

OBI - IDO Training

DEXPI – fPVN WP 3 results

2026-05-28

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Agenda

- fPVN WP 3 – the task
- Pump life cycle story as example
- Life cycle approaches (recap)
- Further fPVN WP 3 results - Modelling with IDO
- Conclusion



fPVN

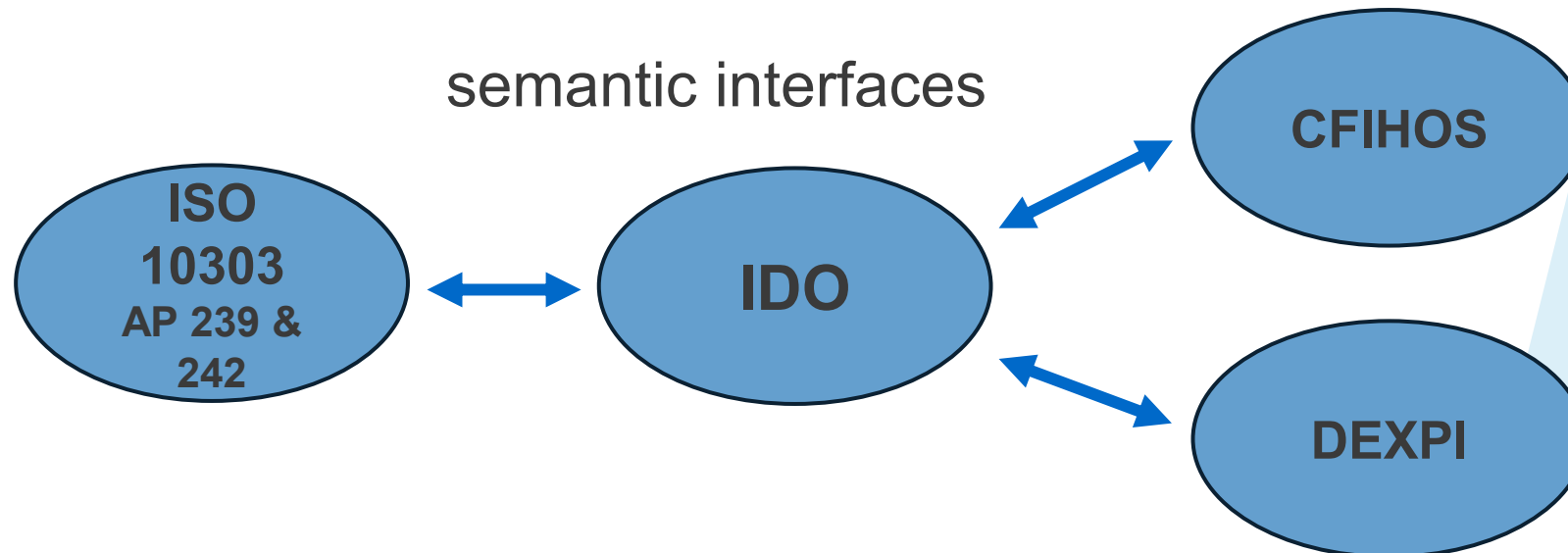
flexible Production Value Network

WP 3 – the task

Arrowhead fPVN Project - WP 3

WP3 — Major Industrial Data Models

- **Purpose:** Define and select a set of *major standardized data models* that the project will support and work with.
- **Activities:**
 - Survey industrial data model languages.
 - Provide guidelines and tooling support for use cases.
 - Analyse differences and relationships between models.
- **Outcome:** A major industrial data model landscape and guidelines for use case alignment.



DEXPI

Pump life cycle story as use case

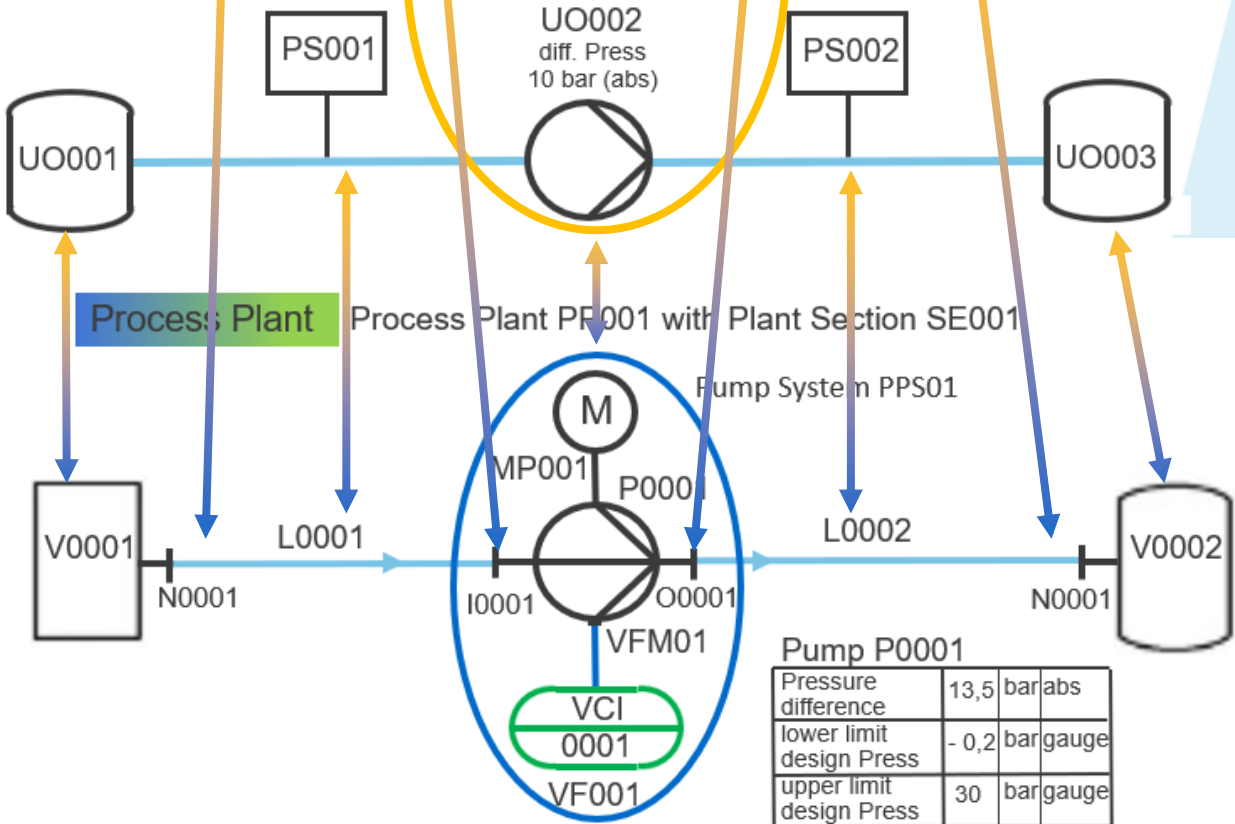
DEXPI Process and DEXPI Plant to IDO

Process Process PR001 with the Process Step PST01:

as a Block Flow Diagram:

