

Asean-factori

Lab Siemens (Following2.) Grafcet Implementation

Autor : KAMMAH Oumaima

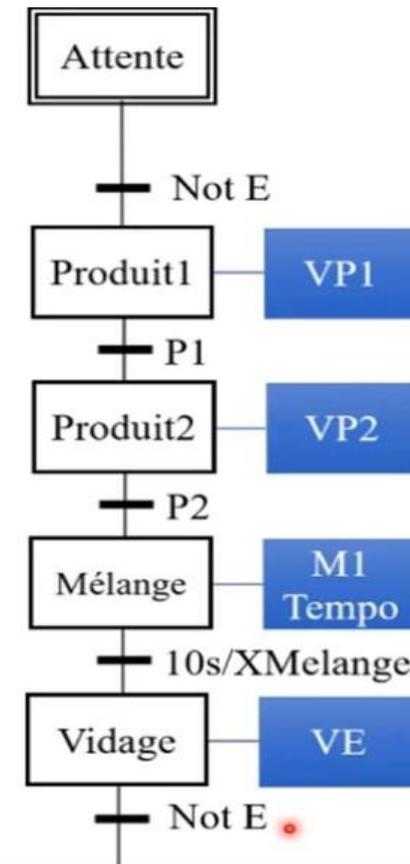
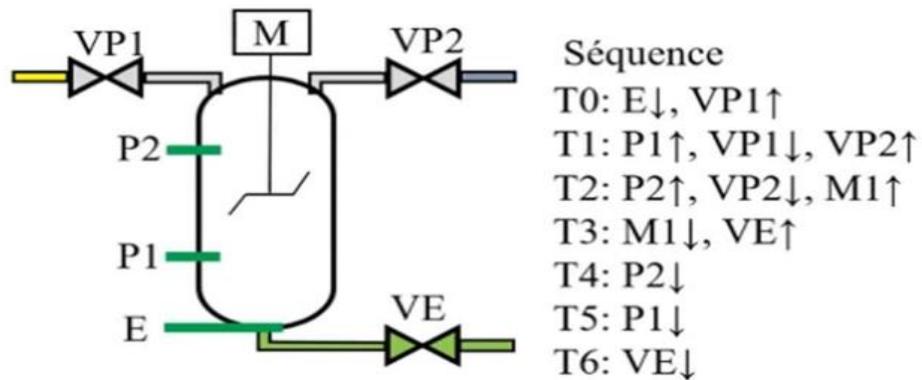
Supervised by: Jean-Marc THIRIET

[Asean-Factori \(grenoble-inp.fr\)](http://www.gipsa-lab.grenoble-inp.fr/~jean-marc.thiriet/asean/asean.html)



<http://www.gipsa-lab.grenoble-inp.fr/~jean-marc.thiriet/asean/asean.html>

- This set of slides follows the set of slides 2.PLC with the implementation of the following Grafcet



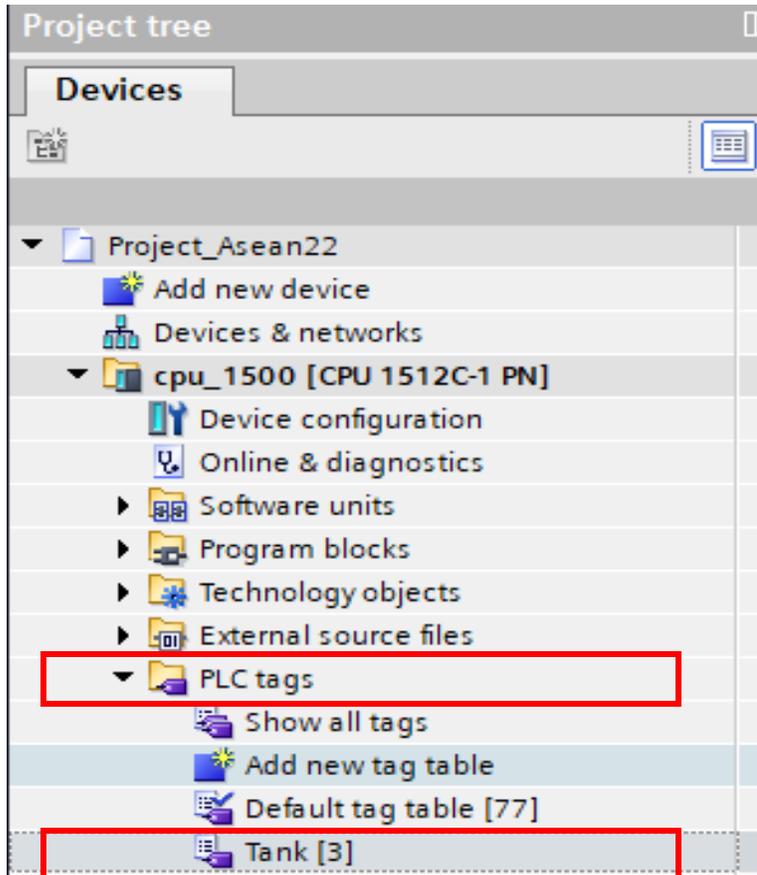
Insert inputs /Output in TIA Portal PLC Tags → Add new tag table

- Definitions of the 4 outputs (same manners)

Tank										
		Name	Data type	Address	Retain	Acces...	Writa...	Visibl...	Supervis...	Comment
1		E	Bool	%I0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		empty
2		P1	Bool	%I0.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		min_level
3		P2	Bool	%I0.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		max_level
4		M	Bool	%Q0.3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Motor
5		VP1	Bool	%Q0.4	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		valve_yellow
6		VP2	Bool	%Q0.5	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		valve_blue
7		VE	Bool	%Q0.7	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		drain valve(green)

Insert inputs /Output in TIA Portal PLC Tags → Add new tag table

- Add Oue 3 inputs



Project_Asean22 ▶ cpu_1500 [CPU 1512C-1 PN] ▶ PLC tags ▶ Tank [3]

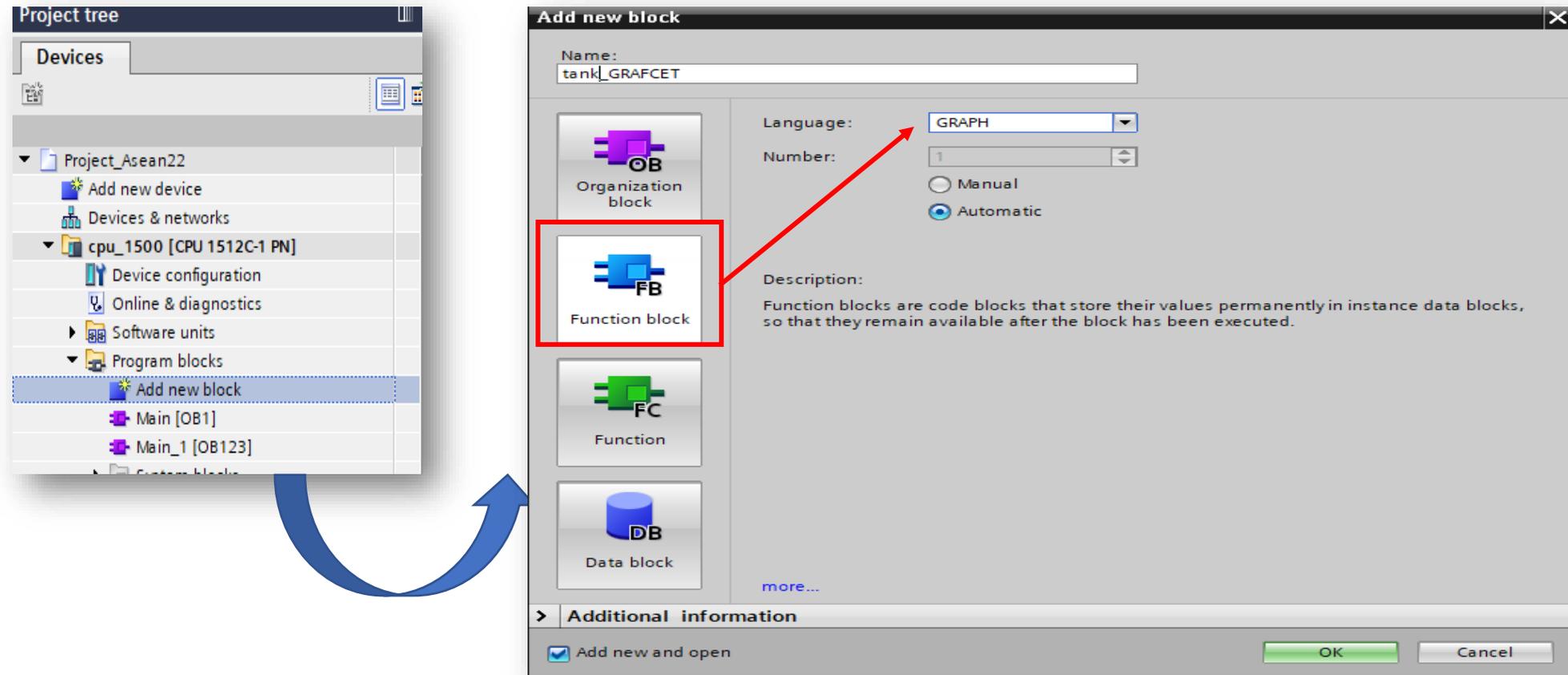
Tank

	Name	Data type	Address	Retain	Acces...	Writa...	Visibl...	Supervis...	Comment
1	E	Bool	%I0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		empty
2	P1	Bool	%I0.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		min_level
3	P2	Bool	%I0.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		max_level
4	<Add new>			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		

