SemWeb.Pro 2020

Semantic modeling approach of the Pallas Nuclear project

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A major EPC contractor in the Netherlands, which designs and realizes technical, integrated solutions for electrical, mechanical, automation and information technical challenges in industry, infra structure and the build environment.

PALLAS will replace the ageing High Flux Reactor (HFR), producing medical isotopes at location Petten, the Netherlands

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Participates in

Contractor

Client

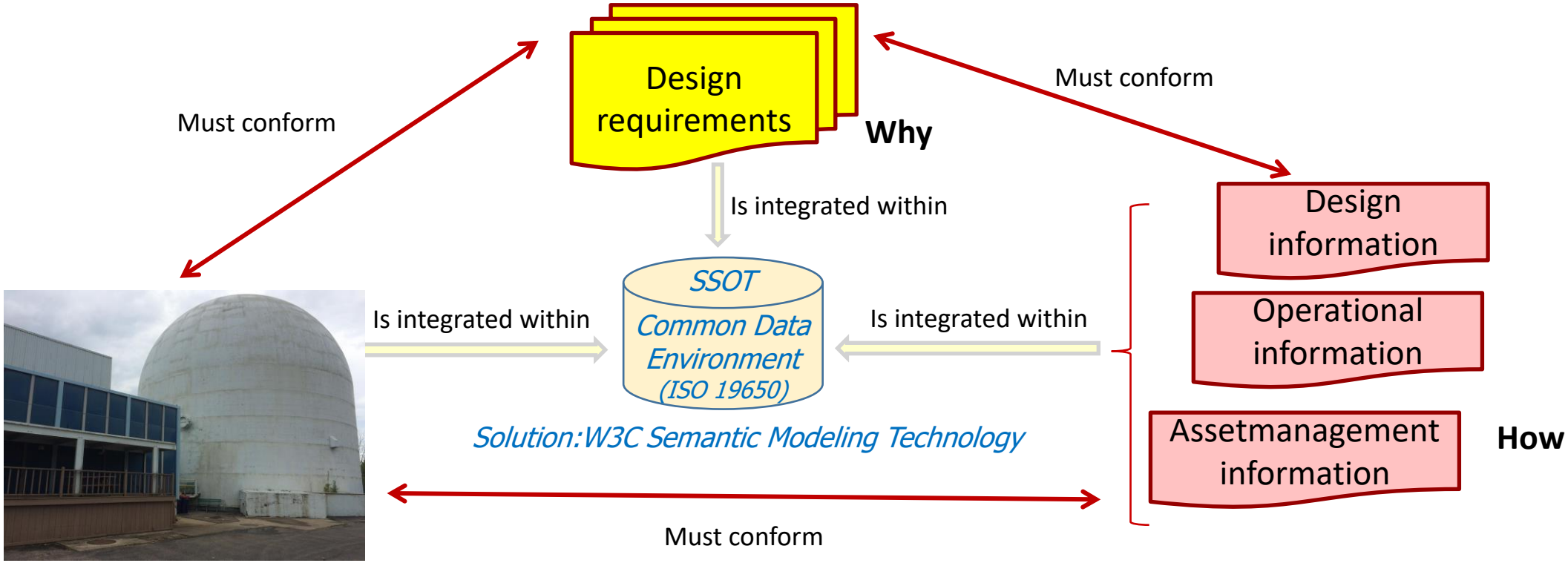
ICHOS

PALLAS

Goal and approach of information and configuration management (IM & CM) within the Pallas project

Design requirements of the system

(what required is to be there, including behavior)



Physical and operational configuration of the system

(what there actually is and how it really behaves)

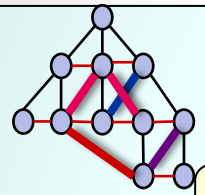
System configuration documentation

(what we say that there is and say how it behaves)

Equilibrium triangle as defined by the International Atomic Energy Agency (IAEA TECDOC 1651)

Breakdown structures are the back-bone of the CDE (Master data)

Elements of the structures have mutual relations, representing the design and physical configuration of the Pallas reactor



Pallas Integrated Information Model (IIM)

Domain and range of all relations are defined by the IIM

Reference Data Library (Pallas RDL)

"Is classified as"

Element

Attribute

Relation

Document breakdown structure

Requirement breakdown structure

System breakdown structure

Geographical breakdown structure

Function breakdown structure

Process breakdown structure

Work breakdown structure

Organisational breakdown structure

DMS

3D model (IFC)

Each relation/attribute is a triple in the CDE

Digital eco system for handover of Nuclear Plant Data
Supporting IM and CM and handover

Engineering process

ICHOS (Contractor)

Baselined output data of engineering tools

Baseline as Turtle file

Cleaning and mapping data to IIM and RDL

Neutral, unambiguous handover of Pallas Reactor data

Pallas (Client)

Business process

input

output

SSOT

Common Data Environment

Weaver Technologies B.V. Netherlands

Pallas Graph Database

PLM

Asset Management Information System

DASSAULT SYSTEMES

Master Data as input for any engineering process

Integrated Information model

Reference Data Library

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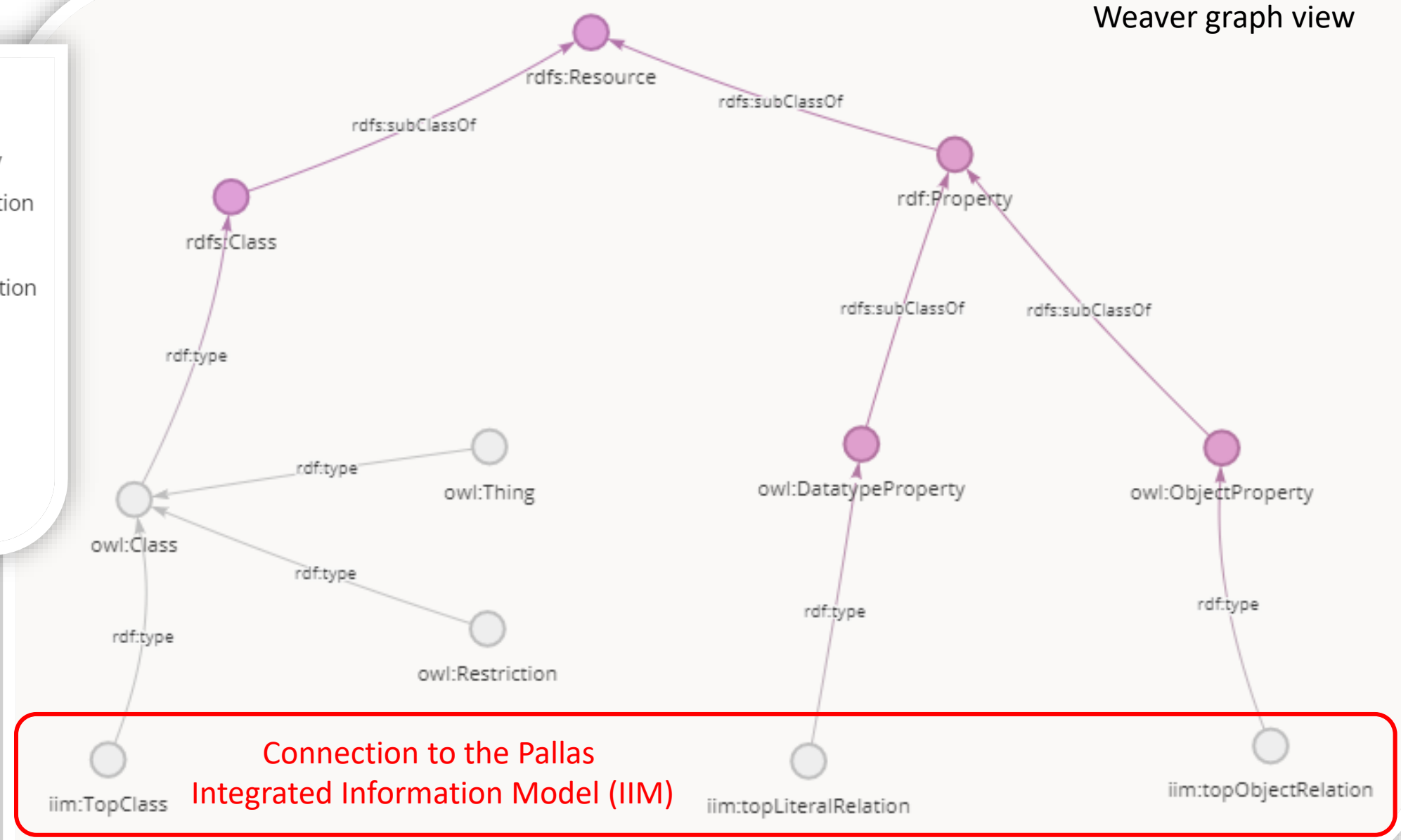
Based on the Dutch NTA 8035 Semantic Modeling Standard and ISO 15926