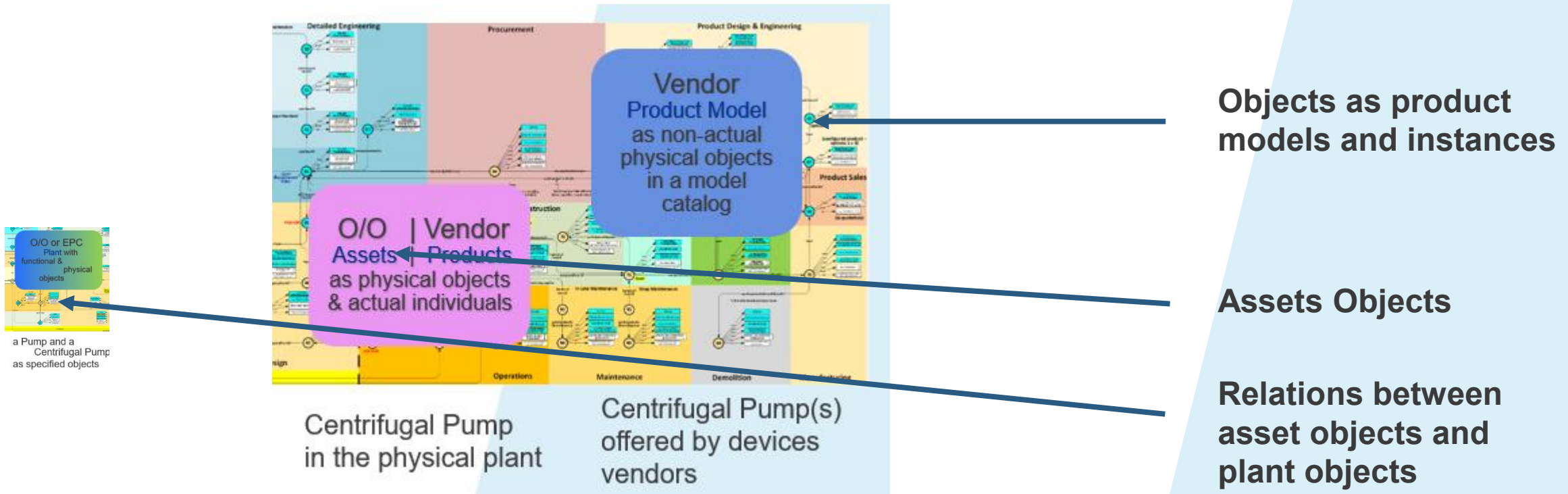


as a Process Flow Diagram:



Relations between process objects and plant objects

Beyond DEXPI Process and DEXPI Plant



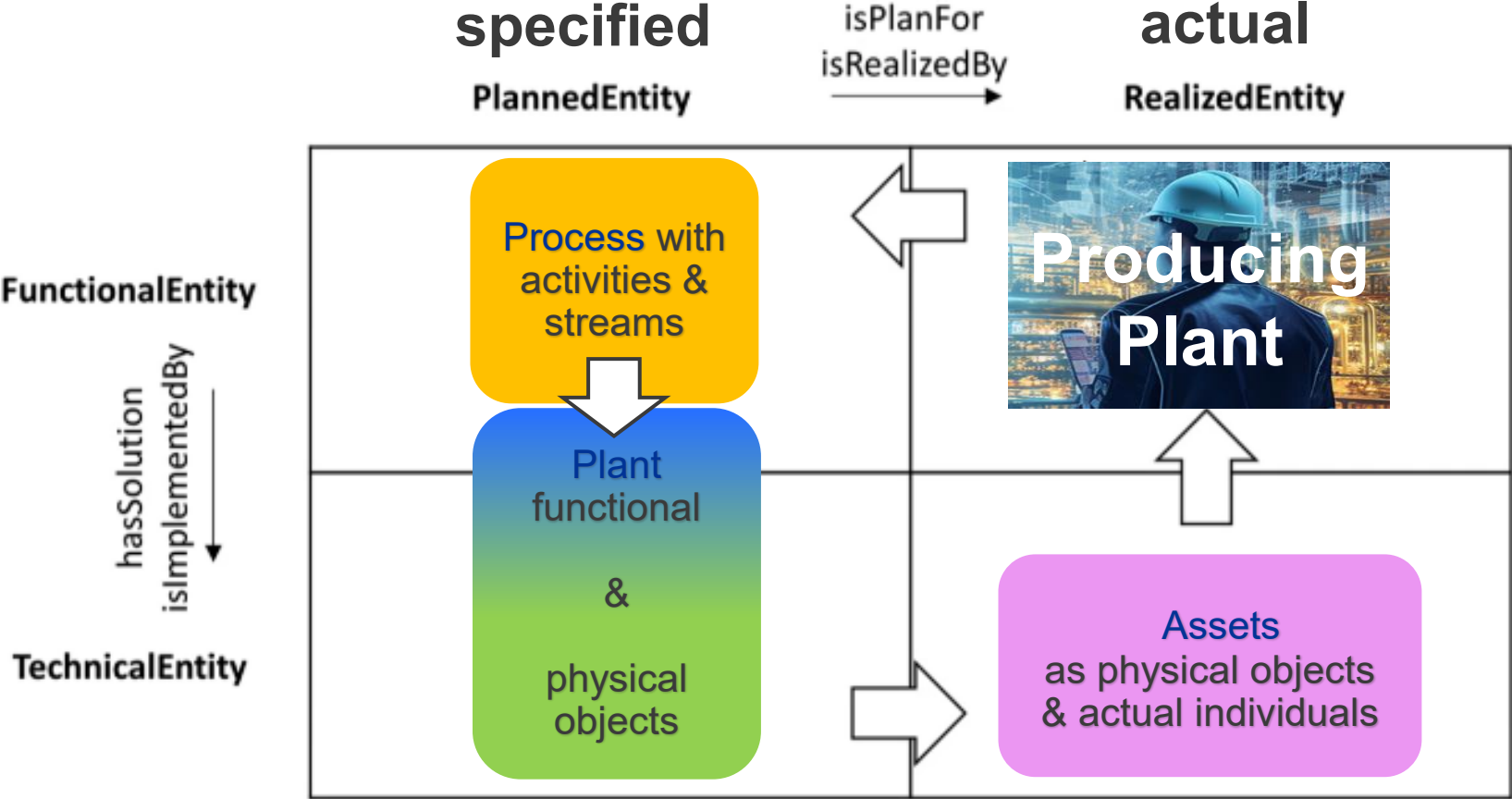
How could an input look for this story?

```
<!-- hand made simplified xml file for the DEXPI pump life cycle story -->
<XMLFile xmlns="http://example.com/dexpi/core/" xmlns:specified="http://example.com/dexpi/2.0/"
xmlns:actual="http://example.com/notindexpi/asset/" xmlns:dexpiaddon="http://example.com/dexpi/addon/" id="01">
  ><specified:Process id="dexpipro.PR001">
    ...
  </specified:Process>
  ><specified:specified_ProcessPlant id="dexpipla.PP001">
    ...
  </specified:specified_ProcessPlant>
  ><actual:actual_Asset>
    ...
  </actual:actual_Asset>
  ><dexpiaddon:Bridges>
    ...
  </dexpiaddon:Bridges>
</XMLFile>
```