Implementation of the Grafcet programmes

To create our Grafcet on TIA Portal v15(Siemens)

- Click on Programs blocks --> Add new block --> Define Name--> Select SCL Language



Implementation of the Grafcet programmes

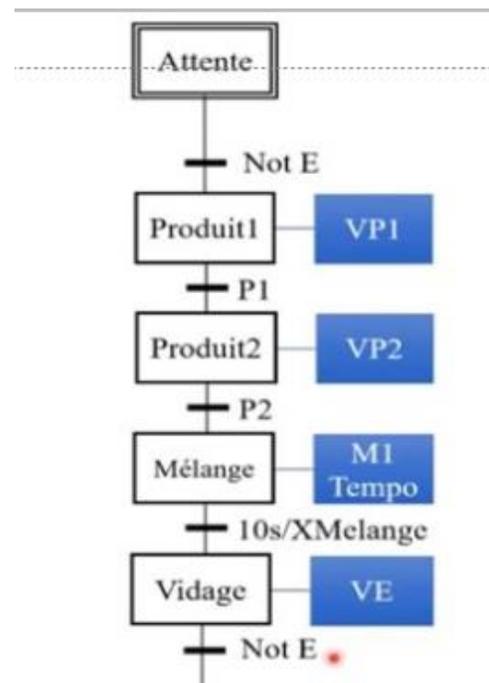
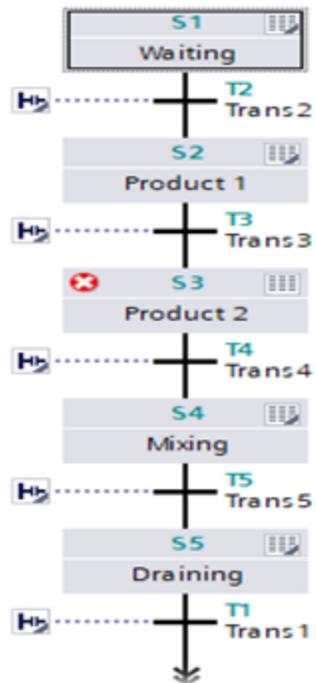
- Click on Programs blocks --> Add new block --> Define Name--> Select SCL Language
- Click OK--> The editing area for the steps and transitions is opened-->We start drawing our behavioural part of the Grafcet

The screenshot shows the 'tank_GRAFCET' software interface. At the top, there is a table with columns: Name, Data type, Default value, Retain, and Access. Below the table is a 'Navigation' panel on the left, which includes a tree view showing 'Sequences (1)' and '1: <new sequence>'. The main editing area on the right displays a state diagram with a state box labeled 'S1 Step1' and a transition labeled 'T1 Trans1'. A red 'X' icon and the text '1: <new sequence>' are visible at the top of the editing area. A red text box on the right side of the diagram contains the following text:

The first state is already created
« Step 1 » then mark « initial state »

Implementation of the Grafcet programmes

- Click on Programs blocks --> Add new block --> Define Name--> Select SCL Language
- Click OK--> The editing area for the steps and transitions is opened-->We start drawing our behavioural part of the Grafcet



- Creation in the chart of the states equivalent states of « Produit1 »,« Produit2 », « Mélange » and « Vidange »

Implementation of the Grafcet programmes

- Implementation of the transitions by double clicking between two states on transition

S1 - [Initial step]: Waiting

Comment

▶ Interlock -(c)-:

▶ Supervision -(v)-:

▼ Actions:

Interlock	Event	Qualifier	Action
		<Add new>	

▼ T2: E

Comment

#E.TV

**This window is opened
We define transition T2 name as follows and we grab a contact NC (not E) and we drop it in line**

Implementation of the Grafcet programmes

- Implementation of the transitions by double clicking between two states on transition

S1 - [Initial step]: Waiting

Comment

► Interlock -(c)-:

► Supervision -(v)-:

▼ Actions:

Interlock	Event	Qualifier	Action
		<Add new>	

▼ T2: E

Comment

#	Event	Qualifier	Action
<01	TS	Bool	Transition switches
<01	TT	Bool	Transition is satisfied
<01	TV	Bool	Transition is valid

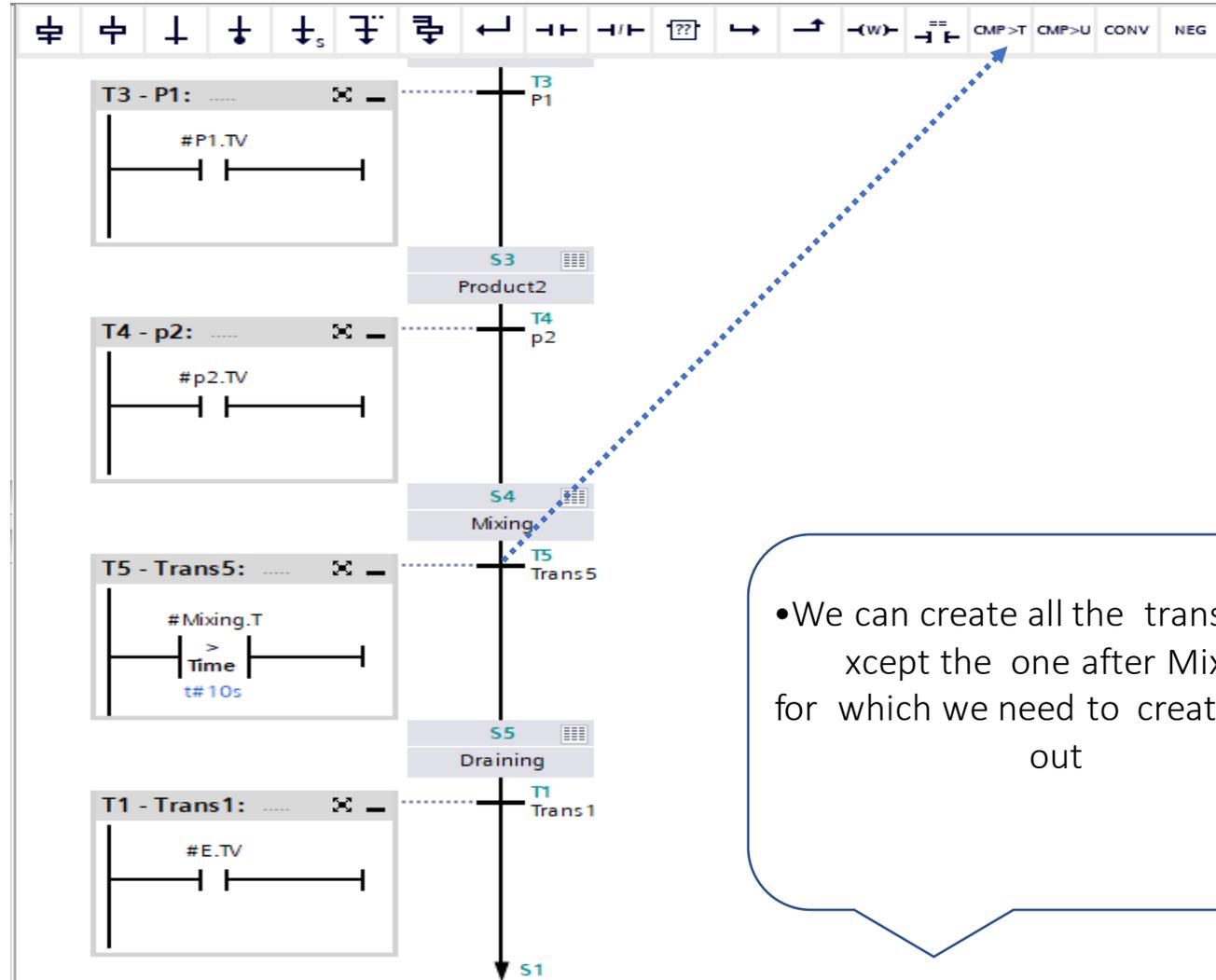
Then we select our variable by writing the name and we select transition is valid

- First transition is « E »
- It should be « inversed » because this is actually « not E »

Implementation of the Grafcet programmes

- Implementation of the transitions by double clicking between two states on transition

Mixing is running for 10s as soon as time is bigger than 10s mixing is deactivate



- We can create all the transitions, except the one after Mixing for which we need to create a time out