The digital eco system based on RDFS and simple usage of OWL

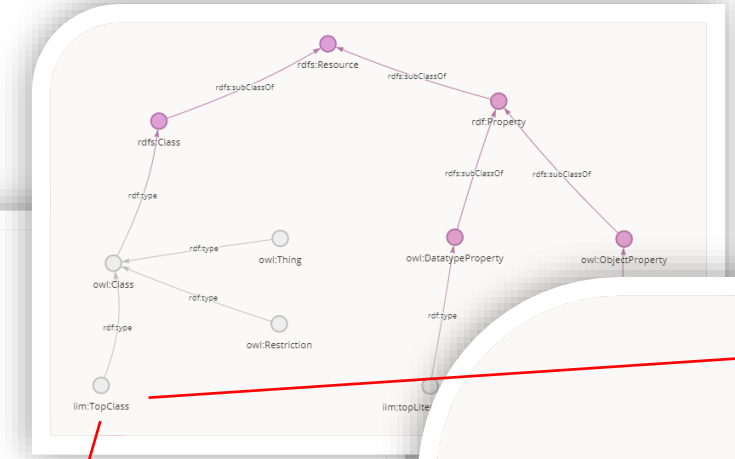
Weaver tree view

- rdfs:Resource
  - rdf:Property
    - owl:DatatypeProperty
      - iim:topLiteralRelation
    - owl:ObjectProperty
      - iim:topObjectRelation
  - rdfs:Class
    - owl:Class
      - iim:TopClass
      - owl:Restriction
      - owl:Thing

Weaver graph view

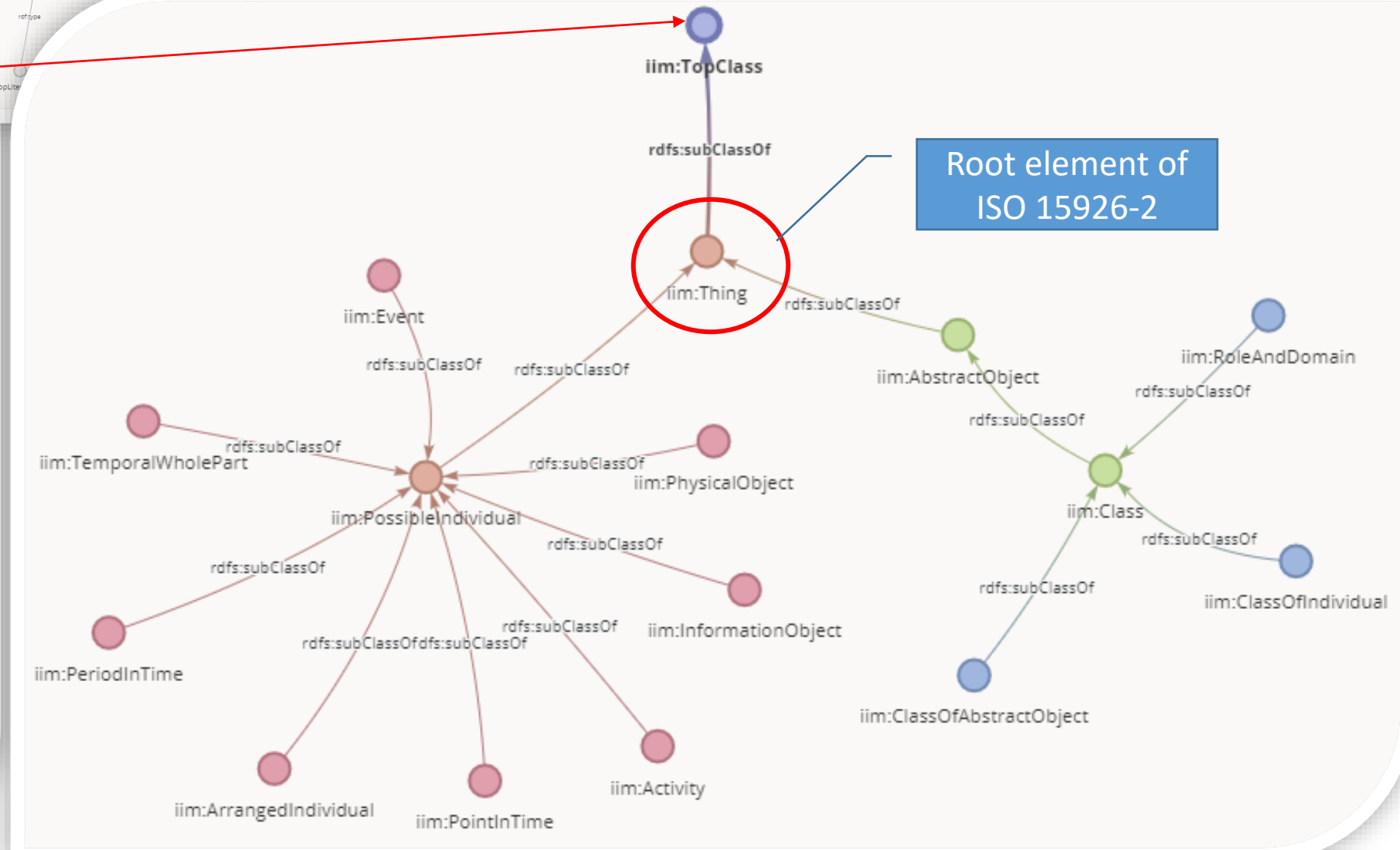


First level of iim:Topclass
(integration with ISO 15926)



Taxonomy

- iim:TopClass
- rdfs:Resource
  - rdf:Property
  - rdfs:Class
    - owl:Class
      - iim:TopClass
        - iim:Thing
          - iim:AbstractObject
            - iim:Class
            - iim:PossibleIndividual
              - iim:Activity
              - iim:ArrangedIndividual
              - iim:Event
              - iim:InformationObject
              - iim:PeriodInTime
              - iim:PhysicalObject
              - iim:PointInTime
              - iim:TemporalWholePart
      - owl:Restriction
      - owl:Thing



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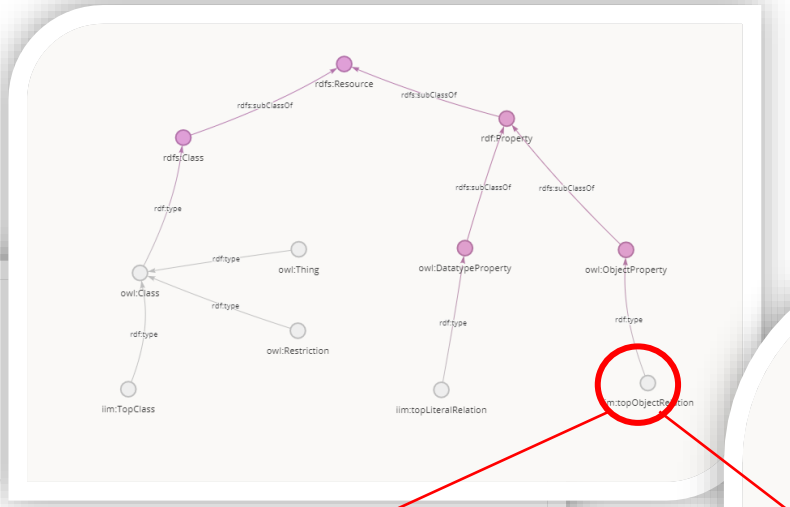
First level of iim:topObjectRelation

