SmartPlant Instrumentation Macro Expansion

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SPI Macro Expansion Terminology

- A "**Macro**" is a collection of one or more typical items in SPI (Instruments and/or Loops).
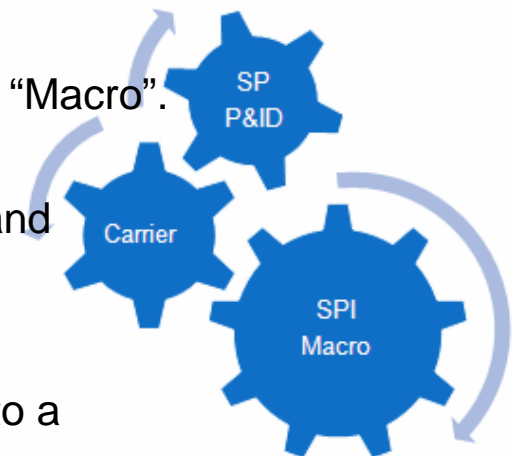
- A "**Carrier**" is a published P&ID object, that during its execution in SPI initiates a "Macro" execution.
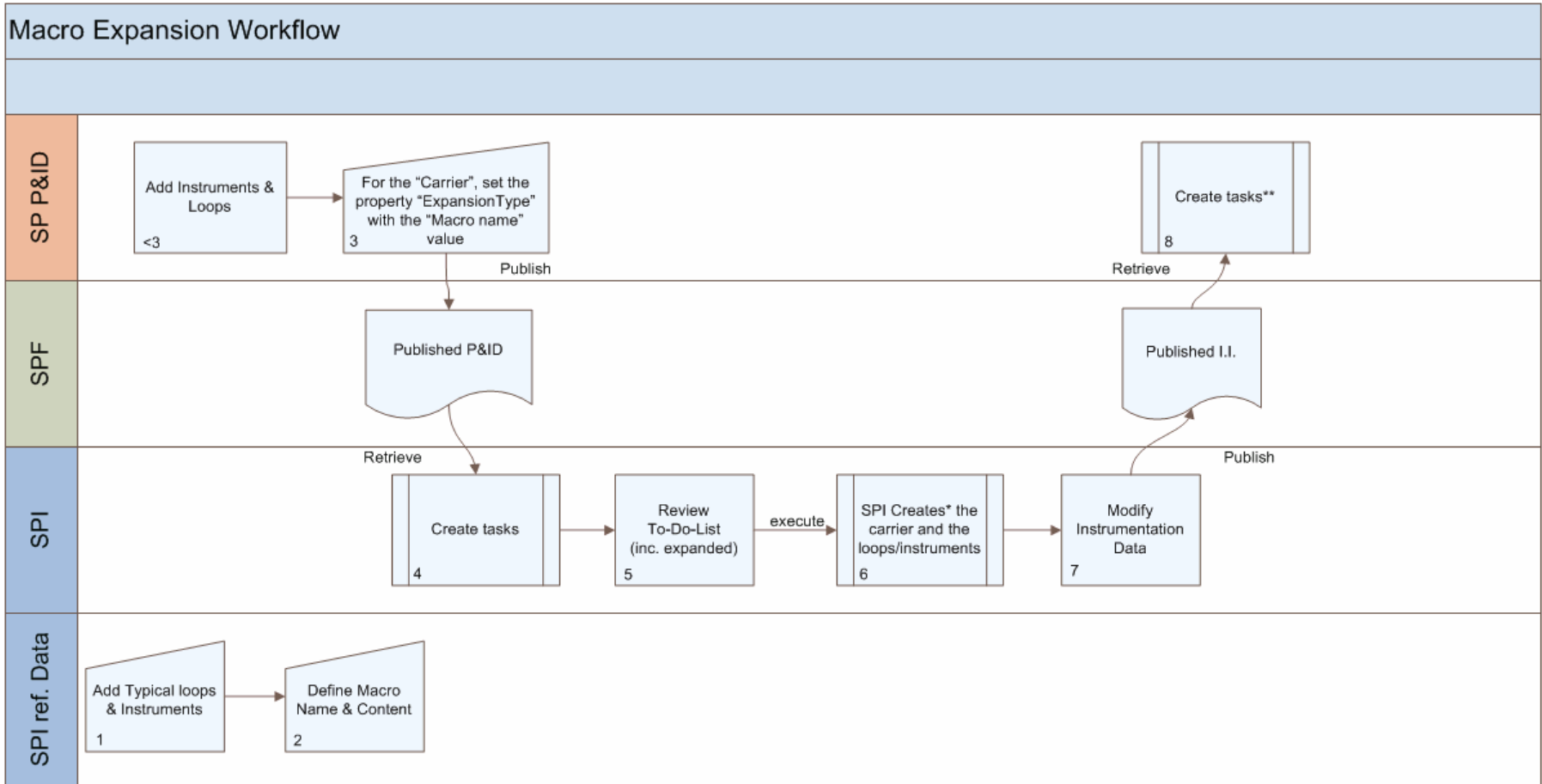
- "**Macro execution**" - the process in which a "Carrier" creates SPI Instruments and/or loops as defined by the "Macro".