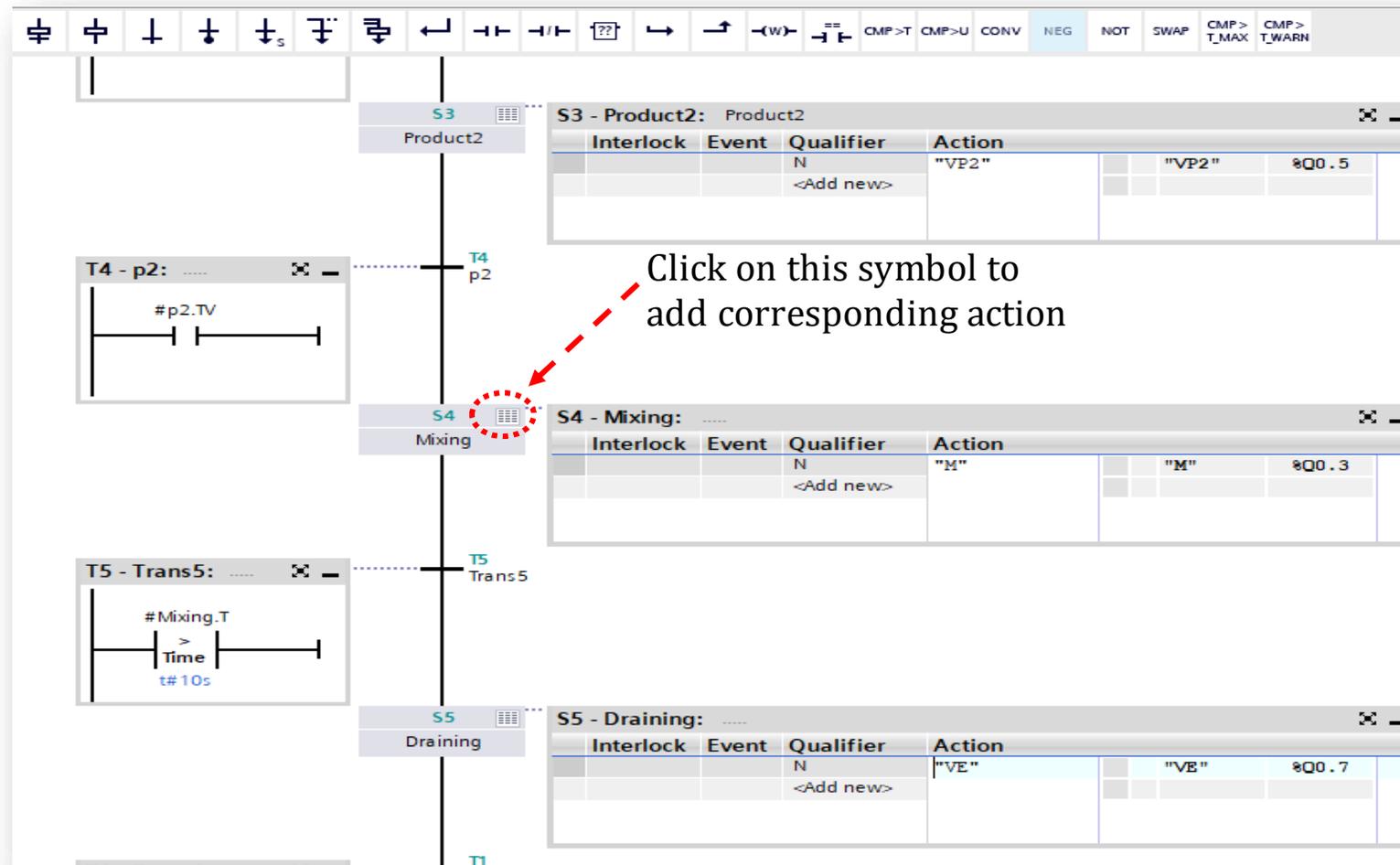
Implementation of the Grafcet programmes

- Implementation of the Actions by double clicking on corresponding step

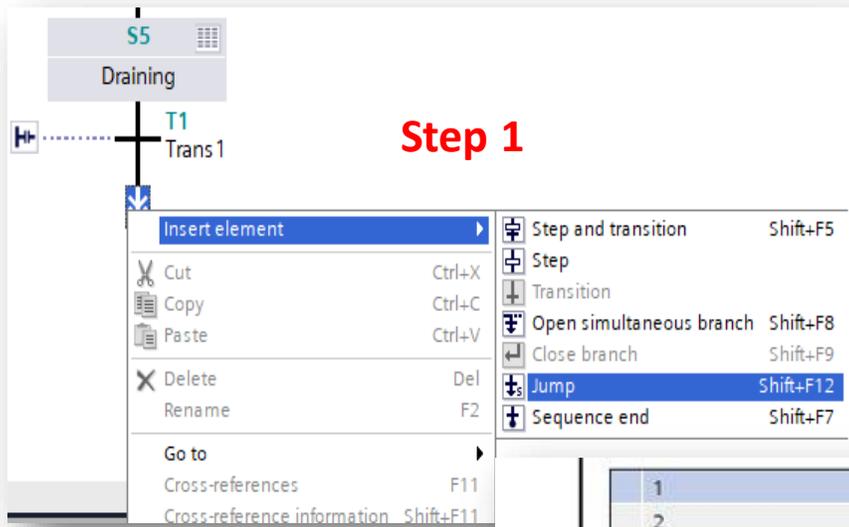
The screenshot displays the Grafcet software interface. On the left, a navigation tree shows a sequence of steps: S1 (Waiting), S2 (Product 1), S3 (Product 2), S4 (Mixing), S5 (Draining), and T1 (Trans1). The main workspace shows the configuration for step S2: Product 1. A red box highlights the 'Actions: Product1' section, which contains a table with columns for Interlock, Event, Qualifier, and Action. A dropdown menu is open over the Qualifier column, listing various actions such as 'CU - Count up', 'D - On delay', 'L - Set for limited time', 'N - Set as long as step is active', 'ON - Activate step', 'OFF - Deactivate step', 'R - Set to 0', 'S - Set to 1', 'TD - Retentive on delay', 'TF - Turn off timer', 'TL - Extended pulse', and 'TR - Hold timer and reset'. The 'N' option is selected. Below the table, a ladder logic diagram shows a normally open contact labeled '#P1.TV' leading to a coil labeled 'T3 P1'. A label 'Product2 S3' is positioned near the coil.

Implementation of the Grafcet programmes

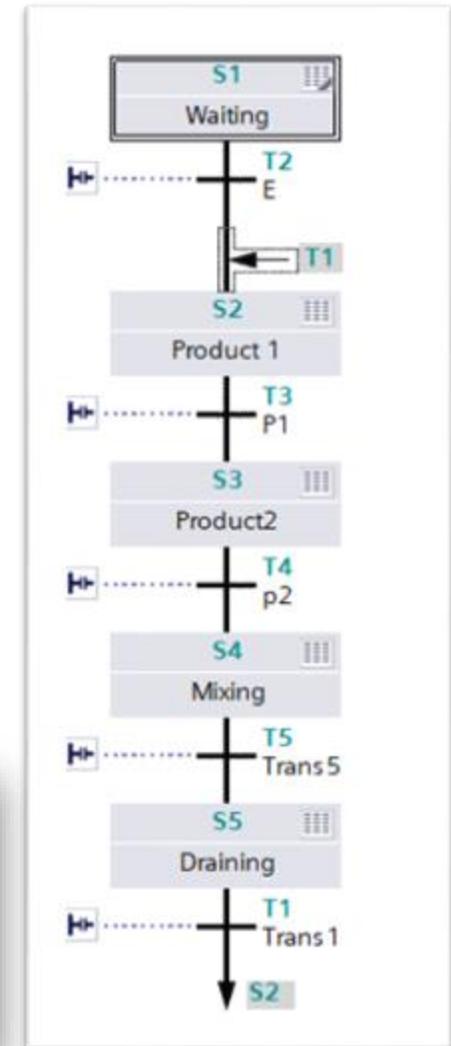
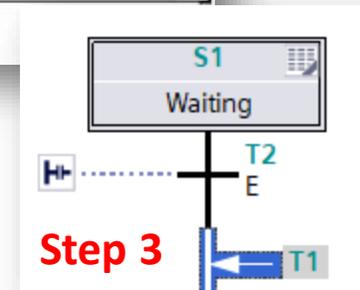
- Implementation of the Actions directly by clicking right on the top of state



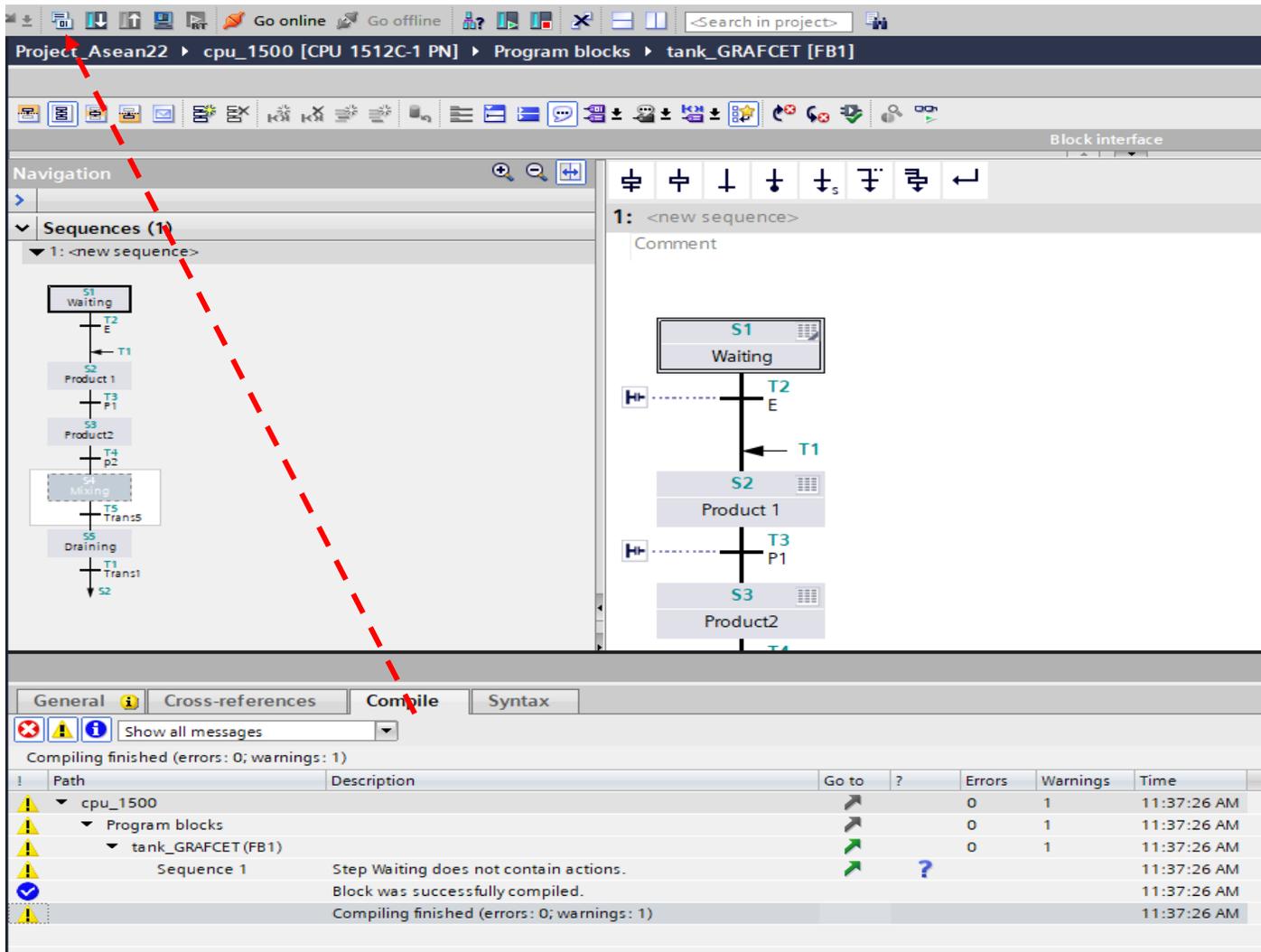
Implementation of the Grafcet programmes