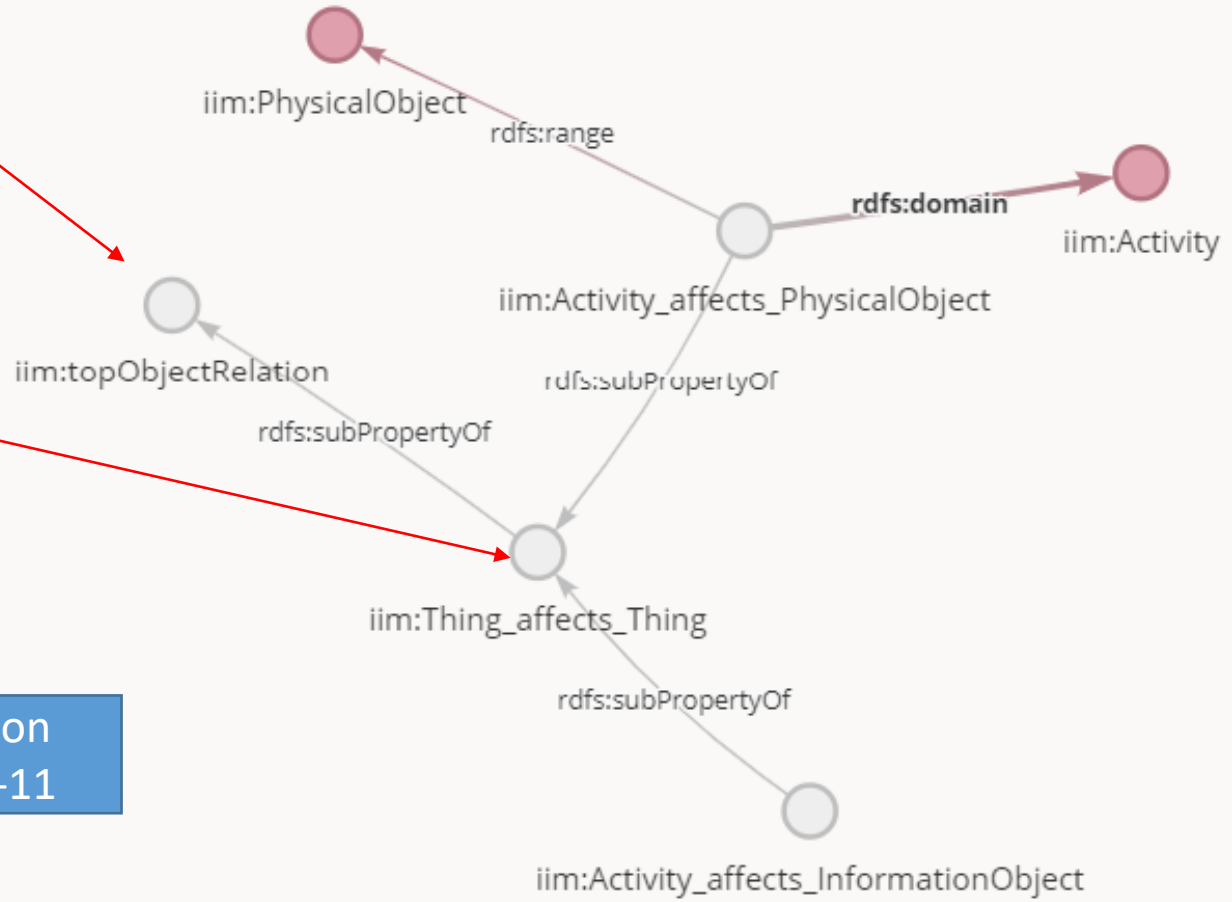
ObjectRelations are defined by domain and range, both being either an iim:Topclass or RDL class



Taxonomy

- rdfs:Resource
  - rdf:Property
    - owl:DatatypeProperty
    - owl:ObjectProperty
      - iim:topObjectRelation
        - iim:Thing_affects_Thing
          - iim:Activity_affects_InformationObject
          - iim:Activity_affects_PhysicalObject
        - iim:Thing_aggregates_Thing
        - iim:Thing_begins_Thing
        - iim:Thing_concerns_Thing
        - iim:Thing_connects_Thing
        - iim:Thing_contains_Thing
        - iim:Thing_contributesTo_Thing
        - iim:Thing_ends_Thing
        - iim:Thing_follows_Thing
        - iim:Thing_hasAuthor_Thing
        - iim:Thing_hasCause_Thing
        - iim:Thing_hasDestination_Thing
          - iim:Interaction_hasDestination_PhysicalObject
          - iim:Stream_hasDestination_PhysicalObject

Extension on ISO 15926-11



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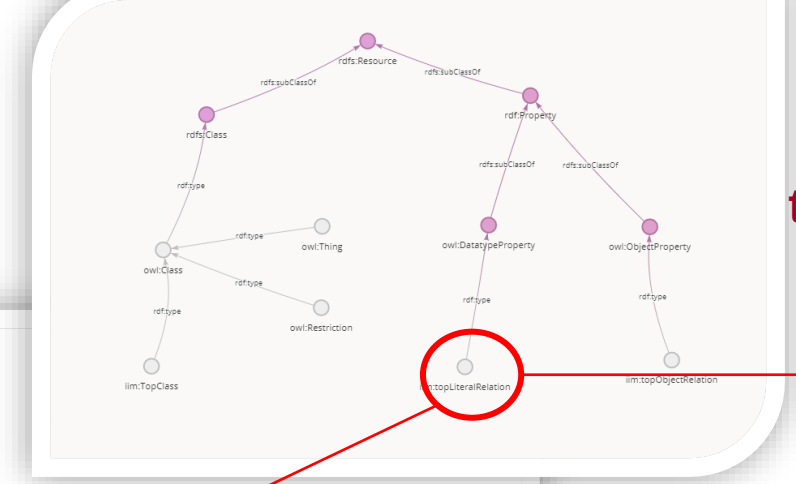
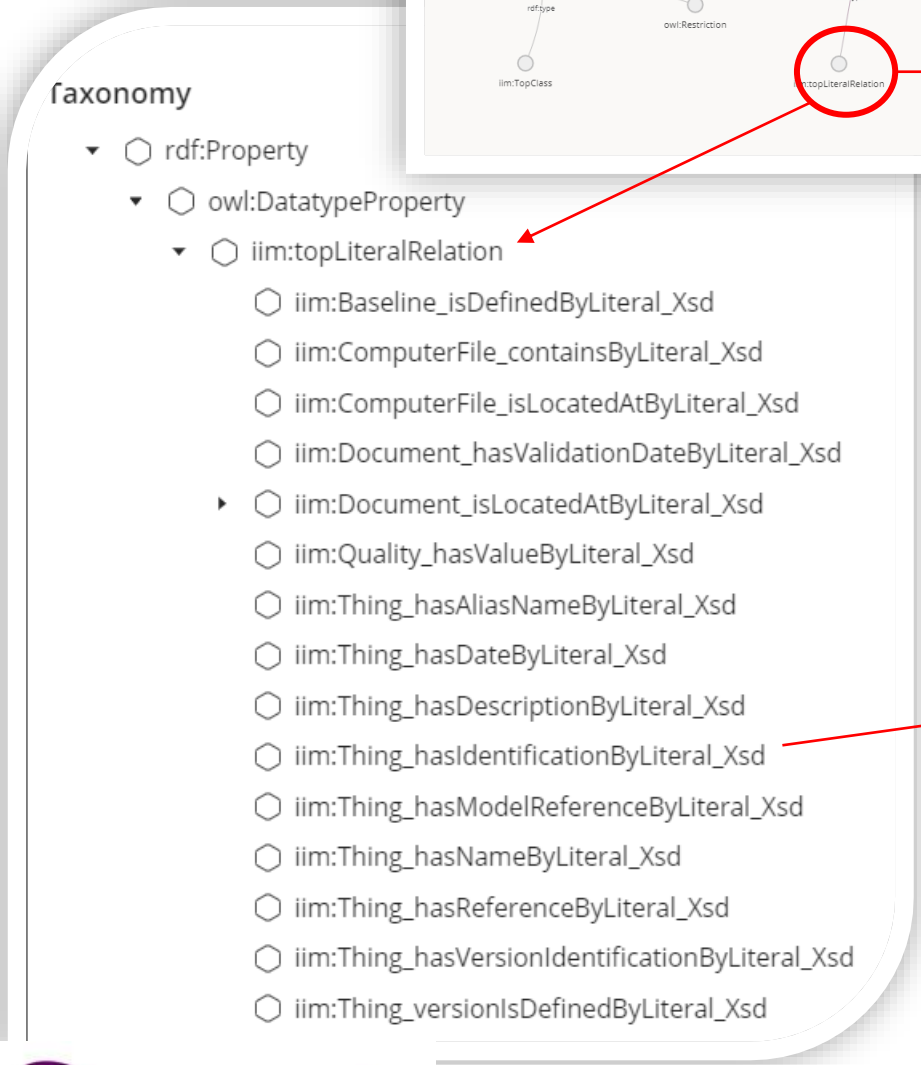
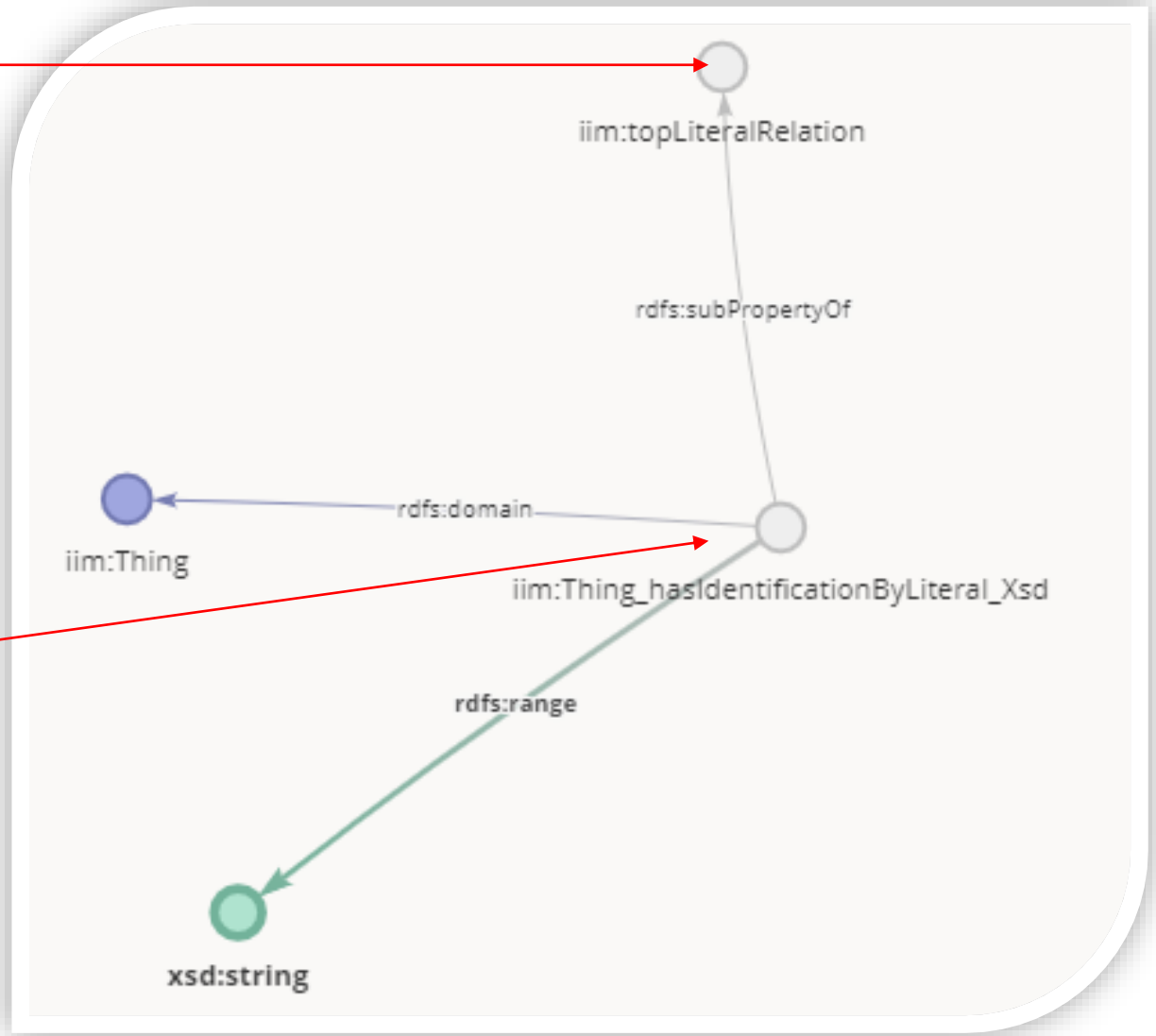
First level of iim:topLiteralRelation