Life cycle approaches – recap 2026-05-28

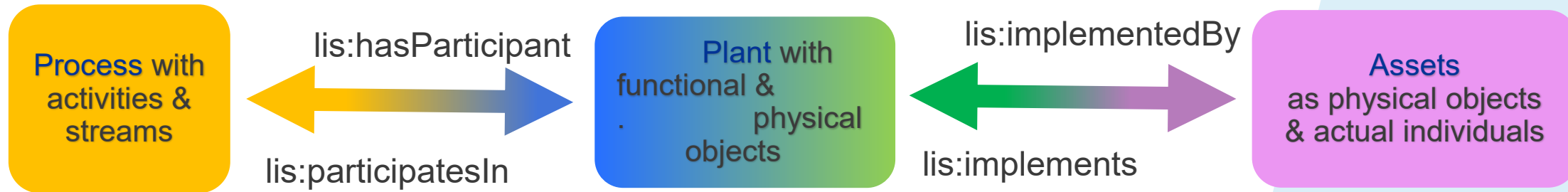
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Life cycle approach: BIM and Process Industry



IDO relations to connect the Objects of the three information structures

On instances level use of IDO object properties:



from `lis:implementedBy` (or its inverse) the IDO classification

`lis:specified` and `lis:actual`
is inferred on instance level

FPVN WP 3

Further results - Modelling with IDO

Used ontology hierarchy

Upper ontologies	lis
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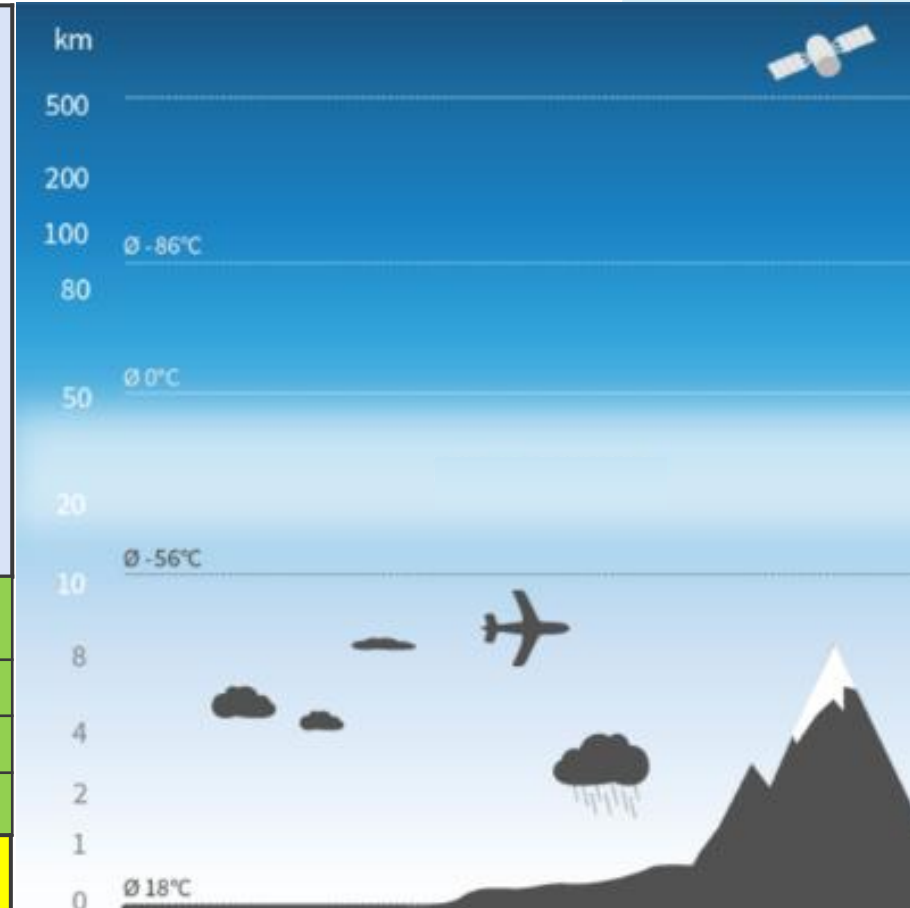
Reference ontologies	lis-odp-ext, lis-pa-ext, lis-va-ext, lis-dt-ext
	qudt, quantitykind, unit
	qudt add ons
	prop, proc, spla, pequi, ass

Application ontologies	dexpifi
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Namespace	description
lis	Industrial Data Ontology (IDO)
lis-odp-ext	Additional IDO object and data properties used for the fPVN project
lis-pa-ext	Property aspects used for the fPVN project
lis-va-ext	Value aspects used for the fPVN project
lis-dt-ext	Data types as extension to IDO
qudt	Quantities, Units, Dimensions and DataTypes
quantitykind	QUDT quantities
unit	QUDT units
qudt add ons	Bridges between QUDT and IDO
prop	properties used for the fPVN project
proc	process classes used for the fPVN project
spla	specified plant classes used for the fPVN project
pequi	physical equipment classes used for the fPVN project
ass	Assignments for assigned properties
dexpifi	Individuals of the dexpi pump life cycle story

Used ontology hierarchy – with atmosphere picture

Upper ontologies	lis
Reference ontologies	lis-odp-ext, lis-pa-ext, lis-va-ext, lis-dt-ext
	qudt, quantitykind, unit
	qudt add ons
	prop, proc, spla, pequi, ass
Application ontologies	dexpifi