•We close the Grafcet by using the tool « Jump to»as follows;



Compiling Our Grafcet

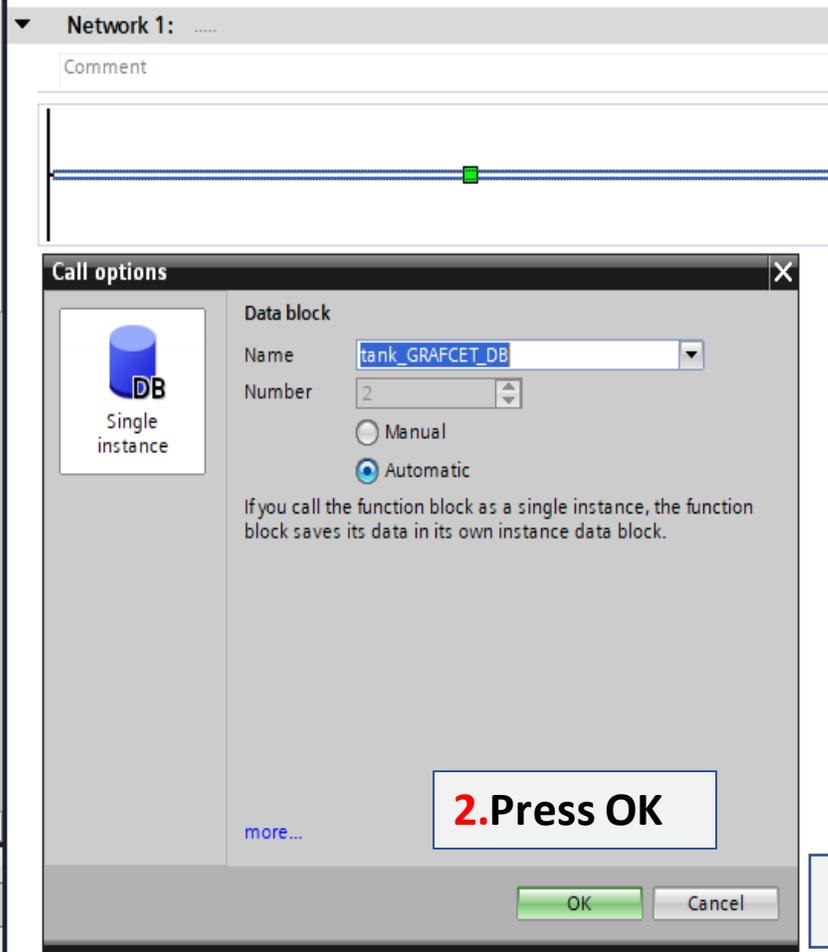
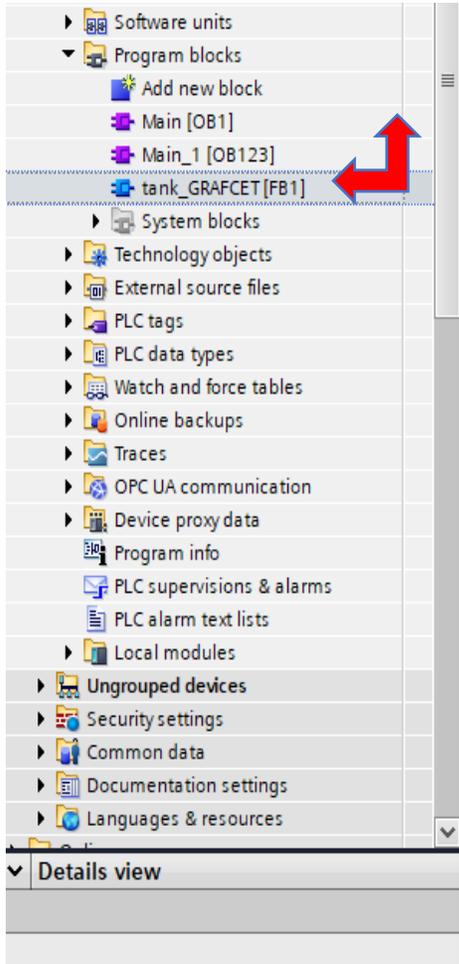


The screenshot shows the software interface for compiling a Grafcet. The main window displays a sequence diagram with steps S1 (Waiting), S2 (Product 1), and S3 (Product 2), connected by transitions T1, T2, T3, T4, T5, and T1 Trans1. The 'Compile' tab is active, showing a message: 'Compiling finished (errors: 0; warnings: 1)'. Below this, a table lists the compilation results:

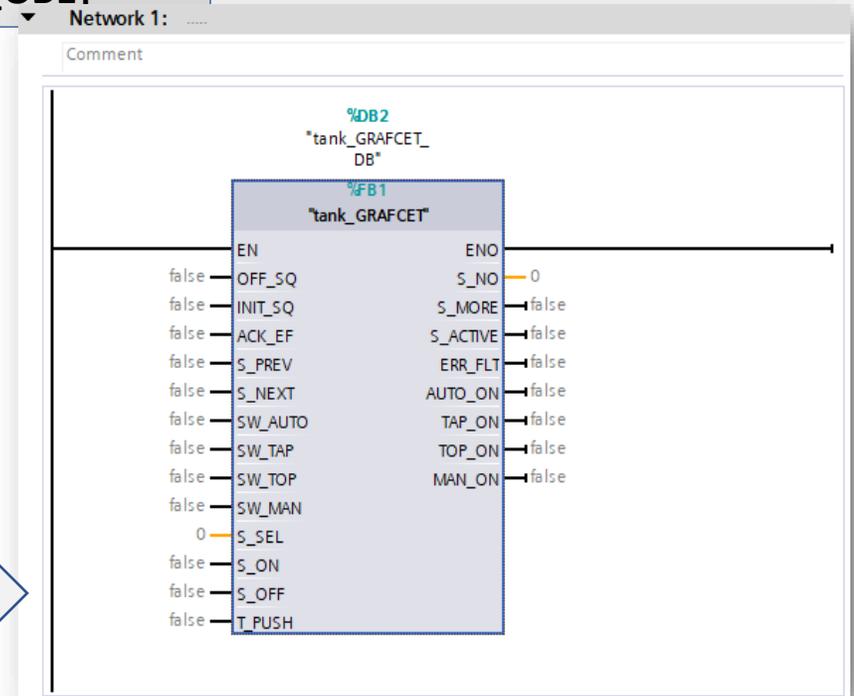
!	Path	Description	Go to	?	Errors	Warnings	Time
!	cpu_1500				0	1	11:37:26 AM
!	Program blocks				0	1	11:37:26 AM
!	tank_GRAFCET (FB1)				0	1	11:37:26 AM
!	Sequence 1	Step Waiting does not contain actions.		?			11:37:26 AM
✓		Block was successfully compiled.					11:37:26 AM
!		Compiling finished (errors: 0; warnings: 1)					11:37:26 AM

**Zero error
==>Compilation done
correctly**

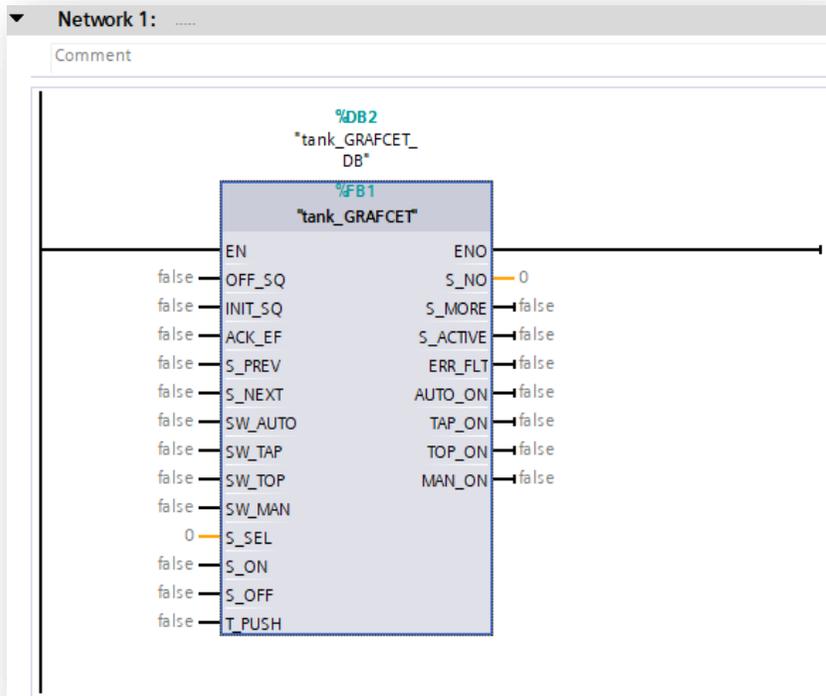
Implementation of the actions in ladder



1. Drag and drop our tank_GRAFCET into network 1 of Main[OB1]



1. Compile block created



Project_Asean22 > cpu_1500 [CPU 1512C-1 PN] > Program blocks > Main [OB1]