LiteralRelations are defined by domain and range where the domain is an iim:TopClass and the range a xsd-value







Digital eco system for handover of Nuclear Plant Data

ICHOS (Contractor)

Engineering process

Baselined output data of engineering tools

Cleaning and mapping data to IIM and RDL

Baseline as Turtle file

Neutral, unambiguous handover of Pallas Reactor data

Master Data as input for an engineering process

SSOT

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Integrated Information model

Reference Data Library

Pallas Graph Database

Pallas (Client)

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Asset Management Information System

DASSAULT SYSTEMES

W3C SPARQL

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Based on the Dutch NTA 8035 Semantic Modeling Standard and ISO 15926-11

Reference Data Library (RDL): separate library based on SKOS and RDFS

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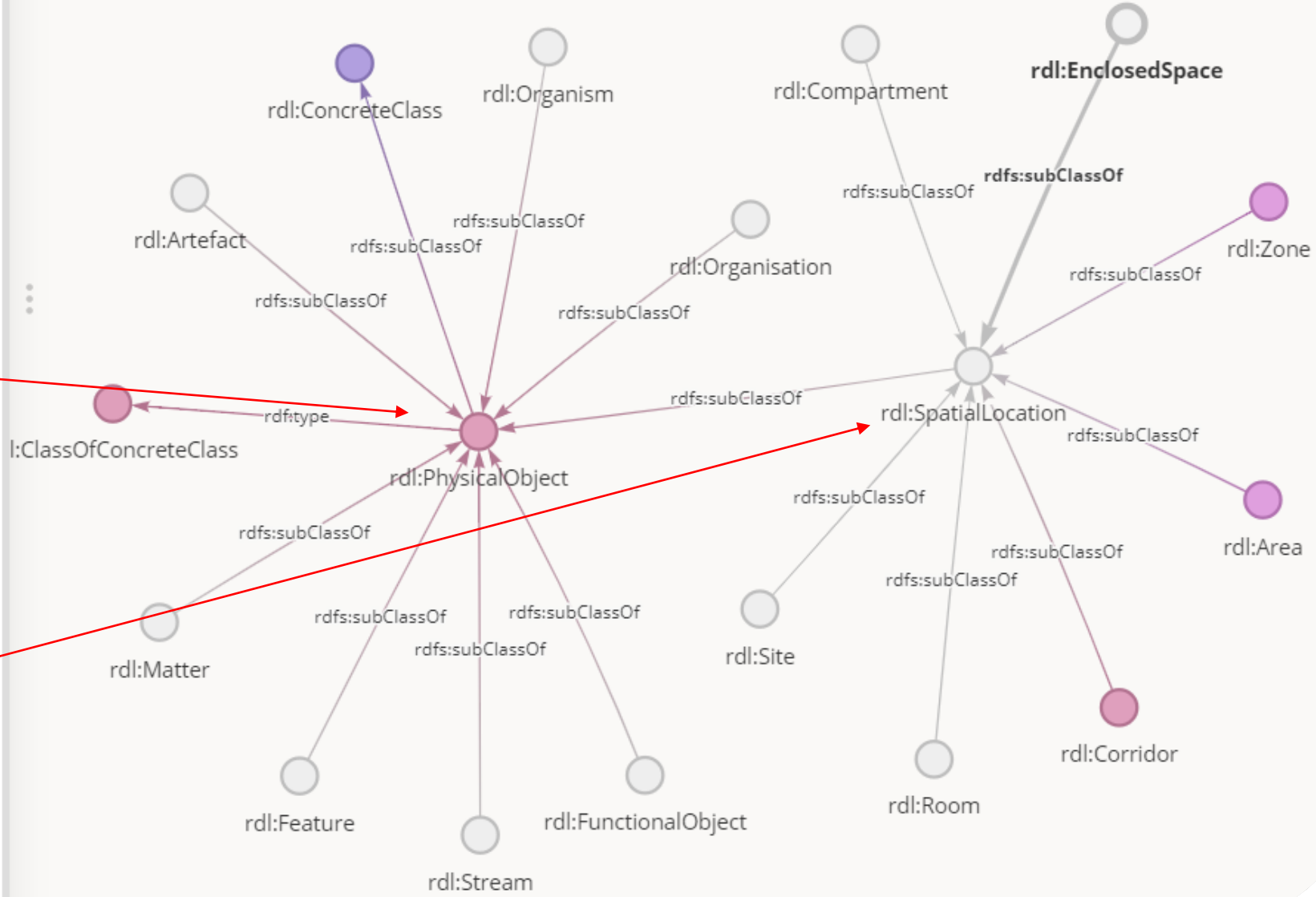
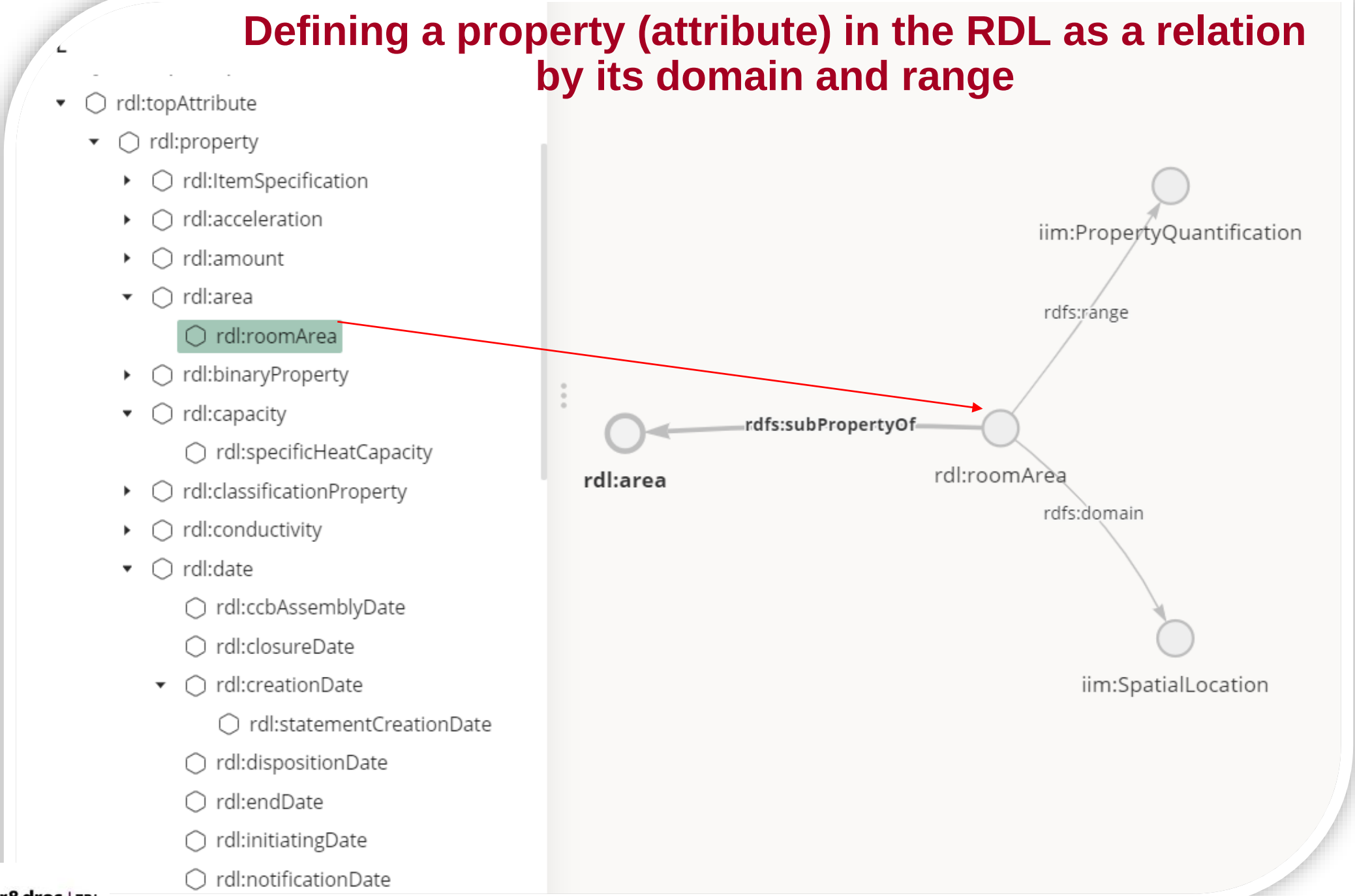
Pallas Reference Data Library (RDL)
Example rdl:ConcreteClass