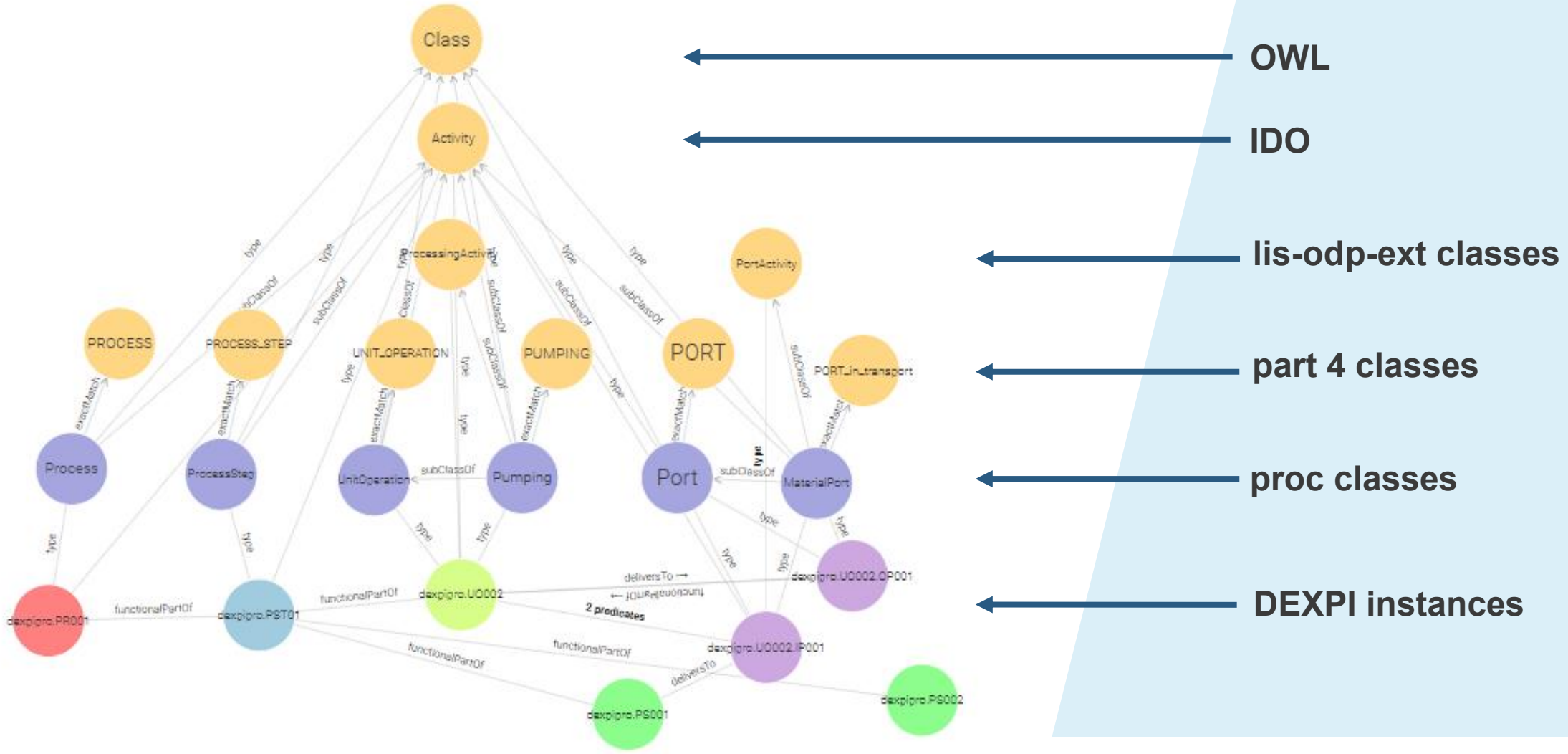
Required process classes

part 4	DEXPI class	proc:	IDO
PROCESS	Process	Process	Activity
PROCESS STEP	ProcessStep	ProcessStep	Activity
UNIT OPERATION	UnitOperation	UnitOperation	Activity
PUMPING	Pumping	Pumping	Activity
CHEMICAL REACTING	Reacting Chemicals	Reacting Chemicals	Activity
STORING	StoringMaterial	StoringMaterial	Activity
PORT	Port	Port	Activity
PORT(transport)	MaterialPort	MaterialPort	Activity
INLET PORT	„Target“		Activity
OUTLET PORT	„Source“		Activity
Stream	Process Connection	Process Connection	Activity
PROCESS STREAM	Stream	Stream	Activity