- **Expanded object** – SPI item that belongs to a carrier and Macro (created or updated by macro expansion).

- **Non-Expanded object** – SPI item that doesn't belong to a carrier and/or macro.

Integration

Macro Expansion Workflow

SP P&ID
- Add Instruments & Loops <3
- For the "Carrier", set the property "ExpansionType" with the "Macro name" value — 3
- Create tasks** — 8

Publish | Retrieve

SPF
- Published P&ID
- Published I.I.

SPI
- Create tasks — 4
- Review To-Do-List (inc. expanded) — 5
- execute → SPI Creates* the carrier and the loops/instruments — 6
- Modify Instrumentation Data — 7

Retrieve | Publish

SPI ref. Data
- Add Typical loops & Instruments — 1
- Define Macro Name & Content — 2

* Carrier can be set not to be created as an object. Objects which already exists in SPI will be updated or skipped.

** Expanded SPI objects can be ignored depending on SPI flag (macro)

Example

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- SPI Macro structure:

Macro:	FlowType1		
Name	Inst. Type	Class	type
FC - nnnn	FC	Soft Tag	*Carrier*
F-nnnn		Flow loop	Sub-items
FE-nnnn	FE	Instrument	Sub-items
FT-nnnn	FT	Instrument	Sub-items
FI-nnnn	FI	Instrument	Sub-items
FY-nnnn	FY	Instrument	Sub-items
FV-nnnn	FV	Instrument	Sub-items

- SPI data before retrieving from SP P&ID

Tag Number	Loop Name	Instrument Type	Service	IO Type Name
101-FE -2214	101-F -2214	FE	Feed to B-101 Pass C	*
101-FT -2214	101-F -2214	FT	Feed to B-101 Pass C	AI
101-FV -2214	*	FV	Feed to B-101 Pass C	*

P&ID (still under development !!!)

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For the FC set the "Expansion Type" property

SPI To-Do-List

SPI To-Do-List

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Loop F-2214 will be associated with the macro
The FC, FI & FY instruments will be created.
The FE, FT & FV will be associated with the macro
The FV 2214 will be associated with the loop.

Example

- SPI Macro structure:

Macro:	FlowType1		
Name	Inst. Type	Class	type
FC - nnnn	FC	Soft Tag	*Carrier*
F-nnnn		Flow loop	Sub-items
FE-nnnn	FE	Instrument	Sub-items
FT-nnnn	FT	Instrument	Sub-items
FI-nnnn	FI	Instrument	Sub-items
FY-nnnn	FY	Instrument	Sub-items
FV-nnnn	FV	Instrument	Sub-items
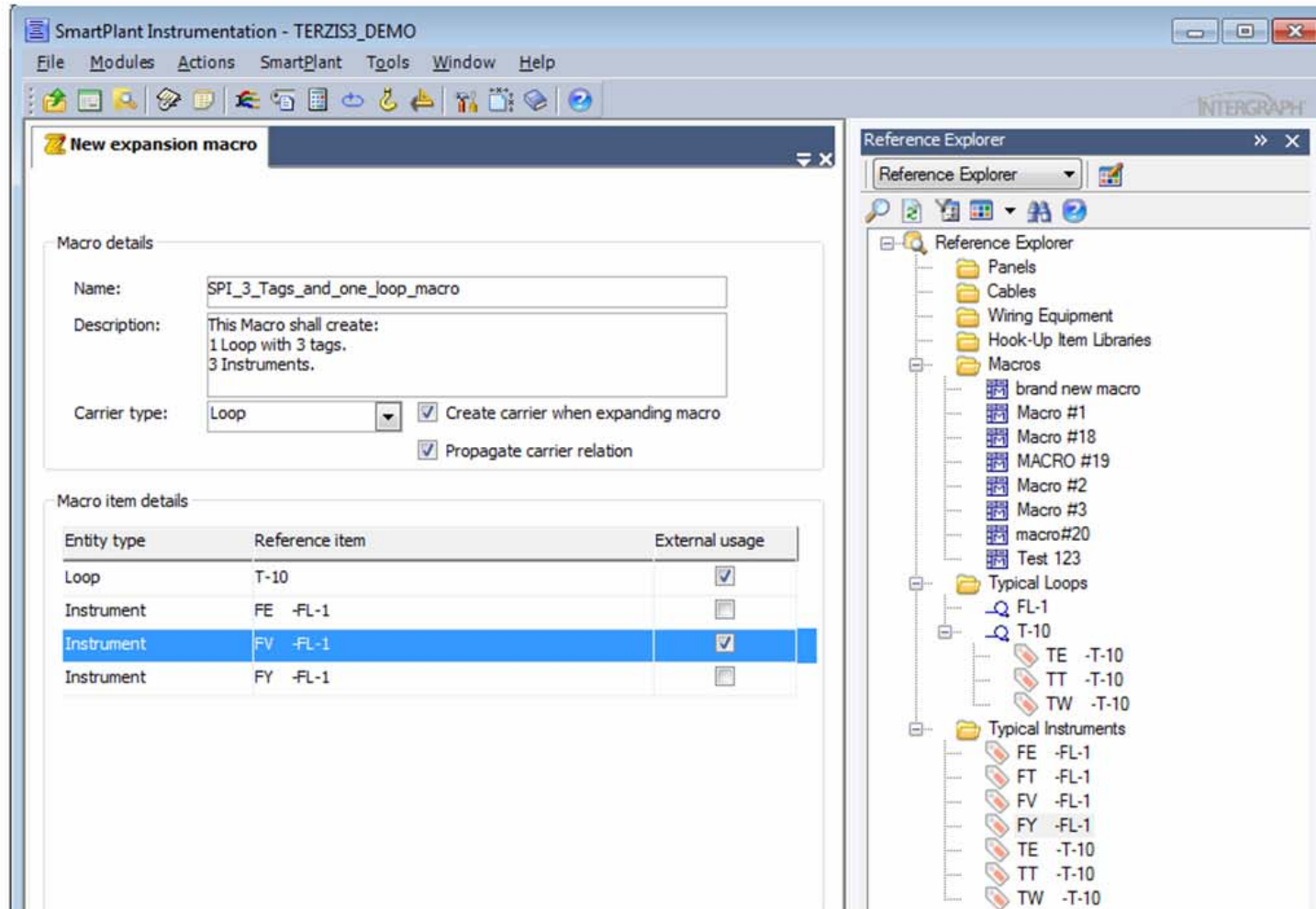
- SPI data before retrieving from SP P&ID

Tag Number	Loop Name	Instrument Type	Service	IO Type Name
101-FE -2214	101-F -2214	FE	Feed to B-101 Pass C	*
101-FT -2214	101-F -2214	FT	Feed to B-101 Pass C	AI
101-FV -2214	*	FV	Feed to B-101 Pass C	*

- SPI data after running To-do-list

Tag Number	Loop Name	Instrument Type	Service	IO Type Name
101-FC -2214	101-F -2214	FC	Feed to B-101 Pass C	*
101-FE -2214	101-F -2214	FE	Feed to B-101 Pass C	*
101-FI -2214	101-F -2214	FI	Feed to B-101 Pass C	*
101-FT -2214	101-F -2214	FT	Feed to B-101 Pass C	AI
101-FV -2214	101-F -2214	FV	Feed to B-101 Pass C	*
101-FY -2214	101-F -2214	FY	Feed to B-101 Pass C	AI

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SPI macro Definition (from Reference Explorer)

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Macro
Details…

SPI macro Definition (from Reference Explorer)

SPI macro Definition (from Reference Explorer)

Selecting this flag prevents P&ID from retrieving expanded items

SPI To-do-List Enhancements

SPI To-do-List Enhancements

Carriers are identified with the macro name.