- rdl:RDL
  - rdl:AbstractClass
  - rdl:ClassOfClass
  - rdl:ConcreteClass
    - rdl:Activity
    - rdl:ArrangedIndividual
    - rdl:Event
    - rdl:InformationObject
    - rdl:PeriodInTime
    - rdl:PhysicalObject
      - rdl:Artefact
      - rdl:Feature
      - rdl:FunctionalObject
      - rdl:Matter
      - rdl:Organisation
      - rdl:Organism
      - rdl:SpatialLocation
      - rdl:Stream
      - rdl:TechnicalSolution
    - rdl:PointInSpace
    - rdl:PointInTime
  - ll:TemporalWholePart

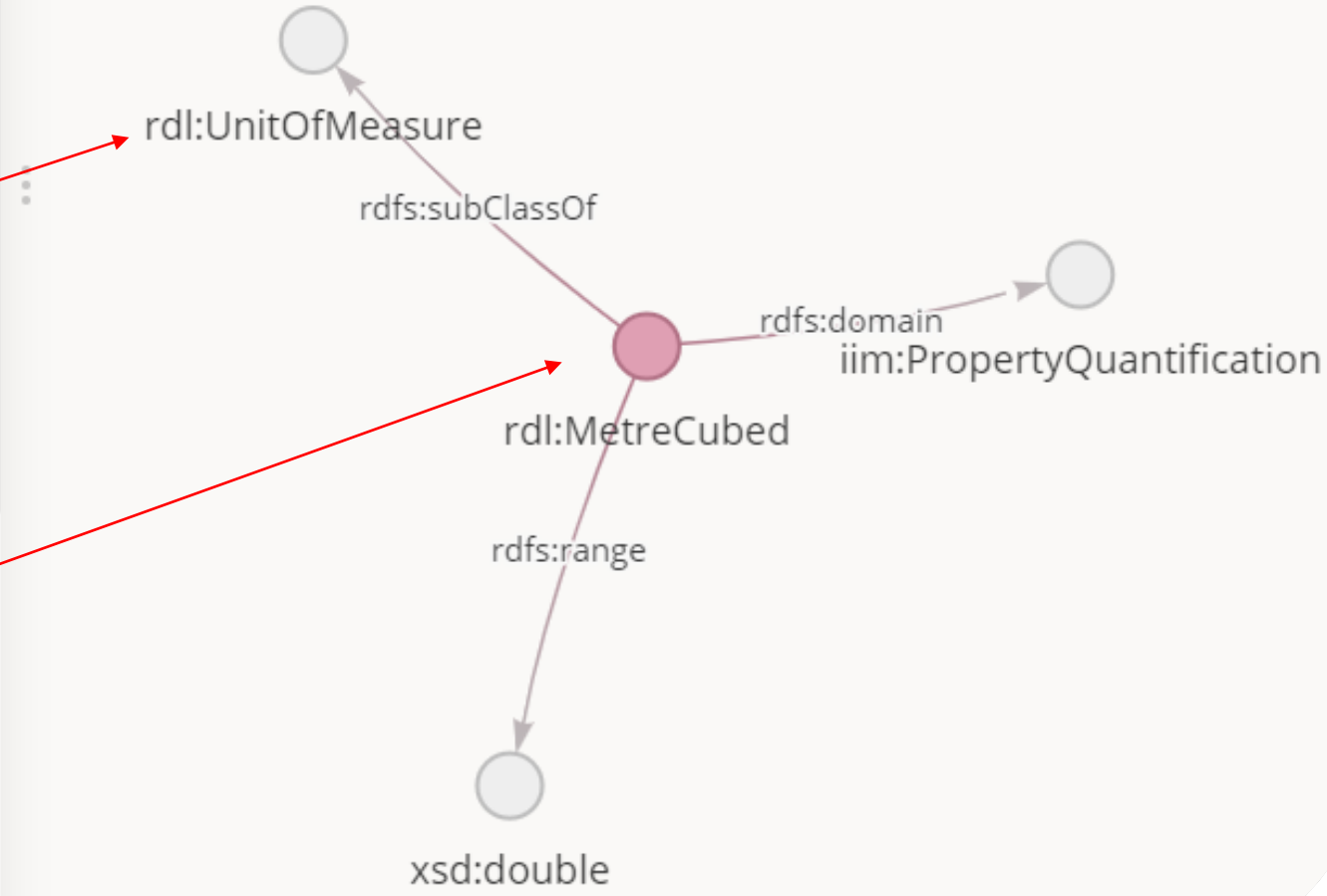


Defining a property (attribute) in the RDL as a relation by its domain and range



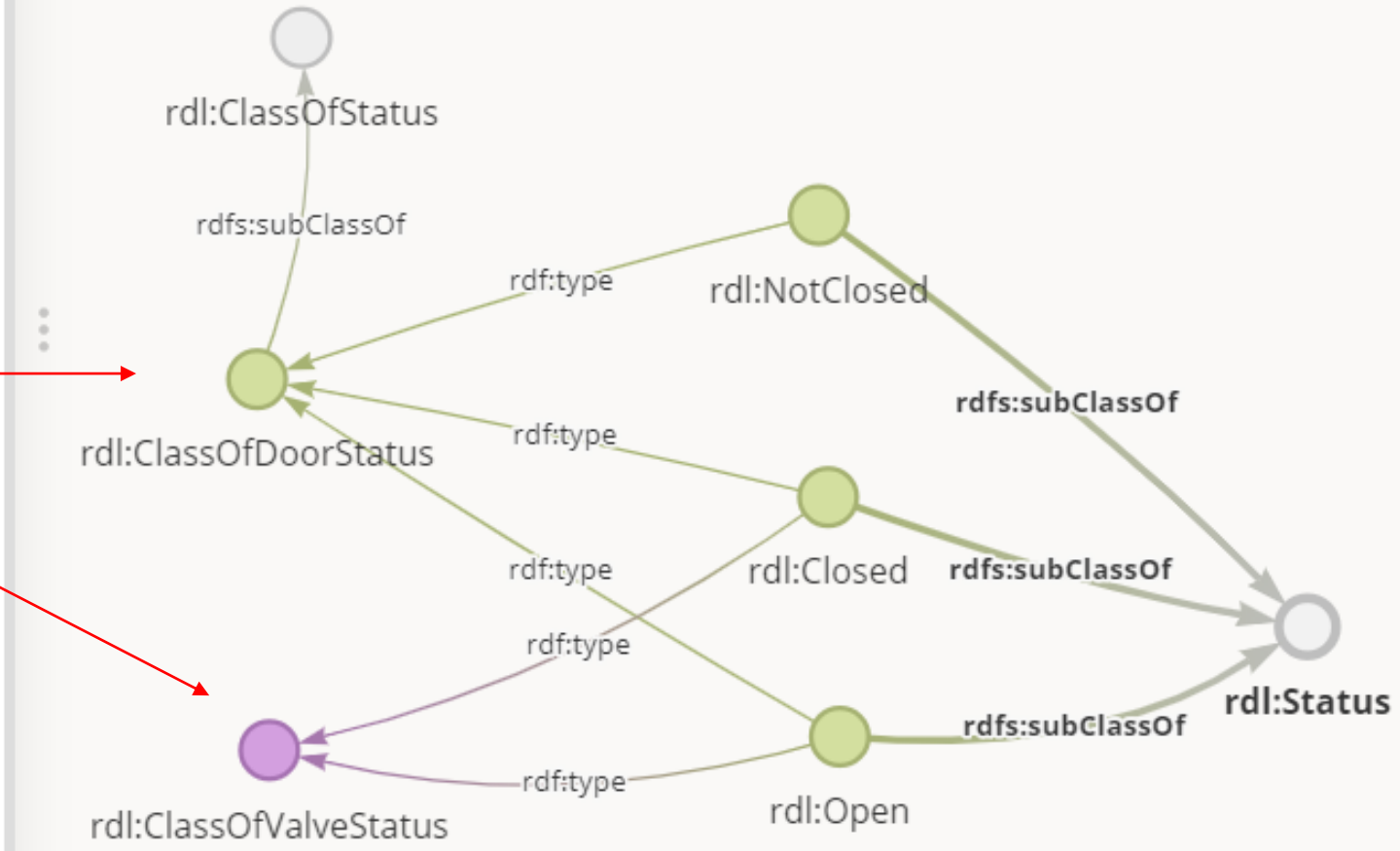
Defining a scale of a property quantification in the RDL as a relation by its domain and range

- rdl:RDL
  - rdl:AbstractClass
    - rdl:Aspect
    - rdl:BinaryClassification
    - rdl:Format
    - rdl:Quality
    - rdl:Right
    - rdl:RoleAndDomain
    - rdl:Scale