Process with activities & streams

Process modelled as activity network

Solution with IDO: specified Process



← OWL

← IDO

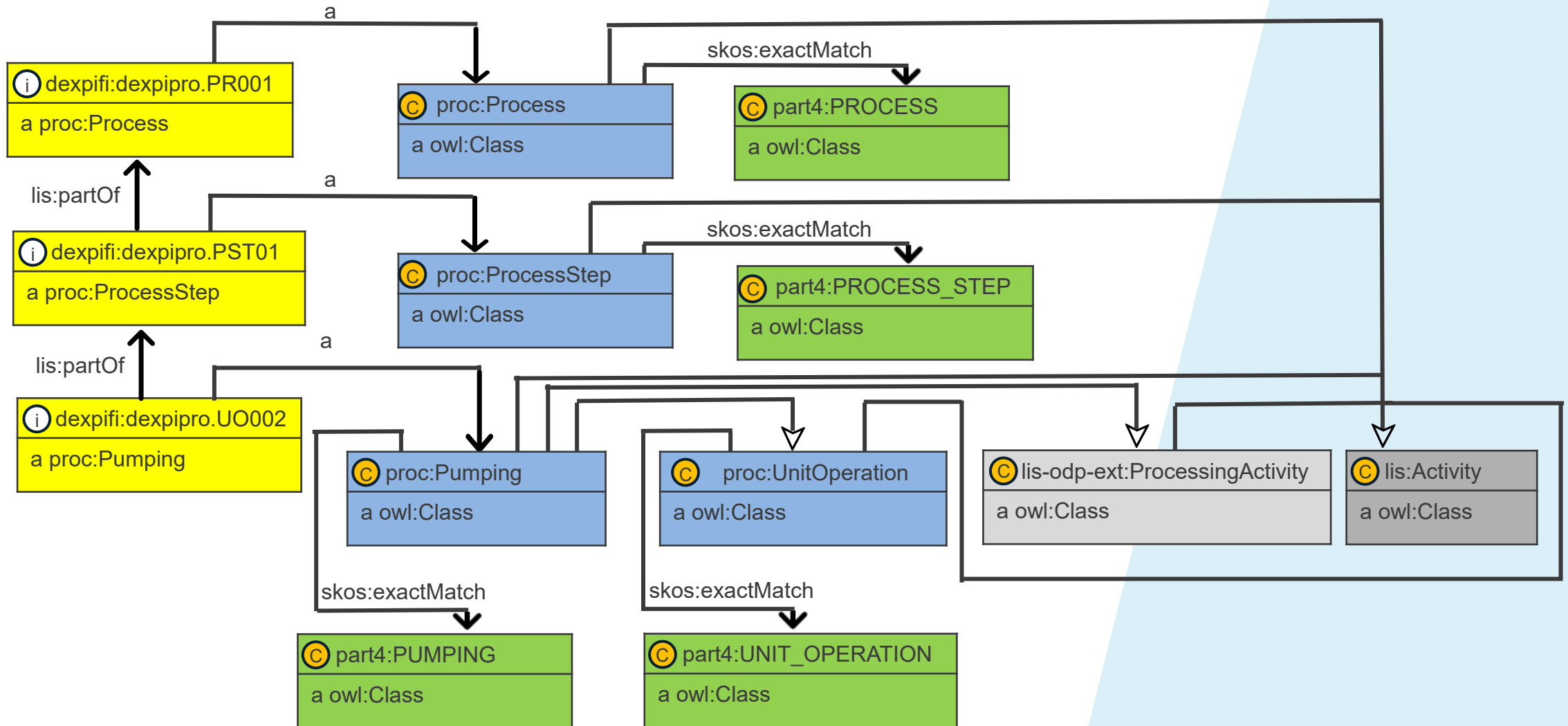
← lis-odp-ext classes

← part 4 classes

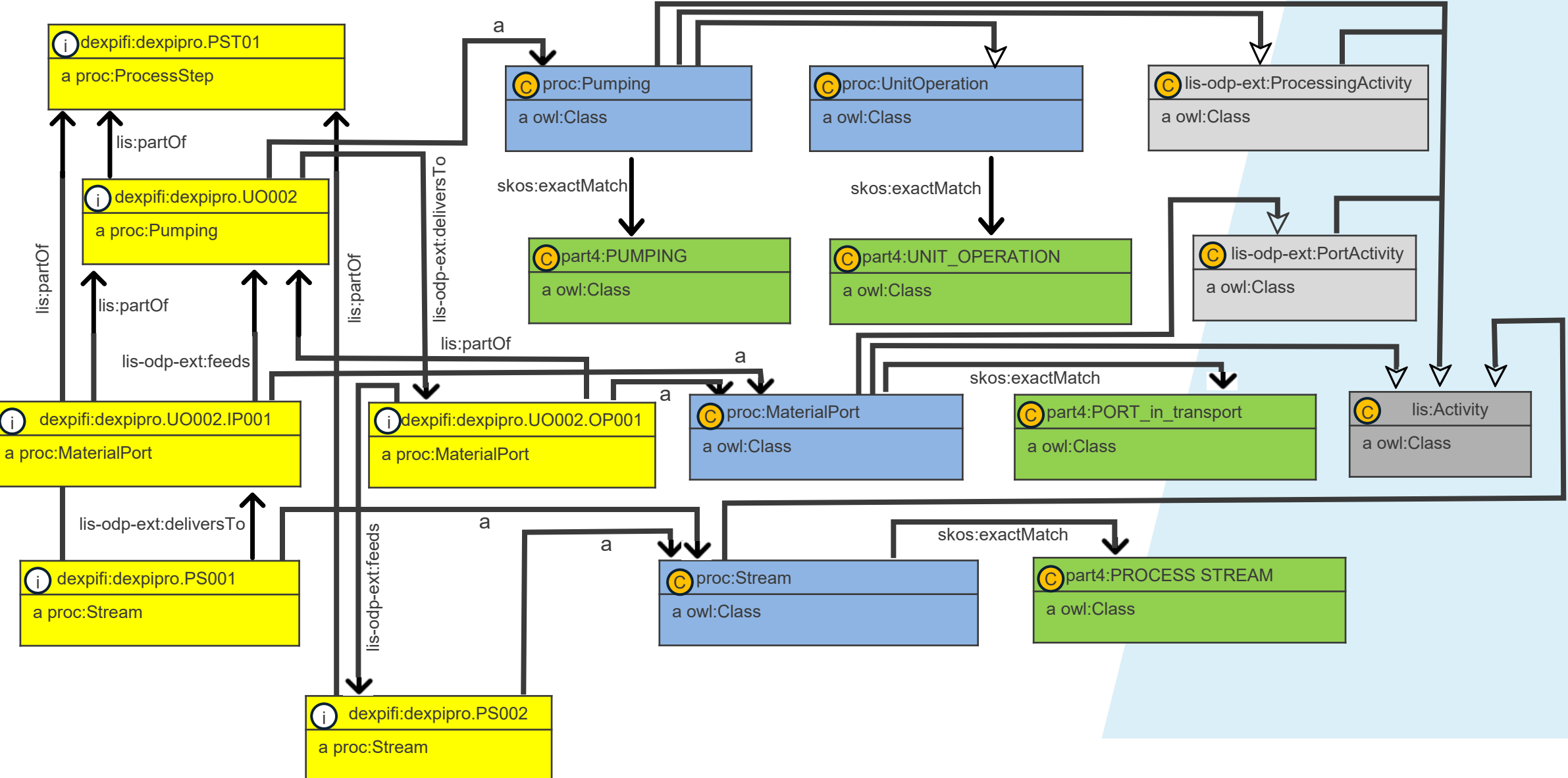
← proc classes

← DEXPI instances

Modelling pattern: Process break down structure



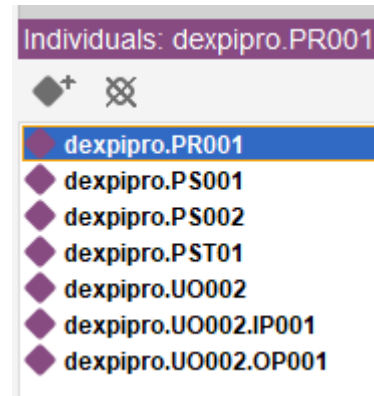
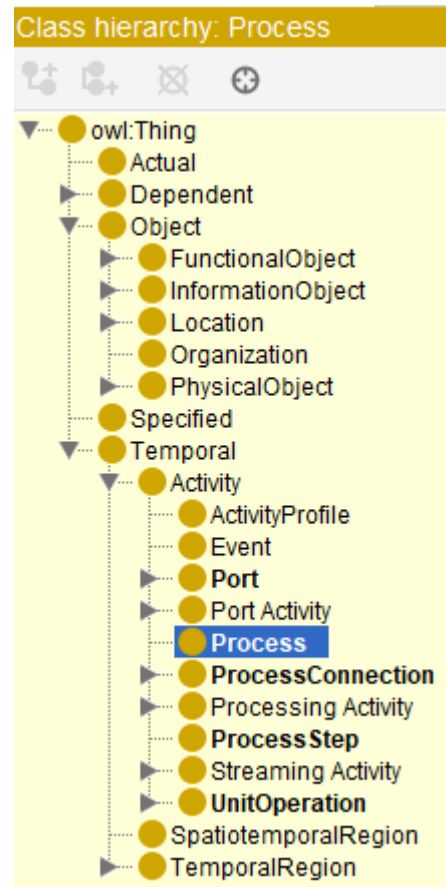
Modelling pattern: Pumping UO002



Solution with IDO: specified Process

Look at:

- Turtle_PLCS_proc_02.ttl
- Load it into Protege



Required classes – specified Plant

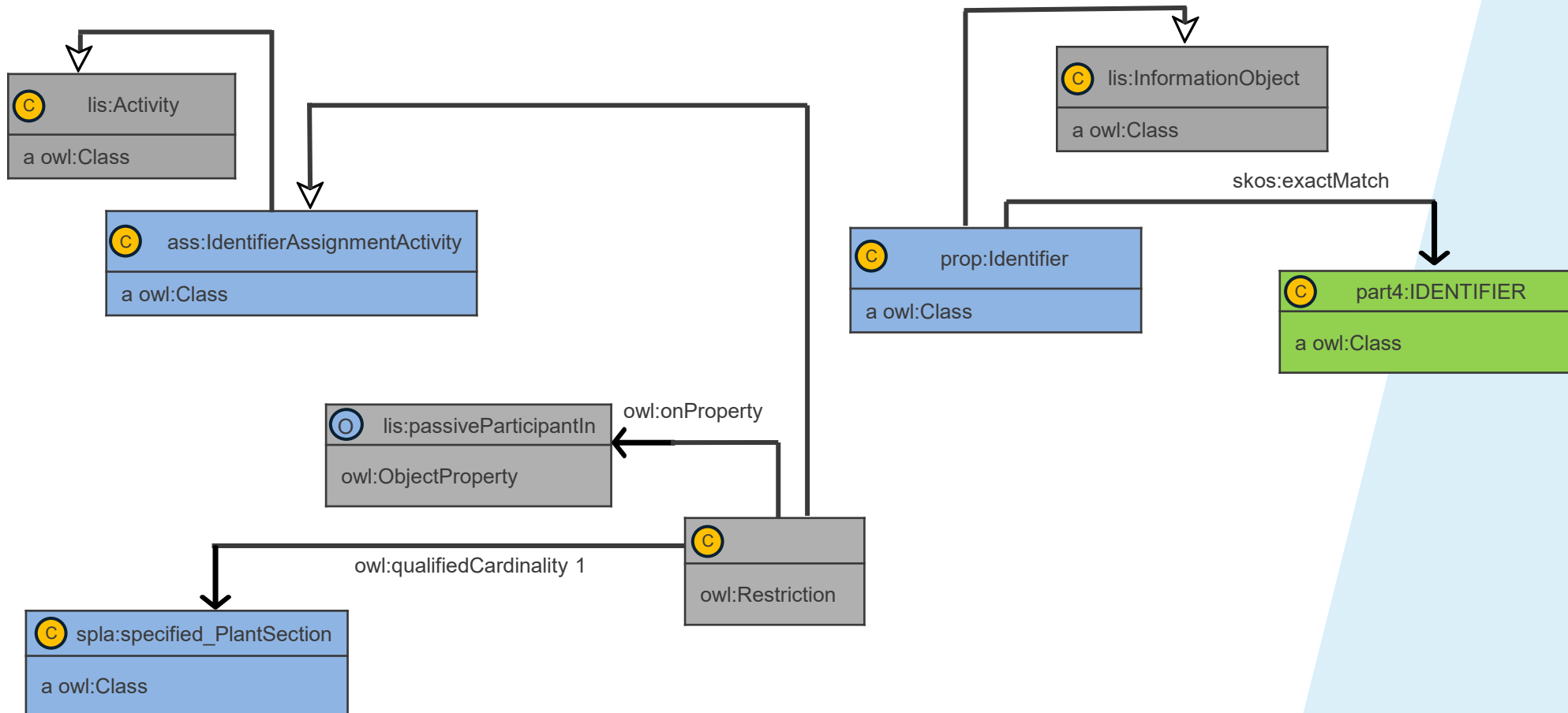
part 4	DEXPI class	spla:	IDO
PROCESS PLANT	ProcessPlant	specified_ProcessPlant	System
PLANT SECTION	PlantSection	specified_PlantSection	System
PUMP SYSTEM	System	specified_System	System
PUMP	Pump	specified_Pump	System
CENTRIFUGAL PUMP	CentrifugalPump	specified_CentrifugalPump	InanimatePhysicalObject
PROCESS NOZZLE	ProcessNozzle	specified_ProcessNozzle	InanimatePhysicalObject
PIPING NETWORK SYSTEM	PipingNetworkSystem	specified_PipingNetworkSystem	System
ELECTRIC MOTOR	Motor	specified_Motor	System
ALTERNATING CURRENT MOTOR	AlternatingCurrentMotor	specified_AlternatingCurrentMotor	InanimatePhysicalObject
INSTRUMENTATION FUNCTION	InstrumentationFunction	specified_InstrumentationFunction	System
PROCESS SIGNAL GENERATING FUNCTION	ProcessSignalGeneratingFunction	specified_ProcessSignalGeneratingFunction	System
MEASURING SYSTEM	MeasuringSystem	specified_MeasuringSystem	InanimatePhysicalObject
VESSEL	Vessel	specified_Vessel	System
TANK	Tank	specified_Tank	InanimatePhysicalObject
PRESSURIZED CONTAINER	PressureVessel	specified_PressureVessel	InanimatePhysicalObject