Main

Name	Data type	Default value	Comment
EN			
ENO			
OFF_SQ			
INIT_SQ			
ACK_EF			
S_PREV			
S_NEXT			
SW_AUTO			
SW_TAP			
SW_TOP			
SW_MAN			
S_SEL			
S_ON			
S_OFF			
T_PUSH			
S_NO		0	
S_MORE		false	
S_ACTIVE		false	
ERR_FLT		false	
AUTO_ON		false	
TAP_ON		false	
TOP_ON		false	

Block title: "Main Program Sweep (Cycle)"

Network 1:

Comment

```

graph TD
    DB2["%DB2  
*tank_GRAFCET_  
DB*"]
    FB1["%FB1  
*tank_GRAFCET*"]
    
    EN --- ENO
    OFF_SQ --- S_NO
    INIT_SQ --- S_MORE
    ACK_EF --- S_ACTIVE
    S_PREV --- ERR_FLT
    S_NEXT --- AUTO_ON
    SW_AUTO --- TAP_ON
    SW_TAP --- TOP_ON
    
    ENO --- S_NO
    S_NO --- 0
    
    S_MORE --- false
    S_ACTIVE --- false
    ERR_FLT --- false
    AUTO_ON --- false
    TAP_ON --- false
    TOP_ON --- false
  
```

General | Cross-references | **Compile** | Syntax

Show all messages

Compiling finished (errors: 0; warnings: 0)

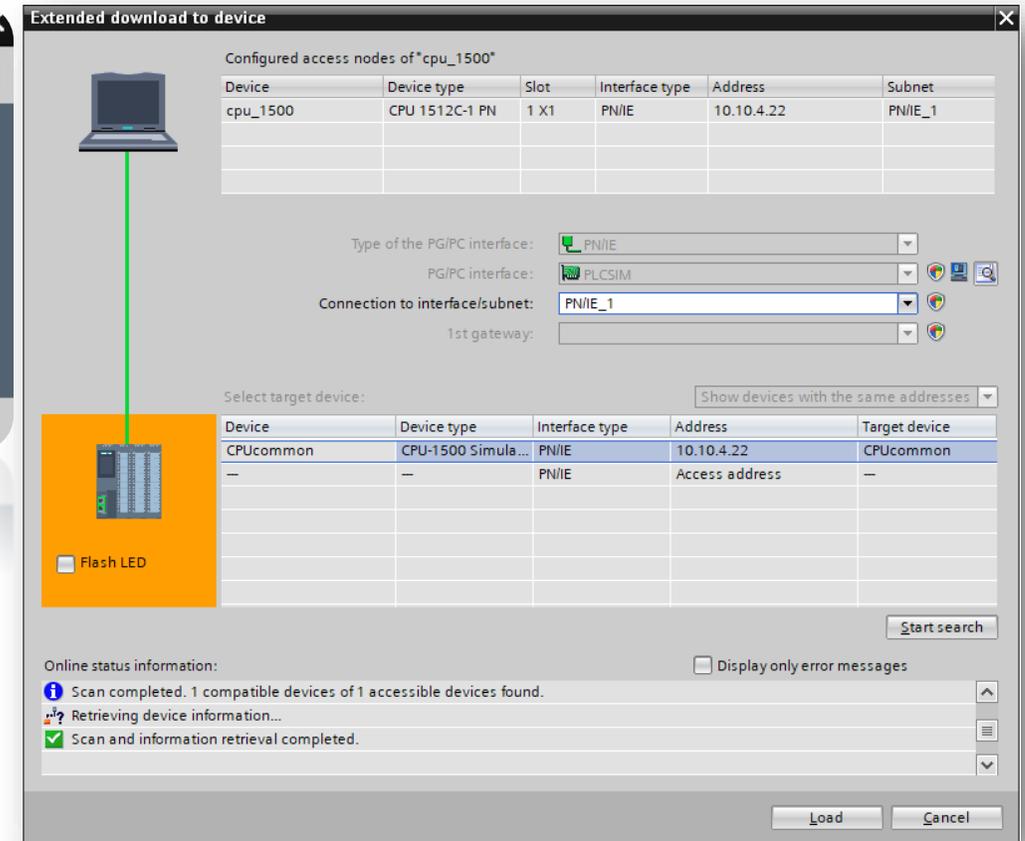
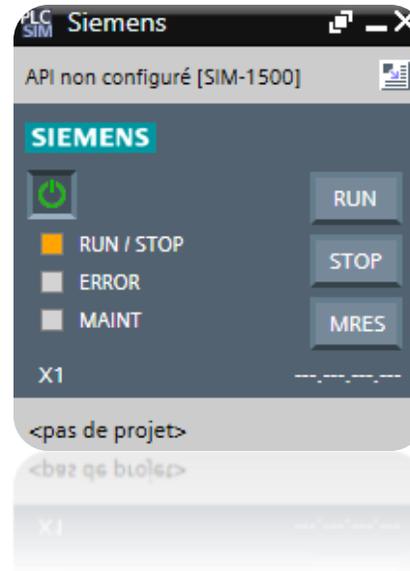
!	Path	Description	Go to	?	Errors	Warnings	Time
✓	cpu_1500		↗		0	0	11:49:38 AM
✓	Program blocks		↗		0	0	11:49:38 AM
✓	Main (OB1)	Block was successfully compiled.	↗				11:49:38 AM
✓		Compiling finished (errors: 0; warnings: 0)	↗				11:49:38 AM

**Zero error
==>Compilation done
correctly**

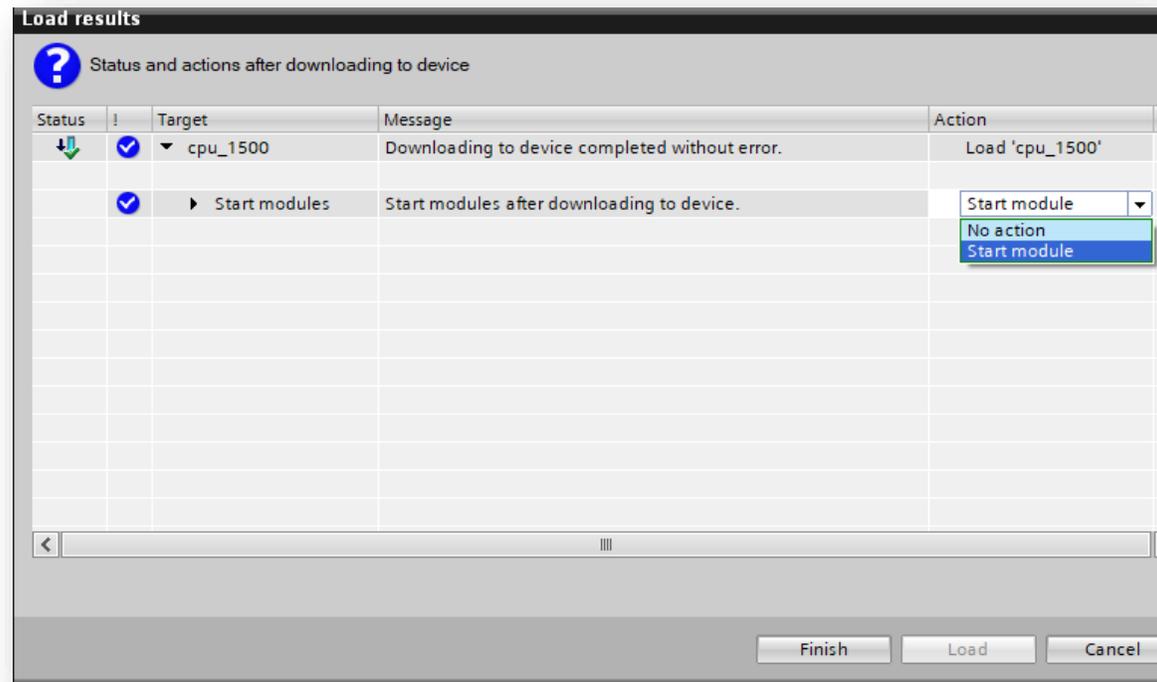
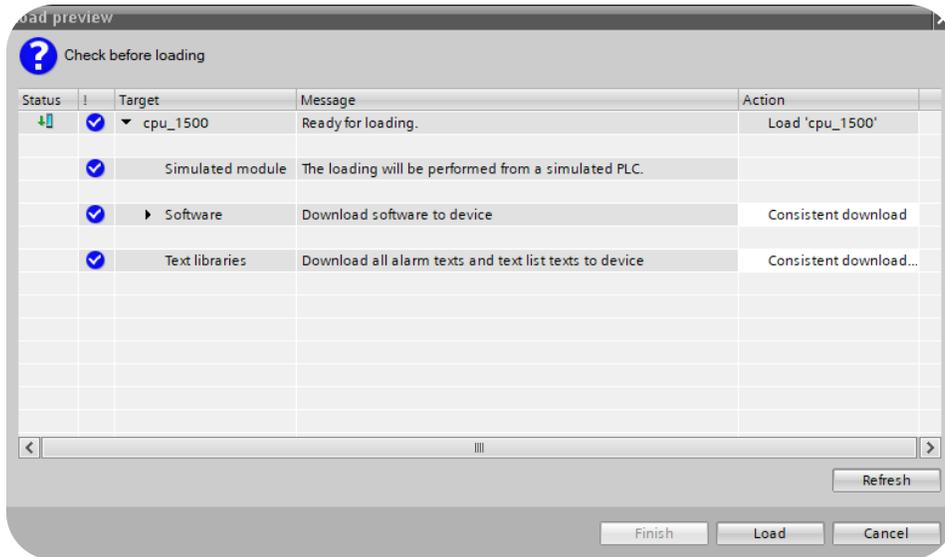
2.1) Simulation by PLCSIM (corresponding virtual PLC)