      - rdl:UnitOfMeasure
        - rdl:Ampere
        - rdl:Celsius
        - rdl:Hz
        - rdl:K
        - rdl:Kg
        - rdl:MetreCubed
        - rdl:MetreCubedPerHour
        - rdl:N
        - rdl:Pascal
        - rdl:Percent
        - rdl:SecondMetreSquared

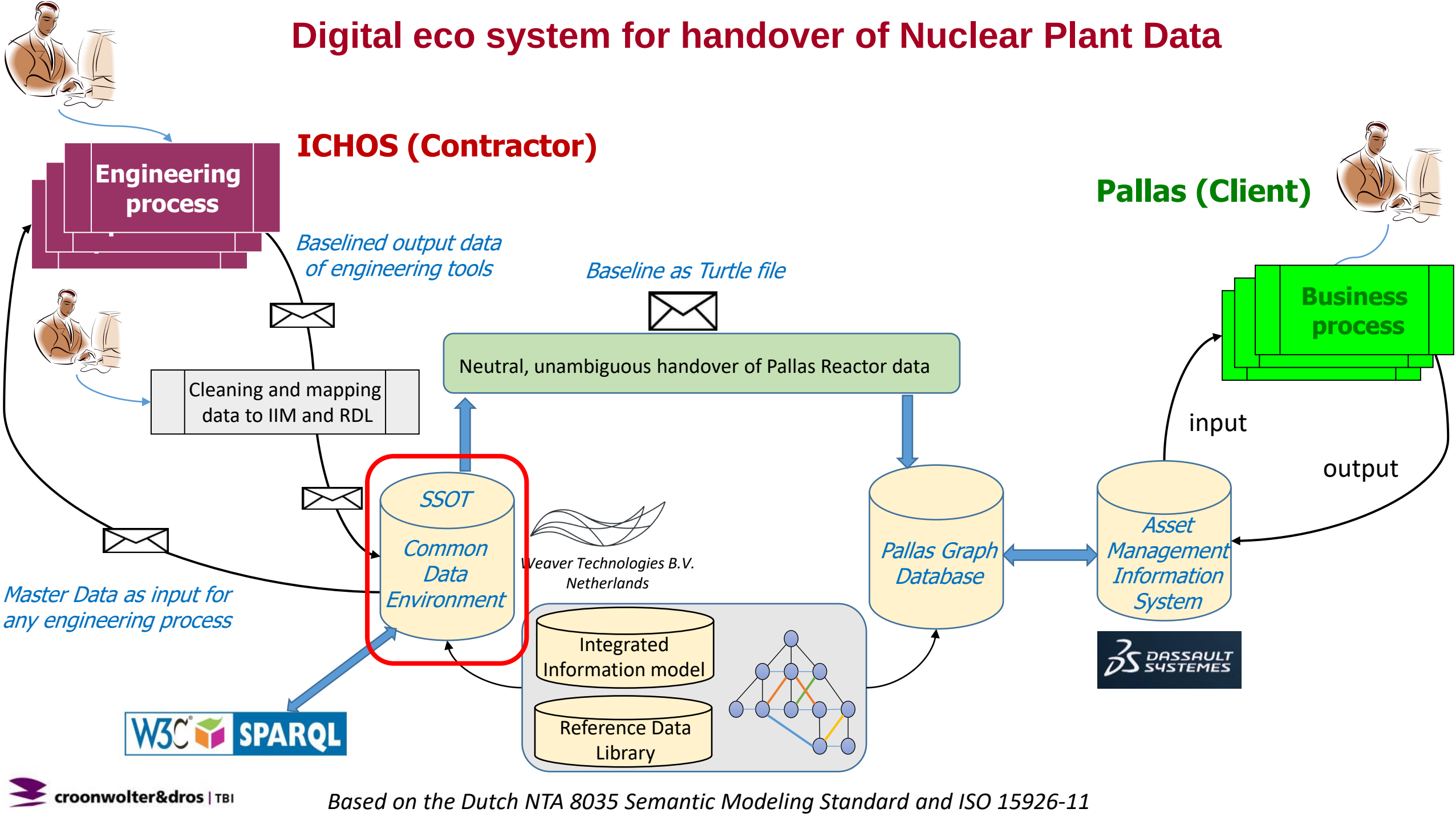


Usage of class of class (ISO 15926) within the RDL to make e.g. specific enumerations and collections

- rdl:RDL
  - rdl:AbstractClass
  - rdl:ClassOfClass
    - rdl:ClassOfAbstractClass
      - rdl:ClassOfRdfStatementAccessRights
      - rdl:ClassOfRole
      - rdl:ClassOfStatus
        - rdl:ClassOfDoorStatus
        - rdl:ClassOfRdfStatementStatus
        - rdl:ClassOfValveStatus
        - rdl:RdlClassOfBaselineStatus
        - rdl:RdlClassOfDocumentStatus
        - rdl:RdlClassOfRequirementStatus
      - rdl:PropertyClass
      - rdl:RdlClassOfInformationAspect
      - rdl:RdlClassOfQuality
      - rdl:RdlClassOfUnitOfMeasure