Plant with functional & physical objects

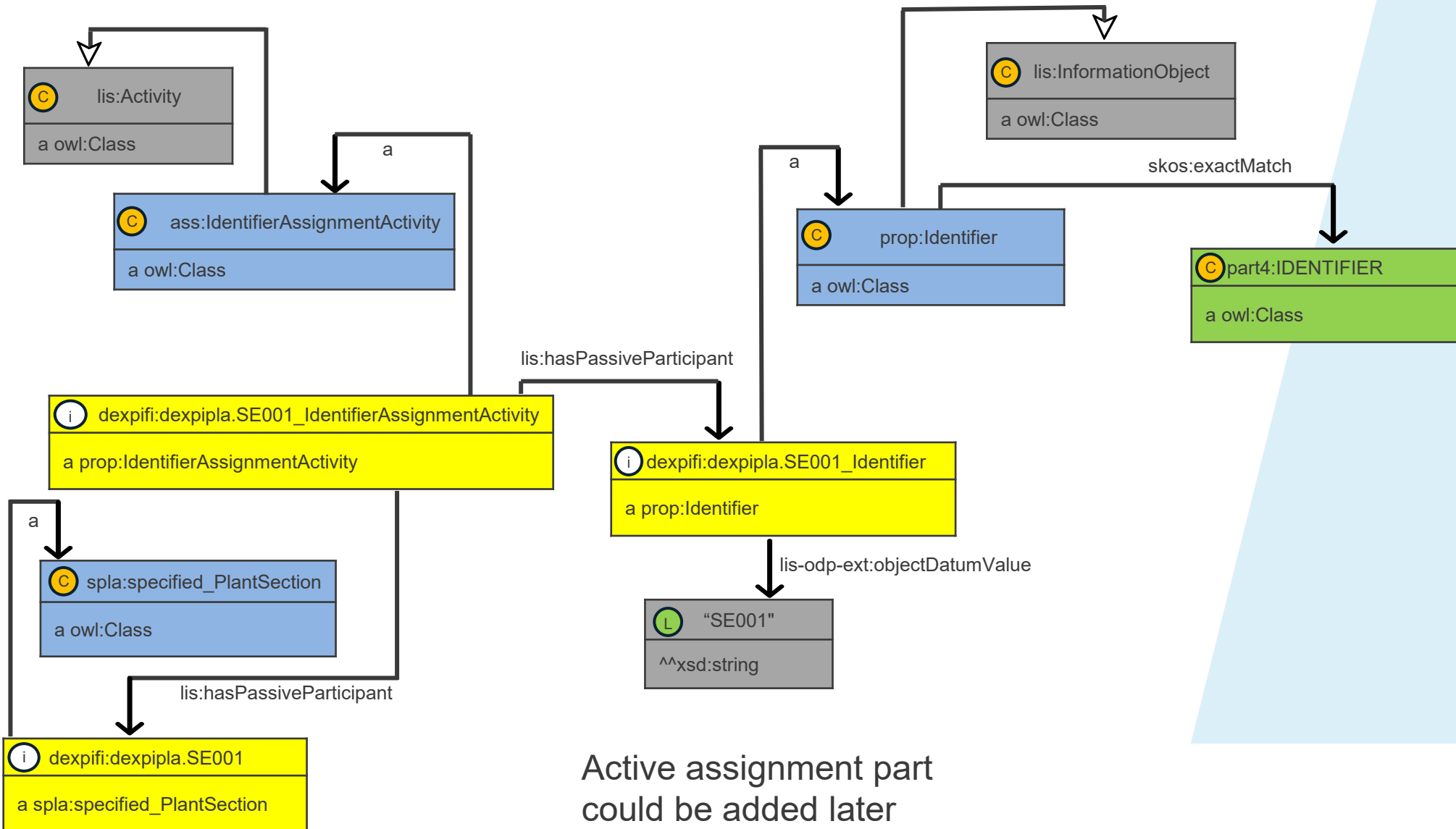
Required properties – specified Plant

class	Property examples	cardinality	IDO property type
specified_ProcessPlant	Identifier	1	assigned
	Description	0..1	assigned
specified_PlantSection	Identifier	1	assigned
specified_System	Identifier	1	assigned
specified_Pump	TagName	1	assigned
	DifferentialPressure	0..1	dependent
specified_CentrifugalPump	LowerLimitDesignPressure	0..1	dependent
	UpperLimitDesignPressure	0..1	dependent
specified_ProcessNozzle	SubTagName	1	assigned
specified_PipingNetworkSystem	LineNumber	1	assigned
specified_Motor	TagName	1	assigned
specified_AlternatingCurrentMotor			
specified_InstrumentationFunction	ProcessInstrumentationFunctionNumber	1	assigned
specified_ProcessSignalGeneratingFunction	ProcessSignalGeneratingFunctionNumber	1	assigned
specified_MeasuringSystem	MeasuringSystemNumber	1	assigned
specified_Vessel	TagName	1	assigned
specified_Tank			
specified_PressureVessel			

Modelling pattern: Identifier of a specified Plant Section

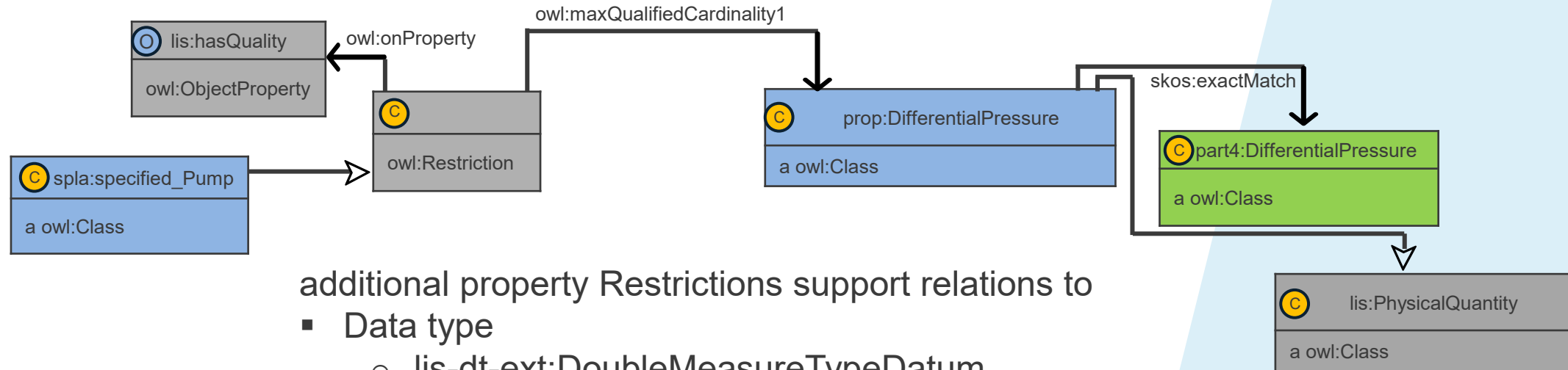


Modelling pattern: Identifier of the specified Plant Section SE001



Active assignment part could be added later

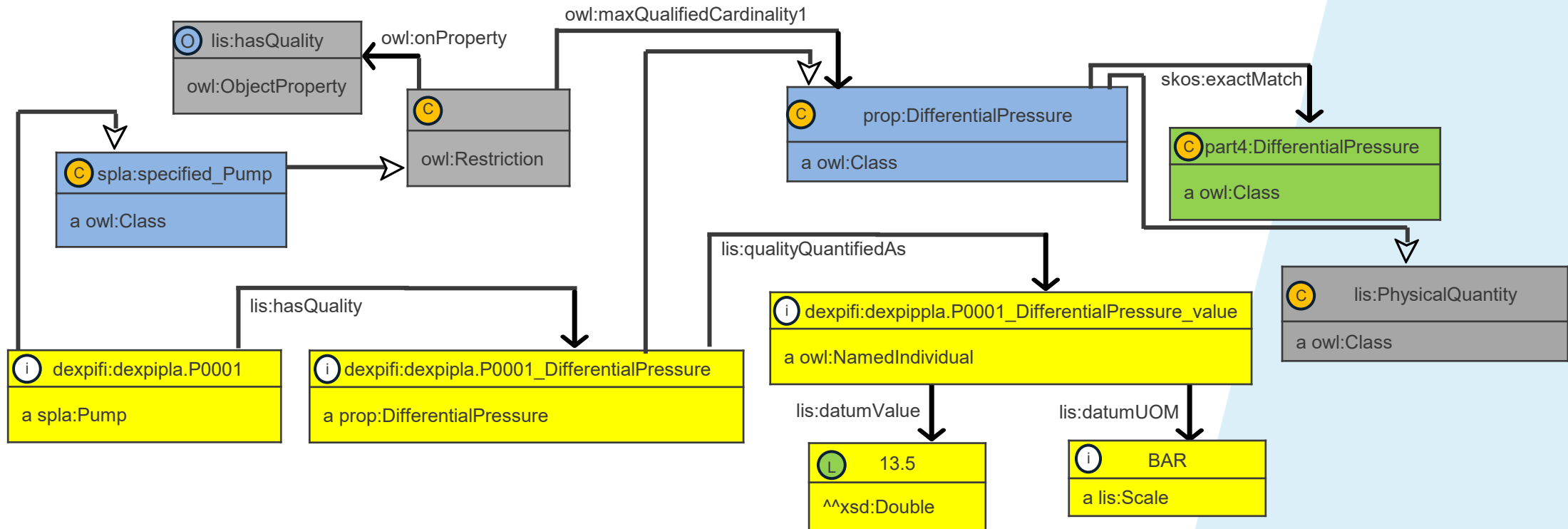
Modelling pattern: DifferentialPressure of a specified Pump