- => Click on Start simulation icon
- => Select PLCSIM in PG/PC interface
- => Start search
- => Select Device 10.10.100.113
- => Load

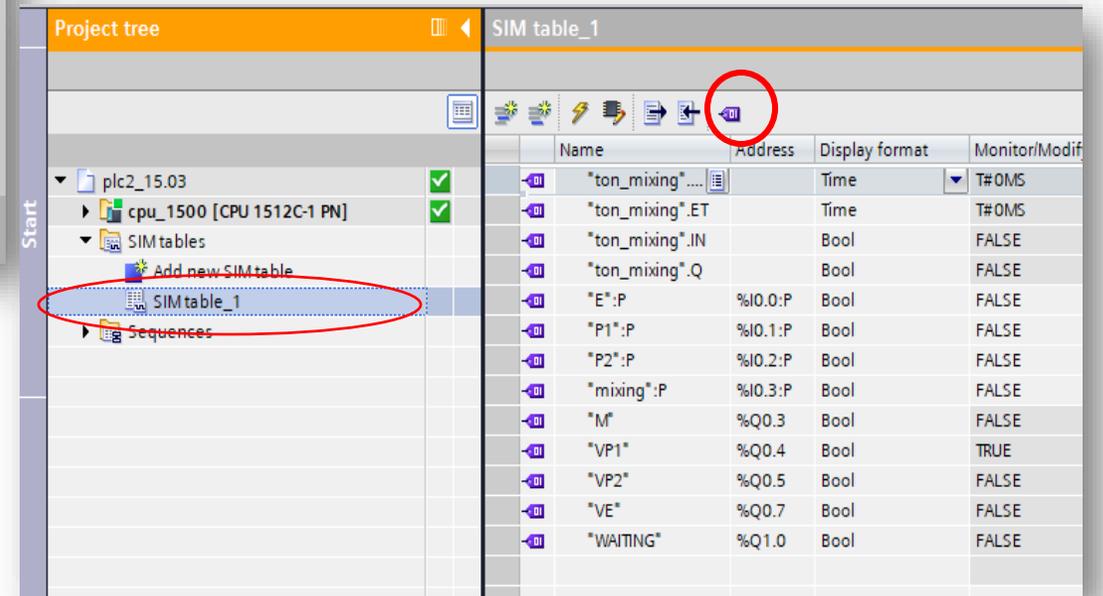
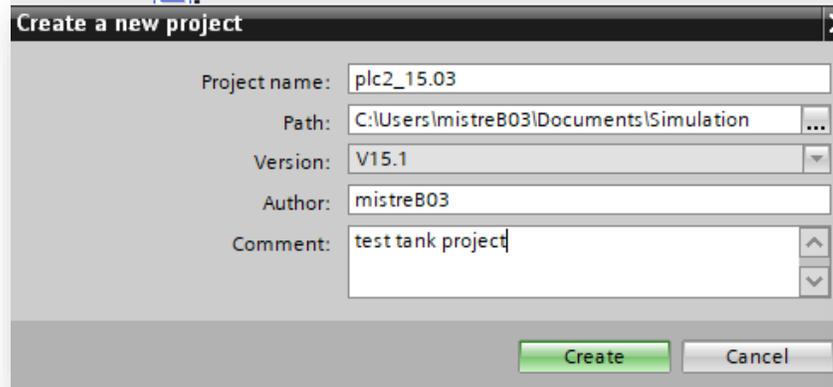


2.2) Simulation by PLCSIM (corresponding virtual PLC)



- => Load preview window is open
- => Click on Load button
- => Load results window is open
- => Select Start module
- => Click on Finish

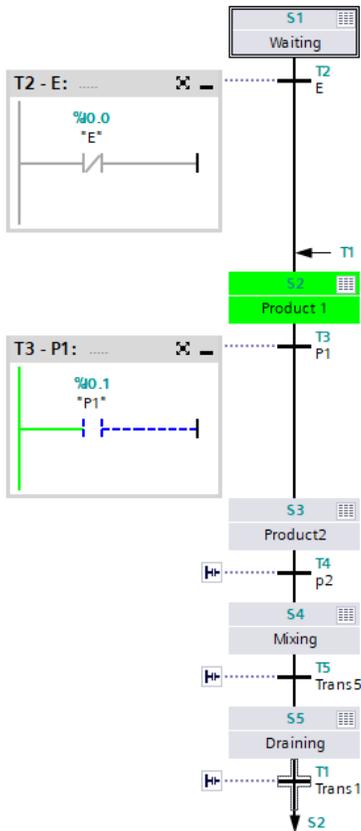
2.3) Simulation by PLCSIM (corresponding virtual PLC)



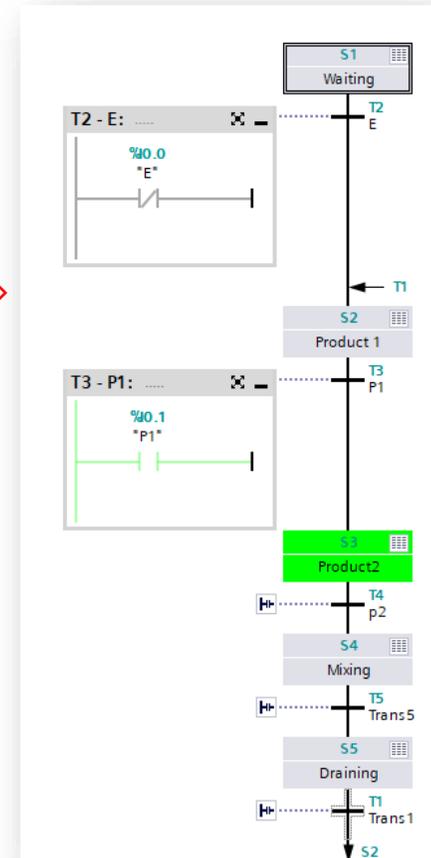
=> Then click on the icon right on the top
 => PLCSIM is open
 => Create a new project
 => load tags

2.4) Go online

=> Click on go online icon
=> Force P1 to true
=> valve of Product 1
switch OFF => valve
Product2 switch ON

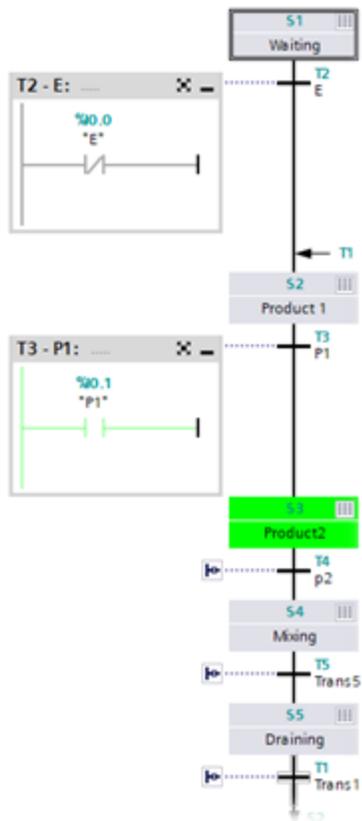


	Name	Address	Display format	Monitor/Modify value	Bits	Consistent m
	ton_mixing.PT		Time	T#OMS		T#OMS
	ton_mixing.ET		Time	T#OMS		T#OMS
	ton_mixing.IN		Bool	FALSE		<input type="checkbox"/> FALSE
	ton_mixing.Q		Bool	FALSE		<input type="checkbox"/> FALSE
	E.P	%IO.0:P	Bool	FALSE		<input type="checkbox"/> FALSE
	P1.P	%IO.1:P	Bool	TRUE		<input checked="" type="checkbox"/> FALSE
	P2.P	%IO.2:P	Bool	FALSE		<input type="checkbox"/> FALSE
	mixing.P	%IO.3:P	Bool	FALSE		<input type="checkbox"/> FALSE
	M	%Q0.3	Bool	FALSE		<input type="checkbox"/> FALSE
	VP1	%Q0.4	Bool	FALSE		<input type="checkbox"/> FALSE
	VP2	%Q0.5	Bool	TRUE		<input checked="" type="checkbox"/> FALSE
	VE	%Q0.7	Bool	FALSE		<input type="checkbox"/> FALSE
	WAITING	%Q1.0	Bool	FALSE		<input type="checkbox"/> FALSE