Digital eco system for handover of Nuclear Plant Data



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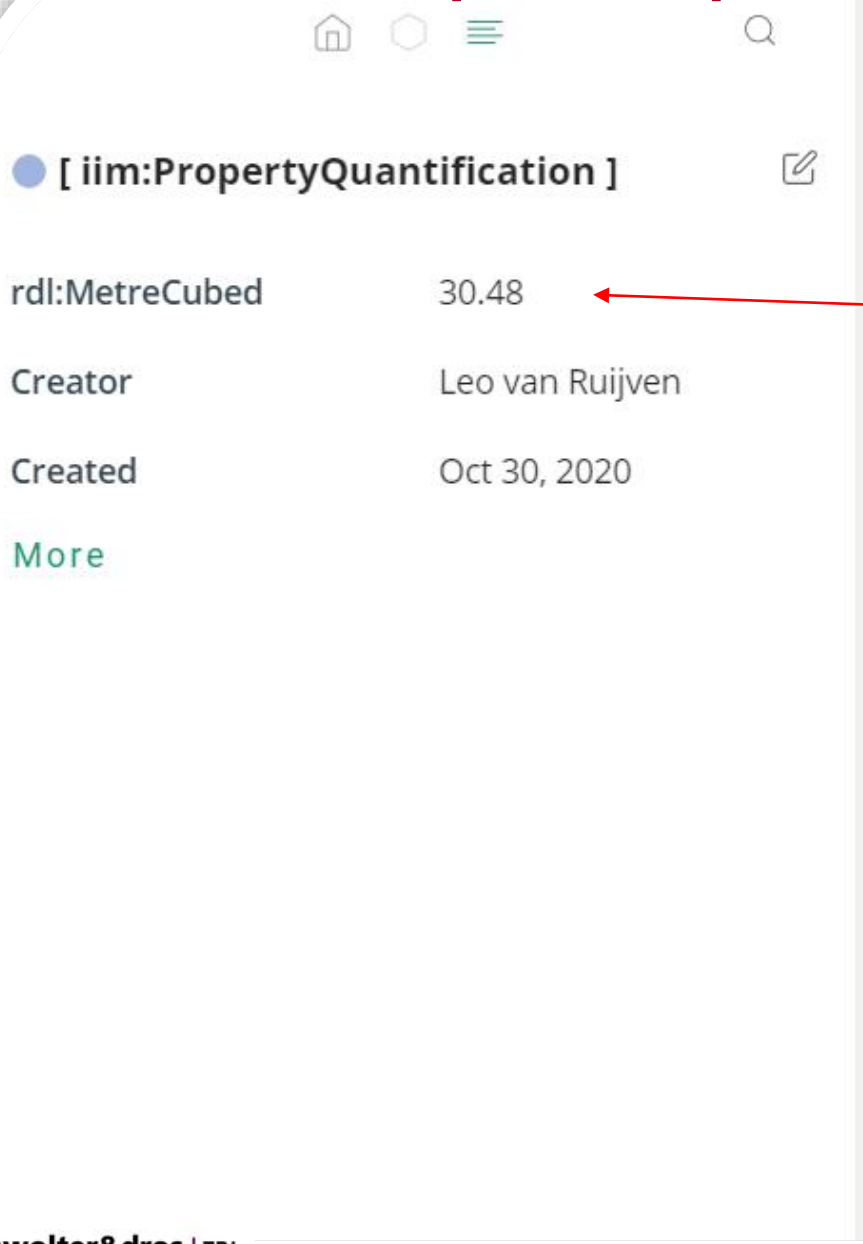
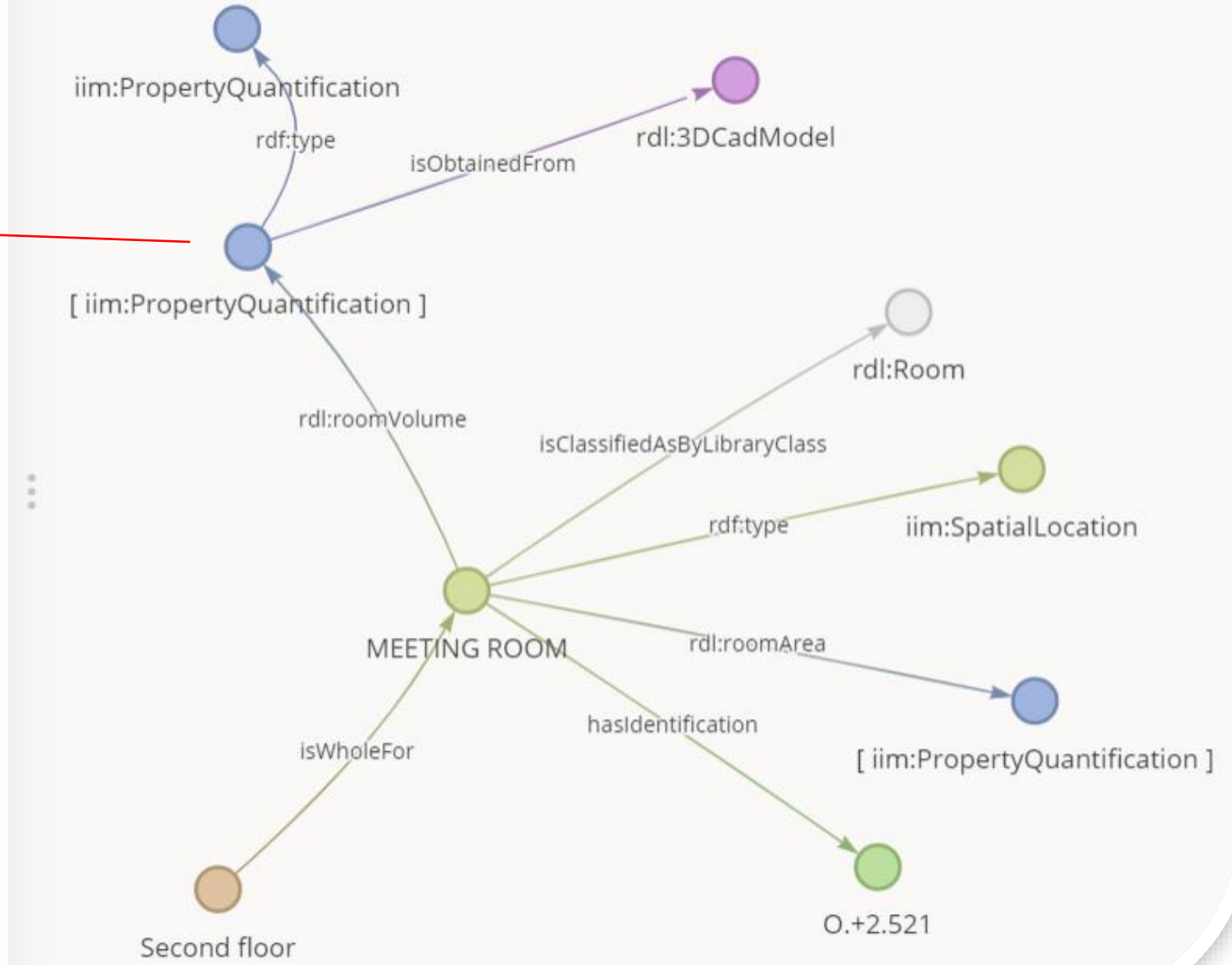
Example of expressing instance data in the CDE (payload data)





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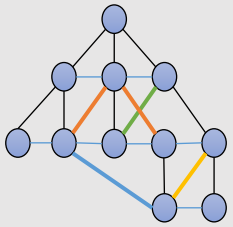

Pallas Graph Database

Pallas (Client)

Business process

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Based on the Dutch NTA 8035 Semantic Modeling Standard and ISO 15926-11

```
:2b136834-006b-4c3c-9e51-46cd0af59afc a rdf:Statement;
  rdf:subject :2b21b8ac-84e1-41f4-b734-af50e27a2df2;
  rdf:predicate rdf:type;
  rdf:object iim:SpatialLocation;
  iim:hasSignature :6d987e42-9eb7-4cc5-b87f-9c21fb657f3f .
```