additional property Restrictions support relations to

- Data type
 - lis-dt-ext:DoubleMeasureTypeDatum
- Property aspects
 - lis-va-ext:DifferentialDatum
 - lis-pa-ext:CalculatedDatum
- QUDT QuantityKinds
 - Pressure
 - AbsolutePressure

Modelling pattern: DifferentialPressure of the specified Pump P0001

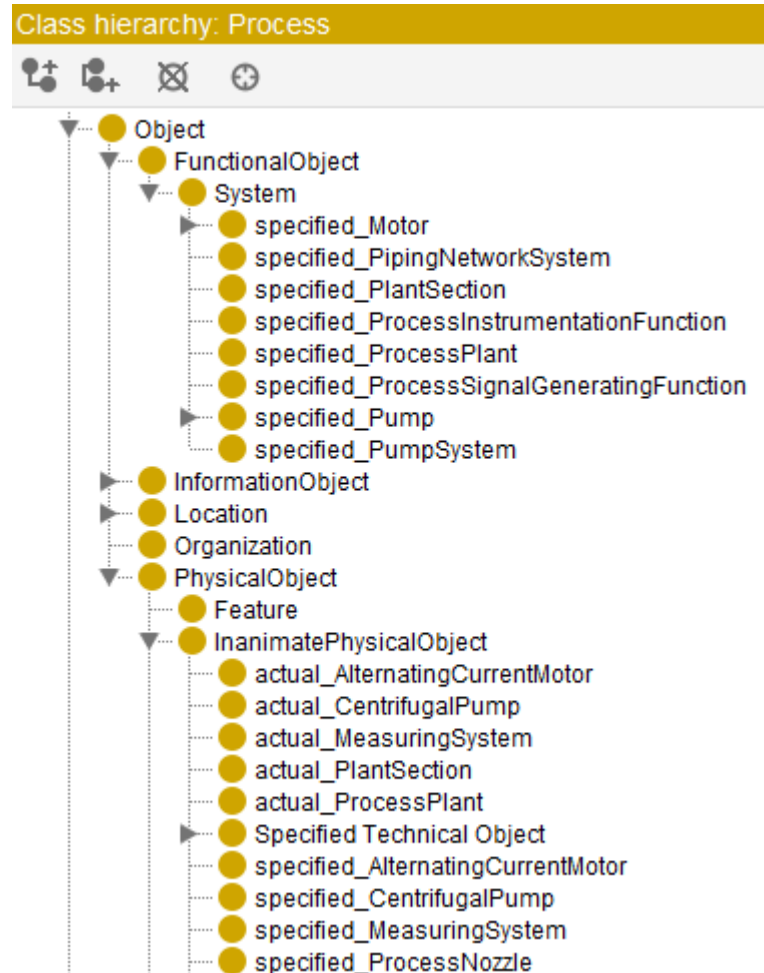


a Restriction checks the UoM against pressure units of QUDT, which were used by DEXPI

Solution with IDO: specified Plant

Look at:

- Turtle_PLCS_prop_01.ttl
- Turtle_PLCS_spla_01.ttl
- Turtle_PLCS_Instances_01.ttl
- Load it into Protege



Individuals:

◆	dexpiass.12345_Identifier
◆	dexpiass.12345_IdentifierAssignmentActivity
◆	dexpiass.12345_SerialNumber
◆	dexpiass.12345_SerialNumberAssignmentActivity
◆	dexpiass.12345_UpperLimitDesignPressure
◆	dexpiass.12345_UpperLimitDesignPressure_value
◆	dexpiass.12346
◆	dexpiass.12347
◆	dexpiass.PP001
◆	dexpiass.SE001
◆	dexpipla.L0001
◆	dexpipla.MP001
◆	dexpipla.P0001
◆	dexpipla.P0001.I0001
◆	dexpipla.P0001_DifferentialPressure
◆	dexpipla.P0001_DifferentialPressure_value
◆	dexpipla.P0001_UpperLimitDesignPressure
◆	dexpipla.P0001_UpperLimitDesignPressure_value
◆	dexpipla.PP001
◆	dexpipla.PP001_ObjectDescription
◆	dexpipla.PP001_ObjectDescriptionAssignmentActivity
◆	dexpipla.PPS01
◆	dexpipla.SE001
◆	dexpipla.SE001_Identifier
◆	dexpipla.SE001_IdentifierAssignmentActivity

Required classes - Asset (physical equipment)

part 4	pequi:	IDO
PROCESS PLANT	actual_ProcessPlant	InanimatePhysicalObject
PLANT SECTION	actual_PlantSection	InanimatePhysicalObject
CENTRIFUGAL PUMP	actual_CentrifugalPump	InanimatePhysicalObject
ALTERNATING CURRENT MOTOR	actual_AlternatingCurrentMotor	InanimatePhysicalObject
MEASURING SYSTEM	actual_MeasuringSystem	InanimatePhysicalObject

Assets
as physical objects
& actual individuals

- Same IDO classification 'InanimatePhysicalObject' for specified and physical equipment on class level
- from `lis:implementedBy` (or its inverse) the IDO classification `lis:specified` and `lis:actual` is inferred on instance level

Conclusion

Conclusion

Modelling pattern for

- Process
 - classes, breakdown structure, UnitOperation Pumping and internal topology
- specified Process Plant
 - classes, dependent property and assigned property
- actual Process Plant
 - classes
- bridges
 - between Process and specified Process Plant
 - between specified Process Plant and actual Process Plant

Conclusion

- The pump life cycle use case was successfully modeled.
- The project identified the need for several additional ontologies between DEXPI and IDO.
- The results still need to be verified by the IDO team.
- The proposed additional ontologies must be further extended for industrial application.
- The documentation is available on PCA web page.