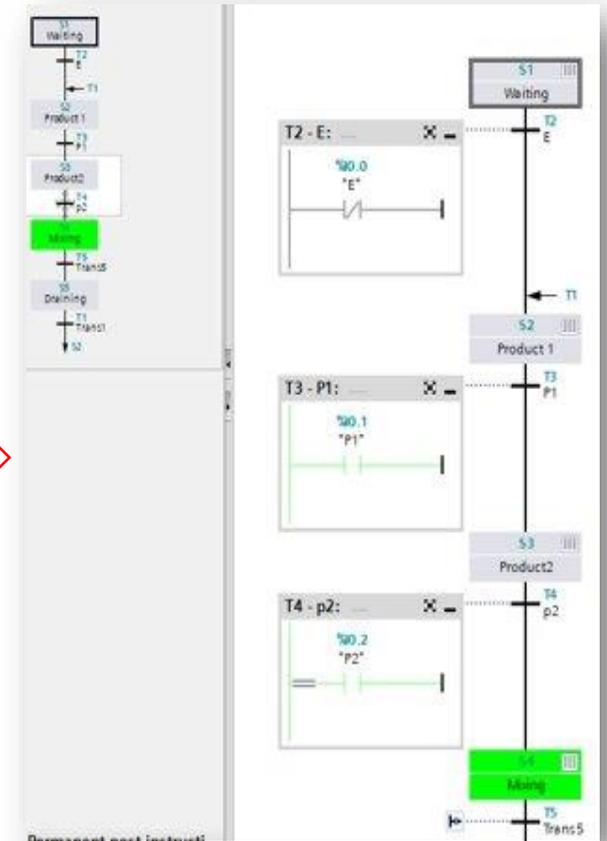


2.4) Go online

=> Force P2 to true to pass from state adding product 2 to mixing state

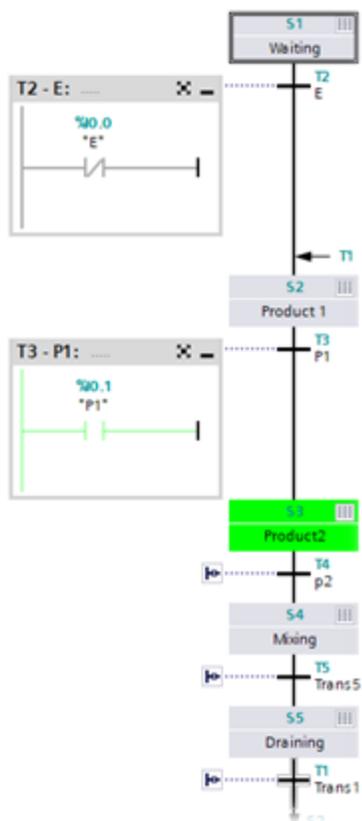


	Name	Address	Display format	Monitor/Modify value	Bits	Consistent modify	
	"ton_mixing".PT		Time	T#OMS		T#OMS	<input type="checkbox"/>
	"ton_mixing".ET		Time	T#OMS		T#OMS	<input type="checkbox"/>
	"ton_mixing".IN		Bool	FALSE		<input type="checkbox"/> FALSE	<input type="checkbox"/>
	"ton_mixing".Q		Bool	FALSE		<input type="checkbox"/> FALSE	<input type="checkbox"/>
	"E":P	%I0.0:P	Bool	TRUE		<input checked="" type="checkbox"/> FALSE	<input type="checkbox"/>
	"P1":P	%I0.1:P	Bool	TRUE		<input checked="" type="checkbox"/> FALSE	<input type="checkbox"/>
	"P2":P	%I0.2:P	Bool	TRUE		<input checked="" type="checkbox"/> FALSE	<input type="checkbox"/>
	"mixing":P	%I0.3:P	Bool	FALSE		<input type="checkbox"/> FALSE	<input type="checkbox"/>
	"M"	%Q0.3	Bool	TRUE		<input checked="" type="checkbox"/> FALSE	<input type="checkbox"/>
	"VP1"	%Q0.4	Bool	FALSE		<input type="checkbox"/> FALSE	<input type="checkbox"/>
	"VP2"	%Q0.5	Bool	FALSE		<input type="checkbox"/> FALSE	<input type="checkbox"/>
	"VE"	%Q0.7	Bool	FALSE		<input type="checkbox"/> FALSE	<input type="checkbox"/>
	"WAITING"	%Q1.0	Bool	FALSE		<input type="checkbox"/> FALSE	<input type="checkbox"/>

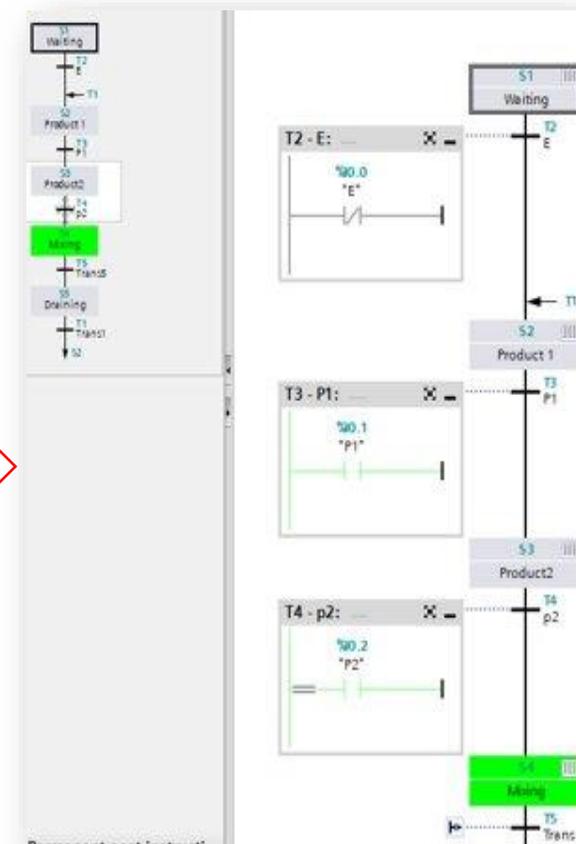


2.4) Go online

=> Force P2 to true to pass from state adding product 2 to mixing state



	Name	Address	Display format	Monitor/Modify value	Bits	Consistent modify	
	"ton_mixing".PT		Time	T#OMS		T#OMS	<input type="checkbox"/>
	"ton_mixing".ET		Time	T#OMS		T#OMS	<input type="checkbox"/>
	"ton_mixing".IN		Bool	FALSE		<input type="checkbox"/> FALSE	<input type="checkbox"/>
	"ton_mixing".Q		Bool	FALSE		<input type="checkbox"/> FALSE	<input type="checkbox"/>
	"E":P	%I0.0:P	Bool	TRUE		<input checked="" type="checkbox"/> FALSE	<input type="checkbox"/>
	"P1":P	%I0.1:P	Bool	TRUE		<input checked="" type="checkbox"/> FALSE	<input type="checkbox"/>
	"P2":P	%I0.2:P	Bool	TRUE		<input checked="" type="checkbox"/> FALSE	<input type="checkbox"/>
	"mixing":P	%I0.3:P	Bool	FALSE		<input type="checkbox"/> FALSE	<input type="checkbox"/>
	"M"	%Q0.3	Bool	TRUE		<input checked="" type="checkbox"/> FALSE	<input type="checkbox"/>
	"VP1"	%Q0.4	Bool	FALSE		<input type="checkbox"/> FALSE	<input type="checkbox"/>
	"VP2"	%Q0.5	Bool	FALSE		<input type="checkbox"/> FALSE	<input type="checkbox"/>
	"VE"	%Q0.7	Bool	FALSE		<input type="checkbox"/> FALSE	<input type="checkbox"/>
	"WAITING"	%Q1.0	Bool	FALSE		<input type="checkbox"/> FALSE	<input type="checkbox"/>

