12,85	398,73	3,15	1,27
74	87,00	300,00	86,95	299,29	0,05	0,71
75	84,00	600,00	83,01	598,13	0,99	1,87
76	31,00	300,00	33,94	301,97	2,94	1,97
77	22,00	200,00	22,30	201,17	0,30	1,17
78	30,00	400,00	30,36	401,36	0,36	1,36
79	26,00	300,00	25,32	299,50	0,68	0,50
80	30,00	600,00	30,69	599,36	0,69	0,64
81	92,00	600,00	90,48	601,96	1,52	1,96
82	38,00	600,00	39,81	601,58	1,81	1,58

83	7,00	400,00	5,87	399,69	1,13	0,31
84	83,00	600,00	81,57	599,12	1,43	0,88
85	25,00	200,00	23,43	200,07	1,57	0,07
86	66,00	500,00	67,01	500,90	1,01	0,90
87	84,00	400,00	85,43	400,41	1,43	0,41
88	92,00	600,00	93,33	600,78	1,33	0,78
89	87,00	200,00	85,51	199,65	1,49	0,35
90	17,00	200,00	15,87	199,56	1,13	0,44
91	28,00	200,00	27,53	200,41	0,47	0,41
92	83,00	600,00	82,74	600,86	0,26	0,86
93	18,00	400,00	18,29	399,07	0,29	0,93
94	48,00	300,00	48,48	299,66	0,48	0,34
95	68,00	600,00	68,16	600,02	0,16	0,02
96	14,00	400,00	13,52	400,57	0,48	0,57
97	53,00	400,00	52,70	400,15	0,30	0,15
98	76,00	400,00	76,54	399,82	0,54	0,18
99	95,00	500,00	94,91	499,22	0,09	0,78
100	100,00	600,00	100,29	600,80	0,29	0,80