SPI To-do-List Enhancements

Use the plus/minus to reveal/hide sub- items according to macro definitions.

SPI To-do-List Enhancements

Indication of Sub-item status :
- Create
- Exists (macro already executed)
- Item to carrier association
- Item to carrier dissociation

SPI To-do-List Enhancements

Macro name property displayed on the task properties

Macro Execution

Macro Expansion Cases*

Case #	Task input	SPI items before running task & macro	SPI items after running task & macro	Object registry							SPI Hierarchy
						Object ID	Publishable flg	macro	Carrier Object ID		

1	• Task: Create Loop 101-F-100
	• Macro M1:
	  ➢ Create Carrier Flag – yes
	  ➢ Create Tag of type FY, Update Relations - Yes
	  ➢ Create Tag of type FE, Update Relations - Yes
	  ➢ Create Tag of type FT, Update Relations - Yes
		Loops and tags not defined in SPI.	Loop 101-F-100 – will be created
			Tag 101-FY-100 – will be created
			Tag 101-FE-100 – will be created
			Tag 101-FT-100 – will be created
				101-F-100	N	xxx	y	M1			Loop 101-F-100
											  └Tag 101-FY-100
											  └Tag 101-FE-100
											  └Tag 101-FT-100

				101-FY-100	n	123	N	M1	xxx		
				101-FE-100	New entry	345	N	M1	xxx		
				101-FT-100	New entry	678	N	M1	xxx		

2	• Task: Create Loop 101-F-100
	• Macro M1:
	  ➢ Create Carrier Flag – yes
	  ➢ Create Tag of type FY, Update Relations - Yes
	  ➢ Create Tag of type FE, Update Relations - Yes
	  ➢ Create Tag of type FT, Update Relations - Yes
		Tag 101-FE-100 already exists, not related to any carrier.	Loop 101-F-100 – will be created
			Tag 101-FY-100 – will be created
			Tag 101-FE-100 – will not be created but will be associated to the carrier
			Tag 101-FT-100 – will be created
				101-F-100	New entry	xxx	Y	M1			Loop 101-F-100
											  └Tag 101-FY-100
											  └Tag 101-FE-100
											  └Tag 101-FT-100

				101-FY-100	New entry	123	N	M1	xxx		
				101-FE-100	Update	345	N	M1	xxx		
				101-FT-100	New entry	678	N	M1	xxx		

3	• Task: Update Loop 101-F-100
	• Macro M2:
	  ➢ Create Carrier Flag – No
	  ➢ Create Tag of type FY, Update Relations - Yes
	  ➢ Create Tag of type FT, Update Relations - Yes
		Loop 101-F-100 already exists. Tags 101-FE-100 already exists, related to this loop.	Loop 101-F-100 – will not be created
			Tag 101-FY-100 – will be created
			Tag 101-FE-100 – will not be created and it will be dissociated from the carrier expansion package.
			Tag 101-FT-100 – will be created
				101-F-100	Update	xxx	Y	M2			Leave physical relation as is.
											Loop 101-F-100
											  └Tag 101-FY-100
											  └Tag 101-FE-100
											  └Tag 101-FT-100

				101-FY-100	New entry	123	N	M2	xxx		
				101-FE-100	update	345	Y				
				101-FT-100	New entry	678	N	M2	xxx		

* Partial list..

Things you should know

- Once a macro has been executed by integration, it cannot be modified in SPI.

- Renaming a carrier in SP P&ID will create update tasks in SPI*

- Changing the macro name in SP P&ID will apply the new macro structure on SPI. Irrelevant items will be dissociated from the carrier and the "package"*

- Deletion of the carrier in SP P&ID will result with deletion of the objects in SPI as it is today*

- There is no user interface that reflects macro relationship with a carrier or sub items.

- In case conflicts are encountered during execution of the To-do-list tasks, the macro execution will fail followed by an appropriate notification.

- Macro execution log files are created in the system's temp directory.

* Not implemented yet