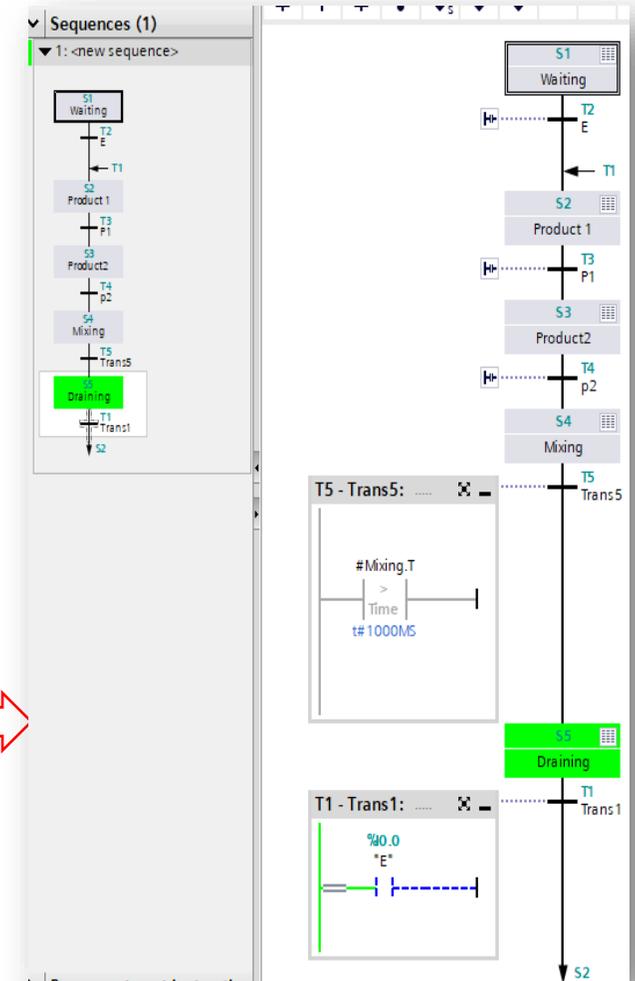
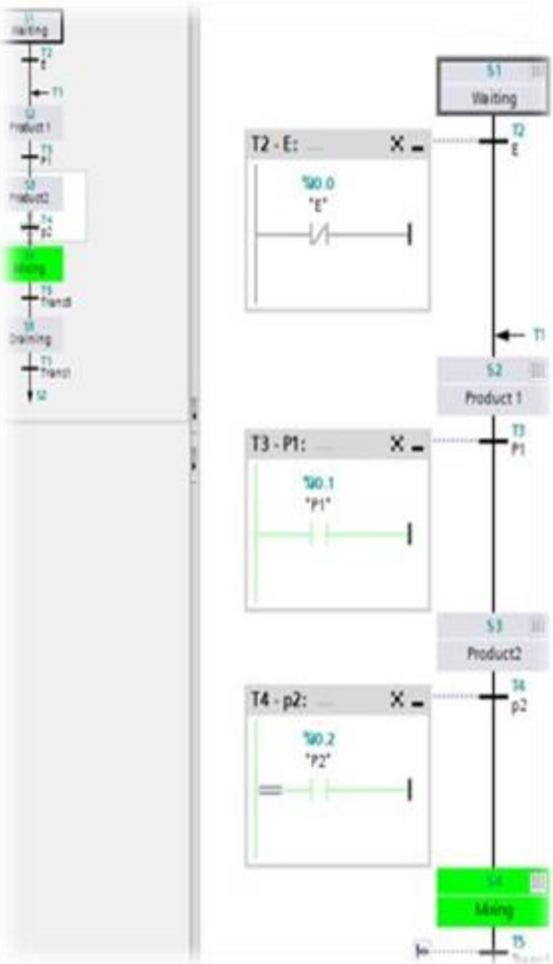


2.4)Go online



=> Mixing state last 1s then without forcing pass to draining state VE TRUE

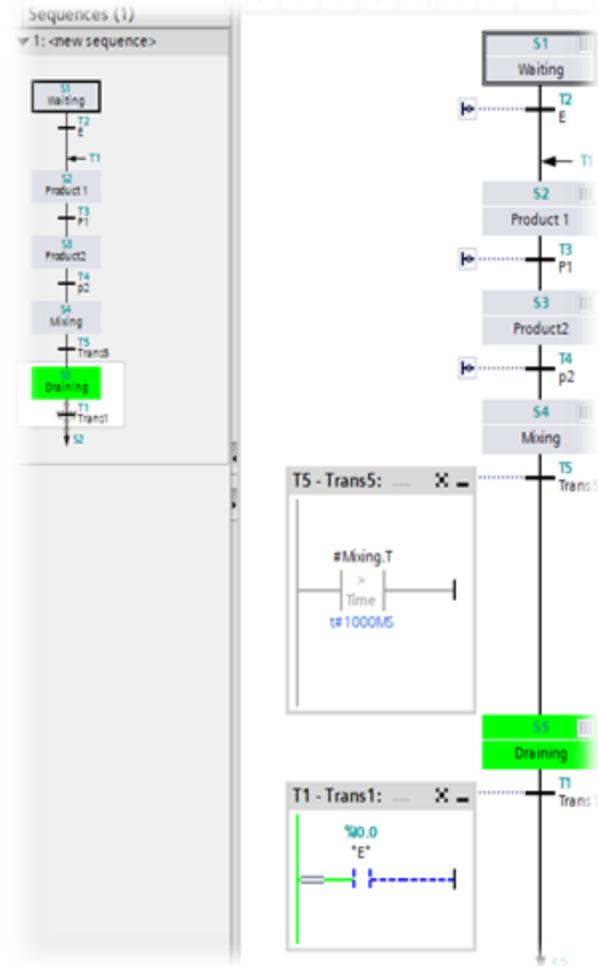
	Name	Address	Display format	Monitor/Modify value	Bits	Consistent modify
	"ton_mixing".PT		Time	T#OMS		T#OMS
	"ton_mixing".ET		Time	T#OMS		T#OMS
	"ton_mixing".IN		Bool	FALSE		<input type="checkbox"/> FALSE
	"ton_mixing".Q		Bool	FALSE		<input type="checkbox"/> FALSE
	"E":P	%I0.0:P	Bool	FALSE		<input type="checkbox"/> FALSE
	"P1":P	%I0.1:P	Bool	FALSE		<input type="checkbox"/> FALSE
	"P2":P	%I0.2:P	Bool	FALSE		<input type="checkbox"/> FALSE
	"mixing":P	%I0.3:P	Bool	FALSE		<input type="checkbox"/> FALSE
	"M"	%Q0.3	Bool	FALSE		<input type="checkbox"/> FALSE
	"VP1"	%Q0.4	Bool	FALSE		<input type="checkbox"/> FALSE
	"VP2"	%Q0.5	Bool	FALSE		<input type="checkbox"/> FALSE
	"VE"	%Q0.7	Bool	TRUE		<input checked="" type="checkbox"/> FALSE
	"WAITING"	%Q1.0	Bool	FALSE		<input type="checkbox"/> FALSE



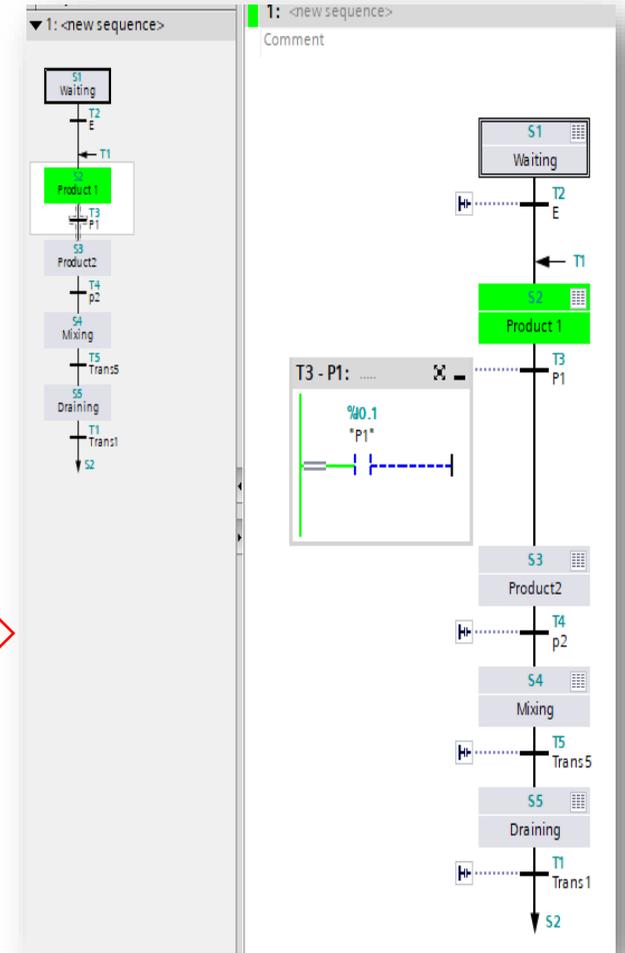
2.4) Go online



=> We force E (empty tank) to true to back into product 1 state



	Name	Address	Display format	Monitor/Modify value	Bits	Consistent
	"ton_mixing".PT		Time	T#OMS		T#OMS
	"ton_mixing".ET		Time	T#OMS		T#OMS
	"ton_mixing".IN		Bool	FALSE		<input type="checkbox"/> FALSE
	"ton_mixing".Q		Bool	FALSE		<input type="checkbox"/> FALSE
	"E".P	%I0.0:P	Bool	TRUE		<input checked="" type="checkbox"/> FALSE
	"P1".P	%I0.1:P	Bool	FALSE		<input type="checkbox"/> FALSE
	"P2".P	%I0.2:P	Bool	FALSE		<input type="checkbox"/> FALSE
	"mixing".P	%I0.3:P	Bool	FALSE		<input type="checkbox"/> FALSE
	"M"	%Q0.3	Bool	FALSE		<input type="checkbox"/> FALSE
	"VP1"	%Q0.4	Bool	TRUE		<input checked="" type="checkbox"/> FALSE
	"VP2"	%Q0.5	Bool	FALSE		<input type="checkbox"/> FALSE
	"VE"	%Q0.7	Bool	FALSE		<input type="checkbox"/> FALSE
	"WAITING"	%Q1.0	Bool	FALSE		<input type="checkbox"/> FALSE



Global methodology for labs

1. Define in TIA Portal/Unity the exact architecture, corresponding to the actual physical one, all the lots should be configured (it is equivalent to add the required libraries in IT)
2. Configure all the variables (I, O, M...)
3. Configure precisely the network interface (crucial step!), external clock for synchronization
4. Write a programme, the actions, possibly specific memories for Modbus frames
5. You can first work in simulation
 1. Choose the simulation
 2. Compile your programme (HW and SW)
 3. Send your programme to the PLC (here in simulation)
 4. Then run
6. You can then work with the real PLC
 1. Choose the actual PLC
 2. Compile your programme (HW and SW)
 3. Send your programme to the PLC (here on the actual PLC)
 4. Then run, you will need to interact using the simulation card
 5. You can also observe what's going on on the PLC using the debug mode
7. **Never forget to save from time to time what you do !**
8. **Always stop running and the debug mode when you want to send a new programme to the PLC**

Thank you