Reified triples from the CDE, enabling making statements about statements

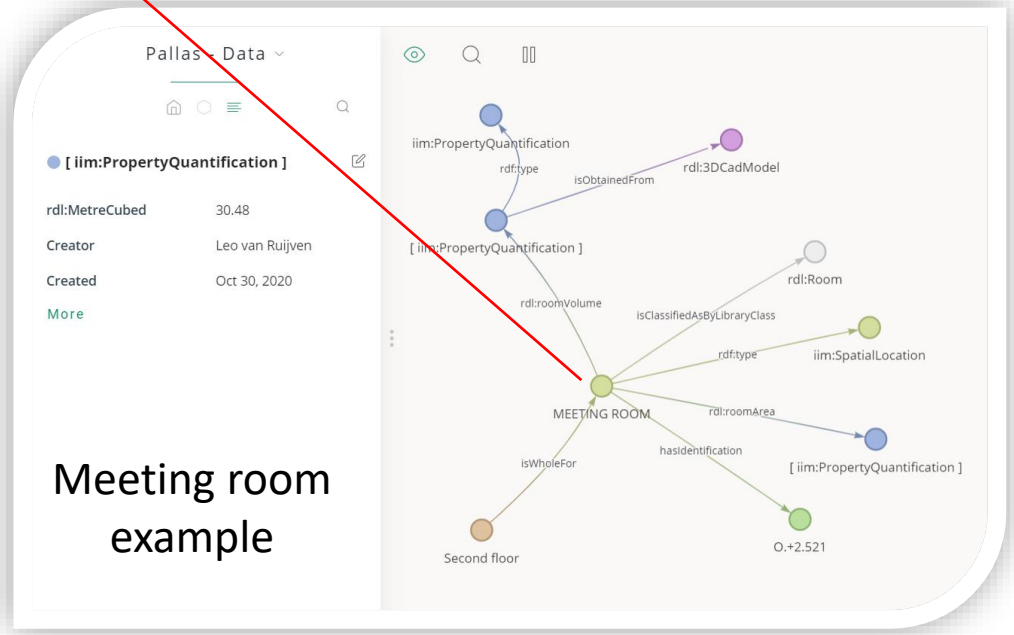
Handover pay load data expressed by rdf:statements, expressed in Turtle (Compliant with the IIM and RDL)

```
:ad04e5ca-55c5-41ea-accd-171ffef52270 a rdf:Statement;
  rdf:subject :2b21b8ac-84e1-41f4-b734-af50e27a2df2;
  rdf:predicate rdl:roomVolume;
  rdf:object :c7b3489a-5c27-4894-913d-27e391a5e9a5;
  iim:hasSignature :6d987e42-9eb7-4cc5-b87f-9c21fb657f3f .
```

```
:89f3ce28-2ecc-4658-a793-0ea70d244e32 a rdf:Statement;
  rdf:subject :c7b3489a-5c27-4894-913d-27e391a5e9a5;
  rdf:predicate rdf:type;
  rdf:object iim:PropertyQuantification;
  iim:hasSignature :6d987e42-9eb7-4cc5-b87f-9c21fb657f3f .
```

```
:37986937-3bd9-41ca-87d7-7a5224c09d71 a rdf:Statement;
  rdf:subject :c7b3489a-5c27-4894-913d-27e391a5e9a5;
  rdf:predicate rdl:MetreCubed;
  rdf:object "30.4899999999999984";
  iim:hasSignature :6d987e42-9eb7-4cc5-b87f-9c21fb657f3f .
```

```
:26566da1-d0be-4654-9c33-9bb783e61c20 a rdf:Statement;
  rdf:subject :c7b3489a-5c27-4894-913d-27e391a5e9a5;
  rdf:predicate iim:QuantityValue_isObtainedFrom_RdlClassOfSourceOfQuantityValue;
  rdf:object rdl:3DCadModel;
  iim:hasSignature :6d987e42-9eb7-4cc5-b87f-9c21fb657f3f .
```



Meeting room example

Handover data expressed in Turtle

Example: A contract requirement

```
:c418de18-e6f3-474d-a2cc-ff7fe61fa199 a rdf:Statement;
  rdf:subject :ebcb2d14-82db-4b5a-a818-05088a39c2be;
  rdf:predicate rdf:type;
  rdf:object iim:Requirement;
  iim:hasSignature :afb6c956-e24d-407b-b7c1-bfae74425f1d .
```

```
:54667a6a-f873-47ac-aa3e-350ba54ef4d0 a rdf:Statement;
  rdf:subject :ebcb2d14-82db-4b5a-a818-05088a39c2be;
  rdf:predicate iim:Thing_hasDescriptionByLiteral_Xsd;
  rdf:object "The Nuclear Island shall have necessary facilities to receive and dispatch goods.
  Especially a dispatch hall.";
  iim:hasSignature :afb6c956-e24d-407b-b7c1-bfae74425f1d .
```

```
:5479255d-4e4a-4d70-ac04-2423fe8e32ea a rdf:Statement;
  rdf:subject :ebcb2d14-82db-4b5a-a818-05088a39c2be;
  rdf:predicate iim:Requirement_isBaseFor_Requirement;
  rdf:object :946285e3-df8c-4413-a049-1db960476c33;
  iim:hasSignature :ec4c691d-2d25-4d65-82f1-07baf169a7cd .
```

```
:47212f29-3f58-4b7a-9747-7fb647032d70 a rdf:Statement;
  rdf:subject :946285e3-df8c-4413-a049-1db960476c33;
  rdf:predicate iim:Requirement_specifies_Thing;
  rdf:object :a030b958-fe5b-41c7-a683-69e93e5b5e2a;
  iim:hasSignature :ec4c691d-2d25-4d65-82f1-07baf169a7cd .
```

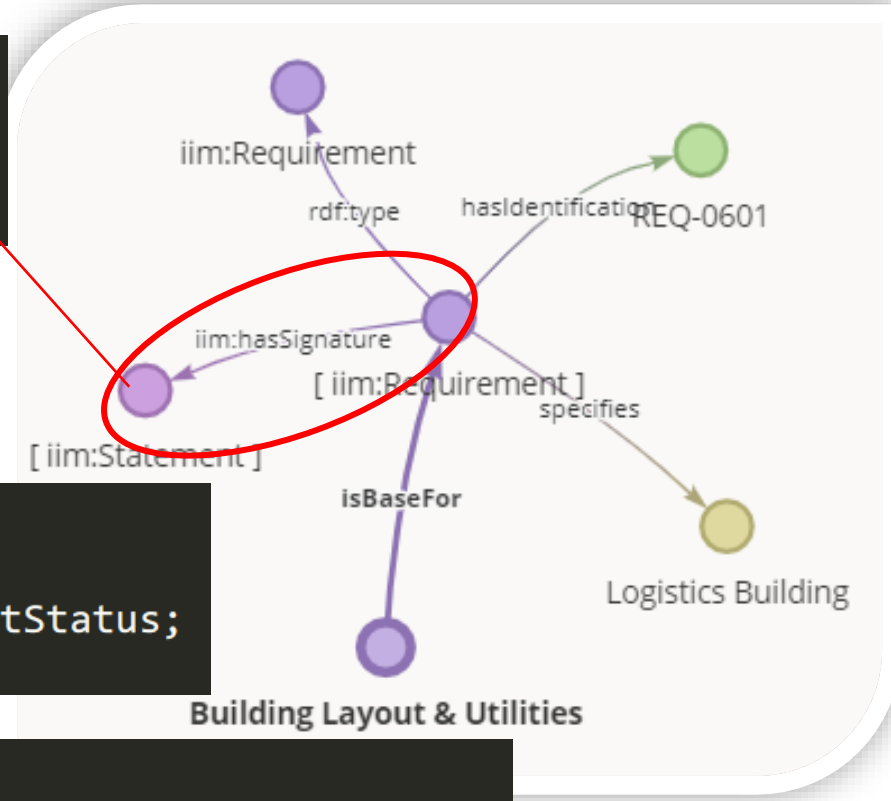
```
:c35a4d2f-0263-4c0c-859c-21e7d0a8eabf a rdf:Statement;
  rdf:subject :ec4c691d-2d25-4d65-82f1-07baf169a7cd;
  rdf:predicate rdf:type;
  rdf:object iim:Statement .
```

```
:10008450-dcb5-4b7d-90e8-4f20b9737600 a rdf:Statement;
  rdf:subject :ec4c691d-2d25-4d65-82f1-07baf169a7cd;
  rdf:predicate iim:Statement_isCreatedBy_Party;
  rdf:object :4a2284ed-aaf9-4be9-8a11-fe5f9108d2c6 .
```

```
:bb2df988-493b-4d51-8252-05e9e33a6ae6 a rdf:Statement;
  rdf:subject :ec4c691d-2d25-4d65-82f1-07baf169a7cd;
  rdf:predicate rdl:statementCreationDate;
  rdf:object "2020-18-10 00:00:00" .
```

The source and provenance of each rdf:statement is defined by means of a Signature Statement

```
:a21f5f7a-2b79-4086-afbc-1ef79bc8b4ea a rdf:Statement;
  rdf:subject :ec4c691d-2d25-4d65-82f1-07baf169a7cd;
  rdf:predicate iim:Thing_isClassifiedAsByLibraryClass_RdlClassOfIndividual;
  rdf:object rdl:SignatureStatement .
```




```
:5f3567d9-9b2e-4cc7-99e7-6be2ad66021e a rdf:Statement;
  rdf:subject :ec4c691d-2d25-4d65-82f1-07baf169a7cd;
  rdf:predicate iim:Statement_isValidInTheContextOf_Baseline;
  rdf:object :85262d18-781c-4b8d-91f4-714084068fed .
```

```
:801835e4-df11-4059-a108-d54d43c59718 a rdf:Statement;
  rdf:subject :ec4c691d-2d25-4d65-82f1-07baf169a7cd;
  rdf:predicate iim:Statement_hasStatusByLibraryClass_ClassOfStatementStatus;
  rdf:object rdl:Approved .
```

```
:18c3362a-9040-4771-8279-e17855e31809 a rdf:Statement;
  rdf:subject :ec4c691d-2d25-4d65-82f1-07baf169a7cd;
  rdf:predicate iim:Statement_hasAccessRightByLibraryClass_ClassOfRdfStatementAccessRights;
  rdf:object rdl:Public .
```

Result:

Explicit, unambiguous and sustainable recording of integrated plant data using international standards, suitable for using and updating the data and tracking changes over the lifespan of the Pallas reactor (at least 40 years).

THANKS FOR YOUR ATTTENTION

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